

Increased nestling mortality among the Chestnut-cheeked Starlings breeding in Sapporo

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Abstract

The Chestnut-cheeked Starlings (*Agropser philippensis*) breed in the northern part of Japan. In 2015 and 2016, there was an unusually high nestling mortality, which seemed to be linked to abnormally low temperatures and high precipitations in mid-May to June. Global warming is said to warm up the environment, but global cooling and irregular climatic patterns are also predicted to occur before a full-fledged warming takes, place especially in the cold temperate regions. Long-term and detailed surveys should be necessary in order not to overlook these changes, which might have profound negative impact on wild birds.

Key words : summer birds, nestling deaths, body mass, irregular weather patterns

Introduction

The Chestnut-cheeked Starlings (abbreviated as CCS hereafter) breed in the northern parts of Japan¹⁾. In Honshu, they are found in more mountainous areas. They are common breeders in Hokkaido, where they breed in a wide range of habitats from lowlands to hilly areas. The starlings winter in Southeast Asia^{2,3)}. Hokkaido is their northernmost breeding area of the species in Japan and the Hokkaido population is believed to travel the longest distance among the conspecifics breeding elsewhere in the country.

It is believed that the livelihood of migratory birds depends on the environmental conditions of breeding areas, migration stopovers, and wintering grounds^{4) 5)}. Degradation of any of the above should

severely affect their survival.

The major aspects of global warming are the temperature rise and changes in climatic patterns. These overall tendencies may be generally true. However, some researchers predict that “global cooling” may occur as a precursor of a full-fledged warming particularly in the cooler temperate and the sub-arctic regions⁶⁾.

This paper describes how abnormally cold and wet months gave profound negative effects on the breeding of CCSs.

It is of course too early yet to say that the climatic anomalies we experienced in the late springs and early summers of 2015 and 2016 were indeed an aspect of global cooling. Continued monitoring will be needed to clarify how climatic changes are going

to occur in Sapporo area and how they will influence the breeding birds.

Study area and methods

The study area was located in Minami-ku, Sapporo, which included Tokai University Sapporo Campus (42° 59' 29" N, 141° 19' 09" E), private land and premises of public schools and a municipal center. The area was a typical residential area of Sapporo with houses, parks, and school woods.

I hanged forty nest boxes in usual years from 1995 to 2016 (ten to twenty in 2011-2013 when the number of breeders dropped as few as one pair). Except for these three years, several to over twenty pairs readily bred in the nest boxes provided.

The CCSs arrived in my study area from late April to early June. I monitored their breeding activities almost every day using binoculars and a telescope. During nest building and egg-laying periods, I limited actual nest visits to about twice a week. The breeding adults were captured in the nest box after the 7th day of incubation, taken measurements, individually marked and placed back to the box. The clutch size, hatching and fledging dates were recorded. Nestlings were also captured in the nest box, weighed and individually marked with plastic color bands and/or aluminum bands usually on the 11th day after hatching. For some nests, the body mass of the nestlings was monitored every other day. Handling of the nestlings were limited as much as possible in order to minimize the risk of predation by the Large-billed Crow *Corvus macrorhynchos*, the Japanese Marten *Martes melampus*, snakes and other potential predators. Limiting the handling of the nestling to the minimum was important to alleviate the stress of the breeding pairs as well.

In 2015 and 2016, four nests and one nest, respectively were abandoned and unfeathered nestlings were found dead. Because it had been unusual for the CCS to abandon nestlings at around 6 days old, some of them were autopsied to

determine the cause of deaths. The dead nestlings were weighed and compared with the data taken from the nestlings from 2001 when several nestlings were weighed at 6 days after hatching.

Two adult birds were found dead in the nest boxes in May, 2016. They were weighed and taken body measurements, which were then compared with those of the other breeders.

Results

The overall breeding success expressed as the proportion the total number of fledglings to that of eggs laid in 2015 and 2016 was 50.9%. That in the typical years, 2004-2006 and 2014, was 94.3%. Nest success, the proportion of nests with fledglings to the total number of nests, was 78.9% in 2015-2016, while that for the four "normal" years was 91.7% years.

Figure 1 shows the body masses of the dead nestlings from 2015 and those of the same age from 2001. The difference between the two groups was statistically significant (Mann-Whitney U-test, $U=9.00$, $p<0.01$).

The diagnoses from the autopsies are shown in Table 1. The cause of the deaths in nest boxes N

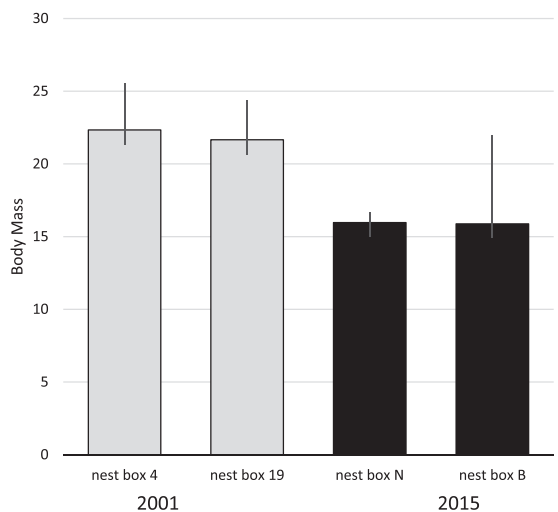


Figure 1 Body mass of 6-day old nestlings which were retrieved dead and that of normal year.

Table 1 Possible causes of nestlings' deaths in 2015 and 2016

	Date of collection	Body mass	Symptom	Possible cause of death	Remarks
nest box N	2015/6/7	15.3	cyanosis	hypothermia or extremely low metabolism	little or no food items in digestive tracts. Color difference in right and left ventricles.
		15.9	"	"	"
		16.7	"	"	"
nest box B	2015/6/7	20.2	cyanosis	hypothermia or extremely low metabolism	little or no food items in digestive tracts. Color difference in right and left ventricles.
		19.3	"	"	"
		19.2	"	"	"
		15.1	"	"	"
		5.6	"	"	"
nest box J	2015/6/22	27.5	puncture in digestive tracts	died from puncture wound	no food item in digestive tracts. Unpalatable object (carpophore) punctured the digestive tract.
		19.5	"	"	"

and B in 2015 was determined to be hypothermia and that of nest box J was from puncture wounds to the stomach wall by carpophores. The digestive tracts of all of the dead nestlings contained no or very few food items, indicating that they were extremely underfed. The nestlings from N and B died around 6 days old and those from J died just over 10 days old.

The body mass of the female breeder found dead in the nest box on May 23, 2016, which was retrieved within 2 days after she had last been seen alive, was 37.5g. She had weighed 50.5g in June, 2015, indicating 25.7% reduction in the body mass. The dead male was retrieved and weighted within a day after he was last seen alive. His body mass was 39.0g. Although there was no previous measurement data for the dead male, being a new comer, weighing only 39.0g was apparently not normal. The body mass of the CCSs in the past 20 years of my survey had never been less than 43g⁷⁾.

The mean body mass of the nestlings in 2015-2016 was lighter ($39.75 \pm 5.883\text{g}$, $n=87$) than that of representative normal years ($46.55 \pm 3.216\text{g}$, $n=73$). Not only were the 2015-2016 nestlings lighter, they tended to have a greater variance, trailing along the lighter gradient (Figure 2). The difference in body mass between the two groups was statistically significant (t -test, $p<0.001$).

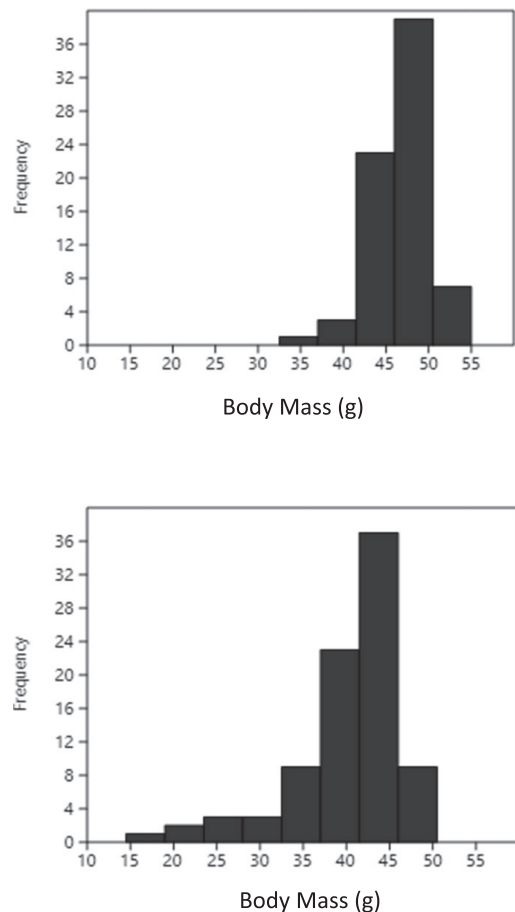


Figure 2 The body mass of the nestlings at 11 days. The upper histogram shows the frequency distribution of the nestling body mass in 2004-2006 and 2014 and the lower shows that of 2015-2016

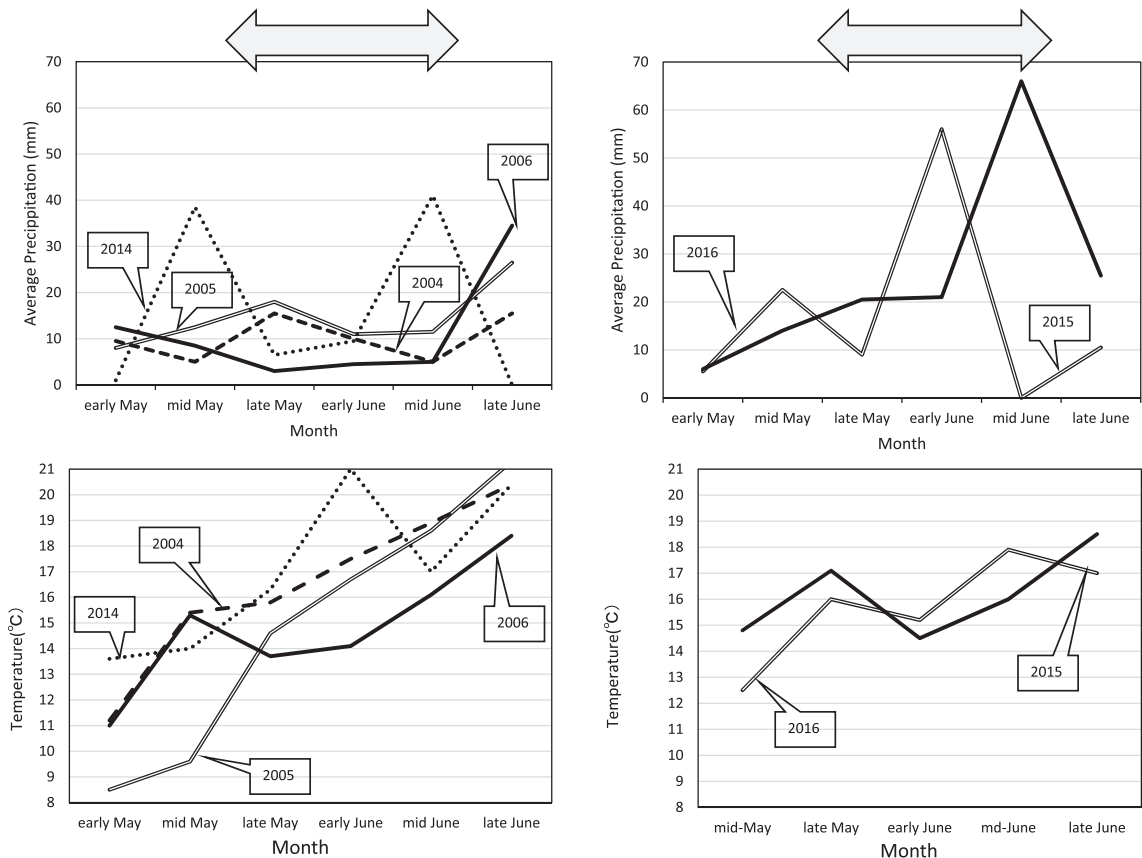


Figure 3 Average temperatures and precipitations of the "normal" years (left side) and 2015-2016 (right side). An arrow on top of each side indicates the critical period for the growth of nestlings

The mean temperatures and precipitation between mid-April and the end of June, which was the peak breeding period of the CCS in my study area, are shown in Figure 3. The figure indicates that there were considerable drops in temperatures from late May to early June in both 2015 and 2016, while such drops were not observed in most of the typical years. Precipitation was markedly greater during the same period in 2015 and 2016. The patterns of the temperature drop and increased precipitation were similar between 2015 and 2016. As shown in the figure, late May-early June was the critical period for the growth of the nestlings.

The nestlings in 2015-2016 tended to stay longer (3-5 days) in nest than those in normal years.

Discussion

The low body mass and high mortality of the nestlings in 2015 and 2016 were probably brought about by the low temperatures and unusually high precipitations during the critical periods for the growth of the young. Buds opened up very late in May in these two years, which normally did so around late April to mid-May. Even after leaves began to spread, low temperatures and heavy rain slowed down insect growth, which are the vital food for many bird species⁸⁾⁹⁾.

Most of the nestlings in 2015-2016 died at about 6 days old and diagnosed that they died most likely from hypothermia and starvation. Aside from the shortage of food due to the cold and wet weather, this seemed to be related to the physiological

change in the nestlings and the change in females' brooding behavior during the night, which coincides with the former. Female CCSs sleep in the nest box until the young are 6-7 days old. Females cease to come back in to brood thereafter. The timing of females sleeping outside the nest box seems to coincide with the time when the young begin to develop homeostatic capability¹⁰⁾. In usual years, the nestlings older than 6 days could get by without the female warming them at night. The nestlings of nest box J (Table 1) thrived over 10 days probably because the temperatures increased towards the end of June.

The devastating effects of the low temperatures and climatic anomalies on wildlife in spring are often overlooked because they are offset by higher temperatures in early summer on as far as economically important industries such as agriculture are concerned.

The serious reduction in the body mass of the breeders found dead in their nest boxes also is a concern. The adults seemed to have died 10 days from their first sightings in the study area. Thus, it is unlikely that most of their body mass reduction occurred after their arrival in the study area. The most likely scenario was that they barely made it back to the breeding ground, but ran out of energy to thrive and go on with breeding. There may be two plausible causes of their deaths; the environmental degradation of the wintering grounds, and that of stopovers, or both. The poor climatic condition of 2015 might be partly responsible for their exhaustion. We may also have to be aware of an unprecedented increase in the number and scale of storms and low pressure systems and their possible negative effects on migratory birds, both of which travel along the Japanese archipelagoes at the time of spring and autumn migration seasons.

There are reports to show that global warming have already altered the breeding schedule and success of birds¹¹⁾¹²⁾. Most of the reports state that global warming simply warms up the environment

and birds tried but failed to adapt to warmer environments. However, as Cohen et.al pointed out, it might cool the environment before a full-fledged warming takes on, especially in the cold temperate and sub-arctic regions⁶⁾. We do not know yet how global warming takes its course and it is yet too early to say the climatic anomalies which we experienced in the past few years were indeed a part of abnormal climatic oscillation. However, we should be aware of the possibility that climate change may well oscillate in both directions, warming and cooling. Nonetheless, this study showed that even 2-3°C drop in temperature and increased precipitation during the critical period of nestling growth had a serious negative effect on the breeding success of the CCSs. A long-term and detailed survey should be necessary to keep track of the connection between the climate change and the breeding wildlife populations.

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Acknowledgements

I would like to express my gratitude to the staff of Moiwa Chiku Center, minamisawa elementary school, Minamigaoka junior high school and Moiwa junior high school, to K. Tsubaki, and T. Liu and many others who offered kind assistance in capturing and making observations on the CCSs in my study area.

Part of this study was funded by toCollabo Eco Conscious Project of the Ministry of Education and Scicences granted to Tokai University in 2015-2016