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PRELIMINARY OBSERVATIONS ON THE COLONIZATION AND BIONOMICS OF THE CRAB-HOLE BREEDING MOSQUITO *DEINOCERITES PSEUDES* DYAR AND KNAB, 1909[1]

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The genus *Deinocerites* Theobald comprises a compact group of highly specialized little-known species of mosquitoes distributed from Florida, Texas and Baja California to northern Brazil and Colombia, including the West Indies. Until the review of the genus by Belkin and Hogue (1959), only four valid species and five nominal ones, considered synonyms of the former, were known. These authors revalidated two of the synonyms and described four new species. There are, undoubtedly, many more awaiting discovery.

Little is known about the bionomics of any of the species, as papers on the subject are mostly based on casual observations (Howard, Dyar and Knab, 1915; Fisk, 1941; Horsfall, 1955; Peyton *et al.*, 1964). To the writer's knowledge, none of the species have ever been colonized. Fisk (1941) observed mating in laboratory-bred couples of *Deinocerites mathesoni* Belkin and Hogue and apparently obtained a few eggs from F_1 females, but no F_2 progeny could be raised, probably due to lack of adequate oviposition containers. Peyton *et al.* (1964) working with *D. pseudes* D. and K. from Texas, attempted to colonize the species but were unsuccessful because of high adult mortality. All species that have been investigated to date breed by preference in the water held by various types of deep ground holes near the seashore, inhabited by land crabs belonging to several genera. Some are known to feed as adults on the blood of man and large mammals (Howard, Dyar and Knab, 1915). A single instance has been recorded of a species feeding on turtles in the laboratory (Fisk, 1941).

Until recently, there had been no reports on the potentialities of *Deinocerites* mosquitoes as vectors of human disease. The isolation of St. Louis encephalitis (SLE) virus in Panama (Grayson *et al.*, in manuscript) from a pool of *Deinocerites pseudes* females captured with human bait in the mangrove swamps just east of Panama City, has focused attention on the need for further investigations on the ecology and bionomics of the species.

D. pseudes was described from adults bred from larvae collected in crab-holes by A. H. Jennings near Ancon, Canal Zone, on the Pacific watershed of Panama. It has been reported along a narrow strip on the Pacific and Atlantic coasts of Middle America from eastern Panama north to Brownsville, Texas. In Panama it is very abundant in the extensive Pacific coastal flats which run almost continuously from border to border.

After the isolation of SLE virus from *D. pseudes*, plans were made to colonize it in the laboratory, in order to study the bionomics of the species and to have adequate material available for virus transmission experiments. Simultaneously, ecological observations were begun in the area of Nueva Gorgona, 55 kilometers southwest of Panama City. This publication presents results of colonization attempts, as well as preliminary observations on the bionomics of the species as studied in the laboratory and in the field.

Colonization of the Species

All colonization attempts were carried out in a room of the Rand insectary (Gorgas Memorial Laboratory) under

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controlled conditions of temperature, relative humidity and artificial daylight. Lights were kept on from hours 0730 until 1630 every day except Saturday and Sunday, when they were on from 0800 to 1200. Natural light was completely excluded. The room was maintained at a constant temperature of 76° F. and a relative humidity which fluctuated between 85 percent and 94 percent.

The first successful colony was established in an aluminum cage of 1 cubic foot capacity. The bottom of the cage is a solid aluminum sheet, the top and three of the sides are covered by aluminum screening, the fourth being provided with a cloth sleeve. This cage is sold by the Cornell Chemical and Equipment Co. of Baltimore, Maryland.

Fifty males and 50 females bred from larvae collected in crab-holes at Nueva Gorgona, province of Panama, were introduced into this cage. Food for adults was supplied by a slice of orange and a cotton wick soaked in sugar solution, both changed every two days. Females were fed blood by allowing them to bite a caged golden hamster (*Mesocricetus auratus*), hung day and night inside the cage. The oviposition container consisted of a hollow cylinder of plaster of paris, in effect a simulated crab-hole. It was made by coating inside and out a copper screen cylinder supported on a stainless steel frame, 8 inches long by 3½ inches in diameter. One end of the cylinder was placed inside a bowl of aged tap water, so that the bottom two inches of it were under water. Most mosquitoes seemed to prefer to rest inside the cylinder.

Due to pressure of other work, activity of the caged insects was not closely observed, although a week after being introduced some females were noted to have engorged on blood. Twelve days after the introduction of the adults, upon removal of the cylinder and the bowl, the water in the latter was seen to contain more than 300 first instar larvae. Many single, black mosquito eggs were seen attached to the plaster both on the inner and outer surfaces of the cylinder, with a large majority being inside and very close to the surface of the water. No eggs were seen in the water. Within a week, more than 500 larvae were removed from the bowl. These larvae were reared in the same insectary room in open white-enameled pans lined inside with a sheet of filter paper and were fed on ground-up Purina laboratory chow.

More than 300 adults were successfully bred out from these larvae. F_2 and F_3 generations were obtained in the same small cage as well as in a larger wooden cage measuring 2 feet on each side. This cage has a wooden bottom, the top and three sides covered with copper screening and the fourth with an upper glass window and a lower sliding wooden door covered with a cloth sleeve. The same system described above was used to obtain eggs from the F_1 and F_2 generations except that an immobilized guinea pig or chickens were used instead of a hamster as the source of blood. Most of the preliminary observations on the bionomics of the adults described below were made on the F_1 and F_2 generations within the large wooden cage.

PRELIMINARY OBSERVATIONS ON THE BIONOMICS OF *D. pseudes*

BITING HABITS OF FEMALES. In the colony, females begin feeding on blood from 4 to 5 days after emergence. They very seldom feed with the lights on, when most of them prefer to rest on the inner walls of the cylinder a few inches above the water surface. If disturbed, some fly out and rest on the floor and sides of the cage or of the cylinder, only to return to the inside of the cylinder soon after being left alone. Others refuse to fly out of the cylinder and merely walk rapidly over the inner surface of it. Females become active in subdued light and readily attack the immobilized guinea pig or chicken, engorging on blood within 3 to 5 minutes after introducing the proboscis.

In the field, 36 daylight and nocturnal

collections with human bait were made concurrently, from hours 1500 to 1730 and 1830 to 2100, near a prolific breeding place. Only 2 females were captured during the daylight collections, while 720 specimens attempted to feed during the crepuscular and nocturnal period of collecting. This confirms previous observations that the species is crepuscular and nocturnal in its feeding habits. In the laboratory, females feed readily on man, guinea pigs, golden hamsters and domestic chicks. In the field the author has taken more than 300 blood-engorged females in one night from a Magoon stable trap baited with a horse in the vicinity of a mangrove swamp.

It may also be observed from the human-baited collections mentioned above, that a total of 720 females were taken attempting to bite man during 90 man-hours of collecting, for an average of 8 mosquitoes per man-hour. The maximum number of specimens captured in a 2½-hour collecting period was 92. Peyton *et al.* (1964), reported similar observations with this species in Texas. It appears from these data that *D. pseudes* has a wide range of hosts and that man is readily attacked, both in the laboratory and in the field.

MATING BEHAVIOR. For the first 3 days after emergence adults remain quietly resting within the oviposition cylinder. Soon after this period is over, the first sexual activity is noted. When light intensity within the cage is decreased, simulating the crepuscular period of day, females fly out of the cylinder and come to rest on the floor and walls of the cage. Males become active and begin a hovering darting flight over resting females, each male selecting a member of the opposite sex over which to perform its prenuptial dance. Once this activity begins it is not deterred by increasing the light intensity.

The male hovers directly above and slightly forward of the female, often darting in and striking firmly with the midtarsi the extended hind legs of the female, first on one side and then on the other. If the female is not ready to receive the male, she merely flies off and comes to rest on another surface. The rejected male continues his darting flight in search of another mate. If the female is ready to accept the advances of the male, her hind legs are extended sideways and the male turns around and comes to rest on the surface directly behind and facing opposite the female, going immediately into copulation end to end. The pairs remain quietly *in copula* for variable periods, which extended from 4 to 15 minutes in eight instances in which it was carefully timed. The prenuptial activity in this species is reminiscent of the one described by Galindo (1958) for *Sabethes (Sabethoides) chloropterus* Humboldt, but the actual mating act differs markedly in these two species.

OVIPOSITION HABIT. In the laboratory, the first eggs are laid 5 to 6 days after a blood meal. They are laid singly, loosely attached to the surface of the plaster, from a few millimeters to several inches above the surface of the water, most of them being concentrated within 2 inches of it. Oviposition takes place at night and the actual act of egg-laying has not been observed as yet. Eggs are elliptical in shape and black in color, being very similar in structure to *Culex* ova.

HATCHING OF THE EGGS. Hatching occurs *in situ* from 48 to 60 hours after eggs are laid, without the need of raising the water level to cover them. Larvae breaking out of the egg-shell either drop or slide down the humid sides of the cylinder to the water below. Observations are now in progress to determine whether eggs have the capability to resist desiccation when attached to the plaster, since this would be one way to survive the long dry season typical of the geographical zone occupied by the species. Ecological investigations have also been scheduled for the dry season to determine whether larvae are obtained by flooding dry materials scraped from the sides of dried up crab-holes known to have contained adults

during the rainy season, and to find out if adults remain quietly in estivation deep within the lower reaches of the crab-holes.

IMMATURE STAGES. The larval cycle, from hatching of the eggs to pupation, lasts approximately 3 to 4 weeks at a constant temperature of 76° F. in the insectary. The pupal stage lasts 3 to 4 days.

LONGEVITY OF THE ADULTS. While we have no exact data as to the longevity of the adults in the insectary, it may be stated that at the temperature and relative humidity described above, mortality of females at the end of one month was less than 50 percent.

SUMMARY

A colony of *Deinocerites pseudes* Dyar and Knab, a crab-hole breeding mosquito, was established in the laboratory. This apparently constitutes the first successful colonization of a member of this genus ever reported. Preliminary observations on the bionomics of the species, as studied in the colony and in the field, are reported. These include mating activity, feeding habits of females, manner of oviposition and duration of larval and pupal periods.

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