MICROBIAL ECOLOGY

Proteorhodopsins tune in

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Spectral tuning is a common property of proteorhodopsins from diverse taxonomic backgrounds, according to results recently reported in *The ISME Journal*.

Proteorhodopsins are light-powered proton pumps that were first identified in 2000, and proteorhodopsin-encoding sequences have since been found to be widely distributed in the photic zone of the world's oceans in various bacterial and archaeal taxa. In previous work, Oded Béjà and colleagues found that different proteorhodopsins can have distinct absorption spectra. They identified a proteorhodopsin family in the SAR86 gammaproteobacteria in which the absorption spectra varied; one family member found in surface waters absorbed light at 527 nm (green light) and another found in deeper waters absorbed light at 490 nm (blue light). This difference in absorption spectra was found to result from a single amino-acid change.

In this latest paper, the authors were interested in investigating how widespread this spectral tuning phenomenon is. The authors used degenerate proteorhodopsin primers to analyse clone libraries constructed from summer and winter samples collected at different depths at two stations, one in the Mediterranean Sea and one in the Sargasso Sea. The amplified proteorhodopsin sequences were sorted on the basis of the predicted absorption spectrum. The results obtained indicate that spectral tuning is not restricted to a single proteorhodopsin family but is instead a widespread phenomenon present in various taxa that is likely to have arisen independently multiple times.

Interestingly, despite the fact that the physical properties of the water column, such as mixing and light penetration, are similar in the two locations, the distribution of proteorhodopsins at each location was strikingly different. In the Mediterranean samples, the distribution of blue and green proteorhodopsin sequences showed the expected variation with depth. By contrast, no green signatures were detected in the samples from the Sargasso Sea, irrespective of depth. As green light should be available at the Sargasso Sea station, the authors comment that this finding is 'puzzling' and speculate that in this location either the green-proteorhodopsin-containing bacteria are competitively disfavoured or the blue-proteorhodopsin-harbouring bacteria have additional unknown adaptations.

Although the specific functions of proteorhodopsins are still being investigated, they are thought to have a significant role in supplying light energy for phototrophy in marine microorganisms. This is strongly supported by two other recent papers, one demonstrating that light stimulates the growth of proteorhodopsin-containing marine Bacteroidetes, and a second demonstrating that expression of an intact proteorhodopsin-based photosystem in a heterologous host results in photophosphorylation.

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ORIGINAL RESEARCH PAPER Sabehi, G. *et al.* Adaptation and spectral tuning in divergent marine proteorhodopsins from the eastern Mediterranean and the Sargasso Seas. *ISME J.* **1**, 48–55 (2007)
FURTHER READING Gómez-Consarnau, L. *et al.* Light stimulates growth of proteorhodopsin-containing marine Flavobacteria. *Nature* **455**, 211–213 (2007) | Martinez, A. *et al.* Proteorhodopsin photosystem gene expression enables photophosphorylation in a heterologous host. *Proc. Natl Acad. Sci. USA* **104**, 5590–5595 (2007).