Numerical Diagnostic Study on Dominant Species Succession Mechanism during HAB in the High Frequent HAB Occurrence Area in the East China Sea

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ABSTRACT

By applying a harmful algal bloom (HAB) mathematical model of competition between two algae species, numerical diagnostic experiments designed for several impact factors are conducted to study the dominant species succession mechanism during HAB in the high frequent HAB occurrence area in the East China Sea. The results show that: assuming sea water temperature increased by 3°C, only a single-species HAB of Prorocentrum donghaiense (P.d) occurs instead of species succession; assuming phosphate concentration in this area remaining above 0.6mmol/m³, the phenomenon of dominant HAB species succession is still there with a shorter time of incubation and a longer time of maintaining. This study not only reveals the sea water temperature plays a important role in the HAB process of species succession above-mentioned, but also suggests long period of eutrophication status in this area in this area is one of the leading causes of early outbreak and long-time maintaining of HAB in spring.

KEY WORDS: East China Sea; harmful algal bloom; numerical diagnostic; dominant species succession.

INTRODUCTION

The East China Sea (ECS) is the highest annual HAB-occurrence-number area of China’s coastal waters, and most of HABs occur in the Yangtze River Estuary and its adjacent water (28°00’ ~ 34°00’N, 120°00’-124°00’E) which is known as the high frequent HAB occurrence area of ECS (Fig. 1). Statistical data indicates that the frequency and scale of HAB occurrence increases year by year in this area (Tang et al, 2006). Analysis of field survey data of this area showed that diatom and dinoflagellate became successively the dominant species during HAB in the spring of 2005 (Zhang et al, 2008). Research results from in-situ observations (Liu et al, 2005; Jiang et al, 2009) and ecological experiments (Cai et al, 2005; Li et al, 2005; Wang et al, 2008; Zhao et al, 2009; Hu et al, 2011), not only provide reasonable ecological parameters for single-species growth rate, but also describe the influence of algal ecological adaptation strategy and interspecific competition mechanism on population succession during HAB. Based on these achievements, marine ecosystem dynamics models with comprehensive consideration of marine environment factors (Dippner, 1998; Li et al, 2008), taking the place of pure mathematics models (Zhao et al, 1992; Pal et al, 2009), have become the present mainstream way to study dominant species succession phenomenon in marine ecosystems.

Fig. 1 Location of the high frequent HAB occurrence area of ECS (Wang et al, 2009)

In the process of HAB, environmental factors, such as sea water temperature and nutrients, play a very important role in the dominant species succession mechanism. Field mesocosm experiments (Li et al, 2003) and indoor culture experiments (Wang et al, 2006) indicate that potential nutrient and water temperature competition exists between Skeletonema costatum (S.c) and Prorocentrum donghaiense (P.d) during the succession process. Based on such a competition mechanism, a HAB ecological mathematical model of competition...