TIP 233: Field Evaluation of the Service Life of Foul-Release Coatings in Columbia River

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Project Synopsis: Deliverables

- Physical damage
  - Columbia River deploy
    - Panel retrieval & evaluation after 0, 3, 9, 15, 21, 27, 33, and 39 months immersion, 108 panels per immersion treatment
  - Laboratory analyses
    - Abrasion, surface roughness, 5 panels per immersion treatment
- Effectiveness
  - Zebra mussels (San Justo Reservoir 5-mo. deploy)
  - Soft fouling, e.g., algae (Columbia River)
- Cost and timeline to apply to CRB hydro facility
- Final report and stakeholder engagement

Panels in Columbia Rv

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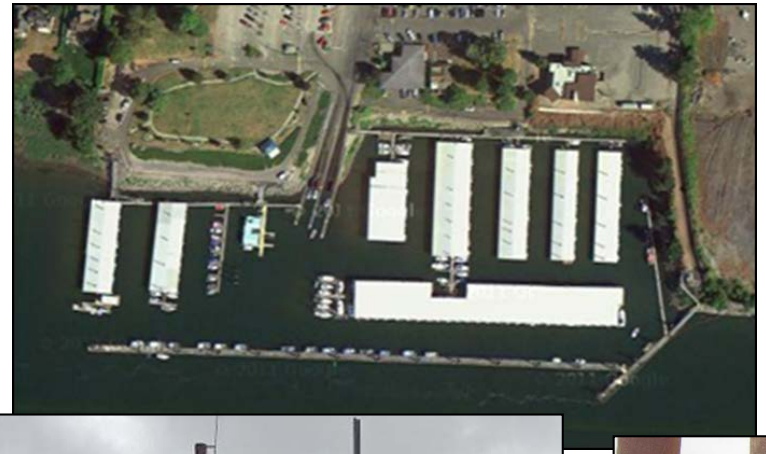
Project Synopsis: Methods

- Columbia River field deployment and retrieval



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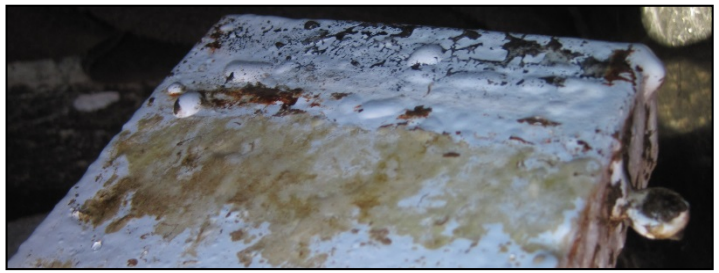
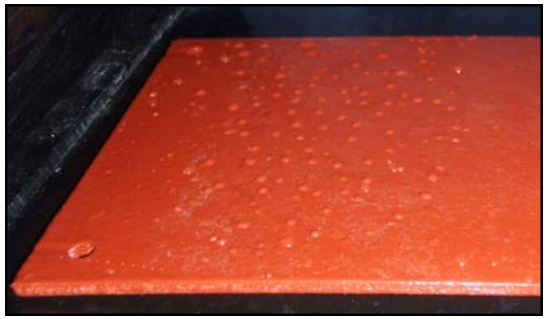
Project Synopsis: Lab Methods

- Resistance to damage by CR field deployment
  - Physical damage, e.g., blistering (ASTM D772-05, D6990-05, D660-05, D661-05, D662-05, D714-02, Pictorial Standards of Coating Defects Handbook
  - Adhesion strength to substrate (ASTM D6677-07)
  - Erosion (ASTM D4938-07 and Skaja 2012)
  - Surface roughness (ASTM D7127-05)
  - Undercutting corrosion (ASTM D1654-05 and Weaver and Beitelman 2001)





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Project Synopsis Field Evaluation Methods

- San Justo Reservoir, CA field deploy - April-Sept

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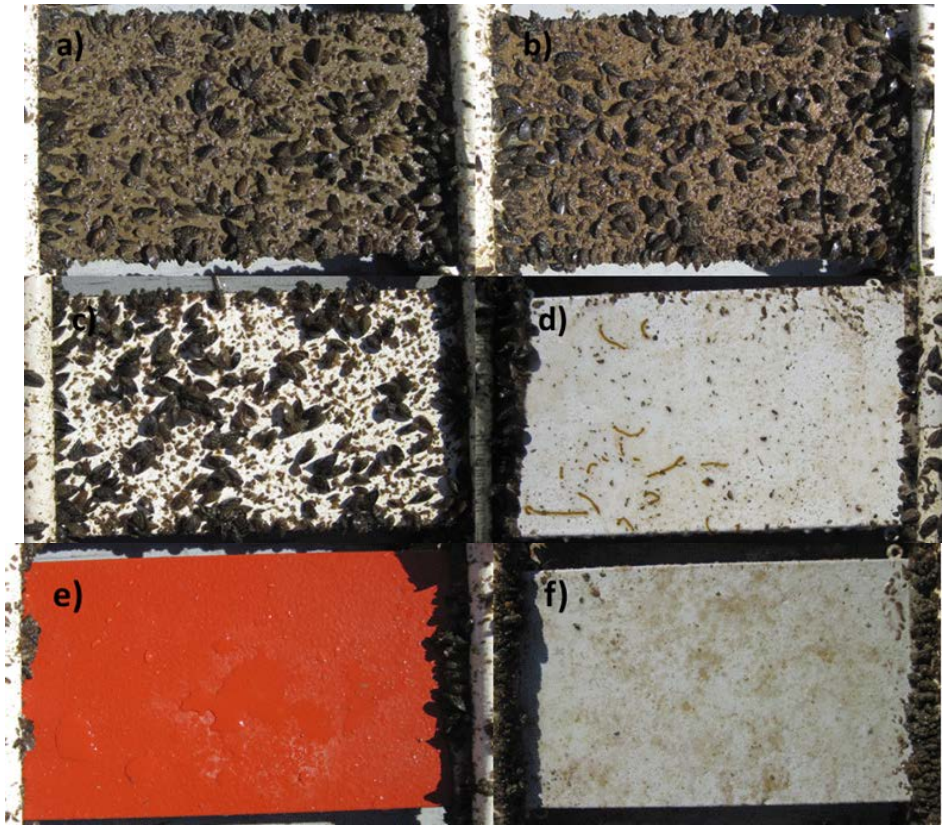
Project Synopsis Field Evaluation Methods

- Resistance to zebra mussel fouling



Results

- Columbia River panel retrieval
  - 3 mo. (July 2012)
  - 9 mo. (January 2013)
  - 15 mo. (July 2013)
  - 21 mo. (January 2014)
  - 27 mo. (July 2014)
  - 33 mo. (January 2015)
  - 39 mo. (July 2015)

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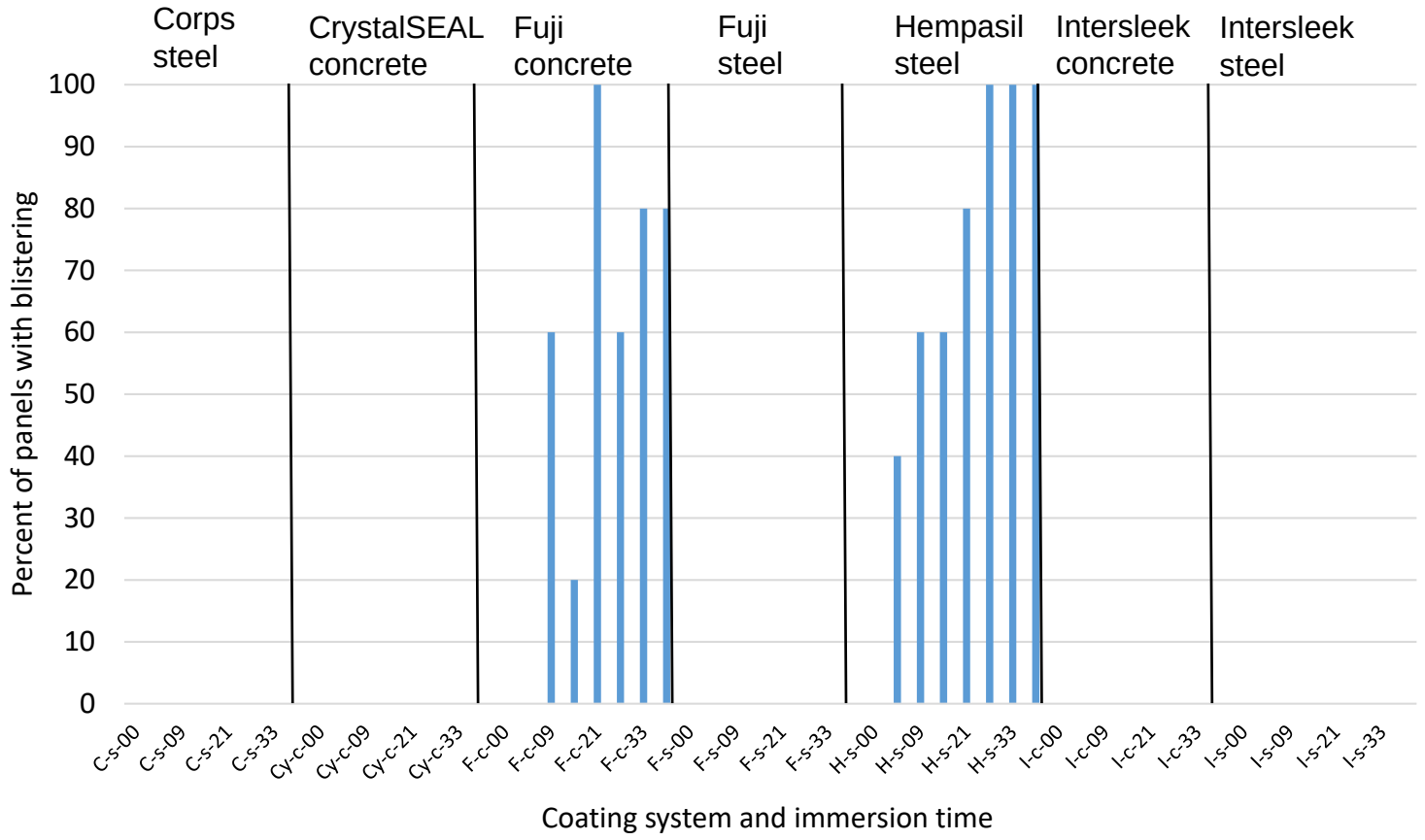
Results: Physical Damage

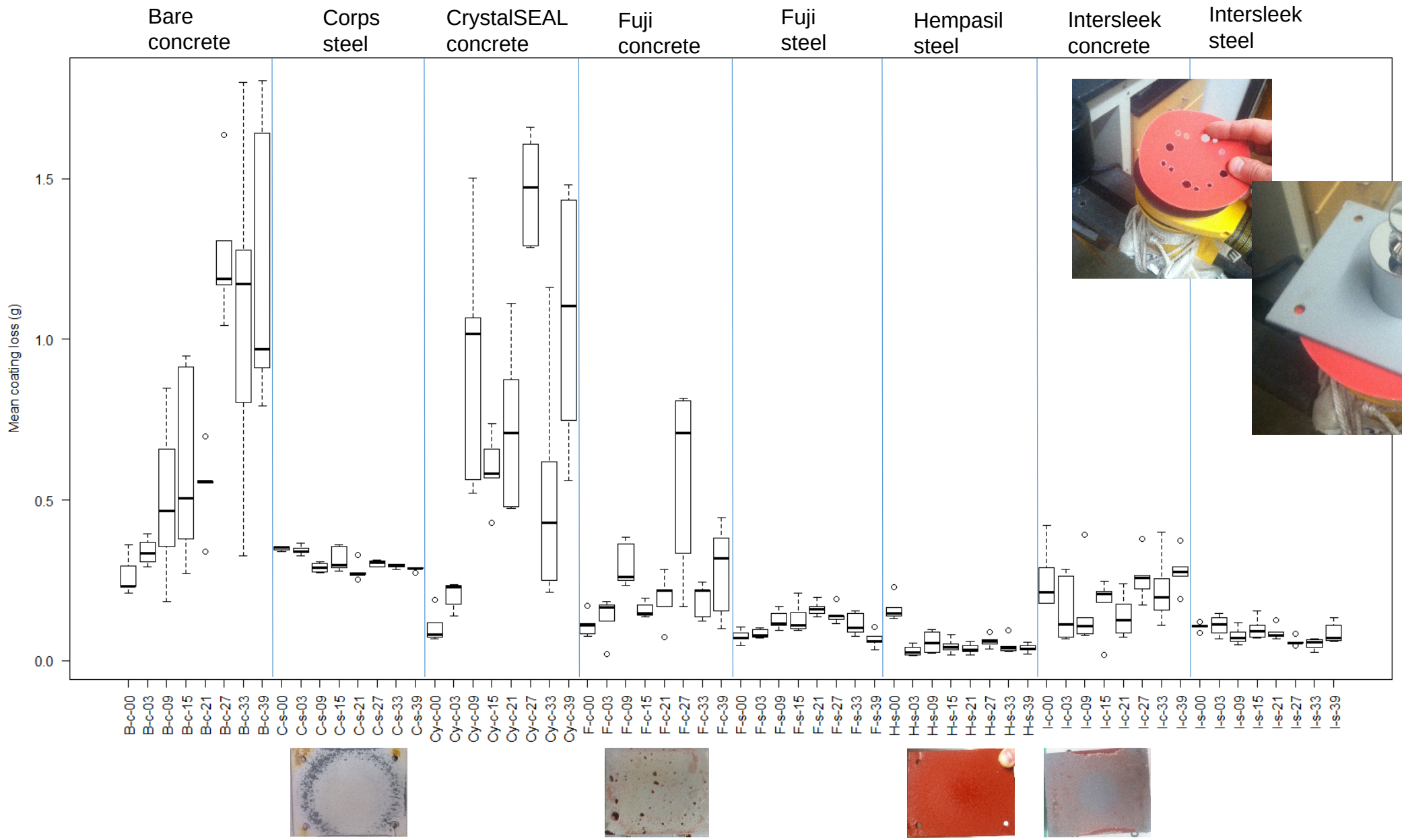
- Blistering…. Fuji (concrete) and Hemp (steel)



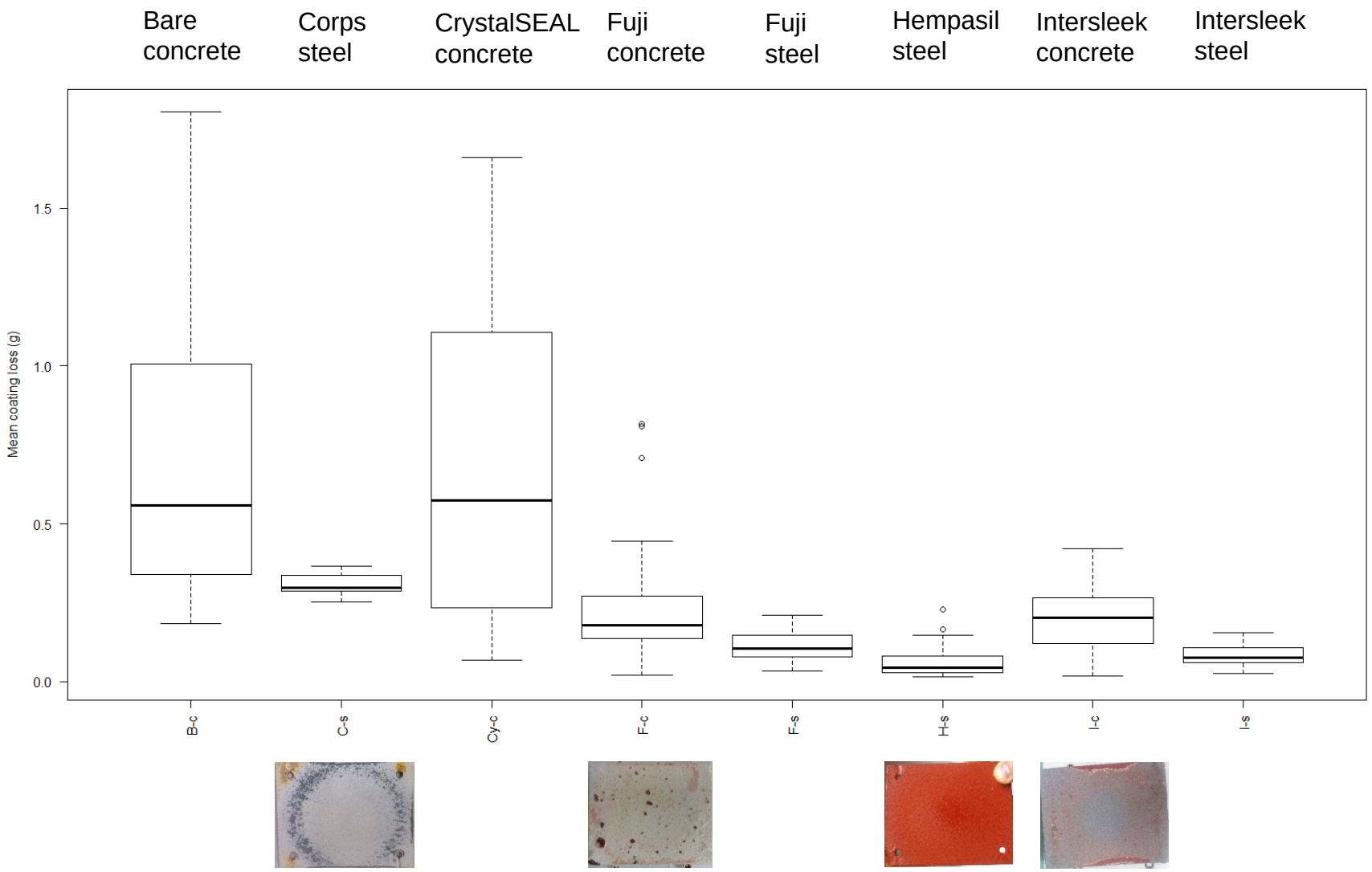
No 6 Few

No 2 Medium Dense

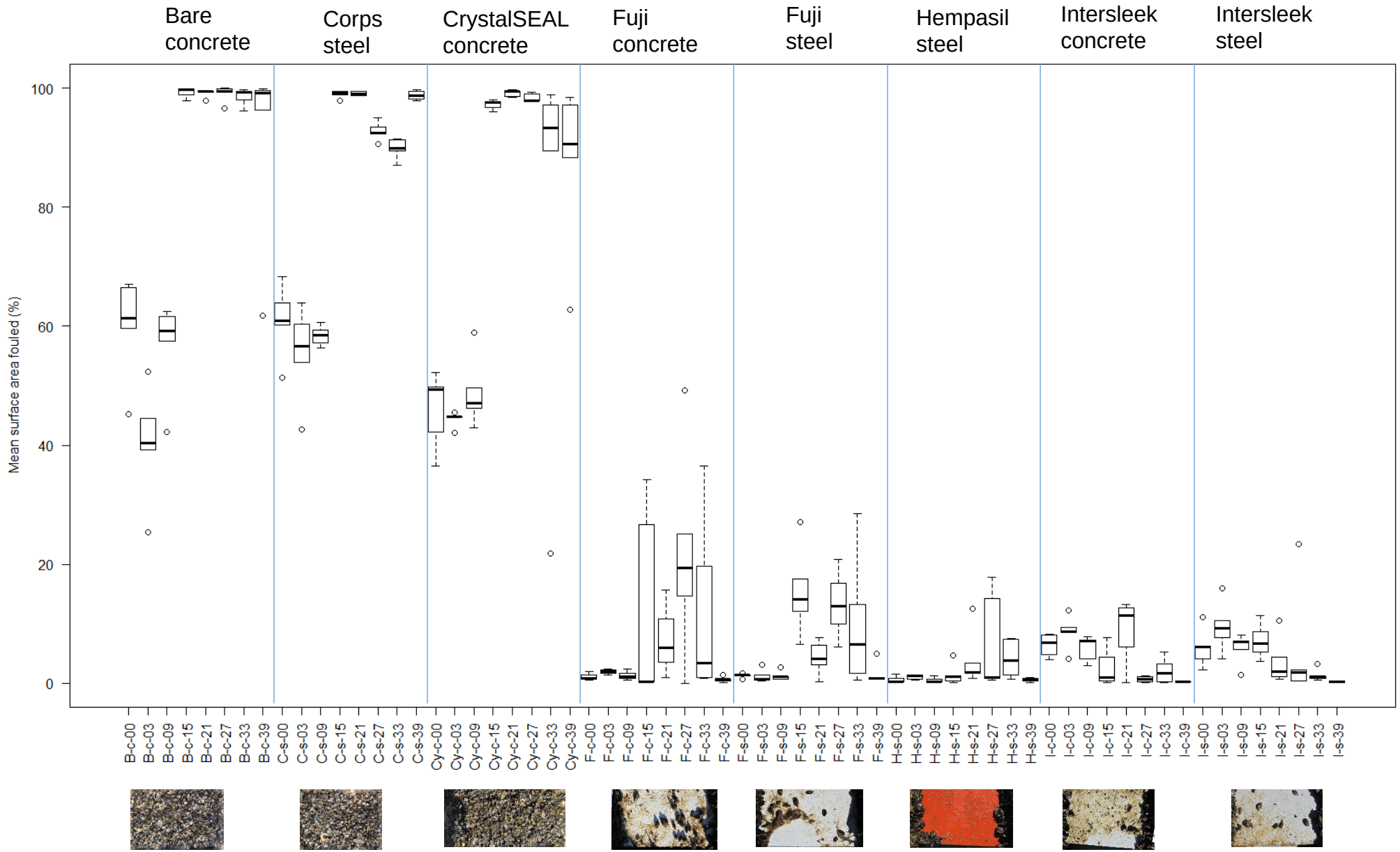
Physical Damage- Abrasion tests



Physical Damage- Abrasion tests



Effectiveness-Zebra mussel % fouled



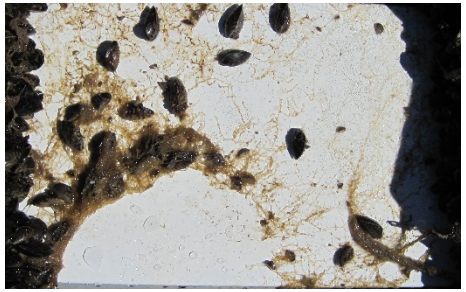
Effectiveness- Zebra mussels

- Resistance to zebra mussel fouling- 5 months

Bare concrete

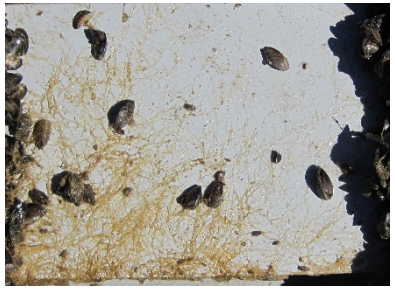
Crystal concrete

Corps vinyl steel



Fuji foul release

Hempasil foul release



Intersleek foul release

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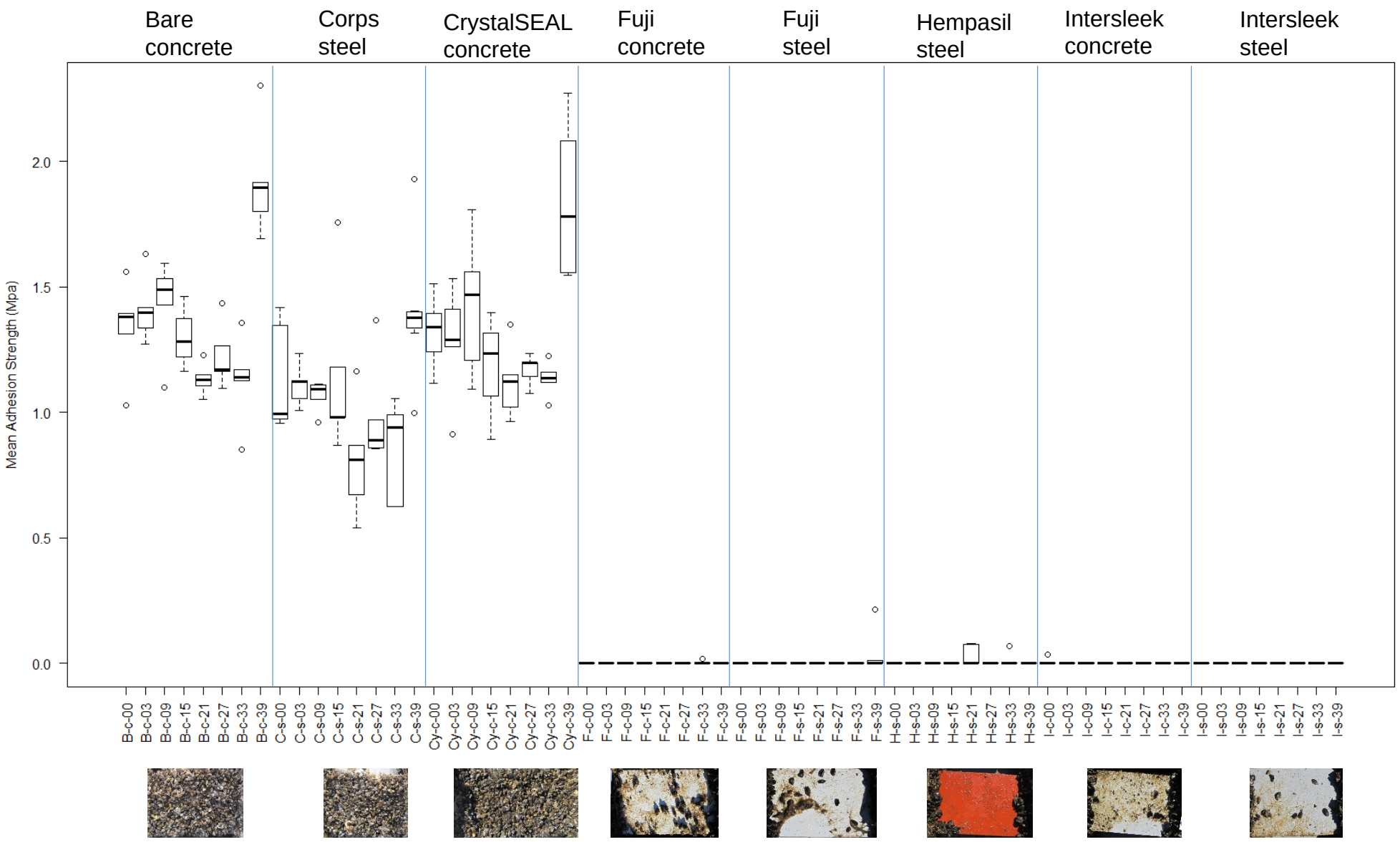
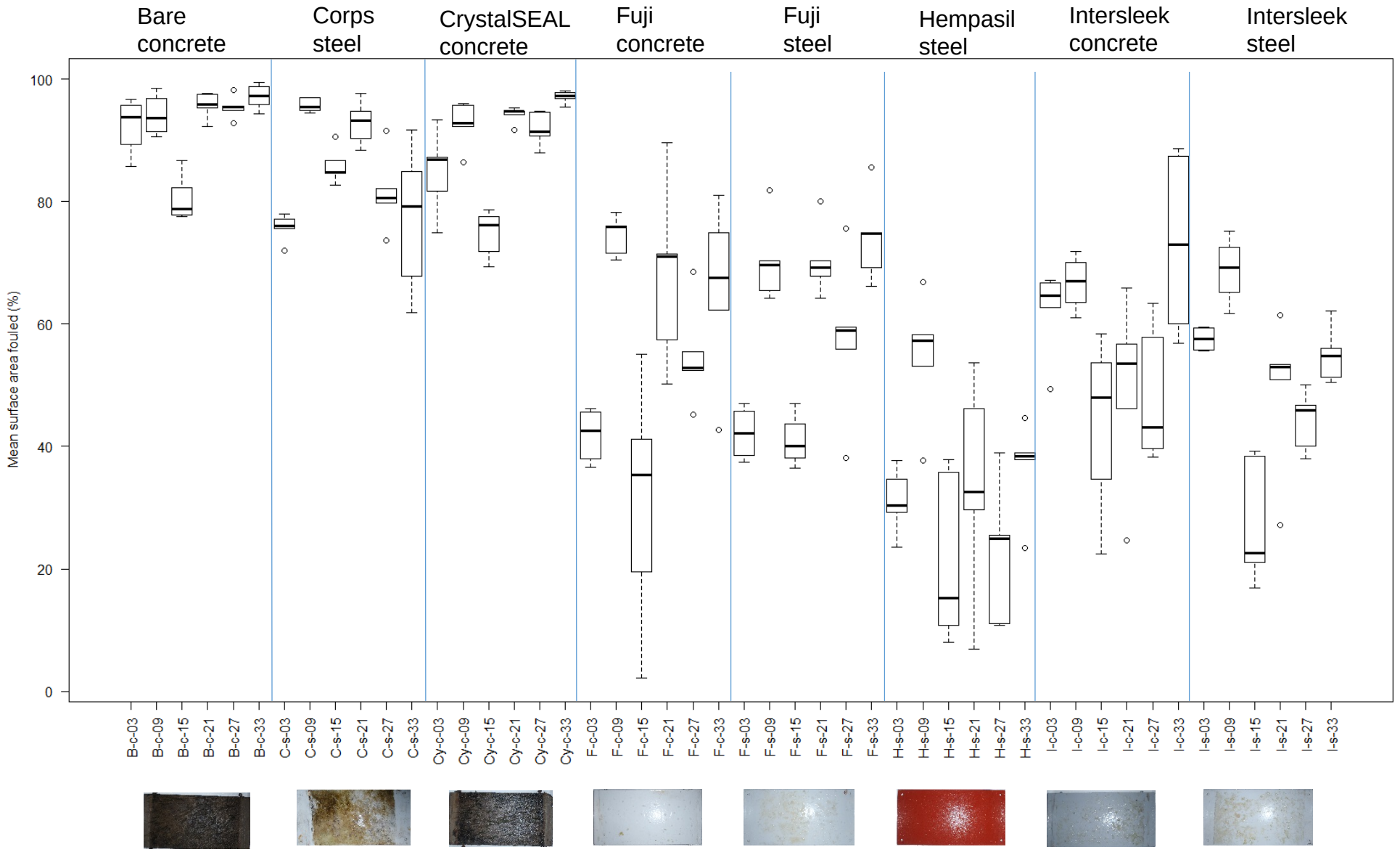
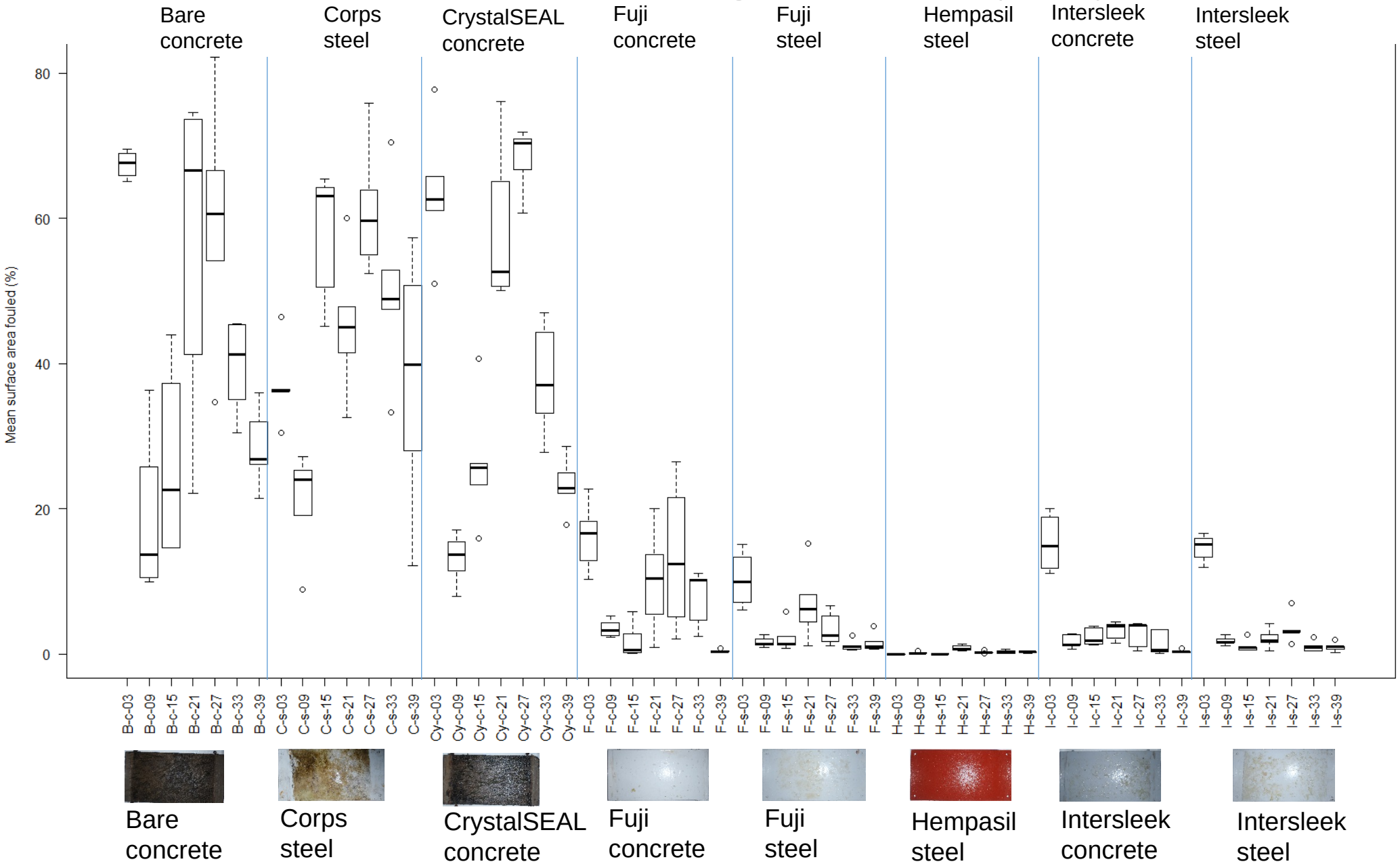
Effectiveness-Zebra mussel MPa



Effectiveness- Soft fouling Raw



Effectiveness- Soft fouling – Post spray



Bare concrete

Corps steel

CrystalSEAL concrete

Fuji concrete

Fuji steel

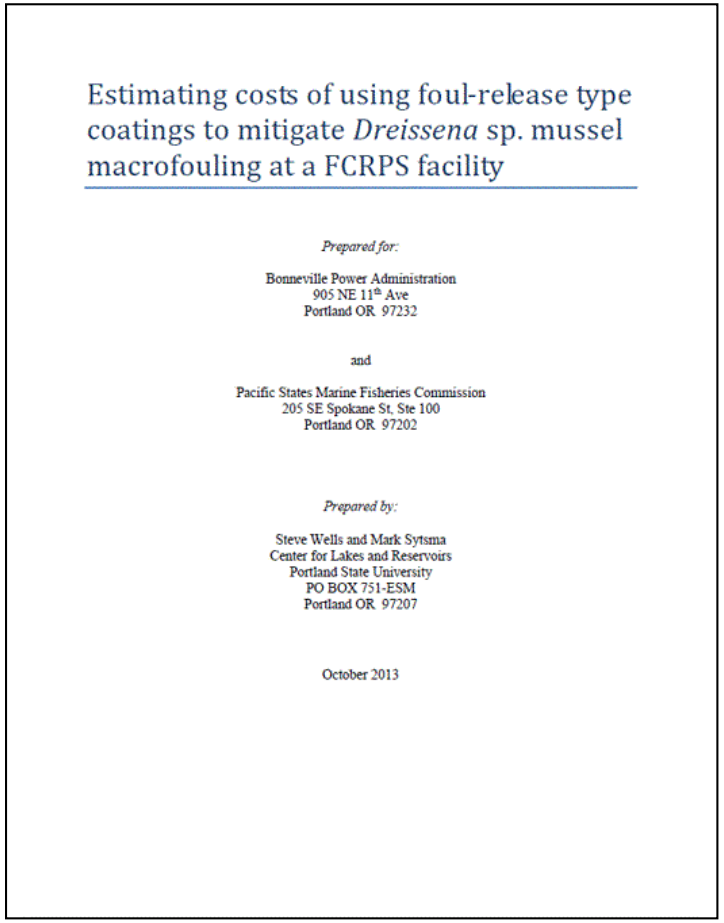
Hempasil steel

Intersleek concrete

Intersleek steel

Cost estimate for applying to FCRPS facility

- $1,111,855 ($9.94/ sqft)
  - 1,300 Auxillary Water System diffuser gratings & flat bars at The Dalles Dam
  - 111,832-ft^2 surface area
  - 112 5-gallon kits
  - Labor, equip & supplies
  - Done during in-water work period



Estimating costs of using foul-release type coatings to mitigate *Dreissena* sp. mussel macrofouling at a FCRPS facility

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Technology Transfer to Users

- Expected Users in CRB
  - US Army Corps of Engineers (collaborators on cost study)
  - US Bureau of Reclamation
  - Public Utility Districts
  - Irrigation Districts & Fish facilities
- Needed for application
  - Mussel infestation requiring control
  - Durability results and detailed cost analyses (This work)
  - Field trials on facilities
  - Salmonid avoidance test (FPOM Team)

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Technology Transfer/Application to BPA

- Milestones for full-scale application
  - Long-term durability in freshwater hydro facilities
  - USBR and others experiences in infested waters
  - Trial applications on components
- Challenges to address
  - Long-term data, i.e. service life under real-world conditions
  - New coatings and other technologies are in development
  - Permitting

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Conclusions

- Intersleek is recommended FR in this 39 mo. study
  - No physical damage
  - Foul-release properties maintained throughout
- Intersleek susceptible to gouging – affects deploy location
- Hempasil blistered on steel after 3-mo. immersion
- Fuji blistered on concrete after 9-mo. immersion
- Application is expensive ($9.93/ft^2 in case study example)
- Longer-term deployment would provide additional information on longevity and cost amortization
- Fish avoidance tests are required (per FPOM)

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