

## Final Report for American Chestnut Foundation External Grant Program

**Title:** Reseeding restored forests: Can seed dispersal mutualisms amplify restoration of American chestnut (*Castanea dentata*)?

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### Narrative Summary

#### *Objectives*

Seed dispersal is a fundamental mutualism between wildlife and trees in forest ecosystems. Wildlife, such as birds, often cache abundant tree nuts during fall for winter consumption, and unrecovered nuts become the next year's saplings, ensuring dispersal and persistence of tree species. In the eastern U.S., Blue Jays (Figure 1) in particular provide essential long-distance dispersal for nut-bearing trees. In the Appalachian region, there is currently an effort underway to restore disease-resistant American chestnut to the landscape, following the loss of 4 billion trees in the early 20<sup>th</sup> century from a disease known as "chestnut blight." While there has been considerable research into the best ways to plant and propagate chestnut, to date little attention has been paid to the influence seed dispersal mutualisms will have on the restoration effort. This research aimed to determine how Blue Jays, a primary tree nut disperser, will facilitate the reestablishment of chestnut, given conditions in the current oak-hickory dominant forest ecosystem. To answer this question, we quantified Blue Jay preference for chestnut seeds compared to existing oak acorns ("seed selection"), and located seed cache sites to determine how far Jays disperse seeds and whether Jay cache sites are beneficial to chestnut seedling growth ("seed dispersal"). Our results will inform chestnut restoration efforts in this critically important ecosystem in Ohio and the Allegheny plateau.

#### *Methods*

**Seed selection:** Using 6 feeding platforms (Figure 2A) established throughout the study site in Vinton County Ohio, we presented 3 species of tree nuts (black oak, white oak, American chestnut) to wild Blue Jays to assess their preference (Figure 2B). Platforms had trail cameras (Figure 2) mounted to record bird visits, and seed selection data (n = 2,469 selections) was analyzed using a Bayesian discrete choice model.

**Seed dispersal:** We placed small VHF transmitters inside hollowed out chestnuts and acorns, and presented these tagged seeds (n = 224 seeds, including 82 chestnuts) to birds at feeding platforms (Figure 3A). We then used handheld antennas and receivers to systematically search the surrounding area after they were removed, until we found either the cached seeds (Figure 3B) or

the remains of consumed ones (we were able to determine fate for 95% of tagged seeds). We then measured the proportion consumed and the distance dispersed for caches. At each cache location and paired random location we planted viable chestnuts and acorns. We returned on a monthly basis to monitor germination and seedling growth.

### *Results*

**Seed selection:** Blue Jays at our field site exhibited a preference for black oak acorns over chestnuts, but preferred chestnuts over white oak acorns. Overall, Jays were between 3.3 to 17.2 times more likely to choose black oak acorns over chestnuts (stronger black oak preference in late season trials), and 3.5 to 4.9 times more likely to choose chestnuts over white oak acorns. This suggests that chestnut dispersal by Jays may be enhanced in areas that have white oak but not black oak, or in years when black oak mast fails. Other seed-hoarding birds exhibited somewhat similar preferences, with Red-bellied and Red-headed Woodpeckers echoing Blue Jay preferences (but with greater variation), and White-breasted Nuthatches showing strong preference for chestnuts over both acorn species (although nuthatches visited platforms much less frequently than other species).

**Seed dispersal:** Most cache sites were located between 8-150 meters from the feeding platforms, however we recorded natural caches of acorns up to 450 meters from the source trees. Of 53 chestnuts whose fate was determined, 32% were cached while 52% were eaten, a similar rate to what we found for black oak acorn fate. Caches were located predominantly in early-successional habitat with high shrub cover, rather than mature forest. Chestnut seedlings at cache sites performed better than white or black oak seedlings, as they grew taller in the first year and survived longer: chestnut survival at cache sites at the end of the first year was 6.2%, compared to 3.8% for black oak and 2.6% for white oak seedlings. Pilferage of cached seeds by small mammals was high for all seed species (>80%), suggesting that this will be a key factor limiting the effectiveness of Blue Jays as seed dispersers.

### **Publications**

**Wright, J.** 2022 Dynamics of a seed dispersal mutualism between avian seed-hoarders and nut-bearing trees: Implications for oak management and American chestnut restoration. PhD Dissertation. The Ohio State University, Columbus, OH.

**Wright, J, S Matthews, C Pinchot, and C Tonra.** 2022. Preferences of avian seed-hoarders in advance of potential American chestnut reintroduction. *Forest Ecology and Management* 511:120133.

**Wright, J, S Matthews, C Pinchot, and C Tonra.** From selection to seedlings: tracking the fate of chestnuts and acorns cached by Blue Jays (*Cyanocitta cristata*). In prep. Target: *Journal of Animal Ecology*

## **Presentations**

Wright, J. 2022. Dynamics of a seed dispersal mutualism between avian seed-hoarders and nut-bearing trees: Implications for management of oak and restoration of American chestnut. OSU Dissertation defense seminar, Virtual.

Wright, J, S Matthews, C Pinchot, and C Tonra. 2021. Impacts of a seed dispersal mutualism on American chestnut restoration. The American Chestnut Foundation, OH chapter, Virtual

Wright, J. 2021. Blue Jays and Oaks: A seed dispersal mutualism driving forest change in the Appalachians. Ecology on Tap, Columbus, OH

Wright, J. 2021. Blue Jays and Oaks: A seed dispersal mutualism driving forest change in Ohio. Toledo Naturalists Association, Virtual.

Wright, J. 2021. Blue Jays and Oaks: A seed dispersal mutualism driving forest change in Ohio. Ohio Woodland Stewards Webinar, Virtual.

Wright, J. Matthews, S., Tonra, C. 2019. Full annual cycle bird research at Vinton Furnace State Forest. Vinton Furnace Day in the Woods program, Vinton County, OH.

Matthews, S., Wright, J., Tonra C. 2019. The Birds of Vinton Furnace. Ohio Division of Forestry Teacher Field Days. Full day program for teachers across Ohio. Presentations with classroom and then field demonstration.

Wright, J., Matthews, S., Tonra, C. 2019. The influence of a seed dispersal mutualism on forest change in Ohio. Presentation to Ohio Bird Banding Association, Waynesville, OH.

## **Figures**



Figure 1. A Blue Jay is fit with a radio transmitter.



Figure 2. Platforms used for seed selection trials. We fit platforms with motion sensitive cameras to identify visitors (A) and filled each tray with different combinations of oak and chestnut seeds (B).



Figure 3. Chestnuts with radio transmitters inserted and resealed with wood putty (A) and an uncovered tagged chestnut in a Blue Jay cache location (B).