The Growth of Abalone (*Haliotis squamata*) in Net Floating Cage at Hulaliu Waters, Central District of Moluccas

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Abstract

Jacqueline M.F. Sahetapy and Magdalena Latuihamallo. 2014. The Growth of Abalone (*Haliotis squamata*) in Net Floating Cage at Hulaliu Waters, Central District of Moluccas. *Aquacultura Indonesiana*, 15 (1) : 21-25. Growth of abalone *Haliotis squamata* were studied over 5 weeks in net floating cages at Hulaliu waters, the Central District of Moluccas. The objectives of the research were to analyze a daily growth rate and absolute growth of abalone *Haliotis squamata* in net floating cage. A total of 45 abalones were observed, with average initial weight ranged of 8.0-8.5 g. The abalones were treated with 3 types of natural foods, and 3 replications were held. The foods type treatment were using 2 species of macroalga namely *Ulva* sp., *Gracillaria* sp., and combination of *Ulva* sp. and *Gracillaria* sp.. The water quality was monitored twice a day included water temperature (28.1 – 29.9°C), pH (7-8.5), dissolved oxygen (8.2-10.1 mg/L) and water salinity (29.6-34 ppt). The highest daily growth rate of weight was gained in *Ulva* sp. treatment which had rate of 0.068 g/day at the fifth week, and also the absolute growth of weight was obtained in *Ulva* sp. treatment which had rate of 4.0 g in 56 days.

Keywords : Growth; *Haliotis squamata*; Net floating cage

Introduction

Abalone *Haliotis squamata* is one of the prospective waters commodity and has a high economic value, caused by its superiority like high in nutritional contents which good for health (protein 71.99%, fat 3.2%, fibre 5.6%, ash 11.11%, water 0.6%) (Latuihamallo, 2011), and also its esthetics value of its shells which could be used in handicraft. The higher demand of this species which also affected to its price causing overexploitation for this species. There was found that the level of the exploitation became critical, signed by the more difficult in finding the species in its nature habitat. It had to be worried that one day the population of abalone could become extinct. To solve this problem, abalone is needed to be cultured.

Abalone could be cultured in many conditions, the laboratory scale or direct in the sea, and one method that could be used to culture abalone was using Net Floating Cage Method. A better technology of cultivation was needed whether in laboratory scale or in its nature habitat including food management, media engineering, breedstock management for hatching and water quality management (Fallu, 1991).

This research was aimed to analyze daily growth rate and absolute growth of abalone cultured in net floating cage in Hulaliu waters. This research hopefully could provide the more efficient, effective, productive and eco-friendly

technology. Thus, the research was held with an accurate concept of abalone culture considering the resources and the geographical aspect.

Material and Methods

Tool and Material

The tools used in the research *i.e.*: net floating cage, boat, plastic container, plastic basket, nylon, thermometer, refractometer (ATAGO), DOmeter (Type H19023), pHmeter (Hanna Type H198107) Caliper, and digital scales. While the material was abalone *H. squamata* with average weight ranged of 8.0-8.5 g about 45 individuals.

Abalone culture

Abalone cultured in net floating cage sized 3x3 m² by putting each individu of abalone into plastic basket and each basket contained 5 individu abalone. The natural foods used in the research were 2 types of alga (*Ulva* sp. and *Gracilaria* sp.) and combination of both of them. Food percentage was about 25% of its weight where the weight was being measured every 5 days (Latuihamallo, 2011).

Data Analysis

a. Daily Growth Rate of Abalone

Daily growth rate of abalone was calculated using a formula based on Zonneveld *et al.* (1991):

$$G = (W_T - W_0) / T$$

where :

G : Daily Growth Rate (g/day)

W_0 : Weight of abalone at initial day of research (g)

W_t : Weight of abalone at the latest day of research (g)

b. Absolute Growth of Abalon

Absolute growth was using formula based on Effendi (1979) :

$$B_m = B_t - B_o$$

where :

B_m : Absolute growth of abalone

B_t : Weight of abalone at the latest day of research (g)

B_o : Initial weight (g)

Results

*Daily Growth Rate and Absolute Growth of Abalone *Haliotis squamata**

At initial day of research, weight of abalones were found in certain equal range of size. Figure 1 showed that abalone with different type of food treatment were in the growth increasing over 5 weeks of culturing. Figure 1 showed that abalone with *Ulva* sp. as its food had the highest rate of growth, compared with other types of food, *Gracillaria* sp. and the combination of both alga. At the first week of culture was found that all types of food giving the same value to both daily growth rate and absolute growth (0.001 g/day), then at the second week *Ulva* sp. showed higher value than others which finally gained 0.068 g/day at the fifth week.

Result of absolute growth of abalone during the period of research showed that there were different rates among the three treatments, where the abalone fed with *Ulva* sp. showed faster growth rate during 5 weeks of culture and being the highest at the end of research, weight 4.0 g, followed with *Gracillaria* sp. treatment, weight 2.6 g and 1.8 g in alga combination treatment (Figure 2).

Figure 1. Daily Growth Rate of Abalone *Haliotis squamata* in Net Floating Cage At Hulaliu Waters

Figure 2. The Absolute Growth of Abalone *Haliotis squamata* in Net Floating Cages

Water quality measured during the research showed that waters where the culture were held was in optimal rate for aquaculture, especially abalone culture. The temperature ranged at 28.1 – 29.9°C, salinity ranged at 29.6-34 ppt, pH ranged at 7-8.5 dan DO ranged at 8.2-10.1 mg/L.

Discussion

Figure 1 showed the graphic of daily growth rate of abalone which could be interpreting the abalone's preference to certain type of food. It was assumed that abalone feed based on its need. While at the second week clearly showed that weight of abalone increased faster at *Ulva* sp. treatment. Thus, it could be assumed that abalone had preference to *Ulva* sp. as its natural food.

Rahmawati *et al.* (2008) stated that alga *Ulva* sp. and *Gracillaria* sp. were better compared to other types of alga used as natural food for abalone culture, which both provided better result. Juveniles of abalone species *Haliotis asinina* fed the red alga *Gracilariopsis heteroclada* and artificial diet showed faster growth in terms of both total body weight and shell length than those fed the red alga *Kappaphycus alvarezii* (Capinpin and Corre, 1996). Capinpin and Corre (1996) also suggested that *Gracillaria* sp. could be used as natural food to stimulate the growth and found to be in proportion as food for abalone culture.

Abalone species *Haliotis asinina* and *H. squamata* preferred alga as their food, however the growth rate was found slow. Priyambodo *et al.* (2005) and Susanto *et al.* (2007) suggested that growth rate of abalone during the culture and fed with alga showed to be slow and heterogeneous (not equal). However, insufficient food availability during the early life stages strongly influences survival and growth of postlarval abalone (Kawamura *et al.*, 1998; Takami *et al.*, 2000; Sasaki and Sheperd, 2001; Roberts *et al.*, 2001), although Onitsuka *et al.* (2008) reported that food limitation was not the only factor affecting the survival of abalone.

Predation is another important factor affecting the survival rate of abalone. Abalone cultured in wild condition, particularly the postlarval and juveniles, are potentially preyed upon by various carnivorous animals, such as polychaetes (Naylor and Mcshane, 1997), fishes (Shibui, 1971; Sheperd and Turner, 1985), crabs

(Shibui, 1971; Mower and Sheperd, 1988) and starfish (McShane and Naylor, 1997). Thus, a better system had to be developed to reduce this threats.

Besides of substrate and food factors, water quality became one of important factors that affected the growth and survival rate of abalone (Setyono, 2006). A stabil temperature could increase the growth of some species of abalone. *Haliotis tuberculata* gained 18 mm/year at temperature 20°C, *Haliotisfulgens* showed growth increasing at temperature above 20°C (Stickney, 2000). Peck (1989) suggested that temperature ranged at 8.5-9.0°C became the lowest temperature to *Haliotis tuberculata*. At lower temperature than the range, abalone would be difficult to absorb food and so the growth became slower. Based on result of laboratory research, the maximum growth of abalone would be gained at temperature 20°C. In Europe as reported by Hayashi (1980), low water temperature during the winter arrested growth, so that the main growth occurred in summer. Conversely, the growth pattern of abalone cultured in land-based culture system at Israel was opposite to the pattern in the natural habit and spawning occurred during the winter (Shpigel *et al.*, 1996). While Koike (1978) maintained the growth of *Haliotis tuberculata* reared in a land-based facility was accelerated due to the constant temperature 20°C.

Abalone most found in high salinity of waters liked sea waters which had range of salinity 30-35 ppt. For example, *Haliotis tuberculata* could not live in brackish water (Fretter and Graham, 1962). The same opinion was suggested by Jeffreys (1865) that *Haliotis tuberculata* was easily to be stricken with disease at lower salinity (below 14 ppt). Optimal salinity suited to abalone growth ranged at 33-35 ppt, while range above 35 ppt would affect not optimal to the growth (Fallu, 1991). Stickney (2000) stated that the optimum growth of abalone depended on each species and also water quality, and salinity had to be kept at range 32-35 ppt. Based on Peck (1983)'s laboratory research, resulted that the survival rate of abalone was very low at salinity 14 ppt, while the rate was good at salinity 24 ppt.

pH affected the toxicity of chemical compounds. At waters with low pH, there were found many nontoxic ammonium (innocuous). Though, at alkali condition (high rate of pH), there were found many unionized ammoniac and

toxic. Unionized ammoniac was easily absorbed into aquatic organism's body compared with the ammonium (Tebbut, 1992). Most of aquatic organisms were sensitive to pH changing and prefer to pH ranged at 7.0-8.5 (Novotny and Olem, 1994). While Stickney (2000) suggested that abalone needed good water quality for its growth, thus must be cultured in clean area of waters. Optimum pH rate to gain an optimal growth of abalone was found at 8.0.

Dissolved oxygen (DO) was one of the limited factor in waters. All of aquatic organisms need oxygen to fulfill their metabolism activity. Based on result, DO measured over the research were ranged at 8.2 mg/L – 10.1 mg/L. Compared to water quality standard, then could be described that DO found in research were in fixed range of DO for culture organism.

Conclusions

Based on analysis of daily growth rate of abalone, absolute growth of abalone, and water quality measurements, could be obtained some conclusions, *i.e*:

1. Natural foods fed during the research were together affecting the daily growth rate of abalone, though the highest rate were found in abalone fed with *Ulva* sp.
2. The absolute growth of abalone was found at treatment with *Ulva* sp.
3. Water quality at Hulaliu waters measured during the research were found in optimal range for abalone growth.

Recommendation

Based on the conclusions, some recommendation were suggested, *i.e*:

1. The research could be continued with some levels of each water quality parameters to investigate the feeding habit of abalone.
2. The research could be continued with different type of food whether natural food or artificial food to investigate the preference of abalone appetite and the influence for its growth.
3. Abalone culture in Hulaliu waters had to be considered to be developed for the waters was suited as culture area of abalone.

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