Waterbirds and their Habitat Utilization of Artificial Wetlands at Dianchi Lake: Implication for Waterbird Conservation in Yunnan–Guizhou Plateau Lakes

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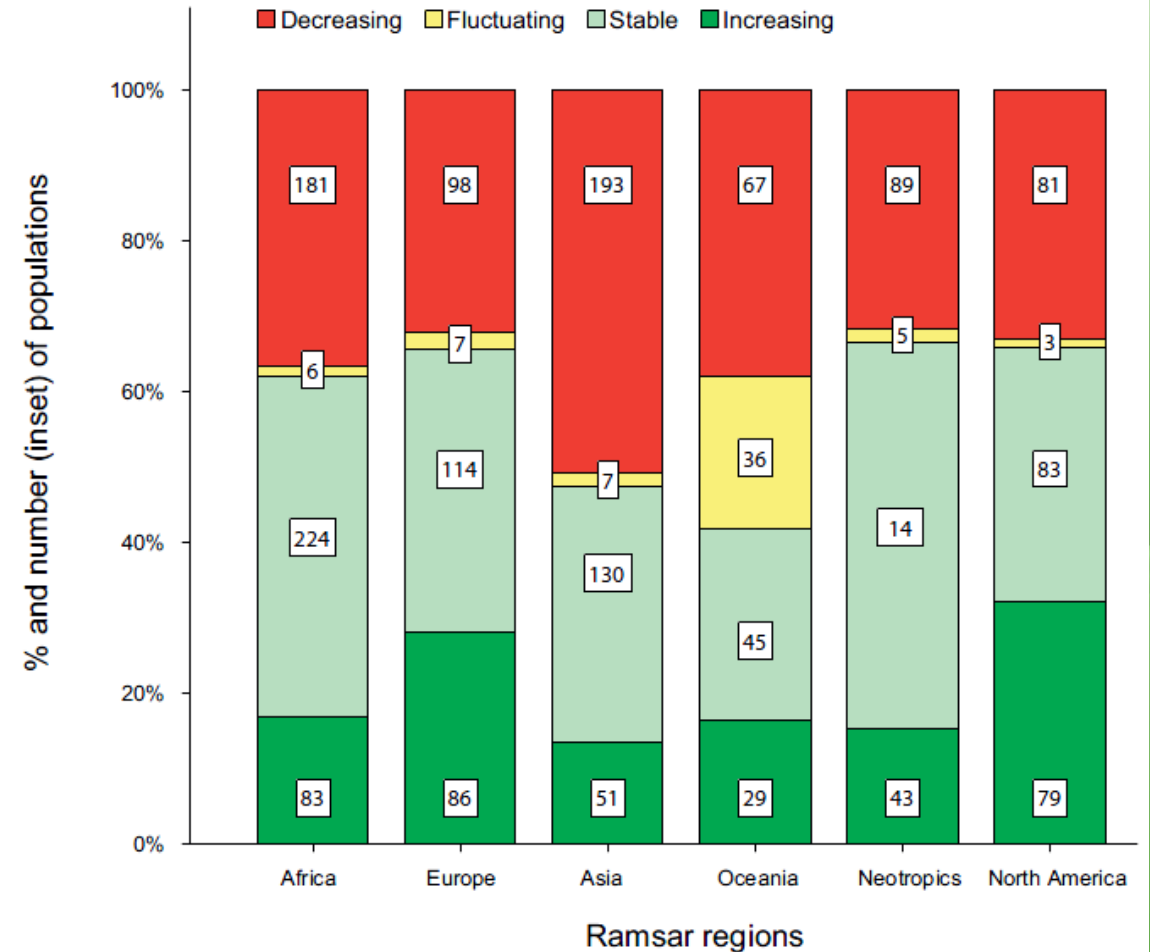Kunming Institute of Zoology, CAS

2016.10.10

(1) Status of the wetlands and waterbirds in the world

•Solution

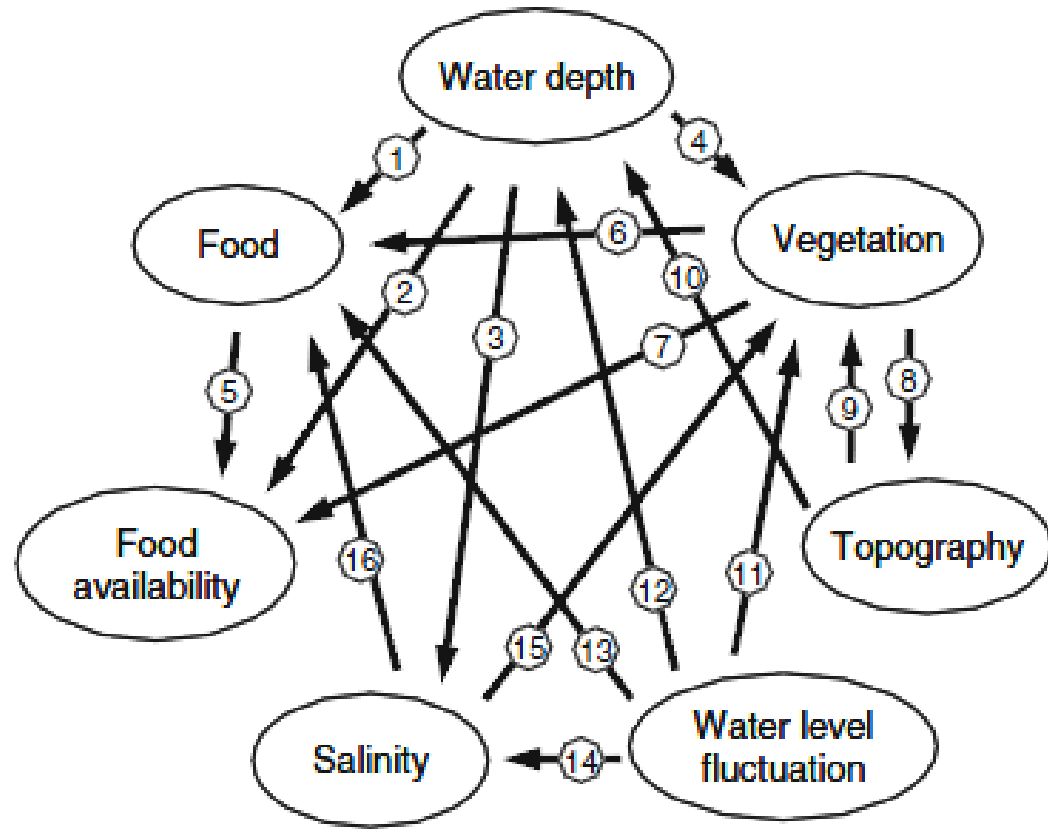(1) Natural wetland conservation or restoration

(2) Artificial wetland construction

China: increased by *c* 122% between 1978 and 2008

([Wetlands International 2012](#))

(2) Habitat variables

Interactions between the major habitat variables affecting habitat use of waterbirds at wetlands in situ(Ma et al.,2010)

However

The variation in habitat requirements among waterbird species and groups suggests that wetland management must be based on the **region-specific** knowledge about waterbird communities, including the species and their abundances and habitat requirements.

(3) Waterbird studies in China
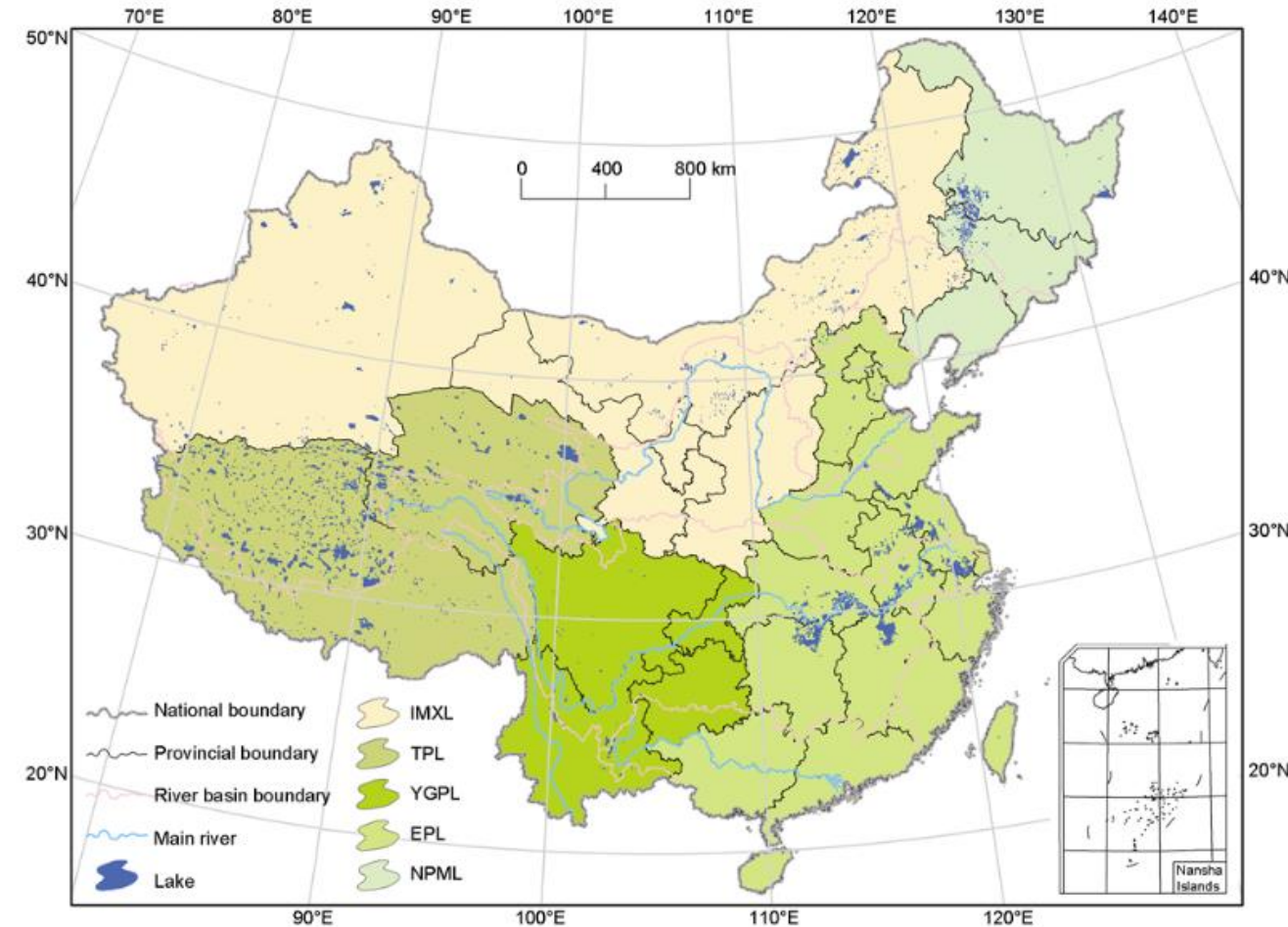
• **Hotspots**

Lower reaches of the Yellow River, Yangtze River and the coastal wetlands.

Such as **Chongming Island, Fujian Coast, Yellow River Delta…**

• **Yunnan–Guizhou Plateau**

Prejudice: wintering place: for geese, ducks, gulls, cranes and storks

Annual waterbirds composition:
poorly understood

Present spatial distribution of Chinese lakes (Ma et al., 2011).

(4) Specialty of Yunnan–Guizhou Plateau Lakes

Wetland ecosystems are fragile

▲ Lie in mountainous area
▲ Formed by faulting
▲ Lakeside narrow and frequently disturbed by human activities
▲ Heavily polluted

- Artificial wetlands: mainly for water purification by planting macrophytes

- However, how waterbirds respond to this strategy is largely unknown.

○ To implement waterbird management and conservation, it is essential to first ascertain the particular habitat requirements of different waterbird assemblages and address related issues.

○ A better understanding of the annual species composition and habitat utilization of waterbirds in the Yunnan–Guizhou Plateau may inform the integral protection of waterbirds on the East Asian-Australasian Flyway.

(5) Objectives of this study

(1) to survey the annual waterbird composition in order to test whether Dianchi Lake can supply habitats for different seasonal waterbirds;

(2) to test whether waterbird composition differs among different types of artificial wetlands around Dianchi Lake, and to find the potentially valuable type(s) of wetlands for waterbird conservation in Yunnan–Guizhou Plateau lakes.

(1) Study site and samples
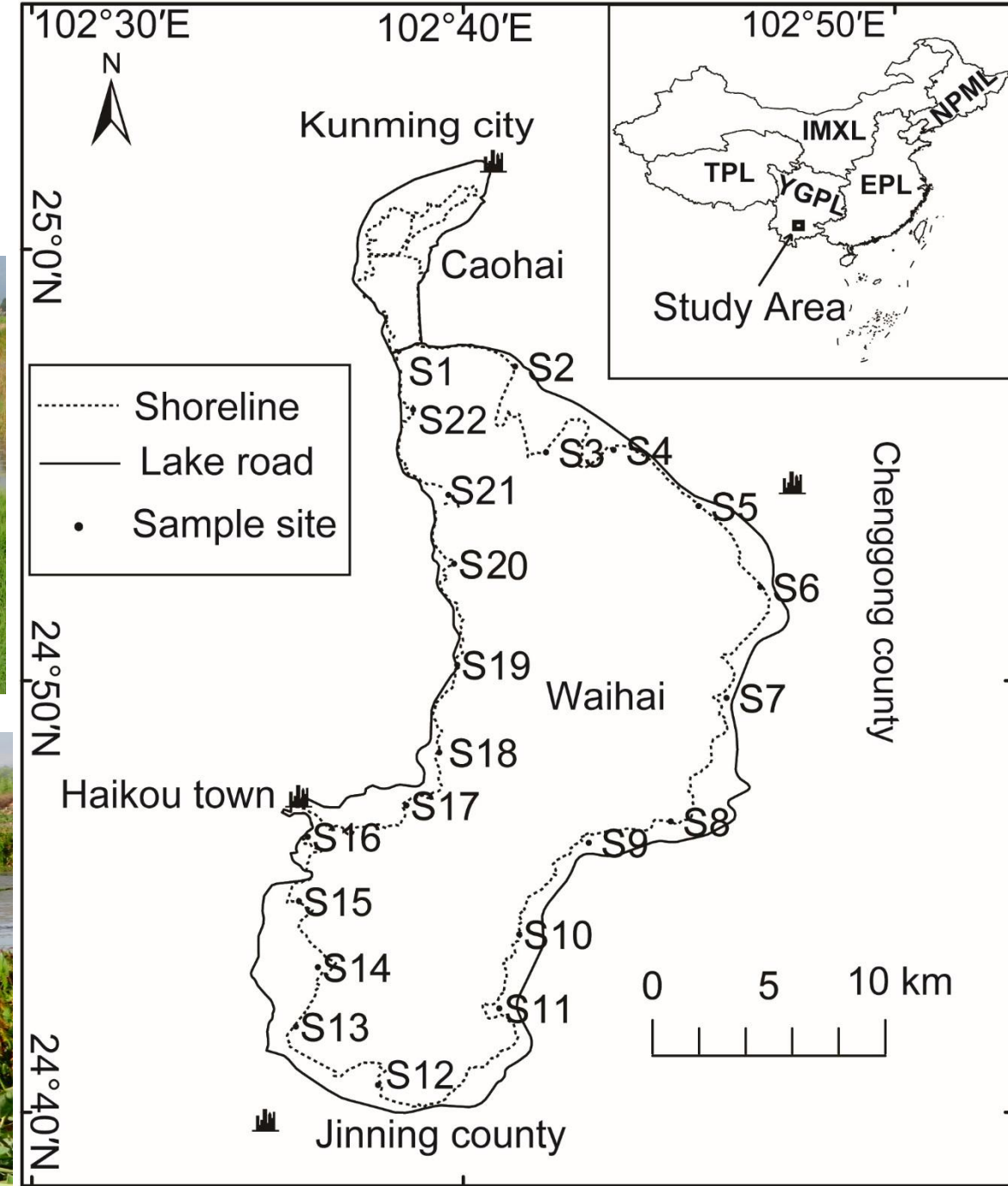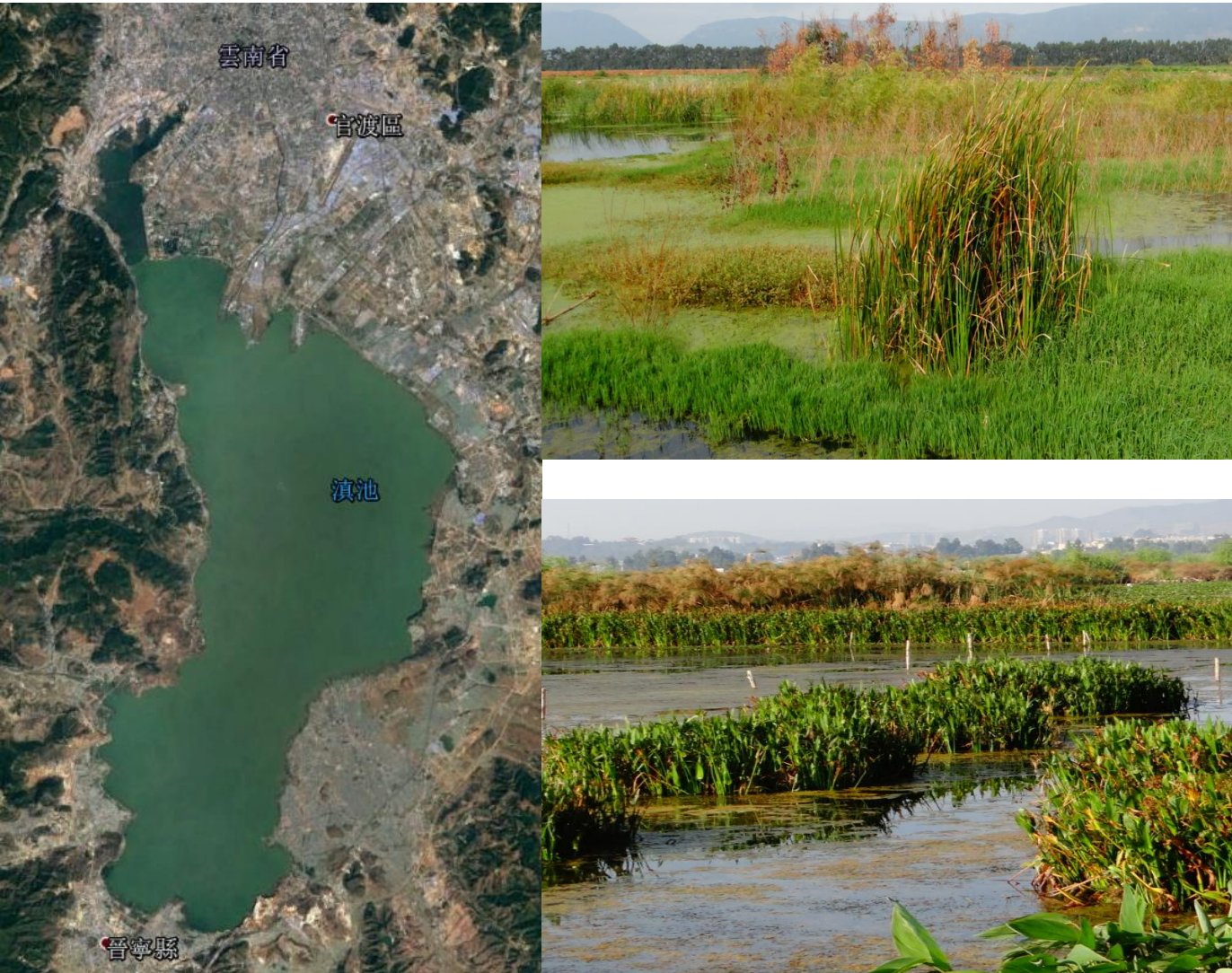
(2) Habitat classfication

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Classification of wetland types

Wetland types	Main vegetation	Height (cm)	Coverage (%)	Representative plants
Pond				Open water (%) >75
Mudflat				Bare land with water. All were formed by temporary construction workyards.
HE	Reed	> 50	≥25	*Phragmites australis*, *Acorus calamus*, *Typha angustata*, *Zizania latifolia*
LE	Wet grassland	≤50	≥25	*Paspalum scrobiculatum*, *Alternanthera philoxeroides*, *Myriophyllum aquaticum*
HF	Water hyacinth	>20	≥25	*Eichhornia crassipes*, *Nymphaea tetragona*
LF	Duckweed	≤20	≥25	*Lemna minor*, *Azolla imbricata*, *Pistia stratiotes*
Mix	Has two or more vegetation types, and each area of the type is no less than 5%. The total area of all vegetations is no less than 25%.			

HE: High emerging plants; LE: Low emerging plants; HF: High floating plants; LF: Low floating plants; Mix: Mixed vegetation. Coverage (%) is the vegetation area percent in the wetlands.

(3) Waterbird Surveys

• *Waterbirds counts*

Lakebody: "look-see" counting method

Lakeside: spot-map census method

• *Survey schedules:* 36 surveys

Three times each month (early, middle, and late) from March 2013 to February 2014

(4) Statistical Analysis

• *Waterbirds composition*

Abundance :maximum number.

• *Artificial habitat utilization by waterbirds*

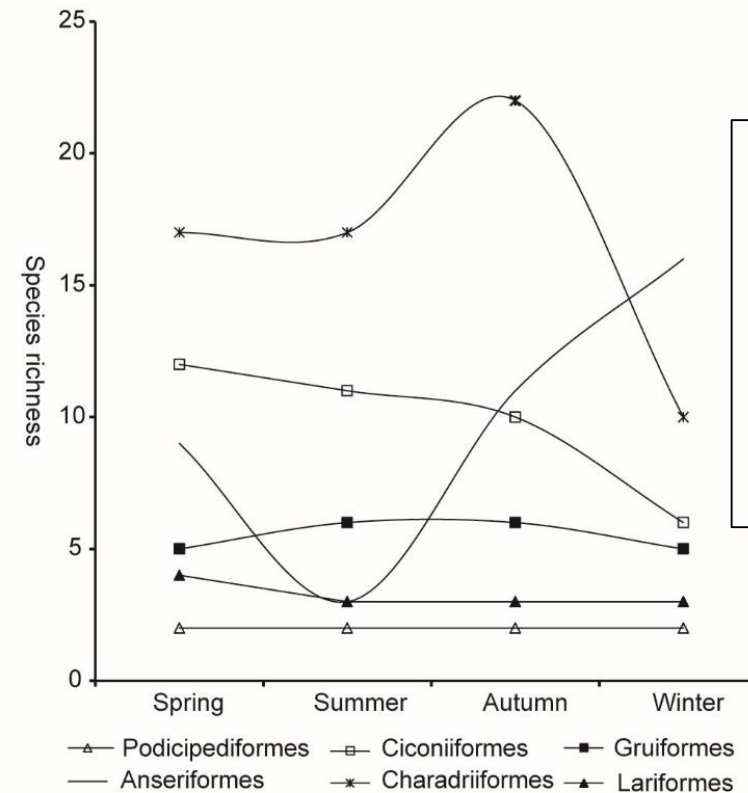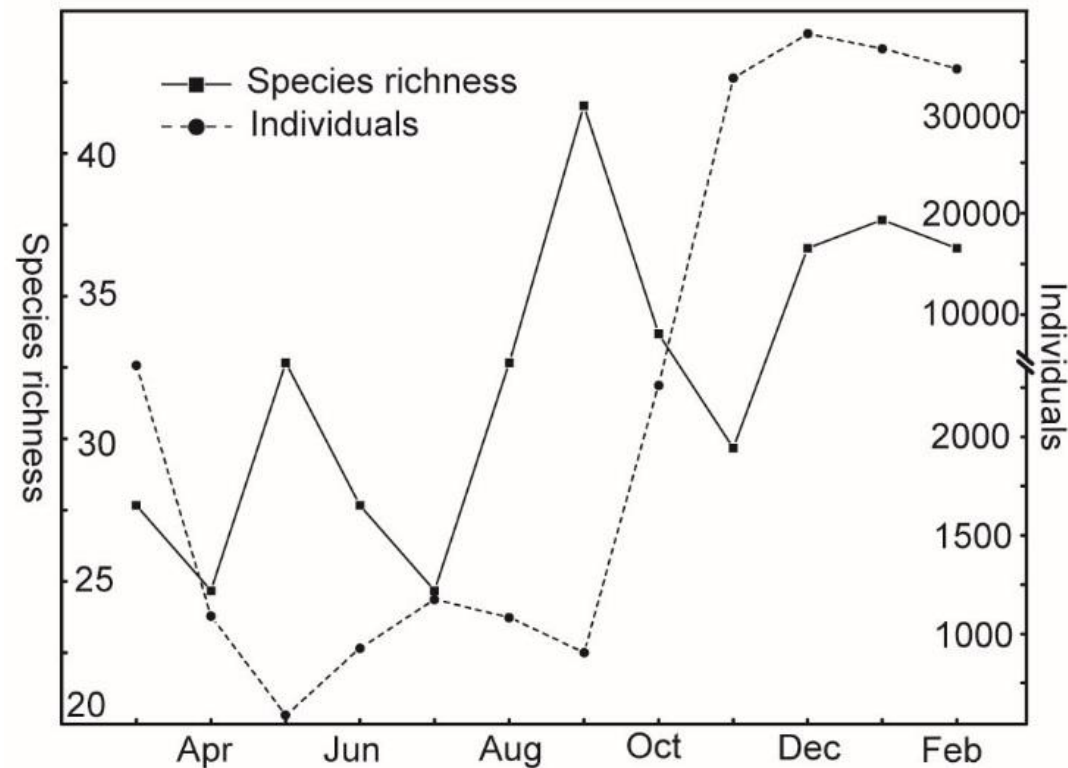Similarity analysis: Bray–Curtis association measurement

Differences: PERMANOVA

(1) Waterbirds composition

▲Podiciped: 2; Lar: 5 ; Gru: 8; Ciconi: 13 ;Anser: 17 ; Charadri: 29.　**Total: 74 species**

▲Breeding: 6 (21.6 %) ; Migrant: 27 (36.5 %); Winter: 29 (39.2 %); Accidental visitor: 2 (2.7%).

Implication:
Dianchi Lake could act as a waterbird breeding, stopover, and wintering site.

(2) Differences of waterbird community among 7 habitats

SIGNIFICANT Difference in:

Total Species richness (Pseudo-F=4.733, P=0.001)
Total Density (Pseudo-F=7.83, P=0.001)

No Difference in:
△Mix and LE
Species richness: Pseudo-F=0.99, P=0.34
Density :Pseudo-F=1.76, P=0.14
△ LF and Pond
Species richness: Pseudo-F=1.02, P=0.35
Density : Pseudo-F=0.05, P=0.995
△ HE and HF
Species richness: Pseudo-F=2.95, P=0.059
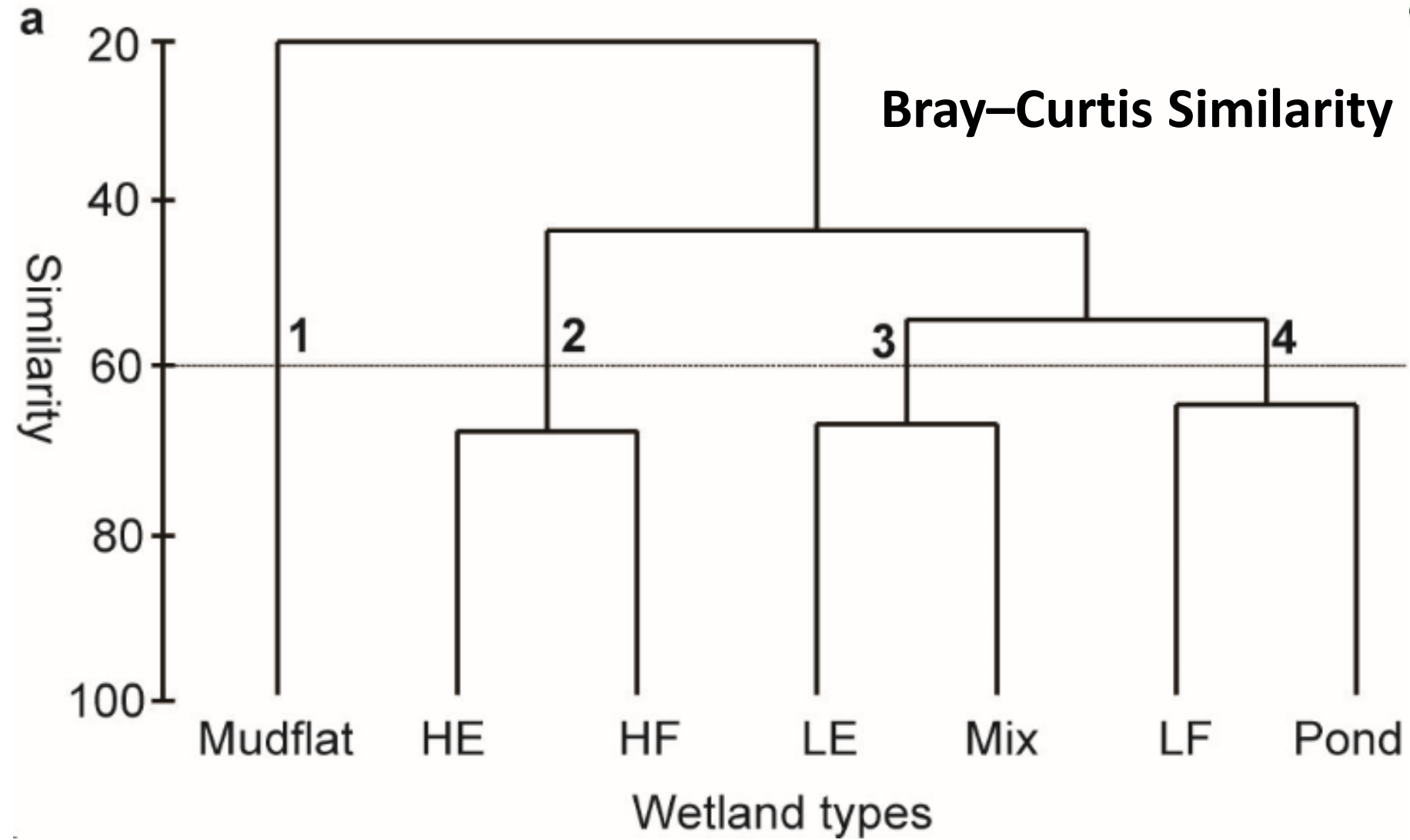Density : Pseudo-F=1.28, P=0.256
△ Mudflat
SIGNIFICANT Different from other

Test for significant differences of species richness (below left) and density (square-root transformed, above right) among wetland types using PERMANOVA

	HE	HF	LE	LF	Mix	Mudflat	Pond
HE		1.28	18.73	8.56	35.89	3.50	11.25
		0.256	0.001 ***	0.004 **	0.001 ***	0.044 *	0.001 ***
HF	2.95		11.15	5.71	24.30	2.50	7.53
	0.059		0.002 **	0.004 **	0.001 ***	0.073	0.004 **
LE	26.74	15.13		2.55	1.76	2.17	3.51
	0.001 ***	0.001 ***		0.07	0.145	0.114	0.032*
LF	2.74	0.98	9.13		4.92	2.03	0.05
	0.066	0.381	0.001 ***		0.005 **	0.117	0.995
Mix	33.71	20.32	0.99	12.58		5.20	6.92
	0.001 ***	0.001 ***	0.343	0.001 ***		0.008 **	0.002 **
Mudflat	62.69	46.19	9.15	32.40	5.24		3.18
	0.001 ***	0.001 ***	0.011 *	0.001 ***	0.028 *		0.036 *
Pond	5.93	2.68	6.87	1.02	9.90	27.40	
	0.007 **	0.043 *	0.002 **	0.35	0.001 ***	0.001 ***	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 ' ' 1

Bray–Curtis Similarity

(3) Habitat utilization by waterbirds

Mean species richness (± SE) among different wetland types

(a) Species richness

	Wetland types (n)							Mean
	HE (55)	LE (19)	HF (38)	LF (25)	Mudflat (3)	Pond (25)	Mix (15)	
All Birds	1.75(0.35)	8.11(1.40)	2.47(0.42)	2.76(0.55)	12.00(4.36)	4.36(0.81)	10.87(2.21)	4.01(0.38)
Podicipediformes	0.25(0.06)	0.63(0.11)	0.13(0.06)	0.60(0.10)	0.00(0.00)	0.68(0.10)	0.93(0.12)	0.43(0.04)
Ciconiiformes	0.58(0.15)	3.00(0.45)	1.29(0.26)	1.12(0.31)	1.00(0.58)	1.32(0.24)	4.20(0.60)	1.47(0.14)
Gruiformes	0.76(0.14)	1.53(0.21)	0.82(0.17)	0.76(0.14)	0.33(0.33)	1.40(0.23)	2.27(0.34)	1.06(0.08)
Charadriiformes	0.13(0.07)	2.53(0.76)	0.11(0.05)	0.16(0.07)	10.00(3.79)	0.48(0.32)	2.93(1.18)	0.83(0.18)
Anseriformes	0.00(0.00)	0.16(0.09)	0.03(0.03)	0.04(0.04)	0.33(0.33)	0.12(0.09)	0.47(0.22)	0.09(0.03)
Lariformes	0.02(0.02)	0.16(0.09)	0.13(0.06)	0.08(0.06)	0.33(0.33)	0.28(0.11)	0.13(0.09)	0.12(0.03)

n: Number of patches.

Results

Mean waterbird density (birds/ha) (square-root transformed) (±SE) among different wetland types

(b) Density

	Wetland types (n)							Mean
	HE (55)	LE (19)	HF (38)	LF (25)	Mudflat (3)	Pond (25)	Mix (15)	
All Birds	2.19(0.44)	8.07(1.60)	2.77(0.61)	5.82(1.12)	3.82(1.28)	5.71(0.88)	10.10(1.29)	4.61(0.38)
Podicipediformes	0.51(0.15)	1.97(0.48)	0.44(0.25)	2.82(.064)	0.00(0.00)	3.02(0.60)	3.11(0.60)	1.53(0.18)
Ciconiiformes	0.88(0.22)	4.89(0.96)	1.65(0.39)	2.05(0.52)	0.56(0.33)	2.09(0.40)	4.07(0.45)	2.06(0.20)
Gruiformes	1.63(0.36)	4.87(1.10)	1.50(0.43)	3.45(0.97)	0.60(0.60)	3.29(0.69)	7.59(1.24)	2.91(0.30)
Charadriiformes	0.11(0.06)	1.88(0.70)	0.20(0.12)	0.14(0.07)	3.66(1.17)	0.21(0.10)	1.21(0.46)	0.48(0.10)
Anseriformes	0.00(0.00)	0.20(0.12)	0.04(0.04)	0.04(0.04)	0.10(0.10)	0.19(0.13)	0.99(0.70)	0.15(0.06)
Lariformes	0.02(0.02)	0.80(0.47)	0.27(0.14)	0.22(0.17)	0.22(0.22)	0.58(0.28)	0.11(0.08)	0.27(0.08)

n: Number of patches.

Summary

▲ All orders:

Species richness / density : Mix, LE and Mudflat $>$ the remainder four types

▲ **Mix / LE** :Highest species richenss and density of 4 order:

Podiciped., Ciconi., Gru. and Anser. Also, LE held highest density for Lar.

▲**Mudflat**: Highest species richenss and density of Charadri. Highest species richenss for Lar.

▲**LF/Pond**: Second-lowest for both species richness.

▲**HE /HF**: Lowest for both species richness and density.

- (1) Waterbirds composition

Historical data on species richness of Lake Dianchi, China.

Literature	Survey time	Region	Species richness
Yang *et al.* (1988)	1984, winter	whole	17
Han *et al.* (2000)	1997.10-1998.5	West part	26
Wu *et al.* (2008)	2007.1-2007.4	Caohai	20
Luo (2014)	2011.10-2013.11	whole	67
This study	2013.3-2014.2	whole	74

- (2) Regional-specific
- (3) Habitat utilization was highly related to vegetation height
- (4) Mudflat are occasional and temporary

Conclusion

- Management of Yunnan–Guizhou Plateau lakes should take the requirements of **different seasonal** waterbirds into consideration.

- **Mixed** vegetation and **low** emerging plant wetlands, as well as **mudflats,** are crucial for satisfying the particular habitat requirements of various waterbirds using the lakeside artificial wetlands of the Yunnan–Guizhou Plateau lakes.
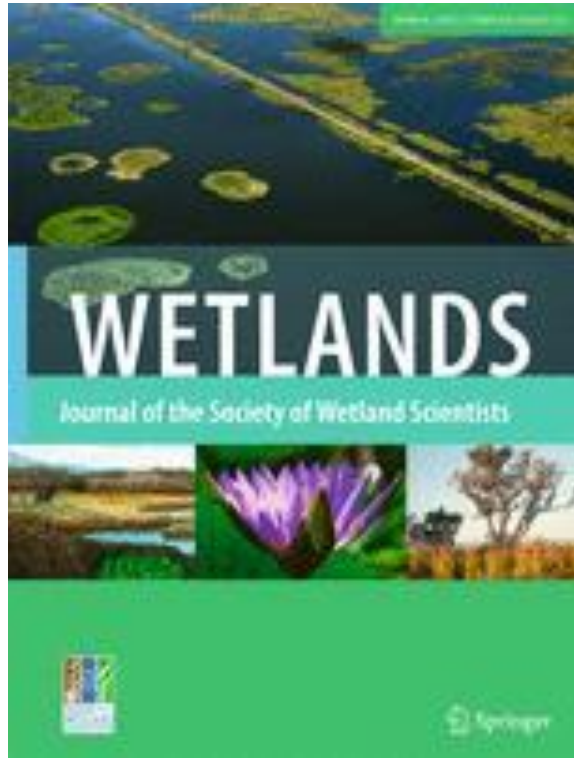
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Waterbirds and their Habitat Utilization of Artificial Wetlands at Dianchi Lake: Implication for Waterbird Conservation in Yunnan–Guizhou Plateau Lakes

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