Biostabilisation

consequences for sediment stability & floc entrainment

Sabine U. Gerbersdorf, Melanie Chocholek, Helen Lubarsky, Bernhard Westrich, David M. Paterson

sabine.gerbersdorf@iws.uni-stuttgart.de
What is Biostabilisation?

- erosive response of sediments to hydraulic forces is significantly changed by the presence and metabolic activity of all kinds of organisms

- biostabilisation covers a broad range of activities (e.g. worm tubes, macrophyte canopies, biofilms)

- cohesive sediments: microbial produced EPS (extracellular polymeric substances) matrix to enhance binding forces
How is Biostabilisation considered?

In research?
- Environment? Mainly intertidal areas
- Organisms? Microalgae
- Interactions? Limited knowledge
- Habitats? Sediment versus Flocs

In sediment transport models?
- First attempts, generally without biota
Microbes as “ecosystem engineers”? 

A. Experimental design

Isolation of natural assemblages from sediments and incubation on glass beads. Monitoring of growth, EPS secretion and stability over time.

B.1. Methods

- bacterial cell numbers (Flow cytometry),
- bacterial assemblages (FISH)
- microalgal biomass (chlorophyll a)
- microalgae composition (microscopy)
- EPS quantity (photometer) and quality (GC-MS, Maldi-TOF)
Microbes as “ecosystem engineers”? 

B.2. Methods – Stabilisation

**CSM** – Cohesive Strength Meter  **MagPI** – Magnetic Particle Induction
Microbes as “ecosystem engineers”?

Stabilisation over time – by MagPI

![Graph showing total clearance over time for different conditions.](Image)
Microbes as “ecosystem engineers”?  
Stabilisation over time

- bacteria do stabilize the substratum significantly
- bacteria stabilize better than diatoms
- no synergistic stabilisation effect in mixed assemblages

Why is this so?
Microbes as “ecosystem engineers”? Biomass / Cell numbers per treatment

- Bacterial cells $10^6$ cells cm$^{-3}$
- Chlorophyll a mg cm$^{-3}$

Control Diatom Bacteria Bac+Dia Control Diatom Bacteria Bac+Dia
Microbes as “ecosystem engineers”?

EPS – carbos & proteins over time
Microbes as “ecosystem engineers”? 

- no mutual benefit in mixed assemblages
  - joint action still provides best the ecosystem function “stabilisation”

- proteins have important role in stabilisation
  - interwoven proteins + carbohydrates create best binding force
Microbes as "ecosystem engineers"?

EPS matrix – visualization by LTSEM

Gerbersdorf et al. 2008, FEMS
Microbes as “ecosystem engineers”? 
Postentrainment & Flocculation

Gust Chamber - Microcosms
Microbes as “ecosystem engineers”? 

Postentrainment & Flocculation

![Graph showing the comparison of Bac+Dia, Dia, and Bac 35 with respect to proteins and carbohydrates.](image-url)
Microbes as “ecosystem engineers”?  

Organisms that create, modify and maintain habitat (Jones 1997)  

YES  

Learn more about organisms / interactions involved & binding features of the EPS matrix  

Long-term goal: Implementation in predictions of sediment erosion & transport!
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