# The Response of Tabanid Species to $CO_2$-Baited Insect Flight Traps in Northern California
(Diptera: Tabanidae)

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Following the initial reports of the attraction and collection of many species of Tabanidae in dry ice-baited traps (DeFoliart *et al.* 1965, Otsuru *et al.* 1965 & Wilson, Tugwell & Burns 1965), a basic objective in our 1966 studies was to determine if blood-sucking species of snipe flies (Diptera: Rhagionidae, *Symphoromyia*) also could be captured in this manner. As reported (Anderson & Hoy 1972), dry ice-baited insect flight traps of the Malaise-type were very successful in catching large numbers of *Symphoromyia* species, as well as non-bloodsucking, but host-seeking, *Cephenemyia* females (Diptera:Oestridae) (Anderson & Olkowski 1968).

In unbaited Malaise traps, Smith, Breeland & Pickard (1965) caught nearly 25 tabanids/trap (7,057 in 6 months), representing 9 species in 5 different genera. As anticipated from this and the 1965 reports of DeFoliart *et al.*, Otsuru *et al.*, & Wilson *et al.*, our experimental baiting of insect flight traps with $CO_2$ proved very efficient in catching many species of Tabanidae as well as many other hematophagous species in other families (Anderson & Hoy 1972). Since the success of $CO_2$-baited Malaise-type traps for catching tabanids was first reported (Olkowski, Anderson & Hoy 1967), several other workers also have used $CO_2$-baited Malaise-type traps to trap Tabanidae (Blume *et al.* 1972, Knudsen & Rees 1968, Roberts 1970, 1971, 1972, Thornhill & Hays 1972). As only a summary of our results concerning Tabanidae were reported in our 1967 abstract, and only a few species were mentioned, we herein report the complete results for comparison with later studies in California and results from other areas.

## Methods

Because the primary emphasis of our research with $CO_2$-baited traps concerned species of *Symphoromyia*, a detailed description of the study area, etc., has been published. For details of the study area, $CO_2$ release and other methodology, trap design, aerial photographs

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The Pan-Pacific Entomologist 50: 255–268. July 1974

of the trap sites and deer pens, etc., readers are referred to Anderson & Hoy (1972). This research was conducted at the University of California field station at Hopland (Mendocino Co.). The topography here is characterized by rolling hills interspersed with ravines; elevation ranges from 200m to nearly 1,000m. The climate consists of winter rains and a summer drought.

All trapping was done in a woodland-grass habitat dominated by oak trees, and we used white nylon mesh insect flight traps of the Malaise-type, 2.74m high × 2.44m wide. These traps, operated from 0800 to 1700 hrs. (Pacific Standard Time), were baited with dry ice held in a polystyrene foam insulated container[3] set on the ground next to the center support pole of the trap. All traps were baited with 6.8kg of dry ice each day from 27 May through 15 June, 1966. Sublimated $CO_2$ escaped through 2cm holes on each side of the box. $CO_2$ emission rates of 2.04kg/trap/day (about 2.0 liters/min) were determined from 9-hour weight losses of the insulated boxes.

In the experimental design, each of 4 traps (I, II, IV & V) was placed in the corners of a grid about 124m on a side, and 1 trap (trap III) was set in the center of the square. A sixth trap (trap VI) was set up 0.77km SE from the center of the grid and 187m WNW from a group of penned, tame black-tailed deer (*Odocoilius hemionus columbianus*) that were observed throughout the study. This design allowed comparison of the catch of the center trap in the 5-trap grid with that caught in each of the 4 corner traps and the isolated trap VI near the tame deer.

Aerial photographs of the 5-trap grid, Trap VI and the deer pens were used to determine the percentage canopy cover within circles having radii of 5, 15, 30 and 60m from each trap site. Temperatures and wind direction and occasionally velocity[4], were taken at trap site I at 0800, 1100, 1400 and 1700 hours. These data later proved to be essentially the same as those recorded at one of the Field Station weather stations 2.4km SE of our trapping grid.

For the principal study comparing flies caught in the 5-trap grid, at Trap VI and at deer, the traps were operated from 27 May through 15 June 1966. Each day the traps were serviced in numerical order with the dry ice containers being rotated from trap to trap to avoid possible bias among different containers. On 16 June traps II, III and IV were baited with dry ice and traps I, V and VI were operated

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[3] Freez/Safe®, Mfgd. by Polyfoam Packers Div., glo-brite Foam Plastics, Chicago, Ill., U.S.A.
[4] FloRite air velocity meter, model MRF, Becharach Industrial Instrument Co., Pittsburgh, Pa., U.S.A.

without dry ice. On 17 June traps I, V and VI were baited with dry ice and traps II, III and IV were without. Between 18 June and 26 June several traps also were operated sporadically with dry ice on a survey basis. In preliminary studies in April and early May a smaller trap (1.52m wide × 1.37m high) was operated with dry ice for 10 days and for 20 days without.

At the apex of a trap flies were collected in a removable 1.4 liter styrene container through which they entered via a 15mm hole in a screen cone which formed the inner base of the collecting container. The removable collecting containers were collected and replaced with empty ones at 1100, 1400 and 1700 hrs each day, except for 4 and 12 June when they were replaced at 1.5-hr intervals (beginning after 1100 hr on 12 June). On 15 June the traps were operated for an additional period from 1700–1930 hrs.

Between 0800 and 1700 hr on each day that traps were operated, J. B. H. observed the fly activity at 4 tame deer. Various tabanid species were sporadically aspirated from, or squeezed and collected by hand from the deer. The deer were held in two pens about 20 × 70m each which enclosed the same type of woodland-grassland habitat as at the trap grid site.

All trap catch data first were assessed by analysis of variance on the basis of the completely random design. For treatments showing significant and highly significant differences, the means of different species caught at different trap sites were compared by Duncan's New Multiple Range Test (Duncan 1955). The original data from trap catches were transformed to the log $(n + 1)$ prior to conducting analysis of variance.

## Results

*$CO_2$-Emission Rates.* An analysis of variance (Anderson & Hoy 1972) showed that the major source of variation for $CO_2$ emission at trap sites was chance error (52%). Day-to-day variation (42.8%) was next, with site-to-site variation accounting for only 5.1% of the variation. There was no significant difference in $CO_2$ emission among trap sites or among days.

*Effect of Temperature on Studies.* Data on the feeding behavior of *Symphoromyia* species during 1964 and 1965 (Hoy 1966) indicated that minimum host-seeking temperatures would not be reached on days when the temperature was below 12.2°C at 0800 hr. Hence, neither host observations were made nor traps operated on 29 and 30 May and 6 June 1966. No flies were seen at hosts on 28 and 31 May nor on 1 and 2 June; respective daily temperature maximums were 18.9, 19.4, 16.7 and 17.2°C. The 6 traps, operated for full trapping periods on 31 May and 1 and 2 June, and until noon on 28 May, caught the following tabanids: 28 May—1 *Hybomitra aasa*, 1 *Tabanus punctifer*, 1 *T. kesseli*; 31 May—1 *T. similis*; 1 June—1 *T. similis*; 2 June—1 *H. aasa.*

*Numbers of Tabanids Caught in $CO_2$-baited Traps vs Unbaited Traps.* Like other results for tabanids (Bennett & Smith 1968, Roberts 1970, Wilson, Tugwell & Burns 1966), our $CO_2$-baited traps caught significantly greater numbers of *Symphoromyia* species (Anderson & Hoy 1972) and tabanids than unbaited traps. Only female tabanids were caught in the traps. On the 10 days the small trap was operated with $CO_2$ between 6 April and 21 May, the combined catch of *Symphoromyia* and tabanids averaged nearly 25 females/day. During 20 days of operation without dry ice in April and early May this trap caught only 1 *T. similis.* When the 6 larger traps were operated with and without $CO_2$ on 16 and 17 June (see methods), the 3 traps baited with $CO_2$ caught 24 tabanids on 16 June and 33 tabanids on 17 June. The 3 unbaited traps caught only 1 tabanid on 17 June and none on 16 June.

*Species Caught in $CO_2$-baited Traps.* A total of 18 species of Tabanidae were caught in $CO_2$-baited traps operated between 6 April and 26 June 1966; 14 species (Table 1) were trapped during the period of the primary study shown in Table 2, one species (*H. procyon*) was caught in $CO_2$-baited traps operated in April and 3 species (*H. melanorhinus*, *Chrysops proclivis proclivis*, *C. furcatus*) were trapped in other studies conducted between 8 and 26 June 1966. Only *C. pechumani*, *C. hirsuticallus*, *S. gigantulus* and *A. incisuralis* were not collected between 18 and 26 June.

A total of 1094 females of 14 species of Tabanidae were caught in the 6 $CO_2$-baited traps during our 13 day study (Table 1) comparing catches in the 5 grid traps versus isolated Trap VI, 0.77 km away. *Silvius notatus* and *Tabanus similis* together made up 57% of the total catch, and the 4 species of which we caught more than 100 specimens each comprised 78% of the total catch.

*The Relationship Between Temperature and the Tabanid Fauna Captured.* The catch data in Tables 2 and 4 shows that activity occurred within a well-defined temperature range. The beginning of activity in the morning was suppressed or delayed by low temperatures, and activity usually was diminished from mid- to late afternoon and finished earlier on cool days. Joyce and Hansens (1968) also

Table 1. The species and total numbers of female Tabanidae caught at all 6 trap sites during 13 trap-days.[a]

| Species[b] | Number | % of total flies caught | No. of days caught | Mean temp. ranges captured at[c] |
|---|---|---|---|---|
| *Silvius notatus* (Bigot)[d] | 355 | 32.45 | 12 | 19.4–40.6 |
| *Tabanus similis* Macquart[d] | 266 | 24.31 | 13 | 16.7–40.6 |
| *Tabanus kesseli* Philip[d] | 124 | 11.33 | 13 | 17.8–40.6 |
| *Apatolestes comastes* Brennan[d] | 112 | 10.24 | 11 | 21.7–40.6 |
| *Chrysops surdus* Osten Sacken[d] | 78 | 7.13 | 10 | 22.2–38.3 |
| *Hybomitra aasa* Philip | 42 | 3.84 | 12 | 15.6–36.1 |
| *Chrysops coquillettii* Hine | 42 | 3.84 | 12 | 19.4–40.6 |
| *Tabanus punctifer* Osten Sacken[d] | 39 | 3.56 | 9 | 15.6–38.3 |
| *Chrysops coloradensis* Bigot[d] | 13 | 1.19 | 5 | 23.9–30.0 |
| *Silvius gigantulus* (Loew)[d] | 11 | 1.00 | 4 | 22.2–25.6 |
| *Chrysops pechumani* Philip[d] | 7 | 0.64 | 3 | 19.4–24.4 |
| *Chrysops asbestos* Philip | 3 | 0.27 | 3 | 24.4–31.7 |
| *Chrysops hirsuticallus* Philip | 1 | 0.09 | 1 | 23.9 |
| *Atylotus incisuralis* (Macquart) | 1 | 0.09 | 1 | 31.7 |

[a] Same dates as in Table 2.
[b] The *H. aasa* and *C. surdus* were identified by Dr. C. B. Phillip who also confirmed the identifications of representative specimens of most other species.
[c] Includes days other than the 13 primary trapping days.
[d] Species seen or collected while feeding on deer.

reported that temperature was one of the major factors affecting the activity (numbers of flies caught on traps) of *T. nigrovittatus* and *T. lineola*.

The minimum temperature threshold of host seeking activity for most species was between 20–21.7°C. Including the 4 trapping days (not included in the tables) when the daily maximum was below 19.4°C, only 2 *T. punctifer*, 3 specimens each of *H. aasa*, *T. kesseli* and 4 *T. similis* were captured at temperatures below 20°C. Although a few specimens of *C. pechumani* and *S. notatus* and 1 *C. coquillettii* were captured during one mid-day period having a mean temperature of 19.4°C (Table 4, and 3 June), we feel that the latter 2 species were caught during the hour when the temperature was at 21.1 and 21.7°C because none were caught during any other periods or on any days having temperatures below 21.1°C.

Overall, the smallest catches during the 13 favorable trapping days occurred on the 3 days having daily maximums below 26.7°C (Tables 2 and 4). Only *T. kesseli* and *T. similis* were caught on 7 June (Table 2). Even on warmer days only 9 specimens (including *H. aasa*, *C.*

Table 2. The numbers and times at which all tabanid species were caught at 6 trap sites during first 10 and last 3 trap-days.

| Date | Wind[a] | Duration of trapping periods (hrs) 0800–1100 | 1100–1400 | 1400–1700 | Total flies |
|---|---|---|---|---|---|
| 27 May | SW | 10 (12)[b] | 46 (56) | 26 (32) | 82 |
| 3 June | NW | 2 (10) | 14 (70) | 4 (20) | 20 |
| 4 June | W | 2 (1) | 128 (59) | 86 (40) | 216 |
| 5 June | SE | 11 (11) | 62 (63) | 25 (26) | 98 |
| 7 June | SW | 1 (11) | 7 (78) | 1 (11) | 9 |
| 8 June | NW | 28 (30) | 46 (50) | 19 (20) | 93 |
| 9 June | NW | 5 (6) | 53 (68) | 20 (26) | 78 |
| 10 June | NW | 1 (3) | 20 (53) | 17 (45) | 38 |
| 11 June | N | 3 (3) | 44 (49) | 43 (48) | 90 |
| 12 June | N | 24 (17) | 72 (51) | 46 (32) | 142 |
| Subtotals | | 86 (10)[c] | 492 (57) | 288 (33) | 866 |
| 13 June | W | 31 (50) | 16 (26) | 15 (24) | 62 |
| 14 June | W | 41 (55) | 12 (16) | 22 (29) | 75 |
| 15 June | W | 45 (49) | 19 (21) | 27 (30) | 91 |
| Subtotals | | 117 (51)[d] | 47 (21) | 64 (28) | 228 |
| Totals all days | | 203 (19) | 539 (49) | 352 (32) | 1094 |

[a] Predominant direction from which wind was blowing.
[b] Percent of total days catch.
[c] Per cent of total flies caught during 1st 10 days.
[d] Per cent of total flies caught during last 3 days.

*pechumani*, *T. kesseli*, *T. punctifer* and *T. similis*) were caught during the first trapping period on the 5 days when the mean temperature for period I was 20°C or lower (Tables 2 and 4). As the mean temperature of the first trapping period increased, so too did the numbers and species of tabanids caught. Thus, during the first 10 days, except for 9 June, from 12 to 30% of a day's total catch was caught during the first period when the mean temperature was greater than 21.1°C. Maximum numbers of tabanids were caught during the first period only on the 3 days when the mean temperature for this period exceeded 24.4°C (Tables 2 and 4).

The temperature range at which all species were most active was 23.9–32.2°C, but activity seemed affected by the time of day the lower figure was reached. Thus at 24.4 and 25°C during the middle trapping period more than 50% of the day's catch was caught, but at 24.4°C during the first period only 17% of the total day's catch was caught (Tables 2 and 4). Below mean temperatures of 32.2°C most flies were

Table 3. The numbers and times at which the 5 most abundant tabanid species were caught during the first 10 and last 3 trap-days.

| Date | Species | Duration of trapping periods (hrs) 0800–1100 | 1100–1400 | 1400–1700 | Total Flies |
|---|---|---|---|---|---|
| 27 May | *S. notatus* | 7 (3)[a] | 181 (72) | 65 (26) | 253 |
| through | *T. similis* | 26 (11) | 111 (46) | 106 (44) | 243 |
| 12 June | *T. kesseli* | 21 (19) | 49 (44) | 42 (37) | 112 |
| | *A. comastes* | 12 (15) | 47 (59) | 21 (26) | 80 |
| | *C. surdus* | 3 (5) | 39 (68) | 15 (26) | 57 |
| | Subtotals | 69 (9)[b] | 427 (57) | 249 (33) | 745 |
| 13 June | *S. notatus* | 36 (35) | 33 (32) | 33 (32) | 102 |
| through | *T. similis* | 11 (48) | 4 (17) | 8 (35) | 23 |
| 15 June | *T. kesseli* | 2 (17) | 0 | 10 (83) | 12 |
| | *A. comastes* | 26 (81) | 4 (13) | 2 (6) | 32 |
| | *C. surdus* | 14 (67) | 0 | 7 (33) | 21 |
| | Subtotals | 89 (47)[c] | 41 (22) | 60 (32) | 190 |
| Total | | 158 (17) | 468 (50) | 309 (33) | 935 |

[a] Percent of total days catch.
[b] Percent of total flies caught during 1st 10 days.
[c] Percent of total flies caught during last 3 days.

caught during the middle trapping period, regardless of temperatures (Tables 2–4), but the middle period usually was the warmest (Table 4). The usual late afternoon decline in activity of most species (Tables 2 and 3, period III) seemed related to the usual cooling temperatures during the last 2 hrs of the third trapping period. Excepting the 3 hot days of 13–15 June, on all days except 27 May and 12 June, the temperature was 20°C or lower, by 1700 hrs. On 4, 10 and 11 June, when the mean temperature of the 3rd period was nearly the same as that of the 2nd period and closer to the daily maximum than on the first 10 other days in Table 4, there was little difference in the numbers of flies caught during the 2nd and 3rd trapping periods. However, when the traps were operated for an additional period from 1700–1930 hrs on 15 June, 24 tabanids were caught during this 4th period compared to 27 caught during the 3rd period. This indicates that when temperatures remain within a favorable range activity may continue until nearly dusk.

The nearly 20% decline in numbers caught during the 3rd period as opposed to the 2nd period on 12 June, seemed associated with a temperature above 32.2°C during most of the 3rd period (Tables 2

Table 4. Temperature data for the 13 days on which $CO_2$-baited traps were operated in the 5-trap grid.

| Date | Mean temp.[a] during 3 hr periods from: | | | Daily max. | Daily min. |
|---|---|---|---|---|---|
| | 0800–1100 | 1100–1400 | 1400–1700 | | |
| 27 May | 22.2 | 26.1 | 25.0 | 27.8 | 7.8 |
| 3 June | 15.6 | 19.4 | 16.7 | 21.7 | 1.7 |
| 4 June | 19.4 | 24.4 | 23.9 | 26.7 | 3.9 |
| 5 June | 20.6 | 24.4 | 23.3 | 26.7 | 9.4 |
| 7 June | 17.8 | 21.1 | 20.0 | 23.3 | 6.1 |
| 8 June | 22.2 | 25.6 | 23.3 | 27.2 | 10.0 |
| 9 June | 21.7 | 25.0 | 23.9 | 26.7 | 8.9 |
| 10 June | 18.9 | 22.8 | 21.7 | 24.4 | 8.3 |
| 11 June | 20.0 | 25.0 | 25.6 | 27.2 | 5.0 |
| 12 June | 24.4 | 30.0 | 31.7 | 32.8 | 9.4 |
| 13 June | 30.6 | 37.8 | 38.3 | 40.0 | 15.6 |
| 14 June | 33.9 | 41.1 | 40.6 | 42.8 | 18.9 |
| 15 June | 32.8 | 37.8 | 36.1 | 40.6 | 18.9 |

[a] Mean temperatures were derived from the average of temperatures at the beginning and end of each trapping period.

and 4). This was the first trapping period having temperatures above 32.2°C, and as indicated by the subtotals in Tables 2 and 3 and the data in Table 4, the host-seeking activity of most species was markedly altered on hot days (13–15 June). During the middle part of hot days activity of all species was suppressed when the temperature rose above 32.2°C, but after several hours of temperatures between 32.2 to over 37.8°C most species exhibited a slight increase in activity during the 3rd period (Tables 2–4). As the temperatures of the 3rd periods on 13–15 June were nearly identical to those of the 2nd periods, the nearly normal percentage level of activity for the 3rd period (see subtotals of Tables 2 and 3) suggests that most species gradually acclimated to the high temperatures. This also is suggested by the gradual increase in numbers of flies caught from 13–15 June. But since collecting containers were only collected at the end of the period, a sudden burst of fly activity with cooler temperatures preceding sunset also was possible. All of the first 10 species in Table 1, except *H. aasa*, were collected during periods having mean maximum temperatures over 37.8°C.

The way in which the 5 most common species reacted on the 3 hot days, as contrasted with their daily activity on the 10 most productive trap days between 27 May and 12 June, is summarized in Table 3. The

Table 5. Mean number of *S. notatus* females caught per day per trap site during 13 days of trapping.[a]

| Distance From Center Of Trap Site | Trap sites IV | II | III | VI | V | I |
|---|---|---|---|---|---|---|
| | 2.38 | 2.92 | 3.08 | 4.85 | 5.31 | 8.77 |
| 5 m | 0[b] | 5 | 0 | 2 | 51 | 35 |
| 15 m | 0 | 16 | 0 | 25 | 70 | 60 |
| 30 m | 14 | 25 | 4 | 47 | 55 | 32 |
| 60 m | 26 | 32 | 12 | 65 | 45 | 23 |

[a] Totals underscored by the same line are not significantly different at the 5% level of confidence when compared by Duncan's multiple range test.
[b] Total percentage canopy cover within a circle with the indicated radius.

larger catches of *T. similis* and *kesseli* (than the other species) in the first period during the first 10 days is indicative of the lower minimum temperature thresholds at which they exhibited host-seeking activity. However, the number of *A. comastes* caught in the first period on these days (Table 3) is misleading when summarized in this manner because all 12 specimens were caught on days having a mean maximum temperature of 21.7°C, or higher, for the first period; 10 were caught on 12 June. By contrast, the first period catches of *T. similis* and *kesseli* on these 10 days were spread out over 6 and 7 days, respectively, 4 of which had mean maximum temperatures of 20°C or lower for the first period.

If one excludes the data for 12 June, then *S. notatus*, *C. surdus* and *A. comastes* all showed similar patterns of activity during the first part of the study which were different from the daily pattern of activity exhibited by *T. similis* and *kesseli* (Table 3). However, on the 3 hot days the daily patterns of activity did not fall into 2 well-defined categories (Table 3). Instead, (1) the activity of *A. comastes* was largely confined to the first period during 13–15 June, as one might have expected from its response in the first period on 12 June; (2) the principal activity of *T. kesseli* unexpectedly occurred in the 3rd period; (3) *S. notatus* exhibited a uniform level of activity throughout the day; and (4) *C. surdus* and *T. similis* exhibited bimodel activity peaks with somewhat greater activity in the first period.

*Tabanids Caught at Various Trap Sites.* After transformation of the numbers of the 5 most abundant species caught/trap/day to the log $(n + 1)$, analyses of variance revealed: (1) no significant difference among site means for *T. similis*; (2) a significant difference

Table 6. Mean number of *T. kesseli* females caught per day per trap site during 13 days of trapping.[a]

| Trap sites[b] | | | | | |
|---|---|---|---|---|---|
| III | VI | II | IV | V | I |
| 0.69 | 0.92 | 1.46 | 1.46 | 2.00 | 3.00 |

[a] Totals underscored by the same lines are not significantly different at the 5% level of confidence when compared by Duncan's multiple range test.
[b] See Table 5 for the total percentage canopy cover within circles having radii of 5, 15, 30 and 60 m from each trap site.

among site means for *C. surdus* and *A. comastes*; and (3) highly significant differences among site means for *S. notatus* and *T. kesseli*. For the numbers of *S. notatus* captured (Table 5, trap I was significantly different from all other traps except V and VI, but there was no significant difference among traps II–VI. For *T. kesseli* (Table 6), the number of flies caught in trap I was significantly different from only the number caught in traps III and VI, and there was no significant difference in the number of flies caught in traps II–VI. Although the more sensitive F test revealed a significant difference among trap sites for both *A. comastes* and *C. surdus*, there was no significant difference among trap site catches of these at the 5% level of confidence when compared by Duncan's multiple range test.

In contrast to the *Symphoromyia* species studied, whose catches were influenced by the percentage canopy cover surrounding trap sites (Anderson & Hoy 1972), the 4 corner traps of the grid did not significantly decrease the number of most tabanid species caught in the center trap (Trap III). Only the numbers of *S. notatus* and *T. kesseli* caught in the center trap were significantly less than the numbers caught in one of the 4 corner traps (Tables 5 and 6). Wind direction also had no marked effect on tabanid catches in different traps as it did for the *Symphoromyia* species (Anderson & Hoy 1972). Thus, the more uniform occurrence of tabanids than snipe flies in all traps probably was related to their being stronger fliers than snipe flies and to their known visual response to traps and targets of different colors (Bracken, Hanec & Thorsteinson 1962, Morris 1963, Thorsteinson, Bracken & Hanec 1965). Although white is not very attractive to most tabanids (Barrass 1960, Bracken, Hanec & Thorsteinson 1962, Hansens 1947), the contrast between the white traps and the surrounding green grass, trees and shrubs made them very conspicuous. It also is commonly known that many species of tabanids, particularly the larger ones, disperse throughout unsheltered pastures where they attack livestock.

Table 7. A comparison of tabanids caught in traps and observed at hosts from 27 May through 15 June 1966.

| Fly Site | No. flies per sampling unit[a] | Adjusted no. flies per sampling unit[b] |
|---|---|---|
| Traps | 183 | 183 |
| Deer | 9 | 18 |

[a] Mean number of flies/trap or host.
[b] Adjustment for hosts is 2× the actual number observed/sampling unit. This is based arbitrarily on the fact that tabanids commonly require about 4 minutes to feed (e.g. Philip 1931, and personal observations) and instantaneous fly counts were made on a host only at 10 minute intervals between 0800 and 1700 hrs.

*Tabanids Feeding on Deer.* Females of 9 of the 14 species listed in Table 1 fed on deer, at least occasionally. Of the more common species trapped only *H. aasa* and *C. coquillettii* were not collected from or specifically recognized when feeding on deer. None of the last 3 species in Table 1 were collected from or seen feeding on deer. *Tabanus punctifer*, readily distinguished from the other local fauna, commonly was observed feeding on deer, whereas the remaining 8 species in Table 1 all were collected while feeding on deer. A total of 37 tabanids was observed feeding on deer from 27 May through 15 June; they fed at temperatures between 21.1–37.8°C. Two specimens fed between 0800–1100 hrs, 26 between 1100–1400 hrs, and 9 between 1400–1700 hrs.

Other species caught feeding on deer were *H. procyon* in March and April, and *C. proclivis proclivis* in June. All *Chrysops* species fed on the face and ears of deer, whereas the 2 *Silvius* species most commonly attacked the rear legs. The larger, more robust *T. kesseli* and *T. punctifer* usually fed on the neck, but occasionally on the back and rarely on the side of the face. Like the *Chrysops* species, *H. procyon* fed on the faces of deer, and recently it was found to be the principal vector of the arterial worm, *Elaeophora schneideri*, to deer in the Hopland study area (Anderson & Weinmann, Weinmann, *et al.* 1973). The above feeding sites are essentially the same as those observed for related fauna in eastern Canada (Smith, Davies & Golini 1970).

*Trap Efficiency for Tabanids.* In general, the traps caught more tabanids than would be expected from concurrent observations of the deer. On average, a trap caught about 10 times as many tabanids as were observed at a host deer (Table 7), whereas about the same number of *Symphoromyia* species were caught in a trap as were seen at a host (Anderson & Hoy 1972). Everett & Lancaster (1968) and Wilson (1968) also caught far more tabanids in $CO_2$-baited traps than were seen attacking cattle.

With respect to the number of blood meals taken from deer in 1964 and 1965, Hoy (1966) found that tabanids were outnumbered by *Symphoromyia* species by 40 or 50 to one. On the 13 trapping days from 27 May through 15 June 1966, 1369 *Symphoromyia* species were seen feeding on deer (Anderson & Hoy 1972) versus only 37 tabanids.

## SUMMARY

A total of 18 species of tabanid females was caught in $CO_2$-baited traps between 6 April and 26 June 1966. The baited traps caught about 10 times as many female tabanids as were observed at deer, and there were fewer significant differences among trap site catches for the most abundant tabanid species than for species of *Symphoromyia* previously studied. Wind direction and the percentage canopy cover surrounding traps had little effect on tabanid catches at various trap sites. The ratio of tabanids caught in dry ice-baited versus unbaited traps was 57:1.

Daily host-seeking activity of various tabanid species occurred within well-defined temperature ranges; for all species activity was suppressed below 23.9 and above 32.2°C. Normal host-seeking times for most species were markedly altered on hot days (daily maximum temperature above 32.2°C). Eleven of the 18 species trapped fed on deer at temperatures between 21.1 and 37.8°C; species of *Chrysops* fed on the face and ears, *Silvius* most commonly on the rear legs, *Hybomitra* on the face, and *Tabanus* on the neck, back, and rarely the face. The ratio of *Symphoromyia*:tabanid species feeding on deer was about 40:1.

## ACKNOWLEDGMENTS

We thank Dr. W. M. Longhurst (University of California, Davis), Resident Zoologist, Mr. A. H. Murphy, Supervisor, and Mr. G. Connolly, Research Technician, all of the University of California Hopland Field Station, for their aid in making this study possible. We also thank Dr. H. F. Heady and Dr. D. Carneggie, School of Forestry and Conservation, University of California, Berkeley, for their provision of and assistance with aerial photographs, and Dr. C. B. Philip, California Academy of Science, San Francisco, California, who identified some of the tabanid species and confirmed the identification of most others.

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