NEW DISTRIBUTION AND HABITAT RECORDS OF BITING MIDGES AND MANGROVE FLIES FROM THE COASTS OF SOUTHERN BAJA CALIFORNIA, MEXICO (DIPTERA: CERATOPOGONIDAE, CULICIDAE, CHIRONOMIDAE, AND PHORIDAE)[1]

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ABSTRACT: *Megaselia minutior* Borgmeier (Phoridae) is reported here for the first time for Baja California. At least in the spring months, *Culicoides furens* (Poey) (Ceratopogonidae) is the commonest biting midge around Isla San José, Bahía Balandra and neighboring sites. It was found breeding around the aerial roots of the mangrove *Avicennia nitida* in swamp mud and burrows of the crab *Sesarma sulcatum. Smittia* sp. (Chironomidae) and an apparently undescribed species of *Dasyhelea* (Ceratopogonidae) were collected from the same habitat on Isla San José. We present also some quantitative results for *C. furens* from emergence traps and preliminary behavior experiments. *Deinocerites mcdonaldi* Belkin & Hogue (Culicidae) was found breeding in burrows of the crabs *Cardisoma crassum* and *S. sulcatum* at several sites north of La Paz; these records extend the known northern limit for its distribution.

In separate and unrelated field trips along the southern coasts of the peninsula of Baja California, Mexico, the authors have collected species of biting midges and other Diptera associated with mud flats and mangrove vegetation. In citing these collections, this paper adds several species to the region's fauna and new information of their ecology.

Cheng's work has centered mainly on Isla San José, a small island about 26 Km long and 3-10 Km wide, situated in the Gulf of California off the coast approximately 90 Km NNW of La Paz. At the southern end of the island there is a rather extensive tidal lagoon, covering an area of 5-8 Km^2 and surrounded by mangrove swamps. The mud flats associated with the mangrove swamp provide ideal breeding grounds for biting midges of the family Ceratopogonidae.

Since these midges have constituted quite a nuisance to human visitors, including members of Scripps Institution of Oceanography expeditions to the area, and since no information on the

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biting midges of Baja California could be found in the literature other than the brief citations of Ryckman and Ryckman (1963), a one-week expedition was made to the island in the spring of 1972 (15-22 April), on the R/V DOLPHIN to collect specimens and to investigate their ecology.

Hogue's contributions derive from a reconnaissance by boat along the entire western coast of the peninsula and two excursions to the vicinity of La Paz. The former was conducted in March of 1966 from the private vessel SEA QUEST. Hogue visited all bays and lagoons likely to support mangroves and populations of land crabs whose burrows often contain larvae of biting midges and mosquitoes. These landing sites, with dates, in 1972, included Bahia Tortola (=B. Bartholome' - 8 March), Bahía de Ballenas (9 March), Laguna San Ignacio (10 March), Bahía Magdalena (11-13 March), and Laguna Saltea, San Jose del Cabo (15 March). In later excursions he concentrated on the small bays (primarily Bahía Balandra) on the west shore of the peninsula north of La Paz in June of 1968, and in September of 1969 on Isla Espíritu Santo (Bahía San Gabriel), and a small estuary west of Todos Santos (Punta Lobos).

MATERIALS AND METHODS

Cheng's Studies

Most of the samples were collected from the mangrove swamp at the southern end of Isla San José; several additional samples were collected from a saltern at the northern end. Adult midges were collected with conventional sweep nets, or were aspirated from human skin or caught in specially devised emergence traps made of galvanized iron in the form of a box top, 10cm deep, with an area of $0.5m^2$. Each trap had two glass vials screwed into diagonally opposed corners (Fig. 1). Twelve such traps were set at approximately 1-meter intervals in two transects in different areas of the southern mangrove swamp. Traps 1-5 were set on sandy beaches between high- and low-water level around low bushes of *Rhizophora mangle*, traps 6 and 7 on a muddy bank below high-water mark in the same area, and traps 8-12 between high- and low-water levels on muddy flats around aerial roots of *Avicennia nitida*.

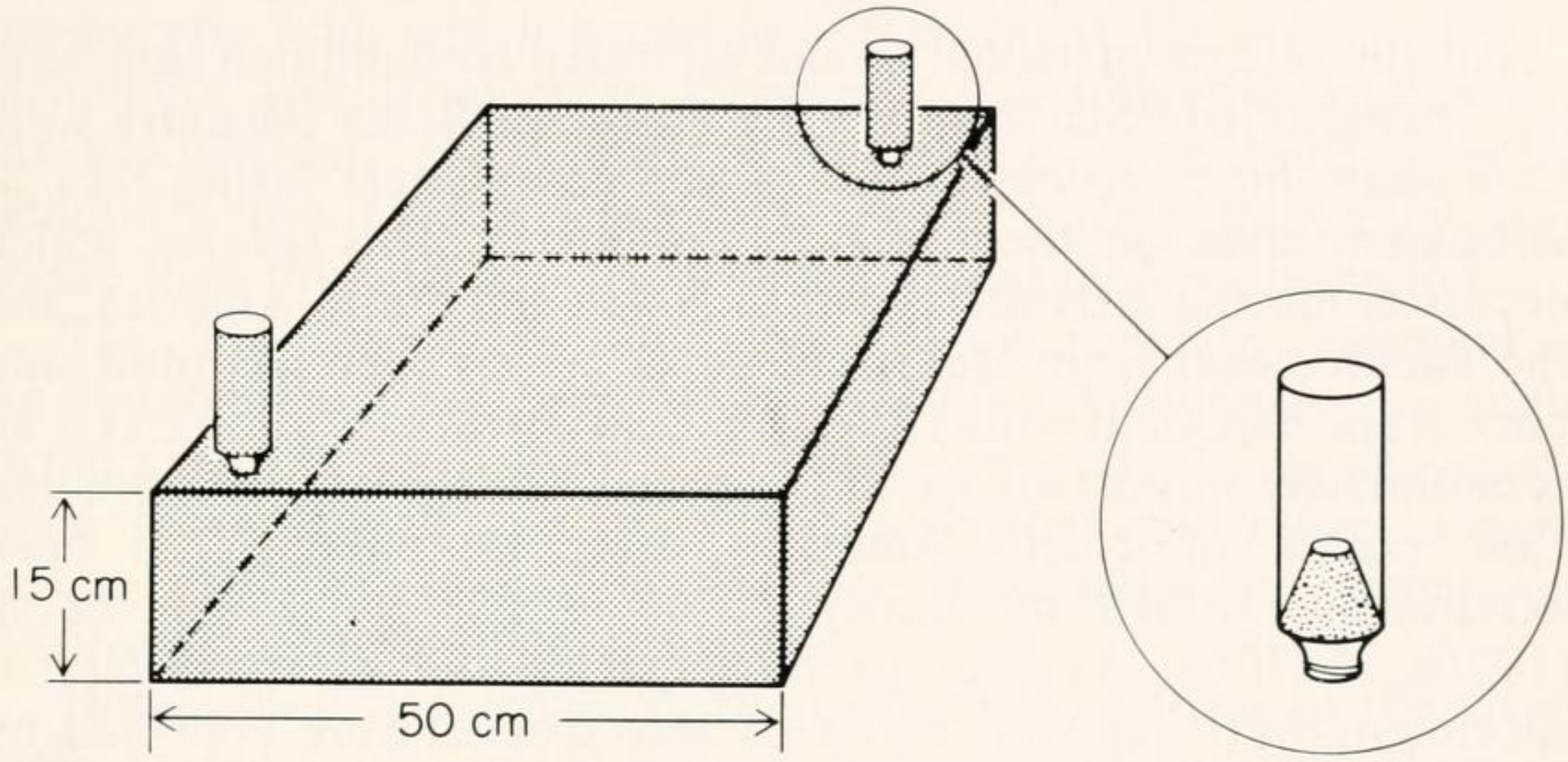

Figure 1. Schematic Diagram of Emergence Trap Showing Positions of Two Screw-Cap Vials in Situ. Each Vial Has a Plastic Cone Glued Into the Opening.

During the first two days vials were emptied four times daily: at 0800, 1200, 1600 and 1800 hours; after it was found that few flies emerged in the afternoons, the vials were emptied only twice a day: at 0800 and 1200 hours.

Mud samples taken from cores made at specific areas in the midge-infested mud flats were kept in the laboratory for over 30 days, during which time various midges and other insects emerged.

In addition, several short experiments were carried out to study the behavior of the biting midges in the field, using variously colored sheets of paper ($\sim 1 m^2$) sprayed with "tanglefoot"* (a non-drying adhesive similar to that used on ordinary fly-paper).

Hogue's Studies

Hogue's collecting was restricted to the vicinity of burrows of land crabs (*Sesarma sulcatum* and *Cardisoma crassum*). Adult flies were collected from burrow mouths and human skin; water samples containing larvae and pupae were taken with a bottle pump (described by Belkin et al., 1965).

*The Tanglefoot Co., Grand Rapids, Michigan

RESULTS

Culicoides, Ceratopogonidae

All the midges attracted to and aspirated from human skin both by Cheng at Isla San Jose' and by Hogue at Bahia Balandra were *Culicoides furens* (Poey), one of the commonest biting flies of salt-marsh areas on the American continents. This species, which occurs along the Atlantic coasts of North and South America, and the Pacific coast from Mexico to Ecuador, has been recorded only once from Baja California (Ryckman and Ryckman, 1963). It is an economically important species, especially in the southeastern and Gulf coasts of North America where its biology has been extensively studied by Linley (1968, 1969) and Linley et al. (1970a, 1970b). As was to be expected, all of the aspirated specimens were females. Males of this species were collected by sweeping a net through midge swarms flying over flowering branches of the *Avicennia* or from emergence traps.

The mud samples collected by Cheng from both ends of the island yielded biting midges of only two species: *Culicoides furens* and *Dasyhelea* sp. (evidently a new species: Wirth, personal communication). Adults of both species were found to emerge from only the top 3cm. *Culicoides mojave* Wirth, a second anthropophilic species known from the area (Ryckman and Ryckman, 1963) was not found.

In general, adult ceratopogonids were caught only in the traps placed amongst the aerial roots of *Avicennia.* The flies caught in traps 8-12 were of particular interest to one of us -Cheng- since they had emerged in presumably one of the biggest and most accessible breeding grounds of biting midges on Isla San Jose'. *C. furens* emerged only from the three upper traps, not from the two lower ones where the mud surface remained submerged except during low spring tides. *Dasyhelea* emerged only from the lowermost trap. These results probably reflect differences in the larval ecology of the two species.

Out of 97 trapped flies, 77 emerged during the morning hours; the rest emerged during the afternoons or at night. More individuals emerged on warm sunny days, and none were trapped on the only overcast, cool day during the experimental period.

The results of the few simple experiments designed to study possible color and odor preferences of the adult female biting

midges indicated that they prefer red and orange to green, white or black surfaces, and are more attracted to surfaces sprayed with iso-butyric acid, which occurs in human sweat, but are repelled by propionic acid. They were apparently less active on cold, windy days when one could work a few meters from their breeding ground without being bitten; whereas on warmer days they soon made their presence felt for several hundred meters downwind.

The adult males of the same species generally swarmed in sheltered areas above branches of *Avicennia.* Very few were caught from above exposed bushes, and none were caught on any windy day. Obviously more extensive observations and more sophisticated experiments are needed to understand the biting and swarming behavior of these insects.

Hogue took one female *C. furens* from the burrow of the marsh crab *Sesarma sulcatum* at Bahia Balandra on 11 June 68. There are no previous records of this species breeding in land crab burrows, although the habit is well known for several other species of *Culicoides* (Bright and Hogue, 1972: 44-45). Larvae of an unidentified *Culicoides,* collected by Hogue from burrows of *Sesarma* (possibly *magdalensis*) at Howland's Lagoon (north of Puerto Magdalena in Magdalena Bay – 11 March 66), may be of this species or *C. alahialinus.* The latter was collected for the first time north of Panama by Hogue, from holes of *Sesarma sulcatum,* in association with *C. furens* at Bahía Balandra (W.W. Wirth, personal communication).

Deinocerites, Culicidae

Hogue found a thriving population of *Deinocerites mcdonaldi* Belkin & Hogue in the burrows of the mouthless crab, *Cardisoma crassum,* at Laguna Saltea, near San José del Cabo (15 March 66), confirming a previous record of Downs (Adames, 1971: 82). This had been the most northerly point of the genus' known range on the Pacific Coast. Since that collection, however, Hogue and Bright found the same mosquito breeding in burrows of *C. crassum* and *Sesarma sulcatum* still further north: on the west coast at Punta Lobos, near Todos Santos (19 September 69), Bahía San Gabriel on Isla Espíritu Santo (17-18 September 69) and Mulege (mouth of Arroyo San Gregoria; D. Bright, collector; 31 August 71).

The association of *Deinocerites* with land crabs, *Cardisoma, Ucides* and *Uca,* is unquestionably specific or obligatory (Bright and Hogue, 1972: 3-4, 38). For this reason we would not expect the mosquito to occur very far north of Todos Santos along the outer western coast of the peninsula, because the prevailing cold surface current flowing southward carries the planktonic crab larvae in the opposite direction. In fact, Hogue found neither *C. crassum* nor *Deinocerites* in *Sesarma* burrows north of there.

Other Diptera

Possibly the most important record of a non-biting fly (caught in one of Cheng's emergence traps) was the phorid, *Megaselia minutior* Borgmeier, kindly identified for us by Dr. W.R. Robinson. It is known from the western United States, but has hitherto not been recorded from Baja California (W.R. Robinson, personal communication). In addition, some non-biting chironomids of the genus *Smittia* emerged from deeper samples of mud, collected 3-6cm below the surface at the southern end of the island.

A summary of the trap emergence data for the four major dipteran genera is presented in Table 1.

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Hogue's appreciation is extended to Mr. Richard Dwyer, Los Angeles, owner and captain of SEA QUEST, for making it possible for Hogue to survey the west coast of the peninsula. During the latter's trips, in company with Dr. Donald B. Bright and Carlos Villalobos, facilities and assistance was extended by the Estacion de Biologia Pesquera, La Paz, through Biol. Jose J. Diaz. Permission to collect specimens was extended by the Departmento de Conservacion de la Fauna Silvestre, Republic of Mexico.

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Table 1. **Summary of trap emergence data.**

Trap No.	Tide level	Type of substrate		*Culicoides* (no.)	*Megaselia* (no.)	*Dasyhelia* (no.)	*Smittia* (no.)
1	A	open	sand	1	–	–	–
2	D	mangrove	sand	–	–	–	–
3	B	open	sand	–	–	–	–
4	C	open	sand	–	–	–	–
5	E	mangrove	sand	–	2	–	–
6	E	open	mud	–	–	–	–
7	D	mangrove	mud	–	–	–	–
8	C	mangrove	mud	6	9	1	1
9	E	mangrove	mud	–	1	1	–
10	D	mangrove	mud	–	–	–	–
11	A	mangrove	mud	5	7	–	13
12	B	mangrove	mud	6	3	–	–

A = highest high water mark
B = medium high water mark
C = lowest high water mark
D = medium low water mark
E = lowest low water mark

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ADDENDUM

In March and April of 1974 the authors visited several of the southern islands in the Gulf of California from the R/V Dolphin where additional collections were made which are pertinent to the subject of this paper:

Deinocerites mcdonaldi. – The range of this species in the Gulf of California is extended, with collections from Isla San José, lagoon east of Bahía Amortejada, 1-2 April 1974 and Isla Carmen, Bahía Balandra, 4 April 1974. In both localities the larvae and pupae were siphoned from burrows of the land crab, *Cardisoma crassum.* The greatest numbers of specimens were found in black, very saline water (41-53 ppt, as determined with a portable optical refractometer) with a strong odor of hydrogen sulfide. Only a few adults were taken, resting on the sides of the burrow.

***Thalassomyia bureni* Wirth.** – A large number of these marine midges were attracted to a table lamp near a cabin door of the ship during the night of 4 April 1974. The ship was anchored in Bahía Balandra, Isla Carmen, about 150 m from the shore. The sky was clear, with the moon at three-quarter phase, the air temperature was approximately 20°C. This species has hitherto been recorded only from Florida; these specimens were identified by H. Hashimoto.

For this additional opportunity to study the coastal insect fauna of Baja California we are again indebted to the Foundation of Ocean Research, San Diego and Mr. Richard F. Dwyer of Los Angeles.