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NEW CANADIAN RECORDS OF ASILIDAE (DIPTERA) FROM AN
ENDANGERED ONTARIO ECOSYSTEMJeffrey H. Skevington^{1,2}

ABSTRACT

The Asilidae (Diptera) of Bosanquet (northern Lambton County, Ontario) are surveyed. Forty-one species are recorded. Twelve species are published for the first time from Canada: *Atomosia puella*, *Cerotainia albipilosa*, *Cerotainia macrocera*, *Holcocephala calva*, *Holopogon (Holopogon) oriens*, *Laphria canis*, *Laphria divisor*, *Laphria grossa*, *Lasiopogon opaculus*, *Machimus notatus*, *Machimus sadyates*, and *Neomochtherus auricomus*. These species plus the following four are new to Ontario: *Laphystia flavipes*, *Lasiopogon tetragrammus*, *Machimus novaescotiae*, and *Proctacanthella copiloga*.

Lambton County, on the southeastern shore of Lake Huron in Ontario, is a unique part of the Great Lakes Region. The coastal dunes and oak savannas of this large (91 km long by 66 km wide; 299,645 ha) county support a wealth of plants and animals found nowhere else in Ontario (Bakowsky 1990, Lindsay 1982, Schweitzer 1984, Schweitzer 1993). This area is a collage of unusual and threatened habitats that include coastal sand dunes with associated cedar savanna and wet meadows, the largest remaining fragments of oak savanna in eastern Canada, and lush floodplain forests containing plants characteristic of the Carolinian Life Zone. As a result, the insect fauna is diverse and unusual.

To date, little has been published summarizing the insect diversity of Lambton County. Species lists can be patched together from general publications and revisions, but do not provide thorough base-line information on the biodiversity of the area. Skevington and Carmichael (1997) summarized the Odonata fauna of the area, and there is some information on Lepidoptera (e.g. Hanks 1998, Hess et al. 1995, Packer 1987, Packer 1990, Schweitzer 1984, Skevington 1996).

The study I report here focuses on the Asilidae of Bosanquet (formerly Bosanquet township), a small (30,596 ha) but varied region at the northern end of the county (Fig. 1). The variety of Asilidae found in this region reflects its unique range of habitats, and will hopefully encourage other students of entomology to continue to document the region's biodiversity.

Asilids are an interesting group to study because they are conspicuous, easy to collect, and relatively easy to identify. Their species-specific habitat

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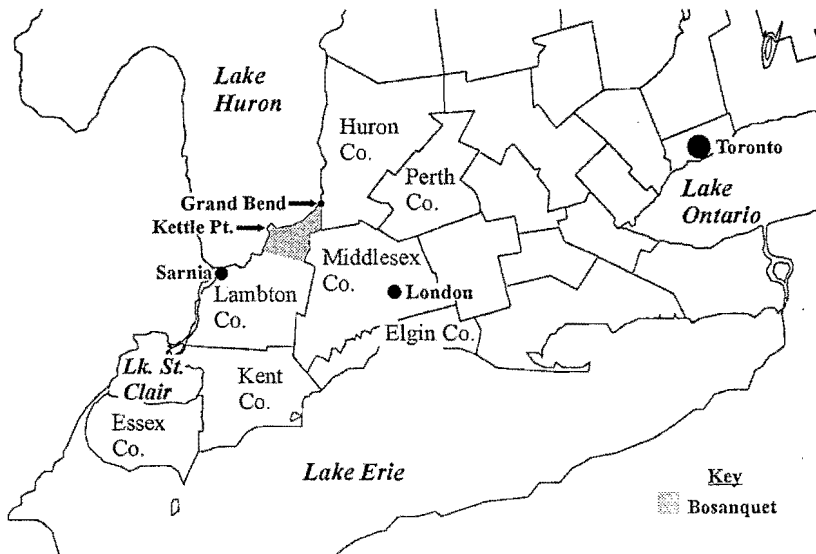


Figure 1. Location of study area in southwestern Ontario.

specializations and their ecological role as primary predators among the insects also make them excellent candidates for ecological monitoring. Baker and Fischer (1975) provide a key to most local species of robber flies, excluding the difficult subfamily Leptogastrinae. A key to the latter by Martin (1957) is available.

In addition to data from this survey, information on Lambton asilids is currently mostly buried in insect collections like the Canadian National Collection (CNC, Agriculture and Agri-Food Canada, Eastern Cereal and Oilseed Research Centre, K.W. Neatby Building, Ottawa, Ontario, K1A 0C6) and the University of Guelph Insect Collection (DEBU, Department of Environmental Biology, Guelph, ON, N1G 2W1). These repositories are a valuable source of historical data for many regions, but they need to be tapped occasionally to make the information available in a summarized form.

MATERIALS AND METHODS

The study sites, described below, are representative of habitats found throughout the lakeshore area. They are part of an extensive corridor of natural habitat that runs from Grand Bend to Kettle Point (24 km \times 2 km). Part of this coastal corridor has been granted long term protection. However, much of this protected land is under intense human pressure. The only other significant parcels of natural land in Bosanquet follow the Ausable River from near Arkona to northeast of Thedford. Most of the remaining area is farmland.

Study Site, Pinery Provincial Park. Pinery Provincial Park contains a spectacular sequence of coastal sand dunes. A mosaic of cedar savanna,

prairie, heath and barrens parallels the Lake Huron shore. Wet, calcareous meadows occur in several low interdunal depressions. Oak-pine woodlands and savannas cover the rolling dune landscape inland from Lake Huron. River floodplain habitats occupy the inactive channel of the Ausable River, which runs the length of this park (Lindsay 1982). Bakowsky (1990) presented a detailed analysis of the floral ecology of Pinery's different habitats.

Of these vegetation communities, oak savanna is one of the most significant. According to Bakowsky (1990), savannas are the rarest of Ontario's plant communities and at least two thirds of Pinery supports this vegetation type. In eastern North America, oak savanna formerly flourished along the boundary between the prairies of the midwest and the northeastern deciduous forest region (Bakowsky 1990). The occurrence of this midwestern vegetation in Ontario, far from its main range, may be explained by the postulated hypsithermal period, when climate warmed between 4000 and 8000 years before the present (Deevey and Flint 1957, Szeicz and MacDonald 1991). This resulted in the vegetation of many upland areas in the northeast changing from deciduous forest to prairie. Subsequent climatic cooling reduced the extent of the grasslands, and the more recent clearing of land for agriculture left only a few pockets of the habitat in Ontario. Oak savanna covered 11–13,000,000 hectares of the midwestern USA at the time of settlement but, by 1985, only about 2,600 hectares, or 0.2% of this habitat remained (Nuzzo 1986). In Ontario, savanna is restricted mainly to isolated localities along the shores of the Great Lakes. Many of the regionally rare robber flies discussed below are associated with this habitat.

In recent years a dense population of white-tailed deer (*Odocoileus virginianus* (Zimm.)) has greatly reduced the understory vegetation in Pinery (Bakowsky 1990; Schweitzer 1993). Deer were culled in 1998 and the vegetation is expected to recover. Presumably, these vegetation changes will affect arthropod diversity and abundance.

Study Site, Karner Blue Sanctuary. The Karner Blue Sanctuary is a small parcel of oak savanna in Port Franks that was purchased by LWI to protect the last significant breeding population of the Karner Blue Butterfly (*Lycaeides melissa samuelis* Nabokov) in Canada. This butterfly was extirpated from Canada following the 1988 drought (Schweitzer 1993), but the habitat is in relatively good condition and is protected from development. Planted pines are being removed from the site and intermittent burns are planned to maintain the savanna habitat. Unlike savannas in Pinery Provincial Park, this area has not had a large deer population. Thus, although the general appearance of the habitat is similar to oak savanna areas in Pinery, there are differences in arthropod fauna attributable to the denser understory (Skevington, unpublished data).

Study Site, Port Franks Forested Dunes. In Port Franks (south of Pinery), L-Lake and the surrounding area are protected as part of an Area of Natural and Scientific Interest (ANSI). The Ausable Bayfield Conservation Authority and the Nature Conservancy of Canada own this area. The Nature Conservancy property, known as Port Franks Forested Dunes, is managed by LWI. Many of the habitats are similar to those in Pinery, but there is considerably less impact from humans and deer. The lowlands on the east side of the property are dominated by floodplain forests that differ from those in Pinery primarily by the pronounced growth of herbaceous and woody understory plants. In addition to the lower deer numbers, frequent flooding of Mud Creek and the associated nutrient wash contribute to this lush landscape. Insect diversity here is noticeably different than in the floodplain forests of Pinery. A series of old, stabilized sand dunes bisect the property to the west of the floodplain forest. The eastern sides of the dunes contain oak forests

similar to those found in Pinery, the dune tops are typically cedar savanna, and the western flank of some dunes give way to oak savanna. Eastern white cedar (*Thuja occidentalis* L.) and eastern hemlock (*Tsuga canadensis* (L.)) fringe L-Lake on the western edge of the property.

Study Site, Ipperwash Army Base. The Ipperwash Army Base is similar to the adjacent Port Franks Forested Dunes. The most notable difference is the presence of large coastal sand dunes. I sampled from the periphery of this area only because I could not get permission to sample within the base. Overall, the fauna is likely analogous to that of the Port Franks Forested Dunes, but I would expect additional taxa to occur in the Ipperwash dunes.

Survey methods. From May 1991 to September 1994 insects were collected at Pinery Provincial Park. Survey work continued in 1995 and 1996, but was less intensive. This work involved hand collecting and Malaise trapping in all available habitats throughout the summer. Spring and fall were sampled less intensively. Approximately 600 hours were spent hand collecting in Pinery.

In 1996, survey work was expanded to include the Karner Blue Sanctuary and Port Franks Forested Dunes, which had received only cursory study in previous years. Collections were made by hand and by six Malaise traps in a variety of habitats from 1 June to 30 September. Three hundred and forty-three hours were spent in the field collecting by hand. No effort was made to collect quantitative data. The survey is intended solely as a baseline inventory of the insect fauna of Bosanquet.

Specimens were pinned and labeled and deposited in DEBU for permanent storage. Duplicate specimens of most species of asilids are deposited in the Royal British Columbia Museum (BCPM, Victoria, British Columbia, V8V 9W2). The only specimen of *Laphria grossa* (Fabricius) is in the BCPM. Additional duplicates of some species are deposited in the CNC. Scientific names are arranged according to Fisher and Wilcox (1998). Fisher and Wilcox (1998) also provide the most current summarized information on distributions of Nearctic robber flies.

RESULTS AND DISCUSSION

Table 1 lists the species recorded during the study. Numbers under each location refer to the number of specimens collected and do not necessarily reflect abundance. Species published for the first time from Ontario are marked (*) and those published for the first time from Canada are marked (**).

We did not tackle the identification of leptogastrines in this study, but numerous specimens from the project are available in the University of Guelph collection for anyone interested. Similarly, identification of species in the *Laphria canis* complex was not attempted here. Records for *L. canis* Williston and *L. winnemana* McAtee were extracted from an unpublished thesis (Bullington 1986). Revision of *Laphria* s.l. is currently in progress and should facilitate the identification of this difficult group.

Schweitzer (1993) considered pine barrens and oak savannas to be the most important habitats for rare Lepidoptera in eastern North America. Given this background, it was not surprising to discover many new insect records for Ontario and Canada in this area. It should be pointed out that although this project contributed to the documentation of 16 robber flies new to Ontario, a survey of the CNC and DEBU collections showed that several of these species had been collected previously in the province, most of them in the areas examined herein. The records had simply eluded publication.

Many of the species new to Canada were expected and occur commonly in

Table 1. Number of specimens of Asilidae species collected in Lambton County, Ontario from May 1991 to 1996.

Taxon	Number of specimens found at locations ¹				DET ²
	KBS	PFD	PPP	IAB	
Asilidae—41+ species					
Leptogastrinae—1+ species					
<i>Leptogaster</i> spp.	X	X	X	X	JS
Laphriinae—14+ species					
Atomosiini					
** <i>Atomosia puella</i> (Wiedemann)	1	6	3		JS
** <i>Cerotainia albipilosa</i> Curran			14		GS
** <i>Cerotainia macrocera</i> (Say)	1				JS
Laphriini					
** <i>Laphria canis</i> Williston				X	SB
** <i>Laphria divisor</i> (Banks)	6				JS
<i>Laphria flavicollis</i> Say	4	4	7		JS
** <i>Laphria grossa</i> (Fabricius)	1				JS
<i>Laphria index</i> McAtee	4	1	1		JS
<i>Laphria janus</i> McAtee		1			JS
<i>Laphria posticata</i> Say	6	4	6		JS
<i>Laphria sacrator</i> Walker	1	3	1		JS
<i>Laphria sericea</i> Say	5	9	6		JS
<i>Laphria thoracica</i> Fabricius		4	1		JS
<i>Laphria winnemana</i> McAtee			X		SB
Laphystiinae—1 species					
* <i>Laphystia flavipes</i> Coquillett				16	EF
Stenopogoninae—6+ species					
Cyrtopogonini					
<i>Cyrtopogon falto</i> (Walker)	3	1	14		JS
<i>Cyrtopogon lutatius</i> (Walker)		1			JS
<i>Cyrtopogon</i> spp.	1				JS
** <i>Holopogon (Holopogon) oriens</i> Martin	1				JS
<i>Holopogon (Holopogon) phaeonotus</i> Loew		15	29	1	JS
<i>Holopogon (Holopogon) vockerothi</i> Martin	12	43	23	1	JS
Dioctriini					
<i>Dioctria baumhaueri</i> Meigen	5	5	2		EF
Stichopogoninae—4 species					
** <i>Lasiopogon opaculus</i> Loew		9			JS,RC
* <i>Lasiopogon tetragrammus</i> Loew			3	2	JS,RC
<i>Stichopogon argenteus</i> (Say)			5	17	JS
<i>Stichopogon trifasciatus</i> (Say)	27		3	1	JS
Trigonimiminae—2 species					
<i>Holcocephala abdominalis</i> (Say)		1	25	50	JS
** <i>Holcocephala calva</i> (Loew)		2	1		GS, JS
Asilinae—13 species					
Apocleini					
<i>Efferia albibarbis</i> (Macquart)		2			JS
* <i>Proctacanthella cacopiloga</i> (Hine)	1	7	1	1	GS, JS

Table 1. Continued.

Taxon	Number of specimens found at locations ¹				
	KBS	PFD	PPP	IAB	DET ²
<i>Proctacanthus hinei</i> Bromley	2	3	6	2	JS
<i>Proctacanthus milbertii</i> Macquart	11	9	13		JS
<i>Promachus bastardii</i> (Macquart)	1		9		JS
Asilini					
<i>Asilus sericeus</i> Say	4	1	4		JS
** <i>Machimus notatus</i> (Wiedemann)	16	49	43		EF, JS
* <i>Machimus novaescotiae</i> (Macquart)	1				EF, JS
** <i>Machimus sadyates</i> (Walker)	4	6	9		EF, JS
<i>Machimus snowii</i> (Hine)		10			EF
<i>Neoitamus flavofemoratus</i> (Hine)	5	7	100		JS
<i>Neoitamus orphne</i> (Walker)		1			JS
** <i>Neomochtherus auricomus</i> (Hine)	1	2	2		EF

¹Location abbreviations are as follows: KBS = Karner Blue Sanctuary; PFD = Port Frank Forested Dunes (formerly Watson Property); PPP = Pinery Provincial Park; IAB = Ipperwash Army Base. See text for descriptions of each location.

²DET = Species determination by the following individuals: SB = S. W. Bullington; RC = R. A. Cannings; EF = E. M. Fisher; GS = G. E. Shewell; JS = J. H. Skevington.

X = Species, but not exact number of specimens, recorded.

* = Indicates a new published record for Ontario.

** = Indicates a new published record for Canada.

nearby states. For example, *Atomosia puella* (Wiedemann), *Holopogon oriens* Martin, *Laphria canis*, *Laphria divisor* (Banks), *Lasiopogon opaculus* Loew, *Machimus notatus* (Wiedemann), and *M. sadyates* (Walker) are all fairly widespread and common in Michigan (Baker and Fischer 1975). All other new discoveries were more unexpected.

The discovery of *Proctacanthella cacopiloga* (Hine) on the survey was very significant. This species is practically unknown from eastern North America. Fisher and Wilcox (1998) record its range as occurring from Alberta to Manitoba south to New Mexico and Texas, with disjunct records from Utah, Illinois, Indiana, and an unconfirmed record from New Jersey. Although only ten specimens of this species were captured in Lambton County, it was found at four different sites (Karner Blue Sanctuary, Port Franks Forested Dunes, Pinery Provincial Park and around the periphery of the former Ipperwash Army Base). One historical specimen in the CNC is also from this area: Grand Bend, Ontario, 15 July 1939, G.E. Shewell. Historical entomological references to Grand Bend refer to the area now represented by Pinery Provincial Park. The possible New Jersey record is intriguing. Several western species of Lepidoptera were collected in Lambton that are restricted in eastern North America to the oak savannas in Lambton County and the pine barrens in New Jersey (Skevington and Stead, unpublished data). Together, these significant areas seem to support a number of prairie disjunct species as well as several savanna endemics.

As mentioned in the introduction, it is hypothesized that oak savanna became established in Ontario between 8000 and 4000 BP during the hypsithermal interval. This habitat occupied a great deal of southern Ontario until land clearance by Europeans at approximately 150 BP (Szeicz and Macdonald 1991). The remaining prairies and savannas in Ontario are severely

fragmented. It appears that *P. cacopiloga* may have entered Ontario during the hypsithermal period when oak savanna and prairies became established. Only one relic population now apparently represents this species in Ontario. Given that fluctuating population densities, poor dispersal abilities, and patchy distributions make prairie-restricted insects especially susceptible to high extinction rates associated with severely fragmented ecosystems (Panzer 1988), this species should be treated as a species of special concern. It is likely an excellent indicator of local environmental health and could be used for habitat management and monitoring in the future.

Laphystia flavipes Coquillett is another species with a predominantly mid-western distribution. Fisher and Wilcox (1998) record its range as Manitoba east to Minnesota, south to Colorado and Kansas, with disjunct populations in Montana and possibly North Carolina. Historical specimens from Hepworth, ON exist in DEBU. The Hepworth area at the base of the Bruce Peninsula contains some relict sand dunes that are very similar in appearance and biota to the Lambton research areas (Skevington, pers. obs.). All of the Lambton specimens of *L. flavipes* were collected on sand dunes on the periphery of the former Ipperwash Army Base. This area contains the most pristine coastal dune habitat in Lambton County, although it is currently under threat from off-road vehicles.

Cerotainia albipilosa Curran is known from only six specimens from five counties in Michigan (Baker and Fischer 1975). Fisher and Wilcox (1998) report its occurrence as Michigan to New York, south to Texas and Florida. Fourteen specimens collected by G.E. Shewell in 1939 from Grand Bend are in CNC. Although this species was not collected during the survey, more effort should be made to rediscover it. This area may support the only Ontario population of the species.

Like *C. albipilosa*, *C. macrocera* (Say) has only a few collection sites in Michigan. Baker and Fischer (1975) refer to nine specimens from nine counties. Fisher and Wilcox (1998) report its occurrence from Ohio to Connecticut, south to Mississippi and Florida, Missouri and Kansas. Only a single specimen was collected during the Lambton Survey, it came from the Karner Blue Sanctuary in Port Franks. No historical specimens are in CNC or DEBU. This species should also be earmarked as a species of special concern in Canada.

Lasiopogon opaculus is known from Iowa, Illinois, Indiana, Michigan, Ohio, Virginia, North Carolina, South Carolina, Georgia, and Mississippi in the USA and from Toronto and Willowdale in Ontario, Canada (Cannings 1999). In Lambton County, *L. opaculus* was collected only in the Port Franks Forested Dunes. *Lasiopogon tetragrammus* Loew is known from New York, New Hampshire, Massachusetts, Connecticut, Quebec, and Wasaga Beach in Ontario (Cannings 1999, Fisher and Wilcox 1998). It was collected from both Pinery Provincial Park and around the periphery of the former Ipperwash Army Base in Lambton County.

Holcocephala calva (Loew) is known from 17 specimens from nine counties in Michigan (Baker and Fischer 1975). Fisher and Wilcox (1998) report its occurrence from Kansas to New York, south to Texas and Florida. There are 48 historical specimens in CNC bearing the following data: Grand Bend, Ontario, 10 July 1939 (1), 14 July 1939 (20), 19 July 1939 (27), G.E. Shewell. One specimen was collected in oak savanna habitat behind the Pinery Provincial Park store on 20 August 1994. The other two specimens are from cedar savanna on the Port Franks Forested Dunes.

During the survey, a single specimen of *Laphria grossa* was collected in the Karner Blue Sanctuary. This species has not been recorded from adjacent Michigan and there are no published records from Canada. Fisher and

Wilcox (1998) record its distribution from Ohio to Quebec and Maine, south to Mississippi and Florida. It is undoubtedly rare in Canada but it should be expected to occur anywhere in the Carolinian Life Zone.

In Michigan, *Machimus novaescotiae* (Macquart) is known from seven specimens from six counties; and *Neomochtherus auricomus* (Hine) from ten specimens from six counties. *Machimus novaescotiae* occurs from Nova Scotia south to Ohio and Florida; and *N. auricomus* from Maine to Michigan, south to Illinois and Virginia (Fisher and Wilcox 1998). No identified historical specimens of these species exist in the CNC or DEBU, but this is not surprising given the difficulty in identifying *Machimus* species and their relatives.

Despite their relatively small size, pronounced isolation, and degraded condition, Ontario's prairie and savanna remnants continue to harbor unique and disjunct populations of insects. Lambton County supports the most significant remnants of these habitats in the province and as such should be the focus of continued research. Entomologists are strongly encouraged to continue to build on our knowledge of Lambton County's insects. Permits are necessary for collecting within Lambton Wildlife properties, Conservation Authority properties, and Provincial Parks. Permits from the first are easiest to obtain (see address under Skevington et al. 2000). Lambton Wildlife requests that vouchers for new species be deposited in recognized institutional collections so that verification of identifications is possible. Applications for permits to collect in Pinery Provincial Park should be sent to the Superintendent, Pinery Provincial Park, R.R.#2 Grand Bend, ON, N0M 1T0. Please contribute your identifications to the list that is being maintained at the University of Guelph Insect Collection web site (see Lit. Cited).

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Data for this project come from a larger survey including a significant proportion of the insects found in Bosanquet. Lambton Wildlife Incorporated (LWI), a non-profit naturalists' club based in the city of Sarnia, is coordinating this survey and is maintaining the list of over 2000 species identified during this project. (For copies see Skevington et al. in prep., University of Guelph Insect Collection web site).

LITERATURE CITED

- Baker, N. T. and R. L. Fischer. 1975. A taxonomic and ecologic study of the Asilidae of Michigan. *Great Lakes Entomol.* 8: 31-91.
- Bakowsky, W. D. 1990. The vegetation of Pinery Provincial Park. Pinery Provincial Park, Southwestern Region, Ontario Ministry of Natural Resources (draft). 84 pp.
- Bullington, S. W. 1986. Two new genera related to *Laphria* Meigen (Diptera: Asilidae), with revisions of the included species in North America north of Mexico. Ph.D. thesis, University of Wyoming, Laramie, Wyoming. 275 pp.
- Cannings, R. A. 1999. The systematics of *Lasiopogon* Loew (Diptera: Asilidae), vol. 1-2. Ph.D. thesis, University of Guelph, Guelph, Ontario. 702 pp.
- Deevey, E. S. and R. F. Flint. 1957. Postglacial hypsithermal interval. *Science* 125: 182-184.
- Fisher, E. M. and J. Wilcox. 1998. Catalog of the robber flies (Diptera: Asilidae) of the Nearctic Region (draft). 39 pp.
- Hanks, A. J. 1998. Butterflies of Ontario and summaries of Lepidoptera encountered in Ontario in 1997. *Toronto Entomol. Assoc. Publ.* 30-98: 1-89.
- Hess, Q. F., J. Skevington and L. Kobayashi. 1995. Lambton County butterfly counts: Results from two years. *Ontario Insects* 1: 9.
- Lindsay, K. M. 1982. Rare vascular plants of twelve provincial parks in the deciduous forest region of southern Ontario. *Ont. Field Biol.* 36: 53-70.
- Martin, C. H. 1957. A revision of the Leptogastrinae in the United States (Diptera, Asilidae). *Bull. Am. Mus. Nat. Hist.* 111: 343-386.
- Nuzzo, V. A. 1986. Extent and status of midwest oak savanna: Presettlement and 1985. *Nat. Areas J.* 6: 5-36.
- Packer, L. 1987. Status report on some rare Lepidoptera species in southern Ontario: World Wildlife Fund and Ontario Ministry of Natural Resources.
- Packer, L. 1990. The status of two butterflies, Karner Blue (*Lycaeides melissa samuelis*) and Frosted Elfin (*Incisalia irus*), restricted to oak savannah in Ontario, pp. 253-272. In: G. M. Allen, P. F. J. Eagles and S. D. Price (eds.), *Conserving carolinian Canada*. University of Waterloo Press, Waterloo. 346 pp.
- Panzer, R. 1988. Managing prairie remnants for insect conservation. *Nat. Areas J.* 8: 83-90.
- Schweitzer, D. F. 1984. A report on the "macro" Lepidoptera of the Pinery Provincial Park, Grand Bend, Ontario. Pinery Provincial Park, Southwestern Region, Ontario Ministry of Natural Resources.
- Schweitzer, D. F. 1993. A recovery plan for the Karner Blue Butterfly (*Lycaeides melissa samuelis* Nabokov) for the Province of Ontario, with discussions of other rare oak savanna species. Pinery Provincial Park, Southwestern Region, Ontario Ministry Nat. Res. 63 pp.
- Skevington, J. 1996. Third annual North Lambton butterfly count a huge success. *Ontario Insects* 2: 13-14.
- Skevington, J. and I. Carmichael. 1997. Dragonflies and damselflies (Odonata) of Bosanquet (North Lambton County, Ontario). *Proc. Entomol. Soc. Ont.* 128: 3-12.
- Skevington, J. H., K. Stead, D. Caloren and J. Connop. 2000. Checklist of the insects and arachnids of Bosanquet Township (including Kettle Point). Lambton Wildlife, Inc. (in press). (Draft version currently available from publisher at P.O. Box 681, Sarnia, ON N7T 7J7.)
- Szeicz, J. M. and G. M. MacDonald. 1991. Postglacial vegetation history of oak savanna in southern Ontario. *Can. J. Bot.* 69: 1507-1519.
- University of Guelph Insect Collection web site. <http://www.uoguelph.ca/~samarsha/>