H. Viles

ENHANCING HARD INFRASTRUCTURE ASSETS TO IMPROVE ECOSYSTEM SERVICES AND RESILIENCE

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OUTLINE

1. What & why ecological enhancement?
2. Case studies of where these techniques have been applied
3. Science basis
4. Benefits & constraints
5. Where next

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WHAT IS ECOLOGICAL ENHANCEMENT?

"Using nature to improve the sustainability, resilience and multifunctionality of hard urban infrastructure" after Naylor et al. 2012

- Ecological enhancement is used where assets must remain grey and green infrastructure is not suitable
- It does not seek to restore but instead improve a) biodiversity value, b) amenity value and/or c) resilience of the structure to weathering-related deterioration.
- www.biogeomorph.org/coastal/

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1. An emerging field

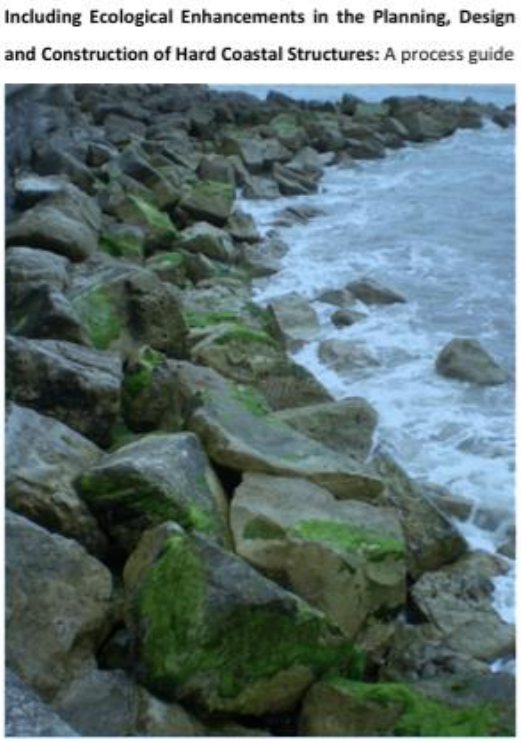
- Ecological enhancement/engineering of hard coastal and marine assets is a new field globally
  - papers have been published for <10 years
  - Teams are geographically dispersed
- Innovation is thus very new, both in the academy and in practice

c. Shimrit Perkol-Finkl

1. Why enhance? Policy & Legislation

Numerous instruments exist including:

- EC directives: Water Framework, Habitats, Marine Strategy, EIA, SEA
- UK laws: NERC, Marine and Coastal Planning Act, UKBAP
- For UK legislative summary see:



1. Naylor, LA et al. 2012. Facilitating Ecological Enhancement of Coastal Infrastructure: The Role of Policy, People and Planning. Environmental Science and Policy, 22, 36-46. 6 citations.
2. Naylor, LA et al. 2011. EA Guidance on Ecological Enhancement via: http://www.therrc.co.uk/MOT/ReferencesEA_Ecological_Enhancements_Planning_Design_Construction_Hard_Coastal_Structures.pdf

1. Why enhance? Non-Legislative Drivers

What other factors have led to enhancements being included in operational schemes or research trials?

- Corporate Social Responsibility
- Public Support & Financial Leverage
- Improved Asset Resilience
- Strategic Corporate Objectives
- Design Criteria
- Extreme Events

1. Other potential drivers that *might* be used

- Blue-Green Infrastructure
- Ecosystem Services / Natural Capital
- Biodiversity offsets

2. Case Study 1 – Shaldon & Ringmore Tidal Defence scheme

- Driver: EIA Directive/UK Planning
- Goal: improve ecological value
- Award winning Shaldon & Ringmore Scheme
- EC WFD best practice guidance

2. Case Study 1 – costs & evidence

Costs:

- Scheme total: £6.5M
- Niche habitats: £20K
- 0.3% total costs

Evidence: (after 18 months)

- Achieved biodiversity goals
- No evidence of enhanced weathering deterioration in niches.

References: Coombes *et al.* 2012. Shaldon Monitoring Report. Environment Agency. Firth et al. 2014. Ecological Engineering.

2. Case Study 2 – Brooklyn Pier

- **Driver: State Legislation**
- **Goal: mitigation of /compensation for habitat loss**
- **Outcon… gains**

ECOncrete®
Concrete Ecological Solutions
www.econcretetech.com

2. Case Study 3 – Hartlepool Headlands

- **Driver:** Habitats Directive /Ramsar Site
- **Goal:** habitat loss mitigation for birds
- **Status:** under construction

Mott MacDonald
University of Glasgow
University of Oxford
Hartlepool Borough Council
Natural England
Environment Agency

2. Non-legislative drivers: CSR

- **Driver:** Corporate Social Responsibility
- **Approval from:** River and Canal Trust and the Environment Agency
- **Funding:** HSBC

Source: @thisisyourriver

2. Non-Legislative Drivers: resilience & plans

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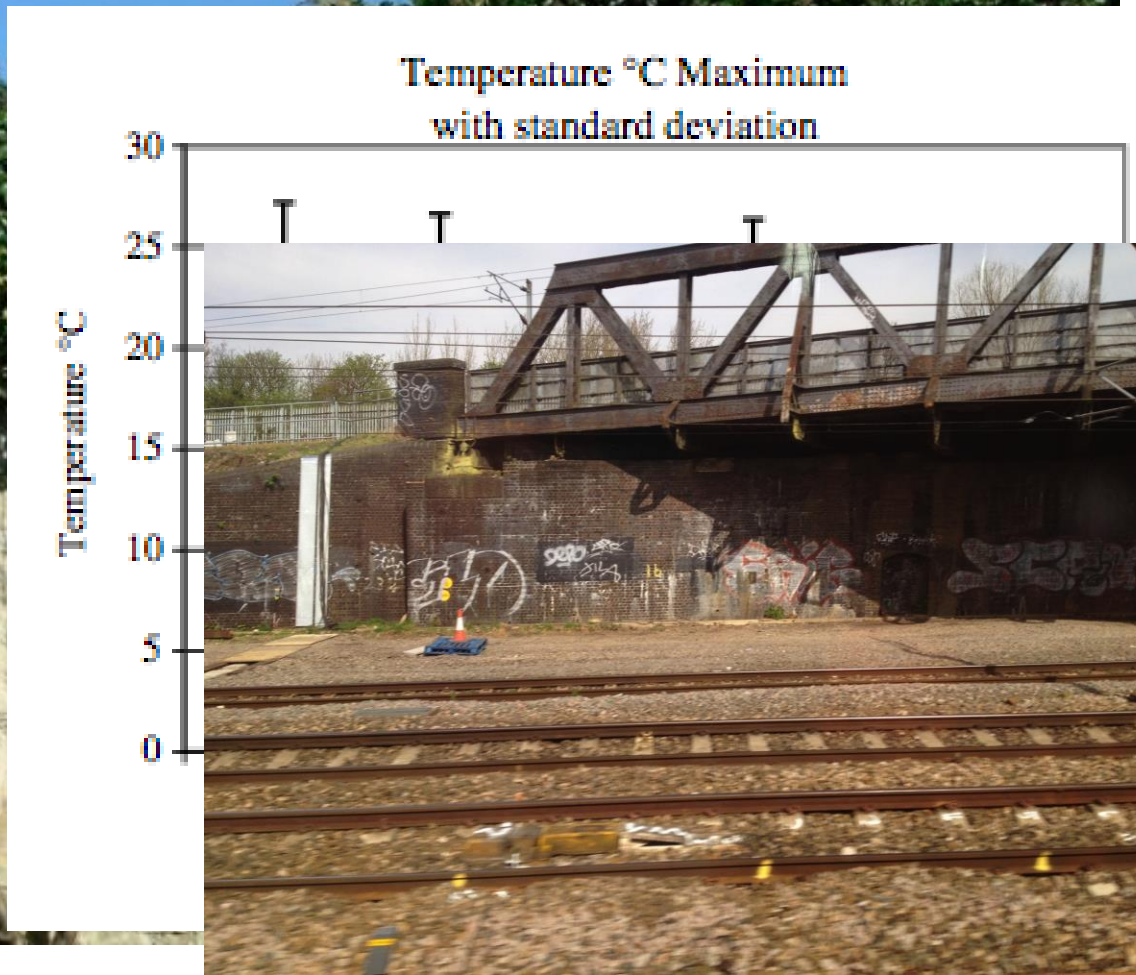
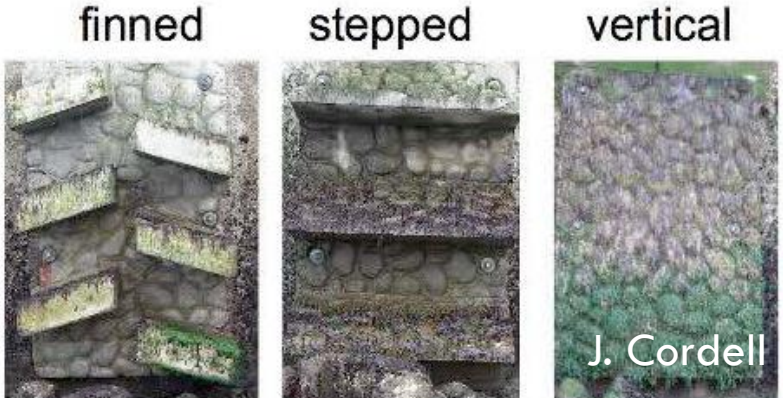
Improving asset resilience



3. Science Base

1. Material Choice Matters

1. Active Enhancement



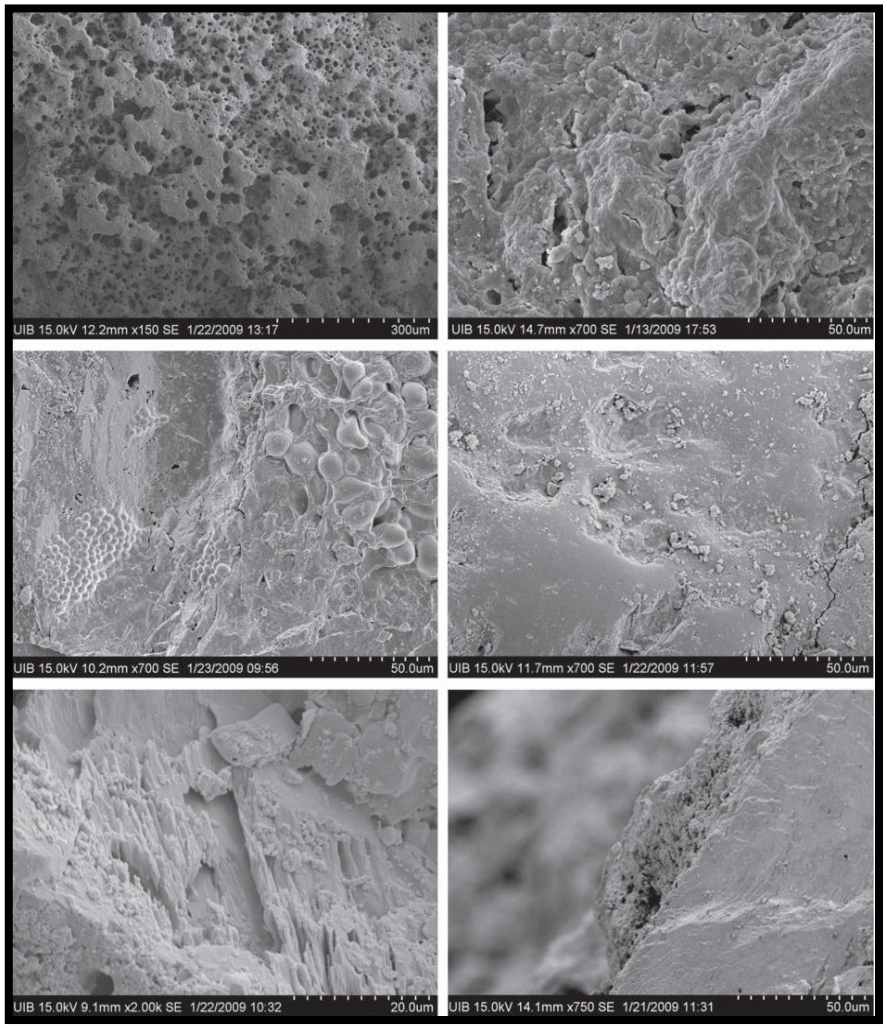
2. Passive Enhancement

Colonisation on concrete altar Hartlepool

1. Improved asset resilience

3. Material Choice Matters

- Common engineering materials behave differently in same environment
- Some are more ecologically suitable than others
- Enhancement can be as simple as choosing a different material type



Coombes *et al.* (2011)

3. Material Choice Matters

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  - Limestone
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    increases
  - Engineerin
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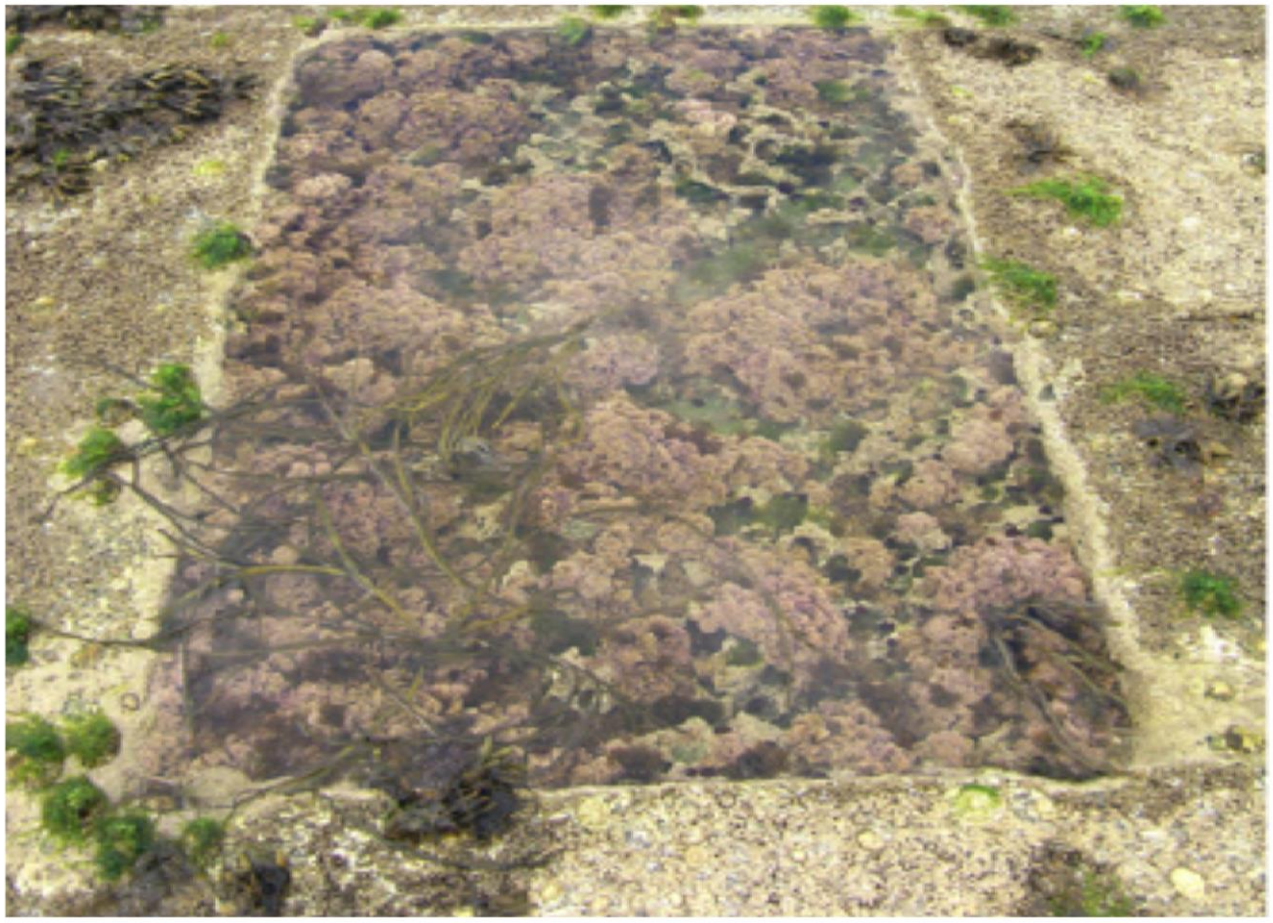

2. Active enhancement

Passive

- Material choice
- Positioning

Active

1. fine scale (mm-cm)
2. crevice (cm)
3. larger (cm-metre)

Coombes et al. 2015

M. Coombes, Portland Port

Firth et al., 2012

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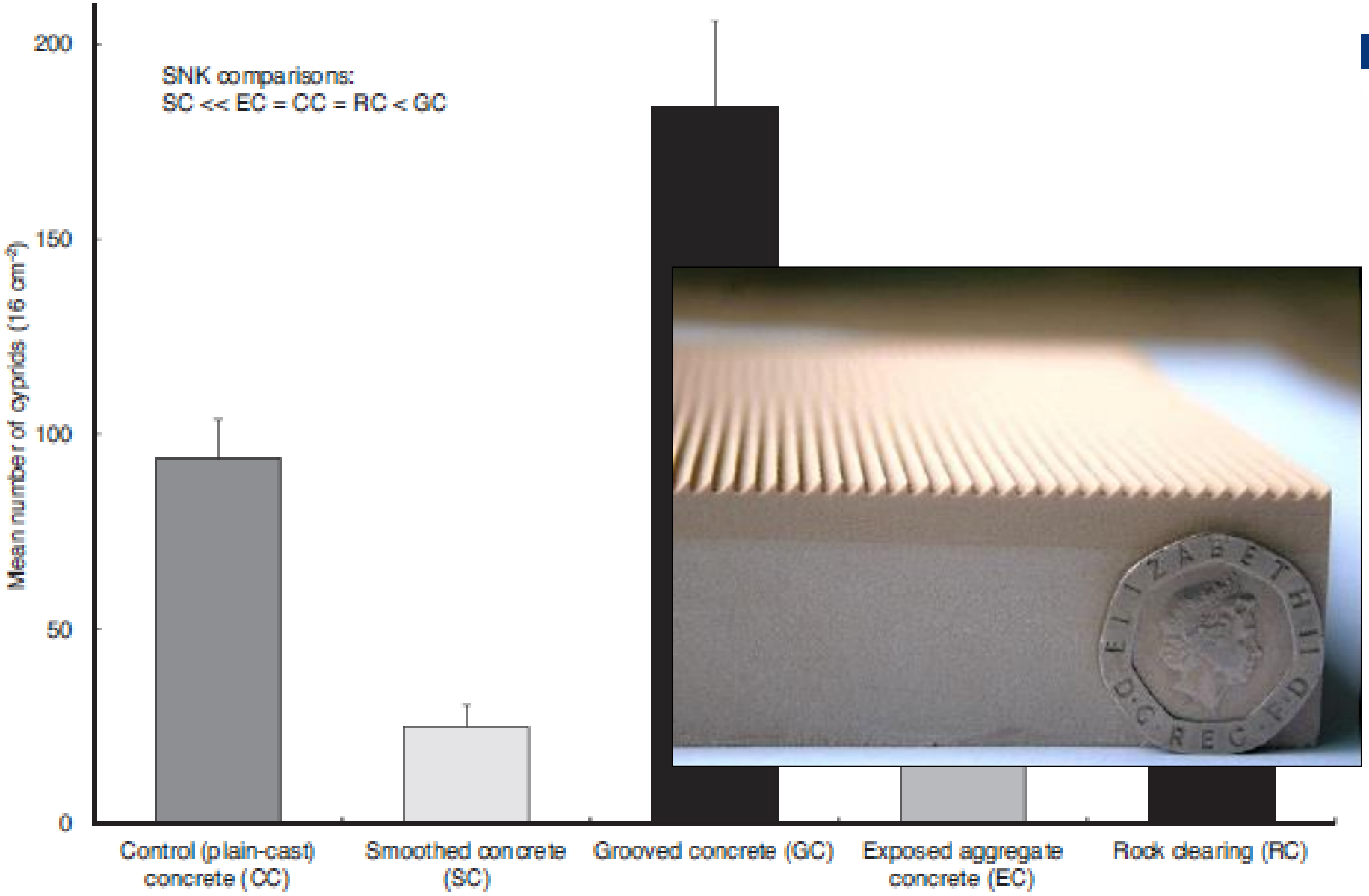
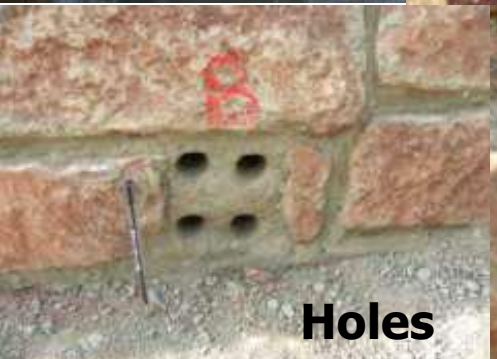

SNK comparisons:
SC << EC = CC = RC < GC
Mean number of cyprids (16 cm-2)
200
150
100
50
0
Control (plain-cast) concrete (CC)
Smoothed concrete (SC)
Grooved concrete (GC)
Exposed aggregate concrete (EC)
Rock clearing (RC)

4. Active Enhancement 2

- Altered surfaces – cm – m
- Built or retrofit habitat niches



3. Passive enhancement

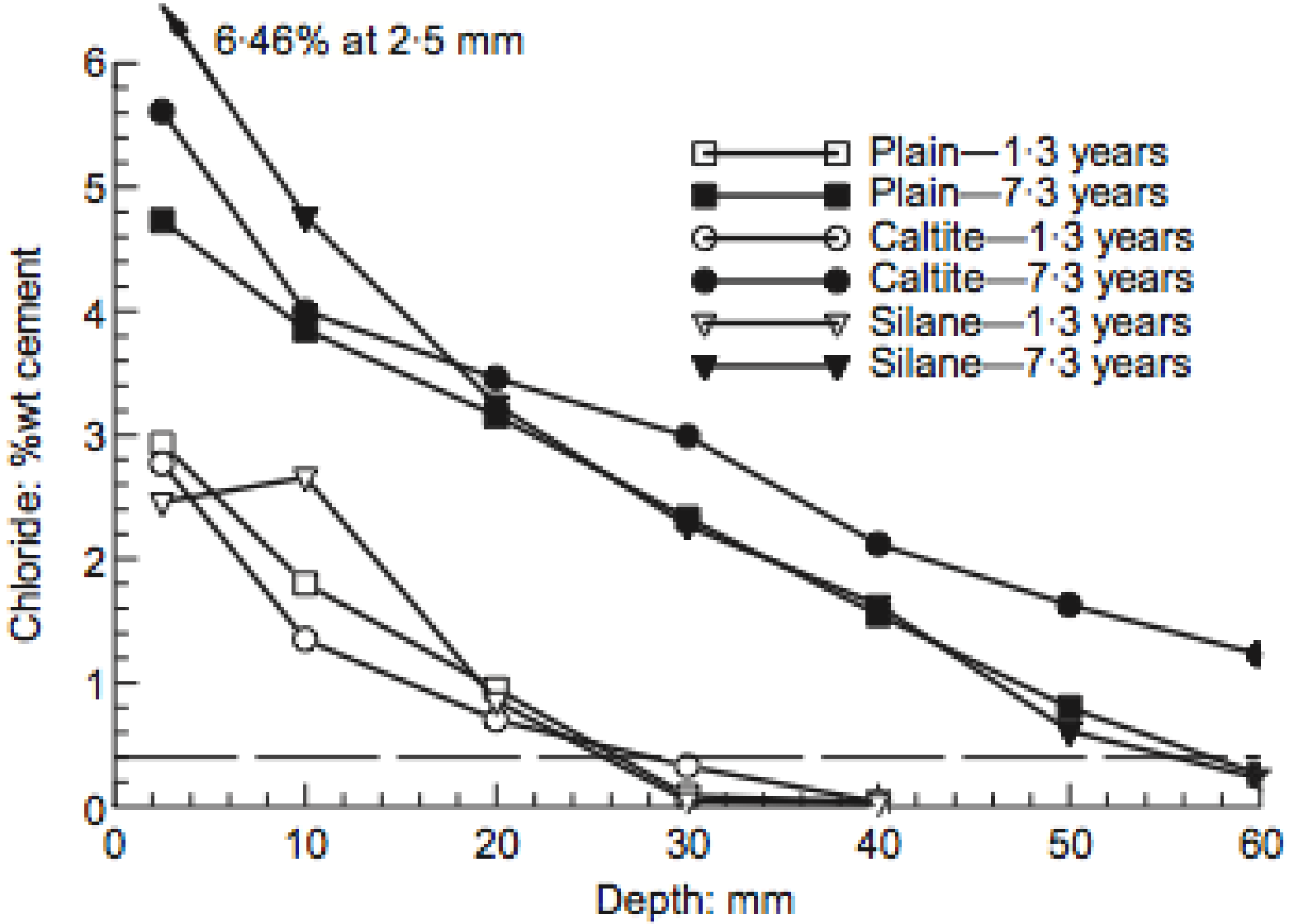
Two types

- Material Choice
  - This is the most researched to date, but not all common engineering materials are well-tested
- Positioning
  - Observations suggest utility
  - Hartlepool Scheme will test this
- Costs/Benefits/Constraints
  - Cheaper?
  - Slower?

M. Coombes, Portland Port

3. Asset Resilience

McCarter et al. 2008



3. Asset Resilience – evidence

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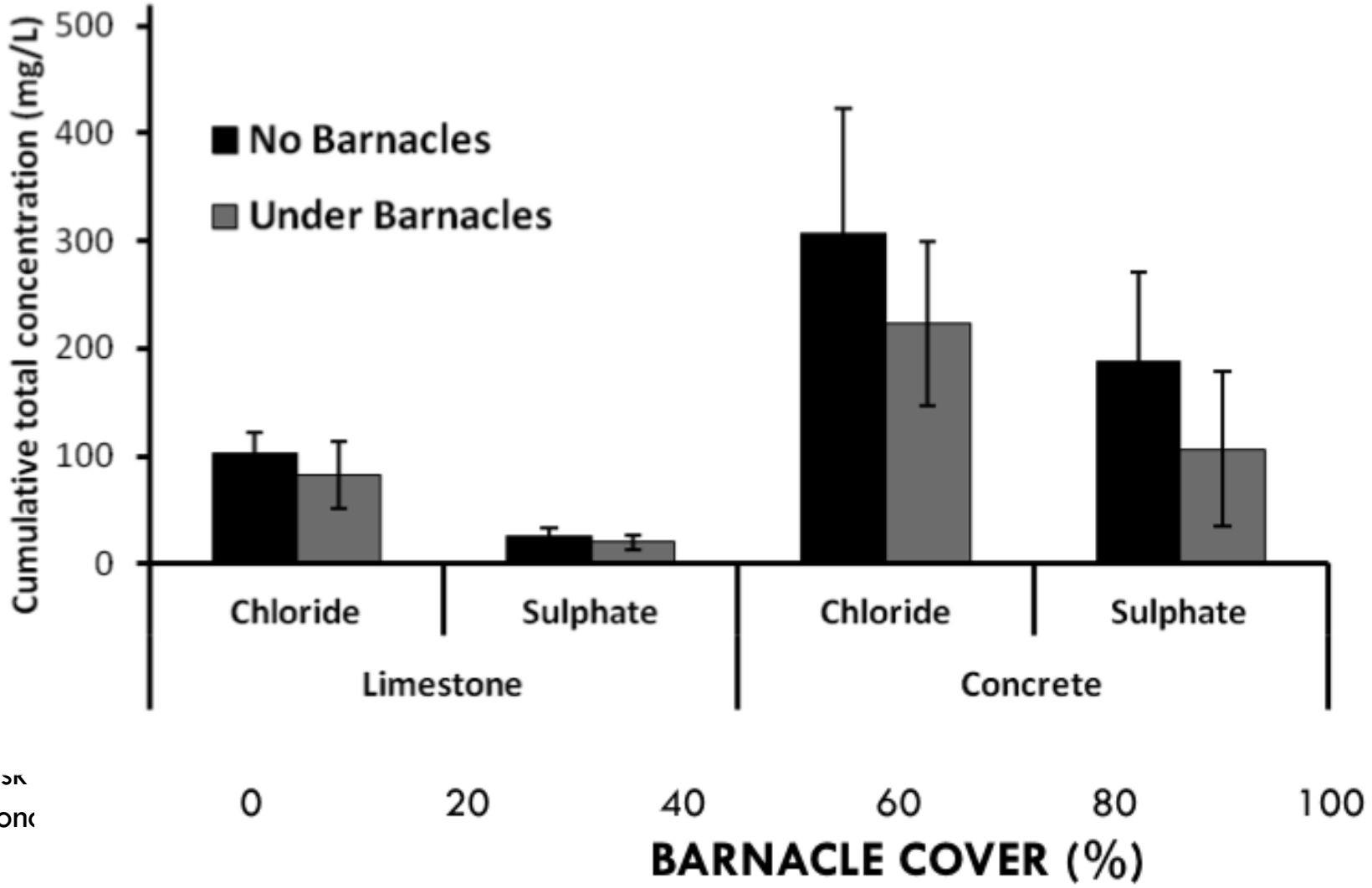


4. Benefits and Constraints of Enhancing

Benefits

- **Helps lever ££**
- **Profile raising**
- **Award Winning**
- **Can help get schemes approved**
- **Urban ecosystem quality improvements**

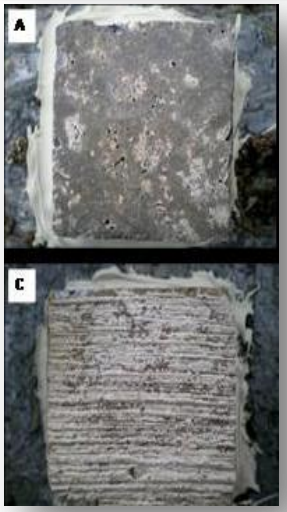
Constraints

- Weight of evidence vs. knowledge available
- Risks to structural integrity are poorly understood but improving
- Geographic Restrictions

5. Where Next? How can we accelerate this?

WFD implementation gap → PhD Research Project → Shaldon Habitat Enhancement → European WFD Best Practice

Environment Agency



CASE STUDY

Preserve and in
edge and bank

Project Summary
Title: Shaldon Intertidal Habitat Enhancement
Location: Shaldon, Devon, England

2005 → 2007-2011 → 2010-2012 → 2013-14

5. Where next? Questions for the audience

Legislative/Policy Drivers	• Will expanded knowledge of these drivers assist you?
Existing Case Studies	• Are these helpful? What else would be useful to facilitate enhancements?
Future Needs	• What more is needed to help move from 'innovation' to widespread application?

From innovation to widespread implementation

EPSRC
Engineering and Physical Sciences Research Council

- A short-term (7 month) capacity building project
- WP1: To identify drivers, successes, needs and challenges in moving from innovation to widespread implementation
- WP2: To identify key topics for future research projects
- WP3: To develop novel advice guides

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EPSRC Project – WP2

1. **Further testing of bioprotective buffering capacity – global study sites**
2. Use engineering scale tests
3. **Manufacturing: Commercialisation potential of ecological enhancement designs**
4. **BioCoat: Testing biogenic surface coatings compared to conventional techniques.**
5. Involve **New Industries:** transport, water, local government.

In collaboration with Daniel Metcalfe and Dr. Justin Marshall, Falmouth University & Richard Thompson, Plymouth University