



<http://dx.doi.org/10.11646/zootaxa.3881.2.1>

<http://zoobank.org/urn:lsid:zoobank.org:pub:A87E25A6-B589-4C68-8368-4337862D0D3E>

First record of *Lucilia bufonivora* Moniez, 1876 (Diptera: Calliphoridae) from North America and key to North American species of the *L. bufonivora* species group

TAREK I. TANTAWI¹ & TERRY WHITWORTH²

¹Canadian National Collection of Insects, Agriculture and Agri-Food Canada, 960 Carling Avenue, Ottawa, Ontario, K1A 0C6, Canada. E-mail: Tarek.Mohammed@agr.gc.ca; t.tantawi@yahoo.com

²Department of Entomology, Washington State University, Pullman, WA 99164-6382, USA. E-mail: twhitworth@wsu.edu

Abstract

The obligate anuran myiasis blow fly *Lucilia bufonivora* Moniez is reported from North America for the first time. The *L. bufonivora* species group is defined on the basis of the aedeagus and the history and biology of the North American species (*L. bufonivora*, *L. elongata* Shannon and *L. silvarum* (Meigen)) are discussed. A key is provided to separate the three North American species of this group. The North American species *L. thatuna* Shannon, a member of the *L. sericata* (Meigen) species group, is also treated because it is likely a parasite of anurans and is poorly known. The male abdominal sternites, aedeagus (*L. elongata* only), pregonites, postgonites, bacilliform sclerites, ejaculatory sclerites, and female ovipositors and spermathecae of *L. elongata* and *L. thatuna* are illustrated for the first time.

Key words: Calliphoridae, *Lucilia bufonivora*, *L. elongata*, *L. silvarum*, *L. thatuna*, anuran myiasis, North America

Introduction

Lucilia bufonivora Moniez, 1876 is widely distributed in the Palaearctic Region (Zumpt 1956, 1965; Schumann 1986; Grunin 1988; Fan *et al.* 1997; Verves 2005; Verves & Khrokalo 2010; Martín *et al.* 2012; Rognes 1991, 2013; Draber-Moňko 2013). Prior to this study, it was unknown in North America (Hall 1965; Baumgartner 1988; Whitworth 2006; Rognes 2013). This study reports for the first time the presence of *L. bufonivora* in North America. We found specimens of this species in the Canadian National Collection of Insects (Ottawa) that were misidentified as *L. silvarum* (Meigen, 1826) (Appendix 1). The specimens were collected from western Canada (Manitoba, Saskatchewan, Alberta, and British Columbia), with 1954 as the earliest collection record. Species confirmation was based on the structure of male and female terminalia as described by Rognes (1991). It is noteworthy that Zumpt (1965) stated “*L. bufonivora* may occur in North America, where it is perhaps confused with *L. silvarum*, but this is a problem which remains to be cleared up.”

Morphologically, *Lucilia bufonivora* is closely related to the Holarctic *L. silvarum* (Rognes 1991) and the western North American *L. elongata* Shannon, 1924 (Whitworth 2006). Moreover, the three species are known to cause myiasis in anurans (Baumgartner 1988). In this study, the three species are grouped in the *L. bufonivora* species group based on the structure of the aedeagus and other external morphological characters. This study aims to define the *Lucilia bufonivora* species group and document our new record of *L. bufonivora* in North America.

Based on our North American specimens, it is of interest to note that adults of *L. bufonivora*, *L. silvarum*, and *L. elongata* have been collected from the same area in the same month and year: 32 miles southwest of Terrace, B.C., June 1960. This coexistence might have contributed to the misidentification of *L. bufonivora* as *L. silvarum* since it was assumed the former species was absent in North America. Also, variation in the number of postacrostichals of *L. bufonivora* may have contributed to the erroneous identification. For these reasons, we provide a key to separate the adults of the three species of the *L. bufonivora* species group. This key will assist entomologists, herpetologists, and wildlife naturalists to accurately identify the three species reared from anuran myiasis cases. Recently, the third instar of *L. bufonivora* was described by Martín *et al.* (2012) and that of *L. silvarum* was described by Fremdt *et al.* (2012).

Acknowledgments

We thank Knut Rognes (Oslo, Norway) for verifying our identification of *L. bufonivora* specimens and his valuable and critical comments on this manuscript. We also thank S.E. Brooks (CNC) for his generous assistance in photographing of the specimens and B.J. Sinclair (CNC) for his kind and excellent preparation of the digital images for publication. Special thanks to J.E. O'Hara (CNC) for his valuable suggestions, comments and support during this work.

References

- Adair, T.W. & Kondratieff, B.C. (2006) Three species of insects collected from an adult human corpse above 3300m in elevation: a review of a case from Colorado. *Journal of Forensic Sciences*, 51, 1164–1165.
<http://dx.doi.org/10.1111/j.1556-4029.2006.00236.x>
- Anderson, R.C. & Bennett, G.F. (1963) Ophthalmic myiasis in amphibians in Algonquin Park, Ontario, Canada. *Canadian Journal of Zoology*, 41, 1169–1170.
<http://dx.doi.org/10.1139/z63-092>
- Aubertin, D. (1933) Revision of the genus *Lucilia* R.-D. (Diptera, Calliphoridae). *Journal of the Linnean Society of London, Zoology*, 38, 389–436.
<http://dx.doi.org/10.1111/j.1096-3642.1933.tb00991.x>
- Baumgartner, D.L. (1988) Review of myiasis (Insecta: Diptera: Calliphoridae, Sarcophagidae) of Nearctic wildlife. *Wildlife Rehabilitation. Vol. 7. Selected papers presented at the Seventh Annual Symposium of the National Wildlife Rehabilitators Association, Denver, Colorado, March 9–13, 1988*, 46 pp.
- Bleakney, J.S. (1963) First North American record of *Bufo lucilia silvarum* (Meigen) (Diptera: Calliphoridae) parasitizing *Bufo terrestris americanus* Holbrook. *The Canadian Entomologist*, 95, 107.
<http://dx.doi.org/10.4039/Ent95107-1>
- Bolek, M.G. & Coggins, J.R. (2002) Observations on myiasis by the calliphorid, *Bufo lucilia silvarum*, in the Eastern American toad (*Bufo americanus americanus*) from southeastern Wisconsin. *Journal of Wildlife Diseases*, 38, 598–603.
<http://dx.doi.org/10.7589/0090-3558-38.3.598>
- Bolek, M.G. & Janovy, J. Jr. (2004) Observations on myiasis by the calliphorids, *Bufo lucilia silvarum* and *Bufo lucilia elongata*, in wood frogs, *Rana sylvatica*, from southeastern Wisconsin. *Journal of Parasitology*, 90, 1169–1171.
<http://dx.doi.org/10.1645/GE-246R>
- Briggs, J.L. (1975) A case of *Bufo lucilia elongata* Shannon 1924 (Diptera: Calliphoridae) myiasis in the American toad, *Bufo americanus* Holbrook 1836. *Journal of Parasitology*, 61, 412.
<http://dx.doi.org/10.2307/3279314>
- Brothers, D.R. (1970) Notes on the saprophagous activity of *Bufo lucilia silvarum* (Meigen) (Diptera: Calliphoridae). *The Pan-Pacific Entomologist*, 46, 198–200.
- Brothers, D.R. (1999) Blow flies (Diptera, Calliphoridae) of Idaho: an annotated checklist. *The Great Basin Naturalist*, 59, 92–96.
- Brumpt, E. (1934) Recherches expérimentales sur la biologie de la *Lucilia bufonivora*. *Annales de Parasitologie Humaine et Comparée*, 12, 81–97.
- Collin, J.E. (1926) Supplementary notes on the genus *Lucilia*, Desv. (Diptera). *Transactions of the Entomological Society of London*, 74, 258–260. [+ 3 plates]
- DeBry, R.W., Timm, A., Wong, E.S., Stamper, T., Cookman, C. & Dahlem, G.A. (2013) DNA-based identification of forensically important *Lucilia* (Diptera: Calliphoridae) in the Continental United States. *Journal of Forensic Sciences*, 58, 73–78.
<http://dx.doi.org/10.1111/j.1556-4029.2012.02176.x>
- Diepenbeek, A. van & Huijbregts, H. (2011) De pad en zijn kwelgeest [The toad and his torturer]. *RAVON* 41, 13, 64–70.
- Dodge, H.R. (1952) A possible case of blowfly myiasis in a rat, with notes on the bionomics of *Bufo lucilia silvarum* (Mg.). *Entomological News*, 63, 212–214.
- Draber-Mońko, A. (2004). Calliphoridae Plujki (Insecta: Diptera). *Fauna Polski*, 23, 1–659.
- Draber-Mońko, A. (2013) Contribution to the knowledge of the calliphorid fauna in Eastern Asia, with new data from North Korea. *Fragmenta Faunistica*, 56, 131–156.
<http://dx.doi.org/10.3161/00159301FF2013.56.2.131>
- Eaton, B.R., Moenting, A.E., Paszkowski, C.A. & Shpeley, D. (2008) Myiasis by *Lucilia silvarum* (Calliphoridae) in amphibian species in boreal Alberta, Canada. *Journal of Parasitology*, 94, 949–952.
<http://dx.doi.org/10.1645/GE-1373.1>
- Eggleton, P. & Belshaw, R. (1992) Insect parasitoids: an evolutionary overview. *Philosophical Transactions of the Royal Society of London, Series B*, 337, 1–20.

<http://dx.doi.org/10.1098/rstb.1992.0079>

- Emden, F.I. van (1954) Diptera Cyclorrhapha. Calypttrata (I). Section (a). Tachinidae and Calliphoridae. *Handbooks for the Identification of British Insects*, 10, Part 4(a). Royal Entomological Society of London, London, pp. 1–133.
- Fan, Z.-d. (1965) *Key to species of the common synanthropic flies of China*. Academia Sinica, Science Press, Beijing, xv + 330 pp. [+ 40 plates] [In Chinese.]
- Fan, Z.-d., Chen, Z.-z., Fang, J.-m., Zheng, S.-s., Tao, Z.-l. & Gan, Y.-x. (1997) (Eds.), *Fauna Sinica. Insecta. Vol. 6. Diptera: Calliphoridae*. Science Press, Beijing, i–xii + 707 pp. [In Chinese with English summary of keys and new taxa]
- Fischer, O.A. (2000) Blowflies of the genera *Calliphora*, *Lucilia* and *Protophormia* (Diptera, Calliphoridae) in south-Moravian urban and rural areas with respect to *Lucilia bufonivora* Moniez, 1976. *Acta Veterinaria Brno*, 69, 225–231.
<http://dx.doi.org/10.2754/avb200069030225>
- Fremdt, H., Szpila, K., Huijbregts, J., Lindström, A., Zehner, R. & Amendt, J. (2012) *Lucilia silvarum* Meigen, 1826 (Diptera: Calliphoridae)—a new species of interest for forensic entomology in Europe. *Forensic Science International*, 222, 335–339.
<http://dx.doi.org/10.1016/j.forsciint.2012.07.013>
- Garanin, V.I. & Shaldybin, S.L. (1976) Parasitism of larvae of the fly, *Lucilia bufonivora*, Moniez 1876, on Anura. *Parazitologiya*, 10, 286–288. [In Russian.]
- Gosá, A., Rubio, X., Etxaniz, M., Luengo, A., García-Cardenete, L. & Océn, M. (2009) Probables casos de parasitismo de *Lucilia bufonivora* (Diptera: Calliphoridae) en anuros del norte ibérico. *Boletín de la Asociación Herpetológica Española*, 20, 112–117.
- Gregor, F., Pont, A., Paterson, H.E. & Wheeler, M.R. (1971) Keys to adult flies. In: Greenberg, B., *Flies and disease*. Vol. I. Ecology, classification and biotic associations. Princeton University Press, Princeton, pp. 85–115.
- Grunin, K.Ya. (1988) Family Calliphoridae. In: Bei-Bienko, G.Ya. (Ed.), *Keys to the insects of the European part of the USSR*. Vol. 5. Part 2. Diptera and Siphonaptera. Smithsonian Institution Libraries and the National Science Foundation, Washington, D.C., pp. 995–1020.
- Hall, D.G. (1948) *The blowflies of North America*. The Thomas Say Foundation, Baltimore, 477 pp.
- Hall, D.G. (1965) Family Calliphoridae. In: Stone, A., Sabrosky, C.W., Wirth, W.W., Foote, R.H. & Coulson, J.R. (Eds.), A catalog of the Diptera of America north of Mexico. *United States Department of Agriculture. Agriculture Handbook*, 276, pp. 922–933.
- Hall, D.H. & Townsend, L.H. Jr. (1977) The blow flies of Virginia (Diptera: Calliphoridae). In: *The insects of Virginia No. 11*. Research Division Bulletin 123, Virginia Polytechnic Institute and State University, Blacksburg, pp. 1–48.
- James, M.T. (1953) Notes on the distribution, systematic position, and variation of some Calliphorinae, with particular reference to the species of western North America (Diptera, Calliphoridae). *Proceedings of the Entomological Society of Washington*, 55, 143–148.
- James, M.T. (1955) The blowflies of California (Diptera: Calliphoridae). *Bulletin of the California Insect Survey*, 4, 1–34.
- James, M.T. & Maslin, T.P. (1947) Notes on myiasis of the toad, *Bufo boreas boreas* Baird and Girard. *Journal of the Washington Academy of Sciences*, 37, 366–368.
- Kano, R. & Shinonaga, S. (1968) *Fauna Japonica. Calliphoridae (Insecta: Diptera)*. Biogeographical Society of Japan, National Science Museum, Tokyo, 181 pp. [+ 23 plates]
- Koskela, P., Itämies, J. & Pasanen, S. (1974) *Lucilia bufonivora* Moniez (Dipt., Calliphoridae), a lethal parasite in *Rana temporaria* L. (Anura). *Annales Zoologici Fennici*, 11, 105–106.
- Kramer, H. (1910) Zur näheren Kenntnis der Dipterengattung *Lucilia* R.D. *Entomologisches Vereinshlatt Nr. 6, Beilage Entomologische Rundschau*, 27, 34–35.
- Linnaeus, C. (1758) *Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus differentiis, synonymis, locis*. 10th edition. Vol. 1. L. Salvii, Holmiae [= Stockholm], 824 pp.
- Lundbeck, W. (1927) *Diptera Danica. Genera and species of flies hitherto found in Denmark*. Part VII. Platypezidae, Tachinidae. G.E.C. Gad, Copenhagen and William Wesley and Son, London, 560 pp.
- Macquart, J. (1834) *Insectes diptères du nord de la France. Athéricères: créophiles, oestrides, myopaires, conopsaires, scénopiniens, céphalopsides*. Vol. 5. L. Danel, Lille, 232 pp. [+ 6 plates]
- Macquart, J. (1844) *Diptères exotiques nouveaux ou peu connus*. Tome deuxième.—3.° partie [1843]. Roret, Paris, 304 pp. [+ 36 plates]
- Macquart, J. (1855) Diptères exotiques nouveaux ou peu connus. 5.° supplément. *Mémoires de la Société Royale des Sciences, e l'Agriculture et des Arts de Lille, Sér 2*, 1, 25–156. [+ 7 plates]
- Martín, B.D., Oteiza, A.G. & Bordas, M.I.S. (2012) Confirmación de la presencia de *Lucilia bufonivora* Moniez, 1876 (Diptera: Calliphoridae) en la península ibérica. *Boletín de la Asociación Española de Entomología*, 36, 433–438.
- McDonagh, L.M. & Stevens, J.R. (2011) The molecular systematics of blowflies and screwworm flies (Diptera: Calliphoridae) using 28S rRNA, COX1 and EF-1 α : insights into the evolution of dipteran parasitism. *Parasitology*, 138, 1760–1777.
<http://dx.doi.org/10.1017/S0031182011001089>
- Meigen, J.W. (1826) *Systematische Beschreibung der bekannten europäischen zweiflügeligen Insekten*. Fünfter Theil. Schulz, Hamm, xii + 412 pp. [+ plates 42–54]
- Mihályi, F. (1977) A new key for Hungarian *Lucilia* species (Diptera, Calliphoridae). *Annales Historico-Naturales Musei Nationalis Hungarici*, 69, 181–184.

- Moniez, R. (1876) Un diptère parasite du crapaud (*Lucilia bufonivora* n. sp.). *Bulletin Scientifique, Historique et Littéraire du Département du Nord et des Pays Voisins*, 8, 25–27.
- Neumann, V. & Meyer, F. (1994) *Lucilia bufonivora* Moniez, 1876 - ein euryxener Amphibienparasit (Insecta: Diptera: Calliphoridae). *Mitteilungen aus dem Zoologischen Museum in Berlin*, 70, 331–341.
<http://dx.doi.org/10.1002/mmnz.19940700214>
- Nuorteva, P. (1963) Synanthropy of blowflies (Dipt., Calliphoridae) in Finland. *Annales Entomologici Fennici*, 29, 1–49.
- Robineau-Desvoidy, J.-B. (1830) Essai sur les myodaires. *Mémoires présentés par divers savans à l'Académie Royale des Sciences de l'Institut de France (Sciences Mathématiques et Physiques)*, (2) 2, 813 pp.
- Rognes, K. (1980) The blow-fly genus *Lucilia* Robineau-Desvoidy (Diptera, Calliphoridae) in Norway. *Fauna Norvegica, Series B*, 27, 39–52.
- Rognes, K. (1981) A recent record of *Lucilia bufonivora* Moniez, 1876 from Norway (Dipt., Calliphoridae). *Fauna Norvegica, Series B*, 28, 119.
- Rognes, K. (1991) Blowflies (Diptera, Calliphoridae) of Fennoscandia and Denmark. *Fauna Entomologica Scandinavica*, 24, 1–272.
- Rognes, K. (2013) Calliphoridae. In: Pape, T. & Beuk, P. (Eds.), *Fauna Europaea: Diptera, Brachycera*. Version 2.6.2. Available from: <http://www.faanaur.org> (Accessed 8 January 2014)
- Salazar, A.D. de, Gosá, A., Rubio, X. & Díaz, B. (2012) *Lucilia bufonivora*, díptero parásito de anuros, en la Selva de Irati (Navarra). *Boletín de la Asociación Herpetológica Española*, 23, 27–29.
- Schumann, H. (1971) Die Gattung *Lucilia* (Goldtliegen). *Merkblätter unber angewandte Parasitenkunde und Schadlingsbekämpfung*, 18, 1–20.
- Schumann, H. (1986) Family Calliphoridae. In: Soós, Á. & Papp, L. (Eds.), *Catalogue of Palearctic Diptera*. Vol. 12. Akadémiai Kiadó, Budapest, pp. 11–58.
- Séguy, E. (1928) Études sur les mouches parasites. Tome I. Conopides, oestrídes et calliphorines de l'Europe occidentale. Recherches sur la morphologie et la distribution géographique des diptères à la larves parasites. *Encyclopédie Entomologique (A)*, 9, 1–251.
- Shannon, R.C. (1924) Nearctic Calliphoridae, Luciliini (Diptera). *Insector Inscitiae Menstruus*, 12, 67–81.
- Shannon, R.C. (1926) Synopsis of the American Calliphoridae (Diptera). *Proceedings of the Entomological Society of Washington*, 28, 115–139.
- Shewell, G.E. (1987) Calliphoridae. In: McAlpine, J.F., Peterson, B.V., Shewell, G.E., Teskey, H.J., Vockeroth, J.R. & Wood, D.M. (Eds.), *Manual of Nearctic Diptera*. Vol. 2. *Research Branch, Agriculture Canada Monograph*, 28, 1133–1145.
- Siebke, H. (1863) Beretning om en i Sommeren 1850 foretagen entomologisk Reise. *Nyt Magazin for Naturvidenskaberne*, 12, 105–192.
- Spence, T. (1954) A taxonomic study of the females of the British *Lucilia* species (Diptera: Calliphoridae). *Proceedings of the Royal Society of London (B)*, 23, 29–35.
- Stevens, J. & Wall, R. (1996) Classification of the genus *Lucilia* (Diptera: Calliphoridae): a preliminary parsimony analysis. *Journal of Natural History*, 30, 1087–1094.
<http://dx.doi.org/10.1080/00222939600770581>
- Strijbosch, H. (1980) Mortality in a population of *Bufo bufo* resulting from the fly *Lucilia bufonivora*. *Oecologia*, 45, 285–286.
<http://dx.doi.org/10.1007/BF00346472>
- Tokumoto, H. (2000) Historical review of studies on *Lucilia chini* Fan for thirty years in Japan. *Hana Abu*, 10, 35–41.
- Townsend, C.H.T. (1919) New genera and species of muscoid flies. *Proceedings of the United States National Museum*, 56, 541–592.
<http://dx.doi.org/10.5479/si.00963801.2301.541>
- Verves, Yu.G. (2002) An annotated check-list of Calliphoridae (Diptera) of the Russian Far East. *Far Eastern Entomologist*, 116, 1–14.
- Verves, Yu.G. (2005) A catalogue of Oriental Calliphoridae (Diptera). *International Journal of Dipterological Research*, 16 (4), 233–310.
- Verves, Yu.G. & Khrokalo, L.A. (2010) The new data on Calliphoridae and Rhinophoridae (Diptera) from Ukraine. *Ukrainska Entomofaunistyka*, 1, 23–54.
- Vestjens, W.J.M. (1958) Waarnemingen en infectie van *Lucilia bufonivora* in *Bufo calamita* Laur. *Entomologische Berichten*, 18, 38–40.
- Walker, F. (1849) *List of the specimens of dipterous insects in the collection of the British Museum*. Part IV. British Museum, London, pp. 689–1172.
- Weddeling, K. & Kordges, T. (2008) *Lucilia bufonivora*-Befall (Myiasis) bei Amphibien in Nordrhein-Westfalen – Verbreitung, Wirtsarten, Ökologie und Phänologie. *Zeitschrift für Feldherpetologie*, 15, 183–202.
- Whitworth, T. (2006) Keys to the genera and species of blow flies (Diptera: Calliphoridae) of America north of Mexico. *Proceedings of the Entomological Society of Washington*, 108, 689–725.
- Wiedemann, C.R.W. (1819) Brazilianische Zweiflügler. *Zoologisches Magazin*, 1 (3), 40–56.
- Wiedemann, C.R.W. (1830) *Aussereuropäische zweiflügelige Insekten. Als Fortsetzung de Meigenschen Werkes*. Zweiter Theil. Schulz, Hamm, xii + 684 pp. [+ 5 plates]
- Zavadiš, V., Kolman, P. & Mařík, J. (1997) Frog myiasis in the Czech Republic with regard to its occurrence in the Cheb district

and comments on the bionomics of *Lucilia bufonivora* (Diptera, Calliphoridae). In: Vaňhara, J. & Rozkošný, R. (Eds.), *Dipterologica bohemoslovaca. Vol. 8. Folia Facultatis Scientiarum Naturalium Universitatis Masarykianae Brunensis Biologia*, 95, 201–210.

Zumpt, F. (1956) 64i. Calliphorinae. *Die Fliegen der Palaearktischen Region*, 11, 1–140.

Zumpt, F. (1965) *Myiasis in man and animals in the Old World*. Butterworths, London, 267 pp.

APPENDIX 1. Specimens examined.

Lucilia bufonivora (15 males, 14 females) (CNC)

Alberta: 1 female (**terminalia examined**), Kananaskis Forest Experiment Station, Seebe, 11.vii.1968, H.J. Teskey.

British Columbia: 1 male, 32 mi. S.W. Terrace, on flowers of *Heracleum lanatum*, 4.vi.1960, G.E. Shewell; 1 male, same data except 6.vi.1960, W.W. Moss; 1 female, same data except J.G. Chillcott; 1 female, same data except C.H. Mann; 2 males (**terminalia of one specimen examined**), same data except 8.vi.1960, G.E. Shewell; 1 male (**terminalia examined**), same data except 11.vi.1960, W.W. Moss; 1 male, same data except B. Heming; 2 males (**terminalia of one specimen examined**), same data except R. Pilfrey; 1 male, Terrace, 17.vii.1960, W.R. Richards; 1 female (**terminalia examined**), Tyee, 27 mi. E. Prince Rupert, 24.vi.1960, W.W. Moss; 1 female, Liard River Hot Springs, 24.viii.1962, P.J. Skitsko; 1 female, same data except 23.vii.1987, M. Polak; 3 males (**terminalia examined**), 3 females (**terminalia of one specimen examined**), 25 km S.W. Terrace Hwy 25, 7–8.vii.1984, J.E. O'Hara.

Manitoba: 1 male, 5 mi. N. Minnedosa, 8.vii.1958, R.L. Hurley; 1 male, 9 mi. N. Forrest, 29.vii.1958, R. Madge.

Saskatchewan: 1 female, Canora, 22.viii.1954, Brooks-Wallis; 1 female (**terminalia examined**), Mossbank, 25.v.1955, A.R. Brooks; 1 male, Assiniboia, 18.vi.1955, A.R. Brooks; 3 females, same data except on flowers of *Achillea*, 25.vi.1955, J.R. Vockeroth.

Lucilia elongata (32 males, 15 females; 3, sex not recorded)

Alberta: 2 males, Waterton Lakes National Park, 14–20.vii.1980, H.J. Teskey (CNC).

California: 1 male, San Mateo Co., Corte Madera Creek, Vic. Portola, 18.vii.1959, P.H. Arnaud, Jr. (TW); 1 male, San Mateo Co., Portola Valley, Alpine Rd., Corte Madera Creek, 1.xi.1985, P.H. Arnaud, Jr. (TW); 1 male, Mendocino Co., Dunlap Campground, 29 km W. Willits, 12.vii.1969, P.H. Arnaud, Jr. (TW); 3 females, Tehama Co., Red Bluff, 2.v.1970, B. Villegas (TW); 2 females, Yolo Co., Davis, 21.x.1979, B.L. Herbold (TW); 2 females, same data except 27.x.1979, Bosque (TW).

British Columbia: 4 males (**terminalia of one specimen examined**), Cultus Lake, 1,9,12,13.vii.1948, H.R. Foxlee (CNC); 1 male (**terminalia examined**), Macmillan Park, Nanaimo Co., 13.vi.1958, D.M. Wood (CNC); 2 males, 32 mi. S.W. Terrace, 11.vi.1960, W.W. Moss & G.E. Shewell (CNC); 1 male (**terminalia examined**), 1 female, Prince Rupert, 18.vi.1960, B. Heming (CNC); 1 male, 8 km S. Hope, 1–2.viii.1990, A. Borkent (CNC); 1 male, 1 female (**terminalia examined**), 25 km S.W. Terrace Hwy 25, 7–8.vii.1984, J.E. O'Hara (CNC); 1 male, Cathedral Province Park, 26.vii.1988, Sid Cannings (TW); 1 female, Vancouver, 29.viii.2002 (TW); 1 male, same data except 6.ix.2002 (TW); 3 males, same data except 16.ix.2002 (TW); 1 male, Glacier National Park, Loop Trail, 1140m, 16.vii.2010 (Guelph DNA); 1 male, Yoho National Park, Emerald Lake Trail, 1307m, 21.vii.2010 (Guelph DNA).

Idaho: 1 female, Kootenai Co., Wolf Lodge Bay KOA, 12.5 km E. of Coeur d'Alene, 29.viii.1981, Paul Arnaud, Jr. (TW).

Oregon: 1, sex not recorded, Crook Co., Ococho Reservoir, 8.vi.2006, G. Dahlem (GD); 2, sex not recorded, Douglas Co., 11.vi.2006, G. Dahlem (GD); 1 female, Washington Co., S.W. Nicol Rd., 3.vii.1981, E. Eaton (TW); 1 female, Harney Co., Malheur Wildlife Refuge, 28.vii.2005, T.L. Whitworth, bait trap (TW).

Washington: 10 males (**terminalia of 2 specimens examined**), Whatcom Co., Glacier, 6.viii.1982, M. Wood (CNC); 1 female, Pierce Co., Tacoma, 3707 96th ST E, 28.v.1997, T.L. Whitworth (TW); 1 female, Spokane Co., Sprague, 4.vi.2006, T. L. Whitworth, bait trap (TW).

Lucilia silvarum (131 males, 88 females) (CNC)

Alberta: 1 male, Lethbridge, 12.vi.1930, R.W. Salt; 2 males, same data except 8.vi, 5.vii.1956, E.E. Sterns; 1 male, same data except Gaol Lake, 4.vii.1926, H.E. Gray; 1 male, Onefour, 13.vi.1956, E.E. Sterns.

British Columbia: 1 female, Agassiz, 29.vii.1926, R. Glendenning; 1 female (**terminalia examined**), Nicola, 27.viii.1923, E.R. Buckell; 1 male, Oliver, 8.viii.1923, C.B. Garrett; 2 males, same data except 25.v.1959, L.A. Kelton; 1 male, same data except 24.v.1959, E.E. MacDougall; 1 male (**terminalia examined**), same data except Vaseux Lake, 29.v.1959, R.E. Leech; 1 male, Point Grey, 19.viii.1972, J.R. Vockeroth; 1 male, 1 female, Summerland, 8.ix.1931, A.N. Gartrell; 1 male, Terrace, airport, 10.viii.1960, B. Heming; 2 males, 32 mi. S.W. Terrace, 4,11.vi.1960, J.G. Chillcott.

California: 1 female, Antioch, Contra Costa Co., 26.iv.1968, D.D. Munroe; 1 male, Dos Palos, Merced Co., 7.ix.1949, J.E. Gillapsy.

Colorado: 1 female, Boulder Reservoir, Boulder, 31.v.1961, B.H. Poole.

Illinois: 1 male, Champaign, 3.x.1956, J.F. McAlpine.

Indiana: 2 males, Valparaiso, 4,9.vii.1954, D. Cobb.

Manitoba: 1 male, Brandon, 3.vi.1968, H.J. Teskey; 1 female, 6 mi. N.W. Brandon, 1.vii.1958, C.D.F. Miller; 1 male, same data except R.B. Madge; 1 male, 2 mi. N. Forrest, 19.vii.1958, R.L. Hurley; 4 males, 4 females, 9 mi. N. Forrest,