"What's the use of their having names," the Gnat said, "if they won't answer to them?" "No use to them," said Alice; "but it's useful to the people that name them, I suppose. If not, why do things have names at all?"

— Lewis Carroll from *Through the Looking Glass*

Introduction

In 1994, the Maryland Department of Natural Resources (DNR) began characterizing the biological condition of its freshwater streams statewide. As part of these efforts, the Maryland Biological Stream Survey (MBSS) has sampled streams and gathered data on benthic macroinvertebrates, fish, physical habitat, and selected water chemistry from Garrett County to the Eastern Shore. There is broad interest in increasing the involvement of the public and improving the accessibility of the MBSS results. This taxonomic identification key has resulted, in part, from a response to that interest.

Humankind's need to categorize and classify objects in nature is as old as our quest to understand our surroundings. Classification serves to organize diversity (in our case, biological diversity) into units or groups that can be managed by the human mind, and around which other knowledge can be organized and interpreted. Taxonomic keys serve as a type of "expert" system by which biological classification can be done by those who are not experts in the identification of particular plants or animals. This key was developed to help in the family-level identification of stream macroinvertebrates of Maryland; we also hope that it will help improve the awareness, appreciation, and recognition of stream biology and contribute to its protection.

Scope of the Key

As is common practice in developing keys, especially for higher taxonomic levels, such as family or order, much of the key's structure, the characters used, and many of the illustrations, are taken and adapted from existing works on invertebrate taxonomy and ecology (Merritt and Cummins 1996, Thorp and Covich 1991, Peckarsky et al 1984, Burch 1982). Much effort was made to convert technical taxonomic and morphological terminology to more broadly understood language, or to provide clear definitions. The taxonomic groups that are included are those benthic macroinvertebrates that are either known to occur in Maryland from the sampling results of the MBSS, or likely to occur from the national and regional taxonomic literature cited above. As such, it should also be useful for identifying macroinvertebrates from samples gathered from non-tidal streams in surrounding states.

Most groups are keyed to the family level, particularly those that are *most commonly* collected by stream monitors and ecologists. However, this key will NOT allow identification of, for example, Annelida beyond Oligochaeta and Hirudinea; or any taxonomic level of the *flying adult* stages of groups such as mayflies (Insecta: Ephemeroptera), caddisflies (Insecta: Trichoptera), or dragon- and damselflies (Insecta: Odonata) that are rarely caught when stream sampling. It also does not help in the identification of egg or pupal stages. Some of the anatomical features described in the key may be visible to the naked eye or by use of a hand lens; however, it will be necessary to use a dissecting microscope with a magnifying power of 50-100x to identify many of the characteristics. Users of this key should assume that some sort of magnification will be needed to identify, with confidence, most of the organisms in the key.

Using the Key

Aquatic insects, like all organisms, are classified using a specific hierarchical arrangement with various named levels. A group of organisms at any level is called a *taxon* (or, in the plural, *taxa*).

This key is primarily concerned with *family-level* classification. However, some groups are only keyed to class or order level. As an example, within the family Leptoceridae, there are several genera and within each of those genera are one or more species. The following table illustrates the taxonomic heirarchy used to classify animals—a system developed by Carolus Linnaeus in the 18th century. You can read the table below as follows:

Leptoceridae is a family within the order Trichoptera ➜
Trichoptera is an order within the class Insecta ➜
Insecta is a class within the phylum Arthropoda ➜
Arthropoda is a phylum under the kingdom Animalia.

Kingdom	Animalia
Phylum	Arthropoda
Class	Insecta
Order	Trichoptera
Suborder	————
Family	**Leptoceridae**
Subfamily	————
Genus	————
Species	————

In some instances, the taxonomic levels of "suborder" and "subfamily" may be used, but are rare in this key. Within the key, each taxonomic ***order*** of organisms (for example, Trichoptera) is separated into several numbered ***couplets***, consisting of an "*a*" and a "*b*" (see the example on the next page). Once you have identified the taxonomic order of an organism (for example, Trichoptera), use the key to identify the ***family*** of the organism (for example, Leptoceridae). Always start with couplet # 1 within any order. The organism you are trying to identify will match the description in either the *a* or *b* half of the couplet—but not both.

It will be easier to understand the terminology describing body parts if some Latin conventions are kept in mind. Specifically, in Latin, a singular noun is not made plural by adding an "s." Rather, an "i," "a," or "ae" are substituted for a plural ending. For example, the plural of the word *antenna* is *antennae*.

If the description keys to a family (as in 4a below), you have identified that organism. If the description doesn't key to a family, go to the next couplet indicated (as in #4b below which directs the taxonomist to couplet #5). The key also contains a brief paragraph about each family immediately after the specimen's identity is resolved. These *family facts* provide additional information on the habitat and habits of the organisms.

4	a. Antennae long (at least 6 times as long as wide) and/<u>or</u> sclerites on mesonotum (middle back) lightly pigmented except for a pair of dark curved lines; hind legs longer than others . . . . . **Leptoceridae** *These larvae are diverse in case construction, habitat and feeding behavior, though they are generally omnivorous.* [M/5/7/C] b. Antennae not more than 3 times as long as wide; no sclerotized lines 5	← *if the organism is described by this half (a) of couplet #4, then the organism keys to (is a member of) the caddisfly family called Leptoceridae* ← *additional details or "family facts"— see below for instruction on deciphering the bracketed information* ← *if the organism is described by this half (b) of couplet #4, then move on to couplet #5*

The *family facts* described above contain information on the habitat and habits of the organisms. The information in the brackets provide more specific detail about the general pollution tolerance and relative abundance of the family as well as estimates of the number of genera in Maryland and northeastern North America. The legend below provides instruction on how to read this information.

General pollution tolerance of family	*Estimated number of genera found in Maryland streams*	*Estimated number of genera found in northeastern North American streams*	*Relative abundance of family in Maryland streams*
[M/	**5/**	**7/**	**C]**
H = high *M = medium* *L = low*			*A = abundant* *C = common* *R = rare*

The tolerance of aquatic organisms to environmental pollution is often estimated on a scale of 0 to 10, with 0 being extremely sensitive to pollution and 10 being extremely tolerant of pollution. For purposes of this key, families with a tolerance value of 0-3 are considered to have a low (L) tolerance to pollution. Families with values of 4-6 are considered to have moderate or medium (M) tolerance and families with values of 7-10 are considered to have high (H) tolerance. Tolerance categories are based on values listed in Appendix A of Stribling et al (1998).

Using the example provided for the trichopteran family Leptoceridae, this family has a medium tolerance to pollution. Within the family, there are an estimated 5 genera in Maryland and 7 in northeastern North America. The state estimate comes from several years of stream sampling by the Maryland Biological Stream Survey (MBSS) (Stribling et al [1998]); the northeastern North America estimate is taken from Peckarsky et al (1984). Lastly, Leptoceridae are common in Maryland streams.

The relative abundance of families is based on qualitative consensus within the Maryland DNR on how geographically widespread a family is, as well as its typical occurrence in large or small numbers. In some cases an "X" will appear in one or more spaces within the brackets, indicating that the information is not known or available. If there are no brackets associated with a family, the information is unknown or unavailable.