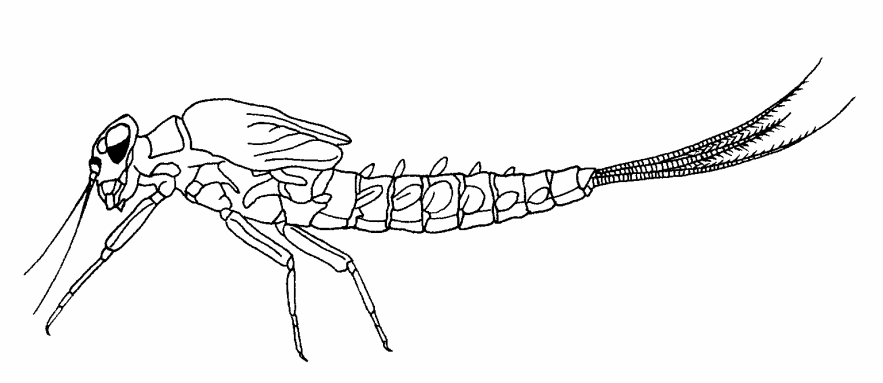
CHAPTER 1

INTRODUCTION



Citation:

Bouchard, R.W., Jr. 2004. Guide to aquatic macroinvertebrates of the Upper Midwest. Water Resources Center, University of Minnesota, St. Paul, MN. 208 pp.

1 INTRODUCTION

This guide has been developed for the identification of common aquatic invertebrates found in Minnesota and the Upper Midwest. Most aquatic and semiaquatic organisms collected from a variety of water body types (*e.g.*, streams, rivers, lakes, wetlands, bogs, seeps, etc.) will key out in this guide. However, invertebrate samples often include semiaquatic and terrestrial invertebrates that are not dealt with in this guide. Additionally, the characters in this guide are based on mature larvae or adults, so some immature larvae may not key out properly because of their small size and lack of well-developed characteristics. Finally, not all aquatic taxa occurring in this region will key out in this guide as it focuses on the taxa most commonly encountered by students and volunteers.

In this guide, dichotomous keys are provided to identify most insects to the family level and non-insects to the family or higher level (*e.g.*, order, class, etc.). The keys are divided into several chapters and placed into hierarchical order. The first key (Chapter 2: Aquatic Invertebrates) deals with all aquatic invertebrates and is designed to separate insects from other invertebrates and to identify non-insect invertebrates to the family or higher level. After you have identified an organism as an insect, the second key (Chapter 3: Class Insecta) can be used to identify insects to the order level. Finally, each insect order has its own key (Chapters 4 through 13) for family level identifications.

The keys in this guide are modified from a number of sources including Merritt and Cummins (1996), Hilsenhoff (1995), McCafferty (1981), Brigham et al. (1982), Pescador and Harris (1995), Pennak (1989), and Thorp and Covich (2001) (see Appendix E for full references). Illustrations in this guide are modified and redrawn from a variety of sources. A complete list of illustration acknowledgements is included in Appendix F at the end of the guide.

How to use this key

Before you begin to key out specimens, take time to page through this guide to familiarize yourself with the diversity of form and structure of aquatic invertebrates. You should also spend some time learning the terms for structures and orientations. You can do this by examining the labeled figures at the beginning of many of the chapters. In addition, you should read through the orientation descriptions in Appendix B. If you have problems with terms, you can reference the glossary provided at the end of the guide in Appendix D. These exercises will improve your ability to use the keys provided in this guide.

Using dichotomous couplets

This guide uses dichotomous keys to identify aquatic invertebrates. A dichotomous key consists of a series of couplets or pairs of characters that are used to narrow down and eventually to determine an organism's identity (Figure 1). To help visualize the structure of a dichotomous key you can compare it to that of a tree. You start at the bottom of the tree trunk and each time the tree branches you must decide which character or characters match your specimen to determine which branch to follow. As you move up the tree you will continue to narrow down the identity of your specimen until you reach the end of a branch and the name of your organism.

To begin, start with the first couplet in the key and read both options. The first half of a couplet is designated by the couplet number (*e.g.*, 1.) whereas the second half is designated by the couplet number followed by an apostrophe (*e.g.*, 1'.) (Figure 1.1). In addition, in all couplets except the first, the couplet number for the first half of a couplet is followed by a number in parentheses (*e.g.*, 2(1).). This is the number of the previous couplet and allows you trace your steps back if you make a mistake. The apostrophe included with the second half of a couplet helps you determine which characters you selected when backtracking trough the key. It is important to read both options completely in order to insure correct identification. Choose the character or characters that match the specimen you are keying out. Illustrations are provided with most character descriptions to help with identification.

Once you have decided what character or characters match your specimen, the number following the character description will direct you to the next couplet. Go to the couplet that is given and again find the character or characters that match your specimen and proceed to the next couplet. Eventually you will reach the name of an organism, which means you have identified the specimen.

If you can identify the specimen further, a chapter number will follow the specimen's name. If a chapter number is given, go to this chapter and begin the new key following the same steps described above. If you reach a couplet and neither character or set of characters matches your specimen, you may have made an error. If this occurs, you may need to backtrack and determine where the mistake was made.

Once you have arrived at a determination, follow the page number given after the organism's name. This will take you to a more detailed description of the organism as well as an illustration of a characteristic member from that group. Use the description to double check your identification. If you are unsure of your identification, reference other entomological texts (see Appendix E) or consult with someone experienced with identifying aquatic invertebrates. Keep in mind, the more practice you have, the easier it becomes to identify aquatic invertebrates.

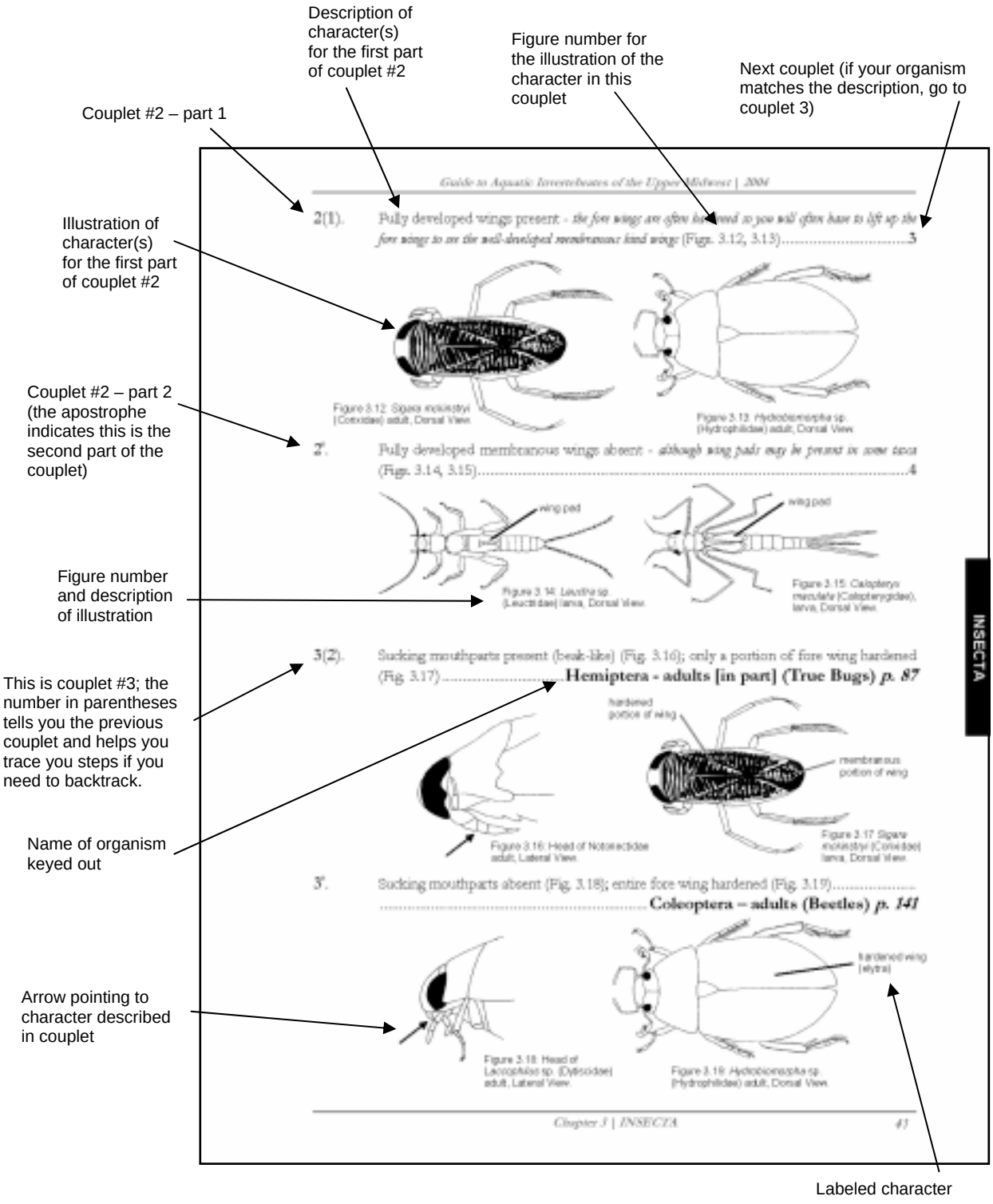


Figure 1.1: Dichotomous key layout example.

Layout of Descriptions for Families and Groups

A description of each insect order is provided before each order key. This information includes a description of the biology of the group and a description of the major characters used to identify the group and families within that group. An illustration of a generalized specimen for each order with labeled structures is also provided to aid with orientation and identification of structures used in the key. In addition, a description of each taxon is provided at the end of each key. Each scientific name at the top of the taxon description is a family name (these names end in "idae"). For taxa that are not families, the classification level (*e.g.*, class, order) follows the taxonomic name in parentheses. The information for each taxon is organized into the following categories:

Common Name: Organisms are designated a single scientific name following rules of the International Code of Zoological Nomenclature, but many organisms also have one or many common names. In this guide, common names for the groups are provided. Due to the variability of common names, some invertebrates may have additional common names or a common name may be applied to multiple groups. If you want to be sure you are applying the correct name to an organism it is generally best to use the scientific name.

Feeding Group: Another way to classify organisms is to place them in categories according to their feeding behavior or habit. The most common feeding habit is given for each taxon. In some cases several feeding habits are listed for a single taxon because many families contain numerous species using variety of feeding strategies. In addition, a single organism may change its feeding habits as it matures, as it passes through different life stages, or as food availabilities change. Be aware that your organism may not match the feeding habit given for the group because there are often unusual species or exceptions in a family. A complete description of feeding habits provided in Appendix C.

Tolerance Value: Invertebrates used to evaluate water quality are often given a number to represent their tolerance or intolerance to pollution. Higher numbers represent increased tolerance while lower numbers represent intolerance. In this guide, values of 0 through 3 are considered indicative of a low tolerance to stress, values of 4 through 6 a moderate tolerance, and values of 7 through 10 a high tolerance. Similar to feeding habits, the pollution tolerance can vary among species within a family or group. Additionally, many pollution tolerance values are based on only one or a few types of impact. For example, the pollution tolerance values given in this key are mainly for organic pollution and may not accurately reflect an organism's tolerance to heavy metals or toxic chemicals. Most of the tolerance values giving in this key are from Hilsenhoff (1988). Tolerance values for taxa not included in Hilsenhoff (1988) are taken from Barbour *et al.* (1999). For example, tolerance values for many Hemiptera and Coleoptera are not included in Hilsenhoff (1988). In addition, tolerance values have not been determined for many taxa and are listed as undetermined in this guide.

Habitat: The habitat section provides information on the type of water body and habitat in which an invertebrate can be found. Again, this information is based on the habitats of the majority of the species or the most common species within the family or group, but there are almost always exceptions. A complete description is provided in Appendix C.

Length: Lengths provided are for mature larvae and adults. Lengths do not include antennae and cerci when they are present.

Characteristics: This section lists a number of the more important diagnostic characters for the group. Unique characters used in the key are listed here along with additional characters not unique

to the group. These additional non-unique characters can sometimes be helpful when you have a difficult specimen. After you key out an organism, check the characteristics listed under the group description in order to double check your identification.

Notes: Some additional information about the biology of the group is included. This can include information on feeding, economic importance, or any interesting facts about these organisms.

Nomenclature: Common and Scientific Names

In this key organisms are often referred to by both their common and scientific names. A single organism can have several common names depending on who is referring to the organism and in what region it is found. Scientific names are more specific because international rules dictate that an organism can have only one scientific name.

The use of scientific names permits the classification of organisms into nested categories based on the evolutionary history of the organisms. For example, the species *Chironomus riparius* belongs to the family Chironomidae that in turn belongs to the order Diptera within the class Insecta (Figure 1.2). This means all of the species within the family Chironomidae are more closely related to each other than they are to any other species outside of the family.

As you move up the classification, all of the families in the order Diptera are more closely related to each other than they are to other families. As you move through the keys you will be working your way down this classification. For example, the first key deals with organisms belonging to the kingdom Animalia. The next key is for Insecta, a class nested within Animalia, followed by keys for several orders within Insecta. However, the individual keys are not necessarily based on the evolutionary relationships of these organisms.

The characters used to identify organisms are not always the same characters used to determine how closely they are related. This is because many of the characters used to determine evolutionary relationships are very difficult to see (*e.g.*, internal morphology, genetics) or require live specimens (*e.g.*, behavior). Therefore, you must be careful about the evolutionary conclusions you make using this guide. The only way to be sure if organisms are closely related is if they belong to the same group (*e.g.*, family, order, class) and not how closely they key out in this guide.

Kingdom – Animalia

Phylum – Arthropoda

Class – Insecta

Order – Diptera

Family – Chironomidae

Genus – *Chironomus*

Species - *riparius*

Figure 1.2: Taxonomic hierarchy using the midge *Chironomus riparius* as an example.