Poster; Contributed Paper; Travel Scholarship and **Presentation Award**

A reliable correction factor for recovery of moist-soil seeds from core samples

Heath M. Hagy, Department of Wildlife and Fisheries, Mississippi State University, Mississippi State, MS 39762, USA *E-mail*: hmh100@msstate.edu

Jacob N. Straub, Department of Wildlife and Fisheries, Mississippi State University, Mississippi State, MS 39762, USA *E-mail*: jstraub@cfr.msstate.edu

Richard M. Kaminski, Department of Wildlife and Fisheries, Mississippi State University, Mississippi State, MS 39762, USA *E-mail*: rkaminski@cfr.msstate.edu

Extended Abstract: Wildlife scientists and conservationists rely on precise estimates of seed abundance to calculate seasonal carrying capacities and assess management of important habitats used by non-breeding waterfowl. Scientists often use core samplers to estimate seed abundance in wetlands. Due to small diameters of most corers (≤ 10 cm), minute areas in the landscape are sampled, and estimated seed densities are extrapolated to local and larger scales. Consequently, possible biases resulting from under- or over-estimation of seed abundance can ensue. Thus, accurate estimates of seed recovery from core samples are an essential component of deriving reliable estimates of seed abundance.

Surprisingly few researchers have reported efficiency of seed recovery. Reinecke and Hartke (2005) estimated seed recovery of barnyardgrass (*Echinchloa crusgalli)* at 88%, while, Stafford et al. (2006) estimated rice grain recovery at 90%. Neither study examined potential biases associated with recovering multiple taxa of differing morphometry, but Kross et al. (2008) recommended need for such research. Small seeds (e.g., *Amaranthus* spp., *Panicum* spp., *Eleocharis* spp.) may have a lower recovery rate than larger seeds. Thus, our objectives were to (1) test the effects of seed size and number of seeds per sample on recovery rate of seeds; (2) evaluate differences between 2 seed recovery methods; and (3) estimate a correction factor for moist-soil seed recovery.

We added known amounts of 12 moist-soil seed taxa of the following three size classes to each of 12 simulated soil cores of ~700 cm^3 of clay and loam: (1) Large (13–25 mm^3; *E. crusgalli, Polygonum pensylvanicum*, *Rhynchospora corniculata, Sesbania herbacea*), (2) Medium (2.6–13 mm^3; *Ipomoea* spp., *P. hydropiperoides*, *P. lapathifolium, Sida spinosa*), and (3) Small (0–2.5 mm^3; *Amaranthus* spp.*, Cyperus* spp.*, Eleocharis* spp.*, Panicum* spp.). Additionally, we prepared 4 test cores containing zero seeds. We collected soil, seeds, grit, and detritus for test samples, from moist-soil wetlands in the Mississippi Alluvial Valley. We sieved all soil twice to ensure no unaccounted seeds remained in samples. We varied experimental seed abundances per core sample (0, 50, 100, 200, 400 seeds), but kept proportions equal among seed taxa and size classes. We chose these abundances because they represented the range of moist-soil seed abundances reported in actual core samples (0 – 1,450 kg/ha).

Technicians washed test samples through sieves (i.e., mesh sizes 50[0.03 mm], 10[1.65 mm], and 4[4.75 mm]), recovered and air dried seeds and other material for 24 hrs, and removed seeds manually from soil and detritus. We interspersed test samples with actual core samples and added dry seedless soil (2 – 5 g) to the large and small samples to encourage consistent processing effort. Seeds retained by 2 large sieves (#s 4 and 10) were removed completely. Contents of the small sieve (# 50) were homogenized and separated by weight into a one-quarter portion and a 3-quarter portion, and then seeds were removed from each as previously described. All seeds found in the one-quarter portion were multiplied by 4 to estimate total seeds per core. After all samples had been processed by

technicians, we re-examined debris and soil for seeds to ensure all had been removed.

We normalized recovery rates with a square-root transformation and then used a paired-*t* test in Program R to evaluate seed recovery rates between partially quartering- and whole-sample processing methods. We used regression analysis (PROC GLM in SAS) to evaluate potential relationships between seed recovery rate, and seed size, observer, and number of seeds per sample. We calculated mean recovery rates for each species, size class, and overall.

There was no difference in recovery rates (t = 0.83, P = 0.42, n = 12) between partially quartered ($\bar{x}$ = 81.3%, SE = 2.2%) and whole samples ($\bar{x}$ = 86.5%, SE = 2.2%). Seed recovery rate of whole samples varied by seed size ($F_{2,35}$ = 6.58, $P \leq 0.01$) but not by number of seeds ($F_{3,35}$ = 2.27, P = 0.10) or observer ($F_{2,35}$ = 0.32, P = 0.73). Recovery rate for larger seeds was greater than for smaller seeds (Fig. 1). We estimated the greatest species-specific recovery rate for *P. pensylvanicum* ($\bar{x}$ = 98.5%) and the lowest for *Cyperus* spp. ($\bar{x}$ = 44.6%).

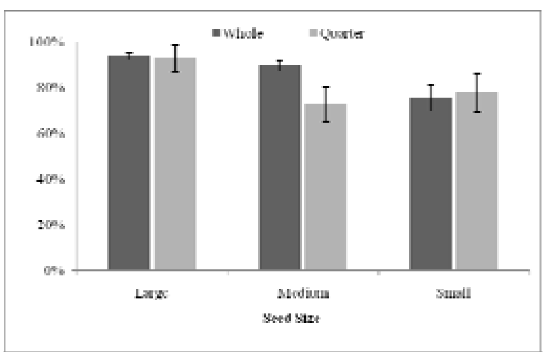

Figure 1. *Seed recovery rate by seed size class and recovery method for 12 species of moist-soil seeds recovered from core samples.*

We suggest quartering fine materials (#50 sieve) in core samples to reduce processing time. We also suggest that if core samples contain seeds of different species and sizes, researchers increase their abundance estimates by 18.7% based on our mean recovery rate from partially quartered samples and our other methods. If researchers sort whole samples, then we suggest that they increase seed abundance by 13.5%.

A post-examination of core samples after the technicians finished processing samples revealed that ~11% of seeds were not recovered by technicians and ~7% were lost or destroyed during the sieving process. As thick clay soils require abrasive washing and sieving, seeds may fragment and be lost during this process resulting in underestimation of seeds in core samples. When we accounted for this bias using results from the partially quartered samples, the total overall recovery rate increased to 89%.

We recovered 92% of large seeds in our partially quartered samples, which is similar to the recovery rate Reinecke and Hartke (2005) reported for barnyardgrass (88%). However, we only recovered 73 and 78% of medium and small seeds, respectively. We plan to report recovery rates for common moist-soil seed species, increase experimental sample sizes, and conduct a similar experiment evaluating core samples containing disproportionately distributed seed sizes.

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Stafford, J. D., R. M. Kaminski, K. J. Reinecke, and S. W. Manley. 2006. Waste rice for waterfowl in the Mississippi Alluvial Valley. Journal of Wildlife Management 70:61–69.