

OBSERVATIONS ON THE MOSQUITOES OF SASKATCHEWAN

BY FREDERICK KNAB

The observations here recorded are the result of an expedition to western Canada during the spring of 1907. Up to the present nothing definite has been known of the habits of the mosquitoes of the northern prairies. Their extreme abundance in that region during the summer and the suffering they cause to man and beast have been frequently reported. Their presence in such large numbers seemed the more mysterious, since water, so essential to mosquito-development, is usually absent or very scarce on these prairies during the summer months. However, we now know that the most important part of the mosquito fauna of the northerly portion of the eastern United States consists of species of the genus *Aedes*,¹ and also that these typically northern forms develop in the snow-water of early spring. It was to be inferred that in the prairie region of the northwest, species of *Aedes* of similar habits would be the predominating forms, and so it proved.

There is but one brood annually of these northern mosquitoes of the genus *Aedes*. The adult mosquitoes live a long time (two or three months) and lay their eggs late in the summer. These eggs lie upon the ground until the following spring, and then hatch in the water from the melted snow. With most of the species the larvæ develop very rapidly and often transform to adults within two weeks. In order to study these mosquitoes and obtain their larvæ, it was necessary to be in the field with the opening of spring, for the season of larval development is very brief. When the writer left Washington, early in April, the magnolias were in bloom, and it was thought that spring would soon open in the north. But when southeastern Saskatchewan was reached, on April 10, the ground was still covered with snow and the weather was cold and windy. The season proved to be an exceptionally backward one, and there was no appreciable change until early in May; indeed, some of the large snow-drifts lasted until early in June.

¹This name is applied as defined in Dyar and Knab: On the Classification of the Mosquitoes. *Canad. Entomologist*, vol. xxxix, 1907, pp. 47-50.

The town of Oxbow, about thirty miles north of the United States boundary, was selected as a suitable location for study. It overlooks the valley of the Souris River, and therefore, besides the typical prairie country, also offers the diversified conditions of the river valley. The prairie is rolling, and in the spring there are numerous pools and small ponds. All but the largest ponds dry out in the course of the spring and summer. It was in these prairie pools of snow-water that mosquito larvæ were found in greatest abundance. On the river bottom-land no larvæ were found, although two species not found on the prairie occurred in the ravines opening upon the river.

The first newly hatched mosquito larvæ were found on May 6, although as yet there had been but few mild days. In fact, on this day there was a strong north wind blowing and icicles formed where the water was dashed against reeds and branches. It was surprising, however, how rapidly the water, particularly in the ditches and smaller pools, was warmed by the sun, so that it was very appreciably warmer than the air. It was in these shallow pools that the larvæ developed most rapidly and in greatest numbers. The details of larval development will be given under the separate species.

In the following account the species are treated in the order of their importance. *Culiseta inornata* Williston, which does not appear until later in the season, and which I did not have an opportunity to collect, is included. We owe specimens of this species to the kindness of Dr. James Fletcher, the government entomologist of Canada, and to Mr. T. N. Willing, of Regina. Eight species of *Aedes* were collected. Four of these, *Aedes spenceri* Theo., *A. fletcheri* Coq., *A. curriei* Coq., and *A. campestris* D. & K., are peculiar to the prairie regions. Two others, *A. fitchii* F. & Y. and *A. fuscus* O. S., occur upon the prairie in lesser numbers. The two species, *A. canadensis* Theo., and *A. subcantans* Felt, were found only in some deep ravines opening upon the Souris River, and do not occur upon the prairie at all. They belong to the eastern wooded region, and have found their way up along the wooded shores of the river. It is significant that they were found only in two ravines, the mouths of which lie close to the river's margin.

AEDES SPENCERI Theobald

This is the common mosquito of the prairies of Saskatchewan, and apparently occupies the entire northerly portion of the prairie region of North America. It is very bloodthirsty, and its excessive abundance makes life upon the prairie a torture during the early

summer. The first larvæ of this species were found, newly hatched, at Oxbow, on May 6, in ditches along the railroad. The weather continued cold for some time after this and the pools froze over at night. This apparently did not injure the young larvæ. On May 16 a large number of pools were examined, and it was found that all but the larger pools contained larvæ. The pool from which the young larvæ were obtained on May 6 now contained many larvæ. It was deep and large and the water cool; in consequence the larvæ were still in the second stage. In smaller, shallow pools, where the water was warm, the larvæ were much further advanced. A shallow puddle in the field close by the railroad station, the water of which was remarkably warm, contained numerous larvæ, mostly in the third stage. The larvæ for the most part kept among the grass close to the margin, where the water was warmest and they were best protected from the wind. These larvæ, brought into the house, nearly all molted on the following day. A day later (May 18) a number of the larvæ pupated. In the meantime there had been severe frosts during the nights and the pools were repeatedly frozen over and thawed out again by the sun of the following day. But in spite of this the larvæ developed as rapidly out of doors as in the house, the effect of the sun more than offsetting the retarding influence of the cold nights. The first adults were bred out on May 22. Larvæ continued to increase in numbers during the following week, those in the small warm pools being most abundant and developing most rapidly. The small permanent ponds contained no larvæ. By the end of the month the larvæ of this species had practically all disappeared.

Adults of this species first appeared active on May 30 and a few came to bite. They were first noted in numbers on June 5, a warm, sunny day following four days of cold, cloudy weather. They came drifting before the wind, and during calm intervals were very annoying. At 10.45 a. m., on a rise of ground west of the town, the highest rise on that part of the prairie, a swarm of about 50 males gathered above my head. They emitted a high-keyed piping sound, swinging backward and forward and swaying sidewise, all the time facing the wind. With every gust of wind they were scattered toward the ground, only to reassemble when the wind decreased. When I passed the place again, at 12.45 p. m., the males were still in evidence, although much interfered with by the wind. The same day, at 5.30 p. m., another swarm of males was observed in the upper part of a ravine, where the slopes were gentle. They were going through rapid evolutions, darting forward and upward and drop-

ping back again, but without unison. When disturbed by the wind their flight became more rapid, and sudden gusts caused them to fly to the ground. Several pairs were seen flying off in copula, and once the female was observed approaching the swarm from beneath. There was a second swarm of males farther down the ravine, about half way up the slope, and, like the other, at the margin of the shrubbery filling the bottom of the ravine. In this case a swarm of very small Chironomids was mixed with the lower part of the swarm. In crossing an open field in the river valley at 6.30 p. m. a swarm of males formed over my head and, following me, increased to the number of perhaps two hundred. They disappeared when I approached the woods on the edge of a ravine. This experience was repeated in the field beyond, and upon nearing the edge of the woods the swarm again departed and could be seen in the middle of the field. Several days of cold and cloudy weather followed, during which the mosquitoes remained quiescent. After the heavy rain of the previous night, the afternoon of June 9 was warm and sunny and the mosquitoes exceedingly abundant and active. At 6.30 p. m. I walked toward the river with a companion. As soon as we had left the town the female mosquitoes began to rise out of the grass and alight upon us. There was a brisk breeze blowing and the mosquitoes settled on the leeward side of our bodies, and a cloud of them followed us, keeping for the most part about our legs. These clouds increased rapidly and became very aggressive as we passed down into the valley, where we came upon a cloud of males on the open prairie. When we approached them they formed in two swarms over our heads. My companion, being the bulkier man, attracted a much larger swarm. We thus each had two swarms of mosquitoes about us; the one, of females, kept about the lower part of our bodies, while the other one, of males, kept above our heads. Several copulations were noted. Upon entering a ravine the males all left us and only a part of the females followed. Upon emerging on the other side of the ravine a new swarm of females quickly gathered, and shortly we came upon another large swarm of males, which again concentrated above our heads in separate swarms. It was now 7 o'clock, but still bright daylight at this season of the year. The swarms of males I judged to contain many hundreds, if not a thousand, individuals. These swarms, in close formation, followed us up the long hill and continued with us nearly to the town, in the end being much disturbed by the wind. About 7 o'clock quite a number of copulations were observed. The females approached the swarm from beneath and left it united with a male,

the pair drifting away toward the ground and the union lasting but a short time. They copulate face to face, grasping each other with their long legs, the female in the upper position, the male back downward. This day proved the maximum of activity for this species of mosquito. No more swarming of males or matings were observed. On June 10 there was a very high wind, which kept the mosquitoes close to cover. Only a few came to bite, but these were very bloodthirsty. They would rise out of the grass to leeward and fly against the wind, alighting with a perceptible momentum.

June 11 was a hot day, with only light wind. The female mosquitoes appeared less numerous than two days previously. The males were abundant on willow blooms, busily probing for honey.¹ None were seen swarming.

June 12 was warm but windy, yet the males were still found upon the willow catkins, although they could maintain their hold only with difficulty. High winds continued for five days and nothing was seen of the mosquitoes. On June 18 the males had nearly all disappeared; there were none on the willow catkins and only a very few could be found by beating grass and bushes. The females were still in evidence.

This species is strictly diurnal and is only active in full daylight. It hides in the grass of the prairie until disturbed or attracted by some passing animal. It appears that the habit of this prairie mosquito, of flying toward prominent objects, under normal conditions brings it to its source of food, some large warm-blooded animal. The blood-sucking habit is doubtless normal in this species, and other foods, such as the honey of flowers, are to be looked upon as supplementary when blood is not available. The idea that but few mosquitoes can obtain a meal of blood is entirely erroneous—at least with reference to this species. In former times the prairie teemed with warm-blooded animals, of which the great herds of bison, the antelopes, and deer need only be mentioned. At the present day man, horses, and cattle furnish an abundant supply of blood. On the other hand, in the male this same habit of gathering around prominent objects leads them to the same places to which the females are attracted for food, and thus the union of the sexes is brought about.

AEDES FLETCHERI Coquillett

Larvæ of this species in the second stage were found on May 19. They frequented the larger ditches and pools and appeared to be

¹ Knab, Frederick: Mosquitoes as flower visitors. Journ. N. Y. Entom. Soc., vol. xv, 1907, pp. 215.

absent from most of the small pools, which dry out in a few weeks and form the favorite habitat of the larvæ of *A. spenceri*. Although next in importance to *A. spenceri*, this species is very much less numerous. The larvæ develop more slowly, and most of them do not reach maturity until after the larvæ of *A. spenceri* have disappeared. They seemed to thrive best in the deeper reedy pools of a more or less permanent character, where they feed near the bottom, ascending for air from time to time. On May 25 the larvæ were still in the second and third stages, and it was not until May 28 that a larva in the last stage was obtained. June 10 the first pupa was found, and the larvæ were at that time nearly all in the last stage. June 13 pupæ were numerous, and by June 18 the larvæ had all disappeared and only a very few pupæ remained. On May 27 the larvæ, in the third stage, were found in ditches and in a permanent swamp which were so strongly alkaline that there was a white deposit along the margins. In the alkaline ditches pupæ and full-grown larvæ of *A. spenceri* and small larvæ of *A. curriei* were associated with the larvæ of *A. fletcheri*. The adults bite in the daytime and also toward evening.

AEDES FITCHII Felt and Young

The larvæ of this species were usually found associated with those of *A. fletcheri*, although usually in still smaller numbers. They develop at the same time with *fletcheri* and their growth is equally slow.

On the evening of June 19 I was fortunate enough to observe the swarming of this species in a shallow depression at the head of one of the ravines near Oxbow. The ground sloped gently from the prairie, which at that point was 15 or 20 feet above the bottom of the depression. When the swarm of males was first noticed, at 8.30 p. m., it was loosely organized, and there were perhaps forty individuals, which gyrated and circled about close to the ground. Close by there were some thorn bushes, and between and around these there were several swarms of Chironomidæ, but no mosquitoes. In a short time other swarms of mosquitoes began to form in the open, along the bottom of the depression and on the western slope, where they were protected from the wind. These various swarms kept close to the ground and spread out in such a way that they might be said to have been loosely connected, but still there were foci where the mosquitoes were massed closer together. At no time was the top of a swarm more than four feet above the ground, while it spread out to at least twice that diameter. The size of the swarms gradually increased until, at 9 o'clock, one swarm contained

several hundred males. Copulation took place most frequently between 9 and 9.15, but matings were observed both earlier and later. The females entered the swarm from beneath, when they were seized by one or more males. Union takes place "face to face," the pair flying obliquely upward for several yards. Then the pair would either separate promptly or swing out end to end and struggle to disengage themselves. In this latter case both of them could be seen to jerk violently and rapidly in their efforts to free themselves, and the pair would slowly rise, but make no appreciable progress in either direction. When two males seized a female the group would rise straight into the air, apparently engaged in a violent struggle, one of the males finally uniting with the female or all of them separating. In one case four individuals rose thus, scrambling over each other, so to speak. The swarm was watched until 9.30, when the twilight was already quite deep; copulation appeared to have ceased and the swarms were gradually breaking up.

AEDES CURRIEI Coquillett

This species is far less generally distributed over the prairie than the preceding three species, and appears to be a straggler from the prairie regions farther south. The larvæ appear somewhat later than those of *A. spenceri*, and in consequence the adults appear a little later. The larvæ were found in large numbers in a small swamp in the Souris River valley about three miles west of Oxbow. They were also found in small numbers in several permanent ditches along the railroad. At Carnduff they were found in a ditch of alkaline water. In the swamp first mentioned there were full-grown larvæ and pupæ on May 30, but young larvæ in the first and second stages were by far the most numerous.

AEDES CAMPESTRIS Dyar and Knab

Eight specimens of this species were taken on June 18 and 19. The females came to bite in the daytime; the males were obtained by beating bushes at the head of a ravine. It appears to be rare, and no larvæ were obtained. Mr. T. N. Willing found this species at Regina, Carnduff, and Qu'apelle.

AEDES FUSCUS Osten Sacken

A few larvæ of this species were obtained on two occasions, once in a permanent ditch and again in the shallow water at the mouth of a culvert, the remains of a stream of snow-water. The first adults issued from the pupæ on June 17.

AEDES CANADENSIS Theobald

Young larvæ of this species were first found on May 17 in a water-hole at the bottom of a deep, narrow ravine near Oxbow. At that time another deep well-hole, farther down the ravine and well protected by bushes, contained no larvæ. On June 7 both of these water-holes contained numerous larvæ; in the more sheltered one they were present in immense numbers. At this time there were many larvæ of *Aedes subcantans* associated with the *canadensis* larvæ; on June 14 the *subcantans* had nearly all disappeared, but *canadensis* in second, third, and fourth stage and in pupa were present in thousands. In another ravine a large vat, which on June 4 still contained ice, on June 14 contained larvæ of *canadensis* in the second and third stages. On June 12 numbers of larvæ of this species in the third and fourth stages and a few pupæ were found in water-filled cattle-tracks at the lower ends of these same ravines. The first adults of *A. canadensis* issued from the pupa on June 13.

AEDES SUBCANTANS Felt

The larvæ of this species were found associated with those of *A. canadensis* in a deep ravine. The larvæ developed somewhat earlier than the majority of the *canadensis* larvæ, and they were far less numerous.

CULISETA INORNATA Williston

This species breeds throughout the summer, the females hibernating and depositing their eggs the following season. It has been taken by Mr. T. N. Willing at Regina, Carnduff, Shepard, Kimistino, Olds, and Maple Creek.