

Aspects on Life History of *Eurycantha insularis* Lucas (Phasmida: Phasmatidae) from Papua New Guinea

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The oil palm stick insect is a sporadic pest but occasionally a serious defoliator of oil palm in Northern (Oro) Province, Papua New Guinea (PNG), although it seldom causes significant damage to warrant any chemical intervention. There are currently two recorded egg parasitoids and one, (possibly two) entomophagous fungi that attack the adults. Parasitoids are not currently being reared as biological control agents. Adults and nymphs are often collected from oil palm cooked and eaten by the local people, especially children. Except for the taxonomy, the biology of this species is not fully understood; and this study attempts to fill in part of this information gap. Egg incubation period is 80 days. Five nymphal instars were identified for males and six for females. Males complete developmental stage in 97 days whilst females in 118 days. Female adults survived only slightly longer than males being 48 and 35 days respectively. Any control efforts should target nymphal stages to break the breeding cycle.

Keywords: Oil palm, stick insect, parasitoids, Northern Province, PNG, biology.

Eurycantha insularis Lucas, the oil palm stick insect, is now recognised as a sporadic, localised, but sometimes serious pest of oil palm, especially in smallholder grower areas in Northern (Oro) Province, Papua New Guinea (PNGOPRA, 2014). The local people, especially children eat these insects as a food snack, as all stages are wingless ('apterous'), and easily collected. However, when deemed necessary as a result of surveys by the Papua New Guinea Oil Palm Research Association (PNGOPRA) Entomology team, they are controlled using the current technique of Targeted Trunk Injection (TTI) to inject the systemic insecticide, thiosultap-disodium into the palms.

HISTORICAL AND NOMENCLATURE

Eurycantha insularis, was first brought to the public attention by M H Lucas, at a meeting of the Société Entomologique de France (SEF) held in Paris in 1869 presided upon by M Paul Gervais (Lucas, 1869). The specimens came from San-Georges (San Jorge's Island) in the Solomon Islands. At this meeting, Lucas named two new species from this genus, namely *Eurycantha calcarata*, Boisduval, 1835 and *E. insularis* (Lucas, 1869). However the specimens of *E. calcarata* were assumed, incorrectly to be *E. insularis* (synonyms of

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E. insularis are *E. coenosa* Redtenbacher, 1908 and *E. coriacea*, Redtenbacher, 1908). These two species are currently known respectively as the giant spiny stick insect and the oil palm stick insect. There is a closely related species, similar, to *E. calcarata*, but with spectacularly long hind femur spines, *Eurycantha horrida* (Boisduval, 1835), the spiny devil stick insect, which also occurs on mainland PNG but is uncommon in Northern (Oro) Province.

The holotype described from the Solomon Islands (loc.cit.); was lost, presumed destroyed, during the unrest in Honiara in 2000. It should be noted that the genus *Eurycantha* is in need of revision (Brock, 2018 - Private Comm.).

Infestations

Stick insects attack oil palm of all stages. The damage they cause is often characteristic,

where they remove large patches of leaflet tissue from the frond across to the midrib. In very severe cases, only the midribs of all fronds remain.

In PNG, *E. insularis* was first reported as a possible threat to oil palm in 2000 on a first planting smallholder block (block number 310004, *Figure 1*) at Koropata in Northern (Oro) Province (*Figure 2*), although in very low numbers. Infestations by these insects were not subsequently observed until 2006 - 2009 when heavy infestations were reported from Saiho and Igora Divisions, which are managed by the PNG Oil Palm Industry Corporation (OPIC). Following these reports from the Saiho and Igora Divisions, all signs of the insect disappeared during 2010 and 2011 and those infested palms in the blocks started to recover (Safitua & Nyaure, 2018 - Private com.). A light infestation was observed in Sorovi Division in one block in 2010, which also



Figure 1 Eight-year-old palms in a smallholder block at Tunana severely damaged by *Eurycantha insularis*

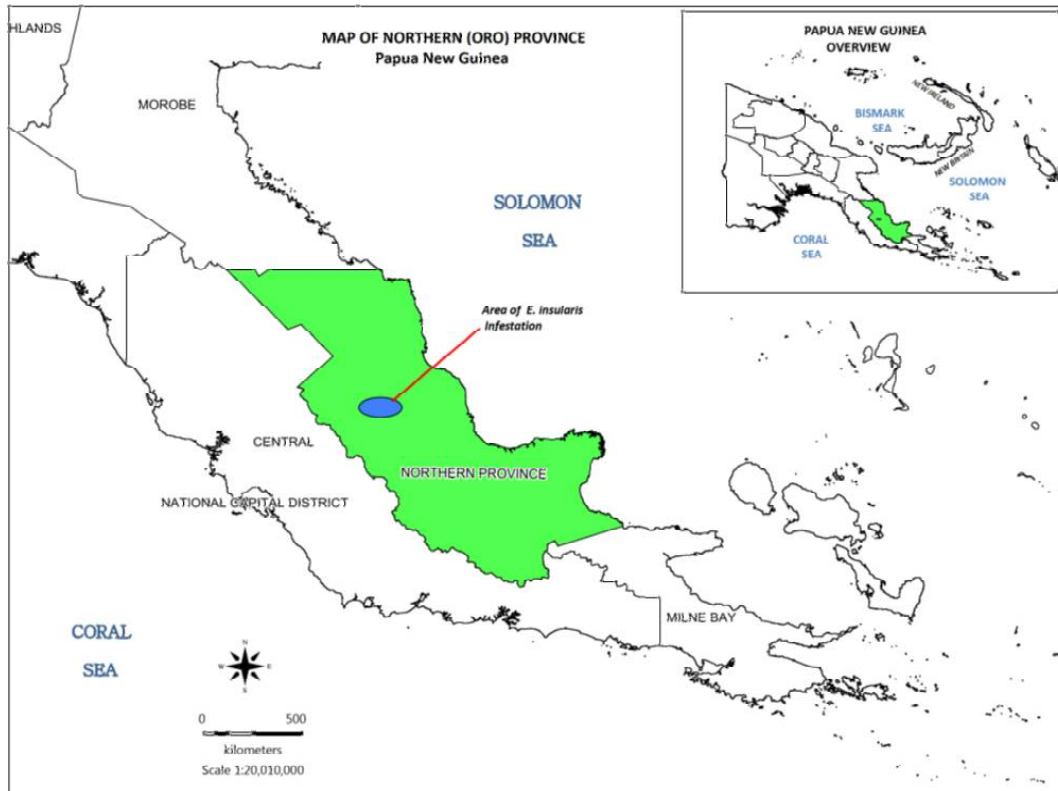


Figure 2 Map of Northern (Oro) Province showing the area of infestation by *E. insularis* on oil palm

“suddenly disappeared” (Safitua, 2018 - Private com.). In August 2014, stick insects were reported from a part of Ilimo Division, mainly those blocks on the Popondetta side of the Kumusi River.

In August 2017, there appeared to be a build up of populations at Tunana still within the Province, and there were small areas where all stages were to be found. However they were not yet at sufficient density to cause economic damage or warrant control (PNGOPRA, 2017). Nevertheless in early January 2018, TTI was undertaken in 120 smallholder blocks at Tunana, totalling about 164.5 ha using thiosultap-disodium. During TTI, a ca. 1.5 cm diameter, 15 cm deep hole was drilled at a 45° angle at waist height using a Stihl power drill.

Ten millilitres (ml) of insecticide was then injected into the palm using a pre-calibrated drench gun (Figure 3). The holes were plugged using pre-cut wooden plugs, (or waste palm seeds) to prevent contamination and infection entering the palm. No further information was available to PNGOPRA from the PNG OPIC on further infestations.

MATERIALS AND METHODS

Adults, eggs and young stages of *E. insularis* were collected from their host plant, oil palm (*Elaeis guineensis* Jacq.), put into clean white, porous “pollination bags” with some cut pieces of frond and taken back to the laboratory.

The nymphs and adult stick insects were



Figure 3 Drilling into the palm using a Stihl drill (L) and injecting the insecticide using a drench gun (R)

kept in aluminium framed mosquito net covered cages in a covered, but not fully enclosed building. Temperature and humidity were daytime ambient conditions typically of 26°C and 80 per cent respectively. Adults and nymphs were fed on oil palm leaflets collected daily from the nearby plantation. The leaflets were sprayed daily with water to provide “free-water” droplets for all stages to drink.

Eggs laid were collected daily from the floor of the cages and placed on moistened river sand in glass petri dishes until they hatched.

Nymph mortality was very high, particularly the first and second instars, and again in the final moult from nymph to adult stage; no obvious causes for this mortality were observed. Records were kept daily until the insects died.

RESULTS AND DISCUSSION

Males and females are a similar fawn (light brown) colour, and no additional colour morphs have been observed. Females are much larger

and more robust than males, and may be easily recognised by the distinct ovipositor at the tip of the abdomen (Figure 4). In the original description by Lucas (1869), females were recorded as being 120 mm in length while the males were 80 mm in length. Measurements of specimens at PNGOPRA show males at 90 mm and females about 130 mm (Ero, 2014). The legs are long and thin, and the abdomen is only slightly flattened laterally (Lucas, 1869). Surprisingly, the females are only lightly armed, and they are quite defenceless except for their camouflage. The females lay their eggs in moss clumps or in the frond bases as well as simply letting the eggs fall to the ground where they look like frass (droppings), as does *E. calcarata*, and, by inference also *E. horrida*.

Under ambient conditions in PNG, the eggs hatch in 80 days. This was found to be similar for male and female nymphs (Tables 1 & 2).

Unlike *E. calcarata*, *E. insularis* has not been observed using communal “day-roosting” areas such as in holes in trees.



Figure 4 *E. insularis*, male (L) -90 mm, and female (R) -120 mm

E. insularis is crepuscular and primarily nocturnal, remaining motionless on the fronds or palm trunks during the day until dusk, when they become active and begin feeding.

The eggs are pale grey/brown colour with a clearly defined operculum and micropylar plate (viz. arrows in Figure 5). The egg of *E. insularis* is smaller and somewhat paler than that of *E. calcarata*. There are no data as to how many eggs are laid by a female.

There are five instars in males and six instars for females, and the egg developmental period is similar in both sexes, males become adult after 97 days and females after 118 days (Tables 1 & 2). The life cycle from egg to death of the adult was about 225 days for males (Table 1) and 233 days for females (Table 2) under ambient conditions in Northern Province PNG. Males become adult more rapidly than the females, and females live slightly longer



Figure 5 Micropylar plate view of the egg of *E. calcarata* (L) and *E. insularis* (R). Operculum is at the top. (Scale bar = 7 mm).

than the males (Tables 1 & 2).

Female *E. insularis* nymphs become noticeably larger than the males from the onset of the third instar. Upon completion of the final moult they reach a maximum of about 130 mm (head and body length), typically 100 mm for adult females, while males are about 90 mm, typically 67 mm (Figure 6).

CONTROL OF *E. INSULARIS*

Any control against *E. insularis* should be carried out during the nymphal stages and preferably before instar v (60-70 mm), as there are currently no data to indicate how long after the final moult adults will mate, and egg laying begin.

Biological control

To date no parasitoids have been reared from adults or nymphs of *E. insularis* in PNG, but tachinid flies (Diptera: Tachinidae) have been reared from the related *E. calcarata*. The eggs of *E. insularis* are parasitised by two different Hymenoptera (Chrysididae: Amiseginae), *Cladobethylus insularis* Kimsey and

Dewhurst and *Exova tunana*, Kimsey and Dewhurst, (Kimsey *et al.*, 2013). However these parasitoids are not currently being reared in the laboratory, although, as with *Anastatus eurycanthae* (Hymenoptera: Eupelmidae), an egg parasitoid of *E. calcarata*, which is cultured at Dami Research Station, West New Britain, they may be candidates for future biological control programmes.

Adults and nymphs were often found in the field, killed by a fungus (as yet unidentified), but which is possibly a species of *Metarhizium* or *Beauveria* (Figure 7). Clarifying the nature and identity of any pathogen is important, as it might be possible to culture it for the management of *E. insularis* in future. A study is currently underway to investigate this possibility.

This insect, especially the young stages, is consumed by some of the local people, especially children.

CONCLUSIONS

Eurycantha insularis (the oil palm stick insect)

TABLE 1
MEAN NUMBER OF DAYS AND INSTAR LENGTHS ($\pm$ SD) OF MALE LIFE STAGES OF *E. INSULARIS*

	<i>Egg</i> <i>incubation</i>	<i>Instar i</i>	<i>Instar ii</i>	<i>Instar iii</i>	<i>Instar iv</i>	<i>Instar v</i>	<i>Adult</i>	<i>Male:</i> <i>survival</i>
Mean days ($\pm$ SD)	80 $\pm$ 8	17 $\pm$ 3	14 $\pm$ 2	18 $\pm$ 4	24 $\pm$ 4	24 $\pm$ 3	48 $\pm$ 12	225

TABLE 2
MEAN NUMBER OF DAYS AND INSTAR LENGTHS ($\pm$ SD) OF FEMALE LIFE STAGES OF
E. INSULARIS

	<i>Egg</i> <i>incubation</i>	<i>Instar i</i>	<i>Instar ii</i>	<i>Instar iii</i>	<i>Instar iv</i>	<i>Instar v</i>	<i>Instar vi</i>	<i>Adult</i>	<i>Female:</i> <i>survival</i>
Mean days ($\pm$ SD)	80 $\pm$ 1	17 $\pm$ 3	14 $\pm$ 2	16 $\pm$ 2	22 $\pm$ 6	22 $\pm$ 7	27 $\pm$ 6	35 $\pm$ 18	233

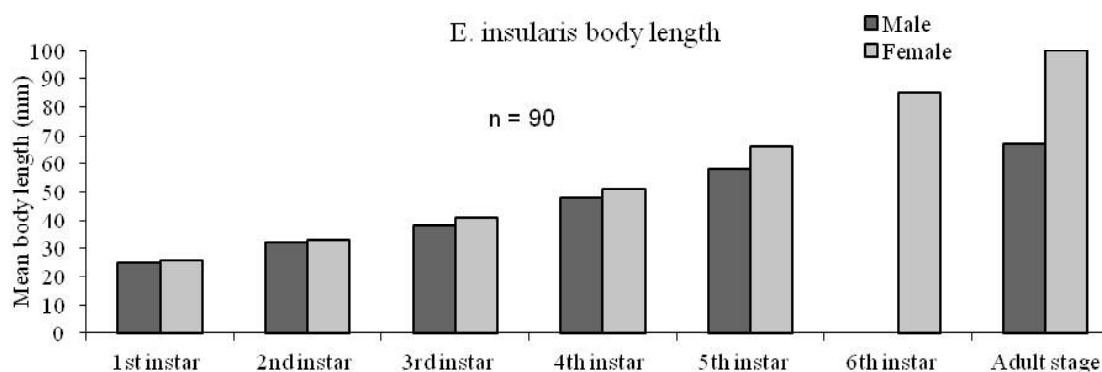


Figure 6 Instar lengths of male and female *E. insularis*

is a sporadically occurring pest of oil palm, which appears to be very localised in its distribution in Northern (Oro) Province of PNG. Worldwide distribution is given as being Asia-Tropical, Papuasias, and the Solomon Islands (Brock *et al.*, 2012).

The genus *Eurycantha* is in need of revision, as there is confusion over the species taxonomy right from 1871 (Brock, 2018 - Private com.).

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Figure 7 Male *E.insularis* with an entomophagous fungus infection (red circle), often visible at the leg joints

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