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*Doctor of Philosophy (PhD)*

# TROPHIC ECOLOGY OF GELATINOUS ZOOPLANKTON IN THE GULF OF NAPLES

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# Abstract

Gelatinous zooplankton are an important component of marine ecosystems and they play a key role in transporting organic matter within and between ecosystems. This PhD thesis addresses the trophic interactions of gelatinous zooplankton within the planktonic food web of the Gulf of Naples (southern Tyrrhenian Sea) using a combination of trophic biomarkers. To achieve this goal, I started with a throughout review of the literature on fatty acid composition of marine plankton. Using a review synthesis, I concluded that the different solvents used to extract lipids may alter the fatty acid composition, which limits their comparability across studies. Indeed, compared to the most commonly used solvent (chloroform), other solvents tend to recover slightly different proportions of fatty acids according to their affinity towards lipids classes, depending also on biological features of the organisms of interest. Thus, I performed an experiment comparing the effect of widely used solvents (chloroform and dichloromethane) and methyl-*tert*-butyl ether (MTBE) on fatty acids and stable isotopes of *in situ* collected plankton. Results indicated that all three solvents yielded an extraction recovery above 80% in phytoplankton, mesozooplankton and the scyphomedusa *Pelagia noctiluca*. However, while proportions and contents of total fatty acids slightly differed across solvents using the statistical tools, they fell within natural variability or analytical accuracy. In addition, stable isotope values ($\delta^{13}C$ and $\delta^{15}N$) of lipid-extracted organisms and tissues did not significantly differed across solvents. This indicates that MTBE is comparable to the most used solvents and is suitable to extract lipids from planktonic organisms in ecological studies. It can therefore be used as a substitute for toxic and polluting solvents such as chloroform and dichloromethane, suggesting larger applications than the restricted tissue types for which it was originally developed.

The literature review on fatty acid composition of marine plankton also highlighted that primary producers (heterotrophic bacteria and phytoplankton) can be identified at a low taxonomic level (class) using a restricted selection of fatty acid trophic markers, while fatty acid composition of planktonic consumers (zooplankton) relates primarily to their trophic guilds. These results were based on multivariate analyses on a large set of published papers and support the fact that fatty acid trophic markers can track trophic pathways within the planktonic food web. Out of 60 fatty acids identified by authors, only 22 can be used as trophic biomarkers for the different marine planktonic groups, which highly simplifies the assessment of dietary composition and trophic pathways using fatty acid trophic markers.

Finally, the dietary composition of gelatinous zooplankton (the scyphomedusa *P. noctiluca* and three species of Salpida (*Salpa fusiformis*, *Salpa maxima* and *Thalia democratica*)) was analysed seasonally in the Gulf of Naples using a combination of stable isotopes and fatty acid trophic markers. Based on the findings from the previous chapters, the potential prey of gelatinous zooplankton were collected at sea concomitantly with gelatinous predators and the most abundant groups were sorted according to their trophic guilds (detritivore, herbivore, omnivore, carnivore). Seasonal variations in trophic biomarkers ($\delta^{13}C$, $\delta^{15}N$ and fatty acid trophic markers) indicate that *P. noctiluca* and Salpida opportunistically feed on the most available prey at sea, *i.e.* copepods and cladocerans. Additionally, stable isotope values, in particular $\delta^{15}N$, indicate that gelatinous zooplankton feed in different trophic webs within the Gulf of Naples according to offshore/inshore advection occurring during the year. These results emphasize the importance of using stable isotopes and fatty acids to examine spatio-temporal patterns in gelatinous zooplankton populations and determine their complex interactions within planktonic trophic webs.

Overall, this thesis explores different aspects of using trophic biomarkers for ecological studies with an emphasis on gelatinous zooplankton. The potential of fatty acids as trophic biomarkers within the planktonic community is reviewed here with considerations of the solvents employed to extract fatty acids and the determination of specific fatty acid trophic markers that can be used to track trophic interactions within food webs.