

Mountain Mosquitoes of the Gothic, Colorado, Area^{1, 2}

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ABSTRACT: Mosquito species inhabiting a high mountain area (9000 to 12,000 feet) in south-central Colorado west of the Continental Divide comprised 11 *Aedes*, 4 *Culiseta*, 1 *Culex*, and 3 chaoborines. They can be placed by altitudinal associations in two major groups: 1) mountain species, subdivided into alpine (*A. impiger*) and subalpine (*A. cataphylla*, *communis*, *hexodontus*, *implicatus*, and *pullatus*; *Culiseta incidens*, *impatiens*, *inornata*; probably *Aedes fitchii* and *Culiseta alaskaensis*), and 2) valley and foothill species (*Aedes cinereus*, *dorsalis*, *inerepitus*, *spencerii idahoensis*, and *Culex tarsalis*). Seasonal development, abundance, and species dominance, as shown by four seasons of collecting, are discussed and illustrated by charts; notes on habits of adults and habitats of larvae, with associated species and collection records, are given for each species, along with pertinent taxonomic observations. The origin of the faunal elements represented by the 28 species of the Colorado Rockies is discussed. One species of mosquito (*Aedes trichurus* Dyar), taken east of the study area, and one chaoborine (*Eucorethra underwoodi* Und.) are listed as new state records.

INTRODUCTION

The mosquitoes of the higher mountains of western United States are primarily *Aedes* of the so-called "snow-water" group — univoltine species which develop from overwintered eggs in pools formed by melting snow water; young larvae appear while the pool is still surrounded by snowbanks or nearly completely covered with ice. Tremendous numbers of adults emerge by early summer, but by midsummer, except at very high altitudes, the numbers have dwindled, and they then gradually disappear. The large females of the genus *Culiseta*, which overwinter as adults, appear in early spring on warm days; these too disappear in early summer.

Because of the great abundance of these pests and the annoyance they cause, their identity, ecology, and distribution have been studied recently in several of the western areas — by Baker (1961) for the Front Range of Colorado (larvae only); by Carpenter (1961-62) and Bohart (1950) for California; by Chapman (1961) for Nevada; and by Nielsen & Rees (1961) for Utah. Although certain species are common to all of the mountainous areas, the exact composition and the seasonal and altitudinal distributions vary from one region to another. The present study deals with the mosquito fauna of a high mountain area (9000 to 12,500 ft) in south-central Colorado, west of the Continental Divide. Seasonal and altitudinal distributions, as

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well as ecological and taxonomic notes, are presented for both larvae and adults.

A brief list of the mosquitoes known to occur in Colorado was published in 1918 by Cockerell and enlarged upon by Dyar (1924) following his studies in the Grand Lake area (8000 to 10,000 ft). In 1949 Harmston reviewed all known state records, bringing the species list to 45. A comprehensive study of the ecology and altitudinal distribution of the 21 species found in the Front Range (4900 to 12,000 ft) has been published by Baker (1961), who made corrections in synonymy and added three species to Harmston's list (although the *Culex territans* Wlk. found by Baker is undoubtedly the species listed by Harmston as *C. apicalis* Adams, and hence not an addition). Sixteen culicine mosquitoes and three chaoborines are covered in the present paper. One species not included in the study can be added to the state list. A single female of *Aedes trichurus* (Dyar) was captured on 1 or 2 July 1957. Unfortunately it is not certain whether the specimen was collected at Monarch Pass summit or on the Rampart Range road above the Garden of the Gods at Manitou Springs.

Field studies were centered at the Rocky Mountain Biological Laboratory in Gothic (altitude 9500 ft or about 2900 m; lat 39°; long 107°), with collections made up to 12,500 ft (3800 m) and less frequently below 9500 ft. The four seasons of collecting embraced the periods from 3-5 July 1957 (a season of abnormally heavy snowfall); 21 June to 7 August 1958, and 13 June to 27 July 1959 (following winters of lighter precipitation and earlier snow-melt); and 19 June to 31 July 1962 (a season of light snowfall but abnormally late snow-melt). Since both larvae and adults were present at the beginning of each collecting season and some were still to be found when collecting ceased, seasonal records are not complete. Dates cannot be given for the time of emergence from the egg by *Aedes* larvae and their earliest appearance as adults or for the first appearance of overwintered blood-seeking *Culiseta* adults, nor can late summer data be supplied regarding the occurrence of larval and adult stragglers among *Aedes* species or the duration of the *Culiseta* breeding period and the possible occurrence in the fall of biting adults. However, the study embraced the period of peak incidence of adults and of the later instars of larval development of most species. It presents a composite picture, from 14 June to 7 August of the mosquito populations, their composition, abundance, and distribution, during four seasons of varied snow and temperature conditions, a picture that should include within its limits most of the annual variations that may occur.

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THE AREA AND ITS HABITATS

Gothic, occupied almost exclusively by the Rocky Mountain Biological Laboratory, lies in a widening of the East River Valley of the Gunnison National Forest (Gunnison Co.) 38 mi N of Gunnison, at an altitude of 9500 ft (2900 m). The precipitous slopes of the enclosing peaks of the West Elk Mountains are clad with scattered patches of spruce-fir forest (well-developed in the Gothic Natural Area), with areas of open grassland and aspen groves. Along the river bottomlands and on the banks of tributary streams are dense willow thickets flanked by extensive beds of hellebore (*Veratrum californicum* Durand), which often cover broad, wet meadowlands enclosing numerous temporary or semipermanent ponds. North of Gothic the forest service road, often snowbound into July, ascends in six miles beyond Emerald Lake (10,448 ft) and over 10,700-foot Schofield Pass into a region of rocky peaks and subalpine meadows of the White River National Forest (Pitkin Co.), in the drainage system of the Crystal River.

Throughout the area larval habitats are abundant and varied: in deep spruce forest and open meadows; in shallow road ruts and semipermanent marshlands; in pools along stream banks and in beaver workings. Most are filled by melting snow, either directly or through overflow of swollen streams, but the usually heavy rainfall which averages 23 inches in Crested Butte (U.S.D.A. Yearbook of Agriculture, 1941, p. 799) and over 50 inches in the East River Valley (Langenheim, 1955), assures maintenance of water level and continuation of breeding well into the summer months.

Below Gothic the road descends along the river for eight miles, through gentle sagebrush- and grass-covered slopes, to Crested Butte (8867 ft), at the foot of the mountains, where the valley opens up into irrigated land and extensive willow flats.

This study is primarily concerned with the so-called snow mosquitoes that occur in the higher elevations. Since the species occurring in Crested Butte and at similar elevations were principally those associated with plains and foothills, sagebrush and irrigation, collections were less systematically made in these areas, and the records, although included, are not as complete as for the mountain species.

SPECIES COLLECTED

Slightly over 1000 biting adults and 1600 larvae and pupae were collected and determined. Adults were collected in ethyl acetate killing-jars as they landed for biting, larvae by means of long-handled

dippers. No quantitative methods were employed. Most of the adults and many larvae were preserved for later study; the pupae and numerous larvae were reared to maturity.

Eleven species of *Aedes*, four of *Culiseta*, and one of *Culex* were collected as larvae, and all but two of these (*Culex tarsalis* and *Culiseta inornata*) as biting adults; the chaoborines were taken only in immature stages.

<i>Aedes cataphylla</i> Dyar	<i>Culex tarsalis</i> Coq.
<i>cinereus</i> Mg.*	<i>Culiseta alaskaensis</i> (Ludlow)*
<i>communis</i> (DeG.)	<i>impatiens</i> (Wlk.)
<i>dorsalis</i> (Mg.)	<i>incidens</i> (Thomp.)
<i>fitchii</i> (F. & Y.)	<i>inornata</i> (Will.)
<i>hexodontus</i> Dyar	
<i>impiger</i> (Wlk.)	Chaoboridae:
<i>implicatus</i> Vock.	<i>Chaoborus americanus</i> (Joh.)
<i>increpitus</i> Dyar*	<i>Eucorethra underwoodi</i> Und.
<i>pullatus</i> (Coq.)	<i>Mochlonyx velutinus</i> (Ruthe)
<i>spencerii idahoensis</i> (Th.)*	

Four Gothic area mosquitoes (marked with asterisks) were not reported by Baker from the Front Range. Nine of the Front Range species were not found in the Gothic area. Of these, six are primarily plains species in Colorado. (*Aedes schizopinax* Dyar) is apparently rare, and, according to Nielsen (1961) most commonly occurs in the lower mountain valleys. The remaining two species, *Aedes pionips* (Dyar) and *A. punctor* (Kby.) were expected but not found.

DISTRIBUTION

Faunal Elements.—The mosquitoes of the Colorado Rockies above 6000 ft (1830 m) represent several diverse faunal elements, although the vast majority are characteristic of more northern latitudes (Free-man 1952, Jenkins 1958, Vockeroth 1954b). Four are arctic species of the northern tundra and mountains; twenty are boreal species of the northern forests; two are plains species commonly occurring below 6000 ft and only occasionally intruding into mountainous areas; and two are indigenous western species.

Three of the arctic species (*Aedes hexodontus*, *A. impiger*, and *A. pullatus*) are characteristic of the treeless tundra, ranging from sea level to high altitude, and seldom occurring very far south of the northern limit of trees. In the United States they extend southward at high altitudes in the western mountains. Two of the species (*A. hexodontus* and *A. pullatus*) occur in the Sierras of California as well as in the Rockies and the Cascade Mts. *Aedes impiger*, although found in the Rockies and in the higher areas of the Cascades, is not known from the Sierras, where its place is taken by the ecologically similar *A. ventrovittis* Dyar. Although found in eastern Canada, these three species have not been reported from any of the alpine summits of the Appalachian Mountains of eastern United

States. The fourth species, *A. cataphylla*, does not occur in low tundra; it is a Cordilleran species restricted to the mountainous areas of western United States from the Rockies to the Sierras, and northward into Alaska. In general, the altitudinal distribution of these species corresponds closely to their latitudinal range (Jenkins 1958). The species most clearly restricted to the higher altitudes in Colorado is *A. impiger*, the most northerly ranging of any known mosquito species (Vockeroth 1954b), whereas the other three, most abundant nearer the northern treeline, can be found at much lower elevations in the mountains.

The greatest number of species are boreal forest mosquitoes inhabiting the northern coniferous forest belt of southern Canada and parts of the northern United States. These species seldom occur north of the treeline. In their southward range, they are abundant in the eastern deciduous forest, but in the arid regions of the West the majority are limited to rather narrow altitudinal belts in mountainous areas, where temperature and rainfall permit development of suitable habitats — open subalpine meadows, spruce-fir forests, and the pine-dominated montane of the drier eastern slopes of the Rockies. Those species occurring most frequently at the higher elevations of the Rockies are those most typical of the northern belts of the coniferous forest (*A. communis*, *A. pionips*, *A. punctor*), whereas species more prevalent at lower altitudes in the mountains and on the plains occur primarily at the southern limits of the boreal belt and deep into the adjoining deciduous forest zone (*A. dorsalis*, *riparius*, *sticticus*, and *vexans* and *Culex tarsalis*). Others are intermediate in altitude and latitude (*A. canadensis*, *cinereus*, *excrucians*, *fitchii*, *implicatus*, *intrudens*, *stimulans*, *trichurus*, and *Culiseta* species).

Although their ranges coincide in the Rockies, the boreal forest species vary in their East-West distributions (Carpenter & LaCasse, 1955). A few are primarily western: *Culiseta incidens* and *Aedes riparius* from Michigan and western New York, respectively, to the Pacific Coast. Many are widespread, found from coast to coast (*Aedes cinereus*, *communis*, *fitchii*; *Culiseta alaskaensis*, *impatiens*, and *inornata*). Other eastern species (*A. canadensis*, *excrucians*, *implicatus*, *intrudens*, *pionips*, *punctor*, *stimulans*) have not penetrated the arid country west of the Rockies, and although frequenting the Cascade Mts. of the Northwest, are not known from California (Stage *et al.*, 1952).

Two species (*Aedes increpitus* and *A. schizopinax*) are indigenous to the western states and are not known from the coniferous forests of Canada. In Colorado, they occur in the mountain valleys and at the lower elevations.

The plains species include typically lowland-inhabiting forms that occasionally extend their ranges into the lower valleys and foothills of the mountains. In Colorado, two such species have been recorded above 6000 ft (Harmston, 1949) — *Culex pipiens* L., transcontinental in distribution, and *Aedes spencerii* (Theo.), primarily restricted to

the plains area of the Central and Rocky Mountain states, with the variety *idahoensis* reaching into the Northwest. Several of the boreal species (*A. dorsalis*, *riparius*, *sticticus*, *vexans*, and *Culex tarsalis*) are similar to the plains species in their distribution in the Colorado mountains, but have affinities with the more northern group in their overall distribution.

Altitudinal Groupings of the Gothic Species.—The 16 species of the Gothic area can be placed in two principal altitudinal groups, which correspond essentially to the species groupings utilized by Baker (1961) for the Front Range of Colorado, Carpenter (1961-62) for California, Chapman (1961) for Nevada, and Nielsen & Rees (1961) for Utah.

I. Mountain species.

A. Alpine — *Aedes impiger*. This species was almost entirely restricted to altitudes above 10,000 ft (3050 m), and was found breeding only in open alpine rock pools and subalpine meadows. Although placed by the preceding authors with the species in Group B, in the Gothic area it was so limited to the higher altitudes that it deserves separate treatment. It is a tundra species with a southward extension of its range along the mountain summits.

B. Subalpine species — *Aedes cataphylla*, *communis*, *hexodontus*, *implicatus*, *pullatus*; *Culiseta incidens*, *impatiens*, *inornata*; and probably *A. fitchii* and *C. alaskaensis*. These most commonly occurred at and above 9500 ft, at or near the treeline. Of *A. fitchii* and *C. alaskaensis*, too few specimens were taken to indicate their altitudinal associations; in both cases larvae were found only at lower elevations (Group II), but most adults were taken at 9500 ft or higher; the preceding authors generally include *A. fitchii* with the mountain species. Of the other species, all but *A. implicatus* frequently occurred above 10,000 ft, but also occasionally at 9000 ft (2750 m) or below. (Since systematic collecting was not carried on at lower elevations, their relative abundance there, however, may be greater than the samples indicated.) This is a heterogeneous group, including, among others, species of the northern tundra (*A. pullatus* and *hexodontus*) and boreal forest species (*A. communis* and *fitchii*).

II. Foothill and Valley species — *Aedes cinereus*, *dorsalis*, *incredibilis*, *spencerii*. These species seldom occurred above 9000 ft, then only infrequently as adults or in areas ecologically more like the foothill zone than the mountain area. They are species typical of the irrigated plains and lower mountain valleys.

SEASONAL DEVELOPMENT

Larval development began later at higher elevations where snow-melt was delayed, but the effect of altitude on the extension of the breeding season at elevations above 9000 ft (2750 m) varied with the species and the breeding site. With *Aedes pullatus*, of wide

altitudinal range and great variety of breeding areas, the completion of all development appeared to be more dependent on the nature of the breeding place (shade and permanency) than on altitude alone. Some snow-melt pools in open subalpine meadows were found to contain only pupae while third- and fourth-instar larvae were still present in deeper shaded pools at lower elevations. *Aedes hexodontus*, however, more uniform in its breeding places, completed emergence earlier at the lower altitudes, and the *Aedes* species characteristic of lower elevations (Group II) all completed development earlier than any of the mountain species.

The depth of the snowfall and spring temperature conditions caused variation in the peak of larval maturation by as much as three weeks from one season to another. At Lake Irwin, *A. communis* larvae were mature on 14 June in 1959, but not until 4 July in 1962, following a cold wet spring; mature larvae of *A. impiger* were abundant at Schofield Pass from 21 to 29 June in 1959, but not until 17 July in 1962.

The often rapid drying of breeding places following dry periods in summer adversely affected developing larvae, doubtless killing many before development was completed. However, in some pools under regular observation the drying appeared to be a stimulus toward premature pupation with the resulting production of dwarfed individuals. Pupae and emerging adults of *A. communis* and *A. pullatus* taken from a small silt-bottomed pool with a mere skim of water remaining were distinctly smaller than those found in deeper adjacent pools or in the same pool a few days earlier. Catches of biting adults of both of these species taken later, both in the immediate vicinity and in other localities, included occasional dwarfed individuals. Since laboratory experiments have shown that increases in temperature above a larval optimum result in decreasingly smaller adults (Bates 1947; Clements 1963:79); it is doubtless not the mere depth of the water that influences the size of developing pupae and adults, but the sharp rise in temperature to which they are subjected directly or as the heat of the mountain sun is absorbed by the rapidly dwindling water supply and the underlying layer of silt.

SEASONAL DISTRIBUTION AND ABUNDANCE

Immature stages (Figs. 1-3).—Larvae of all of the *Aedes* species were found as early as 14 June, or their presence on that date can be assumed on the basis of developmental stages later found. Since later instars and pupae were numerous, hatching of the eggs must have occurred several weeks earlier. By early July in 1959 (the only year with data available for these species), the *Aedes* of the lower altitudes had completed their emergence. Of the mountain species, *A. cataphylla* and *A. implicatus* finished development the earliest, disappearing from the drying pools by early July. *Aedes communis* lingered only a few days longer. *Aedes impiger* and *A. hexodontus* were usually gone by mid-July, except in the late season of 1962 when

immature stages were still found in late July (*A. impiger*) and early August (*A. hexodontus*). *A. pullatus* larvae, always the last in any pool, occurred each year through late July, and in early August stragglers could still be found in small numbers.

Culiseta larvae, developing from egg-rafts deposited by overwintered females, were first collected in mid-June, and the first pupae of the three commonly occurring species from late June to early July.

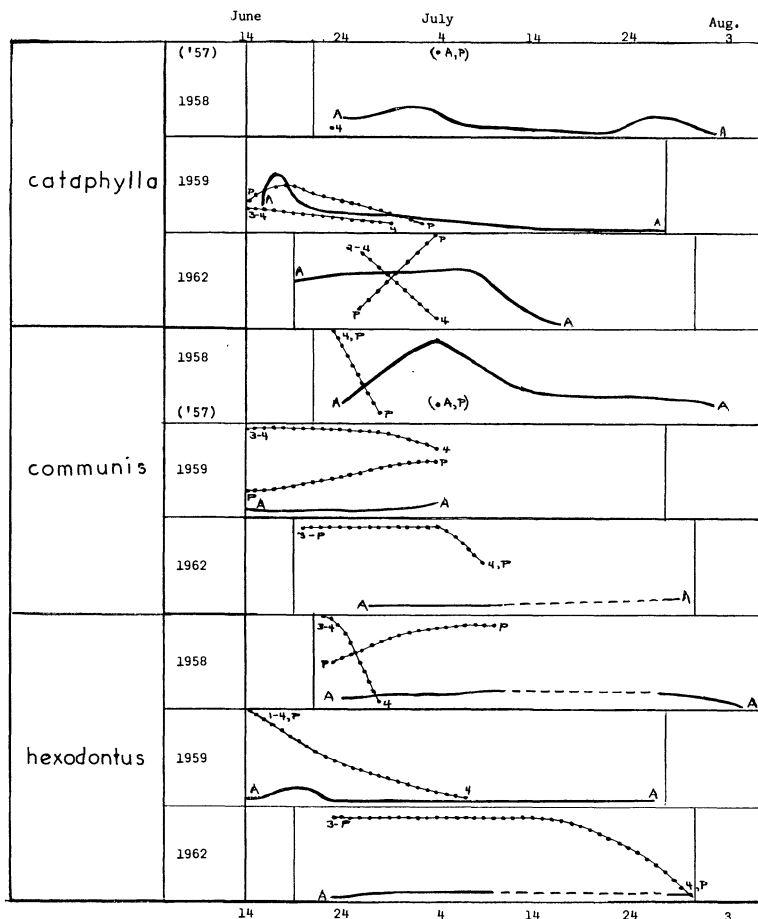


Fig. 1.—Mountain *Aedes*—Seasonal distribution and abundance in 1957, 1958, 1959, and 1962 of adults (A), larval instars (1-4), and pupae (P) of *Aedes cataphylla*, *A. communis*, and *A. hexodontus*. Broken lines (—) in adult records indicate lack of data; vertical lines show beginning and end of collection season for each year; vertical scale represents collections of from 1 to 40 specimens proportionately (more than 40 indicated at the maximum level).

Larvae could still be found when collecting ended, although the drying of temporary pools had by that time eliminated most of their breeding places.

More *A. pullatus* larvae were actually examined, and from a greater number of collections, than were larvae of any other species. In limited areas, however, *A. communis* and *A. impiger* larvae occurred in dense aggregations of more than 100 per dip; their total numbers without doubt far exceeded those of the *A. pullatus* larvae, but their known breeding sites were relatively few. *A. hexodontus* was more abundant than the relatively rare and earlier-maturing *A.*

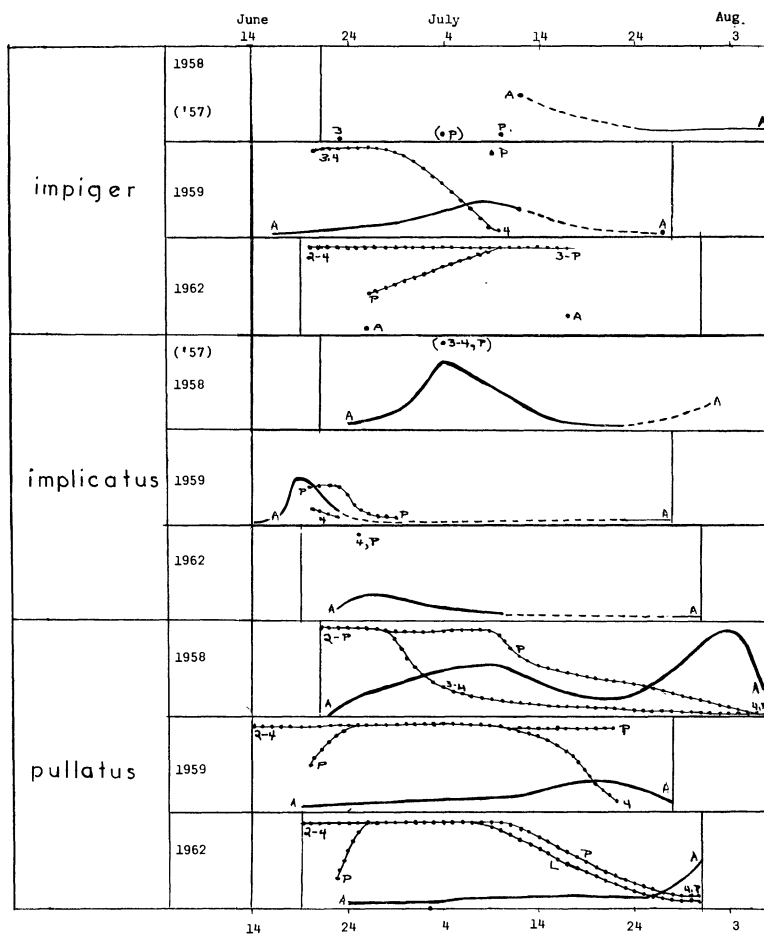


Fig. 2.—Mountain *Aedes*—Seasonal distribution and abundance in 1957, 1958, 1959, and 1962 of adults (A), larval instars (1-4), and pupae (P) of *Aedes impiger*, *A. implicatus*, and *A. pullatus*. See Fig. 1 for legend.

implicatus. Fewer larvae of *A. cataphylla* were found than of any of the other mountain *Aedes*, probably because adult emergence in this species was essentially complete when collecting began.

Adults.—Adults of *Culiseta* and of all the mountain *Aedes* were biting by 14-16 June 1959, the earliest collecting dates. The first appearance of the overwintered *Culiseta* females and of newly emerged *Aedes* adults has not been established, but from other records (Dyar 1924; Harmston 1949) from similar altitudes in the state, it may well be two to four weeks earlier. *Aedes cataphylla* and *A. implicatus* usually reached peak abundance in late June and early July, rapidly diminishing in numbers after that period. *Aedes communis*, *hexodontus*, *impiger*, and *pullatus* were taken most frequently in July. By early August, the numbers of all species were greatly reduced, with *A. pullatus* occurring most commonly, but abundant only at higher elevations.

The last biting *Culiseta* specimens were captured on 4 July, although pupae of these species were abundant by this time. No records are available of females taking blood meals before hibernation.

Of the mountain *Aedes*, *A. cataphylla* made up 35% of the adult catches for the four seasons, followed closely by *A. pullatus* (25%); fewer adults of *A. communis* (13%), *implicatus* (12%), *impiger* (8%), and *hexodontus* (6%) were taken, but a higher percentage of some of these species (*A. communis* and *impiger* in particular) might have been obtained if more collections had been made in the immediate vicinity of their breeding places or if they had been as readily captured as the dominant *A. cataphylla*.

ASSOCIATED ORGANISMS

Occasional adult mosquitoes (*A. cataphylla*, *communis*, *pullatus*) harbored one or more predaceous red hydrachnid mites. One *A. cataphylla* female taken on 30 July 1962, must have been considerably hampered by the presence of three of the mites, each as large as her own head. One was attached behind the head, the others directly posterior to the hind legs. Orchid pollinia were also observed on a few individuals of these same species.

Parasitic nematodes of the family Mermithidae, subsequently determined by H. E. Welch as being close to or identical with larvae of *Hydromermis churchillensis* Welch from *A. communis*, were obtained from *A. communis* and *A. pullatus* larvae in 1959 (Smith 1961), with 138 removed from a single mosquito-rearing jar. Although no further collections were made, these nematodes may well be important factors in reducing the numbers of developing adults.

Larvae were frequently found thickly coated with stalked vorticellid-like protozoan epibionts; such larvae were most often found toward the end of the season in pools containing little water, much organic matter, and often an iron flocculent which clung to the infested larvae. The presence of such external commensals is probably

not a serious impediment to larval development (Welch 1961).

Although the larvae occurred most frequently in small temporary snow-melt pools containing no other macroscopic form of life other than occasional chironomid larvae, they were also often found at the shallow edges of larger and more permanent pools. Here a varied association of animal life, mostly predatory on the smaller mosquito larvae, was encountered. The calling of chorus frogs (*Pseudacris nigrata triseriata*), and of *Rana pipiens*, the leopard frog, frequently revealed the locations of such ponds, where tadpoles of the mountain toad, *Bufo boreas*, as well as of the two frogs, and immature tiger salamanders (*Ambystoma tigrina nebulosum*) abounded. Trichopterous larvae, adults of water beetles (Dytiscidae and Hydrophilidae) and nymphs of dragonflies (Aeschnidae) and mayflies occupied the grassy and weed-grown margins, with scattered larvae of *Aedes communis*, *hexodontus*, and *pullatus*. Fairy shrimp (*Eubranchippus*) abounded in certain high meadow pools in July (Mexican Cut) at 11,200 ft (3415 m) with larvae of *A. pullatus*, and in a rocky snow-bordered pool at about 11,700 ft (Galena Mt.) with larvae and pupae of *A. impiger* and *pullatus*. Predatory chaoborines (*Chaoborus*, *Eucorethra*, *Mochlonyx*) were frequent and in some pools abundant, but there is no evidence of the importance of any of these, or other predators, in reducing the mosquito population of the area.

NOTES ON THE SPECIES

Since adequate keys exist for the identification of the mosquito species occurring in the Gothic area, taxonomic characters are included in the following discussions only if they exhibit variability or deviation from those ordinarily employed in the available keys, or contribute to the basic knowledge of the species. Determinations, both larval and adult, can be made from the Carpenter & LaCasse manual (1955), but more readily from the Nielsen & Rees determination guide for Utah species (1961). In this a particularly helpful section on the mountain *Aedes* includes all but two of the Gothic area *Aedes* (*A. dorsalis* and *spencerii*), lowland forms which are included in the section on valleys and plains mosquitoes.

To avoid duplication in succeeding entries, approximate altitudes for collecting sites are listed here in feet as given on Colorado road maps and on U. S. Geological Survey quadrangles for Anthracite, Crested Butte, and Snowmass Mountain, Colorado. Metric equivalents (in meters) are also given in parentheses.

Gunnison Co. (including Gunnison National Forest)

Gunnison — 7683 (2342)

Pitkin Fish Hatchery — 9800

East of Gunnison:

(2987)

Cumberland Pass — 12,015

Taylor Reservoir — 9200 (2804)

(3662)

East River Valley:

beaver ponds — ca. 11,000

Almont — 7800 (2377)

(3350)

Avery Peak — 12,639 (3852)

Crested Butte — 8900 (2713)	Pittsburg — 9300 (2835)
Copper Creek — to 10,000 (3050)	Meridian Lake — 8700 (2652)
Emerald Lake — 10,448 (3185)	Washington Gulch — 9000 (2743)
Gothic — 9500 (2895)	West of Crested Butte:
Gothic Picnic Area — 9600 (2927)	Floresta — 10,000 (3050)
Gothic Natural Area — ca. 9800 (2985)	Kebler Pass meadows — 10,000 (3050)
Schofield Pass — 10,740 (3304)	Lake Irwin (Brennan) — 10,325 (3147)
Virginia Basin — to 11,000 (3350)	Lost Lake (Trout Cr.) — 9000 (2743)
East River tributary sites:	Ohio Pass — 10,000 (3050)
Cement Creek Campground — 9000 (2743)	
Pitkin County (including White River National Forest)—north of Gothic:	
Elko Park — 10,600 (3230)	North Pole Basin — to 11,900 (3627)
Galena Mt. — 12,580 (3830)	
Mexican Cut — 11,200-11,400 (3415-3475)	Paradise Basin — to 11,000 (3353)
	Schofield Pass — 10,740 (3274)

Aedes (Ochlerotatus) cataphylla Dyar (Fig. 1)

This was by far the most numerous and annoying of the Gothic area mosquitoes. Adults were collected at elevations from 8900 to 12,000 ft (2700-3650 m), and larvae from 7800 to 10,600 ft (2375-3230 m). Although outnumbered at times by *A. communis* in deep spruce woods, by *A. implicatus* in willow thickets, and by *A. impiger* in the higher passes, it was the dominant species in early season in other areas, both open and shaded, biting from early morning until evening, and commonly entering buildings to bite or to rest after a blood meal. It was easily captured, even from clothing, bit readily without noticeable buzzing, and although to most adults a single bite had little aftereffect, its great numbers at times made outdoor living decidedly unpleasant.

With the exception of the overwintering *Culiseta* species, it was the first mosquito to appear in the spring. In the late season of 1962 it appeared in Gothic about 17 June in enormous numbers; other species were not taken until a week later. Until the second week in July it outnumbered all other species by about thirty to one. In 1959 it was on the wing before collecting started on 14 June, occurring then in a three to one ratio, and losing its dominance by late June. By late July, in any year, it was of only minor importance except at very high altitude (Cumberland Pass); the last collection of adults was made on 2 August near Gothic.

Because of its early emergence, relatively few immature specimens were collected, with pupae more numerous than larvae. Since many of the larvae came from a shaded pool at lower elevation, whereas reportedly the species had been a pest for some weeks at higher altitudes, it is apparent that emergence of the adults takes place over

an extended period. However, few immature specimens were seen after the first of July, and the last were collected on 4 July at 10,000 ft. They occurred in a variety of habitats: snow-melt pools, roadside ditches, and stream overflow areas; temporary meadow pools a few inches in diameter and semipermanent ponds frequented by axolotls; pools with or without vegetation, shaded or open, with silty or leafy bottoms. Larvae and pupae occurred at lower altitudes with *Culiseta* species, *Aedes cinereus*, *increpitus*, and *spencerii*; at higher elevations they were usually with *A. hexodontus* and *pullatus*, less often with *A. communis* and *impiger*.

Localities.—Gunnison Co.: Almont (LP), Avery Peak (A), Copper Creek (A), Crested Butte (A), Cumberland Pass (A), Gothic and vicinity (ALP), Kebler Pass meadows (LP), Lake Irwin (L), Pitkin (A), Pittsburg (A), Virginia Basin, Washington Gulch; Pitkin County: Elko Park (AL).

Taxonomic Notes.—Keys to the adults usually employ as a distinguishing character for this species the presence of white scales scattered along the anterior veins to near the wing tip. In the Gothic specimens, many of the biting adults were indeed “speckled” in this manner. However, numerous others, with no speckling beyond the humeral cross vein, still fitted the descriptions of *A. cataphylla* in every other way. Of a series of 55 individuals reared from known larvae, the wings of 13 of the 14 males, and 16 (38%) of the 41 females — 29 individuals or 53% of the total — completely lacked any white scales beyond the humeral vein; 26 (47%) showed a few to many scales on one or more of the anterior veins towards the apex of the wing. Of the speckled females, 7 (27%) had white scales on the Costa, 11 (42%) on the Radius (vein 1), and 24 (92%) on the Subcosta, all beyond the humeral vein.

Of the same 55 individuals, all of the females and about half the males had well-developed patches of white scales on the hypostigial area of the thoracic pleuron. In both sexes the base of the Costa was usually thickly overlaid with a dense patch of white scales extending to or beyond the humeral vein, both dorsally and ventrally; in only a few individuals (9%) was this reduced dorsally. In 9% (all females) the base of Radius possessed a few white scales dorsally, and all but 3 (all males) had from few to many white scales on the ventral surface of the base of Subcosta.

As Beckel (1954) and Vockeroth (1954b) have indicated for various species of *Aedes*, scale color may change during the life of the insect. That this species shows such a tendency is suggested by the collection on 11 July 1962 of a series of individuals in which many or most of the normally bronzy-brown scales of the median area of the mesonotum were grayish-white, concolorous with those of the prescutellar area and the sides of the mesonotum. However, such a color pattern was not observed generally in other late season individuals.

Aedes (Aedes) cinereus Meigen (Fig. 3)

This widespread, small, but annoying mosquito has been reported

from several localities in the Colorado foothills, up to an altitude of 8000 ft (2040 m) at Grand Lake (Harmston 1949). In the Gothic area it was taken at elevations from 7700 to 9000 ft (2345-2745 m). Biting adults were captured on 19 and 22 July at Crested Butte and at Lost Lake near Kebler Pass. Larvae and pupae were collected in

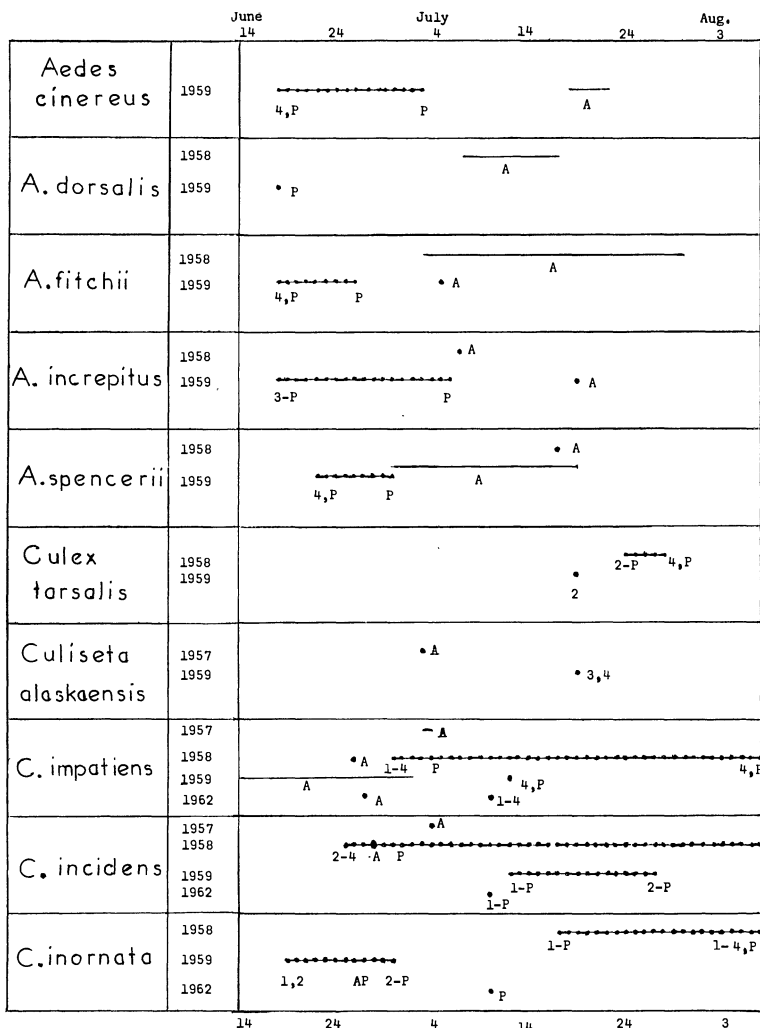


Fig. 3.—Seasonal distribution of Foothill and Valley *Aedes* (*A. cinereus*, *dorsalis*, *fitchii* (perhaps a mountain species), *increpitus*, and *spencerii*) and of species of *Culex* and *Culiseta*. Adults (A) shown by solid lines, immature stages by dotted lines and designations of P, pupa; 1-4, larval instars. Seasonal abundance is not indicated.

Almont, Crested Butte and Gunnison from 18 June to 2 July in rain-filled grassy or leafy-bottomed pools, in association with larvae and pupae of *Aedes cataphylla*, *communis*, *dorsalis*, *fitchii*, *inreptus*, *pullatus*, and *spencerii*, and *Culiseta inornata*.

Aedes (Ochlerotatus) communis (DeGeer) (Fig. 1)

A boreal forest mosquito locally prevalent in the forested areas of the state, this species was taken as an adult from 14 June through 2 August, with the latter specimens badly rubbed. It was most abundant in deep spruce woods in July, and in proximity to its breeding pools, where it was the dominant species. As discussed earlier, adults from rapidly drying pools tended to be smaller than those developing earlier, but both small and large adults bit readily. Adults ranged from 9500 to over 12,000 ft (2900-3660 m); larvae from 8900 to 10,300 ft (2710-3140 m).

Larvae were present in late instars by 13 June, in pools surrounded by snow banks and partially ice-covered. In the early season of 1959, an *A. communis* pool at Lake Irwin was black with larvae (third and fourth instar) on that date; in 1962, a late season, small larvae were numerous on 20 June and on 4 July large larvae with some pupae again blackened the surface. Larvae were last collected on 9 July. Larvae and pupae occurred in small numbers in a shallow willow-shaded roadside ditch with those of *A. pullatus* and *spencerii*, and in small willow-shaded seepage pools with *A. pullatus* and *implicatus*; in tremendous numbers in spruce woods in a deep semipermanent pool with much vegetation, with a few *A. pullatus*; and in vast numbers in a semipermanent grassy meadow pool, only partially shaded, with a few individuals of *A. cataphylla*, *hexodontus*, and *pullatus*. The peak of adult emergence preceded that of *A. pullatus* and most *A. hexodontus*, but followed *A. cataphylla* and *implicatus*.

Localities.—Gunnison Co.: Crested Butte (L), Gothic area (AL), Floresta (L), Lake Irwin (AL), Pitkin Campground (A); Pitkin Co.: Elko Park (AL), Galena Mt. (A).

Taxonomic Notes.—The Colorado adults showed well-defined dark submedian stripes in marked contrast to the paler Massachusetts specimens which seldom exhibit distinct mesonotal markings.

Larvae from all sites were checked against the recent description of *A. communis nevadensis* (Chapman & Barr 1964). All agreed with the typical *A. communis communis* in the rounded and apically fringed comb scales and in the shaded habitats in which larvae occurred. However, in comb scale counts (of 42 combs counted) the Gothic specimens averaged 47 scales (range 28 to 71 but usually fewer than 40), closer to the average of 40 cited for *nevadensis* than the 62 of the typical western race of *communis*.

Larvae are very similar to those of *A. implicatus* Vock. (Smith

1965) and differ in slight details from the description given by Nielsen & Rees (1961). Prothoracic hair No. 1 was usually double but sometimes single; No. 5 usually triple but often double.

Aedes (Ochlerotatus) dorsalis (Meigen) (Fig. 3)

Although this is the dominant species of the Colorado plains (Harmston 1949), it does not penetrate into the higher mountain areas. Baker (1961) did not find it in the Front Range above 5270 ft (1610 m), and it occurred in the Gothic area only in small numbers between 8900 and 9500 ft (2700-2900 m). Biting adults were collected near the Pitkin Fish Hatchery on 7 July, along with *A. cataphylla*, *increditus*, and *pullatus*, and at Crested Butte on 17 July with *A. pullatus* and *spencerii*. Pupae were found on 18 June in a grassy pool in Gunnison, with larvae and pupae of *A. cinereus fitchii* and *increditus*, and *Culiseta* sp. The species is multiple-brooded.

Aedes (Ochlerotatus) fitchii (Felt & Young) (Fig. 3).

Locally abundant in foothills and wooded areas of the higher mountains of Colorado (Harmston 1949), this species in the adult stage was represented by only five biting individuals, taken between 3 and 30 July at Crested Butte, Gothic, and Kebler Pass, at altitudes ranging from 8900 to 10,000 ft. Baker (1961) records larvae from as high as 10,350 ft (3155 m) in the Front Range, but in the Gothic area they were found only at Gunnison (7700 ft, or 2350 m), in a semipermanent grassy roadside pool, with smaller numbers of *A. cinereus*, *A. increditus*, and *Culiseta* spp. A week later, 25 June, only pupae remained, all of them *A. fitchii*.

Taxonomic Notes.—The adult tarsal claw, which serves to distinguish this species from *A. excrucians* (rare in Colorado), closely resembles that shown by Nielsen & Rees (1961) for the latter species. As described in their key, the *excrucians* claw is more abruptly bent, rather than rounded, with a more nearly parallel tooth (see Vockeroth 1954 b).

Comb scale counts on 26 larvae ranged from 11 to 20, with 75% falling in the 14- to 16-scale groups.

Aedes (Ochlerotatus) hexodontus Dyar (Fig. 1)

An abundant and widespread tundra mosquito, according to Vockeroth (1954b) most numerous close to the treeline, this species was collected in the Gothic area from 9000 to 11,400 ft (2740-3475 m) as larvae and to 11,700 ft (3565 m) as adults. The females were occasional but never serious biters in spruce woods as well as on open mountain summits from 14 June until early August, seldom as numerous as *A. cataphylla*, *communis*, and *implicatus* at lower elevations, or *A. impiger* and *pullatus* above. Late instar larvae and pupae were found on 14 June and occurred until the end of July in the late season of 1962, usually in greatest abundance in late June. They occurred primarily in wet open meadows, in small to large snow-melt

pools a few to many inches deep, exactly as described by Dyar (1924) for *A. punctor*, but also in numbers at edges of more permanent pools in subalpine meadows or stream overflow areas.

Localities.—Cumberland Pass beaver ponds (A), Gothic & vicinity (AL), Emerald Lake (L), Kebler Pass (L), Lake Irwin (AL), Lost Lake (A), Virginia Basin (A), Washington Gulch (A); Pitkin Co.: Elko Park (AL), Galena Mt. to summit (A), Mexican Cut (AL), Paradise Basin (L).

Taxonomic notes.—Early records by Dyar (1924) and Harmston (1949) included this species under *A. punctor*, but Baker (1961) recognized the error, finding *A. hexodontus* more abundant in the Front Range than *A. punctor*.

Gothic area adults showed great variation in color markings. In the reared males and in a small number of reared or collected females, a distinct dark brown median stripe (or pair of stripes), and usually a pair of posterior prescutellar half-stripes, contrasted strongly with the yellowish to coppery scales of the sides of the mesonotum and the still paler prescutellar scales. In the majority of the females, such stripes were obscure or wanting, indicated only by scales that were shorter, narrower, straighter and often no darker than the lateral scales of the mesonotum, and appearing as stripes only from a head-on view. But in all specimens the probasisternum was thickly scaled (differing in this respect from other Gothic *Aedes*), the torus dark with numerous white scales on inner and dorsal surfaces, the first antennal segment with a clump of white scales, the fore coxae pale-scaled, the tarsi and middle femora speckled with white scales, the mesonotal setae bronzy to blackish, and the abdominal venter white-scaled. The wings were marked with white scales on the base of Costa, dorsally and ventrally, often as far as the humeral vein, and on Subcosta ventrally, and often on the bases of Radius (vein 1) and Anal (vein 6). In adult features many individuals of this mountain population of *A. hexodontus* correspond with the typical form of the species described by Knight (1951), although others having darker mesonotal scaling with little indication of stripes show a tendency toward the coloration of the tundra type.

Aedes (Ochlerotatus) impiger (Walker) (*nearcticus* Dyar) (Fig. 2)

An arctic species extending southward along the western mountains, this small black mosquito was numerous and a vicious biter from subalpine meadows just below treeline to the summits of the neighboring peaks; only rarely was an individual taken below 10,000 ft (3050 m). Adults were captured from mid-June through early August. They attacked readily in bright sunlight, in the open when the air was still, or when sheltered by treeline krummholz from wind, but were not easily captured. They occurred usually with *A. communis*, *hexodontus*, and *pullatus*, often as the predominant species.

Larvae of late instars were found from 20 June until mid-July often several hundred to the dip. They spent much of the time at the bottom, remaining at the surface only for short intervals. They

developed at a rather uniform rate, the majority in any one pool pupating and emerging as adults within a few days, although the time of emergence varied considerably with both the season and the altitude. In 1962, a late season, third and fourth instars were collected from 20 June through 17 July; in earlier years, emergence from the same pools was completed at lower altitudes (10,700 ft) by 23 June, and at 11,700 ft (3565 m) all but a few stragglers had pupated by 9 July. Larvae were not found below 10,000 ft. They developed in unshaded snow-melt pools, 3 to 18 inches deep, bordered by snow banks. They occurred most commonly in small meadow pools containing grasses and sedges, but were also found in an alpine rock pool and in a weedy pool flooded by stream overflow. All pools observed had dried completely by late July. Associated with *A. impiger* larvae were smaller numbers of *A. hexodontus* and *pullatus* and a few *A. communis*. These species were generally one or two instars behind *A. impiger* in development, and after all *A. impiger* adults had emerged, the other larvae could still be found.

Localities.—Gunnison Co.: Cumberland Pass (A), Emerald Lake (AL), Floresta (A), Gothic picnic area (A), Kebler Pass meadows (ALP), Lake Irwin (AL); Pitkin Co.: Elko Park (ALP), Galena Mt. (LP), Mexican Cut (AL), Schofield Pass (L).

Taxonomic notes.—As with *A. cataphylla*, mesonotal scale color appears to change with aging of the adult. The freshly emerged adult (even after several years' preservation) has the scales of the mesonotum bronzy-brown, with whitish scales on the scutellum, prescutellar area, and along the lower edges of the mesonotum and postpronotum. Biting adults frequently presented a hoary appearance, with the mesonotal scales in whole or in part as pale as those of the prescutellar area. Dyar, in his original description of *A. nearcticus* (1919), mentioned that the black setae of the body become whitish in old specimens; while this is true of the scales, it is not so obvious with the setae, which show some variation in color even in freshly emerged adults.

That these specimens were *A. impiger* was confirmed by the profusion of mesonotal and postpronotal bristles, the sharply bent tarsal claw (Vockeroth 1954 a), the lack of hypostigial scales (present in *A. cataphylla*) and the pattern of white scales on the wings. In about 70 reared females, the bases of Costa and usually of Radius (vein 1), both dorsally and ventrally, were thickly clothed with white scales as far as the humeral cross vein; white scales were often present on the bases of Anal (vein 6) dorsally and Subcosta ventrally, and sometimes on the anterior veins to or beyond the middle of the wing, as in most *A. cataphylla*. The pattern differed from that of *A. cataphylla*, which it most closely resembles, by the white scales usually present basally on Radius and the Anal vein. Males lacked white scales on the wing bases.

Of 50 fourth instar larvae examined, from three distinct areas, morphological characters agreed with those given by Carpenter &

LaCasse (1955) and Nielsen & Rees (1961) for the species, with only minor variations. Comb scale counts varied from 7 to 14, with 82% in the 10-12 range; and gill length varied from about twice to more than five times as long as the anal plate, the latter specimens from a small rocky alpine pool at about 11,700 ft (3660 m).

Aedes (Ochlerotatus) implicatus Vockeroth (Fig. 2)

This boreal forest species is not common in the Colorado Rockies, having been collected by Baker (1961) from only one location in the Front Range (at 8275 ft or 2520 m), once by Dyar (1924, as *impiger* Wlk.) at Grand Lake (May & June), and once by Matheson at 8000 ft (2440 m) (1944, as *impiger*). In the Gothic area it was very local but occurred in a few stations in numbers. Adults were taken from 14 June through July and early August. They were most frequently found in willow thickets or spruce-shaded areas near their breeding places, a few times in buildings, but only rarely in early evening. Most collections were made in Gothic and its immediate vicinity, from 9500 to 9800 ft (2895-2990 m), a few at comparable altitudes in Washington Gulch, and at 9300 ft (2835 m) in Pittsburg.

Larvae were found in numbers only in small overflow and seepage pools in willow thickets adjoining the East River, in Gothic; a few larvae occurred in a more open muddy overflow pool and in a grassy meadow pool filled by running snow-melt water near the Gothic Picnic Area.

Taxonomic Notes.—Adults are easily confused with other dark-legged species. From *A. cataphylla* they differ in lacking a well-developed hypostigial scale patch (only rarely are a few scales present); from *A. communis* and *pullatus* by the presence of postcoxal scales, though these are reduced in number; from *A. impiger* by the smaller number of postpronotal setae; and from both *A. cataphylla* and *A. impiger* by the pattern of the white scalation on the wings. Of 80-odd reared individuals of *A. implicatus*, all had a white patch at base of Costa, both dorsally and ventrally, consisting usually of many scales which, however, rarely extended as far as the humeral vein; other veins were normally entirely black-scaled above except in about 5% of the specimens, which showed a very few white scales at the base of Radius (vein 1); in many individuals the Subcosta beneath was white-scaled at base.

Larvae are most similar to *A. communis* larvae (Smith 1965), differing in the comb scale numbers (usually 15-25, rarely 30) and structure, and, under high magnification, in the more strongly developed saddle spines (Frohne 1955). The Colorado specimens of *A. implicatus* exhibited minor differences from the description given by Nielsen & Rees (1961). Prothoracic hair No. 5, while double in 64% (of 64 hairs), was single in 25% and triple in 11%; the lateral abdominal hairs were often double on segments 3 to 5; the anal gills were sometimes less than the length of the saddle, usually about twice as long, but slightly more than three times as long in one in-

dividual; and the terminal spinule of the comb scale was, more frequently than not, of the same size as the other spinules.

Aedes (Ochlerotatus) increpitus Dyar (Fig. 3)

This western mosquito, a "common and troublesome species in the state" (Harmston 1949), was taken only at lower altitudes (Almont) and at similarly arid but higher Pitkin Fish Hatchery. Biting adults were collected 7 and 19 July, immature stages 18 June and 2 July, associated with *Aedes cataphylla*, *cinereus*, *fitchii*, *pullatus*, and *spencerii*, and *Culiseta* species.

Aedes (Ochlerotatus) pullatus (Coquillett) (Fig. 2)

This ubiquitous arctic mosquito had the greatest altitudinal range of all *Aedes* of the area, with adults taken from 7800 to 12,000 ft (2375-3660 m). Harmston (1949) and Baker (1961) recorded it as locally abundant in mountainous areas of the state. Adults appeared in small numbers in mid- or late June, depending on the season, were abundant in July, although not the dominant species, but were predominant at several localities above 11,000 ft (3350 m) in August. They attacked most frequently in light shade, at any time of day, occasionally entering buildings. On mountain summits and passes, a few hundred feet above known breeding places, they attacked eagerly in hot sun on windless days.

It was the last of the Gothic *Aedes* to complete its development. Larvae of the second through fourth instars were present each year when collecting was started in June; second instars were last collected in mid-July, and mature larvae until 25 July in the East River valley and in early August at high altitude (11,000 ft) in Cumberland Pass and North Pole Basin. The adult emergence in Gothic extended well over a month, with pupation noticeably earlier in open sunlit pools than in shaded ones. By mid-July most of the snow-pool breeding areas had dried completely, and, as in *A. communis*, the last pupae and their emerging adults were often noticeably smaller than earlier individuals.

Larvae were collected more frequently than those of any other *Aedes* species, and were ubiquitous in their habitats, occupying much the same niche that *C. canadensis* fills in the East. They were found in cold seepage pools in willow thickets, open grassy snow-pools at treeline or above in subalpine meadows, small rocky tarns in alpine areas, muddy road ruts, and overflow pools and ditches. They were associated with larvae of every other *Aedes* species collected, except for *A. dorsalis* and *A. fitchii* (which were taken only once), and adults of *A. pullatus* occurred with these. Early in the season they were commonly associated with larvae and pupae of *Aedes cataphylla*, *communis*, *hexodontus*, *impiger*, and *implicatus*; later their development overlapped that of the *Culiseta* species. In altitude, breeding places ranged from 7800 to 11,700 ft (2375-3565 m), closely paralleling the range given by Baker (1961) for the Front Range.

Localities.—Gunnison Co.: Almont (L), Cement Creek (AL), Crested Butte (AL), Cumberland Pass beaver ponds (L) and summit (A), Emerald Lake (AL), Floresta (AL), Gothic and vicinity (AL), Kebler Pass meadows (AL), Lake Irwin (AL), Lost Lake (A), Mt. Avery (A), Pitkin (A), Taylor Reservoir (L); Pitkin Co.: Elko Park (L) to summit of Galena Mt. (A), Mexican Cut (AL), North Pole Basin (AL), Paradise Basin (A).

Taxonomic Notes.—Although the larval gills of this species are usually slightly less than twice as long as the saddle, several individuals with gills four times the saddle length were found in early July in an open subalpine meadow pool that was nearly dry.

Aedes spencerii subsp. *idahoensis* (Theobald) (Fig. 3)

Cited by Harmston (1949, as *idahoensis*) as being troublesome in the plains and lower mountain valleys of the state, this species occurred at the lower elevations of the study area, from 7700 to 9500 ft (2345 to 2900 m). Biting adults were taken from 30 June through 17 July, two at Gothic, larger numbers at the lower elevations (Crested Butte and Gunnison) where they greatly outnumbered other species present (*A. cinereus*, *fitchii*, *increditus*). Immature stages were found only from 18 to 30 June 1959, in Crested Butte and Gunnison, in grassy rain-filled roadside ditches, with *A. communis* pupae and larvae of *Culiseta* and of the preceding *Aedes*.

Taxonomic Notes.—Nielsen & Rees regard *idahoensis* as merely a subspecific form of *spencerii* (1964). The Colorado adults agreed with the usual descriptions of *idahoensis* in that less than 10% of the females examined showed any indication of median or apical white scales on the midabdominal tergites; these scales, if present, were few in number, not forming middorsal stripes as in typical *spencerii*. However, the scales of the postpronotum, even in individuals reared from the same pool, showed a great variation in color, from nearly all white (as in typical *idahoensis*) to primarily brown as described for *spencerii*.

Culex (Culex) tarsalis Coquillett (Fig. 3)

Although five species of *Culex* are recorded from the state by Harmston (1949), the only one found in the Gothic area was *C. tarsalis* — “one of the most important pest mosquitoes in the state, . . . not encountered in the mountainous regions above the 7500-foot elevation” (Harmston). Larvae were collected at Crested Butte, however, at 2713 m (8900 ft), 19-28 July 1959, in a grassy flooded pasture after heavy rains, with numerous larvae and pupae of *Culiseta inornata*. No adults were taken. The species is multiple-brooded.

Culiseta species

Four species of the genus were collected, all of the subgenus *Culiseta*. *C. melanura* and *C. morsitans*, listed by Harmston (1949) from a few localities at lower altitudes, were not found.

Overwintered females, primarily *C. impatiens*, were prevalent and sometimes a nuisance from 14 June, the earliest collecting date, until

4 July. In the open they attacked timidly and were easily frightened off, but females of *C. impatiens* were persistent biters in the shade or in buildings, in early evening.

Since there are existing May records for all of these species, they would undoubtedly be found in the Gothic area prior to the earliest collection date. Although pupation occurred by late June and early July from eggs deposited by overwintered adults, no adults were observed from that date through the end of the collection period (7 August). Since the average date of the first killing frost in Crested Butte (USDA Yearbook of Agriculture 1941) is 22 August, it is probable that at these high altitudes at least *C. impatiens* and probably *C. alaskaensis* follow the type of life cycle which Frohne (1953, 1954) has described for the species in Alaska — overwintering by the fertile unengorged females of the single generation. Larvae of all of the *Culiseta* species with the exception of *C. alaskaensis* were found together at one of the lowest (8900 ft) as well as the highest (about 11,500 ft) collections made within the study area.

Culiseta (Culiseta) alaskaensis (Ludlow) (Fig. 3)

A badly rubbed specimen with indications of broad bands on the tarsal segments, taken in Gothic on 3 July 1957, while biting, was determined as this species. The only prior Colorado record is by Dyar (1924) who took two individuals in the Grand Lake area in May. Five third and fourth instar larvae were collected on 19 July in Crested Butte from a grassy roadside pool containing larvae of *Culiseta inornata*, *C. impatiens*, and *Culex tarsalis*, and from which numbers of *Aedes cinereus*, *communis*, *pullatus*, and *spencerii* had emerged earlier. Since the larvae are distinguishable from those of *C. incidens* only by very careful examination, it is possible that other collections also contained individuals of this species.

Culiseta (Culiseta) impatiens (Walker) (Fig. 3)

This widespread North American species, listed by Harmston (1949) from a half-dozen localities in the mountainous parts of the state and by Baker (1961) as larvae from stations in the Front Range between 6500 and 10,400 ft (1980-3210 m) in altitude, is generally distributed and far from uncommon in the Gothic area, particularly in forested and subalpine localities. Dyar (1924) found the species common in the Grand Lake area, "flying early (May 23) before any others occurred." Locally, biting adults were captured from 14 June through 4 July, at altitudes ranging from 7700 to 10,300 ft (2345-3140 m). Larvae (all instars) were found on 30 June at 9000 ft (2740 m), the first pupae on 4 July (with eggs and larvae) at 9800 ft (2985 m). In early August, larvae could still be found at altitudes of 11,000 to 11,500 ft (3350-3500 m), but had disappeared at lower altitudes with the drying up of known breeding pools. Their habitats were most variable, as reported by Frohne (1953) for Alaska: in open grassy meadows and in forest pools, in clear water and muddy, in

permanent pools and road ruts, in stagnant water and spring-fed pools, but as a general rule in midbottomed pools with little or no vegetation. The larvae occurred with *Culiseta incidens* in seven of nine collections, with *C. inornata* in two, after the majority of the *Aedes* had emerged. A few *A. communis* and *pullatus* larvae occurred with them in three areas.

Localities.—Gunnison Co.: Cement Creek (L), Crested Butte (L), Cumberland Pass beaver ponds (L), Floresta (LP), Gothic and vicinity (ALPE), Gunnison (A); Lake Irwin (A), Ohio Pass (A); Pitkin Co.: Mexican Cut (L), No. Pole Basin (L).

Culiseta (Culiseta) incidens (Thomson) (Fig. 3)

A species with numerous records from the plains and foothills of the state (Harmston 1949) and from the Front Range to 10,400 ft (Baker 1961), in the Gothic area it was collected more frequently in the larval stage than other *Culiseta* species, although only two biting females were taken (29 June, 4 July, in early evening). In altitude it ranged from 8900 to about 11,500 ft (2710-3500 m). Larvae were first found on 25-26 June at 9300 ft (second and third instars) and 10,600 ft (fourth instar); the first pupae on 1 July at 9700 ft (from a pool holding only second instar larvae on 26 June); and late instar larvae and pupae were still present in early August at several stations above 9600 ft. Larvae usually occurred in shaded or open silt-bottomed overflow pools in river flats, in pools isolated by the drying up of small streams, or in flooded road ruts; less often in small silt-bottomed pools in grassy meadow, sometimes adjacent to beaver ponds; and once in a rocky pool of clear water left by stream overflow. In the 17 collections made, the larvae were most frequently associated with *C. impatiens* and *A. pullatus*; less often with *C. inornata*; and once each with *A. communis* pupae, *A. hexodontus* larvae, and *A. spencerii* pupae.

Localities.—Gunnison Co.: Cement Creek (L); Crested Butte (LP), Cumberland Pass beaver ponds (L), Emerald Lake (L), Floresta (LP), Gothic & vicinity (ALPE), Pittsburg (L); Pitkin Co.: Elko Park (L), North Pole Basin (LP).

Culiseta (Culiseta) inornata (Williston) (Fig. 3)

Reportedly a species of the irrigated plains and lower foothills, "widely distributed in the state at elevations below 8000 feet" (Harmston 1949), *C. inornata* showed, as Baker (1961) reported for the Front Range, the widest altitudinal range of any mosquito species collected in this study, with larvae occurring from 7800 to about 11,500 ft. (2375-3500 m). No flying adults were taken: the species is said to prefer animals to man (Carpenter & LaCasse 1955). Early instars were found on 19 June at 7800 ft; pupae and emerging adults on 27 June from the same station. In early August, all larval instars and pupae were found at stations ranging from 8900 to 11,500 ft. (2710-3500 m). Larvae occurred in open or shaded road ruts, muddy overflow pools, roadside ditches, and flooded grassy meadows. In

the six stations at which they were collected they were associated with other *Culiseta* species in three, with numerous *Culex tarsalis* in one, and with *A. cinereus* or *A. cataphylla* larvae or pupae of *A. communis* and *A. pullatus* in the other two.

Localities.—Gunnison Co.: Almont (LP), Cement Creek (L), Crested Butte (LP); Pitkin Co.: North Pole Basin (LP).

Family Chaoboridae

Although long cited as a subfamily of Culicidae, this group of non-blood-seeking gnats is now generally given full family status. However, because of its long taxonomic association with the mosquitoes, and the paucity of Colorado records for the group, the species are included in the present report.

Eucorethra underwoodi Underwood

Although this species is common and widely distributed throughout the northern states, Cook (1956) does not record it from Colorado. Numerous collections of the predaceous larvae were made in the Gothic area, from 14 June through 25 July, and at altitudes from 9500 to 10,300 ft (2900-3140 m). They were found in small semi-permanent willow-shaded pools, always with *Aedes pullatus* larvae, occasionally with larvae of *A. communis*, *Culiseta* spp., or *Mochlonyx*.

Localities.—Gunnison Co.: Gothic & vicinity; Lake Irwin.

Chaoborus (Chaoborus) americanus (Johannsen)

Larvae were found in open permanent meadow pools at Mexican Cut on Galena Mt. at altitudes between 11,200 and 11,400 ft (3415-3475 m), on 10 July 1962. They were associated with larvae and pupae of *Aedes hexodontus*, and with other forms of animal life such as axolotls, dragonfly naiads, and caddisfly larvae. Adults were determined by E. F. Cook, who recorded the species (1956) from Rabbit Ears Pass, Colorado, July 18.

Other *Chaoborus* larvae, perhaps of the same species, were collected in numbers in Paradise Basin (Pitkin Co.) at nearly 11,000 ft (3350 m) on 24 July 1962, by Robert Willey; and a single specimen by the writer from a silt-bottomed pool at river edge at Crested Butte, 10 July 1962, with larvae of *Aedes pullatus* and *Culiseta* spp.

Mochlonyx velutinus (Ruthe)

Larvae of this species, recorded from Grand Lake by Cook (1956), were found in large numbers in a small willow-shaded pool at Lake Irwin on 4 July 1962, associated with *Aedes pullatus* and *Eucorethra underwoodi* larvae and with numerous dytiscid beetles and caddisfly larvae. Adults were kindly determined by E. F. Cook.

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