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Tracking species recovery status to improve U.S. endangered species act decisions

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Abstract

Currently 1677 species are listed under the U.S. Endangered Species Act (ESA), yet only a small percentage have been delisted due to recovery. In the fall of 2021, the U.S. Fish and Wildlife Service proposed delisting 23 species due to extinction. Tracking changes in species ‘recovery status over time is critical to understanding species’ statuses, informing adaptive management strategies, and assessing the performance of the ESA to prevent further species loss. In this paper, we describe four key obstacles in tracking species recovery status under the ESA. First, ESA 5-year reviews lack a standardized format and clear documentation. Second, despite having been listed for decades, many species still suffer major data gaps in their biology and threats, rendering it difficult if not impossible to track progress towards recovery. Third, many species have continued declining after listing, yet given the above (1 & 2), understanding potential causes (proximate and/or ultimate) can be difficult. Fourth, many species currently have no path to clear recovery, which represents a potential failing of the process. We conclude with a discussion of potential policy responses that could be addressed to enhance the efficacy of the ESA.

KEYWORDS

endangered species act, extinction, monitoring, recovery, species classification

1 | INTRODUCTION

In the United States, the Endangered Species Act of 1973 (ESA) was enacted with the goal of recovering listed species and their critical habitat, but this goal of recovery has yet to become a reality for most species. There are currently near 1700 listed species in the United States, but only just over 70 species have been delisted because they were recovered (USFWS, 2023). Before 2021, 11 species were delisted due to extinction, with 23 more species proposed for delisting for the same reason in 2021, of which 21 were actually delisted in 2023 (including the little Mariana fruit bat and several species of freshwater mussels). To effectively conserve imperiled species and prevent further biodiversity loss due to extinction, critical data and accurate information related to species' conservation statuses must be readily available to inform and prioritize adaptive management actions and conservation interventions (Bayraktarov et al., 2021; IUCN Standards and Petitions Committee, 2019). Under the ESA, no concise, standardized metrics exist for assessing changes in species recovery status (Malcom et al., 2016). Instead, the changes are often evident only when a species' ESA legal classification changes (i.e., uplisted, downlisted, or delisted). However, reclassifications are very rare (at best) or nonexistent (at worst) for most ESA-listed species, rendering it impossible for them to capture subtle but important changes in recovery progress (USFWS, 2018). During the recovery period, the species may be progressing toward recovery, but with insufficient change required to trigger a reclassification. Progress, however incremental, is critical to adjusting adaptive management strategies and conservation interventions.

The ESA mandates the U.S. Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service (NMFS; hereafter "the Services") to review the status of every listed species with a recovery plan (about 82% of U.S. listed species) at least once every 5 years to provide updates (the 18% (291/1677) of species that do not yet have recovery plans were excluded from this assessment) (USFWS, 2023). In theory, this approach provides a systematic framework for assessing progress toward recovery. Further, the updates are then used to determine whether a specific status change is warranted. Additionally, updated reviews can identify information warranting the Services to adjust their conservation strategy. In the status reviews, USFWS often uses a framework that focuses on resiliency, redundancy, and representation, known as the 3Rs framework (Table 1), initially developed by Shaffer and Stein (2000), to track changes in species biological status. These reviews can also identify information that could warrant the Services to adjust their conservation strategy. However, in practice, the contents of the reviews are rarely standardized, complicating attempts to track status changes objectively or to compare the status of multiple species. For example, no standardized guidelines exist for assessing population reductions or changes in species extinction risk, as seen

TABLE 1 Principles of resiliency, redundancy, and representation as used by USFWS (USFWS, 2016).

Principle	Definition	Focus
Resiliency	The ability of a species to withstand stochastic disturbance.	Population-level
Redundancy	The ability of a species to adapt to changing environmental conditions over time.	Species-level
Representation	The ability of a species to withstand stochastic events	Species-level, but with multiple populations across the species' range

in other conservation assessments such as the IUCN Red List (IUCN Standards and Petitions Committee, 2019). A standard framework for comparison would be a component of streamlining decisions about how to prioritize the recovery efforts for listed species. Moreover, these reviews will have cascading benefits from the Services by allowing tribal, state, and nongovernmental organizations to coordinate recovery planning efforts to maximize the effectiveness of actions completed and optimize return on investment, or cost efficiency.

A metric that reflects changes in species recovery in a concise, standardized manner represents an important path forward. Such an approach would allow agencies to facilitate more rapid and consistent tracking of changes while affording the opportunity to compare changes across hundreds of species, similar to how a stock index allows for rapid comparison across hundreds of companies. When this species status information is combined with data on funding allocations (to species conservation), habitat and threat assessments, local and regional administrative variation, and conservation interventions, a fuller picture emerges with greater resolution of the factors impacting species improvement or decline. This metric can help prioritize species that are most in need (declining) and prioritize research attention to those species for which major knowledge gaps obscure a reliable assessment of recovery.

To examine the feasibility of a standardized approach, we worked with the USFWS to develop and test such a metric (Li, 2020). These metrics are designed to concisely reflect the most important information in a five-year review about how a species' status has changed since the previous review. We tested our metric with 75 biologists from five organizations representing government, academia, and NGOs for 50 ESA-listed species chosen for taxonomic and geographic diversity, as well as for the recentness of a 5-year review, to ensure testing covered a variety of species and used updated information. Our effort represents the largest number of scientists to have provided a standardized evaluation of the recovery status of a group of ESA-listed species. The USFWS is currently considering whether and how to adopt these metrics.

Based on our metric assessment, we raise broader concerns, identify substantial challenges to recovery revealed during testing, and offer recommendations to address them. These challenges and recommendations are based on 50 test species across a wide range of taxa and our combined experience, and apply broadly to ESA species. We urge federal agencies to consider these recommendations as part of their efforts to conserve species and restore the role of science in the ESA's recovery process (Executive Order No. 13990, 2021).

2 | THE RECOVERY METRICS

At the outset of our assessment, the USFWS identified three criteria for evaluating the success of the metrics: (1) metrics must capture the critical components of tracking species recovery progress; (2) metrics must generate consistent results irrespective of the person applying them; and (3) USFWS biologists could apply the metrics easily and without a significant time commitment. Thus, the metrics must strike a balance between comprehensiveness, reliability, and concision. Based on these criteria, we developed six components to assess changes in species recovery status:

1. Species' current levels of resiliency, redundancy, and representation ("3Rs") (Shaffer & Stein, 2000; Table 1).
2. Changes in the species' 3Rs since its prior ESA status review.
3. Anticipated future changes in the species' 3Rs.
4. Changes in threats to the species since its prior ESA status review.
5. Extent to which conservation measures for the species have been implemented.
6. Progress of the species' recovery planning efforts, including the number of downlisting/delisting criteria that have been achieved.

The six components are complementary, as each assesses a unique aspect of species recovery status. For many species, far more is known about threats than about the 3Rs, but the lack of information also provides future research avenues with direct conservation applications. In those cases, information on changes in threats may offer better insights for conservation intervention than information on changes in the 3Rs.

Second, the metrics generated consistent results when applied to species with an adequate five-year species review, and the experts perceived these metrics to be generally reliable. The main cause of variance was the amount and quality of the information present in a five-year review. Reviews with limited information or ambiguous language are subject to multiple interpretations, thus leading to higher variance, underscoring the need for standardization as well as areas where further research may be needed for certain species.

Third, most reviewers did not believe the metrics were too complicated or time-consuming to apply. Among the USFWS reviewers who tracked the duration of this assignment, the majority finished scoring a species in 60 minutes or less. The metrics performed well enough that the USFWS could rapidly implement them as part of 5-year reviews.

The metrics could also be adapted to ESA candidate species, as components 1–5 of the metrics are not specific to the ESA. In particular, the 3Rs apply as much to non-listed species as to federally listed species. States, tribes, and NGOs could apply these factors to species of conservation concern (though not federally listed) within their jurisdiction to document, in a standardized manner, the degree to which management and conservation actions have (or have not) been successful. This, in turn, can better inform ESA decisions on whether to consider listing those species as they are petitioned.

3 | CHALLENGES AND RECOMMENDATIONS

When we applied the metrics to the 50 test species, we identified several key challenges that we have also observed with many other ESA species reviews.

3.1 | Lack of standardized format and clear documentation of 5-year reviews creates difficulty in comparing progress among species and risks the loss of institutional knowledge

Our experts felt that the reviews varied more than an acceptable amount and varied greatly in detail and substance, with some lacking a comprehensive discussion of the species biology, threats, and effectiveness of conservation measures. A possible explanation is that no checklist or questionnaire exists to remind authors compiling the 5-year reviews to provide all of this information. Information-deficient reviews can impede the public's ability to understand the reviews and subvert the capability for scoring the metric and, hence, assessing recovery progress, management effectiveness, and priority for response. Further, information not documented in reviews can contribute to the loss of institutional knowledge from the turnover of USFWS staff who have unique and extensive knowledge of species.

The USFWS should adopt data management systems that facilitate the efficient inputting, organization, and updating of this knowledge, as well as identify knowledge gaps while increasing accessibility to partners. This recommendation will provide many long-term benefits, including higher-quality 5-year reviews as well as streamlining the process for writing future reviews, recovery plans, and other ESA documents. For example, if the USFWS were to adopt an online database, allowing its biologists and external partners to easily submit species updates in a structured manner, drafting five-year reviews could be more efficient (Malcom, 2020). This can also allow for future reviews to focus on changes in conservation measure implementation and threats. Further, this type of database could be used to track the evaluation of what measures have been implemented and if they have been effective.

3.2 | Despite decades of listed statuses, many species still lack basic information about their biology, response to threats, and effectiveness of conservation measures

One barrier to effective conservation is inadequate information about how best to conserve a species. Among the 50 species reviewed here, many lacked adequate information about their distributions and habitat occupancy, life history traits, population genetics/genomics, responses to threats, and/or effectiveness of conservation measures. The lack of knowledge contributed to a high rate of "low confidence" or "unknown" scores. The Winkler cactus (*Pediocactus winkleri*) presents a particularly stark example. A total of 9 participants assessed the cactus, generating 72 scores for past and future changes in the 3Rs. Of those 72 scores, 58% were "unknown," which aligns with statements in the species' 5-year review about the "lack of knowledge about long-term population trends and recruitment rates," despite the species having been listed since 1998 (USFWS, 2019a). Data deficiencies can also arise when data are collected but never published, further exacerbating this fundamental problem.

Major investments in applied research and dissemination of the results are crucial to addressing these data deficiencies. Because the USFWS no longer has a biological research arm, there is a strong need for research partnerships among the Services, state wildlife agencies, academia, nongovernmental organizations, and the public. For example, in plant conservation, scientists have already proposed strategies for multi-institution research partnerships (Havens et al., 2014; Heywood, 2017). The time is overdue for a robust dialogue on how the Services can encourage external partners to engage with the listing and evaluation process by contributing to timely, relevant, and impactful applied research. One approach is for the agencies to set standards for the type of data they seek from partners. A related approach is to collaborate on multispecies monitoring strategies to help address basic data deficiencies for many individual species (DeWan & Zipkin, 2010). Further, in reports to Congress, scientists could flag data-deficient species, which has the potential to aid funding allocation decisions made by the legislative branch.

3.3 | Although many ESA species have made meaningful conservation progress, many others have continued to decline after listing and face a dismal outlook unless they receive far more resources and attention

Many conservationists assume that ESA listing automatically initiates a suite of conservation measures targeted toward rapidly moving species closer to recovery and that delisting means a species is now "conserved," no longer requiring active management (Scott et al., 2005). This assumption is entirely disconnected from the reality of the ESA in terms of funding, regulatory protections, political support, and other factors needed for recovery. Among the 50 test species, the mean score for current status of the 3Rs was negative, indicative of declines in each of the 3Rs, and consistent with findings that 52% of ESA-listed species are in long-term decline (Evans et al., 2016; Davis et al., 2024). For example, among 54 non-plant ESA-listed species in Florida over which the USFWS has primary jurisdiction, 28 exhibited declines in demographics and threats (Malcom et al., 2016). Thus, although the ESA had some high-profile successes (e.g. bald eagle, gray wolf), it also had to deal with many listed species that continued to decline and the likelihood that the number of new listings would vastly outpace the number of recoveries. Furthermore, this is just for the species in our sample and does not include the 18% (299/1677) of other species without recovery plans that may be exhibiting further declines. With a system in place that allows for periodic reviews under the Endangered Species Act, which some countries do not even have, there is a real opportunity to use these five-year reviews to check on the resources a species is receiving (Woinarski et al., 2023).

Critically, improving conservation outcomes requires sufficient funding and resource allocation, and these results can positively influence this. For many declining species, years of inadequate ESA funding have led to missed opportunities to stabilize and improve species status (Gerber, 2016). Currently, approximately 80% of federal and state funding goes to 5% of ESA-listed species (Evans et al., 2016). Plants are one of several groups that are particularly underfunded relative to other ESA-listed taxa (Negron-Ortiz, 2014), even though they represent 56% of US-listed species. In the five-year reviews we assessed, noncharismatic species received reduced conservation effort, ostensibly due to short shrift of funding, than charismatic species. A more strategic method, informed by a standardization and data-driven review process, of allocating limited conservation dollars would result in more effective conservation and likely more species recovered from the ESA (Gerber et al., 2018). The recovery metrics can track species response to funding and provide justification for funding levels based on that response.

3.4 | Prioritizing extinction prevention or stabilization instead of recovery for certain species

Overall, the data and information included in a standardized, rigorous 5-year review framework (as above) could flag species for prioritization based on extinction prevention and stabilization. We found that approximately 38% of species reviewed appeared to have no current path to full recovery and delisting under the ESA, meaning the species are declining and there is no information available to indicate how they should be managed to reverse that decline. The result corroborates a larger assessment, which found delisting is not considered possible for approximately 26% of the 1173 species with recovery plans (Neel et al., 2012). In fact, many of the Hawaiian plants and invertebrates in the study have struggled to meet extinction prevention goals, much less downlisting goals. For example, the St. John Kaala (*Phyllostegia kaalaensis*) is a Hawaiian flowering plant that is now extinct in the wild and for which all outplanted specimens have died (USFWS, 2019b). For these and other species we evaluated, threats such as climate change, disease, invasive species, urbanization, and large-scale water withdrawal may have already foreclosed all known paths to recovery. As a result, these species may require indefinite listing (Doremus & Pagel, 2001), yet such conservation dependence does not mean that listing is futile. Prior studies indicate that hundreds of species may have gone extinct if they had not been listed (Taylor et al., 2005).

The inability to delist certain species, however, does suggest at least three policy responses that could be addressed by implementing a standardized metric such as the one we tested in this case study. One response is to identify conservation milestones using more achievable goals, such as extinction prevention or stabilization (HPPRCC, 2011). The metrics we tested could help fill the gap by tracking how the 3Rs change across five-year reviews, irrespective of whether the changes are significant enough to warrant downlisting or delisting, and could help with decisions to divert funds and resources accordingly. A second response is preventing highly imperiled species from further declining and conserving at-risk species before they decline to the point where recovery becomes extremely difficult, improbable, or impossible. A similar process in Australia has been successfully used to identify those listed species for which imminent extinction is most likely and hence should be priorities for urgent conservation resource allocation (Geyle et al., 2018). In the past, the USFWS allocated some of its recovery funds to projects designed specifically to prevent extinction, but the agency has not been funded adequately enough in recent years to resurrect this program. If adopted, our recovery metrics would help measure the conservation benefits of the program. A third response is developing new regulatory mechanisms under the ESA that reward landowners and businesses for helping populations reach their conservation goals, even if an entire species still has no path to delisting. For example, for threatened species, the USFWS can issue special rules to relax the ESA's regulatory prohibitions only for specific populations improving or meeting their recovery targets (USFWS, 2006). The recovery metrics can help identify these populations by flagging those improving and declining.

4 | CLOSING

If adopted, the recovery metrics outlined herein will expand the foundational knowledge needed to understand changes in species status and to make better ESA decisions. The metrics require adequate and organized information under a standardized five-year review framework to perform effectively. Our testing revealed opportunities for the USFWS to improve the quality and consistency of those reviews and underscored other related challenges to species recovery. Overall, this metric represents an important step forward in improving the quality of recovery planning for endangered species in the U.S. context and offers promising future directions for monitoring endangered species globally. However, the metric itself is not necessarily an adequate substitute for a comprehensive program of monitoring for all listed species, and such a monitoring program (which encompasses evaluation of the effectiveness of management actions) should still be recognized as the desired standard.

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