

## GENERAL NOTES

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### FIELD OBSERVATIONS ON LARVAL DIAPAUSE IN THE FLORIDA VICEROY, *LIMENITIS ARCHIPPUS FLORIDENSIS*

**Additional key words:** hibernacula, photoperiod, subspecies, thermoperiod.

Recent publications treating nymphaline butterflies of Florida do not mention the occurrence of diapause in the Florida viceroy, *Limenitis archippus floridensis* (Stkr.) (Gerberg & Arnett 1989, Minno & Emmel 1993, Smith et al. 1994, Emmel 1997). In addition, Williams and Platt (1987) could not induce diapause in laboratory strains of *L. a. floridensis* derived from wild stock from Dade Co. No diapause occurred among 220 larvae in three broods reared under laboratory controlled conditions ( $25 \pm 2^\circ\text{C}$ ) with photoperiods ranging from 8L:16D to 18L:6D, and they speculated (p. 351) that "... a high proportion of the Florida subspecies may have lost the ability to construct hibernacula and enter diapause in the third instar." Here we report that some individuals in natural populations of *L. a. floridensis* do, in fact, begin to diapause in northcentral and southwestern Florida, whereas, others apparently remain "on the wing" throughout the year.

Three separate field observations of apparent diapause were made by us during 1995 and 1996 (Table 1). Each involved the collecting of either hibernacula and (or) larvae from foliage of willow, *Salix caroliniana* L. (Salicaceae). All of the hibernacula were found between 1.5–2.5 m above the substrate. The five occupied hibernacula each contained a third instar larva (in apparent diapause). Only one of the hibernacula we found had had its larva eaten by a small insectivorous bird, as evidenced by a small hole having been pecked into the basal portion of the empty hibernaculum. Since there was evidence of larval feeding on the branches supporting these hibernacula, we suspect that the remaining larvae had completed development and had left their foodplants to pupate.

At the Everglades locality, one egg, one second instar larva on its perch, and two fifth instar larvae also were observed alongside the three occupied hibernacula during late January. Adult *L. a. floridensis* also were seen on the wing at the Corkscrew Park and Everglades Localities. At the Gainesville locality, the 25 unoccupied hibernacula apparently had recently been vacated by larvae, since their silken girdles covered the newly emerging spring buds, and their color was a copper-brown rather than gray (both useful characters for estimating hibernaculum age). Our observations indicate that some *L. a. floridensis* larvae apparently possess diapause capabilities. The observations at Everglades N. Pk. suggest differential responses to diapause inducing variables, since all life stages were found contemporaneously at the sites during the latter part of January, a time during the "dead of winter", when the ambient photophase is of shortest duration.

Some individuals of *L. a. floridensis* within a deme may begin to diapause by responding equally well to environmental combinations of photoperiod, temperature, and levels of relative humidity. [The induction of diapause is controlled mainly by photoperiod in all northern populations of *Limenitis* spp. (Clark & Platt 1969, Hong & Platt 1975)]. Such differences in diapause control mechanisms among insects have been described by Beck (1980) and Saunders (1982). Our field observations suggest that some *L. a. floridensis* fly all year long (contradicting Gerberg & Arnett 1989, who report that these insects only fly between April–Sept.).

Induction of diapause in second instar larvae of the temperate subspecies, *L. a. archippus* correlates with the appearance of the whitish, dorsal mid-abdominal saddlepatch on the young larvae. This saddlepatch overlies both the primordial gonads and paired ventrolateral neurosecretory ganglia. Platt (1989) presented evidence that this region of the larvae may be photosensitive, and that it influences both normal and abnormal development in northern populations of *L. a. archippus*. Southern populations of *L. a. floridensis* also possess larval saddlepatches, but the role of these saddlepatches remains unstudied.

TABLE 1. Records of 30 hibernacula of *L. a. floridensis* collected from northcentral and southwestern Florida during 1995–1996.

Date	Location	County	Hibernacula		
			Occupied	Empty	Observer
18–20/I /95	Corkscrew N. Park	Collier	3	0	D. Flaim
18–20/I /95	Everglades N. Park	Dade	2	0	D. Flaim
23/III /96	Newnan Lake Gainesville	Alachua	0	25	A. Platt

A well-documented intergrade zone exists between *L. a. archippus* and *L. a. floridensis* in northern Florida and southern Georgia (Remington 1958, 1968, Williams & Platt 1987, Ritland 1990, Ritland & Brower in review). Gene flow exists between these two subspecies throughout the Florida peninsula, and northward to Athens, Georgia, and the great Dismal Swamp in southeastern Virginia ( $36^\circ40'\text{N}$ ; Clark & Clark 1951). Alleles controlling facultative diapause may pass from these northern populations into more southern populations, and vice-versa.

It might be argued that the empty hibernacula we collected near Gainesville were those of *L. arthemis astyanax*, rather than belonging to *L. archippus floridensis*, since *L. arthemis astyanax* also occurs in Florida. However, five lines of evidence point strongly in favor of these hibernacula belonging to *L. a. floridensis*: 1) several authors (Kimball 1965, Gerberg & Arnett 1989, Platt & Maudsley 1994) report that *L. arthemis astyanax* is rare especially in southern Florida; 2) we identified all of the maturing larvae as being those of *L. a. floridensis* (although all North American *Limenitis* larvae are difficult to tell apart, especially in their early instars); 3) during the time of our observations, no adult or immature specimens of *L. arthemis astyanax* were sighted by us; 4) all of our observations were made in open marshy habitats typical for *L. a. floridensis*, but not for *L. arthemis astyanax*; and, finally 5) The empty hibernacula found near Gainesville all were of relatively large size (between 1.75–2.5 mm long), a further indication that they belonged to *L. archippus floridensis*.

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#### NOTES ON THE GENUS *STHENOPSIS* (HEPIALIDAE) IN ALBERTA, CANADA

**Additional key words:** semivoltine, biennialism.

The nearctic genus *Sthenopsis* Packard (Hepialidae) currently contains five species (Davis 1983), of which *S. argenteomaculatus* (Harris), *S. purpurascens* (Packard) and *S. quadriguttatus* (Grote) purportedly occur in Alberta (Bowman 1951). Despite their large size and peculiar habits, little is known about their biology and specimens are rare in collections. The purpose of this note is to report on the adult biology and distribution of the genus in Alberta. *S. argenteomaculatus* does not occur in Alberta, and *S. quadriguttatus* was placed into synonymy with *S. purpurascens* by Nielsen et al. (1999) based on morphological characteristics. Our observations of sympatric populations of *S. purpurascens* and *S. quadriguttatus* color morphs support this view.

**Specimens examined and study sites.** A total of 96 *Sthenopsis* specimens from Alberta and Saskatchewan were examined, from the following sources: Northern Forestry Centre (NFC) (Canadian Forest Service, Edmonton), University of Alberta Strickland Museum (UASM) and the private collections of the authors.

Behavior observations and habitat notes were based on the following Alberta localities: Finnegan Ferry (51°8'N, 112°5'W), 15-July-1985 (DDL); Didsbury (51°40'N, 114°8'W), 23-July-1987 (BCS); 23 km N. of Lac La Biche (54°55'N, 112°05'W), 22-July-1997 (BCS); Rock Island Lake (55°35'N, 113°25'W), 26-July-1997 (BCS); Gregoire Lake Provincial Park (56°35'N, 111°10'W), 24-July-1997 (BCS); 10 km S Cooking Lake (53°21'N, 113°05'W), 28-31-July-1997 (DDL, BCS); Palisades Research Centre, Jasper National Park (52°58'N, 118°04'W) 1030 m, 8-July-1998 (BCS); Redwater Natural Area (53°55'N, 112°57'W), 28-July-1999 (BCS).

*Sthenopsis argenteomaculatus* occurs from Québec to New England, and westward to Minnesota and Ontario (Strecker 1893, Forbes 1923, Riotte 1992, Handfield 1999). It is also reported from Alberta (Bowman 1951) and Saskatchewan (Hooper 1981), and Ives and Wong (1988) state this species occurs throughout the prairie provinces. However, this species has often been confused with *Sthenopsis purpurascens* (Forbes 1923), and specimens labeled as *S. argenteomaculatus* in the Bowman collection (UASM) and the NFC are variants of *S. purpurascens*. Hooper (1981) and Ives and Wong (1988) provide a figure of a specimen identified as *S. argenteomaculatus*. Comparisons with illustrations of *S. argenteomaculatus*

from eastern North America (Solomon 1995, Handfield 1999) and specimens from Nova Scotia (BCS) reveal that the figures in Hooper (1981) and Ives and Wong (1988) are actually *S. purpurascens*. Furthermore, the peak flight period of *S. argenteomaculatus* is in mid- to late June, whereas *S. purpurascens* has a much later peak, from mid-July to August (Handfield 1999). Hooper (1981) states that in Saskatchewan, "adults [of the Hepialidae] emerge from mid-July to September". Based on this, previous reports of *S. argenteomaculatus* for Alberta and Saskatchewan should be referred to *S. purpurascens*.

*Sthenopsis purpurascens* ranges from British Columbia and the Northwest Territories east to Labrador and New York (Grote 1864, Forbes 1923, Prentice 1965, Handfield 1999), and as far south as the White Mountains of Arizona in the west (D. Wagner pers. comm.). In Alberta, this species is most common throughout the boreal mixed wood and aspen parkland ecoregions, and occurs locally in the mountain and prairie regions. The boreal forest localities include a range of habitats; the Cooking Lake site consists of mature trembling aspen (*Populus tremuloides*) woods, with an understory of beaked hazelnut, *Corylus cornuta*, and wild red raspberry, *Rubus idaeus*. The Redwater site is sandy, open jack pine (*Pinus banksiana*) forest, interspersed with stands of trembling aspen and paper birch (*Betula papyrifera*). Green alder (*Alnus crispa*) is the most common understory shrub. The Palisades Research Centre locality is within the montane ecoregion (Strong & Leggat 1992), and consists of dry, open meadows with stands of trembling aspen and lodgepole pine (*Pinus contorta*). *S. purpurascens* also occurs in riparian balsam poplar (*Populus balsamifera*) groves in the mixed grass prairie ecoregion (Finnegan Ferry site); populations here are likely restricted to riparian areas, since the larvae bore in the roots of poplar and aspen, *Populus* spp. (Prentice 1965, Gross & Syme 1981). It appears that *S. purpurascens* occurs throughout most of the province where suitable host plants occur.

The light color form (formerly *Sthenopsis quadriguttatus*) occurred together with typical *S. purpurascens* at all 1997 localities, with the exception of Gregoire Lake P.P. The fact that both phenotypes were collected together at several sites suggests that the habitat requirements and phenology of the two phenotypes are very