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Consequences of Resource Limitations on ESA Implementation

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I. Introduction

The U.S. Endangered Species Act (ESA) is widely considered the strongest wildlife protection law in the world: almost every species listed is still with us today and many are on the path to recovery. Somewhat amazingly, it has earned this reputation despite being systematically underfunded for decades. For example, we know that only about 25 percent of needed recovery funding has been allocated by Congress on average.[1] Detailed analyses have revealed common taxonomic biases, such as plants—which comprise over 50 percent of ESA-listed species—have received less than 5 percent of annual expenditures from federal and state sources,[2] and plants and invertebrates receive a unexpectedly low proportion of requested funding.[3] Many of the consequences of resource limitation on ESA implementation are not understood, but recent work has helped shed light on several of those uncertainties. For example, Evans and colleagues summarized status trends for threatened and endangered species from 1990 through 2010: 52 percent were declining

1. Leah R. Gerber, *Conservation Triage or Injurious Neglect in Endangered Species Recovery*, 113 Proc. Natl. Acad. Sci. U. S. A. 3563–66 (2016). And that estimate is likely an overestimate: the reported expenditures include both recovery and compliance dollars in the same pool.

2. Vivian Negron-Ortiz, *Pattern of Expenditures for Plant Conservation under the Endangered Species Act*, Biological Conservation 36–43 (2014).

3. Julie K. Miller et al., *The Endangered Species Act: Dollars and Sense?*, 52 BioScience 163 (2002).

during the period, 35 percent were stable, and eight percent were improving.[4] Using a different measure of status changes, a separate analysis found that the majority of species were declining demographically, while threats increased.[5] Perhaps the only surprise about these numbers is that conditions are not actually worse given the lack of funding plaguing the endangered species program.

This chapter reviews what we know and do not know about the consequences of resource limitation on ESA implementation. First are the challenges of resource limitation on the central pieces of the ESA—sections 4, 6, 7, and 10—and then the challenges that span across these sections. The recurring theme of this discussion is how resource limitations lead to delays in ESA action, some of which are known (or suspected) to harm species conservation. The second part of the chapter focuses on possible solutions to those challenges, including both section-specific and cross-cutting solutions.

II. Challenges with ESA Implementation

A. Section 4

Section 4 is the "gateway" to the ESA's protections: it specifies the criteria for listing and delisting species, the designation of critical habitat, the requirement for recovery planning, and the requirement for regular status reviews, among other actions. Because these components are central to ESA implementation, understanding the consequences of resource limitations on each component provides essential insight into how resource limitations affect the overall endangered species program.

1. Listings

The effects of resource limitation on ESA implementation may be most noticeable for decisions to list and delist species because of their public visibility. These effects may manifest in terms of listing delays or a backlog of status change determinations, as well as the carryover effects for other parts of the endangered species programs. A 2019 analysis of the funding needs of the U.S. Fish and Wildlife Service (FWS) found that the listing program budget needed to increase by nearly fivefold, from the fiscal year 2019 request of $10.8 million to $51 million, to meet the demands of the program.[6] Congress has responded with a modest increase, but much more is required.

4. Daniel M. Evans et al., *Species Recovery in the United States: Increasing the Effectiveness of the Endangered Species Act*, 2016 Issues in Ecology (2016), http://escholarship.org/uc/item/8k61j403.pdf (last visited Sept. 13, 2017).

5. Jacob W. Malcom, Whitney M. Webber, & Ya-Wei Li, *A Simple, Sufficient, and Consistent Method to Score the Status of Threats and Demography of Imperiled Species*, 4 PeerJ e2230 (2016).

6. Jacob Malcom & Megan Evansen, *Endangered Species Act Funding Needs of the U.S. Fish and Wildlife Service* (2019), https://defenders-cci.org/files/ESA_funding_needs_final.pdf (last visited Oct 20, 2019).

A well-publicized consequence of underfunding is the long delay between when a species is first considered for listing and when the listing determination is finalized. One recent study used data from 1983 to 2014 to show that species listed by the FWS had to wait a median of 12.1 years from first consideration to listing.[7] The authors also indicate that the annual listing rate is positively associated with the size of the annual listing budget. There are several outstanding questions about the causes and consequences of these delays. For example, what is the biological cost of delays, say, in reduced likelihood of persistence? Some species are believed to have gone extinct while waiting for a listing determination and others were lost before a listing petition could be filed,[8] but whether conservation opportunities were missed as a result of listing delays is not known. It is also unclear how many species did not qualify for listing early in the waiting period (i.e., were not warranted under the FWS's interpretation of the statute) but crossed the threshold to being warranted later. In 2016, the FWS released a seven-year work plan that prioritized over 350 species to be evaluated for listing,[9] and was intended to shorten the expected time to listing and provide more regulatory certainty about the listing process. Currently, the work plan is not being met and the agency is nearly 100 species behind schedule.[10] Ultimately, species that need the protections afforded by the ESA but are unable to get a timely evaluation because of resource limitations bear the brunt of the cost.

The listing budget is also used to reclassify species under the ESA, including uplisting, downlisting, and delisting species. Resource limitations on these decisions are particularly visible in the frequent delays between the time FWS recommends and implements the reclassification. For example, in the 2013–2014 Biennial Report to Congress, FWS reported that five-year reviews included recommended status changes for 83 species: delist two species due to error; delist 11 due to extinction; delist 11 due to recovery; uplist 13 species from threatened to endangered; downlist 39 from endangered to threatened;

7. Emily E. Puckett, Dylan C. Kesler, & D. Noah Greenwald, *Taxa, Petitioning Agency, and Lawsuits Affect Time Spent Awaiting Listing under the US Endangered Species Act*, 201 Biological Conservation 220–29 (2016). The authors did not tally how many species were evaluated but not listed, which could alter our understanding of the delays and possible efficiencies.

8. Kieran Suckling, Rhiwena Slack, & Brian Nowicki, Extinction and the Endangered Species Act 63 (2004). However, some publicized delays (e.g., https://www.biologicaldiversity.org/news/press_releases/2016/stephans-riffle-and-tatum-cave-beetles-10-05-2016.html) are likely of no consequence, such as for the Tatum cave beetle (*Pseudanophthalmus parvus*), which was last observed before the ESA was even written (U.S. Fish & Wildlife Service, *Endangered and Threatened Wildlife and Plants; 12-Month Findings on Petitions to List 10 Species as Endangered or Threatened Species* (2016), https://www.federalregister.gov/documents/2016/10/06/2016-24142/endangered-and-threatened-wildlife-and-plants-12-month-findings-on-petitions-to-list-10-species-as (last visited Oct 20, 2019).

9. U.S. Fish & Wildlife Serv., *National Listing Workplan*, https://www.fws.gov/endangered/what-we-do/listing-workplan.html (last visited Oct. 20, 2019).

10. Center for Biological Diversity, *Analysis: Trump Administration Withholding Lifesaving Protection for 78 Species* (2018), https://www.biologicaldiversity.org/news/press_releases/2018/endangered-species-10-18-2018.php (last visited Oct. 20, 2019).

and update the listing details (e.g., name changes) for seven species.[11] At the time of the 2013–2014 report, the median age of the status change recommendation was 5.42 years (min = 0.61 years, max = 9.57 years). As of early 2018, only nine (10.8 percent) of the status changes from that report had been carried out.[12] Because there are insufficient resources to carry out all aspects of the ESA, the Services may judge that reclassification carries a higher cost than retaining the current classification.[13]

Although difficult to quantify, the overall cost of the listing workload impinges on implementing other parts of the ESA. When insufficient funding collides with court-ordered deadlines for listing determinations, the Services have to allocate their limited resources away from programs such as recovery planning and implementation, consultations, and voluntary conservation efforts. Thus, there is a catch-22: although ESA listing does not itself protect species and is costly and time-consuming,[14] it is still required for initiating section 7 consultations, section 9's take prohibition, and for spurring conservation planning under section 10.

2. Recovery Plans

Recovery plans outline the threats to species and provide actions needed to remove or ameliorate those threats for the long-term conservation of the species. The 1988 ESA amendments introduced the modern requirements for recovery plans, including the requirement that they be created for listed species unless doing so would not advance conservation.[15] Here, I summarize the three primary consequences of resource limitation on recovery plans: incompleteness of plans, delays in planning, and age of plans.[16]

Species can only benefit from recovery plans if those plans exist, and resource limitations have led to many species lacking plans. As of early 2018,

11. U.S. Fish & Wildlife Serv., *Report to Congress on the Recovery of Threatened and Endangered Species Fiscal Years 2013-2014* (2017), https://www.fws.gov/endangered/esa-library/pdf/Recovery_Report_FY2013-2014.pdf (last visited Oct. 20, 2019).

12. Columbian white-tailed deer (*Odocoileus virginianus leucurus*), Florida manatee (*Trichechus manatus*), Santa Cruz cypress (*Cupressus abramsiana*), and the San Clemente Island lotus (*Acmispon dendroideus* var. *traskiae*) were downlisted; and Oregon chub (*Oregonichthys crameri*), Modoc sucker (*Catostomus microps*), Delmarva fox squirrel (*Sciurus niger cinereus*), Kirtland's Warbler (*Setophaga kirtlandii*), and eastern puma (*Puma (=Felis) concolor couguar*) were delisted.

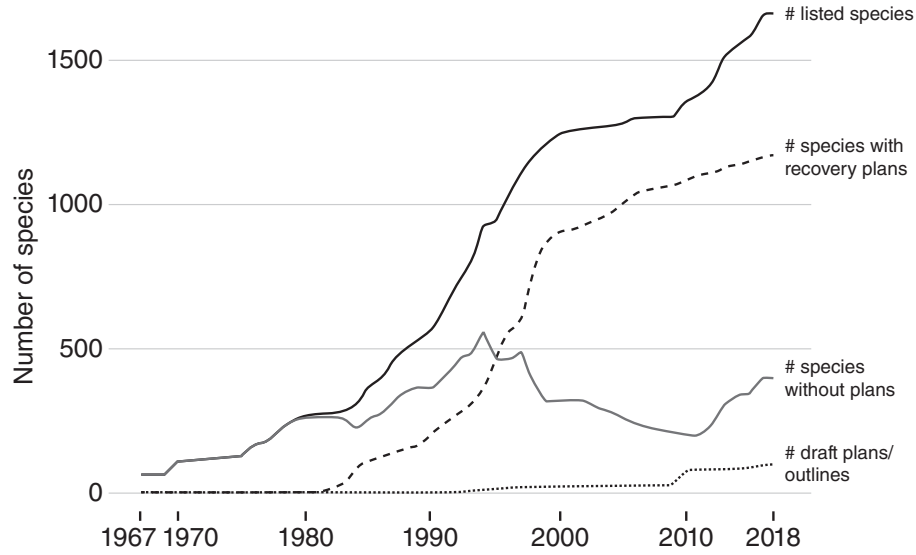
13. For species that have minimal regulatory impact—for example, a plant found only on nonfederal land, so that consultations are rarely if ever needed and Incidental Take Permits from section 10 conservation plans are not required—remaining listed carries very little cost, whereas the very process of delisting can carry a substantial cost.

14. However, the listing itself may raise awareness of a species' imperiled status.

15. U.S.C. § 1533(f).

16. Jacob W. Malcom & Ya-Wei Li, *Missing, Delayed, and Old: The Status of ESA Recovery Plans*, 11 Conservation Letters e12601 (2018). *Missing, delayed, and old: The status of ESA recovery plans*, 11 Conservation Letters e12601 (2018), https://figshare.com/articles/ESA_recovery_plans_through_time/6269840

Figure 15.1 The number of listed species has increased steadily through time (black solid line) and the number of species without final recovery plans (gray solid line) has varied over the same period. The number of species with recovery plans (gray dashed line) has lagged behind listings, and the number of species with draft plans (black dotted line) has increased more rapidly in recent years. The numbers of listed species, and those with or missing recovery plans, comes from data provided by the U.S. Fish and Wildlife Service at https://ecos.fws.gov.



some 25 percent of ESA-listed species lack final recovery plans, a proportion that has changed with presidential administrations (Figure 15.1).[17]

Another consequence of resource limitations on recovery planning is the delay between listing and plan completion. In 1994, the Services issued a joint policy indicating they would complete recovery plans within two and a half years of listing a species.[18] Unfortunately, this timeline has not panned out: the median time-to-plan is approximately five years (mean = 6.7 years), and only 18.6 percent of species' plans met the two-and-a-half-year goal.[19] The Services' joint recovery planning handbook indicates that recovery outlines are required soon after a species is listed.[20] But the paucity of (publicly available) outlines indicates these early guidance documents are not being created in a timely fashion, likely because of insufficient funding.

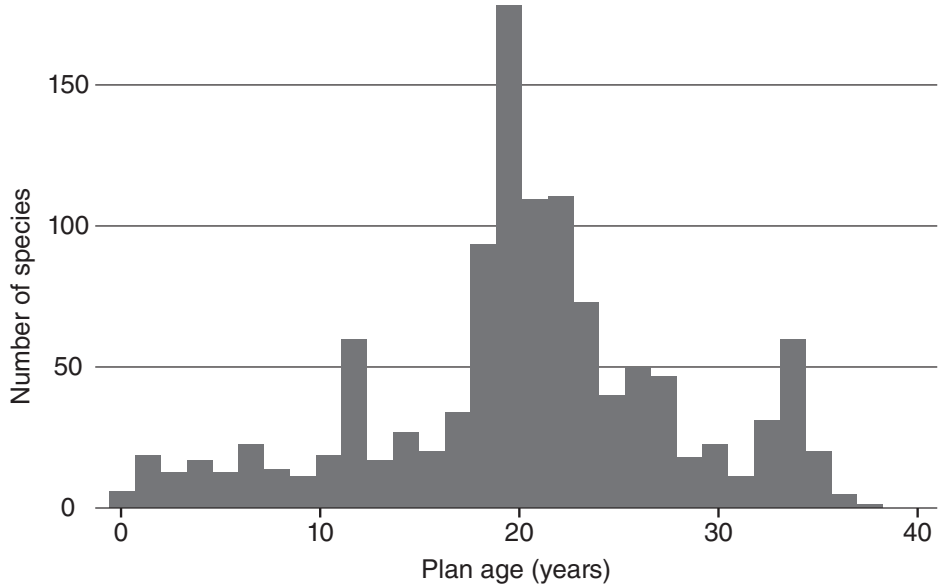
17. CC-BY Jacob Malcom, *ESA Recovery Plans through Time* (2018), https://figshare.com/articles/ESA_recovery_plans_through_time/6269840.

18. U.S. Fish & Wildlife Service and National Marine Fisheries Service, *Cooperative Policy (NMFS & FWS) for Recovery Plan Participation and Implementation Under the ESA*, Federal Register (1994).

19. Malcom & Li, *supra* note 16.

20. National Marine Fisheries Service & U.S. Fish and Wildlife Service, *Interim Endangered and Threatened Species Recovery Planning Guidance* (2010).

Figure 15.2 One consequence of limited resources is that, with a median age of over 22 years, recovery plans for Endangered Species Act-listed species tend to be old.
The histogram shows the distribution of plan age (2018-01-08 minus the plan date). Data on the dates of recovery plans from the U.S. Fish and Wildlife Service's website, https://ecos.fws.gov.



Resource limitation is a key reason recovery plans tend to be out-of-date, with the median age of a recovery plan being 22.8 years (Figure 15.2).[21] A major problem of this older age is that subsequent ESA decisions are frequently made on outdated information, especially because threats and species status can evolve quickly. For example, the eastern indigo snake's (*Drymarchon corais couperi*) last recovery plan was written in 1982, a time when collection by herpetoculturalists was believed to be the major threat to the species.[22] Today, habitat destruction for development and transportation is recognized as the major threat to the species.[23] More generally, we know that very few recovery plans recognize the threat of climate change, and therefore, do not plan for species adaptation or provide any mitigation of future effects.[24]

Lastly, it should not be forgotten that the implementation of recovery actions that are detailed in the plans, no matter how out-of-date they may

21. CC-BY Jacob Malcom, *ESA Recovery Plan Age* (2018), https://figshare.com/articles/ESA_recovery_plan_age/6269873.

22. U.S. Fish & Wildlife Service, *Eastern Indigo Snake Recovery Plan* (1982). Note, however, that the FWS updated the recovery plan as this chapter was being finalized.

23. D.R. Breininger et al., *Habitat Fragmentation Effects on Annual Survival of the Federally Protected Eastern Indigo Snake*, 15 Anim. Conserv. 361–68 (2012).

24. J.B. Ruhl, *Climate Change and the Endangered Species Act: Building Bridges to the No-Analog Future*, 88 B.U. L. Rev. 62 (2008). Anthony Povilitis & Kieran Suckling, *Addressing Climate Change Threats to Endangered Species in U.S. Recovery Plans*, 24 Conservation Biology 372–76 (2010).

be, is severely underfunded. Gerber estimated recovery needs at about $1.2 billion per year,[25] and a recent update using a similar methodology estimated the need of at least $1.62 billion per year.[26] In short, a major, resource-limited implementation gap will exist until Congress, the states, and nongovernmental partners find new ways to fund the ESA program and especially essential on-the-ground actions.

3. Five-Year Reviews

The ESA requires the Services to synthesize and summarize new information about listed species once every five years, and the review results may then be the basis for proposing listing status changes. These five-year reviews are generally behind schedule, but how far behind has not been quantified until recently. Based on data from the FWS's ECOS website as of early 2018, only 479 of 1,189 (40.3 percent) five-year reviews were on time (i.e., less than five years old).[27] As with other parts of ESA implementation, resource limitations are a primary cause of these delays—FWS administrators must decide whether staff will focus on recovery plans, status reviews, or on-the-ground recovery actions. The 2019 analysis of the FWS's endangered species program needs found at least $7.5 million is needed for several years to close the backlog and at least $5.25 million per year on a recurring basis thereafter.[28] Casual observation suggests the Services have recently placed a greater emphasis on five-year review completion, perhaps because the backlog is limiting efforts to down or delist species. It is unclear what effect this emphasis will have on other parts of the ESA.

B. Section 6

Section 6 establishes the federal–state cooperation framework for conserving threatened and endangered species. This includes authorizations for state employees to work with federally listed species, and importantly, funding for nonfederal parties to carry out activities for listed species. Unfortunately, section 6 Cooperative Endangered Species Conservation Fund (CESCF) grants have declined dramatically.[29] For example, in 2003, FWS reported CESCF grants totaling $70,567,460, and that amount had dropped to $44,536,356 (37 percent) in 2016 (Table 15.1). We do not have the data to determine the consequences of this decline on species conservation. However, because so

25. Gerber, *supra* note 1.

26. Jacob W. Malcom, *Over $1.5 Billion per Year Is Needed to Recover Endangered Species Act (ESA)-Listed Species* (2019), https://defenders-cci.org/files/ESA_recovery_costs_2019.pdf (last visited 23 October 2020)

27. Center for Conservation Innovation, *ESA Five-Year Reviews* (2017), https://defenders-cci.org/app/fiveyr_review/ (last visited Oct. 20, 2019).

28. Malcom & Evansen, *supra* note 6.

29. California Habitat Conservation Planning Coalition, *U.S Fish and Wildlife Service Cooperative Endangered Species Conservation Fund: Fiscal Year 2018 Funding Request* (2018).

Table 15.1 Total expenditures by category in the Cooperative Endangered Species Conservation Fund

	2003	2016	Percent change
HCP land acquisition	$51,136,439	$22,000,000	–57%
Habitat conservation planning	6,606,775	5,571,765	–16%
Recovery land acquisition	12,824,246	16,964,591	+32%
Total	70,567,460	44,536,356	–37%

Data from https://www.fws.gov/endangered/esa-library/index.html#grants

many species are found primarily on nonfederal land,[30] the consequences are likely negative. Another possible negative effect is that parties who are unable to get section 6 funding may be more likely to spread the idea it is a faulty program. The FY 2019 budget request zeroed out CESCF funding, while an analysis indicated that the CESCF be needs to be funded at least at $100 million per year.[31]

C. Section 7

Section 7 directs federal agencies to use their authorities to conserve threatened and endangered species in two ways: the affirmative duty to carry out conservation actions in section 7(a)(1) and the requirement that federal agency actions not jeopardize species or modify or destroy critical habitat in section 7(a)(2). The reach of section 7 means it is often considered the strongest section of the ESA.[32]

There are very few 7(a)(1) conservation plans. Part of the absence appears to be driven by lack of formal guidance on what constitutes a 7(a)(1) plan,[33] which may depend in part on funding to develop such guidance. This gap needs to be addressed because some federal agencies are very interested in finding ways to do more to conserve listed species and to do so efficiently. One of the few recent examples of a broad 7(a)(1) plan is the Conservation Plan for

30. C. Groves et al., *Owning Up to Our Responsibilities: Who Owns Lands Important for Biodiversity?*, *in* Precious Heritage: The Status of Biodiversity in the United States 275–300 (2000).

31. Malcom & Evansen, *supra* note 6.

32. Jacob W Malcom & Ya-Wei Li, *Data Contradict Common Perceptions about a Controversial Provision of the US Endangered Species Act*, 112 Proc. Natl. Acad. Sci. U. S. A. 15844–49 (2015). Michael J. Evans, Jacob W. Malcom & Ya-Wei Li, *Novel Data Show Expert Wildlife Agencies Are Important to Endangered Species Protection*, 10 Nature Communications 3467 (2019). *Novel data show expert wildlife agencies are important to endangered species protection*, 10 Nature Communications 3467 (2019).

33. But see recent developments: Fish and Wildlife Service, *Better Conservation More Efficiently: A Guide for Federal Agency Compliance with Section 7(a)(1) of the Endangered Species Act* (2018), https://www.fws.gov/northeast/ecologicalservices/pdf/endangered/R5-7a10-Guidance-030918.pdf (last visited Oct. 19, 2019).

the Lower Mississippi River developed by the U.S. Army Corps of Engineers and the FWS.[34] The plan identifies proactive steps the Corps will take while working on the river to benefit three listed species and how those benefits allow FWS to streamline section 7(a)(2) consultations on the Corps' navigation and channeling activities in the river. Unfortunately, until federal agencies have more funding and prioritize developing section 7(a)(1) plans and there is policy direction to do so, this component of the ESA will remain underused despite the affirmative duty to act.

Consultations under section 7(a)(2) are one of the most important aspects of ESA implementation because of the breadth of activities that are evaluated. Recent work has highlighted that the consultation workload for FWS is high, but that the majority of consultations are still completed on time.[35] However, other research, which included interviews with agency staff, found that the lack of resources and the hard deadlines for formal consultations resulted in immense stress for personnel.[36] Further, the data from that paper suggests that the resource shortage may be contributing to biological opinions falling short of the FWS's own guidance. For example, the authors describe an effort by FWS to expedite consultations by using "concurrence stickers" for Not Likely to Adversely Affect (NLAA) determinations (Figure 15.3). Although a time-saving measure, concurrence stickers provide no administrative record of the justification for concurrence with NLAA determinations, and post-hoc explanations are legally vulnerable.

Consultations at NMFS are different in large part because the agency functions differently than does FWS—it has a different suite of laws to implement, a different structure and culture, and different funding.[37] One result of these differences is that NMFS's rate of on-time consultations in recent years has been closer to 30 percent, whereas FWS's has been closer to 85 percent.[38] Some of this delay is driven by the parallel analyses that NMFS must carry out during many consultations (e.g., related to the Magnuson-Stevens Act), but it is also rooted in insufficient funding.[39]

Pesticides are an emerging challenge for both Services' consultation programs. This is because there are some 736 pesticides with 1,155 active ingredients, which in the aggregate likely affect all domestic ESA-listed species, that require consultations in the coming years. The consultations are necessary for the EPA to comply with the ESA when it registers pesticides under the

34. Army Corps of Engineers and Fish & Wildlife Service, *Conservation Plan for the Interior Least Tern, Pallid Sturgeon, and Fat Pocketbook Mussel in the Lower Mississippi River* (2014).

35. Malcom & Li, *supra* note 32.

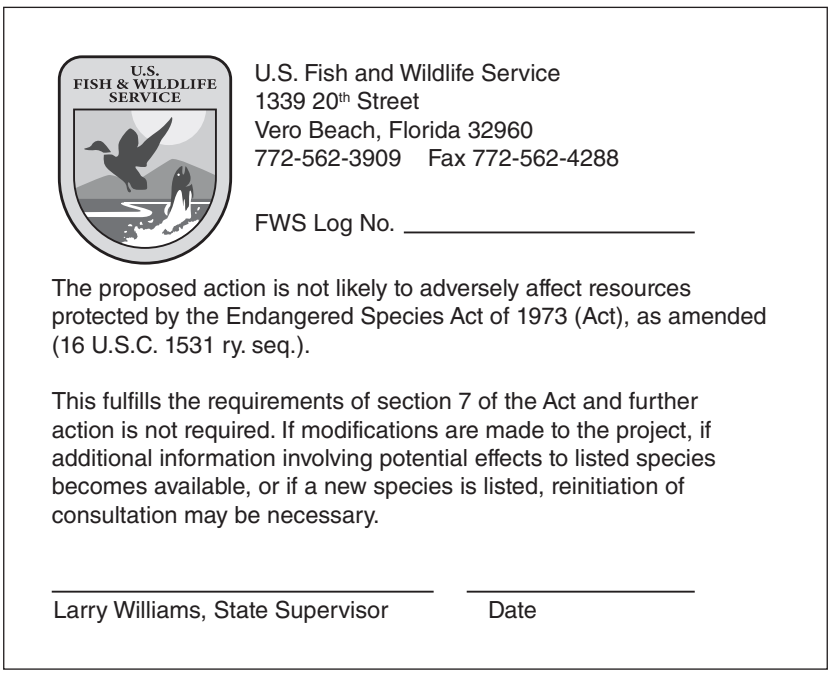
36. Megan Evansen, Ya-Wei Li, & Jacob Malcom, *Same Law, Diverging Practice: Comparative Analysis of Endangered Species Act Consultations by Two Federal Agencies*, 15 PLOS ONE e0230477 (2020).

37. Natalie Lowell & Ryan P Kelly, *Evaluating Agency Use of "Best Available Science" under the United States Endangered Species Act*, 196 BIOC 53–59 (2016). Evansen, Li, & Malcom, *supra* note 36.

38. National Marine Fisheries Service, *FY 2014 Budget Summary (Bluebook)* (2014).

39. *Id.*

Figure 15.3 A "concurrence sticker" used by the U.S. Fish and Wildlife Service in South Florida as a quick way to indicate a "not likely to adversely affect" conclusion. Although these stickers are faster than writing a response document, they do not provide any indication of the justification for the NLAA determination and fall short of expectations for program administration.



Federal Insecticide, Fungicide, and Rodenticide Act. These consultations are massive undertakings. For example, the Biological Opinion for the effects of three organophosphates on just 77 species evaluated by NMFS spanned more than 3,700 pages.[40] With funding declining and regular (non-pesticide) consultations still occurring, the addition of pesticide consultations means even more work for the Services.

D. Section 10

Section 10(a)(1)(A) permits for scientific research on ESA-listed species can be badly delayed. For example, one researcher who needed small tissue samples for basic population genetics work on the rock gnome lichen (*Gymnoderma lineare*) had to wait 450 days for a permit.[41] This delay occurred even though the need for genetic information is identified throughout the species' recovery

40. National Marine Fisheries Service, *Biological Opinion on the Environmental Protection Agency's Registration of Pesticides containing Chlorpyrifos, Diazinon, and Malathion* (2017), https://doi.org/10.7289/V5CJ8BQM (last visited Oct. 20, 2019).

41. J. Allen, *personal communication*.

plan[42] and FWS knew that the permit was needed for time-sensitive grants to the researcher. Unfortunately, there are no publicly available data or published research to indicate the extent or magnitude of the delays, whether there is geographic variation in delays, or what efficiencies may have been found to reduce delays. Most importantly, we do not know how the delays in basic scientific research might be hindering the recovery of listed species.

The second major component of section 10 is the authorization for voluntary conservation plans: Habitat Conservation Plans (HCPs), Safe Harbor Agreements (SHAs), and Candidate Conservation Agreements with Assurances (CCAAs). As of 2016, there were approximately 1,200 HCPs, 91 SHAs, and over 30 CCAAs approved according to FWS records.[43] Although the available data shows that the adoption of these different agreements has varied through time, we cannot tell the extent to which lack of resources (e.g., for applicants to develop plans, or for FWS biologists to evaluate them) has hampered adoption. At best, we can point to the steep decline in section 6 funding to infer that resource limitation is likely hampering voluntary conservation efforts here as well.

E. Lack of Cross-Section Integration

Each of the preceding portions of this chapter focused on one section of the ESA, but the reality is that these sections are not independent. For instance, permitted harm of listed species in sections 7 and 10 often goes against the recovery goals laid out in section 4, or when states and other nonfederal parties (sections 6 and 10) take actions that advance or hinder recovery. Data collection, analysis, and feedback into the management process (i.e., adaptive management[44]) can be an ideal way to integrate across the sections of the ESA. However, the general experience of many practitioners and reviewers[45] is that limited resources have led to insufficient data collection and management.

Monitoring in the section 7 consultation and section 10 conservation programs is perhaps the most significant missing piece of cross-cutting ESA implementation.[46] This component, which is crucial to adaptive management

42. U.S. Fish & Wildlife Service, *Recovery Plan for the Rock Gnome Lichen (Gymnoderma linarae)* 45 (1997), https://ecos.fws.gov/docs/recovery_plan/970930b.pdf (last visited Oct. 20, 2019).

43. Jacob W. Malcom, *Section 10 Agreements Overview* (2016), https://defenders-cci.org/app/section10_agreements/ (last visited Oct. 20, 2019). See https://ecos.fws.gov/ecp0/conservationPlan/.

44. Robin K. Craig et al., *A Proposal for Amending Administrative Law to Facilitate Adaptive Management*, 12 Environ. Res. Lett. 074018 (2017).12 Environ. Res. Lett. 074018 (2017).

45. Government Accountability Office, *The U.S. Fish and Wildlife Service Has Incomplete Information about Effects on Listed Species from Section 7 Consultations* 39 (2009).

46. Meg Evansen, Jacob Malcom, & Andrew Carter, *A Monitoring Policy Framework for the United States Endangered Species Act* (2020), https://osf.io/gmr4u (last visited May 6, 2020).

in ESA agreements,[47] is lacking primarily because of inadequate resources. There are two major aspects of ESA monitoring: first, to determine if permittees are complying with the terms and conditions of their agreements; and, second, to determine if actions required under permits are effective. Compliance monitoring is essential to understanding how often parties engage the permitting process and, if they do, whether the actions they carry out are the same as the actions they propose.[48] Effectiveness monitoring should already be occurring—incidental take authorizations in biological opinions and section 10 agreements require monitoring reports—but are spotty at best.[49] Both pieces of information are needed to adapt policies and procedures for better outcomes. However, informal conversations indicate that the Services' staff simply lack the time and resources to ensure informative monitoring reports are submitted, much less reviewed and acted upon.

The lack of detailed species occurrence and range maps for ESA-listed species is another important cross-section challenge undercut by limited resources. Currently, for many listed species, range data are available only at the county level (see species accounts on FWS's ECOS site[50] and an overview[51]). However, many if not most listed species occupy only a tiny portion of those counties in which they occur. The lack of precise data means that too many conservation decisions are made (or at least are informed) by basic spatial data that are far too coarse. In the context of pesticide consultations, for example, this may mean a large number of pesticides are being analyzed for effects on species that only occur miles away from agricultural areas. In the context of section 10 conservation plans, applicants and Services personnel may waste time evaluating species that are unlikely to be affected by an action. And in the context of recovery, the lack of detailed data may mean missed conservation opportunities, such as land or easement purchases. This is particularly true when considering a species' future range, which, in the face of climate change, may be very different than past or current range.[52]

Another long-running example is the Services' general failure to track incidental take authorized under sections 7 and 10. The Services should track the amount of take they authorize and estimated amount of unauthorized take

47. George F. Wilhere, *The Role of Scientists in Statutory Interpretation of the Endangered Species Act*, Conserv. Biol. (2016). Conserv. Biol. (2016).

48. Jacob Malcom, Tiffany Kim, & Ya-Wei Li, *Free Aerial Imagery as a Resource to Monitor Compliance with the Endangered Species Act*, bioRxiv 204750 (2017). Michael J. Evans & Jacob W. Malcom, *Automated Habitat Change Detection Methods Using Satellite Data to Improve Conservation Law Implementation*, bioRxiv 611459 (2019).

49. Government Accountability Office, *supra* note 45.

50. https://ecos.fws.gov.

51. Center for Conservation Innovation, *ESA Listings* (2018), https://defenders-cci.org/app/listings-summary/#section-range-sizes (last visited Oct. 20, 2019).

52. Ruhl, *supra* note 24. Abbie H. Tingstad et al., *Demonstrating the Applicability of a Robust Decision Making (RDM) to Conservation Decision-Making Under Uncertain Future Climate: Pilot Study Using the Northern Pygmy Salamander (Desmognathus organi)*, 13 J. Conservation Planning 15 (2017).

so that they know whether the amount of harm occurring is impeding species survival or recovery. Once the data are collected, the Services can synthesize the information to determine how much additional take should be authorized. The importance of tracking take has long been recognized, even in Government Accountability Office (GAO) reports:

> The Service also lacks a systematic method for tracking cumulative take of most listed species. Out of 497 listed species in the western states, GAO identified 3 species for which the Service has a formal, Web-based database for tracking cumulative take: northern spotted owl, marbled murrelet, and bull trout. GAO identified 7 more species for which Service biologists developed informal means to track cumulative take.[53]

As of 2019, however, there is still no central take-tracking database.[54] Evansen and colleagues found in a review of certain FWS biological opinions that most of them did not include a tally of previously authorized take, which significantly reduced the quality of those analyses.[55] A GAO report has found that lack of funding was the root cause of why FWS did not adequately track authorized take.[56] Thus, resource limitations undercut the effectiveness of ESA programs and our ability to measure the effectiveness.

III. Solutions

The litany of challenges to ESA implementation that arise from resource limitation is daunting, but there is hope. Although it is clear that increased congressional funding for the ESA is needed,[57] there are complementary solutions, too. For instance, there are several process and policy improvements that can help with ESA implementation.[58] Through these improvements, fewer listed species should fall through the cracks out of basic neglect, and the overall effectiveness of ESA implementation should increase.[59]

53. Government Accountability Office, *supra* note 45.

54. Evansen, Li, & Malcom, *supra* note 36.

55. *Id.*

56. Government Accountability Office, *Despite Consultation Improvement Efforts in the Pacific Northwest, Concerns Persist about the Process* (2003).

57. Jacob Malcom et al., *Solve the Biodiversity Crisis with Funding*, 365 Science 1256–56 (2019). *Solve the biodiversity crisis with funding*, 365 Science 1256–56 (2019 Center for Conservation Innovation, *Over $1.5 Billion per Year Is Needed to Recover Endangered Species Act (ESA)-listed species* 1 page (2019), https://defenders-cci.org/publication/esa-recovery-costs/ (last visited Oct. 20, 2019).

58. Timothy D. Male & Michael J. Bean, *Measuring Progress in US Endangered Species Conservation*, 8 Ecol. Lett. 986–92 (2005).

59. Gerber, *supra* note 1.

A. Section 4

When underfunded, the listing process is one of the most difficult aspects of ESA implementation to find new solutions for. Sufficient funding will be a part of the solution.[60] There are other technical solutions that may offer new efficiencies, but stakeholders on opposite sides of the listing debate are often exceptionally resistant to these changes. As an example, consider the responses of certain organizations to changes in the listing petition requirements.[61] Those revised rules did not change the information used in listing decisions—the substantive content—but shifted some of the data acquisition requirements to petitioners, with a goal of ensuring better information is available earlier in the process and the Services' resources are used more efficiently. The proposed rule was met with condemnation in many comments, with some organizations going so far as to claim the rule constituted a First Amendment violation (see Comment 1 in the final rule[62]). In contrast, when the Services dropped a proposed requirement for extensive coordination between petitioners and states because it was overly burdensome, states and others were up in arms because they believed it removed their role from the listing process (see Comment 13 in the final rule[63]). Regardless of these details, more funding is needed for the listing program.

There are several ways that the challenges of recovery planning can or are currently being addressed. One that is already underway is the Recovery Planning and Implementation (RPI) framework.[64] Under RPI, the traditional ESA recovery plan is split into three parts: a short "core" recovery plan that meets statutory requirements (objectives, cost estimate, and timeline for recovery); a Species Status Assessment (SSA) that is regularly updated;[65] and one or more Recovery Implementation Strategies (RIS) that provide up-to-date information about actions needed and completed for a species. The adoption of RPI can help alleviate the ill effects of resource limitation in a few ways. First, while the core recovery plan will still require public notice and comment when it is published and updated (which should be infrequent), the SSA and RIS—the dynamic portions of recovery planning guidance—can easily be updated to keep knowledge current. This helps address the problem of

60. Malcom & Evansen, *supra* note 6.

61. U.S. Fish & Wildlife Service and National Marine Fisheries Service, *Endangered and Threatened Wildlife and Plants; Revisions to the Regulations for Petitions*, Federal Register (2016), https://www.federalregister.gov/documents/2016/09/27/2016-23003/endangered-and-threatened-wildlife-and-plants-revisions-to-the-regulations-for-petitions (last visited Oct. 20, 2019).

62. *Id.*

63. *Id.*

64. Fish & Wildlife Service, *Recovery Planning and Implementation* 2 (2019), https://www.fws.gov/endangered/esa-library/pdf/RPI.pdf (last visited Oct. 19, 2019).

65. U.S. Fish & Wildlife Service, *ESA Implementation: Species Status Assessment* (2018), https://www.fws.gov/endangered/improving_esa/ssa.html (last visited Oct. 20, 2019).

outdated recovery plans. Second, the content of SSAs accounts for a substantial portion of recovery plans and are drafted during the listing process or a five-year status review. Therefore, the time required for recovery planning can be shortened substantially immediately after listing, and species' planning can be updated to RPI more easily as a normal part of ESA implementation. Third, RISs improve recovery implementation by integrating input from other conservation practitioners (e.g., other federal agencies who can share their accomplishments more readily and improve overall coordination). Further, as RPI is adopted, information can be synthesized across species RISs, increasing the efficiency of other ESA processes (e.g., carrying out similar actions for multiple species in the same location).

Recovery plans can also be made more effective through the judicious use of technology. For example, publishing recovery plans as online documents would allow the plans to pull in real-time data from outside sources for better decision making. In fact, there is a demonstration project underway to illustrate this approach.[66] This early effort already offers examples of real-time data integration (e.g., from the Global Biodiversity Information Facility[67]), novel species status data presentation (e.g., for status scores as presented by Malcom and colleagues[68]), and possibilities for cross-program integration (discussed at length later).

The combination of RPI and web-based recovery plans can make five-year reviews easier and quicker to compile, helping to alleviate the backlog of outdated reviews. For example, with just several clicks of a mouse, it should be possible to generate a report with every change in status found in SSAs or RISs since the last review. Although this tool is not yet available, other approaches to improving five-year reviews are in use. For example, to close the gap in outdated reviews, some FWS offices have taken a "short-form" approach to five-year reviews. The Pacific Islands Fish and Wildlife Office in Honolulu, Hawaii, has used the short-form five-year reviews extensively.[69] There is often little to no new information for many of the office's species, so there appears to be little information loss from using this more efficient form of status review. Some of the short-form reviews include a summary table of the status of threats that, if used more widely, could efficiently present data across hundreds or thousands of species and inform broad-scale (e.g., regional or national) decisions (Table 15.2).

66. Center for Conservation Innovation, *Dynamic Recovery—Web-Based Recovery Plans for Threatened and Endangered Species* (2017), https://esarecovery.org/ (last visited Oct. 20, 2019).

67. Global Biodiversity Information Facility, *GBIF* (2019), https://www.gbif.org/ (last visited Oct. 20, 2019).

68. Malcom, Webber, & Li, *supra* note 5.

69. For example, https://ecos.fws.gov/docs/five_year_review/doc4383.pdf.

Table 15.2 An example of a "threats summary table" in the five-year review for Abutilon eremitopetalum from the Pacific Islands Fish and Wildlife Office. These tables offer a concise, structured format for presenting threats to species and progress addressing those threats. If extended across offices and regions, the compiled data could provide novel insights into conservation needs and opportunities for greater efficiency.

Threat	Listing factor	Current Status	Conservative/ Management Efforts
Ungulate degradation of habitat	A	Ongoing	Partial, small exclosure constructed
Established ecosystem altering invasive plant species degradation of habitat	A	Ongoing	Partial, nonnative plant control within small exclosure
Climate change degradation or loss of habitat	A	Ongoing	None
Fire destruction or degradation of habitat	A	Ongoing	None
Ungulate predation or herbivory	C	Ongoing	Partial, small exclosure constructed
Invertebrate predation or hebivory	C	Ongoing	None
Stochastic events—Reduced viability due to low numbers	E	Ongoing	Partial, propagation and seed storage efforts are ongoing

B. Section 7

Improving the efficiency of section 7 implementation will help relieve resource pressures across the ESA program because consultations are such a large piece of the law. Some efficiencies can be gained through policy changes, such as the FWS's guidance on "Restoration and Recovery Projects."[70] That guidance recognizes that many actions with a net benefit for listed species may also involve relatively minor and transient harms, and it establishes three criteria that proposed actions have to meet for streamlined evaluation and approval.

In their analysis of section 7 data from FWS, Malcom and Li noted two patterns: informal consultations required approximately one-quarter the time for an agency to process (median = 14 days) compared to formal consultations (median = 61.5 days), and programmatic consultations saved up to one-third the time over standard consultations.[71] Thus, it appears that one direct way to improve the overall efficiency of the consultation program is for action agencies—working with their applicants, as necessary—to propose actions that

70. U.S. Fish & Wildlife Serv., *Streamlined Consultation Guidance for Restoration/ Recovery Projects (RRP)* (2016), https://www.fws.gov/endangered/esa-library/pdf/Final%20RRP%20Guidance%20w%20memo%2011012016.pdf (last visited Oct. 20, 2019).

71. Malcom & Li, *supra* note 32.

are not likely to harm listed species (i.e., NLAA determinations) and use programmatic consultations more extensively. If action agencies and their applicants take the time to plan their activities to avoid harming ESA-listed species actions, they reap the benefit of faster evaluation by the Services. Of course, this cannot simply involve labeling actions as NLAA without ensuring they truly do not have adverse effects.

The Services are also beginning to use technology to gain efficiencies. The most prominent example is the FWS's Information for Planning and Consultation (IPaC[72]) system, which it has been developing for many years, with the goal of safely automating consultations for particular species-action combinations. For example, a programmatic consultation for Federal Housing Administration actions that may affect listed bats has been incorporated into IPaC to simplify that agency's consultations by following a dichotomous key format for easier decision making.[73] As more proactive consultations are done in a format that fits the dichotomous key-like structure of IPaC's architecture, the tool will become more useful.

Although the focus of this portion of the chapter is on solutions, it is also worth mentioning ideas that will not work. In particular, there have been suggestions in the past that challenges stemming from resource limitation be addressed by allowing federal agencies to self-consult.[74] In new research, data from NMFS illustrate that consulting agencies often incorrectly gauge the effects of their action—even going so far as concluding certain actions are NLAA when the action would jeopardize a species' existence.[75] New policies may alleviate some pressures of the consultation program, but they must include safety nets to ensure protections are not compromised.

C. Section 10

In 2016, the FWS revised their HCP handbook to incorporate lessons learned over the preceding 20-plus years of habitat conservation planning. The changes to the processes and procedures may improve both the effectiveness and timeliness of HCP development.

72. U.S. Fish & Wildlife Serv., *IPaC: Information for Planning and Consultation* (2019), https://ecos.fws.gov/ipac/ (last visited Oct. 20, 2019).

73. V. Foster, U.S. Fish and Wildlife Service, *pers. comm.*

74. U.S. Fish & Wildlife Serv. and National Marine Fisheries Service, *Joint Counterpart Endangered Species Act Section 7 Consultation Regulations*, Federal Register (2004), https://www.federalregister.gov/documents/2004/07/02/04-15051/joint-counterpart-endangered-species-act-section-7-consultation-regulations (last visited Oct. 20, 2019). U.S. Fish & Wildlife Service and National Marine Fisheries Service, *Joint Counterpart Endangered Species Act Section 7 Consultation Regulations*, Federal Register (2003), https://www.federalregister.gov/documents/2003/12/08/03-30393/joint-counterpart-endangered-species-act-section-7-consultation-regulations (last visited Oct. 20, 2019).2019 U.S. Fish & Wildlife Service and National Marine Fisheries Service, *Interagency Cooperation under the Endangered Species Act*, Federal Register (2008), https://www.federalregister.gov/documents/2008/12/16/E8-29701/interagency-cooperation-under-the-endangered-species-act (last visited Oct. 20, 2019).

75. Evans, Malcom, & Li, *supra* note 32.

To help improve transparency as the new handbook is implemented, the Services could create an easily publicly accessible, searchable database of HCP data, from plans to ITPs to monitoring reports. Despite the rapid growth of the program, HCPs and their supporting documents are kept at regional offices rather than a centralized repository, and very few are publicly accessible. Given the public's interest in ensuring that HCPs are properly implemented and enforced, and the fact that access to HCP documents and data can be a valuable resource to applicants developing their own HCPs, all HCPs, supporting documents (including the ITPs, biological assessments, subsequent monitoring reports, and conservation easements) can be digitized and placed in a publicly accessible online repository. Such a database would also likely advance other cross-sectional monitoring needs, discussed later.

Building from the new guidance in the revised HCP handbook, the Services could create an "HCP Wizard" for small, low-effect HCPs. Hundreds of existing HCPs are tiny—less than just three acres.[76] Many individuals who should apply for ITPs are likely unaware of that fact, or how to best develop HCPs to submit to the Services. An HCP Wizard online application could provide a simple way for potential applicants to map out their properties and learn whether there are listed species on their properties that may be at risk from activities such as construction. Such a wizard can be based on, or extending, the FWS's IPaC system, which already has much of that functionality built in.

To improve the efficiency of carrying out research for conservation, the Services could create a streamlined, web-based scientific collecting permit application, review, and renewal system under section 10(a)(1)(A). The development and use of online systems can dramatically increase the efficiency of permitting for agency personnel, applicants, and interested parties. For example, the Florida Fish and Wildlife Conservation Commission uses an online system for permitting for take of state-listed and (in some limited situations) federally listed species,[77] which provides a simple and effective way to apply for permits and track permits that have been issued or are under review. If the Services were to develop a similar system for 10(a)(1)(A) enhancement of survival permits, some of the costly and time-consuming challenges of scientific research with ESA-listed species could be reduced. This could include a system that allows the public to protest a permit online if the permittee is believed to be unqualified.

Last but not least, the Services can create robust but streamlined programs for low-effect HCPs and those HCPs with a net benefit for listed species. Most existing HCPs are considered low-effect, having a minor or negligible impact on listed or proposed species. Enhanced programs for such a simplified

76. U.S. Fish & Wildlife Serv., *ECOS | Conservation Plans* (2019), https://ecos.fws.gov/ecp0/conservationPlan/ (last visited Oct. 20, 2019).

77. Florida Fish and Wildlife & Conservation Commission, *FWC Permit System* (2019), https://public.myfwc.com/CrossDOI/PermitSystem/loginform.aspx?ReturnUrl=%2fCrossDOI%2fPermitSystem (last visited Oct. 20, 2019).

application process for ITPs could include developing rigorous guidance for determining whether an action is low effect; a "library" of best management practices; and simplified online application, approval, and reporting tools. However, it will be critical for plans that propose to create a net benefit to qualify for streamlining to be carefully evaluated to ensure the actions achieving the benefit are proven and monitored.[78] A streamlining program would encourage greater public participation in HCPs and use resources more efficiently through economies of scale, while simultaneously giving the Services and the public a more accurate and comprehensive understanding of the status of listed species.

D. Cross-Section Integration

1. Monitoring

The emergence of massive remote sensing datasets and platforms creates an excellent opportunity to close the gap in ESA monitoring. One study used freely available aerial imagery and Google Earth Pro software to evaluate how often the footprint of section 7 consultation projects can be identified and potentially monitored.[79] The study showed that approximately 40 percent of sites consulted on could be found when spatial coordinates were recorded, with certain types of actions, such as development (Figure 15.4), found at higher rates. Using this or similar free, off-the-shelf software could dramatically improve ESA implementation by enabling imagery-based monitoring that currently does not occur, for no cost except the time required to look at action sites.

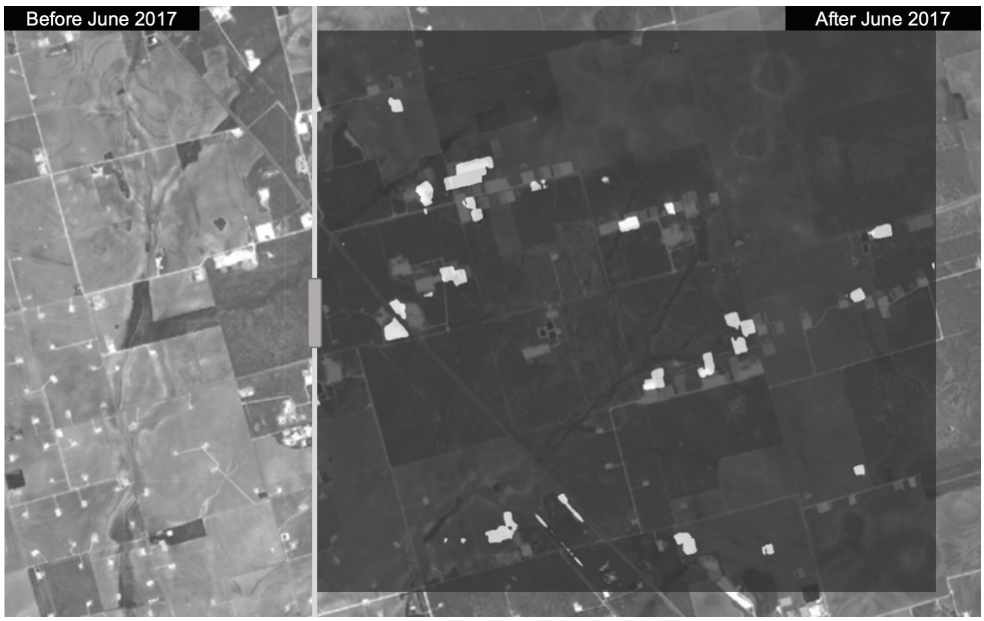
Another way to improve the effectiveness and efficiency of ESA monitoring techniques is through the use of online compliance reporting. Currently, most compliance reporting under sections 7 and 10 is done by physical file transfer. For example, many Biological Opinions still require reporting guidance such as, "All information shall be provided in an Excel spreadsheet. Monitoring results shall be submitted (datasheets, maps, database) on standard electronic media (e.g., CD, DVD) to the [ADDRESS]." This approach tends to result in highly inconsistent data types reported by different parties, requires additional effort by the permittee, and, ultimately, makes reviewing monitoring reports and data more time-consuming.[80] If the Services were to adopt online reporting—using either off-the-shelf web apps or custom software—they could standardize the data that are submitted and make the submission easier for themselves and permittees.

78. Joseph M. Kiesecker et al., *Energy by Design: Making Mitigation Work for Conservation and Development*, *in* Energy Development and Wildlife Conservation in Western North America 159–81 (David E. Naugle ed., 2011), https://doi.org/10.5822/978-1-61091-022-4_9 (last visited Oct. 20, 2019).

79. Malcom, Kim, & Li, *supra* note 48.

80. The author has been told that monitoring reports are often filed or shelved without even being opened.

Figure 15.4 Automated change detection simplifies finding new development, as seen here around a wind farm in lesser prairie-chicken habitat in Texas in 2015. The change in surface reflectance (right, where bright white indicates change and dark is no-change in the overlay) is calculated from multi-band satellite imagery (left). A full explanation of the method, as well as dynamic figures with sliders to view changes, can be found at https://defenders-cci.org/analysis/LPC_delisting/. Image source: public domain Sentinel-2 imagery from the European Space Agency.



Lastly, there are new computational and statistical tools that could help agencies and society identify and implement new opportunities, faster. With the advent of machine learning and other advanced computational tools, it should be possible to make better-informed decisions based on the steady stream of data and documents that are generated as the ESA is implemented. The only limitation now is the resources to develop such tools and the human behavior changes needed to adopt those tools. To date, this option remains the least explored.

2. Openness

Perhaps the biggest long-term opportunity for improving conservation outcomes in the face of resource limitations is for the Services to let others help more with ESA implementation. This is not to suggest the Services turn over responsibility for implementing the law, but rather that they use their position to guide and facilitate the work of conservation partners. For example, the lack of detailed occurrence maps and models for ESA-listed species could be addressed by researchers in academia, industry, and the nongovernmental space. For that to work, however, the Services need to establish guidance on

the contents of the maps and models,[81] then work with the broader community to ensure the best allocation of effort. Similarly, there are many partners, such as associations of taxonomic specialists (e.g., Partners for Amphibian and Reptile Conservation), who could help close the gap on missing and outdated recovery plans.[82] Although we often think of ESA implementation as something for experts, there are important ways that the broader public can be involved, such as through crowd-sourced compliance monitoring.[83] Listed species across the country can benefit from increased openness by the Services and a willingness of more partners to implement much-needed conservation measures.

IV. Conclusion

Available data indicate that the effectiveness of the ESA is remarkable, despite long-running resource limitations. We can see how budget cuts and associated workforce declines hamper implementation of the law, from listings and recovery plans to consultations and voluntary conservation. More funding (from a variety of sources) and new approaches are needed if we are to stem the tide of extinction and make real progress on recovery.

81. During the final revisions of this chapter, the FWS released the first finalized version of a standard operating procedure for mapping. Martha Balis-Larsen et al., *Standard Operating Procedure: USFWS Refined Range Maps for Threatened and Endangered Species* 15 (2019), https://ecos.fws.gov/docs/SR_SOP/SDM_SOP_Final.pdf.

82. Malcom & Li, *supra* note 16.

83. Malcom, Kim, & Li, *supra* note 48.