Short Paper

Growth of the Stomatopod Crustacean
Oratosquilla oratoria in Hakata Bay

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This paper presents male and female growth of the stomatopod crustacean *Oratosquilla oratoria* (de Haan, 1844) in Hakata Bay, Japan. A population study of this species was carried out in the bay by Hamano *et al.*¹⁾ Two kinds of data during the course of the study were used here to calculate equations i.e. the monthly mean carapace length (CL) for each cohort and the settlement period of larvae. In juveniles, the monthly mean CLs of cohorts at two sampling stations from September to the following May were used to estimate both male and female growth. Furthermore, 22 male and 23 female CLs of cohorts obtained from the market were available (see Figs. 4 and 5 in Hamano *et al.*¹⁾). I have assumed that settlement of larvae occurred on the first day of September following Hamano *et al.*¹⁾

The von Bertalanffy model of growth in length was extended to describe seasonally oscillating data by Pitcher and MacDonald,²⁾ Cloern and Nichols,³⁾ Pauly and Gaschütz,⁴⁾ etc. Here, I have adopted the Pitcher and MacDonald sine wave model,²⁾ the earliest model, with the ordinary Bertalanffy equation of a comparative formula. A computer was used to fit the data by the Marquardt method,⁵⁾ with Akaike's information criterion (AIC)⁶⁾ employed as measures of goodness of fit.

The calculated growth equations, derived as above, are: using the ordinary Bertalanffy equation,

$$\text{male: } L_t = 57.2(1 - \exp(-0.0190(t + 8.25))) \quad (1)$$

n=31, AIC=27.3

$$\text{female: } L_t = 55.8(1 - \exp(-0.0191(t + 8.45))) \quad (2)$$

n=32, AIC=29.1

and using the Pitcher and MacDonald sine wave equation,

$$\text{male: } L_t = 49.9(1 - \exp(-0.0628 \sin(2\pi(t - 0.204)/12) - 0.0254(t + 5.66))) \quad (3)$$

n=31, AIC=-0.250

$$\text{female: } L_t = 49.9(1 - \exp(-0.0650 \sin(2\pi(t - 0.301)/12) - 0.0246(t + 5.90))) \quad (4)$$

n=32, AIC=-0.454

where L_t is CL (mm) at age t (months) after settlement on 1 September (Regression equations given by Matsuura and Hamano⁷⁾ can be used to calculate total length and/or other size measurements from CL). Since the growth rate was obviously seasonally dependent, the Pitcher and MacDonald equation, (3) and (4) above, provided a better model for describing the data (Fig. 1). Males are somewhat larger in length than females of the same age as calculated from equations (3) and (4), e.g. the size is 32.4 mm CL for a male and 31.9 mm CL for a female, when $t=36$ months.

The technical term 'growth equation' is often misunderstood. Equations described here do not show the monthly change in size of an individual but that in mean size of a cohort. Thus, it is not inconsistent that a decrease in length is predicted during

Fig. 1. Fitting of two growth models to mean carapace lengths of *Oratosquilla oratoria* cohorts in Hakata Bay. Broken curves show the simplified Bertalanffy equation. Dotted curves show the Pitcher and MacDonald sine wave equation.

winter by the Pitcher and MacDonald equation (dotted curves in Fig. 1), and it should not be taken to indicate negative growth at ecdysis in this species. During winter, when growth is very low, size dependent mortality can markedly influence the mean size of a cohort.

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