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SCIENTIFIC NOTE

CHANGES IN DISTRIBUTION AND ABUNDANCE OF MOSQUITO POPULATIONS IN AN ECOLOGICAL RESEARCH TRACT OVER A 35-YEAR PERIOD

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ABSTRACT. Marked changes in species and numbers of mosquitoes have occurred over a 35-year period. Changes relate to alteration of available larval development sites by beaver (*Castor canadensis*), variation in winter and spring precipitation, and differences in feeding behaviors.

KEY WORDS Mosquito, univoltine, *Castor canadensis,* beaver dam

Studies of populations of anthropophilic mosquitoes on the 146-ha (360-acre) Upper Site of the SUNY Oneonta Biological Field Station near Cooperstown, NY, were begun in 1968 and continued through 1972. During that time, large populations of mosquitoes, primarily temporary pool breeders, presented a problem for faculty and student workers on the site. Applying repellents regularly to exposed skin and wearing clothing of appropriate thickness and weave to prevent penetration by mosquito mouthparts was necessary (Butts 1974). Larvae developed in a number of scattered sites in the woodland, and large numbers were present each year in water surrounding a bog remnant. Water levels changed seasonally in these sites following snow melt and spring rainfall.

In April 1979, beaver (*Castor canadensis*) constructed a dam across the outflow from the water surrounding the bog and, by 1984, had impounded the area along with the adjacent Area 4 sampling site to the fullest extent allowed by the topography (Butts 1986); this water level has been maintained to date.

A drastic reduction in mosquito populations followed and alighting/biting surveys indicated that the species previously encountered were present but in much smaller numbers. The total number of mosquitoes collected in 1981 and 1982 was less than that encountered in one 20-min sampling period in 1977 (Butts 1986). Subsequent surveys from 1984 through 1991 were consistent with these findings. The same species were present but in greatly reduced numbers, and there was no apparent increased development of permanent water species in the impoundment (Butts 1992, 2001).

The winter of 2002–2003 was marked by virtually continuous snow cover of considerable depth in wooded sites of the research area from mid-October 2002 through late April 2003, with persistent snow cover in scattered sites until early May. This heavy snow pack provided the potential for optimum development of temporary pool mosquitoes, thus presenting an unusual opportunity to revisit the original survey sites. No attempt was made to collect at the original Area 4, which has remained completely submerged for about 20 years. Because it is accessible only by boat, the logistics of including it in the normal morning or evening samplings precluded its inclusion. The remaining 5 sites were visited in each sampling sequence unless interrupted by inclement weather. Sampling was conducted on June 6, 10, and 26; July 2, 17, 25, and 30; August 8, 14, and 21. The sampling series on July 30 was conducted from 1720 to 1940 h. All others were conducted between 710 and 1000 h.

Collection was conducted as described originally (Butts 1974), with the collector remaining seated at each station for 20 min with 1 forearm exposed. Mosquitoes that alighted and remained long enough were captured by inverting small vials charged with ethyl acetate over the stationary individuals. They were retained for identification, added to the permanent research collection, and are listed in Table 1.

The dominant species collected was *Ochlerotatus canadensis* (Theobald), a temporary pool species that does not have an obligate prehatching chilling requirement, but that may or may not be multivoltine. The other species collected were tree-hole or small-container breeders (*Ochlerotatus hendersoni* (Cockerell) and *Ochlerotatus triseriatus* (Say)) or confined to permanent or semipermanent water (*Coquillettidia perturbans* (Walker)).

It is noteworthy that, under optimum conditions for development, the numbers of mosquitoes encountered was quite small when compared with populations studied in the initial survey (Butts 1974), which yielded large numbers of 2 univoltine species, *Ochlerotatus punctor* (Kirby) and *Ochlerotatus stimulans* (Walker), with an early season population peak of the former followed by a later peak of the latter. No specimens of either were collected in 2003.

Table 1. Mosquitoes collected, dates of collections, and number of individuals per date listed parenthetically.

Species	Date	Area and numbers
Ochlerotatus canadensis	June 19	Area 1 (1); area 3 (2)
	June 26	Area 1 (4); area 2 (2); area 3 (2); area 6 (1)
	July 2	Area 1 (1)
	July 25	Area 1 (3)
	July 30	Area 2 (1); area 3 (1); area 5 (3); area 6 (1)
	August 14	Area 6 (2)
	August 17	Area 1 (1); area 2 (1)
	August 21	Area 5 (2)
Ochlerotatus hendersoni	July 25	Area 5 (1)
	July 30	Area 5 (1)
	August 21	Area 5 (2)
Ochlerotatus triseriatus	July 30	Area 1 (1)
Coquillettidia perturbans	August 14	Area 5 (1)
	August 17	Area 1 (1)

The reason for this change in species distribution cannot be firmly established, but 2 factors may be important. One possible explanation may be that the bog margin, which is now unavailable to them, may have been the primary site of development for these univoltine species. The margin fluctuated to some extent in both wet and dry springs, and this provided a constant source for larval development. A certain spillover effect of such large populations into smaller temporary pools could support survival after impoundment of the bog, but subsequent successive dry years would select strongly against them.

The spring weather pattern in several of the years between the surveys conducted before 1986 and the current study has been uncommonly dry during weeks critical to development of temporary pool species. This likely exerted heavy pressure on strict univoltine species but placed less stress on *Oc. canadensis,* which has the potential for more flexible multivoltine development and which was present in relatively smaller numbers in the original surveys.

The occurrence of *Cq. perturbans* in current collections is a further indication that this species may be becoming established in the permanent impoundments. Its survival depends on availability of rooted, emergent vegetation to which developing larvae must attach and thus require permanent (or extended semipermanent) water sources. It was the most numerous, albeit low level, species collected over the years 1986–96 (Butts 2001).

Another striking difference is the approach behavior of current populations when compared with that noted in earlier surveys, in which mosquitoes tended to approach rapidly, alight, and proceed to feed. In contrast, the pattern during the summer of 2003 was for mosquitoes to approach with smaller numbers alighting momentarily and departing in response to any movement of the collector and not often attempting to feed. Changes in the attractiveness of the collector may be a factor; his attractiveness to salt marsh species has continued unaltered.

It would appear that the bulk of the greatly reduced anthropophilic mosquito population on the Upper Site is still a temporary pool breeder, but that a permanent water species may be slowly establishing residence. This suggests that a study focused on the periphery of the impounded areas where rooted, emergent vegetation is becoming established could be instructive.

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