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The Growth of Pacific Oyster *Crassostrea gigas* Transplanted into Ambong Bay in Malaysia

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Malaysia 國 Ambong 灣에 移殖한 참굴 *Crassostrea gigas* 의 成長

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한국산 참굴종패를 1981년 2월에 열대수역인 Malaysia 國의 Ambong 灣에 이식하여 1981년 7월까지 양성하였다.

패각의 성장은 온대 수역에 비하여 훨씬 빠른 편이며 7월에 각고가 약 38.91 *mm* 로 성장하였다.

육중은 이식 후 증가하기 시작하여 5월에 약 1.66 *g* 으로 최고의 값을 보인 후 6월 및 7월에는 각각 1.20 *g* 및 0.74*g* 으로 현저히 감소하였다.

비만도의 경우도 5월 이후 현저히 감소하여 7월에 11 % 로 가장 낮은 값을 보였다.

7월까지의 생존율은 약 38 % 로 다른 열대수역에 이식한 것 보다 높은 편이었다.

Introduction

Ambong Bay, tropical waters with the annual water temperature range of 27.2-32.8 °C, is located at the north eastern part of Borneo Island in Sabah State, Malaysia (Fig. 1).

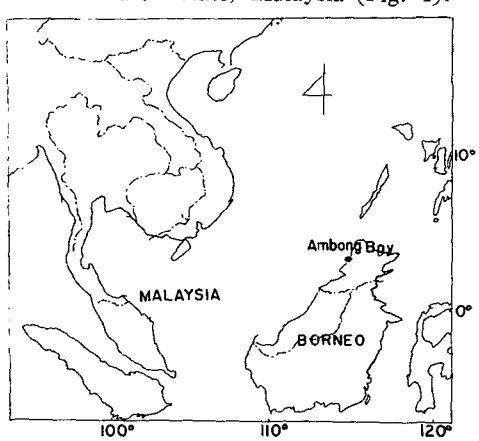

Fig. 1. Map shows the experimental station.

Although large numbers of local oysters which mainly consist of *Crassostrea belcheri* and *Crassostrea cucullata* inhabit extensive areas in Sabah and many efforts have been made on the development of oyster culture for *Crassostrea belcheri* species, the oyster industry in Sabah still remains at a trial-error stage.

As the amount of local oyster production is poor and variable, oysters are flown in from Australia, New Zealand and Japan to cater for demands throughout Sabah. Recently is the State government taking a great concern for the promotion of oyster culture in order to increase the supply of protein foods and raise the living standards of the coastal inhabitants.

According to the studies of Imai *et al.* (1961), Chung *et al.* (1970) and Yoo *et al.* (1972), Pacific oyster *Crassostrea gigas* is known to be a well adapted species to environmental changes. But these experiments have been made only

within the same temperate regions as the natural inhabited ones. Particularly Yoo (1976) reported that Pacific oysters transplanted into the Cocineta Bay in Venezuella, tropical waters similar to Ambong Bay, grew much faster than in the temperate waters.

In this experimental oyster culture, the investigation is mainly focused on the growth of the transplanted Pacific oyster into Ambong Bay based on the shell length, shell height, total weight, meat weight, survival rate and fatness so that this basic work might be some helpful to the industrial oyster culture in that region.

Methods

The seed oysters which had been hardened in coastal waters off Chungmu area, the southern part of Korea, were collected on February 7 in 1981 for transplantation into Ambong Bay in Malaysia.

Eight hundred collectors, each with 40 oyster seeds, were packed in box with moist gauze covered to protect seedlings from shock and dehydration. The box material used in packing was of styrofoam, measuring $1.0\,m \times 0.7\,m \times 0.8\,m$.

Upon arriving at the experimental station (Fig. 1) on February 9 in 1981, the seed oysters were set into the waters in Ambong Bay with 20 collectors hung on every hanging string in the manner as shown in Fig. 2.

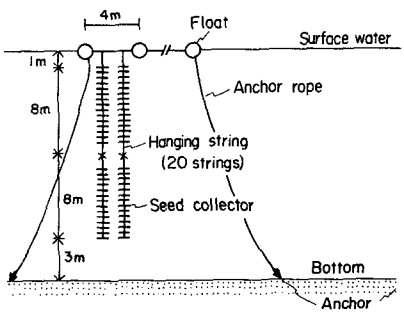

Fig. 2. Schematic diagram of the hanging culture system used for experimental oyster culture.

These seed oysters were reared up to July 9 in 1981 with weekly observations of sea water temperature, specific gravity and growth rate in addition to survival rate. Water temperature was checked with a conventional thermometer and specific gravity with a Akanuma B-type hydrometer. To determine growth rate, shell length, shell height, total weight and meat weight of each individual were measured with Vernier caliper and balance. And survival rate was determined by counting both live and dead individuals on one hanging line with naked eyes.

Results

Water temperature of Ambong Bay during the investigation period ranged from 27.5 °C in February to 32.8 °C in May, and specific gravity from 1.0213 in June to 1.0249 in March (Fig. 3).

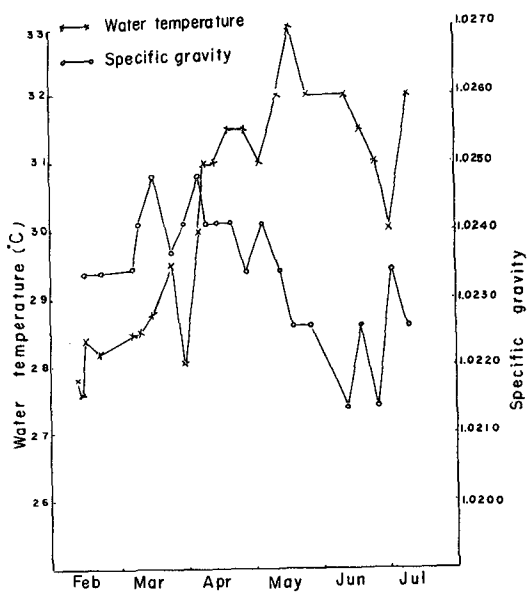

Fig. 3. Weekly variation of the water temperature and the specific gravity at Ambong Bay from February 9 to July 9 in 1981.

Transplanted oysters reached the following average sizes in shell length as shown in Fig. 4: 18.92 *mm* in March, 22.68 *mm* in April, 24.63 *mm* in May, 24.65 *mm* in June and 25.01 *mm* in July.

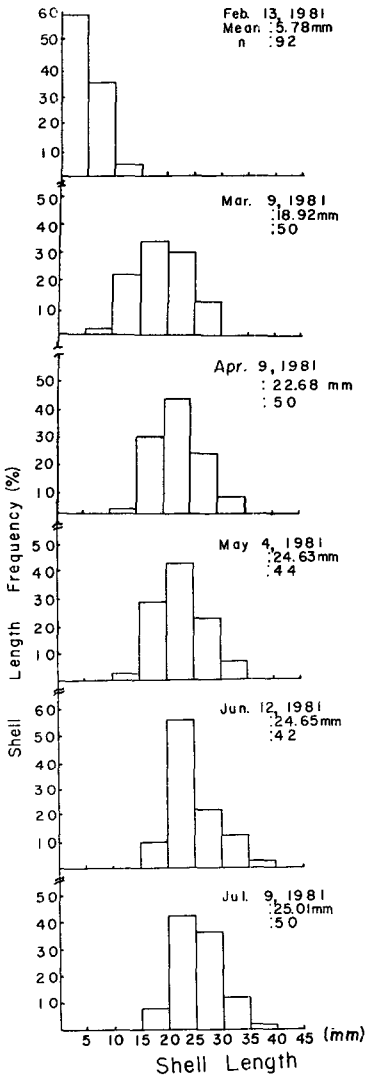

Fig. 4. Monthly shell length distribution frequency of the transplanted Pacific oyster from February to July 1981.

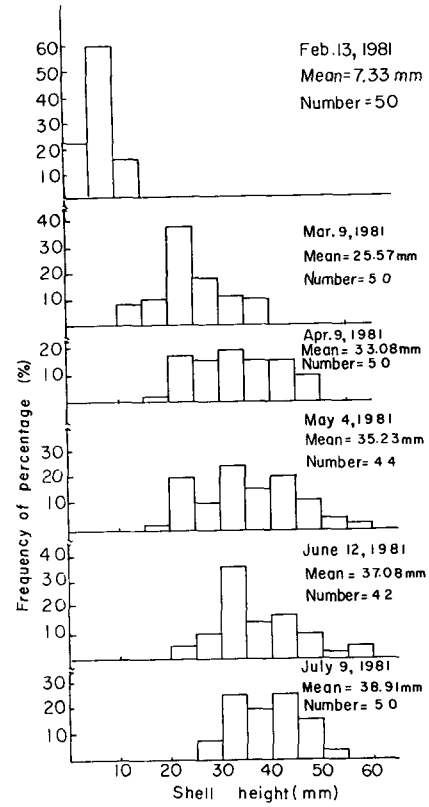

Fig. 5. Monthly shell height distribution frequency of the transplanted Pacific oyster from February to July 1981.

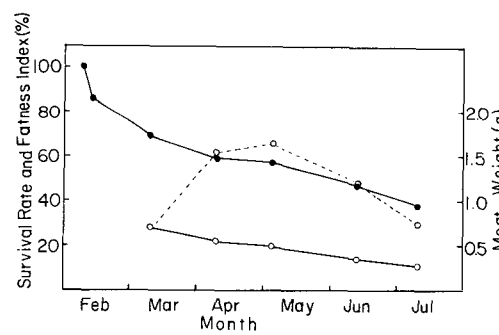

Fig. 6. The monthly variation of survival rate, meat weight and fatness index in transplanted Pacific oyster from February to July 1981.

●——● : survival rate
○·····○ : meat weight
○——○ : fatness index

The growth in shell height is shown in Fig. 5. Namely, the shell height reached the average sizes of 25.57 *mm* in March, 33.08 *mm* in April, 35.23 *mm* in May, 37.08 *mm* in June and 38.91 *mm* in July.

The growth variation of the meat weight is shown in Fig. 6. The average meat weight had a rising tendency from March with 0.70 g to May with 1.66 g, but after May it decreased sharply with 1.20 g in June and 0.74 g in July.

Table 1. The growth rates of the shell height, shell length and meat weight in the transplanted Pacific oyster into Ambong Bay in 1981

W.T. (℃)	S. G.	Growth period Initial	Final	Days	Shell height(*mm*) Initial	Final	G	Shell length(*mm*) Initial	Final	G	Meat weight(*g*) Initial	Final	G
28.5	1.02377	Fed. 13-	Mar. 9,	24	7.33	25.57	0.0520	5.78	18.92	0.0494	—	0.70	—
29.46	1.0243	Mar. 9-	Apr. 9	31	25.57	33.08	0.0083	18.92	22.68	0.0058	0.70	1.54	0.0254
31.25	1.0239	Apr. 9-	May 4	25	33.08	35.23	0.0025	22.68	24.63	0.0032	1.54	1.66	0.0030
32.25	1.0225	May 4-	Jun. 12	38	35.23	37.08	0.0013	24.63	24.65	0.00002	1.66	1.20	-0.0085
31.12	1.0225	Jun. 12-	Jul. 9	37	37.08	38.91	0.0013	24.65	25.01	0.00039	1.20	0.74	-0.0130

W. T. =Water temperature G : Growth rate used by Ricker (1968) S. G. =Specific gravity

Fatness index is expressed here by the percentage of the meat weight ratio to the total weight (meat weight/total weight ×100), which showed the maximum value in March with 28 % and decreasing tendency then with time with the minimum value of 11 % in July (Fig. 6).

The survival rates which showed decreasing tendency with time reached 86 % in February, 69 % in March, 59 % in April, 57 % in May, 47 % in June and 38 % in July (Fig. 6).

The growth rates expressed by Ricker's equation (1968) are shown in Table 1. All the growth rates of shell length, shell height and meat weight showed sharply decreasing tendency with time. In shell length the growth rate showed the maximum value of 0.0494 between February and March, and the minimum of 0.00002 between May and June. In shell height it showed maximum of 0.0520 between February and March and minimum of 0.0013 between May and June. Generally speaking, the growth rate of the shell height is somewhat higher than that of shell length during the whole growth period. In meat weight the maximum growth rate appeared in March-April with 0.0254, and after that period it declined very sharply and showed the value of -0.0130 between June and July.

Discussion

Chin *et al.* (1975) reported that oyster larvae occurred throughout the year round at Ambong Bay with the first peak in March-May and the second in November-January.

In addition to year round spawnings, Ambong Bay has a merit in that local oyster *Crassostrea belcheri* grows very fast compared to some other countries. In New Zealand, it takes 39 months to grow one crop to marketable size by means of rack culture. By bottom culture in Canada, it takes 44 months to reach marketable size. The most advanced method of raft culture in British Columbia requires at least 30 months to harvest the crop. In comparison, the crop at Ambong Bay takes only 18 months to mature and in fact, by the 12th month, 10 % of the crop becomes marketable.

Although there was little difference in the rearing period and oyster seedling sizes when transplanted into each two tropical waters, Pacific oyster transplanted into Ambong Bay has shown by far faster growth than that into Cocineta Bay in Venezuella by Yoo (1976). At Ambong Bay the shell height of the Pacific oyster increased from 7.33 *mm* in the middle of February to 37.08 *mm* at the beginning of June with the increment of about 30 *mm*, but at Cocineta Bay in Venezuella from 16.1 *mm* at the beginning of February to 36.07 *mm* at the beginning of June with the increment of about 20 *mm*. The shell height at Ambong Bay is also much more faster than that of transpl anted within the same temperate regions conducted by Yoo (1975) with the increment of 18 *mm* for the same growth period as in Ambong Bay.

The meat weight of the Pacific oyster at Ambong Bay was beginning to increase shortly after transplantation and reached the maximum in May with an average of 1.66 *g*. But it de-

creased both in June and July with 1.20 *g* and 0.74 *g* respectively (Fig. 6 and Table 1.). The growth rate of the meat weight was also the lowest in June and July (Table 1). This meat weight decrease in June and July may have resulted from the spawning in this area stimulated by the abrupt decrease in specific gravity as shown in Fig. 3.

Compared with the Pacific oyster in temperate region, the fatness of transplanted oyster was in better condition upto the middle of May but it was much poorer since then (Fig. 6.).

From the point of view in survival rate, in Venezuella it 20 % in June, and at Ambong Bay it showed 47 % in June and 38 % in July, nearly 2 times higher than Venezuella.

Although the evident conclusion should be made only through the year round investigation, the result so far is that the season between April and May is suitable for harvesting oyster because after that season the meat weight and survival rate decreased very sharply.

If the barnacles which are the most abundant fouling organisms at Ambong Bay are exterminated by any available methods, the growth of the transplanted Pacific oyster may show faster results than reported now.

Summary

Followings are the results of growth of Pacific oysters transplanted from the temperate waters of Korea in February 1981, and cultivated upto early July in the tropical waters of Ambong Bay in Malaysia:

The shell length increased from 5.78 *mm* in February to 25.01 *mm* in July, and the shell height increased from 7.33 *mm* in February to 38.91 *mm* in July.

The meat weight progressively increased and reached the maximum value of 1.66*g* in May, but then gradually decreased until July, and the fatness varied from 28% of maximum in March to 11 % of minimum in July.

Survival rate was 47 % and 39 % of the initial number in June and July respectively.

Acknowledgement

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