

Length and Weight Relationship for Two Dominant Antarctic Notothenioid Fishes Caught in the Coastal Water off King Sejong Station, King George Island, Antarctica

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ABSTRACT Length and weight relationship (LWR) for dominant Antarctic fishes was determined in two species of the family Nototheniidae; black rockcod (*Notothenia coriiceps*) and marbled rockcod (*Notothenia rossii*). Samples were caught in the offshore sea around King Sejong station located on King George Island, Antarctica in January, 2017. A total of 30 *N. coriiceps* and 7 *N. rossii* were caught by fishing rod and hook. Average total length was 266.0 mm for *N. coriiceps* and 275.4 mm for *N. rossii*. Average total weight was 283.1 g for *N. coriiceps* and 290 g for *N. rossii*. In terms of LWR and b value, the results showed that both two species had positive allometries ($b > 3$) in good health. This size information of two dominant Antarctic fishes would be useful for future physiological studies to understand of adaptation mechanism and biological pathway of Antarctic marine organisms.

Key words: Length and weight relationship, Antarctic notothenioid, condition factor

INTRODUCTION

Antarctic notothenioid is the most dominant ichthyofauna of the Southern Ocean. Their evolution for millions of years are remarkable examples of adaptation to extreme thermal environment (Clarke and Johnston, 1996; Eastman, 1993). Intensive studies over the last 50 years nototheniid fish from Antarctica have revealed Antarctic notothenioid as the most diverse notothenioid family. They possess distinct physiological and biochemical characteristics that have played an essential role in their adaptation to extreme conditions. Among them, acquisition of antifreeze glycoproteins has allowed to survive down to -1.9°C , the freezing point of seawater without intracellular ice formation (DeVries and Wohlschlag, 1969; DeVries and Cheng, 2005).

The two important populations, around the South

Oceans, black rockcod (*Notothenia coriiceps*) and marbled rockcod (*Notothenia rossii*) are regularly exploited by commercial fishing industry (Duhamel, 1982). *N. coriiceps* showed a circumpolar population distribution (DeWitt *et al.*, 1990) and is one of the dominant fish species around the South Shetland Islands (Casaux *et al.*, 1990). *N. coriiceps* is known as primarily a benthic predator for its feeding on polychaetes, thaliaceans, gammarid amphipods, molluscs (Blankley, 1982). *N. rossii* has been the object of several studies concerning the biology and the general aspects of populations (Shust and Pinskaya, 1978; Freytag, 1980)

The first Antarctic station of Korea - Korea Polar Research Institute (KOPRI), based on King Sejong station, has achieved many remarkable results in the area of polar genomics since 1988 (Shin *et al.*, 2012; Shin *et al.*, 2014; Ahn *et al.*, 2016). However, physiological studies of fish have been limited by the shortage of facilities including aquarium to maintain live fishes. In order to overcome the problem, an aquarium having six tanks which has a

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capacity of 300 L and cooling system has been equipped successfully in the King Sejong station in January 2017. Using the facility, we could collect Antarctic fish species and maintain them steadily to perform a variety of experiment.

Length-weight relationship (LWR) is very important factor in fishery assessments (Garcia *et al.*, 1998; Haimovici and Canziani, 2000). The LWR with age data is useful for the stock composition, age at maturity, life span, mortality, growth and production (Beyer, 1987; Bolger and Connolly, 1989; King, 1996; Diaz *et al.*, 2000). This short paper aims to determine length-weight relationship of two dominant Antarctic fishes, which would be a good start for those studies in order to improve understanding of adaptation mechanism and biological pathway of Antarctic organisms.

MATERIALS AND METHODS

Fish samples were collected between January 15th and 20th, 2017 around King Sejong station, King George Island, Antarctica (Fig. 1). The coordination of two main points was 62°13'20.18"S 58°47'13.90"W and 62°14'24.60"S 58°45'43.01"W. Fishes were collected by rod and hook with sliced beef and shrimp as bait on the rigid-hulled inflatable boat. The net fish trap was not appropriate for numerous floating ice. Sampled fishes were

moved into the aquariums of the Sejong Aquazone and maintained in the seawater (temperature: 2°C, salinity: 35 psu).

For species identification, morphological characteristics of two fishes were used classification system described in (Balushkin, 1989).

Length-weight relationship (LWR) was estimated by using the equation $W = aL^b$ (Ricker, 1973). The relationship was estimated via least square linear regression from the log transformed values of length and weight [$\log W = \log a + b \log L$ (Zar, 1984)]. The condition factor (K) was calculated by usual formula $K = 100 W/L^3$ (Pauly, 1983); where W = weight in grams; L = total length (cm). All data on LWR of the two fish species were subjected to t-test analysis at $P < 0.05$.

RESULTS AND DISCUSSION

A photograph of two fishes was shown in Fig. 2. Fig. 3 shows the length-frequency distribution of the two fishes. The size range was similarly to the previous study (Cali *et al.*, 2017). The characteristics of total length and total weight of two fishes were shown in Table 1. Average total length of *N. coriiceps* and *N. rossii* was 266.0 mm and 275.4 mm, respectively. For total weight, *N. coriiceps* was 283.1 g and *N. rossii* was 290 g. There was no significant size difference between two species while average

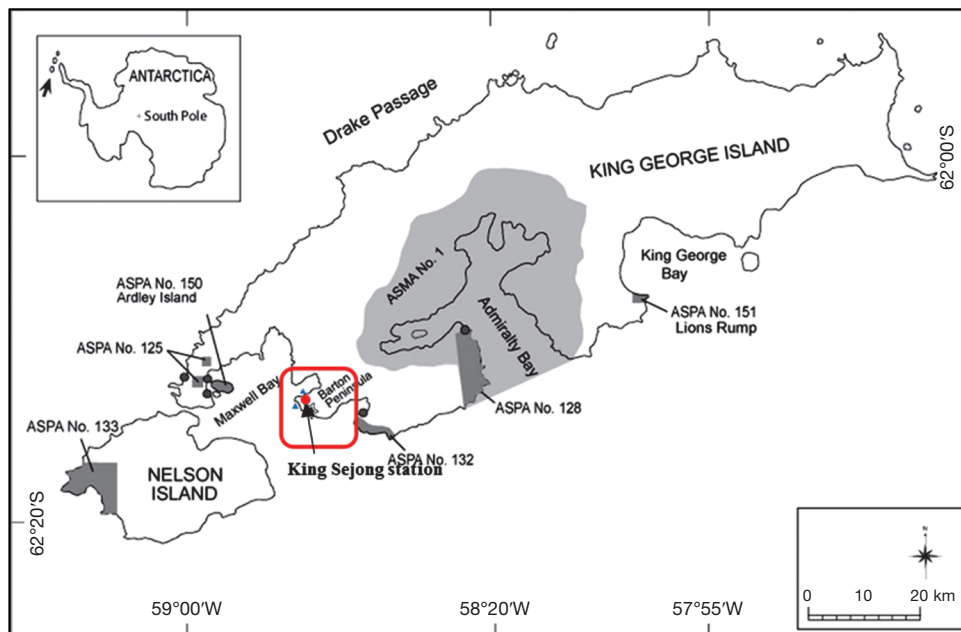


Fig. 1. Map of study site.



Fig. 2. Photograph of A. *Notothenia coriiceps* and B. *Notothenia rossii* collected in the coastal water off King Sejong station in January 2017.

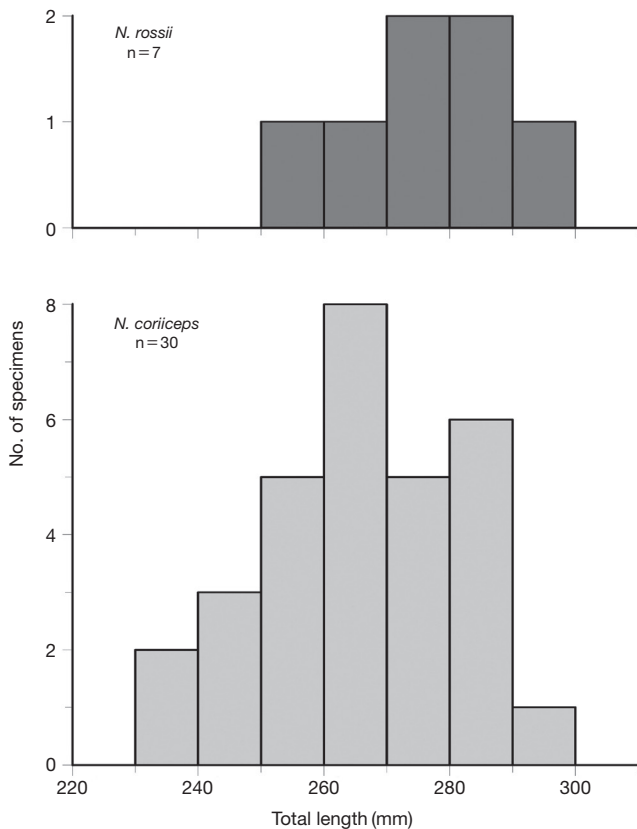


Fig. 3. Length-frequency distribution for two Antarctic *Notothenia* fishes collected in the coastal water off King Sejong station in January 2017.

Table 1. Total length and weight characteristics for two dominant Antarctic notothenioid species caught in the coastal water off King Sejong station in January 2017

Species	n	Total length (mm)			Total weight (g)		
		Mean	Min	Max	Mean	Min	Max
<i>Notothenia coriiceps</i>	30	266.0	230	296	283.1	180	420
<i>Notothenia rossii</i>	7	275.4	255	291	290.0	235	380

n: sample size; Min: minimum; Max: maximum

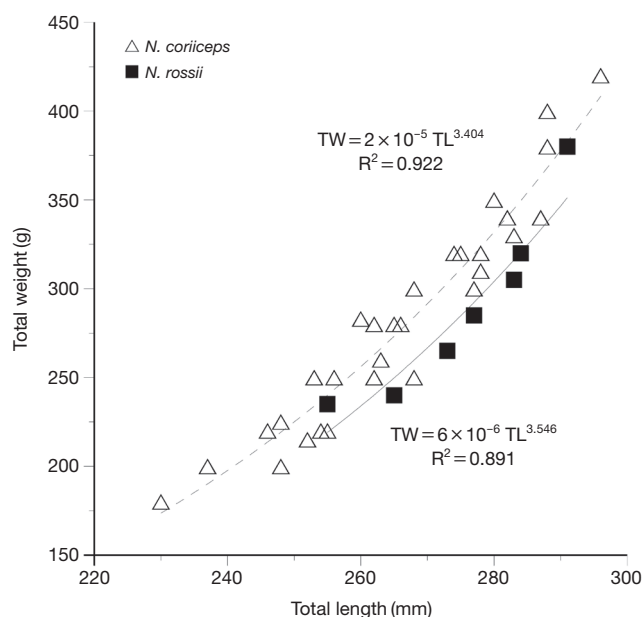
total length and total weight of *N. coriiceps* was higher than those of *N. rossii* ($P < 0.05$).

According to the previous study about age estimation for the species (Barrera-Oro and Casaux, 1992; Eastman, 2011; Cali *et al.*, 2017), *N. coriiceps* and *N. rossii* in this study could be estimated to be about 5~8 years old and 3~4 years old, respectively. Different growth rate and maximum age of the population of *N. coriiceps* and *N. rossii* and were reported with the result that *N. rossii* grew larger size at a lower maximum age than *N. coriiceps*, showing a higher growth rate and shorter age range (Linkowski, 1980; Cali *et al.*, 2017).

The relationship parameters of total length and total weight were shown in Fig. 4 and Table 2. LWR were highly significant ($P < 0.05$) for two species. The determination coefficients (R^2) were > 0.90 for *N. coriiceps*, > 0.80 for *N. rossii*. In terms of b value, *N. coriiceps* was

Table 2. Parameters of length and weight relationship (LWR) for two dominant Antarctic notothenioid species caught in the coastal water off King Sejong station in January 2017

Species	n	Length-weight relationship (LWR)			Condition factor (K)	
		a	b	R ²	Range	Mean
<i>Notothenia coriiceps</i>	30	2×10^{-5}	3.404	0.922	1.299~1.674	1.482
<i>Notothenia rossii</i>	7	6×10^{-6}	3.546	0.891	1.300~1.542	1.376

**Fig. 4.** Scattered diagram of length-weight, and their relationships for two dominant Antarctic *Notothenia* species collected in the coastal water off King Sejong station in January 2017.

3.404 and for *N. rossii* was 3.546, and the results showed that both two species had positive allometries ($b > 3$). These values are similar with the result from other previous studies regarding LWR of the two fish species (Eastman and Sidell, 2002; Eastman, 2011). Average condition factor (K) of *N. coriiceps* (1.482) was slightly higher than that of *N. rossii* (1.376) ($P < 0.05$), suggesting that *N. coriiceps* may be fatter than *N. rossii*. Higher K value of *N. coriiceps* than that of *N. rossii* was also reported in the previous study (Eastman *et al.*, 2011). However, the difference in condition factor and LWR can be caused by the small sample size of *N. rossii*, thus further investigation would be needed to improve the understanding of fish growth in extreme thermal environment.

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남극, 킹조지섬, 세종과학기지 연안에 우점하는 남극암치아속 어류 두 종의 길이와 무게의 관계

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극지유전체사업단 극지연구소, ¹극지생명과학부 극지연구소, ²세종과학기지 극지연구소

요 약 : 남극 연안에 우점하는 남극암치아목과, 암치아목속 어류 두 종 (*Notothenia coriiceps*와 *Notothenia rossii*)의 전장과 무게의 관계를 조사하였다. 어류는 2017년 1월에 남극 킹조지섬에 위치한 세종과학기지 연안에서 낚시로 채집되었다. 총 30마리가 채집된 *N. coriiceps*의 평균 전장은 266.0 mm였고, 7마리가 채집된 *N. rossii*의 평균전장은 275.4 mm이었다. 평균 무게의 경우 *N. coriiceps*는 283.1 g이었고, *N. rossii*는 290 g이었다. 전장과 무게의 관계를 조사한 결과, 두 종 모두 양의 상대성장 값($b > 3$)을 보였다. 본 조사에서 얻은 남극 연안에 우점하는 두 종의 크기 자료는 남극 해양생물의 환경적응 기작과 생물학적 대사과정을 이해하기 위한 관련 생리 연구를 수행하는데 있어서, 좋은 기초자료로 활용될 수 있을 것으로 기대된다.

찾아보기 낱말 : 길이와 무게 관계, 남극 Nototenoid