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ETHOLOGICAL AND ECOLOGICAL OBSERVATIONS ON *GYMNOPHOLUS* SPP. MAINLY *G.* (*S.*) *LICHENIFER* GRESS. (MARCH-APRIL 1967)[1]

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The following notes are extracted from my field note book.

Mt Kaindi, 14.IV.1967: 1500 to 1630 hrs.

Observations were made on two marked specimens of *Gymnopholus* (*Symbiopholus*) *lichenifer* Gress. on an *Eurya* sp. bush (about 1.2 m tall). When I sat down on a camp chair in front of the *Eurya* bush, I saw the two specimens resting on the undersurface of two leaves on the same lateral branch. Both were motionless for the first 35 minutes. They were resting in two different positions:

No. 1. beetle had its head pointed towards the leaf-apex and *No. 2 beetle's* head was pointed towards the petiole. Both appeared to be large female beetles.

At 1535 hrs *No. 1. beetle* began to crawl away from the leaf on which it was resting, it crawled up to the growing point of the lateral (about 15 cm distance)—there it turned around—it balanced over to the next lateral branch and settled on another leaf at approximately the same level as the leaf on the next branch on which it was resting previously. During this procedure which lasted 15 minutes the beetle stopped several times for 2-3 seconds.

At 1610 hrs *No. 2 beetle* has slightly changed its position; it turned 180°—now pointing its head towards the leaf-apex. However it stayed only 15 minutes in this position. At 1628 hrs it turned its body 180° again and settled in the first position: its head pointing toward the petiole. The two procedures lasted 3 minutes each.

At 1631 hrs I left the *Eurya* bush but I returned to it several times until it became dark and I found the two beetles always on the under surface of the same two leaves, resting with their heads pointed towards the leaf petioles.

Furthermore, they were found on the same bush in the same position next morning at 830 hrs.

Mt Kaindi, 15.IV.1967: 830 to 1800 hrs.

I sat in front of the same *Eurya* bush on a chair—apart from a short lunch break—all day: from 830 to 1800 hrs. Upon arrival at the bush in the morning I could not find any other beetles but the two *G. lichenifer* which were resting in the same position since the previous night. Their inactivity made me think that they were ill or "old" and were nearing exitus. My belief in this respect became even stronger when I saw that the two beetles have not moved at all until 1645 hrs; unless they moved away from their leaves at night and returned to the same leaf (which is very unlikely) they were

1. Partial results of a grant to Bishop Museum from the National Science Foundation (GB-7330).
2. Bishop Museum Field Station, Wau, New Guinea.

motionless for more than 24 hours! I expected any minute to be witness of a spectacular death of an insect; however this wasn't the case. They became very much alive later — though only for a short time.

At 1400 hrs R. Straatman brought three marked specimens of *G.* (*S.*) *lichenifer* and we placed these on two branches of the same *Eurya* bush, at a little distance away from the two branches on which *No. 1* and *No. 2* beetles were resting. The three "new" beetles began walking around on the two branches for about 10 minutes; a small male began to follow a large female and it crawled on its back. Within ten minutes all three settled without disturbing the two beetles which were resting on the leaves since the previous day. (No. 1 and No. 2 beetles were easy to recognize from their markings.) The female carrying the smaller male on its back settled on the stem of the lateral (on which I placed them) and the third beetle settled on the lower surface of a leaf with its head pointing towards the petiole.

At 1415 hrs a 6th *G. lichenifer* appeared at the base of the stem of the *Eurya* bush, it crawled up on the stem; from there it crawled to a lateral and settled on the lower surface of a large leaf with its head pointed towards the petiole.

At 1645 hrs to my astonishment *beetle No. 1* left its long time resting position rather swiftly (relatively fast for a *Symbiopholus*), it crawled right up to the top of the growing point of the branch, it turned around and settled on the side of a young soft leaf and began feeding. When doing this it rested on the leaf margin, holding the leaf on both sides of its lamina (see fig. 1) and it began feeding by moving its head up and down. It chewed out a small semi-oval shaped particle of the leaf, then it turned its head to the upper end of the edge of the chewed out area and it began chewing downward—very similar to the feeding method of large caterpillars—gradually widening the notch on the rim of the leaf. This movement was repeated 8 times after which a fair sized semi-oval shaped area was eaten away (see fig. 2). The beetle stopped feeding then, it crawled 10 cm lower down and settled on a hardened old leaf and rested there until 1720 hrs. Its position was similar to its longtime resting position. It rested on the lower surface of the leaf with its head pointed to the petiole. The activity described above lasted 14 minutes.

Between 1715 and 1720 hrs all of a sudden all six beetles began to move; they were crawling from leaf to leaf, on the stems of the laterals. The tendency was: crawling up, then balancing from one branch to the other at the growing point or sometimes even lower down from one large leaf to another large one which grew on the next lateral. During this procedure it happened only twice that a beetle fell to the ground. In both cases the beetles slipped on the smooth slippery leaves of the *Eurya* bush. After having fallen to the ground, the beetles stayed there 1–2 minutes and then began crawling back on the *Eurya* bush, first on the main stem and then onto a lateral branch. The small male which was sitting on the back of the large female left the female and crawled away from it. Apparently no copulation occurred, or at least I have not noticed it.

Between 1740 and 1800 hrs all 6 beetles settled on leaves and branches without feeding: 4 on the lower surface of leaves (three with their heads pointed towards the petioles, 1 with its head pointed towards the leaf-apex) and 2 on the upper portion of the stem of a lateral. I checked upon their position carefully at 1900 hrs with a torch-

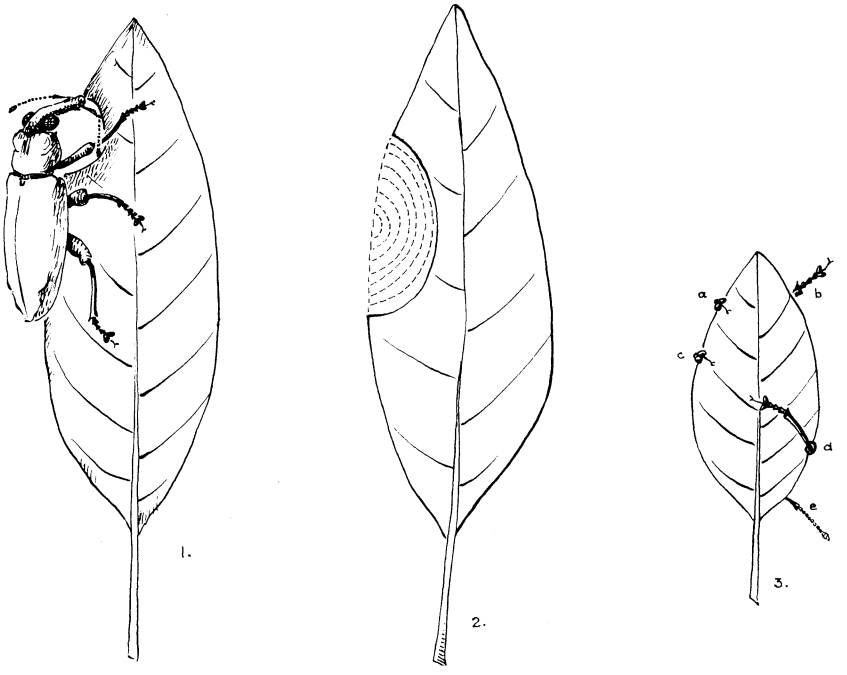

Fig. 1-3. 1, 2, Method of feeding of *G. lichenifer* ; 3, common resting position of same.

light and I found that all six were resting in the same position.

Fig. 3 shows a typical position of a *G.* (*S.*) *lichenifer* when it rests on a leaf with its head pointed towards the petiole. The sketch shows the upper surface of the leaf; thus, the beetle's body cannot be seen, only parts of four of its six legs and part of one antenna. At "a" one can see the claw of the left hindleg with which it holds the leaf lamina, at "b" one can see the right hind tarsus stretched away from the leaf. The claw of the left middle leg is at "c"; at "d" the tibia and tarsus of the right foreleg can be seen with which the beetle holds half of the leaf-lamina and at "e" one can see part of the antenna. I have seen *Gymnopholus* (*S.*) *lichenifer* on many occasions resting in this or in a very similar position on the under surface of leaves.

Further observations and general remarks and conclusions: Observations on the ethology of *G.* (*S.*) *lichenifer* were made on several occasions for shorter periods during my stays on Mt Kaindi and also some observations on *G.* (*G.*) *weiskei*, both on Kaindi and at Wau in the vicinity of R. Straatman's house. I also tried to compare certain behavioral patterns of the two species representing two distinct subgenera and I found some noteworthy differences. I summarize my conclusions and elaborate on further observations in the next 8 paragraphs with an appendix on hostplant range of the four species commonly found on Mt Kaindi and remarks on the various grades of hostplant selectivity:

1. The fact that the adults of *Gymnopholus* (*S.*) *lichenifer* prefer to rest on the lower

surfaces of leaves is a definite sign of *negative phototropism*. In fact I observed on two occasions that a beetle began to feed on a leaf when the sun was covered with a thick grey cloud; as soon as the fast moving cloud moved away and the sun began to shine (it was between 1100 and 1200 hrs), the beetle stopped feeding and it crawled to another leaf which was sheltered from the sun-rays by a larger leaf. On one of two such occasions the beetle settled on the lower surface of the leaf and on the other occasion it grasped the sheltered leaf from the side and began to feed.

2. *Gymnopholus lichenifer* feeds in a fashion which is similar to that of large lepidopterous larvae. It feeds on the leaf margin stripping out semi-oval shaped notches, whereas many other weevils (especially smaller ones of the tribe Celeuthetini) feed in the middle of the leaf lamina causing typical "shot-hole" damage.

3. *G. (S) lichenifer* (probably also many other species of the genus have similar behavior) is inclined to be very inactive for longer periods, resting up to 24 hours in the same position. The long lasting inactive spells do not affect the beetle's relative agility. All of a sudden, a beetle begins to move away from its long lasting resting position; it walks around for a while, it may or may not feed and it takes another long rest after a relatively short spell of activity and agility. However, this is not always the case. There are times of longer distance dispersal (see paragraph 4).

4. *Gymnopholus lichenifer* is slower in its movements and in many ways less active than *G. (G.) weiskei*. In general both species, and also the third common species on Mt Kaindi, *G. (G.) marquardti*, were observed to be more active on sunny mornings after heavy rain on the night before. On such days one can see many more beetles crawling longer distances on open spaces, grassy areas such as the Mt Kaindi plateau in the P & T station area. This has been also observed by G. A. Samuelson and R. Straatman. *G. weiskei* behaves similarly also at lower altitudes on sunny mornings after heavy night-rain. R. Straatman observed beetles approaching the water-race behind his house, crawling into the water, being carried a few meters by the running water and then crawling out of the water on the other side and approaching an area of one of its favored adult hostplants.

5. I measured the speed of a large female *G. (G.) weiskei* on a smooth surface. I placed the beetle on the table which stands in the main building of the P & T station at Mt Kaindi. The first time the beetle began to crawl around erratically in various directions. After several tries I managed to observe it crawling right across the length of the table in a straight line. Its speed was 1 m/30 seconds. This is a relatively high speed for the size of the beetle and for its bulky shape. Theoretically the beetles should be able to cover large distances in a relatively short time and thus it is not impossible that the egg-laying is done in an area which is sometimes quite a distance away from the adult hostplant. This might be the reason why we could not find *Gymnopholus* larvae by digging round and in the close vicinity of host-trees and shrubs.

6. I have not noticed *G. (S.) lichenifer* pretending or simulating death, but I noticed this many times in the case of *G. (G.) weiskei*. On several occasions when I caught a *weiskei* with my hand it simulated death and when placing it on its back on a hardened old leaf, it stayed motionless up to 3-4 minutes before it began moving. Simulating or pretending death — could this be considered a more advanced ethological characteris-

tic? Are there any other characteristics (morphological or behavioral) which would place *Gymnopholus* above *Symbiopholus* as the phylogenetically higher (or more advanced) subgenus? To answer these questions one would need to make many more observations with various species of both subgenera.

7. As it was observed that on bright sunny days after rainy nights *Gymnopholus* spp. were seen actively moving around in open areas, it was also noticed that all species commonly found in the Mt Kaindi area (*G. lichenifer*, *marquardti*, *weiskei*, and *interpres*) favored to rest on open parts of the branches, near the growing points of shrubs and small trees on mornings when there was very heavy dew. Apparently although being negatively phototropic, they are only moderately hydrophilous insects and they tend to move away from very wet conditions after heavy rain (see paragraph 4) or when there is heavy morning dew.

8. A strange behavioral observation was made on *G. weiskei* by R. Straatman and myself on Mt Kaindi. A large specimen (♀?) was observed climbing up on the dry, completely leafless branch of a dead shrub about 2 m above the ground at 1730 hrs. Having checked upon this specimen at 2045 hrs with a torch-light we found that in spite of the cold night and the strong North wind, the *G. weiskei* was resting only 2–3 cm from the top of this branch. One would expect that an insect would try to seek cover amongst thick foliage on such a cold windy night. Instead of that this beetle crawled almost to the top of the dry leafless branch where it was fully exposed to the stormy wind. We could not find it next morning. There was a heavy downpour and hail between 100 and 200 hrs and this probably killed the beetle or washed it off the branch.

HOSTPLANT RANGE OF GYMNOPHOLUS SPP. IN THE WAU - MT KAINDI AREA

I. Arranged according to host plants.

Plant Family	Name of Plant	Weevil
CUNONIACEAE	*Caldcluvia brassii* (Perry)	*G. interpres* *G. marquardti* *G. weiskei*
DIOSCOREACEAE	*Dioscorea* sp.	*G. weiskei*
ELAEOCARPACEAE	*Elaeocarpus trichophyllus*	*G. lichenifer* *G. marquardti*
FAGACEAE	*Nothofagus grandis* van St.	*G. lichenifer*
ULMACEAE	*Trema amboinensis* Willd.	*G. weiskei*
LEGUMINOSAE	*Tephrosia candida* DC	*G. weiskei*
MELIACEAE	*Melia azedarach* L.	*G. weiskei*
RHAMNACEAE	*Alphitonia incana* (Roxb.) T. & B. ex Kurz	*G. interpres* *G. marquardti* *G. weiskei*

ROSACEAE	*Rubus archboldianus* M. & P.	*G. interpres* *G. marquardti* *G. weiskei*
	Rubus moluccanus L.	*G. interpres*
RUTACEAE	*Evodia* sp.	*G. lichenifer* *G. marquardti* *G. weiskei*
SAURAUIACEAE	*Saurauia* sp.	*G. weiskei*
THEACEAE	*Eurya* cf. *meizophylla* (Diels) Kob.	*G. interpres* *G. lichenifer* *G. marquardti* *G. weiskei*
URTICACEAE	*Pipturus* cf. *argentea* Willd.	*G. weiskei*

II. Arranged according to weevil species.

A. *Gymnopholus interpres* Heller

1. *Caldcluvia brassii*
2. *Alphitonia incana*
3. *Rubus archboldianus*
4. *Rubus moluccanus*
5. *Eurya* cf. *meizophylla*

B. *G.* (*Symbiopholus*) *lichenifer* Gressitt

1. *Elaeocarpus trichophyllus*
2. *Nothofagus grandis*
3. *Evodia* sp.
4. *Eurya* cf. *meizophylla*

C. *Gymnopholus marquardti* Heller

1. *Caldcluvia brassii*
2. *Elaeocarpus trichophyllus*
3. *Alphitonia incana*
4. *Rubus archboldianus*
5. *Evodia* sp.
6. *Euryia* cf. *meizophylla*

D. *Gymnopholus weiskei* Heller

1. *Caldcluvia brassii*
2. *Dioscorea* sp.
3. *Trema amboinensis*
4. *Melia azedarach*
5. *Alphitonia incana*
6. *Rubus archboldianus*
7. *Evodia* sp.
8. *Tephrosia candida*
9. *Saurauia* sp.
10. *Eurya* cf. *meizophylla*

Hostplant selectivity: Investigations so far show that *Gymnopholus lichenifer* is the most selective species, with 4 hostplants representing 4 families; *G. interpres* is nearly as selective as *G. lichenifer* (5 hostplants, 4 families); the next one is *G. marquardti* with 6 hostplants representing 6 families and the least selective is *G. weiskei* with 10 hostplants representing 10 families, which is partly the result of its vertical distribution range (900 to 2800 m); in the lower altitude cultivated areas it became adapted to some introduced plants.