Washington Department of Fish and Wildlife

Ballast Water Exchange as a Management Tool

Presented to the

Pacific Ballast Work Group

By

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BWE Effectiveness Study

Objective 4:

Develop recommendations for using ballast water exchange (BWE) sampling as a management tool for minimizing future invasive species risks to Puget Sound.

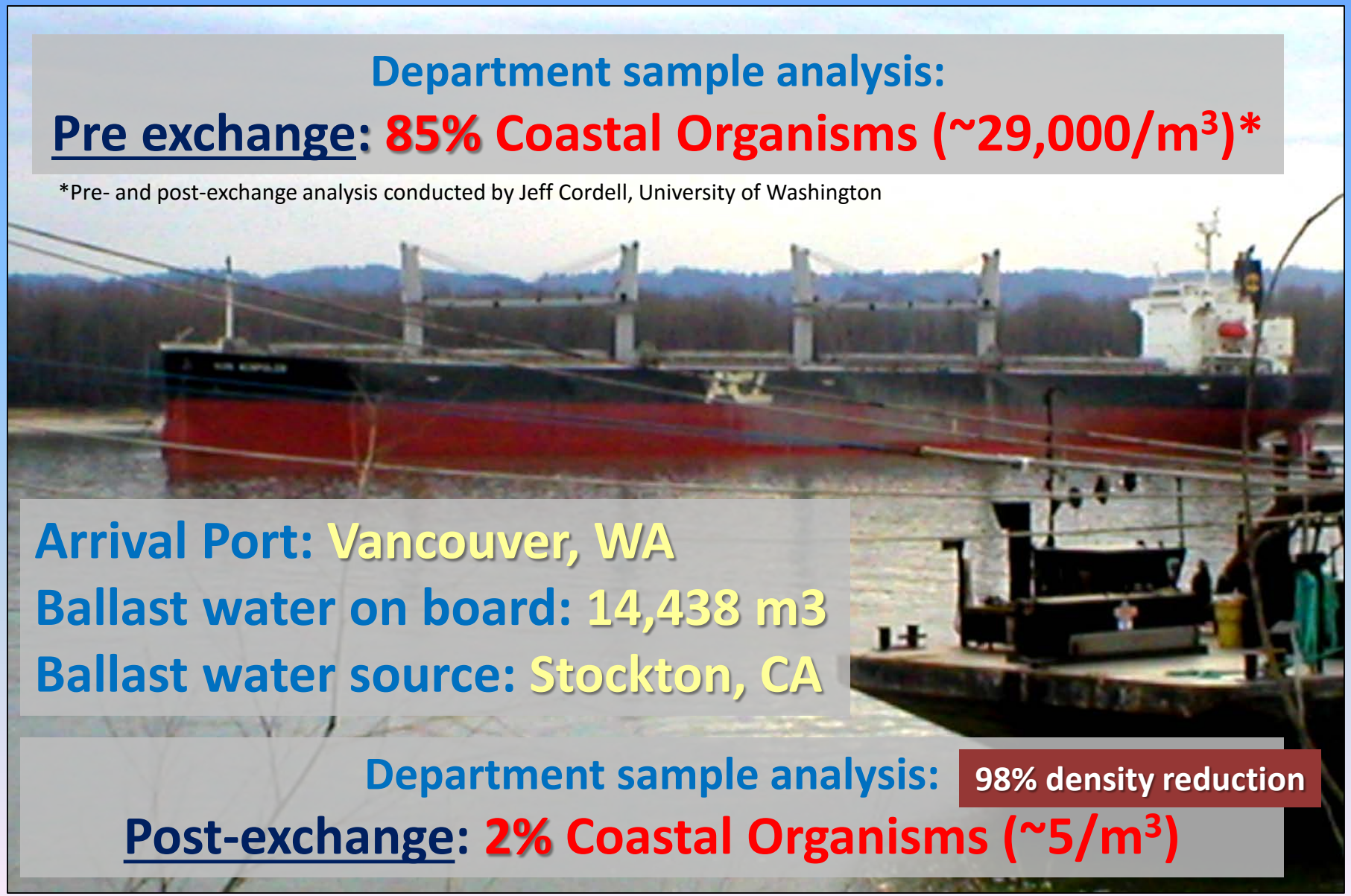
- **Current use of BWE sampling includes:**
  - Estimate overall non-indigenous zooplankton introduction risks to state waters
  - **Demonstrate vessel is carrying high risk ballast water**

WAC 220-150-035

Vessels carrying high risk ballast water

- **Listing factors**:
  - NIS profile of originating waters
  - Volume/frequency of discharge
  - Ballast tank design limitations
  - Unable to conduct BWE outside 50 nm
  - Violation history
  - Frequency of Safety Exemption claims
- **Delisting**:
  - Subsequent BWE sampling shows adequate improvement
  - Changes to BW Treatment System management
  - Completes approved Compliance Plan and/or Alternative Strategy

Case Study: IKAN ACAPULCO



Department sample analysis:

Pre exchange: 85% Coastal Organisms (~29,000/m^3)*

*Pre- and post-exchange analysis conducted by Jeff Cordell, University of Washington

Arrival Port: Vancouver, WA

Ballast water on board: 14,438 m3

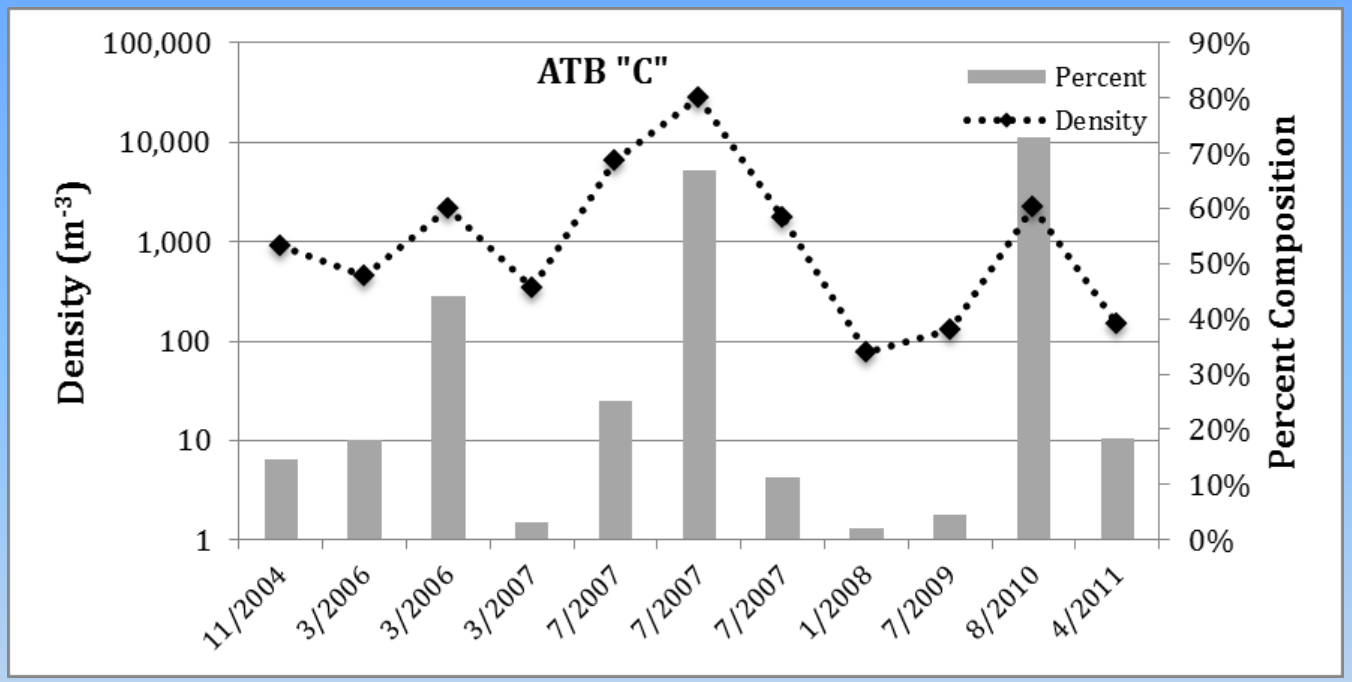
Ballast water source: Stockton, CA

Department sample analysis:

98% density reduction

Post-exchange: 2% Coastal Organisms (~5/m^3)

Case Study: ATB "C"



- **Factors affecting density and percent composition:**
  - Source zooplankton density
  - BWE efficacy
  - Oceanic zooplankton density (% comp)
  - BW age
  - Sampling efficacy

Which values are due to manageable high risk factors?

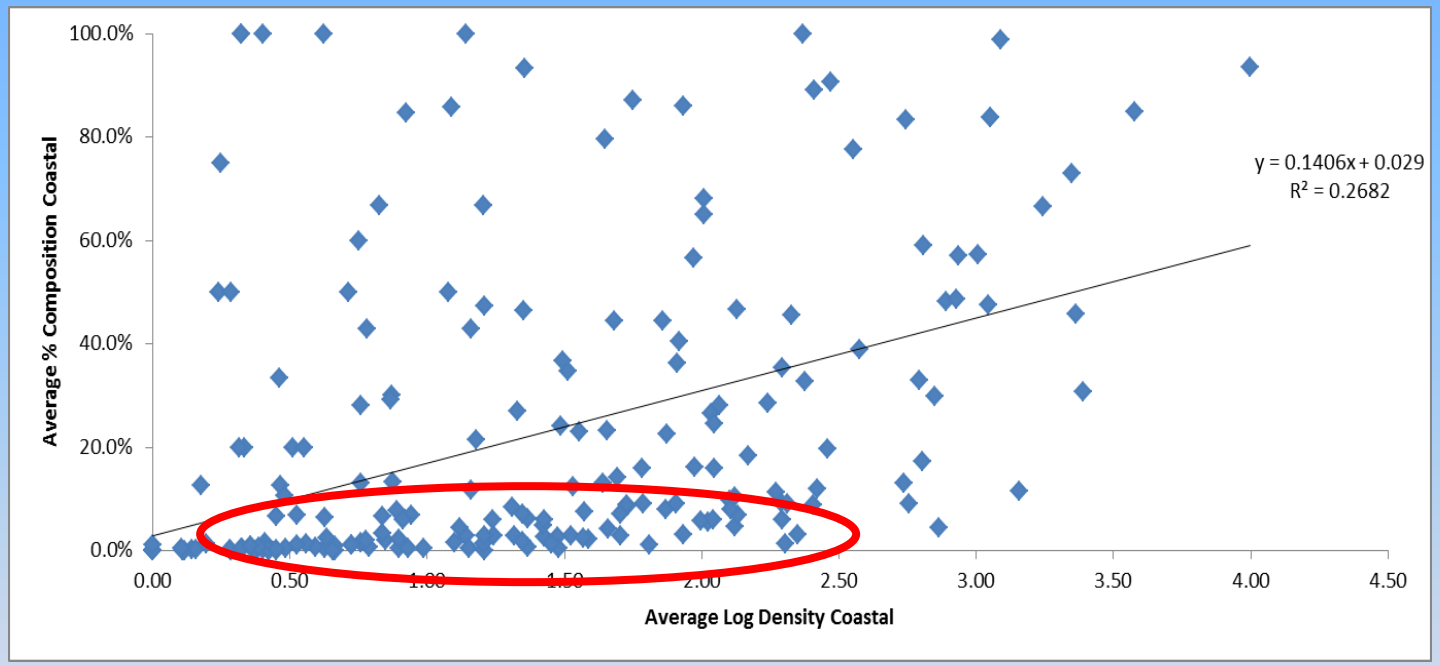
How does this compare to other BWE samples?

Analysis

1. Relationship between percent composition & density
2. Identification of threshold percent composition and density values
3. Application of threshold values for identification of higher risk samples
4. Application of a method to identify low, moderate, and high priority vessels for management

Relationship between percent composition & density

- First cut: 2009 – 2014 Trans Pacific & West Coast BWE samples that discharged (n = 283)



- Weak to moderate bias towards higher density/lower percent composition
- Large variation indicates values should be viewed independently

Identification of threshold percent composition and density values

BWE Threshold: Coastal Species	**Sample Size**	**Percent Composition**		**Density** (per m^3)	
	n =	Average	95%CI	Average	95%CI
Trans Pacific (TP)	175	15%	19%	101	164
West Coast (WC)	108	20%	25%	261	450
TP & WC	**283**	**17%**	**20%**	**162**	**244**
Un-Exchanged TP & WC (2001-14)	95	46%	54%	5,677	9,595

- Evaluation of multiple potential thresholds
  - Trans Pacific and West Coast ballast origin
  - Average and 95% confidence interval
- Conservative principle applied
  - Combined ballast origin
  - Further evaluation of percent composition and density values

Application of threshold values for identification of higher risk samples

Percent Composition	Density (per m^3)	Ballast Age (days)	Count
< 17%	≥ 162	All	12
≥ 17%	≥ 162	All	29
≥ 50%	≥ 50 and < 162	All	4
≥ 50%	≥ 10 and < 162	≥ 25	3
		Total	**49**

- Second cut: samples meeting lowest thresholds (n = 92)
- Third cut: application of additional threshold criteria (n = 49)
  - Row 1: anomalous low % comp/high density
  - Row 2: base % comp/minimum density thresholds
  - Row 3: anomalous high % comp/low density
  - Row 4: anomalous high % comp/low density/high ballast age

Application of a method to identify low, moderate, and high priority vessels for management

Management Priority Level	Coastal Comp (%)	Coastal Density (per m^3)	BW Age (Days)	Count	Total
L	< 17	≥ 162 and < 1,000	-	11	20
	≥ 17 and < 50	≥ 162 and < 244	-	4	
	≥ 50	≥ 50 and < 162	-	4	
	< 50	≥ 10 and < 162	≥ 25	1	
M	< 50	≥ 1,000 and < 2,000	-	2	13
	≥ 17 and < 50	≥ 244 and < 1,000	-	7	
	≥ 50 and ≤ 100	≥ 162 and < 244	-	1	
	≥ 50 and < 100	≥ 10 and < 162	≥ 25	3	
H	< 50	≥ 2,000	-	2	16
	≥ 50	≥ 244	-	14	

- Added subjective thresholds to sort out potential efficacy anomalies and improve separation of management priority levels
  - 50% composition; 10; 244; 1,000; and 2,000 per m3 density

Management Priority Level

- **Vessels meeting LOW priority level**
  - Technical Assistance: Letter to alert potential problems and information on common ways to improve BWE
- **Vessels meeting MODERATE priority level:**
  - Technical Assistance: Letter to alert potential problems and information on common ways to improve BWE
  - Prioritize for subsequent boardings, higher investigation, and more sampling as resources allow

Management Priority Level

- **Vessels meeting HIGH priority level:**
  - Letter to alert BWE problems
  - Prioritize for subsequent boardings, higher investigation, and more sampling
  - Subsequent sampling with poor BWE efficacy may trigger
    - WAC 220-150-035 Vessels with high risk ballast water
    - WAC 220-150-037 Compliance Plans/Alternative Strategies
- **Further investigation on using this system for a "gross exceedance" non-compliance BWE threshold**

Additional Results

1. Minor variation by ballast origin:

- 53% Trans Pacific and 47% West Coast

2. Minor variation by BWE method:

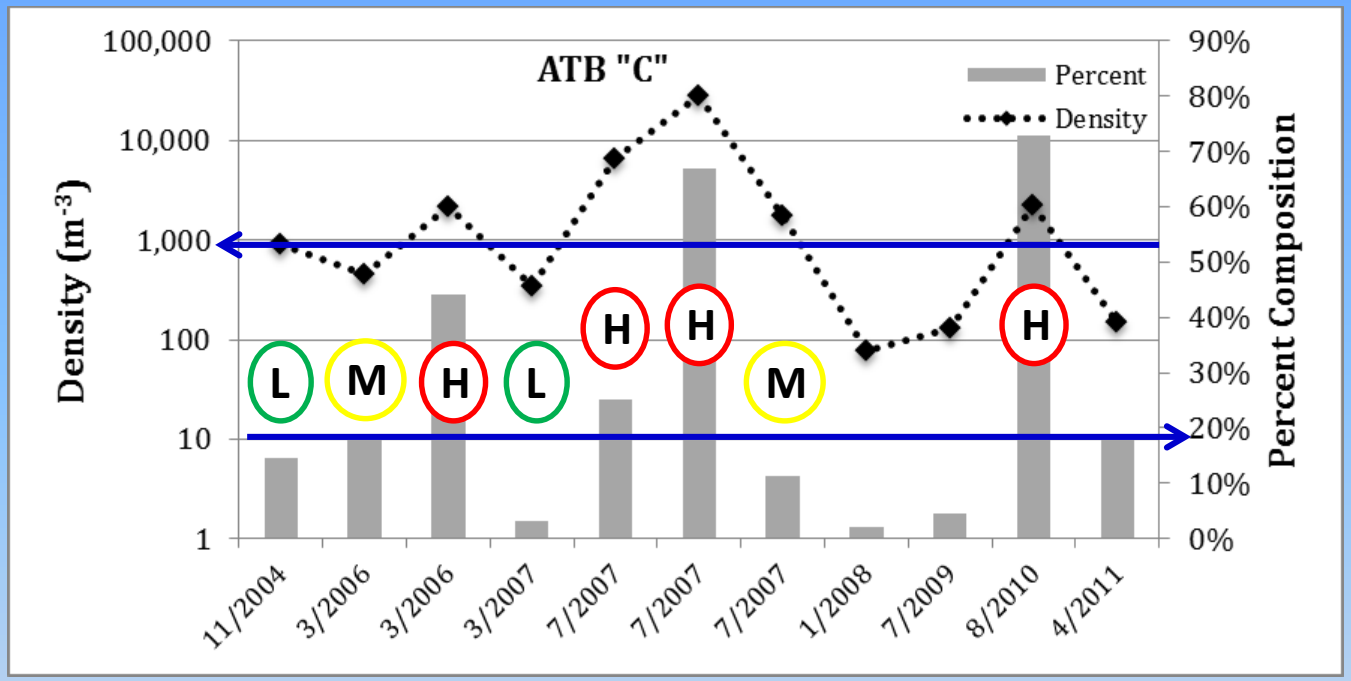
- 57% Flow Through and 43% Empty Refill

3. All but one sample with salinity < 30 ppt.

4. Ship type:

Ship Type/Priority Category	All	Low	Mod	High
Bulk Carrier	15	3	5	7
Oil Tanker	17	10	4	3
Articulated tug-barge	7	2	0	5
Other Tanker	7	4	2	1
Container	3	1	2	0
Total	49	20	13	16

Case Study: ATB "C"



Date	11/04	3/06	3/06	3/07	7/07	7/07	7/07	1/08	7/09	8/10	4/11
Density	911	454	2,127	338	6,483	27,845	1,762	78	131	2,229	147
% Comp	15	18	44	3	25	67	11	2	5	73	18
Priority	L	M	H	L	H	H	M	X	X	H	X

BWE Threshold: Coastal Species	Sample Size	Percent Composition		Density (per m^3)	
	n =	Average	95%CI	Average	95%CI
Un-Exchanged TP & WC (2001-14)	95	**46%**	**54%**	**5,677**	**9,595**

Recommendations

1. Collect and analyze ballast water exchange samples from vessels using risk profiles, data gaps, and random selection criteria.
2. Increase ambient zooplankton research and monitoring efforts in Puget Sound.
3. **Consult with Ballast Water Working Group to define regulatory and management actions based on prioritization thresholds.**
4. Consult with Ballast Water Working Group to determine whether changes to Common Water Zone exemption area are warranted.

Thank You

Questions?