

Factors Governing the Distribution and Dispersal of the Recently Introduced Grasshopper, *Metrioptera roeseli* (Hgb.) (Orthoptera: Ensifera).

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Abstract

Metrioptera roeseli (Hgb.), introduced into the Montreal area during the period 1945-51, has spread in all directions and now occurs in New York, probably in eastern Ontario, and in Vermont. In Europe macropterous forms are rare. Near Montreal, more than 70 percent of the specimens were macropterous in 1961-60, while in 1964-65 less than 10 percent were of this phase. Macropterism is disappearing in areas of establishment of the species, but probably continues to be predominant on the periphery of distribution. In the Montreal area, parasitism by a native nematode is a major factor in limiting population levels.

Résumé

Metrioptera roeseli (Hgb.), espèce introduite dans la région de Montréal au cours des années 1945-51, s'est répandue dans toutes les directions et se rencontre maintenant dans l'état de New York, probablement l'est de l'Ontario et dans le Vermont. En Europe, les formes macroptères sont rares. Plus de 70 pour cent des spécimens observés près de Montréal au cours des années 1960-61 étaient macroptères, tandis qu'en 1964-65, moins de 10 pour cent appartenaient à cette phase. Le macroptérisme tend à disparaître dans les régions où l'espèce s'est établie, mais continue probablement à dominer à la périphérie de son aire de distribution. Dans la région de Montréal, une espèce indigène de nématode parasite s'avère un facteur important dans la limitation de la population de cette espèce.

Introduction

Metrioptera (Roeseliana) roeseli (Hagenbach, 1822) (Fig. 1) was first reported in North America by Urquhart and Beaudry (1953) from Montreal and Ville St. Laurent. Beaudry (1955) was more precise regarding the Montreal specimens, listing the suburbs of Bordeaux and Snowdon as the actual localities. Other locality records, subsequently recorded by Kevan (1961) and Kevan, LeRoux and d'Ornellas (1963), indicated that this species was extending its range (See Table I). More recent captures have extended the known distribution to the east and north of the original point of entry, presumably near Montreal.

There is no doubt that *M. roeseli* has extended its range in all directions beyond the points indicated on the distribution map (Fig. 2). It was intended to survey the limits of distribution during 1965, but this survey was not made due to ill health of the author. *M. roeseli* almost certainly occurs in Vermont and in eastern Ontario, although no specimen has yet been taken in these

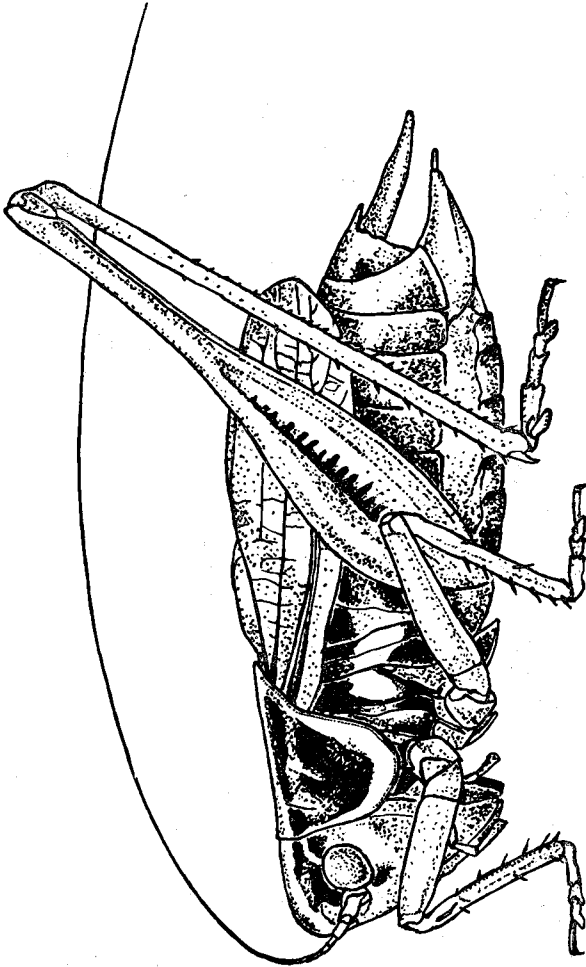


FIG. 1. *Metrioptera roesseli* (Hgb.), male.

TABLE I. *Metrioptera roeselii* locality records.

Year	Author	Locality ¹
1952	Urquhart and Beaudry (1953)	Ville St. Laurent Bordeaux Snowdon (Montréal)
1953	Beaudry (1955)	St. Martin de l'Île Jésus Île Perrot Ste-Geneviève de Pierrefonds
1954	Beaudry (1955)	Mount Royal (Montréal)
1954-55	Kevan (1961)	Rougemont
1959	Present Paper	Ste-Anne de Bellevue
1960	Kevan (1961)	Bois des Filion Ste-Anne de Bellevue
1961	Kevan <i>et al.</i> (1963)	St-Jean Frelighsburg Franklin Centre Hemmingford
1962	Kevan <i>et al.</i> (1963: footnote)	Choisy Ste-Barbe Harrigan's Corners, N.Y. Meacham Lake, N.Y.
1963	Present Paper	Vaudreuil Brownsburg (Lac Louisa) Nicolet South Bolton Knowlton, 5 mi. E. Pike River St-François du Lac Shawinigan Falls, 4 mi. S. St-Barnabé, 21 mi. S.
1964	" "	Mille Isles Granby 6 mi. S. E. of St. Andrews East (Point au Grec)
1965	" "	Rivière Beaudette Mont Gabriel

¹Only first records for a given locality are included, except for Ste-Anne where the earliest capture has not previously been reported. (See Footnote in text for additional distribution).

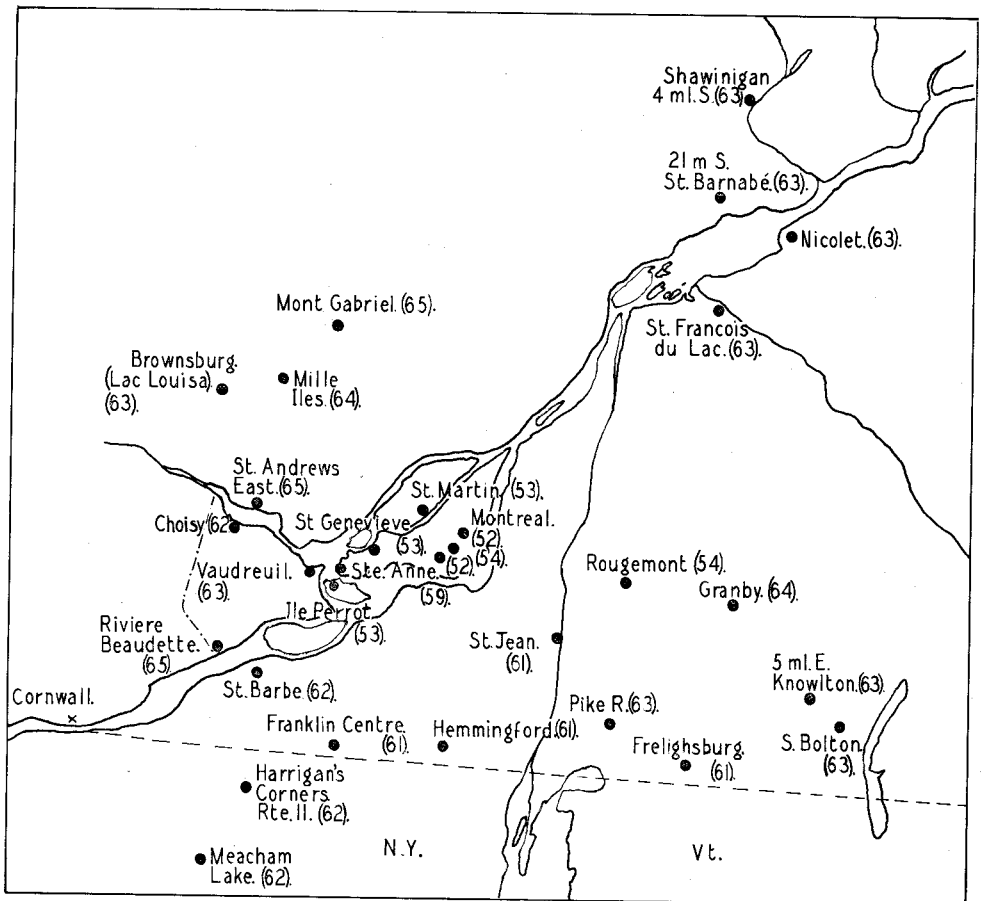


FIG. 2. Present known distribution of *Metrioptera roeseli* (Hgb.). (See Footnote in text for additional distribution).

areas. There is also little doubt that it extends well into the Laurentian Mountains to the north, and probably nearly to Quebec City in the east.¹

Macropterism and Dispersal

Metrioptera roeseli, in its native range, west, central and southern Europe and western Siberia, is normally brachypterous. Like other species, related to it, it also occurs in a macropterous form (form *diluta* Charpentier, 1825), but in Europe this is comparatively rare. Occasionally, it occurs in fairly large numbers in localized populations. Ramme (1931; 1951) and Ebner (1951) considered macropterism to be the result of cool soil conditions in spring and humid environment. No such correlation is associated with macropterism of *M. roeseli* in Canada. (See Kevan, 1961).

¹Subsequent to submission of this paper, the author has been informed by Dr. Harold J. Grant, Jr., Curator of Insects, The Academy of Natural Sciences of Philadelphia (personal correspondence), that *M. roeseli* has been collected near Ithaca, New York, by Dr. L.L. Pechuman, Curator of Insects, Cornell University. Further, Dr. Grant stated that Dr. T. J. Walker has reported verbally to him that it is now extremely common in western and southern New York State and in his opinion probably occurs in Pennsylvania as well.

Ramme (11. cc.), Urquhart and Beaudry (1953) and Kevan (1. c.) indicated that the macropterous form might operate as a dispersal phase, but the last-mentioned observed that "this remains to be seen".

Almost all of the first records of this species in North America were of the brachypterous form, the only exceptions being two single specimens from Ste. Genevieve and Mount Royal (Beaudry, 1955). In 1959, however, the only specimens taken, two males and a female (previously unrecorded) from Ste. Anne de Bellevue in August were all macropterous. In 1960 extensive collections in the Montreal area produced only one brachypterous specimen among many macropterous ones. Kevan *et al.* (1. c.) reported the proportion of macropterous forms to be very high in 1961, nearly half the total, but this fell to about one-third in 1962. During the years 1959 to 1965, the proportion of macropterism fell steadily from 100 per cent (although the 1959 sample was admittedly very small) to 3 per cent of the total population (See Table II).

TABLE II. *Metrioptera roeseli* wing-type proportion

Year and Locality	Macropterous			Brachypterous		
	♂	♀	%	♂	♀	%
1959 Ste-Anne	2	1	100	0	0	0
1960 Ste-Anne	12	8	91	1	1	9
1961 St-Jean	24	50	43	29	65	56
1962 Ste-Anne	0	11	27	41	98	73
1963 Ste-Anne	0	0	0	3	7	100
1964 Ste-Anne	4	4	5	94	90	95
1965 Ste-Anne ¹	0	5	3	73	70	97

¹To 15th of August, 1965.

The present proportion is reaching a condition similar to that considered to be normal in Europe. Thus there would seem no longer to be any doubt that the macropterous form is a dispersal phase. It is possible that very localized unfavourable conditions could induce production of a higher proportion of macropterism than is normal. The theory of Ebner and Ramme (11.cc.) that humid conditions together with cool soils are the governing factors is not valid in North America. There is no correlation between soil temperature and macropterism, and *M. roeseli* is always found in habitats where humidity is high; e.g. at the stem bases in tall grass except when migrating (as in the centre of Montreal — see Kevan (1961)).

Factors Governing Levels of Local Populations

Sharma (1963) reported levels of parasitism in *M. roeseli* by *Mermis nigrescens* DuJardin, a nematode which also attacks other Orthoptera in

TABLE III. Parasitism of *M. roeseli* by *Mermis nigrescens*. (Adapted from Sharma, 1963)

Month	Nymphs			Adults		
	No.	No. infested	% infested	No.	No. infested	% infested
June	252	197	78	—	—	—
July	54	35	65	63	32	51
August	12	4	33	11	5	45

Western Quebec, as well as in many other parts of the world. Previous reference to parasitism of *M. roeseli* by this parasite, native to the area, was made by Kevan *et al.* (1.c.), who illustrated (fig. 3) a female containing a mermithid nematode, at that time unidentified. Sharma (1.c.) stated that this nematode had a definite regulatory effect upon the local population. Table III, adapted from Sharma, shows the level of parasitism in nymphs and adults through June, July and August, 1962. Although nematodes were found throughout the body cavity, averaging three to four per host, they were concentrated in the region of the gonads, which were destroyed. The percentage parasitism is higher early in the season than later. This is probably due to two factors, decrease in the number of viable eggs of the parasite due to desiccation, and decrease in the numbers of the host. Sharma found a variation in percentage of infestation from 37 to 83 per cent in nymphal instars and from 30 to 57 per cent in adults.

Another factor which may regulate population levels is cannibalism. This fact was pointed out by Kevan *et al.* (1.c.) from cage tests and both Sharma (1.c.) and the present author have observed cannibalism in the field. Partially consumed nymphs were found in the field, and the present author has, on several occasions, observed fatal cannibalistic attacks on nymphs which were moulting under field conditions.

Forecast

Metrioptera roeseli will continue to spread over much of the eastern part of Canada and the United States. Since it requires a humid habitat, it will be confined to areas where grass is undisturbed from year to year. Mowing of grass for hay effectively removes the population, as this renders the area unsuitable, since humidity is decreased. Removal of the grass also removes oviposition sites as females oviposit in the soft internodes of plant stems, and eggs deposited prior to cutting would be removed. It is thus doubtful that this species would ever become an agricultural pest in North America although it is capable of causing considerable damage to grass in undisturbed areas.

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