

Seeds of Doubt: Feeding Preferences of White-footed Deer Mice (*Peromyscus leucopus noveboracensis*) and Woodland Deer Mice (*Peromyscus maniculatus gracilis*) on Maple (genus *Acer*) Seeds

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#### ABSTRACT

This study explores foraging choices made by seed predators (white-footed mouse, *Peromyscus leucopus noveboracensis* (Fischer, 1829) and woodland deer mouse, *P. maniculatus gracilis* (LeConte, 1855)) presented with seeds of two dominant tree species (sugar maple, *Acer saccharum* Marsh., and red maple, *A. rubrum* L.). I hypothesized that both species would prefer *A. saccharum* seeds, as they are larger and ostensibly contain more energy. Although *P. l. noveboracensis* consumed more seed than *P. m. gracilis*, there was also a species-specific difference in preference. *Peromyscus maniculatus gracilis* clearly preferred *A. rubrum* over *A. saccharum*, whereas preferences of *P. l. noveboracensis* were less specific. *Peromyscus leucopus noveboracensis*, being a habitat generalist, may demonstrate higher plasticity in response to different food types. *Peromyscus maniculatus gracilis* may prefer *A. rubrum* because of differences in nutrition, handling costs, or germination schedules, although this was not explicitly tested. This species-specific difference in preference indicates the common assumption that *Peromyscus* species are ecologically similar should be made with caution.

Key words: *Acer rubrum*; *Acer saccharum*; woodland deer mouse; foraging; *Peromyscus leucopus noveboracensis*; *Peromyscus maniculatus gracilis*; red maple; seed predation; sugar maple; white-footed deer mouse.

## INTRODUCTION

Seed predation is a prevalent plant-animal interaction that has wide-reaching effects on many ecosystems (Janzen 1971; Moles et al. 2003; Siepielski and Benkman 2008; Zwolak et al. 2010; Young et al. 2013). From the plant perspective, seed predation directly affects fitness and has led to a variety of anti-predator strategies, including the evolution of masting, the development of toxic secondary compounds, and a variety of physical structures to protect seeds (Vander Wall 2010). However, some plants require the actions of seed predators to deliver seeds to suitable microhabitats for germination (Abbott and Quink 1970; Vander Wall et al. 2005). From the predator perspective, seeds are a high energy and nutrient-rich resource which can be easily harvested, stored, and defended (Vander Wall 2010). In forests, small mammals are voracious seed predators, and many studies have documented their effects on forest structure and species composition (e.g., McCormick and Meiners 2000; García et al. 2005; Lobo et al. 2009).

Many studies investigate seed predation by measuring removal of seeds in the field, which generally suffer from two shortcomings. First, some studies suffer from the uncertainty of knowing which species of seed predator is responsible for removal of the seeds (Boman and Casper 1995; Meiners and Stiles 1997; Zwolak et al. 2010). Many studies measure seed predation based on the number of seeds removed from a given location in the forest, making assumptions about the identity of the predator based on independent trapping efforts (Royo and Carson 2008; Hsia and Francl 2009; Shahid et al.

2009; Zwolak et al. 2010), or by use of exclosures (Plucinski and Hunter 2001; Haas and Heske 2005). Second, some seed predation studies cannot address what the ultimate fate of the seeds may be (i.e., eaten on site or cached; Vander Wall et al. 2005). The ultimate fate of any removed seeds has important implications about whether rodents are seed predators or seed dispersers (Vander Wall 2010). Some researchers have used various techniques to address the fate of seeds, including tracking individual seeds by marking them and finding them later (Siepielski and Benkman 2008; Hsia and Francel 2009), and also by direct observation of foragers in the field (Pyare et al. 1993; Smallwood et al. 2001; Lobo et al. 2013). With the exception of direct observation, another issue with seed removal studies concerns the uncertainty of knowing the number of foragers visiting each seed tray and seed preferences at the individual level. These shortcomings were addressed in the present study by measuring foraging preferences for individuals in a laboratory setting. Despite this being a laboratory study, leading to a somewhat unnatural distribution of resources that foragers might encounter, the benefits of knowing the identity and number of foragers outweighs these potential costs (Ylönen and Wolff 1999).

Whereas many have studied the effects of sciurid seed predators (Smallwood and Peters 1986; Pyare et al. 1993; Hadj-Chikh 1996; Smallwood et al. 2001; Steele et al. 2001; McEuen and Steele 2005; Steele et al. 2013), fewer have focused on cricetid rodents, despite the evidence that mice are highly effective seed predators (Abbott and

Quink 1970; Martell and Macaulay 1981; Haas and Heske 2005; Lobo et al. 2009; Lobo et al. 2013). Making direct observations of these species is difficult, given their small size and nocturnal activity. Those that do consider cricetid rodents, especially *Peromyscus*, generalize across species (Schnurr et al. 2002; Royo and Carson 2008; Hsia and Franci 2009) due to the difficulty in making positive identifications in the field, and also because of the assumption that *Peromyscus* species are ecologically similar (Wolff et al. 1985; Schnurr et al. 2002). This assumption is consistently made for systems with deer mice (*P. maniculatus* (Wagner, 1845)) and white-footed mice (*P. leucopus* (Rafinesque, 1818)). Understanding potential differences between these species is becoming more pressing, as *P. leucopus* is expanding its range northward, and replacing *P. maniculatus*, especially in the Great Lakes region (Long 1996; Myers et al. 2009).

Both *Peromyscus* species are diet generalists, and seeds constitute a major component of their diets (Drickamer 1976). For example, peaks in *P. maniculatus* population have been shown to change in proportion to seed resources (Falls et al. 2007). Two prominent tree species in northern deciduous and mesic forests are sugar maple (*Acer saccharum* Marsh.) and red maple (*A. rubrum* L.). Although they are congeners, there are key ecological differences between the species that may affect seed predation. *A. saccharum* produces seeds which are nearly five times larger in size than those of *A. rubrum*, which may make them more desirable to seed predators (Moles et al. 2003). In addition, there are differences in terms of how long seeds are disseminated: *A. rubrum*

tends to have a short dissemination period (ca. 8 weeks), whereas *A. saccharum* releases seeds over a longer period (ca. 25 weeks; Houle 1994). These differences may make *A. saccharum* seeds more preferable to seed predators, because larger seeds contain more energy, and a longer dissemination period means that seeds are exposed to predators over a greater portion of the year.

The objective of this study was to assess the foraging preferences of two *Peromyscus* species (white-footed mouse, *P. leucopus noveboracensis* (Fischer, 1829), and woodland deer mouse, *P. maniculatus gracilis* (LeConte, (1855)), which dominate the forest small mammal community (M.J. Cramer, unpublished data), on the seeds of *A. saccharum* and *A. rubrum*. Two hypotheses were tested: 1) there should be no difference in preference between seed predator species, and 2) mice should consistently choose seeds based on size, and thus show a preference for *A. saccharum* over *A. rubrum*.

## MATERIALS AND METHODS

### Study Site

The University of Notre Dame Environmental Research Center (UNDERC) encompasses approximately 3035 hectares on the border between Wisconsin and the Upper Peninsula of Michigan (46° 13' N, 89° 32' W). It includes a land area of 2490 hectares and 30 lakes and bogs with a combined surface area of 545 hectares. The altitude of the area ranges between 500 and 520 m. The upland habitat is largely comprised of northern mesic forest

as defined by Curtis (1959). Trapping grids were randomly located within forest dominated by sugar maple on the UNDERC property.

### **Trapping Protocol**

Subjects were *P. m. gracilis* and *P. l. noveboracensis* individuals obtained by live-trapping in August 2009 and July and August 2011. Trapping grids contained 25 traps in a 5 x 5 configuration with 15 m spacing. All mice were live-trapped using Sherman traps (7.62 x 8.89 x 22.86 cm; H. B. Sherman Traps, Inc., Tallahassee FL) baited with rolled oats, black oil sunflower seeds, and peanut butter. Upon initial capture, all animals were identified to species [based on ear length (Stephens et al. 2014)], sexed, weighed and individually marked with ear tags (monel 1; National Band and Tag Co., Newport, KY). In 2009, ear biopsies were taken for use in confirming species identities using genetic techniques. To verify the species identification of *P. m. gracilis* and *P. l. noveboracensis* based on phenotypes, a real-time PCR-based assay was developed that targeted the cytochrome oxidase subunit III (COIII) gene (B.J. Ridenhour and M.J. Cramer, unpublished data). Genetic identification using this melting point assay verified all species identifications based on phenotype.

### **Experimental Procedure**

Only adult mice were used for trials, and lactating or pregnant females were not used. Use of adult mice ensured proper species identification (Stephens et al. 2014). Subjects were taken to the laboratory and housed in individual cages (19 x 29 x 12.5 cm) with

shaved pine bedding until trials were held that night. During this period, all mice were provided polyfill nesting material, and food (rat chow) and water *ad libitum*. Five hours prior to testing, all food was removed from the cages. For each trial, subjects were provided with 5 grams each of *A. saccharum* and *A. rubrum* seeds. This amount was used to prevent individual mice from consuming all offered seeds, thus masking actual preferences. Seeds were obtained from professional seed companies (Tree Help, Inc., Buffalo, NY and Sheffield's Seed Co., Inc., Locke, NY). Seeds were weighed to the nearest 0.01 g, mixed, and placed in a petri dish located in the mouse's cage. After eight hours, the dish was removed and all bedding was thoroughly examined for uneaten seeds. Seeds were separated by species and all uneaten seeds were weighed to the nearest 0.01 g. Amount of seeds consumed was obtained by subtracting the weight of the uneaten seeds from the initial weight placed in each cage.

### **Statistical Analyses**

Selectivity was estimated for each seed type using forage ratios:  $p_c/p_a$ , where  $p_c$  is the proportion of consumed seeds that were type  $i$  and  $p_a$  is the proportion of all available seeds that were type  $i$  (Page et al. 2001). Because the amount of each seed type eaten was not independent, the difference in selectivity (*A. saccharum* minus *A. rubrum*) was analyzed. This provided a preference index between -2 and 2. Individuals with a value of -2 showed a complete preference for *A. rubrum* while those with a value approaching 2 preferred *A. saccharum*. Those with a value near 0 showed no preference. Data were

analyzed using a 2-way analysis of variance with the preference index as the dependent variable, and mouse species and year as independent variables. In addition, total amount eaten was compared between species. To control for larger mice eating more seeds, body mass was entered into all analyses as a covariate. Ninety-five percent confidence intervals were used to determine if mice showed a significant preference for either maple seed type. If the confidence intervals included 0, it was concluded that mice showed no preference for either maple species (Johnson 1999). All statistical analyses were conducted with R release 3.0.1 (R Development Core Team 2008). All animal use conformed to the guidelines of the American Society of Mammalogists (Sikes et al. 2011) and the Animal Behavior Society (Ethical and Animal Care Committee of the Animal Behavior Society 2012) and was approved by the Institutional Animal Care and Use Committee at the University of Notre Dame (protocol # 12-120). All statistics are reported as means  $\pm$  standard error of the means.

## RESULTS

Thirty mice (16 *Peromyscus maniculatus gracilis* and 14 *P. leucopus*) were used to test the congruence of species identifications based on phenotype (ear length) with melting point determination based on the cytochrome oxidase subunit III gene. In all cases, mice were identified correctly to species.

A total of 80 adult mice (42 *P. m. gracilis* and 38 *P. l. noveboracensis*) were tested for foraging preferences. Sex ratios of mice tested were similar between species:

29 male and 12 female *P. m. gracilis* and 28 male and 10 female *P. l. noveboracensis* were tested. More males were tested because females that were pregnant or lactating were not used in trials. Total amount eaten was normally distributed (Shapiro-Wilk test:  $W = 0.972$ ,  $P = 0.083$ ), but body mass needed to be log-transformed ( $W = 0.963$ ,  $P = 0.021$  before transformation;  $W = 0.978$ ,  $P = 0.171$  after transformation). *P. l. noveboracensis* ate more seed ( $5.88 \text{ g} \pm 0.36$ ) than *P. m. gracilis* ( $4.88 \text{ g} \pm 0.35$ ;  $F_{1,72} = 4.75$ ,  $P = 0.032$ ), and mice ate more seed in 2011 ( $5.79 \text{ g} \pm 0.28$ ) than 2009 ( $4.63 \text{ g} \pm 0.48$ ;  $F_{1,72} = 8.78$ ,  $P = 0.004$ ) Moreover, there was a significant positive relationship between body size and amount eaten ( $r = 0.23$ ,  $F_{1,72} = 5.07$ ,  $P = 0.027$ ), but all interactions between factors were statistically non-significant (Species x Year:  $F_{1,72} = 2.51$ ,  $P = 0.118$ ; Species x Body:  $F_{1,72} = 0.05$ ,  $P = 0.831$ ; Year x Body:  $F_{1,72} = 0.01$ ,  $P = 0.928$ ; Species x Year x Body:  $F_{1,72} = 1.95$ ,  $P = 0.167$ ).

Data for seed preference were not normally distributed (Shapiro-Wilk test:  $W = 0.92$ ,  $P < 0.001$ ), and transformations could not fix the problem. However, based on the central limit theorem and the high sample size ( $N = 80$ ), this violation of the normality assumption is not catastrophic (Sokal and Rohlf 2012). In addition, results of Fisher's  $F$  tests (Species:  $F_{41,37} = 0.78$ ,  $P = 0.434$ ; Year:  $F_{29,49} = 1.40$ ,  $P = 0.298$ ) supported the homoscedasticity assumption (Crawley 2007), a more serious assumption of the analysis of variance. *P. m. gracilis* demonstrated stronger selectivity for *A. rubrum* ( $1.22 \pm 0.12$ ) compared to *P. l. noveboracensis* ( $0.40 \pm 0.14$ ;  $F_{1,72} = 20.89$ ,  $P < 0.001$ ; Figure 1). Mice

tended to be more selective toward *A. rubrum* in 2011 ( $0.96 \pm 0.12$ ) compared to 2009 ( $0.62 \pm 0.18$ ), but this trend was not statistically significant ( $F_{1,72} = 2.83, P = 0.097$ ). Body mass had no effect on selectivity ( $F_{1,72} = 1.39, P = 0.242$ ), and there were no significant interactions (Species x Year:  $F_{1,72} = 0.58, P = 0.449$ ; Species x Body:  $F_{1,72} = 0.39, P = 0.533$ ; Year x Body:  $F_{1,72} = 1.23, P = 0.270$ ; Species x Year x Body:  $F_{1,72} = 0.24, P = 0.625$ ). The 95% confidence intervals for the mean selectivity of each species did not overlap, also supporting the difference in mean preference between the species. The range of values was greater for *P. l. noveboracensis* (0.121—0.686) than *P. m. gracilis* (0.985—1.458), but intervals did not include zero for either species.

Based on the significant difference between species for both amount eaten and selectivity, regression analyses were conducted to determine if selectivity was affected by total amount eaten, and if species-specific responses were consistent. Both species had significant positive linear relationships between selectivity and total amount eaten [*P. m. gracilis*: Selectivity =  $0.219 (\pm 0.039) * \text{Total Eaten} - 2.287 (\pm 0.211)$ ,  $F_{1,40} = 30.97, P < 0.001$ ; *P. l. noveboracensis*: Selectivity =  $0.133 (\pm 0.060) * \text{Total Eaten} - 1.186 (\pm 0.377)$ ,  $F_{1,36} = 4.908, P = 0.033$ ] but the slopes of these regressions were not significantly different (ANCOVA:  $F_{1,76} = 1.48, P = 0.227$ ; Figure 2).

## DISCUSSION

Although both *Peromyscus* species demonstrated a preference for *Acer rubrum* over *A. saccharum*, the selectivity of *P. m. gracilis* was significantly stronger than that of *P. l.*

*noveboracensis*. These results demonstrate clear differences in foraging behavior between these *Peromyscus* species. Other studies of seed predation in forested ecosystems group *Peromyscus* species together, with the assumption that these species are ecologically similar (Schnurr et al. 2002; Royo and Carson 2008). However, the fact that *P. m. gracilis* shows more selectivity based on seed species, compared to *P. l. noveboracensis*, indicates that this assumption may be unfounded. This has a great potential effect on the interpretation and generalities of many seed predation studies. Studies that combine the effects of *Peromyscus* species may oversimplify the effects of small mammals on seedling establishment and recruitment. In systems with both *P. l. noveboracensis* and *P. m. gracilis*, the documented differences in selectivity could impact the establishment of *Acer* species. Areas dominated by *P. m. gracilis* may find more *A. saccharum* establishment compared to areas dominated by *P. l. noveboracensis*. This is especially important for comparisons of different geographical regions, where the identity and abundance of the *P. maniculatus* subspecies may differ. In cases where both species are sympatric, studies of seed predation should also include a trapping regime that can help determine the comparative population densities of these species.

It is possible that there were species-specific responses to captivity that may have biased the results of this study. However, considering the fact that despite a significant difference between the species in total amount eaten, the effect on preference was consistent between species, this is unlikely. Moreover, both species consumed a

considerable amount of food during the trials, indicating that the stressful effects of captivity were either absent or short in duration (Carr 2002).

*Peromyscus leucopus* is considered a habitat generalist in many systems. They are one of the most widely occurring rodent species in North America, and as such may be more inclined to try new and novel resources. In the laboratory, this species is prone to investigate new items in its home range (*i.e.* they are neophilic; Sheppe 1966). In this study, *P. l. noveboracensis* response to two different resources may be to eat them both in the same proportion in which they are encountered, leading to a weak preference for *A. rubrum*, due to the inclusion of more *A. saccharum* seeds in their diet. This behavioral adaptability should be expected from a species which is able to inhabit a variety of habitat types (Drickamer 1976). Furthermore, *P. leucopus* has been shown to have an exceptionally diverse diet, when presented with a variety of seed types (Ivan and Swihart 2000). This is demonstrated by the large range of preferences by *P. l. noveboracensis* in this study (Figure 1). *Peromyscus maniculatus gracilis*, on the other hand, is limited to northern forested systems, and may be less likely to sample new and novel food sources. In the laboratory, *P. maniculatus* did not demonstrate increased interest in novel objects compared to other *Peromyscus* species (Martin et al. 2007). Moreover, sugar maple (the food source avoided by *P. m. gracilis*) was the dominant tree species on the trapping grids; hence mice should be exposed to both seed types during their daily movements.

Thus, the general ecology of these species may help explain the weak preference by *P. l. noveboracensis*, but it does not explain the food preferences of *P. m. gracilis*.

From an optimal foraging perspective, there may be a difference in the overall value of the two seed types that may explain why *P. m. gracilis* showed a preference for *A. rubrum*. The quality of a food item is dependent on not only its energy content, but also in how much time must be expended to extract that energy (handling time; Stephens and Krebs 1986). The seed coat of *A. rubrum* is significantly thinner than that of *A. saccharum*, presumably making them easier to open. Thus, even though there may be less energy in the smaller *A. rubrum* seeds, foraging mice may be able to compensate for this by eating more seeds per unit time. Moreover, mice may be responding to other limiting nutrients besides energy, such as protein (Lobo et al. 2013). Additional studies on the energetic and nutritional content of maple seeds and measurement of the actual handling time of foraging mice on each seed type would aid in our understanding of diet choices made by *P. m. gracilis*.

Optimal foraging theory posits two reasons for a species to include less desirable foods (*i.e.*, lower energy) in their diet (Lacher et al. 1982; Krebs and Davies 1993). First, animals may increase their diet breadth to gain access to nutrients that may be lacking in a single food item. Second, plant resources may be protected by secondary compounds. These compounds may lead to increased diet breadth because foragers consume more species in lower quantities to avoid the negative consequences of consuming large

amounts of any particular poison. Secondary compounds have been shown to affect foraging and hoarding decisions for agoutis (*Dasyprocta leporina* (L., 1758)), another rodent seed predator (Guimarães et al. 2003). However, research on squirrels and *Apodemus* Kaup, 1829 (a common Old World mouse species) indicates that tannin, a common secondary compound produced by plants, does not affect foraging decisions (Smallwood et al. 2001, Steele et al. 2001, Wang and Chen 2009). However, *Peromyscus* maintained on a diet of only high tannin acorns did develop “oak poisoning,” typified by viscous bright orange urine and weight loss (Briggs and Smith 1989). There is also evidence that foraging mice will avoid feeding on conifer species with high amounts of secondary compounds (Lobo et al. 2009, Lobo et al. 2013). Even though both tree species in this study were closely related, they may employ different strategies to deter seed predators (Siemens et al. 1992). Further investigation of the nutrition derived from each food type is warranted, along with estimates of the secondary compounds produced by trees to protect their seeds.

Seasonal differences between the tree species may also have significant effects on *P. m. gracilis* foraging behavior. Though they are congeners, literature suggests that *A. rubrum* and *A. saccharum* may be ecologically different, which may lead to important distinctions in terms of seed predation. For instance, *A. rubrum* tends to shed its seeds in late spring and early summer (Walters and Yawney 1990), whereas *A. saccharum* sheds its seeds in late summer and early autumn (Godman et al. 1990). In addition, *A. rubrum*

seeds can germinate immediately following dissemination, whereas *A. saccharum* seeds generally germinate following winter (Abrams 1998). This suggests that there may be a significant seasonal effect on the diet composition of mice for two reasons, one concerning seasonal energy requirements and the other germination schedules. First, *P. m. gracilis* may decide to feed on *A. rubrum* seeds in the spring and summer, and consume *A. saccharum* seeds come winter. Despite the fact that these data were collected in July and August (after the seed dissemination period for *A. rubrum*), mice still consumed these seeds. It would be interesting to test preferences for different *Acer* seeds in other seasons, to see if these preferences are season-dependent. The large size and seed coat of *A. saccharum* may make this seed more easily stored for consumption during the winter. In other forest systems, *Peromyscus* tended to cache pine seeds with thicker seed coats and consume seeds with thinner seed coats (Siepielski and Benkman 2008). Thus, *P. m. gracilis* may decide to consume the easily opened *A. rubrum* seeds when energy demands are lower, and save the *A. saccharum* seeds for times of energy shortage (Vander Wall 2010). This is further supported by the observation that *P. m. gracilis* tends to hoard more food than *P. l. noveboracensis* (Pierce and Vogt 1993). In addition, *P. m. gracilis* have been observed caching *A. saccharum* seeds (M.J. Cramer, unpublished data), although more information is needed to determine the composition of seed caches between these species.

Second, *P. m. gracilis* may decide to consume *A. rubrum* seeds because they are more likely to germinate earlier than *A. saccharum*. Similar results have been found for grey squirrels (*Sciurus carolinensis* Gmelin, 1788) foraging on seeds of different oak species: foraging squirrels consumed acorns that were more likely to germinate and cached acorns that would not germinate until the following spring (Hadj-Chikh et al. 1996; Steele et al. 2001). More study of caching behavior of *P. m. gracilis* may provide some insight into when foragers consume seeds and when they store them for later, and the mechanistic basis for this decision.

Another interesting and unexpected result was the effect of year on foraging in these species. Although mice ate more seed in 2011 compared to 2009, this did not significantly affect seed preferences. This is most likely an artifact of the experimental protocol. Due to the low consumption of *A. saccharum* seeds overall, seeds originally obtained in 2009 were also used for the experiments conducted in 2011, whereas fresh *A. rubrum* seeds were acquired in 2011. Thus, the mice may have been responding to some unperceived difference related to the age of the individual seeds used in the experiment. Moreover, individual mice may have compensated for unacceptable *A. saccharum* seeds by increasing consumption on *A. rubrum*, which may have led to slightly higher selectivity in 2011.

Finally, it is important to note that even though *P. maniculatus* is a recognized species, the assignment of subspecies is paraphyletic (Wilson and Reeder 2005), calling

into question the universality of interpretation of similarities between *P. leucopus* and *P. maniculatus* that rely in a large degree on studies conducted on a different subspecies of deer mouse (especially *Peromyscus maniculatus bairdii* (Hoy and Kennicott, 1857)). For example, Drickamer (1970, 1976) conducted similar feeding trials in which he concluded that *P. leucopus* shows a stronger preference for maple seeds than *P. maniculatus*, which prefers grass seed. However, in these studies, the subspecies of *P. maniculatus* being tested was *P. m. bairdii*, the prairie deer mouse. Comparison with the results of this study underscores the importance of knowing which subspecies of *P. maniculatus* is being tested. In many areas, ecological comparisons between *P. leucopus* and *P. maniculatus* are unsurprising, as the more common subspecies (*P. m. bairdii*) has habitat preferences quite distinct from *P. leucopus*. However, there are some instances where these species do co-occur in the same habitat, such as in the northern forests of the United States, where the common subspecies of *P. maniculatus* is *P. m. gracilis*. Throughout this study, I have continued to refer to the forest deer mouse with its subspecific epithet, to avoid confusion with studies of other subspecies of deer mouse, which do have different ecological characteristics. Until the taxonomy of this species has been determined, differences between subspecies of deer mouse need to be considered and cited in future studies.

In conclusion, preferences for seeds of two *Acer* species were different between two common seed predators, *P. l. noveboracensis* and *P. m. gracilis*. *Peromyscus*

*leucopus noveboracensis* showed a weak preference for *A. rubrum* seeds, whereas *P. m. gracilis* demonstrated a distinct preference for seeds of *A. rubrum*. *Peromyscus leucopus noveboracensis*, being a habitat generalist, may demonstrate higher plasticity in response to different food types. *Peromyscus maniculatus gracilis* may prefer *A. rubrum* because of differences in nutrition, handling costs, or germination schedules. Further research will determine the mechanisms behind foraging decisions in this species.

#### ACKNOWLEDGEMENTS

H. Mahon and M. Iglecki provided tireless assistance in the field and laboratory. N. Colón-Rosa, Z. Cruz-Ramos and K. Witkowski also helped with trapping. Seeds were provided by D. Chan in 2009. Genetic assays were conducted by B. Ridenhour and M. Oswald. D. Fligel, C. Hennessy, and H. Mahon provided valuable input during this project. L. Drickamer, D. Fligel, K. Francl, and P. Klug provided helpful comments on earlier versions of this manuscript. This research was supported by the University of Notre Dame Environmental Research Center.

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## Figure Legends

Figure 1. Boxplots of difference in selectivity for both white-footed deer mice (*Peromyscus leucopus noveboracensis*) and woodland deer mice (*Peromyscus maniculatus gracilis*). Difference in selectivity ranges from -2 [absolute preference for red maple (*Acer rubrum*)] to 2 [(absolute preference for sugar maple (*A. saccharum*)], with values of 0 indicating no preference. *Peromyscus maniculatus gracilis* showed a stronger preference for *A. rubrum* than *P. leucopus noveboracensis* ( $F_{1,72} = 20.89$ ,  $P < 0.001$ ).

Figure 2. Plot of difference in selectivity against total amount eaten with linear regression line for both white-footed deer mice (*Peromyscus leucopus noveboracensis*) and woodland deer mice (*Peromyscus maniculatus gracilis*). Both species demonstrated a positive linear relationship: the difference in selectivity increased with increasing amount eaten [*P. m. gracilis* (dashed line): Selectivity =  $0.219 (\pm 0.039) * \text{Total Eaten} - 2.287 (\pm 0.211)$ ,  $F_{1,40} = 30.97$ ,  $P < 0.001$ ; *P. l. noveboracensis* (solid line): Selectivity =  $0.133 (\pm 0.060) * \text{Total Eaten} - 1.186 (\pm 0.377)$ ,  $F_{1,36} = 4.908$ ,  $P = 0.033$ ].



