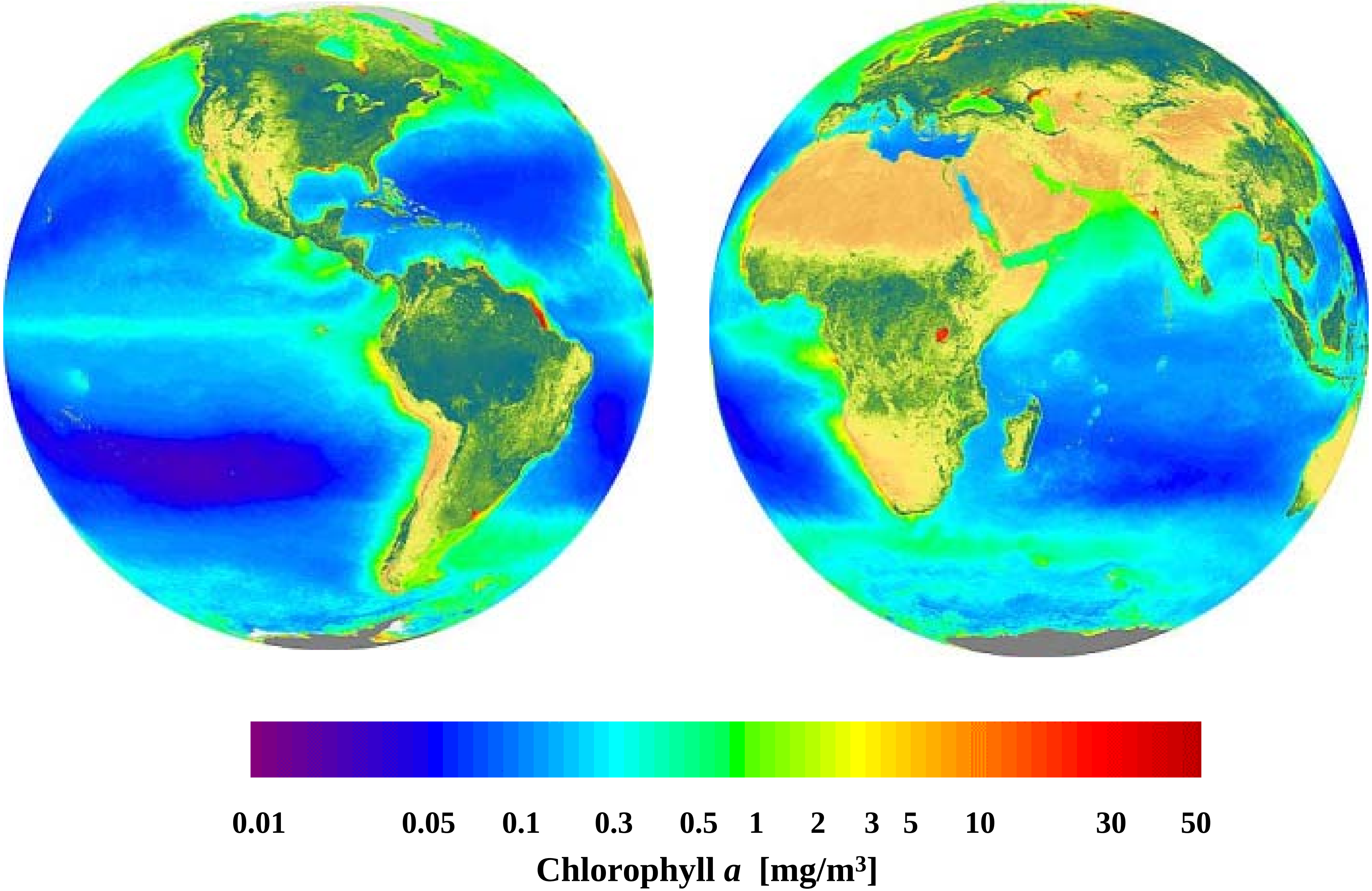
Marine Viruses and Cyanobacterial Community Structure

[1] Martin Mühling, [1] Fuller N.J., [1] Millard A., [1] Scanlan D.J., [2] Post A.F., [3] Wilson W.H., and [1] Mann N.H.

[1] University of Warwick, Coventry, UK

[2] The Interuniversity Institute for Marine Science Eilat, Israel

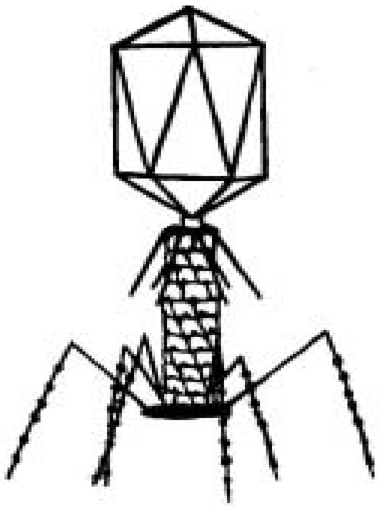
[3] Marine Biological Association, Plymouth, UK


0.01
0.05
0.1
0.3
0.5
1
2
3
5
10
30
50
Chlorophyll *a* [mg/m^3]

Marine cyanophage

- **Phage infecting marine *Synechococcus* have been isolated and characterized**
- **The large majority of isolates are myoviruses, some siphoviruses and podoviruses**

Myoviruses



Virus host interactions

- **Minimum density for productive infection is ~10^4 host cells per mL**

  (Wiggins & Alexander, AEM 1985)

- **Seasonal pattern of lysogeny: induction of prophage during winter**

  (McDaniel et al., Nature 2002)

- **Viruses are responsible for "reduced primary productivity . . . by as much as 78%"**

  (Suttle et al., Nature 1990)

- **Cyanophage "have a negligible effect in regulating densities of marine *Synechococcus*"**

  (Waterbury & Valois, AEM 1993)

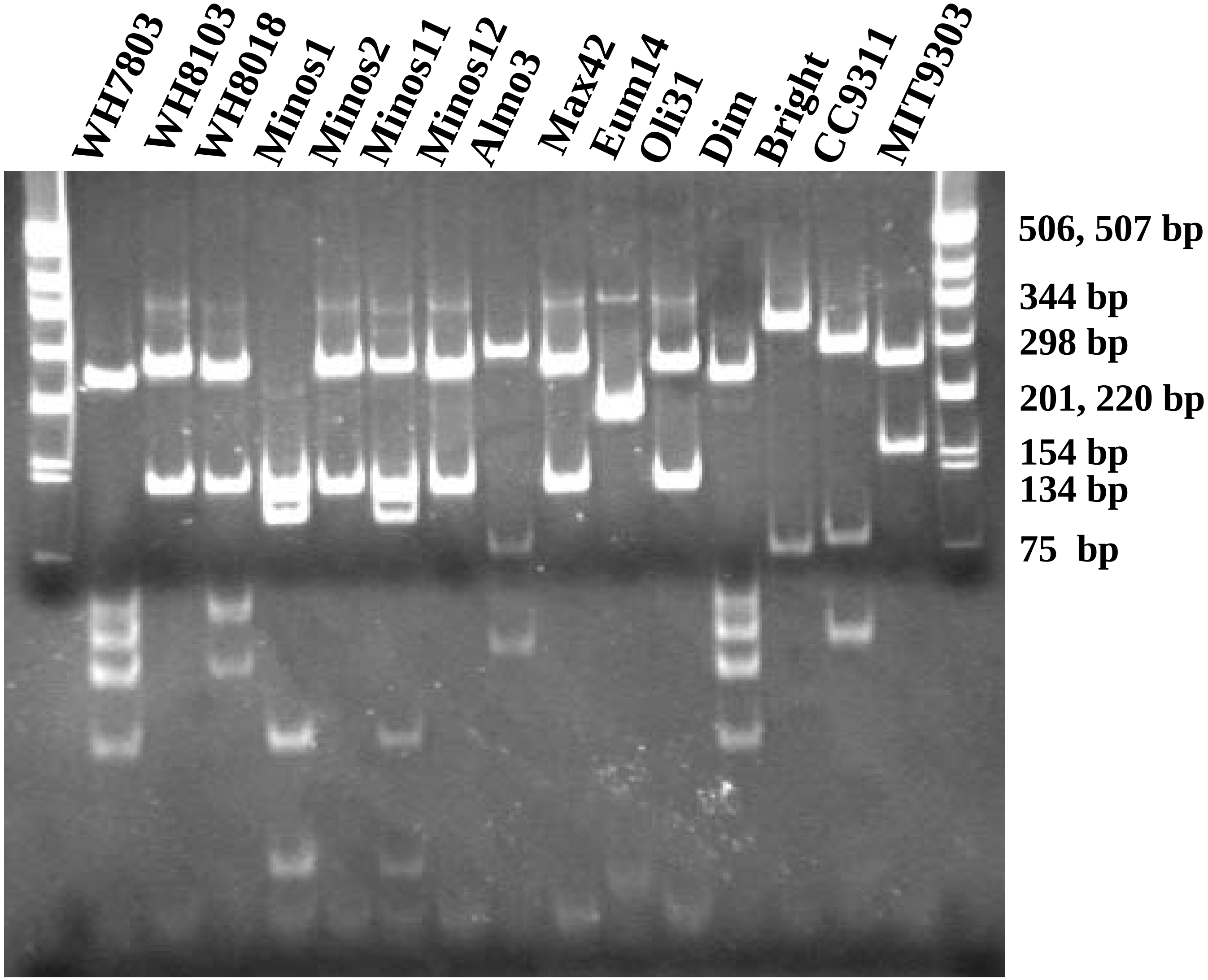
Do cyanophage have an impact on

a) the abundance and

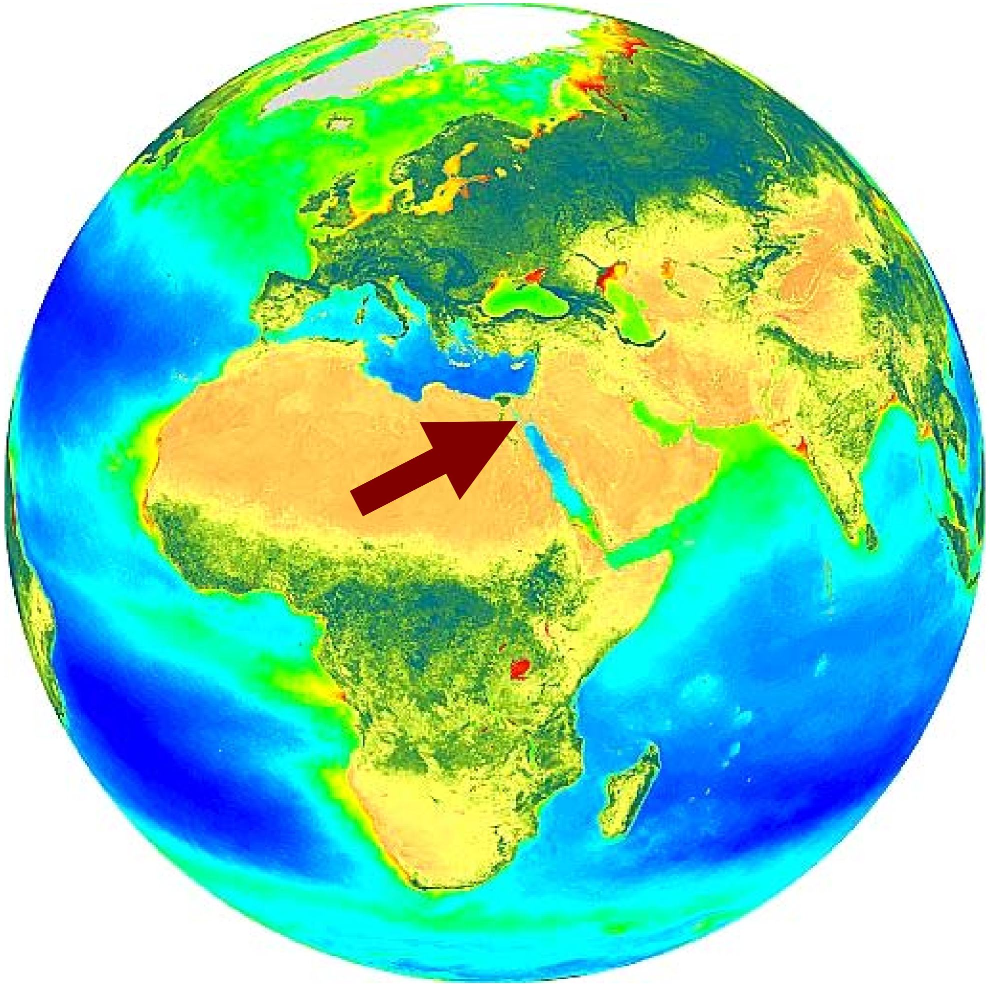
b) the community structure

of marine *Synechococcus* and *vice versa*?

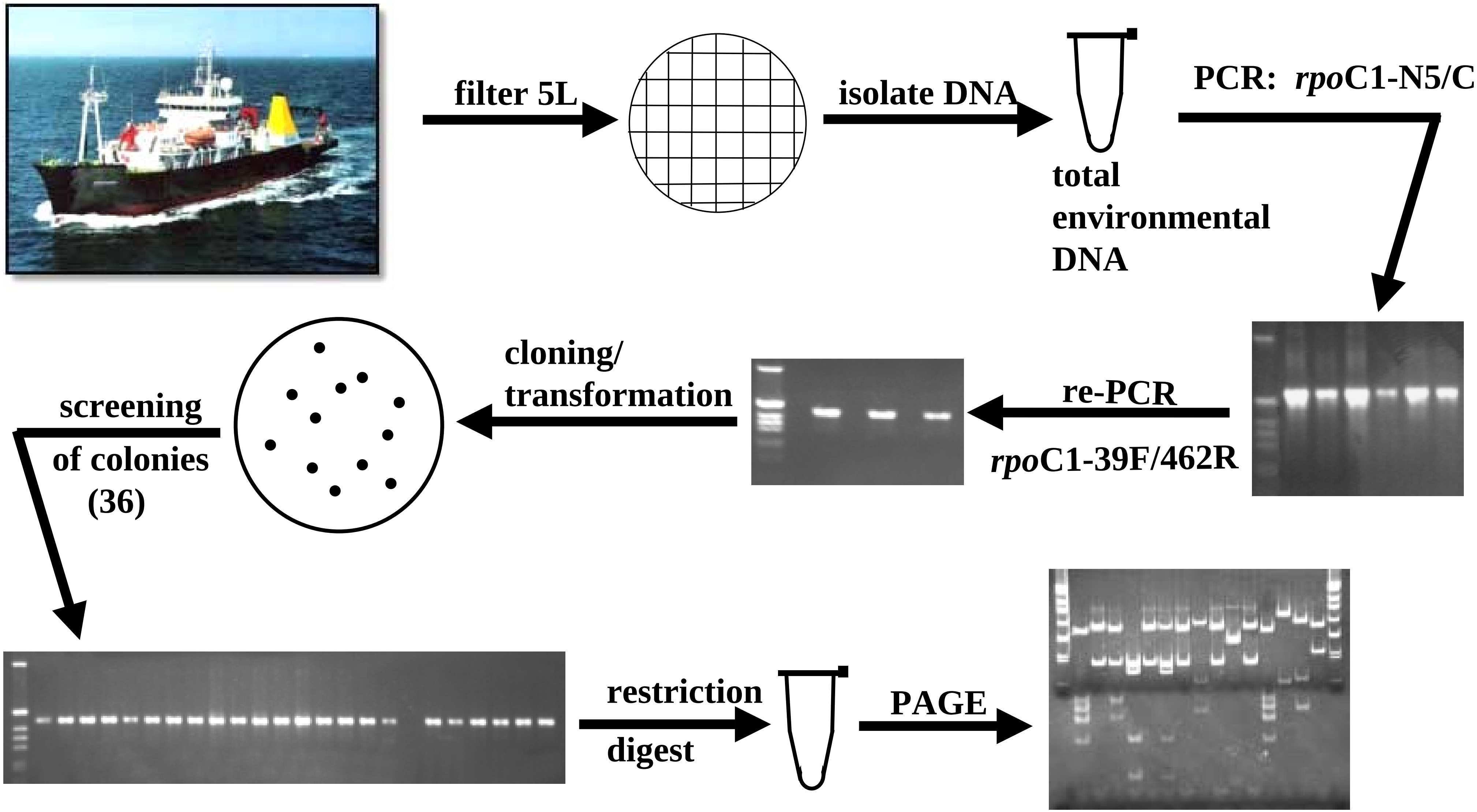
RFLP of *rpo*C1 gene fragments - *Bst*UI, *Hae*III, *Bcl*I



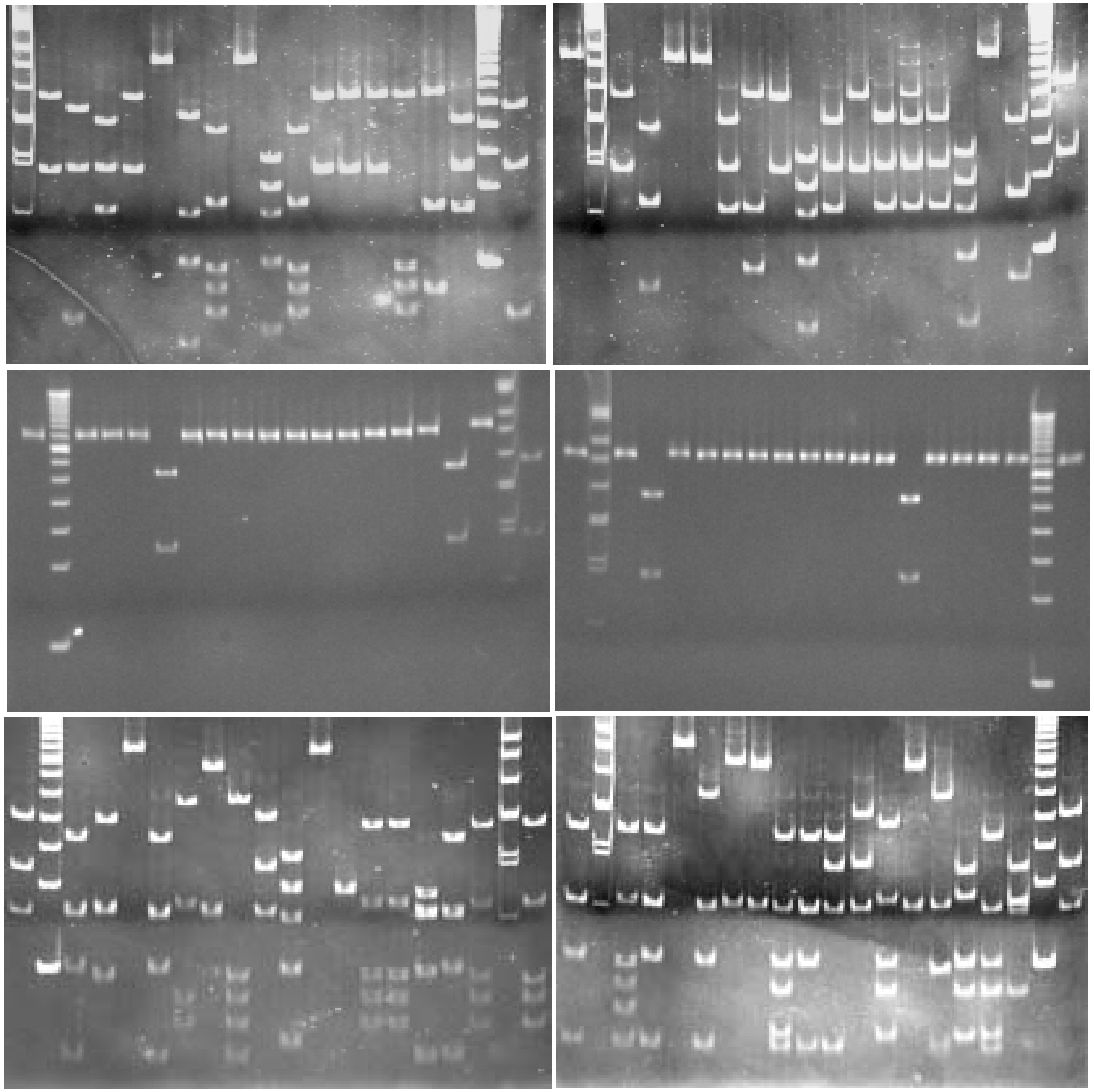
Sampling site in the Red Sea - Gulf of Aqaba



Analysis of *Synechococcus* population structure - Methodology



Examples of *Synechococcus* diversity versus annual cycle

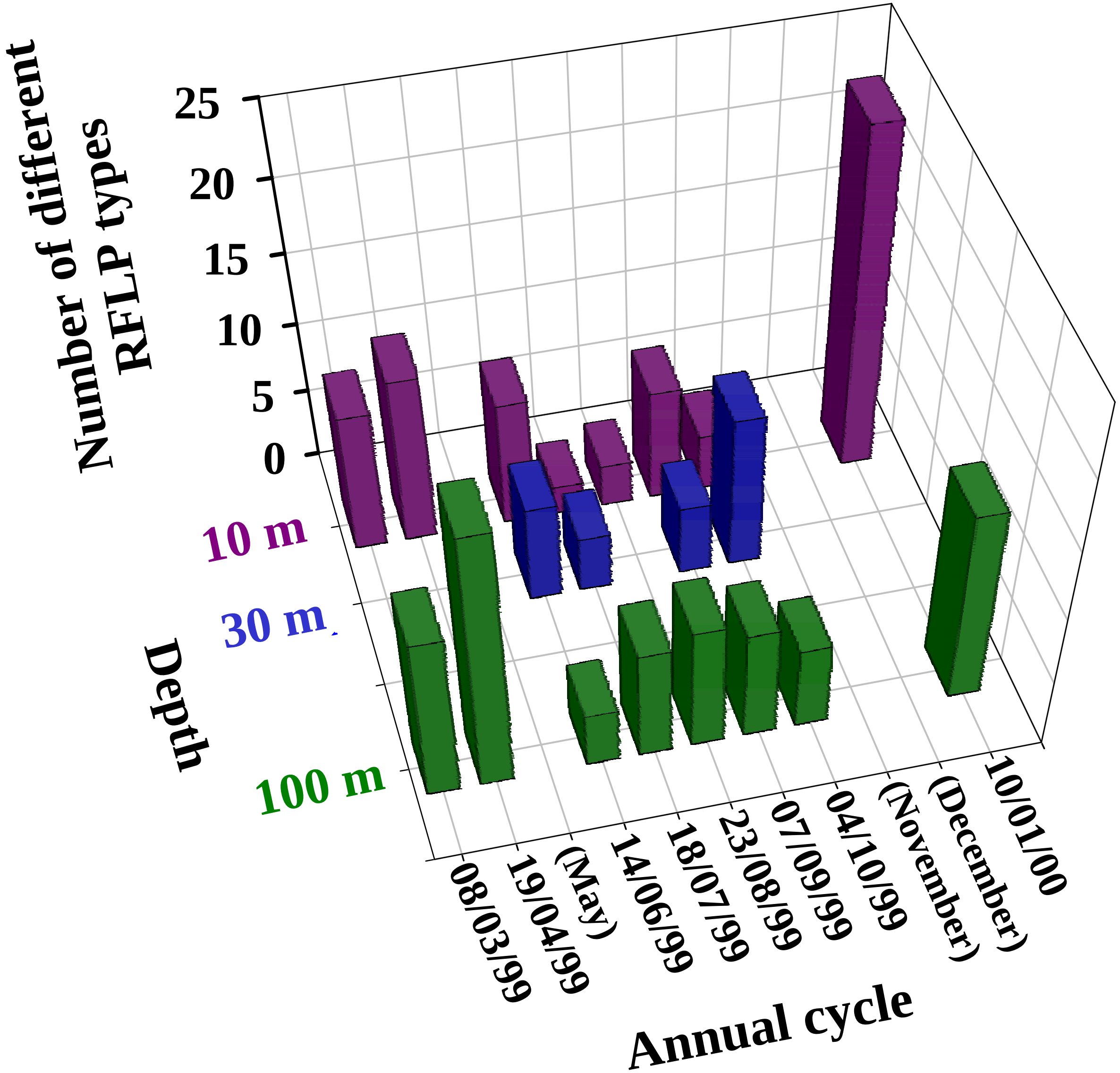


19. April 1999 - 10m

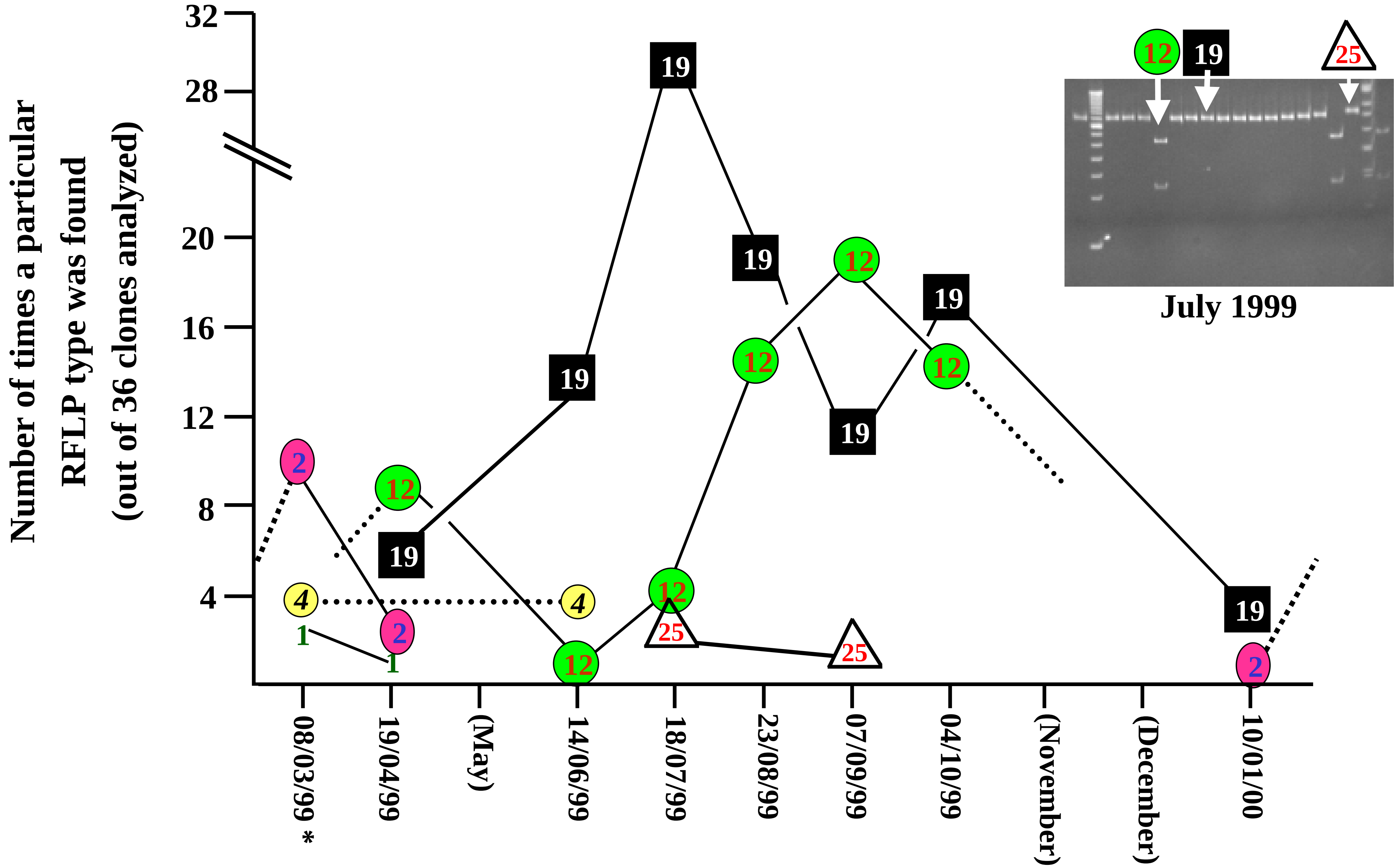
18. July 1999 - 10m

10. January 2000 - 10m

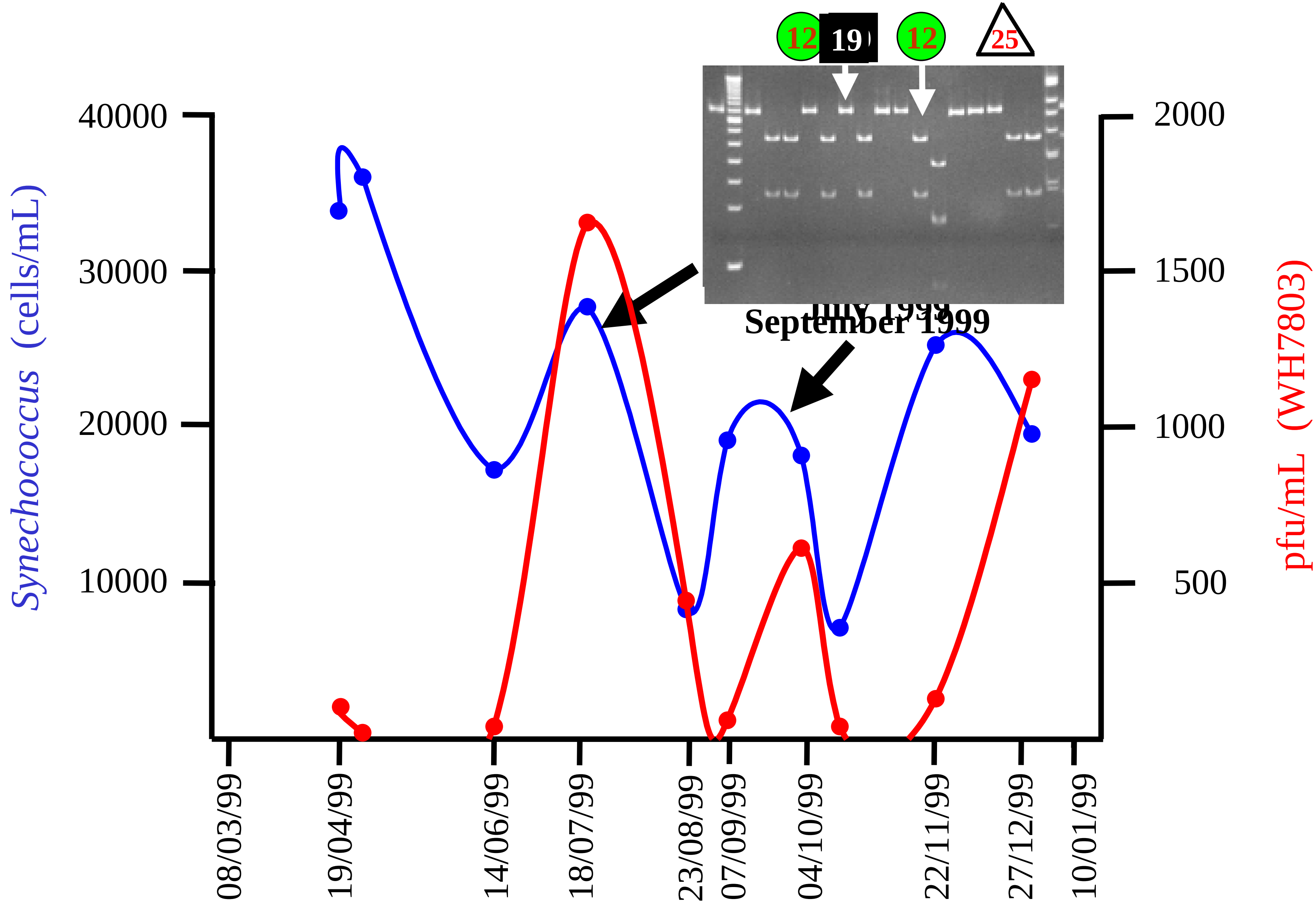
Synechococcus diversity in time and space



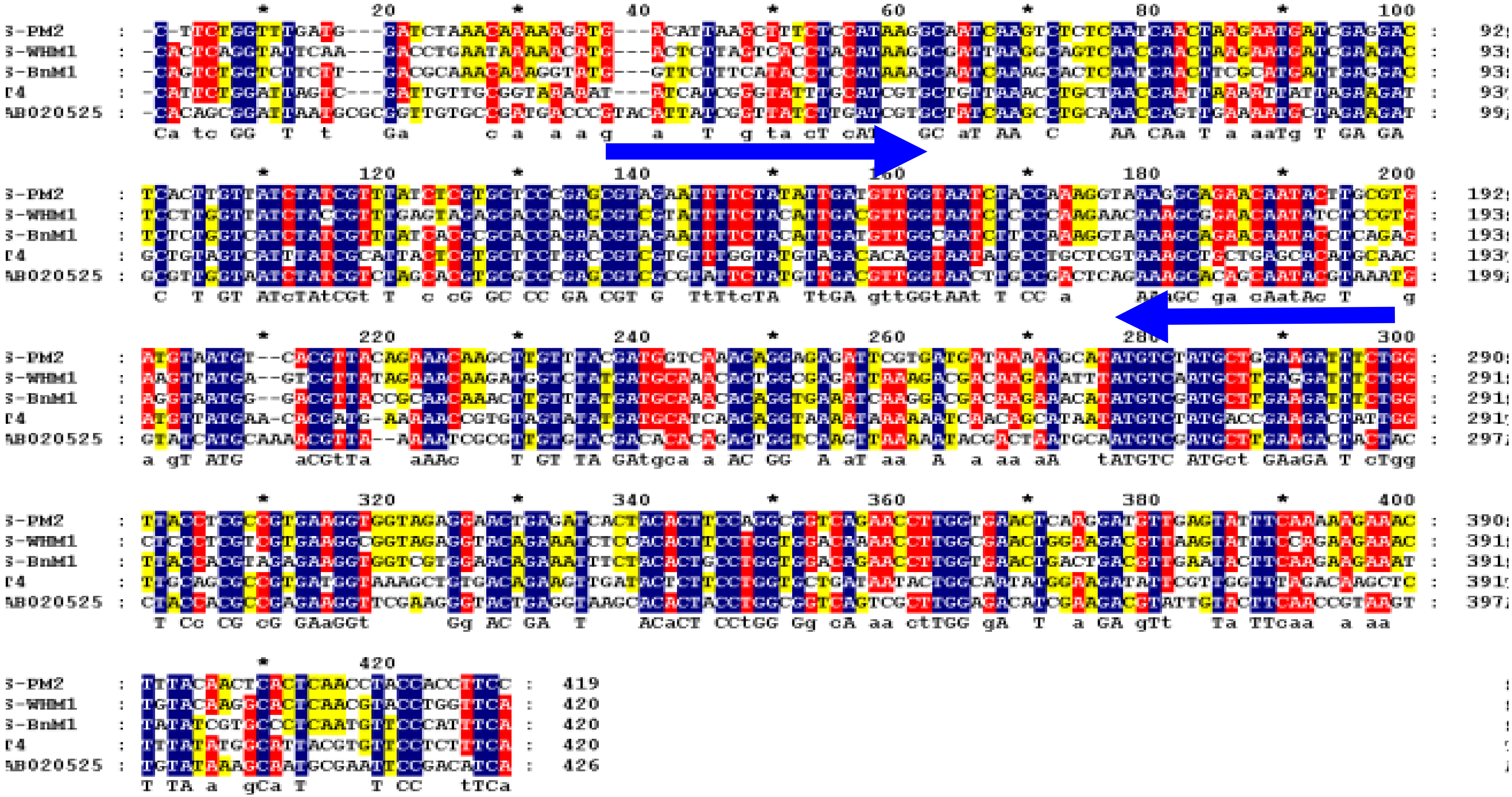
Occurrence of RFLP types over annual cycle (semiquantitatively) - 10 m



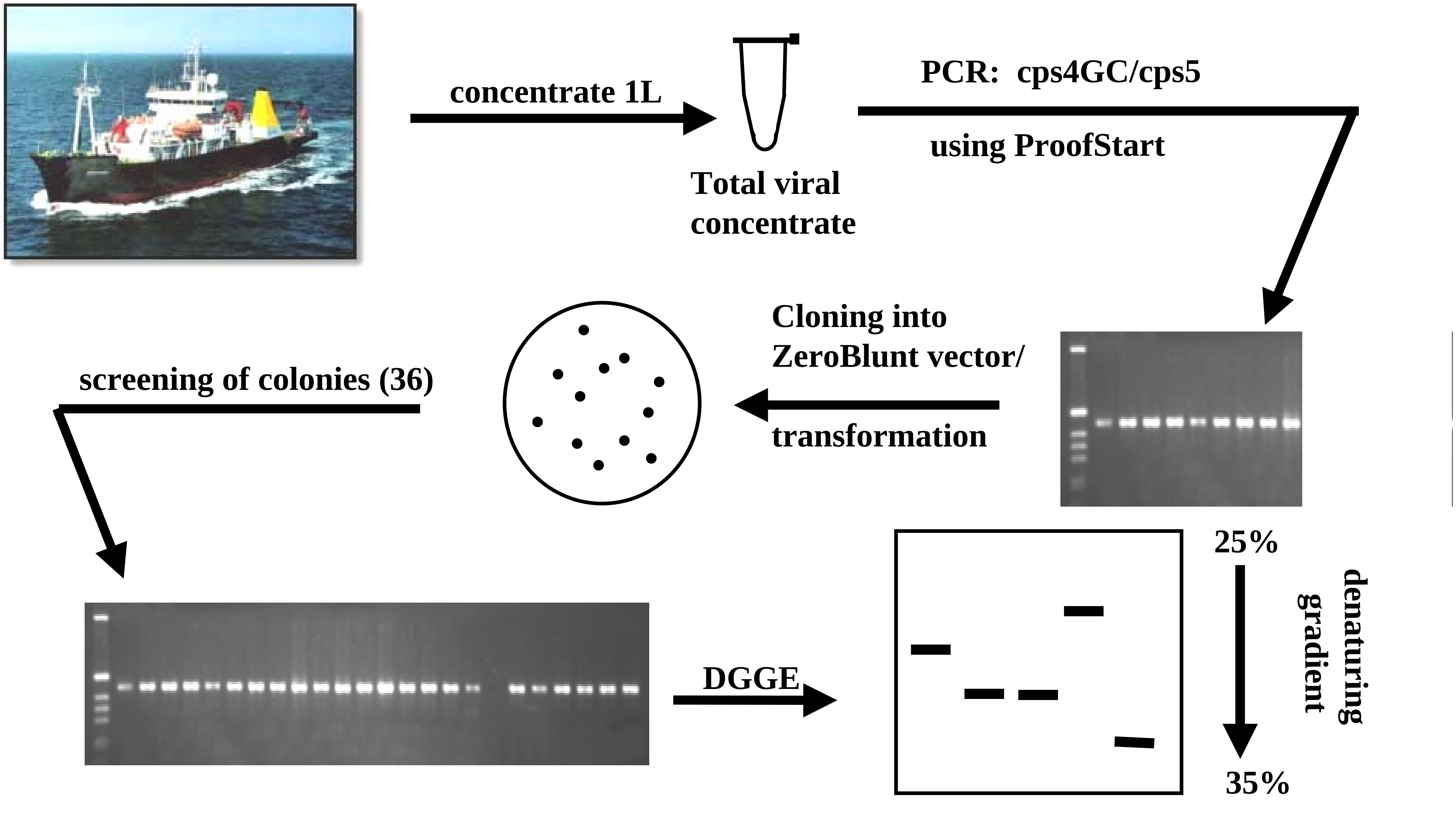
Abundance of cyanophages infecting *Synechococcus* spp. – 10m



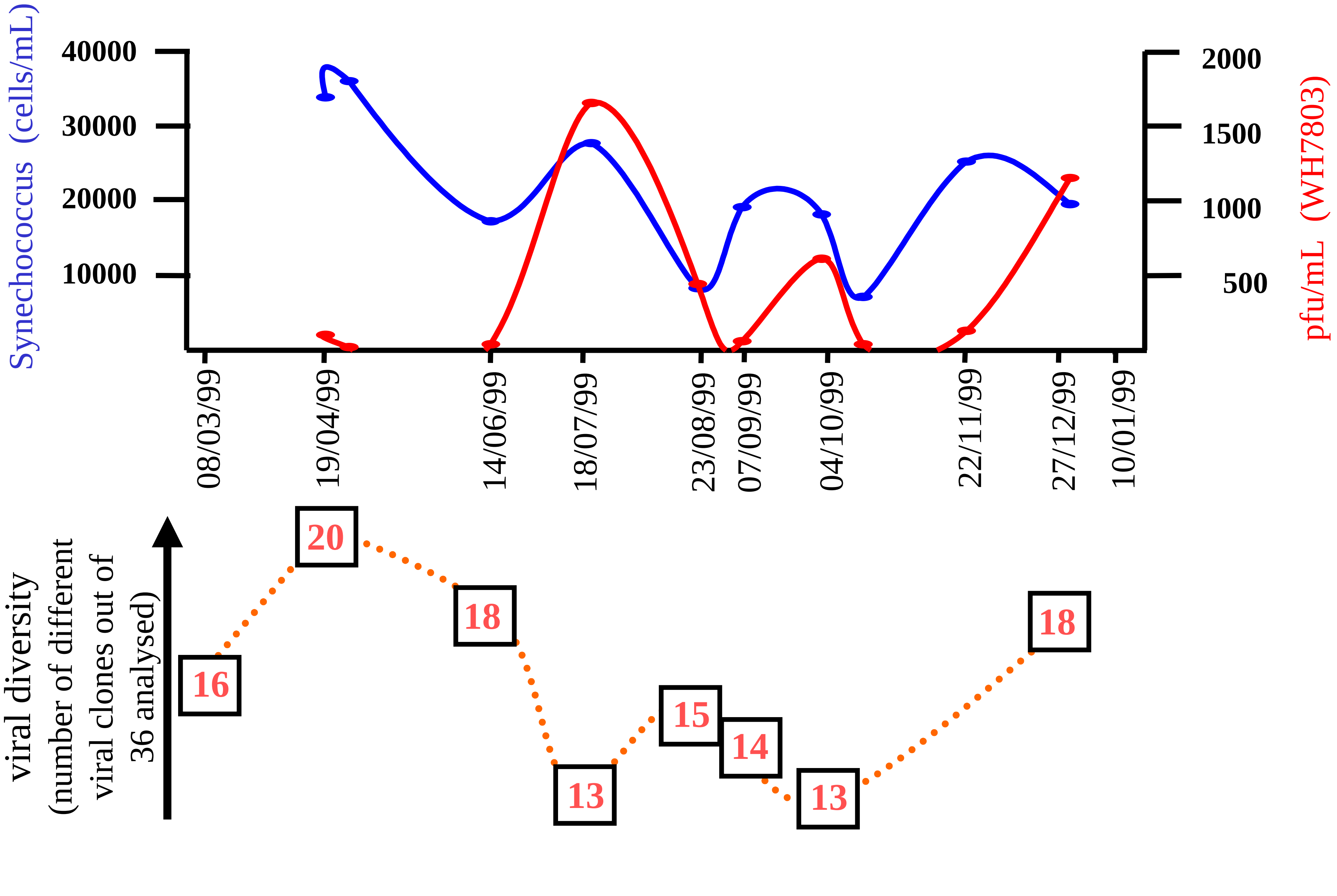
Partial g20 alignment



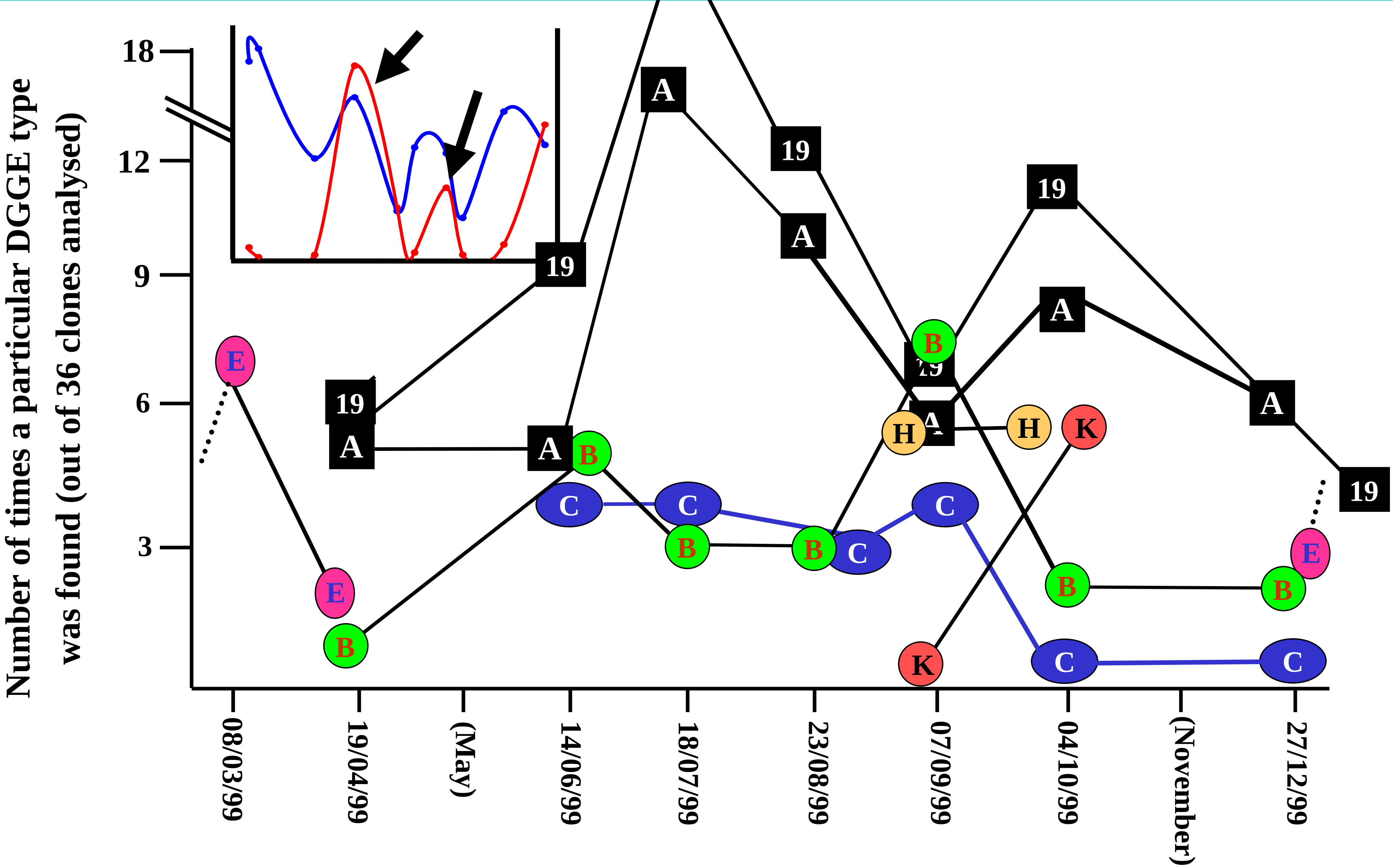
Analysis of viral population structure - Methodology



Viral diversity versus cyanophage abundance



Occurrence of viral DGGE types over annual cycle (semiquantitatively) - 10 m



Conclusion

Cyanophage have an impact on the abundance and population structure of marine *Synechococcus* spp. in the oligotrophic marine environment:

I. Lytic cyanophage are responsible for the the decline of the summer blooms

II. Lysogenic cyanophage are responsible for the decline of the early winter bloom

III. Virus-host interactions influence the population structure of both marine *Synechococcus* and their co-occurring cyanophage