


Norfolk Island Invasive Marine Species (IMS) Survey

Presented By: Dr Ashley Coutts

BIOFOULING SOLUTIONS

Flora and Fauna Society, Norfolk Island, 26 September, 2022

Background

- Project commissioned by: Department of Infrastructure, Transport, Regional Development, Communications and the Arts (DITRDCA).
- With support from: Department of Climate Change, Energy, the Environment and Water (DCCEEW)
- Objective: To plan, design and implement a marine pest survey of the Norfolk Marine Park.

Who are we?

- Biofouling Solutions consists of team of marine biologists/scientists
- Specialise in the detection and management of Invasive Marine Species (IMS).
- Assembled a specialist team consisting of:
  - Ashley Coutts
  - Joe Valentine
  - Toni Copper

Presentation Outline

Part 1 - Background – Invasive Marine Species (IMS)

- What are IMS?
- Common characteristics of IMS
- How are IMS dispersed?
- Are the rate of IMS introductions increasing?
- Where are IMS commonly found around the world?

Part 2 – Norfolk Island Invasive Marine Species Survey

- Likelihood assessment
- Survey design
- Results

Part 1 – Background into Invasive Marine Species (IMS)

What are Invasive Marine Species (IMS)?

Refers to: Any marine species which has had or capable of causing demonstrable impacts across any one of the following four core values:

- Environmental
- Economic
- Human health
- Social cultural

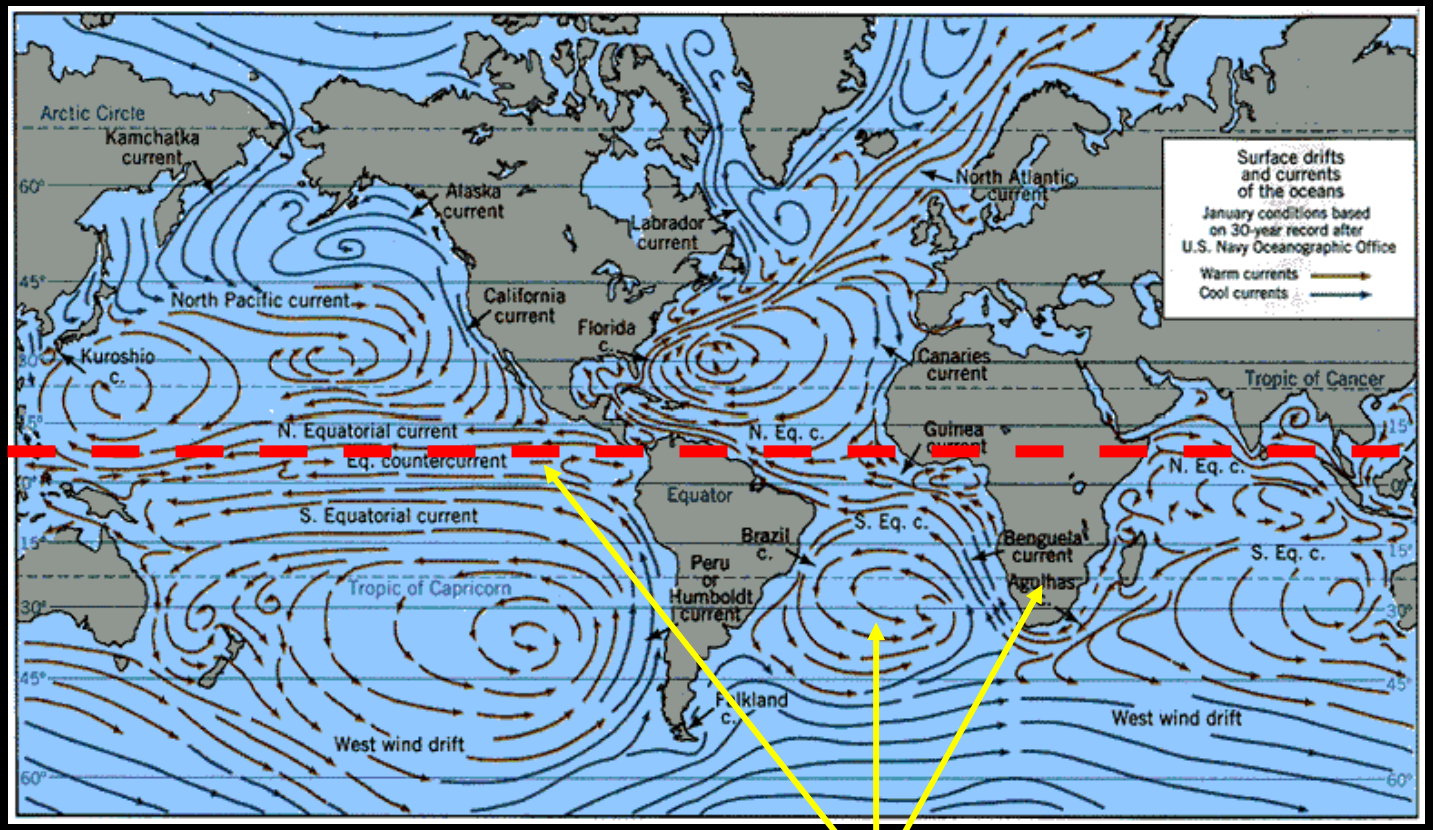
Why do some species become invasive?

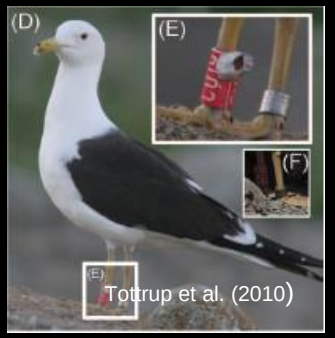
Common Characteristics of IMS:

- Rapid growth and reproduction
- Many can reproductive both sexually and asexually
- High dispersal ability
- Ability to survive in a wide range of changing environmental conditions
- Thrive on disturbance (very opportunistic)
- Ability to consume a variety of food resources
- Ability to displace native species
- Once introduced, they often leave their natural predators, pathogens and diseases behind

How are IMS Dispersed?

- Natural Dispersal:





Although, continents, oceanic currents and the equator acts as a natural barrier

How are IMS Dispersed?

1. Artificial (human dispersal) – (Unintentional)

- Historically – slow-moving sailing vessels
- Solid ballast (e.g. rocks and associated biota)
- External hull – “biofouling” including shipworms


Photo : Cawthron Institute


Photo : IfAO

How are IMS Dispersed?

2. Artificial (human dispersal) – (Intentional)

- Aquaculture/Mariculture
- Aquarium trade
- Fishing (live bait)
- Conservation


Photo: Globalsolutionspgh.org


Photo: Scubaboard.com

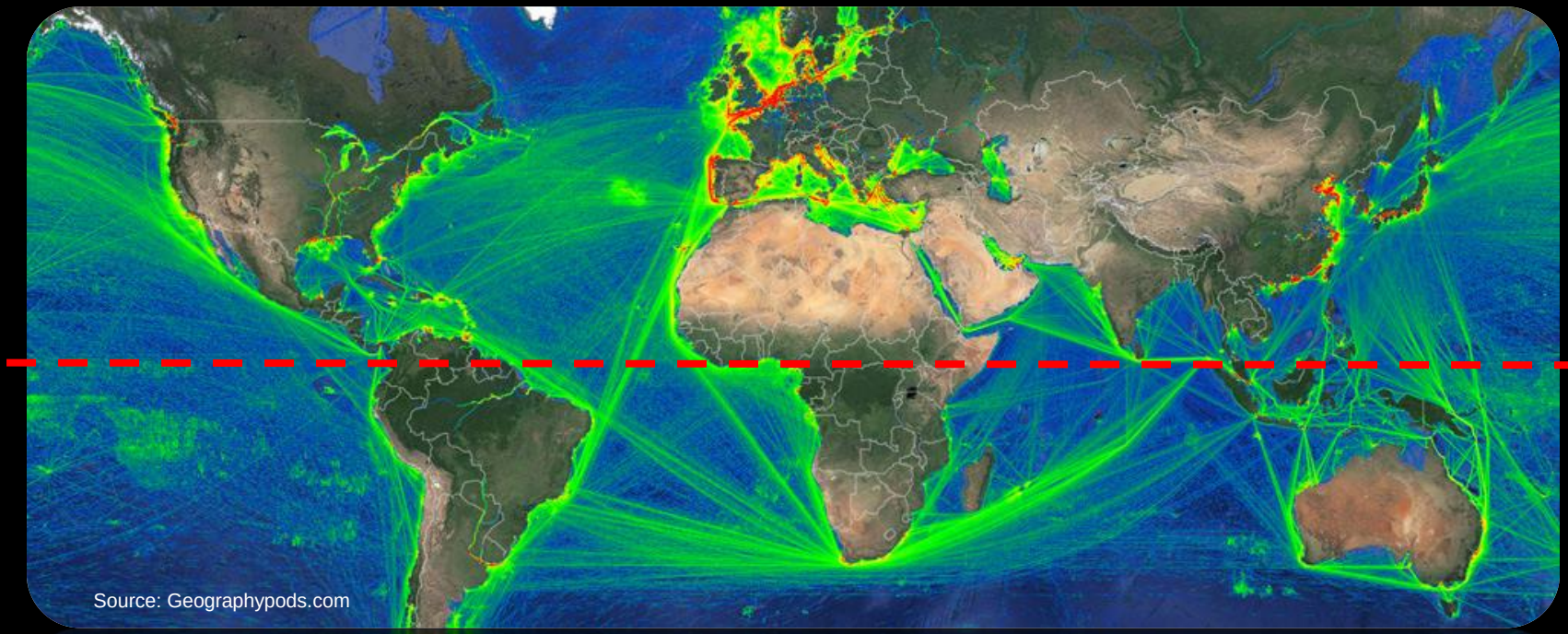

Photo: Striperonlihe.com


Photo: DPIPWE

How are IMS Dispersed?

2. Artificial (human dispersal) – (Unintentional)

- Modern-day vessels are considered the greatest vector for IMS dispersal (ballast water and biofouling)



How are IMS dispersed?

Ballast water

or

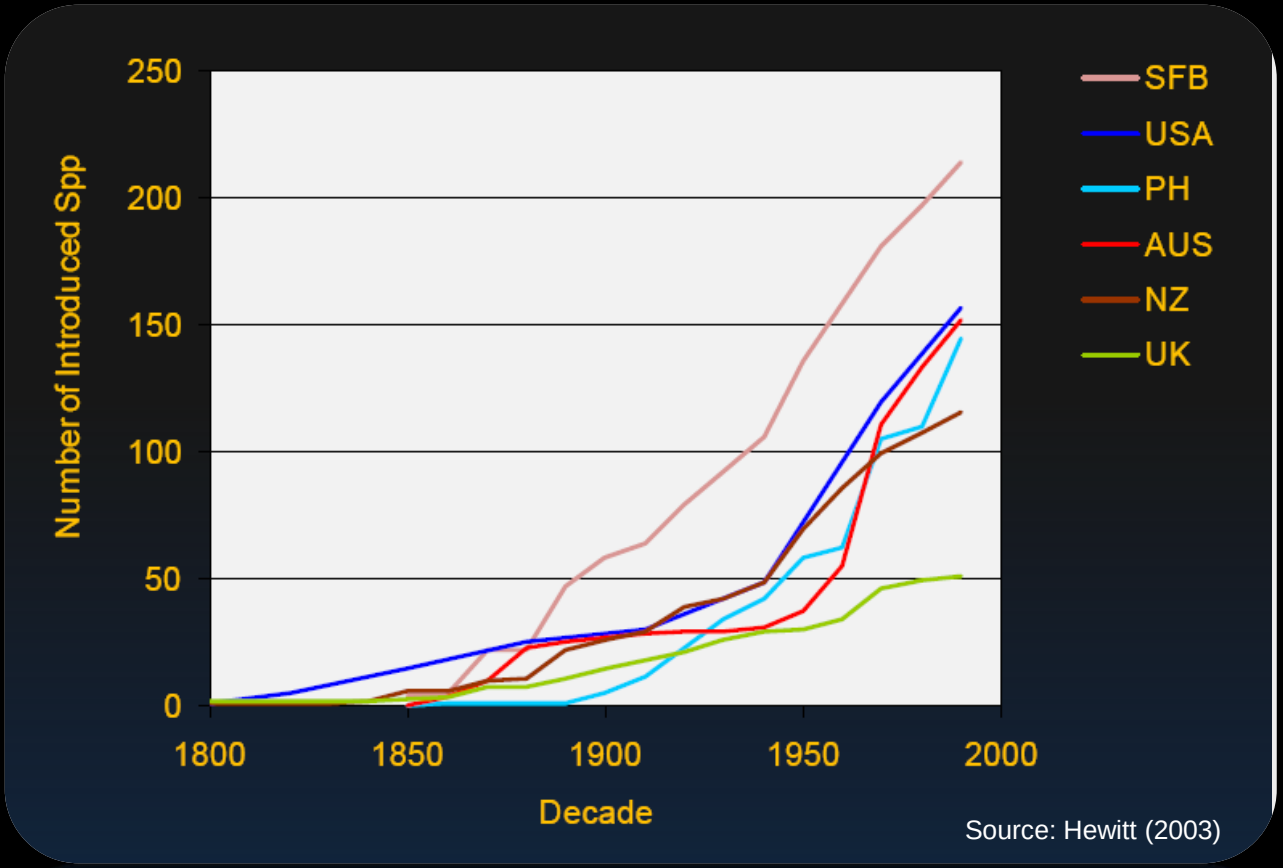
Biofouling

How are IMS dispersed?

- Hewitt and Campbell (2008) estimate that of the 1,781 Invasive Marine Species recorded in ports and harbours around the world, 55-69% were most likely introduced via vessel biofouling.

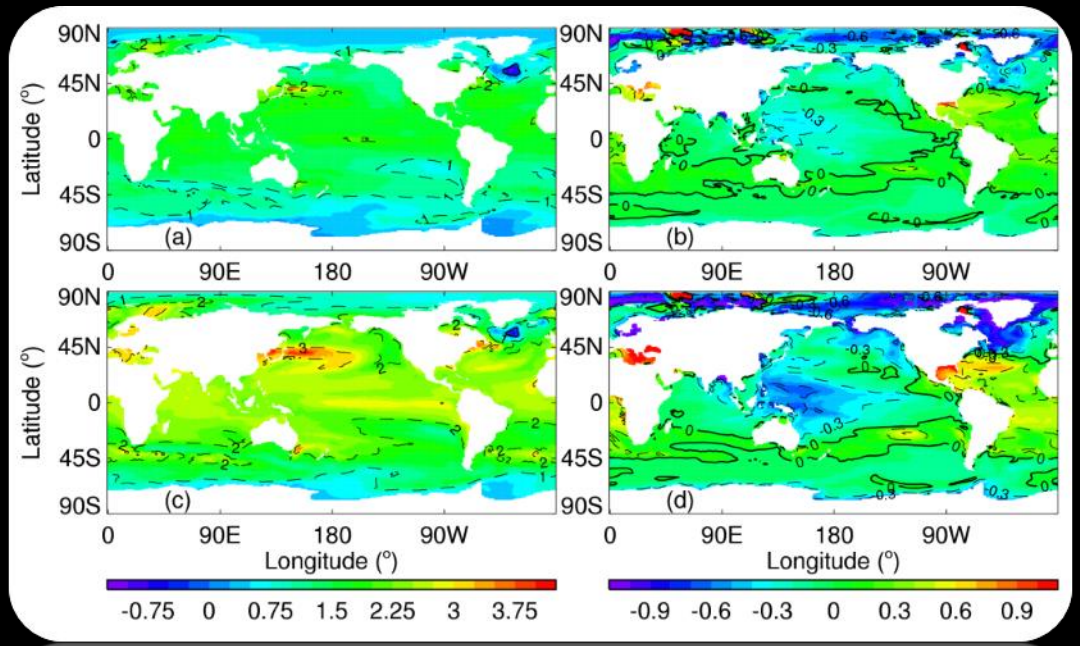
Rate of IMS Introductions

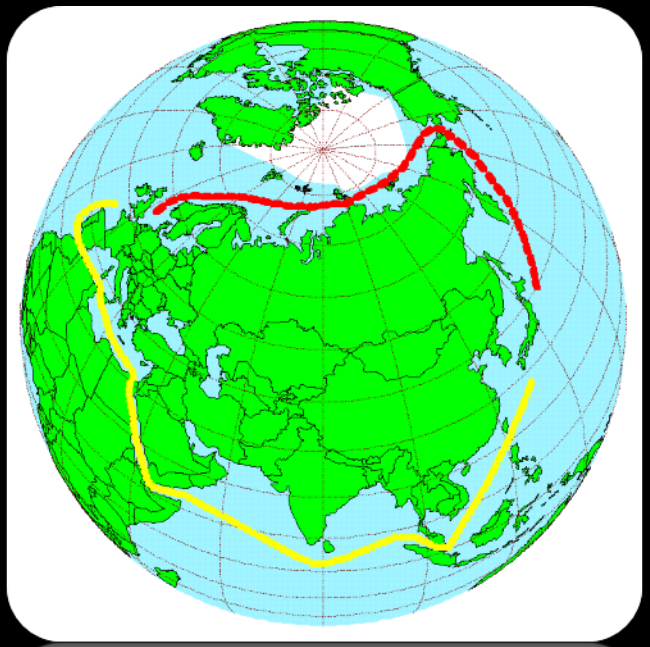
- Rate of IMS introductions/detections appears to be increasing



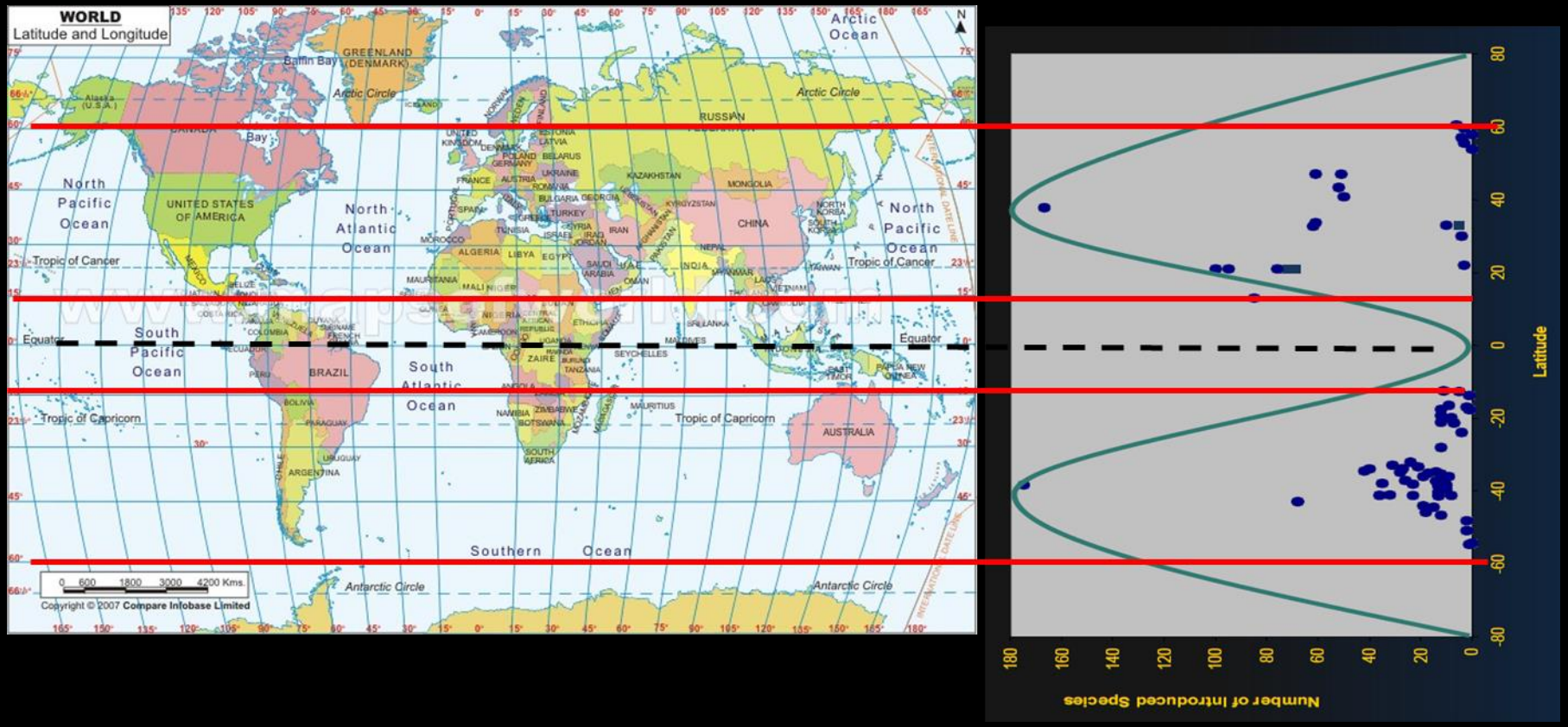
Rate of IMS introductions?

- Global climate change could be weakening natural environmental barriers?





Where are the IMS detections/introductions?



Source: Hewitt et al. (2003)

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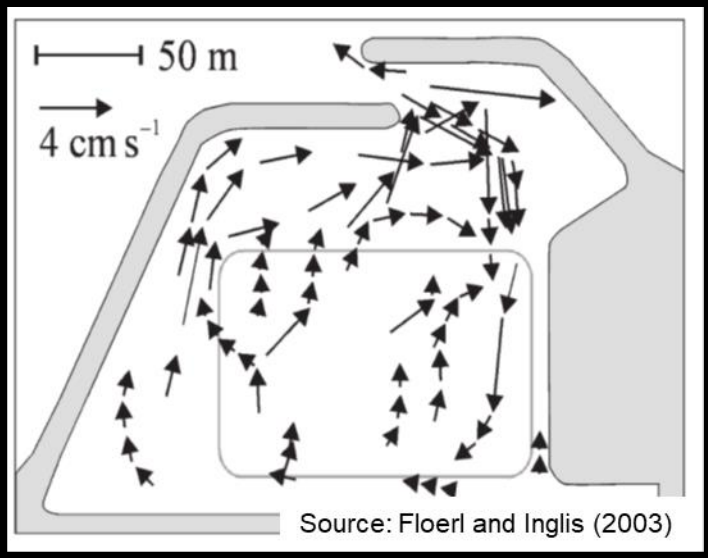

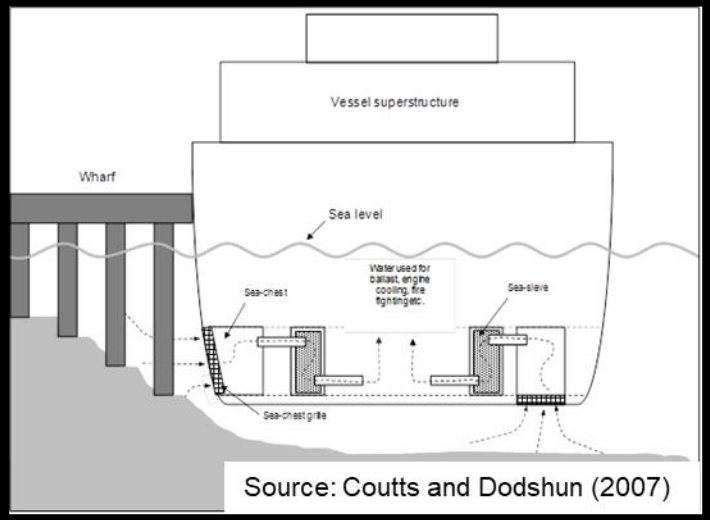

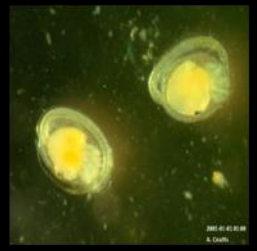

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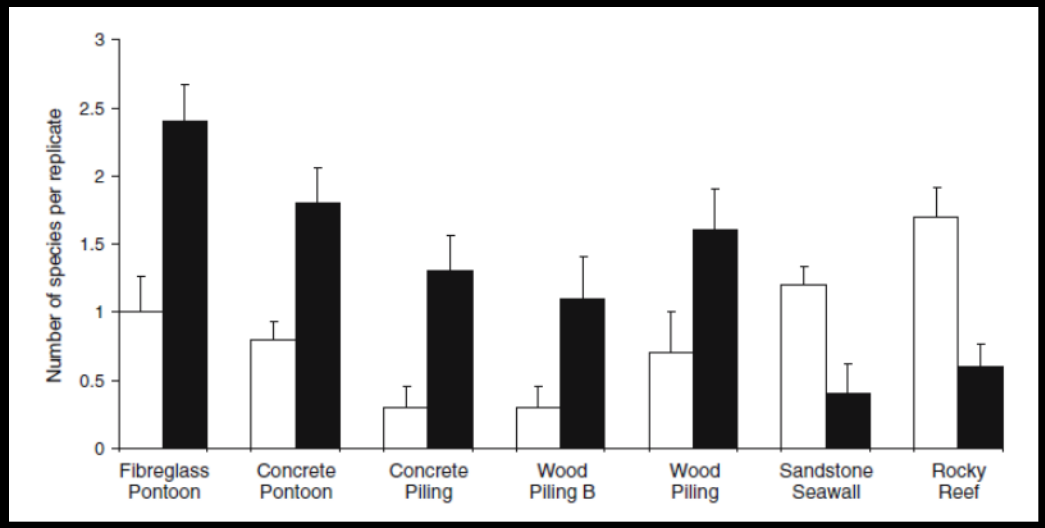
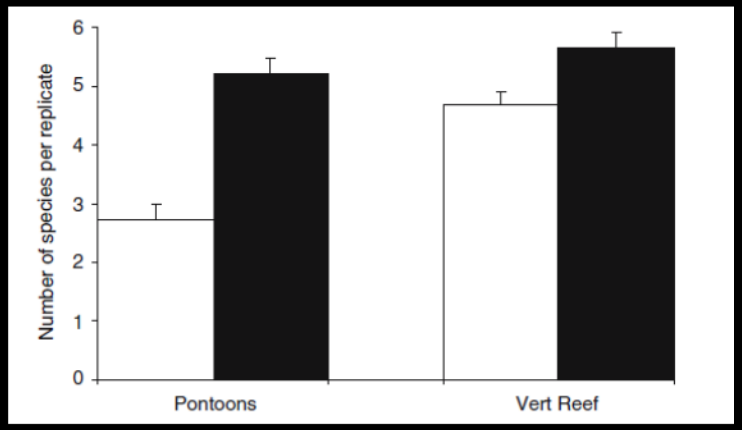
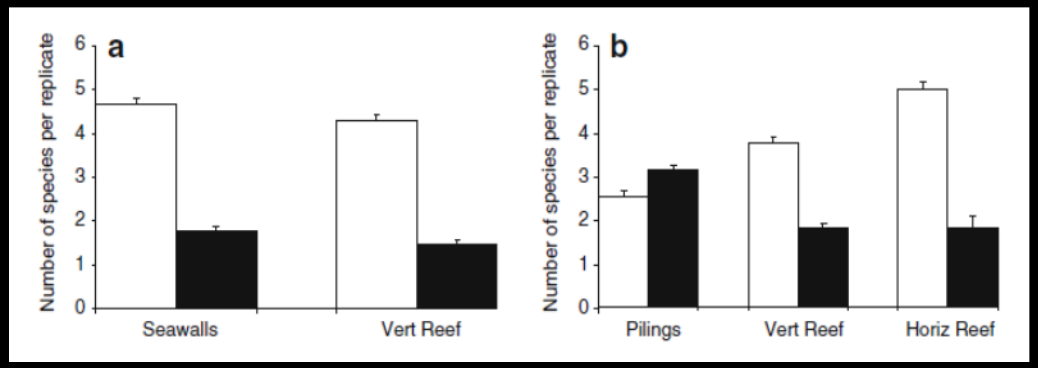
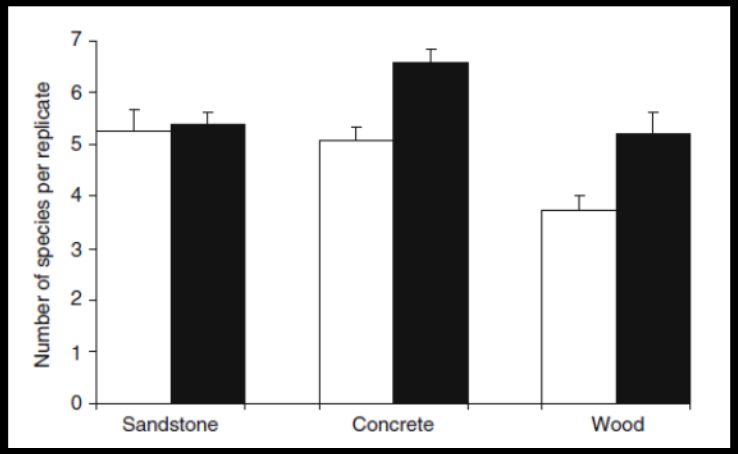








Key: White bars refer to native species
Black bars refer to Nonindigenous Invasive Species (NIS)

Source: Glasby et al. (2007)




Part 2 – Norfolk Island Invasive Marine Species (IMS) Survey

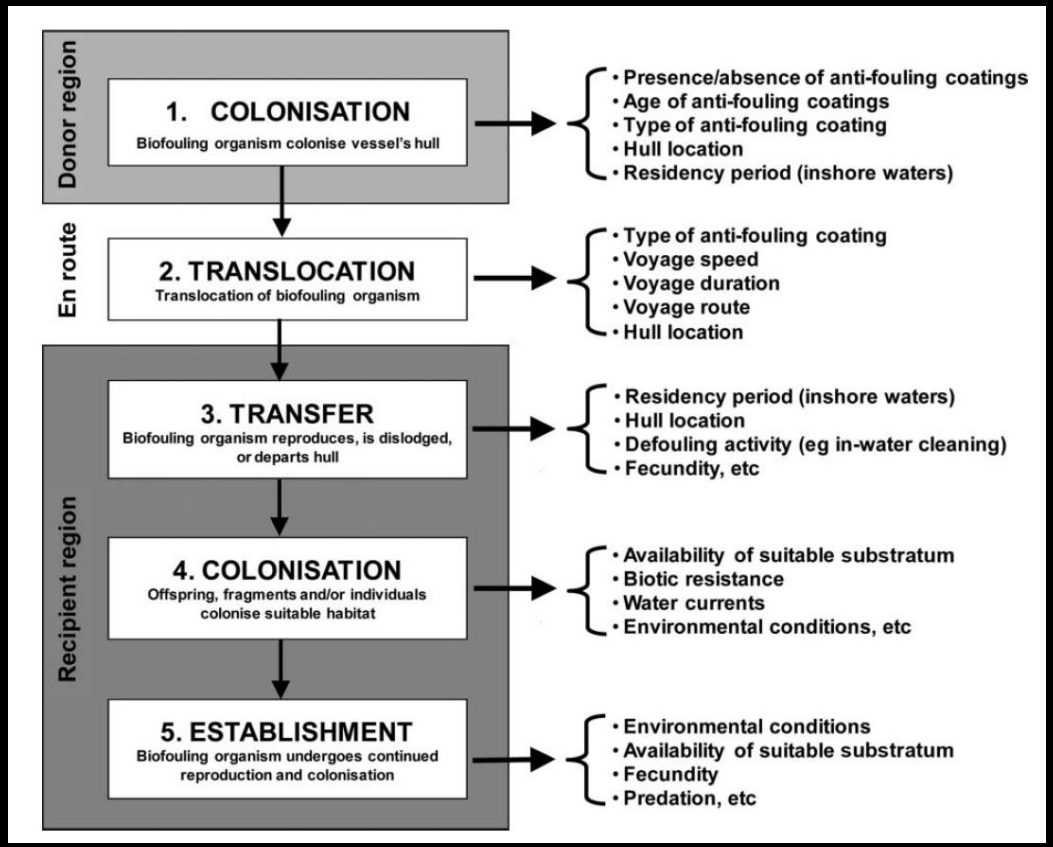
Norfolk Island IMS Survey

Step 1. Establish Invasive Marine Species Target List

Phylum	Genus/Species	Common Name	Australian Priority Marine Pest List	Exotic Environmental Pest List	Ballast Water Risk Assessment Table List
Algae	Centric diatom	*Chaetoceros concavicornis*		✓	
	Toxic dinoflagellate	*Dinophysis norvegica*		✓	
	Japanese wireweed	*Sargassum muticum*		✓	
	Japanese seaweed	*Undaria pinnatifida*	✓		✓
Coelenterata	Comb jelly	*Mnemiopsis leidyi*		✓	✓
Annelida	Red-gilled mudworm	*Marenzelleria neglecta*		✓	
	Mediterranean fanworm	*Sabella spallanzanii*			✓
Mollusca	Asian date mussel	*Arcuatula senhousia*			✓
	Pacific oyster	*Magallana gigas*			✓
	New Zealand screwshell	*Maoricolpus roseus*			
	Soft shelled clam	*Mya arenaria*		✓	
	Black-striped false mussel	*Mytilopsis sallei*	✓	✓	
	New Zealand green-lipped mussel	*Perna canaliculus*	✓	✓	
	Brown mussel	*Perna perna*	✓	✓	
	Asian green mussel	*Perna viridis*	✓	✓	
	Asian brackish-water clam	*Potamocorbula amurensis*		✓	✓
	Rapa whelk	*Rapana venosa*		✓	
	European clam	*Varicorbula gibba*			✓
	Atlantic oyster drill	*Urosalpinx cinerea*		✓	
Echinodermata	Northern Pacific Seastar	*Asterias amurensis*	✓		✓
Crustacea	Japanese skeleton shrimp	*Caprella mutica*		✓	
	European green crab	*Carcius maenas*	✓		✓
	Lady crab / Asian paddle crab	*Charybdis japonica*		✓	
	Chinese mitten crab	*Eriocheir sinensis*	✓	✓	
	Japanese shore crab	*Hemigrapsus sanguineus*		✓	
	Brush-clawed shore crab	*Hemigrapsus takanoi*		✓	
	Harris' mud crab	*Rhithropanopeus harrisi*	✓	✓	
Chordata	Invasive sea squirt	*Didemnum perlucidum*			
	Carpet sea squirt	*Didemnum vexillum*		✓	
		Totals	**9**	**20**	**9**

Norfolk Island IMS Survey

Step 2. Determine which Invasive Marine Species most likely to be present



Norfolk Island IMS Survey

Step 2. Determine which Invasive Marine Species most likely to be present

Phylum	Genus/Species	Common Name	Biofouling	A. Colonisation	B. Translocation	C. Transfer	D. Colonisation	E. Establishment
Algae	Centric diatom	*Chaetoceros concavicornis*	Unlikely	-	-	-	-	-
	Toxic dinoflagellate	*Dinophysis norvegica*	Unlikely	-	-	-	-	-
	Japanese wireweed	*Sargassum muticum*	Possible	Unlikely	-	-	-	-
	Japanese seaweed	*Undaria pinnatifida*	Possible	Possible	Possible	Possible	Possible	Possible
Coelenterata	Comb jelly	*Mnemiopsis leidyi*	Unlikely	-	-	-	-	-
Annelida	Red-gilled mudworm	*Marenzelleria neglecta*	Possible	Unlikely	-	-	-	-
	Mediterranean fanworm	*Sabella spallanzanii*	Possible	Possible	Possible	Unlikely	-	-
Mollusca	Asian date mussel	*Arcuatula senhousia*	Possible	Possible	Possible	Possible	Unlikely	-
	Pacific oyster	*Magallana gigas*	Possible	Possible	Possible	Possible	Unlikely	-
	New Zealand screwshell	*Maoricolpus roseus*	Possible	Possible	Possible	Possible	Possible	Possible
	Soft shelled clam	*Mya arenaria*	Unlikely	-	-	-	-	-
	Black-striped false mussel	*Mytilopsis sallei*	Possible	Unlikely	-	-	-	-
	New Zealand green-lipped mussel	*Perna canaliculus*	Possible	Possible	Possible	Possible	Unlikely	-
	Brown mussel	*Perna perna*	Possible	Unlikely	-	-	-	-
	Asian green mussel	*Perna viridis*	Possible	-	-	-	-	-
	Asian brackish-water clam	*Potamocorbula amurensis*	Possible	Unlikely	-	-	-	-
	Rapa whelk	*Rapana venosa*	Possible	Unlikely	-	-	-	-
	European clam	*Varicorbula gibba*	Possible	Unlikely	-	-	-	-
	Atlantic oyster drill	*Urosalpinx cinerea*	Unlikely	-	-	-	-	-
Echinodermata	Northern Pacific Seastar	*Asterias amurensis*	Possible	Possible	Possible	Possible	Possible	Unlikely
Crustacea	Japanese skeleton shrimp	*Caprella mutica*	Possible	Possible	Possible	Possible	Possible	Possible
	European green crab	*Carcius maenas*	Possible	Possible	Possible	Possible	Possible	Unlikely
	Lady crab / Asian paddle crab	*Charybdis japonica*	Possible	Possible	Possible	Possible	Possible	Possible
	Chinese mitten crab	*Eriocheir sinensis*	Possible	Unlikely	-	-	-	-
	Japanese shore crab	*Hemigrapsus sanguineus*	Possible	Unlikely	-	-	-	-
	Brush-clawed shore crab	*Hemigrapsus takanoi*	Possible	Unlikely	-	-	-	-
	Harris' mud crab	*Rhithropanopeus harrisi*	Possible	Unlikely	-	-	-	-
Chordata	Invasive sea squirt	*Didemnum perlucidum*	Possible	Possible	Possible	Possible	Possible	Possible
	Carpet sea squirt	*Didemnum vexillum*	Possible	Possible	Possible	Possible	Possible	Possible
	TOTALS	**29**	**24**	**12**	**12**	**11**	**8**	**6**

Norfolk Island IMS Survey

Step 3. Review Reef Life Survey Data

Norfolk Island IMS Survey

Step 4. Determine most likely locations to find IMS

Norfolk Island IMS Survey

Step 5. Survey Methods

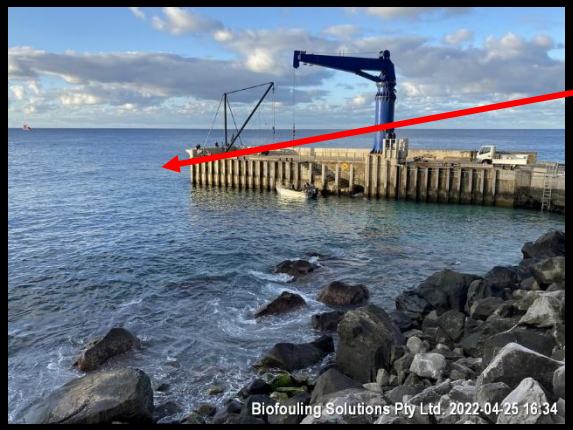
- Visual surveys (diving and snorkelling)
- Sediment cores
- Crab traps
- Plankton tow
- eDNA samples

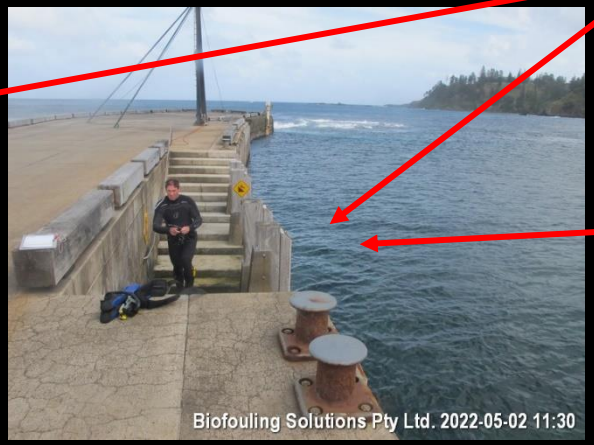



Results – Visual Surveys

Two IMS detected

- Dead Japanese Oyster Shells (*Magallana gigas*)
- Dead New Zealand Greenshell Mussel Shells (*Perna canaliculus*)
- Likely to have been consumed and discarded.





Results – Visual Surveys

Species worthy of further attention

- Suspected colonial sea squirt (*Diplosoma virens*)

Cascade Bay

Emily and Slaughter Bay

Anson Bay

Results – Visual Surveys

Species worthy of further attention

Emily and Slaughter Bay (Photos curtesy of Susan Prior).

Results – eDNA

One IMS detected

- Toxic dinflagellate (*Gymnodinium catenatum*) although detection confidence uncertain!

Emily Bay

Conclusion & Recommendations

- Historically, the likelihood of IMS arriving and establishing at Norfolk Island has been very low!
- However, this could change if the nature and extent of vessel interactions change.
- Vital that any future changes to port infrastructure incorporates effective biofouling management measures.
- On-going surveillance at Cascade, Ball Bay, Emily and Slaughter (including around Kingston Pier) continues.
- Identification cards highlighting the most likely IMS to arrive and establish will be created.

Thank you