

# Species Diversity of Herpetofauna in Response to Silvicultural Treatments in the Southern Appalachians

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## Abstract

Land managers are concerned about widespread oak regeneration failure, especially on mesic, high-quality sites. We trapped reptiles and amphibians in an experimental study of different oak regeneration treatments at the Cold Mountain Game Lands in the southern Appalachian Mountains of western North Carolina. The study compares three different treatments recommended to promote oak regeneration but not well tested: midstory herbicide (MH), shelterwood harvests (to be burned winter 2013-2014) (SW), prescribed burn only (Rx), and a control (C). Each experimental unit was 5 ha with four replicates for each treatment. In each unit were eight 7.6 m long drift fences with a 20 L bucket buried flush with the ground surface at both ends, and a funnel trap on both sides of each fence. Traps were checked daily except Sunday from mid-May to mid-August 2013. Three diversity indices were calculated and compared by one-way ANOVA: the Simpson, Shannon-Wiener, and Probability of Interspecific Encounter (PIE). Mean ( $\pm$  SD) Simpson Index values were  $4.96 \pm 2.22$  (MH),  $4.86 \pm 1.05$  (SW),  $2.35 \pm 0.55$  (Rx), and  $4.83 \pm 0.75$  (C) ( $P = 0.042$ ). Mean Shannon-Weiner values were  $0.64 \pm 0.14$  (MH),  $0.70 \pm 0.10$  (SW),  $0.42 \pm 0.03$  (Rx), and  $0.67 \pm 0.06$  (C) ( $P = 0.0038$ ). Mean PIE values were  $0.76 \pm 0.11$  (MH),  $0.81 \pm 0.09$  (SW),  $0.56 \pm 0.10$  (Rx), and  $0.79 \pm 0.03$  (C) ( $P = 0.0063$ ). Results indicate that in 2013 (3 to 4 years post-burn) the (Rx) treatment had significantly lower diversity than all other treatments. This result does not correspond with results of herpetofaunal trapping conducted in prior years (2009-2011) showing no statistical difference among treatments. The lower diversity in the prescribed burn treatment in 2013 could potentially indicate longer-term response to prescribed burning; further examination and sampling will be required to verify this hypothesis.

## Introduction

In the central hardwoods region, especially on mesic, high-quality sites, oak regeneration is failing on a wide scale. Numerous silvicultural treatments are being attempted to remedy this situation, but their long term effects are still unknown.

In the Cold Mountain State Gamelands, located in the Pisgah National Forest, just outside of Canton, NC, the U.S. Forest Service is testing three different silvicultural treatments to improve the rate of oak regeneration. The midstory herbicide treatment consists of removing the majority of the treatment area's midstory using an herbicide. The shelterwood harvest consists of a 60-70% basal area reduction followed by a burn in 3 to 5 years. The prescribed burn is a controlled fire, which can be a hot or cold fire (Keyser et al, 2008).



Figure 1: Cold Mountain Game Lands is shown in light green. Inset (A) shows the specific location of the game lands within the state of North Carolina (NCWRC, 2013).

## Introduction cont'd

Due in part to the unknown long-term effects of each silvicultural treatment, animal surveys are being performed to assess possible deleterious effects to certain population diversities in areas where the treatments are being carried out. Possible harmful effects of midstory herbicide treatments have been recorded in the nesting of certain species of birds declining after similar treatment (Sutherland 2013). However, little is known about herpetofaunal response to these treatments in the Southern Appalachians.



Figure 3. Six of the most abundant species during the study period (A) *Notophthalmus viridescens* (B) *Plethodon teyahalee* (C) *Eumeces fasciatus* (D) *Bufo americanus* (E) *Thamnophis sirtalis* (F) *Plethodon metcalfei*

## Methods

- Study conducted at Cold Mountain State Gamelands near Asheville, NC
- The study compares three different treatments recommended to promote oak regeneration: midstory herbicide (MH), shelterwood harvests (to be burned winter 2013-2014) (SW), prescribed burn only (Rx), and a control (C).
- Each experimental unit was 5 ha with four replicates for each treatment.
- In each unit were eight 7.6m long drift fences with a 20 L bucket buried flush with the ground surface at both ends, and a funnel trap on both sides of each fence.
- Traps were checked daily except Sunday from mid-May to mid-August 2013.
- Three diversity indices (Shannon-Weiner Index, Simpson Index, PIE Index) were calculated and compared using a one-way ANOVA test for each treatment and control, followed by a Tukey Least Significant Test.

## Methods cont'd

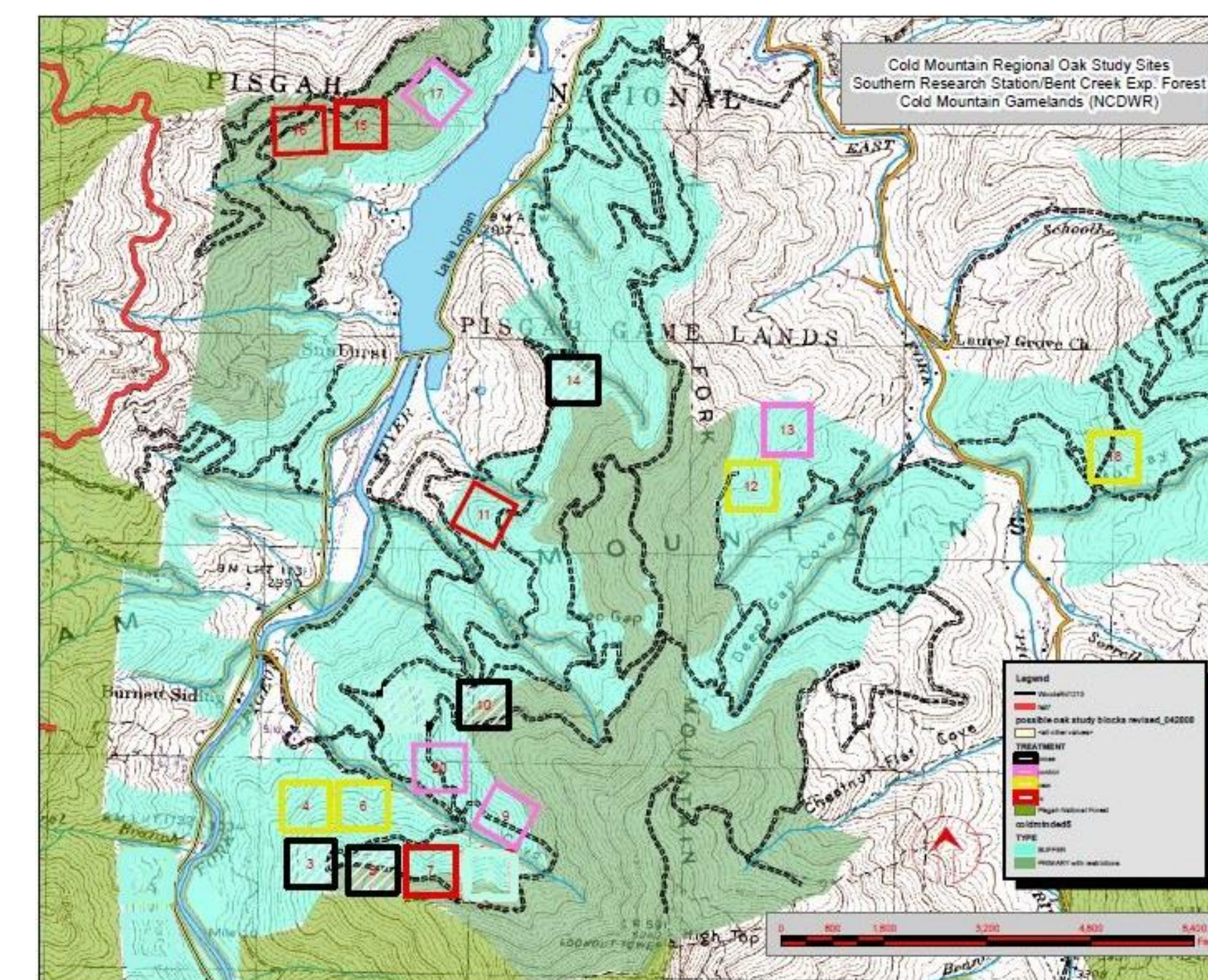


Figure 3: Regional Oak Study area at Cold Mountain State Gamelands showing 3 treatments and control with 4 replicates each. Each treatment unit is 5 ha.

## Results

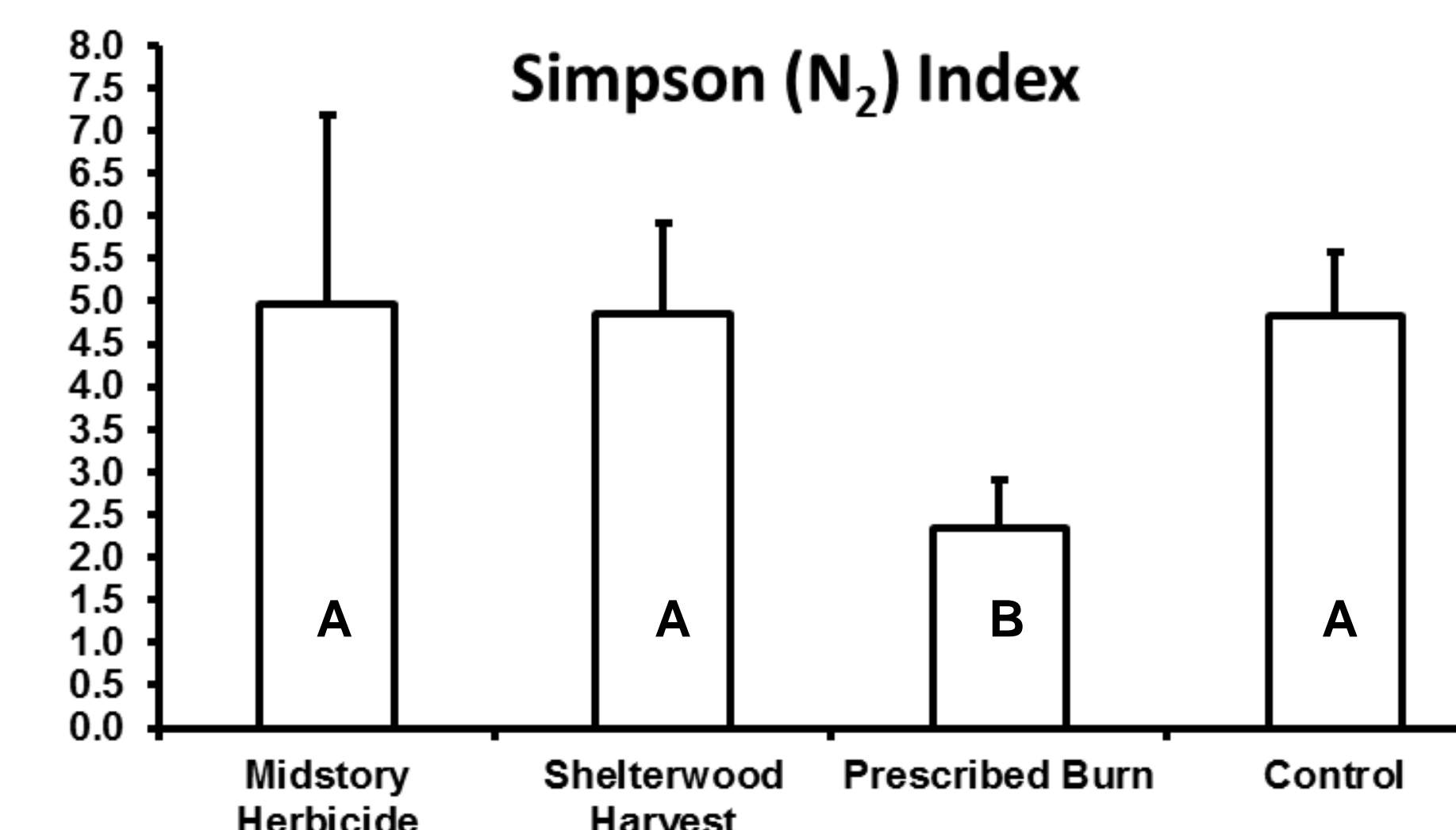


Figure 4. Mean Simpson (N<sub>2</sub>) Index values for each treatment,  $4.96 \pm 2.22$  (MH),  $4.86 \pm 1.05$  (SW),  $2.35 \pm 0.55$  (Rx), and  $4.83 \pm 0.75$  (C). The N<sub>2</sub> index for the prescribed burn treatment is significantly less diverse than the other treatments (ANOVA, Tukey  $P = 0.042$ ).

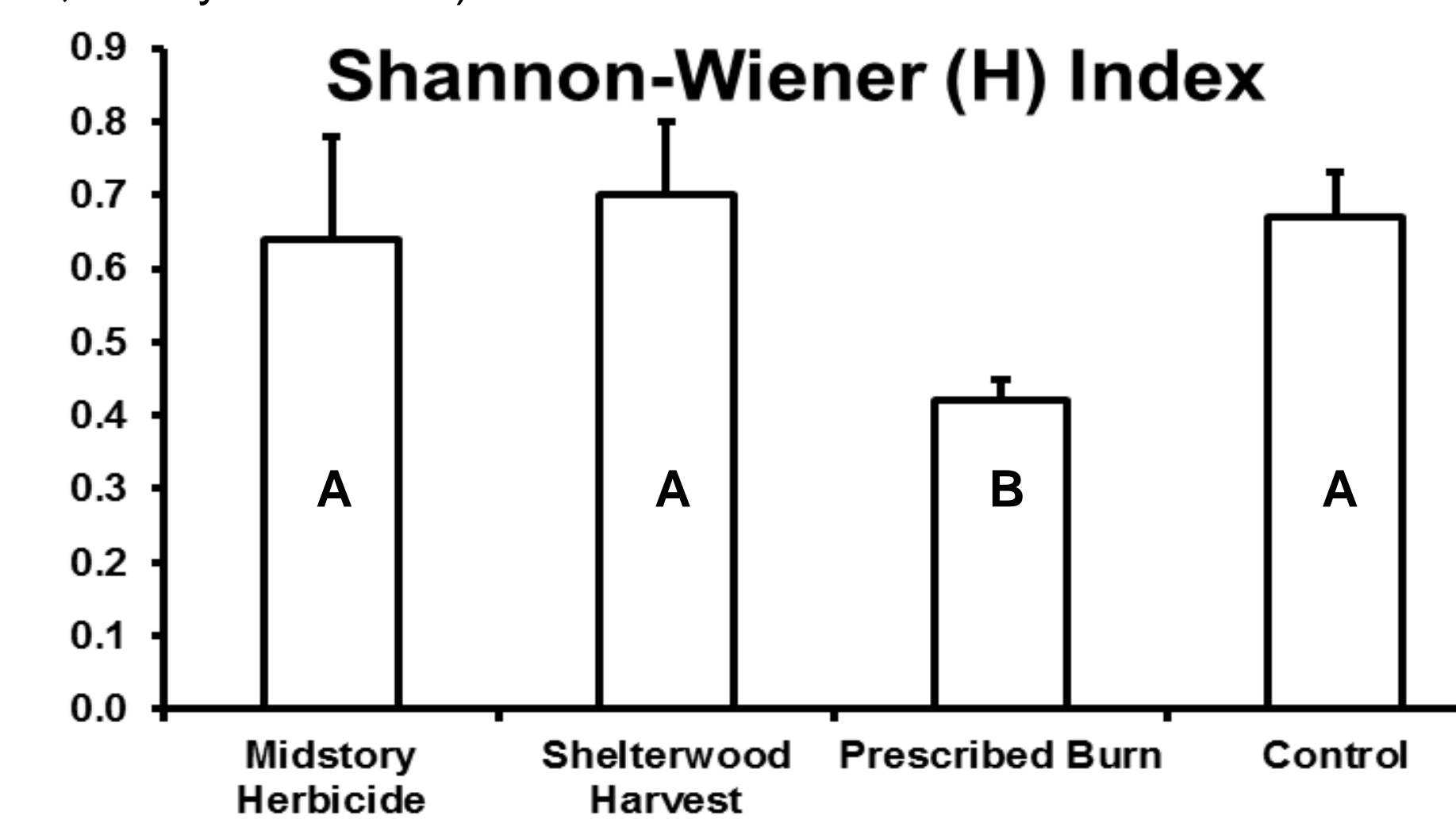


Figure 5. Mean Shannon-Wiener (H) values for each treatment,  $0.64 \pm 0.14$  (MH),  $0.70 \pm 0.10$  (SW),  $0.42 \pm 0.03$  (Rx), and  $0.67 \pm 0.06$  (C). The H index for the prescribed burn treatment is significantly less than the other treatments (ANOVA, Tukey  $P = 0.0038$ ).

## Results cont'd

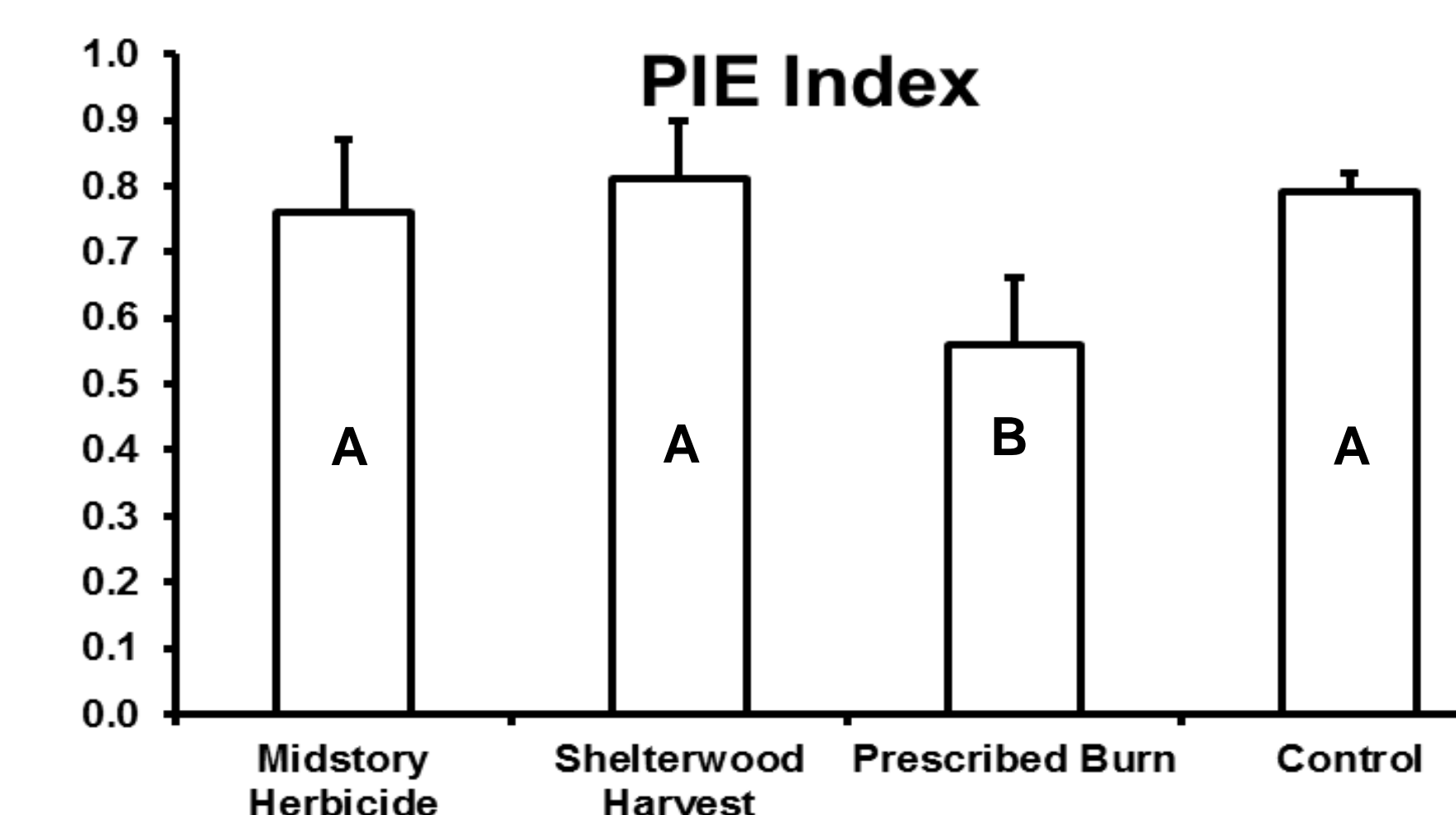


Figure 3. Mean PIE values for each treatment,  $0.76 \pm 0.11$  (MH),  $0.81 \pm 0.09$  (SW),  $0.56 \pm 0.10$  (Rx), and  $0.79 \pm 0.03$  (C). The prescribed burn treatment is significantly less than the other treatments (ANOVA, Tukey  $P = 0.0063$ ).

## Conclusions

- In 2013 (3 to 4 years post-burn) the prescribed burn treatment had significantly lower diversity indices than all other treatments.
- This result does not correspond with results of herpetofaunal trapping conducted in prior years (2009-2011) which showed no significant difference among treatments.
- The lower diversity in the prescribed burn treatment in 2013 could potentially indicate longer-term response to prescribed burning; further examination and sampling will be required to verify this hypothesis.

## References

- Keyser, T.L., Clark, S., Franzreb, K., Greenberg, C.H., Loeb, S., Loftis, D., McNab, W.H., Schweitzer, C.J., Spetich, M.A., 2008. Forest ecosystem response to regeneration treatments for upland hardwoods across the southern United States, with a focus on sustaining oaks. In, US Forest Service, Study Plan #FS-SRS-4157-96, p. 106.
- Williams, David R., Pople, Robert G., Showler, David A., Dicks, Lynn V., Child, Matthew F., zu Ermgassen, Erasmus K.H.J. and Sutherland, William J. (2013) Bird Conservation: Global evidence for the effects of interventions. Synopsis of Conservation Evidence, Volume 2. Pelagic Publishing.
- NCWRC. "N.C. Wildlife Resources Commission Home." N.C. Wildlife Resources Commission Home. 2013

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