Growth Performance and Survivorship of Sea Urchin *(Tripneustes Gratilla)* In Grow-Out Culture

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Abstract

This study was conducted in Nalvo, Sta. Maria, Ilocos Sur from November 2000 to June 2001. It primarily aimed to assess the growth performance and survivorship of sea urchin (T. gratilla) in grow-out culture. In particular, it sought to assess the growth performance of sea urchins in terms of test diameter, test height, and body weight. It further aimed to monitor the percentage survivorship of sea urchins in cages.

Two cages made of polyethylene plastic screen (1m x 2m x .75m) were set up in the reef flat at a depth of about two meters. Each cage was stocked with 100 juvenile sea urchins (2-3 cm in diameter). Prior to stocking, the average test diameter, test height, and body weight of the initial sea urchin stock were recorded. For the seven-month culture, the sea urchins were fed with Sargassum spp. twice a week.

Growth performance of the sea urchins in terms of increases in the above-mentioned parameters was recorded once a month. The average growth rate and percentage survivorship of the sea urchins on the first four months of culture and the last three months of the study period were also monitored and compared.

Results showed that on the average, sea urchins in cages have high growth rate and percentage survivorship. However, findings of the study revealed that the growth rate and percentage survivorship of sea urchins are higher on the first four months than the last three months of the culture period.

From the results of the study, it is evident that grow-out culture of sea urchin, T. gratilla, is a coastal management tool which contributes to the recovery of the depleted population of this resource. Further, this management practice could be an alternative source of livelihood, particularly in coastal communities.

Introduction

Depletion in the natural population of valuable fishery resources is one of the major problems in coastal resource management. Among these resources is the sea urchin, *Tripneustes gratilla*.

Tripneustes gratilla, locally known as *maritangtang* in Iluko, is considered one of the most expensive local delicacies among the Ilocanos. These are sold in the local markets and prices vary according to size. It is the roe or gonad of the sea urchin that is being eaten. Locals, however, even drink the coelomic fluid which they regard as a good source of iodine.

Surveys and field observation show that these echinoderms are no longer abundant as before. This collapse in the natural stock of sea urchins has been due to overexploitation and improper management of the resource. Thus, proper management and recovery should be undertaken.

Cage culture of *T. gratilla* is one of the management tools suggested for the recovery of the resource. Before, production of this resource was only by collection of natural stock, thus its fishery was open-access. At present, grow-out culture of sea urchins has become a livelihood of the fisherfolks in Nalvo, Sta. Maria, Ilocos Sur. This practice of the fisherfolks contributes to the recovery of its depleted population. Sea urchin cage culture increases the probability of successful fertilization. thus, enhancing local recruitment.

The development of sea urchin cage culture can encourage coastal families not to limit themselves to the traditional open-access fishery in which they are accustomed with. Rather, it enables fisherfolks to actively get involved in the recovery of the resource and enhancement of sea urchin population.

The practice of sea urchin grow-out culture is done by feeding juvenile sea urchins with the seaweed *Sargassum spp.* and placing them in bamboo or polyethylene plastic cages for several months or until they reach marketable size. Hence, fishermen gather sea urchins for the local market or for visitors anytime they want.

No data on the growth perfonnance and survivorship of the grow-out sea urchins has been made available. This is important for the fishermen to know the best time to gather and determine the percentage survivorship of the grow-out sea urchins. Further, this data can serve as baseline infonnation for resource management.

Objectives

This study aimed to conduct an assessment of the growth performance and survivorship of sea urchin (T. *gramilla)* in grow-out culture. In particular, it sought to:

1. assess the growth performance in tenns of increase in test diameter, test height, and body weight of sea urchin (T. *gratilla)* in cages;
2. monitor the % survivorship of *T. gratilla* in cages; and
3. recover sea urchin through cage culture.

Review of Related Literature

Tripneustes gratilla, locally known as *swaki, santol-santolan*, and *maritangtang* belongs to Phylum Echinodermata. This organism is characterized by its purplish body surrounded with white and orange spines. It is benthic in its adult stage and mainly found in scagrass/seaweed beds and reef flats.

Sexual maturity of sea urchins is reached 7-8 months after fertilization at which the diameter of the shell or test usually reaches 6-7 cm. Sexes arc separate that males and females are distinguished only by the color of the gonads. The female gonads are orange with granular eggs while male sea urchins have yellow gonads with cream yellow colored sperm. (Juinio-Meres, et al., 2001).

Juinio-Meties, et al. (2001) quoted Keesing and Hall (1998) that sea urchin fishery stocks are under threat of over-fishing throughout the world. In the country, *T. gratilla* is the most commercially exploited species, being one of the major sources of livelihood in coastal villages particularly in the Ilocos and Bicol regions.

An assessment of the sea urchin natural population in Bolinao, Pangasinan conducted by Trinidad-Roa and Pasamonte in 1997 showed that the sea urchin resource is overexploited. The University of Northern Philippines Marine Science Institute (UP-MSI) then initiated a seasonal ban on sea urchin collection during the assumed period of peak in spawning from December to February. This regulation was entailed for only two years, after which the open-access fishery of the resource continued. Due to continued overexploitation and commercial harvesting, the sea urchin fishery collapsed in 1992.

After the collapse of sea urchin fishery in Bolinao in 1992, Juinio-Meiies, et al. suggested grow-out culture as a resource management tool. The concept of grow-out culture of sea urchins was proposed to explore alternative resource management strategies to manage local sea urchin fisheries. This could particularly aid in the recovery of depleted population by creating artificial aggregation where the sea urchin brood stock can spawn freely within a greater likelihood of fertilization success.

As such, grow-out culture could function as reproductive reserves. The cages could facilitate larval recruitment because the aggregation of adults in the cages increases the probability of egg fertilization. Aggregation of sea urchins often spawns en masse, and once a sea urchin starts releasing gametes, others quickly follow. (Levilan, 1991)

Aside from enhancing reproductive rates and fertilization success, grow-out culture effectively protects juvenile from natural predators and increase the survivorship to reproductive maturity and thus enhance the productivity of the reef flats (Juinio-Meñez, et. al., 1998).

In 1997, a study on the use of two types of feeds for sea urchin in cages was conducted by Domingo and Florendo. In their study, pure *Sargassum spp.* and mixed seaweeds were used as feeds. Results showed that the growth performance in terms of increase in diameter and test heights of sea urchins fed with pure *Sargassum spp.* was significantly higher than those fed with mixed seaweeds.

In 2000, another study was conducted by Tabboga on the gonadal performance of sea urchins in relation to some variables which include water level, water temperature, and phases of the moon. Results of her study showed that gonadal performance of sea urchins is not affected by factors like the phases of the moon and water level. Results further showed that higher gonadal performance was observed when temperature was high.

All these studies show that, so far, no reports on growth performance and survivorship of sea urchins cultured in cages have been published.

Materials and Methods

A. Site Description

The study was conducted from November 2000 to June 2001 in the intertidal zone of Nalvo, Sta. Maria, Ilocos Sur. The area, where wild sea urchins (T. *gratilla)* are naturally found, is a sandy-corally area covered by *Sargassum spp.,* other seaweeds and seagrasses. It is free from any freshwater source, with high water movement and tidal flushing.

B. Cage Installation, Stocking and Maintenance

Two cages made of polyethylene plastic screen measuring Im x 2m x.75m were set up in the area of about two meters at high tide. Each cage was stocked with J00 juvenile sea urchins (2-3 cm in diameter) collected from the wild.

The sea urchins were fed with *Sargassum spp.* or *aragan* twice a week for the whole seven-month period. The cages were constantly cleaned, removing the leftover algae and other debris each time the urchins were fed.

C. Monitoring Growth Performance and Survivorship

Prior to stocking, the initial test diameter, test height, and body weight of the sea urchins were recorded. During the seven-month period, the growth performance of sea urchins in tenns of average increase in test diameter, test height, and body weight was recorded monthly, using a caliper and weighing scale. The growth rate as well as percentage survivorship of the sea urchins was also computed.

The growth rate of the sea urchins was computed during the 4" month (first period) (GRI) and the seventh month (second period) (GR2) prior to harvest using the formula of Juinio-Mees, et al. (2001):

a. test diameter

$$GRI = \frac{[TD \text{ ave at month } 4) - TD \text{ ave at start of grow-out}}{4 \text{ months}}$$

$$GR2 = \frac{[TD \text{ ave before harvest}) - (TD \text{ ave at month } 4)}{\#\text{ of mos. between mo. 4 and harvest}}$$

b. test height

$$GRI = \frac{(TH \text{ ave at month } 4) - (TH \text{ ave at start of grow-out})}{4 \text{ months}}$$

$$GR2 = \frac{(TH \text{ ave before harvest}) - (TH \text{ ave at month } 4)}{\#\text{ of mos. between mo. 4 and harvest}}$$

c. body weight

$$GRI = \frac{(BW \text{ ave at month } 4) - (BW \text{ ave at start of grow-out})}{4 \text{ months}}$$

$$GR2 = \frac{(BW \text{ ave before harvest}) - (BW \text{ aye at month } 4)}{\#\text{ of mos. between mo. 4 and harvest}}$$

Percentage survivorship (%survivorship) of the sea urchin stock in month 4 and month 7 was also computed. The following formula was used in computing the % survivorship:

$$\%\text{survivorship} = \frac{\text{final \# of sea urchins}}{\text{initial \# of sea urchins}} \times 100$$

Results and Discussion

A. Growth Performance

Tables 1a to 1e present the growth perfonnance of sea urchins, *Tripneustes gratilla* in terms of increases in test diameter, test height, and body weight.

Table 1a. Mean monthly growth performance of sea urchins (T. *gratilla*) in terms of % increase in test diameter (cm)

DATE OF DATA GATHERING	AVERAGE TEST DIAMETER (cm)	GROWTH INCREMENT (%)
11-08-00	2.94	
12-06-00	3.52	19.73
01-12-01	4.97	41.20
02-09-01	5.99	20.52
03-08-01	6.57	9.70
04-09-01	7.06	7.46
05-08-01	7.55	6.94
06-14-01	7.81	3.44

Table 1a shows that in terms of increase in test diameter, the second month of culture obtained the greatest percentage increase (41.20%) while the lowest was obtained in the seventh month (3.44%). It is also observed from the table that the first three months of the grow-out yielded the highest percentage increase while the two last months yielded the lowest.

It can be observed from the table that the growth performance of sea urchins was raster during the first three months.

In terms of increase in height, the following table shows that the highest growth performance was obtained in the first month of culture (31.31%) followed by the third month (22.30%). The lowest was obtained in the sixth month of culture (0.46%).

Table 1b. Mean monthly growth performance of sea urchins (T. *gratilla)* in terms of % increase in test height (cm)

DATE OF DATA GATHERING	AVERAGE TEST DIAMETER (cm)	GROWTH INCREMENT (%)
11-08-00	1.98	
12-06-00	2.60	31.31
01-12-01	2.78	16.90
02-09-01	3.40	22.30
03-08-01	3.89	14.41
04-09-01	4.37	12.34
05-08-01	4.39	0.46
06-14-01	4.77	8.60

It can be observed from Table 1b that the growth performance of sea urchins is faster during the first months of culture. This manifests that it is during these first months when the sea urchins are in their periods of peak growth.

Table 1e shows the mean monthly growth performance of sea urchins (T. *gratilla)* in terms of increase in body weight.

Table 1e. Mean monthly growth performance of sea urchins *(T. gratilla)* in **terms of % increase in body weight (cm)**

DATE OF DATA GATHERING	AVERAGE TEST DIAMETER (cm)	GROWTH INCREMENT(%)
11-08-00	60.25	
12-06-00	70.28	16.65
01-12-01	81.45	15.89
02-09-01	93.16	14.38
03-08-01	112.52	20.78
04-09-01	127.68	13.47
05-08-01	132.22	3.56
06-14-01	138.44	4.70

As shown in the table, the highest percentage increase in body weight was obtained in the 4 month (20.78%), while the lowest percentage increase was obtained in the sixth month (3.56%).

B. Growth Rates

The growth rates of the sea urchins after four months of culture (GR1) and after seven months of culture (GR2) were also computed. Results are shown in Table 2.

Table Z. Growth Rate of Sea Urchins (T. *gratilla)* in terms of Test **Diameter** (cm), Test Height (cm), and Body Weight (g).

PARAMETERS	GROWTH RATE (cm/mo. and g/mo.)		
	GRI	GR2	Ave. GR
Test Diameter (cm)	0.90	0.41	0.65
Test Height (cm)	0.48	0.29	0.38
Body Weight (cm)	13.13	8.64	10.88

It is shown in Table 2 that in terms of test diameter, test height, and body weight, the sea urchins grew faster during the first four months than during the second half of the culture.

In terms of test diameter, the sea urchins obtained a growth rate of 0.90 cm/month during the first period of culture and obtained a growth rate of 0.41 cm/month during the second period. An average of 0.65 cm/month was obtained for the seven-month duration of cage culture.

In terms of test height, the growth rate of the sea urchins was faster during the first period (0.48 cm/month) than the second period (0.29 g/month), with an average of 0.38g/month.

In tenns of body weight, a growth rate of 13.13 g/month was obtained during the first period of culture, a value slightly higher than the growth rate during the second period which is 8.64 cm/month. An average growth rate of 10.88 g/month was obtained for the whole duration of the study.

These results imply that growth rates in terms of the above mentioned parameters are faster while the sea urchins are smaller or younger, but gradually decline as the animals become larger. Results further imply that it is during the first months where sea urchins have their optimum development in terms of body size.

C. **Percentage** Survivorship

The percentage survivorship of the sea urchin stock in the two cages during month 4 and month 7 are shown in the following table.

Table 3. Percentage survivorship of sea urchins (T. *gratilla)* during the first four months and the second half of the grow-out period,

MONITORING PERIOD	INITIAL **NUMBER OF SEA URCHIN STOCK**		**FINAL NUMBER OR SEA URCHIN STOCK**		**% SURVIVORSHIP**		
	Cage 1	Cage 2	Cage I	Cage 2	Cage I	Cage 2	Ave
Month four	100	100	96	92	96	92	94
Month seven	96	92	79	73	82.29	79.35	80.82
Average	98	96	86	83	89.14	85.67	87.5

Table 3 shows that the percentage survivorship of sea urchins in both cages is higher in the first four months of culture with an average of 94%. A decline in percentage survivorship was observed during the second half of the culture period with a mean of 80.82%. This implies that since growth is faster in the urchin's younger stage, their survival rate is relatively higher than during the later part of the culture period. As the sea urchins mature, they tend to decline in their development. Other factors such as competition for food and space may have caused the decline in the percentage survivorship of the sea urchins.

Conclusions

The following conclusions are drawn from the findings of the study:

1. The growth rate of sea urchins in terms of test diameter, test height, and body weight is faster during the first four months of culture than during the succeeding months of the culture period.
2. Percentage survivorship of sea urchins is higher during the first period of culture (first four months) than during the second period (last three months). On the average, the percentage survivorship of sea urchins in cages is high.
3. Cage culture is a successful management tool for sea urchin resource recovery.

Recommendations

Considering the high growth rate and percentage survivorship of sea urchins in cages, the following recommendations are hereby forwarded:

1. Cage culture of sea urchins should be undertaken as part of coastal management in various areas of the province. Thus, proper dissemination of the technology should be done in different coastal communities.

2. Product formulation should be undertaken for the maximum utilization of the resource and additional source of income for the coastal communities.

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