



Assessment of Seed Production in Moist-soil Wetlands

Justification of Sampling Analysis Design



Credit: H. Hagy

Supplement to the SOP “*Assessment of Seed Production in Moist-soil Wetlands*” documenting the species and model adjustments.

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Introduction

Actively managing moist-soil vegetation is a common practice of National Wildlife Refuges (NWRs) in the Southeast U.S. The intention of the Assessment of Seed Production in Moist-Soil Wetlands standard operating procedure (SOP) was to provide a means of quantifying moist-soil seed production as a metric to inform management decisions for migrating and wintering waterbirds (Howard et al. 2023). With previous methods of quantifying moist-soil seed production being labor intense and/or expensive (Hagy et al. 2021), this assessment refines a method that is time and cost efficient.

Martin et al. (2022) evaluated a wide variety of rapid seed yield production indices for moist-soil wetlands and found that several indices that restricted the number of species to a small number of common taxa and were simple to perform had the best performance. However, they did not evaluate the affect of adjusting the index for total seed biomass production potential. Some species of moist-soil plant have much higher (e.g., barnyardgrass) seed production potential than others (e.g., fall panicgrass), so coverage and quality would naturally vary by species with biomass produced. To make this survey more widely applicable geographically and potentially more accurate, we used data collected by Martin et al. (2022) to evaluate effects of an expanded number of species and addition of biomass correction factors on index performance.

Methods

We obtained soil core data from Martin et al. (2022) which included 16 moist-soil units and calculated a biomass yield potential metric for all plant species observed during the study. We took the greatest three seed yield estimates in soil cores where plant coverage in plots was >50% and averaged these to create the biomass yield potential metric for each individual taxon (biomass correction factor; BCF). We then used this metric for each taxon, extrapolated to lbs/ac, as a correction factor to adjust the seed production index (SPI; $SPI = Area \times Quality$) values ($SPI_{adj} = SPI \times BCF$) for comparison with core biomass estimates. We used data from a single observer (Observer H. Hagy) who was experienced and present for all moist-soil surveys in Martin et al. (2022). We used the whole-unit survey data as Martin et al. (2022) found this approach to be superior to subplot methods. We summed SPI_{adj} ($Unit\ SPI_{adj} = \sum Taxa\ SPI_{adj}$) scores for up to eight taxa within each unit, allowing the taxa to vary across units and the number of species to vary. We include only species with coverages $\geq 5\%$. Finally, we regressed SPI_{adj} on the total biomass from core samples (across all taxa, including uncommon or undetected taxa in the visual surveys for each plot) for each unit from the soil core data to create a linear model to estimate yield (R Core Team 2022).

Results

We determined that SPI_{adj} scores were positively related to known yields from soil core data and the variance explained was greater than the top models from Martin et al. (2022; $F_{1,14} = 108.50$; $P < 0.001$; $R^2_{adj} = 0.88$; $10.10 + 0.02292 * SPI_{adj}$; Figure 1). In our analysis, we allowed for up to eight species to be included per unit with no minimum number to be included so as to incorporate variability in plant taxa occurrence into the predictive model. The number of species

included from Martin et al. (2022)’s unit-level data ranged from 1–8 per unit with a mean of 4.8 species per unit and a standard deviation of 1.9.

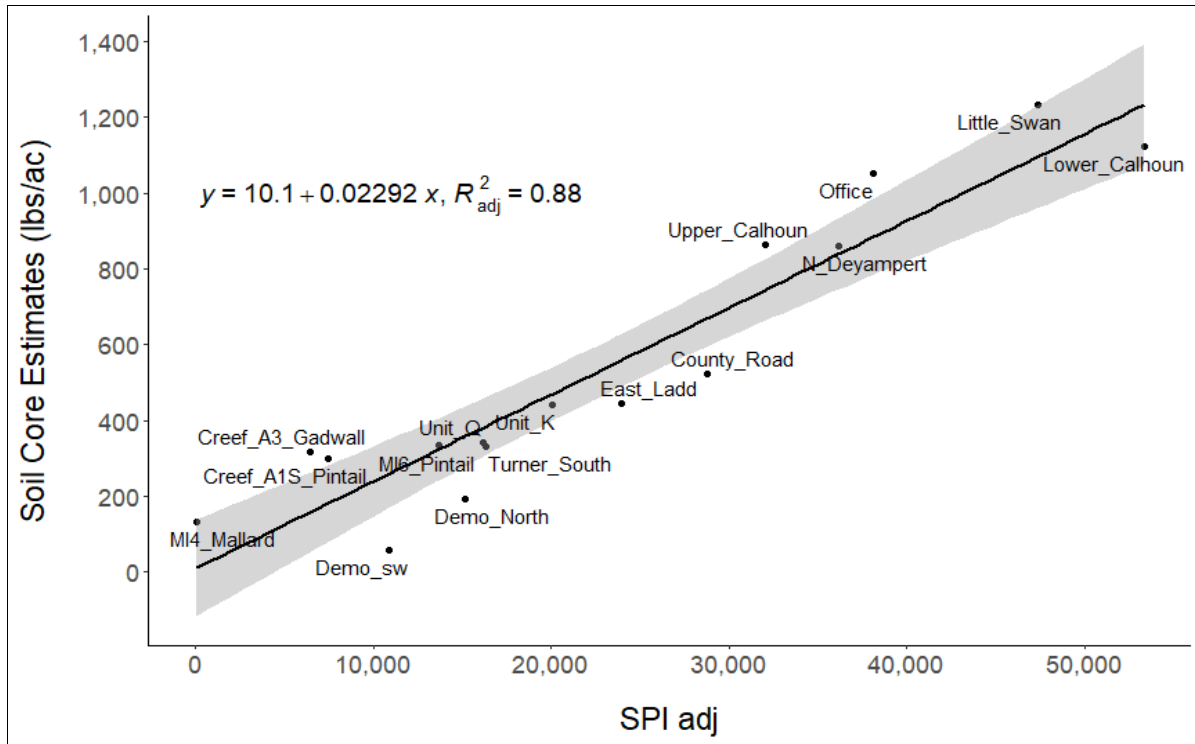


Figure 1. The relationship between moist-soil seed production estimated from soil cores (lbs/ac) and estimated Seed Production Index (SPI) scores multiplied by taxon-specific biomass correction factors (BCF) to get a SPI adjusted (SPI adj) score. SPI scores were estimated for a group of common moist-soil plants by multiplying an Area x Quality score for a total 20 possible points. Solid line fitted by a simple linear regression with 95% confidence intervals (gray).

Discussion

Our analysis expands and improves the rapid seed yield index of Martin et al. (2022; index 2b), by increasing flexibility by allowing variability across > 20 plant taxa that can be included in the survey (Table 1.). This will allow managers to implement this survey design and analysis across more refuges in the Southeast and beyond. Moreover, the precision of the index was improved by our addition of the biomass correction factor metric. We recommend natural resource agencies adopt this version

Table 1. Common Moist-soil plant species to include in the survey and their associated correction factor.

Taxa Name	Species Represented	Correction Factor ¹
Barnyardgrass	<i>Echinochloa crus-galli</i> , <i>E. muricata</i>	1,641
Beakedrush	<i>Rhynchospora corniculata</i>	253
Beggarsticks	<i>Bidens aristosa</i>	7

Taxa Name	Species Represented	Correction Factor ¹
Crabgrass	<i>Digitaria ciliaris</i> , <i>D. ischaemum</i> , <i>D. filiformis</i> , <i>D. sanguinalis</i> , <i>D. villosa</i>	145
Fall panicum	<i>Panicum dichotomiflorum</i>	559
Fall witchgrass	<i>Digitaria cognata</i> , <i>Panicum capillare</i>	559
Fimbry rush	<i>Fimbristylis annua</i>	2
Foxtail	<i>Setaria italica</i> , <i>S. parviflora</i> , <i>S. pumila</i> , <i>S. verticillata</i> , <i>S. viridis</i>	516
Nodding smartweed	<i>Polygonum lapathifolia</i> , <i>P. glabrum</i>	81
Pennsylvania smartweed	<i>Polygonum pennsylvanicum</i> , <i>P. persicaria</i>	397
Pigweed	<i>Amaranthus albus</i> , <i>A. blitoides</i> , <i>A. cruentus</i> , <i>A. hybridus</i> , <i>A. palmeri</i> , <i>A. retroflexus</i> , <i>A. spinosus</i>	340
Prickly sida	<i>Sida spinosa</i>	260
Redroot flatsedge	<i>Cyperus erythrorhizos</i>	510
Redtop panicum	<i>Panicum rigidulum</i>	41
Rice cutgrass	<i>Leersia oryzoides</i>	89
Ricefield flatsedge	<i>Cyperus iria</i>	36
Signal grass	<i>Urochloa fusca</i>	978
Spikerush	<i>Eleocharis palustris</i>	238
Sprangletop	<i>Lepticola fascicularis</i> , <i>L. panicoides</i>	446
Swamp smartweed	<i>Polygonum hydropiper</i> , <i>P. hydropiperoides</i> , <i>P. setaceum</i>	208
Teal grass	<i>Eragrostis hypnoides</i>	29
Toothcup	<i>Ammannia coccinea</i> , <i>A. robusta</i> , <i>A. latifolia</i>	118
Yellow nutsedge (Chufa)	<i>Cyperus esculentus</i>	6
Walters millet	<i>Echinochloa walteri</i>	1,641
Alligatorweed	<i>Alternanthera philoxeroides</i>	0
Aster	<i>Symphyotrichum spp.</i>	0
Balloonvine	<i>Cardiospermum halicacabum</i>	0
Boltonia daisy	<i>Boltonia spp.</i>	0
Broomsedge	<i>Andropogon virginicus</i>	0
Buttonbush	<i>Cephalanthus occidentalis</i>	0
Buttonweed	<i>Diodia virginiana</i>	0
Cattail	<i>Typha spp.</i>	0
Cocklebur	<i>Xanthium strumarium</i>	0
Coffeeweed	<i>Sesbainia macrocarpa</i>	0
Dogfennel	<i>Eupatorium capillifolium</i>	0
Goldenrod	<i>Solidago spp.</i>	0
Gooseweed	<i>Sphenoclea zeylanica</i>	0
Hydrolea	<i>Hydrolea ovata</i>	0
Lizard's tail	<i>Saururus cermus</i>	0
Ragweed	<i>Ambrosia artemisiifolia</i>	0
Marsh mallow	<i>Althaea officinalis</i> , <i>Hibiscus moscheutos</i>	0
Plumegrass	<i>Saccharum giganteum</i>	0
Redvine	<i>Brunnichia cirrhosa</i>	0
Reed	<i>Phragmites australis</i>	0
Sumpweed	<i>Iva annua</i>	0
Trumpet Creeper	<i>Campsis radicans</i>	0
Virginia creeper	<i>Parthenocissus quinquefolia</i>	0
Velvetleaf	<i>Abutilon theophrasti</i>	0

Taxa Name	Species Represented	Correction Factor ¹
Willow	<i>Salix spp.</i>	0
Woolgrass	<i>Scirpus cyperinus</i>	0

¹ Taxa with a “0” CF have not been documented to provide nutrition value for or be commonly consumed by waterfowl (Callicutt et al. 2011, Hagy and Kaminski 2012, Klimas et al. 2020, Bethell 2022).

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