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Introduction:

- Nutrient pollution is a common cause of declining water quality in freshwater ecosystems¹
 - Agricultural fertilizer run-off is a primary source of nutrient inputs, primarily nitrogen and phosphorus
 - Animal farming can also be a source of nutrient inputs
- The Lumbee River* watershed contains both crop and animal agriculture² and may be impacted by nutrient inputs
- Water quality can also affect the diversity of benthic macroinvertebrates¹, an important component of aquatic food chains³
- Dissolved oxygen, turbidity, pH, and other factors are important measures of water quality

Methods:

- 3 sites were selected based on the land use in the surrounding region (Figure 1).
- Sites were sampled three times during the summer season, and one time each during the fall and winter seasons.
 - Spring samples could not be collected due to the COVID-19 pandemic.
- Benthic invertebrates were collected using a D-net and preserved in 70% ethanol.
- In the lab, benthic macroinvertebrates were identified and counted using a dissecting microscope.
- Dissolved oxygen, temperature, pH, and turbidity levels were taken in the field.
- Water samples were collected using a swing sampler.
- Water chemistry levels were analyzed using a Hach® DR3900 spectrophotometer.
- Several water chemistry variables had concentrations that were under the limit of detection for our tests.

Predictions:

- Nutrient levels are expected to be higher at Sampson's Landing and Recreation Center Rd. Decreased benthic invertebrate diversity is also expected at these sites due to increased exposure to agricultural pollution
- Nutrient levels will be higher in the summer due to increased agricultural activity
- Benthic invertebrate diversity may be lower in summer because the adult stages emerge and are terrestrial during this time

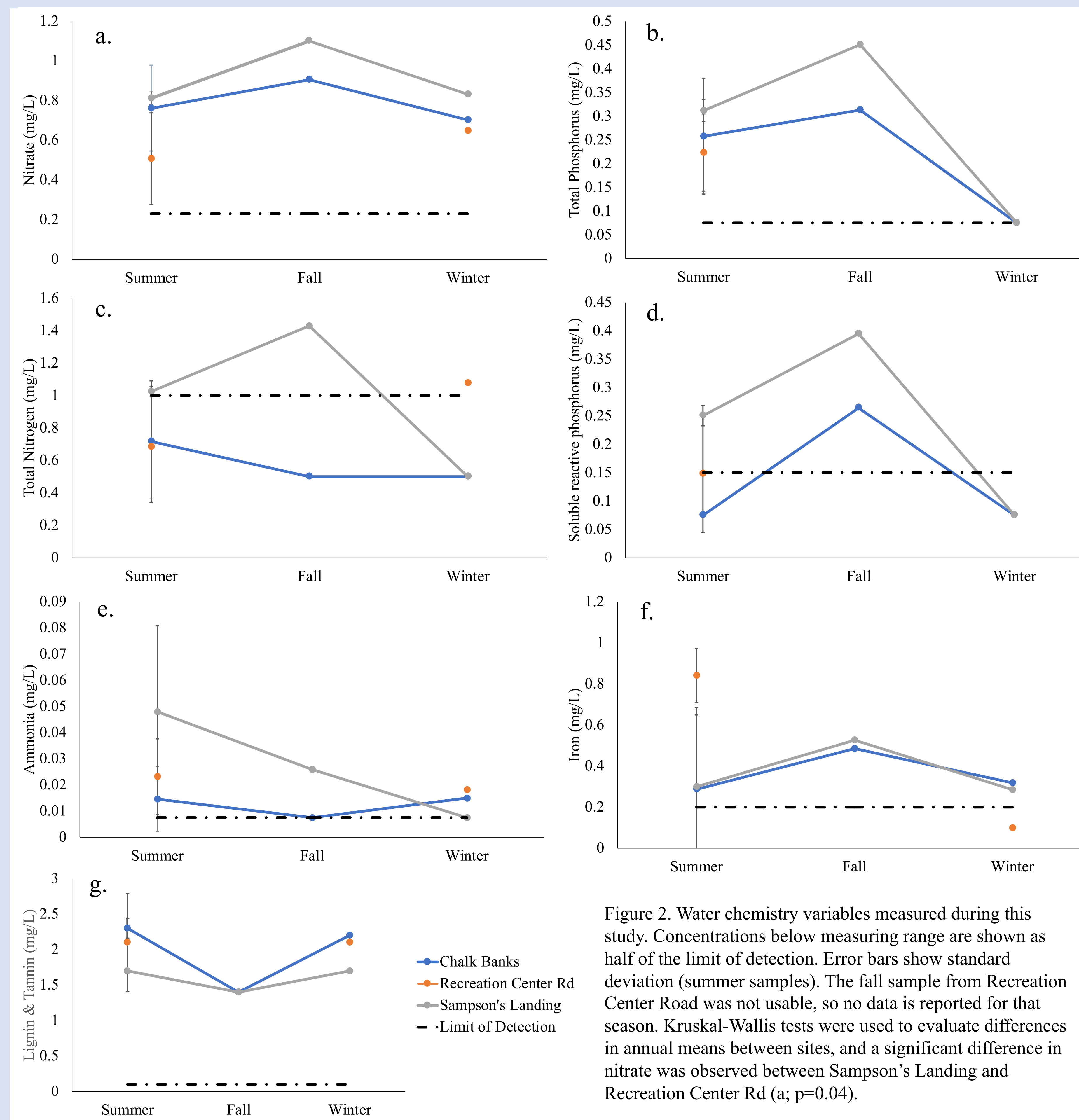


Figure 2. Water chemistry variables measured during this study. Concentrations below measuring range are shown as half of the limit of detection. Error bars show standard deviation (summer samples). The fall sample from Recreation Center Road was not usable, so no data is reported for that season. Kruskal-Wallis tests were used to evaluate differences in annual means between sites, and a significant difference in nitrate was observed between Sampson's Landing and Recreation Center Rd (a; $p=0.04$).

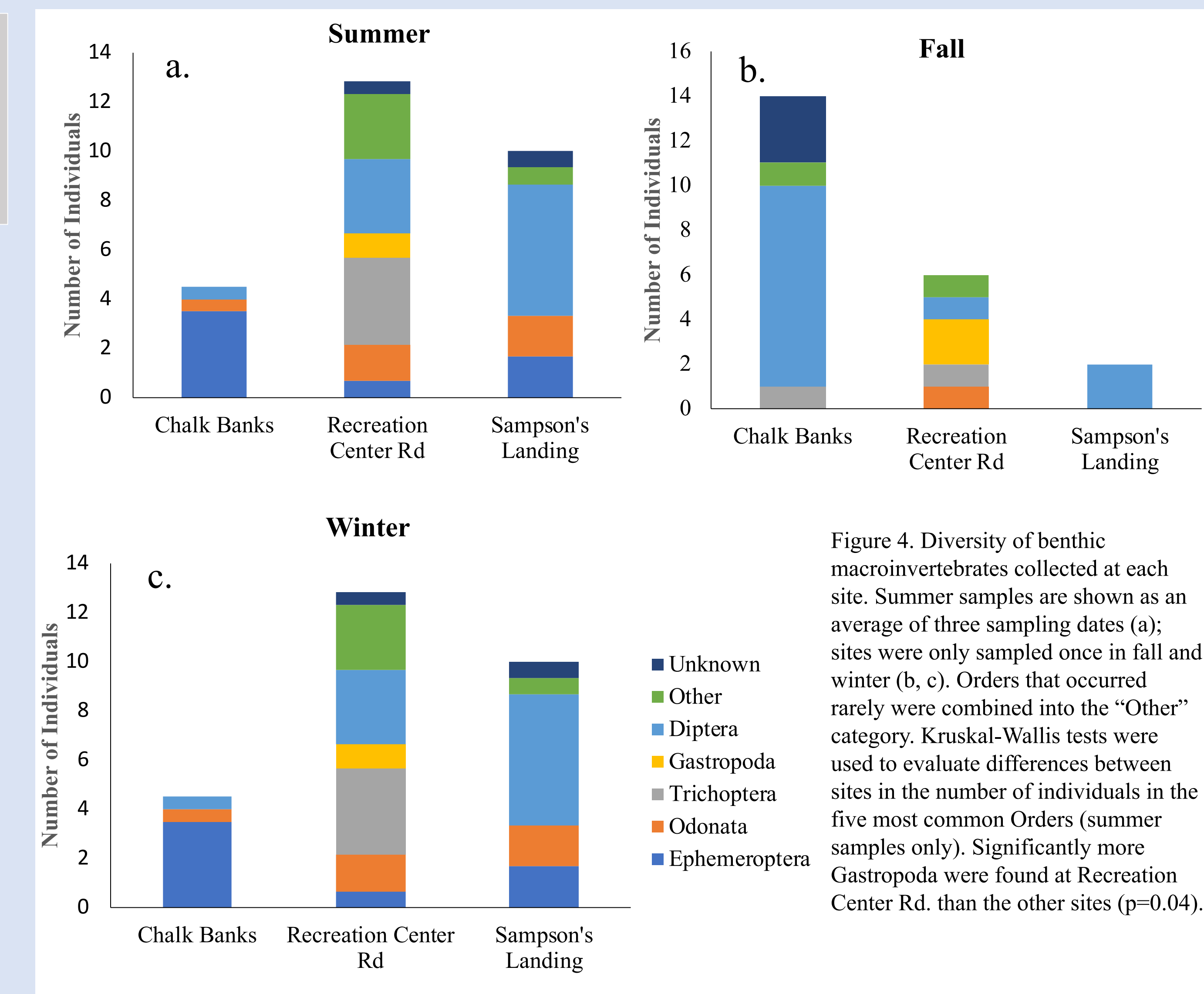


Figure 4. Diversity of benthic macroinvertebrates collected at each site. Summer samples are shown as an average of three sampling dates (a); sites were only sampled once in fall and winter (b, c). Orders that occurred rarely were combined into the "Other" category. Kruskal-Wallis tests were used to evaluate differences between sites in the number of individuals in the five most common Orders (summer samples only). Significantly more Gastropoda were found at Recreation Center Rd. than the other sites ($p=0.04$).

Conclusions:

- Our predictions were not supported
 - However, increased nitrate levels at Sampson's Landing may be due to a buildup of nutrient inputs as the river flows through agricultural areas
 - Invertebrate diversity tended to be highest at Recreation Center Rd.
- Our data suggest that agricultural pollution does not have a strong effect on water quality in the Lumbee River
 - Presence of forested wetland buffer zones may contribute to these results

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References

- Phillips, Iain D.; Parker, Dale; and McMaster, Glen (2008) "Aquatic invertebrate fauna of a northern prairie stream: range extensions and water quality characteristics," *Western North American Naturalist*: Vol. 68 : No. 2 , Article 5. Available at:
- Michael A Malin , Lawrence B Cahoon , Douglas C Parsons & Scott H Ensign. (2001). Effect of Nitrogen and Phosphorus Loading in Coastal Plain Blackwater Rivers, *Journal of Freshwater Ecology*, 16:3, 455-464, DOI: 10.1080/02705060.2001.9665832
- Mermillod-Blondin, Florian; Gérino, Magali; Sauvage, Sabine; Michel Creuzé des Châtelliers. *Canadian Journal of Fisheries and Aquatic Sciences*; Ottawa Vol. 61, Iss. 10, (Oct 2004): 1817-1831.

* The name "Lumber" is used for this river by governmental agencies; however we have elected to use the name "Lumbee" in accordance with a 2009 Lumbee Tribal Council Ordinance (lumbetribe.com/tribal-ordinances).

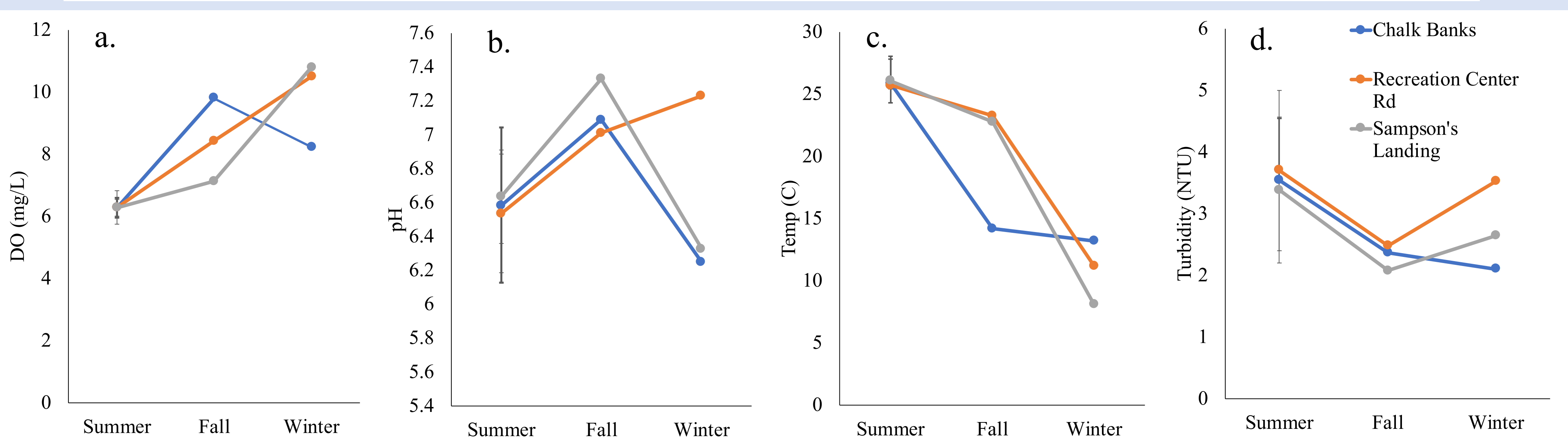


Figure 3. Physical variables that were recorded at each site. Error bars show standard deviation (summer samples). Sites were only sampled once in fall and winter. Kruskal-Wallis tests were used to evaluate differences in annual means between sites, and no significant differences were found.



Figure 1. Map of sample sites: Chalk Banks (top), Recreation Center Rd (middle), Sampson's Landing (bottom). Chalk Banks is the reference site located in a forested state park, and the other two sites are in areas with increased agricultural land use.