

Rapid response of diazotrophs to hydrography changes in an upwelling bay

D. Fernández-Román¹, M. Fontela², E. Broullón^{1,3}, M. M. Varela⁴, H. Farnelid⁵, A. Fernández-Carrera⁶, B. Fernández-Castro³, S. Martínez¹, T. Rodríguez-Ramos⁴, B. Mouriño-Carballido¹

¹Centro de Investigación Mariña, Universidade de Vigo (CIM-UVIGO), Vigo, SPAIN, ²Instituto de Investigacións Mariñas (IIM), Vigo, SPAIN, ³Ocean and Earth Science, National Oceanography Centre, University of Southampton, Southampton, UK. ⁴Centro Nacional Instituto Español de Oceanografía, (IEO-CSIC), Centro Oceanográfico de A Coruña, A Coruña, SPAIN, ⁵Centre for Ecology and Evolution in Microbial model Systems, Department of Biology and Environmental Science, Linnaeus University, Kalmar, SWEDEN. ⁶Univesidad de Las Palmas de Gran Canaria (ULPGC), Las Palmas, SPAIN.

Contact: daniel.fernandez.roman@uvigo.gal

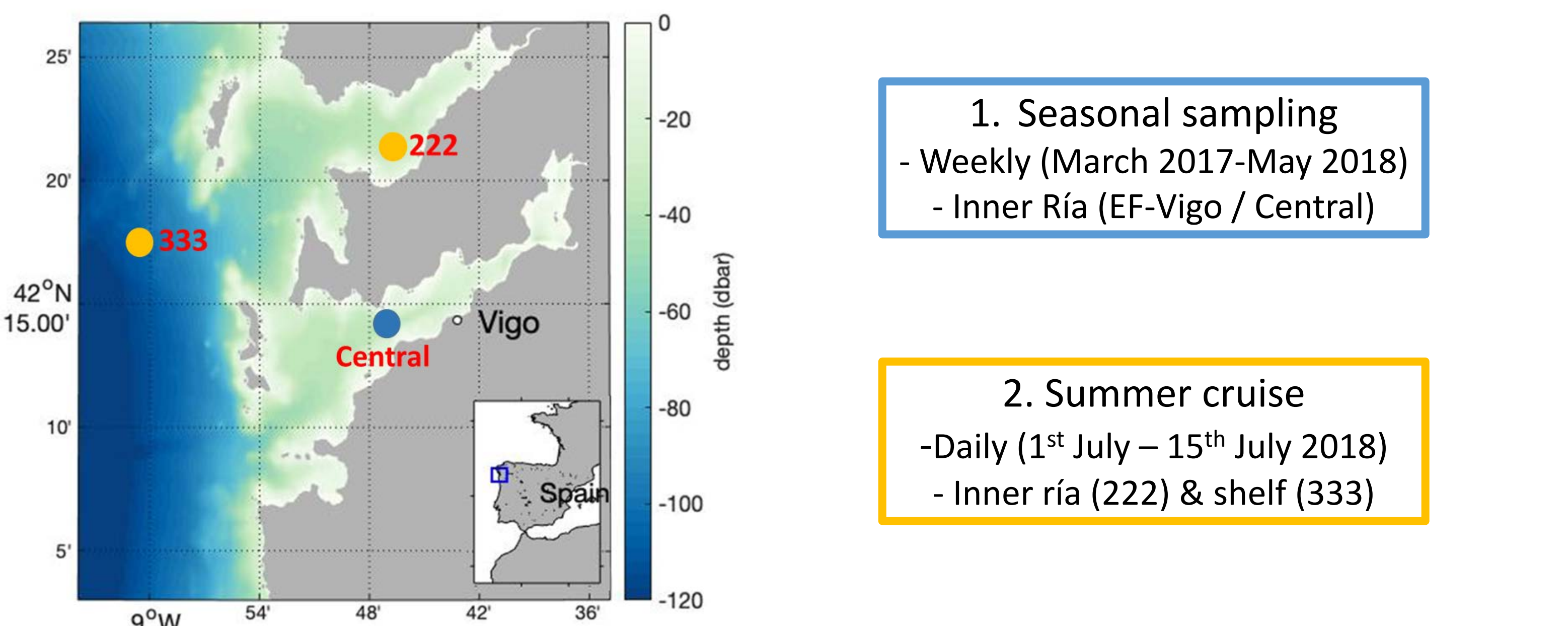
Motivation

Diazotrophs - prokaryotes able to fertilize the ocean through biological dinitrogen fixation (BNF) – are enigmatically present and active in eutrophic regions, including coastal upwelling systems. Previous studies in the upwelling off NW-Iberia showed that the diazotrophic community responds to changes in hydrodynamic forcing over seasonal scales. However, the effect of transient upwelling events, with a typical duration of a few days, remains unknown.

Objective

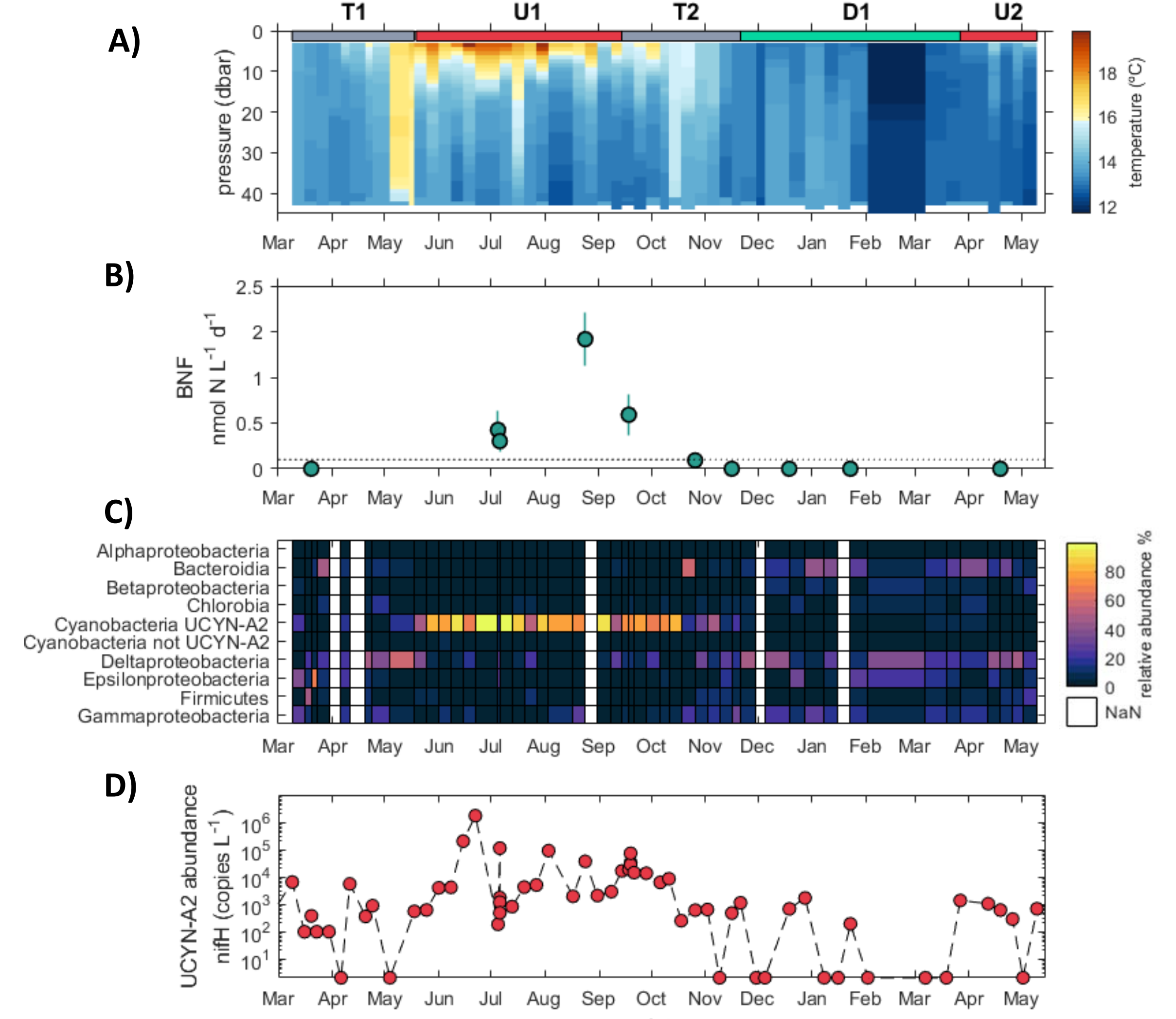
To describe changes in the abundance, composition, and activity of diazotrophs over different temporal scales

1. Sampling and approach



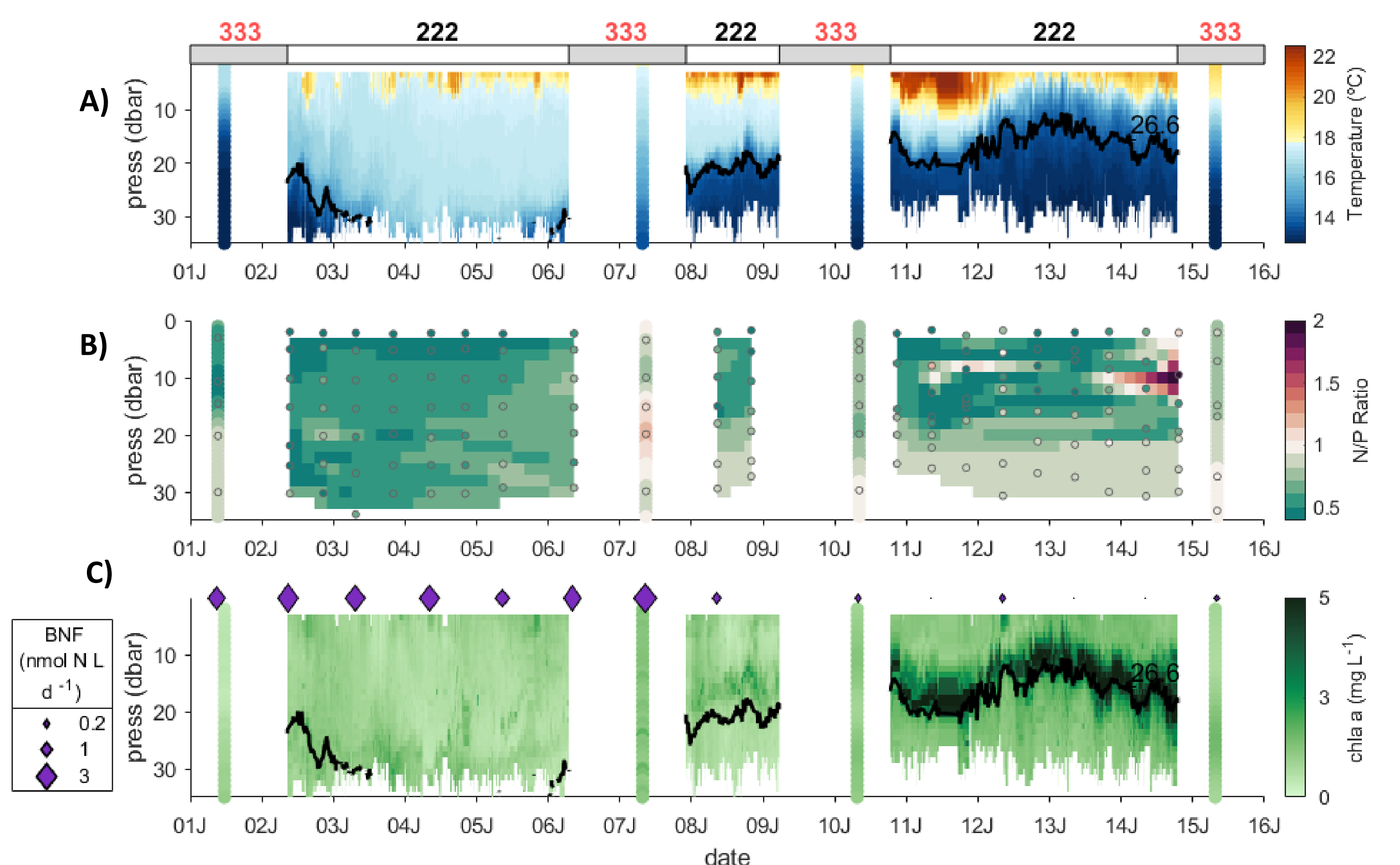
Bathymetry of the REMEDIOS sampling in the two southernmost Galician Rías. Locations of the seasonal sampling (EF) and summer cruise (222 and 333) are marked with blue and orange dots, respectively.

2. Seasonal variability



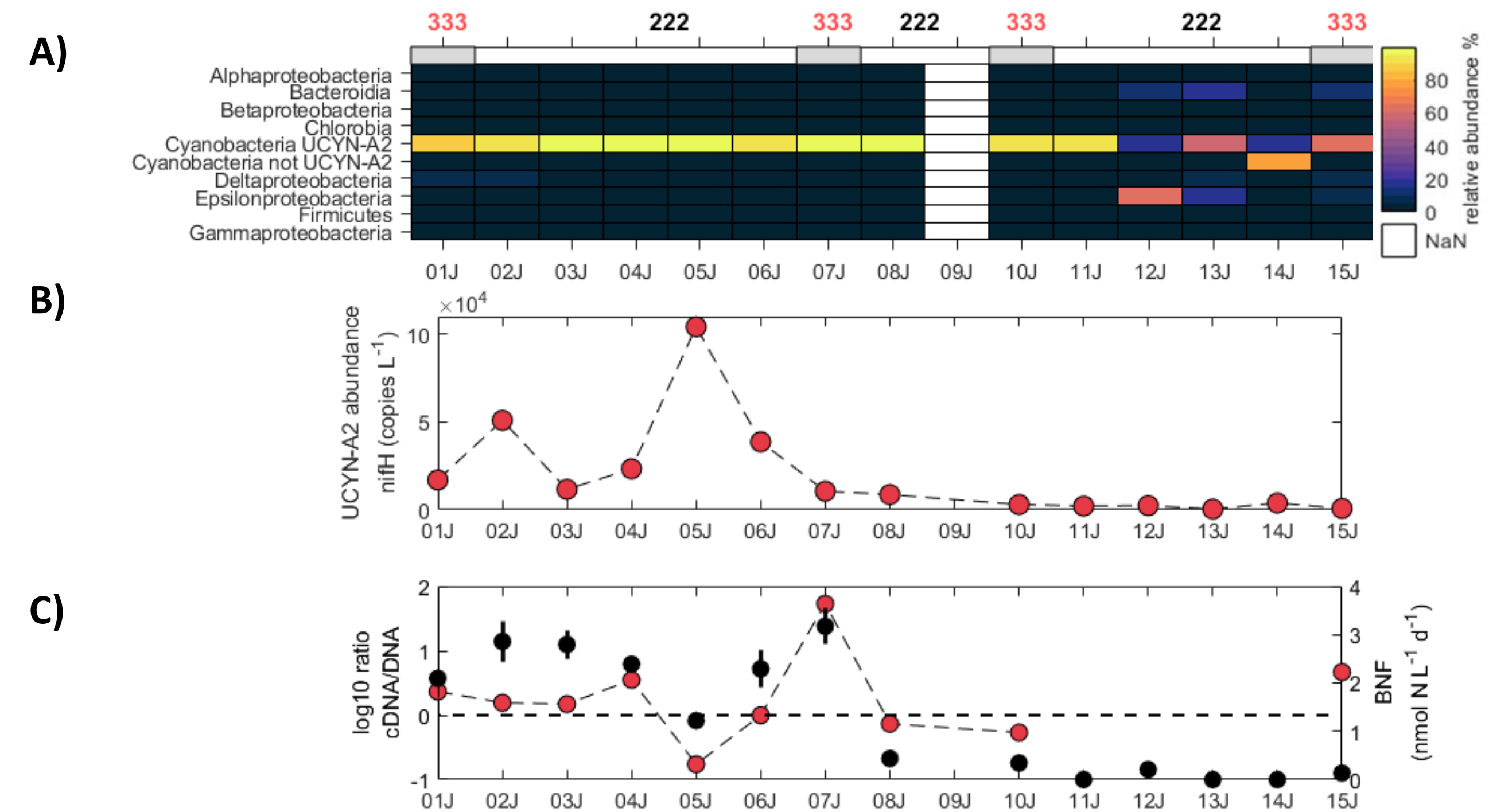
Temporal variability of (A) temperature, (B) surface BNF rates, (C) diversity of the diazotrophic community and (D) abundance of UCYN-A2 during the seasonal sampling. Hydrographic characterization of the sampling period indicated at the top axis of panel A: T stands for transition, U for upwelling and D for downwelling.

3. Short-term variability



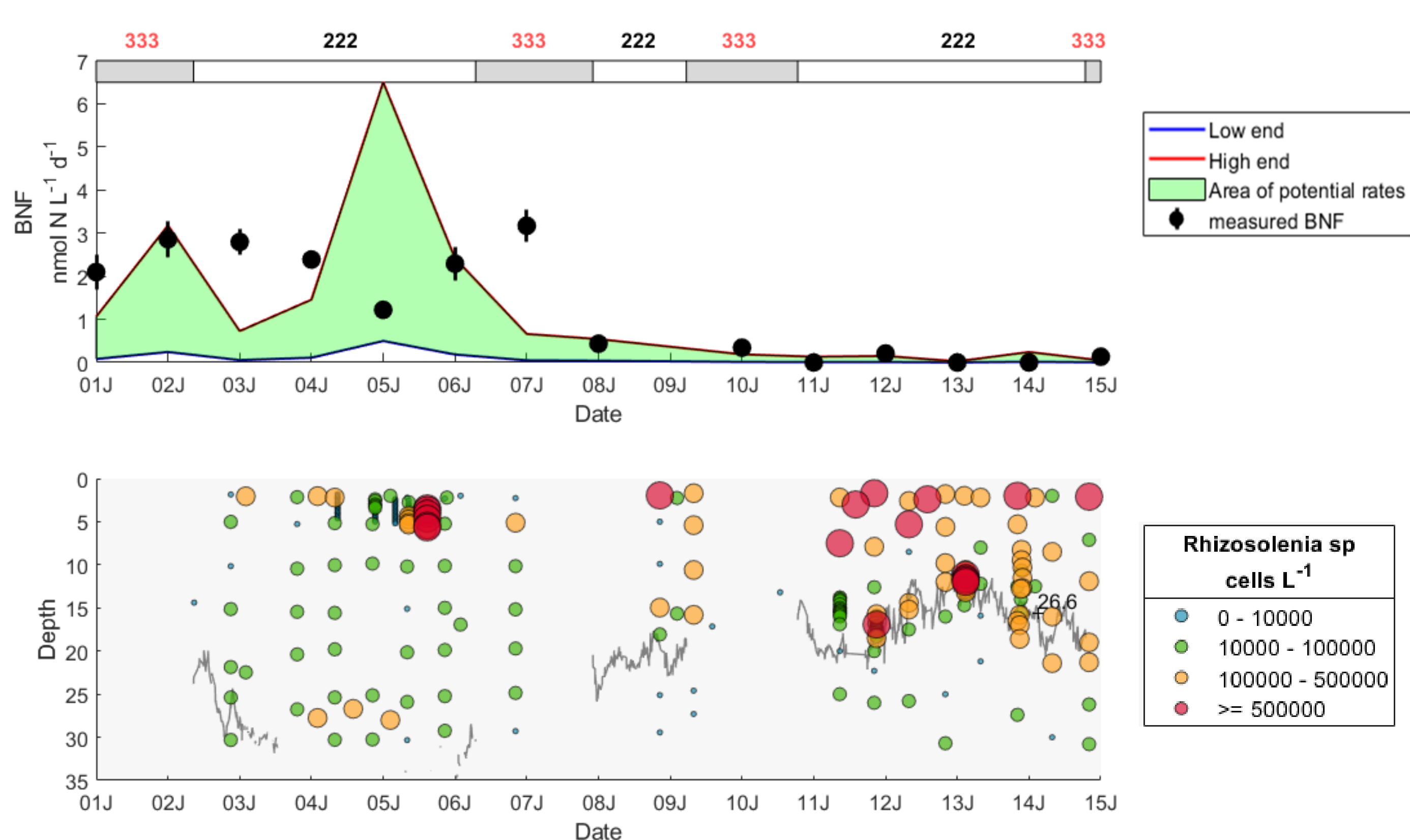
Temporal variability of (A) temperature, (B) normalized N/P ratio, and (C) chlorophyll a concentration during the summer cruise at stations 333 and 222. The black line indicates the 26.6 isopycnal. Magnitudes of surface BNF rates are shown as purple diamonds in panel C.

4. Daily variability of the diazotrophic community



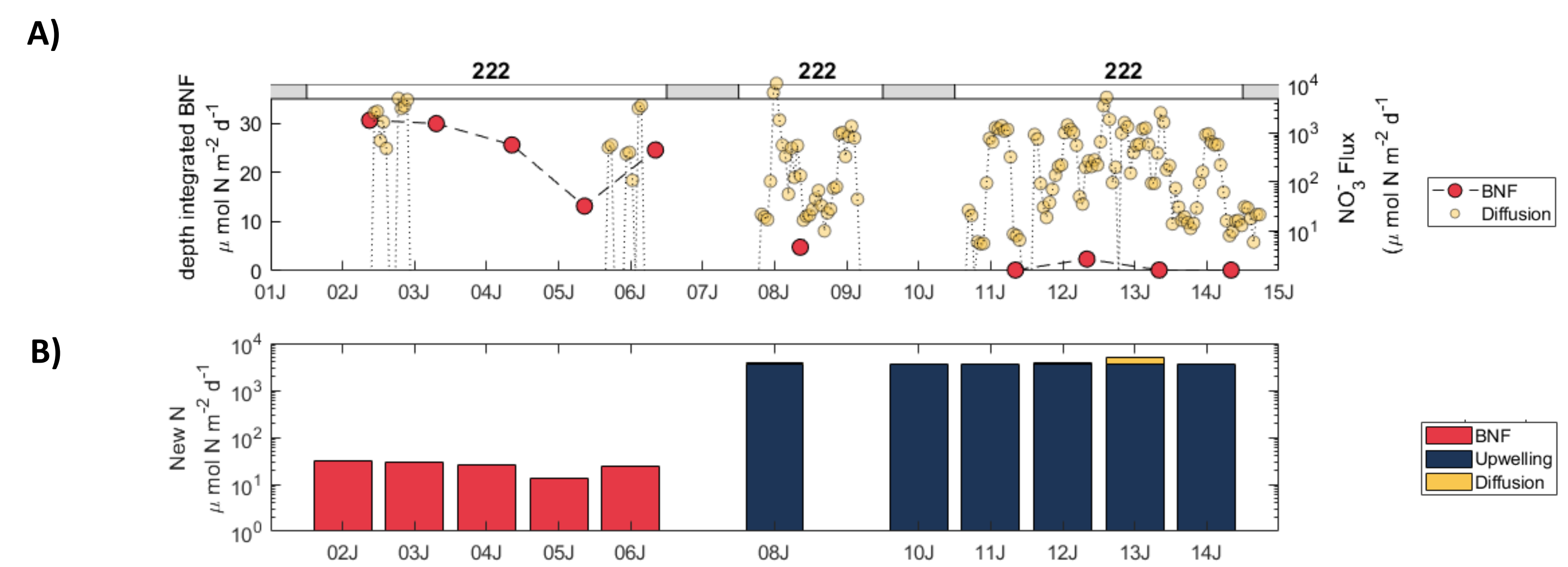
Temporal variability of (A) diazotroph community composition, (B) absolute abundance of UCYN-A2, and (C) log10 of the ratio cDNA/DNA and surface BNF rates during the summer cruise.

5. Potential DDA relevance



Temporal variability of (A) bulk measured BNF rates and range of variability of BNF attributed to UCYN-A2 from cell specific activity (Shao et al., 2023), and (B) abundance of potential DDAs host *Rhizosolenia sp.* during the summer cruise.

6. Biogeochemical role of BNF



Temporal variability of (A) depth-integrated BNF and vertical nitrate supply through turbulent diffusion and (B) contribution of BNF, nitrate supply through upwelling and nitrate diffusive flux to new production calculated in station 222.

Take home messages:

1. Diazotrophs exhibit an important seasonal variability: higher BNF attributed to UCYN-A2 during summer and early autumn
2. Comparable changes occurred over few days: BNF and activity of UCYN-A2 dramatically decreased during upwelling pulse fertilization.
3. Co-occurrence of enhanced BNF and abundance of *Rhizosolenia sp.* suggests the relevance of DDAs in the system.
4. BNF frequently represents the main input of new nitrogen during periods of upwelling relaxation.

Acknowledgements:

This research was funded by project REMEDIOS (CTM2016-75451-C2-1-R) to BM-C from the Spanish Ministry of Economy and Competitiveness. D-FR acknowledges a predoctoral fellowship (FPU2021/04749) from the Spanish Ministerio de Universidades.

To know more... come see our other poster!

Fontela et al., "Puzzling out the ecological niche construction for nitrogen fixers in a coastal upwelling system".