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Fecundity of the Sakhalin Surf Clam, *Spisula sachalinensis* (SCHRENCK), in Sendai Bay

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Summary

The relation between the size and fecundity of the Sakhalin surf clam, *Spisula sachalinensis* (SCHRENCK), in Sendai Bay was examined. Fecundity was estimated by the gravimetric method for samples immediately prior to spawning. A close relationship was found between the fecundity (F) and shell length (L, cm) as $F=7.75\,L^{3.32}\times10^4$, ($r=0.902$). Frequency distribution of the diameter of maturing eggs has a single mode and their mean diameter is about 70 μ. Significant differences in maturity are not observed between ovary parts as well as between clams. The Sakhalin surf clam is considered to be a single-batch spawner.

Although a few papers on the ecology of the Sakhalin surf clam, *Spisula sachalinensis* (SCHRENCK), inhabiting the seas around northern Japan, have been published, little is known about their fecundity except that they produce a great number of eggs. This lack of knowledge results from the difficulty to separate an ovary into individual eggs to be counted, because of the complex structure of the ovary that consists of many follicles containing a number of eggs.

The purpose of the present study is to make clear a relation between the size and fecundity of the clam distributed in Sendai Bay, based on the following two relations: 1) the relation between the shell length and ovary weight, and 2) the relation between egg numbers and weights of small pieces of an ovary as subsamples. Ovarian eggs were released from follicles using a tripsin solution diluted with artificial sea water. This technique is an application of the cell dissociation method commonly used in the field of cell culture (1).

Materials and Methods

Samples were collected once or twice a month from December 1980 through June 1981 in the fishing ground off Isobe, Fukushima Pref. (Fig. 1), and the maximum shell length, soft part of body and ovary were measured and weighed.

Twenty four female adults of over 7.5 cm in shell length collected on April 28, 1981 were used for estimating fecundity. Fig. 2 shows the seasonal change in the gonosomatic index (GSI) of the samples. The GSI increases straight from December through late April and decreases abruptly in early and mid-May. Observation of ovaries shows that while no clam had spawned on April 28, all clams collected on May 22 began to spawn, showing that the former was immediately prior to spawning.

The egg diameter of three parts of an ovary described below was measured to examine the difference in the relation between the egg number and weight by part. The areas were: A) the upper part of the visceral pouch near cloaca, B) near the digestive diverticula, and C) near the intestine. Maturing eggs had been discharged in modified-Herbst's artificial sea water (HASW) and the diameter of about 100 eggs was measured to the nearest 0.001 mm under the supravital conditions. The experiment was carried out for three clams of different size to examine the difference in maturity by size.

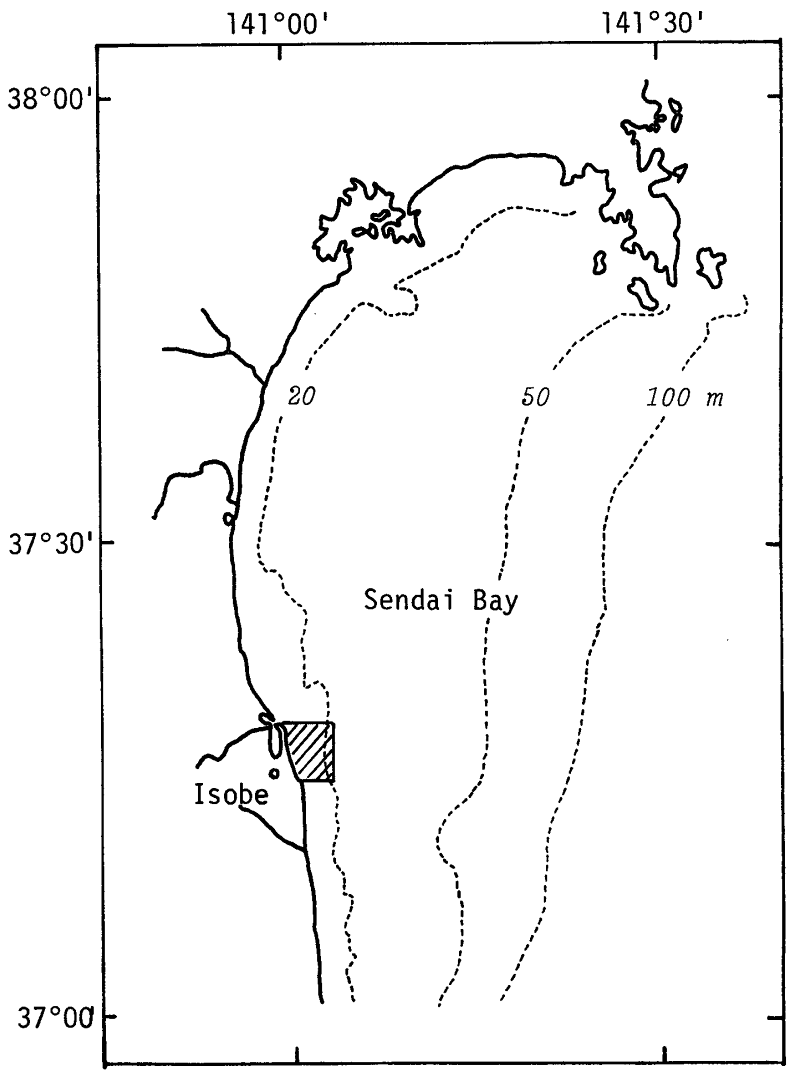

Fig. 1. Sampling locality

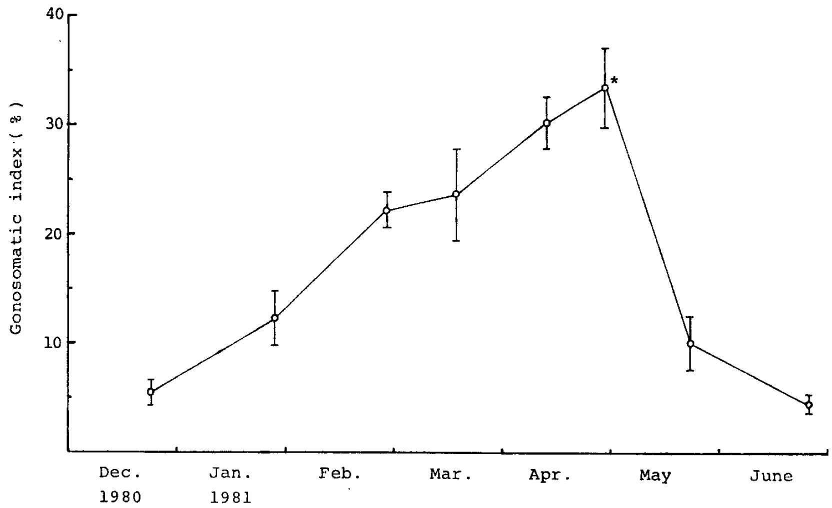

FIG. 2. Seasonal change in gonosomatic index of adult female. Vertical bar denotes a standard deviation on each side. Star (*) shows a sample used for estimating fecundity.

Three subsamples were taken out from Part B of 10 ovaries and the total egg number in each subsample was estimated by the following procedure. A 0.25% tripsin (Difco, 1:250) solution diluted with HASW was used to dissociate eggs from connective tissue. Artificial sea water was used to prevent eggs from bursting by the change in osmotic pressure.

1) A subsample of 0.05–0.5 g has been put into a 30 ml Erlenmeyer flask of known weight, and weighed precisely.

2) After the addition of 10 ml HASW, the flask is shaken lightly. Then the dissociated eggs have been removed into a 200 ml beaker with a pipet and are fixed with 10% formalin solution immediately. This operation is repeated several times.

3) The tripsin solution of 15 ml has been added to the remainder, which is shaken lightly for about 15 minutes.

4) Newly dissociated eggs have been removed into the beaker with a pipet and are fixed.

5) After the tripsin solution of 10 ml has been added to the remainder again, it is repeatedly inhaled and exhaled with a pipet about 50 times.

6) The operations 4) and 5) have been repeated until all eggs are dissociated.

7) The dissociated and fixed eggs are removed into a volumetric flask (volume V ml). After the eggs have been suspended evenly, a part of the suspention of constant volume (v ml) is taken out with a measuring pipet. All the eggs in the pipet including eggs broken in the dissociation process are counted under a light microscope. V plus v is determined so as to contain 300–500 eggs by a pipetting (n). Volumetric flasks of 300, 500, and 1000 ml, and measuring pipets of 0.2, 0.3, and 0.5 ml are used.

8) Five-time counting is made to calculate a mean ($\bar{n}$). Egg numbers in a subsample (N) are estimated by a formula: $N=\bar{n}\cdot V/v$.

Results and Discussion

Frequency Distributions of Diameters of Maturing Eggs

Fig. 3 shows the frequency distributions of the diameters of maturing eggs in three parts of an ovary for three clams of different size. The maturing eggs are nearly spherical. The distribution has a mode at about 70 μ. No difference in the egg diameter distribution is observed either by part of an ovary or by clam, indicating that a subsample from an arbitrary part of an ovary can represent the maturity of the ovary.

Since spawning of this clam lasts for a short time (Fig. 2), the variation in maturity by clams seems to be small at least immediately prior to spawning, suggesting that this species is a single-batch spawner and the number of maturing eggs in an ovary immediately prior to spawning coincides with the fecundity.

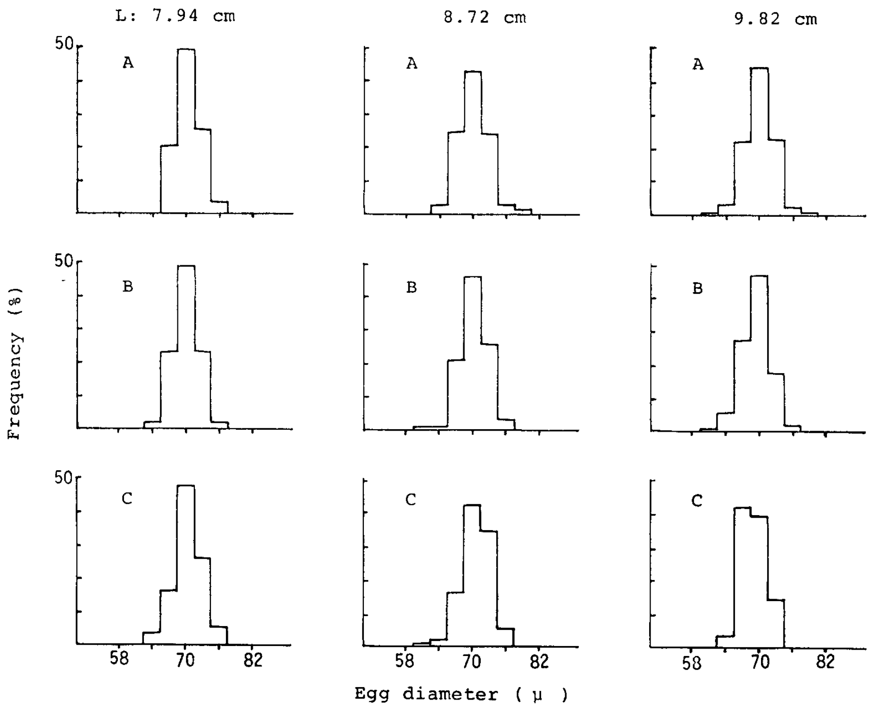

FIG. 3. Frequency distributions of maturing eggs by parts of ovary.
A: upper part of the visceral pouch. B: near the digestive diverticula.
C: near the intestine.

Egg Number-Weight Relation for Subsamples

Fig. 4 shows a regression of egg number in a subsample (N) on its weight (w) for subsamples taken out from Part B. Since maturation in a clam population is

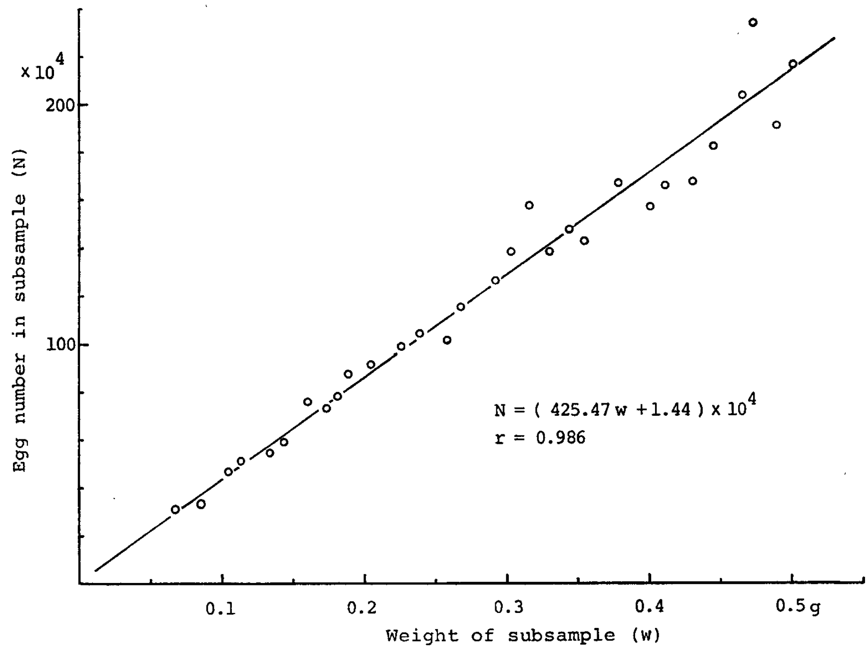

FIG. 4. Regression of egg number (N) on weight (w) for subsamples.

considered to proceed highly synchronously as mentioned earlier, data of individual clams were used discriminately. The egg number of a subsample (N) is closely correlated with its weight (w) as expressed below.

(I) $$N = (425.47w + 1.44) \times 10^4$$

$$r = 0.986$$

Substituting the ovary weight for W, one obtains the fecundity (F).

Fecundity

Fig. 5 shows a regression of ovary weight (W) on shell length (L) for specimens sampled on April 28, 1981. The regression was expressed by an allometric equation.

$$W = 0.00182 L^{3.32}$$

$$r = 0.902$$

The ovary weight of each clam is converted to the fecundity by Equation (I). A regression of fecundity (F) on shell length (L) is given by

(II) $$F = 7.75 L^{3.32} \times 10^4$$

$$r = 0.902$$

Table 1 shows age-specific mean fecundities for the Sendai Bay subpopulation using the growth equation formerly proposed by the present author (2) and Equation (II).

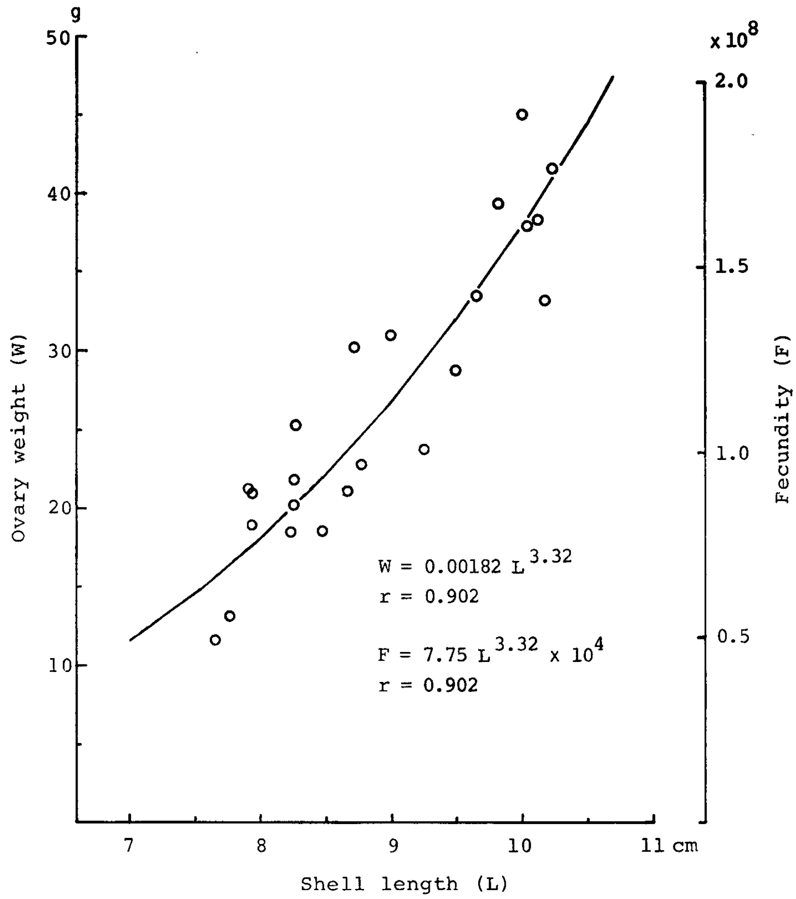

FIG. 5. Regression of ovary weight (W) on shell length (L). The scale on right side is for fecundity (F) calculated by the regressive relation described in Fig. 4.

TABLE 1. *Age-specific Fecundity of the Sakhalin Surf Clam in Sendai Bay.*

Age (yrs)	Back-calculated shell length (cm)	Fecundity ($\times 10^8$)
3	8.52	0.947
4	9.38	1.303
5	9.84	1.528
6	10.07	1.649
7	10.20	1.721
8	10.27	1.761
9	10.30	1.778

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