

Articles

FRAYED SEAMS IN THE “PATCHWORK QUILT” OF AMERICAN FEDERALISM: AN EMPIRICAL ANALYSIS OF INVASIVE PLANT SPECIES REGULATION

BY

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Implementation of certain state and federal renewable energy mandates will require development of new, higher-yielding plant resources. However, many invasive plant species share biological characteristics with ideal biomass feedstocks, such as rapid growth and ability to outcompete local vegetation, prolific seed generation, adaptability to an assortment of soil and climatic conditions, and lack of, or resistance to, pests and diseases. Next-generation biofuel feedstocks may be more productive and profitable at the individual farm level, but also may pose a greater risk of becoming invasive, thereby damaging the broader ecosystem and the economy. Accordingly, the agronomist’s search for yield-maximizing biofuel crops, combined with policies that encourage bioenergy production, prompts a careful re-examination of the regulatory landscape for invasive plants. Our empirical analysis¹ of state regulatory frameworks

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¹ Lauren D. Quinn, Jacob N. Barney, James S.N. McCubbins & A. Bryan Endres, *Navigating the “Noxious” and “Invasive” Regulatory Landscape: Suggestions for Improved Regulatory Performance*, 63 *BIOSCIENCE* 125 (2013) [hereinafter Quinn et al.]. For various tables, figures,

demonstrates that most states fail to regulate invasive plant species (on average, states restrict only 19.6% of invasive plant species in their jurisdiction) and are ill-prepared to manage potential ecological pressure arising from the introduction of new plants. Our typological analysis of state regulatory structures yielded similarly discouraging results, with no regime exhibiting a statistically significant correlation with improved invasive species regulation. We offer three recommendations to improve state responses to the ecological threats posed by invasive plant species, including: 1) formalization of state invasive species councils within the regulatory structure; 2) improved pre-commercialization control through weed risk assessments; 3) and a negligence-based liability regime to shift economic incentives in order to control the introduction and spread of invasive plant species.

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and further analyses supporting the authors' empirical study see Quinn et al., *supra*, at Supplemental Material, available at <http://www.jstor.org/stable/10.1525/bio.2013.63.2.8> (click on the “Supplements” link) [hereinafter Quinn et al. *supra* note 1, at Supplemental Material].

I. INTRODUCTION

Invasive species are not well managed in this country.² Determining the true economic costs associated with invasive species is difficult;³ yet, researchers have estimated that corrective expenditures and other lost revenues exceed \$120 billion annually⁴ and, unfortunately, most of these expenses are absorbed by the public. In most instances, necessary control measures are not in place prior to a species naturalizing in a given ecosystem.⁵ Invasive species most often outcompete their native counterparts for resources within an ecosystem,⁶ resulting in the need for remedial measures in order to preserve ecosystem stability for other flora and fauna.⁷ As some studies have shown, the cost of preventing invasive species from initially establishing a presence is far less than the cost of

² See generally BARBRA H. MULLIN ET AL., COUNCIL FOR AGRIC. SCI. & TECH., ISSUE PAPER 13, INVASIVE PLANT SPECIES (2000), available at http://www.cast-science.org/publications/?invasive_plant_species&show=productID=2864 (describing problems in weed management such as high rates of introduction, inadequate regulations, early detection and mitigation programs, and declines in research funding).

³ See *id.* at 4 (mentioning the difficulty of documenting the economic impacts of invasive species introduction, but placing a “conservative estimate” of agricultural impacts at \$20 billion annually); see also David Pimentel et al., *Update on the Environmental and Economic Costs Associated with Alien-Invasive Species in the United States*, 52 *ECOLOGICAL ECON.* 273, 274 (2005). Estimates are based on known costs, and do not take into consideration the value of species extinction caused by invasive species. *Id.* at 282–83.

⁴ Pimentel et al., *supra* note 3, at 274, tbl.1. Earlier estimates by researchers placed the economic costs in excess of \$137 billion. See David Pimentel et al., *Environmental and Economic Costs of Nonindigenous Species in the United States*, 50 *BIOSCIENCE* 53, 54 tbl.1 (2000); see also U.S. GEN. ACCOUNTING OFFICE, GAO-03-1, INVASIVE SPECIES: CLEARER FOCUS AND GREATER COMMITMENT NEEDED TO EFFECTIVELY MANAGE THE PROBLEM 16 (2002) available at www.gao.gov/new.items/d031.pdf (describing Pimentel et al.’s estimates as conservative). It should be noted, however, that these estimates include both invasive plants and animals.

⁵ See, e.g., EUGENE H. BUCK ET AL., CONG. RESEARCH SERV., R41082, ASIAN CARP AND THE GREAT LAKES REGION 1–14 (2012) (identifying problems surrounding Asian carp, an invasive species in the Great Lakes region—an issue that did not receive critical attention until decades after the carp had been introduced and had over-run major U.S. waterways), available at <http://www.fas.org/sgp/crs/misc/R41082.pdf>; see also DANIEL Q. THOMPSON, RONALD L. STUCKEY & EDITH B. THOMPSON, U.S. FISH & WILDLIFE SERV., SPREAD, IMPACT, AND CONTROL OF PURPLE LOOSESTRIFE (*LYTHRUM SALICARIA*) IN NORTH AMERICAN WETLANDS (1987), <http://www.npwrc.usgs.gov/resource/plants/loosstrf/index.htm> (last visited Nov. 8, 2012) (noting the more than 100-year gap between the establishment of—and first efforts to control—purple loosestrife in North America).

⁶ See, e.g., Kate G. McAlpine, Linley K. Jesson & David S. Kubien, *Photosynthesis and Water-Use Efficiency: A Comparison Between Invasive (Exotic) and Non-Invasive (Native) Species*, 33 *AUSTRAL ECOLOGY* 10, 12 (2008) (discussing the photosynthetic traits of Darwin’s barberry (*Berberis darwinii*), as compared to similar native plant species in New Zealand).

⁷ See generally Fred Kraus & David C. Duffy, *A Successful Model from Hawaii for Rapid Response to Invasive Species*, 18 *J. NATURE CONSERVATION* 135, 135 (2010) (introducing a functional management model for eradicating emerging populations of invasive species); see also Lars W.J. Anderson, *California’s Reaction to Caulerpa taxifolia: A Model for Invasive Species Rapid Response*, 7 *BIOLOGICAL INVASIONS* 1003, 1007–08 (2005).

remedial measures.⁸ However, despite “[a]n ounce of medicine [being] worth a pound of cure,”⁹ our empirical study provides strong evidence that most states within the United States fail to even consider “medicine,” and instead undertake reactionary measures, resulting in significant underregulation of most invasive plants, while overregulating many plants that lack invasive characteristics.

While the word “invasive” inherently holds a negative connotation,¹⁰ many of these problematic species have been introduced to various regions under the auspices of “good intentions.”¹¹ Consider, for example, the introduction of Asian carp¹² into the southern United States and their subsequent migration towards the Great Lakes region. As voracious algae eaters, scientists intentionally introduced Asian carp for the dual purpose of helping keep aquaculture and wastewater treatment facilities clean and as a means of providing fresh fish to fish markets.¹³ Despite the benefits of these fresh-water fish, flooding allowed them to escape into the wild, where they currently threaten not only native ecosystems and fish populations, but also a multi-billion dollar fishing industry in the Great Lakes region.¹⁴ Not to be outdone, plants have also played their part in exacerbating the invasive species challenge. Kudzu (*Pueraria montana* var. *lobata*), originally a native plant to China and Japan, had been promoted in the late 1800s as an ornamental species in the United States.¹⁵ By the 1930s, the species was found to have excellent properties for erosion control,¹⁶ and the government

⁸ Peter M. Rice, *Model Weed Law Provisions for Management of New Invaders, Rapid Response, and Cost-Effective Allocation of Public Resources* 2 (Ctr. for Invasive Plant Mgmt., Working Paper, Sept. 3, 2008).

⁹ Attributed to Benjamin Franklin while discussing firefighting. USHISTORY.ORG, *The Electric Ben Franklin: A Quick Biography of Benjamin Franklin*, <http://www.ushistory.org/franklin/info/index.htm> (last visited Aug. 14, 2012).

¹⁰ Merriam-Webster lists in its definition of “invade” several different examples that have negative inferences—e.g., cancer, weeds, viruses, bacteria, and troops. MERRIAM-WEBSTER ONLINE DICTIONARY, <http://www.merriam-webster.com/dictionary/invade> (last visited Nov. 14, 2012).

¹¹ Many beneficial plant species that are a pillar of agriculture in the United States are nonnative species. However, some species that were thought to have beneficial purposes have had adverse impacts on native ecosystems. ASIAN CARP REG’L COORDINATING COMM., ASIAN CARP – THE PROBLEM 1–2, available at <http://www.asiancarp.us/documents/AsianCarp-TheProblem.pdf>.

¹² Although “Asian carp” refers to several different species, the bighead, silver, and grass carp “pose the greatest, immediate threat.” U.S. FISH & WILDLIFE SERV., ASIAN CARP – AQUATIC INVASIVE SPECIES: ISSUES, PROGRAM ACCOMPLISHMENTS, AND NEEDS 1–3 (2006), available at <http://asiancarp.org/Documents/AsianCarp.pdf>.

¹³ *Id.* at 1.

¹⁴ ASIAN CARP REG’L COORDINATING COMM’N, *supra* note 11.

¹⁵ C. Ritchie Bell & Charles Reagan Wilson, *The Kudzu File*, in *ENCYCLOPEDIA OF SOUTHERN CULTURE* (Charles Reagan Wilson & William Ferris eds., University of N.C. Press, 1989).

¹⁶ Carol Bishop Higgs, *Kudzu: A Vegetable Menace That Started Out as a Good Idea*, *HORTICULTURE*, June–July 1994, at 36; S. S. Dalal & N. Patnaik, *Kudzu Cultivation for Soil Conservation*, 89 *INDIAN FORESTER* 468, 468 (1963); B. H. HENDRICKSON ET AL., U.S. DEP’T OF AGRIC., REVIEW OF PRINCIPAL RESULTS, 1945, at 13 (1946); ROLAND MCKEE & J. L. STEPHENS, U.S. DEP’T OF AGRIC., FARMERS’ BULLETIN NO. 1923, KUDZU AS A FARM CROP 1 (1943); R. Y. BAILEY, U.S. DEP’T OF AGRIC., FARMERS’ BULLETIN NO. 1840, KUDZU FOR EROSION CONTROL IN THE SOUTHEAST 1 (1939); C. J. Willard, *An Interesting Root System*, 18 *AGRONOMY J.* 725, 727 (1926).

not only encouraged people to use it, but subsidized its propagation by providing more than 85 million seedlings and paying \$19.75 for each hectare planted.¹⁷ Proponents of kudzu during this period advocated its versatility as fodder for livestock, a hay crop, and for use in manufacturing starch, paper, and other cloth products.¹⁸ Although the United States government eventually reversed its kudzu-promoting policies, the plant species was already well-established in the southeastern United States,¹⁹ exhibiting its apt monikers of “Mile-a-Minute Vine” and “The Vine that Ate the South.”²⁰ Much like Asian carp, kudzu has the ability to outgrow and outcompete native species.²¹ In fact, in many instances the rapidly growing vine uses native vegetation and surrounding structures to secure vantage points for increased sunlight.²² Despite its varied uses as forage for animals, food for human consumption, erosion control, and ornamentation, kudzu was nationally recognized as a weed by 1970.²³ The aggressively invasive species took nearly 100 years of naturalization, establishment, and promotion before it became identified as a harmful plant by the federal government²⁴—action almost unrecognizable as responsive, much less preventive.

The Energy Policy Act of 2005 charted an initial technology-forcing course for annually increasing the amount of renewable fuels blended into American gasoline supplies—requiring 7.5 billion gallons by 2012.²⁵ As the industry made significant progress, and even exceeded the initial mandates, Congress readjusted the goal and expanded blending requirements under the Energy Independence and Security Act of 2007.²⁶ The revised Renewable Fuel Standard extended the program’s annual increases through 2022 and set a lofty goal of 36 billion gallons by 2022.²⁷ As a result of these ever-increasing mandates, the biofuel industry is searching for, or in some cases attempting to genetically engineer, plant species capable of increased biomass production, with desirable traits such as rapid growth, the ability to outcompete local vegetation, prolific seed production, increased tolerance

¹⁷ JOHN W. EVEREST ET AL., ALA. COOPERATIVE EXTENSION SYS., ANR-65, KUDZU IN ALABAMA, HISTORY, USES AND CONTROL 2 (1999), available at <http://www.srs.fs.usda.gov/pubs/2341>.

¹⁸ Irwin N. Forseth & Anne F. Innis, *Kudzu (Pueraria montana): History, Physiology, and Ecology Combine to Make a Major Ecosystem Threat*, 23 CRITICAL REV. PLANT SCI. 401, 402 (2004) (citations omitted).

¹⁹ See *id.*

²⁰ T. Ombrello, *Plant of the Week: Kudzu*, <http://faculty.ucc.edu/biology-ombrello/POW/kudzu.htm> (last visited Nov. 9, 2012).

²¹ *Id.*

²² Forseth & Innis, *supra* note 18, at 403.

²³ See *id.* at 402.

²⁴ See Richard J. Blaustein, *Kudzu’s Invasion into Southern United States Life and Culture*, in THE GREAT RESHUFFLING: HUMAN DIMENSIONS OF INVASIVE SPECIES 55, 56–57 (J. A. McNeely ed., 2001); Karen Ray, *Are Biofuel Crops the Next Kudzu?*, 17 SAN JOAQUIN AGRIC. L. REV. 247, 247 (2007).

²⁵ Energy Policy Act of 2005, Pub. L. No. 109-58, § 1501 119 Stat. 594, 1067 (2005) (originally codified at 42 U.S.C. § 7545(o)).

²⁶ Pub. L. No. 110-140, § 202 121 Stat. 1492, 1521, (2007) (originally codified at 42 U.S.C. § 7545(o)(2)).

²⁷ See *id.*

to a variety of soils and climatic conditions, a strong resistance to plant pests and diseases, and a lack of predators in the recipient ecosystem—traits shared by many common invasive plants.²⁸ Yet, current wide-spread invasions of animal and plant species, such as the Asian carp and kudzu, serve as glaring warnings of what an uninformed rush to proliferate invasive biofuel feedstocks might look like. Thus, we must ask whether our regularly system is properly prepared to meet federal biofuel mandates and address the potentially invasive nature of emerging biofuel feedstocks.

To some degree, the United States' federalist system of government allows species invasion to occur due to states' differing interests and regulatory focuses. Traditionally recognized as being more capable of handling local issues, states have sovereign authority to enact laws for the health, benefit, and welfare of their citizens—a principle known as subsidiarity.²⁹ Under this principle, “where families, neighborhoods, churches, or community groups can effectively address a given problem, they should. Where they cannot, municipal or state governments should intervene. Only when the lower bodies prove ineffective should the federal government become involved.”³⁰ Invasion ecology harmonizes with this premise—as there are many factors involved invasive plant species determination, such as soil composition,³¹ climate conditions,³² natural predators,³³ and others³⁴—recognizing that an invasive plant may not be invasive in all conditions.

The United States, due to its large landmass and wide geographical and topographical variation, has numerous climate zones and soil compositions.³⁵ In combination with climatic realities, geo-political boundaries assist in fixing several different ecological systems within state

²⁸ Jacob N. Barney & Joseph M. DiTomaso, *Nonnative Species and Bioenergy: Are We Cultivating the Next Invader?*, 58 *BIOSCIENCE* 64, 64 (2008); Joseph M. DiTomaso et al., *Biofuel vs. Bioinvasion: Seeding Policy Priorities*, 44 *ENVTL. SCI. & TECH.* 6906, 6907 (2010).

²⁹ See generally Robert K. Vischer, *Subsidiarity as a Principle of Governance: Beyond Devolution*, 35 *IND. L. REV.* 103 (2001) (discussing the benefits and limitations of subsidiarity—i.e., “bottom-up” governance to address societal problems).

³⁰ *Id.*

³¹ Jacob N. Barney & Joseph M. DiTomaso, *Bioclimatic Predictions of Habitat Suitability for the Biofuel Switchgrass in North America under Current and Future Climate Scenarios*, 34 *BIOMASS & BIOENERGY* 124, 125–26 (2010).

³² See *id.* at 130; Blaise Petitpierre et al., *Climatic Niche Shifts Are Rare Among Terrestrial Plant Invaders*, 335 *SCIENCE* 1344, 1347 (2012) (finding that invasive species rarely range outside their climatic zones).

³³ Caroline V. Myers & Roger C. Anderson, *Seasonal Variation in Photosynthetic Rates Influence Success of an Invasive Plant, Garlic Mustard (Alliaria petiolata)*, 150 *AM. MIDLAND NATURALIST*, 231, 232 (2003); Nat'l Invasive Species Info., U.S. Dep't of Agric., Ctr., *Plants*, <http://www.invasivespeciesinfo.gov/plants/main.shtml> (last visited Nov. 9, 2012) [hereinafter *USDA, Plants*].

³⁴ See Nat'l Invasive Species Info. Ctr., *supra* note 33 (“[A]daptability, aggressive[ness], and . . . high reproductive capacity. . . combined with a lack of natural enemies often leads to outbreak populations [of invasive plant species].”).

³⁵ See A. MILBRANDT, NAT'L RENEWABLE ENERGY LAB., *TECH. RPT. NREL/TP 560-39181, A GEOGRAPHIC PERSPECTIVE ON THE CURRENT BIOMASS RESOURCE AVAILABILITY IN THE UNITED STATES* 3 (2005), available at <http://www.afdc.energy.gov/pdfs/39181.pdf>.

boundaries.³⁶ A recent study identified nearly 600 different ecological systems for the United States,³⁷ where more than one state possessed in excess of 100 unique ecological systems within its borders.³⁸ The rich diversity of these ecological systems results in many different habitats with unique traits.³⁹ These “ecoregions”⁴⁰ have several distinct ecological systems that share many of the species, communities, and environmental conditions contained within them.⁴¹ Aggressive invasive plant species have the ability to adapt to many different ecoregions by generating monocultures through rampant propagation and by outcompeting native species.⁴² However, not all invasive plant species are suited or adaptable to every ecosystem⁴³ and, to some extent, the ecological composition of the system acts as a natural defense against these invasive species.⁴⁴ Because of the broad variations of soil, climate, elevation, and other variables, an “invasive plant” in one region may not constitute a problem in another region of the same state. Thus, the principle of subsidiarity would suggest that the localities threatened by the invasive plant species should provide their best efforts to control local problem species before the state should assist (e.g., through local ordinances and preventive measures).⁴⁵ However, where a particular plant species poses a risk throughout the entire state and local efforts are ineffective, state legislation and enforcement would be necessary. Where a plant species poses a risk throughout the entire United States, federal regulations and cooperation should be forthcoming.

The U.S. legal system, developed more than 250 years ago, initially began under the premise that sovereignty is split between several state governments and a national government. Under the U.S. Constitution, the citizens of the newly formed nation granted certain enumerated powers to the federal government,⁴⁶ while non-delegated powers remained with the states or the people.⁴⁷ Reserving plenary power, states had authority to

³⁶ See, e.g., PATRICK COMER ET AL., NATURESERVE, ECOLOGICAL SYSTEMS OF THE UNITED STATES: A WORKING CLASSIFICATION OF U.S. TERRESTRIAL SYSTEMS 23 (2003), available at <http://www.natureserve.org/library/usEcologicalsystems.pdf>.

³⁷ See *id.* at 3. It should be noted that the study did not cover the entire area of Alaska, and it is unclear how many more climate zones, if any, would have been created as a result of entire inclusion. *Id.*

³⁸ See *id.* at 26 fig.6.

³⁹ See *id.*

⁴⁰ *Id.* at 29 (“Ecoregions are regional landscapes, or relatively large areas of land and water defined by similar geology, landforms, climates and ecological processes.”).

⁴¹ *Id.*

⁴² See, e.g., *supra* note 28 and accompanying text.

⁴³ See Petitpierre et al., *supra* note 32, at 1347 (noting that climate has a statistically significant correlation to species invasion); see also Barney & DiTomaso, *supra* note 30, at 131–32.

⁴⁴ See Barney & DiTomaso, *supra* note 31, at 131–32 (concluding that switchgrass would not likely adapt to western North America without irrigation methods to help it grow).

⁴⁵ See Vischer, *supra* note 29, at 105.

⁴⁶ See U.S. CONST. art. I, § 8 (enumerating legislative powers); see also John B. Attanasio, *Federalism in the United States: Basic Elements and Chances for Survival*, 1995 ST. LOUIS-WARSAW TRANSATLANTIC L.J. 121, 126–27 (noting limitations on federal powers).

⁴⁷ U.S. CONST. amend. X (“The powers not delegated to the United States by the Constitution, nor prohibited by it to the States, are reserved to the States respectively, or to the people.”).

create, enforce, and rule upon the legitimacy of laws through their own independent state constitutions and laws.⁴⁸ Yet, the power of each state could only reach so far, due to the supremacy of the Constitution and the need to create a cohesive, united people.⁴⁹ In the hundreds of years that have passed, the federalist system has undergone major changes. Two different political theories have had a heavy influence on the development of U.S. federalism: dual federalism⁵⁰ and cooperative federalism.⁵¹ Dual federalism takes the approach that the state and federal governments are co-equal in authority,⁵² that states hold plenary powers, and that the federal government is limited to those powers enumerated in the Constitution.⁵³ Alternatively, cooperative federalism suggests that the federal government is supreme, but that national, state, and local governments should work together cooperatively and in harmony to overcome common challenges.⁵⁴ Regardless of the ascribed theory of federalism, the reality remains that states maintain authority to pass laws and regulations for the health, benefit, and welfare of their citizens.⁵⁵ Many commentators have called attention to the idea that differing state regulation and laws leads to a “patchwork” of regulations and generates regulatory inconsistencies and inefficiencies.⁵⁶ The criticism, to some extent, is not without merit, but in some cases the ability for states to generate their own laws and regulations allows them to tailor laws to their unique interests and the needs of their citizens.⁵⁷ Our empirical analysis in Part II, however, indicates that this fragmented set of state laws cannot be

⁴⁸ See Attanasio, *supra* note 46, at 126–27 (“Only federal laws duly enacted under Congress’s Article I, § 8 powers preempted state laws.”)

⁴⁹ See Harry N. Scheiber, *Federalism and the Constitution: The Original Understanding, in AMERICAN LAW AND THE CONSTITUTIONAL ORDER: HISTORICAL PERSPECTIVES* 85, 86–88 (Lawrence M. Friedman & Harry N. Scheiber eds., 1988).

⁵⁰ See generally Norman R. Williams, *The Commerce Clause and the Myth of Dual Federalism*, 54 UCLA L. REV. 1847 (2007); Roderick M. Hills, Jr., *The Political Economy of Cooperative Federalism: Why State Autonomy Makes Sense and “Dual Sovereignty” Doesn’t*, 96 MICH. L. REV. 813 (1998).

⁵¹ See generally Hills, *supra* note 50; Michael S. Greve, *Against Cooperative Federalism*, 70 MISS. L.J. 557 (2000).

⁵² See Williams, *supra* note 50, at 1849–50.

⁵³ *Id.*

⁵⁴ See Hills, *supra* note 50, at 858–91 (advocating the benefits of cooperative federalism).

⁵⁵ Attanasio, *supra* note 46, at 129 (citing cases where states used “legitimate health and safety reasons” to validly pass laws that were outside the scope of federal commerce and dormant commerce clause powers).

⁵⁶ Several legal commentators have pointed out that differences in state and federal regulation generate inconsistent and unpredictable morasses of law in several different fields. See, e.g., J.R. DeShazo & Jody Freeman, *Timing and Form of Federal Regulation: The Case of Climate Change*, 155 U. PA. L. REV. 1499, 1515–16 (2007) (noting that frustrations over “heterogeneous” state greenhouse gas regulations have prompted the U.S. manufacturing industry to advocate for federal preemption); Chad M. Pinson & John B. Lawrence, *FCRA Preemption of State Law: A Guide Through Muddy Waters*, 15 J. CONSUMER & COM. L. 47, 48 (2012) (discussing the Fair Credit Reporting Act’s goal of creating a uniform national standard so that “companies [would] not have to comply with a patchwork of State laws”) (internal citations omitted).

⁵⁷ See Attanasio, *supra* note 46, at 123 (pointing out how state versatility allows laws to be structured to address the particular needs of a region).

adequately described as a “patchwork quilt” at all—as that would suggest some respectable amount of coverage—but, perhaps more correctly, as a collection of fabric scraps in search of a seamstress.

A. Federal Laws

Other than some recent initiatives to improve coordination, such as the 1999 Presidential Executive Order No. 13,112 that established the National Invasive Species Council (NISC),⁵⁸ the federal government’s regulation of invasive plant species can be characterized as reactive, incremental, piecemeal, and focused primarily on protecting agricultural productivity. In 1912, Congress passed the first federal regulatory program directed at invasive terrestrial plants—the Plant Quarantine Act (PQA).⁵⁹ The PQA established the Federal Horticultural Board—composed of representatives from the U.S. Department of Agriculture (USDA)’s Bureau of Entomology, the Bureau of Plant Industry, and the U.S. Forest Service—to develop rules for the importation of nursery stock into the United States, as well as quarantines and restrictive orders to control agricultural pests such as the corn borer and bollworm.⁶⁰ The Act explicitly exempted, however, many potentially invasive mediums, including field, vegetable and flower seeds, bulbs, roots, and bedding plants.⁶¹ Although not directed *per se* at invasive plants, Congress’s next major attempt at protecting agricultural productivity was the 1957 Federal Plant Pest Act (FPPA).⁶² This legislation expanded USDA’s jurisdiction beyond potentially harmful nursery stock to encompass all potential plant pests.⁶³ This would include plant diseases, parasites, insects, and other pestilences that damage or cause disease in plants. The FPPA, however, did not include plants themselves (with the exception of parasitic plants⁶⁴) as among the potentially damage-causing organisms. Again, the underlying motivation for this statute was the protection of agricultural productivity.⁶⁵

It was not until 1974, when Congress passed the Federal Noxious Weed Act (FNWA),⁶⁶ that the federal government instituted a regulatory program that explicitly considered the potential negative ecological impacts of plants,

⁵⁸ Exec. Order No. 13,112, 3 C.F.R. 159 (1999).

⁵⁹ Act of Aug. 20, 1912 (Plant Quarantine Act), ch. 308, Pub. L. No. 62-275, 37 Stat. 315 (originally codified at 7 U.S.C. §§ 151–164a, 167), *repealed by* Plant Protection Act, Pub. L. No. 106-224, § 438(a)(1), 114 Stat. 358, 454 (2000) (a part of the Agricultural Risk Protection Act of 2000).

⁶⁰ Plant Quarantine Act § 12.

⁶¹ *Id.* § 6.

⁶² Federal Plant Pest Act, Pub. L. No. 85-36, 71 Stat. 31 (1957) (originally codified at 7 U.S.C. §§ 150aa–150jj), *repealed by* Plant Protection Act § 438(a)(2).

⁶³ *Id.* § 106.

⁶⁴ *Id.* § 102(c).

⁶⁵ *See* 103 CONG. REC. 5537 (1957) (statement of Rep. Kenneth A. Roberts). Discussing the Federal Plant Pest Act, Mr. Roberts stated: “The bill now before us simply fills the gap which has existed for a number of years in the authority of the Department of Agriculture to protect American agriculture against invasion by foreign plant pest and disease.” *Id.*

⁶⁶ Federal Noxious Weed Act of 1974, Pub. L. No. 93-629, 88 Stat. 2148 (1975) (originally codified at 7 U.S.C. §§ 2801–2813), *repealed by* Plant Protection Act § 438(a)(4).

whether intentionally or unintentionally released into the environment. As a complement to existing USDA authority under the PQA and FFPA, the statute defined “noxious weeds” as plants that can directly or indirectly injure agriculture, navigation, fish or wildlife resources, or public health.⁶⁷ Under this statute, USDA had the authority to develop a federal Noxious Weed List to prevent the introduction or dissemination of harmful species in the United States.⁶⁸ Persons may not move listed noxious weeds into or through the United States without a permit from USDA.⁶⁹

Enacting the Plant Protection Act of 2000 (PPA),⁷⁰ Congress repealed the PQA, FFPA, and FNWA, consolidating USDA authority over noxious weeds and plant pests into a single statute.⁷¹ Taking a slightly different tone than the laws it replaced, the PPA revised the original definition of noxious weed to include injury to the “environment.”⁷² As noted above, once included on the federal Noxious Weed List, the government prohibits transporting or otherwise shipping listed plant species within the United States. Despite the benefit of limited movement, the statute fails to provide authority to order removal or remediation of already established noxious weeds on private land, and lacks the power to stop the movement of noxious weeds entirely within a state.⁷³ In other words, the PPA focuses on preventative measures to prohibit further spread of noxious weeds, but does not require eradication of established invasive plant species. Moreover, species are generally not included on the federal Noxious Weed List until well-established in the United States and documented problems have been identified.⁷⁴ In 2004, an amendment to the PPA authorized financial and technical assistance to state and local agencies to control or eradicate established weeds;⁷⁵ however, funding for this program has been sparse, making it relatively ineffective.

In total, thirteen federal departments and agencies exercise some measure of authority over invasive species (plant and animals), but USDA has primary accountability for invasive plant species control at the federal level.⁷⁶ To spearhead multi-agency efforts, Executive Order No. 13,112 established the National Invasive Species Council.⁷⁷ From a legal

⁶⁷ Federal Noxious Weed Act of 1974, § 3(c).

⁶⁸ *Id.* § 10; 7 C.F.R. § 360.200 (2012) (designating certain plant species as noxious weeds).

⁶⁹ Federal Noxious Weed Act of 1974, § 4(a).

⁷⁰ Plant Protection Act § 438 (codified at 7 U.S.C. §§ 7701–7772 (2000)).

⁷¹ 7 U.S.C. § 7758(a) (2000).

⁷² *Id.* § 7702(10).

⁷³ AVIVA GLASER & PATTY GLICK, NAT’L WILDLIFE FED’N, GROWING RISK: ADDRESSING THE INVASIVE POTENTIAL OF BIOENERGY FEEDSTOCKS 28 (2012), available at <http://www.nwf.org/~media/PDFs/Wildlife/Growing%20Risk-2-FINAL-LOW-RES.ashx>.

⁷⁴ David M. Lodge et al., *Biological Invasions: Recommendations for U.S. Policy and Management*, 16 ECOLOGICAL APPLICATIONS 2035, 2039 (2006). The authors note that there are some cases of preventing species introduction altogether, but reaction is much more often the case.

⁷⁵ Noxious Weed Control and Eradication Act of 2004, Pub. L. No. 108-412, § 1, 118 Stat. 2320 (codified at 7 U.S.C. § 7782 (2006)) (authorizing funding through USDA grants).

⁷⁶ 7 U.S.C. §§ 7711–7712, 7714–7715 (2006); see Nat’l Invasive Species Res. Ctr., U.S. Dep’t of Agric., *Resource Library: Agencies and Organizations*, <http://www.invasivespeciesinfo.gov/resources/orgfed.shtml#UKQK1Zh2PNo> (last visited Nov. 14, 2012).

⁷⁷ Exec. Order No. 13,112, 3 C.F.R. 159 (1999).

perspective, the Executive Order prohibits agencies from funding, authorizing, or otherwise carrying out actions that are likely to cause or promote the introduction or spread of invasive species.⁷⁸ This could include federal subsidies directed to bioenergy crops possessing invasive characteristics.⁷⁹ For example, the Biomass Crop Assistance Program (BCAP), established as part of the 2008 Farm Bill to provide assistance for farms converting to biomass crops, prohibits USDA payments for the use of any plant that is, or has the potential to become, noxious or invasive.⁸⁰ Of course, what may be invasive in one region or ecosystem of the United States may not be a threat in other areas. The variability of climatic conditions across the United States, and the attendant invasive potential of particular plant species, argues for a state- or regional-based regulatory system to tailor plant restrictions to growing conditions. As discussed below, each state has a noxious weed/invasive plant regime that works in parallel with the federal Noxious Weed List promulgated pursuant to the PPA. Our empirical research, however, has brought into serious question the effectiveness of these programs.⁸¹ In the following section we provide a brief overview of the state regulatory system.

B. State Laws

In order to propose a certain level of systemic change, it is important to review how we acquired such a heavy emphasis on agricultural weeds, and an almost complete disregard for invasive species. The residual emphasis on agricultural weeds is a product of the historical development of the extant regulatory systems. Until the mid-nineteenth century, settlers and lawmakers paid little attention to weeds, perhaps viewing them as a part of the rugged agrarian lifestyle that supported more than 90% of the population.⁸² However, as industrialization occurred during the mid- to late-1800s, nascent regulatory measures related to weeds began to appear.⁸³ Many original laws couched regulations for noxious weeds within one or more of the sections of their codes in an effort to effectively regulate noxious weed transportation corridors.⁸⁴ With such a large portion of the

⁷⁸ *Id.*

⁷⁹ GLASER & GLICK, *supra* note 73, at 29.

⁸⁰ Food, Conservation, and Energy Act of 2008 (2008 Farm Bill), Pub. L. No. 110-246, § 9001, 122 Stat. 1651 (codified as amended at 7 U.S.C. § 8111 (Supp. V 2012)).

⁸¹ See generally Quinn et al., *supra* note 1, at 125–26.

⁸² See Max Borders & H. Sterling Burnett, *Farm Subsidies: Devastating the World's Poor and the Environment*, NAT'L CTR. FOR POLICY ANALYSIS, Mar. 24, 2006, available at http://heartland.org/sites/all/modules/custom/heartland_migration/files/pdfs/20096.pdf.

⁸³ See, e.g., CONN. GEN. STAT. tit. XII, §§ 1–4 (1839); COMPILED GEN. L. FLA. § 2958 (1927) (citing to the Acts of the State of Florida, ch. 1688, § 14 (1869)).

⁸⁴ For example, in Michigan and Kansas, statutes controlling highway systems hold specific strictures for noxious weeds. See, e.g., HOWELL'S ANN. STAT. MICH. § 2478 (1913); KAN. REV. STAT. ch. 2, art. 13 (1923) (revising the Kansas Laws of 1895). Iowa and Indiana have regulatory laws for noxious weeds located in their railway statutes. See, e.g., IOWA CODE tit. 16, ch. 3, § 5168 (1919) (citing the supplement of the 1913 IOWA CODE, § 2110-i); IND. CODE, ch. 41, art. 7, §§ 5563–

population reliant upon agriculture for their financial and nutritional well-being, it is understandable that legislatures would pass laws to protect agrarian commodities from any known threats through their codes of agriculture. Codification of noxious weed regulations in the railroad or highway codes may initially seem surprising. However, once consideration is given to potential dispersal vectors for the regulated species,⁸⁵ the relevance to agricultural concerns becomes evident. Animals and people traveling through roadways would easily pick up thistles and burrs, carrying propagating seeds home to the farm. As homesteading and farming reached further and further west, so too did the arm of the railways. These “iron horses” shipped commodities to urban centers and eventually to further markets, dropping noxious seeds at various points along the tracks.⁸⁶ Regardless of where in the statutes the weed regulation appeared, the underlying purpose was to protect agriculture.⁸⁷ Beyond the seed regulations, most states had very little noxious weed regulation occurring until the mid-1970s or later, and most regulations had little to do with invasive plant species outside of agricultural contexts.⁸⁸ Principally, only those species that constituted a nuisance in managed systems were regulated by state law, while the fact that some listed species happened to also be invasive in non-agricultural systems went unnoticed.

As noted above, at the state level, noxious weed laws date back more than 100 years.⁸⁹ In the early 1900s, states began to enact laws designed to protect agriculture from particularly noxious weeds, such as creeping thistle (*Cirsium arvense*), prickly saltwort (*Salsola kali*), and prickly Russian thistle

5564 (1897). Most states, however, placed noxious weed regulation in their agricultural codes. See, e.g., N.C. REV. STAT. § 3901 (1905) (citing to the North Carolina Laws of 1897).

⁸⁵ Dispersal vectors are those ways in which plants regenerate. See generally Pascal Vittoz & Robin Engler, *Seed Dispersal Distances: A Typology Based on Dispersal Modes and Plant Traits*, 117 *BOTANICA HELVETICA* 109 (2007) (noting that dispersal vectors include wind, animals, and other means). Many of the early state laws desired to limit the human vector of seed and plant dispersal, and therefore regulated seed laws and transportation corridors, in order to avoid noxious weed infestations.

⁸⁶ Jacob N. Barney, *North American History of Two Invasive Plant Species: Phytogeographic Distribution, Dispersal Vectors, and Multiple Introductions*, 8 *BIOLOGICAL INVASIONS* 703, 714–15 (2006) (detailing how railroad rights of way have a tendency to distribute invasive plant species).

⁸⁷ During the first half of the twentieth century, most states developed their seed laws. See, e.g., CONN. GEN. STAT. § 496h (Supp. 1945); FLA. STAT., ch. 578, §§ 578.01–578.20 (1942); IOWA CODE tit. 13, ch. 246.1, § 4829.01 (1939); IND. STAT. ANN. § 15-802 (1950) (identifying a 1941 amendment to the original 1934 weed seed law); cf. REV. L. HAW. ch. 37, § 522 (1915) (Hawaii was not a state at this time). Meanwhile, as noted earlier in the text, the federal government initiated its first attempts to protect American agriculture from foreign importation of invasive plants. See Plant Quarantine Act, Pub. L. No. 62-275, 37 Stat. 315 (1912) (originally codified at 7 U.S.C. §§ 151–164a, 167) *repealed by* Agricultural Risk Protection Act of 2000, Pub. L. No. 106-224, 114 Stat. 358). Again, the laws primarily protected farmers and their agricultural commodities by preventing adulterated seed above a certain specified threshold from being sold and eventually planted in their fields. See, e.g., GLASER & GLICK, *supra* note 73, at 26–33.

⁸⁸ See *supra* note 85.

⁸⁹ See *supra* notes 82–84 and accompanying text; see also NEIL E. HARL, *AGRICULTURAL LAW* § 11.02, at 11-3 to 11-4 (Matthew Bender & Co. Inc., 2010).

(*Salsola tragus*).⁹⁰ Under these early state laws, landowners had a duty to eradicate these species from their property, as well as adjacent public transportation corridors.⁹¹ This duty extended to owners of railroad easements—a common entry point for the establishment of noxious weeds due to the initial disruption of the native ecosystem and subsequent uncultivated nature of the land.⁹²

Legal approaches to noxious weeds regulation at the state level gradually evolved,⁹³ with legislatures delegating power to designate noxious weeds via an administrative system.⁹⁴ While administrative agencies in most

⁹⁰ *E.g.*, Act of Feb. 28, 1867 § 1, 1867 Ill. Laws 79 (prohibiting *Cirsium arvense*, *Salsola kali*); Act of Apr. 16, 1870, ch. 177, 1870 Iowa Acts 224 (prohibiting *Cirsium arvense*, *Salsola kali*); COBBEY'S NEB. ANN. STAT. §2331 (1909) (prohibiting *Cirsium arvense*); CODE & STAT. MONT., tit. 16, §§ 1197–1200 (1895) (prohibiting *Cirsium arvense*, *Salsola tragus*); Act of Apr. 30, 1877, § 1, 1877 Ohio Laws 144 (prohibiting *Cirsium arvense*, *Salsola kali*); TEX. PENAL CODE ANN. tit. 17, ch. 3, arts. 1359–60 (1925) (prohibiting *Salsola tragus*). Prior to states enacting statutes to protect the value of farm commodities, protection from invasive plant species was found exclusively in the common law. HARL, *supra* note 89, at § 11.01, p. 11-1. The common law held that without some willful conduct or active negligence, landowners would not be liable for the spread of noxious weeds onto the property of another. *Id.* In other words, between neighbors, natural spread of noxious weeds did not give rise to a cause of action at law. This common law position followed as a remnant from English courts, which refused to extend the strict liability doctrine of *Fletcher v. Rylands* to invasive plants. *Id.* § 11.02, pp. 11-3 to 11-4 (citing *Fletcher v. Rylands*, 159 Eng. Rep. 737 (H.L.) [1865] (appeal taken from Exch.)).

⁹¹ Statutory language indicates that these states were likely concerned with potential weed invasions that could harm agricultural commodities. *See, e.g.*, Act of Feb. 28, 1867, § 1, 1867 Ill. Laws 79 Statutes would then outlaw the growth of these weeds on both public and private lands. HARL, *supra* note 89, at § 11.03[1], p. 11-7. Highway or county road commissioners often had the mandate to eradicate all weeds under their control on public lands, and were usually given the authority by statute to enter onto private property where landowners failed to comply. *Id.* § 11.03[2][d], p. 11-12; *see also* Act of Mar. 15, 1872, 1872 Ill. Laws 210 (creating a “Commissioner of Canada Thistle” and granting the Commissioner the power to enter onto property to eradicate the weed). Some states provided that private landowners had the responsibility to not only get rid of their own weeds, but also all weeds that grew on land bordering streets, roads, or highways. HARL, *supra* note 89, at § 11.03[1][a], p. 11-8. If the landowner failed to remove weeds, then the commissioners, upon proper notice, could enter the private land to eradicate the weeds of the private landowner. *Id.* at 11-9. The landowner would then have to reimburse the county or highway commissioner for the cost of eradicating those weeds; if the landowner failed to pay, then the cost could be assessed as a tax lien against the property. *Id.*

⁹² *See, e.g.*, IOWA CODE § 5168 (1919).

⁹³ In 1911, some states and territories had detailed lists regarding which weeds would be considered noxious. For example, in Hawaii, a U.S. territory at the time, the list included almost 30 weeds. *See* REV. L. HAW. § 522 (1915). In that era, Hawaii's concern over noxious weeds was practically unparalleled by actual states. However, such exuberance over noxious weeds was not a normal occurrence, and most states had fewer than 10 regulated weeds on their statutes.

⁹⁴ As early as 1943, state agricultural commissions or agencies had the power to list noxious plant species. *See, e.g.*, N.C. GEN. STAT. §§ 106-278, 107-279 (1944). For example, one of these early transfers transpired in North Carolina, where the Board of Agriculture specifically had the power to declare noxious weeds. *Id.* Typically though, early grants of authority rarely led to any promulgation of noxious weed lists despite authorization (e.g., North Carolina's administrative agency did not name any plant species until 1991, *see* 2 N.C. ADMIN. CODE 48A.1702 (1991)). This changed as administrative agencies grew in prominence in the 1960s, 1970s, and 1980s. As the federal administrative state doubled in size, state agencies had a tendency to mirror that growth. *See* Veronique de Rugy & Melinda Warren, *Expansion of*

states⁹⁵ now possess authority to add species to their respective state noxious weed list,⁹⁶ effective enforcement of state weed control laws on private property remains variable, and there is generally no civil liability for the spread of weeds onto an adjacent landowner's property.⁹⁷ Accordingly, there is minimal economic incentive for individual landowners to control invasive plant species absent an impact on their own agricultural activities.

The federal Noxious Weed List includes eighty-seven terrestrial plant species.⁹⁸ Parallel state-level noxious weed lists include more than 620 plant species.⁹⁹ While the sheer number of regulated plant species may seem rather large, this multi-jurisdictional approach to noxious weed regulation leaves many terrestrial invaders largely unregulated at both the state and federal levels, as these harmful plant species often are not included on federal or state noxious weed lists. Although state and regional invasive plant councils (IPCs)—usually composed of weed ecologists, land managers, and other stakeholders—have the scientific competence to identify potential invasive plant species within their jurisdictions, the councils rarely are empowered by the state government to include these species on the state's noxious weeds list.¹⁰⁰ Moreover, much like federal laws, lists at the state level continue to be highly reactive—listing species only after significant damage to agricultural production or the environment has occurred,¹⁰¹ and thus with exponentially increased remediation costs.¹⁰²

In a cooperative federalism scheme, the battle against invasive plant species depends upon the active participation of both state and federal governments. Perhaps in an ideal world, local governments would easily

Regulatory Budgets and Staffing Continues in the New Administration: An Analysis of the U.S. Budget for Fiscal Years 2009 and 2010, REGULATORS' BUDGET RPT. 31, Oct. 2009, at 3–11, available at <http://mercatus.org/sites/default/files/publication/Regulators-Budget-Report-Final-Version-October-29.pdf>; HARL, *supra* note 89, at § 11.03[2], p. 11-10 (citing NEB. REV. STAT. § 2-945.53(3) (removing statutory weed control, and transferring listing and de-listing authority to state Director of Agriculture)).

⁹⁵ At least 39 states possess this feature, with state agricultural or state natural resources departments holding listing authority. See Quinn et al., *supra* note 1, at Supplemental Material, tbl.2; see also GLASER & GLICK, *supra* note 73, at 29.

⁹⁶ For a discussion of different typologies in state regulation of noxious weeds, see discussion *infra* Part II.B.

⁹⁷ HARL, *supra* note 89, at § 11.03, p. 11-13. Significantly, American state courts have avoided strict liability for weeds under the premise that they were a “natural condition,” even if the land owner had “unnaturally” transplanted the weeds on their property. See, e.g., *Vance v. S. Kan. Ry. of Tex.*, 152 S.W. 743 (Tex. Civ. App. 1912). Courts in the U.S. have been very reluctant to allow recovery for the spread of noxious weeds, even under the theory of nuisance. HARL, *supra* note 89, at § 11.02, p. 11-5. Due to the failure of the common law at providing a remedy for the spread of noxious plants, most states enacted statutes that provided an affirmative duty on the part of land owners to destroy weeds and other noxious vegetation growing on their land. *Id.* However, despite the affirmative duty to get rid of the noxious plant, statutes provided no civil action for resulting damages. *Id.*

⁹⁸ 7 C.F.R. § 360.200(c) (2012).

⁹⁹ Quinn et al., *supra* note 1, at 125.

¹⁰⁰ *Id.*

¹⁰¹ See *id.*

¹⁰² See Pimentel et al., *supra* note 4, at 54, tbl.1 (listing the costs associated with noxious weed control and remediation).

identify and swiftly prevent plant invasions, eradicating plant species threatening economic and ecologic harm to local interests. At each governmental level—with perfect coordination between local, state, and federal governments—authorities would regulate and eradicate plant species in those areas where invasive plants actually constitute threats prior to naturalization. Unfortunately, we do not live in that idealized world. Our empirical research demonstrates that many states have failed to address the growing concern of invasive terrestrial plant species, which, under the principles of federalism and subsidiarity, ought to affect timely state and federal action in order to protect their respective interests.¹⁰³

While more than 700 plant species are regulated to some degree within the United States,¹⁰⁴ state noxious weeds lists only included, on average, 19.6% of species considered to be invasive in their jurisdiction by corresponding state invasive plant councils.¹⁰⁵ Moreover, our data indicated that the current regulatory processes of several states largely neglect proactive approaches in the fight against invasive plant species, focusing instead on many species not considered invasive in non-agricultural systems.¹⁰⁶ In other words, states underregulate known invaders and may overregulate many plants without invasive potential. However, some of these weeds may nonetheless warrant listing to protect agricultural interests. Just how many deserve listing is the subject of ongoing evaluation. Our research further revealed that although states have known of the impact that certain plant species have had on their livelihoods for more than 100 years, state action is typically reactive and laws regulating problematic plant species have been stagnant.¹⁰⁷

Given the surprisingly poor indices revealed through our empirical analysis, we extended our initial inquiry to analyze whether the structural composition of some state regulatory regimes respond better to the threats posed by invasive plant species than others.¹⁰⁸ To assist us in our evaluation, we identified three major typologies present across the fifty states: 1) the level of government holding authority to trigger the legislative or rulemaking process;¹⁰⁹ 2) the branch of government responsible for creating and maintaining the noxious weeds list;¹¹⁰ and 3) the state agency with

¹⁰³ See discussion *infra* Part II.A.3.

¹⁰⁴ See Quinn et al., *supra* note 1, at 125.

¹⁰⁵ *Id.*

¹⁰⁶ See *id.* at Supplemental Material, fig.2 (describing latency).

¹⁰⁷ Compare HART, *supra* note 8, at § 11.01, pp. 11-1 to 11-2 (describing reliance on common law, instead of existing weed control statutes, to address damages from spread of noxious weeds), with Quinn et al., *supra* note 1, at 125–26 (noting that historically, noxious weed statutes addressed threats to agriculture, public health, or rights of way – i.e. in managed systems).

¹⁰⁸ See Quinn et al., *supra* note 1, at 125–26.

¹⁰⁹ The first typology was used as a way to gauge whether the local levels had increased capacity under a bottom-up approach, or whether the states managed ecosystems better by providing a top-down regime. See *id.* at 125.

¹¹⁰ The second typology was a determination to identify whether legislative bodies or administrative bodies had a statistically significant impact on the number of invasive species listed. See *id.*

enforcement authority.¹¹¹ Surprisingly, our analysis revealed that none of these regulatory typologies had a statistically significant influence on the management of invasive plant species.¹¹²

Part II of this Article will discuss the empirical study in greater detail, laying out the methodologies, results, and implications. We will first outline the manner used to differentiate “noxious weeds” from “invasive plants,” and explain the significance of these two seemingly identical terms. Through our assessment, we were able to analyze and measure the efficacy of state regulatory responses to the threat of invasive species.¹¹³ We used the metric “fidelity” to evaluate a state’s responsiveness in updating its noxious weeds lists to reflect threats posed by invasive species.¹¹⁴ A high fidelity score indicates that a state has adopted regulations restricting most invasive plants in that jurisdiction. To further evaluate regulatory responsiveness, we used the metric “latency” to measure the correlation between the two groups of plant species—noxious weeds and invasive species.¹¹⁵ Although a state may have several regulated species on its noxious weeds list, it does not necessarily follow that those species are invasive in non-agricultural systems, but rather, it could indicate an erratic regulatory focus on non-invasive species.¹¹⁶ Accordingly, latency is a measure of the correlation between invasive species regulated in each state’s noxious weeds list and whether the state is unnecessarily regulating a large number of plants that plant ecologists do not deem invasive.¹¹⁷ An ideal noxious weed list, therefore, would then be one with both high fidelity and low latency.

After illustrating these metrics and regulatory typologies through the lens of several states, we conclude that despite the optimistic potential exhibited by a few high performing states, on balance, current regimes are not working and reform is necessary to address these regulatory shortfalls.

In light of both our regulatory survey and the urgency behind the biofuel mandates of the federal government’s renewable fuel standards, and after having concluded that there is most likely a verifiable agricultural-commodity bias to the listing of plant species embedded within several state and federal regulations, in Part III we proffer recommendations as to how to reformulate the regulatory system. We identify weaknesses in the current federal and state regimes and discuss how to improve the preventive orientation of invasive plant species regimes, focusing on the benefits of

¹¹¹ For example, the state agricultural or natural resources department, or where there was a showing of a bottom-up approach, the local county or municipal authority holding such power. *See id.*

¹¹² *See id.* at 125–26.

¹¹³ *See id.* at 124.

¹¹⁴ *See* Quinn et al., *supra* note 1, at Supplemental Material, 3–4.

¹¹⁵ *See id.* at Supplemental Material, 2–3.

¹¹⁶ Our latency metric provides no value judgment as to whether the listed plants should or should not be regulated. Rather, it measures the correlation between known invasive plant species in unmanaged (i.e., nonagricultural) systems and the current regulated list. There may well be several agricultural weeds deemed economically or agriculturally important, but not invasive, that should remain on noxious weeds lists. *See infra* notes 147–50 and accompanying text.

¹¹⁷ *See* Quinn et al., *supra* note 1, at Supplemental Material, 3.

injecting greater scientific input into state-regulated plant species lists.¹¹⁸ We also suggest structural changes to existing regulatory regimes to increase the correlation between regulated and invasive plant species—what we refer to as fidelity.¹¹⁹ We also submit that scientific advisory roles ought to be formalized to ensure the proper ecological perspective for both agricultural and non-agricultural ecosystems.¹²⁰ We further recommend that states move towards more cohesive definitions for addressing invasive plant species, because existing definitions of invasive plant species may partially contribute to regulatory uncertainty.¹²¹

Further, we propose a liability regime that could be easily adopted by states to redirect and internalize social costs generated by the introduction of invasive plant species.¹²² Specifically, we argue for a negligence regime, coupled with a statutory requirement for a weed risk assessment (WRA) process prior to introducing novel plant species.¹²³ This negligence regime proffers a sufficiently flexible means to address the major gaps in current federal and state laws, and to enhance long-term sustainability and adjustment.

II. AN EMPIRICAL ANALYSIS OF INVASIVE PLANT REGULATION

At the outset of our examination, we began with the hypothesis that the United States held an agricultural bias towards regulating plant species.¹²⁴ In order to empirically examine this hypothesis, we formulated a framework to test our underlying assumption.¹²⁵ First, we identified those species of plants regulated as noxious weeds and those plants recognized by ecologists as harmful invaders within those state jurisdictions. Second, we compared these lists using the metrics of latency and fidelity. Finally, we tested these metrics through our regulatory typologies of top-down versus bottom-up, legislative versus administrative, and the source of enforcement authority. Below, we describe the empirical study in more complete detail.

¹¹⁸ See *infra* Part III.A.1.

¹¹⁹ See *infra* Part III.A.1.

¹²⁰ See *infra* Part III.A.1.

¹²¹ See *infra* Part III A.2.

¹²² See *infra* Part III.B.

¹²³ See *infra* Part III.B.

¹²⁴ See generally HARL, *supra* note 89 (noting that the rising prominence of farming in the U.S. prompted states to eventually enact weed control statutes).

¹²⁵ See Quinn et al., *supra* note 1, at 124–25.

*A. Differentiating “Noxious” and “Invasive Plants”*¹²⁶

Ecologists often use the terms “noxious” and “invasive” interchangeably when discussing troublesome plant species,¹²⁷ but these terms are legally distinct.¹²⁸ The PPA defines “noxious weed” as “any plant or plant product that can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry, or other interests relating to agriculture, irrigation, navigation, natural resources, public health, or the environment.”¹²⁹ In addition to federal law, virtually every state has an independent statute defining noxious weeds within its borders.¹³⁰ On the other hand, the primary legal definition of “invasive species” comes from a presidential executive order, describing “invasive species” as “an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.”¹³¹ The executive order defines “alien species” as “mean[ing], with respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem.”¹³² This has led to further debate in the scientific community over how to define “native,” a subject that we touch on in Part III.A.1. In phase one of our study, we developed a database of all regulated species within each state.¹³³ Next,

¹²⁶ In our experiment we found that “noxious” and “invasive” were not mutually exclusive, when identifying plant species. To make a clear distinction, however, we determined that noxious weeds were those plant species that were banned under noxious weeds statutes or prohibited by some other means, while invasive plants were those that were found to be invasive by scientific groups. Therefore, it was possible to have a noxious weed that was also an invasive plant, owing to the regulations placed upon that plant species. *See id.* at 125.

¹²⁷ *See* Petr Pyšek & Philip E. Hulme, *Biological Invasions in Europe 50 Years After Elton: Time to Sound the Alarm*, in *FIFTY YEARS OF INVASION ECOLOGY: THE LEGACY OF CHARLES ELTON* 77 (David M. Richardson ed., 2011).

¹²⁸ For example, in Florida, “invasive plant” means a “naturalized plant that disrupts naturally occurring native plant communities,” FLA. STAT. ANN. § 581.011(15) (West Supp. 2012), while a “noxious weed” means “any living stage, including, but not limited to, seeds and reproductive parts, of a parasitic or other plant of a kind, or subdivision of a kind, which may be a serious agricultural threat in Florida or have a negative impact on the plant species protected under [section] 581.185.” *Id.* at § 581.011(19). While not every state defines invasive plant, this serves as an excellent example of how the terms do not mean the same thing, regardless of whether they are both regulated.

¹²⁹ Plant Protection Act, 7 U.S.C. § 7702(10) (2006).

¹³⁰ HARL, *supra* note 89, at §§ 11.1, 11.03[1], pp. 11-2, 11-6.

¹³¹ Exec. Order No. 13,112, 3 C.F.R. 159 (1999). Of note, the Executive Order has only limited effect of law. While it may, to some degree, have marginal legal impact on the rulemaking process, it does not hold anyone, beyond executive agencies, responsible for following its orders.

¹³² *Id.*

¹³³ Most states have regulated plant species under state laws having to do with agriculture, however, some have placed plant species control under natural resources, transportation, or other titles of their codes. Some have an eclectic combination, with smatterings of regulations throughout various titles, but they remain in the minority. *See* Quinn et al., *supra* note 1, at 125; *see, e.g.*, IOWA CODE ANN. §§ 199.1(16), 317.1A, 456A.37 (West Supp. 2012) (dealing with weeds in the Agriculture, Transportation, and Natural Resources sections of the code, respectively). Regardless of where the plant species was regulated in statutes or corresponding administrative codes, it was placed within the regulated or noxious category.

we further populated our database by identifying invasive plant species. Invasive plants, while sometimes also regulated, were more likely to be identified by non-governmental bodies—utilizing scientific determination and analysis—concerned with the environmental and ecological well-being of their state or region. Therefore, one logical distinction between noxious weeds and invasive plants included whether a scientifically-based analysis could identify the species as invasive. This is not to say that a regulated weed could not also be invasive, but rather that all weeds could potentially have a dual designation, one emanating from a governmental regulatory body (i.e., noxious) and another based on analysis by a non-governmental, scientific body (i.e., invasive). As a result, for purposes of our analysis, we determined that all plants regulated or controlled by governmental authority would be included in the term “noxious weed.”¹³⁴ “Invasive plants,” on the other hand, would be those included on either state or regional IPC lists.¹³⁵ To avoid artificial inflation of regulatory levels among the states, we removed from the database those species that were redundant with the federal noxious weed list.¹³⁶

Our analysis found that, on average, states regulate thirty-four plant species, while corresponding IPCs more than doubled that number with an average list of seventy-two plant species.¹³⁷ In the sections below we further discuss our findings.

1. Fidelity

To analyze the responsiveness of the regulatory regimes of the states, we compared the lists of both noxious weeds and invasive plants using the

¹³⁴ Quinn et al., *supra* note 1, at 125. To make the distinction more clear, we did not include those weeds that are part of state seed laws, due to the fact that most of these laws include both prohibited and restricted weeds, unless the statutory language regulating noxious weeds specifically indicated that such weeds were to be included.

¹³⁵ See *id.* at Supplemental Material, 5–6. As used in this Article, IPCs collectively refer to Invasive Plant Councils, Exotic Pest Plant Councils, and other non-governmental bodies specifically focused on invasive plant species. IPCs, mainly composed of scientists, researchers, land managers, and other weed interest groups, rarely have any regulatory authority to either name or list invasive plants. See *id.* However, they are involved in recording, monitoring, and synthesizing information on invasive plants. *Id.* As we further conducted our analysis, we found that identifying the invasive species lists was a little more difficult. If a state had an IPC, then the list of species maintained by that body was used. Where a state lacked an IPC, a regional IPC was used, but only if the regional IPC clearly identified invasive plant species for each state within the region. We did not include states where the regional IPCs did not distinguish where the plant species was invasive because we felt it would be unreasonable for a state to label a plant species as invasive if it has not been found to be invasive within state borders. If a particular state had no state or regional IPC, then lists created by a similar entity were used. We thereby included as many states as possible in our examination. However, we were unable to identify IPCs for nine states: Colorado, Iowa, Idaho, Kansas, Montana, North Dakota, New Mexico, Nevada, and South Dakota.

¹³⁶ Upon compiling our database, we then created three categories for each state and totaled the number of plant species in each category: 1) noxious species, 2) invasive species, and 3) species that the two lists had in common. Quinn et al., *supra* note 1, at 125.

¹³⁷ *Id.*

metrics of fidelity and latency.¹³⁸ Fidelity is a measure of state regulatory responsiveness to invasive plant species identified by scientific organizations within the respective jurisdiction (i.e., the degree to which a state listed a species on its noxious weed list).¹³⁹ States with high fidelity would be those that regulated many (or most) of the invasive plants identified by local scientific organizations, while a low fidelity score would indicate relatively few invasive plant species regulated as noxious weeds.¹⁴⁰ To arrive at a numerical value for fidelity we obtained the number of invasive plants (I) identified for a specific state and subtracted that number from the number of species that the noxious list (N) had in common (C), dividing that value by the number of invasive plants (I) in order to normalize it against other states. We subsequently subtracted that number from one (1) to reflect that a higher value was the desirable target.¹⁴¹ The resulting value was then multiplied by 100 for scaling purposes. Thus, fidelity was calculated in the following manner:

$$\text{fidelity} = (1 - ((I - C)/I)) * 100$$

To provide a more concrete example, the State of New Hampshire regulates 57 species of plants resulting in an N value of 57. There are 29 invasive plants identified by non-governmental IPCs, resulting in an I value of 29. Of these 29 different species, only 27 appear on the noxious weed list generated by a non-governmental IPC. Because those 27 species are on both lists, the C value for the equation is 27. The difference, in this case, two (2), is divided by 29 (the number of species on the IPC list), and then subsequently subtracted from one (1), giving a value of 0.9310. Multiplying by 100 for scaling purposes, New Hampshire has a fidelity score of 93.1. High fidelity indicates excellent coverage of invasive species where the noxious weeds list covers a majority, if not all, of the plant species considered to be invasive by non-governmental IPCs.

2. Latency

The latency metric compares state rigor in maintaining noxious weed lists with the actual threatlevel posed by these invasive species.¹⁴² Specifically, latency is a measure of the correlation between invasive plants and noxious weeds. While a state may include several regulated species on its noxious weed list, it does not necessarily follow that those species are, in fact, considered invasive within the ecological community. This could indicate an erratic regulatory focus on non-invasive plant species.

As in our calculation of fidelity, it was important to account for disparities between the several states by retaining sample size information.

¹³⁸ *Id.* at Supplemental Material, 2–4.

¹³⁹ *Id.* at Supplemental Material, 3.

¹⁴⁰ *Id.* at Supplemental Material, 3–4.

¹⁴¹ *Id.* at Supplemental Material, 2–3.

¹⁴² *Id.* at Supplemental Material, 2–3.

Therefore, to arrive at a numerical value for latency, we captured the number of noxious weeds considered to be noxious for a state (N), subtracted the number of species in common (C), and divided that number by the total number of noxious weeds (N).¹⁴³ This step also allowed us to normalize the resulting value amongst states. We multiplied the result by 100 for scaling purposes. Thus, the latency equation is as follows:

$$\text{latency} = ((N - C)/N) * 100$$

Again using New Hampshire as an example: the state regulates 57 species of plants resulting in an N value of 57. Of the 29 different species identified as invasive in New Hampshire, only 27 appear on the noxious weed list generated by a non-governmental IPC. Because those 27 species are on both lists, the C value for the equation is 27, resulting in the following mathematical solution: $((57 - 27)/57) * 100 = 0.526 * 100 = 52.6$. New Hampshire, therefore, has a latency score of 52.6%. This indicates that the state placed perhaps an inordinate amount of attention on species that—although bothersome—the ecology community does not view as particularly invasive in non-agricultural areas, resulting in a potentially significant degree of over-regulation.

3. Interpreting the Results for Fidelity and Latency

To analyze the efficiency of the state regulatory regimes, we applied our metrics of both fidelity—how well the state noxious weed list covered a regional or state scientific groups' list of invasive plants—and latency—the extent that a state regulates plants not considered invasive by the scientific community.¹⁴⁴ The higher the fidelity, the more attention a state gave to invasive species.¹⁴⁵ Where states failed to include large portions of species considered invasive, however, this under-regulation could have major ecological impacts. The measure of latency indicated two different aspects regarding weed regulation.¹⁴⁶ First, a high latency score could be an indicator of a nonscience-based approach to regulation, potentially placing biofuel feedstocks at risk for unnecessary over-regulation.¹⁴⁷ Second, it could also indicate a strong consideration for agricultural weeds that have an economic impact, but which are not necessarily invasive.¹⁴⁸ In order to better understand each state's regulatory actions, one must consider both latency and fidelity.¹⁴⁹

¹⁴³ *Id.*

¹⁴⁴ *Id.* at Supplemental Material, 1–3.

¹⁴⁵ *Id.* at Supplemental Material, 3.

¹⁴⁶ *Id.* at Supplemental Material, 2–4.

¹⁴⁷ *Id.* at Supplemental Material, 3.

¹⁴⁸ *Id.* at Supplemental Material, 4.

¹⁴⁹ It is important to note that it would be possible to have an excellent latency score without regulating at all. For example, applying the latency equation to Virginia's failure to regulate would give Virginia a latency score of zero. They have no noxious weeds (N) and therefore cannot have any weeds in common (C) with the invasive list. Obviously, in order to

The ideal regulatory list from an ecological perspective must include the majority of invasive species and, keeping in mind limited state resources, minimize regulation of those plant species that are not considered invasive.¹⁵⁰

4. *Typologies of Invasive Species Regulation*

In order to gain added understanding with respect to our fidelity and latency response variables, we further analyzed states by determining typologies that would likely be helpful in describing state regulatory regimes and their response to invasive plant species. We found that three typologies provided good descriptors: 1) whether the state employed a top-down or a bottom-up approach to invasive species and plant regulation; 2) which branch of government retained the power to list and de-list plant species (i.e. administrative agency, legislative body, or a hybrid between both); and 3) the state agency charged with enforcement of the provisions.¹⁵¹

The first typology involved identifying whether a top-down regime (in which the state government dictates what species are prohibited) or, perhaps proving the efficiency of the subsidiarity principle, a bottom-up regime (in which local authorities create lists) was better. We classified a regime as top-down when either state legislatures or state agencies held the authority to list or de-list plant species.¹⁵² However, if the states allowed local government authorities to regulate plant species, then we considered it a bottom-up regime.¹⁵³ Some states allowed local authorities to list plant species, while also maintaining a state-regulated plant list.¹⁵⁴ In these circumstances, we classified the structure as a hybrid regime.

The second typology, the division of government holding authority to list species, plays an important role in identifying whether administrative branch efficiencies are reflected in invasive species listing.¹⁵⁵ For many years, some scholars have held out administrative agencies as more efficient than legislative bodies in adjusting the law to current developments and evolving scientific understanding.¹⁵⁶

evaluate the performance of a legal regime, both metrics are necessary. *Id.* at Supplemental Material, 2.

¹⁵⁰ *Id.* at Supplemental Material, 4.

¹⁵¹ *Id.* at Supplemental Material, 5.

¹⁵² *Id.*

¹⁵³ *Id.*

¹⁵⁴ *Id.*; see discussion *infra* Part II.B.2. (describing Kansas's regulatory structure).

¹⁵⁵ In our examination of this typology, we found that we were only able to consider states with an administrative regime, or states with a hybrid system with administrative and legislative authorities. This is because we found only one state—Indiana—with pure legislative authority that also had an active IPC. As we were limited to one state in calculating fidelity and latency for one purely legislative regime, we could not include it in our study for statistical purposes. See Quinn et al., *supra* note 1, at Supplemental Material, 6.

¹⁵⁶ See, e.g., Jeffrey Rudd, *The Evolution of the Legal Process School's "Institutional Competence" Theme: Unintended Consequences for Environmental Law*, 33 *ECOLOGY L.Q.* 1045, 1090 (2006); J.B. Ruhl & James Salzman, *Climate Change, Dead Zones, and Massive Problems in the Administrative State: A Guide for Whittling Away*, 98 *CAL. L. REV.* 59, 66 (2010) (proposing changes to streamline administrative agencies managing multi-jurisdictional issues).

Our third typology classified the entity holding authority to enforce the regulated plant species lists, focusing on either the state departments of agriculture or natural resources.¹⁵⁷ Our purpose in investigating these two entities was to determine if there was a statistically significant difference between the departments in their emphasis on invasive plants as opposed to noxious weeds. If, in fact, there was an agricultural bias, then arguably another department would be better for regulating plant species.

In analyzing our typologies, we found that although most states use an administrative approach to noxious weed listings, a significant number have adopted hybrid approaches wherein both the administrative and legislative branches actively engage in listing weeds as noxious. For example, in Connecticut, the statutory language transfers the power to list and de-list species to a governmental entity called the Invasive Plant Council.¹⁵⁸ Listing of the plant species as invasive automatically prevents any state agency, department, or institution from being able to purchase these plants, unless that purpose is research, education, or eradication.¹⁵⁹ After listing, the IPC forwards a recommendation to the standing committee of the Connecticut General Assembly for a subsequent legislative vote, which would commercially prohibit the species statewide.¹⁶⁰ Interestingly, our analysis of hybrid states found that in those jurisdictions where the legislature has included a substantial number of species within the noxious weed statute itself, the administrative agency normally does not exercise its independent authority to name additional noxious weeds, even when the legislature has not updated the list for several years.¹⁶¹ Thus the hybrid system, in some states, exists in name only.

Additionally, we found that while the vast majority of states use a top-down approach—meaning that one of the state-level branches of government will dictate what weeds will be banned throughout the state—there were a few states allowing local weed authorities to help create noxious weed lists.¹⁶² For example, Michigan allows the regulation of noxious weeds if the local authorities deem the weed to be a nuisance.¹⁶³ However, our analysis indicated that regardless of the state administrative agency responsible for listing or de-listing plant species, noxious weeds lists did not respond effectively (i.e., fidelity and latency values did not show a

¹⁵⁷ Quinn et al., *supra* note 1, at Supplemental Material, 5.

¹⁵⁸ CONN. GEN. STAT. ANN. § 22a-381b (West 2011).

¹⁵⁹ *Id.* § 22a-381c (West Supp. 2012).

¹⁶⁰ *Id.* § 22a-381a(e) (West 2006).

¹⁶¹ *See, e.g.*, IOWA CODE ANN. §§ 317.1A, 317.17 (West 1997 & Supp. 2012) (naming noxious weeds via statute and vesting authority in the secretary of agriculture to name new noxious weeds, but failing to name new noxious weeds since 1985); *see also* CONN. GEN. STAT. ANN. §§ 22a-381 to -381d (West 2006 & Supp. 2012).

¹⁶² *See, e.g.*, KAN. STAT. ANN. § 2-1314 (2001); MICH. COMP. LAWS § 247.62 (2012). Because we found that only one state held a pure bottom-up regulatory structure, for statistical reasons, we could not include it in our analysis.

¹⁶³ MICH. COMP. LAWS § 247.62 (2012) (“For the purpose of this act, ‘noxious weeds’ includes . . . [any] other plant[s] which in the opinion of the governing body of any county, city, township, or village coming under the provisions of this act is regarded as a common nuisance.”).

statistically significant improvement).¹⁶⁴ Additionally, taking a hybrid approach to trigger the rulemaking process and add the input of citizens for plant listing does not necessarily lead to an improved invasive species list.¹⁶⁵ Yet, looking beyond the typologies, some trends do appear that might provide an excellent basis for further study.

First, states in the New England region have very low agricultural exports when compared to other states,¹⁶⁶ and therefore, the attendant lobby in their respective political realms may be relatively weak. Second, each of the high performing New England states worked with a scientific advisory group with specific emphasis on invasive plant species.¹⁶⁷ Arguably, many of the states discussed below have advisory groups that take scientific evaluation into contemplation; yet, perhaps the voices vying for immediate consideration are sufficiently muted (as compared to large agricultural producers like California) to afford adequate regulatory attention to invasive species in non-agricultural areas.

Another important reflection is that despite a plant's invasiveness, no meaningful liability results for intentional (or unintentional) spread of the problematic species.¹⁶⁸ There are, of course, statutory consequences, but those costs are so minor that few are likely to be deterred from introducing new plants with invasive potential—whether intended for the nursery industry or for biofuel production.

After evaluating the different state regulatory systems and the species regulated, we found that on average, only 19.6% of invasive plant species were included on state noxious or invasive lists, and only five states had a fidelity score of more than 50%.¹⁶⁹ In plotting out where each state's regulatory regime would fall, only five states provide more than marginal efforts to combat invasive species, an appalling degree of under-regulation considering the potential ecological impacts at stake. Moreover, the majority of states had latency scores at or above 50%.¹⁷⁰ These results suggest an exceedingly high degree of over-regulation of weeds that are not considered invasive in non-agricultural areas.

The states with fidelity scores above 50% included Connecticut, Massachusetts, and New Hampshire.¹⁷¹ Several states were shown to have a latency score under 50%, but the ideal combinations of low latency and high fidelity regulatory regimes appeared exclusively in Massachusetts and New Hampshire.¹⁷² Interestingly, the only identified typology that these two states

¹⁶⁴ The average fidelity across all states was 19.6%. In other words, states only regulated 19.6% of those species, regardless of the number of plants considered invasive in their borders. Quinn et al., *supra* note 1, at Supplemental Material, 7.

¹⁶⁵ The average fidelity score for states using a hybrid approach was only 26.1%. *Id.* at Supplemental Material, tbl.2.

¹⁶⁶ See USDA COMMODITY EXPORTS, *infra* note 179.

¹⁶⁷ See Quinn et al., *supra* note 1, at 126.

¹⁶⁸ See *supra* notes 93–97 and accompanying text.

¹⁶⁹ Quinn et al., *supra* note 1, at Supplemental Material, 7.

¹⁷⁰ *Id.*

¹⁷¹ *Id.*

¹⁷² *Id.* at Supplemental Material, fig.2.

shared was the top-down approach for regulating weeds and invasive species; yet this particular typology was not unique, as the majority of states scoring lowest on fidelity and latency also used this approach.¹⁷³ Neither of the other typologies identified played a statistically significant role in determining whether the states were more or less responsive to the metrics of latency or fidelity. In other words, the response variables did not respond to the typologies.¹⁷⁴

What our study does indicate clearly is that the current regulatory process is not working for invasive plants, especially considering the degree of overregulation (i.e., high latency) found within the several states. There does appear to be some level of agricultural bias, but the extent of this bias is not entirely clear. Therefore, as of this writing, we are conducting a second empirical study to verify that the plant species listed within the noxious weeds lists of the states are, in fact, agricultural weeds.

Other than the fact that the three best performing states share a top-down approach for regulating plant species, no other typologies were found in common.¹⁷⁵ Therefore, the governmental structure provides minimal insight into creating an ideal framework. Yet, the unresponsiveness of our typologies prompted a deeper inquiry into alternative explanations for why Connecticut, New Hampshire, and Massachusetts scored significantly better than other states. Most strikingly, each state legislature recently (i.e., in the last ten years) specifically created a government body that includes scientific and ecological viewpoints,¹⁷⁶ or incorporated the scientific community and industry interests into the advisory group working with the rulemaking body of the administrative agency.¹⁷⁷ Other alternatives include the fact that these are not major row-crop states, and thus agricultural weeds play a lesser role in these states' economies. As a result, the invasive plant species lobby may have more voice in obtaining positive results with governmental entities.¹⁷⁸ Our study is ongoing, but the rather general commonalities and specific typological differences amongst these states suggest that, while there may be vastly different methods in regulating invasive plant species, perhaps the most important aspect of creating efficient regulatory regimes is how involved scientists and various stakeholders are in creating the noxious weed lists.

The authors recognize that states will not likely have a perfect combination of the two scores, especially where states naturally cater to their attendant lobbies. In row-crop states—such as Illinois and Indiana—agriculture comprises large parts of their local economies,¹⁷⁹ and politicians

¹⁷³ *Id.* at Supplemental Material, tbl.2, fig.1.

¹⁷⁴ To some extent, this indicates that our study needs to more finely tune the typologies.

¹⁷⁵ Quinn et al., *supra* note 1, at Supplemental Material, 7; *see also infra* Part II.B.7–9.

¹⁷⁶ *See* discussion *infra* Part II.B.7–9.

¹⁷⁷ *See* discussion *infra* notes 238–66 and accompanying text.

¹⁷⁸ Or perhaps the specific industries within these states are more susceptible to invasive plant species, but the late adoption of regulations tends to counter the possibility of differing industry concerns.

¹⁷⁹ *See generally* U.S. DEP'T OF AGRICULTURE, U.S. AGRICULTURAL EXPORTS, COMMODITY DETAIL BY STATE [NEW SERIES]: CY2000-2010 (2012), [hereinafter USDA COMMODITY EXPORTS]

must be responsive to those interests or face electoral consequences. Many row-crop states showed poor scores for our response variables, while exhibiting a propensity for agricultural weed regulation.¹⁸⁰ Naturally, economic interests must be protected, which is likely why one major emphasis of the federal PPA is agriculture.¹⁸¹ But, with the push for biomass development, the myopic focus on agricultural interests must be readjusted to include the economic interests states have in invasive species management on non-agricultural lands. As indicated above, the combined state and federal government regulate more than 700 different plant species, but on average, these lists only contain 19.6% of species considered invasive in their respective states,¹⁸² costing the U.S. economy more than \$7.7 billion annually in control expenditures and income losses.¹⁸³

We further illustrate these typologies through our analysis of nine states, selected as a representative cross-section of ranching, commodity row crop production, and specialty crops.

B. States, Structures, and Typologies

1. Nebraska

Nebraska,¹⁸⁴ one of the major producers of livestock in the United States,¹⁸⁵ has transferred authority to list and de-list noxious weeds to its

available at <http://www.ers.usda.gov/data-products/state-export-data.aspx> (listing export data from each state, including Illinois and Indiana—both of which saw large increases in their agricultural exports from 2000 to 2011).

¹⁸⁰ See Quinn et al., *supra* note 1, at 125; *id.* at Supplemental Material, tbl.1, fig.2.

¹⁸¹ See Plant Protection Act, 7 U.S.C. § 7701(1) (2006) (noting that protection of “agriculture” is one of the primary reasons for the legislation).

¹⁸² Quinn et al., *supra* note 1, at 125; *id.* at Supplemental Material, 7.

¹⁸³ Pimentel et al., *supra* note 3, at 274. While Pimentel et al. have estimated that the economic cost from 25,000 alien species is roughly \$34.7 billion, we have arrived at this number by including all alien plant species from those estimates, except those species specifically designated as “crop weeds.” See *id.*

¹⁸⁴ Following from many early laws, Nebraska outlawed *Cirsium arvense* in 1873. See COBBEY’S NEB. ANN. STAT. § 2331 (1909) (citing the 1873 law). It would not be until 1937, however, that Nebraska consolidated its various statutes into a single plant law (though it still had other sections dealing with weeds). See NEB. COMP. STAT. § 2-1401 (Supp. 1937). In the 1940s, the legislature revised the Nebraska statutes and compiled all weed-related statutes under the weed eradication law, allowing the department of agriculture authority to enforce the provisions. See NEB. REV. STAT. §§ 2-901, 2-903, 2-910(1) (Supp. 1954). In the 1960s, the director of the department of agriculture was given authority to name other plant species, if necessary. See NEB. REV. STAT. § 2-954(1) (Supp. 1970). Complete transition to the administrative state did not materialize until 1975, when the legislature removed named plant species from the statutes and the administrative rules and regulations were enacted. NEB. REV. STAT. § 2-953(3) (Supp. 1977). In a unique occurrence, during the 1980s, Nebraska legislature retook control over noxious species regulation by stripping authority from the department of agriculture to name any new noxious species and regenerating a named species list in the statutes. See NEB. REV. STAT. § 2-953(4) (Cum. Supp. 1987). However, in only a couple of short years, the legislature returned authority to the department, where it resides today. NEB. REV. STAT. § 2-953 (Cum. Supp. 1991).

¹⁸⁵ See USDA COMMODITY EXPORTS, *supra* note 179.

department of agriculture¹⁸⁶ and established weed control authorities to carry out the management of noxious plant eradication within their respective territories.¹⁸⁷ Although the language of the statutory language reads very much like a mandate on county weed commissions to control weeds, there is no penalty in the statute for a failure to do so.¹⁸⁸ Interestingly, Nebraska recently passed a law that created an invasive species council under the natural resources title of its statutes.¹⁸⁹ The council, comprised of eleven to thirteen voting members from various state government and industry interests,¹⁹⁰ as well as non-voting federal members,¹⁹¹ is charged with generating awareness and creating a management plan for invasive species.¹⁹²

Nebraska's top-down approach, with the agricultural department having control over rulemaking and enforcement provisions, has thus far resulted in only eighteen plant species being listed as noxious, none of which correspond to any of the seventy-two species considered invasive by the state IPC.¹⁹³ With fidelity and latency scores of 0%, improvement is Nebraska's only possibility. Perhaps in the future this new invasive species council will provide renewed focus on the issue of invasive species. Future research will focus on the agricultural impact of those eighteen species the state does regulate as noxious.

2. *Kansas*

Kansas,¹⁹⁴ another major livestock producer,¹⁹⁵ takes an interesting approach to noxious weed regulation. As one of the few states operating under a purely legislative decision-making process, Kansas still allows some

¹⁸⁶ See Noxious Weed Control Act, NEB. REV. STAT. § 2-945.02(4) (2012).

¹⁸⁷ See *id.* § 2-946.02.

¹⁸⁸ See *id.* § 2-964.01 ("Any person or public agency *may* institute legal action for the failure to comply with the Noxious Weed Control Act." (emphasis added)).

¹⁸⁹ See Legis. B. 391, 102d Leg., 1st Sess. (Neb. 2012) (codified at various sections of NEB. REV. STAT. § 37), available at <http://nebraskalegislature.gov/FloorDocs/102/PDF/Slip/LB391.pdf>.

¹⁹⁰ *Id.* § 13(2).

¹⁹¹ *Id.* § 13(4).

¹⁹² *Id.* § 14.

¹⁹³ Quinn et al., *supra* note 1, at 126 tbl.1.

¹⁹⁴ Kansas began its noxious weed regulation, much like Nebraska, in the 1870s. See 2 KAN. GEN. STAT., ch. 172, § 1 (1897). The laws initially placed weed regulation on the transportation corridors by regulating through the highway laws. *Id.* § 12. Later, the legislature regulated two other species via weed-specific statutes. See *id.* §§ 12, 13 (citing to the laws of 1895). Again, as the organic weed laws developed in several sections of the code, laws began to appear in highway statutes, as well as agricultural statutes. See KAN. GEN. STAT. §§ 315, 3777, 7313, 9722 (1910). By 1923, weed laws were found in five different sections of the code. See KAN. STAT. ANN. §§ 2-1301, 12-1641, 19-2612, 29-420, 68-546 (1923). These sections of the code covered everything from highways to cities to railways. *Id.* Kansas's control over noxious weeds has slowly grown over the last 100 years. Consequently, the list today only includes a total of 18 species, none of which appear on an invasive species list. See Quinn et al., *supra* note 1, at 126 tbl.1; KAN. STAT. ANN. § 2-1314 (Supp. 2011).

¹⁹⁵ See USDA COMMODITY EXPORTS, *supra* note 179 (ranking Kansas fourth in livestock production).

limited input from county authorities when determining invasive species.¹⁹⁶ The legislature decrees which plant species will be considered noxious, and identifies certain other species that can be optionally listed within a county, after a petition to the Department of Agriculture.¹⁹⁷ The Department of Agriculture may then grant petitions to regulate those species as noxious weeds.¹⁹⁸ While enforcement authority—and thus, mandates—largely rests with local authorities, the Department of Agriculture retains the power to dictate the manner and methods to handle and destroy noxious weeds.¹⁹⁹

Unfortunately, Kansas is one of the few states that does not have a formalized invasive species group operating within its jurisdiction from which to compare IPC-listed invasive species with legislatively decreed noxious weeds. As a result, we were unable to calculate fidelity or latency scores for Kansas. Nonetheless, this absence of an IPC presents an excellent opportunity to develop meaningful invasive species regulation and change.

3. Illinois

Illinois,²⁰⁰ one of the largest corn and soybean producers in the United States,²⁰¹ currently only regulates eighteen plant species as noxious weeds.²⁰² Lacking a formalized invasive species council,²⁰³ the Illinois Department of

¹⁹⁶ See KAN. STAT. ANN. § 2-1314b (2001).

¹⁹⁷ *Id.*

¹⁹⁸ See *id.*

¹⁹⁹ See KAN. STAT. ANN. § 2-1315 (Supp. 2011).

²⁰⁰ Illinois, another early adopter of weed laws, began as many states did by regulating *Cirsium arvense*. See ILL. REV. STAT., ch. 18, § 2 (E.B. Myers & Co. 1887). Again, the laws were concerned primarily with transportation corridors and ensuring that burrs and thistles were not transported along those routes. See *id.* In 1903, Illinois adopted laws that allowed counties and towns to control the weed, however the Illinois Supreme Court found the statute to be an unconstitutional tax upon certain counties. See *People v. Bd. of Comm'rs of Cook Cnty.*, 77 N.E. 914, 914–15 (Ill. 1906). Consequently, Illinois only had a valid regulation of *Cirsium arvense*. See *id.* It was not until 1931 that the legislature amended its statutes to add new species. See ILL. REV. STAT., ch. 18, § 1(a) (1941). Over the next several decades, the legislature added very few weeds to the regulated list. See *id.* (showing the addition of three species in 1939); Act of July 6, 1953, 1953 Ill. Laws 843, 844 (adding the two species of the ragweed genus (*Ambrosia*) to the list); Act of July 14, 1959, 1959 Ill. Laws 933, 934 (adding Johnson grass (*Sorghum halepense*) and giant foxtail (*Setaria faberii*)); Act of July 13, 1965, § 1, 1965 Ill. Laws 1431 (adding Columbus grass (*Sorghum almum*)). Although the Illinois Department of Agriculture, following a transition of authority, could name plant species to the noxious list starting in 1971, no actual named species appeared until 1982. See ILL. ADMIN. CODE tit. 8, § 220.60 (1996). In 2002, the state added Kudzu to the list. 26 Ill. Reg. 14,644, 14,645–48 (Oct. 4, 2002), available at http://www.cyberdriveillinois.com/departments/index/register/register_volume26_issue40.pdf. Interestingly, as one of the few states that maintains a hybrid approach to weed law regulation, Illinois has an exotic weed statute that prohibits certain plant species. See 525 ILL. COMP. STAT. ANN. 10/3, 10/4 (West 2004). Currently, Illinois regulates 18 species, but that number pales in comparison to the 102 species considered invasive by IPCs within the state. Quinn et al., *supra* note 1, at 126 tbl.1.

²⁰¹ See USDA COMMODITY EXPORTS, *supra* note 179.

²⁰² Quinn et al., *supra* note 1, at 126 tbl.1.

²⁰³ See 525 ILL. COMP. STAT. ANN. 10/4 (2012) (vesting in the state's Department of Natural Resources the authority to issue permits for exotic weed possession).

Agriculture pays little heed to the dangers of potential invaders—possessing a fidelity score of 10.8% and a latency score of 38.9%. The state sets out to define exotic weeds as “plants not native to North America.”²⁰⁴ Even though the Department of Agriculture has authority to name species, few have made the administrative list.

Illinois employs a hybrid, top-down approach using both legislative and administrative regulatory processes; while potentially offering a way in which to capture *more* invasive species, Illinois has thus far only managed to capture a pittance of the more than 100 invasive plant species identified by the IPC in this state. Illinois also requires major input from the counties in order to control noxious weeds.²⁰⁵ County control authorities must examine all lands within their jurisdiction to identify any infested areas, and must report their findings to representatives of the Illinois Department of Agriculture.²⁰⁶ However, these findings are based upon the weeds listed by the Department, and do not specifically address invasive plant species. On the one hand, the legislature does have specific prohibitions regarding exotic plant species,²⁰⁷ yet between the legislative and administrative lists, Illinois fails to regulate a significant number of invasive plant species.

4. Indiana

As another major producer of corn and other row crops,²⁰⁸ Indiana²⁰⁹ identifies the importance of agriculture by succinctly stating that the noxious weed laws are there with the intent to contain plant species that have a negative effect on state agricultural production.²¹⁰ Surprisingly, this has only resulted in the legislature banning a total of ten plant species.²¹¹ In 2009, Indiana also established a formal advisory council for invasive plant

²⁰⁴ *Id.* at 10/2.

²⁰⁵ *See* 505 ILL. COMP. STAT. ANN. 100/7 (2012).

²⁰⁶ *Id.* at 100/8.

²⁰⁷ 525 ILL. COMP. STAT. ANN. 10/4 (2012).

²⁰⁸ *See* USDA COMMODITY EXPORTS, *supra* note 179.

²⁰⁹ Although Indiana had regulated “noxious weeds” through a general statute, 1889 Ind. Laws 146, the state did not specifically name plant species in its noxious weed regulations until 1899, when it first regulated *Cirsium arvense*. IND. REV. STAT. art. 8, § 2123 (1901). It would be another thirty years before Indiana enacted its next laws. BURNS’ IND. STAT. ANN. ch. 63, § 6866p (1921). Interestingly, the new law not only regulated several noxious weeds, but was uniquely placed within the section of the laws dealing with Purdue University. *See id.* Moreover, Indiana’s early laws were some of the first to transition power to a seed commissioner or other executive agency to establish new weeds and regulations. After three decades, the legislature repealed the specific statute granting authority to the seed commissioner to name new noxious weeds. *See* IND. CODE ANN. §§ 8-802; 8-827(e) (1964). New regulations would not appear for at least another 30 years, when the legislature determined county weed control boards should stand as a primary defense against noxious weeds. *See* IND. CODE ANN. § 15-3-4.6-2 (LexisNexis 1982). Despite the heavy emphasis on state agricultural protection, the legislature has felt it unnecessary to regulate plant species with invasive potential. *See* IND. CODE §§ 15-16-7-2, 15-16-8-2 (2012).

²¹⁰ *See* IND. CODE ANN. § 15-16-7-7(1) (LexisNexis 2008).

²¹¹ *See* Quinn et al., *supra* note 1, at 126 tbl.1.

species.²¹² The council, while tasked with developing information channels and resources, is specifically denied authority to conduct hearings, regulate invasive plant species, or otherwise create rules.²¹³

Indiana's legislative approach to regulating plant species at a state level leaves much to be desired. Indiana scores a 5.9% for fidelity and a 66.7% for latency. After more than two years of formalizing their invasive species council, Indiana's council has devised a fairly comprehensive list of invasive plants species,²¹⁴ but until the legislative body adopts new statutory language, the list will retain its meager coverage.

5. California

California has one of the largest noxious weeds lists in the United States,²¹⁵ which is unsurprising considering its size, its ecosystem diversity

²¹² IND. CODE ANN. § 15-16-10-3, -4 (LexisNexis 2008 & Supp. 2012).

²¹³ See *id.* § 15-16-10-4(b).

²¹⁴ See, e.g., Ind. Coop. Agric. Pest Survey Program, *Indiana's "Most Unwanted" Invasive Plant Pests*, <http://extension.entm.purdue.edu/CAPS/plants.html> (last visited Sept. 2012).

²¹⁵ California has exerted energies to eradicate weeds for more than 100 years. See Gina Skurka Darin, *Prioritizing Weed Populations for Eradication at a Regional Level: The California Department of Food and Agriculture's A-Rated Weeds at 1* (Dec. 1, 2008) (unpublished M.S. thesis, University of California, Davis) (on file with university), available at http://www.cdffa.ca.gov/plant/pc/weeds/pdf/prioritizing_weed_populations.pdf. The first weed to be regulated was the Canada thistle in 1872. See CAL. CODE tit. 285, p. 1219 (Deering 1899). It would be more than 30 years before California took further steps in combating other weeds like the Scotch thistle (*Onopordum acanthium* L.) and the bull thistle (*Cirsium vulgare*). See STATUTES OF CALIFORNIA AND AMENDMENTS TO THE CODES 681, 681-82 (Bender-Chaquette 1907) (outlawing an additional four weeds by 1907). Throughout the early twentieth century, little change occurred in the statutory laws. However, in 1943, California began to take more serious measures to address threats to their agricultural system. CAL. ANN. CODE §§ 911.21-.23 (West 1954). At that time, the weeds were divided into categories of "primary" and "secondary" noxious weeds as part of the California seed law, with more stringent controls placed on those weeds identified as "primary." *Id.* § 911.23.

In 1967, the California Agricultural Code went through some revisions; among these was the Plant Quarantine Act (PQA), which granted the CDFA the authority to carry out the mandate of "prevent[ing] the introduction and spread of injurious insect or animal pests, plant diseases, and noxious weeds." 1967 CAL. STAT. 50. Moreover, PQA specifically identified all weeds named in the seed law as noxious weeds, and granted CDFA the authority to name others through the notice and rulemaking procedures of the state. *Id.* The named species of noxious weeds remained in the statutes until 1977, when the legislature passed all weed naming and determination to the California Department of Food and Agriculture, replacing named species with a broad definition of what would constitute a noxious weed. See CAL. FOOD & AGR. CODE §§ 52257-52258 (West 1986).

As CDFA took over, they immediately set out to identify a substantial number of noxious weeds. CAL. CODE REGS. tit. 3, § 4500 (1978); 1977 Cal. Regulatory Notice Reg. 52 (Dec. 24, 1977). The initial implementation that took effect in 1978 regulated more than 110 noxious weeds, an increase of 350% over those named in 1967. Compare *id.*, with 1967 Cal. Stat. 50-51. For two decades after the first implementation by the CDFA, the noxious weeds list remained largely unchanged with only slight corrections to the scientific names of those weeds contained on the list. See CAL. CODE REGS. tit. 3, § 4500 (1983); 83 Cal. Regulatory Notice Reg. (Mar. 9, 1983). In 1997, CAL. CODE REGS. tit. 3, § 4500 (1997); 97 Cal. Regulatory Notice Reg. (May 9, 1997), and again in 2003, CAL. CODE REGS. tit. 3, § 4500 (2003); 2003 Cal. Regulatory Notice Reg. (Aug. 15, 2003), the CDFA added an additional 10 weeds to the list. In 2007, for only the second time since

(from oceans, to mountains, to deserts, to broad agriculture-producing river valleys), and the level of agricultural interests within the state.²¹⁶ Currently, the state regulates 176 species of plants, including a large number of agricultural weeds.²¹⁷ The state primarily lists noxious weeds through the California Department of Food and Agriculture (CDFA), but also regulates some species through specific legislative decree,²¹⁸ thereby qualifying as a “hybrid” state with both agency and legislative involvement in noxious weed listings. Although CDFA works in tandem with County Agricultural Commissioners (CACs) to eradicate weeds,²¹⁹ the CACs have no authority to actually list species as noxious.²²⁰ In sum, California is a top-down, hybrid legislative-administrative regime, which focuses its powers of enforcement in its department of agriculture equivalent, the CDFA.

Our statistical analysis of states with hybrid, top-down listing structures like California, however, did not provide enhanced regulatory coverage of invasive species. The average fidelity score for these hybrids was 14%, while the latency averaged 44.2%. California scored a 27.9% for fidelity, regulating only 57 of the 204 invasive plant species,²²¹ while achieving a latency score of 67.6%. These hybrid systems, while having the potential to capture a larger number of invasive plant species through multiple opportunities for input (i.e., administrative and legislative), do not necessarily carry an inherent benefit. The likely issue, at least in California, may arise from CDFA having the ability to list species based on statutory authority delegated across a wide array of statutory titles—potentially creating unnecessary duplication of regulatory rulemaking effort. Moreover, weed management and control may lose out on the potency of a unified effort.

California, like many states, has created an invasive species council—the Invasive Species Council of California (ISCC)—in an effort to increase

California began naming noxious weeds (in 1967, Klamath weed and Bermuda grass were removed from the weed seed law, *see* 1967 Cal. Stat. 50–51), nine weeds were removed from the list. CAL. CODE REGS. tit. 3, § 4500 (2008); 2008 Cal. Regulatory Notice Reg. 152 (Feb. 1, 2008). In 2010, however, an additional 31 weeds were added, pushing the official list in the California Code of Regulations (CCR) to 156 species. CAL. CODE REGS. tit. 3, § 4500 (2010). Although the CCR only regulates 156 as “noxious weeds,” the CDFA actually lists about 182. CAL. DEP’T OF FOOD & AGRIC., ENCYCLOWEEDIA: DATA SHEETS (2012) [hereinafter CAL. DATA SHEETS], *available at* http://www.cdfa.ca.gov/plant/ipc/weedinfo/wininfo_list-synonyms.htm. This discrepancy is because the CDFA online list includes not only the named species in the CCR, but also because it has listed “Q”-rated species and some species that were removed from the list in 2008. For example, kelp was placed on the list in 2003. CAL. CODE REGS. tit. 3, § 4500 (2003). However, in 2008, it was one of the species that was removed. *See* CAL. CODE REGS. tit. 3, § 4500 (2008). Additionally, the online list sometimes includes specific species names that are categorically covered in the CCR. For example, the online list includes specific species of the *Onopordum* genus, while the actual CCR only lists the entire genus. *See* CAL. DATA SHEETS *supra*; CAL. CODE REGS. tit. 3, § 4500 (2012).

²¹⁶ California is the nation’s top agricultural commodity producing state. *See* USDA COMMODITY EXPORTS, *supra* note 178.

²¹⁷ *See* Quinn et al., *supra* note 1, at 126 tbl.1.

²¹⁸ *See, e.g.*, CAL. FOOD & AGRIC. CODE §§ 6048, 6049 (West 2001).

²¹⁹ *See id.* §§ 7270–7276.

²²⁰ *See id.*

²²¹ Quinn et al., *supra* note 1, at 126 tbl.1.

cooperation and coordination between the various state agencies that have an interest in invasive plant species.²²² ISCC subsequently developed an expert California Invasive Species Advisory Committee, consisting of twenty-four representatives from state agencies, national agencies, and non-profit organizations interested in invasive species, to provide advice regarding invasive species control.²²³ Although California seems to place a heavy emphasis on invasive species management with its ISCC, the state regulates only 57 of the 204 invasive plant species.²²⁴ Perhaps because of the sheer number of animal and plant species under consideration at any given period in time, the ISCC and its advisory group are not sufficiently focused on the specific problem of invasive plants. Whatever the pretext for not paying more attention to these invasive species, it is clear that some changes should be made in order to improve coverage of invasive plant species in California.

6. Florida

In Florida, the legislature has transferred authority to the secretary of the Department of Agriculture and Consumer Services (DACS) to implement its noxious weed laws.²²⁵ The state, another major producer of agricultural commodities,²²⁶ regulates several species, many of which the federal government already includes on its noxious weeds list.²²⁷ After eliminating redundancies with the federal list, we found that Florida independently regulates only twenty-six plant species as noxious.²²⁸ DACS appointed a governmental body to make recommendations based upon a risk assessment

²²² These agencies include the Departments of Food and Agriculture; Natural Resources; Environmental Protection; Business, Transportation and Housing; Health and Human Services; and Emergency Management. See Invasive Species Council of Cal., *What is the Invasive Species Council of California (ISCC)?*, <http://www.iscc.ca.gov/index.html> (last visited Nov. 10, 2012).

²²³ See Invasive Species Council of Cal., *California Invasive Species Advisory Committee*, <http://www.iscc.ca.gov/cisac.html> (last visited Nov. 10, 2012).

²²⁴ See Quinn et al., *supra* note 1, at 126, tbl.1.

²²⁵ See FLA. STAT. ANN. § 581.083(1) (West 2012).

²²⁶ See USDA COMMODITY EXPORTS, *supra* note 179.

²²⁷ Florida began implementing noxious weeds regulation as part of its seed laws during the late 1930s. See FLA. STAT. ANN. §§ 578.01–578.20 (West 1942). As part of the state Seed Law, the state Plant Board was created and the Commissioner was granted authority to list other species as needed. See *id.* §§ 581.01–581.02. In 1945, the laws outlawing noxious weeds were reworked, creating primary and secondary noxious weeds. See FLA. STAT. ANN. § 581.01(11)–(12) (West Supp. 1945). The transition for Florida, moving the noxious weed regulation to an administrative agency, occurred during the early 1960s. See FLA. STAT. ANN. § 581.011(11)–(12) (West Supp. 1961). The statutes only left a broad definition to guide the Florida State Department of Agriculture and Consumer Services, removing any named species that had appeared in the statutes. See FLA. STAT. ANN. § 581.011(11) (West 1986). Although Florida has a history of concern with weed control, it was not until 1993 that they actually began to take noxious weeds seriously. Compare FLA. STAT. ANN. §§ 578.01–578.20 (West 1942), with FLA. ADMIN. CODE ANN. r. 5B-57.007 (2012). During their first specific regulation of noxious weeds, Florida banned or restricted more than 50 different species of weeds. *Id.* The law enabling the weed list prohibited all introduction or release of plant pests and noxious weeds that may affect the plant life of Florida. See FLA. STAT. ANN. § 581.083(1) (West 2010).

²²⁸ See Quinn et al., *supra* note 1, at 126, tbl.1.

or other evidence to demonstrate plant invasiveness.²²⁹ These appointed representatives are known as the Noxious Weed and Invasive Plant List Review Committee—a group that represents academic and state agencies with a narrow focus or interest.²³⁰ Despite the efforts of this committee, Florida has managed to regulate as noxious only 16 of the 152 invasive plant species (fidelity score of 10.5%),²³¹ a serious degree of underregulation. However, private industry may also be partially to blame. While DACS holds primary authority to trigger rulemaking, private individuals are capable of petitioning DACS for additional species listing.²³² Under Florida regulations, DACS permits any person to petition to add (or remove) species by performing a risk assessment that includes certain required data.²³³ It is possible that DACS is relying upon private citizens and organizations to identify and petition for species to be added to the noxious list, but if so, its reliance is clearly misplaced.²³⁴ Florida's fidelity score of 10.5%, demonstrates that its top-down administrative approach, with explicit provisions for public petitions, does not effectively manage the invasive plant problem.²³⁵ Moreover, its latency score of 38.46%, much like California's, indicates that DACS may focus too much on agricultural weeds vis-à-vis ecologically harmful invasive species, despite the large number of plants officially listed as noxious weeds.²³⁶

²²⁹ See FLA. STAT. ANN. § 570.32 (West 2010) (vesting power in the Division of Plant Industry).

²³⁰ See FLA. STAT. § 581.091(4) (2012) (requiring biennial review by the Department of Agriculture—i.e., by the Division of Plant Industry—“in conjunction with the Institute of Food and Agricultural Sciences at the University of Florida”); FLA. ADMIN. CODE ANN. r. 5B-57.010(2) (2012) (providing for biennial review of the noxious weed and invasive plant list contained in section 5B-57.007 of the administrative code).

²³¹ Quinn et al., *supra* note 1, at 126 tbl.1.

²³² See FLA. ADMIN. CODE ANN. r. 5B-57.010(1) (2012).

²³³ *Id.*

²³⁴ Future research will explore the structure and apparent lack of progress with invasive plant species management through Florida's petition process.

²³⁵ Unlike California, however, Florida has anticipated large-scale biofuel production by implementing a bond mechanism. FLA. STAT. ANN. § 581.083(4)(b)–(e) (West Supp. 2012). In order to get the permit for producing non-native crops within the state, the applicant must post a bond in an amount equal to 150% of the cost of removing and destroying the plant. See *id.* At no point in the permitting process does the Florida law require any assessment of the plant's invasiveness. In fact, all that is required is the permit and the bond. *Id.* However, if the plant is listed on either the state or federal noxious weeds list, then a permit will not be issued. FLA. DIV. PLANT INDUS., BIOMASS PERMITTING: SUPPORTING THE FARM TO FUEL INITIATIVE 2 [hereinafter BIOMASS PERMITTING], available at <http://www.freshfromflorida.com/pi/methods/images/BiomassPermit.pdf>. According to the Division of Plant Industry (DPI) in Florida, the purpose of the permitting process is to “control the introduction into, or movement within, Florida of plant species intended for biomass plantings and to establish procedures that will assist in” providing public and environmental protection. *Id.* Additionally, various safeguards must be put in place for cultivation of non-native plants, such as a system of traps or filters, areas left fallow in order to prevent spread of the plants, equipment cleaning processes, and quarterly site visits from the DPI. *Id.* If at any point the individual decides they want to end the cultivation or they are forced by the department to do so, they must destroy and eradicate all of the non-native plants. FLA. STAT. ANN. § 581.083(4)(b) (West Supp. 2012).

²³⁶ See FLA. ADMIN. CODE r. 5B-57.007 (2012) (listing noxious weeds).

Distinct from major agricultural producers, states like many of those in the New England region have handled invasive species to a much better degree, though as we describe below, not all of these states should boast of their performance.²³⁷

7. *New Hampshire*

New Hampshire²³⁸ is not particularly well known for its large volume of agricultural interests.²³⁹ Of course, the state is not without its farm-based commodities,²⁴⁰ but much of its economy is based on raw nature and the outdoors.²⁴¹ Consequently, finding fewer noxious agricultural plant species on its regulated weeds list (i.e., latency) is expected. As noted above, the state exhibited a score of 50.88% for latency. New Hampshire employs a top-down regulatory mechanism much like the other states and, in 2000, it transferred rulemaking authority to its Department of Agriculture, Markets, and Food (DAMF).²⁴² Yet prior to 2004, New Hampshire had virtually no regulated plant species.²⁴³ For inexplicable reasons, DAMF authority laid dormant for nearly four years.²⁴⁴ However, when the agency finally exercised its authority, a great deal of care went into crafting and responding to a list of invasive plant species.²⁴⁵ The state's fidelity score is 96.55%, ranking it first nationwide.

²³⁷ For example, Vermont regulates 25 species, none of which are considered invasive, while 35 species are considered invasive by its IPC. See Quinn et al., *supra* note 1, at 126 tbl.1.

²³⁸ As early as 1921, New Hampshire began to consider the impacts of weeds on the agricultural industry. See N.H. REV. STAT. ANN. § 434:1(V)–(VI) (1955). While the seed law divided the list in 1943 to “primary” and “secondary” weed seeds, over the next several decades nothing was changed on the list. Compare *id.*, with N.H. REV. STAT. ANN. § 434:1(V)–(VI) (Supp. IV 1967). Not until 1990 was there a major change to the weed seed laws. N.H. REV. STAT. ANN. § 433:1(XXIV), (XXVII) (Supp. 4-A 1990) (eliminating the distinction used in 1955 of “primary noxious weed seeds” from “secondary noxious weed seeds,” and adopting a singular regulated category: “prohibited noxious weed seeds” in 1990). Throughout the history of New Hampshire's statutes and regulations, little was done to regulate noxious weeds outside of the weed seed laws. However, in 2000, New Hampshire made a change with H.B. 1258, 2000 N.H. Laws ch. 88, at 95. The bill created a commission that was tasked with identifying alien plant species that would impact the economic and environmental well-being of New Hampshire residents. See N.H. REV. STAT. § 430:54 (2012). And while the bill also granted the authority to the Department of Agriculture to name and list invasive species, *id.* § 430:53(III)–(IV), the Department did not do so immediately. The Department of Agriculture in New Hampshire did not actually regulate any invasive plants until 2004. See N.H. CODE ADMIN. R. ANN. Agr. 3802.01(a) tbl.3800.1 (2012) (becoming effective June 1, 2004).

²³⁹ New Hampshire ranks 48 out of 50 for total agricultural exports. See USDA COMMODITY EXPORTS, *supra* note 179.

²⁴⁰ See *id.*

²⁴¹ See, e.g., N.H. DIV OF FOREST & LANDS, THE ECONOMIC IMPORTANCE OF NEW HAMPSHIRE'S FOREST-BASED ECONOMY, 7 (2011) available at www.nhdf.org/library/pdf/Publications/NEFA%20NH%20Forest%20Econ%20Impor%202011%20FINAL.pdf.

²⁴² N.H. REV. STAT. § 430:53(III)–(IV) (2012).

²⁴³ See *supra* note 238 and accompanying statutory citations.

²⁴⁴ See *supra* note 238 and accompanying statutory citations.

²⁴⁵ New Hampshire currently prohibits 28 of the 29 invasive plant species it has identified, although it also regulates a few other species that are not considered invasive in non-agricultural areas. See Quinn et al., *supra* note 1, at 126 tbl.1.

New Hampshire formalized an invasive species committee consisting of eleven appointed members, most of whom are from state agencies. However, the group has at least four other appointed members representing environmental, horticultural, public, and livestock interests.²⁴⁶ Some of the committee's responsibilities include evaluating, researching, and discussing potentially invasive plants, as well as preparing a list of proposed prohibited and restricted plant species.²⁴⁷ With respect to covering invasive species identified by non-governmental IPCs, few states come close to New Hampshire.²⁴⁸ The question remains, though, as to why New Hampshire, as opposed to other states with IPCs, is able to capture so many of the invasive species on its regulatory list. Much like the other states, it has a top-down system for regulating invasive plant species, while vesting power in an agency secretary to both trigger rulemaking and enforce the law. Despite sharing many common typological traits with the other states, New Hampshire has done an excellent job of covering invasive plant species.

8. Connecticut

Connecticut²⁴⁹ shares many similarities with New Hampshire. For example, it too ranks poorly for agricultural commodity production²⁵⁰ and

²⁴⁶ See N.H. DEP'T OF AGRIC. MKTS. & FOOD, INVASIVE SPECIES COMMITTEE MEMBERS LIST, available at http://www.nh.gov/agric/divisions/plant_industry/documents/isc-members.pdf.

²⁴⁷ N.H. REV. STAT. ANN. § 430:53 (LexisNexis 2012).

²⁴⁸ See Quinn et al., *supra* note 1, at Supplemental Material, fig.2.

²⁴⁹ Connecticut started its regulation of noxious weeds in 1833. See 1839 Conn. Pub. Acts tit. XII, p. 104 (repealing the 1833 act regulating Canada thistle). For almost 50 years, the only weed that was regulated was the Canada thistle. See Act of Apr. 5, 1881, ch. LIX, 1881 Conn. Pub. Acts 30. In 1881, wild carrots (*Daucus carota*) were added to the list of weeds that were to be eradicated. *Id.* Not until 1935 was the next change lodged in the statutes. See CONN. GEN. STAT. § 1706(c) (Cum. Rev. 1935) (repealing the weed law). At that time, Connecticut removed the thistle and carrots law, going without any regulations in the statutory language until 1945. See CONN. GEN. STAT. §§ 496h–502h (Supp. 1945). However, the new law that was introduced was specifically geared towards weed seed and regulating seeds. See *id.* § 496h. It did not provide for any eradication provisions on the part of landowners. Throughout the next two decades, the weed seed law continued to add different weeds to its list, but again, there were no laws regarding noxious weeds. CONN. GEN. STAT. ANN. § 22-55(e) (West 1975). In 1963, the Department of Agriculture in Connecticut was given the power to add or remove weed seed varieties to the list of restricted and prohibited noxious weeds. Pub. Act No. 75, § 5(a)(3), (4), 1963 Conn. Pub. Acts 142, 148–49.

Laws in Connecticut virtually stood dormant for the next 40 years regarding weeds or even weed seed. See Pub. Act No. 03-136, § 8, 2003 Conn. Pub. Acts 598, 600–01 (Spec. Sess.). In 2003, Connecticut passed an act that created an Invasive Plant Council. *Id.* § 1. The Council would comprise nine different individuals representing different state agencies, non-profit organizations with specialized knowledge of invasive plants, and non-profit associations concerned with the plant and water industries. *Id.* Along with creating the council, the legislature named seven weeds to its invasive species list. *Id.* § 8. The following year, Connecticut added 54 plant species to the list, and provided for an additional 20 to be added in 2005. See Pub. Act No. 04-203, § 2, 2004 Conn. Pub. Acts 751, 752 (Spec. Sess.). As a result, Connecticut is one of the few states that have a more complete list for regulating noxious weeds or invasive species.

²⁵⁰ See USDA COMMODITY EXPORTS, *supra* note 179.

also has employed the top-down approach, creating an Invasive Plant Council—an entity very similar to New Hampshire’s Invasive Species Council.²⁵¹ Interestingly, the creation of the council coincided with the implementation of a new invasive species law, which largely was responsible for generating the current invasive species list.²⁵² Connecticut law places authority in the IPC to identify and list certain plant species that meet statutory criteria.²⁵³ The list, however, is only partially prohibitive.²⁵⁴ Full restrictions do not take effect until the General Assembly amends the list through a public act.²⁵⁵ In the period between IPC action and legislative ratification of IPC listings, only government entities are banned from buying, using, or otherwise propagating council-listed species.²⁵⁶ Therefore, the most apt description of Connecticut’s system is a legislative-administrative hybrid. Interestingly, with its top-down, legislative-administrative hybrid approach, Connecticut allows no single person the authority to list a species, posing what may seem to be obstacles to the listing process. Contrary to expectations, however, Connecticut’s method has resulted in regulating 73 of the 96 invasive plant species (a fidelity score of 76.04%), and beyond the council-recognized invasive species, few other plants appear on the prohibited list (a latency score of 6.41%). As a result, Connecticut appears as one of the best state actors in targeting invasive plant species.

9. Massachusetts

A third New England state, Massachusetts,²⁵⁷ ranks just below Connecticut for agricultural exports²⁵⁸ and yet, recently, has also focused a

²⁵¹ Compare CONN. GEN. STAT. ANN. § 22a-381 (2012), with N.H. REV. STAT. § 430:54 (2012).

²⁵² See CONN. GEN. STAT. ANN. § 22a-381a(a) (2012).

²⁵³ *Id.* §§ 22a-381a(a)(4), 22a-381b.

²⁵⁴ *Id.* § 22a-381c (exempting use pursuant to existing state contracts and for state-led research or education).

²⁵⁵ See *id.* § 22a-381d(a), (b) (stating that the IPC may make recommendations to the General Assembly to prohibit the further import, export, sale and purchase of plants the IPC has deemed invasive).

²⁵⁶ Compare *id.* § 22a-381c (limiting state agency ability to purchase or otherwise plant a species designated as invasive by the IPC), with *id.* § 22a-381d(a) (legislating the full prohibition of a plant species only by statutory law). Under Connecticut law, after the IPC has voted to list a plant species, the species does not experience a full prohibition until legislative action to add the species to the statute.

²⁵⁷ Massachusetts followed a similar pattern to both New Hampshire and Connecticut in the development of weed and invasive species laws. In 1927, the first weed law of any kind was introduced to the state. See 1927 Mass. Acts 314, 315 (later codified at MASS. GEN. LAWS ch. 94, § 261A–261L) (As a note, noxious weed seed laws are distinct from noxious weed laws. Noxious weed seed laws regulate the amount of weed seeds sold as part of agricultural seeds within a state, but otherwise do not specifically prohibit the actual plant outside of the seed-selling context. Noxious weed laws, on the other hand, generally prohibit not only the seeds of the noxious weed, but all parts of the plant. Therefore, this Massachusetts Act is only marginally related to weeds). The Act named four noxious weed seeds: quack grass (*Agropyron repens*), Canada thistle, the dodder genus (*Cuscuta spp.*) and wild mustard (*Brassica arvensis*). *Id.* In 1953, the water chestnut (*Trapa natans*) was officially prohibited. 1953 Mass. Acts 73 (later codified at MASS. GEN. LAWS. ch. 128, § 20A). Three years later, Massachusetts named another controlled weed, poison ivy (*Toxicodendron radicans*). 1956 Mass. Acts. 596, 596–97 (later

great deal of regulatory attention on invasive species.²⁵⁹ Like both New Hampshire and Connecticut, this attention has only come within the past decade, and is manifested in a top-down regulatory environment tailored to plant species.²⁶⁰ The state's Department of Agriculture primarily administers the noxious weed law.²⁶¹ What is singular about Massachusetts, however, is that instead of formalizing an advisory group through the government, the state agency teamed with a private non-profit group known as the Massachusetts Invasive Plant Advisory Group (MIPAG).²⁶² MIPAG is a voluntary, collaborative organization of professionals and others concerned with preserving Massachusetts's landscape.²⁶³ While the MIPAG certainly provides a convenient way to collaborate with industry and other state and federal interests, Massachusetts has not formalized this advisory group. Nonetheless, in 2005, the Executive Office of Environmental Affairs charged MIPAG to provide a list of invasive plant species for regulations.²⁶⁴ That list currently covers 63 of the 66 invasive species for Massachusetts for a fidelity score of 95.45% and a latency score of 18.18%.²⁶⁵

Despite the structural differences of the several New England states, each described here has done an above-average job in addressing invasive species. We do caution, however, that broader statistical analysis of all states indicates that merely forming an invasive plant advisory council or group does not necessarily result in enhanced regulation of invasive species.²⁶⁶

codified at MASS. GEN. LAWS ch. 132, § 11). However, poison ivy was only to be controlled when found "growing within one hundred feet of any public way." *Id.* The poison ivy did not have to be eradicated, but simply controlled in those areas that people were likely to be located. *See id.* at 597. It would be close to another two decades before Massachusetts actually issued any weed seed laws, but there were no specific "noxious weeds" law issued for the control or eradication of noxious weeds. *See* 1975 Mass. Acts 181, 181–82 (later codified at MASS. GEN. LAWS ch. 128, § 84) (defining "prohibited" and "restricted" noxious weed seeds). It was not until 2006 that Massachusetts began to regulate noxious or invasive plants outside of the agricultural seed law created in the 1970s. *See* Mass. Dep't of Agric. Res., *Massachusetts Prohibited Plants: Background*, <http://www.mass.gov/eea/agencies/agr/farm-products/plants/massachusetts-prohibited-plant-list.html> (last visited Sept. 2012) [hereinafter MDAR, *Prohibited Plants*]. *See generally* MASS. GEN. LAWS ch. 128, §§ 2, 16–31A (2012).

²⁵⁸ USDA COMMODITY EXPORTS, *supra* note 179 (showing that in 2011, Massachusetts yielded \$226.7 million in agricultural exports and Connecticut yielded \$257.1 million).

²⁵⁹ *See* MDAR, *Prohibited Plants*, *supra* note 257 (noting that in 2006 the Department "began a two-step ban on the importation and sale of more than 140 plants identified as either noxious and/or invasive.").

²⁶⁰ *See id.*

²⁶¹ *See* MASS. GEN. LAWS ch. 128 §§ 2, 16–31A (2012).

²⁶² The Massachusetts Department of Agricultural Resources (MDAR) oversees the top-down administration of the invasive species list, banning certain species throughout the state. *See* MDAR, *Prohibited Plants*, *supra* note 257.

²⁶³ Mass. Invasive Plant Advisory Grp., *About the Group*, <http://www.massnrc.org/MIPAG/index.htm> (last visited Feb. 17, 2013).

²⁶⁴ *Id.*; Mass. Invasive Plant Advisory Grp., *History*, <http://www.massnrc.org/MIPAG/history.htm> (last visited Feb. 17, 2013).

²⁶⁵ Quinn et al., *supra* note 1, at 126 tbl.1; *see also id.* at Supplemental Material, fig.2.

²⁶⁶ As an example of a state following the general structure of the New England states discussed above, Virginia employs a top-down regulatory approach, focusing power in the Department of Agriculture and Consumer Services. Virginia has implemented a formalized

Nonetheless, as discussed below, we believe that establishing such councils can be a positive step toward greater regulatory efficiency and effectiveness.

III. RECOMMENDATIONS AND CONCLUSION

The sheer number of ecoregions²⁶⁷ and the importance of early identification occurring at the local level suggest that the principle of subsidiarity ought to be at the forefront in the battle against invasive plant species and their attendant economic and ecological harm. In other words, municipal and county resources should bear the brunt of facing the invasive species challenge. In reality, however, most towns and municipalities rely upon the state to provide both the authority to act and the resources to engage in eradication efforts.²⁶⁸ Moreover, county and municipal ordinances only extend as far as their respective geo-political boundaries—artificial limits not respected by invasive plant movements. Local entities also may lack the scientific expertise to engage in independent identification and tracking of invasive species threats. While it is not impossible for local action to be effective by relying on private scientific organizations and cooperating with adjacent government units, further consideration of the application of subsidiarity principles would suggest that a higher level of government ought to step in.²⁶⁹

On the opposite side of the subsidiarity spectrum, the federal government has not exemplified responsiveness in the invasive species context. The federal government has failed repeatedly to provide funding for weed eradication programs.²⁷⁰ After the passing of the PPA, the Animal and Plant Health Inspection Service (APHIS) assumed control for eradication of listed weeds.²⁷¹ Now, however, program funding through APHIS is dedicated

invasive species advisory group for the express purpose of managing the threat of invasive species. The group brings together several state agencies, interested federal agencies, and other stakeholders. While an informal list of invasive species has been generated by the Virginia Department of Agriculture and Consumer Services, the list has limited impact and does not take the effect of law. Except for an emergency quarantine order that bans beach vitex (*Vitex rotundifolia* L.), Virginia does not regulate invasive species or other noxious weeds. Quinn et al., *supra* note 1, at 126, tbl.1. Thus it has a fidelity score of 0% and latency score of 0%. See *id.* at Supplemental Material, fig.2.

²⁶⁷ See PATRICK COMER ET AL., *supra* note 36, at 23–26 (identifying nearly 600 different ecoregions within the project zone, covering nearly the entire continental United States).

²⁶⁸ For example, Kansas has banned some plant species, while allowing counties the option to name certain species as “noxious.” KAN. STAT. ANN. §§ 2-1314, 2-1314b (2012).

²⁶⁹ See *supra* notes 29–45 and accompanying text.

²⁷⁰ Telephone Interview with Hilda Diaz-Soltero, Senior Invasive Species Coordinator, USDA (Oct. 26, 2011). Although Congress passed the bill authorizing \$15,000,000 in funding for invasive species control efforts, none of the funding was actually allocated towards this purpose. *Id.*; see Noxious Weed Control and Eradication Act of 2004, Pub. L. No. 108-412, § 457, 118 Stat. 2320, 2324.

²⁷¹ See U.S. DEP’T OF AGRIC., ANIMAL AND PLANT HEALTH INSPECTION SERVICE, REVIEW OF PETITION TO ADD GENETICALLY ENGINEERED GLYPHOSATE-TOLERANT KENTUCKY BLUEGRASS TO THE FEDERAL NOXIOUS WEEDS REGULATIONS 2–3 (2011), available at http://www.aphis.usda.gov/plant_health/plant_pest_info/weeds/downloads/Kentucky-BG/KY-BG-FNW-PetitionReview.pdf.

to combating only a small number of targeted weeds²⁷² and coordinating efforts through cooperative agreements with state or private party stakeholders.²⁷³ The agency classifies priority weeds as those that have significant ecological and economic impacts in the areas where they have been introduced.²⁷⁴ But APHIS priorities and state interests likely differ in many areas, with states perhaps more interested in leveraging scarce resources at non-federal weeds that have a greater probability of successful eradication from important ecological areas (i.e., early efforts before widespread establishment). Therefore, remediation implementation may have a stronger focus in state governments, where there is adequate authority and potential resources to assert meaningful change.²⁷⁵

In light of the inefficiencies discussed above with both local and federal invasive species regulation and eradication efforts, our attention shifts to state-level reform. Our research has shown that despite the potential structural advantages outlined above (e.g., scientific expertise, resources, and the ability to target areas of high success), state regulatory regimes currently in place are thus far ill-equipped to handle existing invasive species pressures.²⁷⁶ When placed in the context of looming renewable energy mandates projected to demand massive volumes of biomass feedstocks, the potential for irresponsible releases of invasive plant species will increase.²⁷⁷ Therefore, prudence would dictate taking precautionary measures to address the pressures that renewable energy mandates will place upon states. The following discussion will focus on both *ex ante* and *ex post* actions that may not generate a perfect answer, but nonetheless provide a reasonable starting point for mending major holes in the “patchwork” of current invasive plant species management.²⁷⁸

A. *Ex Ante Solutions*

Because the cost to control or eradicate invasive plants increases exponentially over time as the species establishes itself in its new environment,²⁷⁹ early placement of control efforts should be a priority.²⁸⁰

²⁷² *Id.* at 3–4.

²⁷³ *Id.* at 3.

²⁷⁴ *Id.* at 4.

²⁷⁵ There could be an argument here for regional plant authorities within the state structure, but an exploration of this solution is outside the scope of this Article, and left for another time. Moreover, there would have to be some in-depth research into the efficacy of regional authorities in general.

²⁷⁶ See Quinn et al., *supra* note 1, at 125–26.

²⁷⁷ See Barney & DiTomaso, *supra* note 28, at 124–25; Joseph M. DiTomaso et al., *Biofuel vs. Bioinvasion: Seeding Policy Priorities*, 44 ENVTL. SCI. & TECH. 6906, 6906 (2010), available at <http://pubs.acs.org/doi/pdfplus/10.1021/es100640y> (“[M]any plant species proposed, and in some cases under development, for biofuel production in the U.S. are invasive species or have a high likelihood of escaping cultivation and becoming invasive.”).

²⁷⁸ The authors recognize that the solutions provided in this Article would require a great deal of advocacy before several state legislatures. However, as the solutions are neither revolutionary nor implausible, there is increased likelihood of acceptance.

²⁷⁹ MULLIN ET AL., *supra* note 1, at 6 fig.1; see also Barney & DiTomaso, *supra* note 28, at 124–25.

Unfortunately, the patchwork coverage of federal and state rules applies only to those plant species already listed as noxious weeds,²⁸¹ yet the listing process is plagued with inefficiencies as demonstrated empirically in our fidelity and latency calculations.

The political process within states invariably opens itself to competing interests of unaligned industries.²⁸² In those circumstances, legislators may have an aversion to acting hastily in listing a plant as noxious, risking the backlash of industry players within the state—generally the ornamental nursery industry. Political economy in some states has overridden scientific findings.²⁸³ On the other hand, administrative agencies may be just as ineffective. For example, they may possess broad authority as in Virginia, but fail to exercise their regulatory role.²⁸⁴

With these thoughts in mind, we discuss below a series of structural changes to provide a sounder foundation for future regulation of invasive plant species.

1. Formalizing Invasive Species Councils within State Government

While many states have invasive species councils (ISCs) of some form, their composition and structure varies dramatically, as does their attention to invasive plant species.²⁸⁵ Some follow the National Invasive Species Council (NISC) structure—a collaboration between the secretaries of relevant state agencies, under the advisement of a core Invasive Species Advisory Committee composed of scientists, industry representatives, and other stakeholders.²⁸⁶ The NISC model structure is ideal for garnering input from stakeholders and, most importantly, obtaining robust ecological and scientific input for subsequent regulation of plant species. Our empirical study demonstrated the results of states such as Connecticut, Massachusetts, and New Hampshire, where state officials worked with private industry through ISCs to develop more robust plant regulations.²⁸⁷

In addition to formalizing the structure of ISCs within each state, we further recommend that these recognized governmental entities be given authority to directly revise noxious weed lists based upon the most current data. Moreover, by segregating ISCs from the control of a single agency—in

²⁸⁰ See *supra* notes 2–9 and accompanying text.

²⁸¹ See discussion *supra* notes 98–103 and accompanying text.

²⁸² See He Min et al., *Rent-Seeking in Invasive Species Regulation: The Case of Noxious Weeds*, 84 LAND ECON. 306, 324 (2008).

²⁸³ For example, in North Carolina, a special category of noxious weed was created to “quarantine” the economically important, yet highly invasive, oriental bittersweet (*Celastrus orbiculatus*) to the Appalachian region of the state. E-mail from Rick Iverson, N.C. Dep’t of Agric. & Consumer Serv., to Jacob N. Barney, Assistant Prof. of Invasive Plant Ecology in the Dep’t of Plant Pathology, Physiology & Weed Science, Virginia Polytechnic Inst. & State Univ. (Nov. 7, 2012, 04:24 EST) (on file with author).

²⁸⁴ See *supra* note 264.

²⁸⁵ See discussion *supra* Part II.B (highlighting the structural differences in various state approaches).

²⁸⁶ Quinn et al., *supra* note 1, at 128.

²⁸⁷ See discussion *supra* Part II.B.7–9.

most cases the state department of agriculture—there is an increased likelihood of scientific determinations of potential invasiveness counterbalancing other industry interests.

Although evaluation of existing plant species within a given jurisdiction using established weed risk assessment (WRA) processes by ISCs is an important first step, given the nature of invasive species migration, ISCs ideally would have forward-looking authority to review and determine invasiveness potential before new plant species are introduced. While WRAs may not provide a perfect predictive model, there is consensus within the ecology community that WRAs do provide a solid start for screening potentially invasive species before they become established in a particular ecosystem.²⁸⁸ Moreover, implementation of WRAs will lower the frequency of regulating non-invasive plant species, while increasing the likelihood of capturing invasive plant species, thereby increasing latency scores.

2. Regulatory Precision in Defining Invasive Species

A potentially significant issue within the framework of invasive species regulation is the lack of consistency and precision in defining ecological terms. For example, a recent study by these authors identified that half of the states do not define one or more of the terms “invasive,” “native,” “nonnative,” and “alien” in the regulation or statutes discussing noxious weeds or invasive species.²⁸⁹ Alternatively, there is wide variation among the states that have defined those terms.²⁹⁰ In some instances, there is inconsistency within a state itself (e.g., among different sections of the state code or between the statute and implementing regulations).²⁹¹ Perhaps the most important threat in this lack of definitional precision arises from legislatures defining ecologically important terms in a manner that is deleterious to invasive plant species control. This could result in inadequate regulation of invasive species or overregulation of the introduction of potentially beneficial, non-invasive plant species—especially in the bioenergy context.

For example, Mississippi and Florida recently passed laws that provide for an invasive plant permitting process applicable only to bioenergy

²⁸⁸ There are two main versions of WRAs, namely the WRA produced and developed by the Plant Protection and Quarantine division of APHIS, see Anthony L. Koop et al., *Development and Validation of a Weed Screening Tool for the United States*, 14 *BIOLOGICAL INVASIONS* 273, 274 (2012), and the more widely used Australian WRA, see William Roberts et al., *Regulating Invasive Plants and Use of Weed Risk Assessments*, 3 *CURRENT OPINION ENVTL. SUSTAINABILITY* 60, 60–65 (2011).

²⁸⁹ Jacob N. Barney et al., *The Legislative Language of Invasive Plant Ecology: Coming to “Terms,”* at fig.1, supp. tbls.S1 & S2 (Mar. 23, 2012) (unpublished manuscript) (on file with author); see also A. Bryan Endres et al., *Definitional Debates and Uncertainty for Would-be Biofuel Producers*, *FARMDAILY*, http://www.farmdaily.illinois.edu/2012/05/definitional_debates_and_uncer.html (last visited Dec. 10, 2012) (discussing the inconsistent and overlapping usage of “non-native” and “invasive” in legislation).

²⁹⁰ Barney et al., *supra* note 289, at ll. 46–48, fig.1, tbs.S1, S3.

²⁹¹ For example, Florida defines “invasive” five different times throughout its codes and statutes, and only some of the definitions are related. See *id.* at tbl.S3.

crops.²⁹² The stated purpose of the Mississippi law is to prevent the introduction of “nonnative” plants into the state that may become “invasive” or constitute a nuisance.²⁹³ Unfortunately, Mississippi fails to define these critical terms. This can potentially create uncertainty in the bioenergy industry, as producers lack clear guidance on acceptable biomass feedstocks. Accordingly, within the broader context of invasive species regulatory reform, we recommend that legislators and regulatory entities look to the weed ecology community for guidance in eliminating ambiguity and inconsistency in legal definitions of the terms invasive, native, and alien.

B. Ex Post Liability: Internalizing the Social Costs

Civil liability is not available in most states for the negligent or intentional introduction of invasive plant species.²⁹⁴ Moreover, administrative penalties apply only to plants on the noxious weed lists, not all invasive species. As noted above, the minor penalties associated with most noxious weed statutes provide little ex ante incentive for precautionary behavior.²⁹⁵ In the limited instances in which state or federal governments do take action to eradicate these plants—usually on non-agricultural state or federal lands—the party who introduced the invasive species bears no responsibility for his/her action.²⁹⁶ The transfer of responsibility from the individual landowner to the government creates an overall loss to society.²⁹⁷ Stated another way, the harm caused by introduction of invasive species does not fall on the individual who generated the harm, but rather on society as a whole.²⁹⁸

In the current legal environment, there is no economic incentive to limit or control the introduction of invasive plant species that may spread onto others’ land.²⁹⁹ As a result, a classic negative externality problem arises whereby the culpable party shifts the costs of their activity onto society at large.³⁰⁰ Legal theory seeks to resolve this economic-cost misalignment through a Pigouvian tax³⁰¹ or through the assignment of property rights

²⁹² MISS. CODE ANN. § 69-25-10 (West Supp. 2012); FLA. STAT. ANN. § 581.03(4) (West Supp. 2012).

²⁹³ MISS. CODE ANN. § 69-25-10 (West Supp. 2012).

²⁹⁴ HARL, *supra* note 89, at § 11.03[3], p. 11-13.

²⁹⁵ See *supra* notes 95–97 and accompanying text.

²⁹⁶ See *supra* note 97 and accompanying text.

²⁹⁷ See generally R. H. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1 (1960) (discussing the inequitable harm imposed on society, or on a particular individual, when an actor avoids the consequences of his bad conduct).

²⁹⁸ See HARL, *supra* note 89, at §11.03[3], p. 11–13 (noting the absence of a legal remedy for landowners whose property is injured by the spread of invasive weeds from an adjoining property).

²⁹⁹ See generally *id.* at §§ 11.01–11.03 (analyzing the law’s general failure to successfully incentivize the containment of noxious weeds).

³⁰⁰ See Coase, *supra* note 297, at 6–8.

³⁰¹ See A. C. PIGOU, *THE ECONOMICS OF WELFARE* 223–25 (Macmillan & Co., 4th ed. 1932) (discussing how the government can correct inequitable market outcomes by taxing certain behaviors that would otherwise result in negative externalities).

protected by a liability regime.³⁰² For example, a tax on the pollution from a factory would raise costs, providing an economic incentive for the factory to reduce emissions through new manufacturing processes or pollution control technology, or, if the market allows, by passing the tax onto the consumer through increased prices. On the other hand, if the parties impacted by the pollution have an enforceable property right, the loss to society arising from the externality is resolved through the ability of the parties involved to exchange the rights for a price or seek relief in the courts through compensation or an injunction.³⁰³

Florida's biomass permitting process represents a type of regulatory tax that attempts to internalize the potential negative externalities of large-scale biomass cultivation.³⁰⁴ Applicants seeking to cultivate more than two acres of non-native biomass crops within the state must obtain a permit and post a bond in an amount equal to 150% of the cost of removing and destroying the plant should it become invasive.³⁰⁵ Unfortunately, at no point in the permitting process does Florida law require an assessment of the plant's invasiveness prior to the introduction of non-native plant species. In fact, all that is required for production is a permit and a bond.³⁰⁶ Although the permitting process makes an attempt at preventing invasive species, it falls short as a preventive measure. The permitting process applies only to non-native plants, without regard to potential invasiveness within the context of large-scale biomass plantations. Given the ecological diversity of Florida, a native plant from one region of the state may have significant invasive potential within another ecological area, and yet avoid review due to its "native" status. This also begs the question of how the state legally defines the terms native and non-native.³⁰⁷ For those non-native plants, the tax—the financial and economic costs of the permit and bond—applies regardless of

³⁰² See Koon-lam Shea, *Coase Theorem, Liability Rules and Social Optimum*, 114 REV. WORLD ECON. (WELTWIRTSCHAFTLICHES ARCHIV) 540, 541 (1978).

³⁰³ *Id.*

³⁰⁴ See FLA. STAT. ANN. § 581.083(4)(a)(1) (West Supp. 2013). According to the Division of Plant Industry (DPI) in Florida, the purpose of the permitting process is to "control the introduction into, or movement within, Florida of plant species intended for biomass plantings and to establish procedures that will assist in . . . provid[ing] public and environmental protection." See BIOMASS PERMITTING, *supra* note 235.

³⁰⁵ FLA. STAT. ANN. § 581.083(4), (4)(e) (West Supp. 2013). Producers may petition the Department of Agriculture and Consumer Services (DACS) to exempt a non-native plant species from the permitting process. DACS will consult with the University of Florida's Institute for Food and Agricultural Sciences (IFAS) to determine plant invasiveness. If IFAS determines the non-native plant is not invasive, DACS may specifically exempt the species via the rulemaking process. FLA. ADMIN. CODE r. 5B-57.011(4) (2012).

³⁰⁶ FLA. STAT. ANN. § 581.083(4)(a)(1) (West Supp. 2013). The implementing regulations do make clear that the state will not issue permits to non-native plants included on either the state or federal noxious weeds list. FLA. ADMIN. CODE r. 5B-57.011(1) (2012); BIOMASS PERMITTING, *supra* note 235.

³⁰⁷ Currently, Florida defines "invasive" five times—once via statute, FLA. STAT. ANN. § 581.011(15) (West Supp. 2013), and four times via administrative rule, FLA. ADMIN. CODE rr. 5B-57.001(12), 62-348.200(6), 60D-14.006(6), 62S-4.001(7) (2012). While these provisions often define invasive plants as those that disrupt native plant communities, the terms native and non-native are not defined in the statutes or administrative rules. See, e.g., *id.* at r. 5B-57.001.

potential invasiveness. A non-invasive, and yet non-native plant (such as a sterile hybrid similar to *Miscanthus giganteus*), would be subject to the regulatory process despite the absence of an externality to internalize. As a result, the law is not only underreaching for potentially aggressive, native-in-Florida invasive species, but also is overreaching in some aspects because non-native plants with no invasive potential must bear the burden of the permitting process.

The context-driven nature of determining biofuel feedstock invasiveness and the potential to both over and underregulate different species leave the system largely unsustainable. Therefore, an approach that assigns accountability *ex post* presents a possibility to address current gaps in regulatory regimes. Traditionally, these *ex post* solutions have attached liability in the form of strict liability, nuisance, or negligence.³⁰⁸

Because the harsh line of inquiry within the strict liability context is so unforgiving, it is most often reserved for those activities that are either inherently dangerous or ultra-hazardous³⁰⁹—labels that do not properly apply to invasive plant species despite their tremendous cost to society. Moreover, in other contexts, courts have reasoned that weeds are a “natural condition” of nature, regardless of whether they have been intentionally planted by a landowner.³¹⁰ As a result, many states have categorically rejected strict liability recovery at common law for the “natural” spreading of noxious weeds.³¹¹

Although some cases have considered recovery under a common law private nuisance claim for the spread of invasive plants, these are by far the exception. For example, in South Dakota, a statute provides for recovery where a property owner allows the spread of a noxious weed onto the land of another.³¹² In the case of *Collins v. Barker*,³¹³ a neighbor brought a legal cause of action under various theories of liability.³¹⁴ The trial court granted summary judgment for the defendant on all claims because the weed in question was not classified as a noxious weed and its spread onto the neighboring plot was a natural growth.³¹⁵ On appeal, the South Dakota Supreme Court reversed, holding that even though the weed was not a regulated noxious weed, the harmed landowner could nonetheless pursue a nuisance claim against the offending landowner.³¹⁶ The court further stated that while “landowners may not be liable for the ‘natural’ spread of weeds to their neighbor’s property at common law, the allegations against Barker go far beyond what would be considered a ‘natural’ proliferation of weeds. Under the law of nuisance, landowners have a duty to exercise ordinary care. The duty of care is that which an ordinary, prudent, and careful

³⁰⁸ See Quinn et al., *supra* note 1, at 130.

³⁰⁹ 57A AM. JUR. 2D *Negligence* § 377 (2004).

³¹⁰ See HARL, *supra* note 89, at § 11.02, p. 11-3 n.3.

³¹¹ See *id.*

³¹² S.D. CODIFIED LAWS § 38-22-16.2 (2004).

³¹³ 668 N.W.2d 548 (S.D. 2003).

³¹⁴ *Id.* at 551.

³¹⁵ *Id.*

³¹⁶ *Id.* at 552.

landowner would use in similar circumstances, taking into consideration generally accepted agricultural and management practices.”³¹⁷

The limitation of a nuisance recovery is highlighted where the court identified that “generally accepted agricultural and management practices” must have been violated.³¹⁸ Nuisance would not apply where even highly invasive, non-native species are planted and then allowed to “naturally” migrate to an adjacent landowner’s property as a result of “accepted agricultural and management practices.”³¹⁹ Within this framework, the natural spread could include a biomass farmer adhering to normal farming practices of the region, even if an invasive crop escaped into private or public ecological systems.

To remedy this shortcoming inherent in common law forms of recovery, we propose further modification to the statutory noxious weed regimes that incorporates not only noxious weeds, such as in the South Dakota statute,³²⁰ but also recovery for harm caused by unregulated plants, with an accompanying showing of negligence on the part of the individual or producer who introduced the species.

Under our proposal to inject a negligence-based liability regime, we rely on the current state of ecological precaution—the weed risk assessment (WRA).³²¹ Failure to perform a WRA for a novel crop, or conduct some other pre-introduction assessment, would be evidence of unreasonableness on the part of the producer or plant developer. While it seems to be a stark contrast from existing law, in reality, the WRA works as a benefit to both the producer and the state. On one hand, the presence of the WRA will provide better insight for state ISCs to establish noxious weed lists. Yet crop producers would also benefit by gaining a shield against future liability.

A robust negligence regime provides many benefits for internalizing extant negative externalities. First, negligence is highly adaptable. While the initial statutory requirement may suggest a WRA, it is not definitive. Reasonableness may be determined by current industry and ISC standards, with courts free to account for increased improvements in assessment technology and ecological understanding. Additionally, a liability-based incentive is likely to encourage plant developers to actively participate in generating an assessment standard that is workable and that incorporates the latest technologies available for invasion ecology.

A negligence regime also creates a manageable pathway towards bioenergy production. Over the last decade, the United States has made two significant pushes towards increased use of biomass as part of a sustainable energy policy.³²² Both efforts by the federal government encouraged an

³¹⁷ *Id.* at 553.

³¹⁸ *Id.*

³¹⁹ *Id.*

³²⁰ S.D. CODIFIED LAWS § 38-22-16.2 (2004).

³²¹ *See supra* note 288 and accompanying text (discussing use of WRAs as the best predictor of plant invasiveness).

³²² *See* Energy Independence and Security Act of 2007, Pub. L. No. 110-140, 121 Stat. 1492; *see also* Energy Policy Act of 2005, Pub. L. No. 109-58, 119 Stat. 594. For a discussion of the

increased use of biomass feedstocks in order to reduce national dependence on foreign oil consumption, encourage rural development, and to reduce greenhouse gas emissions.³²³ Through the Energy Policy Act, the “carrot” of biofuels incentives partially became a “stick” of renewable fuel production mandates.³²⁴ Congress instructed the Environmental Protection Agency (EPA) to set blending requirements based partially on the “impact of the use of renewable fuels on the environment, air quality, energy security, job creation, and rural economic development.”³²⁵

An invasive risk assessment as contemplated under our proposal complements the environmental concerns embedded within the renewable fuel mandates. Moreover, the incentives created by an ex post liability approach should inject a degree of caution into the plant-breeding industry such that research is focused on high-yielding biomass cultivars with low invasive potentials. This will also reduce pressure on state regulatory regimes bracing for the potential onslaught of biomass plantations in response to renewable energy mandates. Implementation of these liability-avoiding best practices by the plant breeding industry will slow the spread of invasive plant species through novel crop producers and horticulturalists, effectively shifting the unfair financial burden of invasive plant species away from society or private individuals.

As noted above, a negligence regime is not a failsafe solution. For example, if a producer engages in a thorough WRA in order to determine a plant’s invasiveness, and the available knowledge at the time indicates that the species has low invasion potential, a subsequent naturalization of the new plant would not result in liability. Society will bear the damage from this plant. But this hopefully rare occurrence represents the current status quo.

C. Concluding Thoughts

Our empirical study of state noxious weeds statutes and invasive plant species laws represents only the first step toward improved invasive plant regulation. Mending the tattered edges of federalism in the invasive plant species context is no small task. However, as industry stakeholders and legislatures give proper attention to creating certainty for plant producers through industry standards and increased participation in science-based assessments, current societal and environmental costs will be reduced.

history of renewable energy incentives at the federal level, see Jody M. Endres, *No Free Pass: Putting the “Bio” in Biomass*, NAT. RES. & ENV’T, Summer 2011, at 33, 35.

³²³ See Energy Independence and Security Act §§ 202–251, 121 Stat. 1521–48; Energy Policy Act §§ 941–948, 119 Stat. 873–83.

³²⁴ Energy Policy Act § 1501 (codified at 42 U.S.C. § 7545(o)(2)) (providing for renewable fuel use mandates).

³²⁵ *Id.* § 1501(a)(2)(B) (codified at 42 U.S.C. § 7545(o)(2)(B)). The 2005 mandates required an increase of biofuel use each year until the year 2012, with the 2012 blending requirement to include at least 7.5 billion gallons of renewable fuel. *Id.* § 1501(a)(2)(B)(i) (codified at 42 U.S.C. § 7545(o)(2)(B)(i)). Congress raised renewable fuel mandates further in 2007. See Energy Independence and Security Act of 2007, §§ 201–248. For further discussion of the renewable fuel mandates, see Endres, *supra* note 322.

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Importantly, through the process of implementing a negligence regime, those remaining costs may be largely internalized to actors generating negative externalities. Although gaps will remain, our suggestions to mend the current patchwork of federal and state regulation provide an important step to halting the damage generated by invasive plant species.