ARTHROPOD MONITORING:

Mosquito Studies

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The winter of 2002-2003 was marked by virtually continuous snow cover of considerable depth in wooded sites of research areas 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 conditions for development of temporary pool mosquitoes. Research carried out on the Thayer Farm and the Upper Site was based upon this assumption. Activities at Greenwoods were planned in response to reports of mosquito presence in a particular site.

THAYER FARM

A large portion of the eastern half of the former Thayer property consists of a large hill rising rather steeply from its eastern border along New York State Highway 80. It descends somewhat more gradually to open fields along the southern portion of its western slope and to a steep, wooded ravine along the northern portion thereof.

This area supports a continuous stand of forest dominated by eastern hemlock with scattered hardwood species interspersed. (The current dominance of hemlock may be a result of selective logging of mature hardwoods in previous years.) The surface of the soil presents numerous irregularities as depressions from uprooting of trees of varying size and as low areas between spreading basal roots of adjacent large trees. Such depressions present the potential for accumulating standing water from snow melt and rainfall.

The above mentioned snow accumulation suggested that an unusual opportunity to assess the potential of this woodland for development of temporary pool mosquitoes was at hand.

Walking surveys were initiated on 26 March 2003. Access trails around the western edge of the site and inside the eastern boundary (see Figure 1) served as points of departure and return. A compass heading was taken from the western trail along the southern margin of the woods and followed to the trail on the far side. A return on the opposite heading was begun at a point approximately 60 feet to the north of this point and followed to the western trail, with repeated crisscrossing through the woods at 60 foot intervals. All sites within view which held two or more inches of melt water were marked with surveyor's tape and numbered in sequence of their discovery. The survey was continued on 16 April (with snow cover largely remaining but appearing to melt down without measurable surface water accumulation) and completed on 24 April (following a rain and snow fall on the previous day).

A total of 8 sites were found in which initial water depth was 2 inches or more (Figure 1). (The three sites found on 16 March had no water present by 24 April.) By 1

May, no standing water was present except for a few small pools at site 8, and only one pool (beneath an uprooted tree) held as much as 2 inches of water. By 5 May, there was a single small puddle at the bottom of that depression but no standing water in any other site. Rainfall in excess of 0.5 inches within 24 hours had occurred within two days previous to this observation.

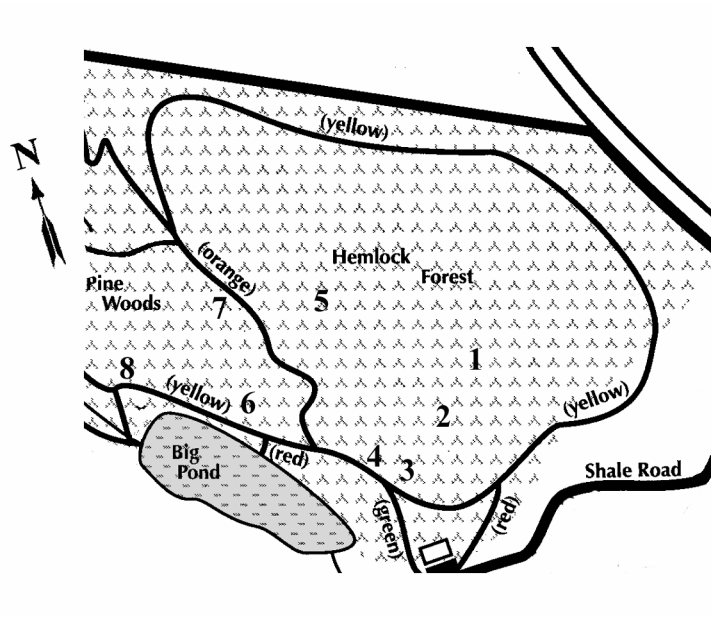

Figure 1. Map of segment of Thayer Farm surveyed for temporary pool mosquito potential. Sites 5, 6 and 8 were complexes of several small ground pools of varying extent and depth. Remaining sites were single.

On 12 May, immediately following rainfall of more than 0.5 inches since mid-day 11 May, no standing water was present in site 1, 2, 3, 4 and 6. (Each site is a single depression). One pool in site 5 held 2 inches of standing water. Less than one inch of water was present in site 7 (a single depression) and in two ground pools in the complex at site 8. In addition, the pool beneath the uprooted tree at the edge of site 8 held about 3 inches of water.

On 14 May, following rainfall of more than 0.5 inches in the previous 48 hours, water was present in four pools in site 8 and in one each in site 5 and 7.

On 22 May and 29 May no standing water was present in any of the sites.

On 2 June, following heavy precipitation on 31 May and 2 June, up to 4 inches of water was present in some pools in areas 5, 7, and 8, but none in any other sites.

On 6 June no water was present in sites 1, 2, 3, 4 or 6. Four pools in the complex at site 8 held 2 inches of water (the pool beneath the uprooted tree had 3 inches). One pool in site 5 and the pool at site 7 had 2 inches of water. All pools were sampled with a standard dipper, and no larvae were found.

On 10 June two small pools in site 8 retained standing water; a few 1st and 2nd instar larvae were found. No other sites had any standing water and by 13 June only one of the two above-mentioned pools held water.

On 19 June no standing water remained in any ground pool.

On 25 June sampling for adult mosquitoes was conducted at site 8. The author sat with one forearm exposed from 7:30 to 8:10AM. No mosquitoes approached. By this date leaf development in both woody and herbaceous plants was well-developed, taking large amounts of water up through the transpiration stream. The soil and leaf litter were largely dry. No standing water remained in any of the sites and would be unlikely to remain long enough for larval development. The area studied is a forest with well-drained upper soil and is extremely unlikely to support populations of temporary pool mosquitoes.

LATE SUMMER LIGHT TRAP COLLECTION

Reports of adult mosquito activity from Thayer Farm resident Dr. Thomas Horvath prompted placement of a CDC miniature light trap (Hausherr Machine Works) north of the access roads at the lower end of the chain ponds. The trap was activated on the evenings of 4 and 21 September and picked up on the following mornings. A single specimen of *Aedes vexans* (Meigen) was collected on the first night and one *Ochlerotatus trivittatus* (Coquillett) on the second. Both species are multivoltine temporary pool breeders.

The margins of some of the chain pools fluctuate to some extent with the pattern of rainfall and could have been the site of larval development. The specimen of *A. vexans* represents a site record for the Thayer Farm.

A subsequent sampling for landing/biting adult mosquitoes was conducted from 5:30 – 6:30 PM on 26 September. The author sat at the trap site with the left arm exposed. Single mosquitoes approached on four occasions, but only one alighted momentarily and left before collection could be made.

Previous light trap collections at the chain ponds were unproductive with single specimens of three species having been taken (Butts 2001). None of these species were typical temporary pool mosquitoes. All three oviposit on the water surface and could well have developed in the chain ponds.

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UPPER SITE

Alighting-Biting Survey

Initial studies on the Upper Site recognized a pattern of development of large numbers of temporary pool mosquitoes exhibiting the typical "Northern Aedes" univoltine life cycle. Larval development takes place in temporary ground pools accumulating from snow melt and spring rains which then dry up in late spring and early summer. Eggs deposited at the receding margins of these pools exhibit an obligate drying period and (in most cases) an obligate chilling requirement prior to hatching when subsequently submerged. Smaller numbers of other species with diverse developmental requirements were also collected (Butts 1974).

Drastic reductions in mosquito populations were noted after beaver (*Castor canadensis*) impounded an area surrounding a bog remnant which had provided an extensive area for "Northern Aedes" type of development. The resultant standing water maintained by beavers and subsequent development of rooted, emergent vegetation in this and a confluent impoundment which inundated original sampling area 4, made conditions inhospitable for these species (Butts 1986). These newly established conditions favor development of permanent water mosquitoes, but surveys since that time have not found evidence of large populations. They instead found much smaller populations of those species collected originally (Butts 1992).

The above noted weather pattern suggested that optimum conditions for temporary pool mosquitoes would present 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. Since it is accessible only by boat, the logistics of including it in the normal morning or evening samplings precluded its inclusion. The remaining five were visited in each sampling sequence (unless interrupted by inclement weather). Table 1 lists dates and sequence of sampling.

Collection was conducted as described originally (Butts 1974), with the collector remaining seated at each station for 20 minutes with one forearm exposed. Mosquitoes which 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 2.

The dominant species collected was *Ochlerotatus canadensis* (Theobald), a temporary pool species which does not have an obligate pre-hatching chilling requirement, but which 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 semi-permanent water (*Coquillettidia perturbans* (Walker)).

It is noteworthy that under optimum conditions for development the number of mosquitoes encountered was quite small when compared to populations studied in the initial survey (Butts 1974). They yielded large numbers of two 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.

The reason for this change in species distribution cannot be firmly established, but two 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 thus provided a constant source for larval development. A certain "spill over" 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 two surveys has been uncommonly dry during weeks critical to development of temporary pool species. This likely exerted heavy pressure on strict univoltine species but placed lesser stress on *Oc. canadensis* which has potential for more flexible multivotine development and which was present in smaller numbers in the original surveys.

The occurrence of *Cq. perturbans* in current collections is a further indication that it may be becoming established in the permanent impoundments. Its survival depends upon availability of rooted, emergent vegetation to which developing larvae must attach and thus require permanent (or extended semi-permanent) 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 to that noted in earlier surveys in which mosquitoes tended to approach rapidly, alight and proceed to feed. This type of behavior led to a study in which the 20 minute sampling period was divided into four 5 minute segments, since the collectors had the impression that they may have been followed through the woods by hungry mosquitoes. (Butts1986). This type of feeding pattern may have been more characteristic of *Oc. punctor* and *Oc. stimulans* than of the other species encountered. In contrast, the pattern encountered 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. This could also be due to some extent to changes in the attractiveness of the collector (who has changed in diverse ways through the intervening 35 years) but current 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.

Table 1. Dates of sampling sequence of areas visited and notes on mosquito activity. Numerical estimates are not listed and could be misleading due to potential for repeated approaches by the same individuals.

Date	Sequence	Notes
June 6	3,2,1	Sampling discontinued–rain. No mosquitoes approached.
June 10	6,5,3,2,1	A few approached in all areas. Probably no more than 6-8 in any one site.
June 26	6,5,3,2,1	Numerous in all sites (up to 20+). Many a-lighted momentarily. Did not attempt to feed.
July 2	1,2,3,5,6	Mosquitoes approached in all areas but in fewer numbers than on June 26th. Few Alighted and were negatively responsive to any movement.
July 17	Sequence started - discontinued due to rain.	
July 25	6,3,1,2,5	A few approached at all sites
July 30	1,2,3,5,6	Mosquitoes approached in all areas with largest number in area 1.
August 8	3,2,1,5,6	One or more approached in all areas except area 2.
August 14	5,2,1,3,6	Mosquitoes approached only in areas 5 & 6.
August 21	1,2,3,5,6	No activity in areas 1 and 2. A few in other areas, most numerous in 6.

Table 2. Mosquitoes collected, dates of collections and number of individuals per date listed parenthetically.

Species	Date	Area & Numbers
Ochlerotatus canadensis (Theobald)	June 19	Area 1 (1); Area 3 (2)
	June 26	Area 1 (4); Area 2 (2); Area 3 (2); Area 6 (2)
	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 (Cockerell)	July 25	Area 5 (1)
	July 30	Area 5 (1)
	August 21	Area 5 (2)
Ochlerotatus triseriatis (Say)	July 30	Area 1 (1)
Coquillettidia perturbans (Walker)	August 14	Area 5 (1)
	August 17	Area 1 (1)

GREENWOODS

Light Trap Collection

Reports from Dr. Earle Peterson and others of mosquito activity along a section of a trail at Greenwoods prompted a series of light trap collections. Three marked trails diverge from a point on the shelter road just west of where it starts down hill towards the dock site. The Seldom Seen trail descends toward and parallels the bog margin, turns abruptly uphill for a short distance then turns northeasterly to the property line of adjoiner Hennessy, crossing two small drainage cuts. Two light traps were placed in the low area below the trail where these drainage cuts reach a level area which extends out to the bog. Two traps were adjacent to a series of temporary pools in the woods north of the shelter. In both installations one CDC miniature light trap of Hausherr Machine Words design and one of the J.W. Hock Co. were paired and set approximately 60 feet apart. Overnight collections were made at intervals of 7-12 days from 26 June to 14 August. Traps were activated in late afternoon and picked up during mid-morning of the following day. See Table 3.

Table 3. Mosquitoes collected. Number of specimens noted parenthetically. All except those marked with an asterisk were collected in Hausherr traps.

Species	Site	Date
Anopheles quadrimaculatus (Say)	Shelter	July 2 (1)
Anopheles punctipennis (Say)	Seldom Seen	July 26 (2)
Anopheles earlei (Vargas)	Shelter	July 26 (1)
Ochlerotatus canadensis (Theobald)	Seldom Seen	July 2 (1); July 17 (2);
	Shelter	July 17 (3); July 26 (2) *
Ochlerotatus trivittatus (Coquillett)	Seldom Seen	July 17 (2)
Aedes vexans (Meigen)	Seldom Seen	August 14 (1)
Culex restuans (Theobald)	Seldom Seen	July 2 (2)
Coquillettidia perturbans (Walker)	Shelter	June 26 (1); July 9 (3); July 17 (7); July 26 (5*,2); August 7 (1)
	Seldom Seen	July 2 (6); July 9 (6); July 17 (25); July 26 (18); August 7 (14); August 14 (11)

*Collected in Hock Traps

Coquillettidia perturbans (Walker), a species dependent upon permanent or semi-permanent water with emergent rooted vegetation dominated collections at both sites. The three species of the genus *Anopheles* are characteristic of that type of developmental site but may be found in other situations. The two species of the genus *Ochlerotatus* and *Aedes vexans* (Meigen) are temporary pool mosquitoes with multivoltine capability.

Although the Cranberry Bog presents a widespread area favorable to development of permanent water species, previous alighting-biting collections along the east side of the bog included *Cq. perturbans* but were not indicative of the numbers encountered in the current survey, suggesting the possibility of other typical developmental sites in the immediate area. Surveys of the drainage associated with the trap sites were conducted. The shelter road enters the property from Zachow road and parallels drainage that is impounded in a small pond west of its outflow beneath the road and into a large pond west of its outflow beneath the road and into a large pond north of the former Zachow grange. On 26 September the author walked upstream from the small pond along a shallow channel of slowly moving water with wider areas of less than one inch depth terminating in the temporary pool complex north of the shelter. The area is rather densely covered with herbaceous growth, largely ferns. On 30 September the two drainage cuts crossing Seldom Seen trail were examined in

the same manner. The northernmost drained a larger area of the slope and originated in a low, flat clearing on the property of adjoiner Hennessy. The southernmost is much shorter and becomes indefinitely obscured, apparently fed by slow, subsurface seepage. The area into which both empty below the trail is wider with spreading patches of water less than one inch deep and largely covered with fern-dominated herbaceous growth. These areas will be revisited after killing frost.

Although development of *Cq. perturbans* could occur in this semi-aquatic habitat, it does not present the typical sites of larval development of this species. The extent to which the rather unusual snow cover in the previous winter may have had some effect upon the level of larval development is unclear. It is possible that deeper than usual water levels away from the usual pond margin may have presented a larger breeding area closer to the path. Both sexes may disperse for long distances (Horsfall 1955), and the specimens collected could well have been from larvae developing in the bog or around the edge of the impoundment.

A second matter of interest in this study is the consistently better performance of the Hausherr trap design. In the final sequence the Hock traps were not used because of their comparative ineffectiveness.

Collection of Over-wintering Adults

While in the process of remodeling the former Zakow farm house, Dr. Earle Peterson noted the presence of active female mosquitoes and submitted a series of several individuals collected on December 16, 2003. Five salvageable specimens were prepared for identification and included two specimens each of *Anopheles punctipennis* (Say) and *Anopheles earlei* Vargas and a single *Anopheles quadrimaculatus* Say.

As the diel pattern shifts to progressively shorter days in late summer, blood meal nutrients ingested are diverted from egg production to fat deposition and storage. Females then enter sites characterized by lower than ambient light and temperature conditions, become physically inactive and metabolize the stored fat. Increased temperature which normally occurs in the following spring and the increasing day length trigger a return to a pattern of host seeking. The change in condition (heating the structure and artificial lighting extending the diel light period) has apparently caused the increased activity in the farm house.

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