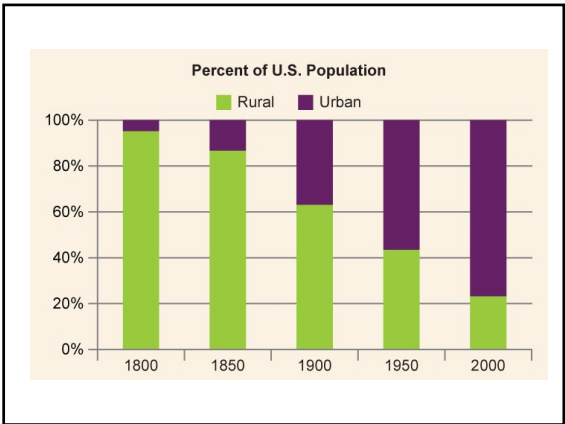




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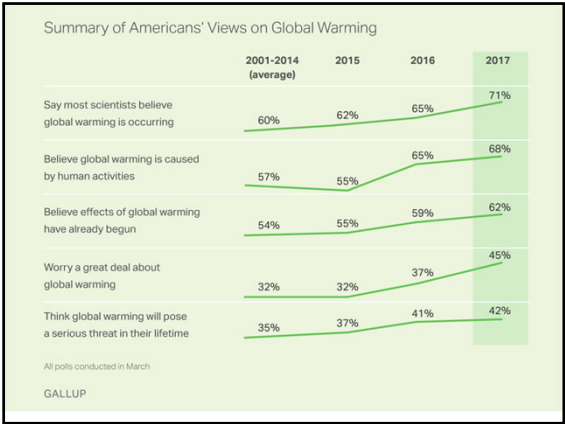
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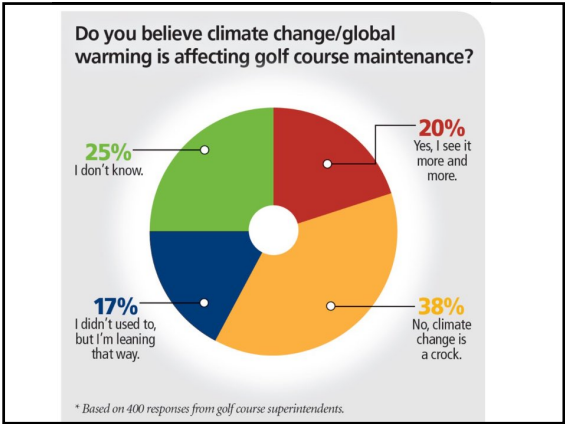
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State/District	Urban Population	Urban Land Area (Square Miles)	Urban Density (Square Miles)	Urban Population %	Urban Population % Rank	Urban Land/ Total Land
Nebraska	1,335,686	524	2,549	73.1%	28	0.7%
Nevada	2,543,797	767	3,315	94.2%	3	0.7%
New Hampshire	793,872	644	1,233	60.3%	40	7.2%
New Jersey	8,324,126	2,920	2,851	94.7%	2	39.4%
New Mexico	1,594,361	827	1,929	77.4%	21	0.7%
New York	17,028,105	4,092	4,161	87.9%	12	8.7%

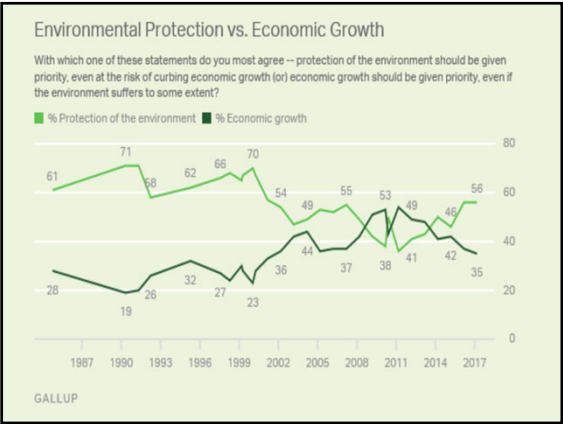
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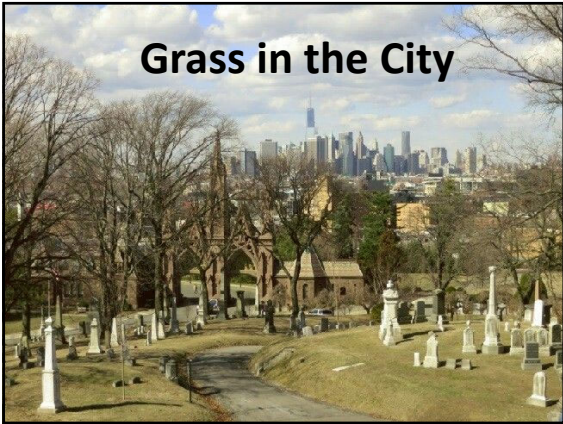
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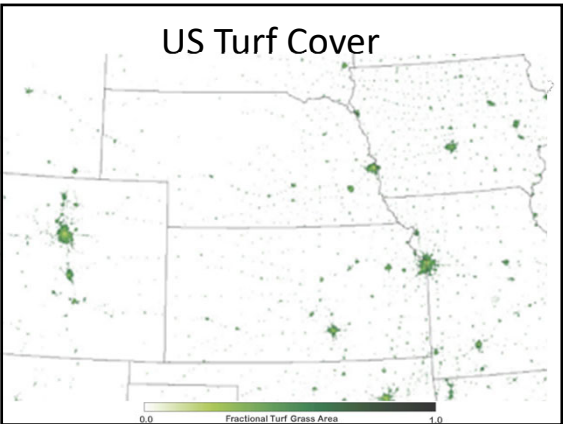
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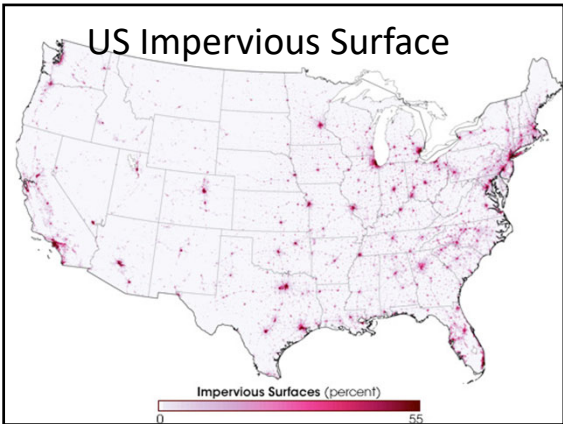
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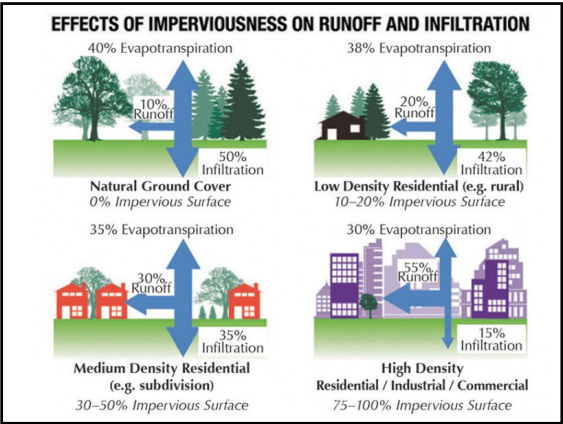
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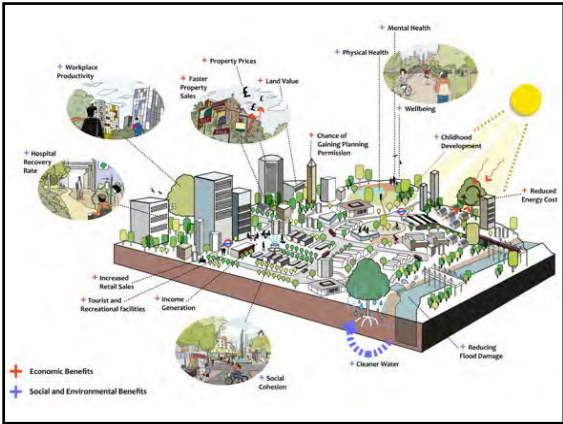
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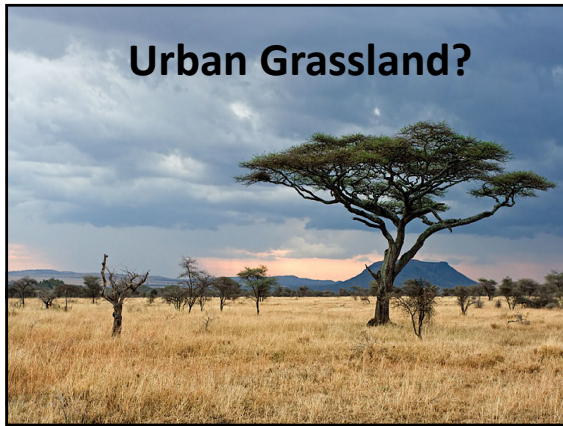
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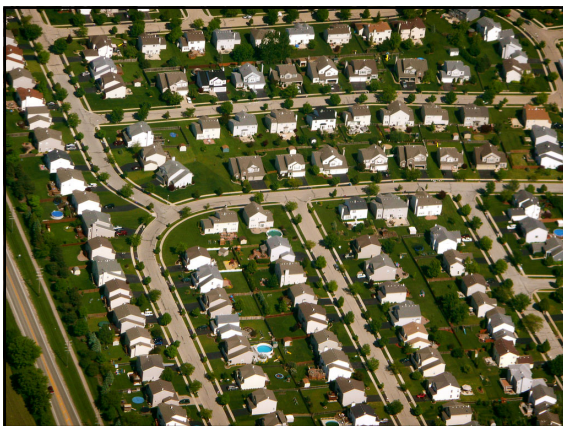
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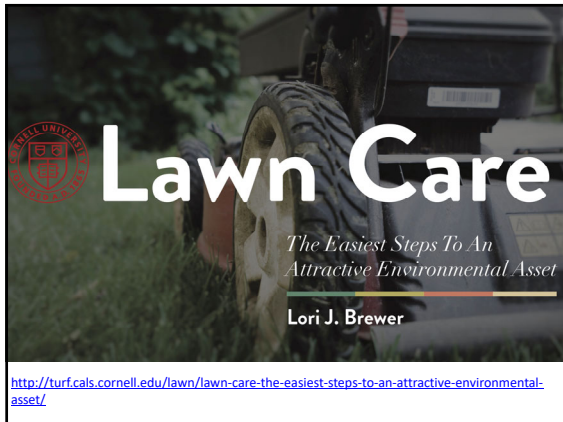


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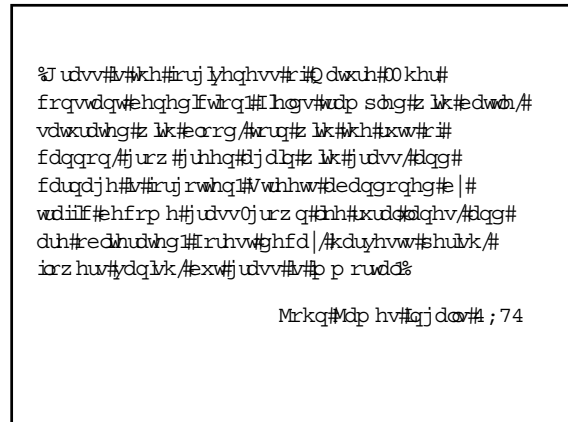
The Modern American Lawn Consumer

- ✓ 90 Million Americans have iPhones; 180M have lawns.
- ✓ 82 Million Single Family Homes; 90% have a lawn.
- ✓ # Lawn increased by 47%, shrunk by 25% since 1980.
- ✓ 1 Million new lawns in 2016.
- ✓ 5 million of 6 million who took up gardening were 18-34 years old.

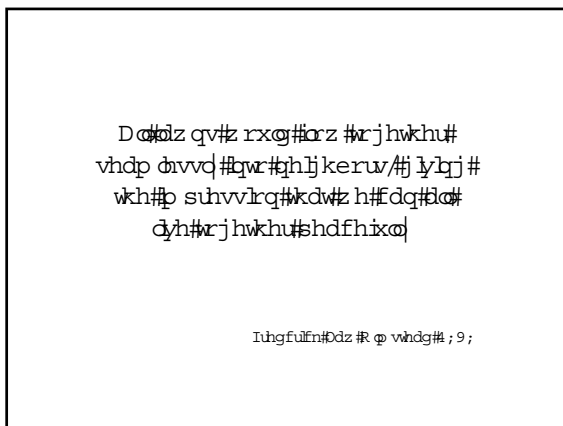
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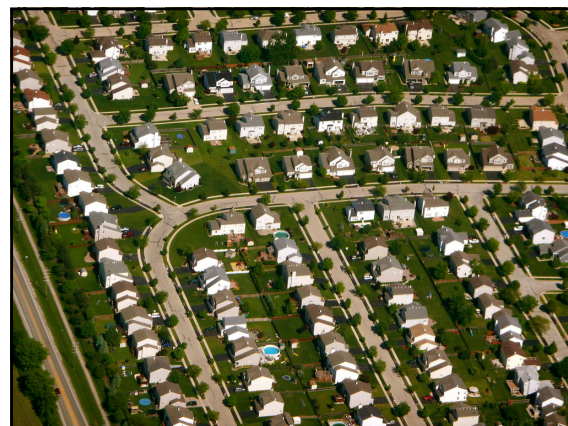
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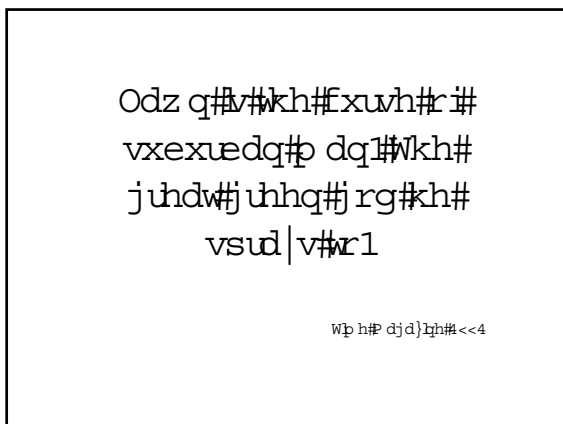
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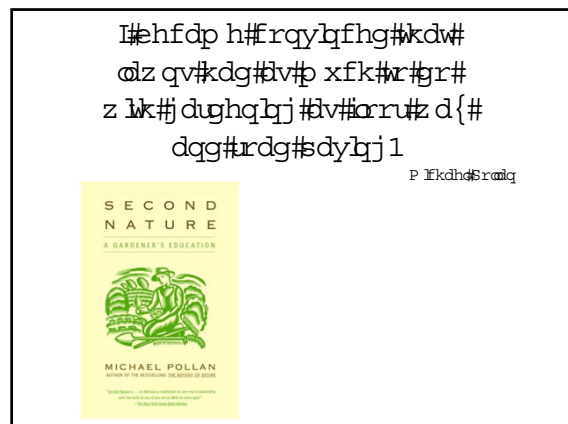
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Anthropology in Practice

The American Obsession with Lawns

Lawns are the most grown crop in the U.S.—and they're not one that anyone can eat; their primary purpose is to make us look and feel good about ourselves

By Krystal D'Costa on May 3, 2017

Lawns are the most grown crop in the U.S.—and they're not one that anyone can eat; their primary purpose is to make us look and feel good about ourselves

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ECOSYSTEMS AND HUMAN WELL-BEING

OUR HUMAN PLANET



Summary for Decision Makers

MILLENNIUM ECOSYSTEM ASSESSMENT

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Ecosystem Services

Provisioning Services Products obtained from ecosystems	Regulating Services Benefits obtained from regulation of ecosystem processes	Cultural Services Non-material benefits obtained from ecosystems
Ground cover Fresh water Sod production Multi-use surfaces	Climate regulation Water purification Nitrogen retention Carbon storage Groundwater recharge Pollutant filtering	Aesthetic Athletics Recreation/Tourism Educational Inspirational Cultural heritage

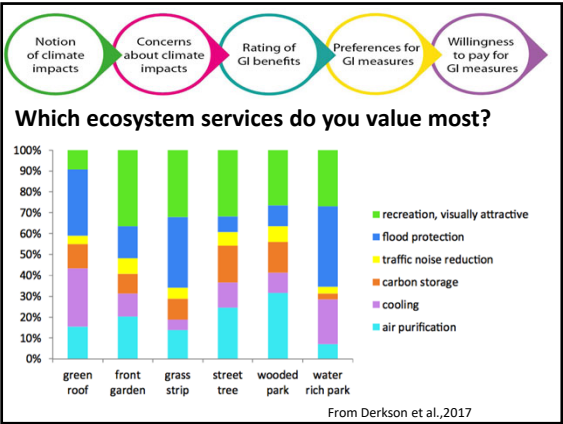
Supporting Services

Services necessary for the production of all other ecosystem services

Soil formation Nutrient cycling Primary production

Kao-Kniffen and Thompson 2017

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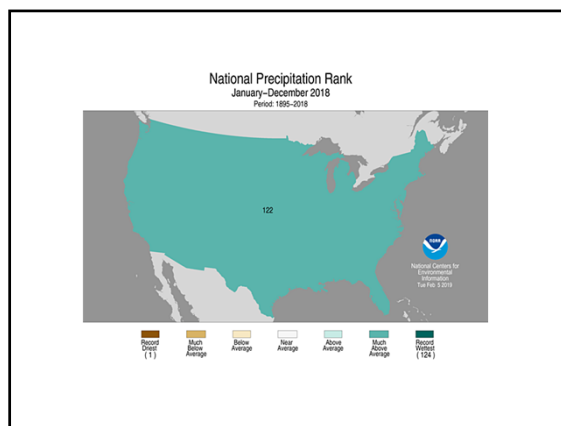


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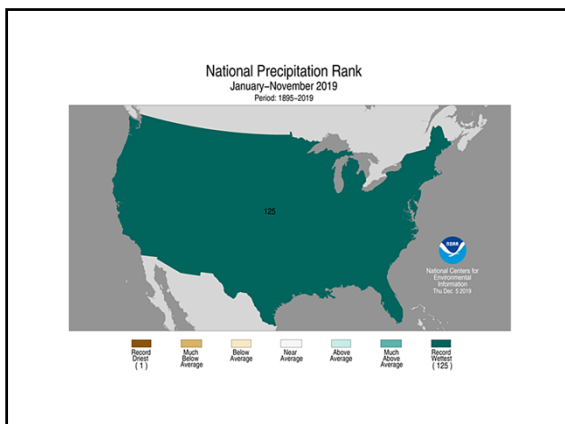
Urban Grassland Role in Climate Resiliency

Ability to anticipate, prepare for and respond to extreme events related to climate.

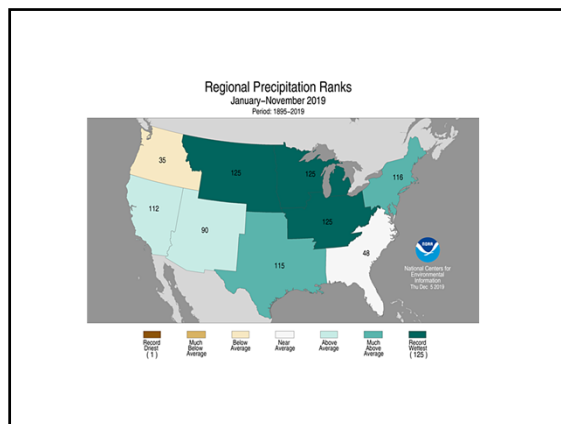
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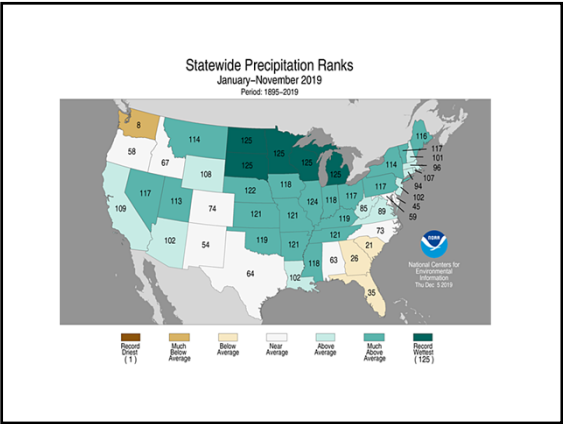
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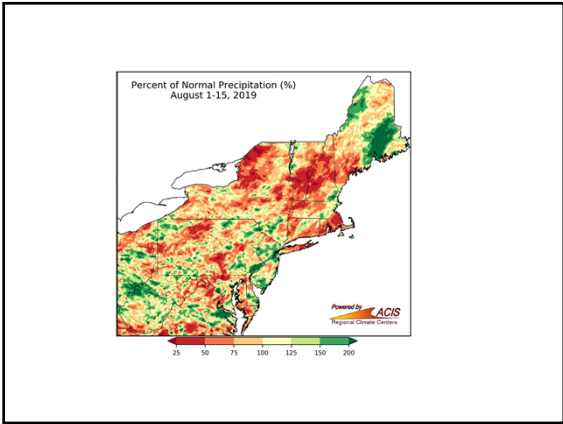
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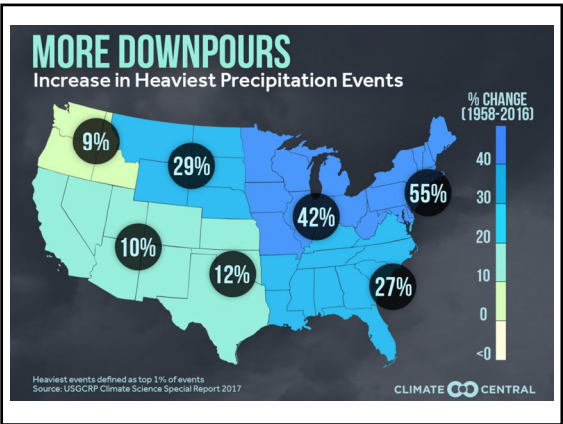
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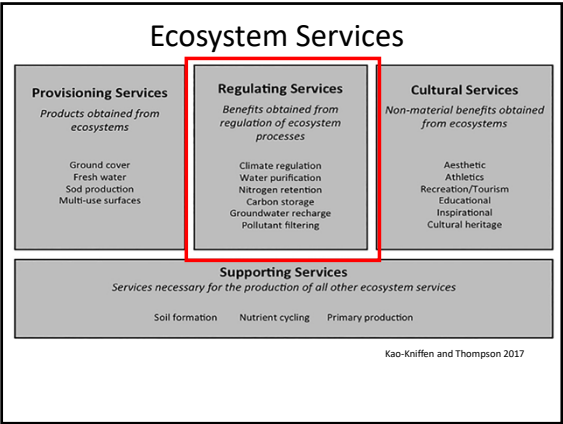
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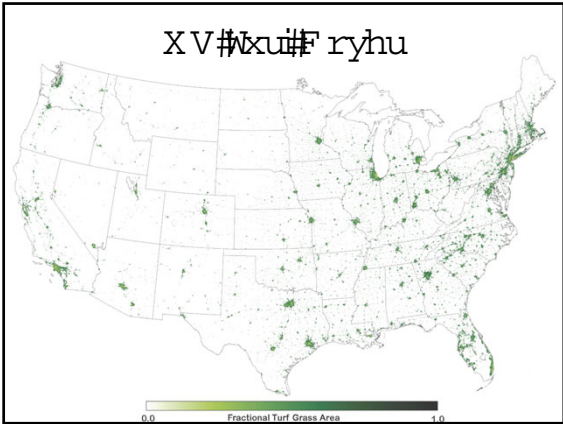
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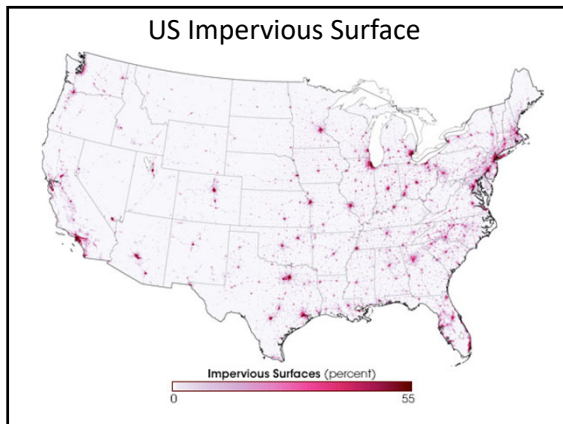
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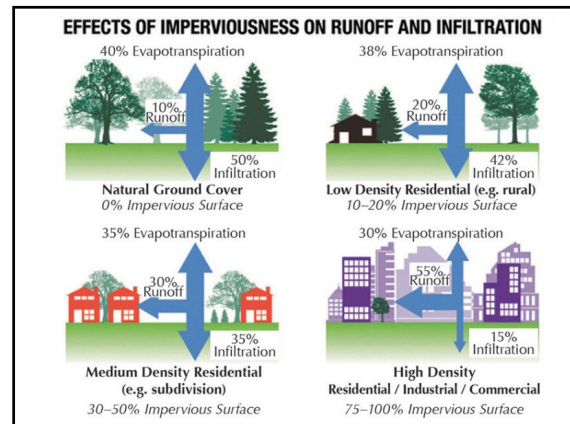
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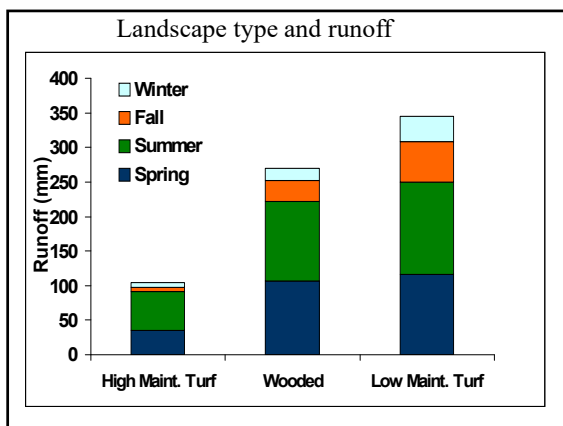
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- ### Climate Resiliency
- ✓ Soil Health
 - ✓ Moderate N rate and MLSN
 - ✓ New Grasses
 - ✓ Pollinator Friendly
 - ✓ Mow responsibly

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CORNELL TURFGRASS TEST REPORT			
Name of Farmer: Chuck Sherri, Jr.		Sample ID: K1856	
Location: One Cottage Rd., Andover, MA, 01810		Agent: 0	
Field Treatment: Sample Area #1 Winthrop Square, Charleston, Agent's Email: 0			
Tillage: 0		Given Soil Texture: 0	
Crop: Grass: 0		Date Sampled: 6/20/2013	
Indicators	Value	Rating	Constraint
PHYSICAL	Aggregate Stability (%)	65.9	95
	Available Water Capacity (mm)	0.28	95
	Surface Hardness (psi)	478	8 - crusting, water transmission
	Subsurface Hardness (psi)	518	2 - Subsurface Pan Deep Compaction
BIOLOGICAL	Organic Matter (%)	3.8	67
	Acidic Carbon (ppm) (Permanganate Oxidizable)	482	38
	Potentially Mineralizable Nitrogen (mg% g/1000 weeks)	4.4	1 - N Supply Capacity
	Root Health Rating (1-5)	3.3	
CHEMICAL	pH (see Nutrient Analysis Report)	6.3	100
	Extractable Phosphorus (see Nutrient Analysis Report)	17.2	100
	Extractable Potassium (see Nutrient Analysis Report)	79.6	100
	Minor Elements (see Nutrient Analysis Report)		
OVERALL QUALITY SCORE (OUT OF 100):		64.4	Medium
Soil Textural Classification: sandy loam			
SAND (%): 56.6 SILT (%): 35.9 CLAY (%): 7.5			

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Reference

November, 2012

Minimum Levels for Sustainable Nutrition Soil Guidelines

Minimum Level for Sustainable Nutrition (MLSN) is a new, more sustainable approach to managing soil nutrient levels that can help you to decrease fertilizer inputs and costs, while still maintaining desired turf quality and playability levels. The MLSN guidelines were developed in a joint project between PACE Turf and the Auburn Turfgrass Center. All soil analyses were conducted at Brookside Laboratories, New Knoxville, OH.

MLSN Soil Guidelines	
pH	>5.5
Potassium (K ppm)	>35
Phosphorus (P ppm): pH<7.5, Mehlich 3	18
Phosphorus (P ppm): pH>7.5, Bray 2	25
Calcium (Ca ppm)	6
Magnesium (Mg ppm)	360
Sulfur as sulfate (S ppm)	5.4
Sulfur as sulfate (S ppm)	13
Sodium (Na ppm)	<10
Electrical conductivity (EC dS/m)	<2
Total Nitrogen (N ppm)*	<3

*N requirements are best determined based on turf growth potential, which incorporates site-specific weather and turf type to calculate nitrogen demand. Griesmer and Brown, 2005, Soil Course Management, a 10th Edition, March, 2005. The values provided above can be used as a guideline to avoid plant stress.

How the guidelines were developed

From a database of over 16,000 soil samples, we selected 1500 that were classified as having:

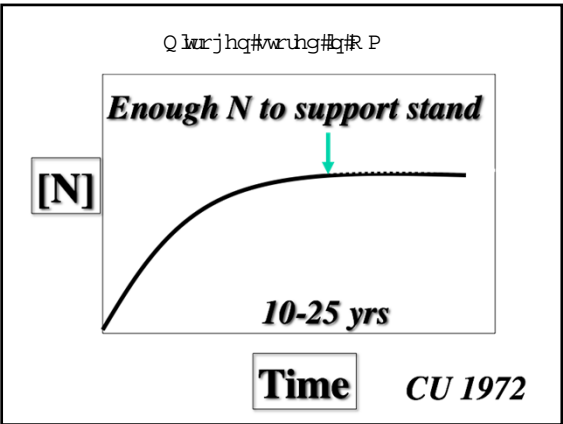
- not poor performing turfgrasses
- pH of 5.5 - 7.5: to avoid aluminum toxicity (for Olsen P analysis, soil pH was 7.5)
- total exchange capacity < 40 cmol/kg
- Sodium < 10 ppm and electrical conductivity < 2 dS/m to avoid plant stress

A log-logistic model provided a significant fit of the data, and was used to identify the concentration (in ppm) of each nutrient that 10% of the soil samples fell below, but were still performing well.

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Frequently Asked Questions (FAQ):

Does the turfgrass industry have a defensible rate of Nitrogen required to produce a functional and aesthetically pleasing turf?

Defensible N Rate:

A rate that ensures WQ Protection and lawn performance

Over 20 years as it relates to preventing contamination from chemicals and herbicides applied to grasslands. In those 50 years the Cornell Turfgrass Program has conducted 12 studies and three large scale nutrient education and reduction programs on Long Island to preserve water quality. In fact, a comprehensive N management review was conducted for Suffolk County in 2010 and is available at http://www.suffolkcountyny.gov/Enviro/EnviroReport/Edited_01_10_11.pdf

Science Says Could Need:

1-2 lbs N per 1000

to 4-6- lbs N per 1000

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Defensible N Rate:

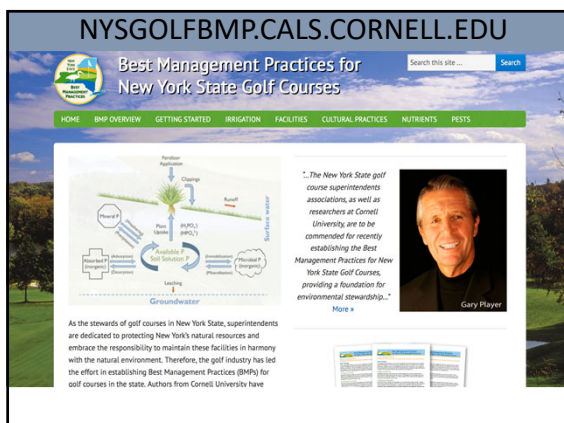
A rate that ensures WQ Protection and lawn performance

Also shown to have negative effects on water quality, Cornell University research conducted over 28ppm (N) will have large effects on water quality, from a growing grasslands with proper N fertilization increases carbon sequestration, improves water infiltration during high rainfall events, and does not contribute to increased emissions from mowing.

Therefore, the defensible annual N rate for Long Island is between 80-100 lbs of actual N depending on the age of the turf and clippings management and a single applications of soluble N should not exceed 20 lbs actual N per acre.

2 to 2.7 lbs per 1000

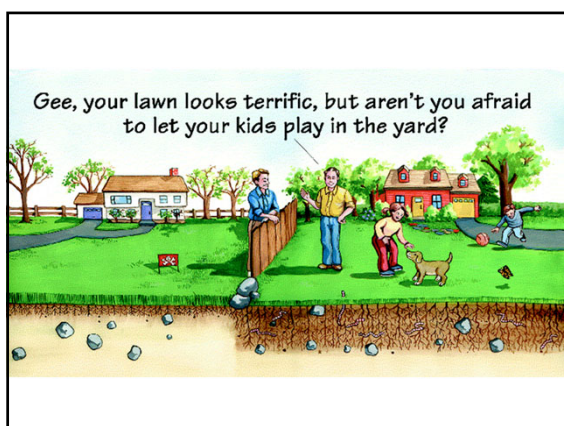
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Cool season turf under drought stress crabgrass thriving.



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Clipped from Industry-leading Turfgrass Seed Company

Fast Facts For Northeast Needs

- Mix of superior cool-season grass varieties
- Suitable for cool, humid Northeast conditions
- Improved cold tolerance
- Improved drought and disease resistance
- Complementary growth habits for thick, lush lawns

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What will it look like in 2025?

Fast Facts For Northeast Needs

- Mix of **warm and** cool-season grass varieties.
- Maintains color during drought.
- Is greenhouse gas neutral.
- Adapted to automated mowing.

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Urban Forestry & Urban Greening 26 (2017) 158–162

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Original article

Biogeochemical cycling of carbon and nitrogen in cool-season turfgrass systems^{*}

Quincy D. Law^a, Aaron J. Patton

^aDept. of Horticulture and Landscape Architecture, Purdue University, 625 Agriculture Mall Drive, West Lafayette, IN 47907, USA

✓ What if I care about sequestering more carbon in soil?

✓ What if I care about emitting less GHG?

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Original article

Biogeochemical cycling of carbon and nitrogen in cool-season turfgrass systems^{*}

Quincy D. Law^a, Aaron J. Patton

^aDept. of Horticulture and Landscape Architecture, Purdue University, 625 Agriculture Mall Drive, West Lafayette, IN 47907, USA

If you want to increase Carbon Sequestration then plant fast growing grass (TF), mow 30% at a time, and leave clippings.

If you want to decrease carbon emissions plant slow growing grass (KBG, FF), mow 30%, mulch clippings to build soil N.

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Autonomous Mowing



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Autonomous Mower Saves Energy and Improves Quality of Tall Fescue Lawn

Nicola Grossi^{1,3}, Marco Fontanelli¹, Elisa Garramone¹,
Andrea Peruzzi¹, Michele Raffaelli¹, Michel Pirchio¹,
Luisa Martelloni¹, Christian Frascioni¹, Lisa Caturegli¹,
Monica Gaetani¹, Simone Magni¹, J. Scott McElroy²,
and Marco Volterrani¹

In Italy, for example, mowing the grass is generally considered a weekend nuisance, whereas in other countries, like the United States, the lawn care is often a pleasant exercise.

(Grossi et al., 2018)

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Table 6. Mowing system mean effect on tall fescue leaf width (cm) and shoot density ($n^{\circ} \text{ cm}^{-2}$) after 32 weeks of treatment.

Mowing System	Leaf Width (cm)	Shoot Density ($n^{\circ} \text{ cm}^{-2}$)
Autonomous mower	0.16	3.6
Rotary mower	0.23	2.2
LSD 0.05	0.02	0.3

32 Weeks after Treatment				
Weed diameter (cm)	<i>Bellis perennis</i>	<i>Trifolium repens</i>	<i>Trifolium subterraneum</i>	<i>Lotus corniculatus</i>
Autonomous mower	6.6	24.0	7.3	14.2
Rotary mower	4.5	7.0	4.8	8.3
LSD 0.05			2.2	

- ✓ Increase in creeping weeds with robotic mower
- ✓ Increase in shoot density
- ✓ No stripes

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5,000 sq ft (50 x 100) lawn mowed at 1.4" ...too low...weekly...

Table 3. Operative characteristics, energy consumption, and estimated costs of the autonomous mower and of the rotary mower working on a surface of 1296 m² (1550.0 yard²) at 3.5 cm (1.38 inch) mowing height.

Parameter	Unit ^a	Value
Autonomous mower		
Working speed	km·h ⁻¹	1.60
Working width	cm	24.00
Set daily working time (mowing and recharging)	h·d ⁻¹	10.00
Daily mowing time (no recharging)	h·d ⁻¹	7.80
Electric energy consumption per week	kWh/week	2.21
Primary energy consumption per week	kWh/week	4.80
Cost per week	euros/week	19.36
Rotary mower		
Engine power	kW	5.00
Working speed	km·h ⁻¹	3.00
Working width	cm	53.00
Total operative time	h/week	1.02
Gasoline consumption	L/week	1.36
Primary energy consumption	kWh/week	12.60
Cost per week (included labor 25 euros/h)	euros/week	32.22

^a 1 km·h⁻¹ = 0.6214 mph, 1 cm = 0.3937 inch, 1 L = 0.2642 gal.

70% reduction in energy consumption

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What will lawn grasses need to be in 2025?

- Mix of **warm and** cool-season grass varieties.
- Maintains color during drought.
- Is greenhouse gas neutral.
- Adapted to automated mowing.



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Urban Grasslands and Changing Turf Perceptions.



Time to change the conversation.

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