

Breeding Status of the Great cormorant *Phalacrocorax Carbo* (Phalacrocoracidae) at Paldang Lake in Korea

Jinmun Jeong¹, Jungho Park², Jinsoo Byun², Haengseop Song² and Heonwoo Park^{3,*}

¹Department of Biology Education, Korea National University of Education, Cheongju 28173, Republic of Korea

²Institute of Ecology, Korea EcoWorks, Chuncheon 24341, Republic of Korea

³Department of Science Education, Chucheon National University of Education, Chuncheon 24328, Republic of Korea

Abstract

Great cormorant (*Phalacrocorax carbo*) have been growing on a large scale since they settled on Jokja Island in Lake Paldang in 2010. In 2017, 827 breeding nests were found in Jokja Island and the breeding success rate was 2.60 ± 0.23 per nest. Nestling tree did not show any specificity for the species and was severely damaged. As the nesting materials for cormorants, branches and leaves, which were easy to come by around the island, were used. Most of their prey were fish in Lake Paldang. The population the great cormorants showed high breeding success rate, indicating that Jokja Island was a good site for breeding. Thus, it shows that continuous research for them needs to be done.

Key Words: Great cormorant (*Phalacrocorax carbo*), breeding status, paldang lake, Korea, nestling tree

Introduction

Great cormorant (*Phalacrocorax carbo*) is a diving waterfowl of 82 cm in size belonging to the family Phalacrocoracidae. It is widely distributed in the Amur River basin, China, Korea, and Japan in Northeast Asia. In Korea, it is a winter visitor, which is seen mainly on the East Coast and in the Nakdong River basins (Won 1963). However Since their first breeding was found on the west coast in 1998, breeding population has been gradually increasing along the Han River (KBS Media 2009; Park 2013).

It is estimated that more than 30,000 cormorant were found in Korea, which may cause an imbalance between environment and ecosystem. If cormorants arrive intensively in a particular area, there is a possibility that they will result

in a decrease in freshwater fish stocks or a change in species composition (Kirby et al. 1996; Kameda et al. 2002; Teruaki and Isida 2012). So, It is necessary to study influence on food quantity, preying habit, habitat pollution and aquatic ecosystem (Warke et al. 1994; Takahashi et al. 2006).

Jokja Island, which is a large-scale breeding of Great cormorant, is located in Lake Paldang and consists of two islands, North and South, stretching from north to south. The area of the North Island is 51,863.1 m², that of the South Island 6,781.1 m². The center of the breeding center is located at 37.526795°N and 127.307675°E with the maximum elevation of 40 m.

Paldang Lake is a water source in the metropolitan area and is thoroughly protected from water pollution. However,

Received: January 19, 2018. Revised: February 8, 2018. Accepted: February 8, 2018.

Corresponding author: Heonwoo Park

Department of Science Education, Chucheon National University of Education, 126 Gongji-ro, Chuncheon 24328, Republic of Korea
Tel: 82-33-260-6462, Fax: 82-33-264-3028, E-mail: phw8033@hanmail.net

there is concern that the water sources may be contaminated by feces since cormorants continue to breed there. This study aims to investigate the breeding status in Jokja island and provide information on the increase and spread of the populations.

Materials and Methods

The survey was conducted four times from April 2017 to August 2017. The first survey (April 20, 2014) and the third survey (June 24, 2017) were conducted to observe the size of population and the number of nests outside breeding sites. The second survey (May 9, 2017) and the fourth survey (Aug. 10, 2017) were conducted to inquire the breeding status in the breeding sites.

Breeding status were recorded population size and the number of nests by observation through a field scope (Swarovski 85T, 25-60) and a binoculars (Kowa 8×42) out of colonies. The population size and the number of nests were measured three times and the mean value was obtained. Inquiries in the breeding sites were conducted twice on May 9th during the breeding period and on August 10th after breeding. We checked in the colony that nests number, clutch sizes, nest size, kind of nestling tree



Fig. 1. Breeding nest of the great cormorants at the northern end of the North Island in Jokja island.

and diet.

Investigation on the nest size and the material analysis was performed on 11 nests, including 4 intact nests that fell down to the ground, and 7 nests that remained on the nestling tree with a tapeline.

The Nest location and the species of nestling tree were investigated in 75 easy - access trees. Taking count the number of the nest and the height of the nest its height were measured from the ground using a range finder and a 7.5 m tapeline.

The extent of the damage of nestling tree was divided into 0, 25, 50, 75 and 100% levels.

All the prey vomited or dropped prey and the food remaining in esophagus or crop of dead chicks carcass were investigated for identifying the species and measuring their size.

Results and Discussion

Most of the Great cormorant in Jokja Island were breeding in the northern end of the North Island (Fig. 1). Egrets-Little egret, Great egret, Grey heron etc.- were breed in the southern part of the island where nut pine trees were cultivated. The number of the nest of great cormorants was 827, and the number of the nest of Ardeidae was Little egret 261, Great egret 5, Grey heron 2, Cattle egret 2 and 1 Black-crowned night heron. Total number of breeding pairs in Jokja island were 1,098 pairs. The number of the nests consists of 75.32% of Great cormorant's, 23.77% of Little egret's, 0.46% of Great egret's, 0.18% of Grey heron's, 0.18% of Cattle egret's, 0.09% of Black-crowned night heron.

It is assumed that cormorants began to breed in Lake Paldang in 2008, and they have settled in Jokja Island since 2010. In 2017, the breeding success rate of each nest in Jokja island was 2.60 ± 0.23 (Table 1), which was higher than the that of 2.51 ± 0.10 at Jeziorsko reservoir in Poland in 2014-15. That of the breeding succession population in

Table 1. Clutch size and the average number of successfully fledged chicks on the Jokja island

	Clutch size					Average no. of successfully fledged chicks (no. of chicks per nest)	Total no. of nest
	1	2	3	4	5		
No. of nest	3	60	66	9	1	2.60 ± 0.23	139

Chuncheon Soyangho was 2.57 ± 0.24 (Park 2013; Janiszewski et al. 2017). These results show that Jokja Island is a good site for Great cormorants' breeding.

The kind and size of the nest materials, branches of the trees such as cherry tree, Acutissima, Pine tree, and Alder tree, and stem of Reed, Corn, Cattail, and Perilla were used as external nest materials. The interior of the nest was made of Cattail, Pine leaves, Mongolian oak, Acutissima leaves, plastic bags and cord, The lengths of the nest material were 402.8 ± 175.6 mm for the branches and 323.8 ± 198.5 mm for the herbage stem, and the mean lengths were 392.7 ± 201.8 mm. branches and leaves, which are easy to come by around the island, were used. The number of materials used in the nest was 316 and 79.17% of the material was made of branches. The outer size of the nest was 560.9×465.5 mm and the height was 216.4 mm. The internal size of the nest was 278.0×226.0 mm and the height was 40.0 mm. The size of the nest was somewhat smaller compared to the point of 0.7-1.0 m in the foreign countries (Dement'ev et al. 1966).

The nestling trees of cormorants were consisted of 44 Pine trees (58.7%), 7 Japanese larchs (9.3%), 7 Mongolian oaks (9.3%), 5 nut pine trees (6.7%), 4 Acutissima (6.7%), 3 Pitch pine trees (4.0%) and 5 other trees (6.7%). Most of the trees in the breeding area are used as nestling trees. It shows that there's no special preference for the pine trees.

And The DBH of nestling trees were was 299.56 ± 47.04 mm and the number of nest per each nestling tree was 5.95 ± 3.41 . The mean height of the nest from the ground was 10.23 ± 2.62 m, the mean height of the lowest nest was 7.22 m, and the mean height of the highest nest was 13.63 m.

Related with influence on nestling tree, It was found that most of nestling trees were suffering serious damage. 44 trees used in the nestling tree, 37 of them (87%) were withered. In the first year, they were used in the form of the branches, which causes about 10% damage of trees. Over more than 2 years, trees have lost the chance of spreading new branches and have started to die off by excretion. In the third year or more, they suffered serious damage. There was no difference in the severity of damage caused by the species.

As a result of the analysis of the prey collected from the breeding area and the dead body, the size of the prey varied from 10 to 30 cm. The species of prey were: Skygager



Fig. 2. Large breeding group of great cormorants in Jokja island.

(*Erythrocyberus erythropotenus*), Bass (*Micropterus salmoides*), Bluegill (*Lepomis macrochirus*), Catfish (*Silurus asotus*), Oriental weatherfish (*Misgurnus anguillicaudatus*), Carp (*Carassius auratus*), Minnow (*Zacco platypus*), Steed barbel (*Hemibarbus labeo*) They were found to inhabit around the Jokja island.

Park et al. (2009) reported in the study of fish fauna and community structure in Paldang Lake that various fishes lives in Lake Paldang. As a result of the prey survey, it was found that the cormorants of in Jokja Island have used fish around the breeding site for their prey. In addition, Keller (1998) showed similar results in the study of great cormorants' praying in Bavaria. He said that the species of fish were varied and its size ranged from 9 to 28 cm. However, the proportion of fish used as food does not match that of the fish inhabiting in the same site, which seems to be related to fish's inhabiting habit and hunting success rate of cormorants.

Jokja Island has good conditions for cormorants breeding because there is little human interference and it is easy to find prey around there. There is also no competing species and no natural enemies, which is a favorable condition for breeding. Due to these conditions, the great cormorants in Jokja Island form a very large breeding group and they are constantly reproducing (Fig. 2). Thus it is necessary to continuously inquiry how the reproductive populations of great cormorant in Jokja island will change in the future, and the effects of cormorants bleeding on the water quality and its impact on fish resources should be studied continuously.

Acknowledgements

This work was supported by Gyeonggi Green Environment Center and Gyeonggi-do in 2017 (17-06-2-70-76). The authors would like to thank the anonymous reviewers for their valuable comments and suggestions to improve the quality of the paper.

References

- Dement'ev GP, Gladkov NA, Ptushenko ES, Spangenberg EP, Sudilovskaya AM. 1966. Birds of the Soviet Union. Vol.1. Israel Program for Scientific Translations Ltd, Jerusalem, pp 18-32.
- Janiszewski T, Minias P, Lesner B, Kaczmarek K. 2017. Age effects on reproductive success, nest-site location, and offspring condition in the Great Cormorant *Phalacrocorax carbo sinensis*. J Orni 158: 193-202.
- Kameda K, Matsubara T, Mizutani H, Yamada Y. 2002. Diet and foraging site selection of the Great Cormorant in Japan. Jap J Orni 51: 12-28. (in Japanese with English abstract)
- KBS Medea. 2009. (Environmental Special) There are cormorants on the island of Paldang Jokja. [video material] KBS Environmental Special; 397th (2009.07.22). (in Korean)
- Keller T. 1998. The food of cormorants (*Phalacrocorax carbo sinensis*) in Bavaria. J für Orni 139: 389-400.
- Kirby JS, Holmes JS, Sellers RM. 1996. Cormorants *Phalacrocorax carbo* as fish predators: an appraisal of their conservation and management in Great Britain. Bio Conserv 75: 191-199.
- Park H. 2013. The abundance and distribution status of Great Cormorant (*Phalacrocorax carbo*) on Uiam Lake region, Chuncheon city, Korea. Korean J Orni 20: 23-31. (in Korean with English abstract)
- Park HK, Lee JH, Choi MJ, Yun SH, Song HB, Lee K, Youn SJ, Shin KA, Byeon MS, Kong DS. 2009. Ecological characteristics and long-term variation of fish community in lake Paldang and its tributaries. J Korean Soc Water Quality 25: 951-963. (in Korean with English abstract)
- Takahashi T, Kameda K, Kawamura M, Nakajima T. 2006. Food habits of great cormorant *Phalacrocorax carbo* hanedae at Lake Biwa, Japan, with special reference to ayu *Plecoglossus altivelis altivelis*. Fisheries Sci 72: 477-484.
- Teruaki H, Ishida A. 2012. Home ranges and seasonal movements of Great Cormorants *Phalacrocorax carbo* in the Tokai area, based on GPS-Argos tracking. Jap J Orni 61: 17-28. (in Japanese with English abstract)
- Warke GMA, Day KR, Greer JE, Davidson RD. 1994. Cormorant (*Phalacrocorax carbo* [L]) populations and patterns of abundance at breeding and feeding sites in Northern Ireland, with particular reference to Lough Neagh. Hydrobio 279: 91-100.
- Won HG. 1963. Birds of Choseon. Sciences Academy Press. pp 33-35. (in Korean)