Systemic Challenges and Pathways to Resilience: A Comprehensive Analysis of Modern Wildlife Management in the United States

I. Executive Summary

Wildlife management in the United States faces a complex array of interconnected challenges that threaten its efficacy and long-term sustainability. Traditional funding mechanisms, heavily reliant on consumptive outdoor recreation, exhibit inherent limitations in addressing the broader needs of biodiversity conservation. Simultaneously, the burgeoning outdoor recreation sector, while economically significant, imposes unquantified ecological and financial burdens on agencies. Historical conservation paradigms, rooted in colonial practices, have perpetuated exclusion and undermined the invaluable contributions of Indigenous communities and their traditional ecological knowledge. This is further exacerbated by severe short-staffing across agencies and a critical lack of diversity within the wildlife profession, which hinders relevance and effectiveness in a changing society. Compounding these issues is the increasing politicization of science, leading to the erosion of expert authority and the manipulation of critical data, particularly concerning human-wildlife conflict. Finally, fragmented interagency dependencies and communication gaps impede cohesive, national conservation efforts. Addressing these systemic issues requires a fundamental paradigm shift towards diversified funding, equitable governance, science-driven policy, inclusive workforce development, and integrated recreation management.

II. Introduction: The Evolving Landscape of Wildlife Management in the 21st Century

Wildlife management in the United States stands at a critical juncture, navigating a confluence of environmental, social, and political pressures that demand urgent re-evaluation and adaptation. Historically, conservation efforts have achieved notable successes, yet contemporary challenges, ranging from climate change and habitat fragmentation to shifting societal values and political polarization, necessitate a more integrated and resilient approach. This report delves into the multifaceted issues confronting wildlife agencies today, exploring the underlying reasons for the need to update funding models, the complex interplay between outdoor recreation and ecological integrity, the imperative to decolonize conservation practices, the pervasive problems of understaffing and lack of inclusivity, the detrimental effects of politicized science and data manipulation, and the critical role of interagency collaboration. By dissecting these interconnected problems, this analysis aims to illuminate systemic vulnerabilities and identify pathways toward a more robust, equitable, and scientifically grounded future for wildlife stewardship in the nation.

III. Financial Foundations Under Strain: Funding

Mechanisms and the Debate Over Match Values

The financial bedrock of wildlife management in the United States is largely built upon a framework established decades ago, primarily through federal excise taxes on hunting and fishing equipment. While historically effective for certain conservation goals, this model now faces significant strain and calls for modernization.

A. Traditional Funding Pillars: An Examination of Pittman-Robertson and Dingell-Johnson Acts

The Pittman-Robertson Wildlife Restoration Act (P-R), enacted in 1937, and the Dingell-Johnson Sport Fish Restoration Act (D-J), passed in 1950, represent the cornerstones of federal financial assistance for state fish and wildlife agencies. These acts channel funds, derived from excise taxes on firearms, ammunition, archery equipment (P-R), fishing tackle, fish finders, and a portion of boat fuel taxes (D-J), to states for wildlife and sport fish restoration programs, respectively. Funds are apportioned to states based on formulas that consider land and water area, alongside the number of hunting and fishing license holders within each state. To qualify for P-R funds, states are legally required to dedicate all hunting license fees solely to the administration of their state wildlife agency, thereby ensuring a direct link between users and the funding of conservation efforts. States are typically reimbursed for up to 75% of their approved project costs, with the remaining 25% generally covered by state hunting and fishing license revenues. Eligible activities under these programs encompass a broad range of conservation work, including habitat management, wildlife research, land acquisition, hunter education, and the development of public shooting ranges.

Recent legislative adaptations have attempted to modernize these acts. For instance, the Modernizing the Pittman-Robertson Fund for Tomorrow's Needs Act (2019) expanded eligible activities to include hunter and recreational shooter recruitment, retention, and reactivation (R3) efforts, and notably removed the previous exclusion of public relations activities. Similarly, the Target Practice and Marksmanship Training Support Act (2019) reduced the state match requirement for public target ranges from 25% to 10% and extended the grant period for such projects.

The established "user-pay, user-benefit" philosophy, inherent in the P-R and D-J Acts, creates a fundamental limitation for comprehensive conservation. Because these programs are directly financed by excise taxes on hunting and fishing equipment and licenses, the funding model naturally prioritizes the management of game species and their habitats. While this approach has provided a stable and substantial revenue stream for these specific areas of conservation, it results in a structural bias in funding priorities. This means that a vast majority of species—those not hunted or fished, often referred to as "wildlife diversity" or "nongame" species—receive severely inadequate funding, typically accounting for only about 10% of an agency's total budget for conservation and law enforcement. This systemic underfunding of non-game species can lead to their decline, potentially necessitating more costly federal listings under the Endangered Species Act (ESA) in the future, thereby shifting conservation from a proactive to a reactive, crisis-management framework. The reliance on a specific user group for broad conservation funding fundamentally restricts a wildlife agency's capacity to fulfill a comprehensive biodiversity mandate.

While recent legislative changes, such as the Modernizing the Pittman-Robertson Fund for Tomorrow's Needs Act and the Target Practice and Marksmanship Training Support Act, aim to adapt to declining participation in hunting and shooting sports, these adaptations primarily reinforce the existing user-fee model rather than fundamentally diversifying the funding base. The inclusion of R3 efforts and public relations as eligible activities reflects a recognition of

changing demographics and the need to broaden the traditional user base to maintain existing funding streams. However, this strategy attempts to shore up traditional revenue sources by expanding the pool of traditional users, rather than exploring new, broader mechanisms that could support a more holistic conservation mandate for all species. This approach perpetuates the inherent bias towards game species, even as the public's values towards wildlife management become increasingly diverse and less centered on traditional consumptive uses.

B. State Wildlife Grants: Bridging the Conservation Gap for Species of Greatest Conservation Need

The State Wildlife Grant (SWG) Program serves as a crucial federal initiative designed to provide funds specifically for the conservation of wildlife and their habitats, including species that are not hunted or fished. Its overarching objective is to prevent species from becoming endangered, thereby proactively avoiding new federal listings under the ESA. These funds are allocated annually by Congress and distributed to states, territories, and commonwealths through a formula that considers both land area and human population. A core requirement for states to receive SWG funds is the development and regular updating of State Wildlife Action Plans (SWAPs), which identify "Species of Greatest Conservation Need" (SGCN). Funds received through the SWG program can only be expended on conservation actions explicitly outlined in these plans.

Despite the program's vital role, a significant challenge lies in its funding structure and adequacy. The SWG program mandates a non-federal match of at least 25% for planning projects and 35% for conservation implementation. While the program has invested over $1.34 billion since its inception in 2000, the annual SWG allocations, typically around $70 million, fall dramatically short of the estimated $1.3 billion annually required to fully implement the comprehensive SWAPs across all states. This substantial funding gap means that, as reported in 2012, states were able to implement, on average, only 21% of their SWAPs, with individual state implementation ranging from a mere 5% to 70%.

The SWG program, while critical, functions as an insufficient stopgap. It is explicitly designed to address the conservation needs of non-game species and prevent new ESA listings, thereby directly counteracting the game-species focus of traditional funding mechanisms. However, the program's reliance on annual congressional appropriations makes its funding less stable and predictable compared to the dedicated excise taxes of P-R and D-J. The severe inadequacy of allocated amounts, relative to the scientifically identified needs within State Wildlife Action Plans, represents a profound systemic flaw. This chronic underfunding prevents states from fully implementing their comprehensive conservation strategies for thousands of Species of Greatest Conservation Need. The consequence is that numerous vulnerable species remain without adequate protection, increasing their likelihood of further decline and eventual listing under the ESA, which then triggers more expensive and complex recovery efforts. This perpetuates a reactive, crisis-driven approach to conservation, where agencies are constantly struggling to mitigate species declines rather than proactively preventing them. The absence of permanent, sufficient funding for broader biodiversity conservation creates a systemic vulnerability that undermines the nation's long-term ecological health.

C. The Economic Engine of Outdoor Recreation and Eco-tourism: Leveraging Revenue for Conservation

Outdoor recreation in the United States represents a substantial economic sector, demonstrating significant potential for contributing to conservation funding. In 2022, outdoor recreation generated $1.1 trillion in gross economic output, accounting for 2.2% of the Gross

Domestic Product (GDP), and supported 5 million jobs nationwide. Within this sector, hunting and fishing contributed $145 billion to the U.S. economy, while wildlife watching added an impressive $250 billion. Overall, outdoor enthusiasts spent an estimated $394 billion on equipment, travel, licenses, and fees in 2022, marking the highest recorded amount in any National Survey, adjusted for inflation. Participation in outdoor recreation has also shown consistent growth, with 168.1 million Americans engaging in these activities in 2022, marking the eighth consecutive year of growth.

Beyond its economic contributions, outdoor recreation offers significant societal benefits, including improved public health and mental well-being, as research indicates that engagement with nature can enhance peace of mind and physical health. National wildlife refuges actively promote these benefits by hosting a wide array of recreational and educational activities, such as walks, runs, bike tours, outdoor yoga, hunting, fishing, birding, hiking, paddling, and nature photography. These natural areas also provide crucial ecosystem services, such as storm resilience, by buffering coastal communities from storm surges and absorbing floodwaters, thereby reducing property damage. Critically, connecting with nature through outdoor recreation can inspire individuals to develop a stronger conservation ethic and a desire to protect the environment.

The Land and Water Conservation Fund (LWCF) is one federal mechanism that leverages outdoor recreation-related revenue for conservation. Primarily funded by offshore oil and gas leases, the LWCF provides $900 million annually for public outdoor recreation areas and facilities, including grants to states for acquisition and development, and supports federal land acquisition for national parks, forests, and wildlife refuges. States also employ various mechanisms to fund outdoor recreation, such as allocating lottery proceeds (e.g., Colorado), utilizing vehicle registration fees (e.g., Colorado's "Keep Colorado Wild Pass"), dedicating portions of state sales taxes on sporting goods (e.g., Georgia, Texas), and drawing royalties from state-owned oil, gas, and mineral rights (e.g., Michigan). Eco-tourism specifically is recognized as a project type eligible for grants from organizations like The Conservation Fund's "Creating New Economies Fund," aiming to generate economic, environmental, and social justice benefits in economically distressed communities. Every dollar spent on conservation through these mechanisms is estimated to return $2.40 in economic activity via tourism, recreation, and ecosystem services.

Despite the substantial economic contributions of the outdoor recreation sector, there exists a significant underutilization of this powerhouse for broader conservation funding. While existing mechanisms like P-R/D-J and LWCF capture some revenue for conservation, there is a clear disconnect in fully leveraging the broader economic impact of *all* outdoor recreation activities, particularly non-consumptive ones like wildlife watching, which alone contributes $250 billion annually. The current funding model remains heavily reliant on traditional user fees from hunting and fishing, which represent a smaller, and in some areas, declining subset of the overall outdoor recreation economy. This places an undue financial burden on a shrinking demographic (hunters and anglers) for overall wildlife management , rather than distributing the financial responsibility more broadly across all beneficiaries of healthy ecosystems and outdoor spaces. This situation highlights a critical need for innovative funding mechanisms that capture revenue from the wider outdoor recreation economy to support the full spectrum of biodiversity, moving beyond the "user-pay" model to a "societal benefit, societal invest" paradigm.

Eco-tourism, while a valuable tool, currently functions primarily as a localized conservation mechanism. It effectively provides economic benefits and fosters community-level engagement in conservation, often through small grants. However, eco-tourism is not currently scaled to address the systemic funding needs of state wildlife agencies for broad species management or core operational costs. This points to a potential area for growth and integration, where successful community-led eco-tourism initiatives could be scaled up or integrated into broader state-level conservation funding strategies. However, current agency structures may not be fully

equipped to leverage these benefits across their wider mandates, suggesting a need for policy innovation to connect local economic gains from eco-tourism to broader, systemic conservation funding.

D. The Burden of State Match Requirements and Calls for Modernization

Federal conservation programs, including the Pittman-Robertson, Dingell-Johnson, and State Wildlife Grants, universally mandate state matching funds as a condition for receiving federal allocations. This match typically stands at 25% of project costs, though it can be as high as 35% for SWG implementation projects. Notably, the 2019 Target Practice and Marksmanship Training Support Act reduced this match to 10% for public target ranges, signaling a recognition of specific financial burdens in certain areas. The state match often originates from revenues generated through hunting and fishing license sales.

This match requirement, while intended to ensure state commitment and shared investment, paradoxically acts as a bottleneck, limiting the effective deployment of federal funds and exacerbating the overall underfunding of state and tribal wildlife agencies. States frequently encounter significant funding gaps, and the burden of securing these matching funds can be substantial, particularly when federal funding is uncertain, delayed, or frozen. Tribal nations, whose wildlife management efforts are often heavily reliant on federal grants as part of the federal trust responsibility, have reported widespread grant freezes (60% of Tribes surveyed) and total cancellations (26%), directly impairing their ability to conduct critical work such as fisheries surveys. Furthermore, audits have revealed administrative complexities and issues with states' documentation of in-kind contributions for matching funds, highlighting inefficiencies within the current system.

The current match system, while promoting shared responsibility, creates a significant vulnerability. It means that even when federal funds are theoretically available, states may be unable to access them if their own revenue streams are insufficient or if political decisions disrupt their financial planning. This disproportionately affects non-game species, which rely more heavily on grants like SWG with their higher match requirements. This systemic issue points to the need for more flexible and reliable funding mechanisms that do not solely depend on the capacity of states to generate matching funds from a narrow revenue base.

Legislative proposals, such as H.R. 2732 in the 117th Congress, reflect a growing recognition of these systemic issues. These proposals advocate for supplemental *mandatory* funding for states, territories, and tribes from the general fund, with increasing allocations over time. They also seek to establish new, dedicated Tribal Wildlife Conservation and Restoration Accounts. These legislative efforts represent a crucial step towards addressing the systemic underfunding and inclusivity issues within wildlife management. By advocating for mandatory funding, these proposals aim to provide more stable and predictable financial support, moving beyond the political uncertainties of annual appropriations. The explicit focus on dedicated tribal accounts acknowledges the federal government's trust responsibility to Tribal nations and seeks to provide more direct and reliable financial support for Indigenous-led conservation efforts, which have historically been disrupted by federal policy shifts and communication breakdowns. This indicates a potential shift towards a more equitable and sustainable funding future for wildlife conservation.

Table 1: Overview of Key Federal Wildlife Funding Programs and State Match Requirements

Program Name	Primary Funding Source	Allocation Method	Typical Federal Share (%)	Typical State Match (%)	Key Eligible Activities	Primary Beneficiary Focus
Pittman-Robertson Wildlife Restoration Act	Excise taxes on firearms, ammunition, archery equipment	State acreage and number of hunting license holders	75% (90% for target ranges)	25% (10% for target ranges)	Wildlife/habitat restoration, hunter education, R3 (Recruitment, Retention, Reactivation)	Game species, hunters, recreational shooters
Dingell-Johnson Sport Fish Restoration Act	Excise taxes on fishing tackle, electric trolling motors, import duties on fishing tackle/yachts, portion of boat fuel taxes	State geographical area and proportion of fishing licenses sold	75%	25%	Sport fish restoration, boating access, fisheries management, research	Sport fish, anglers, recreational boaters
State Wildlife Grants (SWG)	Annual congressional appropriations	Formula based on state land area and human population; competitive grants also available	65-75%	25-35%	Research, habitat management, monitoring for Species of Greatest Conservation Need (SGCN) identified in State Wildlife Action Plans	SGCN, broader biodiversity (non-game species)
Land and Water Conservation Fund (LWCF)	Revenue from offshore oil and gas leases	Formulaic (stateside grants) and federal acquisition proposals	50% (stateside grants)	50% (stateside grants)	Acquisition/development of public outdoor recreation areas, land acquisition for national parks/forests/refuges, historic/cultural site preservation	Public recreation access, federal/state lands, cultural heritage

IV. The Human-Nature Nexus: Impacts and Management of Outdoor Recreation and Eco-tourism

The increasing popularity of outdoor recreation and eco-tourism presents a dual reality for wildlife management: a powerful economic engine and a source of societal well-being, yet also a significant source of ecological impacts and operational costs.

A. Benefits and Growth: The Positive Contributions of Outdoor Recreation

Outdoor recreation is a robust and growing economic sector in the U.S., demonstrating substantial positive contributions. In 2022, it accounted for $1.1 trillion in gross economic output, representing 2.2% of the nation's Gross Domestic Product (GDP), and supported 5 million jobs. The economic activity generated by outdoor enthusiasts is considerable, with participants spending an estimated $394 billion on equipment, travel, licenses, and fees in 2022, marking the highest recorded amount in any National Survey. Specifically, hunting and fishing contributed $145 billion to the U.S. economy, while wildlife watching added an additional $250 billion. This economic activity also yields significant returns on conservation investments; every dollar spent on conservation is estimated to return $2.40 in economic activity through tourism, recreation, and ecosystem services. The U.S. Fish and Wildlife Service (FWS) further highlights that wildlife refuges generate nearly $5 in local economies for every $1 appropriated by Congress, underscoring their economic multiplier effect.

Beyond economics, outdoor recreation offers profound health and well-being benefits. A substantial body of research indicates that engaging with nature, such as on national wildlife refuges, significantly improves mental and physical well-being. Refuges actively promote these benefits by hosting diverse activities like walks, runs, bike tours, and outdoor yoga. These public lands and waters offer a wide array of recreational and educational opportunities, including hunting, fishing, birding, hiking, paddling, wildlife viewing, and nature photography. Furthermore, national wildlife refuges contribute to crucial ecosystem services, such as storm resilience, by buffering coastal communities from storm surges and absorbing floodwaters along major rivers, thereby reducing property damage. Critically, direct engagement with nature through outdoor recreation can inspire individuals to develop a stronger conservation ethic and a deeper commitment to environmental protection.

The broad societal benefits of outdoor recreation extend far beyond simple economic output. The ability of natural spaces to improve public health, mental well-being, and community resilience against natural disasters demonstrates their intrinsic value as essential public goods. This deep connection to nature can foster a stronger conservation ethic among a wider public, potentially broadening the constituency for wildlife protection beyond traditional user groups like hunters and anglers. Wildlife agencies should strategically leverage these broader benefits to advocate for more diverse and stable funding sources. Framing conservation as an essential public good that supports overall quality of life and societal well-being, rather than solely as a service for specific recreationalists, represents a necessary narrative shift. This transition moves from a "user-pay" model, which has inherent limitations in funding broad biodiversity needs, to one that emphasizes "societal benefit, societal investment," recognizing that the health of natural ecosystems benefits everyone and thus warrants broader public financial support.

B. Unintended Consequences: Recreation's Ecological Footprint on Wildlife

Despite the myriad benefits, outdoor recreation carries unintended consequences that can significantly impact wildlife and their habitats. Human presence, even during activities traditionally considered "low-impact" like hiking, can cause wildlife to alter their behavior, including leaving an area, spending less time feeding, or shifting to more nocturnal activities to avoid human disturbance. The distance at which humans affect wildlife varies considerably by species size: small mammals and birds may react within 300 feet, large birds within 1,300 feet, and large mammals such as elk and moose within 3,300 feet. Some species may completely abandon previously used habitats or utilize them less frequently due to repeated human disturbance. While wildlife can adapt to predictable, consistent, non-threatening recreational activities on established roads and trails, unpredictable off-trail activities tend to cause greater disturbance. Wildlife also exhibit seasonal and locational sensitivities to disturbance, particularly during critical life stages such as nesting, giving birth, or raising young, or during periods of high energy expenditure like winter when food is scarce.

Recreation can also lead to direct habitat modification and broader ecosystem impacts. This includes the introduction or dispersal of nonnative plants or animals, the removal of woody vegetation for campfires, and ecosystem-scale impacts from visitor-caused wildfires. Soil erosion from trails and campsites can pollute streams and lakes, reducing the quality of aquatic habitats for invertebrate and fish populations. As human development fragments natural habitats and climate change forces species to shift their ranges, the importance of wildlife corridors increases; these corridors should ideally be recreation-free and at least 3,300 feet wide to enable undisturbed wildlife movement.

A distinction is often made between consumptive and non-consumptive recreational activities. Consumptive activities, such as hunting and fishing, can have long-term effects on wildlife populations by directly altering abundance, distribution, and demographics. These activities are traditionally managed through regulations and permitting that limit harvest, such as quotas and seasons. In contrast, non-consumptive activities, despite often attracting a much larger and growing number of participants, are generally unregulated and have fewer limits.

The significant growth in outdoor recreation participation means that the cumulative impact on wildlife is likely increasing, even from activities traditionally considered "low-impact." This creates a paradox where the very "love of nature" that draws people outdoors can inadvertently lead to negative ecological consequences. This situation necessitates a more sophisticated and proactive approach to recreation management that extends beyond simply promoting access. It highlights the critical need for robust scientific research to accurately quantify these impacts and for adaptive management strategies. Such strategies include implementing seasonal closures to protect sensitive wildlife during critical periods, establishing distance requirements to minimize disturbance, concentrating visitor use on hardened sites and trails to limit habitat degradation, and establishing recreation-free wildlife corridors. Without such proactive and evidence-based management, the long-term ecological integrity of recreational areas may be compromised, potentially diminishing the very wildlife and natural beauty that attract visitors in the first place, thereby creating a self-defeating cycle.

The disparity in regulation and funding mechanisms for different types of recreation creates a significant blind spot and an inequitable burden for wildlife agencies. While consumptive activities are extensively regulated through permits and quotas, non-consumptive activities, despite attracting a much larger and growing number of participants, are generally unregulated. The much larger non-consumptive user base often contributes less directly to the management costs associated with their collective impacts, compared to the direct user fees from hunters and anglers. This lack of comprehensive regulation and dedicated funding for non-consumptive impacts creates a potential for unmitigated ecological harm from the most popular outdoor activities. This points to a critical need for new funding mechanisms that capture revenue from all outdoor recreationists to support comprehensive impact mitigation and management, ensuring that the costs of maintaining healthy ecosystems are shared more equitably among all

who benefit from access to natural spaces.

C. The Operational and Financial Costs of Managing Recreation Impacts

Managing the impacts of outdoor recreation incurs substantial operational and financial costs for wildlife agencies, many of which are often undercounted or unquantified within existing budgetary frameworks. These costs encompass significant resources dedicated to adequate staffing, the development and maintenance of infrastructure (e.g., trails, facilities), and extensive monitoring programs to assess ecological health. A notable challenge in this area is the lack of reliable, comprehensive information on the specific costs associated with providing wildlife-related recreational services, largely due to the inherent complexities in quantifying the intricate interrelationships between habitat health and wildlife populations.

Annual management costs for preserves can vary dramatically, ranging from as little as $6 to over $2,100 per acre per year, with larger projects often benefiting from economies of scale that reduce per-acre costs. Key categories of management tasks that contribute to these costs include land acquisition, site construction, biotic surveys, habitat restoration and ongoing management, water management, providing public services, general maintenance, and administrative reporting. Federal land management agencies, including those responsible for wildlife, already face significant existing funding, infrastructure, and staffing challenges, making the absorption of these additional, often hidden, costs particularly difficult.

The economic burden of managing recreation impacts is likely severely underestimated and consequently underfunded, contributing significantly to the overall financial strain on wildlife agencies. While public lands are often perceived as providing "free" access for recreation, the reality is that managing these activities and mitigating their ecological impacts incurs substantial, often hidden and unquantified, costs for wildlife agencies. These costs span from staff time dedicated to planning and enforcement to the capital investment in infrastructure development (such as trails and visitor facilities) and long-term ecological monitoring and habitat restoration efforts. The absence of reliable, detailed cost data makes it exceedingly difficult for agencies to advocate for adequate funding or to implement effective "user-pays" models for non-consumptive recreation that would more equitably distribute these costs. This creates a systemic challenge where the widespread benefits of outdoor recreation are enjoyed by a broad public, but the full costs of maintaining the ecological integrity that supports these activities are not fully borne by all beneficiaries, leading to a gradual degradation of the resource over time and an unsustainable management model.

Table 3: Impacts of Outdoor Recreation on Wildlife and Management Responses

Type of Impact	Specific Manifestations	Affected Wildlife Examples	Associated Recreational Activities	Management Responses
Behavioral Changes	Increased nocturnality, reduced feeding time, heightened vigilance, altered movement patterns, temporary displacement from preferred habitats	Small mammals (Columbian ground squirrel), large birds (eagles, hawks), large mammals (elk, moose, black bears, grizzly bears, mule deer, bighorn sheep), coyotes,	Hiking, motorized activities (ATVs, e-bikes), mountain biking, trail running, photography, dog walking (off-leash)	Distance requirements (e.g., 300-3300 ft buffers), seasonal closures (e.g., nesting/birthing areas), staying on designated trails, quiet travel, education/outreach, proper trash

Type of Impact	Specific Manifestations	Affected Wildlife Examples	Associated Recreational Activities	Management Responses
		snowshoe hares, cougars		disposal, not feeding wildlife
Habitat Modification	Introduction/dispersal of nonnative species, removal of woody vegetation for campfires, ecosystem-scale impacts from visitor-caused wildfires, soil erosion, pollution of aquatic habitats, habitat fragmentation	Amphibians, reptiles, aquatic invertebrates, fish, various terrestrial species impacted by habitat loss	Camping, off-trail use, campfires, general visitor presence, trail development	Promoting Leave No Trace principles, designated campsites, fire restrictions, trail hardening, restoration of degraded areas, establishing recreation-free wildlife corridors (e.g., 3300 ft wide)
Direct Mortality/Injury	Direct harm from human-wildlife encounters, vehicle collisions, entanglement in human debris/fishing gear, retaliatory killings (less direct)	Various species, especially those habituated to humans or near roads/development	Motorized vehicle use, improper waste disposal, fishing (discarded lines)	Enforcement of regulations, wildlife crossings, public education on responsible wildlife interactions
Displacement	Temporal displacement (using areas at different times), spatial displacement (abandoning areas entirely or using less frequently)	Black bears, elk, white-tailed deer, coyotes, grizzly bears, mule deer, snowshoe hares, bighorn sheep	High-use trails, unpredictable off-trail activities, high-speed/loud activities	Concentrating visitor use on hardened sites, creating designated low-impact zones, establishing wildlife corridors, monitoring use patterns

V. Decolonizing Conservation: Fostering Inclusivity, Equity, and Traditional Ecological Knowledge

The historical trajectory of biodiversity conservation is inextricably linked to colonial legacies, which have significantly shaped its foundational principles and practices. A critical examination of these roots reveals inherent biases that continue to challenge the effectiveness and equity of modern wildlife management.

A. Historical Context: Unpacking the Colonial Roots of Mainstream Conservation

Mainstream conservation approaches, including the establishment of protected areas, the implementation of sustainable resource management plans, and the use of market-based instruments, are deeply rooted in Eurocentric ontologies and epistemologies. These paradigms often promote a distinct separation of humans from nature and rely heavily on positivist science and technological solutions as the primary means of environmental management. The origins of what is frequently considered "effective" conservation, particularly the fortress conservation model, are intimately tied to colonial endeavors. These historical efforts involved the enclosure of landscapes to preserve an imagined "pristine nature," primarily for the benefit of economic and political elites. This model is fundamentally based on the colonial belief that Indigenous peoples are incapable of managing their own lands, leading to their treatment as intruders in "wild" spaces.

Historically, this approach has resulted in the systemic domination and marginalization of local populations, particularly Indigenous Peoples, racial minorities, and women, whose traditional beliefs, cultures, institutions, and knowledge systems were dismissed as inferior. Globally, the implementation of protected areas has led to the forced expulsion of over a million people from their homes, a stark example being the displacement of the Batwa people in Uganda to create mountain gorilla habitat.

This deep-seated colonial history explains why mainstream conservation has frequently resulted in social conflicts and human rights violations. By alienating the very communities who have historically stewarded these lands and possess invaluable local knowledge, conservation efforts inadvertently create resistance and foster deep-seated distrust. This makes long-term, sustainable conservation difficult to achieve and perpetuates a cycle of injustice. The persistent myth of "pristine wilderness," often devoid of human presence, actively undermines effective, community-based conservation that recognizes the intertwined relationship between people and nature. This historical context underscores the need for a fundamental re-evaluation of conservation practices to move towards more equitable and effective models.

B. The Imperative of Inclusivity: Recognizing Indigenous Rights and Valuing Traditional Ecological Knowledge (TEK)

Decolonizing biodiversity conservation entails a fundamental transition towards more locally rooted, plural, socially just, and convivial forms of conservation, moving away from the historically dominant, Eurocentric approaches. This process necessitates disrupting and actively resisting the processes of knowledge production that have traditionally underpinned mainstream biodiversity conservation policy and practice.

Indigenous Peoples and local communities (IPLCs) are critically important to global conservation efforts, managing an estimated 80% of the world's remaining biodiversity. Their perspectives emphasize the inseparability of culture and nature, viewing land, its ecosystems, and biodiversity as integral to community identity, history, and daily social, subsistence, and spiritual practices. Traditional Ecological Knowledge (TEK) is defined as the cumulative body of knowledge held by Indigenous cultures about their immediate environment and the cultural practices that build upon that knowledge, encompassing a detailed understanding of plants, animals, and natural phenomena. TEK is globally recognized as an invaluable resource for conservation efforts, including land stewardship and species protection. Increasingly, it is acknowledged as a valid and crucial form of science. The Biden administration and various conservation organizations are progressively recognizing the importance of Indigenous-led conservation approaches.

The continued exclusion or devaluing of TEK represents a significant missed opportunity for more effective, resilient, and adaptive conservation strategies. TEK is not merely anecdotal or cultural lore; it is explicitly described as a "holistic knowledge" and "world view" that parallels

Western scientific disciplines. The historical marginalization of TEK within mainstream conservation has meant overlooking a rich source of ecological understanding and practical solutions. Integrating TEK into wildlife management is not just an ethical imperative to acknowledge Indigenous rights and knowledge systems; it is a practical necessity. Indigenous communities possess millennia of place-based ecological understanding , which can provide crucial insights for addressing complex environmental challenges like climate change and biodiversity loss. This necessitates a fundamental re-evaluation of how "best available science" is defined and applied in conservation, moving beyond a purely positivist, Eurocentric framework to one that embraces knowledge pluralism and the co-production of knowledge.

C. Pathways to Equitable Partnerships: Co-management and Community-Led Initiatives

Evidence strongly indicates that the most successful conservation projects are those that actively partner with local communities, ensuring they derive tangible benefits from the ecosystems they steward. Academic research robustly supports the efficacy of co-managed or Indigenous-led conservation strategies, demonstrating superior outcomes in biodiversity protection and often achieving these results at a fraction of the cost compared to strictly top-down, protected area models. This success is attributed to aligning conservation with community identity, traditional practices, and deep ecological understanding. Examples of successful Indigenous-led initiatives include securing land rights for herding communities in Mongolia, community capacity building for fisheries management in Tanzania, and traditional fire management in Australia that generates carbon credits and jobs.

Tribal Co-Management (TCM) is defined as principled collaborations among holders of rights and responsibilities, serving as a vital tool to address historical injustices and reclaim Indigenous-Territory relationships. Successful TCM arrangements have been observed at sites such as El Malpais National Monument and Kasha-Katuwe National Monument in New Mexico, where Tribal values and interests are formally integrated into management decisions.

However, implementing this paradigm shift is challenging. A primary hurdle to inclusive conservation is a deep-seated lack of trust between historically marginalized communities and conservation organizations, governments, or funders, often stemming from past displacements and negative impacts on livelihoods. Different groups frequently have incompatible values and priorities, which can lead to conflict. Funding disparities remain stark, with the vast majority of conservation funding still flowing to large international NGOs based in the Global North, rather than directly to local and Indigenous organizations. Furthermore, co-design and co-management processes are inherently time-consuming and can be expensive due to the need for meaningful, sustained engagement. Some critics also express concern that tribal co-management can be undemocratic if agreements are made secretly without broader public review, potentially compromising federal laws.

The demonstrated success of Indigenous-led conservation models proves that a fundamental shift in conservation governance—from top-down control to equitable, shared authority—is not merely a desirable ethical goal but an essential strategic imperative for effective and sustainable conservation. The identified challenges, such as historical distrust, conflicting values, funding disparities, and the time and cost associated with true collaboration, are not insurmountable obstacles but rather areas requiring targeted, systemic interventions. These interventions include land tenure reforms, equitable benefit-sharing mechanisms, direct funding to Indigenous organizations, and capacity building within these communities to empower them to lead and shape conservation agendas. Furthermore, the criticism regarding "secret agreements" in some tribal co-management underscores the need for transparency and broader public engagement even within these collaborative frameworks to build wider societal acceptance and legitimacy for

such partnerships.

D. Diversifying the Workforce: Addressing Systemic Barriers in Wildlife Agencies

The demographic composition of the wildlife profession presents a significant challenge to its future relevance and effectiveness. The profession is overwhelmingly dominated by white males, with 91% of agency respondents identifying as white and 72% as male. This demographic reality stands in stark contrast to the increasing diversity of the broader U.S. population, where minority populations are projected to outnumber white, non-Hispanic populations by 2045. Minorities and women are significantly underrepresented in leadership and advanced positions across natural resource professions.

Several systemic barriers contribute to this lack of diversity. These include a notable absence of mentorship opportunities, pervasive systemic biases, significant financial constraints, perceived discrimination, and non-inclusive work environments. Low pay in field experiences, which are crucial for gaining practical skills and networking for career advancement, disproportionately affects racial and ethnic minority students, making it difficult for them to pursue essential training. Furthermore, prejudice and micro-aggressions actively contribute to pushing minorities out of the field, hindering their retention and progression.

Despite these barriers, the benefits of a diverse workforce in conservation are well-documented. Diverse perspectives bring new ideas, innovative solutions, and crucial cultural insights that are essential for tackling complex environmental challenges effectively. Research consistently demonstrates that organizations with a higher representation of women in leadership roles perform better and have more dedicated and committed teams. Ultimately, increased representation within conservation agencies ensures more inclusive and robust decision-making processes.

The stark demographic imbalance within wildlife agencies is not merely a social equity concern; it is a critical impediment to their long-term relevance, legitimacy, and operational effectiveness. A workforce that does not reflect the diverse public it serves will struggle to understand, engage with, and address the evolving conservation priorities and values of a changing society. This disconnect can erode public support and trust, hinder the ability to develop culturally appropriate management strategies, and ultimately limit the agency's capacity to address complex, human-influenced conservation challenges. Actively recruiting and retaining diverse professionals, and dismantling systemic barriers like low pay for entry-level positions and non-inclusive work environments, is therefore essential for bringing new perspectives, fostering inclusive decision-making, and ensuring the continued success and public mandate of wildlife management in the 21st century.

Table 2: Principles of Decolonized Conservation and Their Practical Application

Principle	Description	Practical Application in Wildlife Management	Key Benefits/Outcomes
Recognition	Acknowledging Indigenous Peoples' inherent rights, sovereignty, and historical connections to lands, waters, and wildlife, regardless of current land ownership.	Formal recognition of Indigenous land and resource rights; respectful engagement with tribal governments as sovereign entities, not merely stakeholders.	Builds trust, addresses historical injustices, fosters genuine partnerships.
Reparation	Addressing historical and ongoing harms	Supporting "Landback" initiatives; providing	Restores equity, empowers Indigenous

Principle	Description	Practical Application in Wildlife Management	Key Benefits/Outcomes
	caused by colonial conservation practices, including land dispossession and cultural erosion.	direct funding and resources to Indigenous-led conservation projects; compensating for past harms.	communities, enables self-determination.
Epistemic Disobedience	Challenging the sole authority of Western scientific knowledge and valuing Traditional Ecological Knowledge (TEK) as a legitimate and essential scientific framework.	Integrating TEK into research design, data collection, and management planning; co-producing knowledge with Indigenous experts; redefining "best available science" to include diverse knowledge systems.	Leads to more holistic, effective, and adaptive conservation strategies; enhances ecological understanding.
Relationality	Fostering reciprocal, respectful relationships between humans and nature, and among diverse human communities, moving beyond human-nature separation.	Promoting community-led conservation; co-management agreements that share authority and responsibility; educational programs emphasizing interconnectedness.	Improves social cohesion, strengthens conservation ethic, fosters long-term stewardship.
Power Subversion	Dismantling entrenched power structures and biases within conservation institutions that privilege certain voices or approaches.	Reforming governance structures to ensure equitable representation; direct funding to local and Indigenous organizations; capacity building for Indigenous leadership.	Creates more just and inclusive decision-making; reduces conflict; increases legitimacy of conservation efforts.
Limits	Recognizing the biophysical and social limits to resource exploitation and human intervention, as guided by Indigenous worldviews and ecological principles.	Implementing sustainable harvest practices; establishing protected areas with Indigenous consent and co-management; prioritizing long-term ecological health over short-term economic gain.	Ensures ecological sustainability; promotes resilience; aligns conservation with local needs and values.

VI. Politicization of Science and Data Integrity:

Undermining Trust and Effective Management

The integrity of wildlife management is increasingly threatened by the politicization of science and issues surrounding data accuracy, leading to an erosion of public trust and hindering effective decision-making.

A. Erosion of Scientific Authority

Historically, wildlife management was primarily the domain of agency scientists within the executive branch, who were trained to interpret interdisciplinary scientific data and balance both human and ecological needs. However, there has been a notable shift where the most dominant voices now belong to legislators, legal advocates, and non-governmental organizations (NGOs), who are increasingly marginalizing agency scientists. This shift in discourse from credentialed agency biologists and scientists to politicians and advocates undermines the science-driven process that is foundational to effective wildlife policy, risking the credibility of crucial environmental laws like the Endangered Species Act (ESA). This pattern is not isolated to specific cases but is observed across various species and regions, leading to a more chaotic and politically charged environment for conservation.

This marginalization is often a direct consequence of budgetary weaponization against scientific research. Recent administrations have proposed and enacted significant budget cuts targeting programs perceived as focusing on "social agendas" like climate change research. For instance, the Trump administration terminated over $1.5 billion in federal research grants from the National Science Foundation (NSF) and the Environmental Protection Agency (EPA), and proposed a 55% budget cut to the EPA, leading to mass dismissals and the shutdown of environmental justice programs. The U.S. Geological Survey (USGS) faced proposed cuts of $564 million from its science and research programs, with sources indicating that 1,000 employees in the USGS Ecosystem Services were expected to be laid off. Similarly, NOAA's climate research programs and cooperative institutes faced proposed cuts and reorganizations, with concerns about immediate funding curtailment and "irrecoverable" damage from layoffs. These cuts are not merely about efficiency but represent a broad attack on the ability to create new knowledge and address critical societal needs, leading to job losses for research assistants and hindering the career paths of future scientists. Such actions cripple fundamental research, diminish regulatory mechanisms, and undermine U.S. competitiveness in scientific fields. Furthermore, there have been documented instances of censorship, suppression of scientific reports, interference with data collection, and the disbanding of scientific advisory committees within federal agencies. Federal scientists have faced reprimands for communicating accurate information that clashed with political narratives. This systematic erosion of scientific authority and defunding of critical research fundamentally undermines the capacity of wildlife agencies to make informed, evidence-based decisions, leaving them vulnerable to political pressures and less effective in their conservation mandates.

B. Exaggeration and Bias in Conflict Data

The politicization of wildlife management is often intensified by misinformation and biases in conflict data, particularly for species like wolves, where social and political factors heavily influence attitudes. One example is the "trophic cascade" narrative regarding the reintroduction of wolves in the Greater Yellowstone Ecosystem. This narrative claims that wolves rehabilitated riparian areas by reducing elk populations and grazing. However, this claim is questionable, as elk rarely alter their feeding behavior due to wolves, and most Yellowstone aspens have not regrown despite significant declines in elk populations. Despite this scientific uncertainty, this

"trophic cascade" narrative is regularly used by some advocacy groups.
Conversely, the risk of livestock depredation by wolves is often exaggerated, contributing to misinformation. While wolf depredation is a genuine concern for livestock producers, its actual risk is sometimes overstated. U.S. Department of Agriculture (USDA) estimates indicate that wolves kill no more than 0.21% of sheep and 0.05% of cattle inventory in states like Idaho, Wyoming, Montana, and Wisconsin. Despite these relatively low figures, farmers, ranchers, and hunters often exhibit a heightened perception of the risk. A study in Minnesota found that rural respondents accepted that wolves caused unacceptable levels of livestock damage, even though less than 1% of livestock were killed in the study area, reflecting a sentiment that any level of damage is unacceptable, but also suggesting an exaggerated sense of damage plays a contributing role.
Media coverage also contributes to this bias, particularly for aquatic predators, where reporting can be sensationalized and lead to an overestimation of risk. More broadly, most studies on human-wildlife conflict do not adequately consider imperfect detection and reporting of conflicts, which can lead to incorrect inferences regarding their spatiotemporal drivers. For instance, conflicts from remote or inaccessible locations may be underreported due to lower sampling effort. This means that official records and reported data may not accurately reflect the true scope or patterns of human-wildlife conflict, hindering effective management strategies and potentially fueling exaggerated claims or political agendas.
The strategic deployment of misinformation in wildlife conflict narratives, whether it involves false ecological claims or exaggerated depredation statistics, profoundly impacts science-based management. Both conservation and rural interest groups have been observed to utilize such narratives to raise the perceived stakes of disputes and advance their political agendas. This manipulation of information, often amplified by media, creates an environment where objective scientific data struggles to gain traction against emotionally charged or politically convenient narratives. The consequence is that wildlife management decisions become less about ecological realities and more about political leverage, undermining the very foundation of evidence-based policy and leading to suboptimal or counterproductive outcomes for both wildlife and human communities.
Furthermore, the systemic challenge of underreporting and imperfect detection in conflict data collection methods, such as reliance on local informants or official records, creates a fragmented and potentially biased understanding of human-wildlife interactions. This means that the reported data may not accurately represent the true prevalence, causes, or locations of conflicts. This lack of accurate, comprehensive data makes it exceedingly difficult for wildlife agencies to develop and implement effective mitigation strategies, allocate resources appropriately, or evaluate the success of interventions. The inherent biases in data collection can fuel exaggerated claims about conflict severity, contributing to the politicization of species management and making it harder to foster coexistence based on factual understanding.

VII. Interagency Dependencies and Collaboration Gaps

Effective wildlife management in the United States relies heavily on intricate interagency cooperation and robust data exchange between federal, state, and tribal entities. However, this complex web of dependencies is fraught with challenges, including contentious relationships, data sharing impediments, and critical gaps in enforcement and technical assistance.

A. Federal-State Dynamics: A Complex and Often Contentious Relationship

The management of species, particularly those listed under the Endangered Species Act (ESA), is characterized by a complex and often contentious "see-saw" dynamic between federal and state control. This instability is evident in the repeated delisting attempts for species like the gray wolf, which have frequently led to population instability and legal disputes. When federal protections are removed, states often move to open hunting seasons, sometimes resulting in unsustainable harvests, as tragically demonstrated by the 2021 Wisconsin wolf hunt where hunters killed 218 wolves in 72 hours, 82% above the quota. This cycle of delisting, overharvesting, and subsequent relisting by federal courts (e.g., *Defenders of Wildlife v. U.S. Fish and Wildlife Service*) due to insufficient recovery planning highlights a fundamental lack of consistent, science-based management.

Federal budget cuts have significantly limited the capacity of agencies like the U.S. Fish and Wildlife Service (USFWS) and the U.S. Geological Survey (USGS) to provide crucial support for wolf management, including population monitoring, conflict mitigation, and habitat management. This erosion of federal capacity forces states to assume greater responsibility, often without adequate resources or consistent regulatory frameworks. For instance, Wisconsin currently lacks permanent management rules for wolves, leaving their future uncertain and vulnerable to political influence rather than long-term conservation strategy.

The perilous pendulum of federal-state control, characterized by inconsistent federal oversight often driven by political shifts, creates profound regulatory instability and undermines long-term species recovery efforts. This instability forces states into reactive management, frequently leading to overharvesting and recurrent legal challenges. The underlying issue is a lack of a stable, science-based framework that transcends political cycles and ensures continuity in conservation. This constant flux not only jeopardizes species populations but also creates uncertainty for stakeholders and wastes resources on repeated legal battles, preventing the establishment of effective, adaptive management strategies.

Furthermore, federal capacity erosion due to budget cuts at agencies like USFWS and USGS significantly shifts the burden of wildlife management to already under-resourced states. These federal cuts reduce the ability of federal agencies to provide critical support such as comprehensive population surveys, essential scientific research, and enforcement of conservation regulations. This transfer of responsibility to states, many of which lack the necessary financial resources or consistent regulatory frameworks (e.g., Wisconsin's absence of permanent wolf management rules), creates a "policy limbo". In this state, inconsistent enforcement, federal-state disputes, and shifting conservation priorities leave vulnerable species without clear safeguards, ultimately jeopardizing long-term conservation success.

B. Data Sharing and Scientific Collaboration Challenges

Effective wildlife management fundamentally relies on robust data sharing and scientific collaboration among various entities. The importance of sharing reliable, secure data for informed planning, decision-making, and research is widely recognized. This necessitates secure data systems and adherence to best practices for data security. Formal mechanisms, such as Confidentiality and Non-disclosure Agreements (CNDAs) and Data Sharing Agreements (DSAs), are crucial for governing access to and use of sensitive ecological data. However, the reality often falls short of this ideal. Federal grant freezes and communication breakdowns have severely impacted Tribal nations' ability to conduct essential wildlife surveys and manage their resources. For example, 60% of surveyed Tribes reported grant freezes, and 26% faced total cancellations, directly halting critical work like fisheries surveys. This is compounded by the loss of Native American liaison positions within the federal government, which were designed to strengthen government-to-government relationships and ensure the federal government fulfills its trust responsibilities to Tribes.

The politicization of science and federal budget cuts directly undermine interagency scientific

collaboration. For instance, NOAA's cooperative institutes, which conduct 50% of the agency's research, and the USGS's Ecosystems Mission Area, which leads wildlife research, have faced proposed funding terminations and layoffs. This loss of expertise and data collection capacity is described as causing "irrecoverable" damage, affecting vital areas like weather forecasting, climate models, and wildlife monitoring.

Fragmented data ecosystems, resulting from inconsistent data sharing protocols and various legal and political barriers, significantly hinder comprehensive conservation efforts. The inability to seamlessly exchange and integrate data across federal, state, and tribal jurisdictions impedes holistic management and limits the understanding of complex ecological systems. This fragmentation is exacerbated by communication breakdowns and the lack of dedicated liaison roles, particularly impacting Tribal nations whose wildlife management efforts are often disrupted by inconsistent federal policy implementation. Without a unified and accessible data infrastructure, agencies struggle to develop coordinated strategies, leading to inefficiencies and suboptimal conservation outcomes.

The unmet potential of interagency scientific synergy is a critical consequence of current challenges. Federal budget cuts and the politicization of science directly undermine the collaborative scientific networks that are essential for addressing large-scale conservation issues. The loss of experienced scientists and the cessation of long-term research projects have "irrecoverable" consequences, affecting not only specific wildlife populations but also broader scientific capabilities, such as the development of next-generation climate models and early warning disaster systems. This erosion of scientific capacity across agencies weakens the collective ability to understand, predict, and respond to environmental changes, ultimately compromising the scientific foundation upon which effective wildlife management is built.

C. Enforcement and Technical Assistance Gaps

The effectiveness of wildlife management is severely hampered by critical gaps in enforcement capacity and the provision of technical assistance. Federal agencies, such as NOAA Fisheries and the USFWS, engage in cooperative enforcement with states, often through Joint Enforcement Agreements (JEAs), to ensure compliance with marine resource laws and protect endangered species. The USFWS also operates the Partners for Fish and Wildlife Program, which provides free technical and financial assistance to private landowners, tribes, corporations, and non-profits for improving wildlife habitat on their land.

However, these efforts are undermined by severe short-staffing across both state and federal agencies. The National Park Service (NPS) experienced a nearly 16.5% drop in employees since FY2023, building on a 20% reduction since 2010 due to underfunding. This has left thousands of essential positions vacant, including superintendent roles, and has impacted basic visitor services. The USFWS saw its staffing shrink by 30% between 2010 and late 2024, with over 400 layoffs in one instance, leading to an "unprecedented brain drain" and disruptions to critical conservation programs. Specific examples include the loss of staff at wildlife refuges for endangered water birds in Kauaʻi and honeycreepers in Hawaiʻi, hindering habitat restoration and invasive species control. State DNRs also face significant shortages; Wisconsin's wildlife division, for example, has 20% of its workforce vacant, with some districts experiencing up to 40% vacancies, leading to insufficient service provision and neglected habitat work. The Michigan Department of Corrections, while not a wildlife agency, illustrates a broader government trend of significant vacancy rates (13.9% overall) and efforts to address recruitment barriers and retention.

The widening chasm in enforcement capacity is a direct consequence of severe staffing shortages at both federal and state levels, which cripple the ability of wildlife agencies to effectively enforce regulations and manage wildlife populations. These shortages are compounded by budget cuts and political interference, leading to reduced patrols, delayed

responses to wildlife conflicts, and an increase in illegal activities such as poaching. For example, Wisconsin's current conservation warden force numbers fewer than 200 officers for 25,000 square miles, and poaching incidents reportedly increased by 25% during delisted periods for wolves. This diminished capacity means that even when regulations are in place, their enforcement is compromised, creating a significant vulnerability for imperiled species and undermining conservation efforts.

Technical assistance, provided through programs like the USFWS Partners for Fish and Wildlife, serves as a critical yet vulnerable bridge for private land conservation and conflict resolution. These programs offer vital expertise and financial aid to landowners, tribes, and other partners, playing a crucial role in restoring and enhancing wildlife habitat on private lands, which constitute nearly 70% of the U.S. land area. However, these essential programs are highly susceptible to federal staffing cuts and funding freezes, as demonstrated by the impact on USGS cooperative fish and wildlife research units. When these programs are weakened, the overall conservation network suffers, leaving private landowners and local communities without crucial support for implementing conservation practices, ultimately hindering landscape-scale conservation efforts.

VIII. Conclusions and Recommendations

The analysis reveals a complex and interconnected web of challenges confronting wildlife agencies in the United States, stemming from outdated funding models, the ecological footprint of growing outdoor recreation, the enduring legacy of colonial conservation, critical workforce deficiencies, and the pervasive politicization of science. These issues collectively undermine the capacity of wildlife agencies to fulfill their mandates, leading to reactive management, jeopardized species recovery, and eroded public trust.

Key Conclusions:

1. **Funding Model Inadequacy:** The reliance on a "user-pay, user-benefit" funding model, primarily from hunting and fishing, creates a structural bias towards game species, leaving the vast majority of biodiversity underfunded. While recent legislative efforts aim to bolster this model, they do not fundamentally diversify the funding base, perpetuating a reactive approach to conservation. The State Wildlife Grant program, though critical for non-game species, remains severely underfunded, preventing comprehensive implementation of State Wildlife Action Plans.
2. **Unquantified Recreation Burden:** The burgeoning outdoor recreation economy, while economically significant and beneficial for human well-being, imposes substantial, often unquantified, ecological and financial costs on wildlife agencies. The lack of comprehensive regulation and dedicated funding mechanisms for non-consumptive recreation means that the full costs of managing these impacts are not equitably borne by all beneficiaries, leading to potential long-term resource degradation.
3. **Colonial Legacy and Exclusion:** Historical conservation practices, rooted in Eurocentric and colonial paradigms, have led to the marginalization and displacement of Indigenous Peoples and the devaluing of Traditional Ecological Knowledge (TEK). This has fostered deep distrust and hindered the adoption of more effective, locally rooted, and cost-efficient Indigenous-led conservation models.
4. **Workforce Crisis:** Severe short-staffing and a profound lack of diversity within wildlife agencies compromise their operational effectiveness, scientific capacity, and ability to connect with an increasingly diverse public. Systemic barriers, including low pay and non-inclusive environments, impede recruitment and retention of a representative workforce.
5. **Politicization of Science:** The erosion of scientific authority, evidenced by budget cuts

targeting research, censorship, and the dominance of political and advocacy voices over expert opinion, undermines the scientific foundation of wildlife management. This is exacerbated by the strategic use of misinformation and biased data in public discourse, particularly regarding human-wildlife conflict, leading to policy decisions based on political expediency rather than ecological reality.

6. **Interagency Fragmentation:** Inconsistent federal-state dynamics, characterized by a "perilous pendulum" of control and shifting financial burdens, create regulatory instability. Fragmented data ecosystems, communication breakdowns, and vulnerable technical assistance programs further impede cohesive, national conservation efforts.

Recommendations:

To foster a more resilient, equitable, and effective wildlife management system, the following recommendations are put forth:

1. **Diversify and Stabilize Funding Mechanisms:**
    - **Broaden the Revenue Base:** Explore and implement new funding mechanisms that capture revenue from the entire outdoor recreation economy, including non-consumptive activities (e.g., through equipment sales taxes, conservation stamps for public lands access, or dedicated portions of general sales taxes). This would shift towards a "societal benefit, societal invest" model, ensuring that all who benefit from healthy ecosystems contribute to their maintenance.
    - **Establish Mandatory, Dedicated Funds:** Advocate for and secure permanent, mandatory funding for Species of Greatest Conservation Need (SGCN) and broader biodiversity conservation, moving away from the unpredictable nature of annual congressional appropriations. This includes fully funding the State Wildlife Grants program to enable comprehensive implementation of State Wildlife Action Plans.
    - **Support Tribal Self-Determination in Funding:** Establish dedicated, direct funding streams for Tribal nations, acknowledging federal trust responsibilities and supporting Indigenous-led conservation efforts without the burden of restrictive matching requirements or unpredictable grant freezes.
2. **Transform Governance through Equitable Partnerships:**
    - **Formalize Co-Management with Indigenous Communities:** Develop and implement transparent, legally binding co-management agreements with Tribal nations that grant genuine shared authority and responsibility in land and wildlife stewardship. These agreements must be publicly accessible and involve broad stakeholder engagement to ensure legitimacy.
    - **Integrate Traditional Ecological Knowledge (TEK):** Systematically incorporate TEK into all stages of wildlife management, from planning and research to implementation and monitoring. This requires redefining "best available science" to embrace knowledge pluralism and actively support co-production of knowledge with Indigenous experts.
    - **Invest in Community Capacity:** Provide resources and training for Indigenous and local communities to strengthen their capacity for self-governance and lead conservation initiatives, recognizing their historical and ongoing role as stewards of biodiversity.
3. **Reinforce Scientific Integrity and Data Transparency:**
    - **Protect Scientific Independence:** Enact and enforce robust scientific integrity policies that shield federal and state scientists from political interference, censorship, and budgetary targeting. Ensure that scientific findings are communicated transparently and without distortion.
    - **Invest in Core Research and Monitoring:** Restore and increase funding for federal science agencies (e.g., USGS, USFWS, NOAA, EPA) to rebuild scientific

capacity, reverse job losses, and ensure comprehensive, long-term data collection on wildlife populations, habitats, and human-wildlife interactions.
    - **Improve Data Sharing Protocols:** Develop standardized, secure, and accessible data sharing protocols across federal, state, and tribal agencies to create a unified data ecosystem. This includes re-establishing and strengthening liaison positions to facilitate inter-governmental communication and collaboration.
    - **Combat Misinformation:** Implement proactive strategies to counter misinformation surrounding wildlife issues, using clear, evidence-based communication to inform the public and ensure that policy decisions are grounded in scientific fact rather than political narratives.
4. **Address Workforce Shortages and Foster Inclusivity:**
    - **Strategic Recruitment and Retention:** Implement aggressive recruitment and retention strategies to address severe staffing shortages across all levels of wildlife agencies. This includes competitive salaries, improved benefits, and clear career pathways.
    - **Prioritize Diversity, Equity, and Inclusion (DEI):** Actively dismantle systemic barriers to diversity in the wildlife profession, including addressing low pay for entry-level positions, providing mentorship opportunities, and fostering inclusive work environments free from bias and micro-aggressions.
    - **Reflect Public Demographics:** Strive to build a workforce that reflects the increasing diversity of the U.S. population to ensure agencies remain relevant, responsive, and effective in engaging with all segments of society.
5. **Implement Adaptive Recreation Management:**
    - **Quantify and Mitigate Impacts:** Conduct rigorous research to quantify the ecological impacts of all forms of outdoor recreation and implement adaptive management strategies, including seasonal closures, distance requirements, and the establishment of recreation-free wildlife corridors, to minimize disturbance to wildlife.
    - **Equitable Cost Sharing:** Develop funding mechanisms that ensure all outdoor recreationists contribute equitably to the costs of managing impacts and maintaining the ecological health of the natural areas they utilize.
    - **Promote Responsible Recreation:** Enhance public education and outreach programs that promote responsible outdoor ethics, emphasizing minimal impact practices and fostering a deeper understanding of human-wildlife coexistence.

By addressing these interconnected challenges with a comprehensive and forward-looking approach, wildlife agencies can strengthen their financial foundations, build more equitable partnerships, restore scientific integrity, cultivate a diverse and robust workforce, and ultimately ensure the long-term conservation of the nation's invaluable wildlife resources for generations to come.

Works cited

1. Administrative Requirements; Pittman-Robertson Wildlife Restoration and Dingell-Johnson Sport Fish Restoration Acts - Federal Register, https://www.federalregister.gov/documents/2024/12/02/2024-27095/administrative-requirements-pittman-robertson-wildlife-restoration-and-dingell-johnson-sport-fish 2. Dingell-Johnson Act | Washington Department of Fish & Wildlife, https://wdfw.wa.gov/fishing/management/dingell-johnson 3. Pittman–Robertson Federal Aid in Wildlife Restoration Act - Wikipedia, https://en.wikipedia.org/wiki/Pittman%E2%80%93Robertson_Federal_Aid_in_Wildlife_Restoration_Act 4. The Pittman Robertson Act: a steady source of wildlife funding for the states,

https://environmentamerica.org/updates/the-pittman-robertson-act-a-steady-source-of-wildlife-funding-for-the-states/ 5. The Pittman-Robertson Wildlife Restoration Act - Congress.gov, https://www.congress.gov/crs-product/IF12229 6. HOW STATE FISH & WILDLIFE AGENCIES ARE FUNDED, https://statewildlifetoolkit.nwf.org/wp-content/uploads/2021/03/HowStateWildlifeAgenciesareFunded.pdf 7. U.S. House Passes The Modernizing the Pittman-Robertson Fund for Tomorrow's Needs Act, https://www.fishwildlife.org/news-archive/us-house-passes-modernizing-pittman-robertson-fund-tomorrows-needs-act 8. Final Management Advisory – Issues Identified With Target Range Grant, North Atlantic-Appalachian Regional Office, U.S. Fish a - Inspector General, https://www.doioig.gov/sites/default/files/2021-migration/Final%20Management%20Advisory_WSFR_IssuesIdentifiedWithTargetRangeGrantFWSNAAR.pdf 9. House Resources Committee Approves Bills to Amend Pittman-Robertson, https://wildlifemanagement.institute/outdoor-news-bulletin/may-2018/house-resources-committee-approves-bills-amend-pittman-robertson 10. Americans' beliefs about wildlife management are changing | SENR, https://senr.osu.edu/news/americans-beliefs-about-wildlife-management-are-changing 11. Partner Fish and Wildlife Agencies Receive $55 Million to Protect ..., https://www.fws.gov/press-release/2025-05/partner-fish-and-wildlife-agencies-receive-55-million-protect-and-manage 12. Fish and Wildlife Agencies Receive $55 Million for Management of Species of Concern | An Official Journal Of The NRA - American Hunter, https://www.americanhunter.org/content/fish-and-wildlife-agencies-receive-55-million-for-management-of-species-of-concern/ 13. State Wildlife Grants | U.S. Fish & Wildlife Service, https://www.fws.gov/program/state-wildlife-grants 14. State Wildlife Grant (SWG) Program, https://wildlife.ca.gov/Grants/State-Wildlife-Grants 15. Bureau of Economic Analysis Releases 2022 Outdoor Recreation Statistics, https://wildlifemanagement.institute/outdoor-news-bulletin/december-2023/bureau-economic-analysis-releases-2022-outdoor-recreation 16. 2022 National Survey of Fishing, Hunting and Wildlife Watching Shows Economic Contribution of $395 billion to US Economy, https://www.fishwildlife.org/landing/blog/2022-national-survey-fishing-hunting-and-wildlife-watching-shows-economic-contribution-395-billion-us-economy 17. Americans Spent $394B on Hunting, Fishing, and Wildlife-Associated Activities in '22, https://www.fws.gov/press-release/2023-10/americans-spent-394b-hunting-fishing-and-wildlife-associated-activities-22 18. 11 Ways Wildlife Refuges Make Life Better | U.S. Fish & Wildlife ..., https://www.fws.gov/story/11-ways-wildlife-refuges-make-life-better 19. Outdoor Recreation | U.S. Fish & Wildlife Service, https://www.fws.gov/activities 20. How to minimize recreation impacts on wildlife | Colorado State University, https://source.colostate.edu/recreation-impacts-on-wildlife/ 21. Land and Water Conservation Fund | How revenue works, https://revenuedata.doi.gov/how-revenue-works/lwcf/ 22. State Funding for Outdoor Recreation - National Conference of State Legislatures, https://documents.ncsl.org/wwwncsl/Environment/funding-outdoor-recreation_v03.pdf 23. Land and Water Conservation Fund | U.S. Department of the Interior, https://www.doi.gov/lwcf 24. Resourceful Communities - The Conservation Fund, https://www.conservationfund.org/focus-areas/resilient-communities/resourceful-communities/ 25. Federal Funding Cuts Are Silencing the Wild | Sierra Club, https://www.sierraclub.org/sierra/federal-funding-cuts-are-silencing-wild 26. Lost federal funding hits Tribal wildlife management, https://wildlife.org/lost-federal-funding-hits-tribal-wildlife-management/ 27. AUDIT REPORT - DOI OIG, https://www.doioig.gov/sites/default/files/2021-migration/R-GR-FWS-0029-2003.pdf 28. Balancing Our Outdoor Desire with Wildlife Welfare - Natural Habitat Adventures, https://www.nathab.com/blog/even-low-impact-activities-could-affect-wildlife 29. Impacts to

Wildlife: Managing Visitors and Resources to Protect Wildlife, March 2019, Edition One, https://visitorusemanagement.nps.gov/Content/documents/Impacts%20to%20Wildlife_Managaing%20Visitors%20and%20Resources%20to%20Protect%20Wildlife_March%202019_Edition%20One.pdf 30. Outdoor Recreation and Ecological Disturbance, https://eplanning.blm.gov/public_projects/2014877/200493037/20057320/250063502/Attachment%20H%20-%20Recreation%20Report%202021%20referenced%20in%20NFD2-1-500204015.pdf 31. The $1.2 Trillion Outdoor Recreation Economy Depends on Keeping Public Lands Public and Accessible, https://recreationroundtable.org/news/the-1-2-trillion-outdoor-recreation-economy-depends-on-keeping-public-lands-public-and-accessible/ 32. Habitat Improvement Costs on State-Owned Wildlife Management Areas i n New Y 0 r k - Forest Service, https://www.fs.usda.gov/ne/newtown_square/publications/research_papers/pdfs/scanned/OCR/ne_rp621.pdf 33. Natural Lands Management Cost Analysis 28 Case Studies - USACE Sacramento District, https://www.spk.usace.army.mil/portals/12/documents/regulatory/pdf/landmanagement_costanalysis.pdf 34. Decolonizing biodiversity conservation - Journals at the University of Arizona, https://journals.librarypublishing.arizona.edu/jpe/article/id/5969/download/pdf/ 35. Decolonize Conservation - Survival International, https://survivalinternational.org/campaigns/conservation 36. How to Decolonize Conservation | Hakai Magazine, https://hakaimagazine.com/news/how-to-decolonize-conservation/ 37. What is inclusive conservation and why is it important for ensuring our survival? - Materia Rinnovabile, https://www.renewablematter.eu/en/inclusive-conservation 38. Hard truths about inclusive conservation - WWF, https://www.worldwildlife.org/stories/hard-truths-about-inclusive-conservation 39. Decolonize Conservation — Common Notions Press, https://www.commonnotions.org/decolonize-conservation 40. Traditional Ecological Knowledge | U.S. Fish & Wildlife Service, https://www.fws.gov/library/collections/traditional-ecological-knowledge 41. Breaking Barriers: Advancing Diversity in Conservation at AWIC, https://blog.cwf-fcf.org/index.php/en/breaking-barriers-advancing-diversity-in-conservation-at-awic/ 42. 5 Ways Scientists, NGOs, and Governments Can Support Indigenous-led Conservation, https://www.americanprogress.org/article/5-ways-scientists-ngos-and-governments-can-support-indigenous-led-conservation/ 43. Tribal Co-Management: What Works Where and How ..., https://www.archaeologysouthwest.org/about/preservation-archaeology-position-papers/tribal-co-management-what-works-where-and-how/ 44. Decolonizing Conservation Through Knowledge Pluralism → Scenario, https://prism.sustainability-directory.com/scenario/decolonizing-conservation-through-knowledge-pluralism/ 45. Partnering with Indigenous People and Local Communities - The Nature Conservancy, https://www.nature.org/en-us/about-us/who-we-are/how-we-work/community-led-conservation/ 46. Why Tribal Co-Management Is A Threat to Our Public Lands - The Wildlife News, https://www.thewildlifenews.com/2025/02/20/why-tribal-co-management-is-a-threat-to-our-public-lands/ 47. The Changing Face of the Wildlife Profession: Tools for Creating ..., https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=1614&context=hwi 48. 1 WHITE PAPER: OVERCOMING THE GENDER AND ETHNIC DIVERSITY GAP IN THE NATURAL RESOURCE PROFESSION The Texas, https://tctws.org/wp/wp-content/uploads/2022/02/Diversity-in-Natural-Resource-Profession-Final-Report.pdf 49. Are We Outside?: Identifying and Unlocking barriers to conservation and the outdoors for BIPOC - Integrative and Comparative Biology, https://integrativeandcomparativebiology.wordpress.com/2025/05/13/are-we-outside-identifying-and-unlocking-barriers-to-conservation-and-the-outdoors-for-bipoc/ 50. Attracting Diverse

Students to Field Experiences Requires Adequate Pay, Flexibility, and Inclusion - PubMed Central, https://pmc.ncbi.nlm.nih.gov/articles/PMC8245294/ 51. The bear in the (court)room: who decides on removing grizzly bears ..., https://www.frontiersin.org/news/2025/04/16/removing-grizzly-bear-endangered-species-list-dunning 52. USGS grants will freeze, layoffs planned - The Wildlife Society, https://wildlife.org/usgs-grants-frozen-layoffs-planned/ 53. The attacks of the Trump II administration on climate, the ... - IRIS, https://www.iris-france.org/en/111410/ 54. Proposed 55% cut to EPA Is a Wrecking Ball that Endangers the Air ..., https://www.environmentalprotectionnetwork.org/20250502_budget-cuts/ 55. Trump Administration's 2026 Budget: Drastic Cuts at NOAA and the EPA, https://www.surfrider.org/news/trump-administrations-2026-budget-calls-for-drastic-cuts-at-noaa-and-the-epa 56. Trump Cancels Federal Research Grants. What Are the ..., https://www.nea.org/nea-today/all-news-articles/trump-cancels-federal-research-grants-what-are-consequences 57. Abuses of Science | Union of Concerned Scientists, https://test.ucsaction.org/resources/abuses-science 58. Trump asks Congress to cut at the heart of the West - High Country ..., https://www.hcn.org/articles/trump-asks-congress-to-cut-at-the-heart-of-the-west/ 59. Science policy this week: June 9, 2025 - AIP.ORG, https://www.aip.org/fyi/the-week-of-june-9-2025 60. Trump cuts would cripple NOAA's wide-ranging science ... - E&E News, https://www.eenews.net/articles/trump-cuts-would-cripple-noaas-wide-ranging-science-partnerships/ 61. EPA's New Scientific Integrity Policy: the Good, the Bad, and the Ugly - The Equation, https://blog.ucs.org/anita-desikan/epas-new-scientific-integrity-policy-the-good-the-bad-and-the-ugly/ 62. The Politicization of Wildlife: Species as Surrogates By Greyson A ..., https://digicoll.lib.berkeley.edu/record/278500/files/2023Summer_Abid_Greyson_A.pdf 63. Government data confirm that wolves have a negligible effect on U.S. cattle & sheep industries, https://www.humaneworld.org/sites/default/files/docs/HSUS-Wolf-Livestock-6.Mar_.19Final.pdf 64. Geographic bias in the media reporting of aquatic versus terrestrial human predator conflicts and its conservation implications, https://www.perspectecolconserv.com/en-geographic-bias-in-media-reporting-articulo-S2530064418301354 65. Mechanistic understanding of human–wildlife conflict through a novel application of dynamic occupancy models, https://wec.ifas.ufl.edu/pdf/oli/2015_Goswami%20et%20al_Dynamics%20of%20human-wildife%20conflict_Conservation%20Biology.pdf 66. The Gray Wolf Under the Endangered Species Act (ESA): A Case Study in Listing and Delisting Challenges | Congress.gov, https://www.congress.gov/crs-product/R46184 67. Federal wildlife regulators deny petitions to reduce or remove protections for wolves - WPR, https://www.wpr.org/news/wildlife-regulators-deny-petitions-reduce-remove-protections-wolves 68. Wisconsin wolf harvest regulations debated amid effort to delist wolves - WPR, https://www.wpr.org/news/wisconsin-wolf-harvest-regulations-debated-delist-wolves 69. DEFENDERS OF WILDLIFE v. FISH AND WILDLIFE SERVICE (2022) - FindLaw Caselaw, https://caselaw.findlaw.com/court/us-dis-crt-n-d-cal/2162945.html 70. Defenders of Wildlife v. U.S. Fish and Wildlife Service | Environmental Law Reporter®, https://www.elr.info/litigation/52/5/defenders-wildlife-v-us-fish-and-wildlife-service 71. Fish & Wildlife Branch Data Sharing Policy - Yukon.ca, https://yukon.ca/sites/default/files/env/fw_branch_data_sharing_policy.pdf 72. Information Sharing Access Agreements | FEMA.gov, https://www.fema.gov/about/glossary/information-sharing-access-agreements 73. Preparing Your Data Management and Sharing Plan - Funding at NSF, https://www.nsf.gov/funding/data-management-plan 74. Enforcement - NOAA Fisheries, https://www.fisheries.noaa.gov/topic/enforcement 75. Partners for Fish and Wildlife | U.S. Fish & Wildlife Service, https://www.fws.gov/program/partners-fish-and-wildlife 76. Parks Group

Rebukes Secretary Burgum's Misrepresentation of National Park Staffing, https://www.npca.org/articles/9221-parks-group-rebukes-secretary-burgum-s-misrepresentation-of-national-park 77. Trouble Ahead: How Staffing Cuts Threaten Air, Water and Wildlife at Your Favorite Parks, https://www.npca.org/articles/9188-trouble-ahead-how-staffing-cuts-threaten-air-water-and-wildlife-at-your 78. On Public Lands, Federal Staffing Chaos Threatens Fragile Ecosystems | Audubon, https://www.audubon.org/magazine/public-lands-federal-staffing-chaos-threatens-fragile-ecosystems 79. Over 80 DNR Jobs Vacant as State Navigates COVID-19 - Patrick Durkin Outdoors, https://www.patrickdurkinoutdoors.com/post/over-50-dnr-jobs-vacant-as-state-navigates-covid-19 80. Staffing Reports - State of Michigan, https://www.michigan.gov/corrections/public-information/staffing-reports