Pride of the South: 
Risk Analysis for Marine Biosecurity in Fiordland

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RESEARCH BASED SOLUTIONS
Outline

- Fiordland’s risk profile
- Risk management model
- Changing behaviour

*Model can be used to identify priority measures.*

*Changing behaviour is key element of a measure’s effectiveness.*
Problem statement

- How to prioritise risk reduction measures when budgets are constrained?

- E.g. Control pest population in nearby source port, or target all vessel traffic?
Fiordland – Pride of the South

- Unique geography => high marine biodiversity
Fiordland – Vessel traffic

- Risk vectors
  - Cruise ships
  - Fishing vessels
  - Private yachts and launches
  - Tourist operators
  - Research vessels
  - Hunters & fishers; tourists

- Source regions
  - Bluff – *Undaria*
  - Nelson, Wellington, other
  - overseas
## Risk profile

<table>
<thead>
<tr>
<th>Vessel type</th>
<th>No. of vessels</th>
<th>Trips /yr (avg)</th>
<th>Days/ trip (avg)</th>
<th>Vessel days/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial fishing</td>
<td>50</td>
<td>12</td>
<td>10</td>
<td>6000</td>
</tr>
<tr>
<td>Recreational (yachts, launches)</td>
<td>100</td>
<td>1.5</td>
<td>5</td>
<td>750</td>
</tr>
<tr>
<td>Commercial charters &amp; tourism</td>
<td>14</td>
<td>3</td>
<td>60</td>
<td>2520</td>
</tr>
<tr>
<td>Research &amp; Agency</td>
<td>4</td>
<td>4</td>
<td>14</td>
<td>224</td>
</tr>
<tr>
<td>Cruise Vessels</td>
<td>18</td>
<td>4</td>
<td>1</td>
<td>72</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>186</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: consensus view of agency officials and a representative of Fiordland Marine Guardians at a workshop held 1 May 2009.
Changing behaviour

*Everything you need for your "shotgun" wedding!*
Existing measures

- **Source control ~ $200k/yr**
  - Vessel monitoring/cleaning in Bluff
  - Wharf pile wrapping/maintenance

- **Vessel measures**
  - Deed of Agreement for Cruise Vessels
  - Resource consent for commercial vessels – excluding fishing vessels
  - Overseas yachts required to report

- **Surveillance**
  - Passive

- **Communications**
  - Boatie’s guide etc.
Risk management model

- Status quo risk: $R_U = P_I \times P_{PD} \times V \times I$

- Managed risk: $R_{Mi} = P_{Ii}^' \times P_{PDi}^' \times V \times I$

- Benefit/Cost: $RR_{Mi} = (R_U - R_{Mi})/C_{Mi}$

$P_I =$ probability of introducing pest species

$P_{PD} =$ prob of establishment at pest density

$V =$ value at risk

$I =$ percent impact on value
Model input values

- Value of Fiordland = $750 m per year
- Impact of pest = 1% loss
- Current rate of incursions = 1 every 5 yrs

- Risk reduction from vector treatment
- Risk reduction from source control
- Existing practices and how they would change
  - Annual anti-foul
  - Pre-trip inspections
  - Hull wrapping
Assumptions

- Treatment measures in discrete categories
  - Vs. continuous variable (e.g. frequency of anti-fouling)
- Treatment equally effective for all marine pests
- Pests have equal impact on Fiordland
- $P_i$ directly related to vessel days spent in Fiordland
- Model 1: Vessel types have equal risk
- Model 2: differentiated risk of infection and compliance across vessel types.
Expert opinion

- Risk reduction for each treatment measure
  - Used orders of magnitude
- Compliance profiles by vessel type
- Change in compliance due to policy measures
- Number of vessels, number of trips per year, and duration of trip, by vessel type.
- Current rate of pest introduction to Fiordland
  - 1 every 5 years
Scenarios

Scenario = intervention to change behaviour

- Status quo
- Voluntary vessel intentions register
- Mandatory register + “clean hull” requirement
- Above + vessel monitoring in Bluff
- Source control option (with each of above)
  - Bluff-resident vessels vs non-residents
- 2nd model: Differentiate by vessel type
# Model Results

Risk reduction per dollar spent:  

<table>
<thead>
<tr>
<th>Scenario &amp; short description</th>
<th>Expected annual loss</th>
<th>Risk reduction (change in annual loss)</th>
<th>Marginal cost of measures*</th>
<th>Risk reduction per dollar (RRM)</th>
<th>Net benefits (Risk reduction less costs)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Without source population control in Bluff</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SQ:</strong> Status Quo</td>
<td>$1,500,000</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td></td>
</tr>
<tr>
<td><strong>A:</strong> Voluntary Register</td>
<td>$1,232,534</td>
<td>$267,466</td>
<td>$26,532</td>
<td>$10.08</td>
<td>$240,934</td>
</tr>
<tr>
<td><strong>B:</strong> Mandatory Register and “clean hull” policy</td>
<td>$325,661</td>
<td>$1,174,338</td>
<td>$45,274</td>
<td>$20.03</td>
<td>$1,102,532</td>
</tr>
<tr>
<td><strong>C:</strong> scenario B + vessel monitoring in Bluff</td>
<td>$185,708</td>
<td>$1,314,292</td>
<td>$81,248</td>
<td>$12.38</td>
<td>$1,161,238</td>
</tr>
<tr>
<td><strong>With source population control in Bluff</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SQ'</strong> (w source control)</td>
<td>$1,188,629</td>
<td>$311,371</td>
<td>$550,000</td>
<td>$0.57</td>
<td>-$238,629</td>
</tr>
<tr>
<td><strong>A'</strong>: Voluntary Register</td>
<td>$976,684</td>
<td>$523,316</td>
<td>$37,134</td>
<td>$14.09</td>
<td>-$63,818</td>
</tr>
<tr>
<td><strong>B'</strong>: Mandatory Register and “clean hull” policy</td>
<td>$258,060</td>
<td>$1,241,939</td>
<td>$77,575</td>
<td>$16.01</td>
<td>$577,230</td>
</tr>
<tr>
<td><strong>C'</strong>: scenario B’+ vessel monitoring in Bluff</td>
<td>$147,159</td>
<td>$1,352,841</td>
<td>$124,058</td>
<td>$10.90</td>
<td>$564,074</td>
</tr>
</tbody>
</table>
Conclusions

- Risk vectors are diverse – characterisation is complex
- Effectiveness of measures depends on human behaviour
- Choosing the most effective measures is complex
  - Model can incorporate risks, values and behavioural change to rank measures in terms of risk reduction per dollar, making assumptions transparent
- Better information on behaviour & change would improve ability to assess options
Acknowledgements

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Thank you!

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