CSU COAST Internship for 2018: Vessel Biofouling Management

California State Lands Commission: Marine Invasive Species Program Marine Environmental Protection Division

Monica Ford and Danielle Nestler July 31, 2018



Overview of Presentation

- Introductions
- Impacts Project-Monica
- Joint Biofouling Management Plan Project

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- > Anti-fouling Coatings Project-Danielle
- > Our experience

Danielle's Background

- 2018 Summer Intern through the CSU COAST program
- Council on Ocean Affairs, Science, and Technology for California State University (CSU)
- Senior at Sacramento State University
- B.S. degree in Biology concentrating in Ecology, Evolution, and Conservation (EEC)
- Background with invasive species in Dr. Davidson's lab
- Passions include billiards and the ocean





Monica's Background

- 2018 Summer Intern through the CSU COAST program
- Senior at California Maritime Academy
- Studies Maritime Policy and Management, graduating with a BA in Global Studies & Maritime Affairs with a Minor in Marine Science
- Student lab assistant for Dr. Alex Parker



Invasive Species

- Also referred to as nonindigenous species, alien species, and non-native species
- Nonindigenous species (NIS) are a great threat because they can
 - impact biodiversity
 - out-compete native species for resources
 - transmit diseases
 - Genes are altered through interbreeding with native species

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Capable of spreading at rapid rates

Introduction of Nonindigenous Species (NIS)

It is important to note that not all NIS are invasive.



Prevention is the most cost-effective and efficient method for invasive species control.

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Impacts of Invasive Species

Economic

- Infrastructure
- Tourism
- fisheries
- Human Health
 - cholera
- Environmental
 - competition





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Introductory Methods

Two primary methods invasive species are transferred from one aquatic environment to another = **Biofouling** and **Ballast**

- ➢ Responsible for up to 81% of the NIS in to CA (Ruiz et al. 2011).
- Large vessels use <u>ballast water</u> to maintain stability while transporting.
- Biofouling (hull-fouling or bioaccumulation) is the accumulation of organisms on various wetted surfaces of a vessel.
- Biofouling introduces NIS to new locations because the ship will transport the attached organisms.

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Biofouling Management Background

Marine Invasive Species Program (MISP)

- > **MISP** is administered by the California State Lands Commission
 - Dedicated to preventing the establishment of Nonindigenous Species (NIS) in California waters.
- ➢ MISP was created through:
 - > 1999 Ballast Water Management for Control of NIS Species Act
 - Expanded in 2003 when the Marine Invasive Species Act was approved.
- Regulation requirement = vessels 300 gross registered tons (+)

Regulations

- MISP uses a vector management approach to aid in the prevention of NIS by regulating the introductory pathway, or vector, in which NIS is introduced.
- Commission adopted and implemented biofouling management regulations in 2017 (Title 2 California Code of Regulations (CCR) section 2298.1 et seq.)
 - First in the world
 - New for everyone
- > This is referenced as **Article 4.8** or 4.8 Regulations



What is Article 4.8?

In order to access California waters...

- Vessels are required to maintain a Biofouling Management Plan (BFMP) that is:
 - vessel specific,
 - describes management strategy for a list of niche areas
 - includes information on antifouling coatings used and the effective coating lifespan.
- Vessels are required to maintain a vessel specific Biofouling Record Book (BFRB) with up to date records of management actions taken.



Who is subject to 4.8?

- Vessel is entering CA waters
- Vessel dry-docked after January 1, 2018

<u>OR</u>

Vessel was newly delivered after January 1, 2018



Image of a tanker docked in Carquinez

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Preparation for Data Collection

- Filtering out vessels that are subject to 4.8
 - AVRF reported dry dock date
- Prioritizing vessels that are subject with weighted risk scoring
 - Information from AVRF
 - Factors believed to influence biofouling on vessels
 - Positive influences
 - Lower score
 - Negative influences
 - Higher score
 - High, medium, low score categories
- Vessels flagged on database- <u>http://misp.io</u>



Annual Vessel Reporting Form (AVRF)



Official / IMO Number:	
Responsible Officer's Name and Title:	
Date Submitted (Day/Month/Year):	
. Does the vessel have a ballast water	treatment system installed?
Yes IF "YES" Complete sections 1	and 2
No IF "NO" Complete section 1 or	ly
If Yes, enter the date and location of	the most recent out-of-water maintenance.
Since delivery, has this vessel ever b	een removed from the water for maintenance?
If Very anter the data and leasting of	
Last date out of water (Day/Month/Yea	ar):
Port or Position:	Country:
If No, enter the delivery date and loca	ation where the vessel was built
Delivery Date (Day/Month/Year):	
Port or Position:	Country:
. Were the submerged portions of the the out-of-water maintenance or ship	vessel coated with an anti-fouling treatment or coating obuilding process listed above?
Yes partial coat Date last full coat	applied (Dav/Month/Year)
I VOL MARTINAL VANALLE I LARANS INTELLINAL VANAL	applied (Day/Month/Year)
lo coat applied Date last full coat	
No coat applied Date last full coat	
No coat applied Date last full coat	
lo coat applied Date last full coat	

STATE OF CALIFORNIA – STATE LANDS COMMISSION MARINE INVASIVE SPECIES PROGRAM ANNUAL VESSEL REPORTING FORM

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Data Collecting

- Accompanied Field Specialists on BW inspections North & South Ca
- What we looked for:
 - Did the vessel have a BFMP and BFRB?
 - What was the format?
 - Did it include management plans for 8 niche areas (biofouling hotspots)?
 - What kind of anti-fouling coatings were used?
 - What is the effective lifespan for each coating?
 - On a scale from 0-5, what was the severity of fouling on the vessel's waterline?
- Recorded everything on iPads using Survey123 app connected to ArcGIS
 - Survey created by GIS team

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Level of Fouling scale examples



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Predicted risk of sampled vessels



- ➢ WRS range: -4, 15
- Vessels subject were recently cleaned
- Vessels not subject in water longer
- Some sampled vessels did not have a LoF recordedobstructed views
- Some low in the water

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What Was Observed?

- 27 vessels sampled
- 14 were not subject
- 13 were subject

 89% of the BFMP formats subject to 4.8 were separate from the BWMP (standalone).





92% of the vessels subject to 4.8 had a combined format.

Overall, 96% of vessels sampled carried a BFMP and BFRB, regardless if subject to 4.8

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Image of standalone BFMP and BFRB



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Previously covered by a dry dock block





Image of engine room



Image of crew members (and Cesar)

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Niche Area Management

- Areas not included in IMO template for BFMP:
 - Bow & stern thrusters
 - Out-of-water support strips
 - Anti-fouling coating lifespan



Conclusions

Most shocking results



Suggestions:

- Provide outreach which documents will have AFC lifespan
- Bridge the gap between LB intern and Sac intern
 - Interaction with field office
 - Introduce joint project at same time
 - Communication

ANTIFOULING COATING PROJECT

- Vessel Biofouling Management through the use of antifouling coatings
- Biofouling is responsible for <u>60%</u> of the (NIS) introduced to CA waters (Ruiz et al. 2011).
- Coatings are one method to manage biofouling on the underwater surfaces of vessels.
- > There are several types of antifouling coatings on the market.
 - Foul-release = typically made of silicon.
 - <u>Biocidal coatings</u> = typically heavy metals (e.g Cu and Zn).





- To collect data on antifouling coatings that have been used on vessels entering California waters.
 - > Large database with many coating characteristics.
- > Two characteristics we need more data on are...
 - effective lifespan (age)
 - effective speed (optimal speed to function efficiently).





Why is this important?

If a vessel is travelling above or below the recommended parameters, it is likely that the coating will be ineffective warding off various organisms.





Energy Commander boarded on July 19, 2018. Hull heavily rusted. The antifouling coating is not effective in this case because...





As the Energy Commander loaded its cargo, the fender scraped the barnacles off of the hull.

This resulted in a collection of barnacles along the fender and the surrounding ecosystem.

The vector (Energy Commander) introduced the barnacles to the receiving environment.





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Sample of barnacles collected from Energy Commander's hull





Magnified Image of the barnacles on the hull



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What is the incentive?

- Biofouling causes drag... Travelling with drag means burning more fuel to maintain speed (less fuel efficient). This can cost a company a substantial amount of money.
- Estimated reports of biofilm can increase fuel consumption up to 12% (Rompay 2012).





Steps

- 1. Initially 400 coatings in the database were evaluated for missing the effective speed and effective lifespan data.
- 2. Every product was thoroughly researched that exhibited missing data.
- 3. Email manufacturers.
- 4. Update database with data received from manufacturers.
- 5. Compare data collected to the lifespan and speed the vessel is operating at.



Dear

Hello, my name is Danielle Nestler and I am an intern with the Marine Invasive Species Program (MISP) for the California State Lands Commission (Commission). The Commission regulates commercial vessels over their biofouling and ballast water management practices.

Recently, The Commission adopted regulations for the management of biofouling and as part of these regulations, we will be looking at vessels' antifouling coatings usage. We have a comprehensive database with the antifouling coatings for all commercial vessels that have arrived at California ports since 2008. We would like to enhance our understanding of those coatings by gathering more data on their **effective lifespan (coating age)** and **effective speed**. We could not collect data from the products listed below and would like to check if you can provide us with a better insight on this matter.

Could you tell us the effective lifespan/coating age (in months) and effective speed (in knots) for the following:

• Bullet point the product name

Could you clarify what the effective speed (in knots) for the following products:

• Bullet point the product name

Thank you for your time and I look forward to hearing from you.

Sincerely,

Danielle Nestler Marine Invasive Species Program California State Lands Commission 100 Howe Ave., Suite 100 South Sacramento, CA 95825 Example of a template email sent to manufacturers of the antifouling coating product

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RESULTS

- > 27% of the 26 emails sent out were responded to
- Comparison part of project includes coatings for 2015 and 2016 In 2015:
- > 97.9% of vessels used coatings within their effective lifespan
 - 1681 antifouling coatings were analyzed
 - ➢ 38 were expired
- > 97.7% of vessels observed did not have expired coatings
 - > 1171 vessels were analyzed
 - 23 had expired coatings





Graph denotes number of antifouling coatings operating within and outside their effective lifespan applied on vessels that visited California in 2015.

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Graph denotes number of vessels operating within and outside their effective lifespan applied on vessels that visited California in 2015.

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- 97.8% of vessels observed used antifouling coatings that were within their effective lifespan
 - 1601 antifouling coatings were analyzed
 - ➢ 35 were expired
- > 97.9% of vessels observed did not have expired coatings.

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- ➤ 1188 vessels were analyzed
- 24 had expired coatings



Graph denotes number of antifouling coatings operating within and outside their effective lifespan applied on vessels that visited California in 2016.

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Graph denotes number of vessels operating within and outside their effective lifespan applied on vessels that visited California in 2016.

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Additional Information

- Important note Many of the manufacturing companies are large, international corporations meaning it can be difficult to get a hold of the company, let alone their data.
- One of the biggest challenges observed when the coating was no longer in production. At that point, there is hardly any information the company or the webpage disclose.
- The data I collected from the manufacturers is <u>critical</u> in expanding the usefulness of this dataset.







Database updated with the new data from the last several months.

- The goal moving forward is to continue merging the collected data with the existing data in the MISP.IO database.
- I intend on using the database to analyze the optimal speed a vessel should be travelling vs. the actual speed travelled during voyage (similar concept to the lifespan analysis).
- The expanded database will be used to evaluate the risk a vessel may present when they enter California waters.



Our Experiences

Rincon Island ROV trip







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- GIS Team (Creation of Data entry Application)
- Field Specialist (Inspections)
- MISP Data Management
- Everyone From MISP

www.slc.ca.gov THANK YOU & QUESTIONS

Intern contact <u>Mford@csum.edu</u> <u>DanielleNestler@csus.edu</u>

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Brown, C., N. Dobroski, R. Nedelcheva, C. Scianni, and J. Thompson. 2017. 2017 Biennial report on the California Marine Invasive Species. Produced for California State Legislature. 115 pgs.

CDFW (California Department of Fish and Wildlife). 2018. Website <u>https://www.wildlife.ca.gov/</u>. Accessed 24 July 2018.

Dobroski, N., C. Brown, R. Nedelcheva, C. Scianni, and J. Thompson. 2015. 2015 Biennial report on the California Marine Invasive Species. Produced for California State Legislature. 99 pgs.

IMO (International Maritime Organization). 2018. Website <u>http://www.imo.org</u>. Accessed 25 July 2018.

Rompay, B. V. (2012). Surface Treated Composites White Book. Clearwater: Tahoka Press.

Ruiz G. M, P.W Fofonoff, B.P. Steves, S. F. Foss, and S. N. Shiba. 2011. Marine invasion history and vector analysis of California: a hotspot for western North America. Diversity and Distributions 17: 362-373.

Ruiz G. M, P.W Fofonoff, B.P. Steves, and J. T. Carlton. 2015. Invasion history and vector dynamics in coastal marine ecosystems: A North American perspective. Aquatic Ecosystem Healthy and Management 18: 299-311.



