

# The Role of Wetland Pattern and Climatic Change in Determining Wetland Bird Diversity, Taiwan.

Liang-Hsien Chen<sup>1\*</sup>, Mark D. Barnes<sup>2</sup>, Monica Kuo<sup>3</sup>

1. Associate Professor, Chinese Culture University Department of Life Science

2. Associate Professor, Chinese Culture University Department of Natural Resources

3. Chairman, Chinese Culture University Department of Landscape Architecture

## Introduction

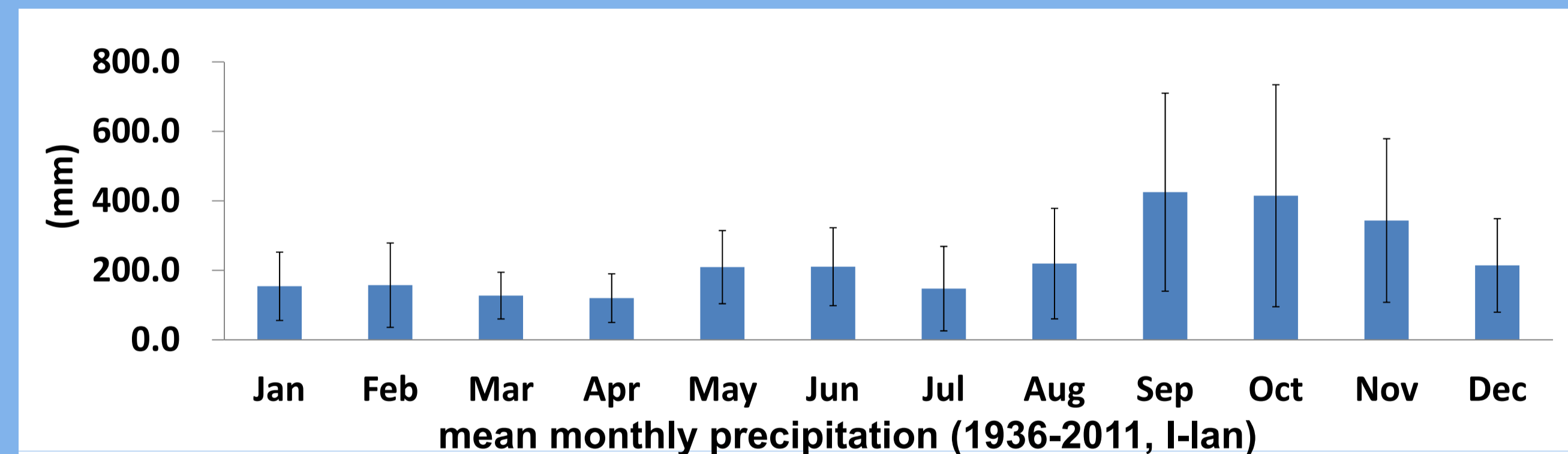
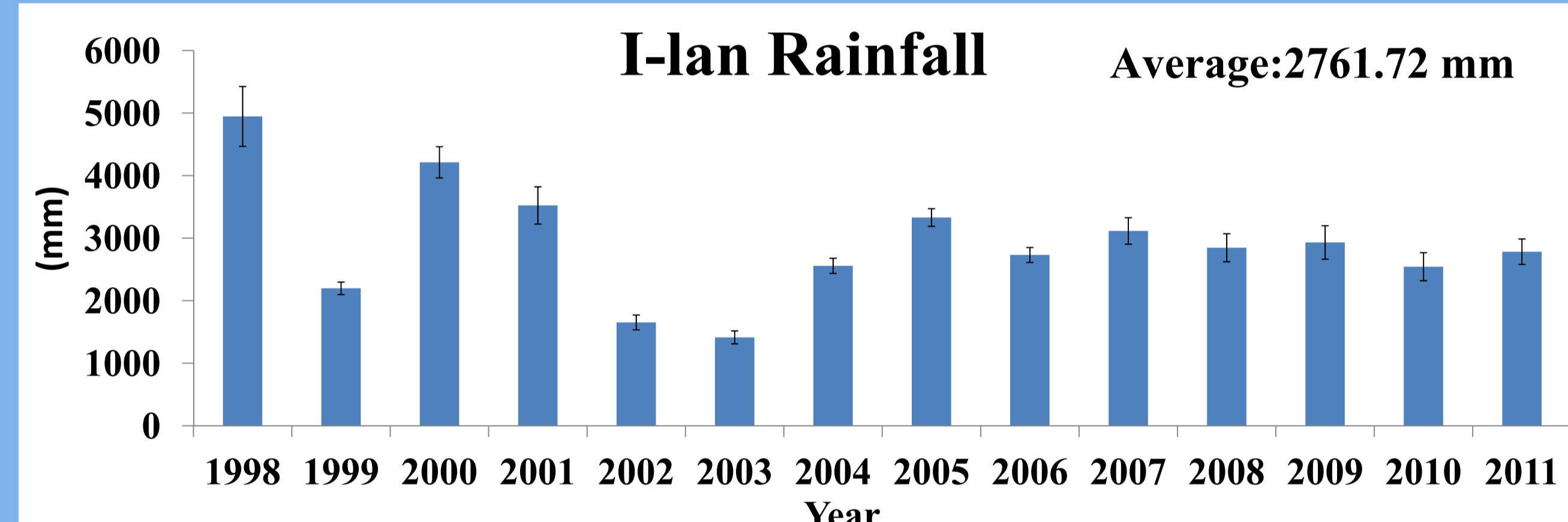
- The main goals of the study were: (1) to test how diversity of wetland birds varies among different wetland habitats, including rice paddies and estuaries, and (2) to determine how diversity of wetland birds varies under climate change. Rice farming creates diverse cultural landscapes, including extensive paddy field and irrigation canals intermixed with wetlands.



52-jia wetland (06.01.2012)



Lanyang Estuary Wetland (06.01.2012)



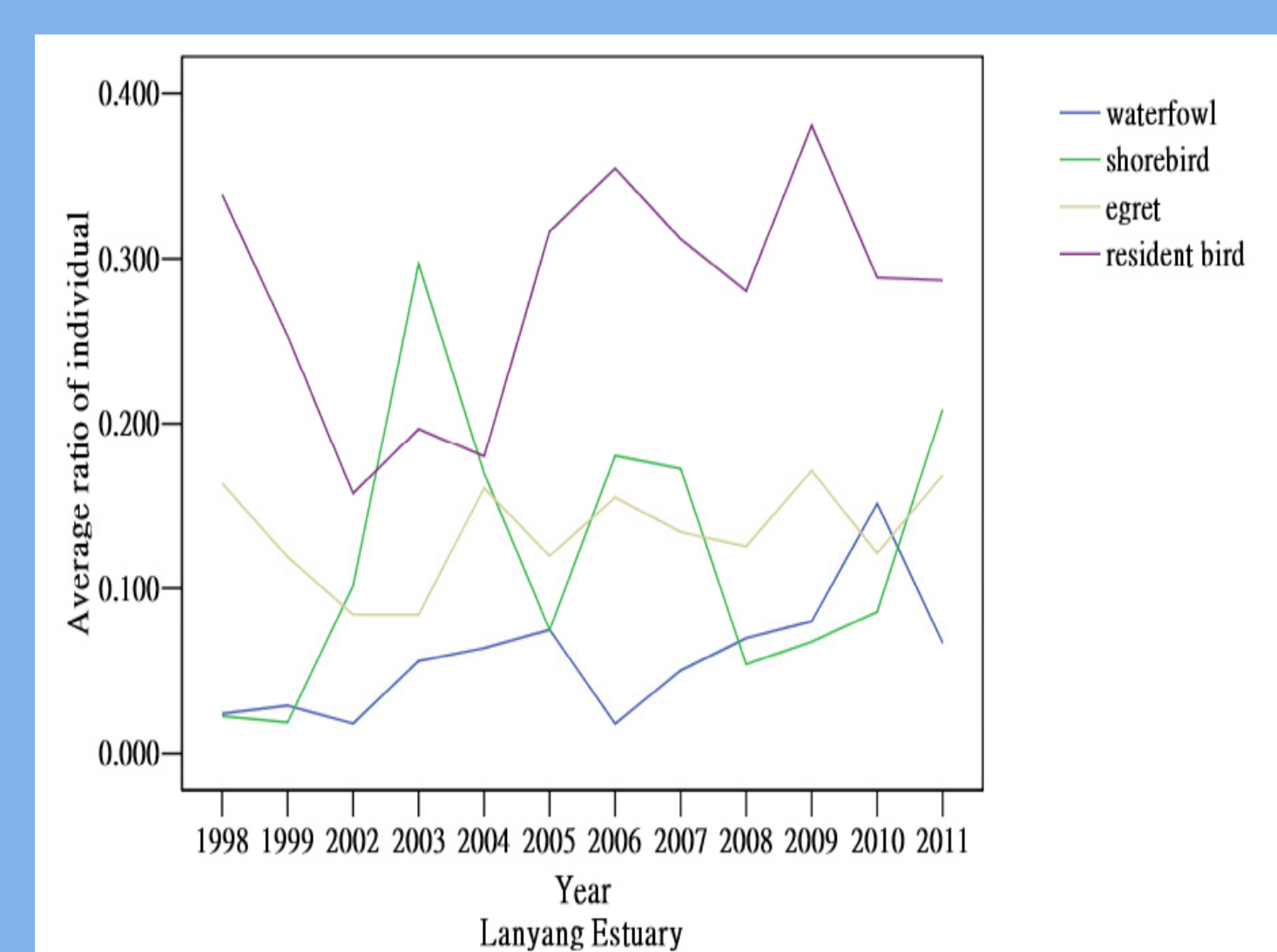
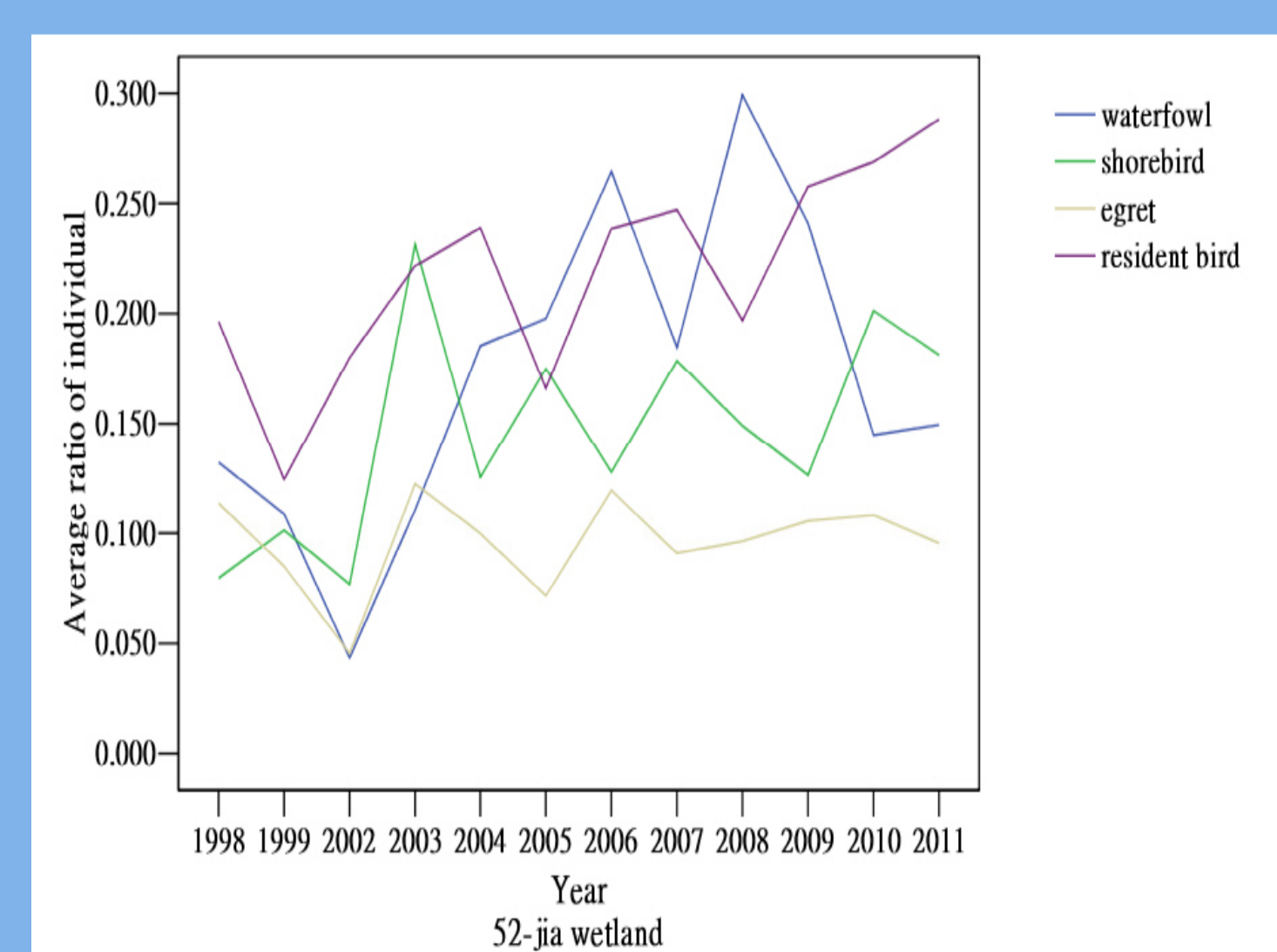
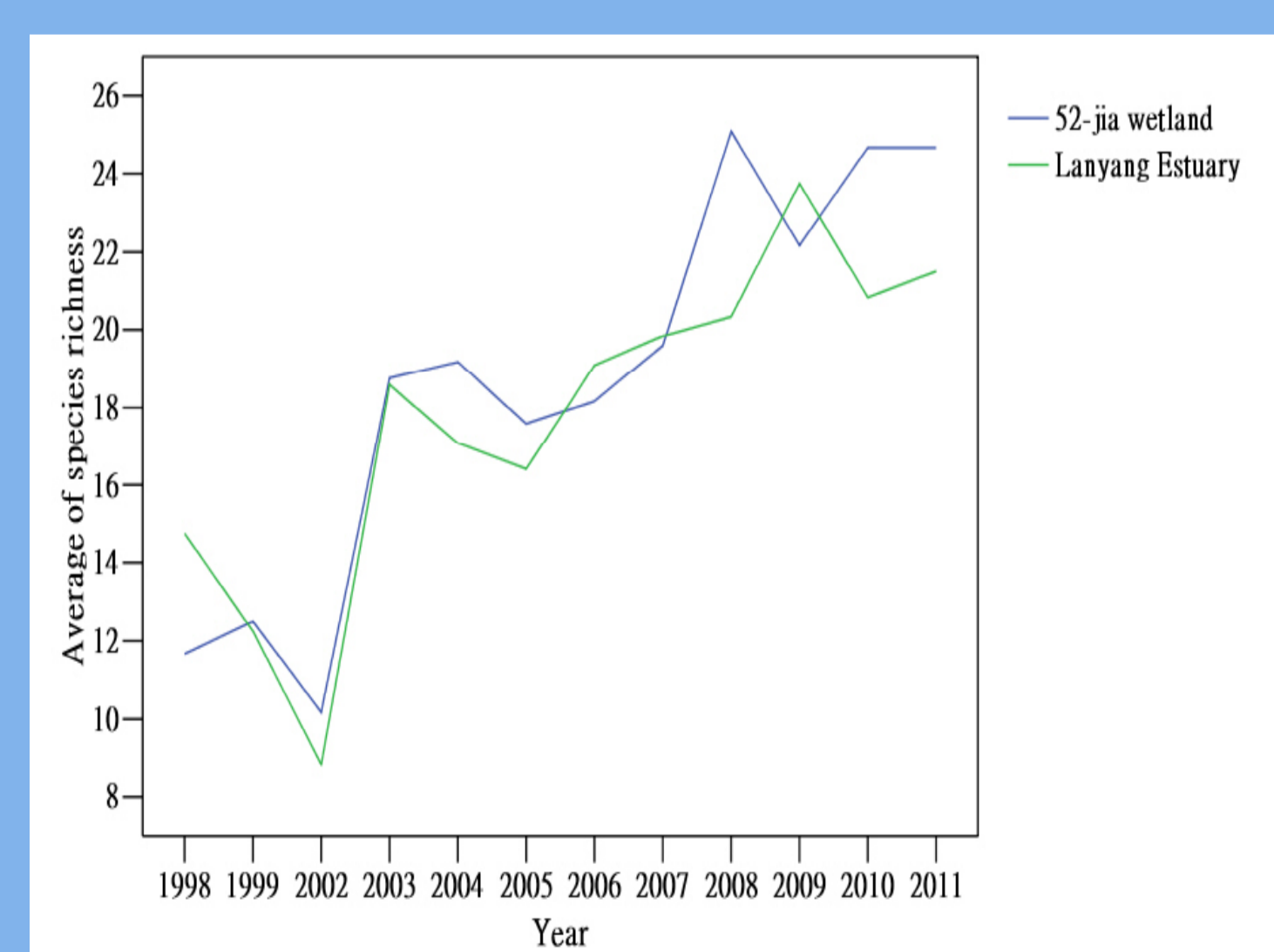
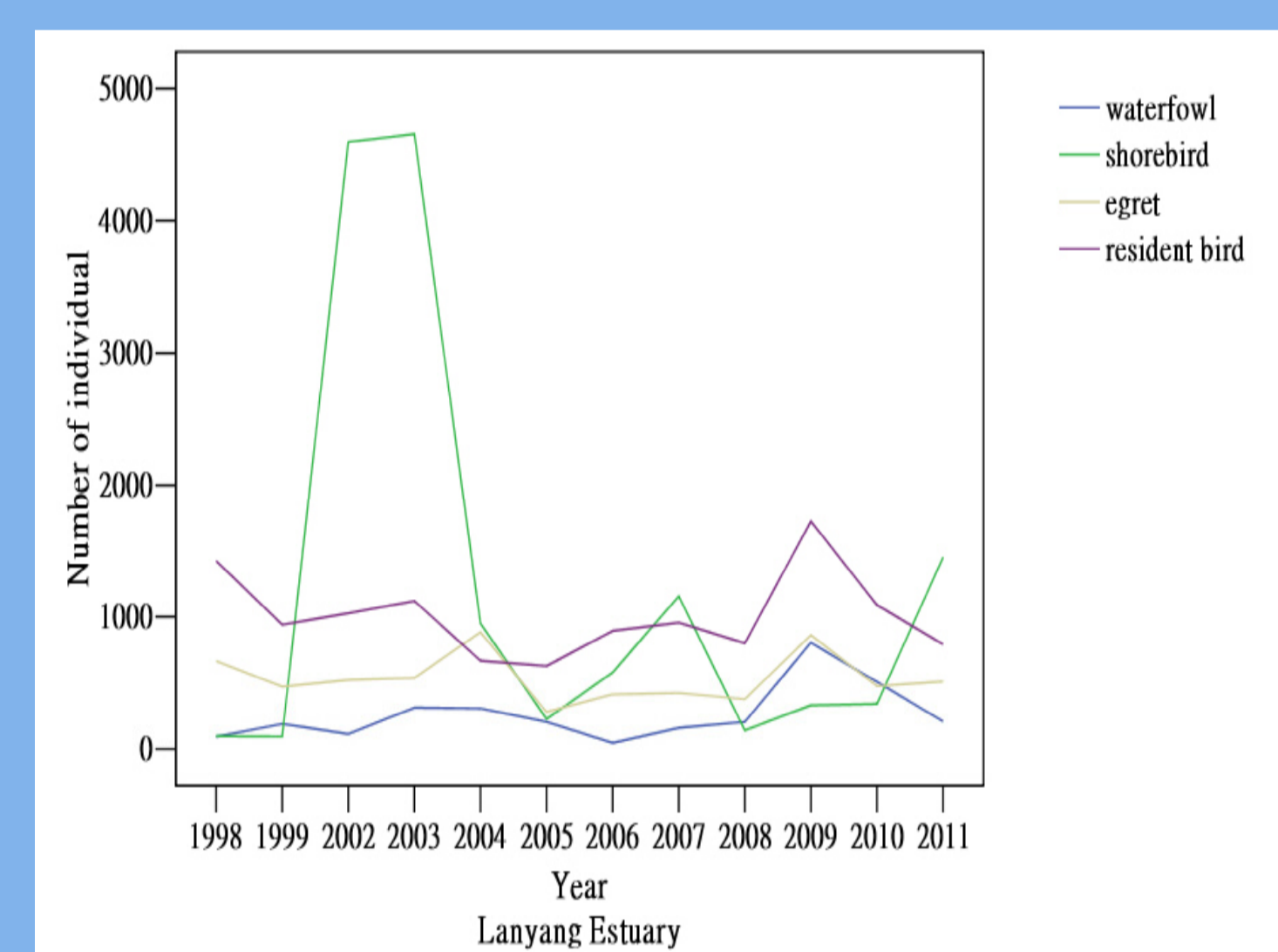
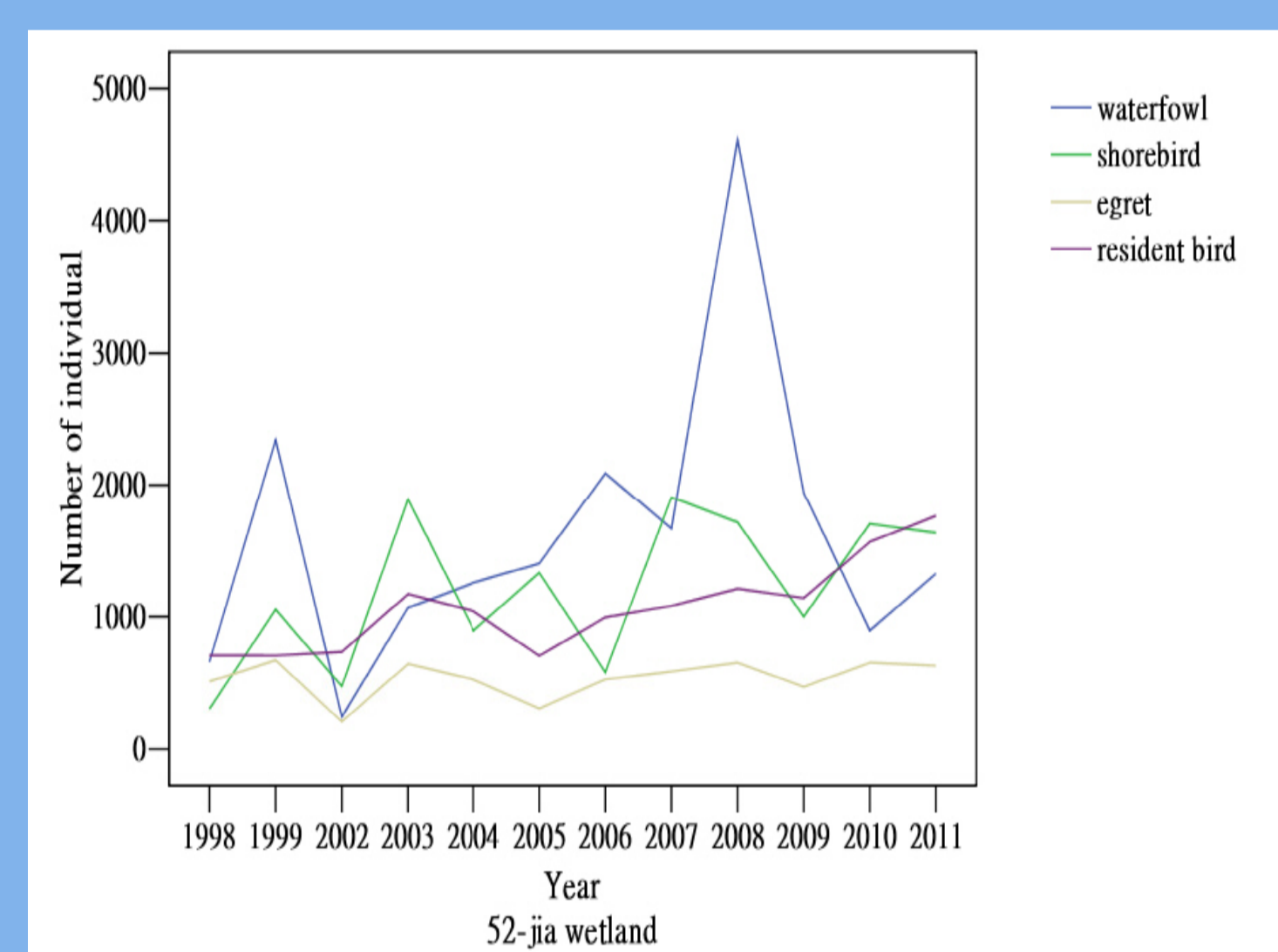
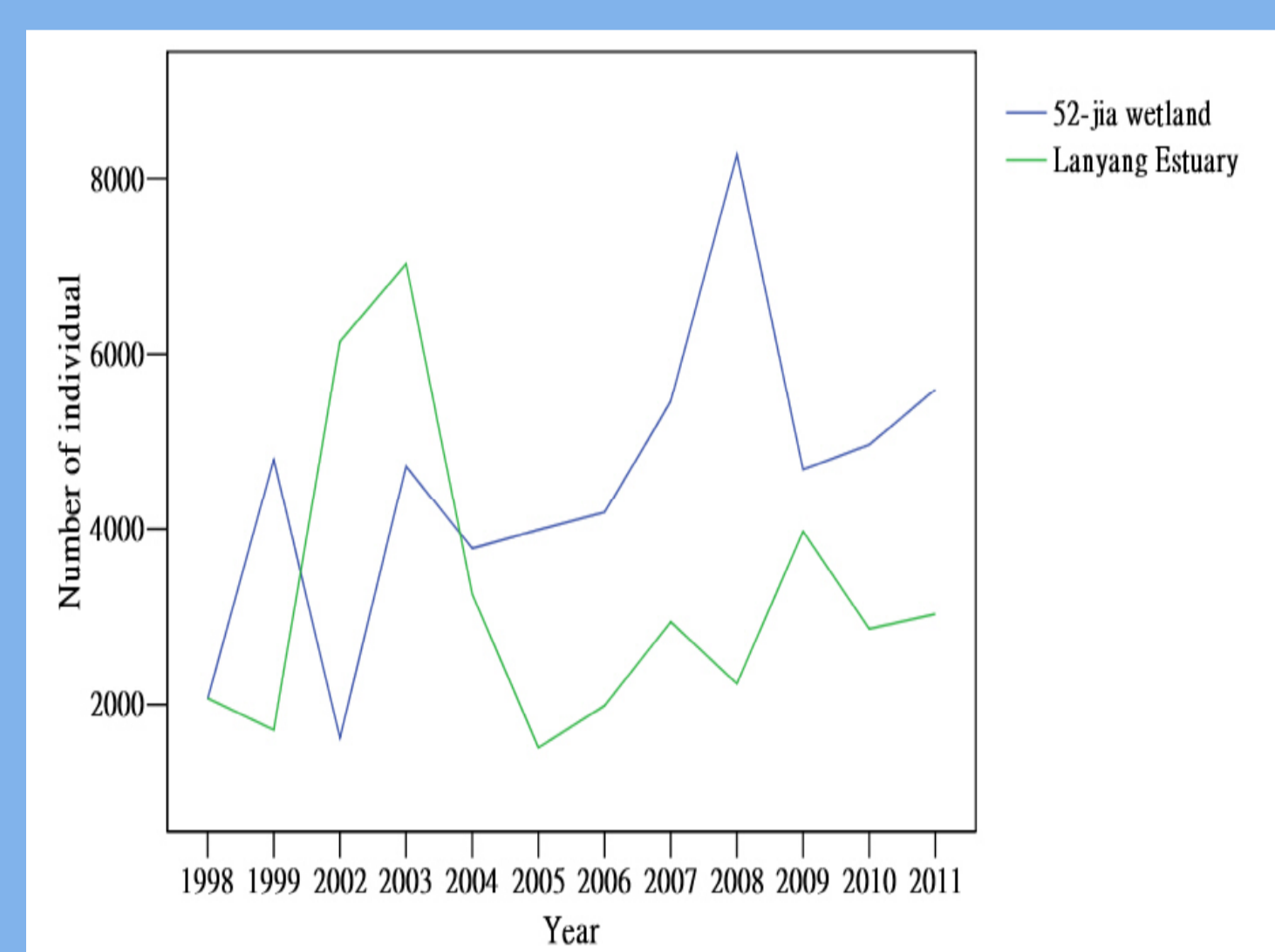
## Methods

- The study was carried out from January 1998 to August 1999 and from June 2002 to December 2011, long enough to investigate the impact of climate fluctuation. Climate change provided the environmental setting for these wetland birds studies.
- We surveyed 52 inland national wetlands and national wetlands in Lanyang Estuary, I-lan County, northeastern Taiwan. I-lan is characterized by high average annual rainfall (2839.9 mm) and paddy coverage. We used the precipitation data from the nearest weather station in I-lan, to examine average monthly precipitation for 1936-2011, average monthly precipitation, from September to November. The rainy season, from September to October, is also the major typhoon season in Taiwan. Typhoon and the northeasterly monsoon are the two major weather systems that generate most rainfall in I-lan Taiwan. 2007-2009 rainfall during autumn (September and October) was relatively high, precipitation decreased abruptly in 2002-2003, with extremely low autumn precipitation recorded.

## Results

### 1. Bird Diversity among Habitats

- A total of 155 species of birds in 36 families were recorded from the study sites. The bird populations in the 52 inland wetlands and the estuarine wetlands exhibited obvious fluctuations. The shorebirds *Charadrius alexandrinus* and *Pluvialis fulva* were the most abundant in Lanyang Estuary (2002, 2003). The dominant species in the 52 wetlands were shorebirds and waterfowl (*Anas crecca*, and *Anas poecilorhyncha*) that were less abundant in summer each year.
- Bird species richness didn't exhibit significant differences among habitat types (GLM  $F_{1,242}=0.302$ ,  $P=0.583$ ). Species richness of birds recorded per survey were significantly different among years (GLM  $F_{10,242}=8.690$ ,  $P=0.008$ ). Data analysis showed a pronounced increase in species richness during 1998 to 2011, including migratory birds and resident birds. The numbers of birds recorded were not significantly different between the two habitats (GLM  $F_{1,308}=3.718$ ,  $P=0.55$ ) but were significantly different among years (GLM  $F_{13,308}=2.553$ ,  $P=0.002$ ). Bird abundance of Lanyang Estuary was highest in 2002 and 2003, and abundance in the 52 wetlands was highest in 2008.



### 2. Consistency among Survey Times

- We compared two sites based on habitat conditions and feeding guilds in our survey, including the categories waterfowl, shorebirds, egrets, and resident birds, to assess community composition fluctuations over time.
- In Lanyang Estuary, the total number of individuals recorded were significantly different among years (GLM  $F_{13,616}=5.857$ ,  $P=0.000$ ) and significantly different among categories (GLM  $F_{3,616}=3.616$ ,  $P<0.05$ ).
- Total number of individuals in the 52 inland wetland were significantly different among years (GLM  $F_{13,616}=6.386$ ,  $P<0.05$ ) and among categories (GLM  $F_{3,616}=10.094$ ,  $P<0.05$ ).
- In Lanyang and the 52 inland wetlands, estimates of wetland birds were not consistent from 1998 to 2011. However, data of 52 inland wetlands showed that the percentages of waterfowl and shorebirds were considerable higher.



The landscape of 52-jia wetland (04.10.2010)



52-jia rice paddy (05.02.2011, 52-jia wetland)



*Platalea minor* (06.05.2011, Lanyang Estuary)



*Anas crecca* (03.02.2012, 52-jia wetland)



*Vanellus vanellus* (01.01.2010, 52-jia wetland)



*Gallinago gallinago* (02.12.2011, 52-jia wetland)

## Discussion

- The critical objective for wetland bird conservation in I-lan County for the next decade is to maintain the rice-growing cultural landscape. The main goal of restoration is to link the sustainable use of wetlands to human well-being. The 52 inland wetland cultural landscape is shaped mainly by rice cultivation. Consequently, wetland birds and their habitats are closely linked to human life and culture. Traditional paddy field landscape provides important habitats for many wetland bird species while increasing nutrient retention and forage. Today there is great demand in I-lan County and throughout Taiwan for approaches such as reconnecting rice paddles and restoring wetlands that allow rice farmers to practice traditional agriculture without deteriorating the ecological value of natural habitats.