Macroinvertebrate relationships with water temperature and water flow in subtropical monsoon streams of Central China: implications for climate change

Fengqing Li, Qinghua Cai*, Wanxiang Jiang and Xiaodong Qu

With 7 figures and 2 tables

Abstract: Effects of global climate change on freshwaters are still poorly known, particularly in systems where they interact with other environmental variables. Using data from a subtropical monsoon stream in Central China, we assessed the relationships between a macroinvertebrate community and variations in temperature and water flow. We then used these data to assess potential changes under different climate change scenarios. Winter macroinvertebrate abundance and richness decreased with increasing water temperature during the last six years. However, effects of climate on biotic metrics in summer were less clear. Partially constrained ordination revealed that variations in community composition could not be explained clearly by individual climatic variables, but total dissolved solids and total nitrogen were more important. Over the period 1978–2008, average annual air temperature in the study area increased by 0.6 °C, whereas total annual water flow declined. Projections suggest that further winter warming of 1 °C could decrease the macroinvertebrate abundance and richness by 11.1 % and 6.0 %, respectively. One unit increase in the smoothed sea surface temperature (SSST) during winter could increase the abundance and richness by 38.2 % and 21.1 %, respectively. With further global change effects likely in future, our data highlight the importance of the conservation of mountainous streams in the upper Yangtze River.

Key words: water temperature, water flow, El Niño Southern Oscillation, macroinvertebrate, biodiversity.

Introduction

Progressive human impact on the composition and distribution of organisms has increased interest in the protection of biodiversity over the last few decades (Burgmer et al. 2007). Losses of biodiversity via habitat deterioration, fragmentation, pollution, exploitation or disturbance have been viewed with great concern (Fahrig 2003, Lotze & Milewski 2004). Since the1990s, the relationship between climate change and biodiversity conservation has also attracted increasing attention and the potential effects of climatic fluctuations on global biodiversity have been recognized by many workers (Root et al. 2003, Harte et al. 2004, Parmesan 2006, Durance & Ormerod 2007). Streams function in hydrological and biogeochemical cycles, and in the processing and downstream transport of materials and energy (Vannote et al. 1980, Naiman & Bilby 2001). As a link between terrestrial and aquatic ecosystems, streams also influence many organisms in the riparian zone (Ballinger & Lake 2006). Effective conservation strategies depend on improving knowledge about the impact of warming on aquatic organisms. Therefore, for conserving biodiversity in aquatic...