31 October 2000

Research Report

Produced by the

DEPARTMENT OF ENVIRONMENT AND HERITAGE

THE EFFECTIVENESS OF AUSTRALIA'S RESPONSE TO THE BLACK STRIPED MUSSEL INCURSION IN DARWIN, AUSTRALIA

A Report of the *Marine Pest Incursion Management Workshop* – 27-28 August 1999

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December 2000

31 October 2000
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Published by Environment Australia

31 October 2000

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Acknowledgments

The Marine and Water Division would like to acknowledge the efforts and considerable contributions of the following in preparing this report: Andria Marshall (NT Department of Primary Industry and Fisheries), Grant Rawlin (Department of Agriculture, Fisheries and Forestry-Australia), Frances Michaelis (Australian Quarantine and Inspection Service), Jane Harmsworth (Australian Maritime Safety Authority) and Pauline Semple (Qld Environmental Protection Agency).

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Report of the Marine Pest Incursion Management Workshop

Carlton Hotel, Darwin
27-28 August 1999

Contents

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Executive Summary

On 27 March 1999, CSIRO divers detected a significant population of unfamilair bivalves in a Darwin marina. These bivalves were later identified as the Black Striped Mussel, *Mytilopsis sallei*. This was the first recorded marine pest incursion to occur in Australian tropical waters. The eventual elimination of the Black Striped Mussel from infected areas was also to become one of the few successful aquatic pest eradication exercises ever to be undertaken in the world.

Infestations of the Black Striped Mussel were eventually identified from within three enclosed sites - Cullen Bay Marina, Tipperary Waters Marina Estate and Frances Bay Mooring Basin ("the Duckpond"). At the time of the discovery 223 vessels were within the three marinas and another 197 had recently left the contaminated areas and put to sea. All these vessels were potentially contaminated.

Following confirmation of the identity of the bivalve and recognition of its potential as a serious marine pest, a high level management committee was established in the Northern Territory (NT) led by the NT Department of Primary Industry and Fisheries (DPIF). The committee included relevant Ministers and senior officials from the NT Government. The three infected sites were quarantined and a dive survey of all surrounding buoys, wharves, marinas, oil rigs, barge landings and nearby Darwin Harbour shorelines was initiated to establish the extent of the contamination. The survey confirmed that the outbreak was limited to the three marina sites originally identified.

The response management committee coordinated the on-ground containment and treatment actions (involving over 300 personnel). The main actions undertaken included the tracking and treatment of vessels that had left infected sites, the treatment of three sites and almost three hundred vessels in the Darwin area and the initiation of a public awareness program to meet local and national needs. Commonwealth agencies led by Agriculture Fisheries and Forestry - Australia (AFFA) established a national working group on 6 April 1999 to coordinate national action to prevent the spread of the mussel to other States. Other agencies involved included Environment Australia (EA), Commonwealth Scientific and Industrial Research Organisation's (CSIRO) Centre for Research on Introduced Marine Pests (CRIMP), the Australian Fisheries Management Authority (AFMA), the Australian Quarantine and Inspection Service (AQIS), the Australian Maritime Safety Authority (AMSA), the Australian Customs Service (ACS), the Australian Government Solicitor (AGS) and the Department of Defence (Navy). A local scientific sub-committee comprising representatives from CSIRO CRIMP, NT Museum and Art Gallery, DPIF and the Northern Territory University developed national protocols to detect and treat the Black Striped Mussel at the Darwin sites and on vectors considered to be at risk.

Between 31 March and 19 April 1999, chlorine (calcium and sodium hypochlorite) and copper sulphate were added to the marina waters. Both treatments killed mussels but the copper sulphate proved more effective. On 23 April 1999, 100% of the exotic Black Striped Mussels were deemed successfully eradicated and , all three marinas were re-opened for normal use. Procedures were established for continued monitoring to detect possible new infestations. No further infestations have been detected to date.

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The Joint Standing Committee on Conservation/Standing Committee on Fisheries and Aquaculture National Taskforce on the Prevention and Management of Marine Pest Incursions (National Taskforce) was established in July 1999. To assist the Taskforce, a national workshop was conducted in Darwin on 27-28 August 1999 to evaluate the response to the Black Striped Mussel outbreak.

Day 1 of the workshop evaluated the effectiveness of the actions taken. Participants considered that, while the local response actions taken after the confirmed detection of the pest were quick and effective, there had been a delay in raising the alarm about the outbreak. The two most effective methods of detecting an introduced marine pest were through an extensive monitoring and surveillance program, or an enhanced public awareness to stimulate voluntary reporting. The scientific team charged with finding a solution to the outbreak was very effective in developing treatment options for the contaminated marinas. Within three weeks, five treatments (chlorine, copper sulphate, chlorine dioxide, detergent and heat) were trialed and two (chlorine and copper sulphate) successfully implemented.

It was recommended that a medium/long term program was required to raise public awareness of the marine pest issue and provide processes for the reporting and identification of potential pests. From the legal perspective, the main message was the need to have appropriate legislation in place prior to pest outbreaks and the need to be aware of the long-term legal implications of some emergency response actions. The workshop found that a directed media campaign throughout the outbreak was essential in obtaining and retaining the cooperation of local communities and in satisfying the information needs of State/Territory, national and international stakeholders. It was also recommended that the vessel tracking approach taken in the Black Striped Mussel outbreak be further examined with a view to developing a national vessel tracking and monitoring capacity.

Day 2 of the workshop identified management actions to address key deficiencies in overall management. It focussed on: determining who has responsibility for management actions; what risk management measures should be in place; the most effective operational planning and implementation processes and monitoring and evaluation options. Discussions highlighted the need for strong political commitment to the issues of marine pest impacts and the need to obtain this commitment from the various jurisdictions in order to obtain a secure funding base for incursion management actions. It was acknowledged that systematic risk management was an essential approach to maximising the effectiveness of preventing and responding to marine pest outbreaks. The Consultative Committee on Exotic Animal Diseases approach was endorsed as the model within which to develop the required national, jurisdictional and local level emergency response and control plans for marine pest outbreaks. Essential elements to consider in monitoring and evaluation actions were identified as pro-active research, early warning pre-incursion monitoring and evaluation of past case studies and monitoring procedures.

The outcomes of the workshop were given further consideration by the National Taskforce and the recommendations of the workshop were substantially incorporated into its report which was presented to Government Ministers in December 1999, proposing a National System for the Prevention and Management of Introduced Marine Pests.

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Introduction

The potential impact of marine pests on Australian coastal environments was again brought to public attention in March/April 1999 when the Black Striped Mussel was detected in the Cullen Bay Marina in Darwin.

Unlike previous marine pest incursions within Australian territorial waters, the Black Striped Mussel incursion was detected while still within enclosable marinas, which allowed effective treatment through the application of chemicals to the waters of the marinas. During a four week period, the Northern Territory Department of Primary Industry and Fisheries led a successful response effort involving a wide range of organisations including Territory, State and Commonwealth agencies. The management of the outbreak highlighted the need for increased preparedness to handle marine pests.

In May 1999 agencies involved in the Australian and New Zealand Environment Conservation Council (ANZECC)/Ministerial Council on Forestry, Fisheries and Aquaculture (MCFFA) National Taskforce on the Prevention and Management of Marine Pest Incursions agreed that a workshop should formally evaluate the response to the Black Striped Mussel incursion. The workshop would be used to guide management of future marine pest outbreaks and highlight areas of management that required immediate attention.

The Marine Pest Incursion Workshop held in Darwin on 27-28 August 1999 provided the opportunity for this evaluation and enabled the Taskforce to address a more forward looking agenda. Key stakeholders and participants were brought together (see Appendix 3 for list of participants) for a formal debriefing of events surrounding the incursion and asked to make recommendations for the management of future events (see Appendix 2 for workshop program). This report is one of the outputs from this workshop and aims to capture key information from the discussions.

The report contains four sections:

Part 1. Chronology of the response to the Black Striped Mussel Outbreak

Part 2. A description of the incursion response to the Black Striped Mussel: Darwin March/April 1999.

Part 3. Evaluation of the response to the Black Striped Mussel outbreak.

Part 4. Management improvements to marine pest incursions.

Part 1: Chronology of response to the Black Striped Mussel outbreak

September 1998 Divers from CSIRO CRIMP and the NT Museum & Art Gallery surveyed Darwin Harbour and marinas, including Cullen Bay Marina, (as part of the Port of Darwin baseline survey) and did not detect any Black Striped Mussels (BSM).

27 March 1999 CSIRO divers conducted the second component of the baseline survey and detected massive infestations of BSM in Cullen Bay Marina.

29 March 1999 NT Museum & Art Gallery alerted NT Department of Primary Industry and Fisheries (DPIF) of BSM detection. The Minister and Chief Executive Officer of DPIF were briefed. The Northern Territory response management committee established.

30 March 1999 Follow-up dive surveys were coordinated by DPIF to determine the extent of the outbreak outside Cullen Bay Marina A special meeting of the NT Cabinet to pass regulatory amendments, approved the establishment of the Taskforce and the expenditure of funds.

31 March 1999 NT Cabinet and Executive Councils convened and legislative changes were approved. A second BSM outbreak was found at Tipperary Waters Estate Marina. Six vessels were contained within Tipperary waters. An emergency management committee was convened, response teams were established, an information campaign commenced (including telephone hotline, Internet site, public meetings), and marina locks were dosed with sodium hypochlorite to create a sterile plug. One hundred and forty seven vessels were contained within Cullen Bay Marina.

1 April 1999 A vessel originally from Cullen Bay Marina moored in Frances Bay Mooring Basin was found to be carrying BSM. 70 vessels were contained within Frances Bay. An interstate alert was issued to owners of vessels from Cullen Bay Marina to check vessels and not scrape hulls. The NT Government quarantined the three infected marina sites to prevent further spread of BSM, using a combination of the powers in the NT *Fisheries Act 1988* and the Commonwealth *Quarantine Act 1908.*

2 April 1999 Four vessels from Cullen Bay Marina moored in Sadgroves Creek were found to have BSM and were removed from the water. Dive teams checked potential contamination sites around Darwin Harbour. A list of potentially contaminated vessels that had left the marinas was developed by AQIS with the support of Australian Fisheries Management Authority.

3 April 1999 Two vessels from Cullen Bay Marina lifted at Spot On Marine were found to have BSM and were removed from the water. Another contaminated vessel located at Frances Bay Mooring Basin was also

removed from the water. Trial of copper sulphate treatment commenced in Tipperary Waters Marina Estate.

4 April 1999 Chlorine treatment of Cullen Bay Marina. Further copper sulphate treatment of Tipperary Waters Marina Estate was undertaken. A vessel tracking database was established and 420 vessels were identified as "at risk" of contamination (either those still in the marinas or those which had left since the infection period). Treatment of internal systems of vessels was trialed.

5 April 1999 Further chlorine treatment of Cullen Bay Marina. Fish species killed during treatment of the marinas were identified by the NT Museum. No further signs of BSM infestation were found outside the three marinas.

6 April 1999 Further chlorine treatment of Cullen Bay Marina. The National BSM Taskforce was established led by Agriculture, Fisheries and Forestry - Australia. Copper sulphate was found to have a 100% kill rate of mussels in Tipperary Waters Marina Estate. Four boats were slipped and found to be infested with BSM.

7 April 1999 Copper sulphate treatment of Cullen Bay. Vessel cleaning protocols were released. Scientific sub-committee of the National BSM Taskforce met to develop National Protocols for treatment of vessels and anchorages between Fremantle and Sydney potentially infected with the BSM. Chlorine treatment of Frances Bay Marina. Second public meeting at Cullen Bay.

8 April 1999 Copper sulphate added to Frances Bay. Gove Harbour was declared clear of BSM. NT DPIF staff commenced checking the internal systems of Cullen Bay Marina vessels with endoscopes.

9 April 1999 Further chlorine treatment of Cullen Bay Marina after heavy rain during previous 24 hours.

12 April 1999 Some cleaned vessels were allowed to leave Cullen Bay Marina after a check of monitoring areas in the marina revealed no live mussels.

15 April 1999 A recently dead mussel found on a yacht from Cullen Bay Marina when lifted at Sadgrove's Quay.

16 April 1999 Surviving mussels were detected on vessels leaving Cullen Bay Marina. Both Cullen Bay and Tipperary Waters marinas were again closed and quarantined. Intensive re-surveying and re-sampling commenced in Cullen Bay Marina. National Protocols formally released.

17-19 April 1999 Intensive sampling of Cullen Bay Marina revealed two live mussels, followed by two recently dead mussels in amongst hundreds of thousands of dead mussels. Copper sulphate was added at specific sites in Cullen Bay Marina.

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20 April 1999	Cullen Bay Marina reopened at high tide for limited access in and out of the marina. Clearance dives were conducted in Tipperary Waters Marina Estate.
22 April 1999	Clearance dives were conducted in Frances Bay Mooring Basin.
23 April 1999	Quarantine conditions were lifted from Cullen Bay, Frances Bay and Tipperary Waters marinas and all were re-opened for normal use. Monitoring and sampling surveys continued.
29 April 1999	National BSM Taskforce ceased operation.
8 May 1999	21 day "all clear" issued for all three marinas. Precautionary vessel checking and treatment arrangements remained in place.
May 1999	The Aquatic Pest Management Program was established to monitor the impacts of BSM response activities and oversee a continuing program of pest surveillance and control in the Northern Territory.
July 1999	The National Taskforce for the Prevention and Management of Marine Pest Incursions was established to examine improvements to all aspects of introduced marine pest management. The Taskforce's report was delivered to Government Ministers on 23 December 1999.

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Part 2: A Description of the Incursion Response to the Black Striped Mussel: Darwin March/April 1999

Introduction

The Black Striped Mussel belonging to the genus *Mytilopsis* is a native of tropical and sub-tropical western Atlantic waters extending from Colombia to the Gulf of Mexico. The soft shelled Black Striped Mussel grows in dense mats with individuals reaching a maximum length of about 2 cm. A mature mussel is capable of producing 50,000 offspring within one month of settlement. The Black Striped Mussel can reproduce in water as cool as 18 degrees Celsius and can survive in water to 10 degrees Celsius, corresponding to an ability to potentially colonise northern Australian waters from Fremantle to Sydney as well as warmer southern Australian waters.

The Black Striped Mussel has colonised a number of countries in the Asia-Pacific region, such as Singapore, Hong Kong, Japan and Taiwan, although not always in pest proportions. However it is known as a significant fouling pest in ports and water systems around India. Little published information on the Black Striped Mussel was readily available before the outbreak, and at the time of the outbreak it was not listed on existing Australian pest lists.

The Black Striped Mussel belongs to the same family as the Northern Hemisphere's zebra mussel (*Dreissena polymorpha*). As a consequence of the zebra mussel's infestation of the Great Lakes and Mississippi River system in the Unites States there exists a wealth of information on management options for the freshwater bivalve. A significant amount of information relevant to the Black Striped Mussel was obtained from the US SeaGrant Zebra Mussel database. The chief investigators of the species following the outbreak were CSIRO, the Northern Territory University and the NTDPIF Darwin Aquaculture Centre.

The outbreak of Black Striped Mussel in Darwin was the most significant exotic marine pest outbreak so far detected in Australian tropical waters. The outbreak also triggered the most intensive emergency response to a marine pest outbreak in Australia to date, requiring both local and nationally coordinated control and follow up actions.

The Port of Darwin Harbour is one of the more significant deep water ports in northern Australia. Darwin Harbour is a large, shallow estuary located at 12°27'S 130°50'E and is subject to major tidal fluxes (up to 7.8 metres). The Port of Darwin experiences two distinct seasons: a wet season associated with high humidity and high rainfall (October to March), and the dry season corresponding to cooler, less humid conditions with no rain (April to September). The Black Striped Mussel outbreak was detected at the closing of the wet season in late March 1999.

The pest incursion represented a substantial threat to the biodiversity of the surrounding marine environment. It also threatened the social and economic benefits derived from the marine environment, through the aquaculture, recreational and commercial fishing, domestic and international tourism industries. It also had the potential to reduce the competitiveness of the ports and shipping industries.

Darwin and the surrounding regions support significant fishing and aquaculture activities, in particular a pearling industry worth $350 million per annum nationally (the Territory component is in the order of $50 million). Darwin ports and marinas are the base for the Northern Prawn Fishery, which had an annual catch worth around $111.2 million in 1998/1999, and $119.4 million in 1997/1998.

Prior to the outbreak of the Black Striped Mussel, the Northern Territory was not regarded as a high risk area for exotic pest outbreaks. This perception was partly due to its proximity to South East Asia and the experiences to date with the more significant marine pest species originating from cooler temperate waters. Consequently, no procedures or processes had been established to specifically deal with an emergency pest outbreak in the northern Australian tropical marine environment.

The process used to control and eradicate the exotic Black Striped Mussel followed generic phases of emergency management:

1. alert phase;
2. operational phase;
3. stand down phase.

The following outlines the key actions taken at each of these phases in responding to and eventually eradicating the Black Striped Mussel outbreak. Evaluation of key processes and actions for each of these phases, arising from the workshop, including recommendations for future actions, is outlined in Parts 3 and 4 of this report.

1. ALERT PHASE

1.1 Detection of pest outbreak

In September 1998, a survey of Cullen Bay Marina was conducted by divers from CSIRO CRIMP and the Museum and Art Gallery of the Northern Territory (MAGNT) as part of the environmental baseline study commissioned by the Darwin Port Authority. No marine pest infestations were detected during this dry season survey.

On 27 March 1999, while conducting a follow-up wet season survey in the same marina, CSIRO divers detected significant populations of what were later identified by MAGNT as the Black Striped Mussel. This identification was later validated by the Western Australian Museum of Natural Sciences in Perth, Western Australia.

On 29 March the Curator of Molluscs at MAGNT alerted the Northern Territory Department of Primary Industry and Fisheries.

An extensive dive survey of Darwin Harbour was conducted between April 1 and 5 to determine the extent of the infestation. Mussel contamination was confirmed as being confined to three sites - Cullen Bay Marina, Tipperary Waters Marina Estate and Frances Bay Mooring Basin ("the Duckpond"). All contaminated sites were waters enclosed by lock gates. Cullen Bay Marina was the most infested site (approx. 10,000 mussels per square metre) with mussels covering almost every vessel hull, fender, rope, rock, pylon,

concrete wall and similar structure within the marina. Light infestations were detected at the other sites (on pylons at Tipperary Waters and on one vessel at Frances Bay).

When the mussels were first detected, 147 vessels were in Cullen Bay, 70 in Frances Bay and 6 in Tipperary Waters. Another 197 vessels, including 57 vessels from the Northern Prawn Fleet at sea, were identified as having left the sites between October 1998 and when the mussels had been detected. These vessels were potentially contaminated and posed a significant risk to the containment and eradication of the Black Striped Mussel in Australian waters.

1.2 Initiation of the local response process

A specific emergency plan for marine pest outbreaks had not been developed prior to the Black Striped Mussel outbreak. The initial trigger for response action was provided by the alert on the mussel's detection given by MAGNT to the primary local management agency, the Department of Primary Industry and Fisheries, on 29 March 1999 following the identification of the pest species. The reasons for the decisive response action were:

- the close similarity of the species to the northern hemisphere's zebra mussel, which has caused billions of dollars of damage to North American waterways and infrastructure (choking pipes, blocking internal systems of boats, massing on available hard structures);
- potential devastating impacts on surrounding marine ecosystems and industries such as aquaculture (crowding out native and cultivated species, fouling of vessels and operational equipment);
- the feasibility of containing and eradicating the outbreak within the semi-closed environment of the marinas.

From the beginning, the Northern Territory Government approached the Black Striped Mussel incursion as a whole-of-government issue. The principles applied by the Government to recent experiences with natural disasters, including application of disaster management plans and involvement of broad cross sections of the community, were used as the basis for initiating response actions for the Black Striped Mussel outbreak.

On 29 March 1999, the Minister and Chief Executive Officer of the Department of Primary Industry and Fisheries received a situation briefing. This briefing was also provided to the Northern Territory Cabinet. An incident management Taskforce was established, headed by the Northern Territory Assistant Commissioner of Police. On-ground direction for response action was delegated to the Department of Primary Industry and Fisheries with support from most other Government agencies including Transport and Works, Lands, Planning and Environment, Attorney Generals Office, as well as Power and Water authorities. The following table lists the support units established to assist with on-ground operational response actions.

Unit	Lead agencies/organisations
media	NT Police, Office of Minister for Primary Industry and Fisheries, NT Department of Corporate and Information Services (DCIS)
vessel tracking	Australian Quarantine and Inspection Service (AQIS), NT Police
emergency services	NT Emergency Services
health	NT Health Services
diving/survey	Fisheries Division of NT Department of Primary Industry and Fisheries (NTDPIF)
eradication	Fisheries Division NTDPIF, CSIRO CRIMP, NT University
biology and treatment	Fisheries Division NTDPIF, CSIRO, NT University

A special meeting of the Northern Territory Cabinet agreed to amendments to the *Fisheries Act 1988* and Regulations that:

- listed the Black Striped Mussel as an aquatic pest,
- designated "aquatic pests" alongside "disease and contaminated fish",
- decreed that restricted areas are to apply to aquatic pests,
- declared the affected marinas to be restricted areas and prohibited the movement of aquatic life from these areas.

The amendments were gazetted on 31 March 1999.

The three infected sites were quarantined, using the Northern Territory *Fisheries Act 1988* (amended for the purpose) and the Commonwealth *Quarantine Act 1908*. The combination of these actions enabled vessel movements to be controlled and, where appropriate, vessels ordered out of the water through the issue of quarantine notices.

In the absence of any special reserve or contingency fund for marine pest outbreaks, the Cabinet also took the decision to approve expenditure of funds necessary to effectively address the response actions, without stipulating a specified funding limit.

2. OPERATIONAL PHASE

2.1 Taskforce on-site control

The Northern Territory Taskforce's primary aims for the emergency response were to:

- survey the extent of Black Striped Mussel outbreaks;
- quarantine all confirmed infected areas in Darwin;
- treat all infected vessels and areas to eradicate the Black Striped Mussels; and
- track and treat potentially infected vessels that had left the infected Darwin sites.

The Taskforce established a control centre headquarters in the Department of Primary Industry and Fisheries with a 1800 hotline (free-call) to answer queries from the public. The Taskforce met twice daily at 9:00am and 2:00pm to coordinate all on-ground

containment and treatment actions which involved over 300 personnel. Primary decisions were recorded and formally signed as evidence of authority to take actions. The Minister for Primary Industry and Fisheries attended almost every briefing session.

The support work units commenced operations from 31 March 1999, reporting to the Taskforce. In addition to the 7 specialist work units, officers from the Department of Primary Industry and Fisheries coordinated activities in the key marina areas to ensure support of the business and local community affected by the outbreak, and minimise disruption and reinforce messages on required actions.

One of the first actions was to quarantine and close the three marinas on 31 March 1999 under direction of the Minister for Primary Industry and Fisheries. At this stage, the first of the Mussel Updates was distributed by volunteers to every letter box near Cullen Bay Marina, Frances Bay Mooring Basin, and Tipperary Waters Marina Estate, including live-aboard yachts, retail outlets and businesses operating near the affected marinas.

As notification of the infestation was released on the eve of April Fool's Day, media efforts focused on validating the message. The first of a number of Public Meetings was convened at Cullen Bay Marina to explain the reasons for closure and solicit support from the public and affected businesses. These meetings were addressed by high level figures such as the Minister for Primary Industry and Fisheries to reinforce the authority for the action.

2.2 Media and Communications

The media team was established at the outset of response activities and was an integral component of the Taskforce's actions. The primary role of the media team was to establish the public information and awareness mechanisms to meet local, national and international requirements. The team was headed by the Media Relations and Corporate Communications section of the Northern Territory Police, Fire and Emergency Services, and included representatives from the Office of Resource Development, and Office of the Minister for Primary Industry and Fisheries.

The media team focussed on delivering coordinated and up-to-date messages on the importance of action being taken on the Black Striped Mussel outbreak. The team ensured the media had ready access to stories showing authorities in action and authoritative scientific comment to prevent misinformation.

The key actions taken by the media team included:

- convening public meetings at Cullen Bay Marina addressed by relevant Northern Territory Government Ministers and senior Taskforce members;
- development and distribution of information fliers ("Mussel Updates" and fact sheets) distributed to residents, businesses and vessel owners/operators;
- daily media advertisements; and
- coordinating responses to inquiries through a 1800 telephone hotline number.

Samples of the information products produced are shown at Appendix 6.

An extremely important vehicle for prompt distribution of this information was the early establishment of a World Wide Web site by the media team. The Web site was used to provide a consistent message on Taskforce actions and provide immediate access to the latest technical information, public awareness material, management decisions, directions to the vessel operators and the general public, and track decisions and actions taken over the period of the outbreak. Samples of Web pages used during the outbreak can be found on the Northern Territory Government web site located at:
http://www.nt.gov.au/dpif/fisheries/environ/environ.shtml.

The Web pages were targeted not only at local needs but also at national and international levels, and were able to provide sufficient information to divert further external inquiries to the Taskforce.

2.3 Vessel Tracking

The tracking and treating of vessels that had left the infected marinas prior to 27 March 1999 was a priority. Around 420 vessels were initially identified as being at risk - that is either being in the three marinas at the time of the discovery of the outbreak or having been in the marinas and since left after the most likely start of the contamination period, which was just before Christmas. A significant concern was held for the 137 vessels of the Northern Prawn Fishery Fleet as 57 of the fleet's vessels had already left the infected marinas for the start of the banana prawn season. The movement of these vessels posed a risk of spreading the pests through contacts with other vessels and visits to other ports, marinas and anchorages interstate.

As no consolidated vessel movement data system existed prior to the Black Striped Mussel outbreak, a vessel tracking Access database was developed by the Northern Territory Police and the Australian Quarantine and Inspection Service with the support and input from the Darwin Port Authority, the Australian Customs Service, the Northern Territory Fisheries Division Licensing Branch, the Australian Fisheries Management Authority and Coastwatch. The database was used to send alerts to interstate vessel owners and authorities to check and treat vessels. The database recorded:

- vessel names, owners and contact details;
- current location;
- history of individual vessel movements and current location; and
- "health status" ie infested/not infested, treated, cleared.

The vessel tracking unit developed the database software, maintained it and provided updates as required. The database eventually recorded details of 743 vessels by including interstate and international vessels that were identified as potentially at risk of contamination at some stage during the designated at risk period of the incursion. States were directly informed of any 'at risk' boats and the details of 'at risk' boats were faxed to the States for action. On arrival of any of these 'at risk' boats in the States, all boats were inspected and found to be completely clear of BSM.

2.4 Emergency Services

Northern Territory Emergency Services provided continuous support to the response action. Staff from the fire brigade, emergency services, police and ambulance services were used to ensure containment and eradication activities were carried out with a high level of safety. A private security firm was engaged to ensure 24-hour security surveillance and prevent any vessel movement in and out of closed areas.

Over the Easter period more than 30 Emergency Service volunteers supported the enforcement of security arrangements for closed contaminated marinas, collected dead fish from the treated marinas, distributed pamphlets to boat owners, distributed chemical treatments in the affected marinas, and supervised and supported treatment applications.

2.5 Health

Territory Health Services (THS) and the Work Health Authority (WHA) were involved in a significant campaign of reviewing health related information and providing timely communication on health related issues relevant to the pest outbreak. Those involved in the transport, storage and application of chemicals (the divers, the security and emergency service personnel and those undertaking the treatment of vessels), faced the greatest risk from a health perspective. Any potential risks that on-ground response action personnel may have been exposed to were handled through the strict application of Occupational Health & Safety and THS guidelines. The processes strongly paralleled those advocated for the practice of disaster medicine, using similar operational and legal processes to any other significant public health situation.

Health messages about swimming and fishing in the marinas were distributed through general public notices.

Fish kill removal teams were deployed shortly after chemical treatments to remove dead organisms from the marinas on a 24 hours per day basis to ensure that there was minimal risk of smell or health issues.

General health warnings were issued by the Taskforce's media unit and these contained advice offered by THS. The Taskforce was responsible for updating advice for dissemination by the media unit.

2.6 Diving/survey

Up to 28 divers and support teams (including armed crocodile spotters) were involved throughout the outbreak surveying for the presence of Black Striped Mussels. An initial survey conducted between March 29 and April 3 of Darwin Harbour and all static structures therein indicated the Black Striped Mussel were contained within the marinas. All areas were resurveyed as the opportunity arose between the completion of monitoring dives within the marinas.

Dive teams coordinated by the Department of Primary Industry and Fisheries included private companies supplemented by the Northern Territory Police, Parks and Wildlife,

Australian Defence Force, Northern Territory Museum and CSIRO. The teams conducted systematic surveys of all potential sites of pest contamination in the marinas and around Darwin Harbour -including vessel hulls, the naval base, cleaning poles, surrounding buoys, wharves, oil rigs, barge landings and nearby Darwin Harbour shorelines. Gove Harbour was also examined in this way. The dive teams, supported by Department of Transport and Works staff, also inspected sewage and storm water drains. These surveys confirmed that the outbreak was limited to the three marina sites originally identified.

Inspection protocols were developed by the Taskforce, in conjunction with CSIRO and the fishing industry, to check vessels and other sites for Black Striped Mussel contamination, with particular attention to the hull surface, ropes, chains, anchors, sea water inlets and internal water systems. These protocols were applied to all vessels in the marinas and those identified at sea that had been in the marinas during the likely contamination period. Around 250 vessels, including barges, oil rigs, wharf piles and the naval base, were subject to this inspection process.

Specialist equipment was used to complement the diver inspections, including a twenty-two metre endoscope and a pair of three metre endoscopes to inspect the more difficult access areas, such as vessel water intake and outlet areas. The dive teams had a critical role in verifying the success of subsequent treatment actions and the clearance of vessels and other potentially contaminated sites.

During the chemical treatment process to kill off the Black Striped Mussel infestations in the three marinas, specially qualified divers were used to monitor the effectiveness of the chemical applications. Ten monitoring stations were set up in Cullen Bay Marina to monitor the efficacy of the chemical treatments on the mussels. Twenty locations within Cullen Bay Marina were sampled by divers to assess the efficacy of the chemical treatments at various locations within the marina as part of the marina clearance and re-opening process.

2.7 Treatment Options

2.7.1 Assessment of suitable treatments

There was essentially an information vacuum relating to the control of Black Striped Mussels as maritime industries and the scientific community had little experience of situations where eradication of a mussel infestation was feasible. The Black Striped Mussel outbreak was therefore treated in an epidemiological manner along the lines of infectious diseases.

The incubation period for the establishment of mussels was estimated to be up to three months, based on the expected length of planktonic life of the species. High, medium and low risk rankings were allocated to areas and vessels in contact with those areas based on the periods of time they may have been exposed to infected or potentially infected sites. As no Black Striped Mussels were detected in Cullen Bay in the September 1998 survey, it was anticipated that the earliest date of a reproductive population being present in Cullen Bay Marina was 1 October 1998. It was estimated that vessels from Cullen Bay Marina infected Tipperary Waters Marina Estate and that the earliest date for a reproductive population to establish there was 1 January 1999. A vessel carrying a

reproductive mussel population entered Frances Bay Mooring Basin on 12 March 1999, although any subsequent spawning activity was yet to be ascertained.

Using this basic risk framework, Cullen Bay and Tipperary Waters were known high risk areas and Frances Bay a medium risk area. Similarly, high-risk vessels were deemed to be those in Cullen Bay Marina any time after 1 October 1998, or in Tipperary Waters Marina at any time since 1 January 1999. All identified high risk vessels were required to undergo treatment, either at Cullen Bay or Tipperary Waters if already located there, or if outside the infected sites to return to the approved quarantine facility at Frances Bay Mooring Basin. Medium risk vessels were determined as those that were in Frances Bay Mooring Basin after 12 March 1999 (in contact with reproductive population but spawning not yet confirmed) and were required to contact Darwin authorities for directions on treatment.

The research effort on suitable treatments was led by the biology and treatment unit comprising the Northern Territory University and CSIRO Centre for Research on Introduced Marine Pests and the Fisheries Division of the NT Department of Primary Industry and Fisheries. Initial scientific advice from the treatment unit suggested chlorine was the most likely available chemical to kill the Black Striped Mussel infestations, based on its past use to counter infestations of the zebra mussel. Chlorine was naturally degradable and was not expected to persist in the marine environment and hence cause significant harm to the surrounding Darwin Harbour.

Laboratory tests were conducted on collected samples of mussels to test the effectiveness of treatments. Toxicity trials at the Northern Territory University showed that copper sulphate was an effective agent against Black Striped Mussels, and that hot water and detergent were even better in enclosed spaces such as internal water systems of vessels. It was also necessary to conduct scientific tests to ensure that copper sulphate would not damage aluminium boats.

Vessel treatment protocols were developed by a scientific sub-committee of the National Black Striped Mussel Taskforce established in Canberra. The scientific sub-committee comprised representatives from CSIRO CRIMP, NT Museum and Art Gallery, the NT Fisheries Division and the Western Australian Museum. The protocols addressed treatment of vessels:

- currently in the three marinas;
- that had left the Frances Bay Mooring Basin after the commencement of the likely infectious period post 12 March 1999 (including the Northern Prawn Fleet vessels);
- already hauled out of the water (to ensure containment and treatment of hull biofouling materials); and
- vessels entering ports other than Darwin.

Technical notes and procedures were also provided to assist with vessel treatments, including hull inspections, engine cooling systems, deck wash and fire systems, refrigeration, sink and toilet systems, and de-salination plants.

2.7.2 Treatment applications;

The treatments needed to consider the logistics of the areas to be treated. The largest marina, Cullen Bay, caters for mainly recreational and tourism vessels and has an estimated water volume of 600ML with a surface area of 12.5 hectares and an average depth of around 4 metres. Mussel densities were up to 10,000 per square metre in some sites. Frances Bay Marina is primarily a mooring basin catering for commercial craft such as the Northern Prawn Fishery and pearling vessels, most of which had already departed the marina. The estimated water volume is 250ML and average depth around 5 metres. The Tipperary Waters Marina had only been recently established and caters for residential recreational craft. It has an estimated water volume of 150ML and average depth around 5 metres. Only 6 vessels were moored in the marina and mussel densities were found at a maximum of 6 per square metre. Treatment action was therefore focussed on the Cullen Bay Marina and the vessels still moored there.

It was estimated that several hundred tonnes of chlorine, in the form of liquid sodium hypochlorite, was needed for successful treatments. As the sole supplier in the Northern Territory, Orica, produced only around 15 tonnes a year, supplies had to be transported from Melbourne, Adelaide and Sydney. Truck drivers from Alice Springs were rostered to bring sodium hypochlorite in 10 special rubber lined trucks to Darwin.

An initial three tonnes of sodium hypochlorite was poured into the Cullen Bay lock to kill off any mussel larvae and act as a sterile ‘plug’ between the marina and the Harbour.

An important factor in the treatments was the use of large pumps to aerate the 12 hectares of water in Cullen Bay to raise the oxygen levels and break the stratification of the salt and fresh water layers.

Checks after the initial chlorine applications in the marinas showed that many mussels could survive the chlorine treatment. It was determined that copper sulphate, added after initial chlorine treatment, was a more effective approach to killing the Black Striped Mussel. This was confirmed following copper sulphate applications in the Tipperary Waters Marina Estate, and was subsequently used in combination with chlorine at Cullen Bay and Frances Bay Marinas.

In total 160,000 litres of liquid sodium hypochlorite and around 6,000 tonnes of copper sulphate were added to the three marinas over two weeks, along with several tonnes of powdered calcium hypochlorite to create sterile ‘plugs’ near the locks.

Vessel treatments involved hauling vessels out and inspection, by invertebrate taxonomists, for recently settled larvae or mature mussels. As a precautionary measure, sampling programs were required for areas outside the known infected marinas where high risk vessels had been in contact. These sampling programs involved the deployment and collection of larval settlement plates for up to three months to determine the presence of spawning mussel populations. The detection of mussels would automatically raise the status of a medium risk area to high risk.

Vessel operators were provided with directions on precautionary actions to treat and prevent further spread of the mussel. These included:

- avoidance of shallow waters in case mussels were released off the boat,
- no scraping or antifouling of vessels hulls at sea,

- the cleaning of internal water systems (with boiling water, or water greater than 50 degrees Celsius for an hour, or 5% detergent solution for 14 hours, or copper sulphate at 4mg/l for 48 hours),
- need for protective linings around vessels when hauled out to prevent mussel fouling of surrounding areas,
- steam cleaning on haul out or drying on hard stands for 7 days,
- disposal of debris and water after cleaning.

2.7.3 Monitoring of treatment outcomes

The Museum & Art Gallery of the Northern Territory conducted a monitoring survey of the marine species killed during the treatment of the marinas, checked fish densities, species diversity in the marinas and identified new species previously unrecorded in the area, such as the blue spotted goby. In all, 67 species of fish were identified in the 4 tonnes of fish removed from Cullen Bay Marina.

Public meetings were an important aspect of advising on progress with treatments. As the aim was for a 100% kill of the Black Striped Mussel to avoid further infestation, public meetings were held to explain the delays in opening Cullen Bay Marina. Industry figures reinforced the message to all boat owners to see past the short-term inconvenience and to cooperate with authorities so that the mussel could be effectively eradicated.

2.7.4 Clearing infected areas

The first boats were allowed out of Cullen Bay Marina from 12 April - two weeks after its closure. The decision was based on the shell kills on the monitoring poles, which suggested that chemical treatments had been successful. By that stage the marinas had received several treatments of chlorine and copper sulphate over successive days. Boats were required to depart on the top of the tide when there would be a negative water exchange. Before clearance the boats were required to follow internal cleaning procedures and be certified clean by Quarantine and Fisheries Officers who carried out inspections and issued clearance certificates.

However, live mussels and evidence of recently dead mussels were found in the following two days on boats that had just left the Cullen Bay Marina and had subsequently been lifted out of the water for hull cleaning and antifouling at Sadgroves Quay ship yard. Cullen Bay Marina was immediately closed and backup sampling commenced. This involved dive teams scouring hulls of the remaining vessels in Cullen Bay Marina. Eleven vessels targeted as suspect mussel carriers were lifted out of the water at Cullen Bay Marina and had their hulls thoroughly inspected. Dive teams also inspected potential mussel fouling sites in Cullen Bay Marina.

The biofouling samples collected during this sampling were thoroughly examined by a specialised sorting team, with every shell opened to check for live or dead mussels. Two live and two freshly dead mussels were found at separate sites among hundreds of thousands of individuals. These sites were dosed with additional copper sulphate. It was suspected that microclimates existed within the marina due to uneven mixing of the water, pipe outlets, seawater seepage through the lock gates and thicker clusters of mussels in some locations.

Despite a follow up dive to inspect the nine selected monitoring stations in Cullen Bay Marina (where no live mussels were found) on 19 April 1999, the Taskforce in consultation with the Cullen Bay Marina took the precautionary approach and decided to keep the marinas closed until 23 April 1999. Follow up survey dives and sampling at all three marinas were conducted in the following days and no live mussels were found.

As a result of these surveys, the restricted area notices were removed from all three marinas on 23 April 1999 and all were re-opened.

2.8 Commonwealth actions and responsibilities

2.8.1 Establishment of National Taskforce

In the absence of agreed national emergency management arrangements for marine pest outbreaks, the initial response actions were solely directed by the Northern Territory Taskforce. Given the potential national significance of the outbreak and the need to coordinate national action to prevent the spread of the mussel to other States, a National Taskforce on Black Striped Mussel Control was established on 6 April 1999.

The National Taskforce based its arrangements around those of the existing Consultative Committee on Emergency Animal Diseases, but with different membership. The National Taskforce was led and coordinated by Agriculture, Fisheries and Forestry Australia (through the National Office of Animal and Plant Health) given its past experience in emergency disease management. Other representative agencies included Directors of Fisheries in each State and the Northern Territory, Environment Australia, CSIRO Centre for Research on Introduced Marine Pests, Australian Quarantine and Inspection Service, Australian Maritime Safety Authority, Australian Fisheries Management Authority, Australian Customs Service, Office of the Australian Government Solicitor and the Australian Defence Force (Navy).

2.8.2 Role of National Taskforce

The main roles of the National Taskforce were to provide a direct line of communication to the lead on-ground action agency, the Northern Territory Department of Primary Industry and Fisheries, a network of communication between the Commonwealth and States and Northern Territory, and peer support for strategies being developed and decisions taken by the Northern Territory Taskforce.

The main operational issues addressed by the National Taskforce were:

- *Effective communications between all stakeholders nationally*

  An operations centre was established in Agriculture, Fisheries and Forestry Australia in Canberra, ACT with two full-time staff, with recent experience in developing animal disease response arrangements, and two part time staff. The operations centre had access to dedicated computer workstations, phones, meeting rooms and fax facilities. Daily phone conference links were held with National Taskforce members in the initial period to ensure all members were aware of key developments, to take a coordinated approach to resolving outstanding and developing issues, and to allocate key tasks and plan future actions. These were conducted along the lines of models used in the exiting AUSVETPLAN. A daily situation report was distributed by the

operations centre by e-mail where possible to all National Taskforce members as a record of progress and key actions required.

- *Support for checking movements of commercial and recreational vessels interstate*

  The Northern Territory Taskforce was primarily responsible for the development of the vessel monitoring database and on-ground vessel movement tracking arrangements. The National Taskforce provided a forum for communication and coordination of checking boats that had moved interstate and to feed these details back to the Northern Territory's database. Epidemiologists from AFFA's National Office of Animal and Plant Health provided advice to set priorities for tracing vessels from the primary "at risk" areas.

- *Surveillance of pest infestation*

  Some National Taskforce member agencies such as the CSIRO Centre for Research on Introduced Marine Pests, Australian Quarantine and Inspection Service, Australian Fisheries Management Authority, and the Australian Defence Force (Navy) provided field support personnel to help the Northern Territory with on-ground pest surveillance and treatment actions. Apart from this individual agency support the primary role of the National Taskforce for surveillance activities was to ensure the distribution of technical material to all States to establish a network of surveillance. The National Taskforce ensured the prompt distribution nationally of pest identification sheets developed early in the outbreak by the CSIRO and the Northern Territory Taskforce, and later the distribution of detection and treatment protocols and technical procedures for monitoring of Black Striped Mussel such as larval settlement plates.

- *Development of effective scientific treatment protocols for Black Striped Mussels*

  The National Taskforce helped convene a working group of the available expertise nationally to develop and endorse protocols for the inspection and cleaning of "at risk" vessels and the surveillance of potentially "at risk" vessels. These protocols drew on the practical work already undertaken in Darwin and were subsequently adopted and applied for further surveillance and treatment actions in the Northern Territory and in other States where required. The Taskforce provided a forum that could approve protocols on a national basis.

- *The legislative requirements to take appropriate containment and treatment actions.*

  Clarification of available legislative powers was a significant issue throughout the Black Striped Mussel outbreak. Several States identified a lack of capacity within their legislation to quarantine ships and areas subject to pest infestation. While the Northern Territory Taskforce drew on the powers of the Commonwealth *Quarantine Act 1908* early in the outbreak to supplement the Northern Territory's *Fisheries Act 1988*, the appropriate use of Commonwealth and State legislation, particularly the powers to direct vessels to take actions recommended in the vessel treatment and surveillance protocols, needed resolution. The National Taskforce established a working group to examine available legislation and subsequently developed a protocol for the use of the Commonwealth *Quarantine Act 1908*, if required, by all States and the Northern Territory for the period of the emergency response arrangements. A copy of the protocol is at Appendix 7.

2.8.3 Agency responsibilities

The main responsibilities and contributions by the members of the National Taskforce were:

CSIRO Centre for Research on Introduced Marine Pests:

- provided scientific advisers and divers on site in Darwin to assist with on-ground control and management actions;
- provided scientific advice in the identification of mussel outbreaks and development of pest identification material; and
- led scientific working group (with NT, WA and QLD agencies, industry groups and relevant Commonwealth agencies) in the development of essential scientific protocols for management agencies in eradication of the pest in ports, the decontamination of vessels and marinas, follow up action in dealing with vessel operators and port authorities concerning contaminated vessels and other measures to prevent the translocation of the pest by vessels, including how to treat vessels at sea.

Agriculture, Fisheries and Forestry - Australia:

- coordinated all Commonwealth and interstate input through the National Taskforce;
- assisted with tracking the movements of domestic and international pleasure craft and (non-fishing) shipping, developing options for recalling and treating these vessels, and investigating compensation issues;
- coordinated national phone conferences with State Fisheries Directors and other relevant management agencies to monitor progress and agree on appropriate containment and treatment actions; and
- provided funding of $332,900 as contribution to the cost of the response action.

Australian Quarantine and Inspection Service (AQIS):

- on-ground advice and support of field staff to Northern Territory, Western Australia and Queensland agencies on vessel management and surveillance and treatment actions;
- monitoring and provision of shipping data to the Northern Territory Taskforce;
- advice on Commonwealth management arrangements and legislative powers relevant to emergency response actions; and
- advice to the International Maritime Organisation (IMO) and neighbouring countries including Indonesia, Papua New Guinea and New Zealand about the Black Striped Mussel incursion.

Australian Fisheries Management Authority (AFMA):

- lead role in tracing the movements of commercial fishing vessels, in particular vessels of the Northern Prawn Fishery, and pearl fleets (in conjunction with Fisheries WA);
- assistance with developing options for recalling and treating these vessels, and investigating compensation issues; and
- provided funding of $220,000 to the cost of the response action.

Environment Australia:

- conducted preliminary environmental impact assessment of proposed Black Striped Mussel control actions (deemed as not requiring further assessment under Commonwealth *Environmental Protection (Impact of Proposals) Act 1974* provisions);
- assisted with investigation and advice on available legislative powers to be invoked and availability of Commonwealth funding to support response actions; and
- provided funding of $400,000 from the *Coasts and Clean Seas* component of Natural Heritage Trust to the Northern Territory Government as contribution to cost of response actions.

Australian Maritime Safety Authority:

- on-ground advice and support of field staff by AMSA marine surveyors in Darwin on vessel operations, inspections and treatment actions.

Australian Customs Service:

- made available the Customs vessel "Roebuck" for port and vessel surveillance.

Australian Government Solicitor (AGS):

- investigated issues of Commonwealth and State/Northern Territory powers to impose control actions and potential liability and compensation issues; and
- assistance with developing protocol on use of Commonwealth *Quarantine Act 1908* powers.

Australian Defence Force (Navy):

- provided dive team (6 divers) and a workboat under Defence Aid to the Civil Community arrangements.

2.8.4 Action by other States

Apart from participation in the National Taskforce, other States were required to take precautionary measures to prevent the spread of Black Striped Mussel to their waters. Western Australia and Queensland were most at risk, given their proximity to the Northern Territory and similar tropical and sub tropical marine environments, the length of their coastlines, and the regular passage of vessels between their State waters and the Northern Territory.

The specific actions taken by these States included:

Western Australia

- a Western Australian Black Striped Mussel Incident Taskforce was convened to coordinate emergency response initiatives in WA. The taskforce comprised representatives from the Department of Transport, WA Museum, Department of Environmental Protection, Department of Conservation and Land Management and Fisheries WA;

- an amendment to the *Fish Resources Management Regulations 1995* was made to declare the mussel a noxious fish;
- two Fisheries WA officers were flown to Darwin for training in mussel identification, vessel inspection and vessel treatment and assisted the Northern Territory in their mussel eradication and vessel treatment operations before returning to WA to undertake vessel inspection and treatment in WA waters;
- nine medium risk vessels, which were in Frances Bay Marina after 12 March, were found in WA waters, five pearling vessels, three prawn vessels and one charter vessel. These vessels were tracked, inspected and treated, according to the National Protocol, by Fisheries WA;
- weekly situation reports were produced following an initial media release to update industry and the wider community on the status of the incursion response nationally and within WA;
- an information leaflet on the Black Striped Mussel was produced and distributed to raise community awareness on the threat the mussel poses;
- key industry groups, particularly the Pearling Industry and WA Fishing Industry Council, were kept informed on the status of the incursion response;
- importation of pearl oyster spat from the Northern Territory was ceased till the risk was eliminated or controlled;
- WA contributed to National Taskforce teleconferences and provided comments on national protocols;
- a monitoring program, based on the national protocol, was established for adoption in harbours within Western Australia.

Queensland

- monitoring at 20 port and marina locations in tropical and subtropical Queensland. CRIMP designed larval monitoring plates and protocols were used. Some 300 plates and 236 ropes have been sent to James Cook University for analysis. Only plates with growth or signs of bivalves were sent in for analysis. Monitoring plates are still deployed in some northern locations. No introduced marine species have been detected in this program.

3. STAND DOWN PHASE

3.1 Stand down of emergency arrangements

The opening of all three marinas on 23 April 1999 after the completion of clearance dive surveys signalled the end of the intensive emergency response arrangements by the Northern Territory Taskforce and a move to a monitoring phase of action. No further live mussels had been detected at the "at risk" sites and the eradication action was considered successful.

The National Taskforce continued to monitor actions nationally until 29 April 1999 when it determined that dedicated supervision of control actions was no longer warranted and that the emergency status of the situation had passed to a monitoring role within existing agency responsibilities. The National Taskforce demobilised on 29 April 1999 after agreeing to conduct a formal evaluation of the outbreak through the appropriate forums

of the Standing Committee on Conservation (reporting to the Australian and New Zealand Environment and Conservation Council) and the Standing Committee on Fisheries and Aquaculture (reporting to the Ministerial Council on Forestry, Fisheries and Aquaculture).

The Northern Territory Government maintained a precautionary approach in the weeks immediately following the outbreak to mitigate against a recurrence of the Black Striped Mussel incursion. Actions taken included:

- continuation of extensive diving and sampling around the three previously infected marinas until a formal "all clear" was given on 7 May 1999;
- maintenance of inspection and treatment protocols for vessels returning to the Darwin marinas, such as those from the Northern Prawn Fishery that were at sea during the outbreak;
- consultations with key stakeholders such as marina and ship yard owners and port authorities to develop future inspection and treatment measures based on a risk assessment approach, to improve health and hygiene protocols for vessels and to improve the handling and treatment of biofouling removed from vessel hulls; and
- a commitment to monitor marinas and "hot spots" for signs of a recurrence of Black Striped Mussels over the next 12 months.

An assessment of the costs of controlling the outbreak was made at the completion of emergency arrangements. The Northern Territory Government estimated the cost in excess of $2.2 million. In the absence of prior agreement on cost sharing arrangements, the Commonwealth Government agreed to reimburse the Northern Territory Government $998,000 towards these costs. It was also estimated that the closure of the marinas and other control actions cost the private sector hundreds of thousands of dollars in lost revenue. The Northern Territory Government was also subject to around fifteen litigation claims for damages alleged to have resulted from the emergency response actions taken. Most were rejected but action continued for some time on a small number of outstanding claims.

Other key resources used for the duration of the response action in the Northern Territory were:

- over 280 personnel directly involved;
- 160 tonnes of liquid sodium hypochlorite and 6 tonnes of copper sulphate used in treatment actions;
- 28 divers involved, many with specialist qualifications for hazardous work;
- over 760 vessel entries on the vessel monitoring database; and
- over 250 vessels inspected and/or treated for presence of Black Striped Mussels.

3.2 NT Aquatic Pest Management Program

The Northern Territory Department of Primary Industry and Fisheries established an Aquatic Pest Management Program in early May 1999 to formally continue the monitoring and preventative measures for the Black Striped Mussel and other invasive aquatic pest species. The program works closely with marina owners, shipping companies, port authorities and the general public and focuses on:

- monitoring for the recurrence of the Black Striped Mussel;
- assessing the recovery of the marinas from the chemical treatments undertaken during the Black Striped Mussel response actions;
- developing management measures to reduce the potential for future aquatic pest incursions; and
- further developing inspection, treatment and maintenance protocols and awareness materials to minimise risk of pest introductions.

The program has expanded its focus beyond Darwin Harbour to include four Northern Territory ports with regular international and domestic vessel trade. The program has overseen the continued monitoring for pest species since the Black Striped Mussel eradication action, including placement of specifically constructed collectors at potential pest introduction sites in combination with a monthly dive survey of selected sites in the marinas and greater Harbour areas. Complementary to the ongoing monitoring is a Public Education Program producing informative posters and leaflets, to encourage community involvement and the reporting of marine pest outbreaks, and a Vessel Inspection Program. A free-call hotline has been maintained to assist with marine pest inquiries and reports. The Vessel Inspection Program has already resulted in the detection of small populations of three potentially damaging exotic marine species, the Black Striped Mussel (*Mytilopsis sp.*), the Asian Green Mussel (*Perna viridis*) and bryozoan species.

The program aims to eventually delegate responsibility for the application of many of the management protocols to the private sector with the Government having an audit role.

3.3 Subsequent National management action

Following the cessation of the National Taskforce, Environment Australia allocated funding of $5,000 to conduct a national workshop held in Darwin in August 1999 to critically evaluate the response to the Black Striped Mussel incursion. The outcomes of that workshop are outlined in Parts 3 and 4 of this report.The Black Striped Mussel incursion highlighted the need for national agencies to examine current procedures and practices across all aspects of marine pest incursion management, including:

- preventative and border control measures;
- preparedness for emergency pest outbreaks;
- capacity for coordinated response to pest outbreaks; and
- ongoing pest mitigation and control actions.

In August 1999 a Joint SCC/SCFA National Taskforce on the Prevention and Management of Marine Pest Incursions was established to examine these and other issues and report to Government Ministers by the end of 1999 on recommended actions. Further information concerning this Taskforce is provided in Part 4 of this report.

Part 3: Evaluation of Response to the Black Striped Mussel Outbreak

Introduction

A national workshop was conducted in Darwin on 27-28 August 1999 to evaluate the actions taken to address the outbreak of Black Striped Mussels in Darwin in March/April 1999. The workshop included many of the representatives of the Northern Territory Taskforce and supporting government and non-government organisations who were directly involved in managing the outbreak. Representatives from Commonwealth agencies that participated in the National Black Striped Mussel Taskforce were also present. The workshop program is at Appendix 2 and participants list at Appendix 3.

The workshop examined the way many of the actions outlined in the Part 2 of this report were handled. Key findings from the workshop are presented as successes and problems, with recommendations for future emergency response or other marine pest management situations. Some of these findings and recommendations were further examined at Day 2 or the workshop on 28 August 1999, where improved longer term management arrangements for marine pest incursions were examined (see Part 4 of this report).

1. ALERT PHASE

1.1 Detection of pest outbreak

The workshop participants considered that while the local response actions taken after the confirmed detection of the pest were quick and effective, there was a delay in raising the alarm about the outbreak.

The key problems identified in detecting the outbreak were:
- an absence of established terms of reference for detecting and responding to marine pest outbreaks;
- absence of advance warning systems and procedures to provide advice to executive management on response action required;
- the absence of systems to identify and contact key stakeholders quickly;
- insufficient information on the extent of the threat posed by the mussel outbreak; and
- lack of established and recognised pest detection methods and clearly defined "triggers" to take action.

It was noted that the two most effective methods of detecting an introduced marine pest were extensive monitoring and surveillance programs, and enhanced public awareness to stimulate voluntary reporting. Indications were that the Black Striped Mussel was detected in Cullen Bay prior to the second CSIRO survey but people were not aware of the significance of what they observed.

It is recommended that:

A medium/long term program is required to raise public awareness (part of a "prepared community" approach) of the marine pest issue and provide processes for the reporting and identification of potential pests.

1.2 Initiation of local response process

Key successes in the set up of the local response actions were seen as:

- adoption of a "whole of government" or "whole-of-community" approach that addressed the Black Striped Mussel outbreak along the lines of a cyclone or other significant natural disaster rather than just a marine or aquaculture problem;
- the capacity to draw on the Northern Territory's political, cultural and historic experience with natural disasters;
- prompt and decisive action in establishing a response management taskforce and identifying key participants;
- twice daily meetings of the taskforce provided for the rapid identification of priorities and the early detection of resources necessary to undertake response actions;
- use of a significant authority figure as the taskforce leader (Assistant Commissioner of Police) and involvement of senior political figures in the public awareness campaign which provided a clear signal to the community of the importance of the situation and assisted in achieving a high level of compliance with regulatory arrangements;
- development of a high level "decision trail" to account for all decisions;
- establishment of scientific benchmark for incursion management.

From the legal perspective, the main message was the need to have appropriate legislation in place prior to pest outbreaks and the need to be aware of the long-term legal implications of some emergency response actions. The successful legislative steps initiated early in the response action were identified as:

- the early call on external legislative support (eg. *Quarantine Act 1908* to support local actions);
- enactment of emergency regulations within 24 hours by the Northern Territory Cabinet to ensure that the necessary powers were available to the management taskforce, particularly powers to allow authorities to quarantine or control the movement of vessels and close-off (quarantine) locations as required. This minimised the possibility of problems arising after the event;
- use of good engineering advice to support decisions enforced under regulatory arrangements. A specific example during the response actions was the management of storm-water run-off into the marinas. Under normal circumstances, storm-water drains into the marinas and if necessary the lock gates are opened to maintain normal water levels inside. On two occasions, after significant storm events, the amount of water flowing into the marinas posed a risk of raising water levels high enough to cause property damage. The decision had to be made whether or not the lock gates should be opened with the subsequent risk of the Black Striped Mussel being released into the open harbour system. Engineering calculations determined that water levels would not exceed safe limits and the gates were not opened;
- close working relationship between the management taskforce and branches of government ensured accuracy and consistency of legal wording of signs, public notices, media releases etc; and
- maintenance of good record keeping systems by the management taskforce to enable rapid response to compensation claims relating to disruption to business or damage to property.

The key problems identified during the initial set up stage were:

- dedicated resources to support response actions and set accounting systems did not exist, and limited advice was available on potential funding sources. Consequently, individual agencies were caught out committing relatively large amounts of resources to the response effort (eg. AFMA and vessel tracking/communications, NT DPIF for all staff and operational expenses) without any certainty of reimbursement. The absence of negotiated funding arrangements in advance distracted from efforts on the response actions and threatens commitment to future responses to marine pest incursions;
- the range of legislation necessary to manage the range of response actions did not exist in the Northern Territory before the outbreak. The Northern Territory Taskforce was unable to immediately clarify key legislative questions such as powers required and available, who could exercise the powers and how they could be delegated. Also it was unclear to emergency managers how legislation from different jurisdictions could operate in harmony. Considerable effort had to be expended by both the Northern Territory and the National Taskforce to determine interim legislative solutions, while the ongoing legislative issues for future outbreaks remain unclear;
- liability coverage for support personnel was never clearly resolved during the outbreak. Consideration must be given to the liability coverage issues arising from the employment of contract personnel and the use of volunteer personnel in emergency situations;
- compensation issues, although managed carefully during the event, still exist. Treatments undertaken were intrusive to many commercial operations. They were in most instances "against the commercial imperative". That is, the restrictions placed on vessels often interfered with the owner's ability to undertake normal business. Although most owners/operators willingly complied with treatments protocols some individuals postponed or avoided treatment for as long as possible. There is a need to clarify legislation pertaining to compensation in relation to responses in emergency situations; and
- the use of appropriate treatment chemicals needed to be considered within the constraints of some national and international accepted practices. Awareness of, and compliance with, international agreements and conventions is likely to be an issue for any marine incursion that occurs in an international port. In this case, the response management taskforce was not aware that use of copper sulphate in open marine waters was in breach of International Maritime Organisation (IMO) conventions. Also, a number of alternative chemicals that may have been useful during the treatment of the Black Striped Mussel incursion are not accredited through the National Residue Survey process. This prevented the use of some chemicals because the accreditation process had not been undertaken.

It is recommended that:

- *Procedures be established to provide information to response managers on funding sources and arrangements that exist between different levels of government with regard to the response to a marine pest incursion;*
- *Guidelines be developed for the employment of contract personnel and the use of volunteer personnel in emergency situations;*

- *Adequate legislation be drafted to provide suitable powers to agencies and functional positions associated with the response to a marine pest incursion;*
- *Legislation be clarified in relation to issues of compensation in situations similar to the Black Striped Mussel incursion; and*
- *A database of chemicals useful for the treatment of marine pests be developed for response managers, listing chemicals accredited for use in the circumstances.*

2. OPERATIONAL PHASE

2.1 Taskforce on-site control

Some of the key successes of the Northern Territory's on-site control approach included:

- the rapid organisation of the Taskforce and deployment of operational personnel working on-site allowed quarantine conditions to commence immediately and early pest containment to be achieved (eg. locked marinas, with chlorine "plugs", prevented the spread of the Black Striped Mussel into open waters). This allowed time to develop the final treatment strategies; and
- obtaining the cooperation of city council (local government authority) with other levels of government and the management taskforce to facilitate application of treatment strategies within the marinas.

Key problems identified by the Northern Territory Taskforce's on-site control arrangements included:

- need for a better designed operations centre, capable of handling multiple group operations, including access to multiple lines of communication, "break out" zones, systems to capture data relating to critical decisions, adequate (and consistent) administrative support to key players (places to charge mobile phone batteries, IT support, acceptance of phone messages etc.);
- given the long and intensive hours involved with the operations, backup was required for leadership roles, such as persons of equal authority and delegation to share key operational duties;
- the pressure applied by vessel owners and businesses connected to the closed marinas to relax the restrictions on vessel use over the Easter holiday period that occurred shortly after the response actions commenced; and
- not involving the shipping sector as an early priority. It was suggested that expertise from the industry could have assisted in the development of effective treatment protocols and in the tracking and treatment of potentially contaminated vessels that had left Darwin.

It is recommended that:

Procedures be developed to ensure all relevant industry expertise is adequately sourced to assist with the development of response protocols during a marine pest incursion or similar incident.

2.2 Media and Communications

The media campaign was essential in obtaining and retaining the cooperation of local communities and in satisfying the information needs of State/Territory, national and international stakeholders. It has been widely acknowledged as a successful model approach to managing the information requirements of an emergency situation.

Some of the key successes in the approach were:

- providing a consistent message as the basis for communications decision making. Throughout the outbreak electronic and print media, public notices, the Internet site, public meetings and government briefings were all designed to provide a consistent message;
- presentation of a positive image of participating agencies and individuals (eg. scientists). Many of the groups working within the response system did not have a particularly positive public profile. Providing information on the work and the achievements of these groups and individuals encouraged the general public to participate in the operation;
- provision of video footage (images) for local and networked television news (eg. Mussel encrusted chair);
- the relationships that developed between government agencies, the scientific community and the media unit reflected the high level of cooperation that was experienced in other areas of the response operation. This generated a level of trust that allowed the media unit to better manage communications issues;
- the use of the Internet to provide highly accessible, up-to-date information, technical data and images of events was particularly successful. The availability of the site alleviated the need for stakeholders to communicate directly with personnel managing the response in Darwin. It was an extremely effective way of disseminating information nationally and internationally;
- the use of a telephone hotline as a focal point for public contact satisfied the needs of individuals within the community and specific groups. However the hotline also assisted staff in the media unit to identify key issues relating to the event;
- the use of fact-sheets to distribute information generally and to targeted audiences proved particularly effective;
- the role of the NT Primary Industry and Fisheries Minister in providing credible and well informed messages to the media and to stakeholders was important in achieving the cooperation of local communities.
- nominating one person to deal with difficult technical or operational questions. This person came to be seen as a source of accurate information. If another respondent referred a question to this person it was seen as a positive action and not a diversion or evasion of the question; and
- the use of daily media advertisements and the use of an information caravan in the area where major response activity was taking place provided a controlled outlet for essential information to the public.

Some of the problems identified through media activities included:

- the need to maintain accurate information provided to the media unit for release. Out-of-date information eroded credibility and a lack of information forces the media to seek ill-informed sources;
- the telephone hotline would have been more useful if established for 24-hour operation (some people would not leave messages on an answering machine), the number should not change once advertised and the operator should be located close to the main operations centre;
- the local media was initially reluctant to take paid advertisements relating to the incursion;
- the Easter holidays at the commencement of the outbreak actions provided logistical problems for some media outlets;
- the provision of information to other State/Territory and Commonwealth government agencies became a significant task. It was necessary to establish a network of State/Territory, Commonwealth focal points for agencies to source information. The Internet site established by the Northern Territory government during the incursion event did partially solve this problem. However the media unit was unable to cope with the level of inquiries from other government agencies; and
- the first major news of the event was released on 1 April (April Fool's Day). Initially many residents did not believe the news reports and press releases detailing the infestation.

2.3 Vessel Tracking

Vessels that had left the three contaminated marinas prior to the quarantine arrangements being imposed provided the greatest risk to the long-term containment of the Black Striped Mussel. It was essential therefore to maintain accurate records and to track the potentially infected vessels. At the time of the incursion there was no established system for completing this task.

Some of the key successes in the eventual vessel tracking approach were:

- coordination and cooperation of key agencies such as Darwin Port Authority, Cullen Bay and Tipperary Waters Marina management, Australian Quarantine and Inspection Service and the Australian Customs Service (international small craft movements), NT Fisheries Licensing Section (NT fishing fleet), AFMA (Northern Prawn Fishery), telephone "hot-line" (local craft in backyards, on private hard-stands etc.), Coastwatch (post-flight vessel reports) and local ship-repair and maintenance facilities (information as required) within a short period of time to obtain and collate movement reports on specific, high risk, vessels;
- establishment of a dedicated data processing area to receive and input vessel data, with progressive inclusion of additional data fields to the program as required to maintain a relevant image of vessels and their status;
- use of on-board GPS tracking systems as part of the Vessel Monitoring System (VMS) provided accurate information on the locations of vessels in the Northern Prawn Fleet;
- the close working relationships developed between different groups and agencies during the response were significant in achieving overall goals, particularly the link between Police and Fisheries Marine Enforcement Unit, AQIS and the management taskforce in the management of the treatment of Northern Prawn Fleet vessels; and

- once the risk analysis and treatment protocols were available the information being generated by the database was enhanced and helped the management team to more accurately judge the risk posed by a vessel and advise vessel operators accordingly.

Some of the problems identified with the vessel tracking arrangements included:

- when the Black Striped Mussel was first detected in Darwin there was no national system of tracking vessels operating within Australian waters. Local vessels can operate as desired and foreign vessels, once clear of customs, health and immigration checks, can apply for a "cruising" permit and virtually operate as a local vessel;
- the amount of data generated by the process of tracking 760 vessels likely to be affected by the Black Striped Mussel incursion was large. With the information being derived from a number of independent sources, some difficulty was associated with determining the most up to date and correct information;
- this situation was exacerbated by a lack of knowledge on the biology of the Black Striped Mussel and therefore a lack of information on time-lines for vessel treatments, and consequently slow development of risk analysis protocols for vessels. These protocols were needed early in the database development to identify the risk a vessel poses based on its movement history (including other vessels it has been in contact with) and past treatments;
- there was some difficulty after the National Taskforce was established with other agencies obtaining access to the key vessel tracking information on the database to determine similar threat assessments in their waters. When the tracking database was eventually received there were additional problems with formatting that required some technical adjustments before use;
- communication with commercial vessels of the Northern Prawn fleet was possible, but very expensive. Polling the entire fleet ensured that individual vessels acknowledged a received message. However costs per message exceeded $2,000. Broadcasting the message was cheaper, but it was not possible to determine if all craft were in receipt of the message;
- while most vessel operators cooperated with vessel tracking arrangements within reasonable timeframes, some vessel owners or operators were reluctant to submit to inspections;
- while the vessel tracking system identified a number of vessels that left the country after mooring in a contaminated marina, and this information was passed to the Department of Foreign Affairs, the arrangements for action on the exchange of vessel information, at an international level, were unclear; and
- while the vessel tracking system developed in Darwin proved an effective tool during the Black Striped Mussel incursion, it is unlikely that larger marinas or small-craft handling facilities (eg. Cronulla in NSW) in other parts of Australia could offer the amount of intensive information that was available from Cullen Bay Marina, Tipperary Waters Marina Estate and Frances Bay Mooring Basin to assist as effectively with risk assessment decisions.

It is recommended that:

The vessel tracking approach taken in the Black Striped Mussel outbreak be further examined with a view to developing a national vessel tracking and monitoring capacity.

2.4 Health

Although the well-being of communities directly associated with areas under treatment was a significant concern, no major public health issues arose during the eradication of the Black Striped Mussel. Territory Health Services (THS) played a major role in the management of public perception through strategic information.

Some of the key successes in the health approach were:

- no actual public health problems arose during the outbreak;
- application of OH&S and NT Department of Land, Planning Environment and THS guidelines, particularly for personnel involved with treatment applications (transport, storage and application of chemicals, the divers, the security and emergency service personnel and those undertaking the treatment of vessels) who faced the greatest risk from a health perspective;
- use of health processes parallel to those advocated for the practice of disaster medicine;
- taking a cross-disciplinary awareness approach to health issues;
- use of effective health messages about the prohibition on swimming and fishing in the marinas;
- the availability for people to access information was enhanced by having a contact number widely advertised, which allayed fears and rumour; and
- prompt removal of dead fish from the marinas through the 24 hours per day fish kill teams, after treatments had commenced. This ensured that there was minimal risk of smell or health issues from dead fish in marinas.

One problem identified was:

- Information relating to health issues was sometimes confusing and beyond the necessary level of understanding for most people, such as discussing the concentration of chlorine in the marinas in terms of parts per million, or tonnes delivered into the water body. This distracted from a public message of reassurance in times of crisis. However, when the concentration was described as similar to that in a public swimming pool, most people understood. This demonstrates that, in any future emergencies, it will be important to communicate effectively with the public in terms the public can relate to, or identify with.

2.5 Diving/survey

Divers (and support teams) were used within all the infected marinas and conducted extensive inspections of both Darwin Harbour and Gove Harbour. They were the primary means of monitoring the populations of Black Striped Mussel prior to, during and after treatments. To ensure safety and the reliability of the monitoring process it was essential that these teams operated at a high level of efficiency at all times.

Some of the key successes in the diving and survey approach were:

- the enthusiasm of the divers in the eradication program despite extremely difficult and exhausting conditions;
- development of routines that ensured rigorous and comprehensive surveys. The last surviving Black Striped Mussels were found in storm-water drains and inside barnacles; and
- despite the number of dives that were completed during the response phase and the conditions under which many of these took place the teams maintained high safety levels. Procedures followed by the teams allowed the flexibility necessary to complete the task without unduly compromising safety. Dive teams were each responsible for observing correct dive protocols in the achievement of stated objectives.

Some of the problems identified included:

- the initial closure and quarantining of Cullen Bay Marina caused a significant logistical problem for the dive teams because all the equipment (including boats) had to be decontaminated and certified before they could be used to survey other areas;
- difficulty in accessing sufficient boats and divers at short notice, given the specialist requirements such as qualifications to dive in chemically polluted waters, within confined spaces such as storm-water and sewage system outlets and under vessels;
- given the lack of prior knowledge of the Black Striped Mussel divers had to be trained in the identification, where to look and how to record any sightings;
- the lack of visibility and high tidal range in Darwin (approximately 7.8 metres) provided divers with a great deal of difficulty. In some instances divers had to be tethered to ensure their safety during a dive in a high tidal flow;
- The Australian National Diving Standards lack the flexibility to cope with some of the situations faced in Darwin during this event. The response actions required large scale, rapid diving programs to be undertaken. While these activities were done safely, at times they may have contravened the Standards;
- every dive team had to be provided with cover against crocodile attack (each year over 100 crocodiles are removed from Darwin harbour). This was achieved using police sharp-shooters;
- due to limited information about the Black Striped Mussel it was decided to dive on virtually every object in Darwin Harbour. The harbour was surveyed three times. At times dive teams conducted over-intensive sampling and surveying, such as conducting an entire keel scrape when surveying a vessel for mussels when a small sample area would have been sufficient; and
- at times, the physical capabilities of divers were stretched to the limit. Due to the hours divers were asked to operate and the conditions under which they were operating, many became exhausted. The limitations of a diver, especially under conditions experienced in Darwin, must be appreciated by those managing the response to a marine pest incursion.

2.6 Biology and Treatment/Eradication

The scientific team was very effective in developing treatment options for the contaminated marinas. The eradication of the Black Striped Mussel had not been attempted before and as such the scientific literature and professional community could offer little assistance. Additionally the timeframes set to achieve successful containment

and eradication were very short. However, within three weeks two treatments were trialed and one successfully implemented.

Some of the specific successes in the treatment and eradication approach were:

- the use of copper sulphate as a treatment agent which was particularly successful in the "closed-system" of the marinas. The chemical achieved a high kill-rate within the environment and general toxicity levels subsided rapidly after treatments were concluded;
- the use of pumps and the propulsion systems of the larger vessels in the marinas to mix the water and evenly distribute the chemicals to overcome "dead spots" in the marinas and the water body stratification (salt (18°C)/fresh/salt (28°C));
- establishment of monitoring processes, including water quality monitoring, to ensure effectiveness of treatments and residual effects;
- development of effective protocols for the treatment of Black Striped Mussel infestations, in a range of situations, including for each of the marinas, for cleaning vessel water systems, for vessels that had left Cullen Bay and gone to the Frances Bay Marina, for vessels that had gone to sea and for the cleaning of vessels on the hard stand;
- development of an "auditable" process to ensure that treatment protocols were being observed for vessels that had been contaminated with Black Striped Mussel. All vessels were numbered and papers issued describing the stage of decontamination achieved;
- the development by research teams of procedures to culture Black Striped Mussels in the laboratory to maintain a stock of animals for ongoing toxicity experiments; and
- appointing a lead controller for the access and transport of required chemicals for treatment actions. This was a particularly difficult logistical operation and by having a dedicated resource to direct activities it achieved a separation of operational logistics and overall administration responsibilities allowing appointed personnel to focus on specific logistical and administrative tasks.

Some of the problems identified included:

- the lack of readily available published information on the Black Striped Mussel, identification of experts with experience with mussel control and use of chemical treatments to control mussel infestations, and the extremely short time frames available for research and application of treatment theories reflected the absence of a prepared approach through advance threat assessment. Despite a history of the Black Striped Mussel spreading into Asia, the incursion in Darwin was not predicted. The mussel had been experienced in Fiji, India, Taiwan, Japan and Hong Kong but we had not considered an incursion into Australian waters;
- the difficulty in maintaining sufficiently high concentrations of chlorine in the marinas;
- availability of adequate supplies of chlorine. This was a problem due to the geographic isolation of Darwin and the relatively small stockpiles of chemicals held in the Northern Territory. Large volumes of toxic chemicals had to be trucked from all over Australia to Darwin;
- unreliability of some technical information. Initially the eradication team was informed that chlorine dioxide was an effective treatment in marine environments.

However, after trials with the chemical it was found it was not effective. Later information showed that previous experience had been in fresh water only;

- there were some inconsistencies between the results from controlled laboratory tests and applications to the field environment which were not always effectively monitored and analysed. The differences between controlled laboratory conditions and the spatial variability of field conditions needed to be given more consideration in the application of treatment measures;
- difficulties were experienced with the introduction of chemicals safely to the water body. Emergency services and security services needed to be on-hand for general safety and contingency reasons. Once the chemical had been introduced to the marinas there was an ongoing security risk due to the high population densities in the immediate vicinity of the, then toxic, water bodies;
- unknown side effects of copper, causing delays in its use. Although the general consensus was that there would be no lasting environmental effects, or damage to aluminium hulls of vessels in the marinas, few people had experience within a similar context. Without documented evidence of previous experience the decision making and preparations for the use of copper sulphate had to be exhaustive;
- the adoption of a strict "epidemiological" approach to manage the incursion may not have been the most efficient method. An immediate scoping exercise to identify and categorise potential risks and response options may have better focused resources, particularly an assessment of the risk posed by different vessels, or different vessel groups. For example, the epidemiological approach required an extensive amount of time and resource in the tracking and treatment of vessels from the Northern Prawn Fishery; and
- as international vessels first entering Australian waters are not subject to a hull inspection under current Australian Quarantine and Inspection Service arrangements, there was a possibility that these vessels also represented a high risk but were not all included in the risk assessment protocol.

It is recommended that:

- *the theoretical and practical experiences with the treatment strategies be documented and made available to managers to assist with future incursion response decisions;*
- *a national listing of expertise in marine pest response actions be established; and*
- *a national bibliographic database to identify high risk marine pests, with the capacity for rapid electronic transfer of information, should be established.*

- **2.7 Commonwealth actions and responsibilities**

In the absence of prior agreed national arrangements for marine pest incursions, coordination at a national level was delayed until a Commonwealth interdepartmental group was able to organise a National Taskforce on Black Striped Mussel Control on 6 April 1999 under the leadership of Agriculture, Fisheries and Forestry Australia (AFFA). This operated on the model used for animal and plant diseases. Once operational the National Taskforce was fairly effective in providing a consistent and coordinated message on required response and surveillance actions.

Some of the successes in Commonwealth coordination through the National Taskforce operation were:

- reliable communications between the Northern Territory Taskforce, State and Commonwealth government representatives and technical experts in a range of fields through a daily reporting schedule. E-mail was used for speed and to track communications;
- use of a single contact point for reporting effectively limited the disruption to other members of the taskforce without limiting the flow of information;
- the national operations centre established in AFFA was a reliable source of information on likely consequences and impacts of actions taken or decisions made. It provided the Northern Territory Government and the Northern Territory Taskforce operating in Darwin ready access to organisations and government agencies at State and Commonwealth levels and facilitated the formation of expert groups to discuss and develop a series of treatment and surveillance protocols and other guidelines for use in Darwin and nationally. The National Taskforce also provided an avenue to examine and modify generic processes to local conditions, such as monitoring systems using larval settlement plates;
- the national operations centre also allowed for the negotiation and adoption of protocols for the use of the *Quarantine Act 1908* in tracking and treating vessels outside of Darwin; and
- the national operations centre organised a range of expertise to be tasked to the Black Striped Mussel outbreak from other areas with related experience to the response activities, such as disease control experts.

Some of the problems encountered included:

- the initial lack of specific guidelines relating to the operation of a national coordination centre. There would initially have been greater certainty of action if guidelines had been in place on the role of the centre and responsibilities of key participants, leadership roles and necessary infrastructure, along with access arrangements to key decision makers within the Commonwealth government and logistics such as rooms, computer equipment and documentation to guide the response action (information on "lead-agency" etc);
- there is a need for an electronic contact list to be established and maintained to facilitate information exchange during an event such as the Black Striped Mussel incursion;
- the difficulty in establishing a communication network without clear jurisdictions, with several agencies participating from one State, along with the tendency for agencies and individuals involved in telephone links to change, caused some difficulties early in the response phase;
- the lack of a national system of protocols generated a considerable amount of extra work, particularly the absence of an agreed use of the *Quarantine Act 1908*. If a system of national protocols cannot be implemented to cover events such as the Black Striped Mussel it is necessary to identify a team of people able to develop them at short notice. There was also a delay in the recognition of the National Taskforce role to facilitate national endorsement or "signing off" of the processes developed under the protocols;
- delays in the early stages of the outbreak in communicating the progress with identifying the number of "at risk" vessels, causing concern on the magnitude of the problem with "at risk" vessels. Additionally, epidemiologists working through the

National Taskforce had some difficulty obtaining access to the vessel tracing information to determine the extent of vessels "at risk";

- the lack of Commonwealth agency representation in Darwin during the response phase attracted some criticism. It was argued that Environment Australia and AFFA should have had personnel in Darwin to gain a deeper understanding of what was going on; and
- delays in accessing technical expertise from organisations interstate (note, CSIRO was in Darwin during the entire detection and eradication). Several national experts in mussel eradication, such as groups working in Tasmania and in Western Australia to remove mussels from pipelines in water-treatment plants and hydro-electric plants, were only identified after the event.

3. STAND DOWN PHASE

The Northern Territory Taskforce established a well defined monitoring and clearance process that provided effective indicators for the success of treatments and good determinants on which to base the stand down of response operations.

The very effective public information program was able to broadcast a clear message that the emergency was over for the time being and that operations at the marinas would resume with certain precautionary measures to be maintained.

The three week monitoring period before the final "all clear" in May 1999 ensured a phased wind down of activities, and the establishment of the Northern Territory Aquatic Pests Management Program shortly after the conclusion of response activities provided an effective vehicle to maintain precautionary monitoring and treatment actions and involvement of key front line organisations such as port and marina authorities and shipyards.

There was some uncertainty nationally on when to demobilise the National Taskforce, based in part on lack of initial agreement on how to evaluate the overall response actions. This was only resolved once a decision had been made for funding to be allocated by Environment Australia for a national workshop to evaluate all aspects of the response and identify management improvements. The evaluation requirements of future marine pest emergencies should be defined and endorsed well in advance of the next outbreak to ensure a continuous learning experience

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Part 4 Management Improvements to Marine Pest Incursions

1. Aims of Workshop

Day 2 of the workshop examined management improvements to key issues encountered during the response to the Black Striped Mussel outbreak. The main aims of Day 2 of the workshop were to:

- identify management actions to address key deficiencies in overall management of marine pest incursions (focussing on problems and successes identified in the previous day's evaluation workshop); and
- recommend both short term and longer term management issues that should be examined and, where appropriate, recommended for implementation by the National Taskforce for Prevention and Management of Marine Pest Incursions (which reported to Government Ministers on 23 December 1999).

2. Participants

The workshop was attended by representatives from key marine pest management agencies at both the Commonwealth and State/NT level, along with other NT participants in the Black Striped Mussel response actions. A list of participants is at Appendix 3.

3. Key Discussion Areas

Day 2 discussions focussed on four main components that need to be addressed and in place to enable successful incursion response action:

- **Determining who has responsibility for management actions**, with a focus on:
  - ♦ specific management structures;
  - ♦ legislative powers; and
  - ♦ funding arrangements.
- **What risk management measures should be in place**, with a focus on options for:
  - ♦ risk assessment; and
  - ♦ risk mitigation.
- **The most effective operational planning and implementation processes**, with a focus on:
  - ♦ management protocols to direct action;
  - ♦ resources required; and
  - ♦ communication systems.
- **Monitoring and evaluation options**, with a focus on:
  - ♦ means of identifying problem areas; and
  - ♦ assessing effectiveness of response action.

Both short term and longer term actions were discussed and potential management actions proposed.

4. Discussion Outcomes

As the four workshop sessions were run concurrently, there was overlap in the recommendations arising from the following four groups.

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4.1 Responsibility for management actions

Discussions highlighted the need for strong political commitment to the issues of marine pest impacts and the need to obtain this commitment from the various jurisdictions in order to obtain a secure funding base for incursion management actions. Key recommendations made were:

Management Structures

4.1.1 The recently established National Taskforce on the Prevention and Management of Marine Pest Incursions needed to immediately define the roles and responsibilities of the existing Australian Ballast Water Management Advisory Council and other organisational arrangements that would contribute to a fully functional and coordinated national system that addresses all components of marine pest introduction and incursion management, and is endorsed at Government Ministerial level;

4.1.2 an aquatic version of the Consultative Committee for Exotic Animal Diseases needed to be formed immediately to more effectively coordinate introduced marine pest outbreaks;

4.1.3 the establishment of a Cooperative Research Centre for marine pests needed to be pursued to ensure a dedicated scientific approach to barrier controls and mitigation action to minimise the impacts of marine pest incursions;

4.1.4 formal agreements needed to be developed between organisations to ensure action on all aspects of marine pest management.

Legislative powers

4.1.5 Commonwealth should immediately identify the relevant legislative powers that exist to manage marine pest incursions, any gaps in legislative requirements, and seek to establish a seamless statutory regime between the Commonwealth and States/Northern Territory along the lines of the Offshore Constitutional Settlement. The States and Northern Territory should also consider conducting scenario exercises to develop and test the adequacy of the regulatory regime;

4.1.6 formal agreements such as Memoranda of Understanding should be instituted to define and confirm the integration of legislative powers;

4.1.7 the issue of 'liability' for incursion response actions should be given priority in any legal review, particularly the questions of reasonable action and exemption from consequent damage. A lead on the initial arrangements could be provided through counter disaster organisations such as Emergency Management Australia.

Funding

4.1.8 interim cost sharing arrangements under the Commonwealth Department of Finance involving a 50:50 Commonwealth/State-Territory apportionment (based on existing animal disease models) should be immediately established to support marine pest

incursion actions. The arrangements should include provision for compensation where appropriate;

4.1.9 the funding arrangements should be consistent with the cost recovery, public interest and compensation principles that apply to established models such as the Australian Animal Health Council arrangements for animal diseases, and be based on existing jurisdictional Treasury agreements for emergency resource allocations;

4.1.10 the interim cost sharing arrangements, along with other interim incursion management arrangements, should be subject to a two year sunset clause to enable testing of their suitability and the negotiation of more comprehensive longer term management arrangements with a greater range of stakeholders;

4.2 Risk Management Measures

It was acknowledged that systematic risk management, including identification of risk and threat levels and implementation of mitigation measures, was an essential approach to maximising the effectiveness of preventing and responding to marine pest outbreaks. Key recommendations made were:

4.2.1 immediately develop a list of 'high risk' introduced marine species, and supporting risk assessment 'listing' procedures, that presented the greatest threat to the marine environment, in terms of their likelihood to be introduced and capacity to establish and cause detrimental impacts. This includes species yet to be introduced and already established;

4.2.2 establish information databases on exotic marine species representing the highest incursion risk, including potential treatment measures for containment and/or eradication;

4.2.3 develop species based action plans including response plans and treatment options;

4.2.4 the Australian Quarantine and Inspection Service should take a leading role in developing measures to prevent the introduction of marine pest species by all vessel based vectors, with common national measures addressing pest introductions and spread by both international and coastal vessels, and that these measures should be incorporated into the developing Decision Support System;

4.2.5 a domestic translocation policy should be implemented, supported by an ongoing research and development program;

4.2.6 a generic decision-making aide should be developed for marine pest incursions, based on a risk assessment/epidemiology framework;

4.3 Response operational planning and implementation

The Consultative Committee on Exotic Animal Diseases approach was endorsed as the model in which to develop the required national, jurisdictional and local level emergency response and control plans for marine pest outbreaks. Along with these plans other essential 'preparedness' aspects need to be in place, such as training and development of

the various components of the plans and identification of key logistical support. Specific actions recommended for these operational plans were:

4.3.1 adopt the centralised communications process used in the Black Striped Mussel outbreak (control room facilities, lines of communication, equipment standards, etc) as a national model;

4.3.2 the external communications process used in the Black Striped Mussel outbreak be used as a national model;

4.3.3 adopt the AQUAVETPLAN model for personnel deployment and support protocols for marine pest outbreaks;

4.3.4 individual jurisdictional response plans should be developed, based on national models where available, and drawing on existing jurisdictional resources;

4.3.5 checklists be established for hardware and software support (boats, divers, nets, transport, storage, communications, treatments, etc) and a skills network (professional experts, volunteer groups, access to disaster plan teams and emergency services, etc).

4.4 Monitoring and evaluation

Essential elements to consider in monitoring and evaluation actions were identified as:

- identifying problems through pro-active research (scope of likely pest establishment, importance of baseline surveys, differences between northern and southern species endemism);
- monitoring protocols (national protocols adapted to local conditions);
- early warning pre-incursion monitoring to identify pests, selection of vectors such as ballast water, fouling, aquaculture, vessel facilities such as inlet pipes, etc);
- monitoring during outbreak (including quarantine activities);
- post-incursion evaluation (improvements to preparedness, costs in resources and environmental terms, lessons learnt, restoration action);
- evaluation of past case studies;
- evaluation of monitoring procedures (effectiveness of response protocols, follow up tests, comparison with other emergency control actions).

Key recommendations made were:

4.4.1 develop visual guides to raise awareness on the listed high risk species;

4.4.2 develop and provide resources to use a network of taxonomic experts and associated taxonomic identification techniques, both in Australia and internationally to rapidly verify the pest status of detected exotic marine species;

4.4.3 establish a generic system of reporting marine pest sightings, including single contact points in each State and Territory;

4.4.4 conduct baseline biological assessments for areas at high risk of pest introduction, using agreed national assessment standards;

4.4.5 review effectiveness of existing quarantine systems;

4.4.6 establish an independent technical auditing process for the proposed Decision Support System;

4.4.7 establish nationally uniform codes of practice for hull maintenance and disposal of foreign material (or implement the ANZECC guidelines if these adequately cover these issues);

4.4.8 produce case study evaluations of previous marine pest incursions in Australia (for species such as *Undaria* and *Asterias*)

4.4.9 evaluate the susceptibility of pest introduction in areas such as ports, sensitive ecosystems, specific regions, etc with the aim of using the data to inform the Decision Support System and improving management measures such as port management arrangements.

5. Follow up to Workshop

The Black Striped Mussel outbreak had provided the impetus for the Taskforce's establishment in July 1999. The outcomes of the workshop were given further consideration by the Joint SCC/SCFA National Taskforce on the Prevention and Management of Marine Pest Incursions. The terms of reference of the Taskforce are at Appendix 1. The Taskforce was required to report to Government Ministers by the end of 1999 and recommend improvements across all aspects of marine pest management.

6. Outcomes of National Taskforce Deliberations

The Taskforce reported to Government Ministers on 23 December 1999. The report proposed a National System for the Prevention and Management of Introduced Marine Pests. The National System is to be coordinated by a single body that reports to all relevant Commonwealth and State Ministers.

The Taskforce's report details recommendations for interim and longer-term action to establish the three main components of the National System.

1. prevention of new marine pest incursions and translocations, featuring an integrated approach to all vessel-based introduction of marine pest species through the Australian Quarantine and Inspection Service's draft *Action Plan for Minimising the Risks to Australia from the Introduction and Translocation of Marine Pests by Vessels*;

2. coordinating emergency response actions to new marine pest incursions and outbreaks, through a detailed Australian Emergency Marine Pest Plan that provides practical guidance on conducting a staged response to an introduced marine pest emergency, and an initial list of marine species that would automatically trigger a report by any jurisdiction to the national emergency response coordination body for advice and action;

3. longer term mitigation and control measures to combat established marine pests, including the option of developing statutory plans to reduce, eliminate or prevent the impacts of introduced marine species through the *Environment Protection and Biodiversity Conservation Act 1999* administered by Environment Australia.

The recommendations of the workshop were substantially incorporated into the National Taskforce report. Subsequently, jurisdictions were asked to endorse the recommendations of the report.

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Appendix 1: Joint SCC/SCFA National Taskforce on the Prevention and Management of Marine Pest Incursions: Terms of Reference and Membership

Terms of Reference

While recognising that the origin of particular species may be uncertain, the Taskforce will confine its attention to introduced marine species, excluding diseases. It will:

- Examine:
    - existing pre-border and border control arrangements for introduced marine pests;
    - existing introduced marine pest incursion management arrangements nationally;
    - previous research and recommendations such as the 1997 SCARM Report *Managing Incursions of Exotic Pests, Weeds and Diseases*.
- Propose short-term actions (eg use of legal powers, protocols etc, drawing on the experience gained as a result of the Black Striped Mussel outbreak and attempted containment of Northern Pacific seastars and Japanese kelps) within existing resources and statutory arrangements to improve existing emergency incursion response arrangements, monitoring and border control measures, and to propose interim cost-sharing arrangements.
- Prepare a report to Ministers on effective and efficient arrangements for a national system for the prevention and management of all components of introduced marine pest incursions (see **Outputs** below).
- Identify the resources and stakeholder responsibilities needed to establish a national system for the prevention and management of introduced marine pest incursions.
- Consult with relevant Commonwealth and State/Territory management agencies and non-government organisations in delivering the various components of its Work Plan.
- Report by 24 December 1999.

Outputs

Prepare a report to Ministers covering:

- Agreement on a national ready response capability within current statutory arrangements and resources that includes:
    - agreed emergency administrative procedures in the event of an outbreak of an introduced marine pest, including clearly defined agency roles, responsibilities and legal powers;

- early warning and prevention systems for a short list of non-indigenous marine species that pose a major threat; and
- interim cost-sharing arrangements.

- The requirements of a comprehensive national system for the prevention and management of introduced marine pest incursions addressing:
  - pre-border efforts to reduce the risk of importation of marine pests;
  - border and post-border (translocation) control systems for ballast water, hull fouling and other vectors;
  - monitoring to detect new incursions or spread of existing introduced marine pests;
  - emergency response to incursions; and
  - mitigation/control of introduced marine pests already in Australia;

  and make recommendations in these areas relating to:
  - administrative arrangements, including national coordination mechanisms;
  - legislation, including regulatory reform;
  - financial arrangements and resource requirements (eg funding requirements and cost-sharing arrangements);
  - supporting research; and
  - other relevant components such as stakeholder liaison and cooperation, awareness programs, training, etc.

Membership

Conall O'Connell, Environment Australia (Chair)
Mike Drynan, AFFA Fisheries & Aquaculture Branch
Mike Nunn, AFFA National Office of Animal and Plant Health
Denis Paterson, AQIS, AFFA
Leonie Mack, Department of Transport & Regional Services
Rod Gowans, SCC, Department of Environment & Natural Resources, Victoria
Rex Pyne, SCFA, Department of Primary Industry & Fisheries, Northern Territory
Pauline Semple, SCEP, Environmental Protection Agency, Queensland
Darryl Grey, NSW Fisheries
Colin Chalmers, Fisheries Western Australia
Vic Neverauskas, Department of Primary Industries and Resources, South Australia
Ron Thresher, CRIMP, CSIRO

Representatives of the following agencies also participated in one or more meetings of the Taskforce:

31 October 2000

- Environment Australia
- AFFA
- Australian Fisheries Management Authority
- Department of Transport, Western Australia
- Department of Primary Industries, Water and Environment, Tasmania
- Chair, Australian Ballast Water Management Advisory Council

31 October 2000

Appendix 2: Introduced Marine Pests Incursion Management Workshop Program

Day 1 – Friday 27 August – Level 3 Meeting Room

9.00 Welcome – workshop aims, arrangements, expected outcomes

9.15 Evaluation Sessions – outline discussion themes

For each session examine:
What happened (summary only);
Problems encountered;

9.30 Session 1 - Alert Phase - Headquarters coordination

Covering:

- Detection
- Local Taskforce creation
- Establishment of emergency services

Short discussion after discussion leader presentations

Discussion leaders:
NT DPIF – Rex Pyne, Roger Smith
NT Police – Ast Comm John Daulby
Other State reps from QLD, NSW

10.15 Morning Tea

10.30 Session 2 - Operations Phase - On site control

Technical issues – biology/treatment protocols/eradication

Short discussion after discussion leader presentations

Discussion leaders:
NT DPIF – Nick Rayns, Colin Shelley
NT University – David Parry
CSIRO CRIMP – Nic Bax
Other State reps from QLD, NSW, Vic

11.15 Dive surveys

Short discussion after discussion leader presentations

Discussion leaders:
NTDPIF – Rex Pyne
NT Museum – Barry Russell
Other State reps from QLD, NSW

11.45 Session 3 - Operations Phase – Preventative actions

Health/legal implications

Short discussion after discussion leader presentations

Discussion leaders:
NT Attorney Generals – David Lisson
NT Health – David Ashbridge
NT AQIS – Ian Kilduft
Other State reps from QLD, NSW

12.15 Vessel Tracking

Short discussion after discussion leader presentations

Discussion leaders:
NT AQIS – Gary Tucker
AFMA – Geoff Rohan
Other State reps Qld, NSW

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1.00 – 2.00 Lunch

2.00 Session 4 - Communications

Discussion leaders:
NT Police – Jane Munday
NT Minister's Office DPIF – Jo Smallcombe, Carol O'Dwyer
Other State reps Qld, NSW

Covering:

- media liaison
- public information

Short discussion after discussion leader presentations

2.45 Session 5 – National Coordination

Discussion leaders:
NT DPIF – Nick Rayns
AFFA – Grant Rawlins
Other State reps Qld, NSW, Vic, SA

Covering:

- national Black Striped Mussel taskforce
- Commonwealth/State cooperation
- Ministerial liaison

Short discussion after discussion leader presentations

3.30 Afternoon Tea

3.45 Session 6 – Follow up actions

Discussion leaders:
NTDPIF – Rex Pyne
AFFA – Grant Rawlins
AQIS – Jonathon Barrington
EA – Conall O'Connell
Other State reps Qld, NSW

Covering:

- ongoing checks
- implications of treatment
- on going responsibilities

Short discussion after discussion leader presentations

4.30 Session 7 - Wrap Up – Outline Day 2 issues

5.00 Field trip to Cullen Bay

Day 2 – Saturday 28 August – Level 1 Ballroom 2

Focus on what improvements we can make to existing management arrangements

9.00 Recap Day 1 – expected outcomes for Day 2

9.15 Icebreaker – Hypothetical outbreak scenario

Drawing on the principles of prevention, preparation, response, recovery

9.45 Plenary discussion on improved incursion management

Focus on areas identified on Day 1

10.15 Morning Tea

10.30 Small Group discussions

Identify critical issues, steps to establish management process, options/alternatives, etc for each of the identified key areas

Discussion leader and reporter for each small group

11.30 Plenary reporting on small group discussions

Discussion leaders from each small group

12.30 Lunch

1.30 Plenary discussion on improved incursion management

Focus on further areas identified on Day 1

2.00 Small Group discussions

Identify critical issues, steps to establish management process, options/alternatives, etc for each of the identified key areas

Discussion leader and reporter for each small group

3.00 Plenary reporting on small group discussions

Discussion leaders from each small group

3.45 Wrap up and conclusions

Key areas for group discussion may include:

- Legislation
- Surveillance and monitoring
- Awareness
- Response systems
- Communication processes
- Control options
- Coordination mechanisms
- Cost sharing

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Appendix 3: Participant List

Participants for Darwin Introduced Marine Pests Incursion Management Workshop
Carlton Hotel 27-28 August 1999

Facilitator

Mr Rob Lee
Australian Emergency Management Institute
Emergency Management Australia

NT Representative

Name	Agency
Roger Smith	Chief Executive Officer, Dept Primary Industry and Fisheries (DPIF)
Nick Rayns	Director Fisheries (DPIF)
Rex Pyne	Deputy Director Fisheries (DPIF)
Colin Shelley	Manager Aquaculture (DPIF)
Ray Clarke	Fisheries (DPIF)
Roland Griffin	Fisheries (DPIF)
Murray Barton	Fisheries (DPIF)
Andria Marshall	Fisheries (DPIF)
Steve Sly	Fisheries (DPIF)
John Daulby	Assistant Commissioner, Police, Fire and Emergency Services
Jane Munday	Director Media Relations and Corporate Communications, NT Police, Fire and Emergency Services
Mike Bowman	Assistant Director Emergency Services, Police, Fire and Emergency Services
Ian Rae	Director, Fire and Rescue Services, Assistant Commissioner, Police, Fire and Emergency Services
Barry Russell	NT Museum
Richard Willan	NT Museum
Jo Smallacombe	Office Minister for Primary Industry and Fisheries
Barbara Singer	Department Lands, Planning and Environment
Brett Struck	Department Lands, Planning and Environment
Mike Lawton	Department Lands, Planning and Environment
David Parry	NT University
David Lisson	Attorney General's Department
David Ashbridge	Northern Territory Health Services
Xavier Schobben	Northern Territory Health Services
Ian Kilduff	Australian Quarantine and Inspection Service
Garry Tucker	Australian Quarantine and Inspection Service
Nigel Scullion	Chairman, NT Seafood Council and Australian Seafood Industry Council

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Hayden Johns	Manager Darwin Sailing Club
Phil Doyle	Chairman Cullen Bay Authority
Peter Owen	Manager Cullen Bay Authority
Penny Lassette	Sadgroves Quay Ship Repair Yard
Louise Fuller	Environmental Resource Officer, Local Government Association
Carolyn Yates	Coasts and Clean Seas Officer
Garry Mayer	Marine Branch, Department of Transport and Works
Sri Srinivas	Marine Branch, Department of Transport and Works
Commonwealth Representatives	
Conall O'Connell	Head Marine Group, Environment Australia
Deb Callister	Marine Group, Environment Australia (Work Unit, National Taskforce)
Peter Graham	Marine Group, Environment Australia
Rob Ferguson	Marine Group, Environment Australia
Jan Forbes	Great Barrier Reef Marine Park Authority
Geoff Rohan	Australian Fisheries Management Authority
Grant Rawlin	National Offices, Agriculture, Fisheries and Forestry Australia (AFFA)
Ian Hamdorf	National Offices, AFFA (Work Unit, National Taskforce)
Mike Drynan	Oceans Policy section, AFFA
Jon Delaney	Director of Environmental Management, Navy Headquarters
Steve Cole	Navy, Darwin
Rod Gowans	Dept Natural Resources and Environment, Victoria
John Gilliland	Dept Primary Industries and Resources, South Australia
Darryl Grey	NSW Fisheries
Ron Thresher	CSIRO Centre for Research on Introduced Marine Pests
Nic Bax	CSIRO Centre for Research on Introduced Marine Pests
Pauline Semple	Environmental Protection Agency, Queensland
Tiina Hawkesford	Department of Primary Industry, Queensland
Jonathon Barrington	Australian Quarantine and Inspection Service (Ballast Water Unit)
Frances Michaelis	Australian Quarantine and Inspection Service (Ballast Water Unit)
Carson Creagh.	Australian Quarantine and Inspection Service (Public Relations)

Total = 56

31 October 2000

Appendix 4: Site maps

Map of Australia

Location

31 October 2000

Aerial view of Darwin

Aerial View of Cullen Bay Marina, Darwin

View of locks at Cullen Bay Marina.

31 October 2000

View inside Cullen Bay Marina

DRAFT 31 October 2000

Appendix 5: Scientific and Treatment Protocols

National Taskforce on Black Striped Mussels
Agriculture, Forestry and Fisheries — Australia

National Protocols for treatment of vessels and anchorages between Fremantle and Sydney potentially infected with the Black Striped Mussel

16/4/99

Contents

Note for usage: Further technical information to that contained in the National protocol is to be found in the technical appendices which refer to "Frances Bay". These documents are designed to be used together.

Department of **AGRICULTURE, FISHERIES AND FORESTRY — AUSTRALIA**

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31 October 2000

National protocols for treatment of vessels and anchorages between Fremantle and Sydney potentially infected with the Black Striped Mussel

The committee

In response to a directive from the National Black Striped Mussel Taskforce, this sub-committee was set up to provide scientific advice on treatment protocols for vessels potentially infested with this noxious pest and for anchorages potentially infected by vessels carrying the pest outside Darwin waters.

The subcommittee comprises Nic Bax (CSIRO, chair), Chad Hewitt (CSIRO), Barry Russell (NT Museum), Colin Shelley (NTDPIF), and Shirley Slack-Smith (WA Museum).

The protocols have been revised following input from Roger Smith (NTDPIF), the National Taskforce and other interested parties. The Protocol Document is subject to change as scientific testing of existing and new procedures become available. Local Darwin protocols have been developed in parallel with these National protocols. If there are inconsistencies, the National protocols should be used.

The problem

The Black Striped mussel is a rapidly growing fecund bivalve, attaining a size of 8 to 10mm within a month of settlement. It is mature at this size, although spawning may be delayed for a suitable environmental signal. Fecundity is most likely in the tens of thousands per spawning. The length of planktonic life is unknown – we suggest that bounds of 1 day and 1 month be used when assessing infection risk. This bivalve is prolific – productivity can reach 100 $kg/m^2/yr$ -- and has the capacity to foul marine communities, vessels and their internal plumbing, as well as ropes, buoys, etc. in contact with the water.

We believe it would primarily colonise northern Australia from Fremantle to Sydney and these are the areas at risk. It is reported to survive in waters as low as 10°C and therefore could survive in pockets of warmer water further south.

The Black Striped Mussel was first introduced into Cullen Bay marina, Darwin sometime after September 1998, and a reproductive population could have been established by October 1, 1998, at the earliest. Vessels from Cullen Bay inoculated Tipperary Waters, where a reproductive population had established itself by January 1, 1999 at the earliest. A vessel carrying a reproductive population entered Frances Bay (Duck Pond) on March 12, 1999, although we do not know whether spawning occurred. Spawning may have occurred at any other site visited by a Cullen Bay or Tipperary Waters vessel carrying a reproductive population of mussels and Frances Bay vessels after April 12, 1999.

Actions taken to date by the Northern Territory Government have a good chance of eradicating Australian source populations of the Black Striped Mussel. We therefore recommend that potentially infected vessels and any anchorages they have visited be treated rapidly to facilitate complete eradication of this pest from Australian waters.

Approach to the Problem

The subcommittee has taken an epidemiological approach in developing these protocols – we treat the Black Striped Mussel as an infectious disease with an incubation period of 30 days. After the putative 30 day incubation period, any area or vessel with which an infected vessel comes into contact with is assigned the same level of infection risk as the infected vessel. Under the epidemiological approach we assume that a vessel or area that has been exposed is infected until it can be shown otherwise.

Thus areas where the mussel is known to exist are deemed confirmed high risk areas. Areas in which the reproductive populations of the mussel have passed through are deemed high risk areas. High risk areas are relegated to medium risk areas if surveys show no signs of infection. Medium risk areas are relegated to low risk areas over time as the likelihood of scientific surveys detecting any infection increases. The risk status of vessels exposed in those areas is correspondingly decreased.

Because of the possible long planktonic life of the larvae and therefore their presumed capacity to travel long distances in prevailing currents, we believe it essential that high risk vessels be identified and treated immediately.

We do not address the issue of liability for costs in these protocols. This is an issue for State and Commonwealth authorities.

Categories of Risk

Areas

CONFIRMED HIGH RISK AREAS are those where spawning is known to have occurred, and are limited at present to:

1. Cullen Bay Marina at any time since October 1, 1998
2. Tipperary Waters at any time since January 1, 1999

HIGH RISK AREAS are those areas exposed to an extant population of the Black Striped Mussel (ie. on an infected vessel) either in the past or currently **AND** there have been insufficient in-water surveys or larval/post larval collections (see below) to determine whether spawning has occurred. These areas are at present ports visited by vessels that were in Cullen Bay Marina at any time since October 1, 1998 or Tipperary Waters at any time since January 1, 1999. A list of these areas is being developed and should include popular anchorages in estuaries, sheltered bays, etc. in addition to ports and marinas.

MEDIUM RISK AREAS are those where an infectious population of the Black Striped Mussel is known to have been or is currently present (ie on an infected vessel) but **EITHER** the source of infection posed a medium risk **OR** extensive and weekly in-water or post larval settlement surveys show no indications of post larval settlement. These areas are at present:

1. Frances Bay at any time since March 12, 1999.
2. Areas and times where vessels from Frances Bay congregate at any time after April 12 (eg. rafting), until such time as Frances Bay vessels have been treated or declared free of infection.

3. Any ports visited by Frances Bay vessels after April 12, until such time as Frances Bay vessels have been treated or declared free of infection.

The number of medium risk areas will expand as potentially infected vessels are traced to other anchorages. Frances Bay vessels are requested to not visit anchorages outside the Darwin area until they have been treated or declared free of infection.

If any larval, juvenile or adult Black Striped Mussels are found, the area becomes a high risk area and all vessels that have used it are deemed high risk vessels. If weekly in-water surveys and/or post larval settlement surveys show no indications of these mussels for 60 days following last exposure then the area becomes a low risk area. If boats in the area are cleared to 'low risk', then the area also becomes a low risk area.

LOW RISK AREAS are those areas that have either been treated or have had two in-water surveys one month apart with no detection of juvenile or adult black mussel, are monitored monthly for post larval settlement and do not receive untreated vessels from medium or high risk areas.

Vessels

HIGH RISK VESSELS are those vessels infested with the Black Striped Mussel, vessels that have been in a high risk area, or vessels that have been in close proximity to a high risk vessel. Note: these protocols have been designed for immediate use for boats associated with the 1999 Darwin incursion. Longer term methods to address the issue of overseas ships will need to be developed after the emergency phase.

MEDIUM RISK VESSELS are those that have been in a medium risk area or have been in close proximity to a medium risk vessel.

LOW RISK VESSELS are those that have had no exposure to medium or high risk areas of vessels or have been inspected and treated.

Treatment of Vessels

High and medium risk vessels and the areas that they have visited need to be identified as soon as possible. They include any vessel which departed

- Cullen Bay after October 1, 1998,
- Tipperary Waters after January 1, 1999 or
- Frances Bay after March 12, 1999.

Because extensive diver surveys have not found Black Striped Mussels except in the three marinas, and on vessels from those three marinas we consider that the level of risk involved in restricting the initial vessel tracking to vessels from these three marinas is acceptable.

While we have attempted to balance the risk posed by the Black Striped Mussel to the Australian environment and fisheries with the inconvenience caused to affected parties, we recognise that the following treatment protocols cause restrictions on many parties including the Northern Prawn Trawl fleet. These protocols will be modified if and when

further treatments become available which would allow the easing of these restrictions while not increasing the risk to other parties.

Treatment of High Risk Vessels

All High Risk Vessels are required to contact the Mussel Hotline (1 800 330 009) and/or State authorities (if not NT) and to proceed to an approved treatment facility immediately. Treatment will carried out either:

1. Treatment in an approved quarantine area in Darwin (see below), or
2. Treatment at the nearest haul out site approved by State authorities (see below).

Note that whenever possible high risk vessels should be inspected before or during cleaning to establish the level of risk that the vessel has posed to anchorages visited *en route* from Darwin.

Treatment of Medium Risk Vessels

All Medium Risk Vessels are required to contact the Mussel Hotline (1 800 330 009) and/or State authorities (if not NT) immediately. Prawn trawlers or mother ships coming alongside Frances Bay vessels after April 12 will be considered to be at medium risk because of the risk of incurring infection from those vessels. However the newly affected vessel is not considered infectious until 30 days later, unless equipment that has been in contact with Frances Bay water has been transferred. In that case the newly affected vessel becomes infectious immediately. It is recommended that Frances Bay trawlers do not congregate with trawlers from other areas or, and if at all possible, with mother ships from other areas.

Medium Risk Vessels may remain at sea

- until treatment at an approved quarantine facility or at the nearest approved haul out site is required,
- until the area where they were at risk of infection is downgraded to low risk, or
- until they are declared clean following internal and external inspection once sufficient protocols can be developed.

If a Medium Risk Vessel needs to approach port before this time, it must notify port authorities because that port would then become a medium risk port. Even short port visits are likely to spread the mussel as the changes in temperature or salinity that are often found close to shore are similar to the environmental stimuli known to trigger spawning of the mussel in its native habitat.

A Medium Risk Vessel approaching a port will be hauled out for inspection as per the protocol or inspected by divers.

- If mussels are found it becomes a high risk vessel and is treated as such.
- If no mussels are found it may return to sea, until treatment at an approved quarantine facility is required.

On the assumption that Medium Risk Vessels remaining at sea and away from the shore pose minimal threat, we consider it acceptable that treatment be deferred until a date convenient to the vessel owners and authorities, AS LONG AS at least two vessels per week be examined externally for mussels to enable the degree of infectivity of the Frances

Bay marina to be reassessed. Based on current movements we expect that at least two vessels per week will need to approach Darwin for emergency or equipment failure and examination of these vessels will provide the required monitoring.

Precautions for All Vessels Exposed to Risk of Infection from Black Striped Mussels

1. Except for emergencies, breakdowns or for treatment, do not go ashore where mussels could be rubbed or drop off. If it is essential to go ashore, ensure that State authorities are informed.
2. Do not go into shallow waters (<50m depth or closer than 1 km to the shore) where spawning could be stimulated and post larval settlement occur.
3. Do not congregate in the same areas as other vessels that are not at risk of inoculation with the mussel.
4. Do not pass material that has been in contact with seawater from an infected to an uninfected vessel
5. Do not scrape hull at sea
6. Do not apply antifouling at sea
7. Be aware that internal vessel systems that are in contact with seawater could become blocked and cease to operate. It is recommended that internal systems be cleaned to the extent possible with
   a) 5% industrial detergent (by volume) in water (preferably fresh) for 14 hours, or
   b) copper sulphate solution (4 mg/l) for 48 hours, or
   c) further treatments as they become available and are approved by this sub-committee. Alternative treatments in the Darwin protocols (eg. d) the use of boiling water, or e) maintaining water throughout internal systems at 50C for 30 minutes) are acceptable only if it can be guaranteed that the required temperatures are met throughout the system for the required time. Other treatments are being developed and owners will be advised as these are developed.
8. A single treatment should be sufficient to remove mussels. Further treatments are not recommended if the vessel is close to environmentally sensitive areas.
9. Technical details for treatment are available from the Darwin Emergency Hotline (1 800 330 009).
10. Clearance from GRMPA is required for any vessels using these treatments in the Great Barrier Reef Marine Park.
11. We recommend that non-infected Commonwealth fishing vessels which wish to demonstrate their lack of contact with risk vessels should request that AFMA track their movements with the Vessel Monitoring System if available.

Treatment of Infected Areas

High Risk Areas

High risk areas are currently restricted to the Darwin area and are being treated by the NT government. Treatments are being monitored by the NT government and CSIRO. Treatment protocols for high risk areas outside the Darwin area will need to be developed on a case by case basis, by the relevant authorities drawing on the expertise of this sub-committee and the NT government. New treatments may need to be developed for large-scale treatment of environmentally sensitive areas.

Initial consultations indicate that heat is one treatment which is suitable for localised patches of the mussel -- a backpack heat gun or flame thrower should be used for mussels above the low tide mark, and an underwater gas axe (with diffuser head) should be used by licensed commercial divers below the low tide mark. An alternative is the application of Quicklime (calcium hydroxide). Regardless of which treatment is used, monitoring will be required until treatment effectiveness is assured.

Medium Risk Areas

1. At the direction of the State government, the harbour master or relevant authority is required to notify the Darwin Emergency Hotline at (1 800 330 009) and/or State authorities (if not NT) must be notified as soon as it is recognised that a vessel or vessels from a high risk area has passed through the anchorage for any period. A faxed copy of the relevant bathymetric map (including map coordinates) of the potentially infected area must be sent to Nic Bax, Centre for Research into Introduced Marine Pests (CRIMP), CSIRO Marine Research (fax: 03 6232 5485) noting the berth(s) of the infected vessel(s)
2. Two vessels near the berth used by the "at risk" vessel and preferably vessels with poor or old antifouling should be immediately hauled out and examined for the presence of larval settlement by a biologist experienced in identifying this animal. State authorities, or failing that CRIMP, CSIRO Marine Research (03 6232 5222) should be contacted for contact details of biologists experienced in this identification. If the time since latest infection is greater than 2 months and water clarity is good, then in-water diver surveys can be used instead of vessel haul out. The operator must be satisfied that an adequate survey has been conducted to ensure absence of mussels on the hull and in the outer piping.
3. The bathymetric map will be returned with recommended placements for larval plankton samplers, instructions for construction and operation of the samplers (see below), sampler kits (if required) and details of surveys to be conducted.
4. Plankton samplers should be deployed as soon as possible (see below).
5. Deployment and collection of settlement plates should continue for 3 months after the vessel from the high risk area departed the anchorage, or until it is demonstrated that the high risk vessel was clean of Black Striped Mussels.
6. If these mussels are found, the medium risk area becomes a high risk area.

Approved Quarantine Areas

The only quarantine area currently available for treating medium and high risk vessels (except those in Cullen Bay or Tipperary Waters) is Frances Bay, Darwin. Quarantine procedures and schedules will be determined by the NT government.

Approved Haul Out Areas

There is a high risk that any mussels dislodged during haul out or cleaning of a high risk vessel would start a new population. Therefore we recommend that State authorities approve haul out areas based on their ability to meet the requirements of the following haul out protocol.

However, if the distance between an at risk vessel and an area approved for haul out or *in situ* treatment is such that the vessel would have to call at other ports on the way, then we recommend that the vessel be hauled out at the first possible location, and then that location be immediately treated if mussels are found on the vessel. This subcommittee should be contacted for the most recent treatment protocols for at-risk areas.

1. A high risk vessel approaching an approved haul out area must be in constant contact with the harbour master (or equivalent) to ensure that the vessel proceeds directly to the haul out area on arrival.
2. Once in the haul out area the vessel should be surrounded by a protective shield without openings. This should encompass the entire underwater surface of the vessel, without openings.
3. All ropes, fenders, dinghies, etc. must be kept within this shield.
4. With the protective shield in place, the vessel and any gear in contact with the water should be either treated *in situ* or hauled out and treated on the hard stand.
5. If water visibility is sufficient (>1m) and 30 days have passed since the most recent exposure to an infected vessel or area, then a diver survey may be used to determine whether Black Striped Mussels are present on the exterior surfaces of the hull. If none are found, the vessel may be hauled out without a protective shield.
6. If 30 days have passed since the most recent exposure and an endoscope or other equipment are available such that the internal piping between the hull and the seacock can be adequately surveyed *in situ* (bearing in mind there are typically 7 internal systems with saltwater entry and the distance between the hull and seacock can be up to 1.5 m), and if no mussel are found, the vessel can be treated internally with no external treatment.
7. For *in situ* treatment, water within the protective shield should be treated with 5% (by volume) detergent solution or copper sulphate at a concentration of 4 mg/l (equivalent to one 5 ml teaspoon per 1000 litres of water) for 48 hours. At the same time all internal systems should be flushed thoroughly with detergent or the copper sulphate solution.
8. Vessels that have were in Darwin less than 30 days ago, or where mussels are found on the hull should be hauled only once the protective shield is in place.
9. Once the vessel is hauled out, the coverage and abundance of mussels (if any) should be recorded (notes and photographs). It should then be steam cleaned with special care being given to nooks, crannies, and any seawater entry points.
10. Cleaned vessels should be left to dry on the hard stand for a minimum of 7 days.
11. Internal systems should be treated as specified above at the beginning of the 7 day period and preferably a second or third time. Care needs to be taken when a vessel is hauled out that the entire internal system, including any piping or sea chest between the hull and seacock is treated, noting that there may be up to 1.5 m of internal piping between the hull and the seacock.
12. Debris and water (that may contain larvae) must be collected and retained in an approved treatment facility (4 mg/l copper sulphate for 48 hours). Transfer to an approved holding tank for treatment may be required.
13. Debris and water includes that contained in the protective shield that encompassed the vessel before lift out and must be treated in the same manner, unless it has already been treated with copper sulphate for 48 hours, when it should be discharged in accordance with local or State regulations.

Technical notes for treatment are available from the Darwin Emergency Hotline (1 800 330 009).

Scientific Monitoring

We recommend that monitoring for larval settlement in northern areas between Fremantle and Sydney that at are risk of infection from the Black Striped Mussel be conducted in a standardised survey design using standardised equipment. High, medium and low risk areas are defined above, but we emphasise here that an area has the risk level of the highest risk vessel that has visited it, unless the area has since been treated or monitored as specified. Specifications are laid out below and we recommend that a central source be responsible for providing the survey designs including equipment design and, upon request, sampling equipment. CSIRO CRIMP has offered to provide this centralised service on a cost-recovery basis, and to enter and maintain the results on a centralised database that will be available for comparison with results from the vessel tracking database. In most cases we believe that it will be most expeditious for the individual States to construct their own monitoring devices, following the recommended design.

Larval Monitoring Device Design

The plankton sampler consists of a central vertical PVC tube through which the mooring rope will pass. There are two vertical tubes on each mooring line –constrained by knots or clips to remain at 1m below surface and at 1m above the bottom. The most updated design can be found at http:/www.marine.csiro.au/CRIMP/

Attached to each vertical tube, using a T-joint are two horizontal PVC tubes at 90° to each other. Midway along each horizontal tube a 15 cm length of “hairy rope” or “Christmas rope” is suspended. At the end of each horizontal tube a 14.5 x 14.5 cm flat sheet of PVC is attached, so that two of the sheets hang vertically and two horizontally. Sheets and hairy ropes are numbered so that it is clear where they were deployed, at which depth and the date at which they were deployed.

Once a week after deployment of the traps, the oldest of each pair of vertical plates, horizontal plates and the two oldest “hairy ropes” are detached from the sampler, placed in containers supplied, the containers filled with ethanol or methanol and the containers shipped to the nearest appropriate State agency or CRIMP for processing. Removed plates and hairy ropes are to be replaced with new ones.

Information and Identification Kits

Each survey design and larval monitoring kit will be dispatched with an information sheet on the mussel and an identification kit. The identification kit will contain photographs of the Black Striped Mussel and common native mussels with which it could be confused and an easy 3-point test to distinguish the black striped mussel. A sample of the Black Striped Mussel preserved in alcohol can be supplied on request.
The identification kit can be also accessed at http:/www.marine.csiro.au/CRIMP/.

Appendix 1 List of Contacts by State

Biologist Experienced in Identifying the Black Striped Mussel

Northern Territory	Barry Russell,	NT Museum	(08) 8999 8245
Western Australia	Shirley Slack-Smith,	WA Museum	(08) 9427 2747
Queensland	TBA		
New South Wales	TBA		

State Contact for Reporting At-Risk Vessel

Northern Territory	Darwin Emergency Hotline 1 800 330 009
Western Australia	Jackie Chappell, Fisheries WA, (08) 9482 7385 (w) or (08) 9316 0397 (h); and Colin Chalmers, Fisheries WA, (08) 9482 7318 (w) or (08) 9339 7787 (h).
Queensland	Ron Fearon, Environment Qld, (07) 3224 8574
New South Wales	Darryl Grey, NSW Fisheries, (02) 4980 4911, or Philip Gibbs, (02) 9566 7854

Appendix 2 Taxonomy

The Black Striped Mussel, now invasive in Darwin, is a *Mytilopsis* or *Congeria* species, most likely *Mytilopsis adamsi*. That species is native to tropical and subtropical Eastern Pacific waters extending from the Gulf of Mexico to Colombia. It is probably the same species that invaded an Indian port in the 1960s and Singapore, Hong Kong, Japan and Taiwan since then. As there remains some uncertainty on its actual taxonomy we recommend that it be referred to as *Mytilopsis* (or *Congeria*) sp. until a definitive taxonomic decision is forthcoming.

Appendix 3 Clearance Survey of Infected Areas

Confirmed High Risk Areas

Confirmed High Risk Areas are currently restricted to the Darwin area and are being treated by the NT government. Clearance from high risk category to medium risk category will be based upon statistically sound sampling to ensure that live adult black striped mussels are detected. It is recommended that:

- In-water diver surveys be conducted to determine the extent of infestation making note of depth distribution and aggregation thickness.
- In areas where treatment has occurred black striped mussel survival should be monitored in a quantitative fashion to determine the efficacy of treatment thus identifying any regions within the treatment area which may have black striped mussel survival. This monitoring should be spread over a wide area and evaluate for multiple depths. Within the Cullen Bay Marina mussels have been placed within cages and suspended 1m from the surface, 1m above the bottom and resting on the bottom. Cumulative mussel mortality has been monitored in these cages twice daily since

deployment. Slow kill rate regions may indicate areas requiring topical dosage treatments.

- Storm water and other drains should be treated and visually inspected either by endoscope or video. Divers may be able to inspect the outlet areas for mussel survival.
- Once 100% kill rates have been achieved by monitoring, in-water diver surveys should be conducted in a thorough fashion to provide statistically sound evaluations of kill rates. In Cullen Bay Marina spot checks are occurring at 10m intervals throughout the Marina in areas with hard substrate including the base of marina piles. Collections of mussels from 100cm^2 are evaluated for live animals. Current indications are that small populations may survive at the mud interface near the base of rocks. Consequently collections of small rock material (<20cm) may be appropriate.

In the advent of live mussel discovery, topical dosages of chemical or other approved treatments should be applied. Following confirmed 100% kill rates a second extensive diver survey should be conducted within 7 days. If no live individuals are detected additional surveys should be conducted every 14 days for 8 weeks and post larval monitoring should commence.

Appendix 4 Clearance Survey of "At-Risk" Vessels

1. Vessels that were last exposed to the risk of Black Striped Mussel infection less than 30 days ago

- copy of Darwin and/or National treatment protocols examined
- copy of Black-striped mussel identification sheets received and understood
- State or Mussel Hotline notified
- external hull treated according to protocols
- all internal systems identified and treated according to protocols
- piping/sea chests between hull and seacocks treated according to protocols
- ropes, fenders, buoys, dinghies and any other equipment in contact with water treated according to protocols

2. Vessels that were last exposed to the risk of Black Striped Mussel infection more than 30 days ago.

Either treatment according to 1 above, or

- copy of Darwin and/or National treatment protocols examined
- copy of Black-striped Mussel identification sheets received and understood
- State or Mussel hotline notified
- external hull examined by divers (good visibility and good diving conditions, the operator must be satisfied that an adequate survey has been conducted to ensure absence of mussels on the hull and in the outer piping.) or upon haul out and found clean of Black Striped Mussel
- internal systems treated according to protocols
- piping between external hull and seacocks treated examined and found clean of mussels
- ropes, fenders, buoys, dinghies and any other equipment in contact with the water, examined and found free of mussels

- Note that if even one mussel is found, then all systems on vessel must immediately be treated according to protocols (1 above)
- Have all areas where vessel was exposed to the mussel been downgraded to low risk? If so no treatment or examination is necessary.

Appendix 5 Longer Term Recommendations

The scientific subcommittee recommends that:

1. Settling plates collected by agencies for detection of post larvae of the Black Striped Mussel be saved in ethanol for one year, until it is determined whether they could be used for a general survey of exotic organisms in northern Australia
2. A national workshop on the Black Striped Mussel be held to promulgate the information gained through response to this incursion, and to plan for future events.
3. A genetic analysis of Black Striped Mussel populations around the Pacific and SE Asia be conducted to determine their relatedness, and perhaps the sequence of colonisation.
4. Overseas researchers with access to the Black Striped Mussel be contacted, and get them to continue toxicity testing of the mussel to new chemicals, eg. QUATS, that may provide a more rapid or environmentally benign treatment.
5. The level of risk of overseas ports as sources of future incursions of the Black Striped Mussel be determined.
6. A survey of existing populations of the Black Striped Mussel in SE Asia and Fiji be conducted to determine the habitats that it could colonise in Australia.
7. ANZECC protocols for marina operations be expanded to include treatment of hull fouling organisms cleaned from vessels, and ANZEC protocols be uniformly applied across Australia.
8. Destination ports in Australian overseas territories (eg. Christmas Island and Cocas Island) and elsewhere be informed of high risk vessels that have listed those areas as destinations.
9. Refugee vessels, should first be examined with divers (if practical), before being burnt and sunk in deep water, rather then being dragged onto the beach or sunk in shallow water, which increases the risk of release of marine pests.
10. A national register of scientists available for response to future marine pest emergencies be developed.

Appendix 6: Sample information guides

Fact sheet No.11 Wednesday , 7 April 1999

Advice to boat owners in Cullen Bay marina

The best advice we have received is that there should be no problem to vessels by adding copper sulphate to Cullen Bay marina.

There is no other proven effective option to copper sulphate in the marina to kill the black striped mussel.

At the concentration to be used (1ppm) of copper in seawater, we do not believe there will be a significant problem. However, boat owners should undertake the following steps:

- Check and replace sacrificial anodes as soon as possible after exiting the marina.
- Steel hulled and aluminium vessels with cathode protection systems are advised to turn these off during treatment and then turn them back on again after leaving the marina.

If you are concerned about the introduction of copper with bare aluminium on your vessel and if you are concerned about possible long –term corrosion then:

- You should arrange to bring forward your normal maintenance and arrange to slip your vessel within one or two weeks of exiting the marina.
- You should use high-pressure water to clean down any bare aluminium and remove residual fouling organisms.
- If you are still concerned, a light surface blasting with garnet abrasive should follow.

Contact **the hot line on 1800 330009 between 8am and 5pm** or check the Northern Territory Government Web site at http://www.nt.gov.au for more information.

Fact sheet No.12 Wednesday , 7 April 1999

Latest advice for owners of vessels in Frances Bay Mooring Basin

The lock entry to the Frances Bay mooring basin has been treated with chlorine to provide a sterile barrier between the internal waters and the waters outside the basin.

All vessels in the basin and piles have been inspected by divers and no further visible signs of the *Congeria sallei* black striped mussel have been found. Both the basin and boats moored in it remain in quarantine until treatment and certified clearance.

Treatment of the basin begins today with 20,000 litres of chlorine. Fish kill teams will be working to remove all dead fish etc from the marina.

Please observe the following:

1. **Tomorrow morning (Thursday 8 April), please run your engine(s) and outboards for 30 minutes from about 7.00am, or as soon after that as possible, to circulate chlorinated marina water through the engine systems and associated inlets and outlets.**

2. Pump and run all showers, heads and other equipment with seawater inlets or outlets several times.

3. After running the engines for 30 minutes, turn off and shut all sea cocks to hold the chlorinated marina water in the system.

4. **Repeat this procedure every morning at about 7am or evening at about 10 pm until further notice.**

5. If you are unable to run your engines from about 7am, please ensure that you run engines for 30 minutes at about 10pm in the evening. This is because the chlorination of the water will be at its highest in the early morning and evening when it is not being broken down by sunlight.

6. If you are unable to comply, please contact the hotline on 1800 330009 and provide full details including your name and phone numbers, your boat's name and details including the pen the boat is in so that we are aware of boats which cannot run engines.

Boats will be checked for compliance. It is essential that all boat owners undertake this procedure to help eliminate the *Congeria sallei* from Frances Bay mooring basin. Until there has been a 100 per cent kill of the pest, no boats will be able to leave the basin.

For further information, contact **the hot line on 1800 330009 between 8am and 5pm** or check the Northern Territory Government Web site at http://www.nt.gov.au.

31 October 2000

Appendix 7: Use of the Commonwealth Quarantine Act for Black Striped Mussel Control Actions

Use of the Commonwealth Quarantine Act for Black Striped Mussel Control Actions

The following is an interim process for using the *Quarantine Act 1908* for action on vessels to treat Black Striped Mussel contaminations only in the absence of appropriate State or Northern Territory legislative powers. The *Quarantine Act 1908* may be used in certain circumstances. These circumstances are:

- To direct a vessel into a port;
- To direct a vessel not to enter a port and to obey further direction; and
- To direct a vessel to undergo treatment action deemed necessary by a Quarantine Officer.

The conditions of using the *Quarantine Act 1908* are:

- AQIS (Christina Cook 0418 671 585 or Jonathon Barrington 0417 275 771) are to be contacted prior to taking the proposed action to determine the appropriate provisions of the *Quarantine Act 1908* that apply;
- Directions to take action under the *Quarantine Act 1908* are to be given by a Quarantine officer; and
- Actions under the *Quarantine Act 1908* should only be taken for those vessels currently recognised as a risk of spreading the Black Striped Mussel (those vessels identified on the database lists for Cullen Bay, Tipperary Waters and Frances Bay).

While the responsibility for directing and approving action under the *Quarantine Act 1908* rests with the Quarantine officer, the actual vessel control and treatment actions will still be handled by the local management agencies.

The following information should be provided to AQIS to assist in determining the appropriate application of the *Quarantine Act 1908*:

- Proposed course of action;
- Location of proposed action;
- Details to identify the vessel involved in the proposed action; and
- Contact details of local management agencies that will be managing the vessel control and treatment.

Appendix 8: Species Identification Sheet

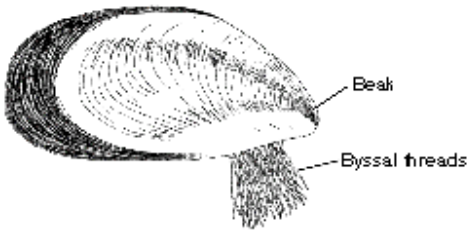
Species Identification Sheet: Black-striped Mussel

Mytilopsis (=Congeria) sp.

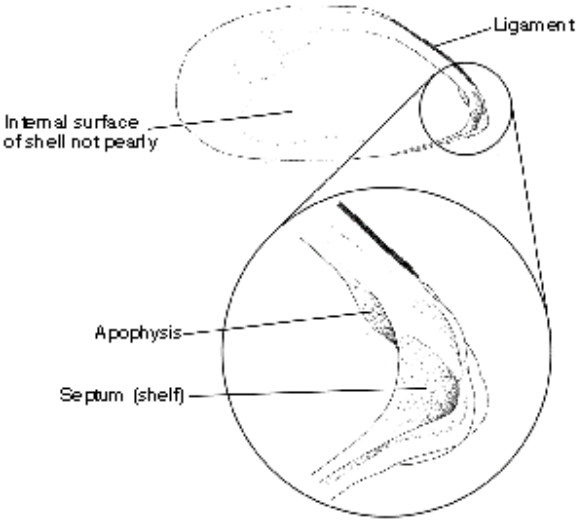
Key features:

- Length up to 25 mm
- Shell delicate – easily crushed with the fingers
- External colour variable – often with two dark stripes; occasionally with a zigzag pattern (particularly in juvenile specimens)
- Interior of shell dull – not pearly
- Apophysis behind septum inside the beak of the shell (key distinguishing feature)
- shells unequal size – one fits slightly inside the other.

External view



Internal view



Known range in Australia:

- Darwin Harbour, NT (as at 9/4/99)

Potential range in Australia:

- Tropical and subtropical areas from Fremantle, WA to Sydney, NSW.

Contacts:

To report sightings of this mussel contact either:

- The nearest government fisheries or environmental agency in your state
- CSIRO (ph: 03 6232 5452)
- The NT Government's free call information line (1800 330 009)

Acknowledgments: photograph CSIRO/CRIMP; line drawing WA Museum.

CRIMP Centre for Research on Introduced Marine Pests

This document and other information about the black-striped mussel can be downloaded as PDF files from the CRIMP web site at: http://www.marine.csiro.au/CRIMP/

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