A STANDARDIZED TAXONOMIC EFFORT (STE) FOR CALIFORNIA STREAM ALGAE

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TABLE OF CONTENTS

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1.0 INTRODUCTION

Algal bioassessment sampling is an integral component to the California bioassessment toolkit. The Surface Water Ambient Monitoring Program (SWAMP) has standardized protocols for the collection, processing, identification and enumeration of diatom and soft-bodied algae (SBA) for wadeable streams (links to these and other resources referred to throughout this document can be found in Appendix A). In recent years, there has been an increased effort to standardize algae taxonomic data across multiple taxonomy labs, including an annual taxonomy training webinar and regular updates to the SWAMP Master Taxa List.

Currently, the SWAMP protocol stipulates the collection, identification and enumeration of diatoms and SBA, resulting in:

1. Complete diatom species list with valve counts.
2. Complete SBA species list with biovolume estimates for each taxon from the quantitative sample (excluding epiphytic algae), which can be converted to a total SBA biomass in the stream reach.
3. Enumeration of SBA epiphytes from the quantitative sample.
4. Macroalgae species list from the qualitative sample.

This full-effort taxonomy protocol has identified thousands of algal species in California's streams and additionally resulted in the description and illustration of over 800 SBA taxa on the SWAMP soft-bodied algae online identification tool (Stancheva et al., 2016) and hundreds of diatom taxa from Southern California on the SWAMP diatom online identification tool (Kociolek, 2012). A Southern California Algal Index of Biotic Integrity (IBI) (Fetscher et al., 2014) was created to leverage this rich taxonomic dataset for assessing the biological health of wadeable streams. A larger, statewide taxonomy dataset was used to create the Algal Stream Condition Index (ASCI).

The guidance provided by a statewide STE will help make algal taxonomy analyses more standardized, comparable, and efficient. Two levels of taxonomic effort are presented in this STE, one following the species-level (or lower) protocol (Stancheva et al., 2015; refer to

Appendix A: 1.) and one that will allow identification to genus-level for macroalga taxa that require reproductive features to identify to species level. The selection of either the STE Level I or STE Level II protocol is at the discretion of program managers for their bioassessment applications. The STE Level II protocol is structured after the current SWAMP full taxonomy protocol (Stancheva et al., 2015; refer to Appendix A: 1.) while the STE Level I protocol provides modified requirements for a limited number of macroalgae taxa. The qualitative taxonomy data was excluded from the calibration of the forthcoming ASCI index, and therefore the exclusion of this species-level information for this macroalgal genera will not impact resulting ASCI scores. The STE will require future revisions and modifications as new taxa are identified and species complexes are updated. This document establishes a few guidelines for the development of the algal STE. Please contact the lead of the algae taxonomy workgroup (Susie Theroux, SCCWRP, susannat@sccwrp.org) with any questions or comments.

2.0 CONSTRUCTION OF THE STE LIST

2.1 Oversight committee

The algal STE will be revised regularly by the California Primary Algae Laboratory at CSU San Marcos. The latest version of the algal STE will be maintained by the SWAMP Office of Information Management and Analysis and will be posted on the SWAMP website's SWAMP-IQ Center Bioassessment webpage.

2.2 Draft revision of the STE

Additions, corrections, or deletions to the STE list may be submitted to the California Primary Algae Laboratory at CSU San Marcos lead at any time; however, changes may not be addressed until the subsequent version of the STE.

2.3 Format of the STE

The STE will consist of a master spreadsheet of all taxa and taxonomic lineage organized alphabetically. Two columns will indicate the STE Level I and Level II designation for each taxon. A Notes field will indicate any applicable additional information. Literature citations for

taxonomic designations can be found in the associated SWAMP Master Taxa list. STE version numbers can be found in the complete STE list and should be cited in taxonomic reports (e.g. STE Version 2018.01).

3.0 TAXA INCLUDED IN THE STE

3.1 Diatoms and soft-bodied algae

The algal STE focuses on all species of diatoms and soft-bodied algae present in the SWAMP Master Taxa list. The STE also includes provisional names (numbered morphospecies), as long as these taxa are properly documented on the SWAMP online identification tools (Section 1; refer to Appendix A: 4. & 5.).

3.2 Addition and deletion of names

Addition and deletion of names must be based on peer-reviewed taxonomic literature, and/or the discretion of the California Primary Algae Laboratory at CSU San Marcos. The STE must reflect the current version of the SWAMP Master Taxa List.

3.3 Taxonomic resolution

Taxonomic determinations must be reasonable and conservative to allow for all taxonomists to achieve identification. Identifications must not exceed the lowest defensible taxonomic level. To this end, a special consideration is made for genera of macroalgae that require culturing of live specimens and reproductive features to be identified to species level.

3.3.1 Genera requiring reproductive features: Taxa that require culturing of live specimens to identify to species level may be identified to genus-level using vegetative morphology. When reproductive structures are missing in the preserved quantitative samples, specimens are identified based on vegetative features to genus-level. This includes species of *Zygnema*, *Mougeotia*, *Spirogyra*, *Oedogonium*, and *Vaucheria*. Provisional names (numbered morphospecies) created for each morphospecies are illustrated on the SWAMP online identification tools so that the names can be applied consistently across labs. When the available provisional names do not match the observed

vegetative morphology, the specimens should be properly documented following Stancheva et al. (2015; refer to Appendix A: 1.) and submitted for approval to the California Primary Algae Laboratory at CSU San Marcos.

3.3.2 Novel taxa: Any novel taxa present in samples must be identified to the lowest possible taxonomic level (typically species level) and properly documented following Stancheva et al. (2015; refer to Appendix A: 1.) and submitted for approval to the California Primary Algae Laboratory at CSU San Marcos. Provisional names (numbered morphospecies) are created for each novel morphospecies and they are illustrated on the SWAMP online identification tools so that the names can be applied consistently across labs.

3.4 STE Levels

The California Algae STE consists of two levels of taxonomic resolution:

1. STE Level I: All species are identified to species or lower in accordance with the SWAMP algae taxonomy protocol (Stancheva et al., 2015; refer to Appendix A: 1.), with the exception of certain species of *Zygnema*, *Mougeotia*, *Spirogyra*, *Oedogonium*, and *Vaucheria* that are identified to genus-level. See complete STE for details (refer to Appendix A: 7.).

2. STE Level II: All species are identified to species or lower in accordance with the SWAMP algae taxonomy laboratory protocol (Stancheva et al., 2015; refer to Appendix A: 1.). This includes permitted provisional taxa that are photodocumented on the algae websites (refer to Appendeix A:4,5). See complete STE for details (refer to Appendix A: 7.).

4.0 LITERATURE CITED

Fetscher, A.E., Stancheva, R., Kociolek, J.P., Sheath, R.G., Stein, E.D., Mazor, R.D., Ode, P.R., Busse, L.B., 2014. Development and comparison of stream indices of biotic integrity using diatoms vs. non-diatom algae vs. a combination. Journal of Applied Phycology 26, 433–450. https://doi.org/10.1007/s10811-013-0088-2.

Kociolek, J. P. 2012. Diatoms of the Southern California Bight: http://data.sccwrp.org/dscb/index.php.

Ode, P.R., Fetscher, A.E., Busse, L.B., 2016. Standard Operating Procedures (SOP) for the Collection of Field Data for Bioassessments of California Wadeable Streams: Benthic Macroinvertebrates, Algae, and Physical Habitat (No. Technical Report 835). State Water Resources Control Board Surface Water Ambient Monitoring Program. Sacramento, CA. https://drive.google.com/file/d/0B40pxPC5g-D0MS1zMjNacnJZOEk/view.

Stancheva, R., Busse, L., Kociolek, J.P., Sheath, R., 2015. Standard Operating Procedures for Laboratory Processing and Identification of Stream Algae in California (No. SWAMP-SOP-2015-0003). California State Water Resources Control Board Surface Water Ambient Monitoring Program (SWAMP) Bioassessment SOP 0003. https://drive.google.com/file/d/0B40pxPC5g-D0VktmM1NTMU5vWGs/view.

Stancheva, R., Fuller, C. & Sheath, R. G. 2016. Soft-Bodied Stream Algae of California: http://data.sccwrp.org/sbsac/index.php.

APPENDIX A: TABLE OF RESOURCES & LINKS

This table provides guidance and full links to resources relevant to the STE document.

Ref #	Resource Name	Resource Description	Hyperlink (full)
1.	Standard Operating Procedures (SOP) for Laboratory Processing, Identification, and Enumeration of Stream Algae (Stancheva et al., 2015)	SWAMP protocol for lab processing & analysis of algae for taxonomy	https://drive.google.com/file/d/0B40pxPC5g-D0VktmM1NTMU5vWGs/view
2.	Standard Operating Procedures (SOP) for the Collection of Field Data for Bioassessments of California Wadeable Streams: Benthic Macroinvertebrates, Algae, and Physical Habitat (Ode et al., 2016)	SWAMP protocol for field collection of algae and BMIs	https://drive.google.com/file/d/0B40pxPC5g-D0MS1zMjNacnJZOEk/view
3.	SWAMP Data Checker Lookup Lists: OrganismLookUp - Full List	SWAMP Master Taxa List of SBA and diatom organism names	http://swamp.waterboards.ca.gov/swamp_checker/DisplayLookUp.aspx?List=OrganismLookUp
4.	SWAMP Soft-bodied Algae Online Identification Tool	SWAMP online identification tool for assistance with identifying SBA	http://data.sccwrp.org/sbsac/index.php
5.	SWAMP Diatom Online Identification Tool	SWAMP online identification tool for assistance with identifying diatoms	http://data.sccwrp.org/dscb/index.php
6.	California Algal Stream Condition Index (ASCI)	Online resource for information about ASCI	https://sites.google.com/view/asci/
7.	SWAMP-IQ Center Bioassessment webpage	Webpage where the STE document and associated STE Excel file with names can be found	https://www.waterboards.ca.gov/water_issues/programs/swamp/swamp_iq/bioassessment.html
8.	Susie Theroux, SCCWRP (algae taxonomy workgroup lead)	Contact for questions or comments about the STE	susannat@sccwrp.org; http://www.sccwrp.org/