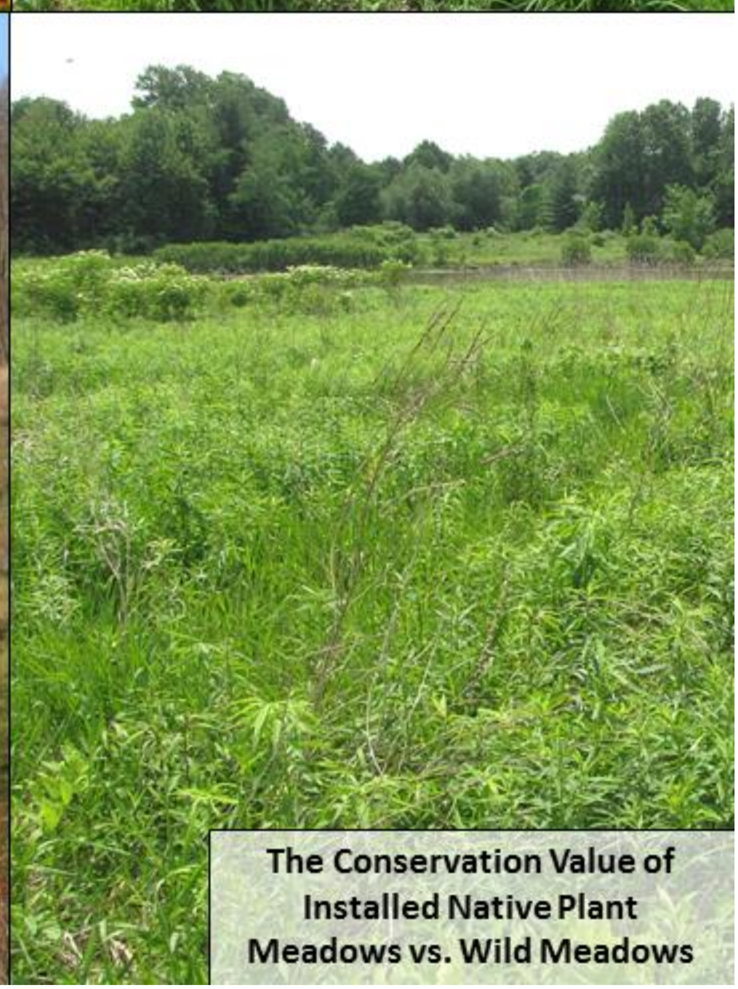

The Conservation Value of Installed Native Plant Meadows vs. Wild Meadows

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INTRODUCTION

Installed native meadows (here called INMs) are a replacement for lawns that have the potential to offer a more varied and aesthetically interesting landscape, while requiring less maintenance than a more formal garden and perhaps even than lawns. Although not at the forefront of every landowner's mind, INMs can also assist nature conservation by directly supporting native flora and presumably indirectly supporting native fauna such as bees and butterflies. There can be little doubt that, when compared to lawns, installed native meadows are better at performing these functions. In rural situations however, where old field or hay field might be an alternative cover, the ecological comparison may be more nuanced.

Furthermore, meadow management practices and concepts developed as part of the private-home landscaping trade also find application in other situations where conservation impact may be relatively more important, such as on open lands owned by land trusts or parks, or as part of the management of marginal farmlands for pollinators and other beneficials. At the same time, full-fledged native meadow installations can be very costly and so, if one's primary goal is ecological rather than aesthetic, it is worth asking whether there are less expensive alternatives which provide similar conservation benefits. Botanically diverse old fields and other wild meadows might be one such alternative, and so comparing their diversity values to those of INMs can be instructive in the other contexts of openland management mentioned above.

The goal of our work with native meadows has been to explore three inter-linked questions:

> *Botanically, how does coverage and diversity of native plants compare between installed native plant meadows and wild, rural meadows?*
>
> *Related to this, is there any indication that installing a native plant meadow influences the diversity of wild native plants? (This would happen, for example, if the soil conditions created to support the planted natives also made the meadow more conducive to colonization by wild native plants.)*
>
> *How, if at all, does the abundance and/or diversity of native insects and spiders differ between installed native meadows and wild, rural meadows? There are at least two related ways that meadow vegetation might be affecting such populations: by increasing overall abundance of some general resource (such as flower nectar) and by increasing the diversity of native food plants and so increasing the diversity of native specialists who feed on particular native plants.*

This work has been a 'hobby' project for us – pursued when and where we had the opportunity. Our methods were rather crude and our sample sizes small. It was a diligent pilot project that might suggest topics for future, more detailed research.

METHODS

Study Sites. In 2012, we looked at plant and insect diversity in six INMs at five sites in northwestern Connecticut. We compared those results to data from old fields and mature hay fields in adjacent Columbia County NY collected during 2012 and previous years. Although we collected data at INMS throughout the growing season, data from wild meadows was only available for mid-summer, and so, for these comparisons, only mid-summer INM data were used. In 2014 and 2015, we paired two installed native meadows – one in Columbia County, NY and the other in Litchfield County, CT (this field also appeared in the 2012 work) - with two nearby wilder meadows in approximately the same locations. These paired meadows were sampled on the same dates throughout the growing season.

Plant Surveys. In all cases, plants were surveyed by walking the meadows and noting all plant species which were evident. When necessary, plant specimens were brought back for identification. Abundance was indexed by species on a scale of 1 to 4, corresponding to rare, occasional, common and abundant. These scores were subsequently converted to the approximate coverages of 1, 3, 7 and 15%, respectively. Because of this imprecision and because plant communities are multilayered, estimated coverages were well in excess of 100%. The estimated coverages are presented for comparative purposes and probably only roughly correspond to actual values.

Invertebrate Surveys. Insects and spiders were sampled in various ways. During both time periods (i.e. 2012 and 2014/15), sweep net samples were taken and the resulting catch was identified to taxonomic order or, occasionally, a lower but easily registered taxonomic level. These gross-level surveys were meant to give a broad measure of general abundances. Three sets of 25 sweeps were conducted at each site. During both time periods, we also did timed visual surveys for butterflies.

In 2012, we also conducted one-hour ground searches for ants and ground beetles, and observations and netting for bees. In 2014 and 2015, we did not conduct ground searches. We did retain leafhoppers, spittlebugs and plant hoppers captured in sweep netting for subsequent identification. We also did one-hour searches for leaf miners. Any leaves showing signs of leaf miners were collected, individually incubated in a moist container in the lab, and the resulting leaf miner adults were submitted to Charley Eiseman for identification. We also used a 15W fluorescent light and a sheet to survey for moths. Macro moths were photographed and identified to species when possible.

Analyses. In light of our small sample sizes, only simple summary statistics are provided, and, with one exception, we have not undertaken statistical tests.

RESULTS & DISCUSSION

So, what did we find?

Plants. Not surprisingly, in both 2012 and 2014/15, the installed native meadows had more native plant species than the wild meadows (Table 1). INMs had approximately 30% more native species than the wild meadows and estimated coverage was about 45% higher. Interestingly, non-native *diversity* appeared to differ little, although estimated *coverage* of non-native plants was around 25% lower in INMs.

In the planted fields, with the help of planting lists, it was possible to partition the diversity into three groups of 'native' species: 1) those which were intentionally planted, but were not known from the surroundings and so likely did not colonize naturally; 2) those which were intentionally planted but could have also colonized naturally (i.e., were known to be present in the surroundings); and 3) those which apparently colonized on their own (i.e., were found in the meadows but did not appear on plant lists). By summing the totals for groups 2 and 3, it was possible to calculate the number of native species which potentially colonized naturally; we call these the 'native & possibly wild' species.

In both sets of data, diversity and coverage of these 'native & possibly wild' species was slightly higher in the INMs than in the wild meadows. This might suggest that managing for planted native species slightly enhanced the suitability of a meadow for colonization by wild native species. This idea gets some support from the fact that diversity (Fig. 1) and coverage of 'native & possibly wild' species increased with meadow age, a pattern one might expect if natural colonization were playing an appreciable role.

Table 1. Plant diversity in installed native meadows (INM) compared to that of wild meadows (such as mature hayfields or well-developed old fields). All values are per-field averages. In 2012, while we did study the INMs throughout the growing season (the "all season" column), we did not have comparable wild data and so calculated a "summer only" description of the INMs to allow comparisons.

	2012, summer only		2012 all season	2015 all season	
	INM	Wild	INM	INM	Wild
Number of Fields	6	14	6	2	2
Non-native Diversity	25	27	44	42	49
Est'd Non-native Cover	65%	87%	130%	106%	138%
Native Planted Diversity	29	0	42	32	0
Native & Possibly Wild Diversity	43	40	73	83	73
Native & Possibly Wild Cover	141%	118%	242%	229%	194%
Total Native Species Diversity	51	40	91	97	73
Estd. Total Native Spp Cover	173%	118%	296%	283%	194%
Total Diversity	98	67	135	140	122
Est'd total Plant Cover	238%	205%	426%	389%	332%

Alternatively, these patterns might simply reflect the fact that, in the INMs, some of our 'native & possibly wild' species were actually cultivated and so were aided in their arrival and establishment. This possibility is supported by the fact that, in the INMs, the average per-species coverage of group 2 native species was higher than that of group 3 species. In other words, the abundance of the planted but potentially wild native species averaged higher than that of the naturally-colonizing native species, perhaps because of the horticultural care devoted to them. Furthermore, the diversity and coverage of group 1 species was even more strongly and positively correlated with meadow age than that of the 'native & possibly wild' species (Fig. 2) , suggesting that active enrichment planting together with a delay in becoming established and visible may have played a stronger role in creating these age-related patterns than passive colonization. Meadows clearly change over time, and one form of that evolution may be from a field with a relatively low diversity dominated by a few species of rapidly colonizing annuals to a more staid meadow containing a diversity of perennial species.

An informative study would involve restricting the planting of 'natives' to those not present in the surroundings and then measuring the diversity and abundance of subsequent native, wild colonizers. Alternatively, if one had adequate technological prowess, one might be able to separate planted vs. wild-colonized growth based on genetic analyses.

<u>Insects and Spiders.</u> Whereas in plants we struggle to explain apparent patterns, with the insects and spiders there are few patterns begging explanations. We saw few consistent patterns in invertebrate abundances across our two data sets (Table 2). The differences we did see were generally small, and probably well within the variation expected by chance. At this point, the best we can say is that, for the most part, we found no evidence that INMs resulted in significantly more diverse or abundant insect communities when they were compared to wild meadows.

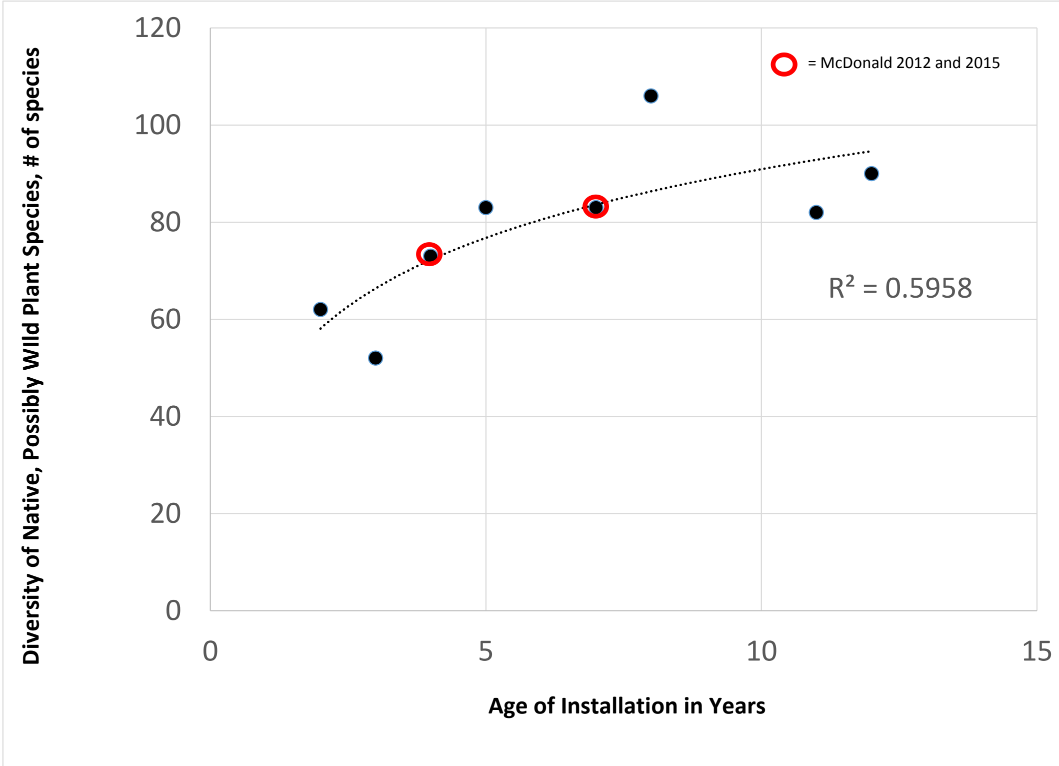

Fig 1. The diversity of native, possibly-wild plants in INMs vs. years since the meadow's installation.

Fig 2. The diversity of group 1 plants in INMs vs. years since the meadow's installation. See text for group definitions.

Table 2. Select indices of invertebrate diversity and abundance in INMs compared with those of wild meadows. In all cases, the value is a per-field average.

		2012		2014/15	
		CT INM	CC Wild	INM	Wild
	Number of fields in Mean	**6**	24	2	2
	Total Native Moth Species	n/a	n/a	23.5	27.5
	Native Meadow Moth Species	n/a	n/a	11.5	16.5
	Native Butterfly Species	7.6	7.4	17.0	14.5
	Individual Butterflies seen per 100mins	55.8	68.4	55.1	58.8
	Estimated Native Leafminer Species	n/a	n/a	27.0	20.0
	Native Plant Species with Mines	n/a	n/a	18.0	16.5
	Est'd Native Leafhopper etc. Species	n/a	n/a	10.5	15.0
Sweep Net Tallies, avg # of Individuals per 25 sweeps	Katydids and Grasshoppers	0.6	2.0	5.7	2.5
	Wasps	2.1	1.2	1.3	3.9
	Native Bees	1.4	0.5	2.4	1.1
	Spiders	7.2	7.3	6.5	8.3
	Beetles	7.4	13.1	6.9	6.4
	Leafhoppers	13.5	17.2	11.6	18.2
	Caterpillars	1.3	2.1	1.0	1.3

The only taxon for which there was an apparently large and consistent difference ($p<.05$, t-test, on 2012 and 2014/2015 data tested separately) in favor of the INMs was in native bee abundance: it was more than twice as high in INMs in both sets of samples, and this might deserve further study. If this difference were due to flower abundance alone, then one would predict similar trends in the abundance of other flower visitors such as butterflies, hover flies, and wasps, but this was not the case. Rarefaction (Fig. 3) hinted that the native bee community of the INMs was relatively diverse (on par with that of old fields). Interestingly, initial community analysis using TWINSPAN indicated that the bee community of INMs grouped with those of upland shrubby fields, Little Bluestem meadows and wet meadows, rather than with hayfields, cropfields or old fields. The fields of the first cluster have higher levels of native plant diversity, suggesting that bees of INMs may be responding in part to a greater diversity of flower types and flowering times. It need also be remembered that not all INMs are meant to be alike – one reason for the apparently high bee diversity may be that under the INMs category we are lumping wet and dry meadows that tend to be treated more distinctly in our assessment of bee diversity in wild meadows.

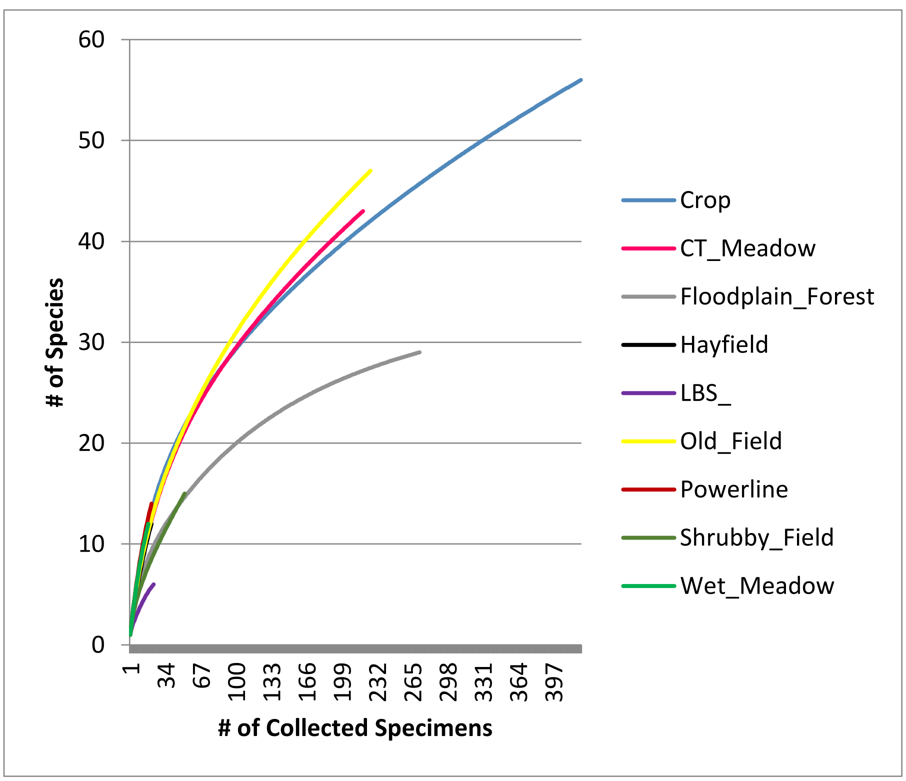

Fig.3. Bee rarefaction curves for various Connecticut INMs (= "CT_Meadow") and various openland habitats in adjacent NY.

Relatively few ground beetles were captured during our initial fieldwork. However, using rarefaction to standardize for the number of individuals captured, INMs had, when compared to all other local habitats sampled, the highest level of diversity for the number of individuals captured. We don't know what greater sampling would reveal, but the INMs ground beetle community may be responding to the diversity of microhabitats created by the increased plant biological and structural diversity.

The level of ant diversity in the INMs was not distinct from that of other upland, open sites. No unusual species were found, and community analysis grouped the INMs ant community together with those of hay field and old field. Rarefaction suggested that INMs diversity may have been slightly less than hay field or old field diversity. Only the oldest INM studied (Twin Maples) had slave-making *Formica*, a group of ants which have a relatively complex social system and are perhaps indicative of more developed open-field ant communities.

<u>Conclusions</u> The conservation value of INMs relative to diverse wild meadows does not seem completely clear. There are additional reasons, beyond conservation, why people install native meadows. We made no attempt to evaluate those other value criteria, and our work is not a critique of INMs. In terms of plants, INMs did have a higher diversity of 'native species' than wild meadows, but this was primarily the result of the group 1, semi-native species introduced through planting, and the diversity of those native species which are also found wild in the region (i.e., groups 2 and 3) was only marginally different. For this last set of natives, abundance, as opposed to diversity, showed a larger difference in favor of INMs, but the values were only about 20% higher. With the apparent exception of native bees (and possibly ground beetles), we were unable to document enhanced abundance and diversity of native invertebrates in INMs vs wild meadows, although our methods were admittedly crude and our sample sizes small. It would be interesting tease apart the causes for apparently higher bee abundance and diversity in INMs: is it due to increased diversity of floral structure and/or are bees which specialize on particular native pollen also being attracted?

These results suggest that the costs of establishing a true INM may not always produce correspondingly large conservation benefits relative to wild meadows. One can thus ask if, when openland conservation of native plants and invertebrates is a primary goal, some of the management techniques developed for INMs might not be applied to wild meadow management so as to economically enhance their native-plant component. Substantial ecological knowledge and practical skill have gone into developing INMs as a landscaping approach and, while INMs themselves may not always be justified outside of private landscaping situations, that knowledge and practical skill, when applied to tweaking wild meadows, may produce an openland landscape whose management is less expensive than an INM but whose conservation benefits are greater than those of largely unmanaged wild meadow. Such techniques might include, for example, selective removal of woody plants, creation of disturbance, and precisely timed and height-adjusted mowing. The potential utility of such a tack is hardly proven by the present work, but this proposition does suggest future lines of practical research.

LITERATURE & ACKNOWLEDGMENTS

For this short note, no attempt was made to diligently review all relevant literature. However, the above thoughts on native meadows management have been largely influenced by the landscaping work of Larry Weaner (see, for example, his recent book with Thomas Christopher entitled *Garden Revolution: How Our Landscapes Can Be a Source of Environmental Change*). Larry also importantly facilitated our connections with landscaped meadows. Our interest in the invertebrate diversity of such meadows was stimulated and informed in part by the work of Doug Tallamy and his students, as exemplified by his books *Bringing Nature Home: How You Can Sustain Wildlife with Native Plants* and, with Rick Darke, *The Living Landscape: Designing for Beauty and Biodiversity in the Home Garden*. Charlie Eiseman, who co-authored *Tracks & Sign of Insects* with Noah Charney and is currently working on a book on North American leaf miners, provided crucial support for our leaf miner work. Several interns and technicians provided much needed field help, these included Kyle Bradford, Dylan Cipkowski, Ben Derr, Anna Fialkoff, Krista Heilman, Sara Powell and Otter Vispo. Finally, without the welcoming collaboration of all participating land owners, this project would not have been possible. Our thanks to all.