



9-30-1977

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Recommended Citation

Mou-Sheng, Cheng and Rushforth, Samuel R. (1977) "The algal flora of the campus of Brigham Young University, Provo, Utah," *Great Basin Naturalist*: Vol. 37 : No. 3 , Article 6.
Available at: <https://scholarsarchive.byu.edu/gbn/vol37/iss3/6>

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THE ALGAL FLORA OF THE CAMPUS OF BRIGHAM YOUNG UNIVERSITY, PROVO, UTAH

Cheng Mou-Sheng¹ and Samuel R. Rushforth¹

ABSTRACT.—The algal flora of the Brigham Young University campus is more diverse than previously thought. Sixty-eight genera containing 160 species of Chlorophyta, Euglenophyta, Chrysophyta, and Cyanophyta were collected and identified. The greatest number of species was obtained from a small pond in the arboretum, with progressively fewer species obtained in the irrigation canal partly surrounding the campus and in specialized habitats in the greenhouses.

Taxonomic and ecological studies of algae in the Intermountain West and Utah in particular have been rare. The earliest papers on Utah algae concerned the flora of the Great Salt Lake (Rothpletz 1892, Talmage 1900, Daines 1917). This unusual habitat has continued to be of interest to the present time and is currently under study by several biologists and water quality specialists.

Other early papers on Utah algae were those of Norrington (1925) on the algae of the lakes and streams of the Uinta and Wasatch Mountains of Utah; Harrison (1926) on the algae of Washington County, Utah; Tanner (1930, 1931) on the algae of Utah Lake; Snow (1932) on the algae of Utah Lake; Kirkpatrick (1934) on the biology of the Great Salt Lake; and Patrick (1936) on the diatoms in core samples from the edge of the Great Salt Lake.

The algal flora found on the Brigham Young University campus has been under observation for several years, particularly for teaching purposes. However, nothing has been written concerning this flora until recently. The most important contribution to a knowledge of this flora was made by the senior author of the present paper in a study during 1971-1972 for the research requirement for the Master of Science degree (Mou-Sheng 1973). The junior author has continued to collect algae from the campus since that time.

METHODS

Several collecting stations were established at selected sites on the Brigham Young University campus. Sites were established in the arboretum pond, the irrigation canal transversing the campus, and in the Department of Botany and Range Science greenhouses. Phytoplankton, attached algae, and algae in the sediments were all sampled. In addition several physical and chemical parameters were measured at the aquatic sites in order to provide an overall picture of the environment.

Algae were returned to the laboratory, subsampled, and examined immediately for nondiatom algae. These were studied using a Zeiss RA microscope with Nomarski interference phase accessories. Algae were identified using standard reference texts.

Following study of the nondiatoms, permanent diatom slides were prepared by standard boiling nitric acid techniques. Diatoms were mounted in pleurax diatom mountant. These slides are in the Brigham Young University diatom collection. Diatoms were examined with the same equipment cited above and identified by us, using standard reference texts.

RESULTS

Sixty-eight genera and 160 species of algae have been identified and described from

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the campus. This flora consists of 27 genera containing 36 species of Chlorophyta, 2 genera containing 2 species of Euglenophyta, 32 genera containing 106 species of Bacillariophyceae, 1 genus containing 2 species of Chrysophyta excluding diatoms, and 6 genera containing 14 species of Cyanophyta.

The Brigham Young University arboretum pond affords an excellent habitat for the growth of algae. This pond contains high levels of dissolved silica (27-81 PPM), bicarbonates, carbon dioxide (8-68 PPM) and oxygen (5-12 PPM) which support a high population of diatoms throughout the winter and spring and Chlorophyta (especially *Spirogyra dubia* Kutz., *S. jugalis* [Dan.] Kutz., *S. neglecta* [Hass.] Kutz. and *S. porticalis* [Muell.] Cleve) through the late spring and summer.

The diatom flora of the arboretum pond is dominated by *Melosira varians* Agardh, *Synedra parasitica* var. *subconstricta* (Grun.) Hust., *S. ulna* (Nitz.) Ehr., *S. ulna* var. *subaequalis* (Grun.) v. Heur., *Cocconeis pediculus* Ehr., *C. placentula* var. *lineata* (Ehr.) v. Heur., *Anomoconeis sphaerophora* (Kutz.) Pfütz., *Cymbella cistula* (Hemprich) Grun., *Nitzschia linearis* W. Sm., *N. sigmoidea* (Ehr.) W. Sm., and *Cymatopleura solea* (Breb.) W. Sm.

Several species of diatoms, especially of *Navicula*, *Cymbella*, and *Nitzschia* have been found only in this pond on campus. These include *Navicula cuspidata* (Kutz.) Kutz., *N. odiosa* Wallace, *N. placentula* var. *rostrata* Mayer, *N. pupula* Kutz., *N. pygmaea* Kutz., *Cymbella heteropleura* (Ehr.) Kutz., *C. mexicana* (Ehr.) Schmidt., *C. pro-*

strata (Berk.) Cl., *C. tumida* (Breb.) v. Heur., *C. tumidula* Grun., *C. turgida* Greg., *Nitzschia hungarica* Grun., *N. sigma* (Kutz.) W. Sm., and *N. tryblionella* Hantz. Other species restricted to this locality were *Melosira distans* (Ehr.) Kutz., *Fragilaria brevistriata* var. *inflata* (Pant.) Hust., *Synedra capitata* Ehr., *Eunotia curvata* (Kutz.) Lagerst., *Caloneis ventricosa* (Ehr.) Meist., *Neidium iridis* (Ehr.) Cl., *Comphonema acuminatum* Ehr., *Epithemia turgida* (Ehr.) Kutz., *E. turgida* var. *granulata* (Ehr.) Grun., and *Rhopalodia gibba* (Ehr.) O. Mull.

The Brigham Young University botanical greenhouses represent rather specialized environmental conditions. Thus, several parameters such as light, water, and temperature are controlled and demonstrate little fluctuation. The algal flora of the greenhouses is dominated by *Protococcus viridis* Agardh, *Chlorococcum humicola* (Naeg.) Rabenhorst, *Oscillatoria sancta* (Kutz.) Gomont, *Amphora normani* Rabh., and *Hantzschia amphioxys* (Ehr.) Grun.

Several species of algae have been collected on campus only from the greenhouses. These include *Lyngbya aestuarii* (Mertens) Liebmann, *L. martensiana* Meneghini, *Oscillatoria angustissima* West and West, *O. animalis* Agardh, *O. cruenta* Grun., *O. limosa* (Roth) Agardh, *O. sancta* (Kutz.) Gomont, *O. tenuis* Agardh, *Phormidium inundatum* Kutz., *Anabaena variabilis* Kutz., *Tolypothrix penicillata* (Ag.) Thur., *Stichococcus bacillaris* Naegeli, *S. scopulinus* Hazen, *S. subtilis* (Kutz.) Klercker, and *Chlorella vulgaris* Beyerinck.

Sixteen genera containing 33 species of diatoms have been collected from the soil in

TABLE 1. Number of species of algae on the Brigham Young University campus by algal division and collection locality.

Algal Division	Collection Locality		
	Arboretum Pond	Campus Stream	Greenhouses
Chlorophyta	10	5	8
Euglenophyta	1	0	0
Chrysophyta	84	80	33
Cyanophyta	1	2	13
TOTAL	96	87	54

the campus greenhouses. *Hantzschia amphioxys* (Ehr.) Grun. and *Amphora normani* Rabh. are the most common soil diatoms. *Achnanthes lanceolata* (Breb.) Grun., *Navicula tripunctata* (Mull.) Bory, *Hantzschia amphioxys* var. *capitata* Mull., and *Nitzschia palea* (Kutz.) W. Sm. are also quite common. *Pinnularia gentilis* (Donk.) Cl. is the only diatom restricted to the soil.

The water in the irrigation canal that crosses the Brigham Young University campus generally has higher levels of nitrates, phosphates, dissolved oxygen, alkalinity, and carbon dioxide than the arboretum pond. It contains near the same number of species of algae but has a lower standing crop due to the paucity of filamentous Chlorophyta.

The flora of this stream is dominated by *Stephanodiscus niagare* Ehr., *Diatoma vulgare* Bory, *D. tenue* var. *elongatum* Lyngb., *Cocconeis pediculus* Ehr., *C. placentula* var. *euglypta* (Ehr.) Cl., *Navicula tripunctata* (Mull.) Bory, *Gomphonema olivaceum* (Lynbye) Kutz., and *Nitzschia sigmoidea* (Ehr.) W. Sm.

Species found only in this stream include *Chaetophora incrassata* (Huds.) Hazen, *Diatoma hiemale* var. *mesodon* (Ehr.) Grun., *Gomphonema acuminatum* var. *coronatum* (Ehr.) W. Sm., *G. angustata* var. *sarcophagus* (Greg.) Grun., *Hannaea arcus* var. *amphioxys* (Rabh.) Patr., *Navicula capitata* Ehr., *Navicula laevissima* Kutz., *N. mutica* Kutz., *Neidium affine* (Ehr.) Pfitz., *Palmella mucosa* Kutz., and *Synedra ulna* var. *contracta* Ostr.

The following list contains those algae collected on the Brigham Young University campus.

CHLOROPHYTA

- Chlorophyceae
 - Chlorococcales
 - Chlorococaceae
 - Characium ambiguum* Hermann
 - Chlorococcum humicola* (Naeg.) Rabenhorst
 - Palmellaceae
 - Palmella mucosa* Kutzling
 - Sphaerocystis Schroeteri* Chodat
 - Oocystaceae
 - Chlorella vulgaris* Beyerinck
 - Scenedesmaceae
 - Scenedesmus denticulatus* Lagerheim
 - S. quadricauda* var. *quadrispina* (Chod.) G. M. Smith
 - Hydrodictyceae
 - Pediastrum boryanum* (Turp.) Meneghini
 - P. tetras* (Ehreb.) Ralfs
- Ulotrichales
 - Protococaceae
 - Protococcus viridis* C. A. Agardh
 - Ulotrichaceae
 - Stichococcus bacillaris* Naegeli
 - S. scopulinus* Hazen
 - S. subtilis* (Kutz.) Klercker
 - Ulothrix zonata* (Weber & Mohr) Kutzling
- Chaetophorales
 - Aphanochaetaceae
 - Aphanochaete repens* A. Braun
 - Chaetophoraceae
 - Chaetophora incrassata* (Huds.) Hazen
 - Stigeoclonium lubricum* (Dillw.) Kutzling
- Oedogoniales
 - Oedogoniaceae
 - Oedogonium* sp.
- Cladophorales
 - Cladophoraceae
 - Cladophora glomerata* (L.) Kutzling
- Zygnematales
 - Zygnemataceae
 - Mougeotia geniflexa* (Dillw.) C. A. Agardh
 - Spirogyra dubia* Kutzling
 - S. jugalis* (Fl. Dan.) Kutzling
 - S. neglecta* (Hass.) Kutzling
 - S. porticalis* (Muell.) Cleve
 - Zygnema insigne* (Hass.) Kutzling
 - Desmidiaceae

TABLE 2. Number of species of algae on the Brigham Young University campus restricted to selected collection localities.

Algal Division	Collection Locality		
	Arboretum Pond	Campus Stream	Greenhouses
Chlorophyta	8	4	8
Euglenophyta	1	0	0
Chrysophyta	22	18	3
Cyanophyta	0	0	12
TOTAL	31	22	23

Closterium lanceolatum Kützing
C. montiferum (Bory) Ehrenberg
Cosmarium botrytis Meneghini
C. perforatum Lund.
Penium navicula Breb.

EUGLENOPHYTA

Euglenophyceae

Euglenales

Euglenaceae

Euglena acus Ehrenberg
Phacus acuminata Stokes

CHRYSOPHYTA

Xanthophyceae

Vaucheriales

Vaucheriaceae

Vaucheria geminata (Vaucher) DeCandolle
V. sessilis (Vaucher) DeCandolle

Bacillariophyceae

Centrales

Coscinodiscaceae

Melosira distans (Ehr.) Kütz.
M. granulata (Ehr.) Ralfs
M. italica (Ehr.) Kütz.
M. varians C. A. Ag.
Cyclotella bodanica Eulenstein.
C. mcneghiniana Kütz.
Stephanodiscus niagare Ehr.

Pennales

Fragilariaceae

Asterionella formosa Hassall
Hannaea arcus var. *amphioxys* (Rabh.) Patr.
Diatoma anceps (Ehr.) Kirch.
D. hemale var. *mesodon* (Ehr.) Grun.
D. tenue var. *elongatum* Lyngb.
D. olivaceum Bory
Fragilaria brevistriata var. *inflata* (Pant.) Hust.
F. capucina var. *mesolepta* Rabh.
F. construens var. *venter* (Ehr.) Grun.
F. crotonensis Kitton
F. leptostauron (Ehr.) Hust.
F. vaucheria (Kütz.) Peters.
Meridion circulare var. *constrictum* (Ralf.) v. Heur.

Synedra acus Kütz.

S. capitata Ehr.

S. fasciculata (Ag.) Kütz.

S. parasitica (W. Sm.) Hust.

S. parasitica var. *subconstricta* (Grun.) Hust.

S. rumpens Kütz.

S. ulna var. *subaequalis* (Grun.) v. Heur.

S. ulna var. *contracta* Ostr.

S. ulna var. *ramesi* (Herib.) Hust.

S. ulna var. *ulna* (Nitz.) Ehr.

Eunotiaceae

Eunotia curvata (Kütz.) Lagerst

Achnantheaceae

Achnanthes lanceolata var. *dubia* Grun.

A. lanceolata var. *lanceolata* (Breb.) Grun.

A. minutissima Kütz.

Cocconeis pediculus Ehr.

C. placentula var. *cuglypta* (Ehr.) Cl.

C. placentula var. *lineata* (Ehr.) v. Heur.

Rhicosphenia curvata (Kütz.) Grun. ex Rabh.
 Naviculaceae

Anomoconeis sphaerophora (Kütz.) Pfitz.

Caloneis ventricosa (Ehr.) Meist.

Diploneis oblongella (Naeg. ex Kütz.) Ross

Frustulia vulgaris (Thwaites) DeT.

Gyrosigma spencerii (Quek.) Griff. & Henfr.

Navicula capitata Ehr.

N. cryptocephala Kütz.

N. cryptocephala var. *veneta* (Kütz.) Rabh.

N. cuspidata (Kütz.) Kütz.

N. elginensis (Greg.) Ralfs

N. laevissima Kütz.

N. lanceolata (Ag.) Kütz.

N. mutica Kütz.

N. oblonga (Kütz.) Kütz.

N. odiosa Wallace

N. placentula var. *rostrata* A. Mayer

N. pupula Kütz.

N. pygmaea Kütz.

N. rhynchocephala Kütz.

N. tripunctata (O. F. Mull.) Bory

Neidium affine (Ehr.) Pfitz.

N. binode (Ehr.) Hust.

N. iridis (Ehr.) Cl.

Pinnularia brebissonii (Kütz.) Rabh.

P. gentilis (Donk.) Cl.

P. viridis (Kütz.) Ehr.

Stauroneis smithii Grun.

Gomphonemaceae

Gomphonema acuminatum Ehr.

G. acuminatum var. *coronatum* (Ehr.) W. Sm.

G. angustata var. *sarcophagus* (Greg.) Grun.

G. constrictum Ehr.

G. intricatum Kütz.

G. olivaceum (Lyngbye) Kütz.

G. olivaceum var. *calcareae* Cl.

G. parvulum (Kütz.) Grun.

G. parvulum var. *micropus* (Kütz.) Cl.

Cymbellaceae

Amphora ovalis Kütz.

A. normani Rabh.

Cymbella affinis Kütz.

C. aspera (Ehr.) Cl.

C. cistula (Hemprich) Grun.

C. ehrenbergii Kütz.

C. heteropleura (Ehr.) Kütz.

C. mexicana (Ehr.) A. Schmidt

C. prostrata (Berk.) Cl.

C. tumida (Breb.) v. Heur.

C. tumidula Grun.

C. turgida Greg.

C. ventricosa Kütz.

Epithemiaceae

Epithemia sorex Kütz.

E. turgida (Ehr.) Kütz.

E. turgida var. *granulata* (Ehr.) Grun.

Rhopalodia gibba (Ehr.) O. Mull.

Nitzschiaceae

Hantzschia amphioxys (Ehr.) Grun.

H. amphioxys var. *capitata* Mull.

Nitzschia amphibia Grun.

N. dissipata (Kütz.) Grun.

N. fonticola Grun.
N. hungarica Grun.
N. linearis W. Sm.
N. palea (Kutz.) W. Sm.
N. signa (Kutz.) W. Sm.
N. sigmoidea (Ehr.) W. Sm.
N. tryblionella Hantz.
 Surirellaceae
Cymatopleura solea (Breb.) W. Sm.
Surirella angustata Kutz.
S. ovalis Breb.
S. ovata var. *pinnata* W. Sm.
S. robusta Ehr.

CYANOPHYTA

Myxophyceae

Chroococcales

Chroococaceae

Chroococcus rufescens (Kutz.) Naegeli

Oscillatoriales

Oscillatoriaceae

Lyngbya aestuarii (Mertens) Liebmann

L. martensiana Meneghini

Oscillatoria amphibia C. A. Agardh

O. angustissima West & West

O. animalis C. A. Agardh

O. cruenta Grun.

O. limosa (Roth) C. A. Agardh

O. princeps Vaucher

O. sancta (Kutz.) Gomont

O. tenuis C. A. Agardh

Phormidium inundatum Kutzing

Nostocales

Nostocaceae

Anabaena variabilis Kutzing

Scytonemataceae

Tolypothrix penicillata (Ag.) Thur.

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