KORESPONDENSI DENGAN JURNAL BIODIVERSITAS TENTANG BREEDING AND LIFE CYCLE of *Neocaridina denticulata* and *Neocaridina palmata*

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Ahmad Dwi Setyawan

Short Communication: Breeding and lifecycle of ornamental shrimps *Neocaridina denticulata* and *N. palmata* in aquariums

5 Feb 2020, 14.48

Abstract. The study of *Neocaridina* sp is important because it plays a role in the economy and trade between the countries. However, lack of sufficient studies on the knowledge. One of the factors that influence of *Neocaridina* sp life production is the cycle and water parameter. Objectives of this study were conducted to notice the life cycle of the two species, and to record water parameter including temperature, pH, ammonia, nitrite, and oxygen. The results shows, that two species have no different in life cycle stages and they were able to reach the first sexual maturity stage of the life cycle at 75 days, maximum length ranged of the parent from 2.30-3.00 cm. The eggs became larvae in 15 days, larvae reached the juvenile stage after 60 days, and the juvenile became mature in 15 days. The number of eggs depends on the size of female of the two species; smaller females produced fewer eggs compared to larger females. The temperature range for the two species were 25-28°C and the pH were between 6.5-8.0.The values of ammonia were in the range between 1.21-1.72 mg/l, the nitrate were between 0.06-7.91 mg/l, and the oxygen were between 5.5-7.9 mg/l.

Key words: *Neocaridina denticulata*, *N. palmata*, ornamental shrimp, life cycle, aquarium

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INTRODUCTION

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Commented [A3]: Please check this statement. *Neocaridina denticulata* and *N. palmata* are not indigenous Indonesia

Genus *Neocaridina* belongs to the phylum Arthropoda, subphylum Crustacea, class Malacostraca, order Decapoda, infraorders Caridea, and family Atyidae (Ariyanathan and Serebiah 2016; Lai and Shy 2009). *Neocaridina* spp.such as *Neocaridina denticulata* and *N. palmata* became popular in aquarium industry over the past years (Lai and Shy 2009; Tropea et al. 2015). These shrimps are freshwater shrimps indigenous of Japan, Korea, China, and Taiwan

(Hung et al. 1993). According to Cai (1996), *N. denticulata* and *N. palmata* originate from a pond, river, agricultural canals, mountain streams, and reservoirs.

Neocaridina denticulata has b red, yellow, and blue color, while *N. palmata* is characterized by transparent color which is quite interesting look great in contrast to green aquatic plant or against a dark-colored background. Due to their beautiful colorl, many people keep those shrimps as ornamental in an aquarium (Heerbrandt and Lin, 2006; Pantaleão et al., 2015; Ganesh, 2015).

Neocaridina has several characteristics such as size 2-3 cm in the total length of the parent, high resistance to environmental conditions fluctuate so that quality of breeding and a high survival rate. Shrimps have a tolerance range of water quality parameters in the aquarium such as pH ranged between 6.5-8.04, temperature between 24-29°C, oxygen between 5-7 mg/l, ammonia ranged from 0.1-1.9 mg/l, and nitrate ranged from 0.1-10.0 mg/l (Ganesh, 2015; Ariyanathan and Sesh Serebiah, 2016; Heerbrandt and Lin, 2006.). With these advantages, *Neocaridina* sp need to develop and improve its breeding. However, the current research of *Neocaridina* species is still a lot to do so we need further observations to improve their performance.

One of the factors that influence the success of *Neocaridina* shrimp production is life cycle i.e. egg, larvae, juvenile, and adult (Hung *et al*., 1993; Shih and Cai, 2007). *Neocaridina* adult produces relatively small-sized eggs range from 1-1.19mm with a long planktonic phase (Shokita, 1981; Lai and Shy, 2009). The common type of development has ranged between 9-12 planktonic larval stages, and the pleopods of the larval stage are not yet developed (Lai and Shy, 2009), the pleopods develop in juvenile stage.

Previously the trading of freshwater ornamental shrimp species has become a highly profitable and a fastest growing industry in the world, the pressure on wild populations is building up creating a wide array of environmental implications and currently breeding in the aquarium minimizing the negative impacts on the natural environment and sustainable supply for the industry. The scope of shrimp keeping in a planted aquarium or in dedicated aquaria is increasing among the hobbyist (Tropea and Lopez-Greco, 2015; Ganesh, 2015). Successful of life cycle and mass production of this shrimp can provide an avenue for the aquarium industry and contribute to national income. The study of *Neocaridina* sp is important because it plays a role in the economy and trade between the country and as a result of the lack of sufficient studies on the knowledge of these species and their biological nature and how they reproduce needs a lot of research in this field.

Objectives of the Study to notice, the life cycle of *N. denticulata* and *N. palmata*, and to records the maximum length reached per adult female, and the every stage of a life cycle in the two species in a laboratory condition and to record the water parameters such as water temperature, pH, ammonia, nitrate and oxygen in aquarium

MATERIALS AND METHODS

Sampling collection sites

Neocaridina denticulata and *N. palmata* used in this study were obtained from Purbalingga fish market, Central Java (Figure 1). Purbalingga fish market is one of the main suppliers of ornamental shrimp aquarium in Central Java.

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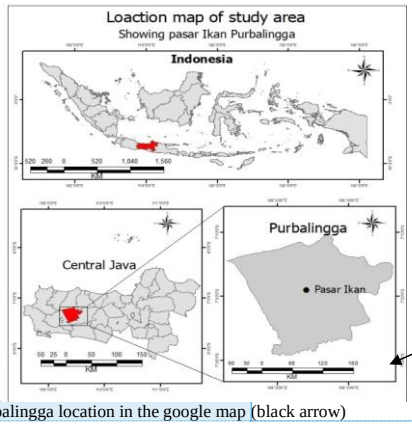

Figure1. Fish market Purbalingga location in the google map (black arrow)

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Study Species of *N. denticulata* and *N. palmata*

A total number of 60 samples consists of 30 *N. denticulata* (Fig. 1) and 30 *N. palmata* (Fig. 2) were kept in aquarium to know their life cycle. Thirty of each species that consist of 15 males and 15 females were breeding in the aquariums from 14th June 2019 to 10th August 2019.

Fig. 2

Fig. 3

Figure 2. *Neocaridina denticulate*
Fig.3. *Neocaridina. denticulata*

Fig. 4

Figure 4. Arrow indicates to transparent colored *N. palmata*

Aquarium preparation and maintenance

The same sizes of glass aquarium (50 cm x 40 cm x 40 cm) were used for conditioning females and males of *N. denticulata* and *N. palmata*. 30 samples from each species 15 males and 15 females were kept in two aquariums filled with 30 L underground water. Power head filters were used with the white stone substrate. Aerated tap water was used as the source of oxygen. Aeration pump was provided throughout the study period. Dissolved oxygen, nitrate and ammonia concentrations were measured weekly until nine weeks while pH and temperature were measured daily until eighty days during the study period by the pH/conductivity meter (pH/Cond.Meter JENWAY, made in China). These are the main deciding factors in establishing

optimal parameters for the aquarium breeding (Ariyanathan and Sesh Serebiah, 2016), and Java moss, *Vesicularia dubyana* was used for shelter in the aquariums. The water in the aquarium renewed partially every three weeks to remove feces and food remains. Adult shrimp and their larvae were fed by pellets (containing 40% crude protein) twice a day (08:00 and 17:00). The length of the adult, larvae and egg were measured under stereo microscope using a ruler and Millimeter block. The eggs were calculated from each female carrying eggs using the needle and microscope. Simple statistical Descriptive analysis (SPSS version 16.0) was performed to analyze the data.

Life Cycle of *N. denticulata* and *N. palmata*

Matured males and females of *N. denticulata* and *N. palmata* were bought from the Purbalingga fish market only females with saddle and healthy males were used. The observation was carried out until female shrimp become ovigerous. Fifteen of ovigerous females from each species were moved to the individual aquarium. The number of eggs produced by each female was counted by using hand lens and recorded. Females were removed after the larvae hatched separately, and number of larvae that hatched from each female was counted. All larvae hatched used in the next experiment. Healthy larvae were reared in the aquarium, observe, and measured the length of each stage was carried out until all larvae reached to maturity stage (Yang and Ko, 2003).

RESULTS AND DISCUSSION

The two species reached the first maturity stage at around 75 days old.This result was similar to Ganesh (2015) who reported that *Caridina* cf. *babaulti* was found to be able to reach the first maturity a round 75 days old. The female has reached the stage of maturity, the presence of visible mark with a dark color located on top of shrimp between the head and abdomen can be seen through the cephalothorax region of the females of *N. denticulata* and *N. palmata* which measured about 2.0 mm in length, this signal was found in the two species shown in figure 5. While for males, maturity appears on appendix masculina on the second pleopod shown in figure 6. In adult male appendix masculine appeared large in size, inner branch of second pleopod in male serve in spermatophores transfer and the distal of end organ covered with an increasing number of setae. A similar observation was reported by Englund and Cai (1999) stated that morphological differences between males and females were only observed when *N. sinensis* reached maturity with the appearances of endopod and appendix masculina in males.

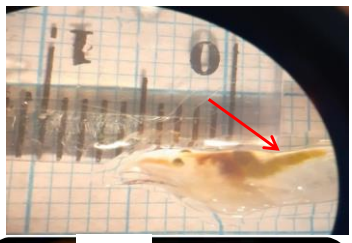

Fig. 5

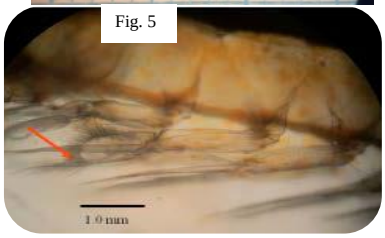

Fig. 6

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Figure 5. Visible mark in mature female cephalothorax (red arrow)
Figure 6. Appendix masculina on the second pleopod of the matured male (red arrow)

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Fifteen pairs of matured males and females of *N. denticulata* and *N. palmata* each were placed in two breeding aquariums. The mating process for both species takes place in three days after the introduction of male and female into the same aquarium. Female of the two species were molted prior mating has taken place. This result is similar to those reported by Demas (2007) examined females molted prior to mate, possibly release certain chemical substances into the surrounding water before or during molting to attract potential mates. The release of this substance allows the male to detect a gravid female in the water aquarium; this signal of male that female is ready to spawn (Nur and Christianus 2013). The result showed that both molting and mating occurred rapidly in less than 10 sec. During the mating process, males and females faced each other and sperm deposited into the genital opening of females using its appendix masculina. This result was similar to that observed by Nur and Christianus (2013) who reported that sperm in cherry shrimp deposited into the genital opening of females using its appendix masculina while the molting happens in the time of mating. The eggs were fertilized when it passed through the sperm in to the brood pouch. The pouch was formed by pleopods and overhanging of the pleura of the female. This result was agreed with Adiyodi and Adiyodi (1994) who examined that eggs were incubated in the brood pouch until hatch. A day after mating, the female was observed to carry fertilized eggs shown in figure 7 and figure 8.

Fig. 7

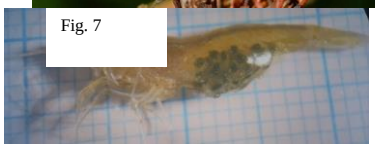

Fig. 8

Figure 7. *N. denticulata* carrying fertilized eggs (yellow arrow)
Figure 8. *N. palmata* carrying fertilized eggs (red arrow)

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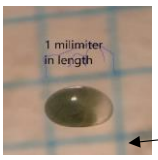
Fertilized eggs were oval in shape and the color varied from greenish to yellowish. The egg size was comparatively large. The length of eggs ranged from 1.0 mm to 1.19 shown in figure 9 mm and 0.5 mm in width shown in figure 10. There was no difference in the size and width of eggs in the *N. denticulata* and *N. palmate*. This result agrees with Ketse (2006) recorded that fertilized eggs in cherry shrimp carry green or yellow eggs with an average length of 1.19 mm. Thin ribbon-like filament binds the eggs in grape-like pouch and attached it to the female's pleopod was shown in figure 11 and figure 12.



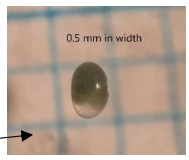


Fig. 9

Fig.10

Figure 9. Length of the egg (black arrow) of the two species
Figure 10. The width of the egg (red arrow). Note: one square represents one millimeter

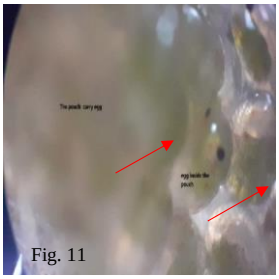


Fig. 11

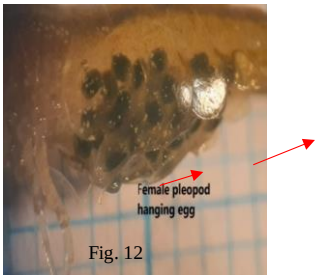


Fig. 12

Figure 11. The eggs in grape-like pouches
Figure 12. The egg hanging on the female's pleopod (red arrow)

The number of the egg depends on the size of the female, smaller female produced fewer eggs compared to the larger one. The number of eggs produced by each female ranged between 21-60 eggs for *N. denticulata*(Table 1) and from 21-58 eggs for *N. palmata* (Table 2). This cohe small size of shrimp has small ovary and the size of egg was relatively large, therefore, the small size of shrimp cannot carry a lot of eggs. The present results similar to that obtained by Schram (1986) recorded that females with small length produce 21 eggs while the large length produced more than 40 eggs per female. The relationship of the length and the number of eggs produced by females of *N. denticulata* and *N. palmata* shown in figure13 and figure 14.

Table. 1. Number of eggs produced by each female of *N. denticulata*

Variable name	Number of samples	Means	Std. Deviation
Length/ cm	15	2.0±3.0	.18770
Number of eggs	15	21±60	10.32685

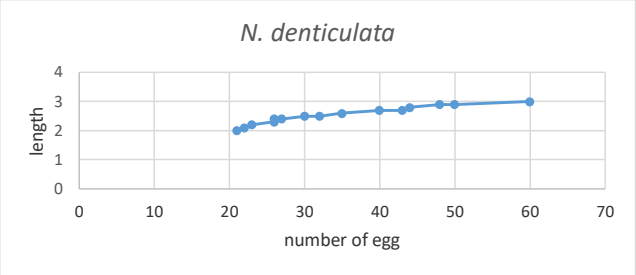


Figure 13. The number of eggs per female compare to the length of *N.denticulata*

Table. 2. Number of eggs produced by each female of *N. palmata*

Variable name	Number of samples	Means	Std. Deviation
Length/cm	15	2.3±3.0	.18770
Number of eggs	15	21±58	10.32684

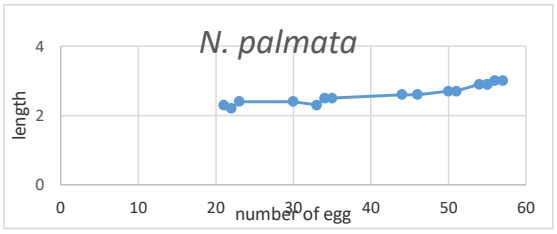


Figure 14. The number of eggs per female compare to the length of *N. palmata*

After the eggs hatched become larvae only healthy larvae were used for the next experiment. The newly hatched larvae of the two species look like the miniature version of the adult with the length 3.3 mm in 24 hours after the eggs hatch. The length of larvae was similar in *N. denticulata* and *N. palmata* shown in figure 15 and figure 16.

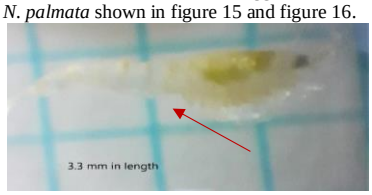


Fig. 15

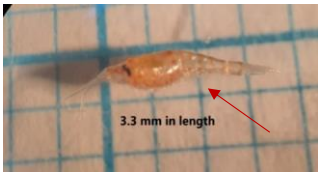


Fig. 16

Figure 15. New larvae at 24 hours after hatching of *N. palmata* (red arrow)
Figure 16. New larvae at 24 hours after hatching of *N. denticulata* (red arrow) under Stereo microscope

The juvenile for both species took 15 days to reach first maturity stages. *N. denticulate* and *N. palmata* life cycle start from the egg, larvae, juvenile and adult. The results shows that no any different in the life cycle of the two species found shown in the Table 3, Figure 17 and Figure 18.

Table. 3. Stages of the life cycle of the two species studied during the research period

Life cycle stage of *N. denticulata* and *N. palmata*	Length	Period /day
Egg	1.0-1.19 mm	15 days to become larva
First Larvae	2.0-3.3 mm	24 hour the length 3.3mm
Second larvae	4.5-5 mm	14 days
Third Larvae	8-9 mm	30 days
Fourth Larvae	9-1 Cm	45 days
Juvenile	1.2-1.5 cm	15 days to become adult
Adult	2.3-3.0 cm	2-3 days to become ovigerou

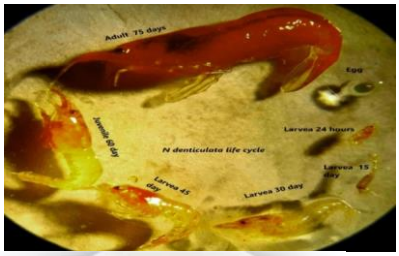


Fig. 18

Figure 17. Life cycle of *N. denticulate*
Figure 18. Life cycle of *N. palmata*

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Water parameters are the most important factors affecting the survival and growth of ornamental shrimp and during the maintenance, the period is observed for water qualities. The water parameter that checked during the study period was the range of dissolved oxygen between 5.5±7.9 mg/l. In this study, the oxygen was still in the category of good for sustaining life in the aquarium. The oxygen used in the combustion of fuel (food) to generate activity, such as swimming activity, growth, and reproductive. While, the range of values for ammonia was ranged between 1.21±1.72 mg/l and nitrate between 0.06±7.91 mg/l, these water parameter are still in normal condition, therefore, these are not harmful to shrimp, then the shrimp are in good survive rate and growth performance. The result match with Ganesh (2015) who reported that *Caridina* cf. *babaulti* shrimp breeding in the aquarium i.e. the ammonia 1.6 mg/l and nitrate <0.1 mg/l. Ammonia is a nitrogen gas effluent from the shrimp by the reshuffle protein metabolism, either in the form of shrimp own excrement (feces and urine) as well as from the rest of the feed (Demas, 2007). The oxygen, ammonia, and nitrate range measured weekly during the study period shown in table 4.

Table 4. Ranges of water parameter measured weekly during the study period

Variable	Number of weeks	Means	Std. Deviat
Oxygen/ mg/l	9	5.50 ±7.90	0.90021
Nitrate/ mg/l	9	0.06±7.91	3.07276
Ammonia/ mg/l	9	1.21±1.72	0.16109

During the study period, ammonia, oxygen, and nitrate checked once a week while the temperature and pH were daily checked in the aquarium. Present results showed that *N. denticulata* and *N. palmata* tolerance range of water temperatures were 25±28°C, as evidenced by its high survival and good growth performance over a 75 days period. The water temperature is very important for the life of aquatic animals because it affects growth, metabolism and the solubility of gases in water such as oxygen and carbon dioxide. The optimum temperature of the high number of eggs from two species is 27°C this result was still in the range from Tropea *et al.* (2015) who reported that water temperature ranged from 25-32°C and the optimum temperature was 28°C. pH range between 6.5±8.0 in a range of activities that was within the range of *N. denticulata* and *N. palmata* shrimp were still able to grow and thrive. The pH scale is closely related to the activity for skin (molting) for growth and reproduction similar to that

observed by Ganesh (2015) breeding the cherry shrimp in pH ranged between 6.5-7.5. With carefully monitored water quality parameters, the two species were bred and growing well after hatching. The range of temperature and pH measured daily shown in Table 5. The relation between the numbers of eggs produced by female of the two species with the temperature shown in figure 19 and figure 20. And the relation between the numbers of eggs produced by female of the two species with pH in the aquarium were shown in figure 21 and figure 22.

Table 5. Ranges of Water Parameter Measured Daily during the Study Period

Variable	Number of days	Means	Std. Deviation
Temperature/ °C	80	25.00±28.00	.89443
pH	80	6.50±8.00	.54558

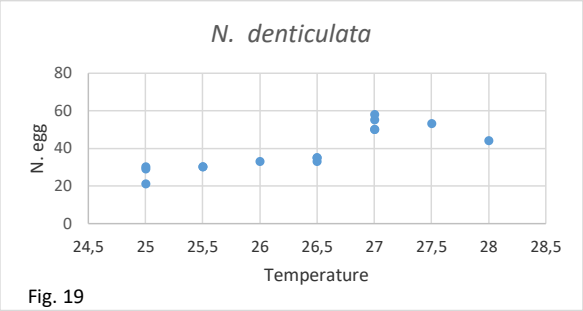

Fig. 19

Figure 19. The relation between the temperature and the number of eggs per female of *N. denticulata* in the optimum temperature to produce the egg of 27℃

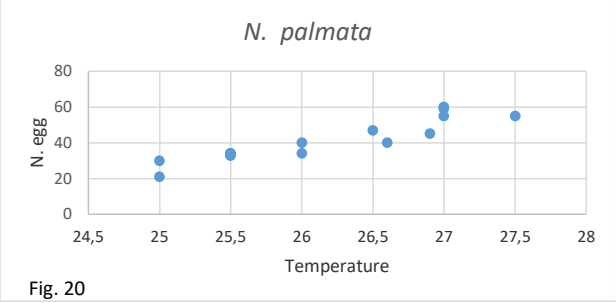

Fig. 20

Figure 20. The relation between the temperature and the number of eggs per female of *N. palmata* in the optimum temperature to produce the egg of 27℃

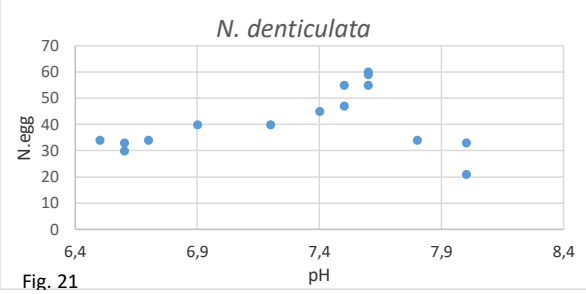

Fig. 21

Figure 21. The relation between pH and the number of eggs produced per female of *N. denticulata* in pH range between 6.5-8.0 mg/l (the fluctuation depends on the change of water in the aquarium

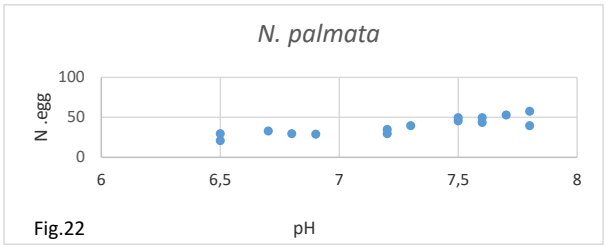

Fig.22

Figure 22. The relation between pH and the number of eggs produced per female of *N. palmata* in pH range between 6.5-7.8 mg/l (the fluctuation depends on the change of water in the aquarium.

Please add conclusion

ACKNOWLEDGEMENTS

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