A Study of the Population of Insects Emerging as Adults from the Dundas Marsh, Hamilton, Ontario, During 1948[1]

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The first recorded studies of insects from the Dundas Marsh concern the phalaenid moths, *Arzama obliquata* and *A. diffusa,* whose larvae drill in the leaves of aquatic plants. Moffat (1888, 1888a) reported collecting *A. obliquata* from reeds and stumps in the vicinity of the marsh and Johnston (1889) recorded the occurrence of both of these species in his collections. Moffat (1889) also reported collecting *A. obliquata* and *Nonagria fodians* from a cat-tail, *Typha* sp. In 1946 a few species of insects were collected about the marsh and in 1947 a project was undertaken to determine the times of first and last emergence and the period of maximum emergence of various species which emerge as adults from the water. These studies are discussed by Judd (1947, 1949, 1949a, 1950a). In 1948 a study was made of the population of insects emerging from the marsh from March to November, the present paper being a report on this project.

ACKNOWLEDGMENTS

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DESCRIPTION OF MARSH

The Dundas Marsh, lying along the northern limits of the city of Hamilton, Ontario, has an area of about 700 acres (Fig. 1). During the past it has received a variety of names. Father Hennepin, missionary and explorer, visited the region early in the seventeenth century and named it "Little Flanders." It was later named "Coote's Paradise" after a Captain Coote of the 8th Regiment of Foot in the garrison at York, who hunted water-fowl in the marsh. The name "Jubilee Sanctuary" was applied to the marsh to com-

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memorate the jubilee year of King George V in 1935. It is now part of the properties of the Royal Botanical Gardens.

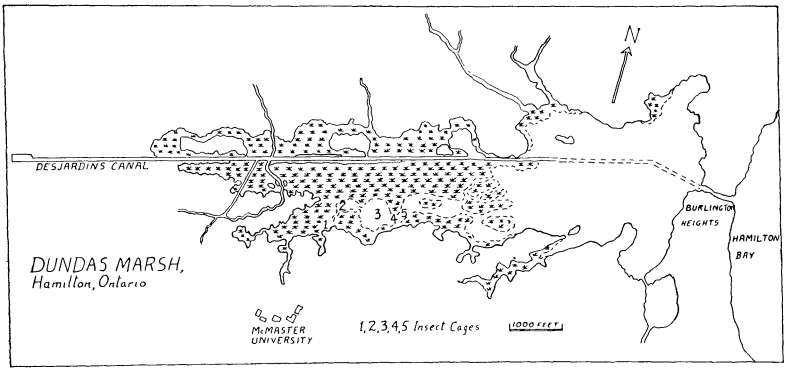

Fig. 1.—Map of Dundas Marsh showing locations of cages.

The marsh lies in the Dundas Valley which is bordered on its northern and southern limits by the Niagara Escarpment, and several streams that pour over the escarpment feed the waters of the marsh. In its original condition it emptied into Hamilton Bay by an outlet at its northeastern end. In 1827 the construction of the Desjardins Canal was begun and it was opened for traffic in 1837. The canal extends eastward from a turning basin in the town of Dundas for a distance of about three miles and has access to Hamilton Bay by a cut through Burlington Heights which separates the marsh from the bay. With the increase in importance of Hamilton as a port and railway center in the latter part of the nineteenth century the Desjardins Canal fell into disuse and today is navigable only by canoe or small boat.

At the eastern end of the marsh is open water which in 1948 comprised about one-third of the total area of the marsh. The remainder of the area supports a heavy growth of aquatic and marsh-dwelling plants (Judd, 1950). The predominant plant in the central part of the marsh is the Old World Manna Grass, *Glyceria maxima* (Hartm.) Holmb. (Dore, 1947). *Typha latifolia* L., also forms extensive stands throughout the marsh and various submerged plants grow in quiet stretches of water extending westward from the open water.

METHODS

The use of traps set out on bodies of water to collect insects emerging from the surface was introduced by Needham (1908) in 1905 when he made quantitative studies of the population of insects in a lake in New York. The same method was used by Adamstone and Harkness (1925) in conducting studies of bottom organisms in Lake Nipigon, Ontario. The cage was moved about from one location to another and emerging midges were trapped. Scott and Opdyke (1941) used floating cages covering one square meter or one-quarter of a square meter of surface on Winona Lake in Indiana. They

visited the cages twice a day and removed insects from them. Miller (1941) studied the chironomid population of Costello Lake, Ontario, using five floating traps anchored at specified points on the lake. Each trap was made of cotton stretched on a frame of wood and wire covering four square feet of surface. In his investigations on the insects of rapid streams Ide (1940) used screen-covered traps set on the rocks or over the bottom of the stream.

To carry out studies of insects emerging from the water of the Dundas Marsh in 1948 five cages were used (Fig. 2), located at the same positions as in 1947 (Judd, 1949, 1949a). They were placed at selected points on the marsh (Fig. 1) in water of differing depths and in regions supporting various growths of vegetation. The wooden frame of each cage was 36 inches long, 30 inches wide and 36 inches tall. The top and four sides were covered with No. 16 copper screening. The bottom of the cage was open. Along the upper part of each of the 36-inch sides was a door of dimensions 32 inches by 15 inches, hinged at the bottom to allow the collector access to the inside of the cage. Each door was held shut by hooks at its top. Each cage was set securely over four 2 inch by 2 inch posts driven firmly into the bottom of the marsh so that the lower border of the cage was about one foot below the surface of the water.

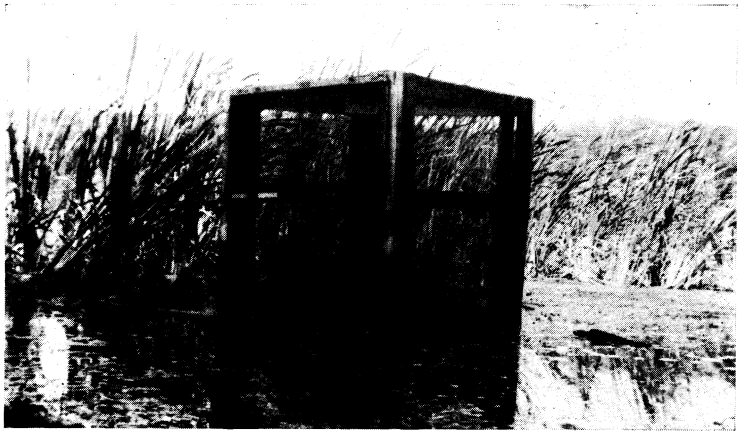

Fig. 2.—Cage 1, August 26, 1948 (water depth—16 inches).

The cages were visited by canoe between 9:30 a.m. and 11:30 a.m. (in a few cases between 2:00 p.m. and 4:00 p.m.) daily, or as frequently as possible during the week. The depth of the water was read from a scale (inches) attached to the side of the cage. The maximum and minimum temperatures of the water for the previous 24-hour period at the bottom of the marsh were taken at each cage with a Taylor Six's maximum-minimum thermometer. The thermometer was attached to the cage by a chain and was drawn up to the surface to be read.

After the depth and temperatures of the water at a cage had been recorded the insects were collected from the cage. The canoe was drawn up alongside the cage and one of the doors was opened. Large insects (dragonflies, damselflies, etc.) were captured by hand and were put in a cyanide jar. Small insects (midges, etc.) were sucked into a jar by means of an aspirator and then transferred to the cyanide jar. Dead insects lying on the surface of the water were scooped up with a small strainer and were placed in preservative. Collections from the different cages were kept separate. On return to the laboratory representative specimens were pinned and labelled (date, name of collector, number of cage) and the remaining specimens were placed in preservative in shell vials, specimens from each of the five cages being kept separate. The number of specimens of each species in a daily catch, from each cage, was determined and recorded. All specimens, pinned and preserved, are retained in collections at McMaster University except series kept by specialists who examined and identified the insects.

On March 16 the marsh was covered with ice except for a small area adjacent to the outlet through Burlington Heights. After this date a thaw set in and by March 21 the open areas of the marsh were free of ice, while in the area in which the cages were to be set out, the ice was still solid and covered with several inches of water. By March 31 the area was free of ice, except close to the shore, and on that date Cages 2, 3, 4 and 5 were set in position. At the prospective site of Cage 1 the bottom of the marsh was still frozen. By April 5, thawing had softened the bottom of the marsh at this point sufficiently to allow stakes to be driven in and Cage 1 was set in position.

Cage 1 was removed from the marsh on October 18 when thin shell ice had formed over the water at this location during the previous night. On October 22 ice one-quarter inch thick formed over the water from the shoreline to the vicinity of Cage 2. On succeeding days warm weather prevented the formation of ice and Cages 2, 3, 4 and 5 were removed from the marsh on October 22, 25, 27 and 29 respectively. The thermometers were left attached to the stakes until November 20 and temperatures and depths of the water were recorded till that date. On December 1 the marsh was free of ice and on succeeding days till December 8 shell ice formed during the night and melted during the day. On December 9 the marsh was frozen over with ice one-half inch thick except in the area of open water and on December 11 the whole marsh was covered with ice one and a half inches thick except in the outlet through Burlington Heights.

DATA ON CAGES

Cage 1.—In operation over period April 5-October 18; located 20 feet from shore (Fig. 1). *Plants in cage: Typha latifolia* (L.) (predominant), *Myriophyllum verticillatum* L. (predominant), *Spirodela polyrhiza* (L.) Scheld., *Lemna minor* L., *Wolffia columbiana* Karst., *Ceratophyllum demersum* L., *Anacharis canadensis* (Michx.) Planchon, *Ricciocarpus natans* (L.) Corda.

Cage 2.—In operation over period March 31-October 22. *Plants in cage: Utricularia vulgaris* var. *americana* Gray (predominant), *Myriophyllum verticillatum* L., *Spirodela polyrhiza* (L.) Scheld., *Lemna minor* L., *Wolffia columbiana* Karst., *Ricciocarpus natans* (L.) Corda.

Cage 3.—In operation over period March 31-October 25. *Plants in cage: Ceratophyllum demersum* L. (predominant), *Spirodela polyrhiza* (L.) Scheld., *Lemna minor* L., *Wolffia columbiana* Karst.

Cage 4.—In operation over period March 31-October 27. *Plants in cage: Nymphaea odorata* Ait. (predominant), *Potamogeton pectinatus* L., *Ceratophyllum demersum* L., *Spirodela polyrhiza* (L.) Scheld., *Lemna minor* L., *Wolffia columbiana* Karst.

Cage 5.—In operation over period March 31-October 29. *Plants in cage: Ceratophyllum demersum* L. (predominant), *Potamogeton pectinatus* L., *Spirodela polyrhiza* (L.) Scheld., *Lemna minor* L., *Wolffia columbiana* Karst., *Ricciocarpus natans* (L.) Corda.

The depth of the water at the five cages reached a maximum at the end of May (Fig. 9) and maintained a high level during June. Thereafter the level fell gradually during the summer and fall and by November 8 the marsh was dry at the site of Cage 1. On April 5 when all cages had been set in position the water depths were 22, 26, 37, 48 and 41 inches at Cages 1, 2, 3, 4 and 5 respectively. At the end of May when maximum depths were recorded the readings were: Cage 1—28 in. (May 27); Cage 2—35 in. (May 26); Cage 3—47 in. (May 27); Cage 4—58 in. (May 27); Cage 5—51 in. (May 27).

RELATION OF TEMPERATURE OF WATER TO EMERGENCE OF INSECTS

The maximum and minimum temperatures of the water over 24-hour periods at the bottom of the marsh were recorded at each cage. These temperatures were averaged and the averages for each day were tabulated. The first readings were taken on March 16 when the marsh was frozen and water in small pools on the ice had a temperature of 0°C. Following thawing, temperatures of the water rose rapidly and the maximum average temperatures were attained on July 14 (Cage 1—22.5°C.; Cage 2—22.2°C.; Cage 3—24.2°C.; Cage 4—24.4°C.; Cage 5—24.2°C.) (Fig. 8). Thereafter the temperatures fell irregularly during summer and fall. Readings of temperature were continued till November 20. The total accumulation of day-degrees at each cage was arrived at by summing the average daily temperatures from

Cage	Day-degrees	Difference from average	Percentage difference
1	3568	—153	—4.1
2	3596	—125	—3.4
3	3792	71	1.9
4	3809	88	2.4
5	3840	119	3.4
Average	3721		

March 16 to November 20. These accumulations are tabulated as follows:

The increase in the average accumulation of temperature at the five cages from March to November is represented in Figure 8. The accumulations of temperature differ little from one cage to another owing to the shallowness of the water at the five cages and consequent lack of thermocline. The accumulations were calculated in the same way as those calculated by Miller (1941) in his study of the Chironomidae of Costello Lake in Algonquin Park. He trapped insects in five floating tent-traps, Number 1 being in water one meter deep and the others in water 3 or more meters deep. The thermocline in the lake was at a level from four to seven meters. The accumulation of day-degrees at Miller's cage 1 was 3,900 in 1938, a temperature of 0°C. being recorded on April 29 and the temperature records being maintained till November 20. The accumulations at his other cages were considerably less, ranging down to 770 at a cage in water 17 meters deep. The accumulation at Miller's Cage 1 in 1938 (3,000 day-degrees) approximates the value obtained in the Dundas Marsh in 1948 (3,721 day-degrees) when it is considered that 342 day-degrees had accumulated in the marsh on April 29, 1948, and the water temperature was still 0°C. in Costello Lake on the same date in 1938.

The curves in Figure 10 represent the numbers of insects of known species that emerged daily from the marsh and the number of species occurring in these collections. Peaks of emergence showed in April, in the first week of June and in the middle of July. The day of maximum emergence was August 4 owing largely to the great numbers of the midge, *Pelopia punctipennis,* that emerged on that day (Fig. 4E). The maximum number of species, 19, emerged on July 15, one day after the temperature reached its maximum at the five cages, indicating that the seasonal variation in the emergence of numbers of species is correlated directly with changes in temperature. Miller (1941), in his studies of emergence of midges from Costello Lake, found that the number of species emerging reached a maximum in the week of July 6-12, 1938, and that the highest temperatures occurred also in that week.

The average accumulation of day-degrees during the season is plotted in Fig. 8. From this graph the number of day-degrees accumulated up to the date of maximum emergence of each species of insect has been determined. These figures are included in the discussion of the times of emergence of each species in the section entitled "Account of species collected."

PRODUCTION OF ADULTS

In a population of larvae and nymphs existing on an area of the bottom of a marsh or on the plants growing from it some insects are destroyed by predators or parasites, some succumb to changes in the physical environment, some fail to complete emergence from the pupal or nymphal skin successfully while others achieve full emergence. The numbers of insects emerging from a given surface of water do not, therefore, represent the total insect productivity of the bottom of the marsh beneath it, but rather only those which successfully emerge. In Table 2 figures are presented to show the amounts and percentages of the crop of adults produced at the different cages in the

Dundas Marsh. It is assumed that each wasp that emerged was a parasite on a single larva of its host species.

The area af water surface covered by each cage was 36 inches by 30 inches (1,080 sq. inches or 7.5 sq. ft.), so that the total area from which emerging insects were collected was five times this area, i.e., 37.5 sq. ft. Over the whole period in which the adults were trapped 15,338 insects emerged, an emergence of 409 per sq. ft. Some sources of error will affect the reliability of this figure. It is likely that some insects were missed in the process of making the daily collections and that some successfully escaped from the cages. Also the presence of the four sturdy stakes at each cage probably attracted into the area covered by the cage adult insects that lay eggs on solid objects beneath the water as well as larvae that require a solid surface on which to pupate and nymphs that climb a vertical support before producing adults.

The numbers of insects of the various orders that emerged in the cages are shown in Table 2. Adult Diptera constituted the large majority of the emergents (87.1 percent) and most of these Diptera (92.5 percent) were midges. Most of the crane-flies (Tipulidae) that emerged (4.3 per cent of the Diptera) did so in the shallower water at Cages 1 and 2 among stands of cat-tail. A few biting midges, Heleidae, (= Ceratopogonidae), 1.4 percent of the Diptera, emerged and were well distributed throughout the cages. Very few mosquitoes (0.1 percent) appeared. Other families of Diptera were represented by a few individuals comprising 1.7 percent of the total. The mayflies (Ephemeroptera) comprised 9.9 percent of the total emergents and most of them appeared in the three Cages 2, 3, and 5 in deeper water, more than half emerging in Cage 5. Odonata constituted a small percentage (1.5 percent) of the total emergents. Dragonflies of the family Libellulidae emerged mainly in Cages 1 and 2 in shallow water. The large aeschnid dragonfly, *Anax junius,* appeared in all cages. Two of the damselflies, *Lestes rectangularis* and *Enallagma ebrium,* emerged mainly in Cages 1 and 2 while the third, *Ischnura verticalis,* appeared only in Cages 3, 4 and 5. The caddis flies (Trichoptera) were represented by 75 adults that appeared in all cages except No. 1, and the five species of moths (0.9 percent) emerged in all cages. The ichneumonid parasites also appeared in all cages and were probably parasitic on lepidopterous larvae, while the single species of chalcid wasp emerged only in Cages 1 and 2 and was very likely parasitic on the soldier fly, *Odontomyia vertebrata.*

The most productive of the cages was No. 4 in which almost half (45.7 percent) of the total number of insects emerged. The midges predominated in this cage, as is in the others; more than half the catch was composed of the midge, *Pelopia punctipennis.* Cage No. 5 yielded 24.0 percent of the total numbers of insects with the midges predominating. These two cages, then, yielded slightly more than two-thirds (69.7 percent) of the total number of insects, owing largely to the concentration of midges in those areas. The other three cages captured lesser numbers of insects but in them some groups predominated, as the Tipulidae in Cage 1, the Zygopterous Odonata in Cages 1 and 2 and several families of Diptera, represented by a few specimens in Cage 2.

ACCOUNT OF SPECIES COLLECTED

EPHEMEROPTERA

BAETIDAE

Caenis simulans McDunnough.—Emergence period: May 29-September 17, maximum July 20 (124 insects; 1,842 day-degrees; Fig. 3A). The majority of these insects emerged from Cages 3, 4 and 5 in open water away from the shore (Table 1). The species was trapped in the cages in 1947 (Judd, 1949).

Callibaetis fluctuans Walsh.—Two mayflies were trapped on September 15, one in

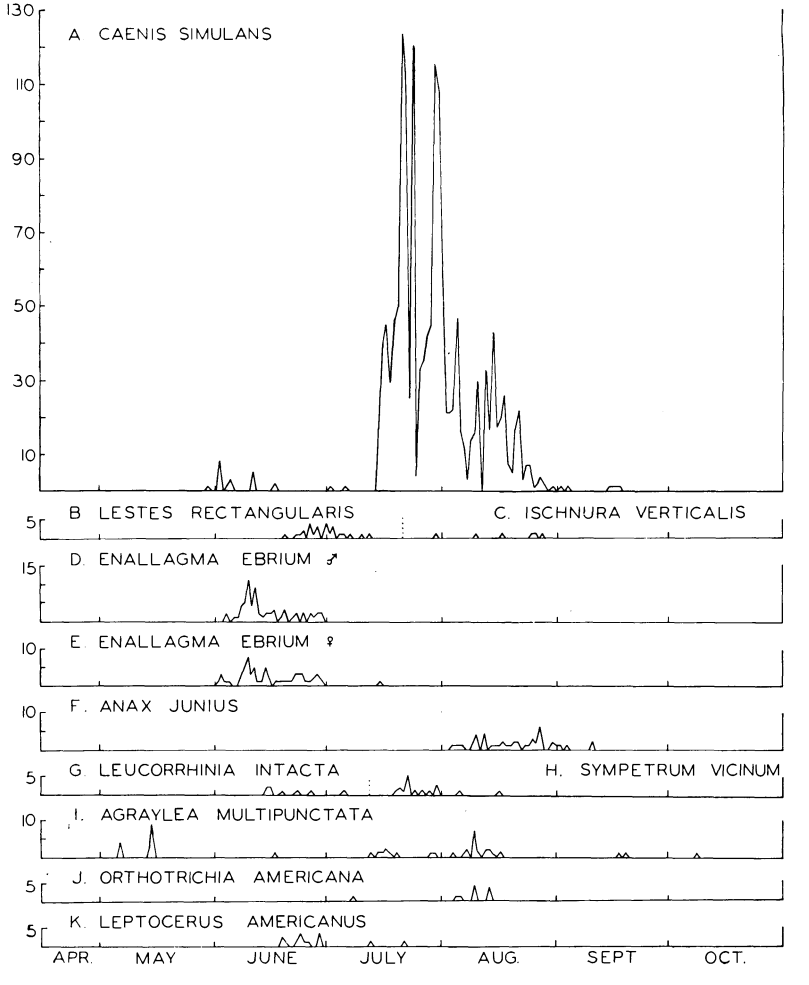

Fig. 3. (A-K).—Periods of emergence of adults of Ephemeroptera, Odonata and Trichoptera.

Cage 4 and one in Cage 5 (Table 1). The species was captured in 1947 at the end of August and in September (Judd, 1949).

ODONATA

LESTIDAE

Lestes rectangularis Say.—Emergence period: June 19-July 12, maximum June 26 (4 insects; 1,307 day-degrees; Fig. 3B). The majority of these insects emerged in Cages 1 and 2, close to shore (Table 1). This species appeared in 1947 in June and July (Judd, 1949).

COENAGRIIDAE

Enallagma ebrium (Hagen).—Males: Emergence period: June 3-29, maximum June 9 (11 insects; 972 day-degrees; Fig. 3D).

Females: Emergence period: June 1-July 15, maximum June 9 (8 insects; 972 day-degrees, Fig. 3E).

More than half of the insects emerged in Cage 1 (Table 1), indicating that the nymphs of this species inhabit shallow, weed-choked stretches of water. Walker (1941) records that this damselfly frequents "still marshy waters." In 1947 the species emerged in June and July (Judd, 1949).

Ischnura verticalis (Say).—Three males and three females emerged in the cages, the first appearing in Cage 5 on July 29 and the last in Cage 3 on August 27 (Fig. 3C). They emerged in Cages 3, 4 and 5 (Table 1). In 1947 this species appeared in July and August (Judd, 1949). Walker (1941) reports that "the majority appear in early June and there is another lower peak of emergence in the second half of August."

AESCHNIDAE

Anax junius (Drury).—Emergence period: August 3-September 10, maximum August 27 (6 insects; 2,624 day-degrees; Fig. 3F). Walker (1941) records that the species occurs in the second half of August and in September. On April 19 and 21 adults were seen in flight and settling on sunny paths near the marsh. They were probably adults returning from the south (cf. Walker, 1941). In 1947 this dragonfly was trapped during August and September (Judd, 1949).

LIBELLULIDAE

Libellula quadrimaculata L.—One specimen emerged in Cage 1 on June 17 (Table 1). In 1946 the species was collected in June (Judd, 1949).

Sympetrum vicinum (Hagen).—Emergence period: July 19-August 16, maximum July 22 (5 insects; 1,887 day-degrees; Fig. 3H). The majority of these dragonflies emerged in Cages 1 and 2 and none appeared in Cage 5 (Table 1), indicating that the species frequents shallow waters. Walker (1941) points out that this insect inhabits the marshy borders of permanent ponds. Emergence occurred in cages during July and August in 1947 (Judd, 1949).

Leucorrhinia intacta Hagen.—Emergence period: June 14-July 5, maximum June 15 (2 insects; 1,089 day-degrees; Fig. 3G). The greatest number of this species emerged in Cage 2 (Table 1). In 1947 adults appeared at the end of June (Judd, 1949).

TRICHOPTERA

PSYCHOMYIIDAE

Polycentropus flavus (Banks).—A single specimen emerged in Cage 4 on July 8 (Table 1). Ross (1944) records that this species has been collected previously in Ontario.

HYDROPTILIDAE

Agraylea multipunctata Curtis.—Emergence period: May 5-October 8, maximum May 14, August 9 (9, 7 insects; 522, 2,253 day-degrees; Fig. 3I). This caddis fly emerged mainly in Cages 3, 4 and 5 in open water (Table 1). In 1947 collections were made in the middle of May (Judd, 1949). Ross (1944) reports collections from other localities in Ontario.

Oxyethira verna Ross.—A single specimen emerged in Cage 4 on August 9. This collection represents an extension in the known range of the species, for Ross (1944) says of this insect "the only record outside of Illinois is from New Brunswick indicating a wide but probably local range."

Orthotrichia americana Banks.—Emergence period: July 7-August 13, maximum August 9 (4 insects; 2,253 day-degrees; Fig. 3J). All the insects emerged in Cages 3, 4 and 5 (Table 1).

LEPTOCERIDAE

Leptocerus americanus (Banks).—Emergence period: June 18-July 21, maximum June 23 (3 insects; 1,245 day-degrees; Fig. 3K). All the insects emerged in Cages 3, 4 and 5 (Table 1). In 1947 a single specimen was trapped in June (Judd, 1949).

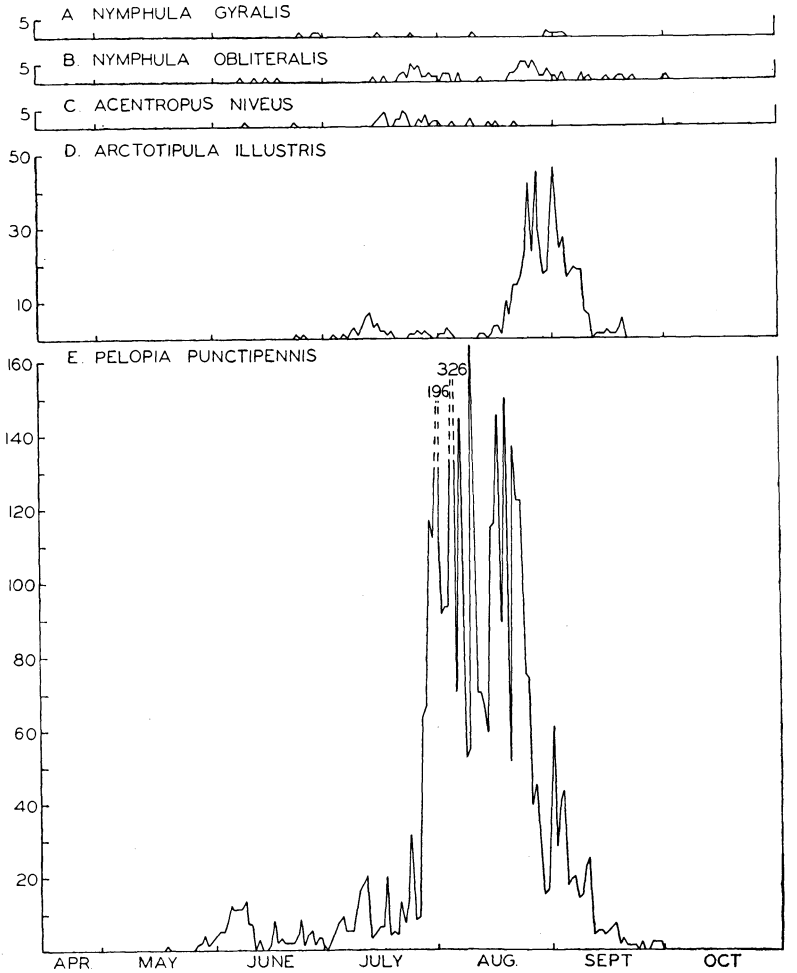

Fig. 4 (A-E) —Periods of emergence of adults of Lepidoptera and Diptera.

LEPIDOPTERA

PYRALIDAE

Nymphula gyralis Hlst.—Emergence period: June 24-September 3, maximum August 30 (2 insects; 2,693 day-degrees; Fig. 4A). This species emerged in Cages 3, 4 and 5 (Table 1). In 1947 the moths were trapped in July, August and September (Judd, 1949).

Nymphula obliteralis Walker.—Emergence period: June 8-October 1, maximum July 24, August 23 (5, 5 insects; 1,930, 2,536 day-degrees; Fig. 4B). The moths emerged in all cages, mostly in 1, 2 and 3 (Table 1). In 1947 they appeared in July, August and September (Judd, 1949). Scotland (1940) records that the larva of this species feeds on and makes cases of *Lemna minor* and Hart (1896), referring to it as *Hydrocampa obliteralis,* says that the favorite home of the larva is among the floating leaves of *Potamogeton natans,* the imagos becoming most abundant in August and September. *Lemna minor* was present on the surface of the water in all cages and seven species of *Potamogeton* grow in the marsh (Judd, 1950). Some of these plants were possibly food for the larvae of *Nymphula obliteralis.*

Nymphula icciusalis Walker.—A single specimen emerged in Cage 5 on July 19 (Table 1). In 1947 this moth was captured in June and August (Judd, 1949). Berg (1949, 1950) and Welch (1916) record that the larval and pupal stages are passed on *Potamogeton natans.* In the Dundas Marsh the young stages possibly inhabit some of the *Potamogeton* that grow in the marsh (Judd, 1950).

Nymphula badiusalis Walker.—One moth emerged in Cage 5 on August 5 (Table 1). Berg (1949, 1950) records that the young stages develop on five species of *Potamogeton* one of which, *P. zosteriformis,* grows in the Dundas Marsh (Judd, 1950). Brodie and White (1883) record this species from Ontario under the name *Oligostigma albalis* Rob.

Acentropus niveus Olivier.—Emergence period: June 9-August 21, maximum July 17 (4 insects; 1,776 day-degrees; Fig. 4C). The largest numbers appeared in Cages 3 and 5 (Table 1) in which the predominant plant was *Ceratophyllum demersum.* This species was collected in the marsh in 1947 (Judd, 1947, 1949) in larger numbers than in 1948. It occurs commonly in Europe where the larva is known to feed on *Anacharis canadensis* (Michx.) Planchon, *Ceratophyllum demersum* L. and *Potamogeton perfoliatus* L. (Judd, 1950b). These three plants grow in the Dundas Marsh (Judd, 1950) and probably form part of the food supply of the larvae.

DIPTERA

TIPULIDAE

Arctotipula illustris Doane.—Emergence period: June 23-September 19, maximum August 31, (46 insects; 2,715 day-degrees; Fig. 4D). About two-thirds of these insects emerged in Cage 1, indicating that the larvae inhabit shallow water among cat-tails (Table 1). In 1947 the flies emerged from July to September (Judd, 1949). Alexander (1919), referring to it as *Stygeropis fuscipennis* Loew, records that the species is a characteristic inhabitant of marshy situations and appears on the wing in July and August, and the same author (Alexander, 1920), referring to it as *Prionocera fuscipennis* (Loew), reports that larval and pupal skins have been found among *Sparganium* stems and in a cat-tail swamp at Ithaca, New York.

Limonia moniliformis (Doane).—Two flies emerged in Cage 1, one on September 19, and the other on October 15, and one emerged in Cage 3 on July 19 (Table 1). Alexander (1919), referring to this fly as *Dicranomyia moniliformis* Doane, records that it has been taken on Long Island, New York.

Helius flavipes (Mqt.)—A single fly emerged in Cage 1 on August 17 (Table 1). Johannsen (1934) reports that larvae and pupae have been found in cat-tail swamps. Alexander (1919) refers to the species as *Rhamphidia flavipes* Macq. and records finding it in organic mud in swamps in New York State. He reports (1920) that it is characteristic of cat-tail swamps and has been reared from leaves of *Sparganium* and that its larvae were associated with the larvae of *Prionocera fuscipennis* (i.e. *Arctotipula illustris* Doane). In the Dundas Marsh the only specimen collected appeared in Cage 1 where most of the population of *Arctotipula illustris* emerged.

CULICIDAE

The collections of mosquitoes were reported upon previously by Judd (1950a).

Anopheles quadrimaculatus Say.—Two adults emerged in Cage 2 on September 3 (Table 1).

Anopheles occidentalis Dyar and Knab.—One mosquito emerged in Cage 3 on August 14 (Table 1).

Culex apicalis Adams.—Two mosquitoes were collected, one from Cage 1 on August 10 and one from Cage 4 on August 3 (Table 1).

Culex pipiens L.—Three mosquitoes emerged in the cages, one in Cage 1 on August 14 and two in Cage 3 on August 3 (Table 1).

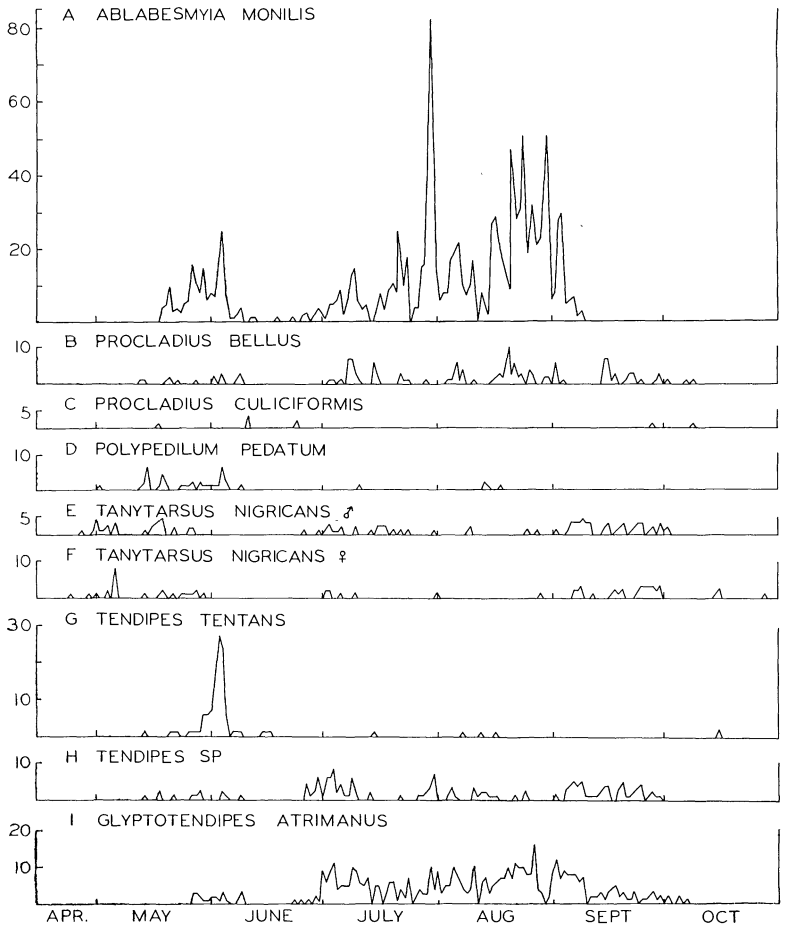

Fig. 5 (A-I).—Periods of emergence of adults of Diptera.

Mansonia perturbans Walker.—Two mosquitoes emerged, one in Cage 3 on August 2 and one in Cage 4 on August 14 (Table 1).

MYCETOPHILIDAE

Phronia rustica Winn. var. "a" Joh.—On fly emerged in Cage 1 on October 8 (Table 1).

TENDIPEDIDAE (Chironomidae)

Pelopia punctipennis Meigen.—Emergence period: May 18-September 29, maximum August 4 (326 insects; 2,160 day-degrees; Fig. 4E). This midge comprised more than one-quarter of the total emergents from all the cages, the great majority appearing in Cage 4 (Table 1). The species emerged in June and July in 1947 (Judd, 1949).

Ablabesmyia monilis L.—Emergence period: May 18-September 8, maximum July 30 (83 insects; 2,055 day-degrees; Fig. 5A). About half the insects emerged in Cage 3 (Table 1). In 1947 they appeared from June to September (Judd, 1949). Johannsen (1937), referring to this species as *Pentaneura monilis* L., reported that it is common in many localities in New York State in ponds, pools and streams, often in masses of algae.

Procladius bellus Loew.—Emergence period: May 12-October 8, maximum August 19 (10 insects; 2,451 day-degrees; Fig. 5B). The majority of the midges emerged in Cages 4 and 5 (Table 1). In 1947 they emerged in May and June (Judd, 1949).

Procladius culiciformis L.—Emergence period: May 17-October 8, maximum June 10 (3 insects; 990 day-degrees; Fig. 5C). They appeared in all cages (Table 1). In 1947 these midges emerged in May and June (Judd, 1949). Johannsen (1937) says that "this cosmopolitan species is widely distributed throughout the United States.

Pseudochironomus middlekauffi Townes.—Five midges emerged in Cage 3, four on June 3 and one on June 4 (Table 1). Townes (1945) records collections of the species in New York State.

Polypedilum pedatum Townes.—Emergence period: May 2-August 17, maximum May 14 (6 insects; 522 day-degrees; Fig. 5D). Most of these insects emerged in Cages 1 and 2 (Table 1). Townes (1945) reports this midge from several localities in New York State.

Tanytarsus nigricans (Johannsen).—Males: Emergence period: April 26-October 1, maximum May 18 (5 insects; 582 day-degrees; Fig. 5E).

Females: Emergence period: April 23-October 27, maximum May 5 (8 insects; 419 day-degrees; Fig. 5F).

Most of these insects emerged in cages 4 and 5 (Table 1). In 1947 they appeared in May and June (Judd, 1949). Johannsen and Thomsen (1937) record that larvae were collected in ponds near Ithaca, New York. Berg (1949, 1950a) found larvae inhabiting folds in rolled edges of floating leaves of four species of *Potamogeton*. It is probable that in the Dundas Marsh the larvae lived in the leaves of some of the seven species of *Potamogeton* present (Judd, 1950). *P. pectinatus* grew in Cages 4 and 5 where most of these insects emerged.

Tendipes tentans (Fabr.)—Emergence period: May 13-October 15, maximum June 2 (27 insects; 830 day-degrees; Fig. 5G). These insects emerged in Cages 3, 4 and 5 (Table 1)). In 1947 some were caught in flight in June (Judd, 1949). Johannsen and Thomsen (1937) record that larvae were collected in a pond in New York State in May, July and December.

Tendipes sp.—Emergence period: May 13-September 29, maximum July 3 (9 insects; 1,462 day-degrees; Fig. 5H). Most of these midges emerged in Cages 4 and 5 (Table 1).)

Glyptotendipes atrimanus (Coq.).—Emergence period: May 26-October 6, maximum August 26 (16 insects; 2,601 day-degrees; Fig. 5I). Most of these midges emerged in Cages 4 and 5 (Table 1). In 1947 they were trapped in June, August and October (Judd, 1949).

Glyptotendipes lobiferus (Say).—Emergence period: April 17-October 15, maximum July 12 (74 insects; 1,663 day-degrees; Fig. 6A). Most of these midges emerged in

Cages 4 and 5 (Table 1). In 1947 they were trapped from May to August (Judd, 1949). Berg (1949, 1950a) reports that the larvae burrow in stems of two species of *Potamogeton* and live in rolled leaves of another species.

Cricotopus trifasciatus Panzer.—Emergence period: April 14-October 27, maximum April 26, July 15, October 22 (59, 20, 12 insects; 307, 1,732, 3,489 day-degrees; Fig. 6B). Most of these midges emerged in Cages 3, 4 and 5 (Table 1). In 1947 the species emerged over a long period from May to October (Judd, 1949) with two peaks of emergence, one in July and one in October. Johannsen (1937) reports that it has a wide distribution in North America and that the larvae mine in the leaves of pond lily. Two species of lily grow in the Dundas Marsh (Judd, 1950) and one of them, *Nymphae*

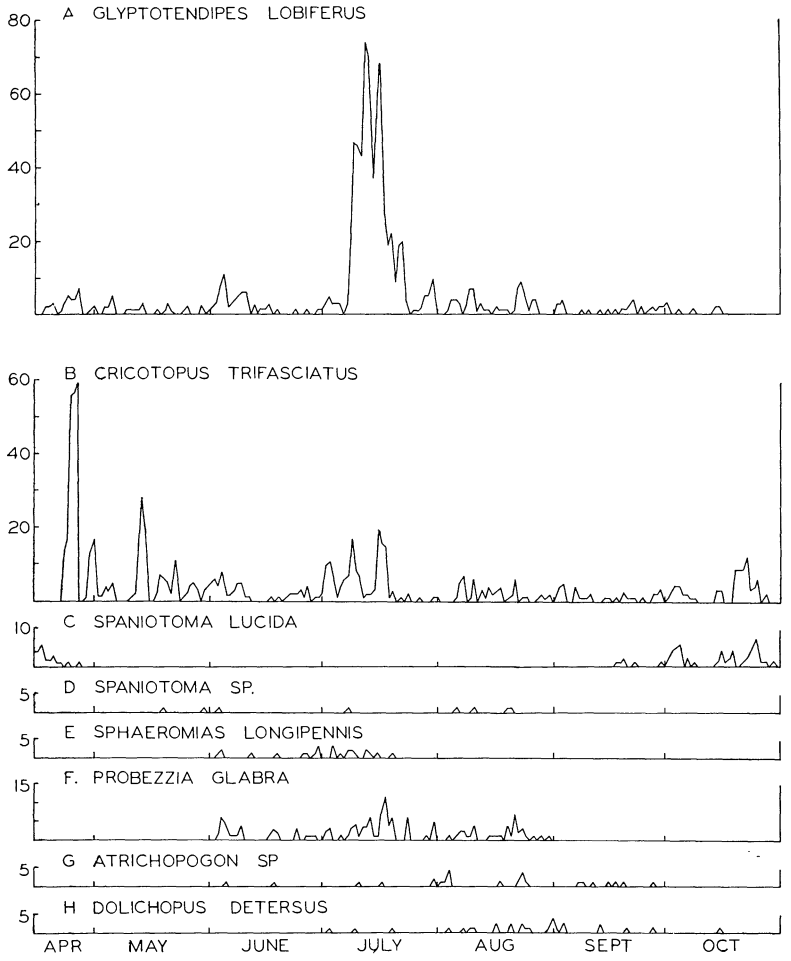

Fig. 6 (A-H).—Periods of emergence of adults of Diptera.

cdorata, grew in Cage 4 where many of these midges emerged. Berg (1949, 1950a) records that the larvae form channels in the leaves of three species of *Potamogeton,* one of which, *P. nodosus,* grows in the Dundas Marsh (Judd, 1950).

Spaniotoma lucida Staeg.—Emergence period: April 14-October 29, maximum April 16, October 25 (6, 7 insects; 189, 3,509 day degrees; Fig. 6C). Almost half the population of this species emerged in Cage 2 (Table 1), the insects showing two definite periods of emergence, one in early spring and the other in late fall. In 1947 collections were made from April to July (Judd, 1949).

Spaniotoma sp.—A few insects emerged in the cages during the season, the first appearing on May 18 and the last on August 20 (Fig. 6D). The majority emerged in Cage 2 (Table 1).

HELEIDAE (Ceratopogonidae) (Genera as in Johannsen (1943).

Sphaeromias longipennis L.—Emergence period: June 2-July 19, maximum June 29 (3 insects; 1,377 day-degrees; Fig. 6E). In 1947 the species was trapped in July and August (Judd, 1949). Johannsen and Thomsen (1937), referring to it as *Palpomyia longipennis,* record that it was collected in great numbers in blanket algae in a lake in New York.

Probezzia glabra Coq.—Emergence period: June 2-August 30, maximum July 17 (12 insects; 1,776 day-degrees; Fig. 6F). In 1947 this biting midge was trapped in July and August (Judd, 1949).

Atrichopogon sp.—Emergence period: June 4-September 27, maximum August 3 (4 insects; 2,139 day-degrees; Fig. 6G). Most of these midges emerged in Cages 3, 4 and 5 (Table 1).

STRATIOMYIDAE

Odontomyia vertebrata Say.—One fly emerged in Cage 2 on July 12. In 1947 four were trapped in Cage 1 and one in Cage 5 (Judd, 1949a). Curran (1927) gives records of collections of this species from several points in Ontario, and Hart (1896) reports rearing adults from aquatic pupae in Illinois.

DOLICHOPIDAE

Dolichopus detersus Lw.—Emergence period: July 2-October 15, maximum August 31 (3 insects; 2,715 day-degrees; Fig. 6H). Van Duzee (1921) records collections of this species in the vicinity of Toronto and Montreal.

Pelastoneurus vagans Lw.—Two flies emerged in the cages, one in Cage 2 on July 14 and one in Cage 1 on August 7 (Table 1). This species was collected in July in 1947 (Judd, 1949a).

Hydrophorus sp.—One fly emerged in Cage 2 on August 16 (Table 1). Curran (1934) writes that flies of this genus occur on the surface of small pools.

Sympycnus ? sp.—Emergence period: July 12-August 21; maximum August 18 (3 insects; 2,431 day-degrees). All but one emerged in Cage 1 (Table 1).

LONCHOPTERIDAE

Lonchoptera dubia Curran.—One fly emerged in Cage 2 on July 13(Table 1).

SYRPHIDAE

Platycheirus quadratus Say.—One fly emerged in Cage 5 on July 21 (Table 1). Adults were collected from vegetation about the marsh in 1947 (Judd, 1949a). Osten Sacken (1878) reported collections of this fly in the Atlantic States and Fluke (1921) found it to be very common in swamps in Wisconsin.

Lejops stipatus (Wlk.).—One fly emerged in Cage 2 on June 15 (Table 1).

MUSCIDAE

Lispe albitarsus Stn.—Emergence period: May 19-September 19, maximum July 19 (8 insects; 1,820 day-degrees; Fig. 7A). This species appeared in all cages (Table 1). Several flies were trapped in cages in 1947 (Judd, 1949a).

Lispe uliginosa Fln.—Two adults emerged, one in Cage 2 on September 3 and one in Cage 3 on September 10 (Table 1). Puparia of this species were collected in muck of a pond at McLean, New York (Johannsen, 1935).

Hylemyia cana Macq.—One fly emerged on July 10 in Cage 4 (Table 1).

Spaziphora cincta (Lw.).—Emergence period: April 23-October 15, maximum May 17 (4 insects; 566 day-degrees, Fig. 7B). This species emerged in all cages except Cage 1 (Table 1). Osten Sacken (1878), referring to it as *Cordylura cincta,* records collections from the District of Columbia.

TETANOCERIDAE

Sepedon fuscipennis Lw.—Emergence period: June 30-September 8, maximum July 29 (3 insects; 2,034 day-degrees; Fig. 7C). These flies appeared in Cages 2, 3 and 5

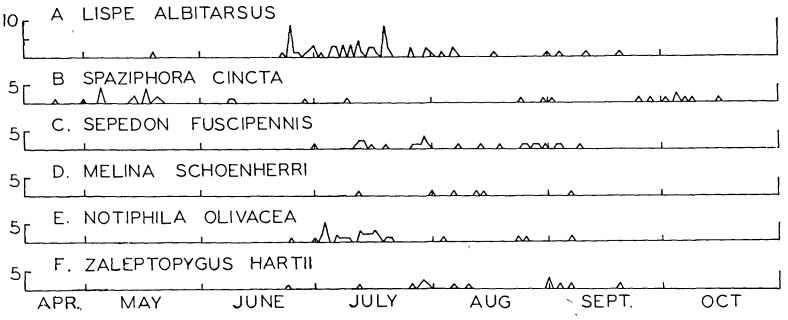

Fig. 7 (A-F).—Periods of emergence of adults of Diptera and Hymenoptera.

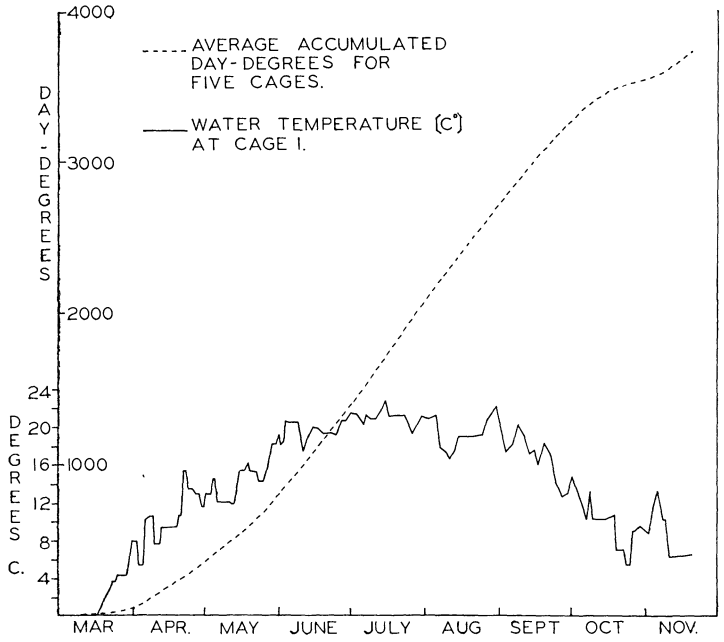

Fig. 8.—Water temperature at Cage 1; average accumulated day-degrees at cages.

(Table 1). Some were collected from vegetation about the marsh in 1947 (Judd, 1949a). Johannsen (1935) writes that pupae of this fly were found in August and October on the margin of a pond under overhanging vegetation near Ithaca, New York, and Osten Sacken (1878) reports collections from the Middle States.

Melina schoenherri Fln.—Emergence period: July 12-September 6 (Fig. 7D). Six flies emerged, four being trapped in Cage 5 (Table 1). Adults were swept from vegetation around the marsh in 1947 (Judd, 1949a).

EPHYDRIDAE

Scatella picea Wlk.—One fly emerged in Cage 3 on June 2 and one in Cage 4 on July 7 (Table 1).

Setacera atrovirens (Lw.).—Seven flies emerged in the cages between June 30 and October 1 (Table 1), the majority in Cage 2. In 1947 adults were swept from vegetation in August (Judd, 1949a). Johannsen (1935) states that a puparium from which an adult of *S. atrovirens* emerged was collected in a pool near Ithaca, New York.

Notiphila olivacea Cress.—Emergence period: June 24-September 6, maximum July 3 (5 insects; 1,462 day-degrees; Fig. 7E). This species emerged in all cages (Table 1). Williston (1908) reports that larvae of *Notiphila* have been observed in the stems of water plants, and Berg (1949) records larvae of *N. loewi* from the roots of three species of *Potamogeton*. It is likely that in the Dundas Marsh the larvae lived in the various plants of this genus (Judd, 1950).

Notiphila sp.—One adult emerged in Cage 4 on September 6 (Table 1).

Dichaeta caudata (Fln.).—Emergence period: June 30-July 15. Six adults emerged in the cages, appearing in all except Cage 5 (Table 1). Adults were swept from vegetation about the marsh in 1947 (Judd, 1949a). Osten Sacken (1878) records collections from Massachusetts.

Hydrellia griseola Fln.—Six flies emerged in the cages, two in Cage 1 on August 19, two in Cage 3 on May 14 and May 27, and one in Cage 4 on June 14 and one in Cage 5 on July 22 (Table 1). Williston (1908) reports that the larvae of *Hydrellia* have been observed in the parenchyma of *Lemna,* on *Alisma* etc., and Berg (1949) records collecting six species of *Hydrellia* from several species of *Potamogeton. Lemna minor* was on the surface of the water in all cages and one species of *Alisma* and several of *Potamogeton* grow in the marsh (Judd, 1950).

HYMENOPTERA

ICHNEUMONIDAE

Zaleptopygus hartii (Ashm.).—Emergence period: June 23-September 19 (Fig. 7F). This wasp appeared in all cages (Table 1). Hart (1896) took adults from the surface of Quiver Lake, Illinois, and his specimens were described as *Cremastus hartii* by Ashmead (1896). Cushman (1930) applied a "new combination" of names to the species, *Cremastus* (*Zaleptopygus*) *hartii* Ashmead. Berg (1950) found an adult of *Cremastus* sp. in a pupal case of the moth, *Nymphula icciusalis*. This species of moth and four other pyralid moths emerged in the cages, and it is likely that *Z. hartii* was parasitic on larvae of one or more of these moths in the marsh. Most of the wasps emerged shortly after peaks of emergence occurred in the populations of *Nymphula obliteralis* and *Acentropus niveus*.

Apsilops hirtifrons (Ashm.).—One wasp emerged in Cage 4 on August 9. Hart (1896), referring to the species as *Cryptus cyaneiventris* Riley, reports that in Illinois it was common in July on floating leaves of *Potamogeton natans,* associated with *Hydrocampa* (i.e. *Nymphula*) *obliteralis* and was constantly present in August about the spot where the largest number of the *Hydrocampa* occurred. Cushman (1933) referred to this wasp as *Trichocryptus hirtifrons* (Ashmead) and said that Hart was the first actually to see the adult insects crawling under water. In the Dundas Marsh the wasp is probably a parasite on larvae of one of the pyralid moths. The commonest species of *Nymphula* in the marsh was *N. obliteralis* (Table 1) and it was with this species that the wasp was associated in Illinois.

CHALCIDAE

Chalcis canadensis (Cress.).—Three wasps emerged, one in Cage 2 on July 12, one in Cage 2 on July 13 and one in Cage 1 on August 5 (Table 1). Burks (1940) records

that the hosts of this species are *Odontomyia vertebrata* Say and *Odontomyia* sp. and Hart (1896) says that species of *Smicra* (*Chalcis*) have been reared from *Odontomyia* spp. It is very likely that *Chalcis canadensis* is parasitic on *Odontomyia vertebrata* in the Dundas Marsh. The specimen of *O. vertebrata* that emerged in 1948 appeared in Cage 2 on July 12 as did one specimen of *Chalcis canadensis*. Four of the adults of *Odontomyia* that emerged in 1947 (Judd, 1949a) appeared in Cage 1 between July 17 and August 5, a period that closely approximates the period of emergence of the adults of *C. canadensis* in 1948. All but one of the adults of *Odontomyia vertebrata* that

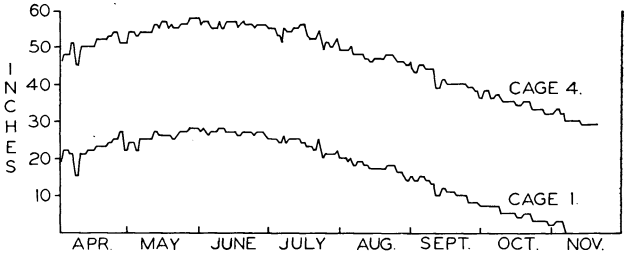

Fig. 9.—Depth of water at Cages 1 and 4.

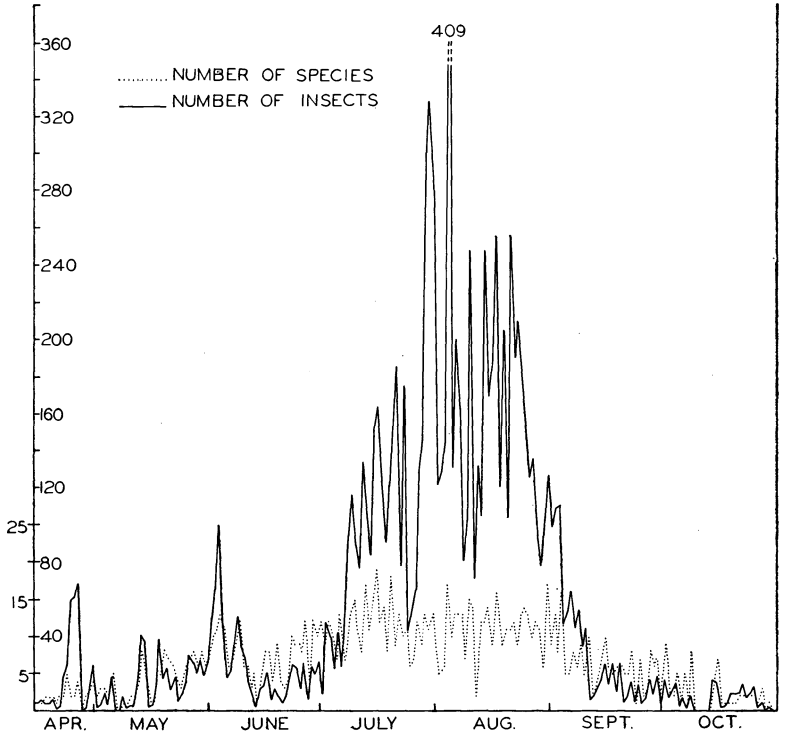

Fig. 10.—Numbers of insects and numbers of species that emerged during the season.

emerged in 1947 and 1948 appeared in Cages 1 and 2, indicating that the pupae of this fly inhabit shallow waters near the shore. All the adults of *Chalcis canadensis* emerged in these two cages.

SUMMARY

Between March 16 and November 20, 1948, 15,338 adult insects emerging from the waters of the Dundas Marsh were trapped in five cages, representing an average emergence of 409 insects per square foot during the period. The orders represented were Ephemeroptera (9.9 percent), Odonata (1.5 percent), Trichoptera (0.5 percent), Lepidoptera (0.9 percent), Diptera (87.1 percent), and Hymenoptera (0.1 percent). Midges of the family Tendipedidae (Chironomidae) constituted 92.5 percent of the Diptera. The times of first and last emergence and of maximum emergence of each species were recorded. The seasonal variation in the emergence of numbers of species was correlated directly with changes in temperature of the water, the day of emergence of maximum numbers of species being preceded by the day on which maximum temperatures were recorded at all cages.

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TABLE I.—Numbers of emergents from cages.

Species	Cage 1		Cage 2		Cage 3		Cage 4		Cage 5		
	No. of Insects	Percent of Total	No. of Insects	Percent of Total	No. of Insects	Percent of Total	No. of Insects	Percent of Total	No. of Insects	Percent of Total	Total No. of Insects
EPHEMEROPTERA											
Baetidae											
Caenis simulans	36	2.3	79	5.3	341	22.5	270	17.8	789	52.1	1,515
Callibaetis fluctuans	0	0	0	0	0	0	0	0	2	100	2
ODONATA											
Lestidae											
Lestes rectangularis	7	26.9	15	57.7	1	3.9	1	3.9	2	7.6	26
Coenagriidae											
Enallagma ebrium	54	43.2	21	16.8	17	13.6	13	10.4	20	16.0	125
Ischnura verticalis	0	0	0	0	3	50.0	1	16.7	2	33.3	6
Aeschnidae											
Anax junius	9	19.1	11	23.4	16	34.2	8	17.0	3	6.3	47
Libellulidae											
Libellula quadrimaculata	1	100	0	0	0	0	0	0	0	0	1
Sympetrum vicinum	5	29.4	7	41.2	3	17.6	2	11.8	0	0	17
Leucorrhinia intacta	2	25.0	3	37.5	1	12.5	2	25.0	0	0	8
TRICHOPTERA											
Psychomyiidae											
Polycentropus flavus	0	0	0	0	0	0	1	100	0	0	1
Hydroptilidae											
Agraylea multipunctata	0	0	1	2.1	16	33.3	11	22.9	20	41.7	48
Oxyethira verna	0	0	0	0	0	0	1	100	0	0	1
Orthotrichia americana	0	0	0	0	1	10.0	6	60.0	3	30.0	10
Leptoceridae											
Leptocerus americanus	0	0	0	0	1	6.7	5	33.3	9	60.0	15
LEPIDOPTERA											
Pyralidae											
Nymphula obliteralis	27	32.2	16	19.0	32	38.1	2	2.4	7	8.3	84
Nymphula gyralis	0	0	0	0	3	27.3	7	63.6	1	9.1	11
Nymphula icciusalis	0	0	0	0	0	0	0	0	1	100	1
Nymphula badiusalis	0	0	0	0	0	0	0	0	1	100	1
Acentropus niveus	0	0	1	2.7	15	40.5	8	21.7	13	35.1	37
DIPTERA											
Tipulidae											
Arctotipula illustris	378	66.5	136	23.9	41	7.0	5	0.9	9	1.7	569
Limonia moniliformis	2	66.7	0	0	1	33.3	0	0	0	0	3
Helius flavipes	1	100	0	0	0	0	0	0	0	0	1

TABLE I.—(*continued.*)

Species	Cage 1		Cage 2		Cage 3		Cage 4		Cage 5		
	No. of Insects	Percent of Total	No. of Insects	Percent of Total	No. of Insects	Percent of Total	No. of Insects	Percent of Total	No. of Insects	Percent of Total	Total No. of Insects
Culicidae											
Anopheles quadrimaculatus	0	0	2	100	0	0	0	0	0	0	2
Anopheles occidentalis	0	0	0	0	1	100	0	0	0	0	1
Culex apicalis	1	50.0	0	0	0	0	1	50.0	0	0	2
Culex pipiens	1	33.3	0	0	2	66.7	0	0	0	0	3
Mansonia perturbans	0	0	0	0	1	50.0	1	50.0	0	0	2
Mycetophilidae											
Phronia rustica	1	100	0	0	0	0	0	0	0	0	1
Tendipedidae											
Pelopia punctipennis	1	0.02	6	0.15	60	1.51	3,841	93.21	210	5.11	4,118
Ablabesmyia monilis	96	7.8	127	10.0	688	53.8	151	11.7	214	16.7	1,276
Procladius bellus	1	0.7	2	1.4	16	10.7	78	52.3	52	34.9	149
Procladius culiciformis	2	25.0	1	12.5	1	12.5	3	37.5	1	12.5	8
Pseudochironomus middlekauffi	0	0	0	0	5	100	0	0	0	0	5
Polypedilum pedatum	32	72.7	10	22.7	1	2.3	0	0	1	2.3	44
Tanytarsus nigricans	2	1.1	12	6.5	32	17.3	68	36.7	71	38.4	185
Tendipes tentans	0	0	0	0	22	19.8	14	12.6	75	67.6	111
Tendipes sp.	1	0.6	0	0	10	6.3	77	47.9	73	45.2	161
Glyptotendipes lobiferus	9	1.0	46	5.3	109	12.7	199	23.1	500	57.9	863
Glyptotendipes atrimanus	0	0	1	0.2	34	6.7	270	53.6	199	39.5	504
Cricotopus trifasciatus	40	5.4	33	4.5	277	37.6	238	32.3	148	20.2	736
Spaniotoma lucida	3	3.4	40	46.5	22	25.6	4	4.7	17	19.8	86
Spaniotoma sp.	1	12.5	5	62.5	0	0	2	25.0	0	0	8
Miscellaneous Tendipedidae	546	13.3	132	3.2	604	14.7	1,650	40.1	1,176	28.7	4,108
Heleidae											
Sphaeromias longipennis	11	42.3	4	15.4	0	0	7	26.9	4	15.4	26
Probezzia glabra	17	12.6	52	38.5	22	16.3	29	21.5	15	11.1	135
Atrichopogon sp.	2	7.4	2	7.4	9	33.3	10	37.0	4	14.9	27
Stratiomyidae											
Odontomyia vertebrata	0	0	1	100	0	0	0	0	0	0	1
Dolichopidae											
Dolichopus detersus	10	37.0	3	11.1	6	22.2	0	0	8	29.7	27
Pelastoneurus vagans	1	50.0	1	50.0	0	0	0	0	0	0	2
Sympycnus ? sp.	7	87.5	1	12.5	0	0	0	0	0	0	8
Hydrophorus sp.	0	0	1	100	0	0	0	0	0	0	1

TABLE I.—(*continued.*)

Species	Cage 1		Cage 2		Cage 3		Cage 4		Cage 5		
	No. of Insects	Percent of Total	No. of Insects	Percent of Total	No. of Insects	Percent of Total	No. of Insects	Percent of Total	No. of Insects	Percent of Total	Total No. of Insects
Lonchopteridae											
Lonchoptera dubia	0	0	1	100	0	0	0	0	0	0	1
Syrphidae											
Platycheirus quadratus	0	0	0	0	0	0	0	0	1	100	1
Lejops stipatus	0	0	1	100	0	0	0	0	0	0	1
Muscidae											
Lispe uliginosa	0	0	1	50.0	1	50.0	0	0	0	0	2
Lispe albitarsus	13	20.0	27	41.5	13	20.0	3	4.6	9	13.9	65
Hylemyia cana	0	0	0	0	0	0	1	100	0	0	1
Spaziphora cincta	0	0	9	28.2	3	9.4	6	18.7	14	43.7	32
Tetanoceridae											
Sepedon fuscipennis	0	0	18	69.3	7	26.9	0	0	1	3.8	26
Melina schoenherri	0	0	1	16.7	0	0	1	16.7	4	66.6	6
Ephydridae											
Scatella picea	0	0	0	0	1	50.0	1	50.0	0	0	2
Setacera atrovirens	1	14.3	5	71.4	0	0	1	14.4	0	0	7
Notiphila olivacea	5	14.7	16	47.1	6	17.6	2	5.9	5	14.7	34
Notiphila sp.	0	0	0	0	0	0	1	100	0	0	1
Dichaeta caudata	1	16.7	3	50.0	1	16.7	1	16.6	0	0	6
Hydrellia griseola	2	33.3	0	0	2	33.3	1	16.7	1	16.7	6
HYMENOPTERA											
Ichneumonidae											
Zaleptopygus hartii	4	28.6	2	14.3	3	21.4	3	21.4	2	14.3	14
Apsilops hirtifrons	0	0	0	0	0	0	1	100	0	0	1
Chalcidae											
Chalcis canadensis	1	33.3	2	66.7	0	0	0		0		3
TOTALS	1,334	8.7	858	5.6	2,451	16.0	7,008	45.7	3,687	24.0	15,338

TABLE II.—Numbers of insects of the six orders that emerged in the cages.

Order	Family	Cage 1		Cage 2		Cage 3		Cage 4		Cage 5		All Cages			
		No. of Insects	Percent of Total	No. of Insects	Percent of Total	No. of Insects	Percent of Total	No. of Insects	Percent of Total	No. of Insects	Percent of Total	No. of Insects	Percent of Diptera	No. of Insects	Percent of Total
Ephemeroptera		36	2.4	79	5.2	341	22.5	270	17.8	791	52.1			1,517	9.9
Odonata		78	34.0	57	24.8	41	17.8	27	11.7	27	11.7			230	1.5
Trichoptera		0	0	1	1.3	18	24.0	24	32.0	32	42.7			75	0.5
Lepidoptera		27	20.1	17	12.7	50	37.3	17	12.7	23	17.2			134	0.9
Diptera	Tipulidae	381	66.5	136	23.7	42	7.3	5	0.9	9	1.6	573	4.3		
	Culicidae	2	20.0	2	20.0	4	40.0	2	20.0	0	0	10	0.1		
	Tendipedidae	734	5.9	415	3.4	1,881	15.2	6,595	53.4	2,737	22.1	12,362	92.5		
	Heleidae	30	16.0	58	30.8	31	16.5	46	24.5	23	12.2	188	1.4		
	Other families	41	17.7	89	38.6	40	17.3	18	7.8	43	18.6	231	1.7		
	Total Diptera	1,188	8.9	700	5.2	1,998	15.0	6,666	49.9	2,812	21.0	13,364	100.0	13,364	87.1
Hymenoptera		5	27.8	4	22.2	3	16.7	4	22.2	2	11.1			18	0.1
TOTAL		1,334	8.7	858	5.6	2,451	16.0	7,008	45.7	3,687	24.0			15,338	100.0