Shipping Traffic, Hull Fouling and Invasion Risk to West Coast Ports

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Problem

- CSLC mission and vision statements:
  “ensure the future quality of the environment....through protection, preservation and restoration”

- NIS compromise the goals of protecting existing biodiversity and ecosystems

- vector management = prevention first
U. S. West Coast Introductions

Data from: USGS NAS database; Cohen & Carlton 1998; Wonham & Carlton 2005
The hull fouling vector

Centuries-old vector

Biofouling hotspots

Purpose

Examine patterns and variation of the hull fouling vector

- Shipping traffic
- Hull fouling
  - Wetted Surface Area (vector magnitude)
  - Biofouling Extent & Composition
- Factors influencing biofouling on commercial vessels
- Assessing Risks – useful data for managers
Shipping – Temporal Variation

Shipping - Temporal Variation

From: Secretariat of the Pacific Regional Environment Program
Pacific Ocean Pollution Prevention Program (SPREP-PACPOL)
Shipping Traffic

Over a 2 yr period for Ca, Or & Wa:

• 29,282 vessel arrivals
• 64% overseas : 34% domestic (2% unknown)
• Overseas arrivals
  - Worldwide
  - Dominated by NW & NE Pacific donor regions
  - Containerships predominate
Shipping Traffic

Number of vessels donated

- 1 - 10
- 11 - 100
- 101 - 1000
- >1001
Shipping Traffic - Three WC states

![Bar chart showing shipping traffic for CA, WA, and OR. The chart includes categories for unknown, coastal, and overseas traffic. CA has the highest unknown traffic and coastal traffic, WA has medium unknown and coastal traffic, and OR has the lowest traffic in all categories.](chart.png)
Shipping Traffic - WSA by Ship Type

WSA: Length, Breadth, Draft & Coefficients
Total WSA over 2 yrs = 265.6 million m² (102 sq miles)
Ship Type: Average Wetted Surface Area

[Bar chart showing WSA (m²) for different ship types: Auto, Barge, Bulker, Container, General, Other, Passenger, Tanker. The WSA values range from 0 to 12000 m².]
WSA Variation by port: e.g. California’s ports

Containerships

Other ship types
Recap: shipping traffic and the hull fouling vector

- 29,282 West Coast arrivals ≈ 265 million m² surface area
- 2:1 ratio of overseas to domestic coastwise traffic
- Worldwide donor distribution
- Dominant transoceanic contribution
- Dominant containership contribution
- Strong connectivity between West Coast Ports
- Variation in vector magnitude
  - between ship types
  - between ports
Biofouling density?

What is the extent & composition of biofouling on vessels?

What are the factors that dominate biofouling accumulation?

Is there an effect of ship type on biofouling accumulation?

Logistics?
Biofouling density?

Rudder (trailing edge)
Biofouling density?  Rudder (trailing edge)

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Biofouling density?

Rudder (trailing edge)
Biofouling density?

Propeller shaft
Biofouling density?  

Propeller shaft
Biofouling density?

Propeller shaft
Biofouling density?

Hull surface
Biofouling density?

Hull surface
Biofouling distribution

10 vessels examined on dry dock

- hull: n=10
- propeller: n=6
- rudder: n=5
- stern tube: n=6
- bow thruster: n=1
- sea chest: n=4
- intakes: n=10

percentage of vessels
Biofouling distribution

9 containerships examined by diver

- hull: n=9
- propeller: n=9
- rudder: n=9
- stern tube: n=9
- bow thruster: n=5
- sea chest: n=2
- intakes: n=1

percentage of ships examined
Factors that determine biofouling accumulation

- harbor residence time
- vessel speed
- voyage duration
- surface area & complexity
- voyage routes & geography
- environmental factors (salinity, temperature)
- season
- hull husbandry
- antifouling regime
## Vector variation among ship types

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<tr>
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<th>Proportion of World fleet</th>
<th>Proportion of US foreign arrivals</th>
<th>Ballast Water</th>
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<tbody>
<tr>
<td></td>
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<td>% of US arrivals discharging</td>
<td>average volume discharged</td>
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<td>Auto</td>
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<td>Bulker</td>
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<td>Containership</td>
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<td>Dry cargo</td>
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<td>Tanker</td>
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**Hull Fouling**

- Average port duration
- Average speed

Davidson, Ruiz & Brown (in prep)
Recap: hull fouling research & risk assessment

*Knows*:

Variation in magnitude & frequency of hull fouling
- by ship type
- by port

*Don’t knows*:

What is the extent (and composition) of biofouling on commercial vessels arriving to West Coast ports?

Is there a causal effect of vessel behavior (ship type)?

How does propagule pressure relate to probability of NIS establishment at West Coast Ports?

Provide data and sound risk assessment that is useful to decision-makers
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