SPATIAL DISTRIBUTION AND DAYTIME DRIFT OF CHIRONOMIDS IN A SOUTHERN CALIFORNIA RIVER[1]

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ABSTRACT. Spatial distribution of chironomid larvae in stony, sandy and muddy substrates in the Santa Ana River was studied from March to June 1975. Riverine drift samples were also collected during the daytime to study the nature and magnitude of chironomid drift in the river.

Larvae belonging to 10 genera were taken in the benthic collections; 9 of these also occurred in the drift. In benthos, *Tanytarsus* spp., *Chironomus* spp., and *Cricotopus* spp. collectively formed 95% of the total midges. The sandy and muddy substrates supported 8–10 times more larvae than the stony substrate. *Tanytarsus* spp. and *Cricotopus* spp. were predominant in the sandy substrate, while *Chironomus* spp. was associated with the muddy bottom type. No significant difference was found in the density of *Tanytarsus* spp. prevailing in the stony and muddy bottoms. *Cricotopus* spp. was significantly more numerous in stony than in muddy substrate. *Chironomus* spp. was taken in smaller numbers from sand than mud and was absent from the stony habitat.

In the drift collections, only *Tanytarsus* spp. and *Cricotopus* spp. were of quantitative importance, forming 79% of the total larvae collected during the study. The mean numbers of larvae taken in 2-hr drift catches were low, ranging from 18–40 only. Among midge pupae, *Cricotopus* spp. predominated in the drift.

INTRODUCTION

The massive emergence of chironomid midges from water impoundments in the Santa Ana River Basin, Orange County, California, poses a variety of pest problems for people residing or working within the dispersal range of these midges. At times, from April to November swarms become so dense that outdoor business, residential, or recreational activities are hampered. At night adults are attracted to lights, swarming around indoor and outdoor fixtures. Dead midges and spider webs, where they are trapped, deface stucco and other wall finishes requiring frequent washing and maintenance. Midges also invade manufacturing facilities, swarm inside and get imbedded in paint finishes, plastics, and other manufactured goods, causing substantial economic loss.

In the summer of 1974, systematic studies were initiated on the bionomics, population dynamics, and integrated control of the nuisance midges in the Santa Ana River spreading system which supports dense populations of larval midges throughout the year (Ali and Mulla, unpublished). During the course of these investigations, studies on the abundance and distribution of chironomid larvae in various substrates prevailing in the main river (upstream of the spreading system) were conducted and are reported here. Also, the number of midges transported downstream during daytime by drift from these upstream main river areas to the impounding structures was assessed to elucidate the extent and magnitude of contribution made by the breeding sources in the main river to the overall midge problem.

MATERIALS AND METHODS

STUDY AREA. The Santa Ana River spreading system previously described by Ali and Mulla (1976a,c) covers ca. 300 ha and consists of a flood control channel, a number of spreading basins, and a few large reservoirs. The present studies were conducted in a 3-4 km long stretch of the main river (having a natural bottom) im-

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mediately upstream of the spreading system. In this part, 3 major types of substrate prevail in the river; the middle regions have stony bottom (consisting of large and small stones mixed with gravel) under 0.5-1.0 m/sec currents, while at the sides where water is very slow moving or stagnant, the river bottom is either muddy (mucky) or sandy. The latter 2 substrate types prevail all along the sides of the main river.

SAMPLING. To study the spatial distribution and abundance of midge larvae in the stony, sandy, and muddy bottoms, quantitative samples from each of the 3 types were collected. The stony substrate was sampled by using a Surber sampler with a 0.09 m^2 frame and 500μ-pore net. A 15×15 cm scoop sampler (Anderson et al. 1964) was used for the other 2 substrates. The 2 sampling devices were required due to the difference in nature of the substrates. The Surber sampler could not be used in stagnant waters and the scoop was inappropriate for sampling the stony substrate. Three sampling stations were established along the river, spaced at 1 km intervals in 3 km area immediately upstream of the spreading system. At each station, a minimum of 3 Surber samples per visit were taken along a transect across the river by the method previously described (Ali et al. 1976). The scoop samples from sandy and muddy substrates also were obtained at each station. A minimum of 4 scoops from each of the 2 bottom types at each station were taken. Larvae were separated from the bottom materials by the procedures described by Mulla et al. (1971).

For drift studies, a plankton net (80 cm long, 25 cm diam. at mouth, and 250μ pore) was used for sampling the 3 stations. The length of the net was adequate for use in 0.5-1.0 m/sec currents (prevailing at the sampling locations during the study period), checking any faunal loss due to a possible build-up of backwash. At each station, the net was left in the middle of the river in 30-40 cm deep water for a 2-hr period during the morning. A 5-m long nylon cord was used to tie the net to an upstream metal stake permanently driven into the river bottom at each site. The net usually remained submerged and did not rest on the river bottom. The metal stake did not obstruct organisms drifting into the net. On each visit, sampling (drift or benthic) was commenced at the downstream station moving upstream, and the drift was sampled prior to the benthic sampling. While collecting Surber samples and also during drift sampling, bottom disturbance was avoided in the area upstream of the sampling location. All samples collected were transferred to labeled plastic containers and placed in an ice chest for subsequent examination in the laboratory. The study was repeated on 9 different occasions March to June 1975.

In the laboratory, each sample was fully searched in the manner previously reported (Ali et al. 1977). Larvae in all benthic samples, and larvae and pupae in all drift samples were counted and identified. Data resulting from the benthic collections were transformed to log (n+1) and analyzed for variance by Duncan's Multiple Range Test (LeClerg et al. 1962).

RESULTS AND DISCUSSION

Larvae of 10 different genera occurred in the benthic collections with *Tanytarsus* spp., *Chironomus* spp., and *Cricotopus* spp. forming 95% of the total benthic larvae. *Procladius* spp., *Cryptochironomus* sp., and *Dicrotendipes* sp. were less common (3.7% of the total benthic larvae), and *Microspectra* sp., *Tribelos* sp., *Polypedilum* sp., and *Pentaneura* sp. were rare.

The mean number of larvae of *Tanytarsus* spp., *Chironomus* spp., and *Cricotopus* spp. recovered from 0.09 m^2 (1 ft^2) of each type of substrate on the 9 sampling occasions is shown in Fig. 1. It is evident that *Tanytarsus* spp. and *Cricotopus* spp. were more abundant in the sand than the other 2 substrates. In contrast, the largest number of *Chironomus* spp. was correlated with muddy substrate (Fig. 1). There was no significant difference (0.05 level) in the density of *Tanytarsus* spp. prevailing in the stony and muddy bottoms. However,

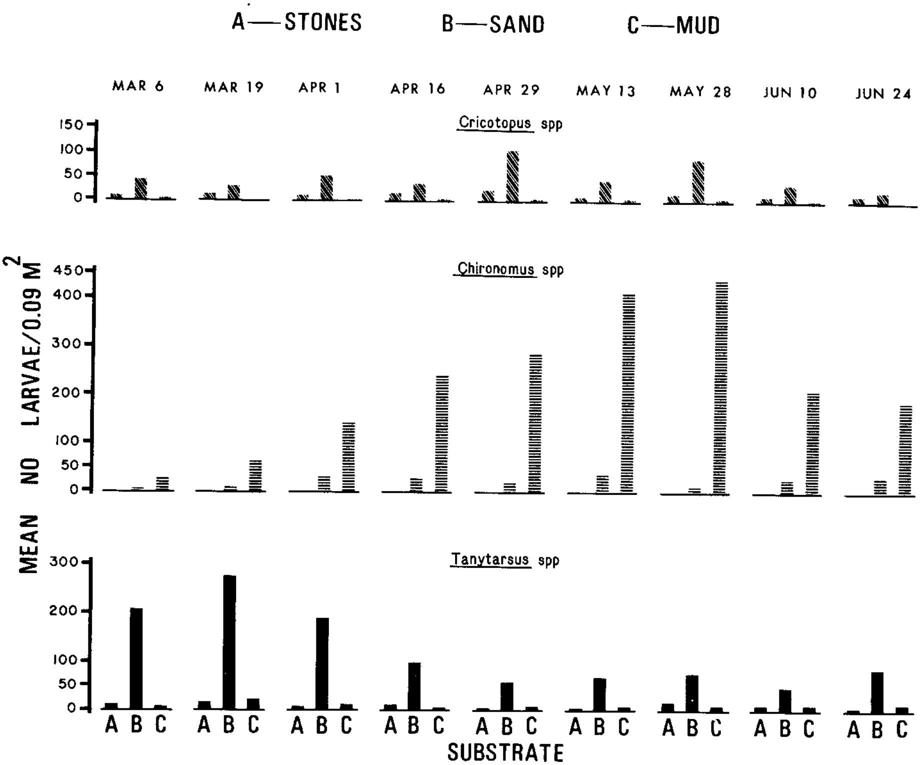

FIG. 1.—Distribution and abundance of *Tanytarsus* spp., *Chironomus* spp., and *Cricotopus* spp. in 3 types of substrate prevailing in the Santa Ana River, Orange County, California (Mar.–June 1975).

Cricotopus spp. was significantly more numerous in stony than in muddy habitat (Table 1). Larvae of *Chironomus* spp. were taken in smaller numbers from sand than mud and were absent from stony substrate. Among the less common genera, the highest number of *Cryptochironomus* sp. and *Dicrotendipes* sp. occurred in sand, and most *Procladius* spp. were recovered from mud (Table 1). *Dicrotendipes* sp. and *Cryptochironomus* sp. were absent from the muddy bottom. Similarly, *Procladius* spp. was lacking in the stony substrate.

In the drift collections, larvae belonging to 9 genera were taken, but only *Tanytarsus* spp. and *Cricotopus* spp. were of quantitative importance on each sampling occasion, forming 79% of the total midge larvae collected during the study (Table 2). These 2 genera are found in the stony habitats with fast-moving currents, therefore, they occur more often in drift. *Cryptochironomus* sp., *Dicrotendipes* sp., *Procladius* sp., *Chironomus* sp., *Micropsectra* sp., *Tribelos* sp., and *Polypedilum* sp. were the other genera taken in drift. The mean number of total larvae taken in 2-hr drift catches ranged from 18–40. Midge pupae, dominated by pupae of *Cricotopus* spp., also occurred in the drift (Table 2).

The present studies show that sandy and muddy substrates at the sides of the Santa Ana River upstream of the spreading system supported 8–10 times more larvae than stony substrate in the river middle. However, previous studies (Ali and Mulla unpublished) in this spreading system have shown that midge densities (March to June 1975) in various water impounding structures (spreading basins or

Table 1. Prevalence of chironomid larvae in different bottom types in the Santa Ana River, Orange County, California (Mar.–June, 1975).

Substrates	Mean no. larvae of various genera/0.09m² (1 ft²) in different substrates							
	Tanytarsus spp.	*Chironomus* spp.	*Cricotopus* spp.	*Cryptochironomus* sp.	*Dicrotendipes* sp.	*Procladius* spp.	Others	Total
Stones	9.44 b*	0.0 c	12.44 b	1.66 b	0.33 b	0.0 c	2.44 a	26.31 b
Sand	122.22 a	22.0 b	49.22 a	5.22 a	3.33 a	1.0 b	2.0 a	204.99 a
Mud	10.11 b	223.22 a	2.0 c	0.0 c	0.0 c	5.88 a	1.77 a	242.98 a

* Means in the same column followed by the same letter are not significantly different at the 5% probability level.

flood control channel) were consistently higher than those at the sides or the middle areas of the main river reported here.

The drift study indicates that during daytime, the river water constantly carries some immature midges from upstream areas of the main river into the spreading structures below. However, the rates of drift presented in Table 2 are too low compared to the daytime drift rates of chironomids in a southern California urban flood control channel system (Ali and Mulla 1976b), although the numbers of drifting larvae in both midge breeding sources may possibly increase during the night due to the increased chironomid larval activity than in some aquatic habitats (Bay et al. 1966, Lewis 1957, Wülker 1963). The small numbers of midges occurring in the daytime drift in the Santa Ana River can be attributed to their lower benthic densities prevailing in areas (stony substrate) exposed to fast currents. Larvae in the higher density areas at the sides of the river where water is slow moving or stagnant are less likely to become drift-borne due to the absence of fast enough currents.

In stagnant waters of residential-recreational lakes (Ali and Mulla 1977b, Mulla et al. 1975), local oviposition is the only source of midge recolonization. However, the present studies on drift have revealed that midge densities in spreading structures of the Santa Ana River are also augmented, to some extent, by drift-carried larvae from upstream areas into these structures.

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Table 2. Occurrence of chironomid midges in daytime drift in the Santa Ana River, Orange County, California (Mar.–June, 1975).

Group	Mean no. larvae or pupae/2 hr sample on								
	3/6	3/19	4/1	4/16	4/29	5/13	5/28	6/10	6/24
Larvae:									
Procladius sp.	0	0	0	0	0	0	1	0	2
Tanytarsus spp.	16	27	9	11	7	10	12	6	10
Chironomus sp.	0	0	0	0	0	2	0	0	0
Cryptochironomus sp.	2	1	0	2	2	1	3	1	2
Dicrotendipes sp.	0	0	1	1	0	0	0	1	0
Cricotopus spp.	9	10	8	14	10	12	4	8	8
Others [a]	4	2	0	4	5	2	6	2	5
Total Larvae	31	40	18	32	24	27	26	18	27
Pupae [b]	7	11	18	26	14	21	15	9	20

[a] *Micropsectra* sp., *Tribelos* sp., and *Polypedilum* sp.
[b] Mostly *Cricotopus* spp.

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BITING FLY CONFERENCE, 1978

The Biting Fly Conference, which is of particular interest to Tabanid specialists, has been scheduled for June 19–23, 1978 in New Hampshire. For information contact should be made with Dr. J. F. Burger, Department of Entomology, University of New Hampshire, Durham, N H 03824.