MARINE PEST INVASION RISKS IN GULF ST VINCENT
MARINE PEST INVASION RISKS IN GULF ST VINCENT

Oceans of Blue: Coast, Estuarine and Marine Monitoring Program

A report prepared for the
Kangaroo Island Natural Resources Management Board

By
Alicia McArdle
Kym Lashmar
Martine Kinloch
Daniel Brock

June 2012
Oceans of Blue – Coast, Estuarine and Marine Monitoring Program

The views expressed and the conclusions reached in this report are those of the author and not necessarily those of persons consulted. The Kangaroo Island Natural Resources Management Board shall not be responsible in any way whatsoever to any person who relies in whole or in part on the contents of this report.

Project Officer Contact Details
Daniel Brock
Coast and Marine Program Manager
Kangaroo Island Natural Resources Management Board
35 Dauncey Street
Kingscote SA 5223
Phone: (08) 8553 4444
Fax: (08) 8553 2531
Email: Danny.brock@sa.gov.au

Natural Resources Kangaroo Island Details
Bill Haddrill
Regional Manager
Natural Resources Kangaroo Island
37 Dauncey Street
Kingscote SA 5223
Phone: (08) 8553 4400
Fax: (08) 8553 2531
Email: Bill.Haddrill@sa.gov.au

© Kangaroo Island Natural Resources Management Board 2012

This document may be reproduced in whole or part for the purpose of study or training, subject to the inclusion of an acknowledgment of the source and to its not being used for commercial purposes or sale. Reproduction for purposes other than those given above requires the prior written permission of the Kangaroo Island Natural Resources Management Board.

For bibliographic purposes this paper should be cited as:

Front cover images:
European Fan Worm (Sabella spallanzanii) covering the hull of a yacht moored in Marina St Vincent (Wirrina). Photo Kym Lashmar

View of vessel berths at Marina St Vincent (Wirrina). Photo Kym Lashmar
Foreword

This project delivers the Kangaroo Island Natural Resources Management Plan ‘Here to Stay—For our Children and Grandchildren—A natural resources management plan for the Kangaroo Island region’. The following Outcomes, Regional Targets and Board Targets from the Plan are relevant to the project.

Program

Oceans of Blue: Managing marine, coastal and estuarine biodiversity on Kangaroo Island

Program outcome

A scientifically rigorous and integrated system of measuring and reporting on the state of marine, coastal and estuarine environments of Kangaroo Island that relates trends in the condition of biodiversity assets to changes in human uses of land and seascapes, provides advice on targeting management action to mitigate anthropogenic impacts where required and empowers the public to respond to threats to natural resource condition and values.

Relevant resource condition targets

8.5 D  An enhancement in the condition of natural biodiversity in marine, coastal and estuarine systems through protection and management of key biodiversity assets and areas.

Relevant management action targets

8.5.1  Establish benchmarks and monitoring program for marine and estuarine water quality, terrestrial and marine coastal biodiversity and condition of fisheries stocks.

8.5.2  Establish representative monitoring program for terrestrial and marine coastal biodiversity focusing on areas subject to water contamination and other threatening processes.
Acknowledgments

To Be Added
## Contents

- Foreword ................................................................................................................... 4
- Acknowledgments ....................................................................................................... 5
- Introduction ................................................................................................................. 8
  - Vectors and Pathways .............................................................................................. 8
  - Nodes ..................................................................................................................... 9
- Methods ....................................................................................................................... 10
  - Boating facilities ..................................................................................................... 10
  - Pest distributions in Gulf St Vincent ....................................................................... 10
  - Invasion Risk Assessment ....................................................................................... 11
- Results ......................................................................................................................... 12
  - Boating facilities ..................................................................................................... 12
  - Marine pest distributions in Gulf St Vincent ............................................................ 13
  - Vessel voyages ....................................................................................................... 15
  - Invasion Risk Assessment ....................................................................................... 18
- Discussion .................................................................................................................... 19
- Recommendations ...................................................................................................... 23
- References .................................................................................................................. 24
Tables and Figures

Figure 1: Significant Boating facilities in Gulf St Vincent Bioregion .............................................. 12
Figure 2: High risk marine pest species distributions in Gulf St Vincent Bioregion .......................... 14
Figure 3: Most common origins of vessels to Kangaroo Island in 2009 ............................................ 15
Figure 4: Vessel destinations on Kangaroo Island in 2009 .............................................................. 16
Figure 5: Commercial shipping routes to major Kangaroo Island ports ............................................ 17
Figure 6: The base of Sabella tubes showing blue antifouling paint removed from Bay of Shoals. 20

Table 1: Presence of high-risk marine pest species in Gulf St Vincent Bioregion mainland ports .. 13
Table 2: Mainland commercial vessel voyages to Kangaroo Island .................................................... 16
Introduction

The discovery of two species of marine pest in Kangaroo Island (KI) waters in recent years has alerted government agencies and the local community to the potential of economic and environmental impacts of a serious marine pest invasion of the Island. Kangaroo Island’s economy is dependent on a range of primary production activities (including fishing and aquaculture), and tourism, which incorporates marine tours, whale, seal and dolphin watching, fishing charters, and diving.

Infestations of marine pests can have devastating impacts on marine and coastal environments and communities. Introduced marine pests, like weeds and feral animals on land, compete with native species for food and territory. They may displace local populations, eradicate rare species, alter community structure, food webs and ecological process or severely modify coastal habitats. Invasive alien species are identified as one of the four greatest threats to the world’s oceans (Jackson 2008). In addition to impacts on biodiversity, marine pests may also increase the cost of maintaining coastal infrastructure and affect important marine industries and recreational activities such as fishing, boating, diving and aquaculture, with economic and social implications for those communities dependent on them. As such, the impact of a marine pest incursion has the ability to negatively affect the triple bottom line of Kangaroo Island’s economy.

The Implementing bioregional marine pests management actions in Gulf St Vincent project is a pro-active collaboration between Adelaide and Mount Lofty Ranges, Northern and Yorke and KI Natural Resources Management Boards to address the threat of marine pest invasions in the Gulf St Vincent (GSV) bioregion.

Following initial detection of marine pests in KI waters, the Kangaroo Island Natural Resources Management Board (KINRMB) initiated a comprehensive program of surveillance and detection of marine pests in conjunction with other agencies e.g. PIRSA Marine Biosecurity (now Biosecurity SA). Results from this survey recommended continuing to identify and investigate likely vectors of marine pests and potential risks of translocation to Kangaroo Island, including vessel types, routes and ports of origin (Kinloch et al 2009).

Vectors and Pathways

Along with the high visitation rates to Kangaroo Island associated with tourism, a number of visitors travel to the island via private vessels such as yachts and motor cruisers. As such, there is a steady stream of sea traffic that connects the Island to an array of ports and harbours on the South Australian mainland that are infested with colonies of marine pests (figure 2). Yachts ranked ninth out of 23 vessel vector categories for the risk of translocating marine pests in an assessment by Kinloch et al (2003). This was due to the fact that yachts accumulate biofouling on their hulls as
they are permanently in the water and they undertake voyages promiscuously at both short and long range, often to sites of environmental significance. The discovery of marine pests fouling the hulls of four yachts moored at Kangaroo Island (two at American River & two at Bay of Shoals) during an initial surveillance demonstrates that recreational boats are high risk vectors for the translocation of marine pests to KI.

Commercial sea traffic is also a known vector for the translocation of marine pests, with several types of vessels visiting KI. A daily ferry service to and from KI operates across Backstairs Passage between Penneshaw and Cape Jervis, both of which are not currently infected with marine pests. Historically, several passenger ferries and a grain barge operated routes between Kingscote and Adelaide (Port Adelaide & Glenelg), and also Kingscote and Wirrina. As these routes were travelled frequently from ports that are infested with several species of marine pest, there is a high probability that translocation of marine pests could have taken place. Commercial fishing vessels, charter boats and recreational vessels operated locally rarely leave the island for long periods, and thus were deemed low-risk for marine pest translocation.

**Nodes**

A node is classified as a point where a vessel's journey begins, ends or where a stopover occurs, and at which they cross paths with other vessels. Nodes are centres of boating activity such as ports, harbours and marinas as well as boat maintenance facilities such as slipways (Kinloch *et al*, 2003). Potentially, these sites can act as marine pest distribution centres and reservoirs, as they characteristically include suitable substrate for marine pests to colonise such as pilings and pontoons (Kinloch *et al*, 2003). Within Gulf St Vincent (GSV), there are several potential invasion pathways and a number of nodes that are vulnerable to marine pest incursions, including new facilities, such as the marina at Port Vincent, that have not yet been properly assessed. This risk will increase as more boating facilities are constructed around the gulf.
Methods

Boating facilities

Locations of significant boating facilities in GSV were obtained from the Department for Transport, Energy and Infrastructure website, with additional marina/port and anchorage locations obtained through Google Earth and EnvMaps. Google Earth was used to plot facility locations in decimal degree format and locations were later mapped using ArcGIS. Anchorages, marinas, commercial ports, slipways and Jetties were deemed significant facilities, as vessels which utilise these services are most likely to be high risk vectors. Marinas, commercial ports and slipways qualified as significant features in their own right as they are facilities that exhibit high levels of vessel use. Anchorages and jetties were only deemed significant if they were present with another type of significant facility. Anchorages or jetties on their own were not deemed significant and therefore not included. For display purposes all boating facilities located in greater Port Adelaide area e.g. Port Adelaide, Outer Harbour, North Haven, Garden and Torrens Islands were combined into the one location on the map.

Pest distributions in Gulf St Vincent

Pest distribution maps were prepared using data from the SARDI Introduced Marine Species geodatabase and results obtained from Biosecurity SA and KI NRM Board for the following high risk marine pests:

- *Carcinus maenas* (European shore crab)
- *Caulerpa sp.* (racemosa var. cylindracea and taxifolia)
- *Ciona intestinalis* (European sea squirt)
- *Musculista stenhousia* (Asian bag mussel)
- *Sabella spallanzanii* (European fan worm)

All of these species, with the exception of *Ciona* are classified as Trigger List Species by the National Consultative Committee on Introduced Marine Pest Emergencies (CCIMPE). *Ciona* was included in this project as it was found in previous marine pest surveys on KI and therefore is particularly susceptible to reinfestation.
Invasion Risk Assessment

Recreational vessels

Data was compiled regarding the common vessel traffic routes between KI and the mainland through consultation with harbourmasters and a review of log books from the Volunteer Marine Radio (VMR) operator in American River. Origin, destination and the month in which vessels arrived at KI were recorded. As a result of American River VMR’s incomplete logbooks for 2010 and 2011, the 2009 data was utilised for the risk assessment. Vessel movements were analysed according to origin, destination, season and type of vessel.

Raw vessel traffic data was spatially analysed using ArcGIS to produce a map displaying vessel voyages to Kangaroo Island. Some interstate vessels from Western Australia and the far west coast of SA visited KI during the sample period and as such were classified as “from the West”. For display purposes, the voyage destinations of North Coast KI, King George Beach, Western River, Snug Cove and Western End (KI) were combined to form the single destination: North Coast Coves, due to their geographic relationship. Adelaide was determined as vessels originating from the Adelaide region, including the ports of Outer Harbour, North Haven, Port Adelaide and Glenelg.

Pest distributions were then overlayed to determine vector pathways from node locations to predict the direction and probability of spread for the identified high-risk marine pests. The GIS outputs were then used to identify high risk sites for invasion threats.

Commercial vessels

Details of commercial vessels visiting Kangaroo Island were collated into two distinct datasets. Charter vessel and cruise ship voyage information, such as destination/s length of stay and frequency of voyages was obtained through phone calls to the relevant business/organisation. Commercial shipping route information, such as passenger and vehicular ferries, and transportation barges, was obtained through a series of internet searches and historical observations by island residents. Due to the large amount of commercial sea traffic to and from Adelaide ports, only commercial vessels travelling to Kangaroo Island were included in the risk assessment.

This data was similarly analysed using ArcGIS to identify high risk sites.
Results

Boating facilities

There is a great range of significant boating facilities available in GSV bioregion (figure 1) with 16 sites providing a total of 36 facilities in the region (the Port Adelaide area contains a further ten facilities). A total of seven commercial ports were recorded, and a further five locations were equipped with marinas. Kangaroo Island provided 10 different boating facilities at 4 sites.

Figure 1: Significant Boating facilities in Gulf St Vincent Bioregion
Marine pest distributions in Gulf St Vincent

Six high risk marine pest species are present in ports situated in the Gulf St Vincent Bioregion (table 1, figure 2). The most infested were the ports located in and around Adelaide with all six high risk species present, including both species of *Caulerpa* and *Musculista senhousia* (not recorded anywhere else in GSV).

Table 1: Presence of high-risk marine pest species in Gulf St Vincent Bioregion mainland ports
(Highlighted ports are those which have high visitation rates to Kangaroo Island)

<table>
<thead>
<tr>
<th>Port</th>
<th>Marine pests present</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Known presence</td>
</tr>
<tr>
<td></td>
<td>Unconfirmed presence</td>
</tr>
<tr>
<td>Edithburgh</td>
<td><em>Carcinus maenas</em></td>
</tr>
<tr>
<td></td>
<td><em>Sabella spallanzanii</em></td>
</tr>
<tr>
<td>Klein Point</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Sabella spallanzanii</em></td>
</tr>
<tr>
<td>Port Vincent</td>
<td><em>Carcinus maenas</em></td>
</tr>
<tr>
<td>Port Wakefield</td>
<td><em>Carcinus maenas</em></td>
</tr>
<tr>
<td>Adelaide (Outer Harbour,</td>
<td><em>Carcinus maenas</em></td>
</tr>
<tr>
<td>North Haven, Port Adelaide,</td>
<td></td>
</tr>
<tr>
<td>Glenelg, West Lakes, Holdfast</td>
<td><em>Caulerpa (racemosa and taxifolia)</em></td>
</tr>
<tr>
<td>Shores, Brighton, Hallet Cove</td>
<td><em>Ciona intestinalis</em></td>
</tr>
<tr>
<td>Port Noarlunga, O’Sullivans Beach</td>
<td><em>Sabella spallanzanii</em></td>
</tr>
<tr>
<td></td>
<td><em>Musculista senhousia</em></td>
</tr>
<tr>
<td>Port Stanvac</td>
<td><em>Carcinus maenas</em></td>
</tr>
<tr>
<td>Wirrina</td>
<td><em>Sabella spallanzanii</em></td>
</tr>
</tbody>
</table>
Figure 2: High risk marine pest species distributions in Gulf St Vincent Bioregion
**Vessel voyages**

**Recreational Vessels**

A total of 305 vessel voyages to KI were recorded by the Volunteer Marine Radio service in 2009. The most prevalent origins for vessel voyages to Kangaroo Island were Wirrina, Adelaide and Edithburgh (figure 3) all located within the Gulf St Vincent bioregion and infested with at least one of the determined high risk marine pests. The majority of vessels travelled to Kangaroo Island during summer and autumn.

![Figure 3: Most common origins of vessels to Kangaroo Island in 2009](image)

American River was almost four times more popular as a vessel destination compared to other ports on KI (figure 4). Kingscote was another popular destination and along with American River has had infestations of marine pests in the past. When combined, visitation rates to the North Coast Coves of King George Beach, Western River, Snug Cove, North Coast (KI) and Western End (KI) were prevalent with a total of 45 vessels visiting the area in 2009. Emu Bay and Antechamber Bay also rated as popular destinations, and neither site has been included in previous surveillance.
The majority of vessels travelled to Kangaroo Island in the warmer months, with summer the busiest (54% of arrivals), and a further 35% visiting in autumn.

**Commercial vessels**

A very small number of charter vessels and cruise ships travel to Kangaroo Island as part of their services (table 2). The majority of the smaller operators originate from ports in mainland South Australia, but the large cruise ships originate from ports in other parts of the world.

**Table 2: Mainland commercial vessel voyages to Kangaroo Island**

<table>
<thead>
<tr>
<th>Business/Organisation</th>
<th>Origin</th>
<th>KI Destinations</th>
<th>Travel details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reef Encounters Fishing Charters</td>
<td>Pondalowie Bay, Marion Bay</td>
<td>Western End</td>
<td>10-15 times per annum</td>
</tr>
<tr>
<td>SA Fishing Adventures</td>
<td>Marion Bay</td>
<td>Western End</td>
<td>Destination depends on charter requirements</td>
</tr>
<tr>
<td>Lady Eugenie</td>
<td>Marina St Vincent (Wirrina)</td>
<td>North Coast Emu Bay</td>
<td>Luxury tours, based at Victor Harbour although tour begins at Marina St Vincent</td>
</tr>
<tr>
<td>MV Athena</td>
<td>Madeira, Portugal</td>
<td>Kingscote</td>
<td>580 passengers, stopover visit in 2009 and 2010</td>
</tr>
<tr>
<td>The World</td>
<td>Bahamas</td>
<td>Kingscote</td>
<td>200 passengers, stopover visit in 2010</td>
</tr>
</tbody>
</table>
Currently, only one shipping route operates between Kangaroo Island and mainland South Australia; a vehicular ferry service between Cape Jervis and Penneshaw run by SeaLink (figure 5). Historically however, between 1972 and 2008 a further eight shipping routes to Kangaroo Island have at different times been in operation, with Kingscote the preferred destination (four vessels docking regularly at the Kingscote Jetty and one at the nearby slipway).

Figure 5: Commercial shipping routes to major Kangaroo Island ports
Invasion Risk Assessment

An overlay of pest distributions, vector pathways and node locations verified that Kangaroo Island ports are at considerable risk of invasion by marine pest species. American River in particular is at great risk, with 88% of vessels visiting there having originated from infested ports (figure 6). The majority of vessels visiting American River came from the Wirrina and Adelaide ports, all of which have been identified as marine pest nodes. Also of note is the high traffic route between Edithburgh and North Coast Coves on KI, with Edithburgh known to be infested with up to two marine pest species, and the North Coast Coves on KI currently pest-free.

Figure 6: Recreational vessel voyages to Kangaroo Island in 2009

(Available overleaf)
Discussion

The invasion risk assessment highlights the clear and present danger that vessel traffic, both recreational and commercial, poses to the ports of Kangaroo Island in terms of high-risk marine pest species translocation. The presence of six high-risk species at locations with significant boating facilities in the GSV bioregion suggest that it is highly probable that locations currently free of marine pests will be faced with incursions in the future.

High numbers of recreational vessel voyages originating from Wirrina and Adelaide during autumn is of particular concern regarding the translocation of *Sabella spallanzanii* to Kangaroo Island, with recreational vessels identified as the highest risk vector for the spread of this species to KI (Kinloch *et al*, 2009). Reproductive history of *Sabella* in Victorian waters follows an annual cycle, and coincided through autumn and winter, with falling seawater temperatures and shorter day lengths (Currie *et al*, 2000). If yachts infested with *Sabella* are visiting KI over the spawning period, the probability for colonisation is expected to increase.

In 2009 and 2010 two yachts were discovered moored in Bay of Shoals, both of which had hundreds of *Sabella* fouling their hulls, and both had previously been berthed at Marina St Vincent (Wirrina) for 18 months and three years respectively. Subsequent surveys uncovered an additional 49 *Sabella* specimens from the seagrass meadows and sandy substrate in close proximity to where the yachts were moored. Many of these specimens were found to have traces of blue anti-fouling paint near the base of their tubes (figure 6) indicating that *Sabella* specimens dislodged from the hull of vessels are able to re-establish successfully on soft substrates (Kinloch *et al* 2010). This discovery has significant current and future implications for the management of this species on KI, and other ports currently *Sabella*-free.

**Figure 6: The base of *Sabella* tubes showing blue antifouling paint removed from Bay of Shoals**
The popularity of American River for visiting vessels, as well as the historic discovery of two marine pest species in the port (Kinloch et al, 2009) suggests that this location is highly susceptible to infestation. The translocation of marine pests to American River could have a direct economic impact on the oyster farm situated there, with Sabella known to be capable of forming dense fouling communities on hard substrates, especially artificial structures such as aquaculture and boating facilities (NIMPIIS 2002).

Of note are the relatively high visitor rates for the remote coves on the northern coast of KI. These areas have not previously been included in surveillance monitoring on KI, which has focused on ports and facilities, however due to the physical characteristics of these destinations, including deep water with high tidal flows, which are not conducive to marine pest establishment, it is unlikely that marine pest species would establish permanent colonies there. Emu Bay and Antechamber bay also rated highly in visitor destinations on KI, and neither site has been included in previous surveillance.

With regard to commercial ports located in the GSV bioregion, there should be some distinction made between the ports of Cape Jervis and Penneshaw and the ports of Ardrossan, Klein Point, Port Giles, Port Adelaide and Port Stanvac. The Cape Jervis and Penneshaw ports are currently free of marine pests and are utilised exclusively by SeaLink who operate vehicular ferries connecting Kangaroo Island to mainland South Australia. These ferries are in constant use and undergo annual slipway maintenance and antifouling, significantly reducing the risk of translocating marine pests. Conversely, the ports of Ardrossan, Klein Point, Point Giles Port Adelaide and Port Stanvac are commercial deep water ports used by bulk carriers, general cargo ships, containerships and oil tankers and are infested with various marine pest species. The vessels which make use of these ports do not travel to Kangaroo Island; however they do use shipping routes through Backstairs Passage and Investigator Strait that take them past the northern coasts of the Island. Backstairs Passage is also a significant shipping route for vessels travelling between Adelaide and the Victorian ports of Geelong and Melbourne which are likewise heavily infested with additional Trigger List marine pests such as the Northern Pacific Seastar (*Asterias amurensis*). Traffic through Backstairs Passage is of the order of 500-1000 vessels per year (Larcombe et al 2002) and a number of ships heave-to and discharge ballast water in Backstairs Passage, which potentially creates another vector for the translocation of marine pests to Kangaroo Island (Kinloch et al 2008)

The potential risk posed by commercial vessels berthing at Kingscote has passed, with the last vessel ceasing operations there in 2008. This coincided with the first discovery and removal of *Sabella spallanzanii* specimens on Kingscote jetty. In response to this, annual surveys of the Jetty and surrounds by the KI NRM Board’s Coast and Marine Program have located and removed a further 30 *Sabella* specimens in 2010, 90 specimens in 2011 and 10 specimens in 2012. This
suggests that the reoccurrence of Sabella on Kingscote Jetty is a legacy of past commercial operations that will have to be dealt with for some time into the future.

Additionally in 2012 a further 15 specimens were discovered and left in-situ on Kingscote Jetty to trial a new pest detection method which involves collecting plankton samples and using a DNA probe to detect the presence of Sabella larvae in the water. Following completion of the trial the specimens will be removed and destroyed.

Although not yet detected at KI, Carcinus maenas and Musculista senhousia both pose a significant threat to KI. According to NIPMIS (2012), C. maenas is “a voracious predator with a broad diet and has been implicated in the decline of native shellfish populations, some of commercial importance”. In addition, it has a wide range of habitat preferences, and is found in both the intertidal and shallow subtidal zones of bays and estuaries, including seagrass and sandy substrate. There are currently several nodes present in GSV, and therefore there is the capacity for this pest to translocate to KI and become established easily, with a wide range of suitable habitat available.

M. senhousia is a highly adaptive species whose presence has been confirmed in the Adelaide ports of North Haven, Outer Harbour and Port Adelaide, colonising soft and hard substrates in the intertidal and subtidal zone to a depth of 20m (NIMPIS 2012). It is known to dominate benthic communities and potentially exclude native species and would have a disturbing effect on the marine ecosystems of KI if this marine pest was to be introduced.

Analysis of vessel pathways between nodes highlighted voyages between Adelaide and American River, and Wirrina and American River, followed by voyages between Edithburgh and North Coast Coves as the most frequently travelled routes for vessels visiting KI. This is significant especially when considering education of the recreational boating sector and directing tailored messages to these stakeholders about the spread of marine pests in the Gulf St Vincent Bioregion.
Recommendations

Although regular monitoring of marine pests has occurred since the initial discovery of specimens in KI waters, the results from this project suggest that a more rigorous monitoring program be implemented to ensure any pest incursions are identified and contained. This should include a review of surveillance sites in light of invasion risk assessment maps produced in this report.

The 2009 vessel movement data obtained from the American River Volunteer Marine Radio, whilst robust, is dated and it is advised that a complete dataset of 2012 vessel movements is obtained in early 2013 to compare changes in activity and distribution of vessel routes between KI and mainland Australia.

There is potential for the KI NRM Board to work collaboratively with the American River VMR to undertake evaluation of educational signage erected at ports in Gulf St Vincent which have high visitation to KI. This would assist in understanding the most effective form of engagement for the stakeholder group.
References


