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Bacterial Forensics to Solve the Mystery of a Serious Threat to Marine Aquatic Systems: *A Genomic and Isotopic Approach to Study Hypoxia*

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Spreading of areas affected by deep water hypoxic conditions has put the health of estuarine ecosystems in danger. Hence, it is of critical importance to identify the causes of such perturbation, which results in serious threats to living species. Estuaries are large deposition centres for organic matter (OM) where stable carbon isotope ratios of either bulk OM or specific organic compounds provide detailed information about carbon cycling and the tracing of OM sources and transformations along the terrestrial-marine continuum. In particular, the $\partial^{13}C$ values of biomarkers that are specific to heterotrophic bacteria (branched iso- and anteiso-C15:0 fatty acids) can be used to assess the type of OM that they preferentially degrade owing to the significant differences in isotopic enrichment of marine and terrestrial organic carbon (OC). However, very little is known on the dynamics between the kinetics of OC degradation and its incorporation as specific fatty acids in bacterial biomass. In this study, we used a batch incubation approach in which natural sediments from the St. Lawrence Estuary and Gulf, amended with fresh terrestrial and/or marine OM characterized by a very different $^{13}C/^{12}C$ ratio, was incubated for varying amounts of time to be able to cover different bacterial growth phases. Quenching of the incubations followed by the extraction, quantification and isotopic characterization of the bacterial fatty acids allowed determining the rate and temporal extent of change of their compound-specific $\partial^{13}C$ values. Bulk elemental and isotopic mass balances were also precisely monitored throughout the experiment. DNA abundances through time in response to external nutrient source was monitored by variations in number of 16S rRNA gene copies. Therefore, for the first time, this study will combine genomic, metagenomic and isotopic data to get a more detailed picture of microbial life under blooming and diagenesis conditions. Acquisition of this knowledge combined with an insight into taxonomic population provides a better understanding of the relative importance of terrestrial and marine OM processing in the onset of hypoxia and will be exploited as a guide for remedial efforts aiming to improve the health of such an important ecosystem.