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Alava, Rosario

Aquaculture Department, Southeast Asian Fisheries Development Center

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Effect of different sex ratios of ablated wild-stock *Penaeus monodon* Fabricius on maturation, fecundity and hatching rates

Rosario Alava and Jurgenne H. Primavera

At present, the most commonly practised sex ratio of 1:1 for both water-based pens and land-based tanks is based on an assumed safety factor rather than on experimental data. Testing other sex ratios may, therefore, allow the establishment of the most suitable sex ratio in terms of ovarian maturation, fecundity, hatching (fertilization) rate and the economy of a minimum number of males per female for broodstock operations.

Adult size *Penaeus monodon* used in the experiment were taken from the wild. Female prawns were characterized with a carapace length (base of eye notch to tip of carapace) of 51 ± 5 mm. body length (base of eye notch to tip of telson) of 176 ± 16 mm, and body weight of 83.2 ± 24.4 g. The male prawns measured 45 ± 4 mm in carapace length, 159 ± 12 mm in body length and 59.0 ± 13.2 g in body weight.

Four different sex ratios, 0:1, 1:1, 1:2 and 1:4 male: female were tested in four 4m diameter circular tanks for a period of 55 days.

During the first and second experimental runs, temperature ranged from 25.0 to 30.5°C and 26.0 to 29.5°C respectively, while salinity fluctuated from 29.8 to 34.3 ppt and 15.4 to 34.8 ppt, respectively.

Table 1 shows the percentage survival of *P. monodon* under the different treatments. Males had generally higher survival rates (22.5 to 100%) than females (0 to 85%). This may be attributed to additional handling stress of the females during eyestalk ablation, regular examination for ovarian maturation, spawning stress, tagging and measuring of spent spawners. Other causes of mortalities were moulting stress and their cannibalistic tendencies on newly moulted prawns.

The data presented in Table 1 show that during the first run the 1 male: 2 females ratio gave: (a) the highest percentage of first (42.40%), second (30.00%) and third (33.33%) spawning; and (b) the highest total and average fecundity (3.9 million eggs and 300,692 eggs, respectively). The 1 male: 2 females ratio is recommended on the basis of highest percentage for the first, second and third spawners, total and average fecundity.

In other related studies, Tuma (1967) indicated no significant deviation from the expected 1:1 ratio for *P. merguiensis* caught from the wild. In culture systems, the 1:1 ratio was assumed to be sufficient to assure regular impregnation of the female of the species with closed thelycum (Aquacop, 1977). The same ratio was used for the culture of *P. japonicus* (Laubier-Bonichon and Laubier, 1976), and in the laboratory recirculation systems for *P. merguiensis,* sex ratios used were initially either 1:1 or 2:1 in favor of the females (Beard et al., 1977).

It may be noted that although the all-female treatment produced 19.65% first spawners and a total fecundity of 3.3 million eggs, none of the eggs were fertilized, thus, the 0% hatching rate. This indicated that even in the absence of males, the ovaries of female *P. monodon* can be induced to mature by unilateral eyestalk ablation. The substance that inhibits reproduction is

synthesized in the eyestalk and reaches the thoracic ganglion or brain. Ablation reduces the concentration of this inhibiting substance, thus initiating ovarian maturation and spawning (Adiyodi and Adiyodi, 1970; Bomirski and Klek, 1974). Since 95% of the females in the 0:1 treatment moulted before ovarian maturation and spawning, the entire spermatophoral mass is lost with the exuviae, and since no male prawns were present, the females were not impregnated. The unfertilized eggs thus accounted for the 0% hatching rate in the experiment.

On the other hand, in treatments where males were present (1:1, 1:2, 1:4), the females were immediately impregnated as evidenced by 87-92% positive spermatophore deposition during microscopic examination of the thelycum in exuviae and mortalities.

The average length of time between ablation and first spawning for wild-stock *P. monodon* held in captivity ranged from 18-35 days and 1—13 days between subsequent spawnings for all treatments (Table 2). The period is relatively longer than that of *P. monodon* broodstock taken from fishponds which average 18-21 days from ablation to the first spawning and 3-11 days between subsequent spawnings (Primavera, 1978; Primavera and Borlongan, 1978; Primavera, et al., 1978). This may be attributed to a greater percentage of moulting before maturation as a result of eyestalk ablation (Aquacop, 1976) and factors like source, health and age of the broodstock used.

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Table 1. Data on survival, % spawners, fecundity and hatching rate of ablated *P. monodon* at different sex ratios. (Number in parentheses refer to actual number of females.)

Sex ratio	0:1	1:1		1:2		1:4	
(No. males: No. females)	(0:60)	(30:30)		(20:40)		(12:48)	
Run	1	1	2	1	2	1	2
% Survival							
Males	0	90.00	33.33	90.00	22.50	100.00	33.33
Females	83.33	76.67	13.33	47.50	85.00	47.92	0
% Spawners							
First	19.65(11)	6.90(2)	69.73(15)	42.40(10)	91.64(21)	16.23(7)	51.39(14)
Second	0	0	35.00(5)	30.00(3)	48.10(10)	28.57(2)	34.19(4)
Third	0	0	20:00(1)	33.33(1)	30.00(3)	0	0
				14	34		
Ave. no. of eggs per spawning	300,500	192,000	244,900	300,700	264,600	263,800	212,300
Total no. of eggs per spawning	3,304,000 (11)	384,000 (2)	5,142,000 (21)	3,909,000 (13)	8,996,000 (34)	2,374,000 (9)	3,821,000 (18)
Total no. of nauplii	0	40,000	1,842,000	923,000	2,504,000	949,000	866,000
Ave. hatching rate (%)	0	10.42	35.82	23.61	27.83	39.97	22.66

Table 2. Average no. of days between ablation and 1st spawning, and between subsequent spawnings of ablated *P. monodon* under different treatments (Numbers in parenthesis refer to no. of females).

Sex Ratio	0:1	1:1		1:2		1:4	
Run	1	1	2	1	2	1	2
Ablation to 1st spawning	31(11)	18(2)	35(15)	33(10)	35(21)	24(7)	22(14)
1st spawning to 2nd spawning	–	–	11(5)	11(3)	6(10)	13(2)	6(4)
2nd spawning to 3rd spawning	–	–	1(1)	3(1)	5(3)	–	–