Functional use of Shengjin Hu National Nature Reserve, China, by three species of dabbling ducks – preliminary observations

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Abstract

Counts made at Shengjin Lake, China, in 2008/09 found internationally important numbers of Falcated Duck *Anas falcata* and nationally important numbers of Baikal Teal *Anas formosa* wintering at the site. Activity budgets showed that neither species fed at all during daylight hours in February, but that the large raft of ducks took to the air at dusk and flew to harvested rice fields to feed at night. Baikal Teal had departed the site by early April, whereas Falcated Duck activity budgets at this time showed the species remaining to forage in a series of feeding/loafing cycles on the lake during the day, having abandoned night-time feeding in the fields. In contrast, the more common and widespread Spot-billed Duck *Anas poecilorhyncha,* which also winters in the area, remained to feed on the lake throughout the day, although the possibility remains that they may also feed in fields if they leave the lake after dark. These findings confirm that the globally threatened Falcated Duck and globally vulnerable Baikal Teal derive a major part of their energy and nutrition from agricultural fields at Shengjin Lake National Nature Reserve in mid-winter, potentially putting them at risk of land-use change and pesticides in the vicinity. On the other hand, the gleaning of waste unharvested grain creates no agricultural conflict and offers opportunities for developing management agreements with farmers, which would provide a feeding resource for maintaining and enhancing stocks of these ducks wintering at the site.

Key words: *Anas falcata, Anas formosa, Anas poecilorhyncha,* feeding ecology, rice field feeding.

Effective management of protected areas requires a fundamental understanding of the range of functions that nature reserves fulfil for key species identified in the designation process. Indeed, an understanding of the way nature reserves support a species during critical periods in the annual cycle is fundamental to shaping the management planning process for such protected areas, by identifying priority key habitat features and management objectives (*e.g.* provision of adequate food stocks and refuge from disturbance) for particular species (Guillemain *et al.* 2002). Wintering waterfowl aggregate at large wetland complexes, but their exploitation of habitats may extend well outside the boundaries of such wetlands. For instance, in Europe and North America, wintering duck species frequently roost in large aggregations on wetlands during the day but fly out to feed on agricultural habitats at night. This has been attributed to the feeding areas being rendered unavailable by day, usually because of predators, human disturbance or hunting pressure (Tamisier 1978; Thomas 1981; Fleskes *et al.* 2003). Such relationships have not been established for Chinese wetlands, many of which hold very large, internationally important wintering concentrations of waterbirds (Cao *et al.* 2008a, 2010).

Shengjin Hu National Nature Reserve, Anhui, China (30°15'–30°30'N, 116°55'–117°15'E) is an exceptionally important wetland within the Yangtze River floodplain, supporting a rich and diverse Anatidae fauna and over 70,000 wintering waterbirds, including internationally important numbers of Falcated Duck *Anas falcata* (classed as "Near Threatened" by the International Union for Conservation of Nature; IUCN 2010) and nationally important numbers of the "Vulnerable" Baikal Teal *Anas formosa* (Cheng *et al.* 2009). To be effective in delivering sympathetic management for such species, it is necessary to understand the reasons why the wetland is important for these rare and threatened taxa, and thus to determine how management may maintain or enhance the value of the reserve and surrounding areas for them. In this paper we present preliminary information on the use of the Shengjin Hu National Nature Reserve by two rare species, Falcated Duck and Baikal Teal, in comparison with the more numerous and widespread Spot-billed Duck *Anas poecilorhyncha* which also uses the site. In particular, we recorded the birds' activities to determine the extent to which the species were sleeping and loafing by day (and by implication feeding at night). We used direct observations to find if, and when, the birds were flying out from the wetlands to feed on adjacent habitats, where these were and on what food stocks the ducks were feeding.

Study area

Shengjin Lake National Nature Reserve (33,340 ha) is one of the few, and numerically most significant, internationally important wetlands amongst the lakes of Anhui Province, which is located on the south side of the Yangtze River, 10 km south of the city of Anqing (Fig. 1). The lake receives water from its own catchment, supplemented by influx during maximum flows from the main Yangtze River via a sluice. The climate is monsoonal which results in large annual fluctuations in river and lake water levels, with the result that the water area of Shengjin

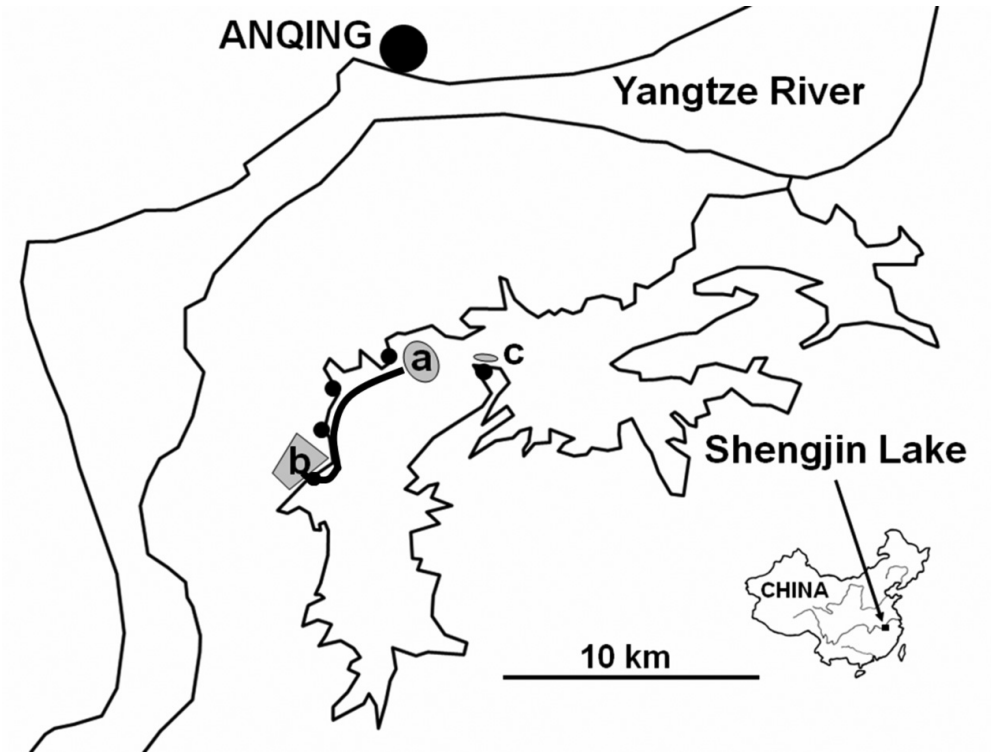

Figure 1. Map of Shengjin Lake, Anhui Province, China. Small inset map shows the position of the lake within China. Larger map shows the locations of the sites used for making behavioural observations during 2008/2009 (black dots), the day-time roosting sites used by the Baikal Teal and Falcated Ducks (shaded area "a"), their night-time feeding location (shaded area "b") and the area used by the Spot-billed Ducks observed during the study (shaded area "c"). The route taken by the Baikal Teal and Falcated Ducks flying to feed at dusk is indicated by the arrow.

Lake can range between 3,400 and 14,000 ha within a year. Further information on the vegetation, birds and other physical and biological characteristics of the lake can be found in Cheng *et al.* (2009).

Methods

Census of the reserve

Shengjin Lake was divided into six major count areas each of which was surveyed nine times during winter 2008/2009, using consistent methods from the same vantage points which enabled viewing of all of the open water areas associated with the lake, using 20–60× Zeiss telescopes. Monthly counts were conducted from mid October to mid April, twice in October, December, February, and April, but no counts were possible in November and January. The counts were usually completed over 2–3 days (exceptionally 6 days) using two teams

communicating by mobile phones to avoid duplicate counting (see Cheng *et al.* 2009 for a full account of the methods). All waterbirds (*i.e.* wildfowl, waders and gulls) observed were counted and the approximate locations of flocks recorded on a map.

Compilation of daylight activity budgets

Data on the activities of the three study species were obtained throughout the day by using 20–60× telescopes to make scan samples of visible flocks at 15 min intervals from dawn until dusk. The behaviour of each successive individual was recorded as it was encountered in the field of view on scanning from one end of the flock to the other (Altmann 1974). The ducks were viewed from cover at a range of 100–1,000 m without causing disturbance to the birds.

Each bird was allocated to one of the following behaviour classes: feeding (including foraging on land, head-dipping and up-ending), preening (all types of plumage care and drinking), sleeping/loafing (stationary on water or land, with or without its head on its back), swimming, flying, aggression (both given and received) and social activities (mostly courtship).

Time budget data were recorded for Falcated Duck on 9 February and 2 April 2009 from ducks aggregated at site "a" (see Figure 1 for locations), for Baikal Teal on 20 February (site "a") and for Spot-billed Duck on 20 October 2008 and 23 February 2009 (site "c" on both occasions). Species were observed until no longer visible in fading light to determine whether or not there was a flight to or from the roost at dusk. Observations were also undertaken on two other occasions in February to see if dusk movements were occurring.

Observing flight-lines

Once it was determined that some species were undertaking evening flights at dusk, observers were positioned along the shore to follow the trajectory of these flights as the ducks left the day-time roosting areas to fly directly to the night-time feeding sites, in order to determine their destinations. This involved several teams of observers being stationed along the route taken by departing ducks until the final point of descent was determined (Fig. 1).

Results

Census result

The Falcated Duck numbers peaked at 7,365 in February 2009 (Fig. 2; Cheng *et al.* 2009). Almost all individuals of this species aggregated in the northern part of the Upper Lake, and in February kept together in a very dense raft (shown shaded at "a" in Fig. 1). On 2 April, when Falcated Duck fed on the lake during the day, they still packed tightly in a large flock in the same area.

Baikal Teal were first found in numbers greater than a few individuals when 3,780 were recorded in early February 2009, these being the largest numbers seen in the Yangtze Floodplain in recent years. Their numbers had dropped to *c.* 1,000 by the end of the month and few remained by the middle of March (Fig. 2).

Unlike the Falcated Duck and Baikal Teal, the Spot-billed Duck occurs at

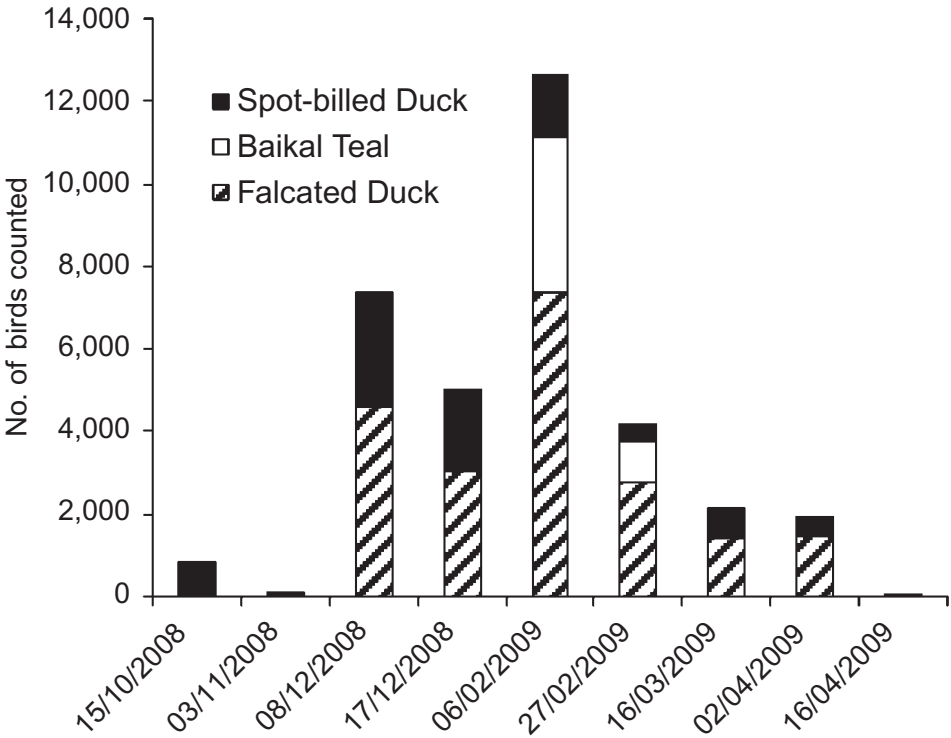

Figure 2. Total numbers of Falcated Duck, Baikal Teal and Spot-billed Duck counted during complete surveys of Shengjin Lake, Anhui Province in winter 2008–2009.

Shengjin Lake throughout the year and breeds at the site. It was less numerous than the other two species during the winter, with numbers peaking at *c.* 2,800 individuals in early December (Fig. 2). This species was more dispersed and not aggregated into dense flocks.

Activity budgets

Falcated Duck were never observed feeding during the day-time observations in February 2009, but 47% of observations (*i.e.* the average of the % feeding recorded in each of the 15 min scans) found birds feeding in daylight hours during observations made on 2 April 2009, prior to their departure for northern breeding areas (Fig. 3; all had departed by 15 April 2009). Baikal Teal were observed in large numbers only during February, and were never seen to feed on the lake during the day at this time (Fig. 3). Twenty percent of Spot-billed Ducks were observed to be feeding during daylight hours in October and 33% in February (Fig. 3).

Diurnal feeding patterns

More detailed inspection of Falcated Duck feeding patterns during the day in April 2009 showed a pulsed feeding pattern.

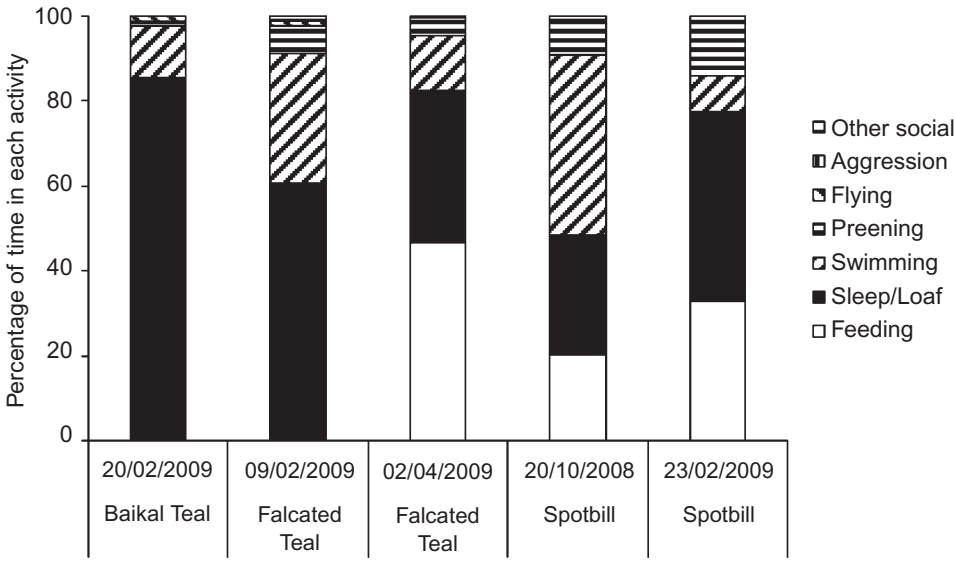

Figure 3. Daily activity budgets recorded for Falcated Duck (scan sample sizes: range 28–226 birds recorded per scan on 9 February; 7–765 on 2 April), Baikal Teal (scan sample sizes: range 79–3,605 birds per scan on 20 February) and Spot-billed Duck (scan sample sizes: range 41–130 birds per scan on 20 October; 7–112 birds per scan on 23 February) observed during day-light hours at Shengjin Lake, Anhui Province in winter 2008/2009.

There was a peak mean of 74.4% of birds recorded feeding per hour (range = 0–96% feeding per 15 min scan) between first light (at 06:30 h) and 08:00 h, followed by a resting period from 08:00–09:00 h, a second peak mean of up to 68.8% birds feeding per hour (range = 1–95% feeding per scan) from 09:00–12:00 h, before resting again until 13:00 h. Except for a less evident period of rest at around 14:00 h, the Falcated Duck then foraged with increasing intensity from 13:00 h until dusk (peak mean percentage birds feeding = 94.2%, range = 0–99% feeding per scan) (Fig. 4).

Spot-billed Duck showed low levels of feeding throughout the day in October (Fig. 5), with peaks in feeding in the morning and afternoon, and a midday peak in resting. In February, the feeding was more pulsed, with maximum feeding at first light, noon, 14:00 h and dusk (Fig. 5). Observations showed this species never undertook dusk roost flights and confined their daylight feeding to the lake.

Night-time feeding

In February Falcated Duck did not feed at all during daylight hours but, together with the raft of Baikal Teal with which they associated, they gathered at sunset into a tight flock, took to the air in increasing numbers (forming a swirling mass of ducks) then gradually gained height before eventually flying strongly to the southwest.

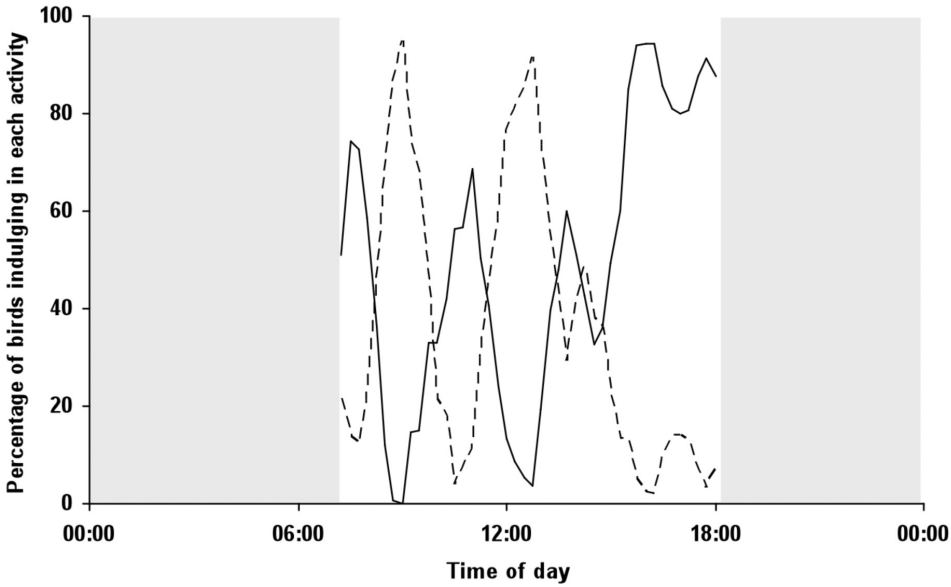

Figure 4. Percentage of time spent feeding (solid line) and resting (sleeping and loafing, dotted line) by Falcated Ducks during daylight hours for birds observed at Shengjin Lake, Anhui Province on 2 April 2009. Lines represent the hourly running means of 15 min interval scans, determined by taking the average % activity (feeding or resting) recorded in four scans immediately preceding and including each 15 min scan.

On two successive evenings, observers followed their progress and eventually located the destination of these flights, which was found to be a series of large harvested rice fields at Hengzhou (30°22' N, 116°59' E) about 5 km from the Shengjin Lake roost (location "b" in Fig. 1). The two species associated by day, sleeping and loafing in large rafts on the lake, but flew presumably to glean rice in the fields by night.

By contrast in early April, by which time the Baikal Teal had left Shengjin Lake, the Falcated Duck no longer undertook the dusk flights. Observations confirmed that they stayed on the lake after darkness, apparently remining there into the night.

Discussion

The count of 3,780 Baikal Teal recorded at Shengjin Lake in winter 2008/2009 represents a return of this species to the Yangtze River Valley after an absence of many years. Baikal Teal used to be one of most abundant duck species in the Yangtze system in the late 19th century (found in "vast flocks in wild open marshes and lakes", but not in paddy fields; Styan 1891), yet declined to very low levels by the second half of the 20th century (BirdLife International 2001). The species has been absent from Shengjin Lake for many years for unknown reasons (Cheng *et al.* 2009). Recent influxes to eastern China (*e.g.* 50,000

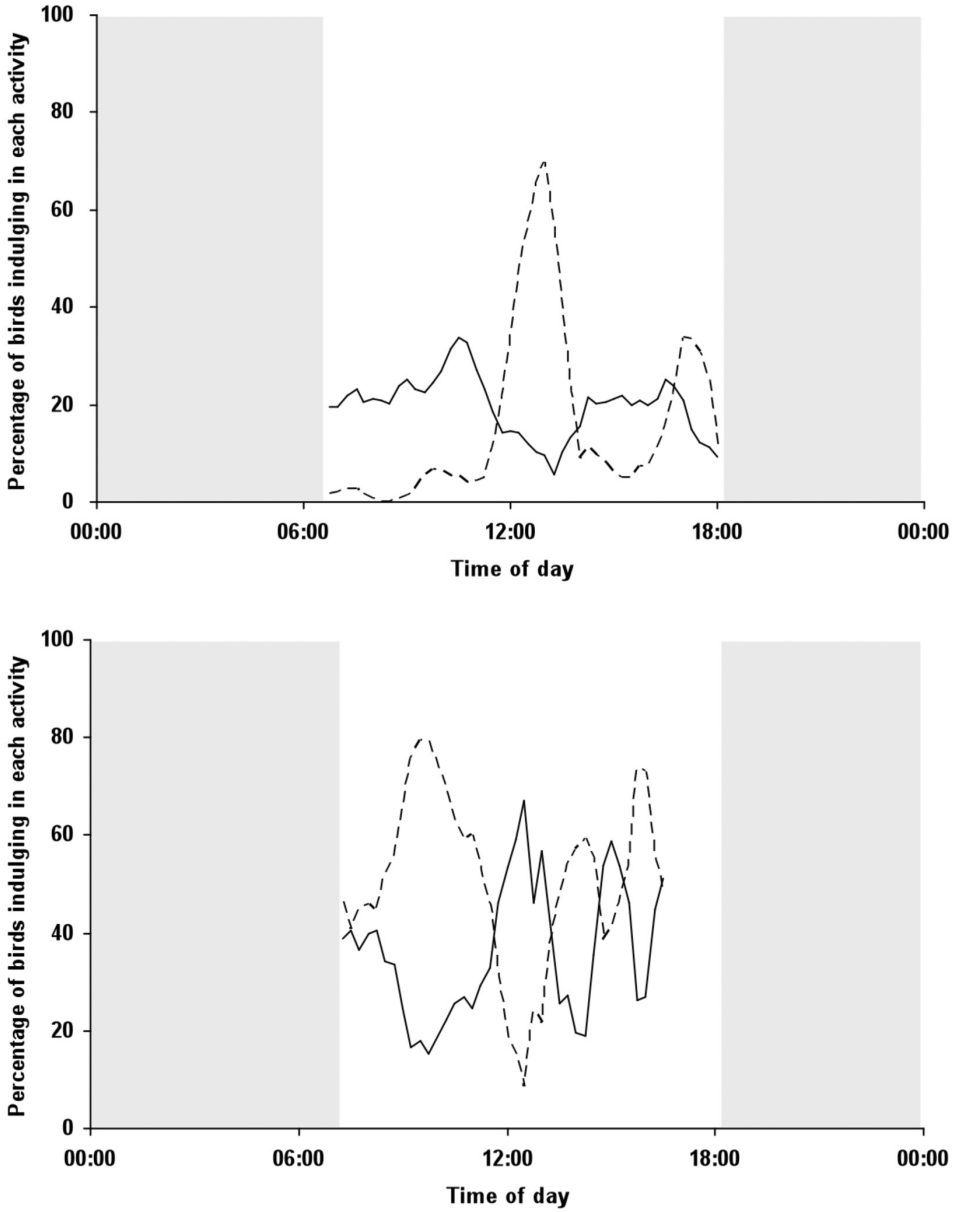

Figure 5. Percentage of time spent feeding (solid line) and resting (sleeping and loafing, dotted line) by Spot-billed Ducks during daylight hours for birds observed at Shengjin Lake, Anhui Province throughout 19 and 20 October 2008 (upper) and 20 and 23 February 2009 (lower graph). Lines represent the hourly running means of 15 min interval scans, determined by taking the average % activity (feeding or resting) recorded in four scans immediately preceding and including each 15 min scan.

in Yancheng National Nature Reserve in December 2006, COS 2006; 8,000 on Chongming Island in February 2006, Zhang 2006; 1,300–2,100 in Fengsha Lake in spring and autumn 2009, and 9,000 at Baidang Lake in February 2010, L. Cao, unpubl. data) suggest expansions from the core contemporary wintering range in South Korea. Numbers in South Korea have shown recent increases, from 20,000 in the 1980s to 660,000 in 2004 and now numbers of >1,000,000 since January 2009 (Li *et al.* 2009; BirdLife International 2010a, b; N. Moores pers. comm.), attributed by some authors to the birds' exploitation of harvested rice fields and the cessation of hunting (Allport *et al.* 1991; BirdLife International 2010b). The present study shows that, at Shengjin Lake, Baikal Teal were also exploiting rice paddy fields. So it is possible that recent increases in abundance in South Korea, associated with exploitation of rice paddies, created an excess of birds dispersing to other areas where they discovered a similar combination of day-time lake roosts and night-time rice paddy fields which enabled them to recolonise traditional areas. A study of the diet of ducks at nearby Tai Hu in 1962–1964 found that gizzards of both Baikal Teal and Spot-billed Duck contained 15–20% rice by item (Qian & Zhu 1980), showing that 45 years ago both species exploited rice paddy fields adjoining lakes in the Yangtze River valley.

The feeding ecology of the Falcated Duck is little studied and the factors determining its distribution remain largely unknown. Counts indicate an increase from < 100 birds at Shengjin Lake on 18 February 2005 to 7,365 just 4 years later in 2008/2009, indicating that the site now holds *c.* 8% of the world population of 35,000 birds of this species (Cheng *et al.* 2009). Dongting Lake is the only other site in the Yangtze River valley known to have supported more Falcated Duck in 2004 and 2005 (Cao *et al.* 2008b). The species shows some flexibility in its use of Shengjin Lake, apparently associating with Baikal Teal in winter in exploiting rice paddies outside the reserve, but remaining later and using the lake itself for feeding during the spring. Falcated Duck gizzards obtained from Tai Hu during the 1960s did not contain rice, but confirmed those specimens fed only on natural foods (Qian & Zhu 1980). More research is needed on this poorly studied duck, its diet and habits, especially in relation to the food supply in the lake in the spring, prior to the birds' migration to the breeding areas.

The Spot-billed Duck is more common and widespread in the Yangtze River valley than either of the other two species, but nevertheless little is known regarding its winter feeding ecology in China. Moreover, although not a species of conservation concern, there are signs of numerical decline in the Yangtze River valley (Cao *et al.* 2008a). Observations made during this study found that the species feeds on Shengjin Lake during the day, but we cannot exclude the possibility that it too flies out after dark for supplementary nocturnal foraging on rice paddy fields, as described for the birds at Tai Hu (Qian & Zhu 1980). The species also feeds nocturnally on cabbage *Brassica oleracea* (Capitata group) in Japan, where it can cause agricultural conflict (Lane & Higuchi 1998).

The results from these preliminary observations have important implications for the Shengjin Lake National Nature Reserve. Firstly, for unknown reasons, despite earlier declines in numbers in the Yangtze River valley of all three species considered here (Cao *et al.* 2008c), Baikal Teal and Falcated Duck have returned within the last 4–5 years in internationally important numbers to a wintering site where they were virtually absent during 2004 and 2005. This may reflect fluctuations in their overall population size, or changes in local conditions at Shengjin Lake, or a combination of these factors. Either way, sympathetic management of local habitat can help to maintain such numbers in order to allow the National Nature Reserve to maintain its value. Both Baikal Teal and Falcated Duck require a safe day-time loafing area and energy-rich night-time feeding grounds. The bay that is used for sleeping during the day is currently rented by a single organisation that does not maintain intensive fishing activity in this part of the lake, a factor that limits disturbance in an otherwise highly disturbed water body. Both species exploited rice paddy fields in the near vicinity. Whilst in the short term, this may make them vulnerable to the use of pesticides associated with such agriculture, this also suggests that the maintenance of such cultivation and the traditional harvesting methods used in this area should be a management objective to keep this food source available, especially since depletion of spilled rice post-harvest creates little conflict with agriculture. Unharvested rice is an extremely important food source for dabbling ducks in North America, where considerable effort is put into assessing the extent of this resource for wintering waterfowl. Indeed, earlier harvests in recent years have caused concern because this has reduced the availability of rice for ducks (Stafford *et al.* 2006). Allport *et al.* (1991) calculated that under South Korean agricultural conditions, 0.27–0.55 km^2 of unharvested rice would be sufficient to support 20,000 Baikal Teal through an entire winter. Other studies (*e.g.* Yamamoto *et al.* 2003) show that the species prefers to glean rice from wet paddy fields within 11 km of the day-time roost, features which could be incorporated into a regional management plan to provide supplementary feeding for Baikal Teal and Falcated Duck at Shengjin Lake. The governments of South Korea and Japan proposed a resolution at the 10th Ramsar Convention of the Parties which encouraged "Contracting Parties to promote research on flora, fauna and ecological functions in rice paddies and on the cultures that have evolved within rice-farming communities that have maintained the ecological value of rice paddies as wetland systems" and invited "Contracting Parties to consider offering recognition and/or protection to such sites through, for example, their designation as Wetlands of International Importance", recognising their importance for Greater White-fronted Geese and, in South Korea, the Baikal Teal. Hence, there is considerable interest in recognising the role played by rice paddy fields in supporting biodiversity in Asia.

Given the rarity of both species, further research should aim to determine the phenology of site use, in particular the timing of arrival, how long the birds stay,

what determines their length of stay and whether management actions could extend the duration of site use. An improved understanding of the precise habitats used by both species throughout the season would help in guiding best management practices. Interestingly, 1,300 Baikal Teal were discovered at day-time roosts on Fengsha Lake (31°00'N, 117°39'E) in December 2009 and 9,000 at Baidang Lake (30°48'N, 117°21'E) in February 2010, both conspicuously close to extensive rice paddies (L. Cao, unpubl. data), so a more extensive survey of numbers and habitat use is required throughout the wintering range.

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