Abstract and introduction to Krumhardt et al. 2019

- Introduction
  - Large quantities of CO_2 are harmful to aquatic environments.
  - CO_2 acidifies the ocean.
  - Acidification negatively affects coccolithophores (calcifying phytoplankton).
- Methods
  - The effects of increasing CO_2 on coccolithophores were isolated using A Community Earth System Model.
- Results
  - Calcification globally is up by 6% annually compared to preindustrial CO_2.
  - Under 900µatm global annual calcification is 11% lower than preindustrial CO_2 levels.
- Discussion
  - Increasing CO_2 concentrations decrease the calcium carbonate production (calcification).
  - Decreasing calcification is shown in large portions of the ocean when compared to coccolithophore growth.
- Conclusion
  - The study concluded that coccolithophores become more abundant with increasing CO_2 concentrations but less calcified that at approximately 600µatm

Introduction

Pg.1 Subject: Coccolithophores account for between 1% and 20% of the phytoplankton carbon pools in diverse ocean regions, are responsible for 10%~ of carbon export, and compromise a major fraction of carbonate in the sediments.

- Through photosynthesis coccolithophores convert carbon dioxide into organic matter.
- Coccolithophores influence both biological carbon and alkalinity pumps.
- Coccolithophores are the most abundant calcifying phytoplankton in the ocean.
- The global carbon cycle is influenced by coccolithophores since they photosynthesize and calcify.
  - Broader purpose: This paragraph flows into the next because it summarizes the importance of the Coccolithophores and then why they are used in this study and others.

Pg.2 Subject: Coccolithophores have been the focus of numerous laboratory studies due to their potential susceptibility to OA but those have yielded contradictory results.

- Calcification in some studies is shown to decrease in others it is shown to have no change/effect on calcification.
- A large data compilation was required to resolve that coccolithophores calcify less relative to photosynthesis as CO_2 increases.
- Culturing techniques such as the way CO_2 is manipulated have produced contradictory results.
    - Broder purpose: This paragraph gives a background on the results that have been previously gathered and shows the limitation other studies have. The subject of this paragraph flows well into the next since it is describing projections that will be gathered by the model.

Pg.3 Subject: On a global scale, predicting the effects of increasing anthropogenic CO2 on coccolithophores is important for estimating changes in total global upper ocean calcification and to assess the potential for these changes in calcification to affect other critical carbon cycle processes.

- In order to more adequately and accurately predicting calcification effects the Earth Systems Model will be used .
    - Broder purpose: This paragraph presents the objective of the study and flows with Pg.2 since it is describing how the model can be used to alleviate the contradictory results in other studies.

Pg4. Subject: A number of studies have modeled pelagic calcifiers, such as coccolithophores, on global and regional scales.

- Other modeling studies have concluded the importance of carbon feedbacks in the Earth system model.
- The model will be conducted on growth rates and how calcification is altered by acidity and temperature as well as to test the conclusion that calcification changes carbon cycling.
    - Border purpose: This paragraph presents the research question and flows well since the previous paragraph introduced the model that will be used.

Pg.5 Subject: Here we perform sensitivity studies with our novel model configuration to explore how coccolithophore growth and calcification may change under increasing atmospheric CO_2.

- The effects of increasing CO_2 were isolated and ran using a simulation.
- The experiments show that increasing CO_2 stimulated coccolithophore growth but decreased overall growth.
    - Broder purpose: This paragraph states the conclusion and discusses the results briefly. The results are expanded on but reflect the information that was in the abstract. Overall flowed well since the previous paragraph stated the purpose, methods, and question for the research .

Final Project Proposal:

Abstract

- Introduction
    - We investigated how different urban attributes related to agriculture impact bird communities in Brownsville and Harlingen, TX, and compared sites that have community gardens to those that do not.
    - Urbanization and agriculture affect biodiversity, which is well-studied, but little is known about how agriculture affects biodiversity in urban areas.
- Methods
    - To determine which factors influenced bird communities, we constructed ANCOVA models that included our three factors and ground cover values
    - Then used post-hoc pairwise tests to compare community gardens to other sites.

Introduction

Pg.1 Subject : This trend has many effects that include increased urbanization, increased habitat fragmentation, new challenges for food production and availability, new niche formation, and opportunities to investigate how land use changes influence ecosystems (Fischer et. al. 2014).

- Human population has boomed in the last century and continues to grow.
- Biodiversity has been declining globally.
- Factors driving birds in urban environments remains poorly understood.
    - Broader purpose: This paragraph flows into the next because it summarizes the impact and interactions between humans, biodiversity, and urbanization. It also presents a question which eventually leads to the research question.

Pg.2 Subject: Humans still need land to produce food for their nutritional needs and, when integrated with urbanization, this can results in the creation of a variety of new niches for wildlife.

- People living in urban areas are farther removed from food sources
- Texas and specifically the RGV are major Ag. producers, yet in the RGV there is food insecurity out of one in four people.
- Fragmentation can cause changes in a habitat matrix and biodiversity.
    - Broder purpose: This paragraph gives a background on the idea of integrating more food producing plots in between urban settings and flows well since the next paragraph further expands on the negative and unsustainable aspect of food production in Texas now.

Pg3. Subject: Why do people still go hungry if there is an overabundance of food in an area that is known for its agricultural prowess?

- Texas ranks third in the nation in annual agricultural cash receipts.
- Access to fresh produce and nutritional sources is inadequate.
    - Border purpose: This paragraph talks about the broader impacts of this study and how growing food in urban cities can alleviate hunger in the RGV. It also presents data on how fragmented Texas is since it is one of the largest agriculture producer.

Pg.5 Subject: To address the increase in human population and food demand, increased percentage of people in urban areas, and the global loss in biodiversity, Perfecto and Vandermeer (2007) suggest that small-scale agriculture is needed to conserve biodiversity and increase the quality of the agroecological matrix.

- Fewer large-scale farms, more food being produced closer to where it is sold.
- Greater conservation of biodiversity by increasing the number and size of suitable habitat patches and decreasing the distance between patches.
    - Broder purpose: This paragraph ties in the idea of green spaces and the a possible solution to alleviate the problems stated in paragraph 3.

Pg.6 Subject: . Most importantly to the present work, it provides opportunities to study how land use changes in an urban habitat can influence local biodiversity. Later, it also be used to study feedbacks between local wildlife and the productivity of urban gardens.

- The University of Texas Rio Grande Valley has begun to research this and many other issues with experimental research and community gardens at two different campuses.
- This garden provides fresh food for students and is used for research on sustainable agriculture, aquaculture/aquaponics, and farm-wetland-fishery linkages.
    - Broder purpose: This paragraph present an already functioning green space in an urban setting that is providing food for people in the vicinity and increasing local diversity. It also presents the research question and flows well from the idea presented in paragraph 4.

Pg.7 Subject: . If we are interested in the relationships between biodiversity and urban gardens, birds provide a reliable and valuable study system because of their ability to fly across geographic boundaries, their relatively quick reactions to landscape changes, their important ecological roles, the diversity of niches and trophic levels they may occupy, and their economic and cultural values and services.

- The lower Rio Grande Valley is a “hotspot” for birds because of its borderline tropical/sub-tropical climate, regional ecological diversity, and bottleneck-like position within the central North American migratory flyway.

- Meaningful studies on local bird communities, their ecological roles, and possibly ecosystem services based on
    - Broder purpose: This paragraph introduces the study focus and makes the connection between the development in urban agriculture and its impact on biodiversity and how birds provide an ideal study.

Pg.8 Subject: We expect that increasing habitat complexity will increase bird diversity and abundance, but we aim to quantify these changes, and to identify which species and/or functional groups are most likely to be impacted by these changes.

- How do habitat attributes influence urban bird biodiversity?
- How do urban gardens (green spaces) affect bird diversity?
- Land use impacts biodiversity.
    - Broder purpose: This paragraph presents all the research questions tied in by the previous paragraph. Expected results are discussed.

Abstract

The Rio Grande Valley of Southern Texas is a major agricultural region, yet it has some of the highest hunger rates in the USA. Urbanization and agriculture affect biodiversity, which is well-studied, but little is known about how agriculture affects biodiversity in urban areas. We investigated how different urban attributes related to agriculture impact bird communities in Brownsville and Harlingen, TX, and compared sites that have community gardens to those that do not. To study three key urban habitat characteristics, we identified sites that exhibited all possible combinations of these factors, quantified land cover classes related to these factors at each site, and surveyed bird communities at each site on three separate days in 2017. To determine which factors influenced bird communities, we constructed ANCOVA models that included our three factors and ground cover values, and then used post-hoc pairwise tests to compare community gardens to other sites.

Introduction:

Human population has boomed in the last century and continues to grow, while biodiversity has been declining globally. This trend has many effects that include increased urbanization, increased habitat fragmentation, new challenges for food production and availability, new niche formation, and opportunities to investigate how land use changes influence ecosystems (Fischer et. al. 2014). As human population increases, urbanization is also increasing. In fact, the percentage of people living in urban areas is increasing (United Nations 2015). Urbanization contributes significantly to habitat loss and fragmentation, which drive the global decline in biodiversity, but urbanization also creates new niches that some wildlife adapt to and fill. For example, bird species have shown to have varied success along an urban-rural gradient (Gilbert 1989, Miller and Adams 1994). Previous studies on this have led to bird species and other wildlife being categorized as "urban avoiders," "urban adapters," and "urban exploiters" (Blair 1999). This shows that even in highly modified environments, communities are nonrandomly assembled and filtered to contain species with specific niches and adaptations (Johnston 2001). However, factors that drive bird utilization in different urban environments remains poorly understood.

Humans still need land to produce food for their nutritional needs and, when integrated with urbanization, this can results in the creation of a variety of new niches for wildlife. The greater the population, the greater the need for food, and the more land that will be used for farming. Another current trend in urbanization is that people living in many urban areas are becoming farther removed from food sources. Currently, global agriculture produces one and a half times more food than is needed to feed the world population (Holt-Giménez et. al. 2012). Also, most food is globally distributed by 10 major food companies (Hess 2014). However, with the overproduction of food and international corporations distributing the food, many people still

go hungry. Some 795 million people in the world do not have enough food to lead a healthy, active life (United Nations 2015). According to the USDA, “12.3% (15.6 million) of U.S. households were food insecure at some time during 2016” (USDA 2016). In the Rio Grande Valley of deep South Texas, one in four people are considered to be “food insecure” (Foodbank RGV). The USDA defines "food insecurity" as the lack of access, at times, to enough food for all household members.

What is interesting is that “Texas ranks third in the nation in annual agricultural cash receipts, behind California ($36.2 billion) and Iowa ($24.75 billion)” (Santa Ana 2011). “Individually, Hidalgo and Cameron counties are ranked seventh and 24th among the 254 counties in the state, while Willacy and Starr counties are among the top 85 counties” in annual agricultural cash receipts (Santa Ana 2011). Why do people still go hungry if there is an overabundance of food in an area that is known for its agricultural prowess? This is also an issue concerning demand for food. Along with its great agricultural production, the Rio Grande Valley has a large population. Out of 254 counties in Texas, Hidalgo County ranks 7th, Cameron County ranks 13th, Starr County ranks 55th, and Willacy County ranks 112th in total population (US Census Bureau). Access to fresh produce and nutritional sources of food are key in these areas. Additionally, the Rio Grande Valley has a high percentage of people with diabetes and obesity, which give an indication of the inadequacy of nutritional sources of food for the population (Green 2012).

To address the increase in human population and food demand, increased percentage of people in urban areas, and the global loss in biodiversity, Perfecto and Vandermeer (2007) suggest that small-scale agriculture is needed to conserve biodiversity and increase the quality of the agroecological matrix. This means fewer large-scale farms, more food being produced closer

to where it is sold, and greater conservation of biodiversity by increasing the number and size of suitable habitat patches and decreasing the distance between patches. One such practice that can aid in this issue is urban agriculture. It is a growing trend globally and has the potential to combat hunger and food insecurity locally (more fresh food for people nearby), increase biodiversity in cities (increasing green space and habitat complexity), and conserve biodiversity outside of cities (less land farmed) (Mok et. al. 2014).

The University of Texas Rio Grande Valley has begun to research this and many other issues with experimental research and community gardens at two different campuses. In 2016, the Brownsville Research and Community Garden (BRCG) was created on the UTRGV campus in Brownsville, Texas, USA. It is comprised of twelve replicated model watersheds, each of which contains a raised soil bed, a treatment wetland, and an aquaculture pond. Each bed, wetland, and pond compartment is 3 m^2 (32 sq ft). This garden provides fresh food for students and is used for research on sustainable agriculture, aquaculture/aquaponics, and farm-wetland-fishery linkages. Most importantly to the present work, it provides opportunities to study how land use changes in an urban habitat can influence local biodiversity. Later, it also be used to study feedbacks between local wildlife and the productivity of urban gardens.

The lower Rio Grande Valley is a “hotspot” for birds because of its borderline tropical/sub-tropical climate, regional ecological diversity, and bottleneck-like position within the central North American migratory flyway. This region also has a long history of agriculture that has led to the extensive alteration of land. Recently, this region has seen significant economic and population growth that has led to increased urbanization (Bonaiti and Fipps 2011). Currently, 95% of wildlife habitat in the Rio Grande Valley has been altered by human means, yet there is still great bird diversity that attracts hundreds of thousands of tourists and birders

every year, which generates $463 million for local economies and supports thousands of part-time and full-time jobs (Woosnam et.al. 2011). This allows for meaningful studies on local bird communities, their ecological roles, and possibly ecosystem services. If we are interested in the relationships between biodiversity and urban gardens, birds provide a reliable and valuable study system because of their ability to fly across geographic boundaries, their relatively quick reactions to landscape changes, their important ecological roles, the diversity of niches and trophic levels they may occupy, and their economic and cultural values and services. Furthermore, given their diversity, bird communities are understudied regionally. Altogether, because of its agricultural history, rapid urbanization, high biodiversity, and recent developments in urban agriculture, the Rio Grande Valley is an ideal location for studies on how urban agroecosystems (e.g., community gardens) impact biodiversity, and birds provide an ideal study system.

We utilized this ideal study system and leveraged the opportunities presented by the construction of the new Brownsville Research and Community Garden to investigate several key questions about how habitat attributes influence (urban) bird biodiversity. To address broader questions about how urban land use change impacts biodiversity, we currently ask more specifically: How does construction of urban gardens in the Lower Rio Grande Valley impact bird diversity? We expect that increasing habitat complexity will increase bird diversity and abundance, but we aim to quantify these changes, and to identify which species and/or functional groups are most likely to be impacted by these changes. Crucially, we are also interested in the mechanisms underlying these impacts, so we ask: How do key habitat attributes (related to urban agroecosystems) influence urban bird diversity?