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

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?
### Approach

- Use national trigger-list (not dinoflagellates)
  - plus NZ green lip mussel, total 30 species
- Environmental similarity
  - Sydney ports vs 360 international ports (IMO - Globalast)
  - 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:...
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)
  - smoothers 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
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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