

April 1982

Foodplant Suitabilities and a New Oviposition Record for *Papilio Glaucus Canadensis* (Lepidoptera: Papilionidae) in Northern Wisconsin and Michigan

J. M. Scriber
University of Wisconsin

G. L. Lintereur
University of Wisconsin

M. H. Evans
University of Wisconsin

Follow this and additional works at: <https://scholar.valpo.edu/tgle>



Part of the [Entomology Commons](#)

Recommended Citation

Scriber, J. M.; Lintereur, G. L.; and Evans, M. H. 1982. "Foodplant Suitabilities and a New Oviposition Record for *Papilio Glaucus Canadensis* (Lepidoptera: Papilionidae) in Northern Wisconsin and Michigan," *The Great Lakes Entomologist*, vol 15 (1)
Available at: <https://scholar.valpo.edu/tgle/vol15/iss1/6>

This Peer-Review Article is brought to you for free and open access by the Department of Biology at ValpoScholar. It has been accepted for inclusion in The Great Lakes Entomologist by an authorized administrator of ValpoScholar. For more information, please contact a ValpoScholar staff member at scholar@valpo.edu.

FOODPLANT SUITABILITIES AND A NEW OVIPOSITION RECORD FOR *PAPILIO GLAUCUS CANADENSIS* (LEPIDOPTERA: PAPILIONIDAE) IN NORTHERN WISCONSIN AND MICHIGAN

J. M. Scriber, G. L. Lintereur, and M. H. Evans¹

The eastern tiger swallowtail butterfly, *Papilio glaucus* L., is polyphagous, and has been reported to feed upon plant species of at least 13 families (Scudder 1889, Teitz 1972). The Canadian subspecies, *P. glaucus canadensis* Rothschild and Jordan, is generally believed to be univoltine, to be devoid of the genetic capacity for dark morph females, and to have morphologically distinct characteristics from the southern subspecies, *P. glaucus glaucus* L. (Ebner 1970, Pliske 1972, Shapiro 1974, Tyler 1975). In addition, the choice of potential foodplants north of the 42–44° latitudinal floral and faunal "suture zone" (Curtis 1959, Remington 1968) lacks many species from the southern contingent of hosts (e.g. tulip tree, *Liriodendron tulipifera* L., cucumber magnolia, *Magnolia acuminata* L., and sweet bay, *Magnolia virginiana* L., of the Magnoliaceae; sassafras, *Sassafras albidum* (Nutt.), and spicebush, *Lindera benzoin* L., of the Lauraceae; and hoptree, *Ptelea trifoliata* L., of the Rutaceae). Sweet bay is the primary, if not the only, host in the southern third of Florida, where tulip tree, cherry, and ash do not occur. While the southern race, *P. g. glaucus*, uses all of these plants (Levin and Angleberger 1972, Scriber 1972, Scriber et al. 1975), none have been reported for *P. glaucus canadensis* (McGugan 1958, Scriber, in press).

Paper birch, *Betula papyrifera* Michx., and trembling aspen, *Populus tremuloides* Michx., have been the most frequently reported host plants for *P. glaucus canadensis* across most of Canada (Brower 1958, McGugan 1958). However, it appears that where they occur, black cherry, *Prunus serotina* Ehrh., and white ash, *Fraxinus americana* L., are also frequently used host plants of the Canadian race.

The zone of overlap of the northern (*P. glaucus canadensis*) and the southern (*P. g. glaucus*) subspecies is narrow throughout all of Wisconsin (Fig. 1). Except for a single record from Waupaca County and a single dark female from Marathon County (in 1935), the dark morph (and yellow morph) of *P. g. glaucus* is essentially non-existent north of the vegetational transition zone. It is uncertain to what extent, if any, gene flow occurs between the two subspecies. Furthermore, with the exception of frequent use of black cherry and white ash by *P. g. glaucus* in the southern half of Wisconsin, the amount of potential overlap in host plant utilization abilities by larvae of the two subspecies is also basically unknown.

It is our objective here to report 1980 field observations regarding actual host plant utilization by *P. glaucus canadensis* from northern Wisconsin. In addition to the favorite plants in northern Wisconsin, we also assessed the larval survival and growth of these *P. glaucus canadensis* populations on various food plants, including several favorites of *P. g. glaucus* from the southern U.S. which do not naturally occur in northern Wisconsin.

FIELD OBSERVATIONS

We collected two eggs on black cherry (on 1 June 1980) near Minocqua, Oneida County, Wisconsin, and three larvae (2nd and 3rd instars) on 28 June 1980 in Carney, Michigan (Menominee County), but found none in our searching of paper birch and trembling aspen leaves in these areas. Choke cherry, *Prunus virginiana* L., was also a source of food for *P. glaucus canadensis* in the Upper Peninsula (six larvae and eight eggs were found on this plant species near Carney, Michigan on 28 June 1980). We also rescued one egg on a choke

¹Department of Entomology, University of Wisconsin, Madison, WI 53706.

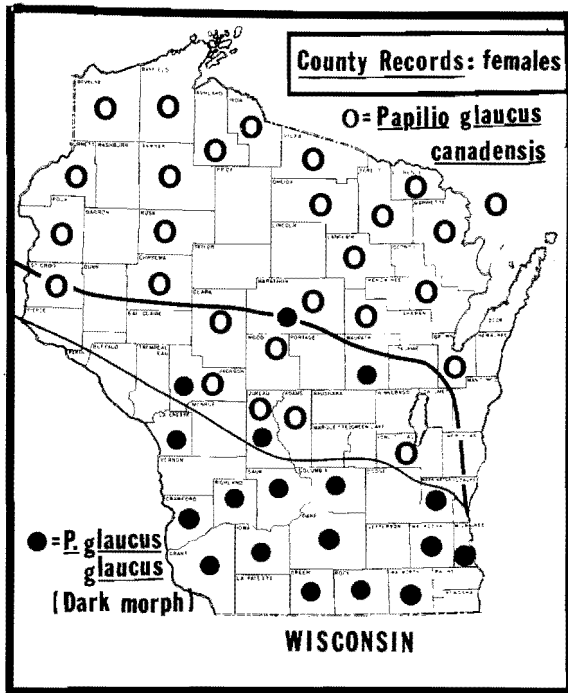


Fig. 1. Distribution of collections of females of the northern (*P. glaucus canadensis*, $n = 83$) and southern (*P. glaucus glaucus*) subspecies of the eastern tiger swallowtail butterfly in Wisconsin. Data for only the dark morph females ($n = 64$) of the southern subspecies are presented.

cherry leaf which was already under consumption by forest tent caterpillars, *Malacosoma disstria* Hübner, in an outbreak area in northern Wisconsin (Bayfield County) on 2 June 1980. *Populus tremuloides* is also used as a foodplant for *P. glaucus canadensis* in Bayfield County (Les Ferge, pers. comm.). All field specimens were reared for positive identification in the laboratory.

Big-toothed aspen, *Populus grandidentata* Michx., has never been reported as a host for *Papilio glaucus*, however on 6 June 1980 an egg was discovered on a big-toothed aspen off County Highway G near Walsh, Wisconsin (Marinette County). To our knowledge, this represents a new host plant (i.e. oviposition) record for the species.

METHODS

Survival and growth of 763 larvae from 22 different females collected from six Wisconsin counties (Adams, Burnett, Clark, Iron, Oneida, Sawyer) were monitored on leaves of 12 tree species in a controlled environment growth chamber (16:8 photo:scotophase with corresponding thermoperiods of 23.5:19.5°C). Freshly eclosed 1st instar larvae from each female were distributed as evenly as possible across all plant treatments and reared through their five instars with frequent changes of plant leaves. Survival is reported through the 3rd instar, after which several were sampled for feeding experiments during the penultimate and final instars. Leaf turgor was maintained by use of aquapics® and a near saturated environment inside 150 × 25-cm clear plastic petri dishes (Scriber 1977). The same procedures were used for larvae of a dark morph *P. g. glaucus* female captured in Richland County in 1979. The more southern foodplants used in these experiments were obtained from the University of Wisconsin Arboretum and Thorstrand Road (Swenson Mansions) in Madison. Balsam pop-

lar, *Populus balsamifera* L., was transplanted from the Peshtigo Wildlife Refuge (Marinette County) and maintained at the Arlington Experimental Farms of the University of Wisconsin.

RESULTS AND DISCUSSION

The striking inability of *P. glaucus canadensis* larvae from Wisconsin to survive even the first instar on tulip tree (Magnoliaceae) and spicebush (Lauraceae) suggests that these southern plants would be unsuitable hosts even if the ranges of these plants did overlap with the Canadian subspecies of the tiger swallowtail. In contrast however, cucumber magnolia, sassafras, and common hoptree are quite suitable hosts for the northern Wisconsin swallowtail even though these plants do not naturally occur even in southern Wisconsin.

The smallest pupae and slowest growth were obtained for larvae fed balsam poplar, which, when combined with the rather low survival on this plant, suggests that these Wisconsin *P. glaucus canadensis* populations are physiologically rather poorly adapted to *P. balsamifera* (especially when compared to *P. tremuloides* Table 1). Part of the explanation for this lack of physiological adaptation may relate to the fact that the range of *P. balsamifera* is generally more northern and barely reaches the counties from which we collected *P. glaucus canadensis*. The greatest survival, fastest growth, and largest pupae were obtained for larvae fed black cherry and trembling aspen. The rapid growth of *P. glaucus* larvae on black cherry is characteristic not only of the northern Wisconsin *P. glaucus canadensis*, but also seems to be the case for the southern subspecies (*P. g. glaucus*) in New York (Scriber and Feeny 1979) and southern Wisconsin (Table 2).

Unlike the case for *P. glaucus canadensis*, *P. g. glaucus* larvae survive and grow well on tulip tree but do very poorly on trembling aspen (Scriber and Feeny 1979; Table 2). This reciprocal inability of one subspecies to survive on the other's favorite host is widespread, and may be of considerable co-evolutionary significance (Scriber, in press). Larvae of both

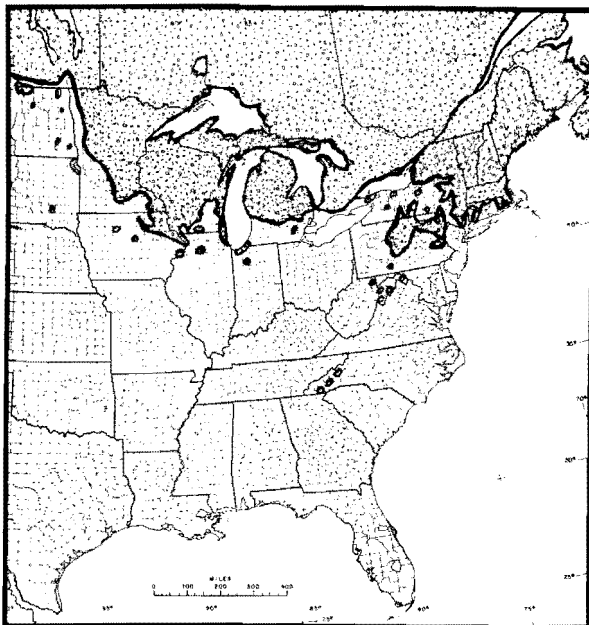


Fig. 2. The geographic range of paper birch, *Betula papyrifera* (After Fowells 1965).

Table 1. Survival and development of *Papilio glaucus canadensis* larvae on various potential foodplants. Madison, Wisconsin, 1980.

Foodplant	Initial larvae (n)	Source Females (n)	% survival through		Larval duration ^a		Pupal weight ^a		Developmental rate ^b (weight gain/duration)
			1st Instar	3rd Instar	days	(n)	(mg dry)	(n)	
Balsam poplar	52	8	69	37	34.3 ± 1.0	(7)	134.2 ± 4.5	(5)	3.9
Mountain ash	65	10	72	37	40.2 ± 1.9	(11)	205.3 ± 11.9	(11)	5.1
Paper birch	61	12	85	67	40.9 ± 1.2	(18)	187.2 ± 8.2	(16)	4.6
Trembling aspen	80	20	86	71	38.7 ± 0.8	(36)	219.2 ± 7.2	(32)	5.7
Choke cherry	62	11	82	66	34.0 ± 0.7	(23)	168.9 ± 6.6	(21)	5.0
Black cherry	73	15	88	85	32.0 ± 0.7	(40)	219.9 ± 7.3	(27)	6.9
White ash	51	8	84	57	44.1 ± 1.5	(12)	201.6 ± 10.6	(12)	4.6
Cucumber magnolia	54	11	70	57	34.6 ± 0.9	(16)	167.6 ± 12.5	(16)	4.8
Hoptree	53	13	77	34	36.6 ± 1.6	(11)	204.0 ± 12.5	(11)	5.6
Sassafras	55	10	62	44	36.9 ± 1.0	(17)	199.8 ± 10.1	(15)	5.4
Spicebush	69	19	1	0	All died	(0)		(0)	—
Tulip tree	88	21	0	0	All died	(0)		(0)	—
(LSD) ^c					(5.31)		(48.5)		

^aData are presented as a mean ± standard error.

^bPupal dry weight/total larval duration (= mg/day).

^cLeast significant differences (P = 0.05, Tukey's test; Winer 1962) are indicated.

Table 2. Survival and development of *Papilio glaucus glaucus* larvae on various potential foodplants. Madison, Wisconsin, 1979.

Foodplant	Initial larvae (n)	Percent survival through:		Larval duration ^a		Pupal weight ^b (mg dry)	Developmental rate (weight gain/duration)
		1st Instar	3rd Instar	Days	(n)		
Balsam poplar	0	Not attempted		Not done	0	—	—
Mountain ash	15	93	80	41.5	7	272.9 ± 8.2	6.6
Paper birch	14	79	57	41.8	5	315.6 ± 15.9	7.6
Trembling aspen	8	13	0	All died	—	—	—
Choke cherry	4	75	75	40.2	1	248.7	6.2
Black cherry	14	100	57	32.4	6	335.4 ± 17.9	10.4
White ash	4	100	50	Not done	0	—	—
Cucumber magnolia	6	100	67	35.4	3	249.0 ± 16.7	7.0
Hoptree	4	75	0	All died	—	—	—
Sassafras	10	91	46	35.6	3	213.2 ± 20.4	6.0
Spicebush	6	50	0	All died	—	—	—
Tulip tree	18	95	63	30.6	5	301.1 ± 14.8	9.8
(LSD)						(70.6)	

^aMean durations were calculated for each instar and added to obtain total duration here, hence there are no standard errors presented.

^bThe LSD (P = 0.05, Tukey's test) excludes choke cherry from the analysis of variance.

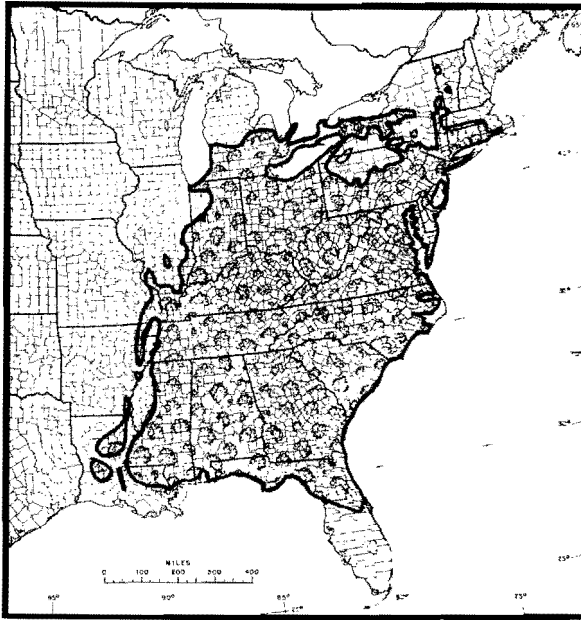


Fig. 3. The range of tuliptree, *Liriodendron tulipifera* (After Fowells 1965).

P. glaucus subspecies from Wisconsin fail to survive the second instar on spicebush, although larvae of yellow morph females in New York populations utilize this plant with slightly better success (Scriber 1975, Scriber et. al. 1975). Spicebush does not occur naturally in Wisconsin, but does occur in much of New York State and throughout most of the eastern U.S.

The close geographic correlation of the Canadian race with one of its favored foodplants, paper birch, is illustrated in Figure 2. Except for the section across northern Illinois, the ecotone separating this northern plant from tulip tree is rather sharply defined (cf. Figs. 2 and 3; Remington 1968). Furthermore, this plant ecotone corresponds very closely to the line of demarcation (42–44° N latitude) between the two swallowtail butterfly subspecies in Michigan (M. C. Nielsen, pers. comm.) and New York (Shapiro 1974) (Fig. 4).

Pupal weights, and presumably the size of resulting adults, is host-dependent and quite variable. Nonetheless, Wisconsin pupae of *P. g. glaucus* are generally 30–60% heavier than those of *P. glaucus canadensis* on any given foodplant (cf. Tables 1 and 2). The significance of these size differences for reproductive isolation in Wisconsin (Ebner 1970) and elsewhere (Tyler 1975) is presently unknown.

The extent of these physiological, morphological, and ecological differences in *Papilio glaucus* subspecies deserves additional attention. In particular, it would be enlightening to know whether *P. glaucus canadensis* larvae outside of Wisconsin (e.g. the Canadian Yukon or Quebec populations) also lack the physiological abilities to utilize tuliptree and spicebush leaves. It would also be useful to assess additional populations of the southern subspecies, *P. g. glaucus*, throughout its range in order to determine the extensiveness of its inability to utilize the favorite foodplants of *P. glaucus canadensis* (e.g. trembling aspen). Such information would provide a means of assessing the physiological implications of local feeding specialization (Gilbert 1979, Fox and Morrow 1981, Scriber and Slansky 1981), especially in regard to the "digestive efficiency hypothesis" of coevolution (Smiley 1978).

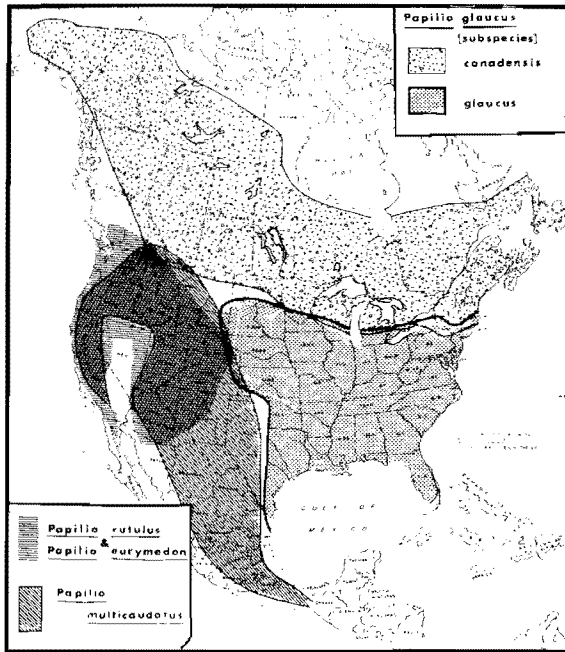


Fig. 4. Distribution of the two subspecies of the eastern tiger swallowtail, *Papilio glaucus*, in relation to three closely related western species (After Brower 1957, 1959; Freeman 1951; McGugan 1958).

ACKNOWLEDGMENTS

We would like to thank George Balogh, Les Ferge, Walter Gould, Roger Kuehn, James Mertins, Robert Moe, M. C. Nielsen, David Ritland, and Randall Shaefer for data from their personal collections. Special thanks are also extended to Sue Borkin and Allen Young for their interest and assistance at the Milwaukee Public Museum. We also thank Katharine Bradley, Ed Hasselkus, Polly O'Hare, and Brian Mohr for their assistance in obtaining insects and/or plants. This research was supported by National Science Foundation Grant DEB-7921749 and the graduate school of the University of Wisconsin and is a contribution of the College of Agriculture and Life Sciences of the University of Wisconsin, Madison, (Hatch Project 5134).

LITERATURE CITED

- Brower, L. P. 1957. Speciation in the *Papilio glaucus* group. Ph.D. dissert. Yale Univ.
 ———. 1958. Larval foodplant specificity in butterflies of the *P. glaucus* group. *Lepid. News* 12:103-114.
 ———. 1959. Speciation in butterflies of the *Papilio glaucus* group. I. Morphological relationships and hybridization. *Evolution* 13:40-63.
 Curtis, J. T. 1959. The vegetation of Wisconsin. Univ. Wisconsin Press, Madison.
 Ebner, J. A. 1970. Butterflies of Wisconsin. Milwaukee Pub. Mus., Wisc. (Handbook no. 12).
 Fowells, H. A. 1965. Silvics of forest trees of the United States. USDA Handbook No. 271.

- Fox, L. R. and P. A. Morrow. 1981. Specialization: Species property or local phenomenon? *Science* 211:887-893.
- Freeman, T. N. 1951. Northern Canada and some northern butterflies. *Lepid. News* 5:41-42.
- Gilbert, L. E. 1979. Development of theory in the analysis of insect-plant interactions. p. 117-154, in D. J. Horn, R. D. Mitchell, and G. R. Stairs, (eds.). *Analysis of ecological systems*. Ohio State Univ. Press, Columbus.
- Levin, M. P. and M. A. Angleberger. 1972. Observations on foodplant records for *Papilio glaucus* (Papilionidae). *J. Lepid. Soc.* 26:177-180.
- McGugan, B. M. 1958. Forest Lepidoptera of Canada recorded by the forest insect survey Vol. 1 Papilionidae to Arctiidae. Pub. 1034 Canadian Dept. Agric. Forest Biology Division.
- Pliske, T. E. 1972. Sexual selection and dimorphism in female tiger swallowtails, *Papilio glaucus* L. (Lepidoptera: Papilionidae): A reappraisal. *Ann. Entomol. Soc. Amer.* 65:1267-1270.
- Remington, C. L. 1968. Suture-zones of hybrid interaction between recently joined biotas. *Evol. Biol.* 2:321-428.
- Scriber, J. M. 1972. Confirmation of a disputed foodplant of *Papilio glaucus* J. *Lepid. Soc.* 26:235-236.
- . 1975. Comparative nutritional ecology of herbivorous insects: Generalized and specialized feeding strategies in the Papilionidae and Saturniidae (Lepidoptera) Ph.D. thesis. Cornell Univ., Ithaca, NY.
- . 1977. Limiting effects of low leaf water content on the nitrogen utilization, energy budget and larval growth of *Hyalophora cecropia* (Lepidoptera: Saturniidae) *Oecologia (Berl.)* 28:269-287.
- . Feeding specialization, physiological efficiency, and host plant races in Lepidoptera in R. F. Denno and M. S. McClure (eds.). *Impact of variable host quality on herbivorous insects*. Academic Press, NY. (in press).
- Scriber, J. M. and P. P. Feeny. 1979. Growth of herbivorous caterpillars in relation to feeding specialization and to the growth form of their food plants. *Ecology* 60:829-850.
- Scriber, J. M. and F. Slansky. 1981. The nutritional ecology of immature insects. *Ann. Rev. Entomol.* 26:183-211.
- Scriber, J. M., R. C. Lederhouse, and L. Contardo. 1975. Spicebush, *Lindera benzoin*, a little known foodplant of *Papilio glaucus* (Papilionidae). *J. Lepid. Soc.* 29:10-14.
- Scudder, S. H. 1889. The butterflies of the eastern U.S. and Canada. (*Jasioniades glaucus*, p. 1288-1305). Publ. by the author. Cambridge, MA.
- Shapiro, A. M. 1974. Butterflies and skippers of New York State. *Search* 4(3):1-60 (Cornell Expt. Stat. Publ.).
- Smiley, J. 1978. Plant chemistry and the evolution of host specificity: New evidence from *Heliconius* and *Passiflora*. *Science* 201:745-747.
- Tietz, H. M. 1972. Index to the described life histories, early stages, and hosts of the Macrolepidoptera of the continental United States and Canada. A. C. Allen, Sarasota, FL.
- Tyler, H. A. 1975. The swallowtail butterflies of North America. Naturgraph, Healdsburg, CA.
- Winer, B. J. 1962. *Statistical principles in experimental design*. McGraw Hill, NY.