ISSN 0029-4608

Number 474 15 December 2000

NOTULAE NATURAE

THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA

Checklist of Non-Vascular Plants of Grand Canyon National Park, Arizona

Kingdoms MONERA, PROTISTA, FUNGI, and PLANTAE (Phylum BRYOPHYTA)

NANCY BRIAN, Compiler

Science Center, Grand Canyon National Park, Grand Canyon AZ 86023, U.S.A.

INTRODUCTION

Non-vascular plants are among the most misunderstood and poorly appreciated organisms in the biological world. In 1775, the pioneering taxonomist Carolus Linnaeus called lichens *rustici pauperrimi*, or the "poor trash" of vegetation (Bland 1971), a perspective little changed in 225 years. "Plants" and "animals" are familiar notions, but what about living things that do not fit into either of these two classical, artificial groups?

Most taxonomists arrange living organisms into five kingdoms, including one prokaryotic group and four eukaryotic groups. The first group includes bacteria and cyanobacteria, or blue-green algae (Monera). The four remaining groups include algae and slime molds (Protista), bread molds, sac fungi, and club fungi (Fungi), mosses (Plantae), and vascular plants. The vascular plant kingdom includes ferns and fern allies, cycads, ginkgos, conifers, vessel-containing gymnosperms, and flowering plants. The mosses and vascular plants are thought to have evolved from an ancient group of green algae earlier than the Silurian Period, more than 425 million years ago (Raven et al. 1981).

Non-vascular plants lack the tissues or vessels that carry water (xylem) or food (phloem) through roots, stems, and leaves. They do not, like conifers and flowering plants, reproduce by seeds. A majority of the more advanced non-vascular plants, reproduce by spores and alternate haploid and diploid generations. The more primitive unicellular and multicellular algae simply divide, or in the case of slime molds, reproduce sexually and asexually. In addition, there are two types of non-vasculars

plants; those that can produce their own food using chlorophyll and those that lack chlorophyll and derive nourishment from dead or decaying organic matter. The later are called saprophytes.

Algae, rusts, lichens, and mosses are at best esoteric subjects. Gastronomical varieties of mushrooms are of great interest, but non-vascular plant poisonings are far more prevalent. For example, St. Anthony's fire is a disease caused by ergot (the common name for fungi of the genus *Claviceps*). It is a parasitic fungus usually found on cereals, particularly rye, where the black sclerotia or spore-producing body of the ergot is found. People who eat bread made from infected grain suffer from gangrene, nervous spasms, psychotic delusions, and convulsions. A few famous ergot poisonings include an epidemic of ergotism in 994 that killed more than 40,000 people. In 1722, the cavalry of Czar Peter the Great was struck down by ergotism on the eve of a battle for the conquest of Turkey, changing the course of 18th century history. In 1951, a group of 30 French villagers became temporarily insane believing they were pursued by demons and snakes; five villagers died (Raven et al. 1981).

The importance of non-vascular plants to humans can not be underestimated. They occur worldwide and in most habitats. Non-vascular plants can be the cause of costly problems, such as plant disease, rotting and spoiling food, and toxic impacts. But many beneficial processes and products are also derived, such as decomposition, nitrogen fixation, food, medicinals, fabric dyes, and alcoholic fermentation. Lichens and mosses are often used as biomonitors or indicator species of air pollution (Stolte et al. 1993), such as that caused by sulfur dioxide.

The uses and benefits of mushrooms are well known, but much less well known are benefits afforded by cryptogams. These microscopic non-vascular assemblages are composed of algae, diatoms, golden-brown algae, lichens, mosses, and a few xerophytic liverworts on more mesic sites. Blue-green algae usually contribute the bulk of the algal tissue. Cryptogams grow on and within soils and other substrates, modifying these surfaces in significant ways. The blue-green algae fix atmospheric nitrogen and thus enhance the nutrient status of the soil. Cryptogams retard erosion by wind and water, help retain soil moisture during dry periods, slow evaporation rates, and enhance seedling establishment.

PREVIOUS WORK AND THIS CHECKLIST

There are few historical reports for non-vascular plants of Grand Canyon National Park. The first list of the park's vascular plants (Patraw 1932, Hawbecker 1936) listed the algae stonewort or *Chara* under "water scum and sea weeds", along with eleven lichens and ten mosses. McDougall (1947a, 1947b, and 1948) updated the park's floral checklist and included slime molds, rusts, fungi, mushrooms, lichens, mosses and liverworts. He acknowledged that the park's algal species list was nonexistent, that of microfungi almost entirely lacking, and that of macrofungi was rudimentary. Clover and Jotter (1944) reported 19 mosses and liverworts, and Haring (1944, 1946) listed 64 mosses.

Numerous manuscripts, texts, and published articles were consulted in compiling this checklist, as itemized by taxonomic group here. Algae, diatoms, and phytoplankton: Bell et al. (1988), Inch and Blinn (1979), Czarnecki et al. (1976), Sommerfeld and Crayton (1976), Czarnecki and Blinn (1978), Crayton and Sommerfeld (1979), Blinn et al. (1986), and Blinn and Cole (1991); additional diatom species were added following identification of samples collected in 1993 by E. E. Spamer (pers. commun., 2000). Rusts: Pady (1942), Miekle (1946), and the park's Museum Collection database. Lichens: McKee (1929), Mead (1929), Boykin (1993), and Boykin and Nash (1994). Mushrooms: Hibbard (1928), Mills (1929), Keener (1956, 1957), Gilbertson and Budington (1970), and the park's database. Mosses: Hawbecker (1936), Haring (1941, 1946), McCleary (1953, 1954), Johnsen (1978), and Spence (1988), and the park's database.

This checklist is the first annotated listing of the non-vascular plants for Grand Canyon National Park, including 887 species (Appendix): 87 species of Monera, 360 of Protista, 371 of Fungi, and 69 mosses under Plantae. Phyla and classes are listed phylogenetically; orders and lower taxonomic categories then are listed alphabetically. The diatoms (Bacillariophyceae) are listed strictly alphabetically given that the taxonomic composition of suprafamilial groups is not wholly resolved. The basic phylogenetic relationships and species information were drawn from many sources, including Arthur (1962), Arora (1986), Dennis (1981), Egan (1987), Esslinger and Egan (1995), Farr et al. (1989), Flower (1973), Hale and Culberson (1970), Hanlin and Ulloa (1988), Lincoff (1998), Miller and Farr (1975), States (1990), Weber and Seaman (1985), and Webster (1980). Common names, habitat, and location within the park are added insofar as information was available. An index to both scientific and common names is included for reference.

Given that much of the park has not been botanically explored, especially for non-vascular plants, this checklist will continue to be revised. It is hoped that this publication will inspire others to explore the non-vascular "wilderness" within Grand Canyon National Park. To assist literature searches, a comprehensive electronic bibliography of Grand Canyon biology and ecology by Earle Spamer is available through the Grand Canyon Association (www.grandcanyon.org/biblio).

ACKNOWLEDGMENTS

Funding was provided through the Millennium 2000 Annual Grants Program administered by the National Park Service. Program monies were awarded by the Grand Canyon National Park Foundation's In-Park Donations and "Cash for the Canyon" donations. Earle Spamer, Academy of Natural Sciences, reviewed a preliminary diatom list. Thomas H. Nash, III, Arizona State University, and Dr. Bruce McCune, Oregon State University, reviewed a preliminary lichen list. Dr. Howard A. Crum, Curator of Bryophytes, University of Michigan Herbarium, and Dr. John Spence, Glen Canyon National Recreation Area, reviewed a preliminary moss species list. Colleen Hyde, Grand Canyon National Park museum specialist, provided non-vascular checklists from Grand Canyon National Park's museum database. Errors or omissions are the compiler's. Suggestions for revision, additions, or deletions are welcome.

In the systematic list, an asterisk (*) indicates a taxon recorded only outside, but adjacent to, Grand Canyon National Park. CRM = Colorado River Mile, by convention measured downstream from Lee's Ferry, Arizona.

SYSTEMATIC CHECKLIST

KINGDOM MONERA

PHYLUM CYANOPHYTA

ORDER CHAMAESIPHONALES

***Chamaesiphon* sp.** Colorado River and tributaries.
***Gloeocapsa polydermatica* Kütz.** Colorado River and tributaries.
***Merismopedia elegans* var. *major* G. M. Sm.** Tributaries to the Colorado River.
***Merismopedia glauca* (Ehrenb.) Naegeli.** Colorado River and tributaries.
***Merismopedia punctata* Meyent.** Colorado River and tributaries.

ORDER CHROOCOCCALES

***Chroococcus minor* (Kütz.) Näeg.** Colorado River and tributaries.
***Chroococcus minutus* (Kütz.) Näeg.** Colorado River and tributaries.
***Chroococcus turgidus* (Kütz.) Näeg.** Colorado River and tributaries.

ORDER NOSTOCALES

* ***Anabaena affinis* Lemmermann**
***Anabaena oscillarioides* Bory.** Colorado River and tributaries.
***Anabaena* spp.** Colorado River and tributaries.
***Calothrix* sp.** Tributaries to the Colorado River.
***Nodularia harveyana* (Thw.) Thur.** Tributaries to the Colorado River
***Nostoc hatei* Dixit.** Colorado River and tributaries.
***Nostoc paludosum* Kütz.** Colorado River and tributaries.
***Nostoc punctiforma* (Kütz.) Hariot.** Colorado River and tributaries.
***Nostoc* spp.** Colorado River and tributaries.
***Nostoc verrucosum* Vaucher** Colorado River and tributaries.
***Nostoc verucosum* (L.) Vaugh.** Point Sublime, North Rim.

ORDER OSCILLATORIALES

***Katagnymene pelagica* Lemm.** Colorado River and tributaries.
***Lyngbya aerugineo-caerulea* (Kütz.) Gomont** Colorado River and tributaries.
***Lyngbya aestaurii* (Mert.) Liebmann** Colorado River and tributaries.
***Lyngbya allegori* Fremy.** Colorado River and tributaries.
***Lyngbya birgei* G. M. Sm.** Tributaries to the Colorado River.
***Lyngbya cryptovaginata* Schkorbatow** Colorado River and tributaries.
***Lyngbya digueti* Gomont.** Colorado River and tributaries.
***Lyngbya epiphytica* Hieronymus** Colorado River and tributaries.
***Lyngbya hieronymusii* Lemmermann** Colorado River and tributaries.
***Lyngbya limnetica* Lemmermann** Colorado River and tributaries.
***Lyngbya major* Meneghini** Colorado River and tributaries.
***Lyngbya martensiana* Meneghini** Colorado River and tributaries.
***Lyngbya mesotrichia* Ruja.** Colorado River and tributaries.
***Lyngbya nordgardhii* Wille.** Colorado River and tributaries.
***Lyngbya perelegans* Lemmermann** Colorado River and tributaries.
***Lyngbya statina* Kütz.** Colorado River and tributaries.
***Lyngbya versicolor* (Wartm.) Gom.** Colorado River and tributaries.
***Lyngbya* spp.** Colorado River and tributaries.
***Microcoleus orthonoplastes* (Fl. Dan.) Thur.** Havasu.
***Microcoleus vaginatus* (Vaugh.) Com.** Havasu.
***Oscillatoria acuminata* Gomont** Colorado River and tributaries.
***Oscillatoria agardhii* Gom.** Colorado River and tributaries.
***Oscillatoria amoena* (Kütz.) Gomont** Colorado River and tributaries.
***Ocillatoria amphibia* Agardh.** Colorado River and tributaries.
***Oscillatoria amphigranulata* Van Goor.** Colorado River and tributaries.
***Oscillatoria angusta* Kappe.** Colorado River and tributaries.
***Oscillatoria angustissima* West & West** Colorado River and tributaries.
***Oscillatoria articulata* Gard.** Tributaries to the Colorado River.
***Oscillatoria chalybea* Mertens** Colorado River and tributaries.
***Oscillatoria clariceptrosa* Gardner** Colorado River and tributaries.
***Oscillatoria cortiana* Meneghini** Colorado River and tributaries.
***Oscillatoria foreaiu* Fremy.** Colorado River and tributaries.
***Oscillatoria fremyii* De Toni.** Colorado River and tributaries.
***Oscillatoria hamelii* Fremy.** Colorado River and tributaies.
***Oscillatoria jasorvensis* Vouk.** Colorado River and tributaries.
***Oscillatoria lacustris* (Kleb.) Geit.** Tributaries to the Colorado River.
***Oscillatoria lemmermannii* Walosz.** Colorado River and tributaries.
***Oscillatoria limnetica* Lenm.** Colorado River and tributaries.
***Oscillatoria limosa* (Roth) C. A. Ag.** Colorado River and tributaries.
***Oscillatoria mougeotii* Kütz.** Colorado River and tributaries.
***Oscillatoria migro-viridis* Thwaites** Colorado River and tributaries.
***Oscillatoria nigra* Vauch.** Tributaries to the Colorado River.
***Oscillatoria obscura* Bruhl.** Colorado River and tributaries.
***Oscillatoria okeni* Agardh.** Colorado River and tributaries.
***Oscillatoria pseudogeminata* G. Schmid.** Colorado River and tributaries.
***Oscillatoria proteus* Skuja.** Colorado River and tributaries.
***Oscillatoria quadripunctulata* Bruhl & Biswas.** Colorado River and tributaries.
***Oscillatoria rubescens* DeCondolle** Colorado River and tributaries.
***Oscillatoria sancta* Kütz.** Havasu Village.
***Oscillatoria schultzii* Lemmermann** Colorado River and tributaries.
***Oscillatoria simplicissima* Gomont** Colorado River and tributaries.
***Oscillatoria* sp.** Tributaries to the Colorado River.
***Oscillatoria splendida* Grev.** Colorado River and tributaries.
***Oscillatoria subbrevis* Schmid.** Colorado River and tributaries.
***Oscillatoria tanganyikae* West** Colorado River and tributaries.
***Oscillatoria tenuis* C. A. Ag.** Havasu Village, North Rim ponds, Colorado River, and tributaries.
***Oscillatoria tenuis* C. A. Ag. var. *tergestina* Rabenhorst.** Colorado River and tributaries.
***Oscillatoria trichoides* Szafer.** Colorado River and tributaries.
***Oscillatoria* spp.** Colorado River and tributaries.
***Phormidium anomala* Rao.** Colorado River and tributaries.
***Phormidium ambiguum* Gomont** Colorado River and tributaries.
***Phormidium corium* var. *constrictum* Playfair** Colorado River and tributaries.
***Phormidium dimorphum* Lemmermann** Colorado River and tributaries.
***Phormidium mucosum* Gardner** Colorado River and tributaries.
***Phormidium retzii* (Ag.) Gomont** Colorado River and tributaries.
***Phormidium tenue* (Menegh.) Gomont** Colorado River and tributaries.
***Spirulina labyrinthiformis* (Menegh.) Gomont** Colorado River and tributaries.
***Spirulina major* Kütz.** Tributaries to the Colorado River.
***Spirulina subsalsa* Oerst.** Tributaries to the Colorado River.
***Spirulina subtilissima* Kütz.** Colorado River and tributaries.
***Spirulina* sp.** Tributaries to the Colorado River.
***Symploca* sp.** Colorado River and tributaries.

ORDER UNKNOWN IN PHYLUM CYANOPHYTA

CHLOROPHYCEAE: PALMELLACEAE
***Aphanocapsa musicola* (Menegh.) Willie.** Colorado River and tributaries.
***Aphanocapsa* sp.** Colorado River and tributaries.
CYANOPHYCEAE: MICROCYSTACEAE
***Gloeothece* sp.** Colorado River and tributaries.
CYANOPHYCEAE: RIVULARIACEAE
***Gloeotrichia intermedia* (Lemm.) Geitler.** Colorado River and tributaries.
CYANOPHYCEAE: MICROCHAETACEAE
***Microchaete elongata* Fremy.** Colorado River and tributaries.
CYANOPHYCEAE: SCYTONEMATACEAE
***Scytonema alatum* (Carm.) Borzi.** Colorado River and tributaries.
***Scytonema rivulare* Borzi.** Colorado River and tributaries.
CYANOPHYCEAE: STIGONEMATACEAE
***Stigonema hormoides* Kütz.** Colorado River and tributaries.

KINGDOM PROTISTA

EUKARYOTES: ALGAE
PHYLUM CHLOROPHYTA

Order Charales

***Chara contraria* Kütz.** (= *C. vulgaris*) Chara, stonewort, muskgrass. Found in pools and quiet water along Bright Angel Creek, Dripping Springs, Elves Chasm, Little Colorado River, and at Lee's Ferry.

Order Chaetophorales

***Stigeoclonum flagelliferum* Kütz.** Tributaries to the Colorado River.
***Stigeoclonium pachydermum* Prescott** Colorado River and tributaries.
***Stigeoclonium* spp.**

Order Cladophorales

***Cladophora fracta* (Dillw.) Kütz.** Colorado River and tributaries.
***Cladophora glomerata* (L.) Kütz.** Filamentous green algae. Common in the Colorado River attached to rocks, wood, and floating in water.
***Rhizoclonium hieroglyphicum* (C. A. Ag.) Kütz.** Colorado River and tributaries.
***Rhizoclonium hookeri* Kütz.** Colorado River and tributaries.

Order Chlorococcales

***Pediastrum boryanum* (Turp.) Meneghini** Colorado River and tributaries.
***Pediastrum integrum* Näeg.** Colorado River and tributaries.
***Pediastrum integrum* Näeg. var. *scutum* Raciborski** Colorado River and tributaries.
* ***Pediastrum tetras* (Ehrenb.) Ralfs.**

Order Tetrasporales

***Tetraspora cylindrica* (Wahl.) C. A. Agardh.** Colorado River and tributaries.
***Tetraspora gelatinosa* (Vauch.) Desv.** Tributaries to the Colorado River.
***Tetraspora* sp.** Colorado River and tributaries.

Order Ulotrichales

***Ulothrix aequalis* Kütz.** Colorado River and tributaries.
***Ulothrix cylindricum* Prescott** Colorado River and tributaries.
***Ulothrix subtilissima* Rabenhorst** Colorado River and tributaries.
***Ulothrix tenerrima* Kütz.** Colorado River and tributaries.
***Ulothrix tenuissima* Kütz.** Colorado River and tributaries.
***Ulothrix variabilis* Kütz.** Colorado River and tributaries.
***Ulothrix zonata* (Weber & Mohr) Kütz.** Colorado River and tributaries.

Order Volvocales

***Pandorina morum* (Muell.) Bory.** Tributary to the Colorado River.

Order Zygnematales

***Closterium acerosum* var. *elongatum* Bréb.** Colorado River and tributaries.
***Closterium cynthia* var. *jenneri* [Authority unknown]** Tributaries to the Colorado River.
***Closterium dianae* Ehr.** Tributaries to the Colorado River.
***Closterium* spp.** Colorado River and tributaries.
***Cosmarium* spp.** Colorado River and tributaries.
***Mougeotia* spp.** Colorado River and tributaries.
***Spirogyra* spp.** Colorado River and tributaries.
* ***Staurastrum americanum* (W. & W.) G. M. Smith**
* ***Staurastrum crenatum* Bailey**
* ***Staurastrum gladiosum* Turner**
* ***Staurastrum margaritaceum* (Ehren.) Meneghini**
***Staurastrum* sp.** Tributaries to the Colorado River.
***Zygnema* spp.** Colorado River and tributaries.

Order unknown in Phylum Chlorophyta

Chlorophyceae: Chlorellaceae:
* ***Ankistrodesmus falcatus* (Corda) Ralfs.**
Chlorophyceae: Chlorococcaceae:
***Chlorococcum* spp.** Colorado River and tributaries.
Chlorophyceae: Cylindrocapsaceae:
***Cylindrocapsa* sp.** Colorado River and tributaries.
Chlorophyceae: Botryococcaceae:
* ***Dictyosphaerium pulchellum* Wood.**
Chlorophyceae: Chaetophoraceae:
***Gongrosira lacustris* Brand.** Colorado River and tributaries.
Chlorophyceae: Desmidiaceae:
* ***Euastrum* spp.**
* ***Penium* sp.**
* ***Spondylosium planum* (Wolle) W. & G. S. West**
Chlorophyceae: Microsporaceae:
***Microspora loefrgenii* (Nordst.) Langerheim** Colorado River and tributaries.
***Microspora pachyderma* (Wille) Langerheim** Colorado River and tributaries.
***Microspora* sp.** Colorado River and tributaries.
* ***Microspora tumidula* Hazen.**
Chlorophyceae: Mesotaeniaceae:
* ***Netrium* spp.**
Chlorophyta: Oedogoniaceae:
***Oedogonium* spp.** Colorado River and tributaries.
Chlorophyta: Scenedesmaceae:
* ***Scenedesmus bijuga* (Turp.) Lagerheim**
* ***Scenedesmus* sp.**
Genera of uncertain systematic position:
***Oocystis crassa* Wittrock** Colorado River and tributaries.
***Oocystis elliptica* W. West** Colorado River and tributaries.
***Oocystis solitaria* Wittrock** Colorado River and tributaries.
***Trentepholia aurea* (L.) Martius** Colorado River and tributaries.

PHYLUM RHODOPHYTA

***Audouinella* sp.**
***Batrachospermum* sp.** Colorado River and tributaries.
* ***Rhodochorton* sp.**

PHYLUM XANTHOPHYTA

***Vaucheria geminata* (Vauch.) De Candolle** Colorado River and tributaries.
***Vaucheria sessilis* (Vauch.) De Candolle** Colorado River and tributaries.
***Vaucheria* spp.** Colorado River and tributaries.

PHYLUM CHRYSOPHYTA
CLASS CHRYSOPHYCEAE

* ***Dinobryon sertularia* Ehrenberg**
* ***Mallomonas acaroides* Perty**

CLASS BACILLARIOPHYCEAE

***Achnanthes affinis* Grun.** Colorado River and tributaries, Buck Farm Canyon in sediment near confluence, spring at Lava Falls; epiphytic or epilithic.
***Achnanthes biasolettiana* (Kütz.) Grun.** Stone Creek.
***Achnanthes coarctata* Bréb.** Buck Farm and Shinumo Creek, moss epiphyte.
***Achnanthes conspicua* A. Mayer** Blacktail Canyon.
***Achnanthes deflexa* Reim.** Elves Chasm, moss epiphyte.
***Achnanthes exigua* var. *heterovalva* Krass.** Colorado River and tributaries, especially Vasey's Paradise, Buck Farm Canyon near confluence, and Shinumo Creek. Prefers warm water.
***Achnanthes flexella* (Kütz.) Brun.** Lee's Ferry.
***Achnanthes lanceolata* (Bréb. in Kütz.) Grun.** Tributaries to the Colorado River, Vasey's Paradise, Buck Farm Canyon near confluence, travertine spring at CRM 34.6 R, Shinumo Creek, Blacktail Canyon, Stone Creek, National Canyon, and Pumpkin Spring; common.
***Achnanthes lanceolata* (Bréb. in Kütz.) Grun. var. *apiculata* Patr.** Shinumo Creek.
***Achnanthes lanceolata* Bréb. var. *dubia* Grun.** Colorado River, Vasey's Paradise, Shinumo Creek, Blacktail Canyon, and Stone Creek; intolerant of organic enrichment.

***Achnanthes lanceolata* Bréb. var. *omissa* Reim.** Deer Creek.

***Achnanthes linearis* (W. Sm.) Grun.** Tributaries to the Colorado River, travertine spring at CRM 34.6 R, and Pumpkin Spring; alkaliphilous.

***Achnanthes linearis* (W. Sm.) Grun. f. *curta* H. L. Sm.** Colorado River and tributaries, usually associated with moss seeps or epilithic communities, mostly alkaliphilous.

***Achnanthes linearis* (W. Sm.) Grun. var. *pusilla* Grun.** Spray zones, along the Colorado River and tributaries, probably alkaliphilous.

***Achnanthes microcephala* Kütz.** Colorado River and tributaries, common.

***Achnanthes minutissima* Kütz.** Lower Lake Powell system, North Canyon near confluence, travertine spring at CRM 34.6 R, Buck Farm Canyon near confluence, Shinumo Creek, Blacktail Canyon, National Canyon, spring at Lava Falls, and Pumpkin Spring; alkaliphilous.

***Achnanthes minutissima* Kütz. var. *scotica* (Cart.) Lange-Bert.** Buck Farm Canyon in sediment near confluence, Blacktail Canyon, and Pumpkin Spring.

***Achnanthes sublaevis* var. *crassa* Reim.** Colorado River and tributaries, probably alkaliphilous.

***Achnanthes wellsiae* Reim.** CRM 48.9, only in waters of high conductivity.

***Acnanthes clevei* Grun.** Cardenas Creek and Paria River, alkaliphilous.

***Amphipleura pellucida* (Kütz.) Kütz.** Colorado River and tributaries, travertine spring at CRM 34.6 R, Buck Farm Canyon near confluence, strongly alkaliphilous.

***Amphiprora alata* Kütz.** Tributaries to the Colorado River.

***Amphora* sp. nov.** [*teste* Czar. & Blinn]. Colorado River and tributaries, prefers high conductivity, alkalinity, and temperature.

***Amphora coffeaeformis* (Ag.) Kütz.** Buck Farm Canyon near confluence, North Canyon near confluence, Blacktail Canyon, spring at Lava Falls, and Pumpkin Spring; good indicator of high conductivity and alkalinity.

***Amphora ovalis* Kütz.** Buck Farm Canyon sediment near confluence, alkaliphilous and calciphilous.

***Amphora ovalis* Kütz. var. *pediculus* (Kütz.) V. H. ex De T.** Colorado River and tributaries, Buck Farm Canyon sediment near confluence, Blacktail Canyon, and Pumpkin Spring; alkaliphilous, prefers high oxygen concentrations.

***Amphora perpusilla* (Grun.) Grun.** Colorado River and tributaries, travertine spring at CRM 34.6 R, Buck Farm Canyon near confluence, Shinumo Creek, Blacktail Canyon, and Pumpkin Spring; alkaliphilous and prefers high conductivity.

***Amphora submontana* Hust.** Buck Farm Canyon near confluence, Blacktail Canyon, and Pumpkin Spring.

***Amphora veneta* Kütz.** Diamond Creek, alkaliphilous and prefers high conductivity.

***Amphora* sp. nov.** [*teste* Czar. & Blinn]. Colorado River and tributaries, prefers high alkalinity and moderate conductivity.

***Anomoeoneis exilis* Kütz.** Tributaries to the Colorado River.

***Anomoeoneis serians* var. *brachysira* (Bréb.) Hust.** Tributaries to the Colorado River

***Anomoeoneis sphaerophora* (Kütz.) Pfitz.** Tributaries to the Colorado River.

***Anomoeoneis vitrea* (Grun.) Ross.** Colorado River and tributaries, espeically Clear Creek and Diamond Creek, alkaliphilous and prefers high conductivity.

***Asterionella formosa* Hass.** Common in Lake Powell, and probably a transient in the Colorado River, not a true component of the periphyton of the canyon.

***Bacillaria paradoxa* Gmelin** (= *Nitzchia paradoxa, Bacillaria paxillifer*) Diamond Creek, prefers high conductivity.

***Biddulphia laevis* Ehr.** Alkaliphilous, prefers high conductivity, found at Elves Chasm, Blacktail Canyon, and Diamond Creek.

***Caloneis amphisbaena* (Bory) Cl.** Havasu Creek, alkaliphilous, usually found in high organic sediments.

***Caloneis bacillaris* (Grun.) Cl. var. *thermalis* (Grun.) A. Cl.** Little Colorado River, Unkar Creek, and Fossil Rapids, and tributaries, prefers high conductivity.

***Caloneis bacillum* (Grun.) Cl.** Colorado River and tributaries, North Canyon near confluence, travertine spring at CRM 34.6 R, Buck Farm Canyon in sediment near confluence, Blacktail Canyon, and spring at Lava Falls; alkaliphilous.

***Caloneis backmanii* A. Cl.** CRM 19; appears to be alkaliphilous and epilithic. Possibly the first report of its occurrence in the United States.

***Caloneis hyalina* Hust.** Cardenas Creek, probably alkaliphilous.

***Caloneis silicula* (Ehr.) Cl.** Buck Farm Canyon in sediment near confluence.

***Caloneis silicula* (Ehr.) Cl. var. *brevistriata* O. Muell.** (= *C. pulchra* var. *brevistriata*) Elves Chasm, probably alkaliphilous and preferring water of high conductivity. Possibly the first report of its occurrence in the United States.

***Caloneis silicula* (Ehr.) Cl. var. *limosa* (Kütz.) VanLan.** Olo Canyon.

***Caloneis ventricosa* var. *truncatula* (Grun.) Meist.** Kanab Creek and Mile 152 seep, alkaliphilous.

***Camplylodiscus balatonis* Pant.** Tributaries to the Colorado River.

***Camplylodiscus hibernicus* (Ehr.) Grun.** (= *C. noricus* var. *hibernica*) Tributaries to the Colorado River, alkaliphilous.

***Campylodiscus noricus* var. *hibernica* (Ehr.) Grun.** Vasey's Paradise.

***Cocconeis diminuta* Pant.** Tributaries to the Colorado River, especially Vasey's Paradise and Elves Chasm, alkalibiontic, usually associated with flowing systems.

***Cocconeis pediculus* Ehr.** Tributaries to the Colorado River, Buck Farm Canyon near confluence, Shinumo Creek, Blacktail Canyon, Stone Creek, and National Canyon; alkaliphilous and prefers moderate conductivity, common.

***Cocconeis placentula* Ehr.** Havasu Creek.

***Cocconeis placentula* var. *euglypta* (Ehr.) Cl.** Colorado River and tributaries, alkaliphilous.

***Cocconeis placentula* var. *lineata* (Ehr.) Cl.** Colorado River and tributaries, Buck Farm Canyon near confluence, Shinumo Creek, Blacktail Canyon, Stone Creek, National Canyon, and Pumpkin Spring; alkaliphilous.

***Coscinodiscus denarius* A. S.** Kanab Creek, alkaliphilous, probably prefers water of high conductivity, first record for Northern Arizona.

***Cyclotella atomus* Hust.** Showerstall seep at CRM 35.5, prefers high conductivity.

***Cyclotella meneghiniana* Kütz.** Colorado River and tributaries, alkaliphilous, prefers water of moderate conductivity.

***Cyclotella michiganiana* Skv.** Colorado River between Lees Ferry and CRM 19, indicator of oligotrophic systems.

***Cyclotella stelligera* (Cl. & Grun.) V.H.** North Canyon near confluence.

***Cyclotella* sp.**

***Cylindrotheca gracilis* (Bréb.) W. Sm.** Tributaries to the Colorado River, especially Bright Angel Creek, Pumpkin Spring, and Shinumo Creek, good indicator of high conductivity.

***Cymatopleura solea* (Bréb.) W. Sm.** Elves Chasm, alkaliphilous, not common.

***Cymbella affinis* Kütz.** Colorado River and tributaries, Shinumo Creek, and Stone Creek; strongly alkaliphilous, and prefers water with high oxygen concentrations.

***Cymbella affinis*, var. nov.** [*teste* Czar. & Blinn]. Colorado River and tributaries, probably strongly alkaliphilous.

***Cymbella amphicephala* Naeg. ex. Kütz.** Colorado River and tributaries, prefers water of moderate conductivity.

***Cymbella caespitosa* (Kütz.) var. *ovata* Grun.** Tributaries to the Colorado River.

***Cymbella cistula* (Hempr.) Grun.** Tributaries to the Colorado River, espeically Elves Chasm, alkaliphilous, prefers high concentrations of oxygen.

***Cymbella cymbiformis* Ag.** Buck Farm Canyon sediment near confluence and Stone Creek.

***Cymbella cymbiformis* Ag. var. *nonpunctata* Font.** (= *C. parva*) Epilithic collection at Elves Chasm, probably alkaliphilous.

***Cymbella hustedtii* Krass.** Spring at Lava Falls.

***Cymbella laevis* Näeg. ex Kütz.** Tributaries to the Colorado River, commonly found near seeps with high conductivity.

***Cymbella leptoceros* (Ehr.) Kütz.** Deer Creek, probably alkaliphilous.

***Cymbella lunata* W. Sm.** Buck Farm Canyon in sediment near confluence, and spring near Lava Falls.

***Cymbella mesiana* Choln.** Buck Farm Canyon near confluence.

***Cymbella mexicana* (Ehr.) Cl.** Colorado River and tributaries, alkaliphilous.

***Cymbella microcephala* Grun.** Colorado River and tributaries, including Blacktail Canyon and National Canyon; alkaliphilous.

***Cymbella microcephala* Grun. var. *crassa* Reim.** Colorado River and tributaries, alkaliphilous, prefers water of moderate to high conductivity.

***Cymbella minuta* Hilse ex Rabh.** Colorado River and tributaries, especially Deer Creek, alkaliphilous, prefers high concentrations of oxygen.

***Cymbella norvegica* Grun.** Buck Farm Canyon, Stone Creek, seems to prefer warm water of high alkalinity and conductivity.

***Cymbella prostata* (Berk.) Cl.** Colorado River and tributaries, alkaliphilous and prefers water with high oxygen concentrations.

***Cymbella pusilla* Grun.** Colorado River and tributaries, especially Elves Chasm and Crystal Creek, also at Buck Farm Canyon in sediment near confluence, probably alkaliphilous.

***Cymbella sinuata* Greg.** Colorado River and tributaries, tolerant to a wide range of ecological conditions, alkaliphilous.

***Cymbella tumida* (Bréb.) V. H.** Colorado River and tributaries, especially Elves Chasm, alkaliphilous.

***Cymbella tumidula* Grun.** Colorado River and tributaries, probably alkaliphilous.

***Cymbella turgida* (Greg.) Cl.** Tributaries to the Colorado River.

***Cymbella turgidula* Grun.** Buck Farm Canyon near confluence.

***Cymbella ventricosa* Kütz.** Tributaries to the Colorado River.

***Cymbella ventricosa* Kütz. var. *semicircularis* (Lagst.) Cl.** Tributaries to the Colorado River.

***Cymbella* sp. nov.** [*teste* Czar. & Blinn]. Colorado River and tributaries, prefers flowing water of high alkalinity and moderate conductivity.

***Denticula elegans* Kütz.** Colorado River and tributaries, including Blacktail Canyon, Stone Creek, and spring near Lava Falls; alkaliphilous and prefers water of high conductivity.

***Denticula rainerensis* Sov.** Colorado River and tributaries, especially Showerstall seep at CRM 35.5 and Vasey's Paradise, good indicator of high alkalinity and conductivity.

***Diatoma anceps* (Ehr.) Grun.** Tributaries to the Colorado River.

***Diatoma elongatum* Ag.** Tributaries to the Colorado River.

***Diatoma hiemale* (Lyngb.) Heib.** Tributaries to the Colorado River.

***Diatoma hiemale* (Lyngb.) Heib. var. *mesodon* (Ehrb.) Grunow.** Colorado River and tributaries, especially Tapeats Creek, probably alkaliphilous.

***Diatoma mesodon* (Ehr.) Kütz.** Tributaries to the Colorado River, including Stone Creek.

***Diatoma vulgare* Bory.** Colorado River and tributaries, common, alkaliphilous, prefers water of moderate conductivity.

***Diatoma vulgare* Bory. var. *breve* Grun.** Colorado River and tributaries, espeically Paria River, Deer Creek, Clear Creek, and Tapeats Creek, alkaliphilous.

***Diatoma vulgare* Bory. var. *linearis* V. H.** Shinumo Creek, alkaliphilous.

***Diploneis elliptica* (Kütz.) Cl.** Vasey's Paradise, alkaliphilous, prefers water of high alkalinity.

***Diploneis oblongella* (Naeg. ex Kütz.) Ross.** Vasey's Paradise, alkaliphilous, prefers water of high conductivity.

***Diploneis oculata* (Bréb.) Cl.** Vasey's Paradise and Little Colorado River, alkaliphilous, prefers water of high conductivity.

***Diploneis puella* (Schum.) Cl.** Colorado River and tributaries, spring at Lava Falls, alkaliphilous, prefers water of moderate to high conductivity.

***Diploneis smithii* var. *dilatata* (M. Perag.) Boyer.** Moss seeps at Elves Chasm, probably alkaliphilous, prefers water of high conductivity.

***Entomoneis alata* (Ehr.) Ehr.** Colorado River and tributaries, alkaliphilous, prefers water of high conductivity.

***Entomoneis alata* (Ehr.) Ehr.** Diamond Creek and Elves Chasm.

***Entomoneis ornata* (Rail.) Reim.** Blacktail Canyon.

***Entomoneis palludosa* (W. Sm.) Reim.** Colorado River and tributaries, alkaliphilous, prefers water of high conductivity.

***Entomoneis paludosa* (W. Sm.) Reim.** Lower Lake Powell.

***Epithemia adnata* (Kütz.) Bréb.** (= *E. zebra*) Buck Farm Canyon and Vasey's Paradise, alkaliphilous, but able to tolerate a wide range of ecological conditions.

***Epithemia argus* var. *alpestris* Grun.** Buck Farm Canyon and Vasey's Paradise, probably alkaliphilous.

***Epithemia argus* var. *longicornis* (Ehr.) Grun.** Colorado River and tributaries, probably alkaliphilous, prefers moderate conductivity.

***Epithemia sorex* Kütz.** Moss seeps along the Colorado River, alkaliphilous, usually associated with moss seps or entanglements of vegetation.

***Epithemia turgida* (Ehr.) Kütz.** Upper part of the Colorado River system below Glen Canyon Dam, alkaliphilous and possibly calciphilous.

***Eunotia exigua* (Bréb. ex Kütz.) Rabh.** Spring near Lava Falls.

***Eunotia grunowi* A. Bg.** Tributaries to the Colorado River.

***Eunotia incisa* W. Sm. Ex Greg.** Blacktail Canyon.

***Fragilaria aequalis* Heib.** Tributaries to the Colorado River.

***Fragilaria brevistriata* Grun.** Tributaries to the Colorado River.

***Fragilaria brevistriata* Grun. var. *inflata* (Pant) Hust.** Cardenas Creek, alkaliphilous, prefers high conductivity.

***Fragilaria capucina* Desm.** Colorado River and tributaries, especially Elves Chasm and Havasu Creek, alkaliphilous, a common plankter.

***Fragilaria capucina* var. *mesolepta* Rabh.** Colorado River and tributaries, especially Elves Chasm and Havasu Creek, alkaliphilous, able to tolerate higher conductivity than the nominate variety.

***Fragilaria construens* var. *venter* (Ehr.) Grun.** Colorado River and tributaries, especially Diamond Creek, also North Canyon near confluence, Vasey's Paradise, and Shinumo Creek; alkaliphilous.

***Fragilaria crotonensis* Kitton.** Colorado River and tributaries, alkaliphilous, a common plankter.

***Fragilaria intermedia* Grun.** Tributaries to the Colorado River.

***Fragilaria leptostauron* (Ehr.) Hust.** Colorado River and tributaries, especially Bright Angel Creek and Tapeats Creek, alkaliphilous.

***Fragilaria leptostauron* (Ehr.) Hust. var. *dubia* (Grun.) Hust.** Cardenas Creek, alkaliphilous.

***Fragilaria* sp.** Tributaries to the Colorado River.

***Fragilaria vaucheriae* (Kütz.) Peters.** Colorado River and tributaries, including Vasey's Paradise, Shinumo Creek, and Stone Creek; alkalliphilous.

***Fragilaria virescens* Ralfs.** Tributaries to the Colorado River.

***Frustulia vulgaris* Thwaites.** Colorado River and tributaries, probably requires high organic content.

***Frustulia weinholdii* Hust.** Stone Creek.

***Gomphoneis herculeana* Ehr.** Colorado River and tributaries, alkaliphilous, probably requires a current.

***Gomphonema acuminatum* Ehr.** Rarely from Vasey's Paradise and Bright Angel Creeks, alkaliphilous.

***Gomphonema affine* Kütz.** Redwall Cavern.

***Gomphonema affine* Kütz. var. *insigne* (Greg.) Andrews.** Kanab Creek, alkaliphilous.

***Gomphonema angustatum* (Kütz.) Rabh.** Tributaries to the Colorado River, Vasey's Paradise, Buck Farm Canyon near confluence, and Stone Creek.

***Gomphonema constrictum* Ehr.** Tributaries to the Colorado River.

***Gomphonema gracile* Ehr. emend. V.H.** Stone Creek.

***Gomphonema grunowii* Patr.** Havasu Creek, alkaliphilous.

***Gomphonema intracatum* Kütz.** Elves Chasm, alkaliphilous.

***Gomphonema intracatum* Kütz. var. *vibrio* (Ehr.) Cl.** Colorado River and tributaries, Buck Farm Canyon near conlfuence, alkaliphilous.

***Gomphonema minutum* (Ag.) Ag.** Stone Creek.

***Gomphonema olivaceum* (Lyngb.) Kütz.** Kanab Creek.

***Gomphonema parvulum* (Kütz.) Kütz.** Tributaries to the Colorado River, including North Canyon near confluence, Vasey's Paradise, Buck Farm Canyon near confluence, and Blacktail Canyon; possibly an indicator of organic enrichment, very common, possibly alkaliphilous.

***Gomphonema* sp.** Tributaries to the Colorado River.

***Gomphonema subclavatum* (Grun.) Grun.** Colorado River and tributaries, probably alkaliphilous and prefers moderate conductivity.

***Gomphonema subtile* Ehr.** Elves Chasm, rare.

***Gomphonema truncatum* Ehr.** Colorado River and tributaries, alkaliphilous and possibly calciphilous.

***Gomphonema ventricosum* Greg.** Tributaries to the Colorado River and Vasey's Paradise.

***Gyrosigma attenuatum* var. *hippocampus* (W. Sm.) Cl.** Tributaries to the Colorado River.

***Gyrosigma balticum* (Ehr.) Rabh.** Tributaries to the Colorado River.

***Gyrosigma spencerii* (W. Sm.) Cl.** Kanab Creek, alkaliphilous, prefers moderate to high conductivity.

***Gyrosigma spencerii* var. *curvula* (Grun.) Reim.** Elves Chasm, Clear Creek, Buck Farm Canyon, alkaliphilous, lower conductivity.

***Gyrosigma strigile* W. Sm.** Tributaries to the Colorado River.

***Hantzschia amphioxys* (Ehr.) Grun. f. *capitata* Mull.** Colorado River and tributaries, alkaliphilous.

***Hantzschia amphioxys* (Ehr.) Grun.** Stone Creek and North Canyon near confluence, alkaliphilous.

***Mastogloia elliptica* var. *danseii* (Thwaites) Cl.** Elves Chasm, alkaliphilous, prefers water of high conductivity.

***Mastogloia grevillei* W. Sm.** CRM 152 seep, probably alkaliphilous.

***Mastogloia smithii* Thwaites ex W. Sm.** Colorado River and tributaries, Buck Farm Canyon sediment near confluence, alkaliphilous and calciphilous.

***Mastogloia smithii* Thwaites ex W. Sm. var. *amphicephala* Grun.** Clear Creek and Buck Farm Canyon, probably alkaliphilous.

***Mastogloia smithii* Thwaites var. *lacustris* Grun.** Colorado River and tributaries, especially Crystal Creek, alkaliphilous and calciphilous.

***Melosira granulata* (Ehr.) Ralfs.** Tapeats Creek, rheophilic and epiphytic.

***Melosira islandica* O. Müll.**

***Melosira varians* Ag.** Colorado River and tributaries, Vasey's Paradise, and Stone Creek; alkaliphilous and restricted to flowing systems.

***Meridion circulare* (Grev.) Ag.** Diamond Creek, Elves Chasm, Deer Creek, and Pumpkin Spring; common in flowing systems.

***Navicula accomoda* Hust.** Kanab Creek and Bright Angel Creek, alkaliphilous.

***Navicula amphibola* Cleve.** Tributaries to the Colorado River.

***Navicula anglica* Ralfs.** Tributaries to the Colorado River.

***Navicula anglica* Ralfs. var. *subsalsa* Grun.** Colorado River and tributaries, alkaliphilous and prefers water of high conductivity.

***Navicula arvenensis* Hust.** Colorado River and tributaries, especially Vasey's Paradise and Elves Chasm, warm water alkaliiphil.

***Navicula atomus* (Kütz.) Grun.** Pumpkin Spring.

***Navicula bacillum* Ehr.** Clear Creek, alkaliphilous.

***Navicula caru* Ehr.** Diamond Creek.

***Navicula cincta* (Ehr.) Kütz.** Cardenas Creek and Kanab Creek, alkaliphilous and prefers water of high conductivity.

***Navicula cocconeiformis* Greg. ex Grev.** Bright Angel Creek, probably alkaliphilous.

***Navicula cryptocephala* Kütz.** Colorado River and tributaries and Buck Farm Canyon near confluence, common throughout Northern Arizona.

***Navicula cryptocephala* Kütz. f. *minuta* Boye-P.** Colorado River and tributaries, common throughout Northern Arizona.

***Navicula cryptocephala* Kütz. var. *veneta* (Kütz.) Rabh.** Colorado River and tributaries, including North Canyon, Buck Farm Canyon, and Stone Creek; alkaliphilous and prefers water of high conductivity.

***Navicula cryptocephala* var. *veneta* (Kütz) Rabh.** Greenland Lake, North Rim and Shinumo Creek.

***Navicula cuspidata* (Kütz.) Kütz.** Colorado River and tributaries (including North Canyon near confluence), common throughout Northern Arizona and usually associated with sediment.

***Navicula cuspidata* Kütz. var. *major* Meist.** *Chara* dominant pool in Havasu Creek, probably alkaliphilous.

***Navicula decussis* Ostr.** Colorado River and tributaries, especially Tapeats Creek and Shinumo Creek, alkaliphilous and prefers water of high conductivity.

***Navicula densestriata* Hust.** Little Colorado River, probably alkaliphilous.

***Navicula dicephala* (Ehr.) W. Smith** Tributaries to the Colorado River.

***Navicula elginensis* var. *rostrata* (A. Mayer) Patr.** Greenland Lake, North Rim.

***Navicula exigua* (Greg.) O. Müll.** Olo Canyon.

***Navicula gastrum* Ehr.** Tributaries to the Colorado River.

***Navicula globulifera* Hust.** Three Springs Canyon.

***Navicula graciloides* Mayer.** Colorado River, rare.

***Navicula gregaria* Donkin.** Kanab Creek, alkaliphilous and prefers water of high conductivity.

***Navicula grimmei* Krasske.** Kanab Creek, alkaliphilous.

***Navicula halophila* (Frun.) Cl.** Elves Chasm, Buck Farm Canyon near confluence, and Blacktail Canyon.

***Navicula lanceolata* (Ag.) Kütz.** Havasu Creek and Kanab Creek, alkaliphilous and prefers water of high conductivity.

***Navicula longirostris* Hust.** Colorado River and tributaries, especially Cardenas Creek, and CRM 115, alkaliphilous and prefers water of high conductivity.

***Navicula luzonensis* Hust.** North Canyon near confluence, and Vasey's Paradise.

***Navicula minima* Grun.** Colorado River and tributaries including Vasey's Paradise, Buck Farm Canyon near confluence, and Shinumo Creek. Alkaliphilous but also tolerant of low oxygen concentrations.

***Navicula miniscula* Grun.** Olo Canyon, Nautiloid Seep, and Havasu Creek, possibly alkaliphilous.

***Navicula mutica* Kütz.** Colorado River and tributaries, including North Canyon near confluence, and Shinumo Creek. Alkaliphilous and prefers water of high conductivity.

***Navicula mutica* Kütz. var. *cohnii* (Hilse) Grun.** Elves Chasm, Vasey's Paradise, Tapeats Creek, and Diamond Creek, alkaliphilous and prefers water of high conductivity.

***Navicula mutica* Kütz. var. *stigma* Patr.** Elves Chasm, alkaliphilous, prefers water of high conductivity, and warmer temperatures.

***Navicula mutica* Kütz. var. *undulata* (Hilse) Grun.** Elves Chasm, alkaliphilous and prefers water of high conductivity.

***Navicula notha* Wallace** Redwall Caverns and Diamond Creek, probably alkaliphilous.

***Navicula pelliculosa* (Bréb.) Hilse.** Kanab Creek, alkaliphilous and prefers water of high conductivity.

***Navicula pseudoreinhardtii* Patr.** Clear Creek and CRM 134, probably alkaliphilous.

***Navicula pupula* Kütz.** Buck Farm Canyon sediment near confluence, CRM 134, Three Springs Canyon, Havasu Canyon, and Pumpkin Spring, alkaliphilous and halophilous.

***Navicula pupula* var. *rectangularis* (Greg.) Grun.** Greenland Lake, North Rim, Colorado River and tributaries, prefers higher conductivity than *N. pupula*.

***Navicula radiosa* Kütz.** Colorado River and tributaries, Buck Farm Canyon sediment near confluence, tolerant of many ecological conditions, widespread but not in high abundance.

***Navicula radiosa* Kütz. var. *tenella* (Bréb. ex Kütz.) Grun.** Colorado River and tributaries, including North Canyon near confluence, Buck Farm Canyon sediment near confluence, travertine spring at CRM 34.6 R, Shinumo Creek, Stone Creek, National Canyon, and Pumpkin Spring; tolerant of many ecological conditions, widespread but not in high abundance.

***Navicula rhynchocephala* Kütz.** North Canyon near confluence.

***Navicula salinarum* var. *intermedia* (Grun.) Cl.** Vasey's Paradise and Stone Creek.

***Navicula secreta* var. *apiculata* Patr.** Colorado River and tributaries, especially Bright Angel Creek and Elves Chasm, alkaliphilous and prefers water of high conductivity.

***Navicula seminulum* Grun.** Vasey's Paradise, CRM 34.6 R, Stone Creek, National Canyon, and Pumpkin Spring.

***Navicula stroemii* Hust.** Spring near Lava Falls.

***Navicula subtilissima* Cl.** Buck Farm Canyon, Stone Creek, and Vasey's Paradise; probably alkaliphilous.

***Navicula symmetrica* Patr.** Buck Farm Canyon and Havasu Creek.

***Navicula tridentula* Krasske** Colorado River tributaries, probably alkaliphilous, possible the first report of this taxon's occurrence in the United States.

***Navicula tripunctata* (Müll.) Bory** Colorado River and tributaries, including Vasey's Paradise, travertine spring at CRM 34.6 R, Buck Farm Canyon near confluence, Shinumo Creek, Blacktail Canyon, Stone Creek, and Pumpkin Spring; alkaliphilous, common diatom in the Grand Canyon.

***Navicula tripunctata* (Müll.) Bory var. *schizonemoides* (V.H.) Patr.** CRM 34.6 R, Buck Farm Canyon, Cardenas Creek, and Blacktail Canyon; prefers water of high conductivity.

***Navicula tuscula* Ehr.** Paria River, probably alkaliphilous.

***Navicula viridula* (Kütz) Kütz.** Olo Canyon, Kanab Creek, and Little Colorado River, alkaliphilous.

***Navicula viridula* (Kütz) Kütz. var. *avenacea* (Bréb. ex Grun.) V.H.** Buck Farm Canyon sediment near confluence and Shinumo Creek.

***Navicula viridula* (Kütz) Kütz. var. *rostellata* (Kütz) Cl.** Buck Farm Canyon sediment near confluence, Havasu Creek, and Diamond Creek, alkaliphilous.

***Navicula zanoni* (Kütz) Hust.** Colorado River and tributaries, especially Vasey's Paradise, Tapeats Creek, and Shinumo Creek, alkaliphilous.

***Navicula* spp.** Tributaries to the Colorado River.

***Navicula* sp. nov. 1** [*teste* Czar. & Blinn]. Colorado River and tributaries, probably alkaliphilous.

***Navicula* sp. nov. 2** [*teste* Czar. & Blinn]. Colorado River and tributaries, probably alkaliphilous.

***Navicula* sp. nov. 3** [*teste* Czar. & Blinn]. Colorado River and tributaries, probably alkaliphilous and halophilous.

***Neidium binode* (Ehr.) Hust.** Elves Chasm, usually associated with a neustonic community, especially in pools with high organic sediments.

***Neidium dubium* (Ehr.) Cl.** Tributaries to the Colorado River.

***Neidium dubium* (Ehr.) Cl. fo. *constrictum* Hust.** Elves Chasm, usually epipelic and probably alkaliphilous preferring dissolved organics.

***Neidium productum* (W. Sm) Cl.** Tributaries to the Colorado River.

***Nitzschia accedans* Hust.** Olo Canyon, Shinumo Creek, Elves Chasm, and Bright Angel Creek.

***Nitzschia acicularis* W. Sm.** Colorado River and tributaries, especiallly Tapeats Creek, probably alkaliphilous.

***Nitzschia acicularis* W. Sm. var. *closterioides* Grun.** Havasu Creek.

***Nitzschia acuta* Hantzsch.** Shinumo Creek, probably alkaliphilous.

***Nitzschia amphibia* Grun.** Tributaries to the Colorado River, Cardenas Creek, North Canyon near confluence, travertine spring at CRM 34.6 R, Buck Farm Canyon near confluence, Blacktail Canyon, National Canyon, spring near Lava Falls, and Pumpkin Spring; alkaliphilous and prefers water of high conductivity.

***Nitzschia angularis* W. Sm.** Tributaries to the Colorado River.

***Nitzschia angustata* (W. Sm.) Grun.** Havasu Creek, Little Colorado River and CRM 34.5, alkaliphilous.

***Nitzschia angustata* (W. Sm.) Grun. var. *acuta* Grun.** Kanab Creek and Shinumo Creek, alkaliphilous.

***Nitzschia apiculata* (Greg.) Grun.** Colorado River and tributaries, alkaliphilous and prefers water of high conductivity, fairly common.

***Nitzschia bicrena* Hohn & Hell.** Shinumo Creek, possibly alkaliphilous.

***Nitzschia bita* Hohn & Hell.** Elves Chasm, possibly alkaliphilous.

***Nitzschia capitellata* Hust.** Kanab Creek, alkaliphilous and halophilous.

***Nitzschia communis* Rabh.** Colorado River and tributaries, alkaliphilous, an obligate nitrogen heterotroph, and halophilous.

***Nitzschia commutata* Grun.** Tributaries to the Colorado River.

***Nitzschia compressa* var. *vexans* (Grun.) Lange-Bert.** CRM 34.6 R.

***Nitzschia denticula* Grun.** Moss seeps at Vasey's Paradise, alkaliphilous and prefers water of high oxygen concentrations and moderate conductivity.

***Nitzschia dissipata* (Kütz.) Grun.** Tributaries to the Colorado River, spring at CRM 34.6 R, Buck Farm Canyon near confluence, Shinumo Creek, Stone Creek, Pumpkin Spring; alkaliphilous, prefers high oxygen concentrations, common in northern Arizona.

***Nitzschia filiformis* (W. Sm.) Hust.** Olo Canyon and Bright Angel Creek.

***Nitzschia fonticola* Grun.** Kanab Creek, Buck Farm Canyon in sediment near confluence, alkaliphilous and tolerant of amino acids.

***Nitzschia frustulum* Kütz.** Tributaries to the Colorado River, alkaliphilous, halophilous, and an obligate nitrogen heterotroph. One of the most important taxa in the canyon.

***Nitzschia frustulum* Kütz. var. *perminuta* Grun.** North Canyon near confluence, Vasey's Paradise, and Shinumo Creek.

***Nitzschia frustulum* Kütz. var. *perpusilla* (Rabh.) Grun.** Greenland Lake, North Rim, Colorado River, and tributaries, alkaliphious, halophilous, and an obligate nitrogen heterotroph. One of the most important taxa in the canyon.

***Nitzschia gracilis* Hantzsch** Elves Chasm, possibly alkaliphilous.

***Nitzschia holsatica* Hust.** Tributaries to the Colorado River.

***Nitzschia hungarica* Grun.** Kanab Creek, alkaliphilous, halophilous, and able to tolderate low oxygen concentrations.

***Nitzschia hybrida* Grun.** Deer Creek, possibly alkaliphilous.

***Nitzschia inconspicua* Grun.** Near confluences in Buck Farm Canyon, Blacktail Canyon, and Stone Creek.

***Nitzschia kutzingiana* Hilse.** Tributaries to the Colorado River, alkaliphilous and one of the most important taxa in the canyon.

***Nitzschia lacunarum* Hust.** Showerstall seep at CRM 35.5, halophilous, calciphilous, and alkaliphilous.

***Nitzschia laevissima* Grun.** Tributaries to the Colorado River.

***Nitzschia linearis* (Ag. ex W. Sm.) W. Sm.** Colorado River and tributaries including North Canyon near confluence and Vasey's Paradise alkaliphilous and prefers water with high oxygen concentrations, on of the most important taxa in the canyon, common.

***Nitzschia littoralis* var. *tergestina* Grun.** Kanab Creek, possibly alkaliphilous.

***Nitzschia longissima* (Bréb.) Ralfs.** Tributaries to the Colorado River.

***Nitzschia longissima* (Bréb.) Ralfs. var. *closterium* (W. Sm) V. H.** Tributaries to the Colorado River.

***Nitzschia longissima* (Bréb.) Ralfs. var. *reversa* Grun.** Tributaries to the Colorado River.

***Nitzschia lorenziana* Grun.** Tributaries to the Colorado River.

***Nitzschia microcephala* Grun.** Tributaries to the Colorado River, including Blacktail Canyon and National Canyon, alkaliphilous and halophilous.

***Nitzschia obtusa* W. Sm.** Blacktail Canyon and Stone Creek.

***Nitzschia palea* (Kütz.) W. Sm.** Greenland Lake on North Rim and tributaries to the Colorado River, including North Canyon, Buck Farm Canyon, Stone Creek, National Canyon, and Pumpkin Spring; a good indicator of organic pollution.

***Nitzschia paradoxa* (Gmel.) Grun.** Tributaries to the Colorado River.

***Nitzschia parvula* Lewis.** Havasu Creek.

***Nitzschia recta* Hantzsch.** *Chara* pool in Havasu Creek, possibly alkaliphilous.

***Nitzschia romana* Grun.** Elves Chasm, Vasey's Paradise, and Bright Angel Creek.

***Nitzschia sigma* (Kütz.) W. Smith.** Little Colorado River, Deer Creek, and Kanab Creek, alkaliphilous and halophilous.

***Nitzschia sigmoidea* (Ehr.) W. Sm.** Elves Chasm, alkaliphilous.

***Nitzschia sinuata* var. *tabellaria* Grun.** Shinumo Creek, alkaliphilous.

***Nitzschia spectabilis* (Kütz.) Grun.** Tributaries to the Colorado River.

***Nitzschia spectabilis* W. Sm.** Tributaries to the Colorado River.

***Nitzschia tropica* Hust.** Vasey's Paradise.

***Nitzschia tryblionella* var. *calida* (Grun.) V. H.** Kanab Creek and *Chara* pool in Havasu Creek, possibly alkaliphilous.

***Nitzschia tryblionella* var. *levidensis* (W. Sm.) Grun.** Olo Canyon and Havasu Creek.

***Nitzschia vermicularis* (Kütz.) Grun.** Shinumo Creek, alkaliphilous and halophilous.

***Nitzschia vitrea* Norm.** Tributaries to the Colorado River.

***Nitzschia* sp.** Tributaries to the Colorado River.

***Nitzschia* sp. nov. 1** [*teste* Czar. & Blinn]. Colorado River and tributaries, probably alkaliphilous and prefers water of high conductivity.

***Nitzschia* sp. nov. 2** [*teste* Czar. & Blinn]. Colorado River and tributaries, probably alkaliphilous and prefers water of high conductivity.

***Opephora ansata* Hohn & Hellerm.** Pumpkin Spring, probably alkaliphilous and halophilous.

***Opephora* sp.** Tributaries to the Colorado River.

***Pinnularia appendiculata* (Ag.) Cl.** Kanab Creek and Pumpkin Spring, aerophilous.

***Pinnularia borealis* var. *rectangularis* Carlson** Elves Chasm, possibly alkaliphilous.

***Pinnularia brebissonii* (Kütz.) Rabh.** Deer Creek spray zone, does not prefer water of low mineral content.

***Pinnularia brevicostata* Cl.** Greenland Lake, North Rim.

***Pinnularia divergentissima* (Grun.) Cl.** Buck Farm Canyon, cool-water form.

***Pinnularia microstauron* (Ehr.) Cl.** Spring near Lava Falls.

***Pinnularia* sp.** Tributaries to the Colorado River.

***Pinnularia* sp. nov.** [*teste* Czar. & Blinn]. Colorado River and tributaries, probably alkaliphilous.

***Plagiotropis lepidoptera* (Cl.) Reim.** Diamond Creek.

***Plagiotropis lepidoptera* (Greg) Czar. & Blinn, comb. nov.** Colorado River and tributaries, euhalobous.

***Pleurosigma delicatulum* W. Sm.** Elves Chasm and Havasu Creek, alkaliphilous and halophilous.

***Reimeria sinuata* (Greg.) Kociolek & Stoermer** Travertine spring at CRM 34.6 R, Buck Farm Canyon, and Stone Creek.

***Rhoicosphenia curvata* (Kütz.) Grun.** Colorado River and tributaries, including Travertine spring at CRM 34.6 R, Buck Farm Canyon and Blacktail Canyon near confluence, and Pumpkin Spring; alkaliphilous, prefers water with high oxygen concentrations, very common in flowing waters, and one of the most important taxa in the canyon.

***Rhopaloidia gibba* (Ehr.) Müll.** Tributaries to the Colorado River, including

Buck Farm Canyon; alkaliphilous, common, usually associated with epilithic or epiphytic communities, and one of the most important taxa in the canyon.

***Rhopaloidia gibba* (Ehr.) Müll. var. *ventricosa* (Kütz.) H. & M. Perag.** Elves Chasm, alkaliphilous, common, usually associated with epilithic or epiphytic communities, and one of the most important taxa in the canyon.

***Rhopaloidia gibberula* var. *vanheirckii* Müll.** Colorado River and tributaries, alkaliphilous and prefers somewhat higher conductivity than *R. gibba*.

***Scoliopleura peisonis* Grun.** Elves Chasm, alkaliphilous and extremely halophilous.

***Stauroneis amphioxys*, var. nov.** [*teste* Czar. & Blinn]. Colorado River and tributaries, probably alkaliphilous.

***Stauroneis anceps* Ehr.** Greenland Lake on North Rim and Elves Chasm, has a wide range of ecological tolerances.

***Stauroneis anceps* Ehr. fo. *gracilis* Rabh.** North Canyon near confluence.

***Stauroneis kriegeri* Patr.** Pumpkin Spring.

***Stauroneis phoenicenteron* (Nitz.) Ehr.** Greenland Lake, North Rim.

***Stauroneis smithii* Grun.** Elves Chasm, alkaliphilous.

***Stenopterobia intermedia* (Lewis) V. H.** Pumpkin Spring.

***Stephanodiscus invisitatus* Hohn. & Hellerm.** North Canyon near confluence.

***Surirella angusta* Kütz.** Colorado River and tributaries, including Stone Creek, alkaliphilous.

***Surirella brightwellei* W. Sm.** Colorado River and tributaries, including Blacktail Canyon, probably alkaliphilous and halophilous.

***Surirella ovalis* Bréb.** Little Colorado River, alkaliphilous.

***Surirella ovata* Kütz.** Colorado River and tributaries, especially Kanab Creek, alkaliphilous, rheophilous.

***Surirella ovata* Kütz. var. *africana* Choln.** Shinumo Creek, possibly alkaliphilous.

***Surirella ovata* Kütz. var. *pinnata* W. Sm.** Kanab Creek, possibly alkaliphilous.

***Surirella patella* Ehr.** Ledges seep at CRM 152, alkaliphilous.

***Surirella striatula* Turp.** Elves Chasm, Clear Creek, and Diamond Creek, alkaliphilous and halophilous.

***Surirella striatula* Turp., var. nov.** [*teste* Czar. & Blinn]. Colorado River and tributaries, alkaliphilous and halophilous.

***Surirella* sp.** Colorado River and tributaries.

***Synedra actinastioides* Lemm.** Tributaries to the Colorado River.

***Synedra acus* Kütz.** Colorado River and tributaries, especially Crystal Creek, alkaliphilous and halophilous.

***Synedra affinis* Kütz.** (*sensu stricto* Hust.) Elves Chasm, not a common component of the Colorado River system, possibly alkaliphilous.

***Synedra berolinensis* Lemm.** Tributaries to the Colorado River.

***Synedra delicatissima* W. Sm.** Buck Farm Canyon in sediment near confluence.

***Synedra delicatissima* var. *angustissima* Grun.** Upper reaches directly below Glen Canyon Dam, phytoplankter.

***Synedra fasciculata* (Ag.) Kütz.** Blacktail Canyon.

***Synedra goulardii* Bréb.** Tapeats Creek and Stone Creek, usually found in warm water.

***Synedra incisa* Boyer.** Tapeats Creek and Diamond Creek, possibly alkaliphilous.

***Synedra kamtschatica* Grun.** Tributaries to the Colorado River.

***Synedra mazamaensis* Sov.** Clear Creek, possibly alkaliphilous.

***Synedra minuscula* Grun., var. nov.** [*teste* Czar. & Blinn]. Colorado River and tributaries, probably alkaliphilous, possibly halophilous.

***Synedra nana* Meist.** Tributaries to the Colorado River.

***Synedra pulchella* var. *lacerata* Hust.** Kanab Creek, benthic collection, probably alkaliphilous.

***Synedra rumpens* Kütz.** Colorado River and tributaries (including Vasey's Paradise), widely tolerant.

***Synedra rumpens* Kütz. var. *familiaris* (Kütz.) Hust.** Olo Canyon.

***Synedra socia* Wall.** Colorado River and tributaries, alkaliphilous and possibly rheophilous.

***Synedra tenera* var. *genuina* Cl.** Tributaries to the Colorado River.

***Synedra ulna* (Nitz.) Ehr.** Colorado River and tributaries, including Blacktail Canyon and spring at Lava Falls, widely tolerant and one of the most important taxa in the canyon.

***Synedra ulna* var. *contracta* Ostr.** Epiphytic, moss seep at Vasey's Paradise, possibly alkaliphilous.

***Tropidoneis lepidoptera* (Greg.) Cl.** Tributaries to the Colorado River.

PHYLUM PYRROPHYTA

* ***Peridinium cinctum* (Muell.) Ehrenberg**

PHYLUM EUGLENOPHYTA

* ***Phacus* sp.**
* ***Trachelomonas superba* (Swir) Deflandre**
* ***Trachelomonas volvocina* Ehrenberg**

PHYLUM CRYPTOPHYTA

* ***Cryptomonas* spp.**

HETEROTROPHIC PROTISTA

PHYLUM MYXOMYCOTA
CLASS MYXOMYCETES

ORDER LICEALES

RETICULARIACEAE

***Lycogala epidendrum* (L.) Fr.** Wolf's-milk slime. Scattered to clustered, on dead wood, especially large logs. June to November.

***Myxomycete* sp.** Slime mold.

KINGDOM FUNGI

PHYLUM EUMYCOTA
SUBPHYLUM ASCOMYCOTINA
CLASS PLECTOMYCETES

ORDER ERYSIPHALES

ERYSIPHACEAE

***Erysiphe cichoracearum* DC.** Powdery mildew fungus.

***Phyllactinia guttata* (Lev.) Karst.** Powdery mildew fungus.

CLASS PYRENOMYCETES

HYALOSCYPHACEAE

***Dasyscyphus arida* (Phill.) Sacc.**

HYPODERMATACEAE

***Hypodermella medusa* Dearn.** Needle-cast fungus.

***Hypodermella abietis-concoloris* (Mayr) Dearn.** Needle-cast fungus.

***Lophodermium juniperinum* (Fries) De Notaris** Needle-cast fungus. On dead leaves of common juniper.

VENTURIACEAE

***Lasiobotrys symphoricarpi* Syd.** Leaf spot fungus.

ORDER PYLLACHORALES

***Trabutia erythrospora* (Berk. & Curt.) Theiss. & Syd.** Leaf spot fungus.

ORDER DIATRYPALES

***Diatrypella favacea* (Fr.) De Not.** (= *D. verruciformis*) Generally on dead wood of hardwoods.

CLASS ASCOMYCETES

ORDER LICHINALES

LICHINACEAE

***Lichinella americana* Henssen.** On calcareous rock

***Lichinella nigritella* (Lettau) Moreno & Egea.** (= *Gonohymenia nigritella*) On siliceous and calcareous rock.

***Lichenella* cf. *stipatula* Nyl.** On schist.
***Peccania arizonica* (Tuck.) Herre.** On siliceous rock.
***Psorotichia schaereri* (Massal.) Arnold** On sandstone.

HEPPIACEAE
***Heppia lutosa* (Ach.) Nyl.** On soil.

ORDER GRAPHIDALES

THELOTREMATACEAE
***Diploschistes* cf. *gypsaceus* (Ach.) Zahlbr.** On sandstone.
***Diploschistes muscorum* (Scop.) R. Sant.** On soil and over moss.
***Diploschistes scruposus* (Schreber) Norman** On soil over sandstone.

ORDER HYPOCREALES

HYPOCREACEAE
***Nectria cinnabarina* (Tode Fr.) Fr.**

ORDER LECANORALES
Suborder Acarosporineae

ACAROSPORACEAE
***Acarospora fuscata* (Schrader) Arnold** On siliceous rock.
***Acarospora oligospora* (Nyl.) Arnold** On sandstone.
***Acarospora schleicheri* (Ach.) A. Massal.** On sandstone, limestone, granite, and soil.
***Acarospora smaragdula* (Wahlenb.) Massal.** On sandstone and limestone.
***Acarospora stapfiana* (Müll. Arg.) Hue.** Parasitic on *Caloplaca trachyphylla.*
***Acarospora strigata* (Nyl.) Jatta** On sandstone, limestone, schist, and granite.
***Acarospora utahensis* H. Magn.** On schist.
***Glypholecia scabra* (Pers.) Müll. Arg.** (= *Acarospora scabra, A. saxicola*) On limestone and sandstone.
***Polysporina simplex* (Davies) Vezda.** (= *Biatorella simplex*, *Sarco-gyne simplex*) On sandstone.
***Sarcogyne clavus* (DC.) Kremp.** On sandstone.
***Sarcogyne novomexicana* Magn.** On siliceous and calcareous rock.
***Sarcogyne privigna* (Ach.) Mass.** On sandstone.

HYMENELIACEAE
***Aspicilia caesiocinerea* (Nyl. ex Malbr.) Arnold** (= *Lecanora caesiocinerea*) South Kaibab Trail and Grandview Trail, on sandstone.
***Aspicilia calcarea* (L.) Mudd** (= *Lecanora calcarea*) South Kaibab Trail, Grandview Trail, Bright Angel Trail, North Kaibab Trail, on sandstone, limestone, and shale.
***Aspicilia cinerea* (L.) Körber.** (= *Lecanora cinerea*) Grandview Trail and North Kaibab Trail; on sandstone and shale.
***Aspicilia contorta* (Hoffm.) Kremp.** (= *Lecanora contorta*) Bright Angel Trail and 6 km north of Phantom Ranch on North Kaibab Trail; on siliceous rock.
***Aspicilia* cf. *gibbosa* (Ach.) Körber.** River Trail on sandstone.
***Hymenelia epulotica* (Ach.) Lutzoni** (= *Ionaspis epulotica*) On calcareous rock.
***Lobothallia alphoplaca* (Wahlenb. in Ach.) Hafellner** (= *Aspicilia alphoplaca*) South Kaibab Trail, Grandview Trail, and Bright Angel Trail; on sandstone.
***Lobothallia praeradiosa* (Nyl.) Hafellner** (= *Aspicilia praeradiosa* and *Lecanora praeradiosa*) South Kaibab Trail, River Trail, Grandview Trail, Bright Angel Trail, 6 km north of Phantom Ranch on North Kaibab Trail, on sandstone and limestone.
***Megaspora veruosa* (Ach.) Hafellner & V. Wirth** *(= Pachyspora verrucosa*, *P. mutabilis*, *Lecanora verrucosa, L. mutabilis, L. urceolata*, *Pertusaria freyi*) On moss, Gambel oak, white fir, Douglas-fir, and dead pine.

Suborder Agryriineae

AGYRIACEAE
***Trapeliopsis granulosa* (Hoffm.) Lumbsch** (= *Lecidea granulosa, L. quadricolor*) On Utah juniper and charred wood.

Suborder Cladoniineae

CLADONIACEAE
***Cladonia cariosa* (Ach.) Sprengel** On soil over mosses.
***Cladonia chlorophaea* (Flörke ex Sommerf.) Sprengel** (= *Cladonia pyxidata* var. *chlorophaea*) On earth, rotten wood, or on moss, North Rim.
***Cladonia coniocraea* (Flörke) Sprengel** On soil over mosses.
***Cladonia fimbriata* (L.) Fr.** On soil.
***Cladonia glauca* Flörke.** On soil.
***Cladonia pyxidata* (L.) Hoffm.** On charred and decaying wood and on soil.

PSORACEAE
***Protoblastenia rupestris* (Scop.) Steiner**
***Psora cerebriformis* W. Weber** South Rim.
***Psora crenata* (Taylor) Reinke** (= *Lecidea crenata*) On soil, South Kaibab Trail.
***Psora decipiens* (Hedwig) Hoffm.** On soil.
***Psora globifera* (Ach.) Massal.** On soil.
***Psora nipponica* (Zahlbr.) Gotth. Schneider** South Rim.
***Psora pseudorussellii* Timdal** On sandstone and on soil in cracks in boulders.
***Psora tuckermanii* R. Anderson ex Timdal** On soil, sandstone, and limestone.

LECIDEACEAE
***Lecidea atrobrunnea* (Ramon ex Lam. & DC.) Schaer.** On sandstone.
***Lecidea tessellata* Flörke** On sandstone and limestone.

PORPIDIACEAE
***Psorula rufonigra* (Tuck.) G. Schneider** (= *Lecidea rufonigra*, *L. brouardii, Psora rufonigra*) Bright Angel Trail.

RHIZOCARPACEAE
***Rhizocarpon* cf. *bolanderi* (Tuck.) Herre** On sandstone.
***Rhizocarpon disporum* (Nägeli. ex Hepp) Müll. Arg.** On sandstone, limestone, and shale.
***Rhizocarpon geographicum* (L.) DC.** On sandstone.

SQUAMARINACEAE
***Squamarina lentigera* (Weber) Poelt** Widespread on calcareous soils, especially gypsum in exposed areas. Reported from Lava Falls.

Suborder Lecanorineae

BIATORACEAE
***Biatora* sp.** (= *Lecidea* sp.) On sandstone and limestone.
***Biatora turgidula* (Fr.) Nyl.** (= *Lecidea turgidula*) On white fir.
***Lecania brunonis* (Tuck.) Herre** On limestone.
***Toninia candida* (Weber) Th. Fr.** On sandstone, limestone, and soil.
***Toninia* cf. *ruginosa* (Tuck.) Herre** On soil.
***Toninia sedifolia* (Scop.) Timdal** (= *Toninia caeruleonigricans*) On soil and sandstone.
***Toninia tristis* (Th. Fr.) Th. Fr.** On soil.

CANDELARIACEAE
***Candelaria concolor* (Dickson) Stein** South Rim.
***Candelariella aurella* (Hoffm.) Zahlbr.** On sandstone, shale and schist.
***Candelariella deflexa* (Nyl.) Zahlb.** On sandstone and Gambel oak.
***Candelariella rosulans* (Müll. Arg.) Zahlbr.** On siliceous and calcareous rock and Douglas fir.
***Candelariella terrigena* Räsänen** On moss.
***Candelariella vitellina* (Hoffm.) Müll. Arg.** On siliceous rock and pinyon pine.
***Candelariella xanthostigma* (Ach.) Lettau.** On Utah juniper and dead pine.

LECANORACEAE
***Hypocenomyce friesii* (Ach.) P. James & Gotth. Schneider** (= *Lecidea friesii, Psora friesii*)
***Lecanora argopholis* (Ach.) Ach.** On sandstone.
***Lecanora cenisia* Ach.** On siliceous rock.
***Lecanora crenulata* Hook.** On sandstone.
***Lecanora dispersa* (Pers.) Sommerf.** On sandstone, limestone, and shale.
***Lecanora garovaglii* (Körber) Zahlbr.** On sandstone, limestone, and shale.
***Lecanora hagenii* (Ach.) Ach.** On Douglas fir, Utah juniper, Gambel oak, and spike moss.

***Lecanora muralis* (Schreber) Rabenh.** On siliceous and calcareous rock.
***Lecanora novomexicana* (B. de Lesd.) Zahlbr.** On sandstone.
***Lecanora* cf. *opiniconensis* Brodo.** On sandstone.
***Lecanora polytropa* (Hoffm.) Rabenh.**
***Lecanora rupicola* (L.) Zahlbr.** On sandstone.
***Lecanora saligna* (Schrader) Zahlbr.** On pinyon pine, ponderosa pine, Douglas fir and *Abies* sp.
***Lecanora thallophila* Magn.** Parasitic on *Dermatocarpon*.
***Lecanora valesiaca* (Müll. Arg.) Stizenb.** On siliceous and volcanic rock.
***Lecanora varia* (Hoffm.) Ach.** On *Abies concolor*.
***Lecidella* cf. *anomaloides* (Massal.) Hertel & Kilias** On sandstone.
***Lecidella carpathica* Körber** On siliceous and calcareous rock.
***Lecidella euphorea* (Flörke) Hertel** On Gambel aok, Utah juniper, and pinyon pine.
***Lecidella patavina* (Massal.) Knoph & Leuckrt.** (= *Lecidea* cf. *alaiensis*) On calcareous rock.
***Lecidella stigmatea* (Ach.) Hertel & Leuck.** On sandstone and limestone.
***Lecidella wulfenii* (Hepp) Körber** On *Selaginella* sp. Very rare, found only on the Grandview Trail.
***Pleopsidium chlorophanum* (Wahlenb.) Zopf.** (= *Acarospora chlorophana*) Lemon-yellow lichen on acidic rocks.
***Protoparmelia badia* (Hoffm.) Hafellner** (= *Lecanora badia*) On sandstone.

PARMELIACEAE

***Bryoria fuscescens* (Gyelnik) Brodo & D. Hawksw.** On firs and Douglas-fir.
***Cetraria weberi* Essl.** On ponderosa pine, very rare, found only on North Rim.
***Flavopunctelia* cf. *darrowi* (Thomson) Hale** (= *Parmelia darrowi*, *Punctelia darrowi*) On Douglas-fir.
***Flavopunctelia soredica* (Nyl.) Hale** (= *Parmelia soredica*, *P. ulophyllodes, P. manshurica*, *Punctelia soredica*) On pinyon pine and Douglas fir.
***Letharia columbiana* (Nutt.) Thomson** On ponderosa pine. Rare, found only at the Grandview Trailhead.
***Melanelia exasperatula* (Nyl.) Essl.** (= *Parmelia exasperuatula*) On ponderosa pine.
***Melanelia fuliginosa* (Fr. ex Duby) Essl.** (= *Parmelia glabruatula*) On Utah juniper, ponderosa pine, and Douglas-fir.
***Melanelia incolorata* (Parr.) Essl.** On sandstone, moss, Gambel oak, pinyon pine, and Douglas-fir.
***Melanelia subolivacea* (Nyl. in Hasse) Essl.** (= *Parmelia subolivacea*) On ponderosa pine, pinyon pine, Utah serviceberry, Gambel oak, blue spruce, Douglas fir, white fir, subalpine fir, New Mexico locust, and Utah juniper.
***Melanelia substygia* (Räsänen) Essl.** On sandstone.
***Pseudevernia intensa* (Nyl.) Hale & Culb.** On blue spruce and Douglas fir.
***Rhizoplaca chrysoleuca* (Sm.) Zopf.** (= *Lecanora chrysoleuca, L. rubina*) South Rim. On sandstone.
***Usnea arizonica* Mot.** Pale greenish yellow fruiticose lichen on tree stems and branches.
***Usnea cavernosa* Tuck.** On Douglas fir and blue spruce.
***Usnea florida* (L.) F. H. Wigg.** Near Yavapai Point, South Rim, on trees.
***Usnea hirta* (L.) F. H. Wigg.** On pinyon pine, ponderosa pine, Utah juniper, Douglas fir, blue spruce, white fir, and subalpine fir. Found on North Rim.
***Usnea lapponica* Vainio** On Douglas-fir, blue spruce, and subalpine fir.
***Usnea subfloridana* Stirton** On Douglas-fir and blue spruce.
***Xanthoparmelia chlorochroa* (Tuck.) Hale** (= *Parmelia molliuscula*, this name is a misidentification for North America and as such, may not be an accepted species.) Cocopa Point, South Rim, Near De Motte Park, Kaibab Forest. May grow loose on soil among prairie grasses.
***Xanthoparmelia coloradoënsis* (Gyelnik) Hale** (= *Parmelia conspersa*, *Stenophylla* sp.) South Rim and North Rim, on surface limestone at Bright Angel Point. On siliceous rock.
***Xanthoparmelia cumberlandia* (Gyelnik) Hale** On siliceous rock.
***Xanthoparmelia lavicola* (Gyelnik) Hale** On sandstone.
***Xanthoparmelia lineola* (Berry) Hale** On siliceous rock.
***Xanthoparmelia mexicana* (Gyelnik) Hale** On siliceous rock.
***Xanthoparmelia plittii* (Gyelnik ex D. Dietr) Hale** On sandstone.
***Xanthoparmelia subdecipiens* (Vainio) Hale** Only found on Hermit Shale.
***Xanthoparmelia* cf. *wyomingica* (Gyelnik) Hale** On moss.

PELTULACEAE

***Peltula bolanderi* (Tuck.) Wetm.** On sandstone.
***Peltula euploca* (Ach.) Poelt** On sandstone.
***Peltula farinosa* Budel.** On calcareous rock.
***Peltula obscurans* (Nyl.) Gyelnik var. *desertícola* (Zahlbr.) Wetm.** On schist.

RAMALINACEAE

***Ramalina calicares* (L.) Fr. var. *subampliata* Nyl.** On trees, old wood, and rarely on rocks. North Rim. This specimen questionable, may not be a good species or identification.
***Ramalina sinensis* Jatta** On Douglas-fir, white fir, subalpine fir, and blue spruce.

PHYSCIACEAE

***Amandinea punctata* (Hoffm.) Coppins & Schneid.** (= *Buellia punctata* (Hoffm) Massal.) On ponderosa pine, Douglas fir, white fir, and on sandstone.
***Buellia disciformis* (Fr.) Mudd** On Utah juniper.
***Buellia erubescens* Arnold** On Douglas fir and Utah juniper.
***Buellia* cf. *novomexicana* de Lesd.** On calcareous rock.
***Buellia retrovertens* Tuck.** On sandstone, limestone, and schist
***Buellia triphragmioides* Anzi** South Rim.
***Dimelaena oriena* (Ach.) Norman** On sandstone and limestone.
***Diplotomma alboatrum* (Hoffm.) Flotow** (= *Buellia alboatra*, *Rhizocarpon alboatrum*) On sandstone, shale, and schist.
***Hyperphyscia adglutinata* (Flörke) Mayrh. & Poelt** (= *Physcia adglutinata*, *P. elaeina*, *Physciopsis adglutinata*, *P. elaeina*) On catclaw acacia and large shrubs.
***Phaeophyscia ciliata* (Hoffm.) Moberg** On Gambel oak and Utah serviceberry. ***Phaeophyscia endococcina* (Körber) Moberg** On North Rim.
***Phaeophyscia hirsuta* (Mereschk.) Moberg** On sandstone.
***Phaeophyscia nigricans* (Flörke) Moberg** On sandstone and Utah serviceberry.
***Phaeophyscia sciastra* (Ach.) Moberg** On sandstone and over moss.
***Physcia adscendens* (Fr.) H. Olivier** On Gambel oak, Douglas fir, and aspen.
***Physcia aipolia* (Ehrh. *ex* Humb.) Fürnr.** On Utah juniper, pinyon pine, and subalpine fir.
***Physcia albinea* (Ach.) Nyl.** On rocks along Bright Angel Trail.
***Physcia biziana* (Massal.) Zahlbr.** On ponderosa pine, Utah juniper, Douglas-fir, and sandstone.
***Physcia caesia* (Hoffm.) Fürnr.** On limestone, sandstone, and Douglas-fir.
***Physcia callosa* Nyl.** On pinyon pine, Utah serviceberry, and sandstone.
***Physcia dubia* (Hoffm.) Lettau** On ponderosa pine, pinyon pine, Douglas-fir, Utah juniper, cliff rose, Gambel oak, and sandstone.
***Physcia mexicana* B. de Lesd.** On Gambel oak and ponderosa pine.
***Physcia phaea* (Tuck.) J. W. Thomson** On sandstone.
***Physcia stellaris* (L.) Nyl.** On ponderosa pine, pinyon pine, Douglas-fir, subalpine fir, and Gambel oak.
***Physcia tenella* (Scop.) DC. in Lam. & DC.** On limestone, Douglas-fir, and Gambel oak.
***Physconia detersa* (Nyl.) Poelt** On Douglas-fir and mosses.
***Physconia grisea* (Lam.) Poelt** On Gambel oak, Douglas-fir, and sandstone.
***Physconia muscigena* (Ach.) Poelt** On moss.
***Physconia perisidiosa* (Erichsen) Moberg** On Douglas fir.
***Rinodina castanomela* (Nyl.) Arnold** On sandstone.
***Rinodina coloradiana* Magn.** On white fir and subalpine fir.
***Rinodina confragosa* (Ach.) Körber** On sandstone.
***Rinodina immersa* (Koerb.) Arnold** Endolithic in limestone.
***Rinodina* cf. *lignicola* Sheard** On Utah juniper.
***Rinodina zwackhiana* (Kremp.) Körber** On sandstone.

Suborder Peltigerineae

PELTIGERACEAE

***Peltigera canina* (L.) Willd.** Dog Lichen. On soil.
***Peltigera didactyla* (With.) Laundon** On North Rim.
***Peltigera rufescens* (Weis) Humb.** On soil.

NEPHROMATACEAE

***Nephroma parile* (Ach.) Ach.** North Rim. Over mosses at base of trees and on rocks in moist woods.

PANNARIACEAE

***Fuscopannaria leucophaea* (Vahl.) P. M. Jörg.** (= *Pannaria leucophaea*) South Rim. On deciduous trees, rarely on rocks, in mature forests.
***Psoroma hypnorum* (Vahl) Gray** North Rim.

COLLEMATACEAE

***Collema coccophorum* Tuck.** On soil.
***Collema furfuraceum* (Arnold) Du Rietz** On sandstone.
***Collema fuscovirens* (With.) Laundon** On limestone and soil.
***Collema polycarpon* Hoffm.** On sandstone, limestone, shale, and granite.
***Collema subflaccidum* Degel.** On soil and Douglas fir.
***Collema tenax* (Sw.) Ach.** On soil.
***Leptogium gelatinosum* (With.) Laundon** On North Rim.

PLACYNTHIACEAE

***Placynthium nigrum* (Huds.) Gray** On sandstone and calcareous rock.

Suborder Pertusariineae

PERTUSARIACEAE

***Pertusaria saximontana* Wetm.** On Utah juniper.

Suborder Teloschistineae

TELOSCHISTACEAE

***Caloplaca approximata* (Lynge) Magn.** On limestone.
***Caloplaca arenaria* (Pers.) Müll.** On sandstone and shale.
***Caloplaca arizonica* Magn.** On Gambel oak, Utah juniper, and shrubs.
***Caloplaca atroalba* (Tuck.) Zahlbr.** On sandstone.
***Caloplaca cerina* (Hedwig) Th. Fr.** South Rim.
***Caloplaca chrysophthalma* Degel.** On Douglas fir.
***Caloplaca cladodes* (Tuck.) Zahlbr.** On sandstone and limestone.
***Caloplaca decipiens* (Arnold) Blomb. & Forss.** On sandstone and shale.
***Caloplaca durietzii* Magn.** On Utah juniper and Douglas fir.
***Caloplaca epithallina* Lynge** On *Rhizoplaca melanophthalma*.
***Caloplaca holocarpa* (Hoffm. ex Ach.) Wade.** On Utah juniper and white fir.
***Caloplaca microphyllina* (Tuck.) Hasse** On catclaw acacia.
***Caloplaca modesta* (Zahlbr.) Fink** On limestone, sandstone, and schist.
***Caloplaca pellodella* (Nyl.) Hasse** On sandstone.
***Caloplaca pinicola* Magn.** On Gambel oak.
***Caloplaca saxicola* (Hoffm.) Nordin** On calcareous rock and sandstone.
***Caloplaca squamosa* (de Lesd.) Zahlbr.** On shale and calcareous rock.
***Caloplaca trachyphylla* (Tuck.) Zahlbr.** On sandstone and limestone.
***Fulgensia desertorum* (Tomin) Poelt** On soil.
***Xanthoria candelaria* (L.) Th. Fr.** On Douglas fir.
***Xanthoria elegans* (Link) Th. Fr.** (= *Caloplaca elegans*) On sandstone and limestone. South Rim.
***Xanthoria fallax* (Hepp) Arnold** On ponderosa pine, pinyon pine, netleaf hackberry, New Mexico locust, catclaw acacia, Gambel oak, and honey mesquite.
***Xanthoria polycarpa* (Hoffm.) Rieber** On ponderosa pine, pinyon pine, Douglas-fir, Utah serviceberry, white fir, subalpine fir, Gambel oak, New Mexico locust and sagebrush.

Suborder Umbilicarineae

UMBILICARIACEAE

***Umbilicaria hirsuta* (Sw. ex Westr.) Hoffm.** (= *Gyrophora hirsuta*) South Rim, Hermit Trail, base of Kaibab Limestone.
***Umbilicaria phaea* Tuck.** On sandstone.

ORDER ARTHONIALES

ARTHONIACEAE

***Arthonia glaucomaria* (Nyl.) Nyl.** Point Imperial, North Rim on *Lecanora rupicola*.

ORDER VERRUCARIALES

VERRUCARIACEAE

***Catapyrenium acarosporoides* (Zahlbr.) Thomson** On granite and limestone.
***Catapyrenium lachneum* (Ach.) R. Sant.** On soil.
***Catapyrenium plumbeum* (de Lesd.) Thomson** On sandstone.
***Catapyrenium tuckermanii* (Rav. ex Mont.) Thomson** On Utah juniper.
***Dermatocarpon miniatum* (L.) Mann** On schist, calcareous and siliceous rock, extremely common and widespread.
***Dermatocarpon moulinsii* (Mont.) Zahlbr.** On sandstone and limestone.
***Dermatocarpon reticulatum* Magn.** On sandstone and limestone.
***Endocarpon pusillum* Hedwig** On sandstone and soil.
***Staurothele areolata* (Ach.) Lett.** On sandstone and limestone.
***Staurothele drummondii* (Tuck.) Tuck.** On limestone and sandstone.
***Staurothele effigurata* Thomson** On sandstone and limestone.
***Staurothele elenkinii* Oksn.** On sandstone and limestone.
***Verrucaria* cf. *muralis* Ach.** On sandstone and limestone.

CLASS DISCOMYCETES

ORDER PEZIZALES

HELVELLACEAE

***Helvella lacunosa* Afz. ex Fr.** Fluted black helvella, bishops mitre, black-capped helvella, cinereous helvella, elfin saddle. Found in early spring in both deciduous and coniferous forests, on the ground or on decaying wood, especially in the spruce-fir forests. Not recommended for eating as the related false morels (*Gyromitra*) are known to contain toxins.

MORCHELLACEAE

***Morchella elata* Fr.** (= *M. conica*, *M. angusticeps*) Black morel, narrow-capped morel, slender-capped morel, mountain fish. On the ground in coniferous forests, especially spruce, but also aspen and pine. Found at the edges of meadows, open areas, and in forested areas recently burned. Poisonous if eaten in large quantities or consumed with alcoholic beverages. April to May, edible, but with caution.

ORDER HELOTIALES

***Cenangium ferruginosum* Fries.** Pruning twig blight fungus. A wound parasite or causing die-back of shoots and twigs, usually on fir, spruce, and pine trees.

ORDER PHACIDIALES

RHYTISMATACEAE

***Elytroderma deformans* (Weir) Darker** Needle-cast fungus. Causes needlecast of pinyon and ponderosa pines.
***Hypoderma pini* (Dearn.) Darker** Needle-cast.

CLASS LOCULOASCOMYCETES

ORDER DOTHIDEALES

DIMERIACEAE

***Dimerium juniperi* Dearness**

PHYLUM BASIDIOMYCOTA
SUBPHYLUM BASIDIOMYCOTINA
CLASS HYMENOMYCETES
SUBCLASS HOLOBASIDIOMYCETIDAE

ORDER AGARICALES

AGARICACEAE

***Agaricus bitorquis* (Quél.) Sacc.** Spring agaricus, urban agaric. On packed ground in urban areas. Edible, May to June, also September.
***Agaricus campestris* L. ex Fr.** Meadow mushroom, common field mushroom, hot-bed mushroom, pink bottom. In grassy areas, August to September, occassionally in spring, edible.
***Agaricus silvicola* (Vitt.) Pk.** Gilled mushroom, forest agaric, sylvan

mushroom, wood mushroom. Mixed conifer and deciduous forest. Not recommended as edible.

AMANITACEAE

***Amanita gemmata* (Fr.) Gill.** (*A. junquillea* may be a variant.) Gemmed amanita, crenulate amanita, jonquil amanita, destroying angel. On the ground in pine and oak woods, possibly poisonous, June to October.

***Amanita muscaria* (L. ex Fr.) Hooker** Fly agaric, false orange, fly amanita, fly-poison amanita. On the ground under pine, spruce, and mixed conifer forests, poisonous. Common name refers to it being used, when mixed with milk, to stupefy houseflies.

***Amanita pantherina* (DC. ex Fr.) Secr.** Panther. Common associate of conifers, particularly Douglas-fir, June, September to October, poisonous.

***Amanita vaginata* (Fr.) Vitt. var. *lavida* Pers.** (= *Vaganita lavida*) Club fungus. This is the brownish colored variety of the species.

***Amanita vaginata* (Fr.) Vitt. var. *vaginata* (Bull. ex Fr.) Vitt.** Grisette, conspicuously veiled vaginata, ringless amanita, sheathed amanitopsis. On the ground in open woods, under pinyon and ponderosa pine, and in grass near trees. Edible with caution, June to September.

BOLETACEAE

***Boletus edulis* Bull. ex Fr.** King bolet, cepe, edible boletus, European boletus, steinpilz. On the ground, under pine and aspen, edible, June to October.

***Boletus pinicola* (Vitt.) Rea.** Bolete. Considered to be a subspecies of *B. edulis*.

***Leccinum testaceoscabrum* (Secr.) Sing.** (= *Boletus versipellis*) Orange-cap boletus, bolete.

***Suillus granulatus* (L. ex Fr.) Kuntze** (= *Boletus granulatus*) Dotted-stalk suillus. Under spruce and pine, or ponderosa pine, especially with sagebrush understory, June to November, edible.

Suillus lakei* (Murr.) A. H. Sm. & Thiers var. *lakei (= *Boletus lakei*) Lake's boletus. On the ground under Douglas-fir, August.

CANTHARELLACEAE

***Cantharellus cibarius* Fr.** Chanterelle, edible chanterelle, egg mushoom, golden chanterelle, pfifferling, girolle, yellow chanterelle. On the ground under oaks or conifers, odor pleasant and fruity, very choice in edibility, but beware of toxic look-alikes.

***Gomphus floccosus* (Schw.) Sing.** (= *Cantharellus floccosus*) Floccose chanterellus, scaly cantherelle, shaggy chanterelle, woolly chanterelle. Under conifers or in mixed woods, edible, but not recommended.

COPRINACEAE

***Coprinus comatus* (Müll. ex Fr.) S.F.G.** Shaggy mane, horse-tail mushroom, inky egg, lawyers wig, maned agaric, shaggy beard. Scattered to clustered and common, in grass, wood chips, margins of roadways, paths, open grassy areas, and hardpacked soil, edible, May to early June, September to October.

***Coprinus micaceus* (Bull. ex Fr.) Fr.** Mica cap, common ink-cap, glistening inky cap, little inky. On stumps or wood debris, edible, April to October.

***Coprinus radians* (Desm.) Fr.** Orange-mat coprinus. Scattered on wet wood, in basements. May to October.

***Panaelous semiovatus* (Sow. ex Fr.) Lund. & Nannf.** Semi-ovate panaeolous. On horse manure.

CORTINARIACEAE

***Hebeloma hiemale* Bres.**

Inocybe decipiens Bres. The genus is generally poisonous, rich in muscarine.

***Inocybe lilacina* (Bond.) Kauff.** (= *I. geophylla* var. *lilacina*) Lilac fiber head. On the ground, under coniferous and deciduous trees, August to November. The genus is generally poisonous, being rich in muscarine.

***Inocybe sororia* Kauff.** Pungent fiber head. Under hardwoods in mixed woods. The genus is generally poisonous, being rich in muscarine.

CREPIDOTACEAE

***Crepidotus sphaerosporus* (Pat.) J. E. Lange** Occurrence of this taxon in North America is questionable. Host is spruce.

HYGROPHORACEAE

***Hygrophorus glicyclus* Fr.** Waxy cap,

***Hygrophorus pudorinus* Fr. var. *fragrans* (Murr.) Hesler & A. H. Sm.** (= *Hygrophorus fragrans*) Waxy cap, turpentine waxy cap. Under spruce, August to October.

***Hygrophorus purpurascens* (Fr.) Fr.** Waxy cap. Under conifers.

LEPIOTACEAE

***Lepiota clypeolaria* (Bull. ex Fr.) Kum.** Shaggy-stalked lepiota, shield lepiota. On the ground, in coniferous (ponderosa pine and Douglas fir), oak, and mixed woods. Poisonous.

RUSSULACEAE

***Lactarius deliciosus* (Fr.) S.F.G.** Orange-latex milky, delicious lactarius, orange-milk lactarius. Under conifers, especially pine, also common on moist but well-drained humus, edible.

***Lactarius uvidus* (Fr.) Fr.** Common violet-latex milky, grape-colored lactarius. On the ground under aspen and pine, poisonous.

***Russula chrysodacryon* Singer** Russula.

STROPHARIACEAE

***Pholiota adiposa* (Fr.) Kum.** Fatty pholiota, pineapple pholiota, sticky pholiota.

***Pholiota aurivella* (Fr.) Kum.** Golden pholiota. On living trunks and on logs of both deciduous and coniferous trees. Edible but with caution. September to November.

***Pholiota squarrosa* (Müll. ex Fr.) Kum.** Scaly pholiota, rough pholiota. Grows at the base of dead or dying hardwoods, particularly aspen, and occasionally conifers. Reported to have odor and taste of garlic, poisonous, causes severe gastric upset.

***Stropharia semiglobata* (Batsch ex Fr.) Quél.** Round stropharia, dung round head, dung stropharia, hemispheric stropharia. On horse dung, June to September, edible but not particularly tasty.

TRICHOLOMATACEAE

***Armillaria albolanaripes* Atk.** Shaggy-stalked armillaria, shaggy stem. Under conifers, summer.

***Clitocybe dilatata* Pers. ex Kar.** Crowded white clitocybe. Roadways in conifer forests, May to November, poisonous.

***Clitocybe gibba* (Fr.) Kum.** Funnel clitocybe, funnel-shaped clitocybe. Under mixed oak and pine stands, July to October, edible.

***Collybia semitale* (Fr.) Quél.** Club Fungus.

***Flammulina velutipes* (Fr.) Kar.** (= *Collybia velutipes*) Velvet foot, Christmas mushrooms, velvet-footed collybia, velvet-stem collybia, velvet-stem flammulina, winter mushroom. On decayed aspen wood, July to August, edible. Species now cultivated and sold commercially as Enotake, but looks very different from the wild mushroom.

***Lentinus lepideus* (Fr. ex Fr.) Fr.** Scaly lentinus, train-wrecker. On decaying logs and stumps of aspen and various conifers, also on fence posts and railroad ties, edible, destroys railroad ties, causing derailments.

Leucopaxillus albissimus* (Pk.) Sing. var. *albissimus White leucopax, white false paxilus, very white clitocybe. Under conifers, particularly Douglas-fir, August to October, reported to be bitter and indigestible.

***Marasmius* sp.**

***Pleurotus ostreatus* Fr.** Oyster mushroom, willow pleurotus. On deciduous trees, such as aspen, and rarely pine, sometimes on buried stumps, edible, often found for sale in supermarkets.

ORDER APHYLLOPHORALES

CLAVARIACEAE

***Clavaria purpurea* Fr.** Purple club coral, fairy clubs, purple tongues. On the ground under spruce and fir, edible, September to October.

***Clavariadelphus pistillaris* (Fr.) Donk** (= *Clavaria pistillaris*) Pestle-shaped coral, pestle-shaped clavaria, club mushroom, Indian club clavaria, large club clavaria, little war clubs. On the ground in woods, July to October, edible, though unpalatable.

CORTICIACEAE

***Peniophora rufa* (Fr.) Boid.** Red tree brain. Usually on dead twigs and branches of aspen, March to December.

GANODERMATACEAE

***Ganoderma applanatum* (Pers. ex Wall.) Pat.** (= *Fomes applanatus*) Artist's conk, artist's fungus, plane brown ganoderma. On dead wood, especially of deciduous trees, but reported on conifers and wounds in living trees.

HYDNACEAE

***Echinodontium tinctorium* Ell. & Ev.** (= *Fomes tinctorius*) Indian paint fungus. On coniferous woods, causes white heartrot of living conifers. Common name refers to fact that Indians used this mushroom to make red war paint. It can be used as a yarn dye.

***Hydnum imbricatum* Fr.** Scaly tooth, imbricated hydnum, scaly hydnum, shingle cap. Fruits abundantly on the ground in coniferous, deciduous, and mixed woods. Edible but varies in taste from mild to unpleasant, June to October.

***Hydnum sauveolens* Fries.** Tooth.

POLYPORACEAE

***Albatrellus ellisii* (Berk.) Pouz.** (= *Polyporus ellisii*) Scaly yellow polypore. On the ground in mixed woods, September to October.

***Bjerkandera adusta* (Fr.) Kar.** (= *Polyporus adustus*) Smoky polypore. On dead deciduous and coniferous wood.

***Cryptoporus volvatus* (Pk.) Hub.** (= *Polyporus volvatus*) Veiled polypore. On living and dead conifers, May to August.

***Daedalea juniperina* Murr.** Thick-maze juniper polypore. On dead juniper, very rare.

***Fomes juniperinus* (Von Sch.) Sacc. & Syd.**

***Fomes texanus* (Murrill) Hedec. & Long** Polypore.

***Gloeophyllum sepiarium* (Fr.) Kar.** (= *Lenzites saepiaria*) Yellow-red gill polypore, chocolate lenzites. On dead conifers, reported on hardwoods, June to November.

***Inonotus dryophilus* (Berk.) Murr.** (= *Polyporus dryophillus*) Polypore.

***Inonotus tomentosus* (Fr.) Gilbertson & Buddington** (= *Polyporus tomentosus*) Polypore.

***Phaeolus schweinitzii* (Fr.) Pat.** (= *Polyporus schweinitzii*) Dye Polypore. On roots, stumps, or trunks of conifers, also reported on some deciduous trees. Young mushrooms are often brightly colored and can produce dyes of many colors. Causes a serious heart rot in conifers, especially abundant in ponderosa pine and Douglas-fir.

***Phellinus demidoffii* (Lév.) Bond. & Sing.** (= *Fomes demidoffii*) Polypore.

***Phellinus igniarius* (Fr.) Quél.** Flecked-flesh polypore, false clinker fungus. On living or dead deciduous trees, especially aspen.

***Phellinus rimosus* (Berk.) Pil.** (= *Poria rimosa, Fomes rimosus, Polyporus rimosus*) Cracked fomes, cracked-cap polypore, polypore. On living or dead locust.

***Phellinus robustus* (Karst.) Bourdot & Galzin.** (= *Fomes robustus*) Polypore. Grows on oak.

***Polyporus abietinus* Dickson ex Fries.** Fir polypore.

***Polyporus anceps* Pk.** Polypore.

***Polyporus arcularius* Bat. ex Fries.** Spring polypore, angular-pored polypore. On dead deciduous wood; on ground over buried wood, May to June.

***Polyporus fibrillosus* Karst.** Polypore.

***Polyporus hirtus* Quél.** (= *Coriolus hirsutus*) Bitter iodine polypore. Near trees and stumps, attached to buried wood, especially in fir, spruce, and Douglas-fir forests, September to March.

***Polyporus leucospongia* Cke. Et Harkn.** On white fir at Robbers Roost and Point Imperial, North Rim, associated with a brown rot.

***Polyporus planellus* (Murr.) Overh.** Polypore

***Polyporus subchartaceus* (Murr.) Overh.** Polypore. On quaking aspen at Robber's Roost and Cape Royal, North Rim, associated with white rot.

***Polyporus varius* Fr.** Elegant polypore, black-footed polypore. On dead deciduous wood, also reported on pine, June to November.

***Poria andersonii* (Ellis & Everh.) Neuman.** Polypore.

***Poria ferox* Long.** Polypore.

***Poria medulla-panis* (Jacq. *ex* Fr.) Bres.** (= *Fomes unita, Perenniporia medulla-panis*) Polypore.

***Poria subacida* (Pk.) Sacc.** Polypore.

***Poria taxicoa* (Pers.) Cke.** On ponderosa pine at Neal Spring campground, North Rim.

***Poria tenuis* (Schw.) Cke.** Polypore.

***Poria xantha* (Fr.) Cke.** Polypore.

***Pycnoporellus alboluteus* (Ell. & Ev.) Kotl. & Pouz.** Orange sponge polypore. Wood-decay fungus on lower surfaces of downed fir and spruce logs in early spring at the edge of melting snowbanks, July to October.

***Pycnoporus cinnabarinus* (Fr.) Kar.** (= *Polyporus cinnabarinus)* Cinnabar-red polypore, cinnabar polyporus. On dead deciduous wood, reported on coniferous wood.

***Spongiporus leucospongia* (Cke. & Hark.) Murr.** White spongy polypore. On old logs and stumps of conifers, such as pine, spruce, and Douglas-fir, August to November.

***Trametes hispida* Baglietto.** Polypore.

***Trametes peckii* Kalchbr. apud Pk.** Polypore.

***Trichaptum biformis* (Fr. in Kl.) Ryv.** (= *Coriolus biformis*, *Polyporus biformis*, *Hirschioporus pargamenus*) Violet-toothed polypore. On dead deciduous wood, also reported on conifers, May to December.

SPARASSIDACEAE

***Sparassis radicata* Weir.** On ground under conifers, North Rim.

SCHIZOPHYLLACEAE

***Schizophyllum commune* Fr.** Common split gill, split-gilled bracket. Common on dead branches of deciduous trees.

STEREACEAE

***Columnocystis abietinum* (Pers. ex Fr.) Pouz.** (= *Stereum abietinum*) Fir stereum. On fir trees.

SUBCLASS PHRAGMOBASIDIOMYCETIDAE

Order Tremellales

AURICULARIACEAE

***Auricularia quercina* (Pk.) Hoehn.** Little ear, Judas' ear, Jew's ear fungus.

CLASS GASTEROMYCETES

Order Lycoperdales

GEASTRACEAE

***Geastrum recolligens* (Woodward ex Sow.) Desvaux.** Earthstar, earth star, star puff ball.

LYCOPERDACEAE

***Bovista* sp.** Puffball. Pastures, around stables, and in open woods. June to October.

Order Nidulariales

NIDULARIACEAE

***Crucibulum laeve* (Huds.) Kamb.** White-egg bird's nest, bird's nest fungus. Inedible, but probably not poisonous. On dead wood and debris such as elderberry branches, old berry canes, fallen branches of willow trees, and old sawdust piles.

Order Sclerodermatales

ASTRAEACEAE

***Astreus hygrometricus* (Pers.) Morg.** Barometer earthstar, water-measuring earth-star. Poor or sandy soils of open meadows, road margins and exposed sites. Not edible because of the consistency.

Order Uredinales

COLEOSPORIACEAE

***Coleosporium crowelli* Cummins** Rust. Found on pinyon pine.

***Coleosporium jonesii* (Pk.) Arth.** Rust.

MELAMPSORACEAE

***Chrysomyxa arctostaphyli* Diet.** Rust on manzanita.

***Chrysomyxa pyrolae* (DC.) Rostr.** Rust on spruce and wintergreen.

***Cronartium coleosporioides* Arth.** Rust.

***Melampsora abieti-carpaearum* Tub.** Rust on white fir, subalpine fir, and willow.

***Melampsora albertensis* Arth.**
***Melampsora lini* (Ehrenb.) Lev.** Rust on flax species.
***Melampsora medusae* Thum.** Rust on aspen.
***Melampsora monticola* Mains.** Rust on Euphorbiaceae.
***Melampsorella cerastii* (Pers.) Schroet.** (= *Melampsorella caryophyllacearum*) Rust on fir and spruce species.
***Peridermium ephedrae* [Authority not known]** Rust on Nevada and mountain joint-fir species with secondary host a fern.
***Pucciniastrum pyrolae* Diet. ex Arth.** Rust on wintergreen species.
***Uredinopsis macrosperma* Diet. ex Arth.** (= *Uredinopsis pteridis*) Rust on fir species and bracken fern.

PLEOSPORACEAE
***Herpotrichia nigra* Hartig.** Brown felt blight fungus.
***Phleospora robiniae* (Lib.) Hoehn.** Leaf spot fungus.

PUCCINIACEAE
***Cumminsiella sanguinea* (Peck) Arthr.** (= *Cumminisiella mirabilissima*) Rust.
***Gymnosporangium inconspicuum* Kern.** Rust.
***Gymnosporangium kernianum* Bethel.** Rust.
***Gymnosporangium multiporum* Kern.** Rust.
***Gymnosporangium nelsonii* Arth.** Rust.
***Gymnosporangium speciosum* Peck.** Rust.
***Phragmidium montivagum* Arth.** Rust on rose species.
***Phragmidium peckianum* Arth.** Rust on blackberry species.
***Phragmidium rubi-idaei* (DC.) Karst.** Rust on blackberry species.
***Puccinia aemulans* Syd.** Rust.
***Puccinia cirsii* Lasch.** Rust.
***Puccinia crandallii* Pam. & Hume** Rust.
***Puccinia dioicae* P. Magn.** Rust.
***Puccinia grindeliae* Pk.** Rust.
***Puccinia monoica* Arth.** Rust.
***Puccinia poae-nemoralis* [Authority not known]** Rust.
***Puccinia pseudocymopteri* Holw.** Rust.
***Puccinia pulverulenta* Grev.** Rust.
***Puccinia pygmaea* Eriks.** Rust.
***Puccinia recondita* Rob. ex Desm.** Rust.
Puccinia stipae* Arth. var. *stipae Rust.
***Puccinia strum epilobii* Otth.** Rust.
***Puccinia substerilis* Ell. & Ev.** Rust.
***Puccinia tanaceti* DC.** Rust.
***Tranzschelia thalictri* (Chev.) Diet.** Rust on meadow rue.
***Uromyces prominens* (DC.) Pass.** (= *Uromyces euphorbiae*) Rust.
***Uromyces fabae* (Pers.) de Bary.** (includes *Uromyces viciae-fabae*) Rust.
***Uromyces intricatus* Cke.** Rust.
***Uromyces suksdorfii* Diet & Holw.** Rust.

CLASS TELIOMYCETES

ORDER USTILAGINALES
***Cintractia caricis* (Pers.) Magn.**

PHYLUM DEUTEROMYCOTINA
FUNGI IMPERFECTI

***Lepraria incana* (L.) Ach.** On sandstone.
***Lepraria neglecta* (Nyl.) Erichsen** Over moss on sandstone.

CLASS HYPOMYCETES

DEMATIACEAE
***Cercospora coleosanthi* Ell. & Ev.** Leafspot fungus.

CLASS COELOMYCETES

***Gloeocoryneum* (Dearn.) J. Weindlymayr** (= *Coryneum cinereum*) Needle-blight fungus.

ORDER MELANCONIALES
***Marssonina populi* (Lib.) Magn.** Leaf spot fungus on aspen and willow.
***Pestalotia stevensonii* Peck.** Needle-blight fungus.

KINGDOM PLANTAE

PHYLUM BRYOPHYTA
CLASS MUSCOPSIDA

AMBLYSTEGIACEAE
***Amblystegium juratzkanum* Schimp.** On moist rocks, soil, and rotten logs, usually in shade.
***Amblystegium noterophilum* (Sull.) Holz.** On moist rocks below Roaring Springs cave opening. New Record for Grand Canyon.
***Campylium chrysophyllum* (Brid.) J. Lange** On soil, humus, rocks, and tree bases, usually in shady places and often scattered among other mosses. Reported from Havasu Canyon in springs.
***Cratoneruron filicinum* (Hedw.) Spruce** On wet calcareous soil, rocks, and logs or submerged in springs, brooks, ponds, or swamps.
***Hygroamblystegium irriguum* (Hook. & Wils.) Loerke** (not *Amblystegium irriguum*)
***Hygroamblystegium orthocladon* (P.-Beauv.) Grout.** Vasey's Paradise on rocks splashed by water and growing under water near village in Havasu Canyon.

BARTRAMIACEAE
***Philonotis capillaris* Lindb.** Vasey's Paradise.
***Philonotis fontana* (Hedw.) Brid.** North Rim, 8,200 ft and above. On soil and rock in wet places and seeps, sometimes in water.

BRACHYTHECIACEAE
***Eurhynchium hians* (Hedw.) Sande Lac.** On soil.
***Rhynchostegium riparioides* (Hedw.) Card.** (= *Eurhynchium rusciforme, Platyhypaelin riparioides*) CRM 26.5 in Marble Canyon, Elves' Chasm at water's edge; Ribbon Falls, Bright Angel Canyon.
***Scleropodium cespitans* (C. Muel.) L. Koch. var. *sublaeve* Ren. & Card. ex Roll.** Tentative reidentification of specimen formerly identified as *Myurella tenerrima*. Found on logs, tree roots, and rocks.

BRYACEAE
***Bryum argenteum* Hedw. var. *lanatum* (P.-Beauv.) B.S.G.** North and South Rims, canyon bottom to 8,200 ft and above. On dry or moist soil, rock, brick walls, sidewalks, and shingle roofs.
***Bryum caespiticium* Hedw.** North and South Rims, canyon bottom to 8,200 ft and above. On damp or rather dry soil, often in disturbed places.
***Bryum gemmiparum* De Not.** Cronac. South Rim, 4,000 to 7,000 ft. On wet, calcareous soil and rocks.
Bryum lonchicaulon C. M. (= *B. cirratum*) South Rim, 4,000 to 7,000 ft.
***Bryum pallens* (Brid.) Sw. ex Roehl.** North Rim, 8,200 ft and above. On damp or wet soil.
***Bryum turbinatum* (Hedw.) Turn.** North Rim, canyon bottom to 4,000 ft. On wet soil and rocks, especially on banks, in seepage areas, dripping cliffs, frequently emergent in water, less frequently on damp soil away from water, usually in the mountains.
***Leptobryum pyriforme* (Hedw.) Wils.** On wet or damp soil, rotten wood, humus, or rocks in moist places, especially on disturbed soil. Also found as a weed in greenhouses.

DITRICHACEAE
***Ceratodon purpureus* (Hedw.) Brid.** North Rim, 4,000 to 8,200 ft., South Rim 7,000 to 8,200 ft. Common on exposed, sterile soils, soon drying out. Also found on rock walls, sidewalks, lawns, along streams or in seepage areas, and open places in thickets or woods.
***Ceratodon purpureus* (Hedw.) Brid. var. *xanthopus* (Sull.) E. G. Britt.** North Rim, 8,200 ft and above.
***Distichium capillaceum* (Hedw.) B.S.G.** North Rim, 8,200 ft. and above. In cool rocky places on rocks, wet or damp substrata, stream banks, rotten logs, rocks, seepage areas, and dripping cliffs, often in crevices.

ENCALYPTACEAE

***Encalypta vulgaris* Hedw. var. *mutica* Brid.** North and South Rims 7,000 ft and above. In crevices and on soil, even on tops of barren windswept peaks.

FISSIDENTACEAE

***Fissidens sublimbatus* Grout.**

FUNARIACEAE

***Funaria hygrometrica* Hedw.** North and South Rims, 7,000 to 8,200 ft. In waste places and on bare soil, under rocks and bases of bushes and ttrees where water drains or drips during winter and spring, wet oil, in crevices of dripping cliffs, often where fires have occurred, and in gardens, lawns, and in greenhouses. Reported in Havasu Canyon in springs.

***Funaria muhlenbergii* Turn.** Conquistador Aisle. On dry soil, often in saline regions, around bases of shrubs, among grasses, and at bases of rocks and cliffs.

GRIMMIACEAE

***Grimmia alpicola* Hedw.** North Rim, 8,200 ft and above. On dry or wet siliceous and ferromagnesian rocks, occasionally on limestone, often in dry exposed places.

***Grimmia anodon* B.S.G.** South Rim, 7,000 to 8,200 ft. On dry rocks of various kinds, soil, or soil over rocks.

***Grimmia apocarpa* Hedw.** (includes *Ceratodon apocarpa* and *C. pulvinata*) North and South Rims, 4,000 to 7,000 ft. On rocks, usually in dry, exposed places, commonly in shade.

***Grimmia apocarpa* Hedw. var. *atrofusca* (Sch.) Husn.** North Rim, 8,200 ft and above.

***Grimmia apocarpa* Hedw. var. *conferta* (Funck.) Spreng.** North Rim, 8,200 ft and above. On dry rocks.

***Grimmia apocarpa* Hedw. var. *gracilis* (Schleich.) Web. & Mohr.** North Rim, 8,200 ft and above.

***Grimmia apocarpa* Hedw. var. *pulvinata* (Hedw.) Jones** North Rim, 4,000 ft to 8,200 ft.

***Grimmia calyptrata* Hook. ex Drumm.** North and South Rims, 4,000 to 7,000 ft. On dry rocks of various kinds.

***Grimmia decipiens* (Schultz) Lindb.** South Rim, canyon bottom to 4,000 ft.

***Grimmia dupretii* Thér.** North Rim, 8,200 ft and above. On various kinds of rocks, usually in the shade.

***Grimmia montana* B.S.G.** North Rim of Grand Canyon. On dry rock and soil over rock, usually in the mountains.

***Grimmia ovalis* (Hedw.) Lindb.** (= *G. commutata*) North and South Rims, 4,000 to 8,200 ft and above.

***Grimmia pilifera* P.-Beauv.** On various kinds of rocks, rarely on decaying wood.

***Grimmia plagiopoda* Hedw.** North and South Rims, 7,000 to 8,200 ft and above. On rock and soil over rock.

***Grimmia pulvinata* (Hedw.) Sm.** North and South Rims, 4,000 to 8,200 ft and above. On rocks, often siliceous, and on concrete walls.

***Grimmia trichophylla* Grev.** CRM 26.5 in Marble Canyon, Tanner Rapids among boulders, near Bass Trail on rocks covered with sand, and dry walls of Spencer Canyon.

***Racomitrium heterostichum* (Hedw.) Brid var. *sudeticum* (Funck) Dix. ex Bauer** North Rim, canyon bottom to 4,000 ft. On rocks, rotten wood, tree trunks, and rail fences.

ORTHOTRICHACEAE

***Orthotrichum alpestre* Hornsch. ex B.S.G.** South Rim, 4,000 to 7,000 ft. On dry rocks and trunks of trees in canyons and mountains.

POLYTRICHACEAE

***Atrichum undulatum* (Hedw.) P.-Beauv.** North Rim, 7,000 to 8,200 ft.

***Polytrichum juniperinum* Hedw.** North Rim, 7,000 to 8,200 ft. On soil and rocks, usually in dry, exposed to partially shaded places.

POTTIACEAE

***Barbula ehrenbergii* (Lor.) Fleisch.** On moist, shaded calcareous rocks, or around springs and streams rich in calcium, often submerged and frequently encrusted with calcium carbonate. Emory Falls, seep 2 miles above Emory Falls, Mooney Falls in Havasu Canyon

***Barbula unguiculata* Hedw.** South Rim, canyon bottom to 4,000 ft. On calcareous soil and rocks, in old fields, waste places, disturbed soil, and edges of creeks and streams.

Bryoerythrophyllum recuvirostre* (Hedw.) Chen. var. *recurvirostre (= *Didymodon recuvirostris*) North Rim, 7,000 to 8,200 ft. On wet or damp soil and rocks, particularly along streams and around seepage areas, but not uncommon on soil under overhanging rocks sometimes where it is quite dry. Favors calcareous rocks and soil, but also frequent in regions of siliceous and ferromagnesian rocks.

***Desmatodon convolutus* (Brid.) Grout.** North Rim, 7,000 to 8,200 ft. On soil and in crevices of rocks, usually in dry places of deserts, valleys, and hillsides. Tolerates mildly saline conditions.

***Desmatodon obtusifolius* (Schwaegr.) Schimp.** North Rim, 7,000 to 8,200 ft. On wet or dry soil and rocks, usually in shaded places, under overhanging rocks, frequent around streams, springs, or waterfalls, and stone walls.

***Didymodon mexicanus* Besch. var. *subulatus* Thér. & Bartr. ex Bartr.** Conquistador Aisle.

***Didymodon tophaceus* (Brid.) Lisa.** South Rim, canyon bottom to 4,000 ft. Growing on wet calcareous rocks and soil, frequently on concrete installations, around springs and dripping cliffs. Reported from 2 miles above Emory Falls.

***Didymodon trifarius* (Hedw.) Roehl.** Questionable identification, name has been misapplied to three different taxa. On wet soil, rocks, and wood in springs, and along streams, in calcareous regions. Reported from Havasu Canyon.

***Eucladium verticillatum* (Brid.) B.S.G.** On wet, mostly calcareous rocks, soil, or wood, particularly around springs, dripping cliffs, and brooklets in calcareous regions. Reported from President Harding Rapid in Marble Canyon and Havasu Canyon.

***Gymnostomum recurvirostrum* Hedw.** On shaded calcareous cliffs or rocks where seepage is common, sometimes on sandstone containing very little calcium.

***Husnotiella pringlei* (E. G. Britt.) Grout.** North Rim, 8,200 ft and above.

***Pleurochaete squarrosa* (Brid.) Lindb.** North Rim, canyon bottom to 4,000 ft. On soil and soil over calcareous rocks, especially of cedar barrens and glades. Bed Rock Rapids, Vasey's Paradise, and Havasu Canyon.

***Pseudocrossidium crinitum* (Schulz) Zand.** (= *Tortula aurea* Bartram, *P. aureum*) Conquistador Aisle on dry soil.

***Pteryogoneurum ovatum* (Hedw.) Dix.** South Rim, 4,000 to 7,000 ft. On dry soil and crevices of rocks, commonly in foothills, plains, or saline deserts.

***Syntrichia obtusissima* (C. Muell.) Zand.** (= *Tortula obtusissima* (C. Muell.) Mitt.) Conquistador Aisle.

***Syntrichia ruralis* (Hedw.) Web. & Mohr.** (= *Tortula ruralis* (Hedw.) Gaertn.) North and South Rims, canyon bottom to 8,200 ft and above. On soil, rocks (often calcareous), bases of trees, in damp shady places to very dry exposed situations. Reported from Deer Creek Falls and dry walls in Spencer Canyon.

***Tortula atrovirens* (Sm.) Lindb.** Dry talus slope in Havasu Canyon.

***Tortula inermis* (Brid.) Mont.** CRM 26.5 in Marble Canyon and common in seepage area below Deer Creek Falls.

***Tortula mucronifolia* Schwaegr.** North Rim, 7,000 to 8,200 ft and South Rim, 4,000 to 7,000 ft. On soil and rock.

***Weissia andersoniana* Zand.** (= *W. glauca*). Rowe's Well, South Rim at 6600 ft.

***Weissia andrewsii* Bartr.** North Rim, 4,000 to 7,000 ft, and South Rim, canyon bottom to 7,000 ft.

RICCIACEAE

***Riccia fluitans* L.** Reported from stream and irrigation ditches above village in Havasu Canyon.

TIMMIACEAE

***Polytrichum piliferum* Hedw.** (= *Timmia piliferum*)

***Timmia megapolitana* Hedw. var. *bavarica* (Hessl.) Brid.** (= *Timmia bavarica*) North Rim, 7,000 to 8,200 ft. On moist to wet shaded humus or soil, decaying wood, especially along streams.

LITERATURE CITED

Arthur, J.C. 1962. Manual of the rusts in United States and Canada. Hafner Publishing Co., New York.

Arora, D. 1986. Mushrooms demystified: A comprehensive guide to the fleshy fungi. Second Edition. Ten speed Press, Berkeley, CA.

Bell, R.A., P.V. Athey, and M.R. Sommerfeld. Endolithic algae. Southwestern Naturalist 33:315-322.

Bland, J.H. 1971. Forests of Lilliput: The realm of mosses and lichens. Prentice-Hall, Inc., Englewood Cliffs, NJ, 210 pp.

Blinn, D.W., C. Pinney, R. Truitt, and A. Pickart. 1986. Examination of the influence of elevated temperture on epiphytic diatom species in the tailwaters of Glen Canyon Dam and the importance of these epiphytic diatoms in the diet of *Gammarus lacustris*. Preliminary rpeort submitted to the Bureau of Reclamation. 8 pp.

Blinn, D.W., and G.A. Cole. 1991. Algal and invertebrate biota in the Colorado River: Comparison of pre- and post-dam conditions. In: National Research Council (editors), Colorado River Ecology and Dam Management. National Academy Press, Washington, D.C., pg. 102-123.

Boykin, M.A. 1993. Floristics and elemental concentrations of lichens from Grand Canyon National Park, Arizona. Master's Thesis, Arizona State University. Contract to Grand Canyon National Park PX8210-1-0717, 68 pp.

Boykin, M.A., and T.H. Nash, III. 1994. The lichen flora of Grand Canyon National Park, Arizona. Journal of the Arizona-Nevada Academy of Science 28:59-69.

Clover, E.U., and L. Jotter. 1944. Floristic studies in the Canyon of the Colorado and tributaries. American Midland Naturalist 32:591-642.

Czarnecki, D.B., D.W. Blinn, and T. Tompkins. 1976. A periphytic microflora analysis of the Colorado River and major tributaries in Grand Canyon National Park. Colorado River Research Program Publication No. 6, 106 pp.

Czarnecki, D.B. and D.W. Blinn. 1978. Diatoms of the Colorado River in Grand Canyon National Park and vicinity. Bibliotheca Phycologica, Band 38, J. Cramer, Germany, 181 pp.

Crayton, W.M., and M.R. Sommerfeld. 1979. Composition and abundance of phytoplankton in tributaries of the Lower Colorado River, Grand Canyon Region. Hydrobiologia 66:81-93.

Dennis, R.W.G. 1981. British Ascomycetes. Strauss and Cramer, Germany.

Egan, R.S. 1987. A fifth checklist of the lichen-forming, lichenicolous, and allied fungi of the Continental United States and Canada. The Bryologist 90:77-173.

Esslinger, T.L., and R.S. Egan. 1995. A sixth checklist of the lichen-forming, lichenicolous, and allied fungi of the Continental United States and Canada. The Bryologist 98:467-549.

Farr, D.F., G.F. Bills, G.P. Chamuris, and A.Y. Rossman. 1989. Fungi on plants and plant projects in the United States. APS Press, St. Paul, MN, 1252 pp.

Flower, S. 1973. Mosses: Utah and the West. Brigham Young University Press, Provo, UT, 567 pp.

Gilbertson, R.L., and Budington, A.B. 1970. New records of Arizona wood-rotting fungi. Journal of the Arizona Academy of Science 6(2):91-97.

Hale, M.E., and Culberson, W.L. 1970. A fourth checklist of the lichens of the continental United States and Canada. The Byrologist 73:499-543.

Hanlin, R.T., and M. Ulloa. 1988. Atlas of introductory mycology. Second Edition. Hunter Textbooks, Inc.

Haring, I.M. 1941. Mosses of the Grand Canyon National Park. The Bryologist 44:122-125.

Haring, I.M. 1946. Mosses of the Grand Canyon National Park—II. The Bryologist 49:90-96.

Hawbecker, A.C. 1936. Check-list of plants of the Grand Canyon National Park, Bulletin No. 6. Revised edition, 75 pp.

Hibbard, H.V. 1928. The *Geaster* or earthstar. Grand Canyon Nature Notes 3:2-3.

Inch, D.C. and D.W. Blinn. 1979. Limnology of Little Park Lake and diatom distribution on the Kaibab Plateau, Arizona. Journal of the Arizona-Nevada Academy of Science 16:14-21.

Johnsen, A.B. 1978. Keys to the mosses of Arizona. Museum of Northern Arizona, MNA Research Paper 14, Biology Research Report 1, 45 pp.

Keener, P.D. 1956. Two fungi associated with a microcyclic rust, *Coleosporium crowelli* Cummins, on needles of *Pinus edulis* Engelm. in Arizona. Madroño 13:189-195.

Keener, P.D. 1957. Fungi of Grand Canyon National Park. Unpublished ms. on file in Grand Canyon Museum Collections, 27 pp.

Lincoff, G.H. 1998. The Audubon Society field guide to North American Mushrooms. Second Edition, Alfred A. Knopf, New York, 498 pp.

McCleary, J.A. 1953. Additions to the Arizona moss flora. The Bryologist 56:121-126.

McCleary, J.A. 1954. Notes on Arizona mosses – Pottiaceae. The Bryologist 57: 238-241.

McDougall, W.B. 1947a. Plants of Grand Canyon National Park. Bulletin No. 10, Grand Canyon Natural History Association, Grand Canyon, AZ, 126 pp.

McDougall, W.B. 1947b. Plants of Grand Canyon National Park. Bulletin No. 10, Addendum to Checklist of Plants of Grand Canyon National Park, pages 106-107, Grand Canyon Natural History Association, Grand Canyon, AZ, 126 pp.

McDougall, W.B. 1948. Plants of Grand Canyon National Park. Bulletin No. 10 Supplement, July 1948. Grand Canyon Natural History Association, Grand Canyon, AZ, 8 pp.

McKee, E.D. 1929. Grand Canyon lichens. Grand Canyon Nature Notes 4:27-29.

Mills, L.E. 1929. Mushrooms on the Kaibab. Grand Canyon Nature Notes 4:3-4.

Miekle, J.L. 1946. Observations on *Coleoporium crowelli*. The Plant Disease Reporter 30:422-423.

Miller, O.K., Jr., and D.F. Farr. 1975. An index of the common fungi of North America (synonymy and common names). Bibliotheca Mycologica, J. Cramer, Germany.

Mills, L.E. 1929. Mushrooms on the Kaibab. Grand Canyon Nature Notes 4:3-4.

Pady, S.M. 1942. Distribution patterns in *Melampsorella* in the national forests and parks of western states. Mycologica 34:612-613.

Raven, P.H., R.F. Evert, and H. Curtis. 1981. Biology of Plants. Worth Publishers, Inc., New York, 686 pp.

Sommerfeld, M.R., W.R. Crayton, and N.L. Crane. 1976. Survey of phytoplankton, bacteria, and trace chemistry of the lower Colorado River and tributaries in the Grand Canyon National Park. Technical Report No. 12, Contribution No. 40, NTIS, Springfield, VA, 131 pp.

Spence, J.R. 1988. Checklist of the mosses of the Intermountain West, USA. Great Basin Naturalist 48:394-401.

States, J.S. 1990. Mushrooms and truffles of the Southwest. The University of Arizona Press, Tucson, AZ.

Stolte, K. et al. 1993. Lichens as bioindicators of air quality. General Tech. Rep. RM-224. Fort Collins, CO, USDA-Forest Service, 131 pp.

Weber, S.A., and P.D. Seaman (editors). 1985. Havasupai habitat: A. F. Whiting's ethnography of a traditional Indian culture. University of Arizona Press, Tucson, AZ, 288 pp.

Webster, J. 1980. Introduction to fungi. Second Edition. Cambridge University Press, Cambridge, England, 669 pp.

INDEX OF COMMON NAMES

INDEX OF SCIENTIFIC NAMES

***** indicates genus name is a synonym on these pages

APPENDIX

Number of Non-Vascular Plant Species of Grand Canyon National Park and Vicinity

Kingdom	Nominal Epithets	Genus Only[1]	Extralimital Species[2]	Proposed Species[3]
Monera	87	11	1	0
Protista	360	24	22	11
Fungi	371	3	0	0
Plantae (Bryophyta)	69	0	0	0
TOTAL	887	38	23	11

[1]Taxa identified only to genus
[2]Presently known only outside of, but adjacent to, Grand Canyon National Park
[3]Taxa recognized to be new but are as yet undescribed

NOTULAE NATURAE OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA
Published by The Academy of Natural Sciences of Philadelphia, 1900 Benjamin Franklin Parkway, Philadelphia PA 19103-1195, USA
Earle E. Spamer, *Editor*