

NOTES ON *ANOPHELES OCCIDENTALIS* D & K AND *ANOPHELES QUADRIMACULATUS* SAY.

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Anopheles occidentalis D & K was reported during the season of 1942 as occurring in numbers at Cayuta Lake, N. Y., at an elevation of 1,272 feet.¹ Considerable numbers of this species were observed late in the season of 1942 (Nov. 7) and were probably preparing for hibernation. At the same time, *A. quadrimaculatus* Say was collected and they were also preparing for hibernation. In the spring of 1943 (May 5) considerable numbers of *A. occidentalis* were collected along with a few of *A. quadrimaculatus*. During the summer a few trips were made to Cayuta Lake but adults were scarce and on July 16 I could find neither larvae nor adults. During the summer of 1942 a diligent search was made for the breeding habitats of these anophelines. The swamp, margins of the lake and the stream outlet, was searched in vain but only a few larvae were taken. In the spring of 1944 (May 1) the adults of *A. occidentalis* were present in considerable numbers and actively biting. A few *A. quadrimaculatus* were also present and biting. From May 1 to May 3 some 50 *A. occidentalis* were taken and sent to Dr. Boyd at Tallahassee, Florida. Dr. Boyd attempted to colonize them but he only obtained a colony, a flourishing one, of *A. quadrimaculatus*. Evidently a few *A. quadrimaculatus* were included in the shipment. All of the *A. occidentalis* refused to lay eggs and died. Dr. Boyd returned some of the reared material and they all proved to be *A. quadrimaculatus*. He also included some of the adults I sent him and amongst them were a few *A. occidentalis*. Early in June I sent a shipment of *A. occidentalis* to Dr. R. B. Watson at Memphis, Tenn., with the hope that he might be able to establish a colony. His results were very

similar to Dr. Boyd's, though he did succeed in obtaining a few eggs and rearing a few adults. He was not successful in establishing a colony.

During the summer of 1944 the sudden appearance of *A. quadrimaculatus* in immense numbers at Cayuta Lake was the remarkable feature of the season. At the same time *A. occidentalis* occurred only in very scattered numbers, though in 1942 it was the dominant species and in the spring of 1943 (May) it was present in considerable numbers. During the season of 1943 neither *A. occidentalis* or *quadrimaculatus* occurred in any considerable numbers.

Early in June, 1944, the adult females of *A. occidentalis* appeared in sufficient numbers to warrant the belief that there would be great swarms of them later in the season. At the same time *A. quadrimaculatus* were more abundant than they had been observed at any time since we found anopheline breeding in this area. On August 4 both species were present but *A. quadrimaculatus* outnumbered *occidentalis* by thousands. In the outlet from Cayuta Lake (Fig. 1) the larvae were abundant and on August 11 single dips would give us 20 or more larvae. The larvae were in all stages of development. Under the slip in the boat house the males of *quadrimaculatus* congregated in immense numbers, all apparently freshly emerged. At a nearby home males and females of this species were present in such numbers that the walls near the entrance door were almost black with them, the males greatly outnumbering the females. At this time very few adults of *occidentalis* could be found.

Large numbers of larvae were taken on August 11 with the hope that we should find enough larvae of *occidentalis* to start a colony. All the larvae, several hundreds, were examined and those having branched inner clypeals were isolated. From this

¹ Matheson, R. and Belkin, J. N. Proc. 30th Ann. Mtg. N. J. Mosq. Exterm. Assoc., pp. 7-10. 1943.

number only sixteen with branched clypeals were found. From these sixteen 6 *A. occidentalis* and 10 *A. quadrimaculatus* were reared. Hundreds of *quadrimaculatus* emerged from the remaining larvae but no *occidentalis*. All the larval skins of the 16 reared were mounted and studied to determine if characters could be found to separate these two species. A summary of the results is given below.

No.	Species	Inner Clypeals		Distance between clypeals (inner)
		branches of: Right	Left	
1.	<i>occidentalis</i>	2	2	Tubercle can be barely placed between clypeals
2.	"	2	2	"
3.	"	2	2	"
4.	"	2	2	Tubercle cannot be placed
5.	"	3	2	"
6.	"	2	2	"
7.	<i>quadrimaculatus</i>	1	2	Clypeals widely spaced more than 1 tubercle can be placed
8.	"	1	2	"
9.	"	2	2	"
10.	"	1	3	"
11.	"	1	2	"
12.	"	3	1	"
13.	"	2	1	"
14.	"	2	1	"
15.	"	1	2	Very widely placed
16.	"	3	2	Clypeals widely spaced

A study of the chaetotaxy of the larva reveals other differences that will aid in separating *occidentalis* from *quadrimaculatus*. The arrangement of the hairs of abdominal segments 4 and 5 correspond rather closely. Hair "O" is present in both and very minute and unbranched. In *quadrimaculatus* hair "2" is stout and unbranched, though occasionally it may be branched near the tip (8 reared specimens examined and only one had this hair

branched near the tip). In *occidentalis* hair "2" is quite long, rather slender and with 4 or 5 branches arising from near the middle (7 reared larvae examined). As we cannot depend on the branching of the inner clypeals to differentiate these two species in the larval stages we must make our determination on a combination of these characters. The branched inner clypeals spaced close together at their bases and the 4 or 5 branched No. 2 hair of segment 4 of the abdomen should differentiate *occidentalis*; the usually unbranched inner clypeals spaced far apart at their bases and the stout unbranched No. 2 hair of segment 4 should identify *quadrimaculatus*. However, these combinations of characters may not always be reliable and rearing should be done whenever possible.

During the season of 1944 *A. quadrimaculatus* was the dominant species whereas in 1942 *A. occidentalis* was very abundant and very few *quadrimaculatus* could be found. The following records will show the relation between the two species. On August 18, 26 and September 9, *quadrimaculatus* was extremely abundant, the males and females congregating in great numbers on nearby houses. Practically no *occidentalis* could be located, just an occasional single specimen. This was also true on October 4 when I made a collection in an old outdoor toilet not far from the lake margin. This collection amounted to several hundred adults. In this collection I found only 2 *occidentalis* (females) and 2 females of *punctipennis*; all the rest were *quadrimaculatus*. On October 12 similar conditions were found, all were *quadrimaculatus* and not a single specimen of either of the other species. On October 28 five females of *quadrimaculatus* were found in the same toilet but none of the other species were present.

Why did *A. quadrimaculatus* supplant *A. occidentalis* during the season of 1944? In 1942 we had severe floods during the early half of August and the lake remained high during most of the season. In 1944 there was little rain and the lake and its outlet were very low. As a result the water lilies (*Nymphaea*) occurred in abundance



Fig. 1. Outlet of Cayuta Lake, N. Y. Note the yellow water lily in the background. In the foreground and center the water milfoil (*Myriophyllum*) breaks the surface and here the larvae occur in great numbers. (Aug. 1944).

in the outlet and the shallower parts of the lake; also the species of water milfoil (*Myriophyllum*) grew in abundance and their tips floated in masses on the water surface (Fig. 1). About the floating leaves of the water lilies and in the mats of water milfoil the larvae of *quadrimaculatus* were present in great numbers. Dipping made in the mats of water milfoil often yielded 20 or more larvae per dip and most of the larvae were those of *quadrimaculatus*. Such conditions would seem ideal

also for *occidentalis*; however, this species failed to breed in any numbers.

The only value in these few observations is the important fact that a malaria transmitting anopheline, *A. quadrimaculatus*, could be considered on the basis of our observations of 1942 and 1943 very unimportant in this isolated region whereas in 1944 the very opposite conclusions would have to be drawn. Similar conditions may occur in many, if not all, parts of our country.