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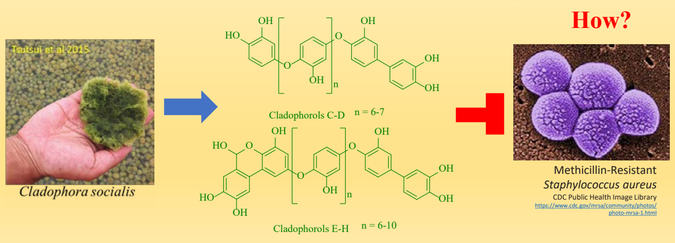
The fields of chemical ecology and natural products chemistry focus on the small-molecule secondary metabolites that organisms produce to provide competitive advantages.

My research in these fields examine 1) how secondary metabolites produce their biomedically effect, 2) how an oil consuming bacterium may use secondary metabolites to compete and thrive, and 3) how common and rare algae use an unusual element in their bioactive secondary metabolites.

Project 1: Probing the antibiotic mechanism of action of marine natural products using a combined ^{1}H NMR and LC/IM-MS metabolomics approach

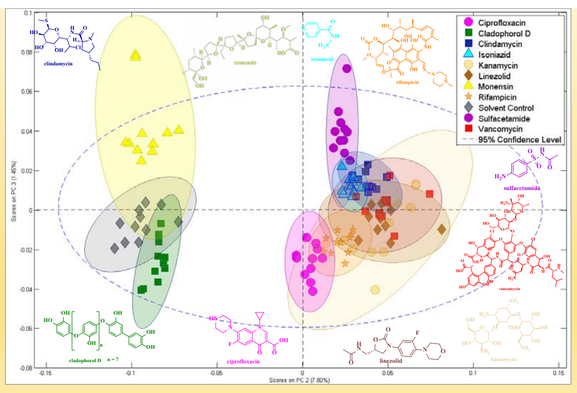
- Cladophorol family of secondary metabolites selectively kill MRSA cells via an unknown mechanism. This study aims to probe this antibiotic activity for biomedical and ecological applications.



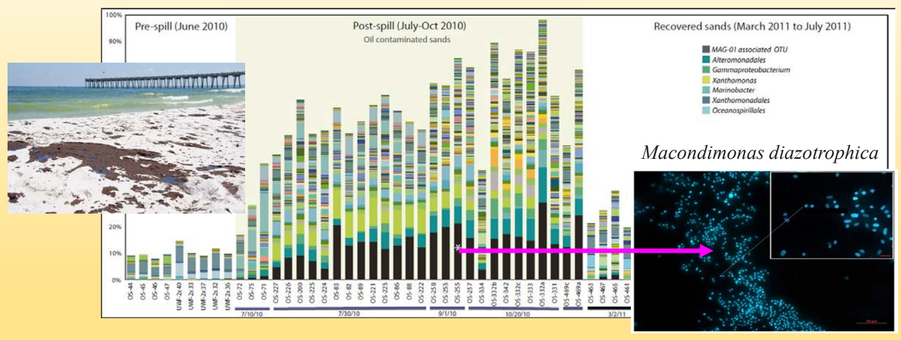
Background

- Establishing the Mechanism of Action (MOA) of a bioactive natural product is important for understanding how it functions and advancing it as a drug.
- Systems-biology approaches, like metabolomics, are effective and efficient at generating hypotheses leading to targeted and prioritized MOA investigations.
- Metabolomics is advantageous for MOA studies: 1) detection of non-protein products of genes, 2) intermediates/products of primary metabolism, 3) metabolism of xenobiotics, 4) secondary metabolites. This study applies a combined LC/IM-MS and ^{1}H NMR spectroscopy -based metabolomics approach to a model microorganism in order to prioritize the most likely MOAs for a group of marine natural products.

Preliminary Results: Cladophorol D has a different impact on the metabolome of MRSA than all of the antibiotics tested. New MOA?

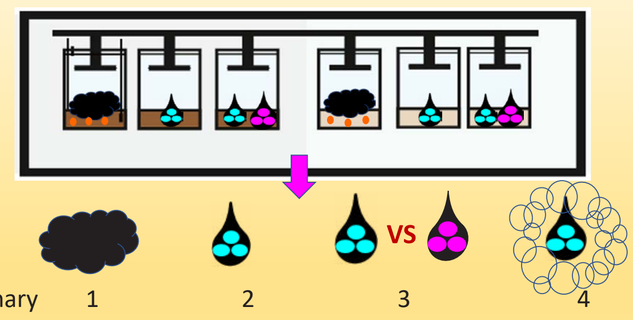


Project 2: To eat or compete; insights into the ecology of an oil-degrading microbe, post oil spill



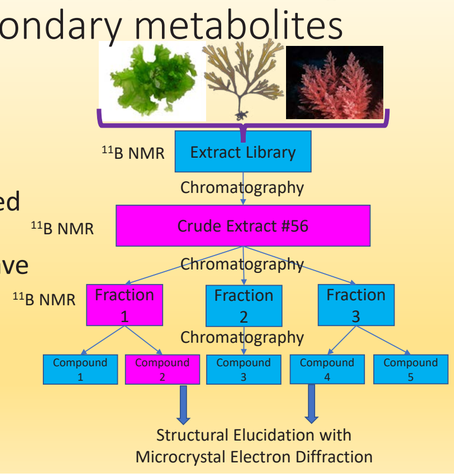
- An environmental metagenomics study discovered *Macondimoas diazotrophica* oil-eating bacteria exploded in abundance after oil spill.

Microcosm manipulation experiments test which evolutionary strategies *Macondimonas* uses to thrive in oil-contaminated beach sediment.



Project 3: Examining taxonomically diverse algae for boron containing secondary metabolites

- Well-characterized/common algae may produce unseen/rare compounds that have been missed with traditional techniques.
- Taxonomically rare or research-neglected algae may produce unseen/rare secondary metabolites because they have not been extensively examined.
- Prescreen chemical extracts using ^{11}B NMR spectroscopy followed by Microcrystal Electron Diffraction for structure elucidation.



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Scholar Awards Celebration
November 17, 2022