

Biology and Mass Rearing Studies of *Eucanthecona furcellata* Wolf. (HEMIPTERA: PENTATOMIDAE) a Potential Polyphagous Predator and its Effect on Field Population of White Slug Caterpillar, *Parasa philepida* in Cabadbaran, Agusan del Norte, Philippines

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ABSTRACT

The biology and mass rearing of *Eucanthecona furcellata* Wolf, a polyphagous predator, was studied under laboratory conditions.

The predator has a total life cycle (egg to adult) of 46.25 days. The egg hatched 6 days after laying. The nymphs undergo seven instars with each stage ranging from 2.0 - 2.35 days.

Mass-rearing techniques, effect of field releases and other ecological factors on pest population as well as other biological informations are also described.

INTRODUCTION

Limacodids are important coconut pests in the Philippines. The most prominent species found in the country are *Parasa philepida*, *Thosea philippina* and *Setora oitens*. Larval stages of the pest are the ones destructive. The larva feeds on the leaflets. In severe cases, only the midrib is left. The damage level range from 25-85%. In areas where the pest has been established for a long time, as was the case in Cabadbaran, Agusan del Norte, reduction in yield is almost 100%.

The slug caterpillar group are found to be rich in natural enemies. One of the most promising is the *Eucanthecona fucellata*, a polyphagous predator. It was reported as potential predator of several leaf eating lepidopter as in Sumatra, Thailand and Asean countries (de Chenon, 1988; Napompeth, 1989, 1990).

OBJECTIVES

In view of the potential of the predator as a biocontrol agent on limacodid pests of coconut, mass rearing and biological studies were conducted to obtain more information on the insect for its utilization as an important control factor in limacodid pest management.

MATERIALS AND METHODS

The biology of *E. furcellata* were studied under laboratory condition using 20 individuals at 37 degree centigrade and 87% relative humidity.

The longevity and fecundity of the adult stage of the predator as influenced by different sources of food and ratio of male and female was determined. Five sources of food were evaluated, which include larvae of coconut spike moth, *Tirathaha cufivena*; green slug caterpillar, *Thosea philippina*; white slug caterpillar, *Parasa philepida*; rhinoceros larvae, *Oryctes rhinoceros* and 100% honey solution. These food materials were made available to the predator *ad libitum*. The female: male ratio monitored were 1:1, 1:2 and 1:3.

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The consumption of 4th, 5th, 6th and 7th nymphal instar and adult of *E.furcellata* was determined by feeding a batch of 10 individuals with 10 third instar larvae of green; slug caterpillar for a period of 8 hours of observation.

The ultraviolet light traps were used to monitor the population of slug caterpillar in the field. To study its effect on the attraction of *E.furcellata* in areas where they were, released and had established its population, light traps were set up from 6:00 P.M to 6:00 A.M at Cabadbaran, Agusan del Norte. The number of catch were monitored every hour for three nights. In one area, the predator was released a day before light trapping was conducted.

Mass rearing of the predator was mostly done on a trial and error basis, especially as to its food requirements and male: female mating ratio among other factors. The rearing method of *E.furcellata* developed under laboratory condition was a modification of that described in Thailand by Napompeth(1990).

Pest population, percentage leaf damage and harvestable nuts were monitored quarterly to determine the effect of field releases of the predator. Leaf number 14 of the coconut crown were cut off to determine pest population and the corresponding damage were taken from 15 leaflets of the sample frond. Harvest data was gathered from 3 harvestable bunches of the sample palms.

RESULTS AND DISCUSSIONS

I. Biological and Behavioral Studies.

Biology of the predator *Eucantbecona furcellata* Wolf. (HEMIPTERA : PENTATOMIDAE) was studied under laboratory condition. These include observation on its life cycle from egg to adult stage, and its behavior (Table 1)

Table 1. Life Cycle of *Eucantbecona furcellata* Wolf*/

Stage	No. of days
Egg	6.0
1 st instar	2.0
2 nd instar	2.0
3 rd instar	2.2
4 th instar	2.05
5 th instar	2.05
6 th instar	2.05
7 th instar	2.35
Adult	25.55
Total	46.25

*/average of 20 individuals

a. Egg

The eggs are laid in clusters on the nylon mesh, first yellowish in color and turning dark brown to black as they mature. An egg cluster contains from 5 to 50 eggs. An individual female can lay from 100 to 350 eggs throughout its adult life. The egg hatches after 6 days.

b. Nymph

The predator undergoes 7 nymphal instars with a total of 14.7 days. The change in nymphal instars can be easily identified by their exuviae. This first instar which last for 2 days measures 1-2mm in length and tends to congregate in batches. They usually do not feed yet and can survive on water. The second instar is characterized by initial feeding on host. The nymphs measure 3 - 4mm and also last for 2 days. The third instar measures 5 - 6mm and starts to become active. They usually move around inside the feeding cage and last for 2.2 days. The 4th instar nymphs measure 7-8mm and last for 2.05 days. The sizes of the male and the female become distinct at this stage with the latter being slightly bigger and longer. The 5th instar measures 9 - 10mm. and lasts for 2.05 days. It is at this stage where the wings start to develop. The nymphs are very active and feed voraciously on the host. The size of the male and the female become more pronounced at this stage. Cannibalism is also noticeable at this stage when food was insufficient. The 6th instar (2.05 days) is characterized by the half developed wings. It is at this stage where the predator can be released in the field for establishment. It measures from 16-18 mm. The 7th instar is characterized by almost developed wing parts. It usually measures from 19 - 20mm. and lasts for 2.35 days. The nymph feed on the larvae placed on the top of rearing cage by puncturing through the nylon mesh to the host body by using its long proboscis.

c. Adult

The adult when fully developed measures from 24 - 26mm. It is characterized by fully developed wing parts. The male is slightly smaller than the female. The adults usually start to mate 5 days after emergence. Egg laying commences three days after mating. The adult feeding behavior follows the same pattern as that of the nymphal stage.

d. Cannibalism

Cannibalism in laboratory cultures develop when there was overcrowding and limited food resources. Two days after the predator runs out of food, the males were the first to weaken and were usually fed upon by the females. The female usually insert their proboscis on the soft portion like the base of the legs of the male. Once it becomes vulnerable to feeding, 3 to 5 adults both male and female feed on it by inserting their proboscis on the ventral portion of the abdomen which is usually soft. The adult usually stays alive for 4 days only when totally starved. Older nymphal instar cannibalized younger instars when kept in the same cage.

e. Adult Longevity and Fecundity as Influenced by Different Sources of Food

Longevity and fecundity of the adult stage of the predator as influenced by different sources of food was determined. Longevity of the adult predator was measured by the number of days they stayed alive upon feeding on different food materials. Result showed that those fed with white slug caterpillar survived longer (28.9) days. This was followed by those fed with coconut spike moth larvae (24.5) and green slug caterpillar with 22.8 days but which was not significantly different from, those feeding on white slug caterpillar. The predators fed with rhinoceros larvae and 100% honey solution lived the shortest with 10.9 and 8.7 days respectively. (Table 2).

Fecundity of the predator as measured by the number of eggs laid showed that those fed with green slug caterpillar gave the highest number of eggs laid (170.3) although it does not differ significantly as compared to those fed with coconut spikernoth (167.7) and white slug caterpillar (111.8). Those fed with rhinoceros larvae and 100% honey solution gave the lowest number of eggs laid (10.9 and 8.7), respectively, which was significantly lower as compared to the above three food sources.

Table 2. Adult longevity and fecundity of *Eucanthecona furcellata* Wolf as influenced by different sources of food.

Food Source	Fecundity* (no.of fertile eggs laid)	Longevity**/ (Days)
Coconut spike caterpillar	167.7a	24.5a
White slug caterpillar	111.8a	28.9a
100% honey	1.5b	8.7b
Green slug caterpillar	170.3a	22.8a
Rhinoceros larva	1.7b	10.9b

* Means, followed by the same letters are not significantly different from each other at 1% level (DMRT).

**Observation based on means of 25 female samples.

f. Fecundity of the predator as Influenced by Ratio of Male to Female

Fecundity of the predator as influenced by ratio of male to female was measured by the number of fertilized eggs laid by the female. Observation showed that the ratio 1:3 gave the most number of fertile eggs laid per female (300.9). This was followed by ratio 1:2 which gave the highest average number of eggs laid per female (338) but had a higher number of unfertilized eggs (97.8) (Table 3).

Table 3. Fecundity of *E. furcellata* as influenced by ratio of male to female*/.

Ratio	Total # eggs laid	Average Female	Fertilized			Unfertilized		
			no.	%	Ave/F	no.	%	Ave/F
1:1	153.1	153.1	106	75.9	106	47.1	24.1	47.1
1:2	677.7	338	579.9	85.6	145.0	97.8	14.43	48.9
1:3	915.4	305	902.3	98.6	300.9	12.6	1.4	4.2

*/ based on 20 samples per ratio.

h. Consumption of *E. furcellata*

Consumption rate was measured by the number of larvae consumed after 8 hours of feeding. Results on Table 4 showed that the fourth instar nymph consumes an average of 1.5 larva per day. The 5th instar consumes 1.7 larva per day. The 6th and 7th nymphal instars at 2.2 and 3.1 larvae per day, respectively. The adult consumes the most number of larvae at 4.4. Younger instars were unable to consume one larva per day.

i. Phototropic reaction of the Predator

The predator, *E. furcellata* showed no phototropic reaction. In three nights of successive trapping, no predator was trapped. In one area where the release of the predator was done a day before trapping was conducted, again, there was no predator trapped in the light trap.

This result suggests that light trapping can still be done in areas with adult limacodid populations without detrimental effect to the established or newly released predator population as the latter was not attracted to light traps.

II. Mass Rearing

The mass rearing technique of *Eucanthecona furcellata* Wolf. Was developed under laboratory condition. This technique was based on the biological studies previously undertaken.

This consists of the following steps (Figure 1):

1. A laying cage measuring 24 x 24 x 12 inches made of stable fine nylon mesh was used. A ratio of 1 male: 3 female adults of the predator were introduced and maintained. They were allowed to mate and lay eggs on the nylon mesh. As many as 10 males and 30 females were maintained in one laying cage.
2. The adults were fed with white slug caterpillar when available. Other alternate hosts such as green slug and ramie sermi-looper were also used when white slug is not available. A frozen larvae of the above hosts were kept in stock for feeding when field population goes down. These were thawed first before feeding. Preserved feeding materials were misted with water to prevent it from drying immediately.
3. The female laid their eggs on the surface of the nylon mesh and started to hatch 6 days after.
4. Newly emerged nymphs were collected by allowing them to congregate on coconut leaflet put on top of the laying cages.
5. These 1st instar nymphs were out inside a smaller round rearing nylon cage measuring 14" diameter and 20" long with wire structure. This is a critical stage in mass rearing; as older instar cannibalized younger instar when kept in the same cage. Only 50 individuals of the same nymphal stages were maintained in a cage to prevent cannibalism. The nymphs were fed with larva of slug caterpillar or its alternate host by putting it on top of the cage. The nymphs feed on the larva by puncturing through the nylon mesh to the host body by use of its long proboscis.
6. The nymphs were allowed to develop on this cage. When fully matured, they were sexed and put inside the mating/laying cages following the ratio of 1.3 male to female.

III. Preliminary Results of the Release of *E. furcellata* on Field Population of White Slug Caterpillar

A very dramatic decrease in population of the pest was observed six months after initial release of the predator (Table 5). Also an abnormally high rainfall that occurred during the second quarter of 1990 might have contributed to the control of pest population. It was observed that during rainy season more number of larvae fell from the crown which eventually died on the ground.

The successive releases of the predator during the 2nd quarter of 1991, combined with other factors, had apparently led to the decrease of the remaining population of the pest. It was Important to note that there was no more damage recorded during the 3rd quarter up to the present. Regular releases of the predator in different barangays of Cabadbaran is being undertaken with the objective of minimizing pest outbreaks.

Nut yield of the palms that had recovered was observed to double one year after recovery (Table 5).

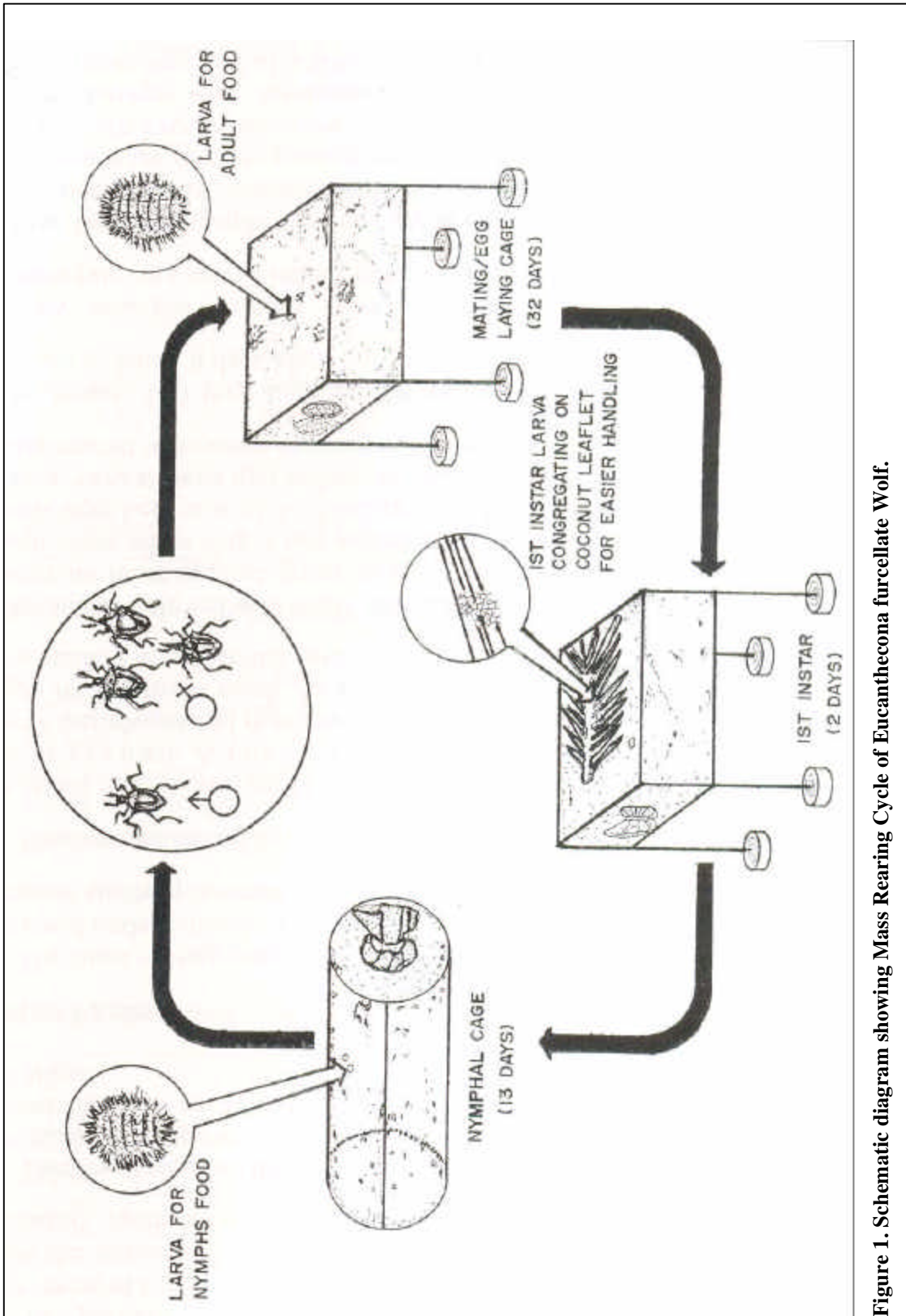


Figure 1. Schematic diagram showing Mass Rearing Cycle of *Eucanthecona furcellata* Wolf.

Table 4. Consumption of *E. furcellata* per day*/

Individual	Nymphal Instar				Adult
	4 th	5 th	6 th	7 th	
1	1.8	1.8	2.3	3.2	5.3
2	1.3	1.8	2.3	3.2	5.3
3	1.8	1.8	1.8	3.2	4.0
4	1.2	1.5	2.3	3.2	5.3
5	1.2	1.8	2.3	3.6	4.0
6	1.2	1.5	2.3	3.2	4.0
7	1.2	1.8	2.3	3.2	4.0
8	1.8	1.8	2.3	3.2	4.0
9	1.3	1.8	2.3	3.2	4.0
10	1.6	2.0	2.3	3.2	4.0
Mean	1.5	1.7	2.2	3.1	4.4

*) Third larval instar, green slug caterpillar

Table 5. Population and damage level of *P. philepida* and nut yield of coconut and rainfall in Cabadbaran, Agusan de Norte before, during and after release of *E. Furcellata*.

YEAR/MONTH	MEAN POPULATION (LARVA/FRON)	DAMAGE LEVEL (%)	YIELD (HARVESTABLE NUTS/QUARTER)	RAINFALL (mm) AVERAGE PER MONTH
1983	34.7	69.3	5.8	476
1984	6.2	54.0	6.1	579
1985	14.8	4.8	5.7	536
1986	16.1	30.9	5.9	668
1987	51.3	50.8	6.0	460
1988	31.0	53.9	6.3	567
1989	10.7	56.5	6.1	560
1990 1 st Q	7.6	54.8	5.7	289
2 nd Q	39.9	64.8	5.3	1,061
3 rd Q	0.0	0.0	6.8	343
4 th Q	0.0	0.0	6.2	458
1991 1 st Q	0.0	0.0	10.5	513
2 nd Q	0.0	0.0	10.2	343
3 rd Q	0.0	0.0	11.4	331
4 th Q	0.0	0.0	11.4	559

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