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Estimating the Size of a Mongolian Racerunner *Eremias argus* (Squamata: Lacertidae) Population at Baramarae Beach, Taeanhaean National Park

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Abstract

To determine the size of an *Eremias argus* population at Baramarae beach in Taeanhaean National Park, we used Peterson's index and Schnabel's index. In addition, we provided physical characteristics of male and female *E. argus*. During our study period, we captured total 152 lizards and among them, 23 individuals were recaptured. The 152 lizards consisted of 54 adult males, 79 adult females, and 19 subadults, respectively. Physical characteristics such as snout-vent length (SVL), tail length (TL), and body mass (BM) were not different between males and females. We recaptured total 23 individuals which consisted of six males and seventeen females. More females (21.5%) tended to be recaptured than males (11.1%), with total average recapture rate of 15.1%. The size of the *E. argus* population at Baramarae beach was estimated as 438 individuals (Min.-Max.: 226-650) by the Peterson's method and 470 individuals (Min.-Max.: 334-796) by the Schnabel's method.

Key words: Peterson, Schnabel, *Eremias argus*, Population size, Capture-mark-recapture, Monitoring

Introduction

Determining the population state is great interest for ecological studies. Usually, capture-mark-recapture method is used to estimate the population size in various animal groups, and it is often applied in the conservational studies of endangered wildlife species (Kaco liris et al. 2009).

World-wildly, approximately three thousand lizard species inhabit tropical and temperate regions (Goin et al. 1978). Gekkonidae, Scincidae, Lacertidae, and Chamaeleonidae as well-known lizard groups belong to the protopathic groups comparing to the Serpentes. Three groups, Gekkonidae, Scincidae, and Lacertidae, are found in Korea. *Eremias argus* in Lacertidae has been designated as an endangered level II species. Decreasing reptile populations in the field is playing a role as a mediator together with amphibians in weakening the food chains in an ecosystem.

Although several studies on *E. argus* were carried out, for example, embryology (Hao et al. 2006; Wu et al. 2006), the body temperature and activity (Zhao et al. 2008), food resources (Jeong and Song 2010) and morphology and age structure (Kim et al. 2010), studies on the estimation of size of field *E. argus* populations are not conducted up to date. In October

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1978, Taeanhaean National Park was designated as the only coastal National Park in Korea. The main site of this study, Baramarae beach (N 36° 24′, E 126° 22′), is located at the southern part of Taeanhaean National Park, Gonammyeon, Janggokri, Taean-gun.

We estimated the size of an *E. argus* populationn at the Baramarae beach to provide useful information for the conservation and management of this endangered species.

Materials and Methods

During the six field surveys from May to September 2008, *E. argus* was captured at Baramarae beach of 2.65 ha (Fig. 1). When an individual was captured, we marked the captured location with a flag (length x diameter: 500 x 3 mm) to release the lizard later at the same location and recorded the GPS coordinates using a portable GPS (Model, Gamin eTrax H). Also, we determined the sex of each individual and measured the snout-ventral length (SVL), tail length (TL), and body weight (BW). In addition, phalange clipping was applied to identify each individual later and the clipped phalanges were stored in 5% formalin and later used for the age structure study of *E. argus* (Kim et al. 2010).

Fig. 1. A photograph of the study area at Baramarae Beach in Taeanhaean National Park (http://map.daum.net). For captured sites of individual lizards, see Fig. 2.

Peterson's and Schnabel's methods were used to determine the size of the *E. argus* population. For the Peterson's method, we separately analyzed the survey results as the first half year and the second half survey (Schnabel 1938, Begon 1979).

The population size by Peterson's method was calculated by $N \pm 1.96 \sqrt{(N)}$ with 95% confidence interval where $N=M(C+1)/(R+1)$, Variance $(N)= M^2 (C+1) (C-R) / (R+1)^2 (R+2)$ and N is the population size, M is the captured individuals in the first survey, R is the recaptured individual in the second survey, and C is the total number of individuals in the second survey. The population size by Schnabel's method was calculated by $1/N\hat{} = \pm 1.96 \sqrt{V(1/N\hat{})}$ with 95% confidence interval where $N=\sum CM/\sum R$, Variance $(1/N)=\sum R/(\sum CM)^2$ and C is the total number of individuals, M is the accumulated individual numbers and R is the number of recaptured individuals.

SPSS software program (ver 21.0) was used for statistical analysis. T-test was used to compare the difference in SVL, TL and BM between males and females.

Results and Discussion

In this study, total 152 *E. argus* were captured and among them, 23 individuals were recaptured. The number of males, females, and subadults captured was 54, 79 and 19, respectively. Among the 23 recaptured individuals, six were males and seventeen were females. The recapture rate for males and females were 11.1% and 21.5%, respectively, with the mean recapture rate of 15.1% (Table 1 and Fig. 2).

Table 1. Numbers of captured and recaptured *E. argus* and the recaptured ratio.

Numbers	Males	Females	Subadults	Total
First-captured	54	79	19	152
Recaptured	6	17	-	23
Recaptured ratio	11.1%	21.5%	-	15.1%

Fig. 2. Capture (closed circle) and recapture (opened circle) points of *E. argus* at Baramarae Beach.

Table 2 shows the physical parameter of *E. argus*. The SVL, TL and BW of males and females were not significant (Ps > 0.05) as Kim et al. (2010). But our results showed the rate of recaptured females tends to be greater than that of males. We think that the movement of females is slower for pregnancy than males, so females might be easier to capture than males.

To determine the population size using the Peterson's method, we separated our field survey periods into the first half and the second half survey period in 2008. For the each survey period, 64 and 88 individuals were newly captured and each 11 and 12 lizards were re-captured. Based on the Peterson's method, the size of the *E. argus* population at Bramarae beach was estimated as 438 lizards, ranged 226 to 650 lizards with 95% confidence interval. The Schnabel's method estimated the population size as 470 lizards, ranged 334 to 790 lizards with 95% confidence interval. Therefore, the size of the *E. argus* population at Baramarae beach could be between 226 and 796. The density per unit area (ha) was estimated as 171 (range 88.2 to 253.9) with the Peterson's method and as 183.3 (range 130.4 to 310.9) with the Schnabel's method.

Table 2. Physical parameters of male and female *E. argus* (mean ± SE) captured at Baramarae Beach.

	SVL (mm)	TL (mm)	BW (g)
Female (n = 79)	49.1 ± 0.8 (31.1～65.8)	58.3 ± 5.2 (12.6～76.8)	3.2 ± 0.2 (0.8～6.8)
Male (n = 54)	49.6 ± 1.1 (32.3～64.9)	62.5 ± 2.0 (41.3～86.1)	3.3 ± 0.2 (1.1～7.4)
p value	p = 0.773	p = 0.520	p = 0.731

The various methods for determining the population size have been used; Mares et al. (1981) applied Lincoln-peterson's, Schumacher-Eschmeyer's, and Schnabel's methods to analyze the population size of the eastern chipmunk *Tamuas striatus*. There are numerous ex-

amples of such estimations. Phillips et al. (1997) using such methods estimated the number of individuals in the populations of *Ambystoma jeffersonianum*. Phillips et al. (2001) showed that the population size of *Ambystoma jeffersonianum* complex was increased over a 20 year period based on the population estimation results.

Kacoliris et al. (2009) estimated the density of an iguana species, *Liolaemus multimaculatus,* as 3.6 and 5.4 individuals per ha in 2007 and 2008, respectively, and proposed that more than 10,000 individuals live in Mar Choquita area. In the study of population size estimating of the sand lizard, *Lacerta agilis*, Bree et al. (2006) estimated the size as 57 in 2000, and 59 individuals in 2005. MaNair and Lombard (2004) estimated the population size of *Ameiva polops* at Green Cay as 183 individuals (ranged between 108 and 258) with a density of 32 (ranged between 19 and 45 ind.) per ha.

Despite of several studies for estimating population sizes, for example, the study that figured out the number of adults and egg clutches of *Hynobius leechii* as 0.03 and 15 per 100 m^2 by scrutinizing individuals and egg sacs during a breeding season, more studies to estimate the size of domestic amphibian and reptile field populations are necessary (Yang et al. 2005).

Presently, *E. argus* is being designated as an endangered level II species by Wildlife Conservation and Management Act. To successfully conserve this endangered species, monitoring the size changes of targeted populations as we did in this study and implanting proper various management actions could be very important.

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