

LIFE HISTORY AND BEHAVIOR OF THE AFRICAN BUSH GRASSHOPPER, *PHYMATEUS VIRIDIPES* (ORTHOPTERA: PYRGOMORPHIDAE) IN CAPTIVITY¹

Tohko Kaufmann²

ABSTRACT: The number of molts in *Phymateus viridipes* is 6 times in males, 7 times in females. Although males were sexually mature at emergence, females were not mature until 2 months after emergence. Oviposition began 2 months after the first mating and lasted 2-3 months. With a diet of *Brassica oleracea acephala*, a female produced an average of 4 eggpods, each containing an average of 162 eggs. Both nymphs and adults aggregate closely by touching and mounting each other.

In and around the Rift Valley town of Nakuru, in the western central region of Kenya, grasslands and forests abound. The place looks like an ideal habitat for grasshoppers. Yet, my search for them from 1988 to 1992 are mostly unsuccessful except for occasional individuals of small species. Then, suddenly, in 1997, I found a group of about 20, 3rd instar hoppers of *Phymateus viridipes* Stal in broad leaves of a wild plant in a bush inside Lake Nakura National Park. Three months later, I found another group of 1st instar hoppers of the same species deep in a dense bush, several km from Nakuru town. These are the only occasions I have found this African bush grasshopper in my almost 12 years' stay in Kenya working as an entomologist.

Literature on this large, green, bizarre-looking insect is scanty. This paper presents some basic research on the biology and behavior observed in cages.

MATERIALS AND METHODS

Thirty plus young nymphs were collected from the 2 sites mentioned above. They were housed in round wire-gauze cages, 60 cm high and 30 cm in diameter, with 5 cm of soil at the bottom. As foodplant, the leaves of kale, *Brassica oleracea acephala* were provided, simply because they are readily available throughout the year. When the nymphs became adults, they were transferred to a large wire-gauze cage, 85 cm high and 100 cm in diameter with 10 cm soil at the bottom. All the cages were placed in my open patio where they received direct sunlight from 9 a.m. to 5 p.m. daily. The range of temperatures during this study was 14° C - 42° C, and that of relative humidity, 50% -100%.

LIFE HISTORY

Eggs: The eggs are cylindrical, pale yellow, about 60 mm long and 1 mm

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² P.O. Box 3880, Nakuru, Kenya, Fax: 000254-37-210188.

wide at center. The incubation period was 4-5 months depending on the weather conditions of the year.

Nymphs: The first instar nymphs were black and measured 6-7 mm long. A pale beige stripe running dorsally from head to the posterior end of the body appeared in the second instar, followed by whitish pink dots on the thorax in the third instar. The body color became more pronounced as nymphs grew so that in the fifth instar, the entire body was speckled with white and pink dots and the dorsal stripe turned golden yellow. Wing pads became visible in the third instar; they were green. In the sixth instar, yellow and orange dots also appeared, and at this stage, the nymphs closely resembled those of *Zonoceros variegatus* L. (Kaufmann, 1965).

Males molted 6 times, lasting an average of 120 days from eclosion to emergence, while females molted 7 times taking an average of 153 days for the same period. According to De Lotto (1951), however, both sexes of *P. viridipes* had 7 instars.

Adults: All adults are long-winged and green except the hind wings which are scarlet.

Females became sexually mature 2 months after emergence, followed by mating, while males were mature at emergence. The first oviposition was observed 2 months after the first mating. Eggs were laid along the edges of the cage avoiding the central area. A female spent 30-90 min. to lay a batch of eggs including the first 10-15 min. to dig a hole in which to oviposit. After oviposition, the egg-holes were kept open. However, since females tend to lay eggs close to each other, these holes became quickly obliterated by their activities. The oviposition period lasted 2-3 months.

Egg-pods are beige brown measuring 6 cm long and 1 cm wide. The largest numbers of eggs were concentrated on or near the top of the egg-pod. The number of eggs per pod ranged from 60 to 231 with an average of 162, and each female produced an average of 4 pods so that the average number of eggs per female was 648. The mature ovaries of *P. viridipes* contained 200 ± 10 at a time. Consequently, 80% of the eggs were laid each time. Chapman (1961) reported that an egg pod of this species collected in southern Ghana had 282 eggs.

An adult female lived an average of 211 days (166-265), while male's average was 300 (297-305) days.

BEHAVIOR

Aggregation: The nymphs of this species are strongly gregarious and move about the cage as a group, depending on the position of the sun, choosing the sunniest spot to aggregate. Nymphs gather close together, touching as well as sitting on top of each other, thus forming a dense aggregation. Even feeding takes place as a group; when one jumps to the foodplant, others follow one by

one. After feeding, they leave the plant in the same manner.

Adults aggregate similarly, but since they are larger and heavier, group formation takes place on or near the ground. As in nymphs, close physical contacts among individuals of both sexes occur. Because males are considerably smaller and lighter, as many as 3 males were often seen sitting on the back of one female. No kicking or other expression of irritation has been observed among the congregating adults.

Aggregation occurred both in small and large cages. The cause of it may be twofold, namely: phototropism and visual attraction to movement.

P. viridipes is strongly phototropic and individuals follow the movement of the sun until the ground temperature rises to 32° C. In *Zonocerus variegatus* (Kaufmann, 1965), *Locusta migratoria migratorioides* (Ellis et al, 1962), *Schistocerca gregaria* (Kennedy, 1939) and others, the movement of the nymphs leaving the outbreak area attracts other nymphs in the close vicinity. Thus, the pioneer marchers are followed by other nymphs. *P. viridipes* is not known to migrate in bands either as nymphs or as adults, but the pattern of aggregation is the same; when one moves to a sunny spot, the one which is in the immediate vicinity optically recognizes the movement and follows the first. The second is followed by the third, and so on.

Sun-basking: Sun-basking, unlike aggregation, is an individual act which usually occurs in the morning when the sunrays first hit the cage floor around 9 a.m. The grasshoppers have roosted overnight and are still sluggish at this hour; their body temperature, therefore, must rise to a certain point, before the daily activity begins. The orientation of the body, directly facing the sun is as follows:

(1) Body lies flat, parallel to the ground surface with head pulled in, and antennae touching the ground (Fig. 1a). This posture warms up the entire dorsal surface.

(2) Head and thorax are raised toward the sun with antennae lifted up. This warms the ventral surface of the thorax (Fig. 1b).

(3) Head and thorax are raised much higher so that the ventral surface of the abdomen is also exposed to the sun (Fig. 1c).

(4) Crawls to shade and assumes a normal posture (Fig. 1d).

In rain: Grasshoppers perch on the upper part of the cage or that of tall upright plants with heads pointing upwards, thus exposing the minimum surface to the rain. Artificial sprinkling of water in the cage produced the same result.

Feeding: Feeding takes place when the atmospheric temperature rises to 20° C. Usually on sunny mornings, it begins around 9 a.m. and ends about 4 p.m. During this period, feeding occurs at any time. On cloudy or rainy days, little or no food is eaten, thus, development depends on daily weather conditions. As a foodplant, kale, *Brassica oleracea acephala* was well received and

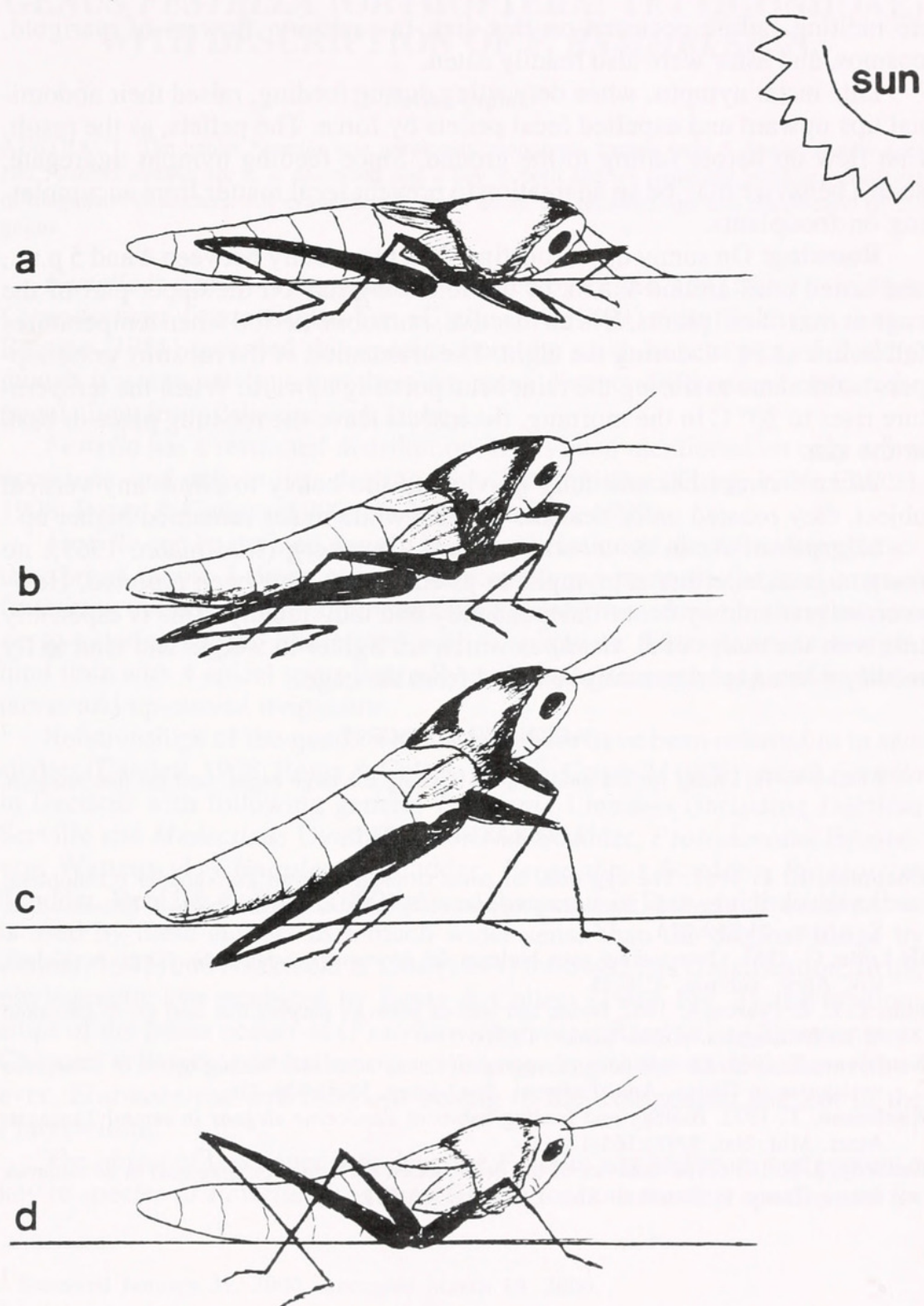


Fig. 1. A last instar *P. viridipes* basking in the sun: a, warming the entire dorsal surface; b, warming the ventral surface of thorax; c, warming the entire ventral surface; d, normal posture in shade.

no molting failure occurred on this diet. In captivity, flowers of marigold, cosmos, and astor were also readily eaten.

Late instar nymphs, when defecating during feeding, raised their abdominal tips upward and expelled fecal pellets by force. The pellets, as the result, first flew up before falling to the ground. Since feeding nymphs aggregate, such a behavior may be an adaptation to prevent fecal matter from accumulating on foodplants.

Roosting: On sunny days, roosting took place daily between 4 and 5 p.m., and lasted until around 9 a.m. of the following day on the upper part of the cage or that of tall plants. It is an inactive, immobile period when temperatures fall as low as 14° C during the night. The orientation of the roosting grasshoppers is the same as during the rain; head pointing upward. When the temperature rises to 20° C in the morning, the insects leave the roosting place to bask in the sun.

When females became fully gravid and too heavy to climb any vertical object, they roosted on or near the ground, while males remained higher up.

Migration: As in *Zonocerus elegans* Thunberg (Kaufmann, 1969), no mass migration, either as nymphs or as adults has ever been reported. However, migration may occur independently and individually. This is especially true with the males of *P. viridipes* which are lighter in weight and tend to fly readily when experimentally released from the cage.

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