CLIMATE SCIENCE AND NATURAL RESOURCE LITIGATION

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SUMMARY

Climate change has major implications for sustainable use and conservation of natural resources. Many natural systems are already under severe stress and may be unable to sustain historical use patterns; resource management decisions can also exacerbate or mitigate climate change by affecting the balance of greenhouse gases in the atmosphere. This Article describes the legal and scientific basis for recognizing agencies' obligations to assess and respond to climate change, drawing insights from a survey of U.S. litigation involving forests, fisheries, rangelands, and freshwater resources. The cases suggest litigants have been somewhat successful in driving more rigorous assessments of climate change. However, agencies still frequently conclude that climate impacts are too uncertain or insignificant to warrant a response, and courts will generally defer unless the agency has overlooked or arbitrarily dismissed actionable scientific information. This underscores the importance of collaboration among resource managers, legal advocates, and scientists to develop, disseminate, and communicate scientific information that can meaningfully inform these decisions.

Climate change is already affecting terrestrial, freshwater, and marine ecosystems across the planet, with significant implications for the sustainable management and conservation of natural resources.[1] Ecological impacts that have been attributed to climate change include changes in species abundance and distribution, alterations to food-chain dynamics, changes in ecosystem productivity and carrying capacity, disruptions to ecosystem services, habitat destruction, species extinctions, biodiversity loss, and more.[2] It is critically important that natural resource managers consider these impacts when making decisions about land uses, management approaches, resource allocations, conservation measures, and environmental protections.

Many jurisdictions have recognized legal obligations on the part of government agencies to manage natural resources in a manner that is sustainable, protective of environmental values, and responsive to the needs of future generations. In the United States, these obligations are largely based on federal and state laws that establish substantive mandates for the sustainable use and conservation of natural resources, often accompanied by detailed planning requirements and criteria for science-based decisionmaking. Other environmental laws, such as wildlife protection and environmental assessment laws, also play a pivotal role in natural resource management.

Federal and state resource management agencies have taken important steps to address climate change, in some cases revising regulations and internal policies to provide for consideration of climate change in management plans and environmental review documents.[3] However, current management approaches are not on track to achieve sustainability and conservation goals in a changing climate,[4] and efforts to advance climate action have been subject to tremendous disruption due to regulatory oscillations and

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1. Intergovernmental Panel on Climate Change (IPCC), Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the IPCC (Valérie Masson-Delmotte et al. eds., 2021) [hereinafter IPCC AR6 WGI]; IPCC, Climate Change 2022: Impacts, Adaptation, and Vulnerability. Working Group II Contribution to the Sixth Assessment Report of the IPCC (Hans Otto Pörtner et al. eds., 2022) [hereinafter IPCC AR6 WGII].
2. *See* IPCC AR6 WGII, *supra* note 1, ch. 2 ("Terrestrial and freshwater ecosystems and their services"), ch. 3 ("Ocean and coastal ecosystems and their services"), ch. 4 ("Water"), ch. 5 ("Food, fibre, and other ecosystem products"). *See also* U.S. Global Change Research Program, Fifth National Climate Assessment ch. 4 ("Water"), ch. 6 ("Land Cover and Land Use Change"), ch. 7 ("Forests"), ch. 8 ("Ecosystems, Ecosystem Services, and Biodiversity"), ch. 10 ("Ocean Ecosystems and Marine Resources") (A.R. Crimmins et al. eds., 2023) [hereinafter NCA5].
3. *See, e.g.*, U.S. Department of Agriculture, Climate Adaptation Plan 2024-2027 (2024); U.S. Department of the Interior, Climate Adaptation Plan (2024).
4. Environmental indicators suggest that a large percentage of federally managed ecosystems are in poor health and highly vulnerable to stressors associated with climate change. *See, e.g.*, Public Employees for Environmental Responsibility, Evaluating Trends in Rangeland Health on Bureau of Land Management Lands: Insights From 2023 Grazing Allotment Data (2024) (finding that approximately 50% of assessed lands were not meeting health standards).

political backlash, particularly at the federal level.[5] Current responses to climate change simply do not reflect the scale and urgency of action needed to effectively mitigate and adapt to climate change-related hazards.[6]

This Article considers the extent to which existing legal frameworks can help address the "climate action gap" in natural resource management. It describes the legal and scientific basis for recognizing obligations on the part of government agencies to account for climate change across different types of management actions. It also examines how legal advocacy efforts—paired with advances in climate science—have contributed to judicial recognition and enforcement of these obligations. In particular, the Article explains (1) how courts have construed agency obligations to engage with climate science pursuant to existing legal mandates for sustainable use, conservation, and science-based decisionmaking; and (2) how litigants have crafted persuasive arguments about climate science and its implications for resource management decisions.

The Article draws insights from a survey of U.S. litigation featuring disputes about how government agencies should respond to evidence of climate change and/or ecological change in management decisions for forests, fisheries, rangelands, and freshwater resources. The scientific disputes in these cases typically centered on the validity of agency determinations that climate impacts were too speculative or insignificant to warrant further analysis or a change in the management action. Plaintiffs carried the burden of proving that the agency had either overlooked relevant scientific information that was on the administrative record, or reached an irrational conclusion regarding that information.

Although there was considerable variation across cases, the decisions did converge on some general trends and principles. Most notably, courts consistently recognized that climate change had implications for management decisions, and agencies therefore had obligations to account for climate change in environmental and scientific assessments. At the same time, courts recognized that agencies were entitled to deference in technical determinations that fell within their expertise. Accordingly, courts remanded actions where there were clear omissions or errors in the agency's analysis, but were otherwise deferential to agency decisions about how to analyze climate impacts and what conclusions could be drawn on the basis of that analysis.[7]

The survey encompassed cases decided between 2007 and 2024. It appeared that judicial recognition of agency obligations contributed to increasingly rigorous assessments of climate change over this period. However, agencies continued to find that climate impacts were too uncertain or insignificant to influence their management decisions, in some cases arguing they could not gain actionable insights about climate impacts because they lacked tools to quantify, measure, or otherwise characterize those impacts with precision and accuracy. Thus, the question of how agencies should deal with scientific uncertainty was and will likely continue to be a major focal point of litigation. Courts generally recognized that agencies had obligations to characterize and resolve uncertainty using scientifically accepted methods, including climate models, but how this standard was applied in any given case was largely dependent on the underlying facts and context.

The Article contains many additional insights about the types of legal and scientific arguments advanced in these cases and how courts have responded to the issues of scientific complexity and uncertainty when adjudicating climate-related claims. This discussion is intended to help both lawyers and scientists understand how legal advocacy and scientific information can help shape legal norms for climate impact assessment, and ultimately promote deeper engagement with climate science in natural resource management.[8]

Part I begins with the scientific context for this discussion. It provides a high-level overview of scientific findings on how climate change is affecting natural systems, discusses the corresponding implications for natural resource management, and identifies examples of scientific tools and data that can be used to support decisionmaking in this context. Part II describes the legal context, specifically focusing on federal laws for natural resource management and conservation in the United States, as these governed the majority of the surveyed claims. Part III presents general findings from the litigation survey. It includes a summary of cases and claims raised therein, as well as a discussion of general trends in how courts construed agency obligations related to climate impact assessment.

Part IV provides more targeted insights on how courts engaged with scientific arguments in specific cases, and how case outcomes differed depending on the nature of the contested action, the framing of legal arguments, and the availability of record evidence to support arguments. Part V presents a synthesis of findings and reflections on the legal claims surveyed in this Article, specifically focusing on barriers to science-based legal advocacy and opportunities for overcoming those barriers. It discusses how both legal and scientific actors can help promote deeper engagement with climate science in the courtroom as well as the broader field of natural resource management planning.[9] Part VI concludes.

5. *See, e.g.*, Exec. Order No. 14157, 90 Fed. Reg. 8439 (Jan. 29, 2025); Rescission of Conservation and Landscape Health Rule, 90 Fed. Reg. 43990 (proposed Sept. 11, 2025), https://www.govinfo.gov/content/pkg/FR-2025-09-11/pdf/2025-17537.pdf. *See also* Jonathan S. Masur, *Regulatory Oscillation*, 39 Yale J. on Regul. 744 (2022).
6. *See, e.g.*, NCA5, *supra* note 2, at 4-23, 7-20, 10-3.
7. Courts remanded actions for further assessment of issues related to climate change and environmental change in approximately two-fifths of the surveyed cases, and otherwise deferred to agencies on these claims. See *infra* Parts III-IV, for a full discussion of the cases.
8. Although the analysis is primarily based on U.S. law, many of the findings may be relevant to other jurisdictions where there are legal requirements for the sustainable use and conservation of natural resources.
9. Part V also provides insights on "climate science information needs" for natural resource management based on the rationales proffered by agencies for inaction on climate change. *See infra* Section V.C.

I. Scientific Context

A. *Effects of Climate Change on Natural Systems*

One of the key findings from the Intergovernmental Panel on Climate Change's (IPCC's) latest Assessment Report (AR6) is that climate change is causing "substantial damages, and increasingly irreversible losses, in terrestrial, freshwater and coastal and open marine ecosystems" across the planet, including "[w]idespread deterioration of ecosystem structure and function, resilience and natural adaptive capacity" with corresponding "adverse socioeconomic consequences."[10] The U.S. Global Change Research Program similarly found in its Fifth National Climate Assessment (NCA5) that climate change is "harming the health and resilience of ecosystems" throughout the United States, "leading to reductions in biodiversity and ecosystem services."[11]

There are many pathways through which anthropogenic greenhouse gas (GHG) emissions and climate change affect natural systems. First there are physical and climatic changes, such as increasing heat, sea ice loss, glacial retreat, hydrological changes, ocean acidification, ocean deoxygenation, and increases in the frequency and severity of extreme weather events.[12] These physical changes lead to biological and ecological changes, such as alterations to the health, distribution, abundance, morphology, and behavior of living organisms; seasonal shifts and changes in the timing of critical biological events; alterations in species interactions and food-chain dynamics; changing vectors for invasive species and pathogens; local losses of species; and extinctions.[13] Even relatively minor shifts in bioclimatic conditions can have profound consequences for ecosystem dynamics, health, integrity, productivity, and carrying capacity.[14] Climate change is also a direct driver of habitat destruction (e.g., through sea-level rise, wildfires, and floods) and other forms of abrupt ecological change.[15]

The effects of climate change are already overwhelming the adaptive capacity of many ecosystems and organisms, causing serious ecological damage.[16] Climate change has been recognized as a major contributor to global biodiversity loss and habitat degradation, and a major threat to the provision of ecosystem services and products.[17] The harmful impacts will continue—and, in some cases, accelerate—with each additional increment of anthropogenic forcing on the climate system.[18] The potential harm to both natural and human communities is enormous.[19]

The sections below summarize some of the key ways in which climate change is affecting natural systems that are managed for human use, specifically forests, fisheries, rangelands, and freshwater systems. It is worth noting at the outset of this discussion that there are many other human activities and stressors that also affect the health and resilience of these ecosystems (e.g., extractive uses, habitat fragmentation, fire suppression, and pollution). Ultimately, all the different drivers of ecological change—and the interactions between them—need to be accounted for in resource management.

1. Forests

Climate change is affecting forests through increases in mean temperature and extreme heat; hydrological changes, including enhanced precipitation, pluvial and river floods, and increased transpiration, with potential effects on runoff and water supply; drought and longer dry seasons; increased fire weather and more severe wildfires; changes in biological communities, organisms, and their interactions; and increases in invasive species, insect outbreaks, and diseases.[20] Forests located in coastal regions may also be affected by sea-level rise, saltwater intrusion into soils and groundwater, and more intense storms and floods.[21] The changes are altering forest ecosystem structure and function, and can seriously undermine forest health, whether due to abrupt change (e.g., a wildfire) or gradual change over time (e.g., range expansion). Some of these impacts can affect the ability of forests to absorb and store carbon dioxide (CO_2), in some cases reducing carbon storage, potentially creating a feedback loop between forest degradation and further climate change.[22]

These changes have already caused significant damage to forests in some regions. For example, IPCC AR6 found with *high confidence* that drought-induced tree mortality

10. The IPCC expressed *high confidence* in this finding. *See* IPCC AR6 WGII, *supra* note 1, at 9, ¶ B.1.2.
11. NCA5, *supra* note 2, at 1-31.
12. Increases in temperature are one of the most fundamental aspects of climate change and a primary driver of ecological change. *See* Nancy B. Grimm et al., *The Impacts of Climate Change on Ecosystem Structure and Function*, 11 Frontiers in Ecology & Env't 474 (2013).
13. *See* IPCC AR6 WGII, *supra* note 1, ch. 2 ("Terrestrial and Freshwater Ecosystems and Their Services"), ch. 3 ("Oceans and Coastal Ecosystems and Their Services"); Sarah R. Weiskopf et al., *Climate Change Effects on Biodiversity, Ecosystems, Ecosystem Services, and Natural Resource Management in the United States*, 733 Sci. Total Env't 137782 (2020); Grimm et al., *supra* note 12.
14. *See, e.g.*, IPCC AR6 WGII, *supra* note 1, at 279 (noting that extinction risks "increase steeply with even small rises in global temperature"); *id.* at 2150 (discussing how islands are particularly vulnerable to even minor changes in climate and habitat).
15. *See* Monica G. Turner et al., *Climate Change, Ecosystems, and Abrupt Change: Science Priorities*, 375 Phil. Transactions Royal Soc'y B 20190105 (2020).
16. IPCC AR6 WGII, *supra* note 1.
17. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), The Global Assessment Report on Biodiversity and Ecosystem Services (Eduardo Brondizio et al. eds., 2019); IPCC AR6 WGII, *supra* note 1, at 117 (fig.TS.AII.3), ch. 2 ("Terrestrial and Freshwater Ecosystems and Their Services"), ch. 3 ("Oceans and Coastal Ecosystems and Their Services").
18. That is to say that each additional ton of GHGs will cause additional climate change. IPCC AR6 WGII, *supra* note 1.
19. *Id.*; NCA5, *supra* note 2; Grimm et al., *supra* note 12.
20. IPCC AR6 WGII, *supra* note 1, ch. 2; NCA5, *supra* note 2, ch. 7.
21. NCA5, *supra* note 2, at 7-8.
22. Specifically, climate change can reduce carbon storage in forests through (1) more severe and frequent wildfires, which produce enormous quantities of smoke and carbon emissions; (2) heavy precipitation and flooding, which can erode forest soils and cause them to release carbon; and (3) tree and vegetation die-off from insects, disease outbreaks, drought, and other stressors, causing the release of stored carbon in plant matter. U.S. Environmental Protection Agency (EPA), *Climate Change Impacts on Forests*, https://www.epa.gov/climateimpacts/climate-change-impacts-forests (last updated Aug. 13, 2025).

attributable to anthropogenic climate change has been a major driver of tree loss in North America and other regions.[23] IPCC AR6 also expressed *high confidence* that insect outbreaks have increased in northern North America due to warmer winters, contributing to tree mortality as well as shifts in carbon dynamics.[24] Climate change is also causing significant biome shifts and structural changes within forest ecosystems.[25] NCA5 found that these and other impacts are adversely affecting the health and productivity of U.S. forests, and their ability to provide critical ecosystem services such as clean air and clean water.[26]

The exposure and sensitivity of forests to climate-related stressors can vary considerably depending on forest location, condition, level of disturbance, and management history.[27] For example, fire activity is projected to increase with warming, and the effect of wildfire on forests depends on fire history, fire suppression, and other management actions.[28] In some cases, "fuel reduction" projects may actually exacerbate wildfire risk, particularly where they involve clearcutting or the removal of large trees.[29] The existing research suggests that forest health, resilience, and adaptive capacity can be enhanced through projects that increase forest heterogeneity (in terms of species size and composition), but there are still many open questions about how to best manage forests in the context of climate change. This task is particularly challenging when balancing goals related to human use (e.g., timber production and recreation) with the goal of forest conservation.

2. Marine Fisheries

Climate change is fundamentally altering the physical and chemical characteristics of ocean and coastal ecosystems.[30] The primary climate and climate-adjacent drivers of marine ecosystem change include ocean warming and marine heatwaves, ocean acidification, deoxygenation, sea-level rise, sea ice loss, changes in ocean circulation, and changes in coastal and estuarine hydrology. IPCC AR6 found that ocean and coastal ecosystems are now exposed to conditions that are "unprecedented over millennia (*high confidence*), and this has greatly impacted life in the ocean and along its coasts (*very high confidence*)."[31]

Examples of ecological impacts attributable to climate change include loss of marine habitats such as coral reefs, seagrass beds, mangroves, and kelp forests; northward shifts and other changes in the geographic distribution of marine organisms; changes in food-chain dynamics, including reductions in upper-ocean nutrient concentration and declines in global phytoplankton biomass resulting in overall declines in marine biomass; population declines; and increased risk of species extirpations and extinctions.[32] In addition to long-term changes, marine heatwaves can trigger rapid and abrupt shifts in ecological conditions that can persist for years, including biodiversity loss and the collapse of regional fisheries.[33] Ecological risks are exacerbated by other human stressors, including pollution and overfishing, and will intensify with ongoing climate change.[34]

These changes have the potential to significantly affect fishery productivity, species composition, and carrying capacity.[35] Models suggest that climate change will cause a large-scale redistribution of global catch potential, with significant increases in high-latitude regions and decreases in low-latitude regions.[36] The overall loss of food production from fisheries may be even higher than potential losses from agriculture.[37] The magnitude of adverse impacts will scale with emissions—the IPCC predicts that warming, acidification, and business-as-usual fishing policies would place approximately 60% of global fisheries at very high risk under a high emissions scenario (Representative Concentration Pathway (RCP) 8.5).[38] The impacts and risks to U.S. fisheries have been extensively documented by scientific researchers and governmental agencies involved in fishery management.[39]

23. IPCC AR6 WGII, *supra* note 1, at 201.
24. *Id.*
25. *Id.* ch. 2.
26. NCA5, *supra* note 2, ch. 7.
27. *Id.* at 7-8.
28. *See* Susan J. Prichard et al., *Adapting Western North American Forests to Climate Change and Wildfires: 10 Common Questions*, 31 Ecological Applications e02433 (2021); Dominick A. DellaSala et al., *Have Western USA Fire Suppression and Megafire Active Management Approaches Become a Contemporary Sisyphus?*, 268 Biological Conservation 109499 (2022).
29. DellaSala et al., *supra* note 28.
30. IPCC AR6 WGI, *supra* note 1, ch. 3 ("Oceans and Coastal Ecosystems and Their Services").
31. *Id.* at 381.
32. *See, e.g.*, Malin L. Pinsky et al., *Climate-Driven Shifts in Marine Species Ranges: Scaling From Organisms to Communities*, 12 Ann. Rev. Marine Sci. 153 (2020); Minrui Huang et al., *The Impacts of Climate Change on Fish Growth: A Summary of Conducted Studies and Current Knowledge*, 121 Ecological Indicators 106976 (2021); Edward W. Tekwa et al., *Body Size and Food-Web Interactions Mediate Species Range Shifts Under Warming*, 289 Proc. Royal Soc'y B 20212755 (2022); IPCC AR6 WGI, *supra* note 1, ch. 3.
33. IPCC AR6 WGI, *supra* note 1, at 381. *See also* Tianyun Dong et al., *Record-Breaking 2023 Marine Heatwaves*, 389 Science 369 (2025).
34. For example, ecosystem models project declines in total marine animal biomass ranging from −5.7 ± 4.1% to −15.5 ± 8.5% under Shared Socioeconomic Pathway (SSP)1-2.6 and SSP5-8.5, respectively, by 2090-2099 (relative to 1995-2014). *See* IPCC AR6 WGI, *supra* note 1, at 382.
35. *See* IPCC, Climate Change 2023: Synthesis Report, Contribution of Working Groups I, II, and III to the Sixth Assessment Report of the IPCC fig.3.2(c2) (Hoesung Lee Lee & José Romero eds., 2023) [hereinafter IPCC AR6 Synthesis Report]; IPCC AR6 WGII, *supra* note 1, ch. 3; Phoebe A. Woodworth-Jefcoats et al., *Climate Change Is Projected to Reduce Carrying Capacity and Redistribute Species Richness in North Pacific Pelagic Marine Ecosystems*, 23 Glob. Change Biology 1000 (2017).
36. William Cheung et al., *Large-Scale Redistribution of Maximum Fisheries Catch Potential in the Global Ocean Under Climate Change*, 16 Glob. Change Biology 24 (2010).
37. Joshua E. Cinner et al., *Potential Impacts on Climate Change on Agriculture and Fisheries Production in 72 Tropical Coastal Communities*, 13 Nature Commc'ns art. 3530 (2022), https://www.nature.com/articles/s41467-022-30991-4.
38. IPCC AR6 WGI, *supra* note 1, at 460.
39. *See, e.g.*, NCA5, *supra* note 2 (identifying the many pathways through which climate change is affecting marine ecosystems, describing harmful effects on fisheries, noting that climate change has already played a major role in 18 major fishery disasters in Alaska); Susan E. Farady & Thomas E. Bigford, *Fisheries and Climate Change: Legal and Management Implications*, 44 Fisheries 270 (2019) (describing how climate change is affecting U.S. fisheries—for example, harvest species such as the American lobster and the black sea bass are migrating northwards, in some cases outside of their historical ranges and assigned fisheries); Lyall Bellquist et al., *The Rise in Climate Change-Induced Federal Fishery Disasters in the United States*, 9

3. Rangelands

Climate change affects rangelands through many of the same phenomena that affect forests. Some of the largest concerns for rangeland health include increases in heat, including extreme heat; changes in precipitation and stream flow; increases in aridity and drought; the spread of invasive plants and pathogens; and wildfires.[40] These phenomena can affect the quality of feed crops and forage, water availability, animal and milk production, livestock disease, animal reproduction, and biodiversity.[41] Livestock management practices can also affect carbon uptake and storage on rangelands, either causing a net increase or decrease in storage, depending on grazing practices and other environmental factors.[42]

NCA5 found that these climate-related factors, along with other human stressors, are already reducing the productivity and carrying capacity of U.S. rangelands.[43] For example, rangeland vegetation production has severely declined in some regions since the early 2000s, and the decreases are strongly correlated with regional-scale climate change exposure.[44] U.S rangelands are also affected by increasingly severe and frequent wildfires.[45]

4. Freshwater Resources

Climate change affects the hydrological cycle through changes in temperature, precipitation, humidity, aridity, soil moisture, snowpack and snowmelt, and extreme events, including storms, floods, and wildfires.[46] Sea-level rise and saltwater intrusion also can affect freshwater resources in coastal areas. These hydrological changes can alter both the supply and quality of freshwater resources in a number of ways—for example, by reducing stream flow (during dry conditions) or increasing runoff and turbidity (during wet conditions).[47] Generally speaking, climate models indicate that wet regions will likely become wetter and dry regions will likely become drier, and some regions may oscillate between drier and wetter periods.[48] The trajectory of hydrological changes is difficult to predict in some areas, such as the western United States.[49]

The hydrological effects of climate change have important implications for water supply as well as agriculture, flood protection, hydroelectric power, and other modes of energy production. Climate change is already contributing to water scarcity in some regions, due to drought and/or declines in glacial runoff and snowmelt.[50] IPCC AR6 expressed *high confidence* that water-related risks will increase with every degree of global warming, and between three and four billion people are projected to be exposed to physical water scarcity at 2 degrees Celsius (°C) and 4°C of global warming, respectively.[51]

B. Management Implications

These effects have important implications for the sustainable management and conservation of natural resources, public lands, and biodiversity.[52] There are several dimensions to this. First, climate change threatens to undermine the provision of ecosystem goods and services such as clean air, clean water, timber, fish, forage for cattle, and much more, and may necessitate changes in resource quotas, extractive uses, and other management decisions.

Second, unsustainable land use and natural resource management practices can adversely affect the health, resilience, and adaptive capacity of natural systems, rendering them more susceptible to harms associated with climate change.[53] Third, natural resource management decisions can exacerbate or mitigate climate change by affecting the balance of CO_2 and other GHGs in the atmosphere.[54] Finally, the disruptive effects of climate change raise serious questions about how resource managers can achieve goals related to resource conservation and environmental stewardship.

Government agencies and other natural resource managers need to account for these considerations when making decisions about land uses, resource allocations, conservation measures, and environmental protections. In particular, resource managers will need to consider what actions

PeerJ e11186 (2021) (documenting a rise in climate change-induced federal fishery disasters in the United States, with 60 of the 71 federally approved fishery disasters from 1989-2020 either partially or entirely attributable to extreme events such as marine heatwaves, hurricanes, and harmful algal blooms); Jonathan A. Hare et al., *A Vulnerability Assessment of Fish and Invertebrates to Climate Change on the Northeast U.S. Continental Shelf*, 11 PLOS One e0146756 (2016) (identifying many harvest, forage, and protected marine species that are vulnerable to the effects of climate change).

40. IPCC AR6 WGII, *supra* note 1, ch. 2; NCA5, *supra* note 2, ch. 6, ch. 11, chs. 24-27.
41. M. Melissa Rojas-Downing et al., *Climate Change and Livestock: Impacts, Adaptation, and Mitigation*, 16 Climate Risk Mgmt. 145 (2017).
42. *Id.*
43. NCA5, *supra* note 2, at 6-11.
44. *Id.* at A4-27 to A4-28.
45. *Id.* at F2-5.
46. IPCC AR6 WGII, *supra* note 1, ch. 4; NCA5, *supra* note 2, ch. 4.
47. IPCC AR6 WGII, *supra* note 1, ch. 4.
48. *Id.*
49. Climate models and studies indicate that climate change is causing more hydrological extremes in the western United States, and that higher temperatures will cause more evaporation, declines in snowpack, and reductions in summer stream flow; however, there is significant regional variation in hydrological impacts, uncertainty about future precipitation trends, and uncertainty about the severity and timing of overall hydrological changes. *See* Wei Zhang & Robert Gilles, *The Role of Anthropogenic Forcing in Western United States Hydroclimate Extremes*, 49 Geophysical Rsch. Letters e2022GL100659 (2022); Tim Barnett et al., *Human-Induced Changes in the Hydrology of the Western United States*, 319 Science 1080 (2008).
50. IPCC AR6 WGII, *supra* note 1, ch. 4.
51. *Id.* at 556.
52. In this Article, "natural resource management" refers to the management of natural landscapes and ecosystems (both terrestrial and aquatic), and constituent elements of those systems. This includes decisions about (1) the use and conservation of tangible resources (e.g., timber, water, fish, forage for cattle); (2) the maintenance and protection of ecosystem services (e.g., water filtration, flood protection); (3) the utilization of natural landscapes for other human values (e.g., cultural and recreational activities); and (4) the preservation and protection of ecosystems and biota (e.g., endangered species and their habitats), whether for anthropocentric or biocentric purposes.
53. IPCC AR6 WGI, *supra* note 1, at 12, ¶ B.2.1.
54. Some management decisions, such as those involving fossil fuel extraction or widespread deforestation, may generate GHGs on the order of millions of tons of carbon dioxide equivalent (CO_2e) or more. Ecosystem feedbacks, particularly those associated with the release of GHG emissions, also exacerbate the problem of climate change.

can be taken to enhance resilience and adaptive capacity—and reduce other human stressors—within managed ecosystems. There are many contexts where it may be necessary to curtail resource uses and extractive practices.

For example, fishery managers will need to consider whether and how to adjust fishery allocations to account for changes in the distribution and abundance of harvest species[55]; and whether closures, catch limits, and other measures are needed to address the combined effects of fishery operation and climate change on marine organisms and ecosystems.[56] Resource managers can also seek to enhance the resilience of ecosystems and organisms through habitat restoration and rewilding projects, creating climate refugia (e.g., through new habitat protections), and promoting habitat connectivity to accommodate species movement in response to shifting bioclimatic conditions.[57] Generally speaking, resource management may need to shift to a more proactive—rather than reactive—model for addressing and preventing harm associated with climate change.[58]

C. *Scientific Resources and Analytical Frameworks for Decisionmaking*

Decisionmakers frequently cite uncertainty as a primary impediment to climate action.[59] In particular, resource managers may believe that they cannot meaningfully address the effects of climate change if they do not have a clear sense of exactly how those effects will manifest in specific areas, within specific time frames.[60] Thus, the lack of downscaled and precise climate data is viewed as a barrier to adaptation. However, other commentators have argued that available data and research already provide actionable insights about how climate change is affecting natural systems, how these effects will influence management outcomes, and how managers can respond to these impacts.[61]

In many cases, even a general understanding of how climate change is affecting or may affect a region can provide meaningful insights for natural resource planning.[62] Ongoing scientific developments are also enabling more fine-tuned assessments of climate impacts. For example, as climate models are improving in accuracy, spatial resolution, and computational power, researchers are increasingly able to generate downscaled projections of climate impacts[63]; integrated modeling techniques are also being used to evaluate the interactions between climate, ecological, social, and economic systems[64]; and detection and attribution studies are providing new insights on the ways in which climate change is already affecting natural systems and lending greater confidence to projections of future impacts.[65] Moreover, many scientific resources have been developed with the explicit aim of supporting adaptation in natural resource sectors.[66] Researchers have also developed methodologies for estimating GHG emissions from land use changes and forestry actions.[67]

Granted, even with these scientific advances, resource managers will continue to encounter uncertainty about climate change and its implications for management actions.[68] This may be due to data and downscaling limitations (e.g., the resolution of models may be too coarse to capture the impact on the geographic and/or temporal scale of the management action). There are also situations where models may generate conflicting or divergent predictions of climate impacts, or may not capture the true

55. History and tradition play a major role in the management of U.S. fisheries. Access to fisheries is often based on past participation in fisheries, fishery allocations are based on historical allocations, and resource assessments often use historical baselines to predict future conditions. But reliance on historical baselines is becoming increasingly untenable due to changes in climatic conditions, ecological baselines, and species ranges. *See* Farady & Bigford, *supra* note 39.
56. For additional insights on how fishery management practices can mitigate climate change-related risks, see Steven D. Gaines et al., *Improved Fisheries Management Could Offset Many Negative Effects of Climate Change*, 4 Sci. Advances eaao1378 (2018).
57. *See* Turner et al., *supra* note 15; Paul R. Elsen, *Priorities for Embedding Ecological Integrity in Climate Adaptation Policy and Practice*, 6 One Earth 632 (2023); Toni L. Morelli, *Climate Change Refugia and Habitat Connectivity Promote Species Persistence*, 4 Climate Change Responses 8 (2017); Climate Change and Ecosystems: Threats, Opportunities, and Solutions, 375 Phil. Transactions Royal Soc'y B: Biological Scis. (Theme Issue) (Janet Franklin et al. eds., 2020).
58. *See, e.g.*, Bellquist et al., *supra* note 39 (describing the need for more proactive management of fisheries); Weiskopf et al., *supra* note 13 (finding that natural resource managers need proactive, flexible approaches to deal with changes).
59. *See* Daniel J. Murphy et al., *Understanding Perceptions of Climate Change Scenario Planning in United States Public Land Management Agencies*, 38 Soc'y & Nat. Res. 269 (2023).
60. *Id.*
61. *See, e.g.*, Camille Parmesan et al., *Beyond Climate Change Attribution in Conservation and Ecological Research*, 16 Ecological Effects Env't Change 58 (2013).
62. This is particularly true where decisionmakers are using adaptative management techniques and other iterative approaches for risk management. *See* Jessi Kershner et al., U.S. Geological Survey, Techniques and Methods 6-C2, Integrating Climate Change Considerations in Natural Resource Planning—An Implementation Guide (2020); Constance I. Millar et al., *Climate Change and Forests of the Future: Managing in the Face of Uncertainty*, 17 Ecological Applications 2145 (2007).
63. Climate modeling has also improved due to additional and longer observational data sets, and the development of new statistical approaches to better account for internal variability in the climate system. IPCC AR6 WGI, *supra* note 1, at 205.
64. *See, e.g.*, Anne Babcock Hollowed et al., *Integrated Modeling to Evaluate Climate Change Impacts on Coupled Social-Ecological Systems in Alaska*, 6 Frontiers in Marine Sci. 775 (2020).
65. In legal contexts, most discussions of attribution science focus on its utility in establishing "responsibility" or "liability" for climate damages. But attribution science can also inform risk assessment, management decisions, and adaptation planning. *See* National Academies of Science, Engineering, and Medicine, Attribution of Extreme Weather Events in the Context of Climate Change (2016); Luke J. Harrington et al., *Integrating Attribution With Adaptation for Unprecedented Future Heatwaves*, 172 Climatic Change 2 (2022).
66. *See, e.g.*, Hollowed et al., *supra* note 64.
67. *See, e.g.*, U.S. Forest Service, *Forest Vegetation Simulator*, https://www.fs.usda.gov/managing-land/forest-management/fvs (last visited Oct. 7, 2025); Food and Agriculture Organization of the United Nations, *Economic and Policy Analysis of Climate Change: The EX-ACT Tool*, https://www.fao.org/in-action/epic/ex-act-tool/suite-of-tools/ex-act/en/ (last visited Oct. 7, 2025); Local Governments for Sustainability USA, *LEARN Tool (Land Emissions and Removals Navigator)*, https://icleiusa.org/tools/learn-tool/ (last visited Oct. 7, 2025).
68. *See, e.g.*, Yadvinder Malhi et al., *Climate Change and Ecosystems: Threats, Opportunities, and Solutions*, 375 Phil. Transactions Royal Soc'y B: Biological Scis. 20190104 (2020) (recognizing the need for more research to understand the ecological dynamics of climate impacts, to identify hot spots of vulnerability and resilience, and to identify management interventions that may assist biosphere resilience to climate change).

probability distribution of an event, and where there is pervasive uncertainty about the complex interactions between climate change and ecological systems. Finally, there is inevitable uncertainty about future GHG emissions, land use decisions, climate policy responses, and other aspects of human behavior—which means that future climate change must be understood as a range of possible outcomes, rather than a single trajectory.

But uncertainty does not necessarily justify inaction. One could argue that uncertainty actually enhances risk and should therefore serve as an impetus for precautionary action. Moreover, uncertainty is omnipresent in planning and risk management, and there are analytical frameworks that can be used to make informed decisions even in the context of pervasive uncertainty.[69] These include "scenario planning" approaches where decisionmakers evaluate management outcomes under multiple potential future scenarios.

These approaches are especially useful when confronted with climate impacts for which there is not a clear trajectory (e.g., climate models suggest that hydrological conditions in the western United States may get wetter, drier, or something in between). Although the use of scenarios is well-developed in natural resource planning contexts,[70] and there has been a proliferation of guidance on how to use these tools for climate impact analysis, surveys suggest that there has been limited uptake of "scenarios" and "future planning" tools among U.S. public land management agencies.[71]

Resource managers can also address and mitigate uncertainty through monitoring and adaptive management approaches. Adaptive management is a structured, iterative process that involves designing and implementing actions based on available information, monitoring and evaluating the results, and adjusting course based on the acquired information. There was a significant push to incorporate adaptive management protocols into the planning protocols for federal lands, but these efforts have been subject to significant disruptions during the first and second Donald Trump Administrations.[72]

Finally, there is a common perception among policymakers and planners that more precise or accurate *quantitative* information about climate change is needed to reduce uncertainty and ultimately inform decisionmaking. However, some researchers have cautioned that this push for quantitative analyses may be counterproductive in the context of ecosystem management and conservation, since it is difficult or impossible to quantify all of the ecological effects of climate change, and there is a clear risk to delaying action.[73] Moreover, qualitative research does provide actionable insights on ecosystem impacts, and there are many adaptation measures that can be implemented based on current understanding of those impacts.[74] At the same time, there are some contexts where quantitative information may be useful or even essential to decisionmaking.[75]

II. Legal Context

Most of the cases surveyed for this Article involved claims arising under U.S. federal law, so that is the focus of this discussion. The sections below describe key elements of the federal legal framework for natural resource management, which consists of (1) the core management statutes that govern the administration of public lands and resources; (2) other environmental and wildlife protection laws; and (3) laws that govern administrative decisionmaking and judicial review of federal agency actions. Some U.S. states have enacted similar laws for resource management and environmental protection, which served as the basis for state-law claims in the surveyed litigation.[76]

A. *Management Statutes*

The federal government is responsible for managing natural resources on approximately 640 million acres of federally owned land, most of which is located in the western United States.[77] There are four land management agencies that administer the majority of these lands: the Bureau of Land Management (BLM) manages 244 million acres of "public lands," the U.S. Forest Service (USFS) manages 193 million acres in the National Forest System (NFS), the U.S. Fish and Wildlife Service (FWS) manages 89 million acres in the National Wildlife Refuge System, and the National Park Service manages 80 million acres in the National Park System.[78] The federal government also has jurisdiction over approximately 3.4 million square nautical miles of federal waters located within the U.S. exclusive

69. It is important to recognize that uncertainty is not unique to the field of climate science. Uncertainty exists across all scientific disciplines—dealing with uncertainty is part of the scientific process—and there are standard techniques for reducing, managing, and communicating uncertainty and ensuring the validity of research findings. *See* Anne Marthe van der Bles et al., *Communicating Uncertainty About Facts, Numbers, and Science*, 6 Royal Soc'y Open Sci. 181870 (2019).
70. Shelley D. Crausbay et al., *A Science Agenda to Inform Natural Resource Management Decisions in an Era of Ecological Transformation*, 71 BioScience 71 (2022).
71. Murphy et al., *supra* note 59.
72. Most recently, federal agencies rescinded their climate action plans and adaptive management programs pursuant to President Trump's Executive Order No. 14148 (Jan. 28, 2025).
73. Parmesan et al., *supra* note 61.
74. *Id.*
75. For example, quantitative data on climate impacts may be useful when setting fishery catch limits, water allocations, or any other quantified resource allocation.
76. The legal strategies discussed herein could also be adapted to non-U.S. jurisdictions where governments also have obligations related to the sustainable use and conservation of natural resources (often rooted in human rights law). There are already some major decisions recognizing the connection between government obligations related to natural resource stewardship and climate change mitigation and adaptation. *See, e.g.*, Corte Suprema de Justicia [C.S.J.] [Supreme Court], abril 5, 2018, L. Villabona, Radicación 11001-22-03-000-2018-00319-01 (Colom.) (*Future Generations v. Ministry of the Environment*).
77. This is approximately 28% of the total land area of the United States. Laura B. Comay et al., Congressional Research Service, IF10585, The Federal Land Management Agencies (2024).
78. *Id.*; Carol Hardy Vincent et al., Congressional Research Service, R42346, Federal Land Ownership: Overview and Data (2020).

economic zone (EEZ).[79] Marine resources are managed by the National Marine Fisheries Service (NMFS) and the Bureau of Ocean Energy Management.[80]

Most federal lands and waters are managed under laws that seek to balance use and conservation objectives. For example, the Federal Land Policy and Management Act (FLPMA) and the National Forest Management Act (NFMA) specify that public lands and national forests must be managed in accordance with the principles of "multiple use" and "sustained yield."[81] Pursuant to these mandates, BLM and USFS must provide for productive use of federal lands in a manner that will best serve the public interest without impairing the productivity or future use of the land.[82] Permitted uses may include, for example, timber production, grazing, energy development, and recreation. The principle of "sustained yield" requires that extractive activities and other uses do not exceed the regenerative capacities of the underlying ecosystem.[83]

FLPMA and NFMA also establish the procedures that BLM and NMFS must follow when managing public lands and national forests.[84] For example, both agencies must conduct periodic resource assessments in order to evaluate the health and status of land units under their jurisdiction, and must periodically develop and revise management plans that specify the overall management objectives and allowed uses for each land unit.[85]

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) establishes a similar framework for the sustainable management of marine fisheries in federal waters.[86] The MSA is administered by NMFS, with assistance from eight regional fishery management councils comprising representatives from state governments and the fishing industry.[87] The councils are responsible for preparing and revising fishery management plans; NMFS is responsible for reviewing and approving plans and ensuring that they comply with federal law. These management plans must include conservation and management measures to prevent overfishing, rebuild overfished stocks, and "protect, restore, and promote the long-term health and stability of the fishery" while also "achieving, on a continuing basis, the optimum yield from each fishery."[88] The MSA also provides for the designation and protection of "essential fish habitat," which is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity."[89]

Notably, the MSA explicitly requires that fishery conservation and management decisions must be "based upon the best scientific information available."[90] FLPMA and NFMA do not contain similar statutory provisions, but USFS and BLM have promulgated criteria for science-based decisionmaking as part of the implementing regulations for those statutes.[91] It is not clear whether these science-based decisionmaking mandates have a significant effect on agency practice or judicial review.[92]

Some federal lands and waters are governed primarily for conservation purposes, and are not subject to multiple use mandates. These include the National Wildlife Refuge System, the National Park System, federally designated wilderness areas, and other protected areas.[93] Recreational and cultural uses may be permitted in these areas, but extractive uses are either prohibited or significantly restricted.

For example, the Wilderness Act authorizes the use of wilderness areas for "recreational, scenic, scientific, educational, conservation, and historical use," but requires that wilderness areas be preserved in their "natural condition" and prohibits commercial enterprises, permanent roads, use of motorized vehicles, and the installation of structures in these areas.[94] These laws are not the focus of this Article, as they have not yet been a major focus in climate litigation, but legal disputes may arise in the future regarding agency obligations to assess and respond to climate impacts in these areas.

79. Specifically, the federal government has jurisdiction over marine resources that extends from the seaward boundary of state coastal waters up to the edge of the U.S. EEZ (200 nautical miles offshore). State waters extend three miles offshore for most states, and nine nautical miles for Texas, western Florida, and Puerto Rico. *See* Magnuson-Stevens Fishery Conservation and Management Act (MSA), 16 U.S.C. §1856; Submerged Lands Act, 43 U.S.C. §1301(a)(2).
80. *See* MSA, 16 U.S.C. §§1801 et seq. (granting the Secretary of Commerce authority over fishery management in federal waters); Outer Continental Shelf Lands Act, 43 U.S.C. §§1331 et seq. (granting the Secretary of the Interior authority over mineral leasing and wind development on the outer continental shelf).
81. *See* NFMA of 1976, as amended, 16 U.S.C. §1601(3), (5); FLPMA of 1976, as amended, 43 U.S.C. §1701(a)(7); Multiple-Use Sustained-Yield Act of 1960, 16 U.S.C. §§528 et seq.
82. *See* 16 U.S.C. §531(a), (b); 43 U.S.C. §1702(c), (h).
83. 16 U.S.C. §531(b); 43 U.S.C. §1702(h). The sustainable use mandates are complemented by other provisions for environmental protection and conservation. For example, FLPMA declares a policy that "public lands be managed in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values," that will "preserve and protect certain public lands in their natural condition," and that will provide "food and habitat for fish and wildlife" (43 U.S.C. §1701(a)(8)), and requires BLM to "take any action necessary to prevent unnecessary or undue degradation" of lands under its jurisdiction (43 U.S.C. §1732(b)).
84. *See* 16 U.S.C. §§1600-1605; 43 U.S.C. §§1711-1712.
85. *See, e.g.*, 16 U.S.C. §§1603, 1604(f); 43 U.S.C. §§1711, 1712.
86. MSA, *amended by* the Sustainable Fisheries Act of 1996, 16 U.S.C. §§1851 et seq.
87. 16 U.S.C. §1852.
88. *Id.* §§1851(a)(1), 1853(a)(1)(A). Under the MSA, "optimum yield" is defined as the amount of fish that (1) will provide the "greatest overall benefit" with respect to food production and recreation, while also accounting for the protection of marine ecosystems; (2) is prescribed on the basis of maximum sustained yield from the fishery, as reduced by any relevant economic, social, or ecological factor; and (3) allows for the rebuilding of stocks in overfished fisheries. *Id.* §1802(33). NMFS regulations define "maximum sustainable yield" as the "largest long-term average catch that can be taken from a stock under prevailing environmental and fishery conditions" (50 C.F.R. §600.310(e)(i)(A)) and contain detailed instructions on how to calculate maximum sustainable and optimum yields (50 C.F.R. §600.310).
89. 16 U.S.C. §1802(10).
90. *Id.* §1851(a)(2). *See also id.* §§1801(c)(3), 1865(a), 1881d(c) (reiterating goals and policies to use the "best scientific information available").
91. *See* 36 C.F.R. §219.3 ("best available science" requirement for national forests); 43 C.F.R. §§6103.1.2(d), 6103.2 ("high-quality information" requirement for public lands).
92. *See infra* Part III.
93. *See, e.g.*, 16 U.S.C. §668dd(a)(2); 54 U.S.C. §100101(a); 16 U.S.C. §1131.
94. 16 U.S.C. §1133(b), (c).

B. Wildlife Protection Laws

The Endangered Species Act (ESA) establishes additional requirements for the conservation and protection of threatened and endangered species that apply across all federal land and resource management decisions.[95] Federal agencies must ensure that their actions will not jeopardize the continued existence of species listed as endangered or threatened.[96] This is accomplished through a consultation process with FWS and/or NMFS that involves evaluating the effects of federal actions on listed species and undertaking mitigation, where necessary, to avoid jeopardy.[97] Federal agencies must use the "best scientific and commercial data available" when fulfilling these requirements.[98]

Federal land management actions often trigger ESA consultation requirements due to the prevalence of endangered species on federal lands and waters, and many of the cases surveyed for this Article included ESA claims. Federal management actions also occasionally trigger requirements under other federal wildlife laws, most notably the Marine Mammal Protection Act (MMPA) for fishery management decisions.[99]

C. Environmental Impact Assessment

The National Environmental Policy Act (NEPA) establishes an overarching federal policy of environmental protection, as well as cross-cutting requirements for environmental impact assessment of major federal actions.[100] The statute requires agencies to prepare a detailed environmental impact statement (EIS) for major federal actions that may significantly affect the environment describing, inter alia, (1) the "reasonably foreseeable environmental effects" of the proposed agency action, including any "reasonably foreseeable adverse effects that cannot be avoided should the proposal be implemented"; and (2) a "reasonable range of alternatives to the proposed agency action" that are "technically and economically feasible" and "meet the purpose and need of the proposal" as well as a "no action" alternative.[101] If an agency is unsure about whether the action will have significant environmental effects, it may prepare a more concise environmental assessment (EA) to evaluate potential impacts, which will either result in a finding of no significant impact (FONSI) or a full EIS.[102]

NEPA has served as an important complement to natural resource and wildlife protection laws by ensuring that agencies take a "hard look" at environmental impacts and opportunities to mitigate those impacts.[103] The implementing regulations issued by the Council on Environmental Quality were particularly important for this purpose, as they established uniform guidelines on how federal agencies should conduct this analysis, and helped inform judicial review of agency obligations under NEPA.

Unfortunately, the regulations were rescinded by the Trump Administration in 2025,[104] following a U.S. Court of Appeals for the District of Columbia (D.C.) Circuit decision holding that the regulations were ultra vires because they lacked explicit statutory authorization.[105] NEPA's core requirements are still in place, but it is unclear how courts will interpret these requirements in the absence of uniform regulatory standards. Further adding to this uncertainty is the U.S. Supreme Court's May 2025 decision in *Seven County Infrastructure Coalition v. Eagle County*, which introduced a new "substantial deference" standard for judicial review of NEPA claims, as discussed below.[106]

D. Other Environmental Laws

Natural resource managers must also ensure that their actions comply with other environmental laws such as the Clean Air Act and the Clean Water Act (CWA). For example, USFS must ensure that the emissions from controlled burns and mechanical thinning on NFS lands will conform to national and state air quality standards,[107] and water management projects must comply with CWA requirements for water pollution and dredge and fill work.[108]

E. Administrative Procedure Act and Standards for Judicial Review

The Administrative Procedure Act (APA) governs federal agency actions and judicial review of those actions. It sets forth requirements for federal agencies to provide adequate notice and opportunities for public participation in decisionmaking (e.g., through "notice and comment" procedures for rulemaking).[109] Importantly, the notice-and-comment procedures provide opportunities for civil society to submit scientific information for inclusion on the administrative record. This becomes part of the body of evidence that the agency must consider when making its final decision, and judicial review of agency actions is generally limited to this "record evidence."[110]

95. *Id.* ch. 35, §§1531 et seq.
96. *Id.* §1536(a)(2).
97. *Id.* §1536(a)-(c).
98. *Id.* §1536(a)(2).
99. The MMPA prohibits the taking (harassment, injury, or killing) of marine mammals unless exempted or specifically permitted pursuant to procedures set forth in the statute and implementing regulations. *See id.* §1362; 50 C.F.R. §216.3.
100. 42 U.S.C. §§4321 et seq.
101. *Id.* §4332(C).
102. Agencies may also designate categorical exclusions for categories of action that are unlikely to have significant effects.
103. Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 350 (1989).
104. Exec. Order No. 14154, 90 Fed. Reg. 8353 (Jan. 29, 2025); Removal of National Environmental Policy Act Implementing Regulations: Interim Final Rule, 90 Fed. Reg. 10610 (Feb. 25, 2025).
105. Marin Audubon Soc'y v. Federal Aviation Admin., 121 F.4th 902 (D.C. Cir. 2024).
106. *See infra* Section II.E.
107. 40 C.F.R. pt. 93, subpt. B, Determining Conformity of General Federal Actions to State or Federal Implementation Plans.
108. *See, e.g.*, 33 U.S.C. §1344 (requiring permits and establishing requirements for dredge and fill activities).
109. 5 U.S.C. §553.
110. Fed. R. App. P. 28.

The APA directs courts to "compel agency action unlawfully withheld or unreasonably delayed" (§706(1)), and to "hold unlawful and set aside" agency actions, findings, and conclusions if they are "arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with the law" (§706(2)).[111] Under the "arbitrary and capricious" standard, a court must determine whether the agency's decision was based on a consideration of "relevant factors," whether the agency has articulated a "satisfactory explanation" for its decisions, including a "rational connection between the facts found and the choice made," or whether the agency has made a "clear error of judgment."[112]

A court may not substitute its judgment for that of the agency, and should afford deference to matters within the agency's expertise.[113] However, a court may find that an action is arbitrary and capricious if the agency

> relied on factors which Congress has not intended it to consider, entirely failed to consider an important aspect of the problem, offered an explanation for its decision that runs counter to the evidence before the agency, or is so implausible that it could not be ascribed to a difference in view or the product of agency expertise.[114]

Thus, courts must strike a careful balance between deference and scrutiny when reviewing agency actions. Courts tend to be more deferential when reviewing agencies' technical and scientific determinations, particularly where those determinations fall within the scope of an agency's subject matter expertise.[115] However, standards of deference are notoriously murky, and the application of these standards can vary significantly across cases, as illustrated in the litigation surveyed here.

These standards are also evolving, with one notable development being the Supreme Court's decision to overrule the *Chevron*[116] deference doctrine in *Loper Bright Enterprises v. Raimondo*.[117] The *Loper Bright* decision marks a major change in judicial review under the APA, holding that courts must exercise their "independent judgment" in questions of statutory interpretation, but it is unclear whether or to what extent the decision may affect judicial review of agencies' scientific and technical findings.[118]

The Supreme Court's more recent decision in *Seven County Infrastructure Coalition v. Eagle County* may have more immediate implications for judicial review of actions implicating an agency's technical expertise. There, the Court held that agencies are entitled to "substantial deference" when making decisions about the scope and content of an EIS—although it is unclear exactly how this differs from the standards of deference that have governed past NEPA litigation.[119] The *Seven County* decision also reiterated the principle that agencies need only consider environmental information in an EIS that is relevant and useful to the decisionmaking process.[120] Accordingly, an agency's obligations under NEPA depend on the nature of the action and the substantive laws governing that action (e.g., FLPMA or NFMA).

Finally, it is important to note that some resource management decisions are not subject to judicial review under the APA. In particular, the Supreme Court's decisions in *Lujan v. National Wildlife Federation*, *Ohio Forestry Ass'n v. Sierra Club*, and *Norton v. Southern Utah Wilderness Alliance* significantly narrowed the opportunities for judicial enforcement of federal land management statutes by holding that broad agency programs, collections of actions, and certain types of planning documents do not qualify as "agency action" within the meaning of the APA.[121]

For an action to be subject to judicial review under APA §706(2), it must be a final action that entails specific commitments (e.g., authorizing or prohibiting specific activities

111. 5 U.S.C. §706(1), (2). The APA also lists other factors for setting aside agency action, such as if the action is "in excess of statutory jurisdiction" or "without observance of procedure required by law." A different test—the "substantial evidence" standard of review—is required for formal rulemaking and formal adjudication, but the vast majority of administrative actions are reviewed under the "arbitrary and capricious" standard. *Id.* §706(2)(E). The failure to address material public comments is also grounds for invalidation. *Id.* §553(c).

112. Motor Vehicle Mfrs. Ass'n of U.S., Inc. v. State Farm Mut. Auto. Ins. Co., 463 U.S. 29, 43 (1983); Citizens to Preserve Overton Park, Inc. v. Volpe, 401 U.S. 402, 416 (1971).

113. *Motor Vehicle Mfrs. Ass'n*, 463 U.S. at 43; *Citizens to Preserve Overton Park*, 401 U.S. at 416.

114. *Motor Vehicle Mfrs. Ass'n*, 463 U.S. at 43.

115. *See* Baltimore Gas & Elec. Co. v. Natural Res. Def. Council, Inc., 462 U.S. 87, 103 (1983) (courts should be at their "most deferential" when an agency is "making predictions, within its area of special expertise, at the frontiers of science").

116. Chevron, U.S.A., Inc. v. Natural Res. Def. Council, Inc., 467 U.S. 837 (1984).

117. The question before the Supreme Court in *Loper Bright* was whether NMFS was entitled to deference in its interpretation of the MSA, specifically its determination that it had statutory authority to require industry-funded fishery monitoring beyond three circumstances explicitly enumerated in the statute. NMFS argued that it had this authority pursuant to MSA provisions generally authorizing it to prescribe measures "as necessary and appropriate" for fishery conservation and management, and specifically authorizing requirements that vessels carry onboard observers.

The D.C. Circuit held that the statute was ambiguous and NMFS was entitled to deference for its interpretation. The Supreme Court reversed, holding that *Chevron* deference was inconsistent with the APA, which directs the reviewing court "to decide all relevant questions of law" and to "interpret . . . statutory provisions." Loper Bright Enters. v. Raimondo, 603 U.S. 369, 411 (2024).

118. The majority recognized a distinction between the legal question at issue in *Loper Bright* and factual questions implicating an agency's "subject matter expertise," but it also suggested that judicial deference may not be warranted even in the context of technical or factual determinations. *Id.* at 373-74.

119. Seven Cnty. Infrastructure Coal. v. Eagle County, 605 U.S. ___ (2025). *See also* Jessica Wentz, Seven County Infrastructure Coalition: *The Supreme Court's "Substantial Deference" Standard and Implications for Judicial Review Under NEPA*, Climate L. Blog (July 2, 2025), https://blogs.law.columbia.edu/climatechange/2025/07/02/seven-county-infrastructure-coalition-the-supreme-courts-substantial-deference-standard-and-implications-for-judicial-review-under-nepa/.

120. *See Seven Cnty.*, 605 U.S. at ___ ("inherent in NEPA . . . is a 'rule of reason,' which ensures that agencies determine whether and to what extent to prepare an EIS based on the usefulness of any new potential information to the decisonmaking process") (quoting Dep't of Transp. v. Pub. Citizen, 541 U.S. 752, 767 (2004)).

121. Norton v. Southern Utah Wilderness All., 542 U.S. 55 (2004); Ohio Forestry Ass'n v. Sierra Club, 523 U.S. 726 (1998); Lujan v. National Wildlife Fed'n, 497 U.S. 871 (1990). For more in-depth discussion of this topic, see Michael Blumm & Sherry L. Bosse, Norton v. SUWA *and the Unraveling of Federal Public Land Planning*, 18 Duke Env't L. & Pol'y F. 105 (2007).

within a land unit).[122] Alternatively, if the plaintiff is seeking to "compel agency action unlawfully withheld or unreasonably delayed" under APA §706(1), the claim must focus on a "discrete action" that the agency is legally required to take.[123] Thus, claims arising under federal land and resource management statutes typically involve relatively discrete actions, such as timber harvests or decisions about catch limits, and the technical findings underpinning those actions.

Table 1. Overview of Legal Decisions and Claims Implicating Climate Science

Management Area	Total# Decisions	Fed	State	Type of Claim				Winner		
				Mgmt	Wildlife	EIA	Other	Agency	Plaintiff	N/A
Fisheries	12	12	0	4	8	1	0	5	7	0
Forests	25	23	2	17	5	23	0	17	4	4
Rangelands	6	6	0	6	2	5	0	3	2	1
Water	10	8	4	1	5	6	1	3	7	0
All	**53**	**49**	**6**	**28**	**20**	**35**	**1**	**28**	**20**	**5**

Note: See Appendix, for a complete list of cases.

III. Survey of U.S. Litigation

A. *Overview of Cases and Claims*

The litigation survey consisted of 53 cases decided between 2007 and 2024, featuring disputes about how natural resource managers should respond to evidence of climate and ecological change in decisions involving fisheries, forests, rangelands, and freshwater resources.[124] Almost all of the cases were "conservation-oriented" (i.e., conservation groups were suing government agencies for inadequate consideration of climate change and the ways in which the management action might exacerbate or otherwise contribute to ecological stress in the context of climate change). There were only two cases where plaintiffs were motivated by "use goals," both of which entailed challenges to fishery management decisions.[125]

The cases included a variety of claims arising under federal and state management statutes, environmental review laws, and wildlife protection laws, and one arising under the CWA (see Table 1). The majority were federal-law claims involving public lands and fishery management; there were only six state-law claims. All cases were governed by APA standards of review or comparable state standards for judicial review of administrative actions. Accordingly, judicial review was deferential and generally limited to record evidence. There were 48 decisions that ultimately addressed claims related to climate change and/or environmental change.[126] Courts deferred to agencies in 28 of those decisions (~58%) and remanded for further analysis of climate change in 20 decisions (~42%).

The scientific disputes generally focused on the validity of agency findings about "uncertain" or "insignificant" climate change impacts. There were several early cases where agencies had essentially ignored climate change.[127] However, most cases involved situations where agencies had conducted a preliminary assessment of climate impacts and concluded that: (1) there was too much uncertainty to gain actionable insights about climate change and its implications for the management action; (2) climate change would not significantly affect environmental conditions within the management area during the time frame for the proposed action (e.g., 10 or 20 years); or (3) the management action would not have a meaningful impact on climate change or climate change-related stressors within the management area.[128]

Plaintiffs challenged these findings on the grounds that the agency had erroneously disregarded relevant scientific information (e.g., climate model results) or reached an irrational conclusion in light of that information. Many of these challenges raised questions about the credibility and reliability of specific scientific resource and data sets, and whether they can generate meaningful insights for resource managers.[129] Plaintiffs also frequently challenged agency

122. *See Lujan,* 497 U.S. at 873 ("agency action is not ordinarily considered 'ripe' for judicial review under the APA until the scope of the controversy has been reduced to manageable proportions, and its factual components fleshed out, by concrete action that harms or threatens to harm the complainant"); *Ohio Forestry,* 523 U.S. at 733 (holding that management plan provisions were not subject to judicial review because they did not "command" any particular action, "grant, withhold, or modify any formal legal license, power, or authority," and did not create new legal rights, obligations, or liabilities).

123. *Norton*, 542 U.S. at 55.

124. The cases selected for this survey featured claims related to climate science, climate impacts, GHG emissions, climate adaptation, and ecological change related to climate change. The cases were identified through the Sabin Center for Climate Change Law's Climate Litigation Database, https://climatecasechart.com (last visited Oct. 7, 2025), and the Westlaw database. The Appendix lists all of the surveyed cases, categorized by management area, and accompanied by brief descriptions of how courts addressed climate change-related claims.

125. *See* New York v. Raimondo, 594 F. Supp. 3d 588 (S.D.N.Y. 2022), *aff'd*, 84 F.4th 102 (2d Cir. 2023); Maine Lobstermen's Ass'n, Inc. v. National Marine Fisheries Serv., 626 F. Supp. 3d 46 (D.D.C. 2022), *rev'd and remanded sub nom*. Maine Lobstermen's Ass'n v. National Marine Fisheries Serv., 70 F.4th 582 (D.C. Cir. 2023).

126. In the remaining five cases, courts did not reach the climate-related claims because they found that the claims had been waived, or the claims were a minor part of the plaintiffs' overall arguments and not essential to resolution of the case. *See* Alliance for the Wild Rockies v. Pena, No. 2:16-CV-294-RMP, 2018 WL 4760503, at *16 (E.D. Wash. Oct. 2, 2018); Monroe Cnty. Bd. of Comm'rs v. U.S. Forest Serv., 595 F. Supp. 3d 713 (S.D. Ind. 2022); Cascadia Wildlands v. U.S. Bureau of Land Mgmt., No. 6:23-cv-01358 (D. Or. July 18, 2024); Klamath Forest All. v. U.S. Forest Serv., No. 3:23-cv-03601 (N.D. Cal. Aug. 23, 2024); Oregon Nat. Desert Ass'n v. Bushue, 644 F. Supp. 3d 813, 823 (D. Or. 2022).

127. *See infra* Section IV.A.1.

128. *See infra* Section IV.A.1-3.

129. *See, e.g.*, County of Butte v. Department of Water Res., 90 Cal. App. 5th 147 (Cal. Ct. App. 2023), *as modified on denial of reh'g* (May 1, 2023), *review denied* (June 28, 2023) (plaintiffs alleged that scientific findings in the administrative record contradicted the California Department of Water Resources' finding that the future effects of climate change on water resources were too speculative to warrant further analysis); League of Wilderness

decisions to use historical conditions when framing the environmental baseline for impact analysis, as this did not reflect how conditions would change—and had already changed—for the duration of the management action.[130]

The cases also implicated broader questions about how natural resource management agencies should respond to climate change across different types of management actions, specifically:

(1) Sustainable use: How is climate change influencing the carrying capacity, productivity, and other attributes of natural systems that are managed for extractive uses (e.g., fisheries, timber harvests, freshwater resources), what implications does this have for the "sustainable yield" from these systems, and has the resource manager adequately accounted for climate impacts in resource assessments, quotas, and allocations?

(2) Management and conservation goals: Will climate change interfere with the attainment of management and conservation objectives (e.g., goals related to ecosystem health, wildfire risk reduction, and water management), and has the resource manager accounted for these impacts?

(3) Impacts on protected species: How is climate change affecting endangered or threatened species that are present in the management area, will the project exacerbate risks associated with climate change, and is there a need for mitigation to avoid jeopardy to the species?

(4) GHG emissions and carbon sequestration: Will management actions contribute to climate change through GHG emissions and changes in carbon sequestration, and has the resource manager adequately considered these impacts?

In most cases, plaintiffs relied on a combination of legal authorities when raising these issues. NEPA claims were frequently brought in conjunction with substantive claims under management statutes and wildfire protection laws. Many of the claims involved "best available science" mandates, but it was unclear whether or to what degree these mandates actually influenced the adjudication and outcome of cases.[131] It appeared that the general rules for administrative decisionmaking, paired with other substantive and procedural mandates, provided a similar basis for recognizing agency obligations related to science-based decisionmaking.[132]

B. *Judicial Standards for Climate Impact Assessment*

In essentially all of the cases, courts recognized that climate change had implications for management decisions, and agencies therefore had obligations to account for climate change in scientific assessments and other aspects of decisionmaking.[133] At the same time, courts recognized that agencies were entitled to deference, particularly with regard to technical determinations that fell within their expertise. Thus, courts had to strike a balance between deference and scrutiny—and there was considerable variation in how courts approached this balancing act.[134] In some cases, courts deferred to agencies with little or no analysis; in others, courts conducted a probing inquiry of record evidence to assess the validity of the agency's technical and scientific conclusions.[135]

Despite this variation, the decisions did converge on some overarching legal principles for agency engagement with climate science. These principles applied across different types of legal claims, including those arising under the ESA, NEPA, and resource management statutes, as well as federal and state claims, although the specific language used to describe these concepts varied depending on the underlying law.

First, agencies cannot ignore or cursorily dismiss the effects of climate change as "too uncertain" without any scientific assessment or justification.[136] Agencies should make a good-faith effort to understand how climate change may affect environmental conditions within the management area, whether the action may contribute to climate change, and corresponding implications for the management action and its environmental outcomes.[137]

Defs.-Blue Mountains Biodiversity Project v. Martin, No. 2:10-CV-1346-BR, 2011 WL 2493765 (D. Or. June 23, 2011) (plaintiffs alleged USFS had improperly ignored scientific studies indicating that proposed forest thinning would result in greater carbon emissions than would occur from a wildfire).

130. *See infra* Section IV.A.1-2.

131. Other authors have found that judicial review under "best available science" mandates is essentially the same as judicial review under the APA, and have called for more judicial oversight of agency adherence to these mandates (i.e., the presence of such mandates should trigger heightened judicial scrutiny). *See, e.g.*, Dennis D. Murphy & Paul S. Weiland, *Guidance on the Use of Best Available Science Under the U.S. Endangered Species Act*, 58 Env't Mgmt. 1 (2016); Elizabeth Kuhn, *Science and Deference: The "Best Available Science" Mandate Is a Fiction in the Ninth Circuit*, Env't L. Rev. Syndicate (Oct. 21, 2016), https://nyuelj.org/2016/10/science-and-difference-the-best-available-science-mandate-is-a-fiction-in-the-ninth-circuit/.

132. *See, e.g.*, Save the Colo. v. Semonite, No. 18-CV-03258-CMA, 2024 WL 4519201 (D. Colo. Oct. 16, 2024).

133. These legal standards include "best available science" requirements, NEPA's "hard look" requirement, and more general principles for administrative decisionmaking (i.e., agencies must make a "rational" decision based on "all relevant factors").

134. For additional insights on the different levels of deference applied to climate science claims, see Daniel Kim et al., *Judicial Review of Scientific Uncertainty in Climate Change Lawsuits: Deferential and Nondeferential Evaluation of Agency Factual and Policy Determinations*, 46 Harv. Env't L. Rev. 367 (2022) (finding that courts did not defer to agency findings where there was irrationality in agency reasoning, incomplete analysis of record science, evidentiary shortcomings, or end result-oriented reasoning).

135. See *infra* Section IV.A, for further discussion of specific decisions.

136. *See, e.g.*, Natural Res. Def. Council v. Kempthorne, 506 F. Supp. 2d 322 (E.D. Cal. 2007); Pacific Coast Fed'n of Fishermen's Ass'ns v. Gutierrez, 606 F. Supp. 2d 1122 (E.D. Cal. 2008); South Yuba River Citizens League v. National Marine Fisheries Serv., 723 F. Supp. 2d 1247 (E.D. Cal. 2010).

137. *See, e.g.*, Oceana, Inc. v. Ross, No. CV 15-0555 (PLF), 2020 WL 5995125 (D.D.C. Oct. 9, 2020); Wishtoyo Found. v. United Water Conservation Dist., No. CV163869DOCPLAX, 2018 WL 6265099 (C.D. Cal. Sept. 23,

Second, agencies have an obligation to use available scientific information to characterize, and where possible resolve, uncertainty about climate change.[138] Agencies must also strive for neutrality in their scientific assessments, and should not adopt assumptions that arbitrarily inflate or minimize climate change-related risks.[139] Accordingly, courts may remand actions if the agency fails to utilize "credible" or "scientifically accepted" tools for resolving uncertainty, where the agency's conclusions are not supported by record evidence, or where there is apparent bias in the agency's assessment of climate impacts. At the same time, courts afford considerable deference to agency conclusions about the credibility and weight of evidence, particularly where these conclusions fall within the scope of the agency's subject matter expertise.

Third, if an agency finds that effects of climate change are foreseeable and relevant to the decision at hand, then the agency should make an effort to account for those effects in relevant portions of its analysis.[140] It is not enough for the agency to merely discuss climate change in an isolated section of an EIS or planning document—the agency should use this information to inform its decisionmaking process.[141] However, the agency's obligation in this context is largely dependent on the availability of scientific data and analytical tools to facilitate its assessment of climate change and implications for the management action. Courts may defer to agency determinations that climate impacts are "too speculative" to warrant further analysis if the agency cannot reliably characterize or predict those impacts using climate models or other available tools.[142]

Finally, agencies do not generally have obligations to conduct new studies or generate new data to support decisionmaking, except where this is explicitly required by statute.[143] This is true even where "best available science" mandates apply—agencies must utilize the best "available" data, not the "best possible scientific data."[144] Accordingly, the agency does not have an obligation to compile a perfect body of scientific evidence in support of its decision, but rather its obligation is to identify and review available evidence.[145]

Importantly, this standard cuts both ways. The agency is not required to amass a perfect record, but it also cannot set the bar of proof too high and require an unreasonable level of certainty in its scientific assessment. For example, even if the agency has limited confidence in specific pieces of evidence, it cannot ignore the aggregate effect of the evidence (e.g., where many low-quality data sources point to the same conclusion).[146]

C. *Evolution of Legal and Scientific Claims*

There were some noticeable developments in the litigation between 2007 and 2024. Whereas early cases involved situations where agencies had wholly ignored climate change or its implications for management actions, later cases involved more complex disputes about, for example, whether it is possible to accurately assess and predict specific impacts in specific locations, and how those impacts may influence management and conservation outcomes.

This was largely due to changes in the underlying administrative records—agencies started conducting more in-depth assessments of climate impacts, and compiling more detailed scientific records, with civil society also playing a major role in the development of those records (e.g., through submission of scientific evidence).[147] The existence of a more detailed scientific record can cut both ways in any given case (i.e., it can support the government's defense that it has adequately reviewed climate impacts,[148] but can

2018), *aff'd*, 795 F. App'x 541 (9th Cir. 2020); Oceana, Inc. v. Pritzker, 125 F. Supp. 3d 232 (D.D.C. 2015); *South Yuba River Citizens League*, 723 F. Supp. 2d at 1274.

138. *See* Maine Lobstermen's Ass'n v. National Marine Fisheries Serv., 70 F.4th 582 (D.C. Cir. 2023).

139. *Id.*; Turtle Island Restoration Network v. U.S. Dep't of Com., 878 F.3d 725 (9th Cir. 2017).

140. *See, e.g.*, Western Watersheds Project v. McKay, No. 22-35706, 2023 WL 7042541 (9th Cir. Oct. 26, 2023); Center for Biological Diversity v. U.S. Forest Serv., 687 F. Supp. 3d 1053 (D. Mont. 2023), *aff'd in part, rev'd in part and remanded*, No. 23-2882, 2025 WL 586358 (9th Cir. Feb. 24, 2025); *Oceana*, 2020 WL 5995125; *South Yuba River Citizens League*, 723 F. Supp. 2d at 1274.

141. *See, e.g.*, AquAlliance v. U.S. Bureau of Reclamation, 287 F. Supp. 3d 969 (E.D. Cal. 2018); Save the Colo. v. Semonite, No. 18-CV-03258-CMA, 2024 WL 4519201 (D. Colo. Oct. 16, 2024); *South Yuba River Citizens League*, 723 F. Supp. 2d 1247; *Wishtoyo Found.*, 2018 WL 6265099.

142. *See, e.g.*, Save the Colo. v. U.S. Dep't of the Interior, No. CV-19-08285-PCT-MTL, 2022 WL 18859975 (D. Ariz. Dec. 23, 2022), *aff'd*, No. 23-15247, 2024 WL 1756103 (9th Cir. Apr. 24, 2024); County of Butte v. Department of Water Res., 90 Cal. App. 5th 147 (Cal. Ct. App. 2023), *as modified on denial of reh'g* (May 1, 2023), *review denied* (June 28, 2023); WaterWatch of Or., Inc. v. Water Res. Dep't, 527 P.3d 1 (Or. Ct. App.), *review denied*, 534 P.3d 1076 (Or. 2023).

143. For example, the MSA and implementing regulations outline requirements for fishery monitoring and data collection, scientific research, stock assessments, and maximum and optimal sustained yield determinations. These include, for example, requirements that observers be stationed on vessels to collect data necessary for "conservation, management, and scientific understanding of fishery conditions." 50 C.F.R. §600.506.

144. *See, e.g.*, Massachusetts v. Pritzker, 10 F. Supp. 3d 208, 217 (D. Mass. 2014) (NMFS "must utilize the best scientific data *available*, not the best scientific data *possible*"); New York v. Raimondo, 594 F. Supp. 3d 588 (S.D.N.Y. 2022), *aff'd*, 84 F.4th 102 (2d Cir. 2023) (same); San Luis & Delta-Mendota Water Auth. v. Locke, 776 F.3d 971, 995 (9th Cir. 2014) ("best available science" standard does not require an agency to conduct new tests or make decisions on data that do not yet exist); Building Indus. Ass'n of Superior Cal. v. Norton, 247 F.3d 1241, 1246 (D.C. Cir. 2001) (agency must utilize the best "available" science, not the best "possible" science); San Luis & Delta-Mendota Water Auth. v. Jewell, 747 F.3d 581, 602 (9th Cir. 2014) ("[T]he 'best scientific . . . data available,'" does not mean "the best scientific data possible.").

145. See cases cited *supra* note 144.

146. *See, e.g.*, Oceana, Inc. v. Ross (*Oceana I*), No. 16-CV-06784-LHK, 2018 WL 1989575 (N.D. Cal. Jan. 18, 2018), *enforcement granted*, 359 F. Supp. 3d 821 (N.D. Cal. 2019).

147. Other studies have generated similar findings. *See*, *e.g.*, Crausbay et al., *supra* note 70 (finding that the climate analyses that underlie natural resource management decisions are increasingly sophisticated).

148. *See, e.g.*, Defenders of Wildlife v. U.S. Forest Serv., 94 F.4th 1210 (10th Cir. 2024); WaterWatch of Or., Inc. v. Water Res. Dep't, 527 P.3d 1 (Or. Ct. App.), *review denied*, 534 P.3d 1076 (Or. 2023); Oceana, Inc. v. Pritzker, 75 F. Supp. 3d 469 (D.D.C. 2014); Center for Biological Diversity v. National Marine Fisheries Serv., 977 F. Supp. 2d 55, 64 (D.P.R. 2013), *as amended* (Oct. 23, 2013), *adhered to on reconsideration*, 191 F. Supp. 3d 157 (D.P.R. 2016); Save the Colo. v. U.S. Dep't of the Interior, No. CV-19-08285-PCT-MTL, 2022 WL 18859975 (D. Ariz. Dec. 23, 2022), *aff'd*, No. 23-15247, 2024 WL 1756103 (9th Cir. Apr. 24, 2024).

also provide a more detailed foundation for scrutinizing and identifying problems in an agency's analysis.[149])

There are several factors that may explain the trend toward more sophisticated discussions of climate science in legal and administrative dockets. First, the effects of climate change are growing in scope and severity, with significant changes already occurring in many natural systems. Second, these effects are now better understood and have been thoroughly documented in IPCC assessments, NCA reports, and other scientific literature—resulting in greater awareness of the importance of climate change adaptation in the natural resource management sector.

Third, there are ongoing advances in the scientific tools and data that can be used to assess climate change impacts in the context of natural resource management actions. Fourth, judicial recognition of agency obligations related to climate impact assessment has likely influenced agency practice in this area. Finally, as noted above, civil society members (e.g., environmental groups and scientific organizations) have used comment periods and other public participation opportunities to ensure that relevant scientific information is included in the administrative record and therefore part of the agency's decisionmaking process.

Thus, there is reason to think that scientific advances and legal advocacy efforts have been somewhat successful in driving more meaningful engagement with climate science in natural resource decisionmaking.

IV. Insights on Scientific Claims and Case Outcomes

The cases surveyed for this Article provide useful insights on how courts engage with scientific claims and how litigants can craft persuasive arguments about climate science and its implications for natural resource management actions.[150] This part begins with a detailed discussion of key cases—specifically those involving in-depth scientific discussions—and how courts resolved disputes related to (1) the effects of climate change within management areas; (2) the potential for adverse impacts on ecosystems and biota (e.g., from the additive impacts of climate change and the management action); (3) the effect of management actions on carbon storage, wildfire risk, and GHG emissions; and (4) the requirement for neutrality in scientific assessment.

The part concludes with some additional insights on how judicial review may differ depending on the nature of the contested management action or scientific determination, and the circumstances in which courts may use extra-record evidence and testimony to manage scientific complexity in record review cases.

A. *Analysis of Key Cases and Decisions*

Although many of the scientific claims in these cases were governed by the same overarching legal standards, there was considerable variation in how courts applied these standards. Case outcomes were largely dependent on contextual factors, including the nature of the contested action, the framing of legal arguments, the availability of record evidence to support those arguments, and the level of deference (or scrutiny) applied to government findings. Thus, most of the insights in this section are drawn from an analysis of how contextual factors influenced the adjudication of specific cases. However, there were some cross-cutting trends that are worth noting at the outset of this discussion.

Generally speaking, it appeared that the more scrutiny that judges applied to scientific disputes, the more likely they were to remand the action for further assessment of climate change and related considerations. This may suggest that deeper judicial engagement with climate science led to more positive outcomes for climate action,[151] or it may be that judges engaged more with the science when confronted with stronger claims and clear evidence of agency error (i.e., the underlying facts and arguments advanced in the case may be what ultimately drove judicial engagement and case outcomes).

As discussed above, courts consistently recognized that climate change was a relevant consideration for management actions and that agencies had obligations to account for changing environmental baselines in their assessments. But in more than half of the cases (~58%), courts found that agencies had satisfied their obligations. When courts remanded cases for further assessment of climate change, it was typically because the agency had arbitrarily overlooked or failed to engage with credible scientific information that provided actionable insights about the effects of climate change within the management area.

Beginning with some of the earliest cases in the survey, courts recognized that climate models were credible and scientifically accepted methods for resolving uncertainty about the effects of climate change.[152] Courts did not explicitly hold that agencies *must* use climate models, since that would violate norms of deference, but courts

149. *See, e.g.*, Save the Colo. v. Semonite, No. 18-CV-03258-CMA, 2024 WL 4519201 (D. Colo. Oct. 16, 2024); Wishtoyo Found. v. United Water Conservation Dist., No. CV163869DOCPLAX, 2018 WL 6265099 (C.D. Cal. Sept. 23, 2018), *aff'd*, 795 F. App'x 541 (9th Cir. 2020); Oceana, Inc. v. Ross, No. CV 15-0555 (PLF), 2020 WL 5995125 (D.D.C. Oct. 9, 2020); AquAlliance v. U.S. Bureau of Reclamation, 287 F. Supp. 3d 969 (E.D. Cal. 2018).

150. This discussion focuses on plaintiffs' experiences and perspectives due to the nature of the surveyed cases. But some of these insights are also relevant to future litigation where agencies are defending climate science and actions taken in response to climate change against legal challenges (e.g., where plaintiffs argue that climate change impacts are too speculative to justify an action). *See, e.g.*, Utah v. Haaland, No. 2:24-cv-00438 (D. Utah filed June 18, 2024), stay granted Feb. 3, 2025 (consolidated lawsuit filed by state plaintiffs challenging BLM's "Conservation and Landscape Health" rule, stayed following the change in administration, while the Trump Administration reevaluates the rule and determines how to proceed).

151. *See* John M. Doherty et al., *Assessing Science-Based Decision-Making in US Climate Change Lawsuits*, 37 J. Env't L. 117 (2025) (finding that high levels of judicial engagement with science tend to correlate with "positive" climate outcomes (i.e., outcomes that favor further analysis of or actions to address climate impacts)).

152. *See infra* Section IV.A.1.

did consistently remand actions when agencies ignored or arbitrarily dismissed the results of climate models—thus sending a strong signal to agencies about the importance of using these tools to support decisionmaking. This was a key issue in cases involving water management projects, as discussed below.

In many cases, courts also confronted questions about climate change that could not be resolved through the use of climate models—for example, questions about the effects of climate change on ecological systems and biota, and questions about how to quantify emissions associated with changes in carbon storage. Courts tended to be more deferential to agency findings about the "uncertain" or "speculative" nature of those impacts, because there was no consensus regarding the best available tools for resolving uncertainties.[153] There were some more recent decisions where courts applied closer scrutiny to these types of claims and ultimately remanded for further analysis, but it was unclear whether this was part of a broader trend or related to advances in the underlying science.[154]

To overcome judicial deference, plaintiffs needed to make clear and targeted arguments about how the agency erred in its analysis or conclusions, and what the agency should have done differently, specifically in reference to scientific evidence in the administrative record. Courts were not responsive to more general challenges (e.g., "the agency should have considered [X]") unless the agency had wholly ignored the contested issue. There were a few cases where plaintiffs were allowed to supplement the record with additional evidence or expert testimony, but this was only permitted where expert testimony was necessary to clarify technical issues for the courts.[155] This underscores the importance of participating in administrative decisionmaking processes to ensure that relevant scientific evidence is included on the record.

The potential magnitude of the contested impacts (i.e., from climate change or from the management action) also had important implications for case outcomes. Courts were more likely to uphold cursory analyses of climate change when the agency claimed that the impacts would be "insignificant" or "minor," and there was no record evidence that clearly contradicted this conclusion.[156] This is consistent with the principle that agencies should assess impacts in accordance with their significance and relevance to the decision. There are also specific statutory requirements related to magnitude—for example, NEPA's requirement that agencies prepare an EIS to evaluate "significant" environmental effects, and the ESA requirement that agencies ensure their actions will not jeopardize the continued existence of endangered and threatened species.

153. *See infra* Section IV.A.2-3.

154. *See, e.g.*, Center for Biological Diversity v. U.S. Forest Serv., 687 F. Supp. 3d 1053 (D. Mont. 2023), *aff'd in part, rev'd in part and remanded,* No. 23-2882, 2025 WL 586358 (9th Cir. Feb. 24, 2025).

155. *See infra* Section IV.C.

156. *See, e.g.*, carbon sequestration cases discussed *infra* Section IV.A.3.

1. Effects of Climate Change in Management Areas

As detailed above, many of the surveyed cases centered on the validity of agency findings that the effects of climate change within the management area were "too speculative" to meaningfully inform the agency's decisionmaking process. As a result, agencies were defining the environmental baselines for management actions in reference to historical conditions—sometimes using decades-old data—thus ignoring both current and future effects of climate change. In these cases, courts typically remanded actions when agencies ignored evidence of climate impacts, or failed to use available scientific tools, including climate models, to resolve uncertainty about those impacts.[157] Courts were more likely to defer to agencies when the record indicated that the agency had at least *considered* relevant information about climate change,[158] but there were limits to that deference, as discussed below.

The earliest decision on this issue, *Natural Resources Defense Council v. Kempthorne*, involved a 2005 biological opinion (BiOp) for two large water diversion projects in California and their impact on the threatened Delta smelt.[159] Although the BiOp briefly discussed climate change, it did not evaluate the potential effect of different climate change scenarios on Delta hydrology, project operations, or the Delta smelt.[160] The Natural Resources Defense Council and other organizations submitted public comments on the BiOp, pointing out that there were "at least half a dozen models" that could be used to assess these impacts, including "sophisticated regional climate models" that indicated that predicted hydrological changes would likely exacerbate the effects of the water diversion projects on fish and their habitat.[161]

Nonetheless, FWS maintained that the effects of climate change on Delta hydrology were too speculative to analyze, and instead assumed that meteorological and hydrologi-

157. Save the Colo. v. Semonite, No. 18-CV-03258-CMA, 2024 WL 4519201 (D. Colo. Oct. 16, 2024); Western Watersheds Project v. Bernhardt, 392 F. Supp. 3d 1225, 1253-54 (D. Or. 2019); WaterWatch of Or., Inc. v. Water Res. Dep't, 527 P.3d 1 (Or. Ct. App.), *review denied,* 534 P.3d 1076 (Or. 2023); Klamath Siskiyou Wildlands Ctr. v. U.S. Fish & Wildlife Serv., No. 1:21-CV-00058-CL, 2022 WL 856035 (D. Or. Mar. 23, 2022); Pacific Coast Fed'n of Fishermen's Ass'ns v. Gutierrez, 606 F. Supp. 2d 1122, 1145 (E.D. Cal. 2008); Center for Biological Diversity v. Salazar, 804 F. Supp. 2d 987, 1008 (D. Ariz. 2011); AquAlliance v. U.S. Bureau of Reclamation, 287 F. Supp. 3d 969 (E.D. Cal. 2018).

158. *See, e.g.*, Save the Colo. v. U.S. Dep't of the Interior, No. CV-19-08285-PCT-MTL, 2022 WL 18859975 (D. Ariz. Dec. 23, 2022), *aff'd*, No. 23-15247, 2024 WL 1756103 (9th Cir. Apr. 24, 2024); Oceana, Inc. v. Pritzker, 75 F. Supp. 3d 469 (D.D.C. 2014); Oceana, Inc. v. Ross, No. CV 12-0041 (PLF), 2020 WL 5834832 (D.D.C. Oct. 1, 2020); Center for Biological Diversity v. National Marine Fisheries Serv., 977 F. Supp. 2d 55, 64 (D.P.R. 2013), *as amended* (Oct. 23, 2013), *adhered to on reconsideration*, 191 F. Supp. 3d 157 (D.P.R. 2016); County of Butte v. Department of Water Res., 90 Cal. App. 5th 147 (Cal. Ct. App. 2023), *as modified on denial of reh'g* (May 1, 2023), *review denied* (June 28, 2023).

159. 506 F. Supp. 2d 322 (E.D. Cal. 2007). The two projects, the federally managed Central Valley Project and the state of California's State Water Project, were among the largest water diversion projects in the world at that time.

160. *Id.* at 369.

161. *Id.* at 367-68.

cal conditions would follow historical patterns.[162] The court held that FWS had acted arbitrarily and capriciously, as the available evidence suggested that climate change had important implications for FWS' jeopardy analysis, "but the issue was not meaningfully discussed in the [BiOp], making it impossible to determine whether the information was rationally discounted because of its inconclusive nature, or arbitrarily ignored."[163]

Following *Kempthorne*, courts were fairly consistent in remanding actions where agencies failed to use climate models or otherwise ignored evidence of climate impacts.[164] However, as time progressed, it became increasingly common for courts to confront situations where agencies did consider available climate data—including model results—but nonetheless concluded that they could not reach meaningful conclusions about the effects of climate change (e.g., due to a lack of precision, accuracy, reliability, or consistency across models). Those cases tend to raise more nuanced questions about whether the agency had gone "far enough" in its assessment of climate change and its implications for the management action.

This issue is best illustrated in subsequent cases involving water management projects. The survey included 10 cases where plaintiffs challenged federal and state agencies for inadequate consideration of climate change in permitting decisions for dams, reservoirs, and water transfer projects. Courts remanded actions to agencies for further analysis of climate change in seven of these ten cases (including *Kempthorne*).

Of the remaining three cases, there were two decisions where courts upheld agency decisions to utilize historical data in some aspects of their hydrological analysis because the agencies had made an effort to account for future changes in stream flow and temperature caused by climate change.[165] There was only one decision where a court upheld an agency's conclusion that future hydrological impacts were too speculative to quantify or model,[166] and that case involved an EIS that was published in 2008, so judicial review was limited to the information available to the agency at that time.[167]

One noteworthy aspect of the water management cases is that courts consistently recognized that agencies had obligations to evaluate—and even quantify—hydrological impacts, despite the existence of pervasive uncertainty about those effects. For example, in *AquAlliance v. U.S. Bureau of Reclamation*, a federal district court in California remanded an EIS for a 10-year water transfer program after finding that the Bureau of Reclamation had not incorporated climate change scenarios into its hydrological modeling.[168] The EIS included a general discussion of climate change impacts, including temperature and precipitation projections, and potential changes in precipitation and runoff.[169] The EIS also acknowledged projected decreases in snowpack and stream flow (e.g., climate models suggested that statewide snowpack water equivalent would decrease 16% by 2035, as compared to a 1971-2000 baseline).[170]

Despite this information, the EIS maintained that the effects of climate change on the project would be "minimal" during the project's 10-year duration, and used hydrological data from 1922-2003 to evaluate the effects of the project on water supplies.[171] The Bureau of Reclamation argued that its reliance on a historical baseline was justified because precipitation models suggested that there would not be significant changes in reservoir inflows *on an annual basis*.[172] The court disagreed, finding that the Bureau had overlooked the "critical" importance of seasonal (or intra-annual) changes in temperature, snowpack, precipitation, and stream flow (e.g., there was record evidence indicating that reduced snowpack and earlier snowmelt would potentially result in a decrease in inflows during peak irrigation periods of June, July, and August).[173]

The court also rejected the Bureau's argument that the projected 16% decrease in snowpack was a "worst case scenario." Although the projection was based on a high emissions scenario, the court found that this was not a "worst case" scenario because actual CO_2 emissions in recent years were even higher than those used in the scenario.[174] Accordingly, the court held that the conclusion of "minimal" impacts from climate change was incompatible with the model data suggesting a 16% decrease in snowpack by 2035.[175] In reaching this decision, the court noted that the Bureau was not necessarily required to use any particular

162. FWS specifically used 72 years of historical data to project hydrological conditions for the 20-year duration of the project. Id. at 368.
163. *Id.* at 369.
164. *See, e.g.,* Pacific Coast Fed'n of Fishermen's Ass'ns v. Gutierrez, 606 F. Supp. 2d 1122 (E.D. Cal. 2008); South Yuba River Citizens League v. National Marine Fisheries Serv., 723 F. Supp. 2d 1247 (E.D. Cal. 2010); Center for Biological Diversity v. Salazar, 804 F. Supp. 2d 987 (D. Ariz. 2011).
165. WaterWatch of Or., Inc. v. Water Res. Dep't, 527 P.3d 1 (Or. Ct. App.), *review denied*, 534 P.3d 1076 (Or. 2023) (holding that Oregon Water Resources Department had adequately considered the effects of climate change on stream flow and temperature when issuing permits for municipal water diversions, that it was reasonable to use historical data in projections of future water use, and that the Department was entitled to deference in its decision not to incorporate a summer curtailment provision into the water permits); Save the Colo. v. U.S. Dep't of the Interior, No. CV-19-08285-PCT-MTL, 2022 WL 18859975 (D. Ariz. Dec. 23, 2022), *aff'd*, No. 23-15247, 2024 WL 1756103 (9th Cir. Apr. 24, 2024) (holding that the U.S. Department of the Interior (DOI) had adequately considered the effects of climate change in its analysis of the Glen Canyon Dam water release plan, and that it was reasonable for DOI to use historical hydrological data in conjunction with predictions of future hydrological impacts to determine how project alternatives would fare under climate change).
166. County of Butte v. Department of Water Res., 90 Cal. App. 5th 147 (Cal. Ct. App. 2023), *as modified on denial of reh'g* (May 1, 2023), *review denied* (June 28, 2023) (upholding an environmental impact report for relicensing of the Oroville Dam and deferring to the California Department of Water Resources' determination that future changes in hydrology were too speculative to study because climate models drew opposite conclusions as to whether conditions would get wetter or drier).
167. *Id.* at 161-62. For comparison, the EISs at issue in *AquAlliance* and *Save the Colorado* were published in 2015 and 2017, respectively.
168. 287 F. Supp. 3d 969 (E.D. Cal. 2018).
169. *Id.* at 1029.
170. *Id.* at 1031.
171. *Id.* at 1032.
172. *Id.* at 1029.
173. *Id.*
174. *Id.* at 1030.
175. *Id.* at 1024 ("one cannot escape the obvious deduction that snow water equivalent is likely to decline by some (possibly significant) fraction of 16 percent by the end of the Proposed Action in 2024").

climate model, but it did have an obligation to consider climate information in a "meaningful" and "logical" way.[176]

A federal district court in Colorado issued a similar holding in *Save the Colorado v. Semonite*.[177] That case involved a dredge and fill permit issued by the U.S. Army Corps of Engineers (the Corps) for expansion of the Gross Dam and Reservoir in Colorado. The plaintiffs alleged that the Corps had breached its obligations under NEPA as well as the CWA, because it had not adequately assessed the effects of climate change on the operation of the dam. This was the only case in the survey that featured a CWA claim—specifically, that the Corps had not demonstrated that this project was the "least environmentally damaging practicable alternative" (LEDPA), a requirement for §404 dredge and fill permits.[178]

The Corps prepared an EIS that acknowledged climate change could reduce inflows to the dam, potentially resulting in the need for "additional replacement sources [of water] to ensure an adequate supply."[179] The U.S. Environmental Protection Agency (EPA), Boulder County, and other commenters urged the Corps to include a quantitative scenario analysis of hydrological changes, as well as a more in-depth analysis of implications for the project—and, in particular, the possibility that there would be no new water for the enlarged dam to impound.[180] Commenters also offered peer-reviewed methods for predicting climate change-induced changes in stream flow, the majority of which "all but guarantee[d] at least a 15-30% reduction in stream flows."[181] Nonetheless, the Corps insisted that there was "no accepted scientific method" for quantifying the effects of climate change on stream flow and reservoir levels.[182]

The court found that the Corps' "refusal to provide even an estimate on future hydrology [was] indefensible, an abject violation of NEPA," and that the Corps had an obligation to consider hypothetical scenarios in which future climate conditions would prevent the project from achieving its purpose.[183] The court further found the Corps could not support its determination that the project was the LEDPA for supplying water in the region without accounting for projected decreases in stream flow, and that the Corps had breached its obligations under the CWA as well as NEPA.[184]

In reaching this decision, the court underscored the inconsistencies in the Corps' discussion of scientific uncertainty. It noted that the Corps was "more than willing to account for uncertainty" in other areas of its analysis,[185] found that the Corps' "conspicuous inability to find a sufficient climate precipitation estimation model is questionable in light of the Bureau of Reclamation's ability to produce climate precipitation estimates," and emphasized that the nature of the project made it "absolutely critical to at least explore whether increased aridity due to climate change will undermine the construction project's capacity to store water."[186] The court also expressly rejected the assertion that the Corps need not quantify future hydrological scenarios because climate models suggested both increases and decreases in precipitation.[187]

One important takeaway from *Save the Colorado* and *AquAlliance* is that both decisions were based almost entirely on scientific evidence that had been submitted by environmental organizations and other entities during the public comment period for the respective EISs. This underscores the importance of civil society contributions to the scientific records for these actions. This was a recurring theme in the cases.

2. Impacts on Ecosystems and Biota

The foregoing discussion provides insights on how courts may interpret agency obligations to evaluate and predict changes in climatological and physical variables, such as temperature, precipitation, snowmelt, and stream flow. This is only the first step of the climate impact analysis for most natural resource management decisions. It is typically also necessary for agencies to consider (1) how changes in local climatological and physical conditions will affect ecological conditions and biota within the management area, and (2) whether the management action will exacerbate (or mitigate) any adverse effects of climate change. These questions often arise in the context of ESA jeopardy determinations, but agencies also need to consider these issues when assessing whether actions are consistent with sustainable use and conservation objectives.

There are tools available for forecasting ecological impacts attributable to climate change, but there is no clear judicial consensus on what qualifies as the "best available science" (or "scientifically accepted" techniques) for characterizing impacts and resolving uncertainties in this context.[188]

176. *Id.* at 1031.
177. No. 18-CV-03258-CMA, 2024 WL 4519201, at *7 (D. Colo. Oct. 16, 2024). The district court issued an order permanently enjoining enlargement of the Gross Reservoir and temporarily enjoining further construction of the Gross Dam, but subsequently vacated the temporary injunction on dam construction after the U.S. Court of Appeals for the Tenth Circuit issued a stay of that injunction and a hearing was held on dam safety. *See* Save the Colo. v. Semonite, No. 18-CV-03258-CMA, 2025 WL 999941 (Apr. 3, 2025), *vacated in part,* No. 18-CV-03258-CMA, 2025 WL 1546970 (D. Colo. May 29, 2025).
178. *Save the Colo.*, 2024 WL 4519201, at *24. *See also* §404(b)(1) guidelines, 40 C.F.R. §230.10(a).
179. *Save the Colo.*, 2024 WL 4519201, at *25.
180. For example, EPA explained that climate change could significantly diminish water availability at some times in the year due to earlier snowmelt and volume of stream flows lost to evapotranspiration. *Id.* at *8.
181. *Id.* at *11.
182. *Id.* at *7, *10.
183. *Id.* at *25, *32.
184. *Id.* at *24-25 (finding that the Corps' omission proved "fatal" to the LEDPA finding because climate change might impair or eliminate the dam's value as a water storage solution).
185. *Id.* at *26. *See also id.* at *32.
186. *Id.* at *32.
187. *Id.*
188. Major assessments like the IPCC and NCA reports address ecosystem impacts, but not necessarily at the level of detail that is needed to inform management actions, and there are additional layers of uncertainty when assessing and modeling ecosystem impacts as compared with, for example, purely physical impacts.

Accordingly, courts are more likely to defer to agencies' analytical choices (e.g., what evidence is relevant and credible) and conclusions about the foreseeability or significance of ecological impacts associated with climate change.[189]

These issues are illustrated in a series of cases involving fishery management decisions and ESA jeopardy determinations. The key questions in these cases were (1) whether NMFS adequately characterized the baseline threat of climate change to the species, and (2) whether NMFS had adequately assessed the additional contribution of the proposed management action to the baseline risk of extinction (i.e., would the action contribute to, exacerbate, or mitigate the baseline risk). The outcome of these cases was largely dependent on the framing of scientific arguments and the availability of record evidence to support those arguments.

In the two cases where litigants prevailed with arguments calling for greater assessment of climate risk, it was because they could point to specific evidence of how climate change was affecting sea turtles within the fishery area during the operational time frame of the proposed management plan. Thus, these cases underscore the utility of having scientific information at an appropriate temporal and geographic scale to support both agency decisionmaking and legal advocacy.

The first of these cases (the *Sea Scallop BiOp* case) involved NMFS' 2012 BiOp and "no jeopardy" determination for the operation of the Atlantic sea scallop fishery and its effect on the Northwest Atlantic population segment of the loggerhead sea turtle.[190] The court found that NMFS had adequately reviewed climate science and had determined that data were too inconclusive to provide a basis for accurate predictions regarding impacts on loggerheads. It noted that this case could be distinguished from those involving "wholesale failures to even address the issue," because NMFS had offered qualitative predictions based on available data.[191] However, NMFS had concluded that the available science only enabled it to offer predictions at a "general, qualitative, and relatively speculative level," and, in the court's view, the plaintiff had not explained how climate change-related data might have been more thoroughly evaluated with respect to the jeopardy analysis.[192]

The second decision (the *Seven Fisheries BiOp* case) involved NMFS' 2013 BiOp and "no jeopardy" determination for the operation of seven North Atlantic fisheries and their effect on the loggerhead turtle. Again, the court found NMFS had adequately explained that it lacked the ability to issue detailed long-term projections of climate change-related risks to the loggerhead ("the agency did address long-term effects, yet found them to be too indeterminate to yield clearly articulable conclusions") and that the plaintiff "had not pointed to relevant data that was ignored, nor [had] it explained how NMFS might have more thoroughly analyzed or modeled the available data."[193]

However, the plaintiff also advanced an argument that was not included in the *Sea Scallop BiOp* case—specifically, that NMFS had failed to consider *short-term* climate risks because it used a "century scale" framework for its climate impact assessment.[194] The court agreed with the plaintiff on this issue, finding that NMFS had failed to assess threats on an appropriate timescale despite "clear evidence [in the BiOp] that these impacts will persist or accelerate in the immediately approaching decades."[195]

On remand, NMFS prepared a revised BiOp and an explanatory memorandum with additional analysis of short-term climate effects. NMFS again concluded that climate change would not significantly affect loggerhead turtles in the action area during the 10-year period of fishery operation, because the projected increases in temperature and sea-level rise in that period were relatively minor. NMFS acknowledged that there were "hot spot" areas of rapid sea-level rise and coastal erosion that did pose a major threat to sea turtle nesting, but NMFS asserted that this was primarily occurring north of the loggerhead's current range, and NMFS believed that the northward migration of loggerheads would likely occur on longer timescales than 10 years. Based on these justifications, the court upheld NMFS' revised BiOp.[196]

The manner in which NMFS addressed short-term climate impacts in the remanded BiOp underscores a recurring problem with climate impact assessments: when agencies only focus on predicted changes for the project duration (e.g., 10 or 20 years), they may conclude that impacts and corresponding ecological risks are relatively minor without considering the broader context. In particular, the agency is ignoring the climatological and ecological changes that have already occurred, as well as future changes after the project ends, both of which are relevant when considering how management actions affect ecosystems and biota. This is one example of how agencies may underestimate (or segment) climate impacts in their assessments.

What if the agency finds that the baseline risk of extinction is already high due to climate change? How should an

189. *See, e.g.*, Defenders of Wildlife v. U.S. Forest Serv., 94 F.4th 1210, 1224 (10th Cir. 2024) (deferring to FWS' judgment that it was unnecessary to discuss climate-related risks to the Canada lynx in a BiOp for a forest management plan because there was "no reliable information indicating a substantial reduction of the current distribution and abundance of" lynx in the project area as compared with "historical conditions").

190. Oceana, Inc. v. Pritzker, 75 F. Supp. 3d 469 (D.D.C. 2014).

191. *Id.* at 492. For example, the BiOp acknowledged that

> increasing sand temperatures at nesting beaches which in turn would result in increased female:male sex ratio among hatchlings, sea level rise which could result in reduction in available nesting beach habitat, increased risk of nest inundation, and changes in the abundance and distribution of forage species which could result in changes in the foraging behavior and distribution of sea turtle species.

Id.

192. *Id.* at 492-93.

193. Oceana, Inc. v. Pritzker, 125 F. Supp. 3d 232, 251 (D.D.C. 2015).

194. *Id.*

195. In particular, the BiOp acknowledged that warming of approximately 0.2°C (0.4 degrees Fahrenheit (°F)) per decade was projected for the next two decades, and that the magnitude and frequency of ecosystem changes would likely increase in the next 25 to 50 years, and it was possible that changes would accelerate. For example, the BiOp noted that, even in the short term, sea-level rise was expected to "result in increased erosion rates along nesting beaches," including within a "620-mile 'hot spot' along the East Coast . . . rising three to four times faster than the global average." *Id.* at 252.

196. Oceana, Inc. v. Ross, No. CV 12-0041 (PLF), 2020 WL 5834832, at *5 (D.D.C. Oct. 1, 2020).

agency assess jeopardy in that context? Courts have also confronted this question in the context of fishery management actions. The first was a lawsuit involving NMFS' 2011 BiOp and "no jeopardy" determination for the operation of the Caribbean fishery and effects on protected coral species (the *Caribbean Fishery BiOp* case).[197] The BiOp acknowledged that climate-related threats, including temperature-induced bleaching, were some of the greatest threats to the corals—these threats were characterized as "severe, unpredictable, likely to increase in the foreseeable future, and, at current levels of knowledge, unmanageable."[198]

In contrast, the BiOp characterized the adverse effects of fishery operations as having "only a small incremental role" in jeopardizing the corals' continued existence.[199] The BiOp recognized that the harvest of herbivorous fish (as authorized by the fishery plan) would likely exacerbate a phase shift to algae-dominated reefs, but concluded this was not a "major stressor" and it was not clear whether even a complete prohibition on fishing would prevent the algae growth.[200] The U.S. District Court for the District of Puerto Rico found that NMFS had adequately considered the synergistic effects of fish harvest along with climate-induced stressors, and that it was entitled to deference in its risk determination.[201]

The *Caribbean Fishery BiOp* decision can be contrasted with a more recent ruling from the U.S. Court of Appeals for the Ninth Circuit in *Turtle Island Restoration Network v. U.S. Department of Commerce*.[202] The *Turtle Island* case involved NMFS' 2012 BiOp for the operation of the shallow-set (swordfish) fishery off the coast of Hawaii and effects on loggerhead and leatherback sea turtles. There were two issues raised in that case that are relevant to this discussion.

First, the plaintiffs challenged NMFS' failure to incorporate quantitative climate change projections into its jeopardy analysis. The BiOp included a qualitative discussion of how climate change was affecting sea turtles (e.g., through rising temperatures, rising sea levels, beach erosion-increased storm activity, and changes in ocean temperatures and chemistry) and potential impacts on nesting habits, gender ratios, reproductive capacity, and other species attributes; however, NMFS had concluded that it lacked tools to quantify the effect of climate change on sea turtle populations, and therefore could not incorporate this into the population model it used to assess the risk of jeopardy.

Second, the plaintiffs argued that NMFS had arbitrarily minimized the threat posed by the action by framing it as a relatively minor contribution to a very large baseline risk of extinction. NMFS' population model showed a significant decline in loggerhead numbers even without the proposed action (99.5% of tests showed the loggerhead falling below the quasi-extinction threshold within 24 models).[203] When the action was incorporated into the model, the additional loss from the proposed action ranged from 4% to 11% for loggerheads.[204] Based on these results, NMFS determined that it did not "believe that the small effect posed by the lethal takes in this fishery, when considered together with the environmental baseline and the cumulative effects, will be detectable or appreciable."[205]

The Ninth Circuit held that NMFS was not required to incorporate quantitative climate projections into its population model, but that it had "improperly minimized" the risk posed to the loggerhead turtle by "only comparing the effects of the fishery against the baseline conditions that have already contributed to the turtles' decline."[206] The court explicitly noted that it was "impermissible" for NMFS to premise a "no jeopardy" conclusion on the "proportionally low risk [of the fishery] relative to other threats, such as international fishing and climate change."[207] Thus, the Ninth Circuit rejected the type of comparative analysis that was previously upheld in the *Caribbean Fishery* case.

Finally, a lawsuit involving NMFS' 2014 BiOp for operation of the southeastern United States shrimp fisheries demonstrates how judicial review may proceed in cases where the administrative record contains more detailed scientific information about the ecological effects of climate change (the *Shrimp Fisheries BiOp* case).[208] The BiOp discussed the various ways in which climate change was already affecting loggerhead, green, leatherback, hawksbill, and Kemp's ridley sea turtles (e.g., inundation of nesting sites from sea-level rise, different hatching sex ratios from temperature changes).

NMFS even used integrated climate and ecosystem models to generate quantitative estimates of climate impacts—for example, it found that an increase of 2°C would result in a sex ratio of more than 80% female offspring for loggerheads nesting near Southport, North Carolina, and close to 100% female offspring in Florida, which could undermine the reproductive capacity of the species.[209] NMFS further noted that an increase of 3° was "likely to exceed the thermal threshold of most clutches, leading to death."[210] The BiOp contained similar findings for other sea turtles. These findings were contained within a section of the BiOp on "status of the species," but climate change was not mentioned anywhere in the section of the BiOp that specifically evaluated jeopardy.

The plaintiffs argued that NMFS had not articulated a rational connection between its "no jeopardy" determi-

197. Center for Biological Diversity v. National Marine Fisheries Serv., 977 F. Supp. 2d 55 (D.P.R. 2013), *as amended* (Oct. 23, 2013), *adhered to on reconsideration,* 191 F. Supp. 3d 157 (D.P.R. 2016).
198. *Id.* at 64.
199. *Id.* at 83.
200. *Id.* at 73-74.
201. *Id.* at 85.
202. 878 F.3d 725, 737 (9th Cir. 2017).
203. The population model reflected regional climate conditions and climate events such as the Pacific decadal oscillation, but did not incorporate forcing from anthropogenic climate change.
204. *Turtle Island Restoration Network,* 878 F.3d at 737.
205. *Id.*
206. *Id.* at 738.
207. *Id.*
208. Oceana, Inc. v. Ross, No. CV 15-0555 (PLF), 2020 WL 5995125 (D.D.C. Oct. 9, 2020).
209. *Id.* at *15.
210. *Id.*

nation and its assessment of climate impacts. They also separately challenged NMFS' treatment of climate change in the "cumulative effects" section of the BiOp, where NMFS had asserted that it was not aware of any "anticipated changes" in "natural conditions," such as "changes in oceanic conditions" that would substantially change the impacts that this threat has on sea turtles.[211] The U.S. District Court for the District of Columbia agreed with plaintiffs on both counts, finding that the administrative record contained "substantial evidence" of climate change-related threats to sea turtles, and NMFS must therefore explain how it reached the "no jeopardy" conclusion "in light of these significant effects from climate change."[212]

With regard to the cumulative effects claim, the court noted that NMFS' assertion that climate change was "not sufficiently certain to occur" was "directly contradicted by the substantial evidence of global climate change in the record and the 'significant impacts' that NMFS itself has concluded will result for sea turtles."[213] Thus, the court found NMFS' jeopardy determination was arbitrary and capricious. It remanded to NMFS without vacatur due to the fact that vacating the BiOp would eliminate protections and mitigation measures for sea turtles contained therein.

Courts confronted similar ESA claims in some of the water management cases,[214] and forest and rangeland management cases.[215] The outcomes of these claims were largely dependent on contextual factors, including the factual background, the framing of legal arguments, and the availability of record evidence to support those arguments.[216] Most of the decisions focused on agency obligations to assess the effects of climate change on the species (step one of the jeopardy analysis), but there were some decisions that went into more detail about agency obligations to evaluate how the action may exacerbate climate-related stressors (step two). For example, the Ninth Circuit recently issued a decision in *Western Watersheds Project v. McKay* remanding a BiOp for a forest management and grazing plan because the BiOp did not adequately account for the effects of climate change on water levels and stream flow, and did not account for whether the Oregon spotted frog population in the project area could "sustain grazing-related impacts on top of potential climate change effects."[217]

Also noteworthy was the Ninth Circuit's decision in *Wishtoyo Foundation v. United Water Conservation District*.[218] There, the Ninth Circuit affirmed a district court decision holding that the operation of a water diversion project would result in unauthorized take of the Southern California steelhead by exacerbating risks associated with climate change. The record indicated that climate change would adversely affect the steelhead's habitat due to increased air and water temperatures, reduced rainfall, drought, and wildfires. The court found that the water diversion project was compounding these harmful effects, for example by "preclud[ing] a properly functioning migration corridor and breeding habitat," and thus the project not only constituted a take, but also was preventing recovery of the species.[219]

As noted above, the question of whether a management action will exacerbate ecological stress associated with climate change is relevant when assessing agency obligations under NEPA and management statutes as well as the ESA. But there was only one case where a court explicitly recognized agency obligations to evaluate such "additive" harm outside of ESA claims. Specifically, in *Western Watersheds Project v. Bernhardt*, a federal district court in Oregon held that BLM had an obligation to account for the additive harms of grazing and climate change prior to renewing a grazing permit pursuant to NEPA and FLPMA.[220] Apart from that, claims arising under NEPA and resource management statutes generally focused on (1) agency obligations to evaluate the physical effects of climate change within the management area, as described above, and (2) agency obligations to evaluate the contribution of management actions to climate change, as described in the following section.

3. Effects on Carbon Storage, Wildfire Risk, and GHG Emissions

Some of the forestry cases involved disputes about how USFS and other forest management agencies should evaluate the effects of management actions on carbon storage, wildfire risk, and other ways in which land management decisions might contribute to climate change.[221] The two primary arguments advanced in these cases were: (1) that

211. *Id.* at *22.
212. *Id.* at *16.
213. *Id.* at *22.
214. *See, e.g.*, Wishtoyo Found. v. United Water Conservation Dist., No. CV-163869DOCPLAX, 2018 WL 6265099 (C.D. Cal. Sept. 23, 2018), *aff'd*, 795 F. App'x 541 (9th Cir. 2020); Natural Res. Def. Council v. Kempthorne, 506 F. Supp. 2d 322 (E.D. Cal. 2007); Pacific Coast Fed'n of Fishermen's Ass'ns v. Gutierrez, 606 F. Supp. 2d 1122 (E.D. Cal. 2008); Pacific Coast Fed'n of Fishermen's Ass'ns v. Raimondo, No. 120CV00426DADEPG, 2022 WL 789122 (E.D. Cal. Mar. 11, 2022); South Yuba River Citizens League v. National Marine Fisheries Serv., 723 F. Supp. 2d 1247 (E.D. Cal. 2010).
215. *See, e.g.*, Defenders of Wildlife v. U.S. Forest Serv., 94 F.4th 1210 (10th Cir. 2024); Western Watersheds Project v. McKay, No. 22-35706, 2023 WL 7042541 (9th Cir. Oct. 26, 2023); Oregon Wild v. U.S. Forest Serv., 193 F. Supp. 3d 1156 (D. Or. 2016); WildEarth Guardians v. U.S. Fish & Wildlife Serv., 416 F. Supp. 3d 909 (D. Ariz. 2019); Klamath Siskiyou Wildlands Ctr. v. U.S. Fish & Wildlife Serv., No. 1:21-CV-00058-CL, 2022 WL 856035 (D. Or. Mar. 23, 2022).
216. *See, e.g.*, Conservation Cong. v. U.S. Forest Serv., 235 F. Supp. 3d 1189 (E.D. Cal. 2017), *aff'd*, 775 F. App'x 298 (9th Cir. 2019) (holding that plaintiffs did not make specific arguments regarding the additive effects of the management action and climate change on the northern spotted owl).
217. 2023 WL 7042541, at *2.
218. 2018 WL 6265099, at *63.
219. *Id.* at *61.
220. The court found that the EA for the permit was based on old data (e.g., from 1999 and 2006) that did not account for the ways in which climate change was affecting ecological conditions in riparian areas, including stream temperatures, and that "grazing may cause harm that was not previously present when the earlier assessments were completed." Western Watersheds Project v. Bernhardt, 392 F. Supp. 3d 1225, 1254 (D. Or. 2019).
221. For example, one lawsuit alleged inadequate consideration of the albedo effect. O'Neil v. Steele, No. CV 19-140-M-DLC, 2021 WL 5770416 (D. Mont. Dec. 6, 2021).

the agency failed to engage with considerable scientific controversy regarding the effects of forest management projects on wildfire risk and carbon sequestration; and (2) that the agency failed to use available tools for quantifying GHG emissions from changes in carbon storage.[222] In most cases, courts deferred to agency judgment regarding how to analyze those issues, often finding that this falls within the special expertise of forest managers.[223]

With regard to the first type of claim, the most authoritative decision on this topic was the Ninth Circuit's decision in *Bark v. U.S. Forest Service*, where it held that USFS had failed to address considerable scientific controversy and uncertainty regarding the effects of "variable density thinning" on fire suppression.[224] The court found the record contained "numerous expert sources concluding that thinning activities do not improve fire outcomes," and that USFS had failed to engage with this "substantial body of research" on this topic.[225] The court concluded that this was a significant omission because variable density thinning was planned for the entire project area, and fire management is a "crucial issue that has wide-ranging ecological impacts and affects human life."[226]

There were two subsequent cases where district courts confronted similar arguments about the controversial and uncertain effects of forest thinning, particularly in regard to wildfire, but ultimately deferred to the agency's judgment.[227] In both cases, the administrative records included scientific studies that contradicted USFS' conclusions about forest thinning and wildfire behavior, but USFS had acknowledged and responded to the competing opinions, and its own conclusions were supported by adequate scientific data—and thus the courts found that USFS had satisfied its obligations under the APA, NEPA, and FLPMA.[228]

With regard to the second type of claim, courts were generally deferential to agency conclusions about how they should evaluate the effects of forestry actions on carbon storage, and whether it was possible or prudent to quantify GHG emissions in that context. In those cases, USFS argued that (1) there were no "scientifically accepted" methods for quantifying those emissions; and (2) even if such methods existed, quantification was unnecessary because the contribution to GHG emissions would be too small to matter. The plaintiffs specifically pointed to the fact that USFS had developed a tool that could be and had been used for this purpose (USFS' "Forest Vegetation Simulator") in some of these cases.[229] Nonetheless, in most instances, courts upheld USFS' decision not to quantify emissions because the projects were relatively small in size (ranging from approximately 800 to 5,000 acres), and primarily consisted of forest thinning and fuels treatments aimed at reducing wildfire risk.[230]

Those decisions can be contrasted to a recent district court decision, *Center for Biological Diversity v. U.S. Forest Service*, which involved a larger forestry project spanning 12,000 acres, including 3,900 acres of commercial timber harvest in the Kootenai National Forest.[231] The court found that USFS' qualitative analysis of project effects on carbon cycling and storage violated NEPA in two ways: (1) USFS failed to utilize "high quality and accurate information" available on the record by "relying almost entirely on . . . cookiecutter and boilerplate" language in its assessment; and (2) USFS had failed to substantiate its assumption that the short-term loss of carbon from logging would be outweighed by a net increase in carbon sequestration resulting from a "healthier" forest.[232] The court specifically took issue with USFS' argument that the project would affect "only a tiny percentage of forest carbon stocks of the Kootenai National Forest, and an infinitesimal amount of total forest carbon stocks of the United States"; noting that, under this logic, USFS could always skirt its obligation to evaluate carbon storage impacts by breaking up the project into small pieces and comparing them to larger carbon stocks.[233]

It remains to be seen whether other courts will follow suit and require quantification of GHG emissions attributable to changes in carbon storage and cycling. With

222. These cases also touched on some of the issues described above, for example whether the management action would make the forest more vulnerable to catastrophic wildfires or other climate-related stressors.

223. *See, e.g.,* Forest Pres. Soc'y v. Department of Forestry & Fire Prot., No. A148182, 2018 WL 4091010, at *5 (Cal. Ct. App. Aug. 28, 2018) ("It goes without saying [the California Department of Forestry and Fire Protection] possesses vastly greater understanding and expertise on the interplay among forests, timber harvesting and climate change than this court and, as such, deserves our deference."); League of Wilderness Defs./Blue Mountains Biodiversity Project v. Connaughton, No. 3:12-CV-02271-HZ, 2014 WL 6977611, at *26-27 (D. Or. Dec. 9, 2014).

224. 958 F.3d 865, 871 (9th Cir. 2020).

225. *Id.*

226. *Id.*

227. *See, e.g.,* Greater Hells Canyon Council v. Wilkes, No. 2:22-CV-00859-HL, 2024 WL 1344067 (D. Or. Mar. 29, 2024), *appeal dismissed,* No. 24-3386, 2024 WL 4891002 (9th Cir. Oct. 1, 2024), *appeal dismissed,* No. 24-3380, 2024 WL 4891007 (9th Cir. Oct. 1, 2024); Friends of the Clearwater v. Probert, No. 3:21-CV-00189-CWD, 2022 WL 2291246 (D. Idaho June 24, 2022).

228. *Friends of the Clearwater,* 2022 WL 2291246, at *15 ("when specialists express conflicting views, an agency must have discretion to rely on the reasonable opinions of its own qualified experts even if, as an original matter, a court might find contrary views more persuasive"); *Greater Hells Canyon,* 2024 WL 1344067, at *15 ("the Service effectively explained in its EA how these limited contrary scientific findings did not undercut the much larger body of scientific research supporting the Service's decision").

229. *See, e.g.,* Plaintiffs' Reply in Support of Amended Motion for Summary Judgment, League of Wilderness Defs./Blue Mountains Biodiversity Project v. Connaughton, No. 3:12-CV-02271-HZ, 2014 WL 6977611 (D. Or. filed Sept. 10, 2014) (noting that USFS could use the Forest Vegetation Simulator to estimate total stand carbon and removed carbon under various management scenarios). *See also* Coeli M. Hoover & Stephanie A. Rebain, U.S. Department of Agriculture, General Technical Report NRS-77, Forest Carbon Estimation Using the Forest Vegetation Simulator: Seven Things You Need to Know (2010).

230. *See, e.g.,* League of Wilderness Defs.-Blue Mountains Biodiversity Project v. Martin, No. 2:10-CV-1346-BR, 2011 WL 2493765, at *4 (D. Or. June 23, 2011) (project involved commercial thinning of 1,963 acres; mechanical fuels treatment on 2,058 acres; noncommercial thinning on 2,764 acres; aspen-stand treatment on 53 acres); Swomley v. Schroyer, 484 F. Supp. 3d 970, 973 (D. Colo. 2020), *aff'd,* No. 20-1335, 2021 WL 4810161 (10th Cir. Oct. 15, 2021) (project authorized logging on 1,631 acres, with approximately 1,000 acres of partial clearcutting). *See also* Hapner v. Tidwell, 621 F.3d 1239, 1242-43 (9th Cir. 2010) (USFS was not required to analyze climate change-related considerations for a forest-thinning project that involved 810 acres of logging and 300 acres of prescribed burns).

231. 687 F. Supp. 3d 1053 (D. Mont. 2023), *aff'd in part, rev'd in part and remanded,* No. 23-2882, 2025 WL 586358 (9th Cir. Feb. 24, 2025).

232. *Id.* at 1075.

233. *Id.*

ongoing advances in scientific understanding of forestry carbon impacts—and corresponding improvements to GHG quantification tools—it is possible that courts will come to view these tools as "scientifically accepted" methods that agencies must use to resolve uncertainties in their climate assessments.

4. Neutrality in Scientific Analysis

Agencies must remain neutral when making objective scientific determinations, and this extends to any assumptions made in the context of scientific uncertainty. There are many decisions that touch on this issue, such as the Ninth Circuit's decision in *Turtle Island*, discussed above. The most direct and comprehensive discussion of scientific neutrality is the D.C. Circuit's decision in *Maine Lobstermen's Ass'n v. National Marine Fisheries Service*, where it held that NMFS could not "give the benefit of the doubt" to an endangered species "by relying on worst-case scenarios or pessimistic assumptions," when it is tasked with making "empirical judgments" in a BiOp.[234] Rather, the court held, NMFS should "strive to resolve or characterize the uncertainty through accepted scientific techniques, not jump to a substantive presumption that distorts the analysis of effects."[235]

Maine Lobsterman's Ass'n was one of two lawsuits that involved climate change-related challenges to NMFS' 2021 BiOp and "no jeopardy" determination for the operation of 10 lobster fisheries spanning from Maine to Key West, Florida, and their effect on the North Atlantic right whale.[236] The case specifically dealt with the validity of NMFS' projections of future entanglements resulting in "mortality/serious injury" (M/SI) incidents attributable to U.S. lobster fishery operation. NMFS used data on confirmed entanglements as the basis for its projections. It specifically chose 2010 as the earliest year because this year coincided with a heat-driven "regime shift" in the Gulf of Maine and a noticeable northward shift in right whale distribution and habitat use.[237]

The entanglement data showed that of the 48.5 right whale M/SI incidents documented between 2010 and 2018, 7.75 were attributable to Canadian waters, two were attributable to U.S. waters, and the remaining 38.75 were not attributable to either country.[238] To apportion the unattributed M/SI incidents, NMFS assumed a 50/50 allocation of entanglements between the United States and Canada, rather than using a linear extrapolation from the observed data (i.e., a 7.75-to-2 ratio). NMFS explained that its choice of a 50/50 ratio was based on several factors, including data limitations.[239]

Elsewhere in the BiOp, NMFS noted that it was resolving uncertainty "in favor of the species"—specifically "select[ing] the value that would lead to conclusions of higher, rather than lower, risk," as this approach "provides the 'benefit of the doubt'" to endangered and threatened species.[240] NMFS ultimately determined that the operation of the lobster fisheries would not cause jeopardy to the right whale, but this determination was contingent on implementation of a "conservation framework" to reduce future M/SI incidents.[241]

Plaintiffs argued that NMFS had arbitrarily inflated the threat of U.S. lobster fishery operations by assuming a 50/50 entanglement allocation without adequate record support, and therefore lacked adequate justification for the conservation framework that would impose costs on fishery participants.[242] The district court held in favor of NMFS, deferring to its determination that the 50/50 ratio was reasonable in the face of scientific uncertainty.[243]

The D.C. Circuit reversed, citing both legal errors and a lack of technical evidence to support NMFS' approach in the BiOp. The court held that NMFS cannot give "the benefit of the doubt" to a listed species when evaluating the risk of jeopardy in a BiOp,[244] because the ESA requires NMFS to provide an "empirical judgment" about what is "likely."[245] On the technical issue, the court held that NMFS had not substantiated its predictions of M/SI attributable to U.S. lobster fisheries, particularly in light of evidence of the northward migration of the whale into Canadian waters.[246]

One important detail about this decision is that the court was interpreting NMFS' obligations as the *consult-*

234. 70 F.4th 582, 586 (D.C. Cir. 2023).
235. *Id.* at 600.
236. The other case was a lawsuit where conservation organizations challenged the BiOp for inadequate analysis of climate change impacts, among other things; the reviewing court briefly acknowledged climate-related threats to the whale but remanded the BiOp on other grounds. But that decision was subsequently vacated due to the D.C. Circuit decision in *Maine Lobsterman's Association v. National Marines Fisheries Service* as well as an intervening act by the U.S. Congress declaring that lobster fishery protections were sufficient. *See* Center for Biological Diversity v. Raimondo, 610 F. Supp. 3d 252, 263 (D.D.C. 2022), *vacated*, No. CV 18-112 (JEB), 2024 WL 324103 (D.D.C. Jan. 29, 2024), *appeal dismissed,* No. 24-5071, 2024 WL 2061696 (D.C. Cir. May 3, 2024).
237. NMFS, Endangered Species Act Section 7 Consultation on the Authorization of the American Lobster et al. Fisheries—Biological Opinion 215 (2021).
238. *Id.* at 215-16.
239. *Id.* at 217. Other factors cited by NMFS included the large number of lines in U.S. waters, the larger diameters and configurations of those lines, and the fact that historical population data suggested an even higher allocation to U.S. waters. NMFS submitted its approach for peer review by the Center for Independent Experts, which agreed that this was a "reasonable" approach without commenting on its accuracy.
240. *Id.* at 206.
241. *See id.* §3.2 ("North Atlantic Right Whale Conservation Framework for Federal Fisheries in the Greater Atlantic Region").
242. Maine Lobstermen's Ass'n, Inc. v. National Marine Fisheries Serv., 626 F. Supp. 3d 46, 59 (D.D.C. 2022), *rev'd and remanded sub nom*. Maine Lobstermen's Ass'n v. National Marine Fisheries Serv., 70 F.4th 582 (D.C. Cir. 2023).
243. The district court acknowledged that "NMFS could have more comprehensively addressed Plaintiffs' evidence that climate change has caused right whales to spend more time in Canadian waters—either altering its models to account for those migration patterns or explaining more thoroughly why it needed not do so." *Id.* at 60. However, after reviewing the record evidence, the court concluded that it should defer NMFS' determination, as "attempting to trace the location of mortal entanglements is quintessentially murky water," and NMFS "considered the relevant data and offered a rational and peer-reviewed explanation for its approach." *Id.*
244. *Maine Lobstermen's Ass'n*, 70 F.4th at 586.
245. *Id.* The court further explained that the term likely should mean "more likely than not." *Id.* at 595.
246. *Id.* at 600.

ing agency under ESA §7(a)(3)(A),[247] where NMFS plays a "limited role" as a scientific advisor and the "core of the Service's remit in the decisionmaking process is to form a scientific judgment."[248] NMFS is tasked with making an empirical judgment as to what is "likely" in that context, and so it makes sense to infer a requirement of neutrality.

The same reasoning cannot be applied to other types of statutory mandates, such as the obligation of an action agency under ESA §7(a)(2) to "insure that any action . . . is not likely to jeopardize" the survival of the species.[249] This language does not mandate a neutral determination of whether the action is likely to cause jeopardy, but rather a protective course of action aimed at ensuring that jeopardy is "not likely."[250] There is nothing in §7(a)(2) that would preclude the utilization of precautionary measures to guarantee this outcome. Thus, *Maine Lobstermen's Ass'n* should not be construed as wholly prohibiting application of the precautionary principle under the ESA, nor should it be extended to other contexts where agencies are tasked with making policy judgments about how to conserve and protect natural resources in the face of scientific uncertainty.

Finally, the D.C. Circuit's decision in *Maine Lobstermen's Ass'n* raises an interesting question about how the "null hypothesis" should be framed in the context of scientific assessments. The court asserted that the "null hypothesis" in the context of a BiOp was "no jeopardy" (i.e., NMFS should assume that the action is not likely to jeopardize the continued existence of the species unless it uncovers evidence to the contrary).[251] This is consistent with how the null hypothesis is typically framed in statistical analyses, but this is ultimately an *assumption* that "gives the benefit of the doubt" to the action, rather than the species. Some climate scientists have also made a similar point about the use of the null hypothesis in climate research—specifically that assuming no relationship between climate change and studied variables will inevitably result in an underestimation of climate impacts.[252]

247. *See* 16 U.S.C. §1536(a)(3)(A) (the consulting service "shall provide to the Federal agency and the applicant, if any, a written statement setting forth the Secretary's opinion, and a summary of the information on which the opinion is based, detailing how the agency action affects the species or its critical habitat").
248. The court explicitly held that the regional fisheries division was the action agency and NMFS' role was limited to that of the consulting service. *Maine Lobstermen's Ass'n*, 70 F.4th at 595-96.
249. 16 U.S.C. §1536(a)(2).
250. That is, using the D.C. Circuit's definition of "likely" ("greater than 50%"), the action agency must ensure that the probability is equal to or *less than* 50%.
251. *Maine Lobstermen's Ass'n*, 70 F.4th at 596.
252. *See, e.g.*, Michael E. Mann et al., *Assessing Climate Change Impacts on Extreme Weather Events: The Case for an Alternative (Bayesian) Approach*, 144 Climatic Change 131 (2017); Theodore G. Shepherd, *Bringing Physical Reasoning Into Statistical Practice in Climate-Change Science*, 169 Climatic Change 2 (2021); Friederike Otto et al., *Causality and the Fate of Climate Litigation: The Role of the Social Superstructure Narrative*, 13 Glob. Pol'y 736 (2022).

B. Distinction Between Policy Judgments and Scientific Determinations

The surveyed cases illustrate how standards of deference may differ depending on the nature of the action or decision under review. All of the cases involved disputes about the technical and scientific assessments underpinning agency decisions. However, the disputes differed in terms of whether the alleged analytical error(s) related to a purely scientific determination, a management decision that entails subjective judgment, or something in between. It appeared that courts were more deferential to agency decisions about how to use and interpret scientific information in the context of management decisions that involved subjective judgments about how to balance different policy factors.[253]

A 2023 decision from the U.S. Court of Appeals for the Second Circuit, *New York v. Raimondo*, illustrates how courts may review agency obligations to use the "best available science" in the context of management actions where the agency has considerable discretion to balance different factors. That case involved NMFS' annual quotas for commercial fishing of summer flounder for Mid-Atlantic states ("2020 Allocation Rule"). The state of New York challenged the 2020 Allocation Rule, arguing that NMFS had ignored evidence of a northward shift in summer flounder populations by setting quotas based on commercial landings data that were initially reported by states from 1980-1989 and were therefore outdated. The administrative record showed that NMFS had acknowledged the northward shift and made some small adjustments to surplus quotas as a result of the shift, but NMFS ultimately opted to prioritize historical state access to the fishery when setting allocations.

On review, the U.S. District Court for the Southern District of New York held that NMFS had lawfully exercised its expertise and discretion under the MSA to balance different factors, which include economic and fairness considerations as well as the conservation of fishery resources.[254] The Second Circuit affirmed.[255] In its decision, the court fleshed out some contours of the MSA's "best available science" requirement—it noted that the phrase "based upon" means that NMFS "must use (and not merely consider)" scientific information when developing fishery management plans, but found that the minor changes in surplus quotas had satisfied this requirement.[256] The court also held that it was acceptable for NMFS to prioritize fish landings data over fish location data, even though the landings data had remained the same since the 1980s (since landings are constrained by catch limits), because the data

253. It is difficult to reach a firm conclusion regarding trends in deference, as the adjudication of each case was context-specific, but plaintiffs were more likely to succeed with, for example, challenges to ESA jeopardy determinations (plaintiffs won 13/23, or 61%, of those claims).
254. New York v. Raimondo, 594 F. Supp. 3d 588 (S.D.N.Y. 2022).
255. New York v. Raimondo, 84 F.4th 102, 108 (2d Cir. 2023).
256. *Id.*

provide insights on which fishing communities depend on the summer flounder.[257]

Other cases suggest that NMFS' discretion is more constrained when the agency is tasked with making technical determinations related to fishery carrying capacity (e.g., maximum sustained yield, optimum sustained yield, and catch limits).[258] In that context, it would be more difficult for NMFS to justify reliance on historical landings data to assess fish stocks in light of the evidence of northward migration. A trio of decisions involving catch limits for the northern anchovy off the California coast provide some insights on how courts may address legal disputes involving shifting environmental baselines, fishery carrying capacity, and annual catch limits.[259]

In the first decision, *Oceana v. Ross* (*Oceana I*), the U.S. District Court for the Northern District of California held that NMFS had improperly ignored scientific evidence of anchovy population collapse when setting a 25,000 metric ton (mt) annual catch limit for the anchovy ("2016 Catch Rule").[260] NMFS used anchovy population data from 1964-1990 to calculate the catch limit, despite multiple studies showing dramatic declines in anchovy populations between 2009 and 2011. These studies included peer reviews as well as assessments from NMFS, FWS, and the National Oceanic and Atmospheric Administration. NMFS argued that they were "unreliable," but the reviewing court found that none of NMFS' criticisms justified its dismissal of this evidence. The court noted:

> [E]ven if the Service could have reasonably disregarded part of Plaintiff's evidence, Defendants have not responded to Plaintiff's compelling point that *in the aggregate*, recent evidence strongly suggests that the anchovy population has declined well below the 733,410 mt value on which the OFL [overfishing limit], ABC [acceptable biological catch], and ACL [annual catch limit] are based.[261]

On remand, NMFS issued a new annual catch limit of 23,573 mt based on anchovy abundance estimates from 2016-2018 instead of historic population estimates ("2019 Catch Rule"). The court found that NMFS had once again erred by disregarding evidence of "drastic anchovy population fluctuations" between 2009 and 2014.[262] It held that setting catch limits for an indefinite period of time under these circumstances was arbitrary and capricious because NMFS could not guarantee that the limits would prevent overfishing.[263] Thus, the decision hinted at a possible role for adaptive management in the next version of the catch rule.

NMFS issued a third rule in which it once again set the catch limit at 25,000 mt ("2020 Catch Rule"). This rule was also based on more updated assessments of species abundance from 2016 through 2019, and NMFS provided further explanation as to why it viewed the studies on population collapse from 2009 through 2014 as unreliable. In particular, NMFS asserted that the methodology used to calculate anchovy biomass in those studies was flawed because it produced outputs that were inconsistent with observations (e.g., the estimate of 2013 anchovy biomass was lower than the 2013 anchovy catch).[264] The court held that this explanation was adequate, and that NMFS had reasonably responded to the remaining uncertainty about anchovy populations by including a margin of error in the catch limit (which was 25% of the overfishing limit).[265]

C. *Scientific Complexity and Extra-Record Evidence*

The judges overseeing these cases are frequently confronted with lengthy scientific records and complex technical questions that fall outside the scope of judicial expertise. This is one reason for exercising deference pursuant to APA standards of review. Still, courts must apply enough scrutiny to determine whether the agency considered "all relevant factors" and whether there is a "rational connection" between facts and findings, and this requires some understanding of underlying scientific concepts (and this is reinforced by "best available science" mandates).

One option for courts is to admit extra-record evidence, including testimony, to clarify technical issues and provide context for scientific disputes. Although judicial review of agency actions is typically limited to the administrative record, courts have recognized exceptions to the "record review" rule, specifically where: (1) the court requires background information to understand technically complex subject matter; (2) supplementation of the record is necessary to determine whether the agency considered all relevant factors and reached a rational conclusion on the basis of evidence; (3) the agency relied on documents not in the record; or (4) there is evidence of "bad faith" on the part of the agency.[266] The party seeking admission of extra-

257. *Id.* at 109.
258. Note that catch limits and optimum sustained yield are technical determinations, but they differ from the maximum sustained yield determination in one important respect—whereas maximum sustained yield is a purely factual determination to be made based on ecological conditions, the MSA specifies that the optimum sustained yield should be "prescribed as such on the basis of the maximum sustainable yield from the fishery, as reduced by any relevant economic, social, or ecological factor," and annual catch limits are set based on the optimum sustained yield. Thus, economic and social considerations factor into those determinations, but they are constrained by the maximum sustained yield.
259. These cases did not explicitly mention "climate change" but were included in the survey due to the highly relevant discussion of whether an agency can rely on historical baselines when confronted with evidence of environmental change. Moreover, climate change is likely one factor influencing anchovy population fluctuations. *See* Haoyu Li et al., *Climate-Driven Synchrony in Anchovy Fluctuations: A Pacific-Wide Comparison*, 7 Fishes 193 (2022).
260. No. 16-CV-06784-LHK, 2018 WL 1989575 (N.D. Cal. Jan. 18, 2018).
261. *Id.* at *14.
262. Oceana, Inc. v. Ross, 483 F. Supp. 3d 764, 783 (N.D. Cal. 2020).
263. *Id.* at 788.
264. Oceana, Inc. v. Coggins, 606 F. Supp. 3d 920, 930-31 (N.D. Cal. 2022).
265. *Id.* at 931-32.
266. *See* Citizens to Preserve Overton Park, Inc. v. Volpe, 401 U.S. 402, 420 (1971); Lands Council v. Powell, 395 F.3d 1019, 1030 (9th Cir. 2005); Audubon Soc'y of Greater Denver v. U.S. Army Corps of Eng'rs, 908 F.3d 593, 609-10 (10th Cir. 2018). *See also* Travis O'Brandon, *Reforming the Extra-Record Evidence Rule in Arbitrary and Capricious Review of Informal*

record evidence has the burden of demonstrating that the evidence is *necessary* for the adjudication of claims.[267]

There were several cases in the surveyed litigation where courts admitted extra-record evidence and testimony to resolve complex technical questions in the context of disputed or conflicting scientific evidence.[268] This evidence was sometimes pivotal to the court's analysis and resolution of claims. For example, in *Western Watersheds Project v. Bern hardt*, the U.S. District Court for the District of Oregon was deciding whether to issue a preliminary injunction of a grazing permit, which required the court to determine whether plaintiffs might succeed on the merits of their NEPA challenge, and also whether the permit might cause irreparable harm to sensitive species in the area.[269]

The court heard scientific testimony regarding the cumulative effects of climate change, wildfires, and grazing, and how these combined stressors could degrade rangeland habitats.[270] This testimony was essential to the court's analysis, as the administrative record contained very limited information about these issues. The court held that plaintiffs were likely to succeed with their NEPA claims because BLM's analysis was flawed due to the omission of climate-related considerations (among other things), and that the issuance of the permit was likely to cause irreparable harm.[271]

The surveyed cases also provide insights on contexts where extra-record evidence may not fall within the limited exceptions described above. For example, in *Swomley v. Schroyer*, the U.S. Court of Appeals for the Tenth Circuit refused to admit extra-record materials that plaintiffs had cited in support of a NEPA claim alleging that USFS had inadequately considered the effect of a timber project on carbon storage, wildfire risk, and GHG emissions. The court found that the extra-record materials did not raise any novel issues that USFS had wholly ignored in its NEPA review, and were therefore unnecessary to resolve the claim.[272]

In another case, *Greater Hells Canyon Council v. Wilkes*, a federal district court in Oregon rejected the defending agency's request to supplement the record with new scientific reports, because the reports essentially served as a "post-hoc rationalization" for the agency's decision.[273] The court specifically confronted and rejected the argument that the new scientific reports should be admitted because they were "synthesis" articles that summarized scholarship that existed at the time of the agency's decision; the court noted that the reports did not merely catalog existing evidence, but rather drew original conclusions from that evidence (which the agency was specifically using to rationalize its position).[274]

V. Synthesis and Reflections

The sustainable management of natural resources is an inherently complex task, made even more complex by climate change. There is no "silver bullet" solution to ensure that agencies meet sustainability and conservation goals, but it is clear that resource management decisions should be based on a strong scientific foundation. The cases surveyed for this Article provide insights on how litigation can help advance progress in this area. They also underscore the importance of having relevant and actionable scientific data to inform management decisions (and judicial review of those decisions). This part concludes with some reflections on the challenges for and barriers to effective science-based legal advocacy, as well as opportunities for overcoming those barriers.

A. *Scientific Uncertainty and the "Bar of Proof" for Climate Assessments*

One of the key takeaways from this litigation survey is that agencies may require too high a level of certainty, precision, or quantifiability when evaluating climate change impacts and, as a result, may fail to address impacts that are both foreseeable and relevant to the management action. There will inevitably be some uncertainty about climate change—particularly as regards the magnitude of future impacts—but this should not be viewed as a basis for inaction. The science clearly does not support the assumption that future conditions will align with historical conditions.

Moreover, there are many contexts where even a general or qualitative discussion of climate impacts can produce actionable and important insights for resource management decisions. Agencies can also use scenario planning

Agency Actions: A New Procedural Approach, 21 Lewis & Clark L. Rev. 981 (2018) (discussing variations in how courts have applied and characterized exceptions to the record review rule).

267. *See, e.g., Lands Council,* 395 F.3d at 1030.

268. *See, e.g.*, Pacific Coast Fed'n of Fishermen's Ass'ns v. Raimondo, No. 120CV00426DADEPG, 2022 WL 789122, at *13 (E.D. Cal. Mar. 11, 2022) (noting that "the matters raised in these cases are extraordinarily complex and their resolution time-intensive" and extensively relying on expert testimony to help resolve these complex matters); Western Watersheds Project v. Bernhardt, 392 F. Supp. 3d 1225, 1245 (D. Or. 2019) (relying on expert testimony from both plaintiffs' and defendants' experts to determine whether grazing permit may cause irreparable harm to protected species, particularly in the context of changing climate conditions); South Yuba River Citizens League v. National Marine Fisheries Serv., 723 F. Supp. 2d 1247, 1274 (E.D. Cal. 2010) (admitting record evidence to determine whether the agency has considered all relevant factors and explained its decision); Natural Res. Def. Council v. Kempthorne, 506 F. Supp. 2d 322, 344 (E.D. Cal. 2007) (admitting 22 extra-record documents to aid the court's understanding of various technical concepts under the "technical terms and complex subject matter exception").

269. 392 F. Supp. 3d 1225.

270. For example, one expert testified on "how an ecological system that could handle a certain level of grazing before a fire cannot handle that same level of grazing after a fire." *Id.* at 1253.

271. *Id.* at 1253-54:

> Additionally, [BLM's assessments] do not include current conditions such as the effects of climate change and fire. In other words, if the ecological condition of the riparian areas, including stream temperatures, are stressed by factors such as climate change and higher temperatures in recent years, or neighboring areas that have been and have not yet recovered, then adding grazing may cause harm that was not previously present when the earlier assessments were completed.

272. Swomley v. Schroyer, No. 20-1335, 2021 WL 4810161, at *4 (10th Cir. Oct. 15, 2021).

273. No. 2:22-CV-00859-HL, 2023 WL 6443562, at *2 (D. Or. Apr. 20, 2023).

274. *Id.* at *4-5.

and iterative adaptive management approaches to support decisionmaking in the context of pervasive uncertainty. There is no reason to ignore foreseeable climate hazards simply because those hazards cannot be quantified or measured with precision.

In other words, agencies—and courts—should not set the bar of proof "too high" with regard to predictions of climate impacts.[275] There may be uncertainties and discrepancies in projections of specific impacts within the management area, but if the totality of the evidence suggests that change is occurring, the responsible agency should make a reasonable effort to incorporate that information into its analysis. Importantly, it is not enough to simply "discuss" or "acknowledge" climate impacts—they need to be accounted for in the agency's assessments of baseline environmental conditions and project outcomes. When uncertainty is pervasive, agencies should meaningfully engage with available data, consider plausible scenarios, explain areas of uncertainty, and provide a reasoned justification as to why the agency can or cannot reach a meaningful conclusion on the basis of existing scientific information.

Courts play a critical role in the enforcement of statutory directives related to science-based decisionmaking, and should not rubber-stamp scientific assessments simply because the agency has "discussed" or "considered" climate change impacts.[276] Rather, courts should look more holistically at the agency's assessment to confirm that it is utilizing climate data in a rational way (e.g., if there is evidence of changing hydrological conditions, then this should be reflected, to the extent feasible, in the agency's hydrological assessment). Relatedly, courts should recognize that the "relevant factors" and "rational connection" tests are two separate inquiries, and the fact that an agency has considered all relevant information does not necessarily mean that the agency has reached a rational conclusion on the basis of that information.

Courts should also strike a reasonable balance between deference and scrutiny in this context. Many of these cases involve factual questions that fall well beyond the scope of judicial expertise, but this does not mean that courts should blindly defer to agency conclusions. Rather than avoiding matters of scientific complexity, courts should use available tools to understand the scientific issues—including extra-record testimony—to provide clarity on areas of scientific complexity.

B. *Scientific Arguments and Record Evidence*

The cases also underscore the need for strong scientific and legal arguments in order to overcome judicial deference to government agencies. Plaintiffs challenging agency findings about the uncertain or insignificant nature of climate change impacts will typically need to show that the agency has overlooked or misinterpreted scientific information that is credible and relevant to the management action under review.[277] Simply asserting that the agency should have considered an issue may be insufficient unless there is a glaring omission in the agency's analysis.[278] Rather, plaintiffs should explain to the court exactly what the agency could have and should have done differently in its analysis, and why the analytical error matters to the final decision.

One important aspect of these cases is that judicial review is generally limited to the administrative record. Thus, the ability of plaintiffs to advance strong legal arguments depends, in large part, on the availability of record evidence to support those arguments. In many of the surveyed cases, plaintiffs relied on public input to the administrative record to support their claims.[279] This highlights the importance of public participation in agencies' planning processes, as discussed below.[280]

The manner in which plaintiffs frame their scientific and legal arguments is also important.[281] There are several key considerations. First, to reiterate, plaintiffs should be specific about the deficiencies in the agency's scientific analysis. This means that plaintiffs should identify specific data or analytical tools that were available to the agency at the time of its decision (i.e., on the administrative record) and explain how the agency should have used those resources to help support its decisionmaking process. It may also be necessary to explain why the agency should use those data and/or tools in lieu of—or in addition to—other scientific information that the agency relied on in its assessment.

Second, plaintiffs should be explicit about how the alleged error relates to the agency's substantive obligations (i.e., as regards sustainable use, conservation, and environmental protection).[282] For example, will climate change exacerbate environmental risks that need to be assessed and/or mitigated, or will it render the project impracti-

275. *See* Elisabeth A. Lloyd et al., *Climate Scientists Set the Bar of Proof Too High*, 165 Climatic Change 55 (2021).

276. The importance of judicial enforcement of science-based decisionmaking mandates is particularly evident in light of the current political climate and the Trump Administration's efforts to dismantle scientific institutions and undermine scientific research, particularly in relation to climate science. *See* Jeff Tollefson et al., *Will US Science Survive Trump 2.0?*, Nature (Apr. 29, 2025), https://www.nature.com/articles/d41586-025-01295-6.

277. *See, e.g.,* WildEarth Guardians v. U.S. Fish & Wildlife Serv., 416 F. Supp. 3d 909, 934-35 (D. Ariz. 2019) ("[w]here a plaintiff fails to point to data omitted from consideration, the claim fails").

278. *See, e.g.*, Western Watersheds Project v. U.S. Bureau of Land Mgmt., No. 2:21-cv-01126, at *23 n.16 (D. Ariz. Aug. 9, 2023) (upholding BLM's NEPA assessment of climate change impacts because "the EA acknowledged that climate change and drought could negatively impact the Monument resources").

279. See, for example, the discussion of water management cases in Section IV.A.1.

280. *See infra* Section V.C.

281. Note that, in some of the surveyed cases, plaintiffs were raising many different objections in the same lawsuit, and did not have an opportunity to flesh out claims and arguments related to climate change. This was one reason that courts did not always address the climate-related claims in their final decisions. *See, e.g.,* Monroe Cnty. Bd. of Comm's v. U.S. Forest Serv., 595 F. Supp. 3d 713 (S.D. Ind. 2022); Cascadia Wildlands v. U.S. Bureau of Land Mgmt., No. 6:23-cv-01358 (D. Or. July 18, 2024); Klamath Forest All. v. U.S. Forest Serv., No. 3:23-cv-03601 (N.D. Cal. Aug. 23, 2024).

282. Courts may not understand why an agency's failure to consider climate change is relevant to sustainability and conservation mandates, even where the connection seems obvious. *See, e.g.*, *Western Watersheds Project*, No. 2:21-cv-01126, at *23 n.16 (finding that plaintiffs cited "no authority for their argument that BLM must make specific findings and disclosures about how drought could affect . . . biological resources" in the context of a NEPA challenge to grazing authorizations in a national monument).

cable, or is there some other legally relevant outcome that must be accounted for in the agency's assessment?[283] Making an explicit connection to substantive statutory requirements will be particularly important for NEPA claims in the wake of the Supreme Court's decision in *Seven County*, as the Court made clear that an agency's NEPA analysis should be guided by the "rule of reason" (i.e., that agencies only need to consider information in NEPA reviews that is relevant and useful to the action under review).[284]

Third, with regard to APA standards, plaintiffs should be explicit about whether they are alleging a violation of the "all relevant factors" test, the "rational connection" test, or both. These are separate but related requirements, and it is important that litigants and courts do not conflate them in their analysis—otherwise the presumption may be that an agency has satisfied the "rational connection" test simply because it reviewed all of the relevant evidence.

Fourth, in many cases, an agency's failure to address climate change impacts could be treated as a failure to address "cumulative effects" or as a failure to accurately characterize the "environmental baseline" for an action. Due to recent regulatory developments under the ESA and NEPA, there are significant questions about how courts will interpret agency obligations to assess cumulative effects going forward.[285] It would therefore be prudent for plaintiffs to frame the analytical error as an inaccurate environmental baseline, rather than (or in addition to) framing it as a problem with the agency's assessment of cumulative effects. It would also be prudent for plaintiffs to support such claims with evidence of how climate change is *already* affecting baseline conditions (when available), as this may help persuade courts that reliance on historical baselines is arbitrary and capricious.

Finally, plaintiffs should tailor their arguments to the specific geographical and temporal boundaries of the project at issue. In many cases, this means that plaintiffs will need to demonstrate that climate change is affecting or will affect a specific geographic region (e.g., the boundaries of a national forest, or even a segment of a forest) within a relatively short time frame (e.g., 10 years).[286] This does not necessarily mean that plaintiffs should *limit* their discussion of climate impacts to the action time frame—to the contrary, plaintiffs should also be explicit about the ways in which environmental conditions have already changed, how this has affected baseline conditions, and why future changes (i.e., after the action time frame) are also relevant when considering long-term sustainable use and conservation objectives.

C. Public Contributions to the Scientific Record

There are various opportunities for members of the public to provide feedback on proposals for natural resource management. These include the formal public notice-and-comment periods for environmental review documents, management plans, regulatory decisions, and other actions,[287] as well as other mechanisms for collaboration and consultation.[288] Interested parties can use these opportunities to submit scientific resources for consideration by the agency (and inclusion on the administrative record) and to provide critical feedback on the agency's assessment of climate impacts.

The most useful scientific inputs are those that provide clear and actionable information about the management action at issue—for example, data showing that the carrying capacity of a particular ecosystem is declining due to climate change and that resource quotas need to be adjusted accordingly. There is already a growing body of research aimed at understanding "climate science information needs" among natural resource managers, primarily through surveys and interviews.[289] The surveyed cases provide additional insights on specific areas of uncertainty—or gaps in information—that agencies have cited as the basis for inaction on climate change.

Downscaled climate data. Agencies frequently asserted that they could not go further with their assessments of climate impacts due to a lack of data about the near-term effects of climate change within the management area. In some cases, agencies also maintained that climate change impacts would likely be insignificant or nonthreatening within the relatively short time frame of the action under review, even where there was considerable uncertainty about the character and magnitude of those impacts. This suggests that natural resource managers may benefit from having more geographically and temporally downscaled climate data to inform their assessment of and responses to climate change. Such data could also be used to support legal claims when agencies fail to act. This is not to suggest that downscaled data is *necessary* in all contexts—but it can play a valuable role in natural resource planning as well as litigation.

283. *See, e.g.*, AquAlliance v. U.S. Bureau of Reclamation, 287 F. Supp. 3d 969, 1026 (E.D. Cal. 2018) (holding that CEQA does not require an agency to consider the effects of existing environmental conditions on a proposed project's users or residents, but CEQA does mandate consideration of how the project might exacerbate existing environmental hazards).

284. Seven Cnty. Infrastructure Coalition v. Eagle County, 605 U.S. ___ (2025).

285. *Cf.* Western Watersheds Project v. Bernhardt, 392 F. Supp. 3d 1225, 1253-54 (D. Or. 2019) (remanding BiOp because it did "not account for climate change as a cumulative effect or baseline condition"); Oregon Wild v. U.S. Forest Serv., 193 F. Supp. 3d 1156, 1167 (D. Or. 2016) (holding that USFS need not consider climate change as part of cumulative effects in biological assessment, as cumulative effects analysis is voluntary in that context).

286. *See, e.g.*, WildEarth Guardians v. U.S. Fish & Wildlife Serv., 416 F. Supp. 3d 909, 934-35 (D. Ariz. 2019) (deferring to FWS' determination that climate change impacts "need not be given much detail" in a BiOp for a forest management action due to the "shorter timeline" of approximately 10 years).

287. *See, e.g.*, BLM, *Public Involvement*, https://www.blm.gov/programs/planning-and-nepa/public-participation (last visited Oct. 7, 2025). The comment periods can be relatively short (e.g., 60 or 90 days), but there is often advance notice of comment periods and there may be multiple opportunities to comment on an action.

288. *See* Matthew McKinney, *Whither Public Participation in Federal Land Management? Replicating Homegrown Innovations in Shared Problem Solving*, 48 ELR 10015 (Jan. 2018), https://www.elr.info/articles/elr-articles/whither-public-participation-federal-land-management-replicating-homegrown.

289. *See, e.g.*, Molly S. Cross, *Tackling the Science Usability Gap in a Warming World: Co-Producing Useable Climate Information for Natural Resource Management*, 70 Env't Mgmt. 881 (2022); Elizabeth Allen et al., *Climate Science Information Needs Among Natural Resource Decision-Makers in the Northwest US*, 5 Climate Servs. 11 (2017).

Integrated climate and ecosystem data. Many cases underscored the need for more scientific information about how climate change is affecting ecosystems and biota, particularly in relation to the effects of climate change on (1) protected species and their habitats; (2) the distribution, health, and abundance of aquatic species and fisheries; (3) forest ecosystems, particularly in relation to wildfire risk, and best practices for forest management in the context of climate change; and (4) grassland ecosystems, particularly in relation to drought and aridity, and best practices for rangeland management in the context of climate change. Natural resource management would likely benefit from additional studies on these types of ecosystem impacts, as well as further refinement of integrated climate and ecosystem models that can be used to generate insights for specific management areas and ecosystems.

Observational evidence and attribution research. Observational data and climate attribution research provide critical insights on the ways in which climate change is already affecting both physical and ecological parameters within natural systems. This information can help with the evaluation of climate impacts at the appropriate temporal scale for natural resource decisionmaking, and, in particular, it can inform decisions about how to characterize the environmental baseline for actions of relatively short duration.

For example, if the observational record shows that major changes are already underway within a management area, this would suggest that historical data will not provide an accurate frame of reference for a future baseline. Information about how climate change is already affecting natural systems and biota can also help counter the notion that the effects of climate change are "insignificant" during a 10- or 20-year project time frame, since the full scope of those effects includes past, present, and future impacts.

Another important function of observational data and attribution research is that it may help persuade decisionmakers (e.g., agencies and courts) of the concrete, real, and immediate (or urgent) nature of climate change impacts. Climate change continues to be discussed as a predominantly future problem in many planning documents, despite evidence of significant and widespread impacts on terrestrial and aquatic systems across the planet. Attribution data and observational research may help persuade courts that climate change impacts are not hypothetical or speculative or merely a future concern, and that major changes in ecological baselines are already occurring due to climate change.[290]

Methodologies for evaluating carbon storage and GHG impacts. USFS has repeatedly made the argument that it lacks "scientifically accepted" methods for estimating the effect of forestry actions on carbon storage and GHG emissions. This suggests that there may be utility in further development and refinement of carbon storage GHG quantification methods or, alternatively, efforts to build scientific agreement on credible and reliable quantification approaches.

Qualitative and quantitative data. Finally, it is important to recognize that both qualitative and quantitative data can provide actionable insights about climate change and its implications for resource management decisions, and both types of data play a complementary role in climate impact assessment. There are many contexts where a quantitative analysis, if feasible, may provide more useful insights for decisionmakers (and, by extension, courts). In particular, quantitative data may be needed to answer questions about the magnitude or significance of climate impacts and associated risks, for example as may be required for ESA jeopardy determinations[291] and NEPA reviews.[292]

However, qualitative analyses are not inherently inferior or less robust. To the contrary, qualitative analyses can provide more detailed narrative accounts of the changes currently underway in natural systems. Moreover, there are many contexts where quantitative assessments of climate impacts, especially ecosystem impacts, simply are not feasible.[293] It may be helpful for scientists to develop resources or initiatives aimed at educating legal decisionmakers about the utility, relevance, and credibility of qualitative data; appropriate contexts for qualitative analyses; and how such analyses can inform specific management and conservation decisions.

VI. Conclusion

As detailed in this Article, legal advocacy efforts—paired with developments in climate science—have helped shape legal norms related to climate impact assessment for natural resource management. Courts have recognized that climate change has implications for a wide array of resource management and conservation decisions, and agencies have obligations to assess available climate data and justify conclusions reached on the basis of that data.

This is an important development in natural resource law, but it is not the end of the story. There is a continuing need for legal advocacy to enforce legal mandates related to sustainability, conservation, and science-based decisionmaking, as well as a need for scientific research to help address the climate action gap in natural resource management.

290. For examples from the ESA context, see Jessica Wentz, *Attribution Science and the Endangered Species Act*, 39 Yale J. on Regul. 1042 (2022). *See also* Maine Lobstermen's Ass'n v. National Marine Fisheries Serv., 70 F.4th 582, 601 (D.C. Cir. 2023) (placing significant emphasis on observational data indicating that the right whale was migrating northward).

291. *See, e.g.*, Oceana, Inc. v. Pritzker, 125 F. Supp. 3d 232.

292. *See, e.g.*, Hapner v. Tidwell, 621 F.3d 1239, 1245 (9th Cir. 2010); League of Wilderness Defs.-Blue Mountains Biodiversity Project v. Martin, No. 2:10-CV-1346-BR, 2011 WL 2493765 (D. Or. June 23, 2011); Center for Biological Diversity v. U.S. Forest Serv., 687 F. Supp. 3d 1053 (D. Mont. 2023), *aff'd in part, rev'd in part and remanded*, No. 23-2882, 2025 WL 586358 (9th Cir. Feb. 24, 2025).

293. Parmesan et al., *supra* note 61.

Appendix: List of Surveyed Cases

A. Fishery Management

Action	Legal Decision	Description	Statute(s)
Caribbean Fishery BiOp	Center for Biological Diversity v. National Marine Fisheries Serv., 977 F. Supp. 2d 55 (D.P.R. 2013), *as amended* (Oct. 23, 2013), *adhered to on reconsideration*, 191 F. Supp. 3d 157 (D.P.R. 2016)	Upheld 2011 BiOp and "no jeopardy" determination for Caribbean fishery and effects on protected coral species, finding that NMFS had considered the synergistic effects of fish harvest along with climate-induced stressors, and that it was entitled to deference in its risk determination.	ESA
Sea Scallop BiOp	Oceana, Inc. v. Pritzker, 75 F. Supp. 3d 469 (D.D.C. 2014)	Upheld 2012 BiOp and "no jeopardy" determination for sea scallop fishery, finding that NMFS had reasonably determined that data were too inconclusive to accurately predict impact of climate change on loggerhead turtles.	ESA
Seven Fisheries BiOp	Oceana, Inc. v. Pritzker, 125 F. Supp. 3d 232 (D.D.C. 2015)	Remanded 2013 BiOp and "no jeopardy" determination for seven fisheries, finding that NMFS had failed to consider short-term climate risks and implications for loggerhead turtles.	ESA
	Oceana, Inc. v. Ross, No. CV 12-0041 (PLF), 2020 WL 5834832 (D.D.C. Oct. 1, 2020)	Upheld revised seven fisheries BiOp prepared on remand from 2015 decision, finding that NMFS adequately addressed short-term climate risks.	ESA
Shallow-Set (Swordfish) Fishery BiOp	Turtle Island Restoration Network v. U.S. Dep't of Com., 878 F.3d 725 (9th Cir. 2017)	Remanded 2012 BiOp for shallow-set (swordfish) fishery, finding that NMFS had improperly minimized the threat to sea turtles by framing the action as a relatively minor contribution to a very large baseline risk of extinction. Court did not reach NEPA claim.	ESA, NEPA
Anchovy Catch Rule	Oceana, Inc. v. Ross (*Oceana I*), No. 16-CV-06784-LHK, 2018 WL 1989575 (N.D. Cal. Jan. 18, 2018), *enforcement granted*, 359 F. Supp. 3d 821 (N.D. Cal. 2019)	Vacated and remanded 2016 anchovy catch rule, holding that NMFS improperly ignored scientific evidence of northern anchovy population collapse when setting annual catch limit.	MSA
	Oceana, Inc. v. Ross (*Oceana II*), 483 F. Supp. 3d 764 (N.D. Cal. 2020)	Vacated and remanded 2019 anchovy catch rule prepared on remand from *Oceana I*, holding that NMFS improperly ignored scientific evidence of anchovy population collapse when setting annual catch limit for the anchovy fishery ("2019 Catch Rule").	MSA
	Oceana, Inc. v. Coggins (*Oceana III*), 606 F. Supp. 3d 920 (N.D. Cal. 2022)	Upheld 2020 anchovy catch rule prepared on remand from *Oceana II*, holding that NMFS had justified its decision to disregard studies on anchovy population collapse and to use an alternative method for estimating the anchovy population.	MSA
Shrimp Fisheries BiOp	Oceana, Inc. v. Ross, No. CV 15-0555 (PLF), 2020 WL 5995125 (D.D.C. Oct. 9, 2020)	Remanded 2014 BiOp for southeastern United States shrimp fisheries, finding that NMFS had not justified its conclusions about the uncertain nature of climate risks and had not articulated a rational connection between its "no jeopardy" determination and its assessment of climate impacts.	ESA
Summer Flounder Allocation	New York v. Raimondo, 594 F. Supp. 3d 588 (S.D.N.Y. 2022), *aff'd*, 84 F.4th 102 (2d Cir. 2023)	Upheld 2020 allocation rule for annual quotas of summer flounder, finding that NMFS had acknowledged climate change was causing northward migration of the flounder, and was entitled to considerable deference regarding how to use that information when setting quotas.	MSA
Lobster Fisheries BiOp	Center for Biological Diversity v. Raimondo, 610 F. Supp. 3d 252 (D.D.C. 2022), *vacated*, No. CV 18-112 (JEB), 2024 WL 324103 (D.D.C. Jan. 29, 2024)	Remanded 2021 BiOp and "no jeopardy" determination for 10 lobster fisheries and impacts on North Atlantic right whale, finding that NMFS had not justified its "no jeopardy" conclusion (and briefly mentioning climate change as one threat to the whale). Decision subsequently vacated due to legislative intervention and D.C. Circuit decision in *Maine Lobstermen's Ass'n*.	ESA, MMPA
	Maine Lobstermen's Ass'n, Inc. v. National Marine Fisheries Serv., 626 F. Supp. 3d 46 (D.D.C. 2022), *rev'd and remanded sub nom.* Maine Lobstermen's Ass'n v. National Marine Fisheries Serv., 70 F.4th 582 (D.C. Cir. 2023)	District court upheld 2021 BiOp for 10 lobster fisheries, rejecting industry challenge to 50/50 allocation of right whale entanglements between the United States and Canada, and finding that discussion of climate impacts was sufficient. The D.C. Circuit reversed, holding that NMFS could not be "too pessimistic" or give the "benefit of the doubt" to an ESA-protected species.	ESA, MMPA

B. Forest Management

Action	Legal Decision	Description	Statute(s)
Smith Creek Project	Hapner v. Tidwell, 621 F.3d 1239 (9th Cir. 2010)	Held that USFS was not required to analyze climate change-related considerations in EA for relatively small forest thinning project.	NFMA, NEPA
Timber Sales in Blue Mountains	League of Wilderness Defs.-Blue Mountains Biodiversity Project v. Martin, No. 2:10-CV-1346-BR, 2011 WL 2493765 (D. Or. June 23, 2011)	Held that USFS was not required to evaluate carbon sequestration effects in EA for relatively small forest thinning project.	NFMA, NEPA
Snow Basin Vegetation Management Project	Defenders/Blue Mountains Biodiversity Project v. Connaughton, No. 3:12-CV-02271-HZ, 2014 WL 6977611 (D. Or. Dec. 9, 2014)	Deferred to USFS' determination that it was not feasible to quantify GHG emissions from forest management action.	NFMA, NEPA

Action	Legal Decision	Description	Statute(s)
Mendocino National Forest Smokey Project	Conservation Cong. v. U.S. Forest Serv., 235 F. Supp. 3d 1189 (E.D. Cal. 2017), *aff'd*, 775 F. App'x 298 (9th Cir. 2019)	Held that USFS and FWS adequately addressed climate change in 2012 EA and 2012 BiOp for forest management project. Noted that plaintiffs did not make sufficiently specific arguments regarding uncertain effects of the project on the northern spotted owl (including cumulative effects with climate change). Remanded EA for other deficiencies.	NFMA, NEPA, ESA
	Conservation Cong. v. U.S. Forest Serv., No. 2:13-CV-01977-JAM-DB, 2018 WL 1142199 (E.D. Cal. Mar. 2, 2018)	Upheld 2017 EA prepared on remand from previous decision. Held that it was reasonable for USFS to use a 97% fire risk in its analysis of impacts on northern spotted owl, particularly in light of climate change risks.	NEPA
Mendocino Redwood Company Timber Harvest Plan	Forest Pres. Soc'y v. Department of Forestry & Fire Prot., No. A148182, 2018 WL 4091010 (Cal. Ct. App. Aug. 28, 2018)	Upheld the California Department of Forestry's (CDF's) approval of a timber harvesting plan. Rejected arguments that CDF failed to meet its obligations under the California Environmental Quality Act (CEQA) and the Forest Practice Act to consider the plan's cumulative impacts on GHGs. Found that substantial evidence supported the conclusion that cumulative impacts on global warming would be insignificant.	CEQA, California Forest Practice Act
Klamath National Forest Wildfire Risk Reduction	Klamath-Siskiyou Wildlands Ctr. v. Grantham, No. 218CV02785TLNDMC, 2019 WL 331171 (E.D. Cal. Jan. 25, 2019), *rev'd*, 785 F. App'x 467 (9th Cir. 2019)	District court issued preliminary injunction of forestry project that plaintiffs alleged would increase future wildfire risk in context of climate change. Ninth Circuit reversed because it found that district court erred in its application of legal standards for preliminary injunctions.	NFMA, NEPA
Region 3 National Forests BiOp	WildEarth Guardians v. U.S. Fish & Wildlife Serv., 416 F. Supp. 3d 909 (D. Ariz. 2019)	Held that analysis of climate change impacts on Mexican spotted owl was sufficient, but remanded BiOp for other reasons.	ESA
Crystal Clear Restoration Project	Bark v. U.S. Forest Serv., 958 F.3d 865 (9th Cir. 2020)	Remanded action for inadequate NEPA analysis, holding that USFS failed to "engage with the considerable contrary scientific and expert opinion" identified in public comments on the EA concerning forest thinning's effectiveness in suppressing wildfires.	NFMA, NEPA
White River National Forest	Swomley v. Schroyer, 484 F. Supp. 3d 970 (D. Colo. 2020), *aff'd*, No. 20-1335, 2021 WL 4810161 (10th Cir. Oct. 15, 2021)	Held that USFS was not required to accord significant weight to GHG emissions in NEPA review because emissions from project were expected to be of such small scale that they would have little bearing on climate change. Also rejected petitioners' scientific arguments based on extra-record evidence.	NEPA
Shasta Trinity National Forest Fuel Reduction Project	Conservation Cong. v. U.S. Forest Serv., No. 2:13-CV-00934-JAM-DB, 2020 WL 2770068 (E.D. Cal. May 28, 2020)	Granted plaintiffs' request to supplement the administrative record in support of a claim that USFS should have considered GHGs when considering whether to issue a supplemental EIS.	NFMA, NEPA
	Conservation Cong. v. U.S. Forest Serv., No. 2:13-CV-00934-JAM-DB, 2021 WL 1966302 (E.D. Cal. May 17, 2021)	Rejected plaintiffs' second request to supplement the administrative record, and held that plaintiffs were precluded from arguing that USFS' NEPA analysis of GHG emissions was deficient because they did not raise these claims during the administrative process.	NFMA, NEPA
Flathead National Forest Management Plan	O'Neil v. Steele, No. CV 19-140-M-DLC, 2021 WL 5770416 (D. Mont. Dec. 6, 2021)	Held that USFS adequately responded to the plaintiff's comments on the albedo effect, had thoroughly considered the plan's impacts on climate change, and (partially in response to the plaintiff's concerns) had generated alternatives that increased timber harvests.	NEPA
Bear Grub Project and Round Oak Project BiOp	Klamath Siskiyou Wildlands Ctr. v. U.S. Fish & Wildlife Serv., No. 1:21-CV-00058-CL, 2022 WL 856035 (D. Or. Mar. 23, 2022)	Held that BiOp adequately considered climate change and fires' impacts on spotted owl critical habitat, and that FWS' use of historical wildfire data was entitled to significant deference.	ESA
Gallatin Forest Plan	Cottonwood Env't L. Ctr. v. Marten, No. 21-35070, 2022 WL 1439127 (9th Cir. May 6, 2022)	Held that USFS was not required to prepare a supplemental EIS for the 1987 Gallatin Forest Plan (to account for climate change impacts) because the plan was not an "ongoing major Federal action" under NEPA.	NEPA
Nez Perce-Clearwater National Forest Health Projects	Friends of the Clearwater v. Probert, No. 3:21-CV-00189-CWD, 2022 WL 2291246 (D. Idaho June 24, 2022)	Enjoined projects due to inadequate analysis of impacts on old growth forest, but rejected other arguments, including that USFS failed to adequately address contrary scientific views on the efficacy of forest thinning to reduce wildfire risk and insect outbreaks.	NFMA, NEPA
Sunny Oaks Project	Ohio Env't Council v. U.S. Forest Serv., No. 2:21-CV-04380, 2023 WL 2712454 (S.D. Ohio Mar. 30, 2023)	Held that USFS adequately addressed plaintiff's concerns about the project's impact on fungal networks and their role in "carbon storage and sequestration . . . and [ ] forest health and resiliency in the face of climate change." The court ruled for the plaintiff on other aspects of its NEPA claim, but denied the plaintiff's NFMA claim.	NFMA, NEPA
Wishbone Timber Sale	Center for Sustainable Econ. v. Washington State Dep't of Nat. Res., No. 23-2-11799-9 KNT (Wash. Super. Ct. Mar. 28, 2024)	Washington State Department of Natural Resources failed to conduct an adequate review of the climate change impacts of a timber sale and therefore erred when it issued a determination of nonsignificance under the State Environmental Policy Act (SEPA).	SEPA
Forest Plan for Large Diameter Trees in Eastern Oregon and Southern Washington	Greater Hells Canyon Council v. Wilkes, No. 2:22-CV-00859-HL, 2024 WL 1344067 (D. Or. Mar. 29, 2024), *appeal dismissed* No. 24-3386, 2024 WL 4891002 (9th Cir. Oct. 1, 2024), *and appeal dismissed* No. 24-3380, 2024 WL 4891007 (9th Cir. Oct. 1, 2024)	Held that action was not controversial based on climate and carbon sequestration impacts, but remanded to USFS for preparation of EIS on other grounds. Plaintiffs had alleged controversy regarding "the value of large trees as major and increasing stores of carbon that help mitigate climate change."	NFMA, NEPA

Action	Legal Decision	Description	Statute(s)
Rio Grande National Forest Management Plan	Defenders of Wildlife v. U.S. Forest Serv., 94 F.4th 1210 (10th Cir. 2024)	Upheld forest management plan and BiOp, finding that FWS adequately considered "projected climate-driven losses in habitat quality and quantity" across the lynx's habitat in the contiguous United States and deferring to FWS' jeopardy determination.	ESA, NEPA
Kootenai National Forest/Black Ram Project	Center for Biological Diversity v. U.S. Forest Serv., 687 F. Supp. 3d 1053 (D. Mont. 2023), *aff'd in part, rev'd in part and remanded*, No. 23-2882, 2025 WL 586358 (9th Cir. Feb. 24, 2025)	The district court held that USFS did not take a sufficiently "hard look" at carbon sequestration effects due to its use of boilerplate language to describe those effects (this issue was not raised on appeal). The complaint also challenged the use of "stale" data as part of an ESA claim, but these arguments were dismissed by the district court and Ninth Circuit.	NFMA, NEPA, ESA
WAIVED OR UNADDRESSED CLAIMS			
Colville National Forest Logging Plan	Alliance for the Wild Rockies v. Pena, No. 2:16-CV-294-RMP, 2018 WL 4760503 (E.D. Wash. Oct. 2, 2018)	Court said plaintiffs waived climate claims.	NFMA, NEPA
Hoosier National Forest Plan	Monroe Cnty. Bd. of Comm'rs v. U.S. Forest Serv., 595 F. Supp. 3d 713 (S.D. Ind. 2022)	Court did not address climate claims in decision because plaintiffs did not include them in their request for relief.	NFMA, NEPA
Big Weekly Forest Plan	Cascadia Wildlands v. U.S. Bureau of Land Mgmt., No. 6:23-cv-01358 (D. Or. July 18, 2024)	Court did not address claims that BLM should have looked at impacts on carbon sequestration and climate resilience.	NFMA, NEPA
Roadside Hazard Tree Project in Nine National Forests	Klamath Forest All. v. U.S. Forest Serv., No. 3:23-cv-03601 (N.D. Cal. Aug. 23, 2024)	Court did not address plaintiff's argument that USFS failed to properly analyze and disclose the project's impacts on climate change and carbon storage.	NFMA, NEPA

C. Rangeland Management

Action	Legal Decision	Description	Statute(s)
Klamath Basin Grazing Plan and Biological Assessment	Oregon Wild v. U.S. Forest Serv., 193 F. Supp. 3d 1156 (D. Or. 2016)	Held that USFS was not required to evaluate the cumulative effects of grazing and climate change during an informal ESA consultation, because consideration of cumulative effects is discretionary in that context.	ESA, NFMA
	Oregon Wild v. Cummins, 239 F. Supp. 3d 1247 (D. Or. 2017)	Held that USFS was not required to supplement its 2009 NEPA analysis for livestock grazing in the Upper Klamath Basin, despite 2013 and 2014 reports from FWS indicating that climate change and drought posed threats to endangered fish species, because this information was "not new" and grazing plan included provisions for addressing uncertain future impacts of climate change.	NEPA, NFMA
Hammond Ranches Grazing Permits	Western Watersheds Project v. Bernhardt, 392 F. Supp. 3d 1225 (D. Or. 2019)	Remanded grazing plan because DOI did not consider the proposed grazing's impacts in combination with other factors such as climate change or take into account current conditions such as the effects of climate change and fire. The court also said that the fact that grazing had taken place on the allotments in the past did not prevent plaintiffs from demonstrating irreparable harm since circumstances had changed, including due to climate change causing increased temperatures.	FLPMA, NEPA
Antelope Allotment in Fremont-Winema National Forest	Western Watersheds Project v. McKay, No. 22-35706, 2023 WL 7042541 (9th Cir. Oct. 26, 2023)	Held that EIS adequately addressed climate change, but remanded BiOp for inadequate consideration of how climate change would affect the endangered Oregon spotted frog in non-drought years.	NFMA, NEPA, ESA
Sonoran Desert National Monument Grazing Plan	Western Watersheds Project v. U.S. Bureau of Land Mgmt., No. 2:21-cv-01126 (D. Ariz. Aug. 9, 2023)	Held that BLM's NEPA analysis of climate change was sufficient, but found other NEPA violations.	FLPMA, NEPA
WAIVED OR UNADDRESSED CLAIMS			
Oregon Greater Sage Grouse Resource Management Plan	Oregon Nat. Desert Ass'n v. Bushue, 644 F. Supp. 3d 813 (D. Or. 2022)	Held that BLM had violated FLPMA on other grounds, but did not address claim that BLM violated NEPA by failing to consider climate change in its analysis.	FLPMA, NEPA

D. Water Management

Action	Legal Decision	Description	Statute(s)
Central Valley Project/State Water Project BiOp	Natural Res. Def. Council v. Kempthorne, 506 F. Supp. 2d 322 (E.D. Cal. 2007)	Remanded 2005 BiOp assessing the effects of the California Central Valley Project (CVP) and State Water Project (SWP) on the Delta smelt in part due to FWS' failure to consider data on global climate change.	ESA
	Pacific Coast Fed'n of Fishermen's Ass'ns v. Gutierrez, 606 F. Supp. 2d 1122 (E.D. Cal. 2008)	Remanded 2004 BiOp assessing the effects of CVP and SWP operations on salmonoid species due to FWS' failure to consider data on global climate change; found that reliance on historical conditions was inappropriate.	ESA
	Pacific Coast Fed'n of Fishermen's Ass'ns v. Raimondo, No. 120CV00426DADEPG, 2022 WL 789122 (E.D. Cal. Mar. 11, 2022)	Granted voluntary remand without vacatur of 2019 BiOp assessing the effects of CVP and SWP on the Delta smelt, noting that the BiOp contained "ominous" findings about the effects of climate change on the Delta smelt, calling into question the conclusion that the operation of these projects would not cause jeopardy to the species.	ESA, NEPA
South Yuba River Dams BiOp	South Yuba River Citizens League v. National Marine Fisheries Serv., 723 F. Supp. 2d 1247 (E.D. Cal. 2010)	Remanded 2007 BiOp for South Yuba River Dams, holding that NMFS had impermissibly ignored the effects of climate change on water conditions when evaluating impact of operating dams on protected fish species.	ESA, NEPA
Sacramento/ San Joaquin Delta Water Transfers	AquAlliance v. U.S. Bureau of Reclamation, 287 F. Supp. 3d 969 (E.D. Cal. 2018)	Held that U.S. Bureau of Reclamation violated NEPA due to inadequate analysis of climate change impacts on hydrology, but did not find a violation under CEQA.	NEPA, CEQA
Vern Freeman Diversion Dam	Wishtoyo Found. v. United Water Conservation Dist., No. CV163869DOCPLAX, 2018 WL 6265099 (C.D. Cal. Sept. 23, 2018), *aff'd*, 795 F. App'x 541 (9th Cir. 2020)	Held that operation of water diversion project resulted in unauthorized take of southern California steelhead, in part because the project would exacerbate risks associated with climate change (e.g., reduction of suitable habitat) and thus prevent recovery of the species.	ESA, California Endangered Species Act
Oroville Dam Relicensing	County of Butte v. Department of Water Res., 90 Cal. App. 5th 147 (Cal. Ct. App. 2023), *as modified on denial of reh'g* (May 1, 2023), *review denied* (June 28, 2023)	Held that the Department of Water Resources had reasonably concluded that climate change impacts were "too speculative" for further analysis, because two models simulating global and regional climate impacts drew opposite conclusions on whether future conditions would be much wetter or much drier.	CEQA
Oregon Permits for Municipal Water Diversions	WaterWatch of Or., Inc. v. Water Res. Dep't, 527 P.3d 1 (Or. Ct. App.), *review denied*, 534 P.3d 1076 (Or. 2023)	Upheld decision from Oregon Water Resources Department rejecting a recommendation from an administrative law judge to incorporate a curtailment provision in summer months due to uncertainty about climate change. Also upheld the Department's reliance on historical data in projections of future water use. Found that the Department had adequately reviewed available evidence on climate change, including projections of flow and temperature in summer months.	Oregon Water Resources Law
Glen Canyon Dam Water Release Plan	Save the Colo. v. U.S. Dep't of the Interior, No. CV-19-08285-PCT-MTL, 2022 WL 18859975 (D. Ariz. Dec. 23, 2022), *aff'd*, No. 23-15247, 2024 WL 1756103 (9th Cir. Apr. 24, 2024)	Upheld NEPA review of Glen Canyon Dam Water Release Plan, finding that DOI had adequately considered climate change impacts, and that it was reasonable for DOI to use historical hydrological data in conjunction with predictions of future hydrological impacts to evaluate how project alternatives would fare under climate change. The Ninth Circuit did find that DOI had violated NEPA by failing to explain its decision not to prepare a supplemental EIS to consider new studies related to climate change, but held this was a harmless error because there was no evidence the studies contained information that was "not already considered" or would "materially affect" the decision.	NEPA
Gross Dam and Reservoir	Save the Colo. v. Semonite, No. 18-CV-03258-CMA, 2024 WL 4519201 (D. Colo. Oct. 16, 2024)	Remanded §404 permit for expansion of dam and reservoir, finding that the U.S. Army Corps of Engineers violated both the CWA and NEPA because it did not adequately account for the effects of climate change on hydrological conditions.	CWA, NEPA

Notes:

- The "description" focuses on the resolution of claims involving climate change, environmental change, and related issues. The cases featured many other types of claims that are not detailed herein.
- The "statutes" listed in the final column are limited to the statutes that governed the climate change-related claims in each case. All of the federal cases also included APA claims, but these are not listed in the final column because they were ubiquitous and did not provide an independent cause of action.