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A revision of the Canadian species of the Genus *Herpetogramma* Lederer, 1863 (Lepidoptera: Crambidae: Spilomelinae: Herpetogrammatini), with descriptions of three new species

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Abstract. The genus *Herpetogramma* Lederer in Canada is revised to include ten species of which three are new: *H. aquilonalis* sp. n., *H. fraxinalis* sp. n., and *H. nymphalis* sp. n. Keys to the Canadian species of *Herpetogramma* are included as well as descriptions, distribution, biology and illustrations of adults and genitalia. *Herpetogramma abdominalis* (Zell.,1872) syn. n. and *H. fissalis* (Grt., 1881) syn. n. are synonymized with *H. thestealis* (Walker, 1859) here.

Key words. *Herpetogramma, abdominalis, aeglealis, aquilonalis, bipunctalis, fluctuosalis, fraxinalis, nymphalis, pertextalis, phaeopteralis, sphingealis, theseusalis, thestealis*, Canada, distribution, biology, hostplants.

INTRODUCTION

In February 1967, when my mother (LH) gave me $20 to buy a used copy of Holland's Moth Book (1903), I acquired a very precious tool (at the time, the only rare and costly book available for amateurs) to identify the moths of my then small collection begun at my parents' home in Mont-Saint-Hilaire (Québec). But my identification problems were not all solved as, amongst others, one of my specimens of a small moth looking like the moth illustrated on plate 47: 54 of Holland's book as *Pyrausta pertextalis* (Lederer, 1863) was similar, but not the same as my specimen. I continued to search for a better answer, but without finding any. The problem remained unsolved and was forgotten until 2004, when a lot of *Herpetogramma* Lederer, 1863 of a very dark form (now known as *H. sphingealis* Handfield & Handfield, 2011) were collected at Rougemont, Québec. This reminded me of my original problem and led me to return to that old *Herpetogramma* specimen. As this specimen could still not be identified, we decided to collect more specimens of this genus and attempt to provide some resolution to this problem.

After many years of collecting hundreds of *Herpetogramma* specimens, studying and searching for more information, we found out that this difficult group could only be resolved with the help of the DNA barcoding and genitalia dissection, the latter being carried by Dr J. Donald Lafontaine. We hope that this revision of the species known to occur in Canada will help future studies of this complex genus.

Herpetogramma sphingealis having been described in 2011, we then decided to tackle the rest of the Canadian species of *Herpetogramma*. It was not an easy task, but as we collected hundreds of specimens in Québec between 2004 and 2019, and we were able to study photographs of all types specimens associated with the existing names, so we can now come to a conclusion.

The first lepidopterist who tried to resolve that group was Forbes (1923) in his treatment of the Lepidoptera of New York and neighboring States, part 1 (under the broader genus *Pyrausta*). In his North American list of species Munroe (1983) attempted to resolve the taxonomy of *Herpetogramma* of the region in providing many new combinations. Solis (2010) published an illustrated list of the North American species of *Herpetogramma*, but it did not give the information needed to resolve issues with the identification of some of the species occurring in Canada or the United States. After our description of *Herpetogramma sphingealis* in 2011, we continued to collect and study the species occurring in Canada. This was aided by sending many of our Canadian *Herpetogramma* to the Canadian Centre for DNA Barcoding Data ("BOLD") for DNA barcoding and this gave us a clearer view of this difficult genus. With the additional characters of the male vesica and other genitalia characters, we are now able to present our conclusions pertaining to the identifications of the species of *Herpetogramma* known

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to occur in Canada and add three new species of *Herpetogramma* to the list of North American species.

In the present paper, the word "Newfoundland" does not include "Labrador" and vice-versa.

MATERIAL AND METHODS

Repository abbreviations

Specimens were examined from the following collections:

AC = Personal collection of Alain Charpentier, Saint-Hyacinthe, Québec, Canada
AMNH = American Museum of Natural History, New York, USA
NHMUK = Natural History Museum (formerly British Museum of Natural History) [BMNH]), London, UK
CNC = Canadian National Collection of Insects, Arachnids, and Nematodes, Ottawa, Ontario, Canada, including the collections of Léo-Paul Landry, Michel Pratte, and parts of the collections of Alain Charpentier and Bernard Landry
CUIC = Cornell University Insect Collection, Cornell University, Ithaca, New York, USA
DANM = Personal collection of Daniel Abraham and Nathalie Michel, Saint-Pierre, Îles-Saint-Pierre-et-Miquelon, France
DH = Personal collection of Daniel Handfield, Orford, Québec, Canada
ÉR = Personal collection of Éric Rassart, Brossard, Québec, Canada
LEM = Lyman Entomological Museum, McGill University, Sainte-Anne-de-Bellevue, Québec, Canada
LH = Personal collection of Louis Handfield, Mont-Saint-Hilaire, Québec, Canada
NH = Personal collection of Norman Handfield, Mont-Saint-Hilaire, Québec, Canada
NHM = Naturhistorisches Museum Vienna (Natural History Museum), Vienna, Austria
NJ = Personal collection of Normand Juneau, Saint-Maurice, Québec, Canada
SEM = E.H. Strickland Entomological Museum, University of Alberta, Edmonton, Alberta, Canada
UM = Collection Ouellet-Robert, Université de Montréal, now Centre de la Biodiversité, Montréal, Québec, Canada
USNM = National Museum of Natural History (formerly United States National Museum), Washington, USA

Dissecting methods and genital terminology.

Dissections of genitalia and terms for genital structures and wing patterns and markings follow Lafontaine (2004) and the terminology used in the Moths of America North of Mexico (MONA) series, few exceptions follow Kristensen, Niels P. (2003).

Diagnosis of genus in North America

Herpetogramma Lederer, 1863
Type species: *Herpetogramma servalis* Lederer, 1863, by monotypy.

Even if the genus *Herpetogramma* is worldwide in distribution (Solis 2010), we have restricted our research to North America – mostly to Canada – as there are so many discoveries remaining to be made and also so many habits of these fantastic species remain unknown. Even for American species, very few details are known as to the biology of *Herpetogramma* (Solis 2010). The latter is the only author who has tried to shed light on that matter. Larvae of our species, so far as known (Solis 2010), are mostly general feeder, especially on herbaceous low plants, no one in Canada are of economic importance (Solis 2010).

The last treatment of North American species of *Herpetogramma* (Scholtens & Solis 2015) lists ten species for the North American fauna including the species we added in 2011 (Handfield & Handfield 2011). With the present revision, the total number of known North American species is now thirteen of which ten occur in Canada.

Adult. Medium-sized moths with a wingspan of 25–37 mm. The three basic forms in North America (*H. phaeopteralis*, *H. bipunctalis*, and *H. theseusalis*) have a pale gray-brown or creamy-brown forewing ground colour with a relatively simple forewing pattern consisting of darker, slightly wavy, antemedial, postmedial, and subterminal lines, and solidly dark reniform and orbicular spots. The other species have a more complex pattern with the veins usually lined in dark shading, the basal and antemedial lines zigzagged, the postmedial and subterminal lines scalloped between the veins, and the terminal line even along the outer edge of the forewing; the orbicular and reniform spots are dark and either solid, or with a pale center. The hind wing has a similar pattern to that of the forewing, although usually paler, and the orbicular and reniform spots are replaced by an elongated discal spot.

Male genitalia. Valva elongated, elliptical; lightly sclerotized, except for narrow sclerotized rod-like brace on dorsal margin, angled at one-third from base, and short rod along basal ¼ of ventral margin, densely covered with hairlike setae. Uncus about ⅓ × length of valve, tapered gradually to a densely setose apex. Vinculum with pair of short eversible coremata each covered with mass

of fine hair-like setae that are longer than valves. Phallus relatively lightly sclerotized, especially dorsally, usually 7–10 × medial width; eversible vesica 0.65–0.95 × length of phallus; vesica with one or two basal diverticula, and a large spiny diverticulum at ½ or ¾ from base.

Female genitalia. Anal papillae elongated, narrow, densely setose; posterior apophyses as long as height of anal papillae; ductus bursae narrow ¼–½ × length of corpus bursae; corpus bursae narrow posteriorly, broad and oval anteriorly, anterior part 1–7 × as long as narrower posterior part of corpus bursae. Large posterior part of corpus bursae covered with minute sclerotized spicules that are concentrated to form a double-pouched signum toward posterior end.

DNA Barcoding tree

With the help of BOLD (Barcode of Life Database), many specimens of all *Herpetogramma* morpho-species could be DNA barcoded, and it appears that the genus *Herpetogramma* is more complex and diversified than was previously suspected (see Appendix 1).

Key to Canadian species of *Herpetogramma* (external markings of adults)

1. Abdomen with two dark dots dorsally on second segment, small dark discoidal spot on hindwing; wingspan 23–24 mm ..... ***H. bipunctalis***
– Abdomen without these two dark dots or the small dark discoidal spot..... 2
2. Forewings narrow; wingspan about 20 mm ..... ***H. phaeopteralis***
– Forewings broader; wingspan 25–37 mm..... 3
3. Reniform spot black, kidney shaped 4
– Reniform spot square, often with paler center 6
4. Hindwing with an even, thin, gray-brown terminal line near margin; wingspan 25–27 mm..... ***H. theseusalis***
– Hindwing subterminal line somewhat checkered, usually projecting into hindwing fringe as dark dots 5
5. Hindwing with dark gray-brown bands contrasting with paler ground colour; wingspan 27–33 mm ..... ***H. aeglealis***
– Hindwing dark gray brown; wingspan 31–37 mm.... *H. sphingealis*
6. Terminal and subterminal lines on hindwing absent; wingspan 29–32 mm ..... ***H. fraxinalis*** sp. n.
– Terminal and subterminal lines on hindwing gray brown; subterminal line scalloped between veins... 7
7. Terminal line on hindwing barely marked, usually represented by minute dots on wing veins; wingspan 23–27 mm..... ***H. aquilonalis*** sp. n.
– Terminal line on hindwing continuous, gray brown 8
8. Forewing with reniform and orbicular spots pale gray brown, concolourous with other markings on forewing; wingspan 23–24 mm ..... ***H. pertextalis***
– Forewing with reniform and orbicular spots contrastingly dark, beeing darker than other forewing markings 9
9. Inner margin of subterminal line on hindwing deeply scalloped between veins; wingspan 29–33 mm ..... ***H. thestealis***
– Inner margin of subterminal line on hindwing slightly scalloped between veins; wingspan 26–27 mm ..... ***H. nymphalis*** sp. n.

Key to Canadian species of *Herpetogramma* (male genitalia)

1. Vesica with single basal diverticulum..... 2
– Vesica with basal and medial or subapical diverticula..... 4
2. Vesica enlarged toward apex..... ***H. phaeopteralis***
– Vesica cylindrical, of even girth for whole length .. 3
3. Vesica projecting posteriorly from apex of phallus... ***H. theseusalis***
– Vesica curved at end of phallus to project ventrally . ***H. bipunctalis***
4. Vesica with spiny diverticulum at ¾ distance to apex of vesica; with two diverticula at base, an elongated one on right side and a small bubble-like diverticulum one dorsally 5
– Vesica with spiny diverticulum at ½ distance to apex of vesica; with one diverticulum at base on right side with a narrow finger-like secondary one projecting from it..... 8
5. Vesica straight at position of spiny diverticulum..... ***H. pertextalis***
– Vesica angled at position of spiny diverticulum 6
6. Two separate diverticula at base of vesica on right... ***H. aquilonaris*** sp. n.
– Single elongated diverticulum at base of vesica on right 7
7. Basal diverticulum on right side of vesica elongated to project posteriorly ..... ***H. thestealis***
– Basal diverticulum on right side of vesica anvil shaped, projecting anteriorly and posteriorly..... ***H. fraxinalis*** sp. n.
8. Phallus 8.0–8.8 × as long as its medial width of phallus 9
– Phallus 10.0–10.6 × as long as its medial width of phallus ..... ***H. sphingealis***
9. Distance between end of phallus and base of dorsal diverticulum 0.5× length of phallus ..... ***H. nymphalis*** sp. n.
– Distance between end of phallus and base of dorsal diverticulum 0.25–0.3× length of phallus ..... ***H. aeglealis***

Note for new names
All names herein for new species are names in apposition.

Species account

Herpetogramma phaeopteralis (Guenée, 1854) (801196, MONA 5274)
Pl. 1, Figs 1 (♂), 2 (♀) (adults); Pl. 4, Figs 35–36 (♂ gen.); Pl. 7, Fig. 55 (♀ gen.).

Synonyms. As listed by Solis 2010; Scholtens & Solis 2015: *Botys vecordalis* Gn., 1854; *Botys ostreonalis* Wlk., 1859; *Botys vestalis* Wlk., 1859; *Botys additalis* Wlk., 1862; *Botys plebejalis* Lederer, 1863; *Botys cellatalis* Wlk., 1866; *Botys communalis* Snellen, 1875; B*otys intricatalis* Möschler, 1890; *Acharana descripta* Warren, 1892. For *Botys neloalis* Wlk. and *Botys triarialis* Wlk., "these names and the type specimens associated with them need to be re-evaluated with respect to the North American fauna" (Alma Solis, *in litt*., 30.iv.2018).

Type material. 1 ♂. Cayenne, French Guyana, lectotype in NHML [NHMUK] (Solis 2010).

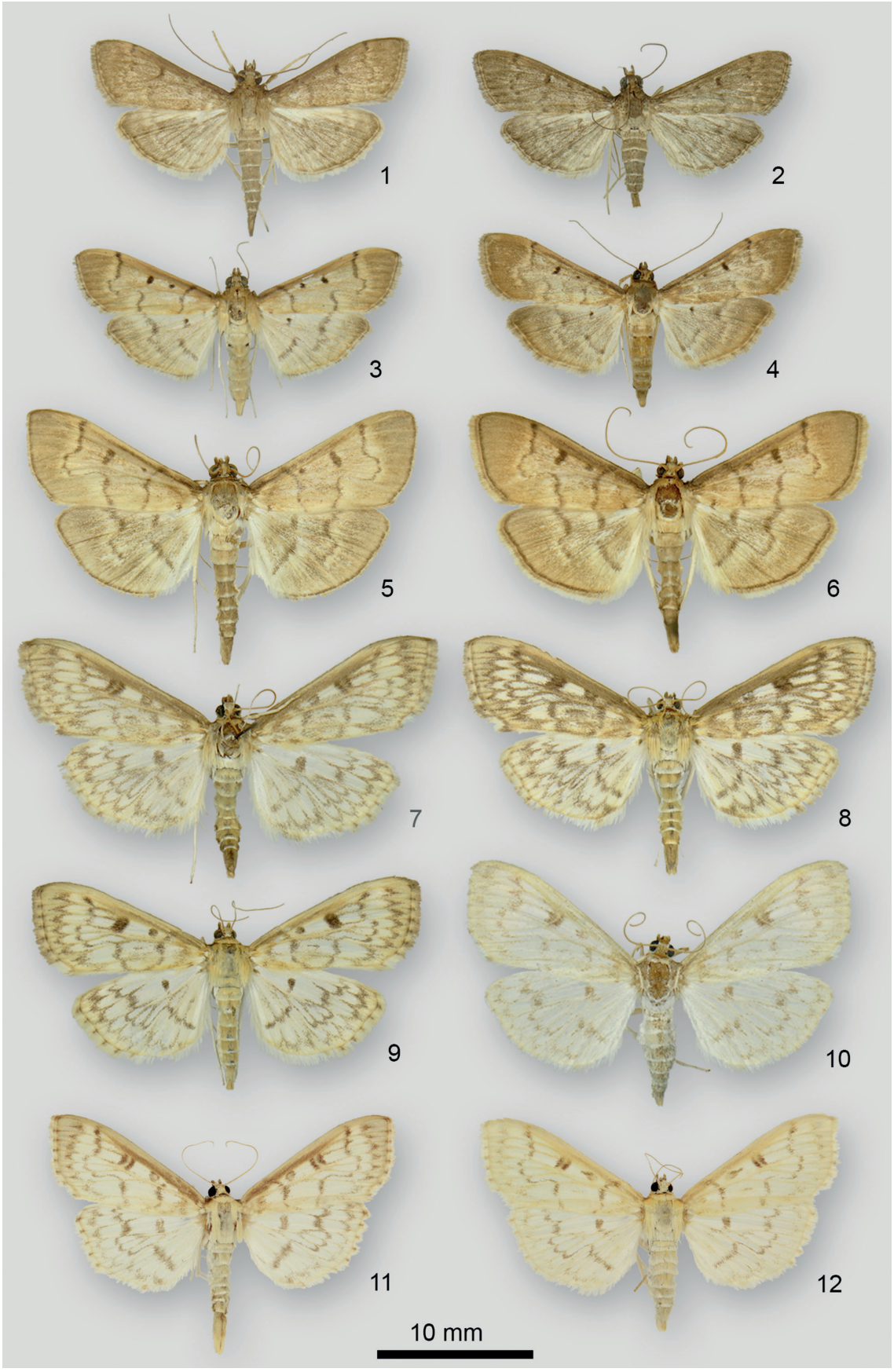
Diagnosis. This is a generally uniformly medium-brown species having a wingspan of generally 20 mm, without any special markings except for the usual black transverse lines, with a long, black, nearly half-moon-shaped reniform spot and a small, black, rounded orbicular spot; there is no pale patch between the orbicular and reniform spots. The forewing narrower than in other soecies; the hindwing is similar in colour or slightly paler than the forewing; there is no sexual dimorphism. Solis (2010: figs 10–11) illustrates a male and a female. **Male genitalia**. Figs 35–36. Valvae and genital capsule generally as described for genus, except sclerotized rod extending along basal third of ventral margin of valva more heavily sclerotized than in other species. Vesica extending posteriorly from phallus, 0.8 × length of phallus, vesica larger posteriorly, with single dorsal subbasal diverticulum. **Female genitalia**. Fig. 55. Large anterior part of corpus bursae elongated with length about 1.7 × width, 2 × length of narrower posterior part, and 1.5 × length of ductus bursae.

Distribution. In the North, it is a rare migrant. Only five specimens are known from Canada: Ontario: "Cave west side of lake Mindemoya, Manitoulin Island, 21–22.x.1979, 4 ♂♂, John K. Morton;" and "Lambton Co., Port Franks, 18.x.2014, one ♀, Kenneth H. Stead" [identification confirmed by BOLD] [in CNC]. Common from southern United States southward through the Caribbean region and Central and South America (BOLD, Solis 2010). In BOLD, there are barcode records from Florida, Oklahoma, South Carolina (Myrtle Beach), Texas, Bolivia, Costa Rica, Honduras, Jamaica, Mexico, Peru, and Brazil. Solis (2010) lists Brazil, Colombia, French Guyana (Cayenne), Haïti, Jamaica, Puerto Rico, and Venezuela. In the United States, it flies in May and June, and from mid-August to December (Solis 2010). It is commonly known as the "tropical sod webworm."

Biology. The larva feeds on St. Augustine grass [*Stenotaphrum secundatum*] (Poaceae) and centipede grass [*Eremochloa ophiuroides*] [Poaceae] (Allyson 1984); also on bermudagrass [*Cynodon* ssp.], seashore paspalum [*Paspalum vaginitium*], carpetgrass [*Axonopus* ssp.], zoysiagrass [*Zoysia japonica*], bahiagrass [*Paspalum notatum*] and creeping bentgrass [*Agrotis stolonifera*] (all Poaceae) (Tofangsazi et al. 2012 rev. 2015). In the United States, the larvae are pests on new lawns, turfgrass, golf courses, and athletic fields (Tofangsazi et al. 2012 rev. 2015). As the moth is only a rare migrant in Canada, there is no special habitat in Canada, but the moth prefers open grassy habitats. It is a nocturnal species, flying from dusk and comes to light.

Note. According to Shaffer & Munroe (2003), *H. phaeopteralis* (Gn., 1854) is a New World species that is not present in the Old World (Europe, Africa, Asia, Oceania). The data for *H. phaeopteralis* in the literature for the Old World list Africa, islands in the Indian Ocean (for La Réunion, see Guillermet 2009), Asia, Korea (see Bae et al. 2008). However, all needs to be re-evaluated and verified (Alma Solis, in litt., 30.iv.2018) because these records likely refer to *H. licarsisalis* (Wlk., 1859) (TL Sarawak, Borneo) which is the Old World species (specimens in CNC of *H. licarsisalis* are from Belgian Congo [Democratic Republic of Congo], Hawaii [USA]), India [Republic of India], Japan, Malacca, Samoa Island, Sik-

Figs 1–12 (opposite page). 1. *Herpetogramma phaeopteralis* ♂, CNCLEP00212001: Canada, ON, Manitoulin, The Cave W side, Lake Mindemoya, 21.x.1979, J. K. Morton. **2**. *Herpetogramma phaeopteralis* ♀, CNCLEP00212002: Canada, ON, Lambton, Port Franks, 18.x.2014, K.H. Stead. **3**. *Herpetogramma bipunctalis* ♂, CNCLEP00212003: Canada, QC, St-Hyacinthe, 4865 rue Maricourt, 45.609426° N, 72.978514° W, 01.x.2016 at light, Alain Charpentier. **4**. *Herpetogramma bipunctalis* ♀, CNCLEP00212004: United States, SC, Myrtle Beach, 10.x.1965, A. C. Sheppard. **5**. *Herpetogramma theseusalis* ♂, CNCLEP00212005: Canada. QC, south end of Pike Lake, Manitoulin Is., 7.viii.2008, J. K. Morton. **6**. *Herpetogramma theseusalis* ♀, CNCLEP00212006: Canada, ON, Rockville Junction Bog, Bidwell Rd, Manitoulin Is., 29.vi.1991, J.K. Morton. **7**. *Herpetogramma aquilonalis* sp. n. Holotype, ♂, CNCLEP00212007: Canada, QC, Mont Rougemont, Rougemont, 45°27.89' N, 73°04.52' W, 14.vii.2008, D. Handfield. **8**. *Herpetogramma aquilonalis* sp. n. ♂, CNCLEP00212008: Canada, QC, Lanoraie, Tourbière de Lanoraie, 45°59.50' N, 73°16.60' W, 5.vii.2016, D. Handfield. **9**. *Herpetogramma aquilonalis* sp. n. ♀, CNCLEP00212009: Canada, QC, Lanoraie, Tourbière de Lanoraie, 45°59.50' N, 73°16.60' W, 5.vii.2016, D. Handfield. **10**. *Herpetogramma aquilonalis* sp. n. ♀, CNCLEP00212010: Canada, QC, Mont Rougemont, Rougemont, 45°28.026' N, 73°04.29' W, 14.vii.2008, Louis Handfield and Daniel Handfield. **11**. *Herpetogramma aquilonalis* sp. n. ♂: United States, NY, Ithaca, Snyder Heights, 15.vii.1977, 1,100 ft, J.G. Franclemont (CUIC). **12**. *Herpetogramma aquilonalis* sp. n. ♀: United States, NY, Ithaca, Snyder Heights, 22.vii.1977, 1,100 ft, J.G. Franclemont (CUIC).



kim [Republic of India], Taiwan and Tonkin [Vietnam]. A barcode analysis (BOLD) (23.iii.2021) shows a large divergence between Australian specimens of *H. licarsisalis* and South American specimens of *H. phaeopteralis*.

Herpetogramma bipunctalis (Fabricius, 1794) (801193, MONA 5272)
Pl. 1, Figs 3–4 (adults); Pl. 4, Figs 37–38 (♂ gen.).

Synonyms (as listed by Solis 2010, Scholtens & Solis 2015). *Botys detritalis* Gn., 1854; *Botys lycialis* Wlk., 1859; *Botys phileralis* Wlk., 1859; *Botys terricolalis* Möschler, 1881; *Botys repetitalis* Grote, 1882; and *Botys simplex* Warren, 1892.

Type material. 1 ♂ from the "West Indies" [Carribean region] (Surinam in original description) in ZMUC (Zoological Museum, Copenhagen, Denmark) (Solis 2010).

Diagnosis. This well-known species is a pest of cultivated beets in the South where it is known as the "southern beet webworm." Specimens generally have a wingspan of 23–24 mm; there is no sexual dimorphism and the species is highly variable in colour pattern being light brown, cream, or even whitish, but is characterized by the solid, black, reniform and orbicular spots, without a white or cream-coloured bar between them as in some other *Herpetogramma* species. It is most easily identified by the two dark spots on the dorsum of the second abdominal segment; also there is a small dark discoidal spot on hindwing. The name *bipunctalis* refers to the two black dots on the forewing that plays the role of the orbicular and reniform. Solis (2010: figs 4–5) illustrates a male and a female of *H. bipunctalis*. Male genitalia. Figs 37–38. Valves and genital capsule as described for genus. Vesica projecting ventrally from apex of phallus; vesica 0.8 × length of phallus, with single ventral subbasal diverticulum. Female genitalia. Recently described in fig. 150 in Landry (2016).

Distribution. In the North of North America, this is a rare migrant. Only a few records are known from Québec: Sainte-Christine, (21.ix.2003, coll. DH [identification confirmed by BOLD]); Montréal (22.ix.1957, A.C. Sheppard); Pincourt (Île Perrot) (24.ix.1970, V. R. Vickery) (LEM); St-Hyacinthe (4865 Maricourt, 1.x.2016, Alain Charpentier) (CNC). Records from Ontario include a migratory flight recorded in 2016 (Long Point and Port Franks; Kenneth Stead, pers. comm.) and at Ottawa (Nolie Schneider, pers. comm.). No records are known from elsewhere in Canada. It is a species generally present in the mid-eastern and southeastern United States. Records in BOLD are from Florida, Oklahoma, Tennessee and Texas (United States of America) and Mexico. The species is common in agricultural areas where the hostplants are cultivated. Adults occur from August to December. It is nocturnal, coming to light and easily flushed during the day from low vegetation.

Biology. The larva feeds on cultivated beets (Chenopodiaceae), cauliflower and cabbage (Brassicaceae), cabbage (Brassicaceae) and weeds, also feeds especially on species of *Amaranthus* (Amaranthaceae), eggplant (*Solanum melongena* [Solanaceae]) and beet (*Beta vulgaris* [Amaranthaceae]) (Allyson 1984). Specimens in the USNM were reared from *Amaranthus* sp., *Ambrosia* sp. (Asteraceae) and soybean (*Glycine max* [Fabaceae]) (J. D. Lafontaine, personal communication, October 2018). The species seems to have found a new hostplant and feed on the invasive *Alternanthera philoxeroides* (Amaranthacea) in Florida and neighboring States (Heppner 2003); it attacks the parts of the plant that are above the water level (Lara-Villalón et al. 2014). As the moth is migratory in Canada, there is no special habitat in Canada, but it is generally found in open areas.

Herpetogramma theseusalis (Walker, 1859) (8011200, MONA 5279)
Pl. 1, Figs 5–6 (adults); Pl. 4, Figs 39–40 (♂ gen.); Pl. 7, Fig. 56 (♀ gen.).

Synonymy. *feudalis* Grote, 1875 (*Botis*) (Solis, 2010) (Scholtens & Solis 2015).

Type material. *Botis theseusalis* Walker, ♀ holotype from "United States" in NHMUK; *Botis feudalis* Grote, ♂ lectotype from New York or Massachusetts in NHMUK by Solis 2010.

Figs 13–24 (opposite page). 13. *Herpetogramma fraxinalis* sp. n. Holotype ♂, CNCLEP00212011: Canada, QC, Mont Rougemont, Rougemont, 45°28.026' N, 73°04.29' W, 5.viii.2009, D. Handfield. **14**. *Herpetogramma fraxinalis* sp. n. ♀, CNCLEP00212012: Canada, QC, Mont Rougemont, Rougemont, 45°28.026' N, 73°04.29' W, 29.vii.2008, Louis Handfield and Daniel Handfield. **15**. *Herpetogramma fraxinalis* sp. n. ♂, CNCLEP00212013: Canada, QC, Brome-Missisquoi, St-Armand, Domaine Baie-Missisquoi, 18.viii.2000, B. Landry. **16**. *Herpetogramma fraxinalis* sp. n. ♀, CNCLEP00212014: Canada, QC, Mont Rougemont, Rougemont, 45°28.026' N, 73°04.29' W, 29.vii.2008, Louis Handfield and Daniel Handfield. **17**. *Herpetogramma thestealis* ♂, CNCLEP00121457: Canada, QC, Gatineau Park, Luskville Falls, creek below picnic ground, 45.5333° N, 75.9955° W, 25.vii.2014, J.F. Landry and B. Landry. **18**. *Herpetogramma thestealis* ♀, CNCLEP00212016: Canada, QC, St-Valérien-de-Milton, Tourbière de St-Valérien, 45°32.55' N, 72°40.24' W, 2.viii.2005, Daniel Handfield. **19**. *Herpetogramma thestealis* ♂, Canada, QC, Mont Rougemont, Rougemont, 45°28.026' N, 73°04.29' W, 25.vii.2008, Louis and Daniel Handfield. **20**. *Herpetogramma thestealis* ♀, Canada, QC, Otterburn Park, Les Bosquets Hudon, 5.viii.2008, Louis and Daniel Handfield. **21**. *Herpetogramma pertextalis* ♂, CNCLEP00212017: Canada, ON, Simcoe, 27.vi.1935, T.N. Freeman. **22**. *Herpetogramma pertextalis* ♂, CNCLEP00212018: Canada, QC, Lac Trousers, 495 rte Mississiquoi, 45°24.86' N, 72°35.25' W, 1.viii.2011, Daniel Handfield. **23**. *Herpetogramma pertextalis* ♀, USNMNH 208285: United States, NY, Six Mile Creek, 31.v.1957, J.G. Franclemont. **24**. *Herpetogramma pertextalis* ♀, CNCLEP00121794: Canada, ON, Lambton Co., Port Franks, 28.ix.2014, K.H. Stead.

Diagnosis. This well-known species has all four wings concolourous with buff brown (rarely light brown), except for slightly darker margins; wingspan usually 25 mm; the antemedial line is black and nearly straight, with no light-coloured patch between the reniform and orbicular spots; the reniform spot is a black bar, sometimes outwardly convex; the orbicular spot is a rounded black dot; the apex of the forewing is more squared, not acutely angled as in other species; the postmedial line is black, sinuous, and strongly bent below the cell, as in most *Herpetogramma* species; the abdomen, thorax, and head, are of the same colour as the wings; the palpi are short (Forbes 1923). There is no sexual dimorphism. Solis (2010: fig. 12) illustrates a male. **Male genitalia**. Figs 39–40. Valves and genital capsule as described for genus. Vesica extending straight posteriorly from phallus, 0.7 × length of phallus, with single dorsal subbasal diverticulum. **Female genitalia**. Fig. 56. Large anterior part of corpus bursae with length about 2 × width, about 4 × length of narrower posterior part, and 2 × length of ductus bursae.

Distribution. In Canada *Herpetogramma theseusalis* is only known by a few specimens from Southern Québec (incl. Saint-Hilaire mountain [in Mont-Saint-Hilaire]), Eastern Ontario, New Brunswick (Cormierville, Cocagne Co., 29.vii.2015 [Bug Guide, 20.ix.2020]) and Nova Scotia (near Sherbrooke, 11.viii.2017) [Butterflies and Moths of North America, accessed 20.ix.2020]. In the United States, it is known from Maine, Massachusetts, New York, and Pennsylvania; farther south it is recorded from Maryland, Delaware, and Virginia southward to Florida, and along the Gulf of Mexico to Texas. Specimens barcoded and available on BOLD form two different Barcode Index Numbers (BINs), suggesting the existence of two species there, one in the North being the typical one, and another one in Southern United States, Only four specimens have been submitted to BOLD and these are from Québec, Ontario, South Carolina, and Florida. The types of *feudalis* are from New York and Massachusetts (Solis 2010) and consequently *feudalis* is considered a synonym of the typical northern *H. theseusalis* (Solis 2010).

Biology. The larva rolls the tips of various ferns (Forbes 1923) "rolling up fronds into round balls" (Winn 1912, p. 79), and especially *Thelypteris palustris* (Thelypteridaceae) [specimens in the USNM] (Solis 2010) and LEM (Hertel lake [on mountain of Saint-Hilaire, Mont-Saint-Hilaire, Québec [handwritten note on A.C. Sheppard's working copy of Winn List]). *Thelypteris palustris* is a common fern in eastern North America occurring from Québec to Florida. The larva also feeds on *Osmunda cinnamonea* (Osmundaceae) (East Concord, New York [CUIC]) and on *Onoclea sensibilis* (Dryopteridaceae) in Maine (Adams & Morse 2014), both common ferns in Eastern Canada. In Maryland, the larva feeds also on *Woodwardia areolata* (Blechnaceae) (Maryland Biodiversity Project, accessed 20.ix.2020), a fern known only from southern Nova Scotia in Canada, and then from Massachusetts to Florida, and along the Gulf of Mexico to Louisiana and eastern Texas (Lady Bird Johnson Wildflower Center, Texas, accessed 20.ix.2020). The moth is associated with mesic habitats, bogs (like the Lanoraie bog in Québec), open boggy habitats, and lake and river shorelines. It is nocturnal and comes to light.

Herpetogramma aquilonalis sp. n.

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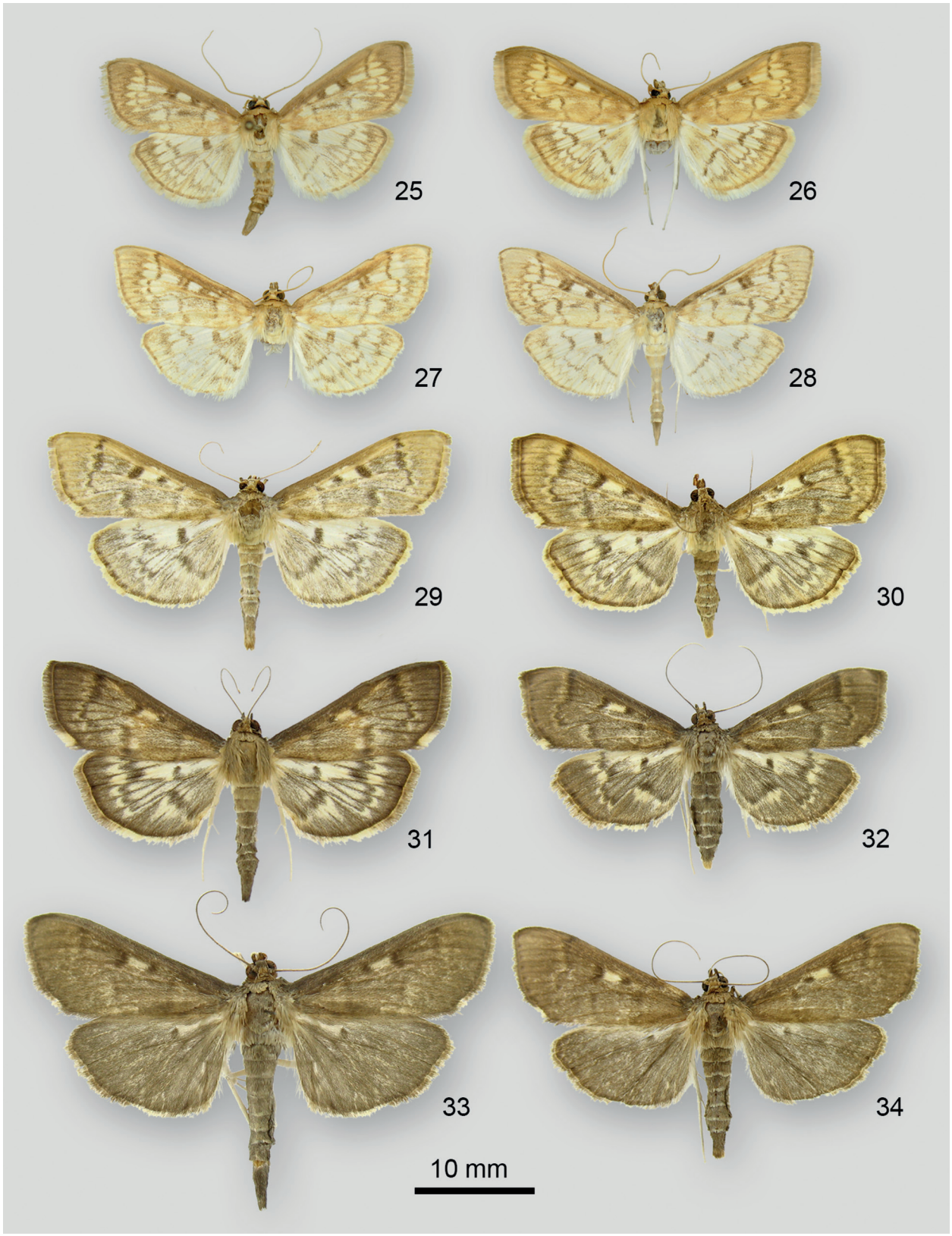
Pl. 1, Figs 7–12 (adults); Pl. 4, Figs 41–42 (♂ gen.); Pl. 7, Fig. 57 (♀ gen.).

Type material. Holotype ♂. Canada: Québec: Rougemont, montagne [mountain] [45°28'026" N, 73°04'029" W], 14.vii.2008, Daniel Handfield collection [MDH006455]. Deposited in CNC.

Paratypes. (54 ♂♂, 38 ♀♀): Canada: Québec: [Daniel Handfield Collection]: Canton de Magog, lac Lovering, 25.vii.2002 (1 ♂); Chambord, usine Louisiana Pacifique, 16.vii.2001 (1 ♂); Franklin, Réserve écologique du Pin-Rigide, 5.vii.2013 (1 ♂), 17.vii.2013 (1 ♂); Lac Trousers, 495 Route Missisquoi, 2.viii.2011 (3 ♂♂); Lanoraie, tourbières de Lanoraie [bogs], 3.vii.2007 (1 ♂), 16.vii.2007 (1 ♂), 24.vi.2016 (2 ♂♂), 5.vii.2016 (13 ♂♂) , 23.vii.2016 (4 ♂♂), 5.vii.2016 (11 ♀♀), 23.vii.2016 (7 ♀♀); Lac Granet, chalet de la SEPAC, 5.viii.2014 (1 ♂); Grand-Remous, club du lac Brûlé, 5.viii.2010 (3 ♂♂); La Présentation, 5e rang, 17.vii.2002 (1 ♂); Hemmingford, chemin Covey Hill, 22.vi.2012 (1 ♂), 27.vii.2012 (1 ♂), 1.viii.2012 (1 ♂); Moisie, bord du fleuve, 30.vi.2016 (1 ♂); Parc des Laurentides, lac Sept-Îles, 11.vii.2011 (1 ♂); Parc national de la Pointe-Tail-

Figs 25–34 (opposite page). 25. *Herpetogramma nymphalis* sp. n. ♂, Holotype CNCLEP0089832: Canada, QC, Gatineau, Parc de la Gatineau, Mont King, 24.v.1989, B. Landry. **26**. *Herpetogramma nymphalis* sp. n. ♀, CNCLEP0089833: Canada, QC, Gatineau, Parc de la Gatineau, Mont King, 24.v.1989, B. Landry. **27**. *Herpetogramma nymphalis* sp. n. ♂, CNCLEP0040835: Canada, MB, Manitoba Tall Grass Prairie Preserve, Nature Conservancy Block, 49.0895° W, 96.7339° W, 294 m, 19.vii.2007, J.F. Landry and V. Nazari. **28**. *Herpetogramma nymphalis* sp. n. ♀, CNCLEP0040836: Canada, MB, Manitoba Tall Grass Prairie Preserve, Nature Conservancy Block, 49.0895° W, 96.7339° W, 294 m, 19.vii.2007, J.F. Landry and V. Nazari. **29**. *Herpetogramma aeglealis*, ♂, Canada, QC, Mont Rougemont, Rougemont, 45°28.026' N, 73°04.29' W, 25.vii.2008, D. Handfield. **30**. *Herpetogramma aeglealis*, ♀, Canada, QC, Mont Rougemont, Rougemont, 45°28.026' N, 73°04.29' W, 25.vii.2008, D. Handfield. **31**. *Herpetogramma aeglealis*, ♂, Canada, QC, Mont-Saint-Hilaire, 845 de Fontainebleau, 26.ix.2006, Louis Handfield. **32**. *Herpetogramma aeglealis*, ♀, Canada, QC, Mont Rougemont, Rougemont, 45°28.026' N, 73°04.29' W, 29.vii.2008, D. Handfield. **33**. *Herpetogramma sphingealis*, ♂, Canada, QC, Mont Rougemont, Rougemont, 45°28.026' N, 73°04.29' W, 29.vii.2008, D. Handfield. **34**. *Herpetogramma sphingealis*, ♀, Canada, QC, Mont Rougemont, Rougemont, 45°28.026' N, 73°04.29' W, 29.vii.2008, D. Handfield.



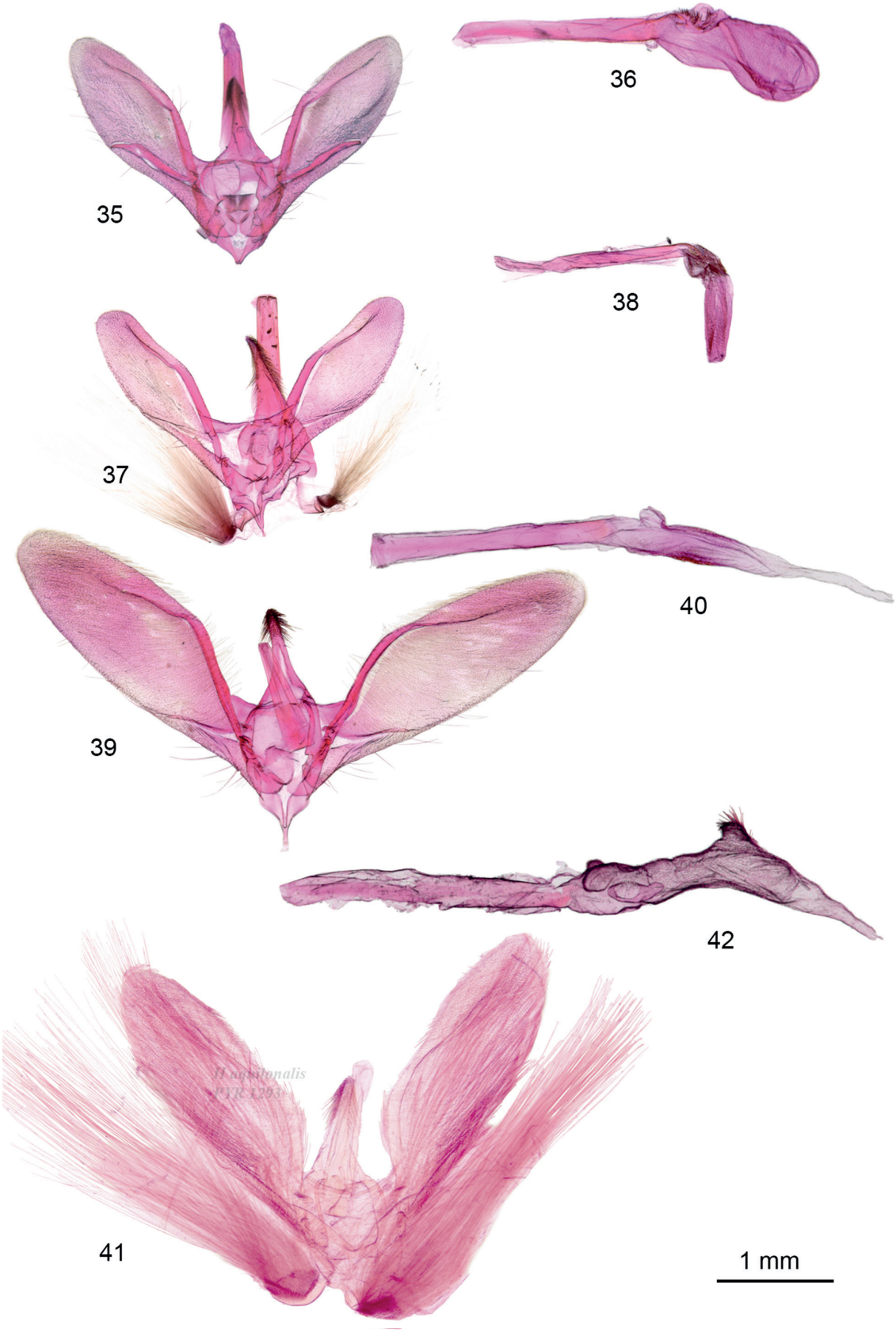
lon, secteur de la dune, 25.vii.2011 (1 ♂); Parc national des Monts-Valin, chalet Courtepointe, 17.vii.2009 (1 ♂), 7.viii.2009 (1 ♂), 7.ix.2009 (1 ♂), 7.viii.2009 (1 ♀); Parc national des Monts-Valin, pic Bellevue, 8.vii.2010 (1 ♂), 27.vii.2013 (1 ♀); Pied des Monts Groulx, refuge du Prospecteur, 28.vii.2014 (1 ♂); S[ain]te-Christine, boisé Julien Picard, 23.vii.2010 (2 ♂♂); S[ain]t-Mathieu-de-Beloeil, 355 des Grands Coteaux, 8.vii.2005 (1 ♂), 355 des Grands Coteaux, 29.vii.2005 (1 ♂); Villeroy, Grande Tourbière, 21.vii.2011 (2 ♂♂); ZEC des Passes, Lac aux Bleuets Secs, 27.vii.2013 (1 ♂) (all DH); [Louis Handfield Collection] : Mont-S[ain]t-Hilaire, 845 de Fontainebleau, 10.vii.2010 (1 ♂); S[ain]t-Charles-sur-Richelieu (Île de Jeannotte) (de jour, battant les grandes herbes au centre de l'île, milieu humide), 20.vii.1969 (1 ♂). [Daniel Handfield Collection]: ♀: Bishopton, chalet Mésange des Sommets, 12.viii.2004 (1 ♀); Canton de Magog, lac Lovering, 23.vii.2004 (1 ♀); Franklin, Réserve écologique du Pin-Rigide, 5.vii.2013 (1 ♀); Henryville, Réserve écologique Marcel-Raymond, 18.vii.2014 (2 ♀); Lac Trousers, 495 Route Missisquoi, 1.viii.2011 (2 ♀♀); La Présentation, 5e rang, 1.x.2002 (1 ♀); Oriskany, 17.vii.2008 (1 ♀); Parc des Laurentides, Lac Sept-Îles, 11.vii.2011 (1 ♀); Rougemont, montagne, 14.vii.2008 (1 ♀), 29.vii.2008 (1 ♀); S[ain]te-Christine, boisé Julien Picard, 15.ix.2006 (1 ♀); S[ain]te-Christine, boisé Julien Picard, 3.vii.2011 (1 ♀), 22.vii.2011 (1 ♀), 27.vii.2008 (2 ♀♀); ZEC des Passes, tourbière du lac Madame, 10.viii.2013 (1 ♀).

Etymology. The species name is derived from Latin *aquilo* for "northern wind," referring to the transcontinental northern distribution of the species.

Diagnosis. *Herpetogramma aquilonalis* sp. n. has long been confused in collections as there is a marked dimorphism in this species. That dimorphism led to a puzzle in identification, white females often masquerading as "*abdominalis*" and males as "*pertextalis*" and sometimes as "*thestealis*." Solis (2010: fig. 14) illustrates a male of *H. aquilonalis* sp. n. from the McClean Bogs Reserve, in New York, as *H. abdominalis*. Overall, the female is a whitish moth, different from the females of its southern counterpart, the true *H. pertextalis*. So, from *H. pertextalis, H. aquilonalis* sp. n. can also be easily separated by its larger size, by the coloring of the wings and even by the wingshape of the forewings.

Description. **Male**. Figs 7–8, 11. Wingspan: 25–27 mm [rarely 28 mm], more heavily marked and longer winged than female; palpi and head white, collar white with a tuft of gray hair dorsally near thorax; thorax and abdomen light gray, each segment of abdomen marked by a thin white line at apex; forewing: fringe light gray marked by a darker line at each vein; terminal line pale gray, bordered interiorly by darker gray subterminal line, scalloped between veins; terminal space slightly wider toward apex; postmedial line wavy, thin, gray, extending from costa to dorsal margin of wing; medial line thin, gray, under reniform spot, upon reaching dorsal margin; turning inwardly toward base of wing; antemedial line extending from costa, a bit wavy, convex, touching dorsal margin of wing near medial line; sometimes postmedial and medial lines connected as in *H. theseusalis*?; basal dash absent; costa dark gray from wing base usually to postmedial line; area between reniform and orbicular spots an elongated white patch, or concolourous with ground colour; reniform spot a dark gray rectangle, solid or with pale center; orbicular spot dark gray, round, barely evident in some specimens, sometimes paler in middle; veins, especially in males, marked by gray. Hindwing upperside: ground colour white, fringes as in forewing, terminal area cream, as wide as on forewing; postmedial line wavy, scalloped between veins; veins not marked with gray as on forewing; discal spot a gray bar. Hindwing underside: ground colour white; lines as on forewing upperside; area between terminal and subterminal lines darker than on upperside of wing; reniform and orbicular spots as on upperside of wing, but darker, also for large dark line on costa and discal spot. **Female**. Figs 9–10, 12. Wingspan: 23–26 mm [rarely 27 mm]; smaller, paler, with forewing apex more squared than in male; head, palpi, and thorax white, abdomen pale gray, abdominal segments marked by a thin white line as in male; forewing mainly white, fringe white, with a very thin gray mark at each vein, subterminal area between terminal and subterminal lines pale gray; subterminal area nearly as wide from base to apex, unlike in *H. thestealis*, rest of wing white, postmedial and antemedial lines thin, gray, following same course as in the male; orbicular spot barely visible, a pale gray dot, reniform spot small, more rounded than in male, gray with a pale-yellow center. Hindwing: white; discal spot an elongated dark gray spot; subterminal line medium gray to barely evident, especially light gray, scalloped between veins, fading out posteriorly. Underside of forewing and hindwing white except for terminal area of forewing, which has a light gray dot on each wing vein, darker toward wing apex; forewing costa marked by a gray line; reniform spot well

Figs 35–42 (opposite page). 35. *Herpetogramma phaeopterali*s valves PYR 1317: Bermuda, 8.xii.1951, W. and E. Mason. **36**. *Herpetogramma phaeopteralis* phallus PYR 1317: Bermuda, 8.xii.1951, W. and E. Mason. **37**. *Herpetogramma bipunctalis* valves PYR 1311: United States, FL, Homestead, 7.x.1958, D.O. Wolfenbarger. **38**. *Herpetogramma bipunctalis* phallus PYR 1311: United States, FL, Homestead, 7.x.1958, D.O. Wolfenbarger. 39. *Herpetogramma theseusalis* valves PYR 1313: Canada, QC, Co. Laviolette, Lac-à-la-Tortue, 22.vii.1947, E. Munroe. **40**. *Herpetogramma theseusalis* phallus PYR 1313: Canada, QC, Co. Laviolette, Lac-à-la-Tortue, 22.vii.1947, E. Munroe. **41**. *Herpetogramma aquilonalis* sp. n. valves PYR 1293: United States, OR, Marion Co., Croisan Gulch, S Salem, 25.vi.1978, R.L. Westcott. **42**. *Herpetogramma aquilonalis* sp. n. phallus PYR 1293: United States, OR, Marion Co., Croisan Gulch, S Salem, 25.vi.1978, R.L. Westcott.


35
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marked; orbicular spot barely evident in most specimens. **Male genitalia**. Figs 41–42. Valves and genital capsule as described for genus. Vesica with doubled diverticulum near base on right side and small dorsal diverticulum at base; spined diverticulum at ¾ toward apex of vesica. **Female genitalia**. Fig. 57. Large anterior part of corpus bursae about 2.4 × as long as wide, about 0.6 x total corpus length, 2.7 × length of ductus bursae.

It is to be noted that we have seen in the CUIC a large collection of specimens of *H. aquilonalis* sp. n. males and females from New York State nearly all whitish in both sexes (Figs 11–12), but still easily recognized by their size, exactly as for other specimens more alike our northern population; male brownish specimens are also present in the New York State population. One of these New York specimens was dissected and the genitalia has proven without doubt its identity, especially since a BOLD analysis has been rejected due to the age of these specimens.

Distribution. *Herpetogramma aquilonalis* sp. n. is transcontinental in Canada, from Newfoundland, Nova Scotia, New Brunswick, Québec (nearly extending to Labrador, as specimens have been caught in the Groulx Mountain Range near the Labrador border [coll. DH]), also present on the North shore of the St. Lawrence river up to Moisie River [coll. DH] and also in the Gaspé Peninsula [Bonaventure along Bonaventure River] [coll. LH] and Maria [coll. AC]; Magdalen Islands [Havre-aux-Maisons] [coll. LH]); the French Territory of the Islands of Saint-Pierre-et-Miquelon (Daniel Abraham and Nathalie Michel [DANM]); Newfoundland (BOLD); New Brunswick (BOLD, CNC); Nova Scotia (BOLD, CNC); Ontario (BOLD, CNC); scattered localities westward to Alberta (SEM [Danny Shpeley in litt. & phot.] and in southern British Columbia (BOLD, CNC). Specimens from Saskatchewan (BOLD) and Manitoba (BOLD, CNC) were all previously and wrongly identified as *H. pertextalis* or *H. abdominalis*. The species is also known from boreal habitats in the United States, from New York (Adirondacks) to Georgia, mainly in the Appalachian Mountains (BOLD). In the West it occurs in montane areas from Washington to California [specimens in USNM; J. D. Lafontaine pers. comm.]. There are even some specimens from British Columbia [Port Alberni] called "*thestealis*" that have been submitted to BOLD; they group with *H. aquilonalis* sp. n., not *H. thestealis*; these specimens are of a peculiar form of *H. aquilonalis* sp. n.

Biology. Powell & Opler (2009: 180), under the name *H. pertextalis*, list the larvae as leaf rollers on *Asarum* (Aristolochiaceae), *Urtica* (Urticaceae), *Rubus* (Rosaceae) and *Viola* (Violaceae) in the Western United States; the larva makes a shelter by folding, rolling and tying one or several leaves of its host plant. It is certainly the same pattern in Canada and the Eastern United States. In Eastern United States *Matteucia struthiopteris* (Onocleaceae), *Plantago lanceolata* (Plantaginaceae), and *Ribes* (Grossulariaceae) are host plants (David L. Wagner, pers. comm.); reared records in the USNM are from *Euonymus* sp. (Celastraceae) and *Lonicera* sp. (honeysuckle) (Caprifoliaceae) (J. D. Lafontaine, pers. comm.); also on *Solidago flexicaulis* and *Solidago bicolor* (Asteraceae) (Tomkins Co., New York [CUIC]). Allyson (1984) reports records from Ottawa, Ontario (as *H. pertextalis*): 10 specimens on Aster *macrophyllus* (Asteraceae) (17. vii.1952), 10 specimens on *Rubus* sp. (Rosaceae) (21. vii.1953), and 10 specimens on *Urtica* sp. (Urticaceae) (30.vii.1955) (only as larvae having not been reared to adults). Specimens in the CNC reared by Dr Bernard Landry on *Pedicularis canadensis* (Scrophulariaceae) (Landry 1993) are *H. aquilonalis* sp. n. and *H. nymphalis* sp. n. (described below). In the CNC, there are many specimens reared on Manitoba maple (*Acer negundo* [Sapindaceae]) (Ottawa, Ont.), basswood (*Tilia americana* [Tiliaceae]) (no locality), *Salix* sp. (Salicaceae) (Forest Insect Survey, British Columbia), violet (*Viola* sp. [Violaceae]) (prob. Ottawa, Ont.), *Lonicera villosa* (Caprifoliaceae) (Almonte, Ontario), basswood (*Tilia* sp. [Tiliaceae]) (Almonte, Ont.), false nettle (*Boehmeria cylindrica* [Urticaceae]) (Almonte, Ont.), *Helianthu*s sp. (Asteraceae) (Annapolis, Nova Scotia), *Agastache foeniculum* (Lamiaceae) (Aweme, Manitoba), *Steironema ciliatum* (Primulaceae) (Aweme, Manitoba) and Broadleaf maple (*Acer macrophyllum* [Sapindaceae (Mission City, British Columbia). Two specimens (as *abdominalis* ♀) reared on *Hamamelis* sp. (Hamamelidaceae) in the Potomac State Forest, in Maryland (see Larry Line, Maryland Moths, visited 20.ix.2020); *Hamamelis virginiana* is the only *Hamamelis* present in Eastern Canada and eastern United-States (Lady Bird Johnson Wildflower Center, Texas, visited 20.ix.2020; Marie-Victorin 1995). It is not surprising that such a widespread species of Herpetogramma would have a range of larval host plants over their geographic range, as found in many examples in the host plant list for species of Lepidoptera in Tietz 1972 (J. D. Lafontaine. pers. com, 20.iii.2021). The species is polyphagous on low plants and rarely found on woody plants. It prefers open habitats, and open forests, humid maple groves, even bogs and boggy habitats. *H. aquilonalis* sp. n. is abundant on the slopes of the mountain of Rougemont, Québec, in maple groves with red oak (*Quercus rubra*) growing on an intrusive igneous rock (essexite) (O'Neill 1914).

Flight period. In Québec, the moth is in flight from mid-June to mid-August (with scattered records into mid-September). The peak flight is from the middle of July to the beginning of August in most of Canada. It is the only *Herpetogramma* species in Canada to have a second generation in particularly long hot summers as was the case in 2019 in South-Eastern Québec, but we have not been able to collect enough specimens to ascertain if it was a full or only a partial second generation. It

is a nocturnal species, coming freely to light. According to Joachim Lafrance (personal notes taken from 1965 to 1969 in Ste-Clotilde, Québec) (under the name *H. pertextalis*), the moth flies until up to three o'clock in the morning.

Herpetogramma fraxinalis sp. n.

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Pl. 2, Figs 13–16 (adults); Pl. 5, Figs 43–44 (♂ gen.); Pl. 7, Fig. 58 (♀ gen.).

Type material. Holotype ♂. Canada: Québec: Rougemont, montagne [mountain] [45°28'026" N, 73°04'029" W.], 27.vii.2008, Daniel and Louis Handfield. CNC.

Paratypes (16 ♂♂, 9 ♀♀). Canada: Ontario: Lake Erie, Wallacetown, reared on *Fraxinus americana*, Forest Insect Survey, 17.vii.1958 1 ♂ (CNC), 15.vii.1958, 3 ♂♂ (CNC), reared on *Tilia* sp., Forest Insect Survey, 15.vii.1958, 1 ♂ (CNC); Manitoulin Island, Mud Creek, Lake Kagawong, 13.vii.1996, John K. Morton, 1 ♂ (CNC) ; Canada: Québec: Milton East [= Sainte-Cécile-de-Milton], reared on *Tilia glabra* [= *Tilia americana*], Forest Insect Survey, 25.vi.1970, 1 ♂ (CNC); S[ain]te-Foy, reared on *Fraxinus americana*, Forest Insect Survey, 6.vii.1961, 1 ♂ (CNC); 10.vii.1961, 1 ♂ (CNC); Rougemont, montagne, Daniel and Louis Handfield, 25.vii.2008, 1 ♀ (CNC), 29.vii.2008, 1 ♂ (LH), 28.vii.2009, 1 ♂ (LH) ; 8.vii.2010, 2 ♂♂ (LH); 12.vii.2010, 1 ♂ (LH); 16.vii.2010, 1 ♂ (LH); 12.vii.2008, 1 ♀ (LH); 24.vii.2008, 1 ♀ (LH); 29.vii.2008, 1 ♀ (LH); 10.vii.2009, 1 ♀ (LH); 5.vii.2010, 1 ♀ (LH); 15.vii.2010, 1 ♀ (LH); 19.vii.2010, 1 ♀ (LH); Rougemont, montagne, 26.vii.2010, Daniel and Louis Handfield, 1 ♀ (LH); Mont-Saint-Hilaire, 845 de Fontainebleau, 5.viii.2017, Louis Handfield, 1 ♂ (LH).

Etymology. The species name is derived from one of the hostplants of the species, *Fraxinus americana* L. (Oleaceae).

Diagnosis. *Herpetogramma fraxinalis* sp. n. has been in the past confused with *H. abdominalis* because of its mainly white wing colour. There is little significant dimorphism in this species, males and females being nearly alike, except that the forewings of males are slightly longer and apically more pointed than those of females and the latter's wings have less dark shading than males. It is a large species (wingspan: 29–32 mm, average 30 mm). It is easily distinguished from *H. aquilonalis* sp. n. females by its wingspan (30 mm for *H. fraxinalis* sp. n. and 24–26 mm for *H. aquilonalis* sp. n. females [rarely up to 28 mm]), by its large, yellow reniform spot, rarely yellow/brownish, and by its yellowish-gray lines on the forewings more visible in fresh specimens. Finally, a larger moth than *H. aquilonalis* sp. n., and easily recognized by its larger size.

Description. **Adult**. **Male**. Figs 13, 15. Head and palpi white; collar light yellow; tegulae light yellow; thorax white; abdomen pale yellow, each segment marked by a white band; forewing upperside mostly pale yellowish white with darker markings faint in most specimens; apex not sharply pointed; costa with a yellow band along from wing base to postmedial line; a thin yellow line from base of wing extending along medial vein almost to postmedial line and lower part of reniform spot; basal area yellow from base to basal line; basal dash absent; antemedial and medial lines pale gray, barely evident in most specimens; postmedial line pale gray, scalloped between veins, when these are more evident, pale grey, starting at $^{3}/_{5}$ of dorsum, curved outwards between CuA1 and CuA2, costal ⅔ scalloped, meeting costa at $^{4}/_{5}$; subterminal line barely evident as faint shade in some specimens; inner part of costa marked by yellow area, especially where the postmedial line and antemedial lines touch costa; reniform spot large, rectangular, with basal and distal edges grey, orbicular spot yellow rounded, gray, centre yellow; hindwing similar to forewing, all lines dentate, thin and gray, discal spot rectangular, gray, with yellow center; ground colour pale yellow except yellow band along antemedial and postmedial lines. Underside of wings typically nearly entirely white, except costal border which shows a thin light-brown or yellow line, especially in males; sometimes reniform and orbicular spots and postmedial line on forewing, and discal spot on hindwing, show through to upper side as very light marks; fringes white, sometimes with a pale brown line on veins. **Female**. Figs 14, 16. Like male except forewings slightly more squared at apex and mainly white with maculation barely evident or absent.

Male genitalia. Figs 43–44. Valves and genital capsule as described for genus. Vesica extending posteriorly from phallus and about length of phallus; vesica with anvil-shaped subbasal diverticulum on left projecting anteriorly and posteriorly, single dorsal subbasal diverticulum; spined diverticulum ¾ toward apex of vesica. **Female genitalia**. Fig. 58. Anterior part of corpus bursae with length 2.5 × width, 2 × length of narrower posterior part, and 2.5 × length of ductus bursae.

Distribution. *Herpetogramma fraxinalis* sp. n. is only known from a small northern area, corresponding exactly to the northern distribution of *Fraxinus americana* and *Tilia americana* in eastern Canada, the two known hostplants of the larvae. It is known from eastern Ontario, southern Québec up to Québec City and the southern part of the Parc Les Grands Jardins (Carle Bélanger, pers. comm.), and New Brunswick. It presumably occurs in northeastern United States.

Biology. Specimens (in CNC) were reared by the Forest Insect Survey on *Fraxinus americana* (Oleaceae) (Wallacetown, Ont. and Ste-Foy, Québec) and *Tilia americana* (Tiliaceae) (Wallacetown, Ontario, and Milton East, Québec). The species could be in a dangerous

decline due to the situation of *Fraxinus* being killed by the Emerald Ash Borer (*Agrilus platipennis* Fairmaire, 1888; Coleoptera, Buprestidae), imported accidentally from Asia through the United States. It is a forest-dwelling moth, where its hostplants are growing in abundance.

Flight period. The moth is in flight from early July to early August, with a peak from mid to late July. It is nocturnal and comes to light.

Note: The yellow on the wings tends to fade or even disappear in older specimens and on those that have flown a lot, as evident from their thinner fringes. Some old specimens are nearly pure white. The best way to accurately identify this species is by genitalia dissection or DNA analysis, or by its large wingspan.

Herpetogramma thestealis (Walker, 1859) (801199, MONA 5277)
Pl. 2, Figs 17–20 (adults); Pl. 5, Figs 45–46 (♂ gen.); Pl. 8, Fig. 59 (♀ gen.).

Synonyms: *abdominali*s (Zeller, 1872) (*Botis*) (syn. n.), *magistralis* (Grote 1873) (*Botis*), *fissalis* (Grote, 1881) (*Botis*) (syn. n.), *gulosalis* (Hulst, 1886) (*Botis*). Alma Solis (2010), Scholtens & Solis (2015). Misspelled as *thestialis* in Forbes (1923) and in Covell (1984).

Type material. One ♂ in BMNH, locality given as "?" [not known] (Solis, 2010).

Diagnosis. *Herpetogramma thestealis* has been confused in collections under the name *abdominalis* due mostly to the misidentification of the type specimen of *Botis abdominalis* Zeller and that of its synonym *Botis fissalis* Grote, as well as its occurrence in two forms: a dark form found in mesic areas such as bogs and marshes, and a paler form found in drier, more xeric areas, a situation also found in *Spilosoma dubia* Walker, 1855 (Noctuoidea, Erebidae) (see Handfield 2011: pl. 27) for example. There is a slight dimorphism in *H. thestealis*, males and females being nearly alike, except for forewing shape and colour of wing, females being paler than males; *H. thestealis* is a relatively large species (wingspan 30–35 mm for males; 29–31 mm for females). This variation has been confirmed by DNA analysis of specimens submitted to BOLD and by genitalia dissections. Solis (2010, fig. 15) illustrated a male of *H. thestealis*, as representing the typical form of the species. The large, round, dark to very dark, subterminal area, wider at the costa, and pointed on the veins (in the fringe), is typical of *H. thestealis* on the forewings as is all the darker features on the forewings of the moth. These are the best distinguishing characters for the species.

Redescription. **Adult**. **Male**. Typical (**dark form**) (Figs 17, 19): Head, palpi, and thorax brown, the same brown as on wings; abdomen same brown colour with white line marking each segment. Forewing: medial line absent, or represented by a few dark spots between postmedial and antemedial lines; antemedial line extending as a slightly sinuate line from costal basal $^1/_5$ to orbicular spot obliquely outward to posterior margin of wing below position of orbicular spot; basal line usually evident only as a dusting of dark scale; reniform spot dark, rectangular in shape, usually dark brown, but sometimes with a light center; orbicular spot V-shaped or rounded, rarely with a light center; area between reniform and orbicular spots cream, as for ground colour of wing; fringe cream, marked by brown on each vein, tornus white, not forming a larger white patch as in other species of *Herpetogramma*; terminal line dark brown; terminal area dark gray brown, with deeply scalloped subterminal line on inner margin; postmedial line curving slightly inward distal to reniform spot, then curving outward at opposite lower margin of reniform spot, then turning abruptly inward to a position below reniform spot, and then downward below reniform spot to hind margin of wing. Hindwing: fringe white, marked with brown at veins; terminal area pale yellowish brown bordered inwardly by dark grayish brown subterminal line scalloped between veins; postmedial line irregular, bending outward around position of dark gray to black discal spot. **Light form** (Figs 18, 20). As for dark form, except lines, markings, and wings paler especially in subterminal area, which is yellow brown and contrasts with dark gray-brown terminal line and deeply-scallopped subterminal line. Maculation as in dark specimens, but lighter brown, often with a reddish iridescence on brown markings. **Underside**. White, all lines, and orbicular, reniform, and discal spots brown; dark terminal area well marked and dark, but lines not as well marked on hindwings. **Female**. As for male, also presenting two forms, but never as dark as for male; forewings not apex less acute, more squared; usually smaller than male. Concolourous with male, but not as dark. Light form more yellow than brown. **Male genitalia**. Figs 45–46. Valves and genital capsule as described for genus. Vesica extending posteriorly from phallus and about 1.4 × length of phallus; vesica with elongated curved diverticulum on left projecting posteriorly, dorsal subbasal diverticulum two lobed; spined diverticulum ¾ toward apex of vesica. **Female genitalia**. Fig. 59. Ante-

Figs 43–48 (opposite page). 43. *Herpetogramma fraxinalis* sp. n. valves PYR 1301: Canada, ON, Wallacetown, Lake Erie, 15.vii.1958, F.I.S. **44**. *Herpetogramma fraxinalis* sp. n. phallus PYR 1301: Canada, ON, Wallacetown, Lake Erie, 15.vii.1958, F.I.S. **45**. *Herpetogramma thestealis* valves PYR 556: Canada, QC, Mont Rougemont, Rougemont, 45°28.026' N, 73°4.029' W, 25.vii.2008, Louis Handfield and Daniel Handfield. **46**. *Herpetogramma thestealis* phallus PYR 556: Canada, QC, Mont Rougemont, Rougemont, 45°28.026' N, 73°4.029' W, 25.vii.2008, Louis Handfield and Daniel Handfield. **47**. *Herpetogramma pertextalis* valves PYR 1315, United States, NY, Monroe Co., 7.viii.1949, C.P. Kimball. **48**. *Herpetogramma pertextalis* phallus PYR 1315, United States, NY, Monroe Co., 7.viii.1949, C.P. Kimball.

rior part of corpus bursae with length 2.5 × width, 1.5 × length of narrower posterior part, and 3 × length of ductus bursae.

Note: We have submitted many specimens of both the dark typical form and the light form to BOLD, males and females, using a very dark male (see Fig. 17) to represent a "typical" *H. thestealis*. All sequences were found to represent a single species, *H. thestealis*. We have also compared males and females of the light form in BOLD and with the images of the type specimens of *abdominalis* and *fissalis*, considering also that the type specimens are old and faded. The forewings of the two types have the same large, dark subterminal area; the dark subterminal area is rounded toward the costa and pointed on the veins, so the area near the postmedial and subterminal lines is much narrower near the wing apex, leaving a small pale cell between the two lines. This is typical of *H. thestealis*, whereas in *H. aquilonalis* sp. n., the other species that has light forms, this area is pale yellowish brown and not as large, nor as rounded, as in *H. thestealis*, and the subterminal line in *H. aquilonalis* sp. n. is usually straight near the apex, leaving a larger and longer pale cell between the two lines. In BOLD, samples of the light and dark forms cluster together leaving no doubt that the forms represent a single species. The large, round, dark to very dark, subterminal area, wider at the costa, and pointed on the veins typical of *H. thestealis* are faded on the types of *abdominalis* and f*issalis* but these distinguishing characters, even though faded, are present so we conclude that these two names represent synonyms of *H. thestealis*.

This is the only Canadian species of *Herpetogramma* to have a white leucistic form, mostly in females, rarely in males. BOLD data confirms that these leucistic specimens are *H. thestealis*. These specimens have a large round, black reniform spot on the forewing and on the hindwing; this is the easiest way to identify them. We have only seen one semi-melanic specimen.

Distribution. *Herpetogramma thestealis* occurs from Eastern Canada (Nova Scotia westward through southern Québec (as far north as Québec City [CNC]), and southern Ontario to southern Manitoba. It occurs in eastern and central United States as far south as Florida. American records in BOLD are from North Carolina and Tennessee. The species is listed from as far west as British Columbia (Pohl et al. 2015), and shown on Moths Photographers Group website (https://mothphotographersgroup.msstate.edu; accessed 20.ix.2020) by dots and photographs from British Columbia and as far south as California; however, these specimens are referrable to *H. aquilonalis* sp. n.; the same is true for a specimen from Port Alberni, British Columbia, shown in Bug Guide (accessed 20.ix.2020) (https://bugguide.net/) that is also a worn *H. aquilonalis* sp. n.. Some specimens from British Columbia [Port Alberni] of "*thestealis*" have been submitted to BOLD and they sort out with *H. aquilonalis* sp. n., not *H. thestealis*; these specimens are of a peculiar form of *H. aquilonalis* sp. n.. In BOLD, there are more than 90 specimens analysed from British Columbia and more than ten from Washington State; none is *H. thestealis*, all being *H. aquilonalis* sp. n.. Also, specimens from Alberta in the E. H. Strickland Entomological Museum at the University of Alberta, Edmonton, which were identified as *H. abdominalis* are referred to *H. aquilonalis* sp. n. and not to *H. thestealis* (SEM [Danny Shpeley in litt. & photo.]) and those from Saskatchewan under *H. thestealis* are referred to *H. aquilonalis* sp. n. (BOLD), so no *H. aquilonalis* sp. n. in Alberta and Saskatchewan. We conclude that *H. thestealis* should be removed from lists of species from areas west of Manitoba.

Biology. *Herpetogramma thestealis* appears to be associated with woody plants such as *Tilia* [Tiliaceae] and *Corylus* [Betulaceae] (Forbes 1923), *Halesia carolina* [Styraceae] and *Aralia racemosa* [Araliaceae] (D. Wagner, pers. comm. 2011) (see Handfield & Handfield 2011); in the USNM, only *Celastrus scandens* [Celastraceae] is reported as a hostplant for *H. thestealis*. Other hostplants listed by Solis (2010), needs verification. The moth seems to prefer wet habitats, like bogs and wet forests, being scarce in less mesic habitats.

Flight period. In eastern Canada, the moth is in flight from early June to late August, with a peak from mid-July to early August. It is nocturnal and comes to light.

Herpetogramma pertextalis (Lederer, 1863) (801187, MONA 5275)
Pl. 2, Figs 21–24 (adults); Pl. 5, Figs 47–48 (♂ gen.).

Synonyms: *thesealis* Zell., 1872 (*Botis*), *gentilis* Grote, 1883 (*Botis*) (Solis 2010) (Scholtens & Solis 2015).

Type material. One male lectotype designated by Solis (2010) from "Nordamerica" in the NHM, in Vienna, Austria; it has a wingspan of 21.5 mm.

Remarks. This is the "true" *pertextalis*, which is smaller and differently marked than its northern counterpart (*H. aquilonalis* sp. n.). All pyraloid species named by Lederer are from the southern United States (Texas and Florida). Some of his southern species occur in the North, but Lederer's species that occur in the North, also occur in the South. This suggests that the type locality is somewhere in the southern United States, and more particularly in Texas or northern Florida, and not from northern United States or Canada. During the years 1850 −1900, the city of Jacksonville was the commercial center of Florida, and an important city for business with Europe (Gannon 2013). It is probable that Lederer received his specimens from Texas, Florida, or elsewhere in southern United States via Jacksonville. Consequently, the name *pertextalis* would not apply to its northern counterpart. Solis (2010) mentions having seen specimens of *pertextalis* in the USNM from Texas and Illinois, under the

name *thesealis* Zell., 1872, a synonym, with specimens from Texas and Massachusetts (2 ♂♂ and 1 ♀) (Solis 2010). We also have documented it in northern Florida (Appalachicola National Forest, Liberty Co., Florida, 29.v.1993, Florida State Collection of Arthropods, Florida Museum of Natural History / McGuire Center, James Hayden, pers. comm.). So, we believe that the type locality of *pertextalis* Led. is Texas or Florida. As most of the specimens of Lederer were from Texas, the type locality is most probably Texas, the specimens being sent to Germany through the port of Jacksonville, Florida.

Diagnosis. *Herpetogramma pertextalis* has been long confused with the species we describe above as *H. aquilonalis* sp. n.. It is a well-marked species, smaller than *H. aquilonalis* sp. n., with a wingspan of 21.5–23.0 mm (males) and 23–24 mm (females) compared to 25–27 mm (males) and 23–26 mm (females) for *H. aquilonalis* sp. n.. Solis (2010: fig. 13) illustrated a female of *H. pertextalis*.

Redescription. **Adults**. There is a dimorphism in the species, but not as pronounced as in *H. aquilonalis* sp. n., the female being larger and more boldly marked than the male. The wingspan of the male is 21.5–23.0 mm, of the female 23–24 mm. **Male** (Figs 21–22): head, palpi, thorax, and abdomen concolourous with the wings. Abdomen with each segment marked by a small white line (yellowish in dark specimens). Forewings cream with gray band on costa from wing base to postmedial line, apex acute, not pointed; fringes white, terminal line dark brown, at base of pale-brown fringe; subterminal area, between dentate subterminal line and sinuate postmedial line cream coloured. Postmedial line dark gray, sharply defined, incurved from costa to M2 vein, then bent outwardly to form three points on veins, then turning inwardly up a position below the reniform spot, then extending straight to posterior margin of wing. Antemedial line dark gray, slightly sinuate, extending from forewing costa proximal to orbicular spot, projecting downward and outward to a position on hind margin of wing below position of orbicular spot. No basal dash but with an oblique gray basal line near base. Orbicular spot a grayish dot; reniform spot a rectangular patch, gray with innerside pale. Area between orbicular and reniform spots cream coloured. Veins lightly marked by gray streaks. Hindwing concolourous with forewing; postmedial line wavy with an outward bend at middle of wing, pointed on veins, as on forewing. Discal spot a gray bar on creamy-white background. Underside pale gray, all lines visible, orbicular and reniform spots pale, but visible, and pale creamy-white area between them. **Female** (Figs 23–24). More boldly marked than male; ground colour typically more yellowish white than creamy white, lines more crisply marked (including costa); postmedial and antemedial lines converge at hind margin of wing to form a V or U in many specimens; orbicular spot a round circle with gray margins and yellow center; reniform spot rectangular, with gray margins and yellow center. Discal spot of hindwing more boldly marked than in male. Ground colour of both wings creamy white except for area between wing margin and submarginal line, which is pale yellow. Underside as in male but more bodly marked. **Male genitalia**. Figs 47–48. Valves and genital capsule as described for genus. Vesica short, extending posteriorly from phallus and about 0.66 × length of phallus; vesica with smaller rounded diverticulum on left, as well as an elongated, curved, multilobed diverticulum projecting posteriorly; dorsal diverticulum ¼ from base and dorsolateral; spined diverticulum ¾ toward apex of vesica. **Female genitalia**. No illustration available.

Distribution. *Herpetogramma pertextalis* is only known from extreme Southern Québec (1 ♂ from Philipsburg, 16.vii.1974 [CNC], 1 ♂ from Trousers Lake, 1.viii.2011 [DH]), 1 ♂ from Franklin [Réserve écologique du Pin-Rigide], 8.x.2017 [DH]), and from southern Ontario (2 ♂ and 1 ♀ from Port Franks, Lambton Co., 18.ix.2014 (♂), 4.ix.2015 (♂), 1.ix.2016 (♀), K. H. Stead [CNC], Simcoe, 22.vii.1939, one ♂ [CNC], Thousand Islands National Park [shoreline transitional area, marsh], 4.ix.2014 (BOLD), Wellington Co., Puslinch Township, concession 11 / Hume road, 7.x.2005, Paul D. N. Hebert (BOLD), Windsor, Ojibway Prairie Provincial Park, 3.ix.2014 (BOLD), and then from New York and Massachusetts to northern Florida along the Atlantic Coast, including rivers and lake shores in southeastern United States and westward to Illinois, Oklahoma, and Texas (Solis 2010). With more than 90 specimens analysed in BOLD, the presence of *H. pertextalis* in British Columbia (Pohl et al. 2015) is clearly an error and the specimens are *H. aquilonalis* sp. n. *Herpetogramma pertextalis* is a specialist of mesic habitats especially along the Atlantic coast; it is absent from the Appalachian Mountain range. In Ontario, it is likely found in Carolinian forests, but it is not known if the specimens from Ontario were residents or migrants. Powell et al. (2009) list *H. pertextalis* as being present in western North America, but these specimens are more likely referable to *H. aquilonalis*. sp. n.

Biology. In Maryland, Larry Line (see Maryland Moths, visited 20.ix.2020) reared a dozen larvae of *Herpetogramma pertextalis* found at the beginning of June "tying conspicuous tubular shelters on terminal shoots of *Clethra alnifolia* L. (Clethraceae) in the Patuxent Wildlife Research Center and in the Millington WMA [Wildlife Management Area]." *Clethra alnifolia* is found along the Atlantic Coastal Plain from Nova Scotia and Maine southward to northern Florida, and westward along the Gulf Coast to Louisiana, but does not occur in the Appalachian Mountains. It is very sporadic in occurrence to the west of the Appalachians (northern New York, western Pennsylvania, Tennessee, etc.). This also represents the range of *H. pertextalis* with western records from Kentucky, Illinois and Oklahoma. The moth has other hostplants and it could use *Clethra acuminata* (Clethraceae) as this plant is found in mountainous ar-

eas of Tennessee (incl. Sevier, where the moth has been found [Mitchell & Hespenheide 1967]), Kentucky, and West Virginia. Larvae have been found or reared on other plants like *Rubus* sp. (Rosaceae) (in West Virginia), and *Plantago lanceolata* (Plantaginaceae) (in Connecticut) (David L. Wagner, pers. comm.). One specimen in the Murtfeld collection in the CUIC has been reared on *Erigeron canadensis* (Asteraceae) in New York in 1899, but this is a questionable old record. Other hostplants listed by Solis (2010: 460) based on specimens in the USNM are not included here because the material has not been positively identified. In Québec, the known specimens have been caught on lake shorelines (Trousers lake and Philipsburg) and a humid habitat (Franklin, Réserve écologique du Pin-Rigide); these specimens are in good condition, but not freshly emerged, and are singletons, so they could have flown from *Clethr*a populations in nearby New York State (Essex Co., Warren Co. along Lake Champlain [New York Flora Atlas, visited 20.ix.2020]) (http://newyork.plantatlas.usf.edu/) as they do not seem to represent a resident population. Concerning the specimens from Port Franks, Lambton Co., Ontario, the male has not been freshly collected, only the female is in good condition; the dates are late in the season and are from the Lake Huron shoreline (near Pinery Provincial Park). The specimen from Simcoe, Ontario, is in good condition. The Ontario specimens likely represent strays, considering that the host plant (*Clethra* sp.) is not present in Canada. It seems to be a moth of shorelines (rivers, lakes, etc.) and especially along the Atlantic Coastal Plain in eastern United States.

Flight period. In Canada, the moth has been found from the 16th of July to 8th of October. It is probably a wandering species, at least in its northern distribution (Ontario and Québec), as there are only a few scattered records. The moth is nocturnal and comes to light.

Note. The specimens identified as *H. pertextalis* by Landry (1993) are in fact *H. nymphalis* sp. n. and *H. aquilonalis* sp. n.

Herpetogramma nymphalis sp. n.

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Pl. 3, Figs 25–28 (adults); Pl. 6, Figs 49–50 (♂ gen.); Pl. 8, Fig. 60 (♀ gen.).

Type material. Holotype ♂. Canada: Québec: Gatineau Park, King Mountain [45°29’33” N, 75°52’42” W.], 14.vi.1989 (emerging date, reared on *Pedicularis canadensis*), Bernard Landry. CNC. Bold CNC-LEP00089832.

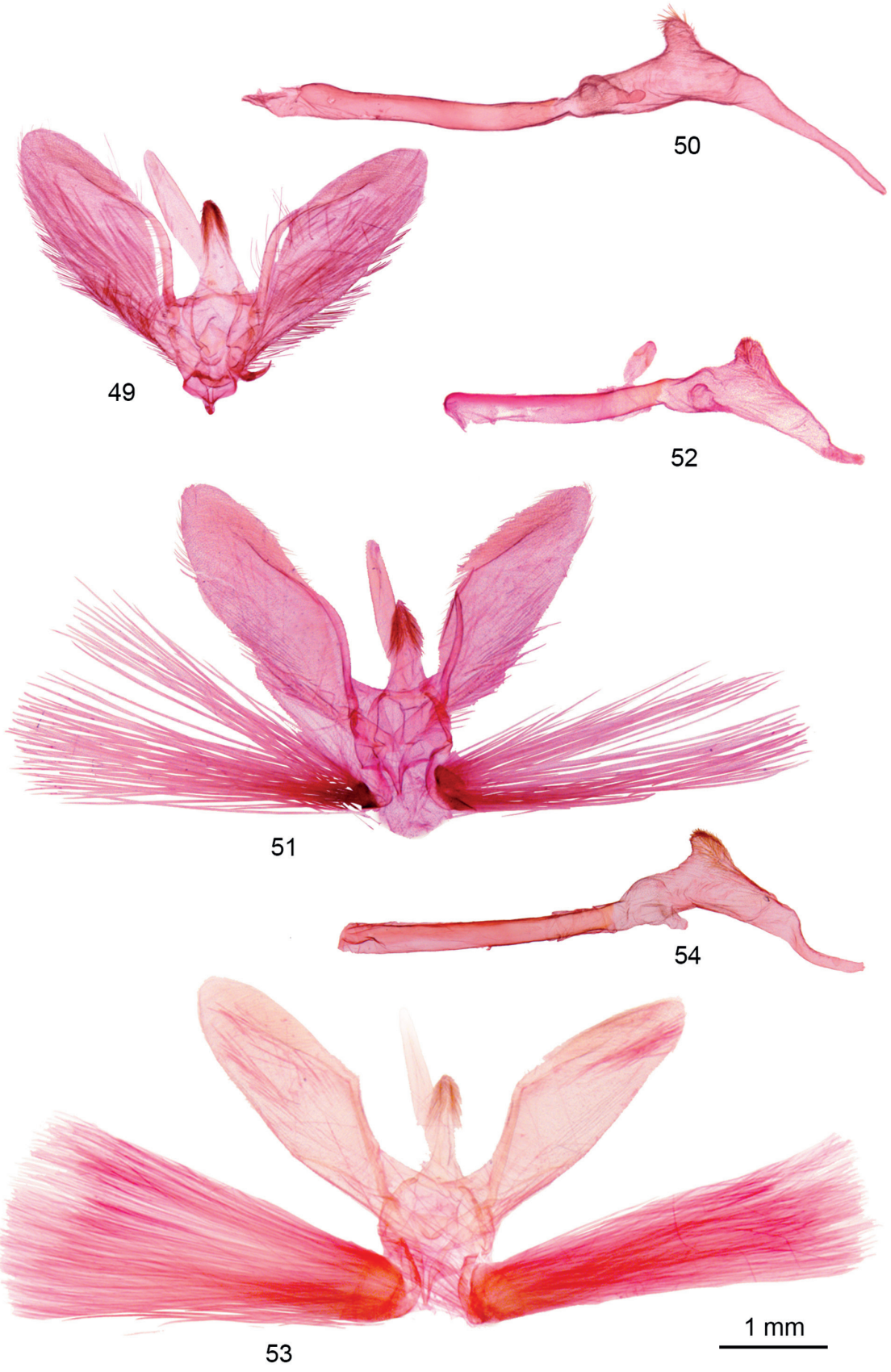
Paratypes. Canada: Québec: Gatineau Park, King Mountain, reared on *Pedicularis canadensis*), Bernard Landry, 16.vii.1989 [emerging date], 1 ♀ (CNC), 19.vi.1989 [emerging date], 1 ♂ (CNC); Canada: Manitoba: Manitoba Tall Grass Prairie Reserve, Nature Conservancy block W[est] of Gardenton, 19.vii.2016, Jean-François Landry and Vazrick Nazari, 3 ♂♂ (CNC).

Etymology. The species name is Latin derived from the word *Nympha* (plural *Nymphae*), the small deities of forests, mountains and rivers, in reference to the little luminous Nymphs haunting the oak and juniper woods at night on the top of King mountain, in Gatineau Park, Québec, according to an old legend to that effect (Laurent Le Sage, pers. comm.).

Diagnosis. *Herpetogramma nymphalis* sp. n. was confused in collections under the name *H. thestealis* due to its similarity with that species, even if it is much smaller (wingspan: 26 mm for *H. nymphalis* sp. n. and more than 30 mm [very rarely 29 mm for females] for *H. thestealis*). It looks like a small orange-brown *H. thestealis*.

Description. **Adult**. Head, palpi, thorax, tegulae, and abdomen concolourous with rusty-brown ground colour of forewing. Each segment of abdomen marked by a thin white line. Wingspan 26 mm. Forewing: apex acute, not round. Fringe: wide, pale brown, marked with darker brown on veins. Terminal line dark brown. Subterminal area between terminal and submarginal lines wide, rusty brown; subterminal line pointed on veins, deeply dentate, wide at anal angle, then a little narrower through middle, then wide toward top of wing, leaving a small whitish cell between it and postmedial line; small cell also typical of *H. thestealis*; area between three outward pointed cells of the postmedial and subterminal lines narrow. Postmedial line a dark brown line from costa to M2 vein, then bent outwardly toward subterminal line, nearly touching it, pointed (dentate) on three cells, then bent inwardly to position below reniform spot, then turning downward to posterior margin of wing. Antemedial line also a dark brown line, sinuous, extending from costa to posterior margin of forewing, but well separated from postmedial line. Reniform spot rectangular, dark brown or represented by two parallel dark lines, with light brown inside, orbicular spot dark, rounded. Area between orbicular and reniform spots creamy white, distinct. Area between

Figs 49–54 (opposite page). 49. *Herpetogramma nymphalis* sp. n. valves PYR 1308: Canada, MB, Manitoba Tall Grass Prairie Preserve Nature Conservancy Block, 294 m, 19.vii.2007, J.F. Landry and V. Nazari. **50**. *Herpetogramma nymphalis* sp. n. phallus PYR 1308: Canada, MB, Manitoba Tall Grass Prairie Preserve Nature Conservancy Block, 294 m, 19.vii.2007, J.F. Landry and V. Nazari. **51**. *Herpetogramma aeglealis* valves PYR 555: Canada, QC, Mont Rougemont, Rougemont, 45°28.026’N, 73°4.029’W, 25.vii.2008, Louis and Daniel Handfield. **52**. *Herpetogramma aeglealis* phallus PYR 555: Canada, QC, Mont Rougemont, Rougemont, 45°28.026’ N, 73°4.029’ W, 25.vii.2008, Louis and Daniel Handfield. **53**. *Herpetogramma sphingealis* valves PYR 551: Canada, QC, Mont Rougemont, Rougemont, 45°28.026’N, 73°4.029’W, 25.vii.2008, Louis and Daniel Handfield. **54**. *Herpetogramma sphingealis* phallus PYR 553: Canada, QC, Mont Rougemont, Rougemont, 45°28.026’ N, 73°4.029’ W, 25.vii.2008, Louis and Daniel Handfield.



subterminal and postmedial lines lightly coloured as is cell between reniform spot and postmedial line. Ground colour light rusty brown (dirty white with rusty brown scales in some specimens [Manitoba]). Costa dark from base of wing to postmedial line; in paler specimens, costal area pale between subterminal and postmedial lines, but still dark brown between postmedial line and wing base. Hindwing light, ground colour pale yellowish except for subterminal area that is dark, but not as dark as on forewing. Discal spot a dark bar. Postmedial line brown, sinuous as on forewing. Underside pale, but with all lines and spots visible including dark band between terminal and subterminal lines. Without sexual dimorphism.

Specimens that have flown a lot have the same lines, but the colours are less pronounced with the ground colour of the wings much paler; however, on the forewing costa, the width of the terminal area is wide, almost reaching the postmedial line, leaving the subterminal area very narrow on the costa. **Male genitalia**. Figs 49–50. Valves and genital capsule as described for genus. Vesica extending posteriorly from phallus and similar in length to phallus; distance between end of phallus and base of dorsal diverticulum 0.25–0.3× length of phallus; vesica with gourd-shaped diverticulum on right, apical narrow part curved posteriorly; spined diverticulum ½ way toward apex of vesica. **Female genitalia**. Fig. 60. Large anterior part of corpus bursae with length 2.8 × width, 2.8 × length of narrower posterior part, and 2.8 × length of ductus bursae.

Distribution. *Herpetogramma nymphalis* sp. n. is known from specimens from Québec (Gatineau Park [King mountain], and Montréal [on Mount Royal]), Ontario (Lambton Co., Port Franks) and Manitoba (Gardenton) (all in BOLD and CNC).

Biology. The specimens from Gatineau Park were reared on *Pedicularis canadensis* (Orobanchaceae), an unusual hostplants for *Herpetogramma* (see Landry 1993; identified as *H. pertextalis*); this hostplant has also been found in the area where the specimens were found in Manitoba (see Rousseau 1974 for Québec, and Scoggan 1957 for Manitoba). We also know that *Pedicularis canadensis* was present on Mount Royal in Montréal at least until 1987 (see Marineau, 2008: 112); it is also present on Saint-Hilaire mountain (see the web site "Végétaux vasculaires du mont Saint-Hilaire," visited 20.ix.2020: https://gault.mcgill.ca/workspace/uploads/fichiers/vascularplant.pdf) but so far the moth has not been found on Saint-Hilaire mountain or on Rougemont mountain. According to Rousseau (1974), *Pedicularis canadensis* is rare and localized in southern Québec and is mostly present in rocky and mountainous woodlands, including maple groves. Is *Pedicularis canadensis* the only hostplant of that species? Probably, but this remains unproven; more data are needed. It is a moth of xeric woods, especially in mountainous and rocky places in Québec.

Flight period. The moth should be searched for in July in suitable areas from New Brunswick (see Hinds 2000), southern Québec (see Rousseau, 1974), Ontario (see Ontario Wildflowers, site visited 20.ix.2020) and southeastern Manitoba (see Scoggan 1957), in the native range of *Pedicularis canadensis* in Canada. The scarcity of specimens prevents us from giving precise information about the habits of the moth, but it is probably nocturnal and comes to light like other *Herpetogramma*.

Note: All specimens reared by Dr Bernard Landry (Landry 1993) on *Pedicularis canadensis* are in the CNC, have been submitted to BOLD, reviewed and re-identified as being *H. nymphalis* sp. n. for the most part, with a few being *H. aquilonalis* sp. n. (see above, and Solis 2010 under *H. abdominalis*).

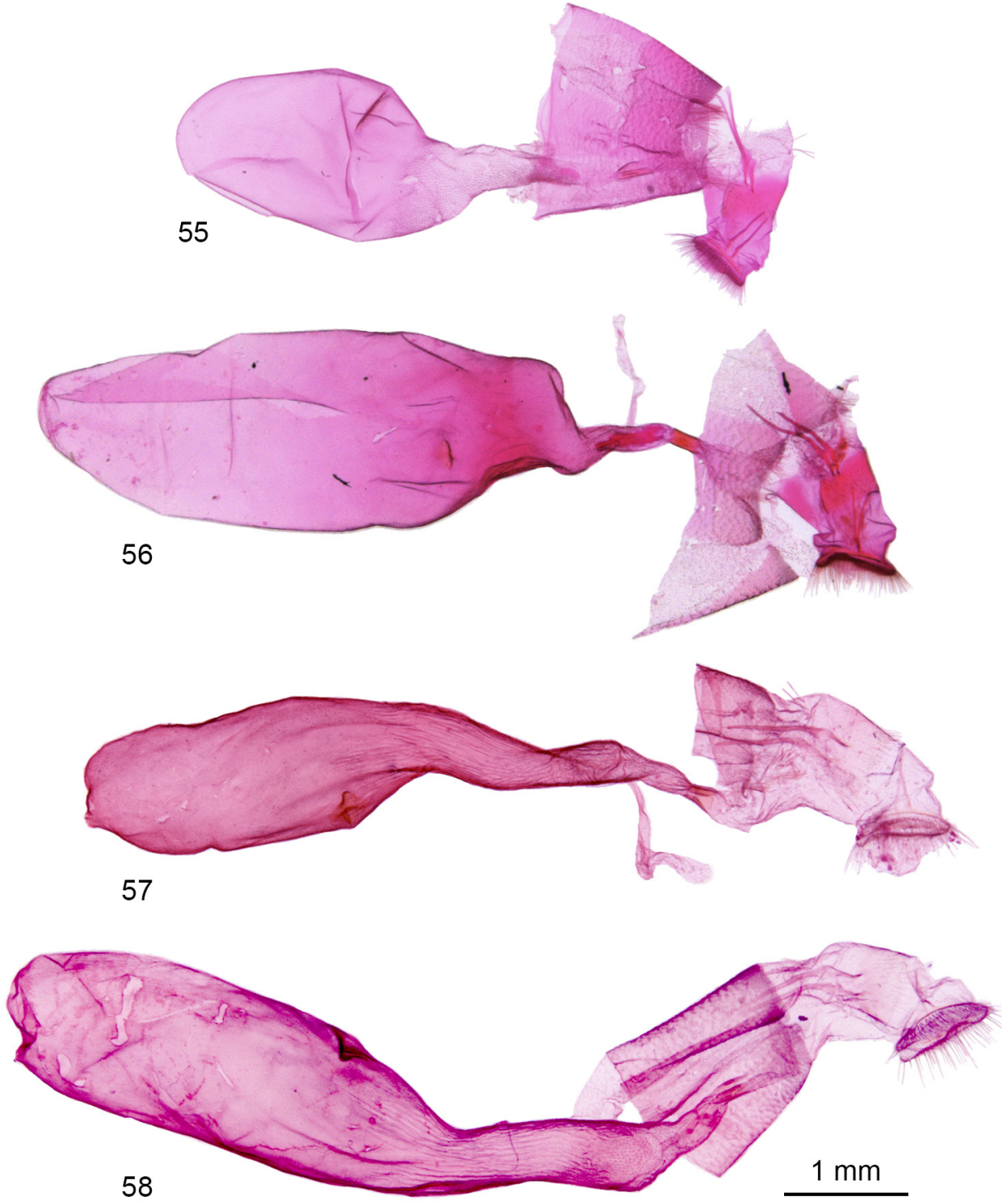
Herpetogramma aeglealis (Walker, 1859) (801191, MONA 5280)
Pl. 3, Figs 29–32 (adults); Pl. 6, Figs 51–52 (♂ gen.); Pl. 8, Fig. 61 (♀ gen.).

Synonym: *quinquelinealis* (Grt., 1875) (*Botis*) (see Solis 2010) (Scholtens & Solis 2015).

Type material. One ♂ from the "United States" in the BMNH (Solis 2010).

Diagnosis This is probably the best known of all Eastern North American *Herpetogramma*. It is common and easily identified even though it is a variable species with a typical form, which is pale gray with a yellowish hue on the forewing. Other forms have a light-gray forewing ground colour. There is also a dark form (more common in females, rare in males) that could be confused with *H. sphingealis*. Wingspan 29–33 mm (male), 27–31 mm (female), showing a sexual dimorphism, females having a more squared and shorter forewing than males, but with the same colouration and lines in both sexes. Solis (2010: figs 1, 3) illustrated a typical *H. aeglealis* (fig. 1) and a darker form (fig. 3).

Redescription. **Adult**. It has a wing pattern typical of *Herpetogramma*. Generally, head, palpi, thorax, and abdomen are concolourous with the wings. The forewing is elongate with a slightly acute apex in the male, but more squared in the female, therefore with a shorter wingspread; the forewing fringe is pale brown or checkered in the pale form, and dark gray brown in the dark form, except the lower part of the fringe is white in both forms (occasionally the white area is absent); the terminal line is dark gray brown, slightly darker to much darker than the fringe and subterminal area; the postmedial line extends obliquely from the costa to the second medial vein at the level of the lower edge of reniform spot where it curves in an outward arc, then curves in an inward arc to the lower edge of the wing; the reniform spot is a dark patch more or less rectangular, or curved and crescentic; the orbicular spot is dark and rounded or square, with a white area in the cell between the two spots; the ante-



Figs 55–58. 55. *Herpetogramma phaeopteralis* female PYR 1310: Bermuda, 8.xii.1951, W. and E. Mason. **56**. *Herpetogramma theseusalis* female PYR 1314: United States, FL, Stemper, no date, G. Krautwurm. **57**. *Herpetogramma aquilonalis* sp. n. female PYR 1294: Canada, CAN, QC, Mont Rougemont, Chemin vers la croix, Rougemont, 27.vii.2008, Louis Handfield. **58**. *Herpetogramma fraxinalis* sp. n. female PYR 1305: Canada, QC, Mont Rougemont, Chemin vers la croix, Rougemont, 27.vii.2008, Louis Handfield.

medial and postmedial lines are dark gray brown, contrasting in pale forms, less so in dark forms, frequently with some pale shading on one or both sides of the lower part of the line. There is no basal dash. The hindwing is usually paler than the forewing with the antemedial and postmedial lines dark gray brown, the discal spot is elongated, and the veins usually are dark and contrast with the paler ground colour; in some forms the subterminal area is contrastingly darker than the general ground colour; the terminal line is dark gray brown and contrasting. **Male genitalia**. Figs 51–52. Valves and genital capsule as described for genus. Phallus 8.0–8.8 mm long; vesica extending posteriorly from phallus and similar in length to phallus; vesica with gourd-shaped diverticulum on right smaller than that of *H. nymphalis* sp. n.; narrow apical part of diverticulum curved posteriorly; spined diverticulum ½ way toward apex of vesica. **Female genitalia**. Fig. 61. Anterior part of corpus bursae with length 2 × width, 3 × length of narrower posterior part, and 3 × length of ductus bursae.

Distribution. *Herpetogramma aeglealis* is known in Canada from New Brunswick westward through southern Québec to southern Ontario. In the United States, it occurs from Maine westward to Wisconsin and Illinois and southward to Florida and Texas.

Biology. *Herpetogramma aeglealis* is a leaf tyer making a shelter by folding and tying one or several leaves of its host plant and is probably a general feeder, but most records are from "ferns" [Polypodiales] (D. Wagner, pers. comm.), like *Woodwardia* [Polypodiaceae] (in Sweet Air, Baltimore Co., Maryland, Larry Line, pers. comm.), and *Osmunda claytoniana* [Osmundaceae] (in Maryland, see https://marylandbiodiversity.com/, visited 20.ix.2020). It has also been reared on a variety of herbaceous plants including *Asarum canadense* [Aristolochiaceae] (West Virginia, Bug Guide.net, visited 20.ix.2020), pokeweed [Phytolaccaceae] (Forbes 1923); specimens of *H. aeglealis* reared have been found in the USNM on *Solidago* sp. [Asteraceae] and one specimen reared on Mayapple (*Podophyllum peltatum*) [Berberidaceae] (W.W. Judd, London, Ontario, 24.VI.1953) (see Judd 1954). Also on *Solidago flexicaulis* and *S. bicolor* (Asteraceae) (Tomkins Co., New York [CUIC]). In southeastern Canada, where *H. aeglealis* is common, *Asarum canadense*, *Osmunda claytoniana*, and *Woodwardia virginica* usually are present. For Québec (see Rousseau 1972), *Asarum canadense* is most common of these three host plants, especially in maple groves (Rousseau, 1974). It is a moth of mesic woods, open boggy habitats, humid maple groves, and maple groves on mountain slopes.

Flight period. It is nocturnal and comes freely to light. According to Joachim Lafrance (personal notes taken from 1965 to 1969 in Sainte-Clotilde, Québec) the moth flies from the beginning of the night up to three o'clock in the morning.

Note. It is a variable species, some specimens first appearing in June are pale, with forewings looking paler and having orangish to pinkish hue; some of these specimens have been submitted to BOLD and, without doubt, they are all *H. aeglealis*. The dark form (male: Fig. 31, female: Fig. 32) is easy to distinguish from *H. sphingealis* by the smaller wingspan, and the postmedial line has pale outside the line in *H. aeglealis*. That dark form is rare in males, commoner in females.

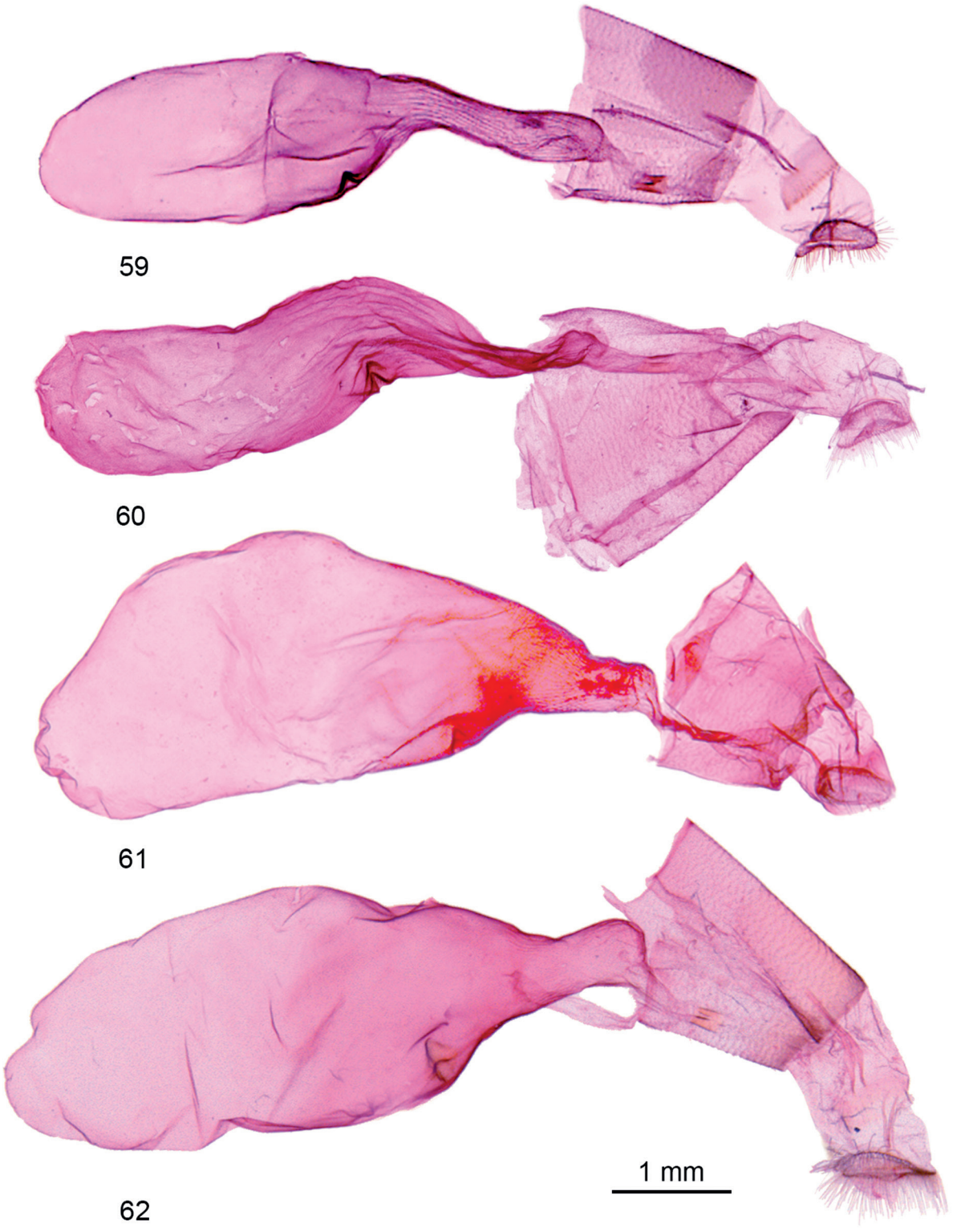
Remarks: Specimens reared by Dr Bernard Landry on *Pedicularis canadensis* were in fact *Herpetogramma nymphalis* sp. n. and *H. aquilonalis* sp. n., and not *H. pertextalis* as identified by Landry (1993).

Herpetogramma sphingealis Louis Handfield & Daniel Handfield, 2011 (801192, MONA 5279,1)
Pl. 3, Figs 33–34 (adults); Pl. 6, Figs 53–54 (♂ gen.); Pl. 8, Fig. 62 (♀ gen.).

Synonym: *H. aeglealis* auct. (in part).

Type material. 1 ♂ from the mountain of Rougemont [45°28'026" N, 73°04'029" W.], Rougemont, Québec, Canada (in CNC) (Handfield & Handfield 2011).

Diagnosis. **Adult male** (Fig. 33). Wingspan 34–37 mm. Upperside of head, palpi (except tufts at base), prothoracic collar, and upperside of thorax and abdomen, concolourous, chocolate brown, fading to a slightly paler brown with age; antenna filiform, finely ciliate on underside, each segment concolourous dorsally with upper surface of head; upperside of abdomen concolourous with wings, except for posterior brownish-yellow tuft covering valvae; maxillary palpi, legs, and underside of head, thorax, abdomen white, being a beautiful flashing white in living specimens; dark brown band (nearly width of eye on side of head) and including the top of the maxillary palpi and chaetosema, gives head appearance of having a longitudinal mask; eye black with greenish bands. Forewing chocolate brown, concolourous with upperside of head, thorax, abdomen, fading slightly to a paler brown with age; apex acutely angled; postmedial line slightly zigzagging from costa to halfway down wing, then turning abruptly inward at nearly right angle to position below reniform spot before turning downwards and zigzagging to posterior margin of wing; no other lines visible (except sometimes a vague trace of an outward curved antemedial line); other marks on forewing are a white patch on fringe at anal angle, two black dots at position of orbicular and the reniform spots, a cream-coloured rectangular patch between two black dots, and a dark terminal line at base of fringe; fringe concolourous with wing except for white anal patch and slightly darker shading on veins. Hindwing concolourous with forewing, including fringe; fringe with dirty white shading at anal angle; transverse lines not visible or barely evident; discal spot black, rounded (more elongated in *H. aeglealis*); a creamy-white patch towards upper margin of wing



Figs 59–62. 59. *Herpetogramma thestealis* female PYR 762: Canada, BC, Vancouver, Stanley Park, 49.063° N, 123.1528° W, 24.vii.2007, A. Li. **60**. *Herpetogramma nymphalis* sp. n. female PYR 1302: Canada, QC, Gatineau, Gatineau Park, Mont King, 24.v.1989, B. Landry. **61**. *Herpetogramma aeglealis* female PYR 546: Canada, QC, Mont-St-Hilaire, 45°31.758' N, 73°10.723' W, 5.vii.2008, Louis Handfield. **62**. *Herpetogramma sphingealis* female PYR 550: Canada, QC, Otterburn Park, Les Bosquets Hudon, 5.viii.2006, Louis Handfield.

base (usually hidden by overlapping posterior margin of forewing). Fringes of all wings even, not crenate. Underside of all wings, including fringes, a dark grey, fading to a paler whitish grey towards wing base with white at base near pure white thorax, especially along inner margin of hindwing; small creamy patch between orbicular and reniform dots on forewing. Discal spot on hindwing often barely evident. Legs mainly pure white, sometimes with brownish scales on upperside of anterior and posterior legs. **Adult female** (Fig. 34). Wingspan 31–34 mm (*H. aeglealis* 27–31 mm). Essentially same as for male except forewing larger, less elongated (more squared at apex); colour of wings a pale chocolate brown, transverse lines more contrasting. Hindwing as for male, but colour fading near base, sometimes showing a vague trace of a postmedial line (Handfield & Handfield 2011). Solis (2010, fig. 2) illustrated a male of *H. sphingealis* under the name *H. aeglealis* (*H. sphingealis* was not yet described at that time). **Male genitalia**. Figs 53–54. Valves and genital capsule as described for genus. Phallus 10.0–10.6 mm long, ⅓ × longer than vesica; vesica with gourd-shaped diverticulum on right with narrow apical part of diverticulum wider than for *H. aeglealis*; spined diverticulum ½ way toward apex of vesica. **Female genitalia**. Fig. 62. Anterior part of corpus bursae with length 2 × width, 3 × length of narrower posterior part, and 3 × length of ductus bursae.

Distribution. The distribution of *Herpetogramma sphingealis* apparently covers the distribution of its only host plant in North America, although there has not been enough sampling in the Maritime Provinces to confirm this. The moth is known from southern Québec and southern Ontario (Wilson Tract, Norfolk Co., 25.vii.2008) in Canada [see www.ontariomoths.com/herpetogramma-sphingealis/]; it has not yet been collected in eastern Ontario. Christmas fern is common in some areas of Eastern Ontario (e.g., Larose Forest near Ottawa), but up to 2020 no *H. sphingealis* has been seen or collected there (Diane Lepage, comm. pers.). In the United States, it is known from all Eastern United States from Maine [River Point Bird Observatory], New Hampshire, Vermont, New York to Northern Florida (Torreya State Park, Liberty Co., Florida [James Hayden, in litt.]), and eastern parts of Central United States from Michigan, Minnesota to Louisiana. It is a moth occurring in the darkest areas of rich xeric forests, with maples and oaks, especially rocky, hilly, maple groves where Christmas fern occurs commonly (Handfield & Handfield 2011).

Biology. As far as known the host plant is exclusively *Polystichum acrostichoides* (Dryopteridaceae) (Ruehlmann et al. 1988 [under *H. aeglealis*], Handfield & Handfield 2011); the larva makes a shelter like a round hut by folding and tying several leaves generally at the tip of the fern. It is the only member of Canadian *Herpetogramma* proven to be specialized on its hostplant.

Flight Period. The moth is nocturnal, flying as soon as the dusk is dying, and comes to light. On the slopes of Mount Rougemont (Québec), the moth is commoner before the full moon of July, rarer during the full moon, and common again after the full moon. Could it be due to its dark colouring, it is much more visible for owls and bats and other birds, so the moth is not flying much during the full moon or is it only due to interference between the moon and the artificial light? Based on our experience, the moth is not flying much during that period even if moonrise is later in the night; anyway it does not fly after midnight. It is one of the most striking and beautiful *Herpetogramma* to see flying and coming to lights.

Note on *Herpetogramma fluctuosalis* (Lederer, 1863)

Herpetogramma fluctuosalis (Lederer, 1863) (801195, MONA 5244) was cited from Québec by Louis Handfield (1997), on the basis of one specimen from Sainte-Anne-de-Bellevue (Québec) in the collection of the Lyman Entomological Museum (LEM) identified under that name. This data led Gregory H. Pohl et al. (2018) to erroneously include that species from Québec in their checklist of the Lepidoptera of Canada and Alaska. The specimen in question is in fact a *Parapoynx allionealis* (Wlk., 1859) (Pyralidae: Acentropinae) (800739, MONA 4764) misidentified. Consequently, *H. fluctuosalis* has to be removed from the lists of Lepidoptera of Québec and of Canada.

Herpetogramma fluctuosalis is present from Maryland to Florida and Texas (Solis 2010), including Georgia, Missouri, Oklahoma, South Carolina and Tennessee (BugGuide, www.bugguide.net, visited 30.ix.2020). It feeds on *Ipomoea batatas* (Convolvulaceae) (Solis 2010).

Conclusion

Our paper presents the first systematic revision of the highly variable *Herpetogramma* species from Canada, with description of three new species. Vesica characters of the male genitalia were significant in distinguishing species morphologically. We did not include distribution maps in this paper, as the paucity of data for nearly all Canadian Provinces and Territories precludes the utility of such maps. Indeed, with the extensive data available from Ontario and Québec, maps would be misleading and would suggest that Ontario and Québec are the world capital of the genus *Herpetogramma*! Undoubtedly, many questions remain unresolved, especially concerning hostplants, but the fact is that the taxonomy of this genus has always been a real puzzle. Now we hope that other researchers will follow up with a revision of *Herpetogramma* species of the United States. With the present work, the total number of *Herpetogramma* species for North America is thirteen, but we expect that additional species remain to be found. Vesica characters of the male

genitalia were significant in distinguishing species morphologically.

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APPENDIX I

Barcode Tree (according to BOLD as of 30.ix.2020).