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## THE OUTBREAK OF AVIAN CHOLERA AND THE IMPORTANCE OF CONSERVING VARIOUS WETLANDS TO DISPERSE WATERFOWL

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### Introduction

In October 2000, the first outbreak of avian cholera (*Pasteurella multocida*) in waterfowl, affecting primarily Baikal Teals (*Anas Formosa*) but also Mallards (*Anas platyrhynchos*), Pintails (*Anas acuta*), Common Teals (*Anas crecca*) and Bean Goose (*Anser fabalis*), was occurred at Seosan Reclamation Area in Korea. The total numbers of dead birds were reached to 12,000 individuals. Of the birds, 90% of them were Baikal Teals, so more than 11,000 of Baikal Teals died during the outbreak. This single outbreak of avian cholera killed about 3% of world population of Baikal Teal. Mallard and Pintail also died large numbers due to the epidemics, and the ratio of dead birds were 5% and 4%, respectively.

Avian cholera is a highly infectious disease caused by the bacterium *Pasteurella multocida*. This bacterium can kill waterbirds swiftly, sometimes as few as 6-12 hours after infection. Bacteria released into the environment by dead and dying birds can subsequently infect healthy birds (Samuel et al. 1999). As a result, avian cholera can spread quickly through a wetland, killing thousands of birds in a single outbreak. Outbreaks of avian cholera among wildbirds were reported in Europe and North America (Samuel et al., 1999). Currently, avian cholera occurs periodically along North America and is affecting more than 100 species of wildbirds (Botzler, 1991).

In 1976, the outbreak occurred in imported myna birds (*Eulabes intermedia*) in Japan. After the incident, outbreak of avian cholera have been reported in several kinds of birds both domestic and wildbirds, in each year, in various areas of Japan (Takahashi et al. 1996). However, avian cholera has not been officially reported in Korea even though it would be possible that the avian cholera occurred periodically but no one recognized the outbreak. The first outbreak of avian cholera in Korea occurred in waterfowl, the majority of dead birds were Baikal Teals in 2000. Thus, we

documented avian cholera mortality chronically in wintering Baikal Teals and other waterfowl.

## **Outbreak of Avian Cholera**

### **Site description**

The outbreak of avian cholera occurred at Seosan Reclamation Area in October 2000. This area was located in Seosan-gun, Chungnam Province, Korea (36° 38'N, 126° 25' E), about 160 km southwest of Seoul. The area, used to be tidal flat, had been reclaimed from 1982, and finished in 1996. The former tidal mudflat was developed for rice field, and deep area was remained for freshwater reservoirs. This area were consisted with two separate field, which A' and B' Areas. The A' Area is 9,800ha including 2,900ha Ganwol Lake, and B' Area is 5,800ha including 1,700ha Bunam Lake. This reclamation project was done by Hyundai Company, and the new land became the property of the company.

The two freshwater lakes located at the reclamation area became many waterfowl wintering and migration staging areas as many as 400,000 waterfowl. Simultaneously, the economic booming in Korea resulted in destruction of alternative waterfowl habitat and urbanization of rural area. Thus, most of the waterfowl are concentrating at large artificial lakes as a result of tidal mudflat reclamation in the West Coast of Korea. Seosan Reclamation Area is one of the largest reclamation area developed during the last three decades in Korea. Since its broad rice field and artificial reservoirs without human residents, it have become the most important wintering ground of waterfowl in which the largest numbers of waterfowl use this area and resting and feeding ground.

### **Cause of the outbreak**

We were informed that a few mortality of Baikal Teals happened at the Seosan Reclamation Area in the evening of October 22, 2000. At first, it was thought that it happened by foraging insecticide treated grains scattered by poachers, sometimes occurred at rural area. In the next day, local government personals had patrolled the area and found few hundreds of stranding birds, the majority were Baikal Teals. Then, we recognized it was very serious problem and it should affect the whole population of

waterfowl including Baikal Teals at the Seosan Reclamation Area. On October 24, research team visited the site and collected dead birds. In the field, we recognized that it was not happened by intoxication by consuming insecticide treated grains. The field sign of dead birds were very different from the former similar incident. Thus, we immediately investigated the cause of mortality and sent dead specimens of Baikal Teals, Mallards and Pintails to the National Veterinary Research and Quarantine Service, and Chungnam Veterinary Service Laboratory. Later, the two institutes reported identical result that they isolated and identified *P. multocida* from the specimen of waterfowl collected in Seasan Reclamation Area. Also, they confirmed the clinical sign of specimen and the sudden death of large numbers of waterfowl during the winter months are the identical to the outbreak of avian cholera in other regions.

### **Field Investigation**

Dead birds were continued to collected to prevent further transmission, and identified for species level for each birds. After identification and counting, the carcasses were incinerated for safety of the reservoirs. The collected dead birds, counted 12,463 individuals, were identified to species level (Table 1). The majority was Baikal Teals (90%), and followed in the order of Mallards (5%), and Pintails (4%). Only a few tens of waterfowl species died during the break were Common Teals (0.6%), Bean Geese (0.4%), and Spot-billed ducks (0.3%). In addition to the species, we collected some other waterbirds, White fronted Geese, Common Coots, Gray Herons, Herring Gulls, Eurasian Widgeon and Black-headed Gull, but their numbers were not greater than four. Therefore, we could not confirm that the birds were dead by the infection of avian cholera.

While we are collecting dead birds, it was very rare to find sick birds. We only found 2-3 dying birds a day, and they soon dead in captive. The dead birds showed blood and other secretion at mouth and respiratory sound. Most birds found dead looked healthy with no sign of malnutrition. Presumptive diagnosis was done at the field based on the necropsy of three Baikal Teals. The specific sign of intestines was the hemorrhages at intestine and the intestines were filled lots of blood. However, the liver had no sign of infection and seemed to be normal. When we were at the field site for collecting dead birds, there was not unusual weather. It is general fall weather, relatively mild day continued during the avian cholera outbreak along with one day's heavy rain recorded 21.6 mm precipitation.

Table 1. Retrived dead birds by avian cholera and waterbird population during the outbreak at Seosan Reclamation Area.

<b>Scientific Name</b>	<b>English Name</b>	<b>Dead Birds</b>	<b>Rate</b>	<b>Observed Population</b>	<b>Mortality</b>
<i>Anas formosa</i>	Baikal Teal	11152	89.5%	170000	6.6%
<i>Anas platyrhynchos</i>	Mallard	581	4.7%	59100	1.0%
<i>Anas acuta</i>	Northern Pintail	542	4.3%	2570	21.1%
<i>Anas crecca</i>	Common Teal	80	0.6%	740	10.8%
<i>Anser fabalis</i>	Bean Goose	55	0.4%	20360	0.3%
<i>Anas poecilorhyncha</i>	Spot-billed Duck	41	0.3%	21800	0.2%
<i>Anser albifrons</i>	White-fronted Goose	4	<0.1%	625	
<i>Fulica atra</i>	Coot	2	<0.1%	25	
<i>Ardea cinerea</i>	Grey Heron	2	<0.1%	56	
<i>Larus argentatus</i>	Herring Gull	2	<0.1%	68	
<i>Anas penelope</i>	Eurasian Wigeon	1	<0.1%	0	
<i>Larus ridibundus</i>	Black-headed Gull	1	<0.1%	179	
Total (Affected Species)		12463		275523	4.5%
Other Waterbirds		0		1685	
Total		12463		277208	4.5%

## **Chronicle Records**

We reorganized the situation of the outbreak of avian cholera while we were Before our field investigation, local bird watchers and governments personal observed and reported the field situation of the outbreak.

On or before 21, 2000: Unusual avian mortality was not known at the Seosan Reclamation. More than 300,000 waterfowl with 200,000 Baikal Teals were arrived from early October and they stayed in this area.

Day 1 (October 22): Local birdwatcher, Hyun-Tae Kim, observed four dead ducks and a Bean Goose, the intestines of the latter was scavenged by unknown predator. On the same day, the other birdwatchers discovered about 200 ducks, mostly Baikal Teals, were stranded along lakeshore. They also found two dying ducks and transferred them to a animal care center. Immediately after transferring, the ducks were all dead. The birdwatchers reported this incident to the local government office.

Day 2 (October 23): Local government personals and NGO volunteers patrolled and collected dead wildbirds. At that time, it was thought that the birds were died by pesticide intoxication by eating contaminated grains, which should be located by illegal poachers. The total number of collected birds was about 400, and most of them were located on lake beach or isolated sand islands at or near the mouth of Haemi Stream, Ganwol Reservoir. Some of the dead birds still maintained worm body temperature.

Day 3 (October 24): The cumulative number of dead birds reached 600. At the B' area, dead birds were begin to be observed at the lake beach and few carcasses were found at rice field and inland waterway. Again, very few dying ducks were rescued, but shortly after the birds were all dead while keeping in cages. It was rained at night and the precipitation was 21.6mm.

Day 4 (October 25): The situation became very serious and speculated that it was not pesticide intoxication because of the symptom of dead birds and the perished huge number of them. From this day, we and other experts joined the investigation team. After examining the birds, we suggested that the cause of the mass die-off should be avian epizootics. Therefore, intensive collecting work was done by local government and NGO members. The dead birds were mainly located at upper region of the Ganwol Reservoir, and they were scattered almost every place of both

Ganwol and Bunam Reservoir. Also, the birds were stranded along beach and sand bars by wave action and wind. Also, a few birds were found nearby rice field and small stream, but it could not be thoroughly surveying the land area by lack of manpower. Therefore, we concentrated our retrieving activity on beach and sand island at both reservoirs. In this day, we found only two dying birds. The cumulative numbers of dead birds were about 2000.

Day 5 (October 26): The situation became even worse, and we continued to retrieve the dead birds. The largest number of birds which was collected was Baikal Teal and in the order of Mallards, Pintails, Spot-billed Ducks, and Bean Geese. And then the numbers reached 4000. At this time, about 300,000 waterfowl including 150,000 Baikal Teals stayed after the fall migration. While collecting dead birds, we could see the huge flocks of waterfowls were floating on the water. At dusk, the waterfowls were moving to rice field for eating scattered rice grains. The majority of waterfowls were looking healthy without sickness.

Day 6 (October 27): The total numbers were 8200 birds, so more than 4000 were collected this day only. Among them, 6500 and 1700 were collected at Ganwol and Bunam Reservoirs, respectively. Moreover, we still found lots of dead birds on the reservoirs after day's work.

Day 7 (October 28): We continued to collect dead birds, but they seemed not to die recently. Approximately, less than 100 birds were freshly killed during the last 24 hours by the epizootics. However, the total numbers reached to 12350 birds. The collected birds were incinerated except a few specimens for future examination.

Day 8 (October 29): Only 50 more birds, not newly killed, were collected. At the mouth of Haemi Stream, the first place which dead birds were found, only a dead female Baikal Teal was found. In the same time, lots of waterfowl were staying on the water with 150,000 Baikal Teals.

Day 9 (October 30): Only 30 more but not freshly killed birds were collected, and extensive searching effort for collecting dead birds was stopped. The cause of the dead birds analyzed by veterinarian was avian cholera which officially announced by the Ministry of Environment.

Day 10 (October 31): No more freshly killed birds were found at the Seosan Reclamation Area.

From November 1 to December 31, 2000: No more freshly killed birds were reported at the Seosan Reclamation Area. Also, mass die-off of waterfowls was not occurred at the major wetlands in Korea. At the end of November, huge flock of Baikal Teals, approximately 280,000 were observed at Haenam Reclamation Area, Jeonnam Province during our monthly census of nationwide wintering waterfowl at major wetlands in Korea. Thus, the outbreak of avian cholera was not critically affected to the population of Baikal Teals in Korea.

### **Vulnerability of Mass Concentration**

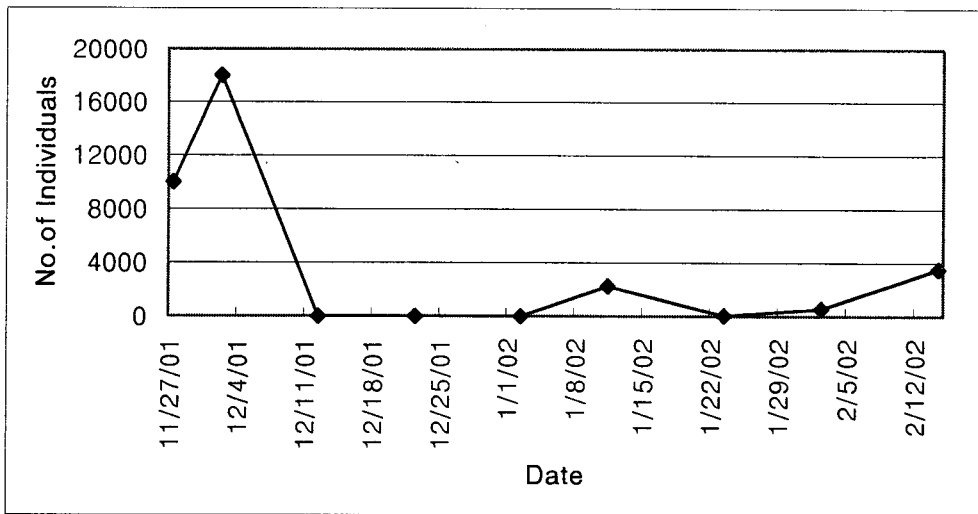
Korea peninsular is an important waterfowl wintering ground, the birds are usually breed in Russian Siberia, Mongolia and Northern China. From the late September waterfowl begin southbound migration reaching to Korea. Much of the wetland in Korea has been drained for agricultural land for supporting densely populated human population. Moreover, constructing and embankment for the various land use relegated huge area of flood plain, which used to be good waterfowl habitat. For this result, waterfowl could not find suitable habitat, so they are congregating few very large reservoirs, which created, by mudflat reclamation in the west coast of Korea. Many researchers predicted that this waterfowl concentration in a few focal areas might cause a problem of conserving wildlife.

Especially, the number of Baikal Teals has increased explosively from a few to a quarter million. Moreover, its behavior of making huge flock, the birds are very vulnerable to the avian epidemic, so ornithologists worried about the mass mortality by spreading epidemics. Their suggestion became real at the Seosan Reclamation Area. In a week of the outbreak, the number of combined waterfowl which died due to the avian cholera, reached to 12 000 birds, and 90% of the birds were Baikal Teals. Thus, more than 10 000 of Baikal Teals died in a week. This number of Baikal Teals is about 2.5% of world population of Baikal Teals. This kind of increased waterfowls were also recorded in Snow Geese in North America. Snow Geese are affected by avian cholera too, and it became annual incidents in the North America, sometimes killed more than one million waterfowl a year (Samuel et al. 1999).

### **Case study of creating new wintering habitat for waterfowl**

To create new wetland habitat for dispersing waterfowl, we maintained water-flooded rice field in the winter at Cheonsu Bay area at two adjacent rice fields (about 2ha in total) with 15cm water depth from

November 21, 2001. In this experiment, we collected data by counting and identifying all birds within the boundary of the field until February 14, 2002. Surveys were conducted at approximately 10-day intervals. In this area, waterfowl usually come to the field 30 minutes after sunset. During the early season, the dominant species were Mallards followed by Northern Pintails and Baikal Teals, and the maximum numbers of ducks were as many as 18,000 on December 2, 2001 (Fig. 1) During the mid-winter the surface of the water-flooded rice field was freezing over, so there was no coming waterfowl. During the late season, the dominant species was changed to Bean goose, and the maximum numbers of geese were as many as 3,500 on February 14, 2001. -



**Fig. 1.** Number of waterbirds observed at water-filled rice field at night.

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