

Southwest Association of Freshwater Invertebrate
Taxonomists (SAFIT) Rules for the Development
and Maintenance of the Standard Level of
Taxonomic Effort

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1.0 INTRODUCTION

Aquatic bioassessment is a primary tool of the regulatory agencies in measuring habitat health and water quality. Comparisons between bioassessment datasets are not possible without standardization; without data standardization the data become subjective. Therefore, it is paramount that taxonomic practices are standardized as they apply to bioassessment. Actions based on biological data require standards of comparability and repeatability. Therefore, there is a pressing need to formalize the rules for defining and updating standard taxonomic effort levels. Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT) is currently mandated to provide guidance to the California State Water Resources Control Board's Surface Water Ambient Monitoring Program (SWAMP), with the ultimate goal of providing the same guidance to all entities conducting bioassessment in the Southwest.

The Standard Level of Taxonomic Effort List (STE) will need many future revisions due to new taxa being discovered and introduced, range expansions and contractions, and new taxonomic rearrangements. This document establishes rules (hereinafter referred to as "Rules") for the preparation and development of the STE, so that future revisions will provide a useful, taxonomically acceptable, standardized level of taxonomic effort. Regulatory agencies will derive information from the names in the STE that will ultimately affect environmental quality.

Taxonomy is a dynamic science; concepts, classifications and phylogenies change. This list is the best effort with the data at hand. Please forward any comments, corrections or suggested additions to the STE Committee (Sections 2.2, 2.6, & Appendix II).

1.1 Acknowledgements

We want to thank the SAFIT membership for their cooperation and their role with SSCWRP in formalizing SAFIT. We gratefully acknowledge SWAMP for support and funding in this endeavor. We especially want to thank Pete Ode for starting the effort to establish quantifiable standards and providing the historical perspective presented in the background section of this document. We also want to thank the following individuals for their input on this document: Hazel Rogers, Joseph Slusark, Allison Brigham, Frank Hovore, Norman Penny, Bill Shepard, Cheryl Barr, Rosser Garrison, Steve Heydon, Lynn Kimsey, Jonathan Lee, Raphael Mazon, Robert W. Wisseman, and Pete Ode.

1.2 Background

The State of California first attempted to standardize benthic macroinvertebrate (BMI) taxonomic data for bioassessment in the mid 1990's. At that time only a few labs were producing taxonomic data and even fewer were using these data for aquatic bioassessments. After which, BMI-based bioassessment rapidly became an important tool for the regulation and management of California aquatic resources. The water quality regulatory

agencies in the state (the State and Regional Water Quality Control Boards) as well as other agencies and organizations, are increasingly relying on bioassessment data. The result is the need for efficient BMI data management standards.

The California Department of Fish and Game's Aquatic Bioassessment Laboratory (ABL) anticipated the need for BMI taxonomic standardization and worked through the taxonomic workgroup California Aquatic Macroinvertebrate Laboratory Network (CAMLnet) (now Southwest Association of Freshwater Invertebrate Taxonomists or SAFIT) to develop a standard taxonomic effort document (STE). The STE included two standard taxonomic levels for benthic macroinvertebrates (roughly equivalent to generic and species level identifications), tolerance values and functional feeding groups, and a list of taxonomic literature for the major taxonomic groups. The STE was first released in 1998 and was last revised in 2003.

SAFIT is responsible for establishing and maintaining these Rules and standards, as well as the STE (SAFIT Mission Statement, 2006). Similar standardization efforts are currently underway for other water quality data components (e.g.; chemical constituents, toxicology, and physical habitat condition) and together will define data management standards for the State Water Board's Surface Water Ambient Monitoring Program (SWAMP) and the California Environmental Data Exchange Network (CEDEN).

1.3 Scope

SAFIT has identified one of its primary functions as the establishment of standard levels of taxonomic effort of macroinvertebrate identifications for bioassessment. The focus is presently restricted to aquatic macroinvertebrates, but may be expanded. Definitions of taxonomic terms used in this document have been provided in Appendix I in order to promote consistency of their use and the benefit of those without taxonomic training.

1.4 Purpose

These Rules are established for the inclusion or exclusion of taxonomic categories and epithets in the STE. Ideally, each year a new STE will be established (section 2), unless there have been no changes that would effect the application of appropriate names to organisms in bioassessment samples, however the list may be updated as frequently as is needed by the STE Committee, especially if errors have been found. Each new STE must cite these Rules (or future versions of these Rules) in the methods section.

1.5 Objectives

These Rules are designed to promote stability, uniformity, and reproducibility of results among workers identifying aquatic invertebrates. All the rules established herein are based upon these three fundamental standards. Data

stability is achieved in the accuracy of the names available in the standard list. Data uniformity is achieved in the standard list that the larger community uses for invertebrate names. Reproducibility is one of the fundamental tenets of the scientific method: other workers must be able to arrive at the same conclusions using the same specimens and data as the worker making the original determination. If a conclusion is not reproducible, it is not science. Reproducibility is achieved in that the names in the STE come from the peer reviewed scientific literature.

1.6 Applicability

These rules are only applicable to the STE. The STE is only applicable to bioassessment studies where the California Standard Bioassessment Protocols (Harrington, 1999) or similar protocols are employed, within the stated SAFIT geographic region. It is recognized that for other studies or projects different levels of effort may be required.

1.7 STE Rule modifications

These Rules may need to be modified at some point, for example, to reflect changes in the ICZN. Suggested emendations to these Rules must be submitted to the SAFIT Board of Directors, and distributed among the membership with arguments for and against as applicable. All changes to these Rules must pass with an 80% or better vote among the membership.

2.0 CONSTRUCTION OF THE STE LIST

2.1 Oversight Committee.

An oversight committee (STE Committee) of at least three people, consisting of at least one SAFIT board member shall develop the STE. The members of the STE Committee must be familiar with the basic standards of the most recent edition International Code of Zoological Nomenclature (ICZN) and be capable of applying its rules. One or more members of the STE Committee must be trained taxonomists, having described or revised taxa according to the standards of acceptability of the ICZN. Ideally, one or more taxonomists external to SAFIT, meeting the standards above, should be engaged to assist or review the work.

2.2 Draft revision of the STE

The draft revision of the list will be submitted to the entire SAFIT membership for review. Errors, omission of taxa or other information, and concerns about the validity of taxa should be brought to the attention of the STE Committee along with the appropriate corroborating peer-reviewed literature or other evidences (see section 2.6 & Appendix II). After a 30-day review period, the

membership must bring any comments, changes, or edits to the attention of the STE Committee for review. The STE Committee has another 30 days to reply to any and all comments, proposed changes and edits from the membership, although extensions may be granted by the SAFIT officers in certain circumstances such as the need for expert verification, or literature requests. The final Standard Level of Taxonomic Effort List as a complete document must be voted on (ratified) by the membership before the list is accepted. A 75% majority vote by the membership is required to overturn decisions made by the STE Committee.

Additions, corrections or deletions to the list may be submitted to the STE Committee at any time; however the submitted changes may not be addressed until the subsequent version (see section 2.6).

2.3 External review by taxonomic specialists

As a matter of practice, regionally or internationally recognized specialists in each taxonomic group should review the Standard Level of Taxonomic Effort List section pertaining to their specialty group. All recommendations must conform to the Rules presented in this document.

2.4 Criteria for inclusion of names in the STE

The STE Committee must use the established, peer-reviewed scientific literature in determining the categories and epithets to be included in the STE. All names must conform to the ICZN.

2.5 Format of the STE

2.5.1 Sections included in the STE. The STE shall include the title, the version designator that includes the date (e.g.; Version 3, 26 June 2006), the names of the compilers, a brief introduction identifying any important change(s) from the previous version, sections discussing and describing methods and materials (as appropriate), a results section (i.e. the names), acknowledgements, and literature cited. All changes from the previous version must be clearly identified in the new version: altered levels of effort and taxa added or removed (with citations) from the previous version will be listed in the Introduction section. All other changes will have that row of the list highlighted in the electronic form. These highlights and changes listed in the Introduction are to be removed with the subsequent version of the STE.

2.5.2 Organization of names in the STE. The Results section will list according to phylogeny (as appropriate) the standard levels of taxonomic effort for phylum through order. Otherwise all taxa should be listed as appropriate by family, genus, species and subspecies in alphabetical order.

2.5.3 Comment field in the STE. A comments field for each taxon must be present. It must be populated when identification is only possible for certain instars, genders, or life stages.

Example: The stoneflies *Kogotus* and *Rickera* are separated from other genera by their unicuspid lacinia. However first, second and third instars have bicuspid lacinia. Therefore, only fourth instar nymphs are identifiable with the existing keys. This information would appear in the comments field for these two genera.

Example: The hydrophilid beetle genus *Tropisternus* is identifiable to species level as adults, but not as larvae. Therefore larval identifications must be left at the generic level, although adults may be taken to species. This information would appear in the comments field for this genus, and each of the *Tropisternus* species.

2.5.4 Rare, threatened and endangered invertebrates. The Rare, Threatened, & Endangered Invertebrates will be identified as such in the comments field. Therefore, when rare, threatened and endangered taxa are discovered in new areas, those taxa can be reported. Rare Threatened, & Endangered Invertebrate species are defined as those species listed as such on any state or federal endangered species act, environmental quality act, or the International Union for the Conservation of Nature and Natural Resources (IUCN) Red List.

2.6 Reporting errors and suggesting changes to the STE

It is the goal of SAFIT and the STE Committee to provide the best available names and guidance in the STE. Therefore, it is the responsibility of the SAFIT membership to provide updated information, correct errors, suggest changes to the STE. Updates, corrections and suggested changes must be sent to the STE Committee via the form in Appendix II.

2.6.1 Submission of suggested changes. All suggested changes must be submitted to the STE Committee using the Suggested Changes Form (Appendix II). The form must be filled out entirely (Figure 1).

Anonymous suggestions will not be accepted. The date is required so that the suggestion is kept on file for the appropriate length of time (see 2.6.1). Contact information is required in case the reviewers have any questions.

The “Suggested Action” may be one of the following: 1) name change, addition, deletion; 2) habitat change; 3) distribution change; 4) literature cited change; 5) comment change.

The “Original Text” field may hold the text to be changed, or if an addition is proposed, should state “none”.

The “Suggested Change” field may contain one of the following: 1) name change, addition, deletion; 2) habitat change; 3) distribution

change; 4) literature cited change; 5) comment change; 6) spelling or grammatical change.

The “Justification” field must provide a defensible justification for the proposed change based upon the Rules defined in this document, specifically sections 2 and 3.

The “Tracking #” field will have a tracking number designated by the STE committee, that will consist of the year, a dash, and then a unique consecutive number for each form.

STE SUGGESTED CHANGES FORM

Submitted by: AB Richards **Date:** 31 August 2006

Address/Affiliation: Aquatic Entomologist, Aquatic Bioassessment Lab, Chico, CA

Telephone #/ email: (530) 898-4792, arichards@csuchico.edu

Suggested action: name change

Original text: *Skwala paralella* (Frison, 1936)

Suggested change: *Skwala americana* (Klapalek, 1912)

Justification: Zwick, P. (1989). "Notes on Plecoptera (18) *Skwala americana* (Klapálek, 1912), comb. n., the valid name for *Skwala paralella* (Frison, 1936)." *Aquatic Insects* **11**(3): 181-182.

Comments: Zwick (1989) showed that *Skwala americana* and *S. paralella* were synonymous. *S. americana* is the older name and thus *S. paralella* is no longer a valid name.

Below this line to be filled out by the STE Committee

Tracking #:

**Accepted / Rejected
Justification:**

Figure 1. Example STE Suggested Changes Form

2.6.2 Evaluation of suggested changes. Applicability of submitted suggestions will be evaluated against the Rules. Suggested changes may be incorporated, rejected, or may not be incorporated until subsequent versions (section 2.2).

Suggestions rejected by the STE Committee must be accompanied by citation of the Rules section with which the suggested change is in conflict and any other corroborating evidence including peer-reviewed literature references. All rejected suggested changes will be kept on file until the subsequent version of the STE has been ratified (section 2.2).

Example: The proposal to add the name *Hyaella azteca* to STE Version I would be rejected on the grounds of conflict with sections 3.1 and 3.3.2. If the suggested change came during the preparation of STE Version I, then this rejection must remain on file and available to all inquiries until STE Version II is ratified. If the suggested change came after STE Version I is ratified, then the rejection must remain on file until STE Version III is ratified.

3.0 TAXA INCLUDED IN THE STE

3.1 Aquatic macroinvertebrates

SAFIT currently focuses on freshwater aquatic macroinvertebrates. Other invertebrate groups may be included in the future. At present the geographical scope of the STE reflects California, the surrounding states and ecoregions. As the geographic and taxonomic scope of SAFIT changes, so will the STE.

3.2 Addition and deletion of names

The addition or deletion of names must be based on the peer-reviewed taxonomic literature. All taxonomic categories (phylum through genus) and epithets (specific and subspecific) included or added in future versions must have viable names under the ICZN. All names must be published in peer-reviewed literature (see section 2.4).

3.2.1 New names or taxonomic arrangements. New names or taxonomic arrangements added to the list, and the elimination of old names must be based on peer-reviewed scientific literature. Unpublished manuscripts, dissertations, “in-house” designations, or records that have not been validated are not acceptable sources of names. All changes must be accepted by the consensus of the STE Committee. (See sections 2.2, 2.5 & 2.6).

3.2.2 New distributional information. Taxa not previously reported from the geographic limits of this organization, or new range extensions or contractions may be proposed for addition to the list without literature support if the taxon was 1) found within the geographic limits of the list,

and 2) if the identification has been validated by one or more recognized experts on the taxon. (See section 2.6).

3.2.3 Species group names. Species group names are not acceptable unless a species group is 1) ecologically significant because it is indicative of specifically described ecological conditions, and 2) generally recognized and accepted in the peer-reviewed scientific literature.

Example: Bode (1983) defined two species groups for the chironomid genus *Tvetenia*. They would be listed as *Tvetenia bavarica* group Bode (1983) and *Tvetenia discoloripes* group Bode (1983).

3.2.4 Provisional names. Provisional names and species designated “taxon 1” or “Species 1” are not acceptable unless 1) the organism is ecologically significant, being indicative of specifically described ecological conditions, and 2) recognized and accepted in the peer-reviewed scientific literature or by experts.

Example: *Mysis relicta* was split into four taxa in the peer-reviewed literature. All North American populations have been designated as “*Mysis* sp. 4”. Since there are no other *Mysis* known to occur in North America, it is best to just stop at “*Mysis*” (Rogers, 2005).

3.3 Taxonomic resolution

Taxonomic determinations must be conservative. Identifications must not exceed the lowest defensible taxonomic level.

3.3.1 Inability to identify some early instars with certainty. Organisms not identifiable beyond a particular taxonomic level must be left at the next highest taxon. (see also section 3.3.5).

Example: Stewart & Stark (2002, pg102) and Stewart (pers. comm.) state that first, second, and most third instar stonefly larvae cannot be determined reliably beyond the family level because of considerable variation in characters. Consequently, only fourth instar and some third instar stoneflies should be identified beyond the family level.

3.3.2 Undescribed taxa. Where it is generally recognized in the peer-reviewed literature or by experts that undescribed taxa occur, the previous taxonomic level must be the end point.

Example: Keys exist for the described amphipod species in the genus *Gammarus*. However, it is well established in the literature that many undescribed species exist (Lang et al., 2003). Therefore, specimens of *Gammarus* should be left at the generic level, unless validated by an amphipod expert.

3.3.3 Descriptions unknown for all species. Keys that only treat the known species of a group, where some species are not described in those life stages, must not be used.

Example: Zloty (1997) revised the mayfly genus *Ameletus* and included keys to the known nymphs. A number of *Ameletus* species were described based on adult material but the nymphs are unknown. Since the nymphs of some species are undescribed, these species cannot be identified using this key. *Ameletus*, would be the lowest defensible taxonomic determination unless the specimens are validated by a taxonomic expert.

3.3.4 Regional identification(s). Regional identifications may be employed only in specifically described circumstances defined by supporting literature for that taxon.

Example: There are presently 20 or more recognized species in the psephenid genus *Eubrianax*. Based on adult material, *E. edwardsii* (LeConte) is the only representative for North America. Based on the distribution information for the adults, larvae of *E. edwardsii* may be determined to species for specimens from North America.

3.3.5 “Slash” taxa. A “slash” taxon is a name that lumps two or more taxa inseparable in one or more life stages. “Slash” taxa are not acceptable unless 1) both taxa names conform to the ICZN, and 2) the “slash” taxon is established in the literature. Special cases may be defined by the STE committee where evidence of grey areas between taxa exist; however these must be established with supportive data.

Example of an established slash taxon: Larvae of the ceratopogonid genera *Bezzia* and *Palpomyia* are inseparable. Courtney et al. (1996) use the term *Bezzia/Palpomyia* as a final identification to distinguish larvae of these two genera from other ceratopogonid genera.

Example of an STE accepted slash taxon: Larvae of the stratiomyid genera *Caloparyphus* and *Euparyphus* may be separated by the anterior spiracle which is either on a long stalk (*Euparyphus*) or sessile (*Caloparyphus*) (Courtney et al., 1996). Sinclair (1989) showed that the long stalk character for *Euparyphus* does not develop until the final larval instar. Thus, early instar *Euparyphus* are inseparable from *Caloparyphus*. For this reason, only final instar larvae of these two genera may be identified to genus. All earlier instars should be recorded as *Caloparyphus/Euparyphus*.

Example of an STE accepted slash taxon: Nymphs of the stonefly genera *Kogotus* and *Rickera* are separable based on a single mesosternal suture. This suture is not evident in early instars so the final identification may be recorded as *Kogotus/Rickera*. (See also 3.3.1).

3.4 Excluded taxa and associated artifacts

Taxa and associated invertebrate artifacts that contribute little to the ecological data set because they are not typically considered to be inhabitants of the stream benthos need not be sorted from stream samples and are usually excluded from the taxa list beyond higher categories. These taxa include most microcrustaceans, all parasites and commensals.

3.4.1 Cladocera. Cladocera are excluded because with few exceptions (*Ilyocryptus* is wholly benthic, and some Chydorids are semibenthic), they are planktonic and probably do not reflect the water quality at the locality where they were collected. Exceptions occur when sampling in lentic or temporary habitats, where cladocerans may constitute 40-100% of the biomass.

3.4.2 Copepoda. Copepoda are rejected from samples because preservation in ethanol often damages or destroys the necessary characters for identification, and because most freshwater taxa remain undescribed. Furthermore there are representatives of nearly every functional ecological group in these two taxa, so generalization is not possible.

3.4.3 Parasites and Commensals. Branchiura, mermithid Nemata, and aquatic Hymenoptera are parasitic, Branchiobdella are commensals on crayfish, and the Nematomorpha are parasitic on terrestrial insects. Parasites must move between hosts, and therefore are typically dependant upon host density, not host stress. Therefore these taxa are not good ecological indicators and are rejected from samples.

3.4.4 Neustonic and shore dwelling taxa. Neustonic and marginal taxa are excluded from the STE; however they should be included in lentic sampling. These taxa include but are not limited to: terrestrial Isopoda and Amphipoda, Collembola, Gerridae, Hebridae, Hydrometridae, Macroveliidae, Mesoveeliidae, Veliidae, Gelastocoridae, Notonectidae, Ochteridae, Leptopodidae, Saldidae, Aphiidae, Carabidae (including Cicindelitae (=Cicindelidae), Omophronini, and Bembidiini), adult Gyrinidae, Staphylinidae, Heteroceridae, Chrysomelidae, and Curculionidae.

3.4.5 Previously deceased invertebrates, terrestrial invertebrates, and abandoned artifacts. Invertebrates that obviously were deceased prior to collection of the bioassessment sample, as well as empty mollusk shells, exuviae, egg masses, statoblasts, gemmules, empty chironomid, caddis or lepidopteran cases, and terrestrial invertebrate taxa are excluded from the STE. Furthermore, larval leeches and immature isopods that fall from a parent should also be excluded.

4.0 LITERATURE CITED

Federal Endangered Species Act. 50 CFR §17.11, plus updates.

- Bode, R. W. 1983. Larvae of North American *Eukiefferiella* and *Tvetenia* (Diptera:Chironomidae). Bulletin of the New York State Museum(452): v + 1-40.
- Brown, H. P. 2001. Synopsis of the riffle beetle genus *Zaitzevia* (Coleoptera: Elmidae) in North America, with description of a new subgenus and species. Entomological News 112(3): 201-211.
- Courtney, G. W., R. W. Merritt, H.J. Teskey & B.A. Foote. 1996. Aquatic Diptera. Part one. Larvae of aquatic Diptera. An introduction to the aquatic insects of North America, 3rd edition, 862 pp. R. W. Merritt and K. W. Cummins. Dubuque, Iowa, Kendall/Hunt Publishing Company: 484-514.
- Floyd, M. A. 1995. Larvae of the caddisfly genus *Oecetis* (Trichoptera: Leptoceridae) in North America. Columbus, OH, Ohio Biological Survey, viii + 85 pp.
- International Commission on Zoological Nomenclature 1999. International Code of Zoological Nomenclature, Fourth Edition. London, The International Trust for Zoological Nomenclature, xxix + 306 pp. Accessible at URL: <http://www.iczn.org/iczn/index.jsp>
- Lang, B.K., V. Gervasio, D.J. Berg, S.I. Guttman, N.L. Allan, M.E. Gordon, & G. Warrick. 2003. Gammarid amphipods of Northern Chihuahuan desert spring systems: an imperiled fauna. Special Publications Museum of Texas Tech University (46): 47-57.
- Mayr, E. & P. D. Ashlock. 1991. Principles of systematic zoology, 2ed. New York, McGraw-Hill.
- Linsley, E. G. & R. L. Usinger 1959. Linnaeus and the development of the international code of zoological nomenclature. Systematic Zoology 8: 39-47.
- Rogers, D. C. 2005. Identification Manual to the Freshwater Crustacea of the Western United States and Adjacent Areas Encountered During Bioassessment. EcoAnalysts, Inc. Technical Publication #1, 77 pp.
- Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT). 2006. Mission Statement.
- Schmude, K. L., C. B. Barr, & H.P. Brown. 1992. *Stenelmis lignicola* new species and *Stenelmis xylonastis* new species, two new North American species of wood-inhabiting riffle beetles (Coleoptera: Elmidae). Proceedings of the Entomological Society of Washington 94(4): 580-594.
- Shepard, W. D. 1993. An annotated checklist of the aquatic and semiaquatic dryopoid Coleoptera of California. Pan-Pacific Entomologist 69(1): 1-11.

Sinclair, B. J. 1989. The biology of *Euparyphus* Gerstaecker and *Caloparyphus* James occurring in macicolous habitats of eastern North America, with descriptions of adult and immature stages (Diptera: Stratiomyidae). Canadian Journal of Zoology 67(1): 33-41.

Stewart, K. W. & B. P. Stark 2002. Nymphs of North American stonefly genera (Plecoptera). Columbus, Ohio, The Caddis Press, xi + 510 pp.

Torre-Bueno, J.R. de la 1989. The Torre-Bueno glossary of entomology; compiled by Stephen W. Nichols; including Supplement A by George S. Tulloch. New York, The New York Entomological Society, xvii + 840 pp.

Winston, J. E. 1999. Describing species: practical taxonomic procedure for biologists. New York, Columbia University Press, xx + 518 pp.

Zloty, J. 1997. Larvae and adults of *Ameletus* mayflies (Ephemeroptera: Ameletidae) from Alberta. Canadian Entomologist 129:251-289.

APPENDIX I

Standardized taxonomic definitions

authorship – the name(s) of the author(s) on any taxonomic description published in the peer-reviewed literature that meets the conditions defined by the ICZN in article 14. The authorship of a taxon and the authorship of the paper may not be equivalent. For example, the description of *Stenelmis xylonastis* Schmude & Barr, 1992 was published in Schmude, Barr & Brown (1992).

available name – a name published in a manner that satisfies the requirements specified in Articles 8 through 20 of the ICZN (Mayr & Ashlock, 1991)

best available literature – synonymous with peer-reviewed literature; legal term used by state and federal agencies.

binominal nomenclature – the scientific name of a species, and not of a taxon at any other rank, is a combination of two names (binomen from bi=two and nomen=name). The first is the generic name (singular, genus; plural, genera) and the second is the specific epithet. Together, the genus and specific epithet comprise a species (singular and plural=species) (ICZN, 1999; Torre-Bueno, 1989).

description – a more or less complete formal statement of the characters of a taxon without special emphasis on those which set limits to the taxon or distinguish it from [other] taxa (Mayr & Ashlock, 1991). Only descriptions that appear in peer-reviewed scientific literature and fulfill the requirements of the ICZN are acceptable.

diagnosis – formal statement of the characters (or most important characters) that distinguish one taxon [from another] (Mayr & Ashlock, 1991)

grey literature – any technical or semitechnical publications including unpublished theses, dissertations, manuscripts, workshop manuals, handouts, or books, generally available and known to the public, but not published in peer-reviewed journals

in-house designations – names applied informally for convenience of identification, ecological considerations, or specimen tracking, but not necessarily a valid name unless accompanied by authorship

International Code of Zoological Nomenclature (ICZN) – the primary purpose of the code is to provide a unique binomial scientific name for every species (Winston, 1999) and is the set of rules that determines the validity of a scientific name. Codes of nomenclature date back to Linnaeus, who constructed a set of rules for botanical nomenclature which he applied by extension to zoology. A number of competing and conflicting codes were developed over the next 100 years (Linsley & Usinger, 1959) until the first international zoological code was proposed at the First International Congress of Zoology in Paris in 1889. The first formal published edition of this code, the ICZN, was

published in 1961. The fourth and current edition was published in 1999 (Wilson, 1999). The code is regularly updated by the International Commission on Zoological Nomenclature and each version of the ICZN is ratified by the International Union of Biological Sciences. The most recent edition supersedes all previous editions. Updates that supersede portions of the current ICZN are published by the International Commission on Zoological Nomenclature in the *Bulletin of Zoological Nomenclature*.

macroinvertebrate/freshwater macroinvertebrate – the term “macroinvertebrate” is a term used for convenience and has many definitions in the literature. In line with the history of bioassessment in California, a “macroinvertebrate” is any invertebrate retained by a mesh or sieve size of 500 micrometer (μm) or larger that can reasonably be identified using a stereo dissection microscope with resolution of up to 50X. The exception is most midge larvae and oligochaetes, which require slide mounting and viewing with a compound microscope. A freshwater macroinvertebrate is defined as an invertebrate that depends on freshwater systems for part of or all of its life cycle

manuscript name – an unpublished scientific name (Mayr & Ashlock, 1991)

monotypic – a genus that contains a single species (Torre-Bueno, 1989)

nomen nudum – literally, a naked name, or a name without a published formal description or diagnosis. Use of a manuscript name in a publication can result in a nomen nudum and invalidate the use of that name. Brown (2001) published the formal description of *Zaitzevia posthonia* Brown, 2001. Prior to this publication, the taxon had appeared in publications as *Z. milleri* Brown. Since that name in these publications was not accompanied by a formal description, it is invalid.

peer-reviewed literature – literature published in taxonomic and biological technical journals that have a rigorous review process for all submissions. Each submitted manuscript is usually critically reviewed by three anonymous reviewers familiar with the manuscript subject matter prior to its acceptance or rejection by the journal editor. All taxonomic and systematic manuscripts must adhere to the conventions of the ICZN.

phylogeny – the study of the relationships between taxa

provisional designation – an incomplete or informal name applied to a taxon that does not have a formal name. As an example, Floyd (1995) designated *Oecetis* species A through G based on distinct larval characteristics, but for which the larvae could not be directly associated to any described species. These names are available under Article 14 and should be used in the form: *Oecetis* species G Floyd (1995). Under Article 14 of the ICZN, a new name with anonymous authorship, or without authorship is unavailable.

reference specimen or collection – a specimen, series of specimens or collection of these that serves as the comparative diagnostic standard for other specimens encountered in any set of samples. Reference specimens are validated by external taxonomic experts

special-status species – species that are listed as rare, threatened, or endangered under state, federal or International law

taxon – (plural: taxa); a taxonomic unit, named or not. “*Hydropsyche californica* Banks”, “Hydropsychidae”, “hydrpsychids”, “caddis” are each a taxon although the latter two names are not formal scientific names.

taxonomic expert or specialist – one who has published taxonomic research in the peer-reviewed, scientific literature on one or more taxa and is generally recognized in the discipline to have sufficient knowledge to identify taxa in a given group

taxonomic identification/determination – assigning the current and correct name to an organism

taxonomist/systematist – one who studies and researches the classification (taxonomist) or phylogeny of organisms (systematist)

taxonomy/systematics – the practice of classifying organisms (Mayr & Ashlock, 1991); the arranging of species and groups thereof into a system that exhibits their relationship to each other and their places in a natural classification (Torre-Bueno, 1989). These terms are often used interchangeably; a common colloquial definition used to distinguish between the two terms is that taxonomy is concerned with describing and naming taxa and systematics considers the affinities of like groups, or their phylogeny.

valid name – an available name that is not preoccupied by a valid senior synonym or homonym (Mayr & Ashlock, 1991)

validation – a quality assurance requirement that mandates the external (not within-lab) verification or confirmation of a taxonomic identification by a recognized taxonomic expert. The specimens that comprise a reference collection must be validated.

verification – the internal (within-lab) quality control process of confirming or re-identifying a specimen(s) by laboratory personnel.

voucher specimen or collection – a voucher is a single collection of a specimen(s) of a taxon that represents a morphological variant, phenotype, location, sample or subsample that is pending external validation by a taxonomic expert

APPENDIX II

STE Suggested Changes Form

The form below is for submitting suggested changes in the STE to the STE Committee (see section 2.6).

STE SUGGESTED CHANGES FORM

Submitted by:

Date:

Address/Affiliation:

Telephone #/ email:

Suggested action:

Original text:

Suggested change:

Justification:

Comments:

Below this line to be filled out by the STE Committee

Tracking #:

**Accepted / Rejected
Justification:**