

AN ECOSYSTEM-BASED APPROACH TO SLOWING THE SYNERGISTIC EFFECTS OF INVASIVE SPECIES AND CLIMATE CHANGE

DAVID A. STRIFLING†

“[I]nvasion is forever. Biological invasions are the least reversible form of pollution.”¹

“[T]he climate change that takes place due to increases in carbon dioxide concentration is largely irreversible for 1,000 years after emissions stop.”²

INTRODUCTION

Spring is springing earlier these days, an average of ten days earlier than it did just twenty years ago.³ This scientific phenomenon, called “spring creep,” is often ascribed to climate change.⁴ Perhaps unsurprisingly, spring creep affects individual species differently. It is a boon to some and a mortal danger to others. However, scientists researching these effects have identified one common theme: spring creep typically favors “invasive species,” defined as non-native species that cause environmental or economic harm, or both,⁵ and

† Abraham L. Freedman Teaching Fellow, Temple University Beasley School of Law. The author thanks Amy Sinden for her helpful comments on an earlier draft of this article and his family for their love and support.

1. *Asian Carp and the Great Lakes: Hearing Before the Subcomm. on Water Res. and the Env't of the H. Comm. on Transp. and Infrastructure*, 111th Cong. 10 (2010) (statement of Dr. David M. Lodge, Director, Center for Aquatic Conservation) [hereinafter Lodge Statement], available at <http://republicans.transportation.house.gov/Media/file/TestimonyWater/2010-02-09-Lodge.pdf>.

2. Susan Solomon, et al., *Irreversible Climate Change Due to Carbon Dioxide Emissions*, 106 PROC. NAT'L ACAD. SCI. U.S. 1704, 1704 (2009).

3. Lauren Morello, “*Spring Creep*” *Favors Invasive Species*, CLIMATEWIRE (Apr. 21, 2010), <http://www.scientificamerican.com/article.cfm?id=spring-creep-invasive-species> (explaining that on the calendar, spring always begins on the vernal equinox; however, scientists judge the beginning of spring based on numerous meteorological and biological factors such as the emergence of certain blooming plants, the date of the last frost, and average temperatures); see, e.g., Mark Schwartz & Bernhard Reiter, *Changes in North American Spring*, 20 INT'L J. OF CLIMATOLOGY 929 (2000).

4. Morello, *supra* note 3.

5. See Exec. Order No. 13,112, 64 Fed. Reg. 6183, 6183 (Feb. 3, 1999).

which generally appear to be adaptable to a broader range of climatic conditions.⁶ At one site, for example, invasive species now flower eleven days earlier than native species, almost perfectly matching the spring creep.⁷ The earlier flowering time confers an advantage on the invasive species, which compete with native species.⁸ Warmer temperatures also facilitate the physical movements of invasive species along previously inaccessible pathways⁹ and to previously inhospitable environments.¹⁰ Interestingly, it appears that the invasive species return these favors. By upsetting the delicate balance in native ecosystems, invasive species simultaneously increase that ecosystem's susceptibility to climate change-related stressors, and reduce its potential for carbon sequestration.¹¹

Even considered separately, invasive species and climate change are each likely to cause significant damage to human health and the environment, as well as enormous economic losses. For example, invasive species place a heavy strain on agricultural systems, they are responsible for a significant percentage of species extinctions, and they are vectors for the spread of disease.¹² Recent studies estimate that invasive species cause worldwide economic damage of about \$1.4 trillion yearly,¹³ or about 5% of the global economy. For its part, climate change "may well alter the lives of every person on the planet."¹⁴ The economic damages flowing from climate change are

6. Charles G. Willis et al., *Favorable Climate Change Response Explains Invasive Species' Success in Thoreau's Woods*, 5(1) PLoS ONE e8878, 2 (2010), available at <http://www.plosone.org/article/info:doi%2F10.1371%2Fjournal.pone.0008878>.

7. *Id.*

8. *Id.*

9. See generally Erika S. Zavaleta & Jennifer L. Royval, *Climate Change and the Susceptibility of U.S. Ecosystems to Biological Invasions: Two Cases of Expected Range Expansion*, in WILDLIFE RESPONSES TO CLIMATE CHANGE: NORTH AMERICAN CASE STUDIES 291 (Stephen Schneider & Terry Root eds., 2002) (noting that published range studies show that climate establishes range limits for numerous invasive species, and warming "will likely allow expanded invasions to occur worldwide").

10. See STANLEY W. BURGIEL & ADRIANNA A. MUIR, *INVASIVE SPECIES, CLIMATE CHANGE AND ECOSYSTEM-BASED ADAPTATION: ADDRESSING MULTIPLE DRIVERS OF GLOBAL CHANGE* 4 (2010); see also Patrick Parenteau, *Lead, Follow, or Get Out of the Way: The States Tackle Climate Change with Little Help from Washington*, 40 CONN. L. REV. 1453, 1470 (2008) ("Climate change is also expected to facilitate the spread of invasive species and disrupt ecosystem services.")

11. BURGIEL & MUIR, *supra* note 10, at 8–9.

12. See *infra* notes 96–100 and accompanying text.

13. BURGIEL & MUIR, *supra* note 10, at 4 (citing David D. Pimentel et al., *Economic and Environmental Threats of Alien Plant, Animal, and Microbe Invasions*, 84 AGRIC., ECOSYSTEMS & ENV'T 1, 14 (2001)).

14. *Nw. Env'tl. Def. Ctr. v. Owens Corning Corp.*, 434 F. Supp. 2d 957, 970 (D. Ore. 2006).

less certain, but recent estimates range from 5 to 20% of worldwide gross domestic product.¹⁵

To consider these phenomena separately, however, ignores the powerful multiplier effect each one exerts on the other. Although a sizable body of research has addressed policy responses to climate change,¹⁶ very little scholarship has addressed the policy response to the invasive species conundrum. And no scholars appear to have addressed the confluence of the two. This article fills that gap, positing that new scientific evidence showing the synergies between climate change and invasive species compels policymakers to consider climate change and invasive species jointly. The synergy between the two will compound the environmental and economic damages each phenomenon causes, and the policy response to each concern should ideally consider the synergistic effects of the other.

Part I of this article examines in detail the synergistic causes and effects of invasive species and climate change, which legal scholarship has entirely ignored to this point. Part II scrutinizes—and finds sorely lacking—federal laws and policies that attempt to control invasive species. One congressionally-commissioned report recently characterized these policies as an “uncoordinated patchwork” that only “partially match[es] the problem at hand.”¹⁷ The monumental ecological and economic impacts that invasive species cause are well-known in the scientific literature, but legal scholars have paid little attention to preventing or redressing these harms.

Finally, part III of this article provides early recommendations on the potential scope of and vehicle for a possible solution to the invasive species conundrum, especially in light of climate change. Part III concludes, in response to the negative synergistic effects identified in part I coupled with the shortcomings in federal invasive species policy identified in part II, that federal policymakers should adopt an ecosystem-based approach to controlling invasive species that has the potential to address both threats. Specifically, federal agencies should

15. NICHOLAS J. STERN, STERN REVIEW: THE ECONOMICS OF CLIMATE CHANGE 143 (2006).

16. See *infra* note 105 and accompanying discussion.

17. M. LYNNE CORN ET AL., CONG. RESEARCH SERV., RL30123, INVASIVE NON-NATIVE SPECIES: BACKGROUND AND ISSUES FOR CONGRESS CRS-55 (2002), available at <http://www.nationalaglawcenter.org/assets/crs/RL30123.pdf> (citing U.S. CONG. OFFICE OF TECH. ASSESSMENT, OTA-F-565, HARMFUL NON-INDIGENOUS SPECIES IN THE UNITED STATES 163 (1993)).

identify key ecosystems and ecosystem services¹⁸ they wish to preserve against the impacts of climate change and concentrate invasive species prevention and control on those same ecosystems, as well as on the pathways by which invasive species may reach them. Reducing the overall threat of invasive species by supporting ecosystem health is a low-risk strategy to combat the effects of climate change, no matter what level of severity those impacts eventually have.

I. THE SYNERGISTIC EFFECT OF CLIMATE CHANGE AND INVASIVE SPECIES

The connections between the environmental phenomena of climate change and invasive species are not immediately apparent. Indeed, at first glance they appear entirely disparate. One is believed to be global in nature, largely caused by the releases of certain gases into the atmosphere.¹⁹ The other proceeds at the ecosystem level, as invasive plants and animals slowly rise to replace their native counterparts.²⁰ The first has been the subject of exhaustive policy debates and negotiations in the United States and abroad, while the second has largely escaped such scrutiny. But these two phenomena have much more in common than the readily apparent production of negative effects on human health, the environment, and the economy. In fact, this part will show that the two are deeply connected in ways that scientists are only beginning to understand. In turn, this means that any adaptation or mitigation measures directed at combating one of the two will have effects on the other, and that policymakers should consider those effects when designing such measures.

18. Ecosystem services are “services of nature” such as “purification of air and water, pest control, renewal of soil fertility, climate regulation, pollination of crops and vegetation, and waste detoxification and decomposition.” James E. Salzman, *A Field of Green? The Past and Future of Ecosystem Services*, 21 J. LAND USE & ENVTL. L. 133, 133 (2006). Ecosystem services are “absolutely essential to our existence.” *Id.*; see also J.B. Ruhl & James E. Salzman, *The Law and Policy Beginnings of Ecosystem Services*, 22 J. LAND USE & ENVTL. L. 157, 157 (2007) (stating that the “suite” of ecosystem services “quite literally underpins human society.”).

19. See generally INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: SYNTHESIS REPORT, SUMMARY FOR POLICYMAKERS 5 (2007) [hereinafter IPCC] (“Most of the observed increase in global average temperature since the mid-20th century is *very likely* due to the observed increase in anthropogenic [greenhouse gas] concentrations.”).

20. See generally Jason A. Boothe, Comment, *Defending the Homeland: A Call to Action in the War Against Invasive Species*, 21 TUL. ENVTL. L.J. 407, 407–08 (2008).

A. *Climate Change*

Nearly twenty years ago, the United Nations Framework Convention on Climate Change defined “climate change” as “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.”²¹ The United States is among 194 parties to the Convention.²² The “ultimate objective” of the Convention is to “achieve . . . stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.”²³ Unfortunately, even the most optimistic assessment would likely conclude that little progress has been made toward that goal.

A detailed examination of the causes and effects of climate change is beyond the scope of this paper; those issues have been exhaustively studied by scientists, economists, policymakers, and legal scholars.²⁴ Suffice it to say that although the climate change phenomenon continues to be hotly debated in political circles,²⁵ there exists a “current scientific consensus that significant global climate change is happening, human activities are a significant contributing cause of that change, and the associated public health and welfare impacts are sufficiently serious to warrant climate change legislation.”²⁶ The most recent report from the Intergovernmental Panel on Climate Change (IPCC) predicted that the continued gradual warming of the globe will, to varying degrees of certainty, cause a host of negative effects including sea-level rise, ocean acidification, and increased frequency of extreme weather events such

21. United Nations Framework Convention on Climate Change art. 1, May 9, 1992, 1771 U.N.T.S. 107 [hereinafter UNFCCC art. 1].

22. UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, STATUS OF RATIFICATION OF THE CONVENTION, http://unfccc.int/essential_background/convention/status_of_ratification/items/2631.php (last visited Oct. 5, 2011).

23. UNFCCC art. 1, *supra* note 21, at 4.

24. *See, e.g.*, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, FOURTH ASSESSMENT REPORT: CLIMATE CHANGE (AR4) (2007); *see also* Robert N. Stavins, *A Meaningful U.S. Cap-and-Trade System to Address Climate Change*, 32 HARV. ENVTL. L. REV. 293 (2008); Richard J. Lazarus, *Super Wicked Problems and Climate Change: Restraining the Present to Liberate the Future*, 94 CORNELL L. REV. 1153 (2009); and many, many others.

25. *See, e.g.*, John M. Broder, *Inhofe Seeks Probe of Climate Science*, N.Y. TIMES GREEN BLOG (Nov. 24, 2009, 5:52 PM), <http://green.blogs.nytimes.com/2009/11/24/inhofe-seeks-probe-of-climate-science> (reporting Sen. James Inhofe’s claims that the work of the Intergovernmental Panel on Climate Change was “contrived and fabricated”).

26. Lazarus, *supra* note 24, at 1159.

as cyclones and droughts.²⁷ The report further predicts that these physical effects will directly affect human health and the environment through decreased agricultural yields, migration of climate refugees from coastal areas, and adverse effects on available water quality and quantity, among many others.²⁸

B. Invasive Species

By the late 1990s scientists and policymakers had begun to study climate change intensively, and in 1997, the Kyoto Protocol was adopted.²⁹ Awareness of the invasive species problem had also increased, but to a lesser extent. In February of 1999, President Bill Clinton issued Executive Order 13,112 (the “Order”) to “prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause.”³⁰ The Order defined “invasive species” as a non-native species “whose introduction does or is likely to cause economic or environmental harm or harm to human health.”³¹

That definition makes plain that not all non-native species are invasive. Most non-native species cause no economic or environmental harm; indeed, many are beneficial, including cattle, wheat, soybeans, and tulips.³² Nevertheless, “invasive” species in the true sense of the Order’s definition “inhabit all regions of the United States and every nation,”³³ and they cause significant economic harm in the United States every year. Recent estimates put the worldwide economic damages in excess of \$1.4 trillion annually, with the harm in the United States alone at over \$120 billion per year.³⁴

27. IPCC, *supra* note 19, at 7–13.

28. *Id.* at 13.

29. See Kyoto Protocol to UNFCCC art. 28, Dec. 11, 1997.

30. Exec. Order No. 13,112, 64 Fed. Reg. at 6183.

31. *Id.*

32. GOV’T ACCOUNTABILITY OFFICE, GAO-03-1, *INVASIVE SPECIES: CLEARER FOCUS AND GREATER COMMITMENT NEEDED TO EFFECTIVELY MANAGE THE PROBLEM* 8 (2002) [hereinafter GAO]; see also NAT’L INVASIVE SPECIES COUNCIL, 2008–2012 NATIONAL INVASIVE SPECIES MANAGEMENT PLAN 4 (2008) [hereinafter NISC MGMT. PLAN] (“Most nonnative species . . . are not harmful; and many are highly beneficial.”); Rick Bragg, *Enterprise Journal*; *A Town Once Menaced by a Bug Wants It Back*, N.Y. TIMES, July 27, 1998, at A10 (explaining that the town of Enterprise, Alabama, erected a statue honoring an invasive species, the boll weevil, in honor of the pest’s breaking the town’s dependence on the cotton industry).

33. NAT’L INVASIVE SPECIES COUNCIL, *FIVE-YEAR REVIEW OF EXECUTIVE ORDER 13,112 ON INVASIVE SPECIES 1* (2005) [hereinafter NISC REVIEW].

34. BURGIEL & MUIR, *supra* note 10, at 4 (citing David Pimentel et al., *Economic and Environmental Threats of Alien Plant, Animal, and Microbe Invasions*, 84 AGRIC., ECOSYSTEMS

Moreover, economic damage estimates do not fully value the nonmonetary damages involved in the displacement of native organisms or the destruction of ecosystems.³⁵ Costs typically not considered include the impact on natural ecosystems, the extinction of native species, lost water-purification capability, aesthetic and recreational impacts, and weakened resistance to impacts of invasions by other species in the future.³⁶ Instead, the estimates are more likely to focus on the effects on commercial activities such as timber or fishery production.³⁷

Invasive species have a long history of wreaking havoc on commerce and the environment. For example, the boll weevil devastated the United States cotton crop for a number of decades in the early twentieth century.³⁸ And it is undeniable that recent years have seen growth in both the environmental havoc wreaked by invasive species as well as the legal discord over them. Two examples illustrate these issues: the invasion of Walden Pond in Massachusetts, and the potential invasion of the Great Lakes by several species of Asian carp.

AND ENV'T 1, 14 (2001)) (stating that damages are estimated at \$1.4 trillion worldwide); Willis et al., *supra* note 6, at 1 (stating that damages exceed \$120 billion annually in the United States alone); see also GAO, *supra* note 32, at 6 (noting that the Formosan termite causes at least \$1 billion in damages annually in eleven states, and fruit flies could cause \$1.8 billion in annual damages).

35. GAO, *supra* note 32, at 13–14 (“Most economic estimates do not consider all of the relevant effects of nonnative species or the future risks that they pose.”).

36. *Id.* at 15.

37. *Id.*; see also Kate R. Bowers, *Saying What the Law Isn't: Legislative Delegations of Waiver Authority in Environmental Laws*, 34 HARV. ENVTL. L. REV. 257, 298 (2010) (“[I]t is difficult to quantify environmental costs and benefits in any way that permits the environment to compete with [other] interests . . .”); Frank Ackerman & Lisa Heinzerling, *Pricing the Priceless: Cost-Benefit Analysis of Environmental Protection*, 150 U. PA. L.R. 1553, 1578 (2002) (arguing that cost-benefit analysis “tends to skew decision making against protecting public health and the environment”).

38. See, e.g., *Tex. Boll Weevil Eradication Found. v. Lewellen*, 952 S.W.2d 454, 457 (Tex. 1997) (explaining that the boll weevil entered Texas from Mexico in 1892, and still “causes an estimated \$20 million in crop loss in Texas every year”); Charles Lewis Nier III, *The Shadow of Credit: The Historical Origins of Racial Predatory Lending and its Impact upon African American Wealth Accumulation*, 11 U. PA. J.L. & SOC. CHANGE 131, 168 n.246 (2008) (explaining that the boll weevil spread across the South in the first decades of the twentieth century and destroyed up to 50% of the cotton crop, resulting in a 30% decrease in cotton acreage in Louisiana, Mississippi, Alabama, Georgia, and South Carolina).

1. Case Study: Walden Pond

Henry David Thoreau spent two years living in semi-isolation at Walden Pond. *Walden; or Life in the Woods*,³⁹ published in 1854, documented Thoreau's observations of the surrounding plant and animal life, among other things, and eventually turned the site into a cultural and environmental icon. Today, Thoreau might find much of the flora and fauna unrecognizable. Harvard biologists studying the pond and its surroundings have found that 30% of the plants once found there are already extinct, and another 30% are so rare that they are likely to become extinct soon.⁴⁰ Walden "natives" such as lilies, orchids, roses, and dogwoods are less capable of flowering earlier to match the earlier spring.⁴¹ "The winners, by and large, are the non-native plant species."⁴² Slowly but surely, the native vegetation is being replaced by invasive species.

In 1851, Thoreau initiated a data-collection effort that is possibly unequalled in the annals of American biology.⁴³ Beginning that year, and in the 160 years since, biologists have collected local data related to temperature, species abundance, and first flowering date.⁴⁴ More recently, Harvard biologists divided the data set into native, invasive, and non-native non-invasive species based on data from the U.S. Department of Agriculture (USDA).⁴⁵ The biologists then examined the historical data to determine whether the three types of species differed significantly in their ability to respond to changing seasonal temperatures.

The biologists found that the invasive species tracked seasonal variations in temperature much better than did the native and non-native non-invasive species.⁴⁶ Over the past century, the invasive plants' flowering time has shifted to an average of eleven days earlier than that of native species. One species hastened its flowering time by an astonishing twenty-three days.⁴⁷ Other studies have shown that this innate ability to quickly adjust to changes in the seasons is not limited

39. HENRY D. THOREAU, *WALDEN; OR, LIFE IN THE WOODS* (Christopher Bigsby ed., 1854).

40. Morello, *supra* note 3.

41. *Id.*; see also Willis et al., *supra* note 6, at 2.

42. Morello, *supra* note 3; see generally Willis et al., *supra* note 6.

43. Willis et al., *supra* note 6, at 1.

44. *Id.* at 3.

45. *Id.* at 2.

46. *Id.*

47. *Id.*

to invasive plants. For example, a researcher studying the Sawtooth National Recreational Area in central Idaho found that invasive insects adjust their behaviors to account for season creep on a yearly basis, much more quickly than their native host forests, which can take decades to do so.⁴⁸

During the same period at Walden, the invasive species “significantly increased in abundance . . . relative to native . . . species.”⁴⁹ According to the researchers, the study provided the strongest proof to date of the synergy between climate change and invasive species.⁵⁰ The biologists concluded that “[a]s climate change accelerates, non-native species’ ability to respond favorably will likely exacerbate the ecological and economic problems that result from their success.”⁵¹

2. Case Study: Great Lakes

While Walden Pond demonstrates the competitive success of invasive species in certain ecosystems, the saga of the threatened invasion of the Great Lakes by several species of Asian carp illustrates how the lack of a cohesive federal program to control invasive species can lead to staggering litigation and administrative costs. As with Walden Pond, it is a story that begins over a century ago.

During much of the nineteenth century, the cities of Chicago and St. Louis engaged in a struggle to determine which of them would become the economic and population hub of the Midwest; as late as 1870, St. Louis remained the “larger and richer” city.⁵² Chicago was handicapped in this pursuit by the flow of its sewage and industrial waste from the Chicago River into the city’s primary harbor in Lake Michigan, thus polluting water intakes for its municipal water supply and causing several outbreaks of typhoid fever.⁵³

48. Jesse A. Logan, *Climate Change Induced Invasions by Native and Exotic Pests*, in PROCEEDINGS: 17TH U.S. DEPARTMENT OF AGRICULTURE INTERAGENCY RESEARCH FORUM ON GYPSY MOTHS AND OTHER INVASIVE SPECIES 8, 8 (2006) (explaining that mountain pine beetle outbreaks have worsened as climate has warmed, and will likely continue to do so).

49. Willis et al., *supra* note 6, at 3.

50. *Id.* at 2.

51. *Id.*

52. James H. Lemly, *The Mississippi River: St. Louis’ Friend or Foe?*, 39 BUS. HIST. REV. 7, 12–14 (1965).

53. See Noah D. Hall, *Toward a New Horizontal Federalism: Interstate Water Management in the Great Lakes Region*, 77 U. COLO. L. REV. 405, 419–20 (2006) (discussing pollution of municipal drinking water sources); see also Robert V. Percival, *The Clean Water Act and the*

The city, backed by the state of Illinois, solved its problem with an amazing feat of civil engineering, consisting of two massive projects. First, it constructed a series of locks and related facilities to reverse the flow of the Chicago River.⁵⁴ Second, to provide an outlet for the reversed flow, it created an artificial connection between the Lake Michigan watershed and the Mississippi River watershed via an entirely manmade body of water, the Chicago Sanitary and Ship Canal.⁵⁵

The practical consequences of the project were remarkable. With a single stroke, Chicago had not only solved the problem of its waste polluting its own harbor, it had in fact diverted that waste to the Mississippi River, where it flowed downstream to its rival St. Louis. Outraged, the state of Missouri promptly sued Illinois in an original action in the U.S. Supreme Court.⁵⁶ The Court ultimately ruled in Illinois' favor because it found that sufficient facts did not then exist to justify Missouri's economic and health-related fears. "There is nothing which can be detected by the unassisted senses—no visible increase of filth, no new smell."⁵⁷ But the Court also struck a note of caution:

It is a question of the first magnitude whether the destiny of the great rivers is to be the sewers of the cities along their banks or to be protected against everything which threatens their purity. To decide the whole matter at one blow by an irrevocable fiat would be at least premature.⁵⁸

In the long run, as the Court seemingly recognized, the greatest consequence of Chicago's project may be ecological, not economic. Today, the artificial connection between the Mississippi River and the Great Lakes is no longer primarily a path for untreated sewage; instead, it has become a pathway for an invasion of the Great Lakes.

The story of the invasion dates back almost half a century, to 1963, when the state of Arkansas imported grass carp, a species of

Demise of the Federal Common Law of Interstate Nuisance, 55 ALA. L. REV. 717, 719 (2004) (discussing typhoid outbreaks).

54. Lawrence B. Christmas, *Luncheon Address*, 17 N. ILL. U. L. REV. 419, 419 (1997).

55. Christopher Theriot & Kelly Tzoumis, *Deep Tunnels and Fried Fish: Tracing the Legacy of Human Intervention on the Chicago River*, 35 GOLDEN GATE U. L. REV. 377, 381 (2005).

56. *Missouri v. Illinois*, 200 U.S. 496 (1906).

57. *Id.* at 522.

58. *Id.* at 521.

Asian carp, for use in aquaculture and research.⁵⁹ A decade later, Arkansas introduced two more species of Asian carp, bighead and silver carp, for fish pond vegetation control.⁶⁰ The practice eventually spread to fish farms in numerous other states.⁶¹ These species of Asian carp are enormous fish. For example, silver carp can grow to three feet long and weigh up to sixty pounds; bighead carp can grow four and a half feet long and weigh up to eighty pounds.⁶² Occasionally, the carp species were accidentally released into the wild, and numerous carp escaped during the flooding of the Mississippi River in the 1990s.⁶³ Intentionally or accidentally, the Asian carp escaped into the lower Mississippi basin and rapidly migrated through nearly the entire basin, with their populations increasing exponentially.⁶⁴

The spread of the voracious predators did not go unnoticed. In 2006, the U.S. Fish and Wildlife Service (FWS) opined that “Asian carp pose the greatest immediate threat to the Great Lakes ecosystem.”⁶⁵ By 2009, silver carp had been observed in the Chicago Sanitary and Ship Canal, very near to Lake Michigan.⁶⁶ If the carp enter the Great Lakes, they could very well overwhelm native species and thereby devastate a fishery the value of which has been estimated at billions of dollars annually.⁶⁷

Attempting to forestall that outcome, in 2009 the state of Michigan, joined by several other Midwestern states, attempted to

59. *Asian Carp Species*, U.S. ENVTL. PROTECTION AGENCY, [hereinafter EPA] <http://yosemite.epa.gov/r10/ECOCOMM.NSF/Invasive+Species/Asian-Carp> (last visited Sept. 15, 2011); see also Theriot & Tzoumis, *supra* note 55, at 387.

60. EPA, *supra* note 59.

61. *Id.*

62. *Id.*

63. *Id.* Extreme weather events such as floods are expected to occur more frequently as a result of climate change, leading to the possibility for similar releases in the future. See Robin Kundis Craig, *Adapting to Climate Change: The Potential Role of State Common-Law Public Trust Doctrines*, 34 VT. L. REV. 781, 790 (2010) (quoting U.S. GLOBAL CHANGE RESEARCH PROGRAM, GLOBAL CLIMATE CHANGE IMPACTS IN THE UNITED STATES: A STATE OF KNOWLEDGE REPORT 48 (2009)).

64. See EPA, *supra* note 59; see also Dan Egan, *Troubled Waters: The Asian Carp Invasion—Chaos Uncorked*, MILWAUKEE J. SENTINEL, Oct. 15, 2006, at A1, available at <http://www.jsonline.com/news/wisconsin/29194474.html>.

65. FISH & WILDLIFE SERV., ASIAN CARP—AQUATIC INVASIVE SPECIES: ISSUES, PROGRAM ACCOMPLISHMENTS, AND PROGRAM NEEDS 2 (2006).

66. Joel Hood, *Asian Carp in Chicago Sanitary and Ship Canal Foil Boaters' Journeys*, CHI. TRIB., Sept. 3, 2009, http://articles.chicagotribune.com/2009-09-03/news/0909020855_1_boaters-carp-chicago-sanitary.

67. See FISH & WILDLIFE SERV., ASIAN CARP—AQUATIC INVASIVE SPECIES: ISSUES, PROGRAM ACCOMPLISHMENTS, AND PROGRAM NEEDS 2 (2006).

launch an original action in the U.S. Supreme Court against Illinois. The petitioning states sought the severance of the connection between the Great Lakes and the Mississippi; in other words, for Chicago to close the canal system.⁶⁸

The petitioning states faced a serious problem. As discussed in more detail in part II of this article, federal law provides scant authority to prevent such an invasion, or to control it after the fact. As such, the petitioning states were forced to root their petition in nuisance-based common law causes of action.⁶⁹ Moreover, the petitioning states lacked a statutory vehicle under which to bring the action, and so sought to engage the Supreme Court's jurisdiction via two attempts perhaps best described as long shots. The first attempt was a petition to reopen a set of cases related to Illinois' diversion of water from Lake Michigan that the Court had initially settled in 1929 and had reopened several times since.⁷⁰ Second, the petitioning states concurrently requested that the Court exercise its original jurisdiction to enter a preliminary injunction to effectively close the locks and prevent the passage of the carp.⁷¹

The Supreme Court denied the petitioning states' motion for an injunction on March 22, 2010,⁷² and a month later the Court denied the petitioners' request to re-open the diversion cases.⁷³ Since then, President Obama named a "carp czar," John Goss, to coordinate federal efforts to keep the carp out of the Great Lakes,⁷⁴ convened a "carp summit" at the White House,⁷⁵ and proposed a \$78 million plan

68. Motion for Preliminary Injunction at 5, *Wisconsin v. Illinois*, 130 S. Ct. 1166 (2010), 2009 WL 6310836 at *5.

69. *See id.* at 25–26.

70. Motion to Reopen and for a Supplemental Decree at 4, 6–7, *Wisconsin v. Illinois*, 130 S. Ct. 2397 (2010), 2009 WL 6310835 at *4, 6–7. Even Congress got into the act, as several House Democrats launched an online petition calling on the Supreme Court to immediately order the closure of the Chicago locks. *See House Dems to Supreme Court: Reopen Asian Carp Case Now*, MICH. HOUSE DEMOCRATIC CAUCUS (Jan. 22, 2010), <http://www.housedems.com/news/article/house-dems-to-supreme-court-reopen-asian-carp-case-now>.

71. Motion for Preliminary Injunction, *supra* note 68, at 5.

72. *Wisconsin v. Illinois*, 130 S. Ct. 1934 (2010) (denying motion for preliminary injunction).

73. *Wisconsin v. Illinois*, 130 S. Ct. 2397 (2010) (denying motion to reopen and for a supplemental decree).

74. Joel Hood, *White House Names Asian Carp Czar*, CHI. TRIB., Sept. 8, 2010, http://articles.chicagotribune.com/2010-09-08/news/ct-met-carp-czar-0909-20100908_1_chicago-waterway-system-million-federal-attack-czar.

75. Andrew Stern, *U.S. Asian Carp Remedies Unsatisfactory—Governors*, REUTERS, Feb. 8, 2010, available at <http://www.reuters.com/article/2010/02/09/us-greatlakes-carp-idUSTRE61801020100209>.

to keep Asian carp out of the Great Lakes.⁷⁶ Meanwhile, in July 2010 Michigan and four other states filed a new lawsuit in federal district court naming as defendants the Army Corps of Engineers and the Metropolitan Water Reclamation District of Greater Chicago.⁷⁷ Although the suit adds an Administrative Procedure Act based claim, it primarily relies on the same legal theory as the earlier suits: that the defendants have created an ongoing public nuisance by operating locks, gates, and other infrastructure through which the carp can enter the Great Lakes.⁷⁸

The enormous expenditure of public resources in such high stakes, “long-shot” cases are necessitated by the traditional failure of federal law to address the invasive species problem in any uniform or effective manner as discussed in part II of this article.

C. Synergies

Despite exhaustive study, the effects of climate change are still not fully understood.⁷⁹ Every day, however, scientists uncover more about how the climate affects the environment, and vice versa. As the Walden Pond case study demonstrates, scientists have recently begun to examine the direct and indirect synergies between climate change and invasive species.⁸⁰ A 2010 study funded by the World Bank revealed evidence of at least three direct synergies between the two.⁸¹

First, climate change will provide invasive species with new opportunities to compete with native species. For reasons yet unknown, invasive species are typically more adaptable than native species.⁸² They can survive in a broader range of conditions and are better able to withstand the rising temperatures and shifting seasons

76. *Id.*

77. *Illinois: States Sue Again Over Carp*, N.Y. TIMES, July 20, 2010, at A12, available at http://www.nytimes.com/2010/07/20/us/20brfs-STATESSUEAGA_BRF.html.

78. See *Michigan v. U.S. Army Corps of Eng'rs*, No. 10-CV-4457, 2010 WL 5018559, at *21 (N.D. Ill. Dec. 2, 2010).

79. See, e.g., Robin Kundis Craig, “Stationarity Is Dead”—*Long Live Transformation: Five Principles for Climate Change Adaptation Law*, 34 HARV. ENVTL. L. REV. 9, 38 (2010). Perhaps the best evidence of this is that the United States government spends billions of dollars every year on research related to climate change. See AM. ASS'N FOR THE ADVANCEMENT OF SCI., AAAS REPORT XXXV: RESEARCH AND DEVELOPMENT FY 2011 172 (2011).

80. See generally BURGIEL & MUIR, *supra* note 10.

81. See generally *id.*

82. See Robert L. Glicksman, *Ecosystem Resilience to Disruptions Linked to Global Climate Change: an Adaptive Approach to Federal Land Management*, 87 NEB. L. REV. 833, 848 (2009).

that scientists predict will result from climate change.⁸³ Moreover, warmer temperatures may facilitate the physical movements of invasive species.⁸⁴ This could occur because invasive species will be able to move along new pathways to previously inaccessible environments and higher elevations, or because invasive species will be transported via extreme wind and wave events, which are expected to become more commonplace as climate change takes hold.⁸⁵

Second, some scholars and conservationists have advocated the concept of “assisted migrations,” under which humans would facilitate the physical movement of species whose continued existence is jeopardized by changing environmental conditions to a less threatening location.⁸⁶ This strategy could end up doing more harm than good if the relocated species becomes invasive in its new location.⁸⁷ Professor Jonathan Wiener has advocated a “risk-risk” analysis to fully consider the countervailing risks associated with policymakers’ decisions to protect human health and the environment, and a similar analysis would likely be appropriate before any major facilitated movements are undertaken.⁸⁸

Third, the presence of invasive species is likely to increase an ecosystem’s susceptibility to climate change-related stressors and to reduce its carbon sequestration potential.⁸⁹ For example, certain invasive insects can increase tree mortality rates, and invasive grasses may induce fires in some tropical ecosystems, thus devastating native

83. Willis et al., *supra* note 6, at 2. Invasive species may thrive in new environments for reasons unrelated to climate adaptability; for example, they often lack natural predators in the new environment, and they have high rates of reproduction and dispersal. See Eric V. Hull, Comment, *Soiling the Sea: The Solution to Pollution is Still Dilution – a Re-Evaluation of the Efficacy of 40 C.F.R. § 122.3 and Annex IV of MARPOL*, 3 BARRY L. REV. 61, 81 (2002).

84. See Matthew D. Zinn, *Adapting to Climate Change: Environmental Law in a Warmer World*, 34 ECOLOGY L.Q. 61, 74 (2007) (“Increasing temperatures may expand the range of vectors and allow parasites to thrive in new locations.”).

85. BURGIEL & MUIR, *supra* note 10, at 4, 7.

86. See Alejandro E. Camacho, *Assisted Migration: Redefining Nature and Natural Resource Law Under Climate Change*, 27 YALE J. ON REG. 171, 173 (2010) (suggesting that a “growing number of conservationists, resource managers, and scientific and legal scholars” support the idea of assisted migration). Professor Camacho argues that “anticipatory strategies such as assisted migration may not only be permissible but even necessary to avert substantial irreversible harm to ecological systems.” *Id.* at 171.

87. BURGIEL & MUIR, *supra* note 10, at 7–8.

88. See John D. Graham & Jonathan B. Wiener, *Confronting Risk Tradeoffs*, in RISK VERSUS RISK: TRADEOFFS IN PROTECTING HEALTH AND THE ENVIRONMENT 1–2 (John D. Graham & Jonathan B. Wiener eds., 1995).

89. BURGIEL & MUIR, *supra* note 10, at 8–9.

forests.⁹⁰ This will weaken the ecosystem's resistance to climate change.

In addition to these three direct synergies, climate change and invasive species will indirectly influence each other in several respects. First, "disturbance events" such as hurricanes and other natural disasters are expected to become more common due to climate change.⁹¹ By increasing the stress on local ecosystems, such events will make it easier for invasive species to establish themselves.⁹² Moreover, well-meaning relief efforts to natural disaster locations may unintentionally result in the direct introduction of new invasive species to nearby ecosystems.⁹³

Finally, climate change is likely to change ecosystem functions and interactions in ways that are currently difficult to predict.⁹⁴ Given the innate ability of invasive species to survive under a broader range of conditions than native species typically can, this too is likely to favor the proliferation of invasive species over natives. In fact, scientists studying the spring creep phenomenon, like those at Walden Pond, could conceivably point to the rising dominance of invasive species in a particular ecosystem as corroborative evidence of climate change, when coupled with rising temperatures in that same ecosystem.

Considered separately, invasive species and climate change are each likely to cause significant economic losses and damage to the environment and human health. Scientists predict that climate change will cause a panoply of serious, irreversible calamities, threatening "the basic elements of life for people around the world."⁹⁵ These impacts will include reduction in drinkable water supplies, eventually threatening up to one-sixth of the world's population; declining crop yields, especially in developing nations; increases in vector-borne diseases, such as malaria; rising sea levels causing increasing floods and even permanent population displacement in coastal areas; mass extinction of species, especially in vulnerable ecosystems; and the

90. *Id.* at 9.

91. IPCC, *supra* note 19, at 12–13; *see also* Nathaniel Keohane, *The Urgency of U.S. Action on Climate Change, and the Prospects for Legislation*, 18 N.Y.U. ENVTL. L.J. 1, 2 (2010).

92. BURGIEL & MUIR, *supra* note 10, at 9.

93. *Id.* at 10.

94. *Id.* at 10–11.

95. STERN, *supra* note 15, at vi.

potential for abrupt, sudden events such as the collapse of polar ice sheets or the drying of the Amazon rain forest.⁹⁶

Like climate change, invasive species also have the potential to inflict significant damages on human health and the environment. First, invasive species may place a heavy strain on agricultural systems through the introduction of new weeds, pests, and diseases.⁹⁷ This will have a domino effect as the weakened agricultural production will cause rising prices at best, and food shortages and security issues at worst, especially in developing nations.⁹⁸

Moreover, invasive species will wreak irreversible havoc on biodiversity. Invasive species are already suspected to be responsible for one-half to two-thirds of species extinctions.⁹⁹

Finally, invasive species are often vectors for the spread of diseases. For example, an increased range for mosquitoes from hot and wet climates may result in a similar geographic increase in the scope of many infectious diseases such as malaria.¹⁰⁰ As of July 2008, the U.S. Centers for Disease Control and Prevention reported that the West Nile Virus, an invasive pathogen common to humans and animals, had caused 1,086 deaths in the United States.¹⁰¹

96. *Id.* at vi–vii; see also John Harte, *Land Use, Biodiversity, and Ecosystem Integrity: The Challenge of Preserving Earth's Life Support System*, 27 *ECOLOGY* L.Q. 929, 947 (2001) (listing some of the dangers of warming and highlighting how many are exacerbated by other unsustainable land use practices); Derald J. Hay, *Post-Kyoto Stress Disorder: How the United States Can Influence International Climate Change Policy*, 15 *MO. ENVTL. L. & POL'Y REV.* 493, 493–94 (2008) (summarizing dangers of climate change); Mary Christina Wood, *Advancing the Sovereign Trust of Government to Safeguard the Environment for Present and Future Generations (Part I): Ecological Realism and the Need for a Paradigm Shift*, 39 *ENVTL. L.* 43, 49 (2009) (“[Runaway heating] would bring floods, hurricanes, killer heat waves, fires, disease, crop losses, food shortages, droughts, and could cause extinctions of 50% or more of the world’s species.”). See generally INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *CLIMATE CHANGE 2007: IMPACTS, ADAPTATION AND VULNERABILITY* (Martin Parry et al. eds., 2007).

97. BURGIEL & MUIR, *supra* note 10, at 21 (“Invasive species . . . are already arguably the largest impediment to global food security and agricultural productivity.” (citation omitted)).

98. *Id.* at 20–21; see also David E. Adelman & John H. Barton, *Environmental Regulation for Agriculture: Towards a Framework to Promote Sustainable Intensive Agriculture*, 21 *STAN. ENVTL. L.J.* 3, 25 (2002) (stating that there are “\$28.8 billion in losses to agriculture annually from invasive species”).

99. BURGIEL & MUIR, *supra* note 10, at 4; see generally *The Growing Problem of Invasive Species: Joint Oversight Hearing Before the Subcomm. On Fisheries Conservation, Wildlife and Oceans Joint with the Subcomm. On National Parks, Recreation and Public Lands, H. Comm. On Resources*, 108th Congress 5 (2003) (statement of Daniel Simberloff, Professor, University of Tennessee–Knoxville) (providing examples of ecosystem disruption and species extinction that include invasive zebra mussels smothering endangered native mussels and invasive plants depriving native plants of nutrients necessary for survival).

100. *Id.* at 24–25; see also Harte, *supra* note 96, at 947.

101. NISC MGMT. PLAN, *supra* note 32, at 4.

The potential economic impacts are also considerable, albeit “difficult to estimate.”¹⁰² Recent studies have estimated that invasive species cause economic damages of about \$1.4 trillion annually, or about 5% of the global economy.¹⁰³ In the United States, these estimates likely do not include the increasing costs of interstate litigation over invasive species like the Asian carp dispute discussed above.

The economic losses from climate change are more uncertain. As noted above, recent predictions put the estimated economic damages due to that phenomenon at 5 to 20% of global GDP.¹⁰⁴ This means that even without considering synergies, the combined economic damages from invasive species and climate change are in the range of 10 to 25% of global GDP. The synergistic effects discussed above will only increase those damages.

The next part details the failure of federal law to effectively address invasive species, much less the synergistic effects described in this part.

II. FEDERAL LAW’S FAILURE TO ADEQUATELY CONTROL THE NEGATIVE EFFECTS OF INVASIVE SPECIES EXACERBATES THE LIKELY DAMAGE FROM CLIMATE CHANGE

As shown above, both climate change and invasive species may have devastating effects on human health and the environment. Moreover, the economic damages caused by climate change and invasive species are similar. Yet the attention given to these two phenomena is strikingly disparate. The failure of federal law to address the potential causes and effects of climate change has been thoroughly studied and debated by economists and legal scholars.¹⁰⁵ By comparison, the scholarly examination of the laws and regulations governing invasive species has been vanishingly small. Part II of this

102. *Id.*

103. BURGIEL & MUIR, *supra* note 10, at 4 (citing David Pimentel et al., *Economic and Environmental Threats of Alien Plant, Animal, and Microbe Invasions*, 84 AGRIC., ECOSYSTEMS & ENV’T 1, 14 (2001)).

104. STERN, *supra* note 15, at 143 (“[T]he appropriate estimate of damages may well lie in the upper part of the 5–20% [of global GDP].”).

105. See, e.g., Andrew Long, *International Consensus and U.S. Climate Change Litigation*, 33 WM. & MARY ENVTL. L. & POL’Y REV. 177, 178 (2008) (“[T]he U.S. political branches have utterly failed to respond to the [climate change] threat in anything approaching an effective and unified manner.”); Arnold W. Reitze, Jr., *Federal Control of Greenhouse Gas Emissions*, 40 ENVTL. L. 1261, 1288 (2010) (noting that a failure to address climate change through federal legislation has forced the EPA to use less than ideal regulatory methods).

article undertakes a comprehensive examination of federal law related to invasive species and reveals its extreme inadequacy. Moreover, none of the measures discussed below anticipated or controlled for the effects of climate change.

A. *The Lacey Act*

The Lacey Act¹⁰⁶ is often described as the first federal wildlife protection law, and even today commentators describe it as the “preeminent government weapon against illegal wildlife trafficking.”¹⁰⁷ It prohibits trade in and transport of wildlife, fish, and plants that have been illegally taken, possessed, or sold.¹⁰⁸ More recently, it has been trumpeted as a primary weapon in the fight against invasive species.¹⁰⁹ Such intent was evident even before the Lacey Act became law. Iowa Congressman John Lacey, the primary sponsor of the Lacey Act, colorfully described the bill’s potential impact on invasive species during congressional floor debates:

If [the Act] had been in force at the time the mistake was made in the introduction of the English sparrow [sic] we should have been spared from the pestilential existence of that “rat of the air,” that vermin of the atmosphere. But some gentlemen who thought they knew better than anybody else what the country needed saw fit to import these little pests, and they have done much toward driving the native wild bird life out of the States.¹¹⁰

Despite Lacey’s apparent intent, there are at least three problems with using the Lacey Act as the primary vehicle for invasive species control.

106. 16 U.S.C. § 701 (2006); *see also* Lacey Act Amendments of 1981, 16 U.S.C. §§ 3371–3378 (2006).

107. Laura T. Gorjanc, *Combating Harmful Invasive Species Under the Lacey Act: Removing the Dormant Commerce Clause Barrier to State and Federal Cooperation*, 16 FORDHAM ENVTL. L. REV. 111, 116 (2004) (citing Robert S. Anderson, *The Lacey Act: America’s Premier Weapon in the Fight Against Unlawful Wildlife Trafficking*, 16 PUB. LAND L. REV. 27, 29 (1995)).

108. 16 U.S.C. § 3372 (“It is unlawful for any person . . . to import, export, transport, sell, receive, acquire, or purchase any fish or wildlife or plant taken, possessed, transported, or sold in violation of any law, treaty, or regulation of the United States . . .”).

109. *See* Gorjanc, *supra* note 107, at 112 (“The solution [to the problem of invasive species] is federal and state cooperation through enforcement of the Lacey Act.”). *But see* Andrea J. Fowler et al., *Failure of the Lacey Act to Protect US Ecosystems Against Animal Invasions*, 5 FRONTIERS ECOLOGY & ENV’T 353, 354 (2007) (“Although the Lacey Act is the primary legal tool available to protect US ecosystems from invasive animal species, its efficacy at preventing the introduction and establishment of species and mitigating the spread of already established invasive species has not been rigorously scrutinized.”).

110. 33 CONG. REC. 4871 (1900).

First, the Lacey Act is powerless on its own. Its prohibition on *illegal* trafficking of wildlife requires a predicate violation of some other law before its provisions take effect.¹¹¹ In practice, that usually means a state law, although conceptions of the commerce clause power have changed since 1900. Congress reiterated in a 1981 Senate report that the Lacey Act “was viewed [in 1900], and should be viewed now, not as increasing the federal role in managing wildlife, but as a federal tool to aid the states in enforcing their own laws concerning wildlife.”¹¹² At least one commentator has suggested the possibility of a Dormant Commerce Clause¹¹³ barrier to an effective state-led solution to the invasive species problem.¹¹⁴ Yet the larger problem with a state-based approach is a practical one: Invasive species simply do not respect state lines. In fact, they often advance in watercourses that straddle state or even national borders. It is difficult to imagine, for example, the states of Michigan and Illinois working together on the Asian carp issue given the litigation that Michigan has already filed.

Second, in implementing the Lacey Act, the U.S. Department of the Interior (DOI) has adopted a “dirty list” approach, meaning that specific invasive species must be administratively listed before any action can be taken under the Act.¹¹⁵ The original Act expressly listed only four organisms: mongoose, fruit bats (also known as flying foxes), English sparrows, and starlings.¹¹⁶ As of 2007, over a hundred years after its passage, the list contained less than twenty-five organisms.¹¹⁷ Notably, the FWS added silver carp and black carp to

111. See Gorjanc, *supra* note 107, at 119.

112. S. REP. NO. 97-123, at 2 (1981).

113. The Dormant Commerce Clause “prevents a State from ‘jeopardizing the welfare of the Nation as a whole’ by ‘placing burdens on the flow of commerce across its borders that commerce wholly within those borders would not bear.’” *American Trucking Ass’n, Inc. v. Mich. Pub. Serv. Comm’n*, 545 U.S. 429, 433 (2005) (citing *Okla. Tax Comm’n v. Jefferson Lines, Inc.*, 514 U.S. 175, 180 (1995)).

114. See generally Gorjanc, *supra* note 107.

115. See, e.g., 50 C.F.R. §§ 16.3, 16.11, 16.12, 16.13 (2010) (listing animals that may not be imported by category of animal); see also Eric Biber, Note, *Exploring Regulatory Options for Controlling the Introduction of Non-Indigenous Species to the United States*, 18 VA. ENVTL. L.J. 375, 391 (1999) (“The current regulations enforcing the Lacey Act . . . adopt what has been described as a ‘dirty list’ approach, in which only those species designated as harmful are prohibited from entry.”); Julianne Kurdila, Note, *The Introduction of Exotic Species into the United States: There Goes the Neighborhood!*, 16 B.C. ENVTL. AFF. L. REV. 95, 104 (1988).

116. Fowler et al., *supra* note 109, at 354.

117. *Id.* at 355–56.

the list in 2007,¹¹⁸ long after those species escaped from captivity into the Mississippi River basin and began their journey toward the Great Lakes. The procedure for adding a species to the list consists of the usual federal rulemaking process, typically including a petition initiated either by the public or by the responsible federal agency, a period of public notice and comment, a proposed rule, additional public comment, and a final rule.¹¹⁹ The onerous and lengthy nature of the listing process ensures that the Lacey Act typically regulates only the *worst* offenders, and often after the damage is done.

Third, the Lacey Act is administered by a veritable alphabet soup of agencies, including the DOI, the USDA, the FWS, the U.S. Department of Commerce (DOC), the National Marine Fisheries Service (NMFS), and the Animal and Plant Health Inspection Service (APHIS).¹²⁰ When a single statute is administered by multiple agencies, inefficiencies often arise. These may include agency turf wars, lack of communication or cooperation, and duplication of effort.¹²¹

These shortcomings deprive the Lacey Act of much of its usefulness to proactively regulate invasive species, especially in light of climate change.

B. The Plant Protection Act of 2000

The Plant Protection Act of 2000 (PPA) consolidated and superseded all or part of ten existing authorities related to plant management, including the Plant Quarantine Act and the Federal Plant Pest Act.¹²² On its face, the PPA created a broad policy with the

118. See Injurious Wildlife Species; Silver Carp (*Hypophthalmichthys molitrix*) and Largemouth Silver Carp (*Hypophthalmichthys harmandi*), 72 Fed. Reg. 37,459 (July 10, 2007); Injurious Wildlife Species; Black Carp (*mylopharyngodon piceus*), 72 Fed. Reg. 59,019 (Oct. 18, 2007).

119. See Biber, *supra* note 115, at 398; see generally Charles H. Koch, Jr., ADMINISTRATIVE LAW AND PRACTICE § 4:32 (2011).

120. See 16 U.S.C. § 3371(h) (2006) (stating that Lacey Act references to administration by the “Secretary” variously means the Secretary of the Interior, the Secretary of Commerce, or the Secretary of Agriculture). These same three persons are the co-chairs of the National Invasive Species Council. Exec. Order No. 13,112 § 3(a), 64 Fed. Reg. at 6184; *About NISC*, NAT’L INVASIVE SPECIES COUNCIL, http://www.invasivespecies.gov/main_nav/mn_about.html (last visited Oct. 1, 2011).

121. Cf. Elizabeth F. Brown, *E Pluribus Unum – Out of Many, One: Why the United States Needs a Single Financial Services Agency*, 14 U. MIAMI BUS. L. REV. 1, 27 (2005) (making similar arguments in financial services context).

122. See Plant Protection Act, Pub. L. No. 106-224, § 438, 113 Stat. 438, 454 (codified as amended at 7 U.S.C. §§ 7701–7772 (2006)). The PPA repealed the Plant Quarantine Act of

capability to address invasive plant species, but its application has been narrowly limited to the protection of agricultural production, overlooking whatever value it might have in the fight against invasive species.

The PPA's core provisions give the Secretary of Agriculture the power to issue regulations to prevent the introduction into the United States, or the movement within the United States, of a "plant pest" or "noxious weed."¹²³ In turn, the PPA defined "plant pest" to include nonhuman animals, parasitic plants, bacteria, fungi, viruses, and other "similar articles" that have the potential to directly or indirectly injure any plant.¹²⁴ It defined "noxious weeds" to include "any plant or plant product that can directly or indirectly injure or cause damage to crops . . . livestock, poultry, . . . the natural resources of the United States, the public health, or the environment."¹²⁵ Four years later, Congress passed the Noxious Weed Control and Eradication Act of 2004, which amended the PPA by creating a grant program to further encourage the control and eradication of listed plant pests and noxious weeds.¹²⁶

Despite its seeming usefulness as a tool to combat invasive species, more detailed analysis of the statute shows that it was intended, and has largely been used, as a tool to protect the American agricultural industry.¹²⁷ Congress did not design the law to broadly address the invasive species issue; instead, one of the bill's sponsors, Representative Charles Canady, indicated that it was intended to "protect our crops" and combat a "very real problem facing American agriculture."¹²⁸ Accordingly, Congress delegated administration of the PPA to the Secretary of Agriculture.¹²⁹

1912, the Federal Plant Pest Act, portions of the Department of Agriculture Organic Act, the Federal Noxious Weed Act of 1974, the Mexican Border Act of 1942, the Insect Control Act of 1937, the Halogeton Glomeratus Act, the Golden Nematode Act, and Section 1773 of the Food Security Act of 1985. *Id.* § 7758. The PPA also superseded the portion of Public Law 97-46 (7 U.S.C. § 147b) that relates to the emergency transfer of plant pests. *Id.*

123. 7 U.S.C. § 7712(a).

124. *Id.* § 7702(14).

125. *Id.* § 7702(10).

126. *See* Noxious Weed Control and Eradication Act of 2004, Pub. L. No. 108-412, 118 Stat. 2320 (codified at 7 U.S.C. §§ 7701, 7781-7786 (2006)).

127. Justin Pidot, Note, *The Applicability of Nuisance Law to Invasive Plants: Can Common Law Liability Inspire Government Action?*, 24 VA. ENVTL. L.J. 183, 195 (2005).

128. 146 CONG. REC. 9244 (2000) (statement of Representative Charles Canady); *see also* Pidot, *supra* note 127, at 195.

129. 7 U.S.C. §§ 7702(16), 7712(a).

In practice, the USDA has carried out Representative Canady's intent to "protect our crops." It has designated approximately 400 plant pests;¹³⁰ and it has designated as noxious weeds nineteen species of aquatic and wetland weeds,¹³¹ five genera of parasitic weeds,¹³² and ninety-five species of terrestrial weeds.¹³³ As part of its mission to "identify *high-priority* invasive plants,"¹³⁴ the National Invasive Species Council (NISC) has profiled on its website forty-six species of invasive plants.¹³⁵ Yet only five of NISC's profiled invasive plant species are regulated by the USDA under the PPA.¹³⁶

The reasons for this lack of overlap are not entirely clear, especially given that the Secretary of Agriculture is a co-chair of NISC.¹³⁷ The most logical explanation is that, as Representative Canady intended and as at least one commentator has observed, the thrust of the USDA's regulations is to "protect our crops," and only to address invasive species in that particular context.¹³⁸ Moreover, while NISC¹³⁹ and independent reports to Congress¹⁴⁰ have cited the PPA as a potential tool for invasive species control, the PPA simultaneously allows the USDA to publish a list of "biological control organisms" that may be introduced to address plant pests or noxious weeds.¹⁴¹ The movement of these control organisms is not

130. See 7 C.F.R. § 330.102 (2010) (indicating that authority to regulate plant pests is granted by the PPA); U.S. DEP'T OF AGRIC., REGULATED PLANT PEST LIST (2000), available at http://www.aphis.usda.gov/import_export/plants/plant_imports/downloads/RegulatedPestList.

131. See 7 C.F.R. § 360.200(a) (2010).

132. *Id.* § 360.200(b).

133. See *id.* § 360.200(c).

134. NISC REVIEW, *supra* note 33, at 12 (emphasis added).

135. See *Plants – Species Profiles*, NAT'L INVASIVE SPECIES INFO. CENTER, <http://www.invasivespeciesinfo.gov/plants/main.shtml> (last updated Oct. 1, 2011).

136. The species appearing on both lists are Cogongrass (*Imperata cylindrica*), Giant Hogweed (*Heracleum mantegazzianum*), Old World Climbing Fern (*Lygodium microphyllum*), Tropical Soda Apple (*Solanum viarum*), and Witchweed (*Striga asiatica*). Compare *id.*, with 7 C.F.R. §§ 360.200(b), (c).

137. See Exec. Order No. 13,112 § 3(a), 64 Fed. Reg. at 6184.

138. See Pidot, *supra* note 127, at 195 (discussing the "agricultural bias" inherent in the structure and implementation of the PPA).

139. See, e.g., *Federal Laws and Regulations*, NAT'L INVASIVE SPECIES INFO. CENTER, <http://www.invasivespeciesinfo.gov/laws/publiclaws.shtml> [hereinafter NISIC] (last updated July 21, 2011) (listing the PPA as one of the "public laws and acts for invasive species").

140. See, e.g., CORN ET AL., *supra* note 17, at 33.

141. 7 U.S.C. § 7712(g)(1) (2006).

restricted in interstate commerce.¹⁴² Unfortunately, some of these control organisms may themselves become invasive species.¹⁴³

For these reasons, although it is often cited as an invasive species control law, the PPA was not designed with that purpose in mind, nor has it been wielded by the USDA to achieve that purpose.

C. The Non-Indigenous Aquatic Nuisance Prevention Control Act and the National Invasive Species Act

The Non-Indigenous Aquatic Nuisance Prevention Control Act (NANPCA) is another federal statute ostensibly aimed at invasive species control.¹⁴⁴ Unlike the PPA, NANPCA has primarily been wielded to combat the spread of invasive species.¹⁴⁵ As will be discussed below, however, the end result has been the same: NANPCA has not provided a broad-based federal solution to the invasive species issue. Its effectiveness as a tool to systematically address invasive species is limited by the fact that it does not apply to terrestrial invasive species at all.¹⁴⁶

NANPCA operates by regulating the release of ballast water carried to the United States from areas beyond the United States' exclusive economic zone (EEZ), meaning coastal waters extending beyond 200 miles of the United States coastline.¹⁴⁷ The invasive organisms contained in ballast water can have detrimental effects on human health and the environment. For example, they may carry diseases or bacteria previously unknown to ecosystems and populations.¹⁴⁸ NANPCA requires vessels carrying such water to choose one of three compliance options. First, such vessels may completely "exchange" such ballast water before entering the 200-

142. *Id.*

143. *See* Pidot, *supra* note 127, at 195.

144. 16 U.S.C. §§ 4701–4751 (2006). Congress stated that one purpose of NANPCA is to "prevent unintentional introduction and dispersal of nonindigenous species into waters of the United States through ballast water management and other requirements." *Id.* § 4701(b)(1) (2006).

145. *See generally* CORN ET AL., *supra* note 17, at CRS-39 (NANPCA implementation devoted to "preventing and controlling aquatic nuisance species"); Cory Hebert, *Ballast Water Management: Federal, States, and International Regulations*, 37 SOUTHERN U. L. REV. 315, 320–22 (2010).

146. *See* 16 U.S.C. § 4701(b)(1) (2006) (purpose of NANPCA is to "prevent unintentional introduction and dispersal of nonindigenous species *into waters of the United States*") (emphasis added). The exception is the brown tree snake, which is separately addressed in NANPCA. *See id.* § 4728.

147. *Id.* § 4711(b)(2)(A).

148. Hebert, *supra* note 145, at 320.

mile EEZ.¹⁴⁹ That exchange eliminates the invasive species from the ballast water either by discharging them into deep sea waters, or by increasing the salinity content of the ballast water to levels that cannot sustain life.¹⁵⁰ Second, such vessels may retain the same ballast water during the entire time they are within the EEZ.¹⁵¹ Third, the vessels have the theoretical option to comply with other alternative methods approved by the Coast Guard; in practice, however, the Coast Guard has never approved any alternatives.¹⁵²

NANPCA was primarily intended to arrest the devastating spread of European zebra mussels into the Great Lakes,¹⁵³ but its success in doing so is unclear at best.¹⁵⁴ In 1996, Congress amended NANPCA through the National Invasive Species Act (NISA).¹⁵⁵ Despite its expansive name, NISA simply expands NANPCA beyond its initial limit of the Great Lakes region to all United States territorial waters.¹⁵⁶ Coast Guard regulations implementing NISA require that vessels have a Ballast Water Management Plan,¹⁵⁷ that vessels record and report all ballast water discharges into United States waters,¹⁵⁸ and that vessels avoid or minimize discharge in environmentally sensitive areas,¹⁵⁹ among other precautionary measures.

149. 16 U.S.C. § 4711(b)(2)(B)(i); 33 C.F.R. §§ 151.1510(a)(1), 151.2035(b)(1) (2009).

150. Hebert, *supra* note 145, at 321.

151. See 33 C.F.R. §§ 151.1510(a)(2), 151.2035(b)(2); *accord* 16 U.S.C. § 4711(b)(2)(B)(ii) (vessels may discharge ballast in “other waters where the exchange does not pose a threat of infestation or spread of aquatic nuisance species in the Great Lakes and other waters of the United States”).

152. 16 U.S.C. § 4711(b)(2)(B)(iii); 33 C.F.R. §§ 151.1510(a)(3), 151.2035(b)(3).

153. *Id.*

154. See Lisa A. Brautigam, *Control of Aquatic Nuisance Species Introductions via Ballast Water in the United States: Is the Exemption of Ballast Water Discharges from Clean Water Act Regulation a Valid Exercise of Authority by the Environmental Protection Agency?*, 6 OCEAN & COASTAL L.J. 33, 37 (2001) (noting that five years after passage of NANPCA, zebra mussels were “still a major economic and ecological problem”); Suzanne Lieberman, *Conference Report Day 2: Friday, March 13, 2009*, 12 U. DENV. WATER L. REV. 471, 475 (2009) (stating that zebra mussels were first sighted in the western United States in 2007).

155. Pub. L. No. 104-332, § 2, 110 Stat. 4073 (1996) (“Amendments to the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990”).

156. *Id.* § 4077 (amending 16 U.S.C. § 4711(c) to create “voluntary national guidelines”); Mandatory Ballast Water Management Program for U.S. Waters, 69 Fed. Reg. 44,952, 44,953 (July 28, 2004) (voluntary ballast water management program becomes mandatory to increase compliance).

157. 33 C.F.R. § 151.2035(a)(7) (2009).

158. *Id.* § 151.1516.

159. *Id.* § 151.2035(a)(1).

More recently, the U.S. Environmental Protection Agency (EPA) has also become involved with ballast water management. For years, the EPA denied responsibility for the regulation of ballast water discharges and exempted such discharges from regulation under its administration of the Clean Water Act (CWA) based on the theory that “this type of discharge generally causes little pollution.”¹⁶⁰ The EPA was forced to reverse that position based on the Ninth Circuit’s 2008 decision in *Northwest Environmental Advocates v. EPA*.¹⁶¹ The Ninth Circuit held that invasive species are a pollutant under the CWA because the Act’s definition of “pollutant” includes “biological materials.”¹⁶² Because ballast water releases fit within the Act’s broad definitions of “discharge” and “pollutant,” the court held that the EPA could not administratively exempt discharges covered by the plain language of the statute.¹⁶³

Moreover, the court held that Congress did not acquiesce to the EPA’s exemption of ballast water discharge by enacting NANPCA and NISA.¹⁶⁴ Instead, the court held that Congress had simply demonstrated an intent to address a “serious national problem . . . on multiple, nonexclusive fronts.”¹⁶⁵ Responding to the court’s decision, the EPA eventually issued a Vessel General Permit in 2008.¹⁶⁶

NANPCA, NISA, and the federal regulations addressing ballast water discharges have provided some limited measure of success at controlling invasive species that travel via ballast water. Nevertheless,

160. Although the text of the CWA requires a permit for a discharge of “any pollutant” to “waters of the United States,” see 33 U.S.C. §§ 1311(a), 1362(7), 1362(12) (2006), the EPA did not require a NPDES permit for discharges “incidental to the normal operation of a vessel,” 40 C.F.R. § 122.3(a) (2010); see also *Nw. Env’tl. Advocates v. EPA*, 537 F.3d 1006, 1010 (9th Cir. 2008).

161. *Nw. Env’tl. Advocates*, 537 F.3d at 1021.

162. *Id.* at 1021 (“The text of the statute clearly covers the discharges at issue here.”); see also 33 U.S.C. § 1362(6) (2006). Courts have held that the term “biological materials” also includes invasive species. See, e.g., *Nat’l Wildlife Fed’n v. Consumers Power Co.*, 862 F.2d 580, 583 (6th Cir. 1988).

163. *Nw. Env’tl. Advocates*, 537 F.3d at 1021.

164. *Id.* at 1025.

165. *Id.*

166. See Final National Pollutant Discharge Elimination System (NPDES) General Permit for Discharges Incidental to the Normal Operation of a Vessel, 73 Fed. Reg. 79,473 (Dec. 29, 2008). A “general permit” is a permit issued to a category of sources (here, certain vessels) for a specific period of time without the need to issue individual permits to each source. See generally U.S. ENVTL. PROTECTION AGENCY, 2008 FINAL ISSUANCE OF NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) VESSEL GENERAL PERMIT (VGP) FOR DISCHARGES INCIDENTAL TO THE NORMAL OPERATION OF VESSELS – FACT SHEET at 6 (Dec. 18, 2008).

the narrow focus of the program and the slow pace of its implementation have prevented it from becoming a more useful tool to control invasive species, especially in terrestrial environments.

D. Other Statutory Authorities

Numerous other federal laws, federal regulations, and international treaties bear on invasive species in some respects.¹⁶⁷ However, none of those remaining authorities are likely to move the needle on the general invasive species problem because all of them fall into one of two categories. The first group directly addresses some aspect of the invasive species problem, but has an extremely narrow focus. The second group contains authorities that are of broader scope but that only peripherally affect the invasive species problem.

The first group of authorities addresses specific, but very discrete aspects of the invasive species problem. This group includes laws such as the Great Lakes Fish and Wildlife Restoration Act,¹⁶⁸ which provides authority for the Great Lakes Fishery Commission to “eradicate or minimize” invasive sea lamprey populations in the Great Lakes;¹⁶⁹ the Salt Cedar and Russian Olive Control Demonstration Act,¹⁷⁰ which directs various governmental agencies to design “strategic solutions” for the long-term management of the salt cedar and Russian olive tree “infestation on public and private land in the western United States”;¹⁷¹ the National Plan for Control and Management of Sudden Oak Death,¹⁷² which directs the USDA to develop a national plan to combat a tree disease caused by an invasive fungus-like pathogen; and the Brown Tree Snake Control and Eradication Act,¹⁷³ which directs the DOI and the USDA to eradicate the brown tree snake on the island of Guam and prevent its spread to the rest of the United States.¹⁷⁴ Still, other laws congressionally approve individual projects related to invasive species. For example, the Water Resources Development Act of 2007¹⁷⁵ authorized funding for a dispersal barrier demonstration

167. See generally NISIC, *supra* note 139.

168. 16 U.S.C. §§ 941–941f (2006).

169. *Id.* § 941c(b)(3).

170. 7 U.S.C. § 7781 (2006).

171. *Id.*; Pub. L. No. 109-320, §§ 2(a)(2)(A), 2(c)(1), 120 Stat. 1748 (2006).

172. 7 U.S.C. § 7720.

173. *Id.* §§ 8501–8507.

174. See *id.* § 8503.

175. Pub. L. No. 110-114, 121 Stat. 1041 (2007) (codified at 33 U.S.C. § 2201 (2006)).

project to prevent the invasive Asian carp from entering the Great Lakes.¹⁷⁶ While these authorities may lead to limited success stories, their narrow focus limits their cumulative impact on the broader invasive species problem.

A second group of authorities are of more general applicability, but only peripherally bear on the invasive species issue. This paper discusses three of them: the National Environmental Policy Act, the Endangered Species Act and the Clean Water Act.

The first of these—and indeed, the first modern environmental statute of any type¹⁷⁷—is the National Environmental Policy Act (NEPA).¹⁷⁸ NEPA generally requires federal agencies to consider the potential environmental effects of “major federal actions” before undertaking such actions.¹⁷⁹ If the action in question “significantly affect[s] the quality of the human environment,” the agency must prepare a formal Environmental Impact Statement that analyzes the adverse environmental impacts of the action, alternatives to the proposed action, and federal resources committed to the action.¹⁸⁰ The resulting analyses conceivably might consider the impact of invasive species; for example, the EPA’s Region Three NEPA Team, which purports to “carr[y] out all aspects of NEPA,” reviews all projects involving the introduction of non-native species to an ecosystem.¹⁸¹ Nevertheless, courts have long held that NEPA’s function is only to “insure a fully informed and well-considered decision”; in other words, its mandate is “essentially procedural.”¹⁸² Under NEPA, as long as a federal agency complies with NEPA’s procedural requirements, a court may not set aside the agency action merely because it is unhappy with the result or would have reached a different decision itself.¹⁸³ For that reason, NEPA’s value in the fight against invasive species is likely to be informative rather than substantive.

176. Pub. L. No. 110-114, § 3061, 121 Stat. 104. Interestingly, the funding authorization provides that the demonstration project is to be constructed pursuant to NANPCA.

177. Todd S. Aagaard, *Environmental Law as a Legal Field: An Inquiry in Legal Taxonomy*, 95 CORNELL L. REV. 221, 223 n.2 (2010); Bradley C. Karkkainen, *Framing Rules: Breaking the Information Bottleneck*, 17 N.Y.U. ENVTL. L.J. 75, 84 (2008).

178. 42 U.S.C. §§ 4321–4375 (2006).

179. *Id.* § 4332(2)(C).

180. *Id.* § 4332 (2)(C)(i)–(v).

181. *NEPA Team*, U.S. ENVTL. PROTECTION AGENCY (June 2009), <http://www.epa.gov/reg3esd1/nepa/pdf/nepa.pdf>.

182. *Vt. Yankee Nuclear Power Corp. v. NRDC*, 435 U.S. 519, 558 (1978).

183. *Id.*

The next possibility is the Endangered Species Act (ESA),¹⁸⁴ sometimes called the “pit bull” of environmental law due to its “powerful framework for the identification and conservation of endangered and threatened species.”¹⁸⁵ The ESA is a statute of general applicability that is conceivably adaptable to regulate climate change, invasive species, or both. The ESA authorizes certain government agencies to create a list of “threatened” or “endangered” species, and to identify “critical habitat” for those species.¹⁸⁶ Listed species enjoy two primary statutory protections. First, the ESA requires all federal agencies to ensure that any action authorized, funded or carried out by them is not likely to jeopardize the continued existence of listed species or modify their critical habitat.¹⁸⁷ Second, the Act prohibits both public and private actors from “taking” listed species, and defines “take” to mean “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.”¹⁸⁸ The “take prohibition” has been broadly defined in implementing regulations to include “an act which actually kills or injures wildlife . . . includ[ing] significant habitat modification or degradation.”¹⁸⁹ For the most part, the courts have also broadly construed the prohibition.¹⁹⁰

The expansive construction the ESA has generally enjoyed makes it a candidate for application to climate change, invasive species, or both. As to the former, some have argued that the FWS should use the ESA as a tool to directly regulate greenhouse gas emissions because the habitat modification resulting from greenhouse gas fueled climate change constitutes a “taking” under the ESA.¹⁹¹ These takings could further lead to the extinction of listed threatened and endangered species.¹⁹² However, Professor J.B. Ruhl has argued

184. 16 U.S.C. §§ 1531–1544 (2006).

185. J.B. Ruhl, *Climate Change and the Endangered Species Act: Building Bridges to the No-Analog Future*, 88 B.U. L. REV. 1, 4 (2008).

186. 16 U.S.C. §§ 1533(c) (listing endangered and threatened species), 1533(a)(3)(A)(i) (designation of critical habitat).

187. *Id.* § 1536(a)(2).

188. *Id.* §§ 1538(a)(1)(B), 1532(19).

189. 50 C.F.R. § 17.3 (2010).

190. *See, e.g.*, *Tenn. Valley Auth. v. Hill*, 437 U.S. 153 (1978) (enjoining dam operation where such operation would eradicate the snail darter, an endangered species); *Babbitt v. Sweet Home Chapter of Communities for a Great Or.*, 515 U.S. 687 (1995) (upholding Interior Department’s broad interpretation of the word “harm” in the statutory definition of “take”).

191. *See Ruhl, supra* note 185, at 40–42; 16 U.S.C. § 1538(a)(1)(B).

192. Ruhl, *supra* note 185, at 40–42.

that the FWS should not use the ESA to regulate greenhouse gas emissions directly because such an action would take both the agency and the statute outside areas of core competency and purpose.¹⁹³ Instead, Ruhl argues, the FWS should more modestly attempt to identify the species that can survive the transition to a post climate change world and aid those species by whatever means possible.¹⁹⁴

A stronger case can be made with respect to the ESA's potential applicability to control invasive species. The National Invasive Species Information Center has suggested that when invasive species threaten listed species, the ESA would provide authority for the FWS to "eradicate" the invasive species.¹⁹⁵ Similar to the argument made above with respect to climate change, the theory here is that invasive species modify the habitat of listed species, and in that sense effect a "take" prohibited under the ESA. In addition, according to Professor Ruhl, unlike greenhouse gas regulation, species and ecosystem evaluation and management falls within the FWS's core competency.¹⁹⁶

Nevertheless, the FWS has not wielded the ESA as a primary tool to control invasive species.¹⁹⁷ As a practical matter, there may be several reasons for this. First, on its face the ESA is limited to situations in which an invasive species threatens an already-listed species.¹⁹⁸ This means that the FWS could not prevent the introduction of an invasive fish into United States waters, even if it knew the invasive fish was likely to spread, unless it could show that the invasive fish would threaten a listed species. Second, the ESA is unlikely to be used to penalize the introduction of invasive species because it is limited by "questions of knowledge, intent, and causality."¹⁹⁹ These requirements would make it difficult, if not

193. *Id.* at 59–60.

194. *Id.*

195. *See generally* NISIC, *supra* note 139.

196. *See FWS Fundamentals*, FISH & WILDLIFE SERV. (last updated Dec. 17, 2010), <http://www.fws.gov/info/pocketguide/fundamentals.html> ("The mission of the U.S. Fish and Wildlife Service is . . . to conserve, protect, and enhance fish, wildlife, plants and their habitats . . .").

197. *See Ruhl, supra* note 185, at 62 ("The ESA has not solved urban sprawl or invasive species—it has helped species deal with them."). Nevertheless, the FWS clearly recognizes that "in many instances," threats to species' survival "may be caused by invasive species." *See Endangered Species Program*, FISH & WILDLIFE SERV. (last updated Jan. 13, 2009), <http://www.fws.gov/invasives/endangered-species.html>.

198. *See* 16 U.S.C. § 1533(f)(1) (2006) (development and implementation of recovery plans is limited to "species listed pursuant to this section").

199. CORN ET AL., *supra* note 17, at CRS-28.

impossible, for federal authorities to penalize or prevent the inadvertent introduction of invasive species, or to impose liability when, as is often the case, it is unknown exactly how an invasive species entered an ecosystem.²⁰⁰ However, the ESA may prove valuable in nudging federal agencies to consider methods of minimizing or preventing the movement and transport of invasive species when setting federal policies.²⁰¹

Finally, some have argued that the CWA²⁰² may serve as a tool to control the spread of invasive species.²⁰³ This statute, however, is probably the most tangentially related of any statute of general applicability. The CWA has a dual structure: Under its National Pollutant Discharge Elimination System (NPDES) program, it prohibits the discharge of any pollutant into navigable water without a permit.²⁰⁴ Simultaneously, the CWA directs states to set water quality standards for water bodies based on the designated uses assigned to those waters.²⁰⁵ If water quality in a particular receiving water does not meet those standards, states must back-calculate a revised, more stringent pollution limit, called a Total Maximum Daily Load (TMDL), at a level “necessary to implement the applicable water quality standards with . . . a margin of safety.”²⁰⁶ One might perhaps argue that some invasive species, whether aquatic or terrestrial, are an illegal discharge of a pollutant,²⁰⁷ or that they may cause violations of these water quality standards. Several problems might arise that would prevent effective implementation of the CWA in this way, however. First, state agencies might have difficulty establishing that invasive species, as opposed to some other cause, were responsible for the violation of standards. Second, the statute could not reach invasive species that have purely land-based effects—certainly a large segment of the universe of invasive species. Finally,

200. The escape of Asian carp into the Mississippi river basin is one example of this uncertainty. *See supra* notes 59–64 and accompanying text.

201. CORN ET AL., *supra* note 17, at CRS-28.

202. 33 U.S.C. §§ 1251–1376 (2006).

203. *See generally* Tyler W. Wickman, Comment, *The Battle Against Invasive Species: The Clean Water Act and Environmental Protection Agency Regulation of Recreational Boats*, 91 MARQ. L. REV. 605 (2007).

204. *See* 33 U.S.C. §§ 1311(a), 1362(7), 1362(12) (2006).

205. *See id.* § 1313(c)(2)(A) The standards must take into consideration the water’s “use and value for public water supplies, propagation of fish and wildlife, recreational purposes, and agricultural, industrial, and other purposes.” *Id.*

206. *Id.* § 1313(d)(1)(C).

207. *See* *Nw. Env'tl. Advocates v. EPA*, 537 F.3d 1006, 1021 (9th Cir. 2008).

the evaluation of invasive species is likely outside the core expertise of many state agencies that issue discharge permits.

E. Executive Order 13,112

Perhaps mindful of the inherent deficiencies in existing federal laws and regulations aimed at controlling invasive species, in 1999 President Bill Clinton issued Executive Order 13,112, intended to “prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause.”²⁰⁸ The Order has several important features.

First, the Order comprehensively defines “invasive species” as non-native species “whose introduction does or is likely to cause economic or environmental harm or harm to human health.”²⁰⁹ This, by itself, was a positive step insofar as it attempted to unify federal agencies’ potentially divergent conceptions of what, exactly, constituted an “invasive species” because, as discussed previously in this article, most non-native species are harmless or even beneficial.²¹⁰

The Order also imposes four primary duties on federal agencies. First, agencies are to identify actions likely to “affect the status of invasive species.”²¹¹ Second, subject to certain important limitations discussed below, the Order directs agencies to prevent the introduction and establishment of invasive species in native ecosystems; detect, monitor, and control invasive species populations, once they are established; restore native species and habitats that have been invaded; undertake research directed at controlling invasive species; and further public education efforts related to invasive species control.²¹² Third, agencies are to avoid funding or authorizing actions that they believe “are likely to cause or promote the introduction or spread of invasive species,” unless “the benefits of such actions clearly outweigh the potential harm caused.”²¹³ Finally, agencies are directed to coordinate their activities with NISC.²¹⁴

However, the Order also contains several important limitations on these duties. First, federal agencies are to carry them out only “to

208. Exec. Order No. 13,112, 64 Fed. Reg. at 6183.

209. *Id.*

210. *See supra* note 32 and accompanying discussion.

211. Exec. Order No. 13,112, 64 Fed. Reg. at 6184.

212. *Id.*

213. *Id.*

214. *Id.*

the extent practicable and permitted by law.”²¹⁵ The Order, as with all executive orders, only directs federal agencies to implement existing law; it does not direct them to fill the gaps that already exist. Second, the Order’s core directive that agencies prevent the introduction of invasive species and control them once introduced is “subject to the availability of appropriations, and within Administration budgetary limits.”²¹⁶ This limit, perhaps the more significant of the two, means that invasive species control efforts are likely to fall victim to budget cuts; indeed, that is one of the weaknesses in the Order that has subsequently been identified, as discussed below.²¹⁷

The Order also forces federal agencies to perform difficult cost-benefit calculations. For example, agencies are directed to detect and control populations of invasive species only in a “cost-effective . . . manner.”²¹⁸ Agencies may even authorize actions that cause or promote the spread of invasive species so long as “the benefits of such actions clearly outweigh the potential harm caused by invasive species.”²¹⁹ Significant scholarly efforts have already been devoted to the question of whether it is even possible to assign economic values to environmental benefits at all.²²⁰ Even if one believes it possible, the accuracy of such estimates is likely to be disputed.²²¹ It is not at all clear that all federal agencies have the ability to undertake such calculations.

In addition to imposing duties on federal agencies, the Order also created a new interagency body noted above: NISC.²²² Today, NISC is composed of the secretaries and administrators of ten federal departments and agencies: the Secretary of State, the Secretary of Defense, the Secretary of the Interior (Co-Chair), the Secretary of Agriculture (Co-Chair), the Secretary of Commerce (Co-Chair), the

215. *Id.*

216. *Id.*

217. *See infra* notes 241–242 and accompanying discussion.

218. Exec. Order No. 13,112, 64 Fed. Reg. at 6184.

219. *Id.*

220. GAO, *supra* note 32, at 15; *see also* Bowers, *supra* note 37, at 298 (“[I]t is difficult to quantify environmental costs and benefits in any way that permits the environment to compete with [other] interests.”); Amy Sinden, *The Economics of Endangered Species: Why Less Is More In The Economic Analysis of Critical Habitat Designations*, 28 HARV. ENVTL. L. REV. 129, 195–96 (2004) (legislative history of the Endangered Species Act shows that Congress believed the value of species to be incalculable); Ackerman & Heinzerling, *supra* note 37, at 1578 (arguing that cost-benefit analysis “tends to skew decision making against protecting public health and the environment”).

221. *See generally id.*

222. Exec. Order No. 13,112, 64 Fed. Reg. at 6184.

Secretary of Transportation, the Secretary of the Treasury, the Administrator of the EPA, the Secretary of Health and Human Services, and the Administrator of the U.S. Agency of International Development.²²³ The Order explicitly appointed the first eight members listed above and the last two have since been added.²²⁴ NISC is advised by the Invasive Species Advisory Committee, a body comprised of thirty-two non-federal members representing various constituencies often involved in environmental policymaking including environmental advocacy groups, industry, state governments, Native American tribes, and academia.²²⁵

The Order charges NISC with general oversight of the Order's implementation, including seven specific tasks that are, perhaps, even more onerous than those it imposes on existing federal agencies.²²⁶ First, the Order directs NISC to "see that the Federal agency activities concerning invasive species are coordinated, complementary, cost-efficient, and effective."²²⁷ Second, NISC must cooperate with stakeholders and existing organizations to "encourage planning and action at local, tribal, state, regional, and ecosystem-based levels."²²⁸ Third, NISC must develop recommendations for "international cooperation" to address that component of the invasive species problem.²²⁹ Fourth, NISC must develop guidance for federal agencies to use in preventing the spread of invasive species and controlling such populations where they have become established.²³⁰ Fifth, NISC must "facilitate" the creation of a federal agency network to "document, evaluate, and monitor impacts from invasive species on the economy, the environment, and human health."²³¹ Sixth, NISC must establish an Internet based "information-sharing system" to facilitate public education and the exchange of information about invasive species.²³² Finally, NISC must periodically

223. *Id.*; GAO, *supra* note 32, at 10, n.7.

224. *Id.*; Exec. Order No. 13,112, 64 Fed. Reg. at 6184.

225. GAO, *supra* note 32, at 10.

226. Exec. Order No. 13,112, 64 Fed. Reg. at 6184.

227. *Id.*

228. *Id.* at 6185.

229. *Id.* For a discussion of the international aspects of the invasive species problem, see Albert G. McCarragher, IV, *The Phantom Menace: Invasive Species*, 14 N.Y.U. ENVTL. L. J. 736 (2006).

230. Exec. Order No. 13,112, 64 Fed. Reg. at 6185.

231. *Id.*

232. *Id.*

prepare and issue a national Invasive Species Management Plan (the “Plan”).²³³

The Order set specific requirements for the contents of the first Plan. First, the Order required the Plan to contain “performance-oriented goals and objectives and specific measures of success” for efforts taken to control invasive species in general, and to implement the Order in particular, both by federal agencies and NISC itself.²³⁴ The Plan also was required to review and evaluate existing methods of preventing the introduction and controlling the spread of invasive species.²³⁵ Finally, to the extent that NISC found those existing approaches unsatisfactory, the Order directed the Plan to develop legislative proposals for change.²³⁶

NISC issued the first Plan in October 2001.²³⁷ The original Plan presented a series of tasks divided into nine areas that NISC identified as priorities: leadership and coordination, prevention, early detection and rapid response, control and management, restoration, international cooperation, research, information management, and education and public awareness.²³⁸

Only a year after the issuance of the first Plan, the U.S. Government Accountability Office (GAO) delivered a scathing indictment of federal efforts to manage invasive species in general, and the Plan in particular.²³⁹ The GAO addressed its report to the three NISC co-chairs: the Secretaries of the Departments of Agriculture, Interior, and Commerce, and entitled it “Invasive Species: Clearer Focus and Greater Commitment Needed to Effectively Manage the Problem.”²⁴⁰ The GAO report identified several weaknesses in the Plan.

First, the discussion of the Order above explained that the Plan is subject to limitations in federal agency budgets. The GAO report found that implementing the Plan was simply not a high priority for individual agencies.²⁴¹ Several of the NISC Invasive Species Advisory

233. *Id.*

234. *Id.*

235. *Id.*

236. *Id.*

237. NAT'L INVASIVE SPECIES COUNCIL, MANAGEMENT PLAN: MEETING THE INVASIVE SPECIES CHALLENGE (2001).

238. *Id.* at 2–7.

239. *See generally* GAO, *supra* note 32.

240. *Id.* at 1.

241. *Id.* at 39.

Committee members told the GAO that it would be helpful if the plan were backed by legislative authority as opposed to the Order.²⁴² Such authority, the members reasoned, would make it both politically and financially easier for agencies to make implementing the Plan a higher priority.²⁴³ Today, NISC still operates without any such authority.

Second, the GAO criticized the Plan on the grounds that it was process-oriented rather than results-oriented. As the GAO put, the Plan “lack[ed] a clear long-term outcome and quantifiable performance criteria against which to evaluate the overall success of the [P]lan.”²⁴⁴ The GAO suggested that instead of providing a “laundry list” of actions and steps that are likely to be helpful, the Plan should have clearly articulated more specific long term goals, for example reducing the introduction of invasive species by a given percentage, or halting the spread of invasive species on public lands.²⁴⁵ In fairness to the Plan, the measurement difficulties inherent in such concrete goals are apparent, but the GAO report did not discuss them.

Third, the GAO report noted that as of the date of its report, three years after President Clinton issued the Order and one year after NISC issued the first Plan, federal agencies had made very little progress in implementing the directives of the Order or the Plan.²⁴⁶ For example, by September 2002, agencies had completed only about twenty percent of the projects called for by then.²⁴⁷ The GAO report advanced several theories for the lack of progress federal agencies had made in implementing the Plan. First, the Plan itself imposes no consequences for missed deadlines.²⁴⁸ As noted above, federal agencies have not given a high priority to implementing the Plan, possibly because of the lack of underlying legislative authority. Without such authority, the GAO noted, a future administration could simply decide to discontinue the Order, meaning that all of an agency’s work under it to that point would have been unnecessary.²⁴⁹ Second, another reason for the slow implementation is the “token”

242. *Id.* at 40.

243. *Id.*

244. *Id.* at 27.

245. *Id.* at 28.

246. *Id.* at 27.

247. *Id.*

248. *Id.* at 29.

249. *Id.* at 40.

level of funding and staff that are tasked to the problem both within NISC itself and in federal agencies generally.²⁵⁰ “It’s embarrassing,” one party involved told the GAO.²⁵¹

The GAO also offered several suggestions to improve the plan. First, it suggested that a future version of the Plan should include a more thorough economic analysis of the risks and impacts associated with different invasive species and pathways.²⁵² Second, it recommended that a revised Plan should contain performance-based goals and objectives, as well as specific measuring sticks for success.²⁵³ Third, the GAO called for a “transparent oversight mechanism” that federal agencies could use to demonstrate compliance with the Order and the Plan.²⁵⁴ Fourth, the GAO recommended that NISC’s ongoing assessment of federal laws and regulations should include an analysis of whether the lack of legislative authority underlying the Order inhibits NISC’s ability to achieve its objectives.²⁵⁵

NISC issued the first revision of the National Invasive Species Management Plan (the “Revised Plan”) in August 2008, covering the years 2008 to 2012.²⁵⁶ The Revised Plan does not specifically address the criticisms identified in the GAO report. Instead, like the original Plan, the Revised Plan generally seeks to coordinate invasive species control efforts among federal agencies and “across boundaries.”²⁵⁷ The Revised Plan consists of five “Strategic Goals” and associated specific implementation tasks designed to accomplish that overall objective. The five goals can be summarized as prevention, early detection and rapid response, control and management, restoration, and organizational collaboration.

The first strategic goal, prevention, is “the first line of defense”; preventing the intentional and unintentional “introduction and establishment of invasive species to reduce their impact on the environment, economy and health of the United States.”²⁵⁸ The Revised Plan notes that prevention is likely to be the most cost-

250. *Id.* at 27, 39, 41–42.

251. *Id.* at 42.

252. *Id.* at 67.

253. *Id.*

254. *Id.*

255. *Id.*

256. NISC MGMT. PLAN, *supra* note 32.

257. *Id.* at 4. It is not expressly clear whether this cross-border coordination includes interstate coordination, international coordination, or both.

258. *Id.* at 11.

effective method of invasive species control due to the difficulty of eradicating established invasive species.²⁵⁹ Three sub-objectives further illustrate this overall strategic goal: preventing the intentional or unintentional introduction of invasive species, and improving governmental standards to prevent such introductions.²⁶⁰ The first two sub-objectives are to be implemented via a number of specific tasks, including the development of new screening processes and evaluation of invasive species movement pathways.²⁶¹ The tasks to implement the third sub-objective consist of risk assessments and pathway identification processes, as well as several information exchange methods.²⁶²

The second strategic goal is to “develop and enhance the capacity to identify, report and effectively respond to newly discovered or localized invasive species.”²⁶³ The Revised Plan attempts to respond to some of the issues raised in the GAO report by calling for enhanced monitoring efforts, increased information dissemination to the public and other stakeholders, and perhaps most importantly, the development of funding mechanisms to support rapid response efforts.²⁶⁴

The third strategic goal is to “contain and reduce the spread and populations of established invasive species to minimize their harmful impacts.”²⁶⁵ The Revised Plan frankly admits that “eradication of widespread invasive species may not be feasible,” and that limited resources—both human and financial—often hamper efforts to remove and contain invasive species.²⁶⁶ It nevertheless seeks to do just that when possible. For example, it suggests increasing the number of “cleaning treatments” that address potential invasive species movement pathways such as watercraft.²⁶⁷ However, the Revised Plan does not include any level of detail as to how such treatments would be accomplished or funded.

The fourth strategic goal is to “restore native species and . . . high-value ecosystems . . . that have been impacted by invasive

259. *Id.*

260. *Id.* at 11–13.

261. *Id.* at 11–12.

262. *Id.* at 13–15.

263. *Id.* at 16.

264. *Id.* at 17–19.

265. *Id.* at 21.

266. *Id.*

267. *Id.* at 22–23.

species.”²⁶⁸ In discussing this goal, the Revised Plan attaches specific importance to engaging local communities and the public by demonstrating and documenting model rehabilitation approaches.²⁶⁹ It also recommends that federal actors prioritize restoration of sites with the “highest ecological or economic value or [that] contribute most to protecting human health.”²⁷⁰

The fifth and final strategic goal is to “maximize organizational effectiveness and collaboration . . . among international, federal, state, local, and tribal governments.”²⁷¹ The Revised Plan here calls for an analysis of existing federal laws and regulations governing invasive species management, as well as leveraging resources by coordinating invasive species programs among federal agencies.²⁷² Notably, the original Plan called for a similar analysis, but one was never completed.²⁷³

F. Summary: Holes in the Patchwork

Nearly twenty years ago, in 1993, the Office of Technology Assessment (OTA) found that “[t]he current Federal framework is a largely uncoordinated patchwork of laws, regulations, policies, and programs. Some focus on narrowly drawn problems. Many others peripherally address [invasive species]. In general, present Federal efforts only partially match the problems at hand.”²⁷⁴

The core problems identified in the OTA report remain unsolved despite some small improvements prompted by Executive Order 13,112 in the areas of information dissemination to the public and coordination among federal agencies.²⁷⁵ A 2002 report to Congress (issued nine years after the OTA report and three years after the issuance of Executive Order 13,112) identified the familiar, major deficiencies in the patchwork of federal law aimed at controlling invasive species.²⁷⁶ First, the 2002 report reiterated that federal laws do not address “(a) prevention of biological invasion across

268. *Id.* at 25.

269. *Id.* at 26–27.

270. *Id.* at 26.

271. *Id.* at 28.

272. *Id.* at 28.

273. GAO, *supra* note 32, at 40.

274. U.S. CONG. OFFICE OF TECH. ASSESSMENT, HARMFUL NON-INDIGENOUS SPECIES IN THE UNITED STATES 163 (1993).

275. CORN ET AL., *supra* note 17, at CRS-55.

276. *See generally id.*

foreseeable pathways (besides ship ballast water); or (b) explicit direction on management during that critical period between the introduction (or intentional release) of new non-native species and when the species become established.”²⁷⁷ Importantly, the report emphasized that the “focus must shift from prevention to control.”²⁷⁸ The authors of the 2002 report further noted the extreme unlikelihood that an invasive species could be eradicated after it has become established;²⁷⁹ “invasion is forever,” to repeat the quote with which this article began.²⁸⁰ Yet existing federal law largely selects species for control based on the damage they have already caused, rather than attempting to prevent future damage.²⁸¹

It is unlikely that the deficiencies in federal law will be remedied by state-based solutions, by the common law, or even by executive order. Most, if not all of the individual states have enacted some invasive species control measures.²⁸² However, by their very nature, invasive species are unlikely to remain within a single state. This is especially true of water-based species, but even terrestrial species typically move about the country with little respect for political boundaries.

Similarly, the courts are also not likely to solve the invasive species problem. Some have attempted to apply well established causes of action like nuisance to invasive species cases, but for the most part the case law is limited to construction of the existing federal invasive species control laws, not judicial addition to them.²⁸³

Finally, while President Clinton’s Executive Order attempted to address some of these deficiencies, the best that can be hoped for is that the Order will lead to greater attention to invasive species by federal agencies, and greater coordination among such agencies;

277. *Id.*

278. *Id.*

279. *Id.* at CRS-55 n.95.

280. Lodge Statement, *supra* note 1, at 10.

281. CORN ET AL., *supra* note 17, at CRS-56. For example, this is apparent in the “dirty list” approach inherent in the Lacey Act. *See supra* notes 115–119 and accompanying discussion.

282. *See State Laws and Regulations*, NAT’L INVASIVE SPECIES INFORMATION CENTER (last modified Jul. 20, 2011), <http://www.invasivespeciesinfo.gov/laws/statelaws.shtml>.

283. *See, e.g., Michigan v. Illinois*, 130 S. Ct. 1934 (2010) (denying motion for preliminary injunction rooted in nuisance claim stemming from potential Asian carp invasion); *Nw. Env’tl. Advocates v. EPA*, 537 F.3d 1006 (9th Cir. 2008) (analyzing construction of NANPCA); *Fednav, Ltd. v. Chester*, 547 F.3d 607 (6th Cir. 2008) (turning on construction of Michigan Ballast Water Statute).

those are among its stated purposes.²⁸⁴ Agency attention and coordination alone, however, cannot fill the gaps in existing law, although it may increase awareness of them.

It goes without saying that in addition to their failure to effectively address invasive species issues, none of the above federal programs remotely consider the synergistic effects between invasive species and climate change that have been discussed in this paper. Nevertheless, just as there are scientific synergies between invasive species and climate change, there are also “policy failure synergies”; in other words, federal law has failed to address the two issues for similar reasons.

First, some academics and policymakers have argued that it is politically difficult to impose costs on one group of people when another group occasioned the costs, or when the benefits will inure to another group.²⁸⁵ This has certainly been true for climate change.²⁸⁶ It also is true of invasive species. Consider, for example, the potential Asian carp invasion of the Great Lakes. That invasion has at least two major underlying causes: first, the introduction of Asian carp into the United States for purposes of aquaculture and wastewater treatment; and second, the artificial connection between the Mississippi River and the Great Lakes.²⁸⁷ The parties responsible for both actions are long since dead and gone.

Moreover, it is often difficult to show cause and effect in the environmental context, especially when dealing with ecologically complex ecosystems. The causes of climate change are well accepted by some but disputed by others.²⁸⁸ Similarly, the devastating effects of invasive species on ecosystems are in many ways only beginning to be fully understood. And even if one accepts the potential environmental and economic costs of climate change and invasive species, the potential benefits of actions taken to address those issues are even more difficult to discern.²⁸⁹

284. Exec. Order No. 13,112, 64 Fed. Reg. at 6184–85.

285. See Cass R. Sunstein, *The World vs. the United States and China? The Complex Climate Change Incentives of the Leading Greenhouse Gas Emitters*, 55 UCLA L. REV. 1675, 1677 (2008). But see Jody Freeman & Andrew Guzman, *Climate Change and U.S. Interests*, 109 COLUM. L. REV. 1531, 1534 (2009).

286. See *id.*

287. See *supra* notes 52–57 and accompanying discussion.

288. See *supra* notes 24–29 and accompanying discussion.

289. See, e.g., Robin Kundis Craig, *Toward a Notion of Environmental Bioethics*, 23 W. NEW ENG. L. REV. 173, 182 (2001) (quoting Eric A. Davidson, *YOU CAN’T EAT GNP: ECONOMICS AS IF ECOLOGY MATTERED* 39 (2000)) (explaining that “many of the benefits of

Finally, psychological factors may also come into play: inaction is easier and less expensive than action, especially in the environmental context.²⁹⁰ This tendency is magnified by the existence of significant investment-backed expectations in the status quo. For example, the city of Chicago and the state of Illinois certainly would object (and have objected, in response to the state of Michigan's legal actions against them) that it would be prohibitively expensive and dangerous to cut off the Asian carp's pathway to the Great Lakes by severing the connection between the Mississippi and the Great Lakes.²⁹¹

These difficulties are often magnified because, at least under existing law, no single entity has the authority to regulate the entire problem of climate change, or that of invasive species. The case of invasive species presents an additional degree of difficulty given that one pathway for their advance is interstate waterways, which typically run with state borders.

III. IMPROVING FEDERAL POLICY VIA AN ECOSYSTEM-BASED APPROACH

Existing scholarship exhaustively discusses potential policies and legislation to address the threat of climate change.²⁹² Re-plowing that ground is beyond the scope of this article. Beginning to address the intractable problem of invasive species is daunting enough for policymakers. Accordingly, this part of the article is limited to broadly sketching out the potential scope of and vehicles for improving the federal response to invasive species, while taking into account and responding to those species' synergistic effects with climate change.

A. *The Scope and Substance of an Ecosystem-Based Approach*

Several threshold questions confront policymakers beginning to discuss the scope of a new effort to address the invasive species problem. The first, and perhaps the most important of these questions goes to the appropriate target for new resources tasked to the

environmental protection are left out of the balance sheet entirely because they are too difficult or impossible to calculate by standard neoclassical economics"); Daniel H. Cole, *Clearing the Air: Four Propositions about Property Rights and Environmental Protection*, 10 DUKE ENVTL. L. & POL'Y F. 103, 116 (1999).

290. William Gerard, Comment, *Norton v. Southern Utah Wilderness Alliance*, 28 HARV. ENVTL. L. REV. 581, 587 (2004).

291. Resp. to Mot. for Prelim. Inj. at 46–50, *Michigan v. Illinois*, 130 S. Ct. 1934 (2010).

292. See *supra* note 96 and accompanying discussion.

problem. Existing law and policy has typically focused on one of two avenues: attempting either to eradicate or control invasive species that are already present or to prevent the entry of new invasive species. Efforts focused on eradication run headlong into the truth of Dr. Lodge's pronouncement that "invasion is forever," quoted at the beginning of this article.²⁹³ It is exceedingly difficult to institute immediate emergency measures that save food supplies already devastated by invasive pests, or that rescue native species from the brink of extinction.²⁹⁴

On the other hand, efforts that focus on prevention, such as NACPA and the Lacey Act, have weaknesses of their own. Invasive species manifest in new environments by at least three methods: accidental introduction; intentional introduction due to anticipated benefits, where the introduction has unanticipated side effects or spreads beyond its initial confines; and intentional, malicious introduction. It is nearly impossible for a single policy instrument to address all three pathways. Moreover, the Lacey Act depends on a "dirty list" approach, meaning that it only applies to invasive species that have been administratively added to a list of prohibited species.²⁹⁵ Non-listed species may easily slip through the cracks. A corollary to the "dirty list" approach could be to issue permits for the beneficial introduction of non-native species, but such an approach would carry heavy social costs in the form of an increased administrative load.

An alternative approach is to focus on ecosystem-based protection and adaptation. An ecosystem is "the sum total of the organisms living in a particular place, the interactions between these organisms, and the physical environment in which they interact."²⁹⁶ In the past few years, methodologies that focus on ecosystem-based environmental protection efforts and policies have gained increasing

293. Lodge Statement, *supra* note 1, at 10.

294. For this same reason, among others, J.B. Ruhl has suggested that the FWS should focus its efforts undertaken pursuant to the ESA on adaptation measures rather than on quixotic measures such as direct regulation of greenhouse gas emitters. See Ruhl, *supra* note 185, at 59–60 (stating that the FWS should "build each species its bridge").

295. See 50 C.F.R. § 16.3 (2010); Biber, *supra* note 115, at 391; Kurdila, *supra* note 115, at 104.

296. Mark Laemmle, *Monumentally Inadequate: Conservation at Any Cost Under the Antiquities Act*, 21 VILL. ENVTL. L.J. 111, 127 n.117 (2010) (quoting STEPHEN R. PALUMBI, PEW OCEANS COMM'N, MARINE RESERVES: A TOOL FOR ECOSYSTEM MANAGEMENT AND CONSERVATION 8 (2003)).

popularity in a variety of contexts, including climate change.²⁹⁷ Moreover, such an approach allows a simultaneous focus on fostering resistance and adaptation to both climate change and invasive species. Both threaten the fundamental ecosystem services upon which humans have come to rely over thousands of years.²⁹⁸

To date, agencies and policymakers charged with wildlife management have typically analyzed threats to native plants and animals on a species-specific basis.²⁹⁹ However, that view is changing based on trends in conservation biology that urge a broader focus in light of the interconnectedness of life within particular ecosystems.³⁰⁰ This approach, while rooted in scientific theory, is not without support in the law. For example, the Congressionally-stated purpose of the ESA is to “provide a means whereby the *ecosystems* upon which endangered species and threatened species depend may be conserved.”³⁰¹

The ecosystem-level approach has similar appeal in the context of invasive species management. Specifically, I suggest that where invasive species threaten ecosystems, agencies should focus on

297. See generally J.B. Ruhl, *Ecosystem Services and the Clean Water Act: Strategies for Fitting New Science into Old Law*, 40 ENVTL. L. 1381 (2010); Glicksman, *supra* note 82; Louis Van Gorder, Comment, *Beyond Borders: an Ecosystem Approach to Environmental Regulation*, 14 ROGER WILLIAMS U. L. REV. 729 (2009).

298. Ecosystem services are “services of nature” such as “purification of air and water, pest control, renewal of soil fertility, climate regulation, pollination of crops and vegetation, and waste detoxification and decomposition.” Salzman, *supra* note 18, at 33. Ecosystem services are “absolutely essential to our existence.” *Id.*; see also Ruhl & Salzman, *supra* note 18, at 157 (stating that the “suite” of ecosystem services “quite literally underpins human society.”).

299. See Karen L. Smith, *Habitat Protection for the New Millennium: An Analysis of Domestic and International Regimes in North America*, 13 GEO. INT’L ENVTL. L. REV. 509, 514 (2001) (“[FWS] has claimed . . . that they are placing new emphasis on ecosystem management However, in practice, the ESA [is] executed on an individual species by species basis.”); accord Richard J. Lazarus, *Congressional Descent: the Demise of Deliberative Democracy in Environmental Law*, 94 GEO. L.J. 619, 630–31 (2006) (criticizing the ESA’s “narrow focus on individual species”).

300. For example, in July 2010 President Obama adopted the recommendation of the Council on Environmental Quality’s Interagency Ocean Policy Task Force to the effect that “[h]uman activities that may affect ocean, coastal, and Great Lakes ecosystems should be managed using ecosystem-based management and adaptive management.” The White House Council on Environmental Quality, *Final Recommendations of the Interagency Ocean Policy Task Force* 15 (July 19, 2010), available at http://www.whitehouse.gov/files/documents/OPTF_FinalRecs.pdf; Exec. Order No. 13,547, 75 Fed. Reg. 43,023, 43,023 (July 22, 2011). Other scholars have framed the primary goal of environmental law as to “make sense of the First Law of Ecology, that everything is connected to everything else.” Zygmunt J.B. Plater, *Environmental Law in the Political Ecosystem—Coping with the Reality of Politics*, 19 PACE ENVTL. L. REV. 423, 480 n. 77 (2002).

301. 16 U.S.C. § 1531(b) (2006) (emphasis added).

preserving biodiversity within ecosystems³⁰² and maintaining the functionality of ecosystem services.³⁰³ This would allow agencies to consider the “domino effects”—both positive and negative—that the entry of an invasive species might have for an entire ecosystem, as opposed to effects of the invasion on individual species or particular types of harm, all with the ultimate goal of preserving biodiversity and the ecosystem services described above.³⁰⁴ Agencies could, perhaps, employ some version of the precautionary principle to determine whether a departure from equilibrium that invasive species cause in a particular ecosystem is likely to have positive or negative consequences.³⁰⁵ While this is a more complex level of analysis, it will likely yield more helpful results.³⁰⁶

An ecosystem-level approach has several potential advantages over traditional, national-level responses to the synergistic problems that invasive species and climate change pose. First, ecosystem-based adaptation has already been recognized as “part of an overall . . . strategy” for responding to climate change.³⁰⁷ It “uses the range of opportunities for the sustainable management, conservation, and restoration of ecosystems to provide services that enable people to

302. See Glicksman, *supra* note 82, at 881 (“As conservation biologists recognize, biodiversity strengthens the resilience of an ecosystem . . .”); Mark Yaggi, *Impervious Surfaces in the New York City Watershed*, 12 FORDHAM ENVTL. L.J. 489, 503 (2001) (“Abundant biodiversity indicates a strong ecosystem . . .”).

303. For a discussion of “ecosystem services,” see *supra* note 298.

304. Glicksman, *supra* note 82, at 881 (“[T]he extinction of a keystone species could result in a domino effect whereby numerous species go extinct and the entire ecosystem is dramatically altered.”).

305. The appropriate formulation of the precautionary principle has long been debated, and precisely defining it is beyond the scope of this article. Compare Noah M. Sachs, *Rescuing the Strong Precautionary Principle from Its Critics*, 2011 U. ILL. L. REV. 1285, 1285 (2011) (offering a defense of the principle’s “strong” formulation), with Cass R. Sunstein, *Beyond the Precautionary Principle*, 151 U. PA. L. REV. 1003, 1003 (2003) (arguing that the principle should be rejected because it produces “literally paralyzing” results). The difficulty lies in placing the principle along a spectrum of severity that includes “strong” versions that shift “the overall burden of proving safety” to the “risk creator”; a “middle-ground” position that “uncertainty justifies regulatory action,” and a “weak” version that “uncertainty does not justify inaction.” John S. Applegate, *The Taming of the Precautionary Principle*, 27 WM. & MARY ENVTL. L. & POL’Y REV. 13, 28–29 (2002) (citing Jonathan B. Wiener, *Precaution in a Multi-Risk World*, in HUMAN AND ECOLOGICAL RISK: THEORY AND PRACTICE 1509, 1513–16 (Dennis D. Paustenbach ed., 2002)).

306. In some cases, a more detailed analysis might even show that it is preferable to avoid preserving the status quo in a particular ecosystem. Cf. Ruhl, *supra* note 185, at 2 (recognizing, in the endangered species context, that “the pika is toast”).

307. BURGIEL & MUIR, *supra* note 10, at 12.

adapt to the impacts of climate change.”³⁰⁸ It also aims to strengthen the defenses of ecosystems and people to climate change by maintaining and increasing the natural resilience of ecosystems.³⁰⁹ One “key element” of ecosystem-based adaptation is “the reduction of other major threats, which when compounded with the effects of climate change would push a system beyond its ability to function properly.”³¹⁰ Without doubt, invasive species are one of those “other major threats,” the reduction of which increases the ability of ecosystems to resist the impacts of climate change. The ecosystem-based approach should be able to accommodate this additional consideration.

Second, the identification and prioritization of key ecosystems and ecosystem services to protect against climate change can also provide order to the federal response to invasive species. Specifically, once those key ecosystems and ecosystem services have been identified, the involved federal agencies can concentrate prevention and response efforts on the invasive species that inhabit these prioritized ecosystems as well as on blocking pathways by which additional invasive species may enter them. This prioritization of critical ecosystems should make the policy response more manageable on both administrative and economic levels, because policymakers will not need to address every single problem nationwide.

Finally, the flexibility inherent in an ecosystem-based approach will allow iterative adjustment of federal practices as agencies gain more information about the impending effects of climate change. Within a particular ecosystem, policymakers might choose to focus on prevention of invasive species entry through particular pathways, or on control of invasive species already present. The success or failure of such efforts can inform similar undertakings at other ecosystems, or could perhaps eventually be generalized to regular procedures to be followed to protect general types of ecosystems. Such an “adaptive management” approach to environmental policy helps policymakers “respond to uncertainty by undertaking reversible actions and studying outcomes to reduce uncertainty at the next decision point.”³¹¹

308. *Id.*

309. *Id.*

310. *Id.* at 13.

311. Bryan G. Norton, *The Rebirth of Environmentalism as Pragmatic, Adaptive Management*, 24 VA. ENVTL. L.J. 353, 362 (2005); see also Holly Doremus, *Adaptive*

In the specific context of the potential invasion of the Great Lakes, for example, an ecosystem-based approach has two distinct advantages. First, had such an approach been in place in the late nineteenth century, the city of Chicago might have been required, or at least encouraged, to find a different solution to its sewage problems given the obvious issues involved with connecting two ecosystems that had previously been entirely distinct. Second, at present, policymakers could choose to address the specific pathways by which the carp may enter the Great Lakes, instead of being forced to make those decisions on a much larger scale (that is, policymakers would not have to set policy that would govern all ecosystems everywhere).

Ultimately, the selected strategy must address a broad range of concerns, potentially including federalism issues and ensuring broad-based participation by state and local policymakers; the extent to which cost-benefit calculations should play a role in selecting particular ecosystem-based projects; an information-gathering dimension to allow the best possible decision making; and the selection of a liability scheme for noncompliance.

The liability scheme deserves further emphasis and study because in the context of invasive species, very small actions can result in enormous consequences, and this makes the selection of a liability scheme extremely complex. Take, once again, the example of the Asian carp. A negligence-based scheme would likely be unhelpful because those responsible for introducing the carp are unavailable, unable to make good individually on the tremendous economic consequences, or even non-negligent in their actions. Likewise, a strict liability scheme would likely be unworkable because the potential economic harms are so vast that those responsible may be unable to shoulder them.

B. The Policy Vehicle for an Ecosystem-Based Approach

Even if policymakers agreed on the ecosystem-based approach that this article recommends, they would still need to select an appropriate vehicle to implement that approach. There are at least three potential options: a new or amended federal statute, modification of Executive Order 13,112, and unilateral administrative action by one agency or a group of agencies.

Management as an Information Problem, 89 N.C. L. REV. 1455, 1466 (2011) (arguing that an adaptive approach is “a necessity” given the data gaps inherent in ecosystem management).

A new or amended federal law would give policymakers the most flexibility to fashion a remedy. However, the difficulties of passing a major environmental statute in the modern era have frequently been expounded upon,³¹² and these concerns seem especially valid in the current weak economic climate. Most commentators agree that Congress has not enacted a major environmental statute since the Clean Air Act Amendments of 1990,³¹³ and this difficulty manifested again in Congress's failure to pass a climate change statute in 2010 despite Democratic majorities in both houses of Congress and a Democratic president.³¹⁴ Yet, the passage of a less ambitious statute with less economic impact might not be impossible. Congress has passed numerous such statutes recently. For example, in the context of invasive species, Congress has authorized funding in the National Defense Authorization Act for Fiscal Year 2008 and the Water Resources Development Act of 2007.³¹⁵ It has also passed several substantive measures, including the Great Lakes Fish and Wildlife Restoration Act of 2006³¹⁶ and the Public Lands Corps Healthy Forests Restoration Act of 2005.³¹⁷ A statute of appropriate scope would likely find broad support in Congress.

Executive Order 13,112, which drives much of existing federal policy related to invasive species control, provides another option to implement the ecosystem-based approach. The very text of the Order directs NISC to "encourage planning and action at . . . ecosystem-based levels."³¹⁸ This could be accomplished by executive amendment or reissuance of the Order (perhaps the path of least political resistance), or by congressional action to adopt some of the Order's precepts into law. Both approaches are not without flaws, however.

312. See, e.g., Lazarus, *supra* note 24, at 1231.

313. See *id.*

314. See Stephen Stromberg, *What Sank the Senate's Climate Bill*, WASH. POST, July 29, 2010, at A23.

315. National Defense Authorization Act for Fiscal Year 2008, Pub. L. No. 110-181, § 314, 122 Stat. 3, 55-57 (requiring the Secretary of Defense to prepare a report on controlling the brown tree snake); Water Resources Development Act of 2007, Pub. L. No. 110-114, 121 Stat. 1041, 1121 (authorizing the Army Corps of Engineers to construct various projects, including an Asian carp dispersal barrier in the Upper Mississippi River).

316. Great Lakes Fish and Wildlife Restoration Act of 2006, Pub. L. No. 109-326, 120 Stat. 1761 (implementing certain recommendations in the Fish and Wildlife Service's Great Lakes Fishery Resources Restoration Study).

317. Public Lands Corps Healthy Forests Restoration Act of 2005, Pub. L. No. 109-154, 119 Stat. 2890 (addressing the impact of insect or disease infestations on forest and rangeland health).

318. Exec. Order No. 13,112, 64 Fed. Reg. at 6185.

Mere amendment or reissuance of the Order would leave it subject to the same difficulties it now faces: the absence of agency prioritization due to the lack of underlying legislative authority, the potential for turf wars among the many agencies that administer the Order, and most worrisome of all, the potential that a future executive could simply discontinue the Order. Congressional adoption of some or all of the Order would eliminate the last concern, but is subject to the same impediments just discussed relating to the difficulty of passing federal environmental legislation. Moreover, any solution based on the Order will have to resolve the “alphabet soup” approach of numerous federal agencies, each with an ill-defined stake in solving invasive species issues.

The third option for an ecosystem-based approach would be for individual agencies to implement it through regulations or in day-to-day practice. For example, the FWS could issue regulations or interpretive guidance pursuant to the ESA that required consideration of potential invasive species impacts when preparing future recovery plans for threatened or endangered species. This approach is the most flexible in terms of allowing expert agency decision makers to select particular ecosystems for prioritization, perhaps based on the presence of endangered native species or other considerations.

This option is limited by the impact that any one agency can impose on the overall invasive species problem, as well as the danger, as with the Order, that a future administration could simply change agency policy. Moreover, some individual agencies may lack the necessary authority to promulgate regulations that address invasive species control or permitting.

CONCLUSION

It is possible, of course, that federal agencies can continue to muddle through, separately addressing the problems of invasive species and climate change as if operating in a vacuum. Yet federal policy can have the greatest impact on these synergistic threats if it responds with a synergistic response of its own, namely ecosystem-based management. Consideration of the “domino effects” that invasive species can have in an ecosystem will provide agencies and policymakers with a more complete and biologically accurate picture of the potential impacts on the ecosystem. Such an approach could fill many of the gaps in the patchwork of federal laws and policies now governing the invasive species problem, and would be a low-risk

method to combat both invasive species and climate change induced impacts, even though we are uncertain as to the precise level of severity of those impacts.