

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



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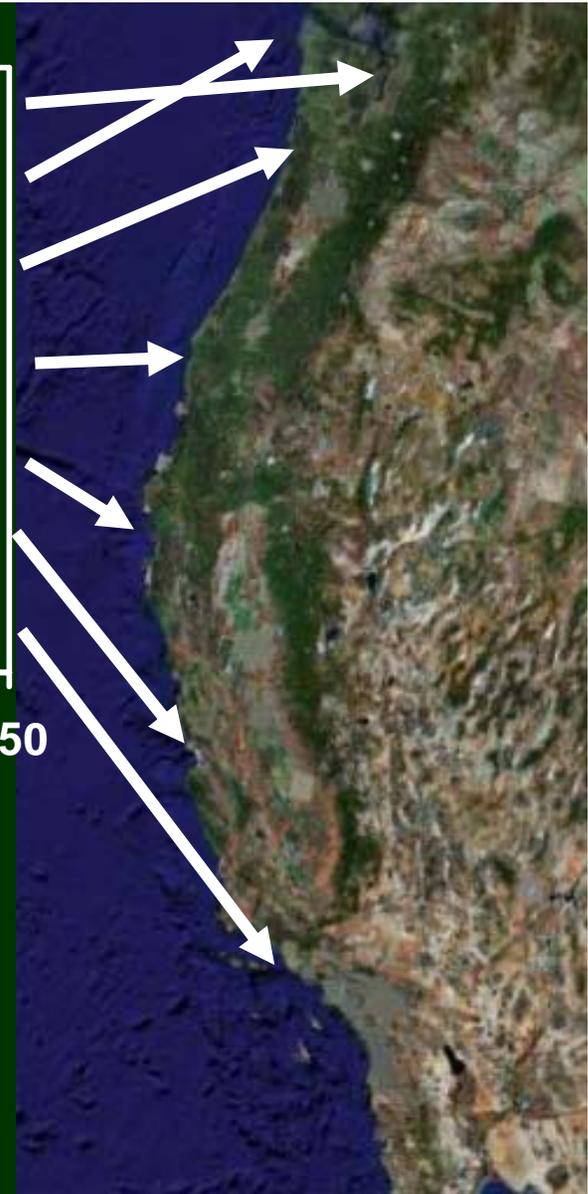
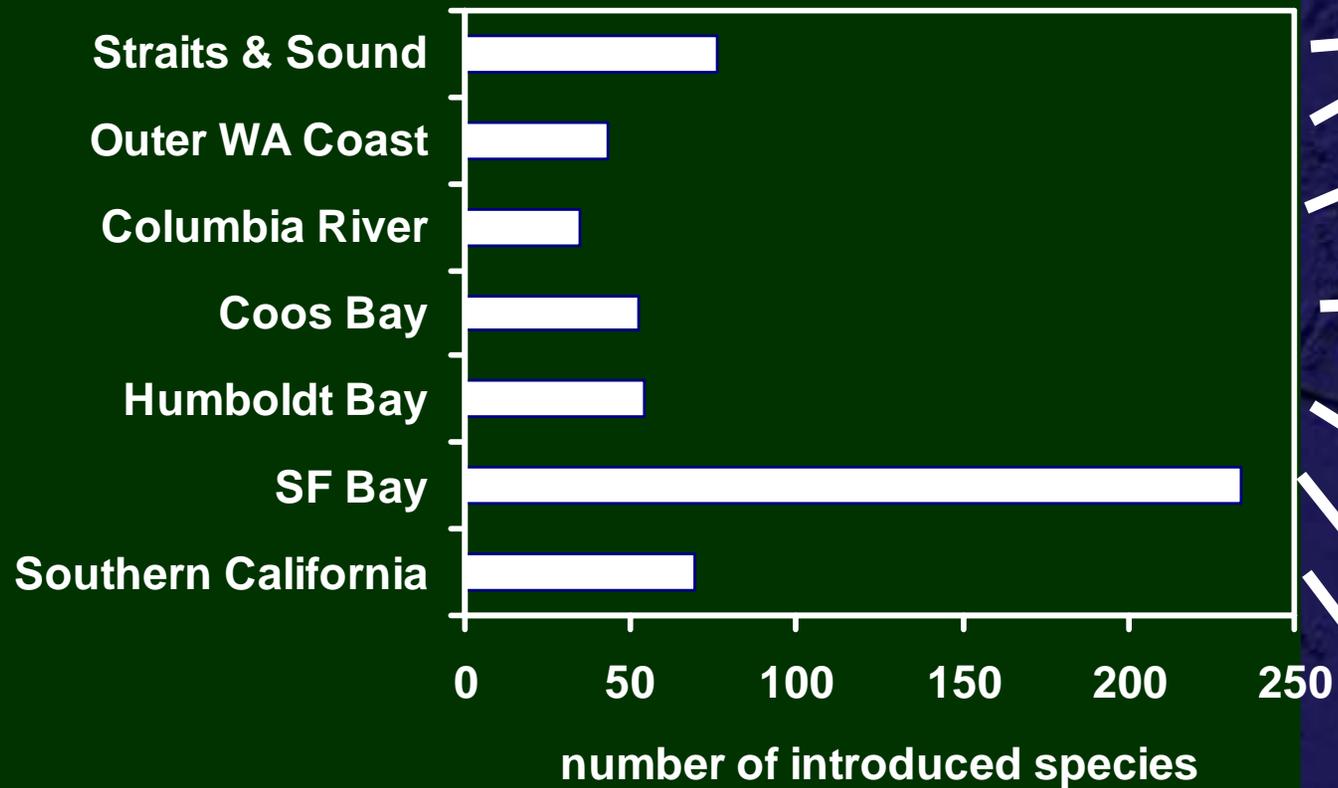
Aquatic Bioinvasion Research & Policy Institute

Portland State University & Smithsonian Environmental Research Center

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

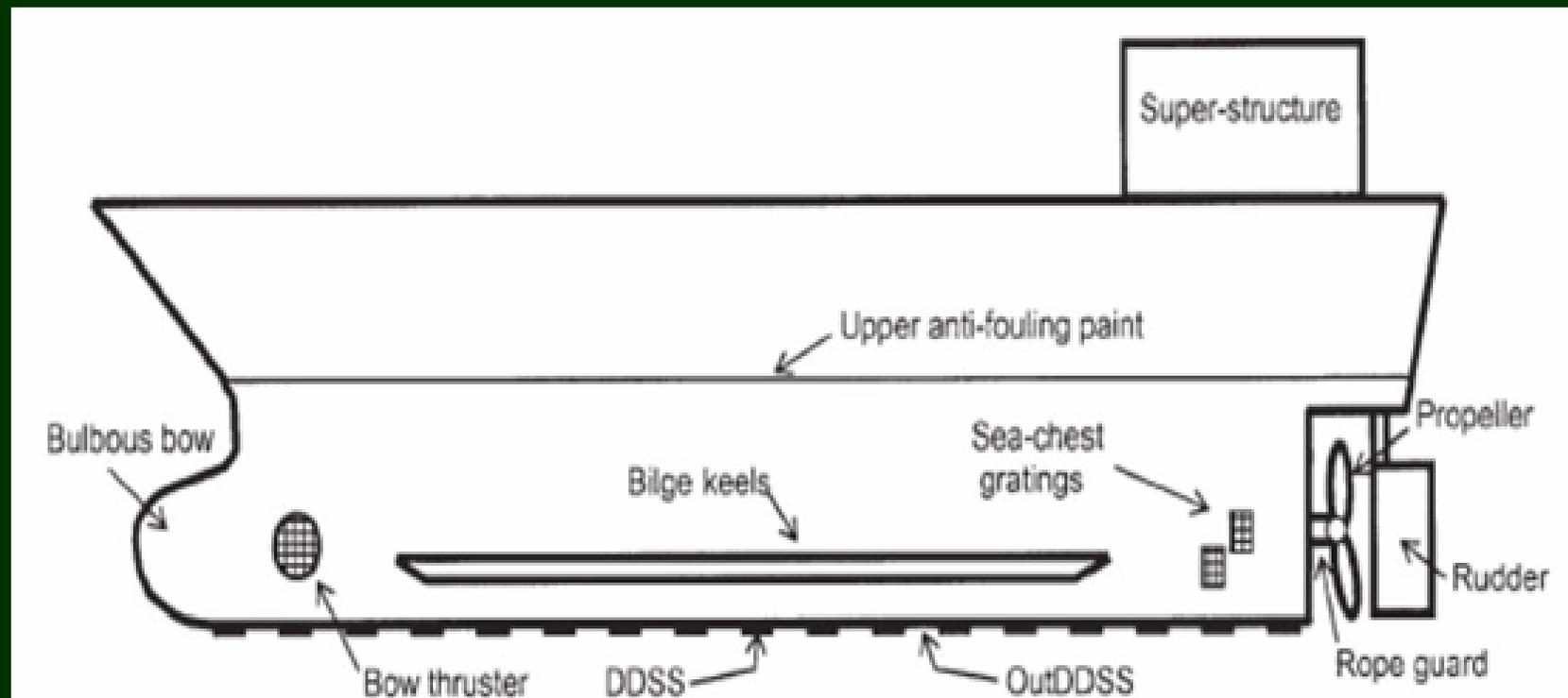
U. S. West Coast Introductions



Data from: USGS NAS database; Cohen & Carlton 1998; Wonham & Carlton 2005

The hull fouling vector

Centuries-old vector
Biofouling hotspots



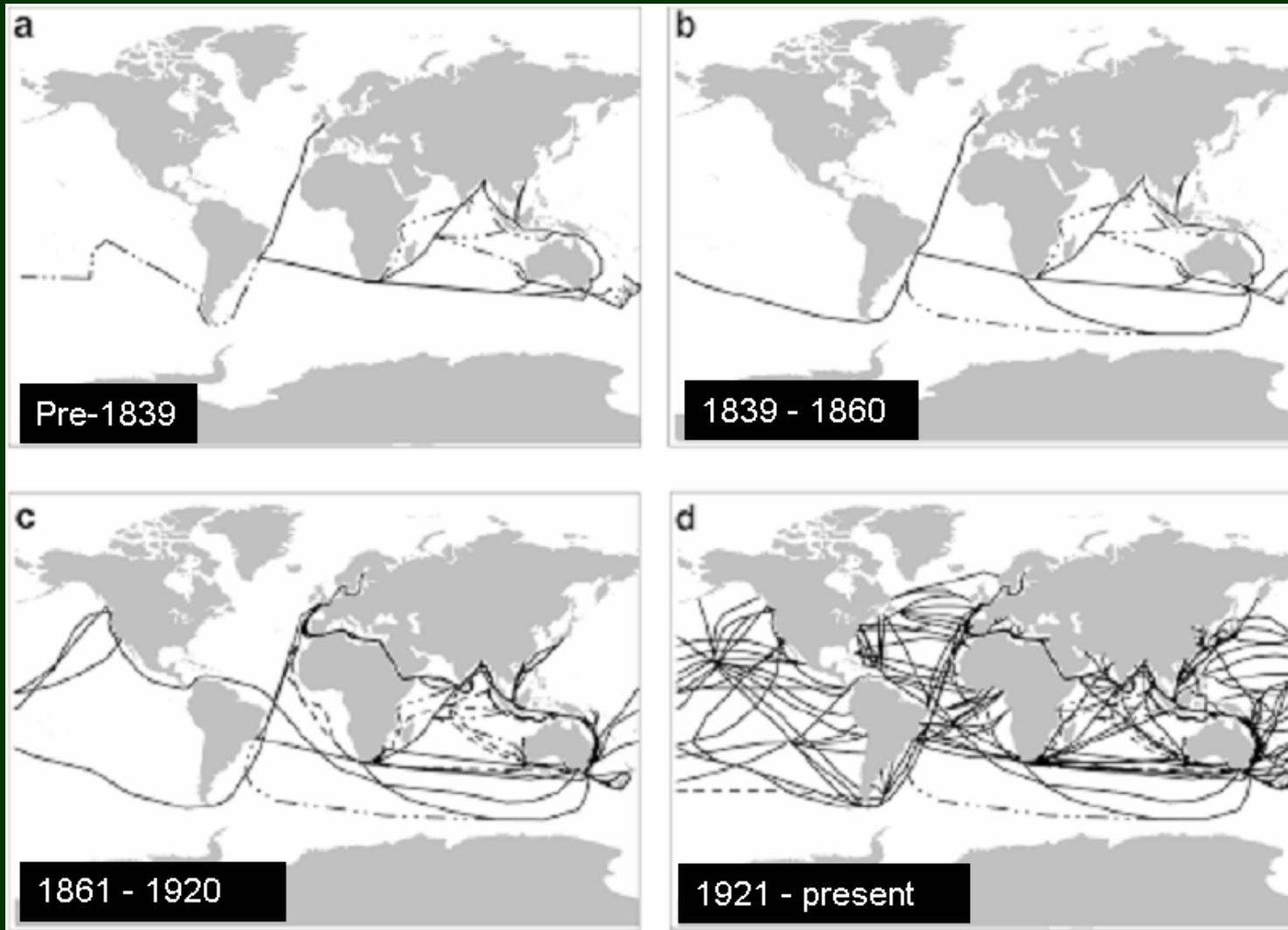
From: Coutts & Taylor (2004) NZ J Mar FW Res. 38: 215-229

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



From: Hewitt et al (2000) Marine Biology. 144: 183-202

Shipping – Temporal Variation



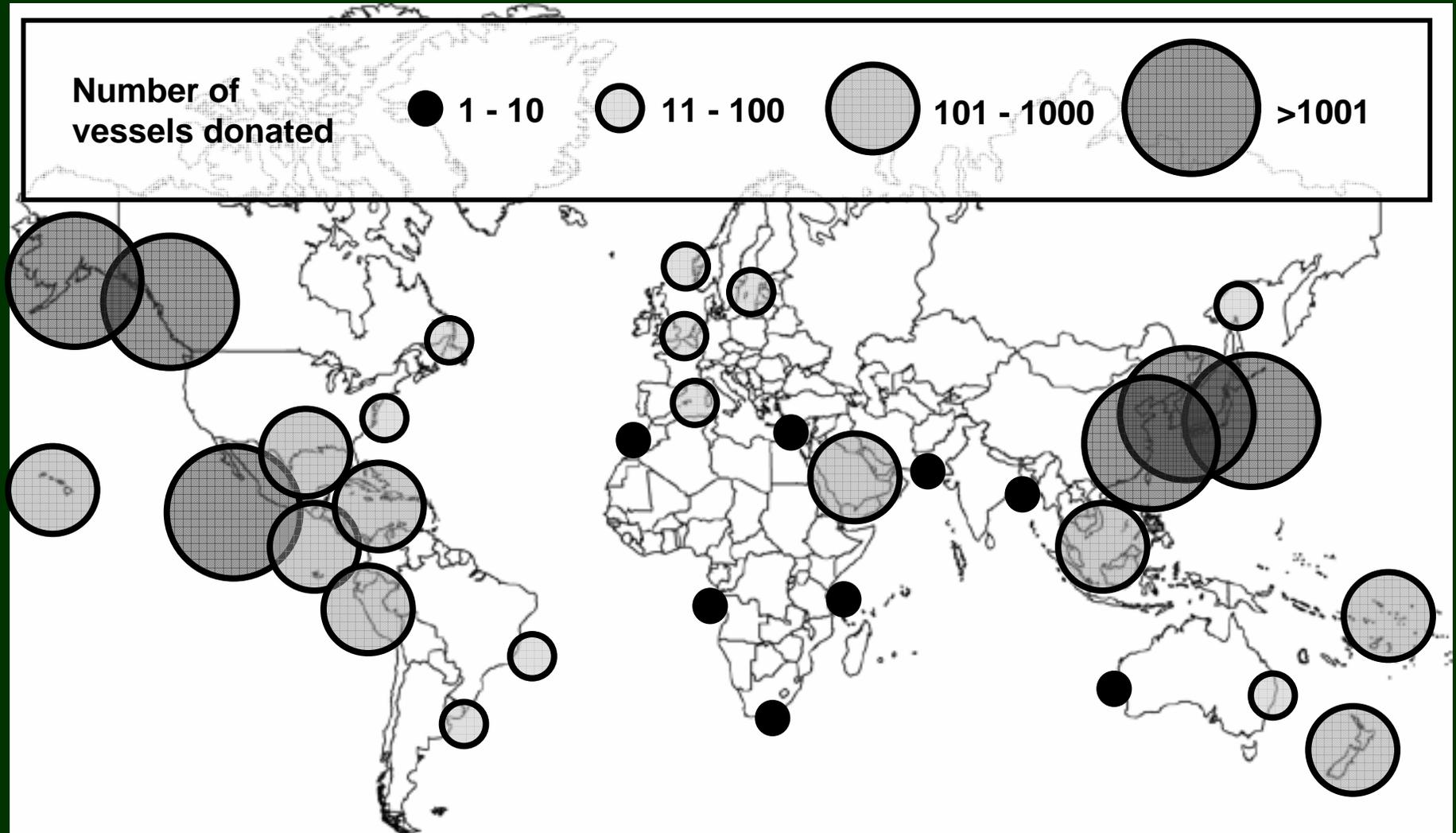
From: Secretariat of the Pacific Regional Environment Program
Pacific Ocean Pollution Prevention Program (SPREP-PACPOL)

Shipping Traffic

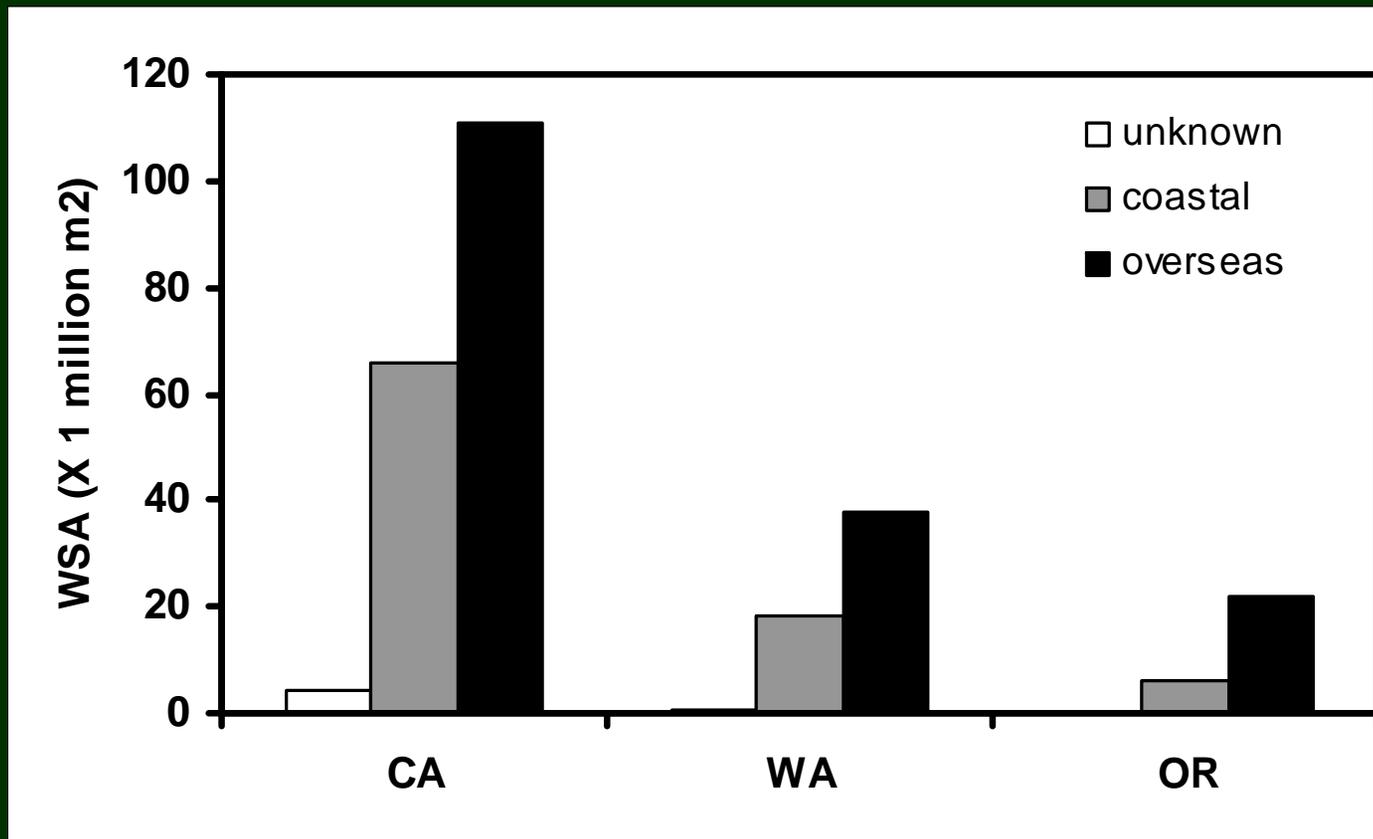
Over a 2 yr period for Ca, Or & Wa:

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

Shipping Traffic



Shipping Traffic – Three WC states

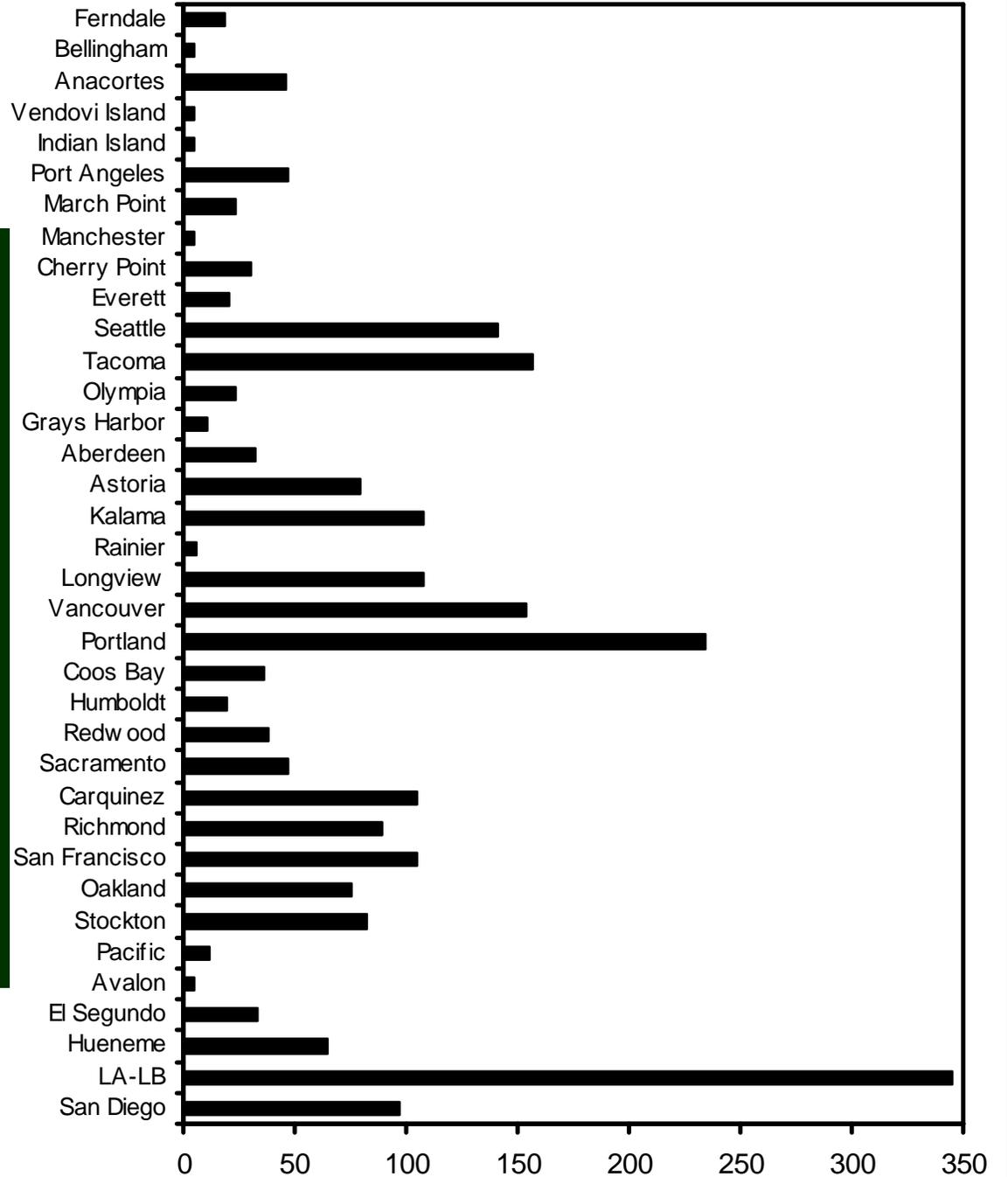


Shipping Traffic

All Arrivals

Last ports of call

West Coast Ports (S to N)

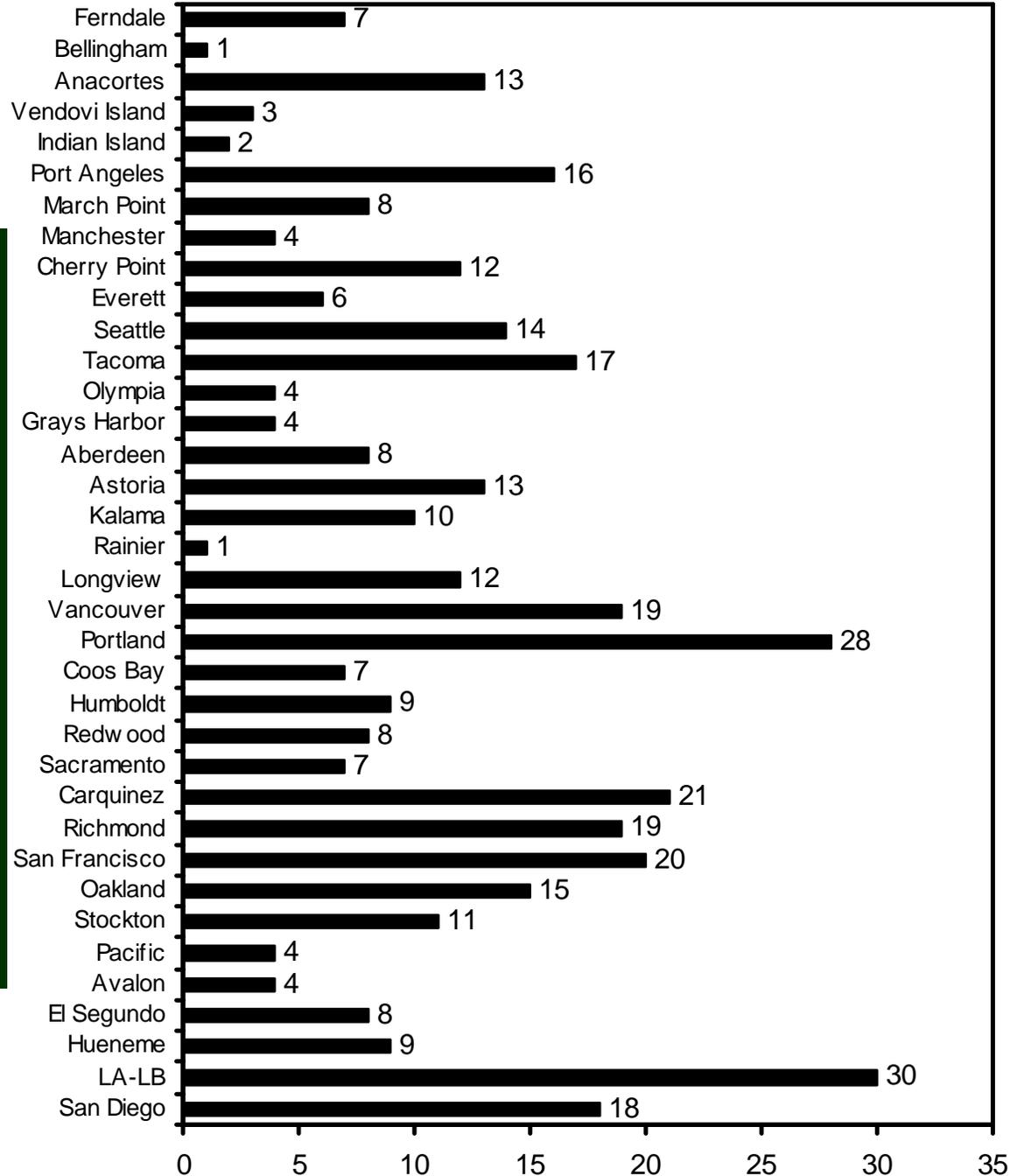


Shipping Traffic

Domestic
Coastwise
Arrivals

Port
Connectivity

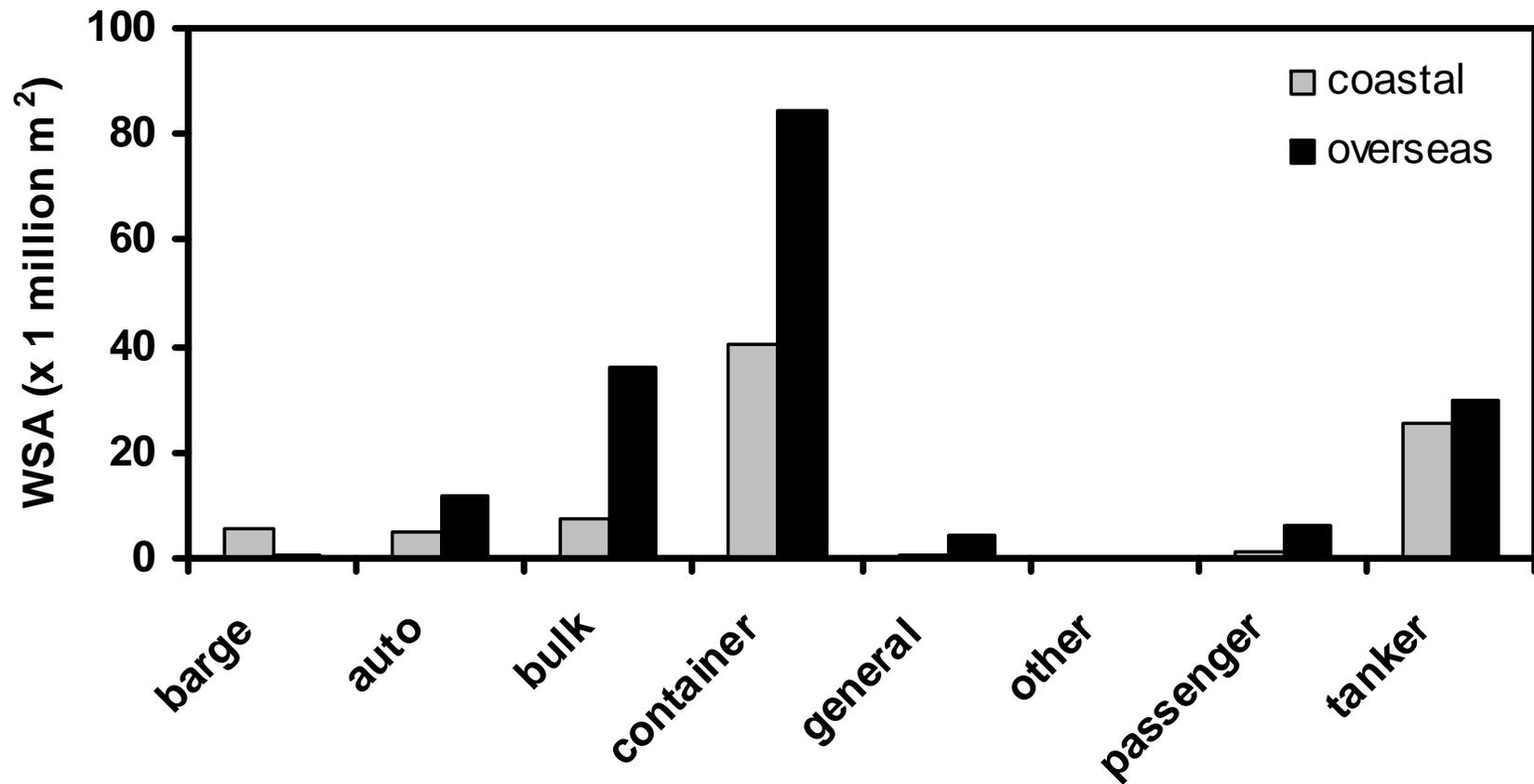
West Coast Ports (S to N)



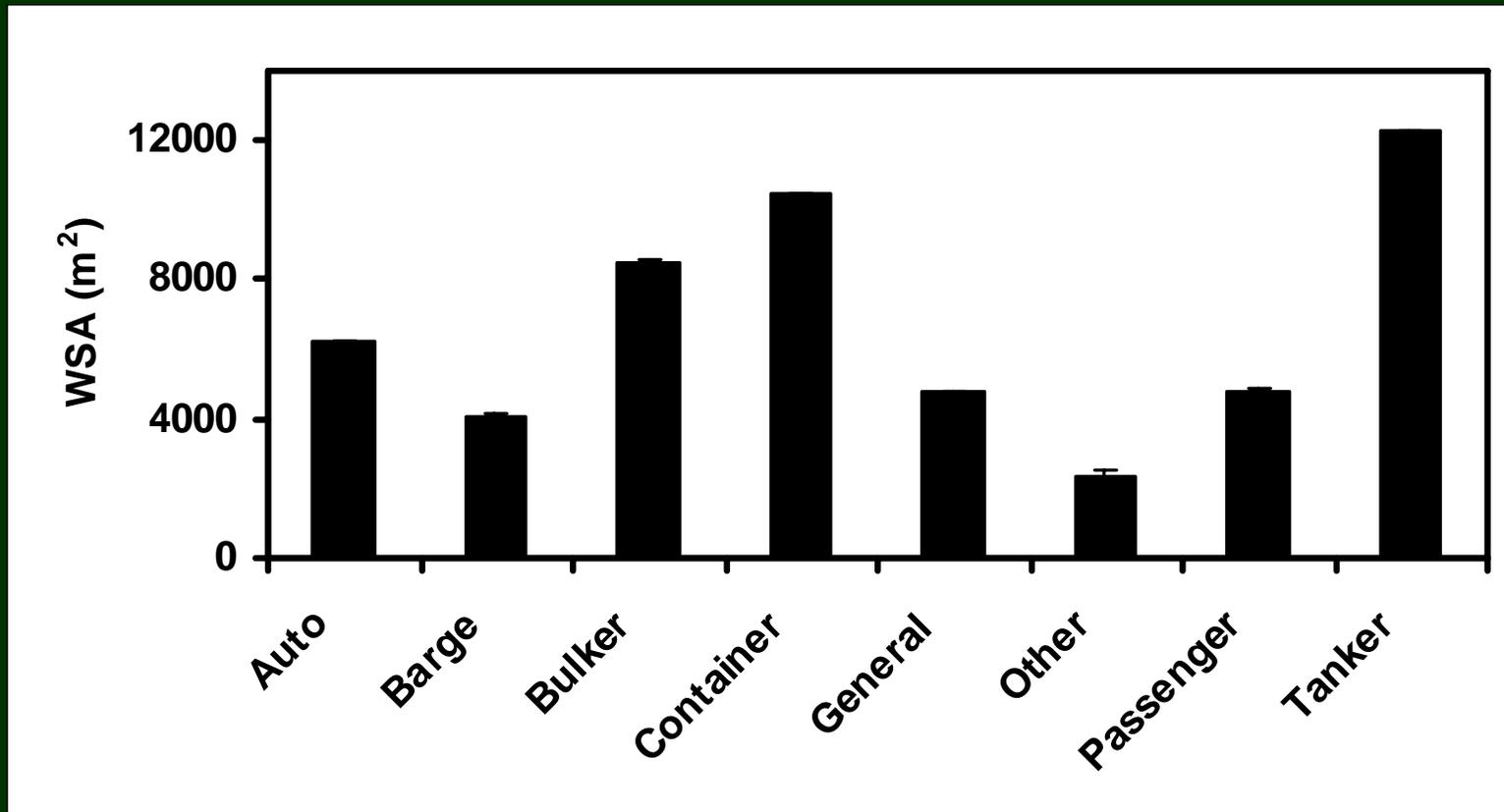
Shipping Traffic – WSA by Ship Type

WSA : Length, Breadth, Draft & Coefficients

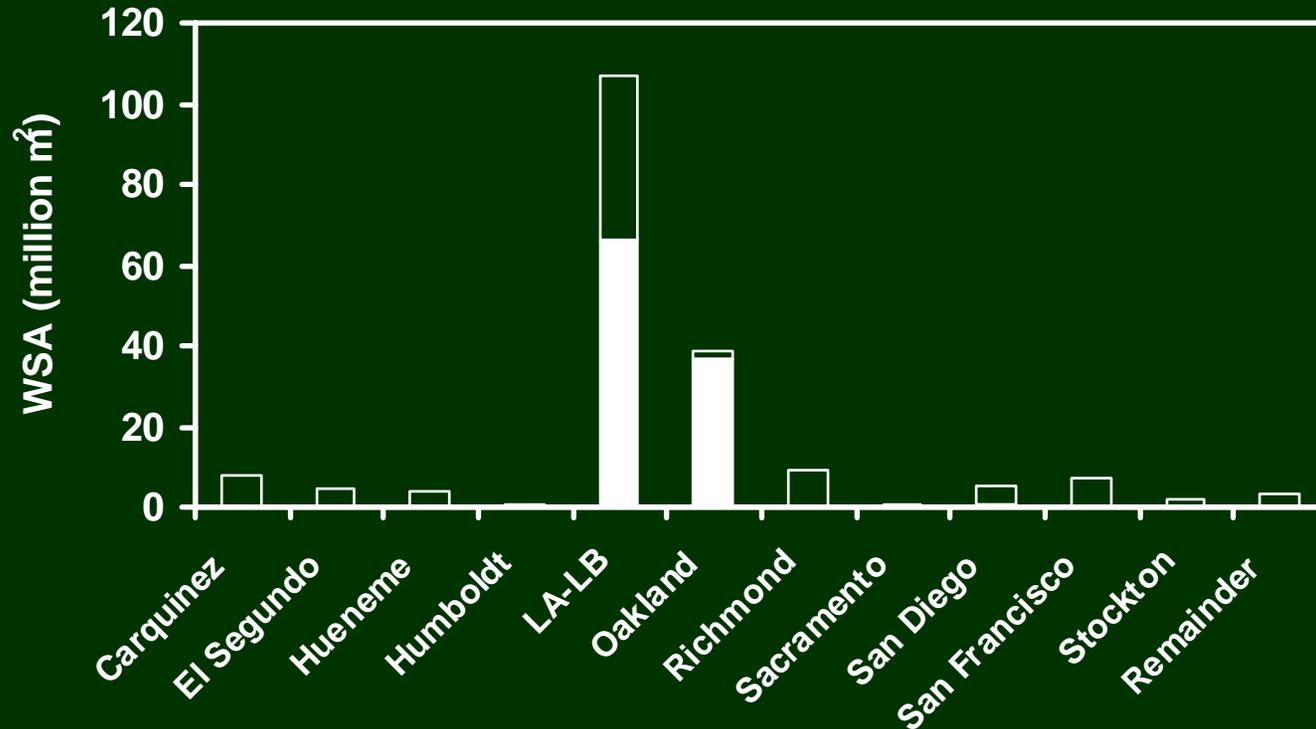
Total WSA over 2 yrs = 265.6 million m² (102 sq miles)



Ship Type: Average Wetted Surface Area



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 \approx 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)



Biofouling density?

Rudder (trailing edge)



Biofouling density?

Propeller shaft



Biofouling density?

Propeller shaft



Biofouling density?

Propeller shaft



Biofouling density?

Hull surface



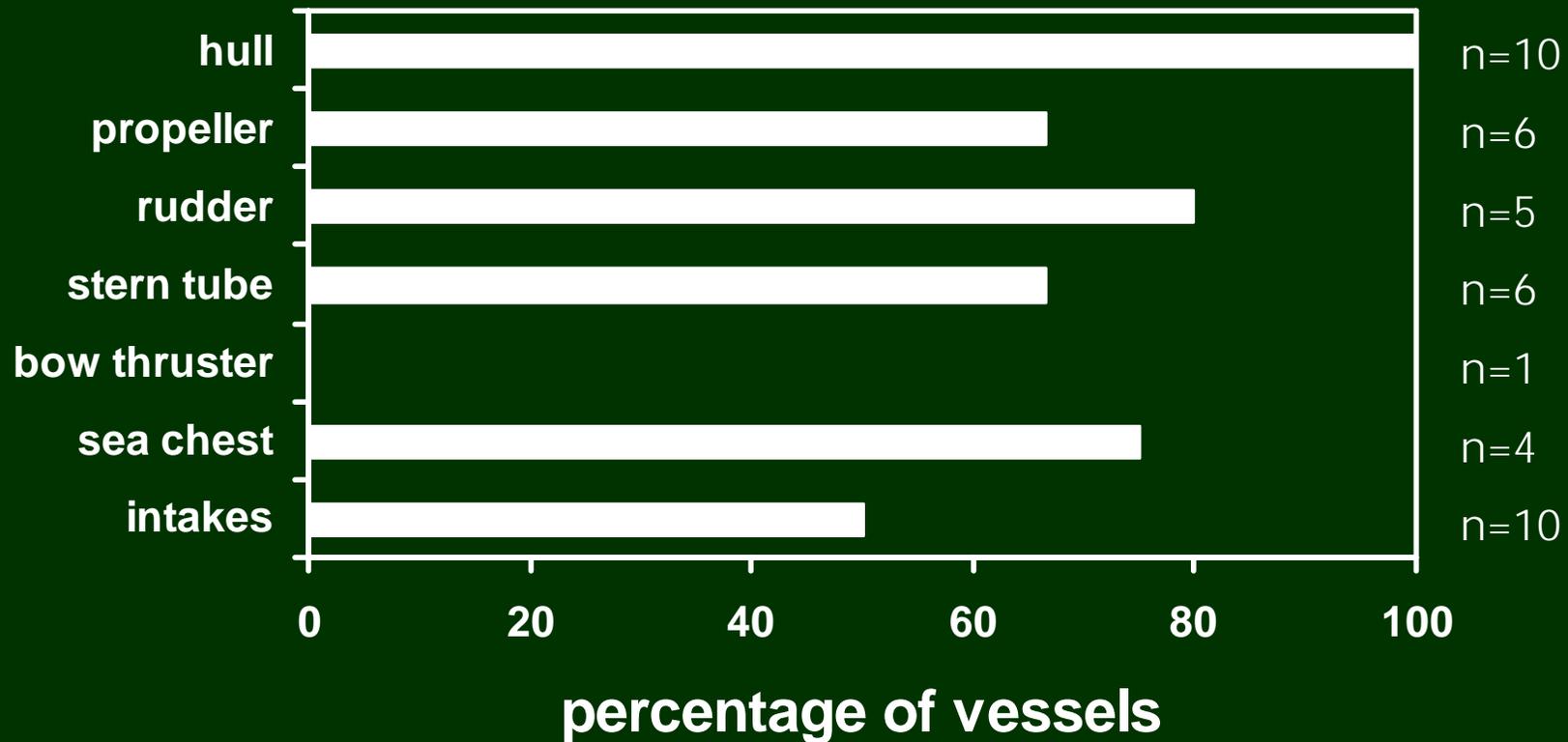
Biofouling density?

Hull surface



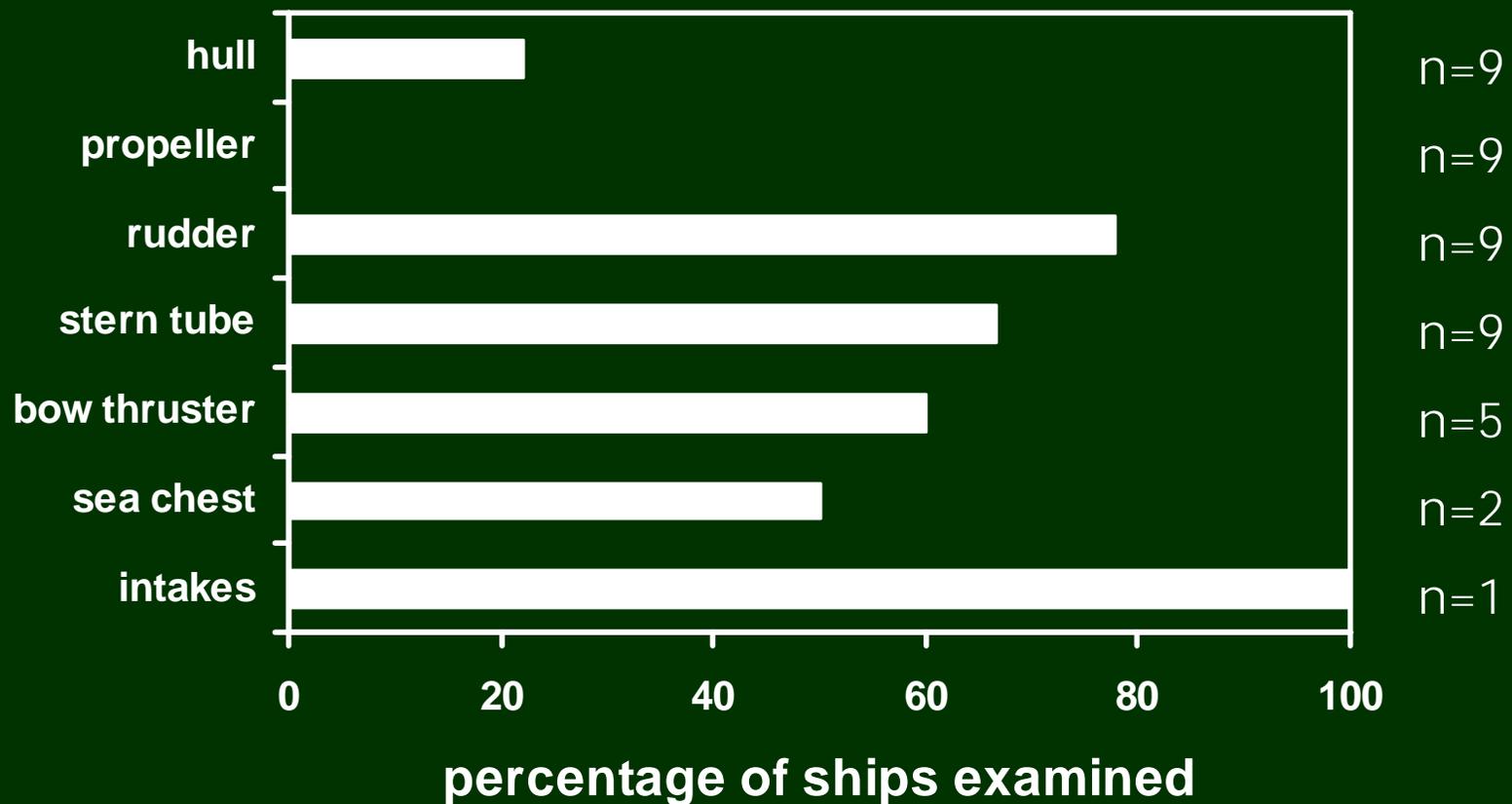
Biofouling distribution

10 vessels examined on dry dock



Biofouling distribution

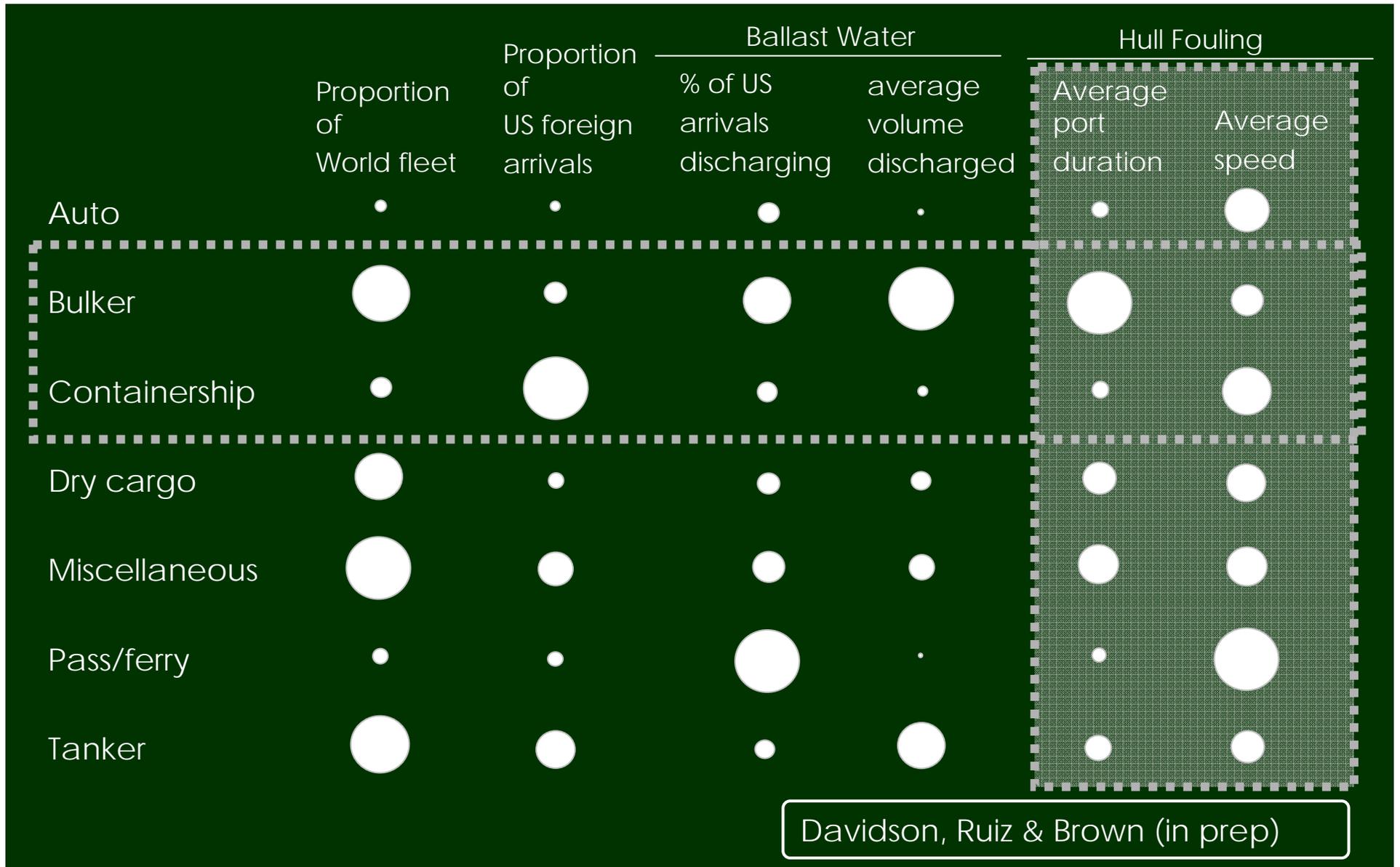
9 containerships examined by diver



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



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

Many Thanks:

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Thanks:

Greg Ruiz & Mark Sytsma

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