Antagonism as a Foraging Strategy in Microbial Communities

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This study reveals how the **Type VI Secretion System (T6SS)**—a contact-dependent molecular weapon—supports bacterial survival under nutrient-limited conditions by releasing intracellular metabolites from competitors. Although only **~3–4% of marine bacterial OTUs** carry T6SS genes, phylogenomic analysis shows T6SS is **widespread** and present in both **nutrient-poor environments** (aquatic systems) and **nutrient-rich environments** (animal guts, wastewater, rhizosphere). Pan-genome comparisons revealed that **T6SS+ strains shows metabolic genes simplification**, suggesting a trade-off: instead of maintaining costly metabolic functions, these bacteria can "forage" by lysing neighbors.

Using **microfluidic culture system and microscopy**, the authors co-cultured **T6SS+ *Vibrio cholerae*** with *E. coli* or other Vibrio species under starvation condition. Target cells remained **rounded and intact for several hours** before **gradual lysis**, a phenotype captured via **fluorescent markers** (e.g., GFP, dsRed, mCherry). This slow leakage provided nutrients that **rescued the growth** of T6SS+ strains but not T6SS-deficient mutants. Fluorescence quantification and propidium iodide (PI) staining confirmed membrane compromise before the completely lysis of the cell. Mathematical nutrient-uptake modeling also supported that **T6SS-mediated killing with slow lysis increases local resource availability**.

Field-scale analysis of **global ocean metagenomes (TARA Oceans, GTDB)** revealed that **T6SS genes occur across multiple marine clades** (e.g., Gammaproteobacteria, Bacteroidota, Pelagibacterales), even at low prevalence. Nevertheless, such rare but strategically placed antagonistic interactions may act as a **"bacterial shunt"**, analogous to the **viral shunt**, recycling organic matter within the microbial loop and influencing carbon and nutrient cycling in the ocean. Overall, the work reframes T6SS not only as a weapon for interbacterial competition but also as a **foraging mechanism** that shapes community structure and biogeochemical processes. It highlights how **few but functionally impactful taxa** can mediate significant ecological effects—especially in oligotrophic oceans where nutrient acquisition is a major survival challenge.