2015 COAST Summer Internship: State Lands Commission’s Marine Invasive Species Program
Vessel Biofouling Management

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  - Major: Global Studies and Maritime Affairs
  - Minor: Marine Science
- COAST 2015 Summer Intern
  - COAST is the Council on Ocean Affairs, Science and Technology for CSU Students

About me (as briefly as possible)
Internship Projects Outline
Project 1: Database Improvement

GOALS
1. Verify Anti-Fouling Coating Biocides
2. Separate Clusters of Coatings
3. Find and populate the database, researching
   A. Biocide delivery method
   B. Expected coating lifespan
   C. Speed intended for use
   D. Biocide contents

Outline of Projects
Outline of Projects

Project 2: Waterline Evaluation

GOAL
To determine which maintenance and operational practices are associated with the extent of fouling on waterlines of commercial vessels.
“The attachment or association of marine organisms to the wetted portions of a vessel”

→ Leads to
Invasive species, $ impact, Regulatory Agency impact..

Definition of Biofouling
Background: Biofouling

- Are there key elements and indicators that could be used to identify a greater level of increased levels of biofouling on commercial vessels?

- Why do we look at FOULING in marine environments? What IMPACT does it have?
Panamax Container annual fuel consumption = $10 million.

Estimates of increases in fuel consumption from biofilm **ALONE** range from 8-12%.

Additional minimal $800,000 addition to fuel costs/year for ships with **minimal** consumption.

A company with a fleet of 18 Panamax container ships **would lose** $14,400,000 a year (not to mention, environmental impacts from drag on the ship, invasive species introduced..)

Example of Economic Impact of Biofilm [algae and bacteria] Alone
Project 1  Database Improvement
1. Identify and begin research on all 420+ coatings, looking for 4 main factors
   A. Biocide delivery mechanism
   B. Expected coating lifespan
   C. Speed intended for use
   D. Biocide contents

2. Identify and separate unusable coatings and clusters

3. If Unable to find on website, conduct outreach
   1. Email Companies
   2. Call Companies, if email reply unsuccessful or unavailable

4. Manually input all data into coatings database

Methodology
Observations

Larger companies were fairly easy to contact and were happy to assist in our project

Help from Raya, Chris, and Chris’ contacts helped facilitate direct communication with company representatives

Observations

Smaller companies were hesitant to be open about coating information

Time change/ language barriers created communication issues

Companies often remove all/any information about outdated/expired coatings
What SLC’s MISP Gains
- Updated coating data, allowing for more thorough analysis
- Cohesive and accurate biocide information inputted by a single source, rather than multiple over a span of time.

What I Gain
- Experience communicating with domestic and international companies
- Connections and knowledge for obtaining coating data for future research
- Basic knowledge of biocides, appropriate coatings for commercial vessels

Final Results from Database Improvement
<table>
<thead>
<tr>
<th>Delivery</th>
<th>Months</th>
<th>Speed (qualitative and quantitative)</th>
<th>Biocides</th>
</tr>
</thead>
<tbody>
<tr>
<td>292</td>
<td>242</td>
<td>215</td>
<td>331</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>Delivery</th>
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</thead>
<tbody>
<tr>
<td>85%</td>
<td>71%</td>
<td>63%</td>
<td>97%</td>
</tr>
</tbody>
</table>

Total Data Collected

1080

78.72% of total
Project 2  Waterline Evaluation
1. **Opportunistic Stratified Sampling**
   A. Available ships
   B. Targeted matrix of variables
      A. Vessel type
      B. Coating age
      C. Vessel speed
      D. # transits through tropical waters
      E. # transits through fresh water

2. **Obtain Hull Husbandry Reporting Form**
   A. If unavailable, contact Jackie in Long Beach for assistance
   B. OR request form when aboard vessel

3. **Go out with inspectors to vessels**
   - document level of fouling* and at least 5 pictures of
      A. Bow
      B. Mid-ship
      C. Stern

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*level of fouling: categorical ranking based on percent cover of the waterline covered in macrofouling*
4. Use iPad app (Collector) to input GPS location, HHRF data, and record level of fouling.

5. Input data into computer
   A. Verify and submit data to ARCGIS
   B. Upload photos
   C. Use photoQuad software to determine accuracy of LOF’s.
   D. Analyze data for association- Are there relationships between the variables and the levels of fouling?

Methodology
Where We Sampled

- Northern California
  - Carquinez
  - Conoco-Phillips/Rodeo
  - Oakland
  - Redwood City
  - Richmond
  - San Francisco
- Southern California
  - Port of LA/ Long Beach
Thank you Amanda Manning for formatting these maps.
Thank you Amanda Manning for formatting these maps.
Timeline: Distribution of ships by years since new coating applied
Results

Data Trends
Coating Age x Cumulative LOF

Cumulative LOF vs Coating Age (In Years)

- Bulkers
- Containers
- Passenger Vessels
- Ro-Ro's
- Tankers
- Unmanned Barges
Speed x Cumulative LOF

\[ y = -0.3519x + 7.6801 \]
\[ R^2 = 0.1887 \]
# FW Ports x Cumulative LOF

\[ y = -0.1041x + 3.3842 \]

\[ R^2 = 0.1007 \]
+ Observations

- There are data trends and association between several factors and levels of fouling
- Use of technology (iPad app, better camera lenses) created efficiency for data collection
- All offices were more than happy to help with the project, including advice, trips out to ports, and valuable learning opportunities, which is the only way this project was possible

- Observations

- There are so many factors attributing to fouling, it would be difficult to develop an accurate, precise method to predict it;
  - however, anything that gives a hint can be useful
- Sampling was often opportunistic, making it difficult to hit targets
  - BUT we still exceeded # of original targets
- Future improvements:
  - More ships = more powerful data
What SLC’s MISP Gains
- Hints that can determine which maintenance and operational practices are associated with the extent of fouling on vessel waterlines
- Basis for improving/developing upon data and methods that I used

What I Gained
- Hands-on experience navigating and working in a port environment, working with port and ship personnel, and port safety and operational practices that I would not otherwise have opportunity to experience
- Opportunity to work with professionals in the maritime industry and State Lands Commission
- Broadened understanding of ballast water and biofouling, as well as in the Marine Science field in general
- Legislative and public policy experience
- Confidence in Excel, data collection, and presentation of results in PowerPoint and research paper format
- Public speaking experience
- Photography experience
- Opportunity to express creativity through initiative in an applied project

Final Results from Waterline Research
Thank you for your time!

Any questions?

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