# SEASONAL OCCURRENCE OF *CULISETA INCIDENS* IN FOOTHILLS OF FRESNO COUNTY, CALIFORNIA [1, 2]

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ABSTRACT. Data from a 5-year collection of *Culiseta incidens* (Thomson) in the foothill area of Fresno County confirm this species is a cold weather mosquito; peak abundance appeared in the winter months and the winter population was mostly composed of teneral and parous females. The blood meals that were identified were from domestic cattle and horses. The average time period from 1st-instar larvae to adult emergence was 44 days and 47 days respectively for males and females in a natural breeding site.

*Culiseta incidens* (Thomson) occurs predominantly in North America from the Rocky Mountains west and north to Alaska (Freeborn and Bohart 1951, Carpenter and LaCasse 1955). In the San Francisco Bay area of California, it is a common mosquito which breeds in artificial containers and shaded pools throughout the year (Hubert 1953). However, in the San Joaquin Valley, it is known as a winter mosquito because it occurs during winter and spring months in foothill areas, and as the season advances it breeds at progressively higher elevations (Abell 1959, Lindegren 1966).

Because it is a potential vector of viral encephalitis (Hammon and Reeves 1943, Reeves and Hammon 1946), *Cs. incidens* has been colonized, and some biological studies were conducted in the laboratory (Hubert 1953, Lindegren 1966, Lee 1973a, b). However, very little is known about its biology, such as seasonal abundance, development of immature stages, reproductive physiology, and host range in nature.

MATERIALS AND METHODS. Most of this study was concurrently conducted with the 5-year study of seasonal occurrence and physiology of *Culex tarsalis* Coquillett which has been reported by Kliewer et al. (1969), and the study area and methods used for collection and dissection of mosquitoes were the same. In brief, the study area lies south of Pine Flat Dam in Tretten Canyon about 26 mi. east of Fresno. The collecting stations (culverts) were in a relatively narrow V-shaped part of the canyon; waterflow fluctuated from a full rushing stream in the winters to dryness in the summers. Elevation of the culverts ranged from 750 to 1,600 feet. Collections were made twice weekly during the winters and every 2 wk during the summers with an aspirator and flashlight. Mosquitoes were collected in cartons (0.5 gal) which were held in an ice chest for transport to the laboratory. In the laboratory, mosquitoes were anesthetized with chloroform and the following information was recorded:

1. Identification of species.
2. The degree of rotation of male terminalia.
3. Gut contents of females, i.e., + or − of the meconium and blood meal.
4. Stage of egg development, i.e., Christopher's Stage I through V.
5. Parity determination, i.e., looseness of ovarian tissue and uncoiled tracheole skeins (Burdick and Kardos 1963).

All dissections were made in 0.675% NaCl solution with a dissecting microscope. Weather data, temperatures and rainfall are obtained from the U. S. Army

[1] This study was supported by the University of California, State Department of Health Mosquito Project.

[2] The blood meal identifications were supported in part by Grant AI-03028 from the National Institute of Allergy and Infectious Diseases.

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Fig. 1. Rearing containers used in isolating immature stages of *Cs. incidens* for observing development under natural conditions. Insert—close-up of a container showing float (A), and screen covered windows (B). Arrows indicate edges of a window.

Corps of Engineers at Pine Flat Dam about 5 miles north of the study area.

Observations of the developmental rate of immature stages under natural conditions were conducted during February and April when the *Culiseta* population was most abundant. An isolated lateral pool, located at the edge of Mill Creek Canyon and Tretten Canyon, was used. It is about 0.1 acre and partially sheltered by surrounding oak, sycamore, and willow trees. Although the pool favored the accumulation of leaf litters, the water remained moderately clean throughout the flow season. Floating cages (opaque polyethylene sandwich boxes, 13 x 13 x 7

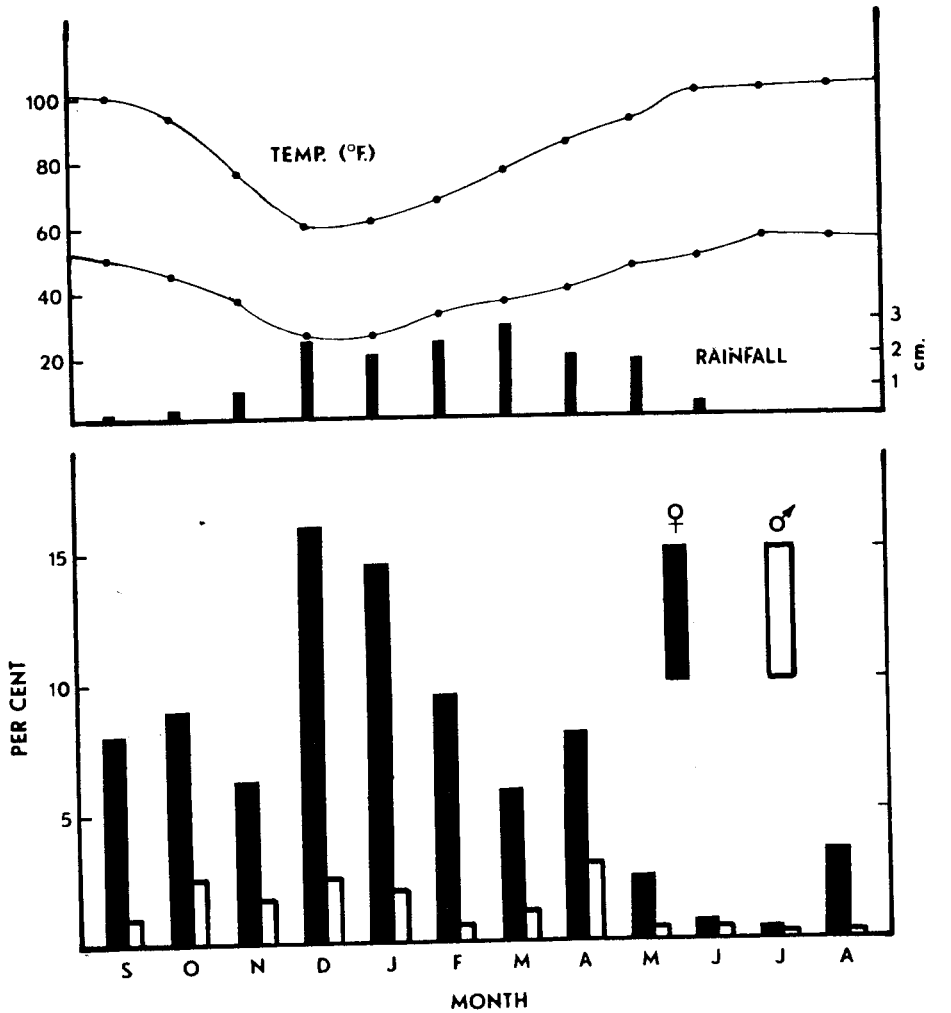


Fig. 2. A 5-year monthly average collection (%) of *Cs. incidens* in foothills of Fresno County, California (1961–1966). Maximum and minimum temperatures (°F) and precipitation (cm) plotted by month.

cm), with their 2 sides covered by a fine nylon net to permit circulation of water, were used as containers to study the young stages of larvae (1st-, 2nd-, and 3rd-instars). The depth of water within cages was kept at ca. 5 cm by means of floats which were affixed on the side (Fig. 1). For observing late stages (4th-stage larvae and pupae), brass screen cages (40 mesh, 30 cm diameter, 28 cm depth) were used (Fig. 1).

Seven hundred or more 8 hr (0 to 16 hr) old, 1st-instar larvae obtained from egg rafts laid by wild caught females were placed in the containers. Daily observations were made of the larvae and pupae. Sexes and number of adults emerging were determined by examining and counting pupal exuviae. The water temperature in the pool was recorded by a portable recording thermograph with remote probe.

The method for handling and shipping mosquitoes and for the identification of blood meals have been described (Tempelis and Lofy 1963, Tempelis et al. 1967).

RESULTS AND DISCUSSION. A 5-year monthly average collection of *Cs. incidens* from culverts in the foothill area is shown in Fig. 2. Culverts may not be the preferred resting sites for mosquitoes in nature, but they are readily accessible landmarks in which the relative abundance of mosquitoes may be determined. Adult mosquitoes were most abundant during fall and winter months; the buildup and decline of populations appeared to be influenced by the number of available breeding sites (intermittent isolated pools along creeks) and availability of host animals. Only a small number of males were collected each month during the year, and the proportion of males to females remained relatively constant. However, sex ratio of the species cannot be estimated from the culvert collection because the en-

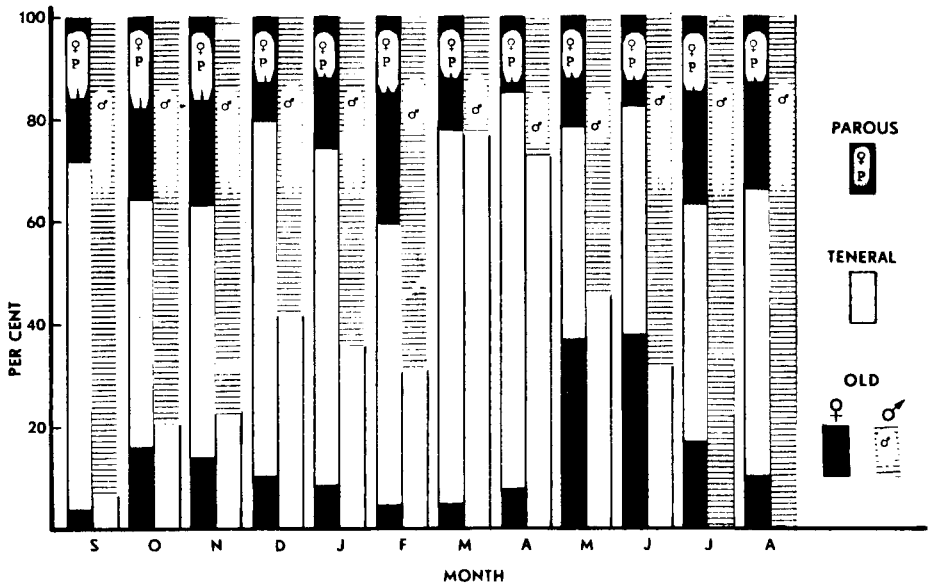


Fig. 3. Monthly reproductive activity (%) of female and male *Cs. incidens* in foothills of Fresno County, California (1961–1966). Parous females are shown in ♀P columns; teneral females in open columns; old gonotrophically inactive females in solid columns. Males with completely rotated terminalia are shown in ♂ columns; males with partillay rotated terminalia in open columns.

vironmental characteristics of this habitat may not be equally attractive to both sexes and also because the sample sizes were too small to provide meaningful estimation other than to show the presence of both sexes.

Fig. 3 summarizes the seasonal reproductive activity of *C. incidens*. Although no larvae were collected during June and July from this area, parous females were present throughout the year. During the period of the year when samples were substantial (i.e., September through April), the peak parous population occurred in February indicating maximum egg-laying activity during this period. Teneral adults similarly reached their peak during the colder months. These results are in agreement with those of Abell (1959) who showed that *C. incidens* larvae were most abundant during November through April in a ⅓ mile section of Dry Creek in Fresno County. Very old females (gonotrophically inactive) were also collected year-round; their proportion increased from March to July.

A total of 189 blood meals from *C. incidens* were identified (Table 1). All females tested fed on mammals. All identified blood meals were either from cattle or horses. In the area of the collection stations, cattle and horses were present. The sudden June through April decline from 10% to 0% in the proportion of females feeding on horses may reflect host availability rather than changes in the feeding behavior of mosquitoes. Blood feeding continued through August, but the collections of engorged females were small. No engorged specimens were kept for identification. The finding that this species preferred to feed on larger mammals is in agreement with those results previously reported (Reeves and Hammon 1944, Tempelis and Washino 1967).

Fig. 4 illustrates developmental rates of immature stages in a natural site during their breeding season. It took an average of 8 (6–9) days for 1st, 14 (11–16) days for 2nd, 25 (21–29) days for 3rd, 37 (30–45 days for 4th to complete each larval stage. First males emerged on the 35th day and last ones on the 46th day after hatch. First females were obtained on the 36th day and last ones on the 53rd day. Although culvert collections indicated a very low proportion to females, the sex ratio of this species is probably 1:1; 245 females and 209 males were obtained in samples taken during this study.

ACKNOWLEDGMENTS. We express our appreciation to those who contributed to this study. M. M. Boreham, C. H. Hurst, C. M. Myers, B. Rosay, T. A. Smith, and G. Yosimura contributed in laboratory and field work.

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Table 1. Feeding pattern of *Cs. incidens* collected from foothill area of Fresno County, California (1965–1966).

| | Sept. | Oct | Nov | Dec | Jan | Feb | Mar | Apr | Total |
|---|---|---|---|---|---|---|---|---|---|
| | Seasonal feeding | | | | | | | | |
| Total females collected | 108 | 100 | 122 | 257 | 127 | 121 | 57 | 52 | 944 |
| No. tested | 19 | 48 | 59 | 13 | 23 | 48 | 7 | 5 | 222 |
| No. reacted | 17 | 44 | 53 | 10 | 17 | 38 | 6 | 4 | 189[1] |
| | Host preference | | | | | | | | |
| Cattle (%)[2] | 88.2 | 90.9 | 92.5 | 90 | 100 | 100 | 100 | 100 | 95.2 |
| Horse (%) | 11.8 | 9.1 | 7.5 | 10 | 0 | 0 | 0 | 0 | 4.8 |

[1] Includes 7 feedings on mammals that failed to react with more specific antisera.
[2] Percentage based on only identified blood meals.

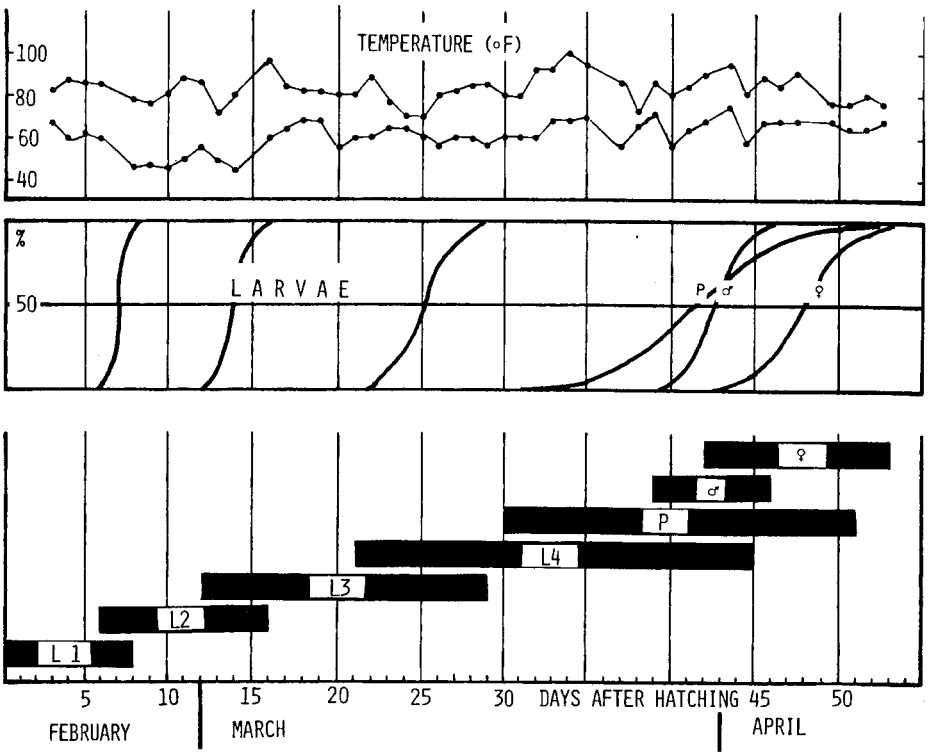


Fig. 4. Growth rate of immature stages of *Cs. incidens* in foothills of Fresno County, California (1966). Duration of stages (horizontal bars), cumulate percent of metamorphoses (sigmoid curve), and daily maximum/minimum water temperatures.

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