

## ASSOCIATES OF THE COCONUT RHINOCEROS BEETLE IN WESTERN SAMOA

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The coconut rhinoceros beetle, *Oryctes rhinoceros* (L.), is native to the Asian tropics but has been accidentally introduced into Western and Central Pacific island groups. It is a major pest of palms in the Palaus, Fiji, Tonga, Wallis, Nukunono (Tokelaus), American Samoa and Western Samoa.

The invertebrate and vertebrate associates of the rhinoceros beetle in the Palaus have been described by Gressitt (1953: 93-104) with a few notes (pp. 121-124) on those in Samoa. Cumber (1957) made extensive studies on beetle populations and discussed some of the organisms contributing to the mortality of *Oryctes* larvae. The observations summarised in this paper represent part of the ecological research in a five year project on the coconut rhinoceros beetle and related dynastids.

*Oryctes rhinoceros* completes its immature stages in logs, sawdust piles and other concentrations of organic matter. The adult beetle feeds on sap in a burrow chewed down the growing tip of the palm. During the period from March 1964 through December 1966, numerous collections of *Oryctes* and its associates were made in both ground and crown habitats. Those animals which might prey on or compete with *Oryctes* received special attention. When possible, the predators were held to determine their modes of attack and rates of consumption.

### DIPLOPODA

*Millipedes*: A red millipede, *Trigoniulus lumbricinus* (Gerstaecker), was found in compost, rotten sawdust, and old logs. A flattened millipede, *Orthomorpha coarctata* (Saussure), was usually seen under, rather than in, logs. Small gray or black millipedes collected from decaying coconut logs included *Litobolus hanevayus* Chamberlin, *Pseudospirobolellus bulbiferus* (Attems) and *Spirostrophus naresii* (Pocock). Even tips of dead standing palms 15 m tall contained millipedes. Apparently millipedes will quickly utilize any wood that is soft enough for them to penetrate. They were not found inside hard breadfruit logs.

### CHILOPODA

*Centipedes*: The most common enemy of *Oryctes* in Samoa is the centipede, *Scolopendra morsitans* L. (= *subspinipes* Leach), a species which reaches a length of 15 cm. It was often seen under logs and in compost heaps. It was also common in palm crowns where it was presumably feeding on cockroaches. *Scolopendra* was most apt to kill *Oryctes* grubs under

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bark or near the surface of compost since it could not burrow through compacted material.

Full-grown centipedes were kept in cages for up to 3 months and consumed large (3rd instar) grubs at a steady rate of one every 5 days. They left only the head capsule and some integument, remains similar to those found under logs. However, even a 15 cm centipede could not kill an adult beetle.

#### ACARINA

*Mites*: Clusters of brown, pedicellate mites were often attached to the legs and body of adult beetles. They were immature *Fuscuropoda* sp. using the beetles not for food but for transport. Mature uropod mites, presumably the same species, were common in decaying material.

Another mite, *Coleolelaps* sp., was associated with all stages of *Oryctes*. Small groups (10 to 20) were seen crawling on the ventral side of adult beetles, usually near the leg bases or mouthparts. Occasionally, they were present in large numbers on larvae but on both adults and larvae they appeared to be harmless ectoparasites. *Coleolelaps*, however, may be able to kill *Oryctes* eggs. Several times, when dissecting clutches out of logs in the field, some of the eggs were found to be shriveled and covered with mites. Perhaps *Coleolelaps* can leave female beetles while they are ovipositing and feed on the freshly laid eggs but laboratory trials indicated that the mite could not attack an egg after the chorion had hardened.

#### ORTHOPTERA

*Cockroaches*: These were found in compost, rubbish, and sawdust. They were also collected under logs and inside dead standing palms, and some were seen in axil debris on living palms. The usual species in heaps were *Diploptera dytiscoides* (Serville), *Periplaneta* spp., and *Pycnoscelus surinamensis* (L.). Under logs, *Cutilia nitida* (Brunner) and *Pycnoscelus* were common. *Graptoblatta notulata* (Stål) and *Periplaneta* were found in palms. None of these species had any direct affect on the rhinoceros beetle but they may be important as alternative prey for the centipede, *Scolopendra*, and for the reduviid bug, *Platymerus "rhadamanthus* Gaerst" which was brought from Zanzibar. Large numbers of the bug are being reared and released in Samoa with the hope that they will prey on *Oryctes* adults in palm crowns.

*Stick Insects*: The coconut stick insect, *Graeffea crouani* (Le Guillou), has severely defoliated palms at certain locations on Taveuni and Vanua Levu in Fiji, on Tutuila in American Samoa, and on some other Pacific Islands but not on the islands of Western Samoa. Unlike the rhinoceros beetle, it damaged only fronds which have at least partially unfolded and made small cuts in the leaflet edges.

#### ISOPTERA

*Termites*: Large black nests made by *Microcerotermes biroi* (Desneux) (= *peraffinis* Silvestri) were occasionally seen on living palms and other trees. Coconut logs rarely contained termite colonies but other logs, when old and moist, sometimes had colonies of *Neotermes samoanus* (Holmgren) or *Prorhinotermes inopinatus* Silvestri. Termites were seldom present early enough, or in large enough numbers, to prevent *Oryctes* larvae from utilizing a log.

## DERMAPTERA

*Earwigs*: In coconut inflorescences, *Chelisoches morio* (F.) was very common, but earwigs were surprisingly scarce in ground sites.

## COLEOPTERA

*Wood-eating and scavenging beetles*: Five scarabaeoid species other than the rhinoceros beetle were frequently encountered in various habitats. Grubs of the rose beetle, *Adoretus versutus* Harold, were found under split coconut logs and at the edges of sawdust or compost heaps where they were feeding on grass roots. The dung beetle, *Copris incertus prociduus* Say, was found only in cow manure. All stages of the flower beetle, *Oxycetonia versicolor* F., were collected commonly from sawdust, grass compost, and other heaps of organic matter but only occasionally from under coconut split log traps. Two stag beetles, *Aegus upoluensis* Arrow, and *Figulus samoanus* Kriesche (*auritus* Arrow), were taken from logs. The *Aegus*<sup>2</sup> was found in breadfruit, coconut, fau (*Hibiscus tiliaceus*), kapok, ngatae (*Erythrina*), raintree, and tava (*Pometia*) logs or stumps but the *Figulus* only in kapok. Moist logs in shady locations appeared to be favored by the stag beetles. Of the scarabs, *Aegus* and *Oxycetonia* were most apt to be found with *Oryctes*. Rarely, however, was there any evidence of interaction, detrimental or otherwise. A few logs reduced to powder by *Aegus* might otherwise have produced *Oryctes*.

Non-scarabaeoid beetles with xylophagous or saprophagous larvae found in logs or stumps included: a rhipicerid, *Callirhipis femorata* Waterhouse; a buprestid, *Cyphogastra abdominalis* Waterhouse; a lamiid, *Dihammus holotephrus* Boisduval; a prionid, *Olethrius insularis* (Fairmaire); a curculionid, *Rhabdoscelus obscurus* Boisduval; and several tenebrionids.

*Callirhipis* was common in many different kinds of logs; breadfruit, coconut, fau, raintree, ngatae, etc. *Olethrius* was most often encountered in kapok but also occurred in fau, mango, raintree, toi (*Alphitonia*), and the logs of various forest trees. The larvae of *Cyphogastra* were usually seen in dead or half-dead leguminous trees. Coconut logs were recorded as the source of *Olethrius* and *Cyphogastra* only on one occasion for each. *Dihammus* sometimes occurred in injured cocoa or breadfruit branches and *Rhabdoscelus* (the sugarcane weevil) was found either in the injured trunk of a living palm or in the fibrous tip of a dead one. The various tenebrionids were usually feeding in frass produced by other beetles or by millipedes. None of these beetles could really be said to compete with *Oryctes* with the possible exception of *Olethrius* which is large enough and common enough to destroy some logs.

*Predatory beetles*: The native click beetle, *Alaus samoensis* Van Zwaluwenburg, mentioned by Gressitt (1953: 123) as a possible enemy of *Oryctes* was not encountered during this study. However, larvae of another elaterid, *Simodactylus* sp., were found with *Oryctes* grubs under breadfruit logs and in sawdust. They readily consumed first instar *Oryctes* larvae in the insectary.

Four species of predatory beetles, two elaterids and two histerids, have been introduced into Upolu, Western Samoa.

The elaterids, *Alaus speciosus* L. and *Lanelater* (ex *Agrypus*) *fuscipes* (F.) were brought

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2. A tachinid fly, *Rutilia nigrihirta* Malloch, parasitized 10% to 20% of the *Aegus* larvae.

from Ceylon in 1955 to help control the rhinoceros beetle (Cumber, 1957: 31). Both have spread from release points and are well established on the north side of Upolu. Larvae of *Alaus* were usually found inside logs, especially kapok, presumably preying on *Olethrius*. *Lanelater* larvae were more apt to eat *Oryctes* eggs and grubs because they occurred under logs, including coconut split log traps, and inside sawdust heaps, but both introduced elaterids must be quite general predators.

The histerids were not brought into Samoa specifically as enemies of *Oryctes*. *Pachylister chinensis* (Quensel), introduced from Java in 1938, feeds primarily on fly maggots in cow dung but it also eats first instar *Oryctes* larvae in sawdust or under logs. *Plaesius javanus* (Erickson) was introduced from Fiji in 1957 against the Banana Weevil Borer, *Cosmopolites sordidus* (Germar) but it has been found with *Oryctes* grubs in rotten papaya stems, a medium in which *Oryctes* can reach the third instar, although possibly not the pupal stage.

#### HYMENOPTERA

*Ants*: Several species of ants were collected in or under logs. *Pheidole megacephala* (F.) was very common under coconut logs in open fields but *Odontomachus haematoda* (L.) was the dominant species when the logs were in shaded sites. *Anoplolepis longipes* (Jerdon) was found in logs and in the rotten tip of a hurricane-felled palm. *Camponotus* spp. colonies sometimes were found inside fairly dry coconut logs. *Tapinoma melanocephalum* F. and *P. megacephala* were found on living palms.

None of the ants appeared to seek out *Oryctes*. Healthy third instar grubs were often collected under logs near ants. However, *P. megacephala* and *O. haematoda* would attack exposed eggs or grubs.

*Zanzibar wasp*: Introduced from Zanzibar in 1945, the large black scoliid wasp, *Scolia ruficornis* F., is now common at several locations on Upolu. It parasitizes *Oryctes* larvae in heaps of compost or sawdust. Parasitization sometimes approached 50% but only during the winter months (July–September) in places where the heaps were shallow and well shaded. Even at Nafanua Experimental Station, where adults were common on flowers (*Justicia*), the average parasitization was about 10%. On one occasion, *Scolia* cocoons were dug out from debris at the base of a half dead *Albizzia* tree but there was no evidence that *Scolia* ever parasitized grubs inside logs.

#### LEPIDOPTERA

*Flat moth*: The coconut flat moth, *Agonoxena argaula* (Meyrick), was the most common leaf-damaging insect on palms in Western Samoa. Some leaflets on almost every frond had small grey scars caused by the feeding of *Agonoxena* caterpillars, but the total defoliation was usually less than 5%.

*Spike moth*: Caterpillars of the spike moth, *Coleoneura* (ex *Tirathaba*) *trichogramma* (Meyrick), were feeding on male flowers, and sometimes on immature nuts, in the inflorescences of many palms. Since slowly unfolding spadices seemed to have the heaviest infestations, severe damage by *Oryctes* may increase the incidence of *Coleoneura*.

*Case-bearing caterpillars*: The larvae of tineids, *Trachycentra* spp., were collected from rotten crowns and from decayed stumps. Sometimes foraging outside their cases, these

caterpillars were secondary scavengers feeding on material already broken down by fungi, millipedes, or grubs.

#### REPTILIA

**Lizards:** Skinks and geckos, when held in the insectory with second and third instar *Oryctes* larvae, ate few or none, even when given no other food. A large black skink, *Emoia nigra* (H. & J.) was common on logs and palm trunks but it apparently could not dig out grubs. Less common lizards on palms included the green skink, *E. samoensis* (Duméril) the big tree gecko, *Gehyra oceanica* (Lesson), and the four-fingered gecko, *Hemiphyllodactylus typus* (Bleeker), none of which were likely enemies of *Oryctes* although they, and ants, may eat released *Platymerus* bugs.

#### AVES

**Chicken:** Domestic fowl ate *Oryctes* eggs and larvae but could only scratch them out of soft logs or shallow rubbish piles.

**Owl:** The only bird in Samoa which might be able to eat *Oryctes* adults is the owl, *Tyto alba lulu* Peale. However, dissections of stomach contents and pellets recovered nothing except remains of the Polynesian rat, *Rattus exulans* (Peale).

#### MAMMALIA

**Fruit bat:** Sometimes quite common on the inflorescences of coconut palms, the fruit bat, *Pteropus* sp., may chew into or dislodge young nuts but this is not considered to be of economic importance and does not seem related to *Oryctes* attack.

**Rodents:** The Norway Rat, *Rattus norvegicus* (Berkenhout), occurred in localized populations. It may have eaten grubs in rubbish heaps.

The roof rat, *R. rattus* (L.) was more common and caused much nut fall in certain dense coconut groves. It also preyed on grubs in compost and rotten stumps. In general, the damage done by this rat in coconut and cocoa plantations outweighed the value of its predation on *Oryctes*.

Common in pastures, gardens and other open areas, *R. exulans* sometimes nested in or under coconut logs and may have eaten grubs. One other rodent, the house mouse, *Mus musculus* L. was often seen under logs in grassy areas and readily ate *Oryctes* larvae, even those in the third instar, leaving only the head capsule.

**Pig:** There are about 40,000 domesticated, but free-foraging, pigs in Samoa. They were frequently seen rooting under logs and in soil or heaps, (cf. Cumber 1957: 21). Trials with grubs exposed in compost-filled trays showed that consumption started at one third instar grub per day but soon dropped to one per week. Apparently, pigs do not favor a steady diet of *Oryctes* when other food sources are available.

#### DISCUSSION

Palm and log communities on the Samoan Islands are less complex and competitive than those found in similar habitats on continents. There was no evidence that other insects

competed with *Oryctes* adults for food since both *Graeffea* and *Agonoxena* fed on unfolded fronds. Logs were sometimes destroyed by millipedes or permeated by fungal myceliae before they could be discovered and utilized by *Oryctes*, but other beetles rarely competed with *Oryctes* grubs. The most likely sites for competition between *Oryctes* and other beetles were raintree logs (with *Aegus*) and kapok logs (with *Olethrius*). In coconut logs, *Oryctes* grubs were clearly dominant.

The lack of natural enemies was striking. Aside from rare attacks by ants and mites, there was virtually no predation on eggs. Pupae and adults were also free from predation. *Oryctes* grubs were more susceptible, many being killed by centipedes, rodents and pigs. However, even on Upolu, the introduced predatory beetles and parasitic wasp have made only minor contributions to larval mortality. *Oryctes* grubs inside a coconut log are well protected from any natural enemy now present in Samoa.

The freedom from competition and predation enjoyed by *Oryctes* in Samoa's coconut logs and palms is emphasized in a tabular summary.

COMMON ASSOCIATES OF *ORYCTES RHINOCEROS* IN WESTERN SAMOA

Habitat	Phytophagous	Xylophagous & Saprophagous	Predacious
Coconut palm crowns	Flat moth, <i>Agonoxena argaula</i> Stick insect, <i>Graeffea</i>	Cockroaches <i>Rhabdoscelus obscurus</i>	Ants Lizards Centipedes
Coconut logs and stumps		<i>Callirhipis femorata</i> Cockroaches Millipedes Tenebrionids <i>Trachycentra</i> spp.	Ants Centipedes Rodents Lizards
Other logs		<i>Aegus upoluensis</i> <i>Callirhipis</i> Cockroaches Millipedes <i>Olethrius insularis</i> Tenebrionids Termites	Ants Centipedes Elaterids Rodents Lizards
Heaps of sawdust compost, etc.		Cockroaches Millipedes Mites <i>Oxyecetonia versicolor</i>	Ants Centipedes <i>Pachylister chinensis</i> Pigs Rodents <i>Scolia ruficornis</i>

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**A NEW SUBGENUS AND NEW SPECIES OF  
FRANCISCOLOA CONCI  
(Mallophaga : Menoponidae)<sup>1,2</sup>**

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*Abstract* : The genus is divided into the subgenus *Franciscoloa*, which includes all 9 species previously recognized in the genus in addition to a new species, *erythropteri* from *Aprosmictus erythropterus*, collected in New Guinea and the new subgenus *Cacamenopon*, which includes 2 new species, *hodsoni* and *kimi*, both from *Kakatooe ducrops*, collected in the Solomon Islands.

In a recent review of the genus *Franciscoloa* Conci, 1942, Price and Beer (1966) discuss the features in common to individuals in this genus and give descriptions for each of the 9 recognized species. It is the purpose of the present paper to describe 3 new species of *Franciscoloa*, and, at the same time, divide the genus into 2 subgenera, *Franciscoloa* and *Cacamenopon*. The subgenus *Franciscoloa*, with the type-species *F. pallida* (Piaget) (= *F. cacatuae* Conci), includes all 9 species previously recognized in the genus in addition to a new species herewith described. *Cacamenopon*, new subgenus, is described to include 2 new species from a parrot of the Solomon Islands.

I thank Dr J. L. Gressitt and Dr Nixon Wilson, Bishop Museum, for making these specimens available to me for study, and Mr P. Shanahan and Mr H. Clissold for their role as collectors of these specimens for the Bishop Museum.

1. Paper No. 6227, Scientific Journal Series, Minnesota Agricultural Experiment Station, St. Paul, Minnesota 55101.
2. Partial results of fieldwork supported by a grant to the Bishop Museum from the U.S. Army Medical Research and Development Command (G-65).