IDENTIFICATION OF ECONOMIC WIREWORMS USING TRADITIONAL AND MOLECULAR METHODS

by

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APPROVAL

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Frank Eric Etzler

August 2013
This work is dedicated to my mother, father, and sister for always lending an ear even when they didn’t understand what I was talking about. For that, I am forever grateful.
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Interest in wireworms has grown in the past decade due to their increasing pest status, largely due to the removal of effective seed treatments from the market. Currently, there is no effective Integrated Pest Management (IPM) strategy to control for wireworms, due to the diverse number of species that make up complexes in cropland. The purpose of this study was to determine what wireworm species are present in Montana’s croplands and develop tools to make species concepts accessible to non-specialists. This was done using DNA barcoding to associate wireworms with adults. DNA barcoding was done by amplifying the Cytochrome-Oxidase I (COI) region of the mitochondrial genome. Twenty-nine (29) species were successfully sequenced and 13 species had adult and larval associations made, including three new associations. In addition, a LUCID pictorial key was also created to help identify species occurring in Montana. A LUCID key is a computer-based key where a user identifies a specimen with the help of pictures of each character. During the wireworm study, one species-group in the genus Limonius was found to include many economic species, including two that are important in Montana. This group needed to be reevaluated due to controversies raised in a recent revision, many of which dealt with economic species. With the combined use of morphological characters and DNA data, eight species are now recognized as belonging to the group. All of these subprojects show the combined use of DNA and morphology as essential to fully understanding wireworm species. With a more precise knowledge of the species that make up the complexes in Montana’s croplands, we can focus on developing IPM strategies for efficient control.
CHAPTER 1 – INTRODUCTION

The larval stage of the beetles in the family Elateridae (Coleoptera) are commonly called wireworms. Since the 19th century, wireworms have been of interest to agriculturalists, due primarily to the damage that they cause to many grain and root crops, as well as some fruit crops. Studies of these larvae, for both taxonomic and control interests, began in earnest in the early 20th century. However, by the 1960s reports of crop damage due to wireworms had diminished significantly in some areas (Wilkinson 1963). Due to this drop, support for the study of wireworms dwindled in the latter half of the 20th century. Now interest in wireworms has grown again due to multiple factors, the main one being the lack of an effective method for control.

Since the spate of wireworm studies that occurred from the 1920s to the 1940s many things have changed, especially in ways insect pests are controlled. Today insect control is part of a process called Integrated Pest Management (IPM). IPM strategies limit pesticide use by targeting key points in a pest’s lifecycle to maximize effectiveness. However, there are many challenges to effective wireworm IPM strategies. These include the facts that there is a complex of species involved in each field and that this complex of species differs depending on the locality. Also, species of potential economic importance belong to many subfamilies and genera, further compounding the issue of control (Vernon and Van Herk 2013). Some species are reported to be nearly identical morphologically (Glen 1944, Becker 1956, Riley and Keaster 1979), again complicating the problem.
Another factor adding to the difficulty of wireworms is their confusing taxonomic history. Many economically important species have been moved many times to different genera, leading some of the older literature to be buried. In order to clarify this confusion, the history of elaterid classification, in relation to wireworms, is presented here. While Europe has a long history of work on wireworms, North America has always been somewhat behind in our understanding of our species. The initial papers in North America at the end of the 19th century dealt only with the identification of pest species (e.g. Comstock and Slingerland 1891), with most of the focus being on control. James A. Hyslop (1917) was one of the first to see value in using wireworm characters to split the Family Elateridae into subfamilial and tribal rankings. He explained which characters he deemed important for determining group relatedness, and split Elateridae into three subfamilies based on larval type, and further subdivided these into well defined tribes. Hyslop’s (1917) classification was very different from that used for adults, highlighting problems in finding a coherent elaterid classification.

After Hyslop, the majority of the work was on descriptions of new species (see Glen 1950 for a detailed review). Robert Glen and his colleagues (Glen et al. 1943) published a key to wireworms of the Prairie Provinces of Canada, the first modern key to species using wireworm morphology. Later, he also focused a paper on distinguishing the sister genera of Dalopius and Agriotes (Glen 1944). However, in his largest publication, Glen focused on species within the defunct tribe Lepturoidini, the genera of which currently belong to the subfamilies Dendrometrinae Gistel 1848, Oxynopterinae Candèze 1857, and Negastrinae Nakane and Kishii 1956 (Bouchard 2011). The main focus was on
the genera that fall within the subfamily Dendrometrinae, and specifically on the composite genus *Ctenicera* (= *Ludius*), *sensu actorum*. In total, Glen covered 93 species in 11 genera, one of the largest and most comprehensive works on wireworms. Glen did a very good job of differentiating the genera and hypothesizing generic relationships. He examined species from Europe, North America, and Australia, and covers both economic and non-economic species.

While extremely useful for many species associations and for the presence of clear and accurate drawings, there are some problems with Glen’s work, as is expected from such an ambitious work. The genera other than *Ctenicera sensu lato* are often not keyed out to species in a useful and practical manner. This means that his generic concepts are very good, but the species concepts are consistently reliable in only one genus. Also, only 37 of the 93 species have clear associations that the author made himself, with the others assigned to three stages of reliability. Unlike most other works, however, Glen highlights the accuracy of these associations so the reader can know the strength of the identifications. Despite these few problems, Glen’s work remains relevant today and is usually the most current key available for these species.

Glen’s colleague, Horace P. Lanchester, (1946) published a key to six economically important wireworms of the genus *Limonius*. This key is better than Glen’s key at separating the species of this subgroup of *Limonius*. These six species occur only in North America, so it is useful in local keying but not for broader taxonomic purposes, yet it does help lay a ground work for the relationships between the species covered. Also during this period, Henry Dietrich (1945) published the Elateridae of New York State. In
this work, he briefly covered the known wireworms of that state. His key for wireworms, unlike those for the adults, goes only to genus level, but he notes the species in the state with described wireworms under each genus.

The next author to deal with North American wireworm associations was Edward C. Becker (1956) with his revision of the genus *Agriotes*. He covered all of the known larvae in the genus in North America (10 of 35 species). Becker created species groups for his adults, laying a frame-work for new species associations at the larval stage. In 1963, Alfred T. S. Wilkinson created a key to the wireworms of cultivated land of British Columbia. He looked at 27 species in nine genera. He updated Glen’s earlier keys (Glen et al. 1943, Glen 1950) with then current taxonomy, including the use of *Ctenicera* instead of *Ludius*. He included short entries describing each larva and also some of their habits. Nine of the species were therein described for the first time. However, the key is only useful for a limited geographic area and difficulties are likely to arise in other regions.

The next author to look at a larger taxonomic scope was Jeffrey N. L. Stibick. He revised the subfamily Hypnoidinae (currently tribe Hypnoidini) of the world, published from 1976 to 1980. He included keys to both adults and larvae. He is the first author to key the genera that were once placed together under *Hypolithus* or *Cryptohypnus*, as well as provide keys to species for each genus. Many of his characters require dissection and a compound scope, so it is sometimes difficult to distinguish between species, but it remains the best resource for this group (although not very useful to non-specialists).
5

Although world-wide in scope, the keys are limited to geographic regions for practical use, making it useful over a broad range.

In 1979, Thomas J. Riley and Armon J. Keaster published a key to nine species of *Melanotus* that are considered pests of corn in Missouri. A few years later (1981), they produced a short pictorial key to wireworms attacking corn in the Midwest. They covered the nine species of *Melanotus* as well as five other species that are also commonly collected in corn fields.

The next major key to North American wireworms appeared in 1991 as a chapter in *Immature Insects* Vol.2, written by Becker, and a key by James R. Dogger, which only goes to the genus level. Unfortunately, the key used outdated taxonomy. The generic names used in the key do not take into account many new generic changes of the late ‘70’s and early ‘80’s. It also separates some genera into different parts, without explaining the species within each part, so it is not useful beyond the generic level. However, it provides a useful resource in determining how the genera are split in North America.

Since it wasn’t the focus of this research, the economic literature was not examined in depth. Edgar H. Strickland (1933) states that many early papers cover wireworms as a single entity, with no mention of the species involved. He continues that this is due to difficulties with correct identifications and not due to any laziness. Following Hyslop’s (1917) paper, wireworm identification was attempted and usually more specific. However, the identities were not always accurate. These difficulties were clearly demonstrated in the limited publications dealing with wireworms in Montana.
The first report of wireworms in Montana occurred in the 13th Annual Report of the State Entomologist (Cooley 1916, Morrill 1983). It was a brief paragraph stating that there were many reports of problems due to wireworms across the state and that they were being sent to a specialist. Brief mention of wireworms continued in later publications, with most stating that they continued to be a problem for cereal crops and some noting novel attacks, such as peas (Cooley 1918), and flax and alfalfa (Cooley 1921). No species names were given until 1930 when *Ludius aeripennis* (= *Selatosomus aeripennis*) and *Ludius inflatus* (auct. = *Hadromorphus glaucus*) were mentioned, as well as reports of *Limonius* sp. attacking some wheat fields (Cooley 1930). Later reports mention reports of wireworm damage, but do not get any more detailed (covered in detail in Morrill 1983).

The next work on wireworms in Montana was reported by Hastings and Cowan in 1954. Their paper was focused on seed treatments for wireworm control, but they mention wireworms collected from a farm in Denton. These wireworms were identified by the identification service is Washington D.C.. Most were given the dubious identification of “probably *Athous* sp.” and one was identified as a *Limonius*. Published records of species of wireworms are absent until Morril did a study in a wheat field in Hill County (1984). He records *Aeolus mellillus*, *Ctenicera destructor* (=*Selatosomus destructor*) and *Ctenicera glauca* (=*Hadromorphus glaucus*) as occurring in the wheat field, with *C. destructor* being the most common. There is doubt, however, that these identifications are accurate for the wireworms collected. This is due to the identifications being made by Becker, who worked primarily with adult Elaterids and very little with wireworms. There
is no doubt that the adults that Becker saw were these species, but it is unknown if the corresponding wireworms match.

The most recent work dealing with this family was completed in 1993 by Catherine Seibert. She conducted a survey of the elaterids of Montana. While focused only on the adults, it was a very extensive work, recording around 150 species occurring in the state, many of which were new records. She also included a list of 22 species and one species complex that had been recorded as economically important in the literature. This provided a starting point to begin research on the wireworms that occur in Montana, as well as a very convenient subset to concentrate on.

Most wireworm associations in the past were made through rearing. Rearing involves keeping the wireworm until it pupates, and describing characters from the exuviae, or shed skin of the larvae, or other wireworms that were collected from the same site and immediately preserved. Rearing may be easy if you collect larvae right before they are about to pupate (Glen 1950), but others often report difficulty (Strickland 1933, Jewett 1946). These difficulties can arise from lack of biological information, particularly with specimens collected from rotting wood, which can lead to the death of the larvae and even the lack of pupation after an extended period of time.

However, in the past decade, new methods have become available to make accurate adult and larval associations. These methods are genetics based and they use highly conserved regions of DNA. Research has been done on wireworm associations using the cytochrome oxidase I (COI) (Lindroth and Clark 2009; Staudacher et al. 2010) and 16S (Benfer et al. 2012) regions of the mitochondria. These proved to be very useful
in making associations, especially when dealing with morphologically difficult to
distinguish species. COI was chosen to examine the wireworms of Montana, because it
has the largest number of available sequences, having been chosen as the international
“barcode” for a species. Many COI sequences are now available on the Barcode Of Life
Data (BOLD) System website, and many, if not most, of these sequences are associated
with voucher specimens and photographs to aid in accurate identifications. This provides
a library already in place with which to associate larvae.

The knowledge of Montana’s wireworms is clearly limited, with only a few
species published for the state, as mentioned above. However, Seibert’s (1993)
unpublished thesis has a list of potentially economically important species, providing a
starting point to determining what species are in Montana’s cropland. With keys to
wireworms available for the three Canadian Provinces touching Montana, there are
morphological tools to aid in species identification. In addition, there are genetic tools
that have been shown to be effective and efficient at associating wireworms with adults
for accurate identification of species.

The major goal of this study is to determine which species make up the wireworm
complex in Montana’s cropland and undisturbed land. This will enable producers to
know which species are causes for concern, and which have a passive or beneficial
presence. The knowledge of species composition in Montana’s cropland also provides a
framework for understanding species’ life histories and ecologies for efficient and
effective control strategies.
In order to accomplish this main overarching goal, three subprojects were conducted. The first was to DNA barcode wireworms collected from across Montana and some surrounding states. The second was to develop a computer-based pictorial key to aid in the identification of wireworms occurring in Montana. And the third was a review of the *Limonius canus* species-group in order to better understand this important group of economic species. Each of these projects has their own set of goals.

DNA barcoding was chosen to make wireworm and adult associations, because it was faster and more efficient than traditional rearing in gaining a broad understanding of what species occur in the state. One goal of this study is to create a base DNA reference library of the 22 potential pest species (Seibert 1993). With COI mtDNA data available for these species, wireworms collected in agricultural fields and natural environments could then be compared to this library. In some cases, the wireworms belonged to a different species than those on the list, so sampling of adults was increased to encompass this. All together, these associations allowed us to test the current literature and to determine which areas should be expanded or improved.

Once the wireworms collected during the study were identified, a LUCID key was produced. This is a pictorial key to Montana’s wireworms, with a focus on commonly encountered species of economic importance. This is a user friendly key to enable Montana’s producers to determine the actual species that infest their croplands. This will also enable others to accurately determine species, especially those dealing with specific control measures for wireworms.
Prior to this study, the genus *Limonius* was revised in the Nearctic region (Al Dhafer 2009). The *L. canus* species-group had many new synonymies proposed in that revision. This species group contains all of the species in *Limonius* that are economically important in the Pacific Northwest and Mountain West regions. Many of the species synonymized had disjunct distributions, and a preliminary review of the species group was undertaken. It combined morphology of adults and wireworms, as well as CO1 mtDNA data to reevaluate the species limits and to see if the new synonymies held up to an in-depth examination. By knowing what species are present, more targeted control methods can be implemented. A new key was also created to aid in the correct identification of the species in this group.

These three things, DNA barcoding of wireworms, the creation of an easy to use key, and a better understanding of an important group of pests, will all help to lay a solid foundation to our understanding of Montana’s wireworms.
CHAPTER 2

DNA BARCODING TO IMPROVE THE SPECIES LEVEL MANAGEMENT OF WIREWORMS

Contribution of Authors and Co-Authors

Manuscripts in Chapters 2 and 4

Author: Frank E. Etzler

Contributions: Implemented the study design. Collected and analyzed DNA data. Identified all specimens to species level. Wrote first draft of the manuscript.

Co-Author: Dr. Kevin W. Wanner

Contributions: Helped conceive the study design. Provided feedback on early drafts of the manuscript and funding for the research.

Co-Author: Anuar Morales-Rodriquez

Contributions: Provided field expertise and specimens for study.

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Abstract

Economically important species of wireworms (Coleoptera: Elateridae) were successfully associated with adults using cytochrome-oxidase I (COI) barcoding, demonstrating the usefulness of this technique to associate life stages in taxonomically difficult pest groups. Previously unrecognized and morphologically difficult, even indistinguishable, pest larvae were shown to be identifiable using this technique. This is a critical step toward discovering effective species-based IPM strategies for this resurgent pest group following the loss of Lindane seed treatments due to regulatory action. Three new adult-larval associations were discovered for Hadromorphus callidus (Brown), Hemicrepidius carbonatus (LeConte) and Metanomus insidiosus (LeConte). Hypnoidus bicolor (Eschscholtz) was shown to comprise multiple divergent lineages at a level usually considered different species, indicating that the population structure of some pest species requires more investigation. The status of the Prairie Wireworm, Selatosomus destructor (Brown) as a full species or as a subspecies of Selatosomus aeripennis (Kirby) is called into question.

Keywords: wireworms, Elateridae, pest-complex, DNA barcoding
Wireworms are the larval stage of beetles in the family Elateridae (Coleoptera). Since the late 19th century, wireworms have been recognized as a serious pest of US agriculture (Comstock and Slingerland 1891). Pest species belong to at least four subfamilies (Johnson 2002), but systematically wireworms have proven to be difficult to work with. The reasons for their difficulty are numerous, including the poorly known taxonomy of adults, high species diversity across regions, soil-dwelling habitat of the larvae which makes them difficult to collect, long immature life-cycle making them difficult to rear, unknown life histories, and subtle interspecific variation (Comstock and Slingerland 1891, Hyslop 1916, Strickland 1933, Lanchester 1946). Consequently, wireworms were usually treated as a single undifferentiated pest complex when control methods were considered, despite the fact that the ecological knowledge was limited to only a few, often unspecified, species.

In the late 19th and early 20th centuries, there were only a few significant reports of wireworm control, life history, and taxonomy (Comstock and Slingerland 1891, Hyslop 1916, Hyslop 1917). However, research in the 1920s - 40s increased and several western species had their larvae described particularly from the Prairie Provinces of Canada (Glen et al. 1943, Glen 1950) and Washington State (Lane 1925, Lanchester 1946). In a few cases, life histories were examined (Lane 1925, Stone 1941, Stone 1944), albeit from very limited geographic areas. All of these studies were initially dependent on rearing specimens to adulthood for larval identification. The rearing process itself is time consuming, often taking years to obtain adults, and was noted as being impractical for rapidly expanding scientific knowledge (Strickland 1933, Lanchester 1946). For some
species, rearing is close to impossible (Stone 1941, Jewett 1946). During this period, some larvae of different species were also found to have indistinguishable morphologies as wireworms (Glen 1944).

During and after World War II (WWII), modern pesticide studies were conducted (Stone 1941, Stone 1944), and agricultural practices changed drastically, resulting in increasing yields through efficiency and agrochemical advances. Pest control also saw a new shift in the next few decades, with Integrated Pest Management (IPM) strategies becoming more important after 1972 (Dent 1995). IPM uses aspects of each specific pest’s biology and ecology to optimize economic impact while limiting pesticide use. In the case of wireworms, however, organophosphates and organochlorides, notably Lindane seed treatments (Lange Jr. et al 1949), virtually eliminated wireworm damage. The result was that new knowledge about wireworms, including species identity, was no longer a priority. These sources of control did not last, with DDT being removed from the US pesticide market in 1972, and Lindane limited in 2002 and removed from agricultural use in 2007 (Edwards 2006). Without effective controls, interest in wireworms is again on the rise (Vernon and van Herk 2013, Vernon et al. 2009, and references therein). IPM strategies are needed, but they require knowledge of the species in question, in order to conduct biological research at the species level and to determine specific economic impacts. The complex of species and the differences in their impacts must first be untangled before effective IPM can be conducted.

Since the complex of species differs depending on the crop, soil type, and geographic area, knowledge of local faunas is required. Critical to this work are
taxonomic tools that allow identification of wireworms. Existing tools are both geographically and taxonomically limited in usefulness. The majority of available larval keys to species were developed in the 30’s and 40’s, and targeted for specific regions. These keys are not comprehensive in their coverage and portions are now out-of-date taxonomically.

New genetic methods have become available to help differentiate larvae. All of these methods utilize DNA, although different genes are used by different authors (Lindroth and Clark 2009; Staudacher et al. 2011, Benefer et al. 2012). The two primary genes used are mitochondrial cytochrome oxidase I (COI) (Lindroth and Clark 2009; Staudacher et al. 2011) and 16s (Benefer et al. 2012). The COI studies matched the adults to larvae with great success, and the 16s study demonstrated significant genetic diversity amongst morphologically identical larvae, suggesting possible cryptic species and reinforcing the difficulties in using morphology alone to identify larvae.

We tested these molecular methods to identify the wireworms of economic importance in Montana. Montana provides a unique geography, where traditionally recognized eastern and western species both occur. The state includes aspects of the Pacific Northwest forests, the Rocky Mountains, the Great Plains, and even portions of the Eastern hardwood forests, making use of regional keys problematic. There is little published information on the individual species involved in Montana pest complexes. Only three publications dealing with wireworms in Montana mention identified species (Cooley 1930, Hastings and Cowan 1954, Morrill 1984). Fortunately, an unpublished study of Montana’s adult-stage elaterids included a list of species that have been reported
in the literature to be economically damaging (Seibert 1993). This list included 22 species and one species complex (Table 2.1).

We used COI DNA sequences to associate field collected wireworms with identified museum adults, focusing on potential pest species that have been collected as adults in Montana (Table 2.1). The barcode region of the COI gene was chosen, since it is a conserved region of the gene and there are already protocols for its use (Lindroth and Clark 2009, Folmer et al. 1994). This particular region of DNA has been shown to be very good for separating specimens at a species level, even when there is cryptic morphology (Hebert et. al 2004, Murray 2008). In addition, there is a current international initiative for barcoding species, the Consortium for the Barcode of Life (CBOL), and data collected by various collaborators are deposited in the Barcode Of Life Database (BOLD) system (Ratnasingham and Hebert 2007). This serves as a useful reference library to further the range and number of species of elaterids available for comparison.

There were three main goals for this study. The first was to create a reference library of COI sequences for the 22 potential pest species known to occur in Montana (Siebert 1993) using identified adult museum specimens (Table 2.1). The next was to sequence COI from wireworms and adults collected in cropland to determine if these specimens match the expected species. Finally, we determined if some of the determinations in the existing literature based on morphology are confirmed with COI barcoding. Montana is fortunate in that the three Canadian provinces that border the state
possess keys to their economic wireworm species, something that is lacking for the majority of the United States (Glen et. al 1943, Glen 1950, and Wilkinson 1963).

Materials and Methods

Sampling and Taxonomy

The majority of adults were specimens deposited in the Montana Entomological Collection (MTEC) and were previously identified by Seibert (1993). Additional adult specimens were freshly collected in 2010 and 2011 from various sites in Montana. Although there was a focus on the 22 agricultural pest species other supposed non-economic species were included to expand the reference library.

Wireworms were obtained from canister traps (Gill 2013) set throughout Montana and a few areas in Idaho and North Dakota in 2010, 2011 and 2012. Specific counties sampled and the number of traps from each is listed in Table 2.2. Wireworm and fresh adult specimens collected from each site were individually separated into vials containing 95% ethanol, assigned a unique identifier in the form of a physical barcode, and stored at room temperature. Larvae were tentatively identified using the existing literature (Glen et al. 1943, Glen 1950, Wilkinson 1963, Becker 1956, Lanchester 1946, and Stibick 1976, 1978, 1980). Voucher specimens are deposited in the Montana Entomology Collection, Montana State University, Bozeman.

Molecular Techniques

Larval specimens used for extracting DNA were cut between the second and third abdominal segment. For adults, the abdomen was removed at the base. Extraction was whole body, following the Qiagen® (Hilden, Germany) DNeasy® spin column protocol
or the protocol with Promega® (Madison, Wisconsin) Wizard® Genomic DNA kit. The samples were lysed over night at 56°C in a Benchmark Scientific (Edison, New Jersey) Multitherm™ shaker (Model H5000-H). Following completion of the extraction process, each sample was assayed using a NanoDrop™ 2000 spectrometer to determine the quality and quantity of DNA present by the UV light absorbance ratio of 260nm/280nm being at or close to two. The barcode region of the COI gene was amplified using the Polymerase Chain Reaction (PCR) on an Eppendorf® (Hamburg, Germany) Mastercycler® using the GoTaq® Green Mastermix (Promega®). Primers LCO1490 and HCO2198 from Folmer et al. (1994) were used with the following cycler protocol: an initial 3 min. at 94°C; 6 cycles of 94°C for 1 min., 45°C for 1:30 min., and 72°C for 2:30 min.; 36 cycles of 94°C for 1 min., 51°C for 1:30 min., and 72°C for 2:30 min., followed by a final 5 min. at 72°C. The PCR product was analyzed on a 1% agarose gel. Successful products were purified by precipitation. To 14µL of PCR product, 22.75µL of dH2O, 12.25µL 2M NaClO4, and 27.0µL of Isopropanol were added in a 0.5mL centrifuge tube, vortexed, and centrifuged for 15 min at room temp at 14,000 rpm. The supernatant was aspirated and 150µL of 70% ethanol added to the pellet, centrifuged for 5 min., at room temp, at 14,000 rpm and the supernatant aspirated. The pellet was allowed to air dry for 10-15 minutes and then re-suspended in 10µL of LoTE, which is a mix of 3mM Tris pH8.0 and 0.2mM EDTA. The purified DNA was sent to MCLabs (South San Francisco, California) for sequencing in both directions. To control for possible laboratory contamination, a set of eight negative PCRs (no template DNA added) was run periodically. After extraction, each specimen was washed with distilled water, followed
by a rinse of 95% ethanol. Larval specimens with their individual barcode were returned to individual vials filled with 95% ethanol. Extracted adults had their abdomens glued on, with the adeagus for males glued on a cardboard card pinned under the specimen. The glue used was Elmer’s® white glue to enable simple removal of both genitalia and abdomens in potential later studies.

Data Analysis

The sequence chromatographs were analyzed using Chromas Lite (Chromas software, Technelysium Pty Ltd. [1998-2005]; Gene Codes Corporation, Ann Arbor, MI, USA [2000]) for quality assessment. Quality forward and reverse sequences from each sample were aligned manually, and the consensus sequence was taken from the area of overlap between the two strands. The consensus sequences were aligned using MAFFT (Katoh 2011). An unrooted Neighbor-Joining tree using the Jukes-Cantor Substitution model was created, with boot-strap values calculated from 500 runs.

Unidentified adults were identified to species using the appropriate literature (Johnson 2002, Brown 1935, Brown 1936, Becker 1956, 1979, Lane 1971, Stibick 1976, 1978, 1980, and Al Dhafer 2009). Locality and sequence information for all specimens was uploaded to BOLD and is available on the BOLD website (NCBI GenBank #s KF549671 - KF549902).

Results

A total of 831 specimens representing 40 species (Table 2.3) were examined (Museum identifiers MTEC007248 to MTEC008111), of which 194 were adults and 637
were larvae. The larvae collected from 29 counties in four states were identified using current taxonomic keys. The majority keyed to *Limonius californicus* (Mannerheim) (54.5%), with *Aeolus mellilus* (Say) (12.5%), *Selatosmus aeripennis* (Kirby) (8.4%), and *Hypnoidus bicolor* (Eschsoltz) (7.4%) being the next most common species. DNA was extracted from 423 specimens, including all 194 adults and 230 larvae. Table 2.3 lists the numbers of adult and wireworm specimens examined for each species. Of the extracted specimens, a total of 246 specimens were successfully sequenced. Thirty of the forty species examined had specimens that produced sequences (Table 2.3). Ten of these were represented by adults only, and six were represented by larval specimens only. *Athous sierraevarius* Lane, *Melanotus longulus oregonensis* (LeConte), *Hadromorphus glaucus* (Germar), and *Hemicrepidius memnonius* (Herbst) yielded DNA from only one life stage, so we were unable to confirm associations between morphologically associated adults and larvae. Both adult and larval specimens of the remaining 14 species were sequenced.

An unrooted neighbor-joining tree was constructed using the 246 COI sequences (Supplementary Figure 2.1). The sequences cluster into 29 distinct groups with 98 - 100 % bootstrap support, n = 500 repetitions. Individual branches within each species group were collapsed (Fig. 2.1) for clarity.

Significantly, all species identified using taxonomic keys formed unique COI groups that are well separated from closely related species (Fig. 2.1). The interspersion of wireworms and adult sequences in the 13 species where both are present demonstrates that COI is a very useful tool for associating larvae with adults (Supplementary Figure 2.1).
Several species clades exhibited surprising sequence diversity (Figs. 2.2 to 2.4). The *Hypnoidus bicolor* clade (Fig. 2.2) formed two distinct groups, “population A” with 30 individuals and “population B” with 8 individuals (100% and 96% bootstrap support, respectively). A single individual, while contained within the clade (99% bootstrap support), was an outlier from populations A and B. Each of these three groups is separated by at least 3% sequence divergence. Significantly, populations A and B include both wireworm and adult sequences, while the third is represented by a single wireworm collected from Beaverhead County, Montana.

The *Hadromorphus* clade (Fig. 2.3) also exhibited surprising diversity. Specimens in this genus, initially all thought to be *H. glaucus*, came out into three crown-groups. One group containing Montana wireworms and an adult male were well separated from two other groups represented by four Washington wireworms and a lone Idaho wireworm. The adult male from Montana was re-examined closely, and the reason for the large separation of this group became clear. This specimen was *Hadromorphus callidus* (Brown), a cryptic species often confused with the more common *H. glaucus*.

Interestingly, the *Selatosomus aeripennis* clade had less diversity than expected, since it includes two closely related species, sometimes referred to as subspecies, *S. aeripennis* and the Prairie Wireworm, *S. destructor* (Brown) (Fig. 2.4). Fig. 4 includes 19 larvae sampled from Montana and Idaho, and five adults from Montana. Based on morphology, three adults key out to *S. aeripennis* and two to *S. destructor*. However, there is less than 1.7% nucleotide diversion within the entire group. Of particular note are a few specimens obtained from a high alpine meadow in the Beartooth Mountain Range,
two adults, male and female, and two wireworms. The male was very small, with a subtle metallic-blue color on his elytra, more typical of *S. aeripennis* despite its small size, while the female was morphologically more of a typical *S. destructor*. However, the COI sequences from these specimens, despite coming from a unique environment, are not unique from specimens sampled from more typical habitats across MT (Figure 2.4).

**Discussion**

Of the 22 target species and the species group determined by Seibert (1993) as potentially economically important in Montana (Table 2.1), 11 were successfully sequenced as adults. Four species from the list were tested unsuccessfully, six were represented in the collection by a single specimen, and the remaining two were too old to attempt extraction.

The current morphological keys for wireworms were shown to be very useful, but not practical for use by a non-specialist. In order to key out all species discovered in the study, multiple keys had to be used, with well-educated guesses to cover gaps. Without expert knowledge of elaterid taxonomy, it would have been difficult to identify the wireworm species present. However, for the most part, associations of wireworms to adults proved to be very accurate, particularly in the works of Glen (1944, 1950). DNA barcoding did demonstrate some limitations of traditional keys, including possible cryptic species as well as allowing new associations to be made between larvae and adults. Using COI barcoding in conjunction with morphology will enable larval keys to be expanded and improved, as well as make the information in the older literature more accessible to non-specialists.
DNA barcoding has shown the potential for the discovery of cryptic wireworm species. Although there is no firm rule for COI nt diversity between species, 3% diversity levels are often indicative of species level divergence across multiple phyla (Kartavtsev 2011). The *H. bicolor* group showed clear evidence for the potential existence of two cryptic species and perhaps a third that was represented only by a single individual. The two crown groups with adults are particularly interesting because they were morphologically identical and did not separate further using existing keys. Interestingly, in his revision of the Hypnoidinae (now Hypnoidini), Stibick (1978) noted a few variants in this species, two of which are stated to occur in Montana. However, one of these forms (Form C) is much less common than the typical form (Form A). Additionally, Zacharuk (1958) noted that there were sexual and parthenogenetic populations in Southern Saskatchewan. Montana lies in the area of overlap between these two populations (Seibert 1993). All adults examined in detail in this study were females, so the possibility of parthenogenic populations is likely.

The *H. bicolor* COI sequences were also compared to sequences from the BOLD website. The larger population A (Fig. 2.2) matched *H. bicolor* specimens coming from Alaska, British Columbia, Alberta, and Manitoba, with an average 99.93% nucleotide (nt) identity, while population B was only 94% similar. The lone *H. bicolor* wireworm (Fig. 2.2) was 98% similar to a single *H. bicolor* specimen in BOLD from Ontario, Canada, but no other data could be obtained for this entry. The lone wireworm did not match other species within the genus *Hypnoidus* that have been entered into BOLD. Interestingly, this distinct genetic difference within populations across Canada was also noted by Benefer et
al. (2012) within the 16s gene. Collectively, these data suggest the existence of several genetically distinct groups within *H. bicolor* across its range that may coincide with morphological forms identified by Stibick (1978). Additionally, there is some indication that the split between the sexual and parthenogenetic populations may be leading to a speciation event. Further studies, such as correlating genotypes with ecological data and mating populations, are required to determine if these groups actually represent new cryptic species. This is expected to play a huge role in determining methods for control since Benefer et al. (2012) concluded that *H. bicolor* is emerging as the dominate agricultural pest in Canada.

The *Hadromorphus* species-group provides another example of the value of DNA barcoding, in both new associations and possible cryptic species (Fig. 2.3). With *H. callidus*, the associated wireworms, morphologically very similar to *H. glaucus*, represent the first association for this species. This was only made possible through COI data. The Washington populations of *H. glaucus* and the single Idaho wireworm were all morphologically indistinguishable, but have a large degree of nt divergence, again, suggestive of a possible undescribed cryptic species. Of the four species known to occur in the genus (Brown 1936), only *H. callidus* and *H. glaucus* are known to occur in Montana and the surrounding region. Due to the lack of an adult associated with either population, the identity of *H. glaucus* cannot be firmly associated with either. However, morphologically both populations match the description of *H. glaucus* wireworms. The finding of two possible species that are morphologically identified as *H. glaucus* may even play a role in determining pest status. *Hadromorphus glaucus* is considered to be a
foliage pest in the Canadian Prairie Provinces (Brooks 1960), a soil pest in Washington (Lane 1925), or rarely of economic importance in British Columbia (Wilkinson 1963). These apparent differences in pest type and status mixed with the above DNA diversity demonstrate that there is still much more to learn about this group of species.

Rather than suggesting the existence of cryptic species based on genetic COI data, the lack of genetic diversity among *Selatosomus aeripennis* and *Selatosomus destructor*, identified based on morphology, questions whether they are in fact separate species. *Selatosomus destructor* is considered to be a major pest of wheat, but can only be separated by its all black coloration from *S. aeripennis*, which has distinctly metallic, often green or green-blue elytra. *Selatosomus destructor* was originally described as a subspecies of *S. aeripennis*, but Brooks (1960) considered them to be separate species, based on differences in habitat. A few years later, Zacharuk (1962) studied these two in detail. He confirmed a preference for different soil types and attempted hybridization of the two. While he was not successful in his attempts, they were few in number and there were probably many confounding factors in his observations. Seibert (1993) covered these two as separate species in her survey of Montana elaterids, and found *S. aeripennis* to be mainly in the western part of the state and *S. destructor* mainly in the eastern part, with overlap of the two in the middle of the state. However, intermediate specimens have been known since their descriptions. The wireworms are likewise virtually indistinguishable, except that *S. destructor* tends to be smaller than *S. aeripennis*.

This study found no significant COI difference in specimens, both adults and wireworms, from across the state (Fig. 2.4). Benefer et al. (2012) also found no
separation of 16S between these two species in specimens from across Canada. Together, these two studies suggest that there may only be one species, represented by two color forms. However, there is evidence (Maddison 2008) that at least COI does not always detect species differences, so this cannot be considered conclusive. Therefore, this problem requires more study, with hybridization studies, rearing under different conditions, and the addition of more genes being obvious avenues.

In addition to the association made for *Hadromorphus callidus* larvae, other species had first associations established. Wireworms were successfully matched to an adult male *Hemicrepidius* sp. nr. *carbonatus* LeConte. A more accurate species identification of the male could not be made, because the genus is in much need of revision. However, this shows the technique’s usefulness in future taxonomic work. Wireworms were also matched to *Metanomus insidiosus* LeConte. Based on the existing literature, these wireworms were originally keyed to the genus *Pseudanostirus*. *Metanomus*, once part of *Ctenicera*, has no known associated wireworms in North America, so the literature cannot lead to the correct identity (Johnson 1992, Majka and Johnson 2008). A formal description of the wireworm will follow in a subsequent publication.

Another potential use of this technique is to help in unraveling difficult Elaterid genera. In this study, species of *Dalopius* were found to be very difficult to key to species as adults and nearly identical as larvae (Glen 1944). Most identifications are only possible through adult males, and we were unable to sequence adult males. Due to the difficulties of this genus’ taxonomy, an in-depth analysis was not done for this complex.
However, the limited CO1 barcoding done shows potential to unravel species concepts in this difficult group (Fig. 2.3).

The sequencing of CO1 mtDNA has advanced the understanding of Montana’s wireworms. The three goals of this study were partially met as we were able to obtain sequence information on half of the species listed by Seibert (1993). The species sequenced are the beginnings of a reference library of important wireworm pest species infesting Montana’s cropland. Towards this we added 246 COI barcode sequences, representing 30 species, to the BOLD database as a resource for future research. Additional sequences from geographically diverse locations entered on the BOLD database will provide a valuable tool for studying genetic diversity of wireworm species. This library can be used to aid in the proper identification of wireworms by producing the correct associations with adults. Of the 22 potentially economic species, half were successfully sequenced, one is likely to not actually occur in the state at the present time, and four are only known from incidental specimens and may never have economically important populations in Montana. This leaves six species needed to fully complete the reference library.

These associations have provided the foundation to survey Montana’s cropland to determine the abundance of specific wireworm species (A. Morales et al. unpublished), which is only made possible by having accurate identifications. Sequencing has also shown some interesting insights in elaterid taxonomy. It has exposed the very high genetic diversity in *Hypnoidus bicolor*, led to the recognition of a newly recognized candidate pest species in the genus *Hadromorphus*, and supported the potential for
synonymy of *S. aeripennis* and *S. destructor*. It has also allowed new associations between adults and previously unrecognized wireworms.

This proof-of-concept work indicates that the use of COI barcoding holds promise for future advances. These range from use as taxonomic tools for difficult taxa to the discovery and expansion of the number of known pest wireworm species

**Acknowledgements**

We thank Charles Hart, Asa Staven, Peggy Bunger and Aracely Ospina for helping with specimen collecting and lab work. Keith Pike, Aaron Esser and Ivan Milosavljevic provided samples from Washington and Idaho and Paramjit Singh Gill and Kevin O’Neill gave us permission to use samples from their Fort Ellis, Montana, study. All of the producers who participated in this project by contributing specimens and/or allowing us to sample on their land were integral to the success of this project. Funding for this research was made possible by USDA Crops At Risk (NISA) grant # 2010-51100-21547 and the Montana Wheat and Barley Committee. This is a contribution of the Montana Experiment Station.
Table 2.1. Wireworm species of potential economic importance in Montana. From Seibert 1993.

<table>
<thead>
<tr>
<th>Potential Montana Pest Species</th>
<th>Potential Montana Pest Species (cont.)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Aeolus mellillus</em> (Say)</td>
<td><em>Hypnoidus bicolor</em> (Eschscholtz)</td>
</tr>
<tr>
<td><em>Agriotes criddlei</em> Van Dyke</td>
<td><em>Hypnoidus impressicollis</em> (Mannerheim)</td>
</tr>
<tr>
<td><em>Agriotes lineatus</em> (Linnaeus)</td>
<td><em>Limonius californicus</em> (Mannerheim)</td>
</tr>
<tr>
<td><em>Agriotes mancus</em> (Say)</td>
<td><em>Limonius canus</em> LeConte</td>
</tr>
<tr>
<td><em>Agriotes pubescens</em> Melsheimer</td>
<td><em>Limonius infuscatus</em> Motschulsky</td>
</tr>
<tr>
<td><em>Anchastus cinereipennis</em> (Eschscholtz)</td>
<td><em>Limonius ursinus</em> Van Dyke</td>
</tr>
<tr>
<td><em>Conoderus auritus</em> (Herbst)</td>
<td><em>Melanotus longulus oregonensis</em> (LeConte)</td>
</tr>
<tr>
<td><em>Conoderus vespertinus</em> (Fabricius)</td>
<td><em>Melanotus similis</em> Kirby</td>
</tr>
<tr>
<td><em>Dalopius spp.</em> Eschscholtz</td>
<td><em>Paradonus beckeri</em> Stibick</td>
</tr>
<tr>
<td><em>Glyphonyx recticollis</em> (Say)</td>
<td><em>Selatosomus aeripennis</em> Kirby</td>
</tr>
<tr>
<td><em>Hadromorphus glaucus</em> (Germar)</td>
<td><em>Selatosomus destructor</em> Brown</td>
</tr>
<tr>
<td><em>Hypnoidus abbreviatus</em> (Say)</td>
<td></td>
</tr>
</tbody>
</table>
Table 2.2. Montana counties sampled for wireworms and the number of traps placed in each county. References are given if the specimens were also part of another study. This does not include material from Broadwater, Fergus, Flathead, Gallatin and Pondera Counties, Montana from A. Morales (unpublished).

<table>
<thead>
<tr>
<th>State</th>
<th>County</th>
<th>Year</th>
<th>Number of Traps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idaho</td>
<td>Bonneville Co.</td>
<td>2011</td>
<td>2</td>
</tr>
<tr>
<td>Idaho</td>
<td>Boundary Co</td>
<td>2011</td>
<td>1</td>
</tr>
<tr>
<td>Idaho</td>
<td>Fremont Co.</td>
<td>2011</td>
<td>2</td>
</tr>
<tr>
<td>Montana</td>
<td>Beaverhead Co.</td>
<td>2011</td>
<td>11</td>
</tr>
<tr>
<td>Montana</td>
<td>Blaine Co.</td>
<td>2011</td>
<td>5</td>
</tr>
<tr>
<td>Montana</td>
<td>Daniels Co.</td>
<td>2011</td>
<td>9</td>
</tr>
<tr>
<td>Montana</td>
<td>Deerlodge Co.</td>
<td>2011</td>
<td>2</td>
</tr>
<tr>
<td>Montana</td>
<td>Fergus Co.</td>
<td>2011</td>
<td>3</td>
</tr>
<tr>
<td>Montana</td>
<td>Gallatin Co.</td>
<td>2010-2011</td>
<td>Gill 2013</td>
</tr>
<tr>
<td>Montana</td>
<td>Garfield Co.</td>
<td>2011</td>
<td>4</td>
</tr>
<tr>
<td>Montana</td>
<td>Granite Co.</td>
<td>2011</td>
<td>3</td>
</tr>
<tr>
<td>Montana</td>
<td>Hill Co.</td>
<td>2011</td>
<td>14</td>
</tr>
<tr>
<td>Montana</td>
<td>Liberty Co.</td>
<td>2011</td>
<td>2</td>
</tr>
<tr>
<td>Montana</td>
<td>Madison Co.</td>
<td>2011</td>
<td>2</td>
</tr>
<tr>
<td>Montana</td>
<td>McCone Co.</td>
<td>2011</td>
<td>4</td>
</tr>
<tr>
<td>Montana</td>
<td>Missoula Co.</td>
<td>2011</td>
<td>3</td>
</tr>
<tr>
<td>Montana</td>
<td>Ravalli Co.</td>
<td>2011</td>
<td>2</td>
</tr>
<tr>
<td>Montana</td>
<td>Richland Co.</td>
<td>2011</td>
<td>6</td>
</tr>
<tr>
<td>Montana</td>
<td>Roosevelt Co.</td>
<td>2011</td>
<td>4</td>
</tr>
<tr>
<td>Montana</td>
<td>Valley Co.</td>
<td>2011</td>
<td>4</td>
</tr>
<tr>
<td>North Dakota</td>
<td>Williams Co.</td>
<td>2011</td>
<td>4</td>
</tr>
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<td>Washington</td>
<td>Benton Co.</td>
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</tr>
<tr>
<td>Washington</td>
<td>Lincoln Co.</td>
<td>2011</td>
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</tr>
<tr>
<td>Washington</td>
<td>Whitman Co.</td>
<td>2011</td>
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<tr>
<td>Washington</td>
<td>Yakima Co.</td>
<td>2011</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 2.3. Total number of specimens and species with DNA extracted and with successful COI sequences. N/A indicates no specimens were successfully sequenced, ? indicates placement is based solely on the available literature, and asterix (*) indicates *Selatosomus destructor* larvae are morphologically identical to *S. aeripennis* larvae and are included in that species’ count.

<table>
<thead>
<tr>
<th>Species Name</th>
<th># of adults extracted</th>
<th># of larvae extracted</th>
<th># of adults sequenced</th>
<th># of larvae sequenced</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Aeolus mellilus</em></td>
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<td>10</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><em>Agriotes criddlei</em></td>
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<td>0</td>
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<td><em>Agriotes ferruginipennis</em></td>
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<td>N/A</td>
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<tr>
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<td>3</td>
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<td>N/A</td>
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<td>0</td>
<td>1</td>
</tr>
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<td>0</td>
<td>1</td>
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<td>0</td>
</tr>
<tr>
<td><em>Athous sierra varius</em></td>
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<td>3?</td>
<td>2</td>
<td>0</td>
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<tr>
<td><em>Corymbitodes lobata</em></td>
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<td>N/A</td>
<td>N/A</td>
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<td><em>Dalopius spp.</em></td>
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<td><em>Glyphonyx recticollis</em></td>
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<td><em>Hemicrepidius sp. nr. carbonatus</em></td>
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<td>1</td>
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<tr>
<td><em>Hypnoidus bicolor</em></td>
<td>21</td>
<td>21</td>
<td>19</td>
<td>19</td>
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<tr>
<td><em>Hypnoidus impressicollis</em></td>
<td>6</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td><em>Hypnoidus leei</em></td>
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<td>3</td>
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<td>2</td>
</tr>
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<td><em>Limonius aegar</em></td>
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<td>1</td>
<td>1</td>
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<tr>
<td><em>Limonius agonus</em></td>
<td>7</td>
<td>0</td>
<td>1</td>
<td>0</td>
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<tr>
<td><em>Limonius anceps</em></td>
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<td>0</td>
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<td>N/A</td>
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<td><em>Limonius californicus</em></td>
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<td>106</td>
<td>4</td>
<td>82</td>
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<tr>
<td><em>Limonius canus</em></td>
<td>9</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td><em>Limonius insulatus</em></td>
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<td>24</td>
<td>5</td>
<td>19</td>
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<tr>
<td><em>Limonius subauratus</em></td>
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<td>0</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><em>Limonius ursinus</em></td>
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<td>0</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><em>Megapenthes angularis</em></td>
<td>4</td>
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<td>1</td>
<td>0</td>
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<td><em>Melanotus longulus oregonensis</em></td>
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<td>1?</td>
<td>1</td>
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<tr>
<td><em>Melanotus similis</em></td>
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<td>N/A</td>
</tr>
<tr>
<td><em>Metanomus insidiosus</em></td>
<td>4</td>
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<td>2</td>
<td>2</td>
</tr>
<tr>
<td><em>Psudanostirus nigrigallowensis</em></td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td><em>Psudanostirus pudica</em></td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
Table 2.3. (continued)

<table>
<thead>
<tr>
<th>Species Name</th>
<th># of adults extracted</th>
<th># of larvae extracted</th>
<th># of adults sequenced</th>
<th># of larvae sequenced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psudanostirus propola</td>
<td>1</td>
<td>0</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Selatosomus aeripennis</td>
<td>7</td>
<td>20*</td>
<td>3</td>
<td>20*</td>
</tr>
<tr>
<td>Selatosomus destructor</td>
<td>6</td>
<td>*</td>
<td>2</td>
<td>*</td>
</tr>
<tr>
<td>Selatosomus pruininus</td>
<td>0</td>
<td>1</td>
<td>0</td>
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</tr>
<tr>
<td>Selatosomus semimetallicus</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>
Figure 2.1. Neighbor-Joining tree of 250 COI sequences, representing 246 specimens. Individual branches within species groups supported by bootstrap analysis have been collapsed. The number next to each species name is the number of specimens with a successful sequence. Branch lengths do not represent nt divergence.
Figure 2.2. Full *Hypnoidus bicolor* clade from the collapsed simplified tree in Fig. 1. Scale bar represents a 3% nt difference between sequences. Numbers on branches represent bootstrap values from 500 runs. Three populations are represented, population A, population B, and a lone larva from Idaho. An ‘A’ indicates an adult specimen and an ‘L’ indicates a larval specimen.
Figure 2.3. *Hadromorus* spp. and *Dalopius* spp. clades. The *Dalopius* and *H. glaucus* clades are collapsed into one branch, each, in the simplified tree (Fig. 1). Scale bar represents a 3% difference between sequences. Numbers on branches represent bootstrap values from 500 runs. An ‘A’ indicates an adult specimen and an ‘L’ indicates a larval specimen.

Figure 2.4. *Selatosomus aeripennis* and *S. destructor* clade. An asterisk (*) denotes an adult identified as *S. aeripennis* and a pound sign (#) denotes an adult identified as *S. destructor*. Scale bar represents a 3% difference between sequences. Numbers on branches represent bootstrap values from 500 runs. An ‘A’ indicates an adult specimen and an ‘L’ indicates a larval specimen.
References Cited


Lane, M. C. 1925. The economic wireworms of the Pacific Northwest (Elateridae). J. Econ. Entomol. 18: 90-95.


CHAPTER 3 – KEYS TO MONTANA WIREWORMS

Wireworms are considered a major crop pest and have been noted for their difficulty of identification (Strickland 1933, Benefer et al. 2012). In order to help many producers and extension agents identify what was present in their fields, attempts were made to create keys to the species of particular areas. While Montana currently lacks a key to species, there are regional keys to species for British Columbia (Wilkinson 1963) and the Canadian Prairie provinces (Glen et al. 1943), providing a starting point for the development of a key for the state.

In addition to the regional keys, there are keys to select groups. The genera of North America have mostly appeared together (Becker and Dogger 1991), but the lack of a species list can make this key difficult to use. Members of the genera *Agriotes* (Becker 1956) and *Limonius* (Lanchester 1946), and portions of the subfamily Dendrometrinae (Glen 1950) all have more specialized keys which cover all of North America. Glen 1950 is the most thorough treatment of North American wireworms available.

All of the above keys are traditional dichotomous keys and can be difficult to use for non-specialists. Recently, there has been an increasing interest in programs that use pictures to allow the keying of species of various groups. These keys allow the user to start at any character and often provide a picture for each character and species covered. This allows the user to become familiar with what certain terms mean as well as giving them a visual for the character, which is often lacking in traditional dichotomous keys. These keys also bring this information to a wider audience, as characters will be shown instead of described, which makes it easier for non-specialists to use. Picture keys for
wireworms, however, are almost non-existent. The only one is Riley and Keaster (1981?) and is limited to the wireworms that are in corn fields east of 104°W, with a focus on species in the genus *Melanotus*. However, unlike modern picture keys, this key only focuses on a few characters.

Another factor that makes the current keys difficult to use is that the majority are now out of date taxonomically. A major change to have occurred in the past 20 years is the splitting of the genus *Ctenicera* into many smaller genera (Majka and Johnson 2008 and references therein). The older keys (pre-1951) use the pre-occupied name *Ludius* for species in these genera, while the later keys use the broad sense of *Ctenicera*. These keys are also often incorrect in their treatment of *Hypnoidus* since they are before Stibick’s revision of the tribe *Hypnoidini* (1975, 1976, and 1980). Unfortunately, the most recent key to genera (Becker and Dogger 1991) continues the improper treatment of *Hypnoidus*. As no key is available for Montana, if one wants to identify wireworms here, they need to know the taxonomic history of multiple genera and have access to multiple keys.

In order to make this information more accessible to Montana’s producers, a pictorial key and traditional dichotomous key were made for the state. The information included is up to date taxonomically, and the two types of keys make it so the user has a few options to choose from. These keys focus on species that are of potential economic importance in Montana, as well as some species that have limited or no distribution in the state, but are important in the Pacific Northwest, are also covered.
The list of characters used for the identification of wireworms are adapted from Glen et al. 1943, Becker and Dogger 1991, and Johnson 1992, with species of *Agriotes* and *Hypnoidus* following Becker 1956 and Stibick 1975, 1976 respectively. Characters are given a ‘0’ where previous authors have treated them as being an ancestral state, but this classification is not followed here due to the lack of specimens. The broad taxonomic coverage and few studied species prevent any implied phylogeny from being developed. Members of the subfamily Cardiophorinae, of which there are about 12 species in Montana, are not covered here. This subfamily has a host of unique characters that will readily distinguish them from other wireworms. Wireworms of this subfamily lack a caudal notch, are weakly sclerotized, possess pseudo-segmentation, and have anal lobes on the 10th abdominal segment.

The genera *Ligmargus* and *Margaiostus* are not keyed out in the pictorial key despite having described wireworms, but are treated in the dichotomous key. *Ligmargus funebris* has described wireworms (Stibick 1975) and is found in western Montana. *Margaiostus glacialis* has described wireworms (Stibick 1976) and is found in north-western Montana. These species are not considered to be economically important.

**Characters of the Ninth Abdominal (A9) Segment:**

**Character 1: Caudal Notch:** 0 – present, urogomphi present (Fig. 3.1); 1 – absent, ninth abdominal segment is often rounded or pointed, lacking urogomphi (Fig. 3.2).
In mature larvae, this character is quite obvious and comes in various sizes. However, in some first instar larvae (Conoderus spp.), there is only a carina running where the notch will eventually form (Rabb 1963). This carina is apparently obvious and these specimens would code as possessing a caudal notch. Urogophi is a term limited to the projections that are adjacent to the opening. Characters two through four are limited to those species that lack a caudal notch, while characters five through ten are limited to those that possess a caudal notch.

**Character 2: Shape of A9 Without Caudal Notch (Fig 3.2):** 0 – pointed (Fig. 3.3); 1 – broadly rounded (Fig. 3.4); 2 – rounded with sharp point at tip (Fig. 3.2); 3 – scalloped (Fig. 3.5).

These states are usually quite distinct. Confusion might be possible between pointed and rounded with a sharp tip. Pointed (as in Dalopius spp.) begins at the base and narrows gradually towards the apex. The rounded with a sharp tip state is very gradual until the apex. Here there is a distinct nipple-like or spine-like projection at the tip. If a distinct projection is on the apex, then it belongs in this character state.

**Character 3: Muscular Impressions (“Eyespots”) on A9:** 0 – absent; 1 – present (Fig. 3.6).

These are very distinct. They are called eyespots in some of the older literature, but Becker (1956) corrected this term. They are only known to occur in species in the genus Agriotes, although not all members of this genus possess this character.

**Character 4: Whorls of Setiferous Tubercles:** 0 – absent; 1 – present (Fig 3.3).
This character refers to tubercles that occur in a circular pattern towards the apex of the ninth segment. These tubercles bear prominent setae. This character appears to be limited to species that possess a pointed ninth segment.

**Character 5: Caudal notch:** 0 – large (Fig. 3.1); 1 – small, often a keyhole shape (Fig. 3.7).

A large caudal notch is defined as having the urogomphi subparallel, and the notch being ‘V’- or ‘U’- shaped. A small caudal notch has the urogophi curve towards each other, and the notch being nearly circular.

**Character 6: Urogomphi:** 0 – “divided”, bearing dorsal tubercles (Fig. 3.8); 1 – “undivided”, smooth, lacking dorsal tubercles (Fig. 3.9).

The dorsal tubercles come off of the urogophi and are often a distinct prong-like projection, although some may be much reduced. An “undivided” urogomphi will be entirely smooth, lacking any sign of tubercles.

**Character 7: Dorsal Tubercles:** 0 – distinct, “prong”-like (Fig. 3.8); 1 – reduced to tubercles (Fig. 3.10).

Dorsal tubercles are considered distinct if they differ in shape from the lateral tubercles on the ninth abdominal segment. If they do not, they are considered to be reduced.

**Character 8: Dorsal Tubercle Shape:** 0 – different shape than urogomphi (Fig. 3.11); 1 – similar shape to urogomphi (Fig. 3.12).
A different shape for the dorsal tubercle is distinct, and one would not be confused with the other. If you are unsure, code as being similar in shape.

**Character 9: Dorsal Tubercle Angle:** 0 – projecting caudodorsally, straight (Fig. 3.13); 1 – distinctly curving anteriorly (Fig. 3.14); 2 – distinctly curving posteriorly (Fig. 3.15).

The curve of the dorsal tubercle is clear when viewed laterally. If the dorsal tubercle is not distinctly curved and only curves at the very tip, it is coded as being straight.

**Character 10: Length of Dorsal Tubercles:** 0 – longer than urogomphi (Fig. 3.11); 1 – subequal to urogomphi (Fig. 3.16); 2 – smaller than urogomphi (Fig. 3.17).

These lengths should be determined from multiple angles of the ninth abdominal segment. If the either the urogomphi or dorsal tubercles are just slightly longer than the other, code as being subequal. The relative lengths are quite distinct.

**Character 11: Hooks on A10:** 0 – absent; 1 – present (Fig. 3.18).

These are present on the segment ventral to A9. This segment bears the anal opening. These hooks are often called anal armature in the older literature.

**Character 12: Lateral Margin of A9:** 0 – smooth (Fig. 3.2); 1 – blunt protuberances (Fig. 3.7); 2 – sharp protuberances (Fig. 3.8).
A smooth lateral margin lacks any distinct markings on the lateral side. Blunt protuberances have a clearly broad and rounded tip, while sharp protuberances come to a distinct point. The sharp protuberances are often heavily sclerotized as well.

Character 13: Dorsotergal Setae on A9: 0 – present, more than two (Fig. 3.19); 1 – present, pair (Fig. 3.20); 2 – absent.

The dorsotergal area is the margined dorsal area on A9 in species possessing a caudal notch and the area past the two apical rows of setae on species where A9 lacks a caudal notch.

Character 14: Mediodorsal Groove: 0 – absent; 1 – present (Fig. 3.21).

This character refers only to a medial impression present on the dorsal surface of A9. There may be lateral impressions, but these are not coded here. This character is often difficult to see, and should only be used as a supplemental character.

Characters of the Head

Character 15: Nasale Type: 0 – tridentate (Fig. 3.22); 1 – one, single pointed tooth (Fig. 3.23); 2 – one, triple pointed tooth (Fig. 3.24).

The terms tridentate and one, triple-pointed tooth are often used interchangeably in the literature. Here, tridentate refers to having three teeth with distinct bases, while one triple pointed tooth is defined as three points sharing a base.

Character 16: Submentum Shape: 0 – rectangular (Fig. 3.25); 1 – triangular (Fig. 3.26).
The submentum is found on the ventral side of the head. A rectangular submentum may have the posterior end rounded, but the lateral edges are always subparallel.

**Character 17: Eyes:** 0 – present (Fig. 3.27); 1 – absent.

Eye presence is often very easy to determine. However, near molt specimens can have the eyespot become clear. In this case, however, this clear spot can be detected and should be coded as having an eyespot.

**Character 18: postepicranial setae:** 0 – present (Fig. 3.28); 1 – absent.

This refers to the setae that are immediately adjacent to the epicranial region.

These are often difficult to see.

**Characters of the Abdomen and Thorax**

**Character 19: Prosternum:** 0 – divided, distinct (Fig. 3.29); 1 – divided, partial (Fig. 3.30); 2 – undivided (Fig. 3.31).

The prosternum is located on the first thoracic segment behind the head. A divided prosternum can be split into three or four parts, with the main suture running down the middle. An undivided prosturnum lacks sutures and is one entire piece. A partially divided prosternum may be hard to detect, and is defined by the suture fading before it reaches the opposite side. The partially divided prosternums may be confused with either of the other two, so extra care should be taken on small specimens.

**Character 20: Punctures:** 0 – indistinct (Fig. 3.32); 1 – distinct (Fig. 3.33).
These punctures are best seen on the abdominal segments. Distinct punctures are large and can be seen under low magnification. If there is a doubt about the presence of distinct punctures, code as indistinct.

Character 21: Anterolateral Impression: 0 – absent; 1 – present (Fig. 3.34).

This is a darkened spot often bearing longitudinal striations occurring on the anterior lateral side of each abdominal segment. It is most often found on species in the subfamily Elaterinae.

Character 22: Medial Anterotergal Setae: 0 – present (Fig. 3.35); 1 – absent.

These setae are immediately adjacent to the medial line and occur on the anterior part of each segment.

Character 23: Anterolateral Carinae: 0 – absent; 1 – present (Figs. 3.36 and 3.37).

These carinae occur on each abdominal segment. They are curved lines with a portion subparallel to the lateral side and a portion subparallel to the posterior edge of the segment in front of it. They are not found on the ninth or tenth abdominal segments.

Character 24: Anterolateral Carinae: 0 – not reaching midline (Fig. 3.36); 1 – reaching midline (Fig. 3.37).

This character is only accurate for abdominal segments two through four. The other segments have been shown to be variable within species, especially in Limonius.

Character 25: Spine-like Setae on the Episterna of Meso- and Metathorax: 0 – absent; 1 – present (Fig. 3.38).
These setae are similar in appearance to those found on the legs of most wireworms. They may be numerous or may only occur as one or two setae. Species with a small number of these setae may be difficult to detect.

**Information About the Species and Coded Characters**

Forty-five species are listed. Some only go to the genus level for this study. Species not examined by myself are often grouped together due to very specific characters that are used for differentiation. Species with specimens examined by me are marked with an asterisk (*) after their name. A ‘-’ is a placement for a character that cannot be coded for that species.

* Aeolus mellillus (Say) (Fig. 3.39)*; Conoderus auritus (Herbst); Conoderus vespertinus (Fabricius)

Code: 0---?01101210010110010-0

The size of caudal notch is not given, because these two genera have different sized notches. *Aeolus mellillus* has a large v-shaped notch, while the *Conoderus* spp. have smaller notches. In earlier instars, these *Conoderus* spp. often have the notch closed, with only a carina or impression to show where the urogomphi will eventually form. More on *Conoderus* can be read in Rabb 1963. These species also have well sclerotized heads which are darker than the rest of the body. *Aeolus mellillus* is the most common of these species, being found across the state of Montana. *C. auritus* is also found across the state, but no larvae were found in this study. *C. vespertinus* is found only in the eastern part of the state and is known only from one specimen.
Agriotes criddlei Van Dyke

Code: 1001-----0020200120000-0

This species is most similar to Dalopius larvae. It can be differentiated by the lack of setae on the central dorsal area. This species is found across the state, but no wireworms were found in this study. More about this species and other Agriotes can be read in Becker 1956.

Agriotes lineatus (Linnaeus)

Code: 1010-----00202001?000-0

This species is known from one suspect specimen in Montana. The date of collection and locality falls well out of its known distribution. It is a major agricultural pest in Europe, Newfoundland, Vancouver Island, and has recently spread to Washington State (Vernon et al. 2001). It is presented here to aid in its identification in new areas.

Agriotes mancus (Say)

Code: 1110-----0020200120000-0

This species is reported as being economically important in wheat fields in eastern U.S. and Canada. In Montana, it is known from one specimen from Custer County, which is the most southeastern County. No wireworms were discovered in this study. A related species, A. pubescens, is stated to have similar wireworm morphology, but it has only been described in one paper and no other authors have seen more wireworms of this species (Becker 1956).

Agriotes sp. nr. sparsus (LeConte) (Fig. 3.40)*

Code: 1210-----0020201121000-0
This species is known from three wireworms collected in an Alfalfa field in Gallatin County, Montana. The lack of eyes suggests that these specimens belong to the *sparsus* species group in Becker’s revision (1956). *A. oregonensis* Becker is reported from Montana (Seibert 1993) and is a likely candidate for this species.

*Ampedus* sp. 1 (Fig. 3.41)*

Code: 1200------0020101121110-0

The wireworms of this genus are poorly understood. In North America, there are five described wireworms, all of which occur in the Eastern Woodlands (Ramberg 1979). Due to this issue, a more specific placement could not be attempted based on morphology. There are 22 species known to occur in the state, none of which are known to be of economic importance, so DNA data was not obtained from most adults.

*Ampedus* sp. 2 (Fig. 3.42)*

Code: 1200------0020200120?00-0

This specimen is from Granite County. There are dark spots where anterolateral impressions would be, but they don’t seem to be true impressions. This was originally thought to be a member of *Magapenthes* based on using Becker and Dogger 1991, but comparing it to illustrations of that genus in Jewett 1946 proved that this identification was in error. DNA data also placed this specimen very close to the other *Ampedus* wireworm, and was distinctly different from the most common member of *Megapenthes* in Montana, *M. angularis* LeConte.

*Anchastus cinereipennis* (Eschscholtz)

Code: 1200------002010?12?0?0-0
This species is known in Montana from only one specimen from Toole County (Seibert 1993). Wireworms for this species are known, but haven’t been formally described (Stone 1941). Wireworms of other species belonging to this genus have been described outside of the U.S. (Johnson 1993). This species was coded using both sources, but many gaps still remain.

*Athous* sp. nr. *sierrae varius* Lane (Fig. 3.43)*

Code: 0---100010012020112101101

This wireworm is known from specimens obtained in an Alfalfa field in Gallatin County, Montana. The species identification is expected to be accurate, but DNA sequences were not obtained from the wireworms extracted. In older literature, this species is called *A. pallidipennis* (Mannerheim). Wilkinson (1963) states that wireworms of this species have sharp tubercles on the lateral margins of A9, but this detail was not confirmed by Glen (1950) or me.

*Dalopius* spp. (Fig. 3.44)*

Code: 1001------0010200120000-0

The species of this genus are nearly identical as wireworms (Glen 1944). They are most similar to *Agriotes criddlei* and can be differentiated by the presence of a pair of dorsal tergal setae in the 3rd row of setae from the apex of A9.

*Hadromorphus glaucus* (Germar) (Fig. 3.45)* and *Hadromorphus callidus* (Brown) (Fig. 3.46)*

0---0001210220100101011101
The adults of these species are found across the Pacific North West and Northern Great Plains. Wireworms of *H. glaucus* were only obtained from fields in Washington and Idaho, however, while wireworms of *H. callidus* were found across Montana. The wireworms of *H. callidus* are a new association for this species, which was only made possible through COI mtDNA data. Based on this preliminary analysis, these wireworms can be distinguished from those of the closely related *H. glaucus* by having the urogomphi curved anteriorly and slightly inwards, while *H. glaucus* has straight urogomphi (see couplet # below). It is unknown at the moment if this is a product of different stages of development, or represents an actual difference between species. Since the character used to separate these two species is not coded in the LUCID key, they key out together.

*Hemicrepidius memnonius* (Herbst) (Fig. 47)*

Code: 0---?00001012120?121011111

These specimens were collected from a sugar beet field in Richland County, Montana. The specimens examined were given this species name based on a DNA match with sequences in BOLD. They do not match the description of the species given by Glen in 1950. This may be due to Glen’s description being based only on near mature larvae or that this genus has not been revised in North America since the late 19th century, so the adult in one of these sources was identified incorrectly. These specimens have medium sized caudal notches, with the urogomphi curving towards each other. Due to the combination of character states, they are coded with a ‘?’. There also appear to be clear spots, which suggest eyespots are present. Glen states that this genus lacks eyes in near mature wireworms. The specimens examined are quite small and may represent an earlier
instar, and the eyespots may disappear as the wireworm matures. Due to the unusual nature of this character and the speculation surrounding it, it is coded with a ‘?’ to represent all known stages.

*Hemicrepidius* sp. nr. *carbonatus* (LeConte) (Fig. 3.48)*

Code: 0---00010101201212101111

These specimens were obtained from an alfalfa field in Gallatin County, Montana. These matched an adult male also collected at the site with CO1 mtDNA data. These wireworms appear to have more similarities to the drawings of *H. memnonius* given in Glen 1950 than the wireworms above, but the associated male is closer to *H. carbonatus*. Again, a more accurate identification of the adult could not be made due to the lack of a recent revision of the genus.

*Hypnoidus abbreviatus* (Say)

Code: 0---00011100002000??0?10?

This species is known from four specimens in Montana from Gallatin and Hill Counties (Seibert 1993). No wireworms were discovered in this study. A more thorough treatment of this species is given in Stibick 1976.

*Hypnoidus bicolor* (Eschscholtz) (Fig. 3.49)*

Code: 0---00010201102000100101

This species is a fairly common species in Montana’s wheat fields. Adults have been collected throughout western Montana. These wireworms are very similar to those of *H. leei* Stibick. Stibick stated that they can be differentiated based on head shape, but I have found this character to be difficult to use, especially on shrunken specimens. An
examination of the episterna showed a few spike-like setae (1-2) present in *H. bicolor* and absent in *H. leei*. Due to the preliminary nature of this study, it has not been confirmed to be a consistent character. However, the consistency in other species suggests that this may be a useful character to use.

*Hypnoidus impressicollis* (Mannerheim)

Code: 0---0001120?002000??0?10?

The adults of this species have been collected throughout Western Montana. No wireworms were discovered in this study. More on this species can be read in Stibick 1976. Due to the incomplete coverage of this species by Stibick (1976), many of the characters used to code the species remain unknown.

*Hypnoidus leei* Stibick*

Code: 0---000102011020001000100

This species was collected in an alfalfa field in Gallatin County, Montana and a trap in Fremont County, Idaho. Adults are known from the central and west regions of Montana. These wireworms are very similar in appearance to *H. bicolor*. A possible way to distinguish the two species is discussed under *H. bicolor*.

*Limonius aeger* LeConte (Fig. 3.50)*; *Limonius ursinus* Van Dyke?

Code: 0---1010-20120112001111

Adults of *L. aeger* are known from across western Montana. Only one wireworm from Beaverhead County was discovered in this study. It is differentiated from other common *Limonius* wireworms by lacking a prominent dorsal tubercle on the urogomphi.
Based on adult morphology, it is expected that *L. ursinus* may have similar larvae. *L. ursinus* is known from counties in Southeast Montana.

*Limonius californicus* (Mannerheim) (Fig. 3.51)*

Code: 0---100002012020112101111

This species is the most common species in wheat fields in western Montana. It can be differentiated from *L. canus* LeConte by its more robust ninth abdominal segment and the anterolateral carinae reaching the midline. It can be differentiated from *L. infuscatus* Motschulsky by the straight dorsal tubercles of the urogomphi.

*Limonius canus* LeConte (Fig. 3.52)*; *Limonius subauratus* LeConte

Code: 0---100002012020112101101

Adults of *L. canus* have been collected throughout western Montana, but wireworms have only been collected for this study in eastern Washington. *L. subauratus* occurs in this area as well, but no wireworms were collected in this study. Based on the literature, these species can be differentiated based on differences in A9 shape and the size of the caudal notch. Since these could not be confirmed, they are coded as the same here.

*Limonius infuscatus* Motschulsky (Fig. 3.53)*

Code: 0---100012012020112101111

Adults of this species are extremely common throughout western Montana. Wireworms have been collected in Gallatin County, Montana and in Eastern Washington. They can be easily distinguished from other *Limonius* wireworms by the presence of distinctly anterior curving dorsal tubercles.
*Metanomus insidiosus* (LeConte) (Fig. 3.54)*

Code: 0---0001100220101011110

This is a new association. These are very similar wireworms of the genus *Pseudanostirus*, but *M. insidiosus* has sharp protuberances on the sides of A9, while *Pseudanostirus* has blunt protuberances (Glen 1950).

*Melanotus longulus oregonensis* (LeConte) (Fig. 3.55)*; *Melanotus similis* (Kirby)

Code: 1300-----012010112011110

One wireworm was examined from Gallatin County. No DNA sequence was obtained from this specimen. Based on its locality in Western Montana, it is expected to be *M. longulus oregonensis*. No differentiation could be made between this species and *M. similis*, because no work of literature treats both species as wireworms and illustrations of the two look very similar. However, in the dichotomous key below, they are separated based on relative length and width of A9, based on available illustrations. It is unknown if this will hold up when actual specimens are compared.

*Microhypnus(Migiwa) dubius* (Horn)

Code: 0---01----00000?112?010-0

The adults of this species are found across the state, mostly in the Western part of the state. No wireworms were found in this study. This species can be distinguished from others in Montana by the smooth urogomphi and the lack of any tubercles on A9. Two generic names are given due to the unknown placement of this species. Siebert (1993) treats this species as part of *Microhypnus*, while Johnson (2002) treats this species as belonging to *Migiwa*. 
Nitidolimonius respelendens (Eschscholtz)

Code: 0---100001012120012001111

The adults of this species are found in the western part of the state. These wireworms are very similar to Limonius wireworms, but the presence of eyes and a mediodorsal groove on A9 can differentiate this species. A more detailed discussion of this species is given in Glen 1950.

Prosternon bombycinus (Germar); Prosternon viduus (Brown)

Code: 0---000112012020010?01100

The adults of this species are found throughout western Montana. No wireworms were examined for this species. They are most similar to wireworms of Pseudanostirus. A more detailed study of these two species is given in Glen 1950.

Pseudanostirus nebraskensis (Bland); Pseudanostirus triundulatus (Randall)

Code: 0---000101012010010001110

These species are found across Montana, mostly in the eastern part. No wireworms were collected for this study. A more detailed study is given in Glen 1950.

Pseudanostirus propola (LeConte); Pseudanostirus pudicus (Brown)

Code: 0---000110012010010001100

Adults of these species have been collected mostly in the western parts of the state. No wireworms were collected for this study. A more detailed study and separation of the two are given in Glen 1950.

Selatosomus aeripennis (Kirby)*; Selatosomus destructor (Brown) (Fig. 3.56)*

Code: 0---000120012110010101101
Adults of these species are found across the state. No differentiation could be made between wireworms of these two species, either morphologically or with CO1 data. While reported as the biggest agricultural pest in the state, they are absent from most fields and are only a minority in fields where they do occur.

*Selatosomus pruininus* (Horn) (Fig. 3.57)*

Code: 0---000101020110010101101

Only one wireworm from Washington was examined. This species is not known to occur in Montana. The wireworm was unable to be matched to an adult with CO1 data, due to the lack of adult specimens. However, it was morphologically the same as that described in Glen 1950.

*Selatosomus semimetallicus* (Walker) (Fig.58)*

Code: 0---000121011010010001101

Adults in Montana are found across the western portion of the state. They are most similar to wireworms of *S. aeripennis* and can be differentiated by a pair of setae on the dorsal surface of A9.

*Selatosomus festivus* (LeConte); *Selatosomus sexualis* (Brown)

Code: 0---000121010010?10101101

Adults of these two species are found in western Montana. Glen 1950 has a more thorough treatment of these species, including how to separate them. Since no wireworms matching these species was discovered in this study, they are not treated further.

*Selatosomus semivittatus* (Say)

Code: 0---000120010010?10?01???
62
Adults are only known in Montana from Gallatin County. A single wireworm was
examined by Glen for his 1950 paper. The coding was done based on his incomplete
account, due to the quality of the specimen, and may not represent this particular species.
Sylvanelater spp.
Code: 0---100002010020112?01111
These species are very similar to Limonius. The wireworms can be differentiated
by sharp tubercles on the lateral margins of A9.

Dichotomous Key to Wireworm Species
Found in Montana Agricultural Fields

(Adapted from Glen et al. 1943, Jewett 1946, Lanchester 1946, Glen 1950,
1.

Caudal notch not present on 9th abdominal (A9) segment . . . . . . . . . . . . . . . . . . . 2

1’.

Caudal notch present on A9 segment . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 10

2.(1)

Sides of A9 scallopped; A9 often dorso-ventrally flattened . . . .(Melanotus spp.) 3

2’.

Sides of A9 smooth or with tubercles near the apex, not scalloped; A9 often
convex, and not flattened dorso-ventrally . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 4

3.(2)

A9, when measured lengthwise from anterior part of anterolateral impressions to
apex and widthwise at widest part, approximately as wide as long . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Melanotus longulus oregonensis

3’.

A9 about 1.5 times longer than wide . . . . . . . . . . . . . . . . . . . . . . Melanotus similis


4. (2')  A9 with muscular impressions, often referred to as “eyespots”.............. 5
4'.  A9 without muscular impressions....................................................... 7

5. (4)  Head with definite eyespot at base of antennae................................. 6
5'.  Head without definite eyespot at base of antennae........... Agriotes sp. nr. sparsus

6. (5)  Apex of A9 broadly rounded; first eight abdominal segments without minute setae
in front of each of the lateral and spiracular anterotergal setae... Agriotes mancus
6'.  Apex of A9 more or less pointed; first eight abdominal segments with minute
setae in front of each of the lateral and spiracular anterotergal setae...........
.......................................................... Agriotes lineatus

7. (4')  A9 with setiferous tubercles; A9 gradually narrowed to a blunt point......... 8
7'.  A9 without setiferous tubercles; A9 ending in a distinct “spine”............. 9

8. (7)  A9 with a pair of dorsal-tergal setae................................... Dalopius spp.
8'.  A9 without a pair of dorsal-tergal setae............................... Agriotes criddlei

9. (7')  Abdominal segments with antero-lateral impressions............... Ampedus spp.
9'.  Abdominal segments without antero-lateral impression....................

.......................................................... Anchastus cinneripennis
10. (1’) Urogomphi without dorsal tubercles; sides of A9 smooth, without tubercles . . . .

.................................................. *Microhypnus (Migiwa) dubius*

10’. Urogomphi with dorsal tubercles, often prong-like .......................... 11

11. (10’) “Anal armature”, or anal hooks, on A10; nasale tridentate ............... 12

11’. Lacking “anal armature”, or anal hooks, on A10; nasale variable ............. 13

12. (11) Frons tapering to a blunt point, cone-shaped ......................... *Aeolus mellilus*

12’. Frons truncate at posterior end, rectangular in shape ....................... 14

......................... *Conoderus auritus, Conoderus vespertinus* (nearly identical)

13. (11’) Head with posteroepicranial setae; thorax and first eight abdominal segments

bearing medial antero-tergal setae ........................................ 14

13’ Head without posteroepicranial setae; thorax and first eight abdominal segments

usually lacking medial antero-tergal setae .................................. 19

14. (13) Basal segment of labial palpus without any setae ............ (*Hypnoidus spp.*) 15

14’ Basal segment of labial palpus with one to four setae ...................... 18

15. (14) Urogomomphi subequal in length to dorsal tubercles ................. 16

15’. Urogomphi longer than dorsal tubercles .................................. 17
16. (15) Galea with one prominent setae ................. Hypnoidus abbreviatus
16’. Galea with five to seven prominent setae ............... Hypnoidus impressicollis

17. (15’) One to two spine-like setae present on episternae of meso- and metathorax;
subnasale with three denticles ......................... Hypnoidus bicolor
17’. No spine-like setae present on episternae of meso- and metathorax; subnasale
with four denticles ................................. Hypnoidus leei

18. (14’) Nasale with several small denticles on each side of base of median tooth ......
......................................................... Ligmargus funebris (Candèze)
18’. Nasale consisting of one triple-pointed tooth .................
......................................................... Margaiostus glacialis (Van Dyke)

19. (13’) Prosternum divided into two or more sclerites ......................... 20
19’. Prosternum undivided, one large triangular sclerite ................. 34

20. (19) Spinelike setae present on episternae of meso- and metathorax; tip of dorsal
tubercle inclined backwards ........................................ 21
20’. Spinelike setae not present on episternae of meso- and metathorax; tip of dorsal
tubercle inclined upward, inward, or forward ........................... 28

21. (17) Urogomphi and dorsal tubercle subequal in size and similar in shape, resembling
grappling hooks; eyes usually small and indistinct ......................... 22
21’. Urogomphi and dorsal tubercle not similar in shape, although they may be subequal in length; eyes usually clearly visible .......................... 24

22. (21) Pleurites of first abdominal segment practically as long as sternal plate ........

.......................................................... *Selatosomus semivittatus*

22’. Pleurites of first abdominal segment less than three-fourths as long as sterna plate ......................................................... 23

23. (22’) Urogomphi and dorsal tubercles relatively straight, with short, curved tips; full-grown larvae exceed 20mm in length ...................... *Selatosomus festivus*

23’. Urogomphi and dorsal tubercles curved, with long, curved tips; full-grown larvae do not exceed 16mm in length ................................. *Selatosomus sexualis*

24. (21’) Urogomphi and dorsal tubercles relatively short and thick ............... 25

24’. Urogomphi and dorsal tubercles relatively long and slender ................ 27

25. (24) Setae present on central dorsal area of A9 .................. 26

25’. Setae not present on central dorsal area of A9 ..............................

...................... *Selatosomus aeripennis, Selatosomus destructor* (Identical)

26. (25) Two pairs of setae (four total) present on central dorsal area of A9 ..........

.......................................................... *Selatosomus pruininus*
26’. One pair of setae (two total) present on central dorsal area of A9 .................

..................................................... Selatosomus semimetallicus

27. (24’) Urogomphi relatively straight, with a slight upward curve at tip .................

..................................................... Hadromorphus glaucus

27’. Urogomphi distinctly curved, curving forward and slightly inwards .................

..................................................... Hadromorphus callidus

28. (20’) Dorsal tubercles with sharp tips curving forward; urogomphi and dorsal
tubercles subequal or dorsal tubercles longer ......................... 29

28’. Dorsal tubercles of a different type; urogomphi and dorsal tubercles subequal or
urogomphi longer ................................................................. 31

29. (28) Abdominal segments two through five with antero-lateral carinae reaching the
midline ..................................................... Metanomus insidiosus

29’. Abdominal segments two through five with antero-lateral carinae not reaching the
midline ................................................................. 30

30. (29’) Dorsal tubercles three times as long as urogomphi . . . . Pseudanostirus pudicus

30’ Dorsal tubercles not more than twice as long as urogomphi .........................

..................................................... Pseudanostirus propola
31. (28') Abdominal segments two through five with antero-lateral carinae reaching the midline; nasale one single-pointed tooth ................................. 31

31’. Abdominal segments two through five with antero-lateral carinae not reaching midline; nasale one triple-pointed tooth ................................. 32

32. (31) Dorsal tubercle standing erect, forming an angle of approximately 90° where it attaches to the urogomphi ......................... *Pseudanostirus nebraskensis*

32’. Dorsal tubercle projecting caudodorsally, forming an angle of approximately 130° where it attaches to the urogomphi ......................... *Pseudanostirus triundilatus*

33. (31’) Six “sensory” appendices on second segment of antennae . . . *Prosternon viduus*

33’. Five “sensory” appendices on second segment of antennae ........................

.................................................................................. *Prosternon bombycinus*

34. (19’) Caudal notch small ................................................................. 35

34’ Caudal notch large ................................................................. 42

35. (34) Dorsal tubercle small, similar in size to lateral tubercles of A9 . . . . . . . .

.................................................................................. *Limonius aeger*

35’. Dorsal tubercle larger and distinct from lateral tubercles of A9 . . . . . . . . 36

36. (35’) Dorsal tubercle subequal in length to urogomphi ................................. 37
36’. Dorsal tubercle much longer than urogomphi; abdominal segments with distinct punctures; eyes absent ... Athous sp. nr. sierra varius

37. (36) Ninth abdominal segment with a distinct medio-dorsal groove; eyes present ...

........................................ Nitidolimoni resplendens

37’. Ninth abdominal segment without distinct medio-dorsal groove; eyes absent . . 38

38. (37’) A9 with blunt lateral tubercles ........................................... 39

38’. A9 with sharp lateral tubercles ........................................... Sylvanelater spp.

39. (38) Abdominal segments two through four with antero-lateral carinae reaching the midline ................................................................. 40

39’. Abdominal segments two through four with antero-lateral carinae not reaching midline ................................................................. 41

40. (39) Dorsal tubercles curved anteriorly .................. Limoniuss infuscatus

40’. Dorsal tubercles not curved, projecting caudodorsally .... Limoniuss californicus

41. (39’) Width of caudal notch approximately one-half distance between tips of dorsal tubercles; A9 convex dorsally ......................... Limoniuss canus

41’. Width of caudal notch approximately one-third distance between tips of dorsal tubercles; A9 flattened dorsally ......................... Limoniuss subauratus
42. (34’) Urogomphi sharp, curving anteriorly at tips; caudal notch roughly ‘V’-shaped . .

.......................................................... Hemicrepidius sp. nr. carbonatus

42’. Urogomphi blunt, projecting medially; caudal notch ‘U’-shaped . .

.......................................................... Hemicrepidius memnonius
Figure 3.1. Caudal notch present on the ninth abdominal (A9) segment. The arrow points to the notch. This is also an example of a large caudal notch. The species shown is *Selatosomus aeripennis*.

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Figure 3.12. The dorsal tubercle is similar in form to the urogomphi. Specimen shown is a *Selatosomus semimetallicus*. 
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Figure 3.14. The dorsal tubercles curve anteriorly. The specimen shown is a *Metanomus insidosus*. 
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Figure 3.16: The dorsal tubercles are subequal in length to the urogomphi. The drawing is of *Selatosomus festivus* (From Glen 1950, Figure 16c, as *Ludius cruciatus festivus*)
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CHAPTER 4

REVIEW OF THE *LIMONIUS CANUS* LECONTE, 1853 (COLEOPTERA: ELATERIDAE)

**Contribution of Authors and Co-Authors**

Manuscripts in Chapters 2 and 4

Author: Frank E. Etzler

Contributions: Concived and implemented the study design. Collected and analyzed DNA data. Identified all specimens to species level. Wrote first draft of the manuscript.

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Contributions: Helped conceive the study design. Provided feedback on early drafts of the manuscript and funding for the research.
Abstract

The genus *Limonius* Eschscholtz, 1829 was recently revised in North America north of Mexico. This recent revision made some new synonymies, including species of economic importance in some regions of North America. Most reportedly economic species were found to belong to the *Limonius canus* LeConte species-group, so an in-depth review of the group was conducted in order to determine species limits in the group. Analysis of species concepts was done using cytochrome-oxidase I (COI) DNA data, and adult and larval morphology. Eight species are now recognized as forming the species group, unified by characters of the female internal genitalia and, to a lesser extent, characteristics of the hypomeron and male genitalia. The species recognized in this paper as valid are: *Limonius agonus* (Say), 1839; *Limonius californicus* (Mannerheim), 1843; *Limonius canus* LeConte, 1853; *Limonius cf. dubitans* LeConte, 1853; *Limonius ectpus* (Say), 1839; *Limonius infuscatus* Motschulsky, 1859; *Limonius pilosulus* Candèze, 1891; and *Limonius subauratus* LeConte, 1853. *Limonius stigma* (Herbst), 1806 was found to not belong in this species-group and was removed and not treated in-depth here. A new key was produced to key out all recognized species and clarify areas of confusion in previous keys.
Wireworms, larval elaterids, are a major pest of wheat and potatoes in the Pacific North-West and Mountain West. In this region, one particular group of species in the genus *Limonius* Eschscholtz, 1829 are a major component of the fauna of affected fields (A. Esser and I. Milosavljevic pers comm.; Moralez et al. in prep). Elaterid adults and larvae are often difficult to determine to species, and species of *Limonius* are a prime example. Fortunately, there is a recent revision of the Nearctic species (Al Dhafer 2009). The key presented therein included all described species and two new species. However, the revision only treated adults, leaving problems with larval identification unresolved. The most recent larval keys for this genus are by Lanchester (1946) and Glen (1950).

Following Van Dyke (1932), Al Dhafer placed the North American fauna into two subgenera, *Limonius s. s.* and *Pheletes* Kiesenwetter, 1858. One species-group in *Pheletes* is of particular interest to economic entomologists, the *L. canus* species-group (LCSG). This group contains the majority of Nearctic *Limonius* considered to be economically important (Lanchester 1946) all but one of which has never been reported to be pestiferous.

While this group was not explicitly recognized by Al Dhafer (2009), the grouping of these 17 names (*Limonius agonus* (Say), *L. anceps* LeConte; *L. arminus* (Say), *L. californicus* (Mannerheim), *L. canus* LeConte, *L. discoideus* LeConte, *L. dubitans* LeConte, *L. ectypus* (Say), *L. hispidus* LeConte, *L. infuscatus* Motschulsky, *L. pilosus* LeConte, *L. pilosulus* Candèze, *L. occidentalis* Candèze, *L. stigma* (Herbst), *L. subauratus* LeConte, *L. subcostatus* Motschulsky, and *L. vernalis* Fall) have historically been placed together in the same group or genus in keys and catalogs (e.g. LeConte
1853, Candèze 1860). Glen (1950) referred to these species as the *L. canus* species group and Glen’s name for the group is followed here. Al Dhafer (2009) pointed out that more questions were raised than answered in his treatment of the species in the *L. canus* species-group (LCSG), but he nicely set up the conditions that allowed this study.

The first published reference to the genus *Limonius* in North America was by David Ziegler (1845) in his description of *Limonius definitus* Ziegler and move of *L. quercinus* (Say) to the genus. However, it wasn’t until 1853, when LeConte revised North American elaterids, that most American *Limonius* species were formally moved to that genus. All names in the *canus* species-group known at that time were placed in LeConte’s group B (Table 4.1). In 1859, Motschulsky described two species from the Russian areas of North America, although they were overlooked for many years (Tables 4.1 and 4.2). Candèze (1860) revised the world elaterid fauna, synonymizing *Pheletes* with *Limonius* and providing a key to the known species of *Limonius* in which the *canus* species-group where grouped together (Table 4.1). In 1863, LeConte moved the species *L. dubitans* to its own genus, *Nothodes*. In 1879, Horn synonymized *L. agonus* with *L. ectypus*. Later, Candèze (1891) created a checklist of species, reflecting the changes that had occurred after his earlier monographs (Table 4.1).

The early part of the 20th century, saw many changes in classification. Schwarz (1906) raised *Pheletes* to full generic status and included North American species (Table 4.2). Leng (1920) continued Schwarz’s usage, and included *L. subcostatus* in lists for the first time. In 1932, Van Dyke synonymized *Nothodes* LeConte and *Pheletes* with *Limonius*, stating that there were not enough differences in the North American species to
justify separate genera. He placed all species of the *L. canus* group in the subgenus *Pheletes*. Van Dyke’s (1932) work produced the first modern key to this genus in North America and provided a bibliography for all 47 species then recognized. While no formal subgroups are proposed, he recognized eight species as valid in the canus subset of the key, and proposing four new synonymies. A few years later in 1934, Fall wrote a response to Van Dyke’s 1932 work. He agreed with most of the synonymies, but felt that *L. discoideus*, *L. agonus*, and *L. pilosulus* were all valid species and should be treated as such. Van Dyke responded in 1943 and stated that he stood by his synonymies with *L. discoideus* and *L. pilosulus*, but made no comment on *L. agonus*.

For the remainder of the 20th century, there were only regional or specialized keys, with some of the first done by Dietrich (1945) for New York State and Lanchester (1946) for the larvae of six economic species. Both authors continued Fall’s treatment of *L. agonus* and *L. ectypus* as distinct species. In 1950, Robert Glen did an important key to the larvae of the tribe *Lepturoidini*, which included the genus *Limonius*. While his work on *Limonius* was not the focus of the paper and closely followed Lanchester (1946), he provided support that the *L. canus* species-group was a distinct group within *Limonius*.

The genus was also briefly covered by Becker (1956), who wanted to demonstrate how the female genitalia could be used to form species groups and help in better phylogenetic understanding. While focused mostly on species of *Agriotes*, he did cover a fair bit of the *Limonius* species. In the following discussion, group numbers are provided for ease of reference, and represent the order that Becker covered the species groups.

Becker placed most of the *L. canus* species-group (LCSG) into group 4, except for *L.*
stigma, which was placed in group 3, with other species with red humeral spots on their elytra. Becker also broke group 4 into another three subparts. All females in group 4 have similar internal structures, but differ based on the external structure of their ovipositor. Group 4a contained *L. anceps*, *L. discoideus*, *L. subcostatus*, *L. subauratus*, and *L. agonus*. Group 4b contained *L. californicus*, *L. canus*, and *L. dubitans*. Group 4c contained *L. infuscatus*, *L. pilosulus*, *L. vernalis*, and an unidentified species. The names *L. ectypus*, *L. hispidus*, and *L. occidentalis* were not mentioned. It should be noted that Becker stated that names were used for ease of use and do not represent actual removal from any previous synonymy.

Lane (1971) covered the genus within Hatch’s *Beetle’s of the Pacific North West*. He only treated the 23 species that occurred in the Pacific Northwest region, which included seven names of the *L. canus* species-group. He disregarded Van Dyke’s subgeneric split, choosing to use *Gambrinus* LeConte and *Cidnopus* Thomson instead. Lane’s definition of the subgenus *Cidnopus* included the canus species-group (LCSG). He considered the names *L. canus*, *L. subauratus*, *L. californicus*, *L. pilosulus*, and *L. infuscatus* as valid species. The last authors to key this group in the 20th century were Downey and Arnett (1996). However, they only focused on the North-Eastern United States and their key did not differ from Dietrich’s (1945) key.

In the 21st century, Hathal Al Dhafer (2009) revised the *Limonius* of North America. He synonymized many of the species in the canus species-group (LCSG), reducing the number of recognized species to six. Many of these synonymies combined species that were traditionally considered to be eastern or western in distribution into a
transcontinental species with a gap in recorded distribution. The new synonymies proposed by Al Dhafer and the historical species confusion in this group suggest a thorough reexamination is needed. The fact that many of the canus-group species (LCSG) are considered pests and the continuing uncertainty on species limits calls for further work. The purpose of this paper is to examine the *L. canus* species-group (LCSG) in greater depth. Characters from morphology, distribution, and DNA will be taken into account to determine which names belong to each species concept. Recognized species and synonymies are given in table 4.3.

**Methods**

Adult specimens used for extracting DNA had their abdomen removed, while larval specimens were cut between the second and third abdominal segments. Extraction was whole body, following the Qiagen® (Hilden, Germany) DNeasy® spin column protocol or the protocol with Promega® (Madison, Wisconsin) Wizard® Genomic DNA kit. The samples were lysed over night at 56°C in a Benchmark Scientific (Edison, New Jersey) Multitherm™ shaker (Model H5000-H). Following completion of the extraction process, each sample was assayed using a NanoDrop™ 2000 spectrometer to determine the quality and quantity of DNA present by the UV light absorbance ratio of 260nm/280nm being at or close to two. The barcode region of the COI gene was amplified using the Polymerase Chain Reaction (PCR) on an Eppendorf® (Hamburg, Germany) Mastercycler® using the GoTaq® Green Mastermix (Promega®). Primers LCO1490 and HCO2198 from Folmer *et al.* (1994) were used with the following cycler protocol: an initial 3 minutes at 94°C; 6 cycles of 94°C for 1 minute, 45°C for 1:30
minutes, and 72°C for 2:30 minutes; 36 cycles of 94°C for 1 minute, 51°C for 1:30 minutes, and 72°C for 2:30 minutes, followed by a final 5 minutes at 72°C. The PCR product was run on a 1% agarose gel to confirm that a product was obtained. Successful products were purified by precipitation, using the following method: to 14µL of PCR product, add 22.75µL of dH2O, 12.25µL 2M NaClO4, and 27.0µL of Isopropanol in a 0.5mL centrifuge tube; vortex to mix then Spin 15 min, at room temp, 14K rpm; aspirate supernatant being careful not to disturb pellet; add 150µL 70% ethanol and spin 5 min, at room temp, 14K rpm; aspirate supernatant, again not disturbing the pellet; let it air dry from 10-15 minutes then re-suspend pellet in 10µL of LoTE, which is a mix of 3mM Tris pH8.0 and 0.2mM EDTA. The purified DNA was then sent to MCLab for sequencing. The sequence chromatographs were analyzed using Chromas Lite (Chromas software, Technelysium Pty Ltd. [1998-2005]; Gene Codes Corporation, Ann Arbor, MI, USA [2000]) for quality assessment. Clean sequences for a sample were aligned manually, and the consensus sequence was taken from the area of overlap between the two strands. To control for possible laboratory contamination, a set of eight negative PCRs was run every six months, which included everything except template DNA. Sequences were aligned with MAFFT (Katoh 2011). An unrooted Neighbor-Joining tree using the Jukes-Cantor Substitution model was created, with boot-strap values calculated from 500 runs. After extraction, each specimen was washed first with distilled water, followed by a rinse of 95% ethanol. Extracted adults had their abdomens glued back on using Elmer’s® white glue, while larvae were stored in vials of EtOH.
Morphological characters to distinguish members of the *Limonius canus* species group were observed through a dissecting stereo-microscope (Leica® Wild 3C) with a Leica® LUX1000 170W fiber optic illuminator. A custom built light diffuser was used, composed of dense foam in an L-shape and translucent plastic along one side, for ease of observation of punctures. Specimens and particular characters were photographed with a JVC® 3CCD KY-F750 digital camera mounted to a Leica® MS5 dissecting microscope with a Schott ® Fostec DCR 111 fiber optic illuminator and a small foam bowl as a light diffuser. The camera is attached to an IB IntelliStation M Pro® and the images are processed using Syncroscopy Auto-Montage Pro® ver. 5.03 Beta and enhanced using GIMP® 2.6.2.

Genitalia were extracted through the terminal opening in the abdomen from specimens that had undergone DNA extraction, or from relaxed specimens. A pair of sharp forceps was inserted and the genital and apical abdominal segments were removed in males and the ovipositor exposed in some females. Some females had their entire genitalia removed, following Becker (1956). This was done by placing the whole abdomen, removed from the specimen, in cold 15% potassium hydroxide for one to two hours to dissolve any soft tissue. The abdomen was cut along the one edge of the tergites with sharp forceps or a pin and the internal genitalia carefully removed. The genitalia were stored in micro-vials containing glycerine and placed in distilled water to view. Male genitalia were glued to cards pinned under the insect.
A total of 319 adult specimens were examined. Specimens were compared to images of type specimens present on the Museum of Comparative Zoology Collection (MCZC) website in order to give as accurate as possible of a review.

Specimens from the following collections were examined:

- CDFA – California Department of Food and Agriculture Collection
- CMNC- Canadian Museum of Nature Collection
- CNCI- Canadian National Collection of Insects and Arthropods
- MTEC- Montana State Entomology Collection

Specimens identified by Edward C. Becker, Hathal Al Dhafer, and Merton C. Lane were used as references for species concepts of each of these authors. An error noted in Al Dhafer’s (2009) paper is that all specimens that were stated as being located in the Canadian Museum of Nature Collection (CMNC) are in actuality located in the Canadian National Collection of Insects and Arthropods (CNCI). Both establishments were visited and Al Dhafer identification labels were only present at the later.

The morphological determination of larvae follows Lanchester (1946) and Glen (1950). In addition to the morphological characters used for adults by Al Dhafer (2009) and references therein, female genitalic characters were used following Becker (1956).

**Results and Discussion**

The species with specimens extracted, with numbers of adults and larvae in parentheses, are: *L. agonus* (6, 0); *L. anceps* (2, 0); *L. californicus* (23, 82); *L. canus* (9, 4); *L. dubitans* (1,0); *L. infuscatus* (8, 16); *L. subauratus* (3, 0). The names given follow Fall’s (1934) concepts. Of these, 119 specimens were successfully sequenced (Fig. 4.1).
Figure 4.1 was constructed based only on CO1 data and is used only for species level identities. Each crown group has the associated species name, the number of specimens with sequences, as well as the general localities of the specimens. A more detailed analysis of these groups will be discussed under each species below. No sequences were obtained for *L. anceps* and *L. subauratus*.

During the course of this study, it was determined that there needs to be a clearer definition of this species group. Further, the subgeneric concepts need to be re-examined, as a look at the world fauna presents a problem with the current classification. In the Palearctic region, *Pheletes* is considered a valid genus, distinct from *Limonius* (Cate 2007). The larva of the type species of *Pheletes*, *P. aeneoniger* (DeGeer, 1774), has been compared with North American species, and has more in common with species in *Limonius s. s.* (North American usage) than the species currently given this name in North America (Glen 1950). Due to the unknown placement of Nearctic species in relation to current Palearctic taxonomy, we suggest that the current Nearctic subgeneric concepts be abandoned, with the species groups proposed by Al Dhafer as a more appropriate starting point.

The first couplet in both Van Dyke’s and Al Dhafer’s keys fails to correctly place all members in the *L. canus* species-group (LCSG), particularly *L. infuscatus* and *L. canus* females with the *L. discoideus*-type coloration. This is due to that fact that these two species possess distinctly grooved, or excavate, prosternal sutures. The couplet used in the keys is also ambiguous, differentiating between “distinctly” and “not distinctly” grooved prosternal sutures. Most of the other species in the canus species-group also
possess weakly grooved prosternal sutures, making this couplet difficult for a non-specialist. The *L. canus* species-group is herein defined as *Limonius* that lack an emargination on the posterior margin of the hypomeron, a relatively large size (8 to 11 mm), and internal female genitalia that are c-shaped and possess two colleterial glands (Becker 1956, Fig. 13). Species recognized as valid members are: *L. agonus, L. californicus, L. canus, L. dubitans, L. ectypus, L. infuscatus, L. pilosulus*, and *L. subauratus* (Table 3). The emarginate hypomeron (H. Douglas, pers. comm.) and different female genitalia (Becker 1956) of *L. stigma* required its removal from this species group and was not examined in depth here.

**Notes on key and description terminology:**

In the key and descriptions, punctures are referred to as either simple, subumbilicate, or umbilicate for ease of reference. Morphologically it is expected that all punctures are truly umbilicate, but the size affects the ability to determine this. Therefore the above three terms are used to indirectly indicate puncture size. Observation at 160x power is expected to view these differences. Simple punctures appear so because they are small, subumbilicate are medium sized punctures, and umbilicate are large enough for the distinguishing characters of this punctuation type to be clearly seen, even under low to medium optical power.

Length is the combined measurement of the medial length of the pronotum and the length of the elytra from base to apex. Width is determined at the widest point of the pronotum.
The key below is an emendation to Al Dhafer’s (2009) key and allows for easier identification of females, as well as including species not recognized in that work. In theory, the key replaces Al Dhafer’s couplets 40 to 43. However, the first couplet of Al Dhafer’s key is difficult due to the variable character of the prosternal suture and some individuals of the canus-group will not arrive at couplet 40. The majority of species in this group possess a slightly excavate prosteral suture, but it is never enough to receive an antennomere. However, two species may confuse non-specialists: *L. canus*, especially females; and *L. infuscatus*. Both possess prosternal sutures that may be able to receive one antennomere, which may lead non-experts to go the wrong direction in the first couplet. These two species can be correctly placed by noting that they lack an emargination on the posterior edge of the hypomeron and are $\geq 8$ mm in length. Similar sized species in western North America possess an emarginate posterior edge of the hypomeron, while species that lack an emargination of the hypomeron are smaller than 8mm.

Some issues became apparent when constructing the current key. *Limonius infuscatus* and *L. pilosulus* are each keyed out twice, due to the presence of punctuation along the edges of their pronota which approaches a lattice-like appearance in some specimens and may confuse users. Specimens from California, particularly from the southern Sierra Nevadas and the San Joaquin Valley, may present difficulties in the key. Some specimens will key to *L. californicus*, but will possess vague carinae on the posterior end of the elytra. Others will key to *L. canus*, but lack carina on the posterior
end of the elytra and often have antennomere 2 subequal in length to antennomere 3.

These should both be treated as *L. californicus*.

**Key to the species of the *Limonius canus* Species-Group**

1  Frontal margin distinct medially with carina linking superantennal carinae and interrupted by at most one or two punctures (Fig. 4.2a) .......................... 2

1’ Frontal margin indistinct medially without carina linking superantennal carinae and interrupted or obscured by many adjacent punctures (Fig. 4.2b) .............. 5

2(1) Pronotal punctures umbilicate, almost touching, forming lattice-like pattern along edges of pronotum (Fig. 4.3a) .......................... 3

2’ Pronotal punctures simple to subumbilicate, and while dense, not forming a lattice-like pattern along edges of pronotum (Fig. 4.3b) .......................... 4

3(2) Pronotum subparallel posteriorly, rapidly narrowing anteriorly (Fig. 4.9); carinae often absent on apex of elytra (c.f. Fig. 4.6); female external genitalia as in Fig. 4.4b; male genitalia as in Fig. 4.10 .......................... *Limonius californicus* (Mannerheim), 1843

3’ Pronotum broadly rounded (Fig. 4.17); carinae always absent on apex of elytra (c.f. Fig. 4.6b); female external genitalia as in Fig. 4.4c; male genitalia as in Fig. 4.18 .......................... *Limonius infuscatus* Motschulsky, 1859 (part)
4(2') Punctures on head simple, with impunctate areas (Fig. 4.5a); punctures on hypomeron simple throughout; abdominal mirrors visible only on ventrites 2 and 3; female unknown; male genitalia as in Fig. 4.18. *Limonius ectypus* (Say), 1839

4' Punctures on head umbilicate, without impunctate areas (Fig. 4.5b); punctures on hypomeron simple, becoming subumbilicate anteriorly; abdominal mirrors visible on all ventrites; female external genitalia as in Fig. 4.4c; male genitalia as Fig. 4.18. *Limonius infuscatus* Motschulsky, 1859 (part)

5(1') Pronotal punctures umbilicate, almost touching, forming lattice-like pattern along edges of pronotum (Fig. 4.3a) ............................... 6

5' Pronotal punctures simple to subumbilicate, and while dense, not forming lattice-like pattern along edges of pronotum (Fig. 4.3b) ............................... 7

6(5) Carinae present on apex of elytra (Fig. 4.6a); antennomere 2 often two-thirds length of antennomere 3; punctures on hypomeron all umbilicate; females with pronotum often light brown with black spot on the disc; female external genitalia as in Fig. 4.4a; male genitalia as in Fig. 4.12 ............................... 

............................... *Limonius canus* LeConte, 1853

6' Carinae absent on apex of elytra (Fig. 4.6b); antennomere 2 subequal in length to antennomere 3; punctures on hypomeron ranging from simple to subumbilicate; pronotum unicolorous; female external genitalia as in Fig. 4.4c; male genitalia as in Fig. 4.20 ............................... *Limonius pilosulus* Candèze, 1891 (part)
7(5') Antennomere 2 rounded, about as wide as along; antennomeres 2 and 3 together subequal in length to antennomere 4 (Fig. 4.7); female external genitalia as in Fig. 4.4a; male genitalia as in Fig. 4.8. \textit{Limonius agonus} (Say), 1839

7' Antennomere 2 variable, often subcylindrical, longer than wide; if antennomere 2 nearly as wide as long, then antennomere 3 is subequal in length to 4; antennomeres 2 and 3 together variable, but often longer than antennomere 4; female external genitalia variable; male genitalia variable. \textbf{8}

8(7') Lateral abdominal mirrors visible on all ventrites; antennomeres 2 and 3 subequal in length; antennomere 3 subcylindrical, not similar in shape to antennomere 4; female external genitalia variable; male genitalia variable. \textbf{9}

8' Lateral abdominal mirrors at most visible on ventrites 2 through 4; antennomere 2 two-thirds length of antennomere 3; antennomere 3 often triangular, similar in shape and subequal to antennomere 4; female external genitalia as in Fig. 4.4a; male genitalia as in Fig. 4.22. \textit{Limonius subauratus} LeConte, 1853

9(8) Posterior medial impression on pronotum absent; antennae long and slender, extending past posterior edge of pronotum by two antennomeres in males; occurring in eastern Great Plains and northern Eastern Temperate forests; female external genitalia reported as in Fig. 4.4b, male genitalia as in Fig. 4.16. \textbf{10}

\textbf{Limonius cf. dubitans} LeConte, 1853
9’ Posterior medial impression on pronotum present; antennae more robust, extending past posterior edge of pronotum by only one antennomere at most in males; occurring along Pacific coast and northern Central Valley of California; female external genitalia as in Fig. 4.4c; male genitalia as in Fig. 4.20. 

........................................ Limonius pilosulus Candèze, 1891 (part)

Treatment of species in the Limonius canus species group

Limonius agonus (Say), 1839

(Figs. 4.7 and 4.8)


Limonius agonus; LeConte 1853: 434; Candèze 1860: 410; Fall 1934: 26; Dietrich 1945: 15; Lanchester 1946: 626; Al Dhafer 2009: 240.

Length: 9.00mm – 12mm. Width: 2.00mm – 2.25mm. Head piceous, bearing yellow setae; punctures dense dorsally, separated by less than diameter of puncture and appearing subumbilicate; frontal margin with distinct carina over antennal insertions, becoming obscured medially by adjacent punctures. Antennae brown, extending beyond posterior edge of pronotum by about length of two antennomeres (male) or failing to reach edge by approximately two antennomeres (female); antennomere 2 rounded in shape, about as long as wide and two-thirds length of antennomere 3; antennomere 3 subcylindrical, longer than wide, approximately one-half length of antennomere 4;
antennomeres 2 and 3 together subequal in length to antennomere 4 and less punctate than following segments; antennomeres 4 to 10 weakly serrate, about two times longer than wide in males, more serrate and about as wide as long in females; antennomere 11 oval in shape, slightly longer than proceeding antennomere; antennomeres 4 through 11 covered in short appressed setae and bearing a ring of elongated setae on distal end. Pronotal lateral edges gradually narrowing anteriorly (males) or broadly rounded (females); pronotum about as wide as long, slightly longer in males; medio-posterior impression shallow, often obscured by setae (Fig. 4.7); color piceus with edges lighter brown color and covered in long appressed yellow setae; pronotal punctures dense, separated by less than a diameter of a puncture, and appearing simple; pronotal hind angles weakly pronounced, without dorsal carina. Hypomeron piceous with edges lighter brown color and covered with appressed yellow setae; punctures dense and appearing simple, posterior edge not emarginate. Prosternum piceous with edges brown; punctures dense (males) or moderately dense (females), appearing simple medially and approaching subumbilicate towards edges; anterior lobe broadly rounded, deflexed approximately 45° in males, less so in females, with distinct basal groove in males which is absent in females; prosternal process densely punctate, flat between procoxae and convex after, gently sloping; prosternal suture weakly excavate anteriorly, enough to receive one antennomere at most, less so in females. Scutellem piceous, flat, longer than wide, covered in long, dense yellow setae. Elytra brown, covered in short yellow setae; interstrial punctures smaller than strial punctures; posterior end often bearing distinct carinae, which are sometimes vague. Metasternum piceous, covered in dense simple
punctures and apressed yellow setae. Abdomen piceous with edges brown, covered in dense simple punctures and short appressed yellow setae; each ventrite bearing a distinct abdominal mirror laterally. Legs brown; tibia with spine-like setae, particularly along lateral edge; two spines present on distal end of tibia along inner edge (base of tarsomeres); tarsomeres covered in spine-like setae, tarsomeres 1 and 2 subequal in length, and progressively smaller to 4, with 5 longest; claws simple, lacking basal setae; empodia bearing two long setae, about as long as tarsal claws. Male genitalia as in Fig. 4.8. Female ovipositor heavily scleortized (Fig. 4.4a).

**Specimens examined:** Nine specimens examined in total, seven from Quebec, Canada, and two from Dane Co., Wisconsin, USA.

**Larvae examined:** No larvae were examined in this study. This species is keyed in Lanchester (1946).

**Specimens extracted:** Six specimens were extracted, bearing the barcodes MTEC007844, MTEC007845, MTEC007919, MTEC007920, MTEC007922, and MTEC007923. No sequences were obtained, so comparisons to other species could not be made.

**Distribution:** Based on the specimen localities in Al Dhafer’s (2009) treatment, this species appears to occur in the Eastern Temperate Forests ranging from Southern Quebec and Ontario in the north to Southern Georgia in the south.

**Diagnosis:** *Limonius agonus* is most similar to *L. dubitans* and *L. subauratus*. *Limonius agonus* can be separated from *L. subauratus* by the second and third antennomeres together subequal to the fourth, having the third antennomere being smaller than the
fourth, and by characteristics of the male genitalia. *Limonius agonus* can be separated from *L. dubitans* by having antennomeres 2 and 3 together subequal in length to 4; having a vague, but visible, medio-dorsal impression on the pronotum; having the elytra more pointed posteriorly and bearing carinae in some specimens; and lacking distinct lateral abdominal mirrors on all ventrites.

**Notes:** I am in agreement with Fall (1934), Dietrich (1945), Lancaster (1946), and Al Dhafer (2009) that *L. agonus* represents a distinct species from *L. ectypus*. The majority of specimens bearing the name *L. ectypus* in collections identified before Al Dhafer’s (2009) work are expected to be *L. agonus*, based on Van Dyke’s concept of the species. While the neotype has not been examined, I feel that it belongs to my concept of this species based on Al Dhafer’s (2009) description. While the male genitalia are very similar, I disagree with Al Dhafer on the synonymy of *L. dubitans* with this species (see below).

*Limoniaceus californicus* (Mannerheim), 1843

(Figs. 4.9 and 4.10)

*Cardiophorus californicus* Mannerheim, 1843: 238-239. Type apparently in the Zoological Museum, University of Moscow (ZMUM). Type locality: California.


Limonius hispidus LeConte, 1853: 432, Candèze 1860: 407; Holotype # 2538 (MCZC).

Type locality: San Francisco, California. Synonymized by Candèze 1860: 407.

Pheletes hispidus; Schwarz 1906: 195, Leng 1920: 168.


Synonymized by Van Dyke 1932: 354.

Pheletes occidentalis; Schwarz 1906: 195, Leng 1920: 168.

Length: 8.0mm – 12.5mm. Width: 1.75mm – 3.50mm. Head black, with frontal margin sometimes brown, bearing white setae; punctures umbilicate and dense, nearly touching; frontal margin distinct over antennal insertions and medially, interrupted medially by at most one or two punctures. Antennae dark brown, extending beyond posterior edge of pronotum by one to three antennomeres (male) or failing to reach edge by approximately two antennomeres (female); antennomere 2 subcylindrical, slightly longer than wide and subequal to (males) or two-thirds length of (female) antennomere 3; antennomere 3 subcylindrical, longer than wide, two-thirds length of (males) or subequal to (females) antennomere 4; antennomeres 2 and 3 together slightly longer than antennomere 4 and less punctate than following segments; antennomeres 4 to 10 serrate and about as wide as long, becoming longer than wide distally; antennomere 11 oval in shape, subequal to proceeding antennomere; antennomeres 4 through 11 covered in short appressed setae and bearing ring of elongated setae on distal end. Pronotal lateral edges subparallel basally and narrowing anteriorly or broadly rounded; pronotum as wide as long, although appearing longer than wide in some males; medio-dorsal impression moderate, visible under magnification (Fig. 4.9); color black and covered in long appressed white setae;
pronotal punctures dense, umbilicate, and nearly contiguous towards edges, forming lattice-like pattern; pronotal hind angles pronounced, bearing distinct dorsal carina running parallel to lateral edge. Hypomeron piceous, with anterior and posterior edges brown, covered with appressed white setae; punctures dense and umbilicate, posterior edge not emarginate. Prosternum piceous; punctures dense, less so medially, ranging from umbilicate to subumbilicate; anterior lobe broadly rounded, deflexed approximately 45°, with distinct basal groove in males which is less pronounced in females; prosternal process densely punctate, horizontally grooved (males) or flat (females) between procoxae, broadly convex after, gently sloping; prosternal suture weakly excavate anteriorly, enough to receive one antennomere at most. Scutellem black, flat, longer than wide, covered in long, dense white setae. Elytra brown, covered in short white setae; interstrial punctures smaller than strial punctures; posterior end lacking carinae. Metasternum black, covered in dense simple punctures and appressed white setae. Abdomen piceous with edges brown, covered in moderately dense simple punctures and short appressed white setae; each ventrite bearing distinct abdominal mirror laterally. Legs dark brown; tibia with spine-like setae, particularly along lateral edge; two spines present on distal end of tibia along inner edge (base of tarsomeres); tarsomeres covered in spine-like setae, tarsomeres 1 and 2 subequal in length, and progressively smaller to 4, with 5 longest; claws simple, lacking basal setae; empodia bearing two long setae, about as long as tarsal claws. Male genitalia as in Fig. 4.10. Female ovipositor heavily sclerotized and bearing two small apical lobes (Fig. 4.4b).
**Specimens examined:** 52 specimens examined in total. 17 specimens were from California if the following counties: Humboldt Co., Merced Co., Monterey Co., Plumas Co., and Sacramento Co. 31 specimens were from Montana in the following counties: Broadwater Co., Fallon Co., Fergus Co., Gallatin Co., Lincoln Co., Pondera Co., and Stillwater Co. One specimen was from Crook Co., Oregon. Two specimens were from Walla Walla Co., Washington, and one specimen was from Yellowstone National Park, Wyoming. 18 specimens from California were also examined that displayed a mixture of characters from other species. These specimens came from the following counties: Fresno Co., Inyo Co., Los Angeles Co., Mono Co., Sacramento Co., and Ventura Co.

**Larvae examined:** Approximately 333 larvae were examined, coming from Idaho, Montana, and Washington State. They were keyed using Lanchester (1946) and matched to adults with COI mtDNA. The characters used by Lanchester were supported by the DNA data.

**Specimens extracted:** A total of 86 specimens of 130 extracted were successfully sequenced, covering a mix of adults and larvae. There is a fair bit of genetic diversity in the specimens examined (Fig. 4.1). Four populations were discovered. Locations of heavily sampled fields are given in parentheses beside the county names. The first group mostly contains specimens collected in Broadwater Co. (Townsend), Montana and a few specimens from Fergus Co. (Denton), Montana. The second group contains a lone Idaho larva. The third group contains specimens from Pondera Co. (Conrad), Montana and a few from Fergus Co. (Denton), Montana. The final group contains specimens from Washington and Flathead Co. (Kalispell), Montana. Despite a fair bit of difference
between the first and last group, there is much less than 3% difference between adjacent groups.

**Distribution:** Using Al Dhafer (2009) as a guide, this species appears to be found throughout western North America, ranging from southern British Columbia to southern California and in the north, ranging eastward to Manitoba (Brooks 1960).

**Diagnosis:** *Limonius californicus* is most similar to *L. canus* and *L. infuscatus*. It can be separated from *L. canus* by having a complete frontal margin, lacking carinae on the posterior end of the elytra, and by the male and female genitalia. Female *L. californicus* are never yellowish-brown with a distinct pronotal spot, which is seen in some *L. canus* females. Male *L. californicus* are in general larger and robust than *L. canus* males and have broadly rounded posterior edges of the elytra. *Limonius californicus* can be separated from *L. infuscatus* by having denser and larger punctures on the disc of the pronotum and by the male and female genitalia.

**Notes:** This species is considered to be of economic importance throughout the western U.S. (Stone 1941). Life history studies were conducted on this species in Southern California in the late 1930s (Stone 1941), and is one of the most well-studied species in the group (Lane 1971, and references therein). The concept of *L. californicus*, as described above, seems to be well defined in the areas of study. Although there is a fair bit of COI variation in this species, no cryptic species were discovered. However, this may not hold up in the southern part of its range. The specimens from California have different shaped pronota, tending towards being broadly rounded; generally darker in color, having the pronotum and elytra being similar in color; and being more setaeous.
Some even seem to blend characters of *L. canus* with typical *L. californicus*. Due to timing issues and the age of many of these specimens, no DNA extractions were able to be done. Based on the amount of DNA variation existing in the studied specimens, it is likely that the California specimens may form a cryptic complex of species which cannot be unraveled in the present study. As such, the conservative approach will be taken and they will be treated as *L. californicus*.

**Limonius canus** LeConte, 1853

(Figs. 4.11 and 4.12)

*Limonius canus* LeConte, 1853: 433; Van Dyke 1932: 340; Lanchester 1946: 626; Brooks 1960: 28; Lane 1971: 23. Type # MCZC (2539). Type locality: San Diego, California.

*Pheletes canus*; Schwarz 1906: 195; Leng 1920: 168


*Limonius discoideus* LeConte, 1861: 348; Schwarz 1906: 194; Leng 1920: 168; Van Dyke 1932: 340; Fall 1934: 25; Van Dyke 1943: 46-47. Type # MCZC (2528). Type locality: Rocky Mountains, at the head of Missouri River. Synonymized by Van Dyke 1932: 340.

Length: 8.0mm – 12.5mm. Width: 2mm – 3mm. Head piceous (males) or black basally and becoming yellow-brown anteriorly, bearing white or yellow setae; punctures umbilicate and dense, nearly touching; frontal margin distinct over antennal insertions
and becoming obscured medially by many adjacent punctures. Antennae piceous, extending beyond posterior edge of pronotum by about one to three antennomeres (male) or failing to reach edge by approximately two antennomeres (female); antennomere 2 nearly rounded, slightly longer than wide and two-thirds length of antennomere 3; antennomere 3 subcylindrical, longer than wide, approximately two-thirds length of antennomere 4; antennomeres 2 and 3 together subequal (males) to slightly longer (females) than antennomere 4 and less punctate than following segments; antennomeres 4 to 10 subserrate (males) to serrate (females) and longer than wide; antennomere 11 oval in shape, slightly longer than proceeding antennomere; antennomeres 4 through 11 covered in short appressed setae and bearing ring of elongated setae on distal end. Pronotal lateral edges gradually narrowing anteriorly; pronotum as wide as long, but appearing longer than wide; medio-dorsal impression moderate, visible under magnification (Fig. 4.11); color piceous with brown edges (males) or yellow-brown with piceous patch on the disc (females) and covered in long appressed white or gold setae; pronotal punctures dense, umbilicate, and nearly contiguous towards edges, forming lattice-like pattern; pronotal hind angles pronounced, bearing distinct dorsal carina running parallel to lateral edge. Hypomeron piceous, with anterior and posterior edges brown (male), or yellow-brown (female), covered with appressed white setae; punctures dense and umbilicate, posterior edge not emarginate. Prosternum piceous (male) or yellow-brown (female); punctures dense, less so medially, ranging from umbilicate to subumbilicate; anterior lobe broadly rounded, deflexed approximately 30°, with basal groove interrupted medially; prosternal process densely punctate, flat between procoxae
and convex after, gently sloping; prosternal suture weakly excavate anteriorly, enough to receive one antennomere at most in males, and clearly excavate in females. Scutellem black (males) or brown (females), slightly convex, longer than wide, covered in long, dense white setae. Elytra brown (males) or yellow-brown (females), covered in short, sparse white setae; interstrial punctures smaller than strial punctures; posterior end with distinct carinae. Metasternum black (males) or light brown (females), covered in dense simple punctures and apressed white setae. Abdomen piceous with edges brown, last ventrite nearly all brown (males) or light brown, becoming yellow-brown posteriorly (females); ventrites covered in dense simple punctures and short appressed white setae; each ventrite bearing distinct abdominal mirror laterally. Legs brown, darker basally (males) or yellow-brown (females); tibia with spine-like setae, particularly along lateral edge; two spines present on distal end of tibia along inner edge (base of tarsomeres); tarsomeres covered in spine-like setae, tarsomeres 1 and 2 subequal in length, and progressively smaller to 4, with 5 longest; claws simple, lacking basal setae; empodia bearing two long setae, about as long as tarsal claws. Male genitalia as in Fig. 4.12.

Female ovipositor heavily sclerotized, lacking lobes (Fig. 4.4a).

**Specimens examined:** 46 specimens were examined in total. Six specimens were examined from the following counties in California: Fresno Co., Sacramento Co., Sonoma Co., and Ventura Co. Six specimens were examined from the following counties in Idaho: Gem Co., Nez Perce Co., and Owyhee Co. 23 specimens were examined from the following counties in Montana: Carbon Co., Cascade Co., Flathead Co., Gallatin Co., Missoula Co., Park Co., Powell Co., and Ravalli Co. Four specimens were examined
from Umatilla Co., Oregon. Eight specimens were from the following counties in Washington: Benton Co., Klickitat Co., Walla Walla Co., and Whitman Co.

**Larvae examined:** A total of four larvae were examined, coming from Washington State. They were keyed using Lanchester (1946) and matched to adults with DNA. Characters used to define the larvae in Lanchester (1946) were confirmed.

**Specimens extracted:** A total of 13 specimens had their DNA extracted, bearing the barcodes MTEC007463, MTEC007464, MTEC007642, MTEC007719, MTEC007720, MTEC007721, MTEC007722, MTEC007910, MTEC007911, MTEC007912, MTEC007939, MTEC007948, MTEC007949. Four are larvae, and the rest are adults. Of these, eight were successfully sequenced, including a mix of adults and larvae. These sequences came from specimens collected in Montana, Oregon, and Washington. The Oregon sequences were slightly different from the others, but it fell well within the generally accepted 3% variance rule. (Fig. 4.1).

**Distribution:** Using Al Dhafer (2009) as a guide, this species ranges from southern British Columbia to southern California and into Western Montana and Southwestern Alberta.

**Diagnosis:** *Limonius canus* is most similar to *L. californicus* and *L. infuscatus*. It can be distinguished from both by having the frontal margin obscured medially, the presence of carinae on the posterior end of the elytra, and the male and female genitalia. *Limonius canus* females sometimes bear a unique coloration for the species group, being a yellowish-brown with a piceous spot on the pronotum.
Notes: Like *L. californicus*, this species is considered to be economically important in the west (Lane 1971 and references therein). While the specimens examined belong to a single species, it should be noted that Becker (1956) stated there was a difference in female external genitalia between *L. canus* and *L. discoideus*, with the former falling under the same category as *L. californicus*. The characteristics of the ovipositor appear to be consistent within a species, so this is an interesting observation. Fall (1934) also states there is a difference in male genitalia between *L. canus* and *L. discoideus* males, but this was not confirmed by either Al Dhafer (2009) or our study. As stated under *L. californicus*, there are some Californian specimens that seem to combine characteristics of both *L. californicus* and *L. canus*. Again, due to time limitations, no extractions were able to be conducted on Californian specimens. It is possible that there may be another complex of species here that this study cannot unravel. Van Dyke (1932, 1943), Lane (1971), and Al Dhafer (2009) all agree that *L. canus* and *L. discoideus* are the same species. Due to a lack of evidence suggesting otherwise, we agree with them.

*Limonius cf. dubitans* LeConte, 1853

(Figs. 4.13 and 4.14)


*Nothodes dubitans*; LeConte 1861: 171; Candèze 1891: 174; Schwarz 1906: 278; Leng 1920: 433.
Length: 9.5mm. Width: 2.5mm. Head piceous bearing short white setae; punctures subumbilicate and dense, separated by less than diameter of puncture; frontal margin distinct over antennal insertions and nearly absent medially, obscured by many adjacent punctures. Antennae brown, darker basally, extending beyond posterior edge of pronotum by two and one half segments; antennomere 2 subcylindrical, longer than wide and subequal to antennomere 3; antennomere 3 subcylindrical, longer than wide, two-thirds length of 4; antennomeres 2 and 3 together slightly longer than antennomere 4 and less punctate than following segments; antennomeres 4 to 10 subserrate and longer than wide; antennomere 11 oval in shape, longer than proceeding antennomere; antennomeres 4 through 11 covered in short appressed setae and bearing ring of elongated setae on distal end. Pronotal lateral edges gradually narrowing anteriorly; pronotum about as wide as long; medio-posterior impression absent (Fig. 4.13); color piceous with dark brown edges and covered in long appressed white setae; pronotal punctures dense, simple, separated by less than a diameter of puncture; pronotal hind angles moderately pronounced, lacking dorsal carina. Hypomeron piceous, with edges brown, covered with appressed white setae; punctures dense and simple, posterior edge not emarginate. Prosternum piceous; punctures dense, less so medially, simple; anterior lobe shorter relative to other species, nearly truncate anteriorly, deflexed greater than 45°, with distinct basal groove; prosternal process densely punctate, flat between procoxae and convex after, sloping sharply; prosternal suture at most weakly excavate anteriorly, not enough to receive one antennomere. Scutellem piceous, slightly convex, longer than wide, covered in long, dense white setae. Elytra dark brown, nearly piceous, and covered in short white setae;
interstrial punctures large, subequal to strial punctures; posterior end without carinae.

Metasternum piceous, covered in dense simple punctures and apressed white setae.

Abdomen piceous with edges dark brown; ventrites covered in dense simple punctures, less dense medially, and short appressed white setae; each ventrite bearing distinct abdominal mirror laterally. Legs brown, darker basally; tibia with spine-like setae, particularly along lateral edge; two spines present on distal end of tibia along inner edge (base of tarsomeres); tarsomeres covered in spine-like setae, tarsomeres 1 and 2 subequal in length, and progressively smaller to 4, with 5 longest; claws simple, lacking basal setae; empodia bearing two long setae, about as long as tarsal claws. Male genitalia as in Fig. 4.14. Female not examined, but reported as appearing like Fig. 4.4b (Becker 1956).

**Specimen examined:** One specimen from Sandusky Co., Ohio was examined.

**Larvae examined:** No larvae were available for examination. Lanchester (1946) keys out *L. dubitans* as a species distinct from *L. agonus*.

**Specimens extracted:** The one specimen examined, MTEC007959, was extracted and successfully sequenced. However, no other eastern specimens were successful, so comparisons could not be made.

**Distribution:** This species has been reported from New York, Pennsylvania, Ohio, Indiana, Illinois, Iowa, and Nebraska. It is unclear if this represents the actual range.

**Diagnosis:** *Limonius cf. dubitans* is most similar to *L. agonus*. It can be distinguished by having abdominal mirrors visible laterally on all ventrites; having the elytra broadly rounded posteriorly and lacking carinae; lacking a medio-dorsal impression; and having antennomeres 2 and 3 being slightly longer than antennomere four. The photograph of the
syntype female in the MCZC shows antennomeres 2 and 3 together as distinctly longer than 4, but the other characters couldn’t be confirmed.

**Notes:** This specimen should be compared to the type specimens of *Limonius dubitans*. While the adeagus is very similar to that of a typical *L. agonus*, it is different enough that, in conjunction with the other characters, it should be placed as a separate species. We link it to *L. dubitans* due to the complete lack of the frontal margin medially, a defining character of that species. While this male could easily be confused with *L. agonus*, the female syntype at the MCZC is distinct enough that by examining just the photo, it is not *L. agonus*. It is of my opinion that more specimens will cement the differences between *L. agonus* and *L. dubitans*. *Limonius dubitans* is also the type species of the genus *Nothodes* LeConte, which may be a more appropriate name for the subgenus. However, *Nothodes* is recognized in the Palarctic as a distinct genus from *Limonius*, but how the species placed there relate to the *L. canus* species group remains unknown.

**Limonius ectypus (Say), 1839**

(Figs. 4.15 and 4.16)

*Elater ectypus* Say, 1839: 167. Type apparently destroyed. Type locality: United States.


*Pheletes ectypus* Schwarz 1906: 195; Leng 1920: 168
Length: 11mm. Width: 3mm. Head piceous, becoming brown on frontal margin, and bearing short white setae; punctures at most subumbilicate, with impunctate areas medially and anteriorly; frontal margin distinct over antennal insertions and medially, shelf-like. Antennae dark brown, lighter basally, extending beyond posterior edge of pronotum by over one antennomere; antennomere 2 subcylindrical, longer than wide and subequal to antennomere 3; antennomere 3 subcylindrical, longer than wide and subequal to antennomere 4; antennomeres 2 and 3 together clearly longer than antennomere 4 and less punctate than following segments; antennomeres 4 to 10 subserrate and longer than wide; antennomere 11 oval in shape, slightly longer than proceeding antennomere; antennomeres 4 through 11 covered in short appressed setae and bearing ring of elongated setae on distal end. Pronotal lateral edges gradually narrowing anteriorly with base subparallel; pronotum about as wide as long, but appearing longer than wide; medio-dorsal impression not present (Fig. 4.15); color piceous with brown edges and covered in short appressed white setae; pronotal punctures dense, simple, separated by approximately one diameter of puncture, but closer towards edges; pronotal hind angles pronounced, bearing distinct dorsal carina running parallel to lateral edge. Hypomeron piceous, with edges brown, covered with appressed white setae; punctures dense and simple, posterior edge not emarginate. Prosternum piceous; punctures dense, simple but becoming subumbilicate anteriorly; anterior lobe broadly rounded, nearly truncate anteriorly, deflexed approximately 45°, with basal groove; prosternal process densely punctate, flat between procoxae and broadly convex after, gently sloping; prosternal suture clearly excavate anteriorly, enough to receive one antennomere. Scutellem black
with brown center, slightly convex, longer than wide, covered in long, dense white setae. Elytra dark brown, covered in short, sparse white setae; interstrial punctures large, subequal to strial punctures; posterior end without carinae. Metasternum piceous, covered in dense simple punctures and apressed white setae. Abdomen piceous with edges brown, covered in dense simple punctures and short appressed white setae; lateral abdominal mirrors distinct only on ventrites 2 through 4. Legs brown to rufous, darker basally; tibia with spine-like setae, particularly along lateral edge; two spines present on distal end of tibia along inner edge (base of tarsomeres); tarsomeres covered in spine-like setae, tarsomeres 1 and 2 subequal in length, and progressively smaller to 4, with 5 longest; claws simple, lacking basal setae; empodia bearing two long setae, about as long as tarsal claws. Male genitalia as in Fig. 4.16. Female unknown.

**Specimen examined:** One specimen from Tippecanoe Co., Indiana was examined.

**Larvae examined:** Accurately identified larvae are unknown for *L. ectypus* (Lanchester 1946), but it is doubtful that they will share the curved dorsal tubercles on the urogomphi that is unique to *L. infuscatus* in this species group, as that character would have been quickly noted by previous workers.

**Specimens extracted:** Due to the age of the available specimen, extractions were not done.

**Distribution:** Due to the lack of specimens, the distribution of this species cannot be determined at this time. It is likely that all eastern specimens under Al Dhafer’s (2009) concept of this species match my concept of this species.
**Diagnosis:** *Limonius ectypus* is most similar to *L. infuscatus*. It can be distinguished by having simple puncture and impunctate areas on the head; simple punctures throughout on the pronotum and the hypomeron; and having abdominal mirrors vaguely visible only on ventrites two through four. *Limonius ectypus* also appears to occur purely east of the central Great Plains, not making it past the Eastern Great Plains. The thickened medial lobe of the adeagus, unobscurred medially frontal margin, and relatively long antennomeres two and three, both subequal in length to four, readily distinguish *L. ectypus* from the other Eastern species.

**Notes:** Al Dhafer (2009) united *L. infuscatus* with this species. While we agree with him that *L. ectypus* is a distinct species from *L. agonus*, we disagree with his choice to synonymize *L. infuscatus* with *L. ectypus*. Both *L. ectypus* and *L. infuscatus* share thickened medial lobes of the adeagus, a unique character of the group, which explains Al Dhafer’s reasoning for uniting the two. However, there are enough other characters that are different between the two that they should be considered separate species. The neotype male designated by Al Dhafer (2009) is expected to match our concept of *L. ectypus*, but this has not been determined. An examination of more eastern specimens would, in our opinion, cement the uniqueness of these two species.
Limonius infuscatus Motschulsky, 1859

(Figs. 4.17 and 4.18)


Limonius vernalis Fall, 1910: 129-130; Leng 1920: 168; Schenking 1925: 297; Van Dyke 1932: 341. Type # 24360 (MCZC). Type Locality: Pasadena, California.

Synonymized by Van Dyke 1932, 341.

Length: 8.5mm – 11.5mm. Width: 2mm – 3mm. Head piceous, becoming brown along frontal margin, bearing short yellow setae; punctures subumbilicate and dense, separated by less than diameter of puncture, larger in females; frontal margin distinct over antennal insertions and medially, shelf-like, occasionally interrupted by one or two punctures. Antennae piceous, lighter basally, extending beyond posterior edge of pronotum by one antennomere (males) or failing to reach posterior edge by length of one or two antennomeres (females); antennomere 2 subcylindrical, longer than wide and two-thirds length of antennomere 3; antennomere 3 subcylindrical, longer than wide, subequal to antennomere 4; antennomeres 2 and 3 together longer than antennomere 4 and less punctate than the following segments; antennomeres 4 to 10 subserrate and longer than wide (males) or nearly as wide as long, becoming longer distally (female); antennomere 11 oval in shape, subequal to proceeding antennomere; antennomeres 4 through 11 covered in short appressed setae and bearing ring of elongated setae on distal end.

Pronotal lateral edges broadly; pronotum about as wide as long (females and some males)
or longer than wide (some males), always appearing longer than wide; medio-dorsal impression weak, often vague (Fig. 4.17); color piceous with dark brown edges and covered in long appressed yellow setae; pronotal punctures variable, ranging from nearly simple to nearly umbilicate along edges, less dense medially but nearly touching along edges; pronotal hind angles moderately pronounced, acute, with distinct dorsal carina subparallel to lateral edge. Hypomeron piceous, with edges brown, covered with appressed white setae; punctures dense and simple to subumbilicate, posterior edge not emarginate. Prosternum piceous with edges brown; punctures dense, less so medially, simple to nearly umbilicate anteriorly; anterior lobe long relative to other species, rounded anteriorly, deflexed shallowly, with basal groove nearly absent; prosternal process densely punctate, flat between procoxae and convex after, sloping sharply in males and gently in females; prosternal suture weakly grooved anteriorly, more so in females, not enough to receive one antennomere. Scutellem piceous, flat, longer than wide, covered in long, dense yellow setae. Elytra brown, covered in yellow setae; interstrial punctures smaller than strial punctures; posterior end without carinae. Metasternum piceous, covered in dense simple punctures and apressed white setae. Abdomen piceous with edges dark brown; ventrites covered in dense simple punctures, less dense medially, and short appressed white setae; each ventrite bearing distinct abdominal mirror laterally. Legs brown, darker basally; tibia with fine setae, not spine-like, lateral spines smaller than in other species; two spines present on distal end of tibia along inner edge (base of tarsomeres); tarsomeres covered in spine-like setae, finer dorsally; tarsomeres 1 and 2 subequal in length, and progressively smaller to 4, with 5
longest; claws simple, lacking basal setae; empodia bearing two long setae, about as long as tarsal claws. Male genitalia as in Fig. 4.18. Female ovipositor lightly scleritized with two long lobes bearing a seta each (Fig. 4.4c).

**Specimens examined:** A total of 169 specimens were examined. Three specimens were examined from the following counties in California: Riverside Co. and Ventura Co. One specimen was examined from Latah Co., Idaho. 152 specimens were examined from the following counties in Montana: Beaverhead Co., Broadwater Co., Flathead Co., Fergus Co., Gallatin Co., Granite Co., Hill Co., Jefferson Co., Lake Co., Lewis and Clark Co., Lincoln Co., Madison Co., Missoula Co., Park Co., Phillips Co., Ravalli Co., and Rosebud Co. One specimen was examined from Benton Co., Oregon. Two specimens were examined from Walla Walla Co., Washington. Ten specimens were examined from the following counties in Wyoming: Park Co., Teton Co., and Yellowstone National Park.

**Larvae examined:** Approximately 30 larvae were examined, coming from Idaho, Montana, and Washington State. They were keyed using Lanchester (1946) and matched to adults with COI mtDNA. The characters used by Lanchester were supported by the DNA data.

**Specimens extracted:** A total of 24 specimens of 33 extracted resulted in successful sequences (Fig. 4.1). There were two distinct populations found. The first group, found east of the Continental Divide, contains specimens from Gallatin and Jefferson counties in Montana. The second group, found west of the Continental Divide, contained specimens from Granite and Flathead counties in Montana, as well as larvae from Idaho.
and Washington. This difference is much less than 3% and these two populations belong to the same species.

**Distribution:** Using Al Dhafer (2009) as a guide, this species appears to range from southern British Columbia to Southern California, and along the eastern edge of the Rocky Mountains in Montana and Alberta.

**Diagnosis:** *Limonius infuscatus* is most similar to *L. californicus*, *L. ectypus*, and *L. pilosulus*. It can be separated from *L. californicus* by having smaller and less dense punctures on the disc of the pronotum, and by the male and female genitalia. It can be separated from *L. ectypus* by having large umbilicate to subumbilcate punctures on the head, which are dense and nearly touching; simple to nearly umbilicate punctures towards the edges of the pronotum and the hypomeron; and having abdominal mirrors visible on all ventrites. It can be separated from *L. pilosulus* by having a frontal margin that is not obscured medially, a more rounded pronotum with a smaller medio-dorsal impression, and the male genitalia.

**Notes:** As noted by Fall (1934) and Van Dyke (1943), this species is morphologically variable, especially in regards to setal color and the size and density of pronotal punctation. While the species is morphologically variable, there is very little genetic variability of the mtDNA, especially when compared to the more morphologically conservative species *L. californicus*. This variability has made it difficult to define this species, especially since the type specimen may be missing (Fall 1934). This name has often included members of *L. pilosulus* (Van Dyke 1932, 1943) and was synonymized
recently under *L. ectypus* (Al Dhafer 2009), but there are enough morphological differences between all three that they should be regarded as separate species.

*Limonius pilosulus* Candèze, 1891

(Figs. 4.19 and 4.20)

*Limonius pilosus* LeConte, 1853: 431; Candèze 1860: 405; Candèze 1891: 149. Holotype # 2537 (MCZC). Type Locality: San Diego, California. Renamed by Candèze 1891: 149.

*Limonius pilosulus* Candèze 1891: 149; Van Dyke 1932 340; Fall 1934: 29; Lane 1971: 23. Type Locality: California.

*Pheletes pilosulus* Schwarz 1906: 195; Leng 1920: 168.

Length: 10.5mm – 12.5mm. Width: 3.00mm – 3.25mm. Head piceous, becoming dark brown along frontal margin, bearing long white setae; punctures simple to subumbilicate and dense, separated by less than diameter of puncture, larger and closer in females; frontal margin distinct over antennal insertions, less so medially, slightly obscured by many adjacent punctures. Antennae brown, lighter basally, extending beyond posterior edge of pronotum by one to two antennomeres (males) or just reaching posterior edge (females); antennomere 2 subcylindrical, longer than wide and subequal to antennomere 3; antennomere 3 subcylindrical, longer than wide, subequal to antennomere 4; antennomeres 2 and 3 together longer than antennomere 4 and less punctate than following segments; antennomeres 4 to 10 serrate and longer than wide (males) or nearly as wide as long, becoming longer distally (female); antennomere 11 oval in shape,
slightly longer than (males) or subequal to (females) the proceeding antennomere; antennomeres 4 through 11 covered in short appressed setae and bearing ring of elongated setae on distal end. Pronotal lateral edges broadly rounded to subparallel, appearing almost quadrate; pronotum about as wide as long; medio-dorsal impression well defined, visible without scope (Fig. 4.19); color ranging from dark brown to piceous and covered in long appressed white setae; pronotal punctures dense, simple to nearly subumbilicate along edges in females, less dense medially but nearly touching along edges; pronotal hind angles moderately pronounced, lacking distinct dorsal carina running parallel to lateral edge in males, but present in females. Hypomeron brown to piceous, covered with appressed white setae; punctures dense and simple, posterior edge not emarginate. Prosternum brown to piceous; punctures fairly dense along edges, sparse medially, simple to nearly subumbilicate anteriorly; anterior lobe broadly rounded anteriorly, deflexed shallowly, with basal groove indistinct medially in males and absent in females; prosternal process sparsely punctate and flat between procoxae, and more punctate after and remaining nearly flat; prosternal suture at most weakly excavate anteriorly, not enough to receive one antennomere. Scutellem brown with edges piceous or just piceous, slightly convex, longer than wide, covered in long, dense white or yellow setae. Elytra brown to dark brown, covered in yellow setae; interstrial punctures subequal to slightly smaller than strial punctures, both less impressed than other species; posterior end without carinae. Metasternum brown to pisceous, covered in moderately dense simple punctures and appressed white setae. Abdomen brown to piceous; ventrites covered in dense simple punctures, and long appressed white setae; each ventrite bearing
a distinct abdominal mirror laterally. Legs brown, darker basally; tibia with fine setae, not
spine-like, making lateral spines distinctive in males, more typical and spine-like in
females; two spines present on distal end of tibia along inner edge (base of tarsomeres);
tarsomeres covered in spine-like setae, finer dorsally; tarsomeres 1 and 2 subequal in
length, and progressively smaller to 4, with 5 longest; claws simple, lacking basal setae;
empodia bearing two long setae, about as long as tarsal claws. Male genitalia as in Fig.
4.20. Female ovipositor lightly scleritized with two long lobes bearing a seta each (Fig.
4.4c).

**Specimens examined:** Six specimens were examined in total. Five of the specimens
were from the following counties in California: Mendocino Co., Sacramento Co.,
Sonoma Co., and Yo-Solano Co. One specimen was examined from Washington Co.,
Oregon.

**Larvae examined:** No larvae are known to be associated with *L. pilosulus*.

**Specimens extracted:** No specimens were extracted in this study.

**Distribution:** This species appears to occur along the Pacific Coast of North America
(Lane 1971), and makes its way into the northern Central Valley of California. It is
unknown which specimens examined by Al Dhafer (2009) from the western states and
provinces under *L. ectypus* would represent this species.

**Diagnosis:** *Limonius pilosulus* is most similar to *L. infuscatus*. It can be distinguished by
having the frontal margin obscured medially, the form of the male genitalia, a distinct
medio-posterior impression, and by being, in general, more robust and larger.
Notes: *Limonius pilosulus* Candèze is a replacement name for LeConte’s species, necessitated by the secondary homonymy with the European *Elater pilosus* Leske, 1785 when Candèze placed both species in *Limonius*. Leske’s species is currently in *Cidnopus* Thomson, removing the homonymy but under ICZN Art. 59.3 LeConte’s name is permanently rejected because *L. pilosulus* is in use and not a cause of confusion.

We are in agreement with Fall (1934) and Lane (1971) that *L. pilosulus* is a distinct species from *L. infuscatus*. It is morphologically very similar to *L. infuscatus*, suggesting a close affinity with it, but the male genitalia and the characteristic of the frontal margin serve to separate this species.

*Limonius subauratus* LeConte, 1853

(Figs. 4.21 and 4.22)


Type locality: Oregon.

*Pheletes subauratus* Schwarz 1906: 195; Leng 1920: 168.


*Pheletes anceps* Schwarz 1906: 195; Leng 1920: 168.

Length: 7.5mm – 10.5mm. Width: 1.75mm – 2.00mm. Head black, bearing short white setae; punctures subumbilicate and dense, separated by less than diameter of puncture,
larger and closer in females; frontal margin distinct over antennal insertions, obscured medially by many adjacent punctures. Antennae piceous, extending beyond posterior edge of pronotum by one and one half antennomeres (males) or just reaching posterior edge (females); antennomere 2 subcylindrical, longer than wide and two-thirds length of antennomere 3; antennomere 3 subtriangular, wider distally but longer than wide in males, subcylindrical in females, greater than two-thirds length of antennomere 4; antennomeres 2 and 3 together longer than antennomere 4 and less punctate than the following segments; antennomeres 4 to 10 subserrate and longer than wide (males) or serrate, nearly as wide as long, becoming longer distally (female); antennomere 11 oval in shape, subequal to the proceeding antennomere; antennomeres 4 through 11 covered in short appressed setae and bearing a ring of elongated setae on distal end. Pronotal lateral edges subparallel basally then gently narrowing anteriorly; pronotum longer than wide; medio-posterior impression shallow, often vague on males (Fig. 4.21); color black and covered in short appressed white setae; pronotal punctures dense, simple to nearly subumbilicate along edges, separated by the less than the diameter of puncture, less dense medially; pronotal hind angles pronounced, lacking a distinct dorsal carina. Hypomeron piceous, nearly black, with posterior edges dark brown; covered with appressed white setae; punctures dense and simple, nearly touching; posterior edge not emarginate. Prosternum piceous, nearly black, with posterior edges dark brown; punctures fairly dense along edges, sparse medially, simple to nearly subumbilicate anteriorly; anterior lobe short relative to other species, nearly truncate anteriorly, deflexed approximately 30°, with basal groove indisctinct medially in males and complete in females; prosternal
process densely punctate and flat between procoxae, broadly convex and gently sloping after in males, nearly flat in females; prosternal suture at most weakly excavate anteriorly, not enough to receive one antennomere. Scutellum black, flat, longer than wide, covered in long, dense white setae. Elytra brown, covered in yellow setae; interstrial punctures fine, smaller than strial punctures; posterior end with at most vague carinae. Metasternum black, covered in moderately dense simple punctures and apressed white setae. Abdomen black; ventrites covered in dense simple punctures, and short appressed white setae; lateral abdominal mirrors vague, partially visible on ventrites 2 through 4, nearly absent on some females. Legs brown, darker basally; tibia with fine setae, not spine-like, making lateral spines distinctive in males, more typical in females; two spines present on distal end of tibia along inner edge (base of tarsomeres); tarsomeres covered in spine-like setae, finer dorsally; metatarsomeres 1 and 2 subequal in length, and progressively smaller to 4, with 5 longest; claws simple, lacking basal setae; empodia bearing two long setae, about as long as tarsal claws. Male genitalia as in Fig. 4.22. Female ovipositor heavily scleritized, lacking lobes (Fig. 4.4a).

**Specimens examined:** 15 specimens in total were examined. Five specimens were examined from Quebec, Canada and bore *L. anceps* labels. Seven specimens were examined that bore *L. subauratus* labels. One of these came from Ventura Co., California. Two specimens came from Granite Co. and Mineral Co., Montana. Four specimens came from Benton Co. and Columbia Co., Washington. Three specimens were examined from British Columbia, Canada and bore *L. sp. nr. subauratus* labels.
Larvae examined: No larvae were discovered for these two species, and accurately identified *L. anceps* larvae are unknown (Lanchester 1946), so no comparisons can be made for this stage.

Specimens extracted: A total of five adult specimens had DNA extracted, bearing the barcodes MTEC007921, MTEC007924, MTEC007936, MTEC007937, and MTEC007938. The first two are eastern, labeled *L. anceps*, and the later are western, labeled *L. subauratus*. No sequences were obtained for any of these specimens, so comparisons could not be done on a molecular level.

Distribution: As stated by Al Dhafer (2009), this species has a disjunct distribution. This species is known to occur across Canada, with a gap in Alberta (Al Dhafer 2009, Brooks 1960, Majka and Johnson 2008). It is recorded in the Northeastern U.S. and the Great Lakes Region, as well as the Pacific Northwest and into California. Al Dhafer (2009) reports one specimen from Mississippi, but this should be reexamined.

Diagnosis: *Limonius subauratus* is most similar to *L. agonus*. It can be distinguished from this species by having antennomere 3 subequal in length to antennomere 4, and by the male genitalia.

Notes: Careful study of specimens from east and west did not reveal any character to consistently separate *L. anceps* from *L. subauratus*. The male genitalia seemed to have some subtle differences between east and west, but were also variable within each population, so differences could just be variation (Fig. 4.22). Due to this, we accept Al Dhafer’s synonymy of the two species. Successful DNA sequences could confirm the synonymy or return the two names to independant species, but that remains. It is
hypothesized that *L. subauratus* is limited to pine forests, and a link between the two populations could be found in northern Alberta. The specimens from Mississippi examined by Al Dhafer also deserve a second look. Specimens labeled *L. sp. nr. subauratus* seemed to be typical *L. subauratus*. It is unknown what Becker (1956) is referring to when he mentions “an unknown species near *subauratus*”, but this may indicate that there may be a cryptic complex in the Western population of this species. Two female specimens from the western part of the range are much larger and robust than other specimens, being 11.5mm and 12mm in length. Since these measurements form outliers to the majority of measurements as well as Al Dhafer’s, we have not included them in the above range. Since they are morphologically similar to the rest, their unique sizes are most likely due to sampling error.

**Conclusions**

This preliminary review of the *L. canus* species-group examined some of the synonymies proposed by Al Dhafer in his 2009 review of the genus. The species group has been redefined based on characteristics of the hypomeron and female internal genitalia. *Limonius stigma* is removed from the group and eight species are recognized in the group. Male genitalia were examined, focusing on the ventral side for more characters. More study on the *L.canus* and *L.discoideus* pair is needed and additional specimens from across each species’ range, especially eastern larvae, are needed for further progress.
Table 4.1. Generic and specific treatment of *Limonius canus* species-group species names in selected 19th Century works. “N/A” is placed for species not described after the work was published.

<table>
<thead>
<tr>
<th>Name</th>
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<th>Candèze 1860</th>
<th>Candèze 1891</th>
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<td>Limonius</td>
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<td>Limonius</td>
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<td>Limonius</td>
<td>Limonius</td>
<td>Syn. of <em>L. pilosulus</em></td>
</tr>
<tr>
<td><em>L. pilosulus</em> Candèze</td>
<td>N/A</td>
<td>N/A</td>
<td>Limonius</td>
</tr>
<tr>
<td><em>L. occidentalis</em> Candèze</td>
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<td>Limonius</td>
<td>Limonius</td>
</tr>
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<td><em>L. stigma</em> (Herbst)</td>
<td>Not Mentioned</td>
<td>Limonius</td>
<td>Limonius</td>
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<td>Limonius</td>
<td>Limonius</td>
<td>Limonius</td>
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<td><em>L. subcostatus</em> Motschulsky</td>
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<td>Not mentioned</td>
<td>Not Mentioned</td>
</tr>
<tr>
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<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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Table 4.2. Generic and specific treatment of *Limonius canus* species-group species in selected 20\(^{th}\) and 21\(^{st}\) Century works. “N/A” marks species described after the work was published.

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<tr>
<th>Name</th>
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<th>Leng 1920</th>
<th>Van Dyke 1932</th>
<th>Dhafer 2009</th>
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<td>Syn. of <em>L. ectypus</em></td>
<td>Syn. of <em>L. ectypus</em></td>
<td>Limoniuss</td>
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<td>Pheletes</td>
<td>Limoniuss</td>
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<tr>
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<td>Syn. of <em>L. stigma</em></td>
<td>Syn. of <em>L. stigma</em></td>
<td>Syn. of <em>L. stigma</em></td>
</tr>
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<td>Pheletes</td>
<td>Limoniuss</td>
<td>Limoniuss</td>
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<tr>
<td><em>L. discoideus</em> LeConte</td>
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<td>Syn. of <em>L. canus</em></td>
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<td><em>L. dubitans</em> LeConte</td>
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<td>Syn. of <em>L. californicus</em></td>
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<td>Limoniuss</td>
<td>Limoniuss</td>
<td>Syn. of <em>L. ectypus</em></td>
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<td>Syn. of <em>L. pilosulus</em></td>
<td>Syn. of <em>L. pilosulus</em></td>
<td>Syn. of <em>L. ectypus</em></td>
</tr>
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<td>Pheletes</td>
<td>Pheletes</td>
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<td>Syn. of <em>L. ectypus</em></td>
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<td>Syn. of <em>L. californicus</em></td>
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Table 4.2. (continued)

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<th>Name</th>
<th>Schwarz 1906</th>
<th>Leng 1920</th>
<th>Van Dyke 1932</th>
<th>Dhafer 2009</th>
</tr>
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<td><em>L. stigma</em> (Herbst)</td>
<td><em>Pheletes</em></td>
<td><em>Pheletes</em></td>
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<td><em>Limonius</em></td>
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<tr>
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<td><em>Pheletes</em></td>
<td><em>Limonius</em></td>
<td><em>Limonius</em></td>
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<tr>
<td><em>L. subcostatus</em> Motschulsky</td>
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<td>Syn. of <em>L. vernalis</em>?</td>
<td>Syn. of <em>L. canus</em></td>
<td>Syn. of <em>L. canus</em></td>
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<td>Syn. of <em>L. ectypus</em></td>
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</tbody>
</table>
Table 4.3. Synoptic table of species in the *Limonius canus* species-group

- *L. agonus* (Say, 1839)
- *L. californicus* (Mannerheim, 1843)
  - *L. hispidus* LeConte, 1853
  - *L. occidentalis* Candèze, 1860
- *L. canus* LeConte, 1853
  - *L. subcostatus* Motschulsky, 1859
  - *L. discoideus* LeConte, 1861
- *L. dubitans* LeConte, 1853
- *L. ectypus* (Say, 1839)
  - *L. infuscatus* Motschulsky, 1859
    - *L. vernalis* Fall, 1910
- *L. pilosulus* Candèze, 1891
  - *L. pilosus* LeConte, 1853
- *L. subauratus* LeConte, 1853
  - *L. anceps* LeConte, 1853
Figure 4.1. Unrooted neighbor-joining tree of 500 runs, using the Jukes-Cantor method. Locality and species names are given.

Figure 4.2. Frontal margin, a) distinct medially, not obscured by punctures (Limonius californicus); b) indistinct medially, obscured by punctures (Limonius cf. dabitans)
Figure 4.3. Lattice-like punctures on edges of pronotum, a) present; b) absent

Figure 4.4. Female external genitalia/ovipositor types, a) heavily sclerotized, lacking lobes; b) sclerotized, with small apical lobes bearing few setae each; c) weakly sclerotized, with long apical lobes bearing many setae each
Figure 4.5. Punctures on the head, dorsal, a) simple, with areas of impunctation; b) umbilicate and dense

Figure 4.6. Carina on apex of elytra, a) present; b) absent

Figure 4.7. *Limonius agonus* pronotum, dorsal view, a) male; b) female
Figure 4.8. *Limonius agonus* adeagus, ventral view, a) Al Dhafer 2009 Fig. 19; b) MTEC007919 from Quebec

![Figure 4.8](image)

Figure 4.9. *Limonius californicus* pronotum, dorsal view, a) male; b) female

![Figure 4.9](image)

Figure 4.10. *Limonius californicus* adeagus, ventral view, a) Al Dhafer 2009 Fig. 25; b) Montana; c) Compton, CA

![Figure 4.10](image)
Figure 4.11. *Limonius canus* pronotum, dorsal view, a) male; b) female

Figure 4.12. *Limonius canus* adeagus, ventral view, a) Al Dhafer 2009 Fig. 26; b) Montana

Figure 4.13. *Limonius* cf. *dubitans* pronotum, dorsal view, male

Figure 4.14. *Limonius* cf. *dubitans* adeagus, ventral view
Figure 4.15. *Limonius ectypus* pronotum, dorsal view, male

Figure 4.16. *Limonius ectypus* adeagus, ventral view

Figure 4.17. *Limonius infuscatus* pronotum, dorsal view, a) male; b) female

Figure 4.18. *Limonius infuscatus* adeagus, ventral view, a) Al Dhafer 2009 Fig. 33; b) Montana
Figure 4.19. *Limonius pilosulus* pronotum, dorsal view, a) male; b) female

Figure 4.20. *Limonius pilosulus* adeagus, ventral view, Sacramento Co, CA

Figure 4.21. *Limonius subauratus* pronotum, dorsal view, western population, a) male; b) female
Figure 4.22. *Limonius subauratus* adeagus, ventral view, a) Al Dhafer 2009 Fig. 61; b) Quebec; c) Quebec; d) Washington; e) Washington; f) MTEC007950, Montana
References Cited


Horn, G. 1879. [Communication on the Elateridae]. Proceedings of the Monthly Meetings of the Entomological Section of the Academy of Natural Sciences, June 1879. xiv-xvi. [Issued with the Transactions of the American Entomological Society, volume 7].


Schwarz, O. 1906. Coleoptera, Family Elateridae. [pp. 1-224] In: Genera Insectorum (P.Wytsman, editor) fasc. 46B.


CHAPTER 5 – CONCLUSION

This preliminary survey of the wireworms of Montana has greatly increased the knowledge base of the fauna in the state. Before this study, the identities of the wireworms that occurred in Montana’s cropland were not well known, with species recorded only from a limited number of studies and counties. As a starting point, a list of potentially economically important species compiled in a previous study (Seibert 1993) was used.

Through the use of COI barcoding, wireworms collected throughout the state were able to be accurately identified. This was accomplished by making a base “library” of sequences extracted from identified museum adults belonging to the economically important species from the Seibert (1993) list, and expanded to included freshly collected adults. Sequences obtained from wireworms collected from Montana and areas of Idaho and Washington, were compared to the adult sequences. This allowed associations to be made between the two life stages. These associations turned out to be very clear and were done with a high degree of accuracy. This limited mistakes due to gaps in the literature and sped up the process of association from years to months.

The usefulness of the DNA barcoding method was discovered to address a host of other issues. Previously, knowledge of most wireworm morphology was limited to nearly mature larva, due to rearing methods. A very small minority of species had been studied from eggs to adulthood, and these sometimes showed different morphologies at different instars. COI barcoding, not being limited by ideal living conditions, can help expand this knowledge to less studied species. A limit of this method, however, is that the exact instar
would be unknown. In this same vein, this method could also show which characters are variable within species and which represent good species indicators. This method also allowed new associations to be made, with three new ones being discovered.

Using this new knowledge of species occurring in Montana, a LUCID key was created. A LUCID key is a user friendly key that allows users to start at any character and has pictures that show an example of each character. The created key allows the separation of most of the species in Montana with described wireworms. Some species were not separated from closely related species in the LUCID key due to very specific characters that were needed. In addition, a traditional dicgutomous key was created that allows the separation of all species with described wireworms. While focused on Montana, these keys could easily be used for eastern Washington, Idaho, western North Dakota, southern Alberta, and southern Saskatchewan. While not comprehensive, it is the first key of its kind for wireworms and is a starting point to a greater understanding of Montana’s species.

During this study, species of the genus *Limonius* were shown to be the most common in wheat fields in western Montana. This genus was recently revised (Al Dhafer 2009). In the revision, there were some unprecedented synonymies, especially in the species-group that contained most of the economic species of *Limonius*. These synonymies combined species with distinct eastern and western distributions. A preliminary study of this species-group was done, suggesting that the group was more complex than presented in the previous review. This was done using a combination of morphological data and COI mtDNA data. A key was also constructed to aid in the
identification of females and the newly recognized species. Eight species were recognized as belonging to the canus species-group, and one species was removed from the group, up from a total of six in the previous review of the genus. This greater understanding of the species composing the group will allow more focused studies to be conducted in the future.

This study has clearly demonstrated how the use of COI data can help with many issues in entomology and wireworms in particular. Why still in a preliminary stage, the knowledge of Montana wireworms was greatly increased. With this knowledge, more effective species-specific controls can be developed. The ecology and biology of these species can also be examined in detail, due to the accurate identifications of these species. The new areas of research opened by combining DNA data and morphological data are numerous and the future studies of wireworms will increase our knowledge of species relationships, ecology, and effective-controls.
REFERENCES CITED


Horn, G. 1879. [Communication on the Elateridae]. Proceedings of the Monthly Meetings of the Entomological Section of the Academy of Natural Sciences, June 1879. xiv-xvi. [Issued with the Transactions of the American Entomological Society, volume 7]


APPENDICES
APPENDIX A

EXTRACTED SPECIMEN LOCALITY DATA AND COI SEQUENCES
<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Genus, Species</th>
<th>Life Stage</th>
<th>Sex</th>
<th>Collectors</th>
<th>Collection Date</th>
<th>Country, State/Province, Region, Exact Site</th>
<th>Latitude, Longitude, Elevation</th>
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MTEC007431, Limonius , californicus, larva, A. Morales et al, 2010, United States of America, Montana, Pondera Co, Conrad, 48.2901N, 111.8883W, 3532ft, TTAAGACTCTTGATTCCGGGCAAGACCTTG GTAACCCTGGGTCTACTAATTGGGAAATGACCAAAATCTATAATGGAATTGTACAGC AGCTCACGCCTTCATCATATTTTTCTTTTATAGTTATACCATATAATCTGTCGTT GGTTCGGAAAATGACTTAGTTCACCTAATATGGGTGCTCCTGATATAGCCCTTC CCTGAAATAAAAATAATAGTCTACTCTTTCTATCCCGTCCCCCTTTCTCTCTTT CTAATAAGAAGAATTGATAAAAATGGGACAGCAACTGGGAACAGTCTACGTCGCCAT CCCCCCTCTTCAGGCTAATTCCGAATAGGCTGCTTCAGTATTGACCCCATTTGTTTG GAGCGAATCTACATCTGCGTCCTTCCTCTCTTCCTCGCTACCTCACAG TTTTAGACGAGAGCTATACATACATATGCTATTGGAATGACCGAAACTTAAAACCTAACACTTAC TCTTCAACCGCTCAGG

MTEC007434, Limonius , californicus, larva, A. Morales et al, 2010, United States of America, Montana, Pondera Co, Conrad, 48.2901N, 111.8883W, 3532ft, CATCCTTAAGACTCTTGATTCCGGGCAAGACCTTG GTAACCCTGGGTCTACTAATTGGGAAATGACCAAAATCTATAATGGAATTGTACAGC AGCTCACGCCTTCATCATATTTTTCTTTTATAGTTATACCATATAATCTGTCGTT GGTTCGGAAAATGACTTAGTTCACCTAATATGGGTGCTCCTGATATAGCCCTTC CCTGAAATAAAAATAATAGTCTACTCTTTCTATCCCGTCCCCCTTTCTCTCTTT CTAATAAGAAGAATTGATAAAAATGGGACAGCAACTGGGAACAGTCTACGTCGCCAT CCCCCCTCTTCAGGCTAATTCCGAATAGGCTGCTTCAGTATTGACCCCATTTGTTTG GAGCGAATCTACATCTGCGTCCTTCCTCTCTTCCTCGCTACCTCACAG TTTTAGACGAGAGCTATACATACATATGCTATTGGAATGACCGAAACTTAAAACCTAACACTTAC TCTTCAACCGCTCAGG

MTEC007438, Hypnoidus , bicolor, larva, A. Morales et al, 2010, United States of America, Montana, Pondera Co, Conrad, 48.2901N, 111.8883W, 3532ft, CATCCTTAAGACTCTTGATTCCGGGCAAGACCTTG GTAACCCTGGGTCTACTAATTGGGAAATGACCAAAATCTATAATGGAATTGTACAGC AGCTCACGCCTTCATCATATTTTTCTTTTATAGTTATACCATATAATCTGTCGTT GGTTCGGAAAATGACTTAGTTCACCTAATATGGGTGCTCCTGATATAGCCCTTC CCTGAAATAAAAATAATAGTCTACTCTTTCTATCCCGTCCCCCTTTCTCTCTTT CTAATAAGAAGAATTGATAAAAATGGGACAGCAACTGGGAACAGTCTACGTCGCCAT CCCCCCTCTTCAGGCTAATTCCGAATAGGCTGCTTCAGTATTGACCCCATTTGTTTG GAGCGAATCTACATCTGCGTCCTTCCTCTCTTCCTCGCTACCTCACAG TTTTAGACGAGAGCTATACATACATATGCTATTGGAATGACCGAAACTTAAAACCTAACACTTAC TCTTCAACCGCTCAGG
TACCATTATTTTGGGTAGCTGTAAGCAATTACTGCACCTTCTACTACTTATTTTCAC
TTCCAGTCCGGAAGCAATCCTAATCAGGACAGGGGAACTTTAAAAA

MTEC007440, Hypnoidus, bicolor, larva, A. Morales et al., 2010, United States of America, Montana, Pondera Co, Conrad, 48.2901N, 111.8883W, 3532ft, TAGGAACTTCTTTAAGAATGCTAATCCGG TGCCGAACTCGGAAGCAATCCCTGCATTAGGGAATGTCAAATCTACAAT
GTAATTGTAAACGCCCATGCTTTTCATTATAATTTTTTTATCTAGTTATACCAATT
ATAATTGGGGGTGTAATGATTAGTACCCCTACATAGGAGACCTGTAATAGTTATACCAATT
TTCCAGTCCTGGCAGGAGCAATCACTATACTACTGACAGACCGAAACTTTAAA

MTEC007441, Aeolus, mellillus, adult, A. Morales et al., 2010, United States of America, Montana, Broadwater Co, Townsend, 46.0987N, 111.5428W, 4081ft,

MTEC007442, Aeolus, mellillus, adult, A. Morales et al., 2010, United States of America, Montana, Broadwater Co, Townsend, 46.0987N, 111.5428W, 4081ft,

MTEC007443, Aeolus, mellillus, adult, A. Morales et al., 2010, United States of America, Montana, Broadwater Co, Townsend, 46.0987N, 111.5428W, 4081ft,

MTEC007444, Aeolus, mellillus, adult, A. Morales et al., 2010, United States of America, Montana, Broadwater Co, Townsend, 46.0987N, 111.5428W, 4081ft,

MTEC007445, Hypnoidus, bicolor, adult, A. Morales et al., 2010, United States of America, Montana, Broadwater Co, Townsend, 46.0987N, 111.5428W, 4081ft,
TTCCAGTCTTGGAGGAAATCACAATACCTACATACACAGAACCGGAAACTTAAA
CACATCATTTTTT

MTEC007446,Hypnoidus,bicolor,adult,,A. Morales et. al,2010,United States of
America,Montana,Broadwater
Co,Townsend,46.0987N,111.5428W,4081ft,CTTCTTAAAGTGCTCTCTAATCCGGCCG
AAGTCCGGAAACCCTTGCTCTCTAATCGGAATATGCAAAGTTACAAATGTGAATT
GAAACAGGCCCATGCATTACCTAAATTTTTTCATAGTTATACCAATTTATGATT
GGAGGATTTGGAATTTGATTTACCTACCCCTCATACAGAAGACCTGACCTGATATAG
CATTTCCACAGAATAAACACACATTCACTAGGAGACCCCTGATATACGCTCTACCGA
ATTCTACTTTAAGAGAATTTGAGAAAAATGGAGAGAACTGGTTGAGTGAGACAC
CAGGCTCTCATTATAATTTTTTTCTAGTATACCAAATATAGTGGGAGTTTGT
GAAAACTGACTAGCAGACACCACTAGTGAATTTTCTAGTAAAAGTCCAGTCCTGGCAGGAGCAAATCACTATACTA
TTACATCATTTTTT

MTEC007447,Hypnoidus,bicolor,adult,,A. Morales et. al,2010,United States of
America,Montana,Broadwater
Co,Townsend,46.0987N,111.5428W,4081ft,CTTCTTAAAGTGCTCTCTAATCCGGCCG
AAGTCCGGAAACCCTTGCTCTCTAATCGGAATATGCAAAGTTACAAATGTGAATT
GAAACAGGCCCATGCATTACCTAAATTTTTTCATAGTTATACCAATTTATGATT
GGAGGATTTGGAATTTGATTTACCTACCCCTCATACAGAAGACCTGACCTGATATAG
CATTTCCACAGAATAAACACACATTCACTAGGAGACCCCTGATATACGCTCTACCGA
ATTCTACTTTAAGAGAATTTGAGAAAAATGGAGAGAACTGGTTGAGTGAGACAC
CAGGCTCTCATTATAATTTTTTTCTAGTATACCAAATATAGTGGGAGTTTGT
GAAAACTGACTAGCAGACACCACTAGTGAATTTTCTAGTAAAAGTCCAGTCCTGGCAGGAGCAAATCACTATACTA
TTACATCATTTTTT

MTEC007448,Hypnoidus,bicolor,adult,,A. Morales et. al,2010,United States of
America,Montana,Broadwater
Co,Townsend,46.0987N,111.5428W,4081ft,CTTCTTAAAGTGCTCTCTAATCCGGCCG
AAGTCCGGAAACCCTTGCTCTCTAATCGGAATATGCAAAGTTACAAATGTGAATT
GAAACAGGCCCATGCATTACCTAAATTTTTTCATAGTTATACCAATTTATGATT
GGAGGATTTGGAATTTGATTTACCTACCCCTCATACAGAAGACCTGACCTGATATAG
CATTTCCACAGAATAAACACACATTCACTAGGAGACCCCTGATATACGCTCTACCGA
ATTCTACTTTAAGAGAATTTGAGAAAAATGGAGAGAACTGGTTGAGTGAGACAC
CAGGCTCTCATTATAATTTTTTTCTAGTATACCAAATATAGTGGGAGTTTGT
GAAAACTGACTAGCAGACACCACTAGTGAATTTTCTAGTAAAAGTCCAGTCCTGGCAGGAGCAAATCACTATACTA
AGCAATTACTGCACTTCTACTACTTATTTTCACCTCCAGTCCCTGGCAGGAGCAATCACTATACTACTGACAGACGACCAGAAACCTAAAACACATCATATTTTT

MTEC007449,Hypnoidus,bicolor,adult,,A. Morales et. al,2010,United States of America,Montana,Broadwater Co.,Townsend,46.0987N,111.5428W,4081ft,CTTCCTTAAGAATCCTAATCCGGCCG AACTCGGAAACCCCTGGCTCATAATTTGGAATGATCAAATCTCAAATGTAAT TGTAACAGGCCCATGCTTTTCACTATAATTTTTTCATAGTTATACCAATTATAAT TGGGCGTTTGGTATTAGTAGATACCTACTAGGAGCACCTGATATAG CATTCCACGAAATCAACACATAGATTCTGATACTTTACCTCCTTTATCACTGCTTTATAAGAAGAATTGTAGAGAATGGAAGCAGAACAG TATACCCTCCTTTATAGGCACAGGATCATCTGTGACCTTA GCAATTTTTAGATTTACATCTGTTCACTTACTTCTACTATATTTAC TCCAGTCTGGCAGGAGCAATCACTATACTACTGACAGACGACCAGAAACCTAAA CACATCATATTTTT

MTEC007450,Hypnoidus,bicolor,adult,,A. Morales et. al,2010,United States of America,Montana,Broadwater Co.,Townsend,46.0987N,111.5428W,4081ft,CTTCCTTAAGAATCCTAATCCGGCCG AACTCGGAAACCCCTGGCTCATAATTTGGAATGATCAAATCTCAAATGTAAT TGTAACAGGCCCATGCTTTTCACTATAATTTTTTCATAGTTATACCAATTATAAT TGGGCGTTTGGTATTAGTAGATACCTACTAGGAGCACCTGATATAG CATTCCACGAAATCAACACATAGATTCTGATACTTTACCTCCTTTATCACTGCTTTATAAGAAGAATTGTAGAGAATGGAAGCAGAACAG TATACCCTCCTTTATAGGCACAGGATCATCTGTGACCTTA GCAATTTTTAGATTTACATCTGTTCACTTACTTCTACTATATTTAC TCCAGTCTGGCAGGAGCAATCACTATACTACTGACAGACGACCAGAAACCTAAA CACATCATATTTTT

MTEC007451,Hypnoidus,bicolor,adult,,A. Morales et. al,2010,United States of America,Montana,Broadwater Co.,Townsend,46.0987N,111.5428W,4081ft,CTTCCTTAAGAATCCTAATCCGGCCG AACTCGGAAACCCCTGGCTCATAATTTGGAATGATCAAATCTCAAATGTAAT TGTAACAGGCCCATGCTTTTCACTATAATTTTTTCATAGTTATACCAATTATAAT TGGGCGTTTGGTATTAGTAGATACCTACTAGGAGCACCTGATATAG CATTCCACGAAATCAACACATAGATTCTGATACTTTACCTCCTTTATCACTGCTTTATAAGAAGAATTGTAGAGAATGGAAGCAGAACAG TATACCCTCCTTTATAGGCACAGGATCATCTGTGACCTTA GCAATTTTTAGATTTACATCTGTTCACTTACTTCTACTATATTTAC TCCAGTCTGGCAGGAGCAATCACTATACTACTGACAGACGACCAGAAACCTAAA CACATCATATTTTT
TTTGAGCTGTCAGCAATTACTGCACCTTCTACTACTTATTTTCACTTCCAGTCCTGG
CAGGAGCAATCTACATACTACTACTGACAGACCGAAACCTAAAACACATCATTTTTT
G

MTEC007452,Hypnoidus,bicolor,adult,,A. Morales et. al,2010,United States of America,Montana,Broadwater Co,Townsend,46.0987N,111.5428W,4081ft,

MTEC007453,Aeolus,mellillus,adult,,A. Morales et. al,2010,United States of America,Montana,Broadwater Co,Townsend,46.0987N,111.5428W,4081ft,

MTEC007454,Limonius,californicus,adult,Male,A. Morales et. al,2010,United States of America,Montana,Broadwater Co,Townsend,46.0987N,111.5428W,4081ft,

MTEC007455,Hypnoidus,bicolor,adult,,A. Morales et. al,2010,United States of America,Montana,Broadwater Co,Townsend,46.0987N,111.5428W,4081ft,

MTEC007456,Limonius,californicus,adult,Female,A. Morales et. al,2010,United States of America,Montana,Broadwater Co,Townsend,46.0987N,111.5428W,4081ft,

MTEC007457,Limonius,californicus,adult,Female,A. Morales et. al,2010,United States of America,Montana,Broadwater Co,Townsend,46.0987N,111.5428W,4081ft,
MTEC007458, Limonius, californicus, adult, Female, A. Morales et al., 2010, United States of America, Montana, Broadwater Co, Townsend, 46.0987 N, 111.5428 W, 4081 ft.

MTEC007459, Hypnoidus, bicolor, adult, A. Morales et al., 2010, United States of America, Montana, Broadwater Co, Townsend, 46.0987 N, 111.5428 W, 4081 ft.

MTEC007460, Limonius, californicus, adult, Female, A. Morales et al., 2010, United States of America, Montana, Broadwater Co, Townsend, 46.0987 N, 111.5428 W, 4081 ft.

MTEC007461, Limonius, californicus, larva, A. Morales et al., 2010, United States of America, Montana, Fergus Co, Denton, 47.2942 N, 110.042183 W, 3776 ft.
MTEC007462, Limonius, californicus, larva, A. Morales et al., 2010, United States of America, Montana, Fergus Co., Denton, 47.2942N, 110.042183W, 3776 ft,

MTEC007463, Limonius, canus, adult, Male, M.A. Ivie, 29-May-91, United States of America, Montana, Flathead Co., "Glacier National Park, S. Big Prairie", 3560 ft,

MTEC007464, Limonius, canus, adult, Male, D.L. Gustafson, 26-Jun-89, United States of America, Montana, Powell Co., "Blackfoot River, MT 141",

MTEC007465, Hypnoidus, leei, adult, C.E. Seibert, 28 Jun to 24 Jul 1988, United States of America, Montana, Wheatland Co., "Two Dot, Musselshell River", 4600 ft,

MTEC007466, Hypnoidus, leei, adult, Female, C.E. Seibert, 30 May to 28 Jun 1988, United States of America, Montana, Wheatland Co., "Two Dot, Musselshell River", 4600 ft,

MTEC007467, Hypnoidus, leei, adult, Male, C.E. Seibert, 30 May to 1 Jul 1988, United States of America, Montana, Judith Basin Co., "Little Belt Mountains, S. fork Judith R., E of Indian Hill Water Gap", 5200 ft,


MTEC007469, Selatosomus, aeripennis, adult, D.L. Gustafson, 4 Jun to 22 Jul 1989, United States of America, Montana, Madison Co., "Hidden Lake Beach", 7400 ft,

MTEC007470, Selatosomus, aeripennis, adult, Ray Wiger, 19-Sep-92, United States of America, Montana, Flathead Co., "Glacier National Park, S. shore Waterton Lake, Goat haunt",...
MTEC007471, Selatosomus, aeripennis, adult, Male, M.A. Ivie, 18-May-94, United States of America, Montana, Flathead Co, "Glacier National Park, 1 mi S Polebridge R.S.", 3520 ft, CTTCTCTTACAGCCTCTCTCAATTCGAGACTAGTAATCCCGGCTCTCTATGGTAACCACTTACACCAATGACGTTCGAAATTTGCGAACTTTAATACATGGGTAATACCAATCATAATTGGAGGATTCGGAAATCCCTCTCTCAGCTATAAATAAGATTCTGATTCTCCTACCCTCTCTATACCTATTACTAAATGGAGAATCTCAGCGAATCCCTCTCTGAGGACATATTTACGATCACTGGAATCCTTTTACTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTCTC
MTEC007478, Limonius, californicus, larva., A. Morales et. al, 17-MAY to 02-JUNE-2011, United States of America, Montana, Broadwater Co. Townsend, 46.0987N, 111.5428W, 4081ft, CATCTTAAGACTCTTGATTCGGGCA GAACTTGGAACCCCTGGGTCACATAATTGGAAACGACCAAAATCTATAATGTATATGTTACAGCTCAGCTTCATCATAATTTTCTTTATAGTTATACCAACTCATATAATGGTGGATTCGGAAACTGACTAGTTCCACTAATATTGGGCGCTCCTGATATAGCCTTCCCTCGAATAAACAATATAAGATTCTGATTCTTGCCCCCATCACTTTCTCTTCTTCTAATAAGAAGAATTGTAGAAAATGGTGCAGGAACTGGATGAACAGTATACCCCCCTCTCTCAGCTAACATTGCCCATAGAGGCTCTTCAGTTGACCTCGCCATTTTCACCCTTCACCTAGCAGGAATTTCATCCATCCGTCTCTCTATAGATTTATCCTAACTGTTATTAATATACGATCTACCGGAATTACCTTCGACCGTAGCCCTCTATTTGTTTGAGCAGTAGCAATTACCGCTCTTCTCCTCTCTTACTTTCACTCCCAGTTTGGCAGGAGCTATCACAATACTATTAACAGATCGAAAACCTAAAC

MTEC007480, Limonius, californicus, larva., A. Morales et. al, 17-MAY to 02-JUNE-2011, United States of America, Montana, Broadwater Co. Townsend, 46.0987N, 111.5428W, 4081ft, CATCTTAAGACTCTTGATTCGGGCA GAACTTGGAACCCCTGGGTCACATAATTGGAAACGACCAAAATCTATAATGTATATGTTACAGCTCAGCTTCATCATAATTTTCTTTATAGTTATACCAACTCATATAATGGTGGATTCGGAAACTGACTAGTTCCACTAATATTGGGCGCTCCTGATATAGCCTTCCCTCGAATAAACAATATAAGATTCTGATTCTTGCCCCCATCACTTTCTCTTCTTCTAATAAGAAGAATTGTAGAAAATGGTGCAGGAACTGGATGAACAGTATACCCCCCTCTCTCAGCTAACATTGCCCATAGAGGCTCTTCAGTTGACCTCGCCATTTTCACCCTTCACCTAGCAGGAATTTCATCCATCCGTCTCTCTATAGATTTATCCTAACTGTTATTAATATACGATCTACCGGAATTACCTTCGACCGTAGCCCTCTATTTGTTTGAGCAGTAGCAATTACCGCTCTTCTCCTCTCTTACTTTCACTCCCAGTTTGGCAGGAGCTATCACAATACTATTAACAGATCGAAAACCTAAAC

MTEC007481, Limonius, californicus, larva., A. Morales et. al, 17-MAY to 02-JUNE-2011, United States of America, Montana, Broadwater Co. Townsend, 46.0987N, 111.5428W, 4081ft, CATCTTAAGACTCTTGATTCGGGCA GAACTTGGAACCCCTGGGTCACATAATTGGAAACGACCAAAATCTATAATGTATATGTTACAGCTCAGCTTCATCATAATTTTCTTTATAGTTATACCAACTCATATAATGGTGGATTCGGAAACTGACTAGTTCCACTAATATTGGGCGCTCCTGATATAGCCTTCCCTCGAATAAACAATATAAGATTCTGATTCTTGCCCCCATCACTTTCTCTTCTTCTAATAAGAAGAATTGTAGAAAATGGTGCAGGAACTGGATGAACAGTATACCCCCCTCTCTCAGCTAACATTGCCCATAGAGGCTCTTCAGTTGACCTCGCCATTTTCACCCTTCACCTAGCAGGAATTTCATCCATCCGTCTCTCTATAGATTTATCCTAACTGTTATTAATATACGATCTACCGGAATTACCTTCGACCGTAGCCCTCTATTTGTTTGAGCAGTAGCAATTACCGCTCTTCTCCTCTCTTACTTTCACTCCCAGTTTGGCAGGAGCTATCACAATACTATTAACAGATCGAAAACCTAAAC

MTEC007482, Limonius, californicus, larva., A. Morales et. al, 17-MAY to 02-JUNE-2011, United States of America, Montana, Broadwater Co. Townsend, 46.0987N, 111.5428W, 4081ft, CATCTTAAGACTCTTGATTCGGGCA GAACTTGGAACCCCTGGGTCACATAATTGGAAACGACCAAAATCTATAATGTATATGTTACAGCTCAGCTTCATCATAATTTTCTTTATAGTTATACCAACTCATATAATGGTGGATTCGGAAACTGACTAGTTCCACTAATATTGGGCGCTCCTGATATAGCCTTCCCTCGAATAAACAATATAAGATTCTGATTCTTGCCCCCATCACTTTCTCTTCTTCTAATAAGAAGAATTGTAGAAAATGGTGCAGGAACTGGATGAACAGTATACCCCCCTCTCTCAGCTAACATTGCCCATAGAGGCTCTTCAGTTGACCTCGCCATTTTCACCCTTCACCTAGCAGGAATTTCATCCATCCGTCTCTCTATAGATTTATCCTAACTGTTATTAATATACGATCTACCGGAATTACCTTCGACCGTAGCCCTCTATTTGTTTGAGCAGTAGCAATTACCGCTCTTCTCCTCTCTTACTTTCACTCCCAGTTTGGCAGGAGCTATCACAATACTATTAACAGATCGAAAACCTAAAC

MTEC007483, Limonius, californicus, larva., A. Morales et. al, 17-MAY to 02-JUNE-2011, United States of America, Montana, Broadwater Co. Townsend, 46.0987N, 111.5428W, 4081ft, CATCTTAAGACTCTTGATTCGGGCA GAACTTGGAACCCCTGGGTCACATAATTGGAAACGACCAAAATCTATAATGTATATGTTACAGCTCAGCTTCATCATAATTTTCTTTATAGTTATACCAACTCATATAATGGTGGATTCGGAAACTGACTAGTTCCACTAATATTGGGCGCTCCTGATATAGCCTTCCCTCGAATAAACAATATAAGATTCTGATTCTTGCCCCCATCACTTTCTCTTCTTCTAATAAGAAGAATTGTAGAAAATGGTGCAGGAACTGGATGAACAGTATACCCCCCTCTCTCAGCTAACATTGCCCATAGAGGCTCTTCAGTTGACCTCGCCATTTTCACCCTTCACCTAGCAGGAATTTCATCCATCCGTCTCTCTATAGATTTATCCTAACTGTTATTAATATACGATCTACCGGAATTACCTTCGACCGTAGCCCTCTATTTGTTTGAGCAGTAGCAATTACCGCTCTTCTCCTCTCTTACTTTCACTCCCAGTTTGGCAGGAGCTATCACAATACTATTAACAGATCGAAAACCTAAAC

MTEC007484, Limonius, californicus, larva., A. Morales et. al, 17-MAY to 02-JUNE-2011, United States of America, Montana, Broadwater Co. Townsend, 46.0987N, 111.5428W, 4081ft, CATCTTAAGACTCTTGATTCGGGCA GAACTTGGAACCCCTGGGTCACATAATTGGAAACGACCAAAATCTATAATGTATATGTTACAGCTCAGCTTCATCATAATTTTCTTTATAGTTATACCAACTCATATAATGGTGGATTCGGAAACTGACTAGTTCCACTAATATTGGGCGCTCCTGATATAGCCTTCCCTCGAATAAACAATATAAGATTCTGATTCTTGCCCCCATCACTTTCTCTTCTTCTAATAAGAAGAATTGTAGAAAATGGTGCAGGAACTGGATGAACAGTATACCCCCCTCTCTCAGCTAACATTGCCCATAGAGGCTCTTCAGTTGACCTCGCCATTTTCACCCTTCACCTAGCAGGAATTTCATCCATCCGTCTCTCTATAGATTTATCCTAACTGTTATTAATATACGATCTACCGGAATTACCTTCGACCGTAGCCCTCTATTTGTTTGAGCAGTAGCAATTACCGCTCTTCTCCTCTCTTACTTTCACTCCCAGTTTGGCAGGAGCTATCACAATACTATTAACAGATCGAAAACCTAAAC

MTEC007485, Limonius, californicus, larva., A. Morales et. al, 17-MAY to 02-JUNE-2011, United States of America, Montana, Broadwater Co. Townsend, 46.0987N, 111.5428W, 4081ft, CATCTTAAGACTCTTGATTCGGGCA GAACTTGGAACCCCTGGGTCACATAATTGGAAACGACCAAAATCTATAATGTATATGTTACAGCTCAGCTTCATCATAATTTTCTTTATAGTTATACCAACTCATATAATGGTGGATTCGGAAACTGACTAGTTCCACTAATATTGGGCGCTCCTGATATAGCCTTCCCTCGAATAAACAATATAAGATTCTGATTCTTGCCCCCATCACTTTCTCTTCTTCTAATAAGAAGAATTGTAGAAAATGGTGCAGGAACTGGATGAACAGTATACCCCCCTCTCTCAGCTAACATTGCCCATAGAGGCTCTTCAGTTGACCTCGCCATTTTCACCCTTCACCTAGCAGGAATTTCATCCATCCGTCTCTCTATAGATTTATCCTAACTGTTATTAATATACGATCTACCGGAATTACCTTCGACCGTAGCCCTCTATTTGTTTGAGCAGTAGCAATTACCGCTCTTCTCCTCTCTTACTTTCACTCCCAGTTTGGCAGGAGCTATCACAATACTATTAACAGATCGAAAACCTAAAC

MTEC007486, Limonius, californicus, larva., A. Morales et. al, 17-MAY to 02-JUNE-2011, United States of America, Montana, Broadwater Co. Townsend, 46.0987N, 111.5428W, 4081ft, CATCTTAAGACTCTTGATTCGGGCA GAACTTGGAACCCCTGGGTCACATAATTGGAAACGACCAAAATCTATAATGTATATGTTACAGCTCAGCTTCATCATAATTTTCTTTATAGTTATACCAACTCATATAATGGTGGATTCGGAAACTGACTAGTTCCACTAATATTGGGCGCTCCTGATATAGCCTTCCCTCGAATAAACAATATAAGATTCTGATTCTTGCCCCCATCACTTTCTCTTCTTCTAATAAGAAGAATTGTAGAAAATGGTGCAGGAACTGGATGAACAGTATACCCCCCTCTCTCAGCTAACATTGCCCATAGAGGCTCTTCAGTTGACCTCGCCATTTTCACCCTTCACCTAGCAGGAATTTCATCCATCCGTCTCTCTATAGATTTATCCTAACTGTTATTAATATACGATCTACCGGAATTACCTTCGACCGTAGCCCTCTATTTGTTTGAGCAGTAGCAATTACCGCTCTTCTCCTCTCTTACTTTCACTCCCAGTTTGGCAGGAGCTATCACAATACTATTAACAGATCGAAAACCTAAAC
CTTCACCTAGCAGGATTTCTCCATCCCTGGGAGGAGTAAATTTCATCTCAAC
TGGTTAATATAATACGATCTACCGGGAATTACCTTGACCCTGATATGCCTTATTTGTTGAGCAGTAGCAATTACCGCTCTTCTCCTCTTTACTTTACTCCTCCAGTTTGTGCA

MTEC007484,Limonius,californicus,larva,,A. Morales et. al,17-MAY to 02-JUNE-2011,United States of America,Montana,Broadwater Co,Townsend,46.0987N,111.5428W,4081ft,

MTEC007485,Limonius,californicus,larva,,A. Morales et. al,17-MAY to 02-JUNE-2011,United States of America,Montana,Broadwater Co,Townsend,46.0987N,111.5428W,4081ft,

MTEC007486,Limonius,californicus,larva,,A. Morales et. al,17-MAY to 02-JUNE-2011,United States of America,Montana,Broadwater Co,Townsend,46.0987N,111.5428W,4081ft,

MTEC007504,Limonius,californicus,larva,,A. Morales et. al,17-MAY to 02-JUNE-2011,United States of America,Montana,Broadwater Co,Townsend,46.0987N,111.5428W,4081ft,
CTCCCAGTTTTTGGCAGGAGCTATCACAATAACTATTAACAGATCGAAACCTAA
ACACTTC

MTEC007506, Limonius, californicus, larva,, A. Morales et. al, 17-MAY to 02-JUNE-2011, United States of America, Montana, Broadwater
Co, Townsend, 46.0987N, 111.5428W, 4081 ft, CATCCTTAAGACTCTTGATTCGGGCA GAACTTGTTAAACCTGGTGTCACCTAAATGGGAAACGACAAATCTATAATGTATACGTTACAGCCTACGCGCTTCATCATAATTTTCTTTTAGTTATAACCTACATAA TTGGTGAGATTCGGAAAACCTAGACTGGTTCATCAATATGGGCGTCTCAGTATAGCATCCTCAGTATCTGATTCTTTTCTCTCCTCTCCTCTTACTTTCACTCCAGTTTTTGGCAGGAGCTATCACAATAACTATTAACAGATCGAAACCTAA
ACACTTC

MTEC007514, Limonius, californicus, larva,, A. Morales et. al, 17-MAY to 02-JUNE-2011, United States of America, Montana, Broadwater
Co, Townsend, 46.0987N, 111.5428W, 4081 ft, CATCCTTAAGACTCTTGATTCGGGCA GAACTTGTTAAACCTGGTGTCACCTAAATGGGAAACGACAAATCTATAATGTATACGTTACAGCCTACGCGCTTCATCATAATTTTCTTTTAGTTATAACCTACATAA TTGGTGAGATTCGGAAAACCTAGACTGGTTCATCAATATGGGCGTCTCAGTATAGCATCCTCAGTATCTGATTCTTTTCTCTCCTCTCCTCTTACTTTCACTCCAGTTTTTGGCAGGAGCTATCACAATAACTATTAACAGATCGAAACCTAA
ACACTTC

MTEC007515, Limonius, californicus, larva,, A. Morales et. al, 17-MAY to 02-JUNE-2011, United States of America, Montana, Broadwater
Co, Townsend, 46.0987N, 111.5428W, 4081 ft, CATCCTTAAGACTCTTGATTCGGGCA GAACTTGTTAAACCTGGTGTCACCTAAATGGGAAACGACAAATCTATAATGTATACGTTACAGCCTACGCGCTTCATCATAATTTTCTTTTAGTTATAACCTACATAA TTGGTGAGATTCGGAAAACCTAGACTGGTTCATCAATATGGGCGTCTCAGTATAGCATCCTCAGTATCTGATTCTTTTCTCTCCTCTCCTCTTACTTTCACTCCAGTTTTTGGCAGGAGCTATCACAATACTATTAACAGATCGAAACCTAA
ACACTTC
ATGCCTCTATTTTGGACAGTAGCAATTACGCTCTTCTCTCCTACTTTCACTCCCAGTTTTTGCAAGGACAGCCTACACAACTATACTATTAACAGATCGAAGACCTAA
ACACTTCA

MTEC007518, Limonius, californicus, larva, A. Morales et. al, 17-MAY to 02-JUNE-2011, United States of America, Montana, Broadwater
Co, Townsend, 46.0987N, 111.5428W, 4081 ft,

MTEC007519, Limonius, californicus, larva, A. Morales et. al, 17-MAY to 02-JUNE-2011, United States of America, Montana, Broadwater
Co, Townsend, 46.0987N, 111.5428W, 4081 ft, CATCCTTAAGACTCTTGTGTACGCGCA
GAACCTGTAGAACCCTGGGTCGTAATGGGAAACGACAAATCTATAATGTTA
TTGTACAGCTCAAGGCTCTTATCATAAATTTCATTTCATATAATCTGTTA
GCCTTCCCTCAAAACAATATAAGATCTGTTCTTGCCCCACATCTCTTC
TCTCTCTAATAAGGAAGATTGTGAAATGTCAGAGAATCTGGAATAA
GTATACCCCTCTCCTCAGTAAACATGCCCCCATTAGGCTTCCTCATGTGACCT
CGCCATTTTCAGGCTTACCTAGCAGAATTTCATCTCCAGGGAGCTGTTA
ATTTATCTCAACTGTATATAATATCGTCTACCTACCCTGAGGC
ATGCTCTATTTTGGACAGTAGCAATTACGCTCTTCTCTCCTACTTTCACTCCCAGTTTTTGCAAGGACAGCCTACACAACTATACTATTAACAGATCGAAGACCTAA
ACACTTCA

MTEC007521, Limonius, californicus, adult, Female, A. Morales et. al, 17-MAY to 02-JUNE-2011, United States of America, Montana, Broadwater
Co, Townsend, 46.0987N, 111.5428W, 4081 ft,

MTEC007523, Limonius, californicus, larva, A. Morales et. al, 17-MAY to 02-JUNE-2011, United States of America, Montana, Broadwater
Co, Townsend, 46.0987N, 111.5428W, 4081 ft, ACTAGGAACATCCTAAGACTCTTGAC
TTGCAGCAGTAATTTGTCGTCAGGTTGAAAAACGACAAATCTATAATTGTTAAGCTTTCATCATAAGGATCGCTCCAGCAGTTAATTTTATCTCTTCTATGTTGACCTA
ACACTTCA

MTEC007524, Limonius, californicus, adult, Female, A. Morales et. al, 17-MAY to 02-JUNE-2011, United States of America, Montana, Broadwater
Co, Townsend, 46.0987N, 111.5428W, 4081 ft, CATCCTTAAGACTCTTGTGTACGCGCA
GAACCTGTAGAACCCTGGGTCGTAATGGGAAACGACAAATCTATAATGTTA
TTGTACAGCTCAAGGCTCTTATCATAAATTTCATTTCATATAATCTGTTA
GCCTTCCCTCAAAACAATATAAGATCTGTTCTTGCCCCACATCTCTTC
TCTCTCTAATAAGGAAGATTGTGAAATGTCAGAGAATCTGGAATAA
GTATACCCCTCTCCTCAGTAAACATGCCCCCATTAGGCTTCCTCATGTGACCT
CGCCATTTTCAGGCTTACCTAGCAGAATTTCATCTCCAGGGAGCTGTTA
ATTTATCTCAACTGTATATAATATCGTCTACCTACCCTGAGGC
ATGCTCTATTTTGGACAGTAGCAATTACGCTCTTCTCTCCTACTTTCACTCCCAGTTTTTGCAAGGACAGCCTACACAACTATACTATTAACAGATCGAAGACCTAA
ACACTTCA
MTEC007527, Limonius, californicus, larva, A. Morales et al, 17-MAY to 02-JUNE-2011, United States of America, Montana, Broadwater Co, Townsend, 46.0987N, 111.5428W, 4081ft,

MTEC007531, Limonius, californicus, larva, A. Morales et al, 17-MAY to 02-JUNE-2011, United States of America, Montana, Broadwater Co, Townsend, 46.0987N, 111.5428W, 4081ft, AAACCTGTACCTGTCAGTTCCGTCACTAATT
GGAAACGACCAAATCTATAATGTTATTGTTACAGCTACCGCTCTCATCATAATTTTCTTTATAGTTATACCAATCATTTAGGTGGATTCGGAAACTGACTAGTTCCACTAATATTGGGCGCTCCTGATATA
gccatAGGGCTCCTCAGTGGACCTCGCAGATTTGCTACCTAACCTCAAACTTGTTATTTGCTAATAGTATGTAATTTTATCTCAGGTTAACCCTGGGTCACTAATTTTGTTACAGCTACCGCTCTCATCATAATTTTCTTTATAGTTATACCAATCATAATGGTTATTGTTATGTTACAGCTACCGCTCTCATCATAATTTTCTTTATAGTTATACCAATCATAAT

MTEC007532, Limonius, californicus, larva, A. Morales et al, 17-MAY to 02-JUNE-2011, United States of America, Montana, Broadwater Co, Townsend, 46.0987N, 111.5428W, 4081ft, CATCCTTAAGACTCTTGATTCGGGCAGAACTTGGTAACCCTGGGTCACTAATTTTGTTACAGCTACCGCTCTCATCATAATTTTCTTTATAGTTATACCAATCATAATGGTTATTGTTATGTTACAGCTACCGCTCTCATCATAATTTTCTTTATAGTTATACCAATCATAAT

MTEC007548, Limonius, californicus, larva, A. Morales et al, 02-JUNE to 14-JUNE-2011, United States of America, Montana, Broadwater Co, Townsend, 46.0987N, 111.5428W, 4081ft, CATCCTTAAGACTCTTGATTCGGGCAGAACTTGGTAACCCTGGGTCACTAATTTTGTTACAGCTACCGCTCTCATCATAATTTTCTTTATAGTTATACCAATCATAATGGTTATTGTTATGTTACAGCTACCGCTCTCATCATAATTTTCTTTATAGTTATACCAATCATAAT
ATGCCTCTATTTTGTTTGAGCATGAGCAATTACGCTCTTCTCCTCTTTACTCTTA
CTCCCAATTGTTGGGCAGGAGCTATACAAATATATAACAGATCGAAACCTAA
ACACTTCATTCTCGACTCTGCTGCGGGGAGGCT

MTEC007550,Limonius,californicus,larva,,A. Morales et. al,02-JUNE to 14-JUNE-2011,United States of America,Montana,Broadwater
Co, Townsend, 46.0987N, 111.5428W, 4081 ft, ACTAGGAACATCCTTAAGACTCTTAGTTGGAGCATGAGCAATTACGCTCTTCTCCTCTTTACTCTTA
CTCCCAATTGTTGGGCAGGAGCTATACAAATATATAACAGATCGAAACCTAA
ACACTTCATTCTCGACTCTGCTGCGGGGAGGCT

MTEC007551,Limonius,californicus,larva,,A. Morales et. al,02-JUNE to 14-JUNE-2011,United States of America,Montana,Broadwater
Co, Townsend, 46.0987N, 111.5428W, 4081 ft, CATCCTTAAGACTCTTCTTGAGTTGGGCA
GAACCTTGGTAACCTTGGTCACTAATGGGAAACGACCAATCATAATGTTA
TTGTTACAGTCAGCCTCTCATCATAATTTTCTCTTTATTATACACCAGTCGCTGTGA
GCCTTCCCCTCGAATAAACAAATATAAGATTGCGTCTGCTATATAACCCCATCAAG
GCCTTCTCTTCTCCTACTAAAGATAATGGGAAATATTGCGAGAATGGGATGAA
GTATACCCCCCTCTCTCTCAGCCTAACCTAGGCGCTCTTTAGTGTTAGGACCT
CGCCATTTTCACCGCCTCACCAGCAATTTCTCCTCATCCTCCTGGGAGCACTTT
ATTTTATCCTCAACTGTATAATATACAGTCTACCAGAATTACTCTTCGACCGT
ATGCTCTCTATTGTTTTAGGAGGATGAGATACCGGCTCTCTCTACCACTTCGCTG

MTEC007555,Limonius,californicus,larva,,A. Morales et. al,02-JUNE to 14-JUNE-2011,United States of America,Montana,Broadwater
Co, Townsend, 46.0987N, 111.5428W, 4081 ft, CATCCTTAAGACTCTTCTTGAGTTGGGCA
GAACCTTGGTAACCTTGGTCACTAATGGGAAACGACCAATCATAATGTTA
TTGTTACAGTCAGCCTCTCATCATAATTTTCTCTTTATTATACACCAGTCGCTGTGA
GCCTTCCCCTCGAATAAACAAATATAAGATTGCGTCTGCTATATAACCCCATCAAG
GCCTTCTCTTCTCCTACTAAAGATAATGGGAAATATTGCGAGAATGGGATGAA
GTATACCCCCCTCTCTCTCAGCCTAACCTAGGCGCTCTTTAGTGTTAGGACCT
CGCCATTTTCACCGCCTCACCAGCAATTTCTCCTCATCCTCCTGGGAGCACTTT
ATTTTATCCTCAACTGTATAATATACAGTCTACCAGAATTACTCTTCGACCGT
ATGCTCTCTATTGTTTTAGGAGGATGAGATACCGGCTCTCTCTACCACTTCGCTG

GTTGACCTCGCCATTTTCAGCCTTCACCTAGCAGGAATTTCATCCATCCTGGGAGCAGTTAATTTTATCTCAACTGTTATTAATATACGATCTACCGGAATTACCTTCGACCGTATGCCTCTATTTTGTGTTGACAGTAAGCTACGCTTCTCTCCTCTCTACTTTCACTCCACGGGAGCTATCACAATACTATTATTAAACAGAGATCGAACCTAAACACCTTC

MTEC007580, Limonius, californicus, larva, A. Morales et al, 15-JUNE to 28-JUNE-2011, United States of America, Montana, Broadwater Co, Townsend, 46.0987N, 111.5428W, 4081 ft, CATCCCTAAAGCTCTGATTCCAGGCAAGACTTGGTAACCCTGGGTCACTAATTGGAAACGACCAAATCTATAATGTATTTTACAGCTCACGCCTTCATCATAATTTTCTTTATAGTTATACCAATCATAA TTGGTGGATTCCGGAAACTGACTAGTTCCACTAATATGGGCGCTCCTGATATA GCCTTTCCCTCGAATAAAACAAAATATAGTTGTTTGGCACTAGTTACCTCTCTCTCTTCTCTCTCTCTTCACTCCAGTTTTGGCAGGAGCTATCACAATACTATTAAACAGAGATCGAACCTAAACACCTTC

MTEC007581, Limonius, californicus, larva, A. Morales et al, 15-JUNE to 28-JUNE-2011, United States of America, Montana, Broadwater Co, Townsend, 46.0987N, 111.5428W, 4081 ft, CATCCCTAAAGCTCTGATTCCAGGCAAGACTTGGTAACCCTGGGTCACTAATTGGAAACGACCAAATCTATAATGTATTTTACAGCTCACGCCTTCATCATAATTTTCTTTATAGTTATACCAATCATAA TTGGTGGATTCCGGAAACTGACTAGTTCCACTAATATGGGCGCTCCTGATATA GCCTTTCCCTCGAATAAAACAAAATATAGTTGTTTGGCACTAGTTACCTCTCTCTCTTCTCTCTCTCTTCACTCCAGTTTTGGCAGGAGCTATCACAATACTATTAAACAGAGATCGAACCTAAACACCTTC


MTEC007584, Limonius, californicus, larva, A. Morales et al, 15-JUNE to 28-JUNE-2011, United States of America, Montana, Broadwater Co, Townsend, 46.0987N, 111.5428W, 4081 ft, CATCCCTAAAGCTCTGATTCCAGGCAAGACTTGGTAACCCTGGGTCACTAATTGGAAACGACCAAATCTATAATGTATTTTACAGCTCACGCCTTCATCATAATTTTCTTTATAGTTATACCAATCATAA TTGGTGGATTCCGGAAACTGACTAGTTCCACTAATATGGGCGCTCCTGATATA GCCTTTCCCTCGAATAAAACAAAATATAGTTGTTTGGCACTAGTTACCTCTCTCTCTTCTCTCTCTCTTCACTCCAGTTTTGGCAGGAGCTATCACAATACTATTAAACAGAGATCGAACCTAAACACCTTCATCCCTGATCTGCGAGGGGAGGTTG
TTGTTACAGCTCAGCCCTTTCACATAATTTTTCATTTATAGTTATACCAATCATAA TTGTTGAGATGCGCGAAGCTAGCAGTTTCCTCAATATTTGGGGCGCTGTGGATATA GCCTTTCCTCGAATAACAAATATAAGCTTCTTGCTCGCCCATCTTCCTCCTCCTCCT CTTTCTCTAATAAGAAAGATTTGAAAGTTGTCAGGACTACATGAACA GTATACCCCTCCTCCTCAGCCTAACATGCGCCATAGGCTCTTCAAGTTGACCT CGCCATTTTTCAAGCTCAGCATCAATTTGCAATTCCTCCTCGGAGCGATTTA ATTTTATCTCAGCTTAAATATACGATCTACCGGAATTACCTTCGACCGTATG ATGCCTCCTATTTGTGGAGCAGTGAATTACGCTCCTCCTCCTCTTACTTTC ATCCTCAGTTTGGGAGGAGGCTATCACAAATATATAACAGATCGAAACCTAA ACACCTCATTCTCGATCCTGGCTGGGGAGGTG

MTEC007585, Limonius, californicus, larva, A. Morales et al, 15-JUNE to 28-JUNE 2011, United States of America, Montana, Broadwater Co, Townsend, 46.0987N, 111.5428W, 4081 ft,

MTEC007589, Limonius, californicus, larva, A. Morales et al, 15-JUNE to 28-JUNE 2011, United States of America, Montana, Broadwater Co, Townsend, 46.0987N, 111.5428W, 4081 ft, CTTAAGAAGCTTTCGTAGTCCGCGAGAA CTTGCTAACCTGGCTGACTAAATTTGAAAAACGAACAAATCTTATATGTATTGT TACAGCTCAGCCTTCATCAATTTTTCTTATAGTTAATACAAATATACTTAAT CTATCCCTCGAATAAAACAATATAAGATTCTGATTCTTGGCCCCCATACCTTTCTCTT CCTAATAAGAAAGATTTGAAAGTTGTCAGGACTACATGAACA GTATACCCCTCCTCCTCAGCCTAACATGCGCCATAGGCTCTTCAAGTTGACCT CGCCATTTTTCAAGCTCAGCATCAATTTGCAATTCCTCCTCGGAGCGATTTA ATTTTATCTCAGCTTAAATATACGATCTACCGGAATTACCTTCGACCGTATG ATGCCTCCTATTTGTGGAGCAGTGAATTACGCTCCTCCTCCTCTTACTTTC ATCCTCAGTTTGGGAGGAGGCTATCACAAATATATAACAGATCGAAACCTAA ACACCTCATTCTCGATCCTGGCTGGGGAGGTG

MTEC007592, Limonius, californicus, larva, A. Morales et al, 15-JUNE to 28-JUNE 2011, United States of America, Montana, Broadwater Co, Townsend, 46.0987N, 111.5428W, 4081 ft, CATCCTTAAGAAGACTTTCGTAGTCCGCGAGAA GAACTTGGTAAACCTGGTGCACCTATTTGAAAAACGAACAAATCTTATATGTATTGT TTGATCAGCTCAGCCTTCATCAATTTTTCTTATAGTTAATACAAATATACTTAAT CTATCCCTCGAATAAAACAATATAAGATTCTGATTCTTGGCCCCCATACCTTT CTCTAATAAGAAAGATTTGAAAGTTGTCAGGACTACATGAACA GTATACCCCTCCTCCTCAGCCTAACATGCGCCATAGGCTCTTCAAGTTGACCT CGCCATTTTTCAAGCTCAGCATCAATTTGCAATTCCTCCTCGGAGCGATTTA ATTTTATCTCAGCTTAAATATACGATCTACCGGAATTACCTTCGACCGTATG ATGCCTCCTATTTGTGGAGCAGTGAATTACGCTCCTCCTCCTCTTACTTTC ATCCTCAGTTTGGGAGGAGGCTATCACAAATATATAACAGATCGAAACCTAA ACACCTCATTCTCGATCCTGGCTGGGGAGGTG
MTEC007593, Limonius, californicus, larva, A. Morales et al, 15-JUNE to 28-JUNE 2011, United States of America, Montana, Broadwater
Co, Townsend, 46.0987N, 111.5428W, 4081 ft, CATCCTTAAGACTCTTGGATTCCGGCA
GAACCTGTTGAACCCTGGGTCTACTAATTGGGAACGACCAAATCTATAATGGTA
TTGTATACGCTCAGCCCTTCATCATAATTTCCTTTTATAGTTATAACAATCTCAA
TTGGTGATTCCGGAAACTGAAGTCTCCACTAATATGGGGCGCTCCTGAATA
GCTTTCCTCGAAATAAATAAGTTGATTTTATCCAGATTTACCCCGGAGATGAGTTA
ATTTATCTACGCTTTATTATATACGATCTACCGGAAATTACCCGCTCCTCTCTCTTTCA
CTCCCCGATTTGGCAGGAGCTATCACAATACATAACAGATCAGAAACCTAA
ACACTTCATTTCTCGATCCTGCTGGGGAGG

MTEC007602, Limonius, californicus, larva, A. Morales et al, 15-JUNE to 28-JUNE 2011, United States of America, Montana, Broadwater
Co, Townsend, 46.0987N, 111.5428W, 4081 ft,

MTEC007608, Limonius, californicus, larva, A. Morales et al, 15-JUNE to 28-JUNE 2011, United States of America, Montana, Broadwater
Co, Townsend, 46.0987N, 111.5428W, 4081 ft, CATCCTTAAGACTCTTGGATTCCGGCA
GAACCTGTTGAACCCTGGGTCTACTAATTGGGAACGACCAAATCTATAATGGTA
TTGTATACGCTCAGCCCTTCATCATAATTTCCTTTTATAGTTATAACAATCTCAA
TTGGTGATTCCGGAAACTGAAGTCTCCACTAATATGGGGCGCTCCTGAATA
GCTTTCCTCGAAATAAATAAGTTGATTTTATCCAGATTTACCCCGGAGATGAGTTA
ATTTATCTACGCTTTATTATATACGATCTACCGGAAATTACCCGCTCCTCTCTTTCA
CTCCCCGATTTGGCAGGAGCTATCACAATACATAACAGATCAGAAACCTAA
ACACTTCATTTCTCGATCCTGCTGGGGAGG

MTEC007610, Limonius, californicus, larva, A. Morales et al, 15-JUNE to 28-JUNE 2011, United States of America, Montana, Broadwater
Co, Townsend, 46.0987N, 111.5428W, 4081 ft, CATCCTTAAGACTCTTGGATTCCGGCA
GAACCTGTTGAACCCTGGGTCTACTAATTGGGAACGACCAAATCTATAATGGTA
TTGTATACGCTCAGCCCTTCATCATAATTTCCTTTTATAGTTATAACAATCTCAA
TTGGTGATTCCGGAAACTGAAGTCTCCACTAATATGGGGCGCTCCTGAATA
GCTTTCCTCGAAATAAATAAGTTGATTTTATCCAGATTTACCCCGGAGATGAGTTA
ATTTATCTACGCTTTATTATATACGATCTACCGGAAATTACCCGCTCCTCTCTTTCA
CTCCCCGATTTGGCAGGAGCTATCACAATACATAACAGATCAGAAACCTAA
ACACTTCATTTCTCGATCCTGCTGGGGAGG
ATTTTATCTCAACTGTATTATAATACGATCTACCGGAAATTACTCTTCGAGCGTTATGCTTCTAATTGTTAGCGAGTAGCAGTACAAATTACCGGCTTCTCCTCCTCTTTTCACTCCCAAGTTTGGCAGGAGCTATCAACAATAACTATTAAACAGATCGAAACCTAAACACTTCATTTCTCGATCCTGCTGCGGAGG

MTEC007614, Limonius, californicus, larva, A. Morales et al., 15-JUNE to 28-JUNE-2011, United States of America, Montana, Broadwater Co, Townsend, 46.0987N, 111.5428W, 4081ft, CATCCTTAAGACTCTTAATTCCGGGCA GAACTTGGTAACCCCTGGGTCACAATTTGAGAAACGACCAAATCTATAATTGTA TTGTTACAGCTCACGCCTCTCATCATAATTTCTTTATAGTTATACCAACTCATAA TTGGTGGTAGCTCGAAAAGTACTGACTGTCCACTAATATTAGGGGCTCCTGTGATATA GCCTTCCCTGAATAAAACATAAAGATCTGCTCTTGGGCATCCTTTC TCTTCTCAATAAGAGAACTTGAGAAAATGTCAGGAACGGAATTACCCGATGAAC GAATTCCTCTCTAGATACTGGCCCATAGAGCTCTCTCTGATCCTGTGACCT CGCCATTTTACGGCTTACCTAGCGAATTTATGCCCAGCTCTCCTCG AACGTGTTTGGCAGGAGCTATCAACAATAACTATTAAACAGATCGAAACCTAAACACTTCATTTCTCGATCCTGCTGCGGAGG

MTEC007615, Limonius, californicus, larva, A. Morales et al., 15-JUNE to 28-JUNE-2011, United States of America, Montana, Broadwater Co, Townsend, 46.0987N, 111.5428W, 4081ft,

MTEC007621, Limonius, californicus, larva, A. Morales et al., 15-JUNE to 28-JUNE-2011, United States of America, Montana, Broadwater Co, Townsend, 46.0987N, 111.5428W, 4081ft,

MTEC007623, Limonius, californicus, larva, A. Morales et al., 15-JUNE to 28-JUNE-2011, United States of America, Montana, Broadwater Co, Townsend, 46.0987N, 111.5428W, 4081ft, CATCCTTAAGACTCTTAATTCCGGGCA GAACTTGGTAACCCCTGGGTCACAATTTGAGAAACGACCAAATCTATAATTGTA TTGTTACAGCTCACGCCTCTCATCATAATTTCTTTATAGTTATACCAACTCATAA TTGGTGGTAGCTCGAAAAGTACTGACTGTCCACTAATATTAGGGGCTCCTGTGATATA GCCTTCCCTGAATAAAACATAAAGATCTGCTCTTGGGCATCCTTTC TCTTCTCAATAAGAGAACTTGAGAAAATGTCAGGAACGGAATTACCCGATGAAC GAATTCCTCTCTAGATACTGGCCCATAGAGCTCTCTCTGATCCTGTGACCT CGCCATTTTACGGCTTACCTAGCGAATTTATGCCCAGCTCTCCTCG AACGTGTTTGGCAGGAGCTATCAACAATAACTATTAAACAGATCGAAACCTAAACACTTC
MTEC007625, Limonius, californicus, larva, A. Morales et al., 15-JUNE to 28-JUNE-2011, United States of America, Montana, Broadwater
Co, Townsend, 46.0987N, 111.5428W, 4081 ft, CATCCTAAAGACTCTCTGGATTCGGGCA
GAACTTGGTAATCCTGGGTCACAATTGGGAAACGACCAGAAATCATCGATTGTTAT
TGTTACAGCTACGGCTTTACTATAATTTCCTTTTATAGTTATACCAATCATATA
TGTTGGGATTCCGAAACTGACTAGTTCCAACTAATATGGGGCGCTCTGATATA
CCTTCCCTCCAATAACAAATGAGTATTGTTACAGCTACGCCTTCATCATAATTT
TTTTATCATTTATTAAATAACGATCTACCGGAGACATTTCAACTTCCCAGTTTTGC
GCAGTGTGGAGCTCATACCAATTACTATAAACGATCGAAACCTAAAC
ACTTCA

MTEC007629, Limonius, californicus, larva, A. Morales et al., 15-JUNE to 28-JUNE-2011, United States of America, Montana, Broadwater
Co, Townsend, 46.0987N, 111.5428W, 4081 ft, CATCCTAAAGACTCTCTGGATTCGGGCA
GAACTTGGTAACCTGGGTCACTAAATTGGGAAACGACCAGAAATCATCGATTGTTAT
TGTTACAGCTACGGCTTTACTATAATTTCCTTTTATAGTTATACCAATCATATA
TGTTGGGATTCCGAAACTGACTAGTTCCAACTAATATGGGGCGCTCTGATATA
CCTTCCCTCCAATAACAAATGAGTATTGTTACAGCTACGCCTTCATCATAATTT
TTTTATCATTTATTAAATAACGATCTACCGGAGACATTTCAACTTCCCAGTTTTGC
GCAGTGTGGAGCTCATACCAATTACTATAAACGATCGAAACCTAAAC
ACTTCA

MTEC007634, Limonius, californicus, larva, A. Morales et al., 15-JUNE to 28-JUNE-2011, United States of America, Montana, Broadwater
Co, Townsend, 46.0987N, 111.5428W, 4081 ft, CATCCTAAAGACTCTCTGGATTCGGGCA
GAACTTGGTAACCTGGGTCACTAAATTGGGAAACGACCAGAAATCATCGATTGTTAT
TGTTACAGCTACGGCTTTACTATAATTTCCTTTTATAGTTATACCAATCATATA
TGTTGGGATTCCGAAACTGACTAGTTCCAACTAATATGGGGCGCTCTGATATA
CCTTCCCTCCAATAACAAATGAGTATTGTTACAGCTACGCCTTCATCATAATTT
TTTTATCATTTATTAAATAACGATCTACCGGAGACATTTCAACTTCCCAGTTTTGC
GCAGTGTGGAGCTCATACCAATTACTATAAACGATCGAAACCTAAAC
ACTTCA
MTEC007637, Limonius, californicus, larva, A. Morales et. al, 15-JUNE to 28-JUNE-2011, United States of America, Montana, Broadwater Co, Townsend, 46.0987N, 111.5428W, 4081 ft, GACTCTTGATTCGGGCAGAACTTGGTCAACCCTGGCTCACTAATTGGAAATGATCAAATCTACAATGTAATTGTAACAGCCTCCTTCATCATAATTTTCTTTATAGTTATACCAATCATAATTGGTGAGATTCCGAGACTGCTCTTCATCTTATAGTTATACCAATCATAATTGGTGGATTGGAAACTGACTAGTTCCACTAATATTGGGCGCTCCTGATATAGCCTTCCCTGAATAAAACATATAAGATTTCTGATTCTTGGCCCATCCTTTTCTCTTTCTTCAA TAAGAAGAATTGTAGAAATGTGGTACGAGAATGGAACAGTAGATACTACCCCGCTCTCAGCTAACATTGACCATAGAGGCTCTTCAGTTGACCTCGCCATTTTCA GCCCTTCACCTAGCAGAAATTTTCATCCATCCTGGGACAGGAGTTAATTTTATCTCA ACTGTTATTAATATAGACTACCCGGAATTACCTTCGAGGCTAGTATGCGCTCTATT TGTTGAGCAGTAGCATAATACCCTGCTTCTCTTTCTCTTACTTTCACCAGAATTTTGCGACAGCTATCACAATTAACAGATTCCAACTCCACATCTCCTCA

MTEC007638, Hypnoidus, impressicollis, adult, D.L. Gustafson, 27-Jun-89, United States of America, Montana, Lake Co, Swan River, 3100 ft, CATCCTTAAGTCTCTCTATAATCCGTGCAGAATCCGGAAACCTTGCTCACTAATTGGAAATGATCAAATCTACAATGTAATTGTAACAGCCTCCTTCATCATAATTTTCTTTATAGTTATACCAATCATAATTGGAGGATTCGGAAACTGATTAGTACCTTCTTACCTAGGATCATCCGTTGATTTAGCAATTTTTAGTTTACA CTTAGCTGGAATCTCCTCTATACCTGTTAGGAGCTAAATTTTATTTTCTACCTGGA TCAACATACAGTCAACAGGAATTACTTGTGATCGAAATACCATGATTATTTTTATTGTTGA GCCGTAGCAATTACGTGCCCTTCTCTCTCTTTCTACTACAGTACGAGG AGCAATCACTATATTATACCAGATCGTAACCTAAAATACACTCTTTTTTGA

MTEC007639, Hypnoidus, impressicollis, adult, D.L. Gustafson, 13-Jun-87, United States of America, Montana, Gallatin Co, Gallatin River, 4700 ft, CATCCTTAAGTCTCTCTATAATCCGTGCAGAATCCGGAAACCTTGCTCACTAATTGGAAATGATCAAATCTACAATGTAATTGTAACAGCCTCCTTCATCATAATTTTCTTTATAGTTATACCAATCATAATTGGAGGATTCGGAAACTGATTAGTACCTTCTTACCTAGGATCATCCGTTGATTTAGCAATTTTTAGTTTACA CTTAGCTGGAATCTCCTCTATACCTGTTAGGAGCTAAATTTTATTTTCTACCTGGA TCAACATACAGTCAACAGGAATTACTTGTGATCGAAATACCATGATTATTTTTATTGTTGA GCCGTAGCAATTACGTGCCCTTCTCTCTCTTTCTACTACAGTACGAGG AGCAATCACTATATTATACCAGATCGTAACCTAAAATACACTCTTTTTTGA
MTEC007640, Hypnoidus, impressicollis, adult,, D.L. Gustafson, 27-Jun-89, United States of America, Montana, Lake Co, Swan River, 3100 ft,

MTEC007641, Hypnoidus, leei, adult, Female, D.L. Gustafson, 01 Jun to 13 Jul 1988, United States of America, Montana, Gallatin Co, Bridger Creek, 4700 ft, CCGwGCAGAATAGGAACCTGGCTCTGACTTAAATTGGAATGAT CAAATCTCAACGTAATTTGTAACGGCCATGCTTTCATTATAATTTTTTCCTCAT AGTTATACCAATCATGATCGGTGGTTTCCGAAATTGGATTAGTACCTTTAATAC TAGGAGCTCCGCATAGCATTTCCCTGAATAATAAATAACAAGATTTTGAATT TCACCCCCCTCTCTGACTACTTTTTAAATAGAAGAATACGCAAAATGGGGGAGGAACCGGATGAACCGTTTATCCCCCCCTCTCAGCTAATATTGCCCATAGAGGGTC ATAGGAGCAGTAAATTTTATTTCAACCGTAGAATCTAATACGATCAACTGGAATCACCTTTGATCGAATACCGTTATTTGTTTGAGCTGTTGCAATTACAGCA CTTCTCCTCCTTTTTCATATTAGTTAGCTGGAGCAATCAGTTACTACTA ACAGACCGAAATTTAAAATAC

MTEC007642, Limonius, canus, adult, Male, "R.F. Lang, J.P. Cuda", 10-May-88, United States of America, Montana, Flathead Co, Hungary Horse, CATCCTAAGACTCTGTATTTCTGGCCAGAATTTGTAACCCCCGCTCAC TAATCGGAAATGACCGAAGCCAAATTTAACATGATTATTGTCAGCACCAGCCTTATT ATAATTTTTCTTATAATGTTATGCGCATCATATAATTGGCGGTTCGCAAATGATT AGTGCCCCTGTATAGTAGGAGCCCGCTGTATAATAGCTTTCTCTCGATAATAAACAC ATGAGATTCTGATTTCTGACCCCCCCGTCTTTCTCTCTCTCTCTACTAATAAGAAGAT CGTAGAAATGATGTCGAGGAAGTCGATGAAACAGTTTACCCCCCTCTATCAGCC AACATTTGCAACAGAGGTAGTCAATCTGGTCTTGCAATTTTTCAGTCTTCAACT AGCAGGTATATCTCTTCTTACTAGTGGAGTTAACTTCTCTACTCTCAACTGATTA ATATGCAGTCCACAGGAAATACCATTTTTGAGCAGGCATATTCTGCATTGAGCA GTAGCAATTACTGCTCTACTCTCCTCTTTCTCTCTCCAGCTCTAGCAGAAC ACATTAAATATTATGTAGCCTAATACCTAACCAAC

MTEC007643, Selatosomus, aeripennis, adult, R.T. Ryti, 01 to 22 Jul 1989, United States of America, Montana, Madison Co, Hidden Lake Beach, 7400 ft, CTTCTCCTTCTAATTTGAGCTGAATTTGTAATCCCGGC TCTCTCAATTTGACTACGAGCTTATAACGTAATAGGTAATCCCGGC TCTCTCATATTTTATATTTTCATACGAGCTTATAACGTAATAGGTAATCCCGGC TCTCTCATATTTTATATTTTCATACGAGCTTATAACGTAATAGGTAATCCCGGC TCTCTCATATTTTATATTTTCATACGAGCTTATAACGTAATAGGTAATCCCGGC TCTCTCATATTTTATATTTTCATACGAGCTTATAACGTAATAGGTAATCCCGGC TCTCTCATATTTTATATTTTCATACGAGCTTATAACGTAATAGGTAATCCCGGC TCTCTCATATTTTATATTTTCATACGAGCTTATAACGTAATAGGTAATCCCGGC
AGCAATTACAATGTACTGACCAGATCGAAAACCTAATACATCCTTTTTTCGACC
CCGCGGGA

MTEC007644,Selatosomus,aeripennis,adult,,M.A. Ivie,16 to 23 Jul 1991,United States of
America,Montana,Flathead Co,"Glacier National Park, N. Fork Flathead area, 2mi S.
Polebridge R.S."",3680ft,

MTEC007645,Selatosomus,aeripennis,adult,,D.S. Sikes,7 to 15 Jun 1993,United States of
America,Wyoming,Yellowstone N.P.,"Lamar Valley, E. side of Yellowstone River, NE
of Bridge near Tower Jctn."",6080ft,

MTEC007646,Selatosomus,destructor,adult,,M.A. Ivie and D.L. Gustafson,17-Jul-
90,United States of America,Montana,Carter Co ,5 mi. W of Alzada at Wyoming
border,,,,

MTEC007647,Selatosomus,destructor,adult,,M.A. Ivie and D.L. Gustafson,31 Dec 1989
to 17 Jul 1990,United States of America,Montana,Carter Co ,5 mi. W of Alzada at
Wyoming border,,,,

MTEC007648,Hadromorphus,glaucus,adult,Male,D.L. Gustafson,7 Jun to 4 Aug
1991,United States of America,Montana,Powder River Co ,Camps Pass,,,,

MTEC007649,Hadromorphus,glaucus,adult,Male,H.W. Ziolkowski,6-Jun-89,United
States of America,Montana,Gallatin Co ,3.5mi W of Bozeman,,,,

MTEC007650,Hadromorphus,glaucus,adult,Male,D.L. Gustafson,28-Jun-86,United
States of America,Montana,Gallatin Co ,"4 mi N of Bozeman, Bridger foothills"",5500ft,

MTEC007651,Glyphonyx,recticollis,adult,Female,D.L. Gustafson,11-Jun-91,United
States of America,Montana,Roosevelt Co ,Snowden Bridge blt,,,,

MTEC007652,Glyphonyx,recticollis,adult,Male,D.L. Gustafson,11-Jun-91,United
States of America,Montana,Roosevelt Co ,Snowden Bridge blt,,,,

MTEC007653,Glyphonyx,recticollis,adult,Female,D.L. Gustafson,11-Jun-91,United
States of America,Montana,Roosevelt Co ,Snowden Bridge blt,,,,

MTEC007654,Agriotes,criddlei,adult,Male,D.L. Gustafson,25-May-88,United States of
Smith"",CATCATTAGAGACTATTAATTCGATTGACCTAGGTAAyCCTGGCTCA
CTAAATTGGAAATGACCACCAATTATAATGGTATTGACACGCACATGCATTTCAT
CATATTTTTTTTTATAGTAATACCAATTTATAATGGGAGATTGATATTGCTAC
TAGTTCCACTAATATAGGGAGCCCAAGATATAGCATTCCCTCGAAATAACAAT
ATAAGATTCTGATTCCTACCACCATCCTTCTCTTTACTTCTTATAAGAAGAATT
GTAGAAAACGGTGCAGGAACAGGCTGAACAGTTTACCCTCCTATCAGCCA
ATATTGCCCATAGAGGCTCATCAGTGAACCTAGCACATTTTCAGGCTATCATTA
ATATTGCCCATAGAGGCTCATCAGTAGACTTACTCAATTTTCAGGCTACATCTA
GCAGGAATTTCATCAATTCTTGGAGCCGTAAACTTTATCTTAACAGTAATTA
CATACGATCAACTGGGAATTACCCTTCGCCGTATACCTTATTGATAGCAG
TAGCAATTACTGCCCTCCTTTCTTTATTATTACCTACrGTACTAGCAGGAGCCA
TTACCATGTTACTAACAGATCGTAATCTGAAACACTCTCATTTTGACCCAGC

MTEC007655,Agriotes,criddlei,adult,,M.A. Ivie,16-Jun-89,United States of America,Montana,Fallon Co ,"16 mi N of Baker, 3.5 mi S. of county line on Hwy 7",...,CATCATTAAGACTATTAATTCGTGCGAACACTAGTAAATCTGCTGCCTACTA
ATTTGGAAATGGACAAATTTTATAATGTCATTGTAACAGCACATGCATTCTCATCT
ATTTTTCTTTATAGTAATACCAATTTAATTTGAGGATTTGTGGGAAATTGATAG
TTCCACATATATATAGAGGGCCCCAGATATAGCATTCCTTCGAAATAAACAAATA
AGATTTTGATTTTACCTACCCCTATTTTATAAGAAAGTTGTA
GAAACCGTGGAGAACAGGGCTTAACGGTTACCTTCCAATCTCAGCCAATA
TTGCCCATAGAGGCTCATCAGTGAACCTAGCACATTTTCAGGCTACATCTA
GCAGGAATTTCATCAATTCTTGGAGCCGTAAACTTTATCTTAACAGTAATTA
CATACGATCAACTGGGAATTACCCTTCGCCGTATACCTTATTGATAGCAG
TAGCAATTACTGCCCTCCTTTCTTTATTATTACCTACrGTACTAGCAGGAGCCA
TTACCATGTTACTAACAGATCGTAATCTGAAACACTCTCATTTTGACCCAGC

MTEC007656,Agriotes,criddlei,adult,,C.E. Seibert,16-Apr-88,United States of America,Montana,Fergus Co ,Lewistown,,,,

MTEC007657,Melanotus,longulus oregonensis,adult,,D.L. Gustafson,14 Apr to 20 Oct 1990,United States of America,Montana,Broadwater Co ,Toston Big Spring,,,,

MTEC007658,Melanotus,longulus oregonensis,adult,,D.L. Gustafson,24-Jun-90,United States of America,Montana,Gallatin Co ,"Bozeman, at "",CATCATTAAGACTATTAATTCGTGCGAACACTAGTAAATCTGCTGCCTACTA
ATTTGGAAATGGACAAATTTTATAATGTCATTGTAACAGCACATGCATTCTCATCT
ATTTTTCTTTATAGTAATACCAATTTAATTTGAGGATTTGTGGGAAATTGATAG
TTCCACATATATATAGAGGGCCCCAGATATAGCATTCCTTCGAAATAAACAAATA
AGATTTTGATTTTACCTACCCCTATTTTATAAGAAAGTTGTA
GAAACCGTGGAGAACAGGGCTTAACGGTTACCTTCCAATCTCAGCCAATA
TTGCCCATAGAGGCTCATCAGTGAACCTAGCACATTTTCAGGCTACATCTA
GCAGGAATTTCATCAATTCTTGGAGCCGTAAACTTTATCTTAACAGTAATTA
CATACGATCAACTGGGAATTACCCTTCGCCGTATACCTTATTGATAGCAG
TAGCAATTACTGCCCTCCTTTCTTTATTATTACCTACrGTACTAGCAGGAGCCA
TTACCATGTTACTAACAGATCGTAATCTGAAACACTCTCATTTTGACCCAGC

MTEC007659,Melanotus,similis,adult,,D.L. Gustafson,10 Aug to 11 Oct 1991,United States of America,Montana,Rosebud Co ,Rosebud,,,,
MTEC007660, Pseudanostirus nigricollis, adult, Male, P. Kraus et al., 24 Jul to 04 Oct 2010, United States of America, Montana, Powell Co, S of junction of Hwys 200 and 141, 46.93888N, 112.94923W, 4304 ft, CTTCCCTAAGCCTTCTAAATTGAGCCGACCTAGGAAATCTGGATCTTTAATCCAGATTAATGTGTTACAGCTCATGCCTTCATCATAATTTTCTTCATAGTAAATCAAATTAATTGCTATGGAAACTTGTCAATTCTACAGCTGTAATTGTTAAGGAAATCCTGGATCTTTAATCGGAAATGATCAAATTTACAATGTAATTGTTACTAGCTGACCTTCATTCTCCATACCTCTCTACTACCGAGGAAACAGGATGAACAGTGTACCCCCCACTTTTCAGCAAATATTGCTCACAGAGGTTCATCAGTAGACCTCGCAATTTTTAGACTTCATCTAGCTGGTATTTCATCAATTCTAGGAGCAGTAAATTTTATTTCAACTGTAATTAATATACGAACAACTGGAATTACTTTTGACCGAATACCCCTATTCGTTTGAGCAGTAGTAATTACAGCACTTTTATTATTATTATATTCTCTTACCACTACTAGCACGATCGAATCACTAACACTATTTACTGAACGGAAACTTAA

MTEC007661, Pseudanostirus nigricollis, adult, P. Kraus et al., 25 Jul to 03 Oct 2010, United States of America, Montana, Flathead Co, "Polebridge, Hay Creek, Chadwick's", 48.74202N, 114.27177W, 3507 ft, TAATTCGAGCCGAAcTAGGAAATCTCTGGATCTTTAATCGGAAATGATCAAATTTACAATGTAATTGTTACAGCTCATGCCTTCATCATAATTTTCTTCATAGTAAATCAAATTAATTGCTATGGAAACTTGTCAATTCTACAGCTGTAATTGTTAAGGAAATCCTGGATCTTTAATCGGAAATGATCAAATTTACAATGTAATTGTTACTAGCTGACCTTCATTCTCCATACCTCTCTACTACCGAGGAAACAGGATGAACAGTGTACCCCCCACTTTTCAGCAAATATTGCTCACAGAGGTTCATCAGTAGACCTCGCAATTTTTAGACTTCATCTAGCTGGTATTTCATCAATTCTAGGAGCAGTAAATTTTATTTCAACTGTAATTAATATACGAACAACTGGAATTACTTTTGACCGAATACCCCTATTCGTTTGAGCAGTAGTAATTACAGCACTTTTATTATTATTATATTCTCTTACCACTACTAGCACGATCGAATCACTAACACTATTTACTGAACGGAAACTTAA


MTEC007664, Athous, rufiventris, adult, Female, P. Kraus et al., 25 Jul to 03 Oct 2010, United States of America, Montana, Flathead Co, "Polebridge, Hay Creek, Chadwick's", 48.74202N, 114.27177W, 3507 ft, TATTCGTCGCAAGACTAGGGAACCT GGTACCCCTATTGGGAAATGCTAAATATCTAAAGGTAT TGTAAACGCAACATGCCTCTCATCATAAATTTCCTCATTAGTTATACCAATCTAA TTGGAGGATCGGAAACTGACTAGTCCTCTAATACTAGGAGCCCCAGATAT AGCTTCCCCACAGATATACATAGTCTTCTCCGAGAATTTCTCTTATCTGCGCTA AATTTCATCTCAACAGTAATCAATATACGCTCAACCGGAATCACATTTGACC GATACCTTTATTGTAGAGCAGATAGCTATTACCCGCTCTACTCTTTTATTATC CCTACCTGTCTTAGCTGGAGCCATCAATAACTCTTTACTGACCCGAAATTAA ACACGTCAATCTTGG

MTEC007665, Athous, rufiventris, adult, Female, P. Kraus et al., 25 Jul to 03 Oct 2010, United States of America, Montana, Flathead Co, "Polebridge, Hay Creek, Chadwick's", 48.74202N, 114.27177W, 3507 ft,
CTAATAAGAAGAATCGAGAAAACGGTGCGAGGACAGGATGAACTGTTTACC CACCATTATCGAAATATTGCCCATAAGAGGTTGGTCCTCAGTAGATCTTGGCTATT TTTAGGTTACCTACGCTGGGATCTCATCAATCCTAGGAGCAGTAATTTTAT TTCTACTGTTATATTGATACACTAAGGAAATGTTGAGGATTTGCGCACCC TATTGATTGAGCTGTTGTTATACAGCACAACCTTCTTGTGTTCTTACTACCAG TACTTGCAGGGCACAACCACTACTATTTTTAAACAGATCAGTTAAACACGTC ATTTTTTGACCTGCA

MTEC007668, Hemicrepidius, brevicollis, adult, Female, P. Kraus et al., 27 Jun to 19 Sep 2010, United States of America, Montana, Dawson Co, Stream by Rd 242 off I94 exit 206, 47.04200N, 104.81924W, 2208 ft. MTEC007669, Limonius, californicus, adult, Female, May 75, United States of America, Washington, Walla Walla Co, Half Hill,

MTEC007670, Limonius, californicus, adult, Female, L. T. Turner, 20-Apr-33, United States of America, Washington, Walla Walla Co, Walla Walla,

MTEC007671, Hypnoidus, bicolor, adult, A. Morales et. al, 14-MAY to 27-MAY 2011, United States of America, Montana, Pondera Co, Conrad, 48.2901N, 111.8883W, 3532 ft. 
MTEC007672, Hypnoidus, bicolor, adult, A. Morales et al., 14-MAY to 27-MAY-2011, United States of America, Montana, Pondera
Co, Conrad, 48.2901N, 111.8883W, 3532 ft, CCTCCTTAAAGAATCTAATTCGGCCAG ACTCGGAACCTGGCTACTAAATGGAAATGATCAAAATCTCAATGTATT GTAACAGCCCATAGTCTTTTATTATAAAATTATTTTCATAGTTATACCAATTATAATT GGGGGTTTGGTAAATTGATTAGTACCCCTCATACTAGGACCTGATATAG CATTCCACGAAATACACACATAGATTCTCTTATTTTACCTCCTCTCATTCA CTCCTGCTTTAAGAAGAATGTAGAGAATGGGGCAGGAACTGGTTGAACAG TATAACCTCCTTATCGCAACATCGCCACAGAGGATCATCTGTTGACTTAGCACATTTTTAGATTACATCTAGCTGGTATCTCATCTATCCTAGGAGCAGTAAA TTTATTTCACACTGTAATACATACGCTACTGCAATTACTGCACTTCTACTAATTTCAC TTCCAGTCCCTGGCAGGAGCAATCACTATATACATCTGACAGAGCCGAAACTTAAA CACATCATTTTTTG

MTEC007673, Hypnoidus, bicolor, adult, A. Morales et al., 14-MAY to 27-MAY-2011, United States of America, Montana, Pondera
Co, Conrad, 48.2901N, 111.8883W, 3532 ft, CCTCCTTAAAGAATCTAATTCGGCCAG ACTCGGAACCTGGCTACTAAATGGAAATGATCAAAATCTCAATGTATT GTAACAGCCCATAGTCTTTTATTATAAAATTATTTTCATAGTTATACCAATTATAATT GGGGGTTTGGTAAATTGATTAGTACCCCTCATACTAGGACCTGATATAGCATTCCCACGAATAAACAACATAAGATTCTCTTATTTTACCTCCTCTCATTCA CTCCTGCTTTAAGAAGAATGTAGAGAATGGGGCAGGAACTGGTTGAACAG TATAACCTCCTTATCGCAACATCGCCACAGAGGATCATCTGTTGACGTA GCAATTTCATTGATTAGATCATCTAGCTGGTATCTCATCTATCCTAGGAGCAGTAAA TTTATTTCACACTGTAATACATACGCTACTGCAATTACTGCACTTCTACTAATTTCAC TTCCAGTCCCTGGCAGGAGCAATCACTATATACATCTGACAGAGCCGAAACTTAAA CACATCATTTTTTG

MTEC007674, Hypnoidus, bicolor, adult, A. Morales et al., 14-MAY to 27-MAY-2011, United States of America, Montana, Pondera
Co, Conrad, 48.2901N, 111.8883W, 3532 ft, CCTCCTTAAAGAATCTAATTCGGCCAG ACTCGGAACCTGGCTACTAAATGGAAATGATCAAAATCTCAATGTATT GTAACAGCCCATAGTCTTTTATTATAAAATTATTTTCATAGTTATACCAATTATAATT GGGGGTTTGGTAAATTGATTAGTACCCCTCATACTAGGACCTGATATAGCATTCCCACGAATAAACAACATAAGATTCTCTTATTTTACCTCCTCTCATTCA CTCCTGCTTTAAGAAGAATGTAGAGAATGGGGCAGGAACTGGTTGAACAG TATAACCTCCTTATCGCAACATCGCCACAGAGGATCATCTGTTGACGTA GCAATTTCATTGATTAGATCATCTAGCTGGTATCTCATCTATCCTAGGAGCAGTAAA TTTATTTCACACTGTAATACATACGCTACTGCAATTACTGCACTTCTACTAATTTCAC TTCCAGTCCCTGGCAGGAGCAATCACTATATACATCTGACAGAGCCGAAACTTAAA CACATCATTTTTTG
MTEC007675, Hypnoidus, bicolor, adult, A. Morales et al., 14-MAY to 27-MAY 2011, United States of America, Montana, Pondera Co., Conrad, 48.2901N, 111.8883W, 3532ft, ACTCGGAAACCCCTGGCTCTCTAATTGGAAATGATCAAATCTACAATGTAATTG TAACACGCCATGCATTATAAATTTTTTCTATGTTATACCAAATATTGATTG GAGGATTGGTTAATACCTGCTTCATACATCTACGACGCATATAGC ATTCGACTTATACATCTACGCTGTATTTCTCTACTATCAGAATAT TTTAACTAATCGTAAATATAGCAGAACACTTCTTTCACTTCTTTCACT TTCAGACTAGCAGGAGCAATTACTATATATTACTAACAGACAGCGAAACTTAAATA CATCATTATTTTGT

MTEC007676, Hypnoidus, bicolor, adult, A. Morales et al., 14-MAY to 27-MAY 2011, United States of America, Montana, Pondera Co., Conrad, 48.2901N, 111.8883W, 3532ft, TAGGAACTTCCTTAAGAATCCTAATCCGTGACTTCGGCATCCCGACTCTAACGTAAATTTTCAACTGTAATCAATATACGATCAACGGGAATCACTTTGATCGTAT ACCATTATTGTGAGCTGTAGCAATTACTGCACTTCTACTACTCTTCTTCATT TCCAGACTAGCAGGAGCAATTACTATATATTACTAACAGACAGCGAAACTTAAATA CATCATTATTTTGT

MTEC007677, Hypnoidus, bicolor, adult, A. Morales et al., 14-MAY to 27-MAY 2011, United States of America, Montana, Pondera Co., Conrad, 48.2901N, 111.8883W, 3532ft, ACTCGGAAACCCCTGGCTCTCTAATTGGAAATGATCAAATCTACAATGTAATTG TAACACGCCATGCATTATAAATTTTTTCTATGTTATACCAAATATTGATTG GAGGATTGGTTAATACCTGCTTCATACATCTACGACGCATATAGC ATTCGACTTATACATCTACGCTGTATTTCTCTACTATCAGAATAT TTTAACTAATCGTAAATATAGCAGAACACTTCTTTCACTTCTTTCACT TTCAGACTAGCAGGAGCAATTACTATATATTACTAACAGACAGCGAAACTTAAATA CATCATTATTTTGT

MTEC007678, Hypnoidus, bicolor, adult, A. Morales et al., 14-MAY to 27-MAY 2011, United States of America, Montana, Pondera Co., Conrad, 48.2901N, 111.8883W, 3532ft,
MTEC007683, Hypnoidus, bicolor, larva, A. Morales et. al, 14-MAY to 27-MAY-2011, United States of America, Montana, Pondera
Co, Conrad, 48.2901N, 111.8883W, 3532 ft, CTTCCCTTAAGAATCTAATCCTGGTGCGGA ACTCGGAAACCCTGGCTCACAATTGGAAATGTACAAATCTCAATATGTAATT GTAAACAGCCCCATGCTTTTCAATTATAATTTTTTTTTTTTTTTTATAGATTACAAATTATAATT GGAGGATTTTGTTAATTGATTAGTACCCCTCACAATTAGGACACTGCAGTACATAG CATTCCACGAATAAAACACATAAGATTCTCTTCTTTACCTCCTGGGCGAGCAATCACTATACTACTACTGACAGACCCGAAACTTAAA CACATCATTTTTTG

MTEC007684, Hypnoidus, bicolor, larva, A. Morales et. al, 14-MAY to 27-MAY-2011, United States of America, Montana, Pondera
Co, Conrad, 48.2901N, 111.8883W, 3532 ft, CTTCCCTTAAGAATCTAATCCTGGTGCGGA ACTCGGAAACCCTGGCTCACAATTGGAAATGTACAAATCTCAATATGTAATT GTAAACAGCCCCATGCTTTTCAATTATAATTTTTTTTTTTTTTTTATAGATTACAAATTATAATT GGAGGATTTTGTTAATTGATTAGTACCCCTCACAATTAGGACACTGCAGTACATAG CATTCCACGAATAAAACACATAAGATTCTCTTCTTTACCTCCTGGGCGAGCAATCACTATACTACTACTGACAGACCCGAAACTTAAA CACATCATTTTTTG

MTEC007685, Hypnoidus, bicolor, larva, A. Morales et. al, 14-MAY to 27-MAY-2011, United States of America, Montana, Pondera
Co, Conrad, 48.2901N, 111.8883W, 3532 ft, CTTCCCTTAAGAATCTAATCCTGGTGCGGA ACTCGGAAACCCTGGCTCACAATTGGAAATGTACAAATCTCAATATGTAATT GTAAACAGCCCCATGCTTTTCAATTATAATTTTTTTTTTTTTTTTATAGATTACAAATTATAATT GGAGGATTTTGTTAATTGATTAGTACCCCTCACAATTAGGACACTGCAGTACATAG CATTCCACGAATAAAACACATAAGATTCTCTTCTTTACCTCCTGGGCGAGCAATCACTATACTACTACTGACAGACCCGAAACTTAAA CACATCATTTTTTG
MTEC007686, Hypnoidus, bicolor, larva, A. Morales et al., 14-MAY to 27-MAY-2011, United States of America, Montana, Pondera Co, Conrad, 48.2901N, 111.8883W, 3532 ft,

MTEC007687, Limonius, californicus, larva, 26?-APR-2011, United States of America, Washington, Whitman Co, ..., CATCCTTAAGAAGCTTTGATTCCGGGCAAGAATCCCTGGATCATGTC
AATGGAAATGACCAAAATCTATAATGTTATTGCAGCTACGCCTCCCTTCCCTAG
TAATTTTTCCTTTTAGTTATACCAATACCTAATTTGTTGGGCTTCCGGAAACCTGGCTA
GTTCCACTAATATTGGAGGCTCCTGATAGCCTCTCCCTTCCGAATAAAACATAT
AAGATTTCTGATTCTTAAAGCCCTTCCCTCTCT CCTCTTTAATAAGAAGAATTGT
TGAAAAATGGTGCAAGAACCTGTGTTGACATCTACCCCTCTCTTCAGCTAAC
ATTGCCCATAGAGGATCTTCAGCTGCAGCTCATATCTTGCAGCTCATATCAG
AGGAATTTTCTATCCATTGGGACAGTTAATTTATCTCAACTGTCATAATA
TGCGATCTACCCGAATACCTCTGGCACCCTATACCTGCTTGTTGGTAGAGCTA
GCAATTACTGCCCTTCCTCTTTACTTTACCTACGAGTTTTGGCGGCGCTATT
AACAATACTATTAACACAGATCGAAACCTAAACACTTC

MTEC007688, Limonius, californicus, larva, 26?-APR-2011, United States of America, Washington, Whitman Co, ..., CATCCTTAAGAAGCTTTGATTCCGGGCAAGAATCCCTGGATCATGTC
AATGGAAATGACCAAAATCTATAATGTTATTGCAGCTACGCCTCCCTTCCCTAG
TAATTTTTCCTTTTAGTTATACCAATACCTAATTTGTTGGGCTTCCGGAAACCTGGCTA
GTTCCACTAATATTGGAGGCTCCTGATAGCCTCTCTCCCTTCCGAATAAAACATAT
AAGATTTCTGATTCTTAAAGCCCTTCCCTCTCTCTTTAATAAGAAGAATTGT
TGAAAAATGGTGCAAGAACCTGTGTTGACATCTACCCCTCTCTTCAGCTAAC
ATTGCCCATAGAGGATCTTCAGCTGCAGCTCATATCTTGCAGCTCATATCAG
AGGAATTTTCTATCCATTGGGACAGTTAATTTATCTCAACTGTCATAATA
TGCGATCTACCCGAATACCTCTGGCACCCTATACCTGCTTGTTGGTAGAGCTA
GCAATTACTGCCCTTCCTCTTTACTTTACCTACGAGTTTTGGCGGCGCTATT
AACAATACTATTAACACAGATCGAAACCTAAACACTTC

MTEC007689, Limonius, infuscatus, larva, A. Morales et al., 24-MAY to 08-JUNE-2011, United States of America, Montana, Gallatin Co, Bozeman, 45.6728N, 111.1517W, 111.1517W, .

MTEC007690, Limonius, infuscatus, larva, A. Morales et al., 24-MAY to 08-JUNE-2011, United States of America, Montana, Gallatin Co, Bozeman, 45.6728N, 111.1517W, .
MTEC007701, Aeolus, mellillus, larva, A. Morales et. al, 24-May to 08-June 2011, United States of America, Montana, Gallatin Co, Bozeman, 45.6728N, 111.1517W,

MTEC007702, Limonius, infuscatus, larva, A. Morales et. al, 24-May to 08-June 2011, United States of America, Montana, Gallatin Co, Bozeman, 45.6728N, 111.1517W,

MTEC007703, Aeolus, mellillus, larva, A. Morales et. al, 24-May to 08-June 2011, United States of America, Montana, Gallatin Co, Bozeman, 45.6728N, 111.1517W,

MTEC007704, Limonius, infuscatus, larva, A. Morales et. al, 24-May to 08-June 2011, United States of America, Montana, Gallatin Co, Bozeman, 45.6728N, 111.1517W,

MTEC007705, Hadromorphus, glaucus, larva, K. Pike and G. Graf, 2-May-11, United States of America, Washington, Klickitat Co, "near Bickleton, Tex Brown Farm", CATCCCTTAGTCTATCAGGCTGACCTGGAAACCCCGGCTCT CTATTGGAAACCCGAATCATAACGTGTGTAACAGGCCATGCTTTCATCTAATTG GAAATGACCAAAATTATAACGTGTAATTGTACACAGACACGCTTTTCATCATATT TTCTCTAGTAAATACAAATTTATACAATCTCTCTGCTGAGATTAGTACC ACTTATACTAGGAGCCCAGACATAGCATCCCCCTGCAAATAATAATATAAAG TACTCTCATTCTCAATTCTTCAATGTCTCCTTACCAACTAGTTGTCTGAGCAGAAATC AACTATTTTTTGGTTTTACCCCCCTCCTTACATCTTACTTATCCCGAATACCTT

MTEC007706, Hadromorphus, glaucus, larva, K. Pike and G. Graf, 2-May-11, United States of America, Washington, Klickitat Co, "near Bickleton, Tex Brown Farm", CATCCCTTAGTCTATCAGGCTGACCTGGAAACCCCGGCTCT CTATTGGAAACCCGAATCATAACGTGTGTAACAGGCCATGCTTTCATCTAATTG GAAATGACCAAAATTATAACGTGTAATTGTACACAGACACGCTTTTCATCATATT TTCTCTAGTAAATACAAATTTATACAATCTCTCTGCTGAGATTAGTACC ACTTATACTAGGAGCCCAGACATAGCATCCCCCTGCAAATAATAATATAAAG TACTCTCATTCTCAATTCTTCAATGTCTCCTTACCAACTAGTTGTCTGAGCAGAAATC AACTATTTTTTGGTTTTACCCCCCTCCTTACATCTTACTTATCCCGAATACCTT
231

AGCAGGAATCTCATCAATCTTAGGAGCTGTAATTTTCAATTTCCAGTTAATCA
ACATACGATCTAACTGGAAATCCACATTTTGTAGCAGCTCAATACCTTATCTTTATTTGAGCA
GTAGCCATACCCGCCTACTACTTTTCTTTTATATTACCTCCCCTCCTCCTCCTATCGAGGC
AATTACAATACATTAAACAGATCGAAACTTTAATAC

MTEC007706,Hadromorphus,glaucus,larva,,K. Pike and G. Graf,2-May-11,United States of America,Washington,Klickitat Co,"near Bickleton, Tex Brown Farm",",,

MTEC007707,Hadromorphus,glaucus,larva,,K. Pike and G. Graf,2-May-11,United States of America,Washington,Klickitat Co,"near Bickleton, Tex Brown Farm",,,CATCCCTTAGTCTACTGATCCGAGCTGAGCTAGGAAACCCCGGCTCT
CTTATGGAACGCAAAATCTAATACGTGATTGAACAGCTTAAACCCGAAACGT
TATAACCTTACTATGAGAATTGCGAACGAATTTTTAACCTCCTCTCATCGGCC
AGCAGGAATCTCATCAATCTTAGGAGCTGTAATTTTCAATTTCCAGTTAATCA
ACATACGATCTAACTGGAAATCCACATTTTGTAGCAGCTCAATACCTTATCTTTATTTGAGCA
GTAGCCATACCCGCCTACTACTTTTCTTTTATATTACCTCCCCTCCTCCTCCTATCGAGGC
AATTACAATACATTAAACAGATCGAAACTTTAATAC

MTEC007708,Hadromorphus,glaucus,larva,,K. Pike and G. Graf,2-May-11,United States of America,Washington,Klickitat Co,"near Bickleton, Tex Brown Farm",,,CATCCCTTAGTCTACTGATCCGAGCTGAGCTAGGAAACCCCGGCTCT
CTTATGGAACGCAAAATCTAATACGTGATTGAACAGCTTAAACCCGAAACGT
TATAACCTTACTATGAGAATTGCGAACGAATTTTTAACCTCCTCTCATCGGCC
AGCAGGAATCTCATCAATCTTAGGAGCTGTAATTTTCAATTTCCAGTTAATCA
ACATACGATCTAACTGGAAATCCACATTTTGTAGCAGCTCAATACCTTATCTTTATTTGAGCA
GTAGCCATACCCGCCTACTACTTTTCTTTTATATTACCTCCCCTCCTCCTCCTATCGAGGC
AATTACAATACATTAAACAGATCGAAACTTTAATAC

MTEC007709,Limonius,californicus,larva,,A. Esser,25-Apr-11,United States of America,Washington,Lincoln Co,"near Davenport, Sheffle Farm",,,CATCCCTTAGTCTACTGATCCGAGCTGAGCTAGGAAACCCCGGCTCT
CTTATGGAACGCAAAATCTAATACGTGATTGAACAGCTTAAACCCGAAACGT
TATAACCTTACTATGAGAATTGCGAACGAATTTTTAACCTCCTCTCATCGGCC
AGCAGGAATCTCATCAATCTTAGGAGCTGTAATTTTCAATTTCCAGTTAATCA
ACATACGATCTAACTGGAAATCCACATTTTGTAGCAGCTCAATACCTTATCTTTATTTGAGCA
GTAGCCATACCCGCCTACTACTTTTCTTTTATATTACCTCCCCTCCTCCTCCTATCGAGGC
AATTACAATACATTAAACAGATCGAAACTTTAATAC

MTEC007709,Limonius,californicus,larva,,A. Esser,25-Apr-11,United States of America,Washington,Lincoln Co,"near Davenport, Sheffle Farm",,,CATCCCTTAGTCTACTGATCCGAGCTGAGCTAGGAAACCCCGGCTCT
CTTATGGAACGCAAAATCTAATACGTGATTGAACAGCTTAAACCCGAAACGT
TATAACCTTACTATGAGAATTGCGAACGAATTTTTAACCTCCTCTCATCGGCC
AGCAGGAATCTCATCAATCTTAGGAGCTGTAATTTTCAATTTCCAGTTAATCA
ACATACGATCTAACTGGAAATCCACATTTTGTAGCAGCTCAATACCTTATCTTTATTTGAGCA
GTAGCCATACCCGCCTACTACTTTTCTTTTATATTACCTCCCCTCCTCCTCCTATCGAGGC
AATTACAATACATTAAACAGATCGAAACTTTAATAC
ACATTGCCCATAGAGGATCTTCAGTTGACCTCGCCATTTTCAGTCTTCACCTA
GCAGGAATTTTCATCCATTTCTGGAGCAGTTAATTTTATCTCAACTGCTAATTA
TATGCGATCTACCGGAATTACCTTCGACCGTATACCTCTGTTTGTTTAGCAG
TAGCAATTTACTGTCCTTCTCTCTTTACTTTTCACTACCAGTTTTGCGGGGCTA
TTACAATACCTATTAACAGATCGAAACCTATAACACTTC

MTEC007710,Limonius,californicus,larva,,A. Esser,25-Apr-11,United States of America,Washington,Lincoln Co,"near Davenport, Sheffle Farm","CATCCTTAAGACTCTTGATTCGGGCAGAACTTGGTAACCCCTGGGTCA
CTAATTGGGAATGACCAATATGTAAATTTTATTTTTGTTTCGACCCCTCCTCAT
CATAATTTCCTTTATAGTTATACCAATCTAATAGTTGGTCTCGGAAACCTGAC
TAGTCCACTAAATATAGGAGCTCTGTGATATAGCCCTCCTCGAATAAACAT
ATAAGATTTCTGTTTCTAACCCTGGCTCTTTTTCTCTCTCTTCTACTAAAGAAGATT
GTGGAAAATGTTGGCAGAGGAACTTGTTGAAACAGGTACCTCCCTTCTCAGCTA
ACATTGCCCAGAGGTAGCTTCTAGTTGGAACCTCGCCATTTTCAGTCTCCACTA
GCAGGAATTTCCATCCATTTCTGGAGCAGTTAATTTTATCTCAACTGCTAATTA
TATGCGATCTACCGGAATTACCTTCGACCGTATACCTCTGTTTGTTTAGCAG
TAGCAATTTACTGTCCTTCTCTCTTTACTTTTCACTACCAGTTTTGCGGGGCTA
TTACAATACCTATTAACAGATCGAAACCTATAACACTTC

MTEC007711,Limonius,californicus,larva,,A. Esser,28-Apr-11,United States of America,Washington,Lincoln Co,"Wilber, Coffen Farm","CATCCTTAAGACTCTTGATTCGGGCAGAACTTGGTAACCCCTGGGTCA
CTAATTGGGAATGACCAATATGTAAATTTTATTTTTGTTTCGACCCCTCCTCAT
CATAATTTCCTTTATAGTTATACCAATCTAATAGTTGGTCTCGGAAACCTGAC
TAGTCCACTAAATATAGGAGCTCTGTGATATAGCCCTCCTCGAATAAACAT
ATAAGATTTCTGTTTCTAACCCTGGCTCTTTTTCTCTCTCTTCTACTAAAGAAGATT
GTGGAAAATGTTGGCAGAGGAACTTGTTGAAACAGGTACCTCCCTTCTCAGCTA
ACATTGCCCAGAGGTAGCTTCTAGTTGGAACCTCGCCATTTTCAGTCTCCACTA
GCAGGAATTTCCATCCATTTCTGGAGCAGTTAATTTTATCTCAACTGCTAATTA
TATGCGATCTACCGGAATTACCTTCGACCGTATACCTCTGTTTGTTTAGCAG
TAGCAATTTACTGTCCTTCTCTCTTTACTTTTCACTACCAGTTTTGCGGGGCTA
TTACAATACCTATTAACAGATCGAAACCTATAACACTTC

MTEC007712,Limonius,infuscatus,larva,,A. Esser,28-Apr-11,United States of America,Washington,Lincoln Co,"Wilber, Coffen Farm",TACTTGGTACATCCTTAAGACTCTTTGACCTCCCTTTACGAGCAGACTTGAAAT
CCTGGCCTCATTTAATTGAGAAATTAACCCCTTATATATAGTAAACCCCAATGGATAGCAG
ACGCTTTTATCAATAATTCTCTCAGTTGATATACCAATATTATATAGTTGAGGATTTG
GAACCTGACTGACCCCTTATGCTAGCAGCTACCCAGCATAGCATTCTCCCTGC
AATAAAATAATATATCTTCTTCCTTCTCCCTACGCGCTTTCTTCTTCAT
AAGAAGAATTGTAAGAAAATGTTGCTGACCCAGCAGGATAACCTGTATTCTCCACC
TTATCAGCAGAACACTCGCCCATAGAGGATCTCCTCGTATTTTTGCGAAATTTTCAG
TCTACATCTAGCAGGAATCTCATAATATTCTAGGACAGATAAACCTTTATCTCCTA
CCGTAATTAATATGCAGAATACAGGAATCCTTTTGACCGAATACCTTTATTT
GTATGAGCATGGCAATACTGCTACTATTACTACTTCTCTCTCTCATACCTTTCT
GCCGGAGAATACACAATACATTAAACAGAGCCGAAATCTAATATACCTTCTTT
TG

MTEC007713,Limonius,californicus,larva,,A. Esser,28-Apr-11,United States of America,Washington,Whitman Co,"Rosalia, Clawson Farm",,,,CATCCTTAAGACTCTCTTGATTTGGCGGGAATTTGTGTGAAACCCTGGATCA
CTAATTGGGAATGACCAAATCTATAATGTATTTATGTCACAGCTCACTACGCTCAT
CATAATTTTTATTATAGTATACAAATCATAATTGTTGGGTGGGGGGAACCTTG
TAGTTCCACTAAATATTAGGAGCTCCTCTGATATAGCCTCTCCCCTCGAATAAAC
ATAAGATATCTGATTTCTACCCCCCTTTTCTCTTCTCTTAATAGAAGAATT
ATTGAAATTGTGCAAGGAAACTGTTGGAAGCTCAGCCTAACCCTCTGACTA
ACATTGCCCATAGAGGATTCCTCAGCTGCTCGGCTATTTTCAGTCTCCTACC
TAGCAATTACGCTGCTCTCCTCTCCTCTACTTTCAACTACAGTCTTTTGGCGGGGCTA
TTACAATACTATTAACAGATCGAAGACCTAAACACTTTCTTCAGTTT

MTEC007714,Limonius,californicus,larva,,A. Esser,28-Apr-11,United States of America,Washington,Whitman Co,"Rosalia, Clawson Farm",,,,CATCCTTAAGACTCTCTTGATTTGGCGGGAATTTGTGTGAAACCCTGGATCA
CTAATTGGGAATGACCAAATCTATAATGTATTTATGTCACAGCTCACTACGCTCAT
CATAATTTTTATTATAGTATACAAATCATAATTGTTGGGTGGGGGGAACCTTG
TAGTTCCACTAAATATTAGGAGCTCCTCTGATATAGCCTCTCCCCTCGAATAAAC
ATAAGATATCTGATTTCTACCCCCCTTTTCTCTTCTCTTAATAGAAGAATT
ATTGAAATTGTGCAAGGAAACTGTTGGAAGCTCAGCCTAACCCTCTGACTA
ACATTGCCCATAGAGGATTCCTCAGCTGCTCGGCTATTTTCAGTCTCCTACC
TAGCAATTACGCTGCTCTCCTCTCCTCTACTTTCAACTACAGTCTTTTGGCGGGGCTA
TTACAATACTATTAACAGATCGAAGACCTAAACACTTTCTTCAGTTT

MTEC007715,Limonius,californicus,larva,,A. Esser,4-May-11,United States of America,Washington,Lincoln Co,"Davenport, DeWalt Farm",,,,CATCCTTAAGACTCTCTTGATTTGGCGGGAATTTGTGTGAAACCCTGGGCTA
CTAATTGGGAATGACCAAATCTATAATGTATTTATGTCACAGCTCACTACGCTCAT
CATAATTTTTATTATAGTATACAAATCATAATTGTTGGGTGGGGGGAACCTTG
TAGTTCCACTAAATATTAGGAGCTCCTCTGATATAGCCTCTCCCCTCGAATAAAC
ATAAGATATCTGATTTCTACCCCCCTTTTCTCTTCTCTTAATAGAAGAATT
ATTGAAATTGTGCAAGGAAACTGTTGGAAGCTCAGCCTAACCCTCTGACTA
ACATTGCCCATAGAGGATTCCTCAGCTGCTCGGCTATTTTCAGTCTCCTACC
TAGCAATTACGCTGCTCTCCTCTCCTCTACTTTCAACTACAGTCTTTTGGCGGGGCTA
TTACAATACTATTAACAGATCGAAGACCTAAACACTTTCTTCAGTTT
TAGCAATTACTGCCCTTCTCTCTTTACTTTTCACTAAGCAGTTTGGCCGAGGGCTA
TTACAACTATTAACAGATCGAAGCCCTAAACACTTC

MTEC007716, Limonius, californicus, larva, A. Esser, 4-May-11, United States of America, Washington, Lincoln Co, "Davenport, DeWalt Farm", ..., GACTTCTTGTACCTCGGAGACATTGGAACCCCTTTGGAACCTGACTAATTTGG
AATGACCAGAATCTTTTTATTTTTTTGGACAGCTCAGCCCTTACTGCATATTCT
CTTTATAGTTATACAAATCATTTATGGTGGGTTCGGAACCAGGCTAGATTCCAC
TAAATTAGAGCTCTCATATAGCCCTCCCTCAGAATAAACATATAAGATTTC
TGATTTCTAGCCCGTTTCTTTTTTATTTTTATTTTTATTTTTAATAGAAGAATTGG
GTGCCAGAAGCCTGTTGTAACCATCCTACCCCCCTCTCTCTATAGCAGAACATTAC
TAGAGGATTCCTGTTGACCTCGCATTCTCACCTATAGCAGGAATTCT
CATCCATTTCTGAGACGTATTTTTTATATCTCAGTGCATAATATTCGCTC
ACCCGAGATTACCTTCGACCGGTATACCTCGTTTGAACACTTCTTCTTCTTTGAGT
TAGCAATTACTGCCCTTCTCTTTACTTTTCACTAAGCAGTTTGGCCGAGGGCTA
TTACAACTATTAACAGATCGAAGCCCTAAACACTTC

MTEC007717, Limonius, californicus, larva, A. Esser, 4-May-11, United States of America, Washington, Lincoln Co, "Davenport, WSU-Wilke Farm", ..., MTEC007718, Limonius, californicus, larva, A. Esser, 4-May-11, United States of America, Washington, Lincoln Co, "Davenport, WSU-Wilke Farm", ..., CATCCTTAGACTCTTGTATGTTGAGACCTGTTAACCCCTTTGGAACCTG
AATAATGAGAATGCACAAATCTTATTTTTTATTTTTATTTTTATTTTTAATAGAAG
AATTGGGTGCCAGAAGCCTGTTGTAACCATCCTACCCCCCTCTCTCTATAGCAG
AACATTAC
TAGAGGATTCCTGTTGACCTCGCATTCTCACCTATAGCAGGAATTCT
CATCCATTTCTGAGACGTATTTTTTATATCTCAGTGCATAATATTCGCTC
ACCCGAGATTACCTTCGACCGGTATACCTCGTTTGAACACTTCTTCTTCTTTGAGT
TAGCAATTACTGCCCTTCTCTTTACTTTTCACTAAGCAGTTTGGCCGAGGGCTA
TTACAACTATTAACAGATCGAAGCCCTAAACACTTC

MTEC007719, Limonius, canus, larva, A. Esser, 24-May-11, United States of America, Washington, Yakima Co, "Grandview, Lou Graf Farm", ..., TCTTGATTTGAGGAGCTCTTGTATGTTGAGACCTGTTAACCCCTTTGGAACCTG
AATAATGAGAATGCACAAATCTTATTTTTTATTTTTATTTTTATTTTTAATAGAAG
AATTGGGTGCCAGAAGCCTGTTGTAACCATCCTACCCCCCTCTCTCTATAGCAG
AACATTAC
TAGAGGATTCCTGTTGACCTCGCATTCTCACCTATAGCAGGAATTCT
CATCCATTTCTGAGACGTATTTTTTATATCTCAGTGCATAATATTCGCTC
ACCCGAGATTACCTTCGACCGGTATACCTCGTTTGAACACTTCTTCTTCTTTGAGT
TAGCAATTACTGCCCTTCTCTTTACTTTTCACTAAGCAGTTTGGCCGAGGGCTA
TTACAACTATTAACAGATCGAAGCCCTAAACACTTC

MTEC007719, Limonius, canus, larva, A. Esser, 24-May-11, United States of America, Washington, Yakima Co, "Grandview, Lou Graf Farm", ..., TCTTGATTTGAGGAGCTCTTGTATGTTGAGACCTGTTAACCCCTTTGGAACCTG
AATAATGAGAATGCACAAATCTTATTTTTTATTTTTATTTTTATTTTTAATAGAAG
AATTGGGTGCCAGAAGCCTGTTGTAACCATCCTACCCCCCTCTCTCTATAGCAG
AACATTAC
TAGAGGATTCCTGTTGACCTCGCATTCTCACCTATAGCAGGAATTCT
CATCCATTTCTGAGACGTATTTTTTATATCTCAGTGCATAATATTCGCTC
ACCCGAGATTACCTTCGACCGGTATACCTCGTTTGAACACTTCTTCTTCTTTGAGT
TAGCAATTACTGCCCTTCTCTTTACTTTTCACTAAGCAGTTTGGCCGAGGGCTA
TTACAACTATTAACAGATCGAAGCCCTAAACACTTC
CAGGAATCACCTTTGGACCGAATGCCTCTATTCGTGTTGAGCAGTAGCAATTACTGCTCTA GCCTCTCCTCTCTGCTCCAGTGCTACGAGGAGCAATTACAATAATATATTGACAGATCGTAATCTAAACACCTCATTCTGAGA


MTEC007721, Limonius, canus, larva,, A. Esser, 24-May-11, United States of America, Washington, Lou Graf Farm", CATCCCTAAGACTCTTGTGATTTGTGCACGGAACCTGGTAAACCCCGGCTCAC TAATCGGAAATGACCAAAATTTACAAATGTTATATTGGTACAGGCCACGCTTCATTATAAATTCTTTATATTGTTATGCGAGGATACTTACGCTTCCCTGCAATAAACAAC ATGAGATTCTGATTCTACACCCCGTCTCTTTCTCCTCCTACTACTACATCAGCTATACGTGATTACCTGCCTTCTTCTGAGA ATCATTACTGATCCTACTCCTCTCTTTCTCTCCAGTGCTAGCAGTCGAAATTACAATTATTATTTGACAGATCGTAATCTAAACACCTC

MTEC007722, Limonius, canus, larva,, A. Esser, 24-May-11, United States of America, Washington, Lou Graf Farm", CATCCCTAAGACTCTTGTGATTTGTGCACGGAACCTGGTAAACCCCGGCTCAC TAATCGGAAATGACCAAAATTTACAAATGTTATATTGGTACAGGCCACGCTTCATTATAAATTCTTTATATTGTTATGCGAGGATACTTACGCTTCCCTGCAATAAACAAC ATGAGATTCTGATTCTACACCCCGTCTCTTTCTCCTCCTACTACTACATCAGCTATACGTGATTACCTGCCTTCTTCTGAGA ATCATTACTGATCCTACTCCTCTCTTTCTCTCCAGTGCTAGCAGTCGAAATTACAATTATTATTTGACAGATCGTAATCTAAACACCTC
GTAGCAATTACTGCTACTCTCCTCCTTTTCTCTCCAGTCTAGCAGGAGC AATTACAATTATTGACAGATCGTAATCTAAACACCTC

MTEC007723,Limonius,californicus,larva,,A. Esser,4-Jun-11,United States of America,Washington,Lincoln Co,Dregger,,,,CTCTTGATTCGGGCAGAACTTGGTAACCCTGGATCACTAATTGG AAATGACCAATCTATAATGTTAACCCTGGATCACTAATTGG AATATGACCAATCTATAATGTTAACCCTGGATCACTAATTGG AATATGACCAATCTATAATGTTAACCCTGGATCACTAATTGG TCTTTATAGTTATACCAATACATAATGGGTTGGTGCAGGAAACTGAGCTAGTCTCTCT CTAATATTAGGAGCTCTGATATGGCCTTCCCTCGAATAAACAATATAGATT CTGATTCTTACCCCCGTCCCTTCTCTTCTAATAAGAAGAATTGTTGAAAA TGGTGCAAGGAATGGAAGATGACATCGTACCCTCTCTCAGTAACTATGG CACAATCCTTCTCCTCTTTACTTAACAG TCTACTTCCTACTACCTACCATGGTGGGCTATTACAAATAC TATTAACAGATCGAAACCCTAAACACTTC

MTEC007724,Limonius,californicus,larva,,A. Esser,4-Jun-11,United States of America,Washington,Lincoln Co,Dregger,,,,CATCCTTAAGACTCTTTGATTCGGGCAGAACTTGGTAACCCTGGATCACTAATTGG AAATGACCAATCTATAATGTTAACCCTGGATCACTAATTGG AATATGACCAATCTATAATGTTAACCCTGGATCACTAATTGG AATATGACCAATCTATAATGTTAACCCTGGATCACTAATTGG TCTTTATAGTTATACCAATACATAATGGGTTGGTGCAGGAAACTGAGCTAGTCTCTCT CTAATATTAGGAGCTCTGATATGGCCTTCCCTCGAATAAACAATATAGATT CTGATTCTTACCCCCGTCCCTTCTCTTCTAATAAGAAGAATTGTTGAAAA TGGTGCAAGGAATGGAAGATGACATCGTACCCTCTCTCAGTAACTATGG CACAATCCTTCTTCTTACTTAACAG TCTACTTCCTACTACCTACCATGGTGGGCTATTACAAATAC TATTAACAGATCGAAACCCTAAACACTTC

MTEC007725,Limonius,infuscatus,larva,,A. Esser,4-Jun-11,United States of America,Washington,Lincoln Co,W,,,,

MTEC007726,Limonius,infuscatus,larva,,A. Esser,4-Jun-11,United States of America,Washington,Lincoln Co,W,,,,

MTEC007727,Limonius,infuscatus,adult,Female,"R.F. Lang, J.P. Cuda",16-May-88,United States of America,Montana,Flathead Co,Kalispell,,,,

MTEC007728,Limonius,infuscatus,adult,Male,H.W. Ziolkowski,16-May-89,United States of America,Montana,Flathead Co,"Whitefish Lake, City Beach",,,,,
MTEC007729, Limonius, infuscatus, adult, Male, D.L. Gustafson, 22-Apr-87, United States of America, Montana, Jefferson Co, Lewis and Clark Caverns, GrCTCCTTATTTTyGACGAGArmTGGGAAAATCCTGGCTCmTwTAATTGGA AATGrmAaAATTtATwAmGTAATTGTAAcArCAcMcGCyTTATCCTAATTTTY TTCATAGTATTwCCAATTATAATCCTGGGATTTGGGAAAaMTGATTAGTwCCmCT TATwmmTAGGArCCCCCAGACATArCmTyCCTCGAATAAAATAATAAAGATTyTG ATTCCTTyCCTCmTScTTTCCCCCTTCTCTCACAAGGAAATTGTAAGAAAATG TrsyrGTACAGGATGAACTTGTATCCACCTTTATACArCAAACATTkCCCTAGA GGAATsTyCGTTGATTGGGAATTTTCAGTTCCTGmTyTArCAGGAAATCTCATCA ATTcTAGGAGCATAAACTTTTATCTCCCCTCAGGAATAAATATATwCGGACTACAGG AATCAGTTTGrCCGAATwCCyTTATTTGkATGArCAGkTGCAATTACAGSsTCTw CTATTACTTCTTCTCTTAYCAGkTCTT


MTEC007731, Limonius, infuscatus, adult, Male, H.W. Ziolkowski, 16-May-89, United States of America, Montana, Flathead Co, "Whitefish Lake, City Beach”,


TTTGAGCCCG


GAGCAATTACAATGTATGGACTGACCGATCGAAAAACCTAAATACATCCTCTTTTTTGACCCGC


MTEC007755, Hypnoidus, bicolor, larva,, "C. Hart, A. Stavens", 5 JUN to 5 JUL 2011, United States of America, Idaho, Fremont Co, "North of Island Park, Hwy 20, mi 396", 44.54572N, 111.3326W, CTTCTCAGCCTAATGTGAGAGGCTTCTAGACGGACATCATGCTGCTTCATTATAATTTTCTTCATAGTTATACCAATCATGATCGGTGGTTTCGGAAATTGATTAGTACCTTTAATACTAGGAGCTCCCGGAGCGAATCCTTTATCAGTTTACACTTGGCTGGAATCTCATCAATTCTAGGAGCAGTAAATTTTATTTCAACCGTAATCAATATACGATCAACAGGAATCACCTTTGATCGAATACCGT

MTEC007756, Hypnoidus, leei, larva,, "C. Hart, A. Stavens", 5 JUN to 5 JUL 2011, United States of America, Idaho, Fremont Co, "North of Island Park, Hwy 20, mi 397", 44.54572N, 111.3326W, CTTCTCATTAAAATGTGAGAGGCTTCTAGACGGACATCATGCTGCTTCATTATAATTTTCTTCATAGTTATACCAATCATGATCGGTGGTTTCGGAAATTGATTAGTACCTTTAATACTAGGAGCTCCCGGAGCGAATCCTTTATCAGTTTACACTTGGCTGGAATCTCATCAATTCTAGGAGCAGTAAATTTTATTTCAACCGTAATCAATATACGATCAACAGGAATCACCTTTGATCGAATACCGT
TATTTGTTTGAGCTTGTGCAATTACAGCATTCTCTCCTCTCTCTTCACTTACCCAG
TATTAGCTGGAGCAATCAGACTATACTACTACTACTACTACTACCAAGGAAATTTAATACATC

MTEC007757, Ampedus, sp1, larva, "C. Hart, A. Stavens", 7 JUN to 28 JUN 2011, United States of America, Montana, Granite Co, Rest Stop at mi143 on I90, 46.70355N, 113.34463W, GCTGAGCTAGGTAACCCAGGATCACTTATCGGAA
ATGACCAGATCTATAACCTGTAACAGCAGTCTTTCTCATATAATTTTC
TTCATAGTTTACCAATCATAATTGAGGATTTGGAATTTGATTAGTGACACT
AATGCTAGGTAACCTGTTACTCTACATTTTACAGACTGACATTGACAGGAT
TTCATCCATTCAGGCGGTAATTCTTACTACTTTCTTGAAGAAACACTATAGAT
CAACAGGAAATTACCTTGACGGCAACGCTAATTCTTACTTTAAGAGATAGAA
TTGTAAGAAAACCCGAGCAAAGATGAAAGTATTTATCTACACACACACACAC
TAGTCCACTATAACTGGGTGCCCAGACATGCTCTTCCCCGGATGAAATTT
CATAGTTCTGCTCTTACTACCTGCCCTCTAATTTAAAGCCTCCTACTACTACTCTACTACCAAGGGCAATTTTTTC
TTCTTAAATACGAT

MTEC007758, Ampedus, sp2, larva, "C. Hart, A. Stavens", 7 JUN to 28 JUN 2011, United States of America, Montana, Granite Co, Rest Stop at mi143 on I90, 46.70402N, 113.33752W, TTCCTAATCCGTGCCGAATTAGGCAACCCTGGTTCC
TTAATTGGGCAATGATCATTAACTTTAGGTAACCTTGTTACTCTAGTCTCAT
CATATAATTTTCTTCTATAGTATACCAATTATAATTGAGGATTTGGAATTTG
GACAGAGGATCTATGCTGACTCTATTTTACAGACTGACATTGACAGGAT
TTCATCCATTCAGGCGGTAATTCTTACTACTTTCTTGAAGAAACACTATAGAT
CAACAGGAAATTACCTTGACGGCAACGCTAATTCTTACTTTAAGAGATAGAA
TTGTAAGAAAACCCGAGCAAAGATGAAAGTATTTATCTACACACACACACAC
TAGTCCACTATAACTGGGTGCCCAGACATGCTCTTCCCCGGATGAAATTT
CATAGTTCTGCTCTTACTACCTGCCCTCTAATTTAAAGCCTCCTACTACTACTCTACTACCAAGGGCAATTTTTTC
TTCTTAAATACGAT

MTEC007759, Dalopius, sp., larva, "C. Hart, A. Stavens", 7 JUN to 28 JUN 2011, United States of America, Montana, Granite Co, Rest Stop at mi143 on I90, 46.70402N, 113.33752W, CATCATATTGCTGAGCTTGAATTAGGT
AACCCAGGATCTATACATAATTCTGCTGCTGACTATTAGGTAACCTTACACAT
CAGTACATCATTATAAATTCTTATCTAGTATACCTACATAATTGGAGGA
TTCGGAATTGATTAGTCCCATGTAATTCTGCTAGCCAGATGATAGCTTTCCCC
TCGAAATAAAACACGGGATGTCTTTTACACCCTACTATACCGATTTCTCTC
ATATAAGAAGATTGTTGGAATTTGGGGGCAACAGGATGAAAGGTTTACCC
CTCATATCTCAATTTGCACTAGGCGCAGATAATTCTTCTTCTTGTGATTTTGC
ATGATTTACTAGGCTGAAATTTTACTGAGCTGAATTTTTATTTTC
TACAGTGAATTAATACAGATCAACTTGAATTACCTTTTGACGAATGCGTTTAT
TTGTGAGCAGTTGCAATTACTGCTTTTTACTACATTCTACAGGATAT
TAGCCGGAGCAATTACTATATTATATTAACAGATCGAAACCTAAACACATCATTCTTTCAGACCCAG

MTEC007760, Hadromorus, callidus, larva, "C. Hart, A. Stavens", 7 JUN to 28 JUN 2011, United States of America, Montana, Granite Co, Rest Stop at mi 143 on I-90, 46.70402N, 113.33752W,.


MTEC007762, Dalopius, sp., larva, "C. Hart, A. Stavens", 9 JUN to 29 JUN 2011, United States of America, Montana, Ravalli Co, Skalkaho Pass Rd, 46.16292N, 113.95837W,.

MTEC007763, Metanomus, insidiosus, larva, "C. Hart, A. Stavens", 9 JUN to 29 JUN 2011, United States of America, Montana, Beaverhead Co, "Chief Joseph Pass, Tie Creek", 45.67052N, 113.69585W,.
CTACCCCTTGAGAAATTCTTCAATTCTAGGAGCTAACTTTATCTCTAC
GTTAACATTATATACGATCAAGGAATTACTTTTGAGCCGAATACTTATTGT
TATGAAGCTGGCATTACGCTCAGTCATTTCTCTCCTCAGCTACTTCGCTCTC
GCCGGAGAACATCAAAACTTACTAACACGAGCAACTT

MTEC007764, Selatosomus, semimetallicus, larva, "C. Hart, A. Stavens", 9 JUN to 29 JUN 2011, United States of America, Montana, Beaverhead Co, "Hwy 43, Sawmill Gulch Trail", 45.75200N, 112.77806W, CTTCTCTTATCTCATGATTGAGGCTGAACCTAGG TAACCCCGGCTCTCTCAATTGTACCCAAATTAACTCAGTATCGTTACAG
CCATGGCCCTATATTAAATTTCATATTACCAATACAAATTTCGAG
TCGGTAATTGCACGTCCCTCTTACTAATCTTACGAGCTCAGTACCTTTAAGC
MTEC007765, Hadromorphus, callidus, larva, "C. Hart, A. Stavens", 9 JUN to 29 JUN 2011, United States of America, Montana, Deerlodge Co, "Hwy 43, mile marker 43", 45.82302N, 113.27215W, CATCCCTTAGACTTCTGATTCGAGCTAGGT AACCCAGGATCTCTCTATGGCAAGATCAAACTCTACACCGTAGTTACAGC
CCACGGCTTCTATTACCTTATGTAATACTACTATATGAGACAGGT
CGGAAAAATTGATTAGTTCCTCCTACTCGGAGCTCCCGACATGGGCTCTCCAC
GAATGAAATAATAGAGATTCTGTGCCATATTACCTTATACCAATACGAGAT
GTTAACCGAGGATCTTTAATTGGAATGATCAGAATATTCAATGATTGTAACA
GCACATGCATTATAATTTTATGATGTATACCATTATATAGGAGGAT
GTTAACCGAGGATCTTTAATTGGAATGATCAGAATATTCAATGATTGTAACA
GCACATGCATTATAATTTTATGATGTATACCATTATATAGGAGGAT
GTTAACCGAGGATCTTTAATTGGAATGATCAGAATATTCAATGATTGTAACA
GCACATGCATTATAATTTTATGATGTATACCATTATATAGGAGGAT
GTTAACCGAGGATCTTTAATTGGAATGATCAGAATATTCAATGATTGTAACA
GCACATGCATTATAATTTTATGATGTATACCATTATATAGGAGGAT
TTTGTTTGGACGTGGCAATTACTGCTGCTTTATTACTTTTACTACCAGTA
TTAGCGGGAGCAATTACTATATTATATTAAACAGATCGAAACCTAAAACATCA

GTAACCCAGGATCATTAATTTGACAAATTGAATTTACATTGTTACAA
GCACATGCATTCATTATAATTTTCTTCTCATGATATTTACATTGATATTT
TTAGCCGGAGCAATTACTATATTATTAACAGATCGAATACCTTTCC
CTCGAATAACAACATAAGATTCTGATTTTTACCCCTTCACTATCCCTTCT
TAATAGAGAAGAATTGTTGAAAAATAGGCGACAGAACAGATGAACCGTTTACCC
MTEC007772, Metanomus, insidiosus, larva, "C. Hart, A. Stavens", 29 JUN to 25 AUG 2011, United States of America, Montana, Beaverhead Co, "Chief Joseph Pass, Tie Creek", 45.67052N, 113.88106W, CTCCTTTAGACTTCGCTGCTGAGCAGAATTAG
AAATCCTGGATCATTAATGCGGAAATTGAAATTGACATTGCTACCC
GCTCATGCTTTTATCAATTTTTTTATAGTTATACCTATCATATAATTGGA
TTTGGAATTTGACTAGTTTCCATTATATTGCTTGGAGCCCGCAGATAGCATTCC
CCGAATAAACACATGAGATTCTGATTTTTACCCCCTTCACTATCCCTAT
MTEC007776, Hyphnoideus, bicolor, larva, "C. Hart, A. Stavens", 29 JUN to 3 AUG 2011, United States of America, Montana, Beaverhead Co, "Hwy 43, mile marker 19", 45.562861N, 113.59083W, CCCCTCTGCTCATGTATCGGAAATTGAAATTGACATTGCTACCC
GCTCATGCTTTTATCAATTTTTTTATAGTTATACCTATCATATAATTGGA
TTTGGAATTTGACTAGTTTCCATTATATTGCTTGGAGCCCGCAGATAGCATTCC
CCGAATAAACACATGAGATTCTGATTTTTACCCCCTTCACTATCCCTAT

CTAGCAGGAGCAATCACTATACATCTACTGACAGACGACG AAAACTTAATACATCATTTTTG

MTEC007778,Hypnoidus,bicolor,larva,,"C.Hart, A. Stavens",29 JUN to 3 AUG 2011,United States of America,Montana,Beaverhead Co,"Hwy 43, mile marker 19",45.62861N,113.59083W,,TCCTAATCCGTGCAACTCGGAAACCCTTGCTCACTAAATGGGAAATAGATTTGAAATCTACAATGTAATTGTAACAGCCCATGCTTTCATATAATTTTTTTCATAGTTATACCAATTATATAATGGGAGGTGTATAGATTAGTACCCTCCTACTAGACTTACTATATTTACTTTCACTCCTGGACGAGAACAACTAATACATACATTTTCTCTCTCTCTCTCTCTCTCTACTAGCTATTACAGCTATTACAGCTCTTCTTCTCTTGTCTCT


MTEC007785,Limonius,aegar,larva,,"C.Hart, A. Stavens",30 JUN to 25 AUG 2011,United States of America,Montana,Beaverhead Co,"Polaris, Clark Creek Rd",45.42515N,113.09007W,ACTAGGCACATCACTAAGACTTCTAATCCGAGCCGAACTTGGTAACCCTGGCTCTCTAATTGGAAATGACCAAATCTATAACGTAATTGCTCACGCCTTTATCATAATTTTCTTCATAGTTATACCAATCATAATTTGGAGGATTCGGAAATTGACTTGTCCCTCTTATACTAGGTGCTCCCGATATTTCCTCGAATAAACAATATAAGATTTTGATTCCTTCCTCCTTCATTATCCTGTTACTAATAAGAAGTATTGTAGAAAACGGAGCAGGAACAGGATGGACCGTTACCCTCCTCTCTCAGCTAATATTGCTCATAGAGGGTCCTCAGTAGACCTAGCTATTTTCAGTCTTCATCTAGCAGGAATTTCGTCAATTCTAGGAGCAGTAAACTTTCATTTCAACTGTAATCAATATACGATCAACTGGGATCACCTTCGACCGAATGCCTCTATTTGTAGATGACGAGTAGCCATTACTGCTGCTCTCTCTCTTGGCTCCTACCAGTACTAGCTGTGGTGAATATTACATATTACGCTATTAACCAGCAAACCTAAACAC
ATATGCGAACTACAGGAATCATTGGGACCAGAAATACCTTTTATTTTGTATGAGCA
GTTGCAATTACAGCTCTACTATTACTCTCTCTCTTACCAGTTCTTGCCGGGAGCA
ATCACAATACTATTAACAGACCAGAAATCTAAATACCTCATTTTTTTG

MTEC007838,Limonius,infuscatus,larva,,M. Hubbard,16-Aug-11,United States of America,Idaho,Boundary Co.,Bonners Ferry

MTEC007839,Limonius,infuscatus,larva,,M. Hubbard,16-Aug-11,United States of America,Idaho,Boundary Co.,Bonners Ferry


MTEC007846, Limonius, californicus, adult, Female, A. Morales et. al, Summer 2011, United States of America, Montana, Fergus Co, Denton, 47.2942N, 110.042183W, 3776ft,

MTEC007847, Limonius, californicus, adult, Female, A. Morales et. al, Summer 2011, United States of America, Montana, Fergus Co, Denton, 47.2942N, 110.042183W, 3776ft, CATCCTTAAGACTCTTGATTCCGGGAGA
ACTTGGTAACCCTGGGTCAAATGGGAAAATGGACAAAAATCTATAATGTAATTG
TCACAGCTACGCTCTCATCATAATTTCATATAGTTATACCACCATATACTGCAG
GTGGGTTCCGAAACTGACTAGTTCGCTAACATTATGGGTTGCTGTCCTGATATAGG
TTCCCTCGAATAAACAAATATAGGCATTCCTTACCCCGTGCCCTTTTCTCTT
CTTCTAATAAGAGAAATTTGAGAAAATGGGAGCAACTGGGTAACAGTCT
ACCCCATCTCCTCAGCTACCATGAAATAGCGCCCTACAGTCTAGTGACCTCGCC
ATTTTCTCAGTCTCACCAGAGGATTTCTCATCCATCGAGCTTTAATTGGTT
ATCTCAACTGTATTATAACATCGATCTACCACGGAAATTACTCTCGACCCTATGCGC
CTATATTGTTTGGAGCAATGAAATTACTTCCTTACCCCTTCCTTCCTTCCTT
AGTTTAGCAGGAGCTATTACAAATACTATTTAACTGACCGAAACCTAAACACTT
C

MTEC007848, Limonius, californicus, adult, Female, A. Morales et. al, Summer 2011, United States of America, Montana, Fergus Co, Denton, 47.2942N, 110.042183W, 3776ft,

MTEC007849, Limonius, californicus, larva, A. Morales et. al, Summer 2011, United States of America, Montana, Fergus Co, Denton, 47.2942N, 110.042183W, 3776ft,

MTEC007850, Limonius, californicus, larva, A. Morales et. al, Summer 2011, United States of America, Montana, Flathead Co, Kalispell, 48.2304N, 114.3951W, 3066ft, ACTAGGAACATCCCTTAAGACTCTTGATTCCGGGAGA
ACTTGGTAACCCTGGGTCAAATGGGAAAATGGACAAAAATCTATAATGTAATTG
TCACAGCTACGCTCTCATCATAATTTCATATAGTTATACCACCATATACTGCAG
GTGGGTTCCGAAACTGACTAGTTCGCTAACATTATGGGTTGCTGTCCTGATATAGG
TTCCCTCGAATAAACAAATATAGGCATTCCTTACCCCGTGCCCTTTTCTCTT
CTTCTAATAAGAGAAATTTGAGAAAATGGGAGCAACTGGGTAACAGTCT
ACCCCATCTCCTCAGCTACCATGAAATAGCGCCCTACAGTCTAGTGACCTCGCC
ATTTTCTCAGTCTCACCAGAGGATTTCTCATCCATCGAGCTTTAATTGGTT
ATCTCAACTGTATTATAACATCGATCTACCACGGAAATTACTCTCGACCCTATGCGC
CTATATTGTTTGGAGCAATGAAATTACTTCCTTACCCCTTCCTTCCTTCCTT
AGTTTAGCAGGAGCTATTACAAATACTATTTAACTGACCGAAACCTAAACACTT
C

MTEC007851, Limonius, californicus, larva, A. Morales et. al, Summer 2011, United States of America, Montana, Flathead Co, Kalispell, 48.2304N, 114.3951W, 3066ft, ACTAGGAACATCCCTTAAGACTCTTGATTCCGGGAGA
ACTTGGTAACCCTGGGTCAAATGGGAAAATGGACAAAAATCTATAATGTAATTG
TCACAGCTACGCTCTCATCATAATTTCATATAGTTATACCACCATATACTGCAG
GTGGGTTCCGAAACTGACTAGTTCGCTAACATTATGGGTTGCTGTCCTGATATAGG
TTCCCTCGAATAAACAAATATAGGCATTCCTTACCCCGTGCCCTTTTCTCTT
CTTCTAATAAGAGAAATTTGAGAAAATGGGAGCAACTGGGTAACAGTCT
ACCCCATCTCCTCAGCTACCATGAAATAGCGCCCTACAGTCTAGTGACCTCGCC
ATTTTCTCAGTCTCACCAGAGGATTTCTCATCCATCGAGCTTTAATTGGTT
ATCTCAACTGTATTATAACATCGATCTACCACGGAAATTACTTCCTTACCCCTTCCTTCCTTCCTT
AGTTTAGCAGGAGCTATTACAAATACTATTTAACTGACCGAAACCTAAACACTT
C
Co, Kalispell, 48.2304N, 114.3951W, 3066ft, CATCCTTAAGACTCTTGTATTGCAAGCAGATTGGAATGCAAAATATATATATATATTGTTAT
GTAAACAGCTCAGCCTTCTCATCATAATTTCTTTATAGTTATACCAAATATTAACTT
GTTGGATTCGGAAAACGTAGCTTTCACCAATATTAGAGCTTCTTTATAGCGCTTCCCT
CTCAATAAAGAGAATTTGTTGAAAAATGCGAGAACTGCTCACTGCAATGCGTTAT
AGCCTTCTCGAGCTGTATACCCATAGGAAGGCTCTTCTGACCCACTTCCTCTTCTC
TTCTTCTAAATAGAAATTGTTAAGACGAGAATTTGTTGAAAAATGCGAGAACTGCT
CAATTCTGTGGTTGACGAATAGTAAATACGTAGCTTCTCGACCCTATTACCTCTTCA
ACTCCAGTTTTGGCAAGGGGCTATCACAATACTATTAAACAGATCGAACGTTAC

MTEC007858, Limoniaceae, larva, A. Morales et al, Summer 2011, United States of America, Montana, Flathead Co, Kalispell, 48.2304N, 114.3951W, 3066ft,

MTEC007859, Hadromorpha, glaucus, adult, Male, D.L. Gustafson, 17-May-90, United States of America, Montana, Gallatin Co, "Bozeman, at "M" trail",

MTEC007860, Hadromorpha, glaucus, adult, Male, D.L. Gustafson, 24-Jun-90, United States of America, Montana, Gallatin Co, "Bozeman, at "M" trail",

MTEC007861, Hadromorpha, glaucus, adult, Female, D.L. Gustafson, 24-Jun-90, United States of America, Montana, Gallatin Co, "Bozeman, at "M" trail",

MTEC007865, Aeolus, mellillus, adult, Female, F.E. Etzler, 18-Jun-11, United States of America, Montana, Gallatin Co, "Bozeman, Peet's Hill", 45.6736N, 111.0295W, 4860ft,

MTEC007866, Aeolus, mellillus, adult, Male, F.E. Etzler, 18-Jun-11, United States of America, Montana, Gallatin Co, "Bozeman, Peet's Hill", 45.6736N, 111.0295W, 4860ft,

MTEC007870, Limoniaceae, adult, Male., 2011, United States of America, Montana, CATCCTTAAGACTCTTGTATTGCAAGCAGATTGGAATGCAAAATATATATATATATTGTTAT
GTAAACAGCTCAGCCTTCTCATCATAATTTCTTTATAGTTATACCAAATATTAACTT
GTTGGATTCGGAAAACGTAGCTTTCACCAATATTAGAGCTTCTTTATAGCGCTTCCCT
CTCAATAAAGAGAATTTGTTGAAAAATGCGAGAACTGCTCACTGCAATGCGTTAT
AGCCTTCTCGAGCTGTATACCCATAGGAAGGCTCTTCTGACCCACTTCCTCTTCTC
TTCTTCTAAATAGAAATTGTTAAGACGAGAATTTGTTGAAAAATGCGAGAACTGCT
CAATTCTGTGGTTGACGAATAGTAAATACGTAGCTTCTCGACCCTATTACCTCTTCA
ACTCCAGTTTTGGCAAGGGGCTATCACAATACTATTAAACAGATCGAACGTTAC

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MTEC007871, Limonius, californicus, adult, Male, 2011, United States of America, Montana, ..., CATCCTTAAGACTCTTCTTCTATTGCAAGCGAACACTTGGTAAACC
TGGGTCACTAATTGGAACACCAATATCTATAATGTAAAATGTTACAGCTCAGG
CCTTCATCATAATTGTTATATAGTTATACCAATCATATTG TGTTACGGGA
AACTGA CACTAGTTCCACTAATATTGGGCAGCTCTGTATAGCCTTCCCCCTGAAT
AACAAATATAAGATTCTGATTCGATTTGCCCCCATCCTTCTTCTTTCTAATAAG
AAGAATTGTAAGAATGCTGAGGAAGCTGAGTAGAAGTAGATATACCCCTCTC
TCAGCTAATTGGAACACTTCTTTGAGCCTCTCTGACCTGACATCTC
TCACCTAGCAGGAATTTCCACTCATCTGGAGCAAGTTAATTATTTATCCTAAGTG
TTAATATATACGTCTACCGGAATTACCTTCG
ACCGTATGCCTCTATTTGTTT
GAGCAGTAGCAATTACCGCTCTTCTCCTCTTTACTTTCACTCCCAGTTTTTGCA
GGAGCTATCACAATATACTATTAACAGATCGAAACCTA
MTEC007879, Selatosomus, semimetallicus, adult, Female, D.S. Sikes, 6 to 12 Jul 1993, United States of America, Wyoming, Yellowstone N.P., "Lamar Valley, NE of Slough Creek turnoff", 44.9167N, 110.4000W, 6320 ft,
MTEC007880, Selatosomus, semimetallicus, adult, Female, M.A. Ivie, 20 to 27 May 1992, United States of America, Montana, Flathead Co, "Glacier National Park, N Fork Flathead area, Bowman-Akokola inst.", ... 3600 ft,
MTEC007881, Selatosomus, semimetallicus, adult, Male, M.A. Ivie, 23-May-90, United States of America, Montana, Lincoln Co, "30 mi E of Libby, milepost 53 on Hwy 2", ..., CTTCTCTTTAGCCTCTTCGATTGGCAACCGTACCTTGAAACCCTGCTCTCAA
TTGGTATATGACCAAATTTACAAACGTAAATCGTTACAGGCCCATGCTTTTATATA
ATTTCTTTTAGTTATACCAATCTATAATTGGAGGATTCCGTAAATTGACTCGT
TCCTCATAACTTGGAGCTCTCTGACATAGCATTTCCACGAATAAAACAACATAA
GATTCTGTTTCTACCCCTCTCTCTGCTGTCTTTTACTATAAAAGAGAAATCGTA
GAAAACGGGGCCGAGAAACGAGATGAACTGGTATTACCCCTCCCTTTCTCA
GGAATCTCACAGAGGCTTCTCAGTAGACCTTGCAATTTTTAGTTTACACTAGCA
GGAATCTCATAATTGAGGATGAAAATTTCTCTTTACTTTAACAATATACACGTA
ACGATCAAACCGGATACCTCCCTGGACCGAAATGCCCATTTTGGATAGAGGATG
CCATTACTGCCCTCTCCTCCTTTTTCTCCCTTCAACGTACTAGCTGGTGAATTA
CAATGCTATTTAACCGGACCGAAAACCTA
MTEC007882, Limonius, aegar, adult, Female, T.K. Philips, 15-Jun-88, United States of America, Montana, Gallatin Co, "Squaw Creek, Gallatin Canyon", ..., ACTAGGCACATCACAAGACCTTCTATACCGAGGCCGAACCTTGTAAC
CCTGGCTCTCTAATTGGAATGGACAAATCTATAACGTAATTTGTACAGCTCA
CGCCCTTATCATATTCTCTCTATAGTTAACCACAATAATTTGGAAGATTCCG
GAAATTCCTTGTCCACCTAATTGAGATGAAATTTCTCTTTACTTAACGTAATTTTCTC
GAAATCACAATACCGGATCACCTCCCTGGACCGAAATGCCCATTTTGGATAGAGGATG
CCATTACTGCCCTCTCCTCCTTTTTCTCCCTTCAACGTACTAGCTGGTGAATTA
CAATGCTATTTAACCGGACCGAAAACCTA
CTTCATCTAGCAGGAATTTTCGTCATATTCAGGAGGTGAGAACTTCACTTTCATTTCAAC
TGTAATCAATATAGCAACAGGTATCACTTTTGGACCAGTAGCTATACCTCCTTTTG
TTTGAGCAGTAGCTATTACAGCTCTCTTCTCTTCCTTTGCTCTCTACGTGTTCTTG
CAGGAGCAATCACAATTTTCTTACAGAGAAAAATCTTAATATCTTC

MTEC007883, Limonius, aegar, adult, Male, D.L. Gustafson, 20 May to 30 Jun 1990, United
States of America, Montana, Madison Co, "Hidden Lake Bench", 7400 ft,

MTEC007884, Limonius, aegar, adult, Male, D.L. Gustafson, 26-Jun-89, United States of
America, Montana, Powell Co, "Blackfoot River, MT 141",

MTEC007885, Hemicrepidius, memnonius, adult, Male, D.L. Gustafson, 18-Jul-90, United
States of America, Montana, Rosebud Co, Rosebud area,

MTEC007886, Hemicrepidius, memnonius, adult, Male, C.E. Seibert, 2 JUL to 14 AUG
1988, United States of America, Montana, Fergus Co, "9 mi. NW Lewistown, Spring
Creek", 3800 ft,

MTEC007889, Aeolus, mellillus, larva, K. Pike, 27-Apr-12, United States of
America, Washington, Klickitat Co, "Bickleton, Tex/Nei Brown Farm", TACTTGGTACATCCTTAAGACTCCTCTTATCTCGAGCAGAGCTGGGAAT
CCTGGCTCATTAATTGGAAATGACCAAATTTATAACGTAATTGTAACAGCAC
ACGCTTTTCATCATAAATTCTTCTTAGAATACCAATTATAATCGGTGATTT
GGAAACTGATATTAGTACACACTTTAATACTAGGAGCCAGACATAGCATTCCCTCG
GAATAAAATATATAAGATTCTGATTCCCTCCTCCTCCATCGCTTTCCTTCTTTCA
TAAGAGAATTGTGAAATATGCTGTTGATCAACGAGATGACAGCTTATCCACC
CTTATCAGCAAAAACTTGCCATAGAGATCCTCCTGTTGATTTGGAATTTTCA
GTPGACATCTGAGGAATTCACTATCAATTCTACGAGATGAAACCTTTATCTCC
ACCAGTAATATATAAGACTACAGGAATCATTCTTTGACGCAATACCTTTATT
TGATTGAGCAATGTTACTACAGCTCTCTACTATTACTACTCTCTCTTACAGTTTCT
TGCTGGAGCAATCACAATAACTATATTAACAGAGCCGAAATCTAAAAATACCTCTT
TTG

MTEC007890, Hadromorphus, glaucus, larva, K. Pike, 27-Apr-12, United States of
America, Washington, Klickitat Co, "Bickleton, Tex/Nei Brown Farm", CATCCCTTAGTCTACTGATCCCCAGCAGCTGAGCTGGAAACCCCGGCTCT
CTTATGGGAACGACCAATATCTATAACGTCATTGGAACAGCCCATGTTTTCAT
TATAATTTTTCTCTTGATATAGTATCTATCTAAATGGAGATCGGAAACTGAT
TAGTTCCCCTAATACTAGGAGCTCCTGATATTAGCATTCCCACGAATAAACAC
ATAAAAGITTGGTTTCTACCCTCCTCTACCTCCTCCTACTAGAAGAAT
CGTAGAAAATGGACAGGAATCCTGTTGAACAGTTTACACCTCCCTCTACGACC
AACATTGCCCCACAGGAGCATCAGTCTATTGAATTTTATTGTTTACACC
AGCAGGAATCTCATACTTTAGGAGCTGAAATTTTCTTTCAACCGGAATCA
ACATACGATCAACTGGAATCATTGATCAACATTTTTTTGTTTGA
MTEC007894, Limonius, californicus, larva,, J. Marshall, 15-May-12, United States of America, Idaho, Bonneville Co., "Ririe, Antelope Flats",... TTTTCTTCATAGCTAGATGGAATACCCCGGTAGGTTAATCCCGGACCCCGGCTCTCCTCATTGGTAATGACCAAATTTACAACGTAATCGTAACAGCCCACGCCTTTATTATAATTTTCTTCATAGTAATACCAATCATAATTGGGGGATTCGGAAATTGACTGTACCCCTAATACTAGGAGCCCCTGATATAGCATTCCCACGTATAAAACAATA...
TAGCTATACAGCCCTCTCTTACTCTTTATCTCTGCCAGTGCCAGGAGCA  
ATTACAAATGTTACTGACCAGTCCAAACCTAAATAC

MTEC007898, Hadromorphus glaucus, larva, J. Marshall, 6-Jun-12, United States of America, Idaho, Bonneville Co., "Ririe, Antelope Flats", ...
MTEC007905, Limonius, californicus, larva, A. Esser, 15-Apr-12, United States of America, Washington, Lincoln Co, "Near Davenport, Scheffels Farm", ... 

MTEC007906, Limonius, infuscatus, larva, A. Esser, 15-Apr-12, United States of America, Washington, Lincoln Co, "Near Davenport, Scheffels Farm", ... 

MTEC007907, Athous, sierrae varius, adult, Female, T.K. Philips, 28-Jun-88, United States of America, Montana, Gallatin Co, Chestnut Mt. near Grouse Creek,... 

MTEC007908, Athous, sierrae varius, adult, Male, D.L. Gustafson, 30-Jun to 17-Aug 1990, United States of America, Montana, Madison Co, Hidden Lake Bench,... 

MTEC007909, Athous, sierrae varius, adult, Male, D.L. Gustafson, 28-Jun-86, United States of America, Montana, Gallatin Co, "4 mi. N of Bozeman, Bridger foothills", ...
AGAATTGTTGAAAATGGAGCAGGAACAGGATGAAACAGTTTATCCACCTCTCT
CAGCAAAATATTTGCCCATAGAGGCCTCATCTGTAGATTTTAGCAATTTTTAGACTT
CACTTAGCTGAATCTCCCTCAATCTTGGGAGCTGTAACACTTCTTTCCACGGT
AATATATACATCAGGAATTACATTTGAGTGATACCCCTTTATTGAT
GAGCCGTAGAATTACCGCTTTCATTTTTACTTTTATCCTTACCTGTCTTAGCAG
GAGCTATCACAATATTATATTAAGTCTGAACTTTAATTTTTTGT
MTEC007910,Limonius,canus,adult,Female,,25-May-83,United States of
America,Montana,Missoula Co, Missoula,,

MTEC007911,Limonius,canus,adult,Female,,26-May-83,United States of
America, Montana, Missoula Co, Missoula,,

MTEC007912,Limonius,canus,adult,Female,B. Zupan,29-May-78,United States of
America, Montana, Cascade Co,,

MTEC007913,Pseudanostirus,pudica,adult,Female,K. Philips & S. Clark,25-May-
88,United States of America, Montana, Jefferson Co, 0.5mi E
Lahood,,,,CTTCCTTAAGCCTACTAAATTGAGCCGAATTTAGGAAACCCTGGATCT
TTAATTTGGAAATGACCAATCATAATGTTAATTTGACACAGCAGCAGTTTTTAT
CATAATTTTTCTCTCATAGTTATACAAATTTATAATTTGGATATCGGAATTGAC
TTGTACCCCTAATGTAGGAGCCCCCTGATATAGCATTTCCCACGAAATAAAC
ATAAGATTTTGTATTTTTACCCCCCTCTCTCTCTCTCTCTACTAAATAGGAAATT
GTTGAAAATGGAGCAGGAACAGGATGAAACAGTTGATACCCCTGCTGAGCCA
ATATTGCCCATAGAGGTTTACATGCATTTGGAATTTTTATTCTTTCATCTTAG
CAGGAATCTCTCTCAATTCTGTTCAGTTAATCTTTCACTTTGATTTAATT
ATACGAACAACTGGAAATCTTTGGACCAGATTCCTATTTTGCTGAGCTGT
AGTAATTACAGCCCCGTATTTTTATTATTTTACTCTCCTCTGTGTTTAGCAGGAGCAA
TCACCATACTTTTTAATCTGAGCAAATCTTTAATACATCATTCTTTTGAG

MTEC007914,Pseudanostirus,pudica,adult,Male,D.L. Gustafson,4-Jun-87,United States of
America, Montana, Gallatin Co, Bozeman Creek,,6000ft,

MTEC007915,Pseudanostirus,pudica,adult,Male,H.W. Ziolkowski,15-Jun-89,United States of
America, Montana, Wheatland Co, "Lewis and Clark National Forest, 3mi NW Judith Gap",,

MTEC007916,Ampedus,brevis,adult,Female,C.E. Seibert,21 May to 25 Jun 1988,United States of America, Montana, Granite Co, "SE of Maxville, S Boulder Creek",,,5400ft,

MTEC007917,Ampedus,brevis,adult,Female,M.A. Ivie,15-22 Jul 1991,United States of
America, Montana, Flathead Co, "Glacier National Park, N. Fork Flathead area, S of Big Prairie",,3560ft,
MTEC007918, Ampedus, brevis, adult, Male, 27 Jul to 13 Aug 1984, Canada, British Columbia, "Prospect Creek, W. of Merritt", ...

MTEC007919, Limonius, agonus, adult, Male, J.F. Landry, 27-May-72, Canada, Quebec, "d.r Levis, St. Romuald", ...

MTEC007920, Limonius, agonus, adult, Male, J.F. Landry, 29-May-76, Canada, Quebec, "d.r. Levis, St. Entienne", ...

MTEC007921, Limonius, aniceps, adult, Male, 22-May-88, Canada, Quebec, "St. Mathieu du parc, St. Maurice", ...

MTEC007922, Limonius, agonus, adult, Male, Yves-Pascal Dion, 12-May-90, Canada, Quebec, Arthabaska Co., St. Louis de Blanford, ...

MTEC007923, Limonius, agonus, adult, Female, P. Belanger, 12-Jun-86, Canada, Quebec, "St. Entienne, Levis", ...

MTEC007924, Limonius, aniceps, adult, Male, P. Belanger, 4-Jun-85, Canada, Quebec, "Ste. Agathe, Lotbiniere", ...

MTEC007925, Metanomus, insidiosus, adult, Male, T.K. Philips, 19 May to 10 Jun 1988, United States of America, Montana, Gallatin Co, "Bridger Canyon, Olson Creek", ...

MTEC007926, Metanomus, insidiosus, adult, Male, K.A. Keating, 26-May-94, United States of America, Montana, Flathead Co, "Glacier National Park, N. Fork Flathead area, 100m N Trout Lake trail head", "965m, TAGGGACTTCCCTTAGACTTCTTGATTCCAGGAGATAGGAAAT CCTGGATCATATTAAATCGGAAATGACCAATCTACACAGGATCTGACAGGCT ATGCTTTTTTCTAATTTTTTTTTTTTTATAGGTTATACCATATCATAATTGAGGATTTG GAATAATGGACTAGTTCTCCAATTGCTTTGGAGCCCGCATGCGATTTCCCGAG ATAAAACACATAAGATCTGACTTTTACCACCACACTATCCCCTGCTTCTAAT AAGAAGAATTGTAAGAAAACCGGAGCAGGAAACAGGATGAACTGCTTACCCCC CCCCTCTCACGAAATATTGCTACAGAGGTTCACCTGATAGATCTCGCAATTTTTA GACTACACCTGCGAGGAATTTCCTCAATTCTGAGGAGCAGTAACCTTCTCATCT ACAGGTAAATCATATCGATCAACTGGAATTACTTTTGACCAGATACCTTATT CGTATGAGCCGTGGATACAGTCTACCTCTCTACCTCTCTCTTTCTCTAAGACTCCCCGATAC TCGCCGGAGCAATCATACATTTCTTTAACAAGACCCAAAATACACCTCCT
MTEC007928, Corymbitodes, lobatus, adult, M.A. Ivie, 29 May to 19 Jun 1991, United States of America, Montana, Flathead Co, "Glacier National Park. N. Fork Flathead area, N. Sullivan Meadow", ..., 3560 ft,

MTEC007929, Metanomus, insidiosus, adult, Female, D.L. Gustafson, 20-Jun-90, United States of America, Montana, Gallatin Co, Bozeman Creek, ..., 6200 ft, CTGATTAGACGACGATTTGGAAACCCCGGATCTTAAATCGGAAATGACCAAATCTACAACGTCATTGTTACAGCCCACGCTTTCATTATAATTTTCTTCTCAATAGTTCTGTAGATCTCGGAATTTGGAAATTGACTAGTTCCATTATGCGTGGAGCCCACGATTTCCCCCAAAATACATAAGATCTGACTTTACCACCACCATCATACTTTGCTCTTTAATAAAGAAGATTTGTAGAAAA CGGAGCAGGAACAGGATGAACTGTTACCCCTCCCCCTCTCTCGCAAAATATGCTCACAGGCTCTCTGATGACTCAGGCAAATTGGAGGATTCGGAAATTGATTAGTTCCCCTAATCTCGGAGCTCCCGACATGGCCTTT TCACGAATTTTACCAGCAATACCTTTTATTCTGTATGAGCCGATGCTATC ACAGCTCTTCTACTTTCTCTCTGTAAGACTCCCGGTCTGCAGGGGAATCACAATACTTCTACAGGACGAAACCTAAACACCTC


MTEC007931, Hadromorphus, callidus, adult, Male, D.L. Gustafson, 7-Jun-96, United States of America, Montana, Stillwater Co, Reed Point FAS, ..., MTEC007932, Hadromorphus, glaucus, adult, Female, USDA, 23 May to 19 Jun 2011, United States of America, Montana, Sweet Grass Co, Greycliffe, 45.7359N, 109.7571W, 3900 ft,

MTEC007933, Hadromorphus, glaucus, adult, Female, K.A. Keating, 26-Jun-99, United States of America, Montana, Glacier Co, "Glacier National Park, Windy Flats", 48.81051N, 113.60539W, 1492 m,

MTEC007934, Hadromorphus, glaucus, adult, Male, 15-May-97, United States of America, Montana, Broadwater Co, Kitto alfalfa 1, ...,
MTEC007935, Hadromorphus, glaucus, adult, Female, D.L. Gustafson, 7-Jun-91, United States of America, Montana, Powder River Co., 5 mi W of Broadus.


MTEC007938, Limonius, subauratus, adult, Female, D. Broers, 30-Apr-03, United States of America, Washington, Benton Co., Plymouth.

MTEC007939, Limonius, canus, adult, Male, "D. Broers, M. Bayer", 31-Mar-10, United States of America, Oregon, Umatilla Co., Hermiston Potato Field.

MTEC007940, Limonius, californicus, adult, Male, A. Morales et al., 2011, United States of America, Montana, Fergus Co., Denton, 47.2942N, 110.042183W, 3776ft.
MTEC007942, Limonius, californicus, adult, Male, A. Morales et al, 2011, United States of America, Montana, Fergus Co
.Denton, 47.2942N, 110.042183W, 3776ft, CATCCTTAAGACTCTTGATTCGcAGAACTTGTAAACCCTGGTGCACTAATTGGAAACGACCAAATCTATAATGTTATTGT
. TACAGCTCAGCCTTCATCATAATTTTTATATAGTTATACCAATTACAATTATTGG
. TGGATTCGGAATTACGGTTCCCTAAATTTAGGGCGGCTGCTTACGACCTGCGCA
. TCCCTCGAATAAAACATATAAGATCTGATCTTGGCCCATCwCTTTCTCTCC
. TTACTATAAGAAAGAATTGTAAGAAPTTGTCAGGAAACTGAGTGAACAGTATA
. CCCCCCTCTCTCATCAGTAACATTGCCATGCGCTCCTATTTACGAGATCT
. TTTTCCCTTCAATCAGCTACGAAGTTTTATTCATCCATCTGGGAGCAGTTAATTTT
. ATCTCAACTGTTTATTAAATATACGATCTACCCGGAATTACCTTGACCCATGATGCC
. TCTATTTGGTAGCAGTACATTACCGCTCTCTCTCTyTTwCTTTCmCTCCC
. AGTTTTGGCAAGGAGCTTTACAAATCTATATTACAGATCG

MTEC007943, Megapenthes, angularis, adult, Female, D.L. Gustafson, 16-Jul-90, United States of America, Montana, Rosebud Co , "Tongue R., Ashland", ,

MTEC007944, Megapenthes, angularis, adult, Female, D.L. Gustafson, 9-Aug-91, United States of America, Montana, Fergus Co , "Missouri R.,
.FRB", 47.6287N, 108.6824W, 712m, TACTAGGGACATTTAAGTCTATTAATTCGA
. GCAGAATTAGGAAAACCAGGTCATTAATTGGAAAGCAACAAATTTATAATG
. TAGTTGTAACCCGCATGCTTTTTATACATAATTTTTATAGTAATACCATATCA
. TAAATTGGGATCAGGAAATTTGATTAGTCCCTTTAATTGAGGCGCTCCAGAT
. ATAGCATTTCCACGAATAAACAATAAAGATTTGATTTTCTACCTCTCTCTCT
. TTCCCTTTTTAATAAGAGAAATGTGAAAGGAAGGAGCAAGGACAGGATGA
. ACTGTTTACCACCTTTGAGCATCAAACATTGCACATAGGAGATCCCTCTGAGA
. TTTAGCCATTTTTTACGCTCCTATTTAGCTGGAATCTGCTCCTCCATTTAGGGCAGT
. TAATTTCTATTTCAACTGTGATTAACATACGATCCACAGAATTACCTCTTTTACC
. GAATACCTTTTATTTGTTAGCTGGGAATCAGTCGACTTTTACCTATTAT
. CTCTACCTGCTACTTGAGCAATACGATACTTTTAACAGATCGGAAATCTA
. AACAC

MTEC007945, Megapenthes, angularis, adult, Female, D.L. Gustafson, 7-Aug-93, United States of America, Montana, Richland Co, Missouri River at Culbertson, ,

MTEC007946, Megapenthes, angularis, adult, Female, D.L. Gustafson, 16-Aug-96, United States of America, Montana, Fergus Co , "Missouri R., Fred Rob Br.", 47.6287N, 108.6824W, 712m,

MTEC007947, Selatosomus, semimetallicus, adult, Female, "C.Hart, A. Stavens", 29 Jun to 03 Aug 2011, United States of America, Montana, Ravalli Co, Blodgett Campground Rd, 46.2649N, 114.214041W, 4041ft, CTTCTCTTTAGCTTCTGATTGGAAGCTGAACTAGGAACCCCGGCTCCTCTCGATTGGATAATGACAAATTTACAAACGTAATCGTAC
AGCCCATGCCTTTATTTAATTTTCTTTATAGTTATACCAATCATAATTGGAGGATTCCGAATATTGACCTCTTCTTTAATACCTGAGCTCTTCATGACATTC
CCACGAATAAAACACATAAGATTCTGGTCTCCATACCCTTCCTTCGATTCTTT
ACTATAAAGAAGATCCTAGAAAAACGGGCAGGAACAGGTAGATCACTCATA
CCCTCCCTTTTCAACATTTGCTACAGAGGGCTTTCAAGTCGAACTAGCAA
TTTTTAGTTTTACAACCTAGCAGGAATTTTCATCAATTCTAGGAGCAGTAAATTT
ATTTCACAAGTATAACATACGATACACTGGAATCACCTTCGACCGAATGTC
CTCTATTGTATGAGCAGTATATTACTGCCCCCTCTTCTCCTTCTTTGT

MTEC007948,Limonius,canus,adult,Male,"D. Broers, M. Bayer",4-Apr-11,United States of America,Oregon,Umatilla Co.,Hermiston Potato
field,,,,CATCCCTAAGACTCTTGATTCGTGCCGAACTTGGTAACCCCCGCTCACT
AATCGGAAATGACAAATTACAATGTATTGTTACAGCCCGACCTTCATTA
TAATTTTCTTTTATAATGCGGTCTTTATTCGAGCCTTTTCGTTTCGGAACATGATTA
GTGCCCTGTAGATAGGAGGCCCCGTGATATAGGCCTCCCTCGAATAAAACAACATAG
TGAGATTCTGATTCTACCCCCGTCTCTCTCCTCTCCTCTCTAATAAGAAGAACATGTGAAGAATGGAAGACGC
CTCTATTGTATGAGCAGTATATTACTGCCCCCTCTTCTCCTTCTTTGT

MTEC007949,Limonius,canus,adult,,,6-Apr-04,United States of America,Washington,Klickitat
Co.,Klickitat,,,,CATCCCTAAGACTCTTGATTCGTGCCGAACTTGGTAACCCCCGCTC
TCACTAATCGGAAATGACAAATTACAATGTATTGTTACAGCCCGACCTTCATTA
TAATTTTCTTTTATAATGCGGTCTTTATTCGAGCCTTTTCGTTTCGGAACATGATTA
GTGCCCTGTAGATAGGAGGCCCCGTGATATAGGCCTCCCTCGAATAAAACAACATAG
TGAGATTCTGATTCTACCCCCGTCTCTCTCCTCTCCTCTCCTCTAATAAGAAGAACATGTGAAGAATGGAAGACGC
CTCTATTGTATGAGCAGTATATTACTGCCCCCTCTTCTCCTTCTTTGT

MTEC007950,Limonius,subauratus,adult,Male,D.L. Gustafson,8-Jun-94,United States of America,Montana,Lincoln Co,Yaak River Camp,,,


MTEC007953, Agriotes, ferruginipennis, adult, Male, D.L. Gustafson, 6-Jun-90, United States of America, Montana, Flathead Co, Glacier National Park near Polebridge,

MTEC007954, Agriotes, ferruginipennis, adult, Male, D.L. Gustafson, 13-Jun-87, United States of America, Montana, Gallatin Co, Gallatin R., 4700ft,

MTEC007955, Limonius, infuscatus, adult, Female, "R.F. Lang, J.P. Cuda", 16-May-88, United States of America, Montana, Flathead Co, Kalispell,

MTEC007956, Limonius, infuscatus, adult, Male, G.J. McDermott, 5-May-90, United States of America, Montana, Granite Co, Nimrod Springs,

MTEC007957, Limonius, infuscatus, adult, Male, "R.F. Lang, J.P. Cuda", 10-May-88, United States of America, Montana, Flathead Co, Hungary Horse,

MTEC007958, Limonius, infuscatus, adult, Male, "R.F. Lang, J.P. Cuda", 10-May-88, United States of America, Montana, Flathead Co, Hungary Horse,

MTEC007959, Limonius, agonus, adult, Male, "F. Etzler, C. Hart", 12-May-12, United States of America, Ohio, Sandusky Co., Outside Fremont on Hwy 6, 41.3573N, 83.1649W, 620ft, CATCCTTAAGACTCTTTGATTCGTGCAGAGCTAGGA AACCCTGGCTCACTAATCGGAAACGCAACAAATTATAACGTTGTAGGTGACCCG AGCCCTTTTATTATAATTTTTCTTCTCATAAGTAATACCAATCTAATTTGGTAGGTGT CGGAAAATTGACTATGGCCTCTCTTAATATTGGAGCCCGCCTGATATAGCATGCCCTT CAGAATAATAATAGTCTGTCCCTTCTCCTCTCACCCTCTCTCTCTTTAATACGATCTACA CTACTTATATTACGACTTCCTACCCCTGGAATTACATGTCTCTCTTCTCTTCTACCTCCTATTTTIGTCA
MTEC007960, Aeolus, mellillus, adult, P.S. Gill, 2010, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft.

MTEC007961, Dalopius, sp., adult, P.S. Gill, 2010, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft.

MTEC007962, Dalopius, sp., adult, P.S. Gill, 2010, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft.

MTEC007963, Agriotes, criddlei, adult, P.S. Gill, 2010, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft.

MTEC007964, Dalopius, sp., adult, P.S. Gill, 2010, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft.

MTEC007965, Hadromorphus, glaucus, adult, P.S. Gill, 2010, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft.
MTEC007966, Dalopius, sp., adult, P.S. Gill, 2010, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987 ft,

MTEC007967, Dalopius, sp., adult, P.S. Gill, 2010, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987 ft,

MTEC007968, Psudanostirus, propola, adult, P.S. Gill, 2010, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987 ft,

MTEC007969, Agriotes, criddlei, adult, P.S. Gill, 2010, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987 ft,

MTEC007970, Hadromorphus, glaucus, adult, P.S. Gill, 2010, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987 ft,

MTEC007971, Hadromorphus, glaucus, adult, P.S. Gill, 2010, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987 ft,

MTEC007972, Hadromorphus, glaucus, adult, P.S. Gill, 2010, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987 ft,

MTEC007973, Dalopius, sp., adult, P.S. Gill, 2011, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987 ft,

MTEC007974, Hadromorphus, glaucus, adult, P.S. Gill, 2011, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987 ft,

MTEC007975, Hadromorphus, glaucus, adult, P.S. Gill, 2011, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987 ft,

MTEC007976, Hadromorphus, glaucus, adult, P.S. Gill, 2011, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987 ft,
MTEC007977, Hadromorphus, glaucus, adult, P.S. Gill, 2011, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft,

MTEC007978, Hadromorphus, glaucus, adult, P.S. Gill, 2011, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft,

MTEC007979, Agriotes, criddlei, adult, P.S. Gill, 2011, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft,

MTEC007980, Hadromorphus, glaucus, adult, P.S. Gill, 2011, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft,

MTEC007981, Hadromorphus, glaucus, adult, P.S. Gill, 2011, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft,

MTEC007982, Hadromorphus, glaucus, adult, P.S. Gill, 2011, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft,

MTEC007983, Athous, sierrae varius, larva, P.S. Gill, 2010, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft,

MTEC007986, Limonius, infuscatus, larva, P.S. Gill, 2010, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft,
MTEC007987, Dalopi us, sp., larva, P.S. Gill, 2010, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft, GCTGTAATTAGGTAACCCAGGATCACAATT GGAAATGATCAAAACCTACTATATTGTGAACACCATGCTATTACATTATTT TTTCCTCATTATTTATTCTACTATAATTGGAGGATTCGGAAAATTGGTACATCC CATTAATCTTGAGCTCCAGATATAGCCCTCTCCGAATAAAACACATAAG ATTCCTGATTTTTACCCTATTTCTCTCTTCTTATAAGAAGAATTTTTGAA AATGGGAGCAGAACCAGGTGAACTGTATTACCACCCCACATTATCTCTAAAATG GACACACAGAGCTCATCAGTTGATTAGCAATTTTTAGGTTACACTTAGCTGG TATCTCGTAATCTTAGGGCGTGAAAATTTTATTTTACAGAAGAATTTATAC GATCAACTGGAATTACCTTTTACCGGAATACCTTTTATTTTGGAGCAGTTGCA ATTACTGCTCATTATTATTAATCTCTACACTACCAGATTAGACTGTGGGAGCA ATTACTTAACCGAGCAATCTAAACACATCA

MTEC007991, Dalopius, sp., larva, P.S. Gill, 2010, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft, CTTCATTAAGACTATTTATTGCAACCTATGGTCAAATTCAACATGCTATTGTTA ACAGCCCATCATTATTATTGGAATTGACCAAAATCTACAATGCTATTGAT TATCCCATGTTTTATTATATAATTGTTATACACAAATTATAATTGGGG GATTCGAAATTTGAGTTATTTCCCTAATAACTAGGGCCAGAACCATGCT TTTCTACAGGAATAGAATTGGAATAAAGTGTGGCAGGAACAGGTGAACGTGTA TTTCTACAGGAATAGAATTGGAATAAAGTGTGGCAGGAACAGGTGAACGTGTA

MTEC007993, Hemicrepidius, sp. nr. carbonatus, larva, P.S. Gill, 2010, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft, CTTCATTAAGACTATTTATTGCAACCTATGGTCAAATTCAACATGCTATTGTTA ACAGCCCATCATTATTATTGGAATTGACCAAAATCTACAATGCTATTGAT TATCCCATGTTTTATTATATAATTGTTATACACAAATTATAATTGGGG GATTCGAAATTTGAGTTATTTCCCTAATAACTAGGGCCAGAACCATGCT TTTCTACAGGAATAGAATTGGAATAAAGTGTGGCAGGAACAGGTGAACGTGTA TTTCTACAGGAATAGAATTGGAATAAAGTGTGGCAGGAACAGGTGAACGTGTA

MTEC007994, Hemicrepidius, sp. nr. carbonatus, larva, P.S. Gill, 2010, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft, CTTCATTAAGACTATTTATTGCAACCTATGGTCAAATTCAACATGCTATTGTTA ACAGCCCATCATTATTATTGGAATTGACCAAAATCTACAATGCTATTGAT TATCCCATGTTTTATTATATAATTGTTATACACAAATTATAATTGGGG GATTCGAAATTTGAGTTATTTCCCTAATAACTAGGGCCAGAACCATGCT TTTCTACAGGAATAGAATTGGAATAAAGTGTGGCAGGAACAGGTGAACGTGTA TTTCTACAGGAATAGAATTGGAATAAAGTGTGGCAGGAACAGGTGAACGTGTA

MTEC007995, Hemicrepidius, sp. nr. carbonatus, larva, P.S. Gill, 2010, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft, CTTCATTAAGACTATTTATTGCAACCTATGGTCAAATTCAACATGCTATTGTTA ACAGCCCATCATTATTATTGGAATTGACCAAAATCTACAATGCTATTGAT TATCCCATGTTTTATTATATAATTGTTATACACAAATTATAATTGGGG GATTCGAAATTTGAGTTATTTCCCTAATAACTAGGGCCAGAACCATGCT TTTCTACAGGAATAGAATTGGAATAAAGTGTGGCAGGAACAGGTGAACGTGTA TTTCTACAGGAATAGAATTGGAATAAAGTGTGGCAGGAACAGGTGAACGTGTA
TTATTTGAGCTTGTATTACAGCCCTTCTTACTACTTTCTCTACCTGTTCTTGCAGGAGCAATTACTATACTTTTTAAGATCGGAATTTAAATACAT

MTEC007996, Selatosomus, aeripennis, larva, P.S. Gill, 2010, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft.

MTEC007997, Hypnoidus, leei, larva, P.S. Gill, 2010, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft.

MTEC008015, Aeolus, mellillus, larva, P.S. Gill, 2010, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft.

MTEC008016, Aeolus, mellillus, larva, P.S. Gill, 2010, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft.

MTEC008017, Aeolus, mellillus, larva, P.S. Gill, 2010, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft.
MTEC008018, Aeolus , mellillus , larva , P.S. Gill, 2010, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987 ft, CGTCAATTGAGATTACTAATTCGAGCCGAAAC TAGGTAACCCGTTCTTTAATTGGAAGAATGACAAATCTATAACGTAATTGTA ACTGCACTGCACTCATATAATTITCTTCATAGTTGAAATCTGCTGAGCCGAAACGATATGGCCT TCCACAGATGAAACAATAATAGATTGCTGGCTTCTCTCTCTTTATAGCTCC TTTTAATGAGAAGAATTGTAAGAATAGGAGAAGAAGTGAACCTTTTATCAGCAAATATTGCCCACAGTTGAAGCAGGACTTAGGCATCATCTCAGTTTAGGCAACGACTCC AATGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACTGGACCG
CTTTCATCATAATTTTCTTCATAGTAATACCAAATTTATAATCGGTGGATTTGGA
AACTGATTAGTACACCATTATACAGAGGAGCCCCAGACATAGCATTCCCTCGAAT
AAATAATAGATTCTGATTTCCCTCCCTACGCGTTCCTTTGCTTTCTCAAGAG
AAGATTGATGAAAGTCTGCTGACTAGGATAGAAGTCTTTATACCCCTCTTAG
TCAGCAAAACATTGCCATAGAGGTCTCGGTTGATTTGGGAATTTTCTAGCT
GCATCTAGCGAATCTCATAAATTCATGAGAACGTAATATTCCCTCCAGG
TAATAATACAGGAAATCTTTATTCTGGCTTTTTACTATTACTCTCTCTCCTTACCAGTTCG
GGGCAATCACAATATAAACTATTAAACAGACCAGAATCTAAATACCTCAATCTTTTTT

MTEC008031,Limonius,infuscatus,larva,,P.S. Gill,2011,United States of America,Montana,Gallatin Co.,Fort Ellis Experiment Station,45.6692N,110.9755W,4987ft,ACTTGGTACATCCTTAAGACTCCTTATTCG
GGAGAGCTGGGAAATCCTGGCTCATTAATTGGAAATGACCAAATTTATAACG
TAATTGTAACAGCAGACAGCTTTCATCATAATTTTCTTCATAGTAATACCAAAT
ATAATTCCGTTGAGTTGGAACCTGATAGTACTCATTAAATCAGAAGCCCGAC
ACATAGCATTCCCCCTGAATAAATAATATAGAAGTGCATTCTGATTTGGCAATTTTCAGTCT
GCATCTAGCAGGAATCTCATCAAATTCATGAGAACGTAATATTCCCTCCAGG

MTEC008032,Selatosomus,aeripennis,larva,,P.S. Gill,2011,United States of America,Montana,Gallatin Co.,Fort Ellis Experiment Station,45.6692N,110.9755W,4987ft,CTTCTCTATGGCCTTTAATTCGAGCTGAAC
AGGTAATCCCGCAGCTCTCAGGTAATTGACCAAATTTACAACCTAATCCGAAC
CAGCCCAACGCTTATATAATTTTCTCAGAATCAGTACATCCCTACACGT
GGAGATCCGAAATTTGGCTATCCCCCTTAAATAGGGAGTACATGCTTTATCG

MTEC008037,Dalopius,sp.,larva,,P.S. Gill,2011,United States of America,Montana,Gallatin Co.,Fort Ellis Experiment Station,45.6692N,110.9755W,4987ft,TCATTAAGACTACTAATTCGTGCTGAATTAG
GGTAATCCCGCAGCTCTCAGGTAATTGACCAAATTTACAACCTAATCCGAAC
CAGCCCAACGCTTATATAATTTTCTCAGAATCAGTACATCCCTACACGT
GGAGATCCGAAATTTGGCTATCCCCCTTAAATAGGGAGTACATGCTTTATCG

MTEC008037,Dalopius,sp.,larva,,P.S. Gill,2011,United States of America,Montana,Gallatin Co.,Fort Ellis Experiment Station,45.6692N,110.9755W,4987ft,TCATTAAGACTACTAATTCGTGCTGAATTAG
GGTAATCCCGCAGCTCTCAGGTAATTGACCAAATTTACAACCTAATCCGAAC
CAGCCCAACGCTTATATAATTTTCTCAGAATCAGTACATCCCTACACGT
GGAGATCCGAAATTTGGCTATCCCCCTTAAATAGGGAGTACATGCTTTATCG

MTEC008037,Dalopius,sp.,larva,,P.S. Gill,2011,United States of America,Montana,Gallatin Co.,Fort Ellis Experiment Station,45.6692N,110.9755W,4987ft,TCATTAAGACTACTAATTCGTGCTGAATTAG
GGTAATCCCGCAGCTCTCAGGTAATTGACCAAATTTACAACCTAATCCGAAC
CAGCCCAACGCTTATATAATTTTCTCAGAATCAGTACATCCCTACACGT
GGAGATCCGAAATTTGGCTATCCCCCTTAAATAGGGAGTACATGCTTTATCG

MTEC008037,Dalopius,sp.,larva,,P.S. Gill,2011,United States of America,Montana,Gallatin Co.,Fort Ellis Experiment Station,45.6692N,110.9755W,4987ft,TCATTAAGACTACTAATTCGTGCTGAATTAG
GGTAATCCCGCAGCTCTCAGGTAATTGACCAAATTTACAACCTAATCCGAAC
CAGCCCAACGCTTATATAATTTTCTCAGAATCAGTACATCCCTACACGT
GGAGATCCGAAATTTGGCTATCCCCCTTAAATAGGGAGTACATGCTTTATCG

GATTCGGAAATTGATTAGTCCCATTAATACCTTGAGCGCyCCAGATATAGCmTTC
CCTCGAATAAAACAYAATAAGATTTTTGTATTTTATCCCCCCTCATTATCTCTTCT
CTtATAAGAAGAATTGTTGAAAATGGAGACAGGAACAGGTATTTACC
CTCCACTATCTTCAAAATTTGCACAATTAGGCTATCGTTTGGCATATGGAATT
TTGAGTTTACACTTAGCTGGATTTTCCATCAATTTTAGGGGCTGAAATTITATT
TCCACAGTAATTAATAGACGTAACCTGGAATTACCTTGGACCCGAAATACCTTT
ATTGTATTGGACATTACCTTACCTTTACTTTACTTTCTACTACCAGT
ATTAGCgGAGCAATTACTATACTATATAAAGACGACAATACTAAACACGAC
MTEC008044, Dalopius, sp., larva, P.S. Gill, 2011, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft, ATCATTAAAGACTACTAAATTCGTGCTGAAATTAG
GGTAACCCAGGATCACATTATTGGAAAATGATCAAATCTACACGTTAATGTAAC
CAGCACATGCATTATATAATTCTCTACCTATCGTTATACCTACAAATTTGGA
GGATTCGGAAATTGATTAGTCCCATTAATACCTTGAGCGCATCCATATAGCCTTT
CCCTCGAATAACAAACTAAGAGATCTGATTTTTACCCCTCTTACCTTCTCTCT
CTTCTATAAGAAGAATTGTTGAAAATGGAGACAGGAACAGGTATTTACC
CTCCACTATCTTCAAAATTTGCACAATTAGGCTATCGTTTGGCATATGGAATT
TTGAGTTTACACTTAGCTGGATTTTCCATCAATTTTAGGGGCTGAAATTITATT
TCCACAGTAATTAATAGACGTAACCTGGAATTACCTTGGACCCGAAATACCTTT
ATTGTATTGGACATTACCTTACCTTTACTTTACTTTCTACTACCAGT
ATTAGCgGAGCAATTACTATACTATATAAAGACGACAATACTAAACACGAC
MTEC008049, Dalopius, sp., larva, P.S. Gill, 2011, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft, ATCATTAAAGACTACTAAATTCGTGCTGAAATTAG
GGTAACCCAGGATCACATTATTGGAAAATGATCAAATCTACACGTTAATGTAAC
CAGCACATGCATTATATAATTCTCTACCTATCGTTATACCTACAAATTTGGA
GGATTCGGAAATTGATTAGTCCCATTAATACCTTGAGCGCATCCATATAGCCTTT
CCCTCGAATAACAAACTAAGAGATCTGATTTTTACCCCTCTTACCTTCTCTCT
CTTCTATAAGAAGAATTGTTGAAAATGGAGACAGGAACAGGTATTTACC
CTCCACTATCTTCAAAATTTGCACAATTAGGCTATCGTTTGGCATATGGAATT
TTGAGTTTACACTTAGCTGGATTTTCCATCAATTTTAGGGGCTGAAATTITATT
TCCACAGTAATTAATAGACGTAACCTGGAATTACCTTGGACCCGAAATACCTTT
ATTGTATTGGACATTACCTTACCTTTACTTTACTTTCTACTACCAGT
ATTAGCgGAGCAATTACTATACTATATAAAGACGACAATACTAAACACGAC
MTEC008050, Agriotes, sp. nr. sparsus, larva, P.S. Gill, 2011, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987ft, ATCATTAAAGACTACTAAATTCGTGCTGAAATTAG
GGTAACCCAGGATCACATTATTGGAAAATGATCAAATCTACACGTTAATGTAAC
CAGCACATGCATTATATAATTCTCTACCTATCGTTATACCTACAAATTTGGA
GGATTCGGAAATTGATTAGTCCCATTAATACCTTGAGCGCATCCATATAGCCTTT
CCCTCGAATAACAAACTAAGAGATCTGATTTTTACCCCTCTTACCTTCTCTCT
CTTCTATAAGAAGAATTGTTGAAAATGGAGACAGGAACAGGTATTTACC
CTCCACTATCTTCAAAATTTGCACAATTAGGCTATCGTTTGGCATATGGAATT
TTGAGTTTACACTTAGCTGGATTTTCCATCAATTTTAGGGGCTGAAATTITATT
TCCACAGTAATTAATAGACGTAACCTGGAATTACCTTGGACCCGAAATACCTTT
ATTGTATTGGACATTACCTTACCTTTACTTTACTTTCTACTACCAGT
ATTAGCgGAGCAATTACTATACTATATAAAGACGACAATACTAAACACGAC
CCTCCTCTATCAGCAAATATTGCTCATAGAGGGTCCTCAGTAGACCTCGCTATTTTCA
TTTCAGTTTACATTTAGCAGGAATCTCATCAATTCTAGGGGCAGTAAATTTTA
TTTCCACAGTAATTAATACGATCTACCAGGAATCATATTGATCGTAGC
TTATTTGTTTGAAGCGTTCATTATACGCCTTTCTTACTACTTCTACTCTGTTCTTGCAAGGACAAATTACATCTACTTTTAACAGATCGAATTTAAATACATCAT

MTEC008054, Hemicrepidius, sp. nr. carbonatus, larva, P.S. Gill, 2011, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987 ft, CTTCATTAAGACTATTAATTCGAGCAGAAC
TTTGTAATCCTGGATCACTTATTGGAAAAATGACCAAAATCTACAATGCTATGTA
ACAGCCCATGCTTTATTATTTATTTATATTAGTTACCAAATTATAATTGGAAT
GGATTCGGAAATTGGTTAGTCCCTCCTACTAGAGCCCAGACATGGGA
TTCCCAATGAAACACATGAGACATGGACATGTA
TTCCACAGTAATTAATACGATCTACCAGGAATCATATTGATCGTAGC
TTATTTGTTTGAAGCGTTCATTATACGCCTTTCTTACTACTTCTACTCTGTTCTTGCAAGGACAAATTACATCTACTTTTAACAGATCGAATTTAAATACATCAT

MTEC008111, Hemicrepidius, sp. nr. carbonatus, adult, P.S. Gill, 2011, United States of America, Montana, Gallatin Co., Fort Ellis Experiment Station, 45.6692N, 110.9755W, 4987 ft, CTTCATTAAGACTATTAATTCGAGCAGAAC
TTTGTAATCCTGGATCACTTATTGGAAAAATGACCAAAATCTACAATGCTATGTA
ACAGCCCATGCTTTATTATTTATTTATATTAGTTACCAAATTATAATTGGAAT
GGATTCGGAAATTGGTTAGTCCCTCCTACTAGAGCCCAGACATGGGA
TTCCCAATGAAACACATGAGACATGGACATGTA
TTCCACAGTAATTAATACGATCTACCAGGAATCATATTGATCGTAGC
TTATTTGTTTGAAGCGTTCATTATACGCCTTTCTTACTACTTCTACTCTGTTCTTGCAAGGACAAATTACATCTACTTTTAACAGATCGAATTTAAATACATCAT
APPENDIX B

*LIMONIUS CANUS*-GROUP SPECIMEN LOCALITIES
**Limonius agonus** specimens examined: Specimens with DNA extracted have an accompanying MTEC barcode. Nine specimens in total examined.

**Canada: Quebec:** Brome, 23 MAY 1938, W.J. Brown (CNCI); Becancour, 23 MAY 1900 Nic., C.Chantal (CNCI); Becancour, 23 MAY 1964 Nic., C.Aubé (CNCI*^); d.r.Lévis St-Romuaid, 27 MAY 1972, J.F. Landry (CMNC*, MTEC007919); d.r.Lévis St-Etienne, 29 MAY 1976, J.F.Lanry (CMNC, MTEC007920); St-Etienne Lévis, 12 JUNE 1986, P.Bélanger (CMNC, MTEC007922); Arthabaska Co. St-Louis-de-Blanford, 12 MAY 1990, Yves-Pascal Dion Coll. (CMNC, MTEC007923).


**Limonius californicus** specimens examined: 52 specimens examined.


Specimens nr. californicus 18 specimens examined in total

Limonius canus specimens examined: 46 specimens in total.

United States: California: Fresno Co., Needles, 28 FEB 1968, ex Hordeum vulgare, Dunnegan (CDFA); Fresno Co., Raisin City, 1 MAR 1968, ex Hordeum vulgare, H.V. Dunnegan (CDFA); Oxnard, 9 MAR 1945, M.T. Osborn, ex vetch and barley (2)(CDFA); Sacramento Co., American river nr. Hwy 80, 14 APR 1983, F. Andrews (CDFA); Sonoma Co., Dillon Beach, 17 May 1975, F.G. Andrews and L.E. Andrews (CDFA); Idaho: Lewiston (MTEC~); Emmett, 15 APR 1926 (CNCI^); Owyhee Co., Bruneau Dunes, 26 FEB 1974, D. Giuliani (4) (CDFA); Montana: Cascade Co., 29 MAY 1978, B. Zupan (MTEC, MTEC007912); Flathead Co., La Salle, 29 MAY 1933, W. L. Jellison (2)(MTEC); Flathead Co., Hungry Horse, 10 MAY 1988, R. F. Lang and J. P. Cuda (MTEC,MTEC007642); Flathead Co., Glacier National Park, N. Fork Flathead Area 1988 Red Beach Fire study, Big Prairie, elev 3560’ 29 MAY 1991, M.A.Ivie (MTEC, MTEC007463); Hamilton, 1 JUL 1928 (MTEC~); Hamilton, 15 MAY 1935, On Cabbage (2)(MTEC~); Hamilton, 20 APR 1936, W. Schockley (2)(MTEC~); Livingston, 12 APR 1962, E. Wiegand (MTEC); Missoula, 22-44 (2)(MTEC~); Missoula Co., Missoula, 25 MAY 1983, on apple and pear blossoms (2)(MTEC, MTEC007910, MTEC007911); Missoula Co., Clark Fork River on Salix exigua, 4 JUN 1988, S. J. Harvey (MTEC); Mont. Exp. Sta. Bozeman, 20 MAY 1920 (MTEC~); Mont. Exp. Sta. Lo Lo, 10 JUN 1913 (MTEC~); Powell Co., Blackfoot R. MT 141, 26 JUN 1989, D.L. Gustafson (MTEC, MTEC007464); Ravalli Co., Laboratory, 7 MAY 1934, W. L. Jellison
(MTEC); Ravalli Co., 14 MAY 1931 (2)(MTEC~); Red Lodge, 25 JUN 1957, R. Bonfill (MTEC); Oregon: Freewater, 4mi N. Milton, 15 MAY 1963, J. A. Onsager (MTEC); Hermiston, 12 APR 2000, 131122 trap, Horton (WSUC); Umatilla Co., Hermiston, 31 MAR 2010, potato field trap, D. Broers and M. Bayer (WSUC, MTEC007939); Umatilla Co. Hermiston, 04 APR 2011, potato field trap, D. Broers and M. Bayer (WSUC, MTEC007948); Washington: Benton Co, Hanford Site sand dunes W of Columbia Riv., N46°31.369’ W119°21.192’, 29 JAN 1999, R. S. Zack and C. N. Looney, crawling on dunes (WSUC^); Klickitat Co., Klickitat, 06 APR 2004, cottonwood (2)(WSUC, MTEC007949); Pullman (MTEC~); Walla Walla, 17 MAY 1933, C.E. Woodowrth (WSUC^); Washington?: septa test, geranyl caprrate, rep 3, 4 APR 2002 (WSUC); actyl butyrate septae test, rep 1, 4 APR 2002 (WSUC); nonyl butyrate repta test, rep 2, 4 APR 2002 (WSUC)

*Limonius cf. dubitans* specimen examined: One specimen.


*Limonius ectypus* specimen examined: One specimen.

United States: Indiana: Lafayette, 12 JUN 1957, G.H. Nelson, Sweeping (CNCI*)

*Limonius infuscatus* specimens examined: 169 specimens were examined in total.

United States: California: Riverside Co., Poppett Flat, Mt. San Jaciato, 23 MAY 1976, K.W. Cooper (2)(CDFA); Ventura Co., Oxnard, 9 MAR 1945, M.T. Osborn, ex. vetch and barley (CDFA); Idaho: Latah Co., Lost Crk. 4 mi NNE Harvard, 30 MAY 1981, R. S. Zack (WSUC^); Montana: Beaverhead Co., Tepee Cr. flats area, 44.6688, -111.7482,
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16 JUN 1995, 2027m, D.L. Gustafson (MTEC); Broadwater Co., 4.3 mi no. of Willow Creek, 12 APR 1985, R. F. Lang (MTEC); Broadwater Co., Hwy 287, Jefferson River 25 MAY 1988, S.M. Clark (MTEC); Broadwater Co., Confederate Gulch, 27 MAR 1990, D. L. Gustafson (MTEC); Big Fork, 16 JUN 1904 (MTEC~); Flathead Co., Hungary Horse, 10 MAY 1988, R. F. Lang, J. P. Cuda (13)(MTEC, MTEC007957, MTEC007958);
Flathead Co., Hungary Horse, 6 JUN 1991, R. F. Lang and R. D. Richard (4)(MTEC, MTEC007730); Flathead Co., Kalispell, 16 MAY 1988, R. F. Lang, J. P. Cuda (19)(MTEC, MTEC007727, MTEC007955); Flathead Co., La Salle, 29 MAY 1933, W. L. Jellison (MTEC); Flathead Co., Whitefish Lake, City Beach, 16 MAY 1989, H. W. Ziolkowski (17)(MTEC, MTEC007728, MTEC007731); Fergus Co., 16.5mi NE Winifred, pitfall, 18 MAY 1983(MTEC); Fergus Co., Lewistown, pitfall 8-28 MAY 1988, 4200ft, C. E. Seibert (MTEC); Gallatin Co., elev. 5800, 16 JUN 1900, E. Koch (MTEC~); Gallatin Co., elev. 4800, 19 APR 1902, R. Benton (2)(MTEC~); Gallatin Co., elev. 4800, 26 APR 1902, R. Benton (4)(MTEC~); Bozeman, 31 MAY 1907 (MTEC); Mont. Exp. Sta. Bozeman, 6 MAY? 1912 (MTEC~); Gallatin Co., 30 MAY 1923 (MTEC~); Gallatin Co., 17 APR 1926 (MTEC~); Gallatin Co., 18 APR 1926 (MTEC~); Gallatin Co., 24 APR 1926, H.C. Donohoe (MTEC~); Bozeman, 2 JUN 1926 (MTEC);
Bozeman, 15 MAY 1927, R. Hutchins (MTEC~); Bozeman, 25 APR 1928 (MTEC~); Gallatin Co., 25 APR 1928 (MTEC~); Gallatin Co. 16 MAY 1929 (MTEC~); Gallatin Co., 10 MAY 1939, J. Blanchard (MTEC); Gallatin Co., 4 APR 1947 (MTEC); Gallatin Co., 11 APR 1947 (MTEC); Gallatin Co., 24 APR 1953, Student Collector (MTEC);
Bozeman, Bridger slopes, 2 MAY 1954, G. Roemhild (MTEC); Gallatin Co. 24 MAY
1954, Student Collector (MTEC); Gallatin Co., 2 MAY 1955, Student Collector (MTEC);
Gallatin Co., 12 MAY 1955, Student Collector (MTEC); Gallatin Co., 19 MAY 1955,
Student Collector (4)(MTEC); Gallatin Co., 12 MAY 1956, Student Collector (MTEC);
Gallatin Co., 10mi N. Manhattan, 16 MAY 1956, J. Warren (MTEC); Gallatin Co., 14
MAY 1957, Student Collector (MTEC); Gallatin Co., 18 MAY 1957, Student Collector
(MTEC); Gallatin Co., 20 MAY 1957, Student Collector (MTEC); Gallatin Co., 15 MAY
1970, D. McLean (MTEC); Gallatin Co., 16 MAY 1970, A. Parks (MTEC); Gallatin Co.,
17 MAY 1970, A.M. Nixon (MTEC); Gallatin Co., 3 km NE of Bozeman, “The M”, 7
MAY 1980, S.D. Rose (MTEC); Gallatin Co., 8mi W of Bozeman, 14 MAY 1980, S.
Rose (2)(MTEC); Gallatin Co., Exp. St. Fm., 8km W Bozeman, 14 MAY 1980, S. Rose
(MTEC); Gallatin Co., 23 APR 1983, MSU Ag. Exp. Station, Student Collector (MTEC);
Gallatin Co., 10 MAY 1983, Student Collector (MTEC); Gallatin Co., 18 MAY 1984,
Student Collector (MTEC); Gallatin Co., 1mi SW of Belgrade, 23 MAY 1987, R.F. Lang
(MTEC); Gallatin Co., Madison Buffalo Jump St. Pk. 7 mi S Logan, 14 MAY 1989,
M.A. and R.O. Ivie (MTEC); Gallatin Co., Belgrade, 01-25 JUN 1990, N.A. Poritz
(MTEC); Gallatin Co., 3mi E Bozeman, 13 JUN 1991, H.W. Ziolkowski (MTEC);
Gallatin Co., 5mi N Bozeman, Story Hills, 21 APR 1993, D.S. Sikes (MTEC); Gallatin
Co., Ecton, Amsterdam, 26 MAY 1999, from alfalfa (3)(MTEC); Granite Co., 2mi SE
Maxville, Deerlodge Nat. For., Boulder Ck, L.Funnel, elev. 5050ft, 8-20 MAY 1988,
C.E. Seibert (MTEC); Granite Co., Nimrod Springs, 05 MAY 1990, G.J. McDermott
(4)(MTEC, MTEC007956); Hill Co., Beaver Crk Park, 48.3866N, 109.6818W, 26 MAY-
Limonius pilosulus specimens examined: Six specimens in total.

United States: California: Sacramento Co., 5 APR 1915, E. J. Vosler (2) (CDFA); Sonoma Co., Plantation, 16 MAY 1969, R.P. Allen (CDFA); Ukiah, 29 MAR 1936, H. Leech (CNCI); Yo-Solano Co., Putah Cyn, 25 JUN 1948, E. I. Schlinger (CDFA~);

Oregon: Forest Grove, MAY 1917, from tanglft screen 17-25, J. F. Brimley (CNCI*)

Limonius subauratus specimens examined: 15 specimens in total.

L. anceps labeled: Canada: Quebec: Berthierville, 2 JUL 1979 (CNCI); St-Entienne, C. Lévis, 5 JUN 1972, C. Chantal (CNCI*); 23 JUN 1932, Fr. Firmin (CNCI*); St-Mathieu-du-parc, St-Maurice, 22 JUN 1988 (CMNC, MTEC007921); Ste-Agathe, Lotbinière, 4 JUN 1985, P.Bélanger (CMNC, MTEC007924)

L. sp. nr. *subauratus* labeled: **Canada: British Columbia:** Agassiz, 4 JUN 1927, R. Glendenning (CNCI); Agassiz, 6 JUN 1927, H. H. Ross (CNCI); Summerland, 26 MAY 1932, A. N. Cartrell (CNCI)
APPENDIX C

LUCID KEY TO THE WIREWORMS OF MONTANA
(ON CD)
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