**題目：**秋季地中海沿岸 Thau 潟湖實驗增溫對小型植物性浮游生物、細菌和病毒的影響

Effects of experimental warming on small phytoplankton, bacteria and viruses in autumn in the Mediterranean coastal Thau Lagoon

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**出處：**Aquat Ecol (2021) vol. 55, p. 647-666

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**報告日期：**19/04/2023

**Abstract**

To investigate the responses of a natural microbial plankton community of coastal Mediterranean waters to warming, which are still poorly known, an in situ mesocosm experiment was carried out in Thau Lagoon during autumn 2018. Several microorganisms, including virio-, bacterio-, and phytoplankton < 10 μm in size, were monitored daily and analysed using flow cytometry for 19 consecutive days in six mesocosms. Three mesocosms (control) had the same natural water temperature as the lagoon, and the other three were warmed by +3 °C in relation to the control temperature. The cytometric analyses revealed an unexpected community dominated by picophytoplanktonic cells, including *Prochlorococcus*-like and *Picochlorum*-like cells, which had not previously been found in Thau Lagoon. The experimental warming treatment increased the abundances of nanophytoplankton, cyanobacteria, bacteria and viruses during the experiment and triggered earlier blooms of cyanobacteria and picoeukaryotes. Only the abundance of *Picochlorum*-like cells was significantly reduced under warmer conditions. The growth and grazing rates of phytoplankton and bacterioplankton estimated on days 2 and 8 showed that warming enhanced the growth rates of most phytoplankton groups, while it reduced those of bacteria. Surprisingly, warming decreased grazing on phytoplankton and bacteria at the beginning of the experiment, while during the middle of the experiment it decreased the grazing on prokaryote only but increased it for eukaryotes. These results reveal that warming affected the Thau Lagoon plankton community from viruses to nanophytoplankton in fall, inducing changes in both dynamics and metabolic rates.

**摘要**

對於地中海沿海水域微生物群集對水溫暖化的反應，至今還不是很清楚，因此本研究於2018 年秋季，在 Thau 潟湖進行了現場中型生態缸模擬實驗。此實驗設計三個中型生態缸實驗組（控制組），其培養水溫控制與潟湖自然水溫相似，另外三個實驗溫度則比控制組高 3°C。 實驗共進行19 天，每天於六個中型生態缸採水使用流式細胞儀計數病毒，細菌及 體型< 10 um 的植物性浮游生物的數量變化。本實驗經流式細胞儀分析發現了一群意想不到的超微細植物性浮游生物群集，其形態及色素特性類似*Prochlorococcus* 和 *Picochlorum* 的細胞，這些群集在 Thau 潟湖未曾被發現過。增溫實驗組在培養期間會使微細植物性浮游生物、藍綠細菌、細菌和病毒的數量增加，而藍綠細菌和超微細真核生物在培養期間會較先產生數量的高值。只有類似*Picochlorum* 的細胞在增溫的實驗條件下，數量會顯著減少。 本研究同時在第 2 天和第 8 天進行培養實驗來估算的植物性浮游生物和細菌的成長和被攝食率。結果發現，經一天培養後增溫實驗組提高了大部分植物性浮游生物群集的成長率，但降低了細菌的成長率。另外實驗結果令人驚訝的是，在實驗初期階段，增溫實驗組會使植物性浮游生物和細菌的被攝食率降低。但在實驗中期階段，它僅使原核生物的被攝食率降低，但增加了對真核生物的被攝食率。 這些結果顯示，秋季期間Thau 潟湖浮游生物群集從病毒到微細植物性浮游生物水溫變暖會影響這些浮游生物的數量和新陳代謝的變化。