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The Systematics and Biology of the Flea Beetle Genus
Crepidodera Chevrolat in America North of Mexico
Including Electrophoretic Studies on a Few Local
Populations (Coleoptera : Chrysomelidae).

by

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A thesis submitted to the Faculty of Graduate Studies
and Research in partial fulfillment of the requirements
for the degree of Doctor of Philosophy.

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The undersigned hereby recommend to the Faculty of Graduate Studies and Research acceptance of this thesis, submitted by Richard Howell Parry, B.Sc. (Agr.), M.Sc., in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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ABSTRACT

Sixteen species of the genus Crepidodera (Chrysomelidae : Alticinae) of America north of Mexico are revised with 8 described as new: C. solita, C. decora, C. browni, C. luminosa, C. vaga, C. digna, C. populivora and C. bella. A neotype is designated for Altica nana Say and lectotypes are designated for C. longula Horn, C. violacea Melsheimer, Haltica opulenta LeConte and Haltica aereola LeConte. Crepidodera opulenta (LeConte) and C. aereola (LeConte) are considered valid for the first time since their original description. Chalcoides chittendeni Heikertinger is placed in synonymy with Crepidodera nana (Say). All species are described and illustrated and the distribution of each species is mapped. Host plant records and information on life history are provided for all species and a key for the separation of the species is presented. Immature stages are described and illustrated and their root mining habits are described for C. solita n. sp. and C. heikertingeri (Lazorko). These are the first immatures known for the genus. An historical review, full synonymy and a redescription of the genus and a general discussion of the biology, including host plants, life history and natural enemies, are provided.

Electrophoretic studies on local populations of 5 sympatric species produced consistent results for 8 enzymes. These results tend to substantiate the taxonomy as worked out by the more classical methods.

TABLE OF CONTENTS

	Page
Abstract	iii
Table of Contents	iv
List of Tables	vi
List of Figures	vii
Introduction	1
Acknowledgments	3
Historical Review	6
Materials and Methods	19
Systematics	
Genus <u>Crepidodera</u> Chevrolat	32
Diagnosis	33
Description	34
Biology	39
Key to Species	60
1. <u>C. longula</u> Horn	70
2. <u>C. violacea</u> Melsheimer	75
3. <u>C. spenceri</u> (Lazorko)	90
4. <u>C. solita</u> new species	98
5. <u>C. decora</u> new species	115
6. <u>C. browni</u> new species	125
7. <u>C. opulenta</u> (LeConte)	134
8. <u>C. luminosa</u> new species	141
9. <u>C. vaga</u> new species	148
10. <u>C. heikertingeri</u> (Lazorko)	154
11. <u>C. digna</u> new species	173

12.	<u>C. populivora</u> new species	182
13.	<u>C. bella</u> new species	194
14.	<u>C. aereola</u> (LeConte)	199
15.	<u>C. sculpturata</u> (Lazorko)	207
16.	<u>C. nana</u> (Say)	214
	Electrophoresis Studies	229
	References	236
	Figures	247
	Maps	275

LIST OF TABLES

	Page
1. Known and probable host plants of North American <u>Crepidodera</u> spp.	43
2. Host plant records for <u>Crepidodera violacea</u> Melsh.	85
3. Gene frequencies for 4 loci in 5 species of <u>Crepidodera</u>	231

LIST OF FIGURES

	Page
Figs. 1-123. Scanning electron photomicrographs of <u>Crepidodera</u> spp.	247
124-127. Photographs of habitats of <u>Crepidodera</u> spp.	261
128-129. Photographs of equipment used in rearing <u>C. solita</u> n. sp.	261
130. Photograph of feeding damage of adults of <u>C. solita</u> n. sp.	261
131-146. Drawings of male genitalia of <u>Crepidodera</u> spp.	262
147-162. Drawings of spermathecae of <u>Crepidodera</u> spp.	266
163-182. Photographs of gels from electrophoresis of <u>Crepidodera</u> spp.	267
183-186. Drawings of third instar larva of <u>C. heikertingeri</u> (Lazorko)	274
Maps 1-16. Distribution maps of <u>Crepidodera</u> spp.	275

INTRODUCTION

Crepidodera Chevrolat is a genus of small metallic-coloured flea beetles belonging to the family Chrysomelidae. Although these insects are quite common in the field and numerous in museum collections, the members of the genus in North America were poorly known. Heikertinger (1948-1950) recognized 4 taxa and recently, Lazorko (1974) described 3 additional species. These 7 species were recognized primarily on the basis of genital differences and are otherwise difficult to identify.

An examination of a large accumulation of museum material and investigations in the field have indicated the presence of several additional species in the North American fauna. A detailed study of external characters, male genitalia and female spermathecae has revealed, in material previously referred to the Palaearctic species, C. fulvicornis (F.), a complex of closely related species.

Essentially nothing was known about the biology of the North American species. General information on host plants was available and the general seasonal occurrence and habits of adults were described by Loan (1967b). However, the immature stages and life history of all members of the genus were unknown. This has now been remedied with the discovery, during the course of this study, of the larvae of two species.

The main purpose of this paper, therefore, is to consolidate the existing information on the genus in North America, describe 8 new species, redefine the previously described species, provide a key and illustrations to aid in their identification, and to describe, for 2 species, the immature stages and their root mining habits. A discussion of the host plant relationships and the general life history of members of the genus is also presented.

In addition to the more usual taxonomic characters, the genetic relationships of several species were studied using electrophoretic techniques to see how well the protein banding supported the more classical aspects of the study.

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The abbreviations in parentheses in the above list are those used in the text when citing material examined.

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equipment, services, field work and museum travel. His encouragement and patience during this study are also much appreciated.

HISTORICAL REVIEW

The generic name Crepidodera was proposed by Chevrolat (1837) without description in Dejean's Catalogue. He included 41 trivial names which he considered to represent 26 species. Each of these names is followed by the name of the author and, although many of them are apparently nomina nuda, some are available names and the names of their authors constitute bibliographical citations to prior descriptions. Some later authors such as Neave (1939) considered the name Crepidodera in its original usage to be a nomen nudum. However, according to Article 16 (a) (v) of the International Code of Zoological Nomenclature, the citation by Chevrolat (1837) of several available specific names with the generic name constitutes an indication and by Article 12, the name Crepidodera Chevrolat is available. Barber and Bridwell (1940) provided a similar discussion on the validity of the many generic names in Chrysomelidae proposed in the Dejean catalogues.

Faldermann (1837) subsequently used the name Crepidodera without description or authority in describing a single new European species, crassicornis. In 1839, Stephens used the name and included 7 species which had been included by Chevrolat (1837) and 4 additional species. In 1844, Chevrolat provided a description for

Crepidodera and included 10 species of which 8 had been included in 1837. Küster (1847-1848) included 5 species that Chevrolat (1837) had included and proposed 4 new specific names.

The genus, as conceived by Chevrolat and these subsequent authors, included species with a transverse pronotal ante-basal depression and elytral punctures in rows. However, in other characters, some of these species are quite diverse. In 1860, Foudras restricted Chevrolat's concept of the genus Crepidodera to include only species with rounded, contiguous frontal tubercles and non-metallic colours. He divided the remaining species into 5 new genera: Ochrosis, Hippuriphila, Epitrix, Chalcoides and Arrhenocoela. In Chalcoides, he included those species with oblong, acute frontal tubercles and metallic colours. These were nitidula (Linn.), helxines (Linn.), and aurata (Marsham) plus 3 new species. It is in this group that the species included in the present study belong.

Foudras' (1860) work was at first apparently not known to some subsequent authors such as Kutschera (1860), Allard (1860), Crotch (1873), Redtenbacher (1874) and Jacoby (1885, 1891) who made no reference to Foudras (1860) and continued to use the name Crepidodera in the broader sense of Chevrolat. In other works, such as those of Allard (1866a), Thomson (1866), Chapuis (1875), Seidlitz (1875) and Leesberg (1881-1882), reference

was made to Foudras' (1860) more restricted genera, including Chalcoides, but the species belonging to these were still placed together under the name Crepidodera.

Weise (1886) was the first author to recognize and accept Foudras' (1860) restriction of the genus Crepidodera Chevrolat and the division of the remaining species into the new genera including Chalcoides. Until 1952, all subsequent European authors, with the possible exception of Fowler (1890) who used the name Chalcoides Foudras as a subgenus of Crepidodera Chevrolat, followed Weise's (1886) example and accepted Foudras' (1860) concept. However, North American authors such as Horn (1889), Blatchley (1910) and Duckett (1920) declined to accept Foudras' (1860) division of Crepidodera Chevrolat sensu lato.

Finally, in 1920, Leng followed Foudras' (1860) and the subsequent European authors' use of the name Chalcoides and used the name Crepidodera Chevrolat for a mixed group of other species. Until 1971, North American authors followed Leng's (1920) example in the application of the name Chalcoides Foudras.

No type species was designated for the genus Crepidodera Chevrolat until 1926 when Maulik, in his work on the Chrysomelidae of British India, designated Chrysomela nitidula Linnaeus (Europe) as type. This species was included by Chevrolat (1837) under the same

name but was there referred to Fabricius instead of Linnaeus. However, nitidula L. is a member of the genus Chalcoides Foudras. Therefore, in order to follow the International Code of Zoological Nomenclature, it is necessary to use the name Crepidodera Chevrolat in place of Chalcoides Foudras. Maulik's (1926) type designation seems to have gone unnoticed or was ignored by subsequent authors until it was pointed out by Heikertinger (1948-1950) in his revision of the Palaearctic and Nearctic members of the "Crepidodera group". However, Heikertinger declined to make any change in the accepted usage of the names Chalcoides and Crepidodera, explaining that such a strict adherence to the rules of nomenclature would cause much unnecessary confusion. The problem was later discussed and brought to wider attention by Hincks (1952). He pointed out that the name Chalcoides Foudras should be replaced by Crepidodera Chevrolat and that Asiolestia Jacobson (1925) was available as a replacement name for Crepidodera of authors. However, he suggested that, since these changes might lead to confusion, application might be made to the International Commission to place the names Crepidodera and Chalcoides in their "hitherto accepted sense" on the Official List of Nomina Conservanda.

As pointed out by Wiesner (1975), no one has yet followed Hinck's (1952) suggestion. Instead, recent authors such as Gressitt and Kimoto (1963), Scherer (1969), Hatch (1971), Balsbaugh and Hays (1972) and

Samuelson (1973) have used either one or both of the names Crepidodera Chevrolat in place of its synonym Chalcoides Foudras and Asiolestia Jacobson in place of Crepidodera of authors. Exceptions include Mohr (p. 247) in Freude, Harde and Lohse (1966) and Lazorko (1974) who continued to use the name Chalcoides Foudras.

Since the establishment of the genus by Chevrolat (1837), many specific names have been proposed under the name Crepidodera. In the Coleopterorum Catalogus, Heikertinger and Csiki (1939) listed, under Crepidodera, 129 species from the Palaearctic, Nearctic, Neotropical, Ethiopian and Indo-Australian Regions. In the genus Chalcoides Foudras, which is now properly called Crepidodera, they listed 8 species from the Palaearctic, 2 species from the Nearctic and 1 species each from the Neotropical and Indo-Australian Regions. In the last major revision of Crepidodera and its relatives, Heikertinger (1948-1950) recognized for Crepidodera of authors, which is now properly called Asiolestia Jacobson, 33 species in the Palaearctic Region. He also recognized, for Chalcoides Foudras, 8 species from the Palaearctic and 4 plus 1 doubtful species from the Nearctic. Up to the present work, the number of Palaearctic species of Crepidodera Chevrolat (= Chalcoides Foudras) has increased to 12 and the Nearctic species to 7 (Lazorko, 1974), of which 1 species, fulvicornis F., has been considered to be shared with the Palaearctic Region.

According to Heikertinger (1948-1950), the genus Crepidodera Chevrolat (= Chalcoides Foudras) is essentially holarctic in distribution. However, there are many species from tropical regions still referred to Crepidodera Chevrolat. With recent additions and subtractions up to 1972 to the species listed by Heikertinger and Csiki (1939), the Neotropical Region has approximately 40, the Ethiopian Region 28 and the Indo-Australian Region 37 species under the name Crepidodera Chevrolat. Recently, Samuelson (1973) recognized 14 species for Oceania. Seven (7) of these are new additions to the genus. From the descriptions and illustrations provided, I am doubtful that the species of Oceania should be considered congeneric with the North American and Eurasian species. I am also suspicious of the many other tropical species referred to the genus, although I have seen very few of these. I was able to examine, in the Bowditch Collection, Museum of Comparative Zoology, six Central American and Mexican species described as Crepidodera by Jacoby (1885, 1891). Of these species, only one, C. guatemalensis Jacoby from Guatemala and Mexico, is congeneric with the North American species as defined in the present work.

The first North American species to be referred to the genus Crepidodera Chevrolat were described by Melsheimer in 1847. He described five species, violacea, erythropus, fusco-aenea, hirtipennis, and atriventrils,

all from Pennsylvania. All but C. violacea have subsequently been placed in other genera.

In 1859, Boheman described as Crepidodera a number of species taken during the 1851-1853 voyage of the Swedish frigate "Eugenie". These included C. vafra from "California (St. Francisco)", C. suturella from "California (St. Francisco), Insula Puna", C. bicolor from "California (St. Francisco), Taiti", and C. puberula from "Montevideo, California, Insulae Puna, Taiti et Oahu". These names were apparently not noticed and not referred to by North American authors until 1889 when Horn pointed them out and made the following comment:

The localities of the Eugenie's Resa material are notoriously badly mixed, and no reliance can be placed upon them. As I have been unable to identify them, notwithstanding all the collecting that has been done in California I think it best to omit them from our lists.

Confusion in the labelling of some of the "Eugenie's Resa" specimens was also reported by Smith and Lawrence (1967) who found, for example, that two species of Diabrotica listed by Boheman (1859) as from "California (St. Francisco)" are actually Ecuadorian forms. They also pointed out that "Insulae Puna" and "Taiti" (Paiti) are localities in Ecuador.

I have not seen Boheman's types but, after careful examination of his descriptions, I am very doubtful that his species belong in the genus Crepidodera. Since the distributions given for some of these species are unusual, it is also possible that specimens were

mislabelled. Therefore, it is probably best to regard these species, supposedly from California, as "incertae sedis".

In 1873, Crotch revised the genus Crepidodera for North America. He recognized six species. These included the three European species rufipes (L.), helxines (L.) and modeeri (L.), C. atriventris Melsheimer, and two new species, C. scabricula from Texas and C. nana (Zimm. M.S.S.) from South Carolina. Crotch listed Crepidodera erythropus Melsheimer (1847) as a synonym of rufipes (L.). Altica nana Say (1824), C. violacea Melsheimer (1847), Haltica aereola LeConte (1857) and Haltica opulenta LeConte (1858) were listed as synonyms of helxines (L.) and Haltica (Crepidodera) mancula LeConte (1861) as a variety of modeeri (L.).

In 1876, Harold proposed a new genus, Trichaltica, and included Crepidodera scabricula Crotch.

The North American species of Crepidodera were again revised by Horn (1889) who recognized seven species. He followed Crotch (1873) in using the three European names, rufipes (L.), helxines (L.) and modeeri (L.) with the synonymies proposed by Crotch. He also included C. atriventris Melsheimer, C. robusta LeConte (1874) and described two new species, C. longula from Kansas and C. nitens from Illinois. Not included in the genus was Crepidodera nana Crotch (not Say, 1824) which he transferred to the genus Altica Muller (= Haltica Illiger).

In defining the genus, Horn referred to the splitting of Crepidodera sensu Chevrolat (1837, 1844) by Foudras (1860) and noted that C. helxines belongs to Chalcoides Foudras, C. modeeri to Hippuriphila Foudras and C. rufipes to Derocrepis Weise (1886). However, he declined to accept these restricted genera, stating that he considered the differences between these groups "totally insufficient for generic separation". Horn also remarked that C. robusta LeConte should be separated generically and that his new species, C. nitens, is probably a glabrous species of Epitrix Foudras. Later, Hatch (1935) established the genus Orestioides for Crepidodera robusta LeConte and Wilcox (1953) placed Crepidodera nitens Horn in the genus Epitrix Foudras.

Blatchley (1910), in his paper on the Coleoptera of Indiana, included six of the species recognized as Crepidodera by Horn (1889) and followed his nomenclature.

Similarly, Duckett (1920) recognized from Maryland three species ascribed to Crepidodera by Crotch (1873) and Horn (1889). These were C. rufipes (L.), C. helxines (L.) and C. atriventris Melsheimer.

In the meantime, however, the European author Heikertinger (1911) had reported that he had examined some North American specimens considered by North American authors to represent Crepidodera rufipes (L.), C. helxines (L.) and C. modeeri (L.) which were originally described from Europe. He disagreed with Horn

(1889) by placing these species in the genera Derocrepis Weise, Chalcoides Foudras and Hippuriphila Foudras respectively. He considered these genera to be, without question, distinct natural groups. By comparing male genitalia and other characters, he showed that Crepidodera rufipes of American authors is distinct from the European species, rufipes L. and should properly be called Derocrepis erythropus (Melsheimer). Similarly, Heikertinger noted that C. helxines of American authors is not helxines L.. He considered the former to be most similar to Chalcoides fulvicornis (F.) of Europe. Even though he showed that the male genitalia of the North American specimens available to him were distinct from Chalcoides fulvicornis and might be called Chalcoides nana (Say), Heikertinger decided to leave them as a subspecies, Chalcoides fulvicornis nana (Say). He considered only Hippuriphila modeeri (L.) to be a holarctic species. Later, Brown (1942) showed that North American species of Hippuriphila are distinct from H. modeeri (L.).

Heikertinger (1924-1925), in his key to the North American genera of Alticinae, included Crepidodera atriventris Melsheimer in the genus Ochrosis Foudras.¹

In the genus Chalcoides Foudras (now Crepidodera Chev.), he recognized only a single taxon, Chalcoides fulvicornis nana (Say). He also remarked that he

¹Wilcox (1953) has referred C. atriventris Melsh. to the genus Hornaltica Barber.

thought it best to sink the name helxines L. (as in Bedel, 1900) since it had been used for different species and retained much confusion.

Heikertinger later (1948-1950) reviewed the North American species of Crepidodera Chevrolat (= Chalcoides Foudras) along with the Palaearctic species. He recognized three North American species, fulvicornis nana (Say), violacea Melsheimer and chittendeni which he described as new from the eastern United States. He included as doubtful Crepidodera longula Horn. His new species, chittendeni, was based on material which he had, in 1911, determined to be distinct from the European Crepidodera fulvicornis (F.). However, at that time, he had considered this form a subspecies, fulvicornis nana (Say), in spite of the distinctive male genitalia. After obtaining additional North American material, he found males with genitalia much more similar to those of C. fulvicornis (F.). Therefore, in this latest work, Heikertinger (1948-1950) identified the latter specimens as fulvicornis nana (Say) and described those with the distinctly different male genitalia as a new species, chittendeni. In this work, Heikertinger was the first author to recognize Crepidodera violacea Melsheimer as a distinct species since its description in 1847.

In 1954, Wilcox recognized (from Ohio) three species, C. longula Horn, C. nana (Say) and C. violacea Melsheimer.

Balsbaugh and Hays (1972) included, for Alabama, two species, Crepidodera nana (Say) and C. longula Horn.

The latest taxonomic treatment of the genus in North America was by Lazorko (1974). He used the generic name Chalcoides Foudras and described three new species, C. spenceri and C. heikertingeri from British Columbia and C. sculpturata from British Columbia and Ontario. He recognized as valid taxa, C. fulvicornis nana (Say), C. violacea (Melsheimer), C. longula (Horn) and C. chittendeni Heikertinger.

In addition to those mentioned in the preceding discussion, several other species from North America north of Mexico have been described as species of Crepidodera by LeConte (1861), Crotch (1874), Linell (1898), Dury (1906), Fall (1910) and Blatchley (1925). However, these species have properly been referred to other genera by subsequent authors.

In the present revision, 16 species of Crepidodera are recognized for Canada and the United States. When compared with determined European material, all of these species appear to be distinct from any of the Palearctic species. Eight previously described species are included. These are Crepidodera nana (Say), C. violacea Melsheimer, C. longula Horn, C. opulenta (LeConte), C. aereola (LeConte), C. spenceri (Lazorko), C. heikertingeri (Lazorko) and C. sculpturata (Lazorko).

Crepidodera opulenta (LeConte) and C. aereola (LeConte) are here considered distinct valid species of Crepidodera for the first time. Also, Chalcoides chittendeni Heikertinger is designated a synonym of C. nana (Say). Eight new species are described.

MATERIALS AND METHODS

The taxonomic part of this study is based on an examination of approximately 10,000 adult specimens of Crepidodera obtained by personal collecting and on loan from a number of museums. These museums are listed in the acknowledgements along with the abbreviations used to refer to them in the text in citing material examined and the deposition of type specimens. The letters RHP used in the text refer to the personal collection of the author.

Previously described North American species of Crepidodera were determined by examining the type specimens, when possible, or on the basis of the original description. The type specimens of Horn, LeConte and Melsheimer were seen during a visit to the Museum of Comparative Zoology, Harvard University. The holotype and allotype of Crepidodera sculpturata (Lazorko) were borrowed from the University of British Columbia.

A synoptic collection (45 specimens) of the Palaearctic species of Crepidodera was borrowed from a European museum for comparison with the North American species.

Collecting Techniques

Adults were collected from the host trees and bushes by beating. Specimens were picked off the beating sheet with an aspirator and were killed with ethyl

acetate fumes. When live specimens were desired for rearing or for electrophoresis work, the beetles were shaken from the aspirator into transparent plastic sandwich bags which were closed with paper and wire twist seals and carried to the laboratory. If the live material required sorting to species or sexing, the beetles were anesthetized in the laboratory with carbon dioxide gas and quickly examined under the microscope.

Preparation and Dissection Techniques

Dead specimens of Crepidodera are best mounted on stiff paper points with the beetle glued on one side in such a way that only one edge of the ventral surface is obscured. This is important, particularly with male specimens which have important ventral setal characters.

Male genitalia and the spermatheca of the female were of much value in separating species.

Extraction of the male genitalia was not difficult provided the specimen was well relaxed. Dried specimens were relaxed by soaking them for about 15 to 30 minutes in a 10% solution of tribasic sodium phosphate (TSP). The relaxed specimen was held under a dissecting microscope and an insect pin with the tip bent in an arc was used to spread the elytra apart slightly, to make a tear in the membrane between the last few abdominal terga and sterna and to pull out the sclerotized median lobe and tegmen. The elytra were then placed back

together and the specimen, showing no traces of dissection, was remounted on a point. Once removed, the median lobe was glued by the basal end on a point beneath the specimen. If the genitalia were to be illustrated, they were softened and slightly cleared in hot 10% potassium hydroxide for about 10 minutes, washed in distilled water, placed in acid alcohol for several minutes to stop the clearing process and washed in 70% alcohol. For drawing, the male genitalia were placed in melted glycerine gel on a glass depression slide and were oriented in the desired position while the gel was allowed to solidify. After examination, the glycerine gel was remelted and the cleared genitalia were removed from the slide and washed in 70% alcohol. They were then placed in glycerine in a microvial which was placed on the pin with the specimen.

Female specimens to be dissected were relaxed in the same manner as the males. The spermatheca was removed by either of two methods. The first method was to remove the entire abdomen and boil it for a few minutes in water. The spermatheca was then extracted by dissecting the abdomen in water on a glass depression slide. Potassium hydroxide was not used to soften the tissues of the abdomen since it tends to weaken the lightly sclerotized spermatheca causing it to collapse when placed in slightly hypertonic solutions. A quicker method of extraction and one less damaging to the

specimen was to dissect a well-relaxed female in a fashion similar to that used in dissecting males. In this, the membrane between the last few abdominal terga and sterna was torn on one side all the way to the apex so that the last two or three terga could be lifted to the opposite side exposing the internal organs. The spermatheca, found near the tip of the abdomen, was removed by teasing it away from the surrounding tissue and severing the membranous spermathecal duct with the hooked insect pin. Once extracted, the spermatheca was cleared for a few minutes in a few drops of Dioxane (diethylene dioxide) on a glass depression slide and then mounted in a small drop of Canada balsam on one end of a small celluloid plate. The celluloid plate was then pinned beneath the specimen.

Larvae and pupae obtained during the study were killed either in hot water or in KAAD mixture (kerosene - 1 part, 95% ethanol - 10 parts, glacial acetic acid - 2 parts, dioxane - 1 part) and were preserved in 75% ethanol. A small number of larvae (4 first instar and 1 third instar) were cleared for a few minutes in cold 10% potassium hydroxide, washed in distilled water, placed in acid alcohol for several minutes to stop the clearing process and rewashed in distilled water. The larvae were then mounted in Hoyer's medium on glass microscope slides for detailed study.

Examination, Measurements and Illustrations

All material was examined using a binocular dissecting microscope at magnifications ranging from, 12.5 to 150X. The considerable glare produced by these very shiny beetles under incident light was greatly reduced by fixing a thin flexible sheet of translucent plastic between the microscope lamp and the specimen being examined. When placed as close as possible to the specimen, this screen served to polarize the beam of light from the lamp and made the surface sculpture of the specimen much more sharply discernible.

Measurements and drawings were made with the aid of an ocular grid. Lengths and widths of adults were measured at 12.5 magnifications. Male genitalia and female spermathecae were measured and drawn at magnifications of 100X and 150X respectively. All drawings were made to scale using graph paper.

Adults of each species were photographed using a JEOL JSM-U3 scanning electron microscope at voltages around 2 kV. These specimens were placed into the microscope without being removed from their points and without coating. It should be noted that the diameters of punctures, the length of setae and the widths of some margins etc., tend to appear slightly smaller in the scanning electron photomicrographs than when observed under an incident-light microscope. This is due, in part, to the absence of the shadowing effects of light

in the SEM and to the properties of the scanning electron beam which strikes some parts, especially the sides, of these convex specimens at a very small angle, causing slight distortion.

Distributional Records and Maps

The records given in the section headed "Material examined" under each previously described species were summarized from the data on specimen labels and include only the locality, the month collected, the host plant (if recorded), the collection from which the material was borrowed, and the number of specimens at hand. The data for the paratypes of new species recorded from 50 or more localities were summarized in a similar manner. When new species were recorded from less than 50 localities, the specimen data were cited in full.

The dots on the distribution maps (Maps 1-16) do not indicate literature records but only those records confirmed by examination of specimens.

Field Studies

Information on habitat and host plants was obtained for several species of Crepidodera during collecting trips to northern Ontario, southern British Columbia and southern Texas. More detailed information was accumulated in the Ottawa area where local populations of Crepidodera spp. were observed throughout the

entire 1975 season and part of the 1976 season. In these studies, adults of several species were collected or observed at regular intervals during the season in an attempt to determine various aspects of their life history. During collecting trips and local field studies, voucher specimens of some host plants, especially Salix spp., were collected and identified. These are deposited in the Carleton University Herbarium.

In an attempt to find immature stages of a willow-feeding species, C. heikertingeri (Lazorko), several samples of soil and willow roots were dug from under bushes of Salix petiolaris in late July, 1975. These samples were either searched by hand in the field or taken to the laboratory and washed in basins of water so that any insects present could be collected by floatation. This process yielded only a very few larvae and pupae of C. heikertingeri.

Laboratory Rearing

Rearing of two species, Crepidodera solita n. sp. and C. heikertingeri (Lazorko) was attempted in the laboratory during the spring and summer of 1976. Two methods were used.

In one method, live adults of each species were collected in the spring and confined in rearing cages containing growing willow plants. The plants were grown from cuttings of Salix alba x fragilis and

S. petiolaris taken in mid and late April. The cuttings were induced to root by placing them upright in containers of water. They were later planted in potting soil, either singly in 5 inch diameter plastic pots or in pairs (conspecific) in each of four 12 x 6 3/8 x 8 inch glass-walled aquaria. The roots of willows planted in each aquarium were placed against the glass side in order that they could be examined later without disturbance. The end walls of each aquarium were covered with strips of black 4 inch plastic tape and the sides were covered with sheets of stainless steel painted black on the inner side and hung from the top edge of the aquarium (fig. 129).

Several weeks later when the willow plants were well established, 6 cages were set up with Nos. 1 to 3 containing Salix alba x fragilis and Nos. 4 to 6 containing S. petiolaris. Two cages of each group (Nos. 1, 2, 4, 5) contained 2 willow plants in an aquarium. One of these cages (No. 5) also contained a willow plant in a pot. The last cage of each group (Nos. 3 and 6) contained 2 potted willows.

Each rearing cage (fig. 128) was set up as follows:

The willows were placed in the centre of a heavy plastic "tote" box measuring 18 1/2 x 14 x 5 inches. The bottom of the box was lined with newspaper and covered by thin polyethylene sheeting. The plants were

then covered by a wooden-framed cage measuring $36 \times 16 \times 3\frac{1}{4} \times 10$ inches and open at the bottom. The ends of the cage consisted of $\frac{3}{8}$ inch plywood and the sides and top were covered with very fine mesh saran plastic screening. One end of the cage was equipped with an access port 5 inches in diameter. This was covered by a tight-fitting, sliding window made of plexiglass. To prevent beetle escapes around the framing, all joints inside the cage were caulked with silicone rubber compound. With the cage resting on the bottom of the tote box, the space between the outside of the cage and the walls of the box was filled with sand to prevent escapes under the cage.

Approximately 25 males and 25 females of C. solita were collected on June 12 and placed in each of cages 1 to 3. About 35 adults of C. heikertingeri were placed in each of cages 4 to 6 on June 14. All cages were stationed on a laboratory bench beside large windows and were examined almost daily to observe the activities of the beetles.

One cage (No. 1) containing C. solita and a cage (No. 4) containing C. heikertingeri were left undisturbed (except for watering the plants) for the remainder of the season.

On July 22 when very few adult beetles remained alive in the rearing cages, Nos. 2 and 5 were dismantled. Each cage component and host plant was carefully searched and all dead and live adults were removed. Both cages

were then reassembled and checked regularly for the emergence of new adults. Cages Nos. 2 and 5 were again dismantled on August 30 and September 2 respectively.

At various times during July and August, one of the potted willow plants was removed through the access port of a cage. The potted willow in cage No. 5 was removed on July 5 and a pot was removed alternately from Nos. 3 and 6 respectively on July 11, July 27, Aug. 4 and Aug. 12. In each case, the plant was immediately removed from the pot and the soil was washed from the roots in a basin of water. After the water surface in the basin had been carefully searched for floating larvae, the cleaned roots were examined for the presence of larvae with the aid of a dissecting microscope. Any roots found to contain larvae were removed and placed on moist filter paper in a petri dish so that the larvae could be maintained for a time while their habits were observed. The larvae were later preserved. The roots of the willows from cages Nos. 2 and 5 were washed and examined in a similar fashion when these cages were dismantled for the second time.

In another rearing attempt, adults of C. solita and C. heikertingeri were collected during June and in early July. These were maintained alive in the laboratory in transparent plastic bags containing a few fresh leaves of the appropriate host plant. Eggs deposited inside these bags were collected every second day and

placed on moist filter paper in 9 cm petri dishes. The eggs were incubated at about 22-24°C and were checked daily until hatching. When a number of these eggs hatched, some larvae were preserved. Others were placed in another petri dish lined with moist filter paper. Pieces of root taken from willow plants growing in a liquid nutrient medium were added and the petri dish was wrapped in aluminum foil to keep the inside humid and dark. The larvae were checked at least twice daily in order to observe their activities.

The pieces of roots initially offered were very thin (less than 1 mm in diameter) with hair-like branches. These were chosen with the idea that the larvae of Crepidodera species probably feed by chewing the smallest tender roots of their host plant. When larvae failed to feed on these roots and died within 1 to 3 days after hatching, subsequent larvae were offered tender new roots which were thicker, at least 1 mm in diameter. These were utilized.

Soon after hatching on June 28, 6 first instar larvae of C. heikertingeri were placed on the soil in a pot containing a growing Salix petiolaris. This plant was left undisturbed until Aug. 23 when the roots were washed and examined. Larvae attacked these roots as discussed in the Life History section of this species.

Electrophoresis

Approximately 960 flea beetles representing 5 species, Crepidodera solita n. sp., C. heikertingeri (Lazorko), C. decora n. sp., C. populivora n. sp. and C. violacea Melsheimer were collected near Ottawa in 1975 and 1976 for isozyme studies. Live adults contained in plastic bags were left for at least 12 hours without food. They were then sorted to species and sexed. Males and females of each species were frozen and stored separately at -90°C until they were to be examined.

Whole beetles were homogenized individually in 0.1 ml glass centrifuge tubes with 20 μl of cold homogenizing solution (10% sucrose and 0.002 M bromphenol blue in 0.1 M Tris-boric acid-EDTA buffer, pH 9.0). The homogenate was centrifuged at 11,600 g for 3 minutes at -4°C . The supernatant in each tube was drawn off for electrophoresis.

Polyacrylamide gel electrophoresis was carried out using equipment and techniques identical to those used by Laing et al. (1976). The homogenate obtained from each individual was injected into 1 of 12 pockets in a gel slab. Extracts of 12 specimens of a single species or of various combinations of 2 or 3 species were run simultaneously on each gel. After electrophoresis, each gel was stained for a particular enzyme.

Of 17 enzymes tested, 8 consistently produced readable zymograms. These were malate dehydrogenase

(MDH), malic enzyme (ME), alpha-glycerophosphate dehydrogenase (GPDH), phosphoglucomutase (PGM), esterase (EST), carbonic anhydrase (CA), peroxidase (PX) and indophenol oxidase (IPO). Staining techniques for MDH, ME, PGM, EST, CA and IPO were the same as those used by Laing, et al. (1976). The staining technique for GPDH was from Brewer (1970) and for PX, from Shaw and Prasad (1970).

SYSTEMATICS

Genus Crepidodera Chevrolat

Crepidodera, Chevrolat 1837, p. 415; 1844 p. 334; Stephens 1839, p. 294; Küster 1847-1848, VIII p. 94, IX p. 83-87, XV p. 91-93; Kutschera 1860, p. 68; *1864, p. 87; Allard 1860, p. 47; 1866a, p. 178; *1866b, p. 10; Thomson 1866, p. 215; Crotch 1873, p. 57, 71; Redtenbacher 1874, p. 496; Harold 1875, p. 3, 33; Chapuis 1875, p. 52, 53; Seidlitz 1875, p. 494; Leesberg 1881, p. 173; 1882, p. 137; Jacoby 1885, p. 342; 1891, p. 283; Horn 1889, p. 236, 238, 316; Fowler 1890, p. 334, 379; *Blackburn 1896, p. 41; Blatchley 1910, p. 1206, 1212; Duckett 1920, p. 116, 148; Leng 1920, p. 300 (in part); Maulik 1926, p. 175, 234 (genotype designation); Hincks 1952, p. 113, 114; Gressitt and Kimoto 1963, p. 744, 773; Hatch 1971, p. 219; Balsbaugh and Hays 1972, p. 123, 155; Samuelson 1973, p. 13, 112.

Chalcoides Foudras 1859 (1860), p. 147; 1860a, p. 56; 1860b, p. 35, 312; Weise 1886, p. 676, 713; *Seidlitz 1887-1891 (1891), p. 711; 1888-1891 (1891), p. 800; *Acloque 1896, p. 449; *Stierlin 1897, p. 595; Bedel 1889-1901 (1897), p. 168, 176; 1900, p. 289; *Lameere 1900, p. 451, 454; *Everts 1903, p. 462; 1922, p. 449; *Edwards 1909, p. 127-129; Heikertinger 1911, p. 8-11, 19; *1912a, p. 145, 155; *1912b, p. 103; 1924-1925, p. 43, 52, 67, 69; 1948-1950, p. 34, 106-116, 133, 135; *Kuhnt 1913, p.

*not listed in references. See Heikertinger and Csiki, 1939.

809, 864; Schaufuss 1907-1916 (1913), p. 981, 985;
 *Aurivillius 1917, p. 95; Leng 1920, p. 300; Schaeffer
 1924, p. 145; Chittenden 1925, p. 120; *Hansen 1927, p.
 169, 177; *Scheerpeltz 1930, p. XII, 231; *Joy 1932, p.
 406; Beller and Hatch 1932, p. 106, 128; Schaeffer 1932,
 p. 243; *Chen 1933, p. 219; *Portevin 1934, p. 268; *Porta
 1934, p. 324, 335; Rapp 1934, p. 395; Heikertinger and
 Csiki 1939, p. 313-325; Wilcox 1954, p. 436, 454; Dillon
 and Dillon 1961, p. 712; Chagnon et Robert 1962, p. 317;
 Mohr 1966, p. 247; Lazorko 1974, p. 146-154.
Foudrasia*des Grozis 1882, p. 134 (new name for
Chalcoides Foudras).

Type Species: Chrysomela nitidula L., designated by
 Maulik 1926, p. 234.

Diagnosis

The diagnostic generic characters of
Crepidodera are as follows: shape broadly oval and
 slightly elongate to elongate-oval, moderately convex;
 dorsum shining metallic with pronotum and elytra
 essentially unicolorous; pronotum generally strongly
 punctate and with a distinct prebasal transverse
 impression limited on each side by a sharp longitudinal
 impression extending from base; space between transverse
 groove and base not swollen, almost flat; elytra glabrous,
 regularly punctate-striate; procoxal cavities closed

behind; hind tarsi with apical segment not globular; tarsal claws appendiculate; head with frontal tubercles elongate, oblique, convex, sharply delimited dorsally by distinct furrows; surface between frontal tubercle and margin of eye conspicuously, moderately punctate.

This combination of characters distinguishes the genus from all other North American Alticinae.

Description

The North American species are of small size, ranging in length from 2.0 to 3.6 mm. The length is generally about twice the greatest width but varies among different species and, to some extent, within individual species from less than twice the width to slightly greater than twice the width. In all but one species, the head, pronotum and elytra are shining metallic, the colours ranging from black, purplish, dark green, dark blue, dark bronze to violet, coppery, coppery-bronze, bright green, blue-green or greenish with brassy, coppery or bronze reflections. The scutellum is piceous or black and the ventral surface shining black, occasionally with greenish reflections in the prosternum, metasternum and first abdominal sternum. Antennae and legs are generally rufotestaceous or light to medium reddish-brown in colour. The hind femora may be darker to piceous in some species. The exceptional species is longula Horn which is entirely light rufotestaceous to

light reddish brown except for a dark sutural stripe on the elytra. However, the sutural region of the elytra and usually the head and pronotum in this species do show a faint metallic greenish reflection.

The structural characters of the genus are as follows:

Body moderately convex both transversely and longitudinally.

Head (figs. 55-70) rounded, hypognathous, inserted to eyes in prothorax; eyes large, oval, bulging, widely separated by frons; vertex with a large seta-bearing fovea on each side near upper, inner margin of eye and several smaller setiferous punctures along furrows at upper margins of eyes and along two short vertical furrows mediad of large foveae; frontal tubercles approximately triangular to rectangular, elongate, dorso-laterally oblique, contiguous medially, each limited ventrally by a shallow furrow (not readily apparent when viewed with SEM) adjacent to upper margin of antennal socket and separated from vertex by a deep, distinct, oblique sulcus extending to upper margin of eye; surface between frontal tubercle and margin of eye conspicuously punctate; frontal carina narrow, distinctly raised; mandibles (figs. 71, 72) five-toothed, the third tooth the most elongate; maxillary palpi short, thin with apical segment elongate-conical; antennae about half as long as body, eleven-segmented with segments

generally in proportions seen in figs. 4 and 7.

Pronotum transverse, broadest at middle, length about two-thirds greatest width; apex truncate, not margined or very narrowly margined with marginal line generally feeble, occasionally obsolete; base distinctly margined, slightly sinuous with medial one-third bowed posteriorly; sides evenly rounded to slightly sinuous with apical two-thirds arcuate and basal one-third subparallel, strongly margined; lateral margins narrow to moderately broad with a smooth, fine raised edge; anterior angles obliquely truncate with inner edge rounded and outer corner obtuse to slightly acute, each angle with a fovea near outer corner bearing a long, fine seta; posterior angles right-angled to slightly acute, each with a setiferous fovea; pronotal disc conspicuously punctate and with a distinct median transverse impression about one-quarter of distance from base to apex; transverse groove almost straight to slightly arcuate posteriorly, limited on each side by a deep longitudinal impression extending to basal margin; surface between transverse groove and basal margin not swollen, almost flat; punctures of disc mainly of two distinct, intermixed sizes with major or larger punctures ranging from fine to coarse in size and smaller punctures in interspaces from minute to about one-half diameter of major punctures.

Scutellum small, semi-oval.

Elytra at base scarcely broader than base of pronotum; humeral umbone moderately prominent; disc with striae indicated by distinct regular rows (often slightly irregular in type species, *C. nitidula* (L.)) of coarse punctures; each elytron with a short scutellar row extending about one-third its length and nine discal rows, the first five from suture beginning at base, the last four beginning posterior to umbone and all extending to apex; discal rows of punctures occasionally slightly confused near apex or, in some species, slightly obsolete apically; interstices very finely punctulate (in type species, also with scattered coarse punctures as large as striae punctures and occasionally forming short rows); epipleuron (figs. 73-81) moderately broad near base, gradually narrowed apically.

Ventral surface as in figs. 73-123; prosternum approximately T-shaped, narrowed between fore coxae, abruptly broadened behind coxae, generally strongly punctate-setose, at least, near margins; anterior coxal cavities closed behind; mesosternum small, inflected anteriorly; metasternum broad, setose; first abdominal sternum medially longer than next three sterna combined, punctate-setose with pubescence often varying sexually and among different species; apex of pygidium visible posteriorly.

Legs of moderate length with hind femora moderately enlarged; first segment of fore tarsus with

very little sexual differentiation, scarcely broader in male than in female; tibiae each with a simple, short, sharp terminal spur on inner margin at apex; tarsal claws distinctly appendiculate, each with a large, sharp basal tooth.

MALE: Last abdominal sternum with apical margin emarginate and with an inflected, truncate median lobe; genitalia (figs. 131-146) consisting of a Y-shaped tegmen and an arcuate, tubular median lobe slightly depressed dorsoventrally.

FEMALE: Generally slightly larger than male; last abdominal sternum with apical margin rounded to almost truncate, without a median lobe; spermatheca (figs. 147-162) (terminology after Samuelson, 1973) with a hook-like tubular pump closed at distal end and opening into a larger cylindrical, oval or globular receptacle, a large sclerotized spermathecal duct containing a small nodiform gland valve opening into a membranous saccular spermathecal gland (not shown in figs., usually torn away in dissection) and with large spermathecal duct tapered distad of gland valve into a small non-sclerotized spermathecal duct.

Biology

• Members of the genus Crepidodera in both North America and the Palaearctic Region have been well known to feed as adults on the leaves of various species of willow (Salix), poplar (Populus) and, in North America, on certain members of the Family Rosaceae such as hawthorn (Crataegus), wild cherry, wild plum (Prunus spp.) and apple (Pyrus). Until now, the species of Crepidodera in the Palaearctic Region have been much better known than those in North America. Accordingly, the European literature contains earlier and more extensive information on the biology of this group. Early records of the food plants of some of the European species were provided by Ratzeburg (1837), Kaltenbach (1874) and Bargagli (1878). Later, Weise (1886) and Schaufuss (1913) listed the food plants of European species of Crepidodera and mentioned briefly the general habitat of a few of these species. Perhaps the best and most comprehensive source of information on the biology of the European species is Heikertinger (1925) who listed, for each of five species, the known food plants, the type of habitat in which it is found, the seasonal occurrence and, in a few cases, provided brief notes on adult feeding habits and time of oviposition. A similar brief treatment was provided by Rapp (1934) who listed, for each species of Crepidodera occurring in Thuringia, its food plants, type of habitat and seasonal occurrence. In his

revision of the Palaearctic species, Heikertinger (1948-1950) again presented briefly the food plants and seasonal occurrence for each species and gave the period of oviposition for two species, Crepidodera aurea Geoff.-Fourer and C. aurata Marsham. Recently, Allen (1972) discussed briefly the food plant preferences of the species of Crepidodera occurring in Britain.

In the North American literature, information on the biology of Crepidodera is mostly confined to brief mention of food plants at the generic level for known species or to lists of plants in collection records (e.g. Hatch, 1924, 1971; Beller and Hatch, 1932) for members of the genus in general. An exception to this was a report by Loan (1967a, 1967b) who made some general observations on the life history of adults of Crepidodera spp. and described the occurrence, in the adult beetles, of two parasites, a braconid wasp and a tachinid fly.

Until the present study, the immature stages of all species in the genus were unknown.

Host Plants

With one exception, all known species of Crepidodera are restricted to feeding as adults on members of the Family Salicaceae, the willows (Salix spp.) and poplars (Populus spp.). The exception is the North American species C. violacea Melsheimer which feeds on various plants of the Family Rosaceae, in

particular, the genera Crataegus L. and Prunus L.. None of the species of Crepidodera are definitely known to be monophagous, i.e. restricted to one species of plant. Most appear to be oligophagous, feeding on a few species of a single genus or, in some cases, on plants of two or three genera.

Most of the Palaearctic species are reported to feed on both Salix spp. and Populus spp. (Heikertinger, 1925, 1948-1950, Rapp, 1934). However, some species apparently exhibit a preference for one or the other of these two genera and seem to prefer certain species of Salix or Populus over others. As Allen (1972) mentioned, each species of Crepidodera seems to have a particular area of preference and no two are exactly alike. For example, the Palaearctic species C. aurata Marsham apparently habitually feeds on various species of both Salix and Populus. Others such as aurea Geoff.-Fourer and nitidula L. are reported to feed on both genera but lean heavily to Populus while plutus Latr. and fulvicornis F. seem to strongly favour Salix. One species, gemmata Ab. is reported only from a single species of Populus.

Some of these species are further restricted within a host genus to a single host or a "compact group of host species" (Allen, 1972). For example, C. plutus is restricted to narrow-leaved tree willows such as Salix alba and S. fragilis. In contrast, C. fulvicornis,

C. lamina Bedel and C. aurea (when it feeds on Salix) strongly favour low-growing shrubby broad-leaved willows (sallows) such as Salix caprea L.. The main species of Populus reported to be hosts of Palaearctic Crepidodera are P. alba L., P. nigra L. and P. tremula L.. Crepidodera aurata apparently occurs on all three of these (Heikertinger, 1925, 1948-1950) with no preference indicated. C. aurea, C. lamina and C. nitidula have been recorded from both P. tremula and P. nigra but are most common on P. tremula (Heikertinger, 1925). C. gemmata, however, is known to occur only on P. alba.

A similar situation seems to exist with regard to the host plant relationships of the North American species of Crepidodera. The known and probable host plants of the genus in North America are listed in Table 1. In addition, a list of host plant records for each species is given after the species description.

The North American species Crepidodera violacea Melsheimer is unique in being the only member of the genus known to have host plants other than the Salicaceae. This species, as mentioned previously, feeds on certain members of the Family Rosaceae (Tables 1, 2). Specimens have been recorded from the three genera, Crataegus L., Prunus L. and Pyrus L.. The species appears to be most common on Prunus spp., particularly P. americana, P. pensylvanica, P. serotina and P. virginiana. It occurs less frequently on Crataegus and very infrequently on

TABLE 1. Known and probable host plants of North American Crepidodera spp.
 (* indicates species records suspected to be adventitious)

Host Plant	Common Name	Form	Habitat	<u>Crepidodera</u> spp. Recorded
Family Rosaceae				
<u>Crataegus</u> L.	hawthorn	tree	disturbed sites, thickets along streams	* <u>nana</u> , * <u>populivora</u> , <u>violacea</u>
<u>Prunus americana</u> Marsh.	wild plum	shrub or small tree	moist woods, road- sides, fence-rows	* <u>browni</u> , * <u>nana</u> , <u>violacea</u>
<u>P. angustifolia</u> Marsh.	chickasaw plum	shrub or small tree	sandy or sterile soil, open woods, thickets, fence-rows	<u>violacea</u>
<u>P. pensylvanica</u> L.	pin-cherry	shrub or small tree	dry or moist woods and forest clearings	<u>violacea</u>
<u>P. persica</u> (L.) Patsch.	peach	small tree	introduced	* <u>browni</u> , * <u>nana</u> , <u>violacea</u>
<u>P. serotina</u> Ehrh.	wild cherry, black cherry	tree	roadsides, waste land, forest margins	* <u>browni</u> , <u>violacea</u>
<u>P. virginiana</u> L.	choke-cherry	tall shrub or small tree	rich moist soils, fence-rows, streams, forest margins	<u>violacea</u>

TABLE 1. (Cont'd)

Host Plant	Common Name	Form	Habitat	Crepidodera spp. Recorded
? <u>Pyrus L.</u>	apple	tree	in cultivation	<u>violacea</u>
Family Salicaceae				
<u>Populus balsamifera</u> <u>L. (P. tacamahacca</u> <u>Mill.)</u>	balsam poplar	tree	wet woods, river banks, lake shores	<u>*decora</u> , <u>*digna</u> , <u>*nana</u> , <u>populivora</u> , <u>*solita</u>
<u>P. deltoides Marsh.</u> <u>(P. virginiana</u> <u>Fourg.)</u>	eastern cotton- wood, Carolina poplar	tree	low woods and moist prairies	<u>*nana</u> , <u>*solita</u> , <u>vaga</u>
<u>P. grandidentata</u> <u>Michx.</u>	large-toothed aspen	tree	dry woods, slopes, recent burns	<u>populivora</u> , <u>*solita</u>
<u>P. tremuloides</u> <u>Michx.</u>	trembling aspen	tree	dry or moist soil, dry open woods, recent burns	<u>*decora</u> , <u>*digna</u> , <u>*heikertingeri</u> , <u>populivora</u> , <u>*solita</u> , <u>*spenceri</u>
<u>P. trichocarpa</u> <u>Torr. & Gray</u>	black cotton- wood, western balsam poplar	tree	low-lying damp areas, sandy or gravelly soils	<u>*heikertingeri</u> , <u>populivora</u>

TABLE 1. (Cont'd)

Host Plant	Common Name	Form	Habitat	Crepidodera spp. Recorded
<u>Salix alba</u> L.	white willow	tree	introduced, escaped along rivers	<u>solita</u>
<u>S. alba x fragilis</u> (hybrid)		tree	low areas, river banks	<u>decora</u> , <u>heikertingeri</u> , <u>solita</u>
<u>S. bebbiana</u> Sarg.	beaked willow	shrub or small tree	moist or wet places	<u>decora</u> , <u>heikertingeri</u>
<u>S. cordata</u> Michx.	heart-leaved willow	shrub	sandy and alluvial shores	<u>sculpturata</u> , <u>solita</u>
<u>S. discolor</u> Muhl.	pussy-willow	few-stem- med shrub or small tree	swamps and wet ground	<u>decora</u> , <u>heikertingeri</u> , <u>*populivora</u> , <u>solita</u>
<u>S. exigua</u> Nutt.	sandbar willow, slender willow	shrub or small tree	sandbars, streambanks	<u>nana</u> , <u>sculpturata</u>
<u>S. fragilis</u> L.	crack-willow	tree	introduced, escaped in low areas, along river banks, lake shores	<u>browni</u> , <u>decora</u> , <u>heikertingeri</u> , <u>nana</u> , <u>*populivora</u> , <u>solita</u>

TABLE 1. (Cont'd)

<u>Host Plant</u>	<u>Common Name</u>	<u>Form</u>	<u>Habitat</u>	<u>Crepidodera spp.</u> <u>Recorded</u>
<u>S. humilis</u> Marsh. (<u>S. tristis</u> Ait.)	upland willow	low, many-stemmed shrub	dry, often sandy uplands, roadsides	<u>nana</u>
<u>S. interior</u> Rowlee	sandbar willow	many-stemmed shrub	sandbars, mudbars, moist alluvial soil	<u>nana</u> , <u>solita</u>
<u>S. lasiolepis</u> Benth.	arroyo willow	shrub or small tree	along rocky streams at lower elevations (s. B.C. to Baja Calif.) and arroyos	<u>aereola</u>
<u>S. lucida</u> Muhl.	shining willow	shrub or small tree	moist low ground, swamps, bogs, wet meadows	<u>decora</u> , <u>digna</u> , <u>heikertingeri</u> , <u>nana</u> , <u>*populivora</u>
<u>S. melanopsis</u> Nutt.	dusky willow	shrub or small tree	stream banks	<u>sculpturata</u>
<u>S. nigra</u> Marsh.	black willow	shrub or tree (when fully developed)	alluvial soils along streams, and in meadows	<u>nana</u> , <u>solita</u>
<u>S. patula</u>				<u>nana</u>

TABLE 1. (Cont'd)

Host Plant	Common Name	Form	Habitat	Crepidodera spp. Recorded
<u>S. petiolaris</u> Smith (<u>S. gracilis</u> Anderss.)	slender willow	clumpy shrub to few-stem- med tree	moist meadows, stream- banks, lake shores, bogs	<u>decora</u> , <u>digna</u> , <u>heikertingeri</u> , <u>nana</u> , * <u>populivora</u> , <u>sculpturata</u> , <u>solita</u>
<u>S. purpurea</u> L.	basket-willow, purple osier	many-stem- med shrub	introduced, escaped along river banks, lake shores, roadsides	<u>nana</u>
<u>S. pyrifolia</u> Anderss.	balsam willow	shrub	moist to wet or swampy ground, bogs	<u>digna</u>
<u>S. repens</u> L.	creeping or silver willow	shrub	introduced from Europe (arboretum)	<u>nana</u>
<u>S. sericea</u> Marsh.	silky willow	shrub or small tree	moist rocky ground, often near running water	<u>nana</u>

Pyrus.

A few of the other North American species have also been recorded from these plants. Eleven specimens of Crepidodera populivora and one specimen of C. nana have been recorded from Crataegus and ten specimens of nana and seven of C. browni have been recorded from Prunus spp.. Because of these low numbers and the fact that these species of Crepidodera occur predominantly on Populus or Salix, I suspect that these records are accidental.

On the basis of specimen records and field studies conducted by the author, it seems that most of the North American species, other than violacea, show a definite preference for a single genus, either Salix or Populus and some favour only certain species within these genera.

At least one-half of the North American species appear to be restricted entirely to Salix spp.. These include longula, spenceri, browni, opulenta, luminosa, bella, aereola and sculpturata. Three of these are recorded only from Salix and the remainder each have only a few other host records which are either so unlikely or so few as to be almost certainly adventitious.

Two species may be either restricted to or mainly confined to Populus spp.. Crepidodera vaga is known only from Populus deltoides. However, this record comes only from a single series of specimens taken in

the same locality on the same date. The usual and most common species found on Populus is C. populivora. The majority (76%) of the host plant records of this species are Populus spp.. However, 18% of the records are from Salix spp.. Therefore, it is possible that populivora utilizes both Populus and Salix although strongly preferring Populus. In field studies, however, populivora was rarely found on Salix, even in habitats where it was abundant on Populus, and seemed to be restricted to the latter group of plants.

Five species (solita, decora, heikertingeri, digna and nana) have been taken in considerable numbers on both Salix and Populus. However, in all of these, 90% or more of the host records are Salix spp.. Therefore, if they do feed on both genera of plants, they all show a very strong preference for Salix spp.. In field studies, solita, decora and heikertingeri were collected very infrequently on Populus and C. digna was taken a little more frequently on this genus. Only one of these species, solita, was actually observed to feed on leaves of Populus. This occurred in the laboratory. As yet, no species of Crepidodera in North America is known definitely to utilize both Salix and Populus as hosts.

On the basis of host plant records and field studies, individual North American species feeding on Salix spp. also appear to have some preference for certain kinds or groups of willows. For example,

Crepidodera solita has been taken predominantly from narrow-leaved tree-willows such as Salix alba, S. fragilis, the hybrid S. alba x fragilis and S. nigra which occur mainly along the banks of rivers and streams. In the Ottawa area, solita is very abundant on Salix alba x fragilis and much less common on shrubby willows such as S. petiolaris and S. discolor which occur mainly in swamps or wet meadows and ditches. This species has also been successfully reared on S. alba x fragilis in the laboratory. Crepidodera browni may also favour tree species since its only specific record from Salix is S. fragilis. However, this record comes solely from a small series of specimens from a single locality. The remaining Salix-feeding species seem to occur predominantly on shrubby willows. However, some of these appear to have even narrower host or habitat preferences. Crepidodera decora, for example, has been found to be most common on the broad-leaved shrubs, S. discolor and S. bebbiana, growing in swamps and wet meadows. It also occurs frequently on the narrow-leaved S. petiolaris in the same habitat. In contrast, C. heikertingeri is most abundant on S. petiolaris on which it has also been successfully reared in the laboratory. This beetle species also occurs frequently on S. discolor and S. bebbiana. Similarly, C. digna appears to be most common on S. petiolaris in swamps and bogs although it also occurs on the broad-leaved species, S. pyrifolia and S.

lucida, in the same type of habitat. Crepidodera sculpturata also seems to favour narrow-leaved shrubby Salix spp.. In Ontario, it has been recorded mainly from S. petiolaris. In British Columbia and Utah, it is found on the narrow-leaved species, S. exigua and S. melanopsis respectively, which occur on sandbars and streambanks. A few specimens of sculpturata have been recorded in Ontario from S. cordata, a broad-leaved shrub which also grows on sandy or alluvial shores. Crepidodera luminosa apparently occurs on small willows on beaches or along creeks. The only specific host record for C. aereola is Salix lasiolepis, a shrubby species which occurs along rocky streams and arroyos in western North America.

Crepidodera nana may have a much broader range of Salix hosts than the above species. Records indicate that this species occurs on narrow-leaved tree-willows such as S. fragilis and S. nigra and also on shrubs. The majority of shrubby willows recorded are the narrow-leaved species, S. exigua, S. interior, S. petiolaris, S. purpurea and S. sericea. Most of these Salix species occur along streams or rivers. A few specimens of C. nana have been recorded also from the broad-leaved species, S. humilis and S. lucida.

Although Crepidodera populivora is found on three species of Populus, it appears to be most common on Populus tremuloides.

It can be seen from the above discussion that it is difficult to determine from specimen records alone exactly how restricted species of Crepidodera are with regard to their host plants. This can only be determined by extensive field studies and rearing experiments. This has been done to some extent for a few species, including C. solita, and C. heikertingeri. In the field, it is usually difficult to observe actual feeding by these flea beetles. Because of their small size, they are often difficult to find on the host plants except by beating. It is possible that adults may have less restricted feeding preferences than the larvae. However, this can only be determined in rearing experiments.

It is difficult to evaluate many of the individual specimen host records, especially those giving unusual or unlikely host plants. The small size of these insects, their generally great abundance, relatively high level of activity and good flying ability make them amenable to dispersal, particularly by strong winds, to many different plants surrounding their normal host plant. The fact that several species of Salix often occur together in a habitat and that Salix and Populus are usually in the same general area also serves to complicate the matter.

Life History

Species of Crepidodera overwinter as adults, generally in the surface litter below their host plants (Loan, 1967b). North American specimens have been recorded during winter months in different parts of the range from leaves, grasses, rotting wood, and "trash". A number of adults of 3 different species have been found overwintering in the lichen, Usnea plicata (Old Man's Beard), growing on oak trees in Oregon.

Overwintered adults emerge early in the season and are found on their host plants soon after the leaves appear. At this time, if warm temperatures prevail, the flea beetles are quite active and abundant. They begin feeding on the leaves of the host and, shortly after, commence mating.

The adults feed on either the upper or lower surfaces of leaves. Feeding damage is of a type typical of flea beetles in general. The beetles produce small holes or pits in the leaf by eating through the epidermis and underlying tissues, leaving the opposite epidermal layer intact. The tissue below the injury eventually dries up and falls out, giving a shot-hole appearance (fig. 130). The pits are irregular in outline and range from about 1 to 3 mm in diameter. Occasionally, larger pits run together to form larger areas of damage.

Mating occurs during a period of close to 2 months, generally including, in the Ottawa area, the latter

half of May, all of June and the early part of July. Copulation takes place usually on the leaves or branches of the host shrubs or trees. The male mounts the female from the rear and, clinging to her posterior dorsum, extends the curved aedeagus down and forward into the female's vagina at the tip of the abdomen.

Loan (1967b) reported that females of Crepidodera collected on Salix near Belleville, Ontario were nongravid in early May and that nearly all females were gravid by mid-June. He also found that the proportion of gravid females decreased from early July to about mid August as old females died from senescence or parasitism and new ones emerged from the soil. In the present study, eggs were produced in the laboratory by field-collected females of C. heikertingeri (Lazorko) from late May until Aug. 25.

Oviposition has not been observed in Crepidodera but it seems probable that eggs are placed in the soil or litter beneath the host plant. During the present study, live females of several species were observed to extrude their ovipositors when anaesthetized with carbon dioxide. When extruded, the ovipositor was from one-third to one-half the length of the abdomen, indicating that eggs may easily be deposited in small cracks or crevices in the soil.

Immature stages of Crepidodera are known only for 2 species, C. solita n. sp. and C. heikertingeri

(Lazorko). These immatures are described for the first time in the present paper. Detailed descriptions of the stages (when found) and their habits are provided in the species descriptions.

Eggs of the two species observed had an incubation period ranging from 10 to 16 days in the laboratory at 22-24°C. The first instar larva emerges through a slit across the apex of the egg.

The larvae resemble the root-feeding larvae of other genera such as Epitrix Foudras and Phyllotreta Stephens. They are long, slender and subcylindrical in shape and whitish in colour except for the head, prothorax and 9th abdominal tergum (anal plate) which are brown. There are 3 larval instars, all of which occur below the soil surface. At least the first and second instar larvae feed by mining inside the smallest tender roots of the host plant. Mines extend along the roots beneath the epidermis and the larvae consume the tissues of the cortex and the soft tissues surrounding the vascular bundle. This is the first record of root-mining, particularly of woody plants, in the Alticinae. Larvae of other genera of flea beetles also feed on the roots of their host (usually an herbaceous plant), but in a different manner. For example, the larvae of Hornaltica atriventris (Melsh.) occur in the soil around the plant roots and feed on the small rootlets, often cutting them off (Balduf, 1926). Similarly, the larvae of some species

of Phyllotreta feed on the root hairs or small tap roots of plants, occasionally tunnelling into the stem near the juncture of stem and roots (Chittenden and Marsh, 1920; Westdal and Romanow, 1972). Epitrix cucumeris (Harris), a member of a genus closely related to Crepidodera, feeds during the larval stages on potatoes, making surface tracks or tunnels in the tubers (Jones, 1944). Full grown larvae of this species have been found feeding with the head in the potato tuber and the rest of the body supported by the soil (Anderson and Walker, 1934). This type of feeding does not seem to occur in Crepidodera. Since exuviae are found inside mines, it appears likely that larvae remain inside the roots, perhaps occasionally leaving an old mine to start a new one in another root. The mining behavior may be an adaptation to avoid the wet soil conditions in which the host willows grow and which are often prevalent well into the summer. It is probable that mature third instar larvae leave the mines to pupate in the soil.

The durations of each larval instar and the pupal stage are not known. In laboratory rearing of 2 species, the first new adults emerged within 48 to 50 days (7 weeks) after old adults had been confined in cages. Allowing for the incubation time of eggs, the larval and pupal stages require, perhaps, 32 to 40 days for development. The above time periods are very similar to the development times observed in species of

other flea beetle genera by Chittenden and Marsh (1920), Jones (1944) and Westdal and Romanow (1972).

There is only one generation per year in Ontario. New-generation adults have been found near the beginning of August in both laboratory rearing (present study) and in the field (Loan, 1967b). The population of new adults increases during August and remains on the host plants until the onset of cold weather or until the leaves have fallen in late October.

Natural Enemies

There are no references to natural enemies of the Palaearctic species but the adults of North American species of Crepidodera are known to be parasitized by a braconid wasp and a tachinid fly (Loan, 1967a, b).

Loan (1967a) described a parasite, Microctonus crepidoderae (Hymenoptera : Braconidae) reared from adult Crepidodera spp. occurring on Salix, Populus and Prunus virginiana L.. In a subsequent paper (1967b), he discussed the biology of Microctonus crepidoderae and also reported on parasitism of Crepidodera by the tachinid, Velocia sp.

In dissections of many adult female Crepidodera collected throughout a single season near Belleville, Ontario, Loan (1967b) found Velocia sp. in different stages, including egg, first instar, second instar and third instar larva and Microctonus crepidoderae as egg,

first instar, second to third, and fourth to fifth instar larva. He found the incidence of Velocia sp. to be higher than that of Microctonus crepidoderae during the period of collection. The incidence of the two parasite species together was higher in late summer on new-generation flea beetles (28%) than on overwintered specimens collected in June (10%) and July (12%). In another season, the incidence of the parasites in early May in overwintered Crepidodera on Salix was 19% (11 Velocia third instar larvae and 8 Microctonus first instar larvae per 100 beetles). At another locality, Fuller, Ontario, 2% of overwintered flea beetles on Salix were parasitized by first instar larvae of Microctonus while 18% of Crepidodera violacea Melsh. on Prunus virginiana were parasitized by first to third instar larvae of Microctonus.

According to Loan (1967b), Microctonus crepidoderae overwinters as a first instar larva and the Velocia species as an immature or mature larva. The tachinid fly (Velocia sp.) apparently attaches its eggs to the underside of the apex of either elytron of the host. From there, the first instar larva penetrates the integument by means of sharp buccal hooks and develops in the haemocoel of the beetle. Loan (1967b) reported that Velocia sp. superparasitized some of the flea beetles in which it was found but that only one larva successfully completed development in each host.

The oviposition behavior of Microctonus crepidoderae, as discussed by Loan (1967b), is different from that of other Microctonus spp. which trail their host beetle and strike with their ovipositor at its head or abdomen. The female of M. crepidoderae leaps onto the back of the flea beetle and simultaneously strikes at the tip of the host's abdomen.

Key to the United States and Canadian Species of
Crepidodera Chevrolat

1. Colour entirely reddish-yellow to light reddish-brown except sutural region of elytra darker and with a faint greenish reflection as in head and pronotum; east-central United States; on Salix.

..... 1. longula Horn

Colour of dorsal surface metallic green, brassy-green, coppery, bronze, blue, violet, purplish, black or a combination of some of these colours; ventral surface black. 2.

2. Dorsal surface violet or dark purple, dark blue, blue-green, greenish, all with violet reflections; pronotal ante-basal transverse impression shallow, feebly pronounced; pronotal disc with major punctures fine to moderate in size; eastern United States and Canada; on Prunus or Crataegus.

..... 2. violacea Melsheimer

Dorsal surface not violet and without violet reflections; pronotal ante-basal transverse impression deeper, strongly pronounced; pronotal disc with major punctures moderate to coarse in size. 3.

3. Elytral disc strongly, distinctly depressed behind basal one-quarter; vertex of head along anterior edge of pronotum strongly, distinctly punctate; southeastern United States; on Salix.

. 13. bella n. sp.

Elytral disc at most only feebly depressed behind basal one-quarter; vertex of head along anterior edge of pronotum smooth, occasionally with a few scattered fine punctures. 4.

4. Elytron at declivity bulging laterally, overhanging and hiding part of lateral margin (figs. 17, 19); dorsal surface metallic green, brassy-green, coppery-green, pure coppery, coppery-bronze or dark bronze; southern Ontario and eastern United States; on Salix. 6. browni n. sp.

Elytron at declivity evenly rounded, not overhanging lateral margin or, if slightly bulging, dorsal surface not coloured as above or range differing from above. 5.

5. Median setae of first abdominal sternum in both sexes short, sparse and inconspicuous; major punctures of pronotum dense, very uniformly distributed, moderate to slightly coarse in size; elytral margins very narrow in dorsal view; dorsal surface black;

California to British Columbia, Montana and Utah.

. 3. spenceri (Lazorko)

Median setae of first abdominal sternum in males longer and more conspicuous than in females or, in females, usually moderately dense; major punctures of pronotum sparse to dense, irregularly distributed, moderate to very coarse in size; elytral margins narrow or relatively broad in dorsal view; colour of dorsal surface variable. 6.

6. Major pronotal punctures very coarse, equal to or greater than size of basal serial punctures of elytra, closely placed; anterior pronotal angles strongly, acutely produced laterally; median setae of first abdominal sternum in males uniformly dense, not forming a brush; California to Washington, Wyoming and Utah. 14. aereola (LeConte)

Major pronotal punctures moderate to coarse, less or not greater than size of basal serial punctures of elytra, sparse to closely placed; anterior pronotal angles feebly produced; median setae of first abdominal sternum in males variable, uniformly dense or denser apically forming a brush. . . . 7.

7. Middle and hind trochanters each with a distinct posterior marginal brush of setae; metasternum

medially almost entirely covered with setae almost as long and conspicuous as those of first abdominal sternum which is, especially in males, conspicuously hirsute from base to apex; dorsal surface dark bronze, dark greenish, purplish or black. 8.

Middle and hind trochanters with a few inconspicuous setae as in adjacent parts of femora; metasternum inconspicuously to conspicuously setose medially but glabrous near midline in posterior two-thirds. 9.

8. Elytral margins strongly broadened in dorsal view; male with median setae of first abdominal sternum slightly denser apically, forming a loose, poorly-defined brush; major pronotal punctures dense, coarse in size; dorsal surface dark bronze, purplish or greenish. 10. heikertingeri (Lazorko)

Elytral margins moderately broad in dorsal view; male with median setae of first abdominal sternum not forming a brush; major pronotal punctures sparse, moderate in size; dorsal surface black.

. 11. digna n. sp.

9. Apical margin of last abdominal sternum emarginate, with an inflected median lobe. (males) 10.

Apical margin of last abdominal sternum rounded or almost truncate, without a median lobe. (females) 20.

MALES

10. Median pubescence of first abdominal sternum not or barely denser apically, not forming a brush. . 11.

Median pubescence of first abdominal sternum denser apically forming a distinct brush near hind margin.

. 13.

11. Shape oval, slightly elongate; dorsum dark purple to black, rarely blue or blue-green; on Populus.

. 12. populivora n. sp.

Shape elongate; dorsum bright green, blue-green, brassy-green, coppery-green, pure coppery to dark bronze; on Salix. 12.

12. Pronotum appearing strongly convex or slightly swollen anteriorly; elytral margins narrow in dorsal view; median lobe of genitalia evenly arcuate in lateral view (fig. 145).

. 15. sculpturata (Lazorko)

Pronotum moderately convex, not appearing swollen anteriorly; elytral margins narrow to moderately

broad in dorsal view; median lobe of genitalia in lateral view, bent at basal one-third, straight in apical two-thirds (fig. 146). . . . 16. nana (Say)

13. Colour of dorsum dark bronze or coppery bronze to purplish. 14.

Colour of dorsum bright green, blue-green, brassy-green, bronze-green or coppery-green. 17.

14. Elytral margins moderately to strongly broadened in dorsal view; brush of setae on first abdominal sternum very distinct, well-defined.

. 4. solita n. sp.

- Elytral margins narrow in dorsal view; brush of setae on first abdominal sternum distinct, well-defined or poorly developed to obsolete. . . . 15.

15. Median lobe of genitalia, in lateral view, bent at basal one-third, straight in apical two-thirds (fig. 146). 16. nana (Say)

Median lobe of genitalia, in lateral view, evenly arcuate. 16.

16. Median lobe of genitalia, in dorsal view, strongly narrowed in apical one-third (fig. 139).

. 9. vaga n. sp.

Median lobe of genitalia, in dorsal view, of almost even thickness or only slightly tapered in apical two-thirds (fig. 137). . . . 7. opulenta (LeConte)

17. Median lobe of genitalia, in lateral view, bent at basal one-third, straight in apical two-thirds (fig. 146). 16. nana (Say)

Median lobe of genitalia, in lateral view, evenly arcuate. 18.

18. Range in southwestern United States; elytral margins narrow in dorsal view.

. 7. opulenta (LeConte)

Range in eastern United States and Canada; elytral margins narrow to moderately broad in dorsal view.

. 19.

19. Elytral margins moderately broad in dorsal view; major pronotal punctures sparse to moderately dense; ventral side of median lobe of genitalia without distinct longitudinal impressions at middle.

. 5. decora n. sp.

Elytral margins relatively narrow in dorsal view; major pronotal punctures dense; ventral side of median lobe of genitalia with a distinct longitudinal impression on each side at middle.

. 8. luminosa n. sp.

FEMALES

20. Dorsal surface dark bronze, coppery-bronze, dark blue, dark purple to black. 21.

Dorsal surface green, blue-green, brassy-green, bronze-green or coppery-green. 25.

21. Elytral margins moderately to strongly broadened in dorsal view; first abdominal sternum with a median patch of very crowded setiferous punctures near hind margin. 4. solita n. sp.

Elytral margins narrow in dorsal view; first abdominal sternum with setiferous punctures uniformly placed or only slightly crowded medially near hind margin. 22.

22. First abdominal sternum with setiferous punctures uniformly distributed medially, not more crowded near hind margin; shape more broadly oval; dorsal surface dark purple to black; on Populus spp. 12. populivora n. sp.

First abdominal sternum with a median patch of slightly crowded punctures near hind margin; shape elongate-oval. 23.

23. Range in Arizona, California and Utah.

..... 7. opulenta LeConte

Range other than above. 24.

24. Spermatheca with receptacle oval in shape (fig.

155). 9. vaga n. sp.

Spermatheca with receptacle globular (fig. 162).

..... 16. nana (Say)

25. Elytral margins moderately broad in dorsal view.

..... 26.

Elytral margins narrow in dorsal view. 28.

26. Elytral margin at declivity strongly rounded to apex; dorsal surface green to blue-green.

..... 5. decora n. sp.

Elytral margin at declivity more gradually rounded to apex. 27.

27. Spermatheca (fig. 154) with receptacle elongate-oval in shape. 8. luminosa n. sp.

Spermatheca (fig. 162) with receptacle globular in shape. 16. nana (Say)

28. Pronotum appearing slightly swollen or more convex anteriorly; shape more elongate.

. 15. sculpturata (Lazorko)

Pronotum not swollen or more convex anteriorly; shape elongate-oval. 29.

29. Range east of Great Lakes and Mississippi River.

. 8. luminosa n. sp.

Range west of Great Lakes and Mississippi River.

. 30.

30. Range in Arizona, California and Utah.

. 7. opulenta (LeConte)

Range east and north of above. . . 16. nana (Say)

1. Crepidodera longula Horn

Figs. 1-3, 55, 73-75, 131, 147; Map 1.

Crepidodera longula Horn 1889, p. 240, 316 (type locality, near McPherson, Kansas); Henshaw 1895, p. 28; Blatchley 1910, p. 1213; Leng 1920, p. 300; Heikertinger 1924-1925, p. 65; Douglass 1929, p. 31; Balsbaugh and Hays 1972, p. 156.
Chalcoides longula (Horn); Schaeffer 1932, p. 243; Heikertinger and Csiki 1939, p. 324; Heikertinger 1948-1950, p. 115, 136; Wilcox 1954, p. 455; Lazorko 1974, p. 146, 152, 153.

Diagnosis

The distinctive reddish-yellow to reddish-brown colour of this species serves to separate it from all other North American species. Also, the setae on the first abdominal sternum of the male are short and inconspicuous as in the female.

Description

MALES: Length 2.4 to 2.7 mm, greatest width 1.2 to 1.5 mm. Shape (fig. 1) elongate-oval; length slightly less to slightly greater than twice the width. Dorsum shining; sutural region of elytra and usually head and pronotum with greenish reflection, remainder entirely light rufotestaceous to light reddish-brown except for a dark, occasionally indefinite, sutural

stripe on elytra. Sutural stripe extending laterally near base to first or second discal stria, tapering apically until, in apical one-third of elytron, only very narrow along sutural margin.

Vertex of head (figs. 2, 55) along anterior edge of pronotum smooth, very finely punctulate.

Pronotum (fig. 2) with sides evenly, feebly arcuate; anterior angles feebly produced, truncation slightly less than length of second antennal segment. Ante-basal transverse groove deep, strongly pronounced. Major punctures of pronotal disc generally sparse, irregularly distributed; size fine to moderate, generally much smaller than basal serial punctures of elytra; punctures in interspaces minute, much smaller than major punctures. Elytron (fig. 3) at declivity evenly rounded; disc in basal one-half almost evenly convex. Lateral margins of elytra very narrow in dorsal view, visible for entire length. Elytral striae strongly, distinctly punctate from base to apex. Metasternum medially very sparsely, inconspicuously setose except glabrous near midline in posterior two-thirds. First abdominal sternum (fig. 74) medially with sparse, short, inconspicuous semi-recumbent setae. Middle and hind trochanters with a few inconspicuous setae as in adjacent parts of femora.

Median lobe of genitalia (fig. 131) about 0.8 mm long, evenly arcuate from base to apex; in dorsal view, slightly tapered apically; tip rounded. Ventral

side without conspicuous sculpture.

FEMALES: Length 2.5 to 3.2 mm, greatest width 1.2 to 1.5 mm. Similar to males except for sexual differences at apex of abdomen (fig. 75). Spermatheca (fig. 147) about 0.20 mm long.

Type Material

LECTOTYPE: here designated, male, with labels "Ks"/"Lectotype 3836"/"Lectotype, Crepidodera longula Horn, ♂, R.H. Parry, 1976". This specimen is in the Horn Collection, Museum of Comparative Zoology, Harvard University. The lectotype is accompanied by one female and two male specimens, each with the label "Ks" and a blue "Paratype" label with the numbers 3836.2, 3836.3 and 3836.4 respectively. Paratype 3836.4 has the head missing.

In addition, the LeConte Collection, M.C.Z., contains a single specimen of this species labelled "Ks". This probably belongs to the type series.

Distribution

Crepidodera longula occurs in the east-central United States from southern Ohio and Alabama west to Kansas and eastern Texas (map 1). In addition to the records cited below, this species has been recorded from southern Indiana (Blatchley, 1910), southern Ohio (Wilcox, 1954) and north-western Alabama (Balsbaugh and Hays, 1972).

Material examined: 35 specimens.

UNITED STATES: Illinois: state records only (CNC) 2 males; Eldorado, May, on locust (USNM) 1 male; Seymour (CNC, CU) 3 males. Indiana: Tippecanoe Co., June (CSCA) 1 male, 1 female. Kansas: state records only (Horn Collection, MCZ) 3 males, 1 female (lectotype and cotypes); Ft. Scott, May (USNM) 1 male; Salina (CNC) 2 males, 2 females. Kentucky: Henderson, Feb. (CNC) 1 male. Missouri: state record only (CNC) 1 female; Williamsville, Oct.-Nov., malaise trap (CNC) 1 male. Texas: Dolores (Bowditch Collection, MCZ) 1 male, 2 females; Nacogdoches, May, on Salix (HAHC, RHP) 6 males, 6 females.

Host Plant: Salix sp.

According to Horn (1889), the type series was collected from willows. I have collected a small series of Crepidodera longula from Salix sp. near Nacogdoches, Texas by beating.

Life History: Immature stages unknown.

Adults are apparently most abundant in May and June.

Remarks

Variation in the specimens examined is slight. The size and spacing of the larger pronotal punctures

varies among specimens, some having them rather small and sparse and others having coarser, more closely placed punctures, giving the disc a slight rugose appearance.

Genitalia were extracted from 8 male specimens. The median lobe in specimens from Texas is slightly more narrowly rounded at the tip than in fig. 131.

The spermatheca was dissected from 1 female specimen.

2. Crepidodera violacea Melsheimer

Figs. 4-6, 56, 76-78, 132, 148; Map 2.

Crepidodera violacea Melsheimer 1847, p. 164 (type locality, Pennsylvania); Balsbaugh and Hays 1972, p. 155.

Crepidodera helxines (L.); Crotch (misidentification) 1873, p. 71 (in part); Hamilton 1889, p. 149; Horn 1889, p. 316; Hamilton 1894, p. 399; Duckett 1920, p. 149.

Chalcoides helxines (L.); Leng (misidentification) 1920, p. 300 (in part); Beller and Hatch 1932, p. 128, 129 (ab. violacea).

Chalcoides helxines violacea (Melsh.); Schaeffer 1924, p. 145.

Chalcoides fulvicornis violacea (Melsh.); Chittenden 1925, p. 120.

Chalcoides fulvicornis (Fabr.); Heikertinger and Csiki (misidentification) 1939, p. 320 (ab. violacea Melsh.), (in part).

Chalcoides violacea (Melsh.); Heikertinger 1948-1950, p. 110 (fig.), 116, 136; Wilcox 1954, p. 455; Lazorko 1974, p. 146, 150, 152, 153.

Crepidodera nana (Say); Hatch 1971, p. 219 (ab. violacea Melsh.), (in part).

Diagnosis

This species can be distinguished from all the other North American species by the violet to dark blue colour of the dorsal surface, the generally fine puncta-

tion on the pronotum and the feebly impressed pronotal transverse groove which is less strongly pronounced than in any other species. Also, the setae of the first abdominal sternum in the male are short and inconspicuous as in the female.

Description

MALES: Length 2.0 to 3.0 mm, greatest width 1.1 to 1.6 mm. Shape (fig. 4) broadly oval, slightly elongate; length less or not greater than twice the width. Dorsum shining, metallic; vertex of head, pronotum and elytra entirely bright violet to dark purple, dark blue or blue-green with violet reflections, rarely entirely dark green, occasionally differing from each other in shade; head, except vertex and median region of frons, blue, blue-green or green; scutellum black. Antennae and legs, except hind femora, testaceous or rufotestaceous to medium reddish-brown; hind femora and, occasionally, hind tibiae dark reddish-brown to piceous. Ventral surface piceous to shining black; apex of last abdominal sternum slightly paler.

Vertex of head (figs. 5, 56) along anterior edge of pronotum smooth, very finely punctulate or, occasionally, with a few scattered fine punctures. Pronotum (fig. 5) with sides evenly, moderately to strongly arcuate; anterior angles feebly produced, truncation slightly less to scarcely greater than length of

second antennal segment. Ante-basal transverse groove shallow, feebly to moderately pronounced. Major punctures of pronotal disc somewhat sparse to moderately dense, irregularly distributed; size fine to moderate, generally smaller than basal serial punctures of elytra; punctures in interspaces minute, much smaller than major punctures. Elytron (fig. 6) at declivity slightly bulging laterally to overhang margin or, occasionally, evenly rounded; disc in basal one-half almost evenly convex. Lateral margins of elytra very narrow in dorsal view, visible for entire length or partially hidden by bulge at declivity. Elytral striae moderately to strongly, distinctly punctate, occasionally somewhat obsolete near apices. Metasternum medially sparsely, inconspicuously setose except glabrous near midline in posterior two-thirds. First abdominal sternum (fig. 77) medially with short, inconspicuous, semi-recumbent setae. Middle and hind trochanters with a few inconspicuous setae as in adjacent parts of femora.

Median lobe of genitalia (fig. 132) 0.8 to 0.9 mm long, evenly arcuate except slightly recurved at apex; in dorsal view, gradually tapered from base to slightly beyond middle, then broadened to apex; tip broadly rounded. Ventral side without conspicuous sculpture.

FEMALES: Length 2.3 to 3.3 mm, greatest width 1.2 to 1.8 mm. Similar to males except for sexual differences at apex of abdomen (fig. 78). Spermatheca (fig.

148) about 0.20 mm long.

Type Material

LECTOTYPE: here designated, male, with the labels "Pennsylvania, Melsheimer"/"Lectotype, Crepidodera violacea Melsh., ♂, R.H. Parry, 1976". This specimen is in the Melsheimer-Ziegler Collection, Museum of Comparative Zoology, Harvard University.

The lectotype is the tenth in a series of 12 specimens. The first specimen in the series, a female, has a piece of red paper on the pin but bears only the label "Melsh.". Therefore, it seems appropriate to select as lectotype the above male with a label denoting the type locality. The lectotype fits Melsheimer's description except that the antennae, palpi and tarsi are rufotestaceous rather than yellow-testaceous, the sides of the pronotum are moderately rounded rather than feebly rounded, and the length is 2.6 mm rather than 1 l. Another female specimen, besides the female mentioned above, bears only the label "Melsh.". Four specimens besides the lectotype bear the label "Pennsylvania, Melsheimer". A single male is labelled "Pa, Ziegler" and 4 specimens on one pin are labelled only "Ziegler".

In addition to the type series, 6 specimens of violacea labelled only "Melsh." occur in the Melsheimer-Ziegler Collection but do not seem to be placed under any name. A single female specimen of violacea labelled

"Melsh." is found under the name Caeporis nana and 2 specimens, a male labelled "Pennsylvania, Melsheimer" and a specimen (sex undetermined) labelled "Pennsylvania, Ziegler" occur under the name Crepidodera helxines.

Distribution

Crepidodera violacea is found in eastern North America from Maine, southern Quebec, southern Ontario and Michigan south to Florida and west to eastern Nebraska, eastern Kansas and Boulder, Colorado (map 2).

Material examined: about 1100 specimens.

CANADA: national records only, April (USNM) 3.

Ontario: provincial records only (USNM) 6; Britannia Hts., July, on Viburnum (CNC) 1; DeCew Falls, Aug., on Prunus (CNC) 6; Jordan, May, on Prunus americana (CNC) 7; Lucknow, June, on Prunus serotina (CNC) 8; Merivale, May, June, on Crataegus (46) and Prunus pennsylvanica (8) (CNC, MCZ) 54; Ottawa, May, June, Aug., Sept., on Prunus virginiana (28) wild cherry (CNC, HAH) 35; Simcoe, June, on Prunus americana (CNC) 1; Toronto (CU) 16.

Quebec: Aylmer, May, June, on Prunus (5) (CAS, CNC) 21; Brome, May, on Prunus pennsylvanica (CNC) 10; Carman Lake, Gatineau Pk., June, Sept., on Prunus serotina (30) (RHP) 34; Covey Hill, June (CNC) 3; Farm Point, Aug. (RHP) 1; Harrington Lk., Gatineau Pk., May, June (CNC)

15; Hull, May, on Prunus virginiana (CNC) 8; Montreal (CU) 4; Old Chelsea, May (CAS) 1; Richelieu, July (CNC) 1.

UNITED STATES: Colorado: Boulder, June, 5,000 ft. (CNC)

2. Connecticut: state record only (CAS) 1; Cornwall, May (CU) 5; Hartford (USNM) 4. District of Columbia:

Washington, May (USNM) 1; Woodridge, March (USNM) 6.

Florida: Dunedin (CNC) 4. Illinois: Ft. Sheridan, Aug.

(CAS) 6; Glen Ellyn, June (FMNH) 1; Heyworth, May (USNM)

2; Kinmundy, Marion Co., May (FMNH) 1; Ogle Co., Aug.,

Prunus americana (USNM) 2; Palos Park, Cook Co., May

(FMNH) 24; Riverside, Cook Co., May, Crataegus blossoms

(3) (FMNH) 8; Tinley Pk., Cook Co., April (FMNH) 1;

Willow Springs, Aug. (FMNH) 1. Indiana: Knox Co., April,

July, wild cherry (15) (USNM) 21; Lafayette, April, May,

on cherry (1) (CNC) 2; Posey Co., May (FMNH) 2; Vigo Co.,

July (FMNH) 1; Vermillion Co., Aug. (FMNH) 1. Iowa:

Iowa City, June, Sept. (USNM) 2. Kansas: Lawrence,

April, on Prunus americana (CNC) 14; Onaga (USNM) 1;

Topeka (CNC, USNM) 3. Maine: Paris, June (MCZ) 1.

Maryland: Baltimore, June (CAS) 5; Beltsville, May,

wild cherry (CNC) 1; Brookland Valley, April, May, on

wild cherry (USNM, CSCA) 100; Cabin John, May, on wild

cherry (USNM) 1; College Park, May (HAHC) 1; Glen Echo,

June (1) (USNM) 7; Hyattsville, May, on wild cherry

(USNM) 6; Lakeland, May, wild cherry (USNM) 1; Oakland,

July (USNM) 1. Massachusetts: state record only (CAS) 1; Agawan, April (USNM) 1; Brookline, June (CAS) 1; Chicopee, May (USNM) 4; Dover, May (CAS) 2; Dracut (MCZ) 2; Framingham, June (MCZ) 1; Melrose High, June (USNM) 1; Princeton, June (MCZ) 1; Sherborn, May (MCZ) 2; Springfield, May (1) (USNM) 3; Tyngsborough, July (MCZ) 1; Wilbraham, June, wild cherry (USNM) 1; W. Roxbury, June (MCZ) 1; W. Springfield, May (USNM) 1. Michigan: Birmingham, Aug. (UA) 1; Fennville, May, on Prunus (18) (CAS, CNC, CSCA, FMNH, USNM) 28. Missouri: Sullivan, Sept. (MCZ) 1. Nebraska: Ashland (USNM) 1. New Hampshire: Barnstead, Sept. (CAS) 1; Mt. Washington (summit-1), July (MCZ) 2; N. Conway, June (MCZ) 1; Rumney, June (MCZ) 2; W. Milton (CU) 1. New Jersey: state records only (CAS, MCZ, USNM) 7; Anglesea (MCZ-HORN) 2; Arlington, April (USNM) 1; Avenel, April, May, June (FMNH, UA) Bound Brook, May (USNM) 4; Califon, June (CU) 2; Cedar Grove, May (USNM) 3; Clifton, May (USNM) 1; Gt. Notch, May (USNM) 1; Haddon Hts., May, on peach (CNC) 2; Hillsdale, May (CSCA) 1; Lake Hopatcong, June (FMNH) 1; Newfoundland (USNM) 2; Newton, April (CU) 1; Palisades, Sept. (USNM) 1; Phillipsburg, May, June (CAS) 2; Raritan Twsh., May (UA) 2; Schooleys Mt., May (CAS) 6; Troy Hills, June (USNM) 1; Woodbury, May (FMNH) 2. New York: state records only (USNM) 6; Aqueduct, March (USNM) 2; Armonk, May (CU) 2; Austerlitz, June (CU) 2; Barre, June (CU) 1; Bear Mt., May, Aug. (FMNH) 7; Bedford,

June (FMNH) 1; Caroline-Harford, June, (CU) 3; Croton
 Falls, May (CAS, FMNH) 5; Crum's Corner (CU) 3; Debruce,
 Sullivan Co., July (USNM) 2; Delmar, March (CU) 1; E.
 Aurora, May, June, July (CU) 3; Gainesville, June (CU)
 1; Hunter, Greene Co., May (UA) 1; Huntington, L.I.,
 Sept. (CU) 2; Ithaca, Feb. (1), April (26), May (66)
 (apple-4, "Haw--"-2), June (56), Aug. (3), Sept. (4),
 Oct. (1) (CU, USNM) 165; Keene Valley, Mt. Mary, 5344
 ft., Aug. (CU) 1; Labrador Lake, Cortland Co., July (CU)
 7; Long Island, May (USNM) 6; McLean Bogs Reserve,
 Tompkins Co., May, June, July, Sept., Oct., on Prunus
 (6) (CU) 41; Mt. Whiteface top, June (CU) 1; Olcott,
 April, May, June (CU) 20; Oliveria, Ulster Co., June
 (CU, USNM) 3; Orchard Park, June (CU) 1; Patterson, May
 (CU) 2; Paul Smith, June (CU) 1; Peru, Clinton Co., June
 (CU) 2; Rhinebeck, July (CU) 1; Rochester Jc., June (CU)
 1; Rock City, Cattaraugus Co., June (CU) 1; Salamanca,
 July (CU) 3; Slaterville, June (CU) 3; Slide Mt., Ulster
 Co., May, June, July (CU) 6; Staten Island (CAS, USNM)
 5; Trout Lake, Aug. (FMNH) 1; Underwood, Essex Co., June
 (CU) 2; Wayne Co., Sept. (USNM) 1; West Point, May, June
 (USNM) 9; Wildwood St. Pk., Suffolk Co., June (CU) 1;
 Yonkers, June (CU) 1. North Carolina: Duke Forest,
 Durham, Durham Co., July, black light (CSCA) 1; Raleigh,
 April (HANC) 1; Smoky Mts. Nat. Pk., 3,000-5,000 ft.,
 Sept., swept Prunus pennsylvanica (USNM) 10. Ohio:
 Clifton, June (OSU) 1; Columbus, April, May, June,

eating leaves of plum (2) (OSU) 4; Delaware Co., April, May, June (OSU) 13; Franklin Co., June (OSU) 2; Greene Co., May (OSU) 1; Hocking Co., April, May (OSU) 2; Shawnee For., June (OSU) 1; Sycamore, Aug. (CAS) 3. Pennsylvania: state records only (Leconte, Melsheimer collections MCZ) 9; Abington, June (MCZ) 1; Allegheny Co., May (CU) 8; Angora, June (MCZ) 4; Collingdale (USNM) 10; Easton, May, June, Oct. (CAS, UA) 7; Edge Hill, May (USNM) 2; Frankford (USNM) 2; Kenneth Sq., on plum (USNM) 6; Lansdale?, May (USNM) 1; McKean Co., June (CU) 1; Minersville, May (RHP) 2; Mt. Airy, April, May, Sept., Oct., Nov. (MCZ) 14; North East, May, on Prunus serotina (USNM) 2; Norwood, May (MCZ) 1; Philadelphia (MCZ) 1; Rochester, June (CU) 1; Starlight, June (USNM) 1; Sullivan Co., June (OSU) 1; W. Park, June (MCZ, OSU) 3. Rhode Island: Tiverton (MCZ) 1. South Carolina: Mountain Rest, June, on Prunus (CNC) 1. South Dakota: Capa, June (SDSU) 1; Cedar Canyon, June (SDSU) 2; Newton Hills St. Pk., Lincoln Co., June (SDSU) 1; Pierre, June (SDSU) 1; Union Co. St. Pk., May (SDSU) 1. Tennessee: Devils Cr. Trl., Unaka Sprs., June (UA) 1; Hamilton Co., April (USNM) 1; Knoxville, April, Aug., dogwood (3) (HAHC) 4; McMinnville, Warren Co., March, wild plum bloom (USNM) 1; Rhea Co., May, foliage Prunus serotina (3), wild plum (1) (USNM) 4; Roane Co., May, foliage Prunus sp. (1), P. angustifolia (1), P. serotina (2) (USNM) 4. Vermont: Brattleboro, spring (USNM) 8. Virginia: Arlington, May, on wild

cherry (11), on cherry (1) (USNM) 13; Mathias Pt., May (MCZ) 2; Nelson Co., Aug. (USNM) 1; Rosslyn, May (USNM) 4; Veitch, May, on Prunus sp. (USNM) 8. West Virginia: East Panhandle, June (CAS) 1; Ft. Pendltn. (USNM) 1; Morgantown, June (CAS) 2; W. Sulphur, July, Aug. (USNM) 7.

Host Plant: Crataegus sp., Prunus spp.

Crepidodera violacea is the only species in the genus known definitely to feed on plants of the family Rosaceae rather than the family Salicaceae.

In the material examined, 389 specimens bear host plant information (table 2). Of these, 49 specimens (12.6%) are recorded from Crataegus (Hawthorn), 330 specimens (84.8%) are recorded from Prunus and 10 specimens (2.6%) are recorded from apple (Pyrus sp.), Viburnum (arrow-wood, haw) and dogwood (Cornus sp.). The records for Prunus include Prunus americana (wild plum, American plum), P. angustifolia (Chickasaw plum), P. pensylvanica (pin-cherry, wild red cherry), P. persica (peach), P. serotina (wild cherry, black cherry), P. virginiana (choke-cherry) and Prunus spp. (wild cherry, wild plum). I suspect that the records from apple, Viburnum and dogwood are accidental occurrences.

This species was reported by Chittenden (1925) to be abundant on Prunus serotina at Ithaca, New York and in the vicinity of the District of Columbia. I

TABLE 2. Host plant records for Crepidodera violacea Melsh.

<u>Plant Name</u>	<u>Common Name</u>	<u>Locality</u>	<u>Time of Year</u>	<u>Number of Specimens</u>
<u>Crataegus</u> <u>sp.</u>	Hawthorn	Ontario - Merivale Illinois - Riverside (Cook Co.)	May, June May	46 3
<u>Prunus</u> <u>americana</u>	Wild Plum, American Plum	Ontario - Jordan - Simcoe Illinois - Ogle Co. Kansas - Lawrence	May June Aug. April	7 1 2 14
<u>Prunus</u> <u>angustifolia</u>	Chickasaw-plum	Tennessee - Roane Co.	May	1
<u>Prunus</u> <u>pennsylvanica</u>	Pin-cherry, Wild Red Cherry	Ontario - Merivale Quebec - Brome North Carolina - Smoky Mts. Nat. Pk.	May May Sept.	8 10 10
<u>Prunus</u> <u>persica</u>	Peach	New Jersey - Haddon Hts.	May	2
<u>Prunus</u> <u>serotina</u>	Wild cherry, Black cherry	Ontario - Lucknow Quebec - Carman Lk. (Gatineau Pk.) Pennsylvania - North East	June June Sept. May	8 13 17 2

TABLE 1 (Cont'd)

<u>Plant Name</u>	<u>Common Name</u>	<u>Locality</u>	<u>Time of Year</u>	<u>Number of Specimens</u>
<u>Prunus virginiana</u>	Choke-cherry	Tennessee - Rhea Co.	May	3
		- Roane Co.	May	2
<u>Prunus spp.</u>	(genus record only)	Ontario - Ottawa	May, June	28
		Quebec - Hull	May	8
		Ontario - DeCew Falls	Aug.	6
		Quebec - Aylmer	May, June	5
		Michigan - Fennville	May	14
		New York - McLean	May	6
		South Carolina - Mountain Rest	June	1
		Tennessee - Roane Co.	May	1
		Virginia - Veitch	May	8
		Ontario - Ottawa	Aug.	6
		Indiana - Knox Co.	April 6	15
		- Lafayette	May	1
		Maryland - Beltsville	May	1
		- Brookland Val.	April, May	99
Wild cherry (no sci. name)		- Cabin John	May	1
		- Hyattsville	May	6
		- Lakeland	May	1
		Massachusetts - Wilbraham	June	1

TABLE 1 (Cont'd)

<u>Plant Name</u>	<u>Common Name</u>	<u>Locality</u>	<u>Time of Year</u>	<u>Number of specimens</u>
	Wild plum (no sci. name)	Virginia - Arlington	May	12
		Ohio - Columbus	April 27	2
		Pennsylvania - Kenneth Sq.	-	6
		Tennessee - McMinnville (Warren Co.)	March	1
		- Rhea Co.	May	1
<u>Pyrus</u> sp.	Apple	New York - Ithaca	May 8	4
<u>Viburnum</u>	Arrow-wood, Haw	Ontario - Britannia Hts.	July	1
	"Haw"	New York - Ithaca	May 21	
<u>Cornus</u> -sp.	Dogwood	Tennessee - Knoxville	April 15	3

2

personally have taken violacea on Prunus serotina at Carman Lake in Gatineau Park near Hull, Quebec.

Lazorko (1974) reported this species to occur on Ulmus sp. (elm) but I have never found it on elm and have seen no other records of this.

Life History: Immature stages unknown.

Adults are found from March to November but appear to be most abundant in all parts of the range from April through June and again in August when the new generation emerges.

Remarks

Variation in C. violacea was pointed out by Melsheimer (1847) in the original description. He described, in addition to his "type", 3 varieties of which 2 are based on slight colour differences and differences in the punctation and smoothness of the pronotum. His third variety (Var c) differs mainly in being "brilliant brassy" and in having the elytra "indented behind the base towards the suture". These characters lead me to suspect that this "variety" is probably a different species, although I found no examples of it with the type material in the Melsheimer-Ziegler Collection.

The specimens examined show some variation in colour. The majority have the dorsal surface either

entirely violaceous or dark blue to blue-green with violet reflections. Others have the pronotum and elytra differing in shade, the elytra violaceous or blue to blue-green with violet reflections and the pronotum more greenish, or vice versa. A few specimens are blue-green, dark green or slightly brassy-green above with no trace of violet.

Genitalia were examined in 34 male specimens. Variation in the median lobe is slight. Some specimens are not as strongly broadened apically as in fig. 132 and have the tip slightly more narrowly rounded.

Spermathecae were dissected from 4 females.

3. Crepidodera spenceri (Lazorko) new combination

Figs. 7-10, 57, 79-81, 133, 149; Map 3.

Chalcoides spenceri Lazorko 1974, p. 147, 148 (fig.),
150, 151, 153 (type locality, Vancouver, British Columbia).

Diagnosis

This species can be separated from all other North American species by its relatively large size, the black colour of the dorsal surface, the strongly impressed pronotal transverse groove, the very narrow elytral margins, the short, sparse, inconspicuous setae of the first abdominal sternum in both male and female and its western range. C. spenceri is also distinguished by its very prominent anterior pronotal angles which give the pronotum a more quadrate appearance and by the dense, rather uniform punctation of the disc.

Description

MALES: Length 2.3 to 3.3 mm, greatest width 1.1 to 1.7 mm. Shape (fig. 7) broadly oval, slightly elongate; length less or not greater than twice the width. Dorsum shining, metallic; vertex of head, pronotum and elytra black, occasionally with bronze, purplish or greenish reflections, rarely dark green; pronotum often more bronze, purplish or greenish than elytra; head below vertex with dark green to blue-green reflections; scutellum black. Antennae light rufotestaceous

to medium reddish-brown, in basal one-third to one-half, apically similar or increasingly darker to piceous.

Legs, except hind femora, light to medium reddish-brown; hind femora partially or entirely dark reddish-brown to piceous. Ventral surface shining black, occasionally with green reflections in thoracic sterna.

Vertex of head (figs. 8, 57) along anterior edge of pronotum smooth, occasionally with a few scattered fine punctures. Pronotum (fig. 8) with sides slightly sinuous with apical two-thirds feebly to moderately arcuate and basal one-third subparallel; sides rarely evenly arcuate; anterior angles strongly produced, truncation equal to or greater than length of second antennal segment. Ante-basal transverse groove deep, strongly pronounced. Major punctures of pronotal disc generally dense, uniformly distributed; size generally moderate, occasionally somewhat coarse, the latter close or equal to size of basal serial punctures of elytra; punctures in interspaces fine to about one-half diameter of major punctures. Elytron (figs. 9, 10) at declivity evenly rounded or, occasionally, slightly bulging laterally to overhang margin; disc in basal one-half almost evenly convex to very gently depressed behind basal one-quarter. Lateral margins of elytra very narrow in dorsal view, visible for entire length (fig. 10) or, rarely, partially hidden by bulge at declivity (fig. 9). Elytral striae moderately to strongly, distinctly punc-

tate basally, generally somewhat obsolete apically. Metasternum medially sparsely, inconspicuously setose except glabrous near midline in posterior two-thirds. First abdominal sternum (fig. 80) medially with short, sparse, inconspicuous semi-recumbent setae. Middle and hind trochanters with a few inconspicuous setae as in adjacent parts of femora.

Median lobe of genitalia (fig. 133) 0.8 to 1.0 mm long, evenly arcuate except occasionally slightly recurved at apex; in dorsal view, gradually tapered from base to just beyond middle, then slightly or scarcely broadened apically; tip narrowly rounded to sub-truncate. Ventral side without conspicuous sculpture.

FEMALES: Length 2.6 to 3.6 mm, greatest width 1.3 to 1.8 mm. Similar to males except for sexual differences at apex of abdomen (fig. 81) and the following: body generally more robust and lateral margins of elytra more frequently hidden by bulge at declivity. Spermatheca (fig. 149) 0.20 to 0.25 mm long.

Type Material

HOLOTYPE: Male, Vancouver, British Columbia, U.B.C. Endow. Lands, on Salix sp., June 10, 1953, W. Lazorko (W. Lazorko Coll.). ALLOTYPE: Female, same data as holotype (W. Lazorko Coll.). Paratypes: 5 males, 5 females, Vancouver, British Columbia, U.B.C. Endow. Lands and Shaughnessy Hosp. Lands, W. Lazorko

(W. Lazorko Coll.; 1 female, L.G. Gentner Coll.).

No type material was seen. The name is applied on the basis of the original description and a single female topotype bearing Lazorko's determination label.

Distribution

Crepidodera spenceri is restricted to western North America. Its range extends from southern California to central British Columbia and east as far as Montana and Utah (map 3).

Material examined: 329 specimens.

CANADA: British Columbia: Bear Lake, July (USNM) 1; Bowser, May, June, on Salix (CNC) 21; Canal Flats, 5 mi. S., Aug., on Salix (RHP) 1; Cowichan Lake, June, on Salix (CNC) 10; Douglas, June, willow (CNC) 1; Fernie, June (CNC) 1; Howser, Selkirk Mts., June (CU) 4; Kaslo, May, June, July (USNM) 25; Langford, Sept. (CNC) 2; Marysville, June (CU) 3; Miracle Beach nr. Oyster River, June, on Salix (CNC) 1; Robson, May, June (CNC) 15; Rosedale, Aug. (SDSU) 1; Saanich, May (CNC) 2; Salmon Arm, June, host Salix (CNC) 2; Terrace, June (3) (CNC, CU, FMNH, MCZ) 6; Vancouver, July (topotype) (CNC) 1; Victoria, May, June (CNC, USNM) 5; Wynndel, May, on Salix (CNC) 1.

UNITED STATES: California: state record only (USNM)
 3; Alameda Co., April, Sept. (FMNH) 3; Beatrice, June
 (CNC) 1; Berkeley, March, May (CAS, CNC) 4; Bridgeport,
 Mono Co., June, ex Populus tremuloides (CSCA) 2; Carmel,
 Monterey Co., Feb., March (CAS) 9; Carrville, Trinity
 Co., June, July (CAS) 6; Castle Crag, July (CAS, USNM)
 2; Cayton, Shasta Co., July (CAS) 4; Chester, June, July
 (OSU) 7; Crystal Lakes, San Mateo Co., June (CAS) 5;
 Crystal Springs Rd., San Mateo Co., April (CAS) 1;
 Delnorte Co., May (FMNH) 1; Dunsmuir (USNM) 3; Eureka,
 Humboldt Co., May, ex Rubus sp. (CSCA) 6; E. Walker Res.,
 Aug. (CAS) 2; Fallen Leaf, Eldorado Co., July, 6500 ft.
 (2) (CAS, FMNH, MCZ) 4; Felton, April (CAS) 1; Green
 Point, Humboldt Co., June (CAS) 1; Hillsboro, San Mateo
 Co., April (CAS) 1; Hornbrook, June (CNC) 1; Humboldt
 Co., May, June (CAS, CSCA, FMNH) 5; La Honda, March, May,
 2,000 ft. (1), on willow (8) (CAS) 9; La Honda Rd., San
 Mateo Co., July (CAS) 1; Lassen Co., June (FMNH) 1;
 Leona, Alameda Co., Nov., Quercus agrifolia (FMNH) 1;
 Little Riv., May (USNM) 1; Los Angeles Co. (USNM) 1;
 Marin Co., May (CAS, FMNH) 3; Markleeville, May, June
 (CSCA) 2; Martinez, May, Salix (CAS) 1; Milbrae, San
 Mateo Co., March (CAS) 1; Mineral, Tehama Co., May (CSCA)
 1; Moss Landing, Monterey Co., Nov. (FMNH) 1; Nash Mine,
 Trinity Co., June (CAS) 1; Oakland, Alameda Co., July
 (CSCA) 1; Oakland Hills, Alameda Co., June, Sept. (CAS,
 FMNH) 4; Orinda, Contra Costa Co., June, Salix (CAS) 1;

Placer Co., June, July, Aug. (CSCA, USNM) 5; Plumas Co.,
 Aug. (FMNH) 1; Plummer Springs, Trinity Co., June (CAS)
 1; Point Reyes, Marin Co., March (CAS) 1; Portola,
 Plumas Co., May, June (CAS, CSCA) 3; Quincy, Fresno Co.,
 Aug., ex fern (CSCA) 1; Quincy, Plumas Co., June, ex
 raspberry (1) (CSCA, OSU) 4; Redwood Canyon, Marin Co.,
 May (CAS) 1; Redwood Creek, Humboldt Co., June (FMNH) 2;
 Rust, April (CAS) 1; San Andreas F., San Francisco Co.,
 May (CAS) 1; San Anselmo, June (CAS) 1; San Francisco
 Bay Area (CAS) 2; San Mateo Co., May (FMNH) 1; Santa
 Clara Co. (FMNH, USNM) 3; Scotia, May (USNM) 1; Shasta
 Co., July (CAS) 2; Sierra Co., June (FMNH) 4; Sierraville,
 11 mi S., Sierra Co., Oct. (CSCA) 1; Skyline Pond, San
 Mateo Co., March (CAS) 1; Stanford Univ., March, April
 (CAS) 3; Stevens Ck., Santa Clara Co., May (CAS) 2;
 Tocaloma, Pt. Reyes Rd., July (CAS) 1; Trinidad, June
 (CAS) 1; Woodacre, Marin Co., May (CAS) 1. Montana:
 Bozeman, May, June (USNM) 3. Nevada: Verdi, Washoe Co.,
 June (CAS) 1. Oregon: state record only (CAS, USNM) 2;
 Chandler State Pk., Lake Co., May, June (FMNH) 5;
 Corvallis, July (CU) 3; Klamath Co., June (FMNH) 4;
 Lakeview, June (FMNH) 11; McCredie Springs, Lane Co.,
 April (FMNH) 4; Orenco, May, on willow leaves (USNM) 7;
 S.E., Aug. (FMNH) 2; Siskiyou, Jackson Co., July (FMNH)
 3. Utah: Salt Lake City, June (FMNH) 6. Washington:
 Centralia (USNM) 1; Easton (CAS, USNM) 10; Kapowsin,
 April, Salix (USNM) 8; Olympia, June (MCZ) 2; Pullman,

April (USNM) 1; Seattle (USNM) 3; Tenino, May (USNM) 4.

Host Plant: Salix sp.

Of 73 specimens in the material examined bearing host or food plant data, 62 (85%) are recorded from Salix sp. or willow. Seven (7) specimens are recorded from Rubus sp. or raspberry, 2 from Populus tremuloides, 1 from Quercus agrifolia and 1 from fern. I suspect that these latter records, especially the last two, are accidental occurrences.

The holotype and allotype are also reported to be from Salix sp. (Lazorko, 1974).

Life History: Immature stages unknown.

Adults are found from May to September in British Columbia and from February to November in California. In all parts of the range, the greatest abundance appears to occur during May, June and July.

Remarks

There is some variation in the colour pattern of the antennae and legs in this species. The antennae typically have the distal one-half to two-thirds darker than the basal segments, becoming piceous or almost black apically. A number of specimens, however, have the more distal segments scarcely or no darker than the basal ones. Rarely, the antenna is entirely dark except

for the basal two or three segments. The hind femora are typically entirely piceous but in some specimens, especially many from California, they are partially light to dark reddish-brown or entirely the same colour as the remainder of the legs.

In the majority of specimens, the pronotal punctation is (as described by Lazorko, 1974) moderately strong, dense and quite uniform. A very few specimens have the pronotum more finely and sparsely punctate giving the disc a smoother appearance while a number of specimens have coarser, virtually contiguous punctures making the disc appear somewhat rugose.

The genitalia of 34 males were examined and spermathecae were dissected from 7 females.

4. Crepidodera solita new species

Figs. 11-13, 58, 72, 82-84, 127-130, 134, 150; Map 4.

Diagnosis

This species can be distinguished by: dorsal surface dark bronze to coppery-bronze with margins greenish; shape elongate-oval; major pronotal punctures moderate to coarse in size; elytral declivity evenly rounded; elytral disc at most only very feebly depressed behind basal one-quarter; lateral margins of elytra moderately to strongly broadened in dorsal view, visible for their entire length; metasternum glabrous near mid-line in posterior two-thirds; males with pubescence of first abdominal sternum longer and more conspicuous than in females, denser apically forming a distinct, sharply-defined median brush near hind margin (Fig. 83); middle and hind trochanters without a distinct brush of setae.

Description

HOLOTYPE: Male, length 2.4 mm, greatest width 1.2 mm. Shape (fig. 11) elongate-oval; length equal to twice the width. Dorsum shining, metallic; vertex of head dark bronze-green; pronotum and elytra dark bronze with green reflections at margins; head below vertex dark green to blue-green; scutellum piceous. Antennae and legs testaceous. Ventral surface shining

black.

Vertex of head (figs. 12, 58) along anterior edge of pronotum smooth, very finely punctulate. Pronotum (fig. 12) with sides slightly sinuous with apical two-thirds moderately arcuate and basal one-third subparallel; anterior angles feebly produced, truncation slightly less than length of second antennal segment. Ante-basal transverse groove deep, strongly pronounced. Major punctures of pronotal disc dense, irregularly distributed; size moderately coarse, close or equal to size of basal serial punctures of elytra; punctures in interspaces minute, much smaller than major punctures. Elytron (figs. 11, 13) at declivity evenly rounded; disc in basal one-half almost evenly convex. Lateral margins of elytra moderately broad in dorsal view, visible for entire length. Elytral striae strongly, distinctly punctate from base to apex. Metasternum medially somewhat sparsely, conspicuously setose except glabrous near midline in posterior two-thirds. First abdominal sternum (fig. 83) medially with a very dense patch of long, erect setae near apical margin forming a conspicuous well-defined brush; area anterior to brush sparsely setose. Middle and hind trochanters with a few inconspicuous setae as in adjacent parts of femora.

Median lobe of genitalia (fig. 134) 0.8 mm long, evenly arcuate except slightly recurved at apex; in dorsal view, of even thickness in apical two-thirds

except slightly tapered near tip; tip rounded, appearing subtruncate. Ventral side smooth except for a short, shallow median furrow at apex.

ALLOTYPE: Female, length 2.8 mm, greatest width 1.4 mm. Similar to male except for sexual differences at apex of abdomen; setae of metasternum and first abdominal sternum (fig. 84) shorter and less conspicuous; first abdominal sternum lacking a brush of setae but with a median patch of very crowded setiferous punctures near hind margin; and the following non-sexual difference: antennae and legs rufotestaceous.

Type Material

HOLOTYPE: Male, Port Rowan, Ontario, June 23, 1944, W.J. Brown, on Salix (CNC No. 15394). ALLOTYPE: Female, same data as holotype (CNC No. 15394). Both holotype and allotype are in the Canadian National Collection, Ottawa.

Paratypes, 1151, in the following collections: CAS, CNC, CSCA, CU, FMNH, HAHC, MCZ, OSU, RHP, SDSU, UA, USNM.

CANADA: Alberta: Calgary, May, 13; Edmonton, June, Aug., Oct., Salix (1), 3; Kimball, June, Salix interior, 1; Lethbridge, June, on Populus, 4; Scandia, July, 1.
British Columbia: Canal Flats, July, on Salix, 1; Creston, May, 3; Golden, July, 1; Hatzic, July on Cornus,

Salix, 2; Kamloops, May, 1; Mission City, June, on Salix,
 1; Oliver, May, on Salix, 2; Oliver (7 mi. N.), June, on
Populus, 3; Salmon Arm, June, host Salix, 4; Similkameen
 R., 7 mi. S. Cawston, Aug., on Salix, 6; Sirdar (2 mi.
 N.), Aug., on Populus (14), Salix (25), 39; Sumas Pr.,
 June, 2. Manitoba: Brandon (6 mi. N.W.), July, 3;
 Cedar Lake, July, on Salix, 19; Minnedosa (5 mi. N.),
 July, 3; Morris, May, 5; Ninette, June, July, 3; The
 Pas, Aug., 1; Winnipeg, May, June, 4; Winnipeg (51 mi.
 E.), July, on Salix, 6. Ontario: Ancaster, May, 2;
 Cumberland, May, malaise trap, 1; Delhi, June, on Salix,
 6; Dunnville, June, on Salix, 21; Georgetown, May, on
Salix, 1; Kingsville, May, 3; Leamington, June, on
Salix alba, S. gracilis (1), 9; Merivale, May, on Populus
tremuloides (5), Salix (15), 20; Moose Factory, June, on
Salix, 15; Moosonee, June, on Salix, 13; Ojibway, May,
 broad-lfd. Salix sp. (2), 5; Ottawa, May, June, July,
 Aug., Sept., Oct., on Salix alba x fragilis (7), S.
discolor (21), S. fragilis (34), S. gracilis (27), Salix
 sp. (115), willow (2), 210; Pelee Island, July, on Salix,
 9; Point Pelee, June, on Salix, 15; Port Rowan, same
 data as holotype and allotype, 16; Simcoe, June, on
Salix, 4; Terra Cotta, July, on Populus balsamifera (1),
Salix nigra (5), Salix sp. (7), 13; Tilbury, June, on
Salix, 2; Turkey Point, June, on Salix, 13; Walsingham,
 June, on Salix, 30; Wheatley, June, on Salix cordata, 1.
Quebec: Hull, May, on Salix, 25; Montreal, 1; St.

Hilaire, June, 2. Saskatchewan: Assiniboia, June, 1; Lumsden, Aug., 4; Sask. Landing, May, on Salix, 8; Saskatoon, May, July, Aug., feeding on Populus tacamahacca (2), P. virginiana (9), Salix spp. (16), 35.

UNITED STATES: Colorado: Buena Vista, 7900 to 8000 ft., July, 1; Garland, June, 2; Keenesburg, sandhills, June, 1; Littleton, June, sweeping, 2; Mesa, June, July, 5; Illinois: Bowmanville, Oct., 2; Chicago, May, Sept., 2; Cook Co., June (1), 18; Glen Ellyn, May, 1; Homewood, May, 1; Mt. Forest, Aug., sweeping, 2; Palos Park, May, 3; Sauk Trail Forest Pres., Steger, July, 1; St. Joseph, Aug., 2; Volo, May, 1; Willow's Sprgs., June, Aug., on willow (1), 2. Indiana: Bluffton (3 mi. W.N.W.), Wells Co., Nov., Berlese-rotting wood and duff, 5; Hessville, July, sweeping, 1; Monroe (4 mi. W.), Adams Co., Nov., 5; Vera Cruz (2 mi. E.), Wells Co., Oct., 1; Vermillion Co., Aug., 1; Vigo Co., July, 2. Iowa: Adair Co., Nov., from trash, 1; Adams Co., Dec., from L. bluestem, 2; Ames, May, 1; Crawford Co., Jan., from bluestem, 1; Davis Co., Jan., from Spartina, 1; Jones Co., Dec., from L. bluestem, 1; Lake Okoboji, June, July, 4. Kansas: Onaga, 3; Topeka, 3. Michigan: Selfridge Field, Mt. Clemens, May, June, 5. Montana: Bozeman, July, Aug., 2; Gallatin Co., elev. 4800, June, 9. Nebraska: near Brady, Lincoln Co., July, 14. New York: Bridgeport, May, 3; Danby, July, 4; Honeoye Falls, Aug., poplar, 10;

Howland Id., Cayuga Co., June, 1; Ithaca, April, May, June, July, Sept., 29; Kingston, March, 1; Lake Placid, 2000 ft., July, 1; Olcott, March, April, May, June, July, 26; Penn Yan, July, 3; Stanley, May, 1. North Dakota: Golden Valley Co., 13 mi. W. Medora, July, 9; Heart Butte Dam, Grant Co., May, 7. Oregon: Burlington, Columbia Co., Oct., 9; Corvallis, July, 3; Dayton, Yamhill Co., April, 1; Orenco, May, on willow leaves, 2; Westport, June, on willow leaves, 6; Willamette Valley, Feb., hibernating in Usnea plicata on oak trees, 16. South Dakota: Aberdeen, July, 5; Badlands, Interior, Wall, June, July, 3; Beresford, July, 1; Big Stone, Sept., 1; Bigstone City, Aug., 1; Blunt, July, 1; Brookings, May, June, July, Sept., Oct., 24; Canning, Aug., 1; Cedar Canyon, June, 1; Chamberlain, June, July, 5; Clark Co., July, 4; Cottonwood, June, 9; Dimock, Sept., 1; Dry Lake, Hamlin Co., 5; Elk Point, May, Sept., 11; Fort Pierre, Aug., 9; Fort Thompson, July, 1; Gettesburg, June, 15; Gregory, June, 1; Hecla, Sept., 1; Highmore, June, July, light trap (14), 31; Kennebec, July, 1; Kimball, June, 1; Lake City, July, 1; Lake Oakwood, June, 9; Lake Poinsett, Sept., 2; Lead, Sept., 2; Mason, June, 1; Midland, June, 3; Newell, June, July, 7; Nisland, Aug., 3; Philip, Aug., 14; Pierre, June, 26; Presho, June, 2; Sisseton, July, 1; Spearfish, July, Sept., light trap (1), 5; Springfield, May, Sept., 3; Sturgis, May, 2; Union Co. State Park, May, Aug., 5;

Vayland, June, 4; Vermillion, June, Sept., 4; Volga, 17; Walker, Sept., 1; Waubay, June, 11; Wentworth, Aug., 1; Yankton, June, 12. Utah: Logan, July, 1; Provo, June, 4. Washington: Hover, July, 6; Lake Semanish State Park, King Co., May, 1; Lewis and Clark State Park, Waitsville, Sept., on Salix sp., 3; Yakima River, Yakima Co., June, 1. Wisconsin: state record only, 1; Madison, May, on Salix (4), 9.

Variation

Males range from 2.1 to 2.9 mm in length and from 1.0 to 1.4 mm in greatest width. Females range from 2.3 to 3.4 mm in length and from 1.2 to 1.7 mm in greatest width. In both sexes, the length is equal to or slightly greater than twice the width. Variation in colour is slight. The pronotum and elytra are typically dark bronze to coppery-bronze with the margins greenish. A few specimens, mostly from British Columbia, have the dorsum bronze-green to coppery-green. Antennae and legs range from light testaceous to rufotestaceous with the hind femora occasionally slightly darker or partially piceous. The metasternum and first abdominal sternum occasionally show a greenish reflection. The sides of the pronotum range from evenly arcuate in very few specimens to slightly sinuous with the apical two-thirds feebly to strongly arcuate. Major pronotal punctation varies among specimens from moderately sparse to very

dense. Size of the punctures ranges from moderate to coarse, about equal to the size of the basal serial punctures of the elytra. The punctures of the interspaces range from very fine to about one-half the diameter of the major punctures. Unlike the holotype, some specimens have the elytral disc slightly depressed behind the basal one-quarter. The lateral margins of the elytra range from moderately broad as in fig. 13 to more conspicuously broad as in heikertingeri (fig. 31). Male genitalia range in length from 0.7 to 0.8 mm. In dorsal view, the median lobe varies from slightly tapered at the aperture to slightly broadened. In females, spermathecae range in length from 0.17 to 0.21 mm and are similar to fig. 150.

Distribution

Crepidodera solita is widespread across Canada and the central and northern United States. The species ranges from Quebec and New York to British Columbia, Washington and Oregon and south to Utah, Colorado and Kansas (map 4).

Host Plant: Salix spp., ? Populus spp.

Food plant records were available for 563 specimens in the type series. Of these, 524 (93%) are recorded from Salix spp. or willow (Alberta, British Columbia, Illinois, Manitoba, Ontario, Oregon, Quebec,

Saskatchewan, Washington, Wisconsin) including Salix alba (8), S. alba x fragilis (7), S. cordata (1), S. discolor (21), S. fragilis (34), S. interior (1), S. nigra (5), and S. petiolaris (= gracilis) (28). The remainder (7%) are recorded from Populus spp. (Alberta, British Columbia, Ontario, Saskatchewan) including Populus balsamifera (1), P. tacamahacca (2), P. tremuloides (5), and P. virginiana (9) and from Cornus sp. (1 specimen, British Columbia). I suspect that the latter record is an accidental occurrence.

In field studies undertaken in or near Ottawa, Ontario, I took Crepidodera solita from Salix alba x fragilis, S. discolor, S. petiolaris (= gracilis), Populus grandidentata and P. tremuloides. In this area, solita was found to be most common on Salix alba x fragilis where it occurs with C. heikertingeri and C. decora. In one locality (Vincent Massey Park, Ottawa) (fig. 127), 91% to 97% of the Crepidodera specimens collected on this willow were solita while heikertingeri made up from 3% to 6% and decora from 3% to 4%. In another locality (Ramsayville Marsh, Ontario), Crepidodera solita was taken with these same two species on Salix petiolaris with a frequency of 2.5% and on S. discolor with a frequency of 13.5%. In this locality, solita is far outnumbered by heikertingeri on Salix petiolaris and by both heikertingeri and decora on S. discolor. Crepidodera solita was never taken from Populus spp.

except in one instance when a few specimens were collected from Populus grandidentata and P. tremuloides growing beside Salix alba x fragilis on which solita was abundant. However, when confined in the laboratory in a container with only leaves of Populus tremuloides, these specimens fed extensively on these leaves.

In the laboratory, all life stages of Crepidodera solita were reared successfully on growing, potted Salix alba x fragilis (figs. 128-130).

Life History

Description of immature stages:

EGG: Length about 0.5 mm, width 0.2 to 0.3 mm. Colour creamy-white to light yellow. Chorion finely reticulate (fig. 54).

FIRST INSTAR LARVA: Length about 1.0 mm, greatest width about 0.2 mm. Maximum length of head capsule 0.18 to 0.22 mm, maximum width 0.16 to 0.18 mm. Colour pale yellowish-white (when alive) except head and terga of prothorax and 9th abdominal segment light brown. Body orthosomatic, subcylindrical, slightly flattened ventrally, widest at thorax and slightly narrowed posteriorly.

Head nutant, prognathous, notched posteriorly; labrum short, transverse, slightly rounded anteriorly, with a lateral pair of long setae placed medially, a

central pair of moderately long setae placed basally and 2 central pairs of short setae at anterior margin; clypeus short, transverse, with a lateral pair of short setae placed medially, and 2 central pairs of very short setae placed basally; frons triangular, distinctly separated from epicranium by V-shaped frontal suture, with 4 pairs of long setae -- a lateral pair at anterior margin and 3 central pairs located anteriorly, medially and posteriorly; epicranium divided posteriorly by a short coronal suture, with 10 pairs of setae -- 5 dorsal pairs, 2 lateral pairs and 3 ventral pairs; ocelli absent. Antenna short, 2-segmented, attached to head by a broad membrane, first segment with several sensilla. Mandible palmate, 5-toothed, the 3rd tooth the most elongate. Maxillary palpus prominent, conical, 3-segmented, with apical segment as long as the other 2 combined. Labium with mentum subquadrate and submentum rectangular; labial palpus short, 2-segmented, apical segment elongate-conical; submentum with 1 anterior pair and 1 posterior pair of setae.

Thorax distinctly 3-segmented; prothorax with a slightly sclerotized, longitudinally divided, transverse tergal shield bearing anteriorly a row of 5 pairs of setae and posteriorly a row of 3 pairs of setae; mesothorax and metathorax dorsally each with a central pair of dark hatching spines located medially and with 2 rows of setae -- anterior row with 1 short lateral

pair and 1 long central pair, posterior row with 3 long pairs located 1 pair centrally, 1 pair posterior to hatching spines and 1 pair laterally; lateral margins of mesonotum and metanotum each with a long, strong, laterally-projecting medial seta and 2 short setae -- 1 located anterodorsal and 1 located posteroventral to median seta; thoracic sterna each with 2 central pairs of setae -- a long anterior pair and a shorter, posterior pair; prothoracic sternum also with a lateral pair of setae located anterior to legs. Legs short, 4-segmented with 4th segment terminated by a moderately curved claw and a membranous empodium; segments 1 to 4 each with several short to moderately long setae.

Abdomen 10-segmented; segments 1 to 8 each divided dorsally into 3-transverse folds -- anterior fold with 3 pairs of long setae, medial fold with 1 short pair and posterior fold with 3 long pairs plus a very short pair ventral to lateral-most pair of long setae; pleural area of segments 1 to 8 with a long, strong medial seta and a shorter seta anteroventral to medial seta; venter of segments 1 to 8 with 2 transverse rows of setae -- anterior row with 2 pairs and posterior row with 3 pairs; 9th segment with a sclerotized, spatulate, posteriorly rounded dorsal plate (anal plate); anal plate flat, with 1 anterior pair and 1 medial pair of moderately long setae located centrally and with 4 pairs of long setae and 1 pair of very short setae.

located laterally and posteriorly; venter of 9th segment with a transverse row of 2 pairs of long setae; 10th segment reduced, hidden from above by 9th segment, disc-like with a single median anal proleg.

Spiracles small, annular; 1 pair on mesothorax and 1 pair on each of abdominal segments 1 to 8.

The above description is based on 12 specimens reared from adults collected in Ottawa, Ontario.

The second instar larva, third instar larva and pupa of this species are unknown.

Habits:

ADULTS: Specimens have been recorded from January to December. Those collected in December (3 specimens) and January (2 specimens) were apparently found overwintering in various grasses in Iowa. Sixteen specimens collected in Oregon in February are recorded as "hibernating in Usnea plicata on oak trees". Six individuals collected in November in Indiana and Iowa are recorded from "rotting wood and duff" and "trash". These were probably in overwintering quarters. Most (84%) of the museum material is recorded from May, June and July.

In the Ottawa area, overwintered adults appear on the host willows when leaves are formed in late April or early May. In 1975, Salix alba x fragilis trees started to leaf out about May 4. On May 14, C. solita was very abundant on this willow. The beetles could be easily seen on the branches and leaves where they were actively moving about, mating or feeding. Adults were abundant, although no longer easily seen, until late June or early July when their numbers began to decrease as they died off. Numbers increased again in August as the new generation emerged. In rearing experiments, new adults were observed in a cage (No. 1) on Aug. 2 and 4 (50-52 days after adults were added). In another cage (No. 2), 11 adults had emerged by Aug. 31 and had begun feeding. In the field, adults were found on their host trees until the leaves had fallen in late October.

Mating was observed from mid May to late June. In large samples of adults collected during May and June of 1975 and 1976, males were slightly more numerous than females, occurring in proportions ranging from 52% to 64%.

OVIPOSITION: Females were not observed to oviposit either in the field or in rearing cages. Specimens that were confined in plastic bags in the laboratory deposited eggs from June 8 until late June. It is probable that oviposition in the field occurs, generally, from late May until mid or late July. The number of eggs produced by individual females was not determined. Eggs are probably deposited in the soil or vegetation below the host plant.

INCUBATION: The incubation period of eggs in the laboratory ranged from 13 to 16 days (mean 14.5 days).

LARVAE: Thirteen first instar larvae were obtained from eggs incubated in the laboratory. Upon emergence, the larvae were entirely pale yellowish-white except for the mandibles which were brown in colour. The head capsule, prothoracic shield and anal plate darkened within a short time after hatching. At this time, the larvae were quite active in crawling around the petri dish, possibly in search of food. These larvae were preserved.

A single first instar larva was found in the roots of a potted willow (Salix alba x fragilis) removed from a rearing cage (No. 3) on July 11, 28 days after adults had been placed in the cage. The larva was mining below the epidermis of a small root about 0.5 mm in diameter. When the mine was dissected, the larva emerged and crawled around the dish containing the washed roots but did not resume feeding. When placed on a fresh new root of S. alba x fragilis and left overnight, the larva chewed at several places on a small lateral root but did not mine. It became inactive and died several hours later. Some of the other small, tender roots on the same plant contained vacant larval mines. Some mines ran for a short distance along a root and out into smaller lateral roots. Entrance or exit holes were apparent in each mine. Larvae had fed on the tissues of the cortex and on the tender tissues, probably endodermis and pericycle, surrounding the central vascular bundle. Reddish-brown frass occurred throughout the mines.

When the remaining potted willow in cage No. 3 was removed and examined on Aug. 4, no larvae were found, although several roots contained mines. The larvae which produced these had not completed development since no new adults emerged in the cage. The roots of 2 willow plants from another rearing cage (No. 2), when examined on Aug. 31, contained many vacant larval mines. Some of these mines contained exuviae. The larvae

responsible for the mines in these plants had managed to reach the adult stage since several new adults had emerged in the cage.

Remarks

The genitalia of 165 males were examined and spermathecae were extracted from 13 females.

The characters given in the diagnosis will separate solita from all the other species. However, solita may be confused with vaga, similarly coloured specimens of nana and, possibly, opulenta. The lateral elytral margins in solita are distinctly broader than in opulenta and slightly broader than in vaga and nana. Males can usually be separated from those of opulenta and nana by the more sharply-defined apical brush of setae on the first abdominal sternum. Males of solita can easily be distinguished from those of nana and vaga by the shape of the genitalia (fig. 134). The shape of the spermatheca (fig. 150) in females will also readily separate solita from the other three species.

5. Crepidodera decora new species

Figs. 14-16, 59, 71, 85-87, 124, 135, 151; Map 5.

Diagnosis

This species can be recognized by: dorsal surface bright green to blue-green; elytral declivity evenly rounded; lateral margins of elytra moderately broad in dorsal view, visible for their entire length; males with pubescence of first abdominal sternum longer and more conspicuous than in females, denser apically forming a distinct, sharply-defined median brush near hind margin; median lobe of male genitalia evenly arcuate in lateral view, without conspicuous ventral sculpture except for a shallow median furrow at apex.

Description

HOLOTYPE: Male, length 2.4 mm, greatest width 1.1 mm. Shape (fig. 14) elongate-oval; length slightly greater than twice the width. Dorsum shining, metallic; vertex of head, pronotum and elytra green; head below vertex blue-green; scutellum piceous. Antennae and legs rufotestaceous. Ventral surface shining black.

Vertex of head (figs. 15, 59) along anterior edge of pronotum smooth, very finely punctulate. Pronotum (fig. 15) with sides slightly sinuous with apical two-thirds feebly arcuate and basal one-third subparallel; anterior angles feebly produced, truncation slightly

less than length of second antennal segment. Antebasal transverse groove deep, strongly pronounced. Major punctures of pronotal disc moderately dense, irregularly distributed; size moderate to slightly coarse, the latter close or equal to size of basal serial punctures of elytra; punctures in interspaces minute, much smaller than major punctures. Elytron (fig. 16) at declivity evenly rounded; disc in basal one-half almost evenly convex. Lateral margins of elytra moderately broad in dorsal view, visible for entire length. Elytral striae strongly, distinctly punctate from base to apex. Metasternum medially somewhat sparsely, inconspicuously setose except glabrous near midline in posterior two-thirds. First abdominal sternum (fig. 86) medially with a very dense patch of long, erect setae near apical margin forming a conspicuous well-defined brush; area anterior to brush sparsely setose. Middle and hind trochanters with a few inconspicuous setae as in adjacent parts of femora.

Median lobe of genitalia (fig. 135) 0.8 mm long, evenly arcuate except slightly recurved at apex; in dorsal view, of even thickness in apical two-thirds except slightly narrowed at tip; tip rounded. Ventral side smooth except for a short, shallow median furrow at apex.

ALLOTYPE: Female, length 2.9 mm, greatest width 1.4 mm. Similar to male except for sexual differ-

ences at apex of abdomen (fig. 87); setae of first abdominal sternum shorter and less conspicuous; first abdominal sternum lacking a brush of setae but with a median patch of crowded setiferous punctures near hind margin; and the following non-sexual differences: anterior pronotal angles with truncation equal to length of second antennal segment; major pronotal punctures slightly more dense.

Type Material.

HOLOTYPE: Male, Ottawa, Ontario, May 31, 1962, W.J. Brown, on Salix discolor (CNC No. 15395).

ALLOTYPE: Female, same data as holotype (CNC No. 15395). Both holotype and allotype are in the Canadian National Collection, Ottawa.

Paratypes, 360 in the following collections:

CAS, CNC, CSCA, CU, FMNH, HAHC, MCZ, OSU, RHP, USNM.

CANADA: Ontario: Arnprior, June 22, 1941, W.J. Brown, on Populus balsamifera, 1; Bell's Corners, May 26, 1973, June 6, 1970, June 18, 1975, R.H. Parry, on Salix, 7; June 6, 1971, R.H. Parry, 1; June 18, 1970, R.H. Parry, on Populus, 1; Blackburn, May 21, 1963, W.J. Brown, on Populus tremuloides, 3; May 22, 1940, June 16, 1941, W.J. Brown, on Salix, 11; Britannia Hts., July 10, 1958, S.D. Hicks, on Salix, 6; Constance Bay, July 7, 1970, R.H. Parry, on Salix, 3; Delhi, June 9, 1956, June 14,

1962, W.J. Brown, on Salix, 29; Georgetown, May 18-19, August 18, 1976, R.H. Parry, on Salix, 3; Hazeldean, July 17, 1970, R.H. Parry, on Salix, 1; Kinburn, May 14, 1968, J.E.H. Martin, 1; Marmora, May 18, 1952, J.C. Mitchell, 1; Merivale, May 15, 1941, W.J. Brown, on Populus tremuloides (1), on Salix (4), 5; May 8, 22, 1941, W.J. Brown, on Salix, 14; Ottawa, May 1, 1941, W.J. Brown, on Populus tremuloides (7), on Salix (13), 20; May 14, 1975, R.H. Parry, on Salix, 5; May 22, 1962, W.J. Brown, on Salix gracilis, 10; May 28, 1962, W.J. Brown, on Salix, 32; May 31, 1962, W.J. Brown, on Salix discolor (37), on Salix fragilis (7), on Salix gracilis (3), 47; June 17, 1975, R.H. Parry, on Salix, 3; June 19, 1941, W.J. Brown, on Salix, 4; July 4, 1962, W.J. Brown, on Salix discolor (26), on Salix gracilis (3), 29; Ramsayville Marsh, May 26, 29, July 17, 1975, May 29, 1976, R.H. Parry, on Salix, 8; June 11, 1975, R.H. Parry, on Populus tremuloides, 1; July 4, 1976, R.H. Parry, on Salix bebbiana, 5; Simcoe, June 12, 1962, W.J. Brown, 10. Quebec: Brown L., Gatineau Pk., Sept. 16, Oct. 2, 1976, R.H. Parry, on Salix, 20; Carman Lake, Sept. 10, 1970, R.H. Parry, 2; Farm Point, Aug. 15, 1970, R.H. Parry, 1; Gatineau Pk., June 26, 1975, R.H. Parry, on Salix, 2; Harrington Lk., Gatineau Pk., June 30, 1954, E.E. Sterns, 1; Hull, May 6, 1941, W.J. Brown, on Salix, 30; Knowlton, June 14, 1928, G.H. Fisk, 4; July 6-7, 1928, J.A. Adams, 4; July 17, 1929, L.J. Milne,

1; Knowlton's Landing, June 18, 1928, G.H. Fisk, 1.

UNITED STATES: Connecticut: New Haven, May 31, 1925, B. Smith, 3. Massachusetts: Boston, Arnold Arboretum, July 8, 1921, Harold Morrison, swept from Salix lucida, 1; West Medford, May 26, 1920, C.C. Sperry, 5. Michigan: Lansing, 1; New Baltimore, Clair Co., July 18-21, 1944, B. Malkin, 1. New Hampshire: Exeter, June 6, 1925, Darlington, 1; Mt. Washington, Aug. 9, 1954, Lakes of the clouds, 5000 ft., Becker, Munroe and Mason, 1; N. Conway, June 11, 1946, C.A. Frost, 1; Rumney, June 16, 1924, Aug. 22-24, 2. New York: state record only, 1; Ithaca, July 5, 1917, H. Dietrich, 1; Lake Placid, 2000 ft., July 19, 1962, J.R. Vockeroth, 1; Mt. Whiteface, top, July 7, 1922, J.M. Aldrich, 2; Wayne Co., Sept. 17, 1948, 6.

Variation

Males range from 2.0 to 2.8 mm in length and from 0.9 to 1.3 mm in greatest width. Females range from 2.3 to 3.2 mm in length and from 1.1 to 1.6 mm in greatest width. In both sexes, the length ranges from equal to twice the width to slightly greater than twice the width. Variation in color is slight. The head, pronotum and elytra range from green to blue-green. Antennae are typically entirely rufotestaceous but occasionally have the apical one-half darker to dark

reddish-brown. Hind femora range from entirely rufotestaceous to partially or entirely dark reddish-brown to piceous. The metasternum and first abdominal sternum occasionally show a greenish reflection. The sides of the pronotum range from evenly, feebly to moderately arcuate in a few specimens to slightly sinuous with the apical two-thirds feebly to moderately arcuate and the basal one-third subparallel. The anterior pronotal angles have the truncation equal to or slightly less than the length of the second antennal segment. The major punctation of the pronotal disc varies from sparse to very dense, the size of the punctures ranging from fine to moderate in some specimens and from moderate to coarse in others. The small punctures of the pronotal interspaces range from very fine to about one-half the diameter of the major punctures. Male genitalia range in length from 0.7 to 0.8 mm. In dorsal view, the median lobe varies from slightly tapered at the aperture to slightly broadened and the tip ranges from narrowly to broadly rounded. In females, spermathecae range from 0.20 to 0.25 mm in length and are similar to fig. 151.

Distribution

Crepidodera decora occurs in eastern Canada and the north-eastern United States, ranging from southern Quebec and southern Ontario to Michigan, New

York, Connecticut and Massachusetts (map 5).

Host Plant: Salix spp., ? Populus spp.

Food plant records were available for 309 specimens in the type series. Of these, 295 (95%) are recorded from Salix spp. (Ontario, Quebec, Massachusetts) including 5 specimens from Salix bebbiana (Ontario), 65 from S. discolor (Ontario, Quebec), 7 from S. fragilis (Ontario), 16 from S. petiolaris (= gracilis) (Ontario) and 1 from S. lucida (Massachusetts). The remaining 14 specimens (5%) are recorded from Populus spp. (Ontario) including 5 from P. tremuloides and 1 from P. balsamifera.

In field studies undertaken in or near Ottawa, Ontario, I took Crepidodera decora from Salix alba x fragilis, S. bebbiana, S. discolor, S. petiolaris and Populus tremuloides. This species appears to be most common in this area on Salix discolor and S. bebbiana. In two different localities (Brown Lake, Gatineau Park, Quebec and Ramsayville Marsh, Ontario) where these two species of willow grow together and with Salix petiolaris, C. decora was taken on Salix discolor and S. bebbiana with Crepidodera heikertingeri only in the first locality and with C. heikertingeri and C. solita in the second locality (fig. 124). Crepidodera decora made up 53% and 26% respectively of the Crepidodera specimens taken on Salix discolor and 35% and 25% respectively of those taken on Salix bebbiana in these two localities. Of

the specimens taken from Salix petiolaris in these same localities, 25% in the first and about 4% in the second were decora, the most numerous species of Crepidodera on this willow being heikertingeri. Crepidodera decorae was found in very small numbers (3-4%) on Salix alba, fragilis where it was far outnumbered by solita and on Populus tremuloides (3-5%) where it was far outnumbered by populivora. I suspect that the records from Populus tremuloides are accidental occurrences. The very few specimens in question were collected from Populus tremuloides growing near Salix spp. on which decora was more abundant.

In a laboratory experiment, live adults of decora were offered leaves of Salix bebbiana, S. discolor and S. petiolaris. When different groups of adults were each given leaves of only one of the three species of Salix, they fed readily on Salix discolor, more reluctantly on S. petiolaris and very reluctantly (only 1 of 4 adults) on S. bebbiana. When different groups of beetles were each offered a combination of two of the three species of Salix, they seemed to prefer Salix discolor to petiolaris and both of these species to bebbiana on which they did not feed at all. It is possible that the refusal to feed on bebbiana in this experiment was due to the fact that picked leaves of this species tended to dry more rapidly than those of the other two species.

Life History: Immature stages unknown.

Adults have been taken from May to October. They are most abundant during May, June and early July. Numbers decrease during July and increase again in August when the new generation emerges.

Remarks

The genitalia of 86 males were examined and spermathecae were extracted from 8 females.

The characters given in the diagnosis and its eastern range should separate decora from all the other species. On the basis of external characters, decora will easily be confused with luminosa, nana, and possibly sculpturata. In colour and shape, decora is similar to some sculpturata but can be distinguished from this species by the distinctly broader elytral margins and, in males, by the pubescence of the first abdominal sternum forming a distinct median brush near the hind margin. The elytral margins in decora are generally only slightly broader than in luminosa. In luminosa, the major punctation of the pronotum is generally denser and slightly coarser than in decora. Male genitalia in decora differ slightly from those in luminosa in lacking distinct longitudinal impressions on the ventral side. In shape, decora usually differs from both luminosa and nana in having the sides of the elytra at the declivities more strongly rounded to the apex. In luminosa and nana,

the sides of the elytra are generally slightly more gradually rounded at the declivities. It is, however, very difficult to separate decora from eastern specimens of nana except by the distinct difference in the shape of the male genitalia (fig. 135) and female spermatheca (fig. 151). The shape of the spermatheca will also separate females of decora and luminosa.

6. Crepidodera browni new species

Figs. 17-19, 60, 88-90, 136, 152; Map 6.

Diagnosis

This species can be separated from all other North American species by the bright green, brassy-green, coppery-green, pure coppery, coppery-bronze or dark bronze colour of the dorsal surface, the elytra in both sexes bulging laterally at the declivities to overhang and hide part of the lateral margins (figs. 17, 19) and the males with the pubescence of the first abdominal sternum longer and more conspicuous than in females and denser apically forming a distinct, feebly to strongly-defined median brush near the hind margin.

Description

HOLOTYPE: Male, length 2.7 mm, greatest width 1.35 mm. Shape (fig. 17) elongate-oval; length equal to twice the width. Dorsum shining, metallic; head, pronotum and elytra brassy-green; scutellum black. Antennae and legs rufotestaceous. Ventral surface shining black.

Vertex of head (figs. 18, 60) along anterior edge of pronotum smooth, very finely punctulate. Pronotum (fig. 18) with sides slightly sinuous with apical two-thirds moderately arcuate and basal one-third subparallel; anterior angles feebly produced, truncation

slightly less than length of second antennal segment. Ante-basal transverse groove deep, strongly pronounced. Major punctures of pronotal disc dense, irregularly distributed; size moderate, smaller than basal serial punctures of elytra; punctures in interspaces minute to about one-half diameter of major punctures. Elytron (figs. 17, 19) at declivity slightly bulging laterally to overhang margin; disc gently depressed behind basal one-quarter. Lateral margins of elytra narrow in dorsal view, hidden at declivity by bulge. Elytral striae strongly, distinctly punctate from base to apex. Metasternum medially somewhat sparsely, inconspicuously setose except glabrous near midline in posterior two-thirds. First abdominal sternum (fig. 89) medially with a dense patch of long, erect setae near apical margin forming a conspicuous, slightly loose brush; area anterior to brush moderately densely setose. Middle and hind trochanters with a few inconspicuous setae as in adjacent parts of femora.

Median lobe of genitalia (fig. 136) 0.8 mm long, evenly arcuate from base to apex; in dorsal view, of even thickness in apical two-thirds except slightly narrowed at tip; tip rounded. Ventral side with a shallow longitudinal impression on each side at middle and a short, shallow longitudinal median furrow at apex.

ALLOTYPE: Female, length 2.8 mm, greatest width 1.4 mm. Similar to male except for sexual differ-

ences at apex of abdomen (fig. 90); setae of metasternum and first abdominal sternum shorter and less conspicuous; first abdominal sternum lacking a brush of setae but with a median patch of slightly crowded setiferous punctures near hind margin; and the following non-sexual differences: major punctures of pronotal disc slightly coarser, punctures of interspaces minute.

Type Material

HOLOTYPE: Male, Plummers Island, Maryland, May 23, 1964, on Salix, W.J. Brown collector (CNC No. 15396). ALLOTYPE: Female, same data as holotype (CNC No. 15396). Both holotype and allotype are in the Canadian National Collection, Ottawa.

Paratypes, 444, in the following collections: CAS, CNC, CSCA, CU, FMNH, HAHC, MCZ, OSU, RHP, SDSU, UA, USNM.

CANADA: Alberta: Medicine Hat, May, 2. Ontario: Britannia, July, 1; New Sarum, June, on Salix, 2; Walsingham, June, on Salix, 82.

UNITED STATES: Alabama: Coleta, 1; Jackson, April, on Salix (2), 4. District of Columbia: Rock Creek Pk., May, 1; Washington, May, willow, 1. Florida: Oak Grove, April, on willow, 9. Georgia: Hiawassee, Towns Co., 2000 ft., Aug., 1. Illinois: Cairo, April, 2;

Chandlerville, May, 4; Grand Tower, Union Co., May, sweeping willow and cottonwood along levee Miss. River, 28; St. Joseph, Aug., 1. Indiana: Elkhart, 1; Hessville, May, 1; LaFayette, July, sweeping, 3; Leavenworth, Aug., willow, 11; Vigo Co., July, 1; Wabash River, June, 3. Iowa: DeWitt, June, 2; Independence, May, 1; Iowa City, May, 1; Keokuk, 1; Solon, 1. Kansas: Topeka, Aug. (1), 3. Kentucky: Louisville, June, field grass, 1; Morehead, May, Salix fragilis, 10. Louisiana: Covington, June, 1; Logansport, March, 3; Morgan City, May, 1; Mound, April, 1. Maryland: Baltimore, July, Aug., 4; Bladensburg, Prince George Co., May, feeding on peach (1), 2; Cabin John, May, 2; Charles Co., June, 1; Ft. Washington, May, 1; Glen Echo, summer, 4; Montg. Co., June, 1; Plummerville, same data as holotype and allotype, 30; May, June, July, Sept., 14; Riverdale, June, 1. Massachusetts: Chicopee, June, 4; Sherborn, May, Salix, 1. Michigan: Maple (? Rapids), July, 1; Mississippi: Agr. Col., May, 1; Leakesville, April 4; Lucedale, Dec., March, April, 13; Meridian, Dec., Feb., April, on Salix (1), 3; Richton, March, on Salix, 2; Starkville, June, 1. Missouri: state record only, June, 1. New Jersey: Bound Brook, July, 1; Phillipsburg, May, 19. New York: West Point, May, 1. North Carolina: state record only, 1; Anson Co., April, 7; Franklin, May, 2000 ft. (1), on Salix (4), 5; Raleigh, April, willow leaves, 1; Richmond Co., April, 1. Ohio: state record

only, 6; Columbus, May, 1; E. Liverpool, 4; Painesville, Aug., 2; Sugar Grove, May, 1; Vinton Co., May, 2.

Pennsylvania: Allegheny Co., May, 3; Clarks Ferry,

July, 1; Easton, May, 1; Reading, July, 1; South Carolina:

Aiken, May, on Salix, 2; Clemson, May, Salix, 10;

Greenwood Co., May, Salix, 7. Tennessee: Clarksville,

April, on willow, 11; various dates in April, hibernating

in leaves (12), 19; Oak Ridge, AEC Area, May, June, July,

Aug., willow (1), 7; Rhea Co., May, from foliage Prunus

sp. (wild plum), 2; Roane Co., April, May, from foliage

Prunus spp. (3), wild cherry foliage (1), 4. Texas:

Austin, April, 1; Corsicana, June, 1; Houston, March,

on willow, 2; Jewett, Aug., 1; Kerrville, April, beating

willow (Salix sp.), 4; Leon Co., April, on willow, 2;

Longview, March, 1; Marshall, March, Salix, 3; Nacogdoches,

May, 14; Navasota, April, 2; Tatum, June, 1. Vermont:

Brattleboro, spring, 1. Virginia: Alex. Co., May, June,

5; Fredericksburg, Sept., 1; Great Falls, July, 1;

Nelson Co., June, Aug., 2; Rosslyn, 1. West Virginia:

Fairmont, Aug., 5.

Variation

Males range from 2.1 to 2.8 mm in length and from 1.0 to 1.4 mm in greatest width. Females range from 2.4 to 3.3 mm in length and from 1.2 to 1.7 mm in greatest width. In both sexes, the length ranges from equal to twice the width to slightly greater than twice

the width. There is considerable variation in the colour of the dorsal surface. Specimens vary in colour from green, brassy-green or coppery-green to pure coppery, coppery-bronze or dark bronze. This variation appears to be clinal. Specimens from the northeastern part of the range, from Massachusetts and Ontario to Georgia are generally green or greenish while specimens from Florida to Texas and from Iowa, Kansas and southern Illinois are darker, from pure coppery to coppery-bronze or dark bronze. Material from Tennessee, Alabama and Mississippi includes both greenish and coppery to dark bronze specimens.

Greenish specimens exhibit some variation in shade. They range from unicolorous, with the head, pronotum and elytra green or brassy-green, to slightly bicolorous with head and pronotum green, blue-green or brassy-green and the elytra more brassy or coppery. Also, the head may be green to blue-green with the pronotum and elytra ranging from brassy-green or coppery-green to pure coppery. Antennae occasionally have the apical four or five segments slightly darker than the remainder to medium reddish-brown. Hind femora range from entirely rufotestaceous to partially or entirely medium to dark reddish-brown.

The sides of the pronotum vary from evenly, moderately arcuate to slightly sinuous with the apical two-thirds feebly to strongly arcuate and the basal one-

third subparallel. The truncation of the anterior pronotal angle ranges from slightly less than to equal the length of the second antennal segment. There is considerable variation in the punctation of the pronotal disc. The major punctation ranges from sparse to very dense. Size of the major punctures ranges from moderate to coarse, the latter equal in size to the basal serial punctures of the elytra. The size in individual specimens varies among moderate, moderate to slightly coarse, moderate to coarse, and coarse. The lateral elytral margins range from narrow to moderately broad in dorsal view. In males, the metasternal setae range from somewhat sparse and inconspicuous as in the holotype to more closely placed and more conspicuous. The setal brush on the first abdominal sternum in males varies from slightly loose as in the holotype to more strongly defined as in fig. 89. Male genitalia range in length from 0.7 to 0.8 mm. In dorsal view, the median lobe varies from slightly more strongly narrowed apically than in fig. 136 to scarcely narrowed apically with the tip appearing subtruncate. In females, spermathecae (fig. 152) range from 0.13 mm to 0.16 mm in length.

Distribution

Crepidodera browni occurs in the eastern United States and southern Canada, ranging from Massachusetts, Vermont and southern Ontario to Florida

and west to southern Alberta, Iowa; Kansas and central Texas (map 6).

Host Plant: Salix spp., ? Prunus spp. .

Host plant records were available for 250 specimens in the type series. Of these, 240 (96%) are recorded from Salix or willow (Ontario, Alabama, D.C., Florida, Illinois, Indiana; Kentucky, Maryland, Massachusetts, Mississippi, North Carolina, South Carolina, Tennessee, Texas) including 10 specimens from Salix fragilis (Kentucky). Six specimens are recorded from Prunus spp. (Tennessee), one specimen from "peach" (Maryland) and one from "field grass" (Kentucky). I suspect that these latter records are accidental occurrences.

I personally have taken this species from Salix sp. near Nacogdoches, Texas.

Life History: Immature stages unknown.

Adults have been taken from February to September and in December. Most were collected from April through June. In southern parts of the range, adults have been taken as early as February (1 specimen, Mississippi) and March (Mississippi, Louisiana, Texas), while in more northern parts of the range, no adults have been collected before April or May. Three specimens from Mississippi were collected in December.

Remarks

The genitalia of 98 males were examined and spermathecae were extracted from 11 females.

In most external characters and in male genitalia, Crepidodera browni is similar to solita, decora, luminosa and opulenta. It can easily be separated from these and most other species by the elytron bulging laterally at the declivity to overhang and hide part of the lateral margin in dorsal view. This condition is also present to some extent in a few other species, namely violacea, spenceri (more commonly in females) and populivora (some females only). However, browni can readily be distinguished from these species by the slightly more elongate shape, the different colour of the dorsal surface and by the pubescence of the first abdominal sternum in males. Males of browni differ from those of violacea and spenceri in having the setae of the first abdominal sternum longer and more conspicuous than in females and from males of populivora in having a conspicuous brush of setae near the hind margin of the sternum.

This species is named in memory of the late Mr. W.J. Brown who collected a good part of the type series of this species and much of the material used in this revision.

7. Crepidodera opulenta (LeConte) new combination

Figs. 20-22, 61, 91-93, 137, 153; Map 7.

Haltica opulenta LeConte 1858, p. 86 (type locality, Fort Yuma, California).

Crepidodera helxines (L.); Crotch (misidentification) 1873, p. 71 (in part); Hamilton 1889, p. 149; Horn 1889, p. 316; Hamilton 1894, p. 399; Duckett 1920, p. 149.

Chalcoides helxines (L.); Leng (misidentification) 1920, p. 300 (in part); Beller and Hatch 1932, p. 128, 129.

Chalcoides fulvicornis (Fabr.); Heikertinger and Csiki (misidentification) 1939, p. 320 (in part).

?Chalcoides fulvicornis nana (Say); Heikertinger 1948-1950, p. 110 (fig.), 136-137 (in part); Lazorko 1974, p. 148 (fig.), 152.

Crepidodera nana (Say); Balsbaugh and Hays 1972, p. 156 (in part).

Diagnosis

This species can be distinguished by: dorsal surface dark green, bronze-green, brassy-green, coppery-green, coppery-bronze to dark bronze; shape elongate-oval; anterior pronotal angles feebly produced; major pronotal punctures moderate to slightly coarse in size; elytral declivity evenly rounded; lateral margins of elytra narrow in dorsal view, visible for their entire length; males with pubescence of first abdominal sternum longer and more conspicuous than in females, denser

apically forming a distinct but poorly developed median brush near hind margin; median lobe of male genitalia evenly arcuate in lateral view; range in southwestern United States.

Description

MALES: Length 2.1 to 2.7 mm, greatest width 1.0 to 1.3 mm. Shape (fig. 20) elongate-oval; length equal to or slightly greater than twice the width. Dorsum shining, metallic; vertex of head, pronotum and elytra dark green, bronze-green, brassy-green or coppery-green to coppery-bronze or dark bronze with margins greenish; head below vertex green to blue-green; scutellum piceous. Antennae and legs testaceous to rufotestaceous. Ventral surface shining black, occasionally with a green reflection in prosternum, metasternum and first abdominal sternum.

Vertex of head (figs. 21, 61) along anterior edge of pronotum smooth, very finely punctulate. Pronotum (fig. 21) with sides generally slightly sinuous with apical two-thirds feebly to moderately arcuate and basal one-third subparallel, occasionally with sides evenly, feebly to moderately arcuate; anterior angles feebly produced, truncation from two-thirds to equal length of second antennal segment. Ante-basal transverse groove deep, strongly pronounced. Major punctures of pronotal disc dense, rarely sparse, irregularly distributed; size

moderate to slightly coarse, the latter close or equal to but generally slightly smaller than size of basal serial punctures of elytra; punctures in interspaces minute to about one-half diameter of major punctures.

Elytron (fig. 22) at declivity evenly rounded; disc in basal one-half almost evenly convex. Lateral margins of elytra narrow in dorsal view, visible for entire length. Elytral striae strongly, distinctly punctate from base to apex. Metasternum medially somewhat sparsely, inconspicuously to conspicuously setose except glabrous near midline in posterior two-thirds. First abdominal sternum (fig. 92) medially with a dense patch of long, semi-erect to fully-erect setae forming a conspicuous, somewhat poorly-developed brush near hind margin; area anterior to brush moderately densely setose. Middle and hind trochanters with a few inconspicuous setae as in adjacent parts of femora.

Median lobe of genitalia (fig. 137) 0.7 to 0.9 mm long, evenly arcuate from base to apex; in dorsal view, apical two-thirds slightly tapered to apex or of even thickness except slightly narrowed at tip, occasionally slightly broadened at aperture; tip rounded. Ventral side without conspicuous sculpture except for a shallow longitudinal median furrow at apex.

FEMALES: Length 2.6 to 3.2 mm, greatest width 1.3 to 1.6 mm. Similar to males except for sexual differences at apex of abdomen (fig. 93) and the following:

setae of metasternum and first abdominal sternum shorter and less conspicuous; first abdominal sternum lacking a brush of setae but generally with a median patch of slightly crowded setiferous punctures near hind margin. Spermatheca (fig. 153) 0.13 to 0.16 mm long.

Type Material

LECTOTYPE: here designated, male, with a circular gold label which represents California, a red label "type 4437" and the following labels: "A. (C.) opulenta Lec. Cal."/"Lectotype ♂, Crepidodera opulenta (Lec.), R.H. Parry, 1976". This specimen is in the LeConte Collection, Museum of Comparative Zoology, Harvard University. The lectotype is accompanied by two female specimens. These each bear a circular gold label and are probably syntypes.

The genitalia of the lectotype were extracted and examined.

Distribution

Crepidodera opulenta occurs in the southwestern United States, ranging from California to Arizona, Utah and western Colorado (map 7).

Material examined: 253 specimens.

UNITED STATES: Arizona: state record only (CNC) 1;
 McNeals (15 mi. E.); Cochise Co., Aug. (CSCA) 15;
 Nogales, April, willow (USNM) 2; Sabino Cn., Santa
 Catalina Mt., April, Aug. (CNC) 3; Williams, June (OSU)
 1. California: Bakersfield, June (CAS) 1; Cajon, San
 Bernardino Co., June (FMNH) 1; Carrville, Trinity Co.,
 2400-2500 ft., May (USNM) 1; Colton, May (CAS) 2;
 Corona, Riverside Co., July, various streamside hosts
 (CSCA) 10; Drytown (2 mi. S.E.), Amador Co., April, ex
Salix (CSCA) 2; Fallbrook, San Diego Co., March, ex
 grasses (CSCA) 3; Fresno, May (USNM) 2; Friant, Fresno
 Co., June, blacklight (CSCA) 1; Hanford (USNM) 8; Kaweah
 (CAS) 1; Kern Co. (USNM) 1; La Jolla (FMNH) 6; Lake
 Pílaritos, San Mateo Co., April, on willow (FMNH) 1;
 Los Angeles, July (7), Aug. (26), (CAS, CNC, MCZ, USNM)
 41; Los Angeles Co., July (USNM) 8; Merced, Merced Co.,
 April (USNM) 1; Modjesna Reservoir, Orange Co., Feb.,
 on willow (CSCA) 1; Needles, April (CU) 59; Niles Canyon,
 Alameda Co., March (2), April (4), May (1) (CAS, FMNH)
 7; Orange Co., March (CNC) 3; Oro Grande, June (OSU) 2;
 Otay, July, willow leaf (USNM) 11; Pasadena, April (2),
 July (4) (CAS, CNC) 6; Pico, Feb. (CAS) 1; Poso (1 mi.
 E.), Kern Co., July (CSCA) 2; Potholes, Imperial Co.,
 April, ex willow (8) (CAS) 18; San Diego, Nov. (CAS) 5;
 San Diego, Old Mission Dam, Feb., ex Salix (CSCA) 3;
 San Francisco Bay Area (CAS) 1; San Jose (USNM) 1; Santa
 Monica, March (CAS) 1; Tonner Cyn., March (RHP) 2; Yuma,

April, Aug. (CAS, USNM) 3. Colorado: Cameo, Mesa Co.,
Aug. (OSU) 1; San Juan Nat. Forest, June (CNC) 2. Utah:
Beaver Creek Hills, Beaver Co. (USNM) 2; Bull Creek,
5000 ft., 15 mi. S. Hanksville, Aug., on willow (4) (CNC,
HAHC) 7; South Creek, Beaver Co., June (USNM) 3.

Host Plant: Salix sp.

In the material examined, 32 specimens are recorded from Salix or willow and 3 specimens are recorded from "grasses". I suspect that the latter records are accidental occurrences.

Life History: Immature stages unknown.

Adults have been taken from February through August and in November as follows: February - 5 specimens, March - 11, April - 92, May - 6, June - 11, July - 42, August - 51, November - 5.

Remarks

In the original description, LeConte (1858) described the colour of this species as "laete viridiaurea" on bright green-gold. The lectotype differs from this in having the dorsal surface coppery-bronze with a slight greenish reflection.

The genitalia of 37 males were examined and spermathecae were extracted from 13 females.

The external characters given in the diagnosis and its southwestern range should separate opulenta from all the other species except western specimens of nana. It may also be confused with sculpturata and vaga. Specimens of opulenta usually differ from those of sculpturata in that the pronotum does not appear as strongly convex or swollen anteriorly as in sculpturata. In addition, males of sculpturata lack a distinct brush of setae in the pubescence of the first abdominal sternum. In vaga, the lateral margins of the elytra are generally scarcely broader than in opulenta. The shape of the male genitalia (fig. 137) will easily separate opulenta from otherwise similar males of nana. This character, along with the shape of the spermatheca (fig. 153) in females, will also readily distinguish opulenta from sculpturata and vaga. The spermatheca in opulenta is occasionally very similar to that in western specimens of nana.

8. Crepidodera luminosa new species

Figs. 23-25, 62, 94-96, 138, 154; Map 8.

Diagnosis

This species can be distinguished by: dorsal surface bright green, blue-green, brassy-green or bronze-green; elytral declivity evenly rounded; lateral margins of elytra narrow to moderately broad in dorsal view, visible for their entire length; males with pubescence of first abdominal sternum longer and more conspicuous than in females, denser apically forming a distinct, well-defined median brush near hind margin; median lobe of male genitalia evenly arcuate in lateral view, with distinct longitudinal impressions on ventral side.

Description

HOLOTYPE: Male, length 2.4 mm, greatest width 1.1 mm. Shape (fig. 23) elongate-oval; length slightly greater than twice the width. Dorsum shining, metallic; vertex of head and pronotum green; elytra brassy-green; head below vertex green to blue-green; scutellum black. Antennae and legs, except hind femora, rufotestaceous; hind femora dark reddish-brown. Ventral surface shining black.

Vertex of head (figs. 24, 62) along anterior edge of pronotum smooth, very finely punctulate. Pronotum (fig. 24) with sides evenly, feebly arcuate; anterior

angles feebly produced, truncation slightly less than length of second antennal segment. Ante-basal transverse groove deep, strongly pronounced. Major punctures of pronotal disc moderately dense, irregularly distributed; size moderately coarse, close or equal to size of basal serial punctures of elytra; punctures in interspaces fine, much smaller than major punctures. Elytron (fig. 25) at declivity evenly rounded; disc in basal one-half almost evenly convex. Lateral margins of elytra narrow in dorsal view, visible for entire length. Elytral striae strongly, distinctly punctate from base to apex. Metasternum medially sparsely, inconspicuously setose except glabrous near midline in posterior two-thirds. First abdominal sternum (fig. 95) medially with a very dense patch of long, erect setae near apical margin forming a conspicuous well-defined brush; area anterior to brush moderately densely setose. Middle and hind trochanters with a few inconspicuous setae as in adjacent parts of femora.

Median lobe of genitalia (fig. 138) 0.7 mm long, evenly arcuate except slightly recurved at apex; in dorsal view, of even thickness in apical two-thirds except slightly narrowed at tip; tip rounded. Ventral side sculptured with a distinct longitudinal impression on each side at middle and a short, shallow median furrow at apex.

ALLOTYPE: Female, length 2.8 mm, greatest width 1.4 mm. Similar to male except for sexual differences at apex of abdomen (fig. 96); setae of first abdominal sternum shorter and less conspicuous, the sternum lacking a brush of setae but with a patch of slightly crowded setiferous punctures near hind margin; and the following non-sexual differences: sides of pronotum slightly sinuous with apical two-thirds feebly arcuate and basal one-third subparallel; major punctures of pronotal disc dense; lateral margins of elytra moderately broad in dorsal view.

Type Material

HOLOTYPE: Male, Hartland, New Brunswick, July 8, 1942, G.M. Stirrett, small willows on beach (CNC No. 15397). ALLOTYPE: Female, same data as holotype (CNC No. 15397). Both holotype and allotype are in the Canadian National Collection, Ottawa.

Paratypes, 144 in the following collections:
CAS, CNC, CU, HAHC, RHP, UA, USNM.

CANADA: New Brunswick: Hartland, same data as holotype and allotype, 19; Woodstock, July 13, 1942, G.M. Stirrett, willow along creek, 2; Young's Cove, July 17, 1942, G.M. Stirrett, willow along beach, 5. Newfoundland: South Branch, W. Newfoundland, July 4, 1949, Ernst Palmen, 5; Spruce Brook, W. Newfoundland, July 8-9, 1949, Ernst

Palmen, 7; Steady Bk., Humber, W. Newfoundland, July 10, 1949, Ernst Palmen, 7. Nova Scotia: Truro, Aug. 12, 1913, R. Matheson, 1. Quebec: Cascapedia, Aug. 2, 1954, W.J. Brown, on Salix, 2; Gaspé, June 25, 1954, W.J. Brown, on Salix, 3.

UNITED STATES: Massachusetts: Little Deer R., July 4, 1930, J.C. Bridwell, Salix, 11. New Jersey: Phillipsburg, May 16, J.W. Green, 1; May 20, 1917, 3; May 25, 1913, J.W. Green, 1. New York: Ithaca, May 8, 1914, 23; May 24, 1915, 26; Aug. 16, 1925, Babiy coll., 9; Lake Placid, 2000 ft., July 19, 1962, J.R. Vockeroth, on Salix, 6. Pennsylvania: Easton, May 18, 1914, 1; Lehigh Gap, Aug. 13, 1904, 12.

Variation

Males range in length from 2.2 to 2.8 mm and in greatest width from 1.1 to 1.4 mm. Females range in length from 2.3 to 3.1 mm and in greatest width from 1.1 to 1.5 mm. In both sexes, length ranges from equal to twice the width to slightly greater than twice the width. Variation in colour is light. The head, pronotum and elytra range from pure green to blue-green, brassy-green or bronze-green. The head and pronotum occasionally differ in shade from the elytra, the latter being slightly more brassy or bronze. Antennae, typically entirely rufotestaceous, occasionally have the apical

one-third to one-half darker to dark reddish-brown. Hind femora range from entirely rufotestaceous to partially or entirely dark reddish-brown. The sides of the pronotum range from evenly, feebly or moderately arcuate to slightly sinuous with the apical two-thirds feebly to moderately arcuate and the basal one-third subparallel. The major punctation of the pronotal disc generally ranges from moderately dense to very dense and is rarely sparse. The lateral elytral margins range in width from somewhat narrow as in the holotype to moderately broad as in the allotype. Male genitalia range in length from 0.7 to 0.8 mm. In dorsal view, the median lobe varies from slightly tapered at the aperture to slightly broadened. In females, spermathecae range from 0.16 to 0.19 mm in length and are similar to fig. 154.

Distribution

Crepidodera luminosa occurs near the east coast from Newfoundland, Nova Scotia, New Brunswick and the Gaspé region of Quebec south to New York, New Jersey and Pennsylvania (map 8).

Host Plant: Salix sp.

Host plant information is available for 50 specimens in the type series. These are all recorded from Salix, more than one-half from willows along creeks or beaches.

Life History: Immature stages unknown.

Adults have been taken from May through August as follows: May - 55 specimens, June - 3, July - 64 and August - 24. It is probable that this species is at its greatest abundance during these months.

Remarks

The holotype and allotype are slightly damaged. The holotype is missing the last three segments of the left front tarsus and the last segment of the right hind tarsus. Part of the left antenna is broken off but this was salvaged and is glued to the point with the specimen. The allotype is missing the last three segments of the left middle tarsus. The tarsi of the right middle and hind legs are broken off but these were salvaged and are glued to the point with the specimen. Both specimens were originally mounted with the antennae and legs held in an excessive amount of an acetate glue. The damage was discovered when the glue was dissolved in amyl acetate in order to remove the specimens from their original mounting for examination of the ventral surface and for dissection of the male specimen.

The genitalia of 28 males were examined and spermathecae were extracted from 14 females.

The characters given in the diagnosis and its eastern range should separate luminosa from all the other species. On the basis of external characters,

luminosa will be easily confused with decora, nana and, possibly, sculpturata. It can usually be distinguished from decora by the generally denser and slightly coarser punctation of the pronotum, the generally slightly narrower elytral margins and the sides of the elytra at the declivities more gradually rounded to the apex. Male genitalia in luminosa differ from those in decora in having distinct lateral longitudinal impressions on the ventral side. In luminosa, the pronotum is not as convex or swollen anteriorly as in sculpturata. Also, males of luminosa differ from those of sculpturata in having a distinct median brush in the pubescence of the first abdominal sternum. The only sure way of separating luminosa from nana is by the shape of the male genitalia (fig. 138) and female spermatheca (fig. 154). These will also distinguish luminosa from decora and sculpturata.

9. Crepidodera vaga new species

Figs. 26-28, 63, 97-99, 139, 155; Map 9.

Diagnosis

This species can be distinguished by: dorsal surface dark coppery-bronze to dark purplish; shape elongate-oval; major pronotal punctures moderately coarse in size; elytral declivity evenly rounded; elytral disc at most only very feebly depressed behind basal one-quarter; lateral margins of elytra narrow in dorsal view, visible for their entire length; males with pubescence of first abdominal sternum longer and more conspicuous than in females, denser apically forming a distinct, sharply-defined median brush near hind margin; median lobe of male genitalia evenly arcuate in lateral view; range east of Rocky Mountains.

Description

HOLOTYPE: ♂ Male, length 2.7 mm, greatest width 1.3 mm. Shape (fig. 26) elongate-oval; length slightly greater than twice the width. Dorsum shining, metallic; pronotum and elytra dark coppery-bronze with margins greenish; head dark green; scutellum piceous. Antennae and legs yellowish-brown. Ventral surface shining black.

Vertex of head (figs. 27, 63) along anterior edge of pronotum smooth, very finely punctulate. Pronotum (fig. 27) with sides slightly sinuous with apical

two-thirds moderately arcuate and basal one-third sub-parallel; anterior angles feebly produced; truncation slightly less than length of second antennal segment. Ante-basal transverse groove deep, strongly pronounced. Major punctures of pronotal disc dense, irregularly distributed; size moderately coarse, close or equal to size of basal serial punctures of elytra; punctures in interspaces fine, much smaller than major punctures. Elytron (fig. 28) at declivity evenly rounded; disc very gently depressed behind basal one-quarter. Lateral margins of elytra narrow in dorsal view, visible for entire length. Elytral striae strongly, distinctly punctate from base to apex. Metasternum medially somewhat closely, conspicuously setose except glabrous near midline in posterior two-thirds. First abdominal sternum (fig. 98) medially with a dense patch of long erect setae near apical margin forming a conspicuous, well-defined brush; area anterior to brush sparsely setose. Middle and hind trochanters with a few inconspicuous setae as in adjacent parts of femora.

Median lobe of genitalia (fig. 139) about 0.8 mm long, evenly arcuate from base to apex; in dorsal view, broadened just posterior to middle, strongly narrowed in apical one-third; tip rounded. Ventral side with a distinct impression on each side near middle converging in apical one-third into a single median longitudinal furrow extending to apex.

ALLOTYPE: Female, length 3.1 mm, greatest width 1.5 mm. Similar to male except for sexual differences at apex of abdomen (fig. 99); setae of metasternum and first abdominal sternum shorter and less conspicuous; first abdominal sternum lacking a brush of setae but with a median patch of crowded setiferous punctures near hind margin.

Type Material

HOLOTYPE: Male, Pt. Pelee, Ontario, June 15, 1940, W.J. Brown, on Populus deltoides (CNC No. 15398).

ALLOTYPE: Female, same data as holotype (CNC No. 15398).

Both holotype and allotype are in the Canadian National Collection, Ottawa.

Paratypes, 32 in the following collections:
CNC, HAHC, RHP, SDSU, USNM.

CANADA: Ontario: Pt. Pelee, same data as holotype and allotype, 23.

UNITED STATES: South Dakota: Fort Pierre, Aug. 6, 1948, H.C. Severin Coll., 1; Newell, May 27, 1951, H.C. Severin Coll., 3; Tennessee: Clarksville, April 16, 17, 18, 20, 23, 1909, hibernating in leaves (3), A.C. Morgan Collector, Collector S.E. Crumb, 5.

Variation

Males range from 2.4 to 2.9 mm in length and from 1.2 to 1.4 mm in greatest width. Females range from 2.7 to 3.3 mm in length and from 1.3 to 1.6 mm in greatest width. In both sexes, length ranges from equal to twice the width to slightly greater than twice the width. Colour of the dorsal surface ranges from dark coppery-bronze to piceous with purplish reflections. The colour of the head below the vertex ranges from green to blue-green and the vertex varies from dark green to dark bronze-green or purplish. In some specimens, the last abdominal sternum has the medial and apical portion paler than the remainder to medium reddish-brown. The sides of the pronotum range from evenly, moderately arcuate to slightly sinuous with the apical two-thirds feebly to moderately arcuate. The major punctation of the pronotal disc ranges from slightly sparse to dense and the punctures of the interspaces vary from minute to about one-half the diameter of the major punctures. The elytral disc varies from very gently depressed behind the basal one-quarter as in the holotype to almost evenly convex. Male genitalia range in length from 0.8 to 0.9 mm. In females, spermathecae (fig. 155) range from 0.15 to 0.16 mm in length.

Distribution

Crepidodera vaga seems to range from southern Ontario south to Tennessee and west to South Dakota (map 9).

Host Plant: Populus deltoides.

In the type series, 25 specimens (including holotype and allotype) from Pt. Pelee, Ontario are recorded from Populus deltoides. This is the only host record.

Life History: Immature stages unknown.

Adults have been taken from April to August as follows: April - 5 specimens, May - 3, June - 25, August - 1. Three specimens collected in April in Tennessee are recorded as "hibernating in leaves". These are probably overwintered adults which had not yet emerged from their winter hiding places in leaf litter at the time of collection.

Remarks

The genitalia of 11 males were examined and spermathecae were extracted from 3 females.

The characters given in the diagnosis and its range east of the Rocky Mountains should separate vaga from all the other species. In external characters, vaga is similar to solita, opulenta and mid-western or

western specimens of nana and will likely be confused with these. Females may also be confused with those of populivora. The lateral elytral margins in vaga are narrower than in solita and generally scarcely broader than in opulenta and populivora. Males of vaga can usually be separated from similar males of nana by the more strongly defined median brush of setae near the hind margin of the first abdominal sternum. The different range of vaga will distinguish it from opulenta. The shape of the male genitalia (fig. 139) and female spermatheca (fig. 155) will readily separate vaga from all of these species.

10. Crepidodera heikertingeri (Lazorko) new combination

Figs. 29-31, 64, 100-102, 123-125, 140, 156; Map 10.

Chalcoides heikertingeri Lazorko 1974, p. 147, 148 fig.,
149, 152 (type locality, Essondale, British Columbia).

Diagnosis

This species is distinguished by: dorsal surface dark metallic bronze, purplish or dark greenish; shape broadly oval; lateral margins of elytra conspicuously broad, relatively wider than in other North American species except for some specimens of solita; males with middle of metasternum covered throughout with setae almost as long and conspicuous as those of first abdominal sternum which is conspicuously hirsute from base to apex, the hairs forming a loose, poorly defined brush; middle and hind trochanters each with a distinct brush of setae on posterior margin. The distinctive male genitalia (fig. 140) will also separate heikertingeri from all other species.

Description

MALES: length 2.0 to 2.7 mm, greatest width 1.1 to 1.4 mm. Shape (fig. 29) broadly oval, slightly elongate; length less than, rarely equal to twice the width. Dorsum shining, metallic; vertex of head, pronotum and elytra commonly dark bronze or purplish with

green to blue-green reflections at margins, occasionally entirely dark green; head below vertex green to blue-green; scutellum piceous. Antennae and legs, except hind femora, rufotestaceous; hind femora entirely rufotestaceous to partially piceous. Ventral surface shining black, occasionally with greenish reflections in thoracic sterna and first abdominal sternum.

Vertex of head (figs. 30, 64) along anterior edge of pronotum smooth or with a few scattered fine punctures. Pronotum (fig. 30) with sides slightly sinuous with apical two-thirds moderately to strongly arcuate and basal one-third subparallel, rarely with sides evenly arcuate; anterior angles feebly produced, truncation equal to or slightly less than length of second antennal segment. Ante-basal transverse groove moderately deep, moderately to strongly pronounced. Major punctures of pronotal disc somewhat sparse to dense, irregularly distributed; size generally coarse, ranging from moderate to coarse, the latter close or equal to size of basal serial punctures of elytra; punctures in interspaces minute to about one-half size of major punctures. Elytron (fig. 31) at declivity evenly rounded; disc gently depressed behind basal one-quarter. Lateral margins of elytra conspicuously broad in dorsal view, visible for entire length. Elytral striae strongly, distinctly punctate from base to apex. Metasternum medially closely, conspicuously setose.

First abdominal sternum (fig. 101) medially with very conspicuous, long, erect setae very closely placed from base to apex, forming a loose, poorly defined brush near hind margin. Middle and hind trochanters each with a distinct posterior marginal brush of setae (fig. 101).

Median lobe of genitalia (fig. 140) 0.7 to 0.9 mm long, evenly arcuate except slightly recurved at apex; in dorsal view, broad, scarcely narrowed to slightly broadened apically, occasionally constricted near aperture; tip truncate to mildly emarginate or shallowly notched at middle, edges rounded. Ventral side smooth except for a shallow median furrow in apical one-third extending to tip and, often, a small oval fovea on each side at apex.

FEMALES: Length 2.2 to 3.2 mm, greatest width 1.1 to 1.7 mm. Similar to males except for sexual differences at apex of abdomen (fig. 102) and the following: setae of metasternum and first abdominal sternum much shorter, less conspicuous and, in metasternum, slightly sparser; brush of setae on middle and hind trochanters less distinct. Spermatheca (fig. 156) 0.16 to 0.22 mm long.

Type Material

HOLOTYPE: Male, Essondale, British Columbia, May 8, 1962, W. Lazorko (W. Lazorko Coll.). ALLOTYPE: Female, Essondale, British Columbia, October 11, 1972.

W. Lazorko (W. Lazorko Coll.). Paratypes: 3 males, 2 females, Vancouver, British Columbia, U.B.C. Endow. Lands, Shaughnessy Hosp. Lands and Beaver Lake, W. Lazorko (W. Lazorko Coll.).

No type material was seen. The name is applied on the basis of the original description plus two specimens from Vancouver, B.C. and three specimens from Vernon, B.C., all bearing Lazorko's determination labels.

Distribution

Crepidodera heikertingeri is widespread across Canada and the northern United States. The species ranges from Newfoundland to British Columbia and south as far as Maryland in the east and Oregon in the west (map 10).

Material examined: 982 specimens.

CANADA: British Columbia: Agassiz, May (CNC) 8; Bonanza Crk., 12 mi. S.E. Nakusp, Aug., on Salix (RHP) 2; Bowser, May, June, on Salix (CNC) 26; Canal Flats, July, Aug., on Salix (HAHC, RHP) 20; Cowichan Lake, June, on Salix (CNC) 3; Crawford Bay, Kootenay Lake, Aug., on Salix (HAHC, RHP) 18; Creston, May (CU) 1; Duncan, June, on Salix (15) (CNC) 16; Enderby, May, Populus trichocarpa (CNC) 1; Golden, 9 mi. N.W., Aug., on Populus (4), on Salix (11) (HAHC, RHP) 15; Lake Errock, near Deroche,

July, on Salix (4) (CNC) 5; Lakelse L. bog nr. Terrace,
 July (CNC) 2; Langford, Sept. (CNC) 10; MacGillivray
 Crek Game Reserve nr. Chilliwack, June (CNC) 3; Miracle
 Beach nr. Oyster River, June, on Salix (17) (CNC) 21;
 Mission City, June, July (CNC) 3; Oliver, 4 mi. N. (1),
 7 mi. N., June, on Populus (1), on Salix (6) (CNC) 13;
 Revelstoke, 21 mi. W., Aug., on Salix (HAHC, RHP) 15;
 Saanich, May (CNC) 1; Salmon Arm, July (CNC) 1;
 Similkameen R., 7 mi. S. Cawston, Aug., on Salix (HAHC,
 RHP) 10; Sproat Lake, June, on Salix (CNC) 9; U.B.C.
 Forest, Garibaldi Pk. nr. Haney, July (CNC) 1; Vancouver,
 July (CNC) 2; Vernon, May (CAS, CNC) 4; Victoria (USNM)
 1. Manitoba: Aweme, May, June (MCZ, USNM) 2; Carberry,
 May (CNC) 4; Cedar Lake, July, on Salix (CNC) 3; Ninette,
 May, swept ex Salix sp. (CNC) 6; Sherridon, Aug. (SDSU)
 6; Stockton, 2 mi. W., May, swept from aspen (CNC) 3;
 Winnipeg (51 mi. E.), July, on Salix (RHP) 2. New
Brunswick: Bathurst, July, host Salix (CNC) 1; Woodstock,
 July, willow along creek (CNC) 1. Newfoundland: Deer
 Lake, July (CNC) 5; Gander, June, Sept. (1), on Populus
tremuloides (8), on Salix (26) (CNC) 82; Glenwood, Aug.
 (CNC) 2; Lewisporte, June (CNC) 1; South Branch, July
 (CNC) 1; Spruce Brook, July (CNC) 6; Steady Bk., Humber,
 July (CNC) 1; Stephenville Crossing, Harrys River, July
 (CNC) 18. Nova Scotia: Mt. Uniacke, June, on Salix
 (CNC) 13; Newport, June, on Salix (CNC) 12; Truro, July
 (CU) 1; Waverley, June, on Salix (CNC) 2. Ontario:

Bell's Corners, May, June, on Populus (1), on Salix (9) (RHP) 13; Blackburn, May, June, on Populus tremuloides (15), on Salix (39) (CNC) 54; Black Sturgeon Lk., 42 mi. N. Hurkett, June, on Salix (7), general sweep (HAHC, RHP) 18; Delhi, June, on Salix (CNC) 1; Georgetown, May, on Salix petiolaris, S. discolor (RHP) 12; Huntsville, July (OSU) 2; Lk. Superior Prov. Pk., Lk. Mijinemungshing, June, on Salix petiolaris (RHP) 2; Marmora, May, July (CNC) 2; Merivale, May, on Populus tremuloides (1), on Salix (CNC) 49; Minden, May (CNC) 1; Moose Factory, June, on Salix (CNC) 2; Ottawa, May, July, Aug., Sept., Oct., on Populus tremuloides (5), Salix discolor (20), S. fragilis (4), S. gracilis (101), S. petiolaris (44), Salix sp. (44) (CNC, HAHC, RHP) 220; Ramsayville Marsh, May, on Populus tremuloides (2), on Salix (RHP) 9; Simcoe, June, on Salix (CNC) 4; Terra Cotta, July, on Salix (RHP) 5; Toronto (CU) 1; Turkey Point, June, on Salix (CNC) 2; Victoria Harbour, May (CNC) 3; Walsingham, June, on Salix (CNC) 1. Quebec: Brown Lake, Gatineau Park, Oct., on Salix (RHP) 14; Carman Lake, Gatineau Park, June, on Salix (RHP) 8; Duparquet, July, host Salix lucida (CAS) 1; Farm Point, Aug. (RHP) 2; Gatineau Park, June, on Salix (RHP) 1; Hull, May, on Salix (CNC) 5; Lake Memphremagog, June (MCZ) 1; Laniel, June (CNC) 6; Montreal (CAS, CU, SDSU) 5; Villeroy, Ltb., Aug. (CSCA) 3. Saskatchewan: Canora, May (CNC) 3; Englefeld, May (CNC) 6; Oxbow, June, Salix (USNM) 1.

UNITED STATES: Idaho: Coolin, Priest Lake, July (CAS)

1. Maine: Bar Harbor, May, Populus tremuloides (USNM) 1; Casco, Aug. (CU) 1; Orono, June (OSU) 1; Winthrop, Sept. (MCZ) 1. Maryland: Baltimore, June (CAS) 1.

Massachusetts: state record only (CAS) 1; Cambridge (USNM) 1; Florida, June (MCZ) 1; Natick, May (MCZ) 1; Notch Road, S. Amherst, Aug. (USNM) 1; Sherborn, May (CNC) 1. Michigan: Detroit (USNM) 1. Minnesota: Euclid, June (USNM) 1; Mora, June (USNM) 6. Montana: Bozeman, Gallatin Valley, Aug. (SDSU) 2; Kalispell, June (MCZ) 1; Missoula, July (FMNH) 1. New Hampshire: Mt. Washington, Alpine Garden, 5200-5600 ft., Aug. (CNC) 2.

New Jersey: Hillsdale, Nov. (MCZ) 1; Mountain Lakes, June (FMNH) 1. New York: Barre, May, June (CU) 3; Bedford, June (FMNH) 1; Danby, May, July (CU) 2; E. Aurora, July (USNM) 1; Heart Lake, Essex Co., June (CU) 2; Ithaca, May, June, July (CU) 6; McLean, Tompkins Co., May (CU) 1; McLean Res., Inlet Brook, May, June, on Salix (CU) 6; Mt. Whiteface, top, June, July (CU, USNM) 19; Olcott, May (CU) 1; Patterson, May (CU) 2; Paul-Smith, June (CU) 1; Shelby, June (CU) 1; Slide Mt., Ulster Co., June (CU) 1; Southfields, May (CU) 1; West Point, May, June (USNM) 6. Oregon: Burlington, Columbia Co., Oct. (RHP) 3; Dayton, Yamhill Co., April (FMNH) 2; Eugene, June (FMNH) 1; Forest Grove, April (CU) 1; Jolliette, June (CAS) 3; Orenco, May, on willow leaves (USNM) 2; Rainier (CAS) 1; Triangle Lake, Lane Co.,

Sept. (CSCA) 1; Westport, June, on willow leaves (USNM) 2; Willamette Valley, Feb., hibernating in Usnea plicata on oak trees (USNM) 6. South Dakota: Brookings, July (SDSU) 1. Vermont: Brattleboro (USNM) 3. Washington: Hoquiam, willow (USNM) 6; Monroe, July (CAS, USNM) 10; Northbend, King Co., July (CAS) 2; Puyallup, Sept., willow (USNM) 16; Snoqualmie, May (FMNH) 1.

Host Plant: Salix spp., ? Populus tremuloides.

In the material examined, 674 specimens bear food plant data. Of these, 633 specimens (94%) are recorded from Salix spp. or willow including Salix discolor (Ontario), S. fragilis (Ontario), S. lucida (Quebec), S. petiolaris (= gracilis) (Ontario) and Salix sp. or willow (British Columbia, Manitoba, New Brunswick, Newfoundland, New York, Nova Scotia, Ontario, Oregon, Quebec, Saskatchewan, Washington). The remainder (6%) are recorded from Populus tremuloides (Maine, Newfoundland, Ontario), P. trichocarpa (British Columbia) and Populus sp. or aspen (British Columbia, Manitoba, Ontario).

In field studies undertaken by the author in or near Ottawa, Ontario, Crepidodera heikertingeri was found to be very common on Salix petiolaris (figs. 124, 125), feeding on the leaves. Collection by beating showed this species to be numerous also on S. discolor and S. bebbiana growing near S. petiolaris although no actual feeding on these willows was observed. In the

laboratory, all life stages of the beetle were reared successfully on growing, potted S. petiolaris. In a laboratory experiment in which adults were offered a choice of different species of Salix, feeding occurred on leaves of S. petiolaris and S. discolor but not on S. bebbiana. Crepidodera heikertingeri was occasionally collected from S. alba x fragilis but it appeared to be very uncommon on this willow, being far outnumbered by C. solita. Very small numbers of specimens were collected from Populus tremuloides but feeding on this was never observed. I suspect that specimens recorded from Populus occurred there by chance and were not actually using it as a food or host plant.

Life History

Description of immature stages:

EGG: Length about 0.5 mm, width 0.2 to 0.3 mm. Colour creamy-white to light yellow. Chorion finely reticulate (fig. 53).

FIRST INSTAR LARVA: Length about 1.0 mm, greatest width about 0.2 mm. Maximum length of head capsule 0.19 to 0.22 mm, maximum width 0.16 to 0.19 mm. Similar to first instar larva of C. solita n. sp.

SECOND INSTAR LARVA: Length 2.6 to 2.7 mm, greatest width 0.3 mm. Maximum length of head capsule 0.26 to

0.28 mm, maximum width 0.21 to 0.23 mm. Similar to first instar larva except prothoracic tergal shield paler, mesonotum and metanotum without a pair of hatching spines and anal plate with a weakly developed pair of dorsal tooth-like projections at apex.

THIRD INSTAR LARVA: Length 3.0 to 3.3 mm, greatest width 0.4 mm. Maximum length of head capsule (fig. 183) 0.38 to 0.41 mm, maximum width 0.30 to 0.33 mm. Similar to second instar larva except for the following: prothoracic tergal shield (fig. 184) very pale brown, almost white, very lightly sclerotized; anal plate (fig. 186) with apical tooth-like projections strongly developed.

PUPA: Length 2.1 to 2.8 mm. Colour white except eyes and mandibular teeth dark. Head with 3 pairs of dorsal setae -- 1 pair medially on vertex, 1 pair on anterior margins of eyes and 1 pair medially at bases of antennae. Pronotum with 8 pairs of setae -- 2 pairs centrally near anterior margin, 2 pairs medially near centre of disc, 2 pairs medially on lateral margins and 2 pairs on posterior margin. Abdomen with 1 pair of lateral setae per segment and with several additional pairs apically on last segment.

The above descriptions are based on 17 first instar, 2 second instar, 4 third instar larvae and 3 pupae. All of the first instar larvae and 1 second

instar larva were reared from adults collected at Ramsayville Marsh near Ottawa, Ontario. The remaining second instar larva, all third instar larvae and all pupae were collected from soil at Ramsayville Marsh.

Habits:

ADULTS: Specimens have been recorded mainly from April to November. Six adults from Oregon were collected in February and recorded as "hibernating in Usnea plicata on oak trees". Most (86%) of the museum material examined was collected in May, June and July.

In the Ottawa area, overwintered adults appear on the host plants soon after leaves are formed in late April or early May and begin to feed on the leaves. By mid or late May, the beetles are very abundant. Their abundance remains high during June and decreases during July. In 1975, the lowest frequency of adults occurred from mid to late July. Numbers began to increase in early August and continued to do so until September as new-generation adults emerged. Although teneral adults were not collected in the field until Aug. 15, it is probable that they begin to emerge in early August or, perhaps, in late July, depending on the earliness or lateness of the start of the season. In the laboratory, a new adult was first observed in a rearing cage (No. 4) on Aug. 2, 1976 (48 days after overwintered adults were confined) and a second specimen appeared on Aug. 18. Adults were numerous in the field during autumn and continued feeding until the leaves dropped from the host plants. During a warm period around Oct. 25, 1975 when most of the willows were bare, adults were still present on Salix petiolaris bushes which had a few leaves remaining.

Mating was observed from early May until early July in both the 1975 and 1976 season. In several samples of over 100 specimens collected in May, 1975, females outnumbered males which occurred at frequencies ranging from 33% to 42%. A sample collected in mid June consisted of 30% males. In subsequent collections, the proportion of males decreased, reaching a low of 14% in mid July. This indicates that the overwintered males probably die off at a greater rate than the females after the mating period. By early August, however, males had increased in frequency to 25% and, by late September, to 45% of the adult population. In contrast, the proportion of males in a sample of 248 adults collected in late May, 1976 was 65%.

OVIPOSITION: Females were not observed to oviposit either in the field or in rearing experiments. However, females that were brought to the laboratory and confined in plastic bags, deposited eggs as early as May 26. A sample of adults collected for rearing experiments on June 4, 1976 produced eggs until July 20 (36 days). Another group, collected on July 4, produced a large number of eggs until mid July and then continued oviposition at a much lower rate until July 26 (22 days). A few females which were collected on Aug. 5 and 15 produced a few eggs as late as Aug. 25 but these eggs collapsed soon after oviposition. From the above

observations, it is probable that oviposition in the field occurs, generally, from late May until late July. The number of eggs produced by individual females was not determined. Eggs are probably deposited in the soil or vegetation below the host plant. It should be noted, however, that the ground below the host plants in most areas where C. heikertingeri is common is often quite wet during the early summer months.

INCUBATION: The incubation period of eggs in the laboratory ranged from 10 to 14 days (mean 11.5 days). Although a large number of eggs were incubated during June and July, no eggs hatched after the end of June. Many which were produced in late June and early July collapsed during incubation or became infested by molds (Penicillium sp. and Aspergillus sp.).

LARVAE: About 20 first instar larvae were obtained from eggs incubated in petri dishes. The larvae, upon hatching, were entirely pale yellowish-white except for the mandibles which were brown in colour. Darkening and hardening of the head capsule, prothoracic shield and anal plate occurred within the first 1 or 2 hours. A short time after emergence, the larvae began to move actively around the dish, possibly in search of food. When very thin pieces of root of Salix petiolaris were made available, no feeding appeared to occur and the

larvae died 1 to 3 days after emergence.

The last first instar larva to emerge in the petri dishes was offered fresh new willow roots which were thicker than those offered previously. This larva immediately began to feed on a tender white root about 1.0 mm. in diameter. Aligning its body longitudinally along the root, the larva bent its head downwards and chewed a hole in the side of the root. It gradually worked its way into the root and began to mine along the length of the root, feeding on the tissue of the cortex. When observed the next day, the mine extended several mm along the root in both directions from the entrance hole. The mine had a rusty-brown colour due to the frass of the larva and the injury to the root tissues. This larva fed for 4 days until the root deteriorated. When removed from this root and placed on a fresh root of similar size, the larva did not resume feeding but remained inactive and died 3 days later.

When the roots of a willow (Salix petiolaris) removed from a rearing cage (No. 5) on July 5 were examined, several larval mines were found, but no larvae. This was 20 days after adults had been placed in the cage.

Later, on July 27, another potted willow (cage No. 6) was checked and 2 larvae were found -- a first instar and a second instar. The first instar larva, about 1.7 mm in length, was mining in a tiny

root about 8.0 mm long and with a maximum diameter of 0.4 mm (scarcely broader than the larva). This root was a lateral branch of a larger root which had also been mined and which showed several entrance or exit holes. In the small lateral root, the larva had consumed most of the tissue inside the epidermis while, in the main, root, the lignified vascular bundle was still intact.

The second instar larva, about 2.6 mm long, was not found feeding but was collected by floatation when the roots were washed.

Other roots of the same willow plant showed evidence of larval mining. One root, about 7 cm long, had been mined its entire length. Most of the tissue of the cortex and some of the tender tissues (endodermis and pericycle?) surrounding the woody vascular bundle had been consumed. The root was filled with frass which gave it a reddish-brown colour in contrast to the whitish or light yellow-brown colour of uninfested roots. Two head capsules (first instar) and other exuvial remains were also found inside the mined root.

One day after these roots had been examined, the first instar larva left its mine in the small root. It was then placed in a petri dish where the second instar larva had been confined with a piece of root of Salix petiolaris. Since the second instar specimen had not fed on this root, fresh new roots of S. alba x fragilis (the only species available) were placed in the dish. Neither larva began feeding on the roots until

2 days later when both were found mining in 2 separate roots.

The mine of the first instar larva was, at first, close to the epidermis of the root and the larva was positioned with its venter closest to the surface. Later, it fed nearer the centre with its dorsum closest to the surface. The second instar larva fed in a similar manner but with its dorsum always closest to the root surface. After approximately 24 hours, the mine of the latter extended a distance of about 5.0 cm. Both larvae were later removed from the roots and preserved.

No immature stages were found in the roots of the remaining potted willow from cage No. 6 when it was examined on Aug. 12. The roots of 2 S. petiolaris plants growing in an aquarium (cage No. 5), when examined on Sept. 2, contained a few larval mines and some exuviae but the larvae were not successful in reaching the adult stage since no adults emerged. Similarly, no adults were obtained from the potted willow to which 6 first instar larvae had been introduced on June 28. These larvae had initially disappeared down into the soil in the pot immediately after being placed on the surface. In an examination of the roots of this plant on Aug. 23, only a single root contained mines. These appeared to be of first instar larvae.

The duration of the different larval stages was not determined.

PUPAE: No pupae were found in rearing cages. However, pupae were collected by floatation from soil taken from around the roots of S. petiolaris bushes in the field.

Parasites:

A single male of Microctonus crepidoderae Loan (Hymenoptera : Braconidae) was found in a rearing cage (No. 5) on July 15. This, almost certainly, emerged from an overwintered adult of C. heikertingeri.

Remarks

As Lazorko (1974) pointed out, this species was apparently recognized by Heikertinger (1948-1950) who, in a footnote, briefly described a single specimen from Riverdale, New Jersey but did not provide a name. His description of the male genitalia corresponds quite well to that of Lazorko (1974) and the above. Lazorko (1974), however, knew this species only from British Columbia.

The characters given in the diagnosis will separate heikertingeri from all of the other species except, possibly, females of digna and solita. It can be distinguished from digna by the slightly wider elytral margins and the generally stronger punctuation of pronotum and elytra. Females of heikertingeri can usually be separated from those of solita by their slightly broader shape, the slightly wider elytral margins and the dense, uniform pubescence of the first abdominal sternum.

The genitalia of 140 males were examined. Spermathecae were extracted from 8 female specimens.

11. Crepidodera digna new species

Figs. 32-34, 65, 103-105, 141, 157; Map 11.

Diagnosis

This species can be distinguished by: dorsal surface shining black; lateral margins of elytra moderately broad, slightly narrower than in heikertingeri; males similar to those of heikertingeri with metasternum conspicuously setose throughout median region, first abdominal sternum conspicuously hirsute from base to apex; males differing from heikertingeri in having setae of first abdominal sternum slightly shorter and less dense, not forming a brush; middle and hind trochanters, as in heikertingeri, each with a distinct brush of setae on hind margin. The distinctive male genitalia (fig. 141) will also separate digna from all other species. In addition, digna can usually be distinguished from heikertingeri by the generally finer, sparser pronotal punctation and, often, by the outer corners of the anterior pronotal angles being more strongly acute.

Description

HOLOTYPE: Male, length 2.4 mm, greatest width 1.3 mm. Shape (fig. 32) broadly oval, slightly elongate; length less than twice the width. Dorsum shining, metallic; vertex of head, pronotum and elytra black with

a purplish reflection on pronotal disc and with pronotal margins and sutural margins of elytra green; head below vertex green to blue-green; scutellum piceous. Antennae light testaceous in basal one-half, darker in apical one-half to medium reddish-brown. Legs, except hind femora, rufotestaceous; hind femora piceous. Ventral surface shining black.

Vertex of head (fig. 65) along anterior edge of pronotum smooth except for a few scattered fine punctures. Pronotum with sides evenly, moderately arcuate; anterior angles feebly produced, truncation slightly less than length of second antennal segment. Ante-basal transverse groove moderately deep, moderately pronounced. Major punctures of pronotal disc somewhat sparse, irregularly distributed; size moderate to coarse, the latter close or equal to size of basal serial punctures of elytra; punctures in interspaces very minute, much smaller than major punctures. Elytron (fig. 34) at declivity evenly rounded; disc in basal one-half almost evenly convex. Lateral margins of elytra moderately broad in dorsal view, visible for entire length. Elytral striae strongly, distinctly punctate from base to apex. Metasternum medially closely, conspicuously setose. First abdominal sternum (fig. 104) medially with conspicuous, long, semi-erect to erect setae closely placed from base to apex of sternum but not forming a brush. Middle and hind trochanters each

with a distinct posterior marginal brush of setae (fig. 104).

Median lobe of genitalia (fig. 141) 0.7 mm long, evenly arcuate; in dorsal view, gradually tapered apically except slightly broadened near tip; tip rounded with a deep notch at middle. Ventral side smooth except for a short, shallow median furrow at apex.

ALLOTYPE: Female, length 2.8 mm, greatest width 1.5 mm. Similar to male except for sexual differences at apex of abdomen; setae of metasternum and first abdominal sternum (fig. 105) much shorter, less conspicuous and slightly sparser; brush of setae on middle and hind trochanters less distinct; and the following non-sexual differences: pronotal disc without a purplish reflection; antennae entirely rufotestaceous; pronotum with sides slightly sinuous with apical two-thirds moderately arcuate and basal one-third subparallel.

Type Material

HOLOTYPE: Male, Gillam, Manitoba, June 30, 1950, W.J. Brown, on Salix (CNC No. 15399). ALLOTYPE: Female, same data as holotype (CNC No. 15399). Both holotype and allotype are in the Canadian National Collection, Ottawa.

Paratypes, 706 in the following collections: CAS, -CNC, CSCA, CU, FMNH, HAHC, MCZ, OSU, RHP, SDSU, UA, USNM.

CANADA: Alberta: Bilby, June 1, 1924, O. Bryant, 1; Edmonton, May 29, 1916, willow, 1, May 9, 1918, 4, April 26, May 1, various dates in June, July 6, Sept. 21, 1914 to 1918, F.S. Carr, 12; Hotchkiss (30 mi. North), June 3, 1950, P. Rubtsoff, swamp, swept from Salix, 5; McMurray, June 10, 12, 1953, W.J. Brown, on Salix, 7; Slave Lake, Aug. 14, 1924, O. Bryant, 2; Westlock (5 mi. North), June 1, 1950, P. Rubtsoff, swamp, swept from Salix, 1; Whitford Lake, May 18, 1924, O. Bryant, 1.

British Columbia: Port Nelson, June 10, 1948, W.R. Mason, 1; Golden (9 mi. N.W.), Aug. 23, 1973, R.H. Parry, on Salix, 27; Lakelse Lake bog, nr. Terrace, July 11, 1960, J.G. Chillcott, 4; Paul Lake, May 24, 1933, A. Thrupp, 2.

Manitoba: Gillam, same data as holotype and allotype, 6, various other dates in June and July, 1950, W.J. Brown, on Salix, 16; Norway House, June 25, 26, 1938, W.J. Brown, on Salix, on Populus balsamifera (1), 4; Riding Mountain Park, June 8, 1937, W.J. Brown, on Salix, 5; Shilo (5 mi. S.W.), June 5, 1958, J.F. McAlpine, ex Populus balsamifera, floodplain community nr. Tamarack Bog, 1; The Pas, May 28, 1930, O. Bryant, 1; Turtle Mountain For. Res., Int. Peace Gardens, July 17, 1958, J.G. Chillcott, 1; Winnipeg, 51 mi. E., July, on Salix, 4.

Northwest Territories: Norman Wells, June 19, 1948, W.J. Brown, on Salix, 7, July 11, 1949, W.R.M. Mason, 2, May 26, 1953, C.D. Bird, 2.

Nova Scotia: Mt. Uniacke, June 15, 1947, W.J. Brown, on

Salix, 1. Ontario: Alcona (4 mi. E.), June 18, 1973; J.M. Campbell and R. Parry, on Salix, 10; Hurkett (46 mi. N., 56 mi. N.), June 27, 1973, R. Parry and J.M. Campbell, on Populus tremuloides (4), on Salix, 56; Hurkett (42 mi. N., Black Sturgeon Lk.), June 26, 1973, R. Parry and J.M. Campbell, general sweep (24), on Populus tremuloides (9), on Salix (13), 46; Ignace, June 16, 1973, Campbell and Parry, on Salix, 32; Lake Superior Prov. Pk., Lake Mijinemungshing, June 12, 1973, J.M. Campbell and R. Parry, on Salix petiolaris, S. pyrifolia, 20; Moose Creek, 10 mi. S. Sioux Lookout, June 17, 1973, Campbell and Parry, on Alnus (1), on Populus tremuloides (2), on Salix, 59; Moose Factory, June 14, 1949, J.R. Vockeroth, on Salix, 21, June 19, 1949, P.J. Lachaine, on Salix, 7, various dates in June, 1949, D.P. Whillans, on Populus (7), on Salix, 34; Moosonee, June 30, 1973, Campbell and Parry, on Salix, 14, (12 mi. N.E.) July 1, 1973, R. Parry and J.M. Campbell, on Salix, 2; Pickle Lake (various localities 27 m. S. to 109 mi. N.), June 19-22, 1973, Campbell and Parry, on Populus tremuloides (30), on Salix, 193; Savant Lake (16 mi. S., 5 mi. N.), June 23, 1973, Campbell and Parry, on Salix, 27; Thunder Bay, Mt. McKay, 1600 ft., June 15, 1973, J.M. Campbell and R. Parry, on Salix, 2; Whitney, May 21, 1971, R.H. Parry, 1. Quebec: Duchesnay, July 5, 1953, O. Peck, 1; Duparquet, May 13, 29, 1942, G. Stace Smith, on Ribes vulgare, feeding —

Alnus incana, 2, June 16, 19, July 3, 5, 1941, G. Stace Smith, on Ilex verticillata (1), host Salix lucida (7), on Salix (1) (CAS) 9, Sept. 24, 1935, G. Stace Smith, lake shore, 1; Mistassini, June 13, 25, 1956, J.R. McGillis, 8; Mistassini Post, July 5, 1956, J.R. Lonsway, 1; Mt. Lyall, 1500 ft., June 27, 1933, W.J. Brown, 1.

Saskatchewan: Canora, May 28 (1), June 4, 1954, Brooks-Wallis, 6; Prince Albert, July 3, 4, 1954, Brooks-Wallis, 4.

UNITED STATES: Alaska: Fairbanks, elev. 448 ft., Aug. 4, 1951, H.C. Severin, 3. Montana: (Fort?) Assiniboine, Aug. 26, Hubbard and Schwarz, 3; Bear Paw Mt., Aug. 26, Sept. 4, Hubbard and Schwarz, 2; Helena, Hubbard and Schwarz, 1. New Hampshire: Mt. Washington, 5-6000 ft., July 11, 1895 (2), subalpine, July 6, 1899, 3. New York: Jordanville, Nov. 21, 1936, H. Dietrich, 2; Mt. Whiteface, top, June 14, 1943, H. Dietrich, 1, July 7, 1922, J.M. Aldrich, 15, Aug. 1922, Asa Lorenz, 1. South Dakota: Flynn Creek, 5400 ft., 8 mi. N. Pringle, July 8-9, 1961, H. and A. Howden, malt, 1. Utah: Park City, June, 1918, Hubbard and Schwarz, 1.

Variation

Size of the males ranges from 2.1 to 2.7 mm in length and from 1.1 to 1.4 mm in greatest width. Females range from 2.3 to 3.0 mm in length and from 1.2

to 1.6 mm in greatest width. The colour of the dorsal surface is shining black, occasionally with purplish or greenish reflections and often with greenish reflections at the margins. Antennae vary from entirely rufotestaceous to testaceous in the basal one-half with the apical one-half darker as in the holotype. The hind femora range in color from entirely piceous to only partially piceous or dark reddish-brown with the remainder rufotestaceous. The sides of the pronotum vary from evenly, moderately arcuate as in the holotype to slightly sinuous as in the allotype. The anterior pronotal angles range from feebly to somewhat strongly produced as in fig. 33 and the truncation ranges from slightly less to slightly greater than the length of the second antennal segment. The major punctation of the pronotal disc ranges from sparse to moderately dense. Most specimens have the major punctures of moderate size while others have them slightly coarser as in most heikertingeri. A few have these punctures relatively fine and sparse. The elytral disc ranges from almost evenly convex in the basal one-half as in the holotype to gently depressed behind the basal one-quarter as in heikertingeri. Elytral striae apically vary from distinctly punctate to somewhat obsolete. Male genitalia range in length from 0.6 to 0.8 mm. In dorsal view, the median lobe is either continuously tapered apically or has the tip slightly broadened. The notch at the tip ranges from somewhat shallow to

deep. In females, spermathecae are about 0.20 mm long and are similar to fig. 157.

Distribution

Crepidodera digna is widespread across Canada, having a generally more northern range than heikertingeri. It appears to occur mainly in the Boreal Forest region, ranging from Nova Scotia to the Northwest Territories and Alaska, and also in the interior of British Columbia. The range extends south to high elevations in New Hampshire and New York in the east and South Dakota and Utah in the west (map 11).

Host Plant: Salix spp., ? Populus tremuloides.

Food plant data were available for 588 specimens in the material examined. Of these, 530 (90%) were recorded from Salix spp. (Alberta, British Columbia, Manitoba, Northwest Territories, Nova Scotia, Ontario, Quebec) including 7 specimens from Salix lucida (Quebec) and 20 from S. petiolaris and S. pyrifolia (Ontario). Of the remainder, 54 specimens were recorded from Populus spp., including 45 from P. tremuloides (Ontario) and 2 from P. balsamifera (Manitoba). Four (4) specimens were recorded from Alnus (Ontario, Quebec), Ribes vulgare (Quebec) and Ilex verticillata (Quebec). I suspect that these last three host records are accidental or very unusual occurrences. I personally have taken

this species primarily on Salix, including S. petiolaris and S. pyrifolia, and only occasionally on Populus tremuloides.

Life History: Immature stages unknown.

Although adults have been recorded from April to November, the greatest abundance appears to occur from May through August. Most of the material examined was collected in June,

Remarks

Crepidodera digna and the closely related heikertingeri overlap in their ranges and both species seem to live in similar habitats. In at least three localities, Lake Mijinemungshing (Lake Superior Provincial Park), Ontario, Black Sturgeon Lake, Ontario, and near Golden, British Columbia, both species were collected in the same habitat from the same species of Salix.

The genitalia of about 100 males were examined. Spermathecae were extracted from 11 female specimens.

12. Crepidodera populivora new species

Figs. 35-37, 66, 106-108, 124, 126, 142, 158; Map 12.

Diagnosis

This species can be distinguished by: dorsal surface dark purple to black, rarely blue, blue-green or dark green; anterior pronotal angles feebly produced; pronotal ante-basal transverse groove strongly pronounced; major pronotal punctures sparse to dense, moderate to coarse in size, irregularly distributed; elytral declivity evenly rounded except in some females which have elytra slightly bulging laterally to overhang lateral margins; elytral disc at most only very gently depressed behind basal one-quarter; lateral margins of elytra narrow, visible for their entire length except when partially hidden by a bulge at the declivity in some females; males with pubescence of first abdominal sternum longer and more conspicuous than in females and uniformly dense, not forming a brush.

Description

HOLOTYPE: Male, length 3.0 mm, greatest width 1.5 mm. Shape (fig. 35) oval, slightly elongate; length equal to twice the width. Dorsum shining, metallic; vertex of head dark green, pronotum and elytra dark purple, margins of pronotum greenish; head below vertex blue-green; scutellum black. Antennae and legs

rufotestaceous. Ventral surface shining black.

Vertex of head (figs. 36, 66) along anterior edge of pronotum smooth, very finely punctulate. Pronotum (fig. 36) with sides slightly sinuous with apical two-thirds moderately arcuate and basal one-third subparallel; anterior angles feebly produced, truncation slightly less than length of second antennal segment. Ante-basal transverse groove deep, strongly pronounced. Major punctures of pronotal disc moderately dense, irregularly distributed; size moderate to coarse, the latter close or equal to size of basal serial punctures of elytra; punctures in interspaces minute, much smaller than major punctures. Elytron (fig. 37) at declivity evenly rounded; disc in basal one-half almost evenly convex. Lateral margins of elytra narrow in dorsal view, visible for entire length. Elytral striae strongly, distinctly punctate from base to apex. Metasternum medially sparsely, inconspicuously setose except glabrous near midline in posterior two-thirds. First abdominal sternum (fig. 107) medially with conspicuous, moderately long semi-erect setae very closely, uniformly placed, not forming a brush. Middle and hind trochanters with a few inconspicuous setae as in adjacent parts of femora.

Median lobe of genitalia (fig. 142) 0.8 mm long, evenly arcuate except slightly recurved at apex; in dorsal view, slightly broadened apically in apical two-thirds; tip broadly rounded. Ventral side without

conspicuous sculpture except for a shallow longitudinal median furrow at apex.

ALLOTYPE: Female, length 3.2 mm, greatest width 1.6 mm. Similar to male except for sexual differences at apex of abdomen (fig. 108), setae of metasternum and first abdominal sternum shorter and less conspicuous, elytron at declivity very slightly bulging laterally to overhang and hide part of lateral margin.

Type Material

HOLOTYPE: Male, Blackburn, Ontario, May 21, 1963, W.J. Brown, on Populus tremuloides (CNC No. 15400).

ALLOTYPE: Female, same data as holotype (CNC No. 15400).

Both holotype and allotype are in the Canadian National Collection, Ottawa.

Paratypes, 1389, in the following collections: CAS, CNC, OSCA, CU, FMNH, HAHC, MCZ, OSU, RHP, SDSU, UA, USNM.

CANADA: Alberta: Beaverlodge, May, 1; Bilby, May, July, 2; Edmonton, May, June, willow (1), 13; Hotchkiss (30 mi. N.), June, swamp, swept from Salix, 2; McMurray, June, July, on Populus tremuloides (26), on Salix (1), 28; Peace River (18 mi. South), June, swept from Salix and grass, 4. British Columbia: Agassiz, May, 9; Alaska Hwy., Lum and Abner, 58°N, Aug., on Populus balsamifera, 6; Canal Flats, July, on Salix, 1; Carbonate,

3

Columbia Riv., Alt. 2600 ft., July, 1; Creston, May, 9;
 Enderby, May, Populus trichocarpa, 2; Gleneden, Aug.,
 2; Golden (9 mi. N.W.), Aug., on Cornus (1), Populus
 (15), Salix (2), 18; Hatzic, July, on Salix, 1;
 MacGillivray Creek Game Reserve, nr. Chilliwack, June,
 1; Mission City, June, 1; Similkameen R., 7 mi. S.
 Cawston, Aug., on Populus, 1; Stanley, Aug., 1; Tappen,
 Aug., 1; Vernon, 1; Victoria, June (1), 2. Manitoba:
 Morris, May, 1; Ninette, May, June, oak-aspen community,
 ex Populus tremuloides, 31; Norway House, June, on
Populus tremuloides, 2; Riding Mt. Pk., June, on Populus
tremuloides, 2; Stockton (2 mi. W.), May, ex Populus
tremuloides, 2; The Pas, May, 4; Winnipeg, May, June, 6.
New Brunswick: Bathurst, July, host Salix, 3; Boiestown,
 July, 4; Chatham, July, 1; Lindsay, July, willow, 1;
 Perth, July, willow, 3; Tabusintac, June, on aspen, 1.
Northwest Territories: Simpson, Sept., 2. Nova Scotia:
 Amherst, June, 1; Mt. Uniacke, June, on Populus
tremuloides (10), Salix (3), 13; Newport, June, on
Populus tremuloides (13), Salix (9), 22; Truro, June,
 July, 4; Waverley, June, on Salix, 10. Ontario:
 Armstrong (52 mi. S.), June, on Populus, 20; Arnprior,
 June, on Populus balsamifera, 26; Bell's Corners, May,
 June on Populus (10), Salix (1), 13; Blackburn, same
 data as holotype and allotype, 144; May, June, on
Populus tremuloides (15), Salix (2), 17; Clifford, June,
 1; Constance Bay, July, on Populus balsamifera (9),

Salix (3), 12; Georgetown, Aug., on Salix, 1; Gold Rock
 (Rainy R. Dist.), July, 1; Gull R. Falls, Mindan, May,
 1; Hurkett (42 mi. N.), Black Sturgeon Lk., June, general
 sweep (1), on Populus tremuloides (3), Salix (1), 5;
 Hurkett (56 mi. N.), June, on Salix, 1; Ignace, June, on
Populus (2), Salix (3), 5; Lake Superior Prov. Pk.,
 Frater, Noisy Bay, Old Woman Bay, June, on Populus
balsamifera (1), on Populus tremuloides (3), 15; Marmora,
 May, 1; Merivale, May, on Populus tremuloides (52);
Salix (3), 55; Moose Creek, 10 mi. S. Sioux Lookout,
 June, on Populus (2), Salix (2), 4; Moose Factory, June,
 on Populus (2), Salix (6), 16; Osgoode, Oct., 2; Ottawa,
 May, June, Sept., feeding on Alnus incana (12), on aspen
 (2), on Populus sp. (2), Populus tremuloides (34), Salix
fragilis (1), Salix gracilis (7), Salix sp. (34), 96;
 Pickle Lake (25, 27 mi. S.), June, on Populus (58),
Salix (1), 59; Pt. Pelee, June, on Populus tremuloides,
 26; Ramsayville Marsh, April, May, June, July, on Populus
tremuloides, 9; Savant Lake (5 mi. N., 16 mi. S.), June,
 on Populus tremuloides (7), Salix (1), 8; Terrace Bay
 (9 mi. E.), June, on Populus (3), Salix (1), 4; Terra
 Cotta, July, on Populus balsamifera (2), P. tremuloides
 (10), 12; Thunder Bay, Mt. McKay, 1600 ft., June, on
Populus (31), Salix (1), 32. Quebec: Anc. Lorette,
 June, 1; Brome, May, on Populus tremuloides, 4; Carman
 Lake, June, on Populus grandidentata (10), P. tremuloides
 (2), 12; Duchesnay, July, Aug., 2; Duparquet, May, June,

July, Sept., on Alnus incana (7), Betula alba (1),
Cornus amomum (12), Crataegus (11), Eupatorium purpureum
 (11), Ilex verticillata (11), Populus balsamifera (9),
P. tremuloides (27), Salix discolor (13), S. lucida (8),
Salix sp. (13), wild rose (4), 126; Gaspé, June, on
Salix (10), 11; Gaspé (25 mi. W.), June, on Salix, 16;
 Hull, May, June, on Populus grandidentata (51), P.
tremuloides (29), Salix (1), 82; Knowlton, June, 1;
 Laniel, June, 2; Mégantic, July, 4; Montréal, 2; Mt.
 Albert (north base, 650 ft.), June, 1; Mt. Jacques
 Cartier, 4000 to 4150 ft., July, on Salix, 25; Rimouski,
 July, 6; St. Alexandre, Aug., 1. Saskatchewan:
 Assiniboia, June, 1; Val Marie, June, on Populus
tremuloides, 23.

UNITED STATES: Colorado: Steamboat Springs, June, Aug.,
 Oct., el. 6800 ft., 10. Connecticut: Hartford, 1.
Maine: Bar Harbor, May, July, Populus tremuloides (103),
 104; Lebson, July, 1; Monmouth, July, 1; Mt. Katahdin,
 summit, el. 5215 ft. (2), June, Aug., 5; Paris, June,
 on Populus, 1; Weld, June, 1. Massachusetts: state
 record only, 1; Charlemont, July, Populus tremuloides,
 3; Dracut, 1; Florida, June, 1; Holyoke, July, 1; Little
 Deer R., July, Populus tremuloides, 1; No. Adams, July,
 2; Springfield, May, on Populus tremuloides (4), 5.
Michigan: Detroit, 1; Hrn. Mtn. Club, June, 1;
 Marquette, July, 1; Port Sanilac, Sanilac Co., July,

1; Sanford, Midland Co., July, 1. Montana: Gallatin Co., July, elev. 4800 ft., 2; Kalispell, June, 2. New Hampshire: Mt. Washington, Alpine Garden 5200-5600 ft., Cow Pasture 5700 ft., Lakes of the Clouds 5000 ft., subalpine, July, Aug., 8; Rumney, Aug., 2; White Mts., 1500 ft., "Glen", June, 3. New York: Buffalo, 1; Chenango Co., July, 1; Croton Falls, May, 1; Crown Pt., June, 1; Gainesville, June, 1; Great Kills, S.I., May, July, 3; Heart Lake, Essex Co., June, 3; Ithaca, April, May, June, 3; Lancaster, July, 1; Long Eddy, June, 2; Mt. MacIntyre, top (2), June, July, 3; Mt. Marcy, top, June, 1; Mt. Whiteface, top, July, 10; Napeague, L.I., June, 3; Olcott, May, 4; Peru, Clinton Co., June, 4; Portage, May, 6; Slide Mt., Ulster Co., June, 1; Underwood, June, 2; Up. Saranac, July, 2; Whitehall, June, 1. Oregon: Hood River, 1. Pennsylvania: McKean Co., June, 3; Pocono Lake, Aug., 4. South Dakota: Englewood, July, 1; Pierre, June, 1; Seechee Hollow, June, 3; Spearfish, June, 1; Sturgis, July, 1; Sylvan L. (2 mi. S.), Black Hills, July, 1. Utah: Fillmore, Aug., 1. Wisconsin: Bayfld. (Bayfield), 3. Wyoming: Jenny Lk., Gr. Tetons, June, 28.

Variation

Males range from 2.2 to 3.3 mm in length and from 1.1 to 1.7 mm in greatest width. Females range from 2.4 to 3.5 mm in length and from 1.2 to 1.8 mm in

greatest width. In both sexes, length ranges from slightly less than twice the width to equal twice the width, rarely slightly greater. There is very little variation in colour in most of the type series. The colour of the pronotum and elytra normally varies from dark purple with greenish margins to black, occasionally with greenish reflections. The head has the vertex similar in colour to the pronotum and elytra or dark green. Geographical variation in colour is exhibited by 12 paratypes from the lower Fraser Valley of British Columbia. These have the head, pronotum and elytra dark blue to blue-green or dark green. In the whole series, hind femora range from entirely rufotestaceous to partially or entirely piceous. The sides of the pronotum are generally slightly sinuous as in the holotype and allotype with the apical two-thirds ranging from feebly to moderately arcuate. A few specimens have the sides evenly, moderately arcuate. The truncation of the anterior pronotal angles ranges from slightly less than to equal the length of the second antennal segment. The major punctation of the pronotal disc ranges from sparse to dense. Size of the major punctures varies among specimens, some having them all of moderate size, others with them moderate to coarse or all somewhat coarse, and rarely with them fine to moderate. The punctures of the interspaces of the pronotal disc range in size from minute to about one-half the diameter of the smaller

major punctures. In females, the declivity of the elytron ranges from evenly rounded to slightly bulging laterally as in the allotype, with the bulge overhanging and hiding part of the lateral elytral margin in dorsal view. The elytral disc ranges from almost evenly convex in the basal one-half as in the holotype to very gently depressed behind the basal one-quarter. Male genitalia range from 0.7 to 0.9 mm in length. In dorsal view, the median lobe varies from slightly broadened apically to slightly narrowed with the tip broadly to slightly narrowly rounded. In females, spermathecae range from 0.17 to 0.22 mm in length and are similar to fig. 158.

Distribution

Crepidodera populivora is widespread across Canada and the northern United States. The range extends from Nova Scotia to British Columbia and the Northwest Territories and south to Pennsylvania in the east and Oregon, Utah and Colorado in the west (map 12).

Host Plant: Populus spp., ? Salix spp.

Host plant records were available for 1,119 specimens in the type series. Of these, 853 (76%) are recorded from aspen or Populus spp. including Populus balsamifera (53 - British Columbia, Ontario, Quebec), P. grandidentata (61 - Quebec), P. tremuloides (587 - Alberta, Manitoba, Nova Scotia, Ontario, Quebec, Saskatchewan,

Maine, Massachusetts), P. trichocarpa (2 - British Columbia). Of the remainder, 196 (18%) specimens are recorded from willow or Salix spp. including Salix fragilis (1 - Ontario), S. petiolaris (= gracilis) (7 - Ontario), S. discolor (13 - Quebec), S. lucida (8 - Quebec). The remaining specimens (6%) are recorded from a variety of plants including Alnus incana (19 - Ontario, Quebec), Cornus amomum (12 - Quebec), Cornus sp. (1 - British Columbia), Crataegus sp. (11 - Quebec), Eupatorium purpureum (11 - Quebec), Ilex verticillata (11 - Quebec), Betula alba (1 - Quebec), and wild rose (4 - Quebec). I suspect that these latter records are accidental occurrences.

I personally have collected this species mainly from Populus tremuloides and occasionally from P. balsamifera, P. grandidentata and Salix spp.. In field studies conducted in the Ottawa area, Crepidodera populivora was found to be common on Populus tremuloides and P. grandidentata. In one locality (Ramsayville Marsh, Ontario, figs. 124, 126), C. populivora is the dominant species on Populus tremuloides which grows in close proximity to several species of Salix. In several collections made during two seasons, Crepidodera populivora made up from 80% to 100% of the Crepidodera specimens taken from Populus. The other specimens were Crepidodera heikertingeri and C. decora which are more commonly found on Salix spp.. In this locality, C.

populivora was rarely taken on the nearby Salix spp. where C. heikertingeri and C. decora are abundant. It is probable that the few specimens of populivora taken on Salix spp. occurred there by accident. From these observations it seems doubtful that C. populivora uses Salix spp. as host plants.

Life History: Immature stages unknown.

Adults have been recorded from April to October. Most (95%) were collected during May, June and July.

In the Ottawa area, overwintered adults appear on Populus spp. after the leaves unfold in late April or early May. Mating occurs during May and June. Their numbers generally decrease during July as the old adults die and increase in August when the new generation emerges. These new adults feed on the leaves of the host plants until the weather becomes too cold or until the leaves fall in October. At this time, they disappear from the host plants, probably into sheltered places in debris or litter where they spend the winter.

Remarks

The genitalia of 184 males were examined and spermathecae were extracted from 9 females.

The characters given in the diagnosis should separate this species from all other North American species. Females of populivora may be confused with

similarly-coloured females of vaga. They can usually be separated from this species by the slightly broader and more convex body, the elytra occasionally slightly bulging at the declivities and the generally slightly narrower elytral margins. The shape of the spermatheca (fig. 158) will easily separate populivora from vaga.

Although differing in some important characters given in the diagnosis, populivora seems to be most closely related to bella and aereola. All three species have a similar pattern of pubescence on the first abdominal sternum in males, similarly shaped male genitalia and generally similar spermathecae.

13. Crepidodera bella new species

Figs. 38-40, 52, 67, 109-111, ~~143~~, 159; Map 13.

Diagnosis

This species can be separated from all the other North American species by: dorsal surface coppery-bronze, dark bronze or black; shape elongate-oval; vertex of head strongly, distinctly punctate at anterior edge of pronotum; elytral declivity evenly rounded; elytral disc with a distinct depression behind basal one-quarter; lateral margins of elytra moderately broad, visible for their entire length; males with pubescence of first abdominal sternum longer and more conspicuous than in females and uniformly dense, not forming a brush.

Description

HOLOTYPE: Male, length 2.5 mm, greatest width 1.2 mm. Shape (fig. 38) elongate-oval; length slightly greater than twice the width. Dorsum shining, metallic; head, pronotum and elytra dark coppery-bronze; scutellum black. Antennae and legs rufotestaceous. Ventral surface shining black with greenish reflections in prosternum, metasternum and first abdominal sternum.

Vertex of head along anterior edge of pronotum closely, moderately punctate (figs. 39, 67). Pronotum (fig. 39) with sides slightly sinuous with apical two-thirds moderately arcuate and basal one-third subparallel;

anterior angles feebly produced, truncation slightly less than length of second antennal segment. Ante-basal transverse groove deep, strongly pronounced. Major punctures of pronotal disc dense, irregularly distributed; size moderately coarse, close or equal to size of basal serial punctures of elytra; punctures in interspaces fine, much smaller than major punctures. Elytron (fig. 40) at declivity evenly rounded; disc strongly, distinctly depressed behind basal one-quarter. Lateral margins of elytra moderately broad in dorsal view, visible for entire length. Elytral striae strongly, distinctly punctate from base to apex. Metasternum medially somewhat closely, conspicuously setose except glabrous near midline in posterior two-thirds. First abdominal sternum (fig. 110) medially with conspicuous, moderately-long, erect setae very closely, uniformly placed, not forming a brush. Middle and hind trochanters each with a rather loose, inconspicuous posterior marginal brush of setae.

Median lobe of genitalia (fig. 143) 0.7 mm long, evenly arcuate from base to apex; in dorsal view, slightly broadened apically in apical two-thirds; tip rounded. Ventral side smooth, without sculpture.

ALLOTYPE: Female, length 2.8 mm, greatest width 1.4 mm. Similar to male except for sexual differences at apex of abdomen (fig. 111); setae of metasternum and first abdominal sternum shorter, slightly sparser, and less conspicuous; and the following non-sexual dif-

ference: anterior pronotal angles with truncation equal to length of second antennal segment.

Type Material

HOLOTYPE: Male, Copeland, Florida, June 28, 1963, D.G. Kissinger, on Salix (CNC No. 15401).

ALLOTYPE: Female, same data as holotype (CNC No. 15401).

Both holotype and allotype are in the Canadian National Collection, Ottawa.

Paratypes, 39, in the following collections:

CNC, CU, HAHC, MCZ, RHP, USNM.

UNITED STATES: Alabama: Spring Hill, June 1, 1917, H. P. Loding, 1. Florida: state record only, 1; Arcadia, July 10, 1963, D.G. Kissinger, on Salix, 4; Copeland, same data as holotype and allotype, 12, July 28, 1963, D.G. Kissinger, on Salix, 3; Elfers, April 16, 1952, O. Peck, on Salix, 1; Ft. Ogden, April 8, 1952, J.R. Vockeroth, on Salix, 2; Homestead, June, 1929, Darlington, 2; Homestead, Royal Palm Park, July 23, 1927, M.D. Leonard, 1; Oviedo, March 10, 1927, F.M. Uhler, 1; Paradise Key, April 6, 1951, H. and A. Howden, sweeping field, 1; Starke, March 18, 1950, H. and A. Howden, sweep, 1. Louisiana: Mansura, Jan. 27, 1909, 1; Tallulah, Aug. 13, 1936, cotton, 1. South Carolina: Yemassee, May 4, 1940, Salix, W.J. Brown, 7.

Variation

Size of the males ranges from 2.2 to 2.5 mm in length and from 1.1 to 1.2 mm in greatest width. Females range from 2.3 to 2.9 mm in length and from 1.1 to 1.4 mm in greatest width. In both sexes, length ranges from equal to twice the width to slightly greater than twice the width. The colour of the head, pronotum and elytra ranges from coppery-bronze to dark bronze or black. In the head, the clypeus and genae are occasionally greenish. The sides of the pronotum are generally slightly sinuous with the apical two-thirds ranging from feebly to moderately arcuate. In a few specimens, the sides are evenly, moderately arcuate. The anterior pronotal angles have the truncation slightly less than to equal to the length of the second antennal segment. The major punctation of the pronotal disc is generally somewhat coarse, the size of the major punctures ranging from moderate to coarse with the latter about equal to the size of the basal serial punctures of the elytra. Punctures in the pronotal interspaces range in size from minute to about one-half the diameter of the major punctures.

In females, spermathecae range from 0.15 to 0.16 mm in length and are similar to fig. 159.

Distribution

Crepidodera bella occurs in the southeastern

United States from South Carolina to southern Florida and west to Louisiana (map 13).

Host Plant: Salix sp.

Food plant information is available for 30 specimens in the type series. Of these, 29 (including holotype and allotype) are recorded from Salix in Florida and South Carolina. A paratype from Louisiana is recorded from cotton but I suspect that this is an accidental occurrence.

Life History: Immature stages unknown.

Adults have been recorded from January to August. The majority (90%) were collected during April, May, June and July with June being the peak month.

Remarks

The genitalia of 10 males were examined and spermathecae were dissected from 3 females.

Although distinctly different in some characters, bella appears to be most closely related to aereola and populivora. All three species are very similar in the pattern of pubescence on the first abdominal sternum in males, the shape of the male genitalia, and in the general shape of the spermatheca.

14. Crepidodera aereola (LeConte) new combination

Figs. 41-43, 68, 112-114, 144, 160; Map 14.

Haltica aereola LeConte 1857 (1860), p. 68 (type locality, San Francisco, California).

Crepidodera helxines (L.); Crotch (misidentification) 1873, p. 71 (in part); Hamilton 1889, p. 149; Horn 1889, p. 316; Hamilton 1894, p. 399; Duckett 1920, p. 149.

Chalcoides helxines (L.); Beller and Hatch 1932, p. 128, 129 (in part).

Chalcoides fulvicornis (Fabr.); Heikertinger and Csiki (misidentification) 1939, p. 320 (in part).

?Chalcoides fulvicornis nana (Say); Heikertinger 1948-1950, p. 110 (fig.), 115, 136-137 (in part); Lazorko 1974, p. 148 (fig.), 152.

Diagnosis

This species can be separated from all the other North American species by the strongly produced anterior pronotal angles with the outer corners acutely pointed, the dense, irregularly distributed, very coarse punctation of the pronotum (figs. 41, 42), the males with the median pubescence of the first abdominal sternum longer and more conspicuous than in females and uniformly dense, not forming a brush, and its western range.

Description

MALES: Length 2.2 to 2.8 mm, greatest width 1.1 to 1.4 mm. Shape (fig. 41) elongate-oval; length equal to about twice the width. Dorsum shining, metallic; vertex of head, pronotum and elytra dark green, bronze-green or cupreo-aeneous to coppery-bronze, dark bronze, purplish or black, and with margins generally greenish; head below vertex green to blue-green; scutellum piceous. Antennae and legs rufotestaceous with hind femora occasionally partially or entirely piceous. Ventral surface shining black with green reflections in prosternum, metasternum and first abdominal sternum.

Vertex of head (figs. 42, 68) along anterior edge of pronotum smooth, occasionally with a few scattered fine punctures. Pronotum (fig. 42) with sides slightly sinuous with apical two-thirds feebly arcuate and basal one-third subparallel; anterior angles strongly produced, truncation from slightly less to slightly greater than length of second antennal segment. Antebasal transverse groove moderately deep, moderately to strongly pronounced. Major punctures of pronotal disc dense, irregularly distributed; size generally very coarse, equal to or slightly greater than size of basal serial punctures of elytra; punctures in interspaces minute, much smaller than major punctures. Elytron (fig. 43) at declivity evenly rounded; disc in basal one-half almost evenly convex to very gently depressed

behind basal one-quarter. Lateral margins of elytra generally narrow, occasionally moderately broad in dorsal view, visible for entire length. Elytral striae strongly, distinctly punctate from base to apex. Metasternum medially somewhat sparsely to closely, conspicuously setose except glabrous near midline in posterior two-thirds. First abdominal sternum (fig. 113) medially with long, conspicuous erect setae densely and uniformly placed from base to apex, not forming a brush. Middle and hind trochanters with a few inconspicuous setae as in adjacent parts of femora.

Median lobe of genitalia (fig. 144) 0.7 to 0.8 mm long, evenly arcuate from base to apex; in dorsal view, apical two-thirds gradually tapered to apex or of even thickness except slightly narrowed at tip; tip rounded. Ventral side with a shallow longitudinal impression on each side at middle and a shallow, median, longitudinal furrow at apex.

FEMALES: Length 2.4 to 3.3 mm, greatest width 1.2 to 1.6 mm. Similar to males except for sexual differences at apex of abdomen (fig. 114) and setae of metasternum and first abdominal sternum shorter and less conspicuous. Spermatheca (fig. 160) 0.14 to 0.18 mm long.

Type Material

LECTOTYPE: here designated, female, with a circular gold label which denotes California, a red label "type 8258" and the following labels: "A. (C.) aereola Lec. S. Fr."/"Lectotype ♀, Crepidodera aereola (Lec.), R.H. Parry, 1976". This specimen is in the LeConte Collection, Museum of Comparative Zoology, Harvard University. The lectotype is accompanied by a male and a female specimen, each with a circular gold label. These are evidently syntypes. In addition, the LeConte Collection contains two females labelled "Cal." and a male with no label. These are similar to the lectotype but are probably not part of the type series.

Distribution

Crepidodera aereola occurs in the western United States, ranging from southern California to Washington and east to Utah and southwestern Wyoming (map 14).

Material examined: 474 specimens.

UNITED STATES: California: state record only (CU, MCZ, USNM) 10; Alameda Co. (CU, OSU, USNM) 8; Bear Lake, Tuolumne Co., June (CSCA) 2; Big Pine, Inyo Co., June (CAS) 2; Bijou, June (OSU) 1; Bishop, 10 mi. N.W., Inyo Co., June (CAS) 1; Bryson, April (CAS) 1; Carmel,

Monterey Co., Feb., April, on willow (1) (CAS) 4; Castle
 Crag, July (USNM) 1; Chiquito Creek, Madera Co., 4100
 ft., April (CU) 2; Cole, July (CAS) 1; Colma, May, from
 apricot (CSCA) 1; Cool, 4.5 mi. E., El Dorado Co., March,
 ex Salix (CSCA) 2; Crescent City, Del Norte Co., Sept.
 (CSCA) 1; Crescent Mills, Plumas Co., July (CSCA) 1;
 Cressy, Merced Co., April (CAS) 1; Dalton Creek, Fresno
 Co., 4800 ft., May (CU) 7; Drytown, 2 mi. S.E., Amador
 Co., April, ex Salix (CSCA) 103; Dunsmuir (USNM) 1;
 Eureka, Humboldt Co., May, ex Rubus sp. (CSCA) 2;
 Fairfax, Marin Co. (CAS) 1; Fallen Leaf, Eldorado Co.,
 6500 ft. (1), July (CAS, FMNH) 4; Forrestville, May
 (CSCA) 5; Glennville, Kern Co., July, ex cocklebur (CSCA)
 1; Gold Lake, Sierra Co., July (CAS) 1; Gray Mtn., Tulare
 Co. (CAS) 1; Greenwood, 2 mi. W., El Dorado Co., March,
 April (CSCA) 21; Half Moon Bay, April (CAS) 2; Hayward,
 April (CSCA) 1; Hopland, May (CAS) 1; Kings Canyon N.P.,
 June (CAS) 13; Konocti Bay, Clear Lk., May (CAS) 1; Lake
 City, Modoc Co., Aug. (CAS) 2; Lake Tahoe, June (CAS) 6;
 Lassen Co., June (FMNH) 1; LeeVining, Mono Co., July
 (CSCA) 1; Los Angeles (CAS, USNM) 2; Los Gatos, June
 (CAS) 1; McClure, June (CAS) 1; Mirror Lake, Yosemite,
 Aug. (CU) 1; Monterey Co., March (MCZ) 1; Mt. Diablo,
 March (CSCA) 1; Oakland, hills back of, April (CAS) 1;
 Orinda, Contra Costa Co., June, Salix (1) (CAS, FMNH) 2;
 Oroville, March, April, May, July, ex Salix lasiolepis
 (22), ex Salix (4) (CAS) 46; Paso Robles, April (CAS) 1;

Placer Co., July (CSCA) 1; Plumas Co., June (1) Aug.
 (FMNH) 6; Plummer Springs, Trinity Co., June (CAS) 1;
 Portola Valley, San Mateo Co., Oct. (CAS) 1; Poso, July
 (CSCA) 1; Quincy, Plumas Co., July, ex native annuals
 (CSCA) 1; Sacramento, March, April, May, ex Salix (1),
 willow (9) (CAS, CSCA, FMNH, USNM) 38; San Francisco,
 March, April, Oct. (CAS, OSU) 9; San Jose (USNM) 1; San
 Juan Bautista, San Benito Co., March, Salix sp. (CSCA)
 12; San Luis Obispo, 5 mi. S., April, willow (CAS) 2;
 San Mateo, Sept., Nov., Salix (4) (CAS, FMNH) 5; San
 Rafael, June (CAS) 2; Santa Barbara, March, April (CU,
 MCZ) 2; Santa Clara Co. (FMNH, USNM) 3; Santa Cruz Co.
 (FMNH) 1; Santa Rosa, April (CU, OSU) 7; Scotia, May
 (USNM) 1; Shasta Spgs., June (CAS) 1; Sierra Co., June
 (FMNH) 2; Sierraville, 12 mi. S., Sierra Co., July (CNC)
 1; Siskiyou Co., Aug. (USNM) 3; Six Rivers N. F., 1200
 ft., Humboldt Co., Aug. (CNC) 2; Sonoma Co. (MCZ, USNM)
 6; Stanford U., Santa Clara Co., March, April, Aug.
 (CAS) 16; Susanville, Lassen Co., April (CAS) 2; Tallac,
 July (CAS) 1; Tocaloma, Pt. Reyes Rd., July (CAS) 6;
 Trinidad, June (CAS) 5; Westwood, June (CNC) 1; Yosemite,
 4000 ft., May (CAS) 1; Yosemite Valley, July (CAS) 3;
 Yuba Co., April (FMNH) 4. Nevada: L. Tahoe, Ormsby Co.,
 July (CNC) 2; Sparks, June (CAS) 1. Oregon: state
 record only (CAS, USNM) 2; Chandler State Park, Lake Co.,
 May, June (FMNH) 5; Corvallis, April, June (CSCA, CU)
 2; Dayton, April (USNM) 7; Deschutes Co., June (FMNH) 1;

Eugene, Aug. (FMNH) 2; S.E., Aug. (FMNH) 1; Willamette Valley, Feb., hibernating in Usnea plicata on oak trees (USNM) 1. Utah: Logan, June, July (CAS, USNM) 4; Monroe, Aug., on sugarbeets (USNM) 1; South Creek, Beaver Co., June (USNM) 1. Washington: state record only (USNM) 1; Colfax, July (CAS) 1; Easton (CAS, USNM) 9; Lewis and Clark State Park, Waitsville, Sept., on Salix sp. (USNM) 5; Monroe, Sept. (CAS) 1; Olympia, June (MCZ) 1; Skokomish R., June (USNM) 1; Winthrop, Aug., on willow (USNM) 4; Yakima River, Yakima Co., June, weeds (USNM) 1. Wyoming: Evanston (USNM) 1.

Host Plant: Salix sp.

In the material examined, 70 specimens are recorded from Salix sp. or willow. These include 22 specimens from Salix lasiolepis. In addition, 7 specimens are recorded from various other plants including bus sp.; apricot, cocklebur, sugarbeets, "native annuals" and "weeds". I suspect that these latter records are accidental occurrences.

Life History: Immature stages unknown.

Adults have been taken from February to November in California. They appear to be most abundant in this state from March to August. In Oregon, specimens are recorded from April to August, except for a single specimen collected in February in Willamette

Valley. This specimen is recorded as "hibernating in Usnea plicata on oak trees". In Washington, specimens are recorded from June to September.

Remarks

The genitalia of 22 males were examined and spermathecae were extracted from 6 females.

Although easily distinguished by some of the characters given in the diagnosis, aereola appears to be most closely related to bella and populivora in having a similar pattern of pubescence on the first abdominal sternum in males, similar male genitalia, and a generally similar spermatheca.

15. Crepidodera sculpturata (Lazorko) new combination

Figs. 44-46, 69, 115-117, 145, 161; Map 15.

Chalcoides sculpturata Lazorko 1974, p. 148 (fig.), 149, 150, 152 (type locality, Creston, British Columbia).

Diagnosis

This species can be distinguished by: dorsal surface bright green, blue-green, brassy-green or coppery-green; shape elongate; major pronotal punctures moderate to coarse in size; elytral declivity evenly rounded; lateral margins of elytra narrow in dorsal view, visible for their entire length; males with median pubescence of first abdominal sternum longer, denser and more conspicuous than in females, not forming a brush; median lobe of male genitalia evenly arcuate in lateral view.

Description

MALES: Length 2.2 to 2.9 mm, greatest width 1.1 to 1.4 mm. Shape (fig. 44) elongate-oval; length equal to or slightly greater than twice the width. Dorsum shining, metallic; head, pronotum and elytra commonly bright green to blue-green, often brassy-green, coppery-green or cupreous; pronotum occasionally more brassy or coppery in shade than elytra; scutellum black. Antennae and legs rufotestaceous. Ventral surface shining black, often with greenish reflections in thoracic sterna and first abdominal sternum.

Vertex of head (figs. 45, 69) near anterior edge of pronotum smooth to very finely punctulate. Pronotum (fig. 45) with sides evenly, feebly arcuate to slightly sinuous with apical two-thirds feebly to moderately arcuate and basal one-third subparallel; anterior angles feebly produced, truncation slightly less than length of second antennal segment. Ante-basal transverse groove deep, moderately to strongly pronounced. Major punctures of pronotal disc dense, occasionally slightly sparse, irregularly distributed; size moderate to coarse, the latter close or equal to size of basal serial punctures of elytra; punctures in interspaces minute to about one-half size of major punctures. Elytron (fig. 46) at declivity evenly rounded; disc in basal one-half almost evenly convex. Lateral margins of elytra narrow in dorsal view, visible for entire length. Elytral striae strongly, distinctly punctate from base to apex. Metasternum at middle closely, conspicuously setose except glabrous near midline in posterior two-thirds. First abdominal sternum (fig. 116) medially with conspicuous moderately long erect setae generally closely, uniformly placed, not forming a brush. Middle and hind trochanters with a few inconspicuous setae as in adjacent parts of femora.

Median lobe of genitalia (fig. 145) 0.8 to 0.9 mm long, evenly arcuate from base to apex; in dorsal view, broadened near middle, slightly constricted near

aperture, then broadened apically; tip broadly rounded. Ventral side feebly sculptured in distal one-half with a shallow longitudinal impression on each side near middle and a shallow median furrow in apical portion extending to tip.

FEMALES: Length 2.5 to 3.3 mm, greatest width 1.2 to 1.6 mm. Similar to males except for sexual differences at apex of abdomen (fig. 117) and the following: setae of metasternum and first abdominal sternum short, sparse and inconspicuous. Spermatheca (fig. 161) 0.13 to 0.14 mm long.

Type Material

HOLOTYPE: Male, Creston, British Columbia, May 29, 1949, host Salix exigua, G. Stace Smith (University of British Columbia Coll.). ALLOTYPE: Female, Creston, British Columbia, June 13, 1952, ex Salix exigua, G. Stace Smith (University of British Columbia Coll.). Paratypes: 6 males, 8 females, Creston, British Columbia, G. Stace Smith (University of British Columbia Coll.).

Only the holotype and allotype were examined. Lazorko (1974) gives the date of collection of the holotype as "29 May 1959". This is slightly in error as the year given on the specimen label of the holotype is 1949.

Distribution

Crepidodera sculpturata appears to be quite widespread in central and western North America. It ranges from southern British Columbia and Manitoba south to Oregon, Utah, Colorado, and Kansas and east to Michigan and southern Ontario (map 15).

Material examined: 478 specimens.

CANADA: British Columbia: Creston, May, June, July, host Salix exigua (MCZ, UBC) 4, including holotype and allotype; Kamloops, May (CAS, CNC) 2; Oliver, May, June, on Salix (21) (CAS, CNC) 27; Osoyoos, May, June (CAS, CNC) 5; Similkameen R., 7 mi. S. Cawston, Aug., on Salix exigua (HARC, RHP) 24. Manitoba: Winnipeg (USNM) 3. Ontario: Leamington, June, on Salix gracilis (CNC) 107; Tilbury, June, on Salix (CNC) 4; Wheatley, June, on Salix cordata (CNC) 5.

UNITED STATES: Colorado: Colorado R. bottom, 4 mi. W. of Rifle, Garfield Co., July (FMNH) 2. Idaho: Carey (CU) 3; Payette, June (CAS) 1. Illinois: Mt. Forest, Aug. (FMNH) 5. Indiana: Hessville, July (FMNH) 2; N. Harmony, April (FMNH) 1. Iowa: Huxley, June (OSU) 2; Silver Lake, Aug. (USNM) 1. Kansas: Onaga, July (3) (CAS, USNM) 6; Topeka (USNM) 2. Michigan: New Baltimore, St. Clair Co., June (FMNH) 8; Orion Lake, Oakland Co.,

June (FMNH) 3; Sanford, Midland Co., June (FMNH) 13; Williamston, Ingham Co., July (FMNH) 1. North Dakota: Fargo (USNM) 1; Heart Butte Dam, Grant Co., May (SDSU) 2. Oregon: state record only (USNM) 1; Corvallis, June, willow (MCZ) 2; Eugene, May, June (FMNH, MCZ) 4; Harvey Co., middle fork of Malheur R., May (FMNH) 1; Huntington (USNM) 1; Orenco, May, on willow leaves (USNM) 6; Yamhill Co., May (CAS) 1. South Dakota: state record only (SDSU) 1; Beresford, July (SDSU) 8; Brookings, June, July, Sept., Oct. (SDSU) 13; Cedar Canyon, June (SDSU) 2; Chamberlain, June (SDSU) 5; Forestburg, June (SDSU) 4; Ft. Pierre, Sept. (SDSU) 7; Gregory, June (SDSU) 2; Highmore, May (SDSU) 2; Midland, June (SDSU) 2; Newell, June, July (SDSU) 6; Pierre, June (SDSU) 1; Rapid City, June (SDSU) 1; Springfield, May, June (SDSU) 2; Vayland, May, June (SDSU) 47; Volga (SDSU) 38; Wolsey, Sept. (SDSU) 1. Utah: Butlerville, June (USNM) 1; Lehi, June, on Salix melanopsis (CNC) 75; Ogden, June (FMNH) 3; Vernal, June (CSCA) 4. Washington: Pullman (USNM) 3. Wisconsin: Madison, May, on Salix (USNM) 1.

Host Plant: Salix spp.

In the material examined, 249 specimens (52%) bear food plant data. These are all recorded from Salix spp. or willow including Salix cordata (Ontario), S. exigua (British Columbia, includes holotype and allotype),

S. petiolaris (= gracilis) (Ontario), S. melanopsis.
(Utah) and Salix sp. or willow (British Columbia,
Ontario, Oregon, Wisconsin). I have collected a small
series of sculpturata from Salix exigua near Cawston in
southern British Columbia.

Life History: Immature stages unknown.

Adults have been recorded from May to October.
The greatest abundance appears to occur during May,
June, July and August. Most of the specimens examined
were collected in June.

Remarks

The variation in the colour of the dorsal
surface in this species is evident within series of
specimens from single localities as well as among speci-
mens from different localities. The majority of speci-
mens are bright green with those from British Columbia,
Washington and Oregon tending to be blue-green.

There is some variation in the punctation of
the pronotum. The size of the major pronotal punctures
ranges among specimens from uniformly moderate, smaller
than the basal serial punctures of the elytra to
uniformly coarse, about equal to the size of the basal
serial punctures. The size also ranges from moderate
to coarse within individual specimens.

The genitalia of 78 males were examined. In some males, the tip of the median lobe is not as strongly broadened as in fig. 145.

Spermathecae were extracted from 7 female specimens.

The external characters given in the diagnosis will separate sculpturata from all the other North American species except, possibly, nana and opulenta. It can usually be distinguished from nana by the slightly narrower elytral margins and from both species by the pronotum appearing slightly more convex or swollen anteriorly. Males can usually be separated from those of opulenta by the lack of a distinct brush in the pubescence of the first abdominal sternum. Western specimens of nana and some specimens of opulenta are very similar in appearance to sculpturata and it is often difficult to separate them. However, the shape of the male genitalia (fig. 145) and female spermatheca (fig. 161) will readily distinguish sculpturata from these and all other species.

16. Crepidodera nana (Say)

Figs. 47-51, 70, 118-122, 146, 162; Map 16.

Altica nana Say 1824, p. 86 (p. 227 in LeConte, 1859)
(type locality, United States).

Haltica nana (Say); Melsheimer 1847, p. 165.

Haltica helxines (L.); LeConte (misidentification) 1858,
p. 87 (var. nana Say).

Crepidodera helxines (L.); Crotch (misidentification)
1873, p. 71 (in part); Austin 1874, p. 271; Hamilton
1889, p. 149; Horn 1889, p. 316; Hamilton 1894, p. 399;
Duckett 1920, p. 149.

Chalcoides fulvicornis nana (Say); Heikertinger 1911, p.
9 (fig.), 10, 19; 1924-1925, p. 67; Heikertinger and
Csiki 1939, p. 320.

Chalcoides helxines (L.); Leng (misidentification) 1920,
p. 300 (in part); Beller and Hatch 1932, p. 128, 129.

Chalcoides chittendeni Heikertinger 1948-1950, p. 110
(fig.), 116, 136 (type locality, "Kahokia", Illinois);
Lzaorko 1974, p. 146, 148 (fig.), 151, 153. New synonymy.

Chalcoides nana (Say); Wilcox 1954, p. 455; Dillon and
Dillon 1961, p. 712.

Crepidodera nana (Say); Hatch 1971, p. 219; Balsbaugh
and Hays 1972, p. 156.

Diagnosis

This species can be distinguished by: dorsal
surface generally green or greenish with brassy, bronze,

coppery or blue tones, occasionally coppery-red, coppery-bronze to dark bronze, rarely pure blue; shape elongate-oval; anterior pronotal angles feebly produced; major pronotal punctures moderate to coarse in size; elytral declivity evenly rounded; elytral disc at most only very feebly depressed behind basal one-quarter; lateral margins of elytra, in dorsal view, moderately broad in eastern specimens, generally narrower in western specimens; males with median pubescence of first abdominal sternum longer and more conspicuous than in females, denser apically forming a distinct, well-defined brush in eastern specimens, a poorly-developed or obsolete brush in western specimens; median lobe of male genitalia not arcuate but straight in apical two-thirds in lateral view.

Description

MALES: Length 2.1 to 3.0 mm, greatest width 1.0 to 1.5 mm. Shape (fig. 47) elongate-oval; length equal to or slightly greater than twice the width.

Dorsum shining, metallic; vertex of head, pronotum and elytra pure green, brassy-green, bronze-green, coppery-green, or blue-green, rarely pure blue, also cupreo-aeneous, occasionally coppery-red, coppery-bronze to dark bronze with margins greenish; head below vertex green to blue-green; scutellum black. Antennae and legs generally rufotestaceous; antennae occasionally with

apical 4 or 5 segments dark reddish-brown; hind femora occasionally partially to entirely dark reddish-brown. Ventral surface shining black, occasionally with greenish reflections in prosternum, metasternum and first abdominal sternum.

Vertex of head (figs. 48, 70) along anterior edge of pronotum smooth, very finely punctulate. Pronotum (fig. 48) with sides generally slightly sinuous with apical two-thirds feebly to moderately arcuate and basal one-third subparallel, occasionally with sides evenly, feebly arcuate; anterior angles feebly produced, truncation slightly less than to equal length of second antennal segment. Ante-basal transverse groove deep, strongly pronounced. Major punctures of pronotal disc sparse to dense, irregularly distributed; size moderate, slightly smaller than basal serial punctures of elytra, to coarse, about equal to size of basal serial punctures; punctures in interspaces minute to about one-half diameter of major punctures. Elytron (figs. 49, 50, 51) at declivity evenly rounded; disc in basal one-half almost evenly convex to very gently depressed behind basal one-quarter. Lateral margins of elytra narrow to moderately broad in dorsal view, visible for entire length. Elytral striae strongly, distinctly punctate from base to apex. Metasternum medially somewhat sparsely, conspicuously setose except glabrous near midline in posterior two-thirds. First abdominal

sternum (figs. 119, 120, 121) medially with a dense patch of long, erect setae near apical margin forming a conspicuous well-defined brush in eastern specimens, a poorly-developed to obsolete brush in western specimens; area anterior to brush sparsely to moderately densely punctate-setose. Middle and hind trochanters with a few inconspicuous setae as in adjacent parts of femora.

Median lobe of genitalia (fig. 146) 0.8 to 1.0 mm long; bent at basal one-third, apical two-thirds straight; in dorsal view, apical two-thirds tapered apically or of even thickness with apex, in both cases, occasionally slightly broadened; tip narrowly or broadly rounded to subtruncate. Ventral side sculptured with a distinct longitudinal impression on each side in middle one-third and a median longitudinal groove in apical one-third.

FEMALES: Length 2.2 to 3.6 mm, greatest width 1.1 to 1.7 mm. Similar to males except for sexual differences at apex of abdomen (fig. 122), setae of metasternum and first abdominal sternum shorter and less conspicuous, first abdominal sternum lacking a brush of setae but generally with a median patch of slightly crowded setiferous punctures near hind margin. Spermatheca (fig. 162) 0.11 to 0.15 mm long.

Type Material

The original type material of this species has been lost. Because Say's (1824) original description could apply to several of the North American species, there has been much confusion in the identity of nana (Say). In 1911, Heikertinger illustrated the distinctive male genitalia of the species described above and referred this form to nana (Say) but considered it a subspecies of the European species fulvicornis (Fab.). He later (1948-1950) recognized this North American form as a new species which he described as Chalcoides chittendeni. In order to end all previous confusion, it seems best to consider this species as being nana (Say), as Heikertinger first suggested in 1911, and to designate a neotype.

NEOTYPE: here designated, male, with the labels "Knoxville, Tenn., V-20-1957, W.J. Brown"/"on Salix"/"Neotype, ♂, Crepidodera nana (Say), R.H. Parry". This specimen is in the Canadian National Collection, Ottawa.

The neotype is 2.8 mm long and 1.3 mm in greatest width. It falls within the remaining variation described above in having the head, pronotum and elytra brassy-green in colour, the antennae and legs entirely rufotestaceous, the major pronotal punctures moderately dense and moderate to coarse in size, the lateral elytral margins moderately broad in dorsal view, the first

abdominal sternum medially with a conspicuous well-defined apical brush of setae, the median lobe of the genitalia tapered apically except slightly broadened at the apex in dorsal view, and the tip of the median lobe subtruncate.

Distribution

Crepidodera nana is widespread in both Canada and the United States ranging from New Brunswick to the Northwest Territories and British Columbia and south to Georgia, Texas and New Mexico. West of the Rocky Mountains, this species occurs only as far south as Oregon (map 16).

Material examined: about 2,000 specimens.

CANADA: Alberta: Calgary, May (CAS) 28; Edmonton, May, June, July, Salix (7) (UA) 13; Kimball, June, Salix interior (CNC) 9; Lethbridge, June, July (1), on Populus (12) (CNC) 14; Magrath, May (CNC) 3; McMurray, June, on Salix (CNC) 63; Medicine Hat, May (CNC) 7; Milk R., June, on Salix (CNC) 7; Oldman River, Lethbridge, June, on Salix (CNC) 25; Onefour, June, on Salix interior (CNC) 11; Scandia, July (CNC) 24; Waterton, June, on Salix (CNC) 90. British Columbia: Alaska Hwy., Lum and Abner - 58°N, June (1), Aug., on Populus balsamifera (23), on Salix (11) (CNC) 35; Creston, July, host Salix

exigua (OSU) 1; Hatzic, July, on Salix (CNC) 14; Kamloops, May (CNC) 2; Mission City, June, on Salix (CNC) 12; Similkameen R., 7 mi. S. Cawston, Aug., on Salix (HAHC, RHP) 18. Manitoba: Carberry, May (CNC) 2; Glenboro, July, on willow (CNC) 6; Herchmer, Aug. (CNC) 1; The Pas, July (CNC) 4. New Brunswick: Bathurst, July, on Salix (CNC) 35; Oakville, July, willow along creek (CNC) 8. Northwest Territories: Fort Liard, June (CNC) 11; Fort Simpson, Aug. (CAS, CNC) 27; Norman Wells, June, on Salix spp. (CNC) 50. Ontario: Ancaster, May (CNC) 2; Delhi, June, on Salix (CNC) 2; Eden, Aug., sand bar willow (CNC) 5; Moose Factory, June, on Salix (1) (CNC) 4; Moosonee, June, on Salix (RHP) 2; Walsingham, June, on Salix (CNC) 71. Quebec: Cascapedia, June (CNC) 2; Gaspé, June, on Salix (CNC) 23; South Bolton, June (CNC) 27. Saskatchewan: Battle River, Aug., host willow (CNC) 7; Elbow, June (CNC) 3; Esterhazy, July (CNC) 3; Pennant, July (CNC) 1; Saskatchewan Landing, May, July, on Salix (18) (CNC) 34; Saskatoon, June, July, Aug., Salix interior (2), host Salix (31), host willow (1) (CNC) 48.

UNITED STATES: Colorado: state record only (USNM) 2; Cameo (near), Mesa Co., Aug. (OSU) 3; Denver (USNM) 1; Granby (2 mi. west), July (CNC) 1; Ladore Canyon, el. 5000-6000 ft., May (CAS) 1. Connecticut: state record only (CAS) 1; Cornwall, July (CU) 5. District of

Columbia: Anacostia, May (USNM) 1; Rock Creek Pk., May (USNM) 15; Washington, April, May, July, Nov., on willow (20) (USNM) 47; Woodridge, April (USNM) 1. Georgia: Peach Co., May, peach foliage (USNM) 1. Illinois: Cairo, April (CU) 1; Chandlerville, May (CNC) 23; Grand Tower, Union Co. (? Jackson Co.), May, sweeping willow and cottonwood along levee Miss. River (FMNH) 13; LaSalle Co., June (CNC) 1; St. Clair Co., Oct. (FMNH) 1. Indiana: Leavenworth, Aug., willow (CNC) 10; New Harmony, April (FMNH) 1. Iowa: Clinton, June (CNC) 3; DeWitt, June (CNC) 1; Iowa City, May, Oct. (USNM) 4; Keokuk (MCZ) 3; Muscatine, May (USNM) 1; Solon (USNM) 1. Kansas: Lawrence, April, on Populus deltoides (23), on Salix (50) (CNC) 76; McPherson, April (6), May, on Populus deltoides (6), on Salix (19) (CNC) 25; Medora, May, on Populus deltoides (18), on Salix (26) (CNC) 44; Topeka, July, Aug., Salix (1) (USNM) 3. Kentucky: Morehead, May, Salix fragilis (CNC) 2. Louisiana: Mansura, April (USNM) 2; Shreveport, March, April, on Crataegus (5) (USNM) 6. Maine: Ft. Kent, Aug. (OSU) 1. Maryland: Baltimore, July (CAS) 43; Beltsville, June (CNC) 2; Bladensburg, April (USNM) 3; Cabin John, May (USNM) 2; Chevy Chase, Aug. (USNM) 4; College Park, May, on willow (CNC, HAHC) 8; Glen Echo, July (5) (USNM) 13; Kensington, July (USNM) 1. Massachusetts: Attleboro, June (USNM) 2; Boston, Arnold Arboretum, July, swept from Salix sp. (2), Salix lucida (12), S. nigra (17),

S. patula (1), S. petiolaris (4), S. purpurea (17), S. repens (1), S. sericea (2), S. tristis (1), Tilia (1) (USNM) 58; Sherborn, May, clump Salix (CNC) 4.

Mississippi: Meridian, April, on Salix (USNM) 1.

Missouri: Scott Co., April, Sept., swept from peach leaves (1) (USNM) 11; Sikeston (2 mi. E.), Scott Co., March (USNM) 1; St. Louis (2 mi. W.), May (USNM) 1.

Montana: Gallatin Co., el. 4800 ft., June (USNM) 1.

Nebraska: Omaha (Child's Point), May (CAS) 1; Waterloo, July (OSU) 2. New Jersey: state record only, Aug. (1)

(CAS, USNM) 2; Clementon, May (USNM) 4; Colonia, May (FMNH) 2; Dundee L., May (USNM) 1; Elizabeth, Nov.

(USNM) 2; Kingston, May (USNM) 4; Lake Hopatcong, June (FMNH) 1; Ocean Co. (USNM) 1; Riverton, May (USNM) 1.

New Mexico: Jemez Mts., May, June, July, Aug. (CAS) 18;

Mesilla Prk. (USNM) 1. New York: state record only

(CAS, USNM) 3; Buffalo (CAS) 1; Chenango Co., July

(USNM) 1; Great Kills, S.I., June, July (FMNH) 8; Ithaca,

May, June, July, Aug. (CAS, CU, UA) 18; Lancaster, July

(CAS) 1; New York, Van Cortland Pk., May, June (FMNH) 3.

North Carolina: Abbottsburg, April, on willow (USNM) 1;

Anson Co., April (USNM) 6; Franklin, 2000 ft., May, on

Salix (4) (CNC) 7; Highlands, 3800 ft., May, July (1),

Nov. (1), on Salix (22) (CNC) 24; Raleigh, March, April,

Nov., willow leaves (3), sweeping grass (2), squirrel

carriion (1) (CNC, HAHC) 6; Richmond Co., May, peach

foliage (USNM) 1; Southern Pines, April, May (HAHC, MCZ,

USNM) 4; Wayah Gap, Macon Co., July (CNC) 2. North Dakota: Medora (13 mi. W.), Golden Valley Co., July (SDSU) 4; Heart Butte Dam, Grant Co., May (SDSU) 3.

Ohio: Ashtabula, July (OSU) 1; Ashville, Pickaway Co., May (OSU) 1; Buckeye Lake, Licking Co., Oct. (OSU) 1; Cedar Swp., May (OSU) 1; Clinton Co., April (1), May (12) (OSU) 13; Columbus, Sept. (OSU) 2; Delaware Co., Aug. (OSU) 1; Ironton, May (OSU) 1; Marion Co., Sept. (OSU) 1. Oklahoma: Norman, May (CNC) 1; Oklahoma Co., April (CAS) 1. Oregon: Corvallis, July (CNC) 3; Hood River, Aug. (CAS) 63. Pennsylvania: Allegheny Co., May (CU) 5; Castle Rock, July (USNM) 2; Easton, May (CAS) 5; Glenolden, June (USNM) 3; Harrisburg, July (USNM) 1; Kennett Sq., on plum (USNM) 1; Lancaster, May (FMNH) 4; Philadelphia, May (USNM) 1; Phila. Neck, May, July (MCZ) 8; Reading, July (FMNH) 4; W. Park, June (OSU) 1; Wissinoming, May (USNM) 4; Wyoming, Philadelphia, June (USNM) 5. South Carolina: Aiken, May, on Salix (CNC) 7; Calhoun Falls, July (USNM) 1; Clemson, Honeycut Creek, Seneca River, May, Salix (CNC) 5; Greenwood Co., May, Salix (CNC) 8; Newry, Oconee Co., 900 ft., Aug. (CNC) 1; Yemassee, Rt. 17 bridge, May, Salix (CNC) 20.

South Dakota: Badlands, Interior, June (SDSU) 7; Beresford, July (SDSU) 1; Cedar Canyon, June (SDSU) 8; Chamberlain, May (1), Sept. (29) (SDSU) 30; Elk Point, May, June, July, light trap (2) (SDSU) 5; Fort Pierre, Aug. (SDSU) 2; Ft. Thompson, Sept. (SDSU) 1; Highmore,

June (SDSU) 1; Newell, July, Aug. (SDSU) 16; Philip,
 Aug. (SDSU) 1; Pierre, July (SDSU) 2; Spearfish, June
 (4), Sept. (16) (SDSU) 20; Springfield, May, Sept.
 (SDSU) 3; Tabor Grainery, May (SDSU) 6; Union Co. State
 Park, May (32), Aug. (9) (SDSU) 41; Vermillion, June,
 July, Aug., Sept., light trap (2) (SDSU) 7; Yankton,
 June (SDSU) 17. Tennessee: Knoxville, May, on Salix
 (CNC) 12; Oak Ridge, A.E.C. Area, Aug. (HAHC) 2; Rhea
 Co., May, from foliage Prunus sp. (wild plum) (USNM) 6.
Texas: state record only (USNM) 10; Austin, April (CAS)
 9; Brownsville, Jan. (1), May (8), July (1), on corn
 foliage (7) (USNM) 10; Burnet Co., June (OSU) 2; Cameron
 Co., April (OSU) 3; Dallas, April, May (USNM) 7; Devils
 Riv., May (USNM) 3; El Paso, July (CU) 5; Gillespie Co.,
 May (OSU) 1; Kerrville, April, beating willow (Salix
 sp.) (104) (CNC) 124; Presidio, May (11), Dec. (4), on
Salix sp. (11), along river (4) (USNM) 15; San Patricio
 Co., Welder Wildlife Ref. nr. Sinton, May, June, on
Salix nigra (RHP) 2; Val Verde Co., May (OSU) 2; Victoria,
 Feb. (2), March (8), sweeping herbage (6), on Salix (1)
 (USNM) 10. Virginia: ? Alex. Co., June (USNM) 2;
 Arlington, April (USNM) 7; Bull Run, Oct. (USNM) 1;
 Fairfax Co., Sept. (USNM) 1; Fredericksburg, Sept. (USNM)
 1; Glencarlyn, May, July (1), on willow (55) (USNM) 56;
 Penington Gap (USNM) 1; Potmac Cr., May (MCZ) 1; Rosslyn,
 May (USNM) 1; Stone Cr., Lee Co. (USNM) 1. West Virginia:
 East Panhandle, July (CAS) 1; Fairmont, Aug. (CAS) 6;

W. Sulphur, July (USNM) 6. Wyoming: Pine Bluff, Sept., on willow (OSU) 2.

Host Plant: Salix spp., ? Populus spp.

Food plant data were available for 1,079 specimens in the material examined. Of these, 976 (90%) from all parts of the range are recorded from willow or Salix spp. including Salix exigua (1 - British Columbia), S. fragilis (2 - Kentucky), S. interior (27 - Alberta, Ontario, Saskatchewan), S. lucida (12 - Massachusetts), S. nigra (19 - Massachusetts, Texas), S. patula (1 - Massachusetts), S. petiolaris (4 - Massachusetts), S. purpurea (17 - Massachusetts), S. repens (1 - Massachusetts), S. sericea (2 - Massachusetts) and S. tristis (1 - Massachusetts). In addition, 82 specimens (8%) are recorded from Populus spp. including P. balsamifera (23 - British Columbia) and P. deltoides (47 - Kansas) and Populus sp. (12 - Alberta). The remaining 21 specimens (2%) are recorded from "corn foliage" (7 - Texas), Crataegus sp. (1 - Louisiana), "grass" (2 - North Carolina), peach leaves (3 - Georgia, Missouri, North Carolina), Prunus sp. (wild plum) (7 - Pennsylvania, Tennessee) and Tilia sp. (1 - Massachusetts). I suspect that these last records are accidental occurrences.

I personally have taken this species on Salix sp. in Moosonee, Ontario and on Salix nigra growing on a river bank near Sinton, Texas.

Life History: Immature stages unknown.

Adults have been taken in all months from January to December. Most (95%) are recorded from April through August. Material collected in January, February and December consists only of 7 specimens from southern Texas. In other southern parts of the range, adults have been taken as early as March (Louisiana, Missouri, North Carolina) and as late as November (D.C., New Jersey, North Carolina). Specimens from Canada have been recorded only for May, June, July and August.

Remarks

This species exhibits considerable variation. The colour of the dorsum varies greatly, both geographically and within many local populations. In eastern populations ranging from New Brunswick, southern Quebec and southern Ontario to Georgia, Indiana and Mississippi, the head, pronotum and elytra are generally pure green to blue-green and occasionally brassy-green or pure blue. In greenish specimens, the pronotal and elytral margins are often bluish. A series of specimens from Gaspé, Quebec ranges from coppery-green or cupreo-aeneous to coppery-red with greenish margins. Similarly, specimens from northern Ontario, Manitoba, Saskatchewan and Alberta are brassy-green, coppery-green or cupreo-aeneous to pure coppery or coppery-red in colour, rarely pure green. This range of colour variation also occurs southward in

Montana, Wyoming, South Dakota and Colorado. Specimens from western Northwest Territories, British Columbia and Oregon have the dorsum generally brassy-green, coppery-green or cupreo-aeneous, occasionally pure green but rarely pure coppery. In populations from the central United States, from Illinois to Nebraska and south to Louisiana, Texas and New Mexico, specimens are generally dark coppery or coppery-bronze to dark bronze or dark purple, occasionally bronze-green and rarely cupreo-aeneous. Specimens from southwestern Texas (El Paso, Presidio) and a few from New Mexico tend to be more greenish, ranging from cupreo-aeneous to pure green. A large series from south-central Texas (Kerrville) containing mainly coppery-bronze to dark bronze specimens, includes also a few dark blue or blue-green individuals. These occur with a frequency of about 11%. The coppery-bronze or dark bronze colour variant also extends into southern Manitoba, South Dakota and Colorado.

There is some geographical variation in the punctation of the pronotum. Specimens from western Canada and northwestern United States generally have the major punctures denser and both major and minor punctures slightly coarser than in specimens from eastern Canada and United States and midwestern and southern United States. The width of the elytral margins also varies geographically. The green or blue-green eastern specimens have the margins moderately broad in dorsal view.

(fig. 50). In all other populations, the lateral elytral margins are generally narrower (figs. 49, 51), only occasionally moderately broad. A similar geographical pattern of variation occurs in the pubescence of the first abdominal sternum in males. In eastern populations (as defined above), males have the setae of the first abdominal sternum denser apically, usually forming a distinct, well-defined brush (fig. 119). In males of populations in northern and western Canada and in the central and western United States, the brush of setae ranges from poorly-developed (fig. 120) to obsolete (fig. 121).

The genitalia of 336 males were examined and spermathecae were extracted from 24 females.

The external characters given in the diagnosis should separate nana from all the other species except vaga, decora, luminosa, opulenta and, possibly, solita and sculpturata. Males and females of nana can be distinguished from some of these species by characters given in their respective diagnoses but are most easily separated by the distinctive male genitalia (fig. 146) and female spermatheca (fig. 162).

ELECTROPHORESIS STUDIES

Many of the North American species of Crepidodera appear to be very closely related and are difficult to separate by the more classical methods used in systematics. Therefore, it seemed appropriate to test the taxonomic decisions based on classical criteria such as morphology, geographical distributions and habits by using the modern techniques of electrophoresis to compare proteins and obtain an indication of the genetic relationships between species. The advantages of electrophoresis in evolutionary studies and in systematics were discussed by Gottlieb (1971) and its particular value in systematics was pointed out by Avise (1974). A review of electrophoretic studies on isozymes in insects and their significance was provided by Wagner and Selander (1974).

Electrophoretic studies on closely related species in various groups of animals have indicated that such species are almost completely distinct in allelic composition at an average of 1/4 to 1/2 of their loci (Avise, 1974). This is considerably greater than the difference normally found within species where populations are nearly identical in allelic content at 85% or more of their loci (Avise, 1974). Evidence for the relatively large amount of genetic divergence between closely related species was provided in several works including that of Ayala, et al. (1970) who estimated,

by means of gel electrophoresis, that individuals of four sibling species of Drosophila differ in more than 1/2 of their gene loci.

In the present study, gel electrophoresis was used to compare 8 enzymes in 5 sympatric species, Crepidodera solita n. sp., C. decora n. sp., C. heikertingeri (Lazorko), C. populivora n. sp. and C. violacea Melsh.. A stain for an additional enzyme, glucose phosphate isomerase (GPI), was used only on 1 gel to compare 3 species, solita, heikertingeri and populivora. The results are shown in fig. 166.

Results

Relatively simple banding patterns were obtained in gels stained for malate dehydrogenase (MDH), malic enzyme (ME), phosphoglucosmutase (PGM) and alpha-glycerophosphate dehydrogenase (GPDH). Each of these enzymes appears to be encoded at a single locus. The gene frequencies for these loci are shown in Table 3. Each allele has been labelled according to the anodal mobility of the resulting isozyme on the gel. For each locus, the most common allele is assigned the number 1.0. The other alleles are assigned numbers derived by adding to 1.0 the migration distance of the alleles minus the migration distance of the most common allele.

MDH - The stain for malate dehydrogenase revealed a

TABLE 3. Gene frequencies for 4 loci in 5 species of Crepidodera.

	<u>solita</u>	<u>decora</u>	<u>heikertingeri</u>	<u>populivora</u>	<u>violacea</u>
MDH					
N	27	6	45	12	12
0.6	-	-	-	-	0.38
0.8	-	-	-	-	0.46
1.0	1.00	1.00	1.00	1.00	0.17
ME					
N	28	6	27	16	6
0.4	-	-	1.00	-	-
1.0	1.00	1.00	-	1.00	1.00
PGM					
N	23	6	12	16	6
0.6	-	-	0.08	-	-
1.0	0.98	1.00	0.92	1.00	1.00
1.4	0.02	-	-	-	-
GPDH					
N	36	6	36	40	12
0.1	-	1.00	0.5	0.06	0.5
0.4	-	-	-	0.59	0.29
0.6	-	-	0.5	0.30	0.21
1.0	1.00	-	-	0.05	-

single locus (fig. 163). In 4 species, solita, decora, heikertingeri and populivora, this locus is monomorphic, apparently for the same allele (1.0). In violacea, however, it is polymorphic, having 2 additional segregating alleles (0.6 and 0.8) in greater frequencies than the allele (1.0) common to the other species. A single heterozygote (0.6/0.8) appeared among the 12 individuals of violacea tested.

ME - A single locus was detected (figs. 167-169). In 4 species, solita, decora, populivora and violacea, this locus is monomorphic, apparently for the same allele (1.0). In contrast, heikertingeri is monomorphic for a different allele (0.4).

PGM - A single locus was revealed. In 3 species, decora, populivora and violacea, only a single allele (1.0) is present. In solita, an additional allele (1.4) was found in a single heterozygous (1.0/1.4) individual. In heikertingeri, another allele (0.6) occurred in 2 heterozygous (1.0/0.6) individuals.

GPDH - A single locus was detected. C. solita is monomorphic for allele 1.0 while decora appears to be monomorphic for a different allele (0.1). C. heikertingeri appears to be heterozygous for 2 alleles (0.1, 0.6). However, it is possible that the 2 bands produced by

each of 36 individuals tested represent 2 separate loci since heterozygous individuals would not be expected to occur in frequencies greater than 50%. In populivora, 4 different alleles (0.1, 0.4, 0.6, 1.0) seem to be present. These may or may not be identical to those in the other species. All individuals of violacea tested appear to be heterozygous (0.1/0.4 or 0.1/0.6) although it is possible that 2 loci are represented by the 2 bands produced. The slowest migrating band (0.1) is identical or, at least, similar to that of heikertingeri while the faster migrating band varies from similar (0.6) to slightly slower (0.4) than that of heikertingeri.

The stains for esterase (EST), carbonic anhydrase (CA), peroxidase (PX) and indophenol oxidase (IPO) produced more complex banding patterns, indicating, in most cases, 2 or more polymorphic loci. No attempt was made to determine gene frequencies since, where loci could be easily determined, different species usually differed markedly in alleles.

EST - A complex banding pattern revealed several loci, some of which were distinct and easily readable (figs. 170-173). Four of the 5 species tested differed in general allele composition although in some cases, a few identical or similar alleles were indicated. Only solita and decora (fig. 173) showed general similarity at some loci.

CA - Several polymorphic loci were indicated by a complex banding pattern (figs. 174-177). Four species, solita, heikertingeri, populivora and violacea, were tested. All differed in general allele composition although some alleles appeared to be shared.

PX - The stain for peroxidase revealed at least 2 loci (figs. 178-182) in a relatively complex banding pattern. Although considerable variation is present within each species, the 4 species (solita, decora, heikertingeri and populivora) tested all differ from each other in allele composition.

IPO - In 3 species tested, at least 2 loci were indicated. The locus with the lowest anodal mobility appears to be monomorphic for the same allele in solita, heikertingeri and populivora. All 3 species differ in allele composition at the loci indicated by faster migrating isozymes (fig. 167).

It can be seen from Table 3, figs. 164-182, and the results given above that, in the 8 enzymes tested repeatedly, 2 (MDH, ME) differed in only 1 of the species examined, PGM differed slightly in 2 species, EST differed markedly among all species except, possibly, between solita and decora and the remainder, with the exception of 1 IPO locus, differed in all species tested. The significance of these results is limited by the small

number of loci sampled, the small number of individuals tested, and by the fact that no estimate of the variation within each species was obtained since only localized populations were sampled. However, the results do seem to be consistent with the high degree of genetic divergence reported for closely related species of other groups. They also tend to support some of the species concepts based, in the present work, on a more classical approach.

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Figs. 1-10. Whole dorsal view, dorsal view of head and pronotum and dorsal view of elytra of Crepidodera spp.

- 1-3. longula Horn, male.
- 4-6. violacea Melsheimer, male.
- 7-9. spenceri (Lazorko), female.
- 10. spenceri (Lazorko), female.

Figs. 11-19. Whole dorsal view, dorsal view of head and pronotum and dorsal view of elytra of Crepidodera spp.

11-13. solita n. sp., male.

14-16. decora n. sp., female.

17-19. browni n. sp., holotype, male.

Figs. 20-28. Whole dorsal view, dorsal view of head and pronotum and dorsal view of elytra of Crepidodera spp.

20-22. opulenta (LeConte), male.

23-25. luminosa n. sp., male.

26-28. vaga n. sp., male..

Figs. 29-37. Whole dorsal view, dorsal view of head and pronotum and dorsal view of elytra of Crepidodera spp.

29-31. heikertingeri (Lazorko), male.

32-34. digna n. sp., male.

35-37. populivora n. sp., male.

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Figs. 38-46. Whole dorsal view, dorsal view of head and pronotum and dorsal view of elytra of Crepidodera spp.

38-40. bella n. sp., male.

41-43. aereola (LeConte), male.

44-46. sculpturata (Lazorko), male.

Figs. 47-54. Crepidodera spp.

47-51. Whole dorsal view, dorsal view of head and pronotum and dorsal view of elytra of nana (Say), male (47-49, Kansas; 50, South Carolina; 51, Texas).

52. Lateral view of left elytron of bella n. sp.

53. Egg of Crepidodera heikertingeri (Lazorko).

54. Egg of Crepidodera solita n. sp.

Figs. 55-63. Anterior view of head of Crepidodera spp.

- 55. longula Horn
- 56. violacea Melsheimer
- 57. spenceri (Lazorko)
- 58. solita n. sp.
- 59. decora n. sp.
- 60. browni n. sp.
- 61. opulenta (LeConte)
- 62. luminosa n. sp.
- 63. vaga n. sp.

*Figs. 64-72. Head of Crepidodera spp. (64-70, anterior view; 71, 72, ventral view showing mouthparts).

64. heikertingeri (Lazorko)

65. digna n. sp.

66. populivora n. sp.

67. bella n. sp.

68. aereola (LeConte)

69. sculpturata (Lazorko)

70. nana (Say)

71. decora n. sp.

72. solita n. sp.

Figs. 73-81. Whole ventral view of male, ventral view
of metasternum and abdomen of male, and of female of
Crepidodera spp.

73-75. longula Horn

76-78. violacea Melsheimer

79-81. spenceri (Lazorko)

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Figs. 82-90. Whole ventral view of male, ventral view
of metasternum and abdomen of male and of female of
Crepidodera spp.

82-84. solita n. sp.

85-87. decora n. sp.

88-90. browni n. sp.

Figs. 91-99. Whole ventral view of male, ventral view of metasternum and abdomen of male and of female of Crepidodera spp.

91-93. opulenta (LeConte)

94-96. luminosa n. sp.

97-99. vaga n. sp.

Figs. 100-108. Whole ventral view of male, ventral view of metasternum and abdomen of male and of female of Crepidodera spp.

100-102. heikertingeri (Lazorko)

103-105. digna n. sp.

106-108. populivora n. sp.

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Figs. 109-117. Whole ventral view of male, ventral view of metasternum and abdomen of male and of female of Crepidodera spp.

109-111. bella n. sp.

112-114. aereola (LeConte)

115-117. sculpturata (Lazorko)

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Figs. 118-123. Crepidodera spp.

- 118-122. Whole ventral view of male, ventral view of metasternum and abdomen of males and of female of nana (Say) (118-119, male, North Carolina; 120, male, Ontario; 121, male, Kansas; 122, female).
123. Left ventro-lateral view of metasternum and first abdominal sternum of male of heikertingeri (Lazorko).

Figs. 124-130.

124. Salix spp. and Populus tremuloides at edge of Ramsayville Marsh, Ontario, habitat of Crepidodera heikertingeri, C. decora and C. populivora.
125. Clump of Salix petiolaris Smith, host plant of Crepidodera heikertingeri (Lazorko). at Ramsayville Marsh, Ont.
126. Stand of Populus tremuloides Michx., host plant of Crepidodera populivora n. sp. at Ramsayville Marsh, Ont.
127. Salix alba x fragilis, host plant of Crepidodera solita n. sp., on bank of Rideau River, Ottawa, Ontario.
128. Rearing cage containing Salix alba x fragilis for Crepidodera solita n. sp.
- 129-130. Salix alba x fragilis from rearing cage showing feeding damage by Crepidodera solita.

Figs. 131-134. Male genitalia (dorsal view of median lobe, left lateral view of median lobe and tegmen, ventral view of base of median lobe and tegmen) of Crepidodera spp.

- 131. longula Horn
- 132. violacea Melsheimer
- 133. spenceri (Lazorko)
- 134. solita n. sp.

0.5 mm

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Fig. 135-138. Male genitalia of Crepidodera spp.

135. decora n. sp.

136. browni n. sp.

137. opulenta (LeConte)

138. luminosa n. sp. (holotype)

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Figs. 139-142. Male genitalia of Crepidodera spp.

139. vaga n. sp.

140. heikertingeri (Lazorko)

141. digna n. sp.

142. populivora n. sp.

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Figs. 143-146. Male genitalia of Crepidodera spp.

143. bella n. sp. (holotype)

144. aereola (LeConte)

145. sculpturata (Lazorko)

146. nana (Say)

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Figs. 147-162. Spermathecae of Crepidodera spp.

(lateral view).

- 147. longula Horn
- 148. violacea Melsheimer
- 149. spenceri (Lazorko)
- 150. solita n. sp.
- 151. decora n. sp.
- 152. browni n. sp.
- 153. opulenta (LeConte)
- 154. luminosa n. sp.
- 155. vaga n. sp.
- 156. heikertingeri (Lazorko)
- 157. digna n. sp.
- 158. populivora n. sp.
- 159. bella n. sp.
- 160. aereola (LeConte)
- 161. sculpturata (Lazorko)
- 162. nana (Say)

Figs. 163-173. Photographs of gels from electrophoresis of Crepidodera spp.

163. Gel stained for MDH. Two males and 2 females of the following species are represented:

- columns 1-4. C. solita n. sp.
- 5-8. C. heikertingeri (Lazorko)
- 9-12. C. populivora n. sp.

All individuals are homozygous (1.0/1.0).

164. Gel stained for GPDH. Six males of the following species are represented:

- columns 1-6. C. solita n. sp.
- 7-12. C. populivora n. sp.

All individuals of C. solita are homozygous (1.0/1.0). An individual of C. populivora indicated in column 7 is homozygous for 0.1 (0.1/0.1). The remaining individuals of C. populivora (columns 8-12) are homozygous for 0.4 (0.4/0.4).

165. Gel stained for GPDH. Females of the following species are represented:

- columns 1-4. C. solita n. sp.
- 5-7. C. heikertingeri (Lazorko)
- 8. C. solita n. sp.
- 9-12. C. populivora n. sp.

All individuals of C. solita are homo-

zygous (1.0/1.0). All individuals of C. heikertingeri are heterozygous (0.1/0.6). Individuals of C. populivora indicated in columns 9, 11 and 12 are homozygous (0.4/0.4). The individual indicated in column 10 is heterozygous (0.1/0.4).

166. Gel stained for glucose phosphate isomerase (GPI). Two males and 2 females of the following species are represented:

columns 1-4. C. solita n. sp.

5-8. C. heikertingeri (Lazorko)

9-12. C. populivora n. sp.

Although no readable bands can be seen, the pattern for individuals of C. heikertingeri differs from that of C. solita and C. populivora.

167. Gel stained for ME. Males of the following species are represented:

columns 1-6. C. solita n. sp.

7-12. C. populivora n. sp.

All individuals are homozygous (1.0/1.0). The white bands were produced by IPO. It can be seen that the pattern for C. solita differs slightly from that for C. populivora.

168. Gel stained for ME. Three males and 3 females of the following species are

represented:

columns 1-6. C. solita n. sp.

7-12. C. heikertingeri (Lazorko)

All individuals of C. solita are homozygous for 1.0 (1.0/1.0) and those of C. heikertingeri are all homozygous for 0.4 (0.4/0.4).

169. Gel stained for ME. Three males and 3 females of the following species are represented:

columns 1-6. C. heikertingeri (Lazorko)

7-12. C. populivora n. sp.

All individuals of C. heikertingeri are homozygous for 0.4 (0.4/0.4) while those of C. populivora are all homozygous for 1.0 (1.0/1.0).

170. Gel stained for EST. Individuals of C. heikertingeri (Lazorko) are represented:

columns 1-6. overwintered spring females.

7-12. new-generation fall females.

In the row of heavily stained bands (2.5-3.0 cm), heterozygotes are indicated in columns 1, 4, 6, 7, 9, 11 and 12. Homozygotes for the allele with the higher anodal mobility are indicated in columns 3, 5 and 10. Homozygotes for the slower migrating allele are indicated in columns 2 and 8.

171. Gel stained for EST. Six males and 6 females of C. populivora n. sp. are represented:

columns 1-6. males.

7-12. females.

In the row of heavily stained bands (about 2.0 cm), 3 different alleles are indicated.

172. Gel stained for EST. Three males and 3 females of the following species are represented:

columns 1-6. C. heikertingeri (Lazorko)

7-12. C. populivora n. sp.

In the row of heavily stained bands (2.0-3.0 cm), it can be seen that C.

heikertingeri and C. populivora differ in alleles at this locus.

173. Gel stained for EST. Three males and 3 females of the following species are represented:

columns 1-6. C. solita n. sp.

7-12. C. decora n. sp.

The row of heavily stained bands (about 3.0 cm) indicates that C. solita and C. decora have alleles in common at this locus.

Figs. 174-182. Photographs of gels from electrophoresis of Crepidodera spp.

174. Gel stained for CA. Individuals of C. heikertingeri (Lazorko) are represented:
 columns 1-6. 3 males, 3 females from
 Ottawa, Ont.
 7-12. 3 males, 3 females from
 Georgetown, Ont.

The row of heavily stained bands indicates homozygotes and heterozygotes for 2 alleles.

175. Gel stained for CA. Two males and 2 females of the following species are represented:
 columns 1-4. C. solita n. sp.
 5-8. C. heikertingeri (Lazorko)
 9-12. C. populivora n. sp.

176. Gel stained for CA. Two males and 2 females of the following species are represented:
 columns 1-4. C. solita n. sp.
 5-8. C. heikertingeri (Lazorko)
 9-12. C. populivora n. sp.

In the most heavily stained row of bands, allelic differences between the 3 species are indicated.

177. Gel stained for CA. Three males and 3 females of the following species are represented:

columns 1-6. C. solita n. sp.

7-12. C. violacea Melsh.

The banding patterns for individuals of C. solita are faded due to lowered enzyme activity as these specimens had remained frozen for several months. The specimens of C. violacea had been frozen only a few days prior to electrophoresis.

178. Gel stained for peroxidase (PX). Six males and 6 females of C. populivora n. sp. are represented:

columns 1-6. males.

7-12. females.

179. Gel stained for PX. Males of the following species are represented:

columns 3-5. C. solita n. sp.

7, 8, 10-12. C. populivora n. sp.

180. Gel stained for PX. Individuals of the following species are represented:

columns 4-6. C. heikertingeri (Lazorko), females.

7-12. C. populivora n. sp., 3 males, 3 females.

181. Gel stained for PX. Three males and 3 females of the following species are represented:

columns 1-6. * C. heikertingeri (Lazorko)

7-12. C. populivora n. sp.

182. Gel stained for PX. Individuals of the following species are represented:

columns 1-6. C. solita n. sp., 3 males,
3 females.

7, 8. C. decora n. sp., males.

11, 12. C. decora n. sp., females.

Figs. 183-186. Third instar larva of Crepidodera
heikertingeri (Lazorko).

- 183. Dorsal view of head.
- 184. Dorsal view of prothorax.
- 185. Dorsal view of typical abdominal segment.
- 186. Dorsal view of anal plate (9th abdominal tergum). •

0.5 mm

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Maps 1-4. Distributions of Crepidodera spp:

1. longula Horn
2. violacea Melsheimer
3. spenceri (Lazorko)
4. solita n. sp.

Maps 5-8. Distributions of Crepidodera spp.

5. decora n. sp.
6. browni n. sp. (0 = state record)
7. opulenta (LeConte)
8. luminosa n. sp.

MAP 5

MAP 6

MAP 7

MAP 8

Maps 9-12. Distributions of Crepidodera spp.

9. vaga n. sp.
10. heikertingeri (Lazorko)
11. digna n. sp.
12. populivora n. sp.

MAP 9

MAP 10

MAP 11

MAP 12

Maps 13-16. Distributions of Crepidodera spp.

13. bella n. sp.
14. aereola (LeConte).
15. sculpturata (Lazorko)
16. nana (Say)

MAP 13

MAP 14

MAP 15

MAP 16

END

3	0	H	1	0	H	8	5
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FIN