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## DISTRIBUTION PATTERN AND MORPHOMETRIC PARAMETERS OF SHALLOW PONDS IN SOUTHERN BUENOS AIRES PROVINCE, ARGENTINA

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In the Buenos Aires province (Argentina) the number of lagoons and shallow ponds surpasses the thousands including permanent and non-permanent water bodies. Most of them are developed in agricultural zones. The rainfall regime presents the higher values in autumn and spring. Due to their physical characteristics, shallow pond spatial variation has a significant correlation with seasonal events. The spatial distribution, morphometric parameters and extension changes of the shallow ponds in the southern Buenos Aires Province were studied during two periods: normal and wet years. GIS operations, satellite image and DEM data were used to evaluate shallow pond area changes and morphometric parameter calculation. The distribution of the water bodies was assessed in relation to the topographic slope, drainage system, soils characteristics and rainfall regime. In all cases of morphometric parameters, the values present an increase during the wet period with respect to the normal one. During the humid period the number of shallow ponds with an area less than 1 $km^2$ increases and, therefore, the area covered by water. The highest shallow pond number was developed in the east of the study area.

Finally, a significant correlation was found among the spatial distribution of the shallow ponds, geomorphologic and edaphic features and the drainage density.

## THE CAUSES AND ECOSYSTEM IMPACTS OF *GLOEOTRICHIA ECHINULATA* BLOOMS IN GLEON SITES IN THE NORTHEASTERN UNITED STATES AND CENTRAL SWEDEN

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*Gloeotrichia echinulata* is a nitrogen-fixing cyanobacterium whose blooms are well-documented in eutrophic systems, particularly in northern Europe. In the past few years, however, *G. echinulata* has started blooming in oligotrophic lakes across New England, USA. *G. echinulata* is unique among cyanobacteria because it can transport a considerable amount of phosphorus from the sediment into the water column and may substantially increase internal phosphorus loading. My research primarily focuses on the causes of *G. echinulata* outbreaks and the ecosystem and community-level impacts of this

organism in two GLEON sites: oligotrophic Lake Sunapee, New Hampshire, USA, and eutrophic Lake Erken, Norrtälje, Sweden. In my poster, I highlight a few mechanisms by which *G. echinulata* may potentially perturb food web processing and biogeochemical cycling: allelopathic biochemicals, microcystin-LR production, nitrogen-fixation, and phosphorus translocation and release. In addition, I present experimental research on the potential causes of *G. echinulata* blooms in oligotrophic Lake Sunapee and synthesize historical data from Lake Erken on bloom triggers. My experiments in Lake Sunapee demonstrate that a phosphorus pulse at the sediment-water interface increases germination rates by 2.5X and recruitment rates by 2-16X. Moreover, my field observations suggest that a pulse of phosphorus at the sediment-water interface can significantly increase *G. echinulata* recruitment after a three-week lag, the interval of time *G. echinulata* akinetes need to develop into planktonic colonies. My results indicate that *G. echinulata* outbreaks in oligotrophic New England lakes may be in response to higher nutrient concentrations and therefore are an incipient sign of increasing eutrophication.

## SYNERGIC EFFECT BETWEEN TEMPERATURE AND ULTRAVIOLET RADIATION ON AQUATIC ZOOPLANKTON IN A GLOBAL CLIMATIC CHANGE SCENARIO

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It is well known that the increase in solar irradiance threatening both ecosystem and organism of mid inhabiting mid and high latitudes of the earth. At the organism level, different mechanisms and strategies provide protection to endure life at high irradiance and particularly, to cope with high ultraviolet radiation (RUV) levels. The accumulation of Photoprotective compounds (PPCs), such as carotenoids and mycosporine-like amino acids (MAAs) has been shown to improve the survivorship of aquatic organisms exposed to high levels of RUV. In this study we analyzed the variability of carotenoids and MAAs in a calanoid copepod in relation to temperature and RUV. The crustaceans were collected from the shallow pond “Los Juncos” (North Patagonia, Argentina). The results of laboratory incubation show up that PPCs (both MAAs and Carotenoids) were highest at 16ºC in the presence of visible light (PAR + UV-A). Remarkably the survivorship of the copepod decrease with increasing temperature and in the presence of visible light. This may be related to the fact that *Boeckella* species are cold-adapted and as reflected by they occurrence at mid and lower latitudes during cold months. Thus, *Boeckella* may be vulnerable to the increase in temperature which could condition their occurrence resulting in changes in geographical distribution as has been observed in several different animal and plant.

## ZOOPLANKTONIC COMMUNITY AND PHYSICO-CHEMICAL PARAMETERS OF THE UNAMUNO SHALLOW POND DURING THE SPRING

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The objective of the present work was to study the zooplanktonic community and the physicochemical parameters of the Unamuno shallow pond, located on the southwest of Buenos Aires Province. Zooplankton was studied in a qualitative and quantitative form, the limnological conditions of the biotope were analyzed and the water body was characterized on the basis of the presence of characteristic species. The approach of the field work was centered in collecting biological material from October to December, 2006 every 15 days. A sampling station was selected (Station 1), where "in situ" measurements of the physicochemical water properties were taken. Meteorological conditions were observed from a nearby weather station. Zooplankton was collected with a net of 200 µm. Seven species were determined: two cladocerans (Moina eugeniae and Alona diaphana), four copepods (Boeckella poopoensis, Metacyclops sp., Microcyclops sp. and Cletocamptus sp.) and a ciliated (Strombidium sp.). The density of total zooplankton for the lagoon was variable, alternating from 221 to 1703 ind/l. The most abundant species was Moina eugeniae (70 %) and marked the tendency of total zooplankton, it was followed by the calanoid copepod Boeckella poopoensis (27 %). Zooplankton shows large size and a high dominance index, with absence of planktonics rotifers. The specific diversity was 2.69 bits/ind and the equitability 0.96 that would indicate a strong dominance of few species. There were no thermal stratification for the study period and water temperatures oscillated between 16.3 and 23.2 ºC (average = 19.4 ºC). Salinity values characterized the lagoon as oligohalin, with low concentrations of nitrates and silicates and high concentrations of nitrites and phosphates. The dominant cation and anion were $Na^+$ and $CL^-$ , respectively, being able to classify it like bicarbonate sodic chlorinated. It shows highs values of chlorophyll, which would indicate high primary productivity.

## CONTROLS ON STABILITY OF MICROBIAL MATS FROM THE FLORIDA EVERGLADES

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Everglades' microbial periphyton mats are assemblages of tightly-coupled autotrophic (algae and cyanobacteria) and heterotrophic (bacteria, fungi, and microinvertebrates). The thick mats dominate production and short-term nutrient cycling in much of the oligotrophic Everglades. Stability of this vital ecosystem component is of special importance given the rapid response and sensitivity to even small changes in nutrient status. I investigate the stability of these microbial mat systems by looking at changes in size-fractionated biomass and fine resolution (every 10 second) dissolved O2 concentrations. I also investigate controls on carbon and nutrient uptake, storage and loss. Both mat structure and metabolic rates respond rapidly and are sensitive to phosphorus (P) additions. P additions to this oligotrophic P-

limited system cause rapid mat breakup, dramatic declines and imbalances in metabolic rates, and increased likelihood of system crash. Loss of mat structure leads to further reductions in stability. Oligotrophy is important to maintaining stability of microbial periphyton mats and mat structure provides whole-system resilience.

## INFLUENCE OF LIGHT AND ORGANIC MATTER SOURCE ON AQUATIC RESPIRATION

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The majority of research in aquatic ecosystems has focused on primary production. However, mounting evidence in lake systems suggests that carbon dioxide supersaturation and a dominance of heterotrophic bacterial activity prevails. Despite its apparent dominance in lake ecosystems, little mechanistic understanding of the factors influencing respiration exists. We have developed a mass-balance model to explore the influences of organic matter source and sunlight on lake respiration. Using published estimates of key rates in our model we hope to isolate knowledge gaps and develop research goals to improve our understanding of respiration in lake ecosystems. Further development of the model may allow adaptation of current lake metabolism models that depend on nighttime respiration measurements to estimate respiration during daylight hours.

## INSTRUMENTATION TO EVALUATE RESPONSE OF PHYTOPLANKTON TO DISTURBANCES IN STRATIFIED LAKES

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Primary productivity in stratified lakes is often limited in summer but may be increased if recycled nutrients are transported across the metalimnion. Strong wind mixing events characterized by low Lake numbers ($L_N$<1) potentially alleviate such nutrient stress in surface waters by upwelling biologically available nutrients. Previous time series data from Toolik Lake, AK, indicate that instabilities in the internal wave field are likely to cause fluxes of nutrients several times during each summer. A similar patterns occurs in Mono Lake, CA, in late summer/early fall. Fluorescence yield can be used to describe the nutrient status of phytoplankton as well as quantify the recent light history of the phytoplankton. We measured *in situ* variable fluorescence with a PhytoFlash submersible fluorometer by Turner Designs, to see if this new instrument would allow us to capture algal responses to these mixing events. Vertical casts made at dawn at Toolik Lake, AK and Mono Lake, CA indicated that fluorescence yield was greater at depth in both lakes, which coincided with vertical nutrient gradients. An experiment was performed in the summer of 2007 at Toolik Lake to measure the response of phytoplankton to changes in the physical structure of the lake. Time series results from the PhytoFlash, deployed at 2 m below the surface, indicated strong diurnal trends in fluorescence yield attributable to changes in irradiance but did not show responses to increased nutrient loading. The thermal regime of the lake was relatively stable in 2007 compared with previous years due to an unusually warm summer. Because $L_N$ did not drop below 3 and $K_z$ values were small, the estimated time of ammonia diffusion through the metalimnion was on the time

scale of months. Despite the lack of phytoplankton response in Toolik Lake in 2007, we anticipate response in other years with stronger mixing events.

## SOURCES OF DOM TO ALPINE SURFACE WATERS: IN-LAKE VS. WATERSHED PRODUCTION

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The pulse of dissolved organic matter (DOM) that occurs during snowmelt in mountain catchments is associated with the flushing of DOM from soils and plant leachates. This flushing may be attenuated and/or the chemical character of the DOM may be altered by the presence of wetlands in the catchment. As summer progresses, the DOM in alpine lakes is also derived from autochthonous algal production. We studied the impact of an unusual 3-day mid-summer rainstorm on the biogeochemistry of DOM in an alpine lake in the Green Lakes Valley in the Colorado Front Range. The July 7th-9th, 2006 rain event produced 9 cm of precipitation and increased discharge from the lake 2.5 fold compared to peak snowmelt. Characterization of DOM by fluorescence spectroscopy, PARAFAC, and other methods shows that immediately following the rain event, the DOM fluorescence characteristics were reset to values similar to those observed during snowmelt. Then, in response to increased primary productivity, the DOM fluorescence indicated an increasing microbial contribution and a progressively more oxidized state of the fulvic acid quinones. Analyses of samples collected from an upstream wetland indicate that the wetland acts as a source of terrestrially derived reduced DOM throughout the season. Lake modeling results provide a quantitative measure of the relative contribution of in-lake and watershed derived DOM over the course of the growing season and attribute these sources to hydrologic and biological changes in the catchment.

## INFLUENCE OF PERIPHYTON ON CARBON DIOXIDE SEQUESTRATION ALONG ENRICHMENT AND HYDROLOGIC GRADIENTS IN EVERGLADES MARSHES

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Periphyton in the Everglades has some of the highest cited production values (up to 10371 g C $m^{-2}$). Biomass of periphyton mats in Caribbean calcareous wetlands has been found to be greater than the biomass of common emergent macrophytes (*Eleocharis cellulosa*), but can also be greater than or equal to that of robust macrophytes (*Typha domingensis* and *Cladium jamaicense*). However, even small increases in phosphorus can have dramatic changes in periphyton productivity, structure, and composition. The resulting periphyton mat disassembly after phosphorus enrichment could have dramatic impacts on carbon dioxide sequestration by periphyton. I wish to determine the cause of

periphyton mat disassembly using closed-system round bottom reaction vessels. I will use high-low treatments of phosphorus to determine their effects on mucopolysaccharide production by cyanobacteria which seems to act as a glue to hold the mat together. I will use high-low treatments of antimicrobials to determine the effect of bacterial abundance on the consumption of mucopolysaccharides and carbon dioxide production by bacteria. Additionally, I will perform chamber studies in Everglades short and long-hydroperiod marshes to determine if these periphyton-dominated marshes are sources or sinks for carbon dioxide.

## USE OF PHYSICAL LAKE-SCALE MODELS AS SUPPORT FOR MULTI-POSITIONAL FIELD SENSOR DATA

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Heterogeneous lake features during turnover events can be difficult or impossible to capture using one-dimensional measurement techniques. By predicting flow conditions with lab-scale and numerical models, multi-positional buoy data can utilize intelligent interpolation to improve the understanding of whole-lake behavioral trends. A 1:100 scale model of north Sparkling Bog, located in northern Wisconsin, was constructed for the purpose of predicting lake dynamics resulting from manipulation of seasonal thermal structures. The model was created as part of preparation for whole-lake mixing efforts scheduled for June 2008. The physical mixing methods are to be simulated in the lake scale model using Reynolds and Weber similarity, and results will be used to coordinate sensor placement during the field experiment. The lake model is composed of a thermoformed acrylic shell, allowing the use of stereoscopic particle visualization techniques to predict flow patterns during full-scale mixing events. The model will be thermally stratified using Weber similarity by establishing a bed temperature and a climate controlled ambient air temperature. We hope physical modeling approaches can yield insight for sensor placement and data interpretation.

## ADDING UV TRANSPARENCY AS AN OPTICAL INDICATOR OF ALLOCHTHONY IN LOW DOM LAKES

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Allochthonous dissolved organic matter (DOM) is an important ecosystem subsidy that regulates many limnological characteristics including transparency, euphotic zone depth, net ecosystem production, pH and buffering capacity, microbial communities, thermocline and temperature stratification, metal availability, and toxicity of many xenobiotics. While studies have used a variety of methods to assess allochthony in high DOM lakes, little research has focused on how differences in allochthony influence the optical properties of low DOM lakes. In the summer of 2007 we examined the relationship between several optical indices (spectral slope, PAR:UV ratios) and degree of allochthony (DOM/chl ratio) in 19 low

DOM alpine and subalpine lakes in the Beartooth plateau, WY/MT. Both spectral slope (280-700nm) and PAR:UV (400-700:320 nm) increased with increased allochthony. These relationships were not present when UV transparency data were omitted from the analyses. This demonstrates that adding UV transparency to assessment of optical changes in low DOM lakes provides a novel metric for understanding how lakes may respond to a variety of factors that influence allochthony such as global climate change and nutrient deposition.

## LAKE MIXING FROM A MICROBIAL PERSPECTIVE: LINKING INSTRUMENTED BUOY DATA WITH AQUATIC BACTERIAL RESPONSE TO OVERTURN

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Lakes are hubs of biogeochemical processes, and are strongly influenced by the watersheds that they drain. Because microbes mediate most of these biogeochemical transformations of carbon and nutrients, knowing which bacteria are present and what they are doing is essential to understanding lake and watershed response to local or global change, or large-scale disturbance. Our study system, Yuan Yang Lake (YYL), Taiwan, offers an advantageous system to investigate bacteria-lake function interplay because it is strongly influenced by terrestrial carbon. YYL is an instrumented GLEON site and uniquely experiences both seasonal and episodic lake mixing, the former driven by winter temperature changes, and the latter driven by typhoon disturbance. High-resolution buoy data show that typhoons completely mixed the vertical water column to homogenous conditions. Previous studies have revealed that these typhoon-induced overturns "re-set" the bacterial community to a pioneer composition. As stratification in temperature and dissolved oxygen re-established, a distinct community predictably developed in each thermal layer. Intrigued by this response to typhoon mixing, we conducted an intensive survey of bacterial community response to winter mixing in March 2007. We collected daily epilimnion and hypolimnion samples during and after winter mixis, and then used molecular techniques to fingerprint the bacterial communities. We examined community dynamics using multivariate analyses, and then related these to dissolved oxygen and temperature changes, as well as water column stability (calculated by lake number). We expected a different community response to winter mixis, as it does not correspond with the same intensive terrestrial run-off or water level increases as typhoon mixis. We found that epilimnion and hypolimnion bacterial communities converged during winter mixis, but that the post-mixis community seemed to be an intermediate in composition between the two initial communities rather than the distinct pioneer community observed after typhoons. We also compared community dynamics following winter mixis and typhoon mixis. Our results suggest that community response to mixis is influenced both by seasonality of proximate drivers (e.g. dissolved oxygen and temperature) and compositional history, and demonstrate the application of high-resolution sensor data to microbial ecology studies.

## AUTONOMOUS LAKE MONITORING: SYSTEMS AND EXPERIMENTAL DESIGN FRAMEWORK

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We present Networked Info Mechanical System for Aquatic applications (NIMS-AQ) – a tethered robotic system that had been used for several deployments in lake and river environments. To optimize on the limited deployment time and to ensure the fidelity of the collected data, we present IDEA - Iterative experiment Design for Environmental Applications. We demonstrate the utility of IDEA framework using data collected during previous deployments in the lake environment (Lake Fulmor, California). Additionally, we present a non-stationary Gaussian Process model developed to perform path planning for adaptively sensing at a small number of locations using a mobile robot. We demonstrate the effectiveness of our modeling approach using temperature data collected at a lake at University of California, Merced campus. Finally, we present the ongoing work on development of a deployment tool that incorporates the phenomena model, enabling autonomous sensing using static and mobile sensing devices in a Labview environment. We provide a generic framework for combining all such building blocks – mobile/static sensing devices, experimental design framework, phenomena modeling, centralized data collection and deployment user interface, for autonomous lake monitoring.

## CHANGE OF PHYTOPLANKTON COMMUNITIES AND RELATED ENVIRONMENTAL FACTORS UNDER DIFFERENT TEMPORAL SCALES IN MEILIANG BAY OF TAIHU LAKE (CHINA) – A LARGE, SHALLOW SUBTROPICAL LAKE

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Long-term data of phytoplankton assemblages and key environmental variables (water temperature, water transparency, suspended solids concentrations, nutrient concentrations) with monthly resolution were monitored in Meiliang Bay since 1991. The correlation analyses of long-term data showed that the dynamics of phytoplankton community was more closely influenced by eutrophication and seasonal succession was mainly related to temperature and underwater light. During the turnover periods from spring to summer (about five weeks from April to May) in 2004, data of phytoplankton, key environmental variables and zooplankton species were collected with weekly resolution. Using these data, we discuss the effect of key zooplankton species (*Daphnia* spp.) on the change of phytoplankton community and the dominance of filamentous / colonized cyanobacteria in summer. At last, we look forward to that the

application of high-resolution on-line monitoring tools (such as delayed fluorescence excitation spectroscopy) for phytoplankton should advance fine-scale study, including the variation of phytoplankton assemblage in the process of a sudden storm, the seeding and floating of some cyanobacterial species which would develop blooms later and so on. What should be addressed is the combination of data collecting and simulation techniques, which can act as an early-warning system of declines in water quality and therefore is useful in water management.

## DEPTH-INTEGRATED, CONTINUOUS ESTIMATES OF METABOLISM IN A CLEAR WATER LAKE.

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High-frequency dissolved oxygen (DO) measurements have been used for estimating gross primary production (GPP) and respiration (R) in lake ecosystems. Most researchers have determined GPP and R only in surface waters, a practice that may underestimate R in general and GPP in clear-water lakes in particular. We deployed oxygen sondes at multiple sites and depths in a clear-water lake. Rates of GPP or R were similar horizontally over the surface waters of the lake. Diel DO signals weakened with depth; however, removing noise from the data, by either wavelet transforms or moving averages, enhanced our ability to resolve diel metabolic signals. While GPP declined sharply with depth, R was unrelated to depth. The majority of GPP and R occurred in the upper mixed layer, but deeper water accounted for 14-28% of GPP and 20-43% of R depending on the statistical filtering technique used. GPP and R were nearly in balance in the surface waters, but for the entire lake R exceeded GPP, and net ecosystem production was negative. Deployment of oxygen sondes in various habitats and at multiple depths allows for a more complete estimate of whole-lake metabolism and a better understanding of the spatial and temporal complexity of lakes.

## MEASUREMENT OF WHOLE SYSTEM METABOLISM USING AUTOMATIC PROFILING SENSORS

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This poster demonstrates the use of automatic profiling sensors to determine true whole lake metabolism and use these data to evaluate the importance of vertical and horizontal differences on annual rates of gross primary production (GPP), net ecosystem production (NEP) and respiration (R).

High-frequency automatic dissolved oxygen (DO) measurements have been used for estimating GPP, NEP and R in lake ecosystems for more than a decade. Most researchers however, have measured GPP, NEP and R only in surface waters, a practice that may underestimate R and overestimate NEP in stratified systems. We deployed an automatic system to measure frequent (30 min) profiles of DO and temperature during a period of 8 months in a temperate dimitic clear water lake.

Application of a curve fitting model to high frequency profiles of T and DO, allowed accurate calculations of continuous temperature and DO profiles and mixing depth. Combining the high resolution T, Zmix and DO data with a DO mass balance model made it possible to calculate true whole lake metabolism with a high vertical and temporal resolution. Our results show that calculation of areal rates using epilimnic data only would significantly underestimate R and overestimate NEP, as anticipated. Furthermore, although differences in volumentric rates were found between surface values of a central station and a shallow water station, much larger variability occurred with increasing depth at the centre of the lake.