

Stone

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OBSERVATIONS ON THE DISTRIBUTION AND ECOLOGY OF MOUNTAIN AEDES MOSQUITOES IN CALIFORNIA

I. Species and Their Habitats^{1/}

Stanley J. Carpenter^{2/}

The rapid increase of the human population in the valleys and coastal areas in California since World War II is bringing about a much greater use of the Sierra Nevada, the Cascade Range, and other mountainous areas for recreational purposes. Most of the people using the mountains for recreation come from localities where mosquitoes either do not present an important problem or where organized mosquito control exists, and they are not inclined to be tolerant of biting mosquitoes. Mountain *Aedes*, often referred to as "snow mosquitoes" since they develop in pools resulting more or less from melting snow, constitute an obstacle to the full enjoyment of many of the mountainous areas of California during the spring and summer months.

A study is now underway by the Bureau of Vector Control of the California State Department of Public Health for the purpose of gathering information on the distribution and ecology of the mountain *Aedes* in California. A great deal of basic information was already available on mosquitoes of the Sierra Nevada and the Cascade Range, but it consists largely of information gathered by individuals on weekend or

vacation trips to the mountains. Much of the information is found in *The Mosquitoes of California* by Freeborn (1926). Bohart (1950) published information on observations he made on snow mosquitoes in the central and northern Sierra Nevada during the spring months of 1947, 1948, and 1949. Additional observations on these mosquitoes in California are recorded in publications by Dyar (1916), Johnson and Thurman (1950), Freeborn and Bohart (1951), Loomis *et al.* (1956), Richards *et al.* (1956), Grudhaus (1959), Chapman (1959a), and Nielsen (1961). Chapman (1959b, 1961) reported on a study of snow-water mosquitoes in the adjoining state of Nevada.

During the spring and summer of 1960 and 1961, the writer spent two weeks of each month in the mountains of California on this study. In 1960, field work was started during the first week of April and continued through August. The work was confined to the Sierra Nevada from Mono and Mariposa counties north to Plumas county. The mild winter of 1960-61 made it possible to reach many of the mosquito breeding sites in the Sierra Nevada during the last week of March. Thus in 1961, field work was started in March and continued through August. Observations were made again throughout most of the same area and were extended north to Lassen, Tehama, Shasta, and Siskiyou counties (Figure 1).

^{1/} The first of a series of articles on mountain *Aedes* in California which will appear in *California Vector Views*.

^{2/} Bureau of Vector Control, California State Department of Public Health.

The so-called "snow *Aedes*" are usually common in the colder parts of the Northern Hemisphere. They

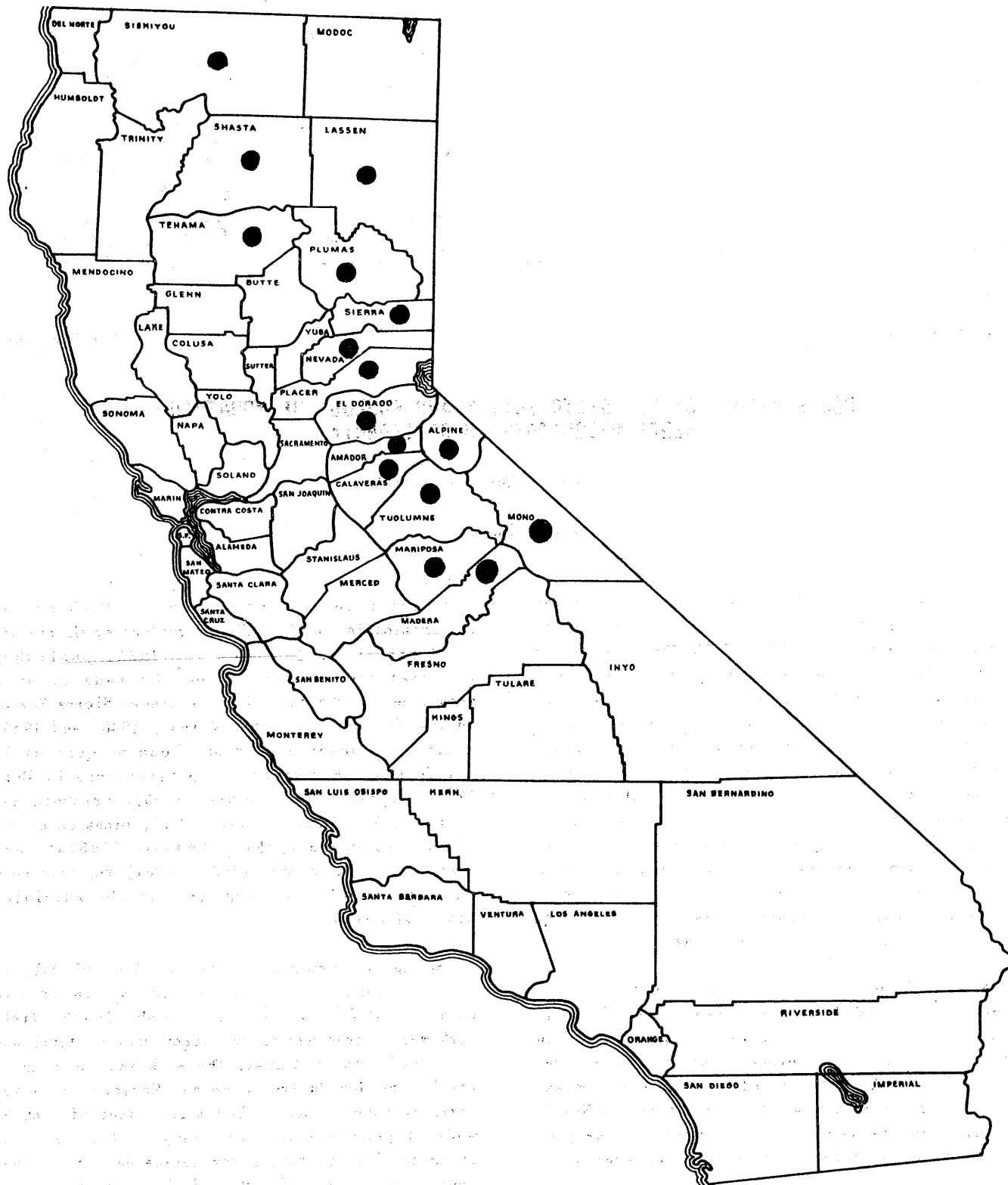


Figure 1. Location of Mountain Aedes Studies, (1960-61).

are widely distributed in Alaska, Canada, and northern United States. Where they extend to the south, most species of the group become restricted to progressively higher elevations. Such is the case in California.

All of the California species except *A. cinereus* belong to the subgenus *Ochlerotatus* which contains some of the most difficult species of mosquitoes to distinguish taxonomically. The nine species of mountain *Aedes* that are now recognized in California are as follows:

1. *Aedes cataphylla* Dyar, which has a wide distribution in northern Europe, Asia, and the Rocky Mountain region of Canada and the United States, is common in many of the meadows of the Sierra Nevada.

2. *Aedes communis* (DeGeer) is a Holarctic species widely distributed in northern United States south to New Jersey and Pennsylvania in the East, and Nevada and California in the West. It is one of the most abundant and annoying pest mosquitoes in the coniferous forests at higher elevations in the Sierra Nevada.

3. *Aedes fitchii* (Felt and Young) has a wide distribution in Canada and the northern United States and extends south through the Sierra Nevada of California.

4. *Aedes hexodontus* Dyar belongs to the *punctor* complex which has a Holarctic distribution. It occurs in western Canada and western United States, southward in California along the crest of the Sierra Nevada.

5. *Aedes increpitus* Dyar occurs in southwestern Canada and western United States south to Arizona and southern California. It is a widespread "snow mosquito" in the mountains of California and also occurs in the valleys and Coast Range practically to sea level.

6. *Aedes pullatus* (Coquillett) is a snow mosquito occurring mainly in mountainous areas of Europe, western Canada, and western United States. It is apparently rare in California where it has been collected at a few localities in the higher regions of the Sierra Nevada.

7. *Aedes schizopinax* Dyar occurs in western United States, for the most part in the Great Basin. It has been found in several localities in California, mostly east of the crest of the Sierra Nevada.

8. *Aedes ventrovittis* Dyar is commonly known as the "little black mosquito" of the High Sierra. It is known from the mountains of western United States and appears to reach its greatest abundance in the Sierran meadows of California where it can be extremely annoying following the melting of the snow.

9. *Aedes cinereus* Meigen is the sole representative of the subgenus *Aedes* in North America. It is found throughout much of the Holarctic region and occurs throughout most of the United States except the arid Southwest. It is not a common mosquito in California where it is found throughout much of the Sierra Nevada northward.

For the most part the species treated here as mountain *Aedes* exhibit a preference for moderate to high elevations depending on the latitude. Elevation is also one of several factors affecting seasonal occurrence and distribution of a species. Observations made on mountain *Aedes* during the two-year period covered in this report took place at elevations between 3,500 and 10,000 feet (Table 1).

Table 1. ELEVATIONS OF *AEDES* COLLECTIONS (1960-61)

ELEVATIONS (Feet)	NUMBER OF COLLECTIONS	NUMBERS OF COLLECTIONS CONTAINING EACH SPECIES								
		<i>A. cataphylla</i>	<i>A. cinereus</i>	<i>A. communis</i>	<i>A. fitchii</i>	<i>A. hexodontus</i>	<i>A. increpitus</i>	<i>A. pullatus</i>	<i>A. schizopinax</i>	<i>A. ventrovittis</i>
3,500- 4,000	6	0	0	0	6	0	2	0	0	0
4,000- 4,500	21	2	1	0	12	3	13	0	0	0
4,500- 5,000	17	4	2	2	7	8	11	0	0	0
5,000- 5,500	44	5	0	12	16	22	24	0	1	8
5,500- 6,000	46	9	3	30	10	9	12	0	0	4
6,000- 6,500	55	25	6	6	15	22	18	0	2	10
6,500- 7,000	51	18	4	29	9	22	17	0	0	8
7,000- 7,500	52	19	8	23	19	32	11	0	1	9
7,500- 8,000	38	15	0	13	9	18	9	0	14	2
8,000- 8,500	25	2	1	14	2	13	1	0	0	11
8,500- 9,000	25	2	0	17	3	11	1	0	0	7
9,000- 9,500	5	0	0	1	1	3	0	0	0	3
9,500-10,000	9	1	0	3	5	4	0	3	0	6

Snowfall was light in the Sierra Nevada during the winters 1959-60 and 1960-61. Snowfall and rainfall are usually heavier on the western slope of Sierra than on the more abrupt eastern slope within the precipitation shadow of the mountains. As a result of rather heavy precipitation, the western slope is largely covered with coniferous forests which are dense in some localities. Mosquito larval habitats in this area usually consist of woodland pools or pools in large and small meadows. The coniferous forests appear to be encroaching on the meadows in many areas.

Most of the eastern slope of the Sierra Nevada is either sparse coniferous forest which appears to be receding or is semi-desert or desert-like. Even though this area gets less precipitation, it has a great variety of larval habitats and generally supports a greater variety of mosquito fauna than is found west of the crest. The snow usually melts earlier on the eastern slope, and mosquitoes hatch

and emerge somewhat earlier in the season.

Larvae and pupae were collected from mosquito breeding sites throughout the study area. A representative number of larvae from each collection site was preserved for identification and record purposes on the day the collection was made. Some larvae were kept alive until they pupated. The pupae were picked daily and transferred to rearing vials from which adult mosquitoes were subsequently killed and pinned. The remaining larvae were carried to the laboratory for further rearing or preserving.

The species associations of the immature stages of mountain *Aedes* represented in collections made during the two-year period are shown in Table 2. The numbers represent the number of times two species were found together in the same habitat. The total number of times each species was collected is also shown.

Table 2. SPECIES ASSOCIATIONS OF IMMATURE STAGES OF *Aedes* (1960-61)

SPECIES	Times Collected	Times Collected Alone	TIMES COLLECTED WITH OTHER SPECIES								
			<i>A. cataphylla</i>	<i>A. cinereus</i>	<i>A. communis</i>	<i>A. fitchii</i>	<i>A. hexodontus</i>	<i>A. increpitus</i>	<i>A. pullatus</i>	<i>A. schizopinax</i>	<i>A. ventrovittis</i>
<i>A. cataphylla</i>	90	12		5	16	39	52	26	1	9	17
<i>A. cinereus</i>	22	1	5		4	11	12	12	0	1	1
<i>A. communis</i>	97	44	16	4		17	34	25	1	1	4
<i>A. fitchii</i>	104	19	39	11	17		38	40	2	3	8
<i>A. hexodontus</i>	143	28	52	12	34	38		44	3	9	22
<i>A. increpitus</i>	105	15	26	12	25	40	44		0	8	4
<i>A. pullatus</i>	3	0	1	0	1	2	3	0		0	1
<i>A. schizopinax</i>	18	2	9	1	1	3	9	8	0		0
<i>A. ventrovittis</i>	27	0	17	1	4	8	22	4	1	0	

Most of the adult mosquitoes attracted and captured during 1960 and 1961 represent collections made during the daytime or early evening. The collecting period was usually ten minutes during which samples of attacking mosquitoes were captured with an aspirator. A midge net was frequently used for collecting mosquitoes seen flying or resting on vegetation, particularly near breeding sites. A net was not generally used for collecting female mosquitoes attempting to bite because mosquitoes are frequently damaged beyond recognition when captured in a net.

There was very little biting activity of female mountain *Aedes* noted on cold or windy days, except for *A. ventrovittis* which was observed to attack even during moderately cold or windy weather. The cold nights so common at high elevations in this area limit the activity of adult mountain *Aedes*.

While observing mosquitoes attracted to the collector in the High Sierra, one is impressed with the fact that these mosquitoes are seldom encountered in large numbers except in close proximity to their breeding sites. Even in areas of heavy mosquito production their numbers decrease rapidly following emergence, and a serious mosquito problem is of a relatively short duration.

Adult collections were made of female mountain *Aedes* attracted to the collector in many localities

in the study area. During both years, adult mosquitoes were present from late April through early August. Although observations made during the two-year period are based on limited material, they indicate that *A. communis*, *A. ventrovittis*, and *A. hexodontus* were the more troublesome species in the study area, and that *A. increpitus*, *A. fitchii*, *A. cataphylla*, and *A. cinereus* were less important (Table 3).

Table 3. *AEDES* CAPTURED WHILE ATTEMPTING TO BITE

SPECIES	1960		1961	
	Times Taken	Number Caught	Times Taken	Number Caught
<i>A. communis</i>	35	183	25	122
<i>A. ventrovittis</i>	23	167	18	168
<i>A. hexodontus</i>	14	44	14	47
<i>A. increpitus</i>	8	12	4	16
<i>A. cataphylla</i>	5	6	5	9
<i>A. fitchii</i>	7	7	1	2
<i>A. cinereus</i>	0	0	2	6

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THE LEICA MANUAL (14th revised edition). By Willard D. Morgan. Morgan and Morgan; 456 pp.; \$6.95.

The publication of a completely revised edition of this well known manual will be of interest not only to those who use a Leica camera but also to those who use other types of 35 mm. cameras. It is written so that it will be useful to both beginning and advanced photographers.

This edition contains two new chapters on medical and press-industrial photography. The other subjects discussed in the manual are: Leica cameras and equipment, lenses, films and exposure, filters, outdoor photography, indoor and artificial light, negative developing, printing and enlarging, color photography, copying and close-ups, and slides and slide projection. There is also an illustrated section giving data on each of the Leica cameras that has been manufactured. One section that has been deleted from the previous edition is the 28 page section on developer formulas.

-- Richard P. Maynard.

CORRECTION

The capacity of the blower used by the Merced County Mosquito Abatement District for dusting underground pipelines is given as 500 cubic feet per minute on page 41 of the August 1961 issue of *California Vector Views*. This should be corrected to 4000 cubic feet per minute.

REFUSE COLLECTION AND DISPOSAL: AN ANNOTATED BIBLIOGRAPHY 1958-1959. By Edward R. Williams and Ralph J. Black. U.S. Public Health Service Publication No. 91, Supplement D. 1961; 73 pp.; \$0.45.

This supplement provides a brief abstract of 358 articles on refuse storage, collection, and disposal that were published in twenty-two periodicals and seven other publications during 1958 and 1959. The references are arranged by subject with an author index.

Copies of this supplement are for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.

LIFE CYCLE OF THE FLY. Text-Film Department, McGraw-Hill Book Co., New York. 1961; 13 minutes; \$80.00.

This 16 mm. film was made at the Pasteur Institute in Paris. The excellent photography clearly illustrates each of the stages in the life cycle of a blow fly. Parasitic wasps are erroneously referred to as ants and the introductory aquatic scenes may be misleading, but these points can be clarified by the person showing the film.

A copy of this film may be borrowed for use in California from the Film Library, Bureau of Health Education, California State Department of Public Health, Berkeley 4, California.

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Donald D. Linsdale, Editor

Wilbur I. Hoff, Benjamin Keh, Basil G. Markos, Thomas D. Mulhern, and Keith F. Murray, Associate Editors

SECOND-CLASS PERMIT APPROVED, Berkeley, California

Dr. Richard H. Foote
Division of Insects
U.S. National Museum
Washington 25, D.C.

SOUTH EAST ASIA MOSQUITO PROJECT
DEPARTMENT OF ENTOMOLOGY
SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM
WASHINGTON, D. C. 20560

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