Distribution of electrogenic cable bacteria in a subtropical estuary

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Cable bacteria are filamentous bacteria that evolved the capacity to conduct electrons over centimetre-scale distances. This mechanism allows cable bacteria to spatially separate sulfide oxidation occurring in deeper sediment, from the reduction of oxygen at the sediment surface. This process, known as electrogenic sulfide oxidation, significantly impacts the local sediment biogeochemistry and thus other organisms within the microbial community.

Cable bacteria are ubiquitously present in coastal sediments, but their activity in natural sediments may vary due to numerous factors, such as salinity, sediment disturbance and oxygen availability (Burdorf *et al.,* 2017; Burdorf *et al.,* 2018; Malkin *et al.,* 2014; Seitaj *et al.,* 2015). To study the distribution and diversity of cable bacteria in a natural system, a published dataset of 16S rRNA amplicon sequences from the Indian River Lagoon and St. Lucie Estuary, Florida, USA was selected (Bradshaw *et al.,* 2020). Sampling sites covered a diversity of sediment environments in these natural systems, including a wide salinity range and different levels of organic matter content resulting in varying levels of bottom water oxygenation. Furthermore, data were collected over two years and four seasons which included a hurricane event that significantly disturbed the sediment. All these factors made the selected dataset well suited to study cable bacteria distribution in these natural coastal systems.

Molecular analysis confirmed a heterogeneous distribution and broad diversity of cable bacteria in the Indian River Lagoon and St. Lucie Estuary. Phylogenetic analysis revealed six distinct clades of amplicon sequencing variants (ASVs) related to cable bacteria, that were found across the full length of the Indian River Lagoon and St. Lucie Estuary. Furthermore, relative abundance and diversity of cable bacteria ASVs was generally higher after Hurricane Irma. At two sites relative abundance increased to >1% of total reads, which indicates electrogenic sulfide oxidation potentially dominating the geochemistry at these locations (Liau *et al.,* 2022). Lastly, our analysis gave insights into the potential salt tolerance of cable bacteria related to the genus *Candidatus* Electronema. These findings agree with recent work by Dam *et al.* (2021) who suggest that *Candidatus* Electronema may not only be present in freshwater sediments, but also at salinities up to 5. The *Candidatus* Electronema ASV considered here was found at an even higher salinity of 8.

Additionally, the dataset was used to compare the microbial community structure in the presence and absence of cable bacteria 16S rRNA sequences. Co-occurrence of cable bacteria with other sulfur-oxidizing bacteria belonging to the Campylobacteria, specifically the genera *Sulfurovum* and *Sulfurimonas*, was evidenced. Previous studies on cable bacteria suggest a tight metabolic link between cable bacteria and these genera (Vasquez Cardenas *et al.*, 2015; Lipsewers *et al.*, 2017).

Overall, our results show year round presence of cable bacteria in the Indian River Lagoon and St. Lucie Estuary. Cable bacteria ASVs were found in a salinity range of 8-40 and potential salt tolerance of *Candidatus* Electronema, a genus that is generally found in freshwater sediments, is confirmed. Furthermore, sediment disturbance by Hurricane Irma appeared beneficial for cable bacteria diversity and abundance, indicating that these unique microbes appear to show opportunistic behavior in dynamic coastal systems such as estuaries.

Keywords
Cable Bacteria; Biogeochemistry; Electrogenic Sulfide Oxidation; Microbial Ecology; 16S rRNA Amplicon Sequencing