

Balancing the Consequences of In-Water Cleaning of Biofouling to Improve Ship Efficiency and Reduce Biosecurity Risk

Pacific Ballast Water Group | April 24, 2024

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Balancing the consequences of in-water cleaning of biofouling to improve ship efficiency and reduce biosecurity risk

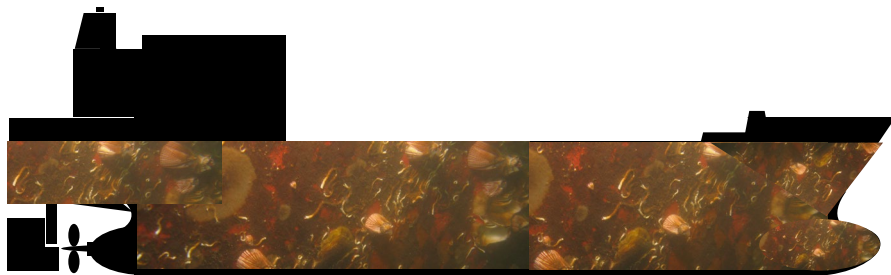
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<https://www.frontiersin.org/articles/10.3389/fmars.2023.1239723/full>

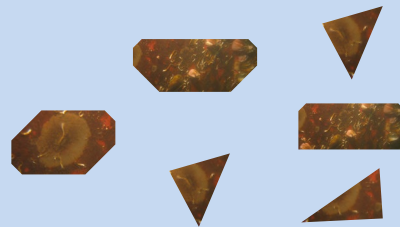
Problem:



Solution: In-water cleaning

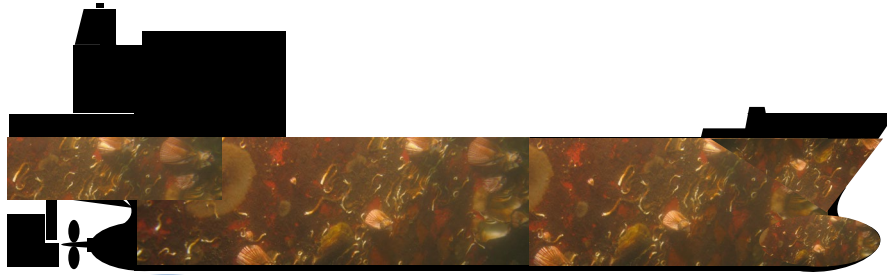


Desired Outcome



Impact

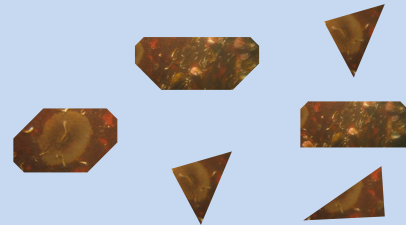
Problem:



Solution: In-water cleaning



Desired Outcome



Impact

Impact Decoupling

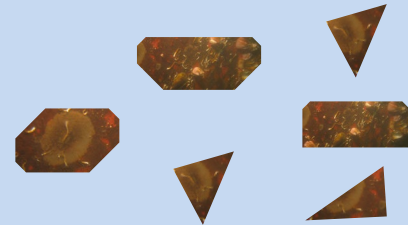
Problem:



Solution: In-water cleaning



Desired Outcome



Impact

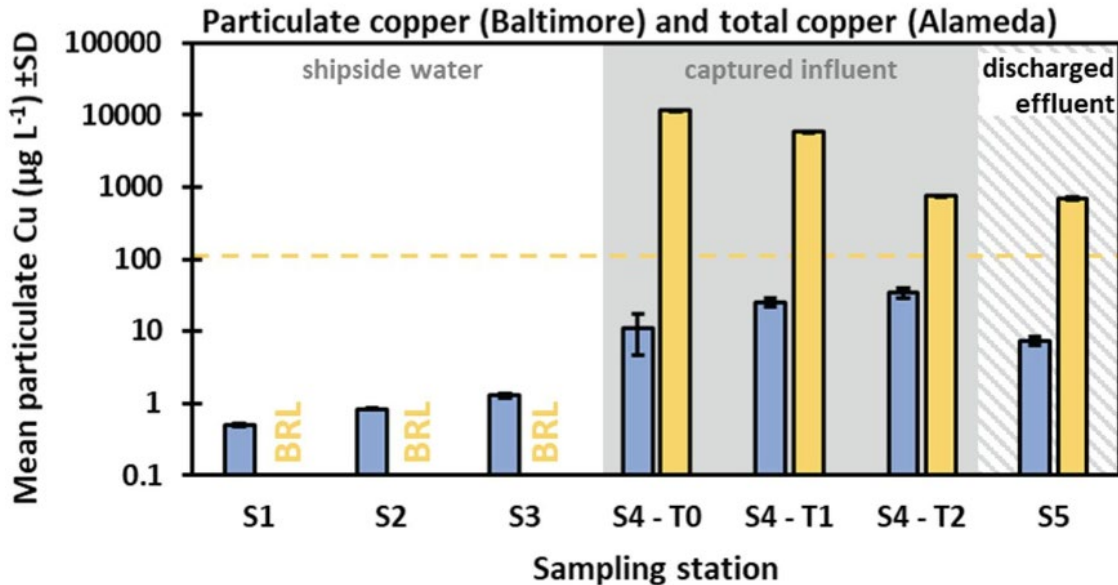
Consequences of In-Water Cleaning

Nonindigenous Species/Biosecurity



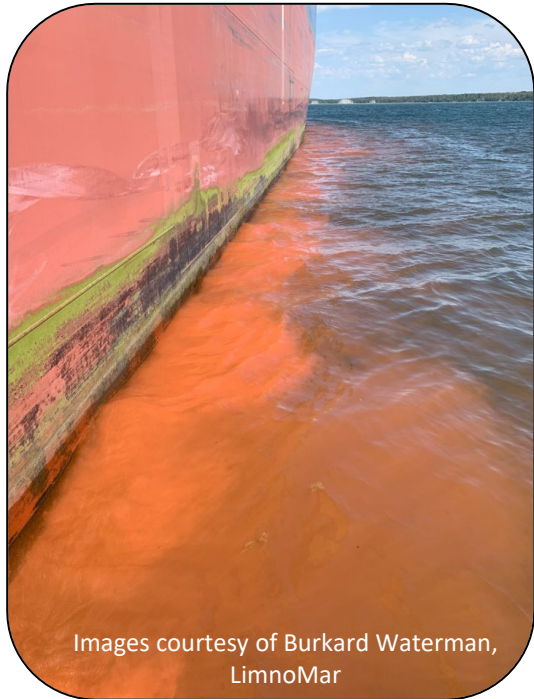
Consequences of In-Water Cleaning

Biocides/Water Quality



Consequences of In-Water Cleaning

Microplastics/Water Quality



Consequences of In-Water Cleaning

Sediment Quality



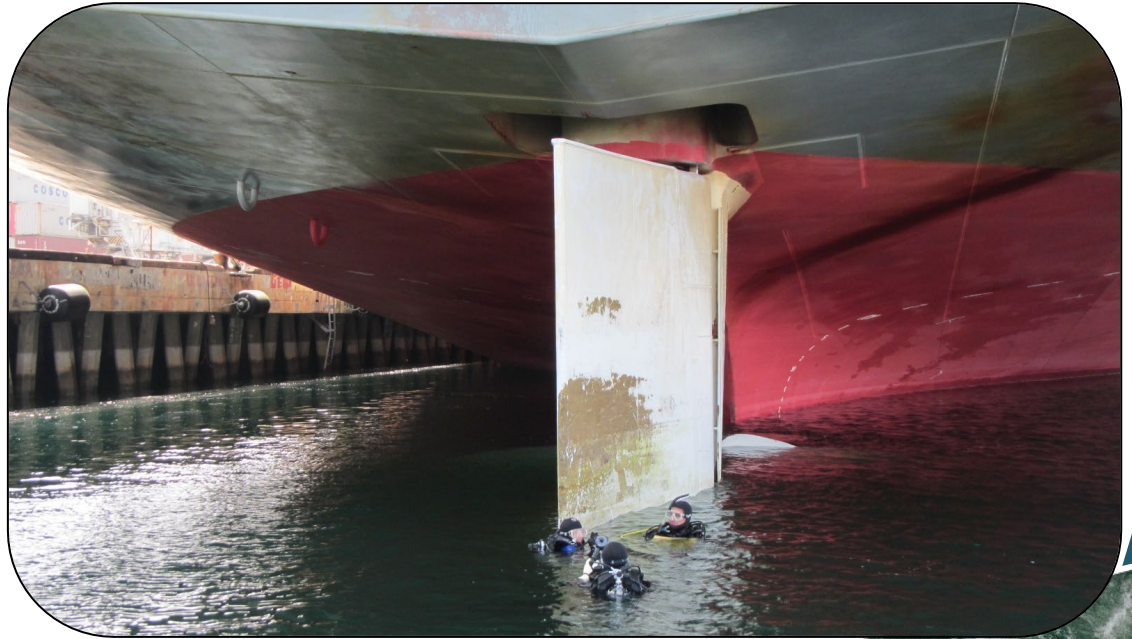
- Accumulation of biocides/microplastics
- Dredging operations
 - Resuspension
 - Redistributing
 - Depth limits leading to increased frequency

["North Korea - Taedong dredging"](#) by [Roman Harak](#) is licensed under [CC BY-SA 2.0](#).

Consequences of In-Water Cleaning

Human Health Impacts

- Diver safety
 - Ship traffic
 - Recesses
 - Suction
 - Visibility
 - Swell
 - Low clearance



Consequences of In-Water Cleaning

Coating Damage and Vessel Efficiency Loss



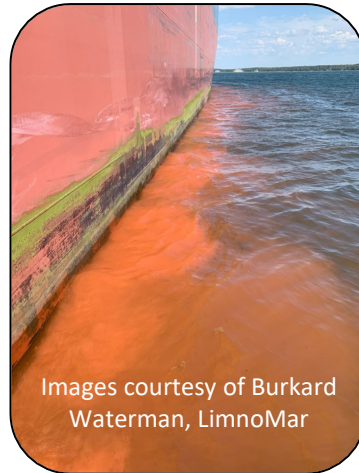
[Tamburri et al. 2020](#)

Consequences of In-Water Cleaning

Facilitating NIS establishment

Creating conditions that are conducive to establishment of nonindigenous species

- Copper contaminated ports facilitate success of copper tolerant species

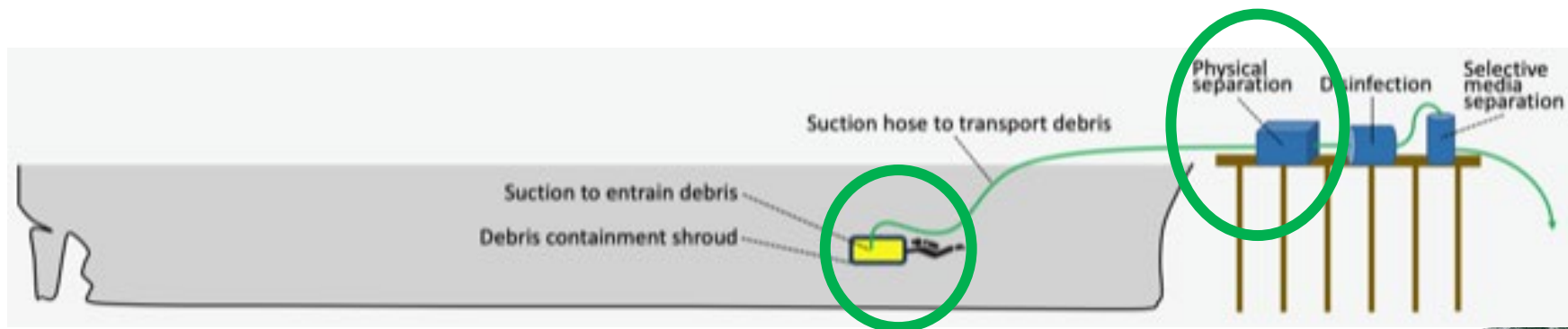




Existing Approaches to Mitigate or Prevent IWC Consequences

Existing Approaches to Mitigate or Prevent IWC Consequences

Capture, separate, and retain particulate and dissolved materials

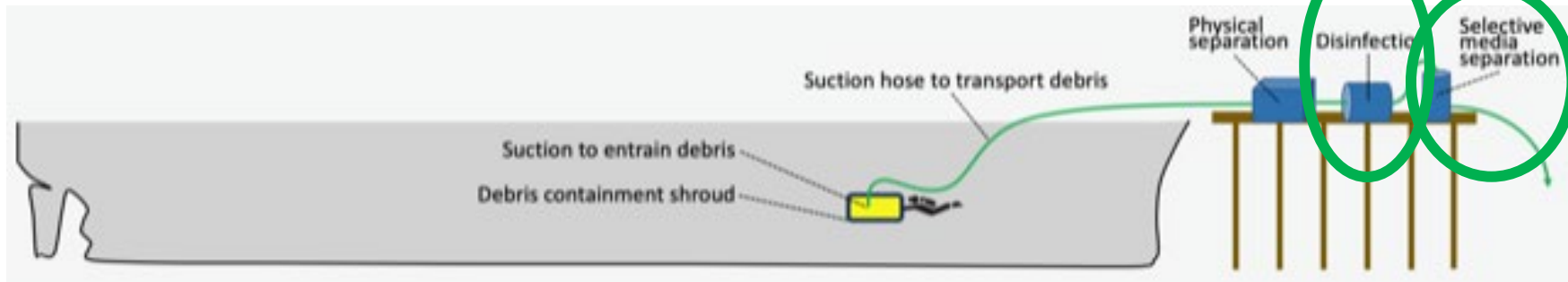


= Primary treatment

Existing Approaches to Mitigate or Prevent IWC Consequences

Additional treatment to:

- Kill organisms (e.g., heat, UV, sodium hypochlorite)
- Remove biocides through selective media separation (e.g., organoclays to bind metal)



= Secondary treatment

Existing Approaches to Mitigate or Prevent IWC Consequences



Proactive IWC

- Less abrasive
 - Likely reduced biocide release
- Paucity of data to support these claims

Existing Approaches to Mitigate or Prevent IWC Consequences

	Time Points	Extractable Mean (SD) (µg/L)
Three background samples 24 h before test	T0	1.82 (0.21)
	T1	1.67 (0.21)
	T2	1.29 (0.18)
One background sample 2 h before test	T3	1.27 (0.31)
During test	B1	3.70 (0.31)
	U1	13.13 (0.95)
	U2	30.04 (0.39)
One background sample 2 h after test	T4	0.98 (0.06)
Three background samples 24 h after test	T5	0.91 (0.11)
	T6	0.67 (0.23)
	T7	1.28 (0.13)

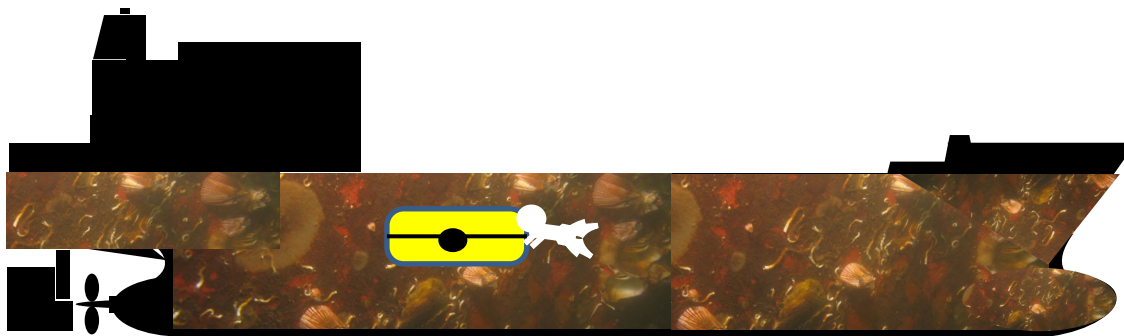
B1 = Background 50m away

U2 = On cleaning head while operational

**We need more of this type of data

Existing Approaches to Mitigate or Prevent IWC Consequences

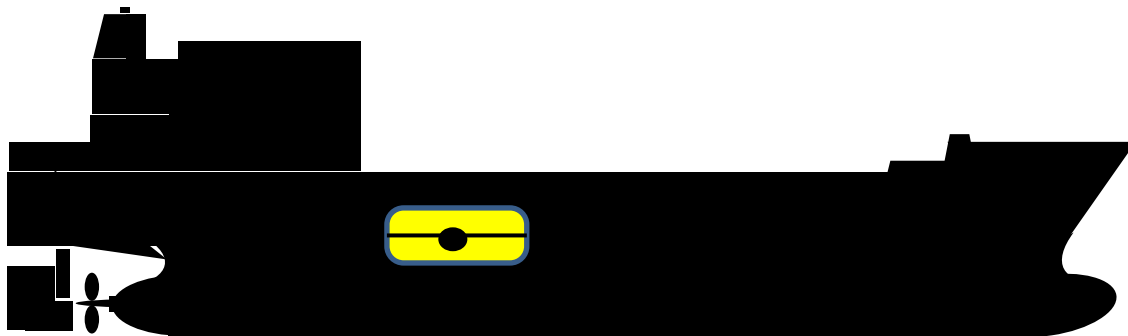
Reactive IWC performed offshore



Diver and crew safety risks

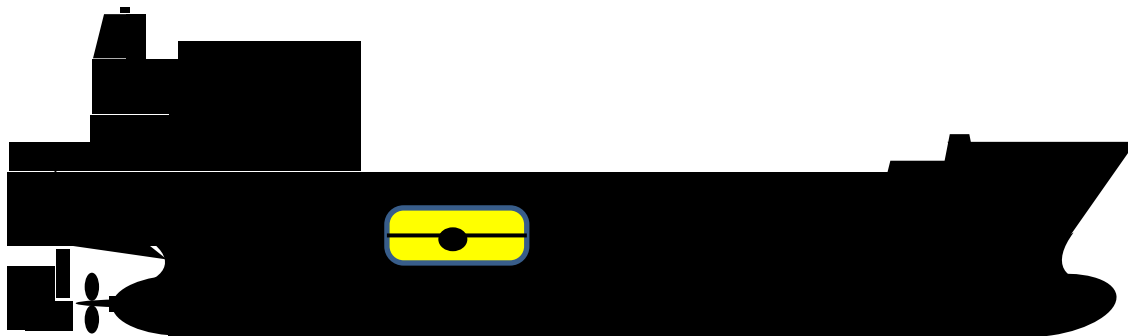
Existing Approaches to Mitigate or Prevent IWC Consequences

In-transit proactive cleaning



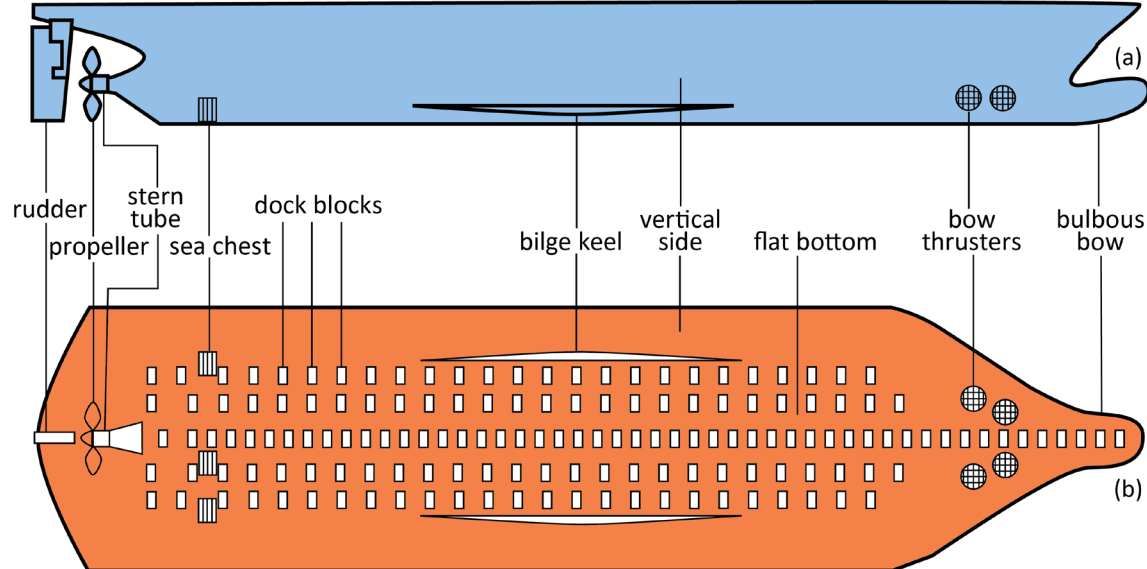
Existing Approaches to Mitigate or Prevent IWC Consequences

Proactive cleaning on biocide-free coatings



Wild Cards

Niche area management





Policy Implications

- Existing approaches all offer some level of risk reduction
 - Some may reduce one type of risk at expense of another
- Policymakers need to be aware of full suite of risks to make fully informed decisions
- Embracing gains now based on current technologies can reduce risks in real time
- Continue making progress by incentivizing innovation



www.slc.ca.gov

THANK YOU & QUESTIONS

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