

ARTHROPOD MONITORING:

Beaver ponds in upstate New York as a source of anthropophilic mosquitoes

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ABSTRACT

Surveys for anthropophilic mosquito species in association with beaver ponds have been conducted over a 30 year period in three research sites in Otsego County, New York. None of the impounded areas studied appears to support significant populations of permanent water mosquitoes. One of the sites had supported large populations of anthropophilic species with "Northern *Aedes*" type development prior to impoundment.

INTRODUCTION

The following is a compilation of survey data collected over a period of 30 years in three research sites in Otsego County, New York. Two of the facilities are portions of the Biological Field Station of the State University College at Oneonta, New York with administrative offices and research laboratories quartered on the west shore of Otsego Lake north of Cooperstown, New York. The third area is an extensive tract, the Greenwoods Conservancy, administered by the Peterson Family Conservation Trust and made available to the Field Station for ecological research.

The site initially studied and hereinafter called the Upper Site is described as follows:

"It is located West of Otsego Lake and just north of the village of Cooperstown. the area consists of mature 2nd growth deciduous forest and of plantings of some conifers. A small amount of open grassland around the edge of a 40 (\pm) acre man-made pond, an old field lying between two segments of abandoned, unpaved airport runway and a remnant of an old bog are also included in the research area" (Butts, 1974).

Considerable change has occurred in this area since 1978 due to beaver (*Castor canadensis*) activity. By 1983 the area surrounding the bog and an adjacent poorly drained deciduous woodland were flooded, resulting in a beaver pond approximately 30 acres in area (Butts, 1986). Since that time an additional impoundment of part of the original drainage into the bog site has occurred, producing a 15 (\pm) acre impoundment lying north of the bog.

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The second research area studied is the Rum Hill tract, a 300-acre site immediately adjacent to the highest point in Otsego County and about 5 miles northwest of the Upper Site. It is a largely wooded area of second growth deciduous species and conifer plantations of varying age with a smaller area of open fields included. A series of several step-wise beaver ponds occupies an area of about 5 acres in the southwest corner of the property. A smaller impoundment near the southeast corner consists of a small pond constructed by the previous owner and subsequently enlarged by beavers.

The Greenwoods Conservancy is a tract of more than 1000 acres located in the Town of Burlington, Otsego County, New York about 12 miles west of the Upper site. It contains an extensive wetland of about 70 acres with a portion covered by a sphagnum mat surrounded by open water. The impoundment is of long standing, and the water level has been maintained by the conservancy staff through periodic reinforcement of the original beaver dam. A step-wise series of three small beaver ponds has been constructed in the drainage above the wetland. Another series of small, step-wise beaver ponds lies in the drainage exiting the property near the mid-line of the eastern boundary. A series of beaver impoundments of about 5 (\pm) acres extends across the southern boundary near its midpoint. A more recently constructed beaver pond of about 2 acres lies along the main access road about 400 yards west of the large wetland.

SURVEY METHODS

Procedures developed for the initial studies on the Upper site have been employed throughout. Collection of landing/biting adult mosquitoes within reach of a seated collector with an exposed forearm were made by inverting small vials charged with ethyl acetate over stationary mosquitoes. Collections were made for 20 minutes at each selected sampling site (Butts, 1974). Several repetitions of the sampling series were generally conducted at approximately weekly intervals during spring and summer. Specimens were returned to the laboratory at the Biological Field Station, mounted and retained in the permanent collection.

Sampling of accessible potential larval breeding sites was conducted periodically using a standard dipper. Specimens collected were either slide mounted or preserved in 70-80% ethanol and retained in the permanent collection.

CDC miniature light traps (without attractants) were also used to some extent to collect adult mosquitoes. In these applications and in the larval surveys there was some potential for collecting species which are not readily attracted to humans; however, the primary goal was to survey populations of anthropophilic species.

Surveys conducted at Rum Hill in 1987 included sampling sites close to each of the above mentioned impoundments, and another that was established near the northern boundary of the property above a beaver pond of 60 (\pm) acres on the adjoining property.

Initial preliminary sampling at Greenwoods in the summer of 1993 differed from other surveys in that time of exposure was for 2 hours or more at a single site at the edge of the woods

beside the lower dam of the large wetland. Time of day of collection alternated between early morning and late evening, and light traps were set after each evening exposure and picked up the following morning.

In 1994 a sampling series was established adjacent to the series of small beaver ponds near the eastern boundary and in areas surrounding the large wetland, beginning at first light on dates indicated. Collections were made for 20 minutes/station.

In 1995 a sampling series was established along the shore line of the large wetland, consisting of a series of eight stations each on the east and west side of the impoundment (the long axis of the wetland lies north and south). Standard 20 minute/station exposures were employed with one side of the wetland sampled in late evening and the other on the following morning. Light traps were also placed in varying sites during the night between each of the paired series.

In 1996 two series of sampling stations were established on largely upland sites. One of these stations was at the margin of the beaver pond at the south boundary of the property.

In 1997 two sampling series were established. One was in an upland wooded area east of the large wetland and the other largely sited along the Mill Brook drainage below the wetland and ending near the point of its impoundment at the south boundary of the property. Timing of these series was set up on alternate evening and following morning in most instances except in situations where precipitation or low temperature required that both series were conducted on the same day or abandoned.

RESULTS

Mosquito populations on all three research sites since 1983 have been maintained at low levels with no evidence of extensive developments of anthropophilic species. Records of sampling dates, specimens collected and collection method used are found in Table 1 for the Upper Site, Table 2 for Rum Hill and Table 3 for Greenwoods.

Table 1. Records of mosquitoes collected on the Upper Site from 1991 - 96. Landing /Biting/Resting collections were opportunistic in the course of other research activities. Multiple specimens collected per date are indicated parenthetically. Method of collection abbreviated as follows: Landing/Biting = LB; Resting = R; Light Trap = LT; Dipper(larval specimens) = D.

A. Collected during observation of waterfowl for 2+ hours/day on 40 days between MAY-23 and NOV-15,1985 - Light traps used JUL - 25,30; AUG - 8,13,22; SEP - 5,10,19.

Species	Date	Method of Collection
<i>Anopheles earlei</i> Vargas	JUN-17;	LB
<i>Anopheles punctipennis</i> (Say)	AUG-28	R

Species	Date	Method of Collection
<i>Anopheles punctipennis</i> (Say)	AUG-28	R
<i>Aedes vexans</i> (Meigen)	JUL-30	LT
<i>Aedes excrucians</i> (Walker)	AUG-16	LB
<i>Aedes stimulans</i> (Walker)	AUG-21	LB
<i>Coquillettidia perturbans</i> (Walker)	JUL-30; AUG-16	LT
<i>Culex restuans</i> Theobald	JUL-30	LT

B. 1986 - collected during observation of waterfowl for periods of 2+ hours/day.

Species	Date	Method of Collection
<i>Anopheles earlei</i> Vargas	JUL-1(8); AUG-7(3)	LB
<i>Aedes canadensis</i> (Theobald)	AUG-12	LB
<i>Aedes hendersoni</i> Cockerell	JUL-25	LB
<i>Coquillettidia perturbans</i> (Walker)	AUG-1	LB

C. 1987 - Collected during observation of waterfowl for periods of 2 (\pm) hours/day on 41 days between APR-2 and NOV-12:

Species	Date	Method of Collection
<i>Aedes vexans</i> (Meigen)	AUG-4	LB
<i>Aedes canadensis</i> (Theobald)	AUG-4	LB
<i>Aedes punctor</i> (Kirby)	JUN-30	LB
<i>Aedes triseriatus</i> (Say)	JUL-7	LB
<i>Coquillettidia perturbans</i> (Walker)	JUL-8(4)	LT

D. 1988 - Landing/Biting and Resting collections made opportunistically - no regular survey. Light traps used JUL-21, 27; AUG-4, 12, 18, 31; SEP-1.

Species	Date	Method of Collection
<i>Aedes stimulans</i> (Walker)	JUL-19	LB
<i>Coquillettidia perturbans</i> (Walker)	JUL-21	LT
<i>Culex pipiens</i> Linnaeus	SEP-1	LT

E. 1989 - No timed, regular surveys. Landing/biting collections made opportunistically. Light traps used AUG-8, 16, 27; SEP-6,13. No specimens collected.

F. Larval surveys of areas accessible by canoe AUG-17; SEP-21.

Species	Date	Method of Collection
<i>Anopheles punctipennis</i> (Say)	AUG-17	D
<i>Aedes punctor</i> (Kirby)	JUN-19 (2)	LB
<i>Aedes stimulans</i> (Walker)	AUG-16	LB
<i>Aedes hendersoni</i> Cockerell	AUG-16	LB

G. 1990 - Landing/biting and resting collections opportunistic. Light traps used JUL-31; AUG-7, 15, 27, 28; SEP-5, 13. Larval surveys AUG-7, 14, 28.

Species	Date	Method of Collection
<i>Anopheles earlei</i> Vargas	AUG-28	LT
<i>Aedes vexans</i> (Meigen)	AUG-27	LT
<i>Aedes canadensis</i> (Theobald)	JUL-9 (3), 16,	LB
<i>Aedes stimulans</i> (Walker)	JUL-23, 30	LB
<i>Aedes triseriatus</i> (Say)	AUG-27	LT
<i>Coquillettidia perturbans</i> (Walker)	AUG-15	LT
<i>Culex territans</i> (Walker)	SEP-5	LT
<i>Culiseta melanura</i> (Coquillett)	AUG-15, 28	LT

H. 1991 - Landing/biting and resting collections opportunistic. Light traps used JUN-24; JUL-1, 8, 15, 23, 29; AUG-5, 13, 19, 26; SEP-3, 17, 23.

Species	Date	Method of Collection
<i>Anopheles earlei</i> Vargas	AUG-14; SEP-19	LT
<i>Aedes canadensis</i> (Theobald)	JUL-29	LB
<i>Aedes hendersoni</i> Cockerell	AUG-13	LB
<i>Aedes triseriatus</i> (Say)	AUG-13	LB
<i>Coquillettidia perturbans</i> (Walker)	JUN-29	LB

I. 1992 - Landing/biting and resting collections made during 2+ hour/day observations of waterfowl on 31 days between APR-22 and SEP-30. Light traps used JUL-7, 14, 22, 29. AUG-3, 12, 18, 26.

Species	Date	Method of Collection
<i>Anopheles earlei</i> Vargas	JUL-23 (2); AUG-26	LT
<i>Aedes cinereus</i> Meigen	AUG-27	LB
<i>Aedes canadensis</i> (Theobald)	AUG-18	LB
<i>Aedes stimulans</i> (Walker)	JUN-18; AUG-18 (2)	LB
<i>Coquillettia perturbans</i> (Walker)	JUL-15 (3); AUG-4	LT
<i>Culex restuans</i> Theobald	AUG-4 (3)	LT

J. 1993 - Larval surveys SEP-1, 10. No adults collected.

Species	Date	Method of Collection
<i>Anopheles punctipennis</i> (Say)	SEP-10 (2)	D
<i>Culex territans</i> (Walker)	SEP-1 (2)	D

K. 1994 - Landing/biting and resting collections opportunistic. Larval surveys SEP-14.

Species	Date	Method of Collection
<i>Anopheles earlei</i> Vargas	SEP-14	D
<i>Aedes trivittatus</i> (Coquillett)	JUL-12 (2)	LB

L. 1995 - No adults collected. Larval surveys AUG-8, 24. No larvae collected.

M. 1996 - landing/biting and resting collections opportunistic. Light traps used JUN-25; AUG-16. Larval survey of portion of shore line JUL-17.

Species	Date	Method of Collection
<i>Anopheles earlei</i> Vargas	AUG-16	LT
<i>Coquillettia perturbans</i> (Walker)	AUG-16	LT
<i>Culex salinarius</i> Coquillett	AUG-16	LT

Table 2. Records of mosquitoes collected at Rum Hill from 1986-91. A timed landing/biting survey at specified sites was conducted in 1987. Other landing/biting collections were opportunistic in the course of other research activities. Multiple specimens collected per date are indicated parenthetically. Method of collection abbreviated as follows: landing/biting = LB; resting = R; Light trap = LT.

A. 1986 - Light traps used JUL-11, 18; AUG-1, 7, 13, 27; SEP-25.

Species	Date	Method of Collection
<i>Aedes provocans</i> (Walker)	JUN-19	LB
<i>Aedes hendersoni</i> Cockerell	JUL-18	LB
<i>Coquillettidia perturbans</i> (Walker)	JUN-30	LB

B. 1987 - Regular timed sampling series were conducted on 14 days between JUN-3 and SEP-7. Light traps were used on JUN-24, JUL-1, 8, 15, 29; AUG-5, 12, 18, 31; SEP-7.

Species	Date	Method of Collection
<i>Anopheles punctipennis</i> (Say)	JUN-24; AUG-5*	LB
<i>Aedes canadensis</i> (Theobald)	MAY-28**, JUN-24	LB
<i>Aedes provocans</i> (Walker)	MAY-28**	LB
<i>Coquillettidia perturbans</i> (Walker)	JUL-1	LB

*Specimens indicated problematical in determination, appearing to be *Anopheles perplexens* Ludlow. Difficulty in separation of adult females and absence of any known or likely specialized sites of larval development of this species argues for inclusion as indicated above.

**Specimens collected opportunistically prior to start of regular sampling series.

C. 1991 - Landing/biting collections opportunistic.

Species	Date	Method of Collection
<i>Aedes canadensis</i> (Theobald)	JUL-15	LB
<i>Aedes hendersoni</i> Cockerell	OCT-2	LB
<i>Coquillettidia perturbans</i> (Walker)	JUL-7	LB

Table 3. Records of mosquitoes collected at Greenwoods from 1993 through 1997. Landing/biting collections in 1993 were made during two hours at a single site per each date. All other sampling series were based on 20 - minute exposure at each of a series of specified sites. Multiple specimens collected per date are indicated parenthetically. Method of collection abbreviated as follows: landing/biting = LB; light trap = LT

A. 1993 - Landing/biting collections conducted JUN-10, 16, 23, 30; JUL-8, 13, 28; AUG-3. Light traps used JUN-16, 30; JUL-13; AUG-3.

Species	Date	Method of Collection
<i>Anopheles punctipennis</i> (Say)	AUG-3	LT
<i>Aedes canadensis</i> (Theobald)	AUG-3	LB
<i>Aedes punctor</i> (Kirby)	JUN-16, 23, 30 (2)	LB
<i>Culex restuans</i> Theobald	AUG-3 (2)	LT

B. 1994 - Landing/biting collections conducted on 14 days between JUN-9 and SEP-28.

Species	Date	Method of Collection
<i>Anopheles punctipennis</i> (Say)	AUG-22	LB
<i>Aedes cinereus</i> Meigen	JUL-26	LB
<i>Aedes canadensis</i> (Theobald)	JUN-15 (3), 23 (2)	LB
<i>Aedes punctor</i> (Kirby)	JUN-15 (16), 23 (7);	LB
<i>Aedes sticticus</i> (Meigen)	AUG-3	LB
<i>Aedes stimulans</i> (Walker)	AUG-10	LB
<i>Aedes trivittatus</i> (Coquillett)	JUL-13 (2); AUG-3	LB
<i>Aedes triseriatus</i> (Say)	SEP-13	LB
<i>Coquillettidia perturbans</i> (Walker)	AUG-22	LB

C. 1995 - Landing/biting collections conducted on 13 days between JUL-25 and SEP-15. Light traps used JUL-26; AUG-2, 16, 24; SEP-1, 15.

Species	Date	Method of Collection
<i>Anopheles punctipennis</i> (Say)	SEP-1	LB
<i>Aedes vexans</i> (Meigen)	AUG-2	LB

Species	Date	Method of Collection
<i>Aedes canadensis</i> (Theobald)	JUL-25	LB
<i>Aedes punctor</i> (Kirby)	JUL-25 (3)	LB
<i>Coquillettidia perturbans</i> (Walker)	JUL-26 (2); AUG-2(2)	LT
<i>Culex restuans</i> Theobald	JUL-26	LT
<i>Culiseta melanura</i> (Coquillett)	JUL-26; AUG-2 (2)	LT
<i>Culiseta morsitans</i> (Theobald)	AUG-2 (2)	LT

D. 1996 - Landing/biting collections conducted on 13 days between JUN-13 and SEP-9.

Species	Date	Method of Collection
<i>Anopheles punctipennis</i> (Say)	AUG-16 (4), 29 (3);	LB
<i>Aedes canadensis</i> (Theobald)	JUN-13 (2); JUL-17 (3)	LB
<i>Aedes fitchii</i> (Felt and Young)	JUN-20	LB
<i>Aedes punctor</i> (Kirby)	JUN-13 (3), 24	LB
<i>Aedes hendersoni</i> Cockerell	AUG-29	LB
<i>Aedes triseriatus</i> (Say)	AUG-7; SEP-5	LB
<i>Coquillettidia perturbans</i> (Walker)	AUG-29 (3)	LB

E. 1997 - Landing/biting collections conducted on 18 days between JUN-4 and AUG-26. Light traps used JUL.-2, 16; AUG-13, 19, 26.

Species	Date	Method of Collection
<i>Aedes canadensis</i> (Theobald)	JUN-12; JUL.-8 (2), 16	LB
<i>Aedes provocans</i> (Walker)	JUN-18	LB
<i>Aedes punctor</i> (Kirby)	JUN-5, 11, 12, 18 (2);	LB
<i>Coquillettidia perturbans</i> (Walker)	JUL.-8, 16, 24, 25, 30	LB

DISCUSSION

Initial surveys on the Upper Site found that large populations of mosquitoes exhibiting the "Northern *Aedes*" type life cycle were present. *Aedes punctor* (Kirby) and *Aedes stimulans* (Walker) were the dominant species with other *Aedes* spp. present in smaller numbers.

Coquillettidia perturbans (Walker) was the only species dependent upon permanent standing water for development (Butts, 1974).

Although there were numerous temporary woodland pools of varying size that supported development of the above mentioned *Aedes* spp., the major site of larval development was an area surrounding the bog mat. There was a significant yearly increase in water level from snow melt and spring rain followed by a summer decline so that this area consistently supported large populations of developing larvae. The impoundment by beavers resulted in a large body of standing water with little or no annual variation (Butts, 1986).

Studies on the Upper Site after the subsequent decline in mosquito development in the bog and environs sought to establish the time required for significant populations of permanent water species to become established therein. The maximum water level was attained in 1983, and by 1991 there was no evidence that such had taken place (Butts, 1992). Landing/biting collections of mosquitoes in the summer of 1992 (Table 1) show that this trend continues. They are particularly relevant since they were made during early morning and/or late evening periods of 2 - hour or longer observations of waterfowl on 31 days between April 22 and September 30. These observations were made from three blinds constructed at the edge of this beaver pond. Collections of adult mosquitoes on the Upper Site by this method have been opportunistic since that time and have been in more limited exposure. However, as of autumn 1997, 14 years after impoundment, this body of water does not appear to support increased mosquito populations.

Studies at Rum Hill and Greenwoods in areas adjacent to several beaver ponds of varying size and stages of development give no indication that they support significant populations of anthropophilic species.

The observation by Means (1979) that most pest mosquito populations in the mountains in New York State are largely *Aedes* spp. which breed in snow melt pools is supported by this study. The data herein also suggest, albeit from a small somewhat localized sample, that the commonly heard indictment of beavers as a source of mosquito problems needs further attention, and that wholesale treatment without prior surveillance may be counterindicated.

A factor that may be more important than these impoundments proper is that there is sometimes sufficient elevation of the local water table to allow ground pools in drainage above the ponds to retain water longer. This may well account for increased survival of "Northern *Aedes*" type species. This appears to be the case in the drainage above the beaver ponds in the southwest part of Greenwoods. Such a situation has also been observed adjacent to a wetland just outside the city of Oneonta, New York (Butts, unpublished).

Another factor that may be important in the apparent lack of use of beaver ponds studied here is the low levels of permanent water species in the local area. As a recipient of local complaints concerning mosquito problems over the last 30 years, I have yet to find a situation in which species involved were other than temporary pool species or *Aedes triseriatus* (Say) developing in discarded containers, old tires or clogged rain gutters. However, the importance of beaver ponds in areas where permanent water species are abundant may be quite different. A reasonable rule in control activity relative to beaver ponds is to survey prior to treatment.

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