which there are complex electromechanical mechanisms, and fish lateral-line hair cells. Although no analogous structure to the long, narrow thread hair in the crab is known in vertebrate hair cells, which do not have piston mechanisms, the greater numbers of hair cells in these organisms may help to increase signal-to-noise ratios.

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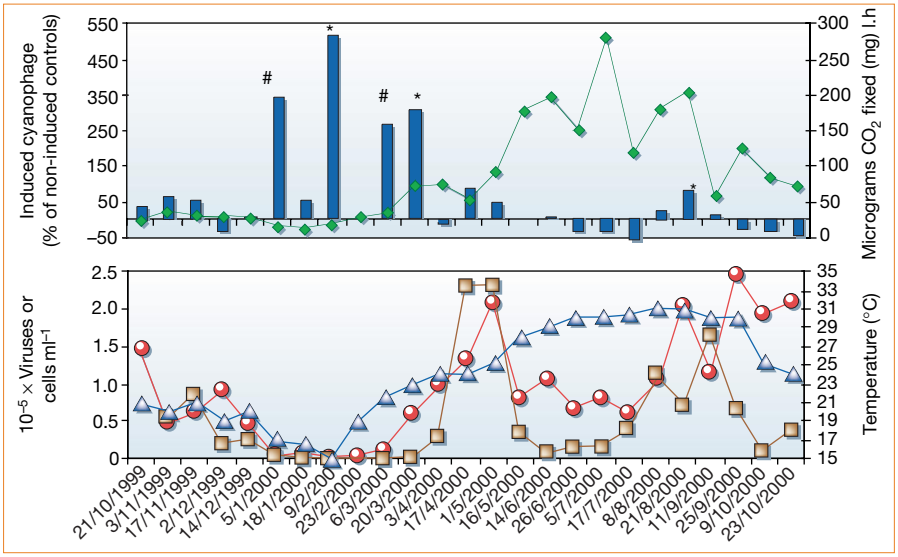

Figure 1 Seasonal induction of prophage in natural *Synechococcus* populations. Top, variation in cyanophage induction (blue bars) compared with primary productivity of *Synechococcus* (green line) for the year ending in October 2000. l.h, litre hour. Bottom, corresponding values for *Synechococcus* abundance (red), cyanophage counts (brown) and temperature (blue) over the same period. Prophage-induction results are expressed as a percentage change in treatment compared with control (asterisks and hash symbols indicate statistical significance at the 95% and 90% confidence interval, respectively; the significance of each induction event was determined by comparison of treatment and control levels of cyanophage by paired *t*-test in three pseudoreplicates of each sample).

Plankton blooms

Lysogeny in marine *Synechococcus*

Viral infection of bacteria can be lytic, causing destruction of the host cell, or lysogenic, in which the viral genome is instead stably maintained as a prophage within its host[1]. Here we show that lysogeny occurs in natural populations of an autotrophic picoplankton (*Synechococcus*) and that there is a seasonal pattern to this interaction. Because lysogeny confers immunity to infection by related viruses[1], this process may account for the resistance to viral infection seen in common forms of autotrophic picoplankton[2].

We undertook a seasonal study in Tampa Bay, Florida, of prophage induction in cyanobacteria over the year ending in October 2000 to find out whether lysogeny occurs in natural *Synechococcus* populations and, if so, how it is affected by changing environmental conditions.

Cyanophage abundance was determined by serial dilution on microtitre plates with addition of the host organism *Synechococcus* st. CCMP 1334 (WH7803, DC2); data were processed by using a most-probable-number (MPN) program[3]. SYBR gold staining followed by epifluorescence microscopy[4] confirmed the presence of viral particles in wells containing lysed cells. To determine whether lysogens were present, we assayed water samples for prophage induction using mitomycin C as the inducing agent. A viral-reduction technique[5] was used in the preparation of samples to increase the sensitivity of the assay.

A statistically significant amount of prophage induction in natural populations of *Synechococcus* was revealed on six occasions in response to exposure to mitomycin C (Fig. 1). Prophage induction, measured as the percentage change over the control cyanophage level, was inversely correlated with cyanobacterial abundance and primary productivity ($r = -0.502$, $P = 0.0123$ and $r = -0.4109$, $P = 0.0461$, respectively; correlations were determined by multiple-regression analysis of arcsine-transformed percentage data and all other measured parameters).

Induction occurred primarily during the late winter months, during times of reduced host abundance (Fig. 1). One induction event was also observed in late August, which preceded a secondary autumn bloom in *Synechococcus*, indicating that prophage induction in *Synechococcus* was not simply an artefact resulting from lower cyanophage abundance during winter months.

A seasonal pattern is consistent with the occurrence of lysogeny at times of low host availability, resource limitation or adverse environmental conditions in order to ensure viral survival[1]. The limited lysogeny that occurred during the summer months may also be explained by greater exposure to ultraviolet light and/or higher temperatures having already caused induction of many of the prophage.

The MPN method of cyanophage detection has a precision that is comparable to that of other methods of viral enumeration[6]. However, it will only detect a subset of the lysogenic *Synechococcus* population (that is, phage infective for *Synechococcus* st. CCMP 1334) and the total number of inducible cyanophages must be higher. Our values are therefore a conservative estimate of the actual number of lysogenic *Synechococcus* present.

Viruses are abundant in the marine environment[7], infecting both heterotrophic and autotrophic microbial populations[8], modulating microbial production and, in some cases, terminating algal blooms[9]. Cyanobacteria can be resistant to lytic infection by co-occurring cyanophage[8], and *Synechococcus* strains may also be less sensitive than larger species of phytoplankton to the photosynthetic inhibition caused by the viral fraction of sea water[10]. We propose that these observations may be explained if homo-immunity is conferred by lysogeny.

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