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Growth and Survival of Red Spiny Lobster *Panulirus longipes longipes* Reared in Floating Netcages Fed with *Sardinella* spp. at Different Feeding Rates

Joel G. Becira and Marivel Orcajada
Western Philippines University-Puerto Princesa Campus
Puerto Princesa City
Email: j_becira@yahoo.com

ABSTRACT

This study was conducted to evaluate the growth and survival of *Panulirus longipes longipes* fed with *Sardinella* spp. in floating netcages at different feeding rates and to determine which feeding rate provides the best feed conversion ratio.

Results showed that 20% feeding rate gave the highest growth in terms of final average weight and length increment. Survival rate ranged from 88.66% (20% feeding rate) to 100% (10% and 15% feeding rate).

Feed conversion ratio among treatments was not significant. Among the different treatments however, stocks fed at 15% body weight attained better feed conversion ratio.

Keywords: *feeding rates, Panulirus longiceps longiceps, cage culture*

INTRODUCTION

Lobsters are favored food in many countries because of their fine flavor. Even in this age of abundant food supply, demand for luxury food like this exceeds their supply (Shokita *et al.* 1991). Lobsters have excellent market demand and price. Live lobsters commands an even higher price compared to frozen lobsters (James and Marian 2003) as they are important export items and expensive delicacies (PCARRD 1981). Lobster business today is a lucrative fishing enterprise because of its unlimited demand (Campomanes 1992).

According to Bardach *et al.* (1972), lobster *P. japonicus* can be cultured in ponds and shallow bay. In Guimaras, Philippines, *P. ornatus*, *P. versicolor* and *P. longipes longipes* were cultured in pens (Tambuli 1988). In Palawan, lobsters were temporarily stocked in submerged cages to keep them alive (Gonzales and Taniguchi 1995) before marketing.

According to Gonzales and Taniguchi (1995), lobster with a weight of 100g or less should not be sold to any market to properly benefit man. They should be released in their natural habitat to grow further or grown in cages or in pens until they reach marketable size (150 grams or more). However, knowledge on the biology of many crustacean species is still inadequate and needs to be extended through further information dissemination and experimentation (Gonzales and Taniguchi 1995). Thus, this study was conducted to evaluate the growth and survival of red spiny lobster (*Panulirus longipes longipes*) grown in floating netcages and fed with chopped *Sardinella* spp. at different feeding rates, and to determine which feeding rate provides the best feed conversion ratio.

METHODOLOGY

The lobster culture was conducted near the Western Philippines University-Puerto Princesa Campus Fish Cage Project in Tiniguiban Cove, Puerto Princesa City located 09°46.464 N and 118°43.898 E.

Three treatments with three replicates were used in the study. Each replicate was stocked with 5 pcs of *P. longipes longipes*. Replicates for each treatment were assigned in the netcages using Completely Randomized Design.

Cage Preparation

The floating netcages made up of bamboo poles (3.5m length) were divided into 9 (1m x 1m) cage frames. A polyethylene B-net 1m x 1m x 1.5m with a mesh size of 0.25cm was used as netcages. These netcages were firmly attached to the cage frame. Reinforcement bar measuring 1 x 1 meter was placed inside the cage as sinker.

Transport, Stocking and Monitoring

Red spiny lobsters were collected from Sabang offshore, Puerto Princesa City. Forty five (45) individuals were soaked in iced seawater for 3 to 5 seconds until they stopped moving. The animals were then wrapped individually with newspaper, and arranged inside the styrofoam box. The lobsters were transported early morning to the study area. Upon arrival, the box was opened and the experimental animals were unwrapped individually inside the cage. Lobsters were held at water surface until they swam freely.

Regular monitoring of the raft and cage was carried out to ensure that the set-up was in good condition. Cleaning was done twice a month by brushing the nets. Attached algae were removed to allow smooth flow of water inside the netcages.

Sampling and Feeding

Weight and carapace length of lobsters were measured at the start of the rearing period and every 25 days thereafter for 75 days using Tanita™ weighing scale (500g capacity) and a vernier caliper, respectively. Sampling was done early in the morning. Water temperature and salinity were also determined daily.

The lobsters were fed with fresh or frozen chopped *Sardinella* spp. Feed was broadcasted once a day between 5 pm to 6 pm at feeding rates of 10%, 15% and 20% body weight.

Data Analysis

Mean feed conversion ratio (FCR), growth increment (weight and carapace length) and survival rate were computed and compared using Analysis of Variance.

RESULTS AND DISCUSSION

Weight

The mean body weight of lobster fed with *Sardinella* spp. is shown in Table 1. Initially, stocks at 15% feeding rate had the lowest mean body weight. They however showed an increase in weight gain at the end of 75 days culture period, approximating the weight gain of stocks fed at 20% level. At 50 days of culture, lobsters fed at 20% and 10% feeding rate attained an almost similar weight (55.22g and 59.33g, respectively. But at 75 days of culture, the body weight of stocks at 10% feeding rate was slightly lower compared to those fed at 20% feeding rate though they had the highest weight gain at the start of the culture period.

At the end of 75 days culture period, stocks fed at 20% feeding rate showed the highest mean body weight and percent weight gain (66.13g and 52.85%) followed by those fed at 15% (65.87g and 52.70%). Stocks at 10% feeding rate showed the least mean body weight and % weight gain of 63.73g and 34.14%, respectively. Differences in final weights and % weight gain among treatments are not significant.

The average increase in body weight of *P. longiceps longiceps* in this study (42.23%) is slightly higher than that observed among *Panulirus argus* in Florida which is approximately 40% (Ellis 1991). Further, Ellis (1991) observed that *P. argus* molt every 50 to 60 days and economics of culturing lobster seems favorable towards 60% ROI.

Table 1. Growth (mean body weight (g)) of *P. longipes longipes* at different feeding rates.

Days of Culture	Feeding Rates		
	10%	15%	20%
0	45.80	43.13	43.27
25	49.07	45.53	47.35
50	59.33	51.93	59.22
75	63.73	65.87	66.13
Weight Gain	17.93	22.73	22.87
% Gain	39.14	52.70	52.85

Length

The initial caraface length of lobsters ranged from 3.45cm to 3.56cm (Table 2). Among the different treatments, stocks fed at 15% feeding rate exhibited the longest caraface length (4.06cm), followed by those fed at 20% (4.03cm) and 10% (3.95cm). These results in caraface length are comparable with the findings of Smale (1975) who reported that the juveniles of *Panulirus homarus* in South Africa had attained 6.0cm caraface length in 18 months. Data in this study showed that stocks fed at 15% feeding rate, with initial caraface length of 4.06cm and 16% caraface length can have a caraface length of 7.36cm in 17.5 months.

Table 2. Mean caraface length (cm) of *P. longipes longipes* at different feeding rates.

Days of Culture	Feeding Rates		
	10%	15%	20%
0	3.56	3.51	3.45
25	3.71	3.54	3.62
50	3.91	3.73	3.85
75	3.95	4.06	4.03
length gain	0.39	0.55	0.58

A similar trend was observed on the body weight gain and caraface length increment of the stocks in the different treatments. Highest caraface length increment was observed among stocks at 10% and 20% feeding rates during the first 50 days of culture. However, stocks at 10% feeding rate showed slow growth towards the end of the culture period which could be attributed to molting. Stocks at 15% feeding rate on the other hand initially exhibited low caraface length increment but growth gradually increased towards the later part of the culture period.

After 75 days of culture, the caraface length increment of stocks fed at 20% and 15% feeding rates was almost similar, 0.58cm and 0.55cm, respectively. The stocks at 10% feeding rate showed the least caraface length gain of 0.39cm. The mean caraface length increment and caraface length among different feeding treatments is not significant.

Survival Rate

One hundred percent survival were obtained from 15% and 10% feeding rates while 20% feeding rate had a survival rate of only 86.66%. The survival rate in this study was generally higher compared to the 90% expected survival rate of lobsters grown in netcages (Tambuli 1998).

Growth and survival of lobsters were affected by temperature, salinity and pollutants. Among the three, temperature is the most critical factor that influenced the growth rate of lobsters. (Phillips *et al.* 1980). According to Phillips (1980) water temperature in the culture cage must range from 29 to 32°C with a salinity of 30 to 34 ppt. Temperature higher than 30°C is detrimental for lobster's growth and survival (Aiken 1980), however, Van Olst *et al.* (1980) stated that lobsters can tolerate temperature as high as 31°C. Likewise, *Panulirus* spp. can be cultured as 18°C with a salinity ranging from 30-35 ppt (Lee and Wickins 1992).

Though lobsters could adjust to a wide range of salinity (Stewart 1980), salinity fluctuations are naturally occurring and causing environmental stress to lobsters, even they are euryhaline and osmoconformer species. Phillips (1980) stated that seven percent salinity difference would cause high mortality.

Another notable major cause of mortality in lobsters during and after molting is dissolved oxygen (Radhakrishan and Vijayakirmaran 1984). Juinio-Menez and Ruinta (1996) as cited by Salvacion (2000) observed that mortality occurred when dissolved oxygen is less than 4.0 mg/l conforming to the statement of Booth and Kittaka (1994), that lethal level of dissolved oxygen for lobster ranged from 0.5 to 3.0 mg/l.

The environmental parameters measured in the study area were within the normal limits as observed in other studies.

Feed Conversion Ratio

During the 25 and 50-day culture period, stocks fed at 20% and 10% showed better feed conversion ratio compared to stocks fed at 15% feeding rate. However at the end of the culture period, stocks at 10% feeding rate showed the best conversion ratio, followed by stocks at 15% and 20%, respectively (Table 3). Though Pascual (1989) stated that low FCR is better because less feed is required per unit weight gain, the trend in FCR showed that 15% feeding rate is better compared to other treatments (Fig. 2). Analysis of variance however indicated that there is no difference in FCR among different feeding rates.

Table 3. Amount of feeds consumed and feed conversion ratio among the different feeding rates.

Days of Culture	Feeding Rates		
	I0%	15%	20%
25	1.71750	2.42606	3.25525
50	1.84013	2.56106	3.55125
75	2.22488	2.92106	4.44150
TOTAL	5.78251	7.908	11.238
FCR	22	23	38

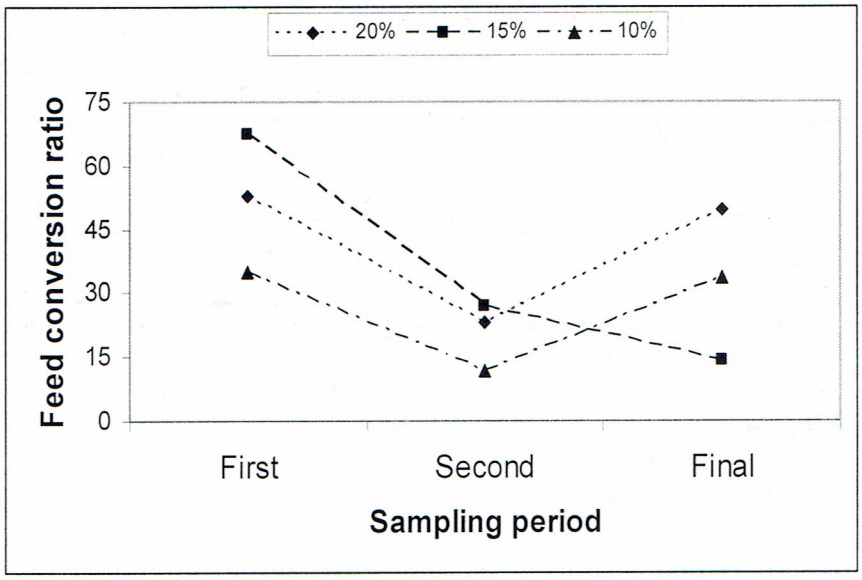

Figure 2. Feed conversion ratio trend of the different feeding rates.

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