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EVALUATION OF EMERGENCE TRAPS IN ASSESSING THE IMPACT OF A MACROPHYTE ON THE PRODUCTION OF CHIRONOMID MIDGES[1]

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ABSTRACT. Chironomid midge emergence was compared from portions of a residential-recreational lake kept free of the Eurasian water milfoil, *Myriophyllum spicatum* var. *exalbescens* and a portion infested with this aquatic weed, using floating and non-floating emergence traps. Quantitative and qualitative differences were observed using floating emergence traps in the hydrophyte free portion, while only quantitative variations were seen in the portion infested with *M. spicatum*. The differences found in the hydrophyte free portion were mainly due to increased catches of *Procladius* spp. and may have been due to pupal drift, which *Procladius* spp. reportedly exhibits prior to emergence. The results of this study suggest that the use of floating emergence traps in the portion of this lake containing hydrophytes provide a more accurate estimate of midge populations than non-floating traps.

A variety of aquatic habitats in and around residential and industrial areas in southern California produce tremendous numbers of nuisance chironomid midges necessitating periodic abatement measures (Ali and Mulla 1975, 1976; Mulla 1974, Mulla et al. 1975). Timing of midge control strategies and evaluating their efficacy rely in part on adult emergence collections obtained from submerged emergence traps (Ali et al. 1978, Johnson and Mulla 1981, Mulla et al. 1975). In some of these habitats, aquatic macrophytes completely cover the bottom and at times interfere with obtaining these collections. During a study comparing midge production from weed free portions of a residential-recreational lake to parts containing hydrophytes (Johnson and Mulla 1982), we saw the need for stationary adult emergence traps which floated above vegetation but remained below the water surface. This investigation provided an opportunity to compare the adult midge fauna, collected from submerged floating emergence traps an-

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chored above the lake bottom, with that collected from emergence traps resting on the lake bottom.

MATERIALS AND METHODS

This study was conducted in Spring Valley Lake (elev. 800 m) located in northern Mojave Desert of San Bernardino County, CA, 10 km south of Victorville, CA. This lake covers an area of 80 ha with an average depth of 4 m (Mulla et al. 1975). Dense stands of Eurasian water milfoil, *Myriophyllum spicatum* var. *exalbescens* Jepsen, completely cover the lake bottom, growing to the water surface when left unmanaged.

For this investigation, 2 narrow channels or fingers each about 2–3 ha, were chosen. One was kept free of hydrophytes by an initial treatment using the pre-emergent herbicide dichlorobenil at the rate of 112 kg of 10% granule/ha. This treatment was followed by a combination of 10 liters/ha of the post-emergent herbicide, diquat, plus 5 liters/ha of chelated copper as an algacide, when necessary. The other channel was mechanically harvested with an Aqua Marine mechanical harvester (Aqua Marine Corp. Waukesha, WI), which removed vegetation to 1.5 m below the water surface (Johnson and Mulla 1982).

Overnight adult emergence was assessed by placing 5 non-floating submerged emergence traps and 5 floating emergence traps at intervals within each study site. Non-floating emergence traps described by Mulla et al. (1974) were modified to floating traps (Fig. 1) by attaching two 18 cm round pool floats to the collar of each trap, and anchoring them with nylon rope through 2 holes in the trap base (Johnson and Mulla 1982). Adult midges collected in these emergence traps were counted and identified in the laboratory.

RESULTS

The numbers of adults emerging from the vegetation free portions of the lake

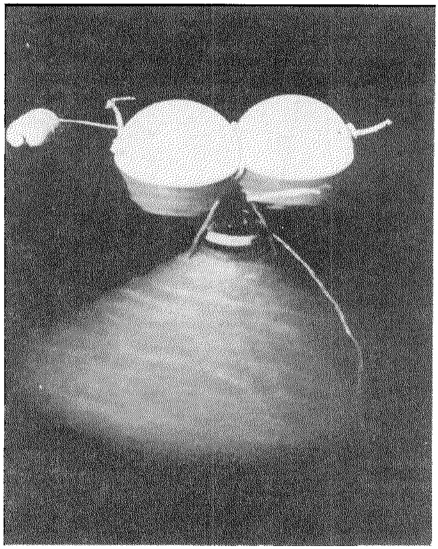

Fig. 1. Floating aquatic midge emergence trap.

are shown in Fig. 2. Approximately 40 adult chironomids were collected from the floating and non-floating traps on the first sampling date (May 16). The average number of adults collected/trap in non-floating traps declined to <5 by mid-June. The floating trap midge collections from mid-May to mid-June reflected 2 peaks. The first peak on May 22 exceeded 120 adults/trap, and the second averaged more than 60 adults/trap. The average number from both types of traps was nearly equal on the July 13 trapping date. The next 2 sampling dates yielded about 20 adults for an increase from the floating traps, while numbers of midges from the non-floating traps declined to approximately 1/trap.

The species composition of the trap collections from the vegetation free finger is presented in Table 1. Initially, species of *Tanytarsus* represented over 75% of the total midge fauna collected from both types of traps. The next 3

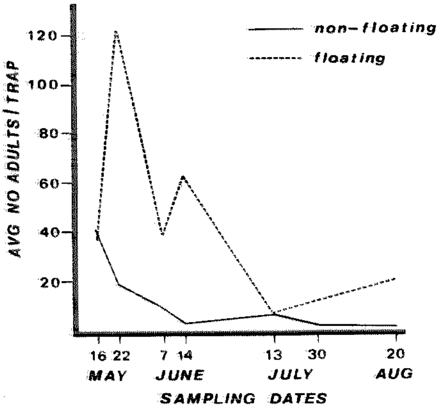

Fig. 2. Average number of chironomid midge adults collected/trap from hydrophyte free portion of lake in floating and non-floating emergence traps.

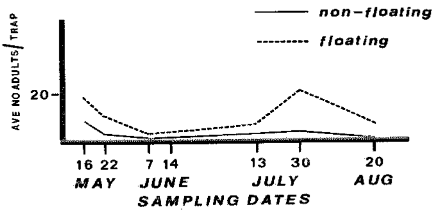

Fig. 3. Average number of chironomid midge adults collected/trap from hydrophyte infested portion of lake in floating and non-floating emergence traps.

sampling dates, May 22, June 7 and 14, floating traps yielded from 73 to 96% *Procladius* spp. with species of *Tanytarsus* and *Chironomus* making up the rest of the fauna. Adult midges collected from the non-floating traps on May 22 were approximately 25% *Procladius* spp. with the remaining being *Tanytarsus* species. Species of *Procladius* and *Tanytarsus* were collected in approximately equal numbers from the non-floating traps on the 2 June sampling dates. The midge composition in the floating traps on July and August dates was predominantly species of *Procladius* except on July 13 when *Tanytarsus* spp. were more numerous. The midge collections from the non-floating traps in the vegetation free site were low during July and August. *Tanytarsus* spp. were most abundant during July, while *Chironomus* and *Procladius* spp. were collected in August.

The average number of adult midges collected/trap in the finger containing dense stands of *M. spicatum* is shown in Fig. 3. On the first sampling date, approximately 20 midges/trap were collected from the floating traps and about 15 midges/trap were collected from the non-floating traps. The average number of adults collected from both types of traps declined to <5 by mid-June, followed by increases in the average number collected by floating traps, reaching to more than 20/trap floating with non-

Table 1. Percent composition of chironomid midge adults collected from hydrophyte free portion of lake in floating and non-floating emergence traps.

Sampling date	Floating[a] *Chironomus* spp.	Floating[a] *Tanytarsus* spp.	Floating[a] *Procladius* spp.	Non-floating[a] *Chironomus* spp.	Non-floating[a] *Tanytarsus* spp.	Non-floating[a] *Procladius* spp.
16 May	0 (0)	77 (127)	23 (39)	0 (0)	92 (190)	8 (16)
22 May	0 (0)	27 (163)	73 (450)	0 (0)	76 (72)	24 (23)
7 June	1 (1)	22 (42)	77 (152)	0 (0)	49 (23)	51 (24)
14 June	1 (1)	3 (10)	96 (303)	0 (0)	44 (8)	56 (10)
13 July	9 (3)	74 (26)	17 (6)	3 (1)	61 (20)	36 (12)
30 July	0 (0)	15 (9)	85 (50)	0 (0)	100 (5)	0 (0)
20 August	0 (0)	0 (0)	100 (102)	20 (1)	0 (0)	80 (4)

[a] Total number of midges collected in parentheses.

floating remaining about 5/trap. The collections from both trap designs tapered off by August 20.

Species composition from the floating and non-floating traps were similar in the vegetated finger on the various sampling dates (Table 2). Species of *Tanytarsus* comprised approximately 90% of the trap collections on May 16 with *Procladius* spp. making up the rest of the fauna. For the next 3 sampling dates, May 22, June 7 and 14, nearly equal proportions of *Tanytarsus* and *Procladius* spp. were collected from floating and non-floating traps. The July 13 and 30 collection dates yielded species of *Chironomus*, *Tanytarsus* and *Procladius* in both types of traps with the latter predominant in each case. Only *Procladius* spp. were collected in the floating traps on August 20.

DISCUSSION

Greater numbers of chironomid adults were collected from that portion of the lake kept free of aquatic macrophytes. As reported in another paper (Johnson and Mulla 1982), reasons for this might include *M. spicatum* acting as a physical barrier or emitting biologically active chemicals inhibiting growth and survival of midge species.

Quantitative differences were recorded at both study sites using the 2 types of traps on all but 1 sample date, with the floating trap catching greater numbers. Differences in aquatic insect catches were also noted by Kimerle and Anderson (1967) and Morgan et al. (1963) who reported that floating traps caught a greater proportion of insects than non-floating traps and gave a clearer quantitative picture of seasonal emergence patterns (Morgan et al. 1963). In contrast, Guyer and Hutson (1955) found no significant differences between the number of aquatic insects, except Ephemeroptera, caught in funnel traps when on the bottom or suspended above it. Similar findings were reported by Palmen (1955) and Kajak (1958).

The species composition showed more variation in the area free of hydrophytes, with *Procladius* adults predominant in collections from the floating emergence traps. According to Mundie (1971) *Procladius* pupae repeatedly move up and down in the water before emergence, and this can give erroneously high estimates of numbers because pupae from surrounding areas drift into floating emergence traps. Therefore, the higher number of *Procladius* in the vegetation free channel might be explained by pupal drift.

Overall, quantitative and qualitative differences were found using floating emergence traps in the *M. spicatum* controlled site. Some of these differences could be a result of drifting *Procladius* pupae. However, the quantitative differences observed in the finger contain-

Table 2. Percent composition of chironomid midge adults collected from hydrophyte infested portion of lake in floating and non-floating emergence traps.

Sampling date	Floating[a] *Chironomus* spp.	*Tanytarsus* spp.	*Procladius* spp.	Non-floating[a] *Chironomus* spp.	*Tanytarsus* spp.	*Procladius* spp.
16 May	0 (0)	89 (49)	11 (6)	0 (0)	82 (45)	18 (10)
22 May	0 (0)	36 (24)	64 (42)	0 (0)	48 (10)	52 (11)
7 June	0 (2)	77 (10)	23 (3)	0 (0)	80 (4)	20 (1)
14 June	0 (0)	50 (6)	50 (6)	0 (0)	40 (2)	60 (3)
13 July	8 (3)	32 (12)	60 (23)	7 (1)	64 (9)	29 (4)
30 July	10 (11)	2 (2)	88 (93)	35 (7)	15 (3)	50 (10)
20 August	0 (0)	0 (0)	100 (39)	0 (0)	0 (0)	0 (0)

[a] Total number of midges collected in parentheses.

ing dense stands of *M. spicatum* suggest that floating traps may provide more accurate estimates of the midge population. Therefore, they could be useful in situations where aquatic macrophytes interfere with other types of emergence traps. Furthermore, floating traps may also detect periphytic midge species which mine vascular hydrophytes or dwell on their surfaces.

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