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Autumnal development of vernal mosquitoes in Kampinos Forest near Warsaw

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Abstract

After sampling during the whole of September had failed to detect any adult mosquitoes, mass emergence of adult *Aedes* mosquitoes was observed in the Kampinos Forest near Warsaw at the beginning of October 1995. The autumnal mosquito fauna was composed of 11 *Aedes* species: *Ae. cinereus, Ae. cantans, Ae. communis, Ae. punctor, Ae. sticticus, Ae. annulipes, Ae. excrucians, Ae. diantaeus, Ae. vexans, Ae. cataphylla* and *Ae. intrudens*. These were present until the middle of November when the first winter frosts appeared.

The summer of 1995 was very hot and extremely dry in Poland, with no rain for almost two months prior to the end of August, when heavy rainfall filled pools usually formed in the spring as a result of snowmelt. This caused the eggs of several normally vernal mosquito species to hatch and develop.

Poland night-time temperatures and the duration of daylight in September are similar to those in March-April. It is considered probable that these factors also contributed to this unseasonal appearance of mosquito species typical of spring. The summer species found at this time had been unable to develop earlier because of the summer drought.

Introduction

The Kampinos Forest is situated in the old bed of the Vistula river and is characterised by two belts of marshes alternating with two belts of dunes overgrown by mixed forest. The marshes are covered by stands of alder with an admixture of ash and birch, interspersed with meadows and pastures. More elevated islands covered with oak, lime and hornbeam forest and interjacent drier meadows are scattered throughout the marshes.

The mosquito fauna of the Kampinos Forest has been studied on several occasions between 1935 and 1996. The first study was in the eastern part of the forest during 1935-1936 (Tarwid, 1952). Further studies were made in 1952-1953 by Dąbrowska & Tarwid (1954), in 1957 (Łukasiak, 1959) and in 1972-1975 (Wegner, 1979).

Methods

The present study was carried out in 1995. Samples were taken regularly every week from early spring until November in an oak-hornbeam forest (3 sites), in wet alder wood (2 sites), in mixed forest (2 sites) and in mid-forest meadow (2 sites). Mosquitoes were collected mainly using human bait (15 minute samples) and additionally with a sweep net.

Results

The study showed no occurrence of adult *Aedes* mosquitoes in September after the summer mosquito community had declined. However at the beginning of October huge numbers of newly emerged adult *Aedes* mosquitoes were observed in the study area. The unexpected autumn mosquito fauna was composed of 11 species: *Aedes cinereus*, which was the most abundant species, with *Ae. cantans, Ae. communis, Ae. punctor* and *Ae. sticticus* less abundant but still numerous, and smaller numbers of *Ae. annulipes, Ae. excrucians, Ae. diantaeus, Ae. vexans, Ae. intrudens* and *Ae. cataphylla*. From Table I it can be seen that he greatest number of species was observed in mid-forest meadows (9 species), with only *Aedes annulipes* and *Ae. vexans* absent. However, both these were amongst the

seven species present in the oak-hornbeam forest sites. Five species were recorded in mixed forest and five in wet alder wood. *Aedes diantaeus* was recorded in only mixed forest and in meadow and *Ae. sticticus* in only oak-hornbeam forest and meadow. Four species: *Aedes cantans, Ae. cinereus, Ae. communis* and *Ae. punctor* occurred in all types of habitat, while *Ae. cataphylla, Ae. excrucians, Ae. intrudens* and *Ae. vexans,* were found in only one type of habitat, *Ae. vexans* in the oak-hornbeam forest, the remaining three species in meadow.

A total of 1746 mosquitoes were captured during October and November 1995 of which nearly 1600 were *Aedes cinereus.* The greatest numbers of newly emerged adult mosquitoes per sample were observed in meadows, wet alder wood and oak-hornbeam forest. Smaller numbers were found in mixed forest. The community declined towards the end of October, although the occurrence of single specimens of *Aedes* mosquitoes was observed until the middle of November when the first frost came.

Discussion

Both Tarwid in the 1930s and Dąbrowska & Tarwid (1954) in the 1950s observed the autumnal mosquito fauna appearing just after the decline and disappearance of the summer mosquito community in this area. The autumnal populations observed by these authors were composed of mass numbers of *Culex pipiens* and single specimens of *Culiseta fumipennis* and *Anopheles claviger.* They did not record *Aedes* mosquitoes typical of either spring or summer during the autumn, and neither did Łukasiak (1959) nor Wegner (1979).

Autumnal development of vernal mosquitoes has rarely been reported. In the Polish literature the author has found only one paper which reported the occurrence of larvae of *Aedes cantans, Ae. cinereus Ae. excrucians, Ae. cataphylla* and *Ae. dorsalis* in October (Wojnarowicz, 1960). Data concerning the phenomenon are rather scarce in the European literature, though there are sporadic records of the autumnal occurrence of larvae or newly emerged adult *Aedes* mosquitoes (*Ae. cataphylla, Ae. communis, Ae. intrudens, Ae. cinereus, Ae. punctor* and *Ae. caspius/ Ae. dorsalis)* in the bibliography of several European countries. However, these records usually report the occurrence of only two or three species at the same time. Only in the paper of Brummer-Korvenkontio *et al.* (1971) were adults of as many as five *Aedes* species reported to emerge in the autumn. Most abundant in their study were *Aedes communis* and *Ae. punctor* (70% and 23.5%, respectively). *Ae. cinereus* (3.5%), *Ae. cataphylla* (1.5%) and *Ae. cantans* (1.5%) were less numerous. These percentages were calculated from the data for the numbers of adult mosquitoes trapped in September, October and November 1962 in southern Finland. Brummer-Korvenkontio *et al.* (1971) also observed larvae of *Ae. caspius* in September and larvae of *Ae. vexans* and *Ae. intrudens* in August. The species composition of Polish and Finnish autumnal *Aedes* mosquito fauna is compared in Table II. In the Polish list the most abundant species, *Ae. cinereus,* is excluded from the calculation, since the extremely high numbers in which it occurred obscure the proportions between the remaining species. Both in species composition and relative prevalence, proportions between autumnal *Aedes* species observed in Finland and in Poland are relatively similar, despite the general differences between the mosquito fauna of these distinct regions. *Aedes sticticus* does not occur in Finland whilst *Ae. cantans* (which is typical of deciduous forests) is much more common in Poland than in Finland. On the other hand, *Ae. punctor* is more common in Finland than in Poland.

The summer of 1995 was very hot and extremely dry in Poland. There was no precipitation for nearly two months before it started to rain at the end of August. However, this rainfall was very heavy and filled all the pools usually flooded in the spring as a result of snowmelt. Probably that is why the eggs of several mosquito species typical of the vernal period began to develop. In addition, the drought conditions delayed the appearance of summer species until the autumn. The summer of 1962 in Finland was also rather dry until August and September when rainfall was higher than usual (Brummer-Korvenkontio *et al.* 1971).

Conclusions

Several *Aedes* species normally regarded as univoltine may, under certain circumstances produce a second generation in autumn. This is true, not only species such as *Ae. cataphylla, Ae. communis* and *Ae. intrudens* in which this phenonomen is already known, but also of others such as *Ae. annulipes, Ae. excrucians, Ae. diantaeus.* Some bivoltine or multivoltine *Aedes* species, which usually have their last generation in August may also produce generations emerging as late as October.

After a dry summer, autumn rainfall sufficiently heavy to fill pools usually formed only in the spring as a result of snowmelt may cause the hatching of the eggs of several mosquito species typical of the vernal period. In addition, the low night temperatures and the duration of daylight in September, resemble those of March/April, and this may contribute to stimulation of development of the eggs of vernal mosquitoes.

The summer species observed in October must have represented a delayed summer generation, which, because of the summer drought, had been unable to develop earlier at the usual time of the year.

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Table I. Species composition (percentages) of *Aedes* mosquito fauna in different habitats of Kampinos Forest in October 1995.

Species	Mixed forest	Wet alder wood	Oak-hornbeam forest	Meadow
Aedes annulipes		0.2	0.3	
Aedes cantans	15.1	1.2	2.2	2.7
Aedes cataphylla				0.2
Aedes cinereus	71.7	97.2	90.8	92.0
Aedes communis	9.4	1.2	5.0	2.7
Aedes diantaeus	1.0			0.4
Aedes excrucians				0.2
Aedes intrudens				0.4
Aedes punctor	2.8	0.2	0.2	0.2
Aedes sticticus			1.2	1.2
Aedes vexans			0.3	
No. individuals	76	487	538	497

Table II. *Aedes* mosquitoes recorded in autumn in Poland (1995) and in Finland (1962).

Species	Percentage of total collections in Poland	Percentage of total collections in Finland*
Aedes annulipes (Meig.)	2.1	
Ae. cinereus Meig.	omitted**	3.5
Ae. cataphylla Dyar	0.7	1.5
Ae. cantans (Meig.)	35.2	1.5
Ae. communis (De Geer)	43.0	70.0
Ae. diantaeus H.D.K.	2.1	
Ae. excrucians (Walk.)	0.7	
Ae. intrudens Dyar	1.4	+
Ae. punctor (Kirby)	4.2	23.5
Ae. sticticus (Meig.)	9.2	-
Ae. vexans (Meig.)	1.4	+

Key:

* Calculated from the data of Brummer-Korvenkontio *et al.* (1971).

** In the Polish fauna the percentage of *Aedes cinereus* is omitted in order to show differences in the proportions between the remaining species more clearly

\- Species not occurring in Finland

\+ Species present in Finland as larvae in August 1962

Figure 1. Number of mosquitoes in different habitats in Kampinos Forest in autumn 1995