# LIPID CONTENTS OF SOME OVERWINTERING ADULT MOSQUITOES COLLECTED FROM DIFFERENT PARTS OF NORTHERN CALIFORNIA

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ABSTRACT. *Anopheles freeborni, Anopheles punctipennis, Anopheles franciscanus,* and *Culex apicalis* adults were collected from the eastern and from the western foothills of Northern California during the 1972-73 overwintering period. No differences in the changes of lipid content were apparent between these areas. There appears to be little change in the lipid content of *A. franciscanus* and *C. apicalis* adults from October through December with a slight decline in January. *A. punctipennis* and *A. freeborni* show a large build-up of lipids at the initial part of the overwintering period and then a gradual decline during the winter months. The build-up of lipids in *A. punctipennis* appears to occur slightly later in the fall than for *A. freeborni.*

INTRODUCTION. In previous studies on the overwintering biology of California mosquitoes, we reported on the composition and changes of the lipids of *Culex tarsalis* Coquillett and *Anopheles freeborni* Aitken in the Sacramento Valley (Schaefer and Washino, 1969, 1970), that the timing of lipid synthesis in *C. tarsalis* in the San Joaquin Valley was the same (Schaefer *et al,* 1971), and on the identities, amounts and sources of energy which adults utilize for the production of overwintering energy stores (Schaefer and Miura, 1972). During the 1972-73 overwintering period, we investigated changes in the lipid content of anopheline species in two different habitats. One of these, Pleasants Valley, is a foothill location at the base of the interior coastal range, Solano County, on the western margins of the Central Valley. Collections were made from a barn, situated near a creek, at approximately 800 to 1,000 feet elevation. The site was basically an oak chaparral area that is now predominantly walnut and prune orchards. The second sampling area, Folsom and Wolfe Creek, is in the foothills along the eastern edge of the Central Valley. Collections were made from under a bridge near Folsom, Sacramento County, at approximately 200 feet elevation and from a culvert and under a bridge at Wolfe Creek, Nevada County, at approximately 1,300 feet elevation. The vegetation is predominantly blue oak and interior live oak at Folsom and ponderosa pine at Wolfe Creek.

MATERIALS AND METHODS. At biweekly intervals from October through January adult mosquitoes were collected by aspiration from the study areas described above. Only the empty females (those with neither blood nor eggs) were utilized; these adults were pooled by species and collection date and the fresh weights of each group were determined. The samples were then frozen and held at -20°C until analysis. Lipid contents were determined as previously described (Schaefer and Washino, 1969). While it was intended to limit the study to anopheline species, *Culex apicalis* Adams adults were also included because we had no knowledge of their lipid content and in previous work (Schaefer and Miura, 1972) the sugar composition of their crop liquids had been reported. It was necessary to lump samples of *Anopheles franciscanus* McCracken from both locations into groups based on collection dates in order to have enough mass to determine lipid content.

RESULTS AND DISCUSSION. Table 1 shows the numbers and physiological conditions of adults collected from October 3, 1972 until January 24, 1973 and also for February, 1973. It is readily apparent that blood feeding is minimal during the overwintering period as previously established (Washino and Bailey, 1970; Washino,

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1970). Blood feeding and gonotrophic activity was initiated during February at Folsom-Wolfe Creek but not at Pleasants Valley. Although only half as many adults were collected at Pleasants Valley during February, as compared to Folsom-Wolfe Creek, the lack of indications of blood feeding or gonotrophic activity there appears real.

The number of adults collected on each date, their wet weights, the lipid contents of *Anopheles punctipennis* (Say), *A. freeborni* and *C. apicalis* and the number and wet weights of *A. franciscanus* are given for each collection area in Tables 2 and 3. It is readily apparent that the population densities of *A. punctipennis, A. freeborni* and *C. apicalis* were higher at Folsom-Wolfe Creek than at Pleasants Valley and that the opposite is true for *A. franciscanus. A. freeborni* was the most abundant species at Folsom-Wolfe Creek but *A. punctipennis* occurred in larger numbers at Pleasants Valley. The pattern of lipid build-up and change in *A. freeborni* was the same as previously reported (Schaefer *et al,* 1971) and there was no difference in this pattern between the two study areas. The same pattern of lipid increase during October occurred at both locations for *A. punctipennis* as well as the same gradual decline during the winter months; the fall build-up of lipids seems to occur later for *A. punctipennis* than for *A. freeborni.* The lipid content of adult *C. apicalis* remained fairly constant from October through December at Folsom-Wolfe Creek and did not show the large increase during late October and November as found previously with *C. tarsalis* (Schaefer and Washino, 1970). The same pattern for *C. apicalis* also appears to occur at Pleasants Valley, but the numbers were too low on most of the collection dates to allow certainty.

Since the numbers of *A. franciscanus* adults collected were quite small and since there were no indications of differences in the lipid content pattern of the other species between the two study areas, they were lumped into four collection date categories and four lipid analyses were made and are shown in Table 4. There appears to be little, if any, change in lipid content from October through December and a decline in January; this same pattern occurred with *C. apicalis* in contrast to the large fall build-up and gradual winter decline as occurs with *A. freeborni* and *A. punctipennis.*

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TABLE 1.—Summary of adult mosquito collections made during the study period.

| Collection period | Species | No. empty | No. blooded | No. gravid | Total no. |
|---|---|---|---|---|---|
| 10/3/72-1/24/73 | | Folsom-Wolfe Creek | | | |
| | *A. freeborni* | 1637 | 11 | 0 | 1648 |
| | *A. punctipennis* | 628 | 0 | 1 | 629 |
| | *A. franciscanus* | 29 | 0 | 0 | 29 |
| | *C. apicalis* | 441 | 0 | 0 | 441 |
| February, 1973 | | | | | |
| | *A. freeborni* | 22 | 25 | 2 | 49 |
| | *A. punctipennis* | 23 | 7 | 0 | 30 |
| | *A. franciscanus* | 1 | 0 | 0 | 1 |
| | *C. apicalis* | 30 | 0 | 0 | 30 |
| 10/10/72-1/31/73 | | Pleasants Valley | | | |
| | *A. freeborni* | 98 | 0 | 0 | 98 |
| | *A. punctipennis* | 429 | 0 | 0 | 429 |
| | *A. franciscanus* | 53 | 1 | 0 | 54 |
| | *C. apicalis* | 59 | 0 | 0 | 59 |
| February, 1973 | | | | | |
| | *A. freeborni* | 14 | 0 | 0 | 14 |
| | *A. punctipennis* | 23 | 0 | 0 | 23 |
| | *A. franciscanus* | 0 | 0 | 0 | 0 |
| | *C. apicalis* | 17 | 0 | 0 | 17 |

TABLE 2.—Lipid content of adult mosquitoes collected October, 1972 through January, 1973 at Folsom-Wolfe Creek.

| Collection date | *Anopheles punctipennis* | | | *Anopheles freeborni* | | | *Anopheles franciscanus* | | *Culex apicalis* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | mg/adult (wet wt.) | lipid/ adult (mg) | No. | mg/adult (wet wt.) | lipid/ adult (mg) | No. | mg/adult (wet wt.) | No. | mg/adult (wet wt.) | lipid/ adult (mg) |
| 10/3 | 14 | 2.44 | .27 | 165 | 3.24 | .55 | | | 1 | 2.05 | — |
| 10/17 | 19 | 2.66 | .48 | 283 | 3.23 | .58 | 10 | 2.36 | 28 | 1.68 | .24 |
| 11/1 | 64 | 2.50 | .44 | 297 | 3.24 | .54 | 4 | 2.33 | 110 | 1.50 | .26 |
| 11/14 | 154 | 2.38 | .40 | 349 | 3.46 | .50 | 4 | 2.54 | 95 | 1.45 | .24 |
| 11/28 | 127 | 1.84 | .34 | 237 | 2.84 | .39 | 2 | 2.01 | 33 | 1.60 | .24 |
| 12/13 | 15 | 2.02 | .36 | 50 | 2.64 | .41 | 0 | — | 7 | 1.28 | .21 |
| 12/26 | 90 | 2.04 | .28 | 175 | 2.76 | — | 1 | 1.98 | 56 | 1.39 | .25 |
| 1/10 | 13 | 2.43 | .26 | 23 | 2.60 | .34 | 0 | — | 28 | 1.41 | .20 |
| 1/24 | 77 | 1.77 | .21 | 83 | 2.42 | .31 | 4 | 1.53 | 83 | 1.20 | .19 |

TABLE 3.—Lipid content of adult mosquitoes collected October, 1972 through January, 1973 at Pleasants Valley.

| Collection date | *Anopheles punctipennis* | | | *Anopheles freeborni* | | | *Anopheles franciscanus* | | *Culex apicalis* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | mg/adult (wet wt.) | lipid/ adult (mg) | No. | mg/adult (wet wt.) | lipid/ adult (mg) | No. | mg/adult (wet wt.) | No. | mg/adult (wet wt.) | lipid/ adult (mg) |
| 10/10 | 41 | 2.84 | .25 | 28 | 3.96 | .57 | 7 | 1.89 | 1 | 1.68 | — |
| 10/24 | 90 | 2.88 | .47 | 20 | 3.44 | .50 | 8 | 2.87 | 9 | 1.64 | .20 |
| 11/7 | 85 | — | .43 | 16 | 3.99 | .57 | 15 | 2.41 | 22 | 1.91 | .23 |
| 11/21 | 66 | 2.29 | .37 | 13 | 2.94 | .47 | 10 | 2.01 | 12 | 1.62 | .22 |
| 12/5 | 65 | 2.45 | .34 | 5 | 2.89 | .51 | 2 | 2.56 | 6 | 1.74 | .30 |
| 12/19 | 33 | 2.44 | .35 | 8 | 2.73 | .40 | 9 | 2.13 | 7 | 1.55 | .25 |
| 1/2 | 15 | 2.41 | .27 | 2 | 2.25 | — | 2 | 2.78 | 1 | 1.65 | — |
| 1/31 | 34 | — | .17 | 7 | 2.90 | .27 | 1 | 2.19 | 2 | 1.45 | — |

TABLE 4.—Lipid content of *Anopheles franciscanus* adults from both locations pooled by collection dates.

| Collection period | Number | mg/adult (wet wt.) | lipid/adult (mg) |
|---|---|---|---|
| 10/10/72 to 10/24/72 | 22 | 2.72 | 0.29 |
| 11/1/72 to 11/28/72 | 35 | 2.28 | 0.30 |
| 12/5/72 to 12/26/72 | 12 | 2.19 | 0.29 |
| 1/2/73 to 1/31/73 | 7 | 1.50 | 0.25 |

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