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DISTRIBUTION AND BIOLOGY OF *CHLOSYNE GORGONE CARLOTA* (NYMPHALIDAE) AT ITS NORTHEASTERN LIMIT

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ABSTRACT. During 1996, *Chlosyne gorgone carlota* was found at 13 localities in eastern Ontario. These locations are northeast of historic Ontario and New York sites and 600 miles east of the nearest sites in the midwestern United States. Three broods were evident. First and second instar larvae were found feeding on *Aster lanceolatus, Aster novae-angliae,* and *Rudbeckia hirta* var. *pulcherrima*. Older larvae were found eating only *R. hirta*. Habitats in eastern Ontario are open areas including hayfields, abandoned farmlands, road verges, and hydroelectric rights of way. It remains unknown whether *C. g. carlota* has been long established or has recently arrived.

Additional key words: New York, Pennsylvania, prairie, disjunct, biogeography.

In 1996 the Gorgone Checkerspot, *Chlosyne gorgone carlota* (Reakirt) was rediscoved in Ontario after a long period without any reports. While the rediscovery has been briefly noted (Catling & Layberry 1996), there has been no comprehensive summary of the data collected. Here we provide details on flight periods, foodplants, development times, behavior, and distribution.

Field surveys were conducted in 1996 throughout eastern Ontario by driving along roads and checking suitable habitats for both adults and larvae. Voucher specimens were deposited at the Royal Ontario Museum (ROM), University of Guelph, and Agriculture Canada in Ottawa (CNC) and in the private collections of P. M. Catling, A. Wormington, R. H. Curry, J. Crolla, B. Bracken, and R. A. Layberry. Vouchers of larval foodplants were deposited in the DAO (Dept. of Agriculture) collection of Agriculture Canada in Ottawa. Both reared and wild-caught specimens were compared with material from western North America at the CNC to verify subspecific identity. Lists of plants were made for each site with an indication of status as dominant, frequent or rare. Species dominant at 3/4 of the sites were used in the description and restricted native species were noted. The nomenclature for plants follows Morton and Venn (1990).

HISTORICAL RECORDS

Although long known from several localities in Michigan (Moore 1960), *C. g. carlota* has not been seen in that state for approximately 35 years (M. C. Nielsen, pers. comm.). It is not known from Ohio (Iftner et

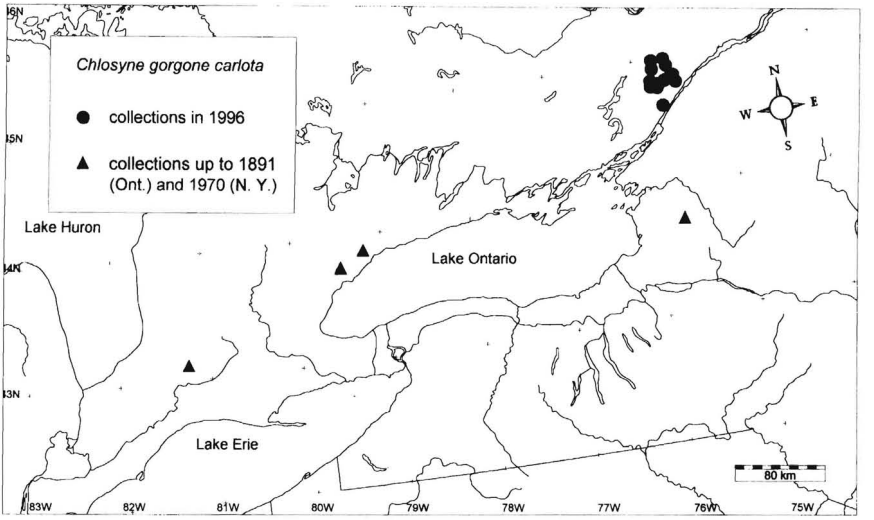

FIG. 1. Geographic distribution of *Chlosyne gorgone carlota* at the northeastern range limit in Ontario and New York. Solid circles, 1996 collections; solid triangles, collections up to 1891 in Ontario and up to 1970 in New York.

al. 1992), has not been observed for 105 years in Ontario (Hanks 1996), and is known from only single occurrences in New York (Shapiro 1974) and Pennsylvania (Davis 1915; there are no recent records, D. Wright, pers. comm.). Major recent texts (e.g., Scott 1986, Opler & Malikul 1992, Opler & Krizek 1984) have mapped these northeastern records.

In Ontario, *C. g. carlota* has been reported previously from London, the Humber valley on the west side of Toronto, and Scarborough east of Toronto (Fig. 1). The report from London is based on a collection by W. E. Saunders (Bethune 1894). The report from the Humber Plains (Riotte 1967) or in the Humber valley (Campbell et al. 1990) is based on collections in 1891 by C. W. Nash. The report from Scarborough is based on four specimens collected by G. Geddes on 6 June 1891 (Bethune 1894, Gibson 1910, Holmes et al. 1991). The Royal Ontario Museum once had voucher specimens, now lost, to support these reports (pers. obs., Hess 1979): three from "Humber valley, Toronto, 6 June 1891, C.W. Nash Collection," and one from "Toronto, C.J.S. Bethune collection."

Recently specimems of *C. g. carlota* labelled "White River, Ontario (presumably the White River in Algoma District at 48°33′N, 86°16′W), June 1907, F. Knab" were discovered at NSM (D. Lafontaine, pers. comm.). *Chlosyne g. carlota* was not listed for northern Ontario by Riotte (1971), and although the White River location is outside the area he defined as northern Ontario, he would likely have listed it along with the

many other records for adjacent regions if he had a record. This species was treated as a stray in the *Ontario Butterfly Atlas* (Holmes et al. 1991) and Campbell et al. (1990) noted that it may never have bred in Ontario. Gregory (1975) did not list it for Ontario and Sutherland (1994) listed *C. g. carlota* as extirpated.

RECENT ONTARIO RECORDS

During 1996, *C. g. carlota* was collected and observed in the eastern portion of southern Ontario within a 355 square mile area bounded by Kemptville and Merrickville to the north and Brockville and Spencerville to the south. Specific sampling included locations near Bishops Mills, Burritt's Rapids, Carley's Corners, Fairfield East, Groveton, Kemptville, Merrickville, McRobert's Corners, North Augusta, Spencerville, Ventnor, and Wolford Centre (Fig. 1). Both reared and wild caught adults from this region proved to be within the normal range of morphological variation exhibited by populations from the prairie provinces of Canada that have been referred to ssp. *carlota*.

The new locations are not only significant records for a species not recorded in Ontario for 105 years, but also represent a range extension 90 miles north of the isolated New York occurrence reported by Shapiro (1974) and ca. 200 miles northeast of the nearest historic Ontario sites at Toronto. The closest extant populations are at least 600 miles to the west, south of Lake Michigan and in Wisconsin (L. A. Ferge, pers. comm.).

There appear to be three broods in eastern Ontario with adults having been seen and/or collected in 1996 from 1–2 June, from 13 July to 7 August and on 3–6 September. In general, the populations appeared to be sparse, with fewer than 3 adults seen at any locality on any day, even during the evident peak flight (the maximum number seen at any site at one time was 10, on 6 September).

LARVAL BIOLOGY

Foodplants. On 5 July 1996 a group of about 200 larvae were found on *Aster lanceolatus* Willd. at the Kemptville site. On 6 July this group had dispersed several feet to another *A. lanceolatus* (52 larvae), an *Aster novae-angliae* L. (40 larvae), and a *Rudbeckia hirta* L. var. *pulcherrima* Farw. (=*R. serotina*)(30 larvae). All of these plants were being eaten. On 6 July at Kemptville another group of 53 younger larvae were found on *Aster novae-angliae* and another group of 30 larvae was found on *R. hirta*. In the same area eight solitary, last instar larvae were found on *R. hirta*.

On 7 July solitary larvae or groups of larvae (2–10) were found 57 times on *Rudbeckia hirta* with 2–15 occurrences at each of seven east-

ern Ontario locations (Bishops Mills, Groveton, Kemptville, North Augusta, Spencerville, Ventnor, and Wolford Centre). At each location there were chewed plants of *R. hirta* with larval skins and frass. At Kemptville groups of smaller larvae were found feeding on both *A. novae-angliae* (8 occurrences) and *A. lanceolatus* (10 occurrences) as well as *R. hirta* (15 occurrences). No large larvae were found on *Aster* and use of these plants was observed only at Kemptville (where *R. hirta* was sparse), by first and second instars. Consequently, the primary foodplant at the new Ontario sites appears to be *R. hirta.*

In captivity, third instar and older larvae refused *Aster lanceolatus*, *A. novae-angliae*, *Helianthus decapetalus*, and *H. divaricatus,* but readily accepted *Rudbeckia hirta* and *Helianthus annuus. Helianthus tuberosus* was also accepted, but less readily.

Development and behavior. Rearing of larvae was done indoors under constant light at temperature of 75–85°F. Second to final instar, solitary larvae 2–2.5 cm long found from 6–8 July and from 19–23 August pupated after 2–8 days of feeding on *R. hirta*. The pupal stage required 4–7 days (n = 13) with one requiring 10 days. An ichnuemon wasp emerged from another pupa after 20 days.

Communal larvae 7–8 mm long collected at the same two sites continued to feed on *R. hirta* for 1–2 weeks, but then hid communally within dry, curled leaves and became inactive. Thus, younger or slowly developing larvae appear to become dormant. *Rudbeckia hirta* grows as scattered plants averaging 1–2 feet tall with 5–7 leaves up to 3 inches long. Plants persist while moist conditions prevail. Completion of flowering is followed by development of new rosettes from the perennial base. Since many of the plants grow in drier sites, summer drought can render them unavailable to *C. g. carlota*, but as soon as moist conditions return, growth resumes. Consequently, the butterfly populations may be able to exploit favorable conditions through three consecutive broods.

Groups of larvae consume whole plants, or most of the leaves on a plant, and then move to new plants. The younger larvae eat the spongy tissue and the upper epidermal layer leaving a whitish, semi-transparent curled leaf. These consumed plants are conspicuous, and along with frass and sometimes shed skins, provide a useful search image for locating larvae. During moves to new plants, larval groups become divided, are more mobile, and frequently do not destroy entire plants. Larvae were found feeding at all times during the day on top of leaves.

HABITATS IN ONTARIO

The area in eastern Ontario where *C. g. carlota* occurs includes extensive marginal farmland that has been largely abandoned and is returning to woody vegetation slowly due to periodic drought, seasonally high wa-

ter table and rugged terrain. It includes sand dunes and sand-covered limestone ridges, as well as gently rolling sandy ground. The open sandy areas were planted with pine and spruce beginning in the 1930's, and few natural openings remain. Granitic, limestone and clay or loam substrates exist to the west, while clay and loam exist to the north and east, but to the east and south of the St. Lawrence River similar isolated areas of sandy substrate are present.

The habitats of *C. g. carlota* include open areas with both wet and dry ground. Some are natural openings with a dominance of native species, but most are intermediate or anthropogenic including road verges, abandoned pastures and hayfields. These latter habitats are dominated by introduced species or contain an admixture of native and introduced species. Three sites are along hydroelectric line rights of way where encroachment of woody plants is actively prevented.

The drier portions of these habitats appear to be preferred, including areas dominated by the shorter grasses, *Danthonia spicata* (L.) P. Beauv. *ex* Roemer & Schultes and *Poa compressa* L. Characteristic herbs include *Apocynum androsaemifolium* L., *Aster lanceolatus* Willd., *Aster novae-angliae* L., *Bromus inermis* Leysser, *Carex blanda* Dewey, *Carex pensylvanica* Lam., *Carex rugosperma* Mackenzie, *Daucus carota* L., *Fragaria virginiana* L., *Hieracium piloselloides* Villars, *Panicum implicatum* Scribner, *Poa pratensis* L., *Prunella vulgaris* L., *Pteridium aquilinum* (L.) Kuhn, *Rudbeckia hirta* L. var. *pulcherrima* Farw., *Senecio pauperculus* Michaux, *Solidago canadensis* L., *Solidago juncea* Aiton, and *Solidago nemoralis* Aiton. Frequent shrubs and vines include *Juniperus communis* L., *Prunus virginiana* L., *Rhus typhina* L., *Rubus allegheniensis* Porter, and *Vitis riparia* Michaux. Locally restricted native species of dry open habitats include *Carex siccata* Dewey, *Cyperus houghtonii* Torr., *Monarda fistulosa* L., *Polygala verticillata* L., *Pycnanthemum virginianum* (L.) Dur. & Jack., *Potentilla arguta* Pursh, *Selaginella rupestris* (L.) Spring, and *Sporobolus cryptandrus* (Torrey) A. Gray.

Chlosyne g. carlota may have existed in eastern Ontario during presettlement times, and become rare partly as a result of the succession of isolated open habitats to dense woody cover as a consequence of restricted fire and changing land use (as appears to be the case with *Plebejus melissa samuelis* (Nabokov) and *Phyciodes batesii batesii* (Reakirt)). Destruction of habitats during intense agricultural use 50–200 years ago may also have contributed to rarity. Since *C. g. carlota* is able to utilize hayfields, recently abandoned agricultural land, and a foodplant that occurs along roadsides, *C. g. calota* may now be expanding its northeastern range. Alternatively *C. g. carlota* may have recently invaded the area, but if this were so, we suspect it would it would have expanded

gradually rather than appearing suddenly in a distant location hundreds of miles from known colonies. It may have moved into eastern Ontario with the cultivation of sunflowers, but such cultivation has been rare over the past few decades.

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