

Quorum sensing and its inhibition in marine biofilms

Sergey Dobretsov






Dep. Marine Science and Fisheries

Sultan Qaboos University

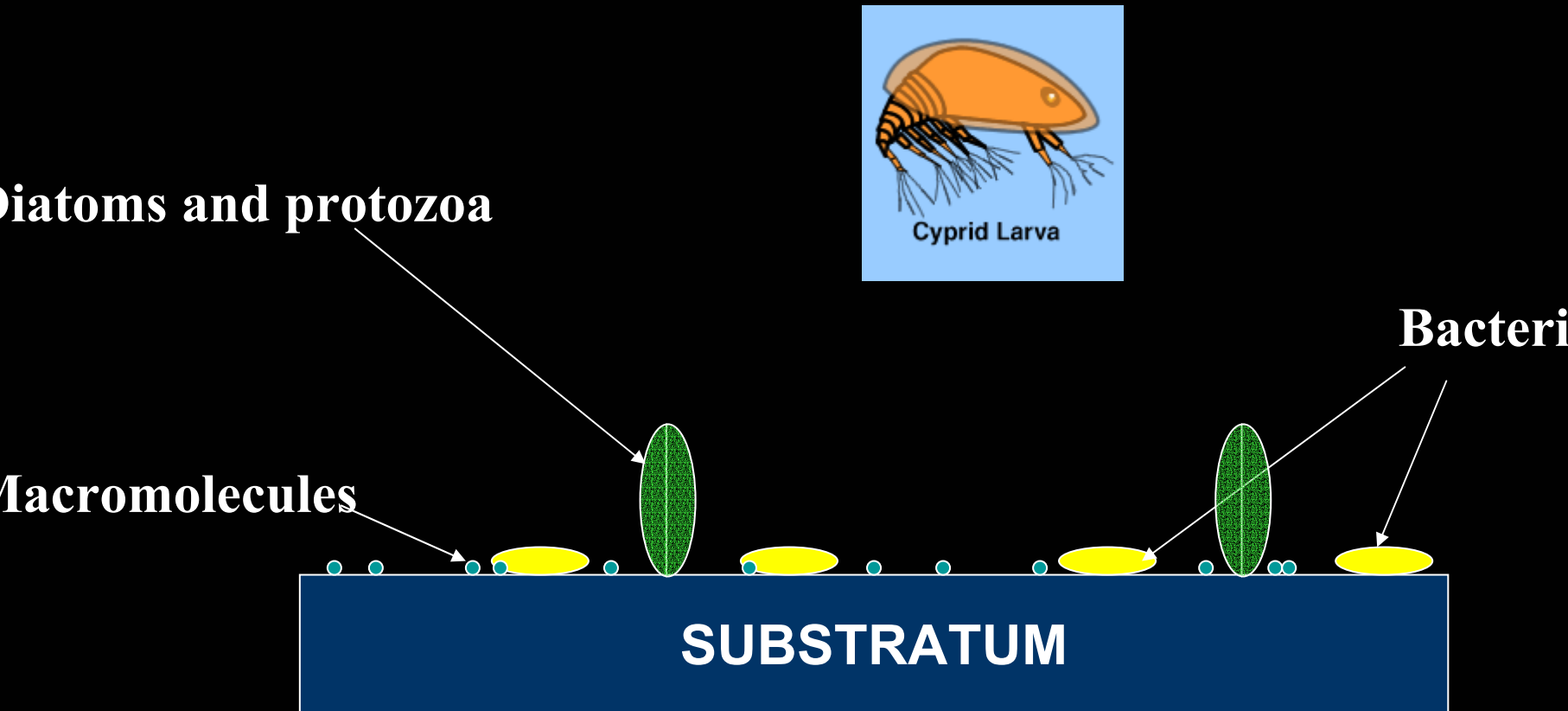
sergey@squ.edu.om



Outline of the presentation

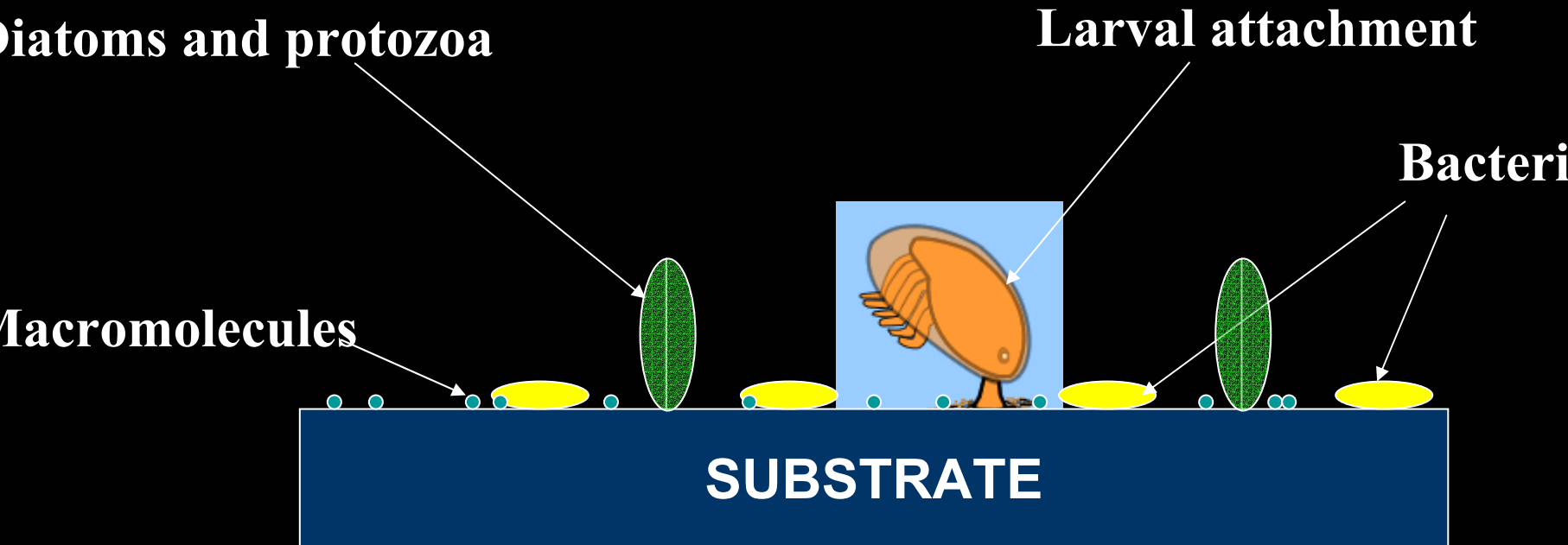
-  Background information about biofouling
-  Antifouling compounds from marine macroorganisms
-  Bacteria as a source of antifouling compounds
-  Quorum sensing and its inhibition
-  Conclusions and future directions

Biofouling sequence



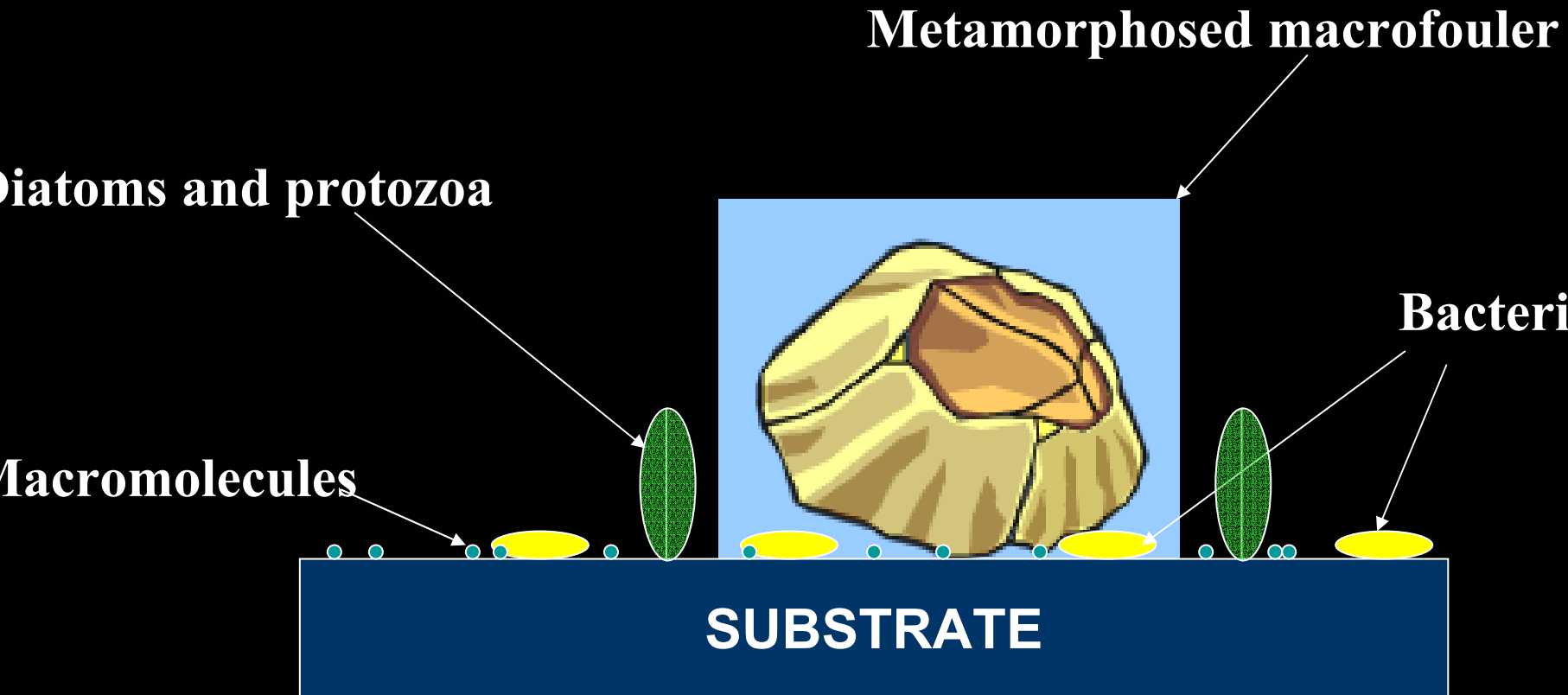
Biofouling is deposition of organisms on submerged surfaces

Biofouling sequence



Biofouling is deposition of organisms on submerged surfaces

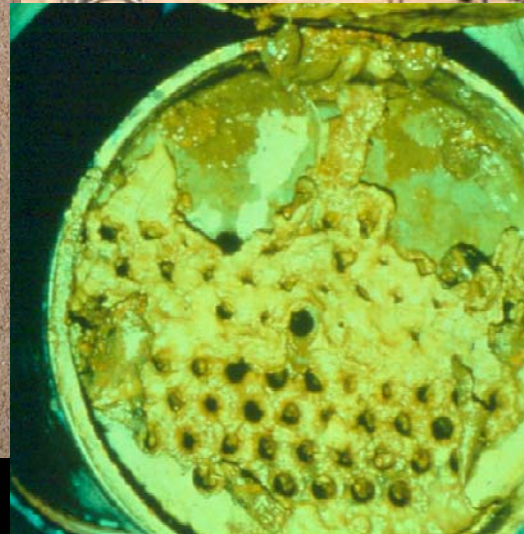
Biofouling sequence



Biofouling is deposition of organisms on submerged surfaces

Marine biofouling has huge economic impact

Biofouling costs industry over \$6.5 billion per year



Drawback of biocidal defense

- Highly toxic
- Non-specific
- Accumulate in organisms and sediments (TBT > 6 months)
- Change morphology and animal behavior

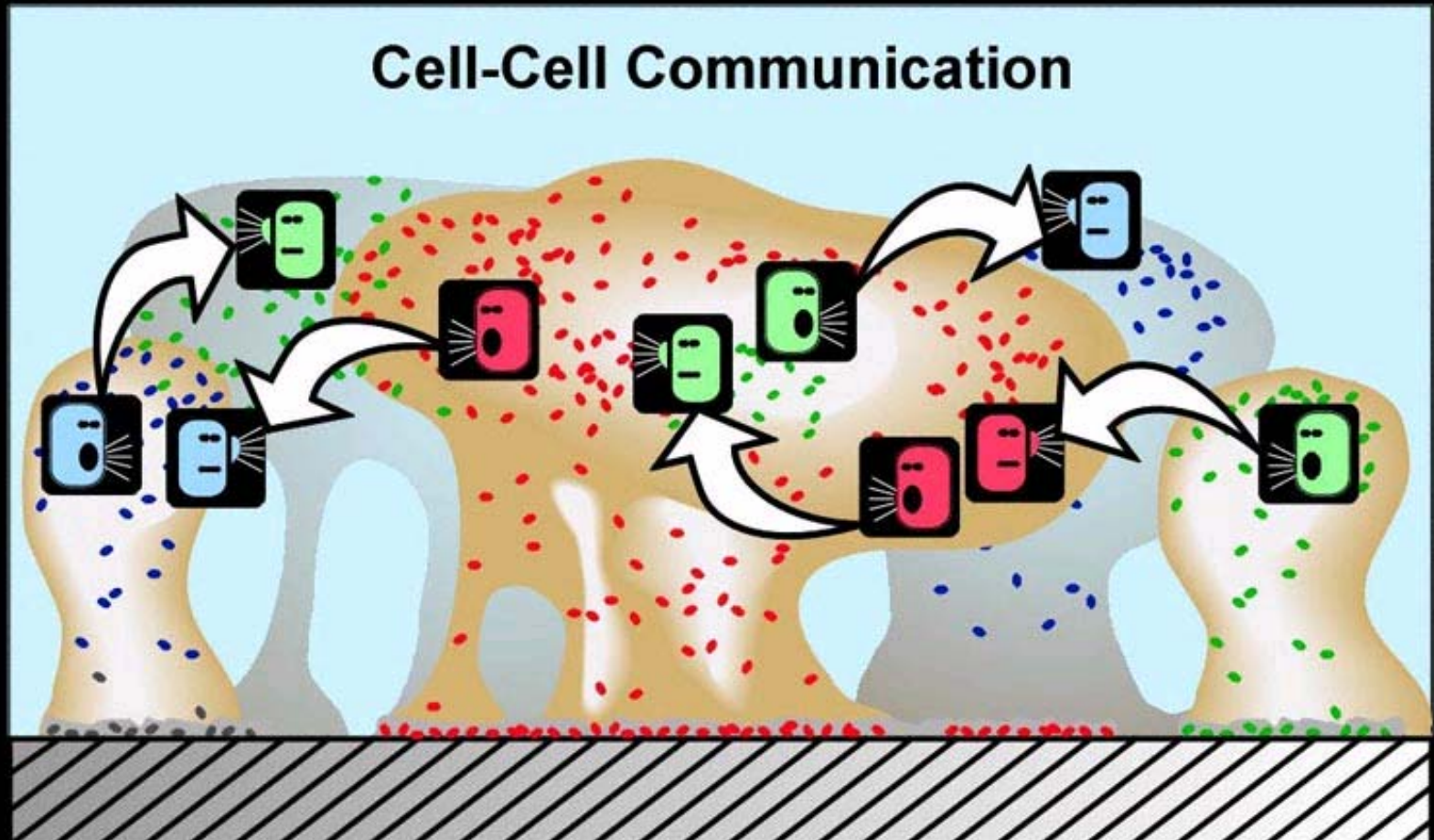
NON-TOXIC defence is urgently needed

- Hazardous to human

International Maritime Organization

- **Banned of TBT production – 2003**
- **Banned of TBT products - 2008**

Bacterial talk - Quorum sensing (QS)

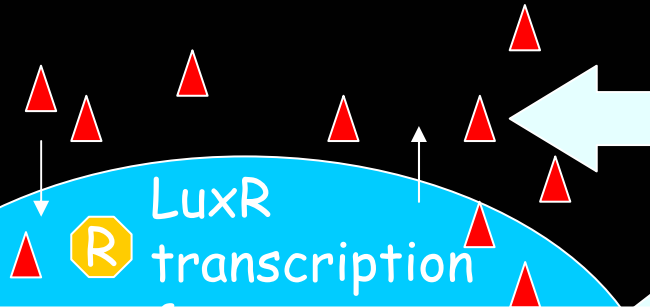


Bacterial QS and its prevention

Quorum
sensing
molecules
AHLs
(acyl-
homoserine
lactones)

Inhibition:

AHL signals
(AHL-acylase)



QS inhibitors can open a new way to deal with
biofouling and treat bacterial infections

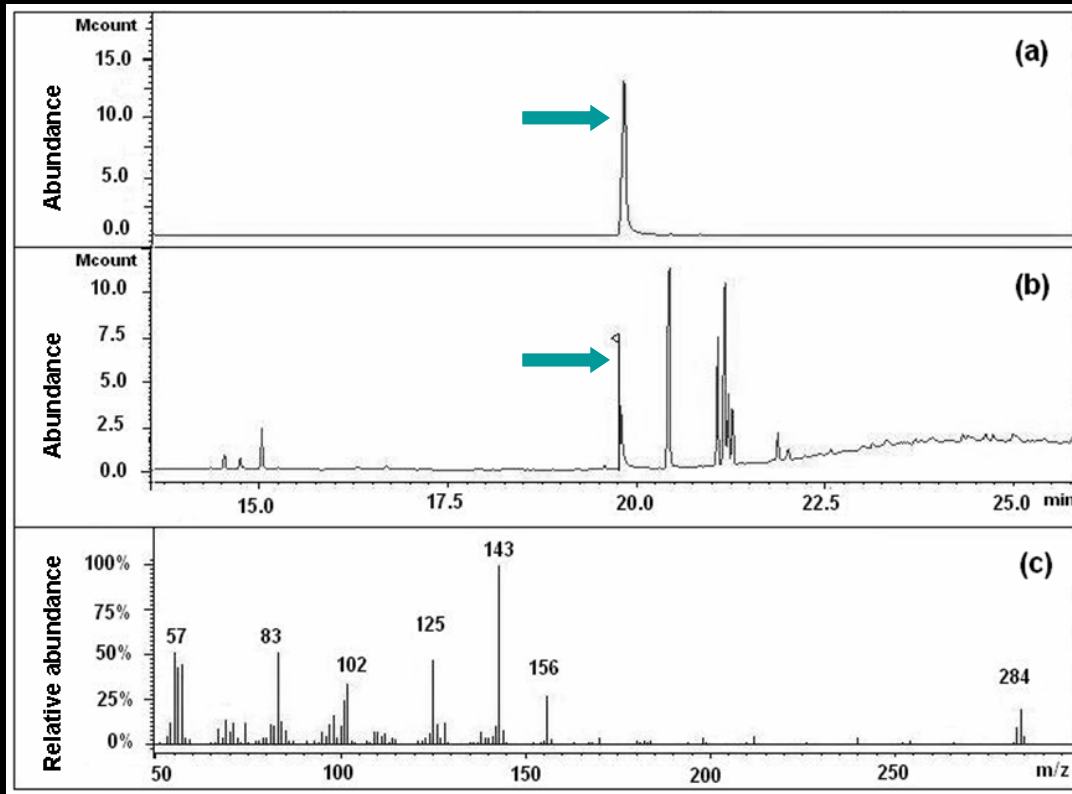
Gram
bacterial cell

Attachment, toxin production, growth
biofilm formation

Larval settlement



QS signals are present in subtidal biofilms

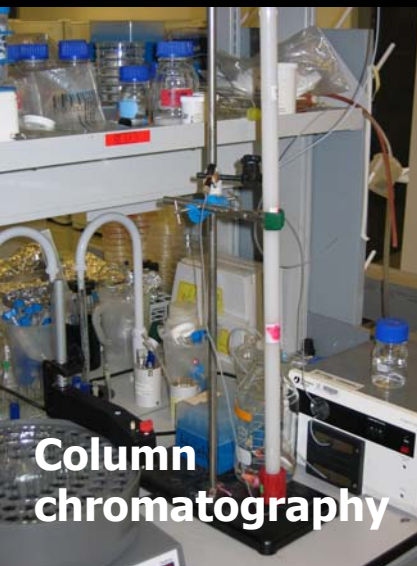
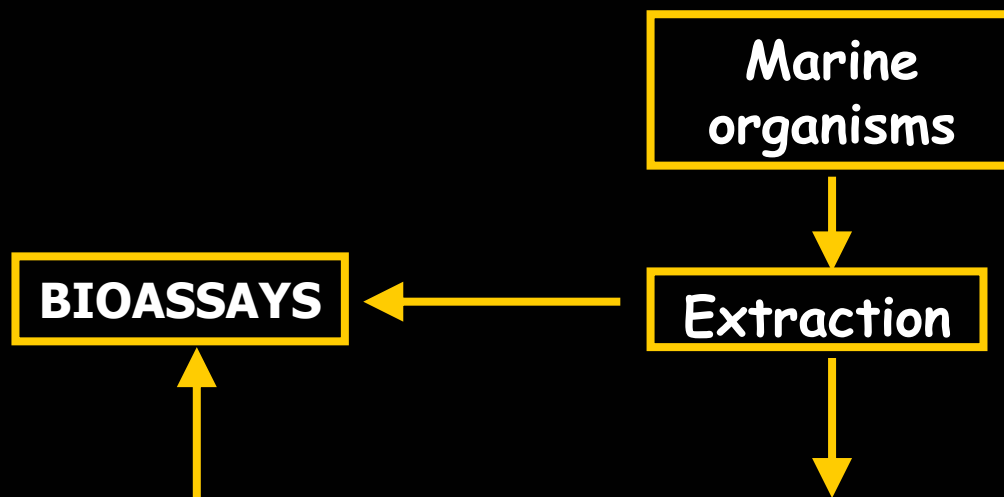


N-dodecanoyl-D,L-homoserine lactone (C12-HSL) standard

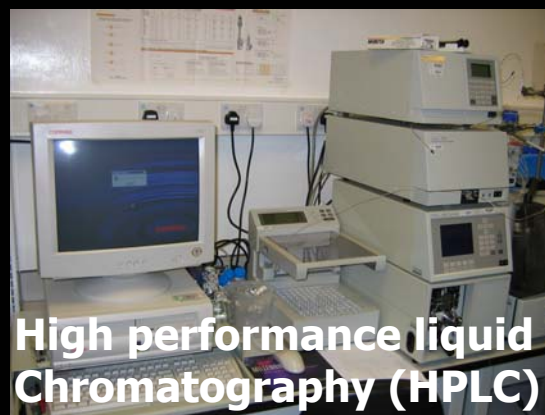
C12-HSL in 6d old biofilm

Mass spectrum of the peak

Isolation of QS inhibitions



Isolation and purification



Structure identification



QS inhibition bioassay



Extracts and fractions



Biosensor strains

Chromobacterium violaceum (short chain AHLs)

Agrobacterium tumefaciens (long chain AHLs)



No QS inhibition



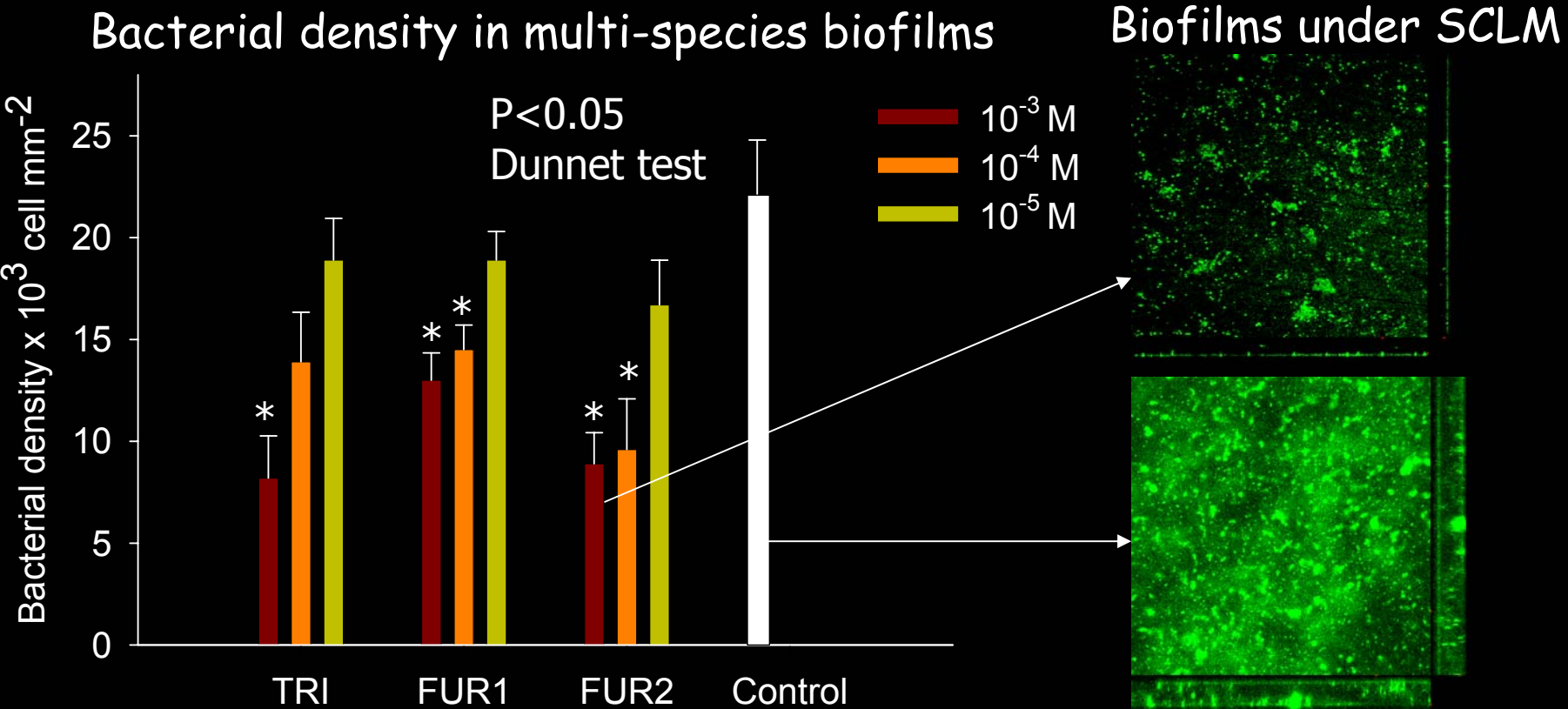
QS inhibition

Screening of marine organisms for production of QS inhibitors

Species	Group	MIC Concentration
<i>Lyngbya sp. 1</i>	Cyanobacteria	66 µg
<i>Lyngbya sp. 2</i>	Cyanobacteria	9 µg
<i>Lyngbya polychroa</i>	Cyanobacteria	50 µg
<i>Lyngbya sp. 3</i>	Cyanobacteria	1.8 µg
<i>Laurencia filliformis</i>	Red alga	270 µg
<i>Spatoglossum sp.</i>	Brown alga	210 µg
<i>Asparagopsis sp.</i>	Red alga	21 µg - toxic

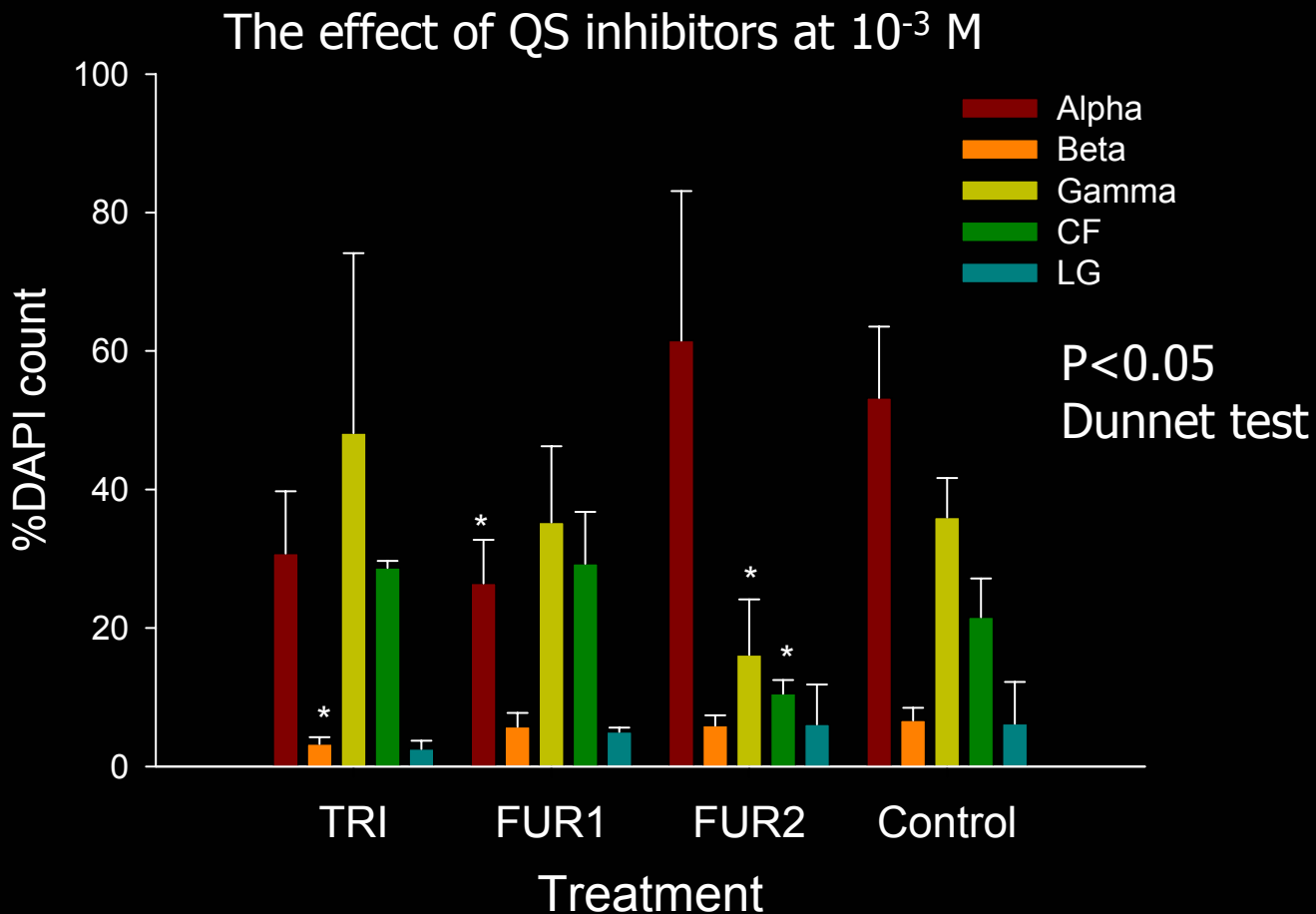
Overall 83 extracts of 51 species were tested. Cyanobacteria is the most effective

QS inhibitors affect biofilm density



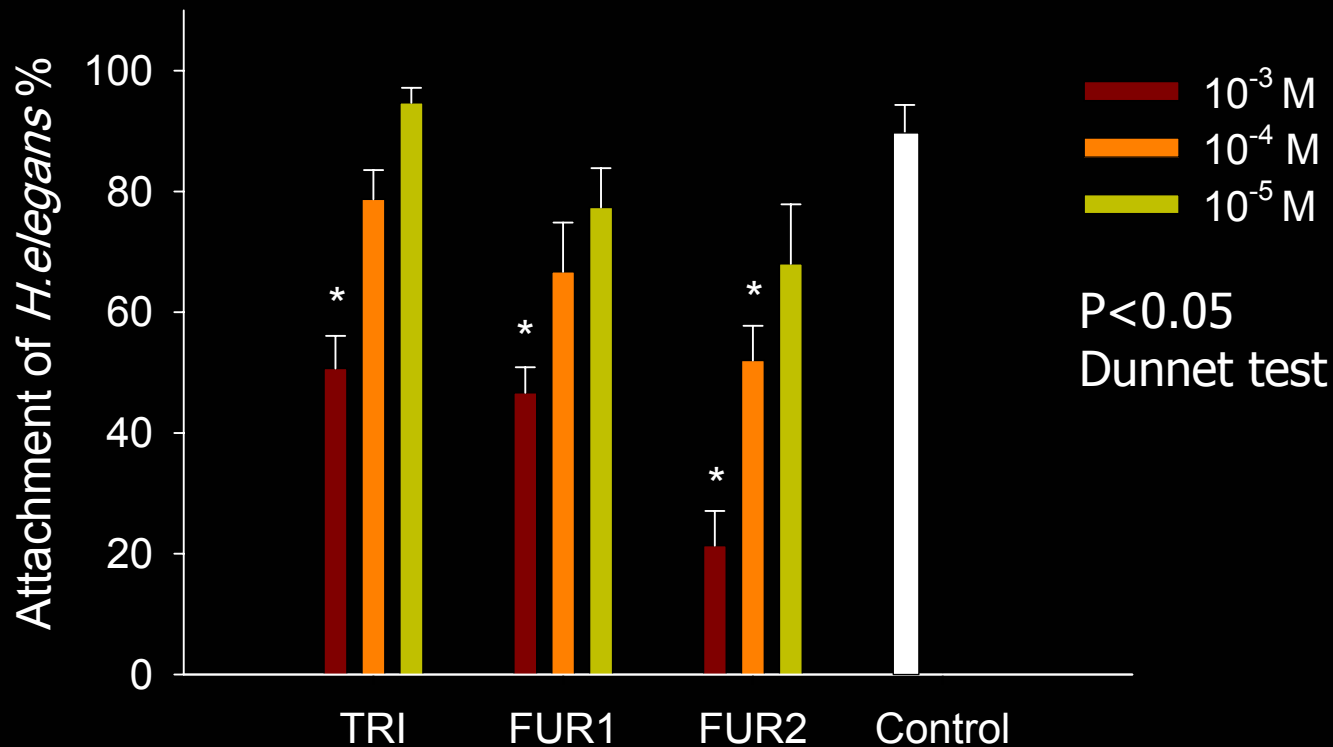
Bacterial density was low in the presence of QS inhibitors at 10^{-3} - 10^{-4} M

QS inhibitors affect composition of bacterial communities



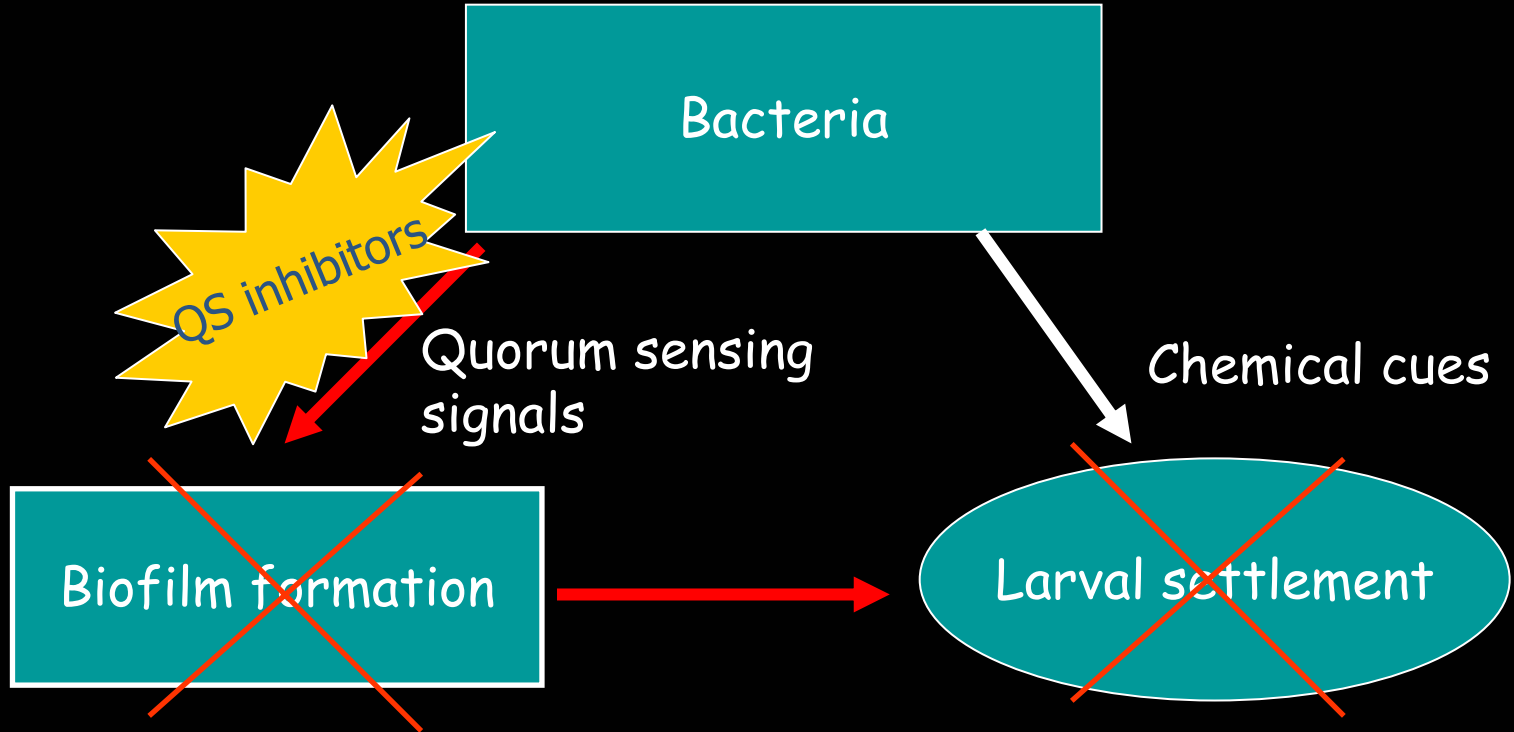
QS inhibitors affect different bacterial groups

Effect of biofilms modified by QS inhibitors on larval settlement



Bacterial films formed in the presence of QS inhibitors at 10⁻³M decreased larval settlement

Conclusion



It is possible to inhibit larval settlement
by inhibition of biofilm growth

Thank you!

Special thanks to
all my colleagues from:



Smithsonian Marine Station at Fort Pierce



Hong Kong University of Science and Technology

