

Captive breeding of Black-faced Spoonbills

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ABSTRACT. Black-faced Spoonbills *Platalea minor* successfully bred in captivity in 1996 for the first time ever, giving us some understanding of their breeding ecology. The captive breeding pair had better breeding success than their wild counterparts owing to the habitat conditions, such as a preferable nest site and the absence of predators. The feeding by both parents observed in the captive pair was different from the wild birds in that no bird remained at the nest as a guard. Details of the chick development were recorded during the hand-rearing process. Sexual maturity was attained at the age of 2 years and 8 months in females, and 1 to 2 years later in males. The combination of creases on the bill and dark patches on the flight feathers will provide a better means of estimating the age of Black-faced Spoonbills.

INTRODUCTION

Black-faced Spoonbills *Platalea minor* breed in restricted areas in the Korean Peninsula (Chong & Pak 1999, these proceedings). This species is known to winter in wetlands, mudflats and estuaries in the Far-east and South-east Asian regions such as Japan, Taiwan, Hong Kong and Vietnam. Formerly a common winter visitor in southeast China, specimens were collected throughout the year in eastern Fujian Province until the 1930s. During the following 50 years, however, the number of wintering birds declined until almost none was observed. Cheng (1987) described this species as a winter visitor and migrant. Therefore, the potential breeding sites in northeast China as were suggested in the early twentieth century, and in southeast China where their breeding is suspected, remain unconfirmed. There is no breeding record from far-east Russia, nor have any observations been made on Lake Khanka. The sole known breeding area of the Black-faced Spoonbill at present is the central to north-western coast of the Korean Peninsula where dozens of uninhabited islands, such as the Dokdo islands, offer breeding grounds for ca. 190 individuals in 1998 (Chong & Pak 1999 in these proceedings). The winter census in 1998 revealed about 600 wintering individuals in the peninsula (see appendix 1 of the proceedings). The breeding or over wintering areas of the remaining 400 individuals remains unknown. Satellite-tracking surveys of Black-faced Spoonbills have been in progress since 1997 but no new breeding site has been found to date. Conservation measures for rare species such as the Black-faced Spoonbill includes such efforts as identifying the breeding, wintering and staging grounds, and may also include increasing the number of birds by captive breeding. Captive breeding of the Black-faced Spoonbill has been attempted since 1985. The first attempt to breed the Black-faced Spoonbill

Table 1. The life history of individuals raised in captivity.

ID No.	Color ring	Sex	Capture date	Capture location
S0575	Orange	Female	1987 July	Daegamdo
S0576	Green	Female	1987 July	Daegamdo
S0668	White	Female	1991 July	Sogamdo
S0669	Blue	Male	1991 July	Sogamdo
S0670*	Yellow	Male	1991 July	Sogamdo*

*died in Jan. 1992

in captivity was made in the Central Zoo in DPRK. Two birds caught in 1985 at Sogamdo, one of the breeding sites, were raised in a cage with other waterfowl. These individuals were a male and a female, which were later transferred to Berlin Zoo in Germany. They were kept in Berlin in a breeding program until 1996, which was unsuccessful. In 1987, another pair was brought to Tama Zoo in Tokyo. This program led to the first successful breeding of the Black-faced Spoonbill in the world in 1996. In 1998, we hand-reared chicks of the same pair that bred in 1996.

We report here the details of the captive breeding processes, as well as knowledge that has not been acquired by field observations such as the development of the chick, breeding age, and age-related differences in morphology.

METHODS OF CAPTIVE BREEDING

Life history of the birds paired: Two chicks were captured in July 1987 on Daegamdo island on the west coast of the Korean peninsula and raised in the Central Zoo of the DPRK for 60 days (Table 1), and then transferred to the Korea University in Tokyo. They were kept there until March 1989 when they became 20 months old, and then were transferred again to Tama Zoo in Tokyo. Blood tests showed both of them to be females. One of the birds (S0576) laid her first egg in April 1990 and the two females laid a total of five eggs in that year. In the following breeding seasons of 1991 and 1992, the two birds laid 12 eggs and 21 eggs (five clutches), respectively. They also conducted mock mounting during these periods.

A further three Black-faced Spoonbill chicks were purchased on Sogamdo island in July 1991, and blood tests showed them to be a female and two males (Table 1). One of the males died prematurely in January 1992, so the other male was chosen as the prospective mate for the female in the captive breeding program.

Pairing: The individuals paired for the captive breeding program were the female (S0576) captured on Daegamdo, and a male (S0669) from Sogamdo. In March 1994, this male (S0669) was moved into the same cage as the female (S0576), which was by then 6 years and 8 months old. The paired birds were kept in a cage together with other waterfowl species, including Hermit Ibises *Geronticus eremita*, Hammerkops *Scopus umbretta*, and Golden-eyes *Bucephala clangula*. They were fed on fish, such as horse mackerel *Trachurus* sp., frozen pond smelt *Hypomesus transpacificus*, and loach *Misgurnus anguillicaudatus*, which were put in a small pool in the cage.

Table 2. Development of Black-faced Spoonbill chicks in captivity.

Date	Day after the first hatching	Development of the chicks
7.May	1	Two chicks hatched and were fed by the parents.
9.May	3	The third chick hatched in the afternoon.
10.May	4	All three chicks were fed by the parents.
11.May	5	The parents took more time feeding on fish (horse mackerel and loach) than brooding the chicks during the day.
16.May	10	Juvenile plumage in sheaths started to appear on the chicks' shoulders, wing coverts, and primary feathers.
19.May	12	Both parents left the nest, which is unusual in the wild where nest predators are abundant.
22.May	15	The parents were feeding themselves, and did not brood the chicks in the rain.
23.May	16	One of the first-hatched chicks went out of the nest. The second hatchling was fluttering in the nest.
24.May	17	All three nestlings went out of the nest.
10.Jun	34	One of the first-hatched chicks moved to the oak tree next to the nest.
12.Jun	36	Both of the first-hatched chicks hopped to the oak tree.
16.Jun	40	All three chicks moved to the oak tree. The first chick that moved out of the nest flew for the first time, which is considered to be its fledging.
23.Jun	47	All the chicks permanently left the nest, but still begged for food.

RESULTS AND DISCUSSION

Breeding of Black-faced Spoonbill

Nest building: The male showed no behavior related to breeding at first. The paired birds brought nest materials to a nest platform situated in a tree in the cage for the first two years. The female laid unfertilized eggs in 1994. The male built a nest in 1995, but did not attempt copulation, and the female laid no egg that year. In the third year, in April 1996, they built their own nest adjacent to the Hammerkop's nest which itself was built on top of a nest box for the Hermit Ibis. The nest material was taken from the neighboring Hammerkop's nest.

Breeding: After the nest was completed, the pair started to enter the nest and sit in it. They also copulated in the nest. Three eggs were laid between April 10 and 19, with the third egg most likely laid on April 15. They started to sit on the eggs after the second egg was laid and both the female and the male took turns in brooding the eggs. On May 7, two chicks hatched 26 days after the second egg was observed, and, two days later, the third chick hatched on May 9. Thus, the female laid three fertilized eggs for the first time only after being together with the male for more than two years. She laid her first (unfertilized) egg at the age of two years and nine months, and the male sired his first fertilized egg at the age of four years and nine months. This record suggests that male Black-faced Spoonbills attain sexual maturity one to two years later than females.

Development of chicks: The three chicks fledged in about 40 days, which is within the range of wild birds (Table 2). During this period, a mixture of dog food and cat food was added to the food to improve the chick's nutrition.

Comparisons of the breeding process in captivity and the wild: We compared the breeding behavior of this pair and that of wild birds observed on Dokdo Island on the western coast of the Korean Peninsula in 1995. In both cases, Black-faced Spoonbills laid three eggs, and the duration of breeding, nest-site use and chicks' development were also

Table 3. Comparison of breeding in captivity and in the wild

Factors	Wild population (1995)	Captive pair (1996)
Nest location	Cliff ledge 50 m (asl)	Flat roof top of a nest box of ibis sp.
Egg laying period	May to June	April
Number of eggs	3	3
Brooding days	26	26
Brooding behavior	Both parents took turns	Female in the morning and male in the afternoon
Fledging time	40	40
Feeding	Female fed the young until 20 days old, and later both parents took turns.	Both parents took turns throughout breeding

Table 4. Age of chicks and the times that fish meal was fed.

Age (days)	Times fed/day	Notes
2-5	7	1/2 of a boiled loach with additional nutrients was fed
5-9	6	
10-12	5	mixed fish meal (loach 70% and pond smelt 30%) was fed
13-26	4	
27-34	3	ate from tweezers on day 30, and ate directly from a vat on day 34
35-64	2	
65-	1	

similar (Table 3). There was a difference in feeding behavior between the captive parents and the wild birds. In captivity, both parents fed the chicks and left the nest together for feeding, whereas in the wild, males usually brood the chicks during the day while females forage and feed the chicks. This behavior continued until the chicks were ca. 20 days old. On Dokdo Island where Slaty-backed Gulls *Larus schistisagus* occur, most Black-faced Spoonbill families were raising one to two chicks, and rarely three. The mortality of the eggs and chicks in the breeding ground was mostly caused by chicks falling off the cliff ledge and predation by Slaty-backed Gulls. In captivity the parents probably left the nest and the young freely, because nest predators were absent or because they were still close to and in sight of the nest while they were feeding.

Hand-rearing of the Black-faced Spoonbill young

The same pair was used for the second breeding efforts in 1997. This time the parents built a nest in a tree, laid eggs, brooded and hatched three successive clutches. However, they failed to fledge the young because the chicks either fell from the nest, or they did not feed them.

In 1998, the same birds were paired and started breeding until the first of the three eggs hatched on May 18, 1998. The young, however, was not fed and showed signs of weakening. Therefore, on May 20, we removed the nestling and the remaining egg (which was starting to hatch) from the nest and raised the young by hand. The egg hatched on that day, and both young ate the fish meal we fed them readily. The late-hatched chick, however, developed arthritis and died at the age of 98 days. The first chick grew up healthily and moved into the adult flock at the age of 124 days on September 20. The experience of hand-rearing the Black-faced Spoonbill gave us valuable insight into the development of the chick which had

Table 5. Weight changes of the paired individuals.

S0669 (male)			S0576 (female)		
Age	Weighing date	Weight (g)	Age	Weighing date	Weight (g)
1	1991, Oct. 28	2,100	3	1989, Mar. 13	1,520
2	1992, Jan. 12	1,750	3	1989, Dec. 6	1,740
6	1996, Dec. 16	1,800	9	1996, Dec. 16	1,800

so far not been available from field observations.

Details of the development of the Black-faced Spoonbill chick

Feed: We fed fish meal prepared by boiling fish, such as loach, cutting it into small pieces and adding vitamins and minerals as needed (Table 4).

Weight change of the young: The first chick which hatched on May 18 weighed 61 g the day it was taken from the nest. The second chick weighed 52.2 g at hatching. The next day we started to hand-rear the chicks, and both birds showed some decrease of weight. The maximum weight rate of weight increase was recorded between day 10 and day 40. They showed almost daily growth until day 40, after which the weight stabilized at 1600 g and 1200 g in the first and the second chick, respectively.

Amount of food ingested and weight increase: On day 5, this chick ate 45.4 g of fish meal, increasing to 200 g/day and 400 g/day on days 10 and 20-30, respectively. The amount of food this chick consumed reached a maximum of 800 g/day on day 38, stabilizing at an average 500 g/day after day 40. The body weight stabilized at 1600 g at day 40, almost the same weight as an adult bird (Table 5).

Growth of wings, tarsometatarsus, tail feathers and bill length: The maximum growth rates per day in body sizes were recorded between day 10 and day 40, the same as for the rate of body weight increase. The tarsometatarsus grew most rapidly and stopped growth on day 30, and was the first measure to reach a maximum. Wing length peaked at day 50 and decreased slightly afterward. This decrease of measurement may be due to the small size of the cage the chick was kept in, which may have caused some fraying of the wing tips. The tail remained downy until day 20, when the tail feathers appeared in sheaths. The morphology of the bill was the most interesting. The bill at hatching seemed to have a slight semblance to the spoon of adult birds. The bill length grew daily and it was still growing at day 70. The width of the bill reached its maximum at day 50 when it stopped growing.

Development of morphological characteristics observed in the captive birds

Color patterns in flight feathers: Juvenile Black-faced Spoonbills have dark parts from the tip of the feather to the middle of the rachis of primary flight feathers, as well as dark patches on the secondary flight feathers. The area of this dark patch decreased until the bird became 5 years old, when only the remnant dark spot remained beneath the outermost primary flight feather (Table 6). This dark spot was lost altogether by the 6th year after hatching. The dark spot on the back of a 5th year individual, however, was so slight that it

Table 6. The change in morphology of Black-faced Spoonbill.

Age (year)	Bill surface	Feather
1	Bill color starts to darken, no crease	
2	Bill color completely dark, no crease	
3	Creases 1/2 of the bill from the base	
4	Creases 2/3 of the bill from the base	Nuptial feather
5	Creases 9/10 of the bill from the base	Remnant dark spot on the lower wing
6	Creases stop to increase and deepen	Completely white plumage

could only be seen when the bird was caught and examined in the hand. The wing feathers of 5 year-old sub-adults will look white in the wild, unless examined closely.

Age-related changes in the bill surface patterns: Estimation of the age of Black-faced Spoonbills has relied on the proportion of the dark parts remaining on the wing feathers when flying birds are viewed from below but it seems that bill morphology can also be a useful guide. We gained insights into the changes in bill morphology by observing the development of our hand-reared individuals. The bill surface started to form creases at the base of the bill, and these spread along the bill toward the tip until the 6th year, when they stopped increasing in extent. So the age of this species can be estimated between the 1st and the 6th year from the shade of the black color on the under wing and the extent of creasing on the bill (Table 6).

Crest and nuptial plumage: The birds developed a crest and nuptial plumage at the age of three to four years. The nuptial coloration of the captive birds looked more faint than wild birds.

Sex identification by appearance: The sexes can be identified by the difference in body sizes if a pair are observed side by side. The body size of female spoonbills is smaller than males. However, it is impractical to identify the sex of a single bird or a bird in a flock.

Individual identification: Yellowish bare skin-patches under the eyes of spoonbills have distinctive sizes and forms, which allowed us to identify individual birds in the wild. We could identify some of the individuals on Dokdo Island by this method, for example. This method will work with small populations, such as on Dokdo where only 5 pairs were breeding. It would be difficult, however, to employ this method in places such as Taiwan where a large number of birds congregate for winter.

Future consideration: The captive breeding program provided us with valuable insights into the Black-faced Spoonbill biology. We would like to continue the observations with more individuals. Much planning is required to enhance the captive breeding program: it includes such efforts as obtaining new strains of wild birds to avoid inbreeding depression and to retain healthy lines of captive birds, as well as reintroduction techniques such as returning young birds to wintering flocks.

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