

BIOLOGY OF THE BUFFALO FLY, *HAEMATOBIA*
EXIGUA DE MEJERE (DIPTERA: MUSCIDAE)¹

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The eggs hatched after 17-22 hours. The first-instar larva measured 1.25 + 0.16 mm long and 0.27 + 0.037 mm wide. Six to 12 hours later it molted, giving rise to the second larval stage. The second-instar larva measured 2.676 + 0.187 mm long and 0.353 + 0.028 mm wide. After 12-24 hours another molting took place. The third-instar larva measured 6.833 + 0.189 mm long and 0.919 + 0.051 mm wide. Pupae emerged after 2-3 days. Duration of the pupal stage was about 5-7 days before the adult emerged.

Under laboratory condition, the buffalo fly completed its life cycle in 9.5 to 10.5 days, whereas under field condition it took 9-14 days with an average of 10.5 days.

The longevity of the male was 29 days, and 32 days in the female. The range of egg production under laboratory condition was between 20-139 per female fly.

The belly and hind legs of the carabao were the most preferred habitat either during cloudy and cool dry or sunny and warm day.

The oviposition activity at night was higher than during the day. The highest was achieved between 11 to 12 p.m. and 1 to 2. a.m. and the lowest was between 7 to 8 a.m. and 1 to 2 p.m.

Buffalo fly, *Haematobia exigua* de Meijere is among the blood sucking flies of cattle and carabao. Its feeding habit interferes with normal weight gains and milk production (Bohart and Gresitt 1951; Snyder 1965). Losses due to the buffalo fly in its area of occurrence is not known. Potential loss due to the buffalo fly could be identical to the closely related species of the hornfly, *H. irritans*. (Lin.). Annual loss in 1965 in the United States caused by the hornfly amounted to 115 million dollars due to weight loss and 64 million dollars to reduction of milk production (Steelman 1976).

Unlike the other blood sucking flies, the buffalo fly rarely leaves the host except for a brief flight when disturbed to transfer to another host or to lay eggs. Hundreds to several thousands flies may settle on cattle and carabaos, particularly bulls.

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Buffalo fly occur in Indonesia (Handschin 1932; Krigsman and Windred 1933; Snyder 1965), Malaya (Tillyard 1931), China (Patton 1926), Philippines (Banks 1919; Snyder 1965; Dumag et. al. 1966), Australia (Newman 1927; Tillyard 1931; Snyder 1965), Micronesia (Lever 1937; Snyder 1965) and India (Thompson 1947; Snyder 1965).

Besides blood loss, the flies create severe irritation and discomfort to carabao and cattle. Mizmain (1912) suspected the fly as vector of surra and a mechanical transmitter of larvae to carabao louse.

The female fly oviposit only on lewly laid fresh manure. Handschin (1932) noted that female fly is attracted to oviposit on less than one-day-old dung.

The present study aimed to define the life cycle and the oviposition of the buffalo fly under field and laboratory conditions. The study was carried out from September 1977 to April 1978 in the Department of Entomology, and the Dairy Training and Research Institute (DTRI, University of the Philippines at Los Banos (UPLB).

MATERIALS AND METHODS

Field Studies

The insects were collected and reared in manure collected from the open pasture of DTRI, UPLB, utilizing six carabaos of similar ages. The carabaos were allowed to graze during morning and late in the afternoon taken back to the barn. Insecticides were not applied to the carabaos during the experimental period.

Only firm and well-formed manure pads were collected in the daytime. The manure pads were exposed in the pasture only for 15 minutes for fly oviposition and prevent oviposition of other dung inhabiting arthropods.

A modified method of Kunz, et. al. (1970) for collecting and field rearing insect was employed. Manure exposed for 15 minutes were transferred into a wooden tray lined with a thick plastic sheet and filled with sand serving as pupation medium and water absorbent and the tray covered with a screen (Figure 1). The trap cages were left on the pasture for 21 days. The newly emerged adults were collected daily from the plastic jar.

The adult activities and oviposition behavior of buffalo fly at night time from 6:00 p.m. to 6:00 a.m. were observed daily for 4 weeks. Night time was divided into 6 two-hour periods at which time the activities of adult flies on the hosts and the number of adult flies ovipositing on the dung were estimated.

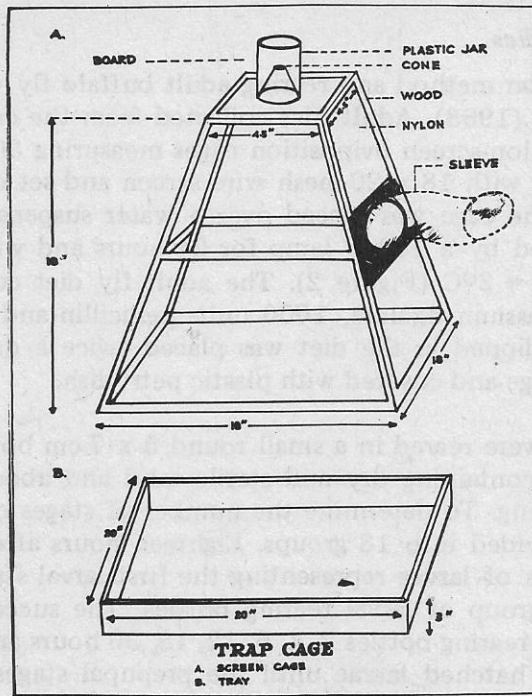


Fig. 1. A diagram of the insect trap cage.

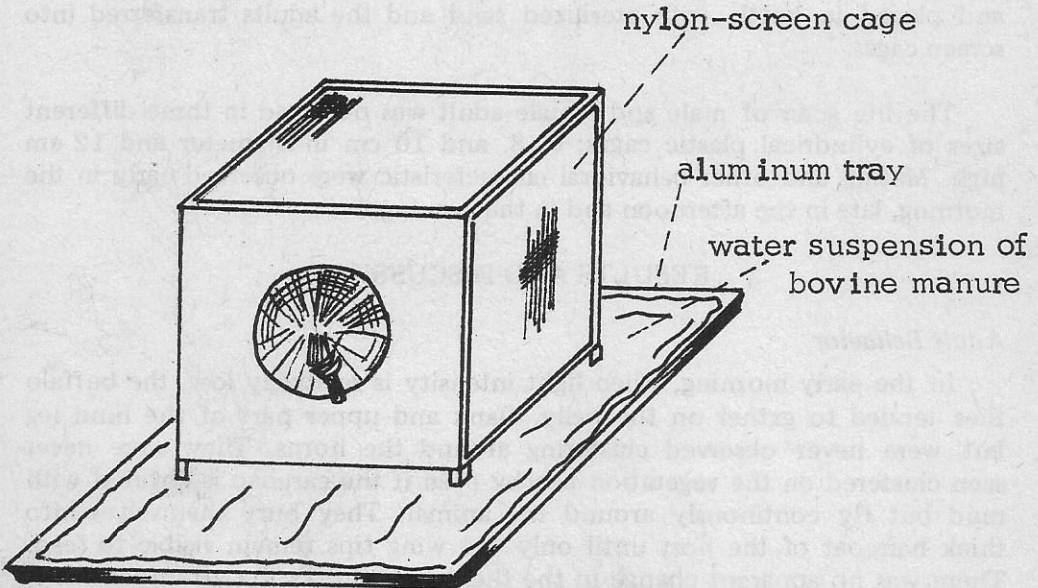


Fig. 2. Oviposition cage on aluminum tray lined with tissue paper saturated with dung suspension.

Laboratory Studies

Egg collection method and rearing adult buffalo fly was patterned after Schmidt, et. al. (1968). Adult flies collected from the carabaos were transferred into a nylon-screen oviposition cages measuring 30 x 30 x 30 cm the bottom covered with 18 x 20-mesh wire screen and set on a plastic or aluminum tray. The cage was placed over a water suspension of bovine manure, illuminated by a 100 W lamp for 24 hours and with an average temperature of $33 \pm 2^{\circ}\text{C}$ (Figure 2). The adult fly diet consists of 1780 ml blood, 2 g potassium oxalate, 1000 units penicillin and ml distilled water. A cotton bud dipped in the diet was placed twice a day on 4 cm muslin on top of the cage and covered with plastic petri dish.

The larvae were reared in a small round 5 x 7 cm bottles with one-third of the volume containing dry and sterile sand and about two thirds filled with carabao dung. To determine the number of stages of larvae, 39 rearing bottles were divided into 13 groups. Eighteen hours after the introduction of eggs, samples of larvae representing the first larval stages were collected from the first group of larval rearing bottles. The succeeding samples were drawn from the rearing bottles 2, 4, 6, 12, 18, 36 hours and 2, 2, 5, 3, 4, and 5 days. Newly hatched larvae until the prepupal stages were periodically collected and preserved in alcohol for instar determination. Identification of the stages of larval development was based on length and width, the degree of development of cephalopharyngeal skeleton and posterior spiracles of the larvae. The remaining larvae developing into pupae were collected and placed in bottle with sterilized sand and the adults transferred into screen cages.

The life span of male and female adult was observed in three different sizes of cylindrical plastic cages; 6, 8, and 10 cm in diameter and 12 cm high. Mating and other behavioral characteristic were observed early in the morning, late in the afternoon and in the evening.

RESULTS AND DISCUSSION

Adult Behavior

In the early morning, when light intensity is relatively low, the buffalo flies tended to gather on the belly, flank and upper part of the hind leg but were never observed clustering around the horns. They were never seen clustered on the vegetation nearby even if the carabao is covered with mud but fly continuously around the animal. They bury themselves into thick haircoat of the host until only the wing tips remain visible to feed. There was no apparent change in the flight behavior in the afternoon when light intensity was relatively higher. When carabao ruminated or simply rests in the shade, the flies hover or cluster around the entire body surface of the animal.

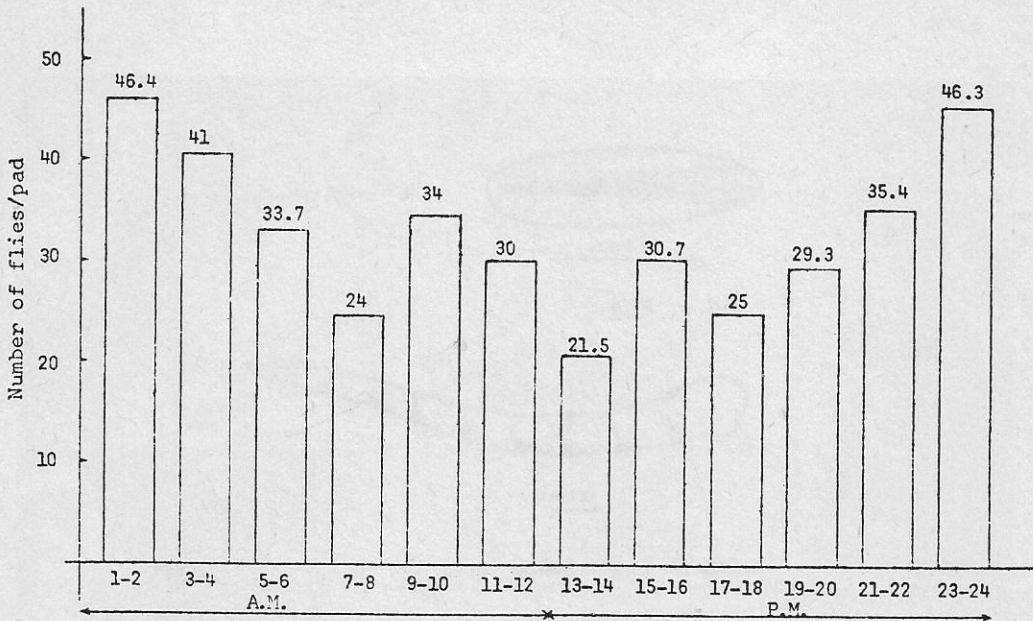


Fig. 3. Effect of time of day exposure to the alightment of buffalo flies from October to December 1977.

During the night the buffalo flies were as active as the nocturnal mosquitoes. It appeared that they were more active at night than at day time, and always shifting to exposed parts of the body when the carabao changed its laying posture. The abundance of buffalo flies thus rendered the host unable to rest in the barn. Roberts (1941) reported similar behavior in Australia.

Oviposition Behavior

The adult flies never oviposit on the mud, nearby vegetation and on old manure heaps but required fresh dung. The flies randomly distributed themselves on the pad surface upon alighting on the feces. Egg is laid singly sometimes, in group of 4-6 eggs.

The oviposition activity at night was higher than during the day (Fig. 3). The lowest was between 7 to 8 a.m. and 1 to 2 p.m., and the highest between 11 to 12 p.m. and 1 to 2 a.m. Oviposition activity tended to increase between 5 to 6 p.m. and gradually decline towards dawn.

The duration of alightment on the dung during the day was shorter than at night. This behavior was apparently influenced by light, wind velocity, humidity, rainfall and the abundance of competitors. The rate of desiccation of feces was apparently faster during the day than at night. This condition strongly influenced the period of alightment.

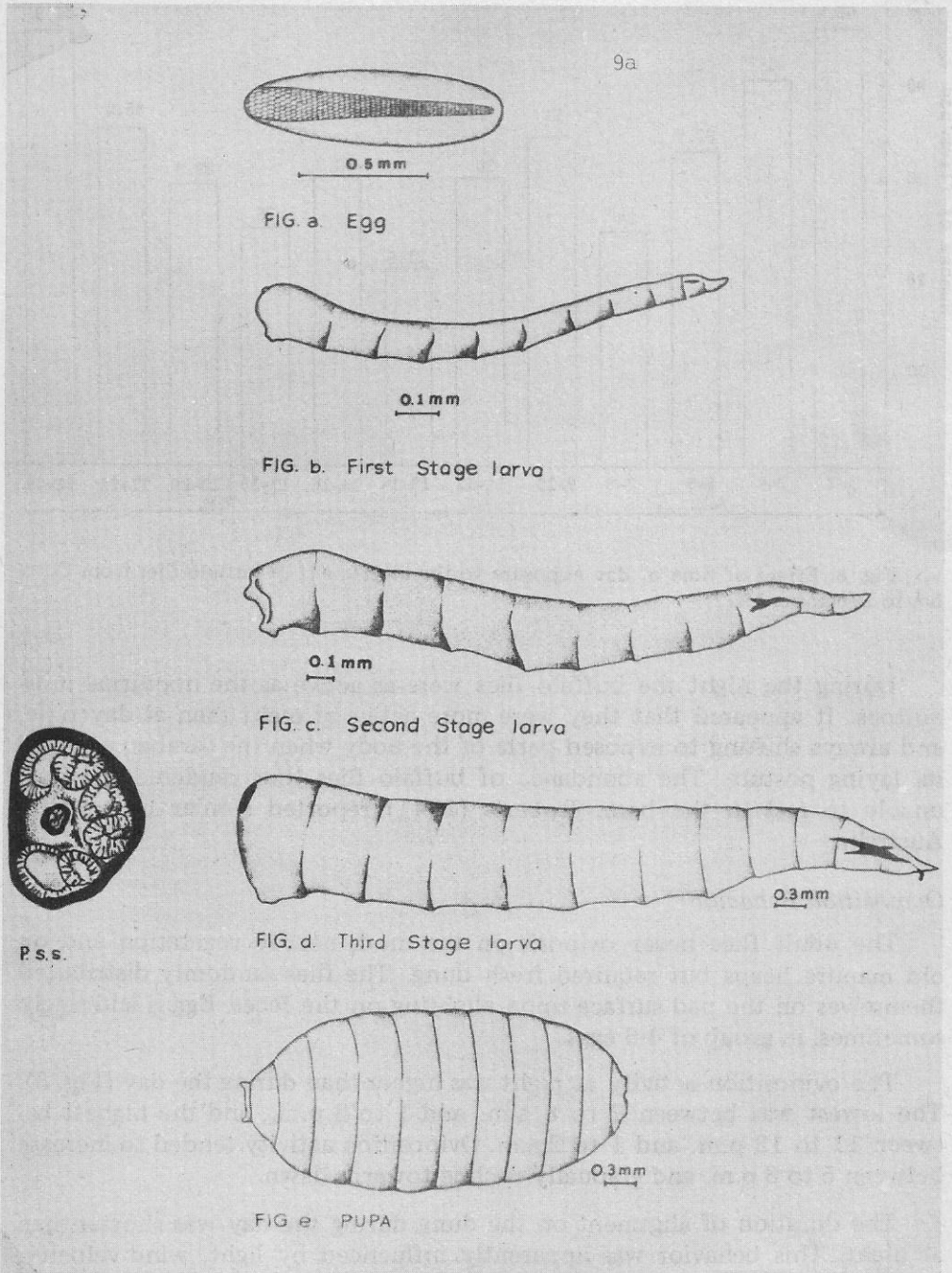


Fig. 4. Developmental stage and morphological characteristic of *H. exigua*.
p.s.s. : Posterior spiracle of third stage larvae

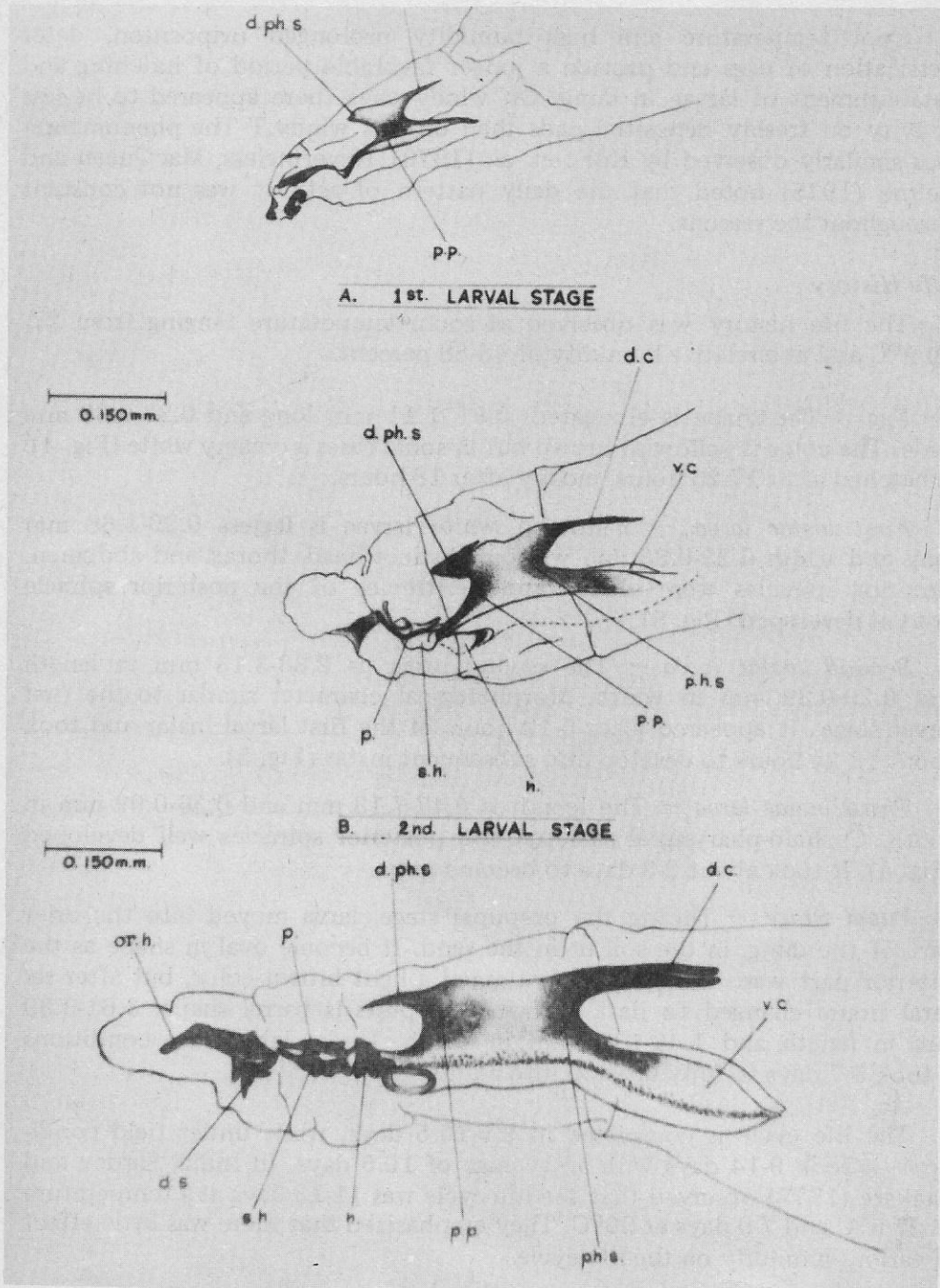


Fig. 5. Cephalo-pharyngeal skeleton of the different larval stages of *H. exigua*.
 d.p.h.s.: dorso-pharyngeal sclerites; d.c.: dorsal cornua; p.p.: pharyngeal plate; v.c.: ventral cornua; p.h.s.: pharyngeal sclerite; h.: hypostomium; s.h.: subhypostomium; p.: parastomium; or.h.: oral hooks; d.s.: dental sclerite

Cool temperature and high humidity prolonged oviposition, deter dessication of eggs and provide a longer favorable period of hatching and establishment of larvae in dung. On windy days there appeared to be less activity on freshly deposited pads than on less windy. The phenomenon was similarly observed by Kunz et. al. (1970). Nevertheless, MacQueen and Beirne (1975) noted that the daily pattern of activity was not constant throughout the seasons.

Life History

The life history was observed at room temperature ranging from 27-29.2°C and at a relative humidity of 48-68 percent.

Egg — The shape is elongated, 0.91-1.11 mm long and 0.23-0.33 mm wide. The color is yellowish brown but in some cases is creamy white (Fig. 4). It hatched after 17-23 hours, mostly after 18 hours.

First instar larva — Yellowish white larvae is legless 0.99-1.68 mm long and width 0.23-0.33 mm without distinct head, thorax and abdomen. Anterior spiracles were absent and peritremes of the posterior spiracle not yet developed (Fig. 5).

Second instar larva — The second instar is 2.33-3.13 mm in length and 0.29-0.39 mm in width. Morphological character similar to the first larval stage. It appeared after 6-12 hours of the first larval instar and took about 12-24 hours to develop into subsequent instar (Fig. 5).

Third instar larva — The length is 6.47-7.13 mm and 0.36-0.99 mm in width. Cephalo-pharyngeal skeleton and posterior spiracles well developed (Fig. 4). It took about 2-3 days to become pupa.

Pupal Stage -- During the prepupal stage, larva moved into the drier part of the dung, in the soil or in the sand. It become oval in shape as the anterior part was drawn in and attained a light brown color, but after several hours changed to dark brown. The pupa is barrel shape, 3.61-3.89 mm in length and 1.42-1.61 mm in width. Under laboratory conditions it took 5-7 days to fully develop into adults.

The life cycle is completed in 9.5-10.5 days, while under field conditions, it took 9-14 days with an average of 10.5 days. In India, Sardey and Thakare (1977) observed that the life cycle was 11-13 days at a temperature of 27.5°C and 7-9 days at 30°C. They emphasized that there was little effect of various humidity on the life cycle.

Despite weather conditions, variation in the duration of life cycle was presumably affected by diet of the fly larvae. It is obvious that the diet was related to the wetness and composition of the dung. Bay and Pitts (1976) concluded that diet also affected the attractiveness of feces.

Longevity and Fecundity -- Under temperature of $33 + 2^{\circ}\text{C}$, female flies survived for 32 days with an average of 18.6 days and male flies up to 29 days with an average of 15.9 days.

The highest egg production was 139 per fly ranging from 20-139 eggs. Pre-oviposition period was 8 to 12 days, and mating occurred on the 6th day at about 8 p.m. The eggs were laid singly and rarely in group.

Buffalo fly is an obligate parasite and therefore, spends most of the time on the body surface of its host. As noted by McLintock and Depner (1954), changes of environment may effect the longevity and fecundity, hence, concluding that 37°C has a profound effect.

ACKNOWLEDGMENT

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