

Shedding light on *Vibrio* Survival Strategies In the Ocean Surface: The Tale of Proteorhodopsin Photosystems

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Proteorhodopsins are globally abundant bacterial photoproteins found in the photic zone of the ocean. This group of proteins has particularly fascinated the scientific community for its potential to generate ATP, which could provide supplementary energy for marine bacteria. However, although their function as proton pumps with energy-yielding potential has been established, the ecological role of proteorhodopsins remains largely unexplored. We report the presence and function of proteorhodopsin in a member of the genus *Vibrio* (*Vibrio sp.* strain AND4), discovered through whole genome analysis. Phylogenetic analysis suggests that AND4 obtained proteorhodopsin through lateral gene transfer, and this acquisition potentially modified the ecology of this marine bacterium. Here we demonstrate an improved long-term survival of AND4 when starved in seawater exposed to light rather than in darkness, and mutational analysis directly links proteorhodopsin phototrophy to this enhanced survival. Thus, the use of proteorhodopsin provides a fitness advantage to its native host, representing a novel instrument for bacterioplankton to undergo frequent periods of resource shortage in the ocean's surface.

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