


Assessing likelihoods of marine pest introductions: a transport vector approach

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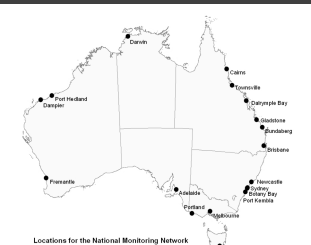
Background

- Marine pests can cause significant impacts
 - ecological (second greatest threat to biodiversity)
 - economic (aquaculture, marine infrastructure)
- Substantial global connectivity
 - commercial shipping (international + domestic)
 - 10 000 species/day transported globally in ballast
 - recreational boating (international + domestic)
 - aquaria



Monitoring for pests

- National port monitoring program 1996-2001
 - Newcastle, Sydney Harbour, Botany Bay, Port Kembla, Eden
- New national system coming soon
 - Commercial ports
 - Standard design
 - Consistent effort
 - States pay



Locations for the National Monitoring Network

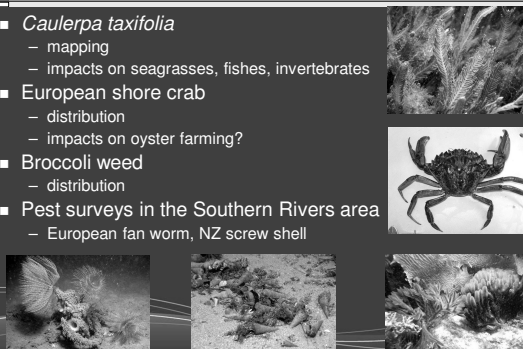
National pest “trigger list”

- Ballast water and hull fouling species only
- 6 toxic dinoflagellates (human health)
- 19 species still exotic to Australia
- 10 species established somewhere in Australia
 - 5 of which are in NSW



NSW DPI pest monitoring

- *Caulerpa taxifolia*
 - mapping
 - impacts on seagrasses, fishes, invertebrates
- European shore crab
 - distribution
 - impacts on oyster farming?
- Broccoli weed
 - distribution
- Pest surveys in the Southern Rivers area
 - European fan worm, NZ screw shell

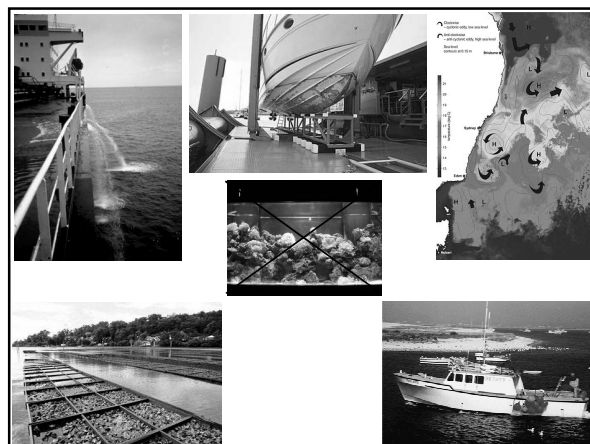


Need for risk assessment

- Where should we search and for what?
 - should NSW consider non-commercial ports?
 - can we prioritise estuaries?
- Which countries are the most likely sources of pests?
 - known or potential new pests
 - next pest unlikely to be on an official list
- Sydney estuaries initially, hopefully extend later
 - Port Jackson, Botany Bay, Port Hacking
- Aims
 - identify likely sources of pests (environmental similarity)
 - determine which of the nationally-listed pests could establish
 - which are most likely to arrive from O/S
 - which are most likely to arrive from within Australia?

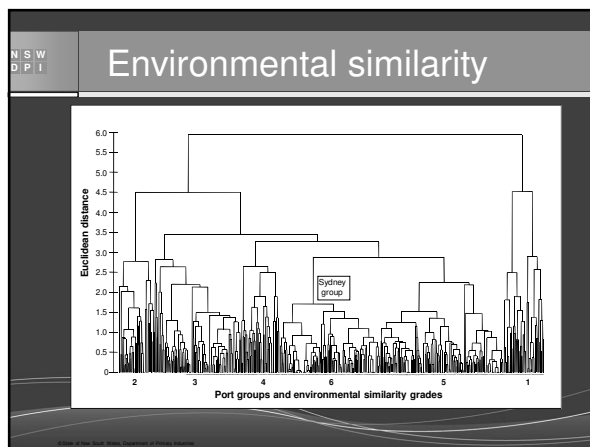
NSW DPI **Approach**

- Use national trigger-list (not dinoflagellates)
 - plus NZ green lip mussel, total 30 species
- Environmental similarity
 - Sydney ports vs 350 international ports (IMO - Globallast)
 - temperature, salinity (max, min, summer, winter)
 - port similarity measure
 - multiplied by number of vessel connections
- Calculate likelihoods of introduction of known pests
 - known locations of trigger-list pests
 - which trigger-list species could survive in NSW
 - degree of connectivity
 - likelihood of species being transported by each vector
- Vectors considered.....



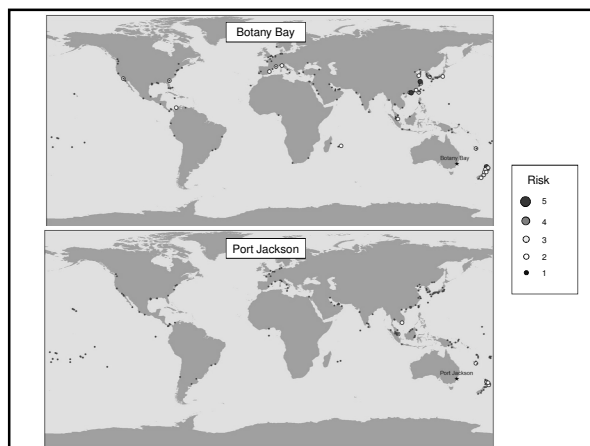
NSW DPI **Vector data**

- Total connections of international ships and recreational vessels
 - Customs; 10 previous ports of call over last 2 years
- Same for domestic ships and recreational boats
 - online survey for rec. boating movements
- Movements of commercial fishing vessels
 - comm. fishing not permitted in Sydney estuaries, but can unload catch in Port Jackson
 - hull fouling the only consideration
- Movements of oysters
- Modelling of oceanic currents (UNSW)
 - duration of larvae in plankton



NSW DPI **Environ similarity x connections**

- Done without considering location of known pests
- Botany Bay at greatest risk on invasion
 - 41 ports (14 countries) connect & similar
 - Shanghai, Hong Kong, Auckland, Pusan (Korea), Kaohsiung (Taiwan), Tauranga (NZ) and Lyttelton (NZ)
- Port Jackson has fewer total connections and with different ports
 - 34 ports (11 countries) connect & similar
 - Singapore, Auckland, Port Vila, Nouméa, Tauranga, Napier (NZ)



Invasion by recognised pests

- All 30 species could potentially survive in Sydney
 - some could only survive in winter or summer
 - habitats suitable
 - reproduction likely
- All 30 species had some chance of being transported from O/S to Port Jackson or Botany Bay
 - i.e. connections with known populations
 - no direct O/S connections with Port Hacking

Overseas invaders

- Asian bag mussel, based on number of connections, the most likely pest to arrive here from overseas
 - also ranked highly as a domestic invader (VIC, SA, TAS, WA)
 - smothers benthic sediments, exclude native invertebrates, potentially affect growth of seagrass, foul structures
- Asian clam the second most likely to invade
 - not yet in Australia
 - global threat to sediments and native invertebrates

Likelihoods of domestic invasions

- Port of Melbourne greatest risk (shipping)
 - Botany at more risk than Port Jackson
 - Melbourne has 7 pests, only 1 of which is in Sydney
- Port Jackson & Port Hacking high risks for Port Botany
 - but currently the same 2 pests are present in all estuaries
- 10 (of 30) pests likely to invade Botany
 - top 2 already there; indicating risk method good
- 11 (of 30) pests likely to invade Port Jackson
 - top 2 already there
- 3 (of 30) pests likely to invade Port Hacking
 - top 2 already there
 - Batemans Bay greatest current risk for Port Hacking as it has the European shore crab (rec boating – low risk)

Domestic invaders

- Northern Pacific seastar
 - Botany Bay
- European shore crab
 - Botany Bay, Port Jackson (Port Hacking)
 - historical records for Botany Bay
- Japanese kelp
 - Botany Bay and Port Jackson

Limitations

- Reliability of vector data
 - rec boating in particular
 - current modelling being improved
 - reporting of commercial fishing not always detailed
- Could not consider all vectors
 - aquarium trade
 - Navy

Conclusions

- Identified the most likely sources for marine pest incursions in Sydney estuaries
 - target vessels for hull inspections
- Identified which of the nationally-listed marine pests are most likely to invade Sydney estuaries
 - help prioritise which marine pests to search for in each estuary

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Next step

- Extend to all of NSW
 - environmental data for all estuaries
 - consider O/S arrivals to all “first ports of call”
 - examine connectivity among all NSW estuaries
 - data on rec boating problematic
 - consider secondary transport of pests
 - e.g. arrive in Sydney, then get spread elsewhere

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