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Rapid range expansion of Asian Openbill *Anastomus oscitans* in China

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Introduction

Range expansions have been documented in many avian studies (e.g. Newton 2008). Most studies have demonstrated that numerous species are spreading to higher latitudes or higher altitude areas (Burton 1995, Pounds *et al.* 1999, Walther *et al.* 2002, Hitch & Lebus 2007, Sekercioglu *et al.* 2008, Thomas 2010). Such spatial spreads have usually been attributed to climate warming (Burton 1995, Davis & Shaw 2001, Pearson & Dawson 2003, Visser & Both 2005, Wu *et al.* 2012). Habitat change has also been indicated as the driving force in the range expansions of some species, e.g. Barred Owl *Strix varia* in North America (Livezey 2009).

There are only two species of openbill storks—Asian Openbill *Anastomus oscitans* and African Openbill *A. lamelligerus* (Kahl 1987). The Asian Openbill has a large range, including India (from Gujarat in the west to the Assam valley), Sri Lanka, south Nepal, Bangladesh, central Myanmar, Thailand, Cambodia and southern Vietnam in the east (BirdLife International 2015). Historically there are no records of the species from China (Yang 1995, MacKinnon *et al.* 2000, Zheng 2005). In 2006, the first Asian Openbill was recorded at Xihu wetland, Yunnan province, a small lake surrounded by paddyfields (Wang 2007). Since then, the species has expanded across a large area of south-west China (Jiang & Ning 2010, QL pers. obs. 2012, F. Li pers. comm. 2012). In this study, we report and review the distribution and population size of Asian Openbill in China. Our objectives are to document the habitat and range expansion of a tropical lowland species to subtropical high plateaus in China, and to discuss its possible causes.

Methods

We collected data on the distribution and status of the Asian Openbill from interviews and field surveys. We gathered records, primarily from the internet, in particular birdwatching forums, to get the basic distribution information. After collating this information, we contacted wildlife officers of the local forestry or wetland departments within the known and potential range. These officers were asked to provide information on the species in their area, including numbers, locations and observation dates, and to describe

the circumstances and habitat associated with any sightings. We also made rapid field surveys at Shangri-La county, Dali city and Puer city, all in Yunnan province, and Caohai Reserve, Guizhou province, between July and August 2012—in total 15 survey days—to verify the interview results, including locations, numbers and habitats (Zhang *et al.* 2006).

Results

Range expansion

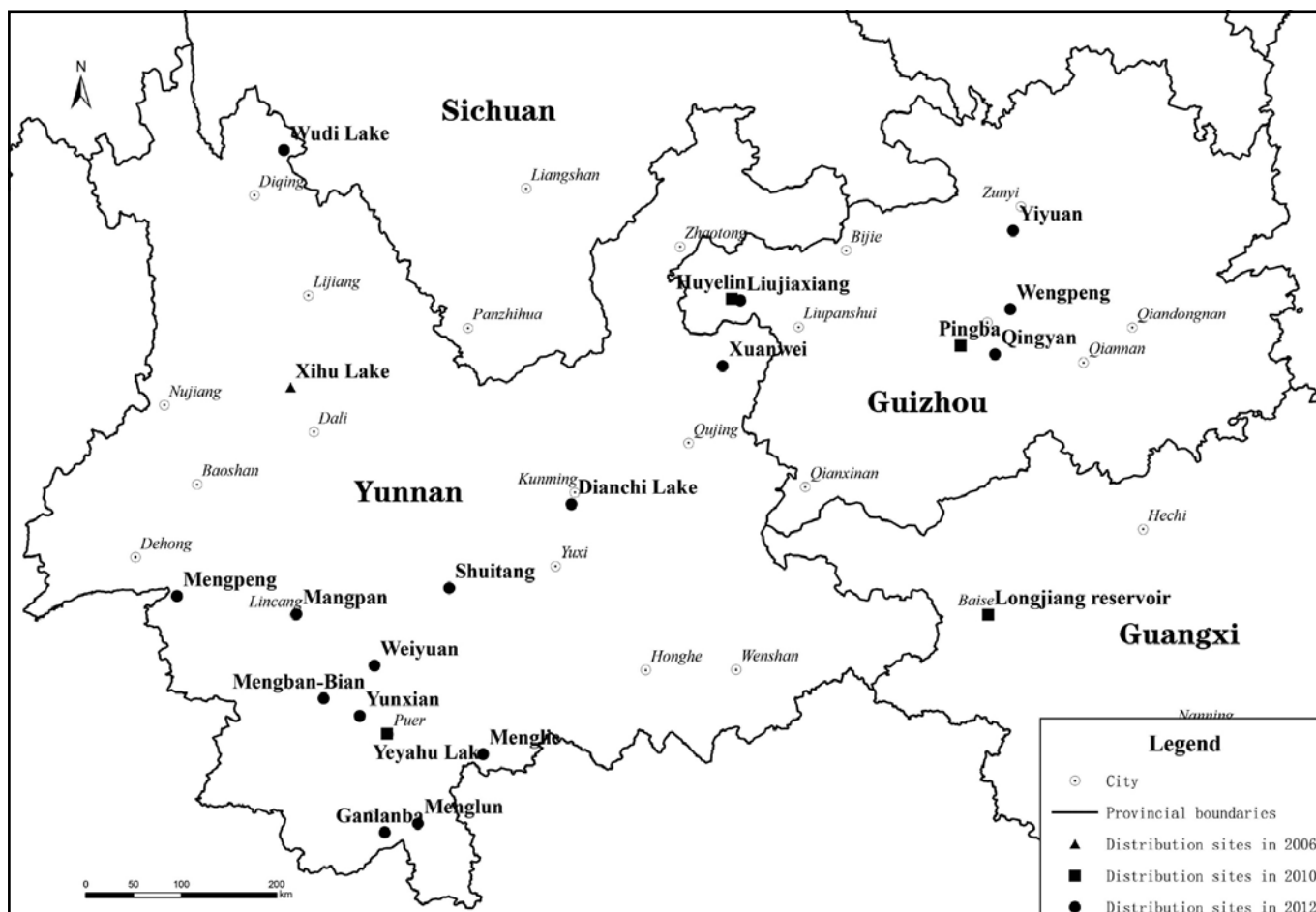
The first confirmed record of Asian Openbill in China was in October 2006 at Xihu wetland, Dali city, Yunnan province. There was no further record until 2010, when a single bird appeared at Caohai wetland and two in Pingba county, both in Guizhou province, one at Baise city, Guangxi province, and two at Puer city, Yunnan province. The Asian Openbill then rapidly spread to the cities of Lincang, Puer, Jinghong, Dali, Kunming and Yuxi, all in Yunnan province, and Guiyang city, Zunyi county, and Weining county, both in Guizhou province (Figure 1; Table 1), in 2012. The largest flock of this species consisted of up to 200 individuals (Table 1). Six years since its first recorded appearance in China, the Asian Openbill has spread quickly through three provinces and across an area of about 421,000 km². The core areas were Mengpeng, Mengban-Bian, Yunxian and Menglie in south-west Yunnan province. The lowest and highest altitude sites, respectively, were Longjiang Reservoir, Baise city (130 m) and Wudi Lake, Shangri-La county (3,840 m).

Behaviour

We observed that the Asian Openbill roosted colonially at night in tall trees, mostly pines, but sometimes on branches of dead poplars. During our 15 survey days, the species foraged in paddyfields (52%), reservoir-paddyfields (32%), lakeside marshland (9%) and river-paddyfield (7%). Asian Openbill mostly foraged in flocks in the paddyfields and fed mainly on large snails and freshwater mussels, especially Chinese mystery snail *Cipangopaludina chinensis*, river snail *Bellamya aeruginosa* and Chinese pond mussel *Anodonta woodiana*. Asian Openbill fed in flocks with other wading species

Table 1. Site details of Asian Openbill records in China (October 2006 to August 2012)

Localities	Latitude	No. of birds	Habitat	Altitude (m)	Date
Xihu Lake, Eryuan county, Yunnan province	26.020°N 100.04°E	1	Lakeside marshland	1,972	October 2006
Yeyahu Lake, Puer city, Yunnan province	22.774°N 100.955°E	2	Lake-paddyfield	1,303	December 2010
Longjiang reservoir, Baise city, Guangxi province	23.893°N 106.623°E	1	Reservoir-paddyfield	130	October 2010
Pingba village, Pingba county, Guizhou province	26.413°N 106.365°E	2	Reservoir-paddyfield	1,246	September 2010
Huyelin village, Weining county, Guizhou province	26.852°N 104.205°E	1	Lakeside marshland	2,172	December 2010
Mangpan village, Lincang city, Yunnan province	23.897°N 100.100°E	20	Paddyfield	1,470	April 2012
Mengglun village, Mengla county, Yunnan province	21.936°N 101.246°E	14	River-paddyfield	563	April 2012
Mengpeng village, Zhenkang county, Yunnan province	24.065°N 98.973°E	80	Paddyfield	1,029	April 2012
Dianchi Lake, Kunming city, Yunnan province	24.927°N 102.695°E	30	Lakeside marshland	1,892	May 2012
Mengban-Bian village, Jinggu county, Yunnan province	23.107°N 100.358°E	200	Paddyfield	1,160	May 2012
Yunxian village, Puer city, Yunnan province	22.945°N 100.696°E	100	Reservoir-paddyfield	1,131	May 2012
Ganlanba village, Jinghong city, Yunnan province	21.852°N 100.933°E	30	River-paddyfield	543	June 2012
Menglie village, Jiangcheng county, Yunnan province	22.586°N 101.860°E	60	Reservoir-paddyfield	1,122	June 2012
Weiyuan village, Jinggu county, Yunnan province	23.416°N 100.837°E	6	Paddyfield	1,234	July 2012
Wudi Lake, Shangri-La county, Yunnan province	28.245°N 99.981°E	1	Lakeside marshland	3,840	July 2012
Xuanwei village, Yunnan province	26.223°N 104.120°E	40	Reservoir-paddyfield	1,962	July 2012
Shuitang village, Xiping county, Yunnan province	24.138°N 101.535°E	24	River-paddyfield	600	August 2012
Qingyan village, Guiyang city, Guizhou province	26.333°N 106.689°E	5	Paddyfield	1,054	April 2012
Wengpeng village, Guiyang city, Guizhou province	26.753°N 106.833°E	1	Paddyfield	1,278	May 2012
Yiyuan village, Zunyi county, Guizhou province	27.490°N 106.858°E	14	Paddyfield	894	May 2012
Liujiaxiang village, Weining county, Guizhou province	26.834°N 104.287°E	24	Lakeside marshland	2,181	August 2012

Figure 1. Range expansion of Asian Openbill in China in 2006, 2010 and 2012.

such as Cattle Egret *Bubulcus ibis*, Little Egret *Egretta garzetta*, Great Egret *Casmerodius albus* and Grey Heron *Ardea cinerea*.

Discussion

Range expansion of Asian Openbill in south-west China followed a south-west to north-east chronology. At the beginning, records were intermittent and of only one or two individuals. However, in 2012 Asian Openbills spread rapidly across Yunnan and Guizhou

provinces, although the distribution pattern was not random or uniform but clumped. The main population occurred in south-west Yunnan province, near the borders with Myanmar and Vietnam.

The rapid spread of the Asian Openbill might be attributed to many factors. The species possesses many inherent characteristics which allow it to adapt to a range of ecological and environmental conditions. It is not a migrant, although some subpopulations shows strong dispersal tendencies (Ali 1959, 1963). Birds may

move widely in response to habitat conditions. Young birds also disperse widely after fledging. Individuals ringed at Bharatpur in India were recovered 800 km to the east and a bird ringed in Thailand was recovered 1,500 km to the west in Bangladesh (Ali & Ripley 1978). High mountains or plateaus usually serve as barriers to many species because of low air pressure and a harsh climate (Newton 2008). However, Asian Openbill showed a robust tolerance of changes in oxygen levels due to altitude, being sighted at heights in excess of 3,840 m on Hengduan Mountain, suggesting that it may have the potential to adapt to plateau environments.

Results of the Asian Waterbird Census clearly showed that Asian Openbill was undergoing a population increase (Wei *et al.* 2009): the maximum count between 1987 and 1992 was 21,030, but between 2003 and 2007 this increased sharply to 258,105. We have no explanation for the increase of Asian Openbill. However, it is likely this population explosion causes serious intraspecific competition and forces some individuals, especially in non-breeding flocks, to leave their native range and disperse to new areas.

It is likely that habitat degradation in the tropical lowlands of the Asian Openbill range is driving range expansion. For example, Inle Lake in Myanmar is an important habitat for Asian Openbills, but timber removal and increased pollution resulting from changing agriculture practices have degraded the lake (Su & Jassby 2000, Sidle *et al.* 2007).

In Thailand, where there has also been an explosive growth in the population of Asian Openbill, it is thought that this has been fuelled by the spread of irrigated rice, in tandem with the spread of the invasive Golden Apple Snail *Pomacea canaliculata*, on which the species feeds. (Round & Gardner 2008). Openbills have spread at least down to Singapore and north into Yunnan in the past 2–3 years. They are certainly now breeding at Chiang Saen Lake in the far north of Thailand and a great many other lowland areas throughout the country where there were absolutely none to be found until less than ten years ago (P. D. Round pers. comm.).

As the species is rapidly spreading rapidly into new areas, detailed information is still limited. In the future, research should be carried out to:

- track the species's movements using satellite-tracking devices;
- investigate habitat use or habitat selection by the species on the plateau and identify important factors for its survival;
- investigate the impact of the species on existing waterbird populations;
- model the species's distribution using ecological niche modelling, e.g. MaxEnt (Phillips *et al.* 2006). Climate warming plays an important role in the northward range expansion of some species (Cox & Moore 2010). The model can provide information about habitat suitable for the storks' survival and hence where they may occur in the future.

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