Northern Pacific seastar

Keep your boat and fishing gear clean to help stop the spread of marine pests

NSW's marine life is under threat from introduced marine plants and animals. Marine pests can also have severe impacts on recreational boating and fishing and marine industries.

The pest seaweed *Caulerpa taxifolia* has already become established in Sydney and on the Central and South Coasts, and action needs to be taken to avoid other pest species arriving and becoming established in our estuaries. A recent study identified key pests which have a high risk of being transferred to Sydney's waterways by boating traffic from southern NSW and other states, such as the Asian bag mussel, Northern Pacific seastar, European/green shore crab and Japanese kelp.

Marine pests can affect your boat

- They damage the paint and hull where they attach
- They increase drag and therefore fuel costs
- They increase maintenance costs
- They clog pipes, motors or propellers causing engine overheating

Marine pests can affect your fishing

- They increase pressure on fish populations by competing for food, damaging their habitats, or preying on them
- A pest outbreak can result in fishing closures to stop the pests spreading further
- The Northern Pacific seastar can even steal your bait!

Meadow of *Caulerpa taxifolia*

How can I help?

Check and clean your boat regularly using the simple steps on pages 4 to 7, to make sure you are not spreading pests. Also, clean your fishing gear.

You may be carrying marine pests on your boat. You could unknowingly be spreading them to your favourite destinations. Cleaning your boat and gear will help stop the spread of marine pests. It will also reduce your fuel costs and increase the life of your boat.

Caulerpa taxifolia

Japanese kelp

Mussels on propeller

Learn to identify important existing or potential marine pests – see pages 8 to 39. If you see existing pests in new locations or new pests in NSW, please report them immediately.

NSW DPI's 24hr recorded hotline
(02) 4916 3877
email: **aquatic.pests@dpi.nsw.gov.au**

Note the location and take photos or collect a sample and freeze in a plastic bag to enable NSW DPI to confirm your sighting.

For more information, please visit:
www.dpi.nsw.gov.au/fisheries/pests-diseases
or phone 1300 550 474

Follow these simple steps to make sure pests aren't hitchhiking on your boat!

TRAILER BOATS, CANOES, KAYAKS, JETSKIS

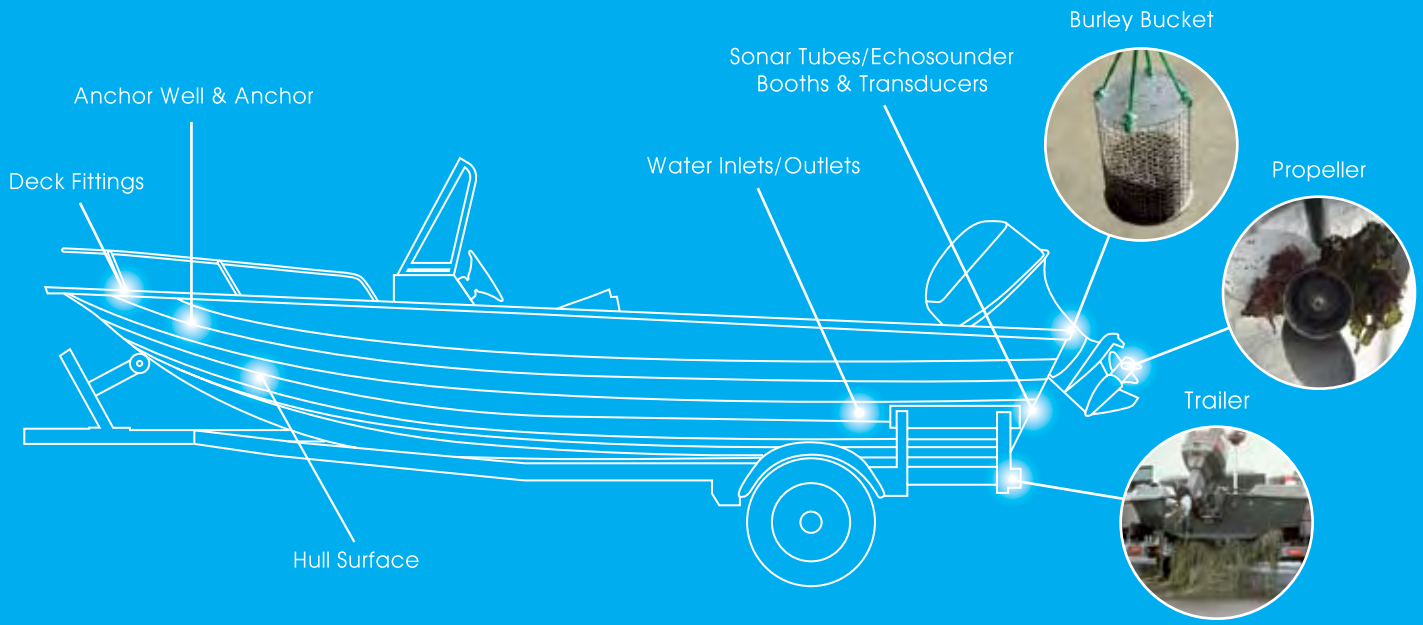
4 key steps to keep your boat and gear clean and dry. Target the areas shown in the diagram.

1. **Remove any weeds, animals or sediment from your boat, trailer and gear and put it in the bin** – NOT back in the water.

2. **After each trip rinse your boat, trailer and gear with fresh water,** in your yard or at a carwash. If you can't do this because of water restrictions go to the next step.

3. **Drain all the water from your boat and gear,** but don't let it drain back into the sea.

4. **Dry your boat and gear completely, including ropes and anchor.** Tiny eggs & plant spores can survive in a damp area for months.

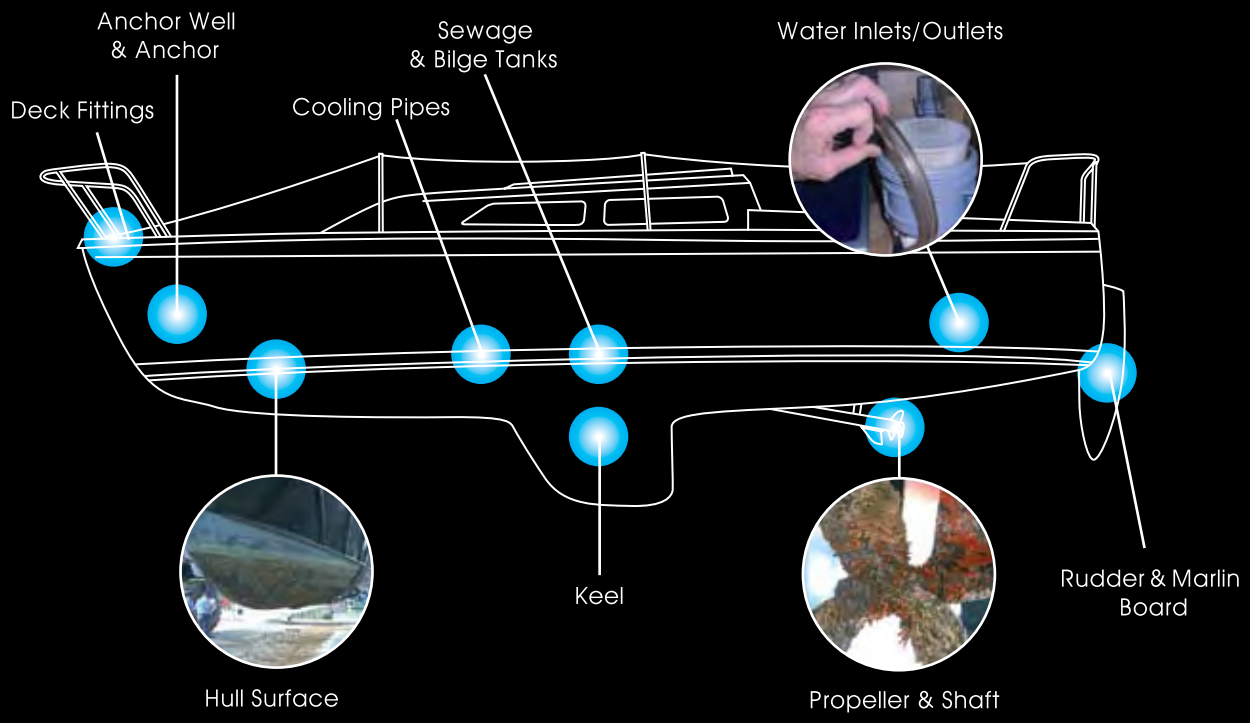


Follow these simple steps to make sure pests aren't hitchhiking on your boat!

MOORED BOATS

It's crucial to make sure your boat is clean before you move it. Follow these 5 key steps and target the areas shown in the diagram.

1. **Slip and clean your boat regularly,** at least every year and anytime there is a build up of fouling.
2. **Select an antifouling paint suited to your boat's activity, and apply it correctly following the manufacturer's advice.** Renew it when persistent fouling occurs.
3. **Check your boat for fouling every month** (any plants or animals attached to your hull, propellers, anchor, cables, fenders, cordage, tenders etc).
4. **Treat internal seawater systems regularly** – flush with fresh water or an approved treatment.
5. **Dispose of sewage and bilge water at an approved pump out facility.** Waste could contain marine pests, their eggs or plant spores.



MARINE PEST FOUND IN NSW

CAULERPA
Caulerpa taxifolia

Frond height 3-25cm

Flattened fronds, bright green colour. Known to turn pale & white during winter in colder waters

Leaflets on fronds attach directly opposite each other, curve upwards

Leaflets constricted at base

Photo: NSW DPI

KNOWN LOCATIONS:

Found in several NSW estuaries and coastal lakes including:

Lake Macquarie
Brisbane Water
Hawkesbury River
Pittwater
Port Jackson
Botany Bay
Port Hacking
St Georges Basin
Lake Conjola
Narrawallee Inlet
Burrill Lake
Durras Lake
Batemans Bay
Wallagoot Lake

Also found in SA

See NSW DPI website for up-to-date information www.dpi.nsw.gov.au

HABITAT:

- Sand or rock in sheltered and moderately exposed areas
- Has not been found in depths greater than 12m in NSW

IMPACTS:

- May compete with native seagrasses
- May adversely affect shellfish living in sediments
- Entangles in boat anchors, fishing nets and trawling gear

REPORT NEW LOCATIONS

SIMILAR NATIVE SPECIES

Photo: David Harasti

Caulerpa filiformis

KEY FEATURES:
Flattened strap-like fronds (not fern-like)

HABITAT:
Exposed and sheltered rocky reef and sandy areas, to 6m depth
Common between Port Stephens and Jervis Bay

Photo: John Huisman, Marine Plants of Australia

Caulerpa scalpelliformis

KEY FEATURES:
Fern-like fronds with leaflets either side of fronds not directly opposite each other

HABITAT:
Exposed rocky reef to 36m depth

Photo: John Huisman, Marine Plants of Australia

Caulerpa flexilis

KEY FEATURES:
Fern-like branchlets with secondary leaflets

HABITAT:
Exposed rocky reef to 40m depth
More common in deeper water

Photo: John Huisman, Marine Plants of Australia

Caulerpa cactoides

KEY FEATURES:
Short rounded club-like leaflets

HABITAT:
Sheltered and less exposed sand, mud and rock surfaces up to 38m depth

MARINE PEST FOUND IN NSW

EUROPEAN/GREEN SHORE CRAB
Carcinus maenas

Photo: © CSIRO

KNOWN LOCATIONS:

Found in several estuaries and coastal lakes along NSW southern coastline including:

Clyde River
Wagonga Inlet
Nangudga Lake
Bermagui River
Wapengo Lake
Nelson Lagoon
Merimbula Lake
Pambula Lake
Twofold Bay
Wonboyn Lake

Also found in SA, Vic, Tas

See NSW DPI website for up-to-date information www.dpi.nsw.gov.au

HABITAT:

- Shallow intertidal areas of bays and estuaries
- Typically amongst rocks with oysters or in mangroves

IMPACTS:

- Competes with native species
- Feeds on native shellfish and other crabs
- Potential impacts on aquaculture and fisheries

REPORT NEW LOCATIONS

SIMILAR NATIVE SPECIES

Photo: Graham Edgar, Australian Marine Life

Thalamita sima

KEY FEATURES:
Has swimming paddles
5 spines either side of eyes
Green/yellow colour

HABITAT:
Sheltered reef and sand up to 34m depth

Photo: Graham Edgar, Australian Marine Life

Surf crab/Sand crab
Ovalipes australiensis

KEY FEATURES:
Two red oval patches towards the rear
Light grey/sand colour

HABITAT:
Sandy beaches up to 34m depth

Photo: © Leon Altoff

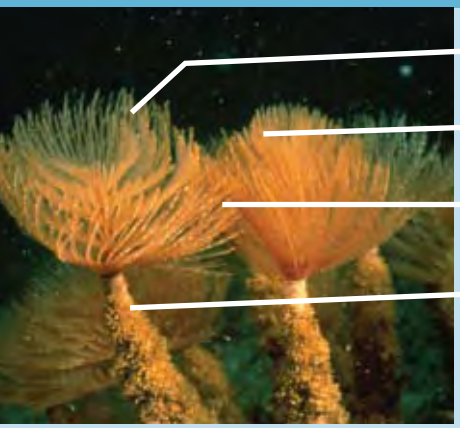
Red swimmer crab
Nectocarcinus integrifrons

KEY FEATURES:
Purple-red/brown colour
4 spines either side of eyes
Slightly hairy, claws black at tips, no swimming paddles

HABITAT:
Sheltered seagrass and seaweed up to 20m depth

MARINE PEST FOUND IN NSW

EUROPEAN FAN WORM
Sabella spallanzanii



Fan colour varies: white/orange/brown

Fan often has brightly banded colours

Feeding tentacles (radiole) form spiralled fan up to 20cm long

Flexible tube up to 40cm

Photo: © CSIRO

KNOWN LOCATIONS:

- Twofold Bay, NSW
- WA, SA, Vic, Tas

HABITAT:

- Sheltered waters up to 30m depth
- Soft sediments and hard surfaces such as wharf/marina piles, channel markers, submerged wrecks and pontoons

IMPACTS:

- Fouls man-made structures and soft sediments
- Competes for food and space with native species and can inhibit their settlement
- Clogs dredges and nets increasing sorting times for commercial fishers

REPORT NEW LOCATIONS

SIMILAR NATIVE SPECIES

Photo: Roger Steene

Feather-duster worm/ Banded fan worm/ Southern fan worm
Sabellastarte australiensis

KEY FEATURES:
Feeding tentacles not spiralled, up to 15cm diameter
Banded white and purple/brown

HABITAT:
Exposed rocky reefs up to 30m depth

Photo: David Harasti

Anemone horseshoe worm
Phoronis australis

KEY FEATURES:
Velvet black colour, tube length up to 20cm

HABITAT:
Silty/sandy sheltered areas, up to 30m depth

Photo: Mark Norman, Museum Victoria

Sabellastarte sp

KEY FEAURES:
Feeding tentacles not spiralled
Banded white/purple/ orange/brown
Shorter tube up to 5cm
Usually solitary not in clumps

HABITAT:
Exposed rocky reef and artificial structures in areas of good current flow, up to 200m depth

NEW ZEALAND SCREW SHELL
Maoricolpus roseus

Smooth spiralled cone (no beads) up to 9cm long

Yellow/red-brown in colour, often marbled or streaked

Photo: © CSIRO

Photo: © CSIRO

KNOWN LOCATIONS:

- Twofold Bay and continental shelf off Merimbula and Bermagui
- Vic and Tas

HABITAT:

- Lying on, or partially buried in sand, mud or gravel
- Intertidal to subtidal
- From 1-130m depth

IMPACTS:

- Densely blankets sea floor with live and dead shells
- Can affect growth of scallops and displace native shellfish

REPORT NEW LOCATIONS

SIMILAR NATIVE SPECIES

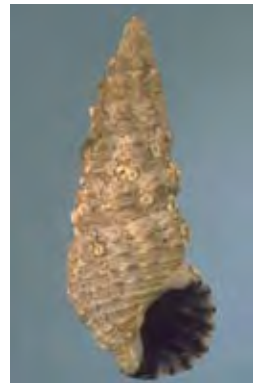


Photo: Patty Jansen, Australian Shells

Mud whelk
Velacumantus australis

KEY FEATURES:
Broader, rough spiralled shell up to 2-5cm long
Dull grey colour

HABITAT:
Soft sediments in sheltered waters, estuaries, mangroves, tidal flats, seagrasses

Photo: Holly Barlow, Australian Museum

Native screw shell
Gazameda gunnii

KEY FEATURES:
Shorter shell up to 5-6cm long
More mottled appearance, lighter colouration – white/light brown
Has fine beads forming ridges around the shell

HABITAT:
Inner continental shelf at depths to 140m

Photo: Patty Jansen, Australian Shells

Hercules club whelk/Mud whelk
Pyrazus ebeninus

KEY FEATURES:
Dark brown shell with flaring lip
Up to 11cm long

HABITAT:
Mudflats and mangrove swamps in estuaries

MARINE PEST FOUND IN AUSTRALIA

NORTHERN PACIFIC SEASTAR
Asterias amurensis

Five pointed arms with radius up to 23cm

Upturned tips, pointed spines (two rows on underside)

Juveniles are yellow with purple markings (adults more yellow)

Photo: © CSIRO

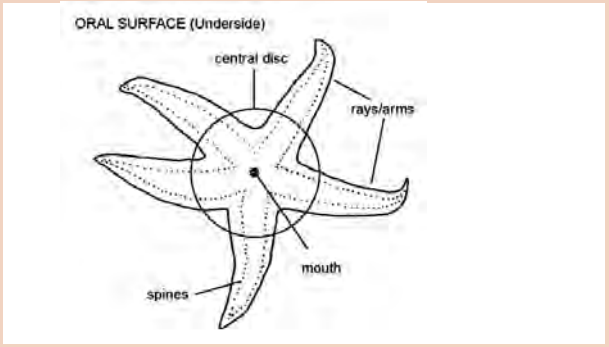


Diagram: © CSIRO

KNOWN LOCATIONS:

- Found in Vic and Tas
- Not known to occur in NSW

HABITAT:

- All surfaces such as mud, sand and rock in sheltered areas
- Intertidal zone up to 25m depth, occasionally to 200m depth

IMPACTS:

- Voracious predator, consumes many bivalves and other small invertebrates
- Impacts aquaculture and fisheries

REPORT NEW LOCATIONS

SIMILAR NATIVE SPECIES

Photo: Graham Edgar, Australian Marine Life

Irregular seastar
Smilasterias irregularis

KEY FEATURES:
Five arms with radius up to 6.5cm
Colour ranges pink/red/brown/grey
Pointed but no upturned tips

HABITAT:
Sheltered reef up to 30m depth
Southern NSW coastline

Photo: David Harasti

Granular/Zig zag seastar
Uniophora granifera

KEY FEATURES:
Five blunt tipped arms
Radius up to 12cm
Orange with purple spines

HABITAT:
Sheltered reef, silt, seagrass up to 30m depth
Entire NSW coastline

Photo: www.rling.com

Many-pored seastar
Fromia polypora

KEY FEATURES:
Five arms with radius up to 11cm
Bright orange/yellow with black pores

HABITAT:
Exposed reef up to 160m

MARINE PEST FOUND IN AUSTRALIA

JAPANESE SEAWEED
Undaria pinnatifida

Photo: © CSIRO

Photo: © CSIRO

KNOWN LOCATIONS:

- Tas and Vic
- Not known to occur in NSW

HABITAT:

- Sheltered temperate waters
- Intertidal to subtidal zone, usually found between 10-20m depth

IMPACTS:

- Can be highly invasive and grow rapidly into dense beds
- Overgrows and excludes native algal species

REPORT NEW LOCATIONS

SIMILAR NATIVE SPECIES

Photo: John Huisman, Marine Plants of Australia

Cray weed/Strap weed
Phyllospora comosa

KEY FEATURES:
No midrib or base
Long strand-like fronds with sawtooth edge, air sacks for floats
Up to 3m tall

HABITAT:
Exposed rocky reef up to 20m depth

Photo: John Huisman, Marine Plants of Australia

Common kelp
Ecklonia radiata

KEY FEATURES:
No midrib or base
Often has spines, brown fronds, up to 2m tall
Appearance varies with depth (longer, smoother fronds in deep water)

HABITAT:
Moderately exposed rocky reefs up to 44m depth

Photo: John Huisman, Marine Plants of Australia

Bull kelp
Durvillaea potatorum

KEY FEATURES:
No midrib or base
Large bulky fronds
Up to 8m tall

HABITAT:
Exposed rocky reef up to 30m depth

ASIAN DATE MUSSEL/BAG MUSSEL
Musculista senhousia

Smooth fragile shell up to 3cm long, olive green/brown colour

Shell has zigzag markings and iridescent radiating bands

Often in clumps of many individuals

Photo: courtesy Northern Territory Government

Photo: Graham Edgar, Australian Marine Life

KNOWN LOCATIONS:

- Found in Vic, SA, Tas and WA
- Not known to occur in NSW

HABITAT:

- Soft sediment or hard surfaces
- Occurs just below the low tide level in aggregated clumps

IMPACTS:

- Fouls man-made structures
- Forms dense mats competing with natives for food and space

REPORT NEW LOCATIONS

Photo: Graham Edgar, Australian Marine Life

Blue mussel
Mytilus galloprovincialis planulatus

KEY FEATURES:
Large fan shaped shell up to 12cm
Blue/black colour
Usually found in clumps

HABITAT:
Sheltered and moderately exposed reefs, pylons and pontoons
Up to 15m depth

Photo: Graham Edgar, Australian Marine Life

Brachidontes rostratus

KEY FEATURES:
Long flat shell up to 4cm
Purple colour, regular rounded ribs
Usually found in dense clumps

HABITAT:
Exposed rock platforms

Photo: Graham Edgar, Australian Marine Life

Hairy mussel
Trichomya hirsuta

KEY FEATURES:
Numerous hairs on lower half of shell
Up to 6cm

HABITAT:
Exposed reef up to 15m depth
Common intertidally and subtidally

Photo: Graham Edgar, Australian Marine Life

Little black horse mussel
Xenostrobus pulex

KEY FEATURES:
Small shiny inflated shell up to 2.5cm in length
Black colour
Forms dense clumps

HABITAT:
Exposed rocky shores
Mid intertidal

MARINE PEST FOUND IN AUSTRALIA

ASIAN GREEN MUSSEL
Perna viridis

Bright green juvenile shell and dark green to brown adult shell

Commonly 8-10cm in length, can reach up to 16cm in length

Smooth pearly shell

Photo: courtesy Northern Territory Government

Photo: Wayne Sheldon

KNOWN LOCATIONS:

- Cairns, QLD
- Not known to occur in NSW

HABITAT:

- Variety of hard surfaces, particularly floating, including vessels, wharves, buoys, intake pipes, aquaculture equipment
- Low tide to 42m depth, lower estuarine habitats to marine
- Tropical to warm waters but tolerates wide ranges of salinities and temperatures

IMPACTS:

- Fast growing, out competes native species
- Forms dense clumps, fouls man-made structures
- Accumulates toxins and is linked to shellfish poisoning in humans

REPORT NEW LOCATIONS

SIMILAR NATIVE SPECIES

Photo: Graham Edgar, Australian Marine Life

Blue mussel
Mytilus galloprovincialis planulatus

KEY FEATURES:
Blue/black colour
Large fan shaped shell up to 12cm

HABITAT:
Sheltered and moderately exposed reefs, pylons and pontoons, typically on floating surfaces
Can occur up to 15m depth

MARINE PEST FOUND IN AUSTRALIA

BLACK-STRIPED MUSSEL
Mytilopsis sallei

Small, fragile shell up to 2.5cm long with one side overlapping the other

Varied shell colour from black/brown-light grey/white

Some show light and dark zig zag pattern

Forms dense clusters, rarely seen as individuals

Photo: courtesy of Northern Territory Government

Photo: courtesy of Northern Territory Government

Photo: © CSIRO

KNOWN LOCATIONS:

- Not known to currently exist in Australia
- Eradicated from Darwin Harbour in 1999

HABITAT:

- Prefers shallow sheltered inshore estuarine habitats
- Tolerates wide range of salinities and temperatures
- Can attach to any hard surfaces, e.g. hulls, pylons

IMPACTS:

- Rapid growth forming dense clusters that exclude most other species
- Fouls man-made structures such as wharves, marinas, seawater systems, aquaculture equipment

REPORT NEW LOCATIONS

SIMILAR NATIVE SPECIES

Photo: Graham Edgar, Australian Marine Life

Brachidontes rostratus

KEY FEATURES:
Long flat shell up to 4cm
Purple colour

HABITAT:
Forms dense mats on exposed rock platforms

Photo: Graham Edgar, Australian Marine Life

Little black horse mussel
Xenostrobus pulex

KEY FEATURES:
Small shiny inflated shell up to 2.5cm in length
Black colour
Forms dense clumps

HABITAT:
Exposed rocky shores, mid intertidal

ASIAN PADDLE CRAB
Charybdis japonica

Photo: Museum of New Zealand Te Papa Tongarewa (CR. 009843)

KNOWN LOCATIONS:

- Single live male found in SA
- Not known to occur in NSW

HABITAT:

- Estuarine and marine habitats
- Subtidal to 10-15m depth

IMPACTS:

- Is host/carrier of the White Spot Syndrome Virus which can infect native and farmed prawns, crabs and lobsters

REPORT NEW LOCATIONS

SIMILAR NATIVE SPECIES

Blue swimmer crab
Portunus pelagicus

KEY FEATURES:
No spines either side of eyes
Dark brown/bluish/ purple colour
Shell width up to 21cm

HABITAT:
Sheltered sand and seagrass habitat
Intertidal and subtidal up to 60-70m depth

Mud crab
Scylla serrata

KEY FEATURES:
9 spines either side of head
Dark brown to mottled green
Large robust claws
Shell up to 25cm wide

HABITAT:
Soft muddy bottoms in sheltered areas such as mangroves

Above illustrations: Pat Tully, NSW DPI

MARINE PEST FOUND OVERSEAS

ASIAN SHORE CRAB
Hemigrapsus sanguineus

Photo: Amy J Benson, U.S. Geological Survey

KNOWN LOCATIONS:

- Not recorded in Australia

HABITAT:

- Estuarine and marine habitats
- Intertidal shallow hard-bottom areas including under rocks, shells, debris and artificial structures

IMPACTS:

- Broad diet, competes with and preys upon native species

REPORT ANY SIGHTINGS

SIMILAR NATIVE SPECIES

Photo: Tim Glasby, NSW DPI

Swift-footed crab/Purple rock crab
Leptograpsus variegatus

KEY FEATURES:
Dark-olive green to dark purple
Shell up to 8cm wide
Purple claws with white tips
Three spines on either side of eyes

HABITAT:
Exposed rocky shores, intertidal

Photo: Michael Marmach, Museum Victoria

Smooth shore crab
Cyclograpsus audouinii

KEY FEATURES:
No spines either side of the eyes
Smooth rounded shell up to 4cm wide
Varied colours from red-brown/purple and yellow to purple, dark grey or brownish grey

HABITAT:
Under rocks on sheltered and moderately exposed shores

Photo: Tim Glasby, NSW DPI

Sowrie
Plagusia glabra

KEY FEATURES:
Smooth shell green-brown colour
4 distinct spines on either side of eyes, spines on legs

HABITAT:
Intertidal, exposed rock platforms or rock pools

Photo: © Leon Altoff

Spotted smooth shore crab
Paragrapsus laevis

KEY FEATURES:
Shell width up to 4cm
2 spines either side of eyes
First set of legs felted with hairs

HABITAT:
Intertidal, sheltered coastal bays and estuaries, prefers hiding under rocks, debris and in mangroves

MARINE PEST FOUND OVERSEAS

CHINESE MITTEN CRAB
Eriocheir sinensis

Photo: Lee Mecum, California Dept of Fish and Game

Photo: Stephan Gollasch GoConsult

KNOWN LOCATIONS:

- Not recorded in Australia

HABITAT:

- Tolerates a wide range of temperatures and modified habitats
- Prefers estuarine and coastal areas including lakes, wetlands and river banks

IMPACTS:

- Forms dense colonies that cause erosion by intense burrowing
- Opportunistic diet, out competes native species
- Can carry lung fluke that can infect humans

REPORT ANY SIGHTINGS

SIMILAR NATIVE SPECIES

Photo: Michael Marmach, Museum Victoria

Red bait crab
Plagusia chabrus

KEY FEATURES:
Hairy body and legs with spines on legs
Red/brown/orange colour
Shell up to 7cm wide
Deeply notched between the eyes

HABITAT:
Prefers subtidal reefs up to 8m depth

Photo: Tim Glasby, NSW DPI

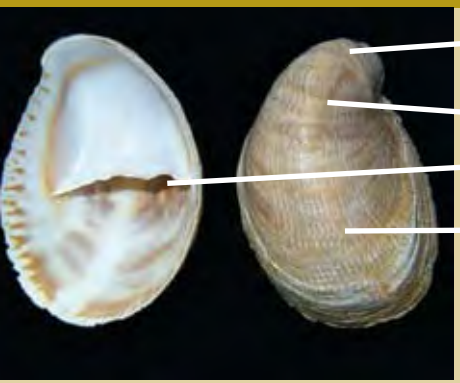
Swift-footed crab/Purple rock crab
Leptograpsus variegatus

KEY FEATURES:
Dark olive-green to dark purple
Shell up to 8cm wide
Purple claws with white tips
Three spines on either side of eyes

HABITAT:
Exposed rocky shores, intertidal

MARINE PEST FOUND OVERSEAS

SLIPPER LIMPET
Crepidula fornicata



Smooth oval shaped shell up to 5cm long

Irregular growth lines

Internal shelf extending half shell's length

White, yellow or pink with red/brown streaks

Commonly found in stacks

Photo: Bill Frank www.jaxshells.org

Photo: Sarah Longrigg

Slipper limpets showing stacking behaviour

KNOWN LOCATIONS:

- Not recorded in Australia

HABITAT:

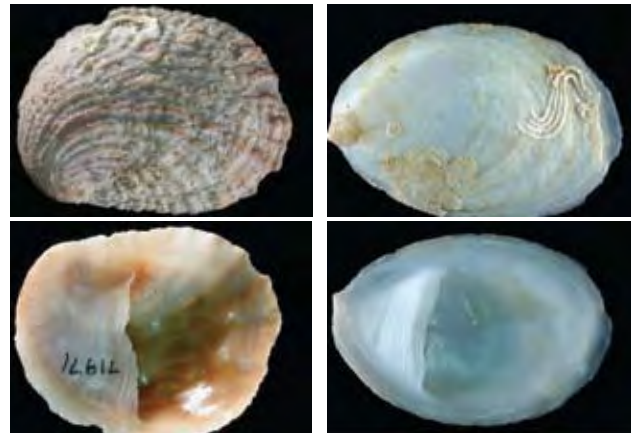
- Intertidal areas of estuaries and coastal bays
- Attached to other shells or hard surfaces in muddy/sandy/gravel/ rocky areas

IMPACTS:

- Can compete with natives for food and space
- Can impact commercial oyster cultivation

REPORT ANY SIGHTINGS

SIMILAR NATIVE SPECIES



Photos: Des Beechey www.seashellsofnsw.org.au

Northern slipper limpet/ Spiny slipper limpet
Crepidula aculeata

KEY FEATURES:
Shell commonly 1-3cm (up to 4cm), has spines and bumps, white and brown colour

HABITAT:
Intertidal to subtidal, exposed rocky shores

Southern slipper limpet
Crepidula immersa

KEY FEATURES:
Flat/thin shell up to 5cm long with internal shelf
White to fawn/brown colour

HABITAT:
Subtidal up to 350m depth

Photo: © Leon Altoff

Limpet
Notoacmea mayi

KEY FEATURES:
Smooth shell, no internal shelf

HABITAT:
Exposed reef, high intertidal zone

MARINE PEST FOUND OVERSEAS

RAPA WHELK/VEINED WHELK
Rapana venosa

- Large heavy shell up to 18cm long with large opening
- Outside shell colour varies grey to red/ brown
- Black vein-like pattern over whole shell
- Distinctive deep orange interior

Photo: US Geological Survey Archives, United States

KNOWN LOCATIONS:

- Not recorded in Australia

HABITAT:

- Tolerates wide range of temperatures and salinities, polluted and oxygen-deficient waters
- Prefers sandy estuarine and marine habitats, can also colonise hard substrates

IMPACTS:

- Can prey heavily on native shellfish and aquaculture species
- Can affect bottom dwelling organisms

REPORT ANY SIGHTINGS

SIMILAR NATIVE SPECIES

Photo: © Leon Altoff

Cartrut shell
Dicathais orbita

KEY FEATURES:
Shell sculptured with grooves
White/grey/brown/ green colour
Shell height up to 7-8cm

HABITAT:
Reef up to 10m depth

Photo: Des Beechey www.seashellsofnsw.org.au

Helmet shell
Semicassis pyrum

KEY FEATURES:
Smooth shell
Cream with brown blotches
Shell height up to 7cm

HABITAT:
Exposed sand up to 480m depth

MARINE PEST FOUND OVERSEAS

BRUSH-CLAWED SHORE CRAB
Hemigrapsus takanoi

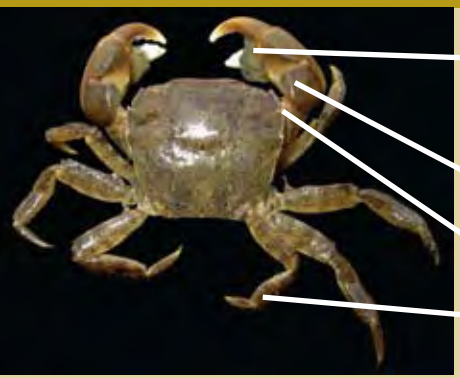


Photo: Hans Hillewaert

Light brown to yellow fur patches at base of pincers on male's claws

Small dark spots on claws

3 spines on either side of eyes

Light and dark banded legs

Most commonly orangey-brown in colour, can be green or maroon

Photo: Arjan Gittenberger

KNOWN LOCATIONS:

- Not recorded in Australia

HABITAT:

- Rocky intertidal habitats, but is also found in soft sediments

IMPACTS:

- Broad diet, competes with and preys upon native species

REPORT ANY SIGHTINGS

SIMILAR NATIVE SPECIES

Photo: Tim Glasby, NSW DPI

Swift-footed crab/Purple rock crab
Leptograpsus variegatus

KEY FEATURES:
Dark-olive green to dark purple
Shell up to 8cm wide
Purple claws with white tips
Three spines on either side of eyes

HABITAT:
Exposed rocky shores, intertidal

Photo: Michael Marmach, Museum Victoria

Smooth shore crab
Cyclograpsus audouinii

KEY FEATURES:
No spines either side of the eyes
Smooth rounded shell up to 4cm wide
Varied colours from red-brown/purple and yellow to purple, dark grey or brownish grey

HABITAT:
Under rocks on sheltered and moderately exposed shores

Photo: Tim Glasby, NSW DPI

Sowrie
Plagusia glabra

KEY FEATURES:
Smooth shell green-brown colour
4 distinct spines on either side of eyes, spines on legs

HABITAT:
Intertidal, exposed rock platforms or rock pools

Photo: © Leon Altoff

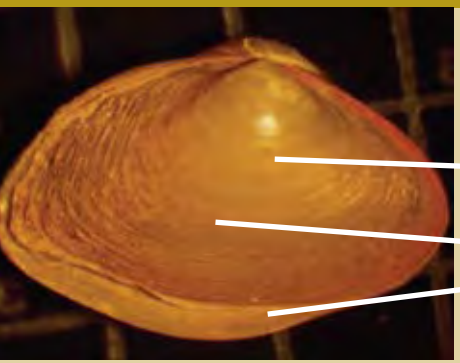
Spotted smooth shore crab
Paragrapsus laevis

KEY FEATURES:
Shell width up to 4cm
2 spines either side of eyes
First set of legs felted with hairs

HABITAT:
Intertidal, sheltered coastal bays and estuaries, prefers hiding under rocks, debris and in mangroves

MARINE PEST FOUND OVERSEAS

ASIAN CLAM
Potamocorbula amurensis



Thin smooth shell; older shells appear wrinkled on shell surface

White, tan or yellow in colour

2-3cm in length

Shell of unequal size – one side is larger than the other

Photo: Janet Thompson, US Geological Survey

KNOWN LOCATIONS:

- Not recorded in Australia

HABITAT:

- Mostly subtidal but also intertidal
- Can be found in marine, estuarine and freshwater habitats
- Occurs in all sediment types including mud, peat, clay, sand but most commonly found on mixed mud/sand bottoms

IMPACTS:

- Competes with native species for food and space
- Reduces planktonic food sources
- Can form dense layers

REPORT ANY SIGHTINGS

SIMILAR NATIVE SPECIES

Photo: John & Maria Grist

Narrow wedge shell/Shining wedge shell
***Paphies* species**

KEY FEATURES:
White/cream shell with brown covering
Interior of shell is white
Up to 2.5cm long

HABITAT:
Sandy intertidal

Photo: John & Maria Grist

Tellina semitorta

KEY FEATURES:
Shell usually white, but sometimes pink
Up to 1.6cm long

HABITAT:
Sandy intertidal

Northern Pacific seastar

Marine pests can:

- Damage your boat
- Increase your fuel and maintenance costs
- Impact on your fishing
- Destroy native habitats
- Threaten human health

Help prevent the spread of marine pests!

Check and clean your boat and fishing gear before you move

and

Report marine pests

24hr recorded hotline (02) 4916 3877
Email: aquatic.pests@dpi.nsw.gov.au

For more information:
www.dpi.nsw.gov.au/fisheries/pests-diseases
or phone 1300 550 474

THE NATIONAL SYSTEM FOR THE PREVENTION AND MANAGEMENT OF MARINE PEST INCURSIONS

BIA
Boating Industry Association

NSW MARITIME

COASTCARE

THE BOAT OWNERS ASSOCIATION OF NSW
BOA

This collaborative effort is supported by the Australian Government, state and Northern Territory governments, marine industries, researchers and conservation groups.

Photos on pages 1 -7 courtesy of BIA VIC, CSIRO, DAFF, Franz Grasser (VRFish), Michigan Sea Grant Archives, NSW DPI, Sandringham Yacht Club, VIC DSE, Yachting Victoria.

Appendix L

National strategic plan for marine pest biodiversity

MarinePestPlan
2018–2023

National Strategic Plan for Marine Pest Biosecurity
2018–2023

Cataloguing data
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Task group members included:

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Angela Gillham	Maritime Industry Australia Limited
Rod Nairn	Shipping Australia Limited
Craig Sherman	Deakin University
Aaron Irving	National Aquaculture Council

Comments were also provided by other stakeholders during the development of this strategic plan. These contributions are gratefully acknowledged.

Cover Image Sources: *Nigar Alizada/Shutterstock.com / Neale Cousland/Shutterstock.com / James Lavender*

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- Primary Industries and Regions South Australia
- Tasmanian Department of Primary Industries, Parks, Water and Environment
- Victorian Department of Economic Development, Jobs, Transport and Resources
- Western Australia Department of Primary Industries and Regional Development
- Maritime Industry Australia Limited
- Ports Australia
- Shipping Australia Limited
- National Aquaculture Council
- OceanWatch

Foreword

Australia's unique marine environment is important for our way of life and prosperity. It supports numerous industries such as fishing, aquaculture and tourism, which are important to our national and regional economies. Our marine environment is also integral to our leisure and recreation, with most Australians living near the coast and enjoying a variety of activities such as fishing, boating, swimming and SCUBA diving. Ensuring a healthy and thriving marine environment allows current and future generations to continue to enjoy these diverse economic and recreational opportunities.

However, Australia's vast marine environment and marine-dependent industries face an ongoing threat from unwanted marine pests. The risk of these pests being introduced, establishing and damaging our marine environments, has increased due to a rise in international and domestic maritime vessel traffic and a greater need for marine infrastructure.

Only strong and coordinated national marine biosecurity can minimise the economic, environmental and social threats of marine pests to our highly valued coasts. Recognising this, the Australian Government made a $5 million commitment to reviewing and strengthening national marine biosecurity arrangements, part of the Coalition's 2013 Policy for a more competitive and sustainable fisheries sector.

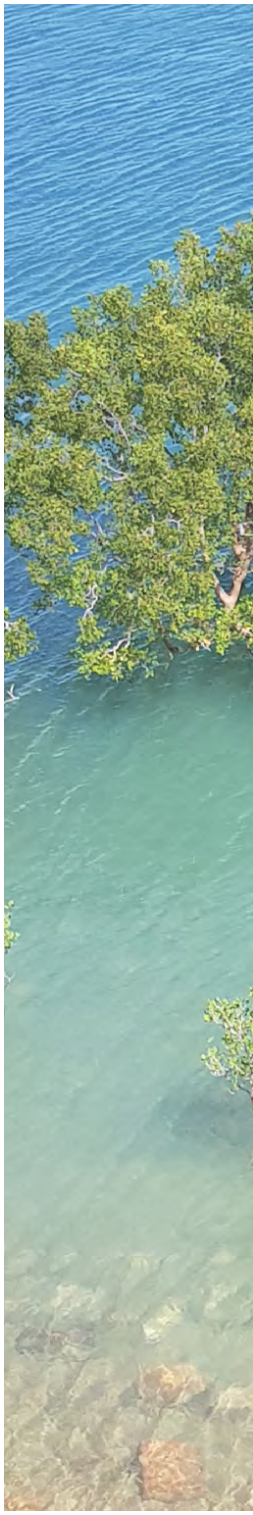
One recommendation of the review was development of a national strategic plan for marine pest biosecurity in Australia. It is with pleasure that we present *MarinePestPlan 2018–2023*, a five-year strategic plan providing direction for Australia's commitment to towards effective management of marine pest biosecurity threats.

MarinePestPlan 2018–2023 details a series of activities to address national priorities for marine pest biosecurity, including improved marine pest prevention, strengthened surveillance, enhanced emergency response capability, support for research and development, and greater stakeholder engagement.

Enhancing stakeholder engagement and collaboration towards common goals is a crucial element of the plan. Government, industry, non-government organisations, researchers and the wider community all have much to contribute to, and gain from, the shared responsibility of marine biosecurity.

As a global leader in marine biosecurity, Australia is committed to ongoing innovation and investment into improving our marine pest biosecurity to ensure a competitive, productive and resilient agricultural sector, and sustainable use of our coastal resources.

Through implementation of this strategy to minimise the marine pest risks, we firmly believe we can continue to provide a profitable and productive marine environment for all Australians.



THE HON. DAVID LITTLEPROUD MP
Minister for Agriculture and Water Resources

Member for Maranoa

SENATOR THE HON. ANNE RUSTON
Assistant Minister for Agriculture and Water Resources

Marine pests present a risk: marine pests can have significant impacts on maritime industries, the marine environment and the community.

Source: James Lavender

Executive Summary

The significant societal, economic and environmental value of Australia's marine environment and marine-based industries means it is in the national interest to protect these assets from threats, such as the introduction, establishment and spread of marine pests. Once established, marine pests can rarely be eradicated, and their negative effects are often long lasting. Preventing the introduction and spread of marine pests is therefore vital to ensure that potentially significant consequences for Australia's marine environment and industries are minimised.

A coordinated and strategic national approach to marine pest biosecurity is necessary to ensure our collective investments and effort are targeted at the needs of highest priority and the areas of greatest risk. This document, *MarinePestPlan 2018–2023*, is Australia's national strategic plan for marine pest biosecurity. It outlines a coordinated approach to building Australia's capacity to manage the threat of marine pests over the next five years.

MarinePestPlan 2018–2023 has been developed jointly by the Australian Government, state and territory governments, industry, research organisations and non-government organisations.

Marine pest biosecurity stakeholders have agreed to the national vision of *maintaining Australia's healthy and resilient marine environment that is protected from the threat of marine pests, and which supports our economy and social amenity.*

MarinePestPlan 2018–2023 identifies five critical areas that need to be addressed in order to strengthen Australia's systems for managing marine pest biosecurity and to take steps towards achieving this vision. The five objectives that form the basis of the five-year plan are:

1	Minimise the risk of marine pest introductions, establishment and spread
2	Strengthen the national marine pest surveillance system
3	Enhance Australia's preparedness and response capability for marine pest introductions
4	Support marine pest biosecurity research and development
5	Engage stakeholders to better manage marine pest biosecurity.

Each objective will be met through a series of activities. Each activity and its expected outcomes will require the cooperation and collaboration of all stakeholders.

Prevent and protect: minimising the risk of marine pest introductions to Australia's marine environment is the priority for national biosecurity.

Source: *Sally Bracewell*

Summary of
Objectives and Activities

Objective 1: Minimise the risk of marine pest introductions, establishment and spread	
Activities	1.1 Implement nationally consistent domestic ballast water regulations under the Biosecurity Act 2015 (Cwlth)
	1.2 Ensure the use of ballast water management systems in Australian waters meets accepted environmental standards
	1.3 Investigate regulatory options to manage biosecurity risks associated with biofouling on vessels
	1.4 Review the *National Biofouling Management Guidelines* for marine sectors and update as required
	1.5 Investigate the benefits of an intelligence-gathering framework to monitor marine pest risk pathways and expand the International Biosecurity Intelligence System as appropriate
Objective 2: Strengthen the national marine pest surveillance system	
Activities	2.1 Develop a national marine pest surveillance strategy
	2.2 Investigate Australia's current passive surveillance capability for marine pests and recommend possible improvements
	2.3 Promote tailored education and awareness materials to engage marine pest observer groups in passive surveillance activities
	2.4 Develop validation guidelines for marine pest molecular detection methods
	2.5 Validate molecular detection methods (including sampling methodology) for selected high-priority marine pest species
	2.6 Audit, maintain and share a database of marine pest identification capability
	2.7 Review surveillance information management needs and ensure an appropriate information system is in place
	2.8 Perform an audit of marine pest surveillance activities and data sets relevant to Australia

Source: James Lavender

Summary of
Objectives and Activities

Objective 3: Enhance Australia's preparedness and response capability for marine pest introductions	
Activities	3.1 Plan and implement a national program of marine pest emergency response exercises
	3.2 Develop a benefit–cost analysis framework to guide response efforts in the event of a nationally significant marine pest incursion
	3.3 Identify marine pest emergency response training needs
	3.4 Review the national Emergency Marine Pest Plan (EMPPlan) framework
	3.5 Plan and implement procedures to develop and update the EMPPlan rapid response manuals and related guidance materials
Objective 4: Support marine pest biosecurity research and development	
Activities	4.1 Periodically review the national marine pest biosecurity research and development priorities
	4.2 Promote research coordination through the national marine pest research network
	4.3 Review the economic, environmental and social impacts of marine pests in Australia
	4.4 Conduct risk analyses of marine pest vectors and pathways, and make recommendations for improved management
	4.5 Assess the effectiveness of current management options for biofouling in niche areas
Objective 5: Engage stakeholders to better manage marine pest biosecurity	
Activities	5.1 Identify and build a profile of marine pest biosecurity stakeholders
	5.2 Develop a national stakeholder engagement strategy for *MarinePestPlan 2018–2023* and the Marine Pest Sectoral Committee
	5.3 Design a targeted national campaign to improve awareness of marine pest biosecurity risks, management actions and shared responsibilities
	5.4 Review, update and maintain the www.marinepests.gov.au website
	5.5 Establish an independent national marine pest network

Source: James Lavender

Table of Contents

Introduction

Australia is an island continent surrounded by over 60,000 kilometres of coastline. Our marine environment is the third-largest marine jurisdiction on Earth, and includes several world heritage-listed areas such as the Great Barrier Reef and Shark Bay. This unique marine environment supports a diverse array of marine species, many of which do not occur anywhere else in the world.

Marine and coastal ecosystems play a valuable part in Australia's society and economy. Over 80 per cent of the population live within 50 kilometres of the coast. Australia's marine tourism industry has an annual value of around $14 billion, while marine industries (for example, commercial fisheries and aquaculture, and oil and gas extraction) are expected to contribute $100 billion to the national economy each year by 2025. Australia relies heavily on shipping for imports and exports, with over 95 per cent of trade by volume carried by ships. The significant value of Australia's marine environment and the associated industries means it is in the national interest to protect these assets from threats, such as the introduction and spread of marine pests.

Many marine pests have established in Australian marine environments and some, such as the northern Pacific seastar (*Asterias amurensis*), have had significant impacts. This species has extensively invaded Port Phillip Bay, Victoria, where its potential effects include loss of commercial and recreational fisheries harvest, reduced aquaculture productivity, competition with native species, predation on native species, and alteration of trophic interactions and food-webs (Department of Agriculture and Water Resources 2015a).

For the purposes of this document, marine pests are defined as non-native marine plants or animals that harm Australia's marine environment, social amenity or industries that use the marine environment, or have the potential to do so if they were to be introduced, established (that is, forming self-sustaining populations) or spread in Australia's marine environment. Marine pests pose a major threat to the Australian environment, economy and social amenity by disrupting ecological processes directly (for example, through predation or competing with native marine plants and animals) or indirectly (for example, through habitat alteration). They may also have an impact on marine aquaculture, shipping and coastal infrastructure. Some marine pests can affect recreational use of marine and coastal areas by depleting fishing grounds and infesting the shoreline, making it unattractive and inaccessible (Arthur, Summerson & Mazur 2015).

Once established, marine pests can rarely be eradicated, and their impacts are often long lasting. Preventing the introduction and spread of marine pests is therefore vital to ensure that the potentially significant consequences on Australia's marine industries and environment are minimised. Marine pest biosecurity is important to ensure that risks from marine pests are managed in a cost-effective way, with a focus on activities that address the highest risks. Managing the biosecurity risks of introduced marine pests must be coordinated across jurisdictions, industries and communities to:

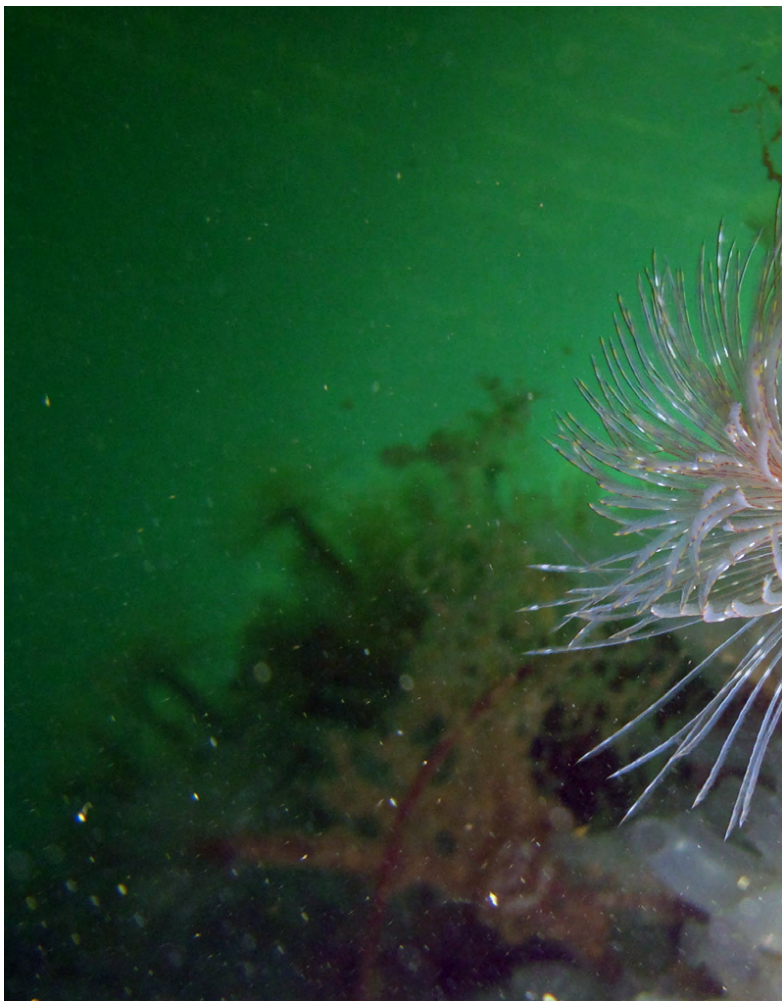
- Minimise the introduction, establishment and spread of marine pests into and within Australia
- Prepare for and respond to marine pest incursions, with a view to containment and eradication
- Manage and stop the spread of marine pests that have established (where eradication is not considered to be the appropriate response)
- Monitor, review and evaluate these activities to determine their effectiveness.

Why we need a plan

A large number of introduced marine species are known to occur in Australian waters, some of which are thought to cause significant impact, or have the potential to do so. The importance of a strong and coordinated Australian marine pest biosecurity system has been recognised for many years. Rapid shifts to the global marine environmental, industrial and political landscape are leading to significant increases in the likelihood of new marine pest incursions to Australia. International vessel arrivals have increased, vessels and cargoes are larger, and vessels are arriving from new shipping routes including South America and Africa (Bureau of Infrastructure, Transport and Regional Economics 2014). Domestic recreational and commercial vessel movements are dynamic and increasing in frequency and number. These changes in vessel movements, together with changes in the marine environment, are altering the potential for non-native marine species to be transported to Australia and establish populations and spread. Australia's national approach to marine pest biosecurity must build on its solid foundation and evolve in response to these growing risks.

Industry and governments have identified the need to improve national marine pest biosecurity (Department of Agriculture and Water Resources 2015f). Australia also has international obligations to minimise the effects of marine pests on the environment. However, effective management of marine pests is complex. Australia's coastline is extensive, with diverse climates and degrees of urbanisation; there are many potential sources of risk, and there are many users of the marine environment. Given the range of competing interests, social and economic benefits of the marine environment, and limited resources available, a coordinated, strategic approach to managing the threat of marine pests in Australia's marine environment is necessary to ensure our collective investments are targeted at the highest priority needs, and greatest risks.

A series of high-profile marine pest detections in Australia in the 1980s and 1990s, including the northern Pacific seastar (*Asterias amurensis*), Japanese seaweed (*Undaria pinnatifida*) and the black-striped mussel (*Mytilopsis sallei*), culminated in the convening of a National Taskforce



Source: Aria Lee

in 1999 that recommended immediate action and longer-term reform of the prevention and management framework of marine pest incursions. This resulted in the National System for the Prevention and Management of Introduced Marine Pest Incursions (the National System) being developed by the National Introduced Marine Pests Coordination Group (NIMPCG), established in 2000. NIMPCG comprised Australian, state and Northern Territory government representatives, marine industries, scientists and environmental organisations. The National System comprised a suite of detailed biosecurity reform measures intended for development and implementation by Australian governments, industry and research organisations.

In 2001, the Australian Government introduced mandatory ballast water management requirements, following the introduction of voluntary arrangements in 1991. In 2002, a High Level Officials Working Group (HLG) was established to advise the Australian Government on

Source: *Aria Lee*

implementing the National System. The HLG's recommendations formed the basis of the 2005 *Intergovernmental Agreement on a National System for the Prevention and Management of Marine Pests Incursions* (Marine IGA), signed by the Australian Government, the Northern Territory Government, and all state governments except New South Wales. Because not all parties signed the Marine IGA, it never came into effect; however, all signatories agreed to the development and implementation of the National System. Additionally, Victoria introduced ballast water management requirements for ships entering Victorian ports from other Australian ports in 2004. In 2004, the International Maritime Organization (IMO) adopted the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention; International Maritime Organization 2004). Australia became a signatory to the BWM Convention in 2005, and it was ratified in 2016. The BWM Convention came into force on 8 September 2017.

In 2009, a marine pest identification guide and a series of *National Biofouling Management Guidelines* were launched, followed in 2010 by the *Australian Marine Pest Monitoring Guidelines* (Department of Agriculture, Fisheries and Forestry 2010a) and the *Australian Marine Pest Monitoring Manual* (Department of Agriculture, Fisheries and Forestry 2010b). In 2011, the Marine Pest Sectoral Committee (MPSC) replaced NIMPCG as the government body responsible for coordination of Australia's marine pest risk management arrangements. MPSC is comprised of representatives from the Australian Government, each state government and the Northern Territory Government.

The 2015 *Review of National Marine Pest Biosecurity* (the Review) recommended that a marine pest strategy be developed that sets nationally agreed objectives and achievable outcomes, and clearly articulates the roles and responsibilities of all stakeholders (Department of Agriculture and Water Resources 2015f). The Review noted that a national marine pest biosecurity strategy (this document) should be an effective framework for implementing the Intergovernmental Agreement on Biosecurity (IGAB; Council of Australian Governments 2012a), and a basis on which to share implementation responsibilities. The IGAB came into effect in 2012 and sets the framework and principles for Australian governments to work towards a consistent and collaborative approach to biosecurity for all sectors. It also describes the key components of Australia's broader (pest and disease) biosecurity system. In June 2016, the *Quarantine Act 1908* (Cwlth) was succeeded by the Biosecurity Act, which now provides the regulatory framework relating to biosecurity matters in Australia, including managing risks of marine pest incursions.

Australia's current state of marine pest biosecurity is underpinned by a foundation of work undertaken over many years to protect our highly valuable marine environment from the threat of marine pests. *MarinePestPlan 2018–2023* aims to consolidate and build on this considerable body of work to enhance marine pest biosecurity in Australia. To achieve this aim, *MarinePestPlan 2018–2023* outlines activities that address current national marine pest biosecurity priorities, in a manner consistent with international and domestic obligations.

National Vision

In formulating *MarinePestPlan 2018–2023*, stakeholders have agreed to a vision of:

Maintaining Australia's healthy and resilient marine environment that is protected from the threat of marine pests, and which supports our economy and social amenity.

While the vision sets the broad direction for the future of marine pest biosecurity in Australia, *MarinePestPlan 2018–2023* describes the steps we will take to make this vision a reality, and the outcomes we are seeking to achieve over the next five years.

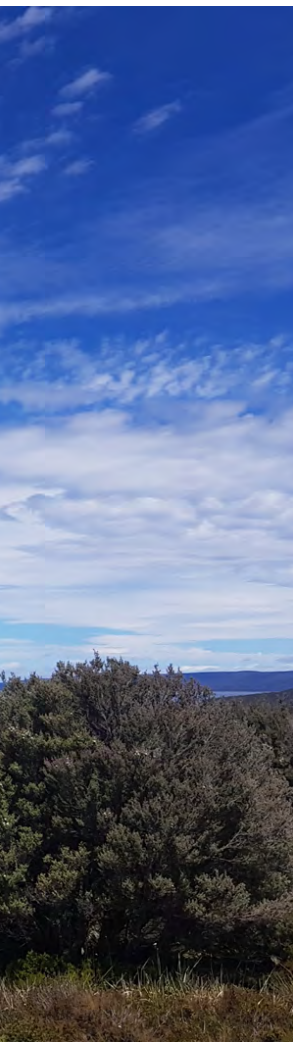
Source: James Lavender

A coordinated approach

MarinePestPlan 2018–2023 is Australia's national strategic plan for marine pest biosecurity. It outlines a coordinated approach to building Australia's capabilities to manage the threat of marine pests over the next five years.

MarinePestPlan 2018–2023 represents agreed priorities and actions of governments, marine industries, and other stakeholders to achieve a common purpose: to manage the risks posed by marine pests and minimise their potential harm to marine industries, communities and the environment. This purpose will be achieved by strengthening Australia's systems for managing marine pest biosecurity including prevention, surveillance, and emergency preparedness and response arrangements.

Fundamental enabling processes such as research and stakeholder engagement will also be enhanced. *MarinePestPlan 2018–2023* is not intended to be a funding initiative or a prescriptive guide for how Australia manages every aspect of national marine pest biosecurity. Rather, it sets out agreed priorities for marine pest biosecurity that need to be addressed to deliver effective policies and programs, and long-term social, economic and environmental outcomes.



Guiding principles

MarinePestPlan 2018–2023 **has been developed on the basis of several principles that are consistent with Australia's integrated approach to biosecurity (see the IGAB). These guiding principles acknowledge that:**

- Marine pest biosecurity is a shared responsibility between the Australian Government, state and territory governments, industry, research organisations, non-government organisations, and other users of the marine environment. This means all parties commit to sharing responsibility for prevention, preparedness, and response and management relating to marine pests.
- Marine pest biosecurity activities should be coordinated and collaborative to ensure resources are targeted towards agreed national priorities that will provide lasting benefits.
- Management of marine pests should apply a risk-based approach with a focus on achievable outcomes, and a clear line of sight between 'what we do' (our activities) and 'what we want to achieve' as a result of what we do (that is, to minimise biosecurity risks).
- Prevention and early intervention to avoid the establishment and spread of marine pests is generally more cost-effective than ongoing impact reduction for widespread, established populations.
- Broad engagement with other users of the marine environment is necessary to ensure a cooperative approach to setting and achieving marine pest biosecurity objectives.

Source: *Nigar Alizada/Shutterstock.com*

Scope

For the purposes of this document, marine pests are defined as non-native marine plants or animals that harm Australia's marine environment, social amenity or industries that use the marine environment, or have the potential to do so if they were to be introduced, established (that is, forming self-sustaining populations) or spread in Australia's marine environment. MarinePestPlan 2018–2023 applies to marine pest management activities within the Australian territorial sea (that is, all waters from the Territorial Sea Baseline to 12 nautical miles offshore) and internal waters (that is, waters inland of the Territorial Sea Baseline). It is designed to guide national prevention, detection, preparedness, and response measures; research and development; and engagement by governments, industry and other stakeholders. However, it does not alter existing arrangements among jurisdictions covered by other legislation and policies.

This strategic plan does not address the undesirable economic, environmental and social effects of:

- species native to Australia, including those undergoing range expansions
- vertebrate animals (such as mammals, birds, reptiles and freshwater fish), whose effects are addressed in the *Australian Pest Animal Strategy 2017 to 2027* (Invasive Plants and Animals Committee 2016a)
- diseases in the marine environment, whose effects are addressed by *AQUAPLAN 2014–2019: Australia's National Strategic Plan for Aquatic Animal Health* (Department of Agriculture 2014)
- weeds (angiosperms) in the marine environment, whose effects are addressed by the *Australian Weeds Strategy 2017 to 2027* (Invasive Plants and Animals Committee 2016b).

Source: *Graeme Clark*

Implementation

MarinePestPlan 2018–2023 is a national initiative that will be jointly implemented by the Australian Government, state and territory governments, industries, and non-government organisations. Although *MarinePestPlan 2018–2023* is national in scope, implementation of the various activities will need to take into account regional and sectoral differences and needs.

MarinePestPlan 2018–2023 is supported by an implementation plan that describes responsibilities and performance measures that will be used to monitor and evaluate its progress. The MPSC has led the development of *MarinePestPlan 2018–2023* through extensive stakeholder consultation, and will coordinate its implementation in collaboration with marine industries and users of the marine environment.

Source: *Cian Foster-Thorpe*

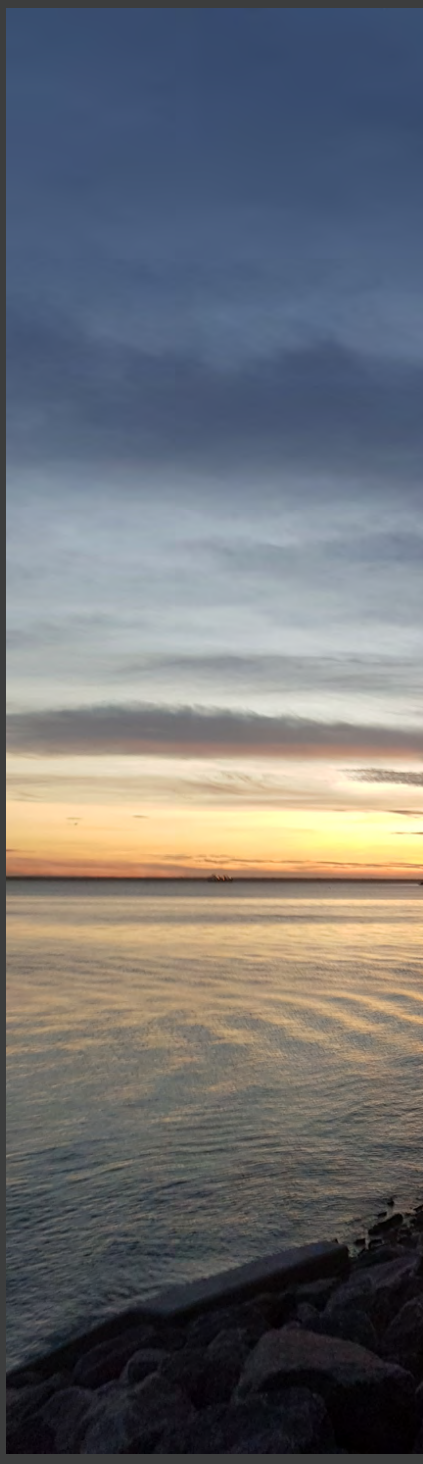
Roles and responsibilities

Australian Government

- Provides a legislative framework, including biosecurity and environmental legislation, to minimise the risk of marine pest incursions in Australian territorial seas, both pre-border and at the border. This includes taking enforcement and regulatory actions when necessary, and in accordance with international agreements and trade obligations.
- Provides oversight and coordination for emergency responses to marine pest incursions of national significance (specific 'national significance' criteria for cost-sharing arrangements are outlined in the National Environmental Biosecurity Response Agreement; Council of Australian Governments 2012b).
- Provides leadership and advice on national and international marine pest biosecurity matters, including arrangements among state and territory jurisdictions.
- Facilitates the coordination of policy across jurisdictions to minimise and manage marine pest risks associated with vectors and pathways (for example, discharge of ballast water that originates from Australian ports).

State and territory governments

- Manage marine pest biosecurity issues within their borders, in conjunction with other stakeholders (for example, port authorities, marina and slipway operators, shipping companies, aquaculture operators, recreational boaters, and fishers). This may include enforcement actions and regulatory or policy interventions when necessary to support effective management of marine pests.
- Collaborate with other state and territory governments to apply nationally consistent regulatory measures to manage unacceptable risks (for example, ballast water and biofouling).
- Implement emergency responses to marine pest incursions within their borders.
- Provide leadership, coordination and resources for research, advisory and education programs about marine pests.
- Support the collection of appropriate high-priority marine pest data and information that can be collated nationally for use in management, surveillance, education or other purposes as required.
- Identify and fill operational requirements of marine pest surveillance, response and management.



Source: *James Lavender*

Be prepared: improving national capability and capacity is vital for effective emergency response to marine pest incursions

Industry

- Manage marine pest risks as required by regulation (for example, ballast water treatment and exchange).
- Implement management practices to minimise the likelihood of the introduction or spread of marine pests (for example, maintaining in-service antifouling coating [AFC]).
- Incorporate marine surveillance into operations and report detections of marine pest incursions and provide assistance (where appropriate) in emergency responses.
- Assist with marine pest surveillance, collection and collation of high-priority marine pest data, emergency responses to marine pest incursions, and information exchange.

Non-government organisations

- Report suspicion of marine pest incursions.
- Assist with marine pest surveillance, data collection and information exchange.

Other users of the marine environment

- Implement management and behavioural practices to minimise the likelihood of introducing or spreading marine pests (for example, maintaining in-service AFC).
- Report suspicion of marine pest incursions and provide assistance (when appropriate) in emergency responses.

Current threats, Future challenges

Managing marine pest biosecurity risks is a challenging task, particularly in the face of increasing trade and environmental change.

Changes in sources and vectors of marine pests

The movement of vessels and marine infrastructure is recognised as the primary pathway for introduction of marine pests. Growth in economic activity and trade worldwide, increased movement of defence vessels and infrastructure into northern Australia and new port developments, or major redevelopments of existing ports may increase the likelihood of marine pest incursions. These developments and changes may result in significant environmental disturbance, creating habitats where invasive species, including marine pests, are able to thrive (Clark & Johnston 2009).

Vessels are also arriving on new shipping routes (for example, from South America and Africa) that present different biosecurity risks and opportunities for new pests to enter and establish in Australian waters (Bureau of Infrastructure, Transport and Regional Economics 2014; Simpson & Srinivasan 2014).

Within Australia, there are increased and changing domestic trading and vessel movements. The recent boom in Australia's resources industries has also increased the movement of drilling rigs and support vessels for offshore oil and gas exploration, and exploitation. Rising personal wealth and community interest has led to increased private boat ownership. Increased recreational boating activity has the potential to increase translocation risk and secondary outbreaks of marine pests. Together, these changes have led to an increased likelihood of marine pest translocation within Australia, which could result in secondary outbreaks.

Changing climate

Climate change is resulting in modified conditions in the marine environment such as increased water temperature and higher acidity. These changes may favour the establishment and spread of new or known marine pests, either directly or through ecological disturbance.

Defining responsibilities

The marine environment is used and relied on by many different businesses (for example, shipping, tourism, and commercial fishing); is important for public recreation and leisure activities (for example, recreational fishing, SCUBA diving and water sport); and has inherent environmental value (for example, the Great Barrier Reef and Shark Bay).

There are multiple risk creators and no single beneficiary of marine pest management. This means that responsibility for managing marine pest biosecurity needs to be distributed across governments, industries and other stakeholders.

Ideally, investment in marine pest biosecurity should rely on benefit–cost analysis to ensure the best return on investment. However, the benefits arising from marine pest biosecurity measures are hard to determine, due to the difficulty in valuing environmental assets (including biodiversity) and social benefits, and the uncertainty in predicting longer-term environmental and social impacts. This makes it challenging to identify the beneficiaries of marine pest biosecurity, and those responsible for funding marine pest responses and management activities.

Source: FiledIMAGE/Shutterstock.com

Cross-jurisdictional processes

Management of marine pests is governed by regulatory arrangements administered by the Australian, state and territory governments. To ensure effective and efficient marine biosecurity management, it is important that these arrangements are consistent—particularly for marine industries that operate across state borders.

Knowledge gaps

Marine environments contain an enormous diversity of organisms that could potentially become pests if introduced to new environments. For known marine pests, risks are evaluated based on their demonstrated impacts in different environments around the world. However, there is still considerable uncertainty about the short- and long-term consequences of a marine pest incursion, in part due to the difficulty in quantifying these consequences. These are particularly important issues for Australia, because our unique ecosystems have evolved in isolation, and we do not know how a new introduced marine species might behave or interact in Australia's marine environments.

Technologies to support marine pest detection are rapidly evolving. Traditional methods such as taxonomic identification are being complemented with new, molecular-based approaches, which present opportunities for improved surveillance.

Despite the challenges, collaboration and advances in technology provide a new range of opportunities to seek out common and lasting solutions that will strengthen our systems for preventing marine pest incursions, and increase our preparedness and response capabilities when incursions do occur. Effective marine pest biosecurity—now and into the future—will require a coordinated, collaborative and dedicated effort that will be mobilised through this strategic plan.

Outcomes for 2022

Successful implementation of *MarinePestPlan 2018–2023* will seek to deliver important outcomes for national marine pest biosecurity. By identifying the changes that we want to make, we will be able to monitor our progress and evaluate the effectiveness of the strategic plan.

Through *MarinePestPlan 2018–2023*:

- Marine pest surveillance will be coordinated across jurisdictions and industry sectors. Surveillance will be cost-effective, focused and responsive to risks, resulting in improved availability and use of information for analysis and regulatory decision-making.
- Risk pathways and vectors of marine pests will be managed effectively, so that valuable marine ecosystems and other marine resource assets are better protected from the effects of marine pests. Ballast water and biofouling management will be improved through Australian regulation and harmonised policy. New approaches and technologies will be available to manage risks associated with international and domestic vessel movements (for example, improved awareness campaigns and ballast water management systems).
- Australia will be prepared for a marine pest incursion, and will have the necessary arrangements and resources to mount a rapid response. Appropriate information, tools and training will be available to ensure all marine stakeholders have the appropriate level of knowledge and skills required to respond to a marine pest emergency in a manner consistent with the respective responsibilities of those stakeholders.
- Improvements in marine pest biosecurity will be well supported by people and processes that enable new knowledge to be applied in more efficient and effective ways. Coordinated, targeted research and meaningful engagement between stakeholders will inform developments across all areas of marine pest biosecurity.

Source: Cian Foster-Thorpe

***MarinePestPlan 2018–2023* identifies five critical areas that need to be addressed in order to achieve these long-term outcomes. These five objectives form the basis of *MarinePestPlan 2018–2023*:**

1. Minimise the risk of marine pest introductions, establishment and spread
2. Strengthen the national marine pest surveillance system
3. Enhance Australia's preparedness and response capability for marine pest introductions
4. Support marine pest biosecurity research and development
5. Engage stakeholders to better manage marine pest biosecurity.

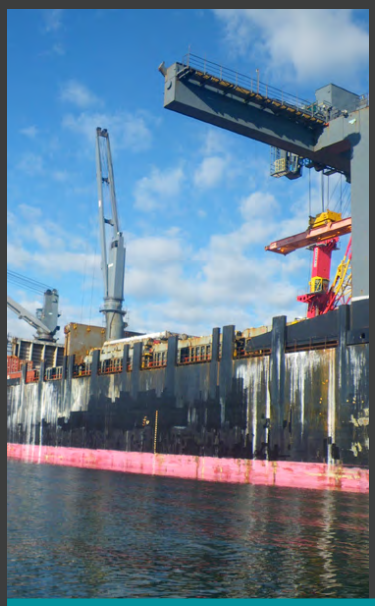
Each objective will be met through a series of activities, described in the following five chapters. At the end of each chapter, a table provides details about the activity, including the expected activity outcomes, the organisations responsible for leading each activity, and resource or financial implications.

Organisations who take a project lead role are expected to coordinate and act as champions for the assigned activity. This may include identifying funding needs and seeking out potential funding sources and collaborators to complete the activity. Other organisations may provide input, expertise or additional support. However, final delivery of each activity and its expected outcomes will require the cooperation and collaboration of all stakeholders.

Source: *Cian Foster-Thorpe*

Source: AM Photography

Source: Cian Foster-Thorpe



Objectives and Activities

Source: Arthur Mostead Photographer

Objectives

1 Minimise the risk of marine pest introductions, establishment and spread

2 Strengthen the national marine pest surveillance system

3 Enhance Australia's preparedness and response capability for marine pest introductions

4 Support marine pest biosecurity research and development

5 Engage stakeholders to better manage marine pest biosecurity

Objective 1

Minimise the risk of marine pest introductions, establishment and spread

Background

National biosecurity management activities are collective actions to minimise the risk of entry of marine pests into Australia, and their establishment and spread within Australia. Prevention activities lower the risk of introductions to and within Australia's marine environment by minimising the likelihood of entry on a given vector. Prevention is considered the most cost-effective option in marine pest biosecurity management because options to manage established marine pests may not be feasible or may provide lower return on investment in the long term. Effective marine pest biosecurity requires a strong focus on prevention activities, through measures offshore, and at international borders and domestically.

Growth in economic activity and worldwide trade has increased shipping traffic. This means that an exotic marine species entering a major port system is more likely to be transported along multiple global shipping routes and to various destinations. International trading patterns are changing over time, which will alter vessel movements and create new pathways for the introduction of exotic species to Australia. The potential for translocation and secondary outbreaks of marine pests within Australia is further exacerbated by increased domestic vessel movements. The complexities of estimating the likelihood and consequence of an exotic marine species arriving and spreading in Australia make it difficult to determine risk for individual pest species. However, risks can be managed by focusing on the management of risk pathways. The major vector pathways for the introduction of marine pest species into Australia are ballast water carried in vessels and biofouling on vessels (or internal parts of the vessel that are exposed to sea water).

Ballast water is recognised as a major pathway for the global spread of marine pests. When ballast water from foreign waters is discharged into Australian seas, live marine organisms that have been carried in that water could disperse and establish populations. It is estimated that up to 30 per cent of all marine pest incursions in Australia have arrived via ballast water. Ballast water taken up and discharged within Australia's territorial sea and domestic ports (that is, domestic ballast water) also poses a risk of spreading marine pests that have already established in parts of Australia. Australia's implementation of the BWM Convention will reduce the risk of marine pest introductions and spread via ballast water.

Biofouling is a significant pathway for the introduction and spread of marine pests, and like ballast water may also be involved in the spread of diseases of aquatic organisms. The Australian Government is currently developing a biofouling management approach for vessels arriving into Australia, which aligns with the IMO *Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species* (Biofouling Guidelines; International Maritime Organization 2011). However, biofouling on vessels that operate within Australian seas (that is, domestic biofouling) is not managed in a consistent manner by Australian governments. Management is carried out on a voluntary basis using sector-based *National Biofouling Management Guidelines* (the Guidelines; National System for the Prevention and Management of Marine Pest

Incursions 2009a–f), or state or territory-specific tools such as noxious or marine pest species regulations or Western Australia's Vessel Check (Western Australia Department of Fisheries 2018).

Through nationally coordinated management of major vector pathways, we can reduce the frequency of marine pest arrivals and limit the potential spread of marine pests within Australia. *MarinePestPlan 2018–2023* will improve the management of these risk pathways and reduce the likelihood of marine pest introduction and establishment in Australia and spread within Australia. Table 1 provides a summary of these activities and the expected outcomes, and indicates who will lead the activity and any resource implications.

Activity 1.1

Implement nationally consistent domestic ballast water regulations under the Biosecurity Act

The Australian Government regulates the management of ballast water and sediments through the Biosecurity Act. The Biosecurity Act includes ballast water requirements for vessels that operate within Australian seas (domestic ballast water) to reduce the risk of spreading marine pests that have already established in Australia. However, these requirements are not yet mandatory and ballast water is currently managed at the state and territory level, through mechanisms such as Victoria's ballast water regulations.

The Biosecurity Act provides a framework for the Australian Government Department of Agriculture and Water Resources to ensure that consistent domestic ballast water regulations are in place to reduce the risk of transferring marine pests between Australian ports. Domestic ballast water regulations will need to be consistent with the BWM Convention. Activity 1.1 will harmonise Australia's domestic controls for ballast water with international approaches of the BWM Convention.

Activity 1.2

Ensure the use of ballast water management systems in Australian waters meets accepted environmental standards

The Ballast Water Management Convention includes a ballast water discharge standard intended to improve current biosecurity risk management standards for ballast water. To meet the discharge standard, the majority of vessels will be required to fit an approved ballast water management system (BWMS). To be approved for use, a BWMS must demonstrate effective water treatment and be approved by member states of the IMO. As part of the approval process, BWMSs that use or produce active substances (that is, chemicals) must demonstrate that their use does not pose unreasonable risks to the environment, human health, property or resources.

As an IMO member state, Australia has an important role to play in contributing to the assessment and approval of proposed BWMSs, advising on Australian environmental standards (including existing legislative requirements) and the possible effects of BWMS use in our marine environment. Activity 1.2 will assess whether the use of proposed BWMSs pose a pollution risk to Australia's marine environment, populations health, property or resources. Where an unacceptable risk is identified, advice will be developed on how best to prevent, mitigate and monitor for potential impacts to the marine environment and recommendations will be made to the IMO Marine Environment Protection Committee. Activity 1.2 will be achieved through Australia's engagement in the BWMS approval process through the IMO, and ultimately help to improve international approval processes for BWMSs.

Activity 1.3

Investigate regulatory options to manage biosecurity risks associated with biofouling on vessels

Biofouling is a high-risk pathway for the introduction and spread of marine pests. Biofouling can also clog vessel cooling water intakes and reduce performance by increasing drag, leading to increased fuel consumption and harmful atmospheric emissions. Although some jurisdictions have established biofouling management frameworks, Australia does not have uniform regulatory requirements between the Australian Government and jurisdictions to manage vessel biofouling. Vessel operators are encouraged to maintain their vessels in line with the Guidelines, which align with the IMO's Biofouling Guidelines. However, the significant risk that biofouling presents warrants stronger management measures such as uniform regulatory arrangements.

In the Biosecurity Act, regulatory provisions to address vessels' biofouling are captured under the general description of a biosecurity risk. The Australian Government has previously investigated practical ways of introducing regulation to manage the biosecurity risks posed by biofouling on international vessels. A consultation Regulation Impact Statement (RIS) was developed in 2011 to analyse regulatory options for managing biofouling. The Review gave consideration to the 2011 consultation RIS, and recommended a significant change in policy direction to focus on prevention and allow for international consistency.

Activity 1.3 will progress the development of a new RIS for managing biofouling internationally and domestically, including a compilation of cost information and baseline data to support future regulation reviews and stakeholder consultation. The RIS will facilitate development of cost-effective, risk-based biofouling requirements that are consistent with the global approach to biofouling management and are harmonised between the Australian Government and jurisdictions.

Activity 1.4

Review the *National Biofouling Management Guidelines* for marine sectors and update as required

All vessel owners and operators are encouraged to manage the level of biofouling on their vessels according to the recommendations outlined in the Guidelines. The Guidelines are available for the following marine sectors; recreational vessels, non-trading vessels, commercial vessels, petroleum production and exploration industry, the aquaculture industry, and marinas and slipways. The Australian Government has commenced work to improve understanding of awareness, adoption and effectiveness of the Guidelines by the domestic and international vessels sectors and the guidelines for nodes, boat harbours, marinas and boat maintenance facilities are being reviewed by MPSC. However, the entire suite of guidelines has not been reviewed since they were first introduced.

Activity 1.4 will investigate the awareness, adoption and effectiveness of the Guidelines within the different sectors to determine if they meet the needs of stakeholders (including government regulators). This activity will also consider whether the Guidelines need to be better communicated, and explore whether they serve their purpose in addressing the biosecurity risks associated with biofouling. The content and scope of the Guidelines will be considered for revision and updated as required.

Activity 1.5

Investigate the benefits of an intelligence-gathering framework to monitor marine pest risk pathways and expand the International Biosecurity Intelligence System as appropriate

Biosecurity intelligence gathering can inform future planning and decision-making in response to potential biosecurity threats. Intelligence-gathering tools include software designed to scan the internet for signals of emerging issues and support the timely and efficient dissemination of new information. These tools are already being used to assist governments and biosecurity managers to minimise the threat of future aquatic, terrestrial animal and plant disease incursions, and to guide preparedness activities.

The International Biosecurity Intelligence System (IBIS) is a web search tool and media aggregator that provides intelligence on emerging pests, diseases and pathogens that affect terrestrial plants and animals, as well as diseases and pathogens that affect aquatic animals. Activity 1.5 will assess the potential benefits and application of IBIS for marine pests. If appropriate, IBIS will be expanded to establish an intelligence-gathering framework to monitor real and potential marine pest risks—both international and domestic. As a result, marine pest managers will have access to another valuable tool to help guide actions to prepare for and prevent the introduction and spread of marine pests.

Table 1: Summary of activities to achieve Objective 1.

	Activity	Expected outcomes	Project lead	Resource implications
1.1	Implement nationally consistent domestic ballast water regulations under the *Biosecurity Act* 2015 (Cwlth)	A practical, risk-based and nationally consistent approach to domestic ballast water management. Reduced regulatory impacts (costs, time delays, uncertainties and mis-understandings) on industry.	Australian Government, all state and territory governments	In-kind resources and Marine Pest Review Implementation.
1.2	Ensure the use of ballast water management systems in Australian waters meets accepted environmental standards	Current IMO approval processes for BWMS using or producing active substances are assessed. Risks posed by the use of BWMS using or producing active substances in Australian waters are identified and options to monitor or manage any risks identified.	MPSC; Australian Maritime Safety Authority to contribute; Department of Agriculture and Water Resources to coordinate	In-kind resources and Marine Pest Review Implementation
1.3	Investigate regulatory options to manage biosecurity risks associated with biofouling on vessels	A consistent national approach to management of biofouling that reduces the risk of marine pest introduction. Australia meets its international obligations.	Department of Agriculture and Water Resources	Funded by Department of Agriculture and Water Resources for international vessels. Funding is required for domestic vessels
1.4	Review the *National Biofouling Management Guidelines* for marine sectors and update as required	Industry adoption of agreed measures to reduce the risk of marine pest spread through biofouling.	MPSC	In-kind resources
1.5	Investigate the benefits of an intelligence-gathering framework to monitor marine pest risk pathways and expand	Improved ability to foresee possible marine pest biosecurity threats.	Department of Agriculture and Water Resources to coordinate	In-kind resources

IMO: International Maritime Organization. BWMS: ballast water management system. MSPC: Marine Pest Sectoral Committee. IBIS: International Biosecurity Intelligence System.

Objective 2

Strengthen the national marine pest surveillance system

Background

Effective surveillance and diagnostic services are essential to the successful operation of Australia's biosecurity system (as described in the IGAB). Marine pest surveillance involves the collection of information on the presence, absence or abundance of marine pests and can involve activities designed to:

- detect marine pest incursions as soon as possible in order to improve opportunities for eradication or containment
- support regulatory arrangements designed to reduce the spread of marine pests
- detect changes to the marine environment, including the presence and distribution of pests for ongoing management purposes
- determine how well prevention or containment measures are working to reduce the risk of marine pest incursions or spread
- support research into potential marine pest incursions, potential vectors, and Australian marine conditions.

Marine pest surveillance involves a range of activities such as sample processing, data management, data sharing, data analysis and communication. Surveillance activities can be regarded as active or passive.

- *Active surveillance* is when data is collected specifically for a surveillance purpose, usually to answer a certain question (for example, are particular marine pests present in this port?)
- *Passive surveillance* is observer-initiated (for example, when a recreational diver sees an unusual animal—a potential marine pest—while out diving, and reports it to the marine authority) or the result of sample collection for another purpose (for example, marine ecology research).

There are strong drivers for Australia to develop a stronger national marine pest surveillance system to meet changing risk profiles for marine pests and support new management arrangements. For example, the Commonwealth Biosecurity Act came into force on 16 June 2016 and sets new arrangements for managing marine pests, including the use of BWMSs for ships. The BWM Convention came into force on 8 September 2017 and will require the use of BWMSs on international vessels (International Maritime Organization 2004). Australia's marine pest surveillance system must evolve so that it can provide the information required to support management of marine pests, including regulatory decision-making.

While surveillance is a fundamental component of Australia's marine pest biosecurity, it can be costly and resource intensive. To ensure resources are used efficiently, national marine pest surveillance must be built on a clear understanding of the desired biosecurity outcomes, the surveillance information required to achieve those outcomes, and the most cost-effective and practical approach to obtaining and using surveillance information.

The following activities undertaken as part of *MarinePestPlan 2018–2023* will strengthen Australia's marine pest surveillance system. Table 2 provides a summary of these activities and the expected outcomes, and indicates who will lead the activity and any resource implications.

Source: *Ingo Ernst*

Activity 2.1

Develop a national marine pest surveillance strategy

Australia's current marine pest surveillance and diagnostic activities are fragmented, with governments and marine industries allocating different levels of resourcing to different activities, based on different risks and requirements. The existing *Australian Marine Pest Monitoring Guidelines* and *Australian Marine Pest Monitoring Manual* are generally considered unsuitable to be sustainably implemented. A national marine pest surveillance strategy will be developed through Activity 2.1 to address these issues. It will outline an agreed national approach to marine pest surveillance, define the objectives, scope and need for active and passive surveillance, describe the different components and types of surveillance required to meet those objectives (including the use of active and passive surveillance), and outline stakeholder responsibilities (including identification of lead agencies responsible for undertaking surveillance). As a result of this activity, Australia will have a more coordinated, risk-based approach to the collection and reporting of surveillance data that ensures more appropriate and efficient use of limited resources. Stakeholders will have a clearer understanding of the operational capacity and capability requirements needed to fulfil their responsibilities as part of a national surveillance strategy.

Activity 2.2

Investigate Australia's current passive surveillance capability for marine pests and recommend possible improvements

Early detection of marine pest incursions or range extensions is essential to support effective response actions, such as eradication or containment. Eradication is often a desirable response objective because, despite high short-term costs, higher long-term impacts and management costs can be avoided. However, eradication of marine pests in open marine environments may only be feasible if the incursion is detected at an early stage of establishment and the population has not spread widely. The opportunity for decisive response actions diminishes the longer an incursion goes undetected. Active surveillance is generally not feasible for early detection, because cost limits the number of locations that can be surveyed and the frequency of sampling.

Passive surveillance can provide a cost-effective approach for early detection of some marine pests, and can produce a wide range of data, including evidence of pest status at particular locations. The sensitivity of the passive surveillance system depends on observers (for example, recreational divers, marina and slipway operators, Indigenous rangers, and citizen scientists) having the knowledge and skills to recognise a marine pest, and the motivation to report suspected incursions to authorities so that they can be investigated.

Activity 2.2 will strengthen Australia's passive surveillance system for marine pests by identifying existing and potential observer groups, motivations for participation, determining their skill and information needs, assessing reporting pathways, and recommending actions to improve the coverage, sensitivity and responsiveness of the system. The recommendations generated by this activity will help inform development of a national marine pest surveillance strategy (Activity 2.1) and inform the development and distribution of education and awareness materials (Activity 2.3). Activity 2.2 will also provide information on the identification capability of stakeholders involved in observing suspect marine pests through the passive surveillance pathway (Activity 2.6).

Source: Oliver Koch/Shutterstock.com

Activity 2.3

Promote tailored education and awareness materials to engage marine pest observer groups in passive surveillance activities

Australia's marine pest passive surveillance system relies on observers having sufficient knowledge to recognise potential marine pests, motivation to report and knowledge on how to report suspected incursions. This activity will identify existing awareness materials that can be shared or improved to better support the expansion of the existing passive surveillance system. Where necessary, tailored materials will be developed to meet the needs of identified observer groups (following Activity 2.2) and targeted at high-priority pests relevant nationally, and to state and territory jurisdictions. Promotion of nationally consistent education and awareness materials and key messages is integral to maximising the effectiveness of engagement and uptake of desired passive surveillance behaviours throughout Australia. The effectiveness of the materials will be measured by assessing the knowledge and skills of observer groups before and after commencement of this activity.

Activity 2.4

Develop validation guidelines for marine pest molecular detection methods

Traditional survey methods for marine pests involving diver observation, physical sampling, sorting and taxonomic identification (based on morphological traits) are expensive, and may be impractical in some locations or for particular purposes. Taxonomic identification of larval life history stages is also not possible for many marine pests that may be present in the water column.

Molecular detection methods are being developed to provide rapid, sensitive, specific and cost-effective detection of marine pests. It is anticipated that these methods will become increasingly important for initial steps in marine pest surveillance. There is a range of molecular detection methods available at different levels of development, from well established to early stages, and the reliability of assays for specific purposes is not well understood. The guidelines developed in this activity will enable the performance of different, fit-for-purpose detection methods to be evaluated in a consistent manner, regardless of the technical approaches used.

Activity 2.5

Validate molecular detection methods (including sampling methodology) for selected high-priority marine pest species

Validated molecular detection methods for priority marine pests will support new national surveillance arrangements to be developed through Activity 2.1. Activity 2.5 will support validation of marine pest molecular detection methods by Australian laboratories, in accordance with the validation guidelines to be developed through Activity 2.4.

Activity 2.6

Audit, maintain and share a database of marine pest identification capability

Timely identification of marine pests is critical for surveillance and responding to incursions. Although new molecular approaches to marine pest detection and identification are being developed, traditional approaches to identification of specimens based on their morphological characteristics will continue to be important. Traditional taxonomic expertise will also be essential to designate type specimens and positive control material for molecular detection methods. This activity will complete an audit of current marine pest identification capabilities for pests included in the Australian Priority Marine Pest List, which is currently under development. Through Activity 2.6, the capabilities of Australia's network of marine pest experts, laboratories and taxonomists to identify priority pests will be updated.

Activity 2.7

Review surveillance information management needs and ensure an appropriate information system is in place

Marine pest management decisions and actions, such as preparedness, prevention and response triggers, should be underpinned by data and information gathered from surveillance. Surveillance data is also essential for informing marine pest status within ports, marinas or designated areas, particularly where regulation is dependent on such evidence. Importantly, information on marine pests of concern needs to be current and complete for it to be useful.

The Australian Government, through the Department of Agriculture and Water Resources, provides a central point for information about national marine pest surveillance, and coordinates and reports on surveillance outcomes. It administers the centralised database and public interface—the National Introduced Marine Pest Information System (NIMPIS; Marine Pest Sectoral Committee 2018). However, NIMPIS currently lacks the capability and functionality to source and compile different surveillance information in a consistent and timely manner. Activity 2.7 will review users' surveillance information needs in the context of the objectives defined in the national marine pest surveillance strategy (to be developed under Activity 2.1). Once information needs are determined, a suitable information system will be established, which may include either the redevelopment of NIMPIS to meet user requirements, or the design and development of a new, fit-for-purpose information system.

Activity 2.8

Perform an audit of marine pest surveillance activities and data sets relevant to Australia

There are numerous sources of marine pest surveillance data that are generated by industries and governments. These data sets represent significant investments in monitoring Australia's marine environments; however, many are inaccessible, under-utilised or unknown. The extent of these data sources, the willingness of data owners to make them available, and their utility as evidence for the presence or absence of marine pests has not been explored. Through Activity 2.8, an audit of marine pest surveillance activities and data sets across Australia will be undertaken, and the utility of this information to contribute to the national surveillance objectives identified in Activity 2.1 will be evaluated.

Table 2: Summary of activities to achieve Objective 2.

	Activity	Expected outcomes	Project lead	Resource implications
2.1	Develop a national marine pest surveillance strategy	Stakeholders agree and commit to a national approach to surveillance. Objectives to guide national marine pest surveillance activities and investment are identified.	MPSC; key stakeholders to contribute	In-kind resources
2.2	Investigate Australia's current passive surveillance capability for marine pests and recommend possible improvements	Identification of marine pest observer groups, their knowledge, reporting behaviours and possible education needs and resources. Improvements to the existing passive surveillance system and opportunities for expansion are identified.	MPSC	Agricultural Competitiveness White Paper
2.3	Promote tailored education and awareness materials to engage marine pest observer groups in passive surveillance activities	Observer groups have access to fit-for-purpose training materials that support marine pest passive surveillance. Improved stakeholder knowledge of marine pests and reporting pathways.	MPSC	In-kind resources and funding to develop training materials will need to be required
2.4	Develop validation guidelines for marine pest molecular detection methods	Agreed national guidelines for validation of marine pest molecular detection methods.	Department of Agriculture and Water Resources	Department of Agriculture and Water Resources
2.5	Validate molecular detection methods (including sampling methodology) for selected high-priority marine pest species	Molecular detection methods are validated and their performance characteristics are known. Increased confidence in the ability of new methods to accurately detect certain marine pests.	Department of Agriculture and Water Resources to coordinate; researchers to conduct studies	Marine Pest Review Implementation and Agricultural Competitiveness White Paper
2.6	Audit, maintain and share a database of marine pest identification capability	Available marine pest expertise including taxonomists and resources identified. More efficient response to possible marine pest incursions.	MPSC	In-kind resources to collect and collate information
2.7	Review surveillance information management needs and ensure an appropriate information system is in place	Marine pest surveillance information needs are defined and support the national marine pest surveillance strategy. Specifications for a redeveloped or new marine pest information system are defined.	MPSC	Agricultural Competitiveness White Paper; ongoing resources will be required to maintain system over time
2.8	Perform an audit of marine pest surveillance activities and data sets relevant to Australia	Increased knowledge of available marine pest data sets. Improved accessibility and sharing of marine pest surveillance data to inform decision-making.	Australian Marine Pest Research Network	In-kind contributions from jurisdictions and Network members

MSPC: Marine Pest Sectoral Committee.

Objective 3

Enhance Australia's preparedness and response capability for marine pest introductions

Background

Australia's approach to national biosecurity emphasises preventative measures as the most cost-effective way to reduce the impacts of marine pests. In open marine environments, eradication of pests once they have established may not be feasible or cost-effective, leaving prevention as the preferred option. However, preventative measures can only reduce the risk of an incursion—they cannot stop all marine pests arriving or spreading in Australia. This means that we must be prepared to respond to marine pest incursions when they do occur.

Emergency responses include planning and operational activities from the time a potential pest is detected until it has been eradicated—or until a decision is made to cease eradication efforts and move to containment or ongoing management. A successful emergency response to marine pests is dependent on early detection, rapid response, and effective implementation of operational actions. Pre-existing arrangements ensure that when an incursion occurs, responsibilities are understood and actioned, and all the necessary resources and services can be quickly assembled and deployed.

Emergency response arrangements for marine pests are governed by the National Environmental Biosecurity Response Agreement (NEBRA) which defines decision-making roles in the event of a marine pest incursion. These include the National Biosecurity Management Group (NBMG) and the Consultative Committee on Introduced Marine Pest Emergencies (CCIMPE). A key NBMG role is to decide whether an outbreak requires a national biosecurity incident response based on the national significance, assessment of risk, technical feasibility of eradication and benefit–cost of eradicating an exotic pest in accordance with a national response plan and agreed cost-shared budget established under the NEBRA. CCIMPE is responsible for providing technical advice to the NBMG and has a role in coordinating the national response, while the affected state/territory is responsible for implementing response actions.

National emergency response arrangements aim to ensure agencies are prepared to respond to marine pest incursions. Ongoing effort is required to maintain the arrangements and ensure they remain fit-for-purpose, despite possible changes in risk profiles, government resources, regulatory and industry changes, and staff turnover. *MarinePestPlan 2018–2023* will help build Australia's response capability by improving components of decision-making, contingency planning, and education and training. Table 3 provides a summary of these activities and the expected outcomes, and indicates who will lead the activity and any resource implications.

Source: *Aria Lee*

Activity 3.1

Plan and implement a national program of marine pest emergency response exercises

Effective emergency response to a suspected marine pest incursion requires appropriate systems for planning, decision-making, communication, resourcing and operational activities. It is also important that government and industry personnel understand the response systems that are in place, and that they have the appropriate skills and experience to contribute to a marine pest emergency response. It is vital that all stakeholders are fully prepared for and understand their roles and responsibilities in a marine pest emergency response situation (including reporting procedures and lead agencies). Stakeholders also need to identify options for collaborative response management, and build partnerships with others during 'peace time' (that is, before an incursion) to facilitate better cooperation during a response. In recent years, there have been limited opportunities to assess response systems and skills under realistic scenarios because few emergency responses have been instigated.

Through Activity 3.1, a program of national marine pest emergency response exercises (desktop or simulations) will be planned and implemented to test and build preparedness for a marine pest incursion. The program will include exercises to evaluate national and state response coordination; to examine the application of the NEBRA and operational response capability. Potential procedural, knowledge and capability gaps will be identified, and measures to enhance existing preparedness and response arrangements will be proposed to stakeholders. This activity will contribute to the identification of training needs for emergency response personnel (Activity 3.3) and the review of response plans to support a marine pest response (Activity 3.5). In addition, this activity will develop stakeholder understanding of the information, skills and logistics required during a marine pest response.

Activity 3.2

Develop a benefit–cost analysis framework to guide response efforts in the event of a nationally significant marine pest incursion

In the event of a marine pest incursion, under the NEBRA arrangements, CCIMPE must make a set of recommendations to the NBMG on the national significance, technical feasibility of eradication, and benefits and costs of such a response. This important step requires personnel experienced in developing benefit–cost analyses (BCA) and the application of appropriate methodology and tools. Activity 3.2 will develop a BCA methodology that will guide the evaluation of management options in the context of an emergency response to a nationally significant marine pest incursion.

Activity 3.3

Identify marine pest emergency response training needs

The ability to detect and respond to marine pest incursions relies on an available, technically trained human resource base (for example, commercial divers, taxonomists, vessel operators and data managers). Different aspects of marine pest emergency response require different skills including species recognition, formal identification (for example, taxonomy), design and implementation of standardised sampling and testing procedures, the use of specialised equipment, and in/on-water capability. While some training needs will become apparent through evaluations of simulation exercises (Activity 3.1), Activity 3.3 will analyse gaps in the national skill and knowledge base to identify marine pest emergency response training needs.

Activity 3.4

Review the national Emergency Marine Pest Plan framework

Effective responses to marine pest incursions requires planning at national, state and territory, and local levels, as well as the involvement of stakeholders including marine authorities, shipping and maritime industries, and emergency management organisations. The Emergency Marine Pest Plan (EMPPlan) is Australia's contingency planning framework for marine pest emergencies. EMPPlan is a series of manuals that describes Australia's preferred policy approaches and relevant technical information to support emergency responses. It currently includes five rapid response manuals (RRMs; Department of Agriculture and Water Resources 2015a–e). MPSC agreed to use the Biosecurity Incident Management System for marine pest incident management (Biosecurity Emergency Preparedness Working Group 2012).

The EMPPlan is adapted from the Australian emergency response plans for terrestrial and aquatic animal diseases—the Australian Veterinary Emergency Plan (AUSVETPLAN) and the Australian Aquatic Veterinary Emergency Plan (AQUAVETPLAN). It provides governments and industry personnel with guidance on how best to respond to any marine pest emergency, based on consolidated scientific and technical information, and sound approaches to emergency management. However, the EMPPlan is under-developed compared to the AUSVETPLAN and AQUAVETPLAN, and its effectiveness relatively untested during emergency responses to marine pests in Australia. Activity 3.4 will review the effectiveness and suitability of the EMPPlan framework, and identify gaps or possible improvements to enhance Australia's emergency marine pest preparedness and response capability.

Activity 3.5

Plan and implement procedures to develop and update the EMPPlan rapid response manuals and related guidance materials

To be effective, EMPPlan manuals must provide emergency response personnel with sound and contemporary guidance to support emergency response activities. The RRMs and related guidance materials play a critical role in guiding emergency responses and it is important that they are periodically reviewed and updated to ensure their continuing relevance. Activity 3.5 will put in place procedures to develop and update the EMPPlan manuals to ensure they remain accurate, relevant and facilitate an effective marine pest emergency response. This will include processes to develop, revise, and endorse new and existing manuals and supporting documents—with a particular focus on developing resources to address the gaps of highest priority identified through Activity 3.4. Activity 3.1 and Activity 3.3 will also inform reviews of relevant EMPPlan manuals.

Table 3: Summary of activities to achieve Objective 3.

	Activity	Expected outcomes	Project lead	Resource implications
3.1	Plan and implement a national program of marine pest emergency response exercises	A coordinated program of marine pest response exercises will test and identify improvements to national arrangements.	MPSC; Department of Agriculture and Water Resources to coordinate national exercises; jurisdictions to coordinate at state/territory and local level	Marine Pest Review Implementation
3.2	Develop a benefit–cost analysis framework to guide response efforts in the event of a nationally significant marine pest incursion	An agreed approach to benefit–cost analysis is developed that facilitates rapid decision-making. Improved consideration of social and environmental values.	Department of Agriculture and Water Resources	Centre of Excellence for Biosecurity Risk Analysis
3.3	Identify marine pest emergency response training needs	Emergency response skills and capability gaps are determined and training needs to address these gaps are identified.	MPSC; partners	In-kind resources
3.4	Review the national EMPPlan framework	The future structure of the EMPPlan framework is agreed.	MPSC	In-kind resources
3.5	Plan and implement procedures to develop and update the EMPPlan rapid response manuals and related guidance materials	Appropriate, agreed technical strategies are in place, to be activated in a marine pest incursion. Readily available information to support an emergency marine pest response. EMPPlan is enhanced through the development of new guidance materials.	MPSC	In-kind resources; some funding for development or revision of manuals may be required

MSPC: Marine Pest Sectoral Committee. EMPPlan: Emergency Marine Pest Plan.

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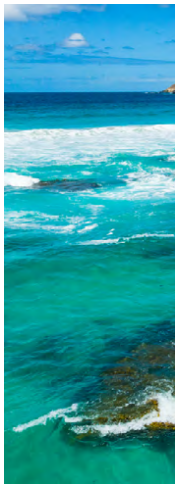

Objective 4

Support marine pest biosecurity research and development

Background

Australia's marine pest biosecurity system relies on solid scientific knowledge that is supported by ongoing research, to remain effective and to ensure marine pest risks are thoroughly understood. Research informs our risk analysis and enhances our decision-making capability, enabling us to identify, prepare for and manage biosecurity threats. Innovative management approaches and new technologies can improve our ability to manage current, emerging and future marine pest biosecurity risks. However, the 2012 *National Biosecurity Research and Development Capability Audit* found significant gaps in marine biosecurity research and development (R&D) capability across organisations at the national and state levels (Intergovernmental Agreement on Biosecurity—Research, Development and Extension Working Group 2012). Taking a coordinated and collaborative approach to marine pest biosecurity research will help to ensure critical knowledge gaps are filled, and facilitate continuous improvement of marine pest management.

Marine pest biosecurity is one of many biosecurity R&D priorities competing for limited resources and funding in Australia. Agencies such as governments and industry sectors must direct their limited R&D funds towards activities that best serve their needs. In order fill these gaps, the use of available resources must be optimised by ensuring investments are targeted towards the most important marine pest biosecurity outcomes that will provide the greatest return on investment.

Australia's current framework for marine pest biosecurity policy and pre- and post-border management is well supported by evidence-based research. To maintain a high standard of marine pest biosecurity in the context of changing risks and resources, Australia needs quality R&D to:

- enable better quantification of risk pathways and determine how best to manage risks
- improve understanding of the biology of marine pests and their likely effects on Australia's marine environment
- facilitate the cost-effective and timely collection of surveillance data to improve knowledge of marine pest presence, distribution and abundance, particularly in high-risk locations
- improve the effectiveness of available management options, and develop new techniques for marine pest detection and management.

A long-term commitment and collaborative approach from governments, industry, and researchers is essential to ensure that marine pest biosecurity R&D provides meaningful outcomes. Some activities for this objective aim to improve the effectiveness of national marine pest biosecurity research, for example through better coordination and collaboration. Other activities address known knowledge gaps that affect our understanding of marine pest biosecurity risks. Table 4 summarises these activities, the expected outcomes, who will lead the activity, and any resource implications.

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Activity 4.1

Periodically review the national marine pest biosecurity research and development priorities

The National Priorities for Introduced Marine Pest Research and Development 2013–2023 was developed by MPSC in consultation with Australian marine scientists, industry and other stakeholders (Marine Pest Sectoral Committee 2013). The document provides direction for national R&D investment and aims to ensure that R&D outcomes provide relevant advice for marine pest management and policy. As new knowledge and technologies become available both in Australia and overseas, and as marine pest biosecurity risks change, these national priorities must be reviewed to monitor progress and ensure they remain purposeful. Activity 4.1 will periodically review the list of R&D priorities, generate an audit of R&D being undertaken to address those priorities, and produce a gap analysis to be circulated to relevant funding bodies and research providers through the national marine pest research network (Activity 4.2). The outcomes of this activity will guide research funders and providers towards marine pest biosecurity R&D priorities that address common knowledge gaps and policy issues.

Activity 4.2

Promote research coordination through the national marine pest research network

National coordination of R&D is essential to the ongoing success of national and international marine pest biosecurity. The *National Marine Science Plan: White Paper on Biosecurity and Marine Pests in Coastal Waters* provided several recommendations for improvements to national marine pest biosecurity R&D (Piola et al. 2014). The development of a national marine pest research network was highlighted as a way to facilitate networking and knowledge exchange, with the ultimate aim of improving marine pest policy and management. A strategic and complementary suite of marine pest research programs will reduce duplication and fragmentation of R&D effort, and deliver scientific outputs that provide national benefits. The Australian Marine Pest Research Network was established in 2015, with the aim of providing a more coordinated approach to marine pest research, development and extension. This activity will promote coordination and communication of marine pest biosecurity research through expansion of the Australian Marine Pest Research Network as part of the broader national marine pest network (Activity 5.5).

Through Activity 4.2, the Australian and international marine science and biosecurity research community (for example, in connection with the *National Marine Science Plan 2015–2022: Driving the development of Australia's blue economy* [National Marine Science Committee 2015]) will track progress against national marine biosecurity research priorities, consider opportunities to undertake collaborative research and build necessary capabilities (for example, marine pest identification skills—Activity 2.6), and communicate research outcomes domestically and internationally. The research network will act as a conduit between stakeholders, and facilitate coordination of important marine pest biosecurity R&D.

Activity 4.3

Review the economic, environmental and social impacts of marine pests in Australia

The decision to invest resources in mitigation measures requires sound knowledge of the potential impacts of marine pests on shipping, trade, ecosystems and social amenity to enable benefit–cost analyses. However, despite an increase in global research on marine ecosystems over the past decade, the economic, environmental and social impacts of marine pests in Australia are not well understood, making management decisions difficult to justify. Through Activity 4.3, a review of the scientific literature on the effects of marine pests in Australia will identify knowledge gaps and constraints associated with quantifying the impact of marine pests in Australia.

Activity 4.4

Conduct risk analyses of marine pest vectors and pathways, and make recommendations for improved management

Ballast water and biofouling are considered high-risk pathways for the transfer of exotic marine species. However, risks are variable and many factors affect the survival, spread and proliferation of introduced species (for example, changes in shipping patterns and climate). It is unclear why some events have led to the successful establishment of some species, while other pathways that have been in place for some time have not resulted in successful establishment of a marine pest.

Understanding the nature, extent (spatial and temporal) and biosecurity risks of potential vectors and pathways is crucial for the successful management of marine pests. Therefore, science-based vector and pathway risk analyses is an important component of Australia's biosecurity system, with the outcomes used to inform national biosecurity regulations and policies.

Activity 4.4 will collate and analyse the most up-to-date information on vectors (for example, commercial ships and fishing vessels) and risk pathways (for example, shipping routes). This will increase our understanding of Australia's risk pathways, and support the development and implementation of effective, risk-based regulation and management to minimise risks. It is particularly important to reduce the knowledge gaps on vector and pathway risks as Australia implements new regulations on ballast water and biofouling to comply with national and international requirements.

Activity 4.5

Assess the effectiveness of current management options for biofouling in niche areas

Implementing practices to manage biofouling on vessels can greatly reduce the risk of dispersing marine pest species. Antifouling coatings (AFCs) are widely used to minimise biofouling on vessel hulls, primarily with the intent of reducing drag from fouling organisms, and associated fuel costs. Niche areas however, are more susceptible to biofouling and present a greater biosecurity risk. This is due to their location on vessels' hulls in areas of lower hydrodynamic flow or associated with features such as angles or edges that result in an absence of AFCs or reduced paint thickness in these areas. As a result, AFCs do not necessarily operate as they should in niche areas, or are considered unnecessary, and these areas can become fouled more quickly.

The paucity of effective AFCs for niche areas has led to the development of a range of alternatives to manage biofouling in niche areas. A particular niche area identified as hotspots for biofouling are sea chests—water intake and outlet areas built into the hull of a vessel and are characterised by relatively low water flows compared to higher velocities experienced on exposed, flat surfaces of the hull (Frey et al. 2014). The size, number and location of sea chests vary with vessel type, and the factors that influence biofouling of sea chests are complex. Marine Growth Protection Systems (MGPS) are commonly installed in sea chests to minimise biofouling, but the effectiveness and understanding of the various MGPS in use is not well known.

Activity 4.5 will review the efficacy of biofouling management options for niche areas, with a particular focus on the MGPS used in sea chests. Improved understanding of different biofouling management options used to minimise biofouling in niche areas will allow Australia to develop more effective policies to help minimise the risk of marine pest introductions and spread. In particular, a thorough understanding of the efficacy of biofouling management options for niche areas will inform assessments to ensure vessels are satisfactorily managing biofouling using fit-for-purpose systems.

Table 4: Summary of activities to achieve Objective 4.

	Activity	Expected outcomes	Project lead	Resource implications
4.1	Periodically review the national marine pest biosecurity R&D priorities	Prioritisation of marine pest research objectives. More coordinated and strategic investment of R&D resources.	MPSC, NBC and partners to coordinate; Australian Marine Pest Research Network to contribute	Funding will be required to support a desk top review
4.2	Promote research coordination through the national marine pest research network	Improved engagement of marine pest researchers and coordination of marine pest R&D. Increased knowledge sharing and contribution to improved biosecurity measures.	Australian Marine Pest Research Network	Start-up funding is being provided by the Department of Agriculture and Water Resources; ongoing resources will be required to maintain network over time
4.3	Review the economic, environmental and social impacts of marine pests in Australia	Knowledge gaps and constraints associated with quantifying the impact of marine pests in Australia are identified. Established evidence base on the impacts of marine pests to support policy development.	MPSC; Australian Marine Pest Research Network	Funding will be required to support a desk top study and prepare a review report
4.4	4.4 Conduct risk analyses of marine pest vectors and pathways, and make recommendations for improved management	Increased understanding of Australia's risk pathways to support the development of regulations and policy to minimise those risks.	Department of Agriculture and Water Resources	Funding will be required for risk assessments for different pathways
4.5	Assess the effectiveness of current management options for biofouling in niche areas	Increased knowledge about uptake and effectiveness of MGPSs. Alternative biofouling management strategies are identified and considered.	Department of Agriculture and Water Resources; state/territory jurisdictions; universities; biofouling inspectors	Funding will be required

MSPC: Marine Pest Sectoral Committee. NBC: National Biosecurity Committee. R&D: research and development. MGPS: marine growth protection systems.

Source: *Cian Foster-Thorpe*

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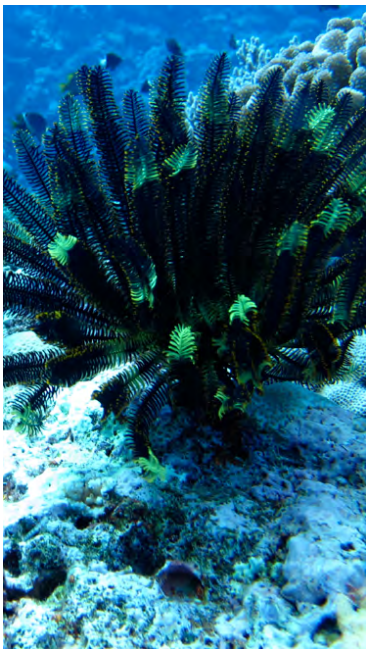

Objective 5

Engage stakeholders to better manage marine pest biosecurity

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Background

Responsibility for marine pest biosecurity is shared among the Australian, state and territory and local governments, industries and the community. Coordination and collaboration, among these groups is essential for effective management of marine pests and is built on sound engagement of stakeholders. 'Engaged' stakeholders are those who play a meaningful role in the deliberations, discussions, decision-making and implementation of marine pest management activities that involve or affect them.

Marine pest stakeholders are those who (an individual may belong to multiple categories):

- take part in marine-based activities (for example, boating and fishing)
- manage marine resources in a volunteer, commercial or regulatory capacity (for example, government biosecurity officers, port authorities, coast care groups, marina managers, owners of marina infrastructure, and Indigenous rangers)
- work for or are involved in a marine-based organisation, business or industry (for example, ship captain, commercial fisher and marine tourism operator)
- rely on marine resource managers and users to take care of the marine environment and resources but may not participate or have an interest in marine-based activities (for example, member of the public).

Stakeholders have different responsibilities related to marine pest biosecurity, and are generally interested in managing biosecurity risks that affect their business, primary industries, fisheries resources or the environment. Some stakeholders have legislative powers or the ability to influence and make decisions about marine pest management, and it is crucial for these parties to engage with others to ensure their actions are appropriate, consistent, effective and supported. As a result, each marine pest issue, policy or circumstance presents different opportunities for engagement, which should be designed with the outcome in mind. Effective communication among stakeholders, and clear guidelines for engagement will encourage trust and transparency, and help clarify roles and responsibilities for marine pest management.

The benefits and importance of stakeholder engagement to Australia's marine pest biosecurity are wide and varied. Effective communication, collaboration and engagement in marine pest biosecurity can:

- improve understanding of obligations under biosecurity legislation, marine pest reporting procedures, and contacts for information and advice
- increase the likelihood that marine pest management actions will be accepted and implemented
- ensure marine pest biosecurity measures that are put in place are practical and effective
- create networks within the marine pest 'community' (meaning that more people are likely to know what is going on, and will be more willing to work towards a common goal)
- create opportunities to discuss emerging issues and identify possible improvements in marine pest management
- increase trust among stakeholders, which can help reduce future conflict.

MarinePestPlan 2018–2023 seeks to enhance the way Australia's marine pest stakeholders communicate and engage with each other. The following activities are important steps towards improving stakeholder engagement and implementing a shared responsibility for national marine pest biosecurity. Table 5 provides a summary of these activities and the expected outcomes, and indicates who will lead the activity and any resource implications.

Activity 5.1

Identify and build a profile of marine pest biosecurity stakeholders

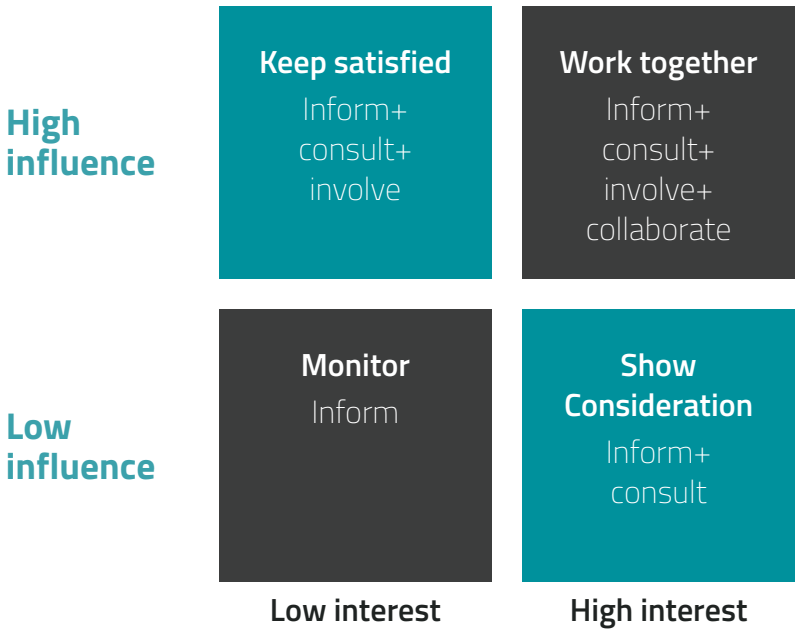
Identifying and characterising stakeholders in a network or system, and the links among them, provides a useful basis for determining appropriate and effective stakeholder engagement activities. Formal quantification and analysis of the marine pest biosecurity stakeholder network can reveal the information, reporting and funding gaps and pathways among the different stakeholders within a system. Activity 5.1 will identify marine pest stakeholders and build a profile of Australia's marine pest biosecurity 'community'. This process will highlight potential risks, opportunities and barriers to successful engagement, which is crucial to the implementation of *MarinePestPlan 2018–2023*.

Activity 5.2

Develop a national stakeholder engagement strategy for *MarinePestPlan 2018–2023* and the Marine Pest Sectoral Committee

Marine pest stakeholders are more likely to benefit from meaningful, well planned interactions that are appropriate to the level of influence and interest they have towards the issue (Figure 1). Through Activity 5.2, a national marine pest stakeholder engagement strategy will be developed to support the implementation and communication of *MarinePestPlan 2018–2023* and MPSC activities. It will establish the objectives and desired outcomes of engagement, and describe how stakeholders can contribute to important marine pest discussions and decision-making processes relating to *MarinePestPlan 2018–2023* and MPSC activities. It will also summarise the roles and relationships of marine pest biosecurity stakeholders. A national stakeholder engagement strategy will help ensure strong engagement and improved awareness of agreed national priorities for marine pest biosecurity.

Figure 1: Each stakeholder group on the grid requires a different level of engagement.



Stakeholders can be mapped into four groups: *low interest, low influence* (those who need to be informed); *high interest, low influence* (those who need to be involved and consulted); *low interest, high influence* (powerful stakeholders who need to be engaged); and *high interest, high influence* (partners who need to collaborate). It is important to remember that stakeholders can move into a different group at different times, or may span multiple groups simultaneously, depending on their circumstances.

Activity 5.3

Deliver a targeted national campaign to improve awareness of marine pest biosecurity risks, management actions and shared responsibilities

'Shared responsibility' is a concept in which those who create biosecurity risks through their decisions and actions, and those who benefit from reduced risks share the responsibility for managing those risks. This includes governments, industries, communities, businesses and individuals. This concept is being implemented as part of national and some state biosecurity legislation. In the marine context, this means stakeholders involved in the protection and use of marine environments (for example, for trade, recreation or tourism) have a general obligation to take all reasonable steps to ensure they do not introduce or spread a pest. However, a lack of awareness among stakeholders can hamper successful management of marine pests, as behaviours due to ignorance continue to have unintended or undesirable consequences (for example, accidental movement of a marine pest on a boat hull).

Activity 5.3 will improve awareness of marine pests through a targeted campaign that engages high-risk stakeholder groups. It will identify high-risk stakeholder groups and the drivers and barriers that affect stakeholders' participation in marine pest management activities. This includes collating and revisiting existing and new social research, and behavioural strategies, and will be informed by the outcomes of Activity 5.1 and Activity 2.2. This knowledge will inform the development and promotion of nationally consistent, tailored communications that will facilitate behaviour change that aims to reduce marine pest risks. Delivery of a targeted national campaign may require a 'shared responsibility' approach, involving a number of key stakeholders such as state/territory governments, and will build on the national stakeholder engagement strategy (Activity 5.2).

Activity 5.4

Review, update and maintain the marinepests.gov.au website

Through the Review, marine pest stakeholders identified the need for improved sharing of information on marine pests, such as instructions on how to identify and report detections of marine pests, and an explanation of the reporting process (including what happens when a new pest is discovered, and how this is communicated to industry and the community). At a national level, an important medium for sharing of information and engagement of stakeholders to support Australia's marine pest biosecurity is through the use of online tools including a national website (marinepests.gov.au) and NIMPIS. Cost-effective communication and engagement require ongoing investment, coordination and utilisation of existing services.

Through Activity 5.4, marinepests.gov.au will be reviewed to determine its current and potential effectiveness and value to stakeholders in supporting them to undertake marine pest biosecurity activities. The outcomes of the review will be used to improve and maintain the website to best service the broad range of stakeholder needs.

Activity 5.5

Establish an independent national marine pest network

Effective engagement depends on two-way communication and the opportunity for a wide range of stakeholders to contribute to marine pest biosecurity discussions and decision-making in a meaningful way. Forming a network between groups of people and organisations with a common goal of improving marine pest biosecurity is a useful way of sharing specialised knowledge, resources and expertise. This approach can enhance coordination, improve communication and lead to better decision-making.

Activity 5.5 will establish an independent national marine pest network, which will facilitate greater coordination and collaboration among marine pest stakeholders. The network will focus on collective actions to improve key aspects of national marine pest biosecurity. These actions will be centred on issues where national collaboration and coordination is required, including communication activities, passive and active surveillance, and R&D. Improving the information flow between government and non-government marine stakeholders will facilitate engagement of those stakeholders, as well as to build trust and promote knowledge exchange that will facilitate the success of other *MarinePestPlan 2018–2023* activities.

Table 5: Summary of activities to achieve Objective 5.

	Activity	Expected outcomes	Project lead	Resource implications
5.1	Identify and build a profile of marine pest biosecurity stakeholders	Improved understanding of marine pest stakeholders and the links between them. Understanding of the potential risks, opportunities and barriers to successful engagement.	MPSC; Department of Agriculture and Water Resources	Marine Pest Review Implementation
5.2	Develop a national stakeholder engagement strategy for *MarinePestPlan 2018–2023* and MPSC	Stakeholders are appropriately engaged on *MarinePestPlan 2018–2023* activities and are aware of agreed national priorities for marine pest biosecurity.	MPSC; Australian Marine Pest Network	In-kind resources
5.3	Deliver a targeted national campaign to improve awareness of marine pest biosecurity risks, management actions and shared responsibilities	Increased awareness of marine pest issues among high-risk stakeholder groups (e.g. recreational boaters) that results in better biosecurity practices.	OceanWatch	Funding will be required to develop resources for campaign
5.4	Review, update and maintain the marinepests.gov.au website	Stakeholders have improved access to accurate marine pest information to support them to undertake marine pest biosecurity management activities.	Department of Agriculture and Water Resources to coordinate	Marine Pest Review Implementation; some content updates in-kind
5.5	Establish an independent national marine pests network	Stakeholder engagement is enhanced to improve collaboration, coordination and use of resources that leads to improved national marine pest biosecurity. Stakeholders play an active role in identifying marine pest issues and participate in relevant national discussions.	Department of Agriculture and Water Resources to coordinate	Start-up funding is being provided by the Department of Agriculture and Water Resources; ongoing resources will be required to maintain network over time

MSPC: Marine Pest Sectoral Committee.

Glossary and acronyms

AFC	antifouling coating
Ballast water	Water (including sediment that is or has been contained in water) held in tanks and cargo holds of ships to increase stability and manoeuvrability during transit
BCA	benefit–cost analysis
Benefit–cost analysis	An analysis that thoroughly and consistently evaluates the benefits and costs ('pros and cons') associated with a prospective action, project, policy or other measure. An attempt to identify and express, in monetary terms, all the effects of a proposed measure
Biofouling	Biofouling is the attachment or accumulation of aquatic organisms such as microorganisms, plants and animals, to any part of a vessel, on surfaces and structures immersed in or exposed to the aquatic environment. Biofouling is also known as hull fouling
Biosecurity	Managing risks to Australia's economy, environment and community of pests and diseases entering, emerging, establishing or spreading in Australia
BWM	ballast water management
BWMS	ballast water management system
CCIMPE	Consultative Committee on Introduced Marine Pest Emergencies
Detection	Interception of a suspected pest species or its identification in a location following incursion
Drivers	Forces of change, positive or negative, that affect supply and demand; for example, population growth or limits on natural resources
EMPPlan	Emergency Marine Pest Plan
Eradication	Management actions or measures to eliminate a pest or disease from an area
Exotic marine species	Any species not normally considered to occur and that may or may not be present in Australia's marine environment
HLG	High Level Officials Working Group
IBIS	International Biosecurity Intelligence System
IGAB	Intergovernmental Agreement on Biosecurity
IMO	International Maritime Organization
Introduction	Transport of an exotic marine species to a location within Australia's marine environment from a source beyond Australia's marine environment
Marine environment	Oceans, seas, bays, estuaries, and other major water bodies, including their surface interface and interaction with the atmosphere and with the land seaward of the mean high-water mark

Glossary and acronyms

Marine IGA	Intergovernmental Agreement on a National System for the Prevention and Management of Marine Pests Incursions
Marine pest	Non-native marine plants or animals that harm Australia's marine environment, social amenity or industries that use the marine environment, or have the potential to do so if they were to be introduced, established (i.e. forming self-sustaining populations) or spread in Australia's marine environment. Many terms are used, sometimes interchangeably, to describe plants and animals that have been moved beyond their native range by humans, including alien, exotic, introduced, invasive, non-indigenous, non-native and nuisance species
MGPS	Marine Growth Protection Systems
MPSC	Marine Pest Sectoral Committee
National significance	A pest or disease likely to have far reaching and/or national impacts (according to the IGAB)
NBC	National Biosecurity Committee
NBMG	National Biosecurity Management Group
NEBRA	National Environmental Biosecurity Response Agreement
NIMPCG	National Introduced Marine Pests Coordination Group
NIMPIS	National Introduced Marine Pest Information System
Outcomes	Benefits or impacts to the stakeholder or physical environment which demonstrate the effectiveness of an activity, program or service; usually changes in knowledge, skills, attitude, behaviour, or a state or condition
R&D	research and development
Regulation	A rule or order, as for conduct, prescribed by authority; a governing direction or law
RIS	Regulation Impact Statement
RRM	rapid response manual
Surveillance	Systematic investigation over time, of a population or area to collect data and information about the presence, incidence, prevalence or geographical extent of a pest or disease; includes active and passive approaches
Vector	Anything capable of introducing or spreading a marine pest including a route or pathway (e.g. biofouling) or a physical or mechanical carrier (e.g. equipment or vessel)
Vessel	Any ship, boat or other craft used in marine environments; includes ships, floating platforms, boats and barges (i.e. structures that can float and be steered or moved by their own means or by other means, e.g. if towed). Also specifically includes smaller craft including recreational boats and other craft

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