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Size-mass relationships for 4 freshwater snails (Gastropoda: Pleuroceridae) from the Guem River in Korea

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ABSTRACT

Size-mass relationships were estimated for 4 species belonging to genus *Semisulcospira* from the Guem River, Korea. These 4 freshwater snail species: *Semisulcospira libertina*, *Semisulcospira coreana*, *Semisulcospira gottschei*, and *Semisulcospira forticosta*. Between June and November 2011, samples were caught by dredge (mesh size 10mm of multifilament nylon, total length 4.35 m) at depths of < 2 m. Estimates of for parameter b of the size-mass relationship ($W = aSH^b$) ranged between 2.0072 (*Semisulcospira libertina*) and 2.3463 (*Semisulcospira gottschei*).

Key words: Size-mass relationships, freshwater snail, Guem River

Introduction

The freshwater snail genus *Semisulcospira* is widely distributed in river, streams, and lakes (Davis, 1969). They have long been used as a healthy food source and provide an economically valuable fishery resource in Korea (Kim *et al*., 2011; Lee *et al*., 2005).

Currently, wild populations of this species are declining due to over exploitation as well as environmental deterioration caused by sewage, pesticides, and the restructuring of riverbeds (Kim *et al*., 2011). The genus *Semisulcospira* comprises the most common species, which are distinguishable by their brood pouch, in which embryo are raised (Lee *et al*., 2007).

As four species in genus *Semisulcospira* (*Semisulcospira libertina*, *Semisulcospira coreana*, *Semisulcospira gottschei*, and *Semisulcospira forticosta*) are one of the dominant fisheries species in Geum River, it is an important target species for small-scale fisherman, who use a variety of improved dredge.

Many ecological questions at the organism, population, community and ecosystem levels of organization can be understood using biomass data (Whiles *et al*., 1990; Poepperl, 2000; Gonzlez *et al*., 2002). The main reasons for their use are: (1) they allow avoidance of biases caused by the mass losses of preserved animals (Heise *et al*., 1988; Gonzlez *et al*., 2002), (2) they make possible further work with the stored samples (Towers *et al*., 1994), and (3) they can be less time-consuming and more precise than direct weighting or biovolume estimation of fauna (Burgherr and Meyer, 1997). The use of size-mass relationships is the fastest way to measure the population biomass (Gonzlez *et al*., 2002).

Studies on size-mass relationships for snails from freshwaters in Korea are scarce (Chang *et al*., 2001). The purpose of this work is to provide equations to estimate biomass from length measurements, for snails of running waters from Geum River.

Materials and Methods

1. Study area

The Geum River is located central part of South

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Table 1. Length and weight characteristics of the sample (n, size; Min, minimum; Max, maximum) and estimated parameters of the size-mass relationship parameter (*a*; *b*; SE, standard error) and determination coefficient (r^2) for 4 freshwater snails from Geum River, Korea

Species	n	Shell height (mm)		Total weight (g)		Parameters			
		Min	Max	Min	Max	*a*	*b*	SE(*b*)	r^2
Semisulcospira libertina	110	9.87	22.57	0.30	1.55	0.0029	2.0072	0.0742	0.872
Semisulcospira coreana	595	9.65	25.91	0.15	1.97	0.0018	2.1346	0.0360	0.854
Semisulcospira gottschei	994	10.00	31.55	0.15	2.80	0.0008	2.3463	0.0277	0.877
Semisulcospira forticosta	186	13.17	30.79	0.30	1.79	0.0007	2.2742	0.0730	0.839

Korea and is one of four major great rivers in Korea. It is 401 km long and its watershed area is 9,859 km^2 (Lee *et al*., 2010). It contains 12 primary tributaries, many secondary tributaries, two multi-propose dams (Yongdam and Daecheong Dams) and estuary reservoir (An *et al*., 1992). Upstream region of the river was mostly consisted with forest mountain and partially agricultural lands, while human impacts and interferences are intense in the midstream region where the tributaries of Gap and Miho streams are confluence (Lee *et al*., 2008).

2. Sampling design and statistical analysis

The data used for the present study come from several works carried out in the Geum River (36°7'-36°4'N: 127°6'-127°2'E) Korea. The data obtained from these works were pooled to obtain sufficient number of samples per species. On the whole, 4 species having a sufficient number of individuals were used for the analyses.

All specimens were collected by dredge (mesh size 10mm of multifilament nylon, total length 4.35 m) between depths of 1-2 m with the aid of local professional fisherman. The study period was from June to November 2011.

The measurement of the total height of the shell (from tip of aperture to tip of apex) was taken using a vernier caliper with a precision of 0.01 mm. Each snail was weighted to obtain the total wet weight. The estimation of size-mass relationships was made by the adjustment of an exponential curve $W = aSH^b$ converted into its logarithmic expression log W = log a + blog SH, where W is the total weight (g), L the shell height (mm), a the intercept and b the slope. Prior to regression analysis of log W on log SH, log-log plots were used to detect and exclude outliers. The parameters a and b were calculated by least-squares regression, as was the coefficient of determination. The b-value for each species was tested by t-test at the 0.05 significance level to verify if it was significantly different from 3.

Results and Discussion

The following four species were analyzed: *Semisulcospira libertina*, *Semisulcospira coreana*, *Semisulcospira gottschei* and *Semisulcospira forticosta*. For each species, the sample size (N), total length and weight range, estimated parameters of the a and b coefficient, standard error (SE) and the correlation coefficient r^2 are given in Table 1. Sample number of the species examined in this study ranged from 110 (*Semisulcospira libertina*) to 994 (*Semisulcospira gottschei*); b values varied from 2.0072 (*Semisulcospira libertina*) to 2.3463 (*Semisulcospira gottschei*); r^2 values ranged from 0.839 (*Semisulcospira forticosta*) to 0.877 (*Semisulcospira gottschei*). All linear regressions were highly significant ($P < 0.01$).

Size-mass relationships in snails usually show the value less than 3, probably because the rate of increase in their weight is less than the rate of increase in their body length. The size-mass regression in freshwater invertebrate can be affected by water temperature (Schröder, 1987), chemistry (Meyer, 1989; Burgherr and Meyer, 1997), food availability (Gee, 1988) and differences in the observed length ranges of the specimens caught, all of which were not accounted for in the present study. In the measurement of growth, lengths give much better data than weights, which vary considerably with a given length (Rapson, 1952). The mathematical relationship between length and weight comes to an aid in the analysis of catch statistics. The relation thus established between them helps in converting one factor into the other. For the back calculations of the past growth also it is necessary to know the length-weight relationship which helps in measuring the variation from the expected weight for a particular snail (Muley, 1978). The length can be measured more quickly and accurately than the weight.

The size-mass results obtained from this study could well be considered when snail populations become subject to management activity for the Geum River.

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