

A Study on the Community of Waterbirds and Protective value at Gangjin Bay in Jeollanamdo, Korea

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Abstract: This study was conducted in Gangjin Bay of Jeollanam-do over a total of 8 sessions, once each month, between October of 2009 and May of 2010. A total of 9,647 birds of 63 species were observed during the study period. The most dominant species was *Aythya ferina* (18.5%), followed by, in decreasing order, *Anas platyrhynchos* (11.5%), *Calidris alpina* (9.6%) and *Cygnus Cygnus* (7.7%). Species which appeared in all months (100% occurrence rate) included a total of 5 species of *Ardea cinerea*, *Egretta alba modesta*, *Egretta garzetta*, *Anas crecca* and *Anas poecilorhyncha*. Furthermore, the study showed a total of 13 government protected species, 3 class-I endangered species, 8 class-II endangered species and 8 natural monument species. The Gangjin Bay region includes the Nakdong estuary, natural monument number 179, and provides stopping grounds for the *Cygnus Cygnus*, at the next highest number of birds. Furthermore, the region is characterized by the wintering of *Cygnus Cygnus* at a bird count higher than that of the Jindo *Cygnus Cygnus* migration destination, natural monument number 101. Therefore, there is a need for the designation of natural monuments and protected wetlands, as well as continued maintenance, in the Gangjin Bay region.

Keywords: Gangjin Bay, Waterbirds, Protective value

Introduction

Gangjin Bay is located to the southwest of Jeollanam-do and includes a number of stopping grounds for large-flock migratory birds, such as Suncheon Bay, Muan Bay, Lake Gocheonam, Lake Geumho, Lake Yeongam and Lake Yeongsan. The region is one of the main sites of winter resting grounds for whooper swan, a class-II endangered species, as designated by the Ministry of Environment, and natural monument number 201-2, as designated by the Cultural Heritage Administration (Cultural Heritage Administration, 2000; 2001), and the area also plays an important role for other aquatic birds during migration and arrival seasons. Furthermore, its natural state which has unblocked estuary bank, in addition to Suncheon Bay, makes the location significant (Kim *et al.*, 2005). Reeds and other plants near tidal flats provide food and hiding grounds for various aquatic birds, including the whooper swan (Krull, 1970). However, recent reclamation projects and waterways maintenance, characterized by the injection of large amount of fresh water and large-scale soil runoff, are expected to cause environment changes in Gangjin Bay.

Until recently, researches on the avifauna of the Yellow Sea and estuaries have included those conducted in Han River estuary (Kang *et al.*, 2008), Lake Shihwa (Yoo *et al.*, 2010) and Muan Bay (Kang *et al.*, 2008). Studies conducted on Gangjin Bay, the study area, includes only a study by Kim *et al.* (2005), a national census on the wintering of winter birds (NIBR, 1999-2010), and a study on the distribution and wintering habit of whooper swan, a government protected species (Jeon and Cho, 2006a, b). This demonstrates that there is a lack of research regarding the distribution and management of the whooper swan and other aquatic birds in the study area.

Therefore, this study was conducted in order to analyze the current situation of government protected species and aquatic birds living and wintering in Gangjin Bay to suggest a method of protection and management of Gangjin Bay, a destination for various winter migratory birds, including the government protect whooper swan.

Materials and Methods

Study area

The study area of Gangjin Bay is located to the southwest side of Jeollanam-do, between DoamSinjeon-myeon and ChillyangDaeguMaryang-myeon and stretches into the center of Gangjin-gun (Fig. 1). Its coordinates are north

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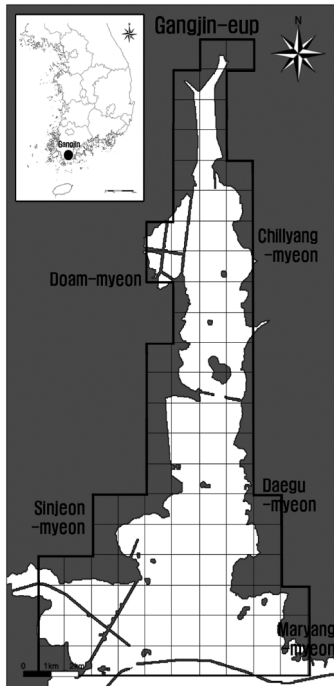


Fig. 1. Map of Doam Bay showing the survey sites.

latitude 34°25'06" and east longitude 126°50'2". The surrounding seaside environment includes the reclaimed land of Mandeok and a reclaimed lake, alongside tidal flats which become visible at low tide. The coastline has severe curvatures, as in the case of the Yellow Sea, and with low salinity, as a result of fresh water moving into Tamjin River, Janggye River, Gangjin River and Doam River, the area provides suitable environment for various fish and other living organisms. The coastline stretches over a total of 35km, and the center of the bay stretches over 2.4 km. The depth of the bay is approximately 10 m, with a total surface area of 90 km² (Gangjin County, 2010). Nearby Gangjin Bay are a number of important destinations for migratory birds, including Muan Bay, Lake Gocheonam, Lake Geumho, Lake Yeongam and Lake Yeongsan.

Method

This study was conducted over a total of 8 sessions, once each month, between October 2009 and May 2010 in order to study the aquatic bird population observed in the bay areas and nearby back swamps. Tide difference in the bay region were taken into consideration for the analysis of distribution, and 2 groups of 2 researchers conducted field observation simultaneously, 2 hours before and after high tide, in order to study habitat usage.

During the study, researchers moved along roads on vehicle at 2 km per hour, used the line census method to determine areas to record observed species and number of birds and used a field scope (Swarovski, ×20~60) to observe and record using the point census method. A

binocular (×8~10) was used to observe birds which were either nearby or migrating.

The data obtained were analyzed using Dominance, Species diversity and Occurrence rate (Shannon & Weaver, 1949).

Results and Discussion

Overall Results of the Study

A total of 98 avian species were observed in the Gangjin Bay region between October and May, the wintering and migratory season of aquatic birds, and during this time, the highest individual count of wintering birds was 10,827 birds. The most dominant species was the pochard (*Aythya ferina*) (18.5%), followed by, in decreasing order, the mallard (*Anas platyrhynchos*) (11.5%), dunlin (*Calidris alpina*) (9.6%) and the whooper swan (*Cygnus Cygnus*) (7.7%).

Among these, 9,647 birds of 63 species were confirmed to be aquatic birds, marking 64.3% of the total number of species, but in terms of the bird count, the figure made up 89.1% of all the birds observed to arrive at Gangjin Bay.

Changes in the number of species per month show increase starting in October, the beginning of the migratory season of aquatic birds, until reaching maximum number of species of 37 species in March. The figure then began to decrease to 20 species in May (Fig. 2). The number of species then decreased rapidly in February, and this is predicted to be caused by the lack of observation of the plover and *Scolopacidae* species.

Changes in the number of birds per month were similar to that of species. The number of birds began to increase in October to peak in February at 3,998 birds, and the number began to decrease afterwards (Fig. 2). The number decreased temporarily in January, and this is assessed to be the result of decrease in the number of the bean goose and the pochard. Furthermore, the number began to decrease after February and then began to increase in May, and this is assessed to be the result of increase in the plover and *Scolopacidae* species (Fig. 3).

Changes in the occurrence rate and number of birds of important aquatic birds

Species which were observed in all months of the study, between October and May (100% occurrence rate) included the 5 species of the grey heron, great egret, little egret, common teal and the spot-billed duck, and 4 species of the mallard, tufted duck, black-tailed gull and the herring gull were observed in 7 months (87.5% occurrence rate) (Table 1). Past results of studies in 2000 and 2001 (Kim *et al.*, 2005) have reported the 100% occurrence rate of the little egret, mallard and the spot-billed duck and 83% occurrence rate of the grey heron, whooper swan, common shelduck,

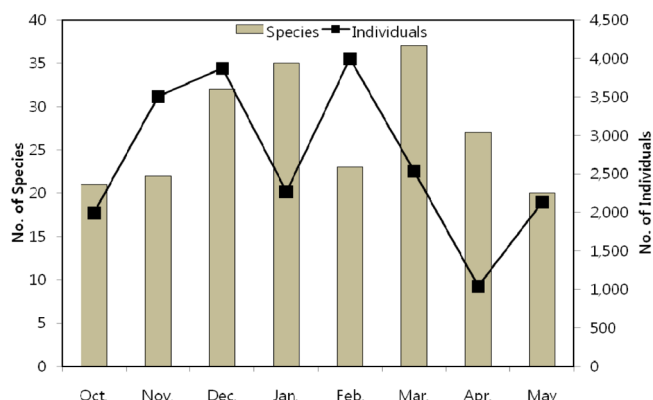


Fig. 2. Monthly change of the species number and individuals of the waterbirds at Doam Bay

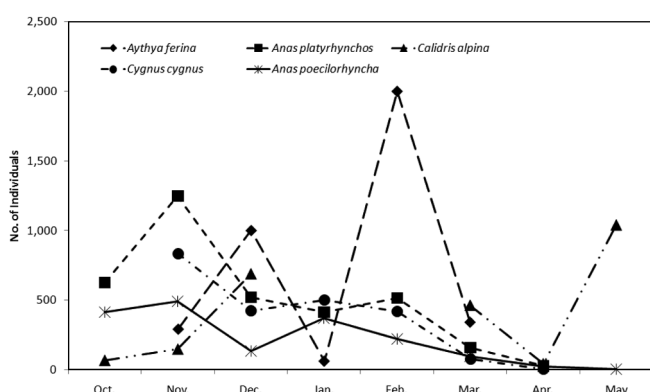


Fig. 3. The individual number of domination species in Doam Bay

herring gull and the black-tailed gull. *Ardeidae* species were observed in high numbers in October, March and April, during migratory season, and duck species showed increase in number in October, followed by decrease beginning in February, which demonstrates typical wintering pattern.

The grey heron showed the highest number at 86 birds in March, a month of migratory season, followed by October, which is the winter migratory season. The great egret and the little egret showed the highest number of birds in October and then decreased in count. In the case of the common teal, mallard and the spot-billed duck, they

showed the highest number of birds in November and December and were either not observed or observed in very low numbers in April and May, which leads to the conclusion that the majority have migrated to the North in February and March (Fig. 3).

Government protected species

A total of 13 government protected species were observed between October 2009 and May of 2010, including 3 class-I endangered species of the spoonbill, Eurasian spoonbill and the peregrine falcon and 8 class-II endangered species of the whooper swan, bean goose, osprey, hen harrier, Eurasian buzzard, white-naped crane, far eastern curlew and the Saunder's gull. A total of 8 species of natural monuments designated by the Cultural Heritage Administration were observed and included the Eurasian spoonbill, spoonbill, whooper swan, hen harrier, sparrow hawk, common kestrel, peregrine falcon and the white-naped crane (Table 2). The majority of government protected species, with the exception of the whooper swan, were observed in upstream areas with well-developed reed fields, such as Mandeok-ri and Yeongbok-ri, Deoknam-ri and Songro-ri, and in the case of the whooper swan, the species was observed in all areas of Gangjin Bay, excluding Naedong-ri and Gusu-ri.

In terms of the individual months, November and December confirmed the highest number of government protected species at 7 species each, and May showed the lowest number at a 1 species. The majority of the protected species were winter migratory birds or permanent residents and showed similar patterns to those of typical wintering grounds in terms of the change in the number of species (Fig. 4).

The Value of Gangjin Bay as a Migration Destination of Aquatic Birds

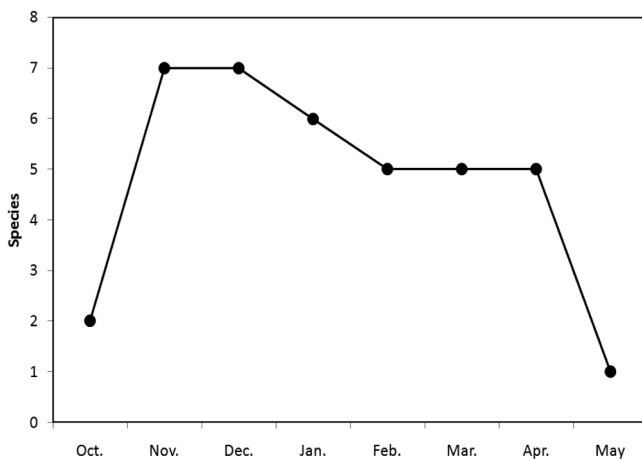
The whooper swan, a class-II endangered species and a natural monument species, are generally found in flocks in areas of low water level, such as seashores, reclaimed lands, estuary deltas, rivers and reservoirs, and they feed on roots

Table 1. The results of appearance ratio (80%<) in Doam Bay with a few waterbird species

No.	Scientific name	2009					2010				Frequency (%)
		Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May		
1	<i>Ardea cinerea</i>	73	16	40	33	47	86	21	20	100	
2	<i>Egretta alba modesta</i>	76	7	19	16	7	7	12	8	100	
3	<i>Egretta garzetta</i>	50	27	16	10	11	8	4	1	100	
4	<i>Anas crecca</i>	153	122	178	127	35	42	56	10	100	
5	<i>Anas platyrhynchos</i>	628	1250	519	416	517	160	29		87.5	
6	<i>Anas poecilorhyncha</i>	410	489	132	368	218	94	23	2	100	
7	<i>Aythya fuligula</i>	30	150	64	130	120	308	329		87.5	
8	<i>Larus crassirostris</i>	370	8	1	1		123	65	61	87.5	
9	<i>Larus argentatus</i>	27	22	13	86	78	25	116		87.5	
No. of species		9	9	9	9	8	9	9	6		

Table 2. The list of species of natural monuments and endangered waterbirds

No.	Scientific name	2009			2010					Total	Peak count	Remark*
		Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May			
1	<i>Platalea leucorodia</i>		5	10			1	5		21	10	●, ○
2	<i>Platalea minor</i>		2					3		5	3	●, ○
3	<i>Cygnus cygnus</i>		834	423	499	420	76	3		2,255	834	○, ○
4	<i>Anser fabalis</i>		24	320	90	256				690	320	○
5	<i>Pandion haliaetus</i>	1	1		1	1	1	1		6	1	○
6	<i>Circus cyaneus</i>						2			2	2	○, ○
7	<i>Accipiter nisus</i>			2						2	2	○
8	<i>Buteo buteo</i>		1	2	2	1				6	2	○
9	<i>Falco tinnunculus</i>	3	2	2	2	1				10	3	○
10	<i>Falco peregrinus</i>			1						1	1	●, ○
11	<i>Grus vipio</i>				7					7	7	○, ○
12	<i>Numenius madagascariensis</i>							2	1	3	2	○
13	<i>Larus saundersi</i>						3			3	3	○
No. of species		2	7	7	6	5	5	5	1	13	13	
No. of individual		4	869	760	601	679	83	14	1	3,011	1,190	

**Fig. 4.** The species number of protected species in Doam Bay

and stems of fresh water aquatic plants and potato grains and other grains on land. In Korea, there are approximately 4,700 whooper swans, which are found wintering in Gyeongpoda of Gangwon-do, Geumgang estuary, Lake Ganwol, Gangjin Bay, Upo swamp, Junam reservoir, Nakdong estuary and more (Cultural Heritage Administration, 2009).

Gangjin Bay is known to provide wintering grounds for approximately 300 whooper swans, a figure greater than those found in Nakdong estuary, natural monument number 179. Furthermore, the area is also significant in that more whooper swans arrive here for wintering than in Jindo's wintering grounds, natural monument number 101.

Assessment of tidal flat using standards of tidal flat classification (Lee *et al.*, 2004) in regards to the avifauna of Gangjin Bay resulted in class III with 9 points: 1 point for total bird count, 3 points for protected species, 3 points for the number of protected birds, 1 point for the number of species of 1% of the living population and 2 points for the number of species of 1% of the domestic population. In the

case of other tidal flat regions (Lee *et al.*, 2004), Nakdong river, Han river, Geum river, Mangyeong river, Dongjin river estuary, Namyang Bay and Asan Bay all received higher rank of class-V, but Gangjin Bay, alongside Suncheon Bay, is valuable as wintering grounds for whooper swans and other aquatic birds, since it is a natural wetland with unblocked estuary bank. Furthermore, tidal flats revealed during low tide show high levels of the *Ilyoplax pingi* and green mussels, as well as *Amphipoda* and *Polychaeta* species, which are all food supplies for the plover and various *Scolopacidae* species (Ministry of Maritime Affairs & Fisheries, 2006), making the tidal flats a significant feeding ground. The upstream region of the bay includes a reef field, similar to the one found in Suncheon Bay, creating a suitable habitat for aquatic birds. However, waterway construction of the recently completed Tamjin Dam, which included injection of large amounts of fresh water and soil run-off, is expected to disrupt aquatic plant and benthic invertebrate habitat. This, in turn, is predicted to decrease food supplies of aquatic birds, including whooper swans. This demonstrates the need for a method of protecting and managing protected wetlands or natural monuments sites which provide habitat for aquatic birds. Furthermore, there is also a need for farming or artificial supplying of food supplies in order to counteract the decrease in food supply. In addition, there is also a need for a more systematic management of aquatic birds, including the whooper swan, via continuous monitoring.

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