Bird communities, biomass, and carbon sequestration in habitat restorations in northwest Illinois

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Summary

In 2010 and 2011, we investigated the biomass potential of oldfield/shrublands in northwest Illinois and the quality of this habitat for birds. Many shrublands and grassland are experiencing significant population declines in Illinois. Although these species are declining, shrublands, as opposed to grasslands, rarely are the target of management efforts. Historically, shrubland bird populations flourished during the harvesting of much of the Midwest's lumber. This lumbering resulted in an increase in the amount of shrubland habitat. Previous to European settlement, it is likely that periodic disturbances facilitated the establishment of shrublands. Over the last century, fire suppression has resulted in many shrublands succeeding into second-growth forests. This conversion of shrublands to second-growth forests is common throughout the state. Intensive management is likely needed to restore many shrublands that have succeeded to second-growth forests. Given the limited resources for conservation, one potential mechanism to restore shrubland habitats is to harvest trees and shrubs in second-growth forests for cellulosic biofuels, while creating shrubland habitats. In addition, other biofuels such as switch grass may provide habitat for grassland birds. This approach may be a win-win. If done correctly, the establishment of biofuels could restore shrubland and grassland habitat and cost little in conservation resources, if the profit margin for harvesters was sufficient. In this study, we did not intend to produce a comprehensive plan on how to achieve ecological and economic goals associated with harvesting cellulose, but rather to collect ecological data that could be used to evaluate the potential management of shrublands via harvesting wood (i.e. managing second-growth forest) or the creation of grasslands via biofuels grass (i.e. miscanthus or native switch grass).

While the shrublands of northwest Illinois are at the range limits of many bird species, they do support good populations of species of conservation concern such as field sparrow, Bell's vireo, and yellow-billed cuckoo. We conducted a nest survival study at Apple River Canyon State Park (Salem unit) and at Lost Mound Unit of the Upper Mississippi River Fish and Wildlife Refuge. Nest success was not particularly high (27%), but compared to other studies throughout the state the success was similar. We deployed nest cameras on a few nests and the primary predators of nests were snakes and small mammals. A survey of the plants of the Salem Unit of the Apple River Canyon S. P. suggests a robust shrubland plant community. The most abundant tree (stems/ha) are eastern red cedar, riverbank grape, black raspberry, prickly ash, red oak, and boxelder. While different trees have different cellulose content the economics associated with harvesting trees for cellulose will be dictated by federal policy and it is extremely unlikely that biofuel mills will only accept or pay different amounts for different species. From an ecological perspective there remains relatively-high quality shrublands in northwestern Illinois and management is needed to protect these habitats. While there is the possibility that the market for cellulosic biofuels will increase providing a mechanism to create and manage shrublands, the future is unknown. The economics are such that at present an increase in biofuel production is unlikely to improve the populations of most birds in Illinois.

Introduction

Due to changes in personnel at the Illinois Natural History Survey, the principal investigator that developed this proposal and project left the employment of INHS/ the University of Illinois mid-stream in this project. Fortunately, the majority of objectives of this project were in-line with a shrubland bird conservation project T.J. Benson and Mike Ward were conducting throughout Illinois. This project on the quality of shrubland habitat is ongoing and

this grant was associated with the quality of northwestern Illinois shrublands. The initial project (designed by D. Wenny) was very ambiguous in its hope of providing very specific recommendations bridging ecological conservation, the harvesting of biomass, and carbon sequestration. Over the course of this project, various economic pressures have resulted in many changes to the outlook of biofuel harvesting. The future of biofuels remains extremely difficult to predict. Regardless, our goal was to determine the status of shrubland and to a lesser extent grassland birds in northwestern Illinois and identify the shrubland plant community. While we did not explicitly sample grassland communities there is a large amount of botanical data associated with Lost Mound and randomly selected grasslands in northwest Illinois (Critical Trends Assessment Program).

Project Objectives:

1. Survey bird communities in grassland, oldfield, and shrubland habitats to determine species richness and abundance of breeding species. Bird surveys will give information on which species use each habitat and therefore which species will probably increase or decrease with changes in habitat.
2. Measure vegetation to estimate above-ground carbon storage, amount of biomass available to harvest, and structural features of wildlife habitat.
3. Combine results to make recommendations on integrating bird conservation and sustainable biomass harvest in the Driftless region.

Bird Community

We conducted point counts, searched for and monitored nests, and deployed nest cameras at Lost Mound and the Salem unit of Apple River Canyon S. P. The census data illustrate that Lost Mound had a much richer shrubland bird community than the Salem unit, however both

supported shrubland bird communities comparable with other locations throughout Illinois. Lost Mound also supports the best sand prairie bird community in Illinois. The most common shrubland bird encountered was field sparrow (2.8 per point count), followed by common yellowthroat (1.8 per point count), American goldfinch (1.3 per point count), and brown-headed cowbirds (1.2 per point count: Table 1). Other species of interest that were recorded include relatively large numbers of Bell's vireos and brown thrashers, and at Lost Mound loggerhead shrikes and orchard orioles. While we were unable to analyze the long-term census data from Lost Mound, multiple sources of data illustrate how Lost Mound has the highest density of grasshopper sparrows, eastern and western meadowlarks, and loggerhead shrikes in northern Illinois (Spring Bird Count data, D. Elbert unpublished thesis 2009). In the context with other locations, the composition of the shrubland bird community was lower (average of 5.1 shrubland species per point) than in other location in Illinois such as northeastern Illinois (6.2 per point) or east-central Illinois (9.0 per point). Though the exact reason for this is unknown, northwest Illinois appears to be in a transition zone where many shrubland species' ranges stop just south and others stop just north.

Nest searching proved to be more difficult at the Salem unit than anticipated, due to the extremely high number of locations that shrubland birds could put their nests and the relatively low number of birds at the site. In total, 10 nests were located of which one was successful, the fate of one was unknown, one was abandoned, and the remaining seven were predated. We had nest cameras on 4 nests at the Salem unit, two were predated by snakes (1 milk and 1 fox snake), one was predated by a raccoon, and someone sliced the cables of the other camera resulting in its failure to capture any footage. The species whose nests were located were field sparrows (6), gray catbird (2), song sparrow (1), and common yellowthroat (1).

Nest searching at Lost Mound was also more difficult than expected, primarily due to access to the installation which is administrated by the US Fish and Wildlife Service. Fifteen nests were located at Lost Mound, these included field sparrows (6), brown thrasher (4), orchard oriole (1), eastern kingbird (3), and yellow-billed cuckoo (1). We were aware of other data from the site but were unable to obtain these data. Six of these 15 nests were successful, we experienced some technical issues with the cameras on Lost Mound, but did obtain footage of snakes and possibly a weasel depredating nests.

Plant Community

We used the Critical Trends Assessment Program (CTAP) protocol to assess the plant community at the Salem unit (species list Table 3). We expect that the plant community at this site reflects much of the shrubland plant community throughout northwestern Illinois. As can be assessed from simply observing the site, the shrubland is dominated by eastern red cedars (Table 2). Cedar is the dominant plant in terms of stem density and basal area. No comprehensive plant survey of the Lost Mound shrublands was conducted, however the structure of these was much different that the Salem unit. The shrublands were generally clumps of vegetation in a larger grassland. While the overall structure of the shrubland differed, many of the nests were located in cedars or clumps of small oaks, similar to the Salem unit.

Biofuel Harvesting and Ecological Conservation

SHRUBLANDS

The August 2011 publication U.S. billion-ton update, Biomass Supply for a Bioenergy and Bioproduct Industry (Perlack and Stokes 2011) outlines the current supply and potential future demand for assorted sources of bioenergy. Forest biomass and wood waste products are

listed as potentially important sources and the publication lists one source of these produce being the residue of results of woodland management. These “residue” products have value but only in situations in which the product is near the mill and there are significant amounts of the product. Figure 1 is an excerpt from (Perlack and Stokes 2011) that suggests that the price of residue (i.e., logging residue or thinning) will not increase until the market increases. Figure 2 suggests that the current and future availability of logging residue in Illinois is very small.

We do not know the status of a proposed cellulosic biofuel mill in northwestern Illinois, but given the projection and economic value of residue products (Figure 2), it seems likely that outside contractors will not be scrambling to harvest cedar from shrublands or second-growth forests in northwest Illinois. Also, estimates of cellulose and above ground carbon in shrubland trees are currently very coarse, and to directly estimate the amount of carbon would be very expensive.

The shrubland bird community is declining throughout Illinois, and northwest Illinois is no exception, extremely low nesting success dictates efforts be made to restore shrublands. The small sample size of nests precludes any intensive analysis, and even in areas of the state where over 500 nests have been located and monitored, questions remain about the attributes of a shrubland that promote nesting success. However, there is one obvious recommendation from this study. Areas such as the Salem unit would benefit from periodic fires if the goal is to promote shrubland communities. Young cedars can be effectively managed and reduced via prescribed burns and these management activities would likely perpetuate shrubland habitat.

GRASSLAND

Since the initiation of this study there has been a handful of studies highlighting how the conversion of Conservation Reserve Program (CRP) grasslands to a grassland biofuel such as

miscanthus or native swithchgrass, while it would produce more fuel, it would be detrimental for native wildlife (Robertson et al. 2010; Hartman et al. 2011). Current economics preclude large scale establishment and harvesting of native grasses (Table 4; Perlack and Stokes 2011), and it is unlikely that biofuel grass will replace corn, suggesting there may be pressure on CRP fields to be converted to biofuel grasses.

CARBON SEQUESTRATION

When the initial author of this grant was developing and submitting this grant, there was a Senate Bill to create a carbon credit system. This bill was never enacted and there appears to be little political will to create a carbon trading system. Currently, it is impossible to speculate about the potential conservation benefit of carbon trading. There are a number of large studies investigating carbon sequestration of soils in Illinois, however, current estimates of soil carbon are highly variable and current efforts will better characterize how soils of different habitat store carbon (currently almost all estimates in Illinois are associated with actively farmed soils; Krug and Hollinger 2003).

Conclusion

This grant provided the resources to address a pressing issue in avian conservation and to begin to explore how the advent of a biofuel market may impact wildlife management and conservation. Northwest Illinois supports a healthy population of grassland birds (at least at Lost Mound) and shrubland birds. While northwestern Illinois supports a lower diversity of shrubland birds, I initially thought reproductive success would be higher because major nest predators such as black rat snake are uncommon in the areas. However, snakes still appear to be an important nest predator. Red cedars can be an important vegetative component of shrublands but the red cedars can quickly spread and convert a high-quality shrubland into a poor quality second-

growth forest. Periodic prescribed fires would provide a good management technique, but harvesting of small trees for biofuel is another possibility. The outlook for biofuels is at best hazy, and the implications for wildlife are mixed. Biofuels could provide new habitats and could contribute to managing shrublands and forests, but it is likely there will be a slow implementation of biofuels on the landscape.

Acknowledgements:

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Robertson, B.A., P.J. Doran, L. R. Loomis, J. R. Roberson, and D. W. Schemske 2010. Perennial biomass feedstocks enhance avian diversity. Global Change Biology Bioenergy doi: 10.1111/j.1757-1707.2010.01080.

Table 1. List of species detected on censuses or while nest searching at the Salem Unit and Lost Mound. The bolded species are considered shrubland species (i.e., probably bred within the shrublands). Note that the Swainson's hawk was observed twice on the road approaching the Salem Unit only in 2010.

Scientific Name	Common Name
Branta canadensis	Canada Goose
Anas platyrhynchos	Mallard
Phasianus colchicus	Ring-necked Pheasant
Ardea herodias	Great Blue Heron
Cathartes aura	Turkey Vulture
Haliaeetus leucocephalus	Bald Eagle
Accipiter cooperii	Cooper's Hawk
Buteo swainsoni	Swainson's Hawk
Buteo jamaicensis	Red-tailed Hawk
Falco sparverius	American Kestrel
Charadrius vociferus	Killdeer
Scolopax minor	American Woodcock
Zenaida macroura	Mourning Dove
Coccyzus americanus	**Yellow-billed Cuckoo**
Caprimulgus vociferus	Whip-poor-will
Chaetura pelagica	Chimney Swift
Archilochus colubris	Ruby-throated Hummingbird
Ceryle alcyon	Belted Kingfisher
Melanerpes carolinus	Red-bellied Woodpecker
Sphyrapicus varius	Yellow-bellied Sapsucker
Picoides pubescens	Downy Woodpecker
Colaptes auratus	Northern Flicker
Contopus virens	Eastern Wood-Pewee
Empidonax traillii	**Willow Flycatcher**
Sayornis phoebe	Eastern Phoebe
Myiarchus crinitus	Great Crested Flycatcher
Tyrannus tyrannus	**Eastern Kingbird**
Lanius ludovicianus	**Loggerhead Shrike**
Vireo bellii	**Bell's Vireo**
Cyanocitta cristata	**Blue Jay**
Corvus brachyrhynchos	American Crow
Progne subis	Purple Martin
Tachycineta bicolor	Tree Swallow
Stelgidopteryx serripennis	Northern Rough-winged Swallow
Riparia riparia	Bank Swallow
Petrochelidon pyrrhonota	Cliff Swallow
Hirundo rustica	Barn Swallow

Poecile atricapillus	Black-capped Chickadee
Sitta carolinensis	White-breasted Nuthatch
Troglodytes aedon	**House Wren**
Sialia sialis	Eastern Bluebird
Turdus migratorius	**American Robin**
Dumetella carolinensis	**Gray Catbird**
Toxostoma rufum	**Brown Thrasher**
Sturnus vulgaris	European Starling
Bombycilla cedrorum	**Cedar Waxwing**
Dendroica petechia	**Yellow Warbler**
Geothlypis trichas	**Common Yellowthroat**
Icteria virens	**Yellow-breasted Chat**
Pipilo erythrophthalmus	**Eastern Towhee**
Spizella passerina	**Chipping Sparrow**
Spizella pusilla	**Field Sparrow**
Chondestes grammacus	Lark Sparrow
Ammodramus savannarum	Grasshopper Sparrow
Ammodramus henslowii	Henslow's Sparrow
Melospiza melodia	**Song Sparrow**
Cardinalis cardinalis	**Northern Cardinal**
Pheucticus ludovicianus	Rose-breasted Grosbeak
Passerina cyanea	**Indigo Bunting**
Spiza americana	Dickcissel
Agelaius phoeniceus	**Red-winged Blackbird**
Sturnella magna	Eastern Meadowlark
Sturnella neglecta	Western Meadowlark
Quiscalus quiscula	Common Grackle
Molothrus ater	**Brown-headed Cowbird**
Icterus spurius	**Orchard Oriole**
Icterus galbula	**Baltimore Oriole**
Carduelis tristis	**American Goldfinch**

Table 2. The relative cover and basal areas of plants at the Salem unit of Apple River Canyon State Park shrublands.

Scientific Name	Common Name	Form	stems/ha	Relative stems/ha	Sum dbh	Basal area /ha	Relative Basal Area
Acer negundo	boxelder	native tree	249.96	5.8	16	0.42	0.9
Juglans nigra	black walnut	native tree	104.15	2.4	32.5	1.73	3.5
Juniperus virginiana	eastern red cedar	native tree	1478.93	34.1	158	40.85	83.1
Morus alba	white mulberry	non-native tree	83.32	1.9	4	0.03	0.1
Parthenocissus quinquefolia	virginia creeper	woody vine	187.47	4.3	9	0.13	0.3
Populus deltoides	cottonwood	native tree	83.32	1.9	11.5	0.22	0.4
Prunus serotina	wild black cherry	native tree	124.98	2.9	7	0.08	0.2
Quercus macrocarpa	bur oak	native tree	229.13	5.3	38.5	2.42	4.9
Quercus rubra	red oak	native tree	249.96	5.8	13	0.28	0.6
Rubus occidentalis	black raspberry	native shrub	479.09	11.1	23	0.87	1.8
Toxicodendron radicans	poison ivy	woody vine	41.66	1.0	2	0.01	0.0
Vitis riparia	riverbank grape	woody vine	666.56	15.4	32	1.68	3.4
Zanthoxylum americanum	prickly ash	native shrub	354.11	8.2	17	0.47	1.0

Table 3. List of all plant species encountered at the shrubland within the Salem Unit of Apple River Canyon State Park.

Scientific Name	**Common Name**
Acer negundo	boxelder
Andropogon gerardii	big bluestem
Asclepias syriaca	common milkweed
Aster lateriflorus	side-flowering aster
Aster pilosus	hairy aster
Bromus inermis	Hungarian brome
Carduus acanthoides	acanthus bristle thistle
Carex grisea	wood gray sedge
Carya cordiformis	bitternut hickory
Centaurea maculosa	spotted centaurea
Daucus carota	Queen Anne's lace
Erigeron strigosus	daisy fleabane
Geum canadense	white avens
Hackelia virginiana	stickseed
Hypericum punctatum	spotted St. John's-wort
Juglans nigra	black walnut
Juniperus virginiana	eastern red cedar
Lonicera maackii	amur honeysuckle
Lonicera tatarica	Tartarian honeysuckle
Monarda fistulosa	wild bergamot
Muhlenbergia schreberi	nimblewill
Nepeta cataria	catnip
Oenothera biennis	common evening primrose
Pastinaca sativa	wild parsnip
Phalaris arundinacea	reed canary grass
Poa pratensis	Kentucky blue grass
Populus deltoides	eastern cottonwood
Quercus macrocarpa	burr oak
Quercus rubra	northern red oak
Rhus typhina	staghorn sumac
Setaria glauca	pigeon grass
Solidago canadensis	Canada goldenrod
Toxicodendron radicans	poison ivy
Ulmus americana	American elm
Verbena urticifolia	white vervain
Vitis riparia	riverbank grape
Zanthoxylum americanum	prickly ash

Table 4. Reported perennial grass yield and acres required for a 50-million gallon cellulosic ethanol plant (Perlack and Stokes 2011).

Feedstock	Yield, dry tons/acre	Acres need to grow 588,000 dry tons/year	Percent of land in 25-mile radius
LIHD prairie[a]	1.75	336,000	27
Managed native prairie[b]	2.5	235,200	19
Shawnee switchgrass[c]	5	117,600	9
Bioenergy switchgrass[d]	7.4	79,500	6
Hybrid switchgrass[e]	9.4	62,600	5

a. Low-input, high-diversity man-made prairies (Tilman et al., 2006).
b. Native tallgrass prairie burned in late spring (Mitchell, 1992).
c. Shawnee is an upland forage-type switchgrass cultivar released in 1995.
d. Lowland bioenergy-specific switchgrass in the cultivar release process.
e. F1 hybrid of ‘Summer’ and ‘Kanlow’ switchgrass (Vogel and Mitchell, 2008).

Figure 1. The predictive economics of logging residue assuming a mill is in the area (Perlack and Stokes 2011). Note that currently logging residue (harvesting trees and shrubs) is not economically viable as Illinois does not produce enough logging residue to support a market.

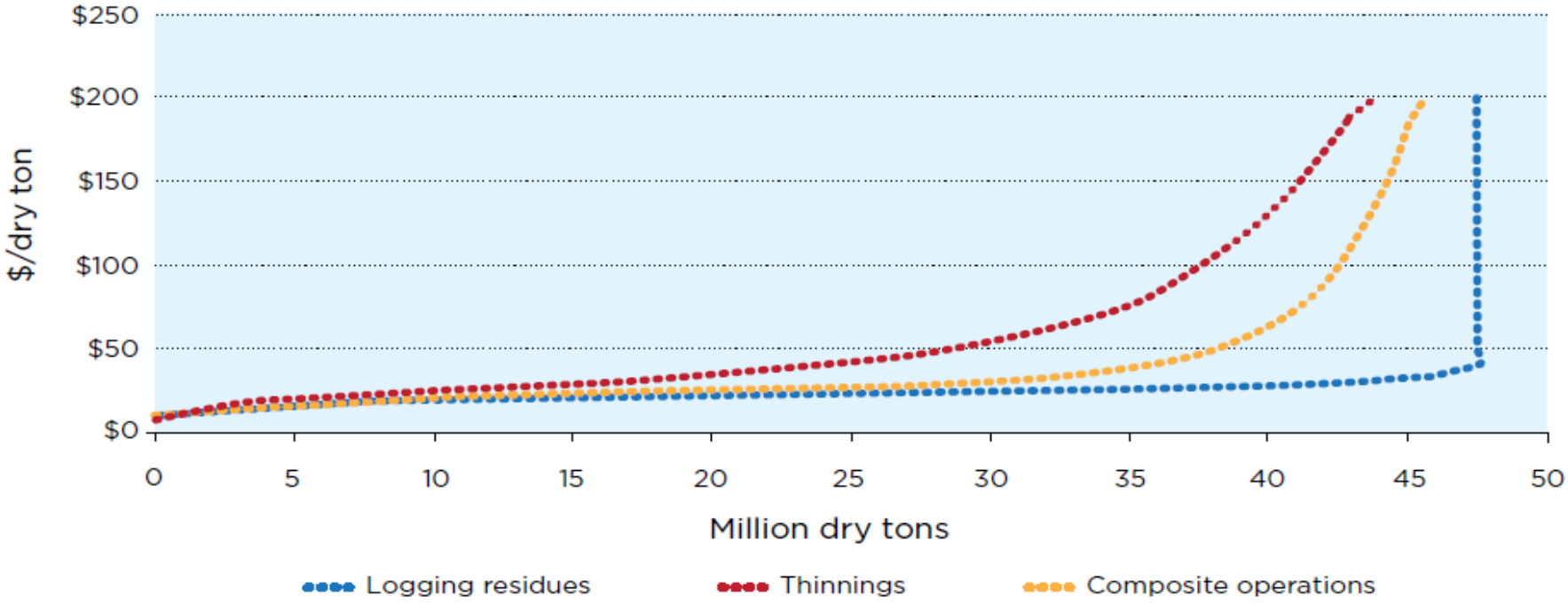
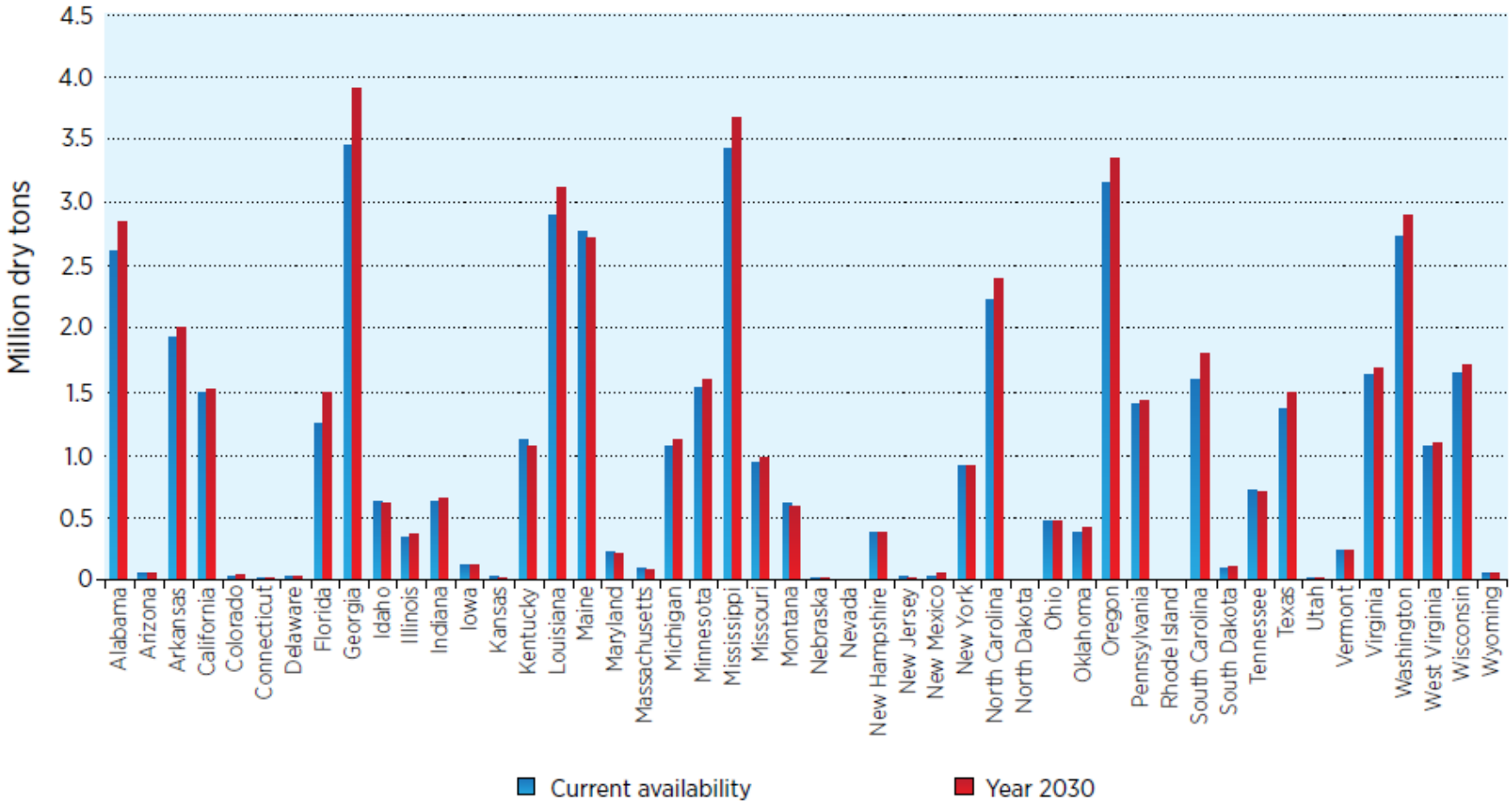


Figure 2. The availability of cellulosic biofuels in the U.S (Perlack and Stokes 2011). Note the low potential in Illinois.



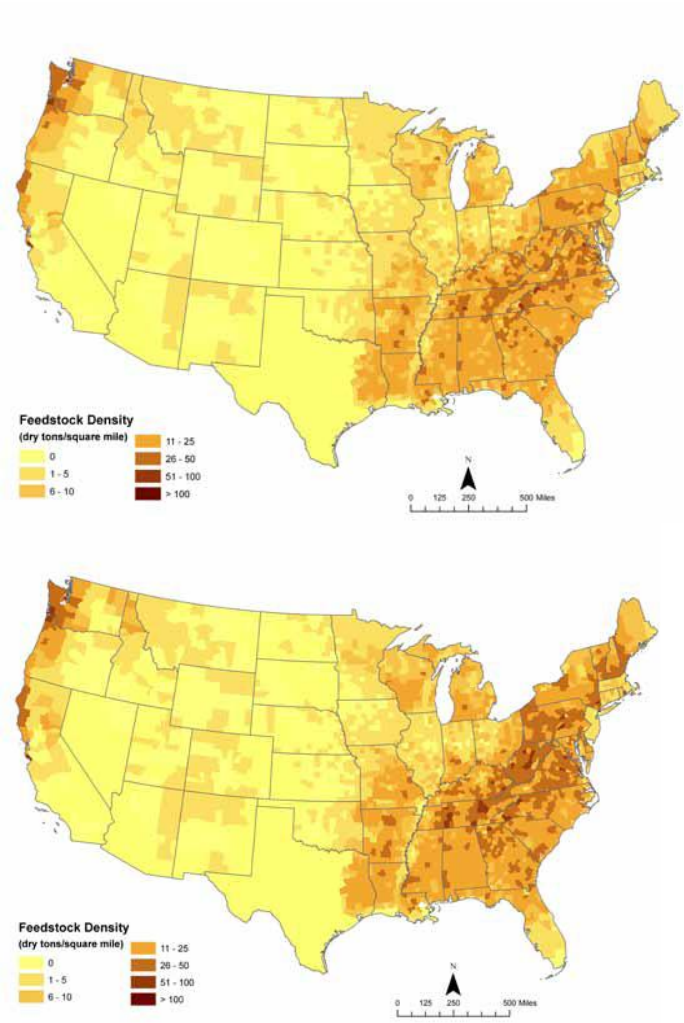


Figure 3. The estimated spatial distribution of simulated forest residue thinning at $30 (top) and $60 (bottom) per dry ton (Perlack and Stokes 2011). Notice the low potential in Illinois.

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FY10 Illinois Wildlife Preservation Fund Awards

Phillips, C. Survey and status of the eastern massasauga (*Sistrurus c. catenatus*) and Kirtland's snake (*Clonophis kirtlandii*) at Allerton Park, Piatt County, Illinois - $2,000 10-019W

O'Neal, B. The Plover Project: Key stopovers, abundance, and habitat associations of American Golden-plovers in Illinois - $1,958 10-021W

Wahl, D. Influence of riparian forest buffers on macroinvertebrate and fish community structure in Illinois agricultural streams - $1,977 10-024W

Dreslik, M.; S. Baker Survey of the eastern massasauga at Carlyle Lake: Year 12 - $9,795 RC10L14W

Hoover, J. The effects of bottomland forest restoration on the breeding bird community in the Cache River watershed - $15,000 RC10L16W

Tiemann, J.; K. Cummings Status of the freshwater snail Family Pleuroceridae in Illinois - $5,816 RC10L17W

Ward, M. Reproductive success of Sandhill Cranes (*Grus canadensis tabida*) in northeastern Illinois - $5,204 RC10L18W

Wenny, D. Bird communities, biomass, and carbon sequestration in habitat restorations in northwest Illinois $14,190 RC10L19W

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