PARASITOID SURVEY OF *Anisota virginiensis* (Lepidoptera: Saturniidae) AT BELAIR, MANITOBA FROM 1989-1999.

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Several species of *Anisota* (Lepidoptera: Saturniidae), collectively known as oakworms, occasionally achieve pest status in the United States and Canada, and infestations sometimes exceed 1,000 ha. For example, the orange-striped oakworm, *A. senatoria* (J.E. Smith), is a common pest of oaks in the northeastern United States (Hitchcock 1961b, Coffelt and Schultz 1990)), and an outbreak of yellow-striped oakworm, *A. peigleri* Riotte, occurred in Gainesville, Florida from 1996 to 2000 (Serrano and Foltz 2003). The Manitoba oakworm, *A. manitobensis* McD., was described as a sporadic pest of bur oak, *Quercus macrocarpa* Michaux (Fagaceae), in southern Manitoba (McGugan 1958). Criddle (1932) reported that three acres of *Q. macrocarpa* south of Carman was severely defoliated by *A. manitobensis* in 1931. *Anisota manitobensis* seems to maintain a low level of abundance, and was only recently located after an extensive search lasting eight years (Henne 2002). The pink-striped oakworm, *A. virginiensis* (Drury) occurs throughout the eastern United States and adjacent southern Canada, west to southern Manitoba (Ferguson 1971, Tuskes et al. 1996). In much of its range, *A. virginiensis* does not normally become sufficiently abundant to be considered a pest (Ferguson 1971). Nevertheless, it has caused occasional severe defoliation of *Q. macrocarpa* in Manitoba (McGugan 1958, Ives and Wong 1988) as well as in Ontario and Quebec (Hall et al. 1998). Larvae of *Anisota* spp. are gregarious, particularly in the early instars (Riotte and Peigler 1981) when they skeletonize leaves of their host, *Quercus* spp. Later instars may consume the entire leaf, except for the midvein, and are easily seen on their defoliated hosts.

An outbreak of *A. virginiensis* occurred at Belair Resort, Manitoba (50°36'11" N, 96°33'7" W) and was studied from 1989-1991, with monitoring and larval collections continuing until 1999. Belair is located within the Belair Provincial Forest, along the southeastern shore of Lake Winnipeg. The vegetation is predominantly a sandy, oak-pine biotope. Defoliation of *Q. macrocarpa* around Belair was not evident prior to 1989; however, by early August 1989, *A. virginiensis* larvae were numerous on *Q. macrocarpa*. Approximately 95% of *Q. macrocarpa* around Belair were completely defoliated, with the remaining trees >50% defoliated. In addition to *Q. macrocarpa*, *A. virginiensis* larvae were observed feeding on hazelnut (*Corylus cornuta* Marsh. (Betulaceae)), and paper birch (*Betula papyrifera* Marsh. (Betulaceae)). McGugan (1958) also reported *A. virginiensis* larval collections from *B. papyrifera*, *C.cornuta* and *A. alnifolia* in southern Manitoba, and Ferguson (1971) suggested that *C. cornuta* is probably utilized naturally by *A. virginiensis*. Moderate to severe defoliation of paper birch by *A. virginiensis* was reported in Quebec (Hall et al. 1998), but no significant defoliation of *B. papyrifera* was ever observed at Belair during the entire survey period. The outbreak was extensive, as *A. virginiensis*-defoliated *Q. macrocarpa* were found from Belair to Hillside Beach, ten kilometers apart. In several areas, thousands of dead fifth-instar larvae were observed on the ground, having succumbed to a disease not unlike that caused by the entomopathogenic fungus *Beauvaria bassiana.*

Parasitism of fifth-instar *A. virginiensis* larvae by an undetermined species of fly was indicated by the presence of small (~1mm), white, ovoid eggs attached to the integument. To determine the identity of this parasitic fly, evaluate per cent parasitism and count numbers of attached eggs, fifth-instar *A. virginiensis* larvae were collected in an approximately 50 ha stand of *Q. macrocarpa* during early August of 1989, 1990, 1991 and September 1992. Cool weather conditions that persisted in southern Manitoba during the summer of 1992 delayed larval development by several weeks. Larvae were collected from >20 *Q. macrocarpa* with at least10m between sampled trees. Trees and larvae were arbitrarily selected, and sampled trees were <2 m in height and <10 larvae/tree were collected, examined closely for attached eggs and the number of eggs found was recorded. Sampling stopped when 200 larvae were collected (except during 1992 when only 100 larvae were collected). As larvae were collected and scored, they were placed in 5 L plastic pails (n=25 larvae/pail), transported to the laboratory and maintained on *Q. macrocarpa* foliage until maggot emergence or host pupation. From 1993 onwards, collections of *A. virginiensis* larvae were restricted to isolated clusters of larvae that could be located within the same stand of *Q. macrocarpa* that was sampled from 1989 to 1992. From 1993 to 1997 *A. virginiensis* larval densities at Belair had declined to low levels of abundance and <50 larvae were collected per year. By 1998, *A. virginiensis* larvae could no longer be collected using reasonable time and effort. The local *A. virginiensis* population was still in existence, however, since a single virgin female (reared from Tennessee *A. virginiensis* stock) attracted 27 males during the afternoon of 28 June 1999.

On 30 June 1990, 21 egg clusters (n=602 eggs) were collected from five small (<1.5 m in height) haphazardly selected *Q. macrocarpa* trees in an attempt to acquire ovarian parasitoids. Egg clusters were held at 22° C and 16:8 photoperiod for 14 days until eclosion of larvae or parasitoid emergence. Of these 602 eggs, larvae hatched from 575 (95.5%) and fertility was 100% in 11 out of 21 egg clusters collected. The number of

eggs in an egg cluster (mean ± SE) was 28.7 ± 3.02 (range 5-63 eggs/cluster, n=21). No ovarian parasitoids emerged from the other 27 eggs. Hitchcock (1961a) reported mean numbers of *A. senatoria* eggs/cluster to be between 94 and 216, with rates of parasitism by *Trichogramma pretiosa* Riley and *Tetrastichus* sp. (Hymenoptera: Trichogrammatidae) between 22.9 and 74.4% respectively. *Anisota senatoria* egg parasitoids generally emerge within 7 days after eclosion of larvae (Coffelt and Schultz 1992). It is possible that the *A. virginiensis* egg clusters collected at Belair were not held for a sufficient duration. Larvae eclosed by 10 days but the eggs were not monitored beyond 14 days. The high rate of larval eclosion from the eggs sampled, however, suggests that little, if any, egg parasitism occurred. Alternatively, the absence of egg parasitoids may have been a brief phenomenon, confined to the year the survey was conducted, or the sample size taken was inadequate to detect ovarian parasitoids.

Five species of larval and pupal parasitoids were reared from *A. virginiensis* larvae at Belair, Manitoba, many of which have been reported from other species of *Anisota* (including *A. virginiensis*), and one of which is a new parasitoid host record. Small numbers (20-30) of larvae collected in 1994 and 1996 yielded no parasitoids.

Diptera: Tachinidae:

Houghia sternalis (Coquillett) – 1 male, 1 female: One pupa of *A. virginiensis* yielded two fly puparia in the laboratory, October 1993 (from a larva collected August 1993). This was one of two parasitoid species reared from 30 *A. virginiensis* larvae collected in 1993. Females of *H. sternalis* deposit their eggs either directly on host larvae or on foliage of hostplants so larvae ingest them (Riotte and Peigler 1981, Peigler 1994). The maggots emerge from their host to pupariate in the soil after the host has pupated (Riotte and Peigler 1981). Peigler (1994) lists this species (as *Eumasicera sternalis*) as a parasitoid of *Dryocampa rubicunda* (F.), *A. virginiensis*, *A. consularis* Dyar, and *A. senatoria*.

Lespesia anisotae (Webber) – 2 males: One *A. virginiensis* pupa yielded two fly puparia in the laboratory, October 1997 (from a larva collected in August 1997). This was the only parasitoid reared from 17 *A. virginiensis* larvae that were located in 1997. Females of *L. anisotae* deposit their eggs directly on host larvae, and emerge from their host to pupariate in the soil after the host has pupated (Riotte and Peigler 1981). Peigler (1994) describes this species as a common parasitoid of hosts in the eastern United States and, as the specific epithet suggests, is a specialist on *Anisota* spp.: *A. virginiensis*, *A. pellucida* (J.E. Smith), *A. peigleri*, *A. senatoria* and *D. rubicunda*.

Winthemia datanae (Townsend): Numerous adults (>50) were reared from fifth-instar larvae collected during August 1989, 1990 and 1991. Females were often observed ovipositing on host larvae at Belair. This is a new parasitoid host record for *W. datanae.* Information about the Belair outbreak and the identity of this parasitoid was communicated to R.S. Peigler and was listed as a parasitoid of *A. virginiensis* in Peigler (1994) based on that communication. Other host species include *A. senatoria*, *D. rubicunda*, *Hyalophora cecropia* (L.), as well as several species from the moth families Notodontidae, Arctiidae, Noctuidae, Sphingidae, Lasiocampidae, and Lymantriidae (Peigler 1994). From 1989 to 1991, prevalence of parasitism of *A. virginiensis* larvae by *W. datanae*

at Belair were very high: 76% (1989), 84% (1990), 78% (1991), (n=200 larvae/year, total n=600 larvae). During 1992, only 26 of 100 larvae sampled were parasitized by *W. datanae*. This parasitoid was not reared after 1992.

Superparasitism of *A. virginiensis* larvae by *W. datanae* was common (Figure 1), with one larva having 20 eggs attached to its integument. The mean number of eggs recorded per host larva from 1989 to 1991 was 3.9 ± 0.14 (n=476 larvae). Superparasitism appears to be common among tachinids that parasitize the genus *Anisota*. For example, Hitchcock (1961b) found 138 eggs of *W. datanae* attached to one larva of *A. senatoria* in Connecticut, with prevalence of parasitism ranging from 25 to 68%.

Hymenoptera: Ichneumonidae

Habronyx magniceps (Cresson). – 1 male, 2 females: One parasitoid emerged from an *A. virginiensis* pupa, October 1993, and two additional parasitoids emerged from separate *A. virginiensis* pupae, 5 March 1996 (from larvae collected August 1995 and pupae overwintered until February 1996). This was one of two parasitoid species reared from 30 *A. virginiensis* larvae collected in 1993. In 1996, a small cluster of <10 larvae yielded a second collection of *H. magniceps*. This parasitoid is a solitary koinobiont and occupies the entire host pupa. Upon eclosion, the adult emerges through the anterior end of the host pupa. Dasch (1984: 15-17) previously reported this widespread parasitoid from *A. virginiensis* in southern Manitoba (Thornhill and Pembina Valley), and lists this species as a parasitoid of *A. oslari* Rothschild, *A. stigma* (F.), *A. senatoria*, and *D. rubicunda*.

Hyposoter fugitivus (Say). Reared from third-instar *A. virginiensis* larvae, collected 2 August 1996: emerged 10-11 August 1996. After *W. datanae*, this parasitoid species appeared to be the second most common parasitoid of *A. virginiensis* encountered at Belair. Eleven specimens were obtained from one larval cluster consisting of 12 parasitized *A. virginiensis* larvae. Host larvae appeared to be in the intermolt period between the third and fourth instars. Larvae that are parasitized by *H. fugitivus* are found attached to the host plant by a cocoon that the parasitoid spun inside its host, using the host skin as a mummy (pers. obs., Peigler 1994). Carlson (1979) cited this parasitoid species from *A. virginiensis* and Peigler (1994) lists *H. fugitivus* as a commonly encountered parasitoid of numerous species of *Anisota* and other Saturniids, and attacks several species in the families Arctiidae, Lasiocampidae, and Notodontidae.

In Manitoba and other areas within the northern parts of its range, some *A. virginiensis* populations periodically become extremely abundant. At Belair, Manitoba, outbreak years of 1989 to 1991 were followed by a population decline from 1992 onwards. This is consistent with Ives and Wong (1988) who found that *A. virginiensis* outbreaks subsided naturally after two or three years. Similarly, Hitchcock (1961b) found that *A. senatoria* outbreaks in Connecticut were characterized by a sudden increase in oakworm populations, followed by up to two years of complete defoliation, and then a rapid decline over two years to low population levels. Predation, parasitism, competition, disease epizootics and other factors probably contribute to suppress population outbreaks such as these.

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REFERENCES

Carlson, R.W. 1979. Family Ichneumonidae, pp. 315-741, in K.V. Krombein, P.D. Hurd, Jr., D.R. Smith and B.D. Burks, eds., Catalog of Hymenoptera in America North of Mexico. Vol. 1, Symphyta and Apocrita (Parasitica). Smithsonian Institution Press, Washington, D.C.

Coffelt, M.A. and P.B. Schultz. 1990. Development of an aesthetic injury level to decrease pesticide use against orangestriped oakworm (Lepidoptera: Saturniidae) in an urban pest management project.

Coffelt, M.A. and P.B. Schultz. 1992. Parasitism of orangestriped oakworm (Lepidoptera: Saturniidae) eggs in the urban landscape. Biological Control 2: 306-311.

Criddle, N. 1932. The Canadian Insect Pest Review – Forest and Shade Tree Insects 10(4): 79.

Dasch, C.E. 1984. Ichneumon-flies of America north of Mexico: 9. Subfamilies Theriinae and Anomaloninae. Memoirs of the American Entomological Institute, Number 36: iii + 610 pp.

Ferguson, D.C. 1971. Bombycoidea (in part), fasc. 20.2B. In The moths of America north of Mexico. Edited by R.B. Dominick et al. Curwen Press, London.

Hall, J.P., W.W. Bowers and H. Nirvonen. 1998. Forest insect and disease conditions in Canada 1995. Forest insect and disease survey, Natural Resources Canada, Canadian Forest Service HQ, Science Branch, Ottawa. 72pp.

Henne, D.C. 2002. Distribution and biology of *Anisota manitobensis* (Saturniidae) in southern Manitoba. J. Lepid Soc. 56(1): 5-8.

Hitchcock, S.W. 1961a. Egg parasitism and larval habits of the orange-striped oakworm. J. Econ. Ent. 54: 502-503.

Hitchcock, S.W. 1961b. Pupal mortality of the orange-striped oakworm. J. Econ. Ent. 54: 962-964.

Ives, W.G.H. and H.R. Wong. 1988. Tree and shrub insects of the Prairie Provinces.

Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-292.

McGugan, R.M. 1958. Forest Lepidoptera of Canada recorded by the forest insect survey. I. Papilionidae to Arctiidae. Forest Biology Div., Canada Dept. of Agric., Publ. 1034. Ottawa.

Peigler, R.S. 1994. Catalog of parasitoids of Saturniidae of the world. J. Res. Lepid. 33: 1-121

Riotte, J.C.E., and R.S. Peigler. 1980 (1981). A revision of the American genus *Anisota* (Saturniidae). J. Res. Lepid. 19:101-180.

Serrano, D. and J.L. Foltz. 2003. Natural history of *Anisota peigleri* (Lepidoptera: Saturniidae) in Gainesville, Florida. Fla. Ent. 86(2): 217-218.

Tuskes, P. M., J. P. Tuttle, and M. M. Collins. 1996. The wild silk moths of North America: a natural history of the Saturniidae of the United States and Canada. The Cornell Series in Arthropod Biology. Cornell University Press, Ithaca. 264pp.

Fig. 1 Frequency distribution - Numbers of tachinid eggs per *A. virginiensis* larva. Belair, Manitoba 1989-1991 (n=600 larvae).