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Long-term variability of zooplankton community under climate warming in tropical eutrophic man-made lake

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Abstract. *Sunardi, Yoshimatsu T, Junianto N, Istiqamah N, DeWeber T. 2016. Long-term variability of zooplankton community under climate warming in tropical eutrophic man-made lake. Biodiversitas 17: 634-641.* The climate warming is increasingly acknowledged as an important driver of lake ecosystems. However, there are no generic patterns of how the aquatic species/community responds the warming climate; instead the changes are complicated by interactions of many factors. To regard the important role of zooplankton in the lake ecosystems, this paper questions whether the climate warming affects their community structure in tropical eutrophic man-made lake. We analyzed a series of data resulted from a long water quality monitoring activities in the Cirata Lake, Indonesia. We anticipated that there would be a strong association between the climates warming with the response of zooplankton community after 19 years. Our result suggested that the lake has been becoming slightly warmer following the atmospheric temperature. Instead of decreasing, the shifting water temperature tend promotes a greater species richness, density, and diversity of the zooplankton. Relevant changes in species composition have been observed. It seems that the magnitude of the shift of the temperature, and the eutrophication status played an important role in shaping the changes of the zooplankton community structure.

Keywords: Cirata Lake, climate warming, eutrophic, tropics, zooplankton

INTRODUCTION

Climate change is a challenge for species survival and ecosystems sustainability. Globally, temperature and precipitation have changed dramatically and are predicted to change even more (Meehl et al. 2007), thus, threats of the climate change to all life-forms are believed to remain in the next few decades. Researches have reported that freshwater ecosystems, such as lakes, rivers, streams, and wetlands, are vulnerable to climate change (eg. Magnuson et al. 1997; Sahoo and Schladow 2008; Sunardi and Wiegleb 2016). Climate warming will likely affect inland waters more than ocean (Christensen et al. 2007), as warming over land is expected to be greater than global annual warming due to the smaller thermal inertia and less available water for evaporative cooling on land.

Climate change is increasingly acknowledged as an important driver of lake ecosystems (Adrian et al. 1995; IPCC 2014), but the understanding of the mechanisms by which climate affects lakes is still patchy (Keller 2007). The complexity of the issue of lake responses to climate change arises from the fact that the various climatic components act on lake physical, chemical, and biological characteristics through many interconnected pathways (Battarbee 2000; Leavitt et al. 2009). Various components of the climate system have been shown to relate to temporal dynamics of natural plankton communities on time scales varying from days (diel periodicity) to years (seasonal periodicity). With our environment changing at an unprecedented rate, an important challenge is to assess the impact of climate change on the temporal plankton dynamics of lake ecosystems (Christensen et al. 2007).

The community structure and ecological role of zooplankton in natural and man-made lakes are issues of fundamental concern to aquatic productivity and/or ecosystem stability. Zooplankton communities are highly diverse and thus perform a variety of ecosystem functions. Arguably, the most important role of zooplankton is as the major grazers in aquatic foodwebs, providing the principal pathway for energy from primary producers to consumers at higher trophic levels, such as planktivorous fish, macroinvertebrate, and turtles. In view of their grazing activities and role in nutrient recycling, zooplankton actually or potentially exert both subtle and gross effects on phytoplankton populations, which in turn have a prime bearing on water quality (Mavuti1990).

A possible effect of climate warming is that the water temperatures would increase to levels that are suboptimal or lethal for aquatic organisms, particularly to those with limited dispersal ability like zooplankton. Temperature affects nearly all biological process rates, from biochemical kinetics to species generation time, with higher temperatures typically resulting in higher rates until an optimum is reached, above which rate processes usually decrease rapidly (Kingsolver 2009). Life history parameters (e.g., growth, development, reproduction), respiration, behavior, and survival of aquatic poikilotherms are affected by temperature (Goss and Bunting 1983).