Composition of fish communities in an intertidal salt marsh creek in the Changjiang River estuary, China*

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Abstract Fish communities in a (third-order) intertidal creek in Dongtan marsh in the Changjiang (Yangtze) River estuary were investigated seasonally for one year. A total of 1,996 fish specimens (10,967.8 g) comprising 26 species and 15 families were collected. Abundances of fish communities in the intertidal salt marsh creek were primarily dominated by *Boleophthalmus pectinirostris* (19.8%), *Collichthys lucidus* (18.6%), *Periophthalmus magnuspinnatus* (18.2%), *Liza haematocheilus* (17.9%), and secondarily by *Mugilogobius abei* (8.5%), *L. carinatus* (7.2%), *Odontamblyopus lacepedii* (4.3%), and *Acanthogobius ommaturus* (3.9%); another 18 species were present only occasionally. Non-MDS ordination and SIMPER analysis indicated that there were two fish communities in the intertidal salt marsh creek. In spring, the communities were dominated by *B. pectinirostris*, *P. magnuspinnatus*, *C. lucidus* and *M. abei*; in summer, autumn, and winter by *L. haematocheilus*, *L. carinatus*, *A. ommaturus* and *O. lacepedii*. Some species showed strong habitat selection; *L. carinatus* and *P. magnuspinnatus* were distributed mainly in the upper and middle creek, while *B. pectinirostris*, *M. abei* and *O. lacepedii* inhabited the middle and lower creek. The study indicated that the salt marshes of the Changjiang River estuary are an important nursery and feeding habitat for many fishes and should be protected.

Keyword: fish communities; habitat; nursery; tidal creek; salt marsh; Changjiang (Yangtze) River estuary

1 INTRODUCTION

Coastal salt marshes have high biological production and heterogeneous habitats, which makes them important nursery areas and feeding grounds for many fishes and macrocrustaceans, including commercially important fishery species (Boesch et al., 1984; Cattrijsse et al., 1994; Peterson et al., 1994; Desmond et al., 2000). In past decades, a large number of studies have been carried out to investigate the fish communities, and to assess the habitat use and ecological importance of salt marshes in the Atlantic (Bozeman et al., 1980; Rozas et al., 1987; Able et al., 2001), the Mexico Gulf (Rozas, 1992; Minello et al., 1994) to the Pacific coast of North America (Desmond et al., 2000), Europe (Cattrijsse et al., 1994; Laffaille et al., 2000; Hampel et al., 2003), Australia (Connolly, 1999; Thomas et al., 2001), and South Africa (Peterson et al., 1996, Paterson et al., 2000). However, there are few studies on the role of estuarine and coastal salt marshes as nurseries for fishes in China.

A complex tidal creek network is one of the most conspicuous features of coastal salt marshes. Tidal creeks not only provide nursery and foraging areas for fishes, but also serve as conduits for fishes to migrate into the marsh surface on the flood tide (Shenker et al., 1979; Peterson et al., 1994; Desmond et al., 2000; Cattrijsse et al., 2006). To date, there is no consistent paradigm stating how fishes use tidal creek habitats (Desmond et al., 2000). Some studies indicate that first-order creeks (i.e. the smallest tidal creeks) have high species richness and densities. Therefore, they are thought to be the preferred habitat for many resident species (Rozas et al., 1987; Rozas, 1992). However, Desmond et al. (2000) found a contrasting pattern; first-order tidal creeks had lower species richness and fish densities than fourth-order creeks. Additionally, little information is available on how co-occurring fish species use common
(habitat and food) resources within tidal creeks, and whether use of them by fish varies with time and location (Allen et al., 1995; Laffaille et al., 2000; Catrijsse et al., 2006).

The Changjiang (Yangtze) River, the third largest river in the world, carries about $928 \times 10^9$ m$^3$ per year of water and $3 \times 10^8$ t per year of fine sediments into the East China Sea (Chen et al., 1986; Li et al., 2007). More than half of the sediments from the river are deposited in the estuarine area, which develops extensive tidal wetlands (Chen et al., 1986; Yang, 1998). The total area of the existing tidal wetlands is approximately 800 km$^2$, and is accreting at 15–20 km$^2$ per year. About one third of the present wetland area is colonized by marsh vegetation (Yang, 1998). In the past two decades, salt marshes in the estuary have been extensively disturbed by land reclamation, plant invasions (e.g. Atlantic Cordgrass *Spartina alterniflora*), and over-fishing (Chen, 1995; Chen et al., 1999; Xu et al., 2005). In particular, extensive reclamation has seriously destroyed the structure and function of salt marsh ecosystems in the estuary (Zhao et al., 2004; Quan et al., 2007a, 2008). Therefore, it is vital to elucidate the role that salt marshes play as nurseries for supporting sustainable exploitation of estuarine fisheries, and for their conservation.

The Changjiang River estuary is the largest estuary in China, and one of the most important fishing grounds (Wang et al., 1984; Zhuang et al., 2006). Previous studies on fishes in the estuary have mainly focused on ichthyofauna (Wang et al., 1984; Zhuang et al., 2006), biodiversity (Chen, 2003; Xu et al., 2005), fisheries biology (Sun et al., 1992; Sun et al., 1994), and fisheries resources in shallow subtidal habitats (Wang et al., 1984; Chen, 1995; Chen et al., 1999). However, there are few studies on the use of the intertidal marsh surface or tidal creek habitats by fish. The goals of this study are to: (1) investigate fish species that use an intertidal salt marsh creek; (2) establish the seasonal and spatial variation of fish communities in an intertidal salt marsh creek; and (3) evaluate the nursery function of the salt marsh for estuarine and coastal fishes.

## 2 MATERIALS AND METHODS

### 2.1 Study area

The study was carried out at Chongming Dongtan wetland natural reserve of Shanghai Municipality, located in the Changjiang River estuary, China (Fig. 1). The wetland is an important stopover site for migratory birds on the East Asian-Australia Flyway; it also functions as a nursery and sanctuary, and feeding and spawning ground for many commercially important fishes and endangered aquatic species (Chen et al., 1999; Chen, 2003; Xu et al., 2005). The total area of vegetation in the wetland is about 2 750 km$^2$ (Li et al., 2006). Three salt marsh macrophytes form dense monocultures in the wetland. Monocultures of *Phragmites australis* and *S. alterniflora* are often found in high and middle marshes, while *Scirpus mariqueter*, a pioneer plant, is located in the lower marshes (Quan et al., 2007b). The climate is characterized by an annual precipitation of 1 124 mm, and a mean temperature of 15.7°C. The Changjiang River estuary has a semi-diurnal mesotidal regime with a mean tidal range of 4.5 m for spring tides and 2.6 m for neap tides (Chen, 2003; Xu et al., 2005).

### 2.2 Sampling design

Fishes were collected from an intertidal salt marsh creek (length, 2 500 m; mean depth, 1.2–3 m; mean