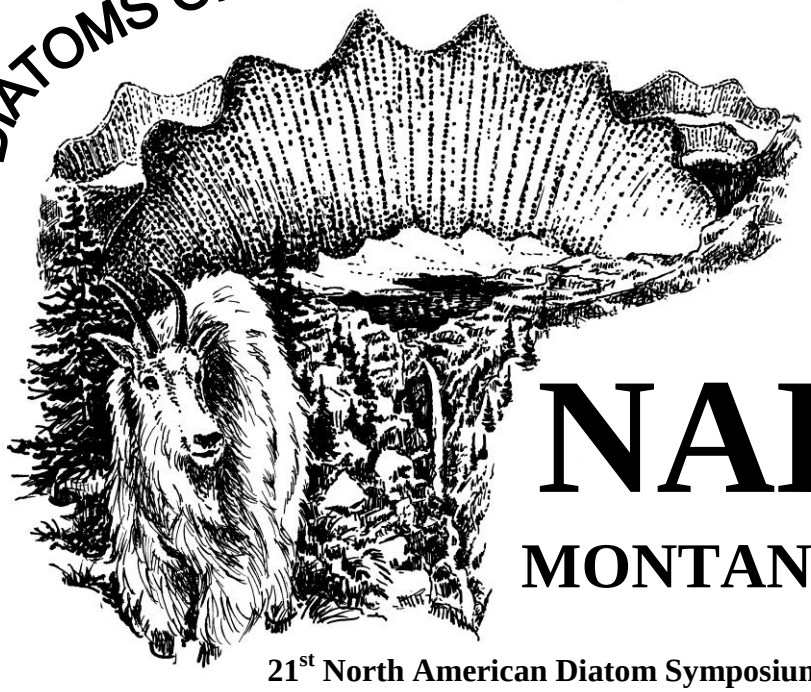
DIATOMS ON THE CROWN OF THE CONTINENT



NADS

MONTANA 2011

21st North American Diatom Symposium
Flathead Lake Biological Station
Polson, Montana
September 14-18, 2011

AATA International, Inc. (formerly Advanced Aquatic Technology Associates, Inc.) was founded in 1989 by long time NADS supporter and limnologist, John G. Aronson, President. AATA is an international environmental and social management, permitting, and technical services consultancy with experience throughout the USA and in nearly 50 countries worldwide. We use our knowledge of diatom ecology to help assess the conditions of rivers, lakes, streams, and estuaries around the globe. AATA International, Inc., 2240 Blake Street, Suite 210, Denver, Colorado, USA 80205. 720-974-2550.
John.Aronson@AATA.com,
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Welcome from the Organizing Committee:

Welcome to NADS 2011!

The North American Diatom Symposium (NADS) is a biennial meeting normally held at field stations throughout the United States and Canada. The meeting was first held in 1970 at Cedar Creek in Minnesota. Since that date, the gathering has been hosted at field stations in Florida, Colorado, Manitoba, Kentucky, Alabama, Ohio, Minnesota, Iowa, Wisconsin, and Michigan. The meeting provides a student friendly atmosphere, ample opportunities to network and socialize, the ever-popular scum run, local field collecting trips, and lively auction of diatom related valuables.

This year's meeting will focus on "Diatoms on the Crown of the Continent". A special lecture discussing the natural history of the area will be presented by Dr. R. Graetz, University of Montana. Plenary speakers will include Dr. R. Crawford, P. Hamilton and Bonnie Ellis. In addition, our local expert, Dr. L. Bahls, will be leading a field trip on Sunday to explore Glacier National Park.

Thanks for joining us!

From the 2011 Organizing Committee:

Loren Bahls, local diatom aficionado and the person to blame for the idea of volunteering to do this
Diane Winter, the one who sent you all those annoying e-mails asking you to pay up
Dennis Vander Meer, the suspicious looking fellow in the corner
Sarah Hamsher, the illustrious and magnificent web mistress
Avery Cook Shinneman, program designer extraordinaire
Chuck Stapleton, the go-to guy for help with last minute details

With additional thanks to:

Matt Julius and his merry maniacal misfits for the madcap adventures of the Scum Run
Mark Edlund and his auction-tastic crew for his amazing, and lucrative, auctioneering skills
Sue Gillespie, the FLBS Associate Director of Operations for making the whole meeting happen
The brave and intrepid field trip drivers: Frank Pickett, Rikki Wagstrom, Virginia Card, and Chuck Stapleton
Erich Weber for the design of this year's logo.

Quick-look Schedule - full schedule, page 9

Wednesday		Thursday		Friday		Saturday		Sunday	
	7:15	Breakfast & Registration	7:15	Breakfast	7:15	Breakfast	7:15	Breakfast	
	8:15		8:15		8:15		8:15		
	8:30	Opening Remarks - Ric Hauer	8:30	Plenary - Paul Hamilton	8:30	Plenary - Bonnie Ellis	8:30	Field trip departure	
	9:00	Plenary - Dick Crawford	9:30	*Research Resources* Charles	9:30	*Local history* Bahls			
	10:00								
	10:00 - 10:20	Coffee Break	9:50-10:10	Coffee Break	9:50 - 10:10	Coffee Break	11:00	Last check out at FLBS	
		Diatom Life Cycles/ Taxonomy and Systematics		*Floristic Surveys*		*Diatom-based metrics in monitoring and paleo-limnology*			
	10:20	Jewson	10:10	Hamsher	10:10	Stevenson			
	10:40	Card and Mambo	10:30	Meadow	10:30	Mosely			
	11:00	Eekhoff and Riggen	10:50	Dominy	10:50	Sgro			
	11:20	Potapova	11:10	Kociolek	11:10	Shinneman			
	11:40	Julius	11:30	Kopalova	11:30	Reavie			
			11:50	Van de Vijver	11:50	Pillsbury			
	12:15	Lunch	12:15	Lunch	12:15	Lunch			
	1:15		1:15		1:15				
		Diatoms in River and Wetland Environments		*Methodological investigations and novel applications*		*Taxonomy: Additions and Revisions*			
	1:30	Bixby	1:30	Govindan	1:30	Vesela			
	1:50	Hausmann	1:50	Weilbacher	1:50	Bartelme			
	2:10	Bramburger	2:10	Etheridge	2:10	Main			
	2:30	Rollins	2:30	Warnock					
	2:50	Carrick	2:50	Peterson	3:00				
3:00	3:10	Eichmann	3:10	Bixby					
	3:30-3:50	Coffee Break	3:30-3:50	Coffee Break					
		Taxonomy and Systematics		*Paleolimnology*					
Arrival & Registration	3:50	Aronson	3:50	Woods		Scum Run			
	4:10	Lowe	4:10	Wolin					
	4:30	Graeff	4:30	Benson					
	4:50	Stepanek	4:50	Chraibi					
	5:10	Kociolek	5:10	Edlund	5:00				
5:30	5:30	Dinner	5:30	Banquet Dinner	5:30	Dinner			
	6:30		6:30		6:30				
	7:00	Poster Session	7:00	NADS auction	7:00	N. American Diatom Webiste discussion			
Evening Social sandwiches, beer, wine	7:30	Rick Graetz - Northern Continental Divide Ecosystem			7:30	Open Discussion - Business Meeting - Evening Socializing			
	8:30	Posters & Evening Socializing							
10:00	10:00		10:00		10:00				

FLATHEAD LAKE BIOLOGICAL STATION

The University of Montana

RULES AND REGULATIONS

1. No fires, cooking or camping on BioStation grounds.

2. Report accidents and fires immediately to the Director or maintenance staff or Dial 911.

4. Alcoholic beverages allowed when preapproved and only inside dorm rooms, apartments and cabins. Use or possession of alcohol/intoxicating substances in any vehicle owned by The University of Montana is strictly forbidden. Groups may consume alcoholic beverages in the dining area.

5. No admittance to any buildings or rooms except those being used specifically by your class or group.

6. Rowboats and canoes may be used during daylight hours, but must remain in Yellow Bay; all boaters must have jackets on. Please pick up and return equipment to the west end of storage building life and help keep the area neat. Users are financially responsible for lost or damaged canoes, paddles, oars and life jackets.

7. Park vehicles in designated ar eas only. Please do not par k in housing ar ea or staff par king lot. No vehicles allowed beyond dormitory building. Observe 15 mph speed limit on station grounds.

8. No smoking is allowed in research or academic buildings, dormitory/apartment/commissary complex, cabins or meeting rooms (if you must smoke, do it outside in a safe manner). Please deposit all litter and cigarette butts in appropriate containers. A $25.00 fee per r oom is assessed for abuse of the smoking policy.

9. Please use sidewalks and pathways to avoid wear on lawns and native vegetation.

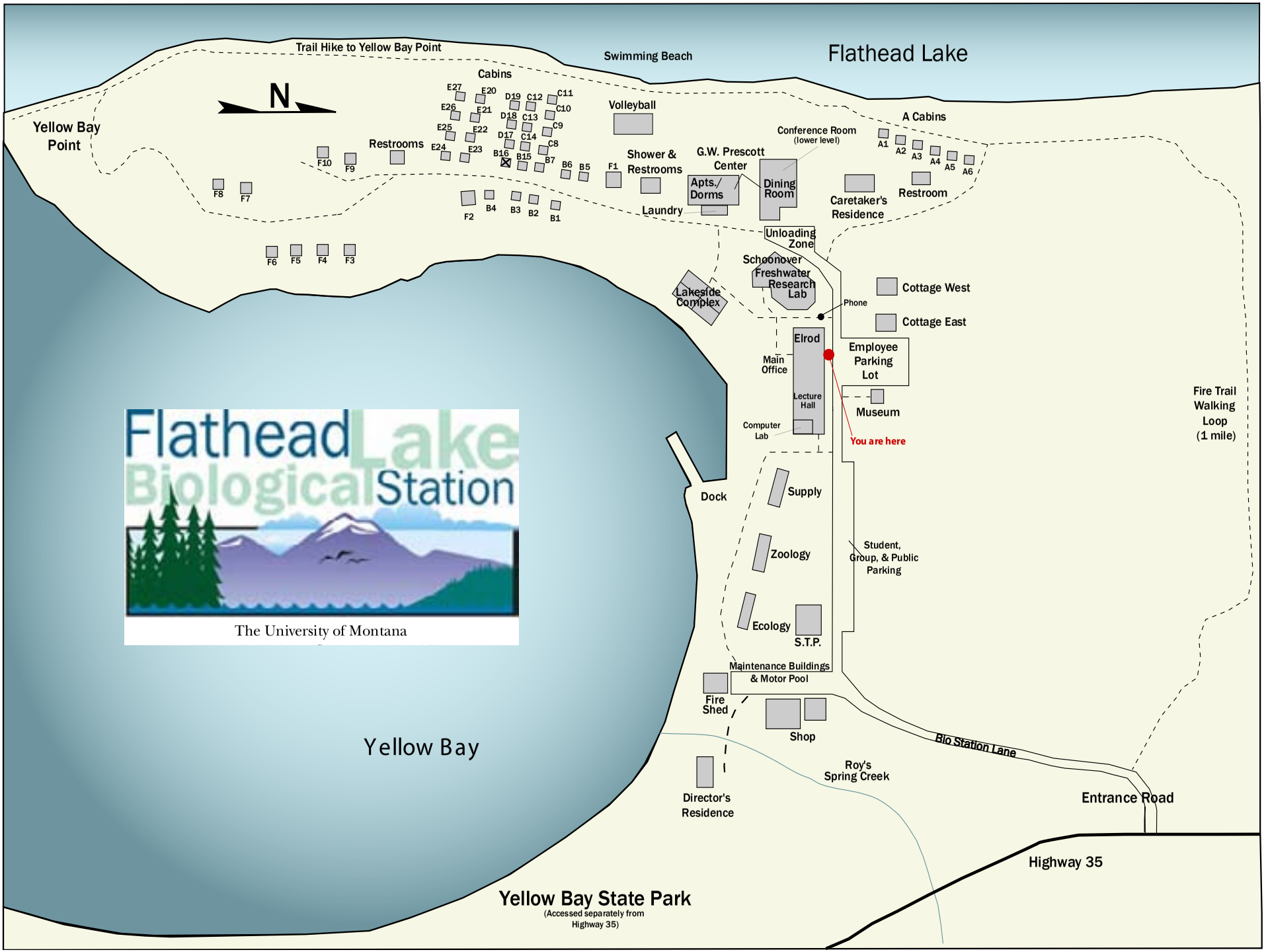
10. Laundry and shower facilities are only for people in residence at the Biological Station.

11. When planning to hike in the backcountry, please sign out at the Commissary. Give sufficient information so that if you do not return in a timely manner we will know where to look for you.

The Biological Station is an educational and research facility. We encour age everyone to have fun, but not at the expense of those who are working. Help us keep the grounds and laboratories neat and clean.

QUIET HOURS: 10:00 PM - 7:00 AM

Checkout time: 11:00 AM


Trail Hike to Yellow Bay Point
Swimming Beach
Flathead Lake
Cabins
N
Yellow Bay Point
Restrooms
Volleyball
Shower & Restrooms
G.W. Prescott Center
Conference Room (lower level)
A Cabins
Apts./ Dorms
Dining Room
Laundry
Caretaker's Residence
Restroom
Unloading Zone
Schoonover Freshwater Research Lab
Lakeside Complex
Phone
Cottage West
Cottage East
Elrod
Main Office
Lecture Hall
Employee Parking Lot
Museum
Computer Lab
You are here
Fire Trail Walking Loop (1 mile)
Dock
Supply
Zoology
Ecology
S.T.P.
Student, Group, & Public Parking
Maintenance Buildings & Motor Pool
Fire Shed
Shop
Bio Station Lane
Roy's Spring Creek
Director's Residence
Entrance Road
Highway 35
Yellow Bay
Yellow Bay State Park
(Accessed separately from Highway 35)
Flathead Lake Biological Station
The University of Montana

Presenting and Moderating:

Speakers: Talks will be held in Elrod Hall; your presentation can be loaded as early as you'd like - the eariler the better! All presentations should be in power point format (.ppt). Please see Dennis, Diane, Sarah H., or Avery for help loading your talks Wednesday evening, or any time before or after sessions on Thursday, Friday, or Saturday. Please keep your presentations to 15 minutes to allow 5 minutes for questions. A remote advance clicker for changing slides and laser pointer will be available.

Poster presenters: Please be sure to hang your posters in Lakeside Lab during the day on Wednesday or Thursday. All necessary implements will be available in Lakeside Lab. Be prepared to stand by your poster from 7:00 to 7:30 and from 8:30-9:00 on Thursday night, with a break for the plenary talk by Dr. Graetz at 7:30. Posters will be left up for viewing on Friday and Saturday as well; please remove yours before leaving the symposium.

Moderators: The 8 responsibilites for moderating:

BEFORE THE SESSION

1. Meet and greet the speakers in your session during the break preceesing the session; double check that they have all loaded their talks, and if they have not, assist them in getting the talk loaded before the session starts.
2. Review your introductory remarks with speakers (including correct pronunciation of their names and presentation titles, if needed), briefly explain the A/V equipment (laser pointers, advancing slides, etc.), and the format of the presentation (15 min talk with 5 min for questions) and how you will warn them as they approach the end of their time (for example, give them a short wave at the first warning at 15 mins, stand up at 18 mins, cut off at 20 mins).
3. Let the speakers know you are there to assist them with anything they may need during their presentation.

DURING THE SESSION

4. Introduce your session (start on time). A good formula for introducing a session is:
    a. Welcome the audience and state the name of the session.
    b. Relate in one or two sentences why the topic is important to the audience.
    c. For each talk, introduce the speaker and give the title of the talk. You might tell the audience something that relates to the speaker (where they are from, their favorite diatom).
    d. If necessary, let audience know how and when you will be soliciting questions (at the end of each talk)
5. Keep your session on time! Inform speakers that they must complete their presentation in 20 minutes and will be cut off at that time. It is very important for the session to stay on time and it is your job to keep it on time. Give a 5-minute warning signal to the presenter, a 2-minute warning, then let them know when their time is up and introduce the next talk.
6. Solicit questions from the audience. Ask the speaker to repeat questions from the audience so that all audience members can hear it before it is answered. Be prepared to help with the question/answer period. You should have at least one question ready in case there are none from the audience. This will usually stimulate other questions from the audience.

AFTER THE SESSION

7. Close the session thanking the speakers, making any relevant announcements that have been given to you by the conference organizers, and suggest posters of similar topic/interest to your session that participants should view.
8. Thank the speakers personally for their participation.

General Information:

NADS Traditions!

SCUM RUN
Please join us Saturday afternoon for the ever popular and challenging Scum Run, organized this year by Dr. Matt Julius and his enthusiastic band of merry students. Be prepared for all eventualities; swim suit, fur hat, multiple pens and colored markers and large stick for beating off bears and moose are recommended. And be sure to keep an eye out for the Flathead Lake Monster!
AUCTION
The NADS auction will take place Friday night after the banquet, also in Elrod lecture Hall. Please be sure to bring lots of cash to benefit student travel to our wonderful meeting! Auction items can be donated during registration or given at any time to Dennis or Diane
BANQUET DINNER
The Banquet will take place on Friday night, from 5:30 to 7:00 out of doors in the grassy area to the west of the Elrod building, next to Flathead Lake by the dock, weather permitting.
FIELD TRIPS
Glacier National Park field trip participants should plan on leaving FLBS at bright and early 8:30 am on Sunday. Please pack your own sack lunches from the food provided in the dining hall at Breakfast.
The sack lunch food available in the dining hall on Sunday is for the Field Trip Participants Only!

Meals
All meals will be held in the Dining Hall, schedule is as follows:
Breakfast: 7:15 - 8:15 am, Lunch: 12:15 - 1: 15 pm, Dinner: 5:30 - 6:30 pm
Food will only be served during these times, in a buffet-style fashion. Please be prompt to meals for the food will disappear after the allotted time! Please return your dishes and trays to the marked areas when you are done with them to allow the caterers adequate time for cleaning (or they may not appear again at the next meal). The inside dining hall only holds 50 people, so in inclement weather we will have to move through in shifts. If this occurs please be understanding of those waiting for seats. In fine weather there are many outside picnic benches with nice views of Flathead Lake.

Coffee Breaks
All coffee breaks will be help in the Lakeside building, where you will have a chance to speak with vendors and view posters. Please use your symposium mugs for coffee and tea to reduce waste. Coffee/tea can be brought back into Elrod lecture hall but please be very careful of spillage, this room was very recently remodeled in 2010.

Internet Access
Wireless is available, login: wguest and password: Flbs3301 (case sensitive)

Please contact Dennis or Diane with questions, concerns or immediate needs.
Dennis (cell) - 406-529-2866
Diane (cell) - 443-989-8705

FULL SCHEDULE

Wednesday - September 14th

3:00	Arrival & Registration: Check-in at FLBS
5:30	Evening Social: Sandwiches, beer, wine will be available in the Dining Hall

Thursday - September 15th

7:15-8:15	Breakfast & Registration
8:30	Opening Remarks - Ric Hauer
9:00	**PLENARY**: Dick Crawford -THE RIMOPORTULA AND THE GENUS CORETHRON; TWO ENIGMAS AMONG THE DIATOMS.
10:00-10:20	Coffee Break: Sponsored by ECO-ANALYSTS

Session1: Diatom Life Cycles/ Taxonomy and Systematics
Moderators: Kayla Sayre and Becky Bixby

10:20	Jewson - DIATOM LIFE CYCLES - HOW FAR BACK CAN WE TRACE THEM?
10:40	Card and Mambo - RELATIVE FREQUENCY OF REPRODUCTIVE MODES IN DIATOMS: A MULTI-SPECIES INVESTIGATION NEAR LAKE PHALEN MINNESOTA
11:00	Eekhoff and Riggin - SEX AMONG DIATOMS: LOOKING FOR PHEROMONES IN THE WATER
11:20	Potapova - ALLOMETRIC ASPECTS OF FRUSTULAR MORPHOLOGY IN DIATOMS
11:40	Julius - SYSTEMATICS AND MORPHOLOGICAL DIAGNOSIS OF CYCLOSTEPHANOS TAXA
12:15-1:15	Lunch

Session 2: Diatoms in River and Wetland Environments
Moderators: Robert Mosely and Bob Pillsbury

1:30	Bixby - BATHTUB RING-A-DING-DING: TURBIDITY MAKES ALGAL COMMUNITIES SING (IN AN ARIDLAND RIVER)
1:50	Hausmann - WHAT CAN DIATOMS TELL US ABOUT WETLANDS AND RIVER DYNAMICS?
2:10	Bramburger - STOCHASTIC AND DETERMINISTIC FACTORS CONTRIBUTING TO ASSEMBLAGE DISSIMILARITY IN DIATOMS OF NORTH AMERICAN KARSTIC WETLANDS
2:30	Rollins - DIATOMS “EAST OF EDEN”: ARE STEAM AND RIVER DIATOM ASSEMBLAGES BEING AFFECTED BY AGRICULTURAL PRACTICES IN THE CENTRAL CALIFORNIA COASTAL REGION?
2:50	Carrick - DO ABRUPT CHANGES IN STREAM DIATOMS REFLECT ECOLOGICAL THRESHOLDS?
3:10	Eichman - DIDYMOSPHENIA GEMINATA AND OTHER DAM DIATOMS OF THE LOWER KOOTENAI RIVER ECOSYSTEM FOR THE YEARS OF 2002 THROUGH 2009
3:30-3:50	Coffee Break: Sponsored by ECO-ANALYSTS

Session 3: Taxonomy and Systematics
Moderators: Evan Thomas and Kalina Manoylov

3:50	Aronson - OBSERVATIONS OF DIDYMOSPHENIA GEMINATA FROM BURYATIA, RUSSIAN FEDERATION, WITH NOTES ON ECOLOGY, WATER QUALITY, DISTRIBUTION, AND SCANNING ELECTRON MICROSCOPY

4:10	Lowe - TAXONOMY, ULTRASTRUCTURE AND BIOGEOGRAPHY OF THE DIATOM GENUS DIADESMIS FROM NEW ZEALAND, HAWAII AND GREAT SMOKY MOUNTAINS NATIONAL PARK
4:30	Graeff - PHYLOGENETIC RELATIONSHIPS WITH THE DIATOM FAMILY AMPHIPLEURACEAE, WITH SPECIAL ATTENTION TO THE GENUS FRUSTULIA RABENHORST
4:50	Stepanek - MOLECULAR PHYLOGENY OF THE AMPHOROID DIATOMS, WITH COMMENTS ON MONOPHYLY OF THE GROUP AND THEIR SYSTEMATIC POSITION WITHIN RAPHID DIATOMS
5:10	Kociolek - PRELIMINARY OBSERVATIONS ON SOME COMMONLY REPORTED FRESHWATER NITZSCHIA HASSALL SPECIES FROM RIVERS IN THE USA
5:30-6:30	Dinner
7:00-7:30	Poster Session
7:30-8:30	Evening Lecuture: Rick Graetz - Northern Continental Divide Ecosystem
8:30-10:00	Posters & Evening Socializing

Friday - September 16th

7:15-8:15	Breakfast
8:30	**PLENARY**: Paul Hamilton - BACK TO THE FUTURE: 40+ YEARS IN NORTH AMERICAN DIATOM RESEARCH
	Session 4: Research Resources *Moderator: Euan Reavie*
9:30	Charles - RESOURCES FOR DIATOM RESEARCH AT THE PHYCOLOGY SECTION, PATRICK CENTER, ANSP
9:50-10:10	Coffee Break
	Session 5: Floristic Surveys *Moderators: Brad Bartleme and Rex Lowe*
10:10	Hamsher - A FLORISTIC SURVEY OF MARINE TUBE-FORMING DIATOMS IN CANADA EMPHASIZING BERKELEYA RUTILANS
10:30	Meadow - DIATOMACEOUS BIOLOGICAL SOIL CRUST COMMUNITIES IN YELLOWSTONE GEOTHERMAL SOILS
10:50	Dominy - DIATOM COMMUNITY SIMILARITIES BETWEEN LITTORAL ASSEMBLAGES ALONG SOUTHEASTERN U.S. COASTAL REGIONS
11:10	Kociolek - ORIGINS AND ELEMENTS OF THE FRESHWATER DIATOM FLORA OF THE HAWAIIAN ISLANDS
11:30	Kopalová - NON-MARINE DIATOMS (BACILLARIOPHYTA) FROM ULU PENINSULA (JAMES ROSS ISLAND, NW WEDDELL SEA, ANTARCTICA)
11:50	Van de Vijver - ENDEMISM AND BIOGEOGRAPHICAL REGIONALISM IN ANTARCTIC DIATOM COMMUNITIES
12:15-1:15	Lunch
	Session 6: Methodological investigations and novel applications *Moderators: Jim Wee and Phil Woods*
1:30	Govindan - BIOACTIVE COMPOUNDS FROM THE MARINE DIATOMS OF AMPHORA COFFEAEFORMIS (AG) KUTZ AGAINST HUMAN PATHOGENS
1:50	Weilbacher - GROWTH OF DIATOM CULTURES UNDER DIFFERENT IN-VITRO CONDITIONS
2:10	Etheridge - DIATOMS AND IN-VIVO CHLOROPHYLL-a FLUORESCENCE: A CASE STUDY OF FLUORESCENCE RESPONSE TO CHANGES IN COMMUNITY STRUCTURE

2:30	Warnock - A NEW DIATOM PRESERVATION PROXY AND RECORD OF PRESERVATIONAL CHANGES IN THE AMUNDSEN SEA.
2:50	Peterson - RELEVANCE OF DIATOM SPECIES COMPOSITION TO BIOFILM-BASED STREAM ECOSYSTEM PROCESSES: POSSIBLE MECHANISMS AND RAMPANT SPECULATION.
3:10	Bixby - CAN DIGITAL IMAGING FLOW CYTOMETRY REPLACE MICROSCOPE MEASUREMENTS OF DIATOM CELL DIMENSIONS?
3:30-3:50	Coffee Break

Session 7: Paleolimnology
Moderators: Sarah Hamshire and Paula Noble

3:50	Woods - DIATOM INFERRED LAKE LEVEL AND HABITAT TRANSITION IN THREE WILD RICE (ZIZANIA PALUSTRIS) LAKES ON THE FOND DU LAC RESERVATION
4:10	Wolin - FROM AGRICULTURE TO CONSERVATION EASEMENT - LAKE RESPONSE TO LANDUSE CHANGE
4:30	Benson - EXCEPTIONAL GENUS-RICHNESS AND MODERNITY IN THE LATE EOCENE FRESHWATER DIATOM FLORA FROM THE FLORISSANT PALEOLAKE DEPOSITS OF COLORADO, USA
4:50	Chraibi - DIATOM-BASED PALEOLIMNOLOGICAL STUDY OF LAKE SUPERIOR
5:10	Edlund - HISTORICAL PERSPECTIVES ON THE DIPOREIA DEMISE: PALEOLIMNOLOGICAL AND GUT CONTENT EVIDENCE OF FOOD LIMITATION
5:30-6:30	Banquet Dinner
7:00-10:00	NADS auction

Saturday - September 17th

7:15-8:15	Breakfast
8:30	**PLENARY**: Bonnie Ellis - THE CHANGING FOODWEB OF FLATHEAD LAKE, MONTANA.

Session 8: Local history
Moderator: Don Charles

9:30	Bahls - THE DIATOM LEGACY OF HARRY SOVEREIGN IN THE PACIFIC NORTHWEST
9:50-10:10	Coffee Break

Session 10: Diatom-based metrics in monitoring and paleolimnology
Moderators: Virginia Card and Sonja Hausmann

10:10	Stevenson - ISN'T IT A PITY ABOUT DIATOM DIVERSITY?
10:30	Mosley - DIATOM BIODIVERSITY COMPARISON AMONG DIFFERENT AQUATIC ENVIRONMENTS AT ANDALUSIA FARM, BALDWIN COUNTY, GA
10:50	Sgro - HISTORICAL WATER QUALITY RECONSTRUCTION OF TINKERS CREEK, OH: ITS NOT WHAT YOU ARE SAMPLING ITS HOW YOU SAMPLE IT
11:10	Shinneman - DIATOM-INFERRED TOTAL PHOSPHORUS RECONSTRUCTIONS FOR LAKE MANAGEMENT: WHEN TO SAY WHEN IN INTERPRETING QUANTITATIVE PHOSPHORUS VALUES
11:30	Reavie - SAMPLE SIZE AND DIATOM-BASED INDICATOR PERFORMANCE
11:50	Pillsbury - PERFORMANCE OF DIATOM METRICS IN AGRICULTURALLY DOMINATED WATERSHEDS
12:15-1:15	Lunch

Session 11: Taxonomy: Additions and Revisions
Moderator: Andrew Bramburger

1:30	Vesela - AN ATTEMPT TO REVISE THE GENUS PERONIA BRÉB. ET ARN. EX KITTON WITH POSSIBLY TWO NEW SPECIES
1:50	Bartelme - A NEW SPECIES OF FISTULIFERA
2:10	Main - THE GENUS PINNULARIA IN IOWA WETLAND MITIGATION SITES

3:00-5:00	Scum Run
5:30-6:30	Dinner
7:00-7:30	Discussion - North American Diatom Website
7:30-10:00	Open Discussion - Business Meeting - Evening Socializing

Sunday - 18th September

7:15-8:15	Breakfast
8:30	Glacier National Park Field trip departs
11:00	Final Checkout time at FLBS

ORAL PRESENTATION ABSTRACTS

In order of presenting author last name

THE DIATOM LEGACY OF HARRY SOVEREIGN IN THE PACIFIC NORTHWEST

Loren Bahls
Montana Diatom Collection, 1032 12th Avenue, Helena, Montana 59601 USA

The unique diatom flora of the Pacific Northwest attracted the attention of prominent European diatomists beginning in the middle of the Nineteenth Century and continuing on into the early part of the Twentieth Century. These included Ehrenberg, A. Schmidt, and Hustedt. Not until the 1930s did the region have its own resident diatomist in the person of Harry E. Sovereign (1884-1965). Sovereign was born and raised in Colorado where he was trained as a civil engineer. His engineering career took him to projects in Idaho and Mexico and finally, in 1927, to Seattle, Washington, where he retired in 1953. His side interest in diatoms began shortly after his arrival in Seattle, where he became acquainted with UW professor and self-proclaimed "omnologist" Trevor Kincaid. He also began corresponding and collaborating with Friedrich Hustedt, who verified Sovereign's new species and prepared figures for Sovereign's publications. Sovereign published only two diatom papers in his lifetime, both after the age of 70. In these papers he described 43 new taxa, most of them endemic to the Pacific Northwest. Sovereign was the first to sample the Pacific Northwest extensively for diatoms and from an ecological point of view. His collection of 1400 strewn mounts, including a number prepared by Hustedt, and 600 vials of cleaned material, resides at the California Academy of Sciences in San Francisco. We will examine twelve species described by Sovereign, along with their habitats and distributions in the Northwest.

A NEW SPECIES OF FISTULIFERA

Jeffrey R. Johansen, Jan Pilný and Bradley Bartelme
Department of Biology, John Carroll University, University Heights, OH 44118, USA

Fistulifera saprophila Lange-Bertalot et Bonik is a common taxon in strongly eutrophic waters in Europe and North America. It is completely hyaline in the light microscope, with a reported striae range of 48-81 striae in 10 µm. The taxon has been a candidate species for algal biofuels since the early work done in the 1980's in the Aquatic Species Program at the Solar Energy Research Institute. A number of strains of *F. saprophila* were studied at that time from lentic inland saline waters in the desert southwest. Recently, we have been working on an algal biofuels program, and have isolated several strains of *F. saprophila* from freshwater rivers, which are also some of our best performing strains. An examination of the fine structure of these diverse populations shows that there are almost certainly two species in the *F. saprophila* complex. Our freshwater strains have only 50 striae in 10 µm in the center, with 60 striae in 10 µm near the ends. The saline strains, which grow best at 10 mS/cm conductivity (~1/3 seawater), can tolerate up to 60 mS/cm conductivity. Saline strains have 75-90 striae in 10 µm. Given the clear morphological and physiological differences in these strains, we conclude that two species are currently encompassed by *F. saprophila*, and this will necessitate description of a new species for the saline populations.

EXCEPTIONAL GENUS-RICHNESS AND MODERNITY IN THE LATE EOCENE FRESHWATER DIATOM FLORA FROM THE FLORISSANT PALEOLAKE DEPOSITS OF COLORADO, USA

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Paleolake deposits of the late Eocene Florissant Formation in south-central Colorado provide a record of the most genus-rich early freshwater diatom flora thus far described. Furthermore, all the diatom genera observed from this flora are extant, as are many of the species.

Diatoms were extracted from highly lithified shales and mudstones that formed from clay- and fine silt-sized particles that accumulated intermittently within the lake, alternating with volcanic ash and sand- to pebble-sized tuff. Radiometrically dated sanidine crystals within volcanic tuff beds provide an average $^{40}Ar/^{39}Ar$ age of 34.05 ± 0.08 Ma (million years old) for the formation.

An original floristics study in the Florissant lake beds at the Clare's Quarry site revealed 20 extant freshwater diatom genera, 8 of which are first occurrences in the geologic record. The results of this investigation combined with findings

from earlier unpublished and published reports of diatoms from several Florissant sites show the presence of a cumulative total of 33 extant genera (14 of which are first recorded occurrences in the fossil record). These genera represent 13 families and are distributed among centric, araphid pennate, monoraphid pennate, and biraphid pennate morphological groups. Such richness at the genus level is uncommon among the 9 unambiguously non-marine fossil diatom floras reported for the period from late Cretaceous (~70 Ma) through Paleogene (~24 Ma). A comprehensive literature review and, in some cases, examination of archival material from published non-marine diatom floras from this pre-Neogene period revealed that the Florissant sites cumulatively contain 20 more genera than the next most genus-rich older flora, i.e., that of the middle Eocene Giraffe Pipe of the Northwest Territories, Canada.

While the conditions that contributed to the occurrence and preservation of this uniquely diverse Florissant fossil diatom flora remain uncertain, the establishment of such a large number of extant genera as early as 34 million years ago supports the view that the earliest ancestral forms of freshwater diatoms are likely to have originated much earlier in geologic history than is documented by the paleontological record of the past 70 million years.

BATHTUB RING-A-DING-DING: TURBIDITY MAKES ALGAL COMMUNITIES SING (IN AN ARIDLAND RIVER)

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Turbidity influences primary production and algal communities in aridland rivers. In the Middle Rio Grande, increased tributary inputs in the summer months are associated with extremely high turbidity levels that create a light-limited environment. Because of this, primary production can be limited to a littoral zone "bathtub ring." We tested the idea of a bathtub ring of primary production in relation to turbidity and light availability. Our objectives were 1) to describe the extent of the bathtub ring of primary producers in this southwestern aridland river and 2) to determine seasonal patterns (cell densities, species assemblages) of this bathtub ring, given differing flow velocity and turbidity levels.

In 2010, we conducted three detailed transverse transects across reaches at one site to document the relationships among turbidity, depth and algal parameters in different seasons (spring, summer, fall). With a standard sampling protocol, physical variables were recorded at each sampling point along a transect: distance from the river edge (m), depth (cm) and flow velocity (m s^{-1}). Turbidity was also measured at each survey time. Samples were also collected for chlorophyll *a* and diatom species identification. Chlorophyll *a* and diatom densities were analyzed using one-way ANOVAs while temporal and spatial patterns in the diatom communities were examined using non-metric multi-dimensional scaling and indicator species analysis.

In periods of relatively high flow (spring and fall), there was evidence of an algal bathtub ring with higher chlorophyll *a* concentrations and greater diatom densities at the edge, compared to the center of the channel. This bathtub ring was restricted to water depths of < 12 cm and flow velocity < 0.2 m s^{-1}. Diatom communities were the least diverse in the spring, when suitable habitat was constrained by high turbidity levels and high flow velocity that limited the extent of the ring. In the fall, turbidity and flow velocity were relatively reduced and communities were much more diverse. There were a number of indicator taxa (*Aulacoseira italica*, *Cymatopleura solea*, *Diadesmis* spp., *Gyrosigma scalproides*, *Hantzschia amphioxys*, *Hippodonta* spp., and *Luticola muticoides*). However, in a period of relatively low flow (summer) the water was shallow and clear, so there was no bathtub ring as primary production occurred across the entire transect. Diatom cell densities were high but diversity was very low; the community was dominated by *Navicula rostellata*, *Navicula* sp. 1 and *Nitzschia* spp.

From a broader perspective, this information can be used to identify energy sources for aridland river food webs which can have limited primary production in the water column. These data can also be used to quantify relationships between the presence of high-quality food sources (high algal abundance and high invertebrate densities) and estimated fish densities.

CAN DIGITAL IMAGING FLOW CYTOMETRY REPLACE MICROSCOPE MEASUREMENTS OF DIATOM CELL DIMENSIONS?

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The development of digital imaging flow cytometry offers the possibility of replacing the often tedious and time-consuming measurements of diatom cell dimensions utilizing light microscopy with a more rapid, quantitative alternative to obtain data. Digital imaging flow cytometry is beneficial for applications that require measurement of large numbers of cells to obtain reliable population estimates, either in space or time. In addition, such an approach offers the opportunity to examine diatom population dynamics in terms of size diminution and the timing of sexual reproduction using large sample sizes, previously prohibitive in terms of time and effort. In this study, we chose three diatom species to evaluate the results from digital imaging flow cytometry; these taxa cover a range of size and shape encountered in fresh waters, *Achnanthidium minutissimum*, *Hannaea baicalensis,* and *Didymosphenia geminata*. Cell lengths were measured using a light microscope and compared with cell lengths measured by a FlowCam (Fluid Imaging Technologies, Maine, USA). The FlowCam acquires and stores digital images of each cell detected from heterogeneous samples over a size range; we tested the range from 1µm to 200 µm. We evaluated the limits of the FlowCam under different operating conditions and determined that best results were obtained by optimizing the system through choice of correct filters, thresholds, and objectives for each species. Using examples from the three test species, both the benefits and limitations of this new technology will be discussed.

STOCHASTIC AND DETERMINISTIC FACTORS CONTRIBUTING TO ASSEMBLAGE DISSIMILARITY IN DIATOMS OF NORTH AMERICAN KARSTIC WETLANDS

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Despite occurring across a wide gradient of climatic conditions, the diatom assemblages of karstic wetland systems within North America exhibit broad taxonomic similarity at large spatial scales. Taxa commonly associated with karstic periphyton, including those within the *Mastagloia smithii* and *Fragilaria synegrotesca* complexes have been widely reported from wetland system ranging from tropical morasses in the Caribbean to Canadian alvars. Regional patterns of assemblage dissimilarity, however, vary with latitude in these systems, and tropical karstic assemblages exhibit higher degrees of similarity than their temperate counterparts. Here, we examine the relative influences of stochastic mechanisms associated with geographic proximity and deterministic mechanisms including environmental differences and ecological specificity of taxa on assemblage dissimilarity along a latitudinal gradient. Preliminary results demonstrate that environmental differences exert a stronger influence on assemblage dissimilarity in tropical regions characterized by more ecologically specialized taxa, while geographic proximity is a more important structuring mechanism at higher latitudes characterized by generalist forms.

RELATIVE FREQUENCY OF REPRODUCTIVE MODES IN DIATOMS: A MULTI-SPECIES INVESTIGATION NEAR LAKE PHALEN MINNESOTA

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Diatoms reproduce both vegetatively and sexually and it has been hypothesized that, due to differences among groups of diatoms in the evolutionary costs and benefits of the two modes of reproduction, the relative frequency of the two modes will vary systematically among groups. In particular, it was predicted that the relative frequency of sexual reproduction would be greater for raphid species than for centric and araphid species, and, similarly, more frequent for benthic species than for planktonic (Card and Carra, 2011). To test these hypotheses, diatom samples were collected biweekly during the fall of 2010 and the spring and summer of 2011 from Round Lake adjacent to Lake Phalen in St. Paul, Minnesota. *Rhopalodia gibba* and several species were counted and measured, including the raphid pennates *Epithemia sorex* and *E. turgida ,* the araphid pennates *Asterionella formosa* and *Diatoma tenuis*, and the centrics *Cyclotella meneghiniana* and *Aulacoseira granulata*. Relative frequencies of the two modes of reproduction were inferred from the number of modes and changes over time in the size-class profiles of the populations.

The raphids have frequent reproduction,

Whilst centrics are shy at seduction.
Araphids, it seems,
Are somewhere betweens,
Or so says this project's prediction.

DO ABRUPT CHANGES IN STREAM DIATOMS REFLECT ECOLOGICAL THRESHOLDS?

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Variation in watershed land use is known to influence the physical and chemical conditions in streams that reside within their boundaries. However, few studies have evaluated variation in ecosystem structure and function as it may relate to specific thresholds in land use and nutrient concentrations. We test two hypotheses here. First, benthic chlorophyll exhibits an inverse relationship with watershed forest cover among streams, such that abrupt changes are evident. Second, abrupt changes in diatoms species composition occurs as a function of forest cover, whereby guilds of nutrient sensitive species are replaced by tolerant species. To test these hypotheses, we conducted seasonal sampling (spring, summer, and fall of 2005-2006) in 43 third order streams across the state of Pennsylvania. Stream physical, biological, and chemical conditions were measured through 28 variables, in addition to benthic chlorophyll concentrations and the relative abundance of diatom species collected from each stream ecosystem. Watershed forest cover explained significant variation in stream benthic chlorophyll (stepwise linear regression, r^2= 39.2%) as selected from a set of relevant variables (TN, TP, % Forest cover, % Agriculture, and stream temperature). Benthic chlorophyll and nutrient tolerant diatom guilds had a negative correlation with forest cover, while nutrient sensitive diatom species had a positive correlation. Regression tree analysis indicated abrupt changes in benthic chlorophyll and diatom guild relative abundance at average thresholds of 60% and 82% forest cover. Despite the correlative nature of this study, the findings here suggest individual ecosystems may exhibit abrupt changes in ecosystem function following declines in forest cover, particularly at the thresholds identified herein.

RESOURCES FOR DIATOM RESEARCH AT THE PHYCOLOGY SECTION, PATRICK CENTER, ANSP

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The ANSP Phycology Section has several resources available for diatom researchers. Three of the most useful are the current set of taxa names (2011 ANSP / NAWQA / EPA), the algae image database and website, and the NADED database with diatom counts and site information. These three are integrated with each other and with a counting program (Tabulator) and a program for calculating metrics (Phyco-Aide).

The Phycology Section is part of the Patrick Center for Environmental Research, and works closely with the Diatom Herbarium (Marina Potapova, Curator). The Phycology Section had it origins in the Limnology Department, which Ruth Patrick started in 1947. Beginning about 1994, the Phycology Section began storing diatom counts and related data in the North American Diatom Ecological Database (NADED). Section staff and collaborators have added diatom data to NADED from many projects throughout the US, including those national in scope such as the USGS National Water-Quality Assessment Program (NAWQA) and EPA's National Lake Assessment and National River and Stream Assessment. NADED now contains more than 22,000 diatom counts (and more than 16,000 soft-algae counts) from over 10,000 sites in the U.S. These records can be searched to find distribution data for individual taxa and to find accession numbers for the corresponding more than 47,000 slides archived in the ANSP Diatom Herbarium.

The 2011 ANSP/NAWQA/EPA set of taxa names is a recent update of previous versions and is the product of much work by many diatomists at several institutions. It includes recent synonyms for 2,000 diatom taxa (>1715 described) and more than 1100 soft algae. This set of names and its predecessors have been used in analysis algal samples for many state and federal projects, including USGS NAWQA and EPA's national assessments. Agencies have supported this effort with the goal of providing a common and consistent set of names that can be used in projects they fund so that resulting datasets can be more effectively compared and combined. Files of names can be downloaded at: http://diatom.ansp.org/nawqa/Taxalist.aspx.

Each name is associated with a unique NADED ID. Names are intended to be consistent with those used in the "Diatoms of the United States" website and equivalent in form to those in the California Academy Catalogue of Diatom Names.

The Algae Image Database and website (http://diatom.ansp.org/algae_image/) document many taxa in the sets of taxa names, particularly undescribed and less common taxa. The database currently includes over 9,000 images of diatoms and

soft algae. Many are publicly available on the website, and many more will be made public pending review. Most of the images were taken by phycologists during routine analysis of algal samples.

DIATOM-BASED PALEOLIMNOLOGICAL STUDY OF LAKE SUPERIOR

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Lake Superior, considered the most pristine and perhaps least understood Laurentian great lake, has nevertheless endured human disturbances. Recent physical, chemical and biological changes in the lake suggest anthropogenic drivers, but unfortunately, little is known about how human activity is affecting the lake as a whole. For instance, significant declines in microscopic biota and nutrients and an increase in chloride have occurred during the last decade. While these changes are disconcerting, whether they are outside the range of natural variability for the lake is not certain.

We are performing a retrospective analysis of environmental quality in Lake Superior using sedimentary diatom archives. In doing this, we intend to answer several questions:

- What are the driving factors behind changes that are occurring in Lake Superior?
- Are conditions improving due to rehabilitation efforts or deteriorating?
- Are inferred changes anthropogenic or within the range of natural variability for Lake Superior?
- Are there spatial variations in historical pelagic conditions?

Currently we are comparing diatom assemblages from a recent core obtained from the eastern basin with historical paleoecological results of a detailed diatom analysis performed by Stoermer et al. in the 1970s. We are focusing on long-term trends in diatom community assemblage, biovolume and accumulation rate as well as examining more recent changes and trajectories. Results will be incorporated into an ongoing study including a core collected in the central basin. Diatom results will be related to historical landscape changes using diatoms as a proxy for water quality fluctuations.

DIDYMOSPHENIA GEMINATA AND OTHER DAM DIATOMS OF THE LOWER KOOTENAI RIVER ECOSYSTEM FOR THE YEARS OF 2002 Through 2009

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The study area encompasses a 325 kilometer river reach from Upper Kootenay River at Wardner, B.C. downstream through Montana and Idaho to Kootenay Lake in B.C. Kootenay River Subbasin includes 48 and 51 north latitude and 115 and west longitude covering 238 miles by 157 miles for 16,180 square miles (Kootenai Tribe of Idaho and Montana Fish, Wildlife & Parks 2004). There is data from 2002 through 2009, representing 14 sites fertilized and not fertilized. The information is a discussion of the diatoms present in the top 5% taxa at each site. The seasonal changes during site samples are included. Comparisons of the Van Dam Indices are used to determine longtime changes. Information has been used for a large picture of the subbasin. Perhaps there has not been enough attention played to the small picture. The small pictures when put together may provide the large picture instead of rolling everything to the same level for the large picture.

THE RIMOPORTULA AND THE GENUS *CORETHRON*; TWO ENIGMAS AMONG THE DIATOMS.

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This presentation will bring together two aspects of diatom study; the rimoportula and the genus *Corethron*.

A review of the structure and position of the rimoportula in the diatom frustule and its distribution among taxa will show the importance of this tube process, which is widespread among non-pennate diatoms and may well be the precursor of the raphe. This would suggest that a fundamental role in the cell was performed by it long before its place in the evolution of movement because very few non-pennate diatoms lack the structure. However, its function in non-raphid diatoms has not been established and what happens during passage of material through the tube is not understood. Nevertheless it is absent from a very small number of species/genera and one such genus is *Corethron*. Is there anything we can learn from the genus that might tell us why it can thrive without the rimoportula or indeed any other tube process?

Corethron is unique because it possesses exceedingly complicated moveable spines and these shall be examined in detail to show how complex the membrane relationships must be during new valve formation. Some unpublished biochemistry indicates that the genus might also be unique in terms of the sterol components that might be considered structurally

primitive when compared to those in other diatom taxa. The genus is also interesting ecologically and the distribution of the three known species may point to an evolution following separation between the two hemispheres. Nevertheless it is a modern diatom and among a majority of genera that vary conservatively so in view of the foregoing, it comes as something of a surprise to see it sitting in the middle of one of the clades of marine "radial centric" diatoms arranged according to rRNA molecular trees.

DIATOM COMMUNITY SIMILARITIES BETWEEN LITTORAL ASSEMBLAGES ALONG SOUTHEASTERN U.S. COASTAL REGIONS

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Few studies have been dedicated to the littoral zones found throughout brackish waters in the Southeastern United States. Littoral zones can be characterized with temporal exposure of algae to diurnal desiccation from high tides. Fifty five years ago Friedrich Hustedt examined two mud samples that were taken from Beaufort, North Carolina. In his study he reported a total of 369 species of diatoms and 25% of the reported were new to science. In the current study, mud samples were taken from the Savannah River estuary along with physicochemical characteristics. Mud habitats can serve as sieves and concentrate taxa from plankton, upstream drifters together with periphyton and attached algae. Through examination of present algal communities and their current response to environmental factors, inferences can be made about the environmental conditions 55 years ago. Live and cleaned diatoms were analyzed following standard protocols. Community indices were compared between the two sampling events, along with bio-volume of common taxa in comparison with published literature. Representatives of the genus *Pseudonitzschia* were the most abundant taxa observed. Several centric diatoms are proposed as new to science. Similarities between the littoral communities 50 years prior and today are reported. Considering the difference in methodology of collection and enumeration between the two datasets, i.e. taxonomic evaluation without predetermined number constrains vs. routine valve count, the observed similarities imply potential stability of diatom communities of the littoral mud zones along the Atlantic US coast.

HISTORICAL PERSPECTIVES ON THE *DIPOREIA* DEMISE: PALEOLIMNOLOGICAL AND GUT CONTENT EVIDENCE OF FOOD LIMITATION

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The amphipod *Diporeia* is a key component of the benthos of the Great Lakes, converting the pelagic algal rain to secondary production, which is critical for most fish species in the Great Lakes. However, declines in *Diporeia* populations in the Great Lakes since the 1980s have been rapid and widespread. There is a temporal relationship between decline of *Diporeia* and spread of zebra *Dreissena polymorpha* and quagga *D. rostriformis bugensis* mussels in the Great Lakes, but establishing a mechanistic link has been a research challenge. *Diporeia* declines are thought to result from competition for food resources with zebra/quagga mussels, but conflicting evidence suggests food limitation may not be the direct link. To test the food limitation hypothesis, we analyzed gut contents of *Diporeia* collected between the 1980s and 2009 from two offshore (>100 m depth) and one nearshore sampling station (~50 m depth) in southern Lake Michigan. We further used paleolimnological analysis of sediment cores from nearshore and offshore southern Lake Michigan to resolve historical relationships among food resources, *Diporeia* diet shifts, and diet selectivity during the pre- and post-dreissenid invasion. Results showed that in spring *Diporeia* fed selectively and almost exclusively on large centric (*Stephanodiscus* spp.) and filamentous centric diatoms (*Aulacoseira* spp.). Diets differed among *Diporeia* size classes, sampling stations, and years. Springtime diets in offshore *Diporeia* populations showed significant shifts during the 2000s that included greater proportions of small *Cyclotella* spp., small *Stephanodiscus* spp., and araphid planktonic diatoms, coincident with widespread *Diporeia* declines and rapid expansion of quagga mussels into offshore regions of Lake Michigan. Sediment cores recorded changes in diatom communities from 1960 to 2009 including declines in *Aulacoseira* and large *Stephanodiscus*, and increases in small centrics especially after dreissenid introduction. Accounting for high selectivity in spring *Diporeia* diets, the community changes in the sediment record are consistent with changes observed in the diet of *Diporeia*, and suggest the decline in *Diporeia* populations has been exacerbated by a shift in diatoms from more nutritious and highly preferred species to less nutritious and negatively selected species.

SEX AMONG DIATOMS: LOOKING FOR PHEROMONES IN THE WATER

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Many diatom species are capable of both sexual and asexual reproduction, making them a good study subject for the question of why species engage in sexual reproduction. Species that are capable of asexual reproduction often have periods of sexual reproduction, so there must be a reason for it (Card and Carra, 2009). The goal of this research is to add to a growing body of work concerning the methods of and reasons for sexual reproduction in diatoms.

Most of the time, when diatoms want to reproduce, they divide. Every time that they divide, one is the same size as the parent cell, and one is slightly smaller. This in turn gradually decreases the size of the diatom over time. It's thought that they eventually reach a size that is too small to divide again, so they have to turn to sexual reproduction to increase the size of the cell back to the size of the large initial cell. Diatoms can make a special cell called an auxospore that regenerates the maximum size of the original cell. There are different signals that diatoms may use to inform other diatoms that it is time to reproduce sexually and create auxospores. Many researchers believe that a lack of light is a signal for sexual reproduction to begin (D.H.Jewson, 1992).

Pheromones are described as "substances secreted to the outside of an individual and received by a second individual of the same species in which they release a specific reaction," (Lüscher, 1959). We are looking for a cascade effect of increasing size in diatoms downstream compared to those upstream, supporting the idea of pheromones in the water. We believe that diatom pheromones will travel downstream and will cause diatoms there to have larger average size due to the fact that there will be a greater number of diatoms reproducing sexually from coming in contact with the pheromones.

THE CHANGING FOODWEB OF FLATHEAD LAKE, MONTANA.

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Introductions or invasions of nonnative organisms can mediate major changes in the trophic structure of aquatic ecosystems. Here we show that a community-wide trophic cascade extended to primary producers at the base of the food chain and to bald eagles at the very top when *Mysis diluviana*, an opossum shrimp, invaded Flathead Lake, Montana, the largest freshwater lake in western USA. Lake trout had been introduced 80 years prior but remained at low densities until nonnative *Mysis* appeared. The bottom dwelling mysids eliminated a recruitment bottleneck for lake trout by providing a deep water source of food where little was available previously. Lake trout subsequently flourished on mysids and this voracious piscivore now dominates the lake fishery; formerly abundant kokanee salmon were extirpated and native bull trout and cutthroat are imperiled. Predation by *Mysis* shifted zooplankton and phytoplankton community size structure. The highest photic zone phytoplankton biomass, chlorophyll *a* and primary production occurred in 1988, the year of maximum mysid abundance. During the period of record, numerous other changes in the phytoplankton community were evident; increase or decrease in biomass and/or density of 8 phytoplankton families, increase in percentage phytoplankton biomass in 10 to 30 μm size fraction, decrease in percentage phytoplankton biomass in >50 μm size fraction and decrease in 0–30 m chlorophyll *a*. Bayesian change point analysis of the primary productivity time series (27 years) showed a significant step increase of 55 mg C m^{-2} day^{-1} concurrent with the mysid invasion, but little trend before or after in spite of increasing nutrient loading. The step increase likely is explained by the increase in density of smaller phytoplankton with higher rates of metabolism. Such a large and sudden shift in carbon cycling during the exponential growth phase of a nonnative species has never been reported. Understanding trophic cascades requires that long-term data sets be formalized by robust models because of the extreme complexity of interactions.

DIATOMS AND IN-VIVO CHLOROPHYLL-*a* FLUORESCENCE: A CASE STUDY OF FLUORESCENCE RESPONSE TO CHANGES IN COMMUNITY STRUCTURE

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Total Maximum Daily Loads (TMDLs) have been established under authority of the Federal Clean Water Act for the Hells Canyon reach of the Snake River, on the border between Idaho and Oregon, to improve water quality and to preserve beneficial uses such as public consumption, recreation, and aquatic habitat. The TMDLs set targets for seasonal average and annual maximum concentrations of chlorophyll-*a* in phytoplankton at 14 μg/L and 30 μg/L, respectively. These criteria were meant to target "nuisance algae". Two sites on the Snake River near the Idaho-Oregon border were sampled up to five times in 2010 for taxonomic analysis of sestonic algae. Meanwhile, continuous monitors measured chlorophyll-*a* fluorescence every 15 minutes. Continuous chlorophyll-*a* fluorescence probes were calibrated using lab results for chlorophyll-*a* analysis, as well as Rhodamine dye standards. Variations in the agreement between in-vivo chlorophyll-*a* fluorescence and chlorophyll-*a* concentration in sestonic algae determined by various laboratory methods have been evaluated as signals for population and physiological changes in the phytoplankton community. Several

dynamics are illustrated when comparing chlorophyll-*a* results with community structure. First, increased numbers of non-diatom sestonic algae are negatively correlated with chlorophyll-*a* fluorescence response. Second, sestonic algal diversity is also negatively correlated with chlorophyll-*a* lab results. Third, agreement between chlorophyll-*a* fluorescence and chlorophyll-*a* lab results improves as diversity increases. This presentation will explore specific sestonic algal species and their characteristics as possible explanations for the trends observed in fluorescence response. Ultimately, this study concluded that continuous chlorophyll-*a* fluorescence probes alone were not the best measure of "nuisance algae". Monitoring the extent of macrophyte and periphyton communities as well as dissolved oxygen response likely provides a more direct measure of impacts on beneficial uses.

BIOACTIVE COMPOUNDS FROM THE MARINE DIATOMS OF AMPHORA COFFEAEFORMIS (AG) KUTZ AGAINST HUMAN PATHOGENS

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A study was initiated to explore bioactive potential of marine diatoms collected from Karaikal, Southeast coast of India. The antibacterial activity of the diatom, *Amphora coffeaeformis* was screened against human pathogenic bacteria such as Gram –positive *Staphylococcus aureus* and *Streptococcus feacalis* and Gram – negative *Escherichia coli* and *Pseudomonas aeruginosa.* The antibacterial activity of diatom was tested with various solvents including, methanol, ethanol, acetone and chloroform. Among the solvents used, methanolic extract was more active against all the bacteria tested. The activity of the extract in terms of zone of inhibition was more (16 mm) against *S. aureus* and less (10 mm) against *E.coli*. Gas chromatographic analysis of extract reveals the presence of bioactive compounds such as 5-methyl-1-heptanol, 3-buten-2-ol, pyridine, 2, 3, 4, 5-tetrahydro-4-heptanol, 1- undecane 9-methyl, tetradecane 1-ido and 1, 14-tetradecanediol. Evidence from the literature suggests that pyridine N-oxide derivatives represent a peculiar class of antiviral compound. The present study also reveals the presence of pyridine derivatives and hence, it is suggested that the extract of the diatom can be tried either in crude or purified form as a possible source of drug against HIV infection.

PHYLOGENETIC RELATIONSHIPS WITH THE DIATOM FAMILY AMPHIPLEURACEAE, WITH SPECIAL ATTENTION TO THE GENUS *FRUSTULIA* RABENHORST

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The diatom family Amphipleureae was proposed by Grunow in 1862. It originally included the genera *Amphipleura* and *Rhapidogloea* (now known as *Berkeleya*). The family Amphipleuraceae, as recognized by Round et al. 1990, includes *Frickea*, *Frustulia* and *Amphipleura*. Subsequently, the genus *Cistula* has been included in the Family. It is diagnosed by its members having a siliceous rib running the length of the axial area.

A survey of valve and girdle features of representatives of the genera *Amphipleura, Frustulia, Frickea, Cistula*, and several outgroup genera of the closely allied family Berkelyaceae, reveals new insights into the diversity of morphologies within and between the members of the Amphipleuraceae.

A phylogenetic analysis of morphological data of the species found in the three genera, show first that the Amphipleuraceae is monophyletic. Within the family, the genus *Frustulia* is non-monophyletic, with certain species groups (such as the rhomboides group) more closely alled with *Amphipleura*, while others, such as *F. creuzbergensis, F. neomundana F. weinholdii* and *F. submarina*, are more closely allied to *Frickea* than to other *Frustulia* species. A continuum of forms was suggested for *Frustulia*, from species lacking a porte-crayon to those who have a large, fully developed porte-crayon structure, but that continuum is not supported in terms of monophyly. To identify monophyletic (natural) genera within this family, it may be necessary recognize additional taxonomic groups. Ecological breadth of the taxa considered in this analysis is mapped onto the phylogenetic analysis and appears to have a historical component.

BACK TO THE FUTURE: 40+ YEARS IN NORTH AMERICAN DIATOM RESEARCH

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Since the establishment of the North American Diatom Symposium over 40 years ago, research using diatoms has increased significantly, with distinct temporal changes in scientific focus and direction. Under the influence of Dr. Ruth Patrick, environmental pollution was the prominent directive in the early years of the symposium, with rivers as the study units. As the North American Symposium evolved, research interests in ecology, cell cytology, and taxonomy flourished. Acid rain dominated research interests in the eighty's and nineties. The enhancement of multivariate statistics during this time further supported the development of environmental assessment research, which ultimately extended into the field

of paleolimnology. Today, climate change based research using diatoms from North America is front and center in the primary literature. From the 1980's up into the 2000's, morphology-based taxonomy flourished with the examination of type specimens and more complete taxonomic descriptions using LM and EM technologies. Polymerase chain reaction (PCR) methodology revolutionized genetic research; today the genomics of the chloroplast are playing a key role in understanding the evolution of diatoms; this symposium and others reflect this research. It is also clear that well-managed databases and collaborative research between disciplines will be key to future research efforts. The final question is, how well are we doing in our quest to incorporate other disciplines, physics and the health sciences for example, into our diatom research, and in turn, diatom research has a lot to contribute to other disciplines.

A FLORISTIC SURVEY OF MARINE TUBE-FORMING DIATOMS IN CANADA EMPHASIZING *BERKELEYA RUTILANS*

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Marine tube-forming diatoms along the rocky intertidal form macroscopic colonies that are often mistaken for filamentous brown algae. These diatoms have been understudied with only a few floristic surveys completed and those available are based purely on morphological features. Many of the morphological features used to identify these diatoms, such as valve shape, are qualitative, making species difficult to identify. This is further complicated by the fact that these 'species' are described based on the overall colony morphology with little attention to the constituent cells. Molecular techniques can be used to distinguish species more objectively. Limited molecular data for this group of diatoms are available currently and this study provides the first molecular survey of these taxa. Our study focuses on using the *rbc*L-3P, LSU D2/D3, and ITS2 regions to identify marine tube-forming diatoms in Canadian waters. The *rbc*L-3P analysis included colonies identified as *Parlibellus delognei* var. *elliptica*, *Parlibellus berkeleya*, *Navicula ramosissima*, and *Nitzschia tubicola*. This analysis also revealed a group of eleven closely related genetic species groups previously described as *Berkeleya rutilans*, indicating this taxon is a complex of species. We sequenced the ITS2 for representatives of the *Berkeleya* species complex and these data were consistent with the *rbc*L-3P genetic clusters for 90% of the colonies tested. The remaining 10% were in conflict possibly indicating that more than a single *Berkeleya* species was present in each macroscopic colony. To investigate this hypothesis further, we developed 'species-specific' ITS2 primers and confirmed the heterogeneity of *Berkeleya* species in 60% of the macroscopic colonies tested. Therefore, a taxonomic assessment of tube-forming species that were originally described on the basis of colony morphology (e.g., *Berkeleya rutilans*), and for which the type collections likely consist of a heterogeneous colony, must be investigate using clonal cultures or single cell analysis. Consequently, currently accepted names and types on which they are based may be of limited taxonomic utility.

WHAT CAN DIATOMS TELL US ABOUT WETLANDS AND RIVER DYNAMICS?

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Can diatoms archived in sediments provide insight into past flood variability? Rivers do not accumulate sediments useful for paleolimnological analysis, but sediments from floodplain lakes (cut-off meanders) might allow inferences of river dynamic. Sediments from upstream get deposited on the floodplain during seasonal recurring inundations. This deposition of sediments has the consequence that the older cut-off meanders are at a higher elevation and have less contact with the river compared to the younger lower elevated lakes, are less frequently inundated and differ in their diatom communities.

This talk presents results of a NSF funded project following the 2008 100-year flood of the lower White River, a tributary to the lower Mississippi in SE Arkansas in the Arkansas Delta. Within the Lower White River National Wildlife Refuge, the annual duration of inundation of the around 400 floodplain lakes ranges from several weeks to several months. In order to develop a quantitative diatom-inference model for river connectivity, surface sediment and water samples were collected from 30 lakes along a gradient from 0 to 6 m height above the Lower White River in spring and summer 2008. Subfossil diatoms were analyzed from the top centimeter of the 30 surface sediments and one of the cores (Adams Bayou). Multivariate statistics revealed that lake height above river bank explained most of the spatial distribution of diatoms and was not correlated to nutrients. Diatoms might have responded to lake level change or might have been transported from the river into the lake. This species-environment relationship allows the development of a diatom-inference model to reconstruct past floods from diatoms archived in floodplain lake sediments. The weighted averaging partial least square (WA-PLS) diatom inference model with two components for height difference between lake and river had a root mean square error of estimation (RMSE) of 51 cm and the jack-knifed root mean square error of prediction (RMSEP) was 108 cm. This high ratio between RMSE to RMSEP shows the need to increase the number of samples in order to increase the robustness of the diatom inference model.

Next to recurring inundation, groundwater depletion and the use of fertilizer seems to be a major factor influencing the floodplain lakes, as the Arkansas Delta is the main rice producing area in the United States. In order to study water

quality changes over time, the sub fossil diatoms archived in a sediment core from Adams Bayou central to the hardwood bottom forest at the lower White River were analyzed and compared to recorded groundwater levels. A shift from the epiphytic diatom *Gomphonema parvum* indicating macrophytes to planktonic *Aulacoseira species* was statistically related to the decline of the groundwater level, suggesting that decreased groundwater recharge of the lake might have led to eutrophication and resulted in accelerated sediment infill of these floodplain lakes valued for their ecosystem services.

DIATOM LIFE CYCLES - HOW FAR BACK CAN WE TRACE THEM?

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There has been a large increase in the number of recorded species of diatoms since the early Cretaceous, from about 50 to over 100,000 at present. One of the adaptations that contributed to this success was the 'sex clock', which permits timing of life cycles longer than one year. However, we only know how sexual reproduction is incorporated into the life history strategies of a handful of species. Part of the reason for this is that sexual reproduction has evolved in a way that does not usually interfere with the increase in cell numbers by asexual reproduction. As a result, it is often overlooked or considered unimportant. Results will be presented to show that the diatom sex clock was already present in the earliest known siliceous fossils from the Lower Cretaceous over 100 million years ago. The community includes both resting stages and vegetative forms from a marine habitat. Also, comparative morphological studies with extant populations have been used to investigate other aspects of the probable life history strategies of selected fossil species found in both the Lower and Upper Cretaceous.

SYSTEMATICS AND MORPHOLOGICAL DIAGNOSIS OF *CYCLOSTEPHANOS* TAXA

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There once was a genus described by Round
Initially his observations seemed quite profound.
But the characters for diagnosis made no sense
And cladistics had to be employed to make it less dense.
So accurate diagnosis could be found.

PRELIMINARY OBSERVATIONS ON SOME COMMONLY REPORTED FRESHWATER *NITZSCHIA* HASSALL SPECIES FROM RIVERS IN THE USA

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With over 300 taxa reported from the continental USA, species of the diatom genus *Nitzschia* Hassall are commonly reported in the freshwater diatom flora. However, there are very few taxonomic studies of *Nitzschia* species from the flora, and only 15 species have been described as new from USA localities; most of the reported species are those originally described from other continents and dealt with in common European floras. We reviewed the commonly reported *Nitzschia* species from studies on rivers in the USA, to better circumscribe the species present in the USA flora, and to provide aids in the identification of the species present. We have treated over 50 of these species, and present LM and SEM observations, comparison with type material, nomenclatural notes and have attempted to verify the species reported. We conclude the *Nitzschia* flora has more endemic species than previously recognized, and that some commonly reported, cosmopolitan taxa cannot at this time be verified in the USA flora. Many of the *Nitzschia* species described from U.S. localities by authors such as Sovereign, Hohn and Hellerman and Camburn have not been identified in recent surveys. None of the common *Nitzschia* taxa described by Friedrich Hustedt previously recorded could be verified as present in the U.S. flora. Taxa such as *Nitzschia dissipata* var. *oligotraphenta* are actually indicators of low nutrient conditions. Eight new species of the genus are described. Additional work is required to more fully understand the *Nitzschia* species occurring in the USA freshwater diatom flora.

ORIGINS AND ELEMENTS OF THE FRESHWATER DIATOM FLORA OF THE HAWAIIAN ISLANDS

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The Hawaiian Islands are an archipelago in the mid-Pacific Ocean, located over 4000 kM from the closest mainland in North America. The Islands developed over a long period of time, with the oldest, Kauai being over 5 million years old, and the youngest, the big island of Hawaii, being ca. 1 million years old. Because they are oceanic islands, and are distant from sources of biodiversity, the flora and fauna of Hawaii have been hypothesized to travel by prevailing westerly winds from Asia and Oceania, from the New World by episodic storm events, and even the arctic dispersed by migratory birds. Some species are invasive and thought to have been introduced to the Islands by humans. The native flora and fauna have many species endemic to the Islands, and several (e.g. honeycreepers, etc.) are textbook examples of evolutionary pattern and process.

The freshwater diatom flora of Hawaii has been explored by relatively few investigators, most of whom concluded that most of the species present are cosmopolitan. A few endemic species were described by Hustedt (1942) and Fungladda et al. (1983). More recently a new genus and several new species were described by Main (2001), and Lowe and Sherwood (2009, 2010), but the compilation by Sherwood concluded that the vast majority of freshwater diatoms species in Hawaii are cosmopolitan.

We have made over 2000 unique collections from a wide variety of habitats on 6 of the islands (Molokai, Lanai, Hawaii, Maui, Oahu, Kauai) and have begun to document the species present. Overall, ¾ of the freshwater diatom genera found in North America occur in Hawaii. The number of species found in each genus is relatively small, compared to North America. It appears that certain groups of species have either directly migrated to Hawaii, or appear to have their closest allies from very distinct origins. Some species are clearly allied with congeners from South America, some from southeast Asia/Oceania and others from North America. Many taxa have crossed the salinity rubicon, invaded freshwater systems, and even radiated in terms of the number of species. In this talk we will discuss the patterns of biogeographic origin, taxon richness and levels of endemism in the Hawaiian freshwater diatom flora.

NON-MARINE DIATOMS (BACILLARIOPHYTA) FROM ULU PENINSULA (JAMES ROSS ISLAND, NW WEDDELL SEA, ANTARCTICA)

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Several years ago, a detailed study on the taxonomy of non-marine diatoms on James Ross Island was started. James Ross Island (64°10'S, 57°45'W) is situated in the north-western part of the Weddell Sea, close to the northern tip of the Antarctic Peninsula. More than 75% of the island is covered with a permanent icecap, leaving only the northern part (=Ulu Peninsula) ice-free. In 2006, a new Czech Antarctic station was constructed on the island and during the austral summers between 2004 and 2009 a large number of samples was collected from seepage areas, streams and lakes.

The aim of our present study is to investigate the diatom communities living in these habitats and the ecological factors determining their composition, diversity and presence. Until recently, most of the non-marine diatom species were believed to have a cosmopolitan nature, mainly due to the use of non-appropriate taxonomic literature. Only a very low percentage of the listed species in the literature showed an Antarctic distribution. However, the results of our study contradict entirely this statement.

A total of more than 100 diatom taxa was identified during the survey. Following detailed morphological research, based on light and scanning electron microscopy, several species have been described as a new for science, such as the endemic *Eolimna jamesrossensis*, *Luticola truncata* Kopalová & Van de Vijver and *Diadesmis inconspicua* Kopalová & Van de Vijver (Kopalová et al. 2009) while several others including *Chamaepinnularia gerlachei* Van de Vijver & Sterken, *Craticula antarctica* Van de Vijver & Sabbe and *Luticola austroatlantica* (Esposito et al. 2008, Van de Vijver et al. 2010) were described from James Ross Island but also occur on neighbouring islands. Recently, five new *Luticola* species have been recorded in the lake samples.

Using multivariate analysis, we were able to characterize ecologically several typical diatom communities with specific

conductance, soluble reactive phosporus, alkalinity and total phosphorus as main determining parameters.
The poster illustrates the morphology of some of the new species and discusses the results of the ecological analysis. The biogeographical relationships of the diatom flora of James Ross Island with other Antarctic localities such as the South Shetland Islands and the Antarctic Continent are briefly demonstrated.

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TAXONOMY, ULTRASTRUCTURE AND BIOGEOGRAPHY OF THE DIATOM GENUS *DIADESMIS* FROM NEW ZEALAND, HAWAII AND GREAT SMOKY MOUNTAINS NATIONAL PARK

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We present identifications and ultrastructural observations on frustular features on *Diadesmis* taxa found in three geographically distinct locations; Great Smoky Mountains National Park (USA), the Hawaiian archipelago and the South Island of New Zealand. Using light and scanning electron microscopy we detail the frustular morphology of 22 different Diadesmis taxa, including 7 new species and 2 *Navicula* species we propose to transfer to the genus.

While members of this genus are commonly found in subaerial habitats around the world, individual species of *Diadesmis* are not cosmopolitan. Species in the Great Smoky Mountains National Park, located in eastern North America, are the same or closely related to species described and found in Europe, while the species in New Zealand and Hawaii are more similar to taxa described from either Oceania or South Atlantic Islands. Each area also has endemic species, which are currently unknown outside the area from which they are described.

Based on the frustular morphology of members of this ~~group of spe~~cies, and their differences with the generitype of *Diadesmis*, namely *D. confervacea*, we propose a new genus, *Humidophila*, to include this group of species.

THE GENUS *PINNULARIA* IN IOWA WETLAND MITIGATION SITES

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Pinnularia is a diverse genus found in many different habitats world-wide, often as a numerical dominant. During a survey of 12 constructed wetlands and three natural wetlands in Iowa, *Pinnularia* taxa were numerous but not abundant in these nutrient-rich, alkaline, hardwater habitats. Counts of over 500 valves from 78 samples found the relative abundance of a *Pinnularia* taxon just over 2% once. Taxa of the genus *Nitzschia* were most numerous, followed by *Navicula*, *Gomphonema* , and then *Pinnularia*. But, in contrast to *Pinnularia*, the other three genera also include numerous taxa with relative abundance over 20% in at least one sample. Although their populations are small, many *Pinnularia* taxa occur in Iowa wetlands. Of 88 *Pinnularia* taxa reported historically from Iowa waters, 41 have been found in this survey. In addition 22 unidentified *Pinnularia* have been observed. The number of identifiably distinct *Pinnularia* taxa ranged from 13 (1 sample) to none (16 samples) with a mean of 2.2 taxa per sample (the mean number of all taxa observed was 49). Too few specimens of most unidentified taxa have been observed to permit describing new species. Environmental factors in Iowa wetlands possibly reduce *Pinnularia* population sizes.

DIATOMACEOUS BIOLOGICAL SOIL CRUST COMMUNITIES IN YELLOWSTONE GEOTHERMAL SOILS

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Diatomaceous
layers o'er magma-warmed soils.
The bison stand guard

A combination of geothermal conditions in an alkaline-chloride soil environment in Yellowstone National Park supports

a novel assemblage of biological soil crust organisms living in a siliceous matrix largely composed of diatomaceous residuum. This unique intersection of thermal soils and biological soil crusts creates an environment that is amenable to diatomaceous growth and frustule deposition and harbors a diverse array of microorganisms conspicuously striated on a small vertical scale. We present a description of the environmental conditions affecting this site, as well as a metagenomic analysis of the eukaryotic and prokaryotic microbial diversity present, with an emphasis on scales, from the soil particle scale to the soil core scale, and across an apparent successional sequence.

DIATOM BIODIVERSITY COMPARISON AMONG DIFFERENT AQUATIC ENVIRONMENTS AT ANDALUSIA FARM, BALDWIN COUNTY, GA

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Andalusia Farm in Middle Georgia has been listed on the National Register of Historic Places for many years and is renowned by descriptions in the letters of Flannery O'Connor. Cultural centers of this importance can serve as reference sites in ecological research. A comprehensive study on diatom biodiversity among the aquatic environments on the property has never been performed. Data on diatom assemblages in ecosystems with minimum human alterations can provide insights on diatom species characteristics, population and community interactions under low nutrient conditions. This research compares diatom biodiversity, species richness, abundance and biomass between the different aquatic habitats at Andalusia Farm. This site is distinct since it contains three different aquatic environments that are affected by the same stimuli (rain, temperature, light, etc.) for the same duration and frequency. Monthly composite samples and physicochemical characteristics of a pond, wetland and a stream continued for a year. Live and cleaned diatoms were assessed with an attempt to predict physiological activities of diatoms in different habitats based on chloroplast's shape and size for the same species found in the different habitats. For live communities, a minimum of 100 algal units were enumerated and for live diatoms, morphometric data together with number and type of chloroplasts present were recorded and used for biovolume calculations and assessment of photosynthetic activity. All live counts were done within 2 hours of collection. Diatoms dominated algal communities in all three habitats. Species richness and diversity in clean diatom analyses were high for the wetland and pond, several species are presented with revised descriptions. Representative species of *Eunotia*, *Pinnularia* and *Navicula* were the most common diatoms among the habitats. Seasonal changes are reported also, as the wetland and stream varied in water levels significantly. The results of this research serve as a comparison to other aquatic environments in Middle Georgia that have been affected by anthropogenic factors.

RELEVANCE OF DIATOM SPECIES COMPOSITION TO BIOFILM-BASED STREAM ECOSYSTEM PROCESSES: POSSIBLE MECHANISMS AND RAMPANT SPECULATION.

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Stream biofilms are often recognized as 'hot-spots' for microbial metabolic activity that drives larger-scale ecosystem processes. The relevance of internal, structural attributes of biofilms to variation in rates of these processes or functional efficiency are rarely considered or examined. Our research focuses on assessing the degree to which variation in the species composition of algal assemblages within stream biofilms influences the quality of organic carbon used by resident bacteria to fuel metabolic activity that ultimately controls biogeochemical processes, such as denitrification, within stream ecosystems. As part of this effort, we characterized the taxonomic structure of algal and bacterial (as 16s rRNA variants) assemblages, and quantified the matrix-associated organic material (via Pyrolysis [Py]/ GC/MS) within diatom-dominated biofilms of varying ages from 6 suburban streams in the Chicago metropolitan area (DuPage County), and examined possible links among these attributes and denitrification potential (DNP) within biofilms. For each study stream, we selected two samples from a larger pool generated from a 12-wk successional study for Py/GC/MS analysis to maximize representation of different dominant diatom species and biofilm-based DNP. Ordination analysis showed broadly similar patterns of separation among study sites in algal and bacterial taxonomic structure, and biofilm organic signatures, with sites exposed to waste-water treatment plant effluent exhibiting both greater separation from other stream sites and greater distance between replicate samples. From our data, no definitive link was evident between biofilm DNP and either algal or bacterial taxonomic composition. However, significant relationships were found between variation in the nature of organic signatures within biofilms and biofilm DNP.

PERFORMANCE OF DIATOM METRICS IN AGRICULTURALLY DOMINATED WATERSHEDS

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This study was designed to determine whether diatom community composition responded to ranges in nutrient concentrations found in low and high levels of agricultural land use. Diatom community composition, nutrient concentrations, and landscape characteristics were determined at 232 sites in eight agriculturally dominated study areas of the continental United States. The eight study areas were separated into two subgroups based on differences in diatom response signature for human disturbance. Two eastern study areas were grouped because they had lower median TP, a lower range in nutrient concentrations, and more wetlands in watersheds than the eight west-central study areas. Diatoms responded to nutrients and ionic gradients in the eastern subgroup of sites and more exclusively to nutrient concentrations in the west-central group of sites. Homogenization of diatom flora in streams as a result of agricultural disturbance was observed at this nationwide scale with the flora converging on taxa adapted to higher alkalinities and nutrient concentrations. Diatom metrics were well related to TN and TP concentration, a multimetric index for nitrogen and phosphorus concentration, and indicators of agricultural land use in watersheds, especially percent row crops. Diatom metrics were more precisely related to N concentrations than P concentrations, but other lines of evidence indicated responses were more likely related to P limitation or N and P co-limitation. The lack of causal linkage between metrics and P concentration may be due to proportionally higher P than N uptake in streams. Diatom community composition responses were related to changes in streams in high as well as low ranges of agricultural activity, which indicates that assessment tools and restoration targets for agriculturally dominated watersheds could be developed using diatom assemblages.

ALLOMETRIC ASPECTS OF FRUSTULAR MORPHOLOGY IN DIATOMS

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Allometry, in the general sense, describes how the morphological, physiological, and ecological traits of organisms change with size. This presentation is focused on the morphology of diatom frustules, so we use the more traditional meaning of allometry, which is the relationship between body size and shape (Huxley 1932). Allometric relationships can be studied at different levels: ontogenetic allometry is related to the growth of an individual, static allometry analyses within-population differences among individuals that are at the same ontogenetic stage, evolutionary allometry examines differences between species and other taxa (Cock 1966). It has long been known that diatoms change their shape as their size diminishes (Geitler 1932), and these profound ontogenetic changes may confound species delimitation. However, only rarely have such ontogenetic-allometric patterns been quantified. Moreover, it is difficult to differentiate between static and ontogenetic allometry in field populations of diatoms, while diatoms in cultures are prone to shape changes caused by artificial growing conditions. Nevertheless, considerable progress has been made recently in describing allometric patterns in diatoms in quantitative terms and understanding their causes. In this presentation we will review concepts and techniques used in studies of allometric relationships in diatom morphology. We will also discuss the application of allometry in taxonomic, ecological, and evolutionary studies of diatoms.

SAMPLE SIZE AND DIATOM-BASED INDICATOR PERFORMANCE

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Several large diatom-based training sets were investigated to determine optimal sample sizes for inference models. The sample sets included (1) assemblages from Great Lakes coastlines, (2) phytoplankton from the pelagic Great Lakes and (3) surface sediment assemblages from Minnesota lakes. Diatom-based weighted average models to infer nutrient concentrations were developed for each training set. Training set sample sizes ranging from 10 to the maximum number of samples were created through random sample selection, and performance of each model was evaluated. For each model iteration, diatom-inferred (DI) nutrient data were related to stressor data (e.g., adjacent agricultural or urban development) to characterize the ability of each model to track human activities. The relationships between model performance parameters (DI-stressor correlations and model r^2, error and bias) and sample size were used to determine the minimum sample size needed to optimize models for each region. Depending on the training set, at least 40-80 samples were needed to capture the variation in diatom assemblages and environmental conditions to such a degree that non-analogue situations should be rare, and so should provide an unambiguous result if the model was applied to any sample assemblage from the region. It is recommended that one exercises caution when dealing with smaller training sets unless there is certainty that the selected samples reflect the regional variability in diatom assemblages and environmental conditions. Further, we

advise that our findings for minimum required sample size may not necessarily extend to other regions and environmental variables. We encourage training set users to employ a similar evaluation to determine whether they have effectively sampled their region of interest.

DIATOMS "EAST OF EDEN": ARE STEAM AND RIVER DIATOM ASSEMBLAGES BEING AFFECTED BY AGRICULTURAL PRACTICES IN THE CENTRAL CALIFORNIA COASTAL REGION?

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Several of John Steinbeck's novels take place along the central California coast, one of the most productive agricultural areas in the world. The area contributes significantly to California's economy (the 10th largest in the world) and has earned the nickname "The World's Salad Bowl." Several streams and rivers within the region have been listed for violating water quality criteria for nitrate and biostimulatory substances. Periphyton in streams and rivers of the central California coastal region was sampled and characterized, along with chemical, physical, and geographic data in order to determine whether agricultural practices are having a significant effect on algal abundance and diatom species composition. Data suggest that while nutrient concentrations are exceptionally high in some areas downstream of intense agriculture, diatom species composition was only weekly related to differences in nitrogen and phosphorus. Diatom assemblages were robust to seasonal changes, showing significantly greater differences between-sites than within-site differences. Water column chlorophyll concentrations, however, did show positive correlations with seasonal increases in nutrients. Factors such as canopy cover, substratum size, specific conductivity, and pH explained more variation in diatom species composition than nutrients among stream reaches. This suggests that alternative states may exist in diatom assemblages once major environmental thresholds are surpassed. Contemporary agricultural conditions may constrain assemblages and limit successful recruitment of other species. Our current survey of reference sites throughout the region should allow us to more effectively evaluate whether diatom assemblages in geologically similar streams have similar diatom assemblages or whether agricultural land use practices have facilitated changes in diatom assemblages.

HISTORICAL WATER QUALITY RECONSTRUCTION OF TINKERS CREEK, OH: ITS NOT WHAT YOU ARE SAMPLING ITS HOW YOU SAMPLE IT

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We inferred Tinkers Creek (Ohio, USA) historical water quality
using diatom assemblages from preserved fish guts for our frivolity.
Our study period spanned 1922 to 1998
to find TP and BOD impacts on the river's fate.
GLEI and LBI indices revealed better water quality in1998
than at any time since 1922 or any other date.
Diversity increased from 1949 to 1952 (years of pollution);
then decreased in 1982 to levels seen in1922 (years of solution).
Cluster and indicator species analysis showed a distinct flora for most years;
at least after we knocked down a few cold beers.
Though the index scores indicate that TP and BOD conditions were better in 1998,
a different diatom flora suggests recovery but not restoration as of late.
This technique allows for accurate historical water quality reconstructions for rivers,
as long as you can get archived fish voucher specimen guts and not the livers.

DIATOM-INFERRED TOTAL PHOSPHORUS RECONSTRUCTIONS FOR LAKE MANAGEMENT: WHEN TO SAY WHEN IN INTERPRETING QUANTITATIVE PHOSPHORUS VALUES

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High TP makes a lake gross and green,
But how to restore a lake to a condition unseen?
Our best bet to manage
Is to take good advantage
Of how diatoms changed in between.

Modern water quality monitoring in the Lake Minnetonka Watershed District (MCWD) indicates current lake conditions vary widely, from mesotrophic to hypereutrophic, and 15 of 18 lakes and bays studied are currently in excess of suggested nutrient targets. To prioritize management efforts and to better understand the degree of impairment in individual lakes, modern and historical (pre-European) nutrient conditions were estimated for eighteen lakes using a combination of modern water quality monitoring and sediment core diatom analysis. A four sample "top-bottom" approach was used to most efficiently and cost-effectively characterize cores to achieve management goals. Sediment diatom assemblages and a statewide diatom calibration set for Minnesota were used to reconstruct historical water column total phosphorus concentrations and to compare recent diatom inferred total phosphorus values (DI-TP) to modern measured values.

Results from the 18 sites showed three main patterns of change in DI-TP from historical to modern samples: bays with direct connection to the main body of the Lake Minnetonka, the largest lake in the watershed, had mesotrophic water quality in historical and modern times, whereas upgradient bays and lakes tended to have eutrophic to hypereutrophic modern conditions and meso- to eutrophic historical water quality. Several lakes, however, showed decreases in DI-TP over time. Previous work with lakes in Minnesota has shown variability in the reliability of DI-TP reconstructions, particularly from shallow lakes. In several detailed reconstructions of lakes from ecoregions similar to the MCWD, trajectories of change down-core do not track TP gradients in modern calibration sets; DI-TP reconstructions from these lakes can therefore provide misleading information regarding the timing and degree of change in trophic status. The amount of variation in diatom assemblages explained by TP changes in shallow lakes (<5m) is also notably low in regional datasets. This makes it difficult to interpret the wide range of inferred changes across the study sites with confidence.

Here we discuss several means of evaluating the reliability of inferred TP values, including examining trajectories of change in core data, comparing historical lake diatom assemblages to modern analogues, and assessing the ability of modern diatom inferred measures to accurately predict modern measured values.

MOLECULAR PHYLOGENY OF THE AMPHOROID DIATOMS, WITH COMMENTS ON MONOPHYLY OF THE GROUP AND THEIR SYSTEMATIC POSITION WITHIN RAPHID DIATOMS

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Amphoroid diatoms comprise a large (>700 named species) and diverse group both morphologically and environmentally with many representatives in freshwater, estuarine and marine environments. With this variety in form and ecology have come a range of taxonomic and systematic problems and the classification of the group as a whole is largely based on nine subgenera proposed by Cleve (1895). Since that time more detailed morphological analyses have lead to the transfer of many taxa into new or existing genera such as *Seminavis*, *Eunophora*, and *Undatella*. Recently analyzed morphological and molecular data from taxa included in the sub-genera *Amphora* and *Halamphora* have supported the non-monophyletic nature of *Amphora sensu lato* and have led to the elevation of the subgenus *Halamphora* to the generic level. Past molecular analyses have included only a few taxa and their position in the larger diatom tree has remained variable. We present here a newly developed multi-gene molecular phylogeny for the group *Amphora sensu lato*, representing the greatest taxon sampling to date, including members from marine subgenera not previously included. We will discus monophyly of *Amphora sensu lato* and its position within raphid diatoms, as well as implications with regards to cell wall morphology and the distribution of taxa across a salinity spectrum.

ISN'T IT A PITY ABOUT DIATOM DIVERSITY?

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The United States Environmental Protection Agency conducted a nationwide assessment of the ecological conditions of lakes. Diatoms in the tops and bottoms of sediment cores, phytoplankton, water chemistry, as well as land use, climate, and geology of lake watersheds were determined for more than 1000 lakes using a probabilistic sampling design. Substantial changes in species composition and decreases in native species diversity were observed along the human disturbance gradient. Large scale decreases in native taxa and increases in invasive taxa were observed in lakes disturbed by humans as a result of shifts from species adapted to low nutrient concentrations to those requiring high nutrient concentrations for growth. In addition, these changes have the potential for substantial alterations in food web structure, such as the observed decreases in percent of chain forming diatoms and increases in percent of small unicellular diatoms with increasing human disturbance. In the National Lakes Assessment, the United States Environmental Protection Agency determined that 47% of US lakes were in good condition, 27% in fair condition, and 23% in poor condition. Based on simple assumptions about native species loss, we estimate that 50 and 75% of native taxa are not observed in fair and poor condition lakes. However, because of the assumptions that we make about relationships between observed and actual diversity, we cannot determine whether we have under or overestimated diversity loss, and how that varies with spatial scale. The pity is that we know so little quantitatively about threats, or lack of them, to diatom diversity.

ENDEMISM AND BIOGEOGRAPHICAL REGIONALISM IN ANTARCTIC DIATOM COMMUNITIES

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Arctic and Antarctic floras and faunas differ strongly in their overall composition and diversity. This reflects the spatial separation between both Polar Regions and different evolutionary origins of lineages in response to interhemispheric contrasts in glacial history and connectivity among land masses. In contrast, prevailing theory predicts that Arctic and Antarctic habitats should share the same microbial communities, because allopatric speciation is expected to be rare among microorganisms and local environmental factors should act as the major process structuring their metacommunities through lineage sorting. Here we examined the diversity and endemism among extant diatom floras in Arctic and Antarctic lake districts to test this prediction. Contrary to theory, strongly contrasting patterns emerged: in the Southern Hemisphere, diatom floras are impoverished and imbalanced compared with their Arctic counterparts. In particular, Antarctic diatom floras are characterized by high levels of endemism, the lack of important functional groups such as planktonic taxa, the overrepresentation of terrestrial lineages and the general poverty of globally successful genera. Comparison with fossil Miocene assemblages and molecular clock analysis of diversification patterns point to high rates of local extinction during Neogene and Quaternary glacial maxima, in combination with radiations through allopatric speciation in refugia. We conclude that processes generating the distribution and diversification of microorganisms can operate at similar spatial and temporal scales as in macroscopic organisms, leading to strikingly congruent biogeographic patterns. Our findings have implications for the response of polar microbial communities in the face of the accelerated rates of warming, and underscore the pressing need for stringent measures to prevent the introduction of non-native microbes in Antarctic environments.

AN ATTEMPT TO REVISE THE GENUS PERONIA BRÉB. ET ARN. EX KITTON WITH POSSIBLY TWO NEW SPECIES

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Peronia Brébisson et Arnott ex Kitton is a small freshwater genus belonging to the Eunotiales Silva, and shares basic characteristics with other genera within this group, e.g. the presence of a rudimentary raphe, the absence of a central nodule, and the ecology. The populations of Peronia species usually occur in very low abundances in oligotrophic and dystrophic water, growing as a periphyton attached to the surface by mucilage.

Although the genus Peronia includes 12 described taxa, only a couple of species are commonly reported, and they appear to have been confused in the past, with various authors having different concepts for them. The type species of the genus, P. erinacea Brébisson et Arnott ex Kitton was described in 1868 without an illustration. Hustedt illustrated two very different forms of P. erinacea in Schmidt's Atlas, one of them he later decided to put in the genus Asterionella, as Asterionella fibula (Brébisson in Kützing) Hustedt based on the name Gomphonema fibula Brébisson ex Kützing, a previous name for P. erinacea. Gomphonema fibula has indeed been a source of the most confusion, because of having been transferred both into Asterionella fibula (Brebisson in Kützing) Hustedt and into Peronia fibula (Brebisson in Kützing) Ross.

Another two species, Peronia heribaudi Hustedt and P. angustivalva Cleve-Euler, were later as well considered synonyms of P. fibula. Peronia intermedium (H. L. Smith) Patrick was found out to be actually a species of the genus Meridion, as originally identified by H. L. Smith. Thus, based on this synonymy, it appears that there are only two species of Peronia: Peronia fibula, and Peronia brasiliensis Hustedt.

Despite this resolution, observations on the type material, original drawings in the classical literature and photographs in the modern literature, it still seems that the concept of those two species is still not clear, probably also due a considerable variability in Peronia valve shapes. Our goal was to look at available type material and other populations from the North America (mostly from the collection of slides at the Academy of Natural Sciences in Philadelphia), and to demonstrate the morphological variability within the Peronia populations.

In addition, we present two forms of Peronia from our samples which are different from the two recognized species: one from the northeastern U. S. (mostly from Maine), having a drawn-out, acute head pole; the second one from Roraima Tepui (on the border of Venezuela, Brazil and Guayana), which has a bluntly capitate head pole. These Peronia forms may be species new to science.

A NEW DIATOM PRESERVATION PROXY AND RECORD OF PRESERVATIONAL CHANGES IN THE AMUNDSEN SEA.

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As oceans warm and acidify, it is of increasing interest how marine biota will react to climactic changes. The diatom response to these changes is of particular interest. Looking at previous climate warmings provides a baseline for predicting changes of the near and distant future. However, in assessing diatom abundance in past oceans, there currently exists no proxy for changes in the rate of silica recycling in the surface waters. That is to say, when reconstructing diatomaceous primary productivity levels, we assume constant preservation of frustules. Here I present a fully quantitative proxy of diatom preservation for the Southern Ocean, a key location for nutrient transport, opal deposition, and deep water formation. Cleaned valves of culture-grown *Fragilariopsis kerguelensis* have been dissolved under controlled conditions. The proxy compares dissolution induced changes in frustule morphology to silica added to the dissolution medium. This creates a link between average silica loss and morphological change. This proxy has been applied ~400ka of sediment from a core from the Amundsen Sea (PS58-254). Evaluations of diatom preservation show a shift to better preservation at Marine Isotope Stage (MIS) 8. This is tentatively tied to a shift in the polar front and diatom growth conditions. In general, we see only a very weak correlation between glacial/interglacial cycling and preservation.

GROWTH OF DIATOM CULTURES UNDER DIFFERENT IN-VITRO CONDITIONS

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Cultured diatoms are valuable model systems, but locally and regionally common or new to sciences taxa are unavailable in commercial culture collections. Samples from different habitats in Georgia were used for cell isolations. Diatom species were collected from brackish waters along the banks of the Savanna River, Georgia. Freshwater communities were collected from Lake Sinclair, Georgia either from natural habitats (water column, vegetation, and sediment), or grown on a diatometer placed in the lake. In the lab, natural chemical compositions of waters from different sources were recreated. Brackish filtered water was used from the Savannah River location and Bold's Basal freshwater medium was prepared following recipe. Soil nutrients were extracted and used to infuse proper nutrients in the lab media for growth and reproduction. Diatoms were allowed to grow in different vial sizes with and without agitation along with the use of agar plates. All inoculated vials and petri dishes were then placed in an incubator under standard conditions (14:10 h light, 17˚C temperature, and 90% humidity) and then checked every two days for growth. Over a 4 week period of time, both vials and petri dishes have shown growth of cultured algae. Preliminary data shows that diatoms grew better on agar substrate compared to liquid medium; this was true for both benthic and planktonic diatoms. Plastic versus glass vials and petri dishes did not show significant difference in growth, implying that our medium had enough Si available. Growth and reproduction were estimated by using a light microscope, where samples were analyzed. The freshwater

sample from the diatometer in Lake Sinclair was easier to culture, because of the lower species diversity. From both brackish and freshwater samples, there were around 23 different species observed where 42% were attempted at culturing. Eleven different diatom species have been identified and grew successfully from both brackish and freshwater samples. Potentially new to science and common representatives of the genera *Achnanthidium*, *Cymbella*, *Gomphonema* and *Navicula*, together with *Melosira varians* thrived in freshwater artificial environment and representatives of the genera *Terpsinöe* and *Hydrosera*, grew successfully in brackish recreated conditions. Documenting growth and reproduction in artificial environments was an important part of the several collaborative molecular, physiological, and ecological projects in the lab.

FROM AGRICULTURE TO CONSERVATION EASEMENT - LAKE RESPONSE TO LANDUSE CHANGE

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The Bass Lake Preserve was acquired by the Geauga Park District, Geauga County, Ohio through the Trust for Public Land in 2003. The Preserve includes a 65 hectare lake and approximately 245 hectares of surrounding land. Ninety percent of the current shoreline is reforested or has extensive wetland vegetation. We conducted an assessment of Bass Lake to determine current conditions, assess over 60 years of basin-wide change in land-use practices, and determine lake response to these changes using sediment diatom assemblages. A 95cm sediment core was collected from the deepest point in Bass Lake and sub-sectioned it into 1 cm intervals. Loss-on-ignition (LOI) analysis was conducted on all samples to determine organic carbon content. Select intervals were analyzed for fossil diatom assemblages based on organic carbon fluctuations. Dates were determined by Pb^{210} analysis on subsamples from a companion core. Correspondence analysis was conducted to identify changes in diatom assemblages, and diatom-inferred total phosphorous concentrations were reconstructed using a locally developed phosphorus inference model from 30 regional lakes in Northeast Ohio and Northwest Pennsylvania. Black and white aerial photos, color orthophotos, Landsat imagery, and Geauga County historic records were incorporated into land-use analysis using ERDAS and ArcGIS. Written historical records were also used to determine possible human impacts and compared with LOI carbon analysis, diatom analysis, and GIS analysis of 20th century land-use changes. Evidence of early damming and dredging with recent eutrophication from development is seen in the carbon and diatom record. Diatom assemblages shift from low-pH, low-TP species such as *Eunotia incisa* to higher-pH, higher-TP including small *Stephanodiscus* species. GIS results show a transition from heavy agricultural use in the watershed during the 1950's to considerable reforestation post-1960's and increased development over the past decade. Diatom data indicate that basin reforestation has little affect in lake phosphorus levels or sedimentation rates, and a return to pre- or early settlement lake conditions does not occur even though vegetative buffers have been in place for more than 40 years. Current land use policies and practices, including landscape fragmentation, aging septic systems, increased upstream residential development, as well as phosphorus reservoirs in lake sediments, reduce the effectiveness of protected shoreline and conservation easements surrounding Bass Lake.

DIATOM INFERRED LAKE LEVEL AND HABITAT TRANSITION IN THREE WILD RICE (*ZIZANIA PALUSTRIS)* LAKES ON THE FOND DU LAC RESERVATION

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Zizania palustris, otherwise known as wild rice, is a large food source and also an important part of the Ojibwe culture. In the 20th century, wild rice production in the lakes on the Fond du Lac Band of Lake Superior Chippewa Reservation declined in wild rice production. The reasons for the decline are not well understood; however, land use change in the region, the sensitivity of wild rice to increased fluctuations in water levels, and diminishing water quality are all thought to play a role. Man-made ditching in the early part of the 20th century, intended to drain the wild rice lakes on the Reservation, provides an interesting case study in how land use change and nutrient loading may affect wild rice production.

The research described here is part of a larger NSF funded project (Manoomin) that focuses on student outreach, education and primary research. Teams of Native undergraduate student researchers with the help of expert mentors complete much of the primary research and data analysis. Sediment cores were taken from Dead Fish, Perch, and Rice Portage lakes with the assistance of students from the Reservation and surrounding area. Student interns counted

diatom valves using standard taxonomic references and the results were analyzed by comparing relative abundances of planktonic/benthic diatoms and lake specific training sets. Pollen, phytoliths, and sediment geochemistry were used as additional indicators of lake depth and habitat transition in these shallow wild rice lakes. The primary objective of this research is to better understand how nutrient conditions have changed as the lakes have filled in with sediment and become shallow enough to support abundant benthic diatoms and submergent/emergent vegetation.

Preliminary data suggest that lake depth decreased in all three lakes sometime between 3000-2000 cal. yr. BP and again as recently as 100 years ago. Recent decreases in lake depth could be the result of increased sediment loading after the surrounding areas were ditched in the 1910s. The diatom communities at all three lakes are currently dominated by benthic taxa and have been for more than 2000 years. More recently, benthic diatom community compositions have shifted away from species previously observed in high abundance throughout the analyzed sediment cores, suggesting potential increases in nutrient levels and changes in habitat availability over the last 100 years. Significant increases in nutrient availability in these shallow wild rice lakes can confound lake depth reconstructions, because shallowing and nutrient loading are linked and can lead to similar shifts in the diatom species assemblage. However, planktonic diatoms (mainly *Aulacoseira* and *Stephanodiscus*) present in low abundance throughout the last 3000 years are now almost completely absent, suggesting decreases in lake depth could be a response to a shift in water balance, as well as increased sediment loads.

POSTER PRESENTATION ABSTRACTS

In order of presenting author last name

ESTABLISHMENT OF A PRELIMINARY PROXY FOR SILICA CYCLING IN SURFACE OCEANS

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To date, there is no proxy for measuring silica cycling in paleo-oceans. This is a significant gap, in that silica can act as a limiting nutrient for diatoms during the peak producing season. Furthermore, rates of paleo-silica cycling can be utilized to determine past production levels of diatoms. Comparing theses presumed paleo productions to current trends can yield useful predictions for the future. This study intends to extrapolate a proxy for paleo silica levels from a Southern Ocean core (PS58-254). The Southern Ocean is chosen for clear record of glacial cycles, and high abundance of diatomaceous opal. A proxy is hereby created comparing morphological change in dissolving cultured diatoms to known loss of silica. The species chosen for analysis is *Thalassiotrix antarctica*. While this species is not overly abundant in sediments, it is continually present in open ocean environments and sediments. The experiment involves the dissolution of diatoms in f/2 standard artificial sea water over heat. The suspension of diatoms and dissolved silica is sampled at regular intervals and analyzed for silica concentration. Corresponding morphological change and loss of surface area in the diatoms themselves is measured via SEM. This poster presents the initial results from analysis of PS58-254.

VALIDATING THEORETICAL FLOW CONSTRAINTS WITH LIVING DIATOM CULTURES

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Stepanek made a mess in the herbarium
With glycerin, diatom models, and an aquarium.
After great effort I was able to make the equipment go
Making it possible to measure real diatoms in flow
And keep Julius from going to the sanitarium.

DIATOMS AS BIOLOGICAL INDICATORS FOR ENVIRONMENTAL ASSESSMENT: A LAB ACTIVITY FOR UNDERGRADUATE ECOLOGY COURSES

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Biological indicators, such as diatoms, are widely utilized for environmental assessment and monitoring. This poster presents a lab activity used in an upper division course in ecosystem and global ecology that is adaptable for use in a range of undergraduate science courses including ecology, general biology, and environmental science. It is the third in a series of three lab activities for which the learning objectives include skill with light microscopy, knowledge of ecology, understanding of environmental assessment methods, quantitative reasoning, civic engagement, and diatom appreciation. In this activity, students use diatoms to assess the trophic status of a water body near campus. Working with prepared

slides, students identify and count diatoms at the species level, with the aid of a local flora and on-line identification guides: Diatoms of the United States (westerndiatoms.colorado.edu), Common Freshwater Diatoms of Britain and Ireland (craticula.ncl.ac.uk/EADiatomKey), Great Lakes Diatom Home Page (www.umich.edu/~phytolab), Diatoms Genus Project (research.calacademy.org) and Algae Image Database (diatom.ansp.org/AlgaeImage). Students calculate the trophic status of the water body using a weighted averaging function and the trophic optima for species from van Dam et al. (1994), Kelly & Whitton (1995; via the Common Freshwater Diatoms of Britain and Ireland web page), or a local transfer function training set. With successful completion of this lab, students have the tools that enable them to develop and propose their own independent project assessing and comparing the environmental conditions of local water bodies, using diatoms as biological indicators.

STEPHANODISCUS THERIOTENSIS A NEW DIATOM FROM THE LAURENTIAN GREAT LAKES

Intana Chanthirath and Matthew Julius
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There once was a diatom from Superior
Who felt its absence of a character was inferior.
Rather than keep its anatomical deficiencies quiet,
It decided to take a name in honor of the "The Riot"
And be proud of its limited exterior.

THE NORTH AMERICAN DIATOM SYMPOSIUM: A BRIEF HISTORY OF NADS 1970-2011

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The Flathead Lake meeting of the The North American Diatom Symposium represents the twenty-first time that diatomists have formally gathered for NADS. The first meeting, called "*Ecology of Freshwater Diatoms*," was held in October 1970 at the Cedar Creek Natural History Area in Minnesota and was organized by Platt Bradbury and Ryan Drum. Four years later, the group gathered again at Hocking Hills in Ohio for the "*Second North American Symposium on Diatom Systematics and Ecology*", a meeting that set the stage for the now biennial gathering of this informal society. In 1978 (Iowa Lakeside Lab) and 1979 (University of Michigan Biological Station) the meeting was held in adjacent years to reset the timing of the meeting to occur in alternate years from the International Diatom Symposium. Over the last 40-plus years NADS has been held in twelve states and once in Canada (1993, Delta Marsh). With use this presentation to gather a brief history of NADS by documenting the first twenty meetings including their programs, photos, t-shirts, highlights, and attendees. The information gathered will be prepared for inclusion on the official NADS website at www.northamericandiatomsymposium.org.

TWO NEW FOSSIL CYCLOSTEPHANOID DIATOMS FROM THE FRENCH CANTAL REGION

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I found two new diatom in France.
You may overlook them with just a glance.
The significance of their morphology is apparent
If you do not find systematics and cladistics abhorrent.
Making the species descriptions more than chance.

FRANKOPHILA WAYQECHAE SP. NOV., A NEW DIATOM SPECIES FROM THE PERUVIAN ANDES

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Frankophila is characterized in appearance as a small chain-forming genus with frustules held together by interdigitating marginal spines. Both valves of species in this genus possess a short raphe at the distal ends of the valve. Five species of *Frankophila* have been recognized to date with most being described from subaerial habitats. Expoloration of moist, vertical, rock walls in the Peruvian Andes led to the discovery of a *Frankophila* species new to science. We describe *Frankophila wayqechae* Furey, Catenazzi, Lowe et Mayama sp. nov. from a high altitude (3506 m.a.s.l), moist, vertical wet wall located in the transition zone between the grasslands and cloud forests growing on the eastern slope of the Andes in Manu National Park. We present light and scanning electron micrographs of internal and external morphology and ultrastructure, along with basic ecological information are presented. We compare this new species with morphological similar taxa, including *Hygropetra* Krammer & Lange-Bertalot. *Frankophila wayqechae* appears to be restricted to high elevation areas in the Peruvian Andes. The triseriate striae and depressions in the valve sternum of *Frankophila wayqecha* differentiate it from other currently described *Frankophila* species. *Frankophila wayqechae* has morphological characteristics intermediate between the genus *Frankophila* and the genus *Hygropetra* which suggests a close phylogentic relationship between these taxa. Tropical mountain tops in Peru and throughout the Andes are areas of high species richness and endemism for many plant and animal groups, including the algae. We anticipate the discovery of more new diatom taxa from the subaerial samples in this study.

AN ECOLOGICAL ANALYSIS OF LACUSTRINE DIATOMS IN COSTA RICA

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Diatom communities vary in species composition on subcontinental scales, and their component taxa may vary in their ecological preferences. We sought to develop ecological relationships for freshwater diatoms in Costa Rica. Seventy-eight lakes were visited a total of 135 times, and each lake was evaluated for up to 27 parameters. Principle Components Analysis confirmed previous work in which many chemical parameters co-varied, including Mg^{++}, Na^{+}, K^{+}, Ca^{++}, Si, pH, and alkalinity; a secondary axis was related to the physical environment (e.g. lake depth, area, transparency, and landscape position). In the surface sediments of the 78 lakes we identified 149 species (in 47 genera) of diatoms that reached at least 5% relative abundance in at least one sample. Canonical Correspondence Analysis revealed that variation in the distribution of diatoms was significantly ($p < 0.05$) related to Mg^{++}, Si, pH, elevation, alkalinity, Cl^{-}, and lake depth. However, because down-core assemblages often have no modern analogs (i.e. share too few taxa with the CCA training set), we also developed transfer functions for individual taxa. We used SPSS to evaluate species-specific relationships of the 20 most widespread diatoms to the 15 best-documented environmental parameters, and found that each environmental parameter was significantly ($p < 0.032$) related to at least 2 species. Similarly, we used LABFit for Gaussian (normal) regressions with the 10 most widespread diatoms, omitting lakes from which each species was absent. This analysis revealed at least one significant relationship ($p < 0.012$) for 14 of the 15 environmental parameters. Among these relationships, we found that species diversity (as measured by Hill's N2 index) was significantly related to lake depth, Mg^{++}, K^{+}, Si, and Cl^{-} (for each, $p < 0.0052$). The relative abundance of *Frustulia saxonica* was significantly related to macrophyte cover, alkalinity, Ca^{++}, and Na^{+} (for each, $p < 0.024$) and that *Eunotia minor* abundance was related to pH, conductivity, and total Fe (for each, $p < 0.029$). Absolute valve abundance was related to Cl^{-}, temperature, Ca^{++}, conductivity, and alkalinity (for each, $p < 0.030$), while total relative abundance of *Pinnularia* was related to alkalinity, conductivity, and macrophyte cover (for each, $p < 0.029$). Overall, the results are consistent with ecological preferences for these taxa in temperate areas, but this study expands our understanding of diatom distribution relative to many environmental parameters in the neotropics. Because several taxa can be used to estimate each parameter, whether by CCA or by transfer function, this analysis may be quite powerful in paleolimnological reconstructions.

A CONSIDERATION OF SOME *GOMPHONEIS* CLEVE SPECIES: CHANGES IN NOMENCLATURAL STATUS, NEW SPECIES AND THOUGHTS ON BIOGEOGRAPHY

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In this poster we consider the taxonomy and nomenclatural status of several taxa we first interpreted as varieties within the *G. herculeana* and *G. eriense* species complexes. We treat these varieties here as separate species, and provide descriptions and nomenclatural changes for these taxa to reflect this new interpretation. A large, fossil species of *Gomphoneis*, depicted originally as *G. mammilla* in Schmidt's Atlas is considered distinct, and we present LM and SEM observations as well as formally describe this new species. Finally, we present observations on some *Gomphoneis* species in North America and in Asia that further strengthen Ehrenberg's proposal that the floras of western North America and Asia may be more similar to one another than the floras on either coast of North America.

FIVE NEW *LUTICOLA* SPECIES FROM ULU PENINSULA (JAMES ROSS ISLAND, NW WEDDELL SEA, ANTARCTICA)

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During a survey of the non-marine diatom flora from lakes on Ulu Peninsula, a large ice-free area in the northern part of the Antarctic James Ross Island (Maritime Antarctic Region), a large number of species belonging to the genus *Luticola* has been found. Most of the observed taxa show a restricted Antarctic distribution. Five of them could not be identified based on the currently available literature and have been described as new taxa (Kopalová et al. 2011). *Luticola desmetii* Kopalová & Van de Vijver sp. nov is a rather large, sturdy species with a clearly rhomboid valve outline and distinct capitate apices. *L. doliaeformis* Kopalová & Van de Vijver sp. nov. has a distinct axial and central area. *L. permuticopsis* Kopalová & Van de Vijver sp. nov. belongs to the group of capitate taxa related to *L. muticopsis* (Van Heurck) D.G. Mann but based on its higher number of areolae, its raphe structure and its more symmetrical valve outline, the species cannot be confused with any other taxon of this complex. *L. tomsui* Kopalová sp. nov. is one of the rare *Luticola* taxa with a constricted valve outline. Finally, *L. evkae* Kopalová sp. nov. is a small, delicate species with a large axial area and a reduced number of areolae per stria.
Detailed morphology descriptions of these taxa are given based on both light (LM) and scanning electron microscopy (SEM). The morphological features of each taxon have been compared with similar taxa and notes on the ecology of the species have been added.

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DIVERSITY OF THE GENUS *DIADESMIS* IN THE ANTARCTIC REGION

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Species belonging to the genus *Diadesmis* are quite abundant in the entire Antarctic Region, both in number of species as in number of individuals. Most of the species in this genus have small valve dimensions, uniseriate striae composed of one, usually elongated areola and a simple raphe structure. When the genus was first erected in 1990 (Round et al. 1990), only seven species were grouped together, subdivided into two subgenera, *Diadesmis* and *Paradiadesmis* (Rumrich et al. 2000).

The past few years, a large number of new species have been described worldwide, several of them apparently endemic to the Antarctic Region (Van de Vijver et al. 2002). During a recent survey of the diatom flora of several islands in the southern Atlantic and southern Indian Ocean, the diversity of the genus *Diadesmis* was re-investigated. While the taxonomy of the *Diadesmis* species in the southern Indian Ocean is rather well-defined, the status of most taxa in the southern Atlantic Ocean is much more uncertain with several taxa showing affinities but also differences to their southern Indian Ocean relatives.

This poster shows the most recent results on the taxonomy and the diversity of this typical aerophilic genus using both LM

and SEM obsverations. Several questionable taxa are discussed and a preliminary biogeography is suggested.

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DREISSENID MUSSELS: A NOVEL HABITAT FOR *ELLERBECKIA* IN THE LAURENTIAN GREAT LAKES?

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Ellerbeckia arenaria (Moore ex Ralfs) Crawford is usually described as an aerophil or occurring on the sandy bottoms of lakes. We have surveyed dreissenid mussels and their associated *Cladophora*-epiphyte assemblages along the western coast of Lake Michigan since 2004, but not until 2010 did we find *Ellerbeckia* growing on quagga mussels at two survey stations. Quagga mussels are now the dominant invasive dreissenid mussel in Lake Michigan. Their shells serve as substrates for a number of algal species and their associated epiphytes, but thus far *Ellerbeckia* has not been documented as an epizootic alga in the Laurentian Great Lakes or elsewhere. Quagga mussels have acted as ecological engineers in the Laurentian Great Lakes by enhancing light penetration to greater depths and by promoting phosphorus cycling close to the bottom. If *Ellerbeckia* populations ultimately respond positively via increased growth on mussel shells, this would be another instance of the benthification of lake food webs as a consequence of dreissenid mussel invasion.

MASTOGLOIA SMITHII VAR. *LACUSTRIS* GRUNOW: TAXONOMIC ORIGINS AND MORPHOLOGICAL VARIABILITY IN NORTH AMERICA

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Mastogloia smithii var. *lacustris* is a widespread diatom taxon that often dominates the flora of karstic environments, especially in habitats that experience periodic desiccation. Despite the large populations, this taxon is often misreported as the nominate variety or the name *lacustris* is given to specimens that do not closely match its description. The occurrence of elongated and deformed initial valves also contributes to taxonomic uncertainty. Furthermore, the original description of this taxon (by Grunow in Schneider 1878) did not designate a holotype or even provide a type locality. These uncertainties spurred an investigation into the taxonomic origins and what characteristics make up the North American concept of *M. smithii* var. *lacustris.* Specimens from Iowa, Ontario, Florida, and several sites in the Caribbean region were compared to a "type" slide of Grunow material from Belgium. The northern specimens appear more similar to the type specimens than the tropical specimens; the latter exhibit consistently finer striae density, more linear-lanceolate rather than elliptical-lanceolate valve margins, and more narrow central areas. We suggest designating a lectotype and elevation of *M. smithii* var. *lacustris* to the species level, and formally describing a new taxon to accommodate the tropical populations.

TWO NEW SPECIES OF *ORTHOSEIRA* (BACILLARIOPHYCEAE) FROM LAVA TUBES IN THE NORTHERN AND SOUTHERN HEMISPHERES

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While studying algal biodiversity on relatively remote archipelago in Hawaii (Lowe& Kociolek) and Ile Amsterdam in the southern Indian Ocean (Van de Vijver) we independently discovered that lava tubes present unique isolated microhabitats that appear to support several new species of algae. In this case, two new species of the diatom genus *Orthoseira* Thwaites. From Pua Poo lava tube in Volcanoes National Park we here describe *Orthoseira johansenii* Lowe & Kociolek sp. nov. and from Ile Amsterdam in the southern Indian Ocean *O. verleyenii* Van de Vijver sp. nov. Based on light and scanning electron microscopy observations, the morphological features of both species are illustrated, comparing them to similar *Orthoseira* species worldwide. Notes on their ecology are added.

DIATOMS FROM CAVES AND LAVA TUBES IN HAWAII: TAXONOMY, SYSTEMATICS, AND BIOGEOGRAPHY

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This paper aims to understand the aerophilous cave diatom flora of three Hawaiian islands and the relationship between these islands based on community assemblage. Diatoms were collected in a total of nine caves and lava tubes on the islands Hawaii, Oahu, and Kauai. A total of 118 taxa were documented with light micrographs, and a Sorensen similarity index was calculated between the three islands. As hypothesized, the community assemblages of Kauai and Oahu are the most similar sharing 12.5% of taxa, while Hawaii and Oahu had the least similarity with an index of 9%. Cave diatom community composition may be affected by a number of factors including island age, island assemblage before the caves were colonized, the cave water source, human impacts, and physical properties of the particular caves and lava tubes.

SUMMARY OF PHYTOPLANKTON MONITORING AT FALLEN LEAF LAKE, TAHOE WATERSHED, CALIFORNIA.

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A limnological monitoring program was established at Fallen Leaf Lake in 2009 in order to provide modern baseline data for interpreting a Holocene paleoclimate signal from diatom-rich cores. Fallen Leaf Lake is a small (5.2 km^2) and deep subalpine lake that fills the Glen Alpine glacial valley at the south end of the Lake Tahoe basin. It is a dilute transparent lake, with secchi depths ranging from 8-15m, and develops a deep chlorophyll maximum (DCM) at 40m that is dominated by diatoms. We have observed a 5-6 month period of summer stratification, with the epilimnion reaching a maximum depth of 17.5m in August. Monthly samples were taken from late April- November in 2009, and continue semiannually. These data support previous work that the lake is N limiting to N-P co-limiting, and provide seasonal and spatial information on the ambient phytoplankton. Strong vertical partitioning of species occurs during stratification, and *Cyclotella bodanica* and *Dinobryon* are the dominant summer epilimnial taxa. A seasonal succession is observed and the early spring is dominated by *Asterionella form*osa, *Aulacoseira subarctica*, *Urosolenia eriensis*, and *Fragilaria tenera*. In the late spring, *U. eriensis* and *F. tenera* concentrations drop off, possibly tied with drops in N and P derived from snowpack, and *A. subarctica* is relegated to depths of 40m and deeper. *A. formosa* and *Tabellaria fenestrata* persist throughout the summer, being dominant components of the CDM. In late summer, large blooms of *Cyclotella rossii* become the successor species in the DCM, and persist until deep mixing in the late fall. Some interannual variation has been observed. In 2010, *T. fenestrata*, occurred in significantly lower concentrations. One possible explanation is that *T. fenestrata* may be more responsive to nutrient pulses, and the prolonged cool temperatures in spring 2010 served to mediate the flow of runoff and nutrients, favoring the growth of other spring species, such as *F. tenera* and *A. formosa*.

Work on the diatom record of the surface sediment and cores is in its initial stages, but large variations in % *Aulacoseira subarctica* are observed down-core, as well as variations in % of araphid phytoplankton, and ratios of the various cyclotelloids. Variations in the abundance of *D. stelligera*, low mantled *Aulacoseira* species, and % periphyton down core may be related to inputs from higher in the watershed, where these taxa reside. They are not observed as live cells in the lake, but instead are washed in during spring runoff. One significant distinction between the modern and fossil flora is the high percentage of araphid pennates. *A. formosa*, very abundant in the modern system, has been tied to anthropogenic eutrophication in other western alpine lake systems. It is hoped that the monitoring data will be useful in interpreting fossil diatom assemblages that may reflect past variations in stratification, inflow conditions, and trophic status.

ASSESSMENT OF THE ABUNDANCE OF THE FRESHWATER STALKED DIATOM *DIDYMOSPHENIA GEMINATA* IN RIVER SEDIMENT FROM THE S. FORK AMERICAN RIVER, SIERRA NEVADA FOOTHILLS, NORTHERN CALIFORNIA

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Analysis of surface sediment downstream from *Didymosphenia geminata* blooms in the South Fork of the American River, Sierra Nevada Foothills, reveal that *D. geminata* is the dominant lotic component, measured in biovolume. This finding justifies further coring programs downstream in Folsom Reservoir to help improve the current understanding of historical abundance patterns. This study focused on measuring abundances in both river water and surface sediment deposited between a *D. geminata*-clogged reach of the river and Folsom Reservoir, an expected depocenter with the

potential to preserve an 80 year record of lotic contributions in an aggradational sedimentary system. The purpose of this study was to test methodologies and determine the feasibility of eventually using cores from lakes and reservoirs with *D. geminata* in inlet streams to quantify past and present *D. geminata* growth patterns. Samples were collected from 3 localities along a 6 km stretch of the river using a Ponar grab sampler, and the intact upper 1cm surface layer was removed and bagged for analysis. Samples were freeze-dried, weighed, and spiked with *Lycopodium* spores to allow for the calculation of biovolume per mg sediment. Strewn slides were made and 400 diatoms were counted per sample and identified to the genus level. Measurements were made of each operational taxon for biovolume calculations.

Genus level identifications indicate a strong river signature with minor reservoir contributions, possibly from upstream reservoir populations. *D. geminata* contributed between 27-49% of dry sediment by biovolume. Surface water samples were also analyzed and found to contain similar percentages of dislodged *D. geminata.* The strong contribution of *D. geminata* communicates that the species is likely to persist in detectable levels, even when diluted by lacustrine floras downstream in the reservoir. Future study justified by the present analysis has the potential to improve understanding of observed changes in *D. geminata* abundance and distribution patterns in the Sierra Nevada Foothills, and assist in regional monitoring efforts of *D. geminata*.

THE DIATOM GENUS *ACTINELLA* IN HAWAII

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The diatom genus *Actinella* is known from South and North America, New Zealand, and Madagascar, with fossil occurrences in Japan and Europe. The genus reaches its highest diversity in South America, with over 60 species having been described, mostly from the Amazon region.

We examined samples from 6 of the Hawaiian Islands, including Lanai, Kauai, Oahu, Maui, Molokai and the big island of Hawaii, have documented the taxonomy, valve ultrastructure and distribution of the genus across the island. We have found 4 morphological entities on the islands, including *A. punctata*, a morphotype similar to *A. punctata*, and two morphologies that appear to be new to science. *Actinella punctata* was found on the big island of Hawaii and Molokai, in almost all of the sites that were sampled. The morphotype similar to *A. punctata* was found only on the big island, while the other two morphotypes were found only on Molokai

In this poster we present LM and SEM observations of these four morphological groups, and provide descriptions and distribution records for the species. Based on morphological data, it appears as though the genus *Actinella* may have dispersed to Hawaii from South America.

NEW SPECIES OF THE GENUS *AMPHIPLEURA* FOUND IN NEOTROPICS

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The diatom genus *Amphipleura* Kutzing (1844) is characterized as a naviculoid diatom with raphe slits at the two poles which are separated by a narrow axial sternum. There are currently approximately twelve described taxon within the genus *Amphipleura*. We describe a potential new species of the genus *Amphipleura* which was collected in streams in the neotropics which is morphologically most closely related to *A. lindheimeri* Kützing and *A. lindheimeri var. neotropica* Frenguelli . Morphologically, this potentially new taxon has a much larger width than other *Amphipleura* taxa. We examined specimens from four sites in Costa Rica and Panama using light microscope with brightfield optics to measure total length, width, and raphe lengths of all specimens.

First, we compared the morphometrics of the new species to those of *A. lindheimeri* and *A. lindheimeri* var. *neotropica*. The length range is continuous among the three diatom taxa but is 150-210 µm in *Amphipleura* sp. since individuals with the much larger width were found to be in this length range. Results indicate that *Amphipleura sp.* has a width range of 33-70 µm compared to *A. lindheimeri* and *A. lindheimeri* var. *neotropica* which range from 23-27 µm and 27-32 µm accordingly. In addition, the raphe length of *Amphipleura* sp. appears to be larger than the two known species with a proportion of around 1:3 to 1:14 of valve length. Length to width scatter plots demonstrate complete separation between populations of this new taxon and populations of *A. lindheimeri*. Preliminary analysis supports the description of a new species of *Amphipleura* based on morphological differences including width.

SEVERAL NEW SPECIES FROM THE GENERA *AMPHORA* EHRENBERG EX KÜTZING AND *HALAMPHORA* (CLEVE) LEVKOV, WITH COMMENTS ON TAXONOMY AND PHYLOGENY OF THE AMPHOROID DIATOMS

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Amphora sensu lato incorporates a large and extremely diverse group of diatoms. Although having its greatest taxonomic diversity in marine environments, inland waters of the United States may hold a large amount of undescribed diversity in need of thorough investigation and taxonomic revision. Presented here are descriptions of several new species from the genus *Amphora* subgenus *Amphora* and the genus *Halamphora,* collected from inland waters of the western United States, based on light and scanning electron microscope observations. We will compare these new species with existing taxa and comment on their systematic position.

FEASIBILITY STUDY FOR USING DIATOM ASSEMBLAGES FROM A SMALL DILUTE SUBALPINE LAKE AS AN INDICATOR OF PAST MEGADROUGHTS IN THE SIERRA NEVADA.

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A 112cm sediment core segment from Fallen Leaf Lake is analyzed to test the potential for using the lake's diatom record as a proxy for paleohydrographic variability in the Lake Tahoe watershed, Northern California. Fallen Leaf Lake is a small, deep dilute oligotrophic system that fills the steep-sided Glen Alpine glacial valley. Its deep southern sub-basin is separated from the shallower northern sub-basin by a series of morrainal ridges that could have potentially partitioned the lake during past lowstands. A previously documented lowstand 36-50m below current lake level serves as an independent calibration point with which to test the diatom sensitivity. This lowstand is interpreted to represent the Medieval Climate Anomaly (MCA), which has been documented to have prolonged drought effects throughout the Great Basin and Sierra Nevada during the 12th and 13th centuries. The MCA is manifested in Fallen Leaf Lake as a series of large submerged trees with drowning ages of 700 cal yr BP. The upper section of a 9.5m core taken in 111m water depth in the southern depocenter is analyzed. Preliminary ^{14}C dates from plant macrofossils collected down-core suggest that the lowstand (circa 950-700 cal yr BP) is preserved somewhere between 50-70 cm. Samples of 0.5 cm thickness were taken every 4cm, and identifications were made to the lowest taxonomic level resolvable by 1000x light microscopy.

Diatom assemblages are dominated by phytoplankton, primarily centrics (*Discostella*, *Aulacosira subarctica*, and *Cyclotella rossii-ocellata* complex,) and lesser amounts of araphid pennates (*Asterionella formosa*, *Fragilaria tenera*, *Tabellaria fenestrata*). Other significant components include several shallower tychoplantonic fragilariods (*Pseudosaurosira brevistrata, Staurosirella pinnata*, and *Staurosira construens*), several low-mantled *Aulacoseira* species (eg. *A. humilis*), and small monoraphids (*Karayevia*, *Psammothidium*, *Rossithidium*), and *Nitzschia* (*N. frustulum, N. gracilis*). Initial counts of 500+ valves were conducted on 10 samples concentrating across the 50-70cm interval, and indicate several changes that may indicate a measure of lowstands or flooding given further investigation. Sample 53 stands apart from those above and below in several ways, including lower numbers of *A. formosa* and *Discostella*, and higher numbers of *C. bodanica* and the larger ocellate variant of the *C. rossi-ocellata* complex. Changes in *Discostella* abundance may be of interest because it presently is not living in the lake, but is washed in from higher in the watershed during spring runoff. The % of low-mantled *Aulacoseria* is markedly higher in the 53 to 69 cm interval than above and below, and may correspond to increased input from marshy habitats established during lowstands. Additionally, small monoraphids (primarily *Psammothidium* and *Rossithidium* species) and shallower water fragilariods (*Staurosira* and *Staurosirella*) increase in both abundance and diversity from approximately 57 to 65 cm depth, which could signal a decrease in planktonic species coincident with the MCA. Additional work will establish planktonic to benthic ratios of counted diatom species and tie these results to a three-dimensional model of the morphometry of FLL currently under development that will help delineate the extent of shallow benthic habitats during lowstands.

FOUR NEW *RHOICOSPHENIA* GRUNOW SPECIES FROM FOSSIL DEPOSITS IN INDIA AND WESTERN NORTH AMERICA

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Four species of *Rhoicosphenia* Grunow are described from fossil deposits from Galteshwar, India and Oregon, U.S.A. The first Indian taxon, *R. gandhii* sp. nov., is large with coarse striae and robust areolae, 16-48 um long and 6-8.25 um wide, with 11-12 striae in 10 microns. The other Indian taxon, *R. indica*, is narrow, with very acute apices, coarsely striated, with unresolved areolae, and is greatly flexed in girdle view, 12.5-44 um long and 3-4 um wide, with 12 striae in 10 microns. The first species from Oregon is *R. reimeri* sp. nov., which is large, much like *R. gandhii*, but varies in valve shape, but shares the robust nature of striae and areolae, 18-70 um long and 6-10 um wide, with 9-11 striae in 10 microns.

The second taxon from Oregon, *R. patrickii* sp. nov., is similar to *R. indica* at first glance, but has blunt rather than acute apices, 11-45 um long and 4-4.5 um wide, with 10-11 striae in 10 microns. These taxa do not appear to sufficiently fit the morphological descriptions of fossil taxa included in Schmidt's Atlas and is also differ from extant taxa in Northern California and are thus described as new in this manuscript.

SYSTEMATIC POSITION OF THE GENUS *RHOICOSPHENIA* GRUNOW IN THE DIATOM TREE OF LIFE

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Based on valve morphology, cytoplasmic features, and sexual reproduction, several hypotheses for the systematic position of the genus *Rhoicosphenia* Grunow have been proposed. One hypothesis, advocated by several including Grunow, Hustedt, and most recently, Patrick & Reimer, place the genus in the Achnanthaceae Kützing, mainly due to valve flexure and the heterovalvate nature of the frustules – one bearing a complete raphe, and the other with a reduced raphe system. A second hypothesis, set forth by Cleve, supported by a cladistic and phenetic study by Kociolek & Stoermer, and adopted by Round, Crawford, & Mann, allies *Rhoicosphenia* Grunow more closely with the Gomphonemataceae Kützing, due to cuneate valve shape and chloroplast structure. Two additional evolutionary scenarios have been described by Mann. The first suggests that *Rhoicosphenia* is the primitive ancestor of the Achnanthaceae and Gomphonemataceae. The other scenario places *Rhoicosphenia* outside of these two lineages at an unknown position within the raphid diatoms.

In the 1980's, *Rhoicosphenia* was the subject of several taxonomic and systematic studies, but to date has not been included in any published molecular systematic studies. The addition of *Rhoicosphenia* to the molecular Diatom Tree of Life will allow testing of past hypotheses based on a variety of morphological characters. A preliminary molecular phylogeny using two populations of *Rhoicosphenia* and additional raphid taxa does not support any of the aforementioned phylogenetic hypotheses. Instead, the results indicate that *Rhoicosphenia* occupies a unique position within the Cymbellales, reflecting a closer relationship to the Gomphonemataceae rather than the Achnanthaceae. These results are consistent with the phenetic and cladistic results of Kociolek & Stoermer. We will increase the taxon sampling of *Rhoicosphenia* in future research in order to answer questions of monophyly within the genus as well as biogeographic questions in regards to the ubiquitously reported *R. abbreviata* (*curvata*).

THE DIATOM FLORA OF THE SOILS OF THE ATACAMA DESERT, CHILE

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The Atacama Desert in coastal Chile is the driest hot desert in the world. We collected a total of 88 soils samples from a 1000 km long region of the Atacama (La Serena to Iquique) as part of a study of the algal flora of the soils of the Atacama Desert, and here report on the diatom portion of that flora. Most of the soil samples collected contained no recoverable chlorophyte or cyanobacterial taxa. Thirty-two of the samples had at least one green algal or cyanobacterial isolate; these samples were examined for diatom frustules. A total of 49 different diatom taxa were recovered from the soils. Of these, the clear soil inhabitants were *Hantschia amphioxys, Luticola cohnii, L. goeppertiniana, L. mutica, L. nivalis, L. ventricosa, Pinnularia borealis*, and *Pinnularia subcapitata*. There were several other taxa reported from desert soils previously, including *Epithemia adnata, Denticula valida*, and *Nitzschia valdecostata*. *Planothidium lanceolatum*, a generally aquatic taxon, was also fairly common. Chrysophyte cysts were also commonly encountered, a typical finding in desert soils. A number of other aquatic taxa were present in very rare numbers, and we suspect wind-blown transport for these species.

TAXONOMY AND BIOGEOGRAPHY OF THE GENUS *NAVICULA* S.S. IN (SUB-) ANTARCTIC INLAND WATERS

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Diatoms (Bacillariophyceae) comprise one of the most diverse and abundant algal groups in the Antarctic and sub-Antarctic freshwater ecosystems. A critical revision of literature reports of *Navicula* s.s. taxa in the Maritime Antarctic and Sub-Antarctic Region indicates that, despite the large number of records (Kellogg & Kellogg 2002), the genus is rather species-poor in the Sub-Antarctic and Antarctic when a more fine-grained taxonomy is applied. A revision of all records of the *Navicula* s.s. species in inland water samples from the Sub-Antarctic (Crozet Archipelago, South Georgia) and the Maritime Antarctic Region (South Shetland Islands, South Orkney Islands, James Ross Island) based on Kellogg & Kellogg (2002) resulted in a confirmed presence of only 14 taxa, five of which needed to be described as new species, viz. *Navicula australoshetlandica* Van de Vijver sp. nov., *N. dobrinatemniskovae* Zidarova & Van de Vijver sp. nov., *N. cremeri* Van de

Vijver & Zidarova sp. nov., *N. conveyi* Van de Vijver sp. nov. and *Navicula bicephaloides* Van de Vijver & Zidarova sp. nov. (Van de Vijver et al. 2011). The poster shows several of these new species. From a biogeographical point of view, there is a clear separation between the Sub-Antarctic localities in the southern Indian Ocean and the islands in the southern Atlantic Ocean, with several species showing a restricted biogeography.

References:
Kellogg T.B. & Kellogg D.E. (2002) Non-marine and littoral diatoms from Antarctic and subantarctic regions. Distribution and updated taxonomy. Diatom monographs 1: 1-795.

LABELLICULA OR *OLIFANTIELLA*? A NEW ENIGMATIC SPECIES FROM THE ANTWERP HARBOUR (FLANDERS, BELGIUM)

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The Antwerp harbour is one of the largest in the world but, unlike most international harbours, it is located more than 100 km from the sea and only connected to the North Sea by the River Schelde, resulting in a mixture of fresh, brackish and saline water flowing through the different docks. During an extensive analysis of the diatom flora in 2008, several unknown, or so far unidentified, taxa were found. One of the unidentified taxa is presented on this poster.

It is a small biraphid species with several unusual features. The valves are typically slightly domed, with the downward facing apices. The striae appear uniseriate, extending from the raphe sternum to the mantle but interrupted at the valve face/mantle junction. Most characteristic is the presence of a small, rounded internal central nodule between the central raphe endings and the presence of a stigma adjacent to this central nodule (visible in SEM as an external small slit with an internal a round thickening). The raphe is filiform with simple terminal and central endings. The areolae are covered internally by hymenes and, unusually, the valve margin seems to fold back inwards and reconnect to the valve interior. The girdle consists of perforated copulae and the valvocopula has an enlarged pars interior. At present it is unclear to which genus this species belongs. Two genera are possible: *Labellicula*, described from the sub-Antarctic Region (Van de Vijver et al. 2005) and *Olifantiella* recently described from the Indian Ocean (Riaux-Gobin et al. 2009).

The poster discusses the morphology of the unknown taxon, illustrating its ultrastructure and comparing it with the descriptions of both *Labellicula* and *Olifantiella*.

References:
Riaux-Gobin C. & Compère P. (2009) Olifantiella mascarenica gen. & sp. nov., a new genus of pennate diatom from Réunion Island, exhibiting a remarkable internal process. Phycological Research 57: 178-185.Van de Vijver B., Frenot Y., Beyens L. & Lange-Bertalot H. (2005) Labellicula, a new diatom genus (Bacillariophyta) from Ile de la Possession (Crozet Archipelago, Subantarctica). Cryptogamie, Algologie 26(2): 125-133.

SPRING DIVERSITY OF SURIRELLA SPECIES IN THREE CENTRAL UNITED STATES SITES

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Surirella species are common in assemblages from many parts of the United States but normally occur in relatively low abundance. Most freshwater species of this genus are highly motile and found in epipelic settings; this genus is usually included in groups of species indicative of increased siltation. This study focuses on the *Surirella* species present in a series of three width-transect samples collected weekly from individual locations in Iowa (Lick Creek), Illinois (Felky Slough) and Missouri (Youngs Creek) beginning 10 May 2011. These early spring samples record a high abundance of several *Surirella* species, with the highest total percent relative abundance of Surirella being 45%, 63% and 25.5% of the diatom assemblages in each of the three locations, respectively. The most abundant species present is *Surirella* cf. *S. brebissonii* var. *kuetzingii* Krammer and Lange-Bertalot. This species averages 84% of all *Surirella* species counted in the Iowa samples, 92% in the Illinois samples and 32% in the Missouri samples. The Missouri site, though, had the most diverse assemblage of this genus with the number of *Surirella* species ranging from 3 to 7 (average 5.4) with the Iowa (1-7, average 2.8) and Illinois (1-5, average 3) having lower diversity of *Surirella*. The other more abundant *Surirella* species observed in these samples are: *S. angusta* Kützing (2-26 counted, 7.9 average), *S. brebissonii* Krammer and Lange-Bertalot (1-25, 5.9), S.cf. *S. brebissonii* var. *punctata* Krammer (2-11, 5.1), *S. minuta* Brébisson in Kützing (1-10, 3.3) and *S. suecica* Grunow in Van Heurck (1-14, 5.4). *Surirella brebissonii* (as *S. ovata*) has been previously noted to have a winter

maximum; the abrupt decline observed in abundance of the dominant S. cf. *S. brebissonii* var. *kuetzingii* at the end of May supports this observation. The other commonly occurring *Surirella* species decrease in abundance at this same time suggesting a winter maximum might be applicable for these also. The morphological variation in the *S. brebissonii, S. cf. S. brebissonii* var. *kuetzingii*, S. cf. *S. brebissonii* var. *punctata* and *S. minuta* from these sites is presented and compared. The high numbers present in the assemblages provides an ideal opportunity to examine the range of features present in and defining each species.

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