



# Evaluating the Efficacy and Environmental Impacts from In-Water Cleaning of Commercial Vessels

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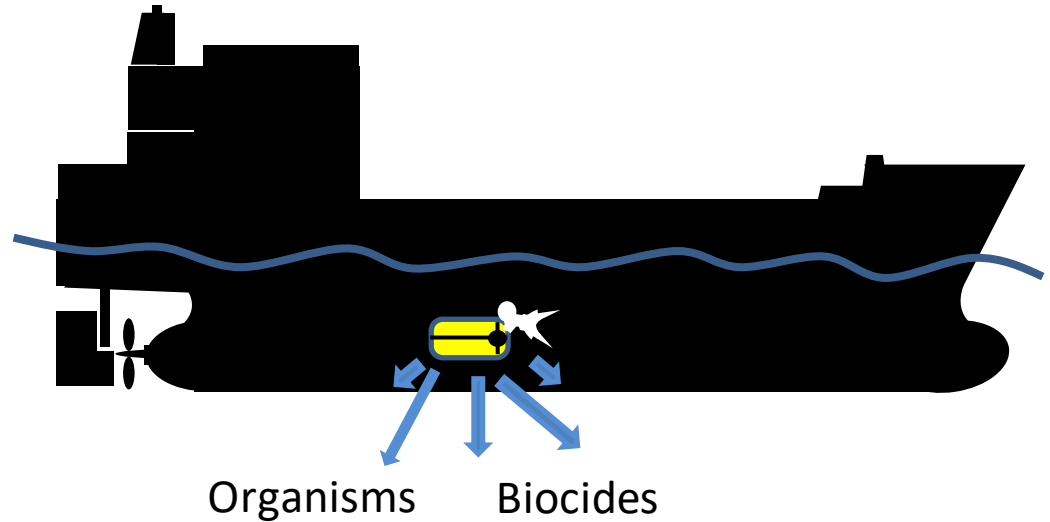
California State  
Lands Commission



## Reactive Cleaning



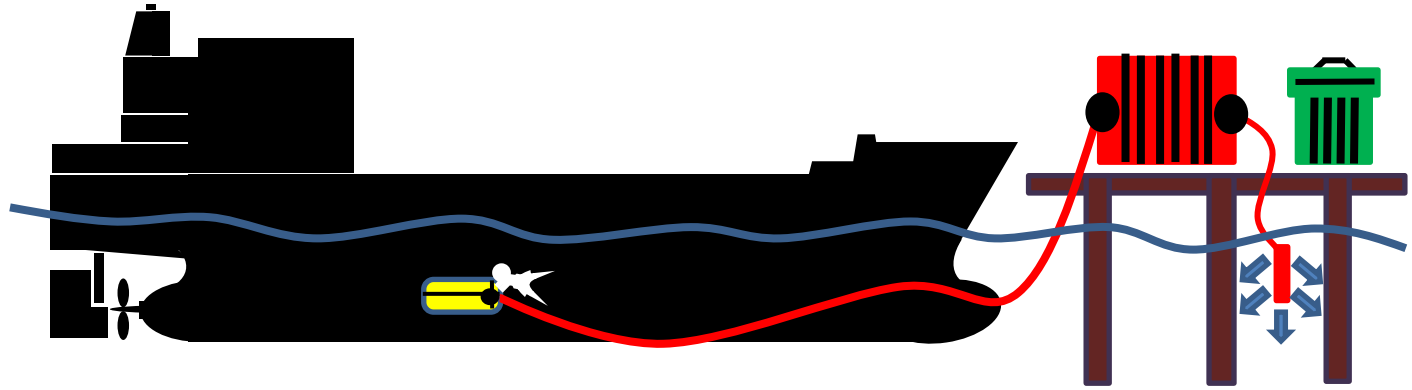
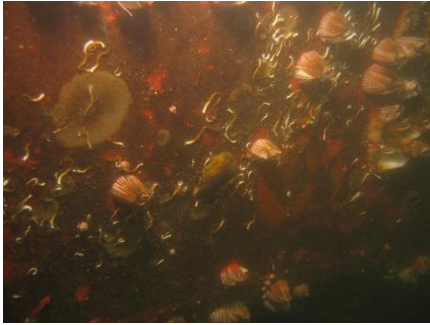
# Traditional paradigm of reactive in-water cleaning



Modified from: Scianni and Georgiades 2019

<https://www.frontiersin.org/articles/10.3389/fmars.2019.00467/full>

# Newer Paradigm of Reactive In-Water Cleaning *and Capture*



Modified from: Scianni and Georgiades 2019

<https://www.frontiersin.org/articles/10.3389/fmars.2019.00467/full>

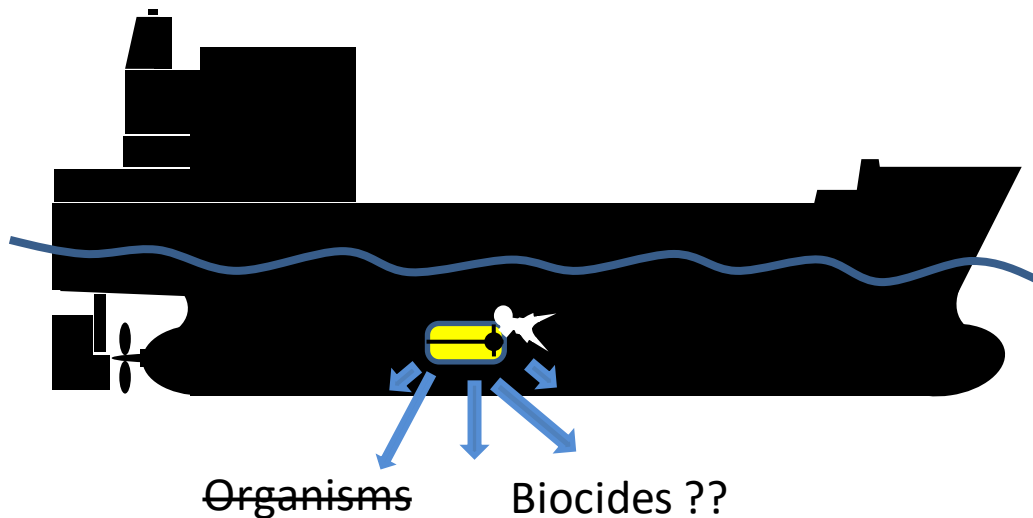
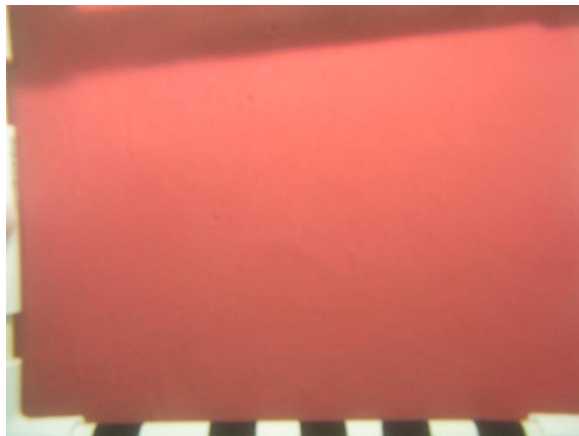
## Questions:

- How well do the systems clean?
- How well do the systems contain the removed debris at the point of cleaning?
- How well do the systems filter/treat the effluent before discharge?

# Proactive Cleaning



# Proactive in-water cleaning

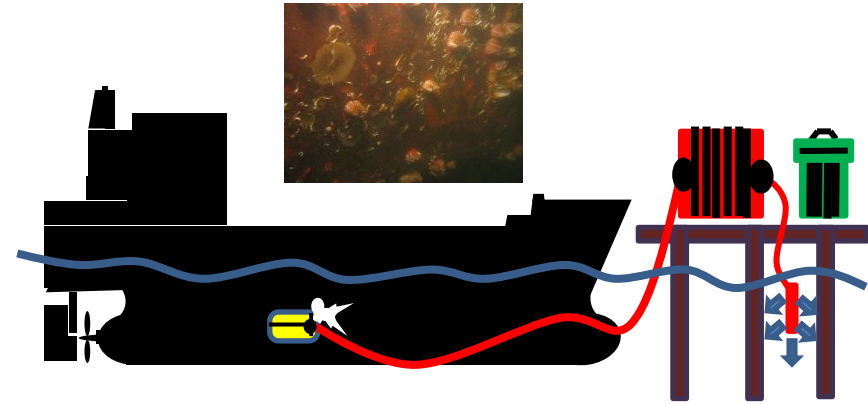


Modified from: Scianni and Georgiades 2019  
<https://www.frontiersin.org/articles/10.3389/fmars.2019.00467/full>

## Questions:

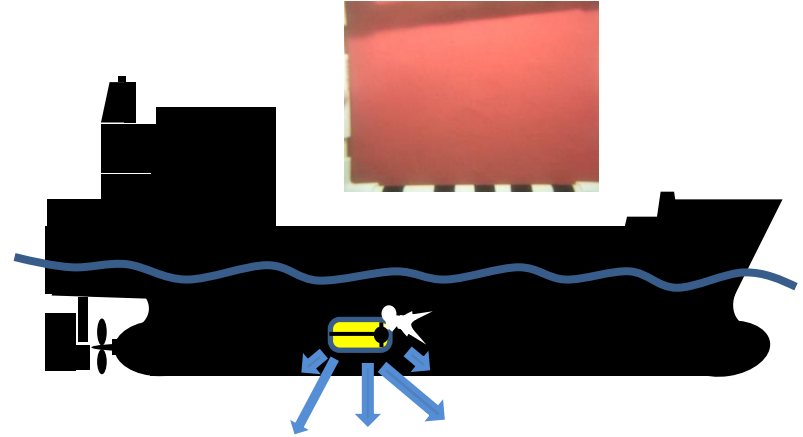
- How well do the systems clean?
- Are biocides released? If so, at what concentration?

# Environmental risks associated with in-water cleaning



## Reactive IWCC:

- Cleaning effectiveness
- Debris capture efficiency
- Filtration/treatment/removal efficiency



## Proactive IWC:

- Cleaning effectiveness
- Biocide release?

Modified from: Scianni and Georgiades 2019

<https://www.frontiersin.org/articles/10.3389/fmars.2019.00467/full>

# Project Team



<https://www.act-us.info/>

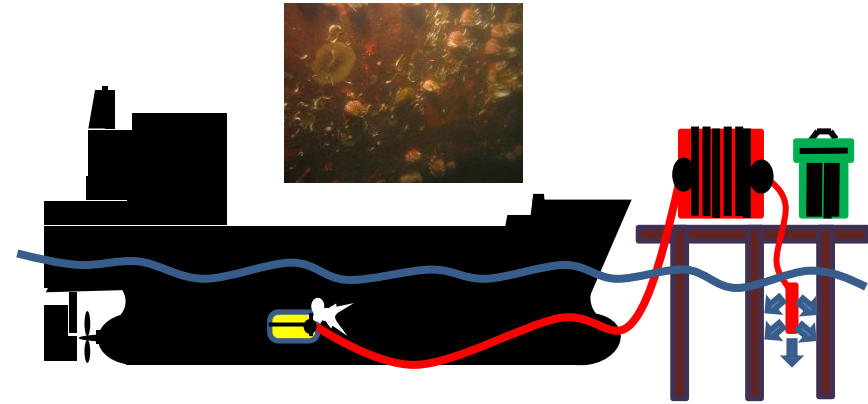


<https://www.maritime-enviro.org/index.php>





# Environmental risks associated with *reactive in-water cleaning with capture*



Reactive IWCC:

- Cleaning effectiveness
- Debris capture efficiency
- Filtration/treatment/removal efficiency

Modified from: Scianni and Georgiades 2019

<https://www.frontiersin.org/articles/10.3389/fmars.2019.00467/full>

# Environmental risks associated with *reactive in-water cleaning with capture*

## Vessel 1:

- Baltimore, MD
- Heavy biofouling: 60-100%
- Low visibility: < 1m



## Vessel 2:

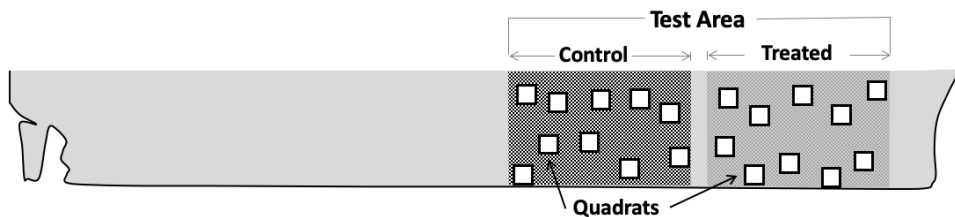
- Alameda, CA
- Moderate biofouling: 50-75%
- Low visibility: < 1m



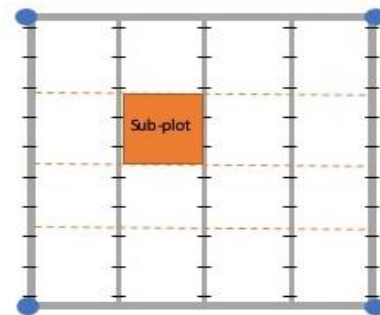
# Evaluation of efficacy and environmental impact from reactive in-water cleaning with capture

Reactive IWCC:

- Cleaning effectiveness



Surface Type	Number of Plots	Number of Images Within One Plot	Total Photos
Vertical flat	6	16	96
Horizontal flat	6	16	96
Vertical curved	6	16	96
Angled Surfaces	6	5	30



Modified from: Tamburri et al., 2020.

<https://www.frontiersin.org/articles/10.3389/fmars.2020.00437/full>

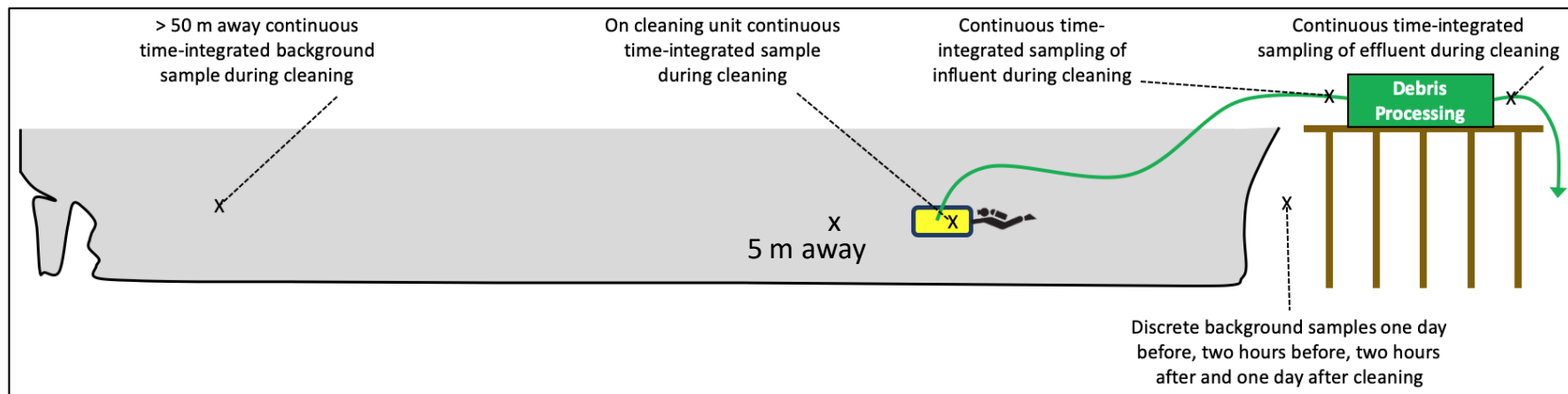
# Evaluation of efficacy and environmental impact from reactive in-water cleaning with capture

## Reactive IWCC:

- Debris capture efficiency
- Filtration/treatment/removal efficiency

Modified from: Tamburri et al., 2020.

<https://www.frontiersin.org/articles/10.3389/fmars.2020.00437/full>

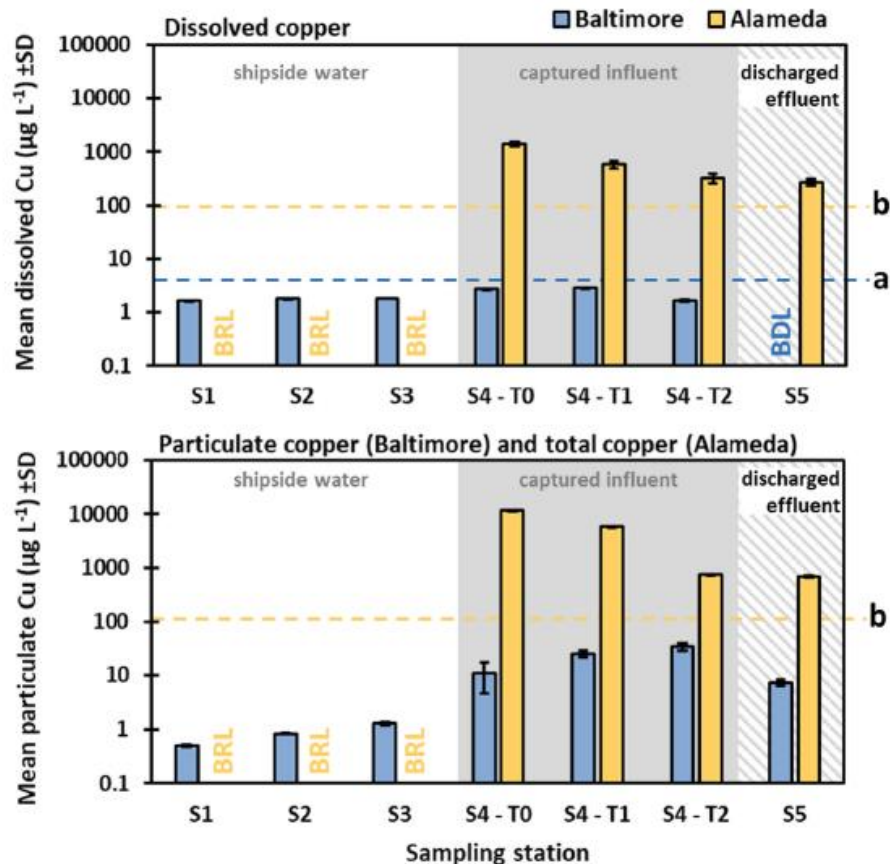
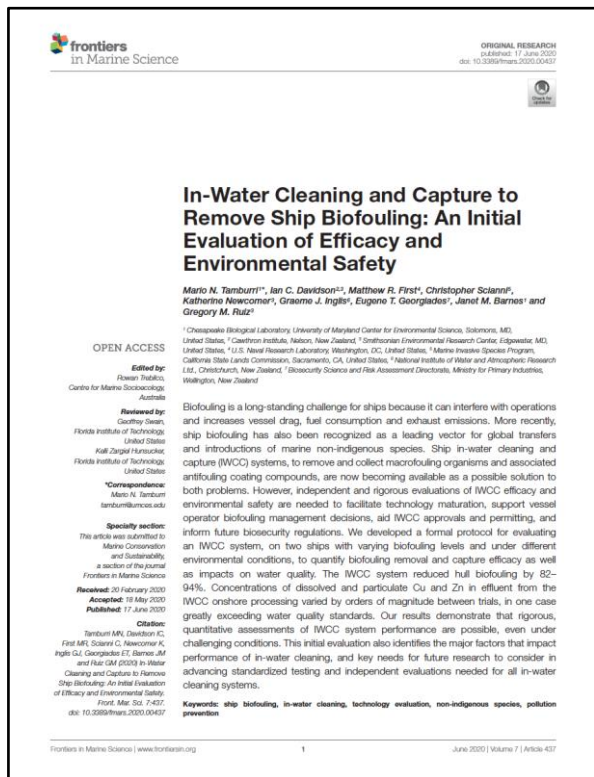


## Water Quality Parameters:

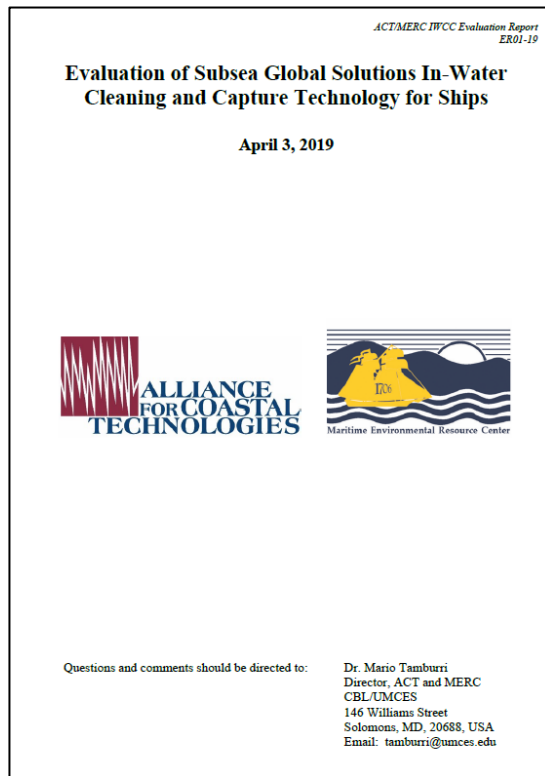
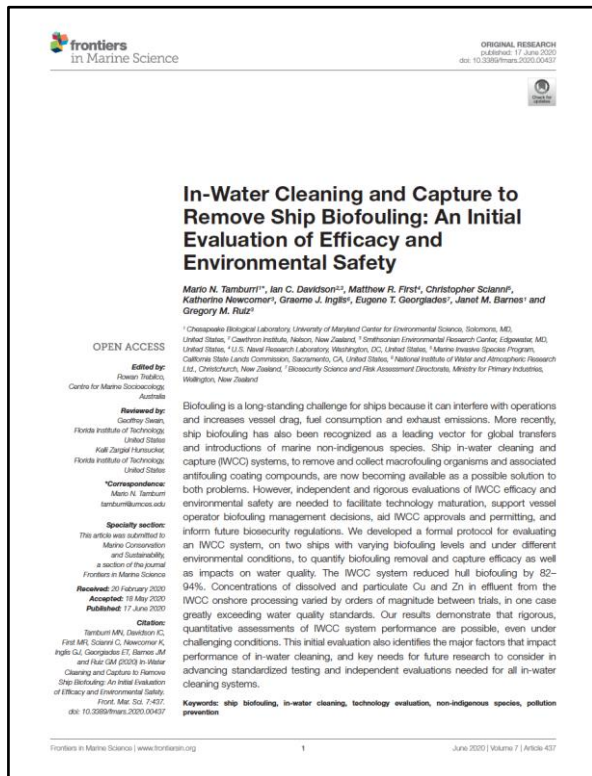
- Biocides (Cu, Zn)
- TSS, POC, DOC
- Particle size distribution



# Evaluation of efficacy and environmental impact from *reactive in-water cleaning with capture*

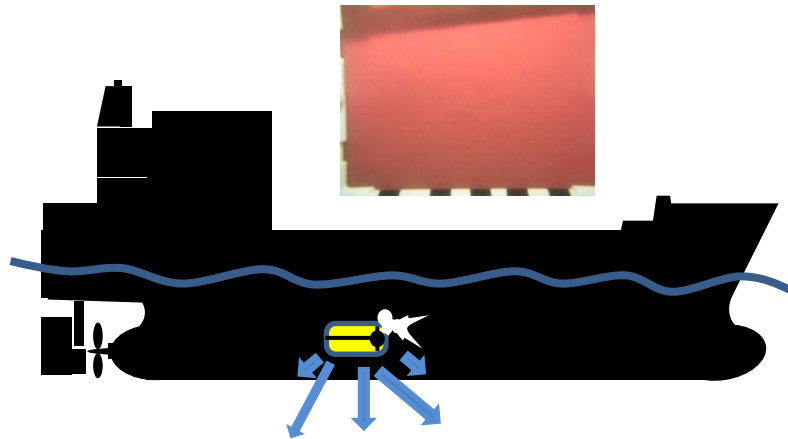


# Evaluation of efficacy and environmental impact from *reactive in-water cleaning with capture*



[https://www.maritime-enviro.org/Downloads/Reports/MERC\\_Inwater/ACT\\_MERC\\_SGS\\_IWCC\\_Evaluation\\_Report.pdf](https://www.maritime-enviro.org/Downloads/Reports/MERC_Inwater/ACT_MERC_SGS_IWCC_Evaluation_Report.pdf)

# Evaluation of efficacy and environmental impact from *proactive in-water cleaning*



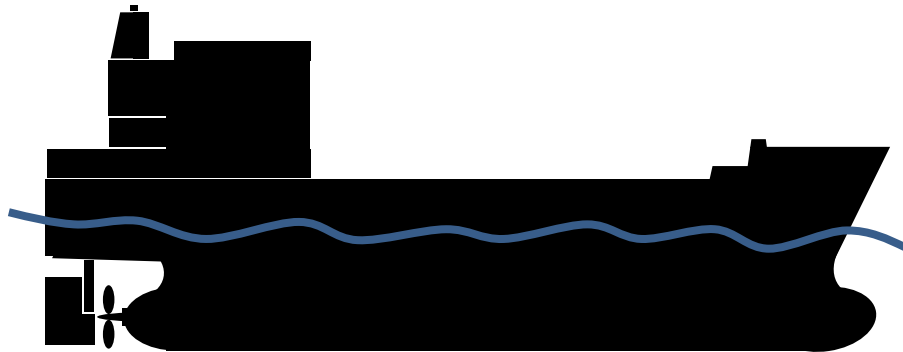
Proactive IWC:

- Cleaning effectiveness
- Biocide release?

# Evaluation of efficacy and environmental impact from *proactive in-water cleaning*

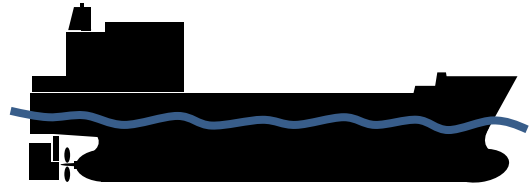
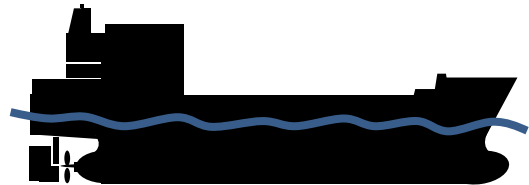
## Primary vessel:

- Start project immediately after dry dock
- 3x Biofouling/biofilm presence absence sampling
- 3x Water Quality sampling during cleaning



## Secondary vessels (2):

- 1x Water Quality sampling per vessel during cleaning



Modified from: Scianni and Georgiades 2019

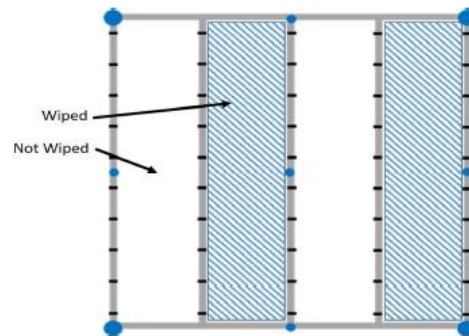
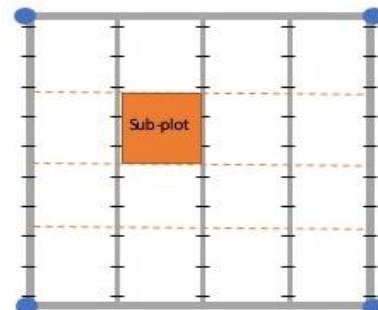
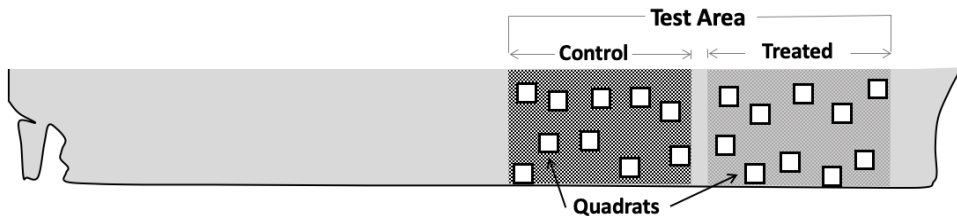
<https://www.frontiersin.org/articles/10.3389/fmars.2019.00467/full>



# Evaluation of efficacy and environmental impact from proactive in-water cleaning

## Proactive IWC:

- Cleaning effectiveness



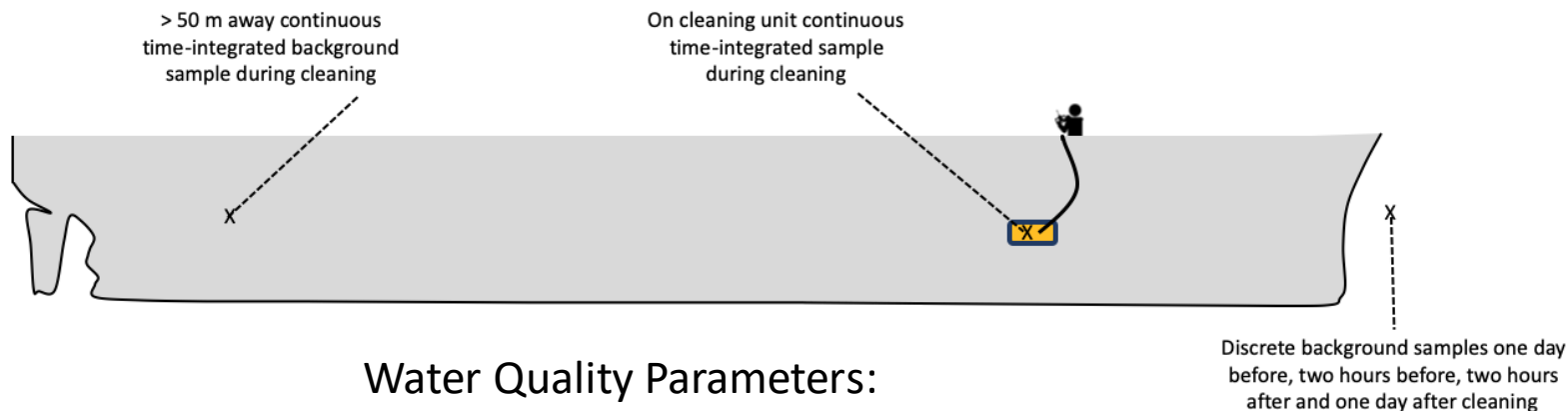
Modified from: Tamburri et al., 2020.

<https://www.frontiersin.org/articles/10.3389/fmars.2020.00437/full>

# Evaluation of efficacy and environmental impact from proactive in-water cleaning

## Proactive IWC:

- Biocide release?



## Water Quality Parameters:

- Biocides (Cu, Zn)
- Particle size distribution
- TSS, POC, DOC
- Microplastics

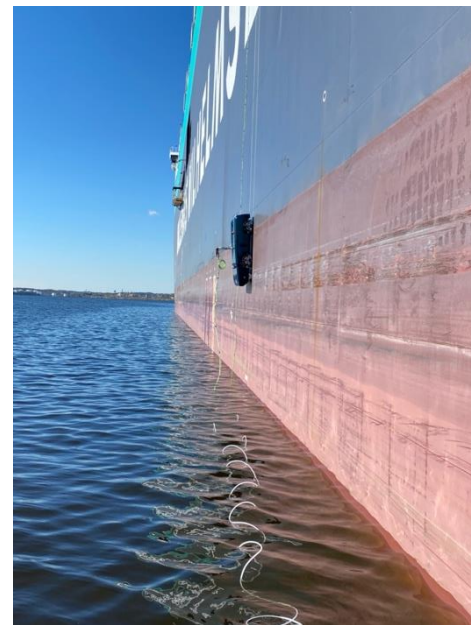
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# Evaluation of efficacy and environmental impact from proactive in-water cleaning

## Sample schedule for Primary Vessel:

- Dry dock and new coating: September 17, 2021
- Dive survey 1: October 2021 in Long Beach
- WQ sampling 1: November 2021 in Baltimore
- Dive Survey 2: March 2022 in Long Beach [last week]
- WQ sampling 2: *April 2022 in Baltimore [next week]*
- Dive survey 3: [TBD]
- WQ sampling 3: [TBD]



# Next Steps

- Finish last two rounds of sampling for primary vessel
- Identify secondary vessels and conduct WQ sampling during proactive cleaning operations
- Produce public report and prepare manuscript for journal peer-review
- Use our experience to offer guidance to permitting agencies on important considerations (next slide)



# Technical Considerations for IWC Policy

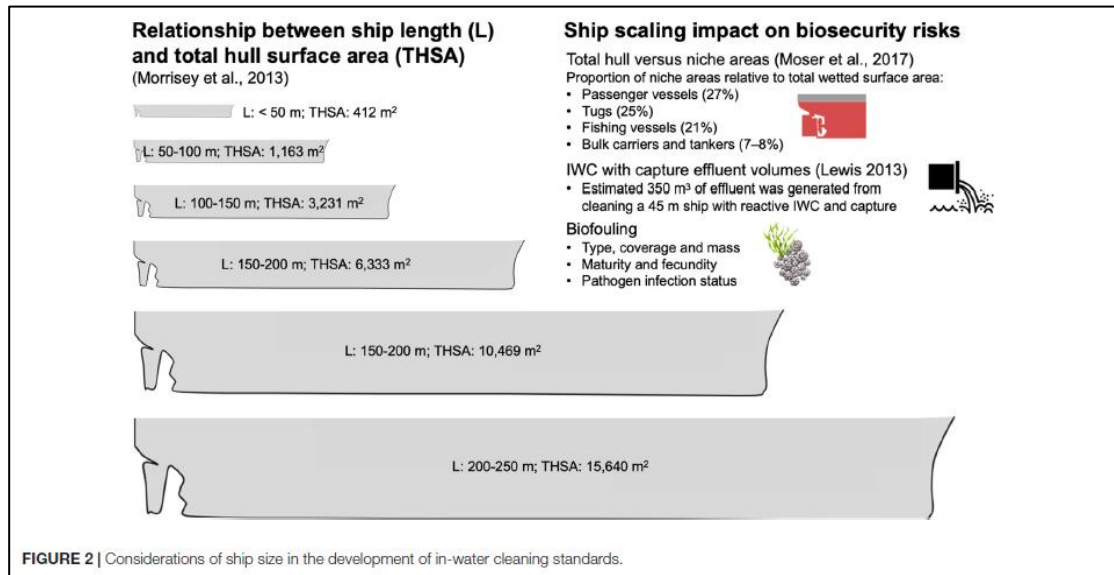
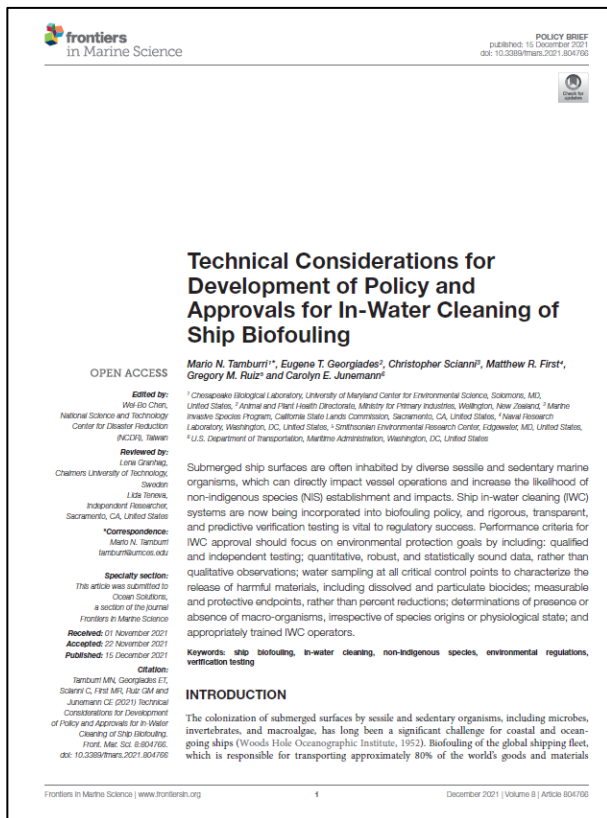


FIGURE 2 | Considerations of ship size in the development of in-water cleaning standards.



www.slc.ca.gov

# THANK YOU & QUESTIONS

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