PRELIMINARY STUDY ON POPULATION DYNAMIC OF HARPACTICOID COPEPOD *Euterpina acutifrons* IN CULTURE CONDITION

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ABSTRACT

The most important factor to high mortality rate in larval rearing is feeding success in early larval stage related to kind and size of natural live food. Copepod basically is the main source of natural food in the open ocean having some advantages such as smaller size of nauplii, attractive movement and high nutritional value. Observation on population dynamic of harpacticoid copepod *Euterpina acutifrons* was carried out using 5-L plastic bucket with initial density 100 ind./L. Green algae *Nannochloropsis* sp. was added to culture media at density of 50,000 cells/mL as a basic feed and additional feeds given were wheat flour (group **A**) and chicken liver (group **B**) at a rate of 50 mg/bucket. The result showed that there was no difference on population pattern in both groups where the incubation time took eight days to hatch, from nauplii to the copepodite stage was three days and from copepodite to adult copepod took five-to-six days. The differences came up from population number: in group (**A**) the highest number of copepod-bearing-egg was only 133 ind., nauplii production up to 62,833 ind. and number of copepodites was 22,333 ind. lower compared to group (**B**) with the highest copepod-egg was 308 ind., nauplii was 113,333 ind. and copepodite was 51,167 ind. The conclusion pointed out that the kind of food did not influence population pattern (quality) but gave effect to population growth.

KEYWORDS: harpacticoid copepod, *Euterpina acutifrons*, population dynamic

INTRODUCTION

Marine finfish hatchery still is facing problem for higher production rate, specifically to increase larval survival rate. Feeding success at larval early stage is an important factor causing high mortality related to given kind and size of natural feeds given during larval rearing period. Basically copepod is the main source as larval food in open ocean water, from littoral to the deep sea and from warm water in tropics up to cold water in polar areas.

Copepods are included in tiny shrimp group of Entomostracan known by their small size, having a body with head, thoracic and abdomen; head and thoracic are fused to make anterior part or form, and have a single simple eye located in median nauplius eye (Newell and Newell, 1986). Groups of copepod have high possibilities to replace the role of rotifer and *Artemia* as life food for marine fish larvae due to the small size from 60 µm up to more than 2 mm and they bloom in nature. Some copepod species are parasitic to fish such as Notodelphyoid, Monstrilloid, Caligoid and Lernaeopodaid while some other copepod species have been studied for live food candidates in hatchery are the pelagic and benthic species such as Calanoid, Cyclopoid and Harpacticoid (Barnes, 1963; Raymont, 1983)

Harpacticoid is easily to detect from Calanoid or Cyclopoid from the body form, the simple one is the differences of thorax segment and abdomen width, where the Harpacticoid almost has no differences and making the body appearance is fusiformed and pointed while other groups the difference is significant. Other specific criteria is at the main antennae where Calanoid has 25 segments,

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Cyclopoid with 8-18 segments and for Harpacticoid usually is short with only 3-9 segments (Raymont, 1983).

The advantage of Harpacticoid group is the small size of body below 1 mm, dense in population and distributed on the sea bed with active movement and has associated with mud ball of Polychaeta, leaves of seaweed and macro algae as source of food and hiding place as well (Thistle dan Eckman, 1988). It also has capability to produce bioluminescence (Herring, 1988), and known having enzyme like D-5, D-6 desaturase and elongase very important to convert the short chain essential fatty acids (LNA - 18:3n3) become long chain essential fatty acids of EPA (20:5n3) and DHA (22:6n3) (Rhodes and Boyd, 2005), and rich with high concentration of long chain HUFA important to accelerate fish grow (Fleeger, 2005). Sumiarsa *et al.* (2005a) stated that the DHA and EPA values were able to increase by managing the densities of algae *Tetraselmi*s as food source and reached the highest value of EPA 42.4% and DHA 38.9%. Other advantage of copepods was also shown by Sumiarsa *et al.* (2005b) in larval rearing of tiger grouper (*E. fuscoguttatus*) using Harpacticoid nauplii resulted higher growth rate compared with the larvae fed on rotifers. Rippingale and Payne (2005) also showed the role of copepod on successfully larval rearing of mahi-mahi *Coryphaena hippurus* fed with harpacticoid *E. acutifrons*.

Research on the possibilities of copepod culture for natural food source has been done already with species selection potential for mariculture was done by Fleeger (2005), observation on factors affecting influencing successful predation of marine fish larvae to copepods as natural food (Chesney, 2005) and research on feed formulation to culture Harpacticoid copepod and its implications to population growth and amino acid composition as well by Rhodes and Boyd (2005). However, it is still needed to more developed technology on mass culture copepod production similar to that of the rotifer culture.

This observation was carried out to gather data on copepod culture with particular emphasize on type of feed in related to the developmental pattern of morphological stage and population numbers as well.

MATERIALS AND METHODS

This observation used a local benthic copepod species from coastal waters at Gerokgak area, Buleleng North Bali. Samples were isolated and reared for 90 days, fed with combination of algae *Nannochloropsis oculatta*, wheat flour, yeast and chicken liver similar to the method by Gaudy and Guerin (*in* Raymont, 1983) where ground pellet and other food sources with high nitrogen content such as casein, cod liver oil and yeast were appropriate for culturing *Tisbe holothuriae* in previous trials. Another reasons for feeding with these types of feed for the copepod is the materials are locally available, inexpensive and easy to obtain. Identification of sampled copepod followed Newell and Newell (1986), Hutabarat and Evans (1985) and by documentation method using a binocular microscope completed with micrometer, microscope digital camera operated with Ulead Photo Exporer 7.0 SE software.

Black plastic containers were used as experimental units with working volume each of 5 liters and all are placed in a rectangular fiberglass tank (Fig. 1). Initial copepod density was 100 adults/liter. The copepods came from an isolation tank distributed randomly and evenly to six observational tanks and divided into two groups of (**A)** fed with *N. oculatta* and wheat flour and the second group (**B)** fed with *N. oculatta* and raw chicken liver.

The algae were fed at 5.0×10^4 cells/ml and maintained every 12 hours following the

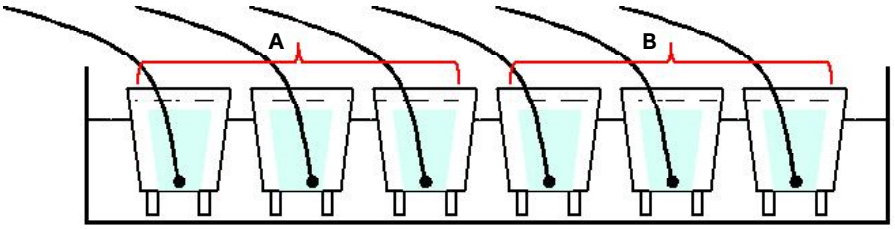


Figure 1. Observational design apparatus in a water bath system

optimal density by Nassogne (*in* Raymont, 1983). Wheat flour and chicken liver were ground and fed at 50 mg/tank daily and given twice a day with 12 hours interval the same as the isolation period prior this observation.

Collected data were morphological stage of copepod for species investigation, number of egg-bearing adults, number of nauplii produced, copepodites and adult copepods. Sampling was conducted every day at 1100 h to count the number of nauplii and copepodites while counting adults and egg-bearing copepods was conducted every other day.

Microsoft® Excel and Microsoft® Word softwares were used to analyse the data and reporting.

RESULTS AND DISCUSSION

Copepod Species

From morphological observation it was confirmed that the copepod was a Harpacticoid copepod having 580-950 mm total length, five segments of antennula, fusiformed body where head and first thoracic segments were joint, lack of obvious division on main body region and head was pointed in front with single nauplius eye. These criteria pointed to the genus of *Euterpina* (Hutabarat and Evans, 1985). Further details based on Newell dan Newell (1986) were body length of 0.5 - 1 mm with pointed head and *setae* 1/3 of body length for female and 2/3 for male, the first thoracic segment was united with head. *Caudal rami* shorter than the last segment and *caudal setae* is as long as four last body segment confirmed as *Euterpina acutifrons*. Uye (2005) described that *E. acutifrons* was one of 13 copepod species recommended for mass culture for marine fish seed production in Japan.

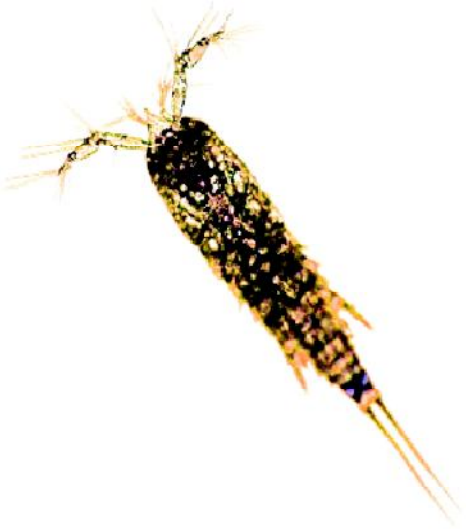


Figure 2. Adult harpacticoid *Euterpina acutifrons*

Population Development Pattern

This observation was started with documentation of specific body form and characters important for stage valuation, form of naupliar stage, copepodite, adult and egg-bearing copepod stage.

Body segment did not develop in naupliar stage, started to appear in copepodite stage with short main antennae and it developed completely with full five segments with several *setae* in adult stage, the length of *caudal rami* was as long as the last segment and the *caudal setae* was nearly the same with the length of four last segments.

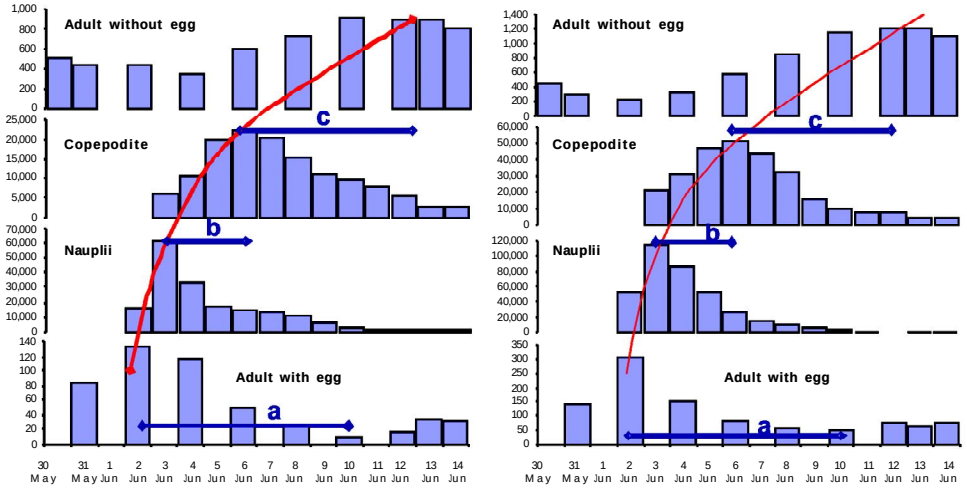
From population data in both groups (Fig. 4) there was no any significant differences between A and B.

Incubation time of egg (**a**) was figured out from the peak of egg-bearing adult copepod population to the lowest population with assumption that the eggs hatched out gradually related to egg maturity level with approximately needed eight days. From peak population naupliar stage to peak population at copepodite stage (**b**) took three days interval meaning a rapid morphological development while from copepodite stage to adult stage (**c**) took 5-6 days development. Total development period from naupliar to adult stage was approximately 8-9 days. A rapid development in culture condition was also reported by Bernard (*in* Raymont, 1983) in trial culturing a harpacticoid *E. acutifrons* in a laboratory condition and founded that the development time was shorter than that of in natural condition (6 weeks).

Estimation of development pattern of the harpacticoid copepod in this observation was based on population frequency distribution and it was suggested that food was unrelated to dynamic of population cycle of *E. acutifrons* rather environmental condition affected on the population dynamic where temperature and salinity resulted in abundance of *E. acutifrons* as reported in colder seas of Southampton by

Naupliar stage **Copepodite stage** **Adult stage**

Figure 3. Developmental stage of harpacticoid *E. acutifrons*



Treatment A Treatment B

Figure 4. Population pattern of every stage of *E. acutifrons* during the observation

Farran (*in* Raymont, 1983). To ensure dynamic population pattern, the observation was continued with individual culture to get more details on life cycle of the copepod from egg incubation time until copulation stage.

Population Growth

Obtained data showed in Fig. 5 that the highest average nauplii population in treatment (A**)** was 62,833 individuals (56,500 – 68,000) lower than that of in treatment (B) at 113,333 individuals (99,500 – 135,500) produced from 133 egg-bearing adults in (A) and 308 egg-bearing eggs adults in treatment (B).

Survival rate from naupliar to copepodite stage was 36 % in treatment A (22,333 individuals) lower to that of treatment B (45 %) with average production of 51,167 copepodites.

However, survival rate from copepodite to the adult stage was higher in treatment A (4%) compared to that of in treatment B for (2%). In total, production of adult copepod in treatment B was higher (1,217 individuals) compared to that of in treatment A (833 individuals, Fig. 6). Data analyses of survival rate in every developmental stage showed that treatment B was superior to that of A at naupliar and copepodite stages but for the rest of the stage treatment A seemed to be better to produce adult compared to that of treatment B.

Differences in term of population development in every stage showed that there was a specific need from type of foods, size and shape as well. It has been reported by Nassogne (*in* Raymont, 1983) that the size of algae of 7–16 µm supported successful culture of *E. acutifrons,* smaller or bigger size was not effective in a certain stage and mixed algae were the best for egg production and in the adult stage. Setiawati and Pratiwi (2004) in their experiment with other harpacticoid copepod of *Tisbe holothuriae* showed results that there were significant effects from type of algae in every stage development of the copepod.

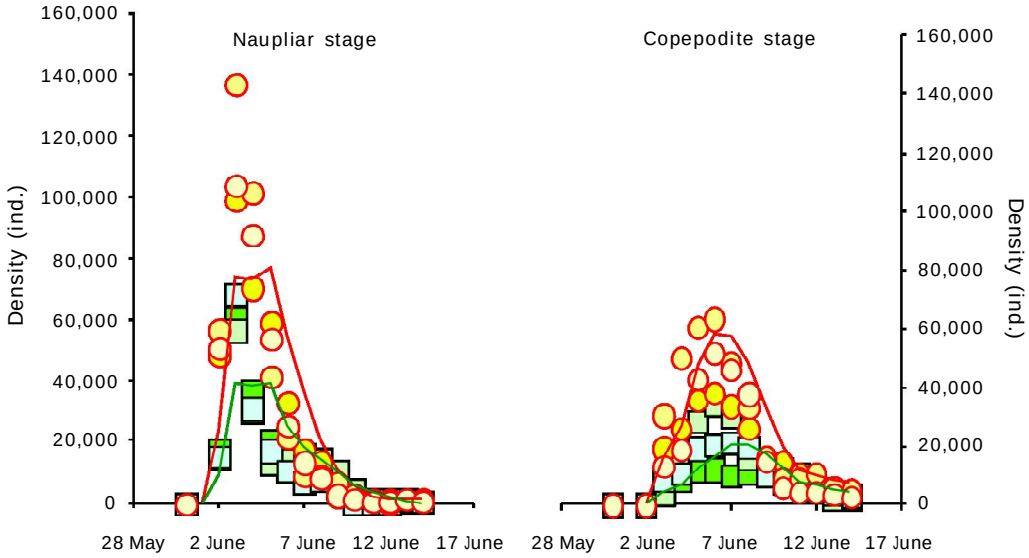


Figure 5. Performance differences on number of nauplii and copepodite stages between treatment A (9 square) and B (O round)

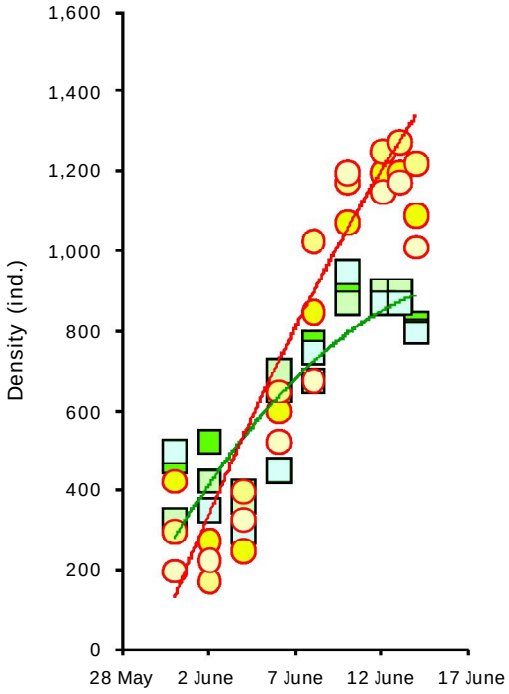


Figure 6. Adult copepod production in treatment A (9 square) and treatment B (O round)

Overall treatment A from initial adult copepod density of 600 individuals/tank grew up to 838 individuals after 15 culture days resulted in population development value of k = 0.021 lower than that of in treatment B with k = 0.044. Composition of algae *N. oculata* and chicken liver was suggested to provide perfect particle size and nutrition and also easy to digest (direct feeding). In addition, foods also induced bacterial growth (indirect feeding) better compared to that of the combination of algae *N. occulata* and wheat flour. Copepods were recognized as herbivore, omnivore or carnivore organisms (Greene, 1988) and also suggested to consume bacteria, detritus and other microorganisms dwelling on bottom substratum or were associated with seaweed like *Halophila ovalis* (Arunachalam and Nair, 1988).

CONCLUSION

Type of food (nutrition) did not affect on population dynamic cycle of the harpacticoid *E. acutifrons* rather it had an important role to increase survival rate in every stage of copepod development (production number).

Further studies should be focusing on the reproduction performance aspects of the harpacticoid copepod such as egg-bearing and the production of the adults, optimum feeding as well as environmental factors such as salinity, light intensity and stress level due to the environmental pressure.

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