Journal of the Lepidopterists' Society
63(1), 2009, 31–36

MELITARA WALKER (PYRALIDAE) IN WESTERN CANADA: THE DOCUMENTATION OF *M. SUBUMBRELLA* (DYAR) IN THE PRAIRIE PROVINCES DEMONSTRATES THE VALUE OF REGIONAL COLLECTIONS AND SPECIES LISTS.

THOMAS J. SIMONSEN
Department of Biological Sciences, University of Alberta, Edmonton, AB, Canada; email: thomas.simonsen@ualberta.ca

JASON J. DOMBROSKIE
Department of Biological Sciences, University of Alberta, Edmonton, AB, Canada.

AND

GREGORY R. POHL
Natural Resources Canada, Northern Forestry Centre, Edmonton, AB, Canada.

ABSTRACT. The moth genus *Melitara* comprises 8 recognized species of medium sized to large micromoths that all feed on *Opuntia* cacti as larvae. One species, *M. dentata* is widespread in western North America, including the southern parts of the Canadian provinces British Columbia, Alberta and Saskatchewan. We report the presence of a second species, *M. subumbrella* in southern Alberta and Saskatchewan, a species hitherto widely believed to extend no farther north than southern Idaho and Wyoming. Closer examinations of *Melitara* collections in major Canadian museums and public collections revealed several additional *M. subumbrella* specimens from Alberta, including specimens from the 1940s. Two specimens were actually reported by K. Bowman (1951) under a previous taxonomic arrangement, but were subsequently overlooked by later workers on North American Phycitinae. Combined with subtle differences in mitochondrial DNA, this leads us to conclude that *M. subumbrella* has been present in Canada for a long time. This provides an excellent example of the scientific value of continuous insect collecting, well-curated regional collections, and regional faunal lists.

Additional key words: Disjunctive distribution, mitochondrial DNA, cactus-feeding

The pyralid genus *Melitara* Walker, a prominent group of cactus-feeding phycitines, is found throughout much of the USA, southwestern Canada, and northern Mexico. One species, *M. prodenialis* Walker, is widespread throughout the east, and another species, *M. dentata* (Grote), is widespread in the west. The remaining 6 species are all restricted to Mexico and the southwestern USA with only *M. subumbrella* (Dyar) extending north to Wyoming and southern Idaho, and west to southern California (Heinrich 1956; Mann 1969; Neunzig 1997). Bowman (1951) reported *M. dentata* and *Olycella* [=*Melitara*] *nephelepasa* from Alberta, but his records were ignored by later workers. The latter is referable to *M. subumbrella*, which was considered to be a synonym of *M. nephelepasa* at the time (McDunnough 1939). A full list of currently recognized species of *Melitara* and their reported range is given in Table 1. Neunzig (1997) included the genus *Olycella* Dyar in *Melitara*, with the three species *O. subumbrella, O. junctionella* (Hulst) and *O. nephelepasa* (Dyar) (Heinrich 1939, 1956). This synonymy has later been shown to be systematically justified (Simonsen 2008). It is not currently clear whether *Melitara* and *Olycella* (both sensu Heinrich 1956) are reciprocally monophyletic and thus deserve subgenus status. All species in the genus feed strictly on prickly pear cactus in the genus *Opuntia* (Mann 1969) and are thus restricted to habitats with *Opuntia*.

Identifying *Melitara subumbrella*. Both *M. subumbrella* and *M. dentata* are large micromoths with wingspans exceeding 50 mm. With their stout bodies and rectangular wings they have a superficial similarity to medium sized Noctuoidea. The resting moth with its large porrect palps, and the wings coiled cigar-like around the body is fairly easy to identify as a phycitine (Fig. 1). Fresh specimens can fairly easily be identified to species without dissection (at least in areas where only *M. subumbrella* and *M. dentata* occur). Both species have white hind wings and gray forewings (sometimes with a yellowish cast—especially in older collection specimens). *Melitara dentata* has a fairly elaborate zigzag pattern across the forewing, whereas *M. subumbrella* has uniformly gray forewings almost devoid of any pattern (Fig. 2a, b). Old, faded, and especially denuded specimens can be much harder to identify. In this case dissection is often necessary. Females are easy to identify based on genitalic dissections as *M. subumbrella*. The species formerly

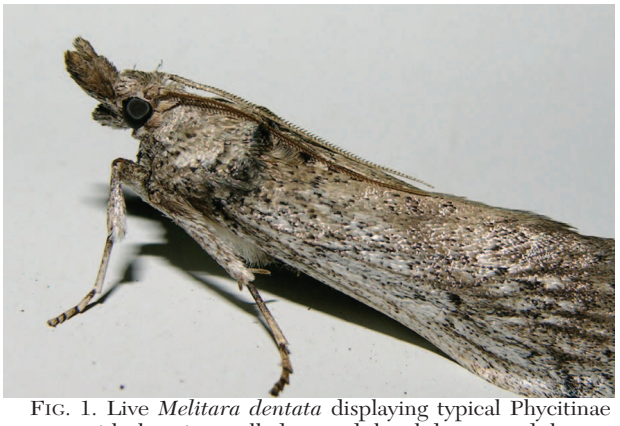

FIG. 1. Live *Melitara dentata* displaying typical Phycitinae posture with the wings rolled around the abdomen and the antennae pressed down along the back. CAN: AB: Buffalo: 50.848°N -110.696°W: 16 viii 2006. Photo: JJD.

grouped in *Olycella* are the only members of *Melitara* with a signum on the corpus bursae (Heinrich 1939, 1956; Neunzig 1997). The males are harder to identify, but the shape of the valves differs slightly between the two species. In *M. dentata* the valve has a fairly pointed apex with curved dorsal and ventral margins. The costa extends almost to the apex of the valve (Fig. 3a). In *M. subumbrella* the valve has a much broader and blunter apex, and the costa does not extend as far (Fig. 3b). Finally, the flight period is often a very good way to tell the species apart. All *M. subumbrella* from Canada were collected between May 15 and July 2, whereas all *M. dentata* were collected between July 27 and October 25, so there is only a small risk of an overlap in flight time between the two species. This pattern where *M. subumbrella* is a late spring to early summer flyer, and *M. dentata* is a late summer to fall flyer seems to be the same in the western USA, though some *M. dentata* are reported from early July (Neunzig 1997).

Herein we report on an examination of *M. subumbrella* specimens, to determine if Canadian populations are distinct from those farther south. To do so, we examined morphological and genetic characters.

MATERIALS AND METHODS

Morphology. To search for morphological differences, two male and one female *M. subumbrella* from Grasslands National Park SK, one male and one female *M. subumbrella* from central USA, and several male and female *M. dentata* were examined. Abdomens were dissected and macerated in 10% KOH, and stained in Chlorazol Black in a 70% ethanol solution by TJS, both for use in this study and others (e.g. Simonsen 2008). Terminology follows Heinrich (1956), Klots (1970) and Neunzig (1997).

Molecular analysis. To test for genetic differences between the Canadian and USA populations, we sequenced 740 bp from the cytochrome oxidase subunit I (COI) gene from three specimens from Grasslands National Park and one from Colorado. DNA was extracted from legs with the QIAgen's DNEasy extraction kit (QIAgen Sciences, Maryland, U.S.A). PCR reactions were performed using the Jerry – Pat primer pair (Simon *et al*. 1994), and the PCR cycling profile was: 95.0ºC for 2 minutes followed by 35 cycles of denaturizing (95.0ºC for 30 sec.), annealing (45.0ºC for 30 sec.) and extension (72.0ºC for 2 minutes). PCR products were purified using the QIAgen's PCR Purification Kit, and the PCR primers were also used for direct sequencing. Sequencing was done with an ABI Prism 377 DNA sequencer using Big Dye®. Consensus sequences from the two sequencing directions were constructed using Sequencher 4.1 and aligned by eye. The sequences are deposited on GenBank under accession numbers FJ422995–FJ423000.

Phylogenetic analysis. An exhaustive maximum parsimony (MP) analysis was carried out in PAUP* 4.10b (Swofford 2002). The haplotype distributions were analyzed in MacClade 4.0 (Maddison & Maddison 2000). The tree was rooted using a *M. dentata* specimen from Alberta as outgroup.

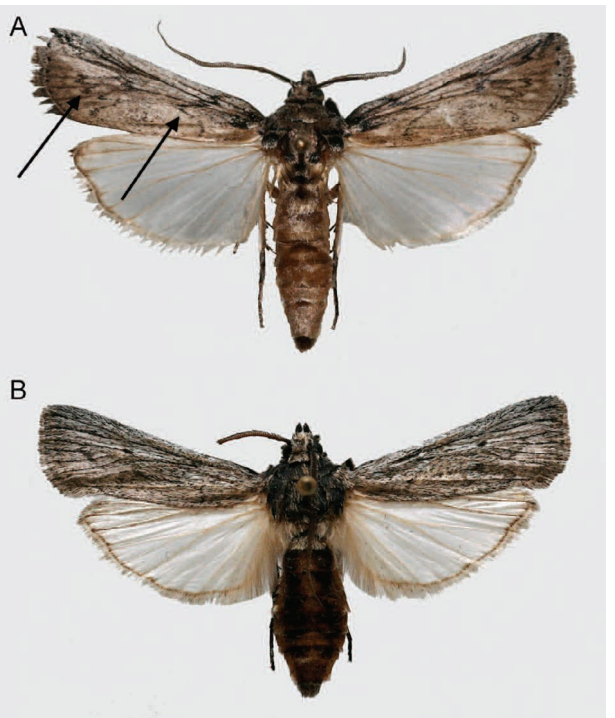

FIG. 2. *Melitara dentata* **(a)** and *M. subumbrella* **(b)** displaying subtle, yet clear differences in forewing pattern (arrows point to the zigzag pattern on the forewing of *M. dentata*).

TABLE 1. Currently recognized species of *Melitara* and their distributions following Heinrich (1956), Mann (1969), and Neunzig (1997).

Species	Distribution
Melitara prodenialis Walker	Southeastern U.S.A. from Texas and Florida to New York
Melitara dentata (Grote)	Interior western North America from north western Mexico, Arizona and western Texas to southwestern Canada.
Melitara texana Neunzig	Texas
Melitara doddalis Dyar	Southern Arizona, southern New Mexico and western Texas.
Melitara apigramella Blanchard & Knudson	Southwestern Texas
Melitara junctionalla Hulst	Southern Texas and eastern Mexico.
Melitara nephelepasa (Dyar)	Central Mexico
Melitara subumbrella (Dyar)	Southwestern USA from southeastern California and western Texas to southern Idaho, Wyoming and Nebraska.

RESULTS

Morphology. When dissected, males from Grasslands National Park were found to be indistinguishable from males from Colorado, USA. The dissected female from Grasslands National Park, showed a very subtle difference. The signum on the corpus bursae was less developed than the corresponding structure in specimens from Colorado.

Molecular analysis. The MP analysis resulted in a single tree 62 steps long (Fig. 4). The four specimens from Grasslands National Park all shared the same haplotype; whereas the specimen from Colorado differed in three base pairs, corresponding to a difference of 0.4%. *M. dentata* differed in 59 base pairs compared to all four *M. subumbrella* specimens, corresponding to a difference of 8.0%.

DISCUSSION

***Melitara* in Canada.** In 2004 GRP collected five specimens of *M. subumbrella* in Grasslands National Park, Saskatchewan. In his annotated list of Lepidoptera in Alberta, Bowman actually reported two specimens of *M. subumbrella* from the Medicine Hat region (Bowman 1951), though he listed them as *Olycella nephelepasa* (following McDunnough 1939). *Melitara subumbrella* is technically a new record for Canada. However, a simple update of Bowman's (1951) checklist, following the synonymy reported in Munroe (1983) would yield the report of this species in Alberta. Both the specimens and Bowman's paper have been overlooked by later workers on the genus in North America (e.g. Heinrich 1956; Mann 1969; Neunzig 1997). One of Bowman's specimens was located in the University of Alberta Strickland Museum. Four other specimens were misidentified as *M. dentata* in the same collection, including another specimen collected by Bowman in 1940 near Medicine Hat. The latter is obviously Bowman's second specimen which later must have been misplaced in a tray with *M. dentata*. The three remaining specimens were collected in 2005 at two different localities in southeastern Alberta. This inspired us to examine other public collections that we felt could hold either overlooked or misidentified specimens of *M. subumbrella* from western Canada. Examinations of the materials in the collections of the Canadian Forest Service (Edmonton, AB), Royal Alberta Museum, (Edmonton, AB), Olds College (Olds, AB), Royal Saskatchewan Museum (Regina, SK) and the Canadian National Collection, (Ottawa, ON) revealed one *M. subumbrella* from Lethbridge, AB collected by C. E. Lilly in 1949, and one from Onefour, AB collected by GRP in 1995. The same examinations also showed that *M. dentata* occurs from south-central

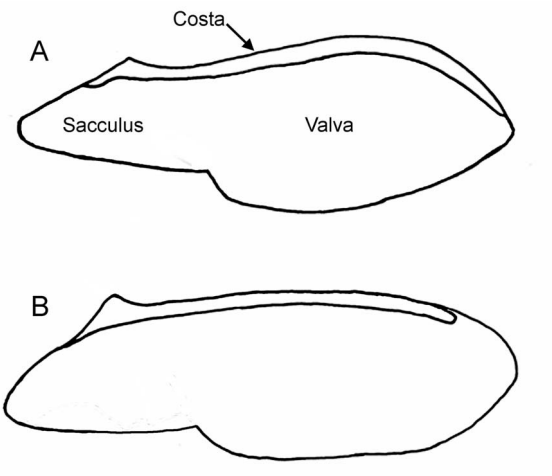

FIG. 3. Differences in male genitalia between *Melitara dentata* **(a)** and *M. subumbrella* **(b)**. Note the more pointed apex of the valve and that the costa extends to the apex in *M. dentata*.

Saskatchewan to the southern interior of British Columbia (Table 2), a more widespread Canadian distribution than reported recently by Neunzig (1997), who only listed the species from southern Alberta. The distributions of both species based on the collection data are shown in Fig. 5. These records underscore the importance of regional collectors, and their published lists and collections, in determining species ranges. Local collectors typically have extensive knowledge of productive collecting localities, and often amass extensive collections of excellent quality (Ferris 1986; Hendra 2005, 2007). These collections and publications are a neglected resource that can yield many exciting finds to the diligent taxonomist.

Two prickly-pear species, *Opuntia fragilis* (Nutt.) Haw. and *O. polyacantha* Haw., occur (sometimes abundantly) throughout the southern parts of Canada's Prairie Provinces (personal painful observations). Though Fragile Prickly-pear Cactus (*Opuntia fragilis*), a possible host plant for *M. dentata* (Mann 1969; Neunzig 1997), occurs scattered in remnants of the Peace River grasslands in northwestern Alberta (Royer & Dickinson 2007), there are no records of *M. dentata* from that region. It is, however, quite possible that *M. dentata*

TABLE 2. Records of *Melitara* in Canada based on the collections listed in the text. Collection acronyms: CNC: Canadian National Collection of Insects, Arachnids and Nematodes; NFRC: Northern Forestry Centre Research Collection; OC: Olds College; RSM: Royal Saskatchewan Museum; UASM: University of Alberta, Strickland Museum.

Species	Locality	Coll. period	Year	No.	Collection
M. dentata	Grasslands National Park, SK	24/7-12/9	2002	6	RSM
M. dentata	Buffalo Pond Provincial Park, SK	7/8-25/8	1974, 1984-85	3	RSM
M. dentata	Wood Mountain Park, SK	4/9	2002	2	RSM
M. dentata	Fort Qu'Appelle, SK	12/8-31/8	1976, 1991	2	RSM
M. dentata	St. Victor, SK	14/8	2002	1	RSM
M. dentata	Matador, SK	7/8	2002	1	RSM
M. dentata	Eastend, SK	reared	1974	1	RSM
M. dentata	Saskatchewan Landing Provincial Park, SK	10/8	1981	1	RSM
M. dentata	Scout Lake, SK	27/8	1968	4	CNC
M. dentata	Swift Current, SK	8/8	1936	1	CNC
M. dentata	Tolman Bridge, AB	3/8-25/10	2000-2, 2006	13	UASM, NFRC, OC
M. dentata	Taber, AB	14-15/8	1999, 2005	2	OC
M. dentata	Medicine Hat, AB	17/8	1943	1	UASM
M. dentata	Edgerton, AB	24-25/8	2002	1	UASM
M. dentata	Steveville Bridge, AB	13/8	1999	2	UASM, NFRC
M. dentata	Buffalo, AB	16/8	2006	1	UASM
M. dentata	Champion, AB	3/8	1961	12	CNC
M. dentata	Coaldale, AB	4/8	1961	8	CNC
M. dentata	Manyberries, AB	10/8	1951	1	CNC
M. dentata	Lethbridge, AB	26/7-24/8	1921-22, 1949, 1986	6	CNC
M. dentata	Willow Creek Canyon, AB	29/7	1961	4	CNC
M. dentata	Kamloops, BC	5/8-9/8	1937, 1956	4	CNC
M. dentata	Nicola, BC	29/8-6/9	1922-23	4	CNC
M. dentata	Oliver, BC	1/8-15/9	1923, 1953	113	CNC
M. subumbrella	Grasslands National Park, SK	2/6	2004	5	NFRC
M. subumbrella	Onefour, AB	19/6	1995	1	NFRC
M. subumbrella	Lost River Valley w. of Onefour, AB	20-21/5	2005	1	UASM
M. subumbrella	Medicine Hat, AB	31/5	1940	2	UASM
M. subumbrella	Oldman River Hwy. 36, s of Vauxhall, AB	18/5	2005	2	UASM
M. subumbrella	Lethbridge, AB	15/5	1949	1	CNC

does occur in the Peace River region, as suitable habitats in the region are fairly poorly collected, especially during *M. dentata*'s main flight period (G. G. Anweiler pers. com.).

The status of *Melitara subumbrella* in Canada. The three oldest specimens of *M. subumbrella* from southern Alberta show that the species was present in the province 60–70 years ago. The presence of recently collected individuals from different localities in southeastern Alberta and Saskatchewan clearly demonstrates that *M. subumbrella* occurs at multiple localities in western Canada. It is also not unthinkable that the species still is overlooked and is more widespread, not only in southwestern Canada, but also in Montana, though an examination of the *Melitara* specimens in the entomological collection of Montana State University in Bozman did not result in additional specimens.

Are Canadian *M. subumbrella* different from *M. subumbrella* in the U.S.A.? Ideally, many more specimens from both Canada and the U.S.A. should have been included to strengthen the results of the molecular analysis. Unfortunately such material was not available. Nonetheless, the difference reported here is well within variations that have been found in other insect populations considered to be conspecific (e.g. Simonsen *et al*. 2008; Cognato 2006; Laffin *et al*. 2005a, b; Scheffer & Grissel 2003). The slight difference in female genitalia may well represent individual variation. It is not known whether the species is present in Montana, and the variation thus could be continuous. Despite the apparent geographical isolation, these differences do not in our opinion justify separate taxonomic status (subspecies or otherwise) for the Canadian *M. subumbrella* populations. The species should be sought after in Montana to determine whether the distribution is continuous or the Canadian populations are disjunct.

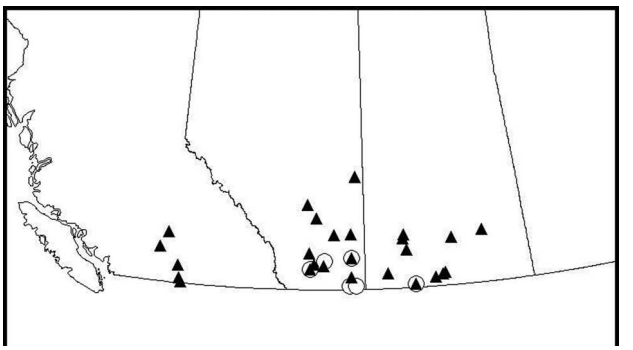

FIG. 5. Distribution map for *Melitara* in western Canada based on the records listed in Table 2. An open circle marks a *M. subumbrella* locality, and a closed triangle marks a *M. dentata* locality.

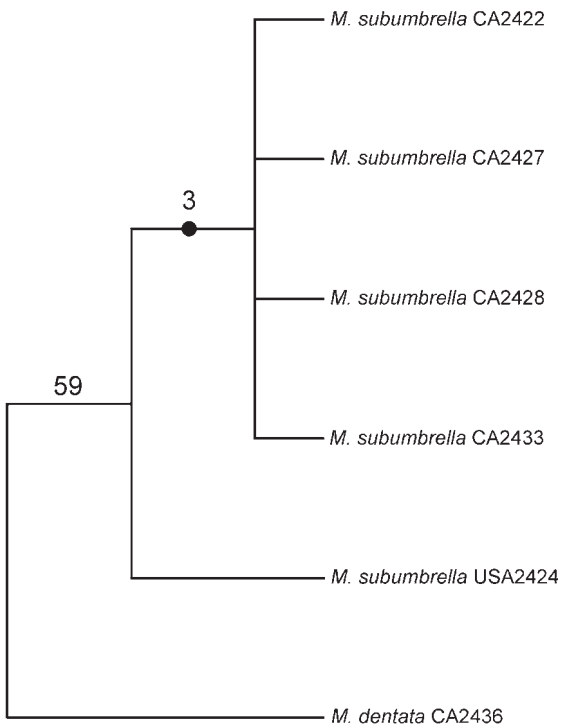

FIG. 4. Haplotype tree showing relationship between *Melitara subumbrella* in Canada and west central USA. The closed circle marks the clade comprising the four Canadian specimens. The six digit code after the species name is the specimen ID. The numbers indicate the number of unique base pair changes.

ACKNOWLEDGEMENTS

We wish to thank Paul Opler, of the Gillette Museum, Colorado State University for loans of specimens from the U.S.A. and for permission to extract DNA from these. We thank the following people and institutions for help and assistance: Jean-François Landry, Canadian National Collection, Ray G. Poulin, Royal Saskatchewan Museum, Tyler Cobb, Royal Alberta Museum, Ken Fry, Olds College and Michael A. Ivie, Montana State University, Bozman. Felix A. H. Sperling, Gary G. Anweiler, Danny Shpeley, Marie Djernaes and Lisa Lumley, all of the University of Alberta, and Brenda Laishley, Canadian Forest Service, Edmonton, AB, are thanked for help, advice and discussions. Financial support was provided by The Carlsberg Foundation, Copenhagen, Denmark (post doc salary for T. J. Simonsen), NSERC (a Discovery Grant to Felix A. H. Sperling paid for lab work and various expenses), and Natural Resources Canada (support for faunistics work by G. R. Pohl).

LITERATURE CITED

BOWMAN, K. 1951. An annotated list of the Lepidoptera of Alberta. Can. J. Zool. 29: 121–165.

COGNATO, A. I. 2006. Standard percentage DNA sequence difference for insects does not predict species boundaries. J. Econ. Entomol. 99: 1037–1045.

FERRIS, C. D. 1986. Presidential address, 1986: unexplored horizons—the role of the amateur lepidopterist. J. Lepid. Soc. 40: 247–254.

HEINRICH, C. 1939. The cactus-feeding Phycitinae: a contribution towards a revision of the American pyralidoid moths of the family Phycitidae. Proc. U. S. Nat. Mus. 86: 331–413.

_____. 1956. American moths of the subfamily Phycitinae. U. S. Nat. Mus. Bull. 207: i–viii, 1–581.

HENDRA, L. 2005. Kenneth Bowman, Alberta Lepidopterist. Blue Jay 64:168–174.

_____. 2007. Kenneth Bowman, Alberta Lepidopterist, part 2. Alberta Lepidopterists' Guild website: http://www.biology.ualberta.ca/old_site/uasm/alg/downloads/KBowman_article_Part2_Sept2007.pdf

KLOTS, A. B. 1970. Lepidoptera. Pp. 115–130. *In* S.L. Tuxen (ed.), Taxonomist's glossary of genitalia in insects (second edition). Munksgaard, Copenhagen, Denmark.

LAFFIN, R. D., L. M. DOSDALL, & F. A. H. SPERLING. 2005a. Population structure of the cabbage seedpod weevil, *Ceutorhynchus obstrictus* (Marsham) (Coleoptera Curculionidae): Origins of North American introductions. Environ. Entomol. 34: 504–510.

_____, _____, & _____. 2005b. Population structure and phylogenetic relationships of *Ceutorhynchus neglectus* (Coleoptera: Curculionidae). Can. Entomol. 137: 672–684.

MADDISON, W. P. & D. R. MADDISON. 2000. MacClade: version 4.0 PPC. Sinauer, Sunderland.

MANN, J. 1969. Cactus-feeding insects and mites. U. S. Nat. Mus. Bull. 256: v–x, 1–158.

MCDUNNOUGH, J. H. 1939. Check list of the Lepidoptera of Canada and the United States of America. Mem. South. Cal. Acad. of Sci. 1: Part II.

MUNROE, E. 1983. Pyralidae (except Crambinae). pp. 67-85. *In:* Hodges, R. W., Dominick, T., Davis, D. R., Ferguson, D. C., Franclemont, J. G. Munroe, E. G., & Powell, J.A. 1983. Check list of the Lepidoptera of America North of Mexico. E. W. Classey Ltd. and the Wedge Entomological Research Foundation, London, UK. 284 pp.

NEUNZIG, H. H. 1997. Pyraloidea, Pyralidae (part), Fascicle 15.4 *In* Dominick, R. B., *et al*. (eds), The moths of America north of Mexico. The Wedge Entomological Research Foundation. Washington, D.C. 157pp.

ROYER, F. & R. DICKINSON. 2007. Plants of Alberta. Lone Pine Publishing. Edmonton, AB, Canada. 527pp.

SCHEFFER, S. J. & E. E. GRISSELL. 2003. Tracing the geographic origin of *Megastigmus transvaalensis* (Hymenoptera: Torymidae): an African wasp feeding on a South American plant in North America. Molec. Ecol.12: 405–414.

SIMON, C., F. FRATI, A. BECKENBACH, B. CRESPI, H. LIU, & P. FLOOK. 1994. Evolution, weighting, and phylogenetic utility of mitochondrial gene sequences and a compilation of conserved polymerase chain reaction primers. Ann. Entomol. Soc. Amer. 87: 651–716.

SIMONSEN, T. J. 2008. Phylogeny of the cactus-feeding phycitines and their relatives (Lepidoptera: Pyralidae) based on adult morphology: evaluation of adult character-systems in phycitine systematics and evidence for a single origin of Cactaceae-feeding larvae. Insect Syst. Evol. 39: 303–325.

_____, R. L. BROWN, & F. A. H. SPERLING. 2008. Tracing an invasion: phylogeography of the cactus moth, *Cactoblastis cactorum* (Berg) (Lepidoptera: Pyralidae) in the U.S.A. based on mitochondrial DNA. Ann. Entomol. Soc. Amer. 101: 899–905.

SWOFFORD, D. L. 2002. PAUP*: Phylogenetic Analysis Using Parsimony (*and Other Methods) (Version 4.0b10). Sinauer Associates, Sunderland.

Received for publication 5 June 2008; revised and accepted 27 October 2008.