



Changes in free-living nematode community structure in relation to progressive land reclamation at an intertidal marsh

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Abstract

Nematode communities were investigated at two locations along two transects on Chongming Island in the Changjiang Estuary, China, which had received different intensities of intertidal marsh reclamation. Our results demonstrate that marsh reclamation altered nematode community structure, and the frequency of reclamation also substantially affected nematode communities. Nematode generic richness and diversity were significantly lower at reclaimed stations than at tideland stations, whereas nematode abundance and evenness did not change significantly after reclamation. MDS ordination indicated that different nematode communities could be distinguished for un-reclaimed, newly reclaimed and old reclaimed stations. Stations on the same land type at two locations were grouped together, suggesting that land use management exerted greater influence on nematode communities than location.

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1. Introduction

Disturbance is ubiquitous feature of estuarine environments (Levin et al., 1996). As the population grows and the demands imposed on natural resources increase in many coastal regions worldwide, estuaries exhibit a wide array of human disturbance (Talley et al., 2003). Compared with natural disturbance, the impacts of human-induced distur-

bance are often more influential and long-lasting (Czech et al., 2000; McKinney, 2002). Since biota in coastal watersheds and salt marshes tend to be highly vulnerable to human activities (Gordon, 1994), the destruction of fringing wetlands (e.g., due to diking, ditching, canal construction, impounding and draining, dredging and filling) usually degrades biotic communities, and may produce some of the greatest local species extinction (Kennish, 2002). These modification processes and estuarine habitat loss exert effects not only on local biodiversity, but also on regional and even global ecosystems through biochemical cycling (Wall, 1999). Thus, information

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on how land use activities shape local biodiversity and how alteration of biodiversity leads to ecosystem simplification is necessary for understanding the overall impacts of anthropogenic disturbance on estuarine ecosystems.

Nematode communities are typically species-rich and usually numerically dominant in marine, freshwater and terrestrial habitats. They regulate the turnover of microbial communities (Ingham et al., 1985; Griffiths, 1990; Coull, 1999), contribute to several trophic components of food webs (Yeates et al., 1993), and may play essential roles in ecosystem functioning (Bardgett et al., 1999, 2001; Ritz and Trudgill, 1999; Ekschmitt et al., 2001). Due to their life history and high turnover rates, nematodes respond rapidly to changes in environmental conditions and are considered to be ideal bioindicators for environmental assessment (Wardle et al., 1995; Bongers and Ferris, 1999). Studies investigating the effects of land use practices on soil nematodes have been mainly carried out in terrestrial environments such as agricultural land (Freckman and Ettema, 1993; Yeates and Bird, 1994; Ferris et al., 1996; Neher et al., 1998; Yeates et al., 1999), forest (Ruess, 1995; Armendariz and Arpin, 1996; de Goede, 1996; Háněl, 2001), and grassland ecosystems (Wasilewska, 1994, 1999; Popovici and Ciobanu, 2000; Ekschmitt et al., 2001). There are relatively few studies on how nematodes respond to habitat alternation in wetlands (Neilson and Boag, 2002; Wu et al., 2002).

Chongming Island (121°50′–122°05′E, 31°25′–31°38′N), located at the Changjiang River (Yangtze River) mouth, China, is the largest estuarine alluvial island in the world. It is a rapidly growing island due to the sedimentation provided by the Changjiang River (Yang, 1999). The river transports 4.68×10^8 t of sediment into the East China Sea per year (GSICI, 1996). About half of the sediment settles in the area of the river mouth (Chen et al., 1985). Consequently, the intertidal marsh on the southeast side of Chongming Island expands at a rate of 100–150 m per year, forming about 5 km² new marsh flats every year. In addition to these natural environmental changes, the island is also drastically changed by extensive local land use practices. Over 500 km² of intertidal marsh flats has been reclaimed by constructing dikes since 1956 by the Shanghai government. In the different

zones of the Chongming salt marshes, the wetland has been reclaimed to differing extents. The aim of this study was to describe differences in free-living nematode community structure along spatial gradients reflecting different stages of land reclamation, and to determine (1) whether nematode communities are affected by progressive land reclamation; and (2) whether nematode communities differed with time since reclamation. The study was carried out by comparing different locations along the two transects on Chongming Island situated in the Changjiang Estuary.

2. Materials and methods

2.1. Study area

The study was carried out in two different sites on Chongming Island, viz. Dongwangsha and Beibaxiao (Fig. 1).

The vegetation in Dongwangsha intertidal salt marshes was dominated by *Scirpus mariquete*, which is a typical pioneer species widespread in coastal areas of East Asia (Sun et al., 2001). After reclamation, *S. mariquete* was gradually replaced by the reed, *Phragmites australis* (Sun et al., 2003). The most recent dikes were constructed in 1998. There is no tidal flooding behind the 1998 dikes. Seven sampling stations at regular intervals of 0.9 km were established along the successional gradient, each representing a stage of vegetation succession. The stations at Dongwangsha were abbreviated as D1, D2, D3, D4, D5, D6 and D7 (Fig. 1).

Beibaxiao is the marsh flat located in the northeast part of Chongming Island. The pioneer plant in intertidal marshes is *Spartina alterniflora*, an exotic species to the area. In the high tidal zones, *P. australis* replaces *S. alterniflora* and becomes the climax plant species. Since the sediment suspension is less, and thus the expansion of tidal marshes is slower in Beibaxiao than in Dongwangsha, the reclamation in 1998 was not extended to Beibaxiao. The most recently built dikes in Beibaxiao were constructed in 1992. The 1992 dikes were constructed in the area covered by *P. australis*. Therefore, the plants were dominated by reed on both sides of the 1992 dikes. There is no tide flooding inside of the 1992 dikes. Five

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