The Cecropia Moth in the Prairie Provinces*

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The Cecropia Moth is one of our largest Canadian Lepidoptera. The females may achieve a wing spread of more than six inches. The known range of this moth in North America includes the United States east of the foothills of the Rocky Mountains, and in Canada the Maritime Provinces and the southern portions of Quebec, Ontario and the Prairie Provinces (Sweadner, 1937). Its reported host plants number more than 30 species, the preferred ones being currant, box elder and willow (Gentry, 1877; Houser, 1918; Marsh, 1937, 1941; McDaniel, 1938; Saunders, 1871).

Figure 1. Adult male Cecropia Moth.

The Cecropia Moth was described by Linnaeus (1758) as *Phalaena cecropia.* Subsequent taxonomic changes have been reviewed by Sweadner (1937). Currently this species is referred to in entomological literature as *Hyalophora cecropia* (Linn.). It is capable of mating with other closely related species to produce fertile hybrids (Sweadner, 1937).

Occurrence in the Prairie Provinces

Infestations of the Cecropia Moth in the Prairie Provinces were first recorded in 1927. They occurred in farm shelterbelts in south-central Saskatchewan (Stewart, 1931). These infestations proved to be the beginning of an outbreak which spread during the next three decades over much of the prairie region and adjacent parkland areas of Saskatchewan, southwestern Manitoba, and southern and mid-eastern Alberta. The outbreak reached Manitoba by 1936, and the species was still present and abundant in many localities in the province in 1948. In Saskatchewan the northward extension carried the outbreak across the South Saskatchewan River by 1940, and reached almost to the North Saskatchewan River in western Saskatchewan by 1944. Local infestations first appeared in southwestern Alberta in 1934 and in mid-eastern Alberta about 1940. These were the forerunners of the main outbreak which, by 1942, spread over much of the eastern portion of the province between the South Saskatchewan River and the Battle River, and resulted in sporadic, local infestation in more southern districts in the province. A general decline of the outbreak began in 1948. A few sporadic, light infestations persisted till 1952. Since 1952, the species has been reported in very small numbers only at Maple Creek, Saskatchewan, and in eastern Alberta.

Infestations on box elder were much more frequent and defoliation was more severe than for any other host (King, 1931; McGugan, 1958). In south-central Saskatchewan when the outbreak was at a peak, it was estimated that 75 per cent of the farm shelterbelts were infested, and up to 80 per cent of the foliage on older trees, was destroyed (Stewart, 1931). In general, defoliation of shelterbelts was more extensive and severe in Saskatchewan than in Manitoba or Alberta. New hosts recorded during the outbreak were caragana, *Caragana arborescens* Lam., green ash, *Fraxinus pennsylvanica* Marsh, var.

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lanceolata (Borkh.) Sarg., saskatoon, *Amelanchier alnifolia* Nutt. and Russian almond, *Prunus nana* Stokes.

In order to appraise more fully the potential of the Cecropia Moth as a shelterbelt pest, observations pertinent to the Prairie Provinces were made on the life history and habits of the insect and on natural control agencies. For several seasons cocoons were obtained annually from infested plantings for rearing studies in the laboratory and field. Population trends in farm shelterbelts were also noted.

Appearance, Life History, Habits
Adult stage

The adult is shown in Figure 1. Sweadner (1937) has pointed out that the grizzled ground color and tapering extradiscal band on the forewing, and to some extent the red part of the extradiscal band, will separate this species from other closely related species.

Earliest emergence of moths from the collected cocoons was on May 27, and the latest on July 17. Yearly variations occurred, caused by climatic conditions before and during the period of eclosion. Emergence in sunny sites was 10 to 15 days earlier than in sites shaded by tree growth. Most of the daily emergence occurred during the late forenoon and early afternoon. Thirty-two to 58 per cent of the moths which emerged in captivity were females.

The maximum length of life for moths confined in field cages was 26 days for the males and 20 days for the females.

Confined moths frequently mated on the day after emergence from the cocoons and some re-mated at a later date. Duration of mating was from less than one day to more than four. Marsh (1941) reported an average mating time of 15 hours and found that the males rarely re-mated with other females.

The oviposition period of reared moths varied from 3 to 18 days; the average was 12 days. Under natural conditions, approximately 99 per cent of the eggs were deposited on the under surface of the leaves. The remainder occurred on the upper surface, the leaf petioles and the twigs. The eggs were usually placed in small clusters and were held together and to the host plant by a sticky, dark brown fluid secreted by the females. The number of eggs per cluster varied from one to 17, the average was four for 545 clusters collected from farm shelterbelts. In field cages the numbers varied from three to 30 eggs; the average was 12. In contrast, Saunders (1871) reported that the eggs were laid singly, and seldom more than one or two on each tree or bush. Mated females produced an average of 290 ova and laid an average of 213 eggs. Unmated females also laid eggs, but deposition was delayed and sporadic, and the eggs were sterile.

Egg Stage

The minimum, maximum and average length of the eggs were 2.0, 2.4 and 2.3 mm., respectively. Corresponding measurements of width were 1.5, 1.9 and 1.7 mm. The ends were bluntly-rounded and a marked depression occurred on one side. The color of the eggs varied from dull-yellow to brown.

Incubation of Cecropia eggs occurred in 30 days at a temperature range of 33° to 69°, 17 days at 55° to 78°, and 15 days at a range of 66° to 74° F. At 80° to 90° F, and a low relative humidity, incubation occurred in six days (Gentry, 1877).

The eggs were present in field samples as early as the first week in June and as late as the fourth week in July. Hatching commenced by late June.

Figure 2. Larva of Cecropia Moth.

Larval Stage

Reared larvae passed through five stages of development and underwent four moults. Marsh (1941) reported six instars and five moults.

All instars of the Cecropia larva (Fig. 2) have eight rows of spined tubercles or warts. One row is located on each dorsolateral surface, and terminates in a large median tubercle on the eight abdominal segment. Two rows occur on each lateral surface; one is above the spiracles, the other subspiracular. One row occurs on each lateroventral surface immediately above the thoracic legs, and on the fifth instar, terminates on the second abdominal segment. The following descriptive key gives the general anatomical and colour characters of each larval instar. Greatest variation between instars occurs in the coloration of the dorsal tubercles, especially noticeable in the ultimate instar, and in the size of the black-pigmented areas of third and later instars.

KEY TO LARVAL INSTARS OF CECROPIA MOTH

Instar	Head (size range in mm.)	Body	Tubercles	Markings
First	Black 0.95 - 1.23	Black in early stage, greyish with yellowish areas around bases of tubercles in late stage. Spiracles silvery.	Black, with black spines, becoming brownish in late stage.	
Second	Black 1.47 - 1.76	Yellowish to light orange in early stage, greenish - yellow in late stage.	Black, with black spines.	Two black spots on each body segment between adjacent rows of tubercles.
Third	Yellow to yellowish - green. 2.25 - 2.77	Greenish - yellow; broad mid-dorsal line light yellow in early stage, bluish in late stage.	Dorsolateral row wart - like, blue on prothorax, red on mesothorax and metathorax, yellow on abdomen; lateral rows bluish; lateroventral row black. Spines black, present on al tubercles.	Two black spots on each body segment between adjacent rows of tubercles smaller and often indistinct on dorsum in late stage; black spots dorsad and laterad on yellow tubercles; black spots dorsad on blue tubercles above spiracles.
Fourth	Greenish - yellow. 3.56 - 3.81	Yellowish-green with broad mid - dorsal bluish line.	Dorsolateral row wart - like, blue on prothorax, pinkish - orange on mesothorax and metathorax, yellow on abdomen; lateral rows bluish; lateroventral row black. Spines black, present on all tubercles.	Black spots between adjacent rows of tubercles absent, or faintly present below spiracles; circle of black spots around necks of pinkish - orange tubercles on mesothorax and metathorax; black spots on tubercles above spiracles in early stage, sometimes absent in late stage.
Fifth	Yellowish - green. 5.11 - 5.74	Yellowish-green shading to bluish-green along dorsum.	Dorsolateral row wart - like, blue on prothorax, orange with black spots on mesothorax and metathorax, yellow on abdomen; lateral rows and lateroventral row blue, white-tipped. Spines black, absent on prothorax, present on remaining segments but fewer than on earlier instar.	Circle of distinct black spots around necks of yellow tubercles on first abdominal segment.

The average lengths of the stadia, for larvae reared under outside conditions, were: first, 6 days; second, 8 days; third, 7 days; fourth, 11 days; fifth, 34 days of which 22 days elapsed between the commencement of cocoon formation and occurrence of the last larval moult.

The larval period extends from late June to late September. The seasonal duration of each stadium as observed in 1942 and 1943 was as follows: first, July 4 to July 26; second, July 9 to August 5; third, July 16 to August 15; fourth, July 22 to August 26; fifth, July 31 to September 26.

Attempts to rear newly-hatched caterpillars on green ash were only partially successful. Young larvae transformed to American elm leaves failed to establish themselves and soon died. Larvae reared on box elder fed and developed normally. Gentry (1877) reported that first and second instars reared and thrived only on the common red currant, but that third and later instars transferred successfully to other species of *Ribes* and to species of *Prunus, Spiraea, Rosa, Wistaria, Philadelphus, Syringa, Symphoricarpus, Sambucus.* Newly-moulted larvae were observed to feed on their cast skins.

Relatively small amounts of leaf surface were devoured by the first three instars. Small holes were eaten in the leaves during the first stadium. In the second and third stadia such holes became increasingly larger. Noticeable damage did not occur till the fourth stadium when larger and more irregular portions were eaten out of the leaves. Feeding in the last larval stadium exceeded the total for the four preceding stadia. In all stadia, feeding declined sharply about two days before moulting and increased again on the second day following moulting.

Observations on dispersal activities of the larvae were made in 1960, in an eight-year-old box elder plantation. The plantation contained approximately 80 trees planted in rows 12 feet apart, with six-foot spacing in the rows. Since the trees had been cut back to a height of three feet in 1959, secondary growth in 1960 was vigorous and food was abundant. The trees were hand-infested with recently hatched Cecropia larvae. During the first four stadia and the early part of the fifth stadium, the larvae showed very little inclination to wander away from their feeding sites except to reach new, nearby food supplies. Toward the end of the fifth stadium a marked restlessness occurred which was broken by short periods of feeding prior to formation of the cocoons. One hundred and thirty-three of the larvae in the plantation reached this stage. One of them wandered to a caragana hedge 36 feet distant from the east side of the plantation where it formed its cocoon; 18 formed cocoons on a caragana-honeysuckle hedge 12 feet distant from the west side of the plantation. The remaining 114 formed cocoons throughout the plantation. One larva was seen to wander southward for a distance of 25 feet across cultivated land, then turn about and return to its original host tree where it formed its cocoon. Another larva left the tree on which it had developed and formed its cocoon on a tree two rows to the eastward.

All of the cocoons were attached to the stems or branches of the trees. Sixty-three per cent of them were placed less than one foot above the ground level; 26 per cent between one and three feet; and 11 per cent, more than four feet above ground level. Data from a shelterbelt infestation in western Saskatchewan indicated that 99 per cent of the cocoons were located less than three feet above ground level. Marsh (1941) reported cocoons evenly distributed from the ground to the tops of 35-foot trees.

Pupal Stage

The cocoon (Fig. 3), enclosing the pupa is approximately 80 mm. long and 25 mm. wide. It is composed of two layers, an outer one and an inner, more delicate one. The cocoon is spindle-shaped, with pointed ends. Its colour varies from tawny grey to dull brown.

The pupa is approximately 38 mm. long and 20 mm. wide. It is reddish brown. The wide antennal sheath of the male pupa distinguishes it from the female pupa.

In a sample of 22 larvae reared outside, cocoon formation began on August 17 and the first pupa appeared on September 1. All of the

larvae had formed cocoons by August 31 and become pupae by September 22.

The pupal period, ending in June, is approximately nine months. In rare cases it has extended to the second spring, giving a pupal period of 21 months (Marsh, 1941). Extension of the pupal period to the second spring has also been reported for another local species, *H. gloveri nokomis* Brodie (Cumming - Hopkins, 1960).

Natural Mortality

Birds, spiders, and parasitic Hymenoptera and Diptera have been regarded as the chief factors in reducing population abundance of the Cecropia Moth (Gentry, 1877; Marsh, 1937).

In the Prairie Provinces local infestations in shelterbelt plantings usually reached a peak and declined to relative unimportance in a period of three or four years. Disease, parasites, and predators were agencies which contributed to the decline of these infestations.

Disease

Disease was the most important natural control factor in checking severe infestations. One of the earliest authentic records was Manson's (1933) which stated that local Cecropia populations in southwestern Saskatchewan were practically wiped out in the fall of 1932, just prior to pupation, by a disease which resembled "flacherie". A similar situation was reported in 1943 in south-central Saskatchewan. Cecropia larvae had been very abundant in 1941, and defoliation of box elder in farm shelterbelt was severe. In 1942 a marked decline occurred. In farm plantings, where defoliation was 90 per cent in 1941, only five per cent damage occurred in 1942. Numerous dead caterpillars were on the ground and 75 per cent of those present on the trees appeared emaciated and were not feeding. A fluid oozed from the dead bodies adhering to the twigs.

Parasites

Parasitism played a minor role in reducing population abundance. Small numbers of Cecropia eggs were parasitized by a Scelionid, *Telenomus* sp., near *coloradensis* Cwfd. Only four of the 47 field samples examined in 1948 contained this parasite.

Figure 3. Cocoon of Cecropia Moth.

The dipterous parasite, *Achaeton-eura samiae* Webb, was reared from Cecropia larvae and pupae but the percentage parasitisim was small.

Predators

Acts of predation were not witnessed during the investigation but circumstantial evidence indicated that predation did occur. In 1948, Starlings (*Sturnus vulgaris*) were reported eating larvae at Lancer, Saskatchewan. In 1959, first instar larvae were transferred to box elder trees in a field planting for rearing. They became established on the foliage but within a few days most of the larvae had vanished from the trees. The remaining ones became second instar larvae, and then they also disappeared. A further lot of second instar larvae was then transferred to the same plantation. Each larva was placed on a separate branch covered with a cheesecloth cage. Almost all larvae in this lot reached the ultimate larval stage. A further experiment was conducted in 1960 in the same box elder plantation. More than 800 first instar larvae were transferred to 73 trees on July 5. Only 54 per cent of the larvae were still present on the trees by August 4.

The percentage of survival was further reduced to 16 by August 30. Although disease accounted for most of the larval loss, it appeared probable that some of the larvae were destroyed by birds and predaceous insects.

Predation of the pupae also takes place. Frequently cocoons are torn open or totally removed. Many cocoons covered by snow which lodges in shelterbelts during the winter months, are chewed, and the pupae destroyed. These depredations appear to be the work of small rodents. In 1960, 118 cocoons containing pupae were marked in a box elder plantation and in two adjacent hedges. Few cocoons were lost before September 14, but between September 14 and September 28, all but two had been removed or destroyed. The cocoons, with few exceptions, had been torn from the stems and branches and carried away. Those destroyed on the trees had been torn open and the pupae removed. Pictures taken with a field camera triggered to 'planted' cocoons showed Black-billed Magpies (*Pica pica*) tearing at the cocoons to remove them from the trees. Similar depredations in previous years had also been attributed to magpies.

Other Factors

Infertility of the eggs and failure of larvae to hatch caused small population losses. In samples comprising more than 2000 eggs these losses were less than three per cent.

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S.N.H.S.) states that in March, 1904, a rufous specimen was taken at Regina for the Chicago Natural History Museum. In December, 1931, a specimen was taken at Tregarva (also rufous). Another was taken in March, 1934, by Mr. Fred Bard (this specimen being found in a store basement). Also Miss Belcher mentions a number of sight records: in December, 1932, a red-phased Screech Owl was seen by Mr. Bard; another was seen in November, 1935, by Knowles; and Mr. Bard identified an owl seen by Mrs. J. Couturier in the fall of 1940 as a red-phased Screech Owl. It is interesting that most of these birds had the rufous plumage.

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Besides that nest ¼ mile north of us, we had another family of flickers, in a post planted for that purpose in our yard. Now that's a lot of flickers in one year for our locality —in comparson with the past. The young flickers in our yard survived quite an experience. When they had begun to feather, our children along with some visiting youngsters filled the nest full of stones. When I went out into the yard the next morning, the adult was noisily flying about. I wondered at her behaviour. Then about noon my young daughter Theresa gave me an inkling of what had happened and I was able to remove the stones. The stones were in the nest from 8:00 p.m. until 12 noon the following day, and yet three of the four young survived.