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NOTE

Records of two new Palearctic moth species associated with Queen Anne's lace in Nova Scotia

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Daucus carota Linnaeus, commonly known as Queen Anne's lace or wild carrot, is native to Europe and southwestern Asia. It is believed to have been introduced to North America in soil ballast by the first European settlers (Lindroth 1957). It has historically been used as a food source and is the ancestral plant of our common cultivated garden carrot. Since its introduction, *Daucus carota* has spread widely and is common to much of North America. In Nova Scotia, this biennial is a very common plant of fields, roadsides and other weedy areas throughout the mainland and parts of Cape Breton (Zinck 1998). Previous insect surveys have recorded hundreds of species of insects attracted to the large white flower heads of the plant (Judd 1970; Largo & Mann 1987). Although considered a common weed species, *Daucus carota* is an important host to numerous beneficial insect species, including many pollinators and predatory species (Judd 1970).

In this report, the first detections of *Sitochroa palealis* (Denis & Schiffermüller) (Lepidoptera: Crambidae), the carrot seed moth, and *Depressaria depressana* (Fabricius) (Lepidoptera: Depressariidae), the purple carrot seed moth, are described from Nova Scotia. Larvae of each species were collected within the flower heads of *Daucus carota* during the summers of 2015 to 2017. Adults were collected as part of an ongoing light trapping survey and through lab rearing. Verified photograph records were also considered. Voucher specimens have been deposited in the Nova Scotia Department of Natural Resources Reference Collection, the Nova Scotia Museum, and the author's personal collection.

Sitochroa palealis

The carrot seed moth occurs in most of continental Europe and Great Britain, northern Africa, eastern Russia, and many parts of Asia (Balachowsky 1972). It was first reported from North America in the mid-western United States in 2002, around the Great Lakes region (Passoa et al. 2008). In Canada, it has been confirmed, as early as 2009, from various specimen and photographic records in southern Ontario, from Quebec in 2013, and more recently, in 2015 from New Brunswick (Joshi et al. 2013; BugGuide 2017). The larvae feed primarily on plants of the family Apiaceae, the parsley or carrot family. Hosts include various weed and crop species, such as those of the genus *Daucus* Linnaeus, *Foeniculum* Miller, *Heracleum* Linnaeus, *Laserpitium* Linnaeus, *Peucedanum* Linnaeus, *Seseli* Linnaeus, and *Silaum* Miller (Hasenfuss 1960; Gaedike 1980).

The forewing of *Sitochroa palealis* is pale yellow with a faint greenish tint, and a diffuse dusky median spot (Figure 1a). Adults have a wingspan between 26—34 mm (Passoa et al. 2008). Mature larvae are light greyish-brown with conspicuous dark dots along the body (Figure 1b). The head and prothoracic shield are generally light, with small circular markings (Passoa et al. 2008). In Great Britain, there is one generation per year, while in warmer areas of the Mediterranean there are often two (Balachowsky 1972; Goater 1986). In North America, there appears to be a single generation per year (Passoa et al. 2008). Mature larvae overwinter as prepupae within a web-spun flower head, then pupate in a tough silken cocoon in the soil the following spring. Adult eclosion occurs later the same summer. Flight period in North America has been recorded from late June to mid-September (Passoa et al. 2008; Joshi et al. 2103; BugGuide 2017; Moth Photographers Group 2017).

The first records of *Sitochroa palealis* in Nova Scotia were adults collected at lights on 27 July 2015 in Sunrise Valley, Victoria County, Nova Scotia (46°53'10.3"N, 60°31'38.6"W) as part of an ongoing general moth survey being conducted in northern Cape Breton (Figure 2). Adults were collected again at the above location in July 2016 and July through

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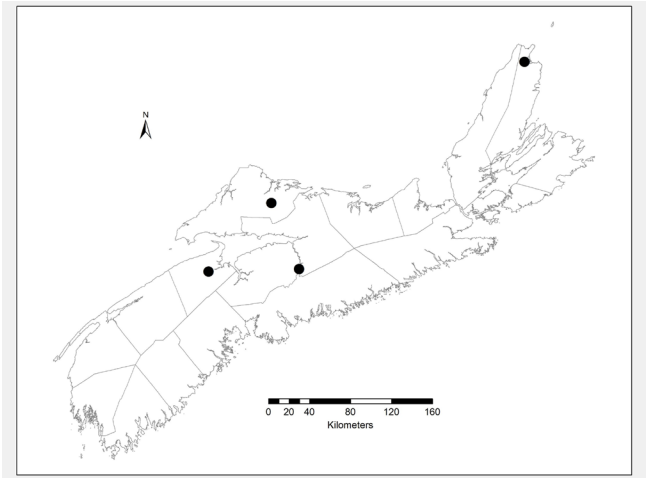
Figure 1: Adult *Sitochroa palealis* (D. & S.) (a) and larva in seed head of Queen Anne's Lace, *Daucus carota* L., in September 2015 (b).

Figure 2: Collection locations of *Sitochroa palealis* (D. & S.) in Nova Scotia.



August 2017 (F. McEvoy, personal communication). On 24 July 2016, a single adult was collected by the author at a light at Five Islands Provincial Park, Colchester County (45°23'30.4"N, 64°03'24.6"W). An additional specimen was photographed on the same day in Kentville, Kings County (45°04'09.4"N, 64°31'18.2"W) (Butterflies and Moths 2017). Mature larvae and prepupae of *Sitochroa palealis* were collected within frass covered, silken pouches of the seed heads of *Daucus carota* between 12-20 September 2015 in weedy fields and waste areas near Truro (45°21'31.3"N, 63°17'38.7"W) and Shubenacadie East (45°05'35.3"N, 63°24'05.6"W), Colchester County and Malagash, Cumberland County (45°48'47.4"N, 63°25'13.2"W). Additional larvae and prepupae were again collected from the same areas in September of 2016 and 2017. To date, attempts to rear the overwintering larvae *Sitochroa palealis* have been unsuccessful.

Depressaria depressana

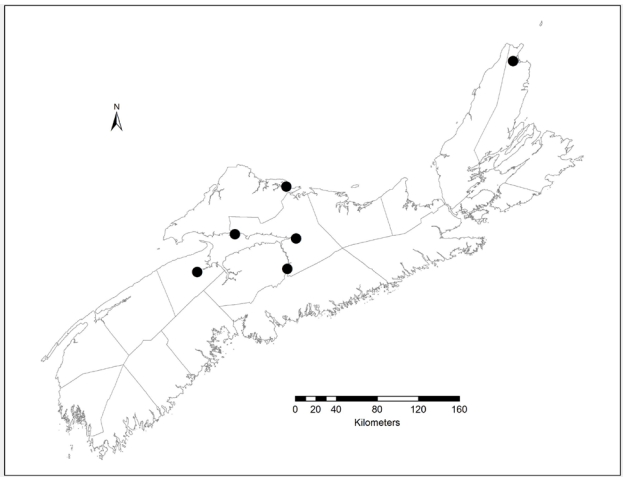
The purple carrot-seed moth, is native to Europe and western Asia. Its populations have recently decreased over much of its native range and is now considered extinct in Britain, possibly due to climatic changes at the time (Hantsmoths 2017; UK Moths 2017). The first record of this species in North America is from Ontario in 2008 (Landry et al. 2013). It has also been detected in 2010 from several Northeastern States, in 2012 from Quebec, and in 2015 from the Midwestern United States (Landry et al. 2013; Harrison et al. 2016; Butterflies and Moths 2017). Similar to *Sitochroa palealis,* the larvae of *Depressaria depressana* feed almost exclusively on the flowers and unripe seeds of the family Apiaceae. Reported hosts from Europe include *Daucus* Linnaeus, *Carum* Linnaeus, *Pimpinella* Linnaeus, *Pastinaca* Linnaeus, *Peucedanum* Linnaeus and *Seseli* Linnaeus (Palm 1989; Landry et al. 2013).

The adults of *Depressaria depressana* are small, with a wingspan between 14—20 mm. They are predominately dark greyish to purplish brown with a contrasting white head and prothorax (Figure 3). Larvae are dark brown with numerous whitish spots along the body and a shiny black head and prothorax (Harrison et al. 2016). There is a single generation per year over much of its northern range in Europe and North America, while multiple broods are known to occur in warmer areas (Harper et al 2002). The species overwinters as an adult moth (Harper et al. 2002).

Depressaria depressana was first recorded in Nova Scotia between 12-20 September 2015 in Shubenacadie East, Colchester County (45°05'35.3"N, 63°24'05.6"W), as mature larvae and pupae during surveys made for

Figure 3: Adult *Depressaria depressana* (Fab.).

Figure 4: Collection locations of *Depressaria depressana* (Fab.) in Nova Scotia.



Sitochroa palealis (Figure 4). Similarly, larvae were found within frass covered, silken pouches of the seed heads of *Daucus carota.* Attempts to rear the pupae to adults failed in 2015. Additional larvae and pupae were collected again at the Shubenacadie site on 4 September 2016, Adults eclosed on 15 September 2016. Adults were also reared on 15 August 2017 from larvae collected near Thompson Station, Cumberland County, Nova Scotia (45°40'14.1"N, 63°45'15.2"W). Adult moths were collected at Sunrise Valley, Victoria County, Nova Scotia (46°53'10.3"N, 60°31'38.6"W) on 22 August 2016, as part of a general moth survey (McEvoy, personal communication). An additional specimen was photographed on 21 June 2017 in Kentville, Kings County (45°04'09.4"N, 64°31'18.2"W) (Butterflies and Moths 2017) (Figure 4). In Nova Scotia, the flight period of *Depressaria depressana* has been recorded from late July to mid-September, shorter than within its European range (McEvoy, personal communication). It also remains unclear if this species has multiple generations in Nova Scotia or if it is the adult moth that overwinters.

Although the host plant, *Daucus carota*, has been established for over 200 years in North America, the introduction of both *Depressaria depressana* and *Sitochroa palealis* appears to be a relatively recent event, the earliest records being within the last two decades. Despite their only recent detection in Nova Scotia, the scattered distribution suggests that both species are established in the province. In 2017, several additional sites with damaged *Daucus carota* seed heads were also noted from various areas of Nova Scotia, however, attempts to identify the cause of the damage were unsuccessful. The records of *Depressaria depressana*, a range extension of over 900 km, are a first for Atlantic Canada (Joshi et al. 2013; BugGuide 2017; Moth Photographers Group 2017). Although previously recorded in New Brunswick, the current collections of *Sitochroa palealis* are also a range expansion (approximately 200 km), making these accounts the furthest east either species have been recorded in North America (Passoa et al. 2008; Joshi et al. 2013; BugGuide 2017; Moth Photographers Group 2017).

It is yet to be determined how the feeding habits of either of these species could affect the host or its kin in Nova Scotia. In Europe, *Sitochroa palealis* has been known to cause severe damage to the flowers heads of commercially grown carrots used for seed production (Balachowsky 1972; Passoa et al. 2008). There is also the potential of it becoming a pest of crops such as parsnip or the seeds of related plants that are used for various spices (Balachowsky 1972). *Depressaria depressana* feeds on the flowers and unripe seeds of many members of the parsley family used as important food crops such as coriander, celery, caraway, cumin, fennel and parsley in Europe (Joshi et al. 2013; Landry et al. 2013). It remains unclear what affect the two species may have on flower production and the impact a reduction of available plants may have on pollinators or other beneficial insect species that currently utilize the various hosts. Additional study of the distribution, phenology, population dynamics and ecological interactions would greatly aid in better understanding what, if any, impact either of these adventive species may have on the native fauna and flora of Nova Scotia.

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