A new milliped of the genus *Metaxycheir* from the Pacific coast of Canada (Polydesmida: Xystodesmidae), with remarks on the tribe Chonaphini and the western Canadian and Alaskan diplopod fauna

ROWLAND M. SHELLEY
North Carolina State Museum of Natural Science, P.O. Box 27647, Raleigh, NC 27611, U.S.A.

Received January 10, 1990

SHELLEY, R. M. 1990. A new milliped of the genus *Metaxycheir* from the Pacific coast of Canada (Polydesmida: Xystodesmidae), with remarks on the tribe Chonaphini and the western Canadian and Alaskan diplopod fauna. Can. J. Zool. **68**: 2310–2322.

Metaxycheir pacifica, a new chonaphine xystodesmid milliped from Vancouver Island, British Columbia, inhabits decidous spots in the forests along the Pacific Ocean from Bamfield to China Beach Provincial Park. It displays a subcylindrical body, imparted by reduced paranota caudal to segment 4; an acropodite in the form of a broad, open loop; and an acicular prefemoral process with minute subapical barbules. It is segregated from the type species, *M. prolata* Buckett and Gardner, in northern Idaho, by over 600 km, and is the second western Canadian xystodesmid. The tribe Chonaphini occupies five areas of allopatric populations: that of *M. pacifica;* from central Oregon to western Montana; and three areas in the north central and eastern states. The Pacific coastal region harbors the most diverse fauna of western Canada, and a second center of diversity lies around Mount Revelstoke and Glacier national parks. The diplopod fauna of Alaska and western Canada consists of at least 5 orders, 13 families, 22 genera, and 24 species; of these, 5, 10, 16, and 17 are indigenous forms and 2, 4, 6, and 7 are introductions, respectively. The chordeumatoid family Rhiscosomididae and the genus *Rhiscosomides* are new to Canada; five allochthonus species, *Cylindroiulus caeruleocinctus* (Wood), *Ophyiulus pilosus* (Newport), *Oxidus gracilis* (C. L. Koch), *Brachydesmus superus* Latzel, and *Polydesmus inconstans* Latzel, are new to the western provinces; and the Polyxenidae (Polyxenida) and Caseyidae (Chordeumatida) are new to Alaska.

SHELLEY, R. M. 1990. A new milliped of the genus *Metaxycheir* from the Pacific coast of Canada (Polydesmida: Xystodesmidae), with remarks on the tribe Chonaphini and the western Canadian and Alaskan diplopod fauna. Can. J. Zool. **68**: 2310–2322.

Metaxycheir pacifica, un nouveau diplopode xystodesmide de la tribu des Chonaphini trouvé dans l'Île de Vancouver, Colombie-Britannique, habite les endroits décidus des forêts côtières du Pacifique, de Bamfield au Parc Provincial China Beach. La nouvelle espèce a un corps rendu à peu près cylindrique par la réduction des paranotums derrière le segment 4, une acropodite en forme d'anneau large et ouvert, ainsi qu'un processus aciculaire préfémoral à minuscules barbules subapicaux. L'espèce est séparée géographiquement de l'espèce type, *M. prolata* Buckett et Gardner, dans le nord de l'Idaho, par une distance de plus de 600 km, et elle constitue le second xystodesmide trouvé dans l'ouest du Canada. La tribu des Chonaphini occupe cinq régions bien séparées : celle de *M. pacifica,* l'une du centre de l'Oregon jusque dans l'ouest du Montana, et trois régions dans les états du centre nord et dans les états de l'est. La côte du Pacifique arbrite la faune la plus diversifiée de l'ouest canadien et un autre noyau diversifié se trouve aux environs des parcs nationaux Mount Revelstoke et Glacier. La faune des diplopodes de l'Alaska et de l'ouest du Canada se compose au total d'au moins 5 ordres, 13 familles, 22 genres et 24 espèces, les formes indigènes comprenant 5, 10, 16 et 17 de ceux-là, et les formes introduites, 2, 4, 6 et 7. La famille chordeumatoïde des Rhiscosomididae et le genre *Rhiscosomides* sont rencontrés pour la première fois au Canada; cinq espèces allochtones, *Cylindroiulus caeruleocinctus* (Wood), *Ophyiulus pilosus* (Newport), *Oxidus gracilis* (C. L. Koch), *Brachydesmus superus* Latzel, et *Polydesmus inconstans* Latzel n'avaient encore jamais été vues dans les provinces de l'Ouest, enfin les Polyxenidae (Polyxenida) et les Caseyidae (Chordeumatida) sont rapportés pour la première fois en Alaska.

[Traduit par la revue]

Introduction

In 1985 and 1986, I discovered three samples of an undescribed xystodesmid milliped from the western rim of Vancouver Island, British Columbia, at the National Museum of Natural Sciences, Ottawa, and the Royal Ontario Museum, Toronto. These specimens indicated a need for fieldwork on Vancouver Island, which became an objective of an expedition to western Canada in 1989, where I concentrated on the region known to contain this form, the southern one-fourth south of Parksville and Port Alberni. Three additional samples were secured, and another was discovered in the collection at the Royal British Columbia Museum, Victoria, formerly the Provincial Museum of British Columbia. The species is assigned to *Metaxycheir,* tribe Chonaphini, because of its simple, curved acropodite and simple prefemoral process, which display the general configurations of the type species, *M. prolata* Buckett and Gardner. Kevan and Scudder (1989) included *Metaxycheir* among known Canadian milliped genera and alluded to this species in endnote 39. Beyond re-collecting it, the objectives of my expedition were to gain insight into the fauna west of the Central Plains, to ascertain approximate geographical limits for diplopod families in British Columbia, and to identify potentially productive regions for intensive future study. I therefore sampled along transects from the Pacific Ocean to the Rocky Mountains of Alberta from Jasper to Waterton Lakes National Parks. No systematic milliped collecting had been conducted in this area, which contains, along with southern Alaska, the northern distributional limits of nine indigenous families in western North America: Polyxenidae, Hirudisomatidae, Nemasomatidae, Parajulidae, Conotylidae, Caseyidae, Polydesmidae, Nearctodesmidae, and Xystodesmidae. The region is thus significant to Nearctic diplopodology, and this contribution concludes with a review of its known fauna. I also summarize current knowledge of the Chonaphini, newly recorded from Canada, which is of singular interest in being the only western xystodesmid tribe represented in eastern North America. Acronyms of sources of preserved study material are as follows: AMNH, American Museum of Natural History, New York; BRC,

Printed in Canada / Imprimé au Canada

Biosystematics Research Centre, Ottawa; CAS, California Academy of Sciences, San Francisco; FSCA, Florida State Collection of Arthropods, Gainesville; ILNHS, Illinois Natural History Survey, Urbana; LEM, Lyman Entomological Museum, MacDonald College, McGill University, Sainte Anne-de-Bellevue, Quebec; MCZ, Museum of Comparative Zoology, Harvard University, Cambridge, MA; NCSM, North Carolina State Museum of Natural Science, Raleigh; NMNH, National Museum of Natural History, Smithsonian Institution, Washington, DC; NMNS, National Museum of Natural Sciences, Ottawa; NSM, Nova Scotia Museum, Halifax; RBCM, Royal British Columbia Museum, Victoria; ROM, Royal Ontario Museum, Toronto; UA, Entomology Department, University of Alberta, Edmonton; UBC, Zoology Department, University of British Columbia, Vancouver; and WASU, James Entomological Museum, Washington State University, Pullman.

Metaxycheir pacifica n.sp.

Figs. 1–5

TYPE SPECIMENS: Male holotype (RBCM) collected by R. M. Shelley, 31 July 1989, at Port Renfrew, Vancouver Island, British Columbia, Canada. Three male, 3 female, and 4 juvenile paratypes (NCSM), and one male paratype (FSCA), taken with holotype.

Diagnosis

Distinguished from *M. prolata* by reduced paranota on sements 5–18; shorter gonapophyses, barely elevated above surfaces of 2nd coxae; absence of lobes on 3rd coxae; symmetrical ovoid gonopodal aperture; acropodites in the form of a broad, open loop; and narrower, acicular prefemoral processes with distal barbules. Distinguished from syntopic populations of the xystodesmid *Harpaphe haydeniana haydeniana* (Wood) by a narrower body, a more vaulted or cylindrical appearance, and longer male gonopods, extending anteriad well beyond aperture to vicinity of 6th segment.

Color in life

Dorsum mottled but rather uniformly dark gray, fading laterad; peritremata bright lemon yellow, extending mediad in short but broad bands on segments 1–4 and along caudal margins of remaining metaterga, bands becoming progressively shorter caudally; epicranium light mottled gray, color becoming darker in interantennal region, extending onto frons, and terminating abruptly; antennae becoming progressively darker distad; venter with light speckling continuous with dorsal pigmentation; legs white.

Holotype

Body parallel-sided for most of length, tapering slightly at both ends, general appearance somewhat rounded or subcylindrical because of reduced paranota and arched or curved profile; length 32.6 mm, maximum width 4.5 mm, width/length ratio 13.8%, depth/width ratio 80.0%.

Head smooth, polished; epicranial suture strong, distinct, terminating above interantennal region, not bifid. Width across genal apices 3.6 mm, interantennal isthmus 0.8 mm. Antennae moderately long and slender, reaching back to caudal margin of 3rd tergite, becoming progressively more hirsute distad, with 4 apical sensory cones, no other sensory structures apparent; first antennomere subglobose, 2–6 clavate, 7 short and truncate; relative lengths of antennomeres $2 > 6 > 5 > 3 > 4 > 1 > 7$. Genae not margined laterally, with distinct, broad central impressions, ends broadly rounded and extending slightly beyond adjacent cranial margins. Facial setae with only clypeal and labral series present, about 5-5 and 11-11, respectively; epicranial, interantennal, frontal, and genal setae absent.

Terga smooth, highly polished, glossy. Collum broad, ends terminating well before those of succeeding tergite. Paranota strongly depressed, creating appearance of highly arched or vaulted body; lengths varying (Fig. 1), distinct, and extending strongly ventrolaterad on segment 2, becoming progressively shorter on segments 3 and 4 and indistinct on remaining segments except for ozopore swellings on segments with defensive glands. Peritremata indistinct on segments 2–4, absent from remaining segments. Ozopore swellings moderately distinct, openings directed sublaterad.

Sides of metazonites smooth, polished, with slight ventrally directed lobes on segments 2–4; strictures sharp, distinct. Gonapophyses very short, indistinct, barely elevated above surfaces of 2nd coxae. Pregonopodal sterna glabrous, without modifications except for strong impression between 7th legs to accommodate gonopodal acropodites. Postgonopodal sterna glabrous, generally flat and unmodified, with variably impressed transverse grooves originating between leg pairs, caudal margins shallowly indented along midline. Coxae with short ventrodistal tubercles beginning on 9th legs and extending through segment 14, becoming progressively smaller thereafter; prefemora with short ventrodistal spines arising on segment 9, larger through segment 16, becoming shorter thereafter; tarsal claws gently curved and acuminate on all legs. Hypoproct broadly rounded, paraprocts with margins strongly thickened.

Gonopodal aperture ovoid, 1.1 mm long and 0.4 mm wide at maxima; anterior and posterior margins subparallel, without expansions or indentations, sides slightly elevated above metazonal surface. Gonopods *in situ* (Fig. 2, not this specimen) with coxae protruding through aperture, acropodites angling toward midline in subparallel arrangement, extending well beyond anterior margin of aperture and overlapping caudal margin of 6th sternum, prefemoral processes angling anterolaterad, extending well beyond lateral margins of acropodites. Gonopod structure as follows (Figs. 3 and 4): Coxa of moderate size, without modifications. Prefemur composing about 1/2 of telopodite length, with long, acicular process arising at 1/3 length, curving gently dorsad and angling strongly laterad across inner (dorsal) surface of prefemur, extending through base of acropodite loop, protruding laterad, sides narrowing continuously throughout length to finely acuminate tip, with 3 or 4 minute subapical barbules, Acropodite in form of a broad, open loop, arising terminally from prefemur, strongly demarcated from latter by basal constriction on outer (ventral) surface, inner surface continuous with prefemur, curving broadly dorsad, with anteriormost point near midlength of curve, latter overhanging coxa with tip extending inward and terminating near level of midlength of curve, sides narrowing continuously throughout length to finely acuminate tip. Prostatic groove arising in pit on medial surface of prefemur, angling to lateral side distal to origin of prefemoral process, extending onto acropodite basally and continuing along outer surface to terminal opening.

Male paratypes

The male paratypes agree closely with the holotype in all particulars, except for a deformation of a midbody paranotum into a long, caudally directed projection on the left side of one individual.

Female paratype

Length 28.1 mm, maximum width 4.1 mm, width/length

ratio 14.6%, depth/width ratio 92.7%. Agreeing essentially with males in somatic features, except body slightly thicker and thus appearing more vaulted; prefemoral spines beginning on segment 5. Cyphopods *in situ* with valves lying transversely in aperture, distal corners curving strongly ventrad near midline. Valves (Fig. 5) large, closely appressed together, with depression on ventral surface, distal corners curving strongly ventrad, projecting well below level of opposite end of valves, with scattered setae, densest on proximal corners. Receptacle small, subtriangular, displaced dorsad and located beneath distal end of valves, not cupped around latter, with numerous long distal setae. Operculum large, located at proximal end of valves, length subequal to adjacent valvular width, densely hirsute.

Variation

The nontypical specimens vary little from the described conditions. In males, the number of terminal barbules on the prefemoral process, visible only under high magnification, varies from 2 to 5, and the prefemoral process on the ROM specimen is bisinuate and extends below the acropodal loop instead of through it. The paranota on the male from Bamfield are shorter than those of the holotype. In females, the depression on the ventral valvular surface varies inversely with the height of the distal corners; specimens with more elevated corners have stronger central depressions. The female from China Beach has both the shallowest depression and the lowest distal elevation.

Ecology

The species appears to be restricted to the wet rain forests along the western fringe of Vancouver Island, where moisture-laden fog banks roll in from the Pacific Ocean. The specimens that I collected were encountered in patches of deciduous litter well within these primarily coniferous environments, where there was dense overstory with little light filtering to the substrate. Much of this area has been heavily logged, even to Highway 14 along the coast between Victoria and Port Renfrew, and *M. pacifica* doubtlessly cannot survive in a clearing. Some areas have been replanted with firs, but this practice may not restore desirable habitat because *M. pacifica* appears to occur in deciduous patches within these forests. Consequently, the effect of logging and replanting in a monoculture coniferous forest may be to eradicate the milliped from parts of its range. Since the species occurs in the West Coast Trail Unit of Pacific Rim National Park, its survival seems assured, but protection of more rain forest within this park and provincial parks is desirable to conserve this unique Canadian species.

Distribution

The western periphery of Vancouver Island, from the vicinity of Bamfield to China Beach Provincial Park. I encountered the species 5–10 km inland from Port Renfrew but not farther east around Lake Cowichan or on the eastern side of the island, even in the lush vegetation of MacMillan Provincial Park or other sites along Highway 4 between Parksville and Port Alberni. Nor did I encounter it along Highway 14 south of China Beach, where the island borders the Strait of Juan de Fuca. I therefore believe that *M. pacifica* is restricted to the outermost fringe of the island bordering the Pacific Ocean itself. In addition to the West Coast Trail Unit of Pacific Rim National Park, it may also occur in the Broken Group Islands and Long Beach units. Although presently known only from the southern one-fourth of Vancouver Island, the diplopod may range considerably farther north, possibly even spanning its length in a narrow strip along the Pacific. Further exploration by Canadian biologists with access to boats and four wheel drive vehicles, who can reach remote points along the coast, will pinpoint its exact distribution and determine the potential effects of extensive logging on its conservation status. The following specimens were examined:

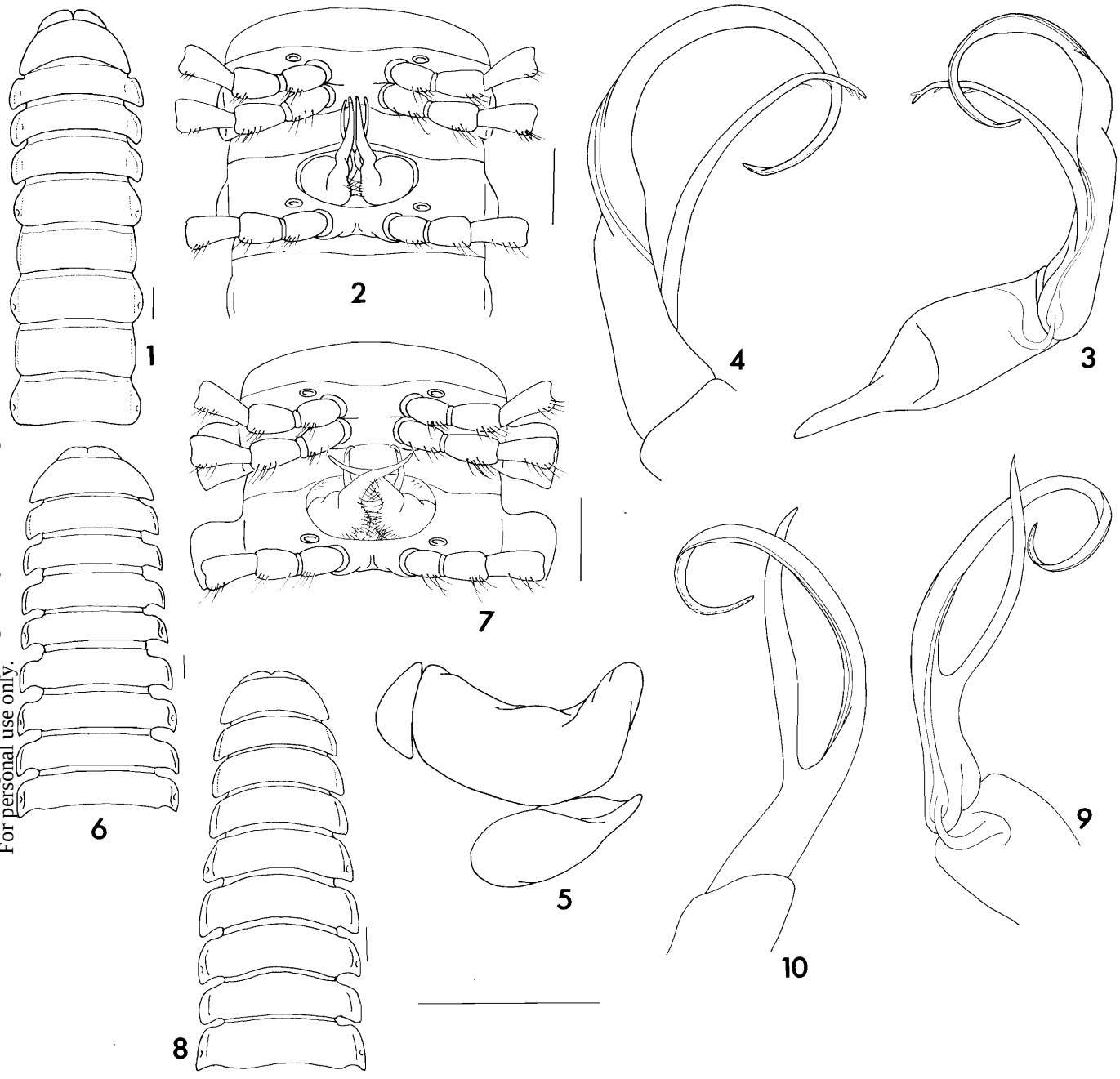
BRITISH COLUMBIA: *Vancouver Island:* Bamfield Island, Brady's Beach, 1 male (M), 29 July 1964, E. L. Bousfield (NMNS). Pachena Bay S of Bamfield, now in Pacific Rim National Park, M, 17 July 1970, E. L. Bousfield (NMNS). Carmanah Creek valley, West Coast Trail Unit, Pacific Rim National Park, 3 M, 3 females (F), 2 juveniles (J), 24 September 1989, G. E. Hutchings (RBCM). Ca. 82.2 km W Shawnigan Lake, just W Fairy Lake. Campground beside pool on road to Port Renfrew, 1 M, 28 June 1969, ROM field party (ROM). Ca. 5–10 km E Port Renfrew along unnumbered logging road, 3 M, 5 F, 31 July 1989, R. M. Shelley (NCSM). Port Renfrew, 5 M, 3 F, 4J, 31 July 1989, R. M. Shelley (RBCM, NCSM, FSCA).

TYPE LOCALITY: China Beach Provincial Park, 1 F, 31 July 1989, R. M. Shelley (NCSM).

Remarks

Metaxycheir pacifica, the second species in the genus, the second xystodesmid recorded from western Canada, and the first representative of the Chonaphini from the country, is syntopic with *H. h. haydeniana,* which is common along the Pacific coast from Oregon to southern Alaska (Buckett and Gardner 1968). The two millipeds are black dorsally, with yellow peritremata, and can be confused in the field. The black base color is darker in *H. h. haydeniana,* and more of a dark gray in *M. pacifica,* and the yellow border is much broader in the former, covering most of the paranota. In contrast, the yellow color extends mediad as short bands along the caudal metatergal margins in *M. pacifica*. The pigments of *M. pacifica* also dissolve more rapidly in alcohol and were faint with little contrast 3 months after collection; however, specimens of *H. h. haydeniana* were still brightly colored after 6 months in preservative. Distinctions in overall body form and comparative size of the gonopods are more obvious to the unaided eye and thus hold more utility for field determinations. Because of the reduced paranota on segments 5–18 and the strongly depressed flanges on segments 1–4, *M. pacifica* is narrow and subcylindrical to juliform in appearance (Fig. 1), whereas *H. h. haydeniana* is much broader and clearly flattened or polydesmoid-like because the paranota are broad on all segments and subparallel to the substrate (Fig. 6). The gonopods of *M. pacifica* are longer, extend anteriad well beyond the anterior margin of the aperture (Fig. 2), and depending upon the degree of telescoping of the segments, overlap part or all of segment 6. In contrast, the gonopods of *H. h. haydeniana* are short, extend ventrad and lie mostly over the aperture, and do not overlap part of segment 6 (Fig. 7).

To assess the differences between *M. pacifica* and *prolata,* I borrrowed the male holotype of the latter from the Bohart Entomological Museum, University of California at Davis, for direct comparison with individuals of the former. The paranota of *M. prolata* are strongly depressed, imparting a highly arched or vaulted body form, and are well developed on all segments (Fig. 8). On the gonopods, the acropodal loop is narrower in *M. prolata,* and its prefemoral process is broader, tapers only apically instead of throughout its length, and lacks barbules (Figs. 9 and 10). As noted by Buckett and Gardner (1969), the gonapophyses of *M. prolata,* which they termed coxal processes, are long and clearly elevated above the surfaces of the 2nd coxae, and the 3rd coxae possess short, rounded projections.



FIGS. 1–5. *Metaxycheir pacifica*. Fig. 1. Profile of anterior segments of holotype, dorsal view. Fig. 2. Gonopods *in situ*, ventral view of paratype. Fig. 3. Left gonopod of holotype, medial view. Fig. 4. Telopodite of the same, lateral view. Fig. 5. Left cyphopod of female paratype, caudal view. Figs. 6 and 7. *Harpaphe haydeniana haydeniana*. Fig. 6. Profile of anterior segments of male from Port Renfrew, B.C., dorsal view. Fig. 7. Gonopods *in situ* of the same specimen, ventral view. FIGS. 8–10. *Metaxycheir prolata*. Fig. 8. Profile of anterior segments of holotype, dorsal view. Fig. 9. Right gonopod of the same, medial view. Fig. 10. Telopodite of the same, lateral view. Setation is omitted from cyphopod and dissected gonopod drawings. Scale bars: 1.00 mm for Figs. 1, 2, 6, 7, and 8; 0.80 mm for Figs. 3, 4, 9, and 10; 0.50 mm for Fig. 5.

However, in *M. pacifica* the gonapophyses are very short, and there is no trace of a projection on the 3rd coxae. A second male of *M. prolata,* from Idaho, Latah Co., Laird Peak, 4.8 km SE Harvard, collected on 1 May 1971 by W. A. Turner (WASU), conforms closely to the holotype. The two species of *Metaxycheir* are thus segregated by some 600 km (375 mi), an area spanning the Columbia River, the Cascade Mountains, and parts of Puget Sound and the Straits of Georgia and Juan de Fuca (Fig. 11). The breadth of this hiatus suggests that undiscovered forms may exist in Washington, a state needing thorough sampling, particularly in the most environments along the western slope of the Cascade Mountains and in the rain forests of the Olympic Mountains.

The tribe Chonaphini

Like the other western Nearctic xystodesmid tribes, the Harpaphini, Orophini, Sigmocheirini, and Xystocheirini, the Chonaphini is poorly known; none of its genera has been studied in detail. Characterized by a simple, narrow, acicular to curved acropodite and a variable prefemoral process, elaborately

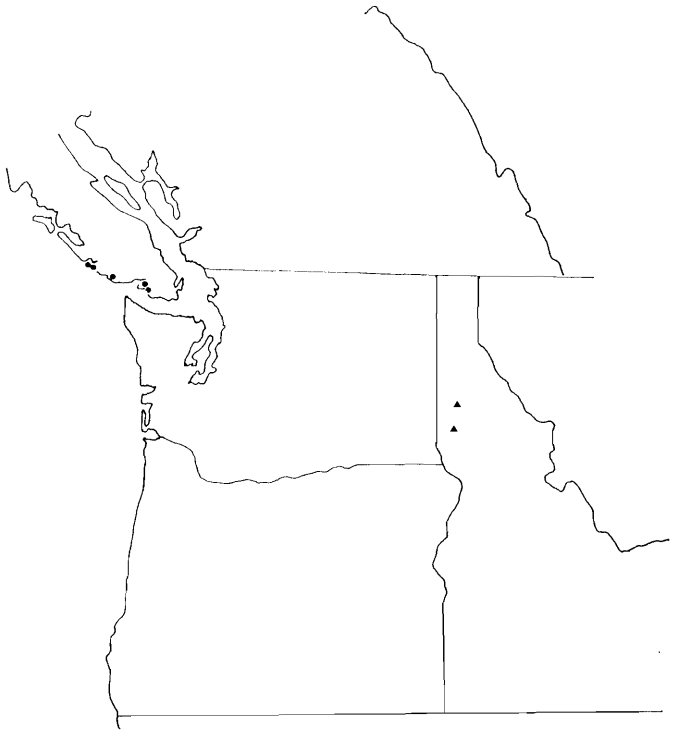


FIG. 11. Distribution of *Metaxycheir*. ●, *M. pacifica;* ▲, *M. prolata.*

complex in some forms, the Chonaphini is biogeographically significant in being the only western tribe occurring in eastern North America. Hoffman (1979*a*) recognized four component genera, *Chonaphe* Cook, *Montaphe* Chamberlin, *Semionellus* Chamberlin, and *Metaxycheir* Buckett and Gardner, and all the preserved speciments that I have seen can be accommodated by one of these names. When all literature records and reported samples in museum collections are mapped, the Chonaphini is found to occupy five areas inhabited by allopatric populations (Fig. 12): that of *M. pacifica;* a broad area in the northwestern United States, extending from north central Oregon to western Montana, inhabited by seven nominal species, five in *Chonaphe* and one each in *Montaphe* and *Metaxycheir*; and the following three regions in the north central and eastern states occupied by *Semionellus placidus* (Wood): from southeastern Minnesota to eastern Wisconsin, from central Michigan through western Ohio to western Indiana, and from western Maryland through West Virginia to west-central Virginia. A large hiatus of around 1694 km (1053 mi) therefore exists between the western tribal region in Montana and the Minnesota population of *S. placidus*. The intervening area is chiefly grassland, and unsuitable for xystodesmids, but the Black Hills in southwestern South Dakota, located slightly south of a direct line between these states, is an island of forested mountains in the midst of the plains and is a plausible site for an undiscovered relict population of a chonaphine xystodesmid. Consequently, I spent a week sampling there in May 1986 but found only parajulids and introduced species, possibly because of unseasonably cold weather. The Black Hills mostly contain pine forests, but substantial moist hardwood and aspen–fir areas, potential xystodesmid habitat, occur in Spearfish Canyon, along the north slope of Mount Harney, and in the Iron Creek drainage above the Needles Section of Custer State Park. Because the environmental parameters in these sites are favorable, investigations in warmer, more seasonable spring weather may still reveal a chonaphine xystodesmid, a remnant of a formerly continuous distribution across what is now the northern United States. As *Metaxycheir* was reviewed in the first section of this paper, knowledge of the other three genera is summarized in the ensuing paragraphs.

Hoffman (1979*a*) recognized four species in *Chonaphe,* but there are five nominal species, the four listed by Chamberlin and Hoffman (1958), from Oregon, Washington, and Idaho, plus *C. serratus* Loomis and Schmitt (1971) from western Montana. Hoffman (1979*a*) suggested that the nominal species might be subspecies, but I find few differences among them and believe that *Chonaphe* may be monotypic, the oldest available name being *C. armata* (Harger). Its type locality is John Day Valley, Oregon (Harger 1872), probably in Sherman or Gilliam counties, and the species also occurs in Pierce and Yakima counties, Washington, Kootenai County, Idaho and Sanders County, Montana (Chamberlin and Hoffman 1958; Loomis and Schmitt 1971). From unpublished, apparently conspecific museum samples, *C. armata* can be recorded from Benton, Clackemas, and Multnomah counties, Oregon, King, Chelan, Kittitas, and Stevens counties, Washington, Latah and Clearwater counties, Idaho, and Lincoln and Missoula counties, Montana. The southernmost–westernmost record is in Benton County, Oregon, and the northern- and eastern-most are in Lincoln and Missoula counties, Montana, respectively. *Chonaphe* thus occupies essentially the entire tribal range in the northwestern United States.

Noting that its occurrence is sporadic, Chamberlin and Hoffman (1958) stated that *S. placidus* ranges from Minnesota and Michigan eastward to New York and southward in the Appalachians through western Maryland and Virginia to Fort Benning, Georgia. The last locality is based on a misidentification, and I have seen no authentic samples from New York; otherwise, this statement generally describes the totality of the range. The southern- and eastern-most localities are in Botetourt and Madison counties, Virginia, with the northernmost–westernmost site being in Rice County, Minnesota. I have also seen specimens from Wisconsin, Michigan, Indiana, Maryland, and West Virginia, and Williams and Hefner (1928) recorded the milliped from Allen, Hardin, Wood, and Seneca counties, Ohio. The available records cluster into three segregated areas as opposed to continuous or sporadic distribution between Minnesota and Virginia. For example, *S. placidus* has not been collected in Illinois, even in the eastern part of the state near known sites in Indiana, and in view of the substantial sampling that has occurred in northern Illinois and around Coles and Champaign counties by personnel at the Field Museum of Natural History, the University of Illinois, and Eastern Illinois University, I believe that *S. placidus* truly does not occur there. The eastern area may extend more into central West Virginia than is shown in Fig. 12, and the middle one may protrude more into central Ohio, but there is no evidence of connection. Thus, *S. placidus,* a western element in these areas of eastern North America, is sympatric with representatives of the tribes Rhysodesmini, Apheloriini, and Nannariini (Shelley and Whitehead 1986). It can be readily distinguished by its narrow, rounded, subcylindrical body, which contrasts markedly with the broad, flattened appearance of representatives of the other tribes.

The sole species of *Montaphe, M. elrodi* (Chamberlin), known previously from the type locality in Flathead County, Montana, and Stevens County, Washington (Chamberlin and Hoffman 1958), was recorded from Sanders, Lake, and Missoula counties, Montana, and Idaho County, Idaho, by

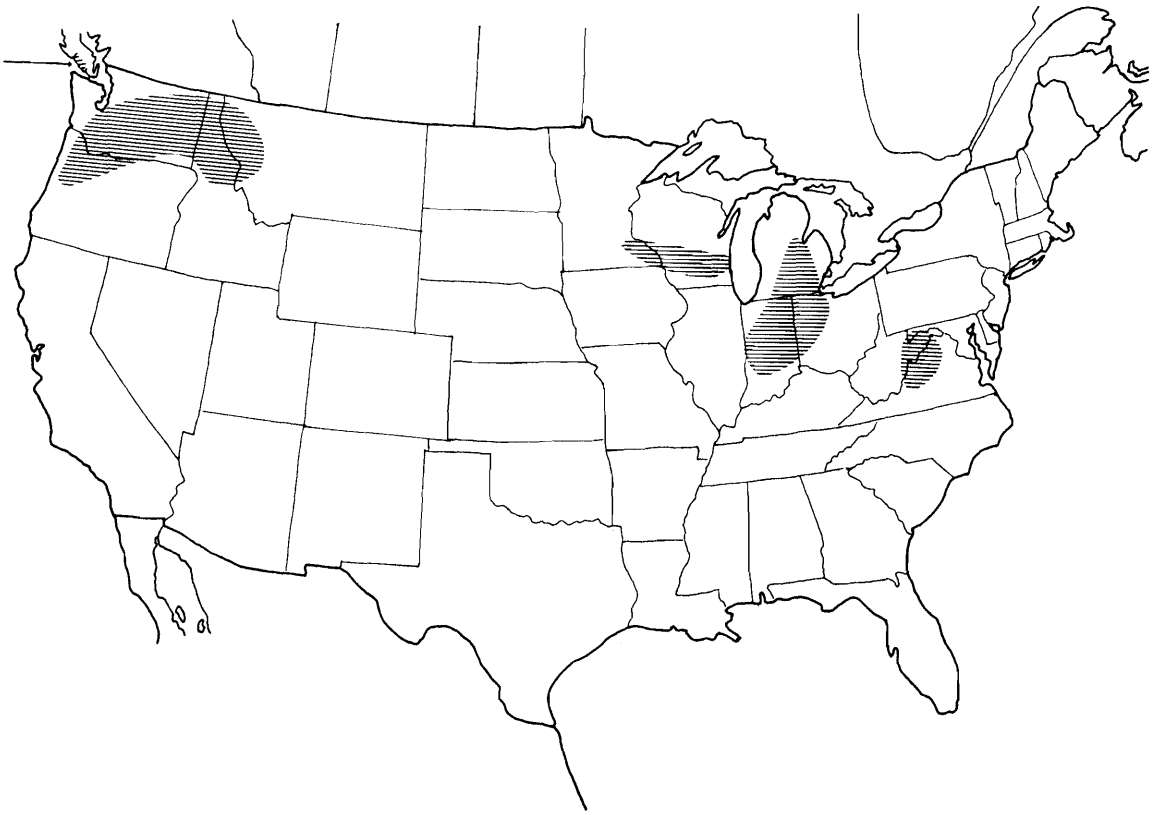


FIG. 12. Distribution of the tribe Chonaphini. The arrow indicates the area occupied by *M. pacifica*.

Loomis and Schmitt (1971). From unpublished museum specimens, I add Clearwater and Shoshone counties, Idaho, and Spokane and Whitman counties, Washington. Thus, *M. elrodi* ranges from Flathead Lake, Montana, to Evans, Stevens County, Washington, which is also the northernmost locality; the southernmost site is Lowell, Idaho County, Idaho. *Montaphe* therefore occupies approximately the eastern one-third of the tribal range in the northwestern United States.

The western Canadian and Alaskan diplopod fauna

In discussing the known and potential milliped fauna of Canada, Hoffman (1979*b*), Kevan (1983), and Shelley (1988) indicated that British Columbia, particularly the Pacific coastal region, should harbor a relatively diverse fauna. Sampling in this province, western Canada in general, and southern Alaska has been sporadic and consists mostly of miscellaneous specimens taken by entomologists in the course of other studies, but it has nevertheless revealed that the Xystodesmidae, represented by *H. h. haydeniana,* extends northward to the southern tip of Alaska (Buckett and Gardner 1968). The Nemasomatidae, represented by *Orinisobates expressus* (Chamberlin), has been documented across the mainland of southern British Columbia into the Rocky Mountains of Alberta (Enghoff 1985), while the Conotylidae, represented by *Conotyla atrolineata* (Bollman), *C. albertana* Chamberlin, and *Austrotyla borealis* Shear, is known from Glacier, Yoho, Banff, and Jasper national parks, and Mount Robson Provincial Park, British Columbia (Shear 1971). Though not studied specifically, the Polydesmidae and Nearctodesmidae have been recorded from type localities around Vancouver and on Vancouver Island (Chamberlin and Hoffman 1958), and Gardner and Shelley (1989) confirmed the Caseyidae from southern Vacouver Island, the southwestern corner of the mainland, and Jasper National Park. Distributional patterns of these and other families in eastern Washington, northern Idaho, and western Montana further suggest that British Columbia may contain undiscovered, biogeographically significant forms in the southern reaches adjacent to the United States. For example, the western faunal region of the Xystodesmidae ranges along the Pacific coast from Los Angeles to southern Alaska, spreading eastward into western Montana (Fig. 1 in Shelley 1987),[1] and there is a similar eastward extension of the Nearctodesmidae (Fig. 6 in Hoffman 1962). The boundaries of these extensions are unknown, but the northern ones are shown to angle southeastward through central British Columbia, on the assumption that the proximity of American records mandates forms in the interior. Delineating these boundaries was thus a prime objective of my western Canadian expedition. With collecting permits for British Columbia provincial parks and national parks on the mainland, I sampled along or near major highways between the Pacific Ocean and the prairies, particularly those leading to the international border. This effort revealed the Purcell and Selkirk mountains around Glacier and Mount Revelstoke national parks, containing the only rain forests east of the Coast Range, to be a promising area for future investigation, harboring indigenous representatives of both the Polydesmidae and Nearctodesmidae. Otherwise, the Pacific coastal region is the

[1]In addition to incorrectly depicting the western faunal region as slanting across the interior of British Columbia, Fig. 1 in this reference also erroneously excludes eastern Texas from the eastern faunal region. Figure 3 in Shelley (1987) shows four Texas sites for *Pachydesmus clarus* (Chamberlin), so a substantial part of eastern Texas should be shaded in Fig. 1.

only area with substantial diversity. Much of the interior of British Columbia is dry, open pine forest, and the deciduous tracts that I saw are too small or too narrow to harbor a diversity of millipeds. Isolated exceptions may exist, such as around Rossland and Trail, where the forests seemed more most and extensive, but I investigated and observed enough habitat across British Columbia to conclude that the northern limits of the faunal extensions in the Xystodesmidae and Nearctodesmidae lie south of the international border in the United States. This conclusion should be confirmed by sampling in Washington, Idaho, and Montana, which is also needed to define the southern boundaries of the extensions.

Knowledge of western Nearctic millipeds is not as advanced as that of the eastern fauna; detailed taxonomic investigations have not been conducted in the widespread families Polydesmidae, Nearctodesmidae, Xystodesmidae, and Parajulidae. Consequently, a key to species and a detailed treatment analogous to that on the eastern Canadian fauna (Shelley 1988) is impossible, but with completion of a concerted field effort and with knowledge of holdings in most North American collections, I can summarize the fauna of Alaska and western Canada at the family level. The chordeumatoid family Rhiscosomididae and the genus *Rhiscosomides* are newly recorded from Canada; the families Polyxenidae (Polyxenida) and Caseyidae (Chordeumatida) are newly reported from Alaska; and the allochthonus species *Cylindroiulus caeruleocinctus* (Wood), *Ophyiulus pilosus* (Newport), *Oxidus gracilis* (C. L. Koch), *Brachydesmus superus* Latzel, and *Polydesmus inconstans* Latzel are added to the western Canadian fauna. As is suggested by Kevan and Scudder (1989), *Rhinocricus vancouveri,* described by Chamberlin (1951) from Clayoquot Sound, Vancouver Island, can only represent a labeling error, because in the western hemisphere, the family Rhinocricidae occurs on Caribbean islands and from southern Mexico to Argentina (Hoffman 1979*a*). Consequently, the order Spirobolida, represented by *Narceus a. americanus* (Beauvois) (family Spirobolidae) in eastern Ontario and southern Quebec (Shelley 1988), is absent from western Canada. I also agree with Kevan and Scudder (1989) that *Eumastigonus insulans* (Attems) (Spirostreptida: Cambalidae) does not occur on Stephens Island, British Columbia, and probably came from an island by the same name in Cook's Strait, New Zealand. Attems (1903) described this species in *Dimerogonus* and listed it from Stephens Island without indicating the country or region of the world. Verhoeff (1944) erected *Insulocambala* to accommodate the species and cited it from New Zealand without elaboration. Hoffman (1972) demonstrated that *insulans* is congeneric with the type species of *Eumastigonus* Chamberlin, which has 24 years of priority over *Insulocambala*. He further noted that the collector of *E. insulans* sampled along the coast of western North America and that there is a Stephens Island near Prince Rupert, British Columbia. However, since *Eumastigonus* otherwise refers to New Zealand cambaloids, Hoffman suggested that the type of *insulans* probably came from the North Island of that country. Thus, neither the family Cambalidae nor the order Spirostreptida is known from either western Canada or the entire country.

In the ensuing paragraphs, the western Canadian and Alaskan milliped fauna is discussed by order and family. I review the literature and past records, summarize known ranges, report type localities in the Parajulidae, Polydesmidae, and Nearctodesmidae, as their species cannot be identified, and list new localities for the introduced species and *H. h. haydeniana*, because a complete listing of collection data would be prohibitively long. Detailed locality data are provided for new records of other indigenous species. Because specific and generic compositions are unknown in the aforementioned families, faunal data shown in the figures are approximate, subject to change, and based on the conservative assumptions of three parajulid genera and species and one each in the Polydesmidae and Nearctodesmidae, as explained in the accounts of these families. With these assumptions, the known diplopod fauna of Alaska and Canada west of the plains consists of 5 orders, 13 families, 22 genera, and 24 species (hereafter given as orders/families/genera/species). Indigeneous forms constitute 5/10/16/17 and introductions 2/4/6/7. Thus, 29.2% of the known western Canadian and Alaskan millipeds are imports from other continents, primarily Europe, whereas over 2/3 of the species, 70.8%, are native to North America. The percentage of introduced species is thus significantly lower in western Canada than in the east, where nearly half the species, 47.4%, are exogenous (Shelley 1988). *Polyxenus lagurus* (L.) is thought to be the only common indigenous species between these regions, and *Scytonotus* and *Conotyla* are common genera. The order Spirobolida and the families Spirobolidae, Polyzoniidae, Okeanobatidae, Cleidogonidae, and Trichopetalidae occur only in the east, whereas the Hirudisomatidae, Nemasomatidae, Rhiscosomididae, and Nearctodesmidae are unique to the west.

Polyxenida: Polyxenidae

The western Canadian representative of the subclass Penicillata, the only milliped not in the Helminthomorpha, is believed to be *Polyxenus lagurus,* the species that Shelley (1988) recognized from eastern Canada. Kincaid (1898) described *P. pugetensis* from western Washington; it was subsequently listed by Chamberlin and Hoffman (1958) and Kevan (1983), who recorded it from an unspecified site in British Columbia, but Kane (1981) concluded that this and the other five species-group names proposed for Nearctic penicillates are actually synonyms of *P. lagurus*. However, one of these, *P. bartschi* Chamberlin from the Tortugas Keys, Florida, was transferred to *Macroxenus* by Nguyen Duy-Jacquemin and Condé (1984), implying that other taxa may occur in the southern United States. However, Kane's conclusion that *P. lagurus* is the only Nearctic representative of the Penicillata probably holds for the northern United States and Canada. A rigorous review of Nearactic penicillates is much to be desired, but their study requires different techniques from those used with helminthomorphs, and there are no qualified specialists in the western hemisphere. Abundant preserved material is available in North American insitutions awaiting anyone wishing to pursue the study of this relatively unexplored problem.

In western Canada, *P. lagurus* is known sporadically from Vernon, at the northern end of the Okanagan Valley, to the Pacific Ocean along the southern one-fourth of Vancouver Island (Fig. 13). As indicated on the map, it is newly recorded from Alaska, from Haines in the northern extremity of the panhandle, thus confirming the prediction by Cook (1904) that it would eventually be discovered in this state.

BRITISH COLUMBIA: Vernon, 1 specimen, date and collector unknown (NMNH). Mission, 1 specimen, 25 July 1953, W. R. M. Mason (BRC). *Vancouver Island*: Victoria, 1 specimen, date and collector unknown (NMNH) and 1 specimen, 14 January 1959, G. Oak (BRC). Saanich, 1 specimen, 23 October 1953, O. Peck (BRC). Errington, 1 specimen, 14 February

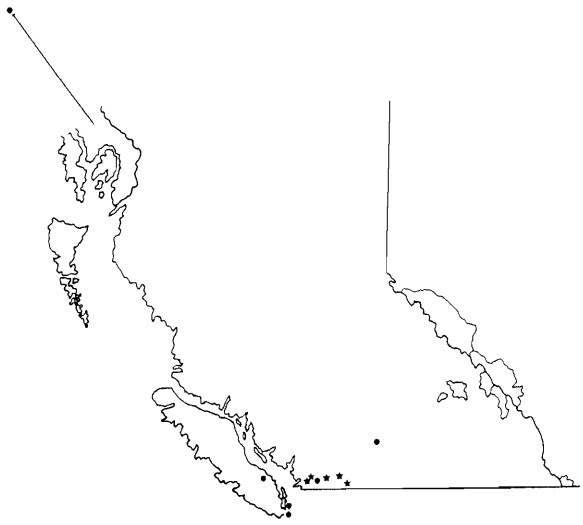


FIG. 13. Distributions of the families Polyxenidae (Polyxenida) and Hirudisomatidae (Polyzoniida) in western Canada and Alaska. *Polyxenus lagurus* (●) and *Hypozonium anurum* (★) are the only known or presumed species. The arrow indicates the Haines, Alaska, record of *P. lagurus*.

1952, G. H. Lardner (NMNH). Kyuquot, 1 specimen, 20 April 1959, S. L. Neeve (AMNH). ALASKA: Haines, 5 specimens, 20 August 1945, J. C. Chamberlin (NMNH).

Polyzoniida: Hirudisomatidae

Hypozonium anurum Cook, the sole Canadian representative of the family and the sole member of the order in western Canada, was first recorded from British Columbia by Kevan (1983). He did not give a specific locality, but its occurrence at Seattle and Bremerton, Washington (Cook 1904; Cook and Loomis 1928; Chamberlin and Hoffman 1958) suggests discovery around Vancouver, where it can now be confirmed. Its known distribution in Canada is west of the Cascade Mountains in the southwesternmost corner of the mainland along the border with the United States, extending northward less than 40 km (25 mi) into the country (Fig. 13).

BRITISH COLUMBIA: Steelhead, 1 F, 2 June 1933, H. B. Leach (NMNH). Burquitlam, 1 F, 10 March 1940, U. Dale (NMNH). Burnaby, Simon Fraser University, 2 M, 2 F, 1972, R. G. Holmberg (NMNS). 3 km SE Hope, Silver Skagit Road, MM, FF, 30 June 1988, S. and J. Peck (NCSM). Manning Provincial Park, west gate, 1 M, 3 F, 1 July 1988, S. and J. Peck (NCSM).

Julida: Julidae

The Palearctic family Julidae, well represented in eastern Canada by seven introduced species, a few of which have become established primarily in urban biotopes (Shelley 1988), is poorly represented in western Canada and Alaska. Kevan (1983) recorded only *Allajulus latistriatus* (Curtis), recently returned to *Cylindroiulus*, from an unspecified locality in British Columbia, and I have seen specimens from Kamloops, Penticton, New Westminster, and Vaseux Lake Provinicial Park plus Edmonton, Alberta (NCSM, NMNH, NMNS). *Cylindroiulus caeruleocinctus* can be reported from Chilliwack (UBC), and *Ophyiulus pilosus* has been taken at Bella Coola, Hagensborg, Tappen, Salmon Arm, 7 km E Salmon Arm, Mission, and Port Coquitlam (BRC, NCSM, NMNH, RBCM, UBC). These locations are plotted on the occurrence map of introduced species (Fig. 14).

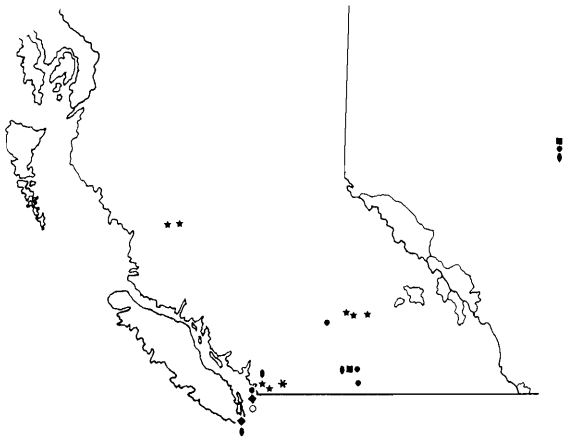


FIG. 14. Occurrences of introduced Palearctic millipeds in western Canada: ●, *Cylindroiulus latistriatus*; *, *C. caeruleocinctus*; ★, *Ophyiulus pilosus*; ■, *Nopoiulus kochii*; ♦, *Oxidus gracilis*; ○, *Brachydesmus superus*; ⬮, *Polydesmus inconstans*.

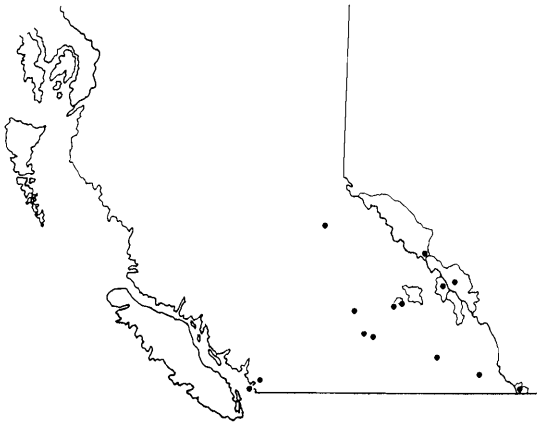


FIG. 15. Distribution of the family Nemasomatidae (Julida) in western Canada. *Orinisobates expressus* is the only known or presumed species.

Julida: Blaniulidae

Kevan (1983) cited *Nopoiulus kochii* (Gervais) from British Columbia in general, and I can report it specifically from Penticton and Edmonton, Alberta (NMNS) (Fig. 14).

Julida: Nemasomatidae

Orinisobates expressus, one of the most common western Canadian millipeds, ranges from the Rocky Mountains of Alberta to the Strait of Georgia (Fig. 15). The type locality is Arlington, Snohomish County, Washington, but Chamberlin (1951) proposed the synonym *Nemasoma leechi* for a form from Trinity Valley, British Columbia, a site that Hoffman (1964) located as 6.4 km N Lumby, on Highway 6 east of Vernon. Causey (1954) transferred *leechi* to *Utoiulus* and recorded it from Sunwapta Pass, Jasper National Park. Hoffman (1964) synonymized *N. leechi* with *Tiviulus expressus* Chamberlin, which he later (1966) transferred to *Orinisobates*. Kevan (1983) cited *O. expressus* from both Alberta and British Columbia, and Enghoff (1985) added four localities in the latter province: "probably from the Cariboo," presumably the mountains by that name south of the Yellowhead Highway in the vicinities of Bowron Lake and Wells Gray provincial parks; Kaslo; Kicking-horse Campground, ca. 3.2 km S Takakkaw Falls, Yoho

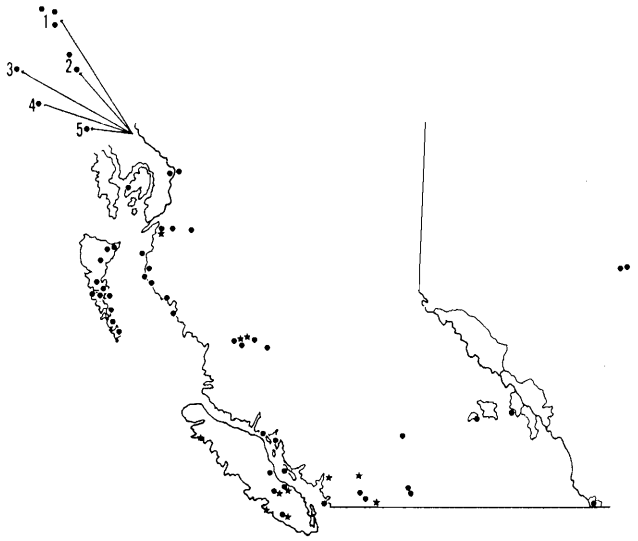


FIG. 16. Known distribution of the family Parajulidae (Julida) in western Canada and southern Alaska, including records from offshore islands. ★, forms with decurved epiprocts, representing the tribe Uroblaniulini; ●, forms with straight epiprocts. The Alaskan records, indicated by arrows, are as follows: 1, Haines and vicinity; 2, Juneau and Admiralty Island; 3, Yakobi Island; 4, Baranof Island; 5, Mitkof Island.

National Park; and Brockton Point in Stanley Park, Vancouver. Enghoff also recorded the milliped from the Olympic Peninsula of Washington, as well as from the eastern side of Puget Sound, but curiously it has not been encountered on Vancouver Island, despite occurring on the mainland across both the Strait of Georgia and the Strait of Juan de Fuca. In August 1989, I collected *O. expressus* under bark of decaying hardwood logs beside streams in Mount Revelstoke and Waterton Lakes national parks. Specimens were examined from the following new localities:

ALBERTA: Banff National Park, Lake Louise, Larch Valley, 7 M, 1 F, 7 April 1964, D. Elliott (RBCM). Waterton Lakes National Park, along Blakiston Creek, Red Rock Canyon Road, 2 M, 1 F. 11 August 1989, R. M. Shelley (NCSM). BRITISH COLUMBIA: Mount Revelstoke, Mount Revelstoke National Park, 1 F, 30 June 1952, G. P. Holland (BRC) and Skunk Cabbage area, 5 M, 1 F, 9 August 1989, R. M. Shelley (NCSM). Salmon Arm, Tappen Mountain, MM, FF, 7 October 1933, H. B. Leech (NMNH). North Vancouver, Grouse Mountain, 1 F, 21 August 1932, H. B. Leech (NMNH). Sugar Lake, 40 km E Vernon, 1 F, 31 August 1974, A. P. Mackie (RBCM). Fernie, 3 F, 6 June 1934, H. B. Leech (NMNH).

Julida: Parajulidae

The dominant indigenous Neararctic diplopod family, also represented in Japan and China by a single species, the Parajulidae occurs in all North American physiographic provinces from southwestern Guatamala to around the latitudes of Anchorage, Alaska, and the southern half of James Bay, Ontario (Causey 1974; Shelley 1988). As shown in Fig. 16, the family is not known to extend as far north in the interior of western Canada as along the coast, where it is common on the mainland well into Alaska and throughout Vancouver Island and the Queen Charlotte Islands (BRC, CAS, FSCA, NCSM, NMNH, NMNS, RBCM, UA, UBC). The taxonomy of this complex family is in disarray, and although the eastern Canadian species can be determined (Shelley 1988), the western

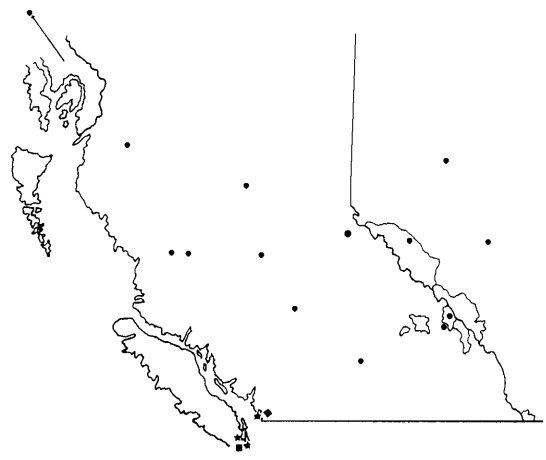


FIG. 17. Distributions of the families Caseyidae and Rhiscosomididae (Chordeumatida) in western Canada. ♦, *Vasingtona irritans*; ★, *Opiona columbiana*; ●, undetermined forms, mostly female only samples; ■, *Rhiscosomides* sp. The arrow indicates the caseyid record in Juneau, Alaska.

fauna is unidentifiable without in-depth revisionary studies, probably a decade or more into the future. However, clear somatic differences between forms with straight and strongly decurved epiprocts, the latter representing the tribe Uroblaniulini, with a coastal distribution in British Columbia (Fig. 16), indicate the presence of at least two species and genera, and I think there are at least two species and genera with straight epiprocts. Figures showing faunal data are therefore based on three genera and species of parajulids, two with straight and one with decurved epiprocts. Type localities for the following nominal species are in western Canada and Alaska: British Columbia: *Bollmaniulus spenceri* Chamberlin, 1951, Kamloops, and *Tuniulus hewitti* (Chamberlin, 1919), Agassiz: Alaska: *Litiulus alaskanus* (Cook, 1904), Metlakatla.

Chordeumatida: Caseyidae

The Caseyidae has been known from eastern Canada since 1872, when Harger described *Trichopetalum iuloides,* now in *Underwoodia*. However, 79 years elapsed before Chamberlin (1951) recorded the first representative from western Canada, *Opiona columbiana* Chamberlin, from Victoria. Kevan (1983) cited this species from British Columbia, and Gardner and Shelley (1989) redescribed it and added a second locality, Vancouver. An unidentifiable female from Goldstream Provincial Park, west of Victoria, collected on 8 May 1975 by B. D. Ainscough (RBCM), probably constitutes a third site. Gardner and Shelley (1989) also reported *Vasingtona irritans* (Chamberlin) from North Surrey and stated that a male of an undetermined form, possibly referable to *Underwoodia,* had been taken in Alberta. Details of this locality are provided below, along with new records of possibly conspecific, but undetermined or unidentifiable, forms, including the first for the family from Alaska, indicated on the distribution map (Fig. 17). The Caseyidae thus occurs widely across northwestern North America, and many additional discoveries are expected.

ALBERTA: Jasper National Park, near the confluence of the Rocky and Athabasca rivers, 1 m, 11 F, 13 August 1965, J. and W. Ivie (AMNH). Camp Creek, near Carrot Creek, ca. 32 km NE Edson, 3 F, 25 August 1962, J. and W. Ivie (AMNH). House R. at little Smoky R., ca. 32 km N Valley view, 1 J, 6 September 1968, J. and W. Ivie (AMNH). BRITISH COLUMBIA: Terrace, 4 F, 10 August 1988, S. and J. Peck (NCSM). Prince

George, Meadow Park, 2 F, 2 J, 12 August 1988, S. and J. Peck (NCSM). Bella Coola, Nusatum Mountain, 1 F, 16 June 1988, S. and J. Peck (NCSM). Hagensborg, 2 F, 13 July 1988, S. and J. Peck (NCSM). 16 km S Kersley, along Highway 97, 1 F, 16 June 1980, B. D. Ainscough (RBCM). 8.3 km S Hundered Mile House, along Highway 97, 1 F, 16 June 1980, B. D. Ainscough (RBCM). 19.2 km SW Westwold, along Douglas Lake road near Salmon R., 3 F, 3 J, 24 May 1980, R. A. Cannings (RBCM). 16 km E Golden, along Highway 1, FF, 28 June 1988, S. and J. Peck (NCSM). ALASKA: Juneau, 1 F, 28 April 1929, J. C. Chamberlin (NMNH).

Chordeumatida: Rhiscosomididae

Kevan (1983) and Kevan and Scudder (1989) reported this family from Washington and considered it a potential inhabitant of British Columbia. I know of no Washington records, published or unpublished, but it can now be added to the Canadian fauna, because a sample of *Rhiscosomides* with an adult male has been collected at the following locality on Vancouver Island (Fig. 17). The species appears close to *R. mineri* Silvestri from northern Oregon (Shear 1973), the most proximate known form, but further study is needed to determine its identity.

BRITISH COLUMBIA: *Vancouver Island*: Point No Point, W of Sooke, 1 M, 2 F, 7 March 1980, R. A. Cannings (RBCM).

Chordeumatida: Conotylidae

With three western Canadian species, the Conotylidae is the dominant family between the Coast Mountains and the plains; it is known as far north as Pine Pass, around 128 km west of Dawson Creek. Forms inhabit both hardwood and coniferous areas, as specimens have been found in aspen and fir litter as well as under bark and moss of decaying logs.

The first record of a western Canadian conotylid was the description of *Craspedosoma atrolineatum* from Glacier, British Columbia, presumably Glacier National Park, by Bollman (1987). Based on a female, he later (1893) recorded the milliped from Winona, Minnesota, a misidentification of another conotylid, as noted by Cook and Collins (1895) when they transferred the species to *Conotyla*. Chamberlin (1920) described *Conotyla albertana* from the Bow River, Alberta, which was restricted to the vicinity of Lake Louise, Banff National Park, by Shear (1971). Chamberlin (1951) proposed *Zygotyla phana* for a form from Blue River, British Columbia, a name that Shear (1971) considered a *nomen dubium*. The type has since been received at the RBCM, as indicated by Kevan (1983), and is a female with 28 segments, which explains why Chamberlin (1951) could not find the gonopods and mentioned that they "seem to have been broken off in the type." Shear (1971) stated that the name could refer to a new species or be synonymous with *C. atrolineata*, but because *C. albertana* is now known from British Columbia and both species occur north and south of Blue River, *Z. phana* could also be a synonym of this binomen. As no additional forms have been taken in western Canada, I doubt if any undiscovered species of *Conotyla* occur there, but I agree with Shear (1971) that *Z. phana* should be considered a *nomen dubium*, because it could be a synonym of either older name. Female conotylids cannot be identified with certainty and their cyphopods are virtually identical and poorly sclerotized (Shear 1971), so *Z. phana* will surely retain this status until a male topotype is collected; I did not find one in 1989. Chamberlin and Hoffman (1958) included *C. atrolineata* and *C. albertana* in their list of Nearctic millipeds, and Shear (1971) described the third species, *Austrotyla borealis*, from "Sta. 5"

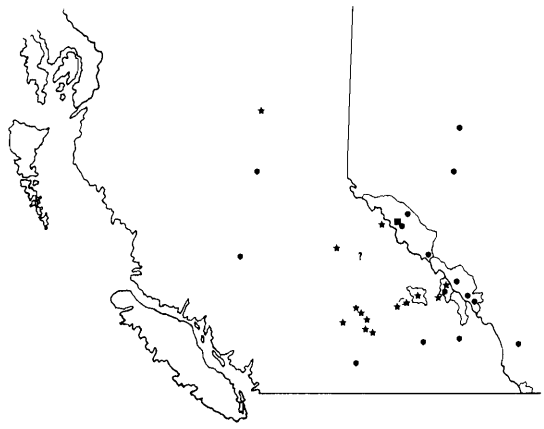


FIG. 18. Distribution of the family Conotylidae (Chordeumatida) in western Canada. ●, *Conotyla albertana*; ★, *C. atrolineata*: ■, *Austrotyla borealis*. The question mark indicates the type locality of *Zygotyla phana*.

in Jasper National Park, on the northwestern slope of Mount Edith Cavell, approximately 16 km south of Jasper (G. E. Ball, in litt.). Loomis and Schmitt (1971) erected *Brunsonia* for *B. complexipes* from Montana, but Shear (1976) placed this genus in synonymy under *Conotyla* and the species under *C. albertana*. Kevan (1983) recognized *A. borealis* but inexplicably placed both *atrolineata* and *albertana* in *Brunsonia*, referring to Shear's action on *Brunsonia* in a footnote, while accepting his synonymy of *complexipes* with *albertana*.

Today, *A. borealis* is still known only from the type locality, but the two species of *Conotyla* have been collected repeatedly. In Canada they previously appeared to be segregated by the Continental Divide, *albertana* occurring to the east, Alberta, in Banff and Jasper national parks, and *atrolineata* to the west in British Columbia, in Glacier and Yoho national parks and Mount Robson Provincial Park (Shear 1971). However, *albertana* occurs west of the divide in Montana and can be expected in British Columbia, where it actually does occur. The two millipeds are sympatric in this province and both have been taken in Yoho National Park, but only *albertana* is known from Alberta. The available material shows a broader range for *albertana*, extending from the western periphery of the plains to near the Coast Mountains at Fletcher Lake, southwest of Williams Lake, with the northernmost site at Prince George (Fig. 18). *Conotyla atrolineata*, which can now be reported from the United States, extends from the eastern periphery of Yoho National Park to the upper Okanagan Valley, with the northernmost site at Pine Pass (Fig. 18). Although both species are known from Yoho, neither has been collected in adjoining Kootenay National Park. Authentic new records of the species of *Conotyla*, or those considered as such because of proximity to samples with adult males, are as follows (the American localities of *C. atrolineata* are listed after those from British Columbia):

Conotyla albertana

ALBERTA: 32 km NW Whitecourt, 1 M, 31 August 1969, collector unknown (UA). 12 km NW Mountain Park, NE slope Prospect Mountain, 1 M, 2 F, 21 September 1974, collector unknown (UA). Jasper National Park, precise locality not specified, 1 J, 1 M, 15 September 1966, B. Wright (NSM); near confluence of Athabasca and Rocky rivers, 3 F, 13 August 1965, J. and W. Ivie (AMNH); Mount Edith Cavell (Lodge),

MM, FF, 24 August 1965, J. and W. Ivie (AMNH); and near Athabasca Glacier, 1 M, 24 August 1965, J. and W. Ivie (AMNH). Banff National Park, Banff, 1 M, 15 September 1966, B. Wright (NSM), and 1 F, date unknown, N. B. Sanson (NMNH); Bow River at Baker Creek, 4 J, 26 August 1965, J. and W. Ivie (AMNH). 60 km W Nanton, Hailstone Butte, 1 M, 22 July 1989, A. T. Fennimore (NCSM). BRITISH COLUMBIA: Prince George, Meadow Park, 2 M, 4 F, 12 August 1988, S. and J. Peck (NCSM). 96 km SW Williams Lake, between Mons and Fletcher lakes, 1 M, 2 September 1968, E. T. Thorn (RBCM). Yoho National Park, Wapta Lake, 1 M, 19 August 1988, S. and J. Peck (NCSM). Invermere, along Toby Creek, 4 M, 2 F, 29 August 1925, E. R. Buckell (RBCM). 3.8 km S Silverton, along Highway 6, 1 M, 4 September 1975, B. D. Ainscough (RBCM). 6.4 km N Oliver, 1 M, 1 F, 1 August 1955, E. L. Bousfield (NMNS).

Conotyla atrolineata

BRITISH COLUMBIA: 128 km W Dawson Creek, Pine Pass, 1 M, 1 F, 1 August 1969, E. Thorn (RBCM). Wells Gray Provincial Park, along Clearwater R., 3 M, 2 F, 17 September 1953, G. C. Carl (RBCM). Yoho National Park, 3.2 km S Takkakaw Falls, 1M, 2 F, 5 October 1963, collector unknown (NMNH). 16 km E Golden, along Highway 1, 1 M, 28 June 1988, S. and J. Peck (NCSM). Mount Revelstoke National Park, Giant Cedars, 3 F, 14 August 1988, S. and J. Peck (NCSM) and Mount Revelstoke, 1 F, 1 July 1952, G. P. Holland (BRC). Salmon Arm, 1 M, 23 March 1932, and 1 M, 1 F, 20 April 1933, H. B. Leech (NMNH) and Tappen Mountain, 2 M, 2 F, 7 October 1933, H. B. Leech (NMNH). Halfway between Salmon Arm and Enderby, 2 M, 28 March 1934, H. B. Leech (NMNH). Monte Lake, 1 M, 1 F, 14 October 1933, H. B. Leech (NMNH). Vernon, 4 M, 2 F, 20 October 1934, 4 M, 2 F, H. B. Leech (NMNH), and along Okanagan Lake, 2 M, 2 F, 24 November 1934, H. B. Leech (NMNH). E of Lumby along Shuswap R., 2 M, FF, 12 October 1935, H. B. Leech (NMNH). WASHINGTON: *Stevens Co.*, 56 mi (1 mi = 1.609 km) N Colville, Cedar Lake, 1 M, FF, May 1962, MM, FF, 10 September 1963, and 1 M, 1 F, 30 September 1964, J. and W. Ivie (AMNH). IDAHO: *Latah Co.*, 3–4 mi SE Helmer, along Little Boulder Creek, M, 2 May 1985, R. S. Zack (WASU).

Polydesmida: Paradoxosomatidae

Shelley (1988) summarized eastern Canadian records of *Oxidus gracilis* (C. L. Koch), the common introduced milliped that is widespread in the contiguous United States, and it can now be reported from British Columbia, from Victoria and Murray Nurseries, on W 57th Avenue, Vancouver (Fig. 14) (NMNH. NMNS).

Polydesmida: Polydesmidae

As in the east, this family is represented in western Canada by both introduced and native species, but in this case, only the generic distribution of *Scytonotus* can be reported because its western forms have not been reviewed. I therefore conservatively assume one species in the figures showing faunal composition, as is the case in eastern Canada (Shelley 1988), where *S. granulatus* (Say) is the only species, and throughout most of the eastern generic range (Hoffman 1960). *Scytonotus* occupies two areas in western Canada (Fig. 19) that connect in the northwestern United States. It ranges along the Pacific coast as far north as Juneau and Sitka, Alaska, extending inland in the north to Terrace and Stewart, British Columbia, and to the

FIG. 19. Distribution of indigenous representatives of the family Polydesmidae (Polydesmida) in western Canada and Alaska, showing a record from an offshore island. *Scytonotus* is the only known or presumed genus. The arrows indicate the Sitka and Juneau records.

vicinity of Hope in the south (AMNH, ILNHS, NCSM, NMNH, RBCM). *Scytonotus* is abundant on Vancouver Island but appears to be absent from the Queen Charlotte Islands, in marked contrast to *H. h. haydeniana,* which has a similar coastal distribution. In the interior, a finger of *Scytonotus* protrudes into British Columbia east of Salmo and extends through Creston and Kaslo to Kootenay, Mount Revelstoke, and near Yoho National Parks (AMNH, NCSM, NMNH, UA). *Scytonotus* is unknown from Alberta and the MacDonald Range and Kootenay drainage in the southeastern corner of British Columbia. Type localities for nominal western Canadian species are as follows: *S. columbianus* Chamberlin, 1920, British Columbia without further specification; *S. pallidus* Attems, 1931, Vancouver Island without further specification; and *S. insulans* Attems, 1931, Nanaimo.

Two introduced polydesmids can be reported from urban environments in western Canada (Fig. 14): *Brachydesmus superus* and *Polydesmus inconstans*. The former has been taken in Vancouver (FSCA) and the latter has been encountered in Edmonton, Alberta, and New Westminster, Penticton, and Victoria, British Columbia (LEM, NMNH, NMNS).

Polydesmida: Nearctodesmidae

A dominant element in the diplopod fauna of northwestern North America, the large, flat, brown to brownish-red nearctodesmids are abundant in moist coastal environments on Vancouver Island, the mainland, and associated islands as far north as Prince Rupert, ranging inland in the south to Agassiz (Fig. 20) (BRC, CAS, MCZ, NCSM, NMNH, NMNS, RBCM, UBC). In the Queen Charlotte Islands the family is known only from Burnaby Island. There is also an isolated allopatric population in the interior, in the northern Purcell – Selkirk mountains area. I found specimens in a cove along Highway 1 about 7 km east of Salmon Arm in July 1989, and there is a sample from Sicamous at the RBCM. Consequently, the family does not extend broadly across the interior of British Columbia, as is shown by Hoffman (1962, Fig. 6), and the northern boundary of the eastward faunal extension into Montana lies south of the international border in the United States. All the Canadian males that I have examined refer to *Nearctodesmus,* but species identifications await a comprehensive family-level revision. As with *Scytonotus,* I

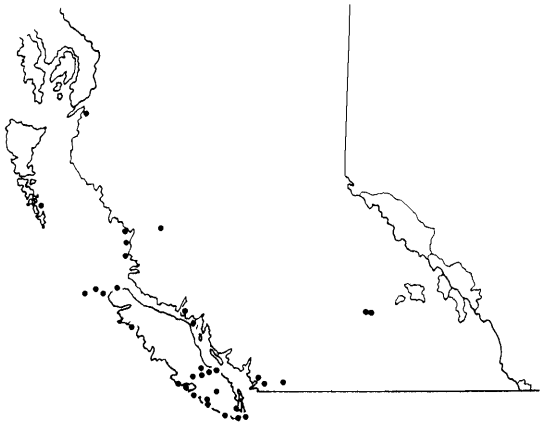


FIG. 20. Distribution of the family Nearctodesmidae (Polydesmida) in Canada, showing records from offshore islands. *Nearctodesmus* is the only known genus.

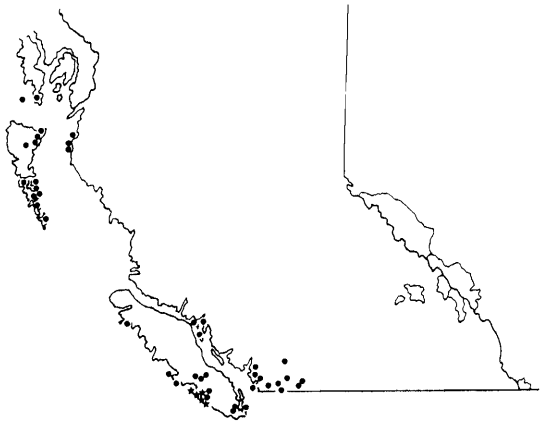


FIG. 21. Distribution of the family Xystodesmidae (Polydesmida) in western Canada and Alaska, showing locatable records from offshore islands. ★, *Metaxycheir pacifica:* ●, *Harpaphe haydeniana haydeniana.*

conservatively assume one nearctodesmid species in the figures showing faunal composition. Type localities for nominal western Canadian species are as follows: *Nearctodesmus insulans* (Camberlin, 1941), Vancouver Island without further specification; *N. carli* Chamberlin, 1951, Scott Islands; and *N. boydi* Chamberlin 1951, Lake Cowichan, Vancouver Island.

Polydesmida: Xystodesmidae

Aside from *M. pacifica,* the only xystodesmid known from western Canada and southern Alaska is the ubiquitous *H. h. haydeniana.* Buckett and Gardner (1968) recorded it from Dall and Forester islands, Alaska, which remain its northernmost and only Alaskan records. They also reported it from the following British Columbia localities, all on coastal islands not shown on the accompanying map: Copper, George, Harrison, Hotspring, Huxley, Langara, Lucy, Maude, and Shooting Star; Rose Harbor in the Queen Charlotte Islands, exact island not specified; and Lake Shawnigan, Vancouver Island. On the mainland, *H. h. haydeniana* occurs as far inland as Allison Pass, in the Cascade Mountains of Manning Provincial Park (RBCM), and I collected the milliped myself in Bridal Veil Falls Provincial Park, in Capillano Canyon and other sites around Vancouver, and in a cove along Highway 1 just north of Hells Gate in Fraser Canyon (NCSM). Hence, *H. h. haydeniana* occurs west of the crest of the Cascade and Coast mountains, and its range appears to extend farther inland in the south and become increasingly restricted to the coastal periphery in the north (Fig. 21), because investigations around Hyder, Alaska, and Pemberton, Bella Coola, Tweedsmuir Provincial Park, and Stewart, British Columbia, have failed to produce specimens. The milliped occurs throughout Vancouver Island and, unlike *Scytonotus* and the Nearctodesmidae, is abundant on the Queen Charlotte Islands, having been collected on Huxley, Graham, Moresby, Louise, Anthony, Ross, Tanu, Kunghit, and Limestone islands (CAS, RBCM, UA, UBC). Thus, in western Canada the Xystodesmidae is restricted to the Pacific coastal region and is not known east of the Coast Mountains in the north or the Cascade Mountains in the south (Fig. 21) and as with the Nearctodesmidae, the northern limit of the eastward extension into Montana (see Fig. 1 in Shelley 1987) lies in the United States. Delineating the boundaries of these extensions and correlating them with environmental or physiographic features are major objectives of future field research.

Acknowledgements

I am indebted to the National Geographic Society for supporting my fieldwork in Canada and the Black Hills of South Dakota by grants 3871-88 and 3203-85, respectively. I am equally indebted to the South Coast, Southern Interior, and Northern Regional offices of the British Columbia Ministry of Parks for permission to collect in areas under their supervision, and to Parks Canada for issuing permits to sample in Jasper, Kootenay, Yoho, Glacier, Mount Revelstoke, Waterton Lakes, and Banff national parks. The holotype of *M. prolata,* Bohart Entomological Museum, University of California at Davis, was loaned by Lynn S. Kimsey; that of *Zygotyla phana* and other samples at the RBCM were provided by R. A. Cannings. Specimens from the following collections were loaned by the curators indicated: AMNH, N. I. Platnick; BRC, R. A. Footit; CAS, W. J. Pulawski; FSCA, G. B. Edwards; ILNHS, K. C. McGiffen; LEM, D. K. McE. Kevan; MCZ, H. W. Levi; NMNH, J. A. Coddington; NMNS, P. F. Frank; NSM, B. Wright; RBCM, R. A. Cannings; ROM, D. C. Darling; UA, G. E. Ball, UBC, S. G. Cannings; and WASU, R. S. Zack. Stewart Peck, Carleton University, Ottawa, donated his valuable western Canadian and Alaskan collections to the NCSM, and the following Canadian colleagues advised on habitats, localities, and pertinent Canadian customs: G. E. Ball, R. A. Cannings, S. G. Cannings, H. V. Danks, A. T. Fennimore, and C. S. Guppy. Thanks are also extended to R. C. Funk, Eastern Illinois University, Charleston, and D. A. Summers, Field Museum of Natural History, Chicago, for providing access to and loans from the collections under their care. The absence of Illinois specimens of *S. placidus* from these regional holdings and the ILNHS influenced my decision of three areas of allopatric populations for this species instead of two, or a continuous range from Minnesota to Virginia. Figures 1, 2, 6, and 8 were prepared by Renaldo G. Kuhler, NCSM scientific illustrator.

ATTEMS, C. G. 1903. Beitrage zur Myriapodenkunde. Zool. Jahrb. Abt. Syst. Oekol. Geogr. Tiere, **18**: 63–154.

BOLLMAN, C. H. 1887. Descriptions of fourteen new species of North American myriapods. Proc. U. S. Natl. Mus. **10**: 617–627.

——— 1893. The Myriapoda of North America. U.S. Nat. Mus. Bull. No. 46.

BUCKETT, J. S., and GARDNER, M. R. 1968. Revision of the milliped genus *Harpaphe* Cook from western North America (Polydesmida: Xystodesmidae). Calif. Dep. Agric. Bur. Entomol. Occas. Pap. No. 11.

——— 1969. A new genus of xystodesmid milliped with the description of a new species from Idaho (Diplopoda: Xystodesmidae). Proc. Entomol. Soc. Wash. **71**: 65–70.

CAUSEY, N. B. 1954. New records and species of millipeds from the western United States and Canada. Pan-Pacific Entomol. **30**: 221–227.

——— 1974. The phylogeny of the family Paraiulidae (Paraiuloidea: Blaniulidea: Iulida: Diplopoda). Symp. Zool. Soc. Lond. No. 32. pp. 23–39.

CHAMBERLIN, R. V. 1920. Canadian myriopods collected in 1882–1883 by J. B. Tyrrell, with additional records. Can. Entomol. **52**: 166–168.

——— 1951. Eleven new western millipeds. Nat. Hist. Misc. (Chic.) No. 87.

CHAMBERLIN, R. V., and HOFFMAN, R. L. 1958. Checklist of the millipeds of North America. U.S. Natl. Mus. Bull. No. 212.

COOK, O. F. 1904. Myriapoda of northwestern North America. *In* Harriman Alaska Expedition. Vol. 8. Insects, Pt. 1. pp. 47–82.

COOK, O. F., and COLLINS, G. N. 1895. The Craspedosomatidae of North America. Ann. N.Y. Acad. Sci. **9**: 1–100.

COOK, O.F., and LOOMIS, H. F. 1928. Millipeds of the order Colobognatha, with descriptions of six new genera and type species, from Arizona and California. Proc. U.S. Natl. Mus. **72**: 1–26.

ENGHOFF, H. 1985. The millipede family Nemasomatidae, with the description of a new species, and a revision of *Orinisobates* (Diplopoda: Julida). Entomol. Scand. **16**: 27–67.

GARDNER, M. R., and SHELLEY, R. M. 1989. New records, species, and genera of caseyid millipeds from the Pacific coast of North America (Chordeumatida: Caseyidae). Pan-Pacific Entomol. **65**: 177–268.

HARGER, O. 1872. Descriptions of new North American myriapods. Am. J. Sci. Arts Ser. 3, **4**: 117–121.

HOFFMAN, R. L. 1960. The milliped genus *Scytonotus* in eastern North America, with the description of two new species. Am. Midl. Nat. **67**: 241–249.

——— 1962. A new genus and species in the diplopod family Nearctodesmidae from Illinois (Polydesmida). Am. Midl. Nat. **68** 192–198.

——— 1964. Taxonomic notes on some American nemasomatid Diplopoda. Trans. Am. Entomol. Soc. (Phila.), **89**: 165–182.

——— 1966. The status of the milliped genus *Orinisobates* (Julida: Nemasomatidae). Radford Rev. **20**: 175–181.

——— 1972. On the identity of three genera of cambaloid millipeds from the Australian region (Spirostreptida). Psyche, **79**: 200–208.

——— 1979*a*. Classification of the Diplopoda. Museum d'Histoire Naturelle, Geneva, Switzerland.

———1979*b*. Diplopoda. *In* Canada and its insect fauna. Mem. Entomol. Soc. Can. No. 108. pp. 294–296.

KANE, M. M. 1981. Systematics, morphology, and natural history of *Polyxenus lagurus* (Linne, 1758) (Diplopoda: Polyxenidae) in North America. Ph.D. thesis, Michigan State University, East Lansing.

KEVAN, D. K. MCE. 1983. A preliminary survey of known and potentially Canadian millipeds (Diplopoda). Can. J. Zool. **61**: 2956–2975.

KEVAN, D.K. MCE. and SCUDDER, G. G. E. 1989. Illustrated keys to the families of terrestrial arthropods of Canada. 1. Myriapods (millipeds, centipedes, etc). Taxonomic Ser. No. 1, Biological Survey of Canada.

KINCAID, T. 1898. A new species of *Polyxenus*. Entomol. News. **9**: 192–193.

LOOMIS, H. F., and SCHMITT, R. 1971. The ecology, distribution and taxonomy of the millipeds of Montana west of the Continental Divide. Northwest Sci. **45**: 107–131.

NGUYEN DUY-JACQUEMIN, M., and CONDÉ, B. 1984. Nouvelle description et statut de *Polyxenus bartschi* Chamberlin (Diplopodes: Penicillates). Bull. Mus. Natl. Hist. Nat. Sect. A, **6**: 721–728.

SHEAR, W. A. 1971. The milliped family Conotylidae in North America, with a description of the new family Adritylidae (Diplopoda: Chordeumida). Bull. Mus. Comp. Zool. **141**: 55–97.

——— 1973. The milliped family Rhiscosomididae (Diplopoda: Chordeumida: Striarioidea). Psyche, **80**: 189–203.

——— 1976. The milliped family Conotylidae (Diplopoda, Chordeumida): revision of the genus *Taiyutyla*, with notes on recently proposed taxa. Am. Mus. Novit. No. 2600.

SHELLEY, R. M. 1987. The milliped *Stenodesmus tuobitus* (Chamberlin) Polydesmida: Xystodesmidae) in Texas and New Mexico. Natl. Geogr. Res. **3**: 336–342.

——— 1988. The millipeds of eastern Canada (Arthropoda: Diplopoda). Can. J. Zool. **66**: 1638–1663.

SHELLEY, R. M., and WHITEHEAD, D. R. 1986. A reconsideration of the milliped genus *Sigmoria*, with a revision of *Deltotaria* and an analysis of the genera in the tribe Apheloriini (Polydesmida: Xystodesmidae). Mem. No. 35 Am. Entomol. Soc.

Verhoeff, K. W. 1944. Zur Kenntnis der Cambaliden und über einige neue Australische Formen derselben. Zool. Anz. **145**: 27–45.

Williams, S. R., and HEFNER, R. A. 1928. The millipedes and centipedes of Ohio. Bull. Ohio Biol. Surv. No. 18, **4**(3) (Ohio State Univ. Bull. **33**(7)): 93–146.