FIELD OBSERVATIONS ON THE NECTAR FEEDING HABITS OF SOME MINNESOTA MOSQUITOES[1]

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Introduction. The literature contains reports of a number of casual daylight observations of mosquito visitation to flowers. Robertson (1889, 1928) and Knab (1907) were among the earliest to report such activities. Raup (1930), Britten (1937), Philip (1943), Larsen (1948), and Nielson and Greve (1950) recorded similar findings, but from these early records it is often difficult to determine whether an actual nectar meal was taken. West and Jenkins (1951), through the use of radioactive phosphorus, proved in the laboratory that *Aedes communis* (DeGeer) did take up nectar from flowers. Hocking (1953) thinks floral nectar furnishes most of the energy used in flight. More thorough field studies have been made recently by Haeger (1955) on a salt marsh mosquito and by Breeland and Pickard (1961) on mosquito visits to the flower heads of *Eupatorium* and *Solidago*. There has been, however, no extensive published study on the nocturnal nectar feeding habits of mosquitoes in nature. It is our purpose here to present such observations made throughout the summer in Minnesota.

Methods and Observations. Mosquitoes were observed and collected from twilight up to midnight from early June through September, 1962. During this period 102 collections were made, each representing the capture of one or more mosquitoes taking nectar from a plant species for one evening. A flashlight emitting red light was used to detect and observe the mosquito activity; the mosquitoes were seemingly insensitive to the red light as it did not disturb their activity in any noticeable manner. Once a mosqui had been observed to be taking nectar, aspirator was used to remove it from t flower of the plant; all resting mosquito were ignored. After capture, the mosq toes were transferred from the aspirat to a killing jar and retained for identi cation in the laboratory. The majority the observations were made at the Univ sity of Minnesota Arboretum located abo 20 miles west of Minneapolis, since th area afforded access to a large variety flowering plants. Supplementary recor were made in the northern and sout central portions of the state.

Mosquitoes and the Plants Fro Which Nectar Meals Were Take (numbers represent males and females, r spectively) *AEDES VEXANS* (ME GEN): (825, 702), *Apocynum andros emifolium* (1, 6), *Aquilegia chrysant* (0, 1), *Asclepias syriaca* (149, 155), *Ast alpinus* (1, 0), *Catalpa bignonioides* (2 5), *Cirsium arvense* (15, 18), *C. lanceol tum* (2, 4), *Cornus stolonifera* (0, 5 *Echinocystis lobata* (4, 36), *Eupatoriu purpureum* (8, 8), *Heracleum lanatu* (2, 1), *Hydrangea arborescens inscolor* (8), *H. radiata* (2, 4), *Lilium* "emera trumpet" (19, 17), *L.* "regal" (16, 19 *L. superbum* (3, 0), *Melilotus alba* (40), *Nepeta cataria* (12, 8), *Pastina sativa* (2, 2), *Philadelphus californicus* (9), *P. caucasicus* (6, 15), *P. coronari Phlox paniculata* (45, 24), *Physocarp opulifolius* (0, 2), *Potentilla fruticosa* (2 8), *Rosa* "Sir Thomas Lipton" (0, 14 *Rudbeckia subtomentosa* (0, 6), *Solidag canadensis* (31, 72), *Sonchus oleraceus* (6), *Spiraea bumalda* (12, 11), *S. collo* (15, 10), *S. latifolia* (335, 81), *S. rosal* (14, 7), *S. salicifolia* (0, 5), *Sympho carpos occidentalis* (3, 4), *Syringa am rensis japonica* (19, 39), *Tamarix pe*

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ıdra (16, 14), *Trifolium pratense* (20,), *T. repens* (16, 13).

AEDES CINEREUS (MEIGEN): (9,), *Asclepias syriaca* (1, 2), *Cirsium ar-ıse* (0, 3), *Cornus stolonifera* (0, 3), *hinocystis lobata* (0, 1), *Lilium* "regal" 3), *Philadelphus californicus* (2, 11), *caucasicus* (3, 6), *Rosa* "Sir Thomas ›ton" (0, 1), *Solidago canadensis* (0, 6), *iraea latifolia* (1, 0), *S. salicifolia* (0, 1), *nphoricarpos occidentalis* (2, 0), *Sy-ga amurensis japonica* (0, 2), *Verbena ᶜcta* (0, 1).

AEDES FITCHII (FELT AND)UNG): (1, 16), *Chrysanthemum* sp. 1), *Fraxinus pennsylvanica lanceolata* 1), *Philadelphus caucasicus* (0, 1), *coronarius aureus* (0, 1), *Potentilla ticosa* (0, 1), *Rosa* "Sir Thomas Lip-" (0, 5), *Spiraea latifolia* (0, 1), *Sy-ga amurensis japonica* (0, 4), *Trifolium ens* (0, 1).

AEDES TRIVITTATUS (COQUIL-TT): (7, 4), *Apocynum androsaemi-um* (0, 2), *Catalpa bignonioides* (3, 0), *nus stolonifera* (1, 0), *Phlox paniculata* 0), *Tamarix pentandra* (0, 2).

AEDES PUNCTOR (KIRBY): (0, 8), *racleum lanatum* (0, 1), *Solidago cana-ısis* (0, 3), *Spiraea salicifolia* (0, 1), *Ver-ıa stricta* (0, 3).

AEDES STICTICUS (MEIGEN): (0, *Heracleum lanatum* (0, 1), *Spiraea sal-olia* (0, 2), *Verbena stricta* (0, 2).

AEDES CANADENSIS (THEO-LD): (0, 3), *Chrysanthemum sp.* (0, *Heracleum lanatum* (0, 1), *Solidago adensis* (0, 1).

AEDES DORSALIS (MEIGEN): (0, *Asclepias syriaca* (0, 2), *Phlox pani-ata* (0, 1).

AEDES ABSERRATUS (FELT AND)UNG): (0, 2), *Physocarpus opulifolius* 1), *Trifolium hybridum* (0, 1).

AEDES EXCRUCIANS (WALKER): 1), *Heracleum lanatum* (0, 1).

MANSONIA PERTURBANS ALKER): (165, 135), *Apocynum an-saemifolium* (0, 1), *Heracleum lana-ı* (0, 2), *Lilium* "emerald trumpet" 1), *L.* "regal" (0, 3), *Nepeta cataria* 5), *Philadelphus californicus* (9, 3), *P. caucasicus* (3, 2), *P. coronarius aureus* (12, 6), *Phlox paniculata* (0, 1), *Potentilla fruticosa* (0, 12), *Spiraea latifolia* (18, 42), *Syringa amurensis japonica* (123, 57).

CULEX RESTUANS (THEOBALD): (12, 10), *Asclepias syriaca* (2, 0), *Catalpa bignonioides* (2, 0), *Chrysanthemum* sp. (1, 0), *Eupatorium purpureum* (0, 2), *Melilotus alba* (0, 2), *Philadelphus caucasicus* (1, 0), *Solidago canadensis* (0, 3), *Spiraea latifolia* (6, 3).

CULEX TARSALIS (COQUILLETT): (0, 2), *Solidago canadensis* (0, 2).

CULISETA INORNATA (WILLISTON): (12, 19), *Heracleum lanatum* (0, 1), *Melilotus alba* (0, 3), *Philadelphus caucasicus* (0, 1), *Physocarpus opulifolius* (0, 1), *Potentilla fruticosa* (1, 0), *Solidago canadensis* (0, 6), *Spiraea latifolia* (2, 3), *Syringa amurensis japonica* (9, 4).

There were 1,981 specimens distributed among 10 species of *Aedes*, two of *Culex*, and one each of *Culiseta* and *Mansonia*, in many instances with both sexes participating in the feeding. *Ae. vexans* provided the greatest numbers of mosquitoes (1,527) and the widest range of plant species (39) involved; this is as would be expected, since this mosquito is the most consistently abundant species over much of the state. Of special interest is the apparent wide choice of plants from which a nectar meal may be obtained and the ease with which mosquitoes may be found and observed in the act of imbibing nectar.

The feeding activity itself is worthy of comment. In most cases a probing action preceded the actual feeding. Although the feeding time as such is not very long, if a flower cluster is present the mosquito may continue to probe and feed over the entire flower area. As the nectar is being imbibed, the abdomen may be observed to be pulsating and swelling gradually. On two occasions nectar-fed females were taken that still had the remains of a partially digested blood meal. Once satiated, the mosquito will rest and engage in much rubbing of its hind legs. Several photographs of mosquitoes feeding on flowers at night are shown in Figures 1–3.

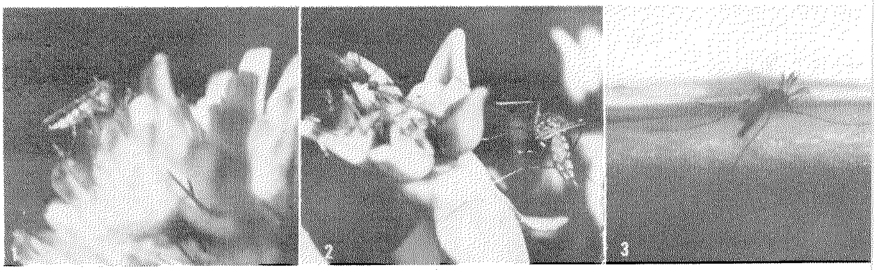

FIG. 1 (Left).—*Aedes vexans* female feeding on head of *Trifolium pratense*. FIG. 2 (Center).—*vexans* females on *Asclepias syriaca*. FIG. 3 (Right).—*Ae. vexans* male feeding inside the flower of regal lily.

Very few mosquitoes could be found feeding before dark. On nights when swarming was observed, heavy feeding on flowers invariably followed. For instance, on July 17, after swarming had taken place at a site near several *Spiraea latifolia* bushes, 20 male and female mosquitoes were collected from a single flower cluster during one 15-minute period and 41 during the following 15 minutes. The flowers were literally covered with mosquitoes.

Another example of such heavy feeding occurred on June 25 on the Japanese lilac, *Syringa amurensis japonica*. From 9:00–9:15 (CDT), only one *Ae. vexans* was taken; from 9:16–9:31, five mosquitoes representing this species as well as *Ae. fitchii* and *Mansonia perturbans* were captured. Then feeding increased dramatically, with 24 specimens, including the above 3 species plus *Culiseta inornata,* captured from 9:33–9:48. Thirty-three specimens of these four species were taken in only a 5-minute period between 10:00–10:15, as feeding reached its climax.

The first hour or so after dark would consistently produce the greatest numbers feeding at any one time, but if conditions were favorable, feeding did not completely stop during the entire observation period. Contrasted to the above observations, Downes (1958) reported that three northern *Aedes* species showed males predominating in the afternoon and females late in the evening.

Ae. cinereus was one of the earliest mosquitoes to feed. This species was of collected before it had become complet dark. Once it was dark, any of the ot species might be collected. As one wo anticipate, too much wind or temperatu down in the 50° F. range reduced the fe ing activity; also rainfall, even if it l occurred two or three hours before da seemed to detract from feeding. The te perature effect was particularly evident many cool September nights; when te peratures dropped into the forties no lections could be made.

One of the most interesting observati concerned the greater numbers of m quitoes feeding on the lighter colo flowers. The white, pink and yell flowers standing side by side with dar ones produced feeding mosquitoes wl the darker ones proved negative or tually so. For example, red clover (*T folium pratense*) would be negative wl the white clovers (*Trifolium repens* *Melilotus alba*) would produce number feeding mosquitoes. Only when the mo was in its full phase and the sky was cl did mosquitoes appear in any numl on such plants as red clover and phlox.

The availability of the nectar in flower must also be an important fac for feeding; yarrow, some of the mu petaled roses, and similar flowers pro negative even though the flowers are li colored. It is uncertain how import flower aroma may be to the attraction nosquitoes. They do feed very heavily on he fragrant blossom of the common milkveed *(Asclepias syriaca)*; 25 *Ae. vexans* vere collected from one flower cluster of nilkweed in 15 minutes. The age of the lower was also a factor, with fewer feeding attempts being observed on the older blossoms.

Summary and Conclusions. A total f 1,981 specimens representing 4 genera nd 14 species of mosquitoes was captured n nature after imbibing nectar meals. They were taken from a large number of lifferent plant species during the early night-time hours. Various factors, such s temperature, wind and rainfall, in addition to availability of the nectar, and the olor, age and aroma of the flower, may ffect the plant-feeding activity of the mosquito. The ease with which nectar-feeding nosquitoes are found and the variety of plants upon which they feed supports the belief that mosquitoes in nature may rely xtensively upon nectar for satisfying their biological requirements.

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THE INFLUENCE OF FLOWER SCENTS ON AGGREGATIONS OF CAGED ADULT *AEDES AEGYPTI*

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Introduction. Female mosquitoes have een observed to visit and probe several pecies of flowering plants for nectar and uices (Barr, 1958). Under laboratory conitions *Aedes communis* (De Geer) males nd females visit flowers and ingest plant uices and nectars as shown by their acumulation of radioactivity from flowering lants treated with P^{32} (West and Jenins, 1951).

This behaviour is undoubtedly a factor in longevity of adult mosquitoes. In our preliminary experiments we observed that *Aedes aegypti* (Linnaeus) adults survived only 24–48 hours without water and 4 to 5 days on water without sugar whereas they can survive about 60 days in the laboratory when provided with sugar syrup or honey. Hocking (1953) has shown that nectar supply is important for