MICROBIAL INTERACTIONS ON MOS

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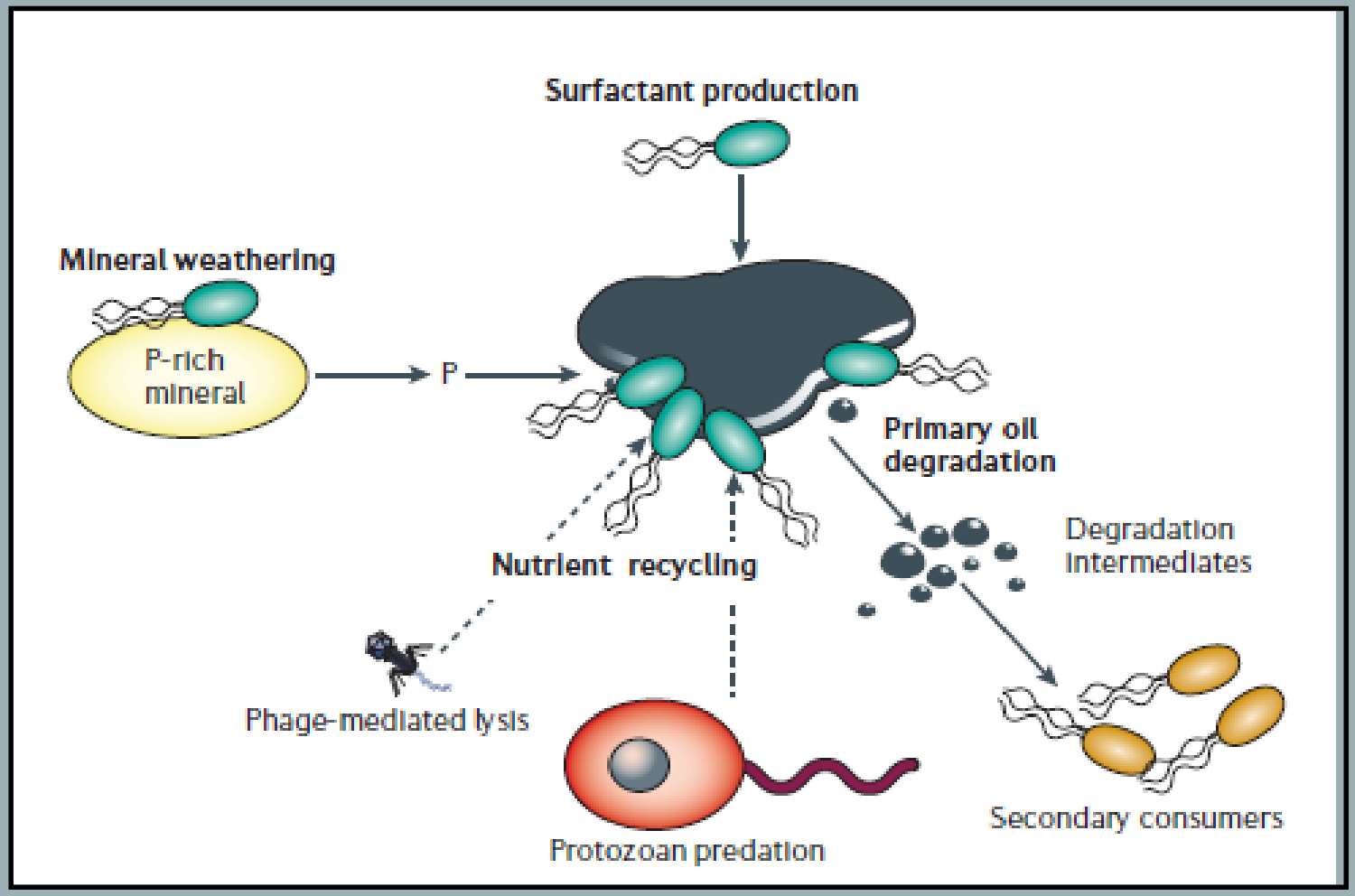
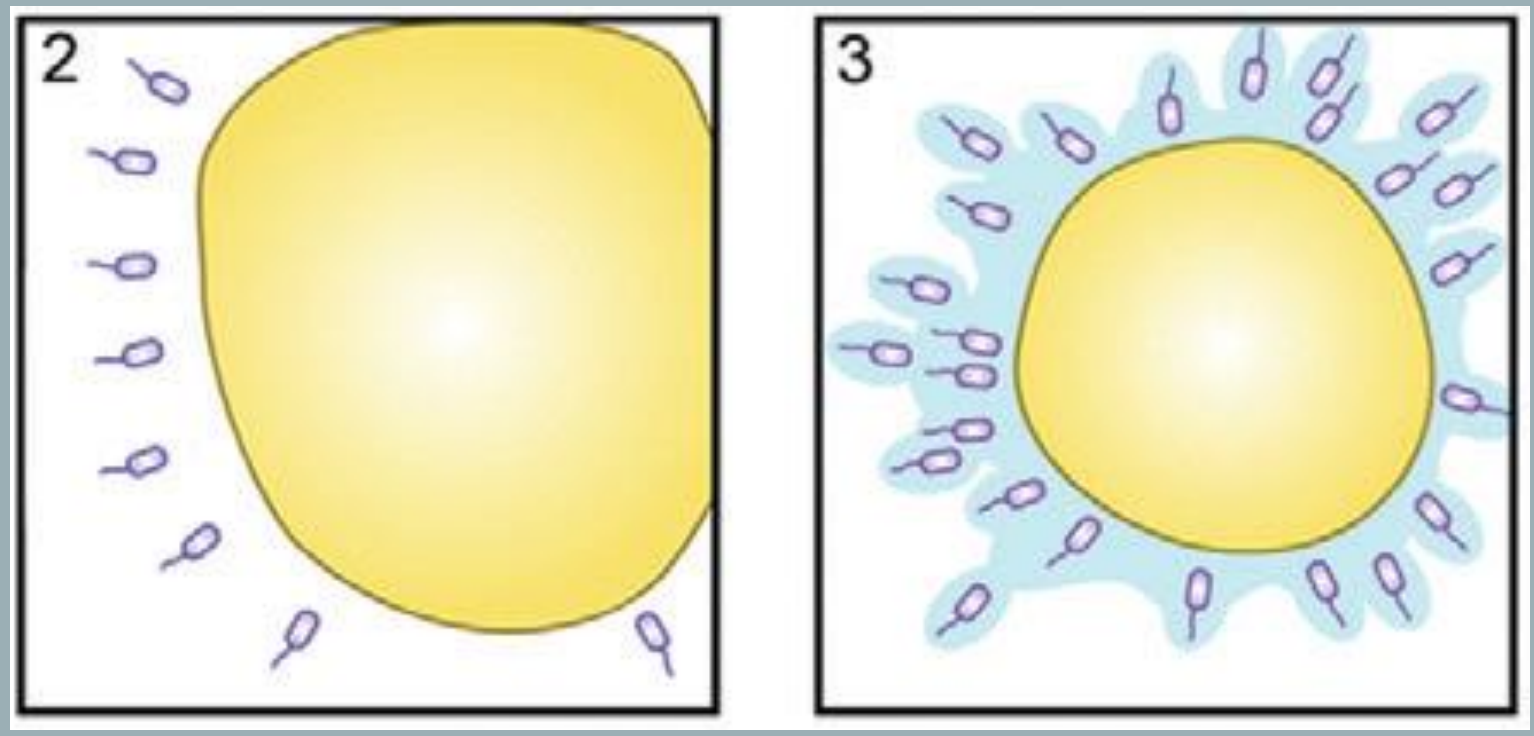
Ocean Ecosystem Research

MICROBES AND OIL



Head et al. (2006)

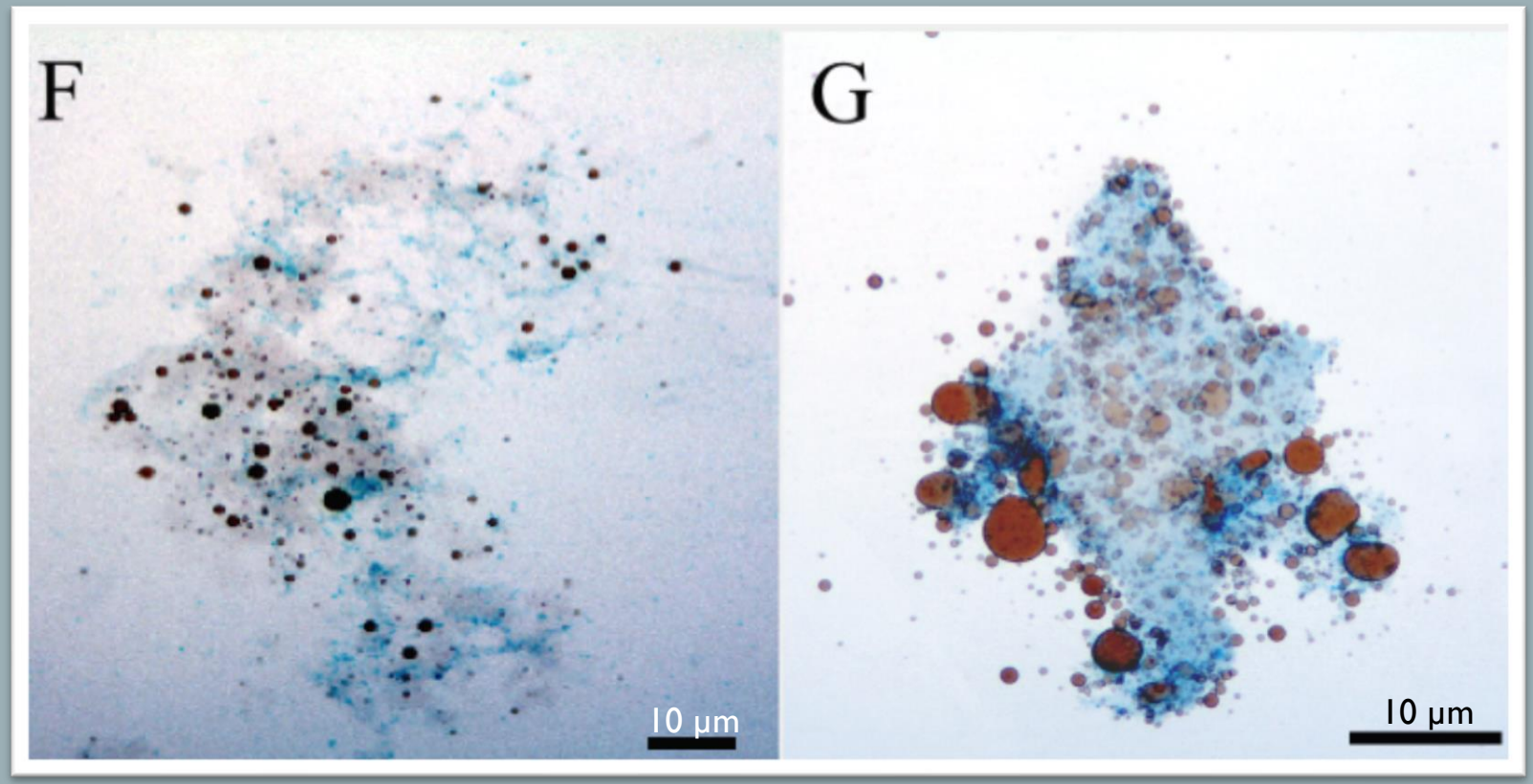
EPS – EXOPOLYMERIC SUBSTANCES



Bælum et al. (2012)

Yellow – oil, blue – EPS, with associated microbial cells

EPS AND OIL:
(F) POLYSACCHARIDES AND (G) PROTEINS

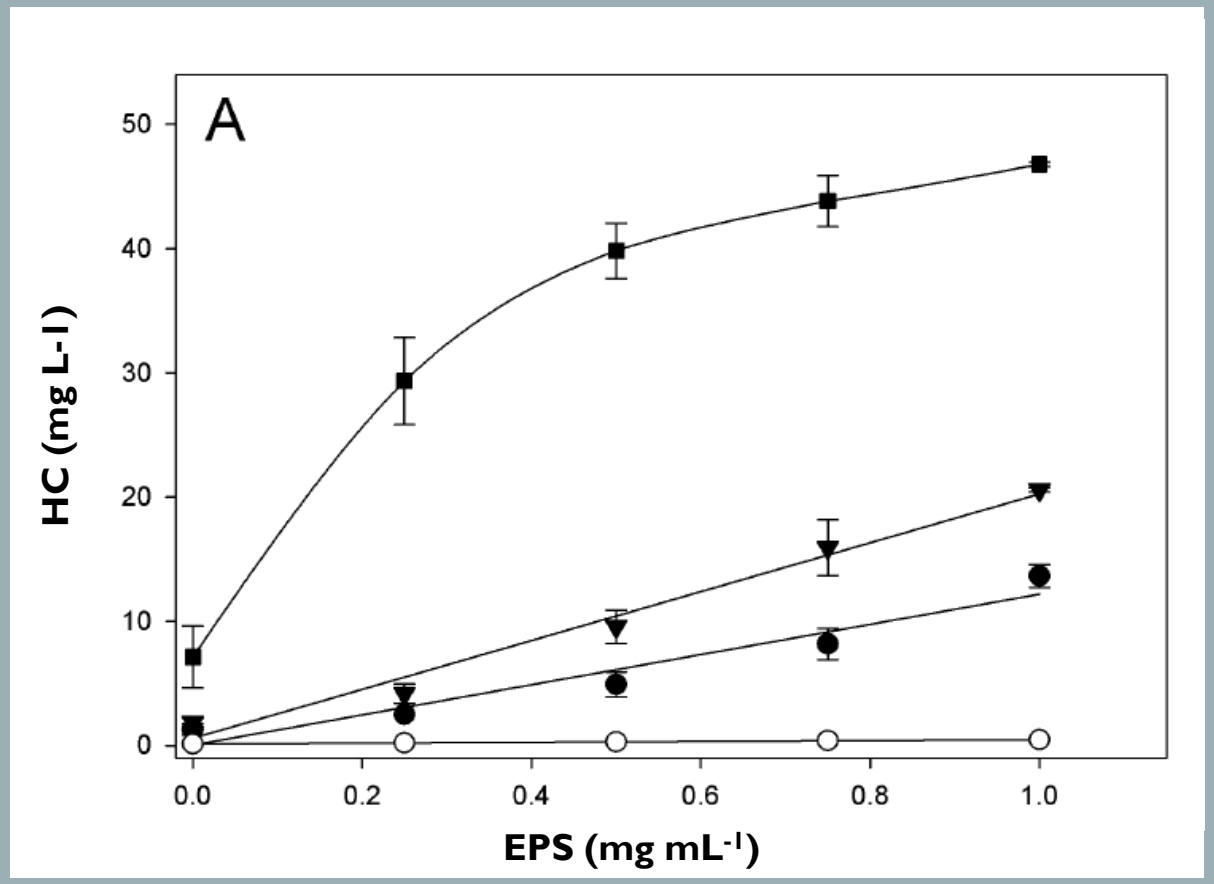


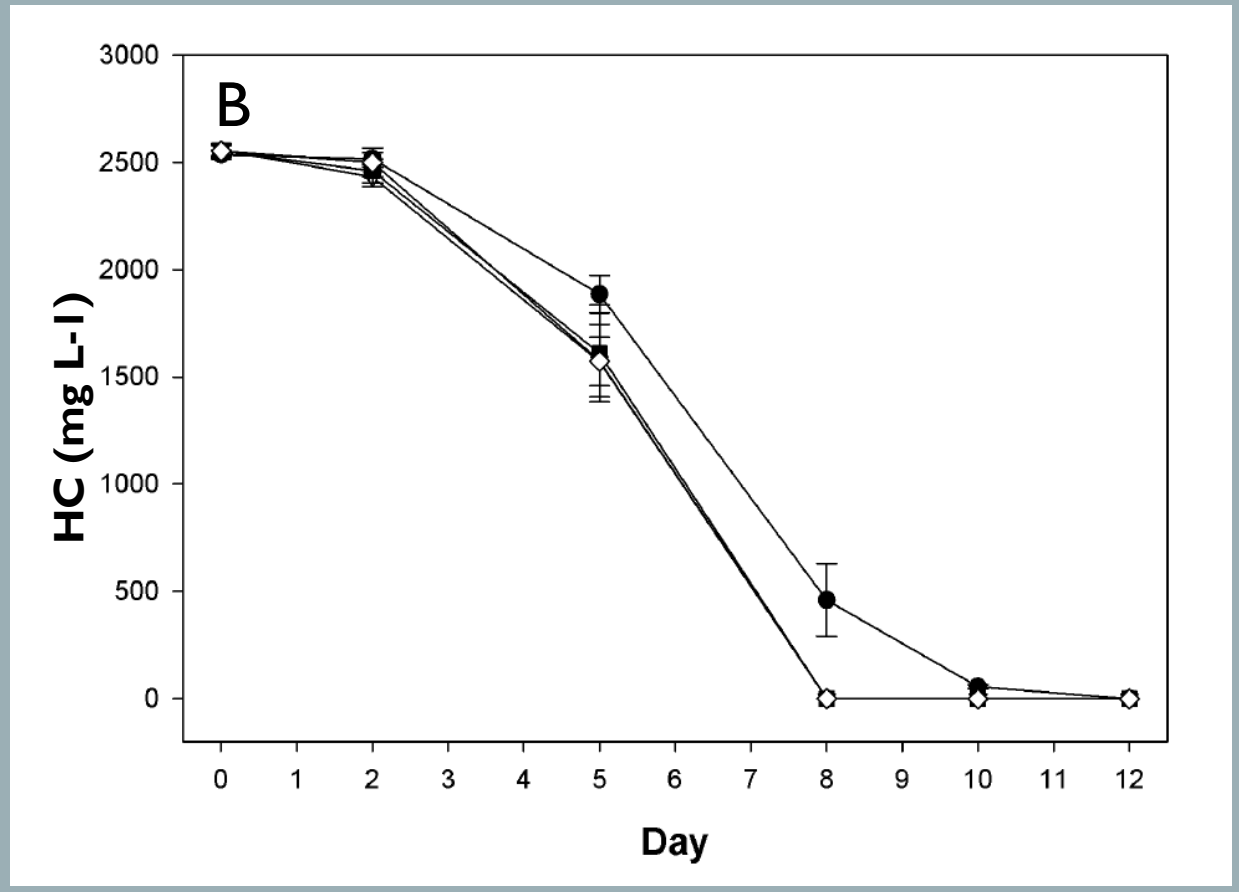
Gutierrez et al. (2013)

Black/reddish dots – oil droplets, blue – EPS, microbial cells not visible (*Halomonas* sp.)

EPS AND OIL:

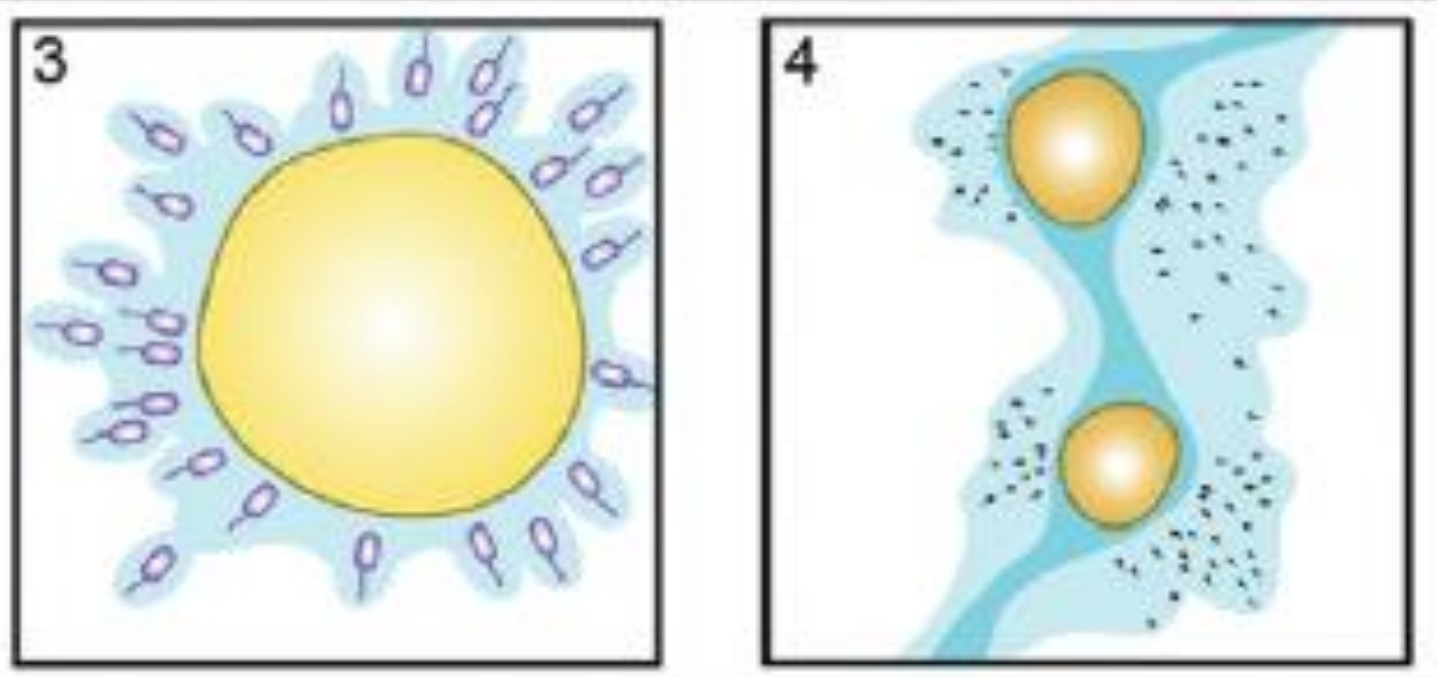
(A) ENHANCED SOLUBILITY OF HYDROCARBONS (HC)
(B) ENHANCED HC DEGRADATION





Gutierrez et al. (2013)

EPS AS MATRIX FOR MICROBIAL OIL FLOCS



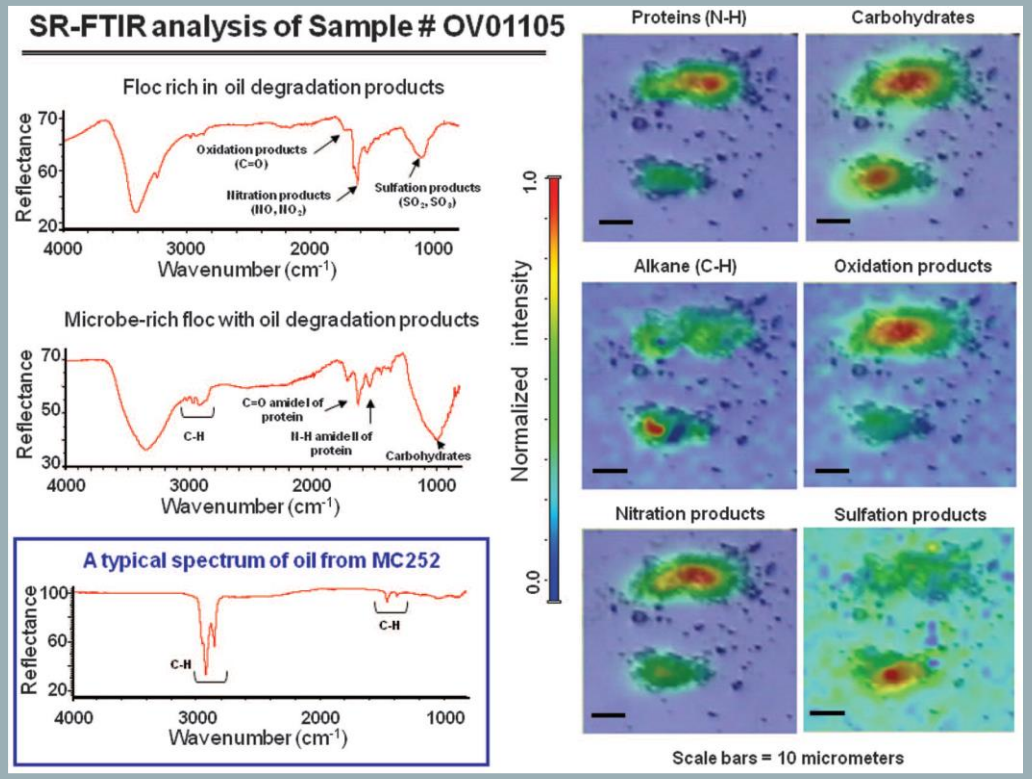
Bælum et al. (2012)

Yellow – oil, blue – EPS, with associated microbial cells

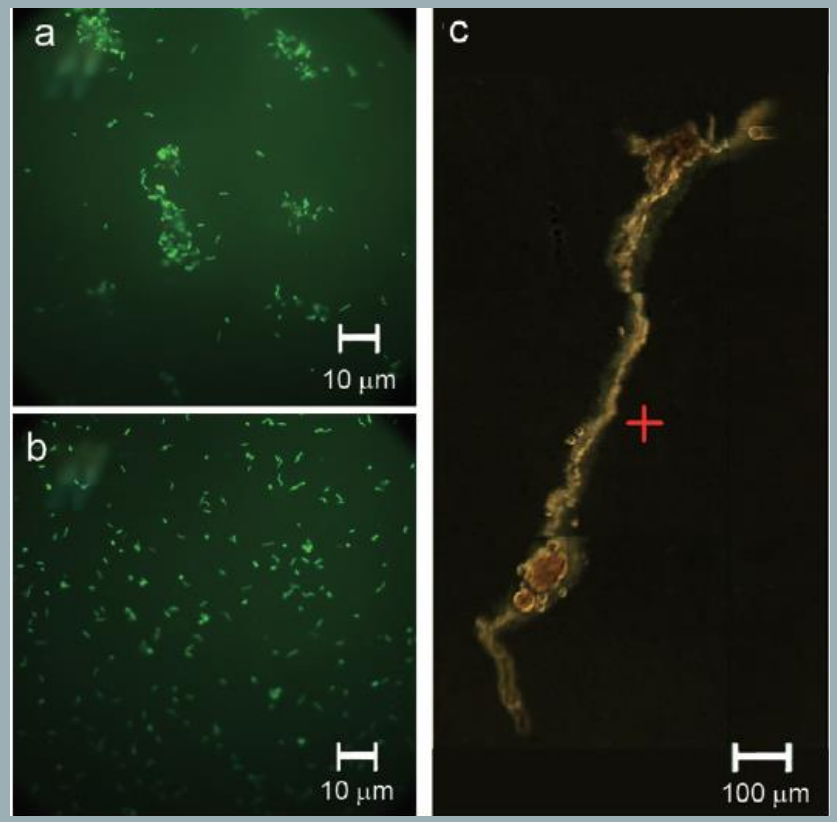
MICROBIAL OIL FLOCS

'Cellular flocs' – bacteria, EPS, oil, and oil degradation products (non-sinking flocs)

Flocs in deep plume water (Hazen et al., 2010)

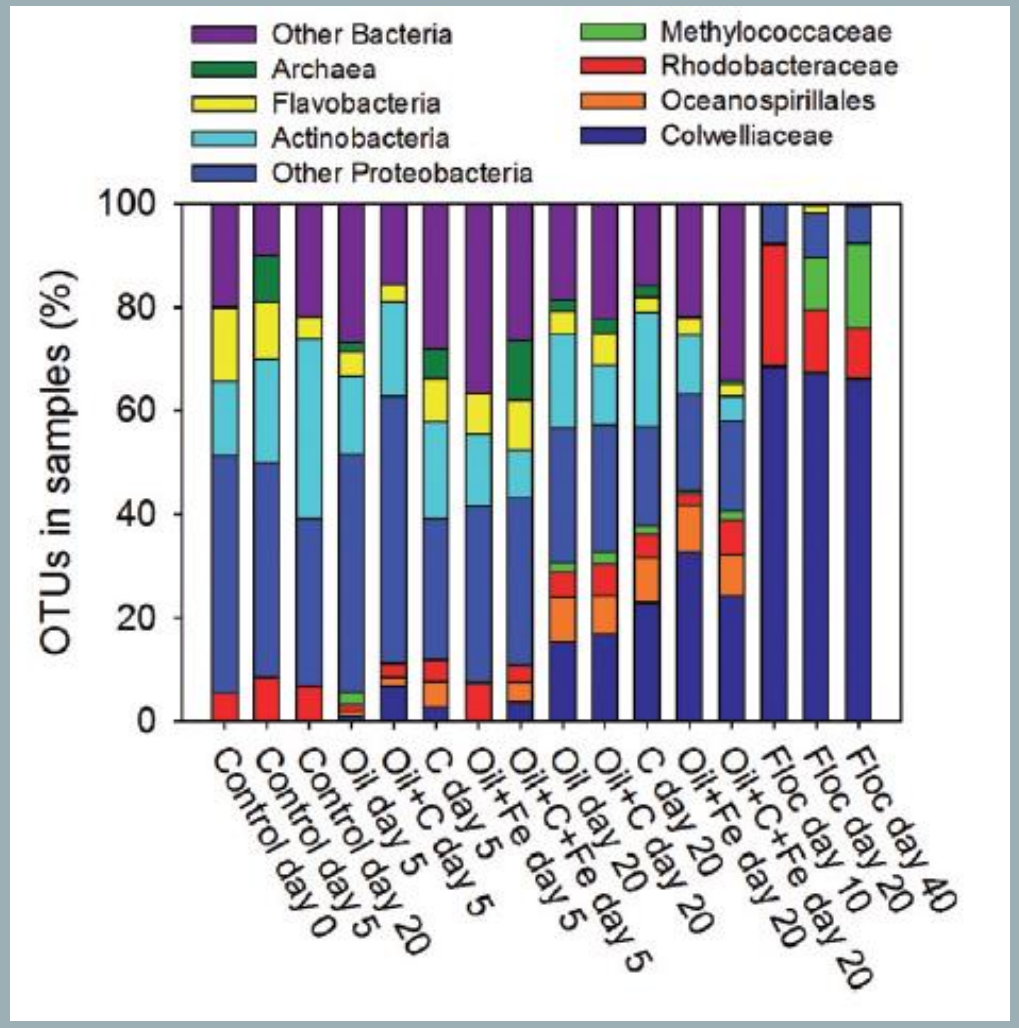


Floc formation *ex situ* (Bælum et al., 2012)

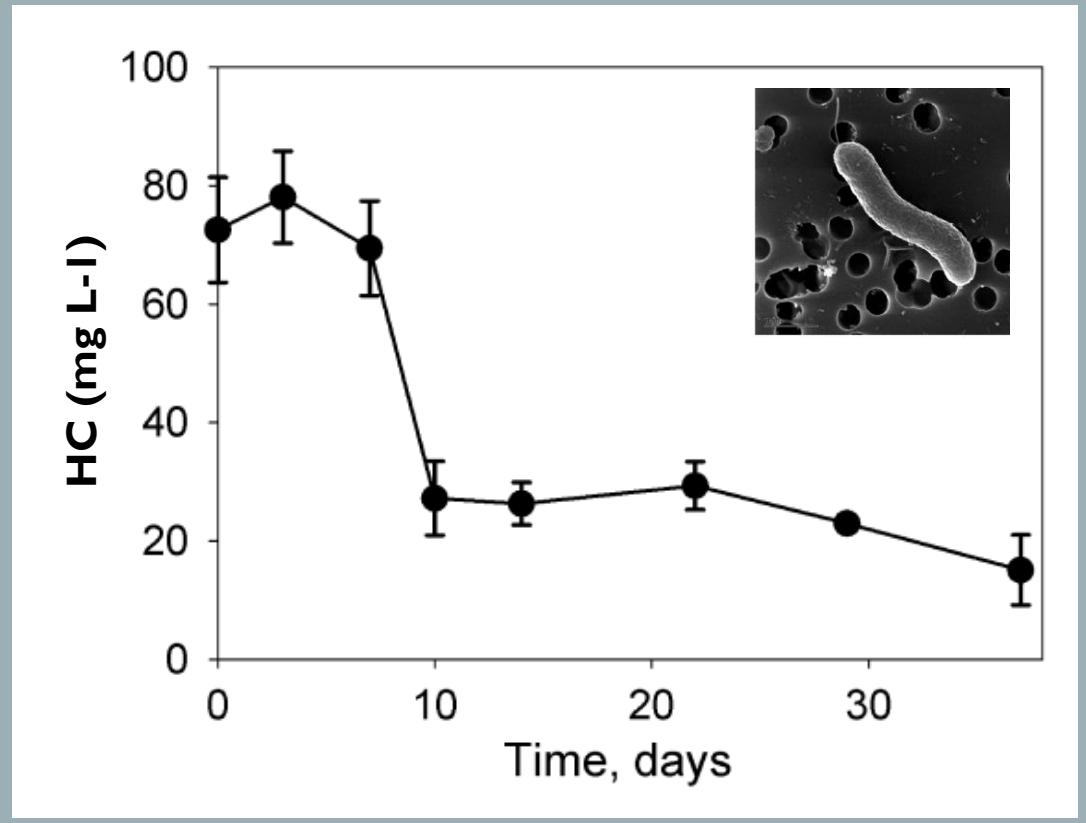


→ see also Doyle et al. (2018): Cells clumped around oil droplets (10 – 200 µm in diameter)

MICROBIAL OIL FLOCS DOMINATED BY *COLWELLIA*



HC degradation by *Colwellia* sp. isolated from floc



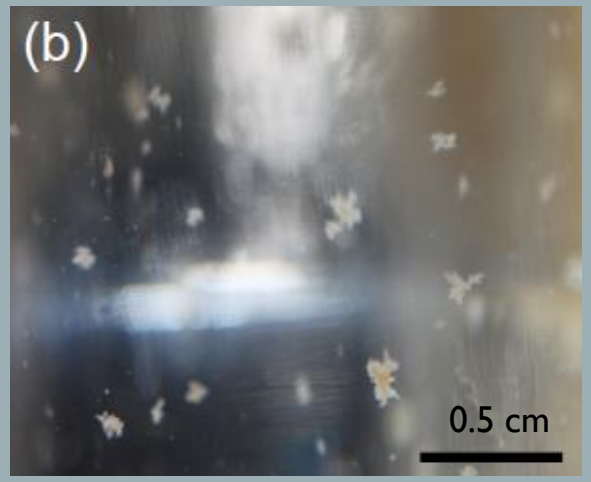
Bælum et al. (2012)

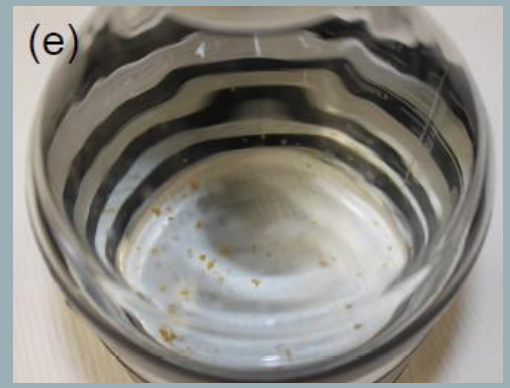
COLWELLIA IN MOS FORMED IN ROLLER BOTTLES

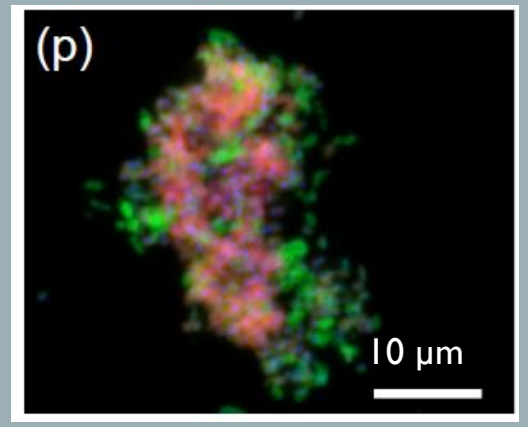
Enrichment of oil-degrading bacteria from oil seep (~1100m)

Stage I: EPS-oil matrix (15 d)

Stage II: EPS-oil + ballast (50 d)







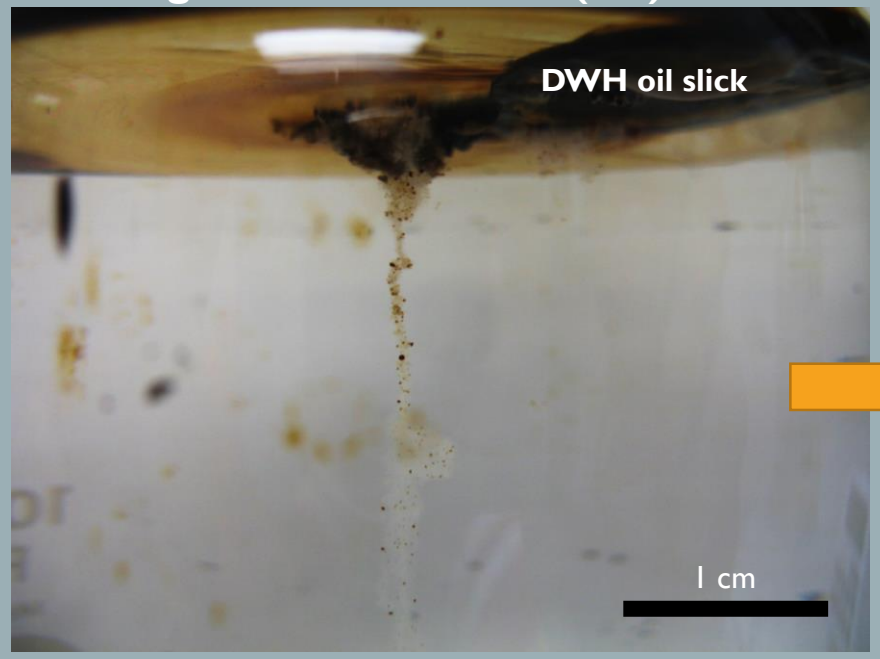
Dual CARD-FISH hybridization of MOS:
Red - *Colwellia*; green – all Bacteria

Kleindienst et al. (2015)

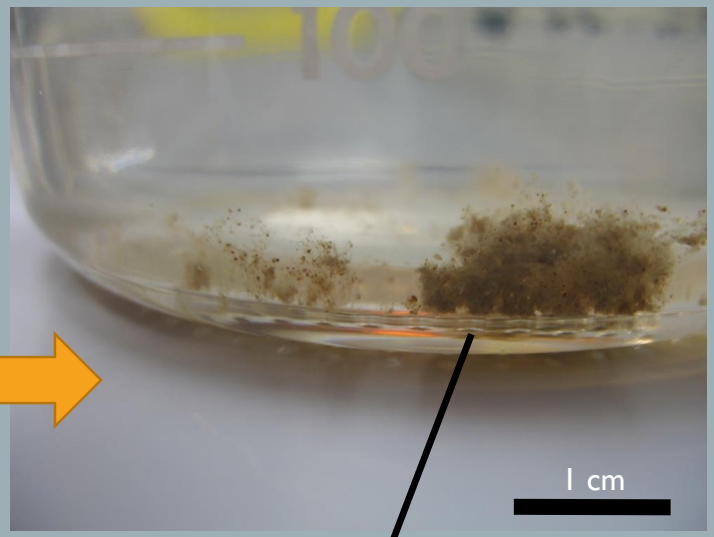
MICROBIAL MOS IN ROLLER BOTTLES

Enrichment of oil-degrading bacteria from oil slick (DWH, May 2010)

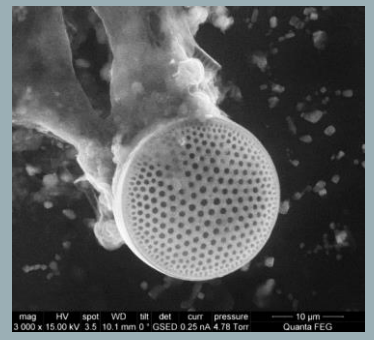
Stage 1: EPS-oil matrix (7 d)

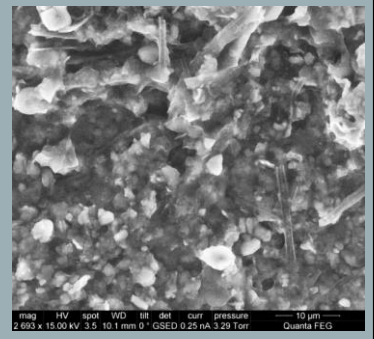


Stage 2: EPS-oil + ballast (21 d)



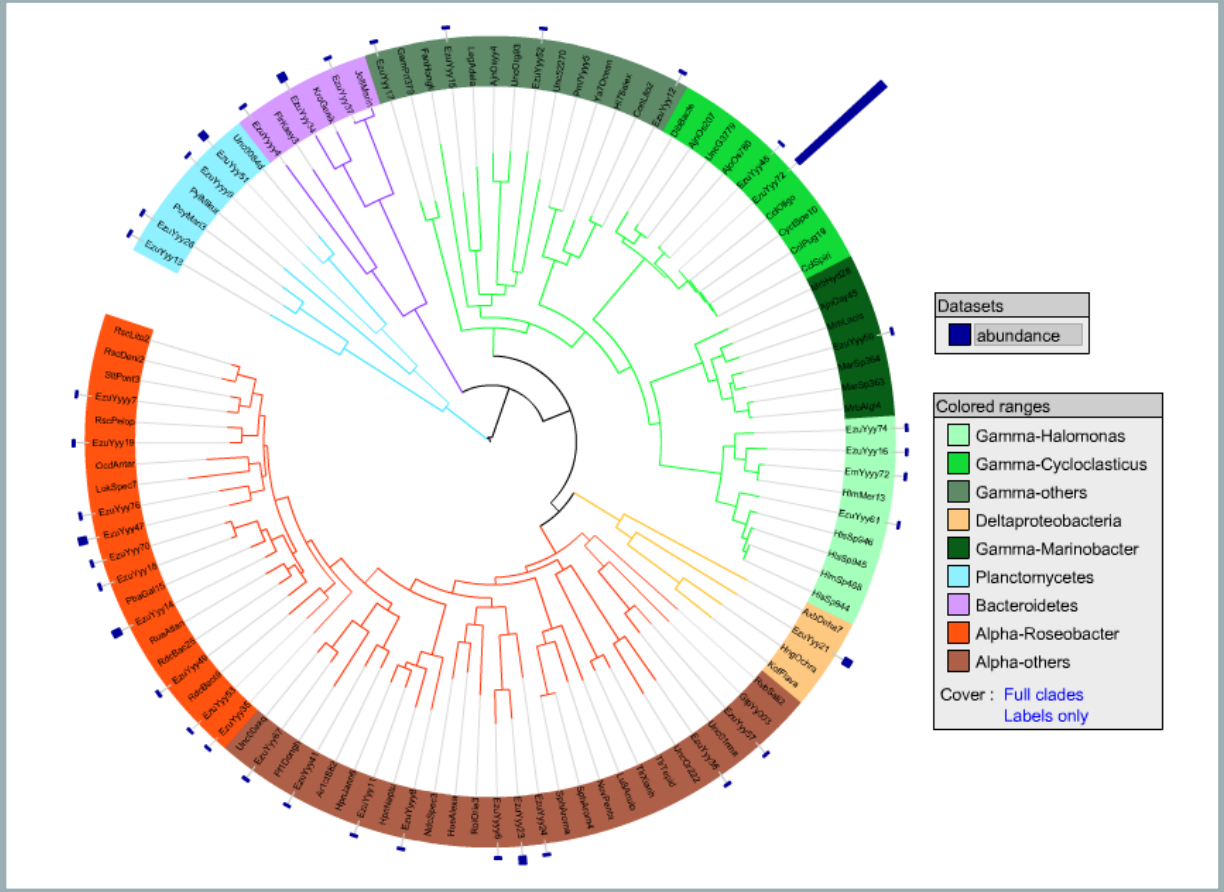
Ballast: Planktonic cells and minerals





Ziervogel et al. (2012)

MOS-ASSOCIATED MICROBIAL COMMUNITY:
MORE DIVERSE COMPARED TO DEEP FLOCS/MOS



- **Gammaproteobacteria**
  Cycloclasticus -- PAH-degraders

  Marinobacter, *Halomonas* – Alkane-degraders and EPS-producers (see also Gutierrez et al., 2013)

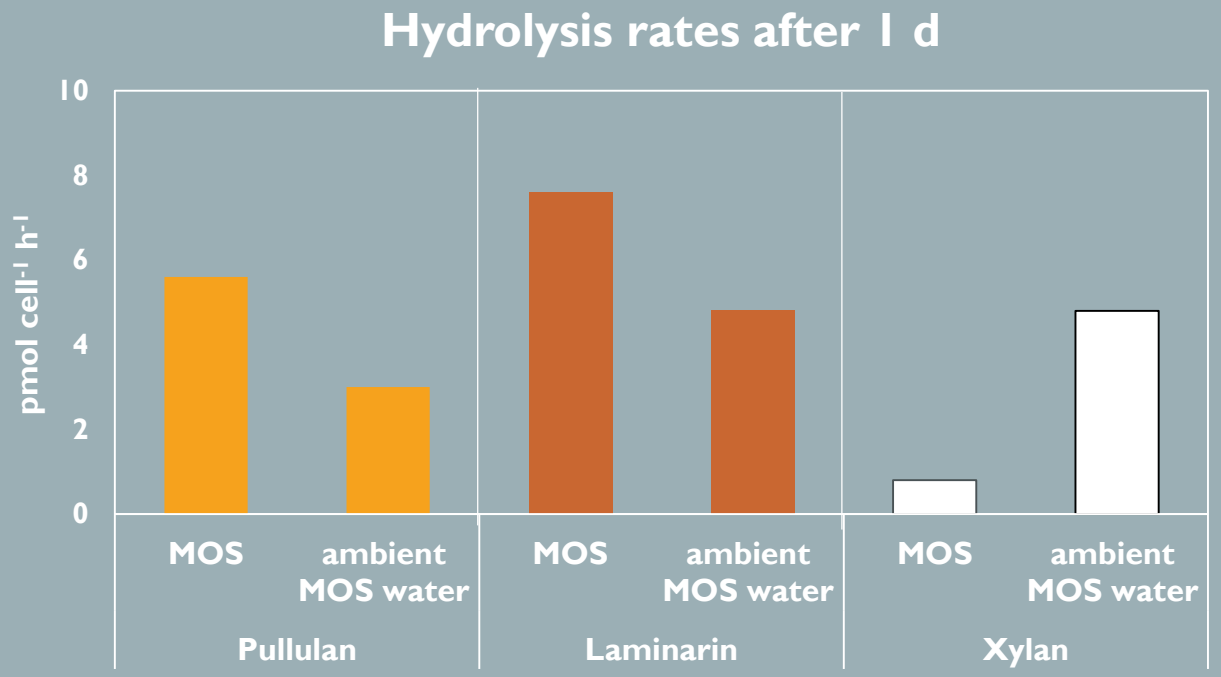
- **Alphaproteobacteria, Deltaproteobacteria, Bacteriodetes**

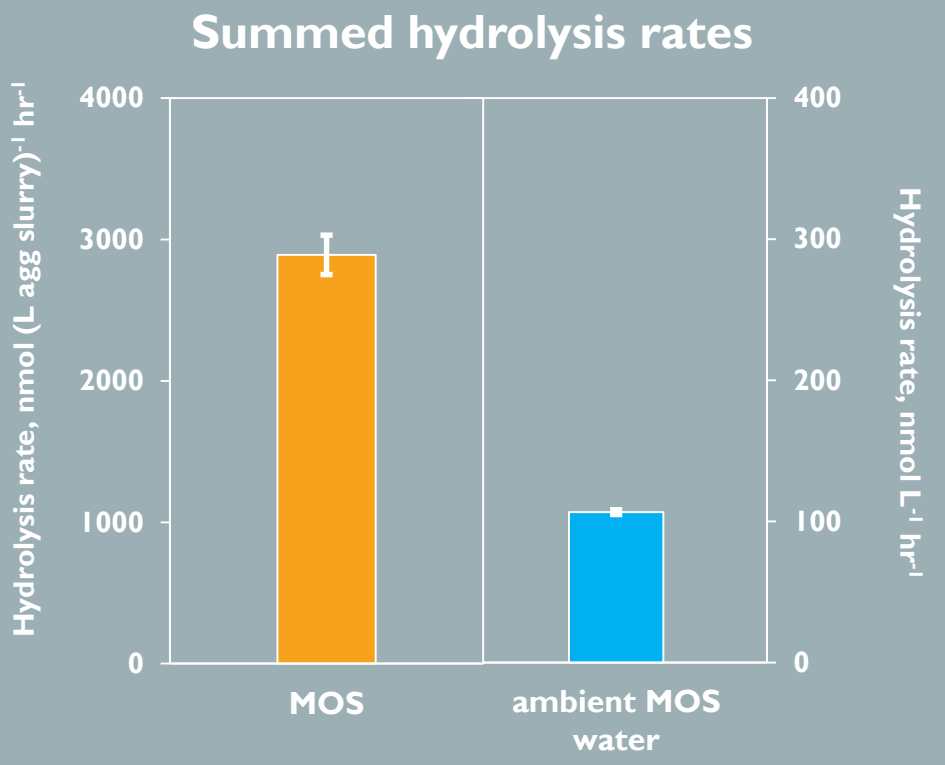
  Broad metabolic capabilities → *Secondary consumers* (Head et al., 2006)

Arnosti et al. (2015)

MICROBIAL ACTIVITIES IN MOS

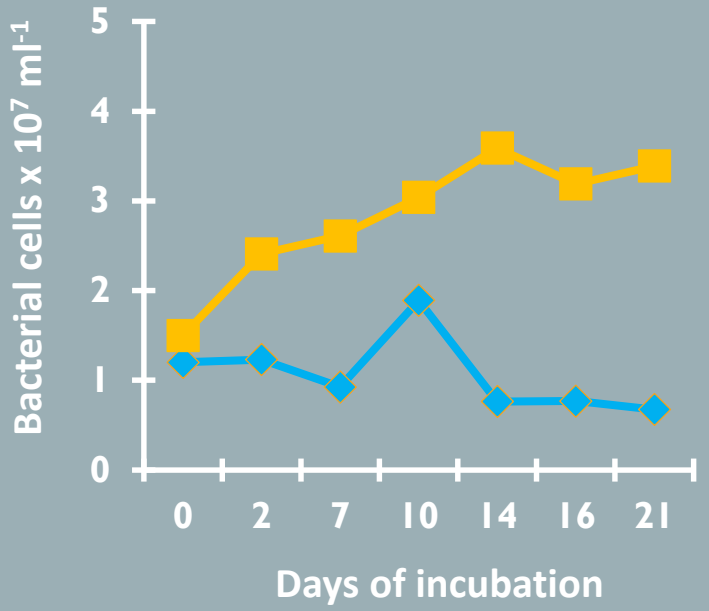
Polysaccharide degradation in MOS → *Secondary consumers*

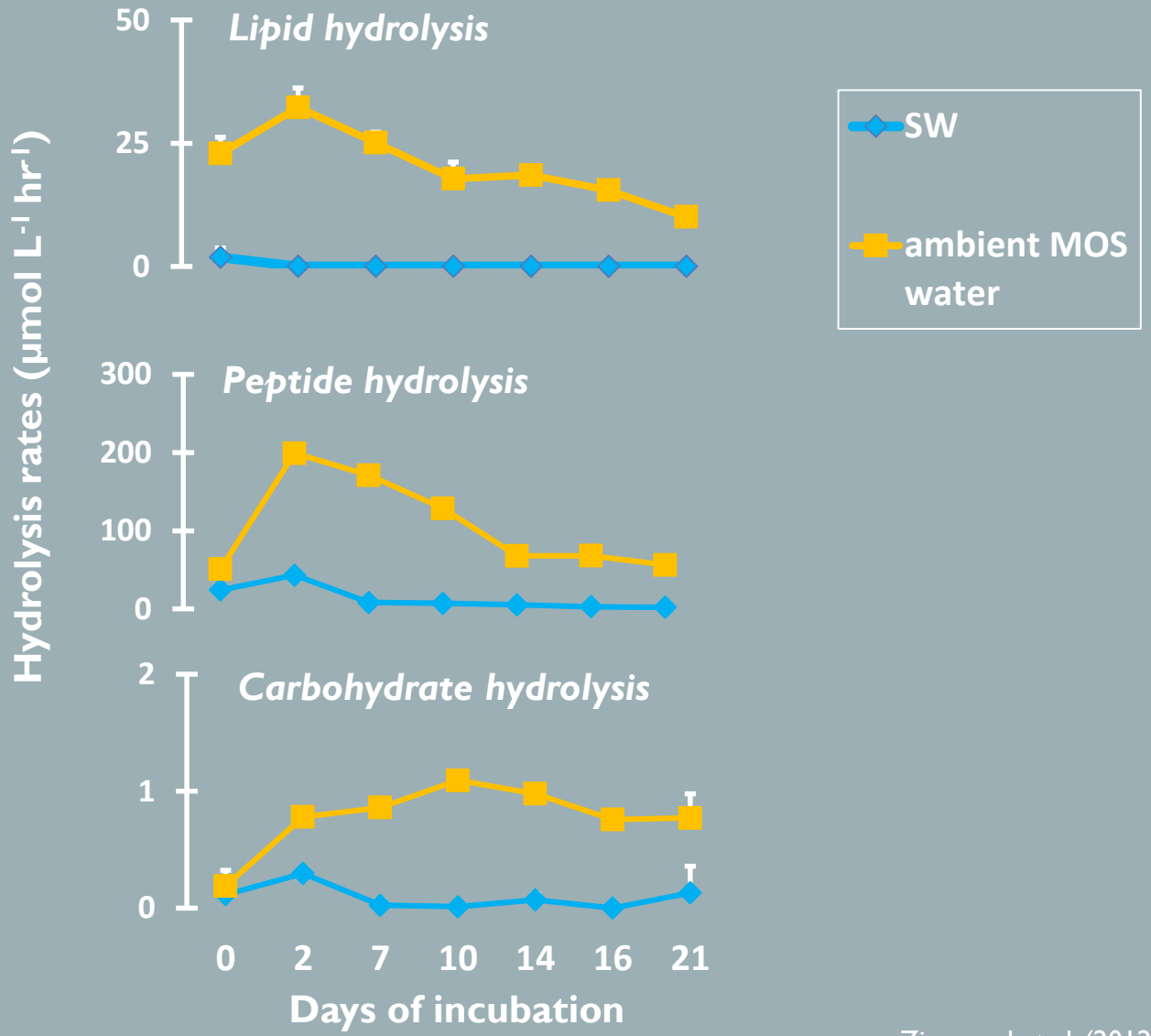




Arnosti et al. (2015)

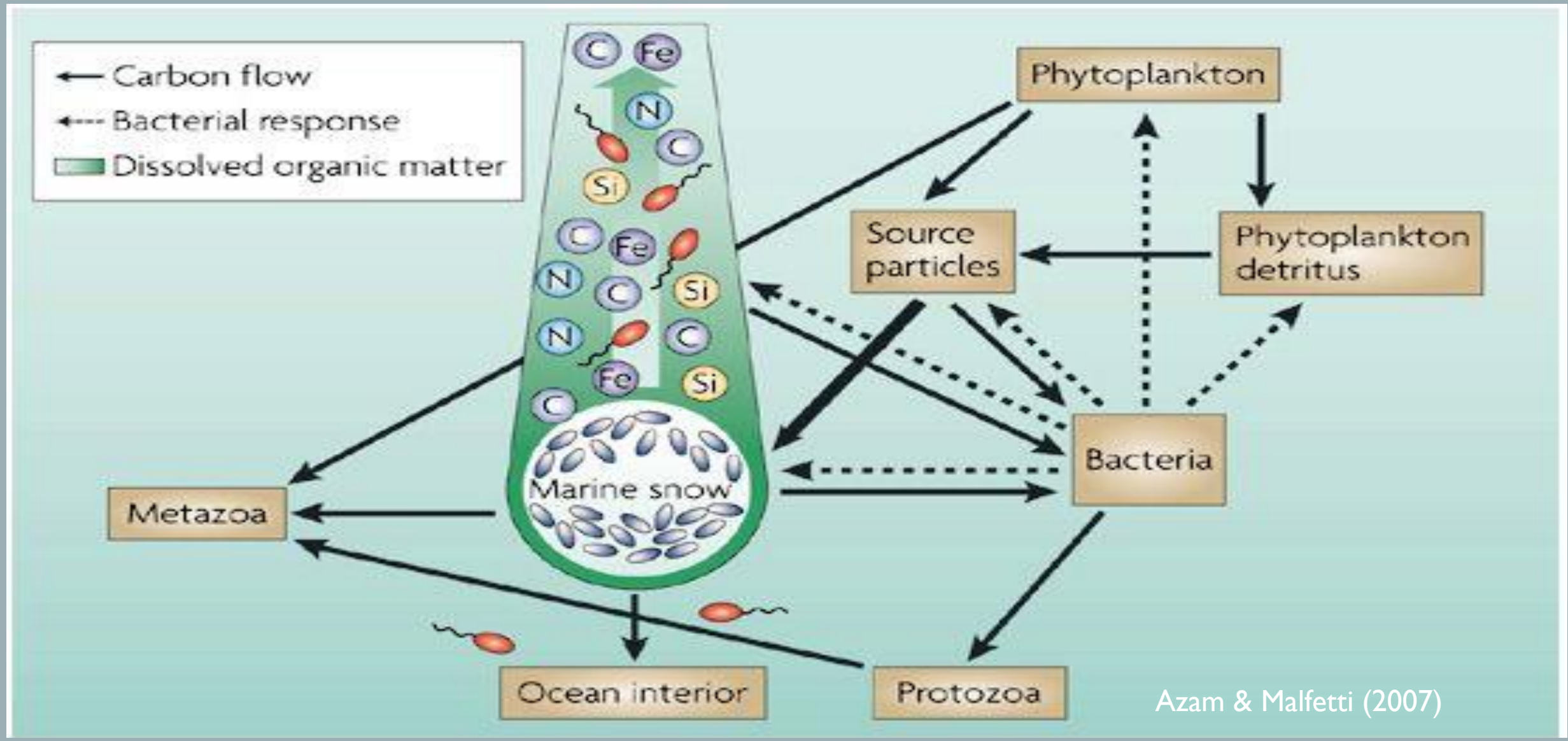
MOS STIMULATES MICROBIAL ACTIVITIES IN AMBIENT WATER





Ziervogel et al. (2012)

MOS STIMULATES MICROBIAL ACTIVITIES IN AMBIENT WATER



Azam & Malfetti (2007)

SUMMARY

- **Oil-degrading microbes trigger MOS formation**

  <u>Step I</u>: Formation of 'cellular flocs' (cells, EPS, oil, oil degradation products)
  → physiological mechanism for oil-degrading microbes (e.g. Bælum et al., 2012)?

  <u>Step II</u>: MOS formation
  → 'Cellular flocs' grow and sink (e.g. Kleindienst et al., 2015)
  → Ballast material trapped in mucus matrix (e.g. Ziervogel et al., 2012)

- **Microbial communities on MOS in deep water less diverse compared to surface water MOS**

- **Microbial activities on MOS (including *Secondary consumers*) affects elemental fluxes in the water column**

WHAT ABOUT COREXIT????

- ‘Cellular flocs’ formed with and w/o COREXIT (Bælum et al., 2012; Doyle et al., 2018)
- Microbial MOS in deep waters with and w/o COREXIT and nutrients (Kleindienst et al., 2015)
- Microbial MOS in surface waters during spill ?COREXIT? (Ziervogel et al., 2012)
- Microbial MOS with COREXIT and nutrients only (Suja et al., 2017):

Subarctic NE Atlantic