

## **Preliminary Study on the Breedings of Chinstrap and Gentoo Penguins at Barton Peninsula, King George Island**

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A preliminary survey on two penguin species, chinstrap and gentoo, was conducted in the penguin rookery at Barton Peninsula on King George Island during the fledging period of 1991/92 season and in 1992/93 breeding season, based on the CCAMLR standard methods. Totals of 96 nests for chinstraps and 121 nests for gentoos were monitored to determine breeding chronology and breeding success. Chicks were hatched out at 50% of the monitored nests on 18 and 25 December for gentoos and chinstraps, respectively. Among the all nests which had been checked from the beginning of the observation, 1.45 chinstrap chicks and 1.32 gentoo chicks were raised per pair to the creche stage. Of the nests which were active until the conclusion of the breeding success measurement, 1.67 chinstrap chicks and 1.54 gentoo chicks per pair reached the creche stage. The growth of chicks were measured from the beginning of January to the beginning of February. Chinstraps grew from 0.61 to 3.43 kg and gentoos from 0.56 to 4.59 kg during the measurement period. During the late creche period, some chicks were banded to determine the survival and return rates in the following years.

**Keywords:** penguin breeding, chinstrap penguin, gentoo penguin, King George Island, Barton Peninsula.

### **INTRODUCTION**

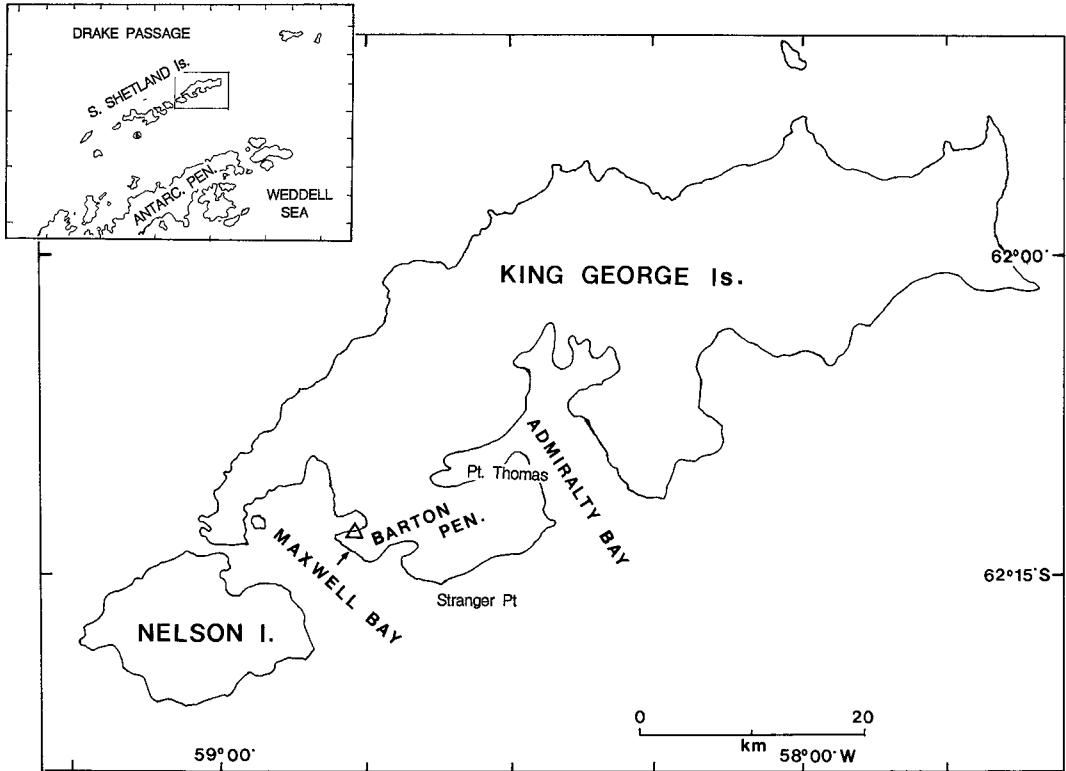
Antarctic penguins forage mainly on krill over large areas of the continental shelf in the Southern Ocean. During the 4-5 months of breeding season, however, they are tied to one location to which they return. Being flightless seabirds, they are limited in the distance they are able to forage from the breeding sites. Therefore penguins, which act as samplers of the marine environment, have been shown to serve as useful monitors of antarctic marine living resources and even as indicators of environmental change.

There lies a breeding colony of two penguin species, chinstrap (*Pygoscelis antarctica*) and gentoo (*P. papua*), at Barton Peninsula near the Korean Antarctic research station, King Sejong, on King George Island. At King George Island, there were a number of penguin studies (Trievelpiece *et*

*al.*, 1987; Volkman *et al.*, 1980) and are ongoing programs on them. Although there have been some fragmentary reports on penguins in this rookery at Barton Peninsula by Korean scientists (KORDI, 1990, 1992; Yoon, 1990), no systematic study was carried out on penguins until 1991/92 season. Recognizing the importance of penguins as top predators in antarctic marine food web and a highly influential factor in coastal ecosystem, Korean Antarctic Research Program (KARP) commenced the penguin monitoring program.

In this report, results of our preliminary survey conducted to achieve the research goals set as follows are presented.

- 1) document breeding chronology for the two species in this area.
- 2) provide an estimate of breeding success.
- 3) obtain data on chick growth.
- 4) band chicks for the study of survival and



**Fig. 1.** A map showing the study site. The arrow and triangle indicate the penguin rookery and the location of the King Sejong Station, respectively.

return rates in the following years.

### STUDY AREA

The penguin rookery is located at about 2 km away to south from the King Sejong Station at Barton peninsula (Fig. 1). Lower part of the area is occupied by chinstraps. Gentoo penguins nest at upper hill though they arrive earlier. Some numbers of other birds such as skua and giant petrel also inhabit this penguin rookery. This area has some rich flora of lichens and freshwater algae. Antarctic cods, diverse benthic animals and macroalgae abound in subtidal waters in front of the penguin rookery. The area around the penguin rookery can be said a stage of most intense biological activity near the King Sejong station.

Jablonski (1984) reported 6298 breeding pairs of chinstraps in this rookery in 1980/81 breeding season. Trivelpiece *et al.* (1987) reported 7306 pairs of chinstraps and 566 pairs of gentoos with some corrections on Jablonski (1984)'s data. However,

Shuford and Spear (1988) reported roughly 3500 chinstrap adults in this rookery in 1987 breeding season. Yoon (1990) reported 1161 breeding nests of chinstraps and 682 breeding nests of gentoos. In the census activity of KORDI (1992) including breeders and nonbreeding subadults in 1991/92 breeding season, about 4000 chinstraps and about 1500 gentoo penguins were reported when the maximum number of the birds were in the colony. Though we did not succeed in counting the number of breeding nests in 1992/93 season, it is estimated from browsing the colony that approximately 2000 pairs of chinstrap penguins and some more than 500 pairs of gentoo penguins breed in these years.

### MATERIALS AND METHODS

Preliminary study on the two species of penguins, chinstrap and gentoo, was conducted in the rookery at Barton Peninsula during the fledging period of 1991/92 breeding season and in 1992/93 breeding season. Due to the late observation, only

fledgling measurements were made during 1991/92 breeding season. To develop monitoring items adequate to our situation, the standard methods (CCAMLR, 1988) recommended by Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) were applied with some modifications in this survey and we intended to obtain some baseline data on the ecology of the two penguin species in our study colony.

### ***Breeding Chronology and Breeding Success***

Totals of 96 nests for chinstrap and 121 nests for gentoo were selected at mid November which is some days after the onset of egg laying of both species. The nests to be monitored were chosen in groups of ten to twenty from several locations scattered in the colony. This aimed to average the possible variabilities in breeding chronology from different locations in one colony. They were visited by 2-3 day interval and the number of offspring and behavior of parents were noted. The ratio of number of nests where hatching occurred - even one chick - to number of nests monitored was defined as hatching rate. The change in hatching rate with the lapse of days was determined.

$$\text{Hatching rate} = \frac{\text{No. of nests hatched}}{\text{No. of nests monitored}}$$

The number of chicks raised to the creche stage per nest was used as breeding success. The nest check which was used to determine the breeding chronology also gave a measure of breeding success. After the creche stage, it became difficult to follow the number of chicks at the respective nest. Thus breeding success was determined on 13 January for gentoos and on 18 January for chinstraps. In most cases, the adults gave up their nests soon after they lost their chicks or eggs either due to neglect of care or by predation. Therefore we figured out breeding success in two ways; number of chicks per pair about all the nests which had been monitored from the initiation of the investigation and also about the nests which were active until the conclusion of the breeding success measurements i.e., the nests where the chicks had been taken care of. We excluded, from active nests, the nests where the chicks were not hatched out but only eggs were kept until we determined breeding success.

### ***Measurement of Chick Growth and Fledgling Size***

From the beginning of January to the beginning of February 1993, measurements were made on chicks randomly caught to obtain data on their growth. We measured the weight of chicks in a bag with a spring scale to the nearest 50 g and the length of right wing with a ruler to the nearest mm. Six measurements were made on chinstraps from 3 January to 6 February. Gentoo chicks were measured five times from 3 January to 1 February. At each measurement, about 20 chinstrap chicks and 10-15 gentoo chicks were measured. Before release, the chicks were dyed with picric acid so that they should not be caught again.

In order to obtain data of chick weight at fledging, we captured the chicks which left their colony, wandering on the beach. After measurements on weight and wing length, the birds were released with picric acid on their breasts. In 1991/92 season, 168 gentoo fledglings were measured from 24 February to 13 March. Regarding chinstraps, we could measure only 3 fledglings on 24 and 27 of February. During fledgling measurements, 50 gentoo fledglings were included in our banding procedures. In 1992/93 season, fledgling measurements could not be made, since no scientific personnel was available after fledging period.

### ***Chick Banding***

We banded chicks to get some information on survival and return rates in the further years. Banding was done only on chicks so that we could know the age of the individual bird. We caught the chicks in the colony sometime after creche but before fledging and put on the left flipper a stainless steel band which has one English character and four digits of unique numbers.

In 1991/92 season, 10 chinstrap chicks and 62 gentoo chicks were banded. Some of the gentoo chicks were banded during the fledgling size measurement. After 7 March, however, we stopped banding because the invasion of other penguin population might cause biased results; there were good possibilities that some gentoo chicks, who were not born here but in some other nearby rookery, visited this beach. In 1992/93 season, 230 chinstraps and 171 gentoos were banded.

## RESULTS AND DISCUSSION

### Breeding Chronology

**Chinstrap penguin:** Chinstraps returned to the rookery in late October. After repeated copulation, they started to lay eggs around 15 November. In about 35-40 days of incubation period, hatching started. Among 96 nests checked, chicks were hatched out at 50% of the nests on 25 December. On 30 December, at 90% of the nests, hatching occurred (Fig. 2). From about 15 January, when the chicks entered creche stage, they seemed to be relatively free from their parents and nests, wandering around between the nests. Therefore it became impossible to note the nest contents. In 1992/93 season, the first fledgling was sighted on 17 February, which was just before the observer left the station. In 1991/92 season, few chinstrap fledglings were seen after 24 February when the observation was initiated. Chinstraps may have started to fledge from mid February and completed to fledge at least in the end of February, in that season. The parents started to moult after the chicks fledged and at about mid April, almost no chinstrap adults were seen.

**Gentoo penguin:** Gentoo penguins seemed more tied to land than chinstraps. Some gentoos appeared on shore when the sea ice began to melt in September. However, it was not until mid October that most of the adults started to copulate. Although some earlier adults were observed to lay eggs even in late October, most gentoos began to lay eggs about on 10 November, when the rate of laying eggs were about 5%. After about 35 days of incubation period, the chicks began to be hatched. Among 121 nests monitored, chicks were hatched out at 50% of the nests on 18 December. On 27 December, at 90% of the nests, hatching occurred (Fig. 2). Gentoo chicks started to enter creche stage

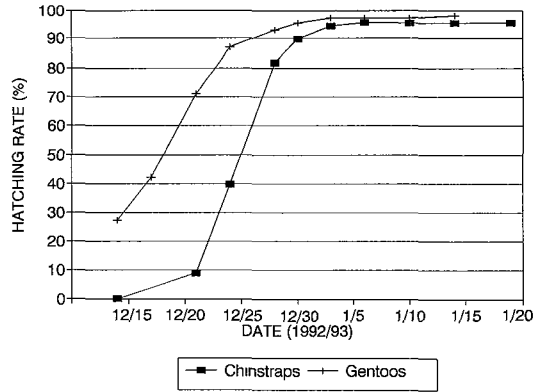


Fig. 2. Hatching rate curves of chinstrap and gentoo penguins.

around 10 January. From that day on, it was difficult to judge which individual nest the chick belonged to. After chicks almost finished moulting, they left the colony where they had been brooded. But they did not go out to sea promptly. They wandered around the beach for quite a long time and even up to their breeding sites again. After raising up their chicks, gentoo adults got into moulting. From March the number of gentoo birds decreased gradually and it was after the sea was totally frozen that no gentoos were seen in our rookery.

The hatching day of gentoo showed great variabilities, taking more time than chinstraps (Fig. 2). The hatching process of the gentoo population seems to progress more slowly.

### Breeding Success

Figures 3 and 4 showed the pattern that chicks were hatched out from eggs and the offsprings were removed with the progress of breeding process. Table 1 shows that 13.5% of the chinstrap pairs and 15.7% of the gentoo pairs failed in the course of breeding. Of all the nests which had been checked from the beginning of the observation, 1.45 chinstrap chicks and 1.32 gentoo chicks were

Table 1. Number of chicks raised to the creche stage per nest

	Nests monitored	Nests abandoned	Active nests	Chicks/pair all nests	Chicks/pair active nests
Chinstrap	96	13	83	1.45	1.67
Gentoo	121	19	102	1.32	1.54

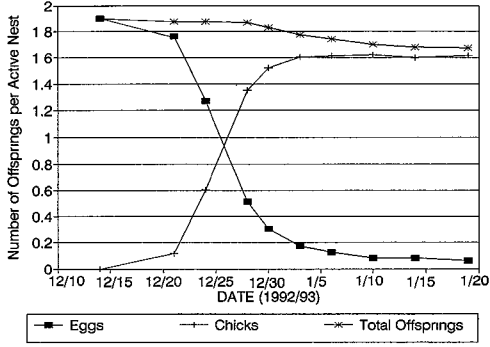


Fig. 3. Change in number of chinstrap offsprings per nest through the season.

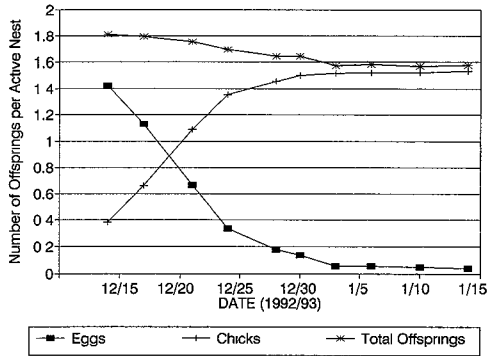


Fig. 4. Change in number of gentoo offsprings per nest through the season.

raised per nest to the creche stage. Among the active nests, 1.67 chinstrap chicks and 1.54 gentoo chicks per pair reached the creche stage (Table 1). Trivelpiece *et al.* (1990) reported reproductive success of chinstraps on King George Island in terms of chicks hatched per pair in the range of 1.37 to 0.62 from 1977/78 season to 1986/87 season. Our date of nest selection might be later than those by Trivelpiece *et al.* (1990) because pairs for breeding success estimation were selected upon the arrival of penguins on the colony in their study. However, our breeding success is in terms of chicks raised to creche per pair and it should be lower than the data in terms of chicks hatched per pair. In order to assess if our high breeding success is due to the year of unusually high breeding success or some problems inherent in our estimation procedure, the data from the nearby area during the same period need to be compared with ours.

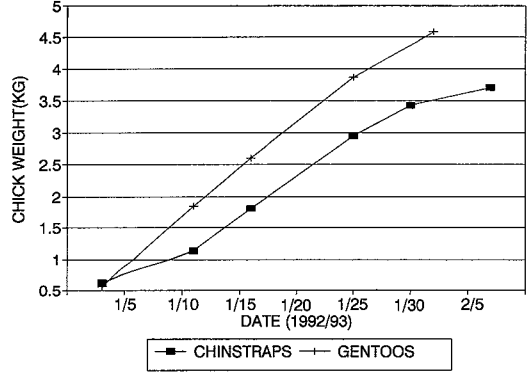


Fig. 5. Growth of chicks in weight with the lapse of days.

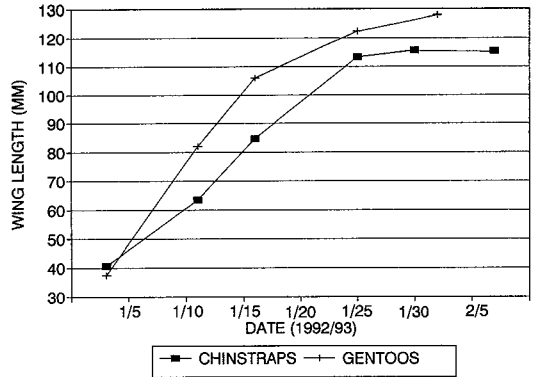


Fig. 6. Growth of chicks in wing length with the lapse of days.

**Growth of Chicks and Fledging Size**

**Chinstrap:** Chinstrap chicks showed weight growth from 0.61 kg to 3.7 kg and growth in wing length from 40.6 mm to 115.6 mm (Figs 5, 6). The result shows daily weight increment of some less than 100 g in January. We could not continue measurements until the chick growth showed a peak. However, the shape of the growth curve, especially the curve in terms of wing length, may indicate that in 1992/93 season, chinstrap chicks reached almost the peak of growth around 6 February when the final measurements were made. The average chick weight of 3.7 kg at the final measurements was well in excess of 3.32 kg, the fledging weight in 1991/92 season, although it was obtained from only 3 individuals (Table 2).

**Gentoo:** Gentoo chicks showed growth in weight from 0.56 kg to 4.6 kg and growth in wing

**Table 2.** Size of chinstrap and gentoo fledglings in 1991/92 breeding season (mean  $\pm$  standard deviation)

Period	Weight (kg)	Wing length (mm)	No. of fledglings
<b>Chinstrap penguin</b>			
2/24 - 2/27	3.3 $\pm$ 0.21	116 $\pm$ 4.32	3
<b>Gentoo penguin</b>			
2/24 - 2/29	4.835 $\pm$ 0.554	125.9 $\pm$ 4.09	57
3/ 2 - 3/ 5	4.83 $\pm$ 0.594	128.3 $\pm$ 3.829	62
3/ 6 - 3/13	4.514 $\pm$ 0.476	128 $\pm$ 3.852	49
whole period	4.739 $\pm$ 0.567	127.4 $\pm$ 4.071	168

length from 37.6 mm to 127.8 mm (Figs 5, 6). The result shows daily weight increment of quite more than 100 g in January. Also on gentoos, we could not continue measurements until the chick growth showed a peak. The average chick weight of 4.6 kg at the final measurements was below than 4.835 kg, the fledgling weight obtained during 24-29 February 1992 (Table 2). The slope of the growth curve suggests that the beginning of February is still some time before the peak of chick growth in 1992/93 season (Figs 5, 6). Gentoo chicks showed a small decline in their weight in the course of fledgling measurement, while the wing length did not show any significant decrease (Table 2). It may suggest that gentoo chicks stopped being fed temporarily before being accustomed to feeding themselves in the early March.

### FUTURE STUDY

For the KARP penguin monitoring program to be settled and make fruitful achievements in further years, followings are suggested.

1) The census on the breeding population size must be conducted and it is recommended to do it at the peak of laying eggs, hatching and creche.

2) Accurate documentation of breeding chronology is one of the tasks which should be carried out every year.

3) The method to count the number of chicks after creche stage especially per each nest should

be worked out.

4) There must be some knowledge about how to determine when creche is ended, and fledgling is begun and terminated. When it comes to gentoo, there must be clear field definition about the fledgling period of gentoo, since gentoo birds wander around for longer period even after leaving their colony without going out to sea.

5) Variabilities in breeding chronology from different individuals are quite so large that many of our surveys, especially chick growth measurements need larger sample size. Surveys requiring relatively small sized sample with little bias should be designed which is adequate to the colony of limited number of animals like ours.

6) The investigations about not only population parameters but also on foraging behaviors should be added. Deployment of dive recorders and study on chick diet are required for that.

7) Chick banding must be continued without forthcoming outcome in one or two year. More easily recognized tag for birds with less disturbance should be considered.

8) For easier observation with more hours, observation posts are necessary.

9) The extent of disturbance caused by the investigation activity should be checked and there must be some effort to minimize it.

10) There should be co-operated activities with the ongoing penguin monitoring programs of other countries on King George Island.

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