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Species diversity and functional diversity of insects in Wuxijiang National Wetland Park, East China

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ABSTRACT

World-wide wetlands are experiencing increasing pressure from economic development, including the conversion of wetlands to agriculture. While it is assumed that this land use change will have negative impacts on local biodiversity, the specific impacts of agriculture on insect biodiversity in wetland ecosystems are poorly understood. To address this knowledge gap we investigated insect communities in the multi-land use Wuxijiang National Wetland Park, quantifying both species diversity and functional diversity. Four species diversity indexes and twelve functional diversity indexes were used to describe species diversity and functional diversity respectively. We provide three primary results: 1.) Species diversity and functional diversity of natural wetland plants is not necessarily higher than artificial economic plants; 2.) Species diversity indexes are generally correlated with functional diversity indexes; and 3.) Straw mulch cultivation can increase the species diversity and functional diversity of insect.

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Contents

1. Introduction

Since the year 1700, a minimum of 54% of global wetlands have been lost to other land uses [1]. Agricultural expansion is a primary cause of this wetland loss with >27% of historical wetland area converted to agriculture across Asia [2]. The impacts of this large scale land use land cover conversion are wide-ranging, causing changes in local community composition, regional flood prevention, and the global climate, suggesting that wetland loss is a significant factor across a range of geographic scales [2]. Taken together, the global loss of swamps and floodplains costs 2.7 trillion USD per year in lost in ecosystem services, representing a significant opportunity cost [3].

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However, while the impacts of wetland loss are generally well understood at the global scale, the impacts of wetland loss on individual communities remain understudied. Specifically, we know little about how the loss of wetland habitat impacts the biological diversity of insects. Biological diversity is the variety and variability among living organisms and the ecological complexes in which they occur [4]. It is reflected at the level of genes, species, and ecosystems [5]; however, biodiversity research has mainly focused on species diversity [6,7]. In fact, though species diversity is the most studied form of biodiversity, other dimensions of biodiversity, such as functional diversity, which regulates ecosystem processes [8], pedigree diversity, which focuses on evolutionary relationships, and genetic diversity, which quantifies genetic variation, may be more ecologically relevant than species diversity. Therefore, to fully understand the importance of biodiversity and to connect biodiversity to ecosystem functioning, research will need to quantify biodiversity across multiple, ecologically relevant dimensions [9].

One such dimension is functional diversity [10], which, due to the importance of functional traits on ecosystem stability, productivity, and nutrient balance [11], plays a key role in determining the link between biodiversity and ecosystem function [12]. However, while it is clear that functional diversity underlies ecosystem functioning, the measurement of functional diversity is complex and controversial. As identified by Mason [5], a functional diversity index must reflect the range and abundance of characteristics present in the community while also remaining unaffected by the measurement units used or by the number of species [13]. So far no common functional diversity index has been developed that completely meets these goals.

Though there has been an increasing interest in functional diversity over recent years [14–17], the study of functional diversity in insect communities is still in its infancy and lacks real direction. As insects are highly susceptible to the effects of environmental changes [17], they can serve as an effective indicator of environmental quality. What's more, insects have complex relationships between with plant, soil, and even itself, it means that insects are important and necessary materials to study biodiversity. To address these knowledge gaps, we studied insect species and functional diversity in Wuxijiang National Wetland Park [18], with three goals: 1.) To assess the impact of conversion to economic plants on species and functional diversity; 2.) To assess the relationship between species diversity and several functional diversity indices; and 3.) To recommend economic development pathways in these wetland regions which will minimize functional diversity loss.

2. Methods

2.1. Study period and site selection

Wuxijiang National Weland Park is founded in 2009 and it's a large reserve within Zhejiang Province China, includes Xianxia lake, Jiulong lake and four-stage hydroelectric power station. Falling within the coordinates 18°47′28″-118°55′50″ E and 28°31′40″-28°49′45″ N, the park has a total area of 12,400 ha (Fig. 1). As in typical mountain riverine wetlands, the ecology of the wetland system and upstream plants are tightly coupled. Specific to this study area, there is a diversity of vegetation types in these wetland plants because almost 3000 ha of artificial economic plants surrounding woodlands are contracted out to individuals for farming and forestry operations.

To assess the impacts of artificial plants creation on insect functional diversity we sampled insect populations within each of the ten

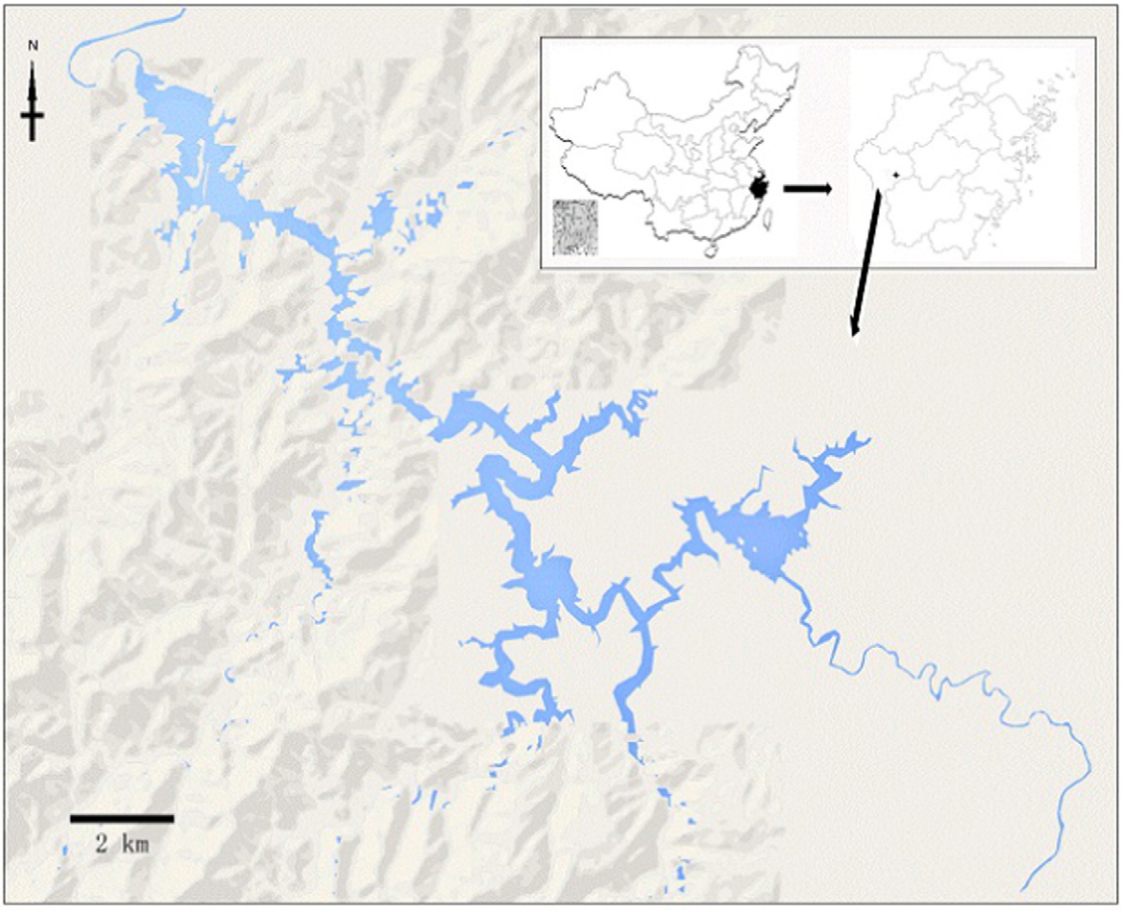

Fig. 1. Map showing the location of the Wuxi River National Wetland Park.

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