Recent range expansion of the Praying Mantis, *Mantis religiosa* Linnaeus (Mantodea: Mantidae), in British Columbia

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ABSTRACT

The Praying Mantis, *Mantis religiosa*, was introduced into eastern North America in the 1890s and is now a common species throughout much of the eastern United States and southern Ontario and Quebec. It was introduced from Ontario into the southern interior of British Columbia to control grasshoppers in 1937 and 1938. These introductions became established only in the southern Okanagan Valley where populations have persisted from Okanagan Falls south to Osoyoos. Since the late 1990s, the species' range has expanded from the South Okanagan north at least to Kamloops and east to Nelson. In addition, in the core of its traditional British Columbia range, the South Okanagan, this mantid has become more commonly encountered during the past decade. *M. religiosa* has also been collected on Vancouver Island. Specimen, photograph and sight records that document this change in status are listed and discussed and a distribution map is included. Characters used to distinguish *M. religiosa* from the native Ground Mantis, *Litaneutria minor*, and the exotic Chinese Mantis, *Tenodera aridifolia sinensis*, which is available commercially as a biocontrol agent, are summarized.

INTRODUCTION

The Praying Mantis, *Mantis religiosa* Linnaeus, was introduced into the eastern United States and Canada from Europe, being first reported in New York State in 1899 and in Prince Edward County, Ontario in 1914 (McLeod 1962). It appeared in Quebec by about 1940 (Kevan 1979). It was introduced from Ontario into the Okanagan and Thompson valleys in the southern interior of British Columbia (BC) to control grasshoppers in 1937 and 1938 (Baird 1938, 1939; Buckell 1941; Vickery and Kevan 1983). Mantid oothecae (egg cases) were found in Salmon Arm orchards as late as 1940 (Buckell 1941); however, McLeod (1962) stated: "the insect has not been observed in recent years and there is no evidence of its permanent establishment in British Columbia". Currently, it is thought that the initial releases of *M. religiosa* became established only in the southern Okanagan Valley. Since the early 1970s, *M. religiosa* specimens regularly have been found between Okanagan Falls and Osoyoos (Cannings and Scudder 2001); both the green and brown colour phases occur there (Cannings 1987). More recently, especially since the late 1990s, I have collected reports from interested naturalists and the general public that indicate that the species' range has expanded in BC. It also is found in Washington and Idaho, although it is not clear how those populations arrived. Although most of the BC records are not museum specimens, the photographs and written sight records are largely convincing. This paper documents the spread and present status of *M. religiosa* in the Province.

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MATERIALS AND METHODS

Data were collected from adult specimens and oothecae of *Mantis religiosa* from the collections of the Royal British Columbia Museum, Victoria, BC (RBCM), the Spencer Entomological Museum, University of British Columbia, Vancouver, BC (UBCZ) and the Canadian National Collection of Insects, Agriculture and Agri-Food Canada, Ottawa, ON (CNCI) and the personal collection of Ward Strong, Vernon, BC (STRONG). The collections of the Pacific Forestry Centre, Canadian Forest Service, Victoria, BC and the Lyman Entomological Museum, McGill University, Ste. Anne de Bellevue, QC do not contain any specimens of *M. religiosa* from BC.

Photographs and sight records were compiled from personal communications to the author from colleagues and the general public.

RESULTS

Specimens examined (all specimens are single adults unless otherwise noted):

Duncan, Maple Bay, 6139 Denali Place, near Quamichan Lake, 31.x.1999, L. Taylor (RBCM, ENT001-011034); Naramata, 27.viii.1998, R.C.H. Cannings (RBCM, ENT000-000416, ootheca and hatchlings in ethanol); Okanagan Falls, 22.v.1986, S. Orchard (RBCM, ENT991-014761, -014762, -014763, 3 oothecae); Okanagan Falls, White Lake, 49º17'58.8"N x 119º37'21.1"W, 29.v.2006, R.A. Cannings (RBCM, ENT006-004184, ootheca); Oliver, ix.1975, B. Francis (CNCI, in ethanol); Oliver, ix.1990, S. Orchard (RBCM, ENT991-066770); Oliver, 10 miles south, *Artemisia-Purshia* habitat, 1.x.1963, W.B. Preston (UBCZ); Oliver, UBC Geology Camp, 3.ix.1982, S.G. Cannings (UBCZ, 5 specimens); Osoyoos, 14.v.1972, no collector stated (CNCI, ootheca collected and reared to adult, in ethanol); Osoyoos, 29.viii.1976, no collector stated (RBCM, ENT991-014757); Osoyoos, at light, 23.viii.1982, J.A. Garland (RBCM, ENT991-014756); Osoyoos, Deadman Lake, 6.ix.1980, L. Vasington (UBCZ, 2 specimens *in copula*); Osoyoos, Haynes Ecological Reserve, 3.ix.1983, R.A. Cannings (RBCM, ENT991-017647); Osoyoos, Haynes Ecological Reserve, pitfall trap, 6.vii.-17.viii.2000, G.G.E. Scudder (UBCZ); Osoyoos, Haynes Ecological Reserve, pitfall trap, 25.vi.-22.vii.2003 (UBCZ); Osoyoos, Osoyoos Desert Society, 20.viii.1998, P. Liu (UBCZ); Osoyoos, Haynes Point Prov. Park, 20.viii.1977, C. Denbigh (RBCM, ENT991-014758, -014759, 2 specimens); Osoyoos, Road #22, 10.vii.1986, R.A. Cannings (RBCM, ENT988-001350, ootheca); South Okanagan Valley, vii-viii.1984, S.R. Cannings (UBCZ); Pend d'Oreille Valley**,** east of Waneta, 11U 463978 5432563, 700m asl**,** 26.iv.2004, J. Dulisse (RBCM, ENT007-002472, ootheca); Summerland, 19.viii.2005, D. Chan (UBCZ); Vaseux Lake, Hack's Ponds, 19.v.1980, R.A. Cannings (RBCM, ENT991-014433, ootheca); Vernon, Kalamalka Seed Orchards, 10.v.2004, W. Strong (STRONG); Vernon (50º17.909'N x 119º16.463'W), 24.viii.2007, G. French (RBCM, ENT007-001057, ootheca); Vernon, 4.ix.2007, B. Corbett (RBCM, ENT007-002457); Vernon, Middleton Mtn., 10.ix.2007, M. Fowler (RBCM, ENT007-002458); Vernon, Kalamalka Seed Orchard #307, 18.ix.2007, D. Hopkins (RBCM, ENT007-002459, ootheca); Vernon, 10.x.2007, W. Strong (RBCM, in ethanol, ENT007-002460).

Photographs:

Armstrong, near Tolko Lumber Mill, Hwy 97, south of town, 23.viii.2007, Karen Meggait (brown adult found on 18.viii.2007); Castlegar, side of house, 23.ix.2002, Lynn Westcott (green adult); Castlegar, in ornamental cedar tree, 27.ix.2002, Lynn Westcott (brown adult); Castlegar, 25.v.2005, Genevieve Lachance (ootheca with hatchlings); Kamloops, Knutsford, grassland and Ponderosa Pine

habitat, on garage door, 12.x.2006, Richard Suttie (green adult); Lake Country, backyard near grassland, 7.viii.1998, Steve Kidd (brown adult); Lake Country, 21.vii.1998, Steve Kidd (yellowish adult); Okanagan Falls, White Lake, 1.ix.2006, V. Skilton (brown adult); Oliver, 22.iii.2006, Werner Eigelsreiter (ootheca); Oliver, 23.ix.2006, Werner Eigelsreiter (green adult); Oliver, 24.ix.2006, Werner Eigelsreiter (brown adult); Osoyoos, Haynes Point Prov. Park, vii.1974, Sydney Cannings (brown adult); Taghum (west of Nelson), ix.2004, Rachel Holt *fide* Jakob Dulisse (green adult); Trail, Oasis Wetland, 26.viii.2007, Bruce Enns (green adult) (Fig. 1); Vernon (50º17.909'N x 119º16.463'W), 25.v.2007, Lea Gelling (ootheca, collected 24.viii.2007, RBCM, ENT007-1057);Vernon, 50º17.909'N x 119º16.463'W, 15.viii.2007, Gord French (green adult).

Other records without specimen or photo:

Deer Park, Lower Arrow Lake (11U 425791 5474447 NAD 83), 14.vi.2004, Jakob Dulisse (ootheca); Kelowna, on house, about 25.ix.2000, *fide* Tanis Stoltz (adult); Keremeos, road to Keremeos Columns, sagebrush grassland, early vii.2001, Malcolm Martin (green immature and oothecae); Oyama, on house, 30.ix.2000, Tanis Stoltz (adult); Osoyoos, East Bench, 28.viii.2007, G.G.E. Scudder (adult male); Osoyoos, East Bench, 29.viii.2007, G.G.E. Scudder (adult male and female); Peachland, 6412 Renfrew Road, 25.viii.1998, Bill Fleming (green and brown adults); Port Alberni, Sproat River, Seaton Park, on tent, vii-viii.1991, Dee Cullon (green adult); Vernon, garden on north side of Middleton Mountain, summer 1999 or 2000, *fide* Malcolm Martin (green adult).

Figures 2 and 3 map the records documented above.

Figure 1. *Mantis religiosa*: Trail, 26 August 2007. Photo: Bruce Enns. This green adult is feeding on a female dragonfly, *Sympetrum obtrusum* (Hagen) and represents one of the more easterly records of the species in BC. The black-ringed white spot on the inner base of the procoxa is diagnostic of *M. religiosa*.

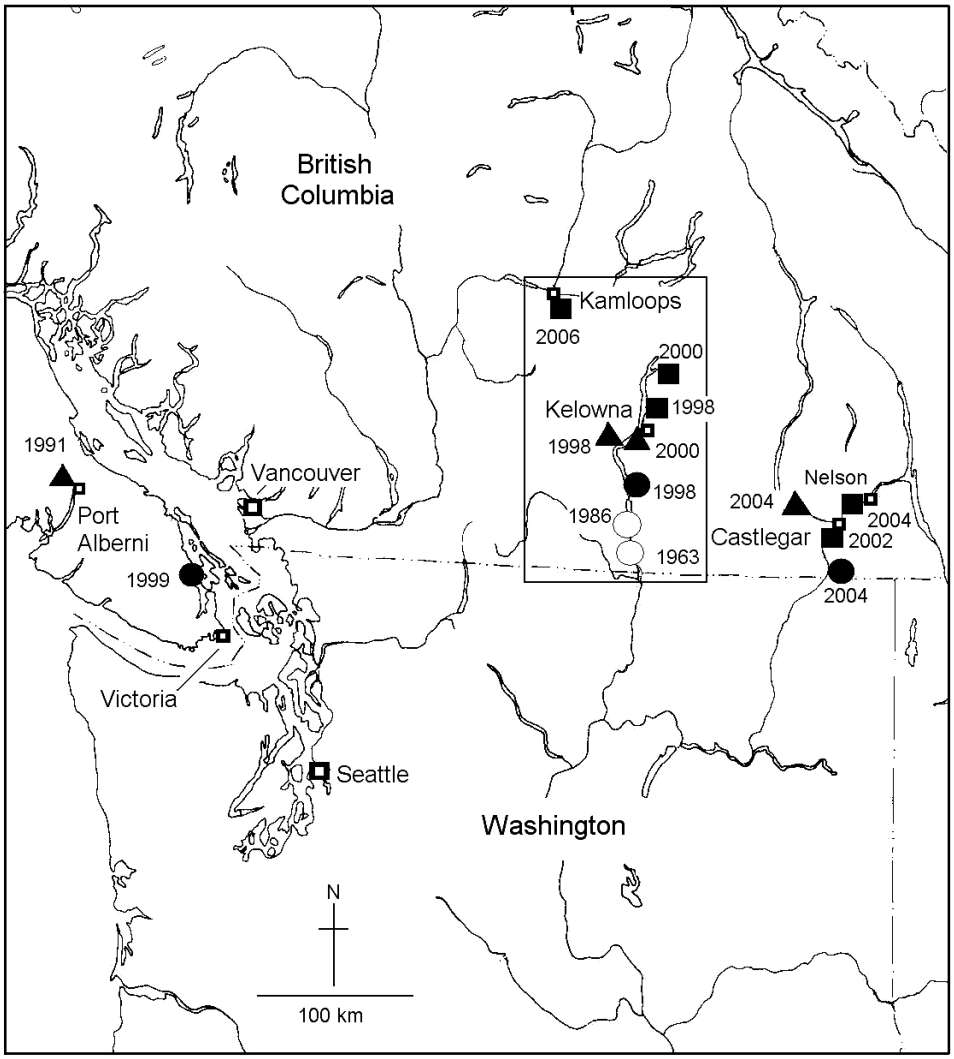

Figure 2. Map of southern British Columbia and northwestern United States showing selected distribution records of Mantis religiosa. Symbols: ● specimen records, including oothecae; ■ photographic records; ▲ sight records. Open symbols represent records before 1998. The dates represent the first records for the localities and illustrate the general geographical and temporal trend of range expansion. Rectangle shows area of Fig. 3.

DISCUSSION

In 1937, 491 oothecae and 161 adult *Mantis religiosa* from Europe and Ontario were released in the Okanagan Valley and the Kamloops-Shuswap region (Baird 1938). The next year, at Salmon Arm and Vernon, 175 oothecae and 175 adults were introduced (Baird 1939). Buckell (1941), who was interested in grasshopper control, at first expressed hope that the introductions might succeed: "The finding of two fresh egg masses laid in apple boxes in the orchards at Salmon Arm [in 1940] shows that it is still present and may yet become thoroughly established." But Vickery and Kevan (1983) point out that even though this generalist predator favours Orthoptera prey in many situations, the slow rate of mantid reproduction makes it an unsuitable

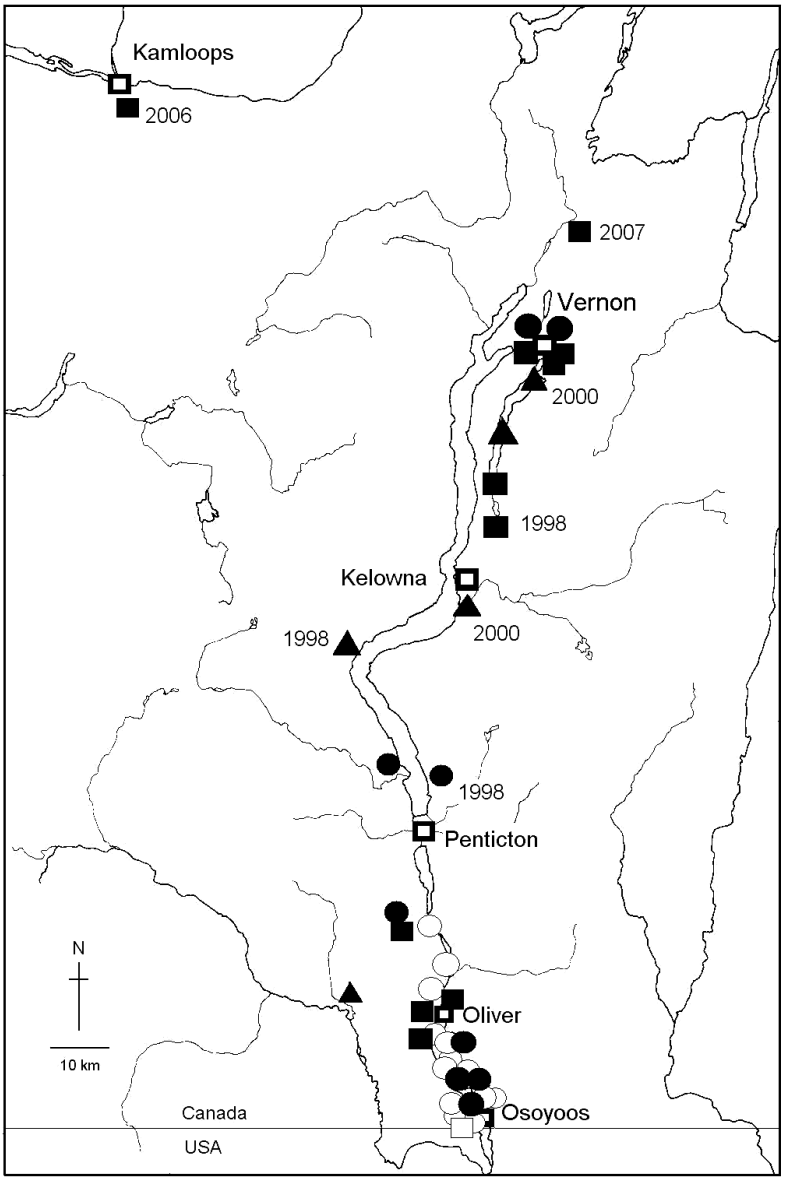

Figure 3. Map of the Okanagan Valley and part of the Thompson River drainage to the north showing some distributional details not given in Fig. 2. Symbols: ● specimen records, including oothecae; ■ photographic records; ▲ sight records. Open symbols represent records before 1998. The dates represent the first records for the localities and illustrate the general geographical and temporal trend of range expansion.

biological control agent.

However, although no mantids were ever reported from most of the areas where these releases were made, by about 1962 periodic specimen sightings and collections were being made in the extreme southern part of the region. The first specimen known to me was from 10 miles south of Oliver in 1963. By the end of the 1970s, if one looked specifically for mantids, they could be found in small numbers in the Oliver-Osoyoos area, although few specimens were collected. Without evidence to support other origins for this population, it

has always been assumed that it derived from the releases of 1937-38.

As far as I am aware, since 1940, no *Mantis* specimens were collected and no observations were reported from the Thompson/Shuswap region or the Okanagan Valley north of Okanagan Falls until 1998 when specimens were recorded in Naramata, Peachland and Lake Country (=Winfield, north of Kelowna). In 2000, mantids were first reported from Kelowna and Oyama; to the north in Vernon, the first sightings were made about the same time. Jim Corrigan (pers. comm.) notes that he saw several mantids around the BC Ministry of Forests Kalamalka Seed Orchards at the southern edge of Vernon in 2006 and that staff there have seen specimens around Vernon for several years. The first Vernon specimen was collected in 2004 (Ward Strong, pers. comm.), and several specimens were taken at Vernon in 2007. There is also a photographic record from Armstrong in 2007. The only recent record in the Thompson/Shuswap was from Knutsford near Kamloops in 2006. This sequence of dates moves more or less from south to north (Fig. 3), suggesting that the mantid population expanded in this direction, the northern specimens descending from the long-standing South Okanagan population rather than resulting from recent independent introductions. This would also seem to be the most parsimonious explanation. The same goes for the numerous mantids now seen in the West Kootenays (Figs. 2), especially in the Castlegar region. The first two reports were from Castlegar in 2002; the next ones were all in 2004 – northwest in Deer Park, northeast in Taghum and south near Waneta. Figure 1 illustrates an adult from Trail in 2007. This expansion well north and east of the South Okanagan is probably the result of both natural dispersal and, more importantly, movement aided by human activity. Mantid adults are not strong wanderers but oothecae are laid on all sorts of solid substrates and can be transported long distances on trailers and other vehicles. It is unclear why, after decades of stability in the southern Okanagan Valley, this population has expanded almost 200 km, to both the north and east, in fewer than ten years.

Although few specimen collections have been made and the evidence is anecdotal, this range expansion has occurred at the same time that residents of the South Okanagan have observed an increase in mantid abundance from Osoyoos north to the Penticton region. My brothers and I were raised in the Penticton-Summerland area and since the 1950s we roved all over the countryside looking for animals and plants. Never once before the mid-1990s did we see a mantid anywhere north of Okanagan Falls, and south of there, they were uncommon. My brother Richard (pers. comm.), who now lives in Naramata, writes: "They are common in late summer and fall – you see them often while walking along the Kettle Valley Railway trail or similar trails in late August and early September and I often find egg cases. I can't say I've noticed an increase since we moved here in 1995 – I just remember that shortly after we arrived I realized that I was seeing them regularly". Geoff Scudder (pers. comm.) says he frequently sees adults, mostly gravid green females, around Osoyoos. He has observed them in the native steppe vegetation and in his garden, where he finds oothecae and two to three adults each year.

There are no coastal mainland records of *M. religiosa* in BC, but there are two from Vancouver Island – an early sight record from the Port Alberni area in 1991 and a specimen from Duncan in 1999 (Fig. 2). Presumably these are the result of long-distance, human-aided dispersal or purposeful release of adults from the BC interior or elsewhere. The Duncan specimen was the only one that was observed in 1999 and one more was seen in 2000 (no date). None has been seen there since. Laurie Taylor (pers. comm.), who made these observations in her garden, believes that the mantids originated from plants she bought at a local nursery.

There are also populations in Idaho and Washington State, including coastal ones,

that may be potential sources of additional introductions. Antonelli and Glass (2004) report specimens of introduced mantids (not necessarily *Mantis religiosa*) from western Washington counties such as Clark, Cowlitz, Pierce and King as well as from east of the Cascade Mountains; all specimens observed by colleagues in Washington seem to be *M. religiosa*. Kelly McAllister (pers. comm.) states that populations of *M. religiosa* in the prairies of south Puget Sound are large: "I've heard that there are literally thousands that fly about when Scot's Broom [*sic*] is being mowed at Scatter Creek Wildlife Area in late summer. I think the Nature Conservancy folks who mow Scot's Broom at places like McChord Air Force Base and Fort Lewis would probably attest to the widespread distribution and general abundance on prairie areas at least. It's my sense that they are very firmly established in appropriate habitat in the south Puget lowlands." Probably, *M. religiosa* could rather readily spread from northwestern Washington into coastal BC.

Tenodera aridifolia Stoll ssp. *sinensis* Saussure (Chinese Mantid) is an unrestricted and commercially produced species of mantid available as a biological control agent and in the pet trade in BC (David Blades, pers. comm.). It is released in gardens in attempts to control pests, although Don Elliott of Applied Bio-nomics (pers. comm.) considers it ineffective as it often feeds on other beneficial insects. Undoubtedly, releases of *T. a. sinensis* into greenhouses and gardens have occurred many times over the years in BC but no established populations are known. Experiments on the survival ability of the species in various locations in BC are required to determine whether this species is capable of becoming established here. Possibly, the development of *T. a. sinensis* requires more accumulated degree-days than are available on the BC coast (David Blades, pers. comm.).

In Canada, this Asian species is an exotic resident of extreme southern Ontario (the shores of lakes Erie and Ontario) and is recorded from, but not established in, southern Quebec (Vickery and Kevan 1983). It is also known from California. Adults are larger than those of *Mantis* (*Tenodera*: 83-104 mm long; *Mantis*: 47-56 mm long (Vickery and Kevan 1986)); the middle and hind femora have an apical spine lacking in *M. religiosa*; and the black-ringed white spot on the inner base of the procoxa characteristic of *M. religiosa* is absent (Vickery and Kevan 1986).

The Ground Mantis, *Litaneutria minor* (Scudder), Canada's only native mantid, also occurs in the southern Okanagan Valley where, in some habitats, such as antelope-brush (*Purshia tridentata* (Pursh) de Candolle) and big sagebrush (*Artemisia tridentata* Nuttall) grasslands it is sympatric with *Mantis religiosa* (Cannings 1987). However, it is easily distinguished from the latter; Cannings (1987) gives characters to separate the two species. Briefly, *Litaneutria* adults are grey to dark brown and less than 35 mm long while those of *Mantis* are green or pale brown and much longer than 35 mm. Females of the former have short, non-functional wings, one-third or less the length of the abdomen, while males are usually fully winged with a dark spot on the hindwing. Both sexes of *M. religiosa* are winged and have a black-ringed white spot on the inner base of the procoxa. Vickery and Kevan (1986) key the three species that occur in Canada.

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REFERENCES

Antonelli, A. and J.R. Glass. 2004. Mantids in Washington. Washington State University Extension. http://www.puyallup.wsu.edu/plantclinic/resources/pdf/pls9mantidsinwashington.pdf. Accessed 22 August 2007.

Baird, A.B. 1938. Summary of insect parasites and predators liberations in Canada up to December 31, 1937. Canadian Insect Pest Review 16: 77-154.

Baird, A.B. 1939. Summary of parasite liberations in Canada during the year 1938. Canadian Insect Pest Review 17: 102-128.

Buckell, E.R. 1941. Field Crops and garden insects of the season 1940 in British Columbia. Canadian Insect Pest Review 19: 81-84.

Cannings, R.A. 1987. The Ground Mantis, *Litaneutria minor* (Dictuoptera: Mantidae) in British Columbia. Journal of the Entomological Society of British Columbia 84: 64-65.

Cannings, R.A. and G.G.E. Scudder. 2001. An overview of systematic studies concerning the insect fauna of British Columbia. Journal of the Entomological Society of British Columbia 98: 33-59.

Kevan, D.K. McE. 1979. Dictuoptera, pp. 314 –316. *In* H.V. Danks (ed.), Canada and its insect fauna. Memoirs of the Entomological Society of Canada volume 108. Entomological Society of Canada, Ottawa, Ontario, Canada.

McLeod, J.H. 1962. Part I: Biological control of pests of crops, fruit trees, ornamentals and weeds in Canada up to 1959, pp. 1-33. *In* J.H. McLeod, B.M. McGugan and H.C. Coppel (eds.), A review of the biological control attempts against insects and weeds in Canada. Technical Communication of the Commonwealth Institute of Biological Control volume 2, Silwood Park, Ascot, United Kingdom.

Vickery, V.R. and D.K. McE. Kevan. 1983. A monograph of the orthopteroid insects of Canada and adjacent regions. Vol. 1. Memoirs of the Lyman Entomological Museum and Research Laboratory volume 13. Lyman Entomological Museum and Research Laboratory, McGill University, Ste. Anne de Bellevue, Quebec, Canada.

Vickery, V.R. and D.K. McE. Kevan. 1986. The grasshoppers, crickets and related insects of Canada and adjacent regions. Ulonata: Dermaptera, Cheleutoptera, Notoptera, Dictuoptera, Grylloptera and Orthoptera. The insects and arachnids of Canada. Part 14. Research Branch, Agriculture Canada Publication 1777. Ottawa, Ontario, Canada.