RANGE OF ATTRACTIVENESS OF CARBON DIOXIDE TO *HYBOMITRA* SPP. (DIPTERA: TABANIDAE)

PAUL E. McELLIGOTT AND SUSAN B. McIVER

Department of Environmental Biology, University of Guelph, Guelph, Ontario, Canada N1G 2W1

Carbon dioxide (CO_2) is a known attractant to female tabanids and is frequently added to various traps to increase numbers collected (Roberts 1971, 1975, 1976). The attractiveness of different amounts of CO_2 for tabanids has been investigated (Roberts 1975), as well as its possible selective attractiveness to flies of a certain age composition and a specific physiological state (Leprince and Lewis 1983, Leprince and Jolicoeur 1986). Roberts (1971) reported that each tabanid species has a definite individual response to CO_2, and Leprince and Lewis (1983) found that reactions of parous and nulliparous females to CO_2 may also differ among species. This note reports observations on the range over which CO_2 is attractive to female *Hybomitra* spp. These observations were made during an in-depth study of mosquitoes in southwestern Ontario during the summer of 1986.

Experiments were conducted between May 27 and August 5, 1986 near Aberfoyle, Ontario (43°C 35'N, 80°C 15'W) in an open field where the vegetation consists primarily of grass (*Poa* sp.) and goldenrod (*Solidago* sp.). Twenty ramp traps, similar in design and size to those of Gillies (1969), but constructed from aluminum window framing and black wire screen, were arranged radially with 4 traps located at 3, 7, 11, 15 and 19 m from a central CO_2 source. The openings of the traps faced away from the CO_2 source. On 7 of the 14 days when the study was conducted, CO_2 was released at a rate of 1,000 ml/min from a 20 lb pressurized tank via a regulator. This rate was comparable to the release of CO_2 by Hereford beef heifers (1.2 to 1.8 liters/min, Roberts 1972). No CO_2 was released on the other 7 days. Carbon dioxide and non-CO_2 trials were carried out alternately, and trials were only conducted on days without cloud cover and a slight (0–10 km/h) breeze. The temperature range was 20–31°C in the course of the experiments. Trials commenced at 0930–1000 EDST and terminated at 1500–1530 of the same day. Tabanids in the traps were removed using a battery-powered aspirator and transported to the laboratory for identification.

Three species of tabanids, *Hybomitra epistates* (Osten Sacken), *H. nuda* (McDunnough) and *H. lasiophthalma* (Macquart), were caught in sufficient numbers for inferences to be made regarding the range of attraction of CO_2 (Table 1).

Table 1. Total number of female *Hybomitra* in relation to distance from carbon dioxide source (4 traps/range; 7 days with and 7 without CO_2).

Species	CO_2	Distance from CO_2 source					
		3 m	7 m	11 m	15 m	19 m	Total
H. epistates	+	91	5	0	1	1	98
	−	0	0	0	0	0	0
H. nuda	+	15	4	1	0	1	21
	−	0	1	0	0	0	1
H. lasiophthalma	+	34	9	2	0	1	46
	−	0	0	0	1	0	1
all *Hybomitra* spp.[1]	+	147	19	3	1	3	165
	−	0	1	0	1	0	2

[1] Includes *H. sodalis* and *H. metabola* as well as the other 3 species.

Comparisons of total catches of these 3 species and of all *Hybomitra* spp. in traps 3 m from the CO_2 source with those in traps at greater distances demonstrated that, when CO_2 was present, the numbers of females was much higher at 3 m than at any other distance (Table 1). For *H. epistates*, the only species caught consistently in numbers sufficient for meaningful statistical analysis, the number of flies caught at 3 m was significantly higher than at greater distances ($P < 0.05$, SNK test) (Sokal and Rohlf 1979). In the absence of CO_2 only 2 females of any species were caught: one at 7 m and one at 11 m. The presence of CO_2, therefore, clearly has an aggregating effect on females of *Hybomitra* spp. and is operative at least over a distance of between 3 m and 7 m, when released at a rate of 1,000 ml/min.

It appears that CO_2 is operative for host-seeking *Hybomitra* females over a short to moderate distance from the host. In general visual cues are recognized as being the most important long-range attractant for tabanids (Hanec and Bracken 1962, Allan and Stoffolano 1986). The fact that tabanids will closely approach, and even land on a visually attractive target has been incorporated into trap designs such as the Manitoba horse fly trap (Thorsteinson et al. 1964). The Manitoba horse fly trap efficiently attracts tabanids in the absence of CO_2, yet in the current study tabanids were attracted by CO_2 to traps which offered little visual stimulus; very few flies were caught in the ramp traps in the

absence of CO_2. The relative importance of visual cues and CO_2 to host-seeking tabanids appears to vary. In very attractive traps, such as Manitoba horse fly traps, high catches are possible without CO_2, but can be increased by the addition of CO_2 to the traps. In traps with little visual attraction, such as ramp traps, CO_2 serves as the main stimulus to host-seeking tabanids. This variable importance of the two types of stimuli is related to the habitat and behavior of *Hybomitra* spp. Adults inhabit semi-open to open spaces where they attack medium to large-sized mammals, such as livestock. In an open situation, view of a large host would be unobstructed for long distances, while air-borne stimuli such as CO_2 would be readily disrupted by the strong breezes frequently associated with open areas. In a more closed habitat, view of the host would frequently be obstructed, but the presence of CO_2 would alert a tabanid to the animal's presence. The variable relative importance of CO_2 and visual stimuli, then, enables tabanids to seek hosts in a variety of habitats, and therefore, be of selective advantage.

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