Photosynthetic picoplankton in French Polynesian atoll lagoons: estimation of taxa contribution to biomass and production by flow cytometry

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ABSTRACT: Picophytoplankton was studied by flow cytometry in 11 Tuamotu (French Polynesia) atoll lagoons and in the surrounding ocean. The respective contribution of \textit{Prochlorococcus}, \textit{Synechococcus} and picoeukaryotes on biomass and primary production was evaluated. Red fluorescence was demonstrated to be a proxy for chlorophyll. The relative sizes of the 3 picoplankton groups were estimated using forward light scattering measured in Takapoto lagoon on living cells. The average diameters for \textit{Prochlorococcus}, \textit{Synechococcus} and picoeukaryotes were estimated as 0.62 ± 0.08 (SD), 0.89 ± 0.09 and 3.11 ± 0.22 \(\mu\)m, respectively. The lowest values occurred before sunrise and the highest in the afternoon. Cellular carbon content was estimated using C/biovolume ratios from the literature. The average biomass for \textit{Prochlorococcus}, \textit{Synechococcus} and picoeukaryotes was calculated as 60 ± 20, 178 ± 52 and 4695 ± 834 fg C cell\(^{-1}\) respectively. \textit{Synechococcus} formed the predominant group in terms of abundance and carbon biomass and had the highest planktonic primary production in most lagoons. As it is generally scarce in deep water with limited light availability, its biomass contribution was reduced in deep lagoons. Average lagoonal picoplankton abundance varied by a factor of 200 for the different populations and was affected by the geomorphology of the atolls. In very shallow lagoons, no general trend could be observed, as the dominant group appeared to depend on the water renewal rate within the lagoon. In the surface layer of the surrounding ocean the community structure was dominated by \textit{Prochlorococcus}. However, the observed percentage of \textit{Synechococcus} (>10\%) is usual for the coastal zone. In the upper 120 m of ocean waters surrounding Takapoto, the integrated picoplankton biomass (1242 mg C m\(^{-2}\)) consisted of 65\% \textit{Prochlorococcus}, 1\% \textit{Synechococcus} and 34\% picoeukaryotes.

KEY WORDS: Flow cytometry · Cyanobacteria · \textit{Prochlorococcus} · Chlorophyll · Primary production · Atoll lagoons · Diurnal cell size variations