

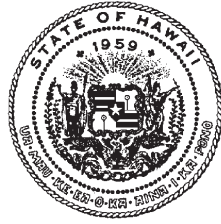


**Stream macroalgae of Hawai`i:
An identification guide to the common genera**

Written for the
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Department of Land and Natural Resources

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Scope and Purpose of the Guide

The purpose of this guide is to provide basic descriptions and photographs of Hawai'i's most common stream algae in order to aid state biologists in their management-based investigations. It is recognized that time and resources are generally not available for species-level taxonomic identifications of stream algae, and the guide is designed to lead the biologist to a generic placement, with some additional sources listed if further information is desired. Given that the systematics of most groups of freshwater algae in Hawai'i have not been investigated using molecular tools and thorough systematic comparisons, identification of collections to the generic level seems a prudent compromise at this point in time.

Although the vast majority of stream macroalgae in the state require examination at the compound microscope level of magnification for identification, a few of Hawai'i's stream macroalgae can be identified through direct observation. In either case, characteristics such as color, branching pattern and habitat will be needed.

How to use this Guide

The guide begins with a description of recommended collection and preservation techniques for stream macroalgae, along with a bibliography of identification literature and websites for freshwater algae that may be consulted for species-level

identification, clarification of the present guide or simply to obtain more detailed information on freshwater algae. A key to the common genera of freshwater macroalgae in Hawaiian streams is subsequently presented. The key employs field-recognizable characters wherever possible; however, in most cases at least some microscopical examination is necessary for determination of the appropriate characters. A set of page numbers is provided next to each genus name in the key - these pages contain text descriptions of the important characteristics of the genus, along with photographs of representatives (overall habit plus photomicrographs of diagnostic characters), an estimation of the number of species present in Hawaiian streams, and the known distribution of each genus within the state of Hawai'i. Five main groups of stream macroalgae are recognized and presented here: 1) Cyanobacteria, or the photosynthetic prokaryotic organisms, 2) Chlorophyta, or the green algae, 3) Rhodophyta, or the red algae, 4) Tribophyta, or the yellow-green algae, and 5) Bacillariophyta, or the diatoms. The most common macroalgal groups in Hawaiian streams are the green algae and Cyanobacteria, followed by the red algae, diatoms and yellow-green algae; however, the diatoms possess considerably more diversity in the periphyton community than represented here. The broad taxonomic category to which each representative belongs is indicated at the top of the description pages through the color of the heading bar, as follows: Cyanobacteria = turquoise, Chlorophyta = green, Rhodophyta = red,

Tribophyta = yellow, Bacillariophyta = gray. Distribution information, in terms of what is known so far, is indicated for each genus. It should be recognized, however, that the potential and likelihood for extension of ranges on other islands is high. Additionally, the reports included in this guide represent records from streams only – many of these genera have representatives in marine, brackish and subaerial/terrestrial habitats, which are not included here. The guide has been exclusively illustrated using Hawaiian material.

Collection and preservation techniques

Since almost all stream macroalgae require at least some microscopical examination for identification, collection and preservation techniques should be developed to fit the needs and intentions of the study. One necessary piece of equipment for stream macroalgae sampling is a viewbox (or snorkel mask, if the collector is in the water; e.g. for fish surveys). A view box is relatively easy to construct, and can be made by cutting a square hole in the center of a plastic tupperware container, and using silicone aquarium gel to seal in a piece of glass cut to the correct size. The collection of macroalgae from the stream is accomplished most easily using long-handled forceps, which allow the alga to be removed in one piece at its base. Inclusion of the basal attachment is important, since some taxonomic descriptions use information pertaining to this part of the plant. A few forms may be more easily removed

using a single-edged razor blade (e.g. *Hildenbrandia*, *Calothrix*, some diatom films), or toothbrushes. Some gelatinous growths in side pools are easily collected using a turkey baster (e.g. *Anabaena*). It is also important to search all habitats in the vicinity of the stream to ensure that all taxa are represented in the collections – including rocks and other bottom substrata in fast-flowing stream areas, slow flowing areas at the edges of the stream, side pools, waterfall faces, seep faces, floating material in the stream and vegetation. As well, macroalgae prefer different light regimes, and so both brightly illuminated and shaded areas should be searched. Scintillation vials or WhirlPak bags work best for storing collections from the field, but it is important not to overfill the containers with algae since this will result in their rapid degradation. Most field collections kept cold (on ice or in a refrigerator) will remain in good condition for several days.

The most highly recommended preservative for freshwater macroalgae is CaCO₃-buffered glutaraldehyde (a 2.5% solution made from dilution of 25% glutaraldehyde, add a pinch of CaCO₃ powder to buffer the solution). This preservative maintains the original color of the specimens very well, and also minimizes the morphological distortion inherent in the preservation process. Samples preserved in glutaraldehyde should be kept cold until they are identified. Large numbers of collections are easiest to organize in scintillation vials, since these can be stored in flats of 100 vials in a fridge. In the

absence of glutaraldehyde, Lugol's Iodine Solution could be used, which has the benefit of staining the starch-positive groups of algae, but affects the overall color of the samples. Alcohol-based preservatives are not recommended since they destroy important information about specimen color, and severely distort the internal cellular details.

Finally, collections should be thoroughly labeled with all relevant information, such as collection location (including GPS coordinates, where possible), the collector, date and habitat.

Additional Sources of Information

General Books:

Dillard, G.E. 1999. *Common Freshwater Algae of the United States*. J. Cramer, Berlin/Stuttgart, Germany.

Entwistle, T.J., Sonneman, J.A. and Lewis, S.H. 1997. *Freshwater Algae in Australia: a Guide to Conspicuous Genera*. Sainty & Associates, Australia.

Pentecost, A. 1984. *Introduction to Freshwater Algae*. The Richmond Publishing Co. Ltd., Surrey, England.

Prescott, G.W. 1951. *Algae of the Western Great Lakes Area*. W.M. C. Brown Publishers, Dubuque, Iowa, U.S.A.

Websites:

General algal taxonomic information:
<http://www.algaebase.org/>

Bowling Green State University Algal Homepage:
<http://www.bgsu.edu/Departments/biology/algae/index.html>

Great Lakes Diatom Homepage:
<http://www.umich.edu/~phytolab/GreatLakesDiatomHomePage/top.html>

Freshwater Algae from southeastern Ohio:
<http://vis-pc.plantbio.ohiou.edu/algaeindex.htm>

Algae Homepage of the Smithsonian Institution:
<http://www.nmnh.si.edu/botany/projects/algae/>

CYANOSITE – Cyanobacterial research:
<http://www-cyanosite.bio.purdue.edu/index.html>

Desmid information:
<http://www.desmids.info/>

Freshwater algae of the British Isles:
http://www.nwl.ac.uk/~loissys/algae_coded_list.htm

Fritsch collection of illustrations of freshwater algae:
<http://www.ife.ac.uk/fritsch/>

Diatom Collection of the California Academy of Sciences:
<http://www.calacademy.org/research/diatoms/diatoms.html>

Key to the common genera of Hawaiian stream macroalgae

1.a. Large alga (several to many centimeters in length) with a plant body differentiated into a stem-like axis with whorls of branches, not surrounded by mucilage – *Chara* (p.28)

1.b. Organism either microscopic or macroscopic at the individual level, but cellular structures not evident without microscopic examination - 2

2.a. Alga siphonous, as seen at the microscopic level (lacking cellular cross walls), or in some other form (e.g. needle-shaped colonies) - 3

2.b. Alga filamentous when observed at the light microscopic level (includes crustose algae composed of filaments) - 4

3.a. Alga a felty green mass of filaments, coarse to the touch, cells a yellowish-green color when observed under the light microscope, lacking cross walls - *Vaucheria* (p.44)

3.b. Alga forming small star-shaped clusters of needle-like cells, usually growing on larger algae or mosses, chloroplasts a golden color - *Synedra* (p.48)

4.a. Filaments branched when observed macroscopically or using the light microscope, or

main axis composed of multiple filaments (multiseriate) - 5

4.b. Filaments unbranched, or only very occasionally branched when observed macroscopically or using the light microscope, main axis composed of only a single filament (uniseriate) - 18

5.a. Cell contents blue-green, olive-green or pinkish in color, lacking a nucleus and chloroplast - 6

5.b. Cell contents colored grass-green, yellow-green, or as in 5a, but containing at least one nucleus and chloroplast - 11

6.a. Main axis of the alga (when viewed microscopically) composed of multiple filaments of cells, alga appears cartilaginous and is often pigmented a yellowish-brown color - *Stigonema* (p.24)

6.b. Main axis of the alga composed of only a single filament (uniseriate) - 7

7.a. Algal filaments uniform in diameter along their length or composed of bead-like cells - 8

7.b. Algal filaments gradually tapering in diameter along their length - *Dichothrix* (p.14)

8.a. Alga with distinctly inflated cells, appearing bead-like under the light microscope, cell contents a uniform light bluish-green color, no distinct sheath surrounding the filaments - *Nostochopsis* (p.19)

8.b. Algal filament contained within a sheath, with cells more or less the same diameter (not bead-like and rounded), although some may have slight constrictions at cross walls - 9

9.a. Alga typically forming two false branches at the same point - *Scytonema* (p.23)

9.b. Alga typically only forming a single false branch at any one point, if at all - 10

10.a. Filaments long, single false branches common, branching occurs adjacent to a larger, clearer cell (heterocyst) in the filament - *Tolypothrix* (p.25)

10.b. Single false branches rare, filaments quite short - *Microchaete* (p.16)

11.a. Chloroplasts a yellow-green, grass-green or dark green color - 12

11.b. Chloroplasts olive-gray, blue, pink, purple or red in color - 16

12.a. Alga branching only at the base, near the point of attachment - *Basycladia* (p.26)

12.b. Alga branching in regions other than just at the base, near the point of attachment, or not at all (but possessing a multiseriate main axis) - 13

13.a. Chloroplasts dense and net-like, often seeming to fill the cell - *Cladophora* (p.29)

13.b. Chloroplast a plate-like band, especially evident in the main axis cells - 14

14.a. Alga multiseriate (multiple filaments composing the main axis) in the upper regions of the plant - *Schizomeris* (p.35)

14.b. Alga uniseriate throughout (only one filament composing the axis) - 15

15.a. Alga forming a distinct colony, filaments gradually tapering toward their ends - *Chaetophora* (p.27)

15.b. Alga a feathery tuft, cells of branches not markedly different in diameter from the main axis, tips of branches tapering to a point or ending in a fine hair - *Stigeoclonium* (p.37)

15.c. Alga a feathery tuft, cells of the branches smaller than those of the main axis, tips of branches not tapering to a point or ending in a fine hair - *Cloniophora* (p.30)

16.a. Alga composed of a main axis with whorls of branches emerging from it, gelatinous to the touch - *Batrachospermum* (p.40)

16.b. Alga either crustose or filamentous, but not gelatinous - 17

17.a. Alga crustose, resembling spots of red paint, usually on rock surfaces - *Hildenbrandia* (p.42)

17.b. Alga branched and filamentous, forming long bluish-green or bluish-gray strands, main axis with a bead-like appearance that can be seen without a microscope - *Compsopogon* (p.41)

17.c. Alga filamentous and branched, chloroplasts bluish or reddish in color, round-shaped reproductive structures (monosporangia) common at the tips of branches - *Audouinella* (p.39)

18.a. Cell contents blue-green, olive-green or pinkish in color, lacking a nucleus and chloroplast - 19

18.b. Cells with chloroplasts colored grass-green, yellow-green, or as in 18a, but containing at least one nucleus and chloroplast - 25

19.a. Cells bead-like or barrel-shaped, heterocysts present at various positions within the filaments, or only at the ends - 20

19.b. Cells otherwise - 21

20.a. Alga with a thick outer mucilage layer that gives the organism a definite shape - *Nostoc* (p.18)

20.b. Alga without a thick outer mucilage layer, does not retain its shape when removed from the water, heterocysts common at multiple positions within a filament - *Anabaena* (p.11)

20.c. Alga without a thick outer mucilage layer, does not retain its shape when removed from the water, heterocysts only at the ends of the filaments - *Cylindrospermum* (p.13)

21.a. Filaments of the alga tapering in diameter along their length, with a heterocyst at the base of the filament - *Calothrix* (p.12)

21.b. Filaments much the same diameter along their length - 22

22.a. Only a single filament present within a surrounding sheath, if present at all - 23

22.b. Two or more filaments sometimes or always seen within a single surrounding sheath - 24

23.a. Filaments not surrounded by a sheath - *Oscillatoria* (p.20)

23.b. Filaments usually surrounded by a sheath, entangled to form a definite mat-like structure that

is conspicuous at the macroscopic level -
Phormidium (p.21)

23.c. Filaments surrounded by a sheath, can be entangled in small growths but not as large mats -
Lyngbya (p.15)

24.a. Many filaments bundled together within a sheath, entangled to form a mat that is usually greenish in color - *Schizothrix* (p.22)

24.b. Only a few filaments typically bundled together within a sheath, mat is usually bluish-purple or purplish-gray in color - *Microcoleus* (p.17)

25.a. Cells with grass-green chloroplasts and containing starch (positive stain with Lugol's Iodine Solution) - 26

25.b. Cells with yellow-green or brown chloroplasts, not containing true starch (alga does not positively stain with Lugol's Iodine Solution) - 30

26.a. Cells with round chloroplasts that appear flattened against one wall of the cell, chloroplasts do not occupy majority of the cell - *Klebsormidium* (p.31)

26.b. Cells otherwise - 27

27.a. Cells containing net-like chloroplasts - 28

27.b. Cells otherwise - 29

28.a. Some cells with conspicuous rings at one end, chloroplast usually not dense and net-like structure can be easily discerned - *Oedogonium* (p.33)

28.b. Cells without rings at the ends, chloroplasts usually very dense and the net-like structure difficult to see - *Rhizoclonium* (p.34)

29.a. Cells with one or more spiral-shaped chloroplasts - *Spirogyra* (p.36)

29.b. Cells with one plate-like chloroplast that may be either lying in a flat plane or twisted once - *Mougeotia* (p.32)

29.c. Cells with two star-shaped chloroplasts - *Zygnema* (p.38)

30a. Cells with yellow-green chloroplasts, cell walls in two sections that overlap in the central region, forming H-shaped sections - *Tribonema* (p.43)

30b. Cells with brown chloroplasts, cell walls highly ornamented (diatoms) - 31

31a. Cells arranged in filaments such that all or most of the adjacent cell surfaces are touching - 32

31b. Cells in filaments such that only the corners of the adjacent cells are touching (zig-zag filaments) - 33

32a. Filaments constructed of cylindrical cells composed of overlapping pieces, ornamentation in the form of organized lines of holes (striae) along the two halves of the cylinder - *Melosira* (p.46)

32b. Cells of filament appear rectangular, when individually separated appear rounded with six protrusions equally spaced around cell perimeter - *Hydrosera* (p.45)

33a. Cells appear rectangular in filaments, but elliptical when seen in valve view - *Pleurosira* (p.47)

33b. Cells in filaments form appear rectangular, small “musical-note” shaped ornamentations visible on the cell wall - *Terpsinoë* (p.49)

Anabaena

Classification: Cyanobacteria (Family Nostocaceae)

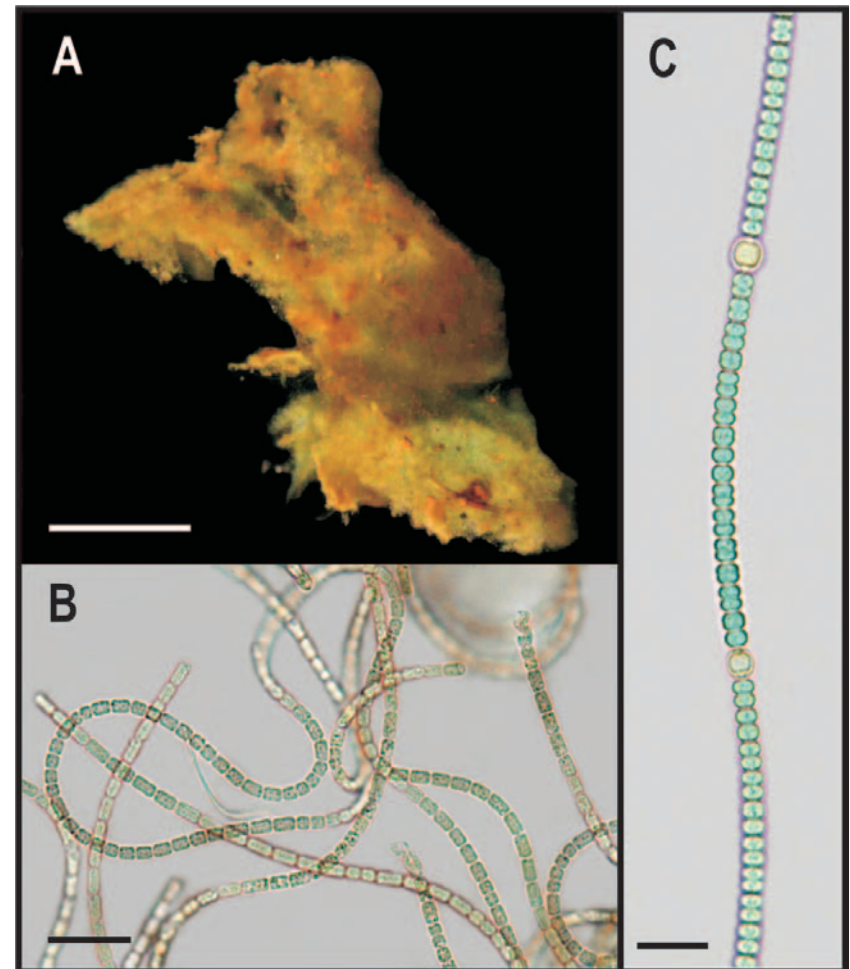
General habit: unbranched filaments in an entangled mass, often in clumps or mats, surrounding mucilage does not have a definite shape that is retained when the alga is removed from the water

Species in Hawai'i: *A. catenula*, *Anabaena* sp.

Island distribution: Kaua'i, O'ahu

Distinguishing features: bead or barrel-shaped cells in unbranched filaments, slightly larger and less pigmented cells (heterocysts; sites of nitrogen fixation; Fig. C) spaced along filaments, similar to *Nostoc* but colony does not have a well-defined mucilage coating that retains its shape

Compare with: *Cylindrospermum*, *Nostoc*, *Nostochopsis*



A. Piece of an epilithic *Anabaena* mat. Scale bar = 2mm. **B.** Filaments of *Anabaena* as seen with the compound microscope. Scale bar = 20 μ m. **C.** Single filament with both vegetative cells (colored) and heterocysts (larger and less pigmented). Scale bar = 15 μ m.

Calothrix

Classification: Cyanobacteria (Family Rivulariaceae)

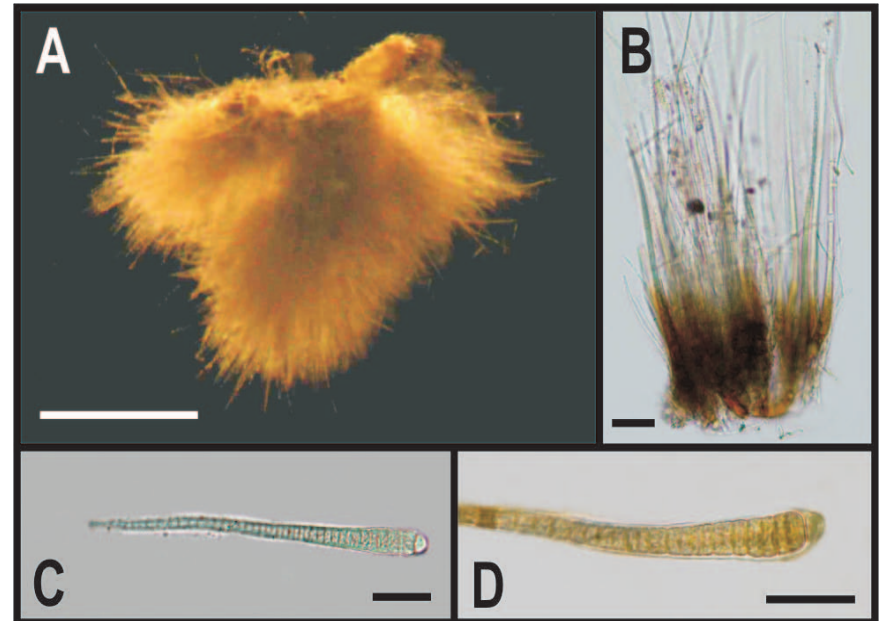
General habit: plants either growing individually or clustered in tufts or mats (sometimes in a star-shaped formation), can grow on rock surfaces or epiphytically on other algae or plants

Species in Hawai'i: *C. braunii*, *C. fusca*

Island distribution: Necker, O'ahu, Maui

Distinguishing features: Filaments taper from the base (which usually ends in a heterocyst; Figs C, D) to a fine point at the distal end, cells shorter than wide in the lower regions of the filament and gradually becoming longer than wide toward the tips

Compare with: *Scytonema*, *Tolypothrix*



A. An epilithic tuft of *Calothrix*. Scale bar = 1mm.
B. View of several filaments under a compound microscope. Scale bar = 25 μ m. **C, D.** Individual filaments of *Calothrix* illustrating tapering of the filaments and heterocysts at the ends. Scale bar = 25 μ m.

Cylindrospermum

Classification: Cyanobacteria (Family Nostocaceae)

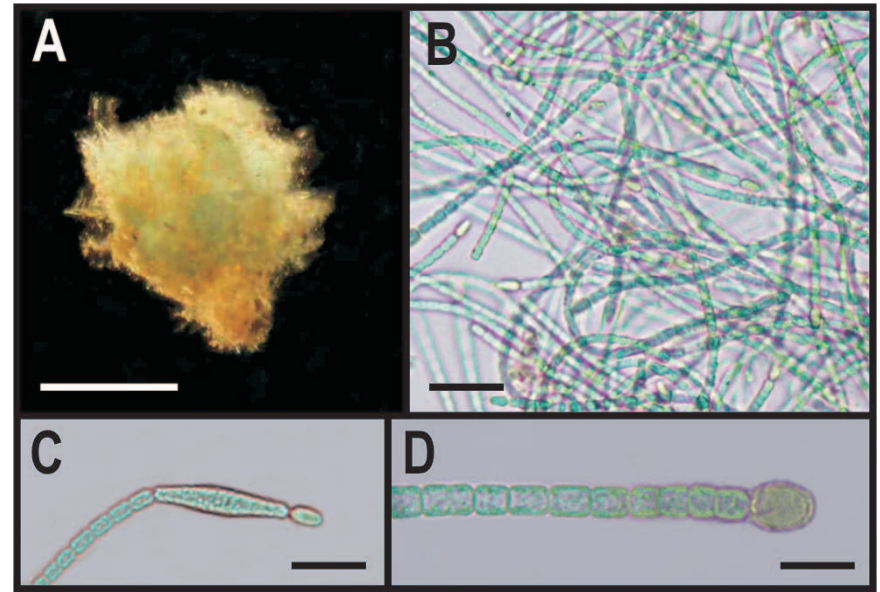
General habit: a series of intertwined filaments in a mucilage coat, forms dark green mats or patches on rocks in streams, occasionally on submerged vegetation

Species in Hawai'i: *C. catenatum*, *C. stagnale*, *Cylindrospermum* sp.

Island distribution: Kaua'i, O'ahu, Maui, Hawai'i

Distinguishing features: heterocysts present at one or both ends of the filaments (Fig. D), cells cylindrical or barrel-shaped, cross walls defined by constrictions, gonidia (reproductive bodies) occasionally visible at the ends of filaments adjacent to heterocysts

Compare with: *Anabaena*, *Oscillatoria*, *Phormidium*



A. A piece of an epilithic mat of *Cylindrospermum*. Scale bar = 1mm. **B.** View under a compound microscope of a *Cylindrospermum* mat, illustrating intertwined filaments. Scale bar = 25 μ m. **C.** Filament with a gonidium and heterocyst at the end. Scale bar = 20 μ m. **D.** Filament with a terminal heterocyst. Scale bar = 10 μ m.

Dichothrix

Classification: Cyanobacteria (Family Rivulariaceae)

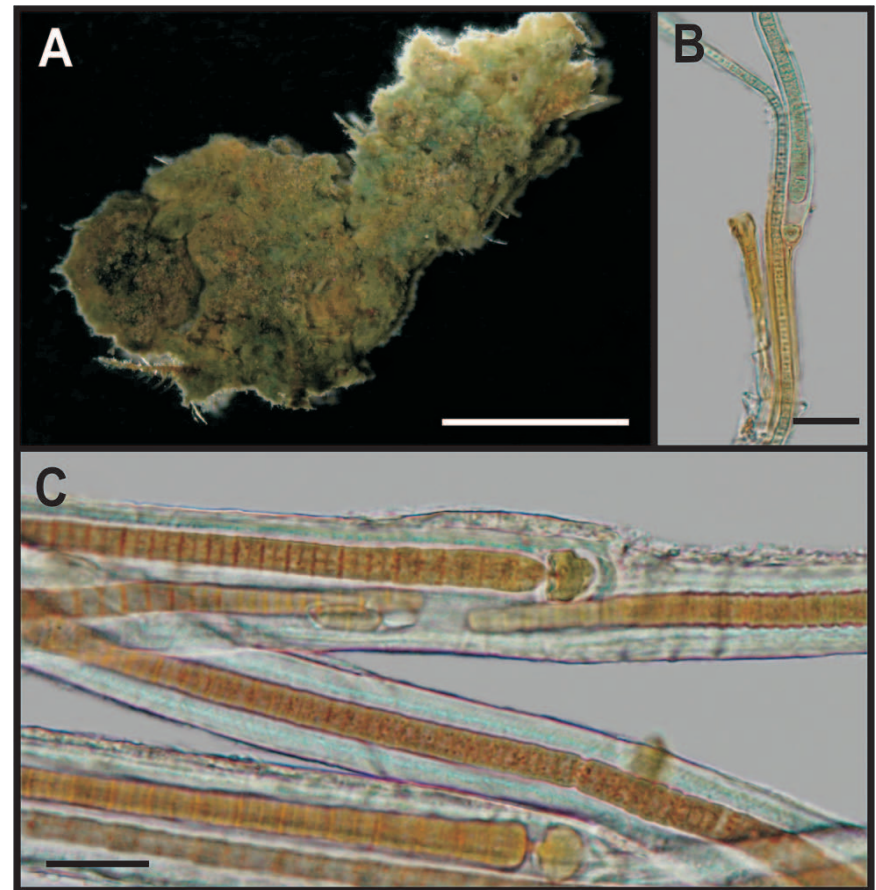
General habit: forming small mats or feathery tufts on a variety of surfaces in streams, sometimes growing only as solitary plants, yellowish-brown in color

Species in Hawai'i: *D. baueriana*, *D. fusca*

Island distribution: Maui, Hawai'i

Distinguishing features: filaments tapering slightly along their length, heterocysts usually at the larger ends of filaments (although they can be present in the central areas of the filaments as well), usually 2-6 filaments contained within a single sheath for at least part of their length

Compare with: *Scytonema*, *Tolypothrix*



A. A piece of an epilithic mat of *Dichothrix*. Scale bar = 2mm. **B.** Filaments enclosed in a single sheath for part of their length. Scale bar = 20 μ m.

C. Basal heterocysts on *Dichothrix* filaments. Scale bar = 10 μ m.

Lyngbya

Classification: Cyanobacteria (Family Oscillatoriaceae)

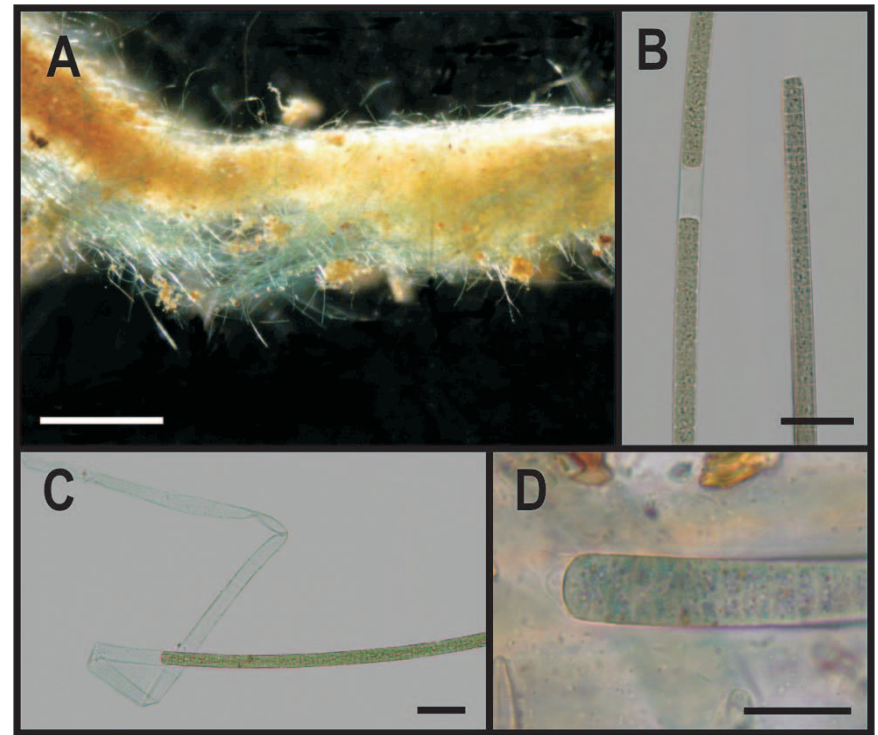
General habit: loose filaments that occasionally aggregate macroscopically in mats or tufts, can be epiphytic on other vegetation or epilithic on rock surfaces, color varies from bluish-green to reddish or purplish

Species in Hawai'i: *L. aestuarii*, *L. cladophorae*, *L. major*, *L. martensiana*, *L. putealis*, *Lyngbya* sp.

Island distribution: O'ahu, Hawai'i

Distinguishing features: filaments unbranched, mostly cylindrical and tapering very little if at all, enclosed in a sheath (Figs B, C), heterocysts absent, filaments loosely entangled rather than forming a distinct mat-like structure (as in *Phormidium*)

Compare with: *Oscillatoria*, *Phormidium*



A. Filaments of *Lyngbya* entwined on a branch. Scale bar = 1mm. **B.** Two individual filaments of *Lyngbya* illustrating the surrounding sheath. Scale bar = 30 μ m. **C.** A long sheath surrounding a *Lyngbya* filament. Scale bar = 30 μ m. **D.** High magnification view of a terminal region of a filament. Scale bar = 20 μ m.

Microchaete

Classification: Cyanobacteria (Family Microchaetaceae)

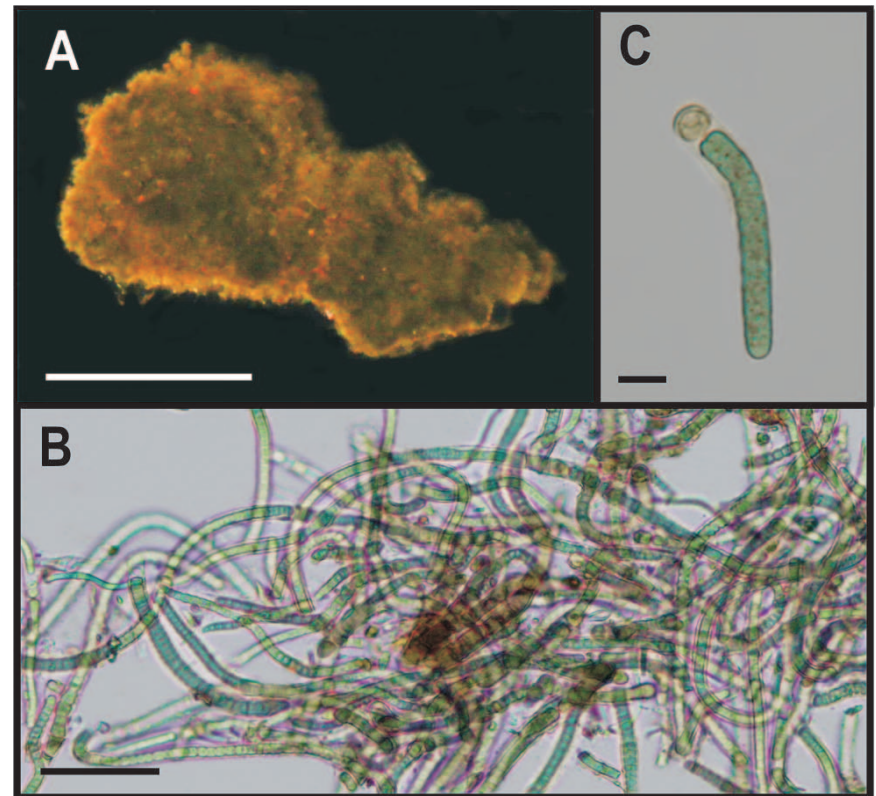
General habit: entangled filaments, macroscopically seen as small, stellate tufts or as mats on rock surfaces or submerged vegetation in streams, usually brownish or gray in color

Species in Hawai'i: *M. uberrima*, *M. tenera*

Island distribution: Kaua'i, Hawai'i

Distinguishing features: filaments not tapering along their length, enclosed in a sheath, occasional false branching present, heterocysts can be at the ends of filaments (Fig. C) or along the length of the filament

Compare with: *Dichothrix*, *Scytonema*, *Tolypothrix*



A. A piece of an epilithic mat formed by *Microchaete*. Scale bar = 2mm. **B.** Compound microscope view of intertwined *Microchaete* filaments from a mat formation. Scale bar = 70 μ m. **C.** High magnification view of a small filament illustrating the basal heterocyst and uniformity of filament diameter along its length. Scale bar = 15 μ m.

Microcoleus

Classification: Cyanobacteria (Family Phormidiaceae)

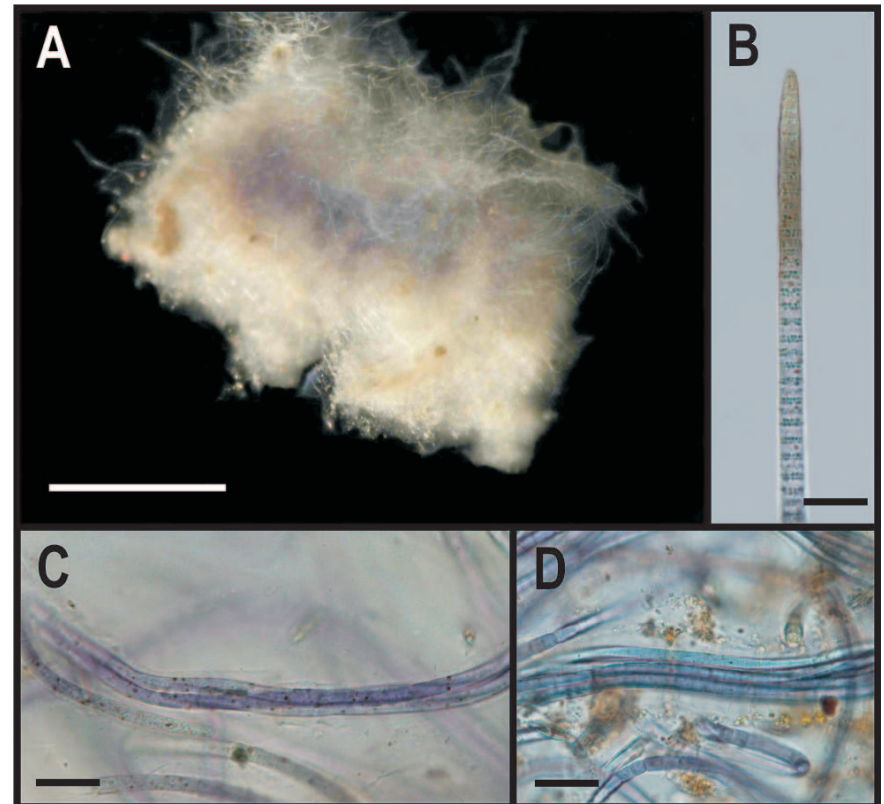
General habit: forms dark blue-green patches or mats on submerged surfaces, composed of filaments in confluent sheaths, usually a purplish-gray mass

Species in Hawai'i: *M. lacustris*, *M. vaginatus*

Island distribution: O'ahu, Hawai'i

Distinguishing features: parallel filaments enclosed in a mucilaginous sheath, slight tapering toward the end of the filament (Fig. B), cross walls sometimes have a granular appearance (Fig. B)

Compare with: *Phormidium*, *Schizothrix*



A. A piece of an epilithic mat formed by *Microcoleus*. Scale bar = 2mm. **B.** A compound microscope view of a *Microcoleus* filament, illustrating granular cross walls (some species). Scale bar = 10 μ m. **C, D.** Parallel trichomes enclosed in a sheath. Scale bar = 15 μ m.

Nostoc

Classification: Cyanobacteria (Family Nostocaceae)

General habit: colonies can be membranous, globular or lobed, or dried in clumps, composed of unbranched filaments of cells, enclosed in a thick mucilage that lends a definite shape to the colony (which retains its shape when removed from the water)

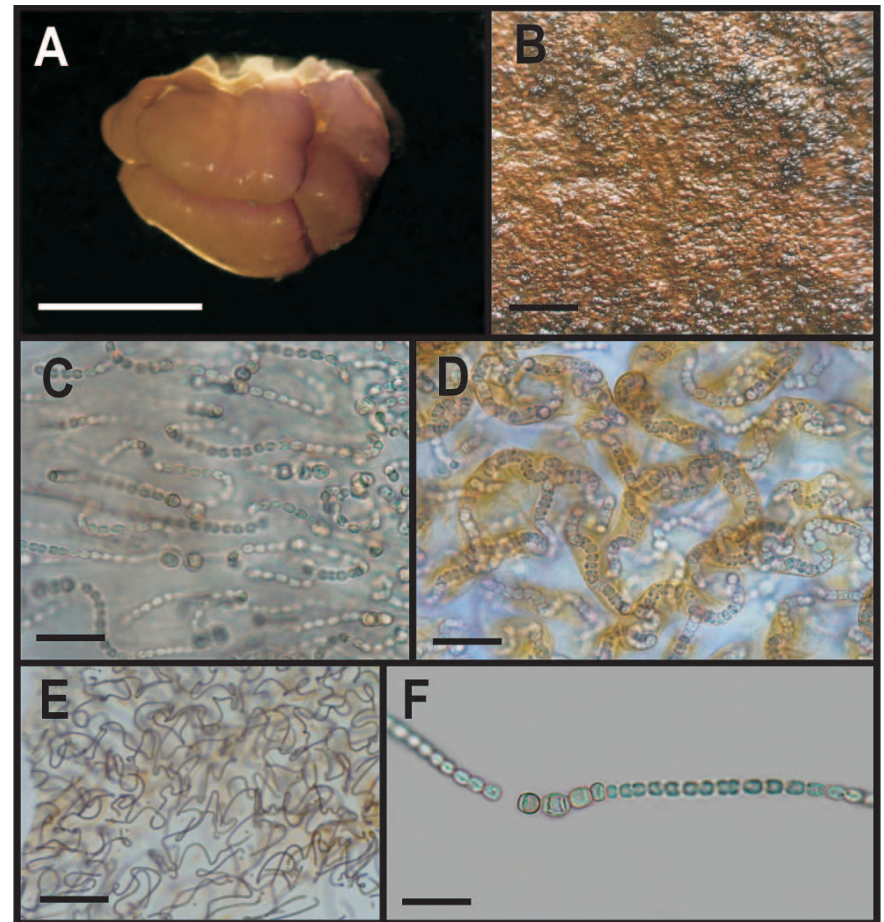
Species in Hawai'i: *N. foliaceum*, *N. hatei*, *N. linckia*, *N. microscopicum*, *N. paludosum*, *N. pruniforme*, *N. sphaericum*, *N. verrucosum*, *Nostoc* sp.

Island distribution: Kaua'i, O'ahu, Maui, Hawai'i

Distinguishing features: colonies surrounded by a thick layer of mucilage which gives the alga a definite shape, cells of filaments resemble those of *Anabaena* (bead or barrel-shaped), heterocysts frequent along length of filament (Fig. F)

Compare with: *Anabaena*, *Cylindrospermum*, *Nostochopsis*

A. View of an individual epilithic *Nostoc* colony
Scale bar = 3mm. **B.** Numerous *Nostoc* colonies attached to a rock. Scale bar = 5cm. **C.** Compound



microscope view of inside a colony, showing filaments with heterocysts (larger cells). Scale bar = 20 μ m. **D.** Filaments with highly pigmented sheaths. Scale bar = 20 μ m. **E.** Arrangement of filaments within a colony. Scale bar = 100 μ m. **F.** An individual filament with several heterocysts. Scale bar = 15 μ m.

Nostochopsis

Classification: Cyanobacteria (Family Nostochopsaceae)

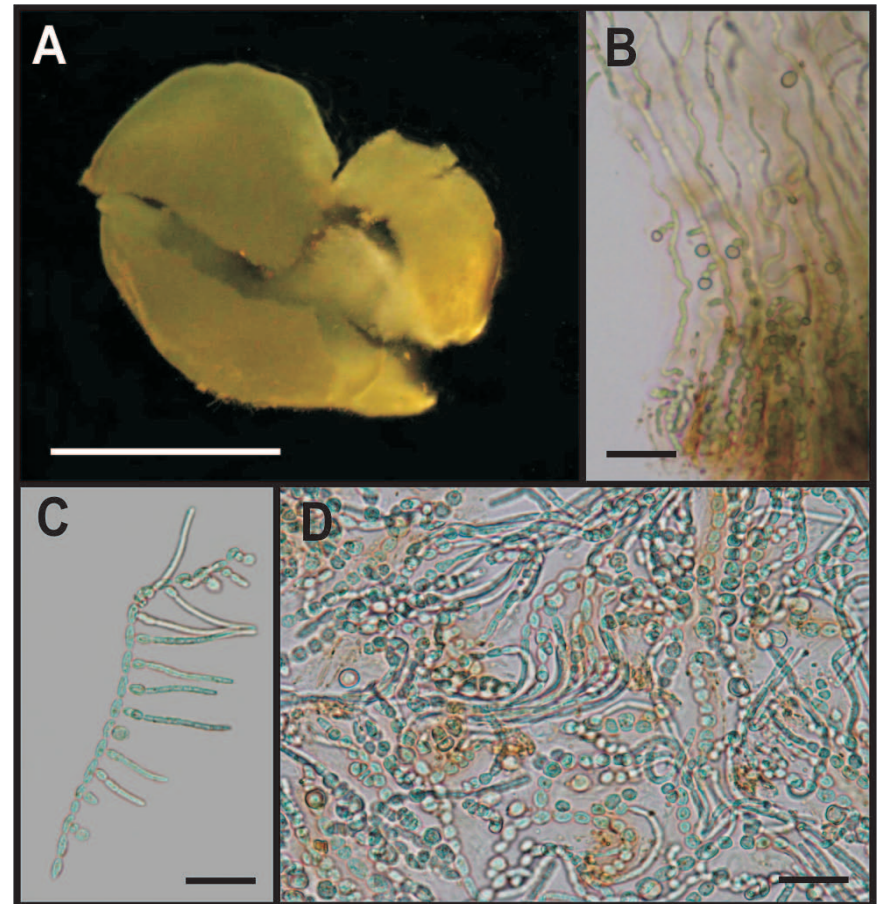
General habit: bright blue-green globular colonies, composed of filaments encased in mucilage, colonies retaining their shape when removed from the water

Species in Hawai'i: *N. lobatus*, *N. radians*

Island distribution: Kaua'i, O'ahu, Maui

Distinguishing features: macroscopically similar to *Nostoc*, but filaments branching, appears as bright blue-green to grass-green colonies in streams, usually attached to rocks, heterocysts can be either apical, or both intercalary and apical (depending on the species)

Compare with: *Nostoc*, *Chaetophora*



A. An individual colony of epilithic *Nostochopsis*. Scale bar = 2mm. **B.** Compound microscope view of filaments arranged in a colony. Scale bar = 20 μ m. **C.** Branched filament with heterocysts. Scale bar = 20 μ m. **D.** Intertwined filaments of *Nostochopsis*. Scale bar = 15 μ m.

Oscillatoria

Classification: Cyanobacteria (Family Oscillatoriaceae)

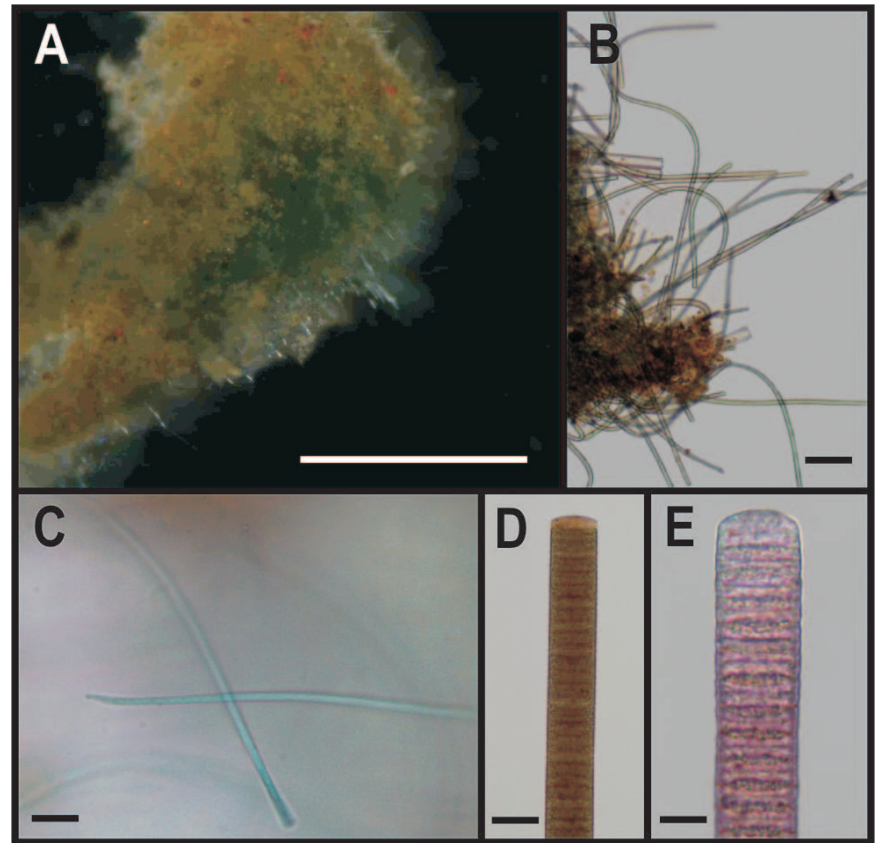
General habit: forming either an expanded plant mass or present as loose filaments, attached to submerged rocks or vegetation in a stream, color can range greatly from blue-green to dark red, brown or purple

Species in Hawai'i: *O. chalybea*, *O. curviceps*, *O. formosa*, *O. limosa*, *O. princeps*, *O. sancta*, *O. splendida*, *O. subbrevis*, *Oscillatoria* sp.

Island distribution: Kaua'i, O'ahu, Hawai'i

Distinguishing features: unbranched filaments lacking a sheath, filaments cylindrical and not tapering along their length, heterocysts absent, can be either single filaments or aggregated in small colonies, when live, filaments often exhibit a characteristic “oscillating” movement

Compare with: *Lynngbya*, *Phormidium*



A. A piece of an epilithic mat formed by *Oscillatoria* filaments. Scale bar = 2mm. **B.** Compound microscope view of an *Oscillatoria* mat. Scale bar = 40 μ m. **C.** Filaments of a small species of *Oscillatoria*. Scale bar = 15 μ m. **D, E.** Filaments of large species of *Oscillatoria*, demonstrating the lack of a surrounding sheath. Scale bar = 15 μ m (D), 10 μ m (E).

Phormidium

Classification: Cyanobacteria (Family Phormidiaceae)

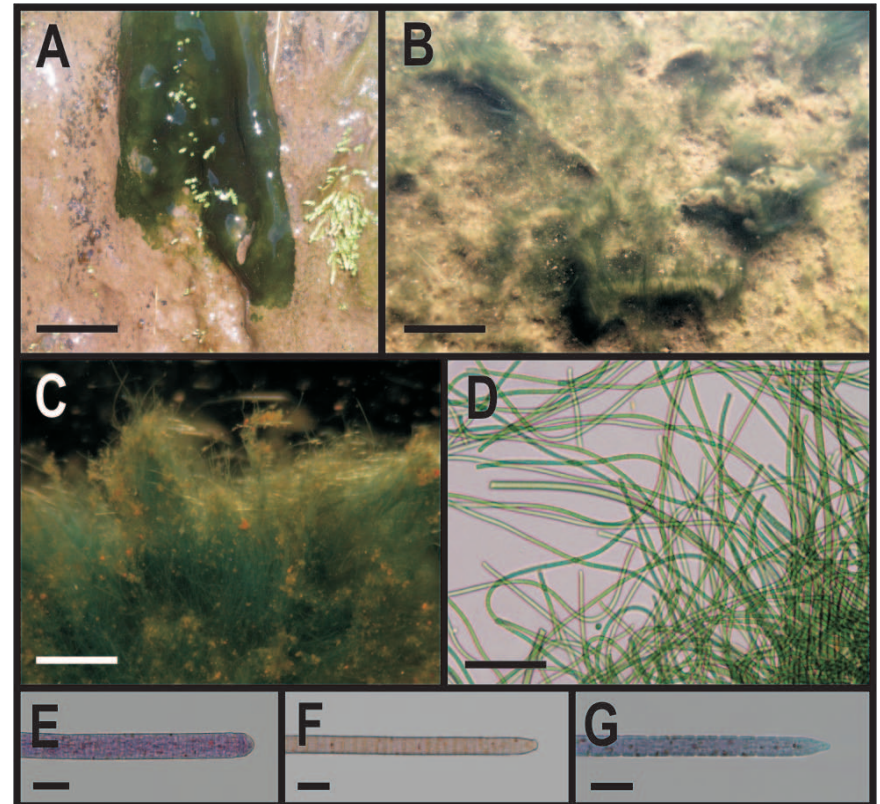
General habit: masses of entangled filaments forming mats that are attached to rocks or vegetation, or growing in sediments in slower-flowing stream areas, can range in color from light blue-green to red/purple or black/gray

Species in Hawai'i: *P. ambiguum*, *P. amoenum*, *P. corium*, *P. favosum*, *P. formosum*, *P. foveolarum*, *P. inundatum*, *P. pachydermaticum*, *P. retzii*, *P. splendidum*, *P. stagnina*, *P. subfuscum*, *P. subincrustatum*, *P. tinctorium*, *P. uncinatum*, *Phormidium* sp.

Island distribution: Kaua'i, O'ahu, Maui, Hawai'i

Distinguishing features: unbranched filaments entangled and forming a mat, filaments not tapering along their length, heterocysts absent, cells at the ends of filaments with a variety of possible morphologies (Figs E-G)

Compare with: *Lynxbya*, *Oscillatoria*



A. A mat of *Phormidium* growing on a damp rock wall. Scale bar = 5cm. **B.** A *Phormidium* mat growing in bottom sediment of a stream. Scale bar = 5cm. **C.** A dissection microscope view of a *Phormidium* mat. Scale bar = 2mm. **D.** Compound microscope view of intertwined filaments in a *Phormidium* mat. Scale bar = 80 μ m. **E, F, G.** Individual filaments illustrating some of the variation in cell size and terminal cell morphology. Scale bar = 10 μ m.

Schizothrix

Classification: Cyanobacteria (Family Schizotrichaceae)

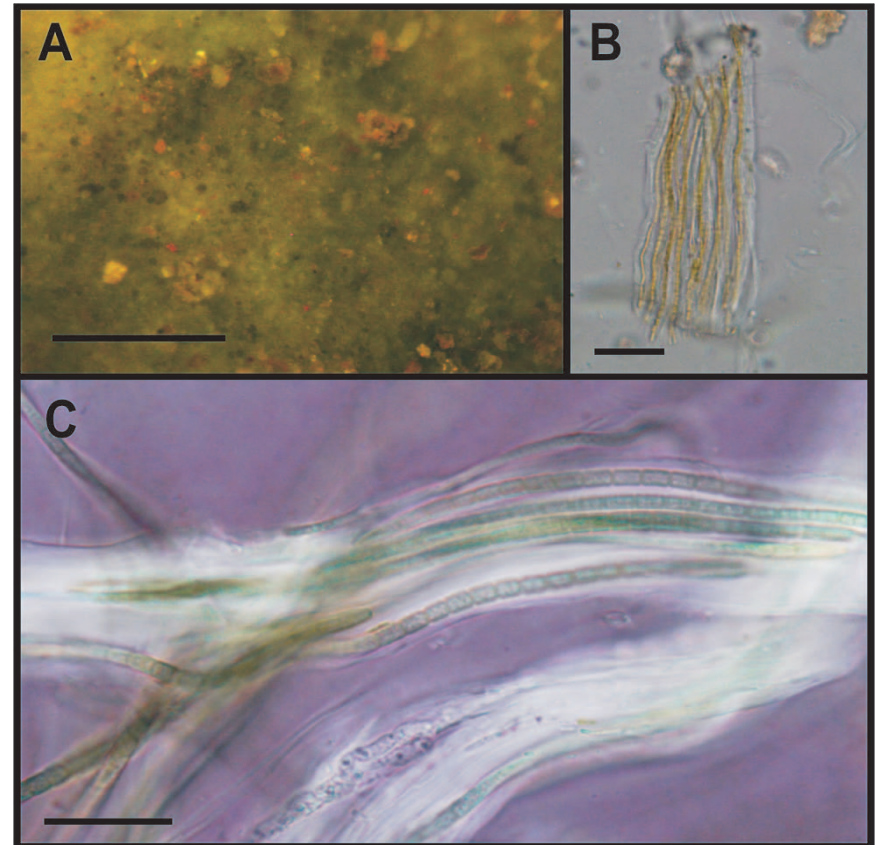
General habit: series of filaments enclosed in a sheath of mucilage, forming broad mats that are attached to rock surfaces or lightly embedded in sediment

Species in Hawai'i: *S. calcicola*, *S. friesii*, *S. lacustris*, *S. rivularis*

Island distribution: Ni'ihau, Kaua'i, O'ahu, Moloka'i, Maui, Hawai'i

Distinguishing features: several filaments enclosed in a sheath of mucilage, the sheath can either be colorless or yellowish, cells cylindrical in shape but with the apical cell tapering

Compare with: *Dichothrix*, *Microcoleus*, *Phormidium*



A. Dissecting microscope view of a mat formed by *Schizothrix* filaments. Scale bar = 2mm. **B.** Several filaments enclosed in a mucilage sheath. Scale bar = 10 μ m. **C.** India Ink preparation illustrating the sheath surrounding *Schizothrix* filaments. Scale bar = 15 μ m.

Scytonema

Classification: Cyanobacteria (Family Scytonemataceae)

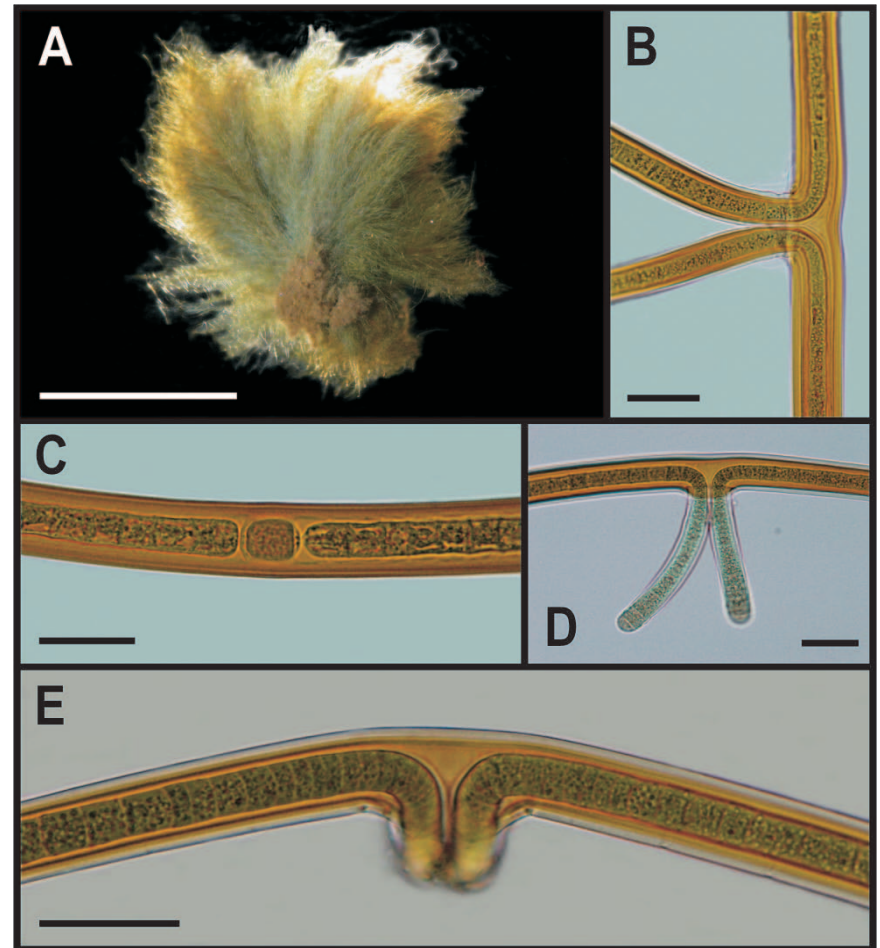
General habit: a falsely branched cyanobacterium that forms thick mats or tufts that can be abundant in streams, often yellowish-brown in color from pigmentation, most commonly attached to rock surfaces

Species in Hawai'i: *S. archangelii*, *S. chiastum*, *S. coactile*, *S. crispum*, *S. figuratum*, *S. fritchii*, *S. guyanese*, *S. hofmannii*, *S. myochrous*, *S. ocellatum*, *S. rivulare*, *S. stuposum*, *S. tolypothricoides*, *S. varium*, *Scytonema* sp.

Island distribution: Kaua'i, O'ahu, Maui, Hawai'i

Distinguishing features: false branches normally occur in pairs in this genus (Figs B, D, E), only a single filament is contained within the surrounding sheath, sheath can be thick and layered in appearance and often highly pigmented in Hawaiian specimens

Compare with: *Dichothrix*, *Tolypothrix*



A. A tuft of *Scytonema* as viewed under a dissecting microscope. Scale bar = 1 cm. **B.** Filament of *Scytonema* under a compound microscope illustrating double false branching. Scale bar = 25 μ m. **C.** A heterocyst of *Scytonema*. Scale bar = 25 μ m. **D, E.** Double false branching of *Scytonema* filaments. Scale bar = 25 μ m (D), 30 μ m (E).

Stigonema

Classification: Cyanobacteria (Family Stigonemataceae)

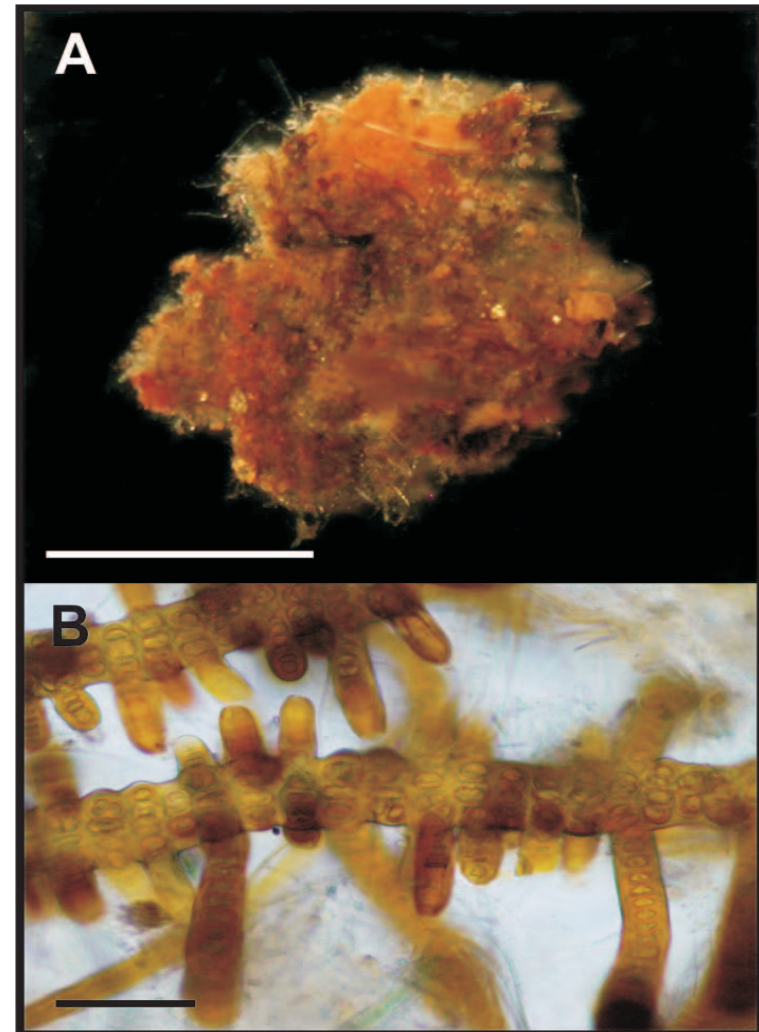
General habit: filaments multiseriate (several cells thick on the main axis), forming small clumps amid other filaments of algae, sometimes present as a mat, specimens in Hawai'i usually highly pigmented a yellowish-brown color, epilithic or epiphytic

Species in Hawai'i: *S. mamillosum*, *S. minutum*

Island distribution: Lana'i, Maui, Hawai'i

Distinguishing features: this is the only common multiseriate cyanobacterium in the Hawaiian stream algal flora, filaments branched with a firm mucilaginous sheath, can be highly pigmented, heterocysts present

Compare with: *Scytonema*



A. A piece of a mat formed by *Stigonema* filaments, viewed with a dissecting microscope. Scale bar = 5mm. **B.** Multiseriate filaments of *Stigonema* viewed under a compound microscope. Scale bar = 50 μ m.

Tolypothrix

Classification: Cyanobacteria (Family Microchaetaceae)

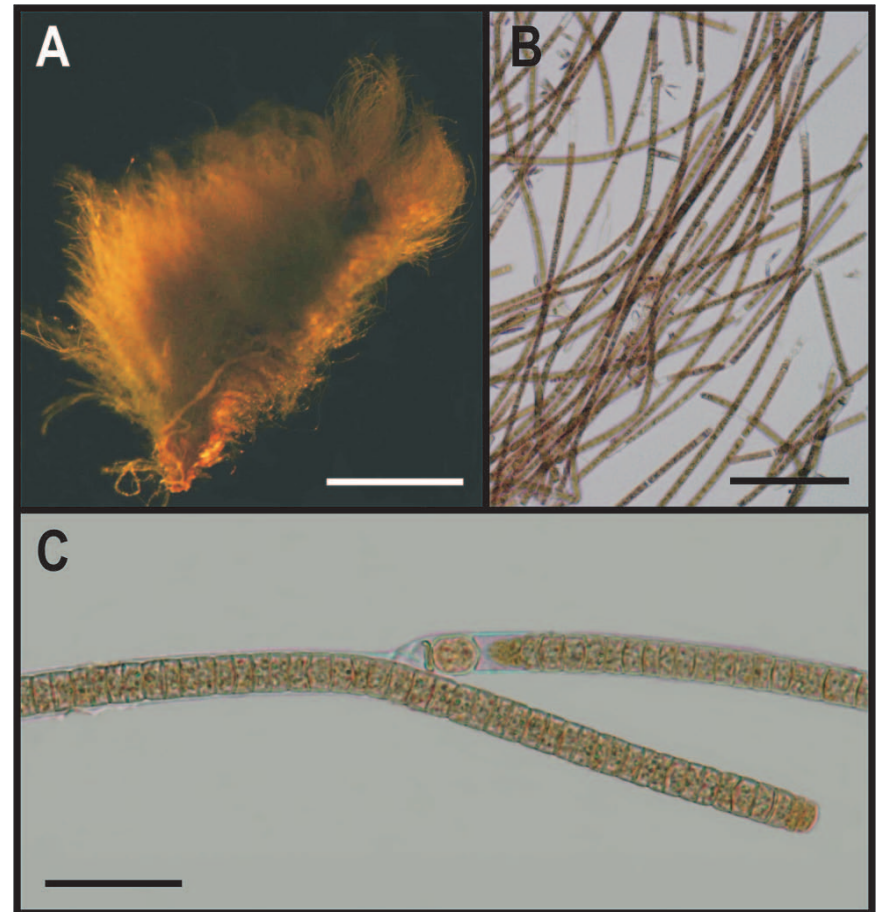
General habit: a falsely branched cyanobacterium that forms fluffy tufts and expanded masses due to intertwined filaments, bluish-green to brown in color, usually epilithic, can be several cm in length

Species in Hawai'i: *T. distorta*, *T. nodosa*, *T. tenuis*

Island distribution: O'ahu, Hawai'i

Distinguishing features: false branches occur singly, arising at a heterocyst (pale colored cell, larger than vegetative cells), filaments surrounded by a sheath that is usually thin and sometimes layered

Compare with: *Scytonema*



A. An epilithic mat formed by *Tolypothrix*. Scale bar = 1mm. **B.** Compound microscope view of intertwined *Tolypothrix* filaments. Scale bar = 100 μ m. **C.** A single filament illustrating single false branching at a heterocyst. Scale bar = 30 μ m.

Basicladia

Classification: Chlorophyta (Family Cladophoraceae)

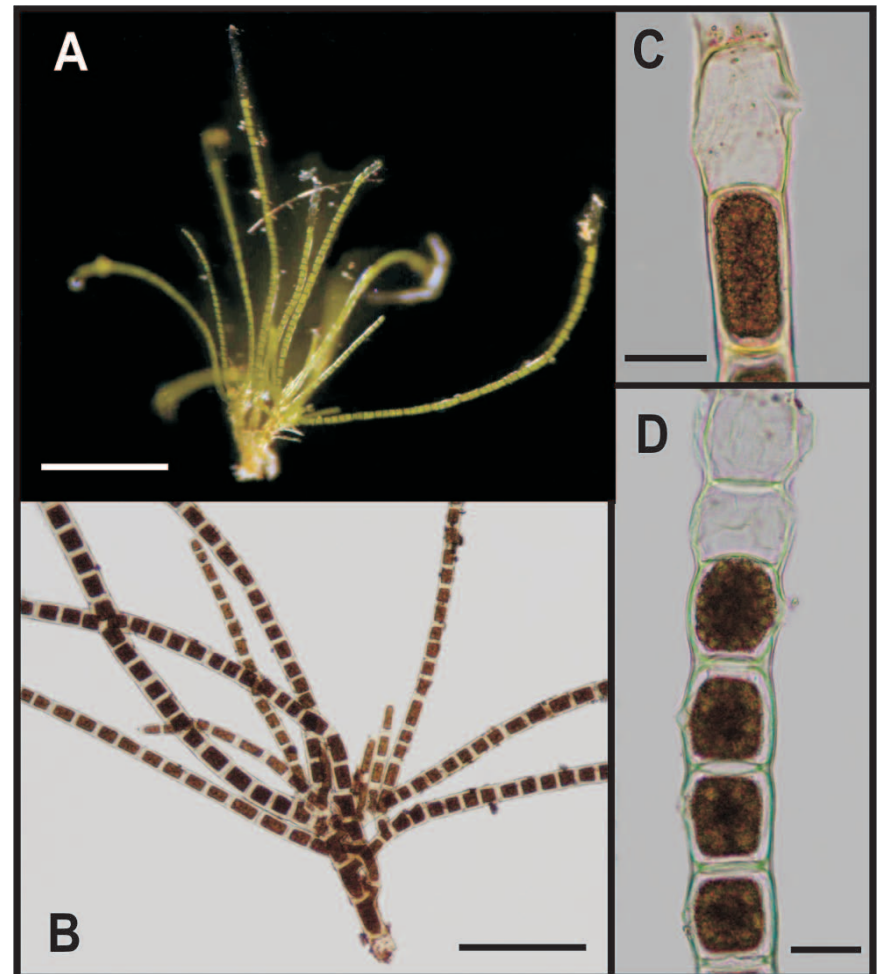
General habit: commonly reported in other locations as growing on the backs of turtles, in Hawai'i it has only been reported growing on rock surfaces, bright green in color

Species in Hawai'i: *B. chelonum*

Island distribution: O'ahu

Distinguishing features: this distinctive green alga is typically quite small, filaments have a coarse appearance and cells have thick walls, chloroplast usually a dense net and appearing to fill the cell, composed of a series of filaments that branch only toward the base of the plant

Compare with: *Cladophora*, *Rhizoclonium*



A. *Basicladia* plant viewed under a dissecting microscope. Scale bar = 1mm. **B.** Plant viewed under a compound microscope, showing branching near the base. Scale bar = 250 μ m. **C, D.** Empty cells near the apex of the filament indicating zoospore production and release. Scale bar =

Chaetophora

Classification: Chlorophyta (Family Chaetophoraceae)

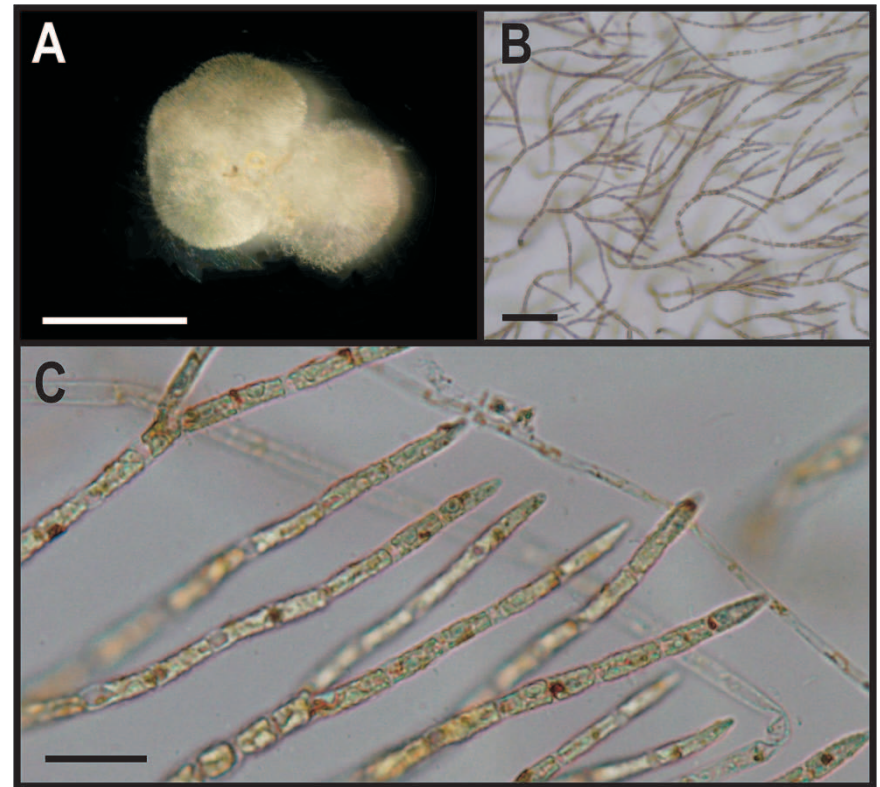
General habit: a series of branched filaments that radiate from a common central point, filaments encased in a soft mucilage, appearing as small yellow-green globules in a stream, usually epilithic or epiphytic

Species in Hawai'i: *C. elegans*

Island distribution: Kaua'i, O'ahu

Distinguishing features: composed of a series of highly branched filaments, colony surrounded by soft mucilage that lends a distinctive shape to the organism, filaments either tapering to a blunt point or to a long hair, chloroplast band-shaped and encircling the wall of the cells (especially visible in main axis cells)

Compare with: *Cloniophora*, *Stigeoclonium*



A. Colony of epilithic *Chaetophora* as viewed under a dissecting microscope. Scale bar = 500 μ m. **B.** Arrangement of filaments within a *Chaetophora* colony. Scale bar = 50 μ m. **C.** Tips of branched filaments showing band-like chloroplasts in cells. Scale bar = 25 μ m.

Chara

Classification: Chlorophyta (Family Characeae)

General habit: coarse plants, may be easily mistaken for a higher plant, composed of a main axis with unbranched branchlets extending from nodes

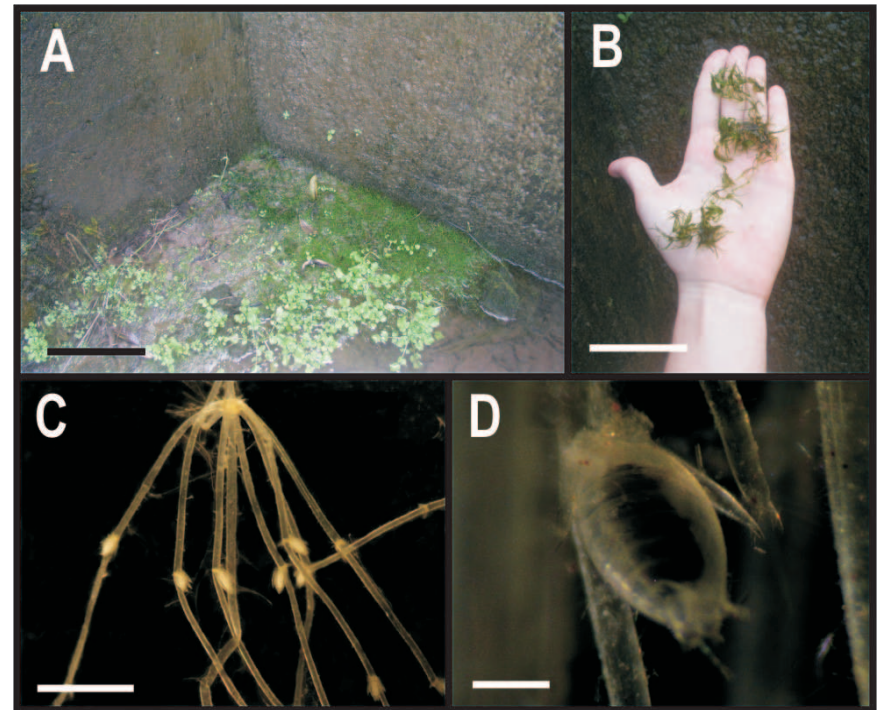
Habitats found: generally floating or only mildly embedded in substrate of slow-flowing or pooled areas, occasionally found in areas of moderate flow, yellowish-green to grass-green in color

Species in Hawai'i: *C. braunii*, *C. zeylanica*

Island distribution: Kaua'i, O'ahu, Maui

Distinguishing features: very long internodal cells, unbranched branchlets (Fig. C), plants quite large compared with other macroalgae in Hawaiian streams and may be easily mistaken for higher plants

Compare with: higher aquatic plants, may possibly be confused with large clumps of *Cladophora*, *Rhizoclonium* or *Compsopogon*



A. A mat of *Chara* plants entangled with other vegetation in a small roadside stream. Scale bar = 30cm. **B.** A single *Chara* plant. Scale bar = 10cm. **C.** A nodal region of *Chara* illustrating the unbranched branchlets. Scale bar = 250 μ m. **D.** The female reproductive structure (oogonium). Scale bar = 50 μ m.

Cladophora

Classification: Chlorophyta (Family Cladophoraceae)

General habit: branched filaments forming feathery tufts or coarse clusters, bright green to yellow-green in color, can form large growths in slower flowing stream areas, less than 1cm to greater than 30cm in length

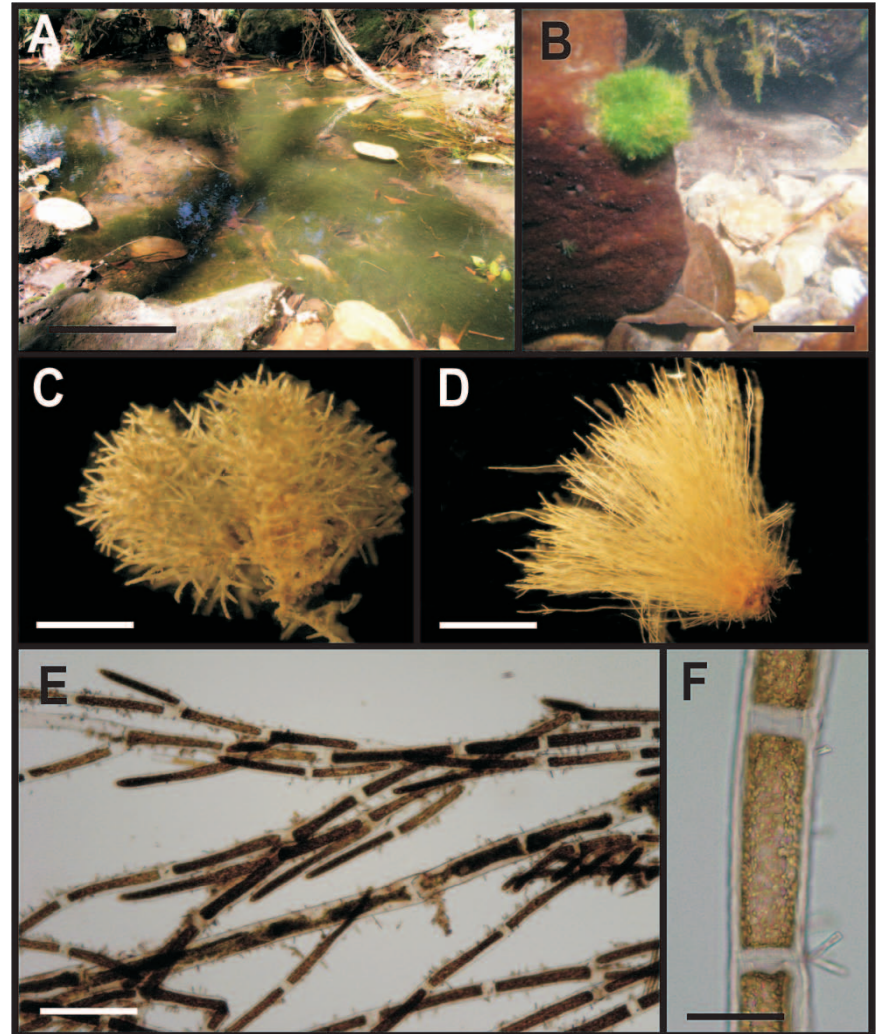
Species in Hawai'i: *C. canalicularis*, *C. fracta*, *C. glomerata*, *C. longiarticulata*, *C. rivularis*, *C. sericea*, *C. vagabunda*, *Cladophora* sp.

Island distribution: Necker, Kaua'i, O'ahu, Maui, Hawai'i

Distinguishing features: branched, filamentous green alga, branches smaller in diameter than the main axis, chloroplast a net-like structure than can densely fill the cell in some cases

Compare with: *Cloniophora*, *Oedogonium*, *Rhizoclonium*, *Vaucheria*

A. A region of a stream overgrown with *Cladophora*. Scale bar = 30cm. **B.** A single *Cladophora* plant attached to a rock in a stream. Scale bar = 2cm. **C, D.** Individual plants viewed under a dissecting



microscope. Scale bar = 500 μ m (C, D). **E.** Branched filaments of *Cladophora* viewed under a compound microscope. Scale bar = 200 μ m. **F.** High magnification view of a filament showing the dense, reticulate chloroplast. Scale bar = 60 μ m.

Cloniophora

Classification: Chlorophyta (Family Chaetophoraceae)

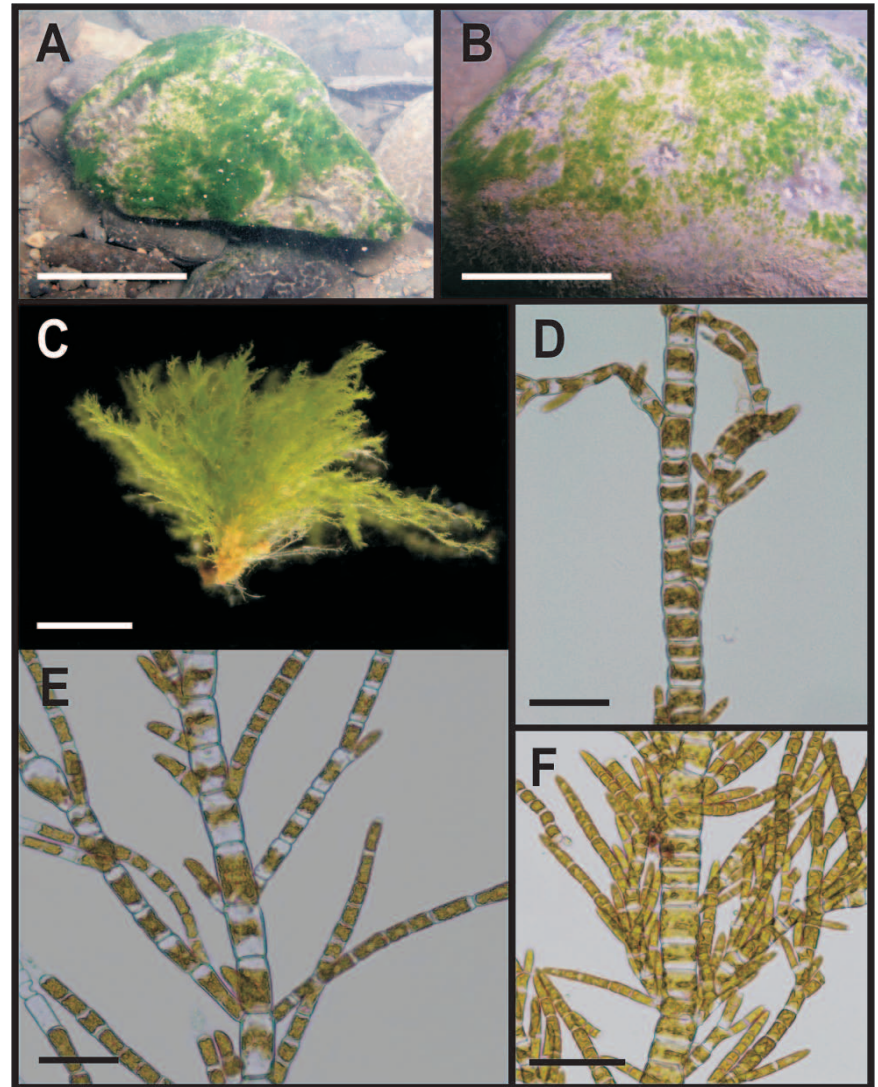
General habit: plants forming grass-green or sometimes yellow-green tufts on rocks, composed of branched filaments, not as coarse to the touch as *Cladophora*, often with a feathery appearance, usually epilithic

Species in Hawai'i: *C. macrocladia*, *C. plumosa*, *C. spicata*, *Cloniophora* sp.

Island distribution: Kaua'i, O'ahu, Maui, Hawai'i

Distinguishing features: a filamentous, branched alga, branches sometimes in whorl-like formation, main axis cells larger than cells of branches, chloroplast band-shaped, mostly encircling the cell (especially in the main axis cells)

Compare with: *Chaetophora*, *Cladophora*, *Stigeoclonium*



A, B. A rock in a stream covered with *Cloniophora*. Scale bar = 10cm (A), 2cm (B). **C.** An individual *Cloniophora* plant viewed under a dissecting microscope. Scale bar = 5mm. **D.** Main axis of a filament

showing the band-shaped chloroplasts. Scale bar = 50 μ m. **E, F.** Branched *Cloniophora* filament showing band-shaped chloroplasts. Scale bar = 50 μ m.

Klebsormidium

Classification: Chlorophyta (Family Klebsormidiaceae)

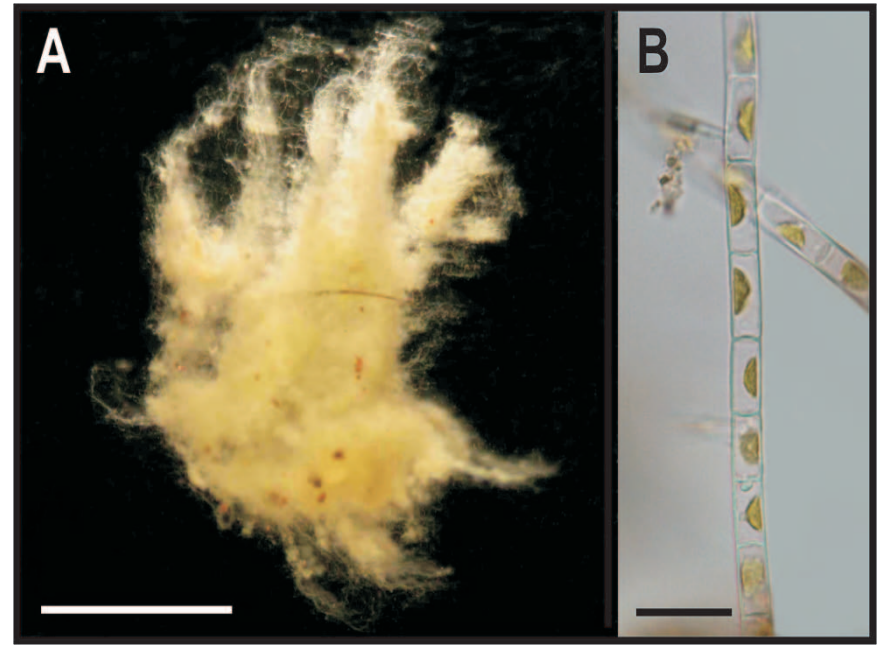
General habit: unbranched filaments, a single cell in thickness, no differentiation along the length of the filament, forming entangled mats on submerged surfaces

Species in Hawai'i: *K. flaccidum*, *K. rivulare*, *K. subtile*

Island distribution: O'ahu, Moloka'i, Hawai'i

Distinguishing features: filaments unbranched, usually growing in unattached mats, chloroplasts single within the cell, round and flattened against the cell wall

Compare with: *Rhizoclonium*



A. A piece of an epilithic mat formed by *Klebsormidium* filaments. Scale bar = 1cm. **B.** A single filament (unbranched), showing the chloroplast flattened against one edge of the cell wall. Scale bar = 20 μ m.

Mougeotia

Classification: Chlorophyta (Family Zygnemataceae)

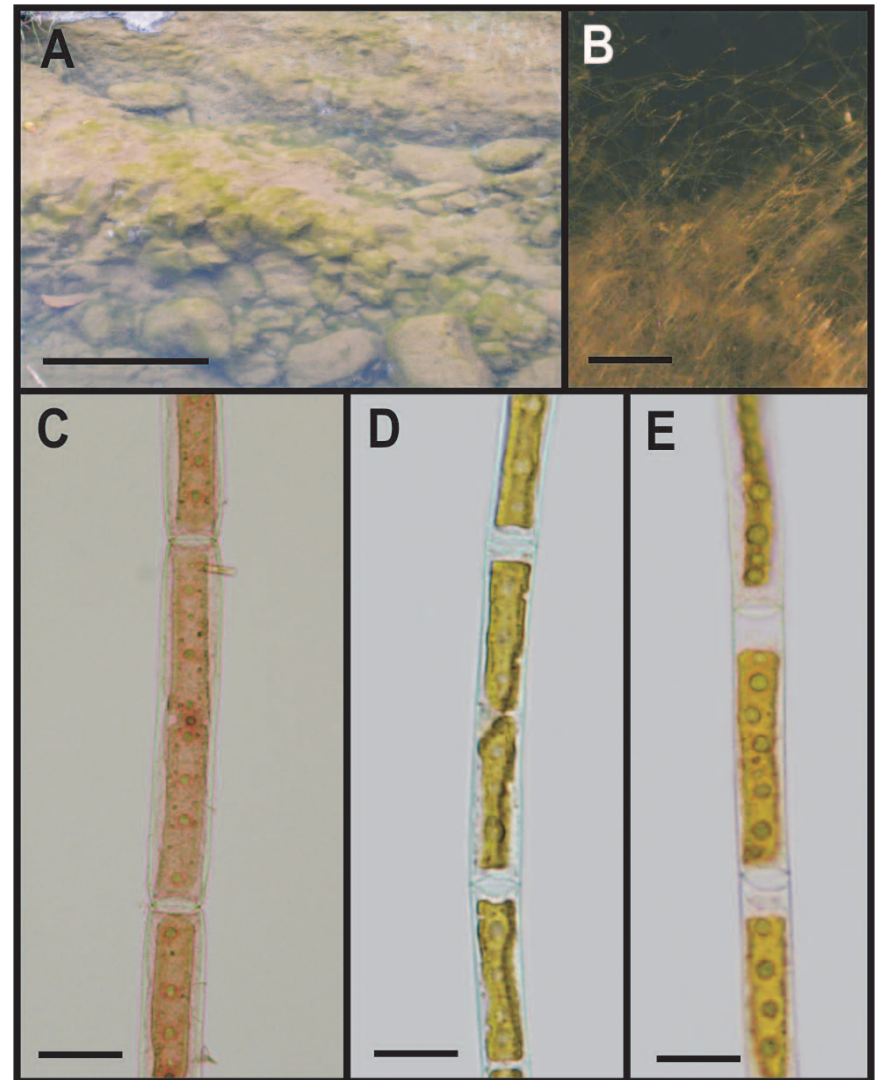
General habit: unbranched filaments, a single cell in thickness, forming growths around the edges of ponds and the slow-flowing areas of streams, yellow-green in color

Species in Hawai'i: *M. capucina*, *Mougeotia* sp.

Island distribution: Kaua'i, O'ahu, Maui, Hawai'i

Distinguishing features: filaments unbranched, uniform diameter along the length of the filament, chloroplast a flat plate that is occasionally slightly twisted in view (Fig. D), "lens-shaped" cross walls evident (Figs D-E).

Compare with: *Oedogonium*, *Rhizoclonium*, *Spirogyra*, *Tribonema*, *Zygnema*



A. A large growth of *Mougeotia* covering rock surfaces on the bottom of a stream. Scale bar = 1m. **B.** *Mougeotia* filaments viewed under a dissecting microscope. Scale bar = 500 μ m. **C, D, E.** Filaments

of *Mougeotia* showing plate-like chloroplasts with pyrenoids suspended in the middle of the cell. Scale bar = 30 μ m (C), 20 μ m (D), 25 μ m (E).

Oedogonium

Classification: Chlorophyta (Family Oedogoniaceae)

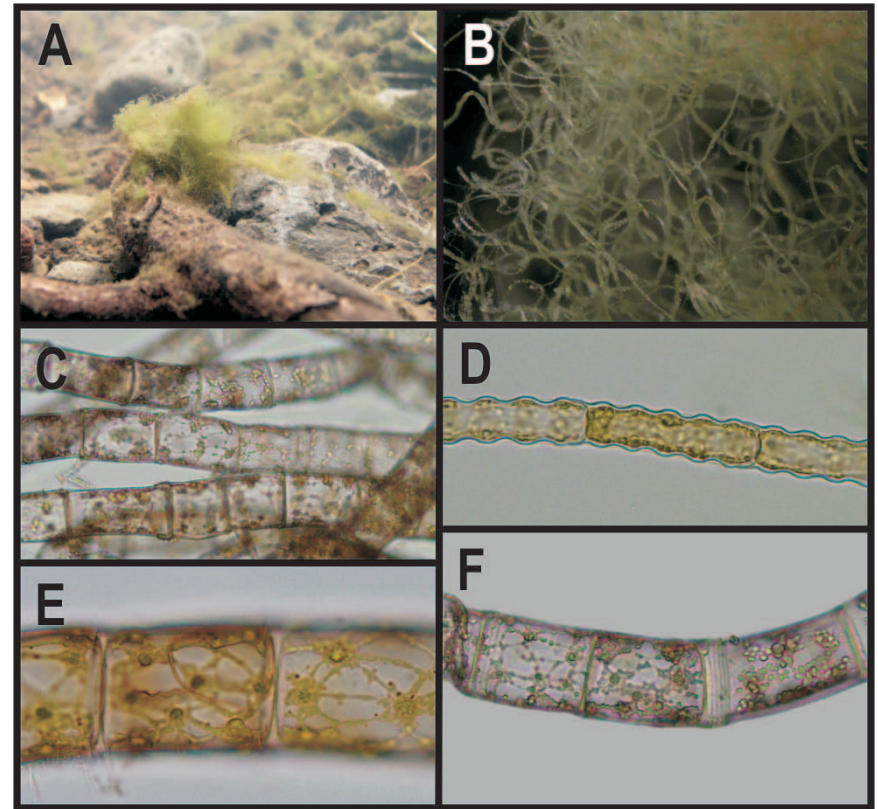
General habit: unbranched filaments of cylindrical cells, can form dense mats of coiled filaments, yellowish-green in color, epilithic or epiphytic on submerged surfaces in streams

Species in Hawai'i: *O. crispum*, *O. globosum*, *O. undulatum*, *Oedogonium* sp.

Island distribution: Kaua'i, O'ahu, Maui, Hawai'i

Distinguishing features: filaments unbranched, chloroplast a reticulate network (Fig. E), characteristic "rings" present at one end of many of the cells (Fig. E, F) due to unequal cell divisions

Compare with: *Cladophora*, *Rhizoclonium*



A. Large growth of *Oedogonium* attached to a submerged branch in a stream. Scale bar = 5cm.
B. *Oedogonium* filaments viewed under a dissecting microscope. Scale bar = 1mm
C. Unbranched filaments. Scale bar = 40 μ m.
D. Variation in cell shape in *Oedogonium*. Scale bar = 25 μ m.
E. High magnification view of *Oedogonium* cells illustrating the reticulate chloroplast. Scale bar = 30 μ m.
F. View of rings formed at the ends of cells in *Oedogonium* due to unequal cell division processes. Scale bar = 30 μ m.

Rhizoclonium

Classification: Chlorophyta (Family Cladophoraceae)

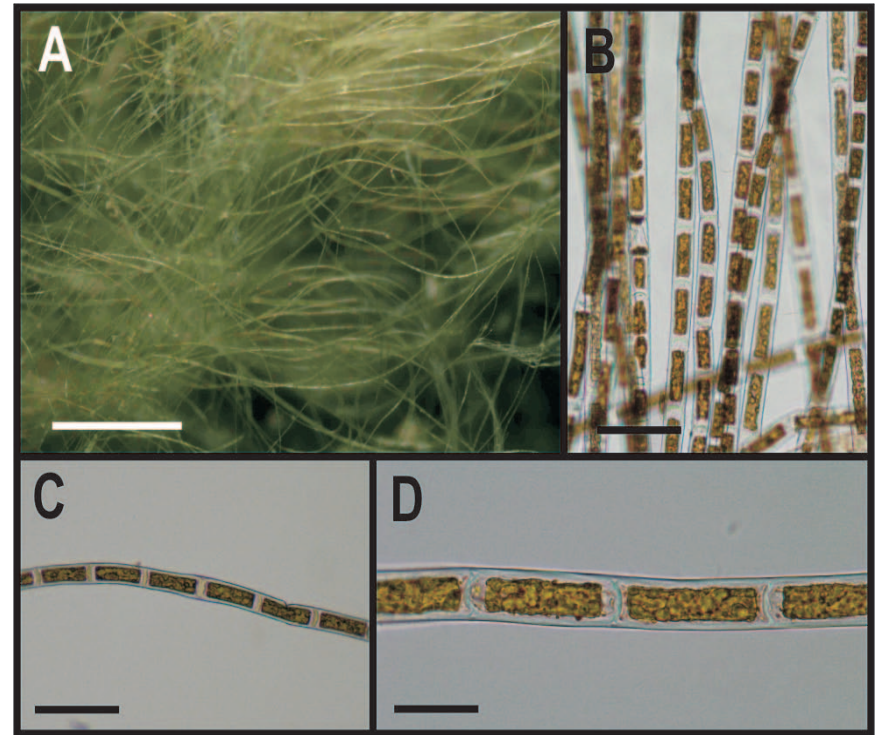
General habit: unbranched filaments that resemble an unbranched *Cladophora*, yellow-green to grass-green or dark green in color, can form tufts or dense mats, attached to rock or vegetation

Species in Hawai'i: *R. crassipellitum*, *R. hieroglyphicum*, *R. hookeri*

Island distribution: Kaua'i, O'ahu, Maui, Hawai'i

Distinguishing features: filaments generally unbranched, uniform in diameter along the length of the filament (except for the apical cell), chloroplast a dense network that often appears to fill the cell

Compare with: *Cladophora*, *Oedogonium*



A. A mat of *Rhizoclonium* viewed under a dissecting microscope. Scale bar = 500 μ m. **B.** Unbranched filaments. Scale bar = 50 μ m. **C, D.** Cells of *Rhizoclonium* illustrating the dense, reticulate chloroplast. Scale bar = 50 μ m (C), 30 μ m (D).

Schizomeris

Classification: Chlorophyta (Family Schizomeridaceae)

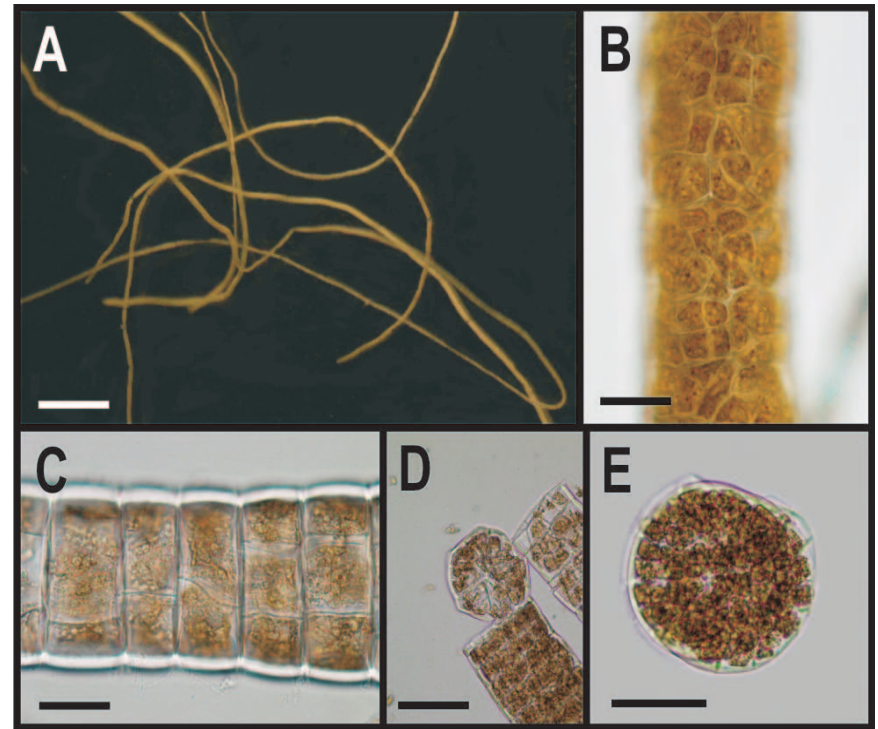
General habit: plants uniseriate in lower regions but becoming multiseriate above, yellow-green to grass-green in color, loosely attached to rock surfaces in streams

Species in Hawai'i: *S. leibleinii*

Island distribution: O'ahu, Maui

Distinguishing features: main axis composed of only a single filament in the lower areas, but becoming multiseriate (composed of several filaments) in the upper regions, brick-like cells, chloroplast plate-like and often encircling and filling the cells, especially in mature regions

Compare with: not likely to be confused with other common stream algal genera



A. *Schizomeris* plants viewed under a dissecting microscope. Scale bar = 500 μ m. **B.** Lugol's Iodine Solution-stained filament of *Schizomeris* showing the surface of the filament. Scale bar = 25 μ m. **C.** Unstained view of filament. Scale bar = 20 μ m. **D.** A cross-section through a filament. Scale bar = 40 μ m. **E.** High magnification view of a cross-section through a filament. Scale bar = 25 μ m.

Spirogyra

Classification: Chlorophyta (Family Zygnemataceae)

General habit: unbranched filaments with one or more spiralled chloroplasts, can form dense mats, clots or tufts, yellow-green to grass-green to brownish in color, can grow rapidly into the dominant species of a stream region

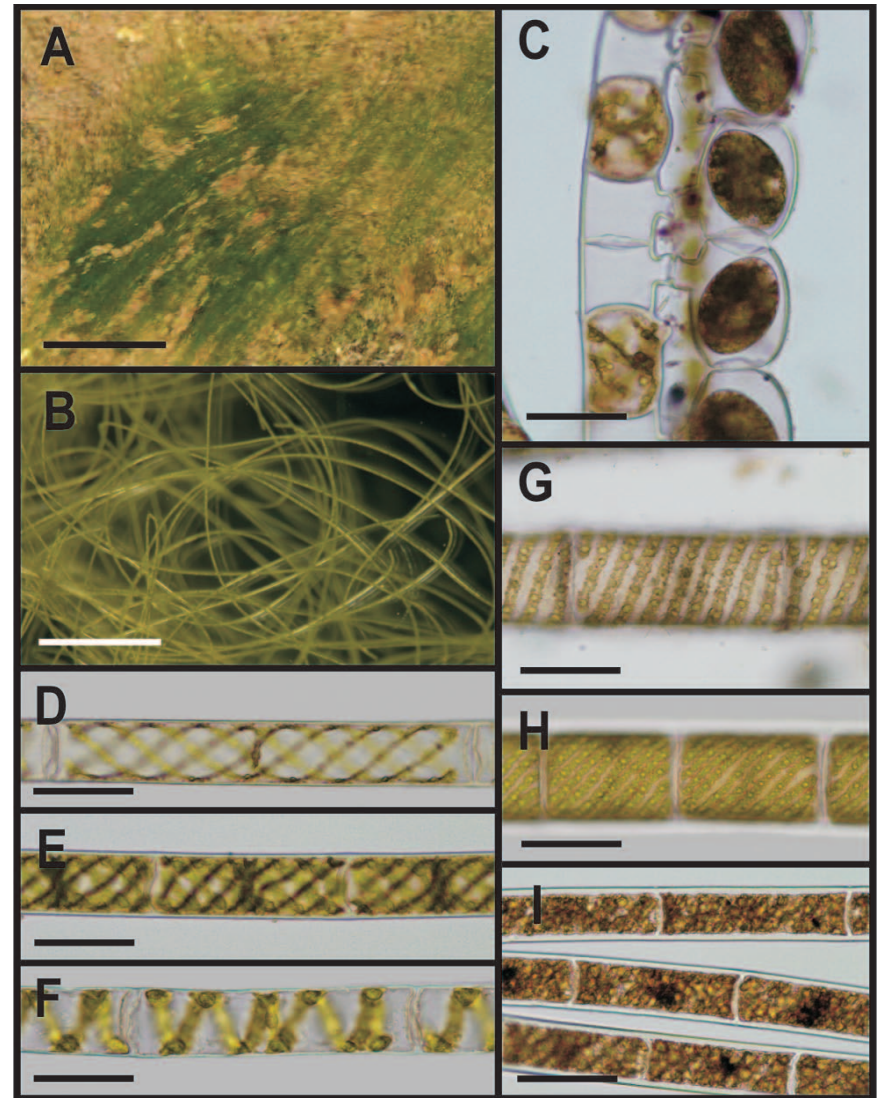
Species in Hawai'i: *S. dictyospora*, *S. dubia*, *S. elegantissima*, *S. fallax*, *S. fluviatilis*, *S. plena*, *S. rivularis*, *Spirogyra* spp.

Island distribution: Kaua'i, O'ahu, Maui, Hawai'i

Distinguishing features: filaments unbranched, uniform in diameter along their length, chloroplast one or more spiralled in a regular pattern through the cell, sexual reproduction occasionally observed (Fig. C - as conjugation of filaments)

Compare with: *Mougeotia*, *Oedogonium*, *Rhizoclonium*, *Zygnema*

A. A patch of *Spirogyra* filaments growing on a cement surface in a stream. Scale bar = 2cm. **B.** Filaments viewed under a dissecting microscope. Scale bar = 2mm. **C.** Conjugated filaments of *Spirogyra* with zygospores (right filament). Scale bar =



50 μ m. **D-I.** Some variation in chloroplast morphology in Hawaiian *Spirogyra*. Scale bar = 50 μ m (D, E), 30 μ m (F), 60 μ m (G), 40 μ m (H, I).

Stigeoclonium

Classification: Chlorophyta (Family Chaetophoraceae)

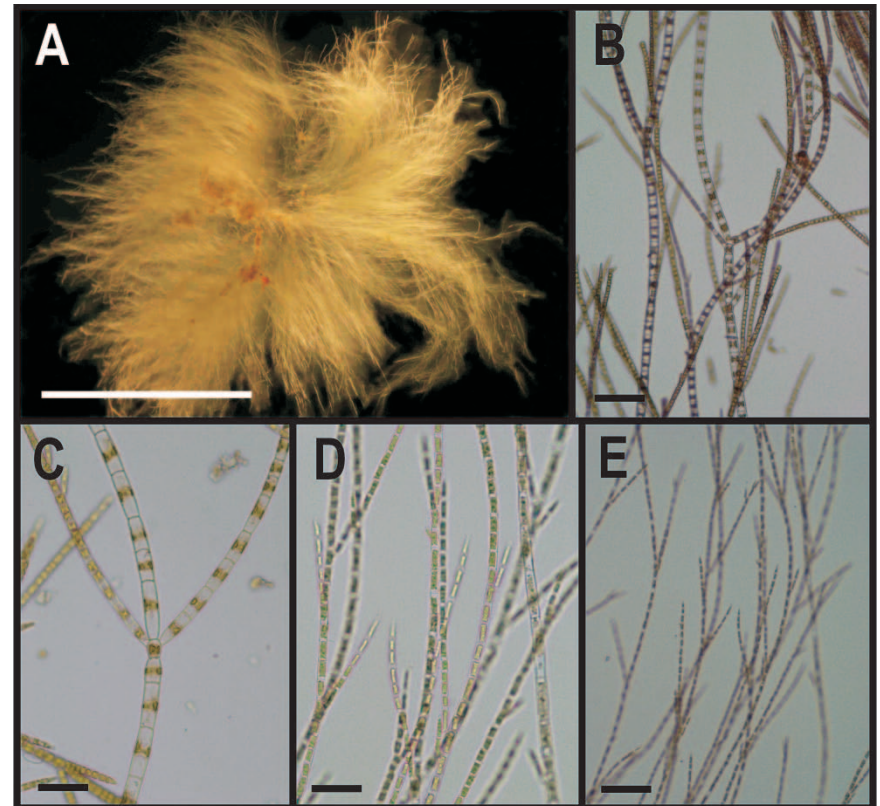
General habit: branched filaments forming feathery tufts or expanses, yellow-green to grass-green in color, not enclosed in mucilage, attached to submerged rock or vegetation in streams

Species in Hawai'i: *S. amoenum*, *S. falklandicum*, *S. fasciculare*, *S. flagelliferum*, *S. lubricum*, *S. nudiusculum*, *S. pachydermum*, *S. segarare*, *S. setigerum*, *S. stagnatile*, *S. subsecundem*, *S. tenue*, *S. variabile*, *Stigeoclonium* sp.

Island distribution: Kaua'i, O'ahu, Maui, Hawai'i

Distinguishing features: branched filaments, branches can be arranged opposite, alternate, or sometimes dichotomously, filaments tapering to a blunt point or a long hair, chloroplast plate-like and encircling the cell (especially visible along the main axis), not as much distinction in the diameter of the main axis versus the branches (compared with *Cloniophora*)

Compare with: *Chaetophora*, *Cloniophora*



A. An epilithic tuft of *Stigeoclonium* as viewed under a dissecting microscope. Scale bar = 0.5cm. **B.** Branched filaments viewed under a compound microscope. Scale bar = 50 μ m. **C.** Main axis of a plant showing the plate-like chloroplasts. Scale bar = 30 μ m. **D, E.** Branching patterns of some *Stigeoclonium* viewed under a compound microscope. Scale bar = 50 μ m (D), 80 μ m (E).

Zygnema

Classification: Chlorophyta (Family Zygnemataceae)

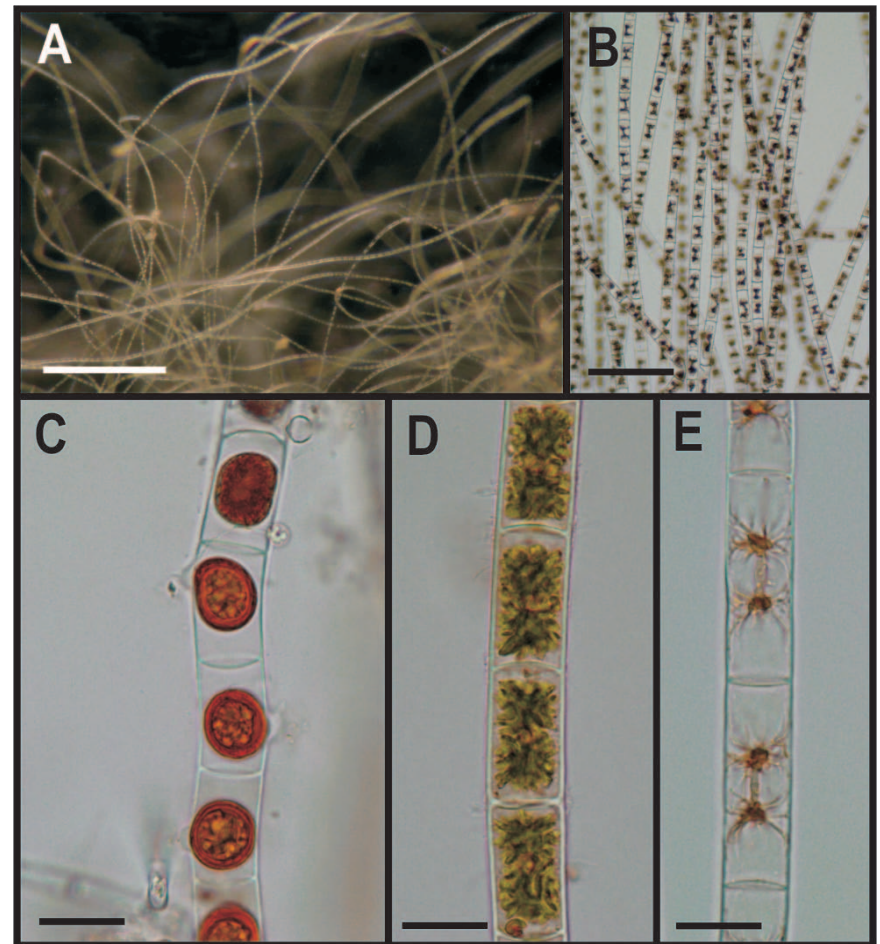
General habit: unbranched filaments, forming cottony masses or tufts of filaments, yellow-green to grass-green or slightly darker in color, can develop into large plant masses in slower-flowing areas of streams and ponds

Species in Hawai'i: *Zygnema* sp.

Island distribution: Kaua'i, O'ahu, Maui, Hawai'i

Distinguishing features: unbranched filaments, filaments uniform in diameter along their length, each cell contains two axial, stellate chloroplasts, each with a pyrenoid (Figs D-E), sexual reproduction through conjugation of filaments and subsequent development of zygospores (Fig. C)

Compare with: *Mougeotia*, *Oedogonium*, *Rhizoclonium*, *Spirogyra*



A. *Zygnema* viewed under a dissecting microscope. Scale bar = 3mm. **B.** Aggregation of unbranched *Zygnema* filaments viewed under a compound microscope. Scale bar = 100 μ m. **C.** A filament (post conjugation) containing zygospores. Scale bar = 40 μ m. **D, E.** Chloroplast morphologies in Hawaiian *Zygnema*. Scale bar = 30 μ m.

Audouinella

Classification: Rhodophyta (Family Acrochaetiaceae)

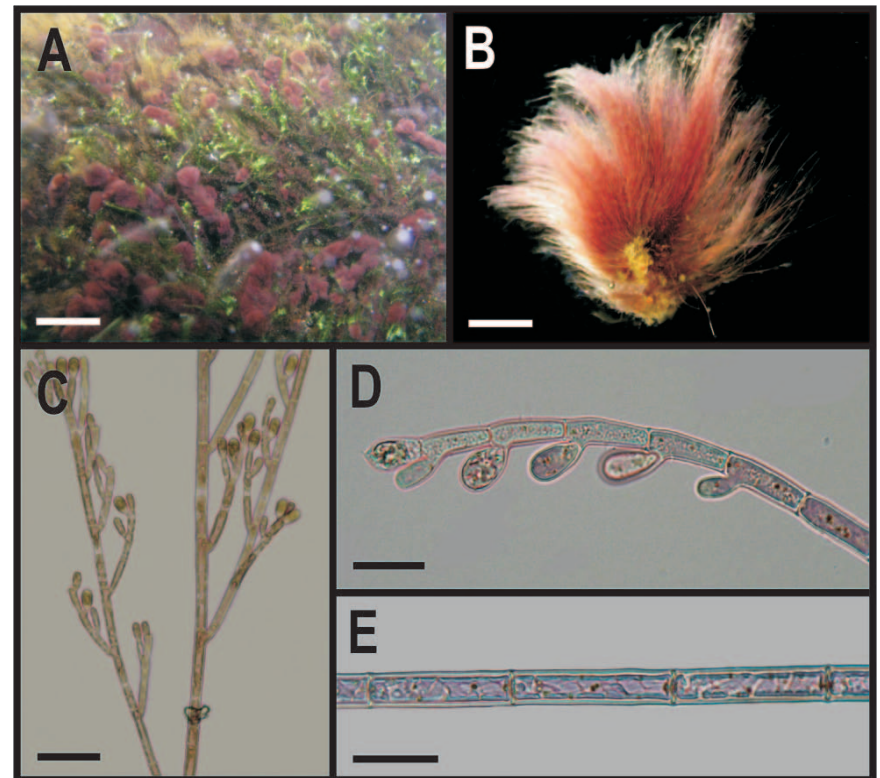
General habit: branched filaments, usually present in tufts or a spreading, mat-like arrangement, can be steel blue, gray, reddish, or purple in color, usually found in faster-flowing areas of streams, growing directly on rock surfaces or epiphytically on mosses

Species in Hawai'i: *A. chalybea*, *A. eugenea*, *A. pygmaea*

Island distribution: Kaua'i, O'ahu, Maui, Hawai'i

Distinguishing features: branched filaments, branches only slightly smaller in diameter than the main axis, chloroplasts one to several per cell (plate-like or ribbon-like), reproduction through rounded spores (termed monospores) produced at the tips of branches

Compare with: *Cladophora*



A. *Audouinella* plants (purplish-red color) attached to mosses in a stream. Scale bar = 2cm. **B.** A single plant viewed under a dissecting microscope. Scale bar = 3mm. **C.** Branched filaments. Scale bar = 50 μ m. **D.** A series of monosporangia produced along a filament of *Audouinella*. Scale bar = 30 μ m. **E.** A high magnification view of the chloroplast morphology of *Audouinella*. Scale bar = 30 μ m.

Batrachospermum

Classification: Rhodophyta (Family Batrachospermaceae)

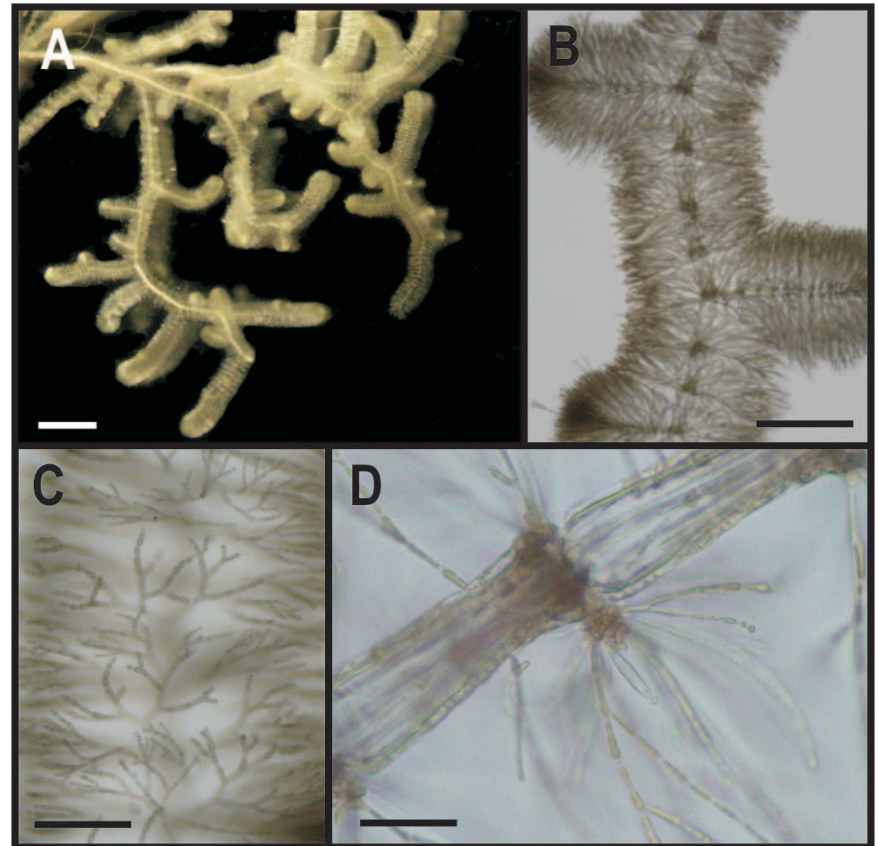
General habit: usually found in faster-flowing areas of streams, greenish-gray in color, plant body enclosed in a soft mucilage

Species in Hawai'i: *B. spermatiophorum*, *Batrachospermum* spp.

Island distribution: O'ahu, Maui, Hawai'i

Distinguishing features: typically found in swifter flowing areas of streams, also in shadier stream regions, branched (whorled) filaments, attached, whorls present along the main axis of the plant, sexual reproduction through fertilization of carpogonia by spermatia (Fig. D)

Compare with: *Chara*, *Cloniophora*



A. *Batrachospermum* plant viewed under a dissecting microscope. Scale bar = 1mm. **B.** Compound microscope view of the axis of a plant, with lateral whorls of filaments. Scale bar = 400 μ m. **C.** Closer view of a main axis showing the branched filaments of the whorls. Scale bar = 100 μ m. **D.** A fertilized carpogonium (female reproductive structure) extending from the lower side of the center whorl. Scale bar = 50 μ m.

Compsopogon

Classification: Rhodophyta (Family Compsopogonaceae)

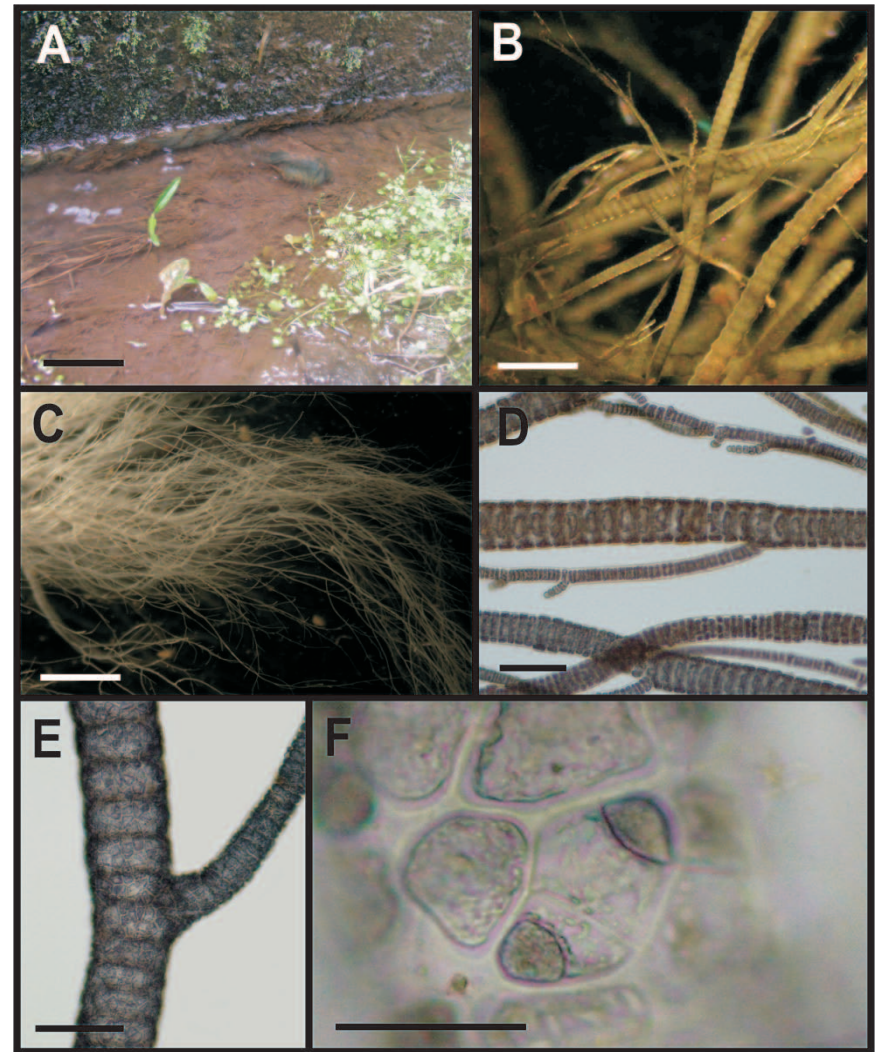
General habit: branched filaments, becoming corticated in mature regions, typically bluish-gray to light greenish-gray in color, can form dense mats, attached to rocks or vegetation

Species in Hawai'i: *C. coeruleus* (most previous reports as *Compsopogonopsis leptoclados*, which is now in synonymy), *Compsopogon* sp.

Island distribution: Kaua'i, O'ahu, Maui, Hawai'i

Distinguishing features: branched filamentous alga, the main axis of mature plants has a “bead-like” appearance, main axis covered with cortical cells (Fig. F), reproduction through production of monospores (Fig. F)

Compare with: *Cladophora*



A. A rock in a small stream covered with bluish-colored *Compsopogon* filaments. Scale bar = 20cm.

B. Branched filaments of *Compsopogon* as viewed under a dissecting microscope. Scale bar = 250 μ m.

C. A mat of *Compsopogon* filaments viewed under a dissecting microscope. Scale bar = 3mm. **D.** Branched filaments seen under a compound micro-

scope. Scale bar = 100 μ m. **E.** Cortication on the larger filaments. Scale bar = 100 μ m. **F.** A cortical cell producing two monosporangia. Scale bar = 50 μ m.

Hildenbrandia

Classification: Rhodophyta (Family Hildenbrandiaceae)

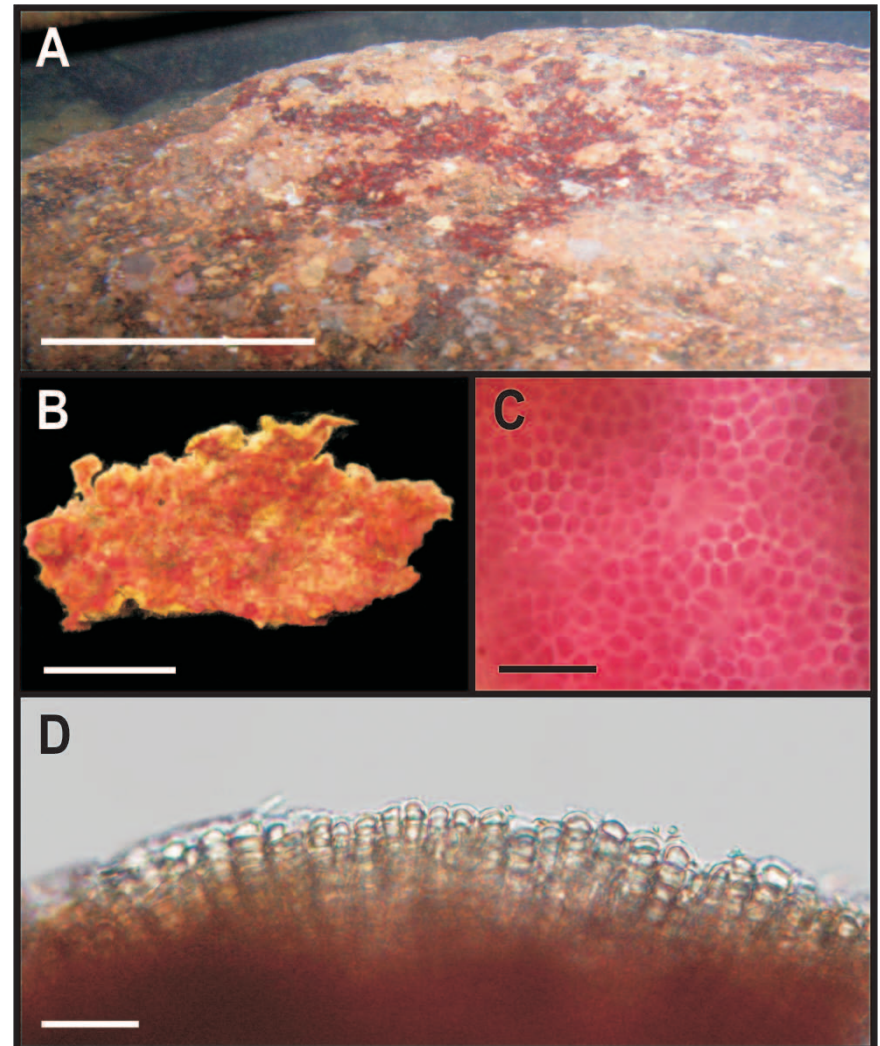
General habit: a crustose red alga that appears as pink to dark red splotches on rocks, usually grows in shadier areas of streams, can be small patches under 1cm in diameter up to expanses of 10's of cm

Species in Hawai'i: *H. angolensis*

Island distribution: Kaua'i, O'ahu, Maui, Hawai'i

Distinguishing features: this alga should be checked using a microscope since Hawaiian streams often contain crusts of various algae that can easily be confused with *Hildenbrandia* at the macroscopic level; *Hildenbrandia* is a filamentous alga that is composed of a series of branched vertical files of cells, cells have a "honeycomb" appearance from the surface of the crust

Compare with: periphyton growths, cyanobacterial crusts



A. Surface of a rock in a stream with patches of *Hildenbrandia*. Scale bar = 4cm. **B.** A piece of *Hildenbrandia* crust viewed with a dissecting microscope. Scale bar = 0.5cm. **C.** A surface view of the

crust viewed with a compound microscope. Scale bar = 20 μ m. **D.** A cross section through a piece of crust illustrating the vertical files of cells. Scale bar = 15 μ m.

Tribonema

Classification: Tribophyta (Family Tribonemataceae)

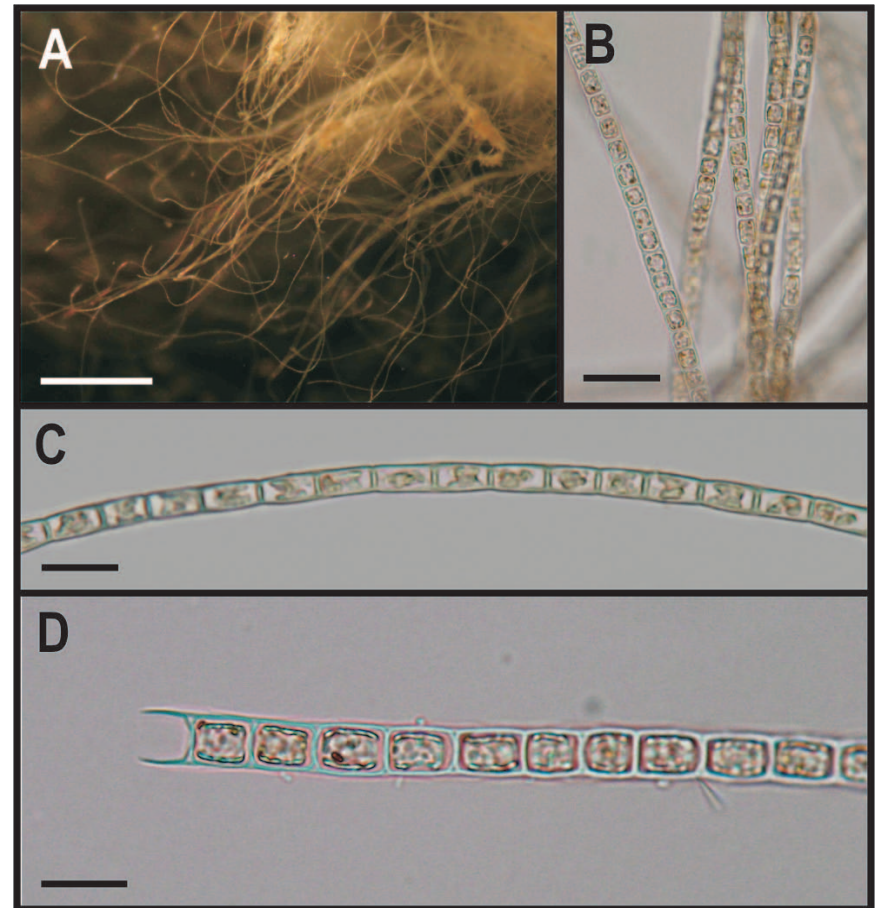
General habit: unbranched filaments, light yellow-green in color, can form dense mats and expanses of growth, often free-floating masses but sometimes attached to a substrate when immature

Species in Hawai'i: *T. aequale*, *T. affine*, *T. minus*, *Tribonema* sp.

Island distribution: O'ahu, Hawai'i

Distinguishing features: filaments unbranched, usually several chloroplasts within the cell, cells composed of overlapping "H-pieces" that are especially evident at the ends of the filaments (Figs C, D), cell contents do not display a positive staining reaction with Lugol's Iodine Solution

Compare with: *Mougeotia*, *Rhizoclonium*, *Oedogonium*



A. A mat of *Tribonema* filaments viewed through a dissecting microscope. Scale bar = 500 μ m. **B.** Several filaments (unbranched). Scale bar = 30 μ m. **C.** Unbranched filament with one or several chloroplasts per cell. Scale bar = 10 μ m. **D.** H-shaped cell walls in overlapping pieces. Scale bar = 10 μ m.

Vaucheria

Classification: Tribophyta (? *incertae sedis*) (Family Vaucheriaceae)

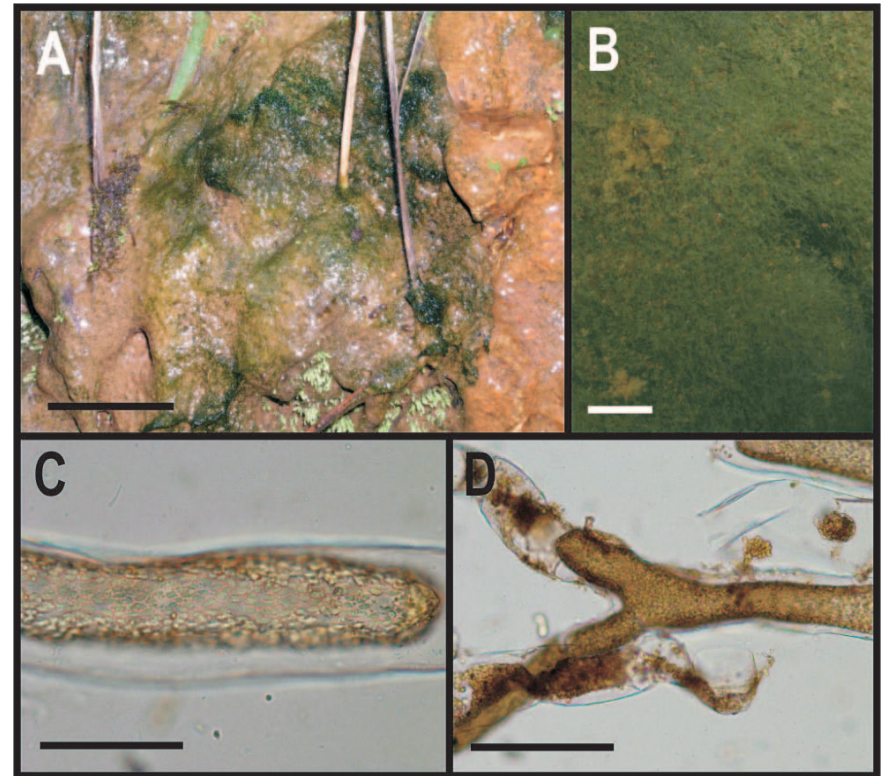
General habit: forming green felty patches on damp surfaces, or growing attached to surfaces within a stream, usually a grass-green color, coarse in texture

Species in Hawai'i: *Vaucheria* sp.

Island distribution: O'ahu, Maui

Distinguishing features: siphonous (multi-nucleate, lacking internal cell walls within a filament, or cross walls), identification of *Vaucheria* to species requires examination of morphological characters pertaining to sexual reproduction, these characters are often absent in field-collected material, cell contents do not display a positive staining reaction with Lugol's Iodine Solution

Compare with: *Cladophora*, *Rhizoclonium*



A. A mat of *Vaucheria* growing on a damp wall. Scale bar = 10cm. **B.** A mat of *Vaucheria* viewed through a dissecting microscope. Scale bar = 700 μ m. **C.** A large, multi-nucleate cell. Scale bar = 40 μ m. **D.** Branched filament. Scale bar = 60 μ m.

Hydrosera

Classification: Bacillariophyta (Family Biddulphiaceae)

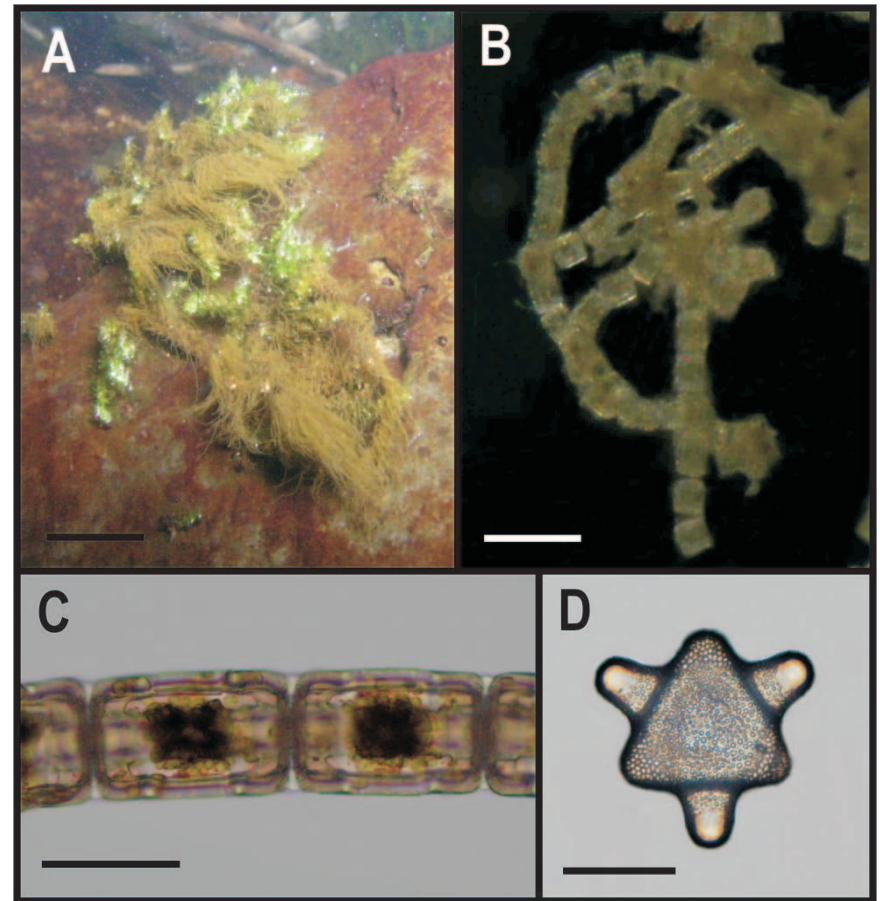
General habit: filamentous chains of cells, can be either attached to a substrate or free-floating, appear as light brown masses of filaments that can easily be broken apart when removed from the stream, growths can be up to many cm in length

Species in Hawai'i: *H. whampoensis*

Island distribution: Kaua'i, O'ahu, Maui, Hawai'i

Distinguishing features: cells exhibit a characteristic shape of overlapping triangles when in valve view (Fig. D); material should be examined in this view for positive identification

Compare with: *Melosira*, *Pleurosira*, *Terpsinoë*



A. Epiphytic filaments of *Hydrosera* in a stream. Scale bar = 5cm. **B.** Chains of cells viewed under a dissecting microscope. Scale bar = 110 μ m. **C.** View under a compound microscope of a *Hydrosera* chain. Scale bar = 50 μ m. **D.** Valve view of a *Hydrosera* cell. Scale bar = 25 μ m.

Melosira

Classification: Bacillariophyta (Family Melosiraceae)

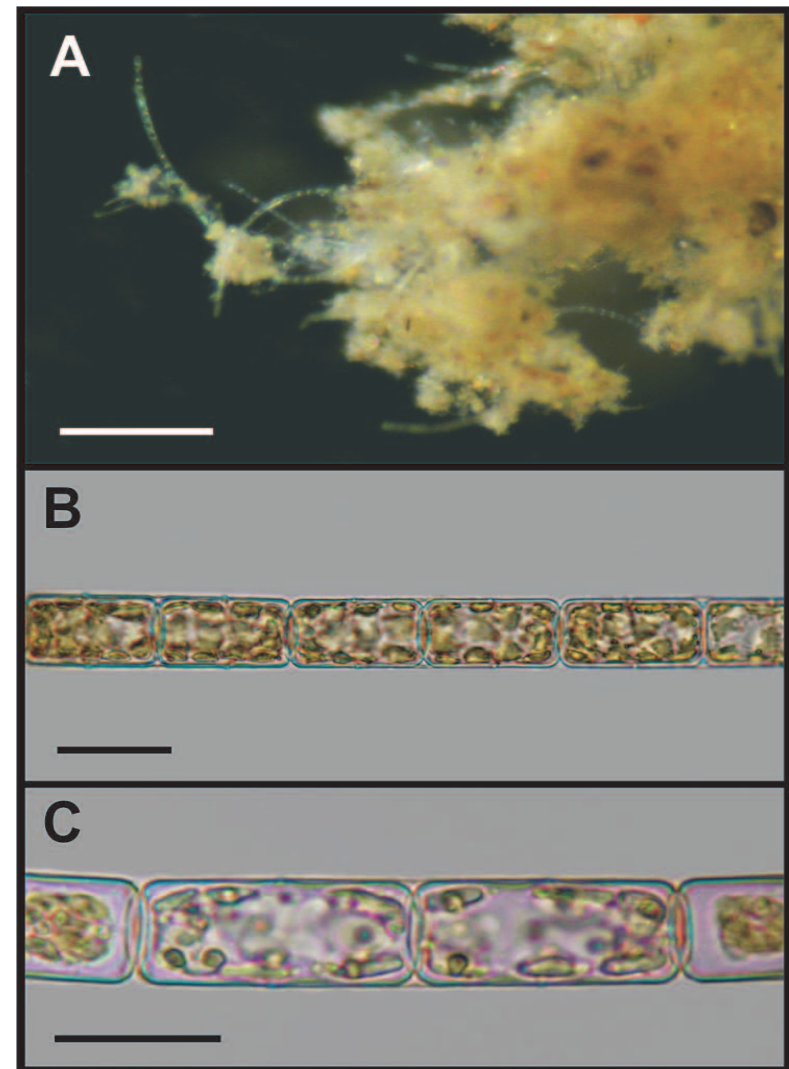
General habit: filamentous chains of cells, can be either attached to a substrate or free-floating, appear as light brown filaments, often entangled with other filamentous algae, growths can be several cm in length

Species in Hawai'i: *M. varians*

Island distribution: O'ahu, Hawai'i

Distinguishing features: chains of cells of uniform diameter, cells appear cylindrical and have multiple golden-colored chloroplasts (Fig. B, C)

Compare with: *Hydrosera*, *Pleurosira*, *Terpsinoë*



A. Mat of *Melosira* chains viewed under a dissecting microscope. Scale bar = 500 μ m. **B, C.** Unbranched chains of cells viewed under a compound microscope. Scale bar = 30 μ m.

Pleurosira

Classification: Bacillariophyta (Family Triceratiaceae)

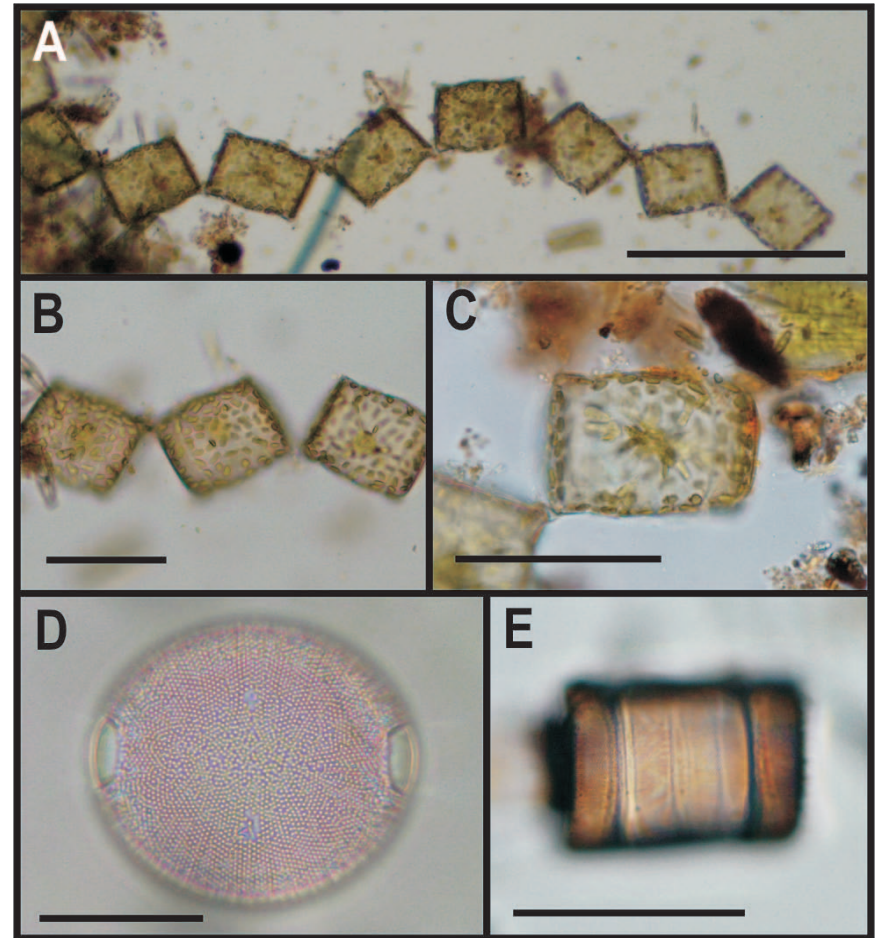
General habit: filamentous zig-zag-shaped chains of cells, light brown in color, often entangled with other filamentous algae, growths can be several cm in length

Species in Hawai'i: *P. laevis*

Island distribution: Kaua'i, O'ahu, Maui

Distinguishing features: chains of cells in a zig-zag formation (Figs A, B), cells containing numerous golden-colored chloroplasts, cells in valve view are elliptical with small ornamentations in the majority of the valve surface (Fig. D)

Compare with: *Hydrosera*, *Melosira*, *Terpsinoë*



A. A zig-zag shaped filament of *Pleurosira* cells. Scale bar = 100 μ m. **B.** A closer view of the chain of cells under a compound microscope. Scale bar = 45 μ m. **C.** Many chloroplasts within a single cell. Scale bar = 45 μ m. **D.** A *Pleurosira* cell in valve view. Scale bar = 15 μ m. **E.** A cell in girdle (side) view. Scale bar = 45 μ m.

Synedra

Classification: Bacillariophyta (Family Fragilariaceae)

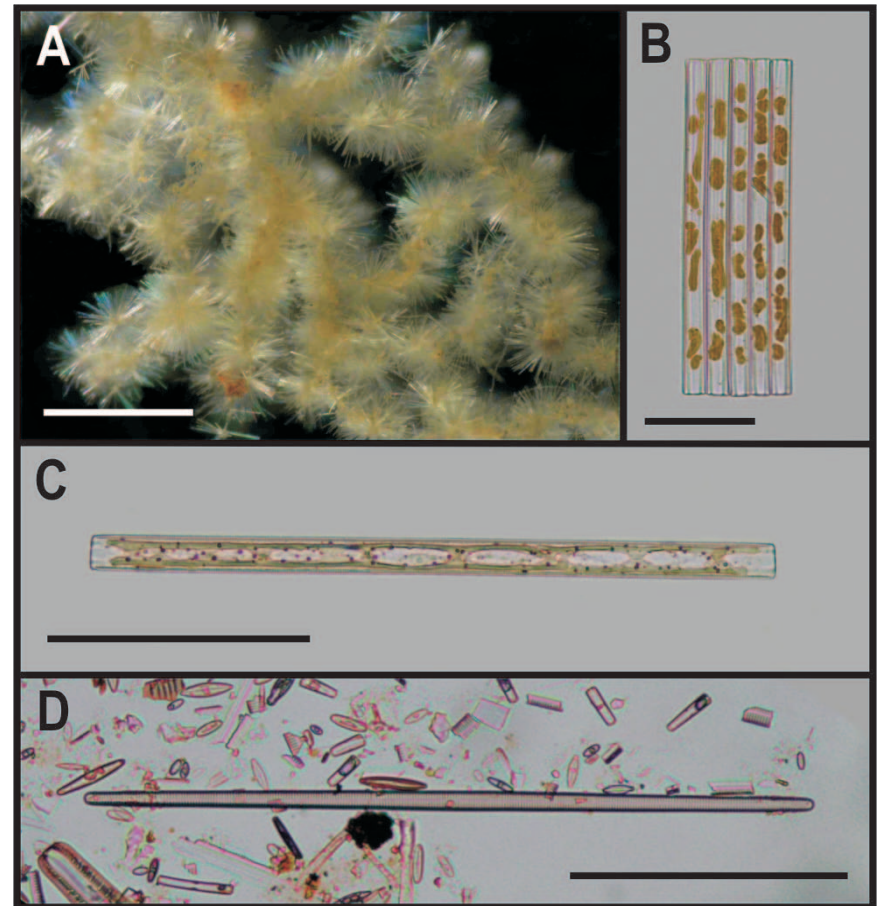
General habit: radiating needle-like colonies, seen as small, light brown colored “balls”, usually epiphytic on mosses or algae

Species in Hawai‘i: *S. ulna*

Island distribution: Kaua‘i, O‘ahu, Maui, Hawai‘i

Distinguishing features: cells formed into needle-like clusters, cells a golden color due to the presence of multiple chloroplasts, cells can sometimes be stacked into vertical colonies (Fig. B)

Compare with: periphyton growth



A. A mat of needle-like clusters of *Synedra* cells seen under a dissecting microscope. Scale bar = 500 μ m. **B.** A series of cells attached together. Scale bar = 25 μ m. **C.** A girdle (side) view of a cell showing the chloroplasts. Scale bar = 50 μ m. **D.** A mount of diatoms showing a large *Synedra* cell in the center. Scale bar = 50 μ m.

Terpsinoë

Classification: Bacillariophyta (Family Biddulphiaceae)

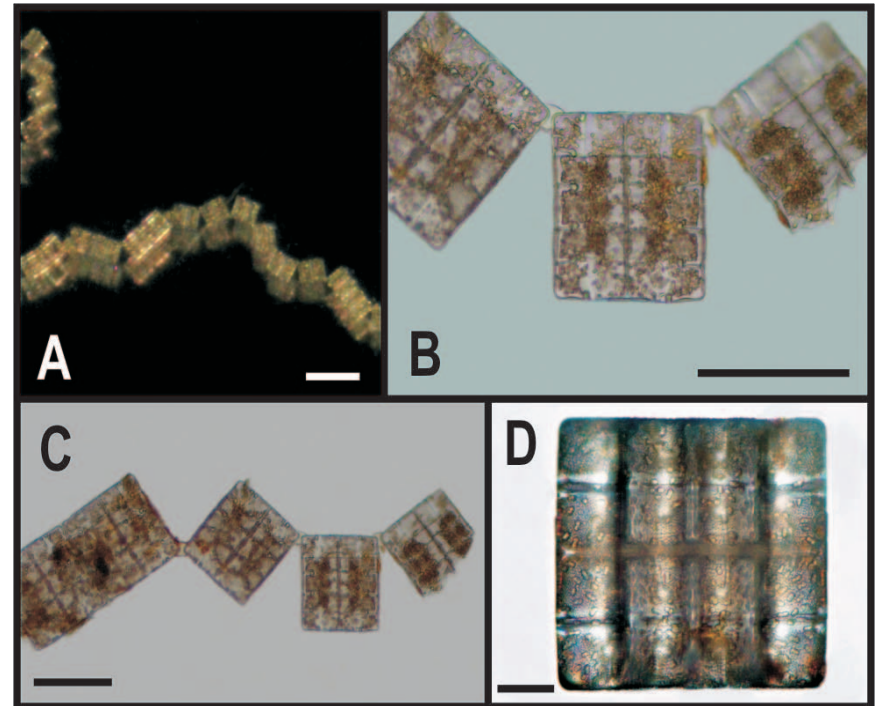
General habit: zig-zag-shaped filaments of cells, light brown in color, can form growths of up to several cm in length, usually attached to mosses or other algae, sometimes epilithic

Species in Hawai'i: *T. musica*

Island distribution: O'ahu, Maui

Distinguishing features: filaments composed of zig-zag chains of cells (Figs B, C), cells containing multiple golden-colored chloroplasts, cells viewed from the side have small ornamentations that resemble musical notes (Fig. B) - hence the species epithet

Compare with: *Hydrosera*, *Melosira*, *Pleurosira*



A. A chain of cells viewed under a dissecting microscope. Scale bar = 200 μ m. **B, C.** A closer view of the chain of cells under a compound microscope, showing the mucilage pad adhesion. Scale bar = 100 μ m. **D.** A cell viewed under a compound microscope. Scale bar = 25 μ m.

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