AMBUSH BUG STUDIES. A SUMMARY

W. V. Balduf

University of Illinois, Urbana, Illinois

Ambush bugs form a family of the insect order Hemiptera. They are widely distributed in the world. In our area of the United States, one species, *Phymata pennsylvanica*, is fairly common. It is this species that I have studied in the past two years in the vicinity of the University of Illinois. It is about 2/5 inch long as an adult, and its color is a rather neutral combination of yellow, brown and green, with a band of black across the middle of the abdomen. Like most of its fellow bugs, it has two pairs of wings, flies readily when stimulated by hunger and heat, and possesses a proboscis containing thread-like piercing and sucking instruments. Perhaps its most remarkable anatomical features are the front legs, of which the femur is unusually short and powerful, whereas the tibia is slender and curved sickle-shaped, and folds along the rounded edge of the femur. From the structure of these legs, you would at once guess correctly that the ambush bug lives at the expense of other insects which it catches by means of these very efficient and wonderfully adapted raptorial mechanisms.

The name "ambush" bugs suggests that these insects lie in hiding in order to take their victims unawares. Indeed, it has been suggested in the earlier literature, that they are an exceptionally good instance of protective coloration, and that such coloration is utilized as an adjunct in the business of securing a livelihood. While it is true that these bugs mostly frequent flowers of the same color as themselves, they not infrequently also await prey in flowers whose colors are purple, greyish green and other hues, in which the bug is not particularly inconspicuous and is not therefore well concealed. My field observations have convinced me time and again that the flowers chosen by this bug for ambush are not selected according to their concealing color, but by a process of trial and error, and the flower, regardless of its color, form or size, which attracts the necessary number of prey insects, is the flower which the bug inhabits. Flowers that yield a quantity of nectar sufficient to attract bees, flies, moths and butterflies, and a rich supply of pollen or tender tasty petals that delight the palate of beetles and bees, such flowers constitute the principal abiding places of this clever hunter.

The technique of this hunter is of the watchful waiting type. While many predators aggressively pursue their prey on foot, the ambush bug sits quietly at the edge of the disk of a composite flower with the head end elevated and the grasping front legs ever ready to flick out should a fly, beetle, bee, butterfly or other bug come within reach. Or, particularly when the air temperature goes up above 90°F., they cling to the under side of the rays of the flowers and poke their heads and front legs up between rays in an attitude of alert watching. They commonly sit nestled down among the rich yellow of fresh goldenrod flower clusters, or back down caudal end first into the hairy disk of thistle flowers.

In such situations they sit in waiting. The only change in posture made usually is an orientation movement which keeps the grasping mechanism aimed in the direction of the prey as it moves over the flower. Should it come within the reach of the extended front legs, the insect visitor to the flower in search of pollen or nectar may be caught in the vice-like grip of the tibia and tarsus. The unsuspecting visiting insect may be seized by one of several parts, such as an antenna engaged in tapping the flower to locate food, or a leg, or the extended siphon of a butterfly or moth, the proboscis of a bee or the labium of a fly in search of nectar. Though often several times larger than their captor, the captive rarely frees itself from this grip, despite the almost universal practice of utilizing only one front leg in making the catch. In this way, it catches and holds victims as large as sulphur butterflies, cutworm moths, and, under conditions of cool air

in autumn, even large slender-waisted wasps and bumblebees.

As soon as caught, the captive insect is brought within reach of the proboscis. The stylets, or thread-like piercing mandibles and maxillae explore the victim's body surface and penetrate the skeleton at the junctures of the body regions, the segments of the abdomen, the joints of the legs and even at the mouth. Obviously the next act in the feeding process is to inject a secretion. This fluid inflates the body of smaller prey insects to its maximum extent, and also serves to kill the captive within a fraction of a minute to several minutes, the time required to render it lifeless and relaxed depending on the size of the insect caught. It is obvious also that the fluid injected acts to reduce the tissues of the internal organs, and particularly the muscles, to fluid form, for the discarded body of the insect victim is more or less translucent as compared with its opacity before capture. This is equivalent to saying that the prey tissues are digested before the ambush bug sucks them out. The predigested liquefied or comminuted tissues, along with the victim's blood are then sucked out. Discarded prey specimens, particularly the smaller ones, have the abdomen more or less telescoped into the thorax. The males feed only about one-fifth as frequently as the somewhat larger females.

In nature, this species succeeds in capturing and feeding on a large range of other insects, yet obviously can not overcome such larger beetles as the Pennsylvania soldier beetles and blister beetles, or certain large bee flies. But from sulfur butterflies, noctuid moths, drone flies and honey bees down to gnats, there are not many winged, flower-visiting insects that are not subject to seizure. To date, I have taken from the grasp of adult ambush bugs along the roadsides of Illinois 544 specimens of insects. These represent 185 species belonging mostly to the order Diptera, Hymenoptera and Lepidoptera, and to a lesser extent to the Coleoptera and Hemiptera. Of the 544 insects so obtained, 119 are moths, skippers and butterflies, and 245 are Diptera.

Another feature of outstanding interest is the life history of this ambush bug. The male is strongly attracted by the female. Accordingly, he may be seen most frequently perched upon the back of his mate, in a more or less passive way. While his burdened mate engages in lurking for prey or in feeding, he does little more than sit. This coupled relation is modified frequently to a side-to-side position of the two individuals, which is the true mating posture. In this, the bodies of the two members of the pair form a V-shaped design. The mating process is often quite prolonged. It is of interest that this activity is almost entirely restricted to the afternoon, whereas the coupled relation of the pair may be observed in any part of the warmer days.

Each of the two ovaries consists of 3 tubes, and the mature eggs accumulate in them until as many as 21 may be present simultaneously in a single female. These are then deposited in masses, each formed of a single layer, the eggs standing on end in an inclined position. The entire cluster is more or less covered with a flocculent matrix that is at first golden but soon turns brown. A series of eleven females kept isolated with males as long as they lived, deposited eggs ranging in number per female from 133 to 350, or an average of 235 per female. These females began laying eggs from 12 to 21 days after they reached adulthood. No one has yet succeeded in observing the act of oviposition in the field, but it is probable the masses are attached to leaves or stems of plants. I have, however, succeeded in carrying fertile eggs through the winter in both 1938-1939 and 1939-1940. This result, coupled with the frequently observed fact that the adults die off in September and October, shows the eggs form the overwintering stage of this bug. Eggs laid in captivity from June to October invariably developed to a certain advanced embryonic state immediately, but failed to go beyond that level until the next spring. Preliminary tests show that eggs subjected to natural winter temperatures from October to February and March, hatched in a week or 10 days after being placed in a warm room and kept in an atmosphere of high humidity. A conclusive explanation of this remarkable diapause of 8 or 9 months in the egg has not yet been found.

In nature, the eggs probably hatch during May. This is indicated by the occurrence of nymphs in the third to fifth instars during June and July. In hatch-

ing, the nymph pushes a circular flat lid off the end of the egg, and sheds its embryonic skin either before it has entirely issued from the egg shell, or at once thereafter. The nymphal life embraces five instars. Twenty nymphs were reared in 1939. These required an average of 42.75 days to complete their development from hatching, through the five instars, to the adult form. The instars, from first to fifth, averaged 9.7, 8.2, 5.7, 7.25 and 12.0 days. Of the twenty nymphs, 15 became males and 5 females, and the average developmental period of the males was 3.54 days shorter than that required by the females.

Numerous field records of adults revealed the interesting fact that sexes underwent a significant seasonal shift in ratio of numbers. The daily total of males regularly exceeded the daily total number of females from July 8 to September 12, 1939. The ratio of male to female then vacillated on September 13 and 14, when after the proportion changed consistently in favor of the females over the males. From September 15 to October 20, the preponderance of females increased. This increase was somewhat gradual, and in this respect resembled the decrease in superiority of the males observed from July 8 to September 12. These changes in sex ratio signify that, on the whole, the males reach adulthood somewhat earlier in the season than the females, and that the males also die off somewhat before the females. This fact is in part traceable to the shorter time required for the development of male nymphs. For the season of adults as a whole, I recorded 1324 males and 1287 females,—an insignificant difference of only 37 in favor of the males.

This common ambush bug therefore completes a single generation in a year. The egg stage begins about mid-July and carries through the winter to May of the next year. The nymphs hatch in May, and all reach the adult form by mid-July. The adults occur from early July to October, when the cold frosty nights finish off a life of wholesale destruction of other insects at the hands of as clever a hunter as the animal kingdom knows.