THE OCCURRENCE OF *DEINOCERITES PSEUDES* DYAR AND KNAB IN THE UNITED STATES, WITH ADDITIONAL NOTES ON THE BIOLOGY OF *DEINOCERITES* SPECIES OF TEXAS[1]

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DISTRIBUTION. The genus *Deinocerites* Theobald is a small and unique genus of mosquitoes confined almost entirely to the American Mediterranean Region, that is, the intercontinental area of Central America and the West Indies and the adjacent parts of the North American and South American continents (Belkin and Hogue, 1959:418). *Deinocerites pseudes* Dyar and Knab has the widest range of all the known species in the genus. It has been reported on the Pacific Coast from the Panama Canal Zone north to Puerto Vallarta (Jalisco), Mexico, as well as on the Atlantic coast of the Panama Canal Zone and in Mexico from Vera Cruz northward along the coast to Tampico, just 250 miles south of Brownsville, Texas. Records indicate that all known species of the genus *Deinocerites* breed in brackish water in the holes of land crabs located along the coast.

Previous to this reporting, only two species of *Deinocerites* were recognized as occurring in the United States: *D. cancer* Theobald, reported only from Florida on the keys and on the southeast coast as far north as Volusia County (King *et al.*, 1960:127); and *D. mathesoni* Belkin and Hogue, reported only in the State of Texas along the Gulf Coast from Brownsville north to Corpus Christi (Belkin and Hogue, 1959:427).

TAXONOMIC DISCUSSION. Prior to the excellent work by Belkin and Hogue (1959) on the genus *Deinocerites,* there was some question as to the taxonomic status of species within this little-known group. It is very doubtful that the majority of species occurring outside of the United States could have been identified with certainty with the keys, descriptions, and illustrations then available. Only four valid species were recognized by most authors. Belkin and Hogue (1959) recognize eleven species in their paper and present some very excellent keys, descriptions, and illustrations of various stages for identifying all eleven species. All stages of *D. pseudes* taken in Texas appear to agree in detail with the descriptions and illustrations presented by Belkin and Hogue. The lower head-hair 6–C (designation of Belkin and Hogue (1959)) is a highly variable character in larval specimens from Texas. There also appears to be some variation in size in both adult and larval specimens collected in Texas. The identification of *D. pseudes* specimens collected in Texas has been verified by Dr. Alan Stone of the U. S. Department of Agriculture. Specimens have been deposited in the collection of the U. S. National Museum.

BIOLOGICAL DISCUSSION. The meager information available on the bionomics of *D. pseudes* is summarized in Belkin and Hogue (1959). The bionomics of *D. mathesoni* are quite extensively re-

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ported by Fisk (1941); but since *D. mathesoni* has been encountered so frequently in association with *D. pseudes* in our study area, we propose to discuss the biological relationships of the two species.

COLLECTION LOCALITIES. *D. pseudes* larvae and adults were first collected in the United States on 23 November 1963 approximately 21 miles east of Brownsville (Cameron County), Texas, along the banks of Stell-Lind Banco, a small lake formed by the changing channel of the Rio Grande River. The main body of the lake runs parallel to the river and is approximately 100 yards north of the Rio Grande at a point 2¾ miles west of Boca Chica, the mouth of the Rio Grande. The lower end of the lake is connected to the river by a narrow, shallow channel and at high tide the water from the river backs into the lake causing a rise in the water level by several inches. Larvae were taken from water contained in the holes of land crabs. Adults were taken in light traps operated during the evening of 23 November 1963.

Since the initial collection of *D. pseudes,* adults and larvae have been collected at several different localities, but all within the confines of an area bounded by the Rio Grande on the south, the Brownsville ship channel on the north, the Gulf of Mexico on the east, and extending up to 5¼ miles inland to the west. This is within an area commonly referred to as Boca Chica. The collections are represented by larvae from over 100 crabholes and by adults obtained with a variety of methods. Specific localities include: (1) an area around the lake; (2) a narrow, heavily wooded strip extending along the bank of the river 2½ miles inland from the west end of the lake; and (3) the Boca Chica beach, 1 mile north of U. S. Highway No. 4 and 200 yards west of the Gulf between the sand dunes. The greatest concentration of breeding is centered around the area of the lake.

The area of Boca Chica is a very interesting geographical area ranging in elevation from sea level to 15 feet above sea level. It is a contrast of small hills, low flat plains, salt marshes, and sand dunes along the beach. Trees are found only in small patches usually no more than 150 yards wide and only along the banks of the lake and the river. From the lake to the beach there are open flat plains, salt marshes, and no hills or trees. We were unable to find *Deinocerites* breeding in any of the open plains or salt marshes. The climate of Brownsville (Cameron County), Texas, is semitropical. The annual mean temperature is 77° F.; the average temperature in January is 61° F. and in July 83° F. Rainfall averages 27.62 inches, with most of it falling during the spring and fall.

Judging from the large number of larvae and adults collected from the Boca Chica area, it is not unreasonable to assume that *D. pseudes* has been established in the area for some years. It is almost certain that future collections will reveal a much wider distribution, both inland and to the north, than the area in which we have confined our present studies. *D. pseudes* has probably been overlooked by earlier workers in Texas, as well as other areas along the Central American coast, because of its highly specialized habitat, its restriction to coastal areas, and the assumption that this species is of no economic significance. Ideal ecological conditions exist along the coast of Mexico from Boca Chica south to Tampico; the occurrence of *D. pseudes* in Texas is probably a natural extension of range up the northern coast of Mexico.

However, the possibility of its being introduced into Texas cannot be ruled out until a thorough search for this species has been made in this area. The possibility of an introduction is strongly suggested by records provided us by Dr. Richard B. Eads of the USPHS Quarantine Station, Brownsville, Texas. In a personal communication with the senior author, Dr. Eads writes: "We recovered four specimens (including males) May 11, 1962, from a single engine plane arriving in quarantine from a fishing camp

north of Tampico, where the San Rafael River empties into the Gulf. This location is some 250 miles below Brownsville. The mosquitoes were dead, but only recently so. In 1963, we recovered nine *D. pseudes* from three oil tankers exclusively engaged in regular runs carrying crude oil from Coatzacoalcos and Tampico, Mexico, to Port Brownsville. The collections were: 6/13/63, two specimens; 8/1/63, three specimens; 8/5/63, one specimen; 10/23/63, two specimens; and 10/31/63, one specimen. As these ships do not go anywhere else, the mosquitoes had to be picked up in one of three above-mentioned ports. All nine were dead."

LAND CRAB ASSOCIATIONS. Although all known species of *Deinocerites* are reported to breed in the holes of land crabs, there are only three recorded cases in which a specific identification of the crabs has been given: Dyar and Knab (1915: 212) recorded *D. pseudes* from the hole of *Cardisoma crassum* Smith at Puntarenus, Costa Rica; Fisk (1941:543) recorded *D. mathesoni* (as *spanius*) from the holes of *Uca pugilator* (Bosc) at Brownsville, Texas, and King *et al.* (1960: 127), records *D. cancer* from the holes of *Cardisoma guanhumi* (Latreille) in Florida.

D. pseudes has been collected in Texas from the holes of: the fiddler crab, *Uca subcylindrica* (Stimpson), located along the banks of Stell-Lind Banco and the Rio Grande; *Cardisoma guanhumi* (Latreille) in the sand dunes of Boca Chica Beach and *Gecarcinus lateralis* (Freminville) in the sand dunes of Boca Chica Beach and along the banks of the lake and the Rio Grande. *D. mathesoni* has been collected from the holes of *Uca subcylindrica* and *Gecarcinus lateralis* only along the banks of the lake and the Rio Grande. The two large land crabs, *Cardisoma* and *Gecarcinus* are the common land crabs of the Western Atlantic; both have extensive ranges through the Caribbean and are most commonly found in association with *D. pseudes*. The smaller fiddler crab, *Uca subcylindrica,* is known only from Texas and Mexico and is most commonly found in association with *D. mathesoni*. Holes of *Gecarcinus* and *Cardisoma* are numerous throughout the areas described, but *Uca* appears to be the predominant crab from the Gulf inland to Brownsville. Identification and distribution of land crabs collected in association with *Deinocerites* in Texas were provided by Dr. Raymond B. Manning, Division of Marine Invertebrates, U. S. National Museum.

METHODS. Crabholes were examined for the presence of larvae by inserting a long flexible rubber hose into the hole. Water was then drawn through the hose by attaching a 3-ounce syringe with rubber bulb to the open end. The hose was not withdrawn from the hole until the collection was completed. Each syringe full of water and larvae was detached from the hose and emptied into an automatic separator. In some holes the depth of water level was so great the rubber bulb did not have sufficient suction to lift the water to ground level. Standard equipment for examining crabholes is normally a rubber hose and bulb; but because of great quantities of water and depth of some of the holes, it is now recognized that this technique is a very poor one. Much valuable time could have been saved for locating and examining new breeding areas had some type of automatic siphoning device been available for use.

Some typical crabholes were dug out to study the structure of the holes and for the possible recovery of eggs and host crabs. Mud scrapings from the sides of the holes were later flooded in the laboratory.

All larvae collected in the field were transported to the laboratory and reared in the water from crabholes at a constant temperature of 70° F. and a relative humidity of 80 to 90 percent.

Adult activities were studied by the employment of CDC miniature light traps, standard New Jersey light traps, a modified Shannon trap, crabhole traps,

and biting collections. The light traps were placed into operation at sunset and checked the following morning. The crabhole traps (Evans, 1962:255) were placed over the crabholes prior to sunset, checked at hourly intervals until midnight, and then checked once the following morning after sunrise. Biting collections were made during the periods of sunset to midnight. Fully engorged females were captured individually in shell vials for possible recovery of eggs. The vials were provided with 1 inch of moist absorbent cotton with a circular filter paper in the bottom and a gauze-covered cotton plug for the top. An attempt was made to colonize *D. pseudes* but because of a high adult mortality the effort was unsuccessful.

LARVAL HABITATS. Many collectors expect to find *Deinocerites* breeding only in crabholes located very near the seashore or in salt marshes where they are directly affected by the tides and contain moderately to heavily brackish water. It is generally true that most species do occur under these conditions, but the distribution and habits of the host crabs probably have as great an influence on the distribution of the mosquito as does any other single factor. It has not been definitely established that brackish water has any influence on the female mosquito when selecting a hole for oviposition. Apparently several collections have been made from crabholes where it was assumed the water in them was fresh. However, as far as we can determine, where actual chemical tests have been made on the water from crabholes containing *Deinocerites,* the water has been shown to be brackish. Dyar and Knab (1915:212) give accounts of *D. pseudes* being collected in Central America from crabholes near the shore above tide overflow, but sometimes a considerable distance from the shore and also from a hole on a hillside. They further state that the water in these holes must have been nearly if not quite fresh. Fisk (1941) collected *D. mathesoni* from crabholes some 20 miles inland near the municipal airport at Brownsville, Texas. Holes made by these small fiddler crabs of the genus *Uca* are very common around the city of Brownsville. A pooled sample of water taken by Fisk (1941:547) from several crabholes in this area showed a soluble chloride content of 8,430 parts per million. This reading is within the range of moderately brackish water (Anonymous, 1962). Colorimetric pH determinations made on water from crabholes containing *D. mathesoni* showed pH values of 7.2 to 7.6 (Fisk, 1941:547).

Chloride determinations by the automatic titration method, utilizing the "Chloridimeter," were made on several samples of water from crabholes containing *D. pseudes* and *D. mathesoni* in the Boca Chica area. With the exception of crabholes in the sand dunes on the beach the samples are representative of the areas where we have found larvae of these two spcies. They were taken from a few feet to several yards away from the edges of the lake and the river. Test of the various samples from crabholes showed a total chloride content of 1,115 to 2,603 parts per million, with most showing above 1,700 parts per million total chlorides. A test made on a sample of water taken from the lake showed a total chloride content 2,603 parts per million. Results indicate that the samples tested were within the range of mildly brackish water; however, the lowest reading very closely approaches the classification of fresh water (Anonymous, 1962). Colorimetric pH determinations made on these samples also showed pH values of 7.2 to 7.6.

All of our larval collections were made from crabholes well above overflow of the tides, lake and river. As we have indicated, some of these holes were near while others were some distance away from these water sources. Only around the lake does it appear that the tides may have an indirect effect on the water in the holes. The water level in most of the holes appears to equalize with the level of the lake. The chloride content of the holes corresponds rather closely with the chloride content of the lake,

some having exactly the same amount as the lake but none with a higher amount.

The inland crabholes are constructed in very tight soil and are situated well within the protection of trees and underbrush. Water level in the holes averaged from 4 to 5 feet below ground level, but in a few holes encountered the water level was greater than 7 feet. A close examination of a typical 3½ inch diameter hole dug to a depth of 6 feet revealed a slightly curved hole of uniform size and no significant chambers below the surface of the ground. The water level in this hole was 4 feet below the surface of the ground.

Crabholes containing *D. pseudes* larvae during the month of December 1963 were situated between the sand dunes on the beach in the open with no protection other than a few weeds, grass, and the surrounding sand dunes. The holes were constructed in very loose sandy soil and the slightest touch would cause them to crumble and fill up. The depth of the holes was no greater than 2 feet and the water level was approximately ground level. In diameter these were some of the largest holes encountered in our studies, some having openings of 8 inches or more. Numerous fourth instar larvae could be observed suspended from the surface of the water. These holes could have been filled only by recent heavy rains, evident because of several standing pools of water in low depression areas. We returned to this area several times during the months of February and March and found no further evidence of *Deinocerites*. The holes were either dry or filled with sand.

In some areas examined around the lake, crabholes were so numerous that many were only inches apart. All holes containing water and of ¾-inch in diameter or more were almost certain to have larvae of either *D. pseudes* or *D. mathesoni*. The majority of holes would usually have both species in association. Even though the two species are commonly found in association, each has a definite preference of size hole. *D. pseudes* prefers holes of 2 inches or larger in diameter while *D. mathesoni* prefers the smaller holes of ¾ inch to 1¼ inches in diameter; occasionally larvae of this species can be found in holes of ½ inch diameter. *D. mathesoni* can be found in holes of all sizes in a greater or lesser number; but *D. pseudes* was never found in holes under ¾ inch in size, and only an occasional specimen has been taken from holes of ¾ inch size. In the intermediate size holes 1¼ to 2 inches in diameter both species are apt to occur, often in almost equal numbers but occasionally with one or the other predominating. However, if collections are made from holes within the preference range noted, that species will almost always predominate and it is within these ranges that pure populations of one or the other species can be found.

Although *D. pseudes* and *D. mathesoni* breed almost entirely in holes made by land crabs of the families Gecarcinidae and Ocypodidae, we have two records of *D. pseudes* in other than crabholes. One collection was made on 16 December 1963 from an open sunlit grassy pool in a low depression between the sand dunes on Boca Chica Beach. There was one large crabhole approximately 8 inches below the surface of the water, and one fourth instar larva was observed emerging from the hole as the crab emerged; however, other fourth instar larvae were collected in the pool several feet from the hole in association with three other species of mosquitoes. All *D. pseudes* larvae collected from this pool were very active and did not appear to be affected by the direct sunlight. Temperature of the water in the pool at the time of collection was 54° F. We did not make a chloride determination on the water from this pool, but because of its location and proximity to the beach, we assumed that it was brackish. Similar type collections have been recorded for *D. cancer* by Dyar and Knab (1915) and Thurman *et al.* (1949). Although the collection is of interest to note, it is only logical to assume that this is not a natural habitat

and that either the larvae or eggs were in the large crabhole prior to inundation by the pool. The other record made available to us through Dr. Richard B. Eads (1964) consists of 5 larvae collected on 13 July 1963 from a treehole in Tecolutla, State of Vera Cruz, Mexico. It is understood this was a treehole very near the seashore. Since larvae seem to fare quite well in the type of habitats described, adult selectivity would appear to be the factor chiefly responsible for the restriction to crabholes.

DEVELOPMENT. All observations on the development of *D. pseudes* were made from larvae collected in the field. The complete life cycle requires from 2 to 2½ months. The length of the pupal stage is from 7 to 8 days. Fourth instar larvae collected during the latter part of November and December required more than two months to pupate, whereas fourth instar larvae collected in March pupated within 30 days or less. The winter cycle appears to be longer; but since no first instar larvae were taken during the winter months, the winter cycle cannot be accurately determined. Water temperatures in the holes during the winter ranged from 50 to 70° F. on days checked. Larvae averaged 40 to 50 per hole but some holes were obviously overcrowded. From the 3½ inch diameter hole reported as dug out, a total of 638 fourth instar *D. pseudes* larvae were taken. This overcrowding probably explains the occasional variations in size noted in specimens from Texas. All adult *D. pseudes* emerging in the laboratory were very fragile and usually died within 4 hours of emerging and none lived over 24 hours. Adult *D. mathesoni* reared in the laboratory under the same conditions as *D. pseudes* were very hardy and lived for many days even without an offering of food.

MOSQUITO ASSOCIATIONS. Apparently no other species of mosquito has adapted to breeding in crabholes in Texas and we know of no recorded association of *D. pseudes* or *D. mathesoni* larvae with other species in crabholes. As with other species with highly restricted habitats, associations with other species are infrequent. We encountered *D. pseudes* in association with *Aedes sollicitans* (Wlk.), *Culex salinarius* Coq., and *Culiseta inornata* (Will.) between the sand dunes of Boca Chica Beach in the flooded area described earlier in this paper. Two large crabholes in the same general area with the water level near the surface of the ground had fourth instar larvae of both *D. pseudes* and *C. inornata*. One pupa and fourth instar larva of *A. sollicitans* were recovered in March 1964 from a small crab hole 1 inch in diameter near the Rio Grande River. The ground surrounding the hole was low and dry. The water level in the hole was approximately 2 feet below the surface of the ground. No *Deinocerites* were recovered from this hole. As we have stated earlier we regard the association of these additional species to be accidental, probably resulting from flooded conditions previous to our collections. Each of the three above named species has been known to breed in brackish water.

SEASONAL OCCURRENCE. Our studies of the seasonal occurrence of *Deinocerites* in Texas cover the period November 1963 through March 1964 inclusive and are therefore incomplete. From these studies and other available records, however, we conclude that in areas such as around the lake, where a constant source of water is available, adults and larvae occur throughout the year. In areas where the principal water source is rainfall, as in the sand dunes of Boca Chica Beach, adults and larvae occur only during spring and fall, and the ensuing dry periods are passed in the egg stage. Peak populations probably occur in all areas during late spring and fall. During the winter months, the period of development for the immature stages is retarded or prolonged and a corresponding decrease in adult population occurs. Eggs laid during fall and winter do not begin to hatch until late winter or early spring.

Collection records (including nearby Mexico localities) for *D. pseudes* are: adults, every month except April and September; larvae, July and November through March inclusive. Texas records for *D. mathesoni* are: adults, every month except May, June and July; larvae, September and November through March inclusive.

Late in November 1963, when larvae of *D. pseudes* and *D. mathesoni* were collected at Boca Chica, only fourth instar larvae were present in the holes. No first instar larvae were noted until mid-February 1964. An increase in the number of first instar larvae was noted in March, and during this month they were as numerous as fourth instar larvae. Larvae of *D. pseudes* were more numerous than larvae of *D. mathesoni* from November to February. Both species were rather evenly represented in the newly hatched larvae during February and March.

The number of pupae per hole during the winter months was very low. In a typical hole containing 100 to 300 fourth instar larvae, never more than 3 pupae were recovered and in several cases none were recovered. A gradual increase in the number of pupae per hole became apparent during early March. An increase in the number of pupae in larval collections being reared in the laboratory was also noted during March through mid-April.

Adult populations corresponded closely with the number of pupae per hole during November through March. In November the adult population was higher than in any other month. A decrease in adults was noted from December through February and a gradual increase was noted in March. In November, adult catches per light trap averaged 15 to 20 during favorable weather conditions, and in one night's operation with a modified Shannon trap, over 100 were recovered. Trap collections during December through February were represented by 2 to 6 adult *Deinocerites* per trap. Adult collections with the crabhole traps were represented by maximum catches of 6 *Deinocerites* per hole. The average catch per hole was 2. No noticeable increase in adults per hole occurred during March.

MATING HABITS. No mating of *Deinocerites* in Texas was observed. It has been reported that the males of *D. pseudes* form mating swarms above the crabholes in the evening (Dyar and Knab, 1915).

FEEDING HABITS. Little is known of the feeding habits of *Deinocerites*. There are scattered reports of occasional attacks on man by three species of *Deinocerites*. There are no reports of *D. pseudes* or *D. mathesoni* feeding on man. It has been generally assumed that the majority of species of *Deinocerites* either take no blood or feed on reptiles and amphibians (Belkin and Hogue, 1959:416). There are several reports of *D. pseudes* being attracted to horse-baited traps: in Costa Rica (Kumm *et al.*, 1940:392), in El Salvador (Kumm and Zuniga, 1942:406) and in Panama (Carpenter and Peyton, 1952:677 and Blanton *et al.* 1955:41 as *Deinocerites* spp. in part). Recognizing the presence of previously unreported species and the inadequacies of existing keys and descriptions of *Deinocerites* in Panama, Blanton *et al.* (1955) elected to report the 2,195 specimens collected from horse-baited traps as *Deinocerites* spp. The senior writer of the present paper personally examined the majority of the specimens reported from Panama and recalls a number of these being represented by *D. pseudes*.

Our observations on *D. pseudes* in Texas indicate that the females will readily feed on man. We have encountered *D. pseudes* biting on several occasions during the hours from dusk to midnight. We have made no observations from midnight to sunrise. Four *D. pseudes* were also taken in the act of biting, at twilight, on the same date and location as that reported earlier for the larval collection from a tree hole in Mexico (Eads, 1964). Biting activities appear to be greatest from dusk to two hours after darkness

with only an occasional specimen biting during the later hours. The females are vicious biters and begin feeding almost immediately upon alighting. There appears to be a minimum of probing or hesitation in the act of biting. They have no areas of preference upon the body and will attempt to feed even through clothing. The female does seem to require a little longer than normal to engorge completely, usually requiring from 3 to 5 minutes. The most unusual observation made on the feeding habits of this species is that pain is felt only during the first 30 seconds of feeding and thereafter no irritation is noticed.

Our first encounter with *D. pseudes* biting was on the evening of 25 November 1963. While operating a modified Shannon Dawn Trap near the lake at Boca Chica, the collectors inside the trap became annoyed by the persistent biting of this species. It suddenly became apparent that the three collectors working in and around the trap were the attractant and not necessarily the light from the trap. The trap was placed out of operation and a biting collection was then made. In a period of approximately 20 minutes 60 females were taken in the act of biting. No further biting observations were made until the middle of December 1963 at which time there appeared a sharp decline in biting activities. Subsequent observations were made off and on through March 1964. The number of biting adults collected during the winter months averaged around 10 for an effort of an hour or longer. These decreased activities correspond with other observations we have made on the occurrence of *D. pseudes* adults during the winter months. A slight increase in activity was noticed during March.

The biting activities of *D. pseudes* are apparently dependent upon some rather complex atmospheric conditions. We have attempted to determine some of the factors influencing their biting activities, and we conclude that *D. pseudes* will not bite during clear moonlit nights or during periods of moderate wind even within the protection of trees. Optimum conditions include dark nights (preferably cloudy or overcast) with a very mild breeze. During very cloudy nights and low wind, females will begin to feed as early as the hour of sunset. A combination of the factors which appear necessary to induce the females of this species to bite are uncommon in the area of Boca Chica, Texas. There are strong winds during most of the year with only intermittent periods of calm during the evening hours. Even so, during clear bright nights or strong winds, biting collections and trap collections were always negative. Temperature apparently is not a factor since females have been taken biting during very cool nights as well as warm nights. Wood rats of the genus *Neotoma* Say and Ord are probably another source of blood for this species since nests of this rat are quite numerous in the breeding area and many large crabholes with heavy breeding are located within inches of these nests.

Although adults of *D. mathesoni* were consistently taken in light traps and crabhole traps, none were ever taken biting.

EGG LAYING. Nothing is known of the egg laying habits of *Deinocerites* except to say that the eggs are laid in crabholes. However, Dyar and Knab (1915:205) surmise that the eggs are apparently laid singly on the sides of the holes and that dry periods are probably passed in this state. Fisk (1941:547) recovered a few eggs of *D. mathesoni* from females being reared in the laboratory. This is the only known record of egg recovery from *Deinocerites*. All attempts to recover eggs from *Deinocerites* collected in Boca Chica, Texas were unsuccessful.

FLIGHT AND RESTING HABITS. Species of *Deinocerites* in Texas have a relatively short flight range and activities are usually restricted to the immediate vicinity of their breeding sites. In each instance where adults have been taken in light traps we have been able to search out nearby breeding. During daylight, it is difficult to persuade an adult to fly more

than a few inches indicating, as some observers surmise, that they are weak fliers, but this habit appears to be more of a reluctance to fly in daylight than the ability to fly. Observations made during the hours of darkness indicate that they are relatively strong and proficient fliers. This unusual habit is probably explained by the fact that the entire life cycle of this mosquito is usually passed in total darkness and the flight habits have adapted accordingly, yet they appear to be readily attracted to light traps at night.

During periods of inactivity the adults rest in the upper portions of the holes above the water level. It is very difficult to drive adults from the holes during daylight. Inserting a stick or blowing smoke into the holes will drive an occasional adult out. When out of the hole, the adult will alight on the ground, never more than a few inches from the hole. If undisturbed it will return to the same hole or a nearby hole almost immediately. Adults possess the phenomenal ability to walk or crawl as well or better than they can fly and they are quite proficient crawling forward, sideways, or backward. This ability has probably been adapted through the mosquito's association with the crab and enables the mosquito to avoid the crab when the crab enters or leaves the hole. This fact can be appreciated when it is realized that in many cases the crab almost completely fills the hole. We have observed the crawing habits of these mosquitoes in the field and in the laboratory. In one experiment lasting several hours, an open quart jar three-fourths filled with crabhole water and with a few adult *Deinocerites* was placed outside in the laboratory. The adults were constantly teased with a wooden applicator. The slightest touch or movement near the legs or the extremely long antennae would cause them to crawl in the opposite direction. Only an occasional wing vibration was noted and none of the adults attempted to fly from the jar.

Our use of the crabhole traps indicates that the adults begin to leave the holes after sunset. On very cloudy days they will leave the holes a few minutes before the hour of sunset. All adults do not leave the holes at the same time. We have collected adults in the crabhole traps every hour from sunset to midnight and on several occasions, traps that were negative at midnight contained several adults the following morning when checked. Crabhole trap results were also used to evaluate adult activities during varying weather conditions, and the conditions influencing the trap collections were essentially the same as those described for the biting observations. Both species of *Deinocerites* were represented in the crabhole trap collections. As in our larval collections, adults of *D. mathesoni* were more common in the smaller holes and adults of *D. pseudes* were more common in the larger holes. Males and females were evenly represented in the crabhole trap collections.

ECONOMIC IMPORTANCE. Species of *Deinocerites* in Texas are of no apparent economic importance. Only *D. pseudes* could be considered of potential importance and then, only in the immediate neighborhood of its limited habitat.

SUMMARY. Adults and larvae of *Deinocerites pseudes* Dyar and Knab were first collected in the United States in November, 1963 approximately 21 miles east of Brownsville (Cameron County), Texas. *D. pseudes* is commonly found in association with *D. mathesoni* Belkin and Hogue in crabholes, yet each appears to have a definite preference of size hole; *D. pseudes* prefers holes of 2 inches or larger in diameter while *D. mathesoni* prefers holes of ¾ to 1¼ inches in diameter. Larvae of *D. pseudes* were taken from the holes of the land crabs, *Uca subcylindrica* (Stimpson), *Gecarcinus lateralis* (Freminville) and *Cardisoma guanhumi* (Latreille). Larvae of *D. mathesoni* were taken from the holes of *Uca subcylindrica* and *Gecarcinus lateralis*. The complete life cycle for both species appears to be from 2 to 2½ months.

The winter is passed in all stages, but a marked reduction in pupae and adults occurs during the colder months. The period of development of the immature stages is prolonged during the winter. Hatching of eggs in the field occurred during late February and early March. Females of *D. pseudes* will readily feed on man and on occasion can be quite annoying in the immediate breeding area. Adults of both species appear to be nocturnal in habits and each shows a reluctance to fly in daylight. Both species have been collected in light traps. Crabhole traps as described by Evans (1962) proved to be quite useful in studying adult activities and are an excellent tool for the collection of males.

ACKNOWLEDGMENTS. The writers are indebted to the following persons from the Department of Preventive Medicine, Medical Field Service School (MFSS), Brooke Army Medical Center, Fort Sam Houston, Texas, for their support and encouragement during the many hours spent on this project. Of special note are: Lt Col John H. Painter, Director, Department of Preventive Medicine; Lt Col Alvin A. Therrien, Entomologist, formerly Chief, Entomology Branch; Maj Vernon J. Tipton, Entomologist, present Chief, Entomology Branch; and 1st Lt Robert L. Gantenbein, Sanitary Engineer, Chief, Applied Preventive Medicine Branch. Thanks are extended to Pfc Michael G. Contompasis of the Enlisted Preventive Medicine Branch, Department of Preventive Medicine, MFSS, and personnel of the Biochemistry Branch, Department of Pathology and Laboratory Science, MFSS, for performing chemical analysis on the water samples reported. We are grateful to Dr. Richard B. Eads of the U. S. Department of Health, Education, and Welfare, USPHS Quarantine Station, Brownsville, Texas, for supplying us with unpublished records of the quarantine service; and to Dr. Alan Stone, U. S. Department of Agriculture, for confirming the identification of *D. pseudes*, assisting in obtaining identification of the land crabs, and for his suggestions and editorial comments.

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