The Status and Potential Future of Biomass Harvesting Guidelines

Dr. Zander Evans

Research Director, Forest Guild

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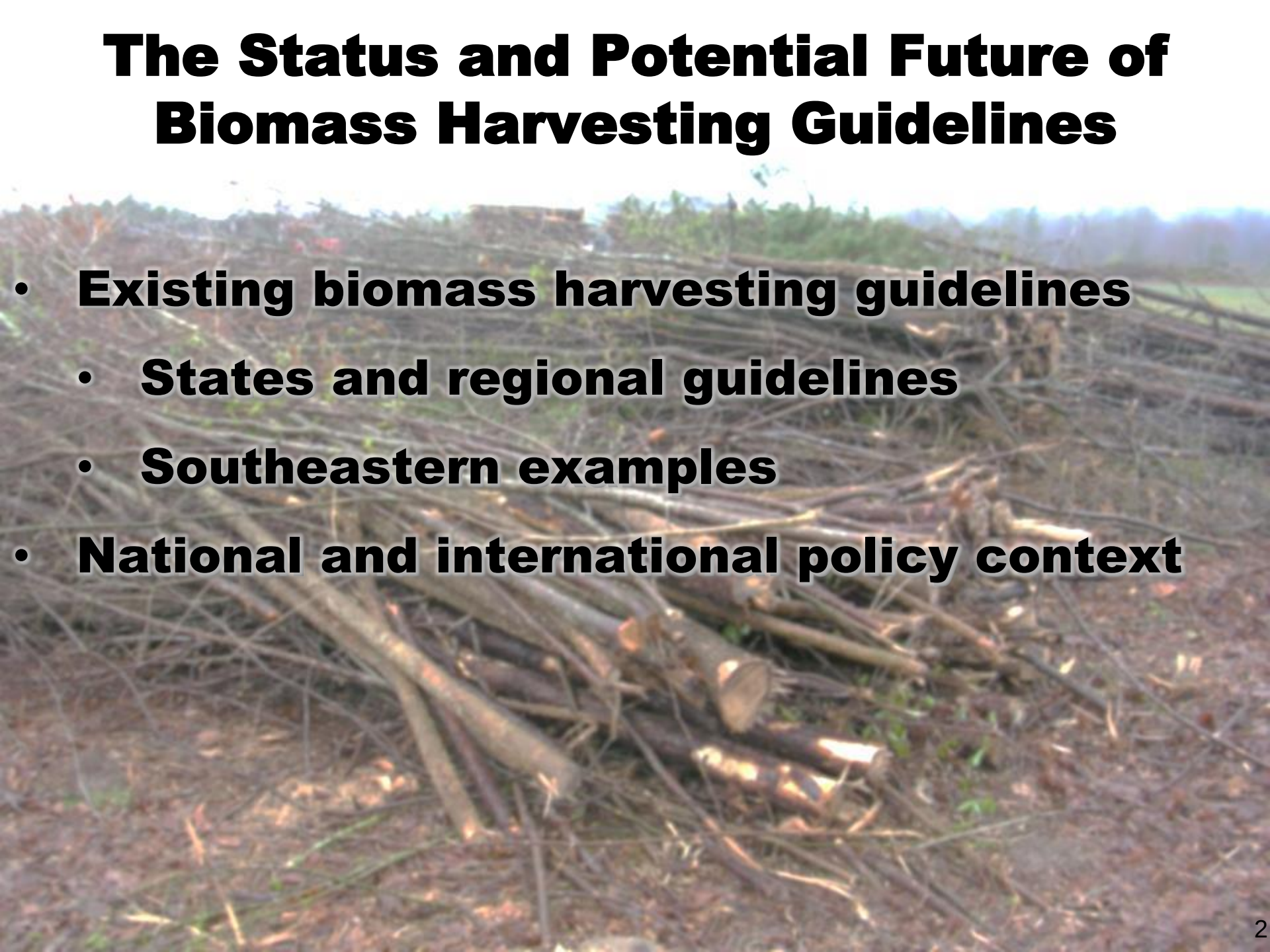


- Existing biomass harvesting guidelines
  - States and regional guidelines
  - Southeastern examples
- National and international policy context


What is “woody biomass”

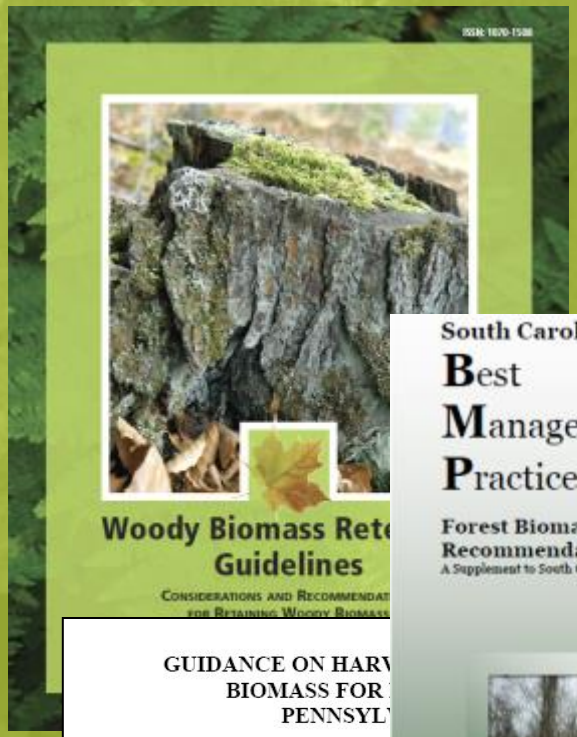
Why Biomass Guidelines?

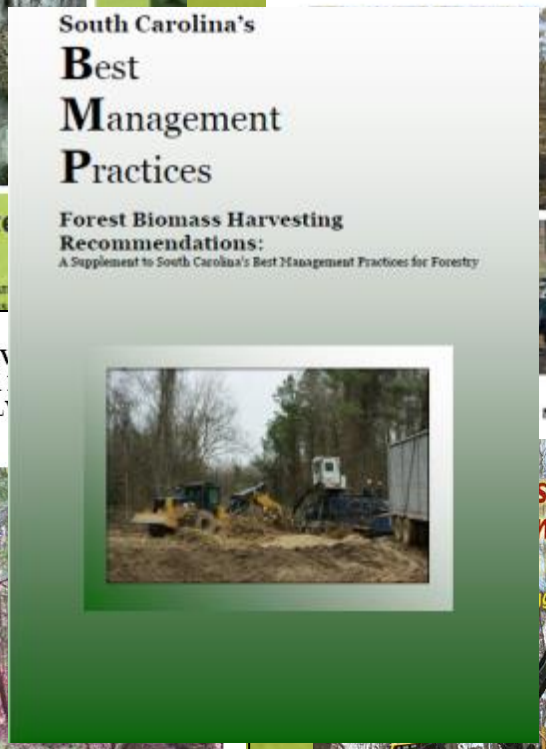
"Good biomass harvesting practices can enhance and improve forest land; poor practices can damage and devalue it." (Pennsylvania Guidelines)

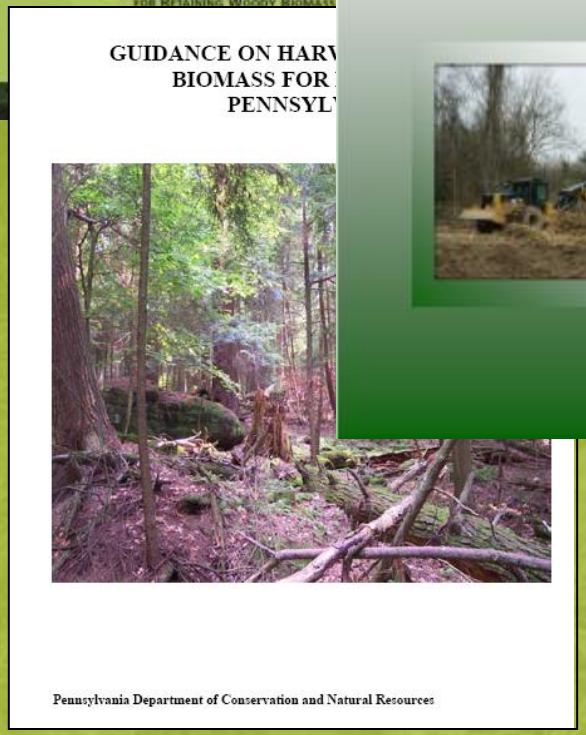
Why Biomass Guidelines?

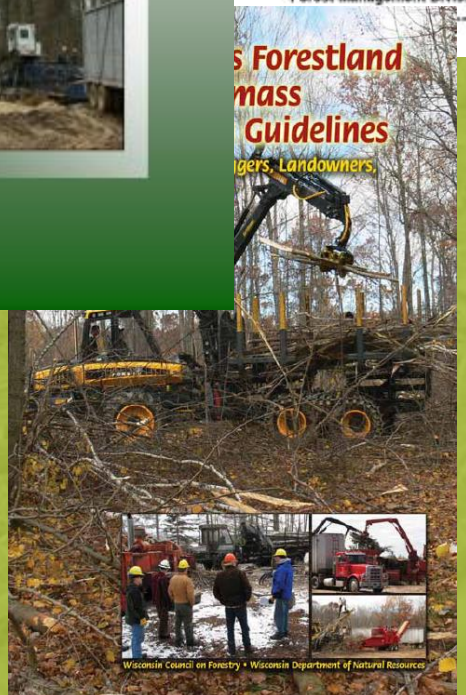
Previous best management practices (BMPs) tend not to include guidance on tops, limbs, and low value products.

- Minnesota
- Wisconsin
- Pennsylvania
- Missouri
- Maine
- Michigan
- Maryland
- Kentucky
- South Carolina

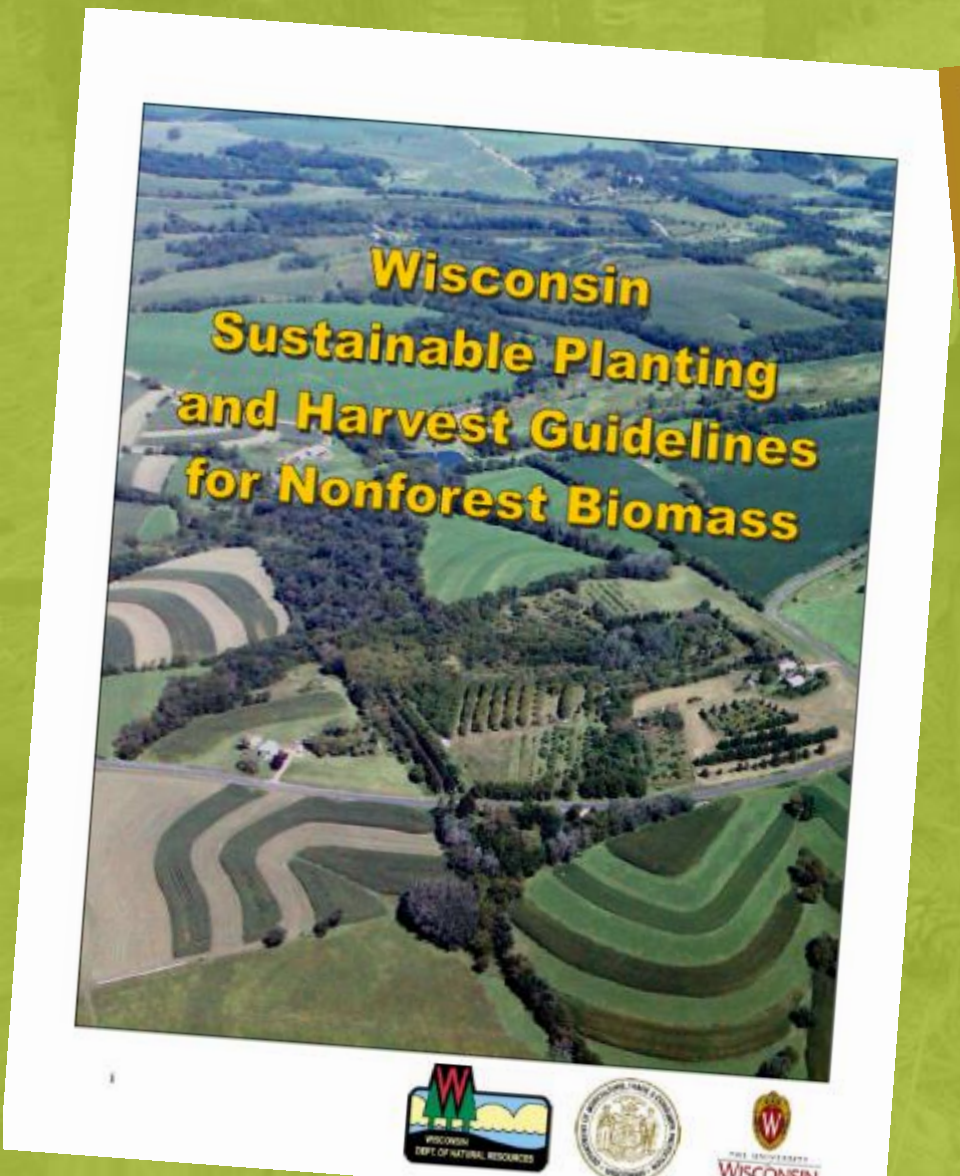


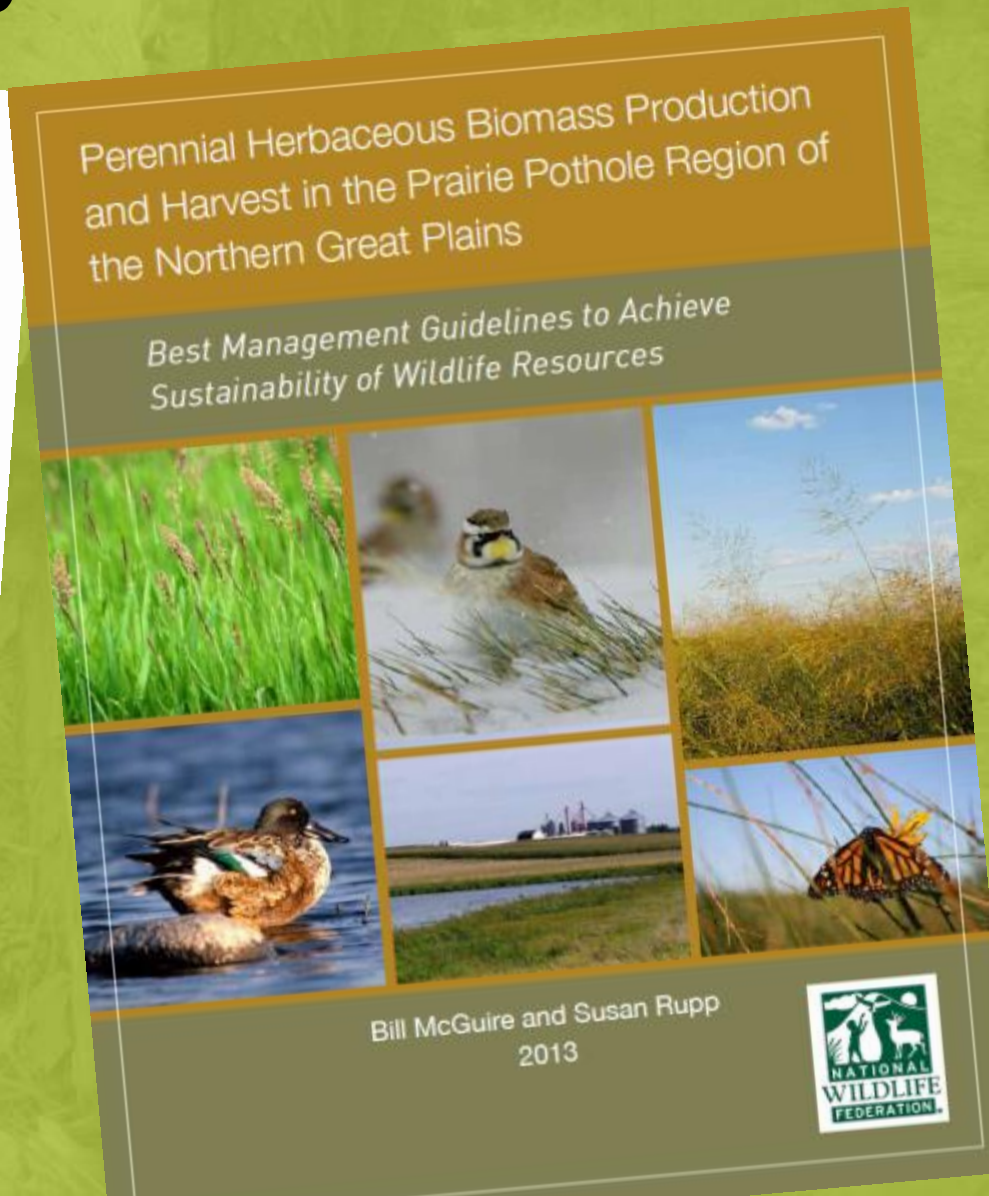






Non-Forest Biomass Harvesting Guidelines





SECTION 2

SFI 2010-2014 STANDARD

…articipation in, and support of, fire and pest prevention …d control programs.

Performance Measure 2.5. *Program Participants that deploy improved planting stock, including varietal seedlings, shall use sound scientific methods.*

Indicator:

1. *Program for appropriate research, testing, evaluation and deployment of improved planting stock, including varietal seedlings.*

Objective 3. Protection and Maintenance of Water Resources. To protect water quality in rivers, streams, lakes, and other water bodies.

Performance Measure 3.1. *Program Participants shall meet or exceed all applicable federal, provincial, state and local water quality laws, and meet or exceed best management practices developed under Canadian or U.S. Environmental Protection Agency–approved water quality programs.*

Indicators:

1. *Program to implement state or provincial best management practices during all phases of management activities.*
2. Contract provisions that specify conformance to *best management practices.*
3. Plans that address wet-weather events (e.g. *forest inventory systems*, wet-weather tracts, definitions of acceptable operating conditions).
4. Monitoring of overall *best management practices* implementation.

Performance Measure 3.2. *Program Participants shall have or develop, implement and document riparian protection measures based on soil type, terrain, vegetation, ecological function, harvesting system and other applicable factors.*

Indicators:

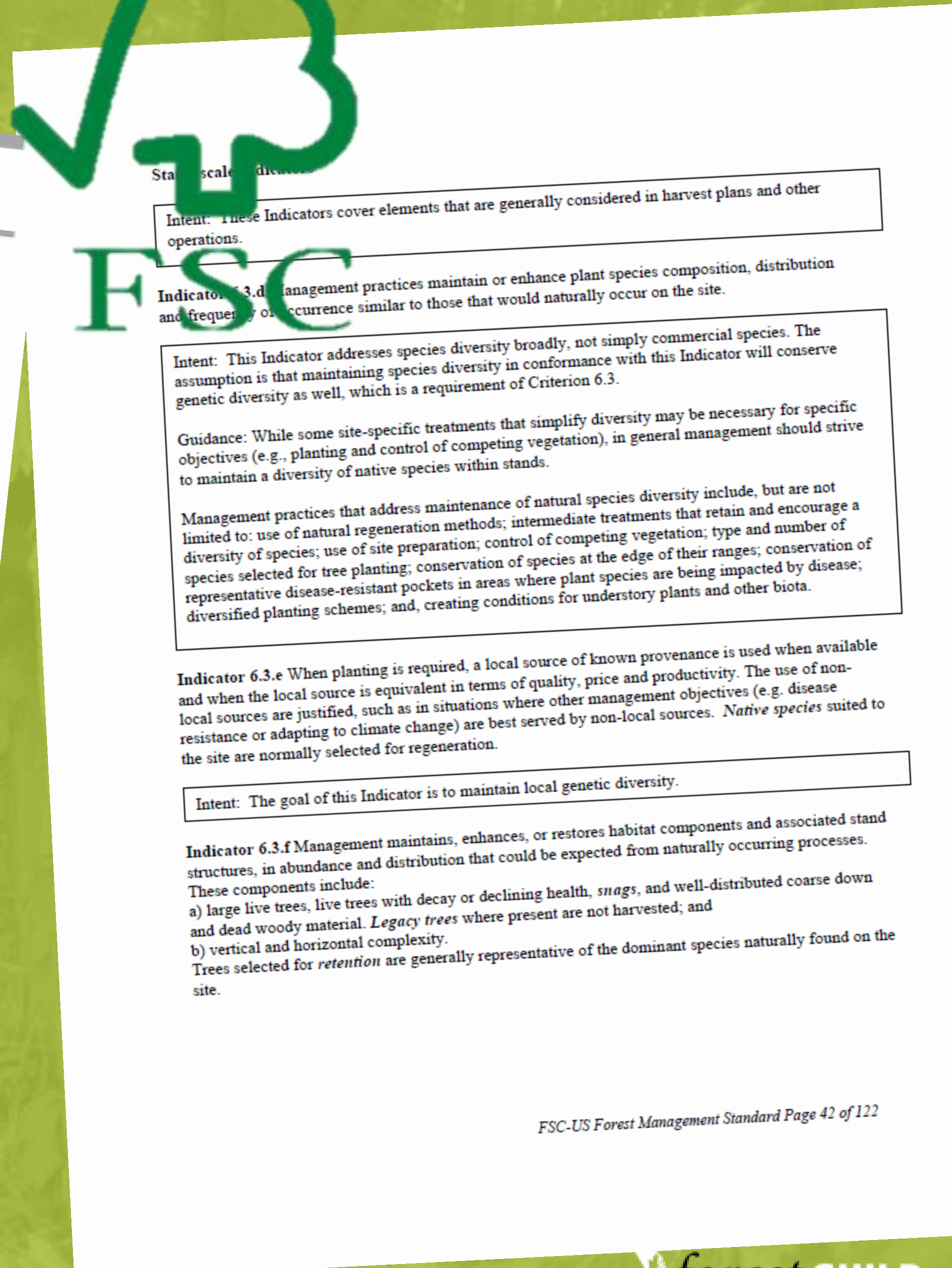
1. *Program addressing management and protection of rivers, streams, lakes, and other water bodies and riparian zones.*
2. Mapping of rivers, streams, lakes, and other water bodies as specified in state or provincial *best management practices* and, where appropriate, identification on the ground.
3. Implementation of plans to manage or protect rivers, streams, lakes, and other water bodies.
4. Identification and protection of *non-forested wetlands*, including bogs, fens and marshes, and vernal pools of ecological significance.
5. Where regulations or *best management practices* do not currently exist to protect *riparian areas*, use of experts to identify appropriate *protection measures*.

Objective 4. *Conservation of Biological Diversity* Including *Forests with Exceptional Conservation Value*. To manage the quality and distribution of *wildlife habitats* and contribute to the *conservation of biological diversity* by developing and implementing *stand- and landscape-level* measures that promote a diversity of types of *habitat* and successional stages, and *conservation* of forest plants and animals, including *aquatic species*.

Performance Measure 4.1. *Program Participants shall have programs to promote biological diversity at stand- and landscape-levels.*

Indicators:

1. *Program to promote the conservation of native biological diversity, including species, wildlife habitats and ecological community types.*
2. *Program to protect threatened and endangered species.*
3. *Program to locate and protect known sites associated with viable occurrences of critically imperiled and imperiled species and communities also known as Forests with Exceptional Conservation Value. Plans for protection may be developed independently or collaboratively, and may include Program Participant management, cooperation with other stakeholders, or use of easements, conservation land sales, exchanges, or other conservation strategies.*
4. Development and implementation of criteria, as guided by regionally appropriate *best scientific information*, to retain *stand-level wildlife habitat elements* such as snags, stumps, mast trees, down woody debris, den trees and nest trees.
5. *Program for assessment, conducted either individually or collaboratively, of forest cover types, age or size classes, and habitats at the individual ownership level and,*



Sta… scale … di…

Intent: … Indicators cover elements that are generally considered in harvest plans and other operations.

Indicator …3.d …anagement practices maintain or enhance plant species composition, distribution and freque… o… …ccurrence similar to those that would naturally occur on the site.

Intent: This Indicator addresses species diversity broadly, not simply commercial species. The assumption is that maintaining species diversity in conformance with this Indicator will conserve genetic diversity as well, which is a requirement of Criterion 6.3.

Guidance: While some site-specific treatments that simplify diversity may be necessary for specific objectives (e.g., planting and control of competing vegetation), in general management should strive to maintain a diversity of native species within stands.

Management practices that address maintenance of natural species diversity include, but are not limited to: use of natural regeneration methods; intermediate treatments that retain and encourage a diversity of species; use of site preparation; control of competing vegetation; type and number of species selected for tree planting; conservation of species at the edge of their ranges; conservation of representative disease-resistant pockets in areas where plant species are being impacted by disease; diversified planting schemes; and, creating conditions for understory plants and other biota.

Indicator 6.3.e When planting is required, a local source of known provenance is used when available and when the local source is equivalent in terms of quality, price and productivity. The use of non-local sources are justified, such as in situations where other management objectives (e.g. disease resistance or adapting to climate change) are best served by non-local sources. *Native species* suited to the site are normally selected for regeneration.

Intent: The goal of this Indicator is to maintain local genetic diversity.

Indicator 6.3.f Management maintains, enhances, or restores habitat components and associated stand structures, in abundance and distribution that could be expected from naturally occurring processes. These components include:

a) large live trees, live trees with decay or declining health, *snags*, and well-distributed coarse down and dead woody material. *Legacy trees* where present are not harvested; and

b) vertical and horizontal complexity.

Trees selected for *retention* are generally representative of the dominant species naturally found on the site.

FSC-US Forest Management Standard Page 42 of 122

SUSTAINABLE FORESTRY INITIATIVE

FSC

...rticipation in, and support of, fire and pest prevention ...d control programs.

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Objective 4. Conservation of Biological Diversity including Forests with Exceptional Conservation Value. To manage the quality and distribution of *wildlife habitats* and contribute to the conservation of *biological diversity* by developing and implementing stand ...

2. Program to protect *threatened and endangered species.*
3. Program to locate and protect known ...

SECTION 2

SFI 2010-2014 STANDARD

7/14

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Sta... scale ...

Intent: These Indicators cover elements that are generally considered in harvest plans and other operations.

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FSC-US Forest Management Standard Page 42 of 122

Summary of biomass harvesting guidelines

	ME	MN	MO	PA	WI	FSC
Dead Wood						
Coarse woody material	√	√	√	√	√	√
Fine woody material	√	√	√	√	√	√
Snags	√	√	√	√	√	√
Wildlife and Biodiversity				√		
Wildlife	√	√	√	√	√	√
Sensitive wildlife species	√	√	√	√	√	√
Biodiversity	√	√	√	√	√	√
Plants of special concern	√	√	√	√	√	√
Sensitive areas	√	√	√	√	√	√
Water Quality and Riparian Zones						
Water quality	√	√	√	√	√	√
Riparian zones	√	√	√	√	√	√
Non-point source pollution	√	√	√	√	√	√
Erosion	√	√	√	√	√	√
Wetlands	√	√	√	√	√	√
Soil Productivity						
Chemical (Nutrients)	√	√	√	√	√	√
Physical (Compaction)	√	√	√	√	√	√
Biological (Removal of litter)	√	√		√	√	
Silviculture						
Planning	√	√	√	√		√
Regeneration		√		√	√	√
Residual stands	√	√	√	√	√	√
Aesthetics			√	√	√	√
Post operations	√	√	√	√	√	
Re-entry		√	√	√		
Roads and skid trail layout	√	√	√	√	√	√
Disturbance						
Insects		√	√	√	√	√
Disease			√	√	√	√
Fire		√	√	√		√
Fuel reduction		√		√		√
Pesticides		√		√		
Invasives		√	√	√		
Conversion from forest			√	√		√

Common Elements of Biomass Harvesting Guidelines

- Dead wood
- Wildlife and biodiversity
- Water quality and riparian zones
- Soil Productivity
- Silviculture




Dead wood…

- on the ground is habitat,
- as standing dead trees provides nest sites,
- in streams improve aquatic habitat,
- serves as a seedbed for regeneration,
- releases nutrients back to the soil and forest,
- decreases runoff and erosion, and
- facilitates nitrogen fixation.

How Much to Leave?

- Maine recommends 20% of FWM,
- Minnesota recommends tops and limbs from 20% of trees harvested,
- Wisconsin recommends at least 1 ton per acre of FWM,
- Pennsylvania recommends 15 to 30% of “harvestable biomass”
- Missouri recommends 33% of harvest residue

Ecology of Dead Wood in the Southeast

by Alexander M. Evans

EDF ENVIRONMENTAL DEFENSE FUND
Finding the ways that work

forest GUILD

February 2011

Southern Appalachian Hardwood

- Most small mammals, including shrews, red-backed voles, woodland jumping mice, deer mice, and white-footed mice, are associated with CWM, particularly large pieces
- In contrast, habitat for some reptiles is better in more open environments and is not associated with CWM

Wildlife in Piedmont & Coastal Plain Pinelands

- Horn and Hanula (2008) found 27 orders and 172 families of arthropods on the ground near CWM and 20 arthropod orders on tree boles
- Many small mammals, including golden mouse, cotton mouse, white-footed mouse, and cotton rat, are associated with CWM, particularly large logs and stumps

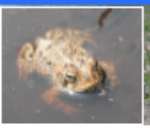
Wildlife in Piedmont & Coastal Plain Pinelands

- Herpetofauna of the southeastern Coastal Plain do not respond strongly to CWM, perhaps because of the importance of burrows and litter layer for these animals

NCSU: Biomass Ecosystem Sustainability Team

- Facilitate development of practical science-based BHGs,
- Determine the effectiveness of BHGs in sustaining small mammals, reptiles, amphibians, and arthropods, and
- Assess perceived economic or operational feasibility of the BHGs among loggers, forest managers, and forest landowners.

Effects of Biomass Harvesting Guidelines on Reptile and Amphibian Use of Clearcuts



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*Fisheries, Wildlife, and Conservation Biology, North Carolina State University, Raleigh, NC, 27695
**Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA , 30602
***Weyerhaeuser , Vanceboro, NC , 28586

Introduction

- Demand for renewable energy sources is expected to increase in the near future.
- Woody biomass from forests likely will be the primary source of renewable energy in the southeastern United States because of its low cost and availability.
- Gleaning of harvest residuals, such as tops, limbs, and small-diameter trees, may reduce down woody debris that amphibians and reptiles use to meet life history requirements.
- Biomass Harvesting Guidelines (BHGs) have been implemented in 6 states to ensure retention of down woody debris and protection of environmental services.
- Existing BHGs often recommend retention of a minimum volume and spatial allocation of woody debris.
- BHGs are not field tested and recommendations to maximize operational feasibility while sustaining wildlife are needed.
- We hypothesized that more retained woody debris would result in a greater abundance and greater species richness of reptiles and amphibians, while spatial allocation of debris would have less overall effect.

Study Design

- We replicated 6 biomass harvest treatments each in 4 clearcuts in North Carolina and 4 clearcuts in Georgia.
- We examined the effects of volume and spatial allocation (clustered vs. dispersed) of retained woody debris.
- The 8-ha treatments were:
  - No biomass harvest
  - 30% of harvest residue retained in large clusters
  - 30% of harvest residue retained dispersed throughout
  - 15% of harvest residue retained in large clusters
  - 15% of harvest residue retained dispersed throughout
  - Biomass harvest with no BHGs

Field Methods

- We estimated volume of residual woody debris using a line-intersect method and by measuring all debris piles.
- We captured reptiles and amphibians using 3 Y-shaped drift fence arrays per treatment with 4 traps per array.
- We captured animals from April through July in 2011 and 2012.

Results

- Volume of residual woody debris was lowest in units with no BHGs and greatest in units with no biomass harvest (Fig. 1).
- Species richness of reptiles and amphibians (Fig. 2) and captures of 2 toad species (Fig. 3) did not differ among treatments.

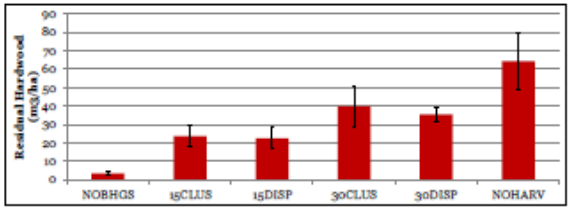

Fig. 1. Hardwood debris was less in NOBHGS than in 30CLUS (P=0.01), 30DISP (P=0.02), and NOHARV (P<0.01). Debris was greater in NOHARV than in 15CLUS (P=0.01), 15DISP (P<0.01), 30CLUS (P=0.07), and 30DISP (P=0.04).

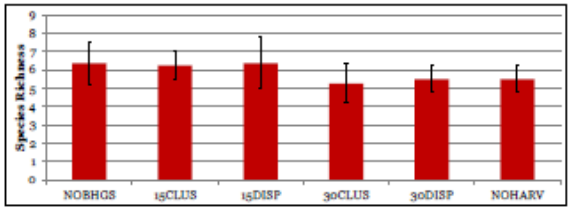

Fig. 2. Species richness of reptiles and amphibians did not differ among treatments.

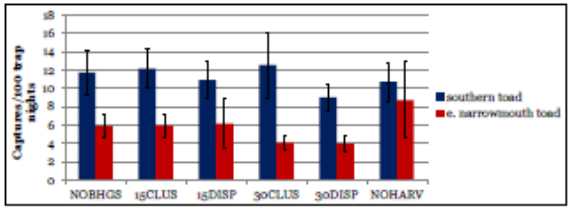

Fig. 3. Captures of 2 common toad species did not differ among treatments.

Results

- Number of toad captures was not affected by proximity to debris pile (Fig. 4).

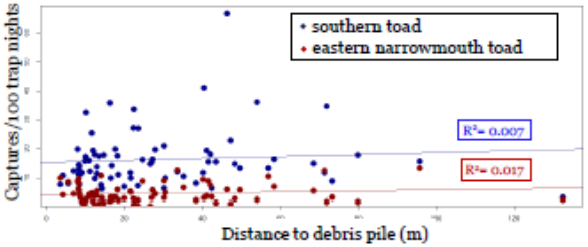

Fig. 4. The relationship between toad captures and distance to woody debris pile was weak.

Ongoing Research

- Results are preliminary and need to be corrected for potential detection bias.
- We are exploring ways to estimate detection probability when recapture rates are extremely low (<3%).
- We will operate drift fence arrays at all 8 sites in 2013.
- In a mesocosm, we are measuring southern toad movements and physiological condition in response to varying amounts of coarse woody debris (Fig. 5).

Fig. 5. We implanted southern toads (above left) with PIT tags and tracked their movements among experimental areas with varying amounts of coarse woody debris (above right).

Acknowledgments

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Evaluation of wildlife response to woody biomass harvesting

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Project funded by NRI/AFRI Managed Ecosystems program, National Council for Air and Stream Improvement, the Southeast Climate Science Center, Weyerhaeuser Company, Plum Creek, and Georgia Pacific

Introduction

- There is expanding interest in renewable energy, and new policies mandate energy from renewable sources in the near future.
- Woody biomass from forests likely will be the primary source of renewable energy in many regions of the US, especially the Southeast.
- Logging residues are gleaned during clearcut harvests and chipped to be burned or converted to biofuels later (Fig. 1).
- Removal of logging residues for use as energy could reduce habitat quality for species associated with down wood while enhancing it for others.
- Biomass Harvesting Guidelines (BHGs) have been proposed to ensure retention of down wood, thereby conserving wildlife habitat and other environmental services.
- Yet, BHGs have undergone limited field testing and suggestions to maximize operational feasibility and ecological value are needed.

Fig. 1. Woody biomass is skidded and chipped during a clearcut timber harvest.

Study Objectives

- Birds, amphibians, and reptiles use clearcuts where woody biomass harvesting occurs and some species rely on down wood for aspects of their life history (Fig. 2.).

Our objectives are to:

- Determine effects of varying amounts and distributions of logging residue on wildlife species richness and abundance.
- Relate empirical results to inform development of sustainable BHGs.

Fig. 2. Early successional birds, such as blue grosbeaks eat insects harbored in down wood (a.), and ground-dwelling reptiles and amphibians, including southern toads (b.; in amplexus) and ringneck snakes (c.), use down wood for thermoregulation, desiccation prevention, and travel corridors. These animals may benefit if woody debris is retained following biomass harvests.

Experimental Design

- Treatments were replicated in 8 clearcuts across 2 states (4 in North Carolina and 4 in Georgia).
- Six 6- to 14-ha biomass harvest treatments were created in each clearcut including:
  - Biomass harvest with no BHGs
  - Biomass harvest with 15% of residue left in a dispersed distribution
  - Biomass harvest with 15% of residue left in a clustered distribution
  - Biomass harvest with 30% of residue left in a dispersed distribution
  - Biomass harvest with 30% of residue left in a clustered distribution
  - Clearcut with no biomass harvest
- We used an area-based approach to guide retention of woody biomass (i.e., for 30% retention treatment, logger left biomass from 30% of treatment unit area).
- Loggers dispersed biomass using a skidder grapple.

Methods

- During the winter of 2011 and 2012 and breeding season of 2012, we counted birds using spot mapping.
- During the spring and summer of 2011 and 2012, we captured reptiles and amphibians using 3 Y-shaped drift fence arrays/treatment unit with 4 traps/array.

Preliminary Results - Birds

- Mean number of bird detections did not differ among treatments in winter (Fig. 3) or the breeding season i North Carolina (Fig. 4.).

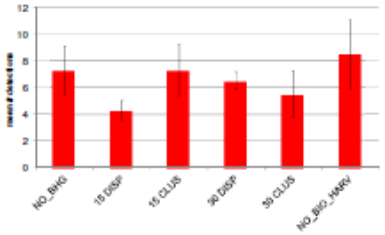


Fig. 3. Mean (SE) number of bird detections during winter 2011

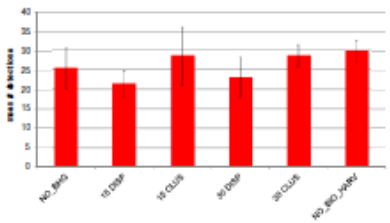


Fig. 4. Mean (SE) bird detections during 2012 breeding season

Preliminary Results – Amphibians and Reptiles

- Number of reptiles and amphibian species did not differ among treatments (Fig. 5.).

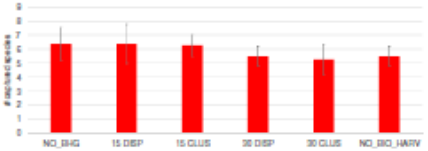


Fig. 5. Mean (SE) number of reptiles and amphibian species captured

- Number of toad captures was not affected by proximity to debris pile (Fig. 6.).

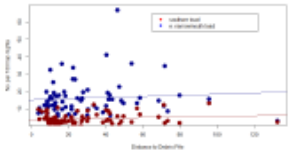


Fig. 6. Toad captures/100 trap nights plotted against distance to logging debris pile

Discussion

- **Preliminary results indicate no effect of down wood removal on amphibians, birds, or reptiles, but additional years of study may reveal an effect as down wood decays.**

in vegetation more so than availability of down wood.

- Amphibians and reptiles present in historically fire-mediated ecoregions such as the Southeast may be adapted to reduced levels of down wood.
- Amphibians with low vagility may respond to retention of logging debris at relatively small scales, so finer scale resolution of study may be needed.

In the future, we will:

- Collect additional seasons of data for reptiles (2013), amphibians (2013), and birds (2013-2014).
- Assess arthropod (2012-2014) and small mammal (2011-2013) response to the treatments.
- Collect behavior data to better understand how birds use residual logging debris.
- Incorporate detection probability into amphibian and reptile abundance estimates.
- Track southern toads using radio-telemetry to investigate fine-scale habitat selection and spatial resolutions finer than the large treatment areas (Fig. 8.).

Fig. 8. Southern toad fitted with a radio transmitter.

NATURAL RESOURCES · WARNELL · Forest Guild

Forest Biomass Retention and Harvesting Guidelines for the Southeast

by the Forest Guild Southeast Biomass Working Group

forest GUILD

February 2012

Introduction and Background

The guidelines:

- Encourage protection of soils, wildlife habitat, water, and other forest attributes
- Address several difference audiences including field foresters, loggers, policy makers, biomass facilities, third party certifiers, and general public
- Emphasize the Forest Guild principles





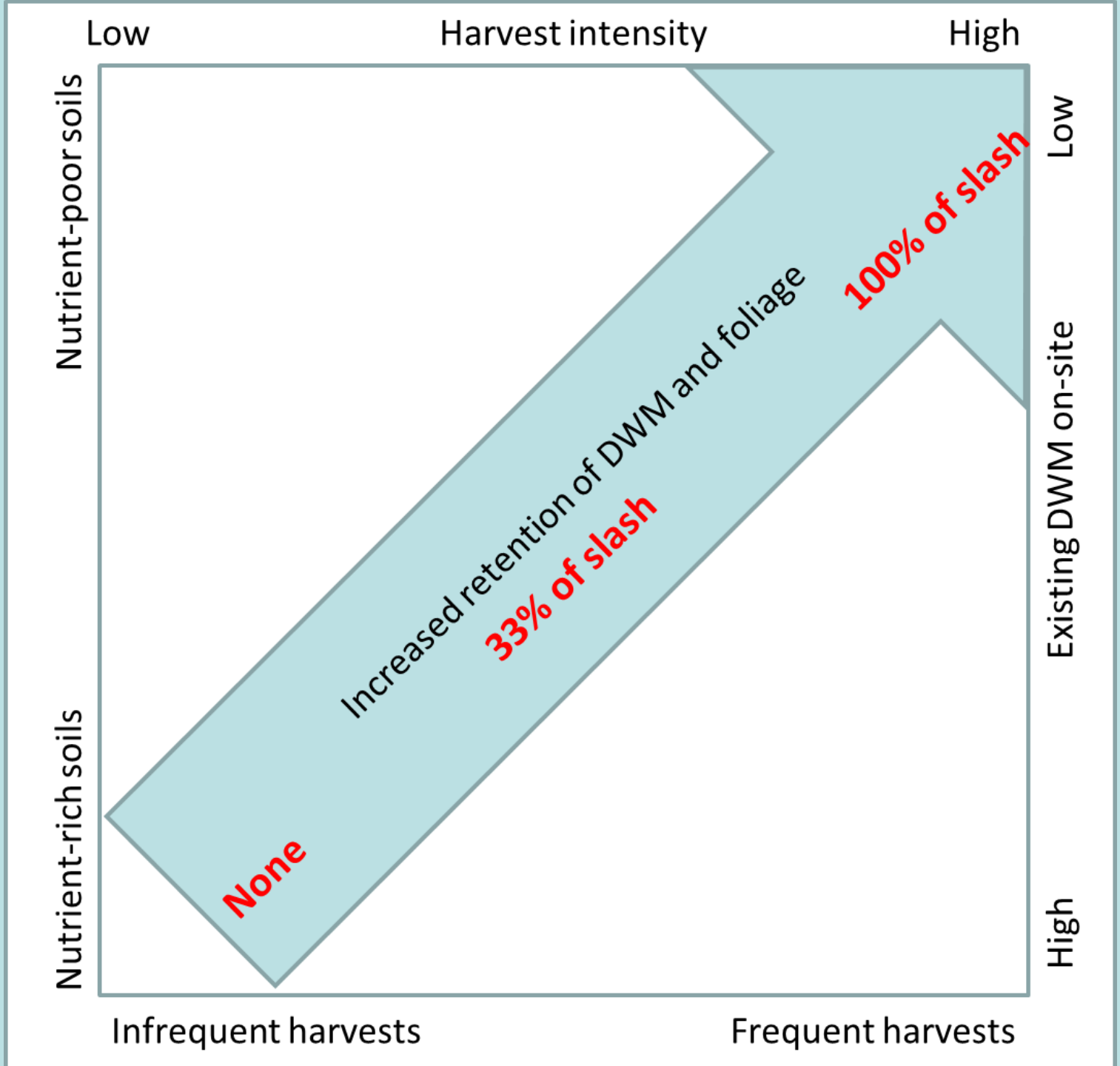
Site Considerations to Protect Rare Forests and Species

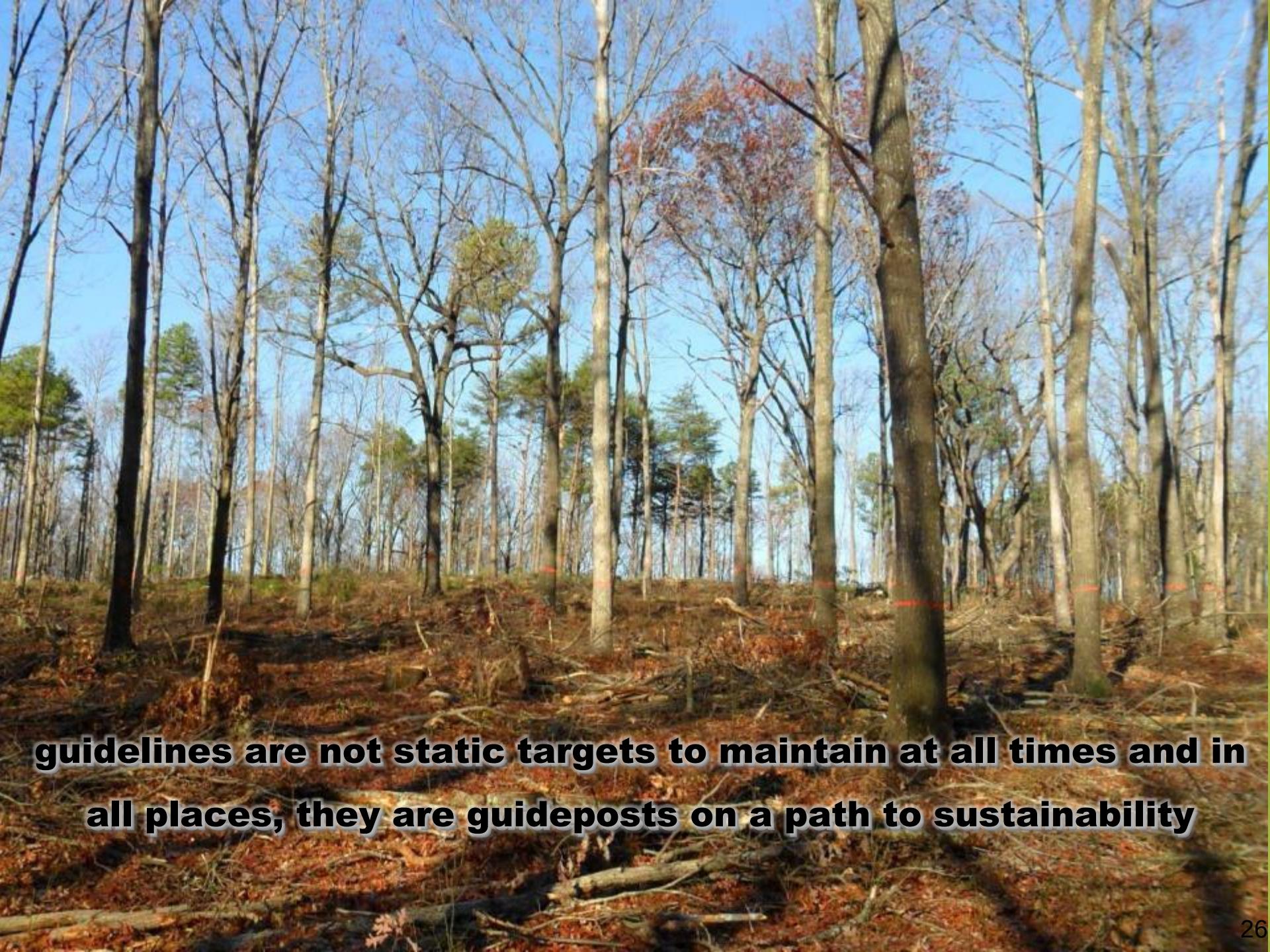
- Biomass harvests in imperiled forest types should be avoided – *unless necessary to perpetuate the type.*
- Biomass harvesting ***may*** be appropriate in sensitive sites to control:
  - invasive species,
  - enhance critical habitat, or
  - Restore fire as an active ecosystem process
- ***However***, restoration activity should be guided by ecological goals and not designed solely to supply biomass.

Retention of Downed Woody Material

- Retain dead wood of all sizes on-site including foliage and large downed logs.
- In general, leave slash distributed across the site.
- Avoid harvesting on low-nutrient sites or adjust retention of tops, branches, needles, and leaves.




Low
Harvest intensity
High
Nutrient-poor soils
Nutrient-rich soils
Low
Existing DWM on-site
High
Increased retention of DWM and foliage
100% of slash
33% of slash
None
Infrequent harvests
Frequent harvests


guidelines are not static targets to maintain at all times and in all places, they are guideposts on a path to sustainability

Retention for Wildlife & Biodiversity

- Leave and protect roots, stumps, and large downed logs.
- Leave and protect live cavity trees, den trees, other live decaying trees, and snags.

Table 1. Goals for Forest Structures ***(see Section 3 for more details)***

Forest Type	Snags	DWM
Southern Appalachian Hardwoods	At least 17 snags per acre greater than 4" DBH	At least 3 tons per acre (t/ac)
Upland Hardwoods and Mixed Pine–Hardwoods	At least 11 snags per acre greater than 4" DBH	At least 3 t/ac
Bottomland Hardwoods	At least 6 snags per acre greater than 10" DBH	At least 3 t/ac
Piedmont and Coastal Plain Pinelands	At least 5 snags per acre greater than 4" DBH	At least 1 t/ac


Water quality

Harvesting Operations

- Involve a professional forester in development of a long-term management plan and supervision of harvests.
- Engage a well trained logger from the ‘Timber Operations Professional” program in South Carolina or similar program.

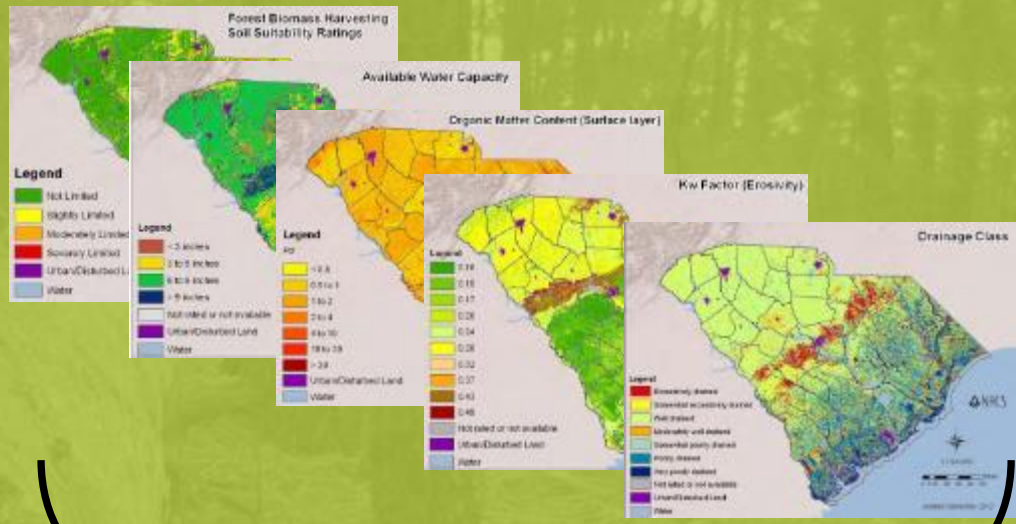
- Encourage decisions that keep forest as forests
- Advocate against conversion of forests to non-forest use

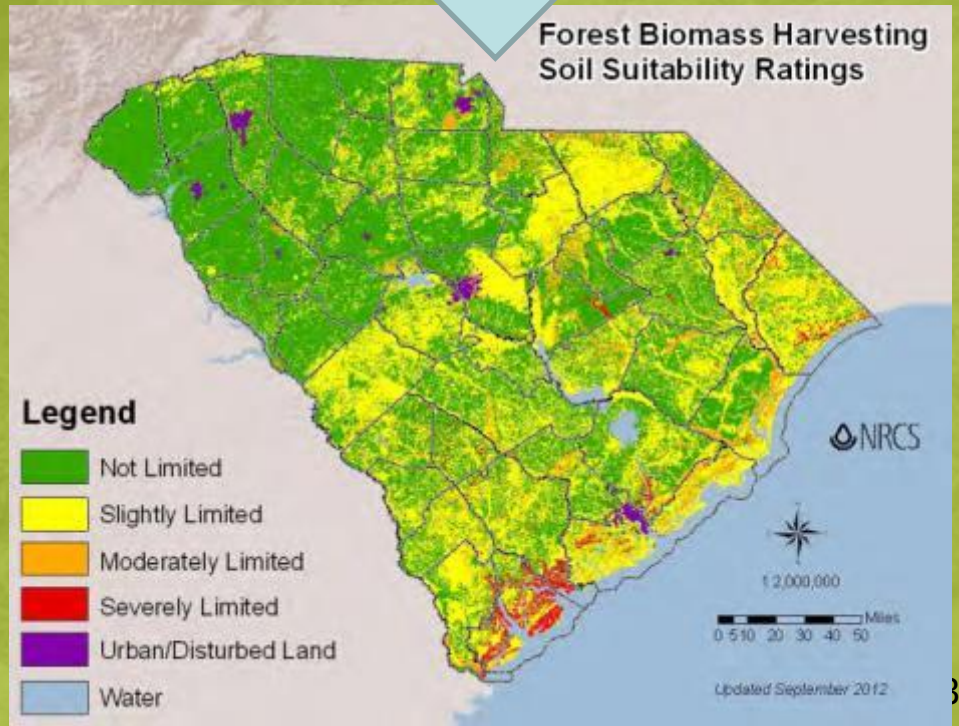
South Carolina's

Best Management Practices

Forest Biomass Harvesting Recommendations:

A Supplement to South Carolina's Best Management Practices for Forestry



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Outcome Paper:
Sustainability Criteria and Indicators for
United States Court of Appeals
12.11.2010
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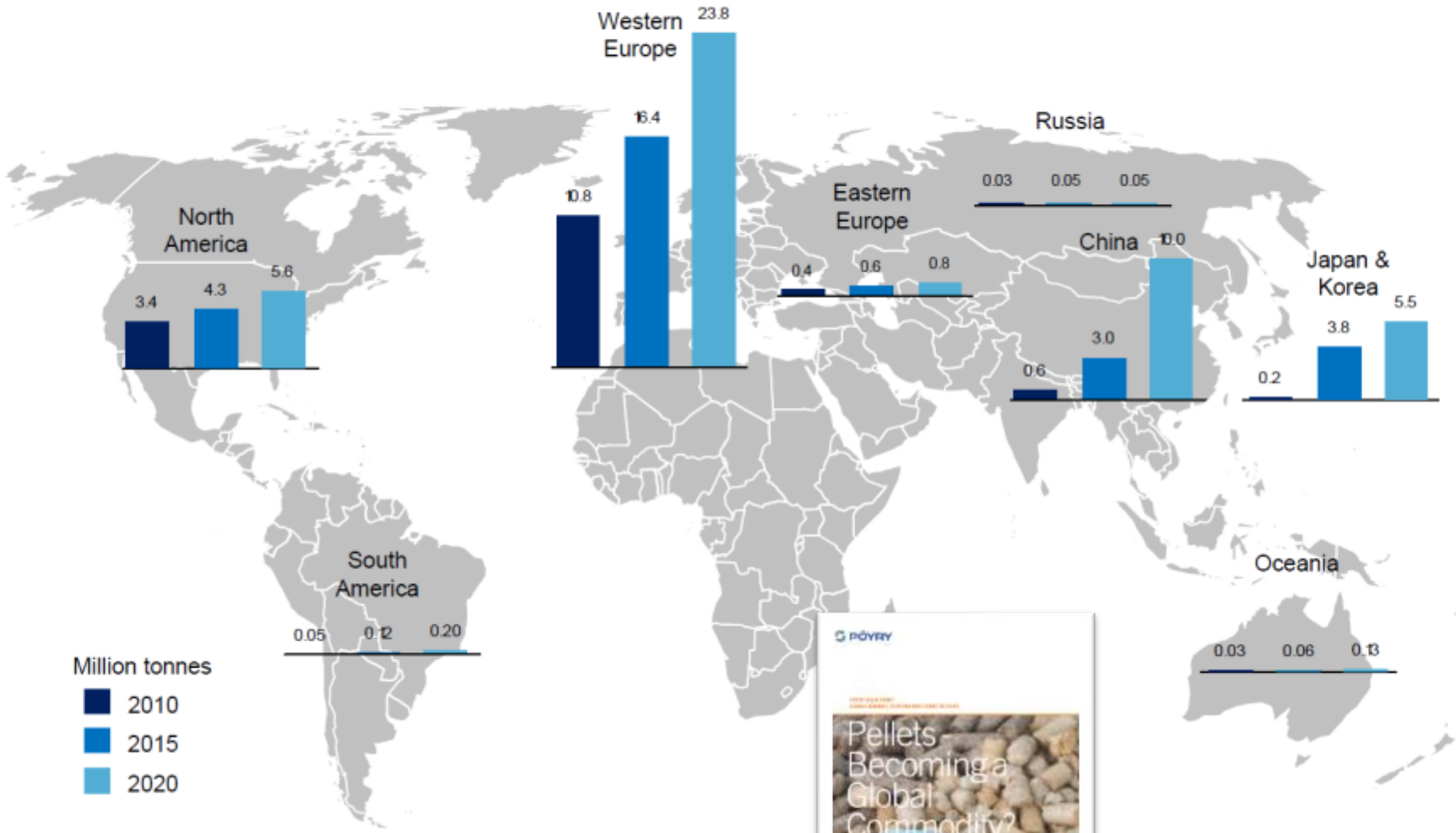
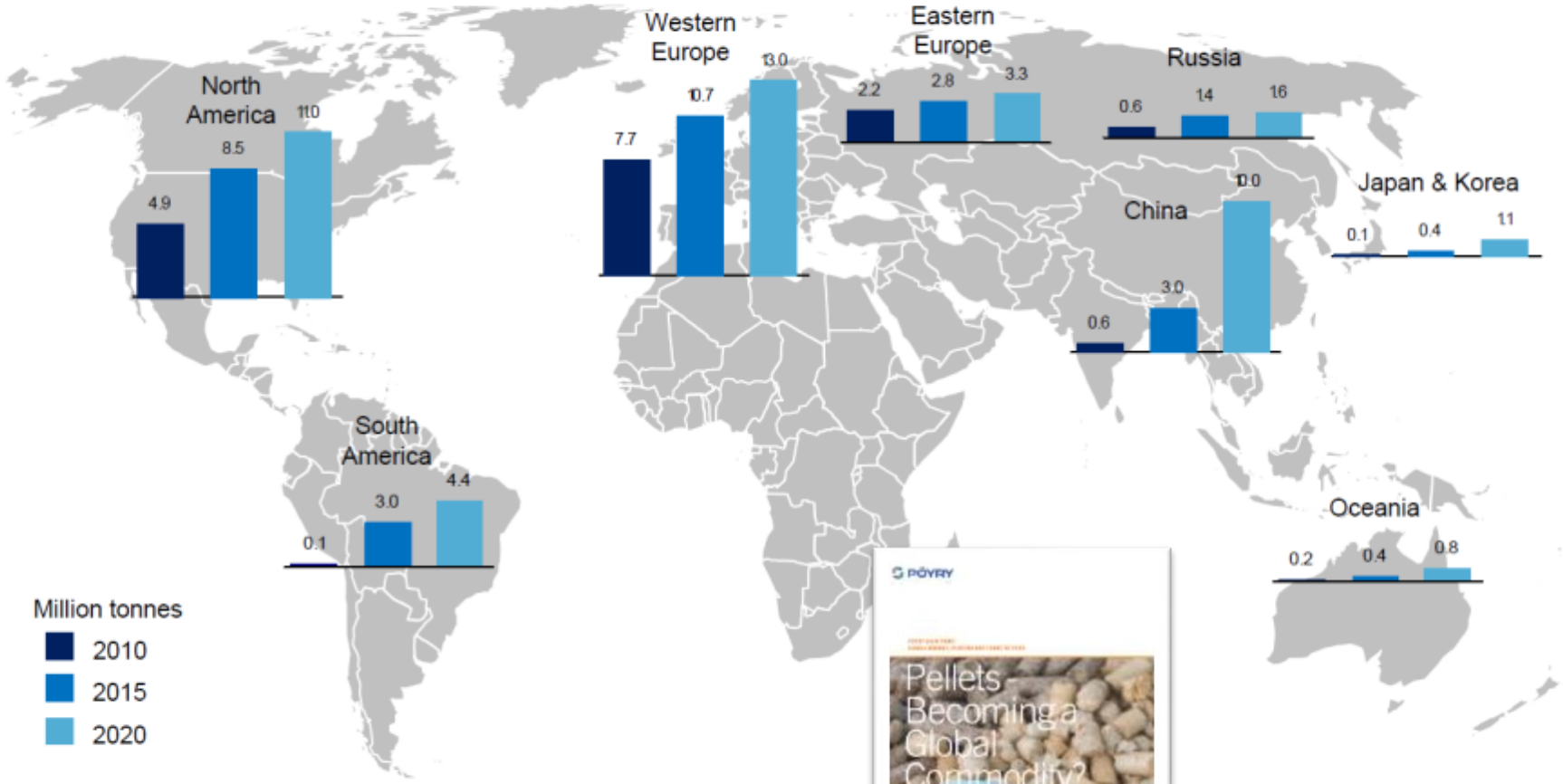
REGULATION (EU) No 995/201
laying down the obligations of o
THE EUROPEAN PARLIAMENT AND THE COUNC
EUROPEAN UNION,
Having regard to the Treaty on the Functioning of the
Union, and in particular Article 192(1) thereof,
Having regard to the proposal from the European Com
Having regard to the opinion of the European Econom
Social Committee (1),
After consulting the Committee of the Regions,
Acting in accordance with the ordinary legislative procedu
cpet
Central Point of Expertise on Timber
UK Government Timber
Procurement Policy

GLOBAL PELLET CONSUMPTION - 2010, 2015 AND 2020 OUTLOOK



GLOBAL PELLET PRODUCTION - 2010, 2015 AND 2020 OUTLOOK



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OUR FORESTS AREN'T FUEL!

NRDC

Dear Zander,

It may be the worst idea ever: Cutting down massive swaths of our native forests so that utilities can burn them to produce electricity.

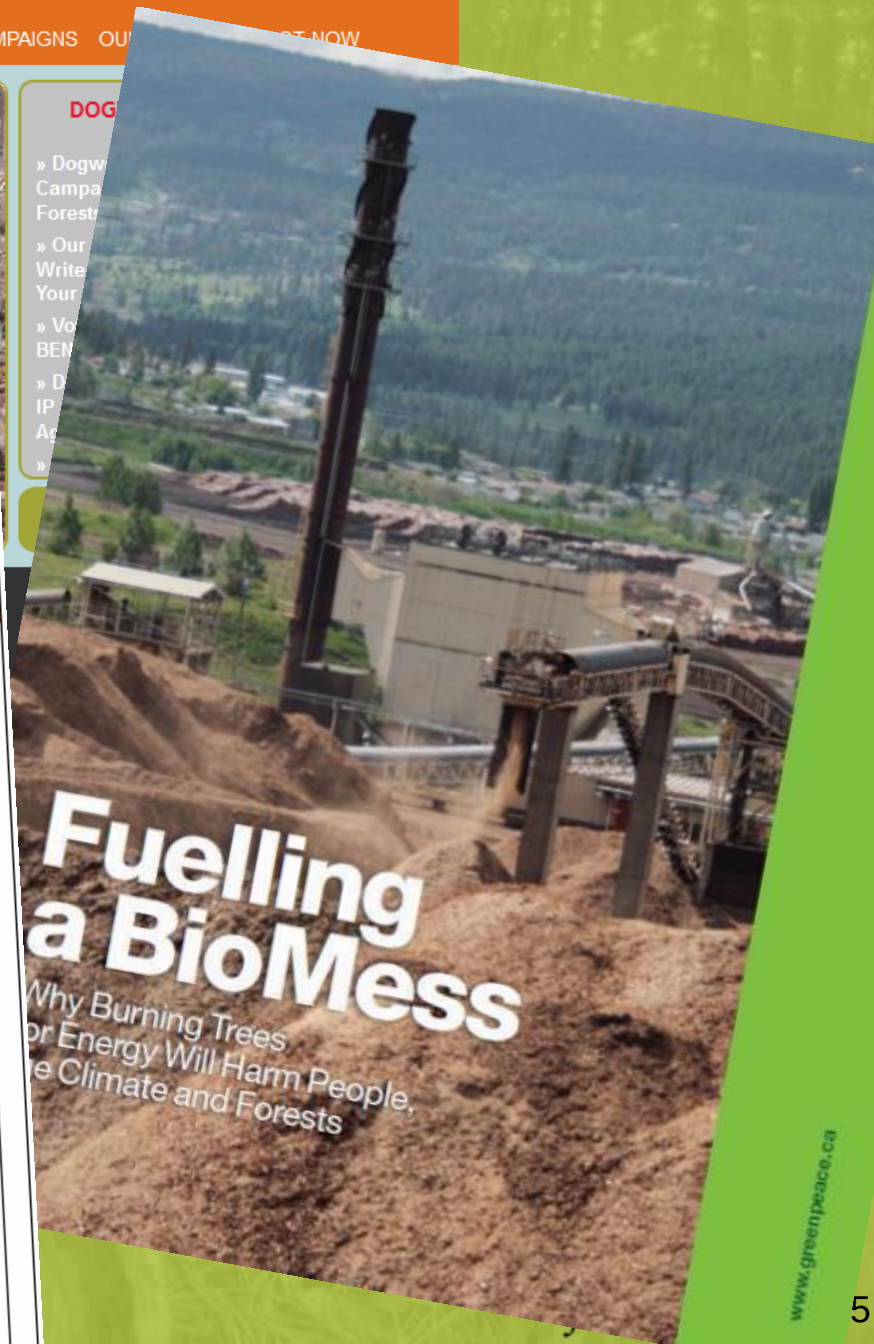
And the results are devastating: Leveling hardwood forests across the mid-Atlantic coastal region ... threatening wildlife ... and driving even more global warming pollution and climate chaos.

Tell the energy giants to stop destroying our forests for fuel and to start producing their power with clean energy alternatives. No one wants to turn on the lights and burn down a forest!

Our native southern forests are home to countless species of plants and animals found

When you turn on the lights, it shouldn't destroy a forest.

But some utilities are forcing us to do just that -- by clearcutting forests and burning them for electricity. Tell them to stop using our



Why Biomass Guidelines?

"Good biomass harvesting practices can enhance and improve forest land; poor practices can damage and devalue it." (Pennsylvania Guidelines)

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