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We are honored to dedicate this body of work to our colleague Steve Ashe for his many authoritative contributions to aleocharine systematics through his impressive scientific publication record and his love of little rove beetles. His unwavering commitment to promoting and strengthening our knowledge of the Aleocharinae is unsurpassed.

Preface

Worldwide, aleocharine beetles are among the most poorly known and difficult-to-identify groups of Coleoptera. Here, we present the first comprehensive synopsis of all known valid aleocharine rove beetle species (Coleoptera, Staphylinidae) from British Columbia, Canada. Two hundred twenty-seven confirmed and valid species from the province are presented and discussed here. This taxonomic account includes one new BC genus (not including new genus from CA not recorded from BC), 15 new species, 16 new generic records, and 37 (excluding new species) new provincial and 6 state records, in 79 genera and 14 tribes. For each species, the illustrations include color habitus and genital diagnostic structures of both sexes. Tribes and subtribes are arranged in phylogenetic order as it is currently recognized, and genera and subgenera are listed alphabetically within each tribe or subtribe. Species are listed alphabetically or in species groups to better reflect their relationships. Species distribution is listed by provinces and territories in Canada and states in the United States, and the geographic origin of each species is categorized as native, Holarctic, adventive, or undetermined (either adventive or Holarctic). Collection and habitat data are presented for each species, including collecting period and collecting methods. A faunal analysis and discussion on BC aleocharine in a broader context of North America is provided. Two lists of Canadian and BC species with their currently known distribution in North America are presented at the end of the book (Tables A.1 and A.2 in Appendix).

TAXONOMIC SYNOPSIS. "*Salinamexus" giulianii* Moore was incorrectly included in *Bryobiota* and is here assigned to a newly erected genus, *Ashella* Klimaszewski, **gen. n.,** of the tribe Liparocephalini Fenyes. *Ashella* is, so far, not recorded from BC. *Bryobiota* Casey is redefined based on morphology of the type species. We record **fifteen new species**: *Atheta copleyi* Klimaszewski, **sp. n.**; *Atheta godini* Klimaszewski, **sp. n.**; *Atheta wheelerae* Klimaszewski, **sp. n.**; *Boreostiba pseudolaticollis* Klimaszewski and Godin, **sp. n.**; *Atheta winchesteri* Klimaszewski, **sp. n.**; *Calodera bennetti* Klimaszewski, **sp. n.**; *Dinaraea inexpectata* Klimaszewski, **sp. n.**; *Geostiba horwoodae* Klimaszewski and Godin, **sp. n.**; *Gnypeta baranowskii* Klimaszewski, **sp. n.**; *Leptusomorpha claudiae* Klimaszewski, **sp. n.**; *Liogluta scudderi* Klimaszewski, **sp. n.**; *Neothetalia robergei* Klimaszewski, **sp. n.,** *Philhygra charlottae* Klimaszewski, **sp. n.**; *Philhygra terrivaga* Klimaszewski, **sp. n.**; *Stictalia kranabetteri* Klimaszewski and Godin, **sp. n.**

One new genus is erected, *Leptusomorpha* Klimaszewski and Hoebeke of the tribe Homalotini. **Thirty-seven** new BC-specific provincial records are noted (excluding new species): *Amischa analis* (Gravenhorst), *Atheta alesi* Klimaszewski and Brunke, *Atheta capsularis* Klimaszewski, *Atheta brunswickensis* Klimaszewski, *Atheta lucifera* Bernhauer, *Atheta munsteri* Bernhauer, *Atheta pseudoklagesi* Klimaszewski and Webster, *Atheta pseudometlakatlana* Klimaszewski and Godin, *Atheta ripariides* Newton, *Atheta terranovae* Klimaszewski and Langor, *Boreostiba parvipennis* (Bernhauer), *Dinaraea angustula* (Gyllenhal), *Dinaraea subdepressa* (Bernhauer), *Dochmonota rudiventris* (Eppelsheimer), *Blepharhymenus illectus* Casey, *Brachyusa helenae* (Casey), *Bryothinusa catalinae* Casey, *Liogluta trapezicollis* Lohse, *Lypoglossa franclemonti* Hoebeke, *Mocyta discreta* (Casey), *Nehemitropia lividipennis* (Mannerheim), *Philhygra terrestris* Klimaszewski and Godin, *Schistoglossa hampshirensis* Klimaszewski, *Strigota ambigua* (Erichson), *Strigota obscurata* Klimaszewski and Brunke, *Gymnusa grandiceps* Casey, *Oligota parva* Kraatz, *Neoisoglossa agnita* (Casey), *Ocyusa canadensis* Lohse, *Oxypoda canadensis* Klimaszewski, *Oxypoda convergens* Casey, *Oxypoda irrasa* Mäklin, *Oxypoda orbicollis* Casey, *Parocalea pseudobaicalica* Lohse, *Phloeopora arctica* Lohse, *Phloeopora canadensis* Klimaszewski and Langor, and *Phloeopora oregona* Casey. In addition, **sixteen new generic provincial records are** (including new genus): *Amischa* C.G. Thomson, *Blepharhymenus* Solier, *Bryothinusa* Casey, *Calodera* Mannerheim, *Dinaraea* C.G. Thomson, *Dochmonota* C.G. Thomson, *Geostiba* C.G. Thomson, *Leptusomorpha* Klimaszewski and Hoebeke, *Meotica* Mulsant and Rey, *Nehemitropia* Lohse, *Neoisoglossa* Casey, *Ocyusa* Kratz, *Oligota* Mannerheim, *Parocalea* Bernhauer, *Phloeopora* C.G. Thomson, and *Strigota* Casey. We note, **three New Synonyms** (first name being valid): *Atheta* (*Datomicra*) *celata* (Erichson, 1837) = *Datomicra wrangleri* Casey, 1910 = *Pseudota nanulina* Casey, 1911; *Stictalia brevicornis* Casey, 1906 = *S. arcuata* Casey, 1906; *S. californica* (Casey, 1885) = *S. densicollis* Casey, 1906. **Twelve New Lectotypes are designated**: *Acrimea acerba* Casey, 1911 (=*Aleochara* (*Tinotus*) *acerba* (Casey)); *Atheta holmbergi* Bernhauer (*Atheta* (*Microdota*) *holmbergi* Bernhauer); *Atheta munsteri* Bernhauer (=*Atheta* (*Dimetrota*) *munsteri* Bernhauer); *Atheta relicata* Casey (=*Atheta* (*Lamiota*) *relicata* Casey); *Datomicra wrangleri* Casey (=*Atheta* (*Datomicra*) *celata* (Erichson)); *Ousipalia pacifica* Casey; *Stictalia arcuata* Casey (=*S. brevicornis* Casey); *Stictalia carlottae* Casey; *Stictalia densicollis* Casey (=*S. californica* (Casey)); *Trichiusa columbica* Casey; *Pseudota nanulina* Casey (=*Atheta* (*Datomicra*) *celata* (Erichson)); *Datomicra surgens* Casey (=*Atheta (Microdota) surgens* (Casey)). **Nomen nudum**: *Stictalia notata* (Mäklin, 1852), type lost at ZMH. **Species with unconfirmed status are**: two Palearctic species, *Atheta subrugosa* (Kiessenwetter) and *A. basicornis* (Mulsant and Rey), and records in BC were not confirmed in this study and most likely represent misidentifications.

These two species are illustrated here for further reference. *Brachyusa americana* (Fenyes), known only from damaged male holotype, was not available for study but was included in this book with illustrations of the median lobe of aedeagus and paramere, provided by Seevers (1978).

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Contents

Introduction

1

The family Staphylinidae is the most diverse family of Coleoptera in North America north of Mexico (Poole and Gentili 1996), with over 4000 valid names (Newton et al. 2001), and much of this diversity is associated with habitats found in forest ecosystems (Pohl et al. 2008). Rove beetles occur in all habitat types with the exception of extremely dry habitats (Newton et al. 2001). At the landscape scale, species composition is dictated by forest type and species have strong affinities with forest microhabitats where moisture, temperature, substrate type, and debris accumulation are variables that promote high diversity in rove beetles (Pohl et al. 2008).

The subfamily Aleocharinae is one of the largest lineages of all the beetles (Coleoptera) worldwide. This group includes approximately 62 tribes, 1310 described and probably valid genera and nearly 17,000 described species (Newton, unpublished database; Klimaszewski et al. 2018). The immense number of described and formally named aleocharine rove beetles only hints at the true diversity of this subfamily, with many thousands of species, and numerous higher taxa, remaining to be described throughout the world, especially in tropical regions (Ashe 2007). This seemingly endless diversity, the minute size of most adults, and the virtual lack of illustrated keys and descriptions of species for most geographical regions make the Aleocharinae one of the most taxonomically challenging groups of beetles (Ashe 2007). Aleocharines are widely distributed in North America and occur in almost all terrestrial habitats, but the majority of species are forest dwelling where they occur in leaf litter, under bark, in fungi, in moss, and in the nests of ants, termites, mammals, and birds. Elsewhere, they inhabit seashores, edges of water bodies, wetlands and prairies (Klimaszewski et al. 2018).

Aleocharine rove beetles represent key ecological or environmental indicators of changes in managed forests due to their highly specific microhabitat associations, their response to disturbances, their high local abundance, and their ease of collection (Paquin and Dupérré 2002; Pohl et al. 2008; Venier et al. 2017; Klimaszewski et al. 2018). As indicators, the presence or absence of particular taxa of these minute rove beetles may reveal details about the overall health of ecosystems and the impact of human activity on them.

For this body of work we focus on British Columbia, the western most province of Canada. This province has a large diverse land area, bounded by the Pacific coastline, mountains, and islands, and is characterized by a wide range of ecosystems and habitats (Meidinger and Pojar 1991), harboring an exceptionally rich biota (Cannings and Cannings 1996). It is alleged to have more species than any other province (or territory) in Canada, with both rarity and richness "hotspots" located in three areas of the province, namely the South Okanagan, the Lower Mainland, and southeastern Vancouver Island

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plus the Gulf Islands (Scudder 2004). Some of the largest remaining tracts of intact ancient coniferous forests in North America are found in British Columbia (Winchester 1997). Although the forests are the dominant vegetation type, there also are extensive areas of tundra, wetlands, grasslands, and rolling scrub.

British Columbia has several genera of aleocharines that are geographically unique to its inventory list and not found in the remaining provinces and territories of Canada. The tribe Liparocephalini, includes four genera (*Amblopusa*, *Paramblopusa*, *Diaulota*, and *Liparocephalus*) and five species that are primarily found in the intertidal zones of the Pacific shores from Korea, Japan, through Alaska to southern California and Mexico (Ahn and Ashe 1996). In the tribe Athetini, *Pontomalota* is another intertidal zone, seashore genus that includes two species from the Pacific coast, occurring from Alaska to Baja California (Ahn and Ashe 1992). The athetine genera *Adota* Casey, 1910 and *Psammostiba* Yosii and Sawada, 1976—both including seashore species common in decomposing seaweed on the beach—are restricted to the Pacific coast of North America and to the coasts of the northern Pacific, respectively (Gusarov 2003), but each include species recorded from British Columbia. Work on the Aleocharinae in the province is dependent on the availability of specialist taxonomists. No ecoregion, ecosystem, or habitat in British Columbia has been thoroughly inventoried for invertebrates, let alone staphylinid rove beetles.

Here, we present the first comprehensive synopsis of all aleocharine rove beetle species (Coleoptera, Staphylinidae) known from British Columbia. For every species, illustrations are provided, including colour habitus and genital diagnostic structures of both sexes. Two hundred and twenty-seven confirmed and valid species from British Columbia are here presented and discussed. This taxonomic summary includes one new genus, 15 new species, 16 new generic records, and 37 (excluding new species) new BC provincial and 5 USA state records, in 79 genera and 14 tribes and provides the necessary taxonomic tools for their identification.

Several metrics can be used to assess the Aleocharinae of Canada and particularly British Columbia. Thomas Casey was responsible for naming and describing 200 aleocharine species that occur in Canada, and 160 of these, approximately 80% of the total, have been retained as valid species-level taxa. As a result, Casey's descriptive efforts account for about 30% of all named species in British Columbia, a considerably large and notable contribution. During the past three decades, an historical examination of the recorded inventories of aleocharines in British Columbia illustrates a compelling and not too surprising increasing trend in the number of species recorded. Bousquet's checklist recorded a total of 106 species of Aleocharinae in British Columbia, Gouix and Klimaszewski (2007) listed 153 species from the province, and by 2013 the second edition of the checklist (Bousquet et al. 2013) listed 176 species, a 66% increase from 1991. With the completion of this treatment, 227 species of aleocharines are currently documented for the province, a 28% increase since 2013. Since the 1991 checklist, the number of recorded aleocharines in British Columbia has increased by about 114%, more than doubling. For all Staphylinidae, Bousquet et al. (2013) records 779 species from British Columbia alone, second in overall species richness in Canada next only to Ontario (865 spp.). With the 227 species treated herein, the Aleocharinae rove beetles constitute nearly 29% of all species of Staphylinidae recorded for the province. Nearly one-half are represented by the large, genus-rich tribe Athetini (101 spp. in 29 genera), followed (in descending number of species) by the Oxypodini (44 spp. in 18 genera), Aleocharini (23 spp., 1 genus: *Aleochara*), Homalotini (15 spp. in 6 genera), and Tachyusini (12 spp. in 4 genera). For additional details on these dominant tribes in British Columbia, the reader is referred to Chap. 6.

This new body of work and its companion piece (Aleocharine rove beetles of eastern Canada; Klimaszewski et al. 2018) will fill a void where before it was nearly impossible to identify most aleocharine rove beetles with

accuracy. Armed with habitus illustrations of the adults and detailed photographic depictions of the male and female genital structures along with the terminal segments, identification is now made possible.

It is our expectation that the identification tools and information provided herein will inspire future taxonomic and ecological studies of the Aleocharinae in Canada. Further inventory work and examination of specimens in collections will likely greatly increase numbers of species in future checklists for the province. Future studies will also help gauge whether particular groups of species are at risk and will continue to reveal the captivating biologies of this diverse and complex group of beetles.

References

Ahn KJ, Ashe JS (1992) Revision of the intertidal aleocharine genus *Pontomalota* (Coleoptera: Staphylinidae) with a discussion of its phylogenetic relationships. Entomol Scand 23:347–359

Ahn KJ, Ashe JS (1996) Revision of the intertidal aleocharine genus *Amblopusa* Casey and description of the new genus *Paramblopusa* (Coleoptera: Staphylinidae). J N Y Entomol Soc 103:138–154

Ashe JS (2007) Aleocharinae. Version 25 April 2007. http://tolweb.org/Aleocharinae/9777/2007.04.25. In: The tree of life web project. http://tolweb.org/

Bousquet Y, Bouchard P, Davies AE, Sikes DS (2013) Checklist of beetles (Coleoptera) of Canada and Alaska: second edition. Pensoft Series Faunistica No. 109. Pensoft Publishers, Sofia-Moscow. 402 pp

Cannings R, Cannings S (1996) British Columbia: a natural history. Greystone Books, Vancouver, BC. 310 pp

Gouix N, Klimaszewski J (2007) Catalogue of aleocharine rove beetles of Canada and Alaska (Coleoptera, Staphylinidae, Aleocharinae). Pensoft, Sofia. 165 pp

Gusarov VI (2003) Revision of some types of North American aleocharines (Coleoptera: Staphylinidae: Aleocharine), with synonymic notes. Zootaxa 353:1–134

Klimaszewski J, Webster RP, Langor DW, Brunke A, Davies A, Bourdon C, Labrecque M, Newton AF, Dorval J-A, Frank JH (2018) Aleocharine rove beetles of eastern Canada (Coleoptera, Staphylinidae, Aleocharinae): a glimpse of megadiversity. Springer, Cham. 902 pp

Meidinger D, Pojar J (eds) (1991) Ecosystems of British Columbia. Special Report Series No. 6. British Columbia Ministry of Forests, Victoria, BC, 330 pp

Newton AF, Thayer MK, Ashe JS, Chandler DS (2001) Staphylinidae. In: Arnett RH, Thomas MC (eds) American Beetles, vol 1. CRC Press, Boca Raton, FL, pp 272–418

Paquin P, Dupérré N (2002) Beetles of the boreal forest: a faunistic survey carried out in western Québec. Proc Entomol Soc Ont [2001] 132:57–98

Pohl G, Langor D, Klimaszewski J, Work T, Paquin P (2008) Rove beetles (Coleoptera: Staphylinidae) in northern Nearctic forests. Can Entomol 140:415–436

Poole RW, Gentili P (comps) (1996) Volume 1: Coleoptera and Strepsiptera. Nomina Insecta Nearctica: a check list of the insects of North America. Entomological Information Services, Rockville, MD, 827 pp

Scudder, GGE (2004) Rarity and richness hotspots in British Columbia. In: Proceedings of the species at risk 2004 pathways to recovery conference, 2–6 March 2004, Victoria, BC, 6 pp

Venier LA, Work TT, Klimaszewski J, Morris DM, Bowden JJ, Kwiaton MM, Webster K, Hazlett P (2017) Ground-dwelling arthropod response to fire and clearcutting in jack pine: implications for ecosystem management. Can J For Res 47(12):1614–1631

Winchester NN (1997) The arboreal superhighway: arthropods and landscape dynamics. Can Entomol 129(4):595–599

2 Prominent Forebearers of Modern Aleocharine Systematics in North America

Today's staphylinid specialists stand on the shoulders of some of the early and contemporary giants who have contributed substantially to our understanding of aleocharine systematics in North America. Based on their life's work and achievements, a number of deceased individuals are worthy of recognition here. We have selected five beetle specialists who have had, in our estimation, the most profound impact on aleocharine systematics in the past century and a quarter. Each has contributed substantially to the exploration and study of genus- and species-level taxa, some of which are reported from British Columbia, the principal focus of this book. The biographical sketches available in Smetana and Herman (2001: 40–159) were invaluable in producing the synopses below.

* * *

The Lasting Influence of Thomas Lincoln Casey (1857–1925) (Fig. 2.1a) on North American aleocharine systematics is legendary and he is discussed at greater length below in context with the historical review of research on the Aleocharinae.

Max Bernhauer (1866–1946) (Fig. 2.1b), a German coleopterist, first turned his attention to the family Staphylinidae in the late 1890s, and developed into one of the leading researchers on the group. Early in his career, he published papers on the Aleocharinae, including a monograph on the Palearctic species of *Leptusa* (Bernhauer 1900) and a synthesis of the tribe Aleocharini of the Palearctic region (Bernhauer 1901, 1902) (Smetana and Herman 2001). He published several early papers describing new aleocharine beetles from North America (Bernhauer 1905, 1906, 1907, 1909). As one of the leading world staphylinidologists, these collective works became standard references and identification tools for that time. Beginning in 1910, in conjunction with European workers Karl Schubert and Otto Scheerpeltz, he produced a world catalog of the Staphylinidae within the Junk-Schenkling *Coleopterorum Catalogus*, a reference still consulted today as a "database" on the Staphylinidae (Smetana and Herman 2001). He described over 5000 species and in excess of 340 genera of Staphylinidae during his productive career (Capinera 2008). His extensive collection of rove beetles is housed in the Field Museum of Natural History in Chicago.

Adalbert Fenyes (1863–1937) (Fig. 2.1c), another noted staphylindologist and Hungarian physician by training, started his studies of the subfamily Aleocharinae beginning around 1905 and thereafter was recognized as an authority on the group. Historical accounts indicate that he completed a manuscript for a monograph of the North American Aleocharinae, including 766 coloured figures, but because of its size it was never published (Smetana and Herman

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2001). A copy of his notable work on aleocharine beetles is found in the Fenyes Collection in P. Wytman's *Genera Insectorum* dated 1920–1921 (Pratt 2013). He also left behind an extensive collection of Aleocharinae (in the California Academy of Sciences, San Francisco) (Pratt 2013) containing over 19,000 specimens, representing some 1800 species (Smetana and Herman 2001).

Gustav Adolf Lohse (1910–1994) (Fig. 2.1d), German born and a dentist by profession, developed into an accomplished taxonomic coleopterist and became a widely recognized expert on central European beetle groups and was the driving force behind the series "Die Käfer Mitteleuropas." He published numerous papers on central European staphylinids, and particularly on the Aleocharinae. Late in his career, he published several seminal papers on North American Aleocharinae, and particularly those with arctic and Holarctic distributions (Lohse et al. 1990; Smetana and Herman 2001). He also worked on a review of Canadian species of *Gnypeta* but was unable to complete the project (Klimaszewski et al. 2008).

Charles Hamilton Seevers (1907–1965) (Fig. 2.1e), recognized at the height of his career as an internationally acclaimed specialist on the systematics of Aleocharinae, contributed substantially to our knowledge of rove beetles, publishing on termitophilous and myrmecophilous Staphylinidae (Seevers 1957, 1965) of which a large percentage are represented by genera of Aleocharinae, and his published studies on the mushroom-inhabiting Gyrophaenae of North America and Europe (Seevers 1951). Perhaps his most acclaimed paper was published posthumously in 1978—"A generic and tribal revision of North American Aleocharinae." Although this research was primarily concerned with genera of North America, its overall importance and relevance extends well beyond this faunal region. He was one of the first to attempt integrating the nomenclature and classification of North American taxa with that of Eurasia (R. Wenzel, in Smetana and Herman 2001). Seevers described 215 species and 42 genera in the Staphylinidae (Smetana and Herman 2001).

James Stephen "Steve" Ashe (1947–2005) (Fig. 2.1f), one of the world's experts on the subfamily Aleocharinae and our esteemed staphylinidologist colleague, will be remembered primarily as one of the outstanding beetle systematists of his generation. Steve loved natural history, was a keen observer of nature, and delighted in discovering a beetle new to him (Timm 2006). During the height of his professional career, Steve published over 100 peer-reviewed papers, including many large monographs, and numerous web pages for the *Tree of Life* (eg., Ashe and Maus 1998) and other projects (Lingafelter et al. 2006). His main taxonomic interest was the Aleocharinae, and his published works included a generic revision and phylogeny of the Gyrophaenina (Ashe 1984a, b), a phylogeny of the Bolitocharina (Ashe 1992), and studies of the genera *Tachiona* (Ashe and Wheeler 1988, Ashe 1990, 1993) and *Gansia* (Ashe and Lingafelter 1996). Smetana and Herman (2001) noted that the long-range goals of Steve Ashe were to make the Aleocharinae more accessible to researchers by producing a database of images of aleocharine staphylinids and by providing a framework for a phylogeny of the genera and tribes of the subfamily. In the end, he described at least 103 new species and 17 new genera during his shortened life, and as evidenced by his colleagues respect for him as a researcher and educator, 25 new species were named in his honor (patronyms), many of them Staphylinidae (Lingafelter et al. 2006).

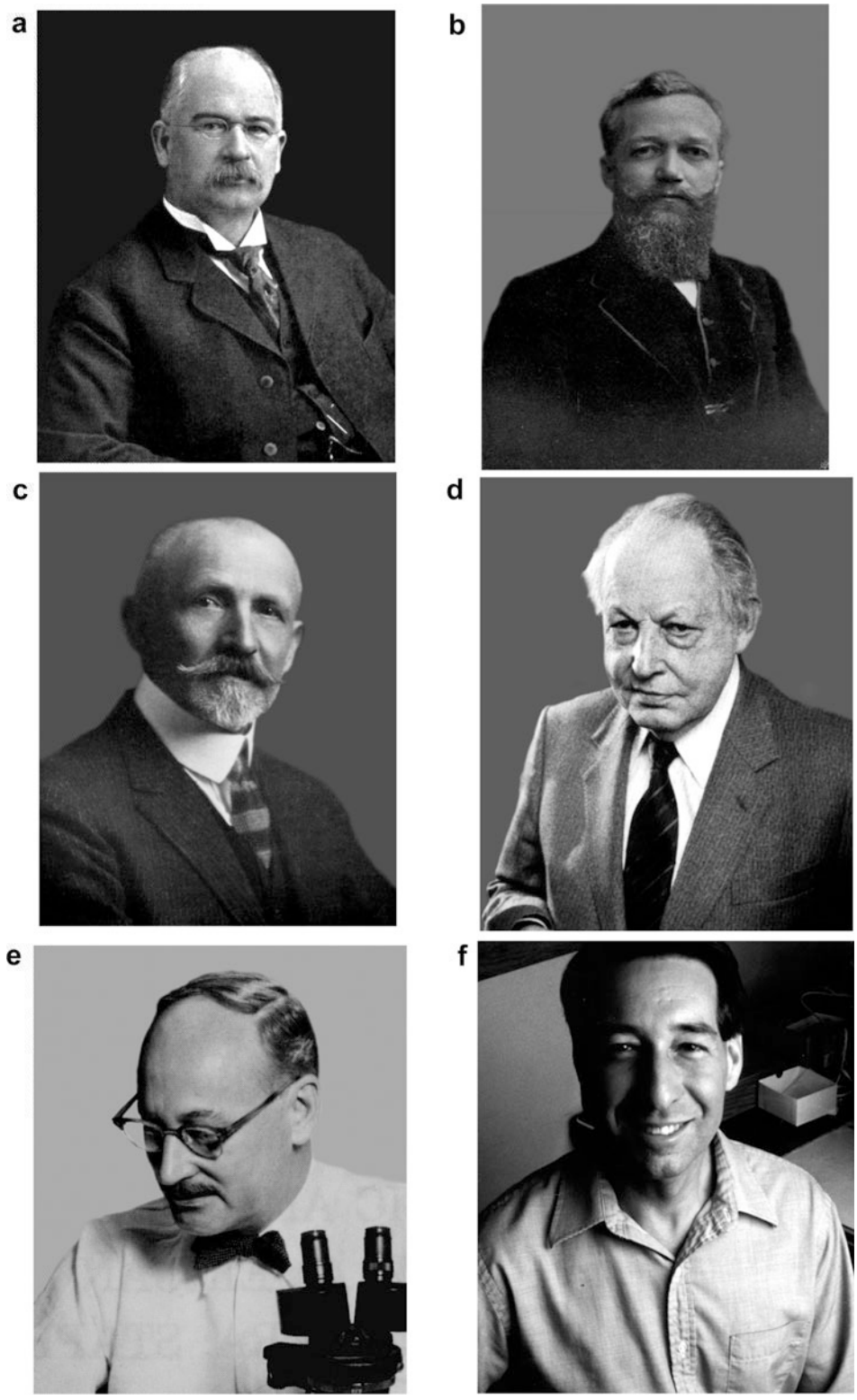

Fig. 2.1 (**a–f**) Photographs of early and contemporary researchers who have had the most profound impact on aleocharine systematics in North America: (**a**) Thomas Lincoln Casey (1857–1925); (**b**) Max Bernhauer (1866–1946); (**c**) Adalbert Fenyes (1863–1937); (**d**) Gustav Adolf Lohse (1910–1994); (**e**) Charles Hamilton Seevers (1907–1965); (**f**) James Stephen "Steve" Ashe (1947–2005)

References

Ashe JS (1984a) Major features of the evolution of relationships between gyrophaenine staphylinid beetles (Coleoptera: Staphylinidae: Aleocharinae) and fresh mushrooms. In: Wheeler Q, Blackwell M (eds) Fungus/insect relationships: perspectives in ecology and evolution. Columbia University Press, New York

Ashe JS (1984b) Generic revision of the subtribe Gyrophaenina (Coleoptera: Staphylinidae: Aleocharinae) with review of the described subgenera and major features of evolution. Quest Entomol 20(3):129–349

Ashe JS (1990) New species, phylogeny and natural history of *Tachiona* Sharp 1883 (Coleoptera: Staphylinidae: Aleocharinae). Trop Zool 3(2):225–235

Ashe JS (1992) Phylogeny and revision of genera of the subtribe Bolitocharina (Coleoptera: Staphylinidae: Aleocharinae). Univ Kans Sci Bull 54(10):335–406

Ashe JS (1993) New species and records of *Tachiona* Sharp (Coleoptera: Staphylinidae, Aleocharinae) with a revised key to known species. Ent Scand 24:231–239

Ashe JS, Lingafelter S (1996) Revision of *Gansia* Sharp of Mexico and Central America (Coleoptera: Staphylinidae: Aleocharinae). J N Y Entomol Soc [1995] 103:251–280

Ashe JS, Maus C (1998) The tree of life web project, Aleocharini. Available at http://tolweb.org/Aleocharini. Accessed 3 July 2019

Ashe JS, Wheeler QD (1988) Revision of *Tachiona* Sharp (Coleoptera: Staphylinidae: Aleocharinae) with a description of the larva of *T. latipennis* new species, and a preliminary assessment of generic relationships. J N Y Entomol Soc 96:176–199

Bernhauer M (1900) Die Staphyliniden-Gattung *Leptusa* Kraatz, nebst einer analytischen Bestimmungstabelle der paläarktischen Arten. Verh Zool Bot Ges Wien 50:399–432

Bernhauer M (1901) Die Staphyliniden der paläarktischen Fauna. Verh Zool Bot Ges Wien 51:430–506

Bernhauer M (1902) Die Staphyliniden der paläarktischen Fauna. I. Tribus: Aleocharini. (II. Theil.). Verh Kaiserlich-Königlichen Zool Bot Ges Wien 52:87–284

Bernhauer M (1905) Neue Aleocharinen aus Nordamerika. Deut Entomol Z 1905(2):249–256

Bernhauer M (1906) Neue Aleocharinen aus Nordamerika. (II. Teil). Deut Entomol Z 1906(2):337–348

Bernhauer M (1907) Neue Aleocharini aus Nordamerika (Col.) (3. Stück). Deut Entomol Z 1907(4):381–405

Bernhauer M (1909) Neue Aleocharinen aus Nordamerika. (Col.) (4. Stück). Deut Entomol Z 1909(4):515–528

Capinera J (2008) Encyclopedia of entomology, 2nd edn. Springer Science & Business Media, Heidelberg. 2061 pp

Klimaszewski J, Savard K, Pelletier G, Webster R (2008) Species review of the genus *Gnypeta* Thomson from Canada, Alaska and Greenland (Coleoptera, Staphylinidae, Aleocharinae): systematics, bionomics and distribution. ZooKeys 2:11–84

Lingafelter SW, Anderson RS, Timm B, Falin Z, Jameson ML, Newton AF, Ball GE, Ahn K-J, Leschen R (2006) In: Memoriam, James Stephen "Steve" Ashe (1947–2005). Coleopt Bull 60(1):1–12

Lohse GA, Klimaszewski J, Smetana A (1990) Revision of Arctic Aleocharinae of North America (Coleoptera: Staphylinidae). Coleopt Bull 44(2):121–202

Pratt NF (2013) Dr. Adalbert Fenyes: a biographical sketch of a twentieth century entomologist. Pan-Pac Entomol 89(1):1–6

Seevers CH (1951) A revision of the North American and European staphylinid beetles of the subtribe Gyrophaenae (Aleocharinae, Bolitocharini). Fieldiana: Zoology 32(10):655–762

Seevers CH (1957) A monograph on the termitophilous Staphylinidae (Coleoptera). Fieldiana: Zoology 40(1):1–334

Seevers CH (1965) The systematics, evolution and zoogeography of staphylinid beetles associated with army ants (Coleoptera, Staphylinidae). Fieldiana: Zoology 47:139–351

Smetana A, Herman L (2001) Brief history of taxonomic studies of the Staphylinidae including biographical sketches of the investigators, pp 17–159. In: Herman L (ed) Catalog of the Staphylinidae (Insecta: Coleoptera). 1758 to the end of the second millennium. I. Introduction, history, biographical sketches, and omaliine group. Bull Am Mus Nat Hist 265:1–650

Timm RM (2006) In memoriam: James S. ("Steve" Ashe, 1947–2005). J Kansas Entomol Soc 79(2):89–91

Historical Review of Research on Aleocharinae in Canada, with a Focus on British Columbia

3

A serious dialogue cannot take place on a historical review of taxonomic research on the North American Aleocharinae without the mention of one of the early students of Coleopterology in this country, **Thomas Lincoln Casey** (Fig. 2.1a). Casey was one of the most prolific describers of species-level taxa in the subfamily Aleocharinae.

Casey's taxonomic philosophy, however, was the topic of appreciable criticism by his peers. He was considered as a "splitter" as opposed to a "lumper," for he recognized more species, rather than less. One colleague (W. Dwight Pierce) once accused Casey of being a splitter, to which he responded, "Pierce, I am just a generation ahead of the rest of you" (Mallis 1971: 262). His many detractors charged that the morphological characters he relied upon were too trivial, failing to take into account intraspecific variation, to support the naming of new species-level taxa, and that he ignored or made little attempt to refer to previous published literature (Mallis 1971). As a result, many of Casey's new species eventually fell into synonymy. This is evident in other beetle groups he studied, such as the Carabidae (Lindroth 1969). For example, of the 902 Casey "types" of Carabidae, only 81 of those remained valid species after close study by Carl Lindroth (Majka and Sikes 2009). Similarly, Casey's taxonomic studies of the aleocharine genus *Gyrophaena*, a mushroom specialist and related genera were thoroughly re-examined by Charles Seevers (1951), and the result was much the same. Casey had described 47 new species in this group of genera and Seevers (1951) synonymized 20 of them. Casey may best be remembered for producing more synonyms than any other individual.

The North American beetle fauna was largely unknown before the late 1800s, despite the efforts of other North American coleopterists of that era, such as Thomas Say, John LeConte, and George Horn. The slate was essentially clean for Thomas Casey to initiate his descriptive studies of staphylinids and other beetles. Casey published his first major treatment on staphylinids in 1884–1885, with his "*Contributions to the descriptive and systematic coleopterology of North America, Parts I and II*." In the early 1900s, Casey published monographs on the North American Aleocharinae exclusively (Casey 1906, 1910, 1911). His most meaningful body of work was his privately published *Memoirs on the Coleoptera* (1910–1924) (Essig 1972).

Notwithstanding his inability to recognize and accept intraspecific variation and several other taxonomic shortcomings, Casey still was one of the first to provide comprehensive taxonomic studies of staphylinid rove beetles, in particular the Aleocharinae, in the United States and

A comparable historical review of research on taxa of eastern Canadian Aleocharinae was completed by Klimaszewski et al. (2018). A significant number of aleocharine genera and species occurring in eastern Canada are also found in British Columbia.

J. Klimaszewski et al., *Aleocharine Rove Beetles of British Columbia: A Hotspot of Canadian Biodiversity (Coleoptera, Staphylinidae)*, https://doi.org/10.1007/978-3-030-36174-7_3

Canada. Among the fauna of Aleocharinae of Canada, many of his species concepts still survive today and represent the majority of species-level taxa within some genera (i.e., *Aleochara*, *Oxypoda*, and many Athetini genera and species) (Majka and Sikes 2009).

Below, we provide an historical account of taxonomic research of the Aleocharinae of North America, beginning from the early and mid 1800s to present day. For the majority of taxa treated by specialists over this time span, distribution records of aleocharine species occurring in Canada, particularly in British Columbia and elsewhere in the Pacific Northwest, were documented.

Using the Casey years (era) as a point of reference or benchmark in this historical analysis, we have divided our treatment into three time periods: the pre-Casey era, the Casey era, and the post-Casey era.

Pre-Casey Era (<1885)

Prior to 1885, about 86 endemic species of Aleocharinae had been recorded in North America. Thomas Say (1830, 1834, 1839) was the first American entomologist to name aleocharine species (Seevers 1978). Say proposed the first endemic American genus (*Aleodorus* Say, 1830), but eleven of his species were eventually placed in *Aleochara* (Seevers 1978). The pre-Casey era was defined by taxonomy consisting entirely of isolated, weak descriptions, and no illustrations, that did not allow for identification of individuals. From the end of the 1830s and during the next 50 years, a number of aleocharine species occurring in Canada were described by C. R. Sahlberg (1831), Erichson (1839, 1840), von Mannerheim (1843), Mäklin (1852, 1853), Walker (1866), and LeConte (1867), some of which were recorded from British Columbia (Seevers 1978).

Casey Era (1884–1924)

Recognized for the formal description of over 9200 species, subspecies, and varieties of beetles (Coleoptera) over his long professional career, Casey made enormous contributions to the study of North American Staphylinidae (Majka and Sikes 2009), and is credited with describing over 1800 species. Before Casey's work, a small portion of North American staphylinid species had been described, particularly those of the Aleocharinae (Smetana and Herman 2001). As a result of Casey's early work, the composition of the North American aleocharine fauna became better known, even though he devoted only a fraction of his taxonomic career to the Aleocharinae (Seevers 1978). Casey has been credited with the description of about 90% of the North American species of aleocharines, with an additional 8% described by Max Bernhauer (Seevers 1978).

Despite the descriptive work on new genera and species of Aleocharinae during the late 1800s and early 1900s by Casey and his contemporaries (Bernhauer, Blatchley, Fenyes, and Ganglbauer), no attempt was made to inventory the Aleocharinae of Canada. The first checklist of Canadian Staphylinidae was by Beaulne (1920–1922), who listed 215 species of Aleocharinae in 50 genera in his series "Les Coléoptères du Canada," including 93 species from British Columbia. Other available records of beetle species occurring in Canada are that found in Charles W. Leng's 1920 *Catalogue of the Coleoptera of America, North of Mexico* and its five supplements (between 1927 and 1948), the out-dated *Coleopterorum Catalogus*, and records found in Melville Hatch's 1957 volume on the Staphyliniformia of his seminal multivolume series "*The Beetles of the Pacific Northwest*." In the latter, Hatch documented species and genera occurring in northern California, Oregon, Washington, and southern British Columbia.

Post-Casey Era (>1925)

From the late 1920s through the 1940s, little taxonomic progress was made in aleocharine studies despite numerous publications on taxonomy, classification, developmental stages, ecology, and distributions of species of this subfamily. A few minor papers contributed to our taxonomic knowledge base during this three-decade time period. Included here is an obscure paper that provided a short list of aleocharine species, among other rove beetles, recorded from Alaska and adjacent parts of the Yukon Territory (Fall 1926). Some of these same taxa are listed from British Columbia herein. An early account of intertidal aleocharines (*Liparocephalus* and allied genera) occurring on shorelines of the northern Pacific coast of North America was provided by Chamberlin and Ferris (1929).

The 1950s saw only a modicum of published papers on the aleocharines of Canada. The first person to provide a substantial improvement to our taxonomic knowledge of the Canadian aleocharine fauna was Charles Seevers in 1951 with a revision of North American and European *Gyrophaena* and allied genera (Seevers 1951). A review of the Canadian Gyrophaenina by Klimaszewski et al. (2009b) provided a modern update to Seever's (1951) study. Another attempt to characterize and revise the group of intertidal genus-level taxa of the "Phytosi" (=tribes Liparocephalini and Athetini, in part, of authors) of the Pacific coast was addressed in an early paper by Moore (1956). Melville Hatch (1957) added many B.C. records in Part II (the Staphyliniformia) of his seminal multivolume series "*The Beetles of the Pacific Northwest*," in which he documented species and genera occurring in northern California, Oregon, Washington, and southern British Columbia. This publication has served as an invaluable historical resource for distribution records of the Pacific Northwest.

While the 1960s did not see any significant number of taxonomic publications on Canadian aleocharines, the 1970s did see a profusion of published studies on the fauna of North American Aleocharinae. Revisions of the charismatic myrmecophilous genus *Xenodusa* (Hoebeke 1976) and the distinctive wetland-dwelling genera *Gymnusa* and *Deinopsis* (Klimaszewski 1979, 1982b) were completed. In 1978, a revision of the North American genera and tribes of Aleocharinae was published (Seevers 1978), with a checklist of the genera. This comprehensive monograph attempted to coordinate the nomenclature and classification of North American taxa with those of Eurasia. This study and Charles Seever's earlier work on North American and European *Gyrophaena* and allied genera (Seevers 1951) represent "the only serious and comprehensive attempts to bring some degree of order out of chaos of numerous, superficially described genera for North American aleocharines. . ." (Ashe 1986). Prior to 1978, the fauna of North American Aleocharinae had never been treated systematically and keys to genera were non-existant and thus this became one of the first published works that allowed for the identification of aleocharines. Additionally, it provided a wealth of long-needed illustrations, although line drawings only, of important morphological characters and a greatly needed, critical synthesis of generic concepts (Klimaszewski et al. 2018). Seevers' revision has become the standard reference for the study of North American aleocharines (Ashe 1986) and has also served as an important catalyst for later improvements to generic classification (e.g., Ashe 1984, 1992; Gusarov 2003a).

Progress during the 1980s included taxonomic revisions of the tribe Falagriini (Hoebeke 1985), the tribe Myllaenini (*Myllaena*) (Klimaszewski 1982a), and the genus *Aleochara* (Klimaszewski 1984 and several supplements). Ashe (1986) erected a new athetine genus and species (*Seeversiella bispinosa*), only later to be revised by Gusarov (2003a) to include twenty-seven new species from the Nearctic and Neotropics, and to synonymize Ashe's *S. bispinosa* with *S. globicollis* (Bernhauer), known to occur in British Columbia. The morphologically unique tribe Autaliini, including the single genus *Autalia*

in North America, was reviewed by Hoebeke (1988).

Additional research on aleocharines in Canada during the 1990s included a revision of the arctic members of the tribes Aleocharini and Athetini of North America (Lohse et al. 1990); several genera of the distinctive and ecologically unique tribe Liparocephalini whose members are intertidal species specialized to live in low and high tide zones [*Amblopusa* (Ahn and Ashe 1996), *Diaulota* (Ahn 1996a), *Liparocephalus* (Ahn 1997a), and *Paramplopusa* (Ahn and Ashe 1996)]; and also notable work on other marine intertidal athetine specialists of the genera *Pontomalota* (Ahn and Ashe 1992), and *Thinusa* and *Tarphiota* (Ahn 1996b, 1997b, 1999, respectively).

During the first decade of the 2000s, most of the taxonomic literature that reinforced our understanding of the eastern Canadian aleocharine fauna also provided for a better comprehension of the shared fauna with British Columbia. A number of modern revisions, reviews, descriptions of new taxa, and new data on bionomics and distributions all resulted in new diagnostic tools for the provincial fauna of BC. The first comprehensive treatment of aleocharine rove beetles of British Columbia was by Klimaszewski and Winchester (2002), wherein 40 species in 9 tribes were recorded from the ancient Sitka spruce forest of the Carmanah Valley on Vancouver Island. Also, they erected a new genus *Paraleptonia* to accommodate an undescribed species (*pacei* Klimaszewski).

Gusarov (2003c) examined a large number of North American type specimens of Aleocharinae that resulted in some valuable insights relevant to taxonomic work on Nearctic aleocharines (Klimaszewski et al. 2018). Species described by early workers (e.g., Casey) were often misidentified to genus, causing them to be often overlooked in modern taxonomic treatments. Some Aleocharinae, especially Athetini, were found to be more widespread than previously thought by workers such as Casey, underscoring the importance of checking all North American types as many species were potentially synonyms or incorrectly classified. Also, subtle variation in external morphology had led to the proliferation of synonyms (for example, ten names are found under *Strigota ambigua*). Gusarov (2003c) also provided aids to reliably identify several of the most common *Atheta* species in Canada. In 2004, *Neothetalia* Klimaszewski, an oxypodine genus, was described and added to the eastern Canadian fauna (Klimaszewski and Pelletier 2004). This resulted in six described species of which five are recorded from British Columbia. In the same year, the Canadian species of *Leptusa* were also revised (Klimaszewski et al. 2004).

Other genera of aleocharines that underwent critical revision or review in the early 2000s included *Placusa* (Klimaszewski et al. 2001); *Earota* (Gusarov 2002a); *Geostiba* (Gusarov 2002b); *Pelioptera* (as *Tropimenelytron*) (Gusarov 2002c); *Seeversiella* (Gusarov 2003a); *Silusa* (Klimaszewski et al. 2003); *Psammostiba* (Gusarov 2003d); *Strigota* (Gusarov 2003c), *Tinotus* (now a subgenus of *Aleochara*; Klimaszewski et al. 2002, Yamamoto and Maruyama 2016); *Goniusa* (Gusarov 2003b); *Adota* (Gusarov 2003d); *Lypoglossa* (Gusarov 2004); the other genera of the *Ocalea* group of the Oxypodini, including *Alfocalea*, *Betocalea*, *Megocalea*, *Metocalea*, *Neoisoglossa*, and *Parocalea* (Klimaszewski and Pelletier 2004); *Oxypoda* (Klimaszewski et al. 2006); *Tachyusa* (Paśnik 2006); *Gnypeta* (Klimaszewski et al. 2008); *Calodera* (Assing 2008); *Ocyusa* (Webster et al. 2009); and *Schistoglossa* (Klimaszewski et al. 2009a). Three species of adventive Palearctic Aleocharinae from the Maritime Provinces were reported by Majka and Klimaszewski (2008c)—including two species of the genus *Meotica* [*pallens* (Redtenbacher) and *exilis* (Knoch)], one of which (*pallens*) was recorded from British Columbia. Majka and Klimaszewski (2008b) provided eighty-eight new Canadian provincial records of Aleocharinae, including eleven first time records from British Columbia [*Aleochara quadrata* Sharp, *Gnathusa eva* Fenyes, *Atheta strigosula* Casey, *A. longicornis* (Gravenhorst), *A. platanoffi* Brundin, *A. klagesi* Bernhauer, *A. frosti* Bernhauer, *Mocyta fungi*

(Gravenhorst), *Philhygra botanicarum* Muona, *P. clemens* (Casey), and *P. "humivaga"*].

A special issue of the journal ZooKeys, entitled '*Biodiversity, Biosystematics, and Ecology of Canadian Coleoptera*' (Majka and Klimaszewski 2008a), triggered a measured increase in our knowledge of the composition of the eastern Canadian fauna and included taxonomic papers that newly addressed the taxonomy and biogeography of several aleocharine taxa in British Columbia. For example, a review of the genus *Gnypeta* from Canada, Alaska, and Greenland recorded three species from British Columbia (Klimaszewski et al. 2008).

In a second issue (McLean et al. 2009a, b), two papers focused on aleocharine species collected in portions of undamaged and storm-damaged forests in Stanley Park, Vancouver, British Columbia between 2007 and 2008 (McLean et al. 2009a, b). Trapping yielded 35 species of Staphylinidae in the first survey conducted in 2007, including one species new to science, *Oxypoda stanleyi* Klimaszewski & McLean; three adventive aleocharine species, *Dalotia coriaria* (Kraatz), *Mocyta fungi* (Gravenhorst) and *Oxypoda opaca* (Gravenhorst) were recorded for the first time from British Columbia; and new distribution records for another four species (McLean et al. 2009a). An additional eighteen species of aleocharines were recorded in the second trapping survey of 2008 (McLean et al. 2009b). In another paper in this special issue, the Holarctic athetine genus *Schistoglossa* Kraatz was listed for the first time from Canada, including three species recorded from British Columbia (Klimaszewski et al. 2009a).

New genus-level taxa were also described in the early 2000s and included species from the Pacific Northwest and British Columbia. For example, the new genus *Paragoniusa* Maruyama and Klimaszewski (2004) was erected for a new myrmecophilous species (*myrmicae*) known to occur in British Columbia, and also the new genus *Paraleptonia* Klimaszewski was described (in Klimaszewski and Winchester 2002). The publication of the first North American catalogue on Staphylinidae, including the Aleocharinae, by Moore and Legner (1975), was followed much later by the first comprehensive catalogue of aleocharine beetles from Canada and Alaska (Gouix and Klimaszewski 2007). A worldwide checklist and a complete account on the biogeography and natural history of coastal Staphylinidae were produced by Frank and Ahn (2011). This contribution listed 392 species, in 91 genera, of Staphylinidae that are believed to be confined to coastal habitats worldwide. In this publication 4 tribes and 11 genera of aleocharines that include species adapted to saline habitats of the Pacific coast of North America were recorded.

From 2011 to 2019, current aleocharine research has again focused on a number of comprehensive taxonomic reviews, revisions, and new distributional records in Canada for several little known and obscure genera—*Dinaraea* (Klimaszewski et al. 2013), *Gnathusa, Mniusa* and *Ocyusa* (Klimaszewski et al. 2014), *Trichiusa* (Klimaszewski et al. 2015a), *Mocyta* (Klimaszewski et al. 2015b), *Clusiota* (Klimaszewski et al. 2015c), *Liogluta* (Klimaszewski et al. 2016), and *Boreophilia* (Klimaszewski et al. 2019)—including the validation of species occurring in British Columbia.

During the past nearly 30 years, documentation of the aleocharine fauna of British Columbia has proceeded at an accelerated rate, through the many published works mentioned above and others. Campbell and Davis (1991) checklist recorded a total of 106 species of Aleocharinae in British Columbia. By 2007, the total number of aleocharine taxa recorded in the province climbed to 153 species (in 54 genera) (Gouix and Klimaszewski 2007). In the second edition of the "Checklist of Beetles of Canada and Alaska" (Bousquet et al. 2013), 176 species were inventoried for British Columbia, a 66% increase from 1991. With the completion of the present treatment, 227 recorded species of aleocharines are now documented for the province, an additional 28% increase since 2013. Since the publication of Campbell and Davis (1991) checklist, the number of recorded aleocharines in British Columbia has more than doubled, increasing by 114%. For all Staphylinidae, Bousquet (2013) records 779 species from British Columbia alone, second in

overall species richness in Canada only to Ontario (865 spp.). With the 227 species treated herein, the Aleocharinae rove beetles constitute nearly 29% of the total number of staphylinids recorded for the province. The present work provides additional identification tools to hopefully steer and motivate others to continue the documentation of these regional faunas.

References

Ahn KJ (1996a) A review of *Diaulota* Casey (Coleoptera: Staphylinidae: Aleocharinae), with description of a new species and known larvae. Coleopt Bull 50(3):270–290

Ahn KJ (1996b) Revision of the intertidal aleocharine genus *Tarphiota* (Coleoptera: Staphylinidae). Entomol News 107(4):177–185

Ahn KJ (1997a) A review of *Liparocephalus* Mäklin (Coleoptera: Staphylinidae: Aleocharinae). Pan-Pac Entomol 73(2):79–92

Ahn KJ (1997b) Revision and systematic position of the intertidal genus *Thinusa* Casey (Coleoptera: Staphylinidae: Aleocharinae). Entomol Scand 28:75–81

Ahn KJ (1999) *Tarphiota densus* (Moore), a new combination and key to the species of the genus *Tarphiota* Casey (Coleoptera: Staphylinidae: Aleocharinae). J Kansas Entomol Soc 71:191–193

Ahn KJ, Ashe JS (1992) Revision of the intertidal aleocharine genus *Pontomalota* (Coleoptera: Staphylinidae) with a discussion of its phylogenetic relationships. Entomol Scand 23:347–359

Ahn KJ, Ashe JS (1996) Revision of the intertidal aleocharine genus *Amblopusa* Casey and description of the new genus *Paramblopusa* (Coleoptera: Staphylinidae). J N Y Entomol Soc 103(2):138–154

Ashe JS (1984) Generic revision of the subtribe Gyrophaenina (Coleoptera: Staphylinidae: Aleocharinae) with a review of the described subgenera and major features of evolution. Quaestiones Entomol 20:129–349

Ashe JS (1986) *Seeversiella bispinosa*, a new genus and species of athetine Aleocharinae (Coleoptera: Staphylinidae) from North America. J N Y Entomol Soc 94(4):500–511

Ashe JS (1992) Phylogeny and revision of genera of the subtribe Bolitocharina (Coleoptera: Staphylinidae: Aleocharinae). Univ Kansas Sci Bull 54:335–406

Assing V (2008) The genus *Calodera* Mannerheim in Canada (Insecta, Coleoptera, Staphylinidae, Aleocharinae). ZooKeys 2:203–208

Beaulne J-I (1919–1922) [Staphylinidae sensu lato] In: Les Coléoptères du Canada. Le Naturaliste Canadien 46: 47–48, 69–72, 94–96, 117–119, 136–143, 164–167, 181–185, 212–216, 235–239, 260–263, 274–284; 47:66–71, 89–95, 117–120, 138–142, 279–284; 48:21–24, 42–48, 64–72, 89–96, 113–120, 141–144 [Aleocharinae in 48:46–144]

Bousquet Y, Bouchard P, Davies AE, Sikes DS (2013) Checklist of beetles (Coleoptera) of Canada and Alaska: second edition. Pensoft Series Faunistica No. 109. Pensoft, Sofia, Moscow, 402 p

Campbell JM, Davies A (1991) Family Staphylinidae rove beetles [pp. 86–124]. In: Bousquet Y (ed) Checklist of beetles of Canada and Alaska. Publication 1861/E, Research Branch, Agriculture Canada, Ottawa, vi + 430 pp

Casey TL (1906) Observations on the staphylinid groups Aleocharinae and Xantholinini chiefly of America. Trans Acad Sci St Louis 16(6):12–435

Casey TL (1910) New species of the staphylinid tribe Myrmedoniini. Memoirs on the Coleoptera I. Lancaster, New Era Printing Co, pp 1–183

Casey TL (1911) New American species of Aleocharinae and Myllaeninae. Memoirs on the Coleoptera II. Lancaster, New Era Printing Co, pp 1–245

Chamberlin JC, Ferris GF (1929) On *Liparocephalus* and allied genera (Coleoptera: Staphylinidae). Pan-Pac Entomol 5(3):137–143, (4):153–163

Erichson WF (1839) Genera et species Staphylinorum insectorum coleopterorum familiae, vol 1. F. H. Morin, Berlin, I–VIII + 400 pp

Erichson WF (1840) Genera et species Staphylinorum insectorum coleopterorum familiae, vol 1. F. H. Morin, Berlin, pp 401–954

Essig EO (1972) A history of entomology. Hafner Publishing, New York. 1029 pp

Fall HC (1926) A list of the Coleoptera taken in Alaska and adjacent parts of the Yukon Territory in the summer of 1924. Pan-Pac Entomol 2(3):127–154

Frank JH, Ahn KJ (2011) Coastal Staphylinidae (Coleoptera): a worldwide checklist, biogeography and natural history. ZooKeys 107:1–98

Gouix N, Klimaszewski J (2007) Catalogue of aleocharine rove beetles of Canada and Alaska (Coleoptera, Staphylinidae, Aleocharinae). Pensoft, Sofia. 165 pp

Gusarov VI (2002a) A revision of Nearctic species of the genus *Earota* Mulsant & Rey, 1874 (Coleoptera: Staphylinidae: Aleocharinae). Zootaxa 92:1–16

Gusarov VI (2002b) A revision of Nearctic species of the genus *Geostiba* Thomson, 1858 (Coleoptera: Staphylinidae Aleocharinae). Zootaxa 81:1–88

Gusarov VI (2002c) A revision of Nearctic species of the genus *Tropimenelytron* Pace, 1983 (Coleoptera: Staphylinidae: Aleocharinae), a new genus for North America. Zootaxa 114:1–24

Gusarov VI (2003a) A revision of the genus *Seeversiella* Ashe, 1986 (Coleoptera: Staphylinidae: Aleocharinae). Zootaxa 142:1–102

Gusarov VI (2003b) A revision of the genus *Goniusa* Casey, 1906 (Coleoptera: Staphylinidae: Aleocharinae). Zootaxa 164:1–20

Gusarov VI (2003c) Revision of some types of North American aleocharines (Coleoptera: Staphylinidae;

Aleocharine), with synonymic notes. Zootaxa 353:1–134
Gusarov VI (2003d) A revision of Nearctic species of the genera *Adota* Casey, 1910 and *Psammostiba* Yosii & Sawada, 1976 (Coleoptera: Staphylinidae: Aleocharinae). Zootaxa 185:1–35
Gusarov V (2004) A revision of the genus *Lypoglossa* Fenyes, 1918 (Coleoptera: Staphylinidae: Aleocharinae). Zootaxa 747:1–36
Hatch MH (1957) The Beetles of the Pacific Northwest. Part II: Staphyliformia. University of Washington Press, Seattle. ix + 384 pp
Hoebeke ER (1976) A revision of the genus *Xenodusa* (Staphylinidae, Aleocharinae) for North America. Sociobiology 2(2):109–143
Hoebeke ER (1985) A revision of the rove beetle tribe Falagriini of America north of Mexico (Coleoptera: Staphylinidae: Aleocharinae). J N Y Entomol Soc 93 (2):913–1018
Hoebeke ER (1988) A new species of rove beetle, *Autalia phricotrichosa* (Coleoptera: Staphylinidae: Aleocharinae), from Mexico, with a key to the New World species of *Autalia*. Coleopt Bull 42(1):87–93
Klimaszewski J (1979) A revision of the Gymnusini and Deinopsini of the world: Coleoptera, Staphylinidae, Aleocharinae, No. 25. Agriculture Canada, Research Branch. Monograph No. 25, 169 pp
Klimaszewski J (1982a) Studies of Myllaenini (Coleoptera: Staphylinidae, Aleocharinae): 1. Systematics, phylogeny, and zoogeography of nearctic *Myllaena* Erichson. Can Entomol 114(3):181–242
Klimaszewski J (1982b) A revision of the Gymnusini and Deinopsini of the world (Coleoptera: Staphylinidae). Supplementum 2. Can Entomol 114(4):317–335
Klimaszewski J (1984) A revision of the genus *Aleochara* Gravenhorst of America north of Mexico (Coleoptera: Staphylinidae, Aleocharinae). Mem Ent Soc Can 129, [2] + 211 pp
Klimaszewski J, Pelletier G (2004) Review of the *Ocalea* group of genera (Coleoptera, Staphylinidae, Aleocharinae) in Canada and Alaska: new taxa, bionomics, and distribution. Can Entomol 136:443–500
Klimaszewski J, Winchester NN (2002) Aleocharine rove beetles (Coleoptera Staphylinidae) of the ancient Sitka spruce forest on Vancouver Island, British Columbia, Canada. Mém Soc ro belge d'Entomol 40:3–126
Klimaszewski J, Pelletier G, Germain C, Hebert C (2001) Diversity of *Placusa* (Coleoptera: Staphylinidae: Aleocharinae) in Canada, with descriptions of two new species. Can Entomol 133(1):1–47
Klimaszewski J, Pelletier G, Sweeney J (2002) Genus *Tinotus* (Coleoptera: Staphylinidae, Aleocharinae) from America north of Mexico: review of the types, distribution records, and key to species. Can Entomol 134(3):281–298
Klimaszewski J, Pohl G, Pelletier G (2003) Revision of the Nearctic *Silusa* (Coleoptera, Staphylinidae, Aleocharinae). Can Entomol 135(2):159–186
Klimaszewski J, Pelletier G, Majka C (2004) A revision of Canadian *Leptusa* Kraatz (Col., Staphylinidae, Aleocharinae): new species, new distribution records, key and taxonomic considerations. Belgian J Entomol 6(1):3–42
Klimaszewski J, Pelletier G, Germain C, Work T, Hébert C (2006) Review of *Oxypoda* species in Canada and Alaska (Coleoptera, Staphylinidae, Aleocharinae): systematics, bionomics, and distribution. Can Entomol 138(6):737–852
Klimaszewski J, Savard K, Pelletier G, Webster R (2008) Species review of the genus *Gnypeta* Thomson from Canada, Alaska and Greenland (Coleoptera, Staphylinidae, Aleocharinae): systematics, bionomics and distribution. ZooKeys 2:11–84
Klimaszewski J, Webster RP, Savard K (2009a) First record of the genus *Schistoglossa* Kraatz from Canada with descriptions of seven new species (Coleoptera, Staphylinidae, Aleocharinae). ZooKeys 22:45–79
Klimaszewski J, Webster RP, Savard K (2009b) Review of the rove beetle species of the subtribe Gyrophaenina Kraatz (Coleoptera, Staphylinidae) from New Brunswick, Canada: new species, provincial records and bionomic information. ZooKeys 22:81–170
Klimaszewski J, Webster RP, Langor DW, Bourdon C, Jacobs J (2013) Review of Canadian species of the genus *Dinaraea* Thomson, with descriptions of six new species (Coleoptera, Staphylinidae, Aleocharinae, Athetini). ZooKeys 327:65–101
Klimaszewski J, Webster RP, Langor DW, Bourdon C, Hammond HEJ, Pohl GR, Godin B (2014) Review of Canadian species of the genera *Gnathusa* Fenyes, *Mniusa* Mulsant & Rey and *Ocyusa* Kraatz (Coleoptera, Staphylinidae, Aleocharinae). ZooKeys 412:9–40
Klimaszewski J, Godin B, Langor D, Bourdon C, Lee S-I, Horwood D (2015a) New distributional records for Canadian Aleocharinae (Coleoptera, Staphylinidae), and new synonymies for *Trichiusa*. ZooKeys 498:51–91
Klimaszewski J, Webster RP, Bourdon C, Pelletier G, Godin B, Langor DW (2015b) Review of Canadian species of the genus *Mocyta* Mulsant & Rey (Coleoptera, Staphylinidae, Aleocharinae), with the description of a new species and a new synonymy. ZooKeys 487:111–139
Klimaszewski J, Webster RP, Sikes D, Bourdon C, Labrecque M (2015c) A review of Canadian and Alaskan species of the genera *Clusiota* Casey and *Atheta* Thomson, subgenus *Microdota* Mulsant & Rey (Coleoptera, Staphylinidae, Aleocharinae). ZooKeys 524:103–136
Klimaszewski J, Webster RP, Langor DW, Sikes D, Bourdon C, Godin B, Ernst C (2016) A review of Canadian and Alaskan species of the genus *Liogluta* Thomson, and descriptions of three new species (Coleoptera, Staphylinidae, Aleocharinae). ZooKeys 573:217–256

Klimaszewski J, Webster RP, Langor DW, Brunke A, Davies A, Bourdon C, Labrecque M, Newton AF, Dorval J-A, Frank JH (2018) Aleocharine rove beetles of eastern Canada (Coleoptera, Staphylinidae, Aleocharinae): a glimpse of megadiversity. Springer, Cham. xvi + 902 pp

Klimaszewski J, Sikes DS, Brunke A, Bourdon C (2019) Species review of the genus *Boreophilia* Benick from North America (Coleoptera, Staphylinidae, Aleocharinae, Athetini): systematics, habitat, and distribution. ZooKeys 848:57–102

LeConte JL (1867) Additions to the coleopterous fauna of the United States. No. 1. Proc Acad Nat Sci Phila 19:361–394

Leng CW (1920) Catalogue of the Coleoptera of America, north of Mexico. John D. Sherman, Jr., Mount Vernon, NY. x + 470 pp

Lindroth CH (1969) The ground-beetles (Carabidae, excl. Cicindelidae) of Canada and Alaska, Part 1–3. Opusc Ent Suppl XXXV, 408 pp

Lohse GA, Klimaszewski J, Smetana A (1990) Revision of Arctic Aleocharinae of North America (Coleoptera: Staphylinidae). Coleopt Bull 44:121–202

Majka CG, Klimaszewski J (eds) (2008a) Biodiversity, biosystematics, and ecology of Canadian Coleoptera, vol 2. PenSoft, Sofia

Majka CG, Klimaszewski J (2008b) New records of Canadian Aleocharinae (Coleoptera: Staphylinidae). ZooKeys 2:85–114

Majka CG, Klimaszewski J (2008c) Adventive Staphylinidae (Coleoptera) of the Maritime Provinces of Canada: further contributions. ZooKeys 2:151–174

Majka CG, Sikes DS (2009) Thomas L. Casey and Rhode Island's precinctive beetles: Taxonomic lessons and the utility of distributional checklists. ZooKeys 22:267–283

Mäklin F (1852) Descriptions of new taxa. In: Mannerheim CG (ed) Zweiter Nachtrag zur Kaefer-Fauna der nordamerikanischen Laender des Russischen Reiches. Bull Soc Imp Nat Moscou 25(2):283–387

Mäklin FG (1853) [Description of new taxa]. In: von Mannerheim CG (ed) Dritter Nachtrag zur Kaefer-Fauna der nord-amerikanischen Laender des Russischen Reiches. Bull Soc Imp Nat Moscou 26:95–269

Mallis A (1971) American entomologists. Rutgers University Press, New Brunswick, NJ. 549 pp

Mannerheim CG (1843) Beitrag zur Käfer-Fauna der Aleutischen Inseln, der Insel Sitkha und Neu-Californiens. Bull Soc Imp Nat Moscou 16:175–314

Maruyama M, Klimaszewski J (2004) A new genus and species of the myrmecophilous Athetini, *Paragoniusa myrmicae* (Coleoptera: Staphylinidae: Aleocharinae) from Canada. J Entomol Rev Japan 59(2):241–248

McLean JA, Klimaszewski J, Li A, Savard K (2009a) Survey of rove beetles (Coleoptera, Staphylinidae) from Stanley Park, Vancouver, British Columbia, Canada, with new records and description of a new species: Part 1. ZooKeys 22:5–17

McLean JA, Klimaszewski J, Chandler DS, Savard K, Li A (2009b) Survey of rove beetles (Coleoptera, Staphylinidae) from Stanley Park, Vancouver, British Columbia, Canada, with new records and description of a new species: Part 2. Zookeys 22:19–33

Moore I (1956) A revision of the Pacific coast Phytosi with a review of the foreign genera (Coleoptera: Staphylinidae). Trans San Diego Soc Nat Hist 12 (7):103–152

Moore I, Legner EF (1975) A catalogue of the Staphylinidae of America north of Mexico (Coleoptera). Division of Agricultural Science, University of California. Special Publication No 3015:514 pp

Paśnik G (2006) A revision of the World species of the genus *Tachyusa* Erichson, 1837 (Coleoptera, Staphylinidae: Aleocharinae). Zootaxa 1146:1–152

Sahlberg CR (1831) Insecta Fennica, dissertationibus academicis, A. 1817–1834 editis. Pars I: A. Frenckelliana, Helsingforsiae, pp 361–408

Say T (1830) Descriptions of new species of North American insects, and observations on some already described. New Harmony, pp 1–41

Say T (1834) Descriptions of new North American insects and observations on some already described. Trans Am Philos Soc 4(NS):409–470

Say T (1839) Descriptions of new North American insects and observations on some already described. Trans Am Philos Soc (NS)6:155–190

Seevers CH (1951) A revision of the North American and European staphylinid beetles of the subtribe Gyrophaenae (Aleocharinae, Bolitocharini). Fieldiana Zool 32:655–762

Seevers CH (1978) A generic and tribal revision of the North American Aleocharinae (Coleoptera: Staphylinidae). Fieldiana Zool 71:vi + 275 pp

Smetana A, Herman L (2001) Brief history of taxonomic studies of the Staphylinidae including biographical sketches of the investigators, pp 17–160. In: Herman LH (ed) Catalog of the Staphylinidae (Insecta, Coleoptera): 1758 to the end of the second millennium. vol. 1, Introduction, history. Bull Am Mus Nat Hist 265:1–650

Walker F (1866) Appendix. A list of mammals, birds, insects, reptiles, fishes, shells, annelides, and Diatomaceae, collected by myself in British Columbia and Vancouver Island, with notes on their habits. [List of Coleoptera], pp 309–334. In: Lord JK (ed) The Naturalist in Vancouver Island and British Columbia, Richard Bentley, London, 375 pp

Webster RP, Klimaszewski J, Pelletier G, Savard K (2009) New Staphylinidae (Coleoptera) records with new collection data from New Brunswick, Canada. 1. Aleocharinae. ZooKeys 22:171–248

Yamamoto S, Maruyama M (2016) Revision of the subgenus *Tinotus* Sharp, stat. n., of the parasitoid rove-beetle genus *Aleochara* Gravenhorst (Coleoptera, Staphylinidae, Aleocharinae) from Japan, Taiwan, and the Russian Far East. ZooKeys 559:81–106

Material and Methods

4

Format

The classification of taxa used herein selectively follows concepts expressed by Benick and Lohse (1974), Seevers (1978), Klimaszewski (1979, 1982, 1984), Klimaszewski et al. (2018), Lohse et al. (1990), Ashe (2001), Gusarov (2003, 2011), Elven et al. (2010, 2012), Paśnik (2010), Bouchard et al. (2011), Hlaváč et al. (2011), Schülke and Smetana (2015), and several treatments of Canadian genera by Klimaszewski et al. (2018), and Yamamoto and Maruyama (2017). Distributional records and bionomic information (e.g., habitat associations, collection dates, collecting methods) are based on published records and on specimens in the collections of Laurentian Forestry Centre, the Canadian National Collection of Insects, Arachnids and Nematodes, collection of University of British Columbia, George J. Spencer Entomological Museum, and Royal British Columbia Museum. In the case of unpublished records, we provide specimen data under the respective species. Only records considered to be reliable are listed.

Abbreviations

BC jurisdictions are boldfaced and other jurisdictions in Canada and USA are in plain text.

AB—Alberta
AK—Alaska
BC—British Columbia
LB—Labrador
MB—Manitoba
NB—New Brunswick
NF—Newfoundland
NS—Nova Scotia
NT—Northwest Territories
NU—Nunavut
ON—Ontario
PE—Prince Edward Island
QC—Quebec
SK—Saskatchewan
YT—Yukon Territory

State abbreviations for the United States of America follow those of the United States Postal Service.

Institution Codes

AMNH	American Museum of Natural History, New York, New York, USA
BGC	Benoit Godin private collection, Whitehorse, Yukon, Canada
CAS	California Academy of Sciences, San Francisco, California, USA

J. Klimaszewski et al., *Aleocharine Rove Beetles of British Columbia: A Hotspot of Canadian Biodiversity (Coleoptera, Staphylinidae)*, https://doi.org/10.1007/978-3-030-36174-7_4

CNC Canadian National Collection of Insects, Arachnids, and Nematodes, Agriculture and Agri-Food Canada, Ottawa, Ontario, Canada.

FMNH Integrative Research Center, The Field Museum of Natural History, Chicago, Illinois, USA

LFC Natural Resources Canada, Canadian Forest Service, Laurentian Forestry Centre, R. Martineau Insectarium, Quebec City, Quebec, Canada.

MCZ Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, USA

RBCM Royal British Columbia Museum, Victoria, British Columbia, Canada

SEMUC Snow Entomological Museum, University of Kansas, Kansas, USA

UBC University of British Columbia, George J. Spencer Entomological Museum, Vancouver, British Columbia, Canada

USNM United States National Museum, Washington, DC, United States of America.

ZMLU Zoological Collection, Lund University, Lund, Sweden

ZMH Zoological Museum, Helsinki, Finland.

VAC Volker Assing collection, Hannover, Germany.

Diagnostic Features (Figs. 4.2–4.9)

Most of the text below regarding diagnostic features is taken from Klimaszewski et al. (2018). It is important that BC readers have all the information accessible in one information source thus reducing unnecessary searches in other documentation. Aleocharine beetles are highly diverse taxonomically, morphologically (Figs. 4.2, 4.8, and 4.9), and ecologically. Significant challenges with species identification due to the poor state of knowledge of many groups and the lack of comprehensive diagnostic tools are the main obstacles to understanding species richness, assemblage composition, and ecological roles of aleocharines in terrestrial ecosystems. There are many species, often forming groups of cryptic species, which are externally similar, especially in the large tribes Aleocharini (e.g., *Aleochara*), Athetini (e.g., *Atheta*), Oxypodini (e.g., *Oxypoda*), Homalotini (e.g., *Gyrophaena*). In Canada, these are often represented by pairs of sibling species that can only be distinguished with certainty by the examination of genital structures.

External Body Structures Important for Identification (Figs. 4.2–4.6)

The terminology used herein follows that used by previous authors (Benick and Lohse 1974; Seevers 1978; Klimaszewski 1979, 1984; Klimaszewski et al. 2018; Lohse et al. 1990; Ashe 2001; Gusarov 2003).

The body length of aleocharine beetles ranges from 1.0–13.0 mm (typically 3.0–5.0 mm) and habitus forms are diverse (Fig. 4.2a–l), reflecting different adaptations to a variety of microhabitats. They range from somewhat flat (e.g., *Dinaraea*, *Placusa*, and *Xenodusa*) to subcylindrical (e.g., some *Leptusa*), and from robust (e.g., *Aleochara*, *Gymnusa,* and *Oligota*) to slender (e.g., *Atheta*, *Clusiota*, *Myllaena*, and *Meotica*).

The term forebody refers to head, pronotum, and elytra as a combined structure. The most important body structures used in identification of aleocharines are illustrated (Figs. 4.3–4.6). These relate to the **head** (Fig. 4.3): frontal suture, genae (postocular area, temples), infraorbital carina, neck; **mouthparts** (Fig. 4.4a–f): labrum, labium, maxillae, labial palps, and ligula; **prothorax** (Figs. 4.3 and 4.5): pubescence pattern, hypomeron, pro-, meso- and metaventrites and their intercoxal processes, isthmus, mesothoracic peritremes (small structures that encompass the spiracles behind the procoxae), and coxae; **elytra** (Fig. 4.3): size and shape, pubescence pattern, elytral suture, basal margin, and lateral emargination; **abdomen** (Figs. 4.3 and 4.6e) [ten segmented, position indicated by Roman numerals starting at the base; when describing features of the "first visible tergites" in the keys and