Title: Seagrass meadows emit greenhouse gases but are still net carbon sinks

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Abstract: Seagrass meadows are lauded for their potential to capture and store organic carbon, but meadows also generate GHGs, including N_2O and CH_4, through sediment microbial metabolism. GHG emissions are important to quantify in seagrass meadows because they could counteract or diminish the seagrass ecosystem service of sediment carbon storage. Meadow species composition may influence GHGs because species-specific plant morphology and physiology affect organic matter trapping, rhizosphere oxygenation and sediment microbial activity. We examined the effect of seagrass species composition on sediment-water GHG fluxes in subtropical meadows in the northern Gulf of Mexico. We measured seasonal N_2O and CH_4 fluxes from bare sediments and sediments with *Thalassia testudinum* (turtlegrass) or *Halodule wrightii* (shoalgrass). We found that N_2O fluxes were negligible across all treatments. Bare sediments produced net neutral CH_4 fluxes while sediments with seagrass were net sources of CH_4 in both spring and summer. Maximum mean flux rates observed for seagrass sediments in the summer, 3.6 µmol CH_4 m^{-2} day^{-1}, were low relative to the global range reported for seagrass meadows. Plant traits, such as biomass and root area, rather than species composition, most strongly influenced fluxes. The data reported here are particularly important because seagrass GHG emissions are highly variable, and few flux measurements are available for subtropical multi-species meadows. In a separate study, we found sediments dominated by *T. testudinum* stored greater amounts of carbon than meadows dominated by other species. Together, these findings suggest meadows that store higher amounts of carbon do not necessarily produce greater GHG fluxes.

CO_2: carbon dioxide
CH_4: methane
GHG: greenhouse gases
N_2O: nitrous oxide

Title: Abundance of Ultrafine P in < 0.45 µm "Dissolved" Fraction of Waters Entering and Leaving Everglades Stormwater Treatment Areas and Implications for Management Practices

Authors: Caroline Buchanan and Jonathan Judy

The Everglades STAs are constructed wetlands designed to retain P that would otherwise be transported into the Everglades by inducing transformation of inflow P into stable, non-mobile forms. P flux out of the STAs is typically monitored using routine methods that analyze P in <0.45 and >0.45 µm size fractions, which does not consider ultrafine particulate P within the <0.45 µm fraction. These relatively mobile and reactive particulates will have different pathways of biogeochemical cycling than that of truly dissolved P. Here, we determined the percentage of ultrafine particulate P within the <0.45 µm P fraction of inflow, outflow and in some cases, mid-flow water from a selection of well-performing and under-performing FWs containing EAV, SAV or a mix of EAV/SAV during both the wet and dry seasons. During the wet season in well-performing FWs, inflow <0.45 µm P was predominately (60-100%) truly dissolved (<3 kDa), with the percentage of <0.45 µm P present as particulates increasing up to 100% as distance from the inflow increased. In under-performing FWs, outflow P largely remained truly dissolved from inflow to outflow. Both FWs with 100% particulate P at the outflow contain an EAV cell followed by an EAV/SAV cell. However, in FWs containing more SAV, particulates were a smaller proportion of outflow P (26-29%). During the dry season, ultrafine particulate P similarly increased from inflow to outflow, but not to the same extent as well-performing FWs in the wet season. These findings suggest that the predominant management strategy of an EAV cell followed by an EAV/SAV polishing cell is successfully reducing TP but that the <0.45 µm P leaving flow ways configured in this manner is dominated by ultrafine particulate P during the wet season.

EAV: emergent aquatic vegetation

FW: flow way

P: phosphorus

SAV: submergent aquatic vegetation

STA: stormwater treatment area

Shifts in the coral microbiome in response to *in situ* experimental deoxygenation

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ABSTRACT

Global climate change impacts ocean communities through rising surface temperatures, ocean acidification, and deoxygenation. While the response of the coral holobiont to the first two effects has been relatively well studied, little is known about the response of the coral microbiome to deoxygenation. In this study, we investigated the response of the microbiome to hypoxia in two coral species that differ in their relative tolerance to hypoxia. We conducted *in situ* oxygen manipulations on a coral reef in Bahía Almirante, Panama, which has previously experienced episodes of low dissolved oxygen concentrations. Naïve coral colonies (previously unexposed to hypoxia) of massive starlet coral (*Siderastrea siderea*) and whitestar sheet coral (*Agaricia lamarcki*) were transplanted to a reef and either enclosed in chambers that created hypoxic conditions or left at ambient oxygen levels. We collected surface samples of mucus and tissue after 48 hours of exposure and characterized the microbiome by sequencing 16S rRNA genes. We found that the microbiomes of the two coral species were distinct from one another and remained so after exhibiting similar shifts in microbiome composition in response to hypoxia. There was an increase in both abundance and number of taxa of anaerobic microbes after exposure to hypoxia. Some of these taxa, including Campylobacteria, may play beneficial roles in the coral holobiont by detoxifying the surrounding environment during hypoxic stress. This work describes the first characterization of the coral microbiome under hypoxia, and is an initial step toward identifying potential beneficial bacteria for corals facing this environmental stressor.

Manatee bioturbation effects supersede nutrient inputs to alter ecosystem function

Adam C. Siders, Alexander J. Reisinger, and Matt R. Whiles

Animals can affect ecosystem processes through numerous pathways such as excretion of nutrients, foraging, and bioturbation. Florida manatees may provide nutrient subsidies to biofilms, a matrix of algae, fungi, bacteria, and detritus, via excreta when they migrate from the ocean to coastal springs in the winter for thermal refugia. Nutrient diffusing substrata (NDS) assess biofilm nutrient limitation using amendments of nitrogen (N), phosphorus (P), or both and comparing gross primary production (GPP) and chlorophyll *a* (chl *a*) in nutrient-amended and control treatments. We used NDS to study how migrating manatees from the ocean to spring-fed freshwater ecosystems affected biofilm nutrient limitation status in six coastal springs near Crystal River, Florida, before, during, and after the annual manatee migration. Manatees congregate in high numbers at three of the springs and do not congregate at the other three. Three patterns emerged: (1) biofilms were frequently co-limited by N and P when manatees were absent from the springs, but were never nutrient limited when manatees were present, (2) GPP and chl *a* in control treatments were lowest at all sites when manatees were present because manatee bioturbation buried NDS and likely induced light limitation, and (3) manatees affected the entire Kings Bay ecosystem by increasing total suspended solids from January through March (period of manatee migration) by 45% relative to the remainder of the year. These results demonstrate how migration of a large aquatic animal can affect ecosystem function through altering the physical environment and that manatee bioturbation effects override their nutrient inputs.

Metabolic Regimes of Sub-Tropical Urban Streams

Emily Taylor, Jacob D. Hosen, Matthew J. Cohen, Alexander J. Reisinger

The southeastern U.S. is experiencing unprecedented population growth and development over large areas, particularly in the form of “urban sprawl” (e.g., low density residential and commercial development). Resulting impacts on urban stream conditions are not easily predictable due to the heterogeneity of urban growth, the numerous ways water chemistry can be altered, and the influence of the regional environmental context (i.e., climate) on various local factors (i.e., canopy cover, temperature, etc.). Stream metabolism represents the base of food webs, and therefore provides a tool to diagnose and monitor water quality and ecosystem health. However, metabolism research in sub-tropical streams is limited which constrains direct comparison to current paradigms developed from temperate stream metabolism dynamics. To better understand how regional and local factors interact to influence stream metabolism and broader ecosystem dynamics, we assessed metabolic regimes of sub-tropical urban streams in north-central Florida. We measured continuous stream metabolism for 2+ years in six streams spanning an urbanization gradient. We compared metabolic regimes (annual patterns) and fingerprints (sub-annual variability) across sites to establish whether the timing and magnitude of metabolic peaks were more strongly influenced by regional (i.e., climate) or proximal (i.e., land use) drivers. Preliminary results indicate constraints on metabolism shift along urbanization gradients, suggesting that proximal drivers control metabolic fingerprints, whereas regional drivers regulate metabolic regimes. Through this research we aim to identify which drivers are most responsible for setting the metabolic regime and fingerprint in this region and how those change across varying degrees of urbanization.

Word Count (250-word limit/1500-character limit): 247