Sustainability Science
https://doi.org/10.1007/s11625-022-01173-4

SPECIAL FEATURE: ORIGINAL ARTICLE

Networks of Action Situations in Social-Ecological Systems Research

Diverse stakeholders and their interests matter to the U.S. Forest Service: a network of action situations analysis of how stakeholders affect forest plan outcomes

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Received: 31 August 2021 / Accepted: 20 April 2022

Abstract

Since the 1980s, the U.S. Forest Service (USFS) has transformed from an agency predominantly focused on timber production to one focused on recreation and ecosystem management. This shift is particularly remarkable because it occurred without major substantive national forest policy changes. During this period, many national forests changed their forest planning processes in ways that provided greater opportunity for public input into forest plans, and in 2012 the USFS issued new planning rules that institutionalized these practices. In this study, we ask: how has the planning process changed over time, and how have these changes shaped forest plan outcomes? To answer these questions, we conduct a comparative case study of two national forests—the Lake Tahoe Basin Management Unit and the Inyo National Forest—that produced forest plans in the 1980s and again in the 2010s. We use the Network of Action Situations (NAS) approach to compare planning processes over time and across forests. We find that in addition to the changes mandated by the 2012 rules, both forests developed a series of forums to engage the public in plan development and review, and that increased stakeholder engagement has helped shape forest priorities. These findings suggest that greater involvement by regional stakeholders could pressure the USFS to adopt more regional approaches for addressing challenges like climate change and wildfire risk.

Keywords Networks of action situations · US forest service · Administrative decision-making · Institutional analysis · Ecoclimate teleconnections

Introduction

Global and regional environmental problems like climate change, deforestation, and increased wildfire risk have begun to change the way that we think about environmental sustainability. The ecological realities of the twenty-first century suggest that sustainable land management is not only about sustainable resource use but must also address the way that individual management units contribute to global climate change, continental-scale atmospheric conditions, and regional-scale[1] fire regimes and habitat networks.

The U.S. Forest Service (USFS) manages approximately 78 million hectares of forest and rangelands (USFS 2018). Collectively, these hectares influence the extent and severity of wildfires in the U.S. (Abatzoglou et al. 2021; Podschwit and Cullen 2020; Brown et al. 2021); affect habitat

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[1] By "management unit," we mean a single jurisdiction, for example a national forest, national park, or local political jurisdiction, and by "regional scale," we mean geographic extents larger than a single management unit or local political jurisdiction; in the US, regions can contain multiple national forests (the individual management unit) and span multiple political jurisdictions at the intra- and inter-state levels.

Published online: 28 July 2022

connectivity within shared regional ecosystems and between more distant regions (Schröter et al. 2018; Oberlack et al. 2018); and can even affect plant productivity in other parts of the U.S. and North America via impacts on climate, a phenomenon called ecoclimate teleconnections (Swann et al. 2018; Stark et al. 2016; Garcia et al. 2016). In sum, ecological science increasingly shows that land use changes in one location can affect ecological processes—and therefore natural resources and human well-being—in distant locations (Lopez-Hoffman et al. 2013; in ecological and atmospheric sciences, these phenomena are known as telecouplings or teleconnections, respectively). Since a land manager's actions in one region of the US can and will affect ecosystems and people in other parts of the country, sustainable land management may require land managers to shift from a traditional focus on within-jurisdiction resource management, to a more spatially-connected regional perspective (Adger et al. 2009; Hull and Liu 2018; López-Hoffman et al. 2017; Schröter et al. 2018).

To assess whether such a shift is possible within the current USFS planning environment, this paper examines the institutional drivers of a remarkable historical shift in USFS priorities. Until the 1980s, the USFS's primary priority was timber management. Today, however, the agency is much more focused on managing forest lands for recreation and ecosystem management. No major substantive federal policy changes prompted this shift (Kessler et al. 1992; Koontz 2007; Koontz and Bodine 2008; Ryan et al. 2018; Orth and Cheng 2019). During this time, however, forest managers developed new practices for engaging the public in forest planning, some of which have since been institutionalized in the USFS's 2012 Planning Rule. In this study, we ask: how has the planning process changed over time, and how have these changes shaped forest plan outcomes? By empirically examining changes to the forest planning process and assessing whether and how these changes contributed to the USFS's historic shift in priorities, we can draw preliminary conclusions about whether the current institutional framework supports additional future shifts in USFS priorities.

Forest planning is guided by formal institutions and affected by both biophysical and local socio-economic conditions (Ryan et al. 2018). The forest planning process was created by the National Forest Management Act of 1976 (NFMA) and is implemented through USFS planning rules. Through forest planning, individual forests explicitly describe how they will meet statutory requirements through place-specific management (Wilkinson and Anderson 1985).

While the NFMA codified the implementation of multiple use management through forest planning, strong agency traditions around silviculture and forestry, economic dependency of local communities on resource extraction from national forests, and relatively light use by recreationists when compared to recent decades all contributed to a continued focus on timber harvests (Wilkinson 1992; Miller and Staebler 2004). Beginning in the 1980s, however, conflicts began to increase as user communities diversified, resource concerns such as endangered species became more prominent, and political coalitions supporting these interests strengthened (Fleischman 2017). In response, the Forest Service began to adopt ecosystem and adaptive management principles as the guiding logic for planning and decision making to best deliver on its multiple uses (Kessler et al. 1992). These changes are reflected in agency-promulgated rules for implementation of NMFA, culminating in 2012 with the adoption of a revised National Forest System Land Management Planning Rule by the US Department of Agriculture.[2]

The 2012 planning rule explicitly acknowledges the historical shift in the demands placed on USFS management. It increases transparency in decision making by expanding opportunities for public engagement, increases flexibility by embracing principles of adaptive management and ecosystem management, and focuses on public priorities by applying ecosystem services concepts (USFS 2012). The overall emphasis of the rule is on watershed and ecosystem management to enhance ecological conditions, both on national forests and adjacent lands. To give forest managers greater ability to adapt their management activities, the 2012 planning rule also explicitly acknowledges the importance of climate change to future forest management (USFS 2012). Finally, in addition to the public comment opportunities required by the National Environmental Policy Act (NEPA), the 2012 planning rule also provides the public an additional opportunity to object to forest plans after plans are finalized, but before they are officially adopted. Ultimately, the 2012 planning rule is the culmination of a period of rapid change of the USFS from an agency primarily concerned with the management of resource extraction through the 1980s, to an agency primarily concerned with ecosystem management by the 2010s.

Our research design focuses on a comparative case study of two California forests—the Lake Tahoe Basin Management Unit and the Inyo National Forest (see Fig. 1 for a map of the two forests). Both forests have outstanding timber potential, but over time have shifted to focus greater attention on recreation and ecosystem management. And unlike many national forests that have produced only a single forest plan during our study period (1980–2020), both forests produced a plan in the 1980s and another in the 2010s, allowing

[2] At the time this article was written in 2021, relatively few forests had completed a forest plan under the 2012 rule because the forest planning process takes several years, and many forests initiated the process before the 2012 rule became final. Going forward, however, the 2012 planning rule will apply to all new forest planning processes (USFS 2012).

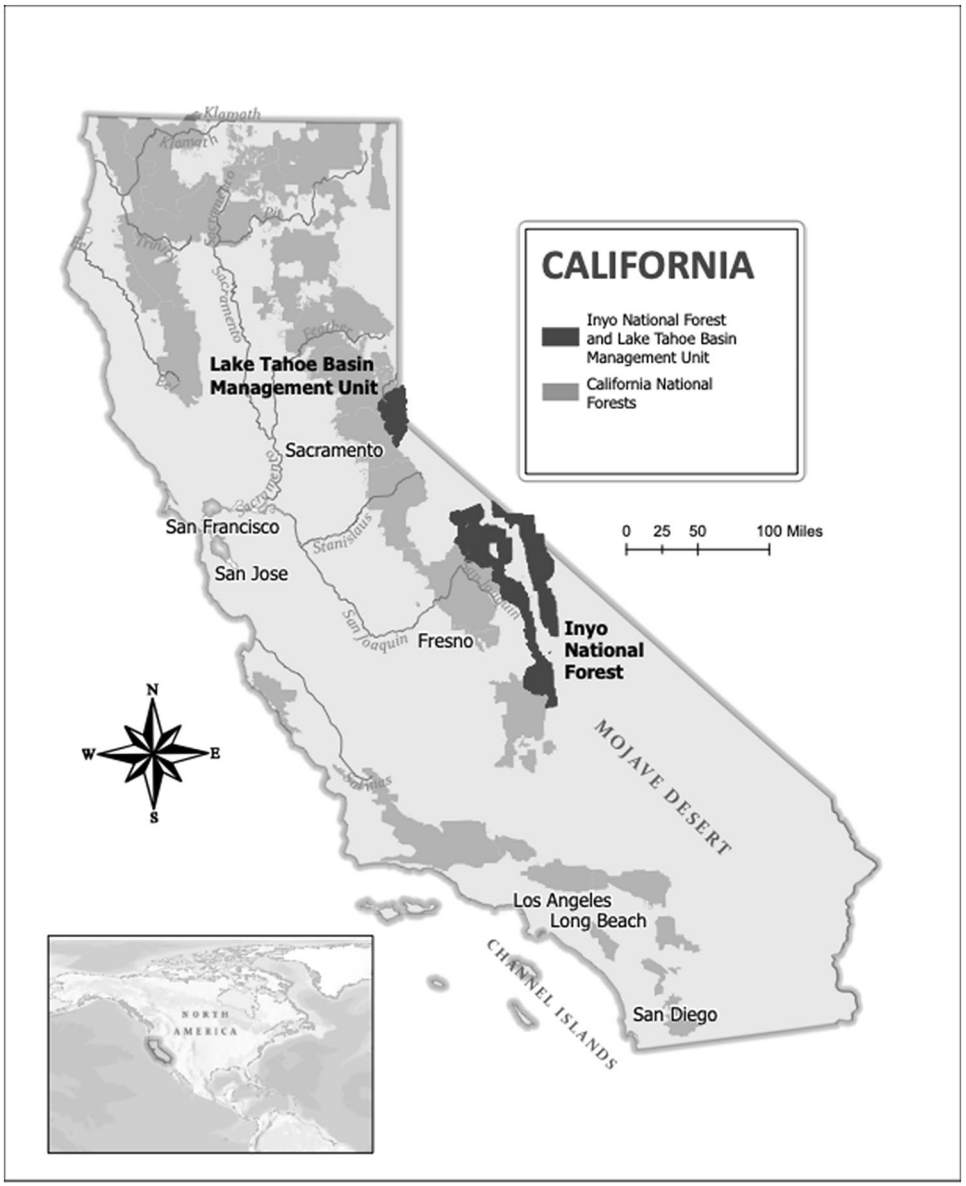

Fig. 1 Map of the locations of the Inyo National Forest and Lake Tahoe Basin Management Unit (LTBMU) (created by University of Arizona student Sawyer Thies)

us to examine changes to the planning process over time. Our empirical inquiry is guided by the emerging Network of Action Situations (NAS) approach (McGinnis 2011; Kimmich 2013), which recognizes policy outcomes as the result of a series of connected "action situations" where policy actors share information and make policy decisions. This approach is particularly useful here since forest plans are shaped by a complex system of procedural and substantive rules, local ecological conditions, and social and political conditions, all of which may have played a role in the historical shift. We use this approach to explain how this occurred from an institutional perspective and to question if an even larger shift—one that demands not only consideration of different types of users and uses of individual national forests but also the impacts of national forest management on distant, seemingly unrelated places—is possible again in a similarly short time frame.

We find that in both forests, the planning process now solicits more public input into draft forest plans. In the Lake Tahoe basin, a multi-stakeholder regional planning process existed in 1988, but intensified considerably by the 2015 forest plan in response to continued pressure on the basin's finite environmental amenities. Similarly, the Inyo's 2019 plan relied on extensive pre-draft scoping that informed plan development. Both forests saw a shift in priorities from an early emphasis on timber management to a later emphasis on recreation and forest health, as well as clear signs that the Forest Service has worked to become more inclusive and responsive to stakeholders' interests in national forests.

While other scholars have documented this shift (Koontz 2007; Koontz and Bodine 2008; Fleischman 2017), this is the first study to explore the institutional changes by which this shift was implemented in practice. Our results show that stakeholders use the current planning process to inform the Forest Service about land uses that would benefit the public, and the Forest Service uses the process to respond to stakeholder demands. To date, however, most of the stakeholders engaged in the process have been geographically proximate to the relevant forest. It remains an empirical question whether the planning process would work similarly for more geographically distant stakeholders who wanted to use the planning process to inform the Forest Service about how land uses affect regional or national wildfire, habitat, or climatic conditions.

Finally, this study contributes to the emerging NAS approach by showing a detailed sequence of steps that analysts can take to construct a NAS conceptual map from archived documents, and also illustrates how such maps can be constructed to allow visual comparison of institutional arrangements over time or across cases. Along with other articles in this Special Issue, we hope that this study will be useful to other scholars interested in further development of the NAS approach.

Research methods, design, and data

Using the NAS approach to guide empirical research

The NAS approach is an extension of Elinor Ostrom's Institutional Analysis and Development (IAD) framework (Ostrom 2011). The IAD framework is built around the "action situation," defined broadly as a social setting where policy actors interact to make, implement, comply with, or respond to policy decisions (Ostrom 2005). Action situations (ASs) include a wide range of policy settings, from legislative proceedings to public meetings. A key contribution of the IAD is identifying key sets of variables that can be used to describe any AS, including the starting biophysical, social, and institutional conditions, as well as the actors, information, and internal rules that lead to outputs and outcomes. The IAD also identifies seven rule types (position, boundary, choice, aggregation, information, pay-off, and scope) that combine in different ways to define the scope, participants, and range of interactions of a given action situation (Ostrom and Crawford 2005). Finally, the IAD draws careful distinctions between different levels of governance. At the constitutional level, actors are assigned authority and responsibility for particular matters (deCaro et al. 2017); at the collective choice level, actors collectively decide on major courses of action; and at the operational level, actors implement those collective choice decisions (Ostrom 2005).

McGinnis (2011) first articulated the concept of "networks of adjacent action situations," based on the idea that even the simplest policy settings often include multiple, linked ASs that jointly produce or affect outcomes. Using a stylized example of a commonly owned and managed fishery, McGinnis (2011) identifies one AS where users adopt rules about how much fish each fisher is allowed to take, another where users' compliance is monitored, and another where courts resolve disputes between users. The output of one AS becomes an input to another AS, creating links between ASs that jointly lead to the outcome of interest—sustainable use of the fishery.

Kimmich (2013) conceived of ASs as nodes in a network, thereby tying the NAS concept into a broader set of possible analytical tools based in social network analysis. Since then, a small but growing number of studies have used the NAS concept to frame research, focusing on three basic sets of questions. First, a series of papers has used the NAS concept to identify the way that seemingly distant ASs in different sectors or geographic regions may be connected through transactions, actors, institutions, or flows of information and resources (Villamayor-Tomas et al. 2015; Grundmann and Ehlers 2016; Oberlack et al. 2018). A second set of papers uses longitudinal analysis to understand how complex governance systems evolved over time, using the NAS approach not only to disaggregate complex systems into component ASs, but also to understand how strategic or game-theoretic type interactions between ASs affect collective action outcomes in other ASs (Mock et al. 2019; Dennis and Brondizio 2020; Mendez et al. 2021). A third set of papers explores how multiple ASs may jointly shape outcomes of interest (Gritsenko 2018; Kimmich and Villamayor-Tomas 2019). For example, Baldwin and Tang (2021) examine how diverse policy approaches (command and control policies; cooperative planning; competitive energy markets) are implemented in a series of ASs that jointly combine to affect levels of renewable energy in two different U.S. states.

Methodologically, NAS has been used primarily as an analytical tool to guide systematic and detailed institutional analysis within a qualitative case study (or studies; Kimmich et al. 2022; Kimmich 2013; Mock et al. 2019; Mendez et al. 2021; Baldwin and Tang 2021). Studies also vary in their level of analytical detail and the steps in analysis. Our approach (described in more detail below) follows Kimmich and Villamayor-Tomas (2019) and Baldwin and Tang (2021) by following a series of steps, summarized in Table 1.

Research design, data, and methods

Our study focuses on forest planning for California's national forests from the late 1980s to the present. California provides an ideal test case for examining the USFS's historical shift from timber management to ecosystem management. The

Table 1 Steps in NAS analysis

Steps in NAS analysis	Rationale and description
1. Identify AS_1 and define its boundaries	AS_1 is the focal action situation that most directly produces the outcome of interest. Because ASs can be defined at various levels of aggregation, the analyst must also define the boundaries of AS_1, which will shape the level of detail required in the remainder of the analysis
2. Collect data on the working components of AS_1	Understanding the working components of AS_1 provides a qualitative understanding of how outputs and outcomes are produced, which usually requires relying on textual or interview data. The level of detail required to describe AS_1's working components will depend on the way the analysis defines AS_1's boundaries and scope. Depending on the level of detail in the analysis, the analyst may wish to repeat this process for other ASs in the network
3. Identify additional ASs that are linked to AS_1 and define the scope of the NAS	Adjacent ASs are those that affect AS_1's outcomes directly, or indirectly through their impacts on AS_1. Potentially adjacent ASs are nearly infinite, requiring the analyst to determine the boundaries of the NAS that will be studied—for example, by identifying adjacent ASs that have the greatest potential effect on the outcome of interest. One way to identify adjacent ASs that affect outcomes indirectly is by examining the working components of AS_1 and identifying ASs that produce or shape those working components
4. Create a conceptual map of the NAS	A conceptual map of the NAS provides a systematic, visual description of relationships between components of complex governance arrangements. The conceptual map can include ASs at multiple levels. It may also include constitutional or collective choice level rules that affect ASs
5. Additional qualitative or quantitative analysis	Analysts who wish to move beyond description can use variables and relationships identified in the NAS to inform hypothesis development, research design, or other additional qualitative and quantitative analysis

demand for endangered species habitat, wilderness, recreational access, and other management priorities for national forests is particularly acute in California because of population growth and changing demographics. California's forests are also part of a regional fire regime that has received increased attention in recent years. Regional management is likely needed to address the increase in very large wildfires (Goss et al. 2020; Podschwit and Cullen 2020; Burke et al. 2021).

Within California, we selected two forests for a within- and across-case comparative study: the Lake Tahoe Basin Management Unit (LTBMU) and the Inyo Forest. Unlike many forests that completed only one forest plan during our study period, each of these forests completed two, allowing us to directly compare how the forest planning process changed over time. These two forests also have similar biophysical contexts—rich acres of timberland surrounding world-class waterbodies (LTBMU) or geological features (Inyo). But they have different social and institutional settings. The LTMBU is a special unit of the USFS established to manage the unique recreation and water quality issues surrounding Lake Tahoe. Because Lake Tahoe is a vacation destination, the LTMBU operates within an environment of increasing demand for finite environmental resources and amenities. The Inyo has a wider and more traditional range of resource management concerns including recreation, wildfire, endangered species, and old growth forests. This cross-forest variation allows us to see how planning processes change over time and across different environmental and institutional contexts.

Our comparative case study maps and compares the NASs leading to forest plan adoptions across four cases—the 1988 and 2015 planning processes in the LTBMU, and the 1988 and 2019 planning processes in the Inyo. We start by identifying the forest plan development process as the focal action situation, because the final adopted forest plan directly produces our outcome of interest: forest planning outcomes. We define "planning outcomes" to include the following three elements: the forest plan scope, e.g., the issues that will be addressed in the plan; the substantive choices made in the plan, e.g., to expand or contract recreational access, resource extraction, timber harvests, or ecosystem restoration; and the degree to which the plan considered needs outside the spatial confines of the forest itself, e.g., impacts on local or regional communities or ecosystems. The forest planning process is thus identified as AS1. The forest planning process itself is guided by the National Environmental Policy Act, which requires the preparation of an Environmental Impact Statement (EIS) and a period where the public can comment on draft plans.

Next, we collect qualitative data on the working components of AS_1. Undergraduate research assistants reviewed forest plans and impact statements to highlight portions of the text that describe one or more of AS_1's working components, and PIs then reviewed the highlighted text and generated qualitative descriptions of those working components, summarized in Tables 2 and 3. This step

Table 2 Working components of the 1998 and 2015 planning processes for the LTBMU

Working component	1998 plan	2015 plan
Biophysical conditions	Declining water, air quality, and visibility	Declining water quality Increased fire risk Inadequate infrastructure
Social conditions	Six groups of stakeholders in the area: • Recreation-dependent businesses; • Lifestyle residents; • Recreation visitors; • Environmental groups; • "Old Tahoe" summer vacation enclaves • owners of undeveloped lots	Increasing demand for recreation facilities for snowboarding and mountain biking Increasing demand for non-motorized recreation Growing stakeholder interest in "passive management" approaches to fire and water (restoring natural fire/hydrological cycles)
Institutional conditions	Procedural rules determined by NFMA and NEPA; 1982 planning rules apply Substantive choices constrained by obligation to comply with Tahoe Regional Planning Agency ecological thresholds	Procedural rules determined by NFMA and NEPA; 1982 planning rules apply, with the addition of a new objection process from the 2012 planning rule Substantive choices constrained by obligation to comply with Tahoe Regional Planning Agency ecological thresholds Substantive choices informed by Pathway 2007 vision for the Tahoe region
Actors	LTBMU's Interdisciplinary Planning team LTBMU Forest Supervisor Expert consultants Public commenters	LTBMU's Interdisciplinary Planning team LTBMU Forest Supervisor Expert consultants State and tribal wildlife officials Public commenters
Information	Nine plan alternatives Assessment of each plan's environmental and social impacts Public comments on draft plan	State and tribal agency input in pre-scoping sessions Five plan alternatives Public feedback on plan alternatives Assessment of each plan's environmental and social impacts Public comments on draft plan Objections raised on revised plan
Outcomes—plan scope	• Water quality • Recreation access • Resource extraction • Management of roadless areas • Management of newly acquired environmentally sensitive lots	•Watershed health •Forest health and fire risks •Sustainable recreation •Infrastructure for recreational access
Outcomes—content of preferred alternative	• Active riparian restoration program • Expansion of ski areas • New nonmotorized recreation access • Reduced timber harvest • Two new wilderness or Special Interest land designations	•Retain 1988 plan objectives •Maintain ecological conditions as they were in 1980s •Continue active riparian restoration •Modify timber harvest to reduce wildfire risk •Small increases to ski area capacity
Outcomes—spatial impacts	LTBMU "zone of influence" defined as including the basin; plan contents reflect consideration of forest impacts on the local economy, air quality, and water supply	LTBMU "zone of influence" defined as including the basin; plan contents reflect consideration of forest impacts on the local economy, air quality, and water supply

Table 3 Working components of the 1998 and 2019 planning processes for the Inyo

Working component	1998 plan	2019 plan
Biophysical conditions	Good air quality Modest fire risk Rich in timber and mineral resources Provides 80% of LA's water Declining waterfowl habitat	Increased risk of high-intensity wildfire Ecosystem threats due to fire, drought, and climate impacts
Social conditions	Six groups of stakeholders in the area: • Long-time residents • Regional recreationists • Seasonal employees • Special use permittees • American Indians • Retirees	Increasing demand for recreation; overcrowded recreation facilities Increased stress on watersheds Smoke from wildfires and prescribed burning affecting tourism
Institutional conditions	Procedural rules determined by NFMA and NEPA; 1982 planning rules apply Substantive choices informed by Mono County planning processes	Procedural rules determined by NFMA and NEPA; 2012 planning rules apply Process informed by bioregional assessments and Sierra Cascades dialog
Actors	Inyo's Interdisciplinary Planning team Inyo Forest Supervisor Consulting parties include state, tribal, and LA county natural resource agencies Public commenters	Inyo's Interdisciplinary Planning team Inyo Forest Supervisor Consulting parties include state, tribal, and LA county natural resource agencies Public commenters
Information	Nine plan alternatives Assessment of each plan's environmental and social impacts Public comments on draft plan	Results of bioregional assessments, Sierra Cascades dialog Four plan alternatives Assessment of each plan's environmental and social impacts Public comments on draft plan Objections to revised plan
Outcomes—plan scope	Plan scope was not narrowly defined; plan would need to address wide-ranging issues about the forest's future directions for timber, grazing, wildlife, wilderness, and recreation	• Ecological resilience • Fuels treatment and fire management • Watershed restoration • Additional wilderness designations
Outcomes—content of preferred alternative	• Adds developed recreation sites for summer recreation and skiing • Manages timber to provide continuing supply • Increases grazing in response to demand • Increases wilderness designations where there are no conflicts with other uses	• Creates new wildfire management zones based on risks to wildlife, communities, developed recreation sites • Creates new conservation watershed districts to address ecological integrity • Establishes 3 management areas for destination, general, and backroad recreation
Outcomes—spatial impacts	Plan recognizes its important role in the local economy and the LA watershed	Plan recognizes its important role in the local economy and the LA watershed

in the analysis is iterative with step 3, where we identify additional ASs that affect outcomes. As suggested by McGinnis (2011), "adjacent" ASs affect the working components of the focal AS. During this step, the analyst must make decisions about where to draw the boundaries of the network. In the present study, we identify adjacent ASs by reviewing forest planning documents for mention of forums, workshops, regulations, and other potential ASs that affect a working component of AS_1 in some way. To put some practical boundaries around our analysis, we then filtered these mentions to exclude potential ASs that seemed likely to have limited impact on our outcome of interest. Our approach provides a reasonable picture of the "official" NAS as it is described in government documents. It is likely not comprehensive, however, since it may miss potentially relevant ASs that are not mentioned in planning documents, including informal ASs, or ASs that have an indirect effect on forest planning outcomes.

We used these data to create a conceptual map of the NAS for each forest planning process, shown in Figs. 2, 3, 4, 5. These maps reflect the presence and direction of links between ASs, as well as the specific working components of AS_1 that are affected by a given link. Our particular approach to constructing links between ASs is driven in part by our underlying data source, which provides considerable detail about the institutions and venues that constrain or inform forest plans, but provides limited detail about the individual actors who participate in these adjacent venues.

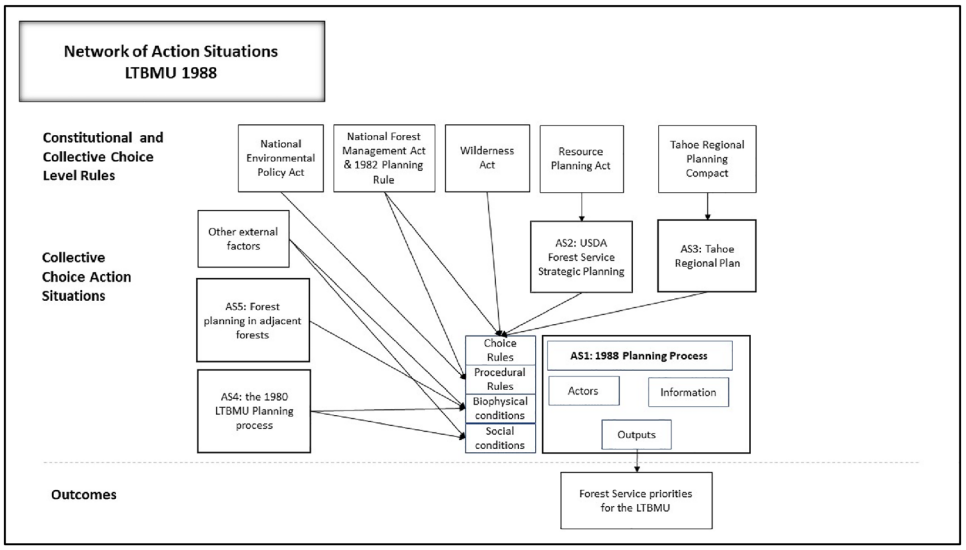

Fig. 2 The Network of Action Situations for LTBMU's 1988 Planning Process. Data were drawn from forest planning and EIS documents for the LTBMU

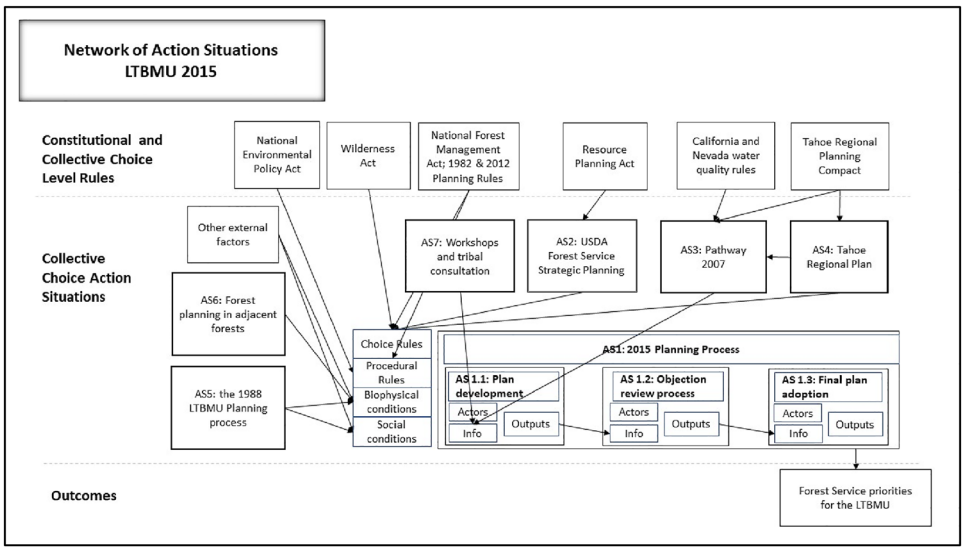

Fig. 3 The Network of Action Situations for LTBMU's 2015 Planning Process. Data were drawn from forest planning and EIS documents for the LTBMU

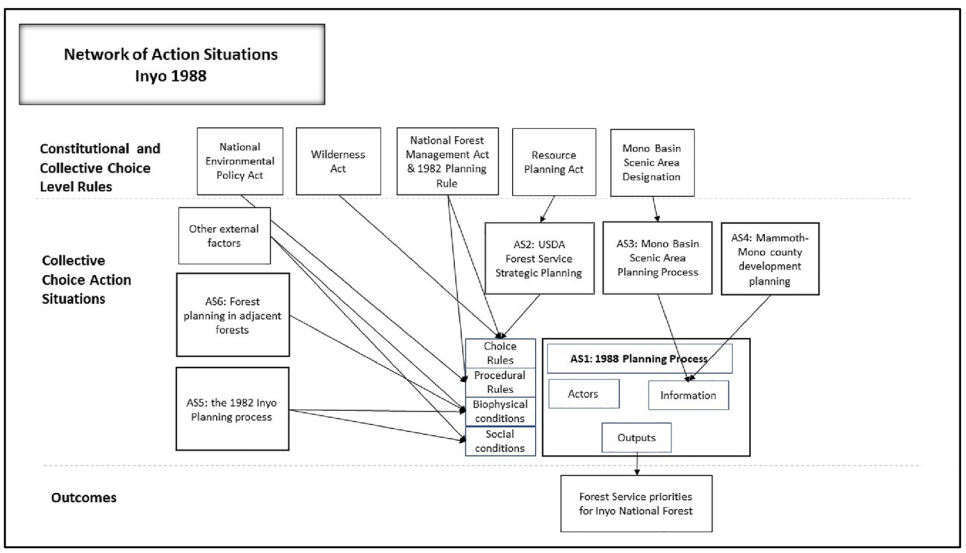

Fig. 4 The Network of Action Situations for Inyo's 1988 Planning Process. Data were drawn from forest planning and EIS documents for the Inyo National Forest

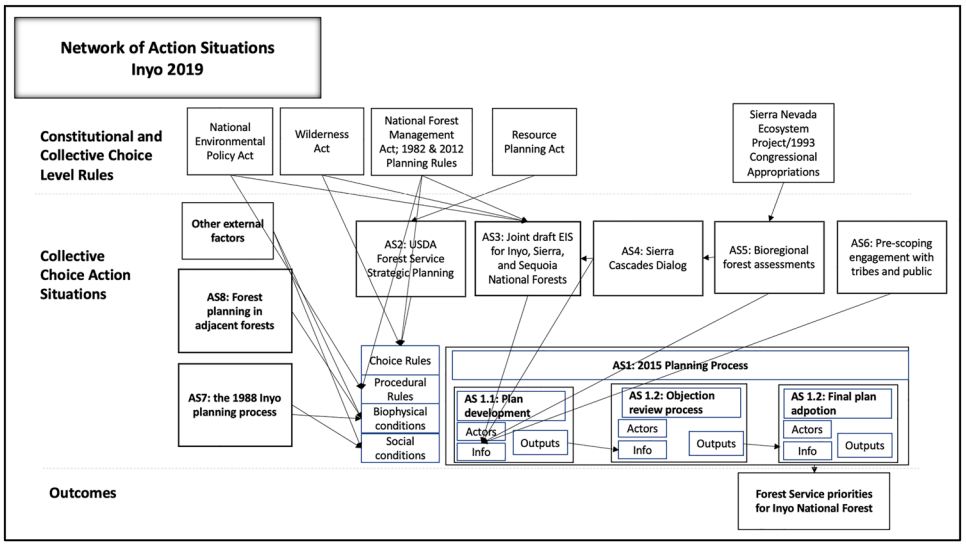

Fig. 5 The Network of Action Situations for Inyo's 2019 Planning Process. Data were drawn from forest planning and EIS documents for the Inyo National Forest

This contrasts with other possible approaches—for example, social network analyses would identify links based on actors who participate in multiple forums within the NAS. Here, our research question focuses on institutional links between ASs, rather than actors' behaviors, and our data sources and methods reflect this focus.

Finally, we use these NAS maps as the basis for a qualitative comparative study of how forest planning processes have changed over time and across forests. While our research design does not permit causal inference about the impact of process on outcomes, we use qualitative process tracing to explore how each plan changed over time, taking particular note of instances where changes to the process created opportunities for stakeholder input.

Results

Both National Forests produced plans in 1988 and then again in the 2010s. Below we summarize the working components for each forest planning process. Unless otherwise noted, data below are drawn directly from the forest plans and environmental impact statements for each planning process.

The Lake Tahoe Basin Management Unit (LTBMU)

The Lake Tahoe Basin Management Unit (LTBMU) is a special unit that was created to address the unique management challenges of maintaining the ecological health of Lake Tahoe and the three national forests immediately surrounding the lake, which were originally administered separately. Lake Tahoe is recognized as a "recreation resource of world significance," and the lake is a main draw for the surrounding community's tourism-dependent economy. Although 78,000 acres within the LTBMU were considered suitable for timber production in the 1988 forest plan, receipts from skiing produced far greater revenue for the forest.

By the late 1980s, policy leaders in the area recognized that the basin could not continue to support unlimited development and that space, water supply, and infrastructure were limited. However, there were different views about whether limits on development had been reached, or how to allocate any remaining development potential across USFS, other public landowners, existing private users, and new private development. To address these issues, the states of California and Nevada entered into a Congressionally ratified Tahoe Regional Planning Compact (TRPC), which created the Tahoe Regional Planning Agency (TRPA) to oversee economic development in the area, and a new collective choice action situation for regional planning that includes both the USFS and other actors. Starting in 1982, TRPA has established and updated threshold limits for water and air quality, solid waste, noise pollution, and other ecological thresholds that the LTBMU must comply with in their planning process. The TRPC is a unique constitutional level institution that is not present in other national forests and has the effect of mandating regional cooperation by the USFS in its management planning.

The planning process for the LTBMU's 1988 plan is summarized in Fig. 2. In 1988, the USFS developed an initial draft plan that complied with the substantive requirements of the TRPA and was consistent with the USFS agency-wide strategic plan. Beyond concerns about water quality and timber harvest, a key issue in the 1988 plan was whether the USFS wanted to exert claims to new recreation development. The USFS developed nine alternatives, including the "do nothing" alternative to retain the goals and objectives of its prior 1980 plan. Its preferred alternative initiated active forest restoration to improve water quality along riparian areas, a reduction in timber harvest to help meet regional

ecological thresholds, and the addition of five new ski areas, as well as new nonmotorized access to dispersed recreation sites. Per the procedural requirements of the 1982 Planning Rule and the National Environmental Policy Act, the USFS developed a draft EIS and proposed forest plan and made it available for public comment. Public comments were not summarized in detail in the 1988 Plan. Following public comment, the LTBMU made minimal changes to the plan and retained its preferred alternative, suggesting that public participation had limited effect on the plan's scope and substance.

The planning process changed considerably between 1982 and 2015. Figure 3 visually shows these changes by splitting AS1 into three sub-ASs: $AS_{1.1}$ for plan development; $AS_{1.2}$ for the objection process; and $AS_{1.3}$ for plan adoption. We consider these sub-ASs to be part of AS_1 because they share the same biophysical, social, and institutional conditions and are guided by a common set of rules designed to produce a final forest plan; but each has a distinct set of internal working components (actors, information, and outputs), suggesting that they are distinct sub-ASs within AS_1.

$AS_{1.1}$, plan development, was informed by "Pathway 2007," a series of basin-wide meetings designed to help establish a shared vision for the basin that would inform the LTBMU's forest planning. Pathway 2007 revealed, among other things, that stakeholders differ in whether they believe the USFS should continue to actively manage hydrological and fire conditions in the basin, or whether USFS should seek to restore natural hydrological and fire cycles to the region. The LTBMU subsequently held five public workshops over a two-year period to better understand the issues that the public wanted the plan to address, a continuation of the early phase of $AS_{1.1}$. After initiating the planning process, the LTBMU also held a series of consultation meetings with the Washoe Tribe and with California and Nevada wildlife agencies (AS_7) to seek input on plan alternatives. The preferred alternative continued the management goals and direction established in the 1988 plan, including active riparian area management, and provided for small additions to dispersed recreational access and no major new infrastructure. Once the draft plan was developed, the LTBMU held two public meetings and received over 18,000 comments on the draft. The public process prompted the LTMBU to modify its initial preferred alternative by adding small increases to the forest's ski areas and hotel capacity. Together, the length and breadth of the public input and consultation processes carried out in $AS_{1.1}$ indicate a dramatic increase in the role of public involvement in the planning process compared to the 1988 plan.

While the 2015 plan was initiated prior to the Forest Service's promulgation of its 2012 planning rule, the LTBMU did adopt one element of the 2012 rule—the establishment of an objection process, where objections not resolved in the LTBMU's post-comment revisions would be reviewed and resolved by external USFS personnel in the D.C. office ($AS_{1.2}$). Twelve objections were submitted under the new objection rule, identifying 200 issues. The objections resulted in two meetings with objection Reviewing Officers in USFS's Washington D.C. headquarters to clarify and resolve objections and minor adjustments to the forest plan before its adoption.

In both planning processes, the LTBMU recognizes that the forest attracts visitors from all over the world but defines its primary "zone of influence" to include the basin itself. The LTBMU supports an "extended zone of influence" through robust recreational activities that spur employment and population growth in adjacent communities. Both plans mention the economic (e.g., employment, income) and social (e.g., lifestyle, beliefs, community stability) effects on the immediately surrounding Greater Lake Tahoe area. Although it is assumed that the LTBMU impacts ecosystems linked outside of the spatial confines of the basin, little was explicitly noted in either plan. The working components of both processes are summarized in Table 2.

The Inyo national forest

The Inyo National Forest is much larger than the LTBMU, comprising 1.9 million acres, of which 565,000 acres are congressionally designated as wilderness areas. The forest is the fifth most visited national forest in the U.S., and is a top destination for skiing, wilderness recreation, and cold-water fishing. In the 1988 plan, 91,000 acres were identified as suitable for timber production, with average harvests around 10 million board feet annually—considerably higher than in the LTBMU. Unlike the LTBMU, the surrounding counties had low population density in the 1980s, although the population has grown considerably in recent decades. In 1988, the forest supplied 80% of Los Angeles' water supply, leading to conflicts between consumptive uses of water and instream uses.

When the Inyo began its 1988 planning process, the primary issues to be resolved focused on assessing and managing tradeoffs between economic, recreational, ecological, and socio-cultural uses of the forest. Congress had recently passed the California Wilderness Act of 1984, which designated over 500,000 acres as wilderness and identified an additional 500,000 acres as "future planning areas," potentially suitable for wilderness or other conservation designations. Stakeholders had different views about whether these acres should be immediately designated as wilderness to prevent roads and development, or specifically designated as areas where timber, mining, and other economic uses could be pursued. The forest had also recently acquired the Mono Basin National Forest Scenic area, 116 mostly lakeside areas that had formerly been managed by the Bureau of

Land Management and the state of California. This unique constitutional level institution prompted a related collective choice action situation to plan the future management of this new resource. Through this action situation, all decisions about whether and how to develop the scenic area for economic use were coordinated with the Mammoth-Mono County Development Plan (Fig. 4).

The planning process for the 1988 plan (Fig. 4) is very similar to the 1988 process for the LTBMU. In 1988, the USFS developed an initial draft plan and EIS that complied with federal requirements and included consultation and coordination with other planning processes in the basin, as well as with other natural resource agencies including Los Angeles water district. Unlike the LTBMU, where the plan scope was narrowed to a few priority issues early on, the Inyo identified over 20 priority issues. The USFS developed six alternatives, including the "do nothing" alternative to retain the goals and objectives of the prior plan, one alternative that prioritizes commodity extraction, another that maximizes revenue-generating activities (including recreation and grazing), and two that emphasize amenity values such as wilderness, wildlife, and recreation. The preferred alternative in the draft plan balances commodity and amenity outputs by maintaining existing levels of timber and water extraction, adding grazing and recreation opportunities in response to growing demand, and increasing the wilderness land base to the degree that doing so does not conflict with other uses.

Similar to the LTBMU, the Inyo plan appreciates the forest's wonderment both domestically and internationally, and acknowledges it is the most heavily used wilderness in the nation. However, through land ownership and employment opportunities, the primary economic and social zone of influence encompasses the forest's Inyo and Mono Counties. Economic and social stability of these counties are directly linked to the forest's recreation and tourism industries. Unlike the LTBMU, the plan notes that other immediately adjacent urban counties (i.e., Madera and Fresno) are less reliant upon and less impacted by the forest. The Inyo's "secondary zone of influence" is Southern California, where strong demand for recreational activities has feedback effects on communities in the primary zone of influence. Additionally, because the forest supplies a majority of Los Angeles' water supply, the plan focuses on both local and distant (i.e., Los Angeles) demand for public water.

As in the LTBMU, the planning process changed considerably between 1982 and 2019, as shown in Fig. 5. Procedurally, the process was subject to the 2012 Planning Rule, including the separate objection review process, resulting in the same three-part AS1: plan development ($AS_{1.1}$), the objection process ($AS_{1.2}$), and plan adoption ($AS_{1.3}$). As with the LTBMU, the 2019 planning process involved considerable public engagement and coordination in the plan development phase of the process, prompted in part by new constitutional level institutions established by Congress. In 1993, Congress appropriated funds for a regional study of the Sierra Nevada, leading to a series of bioregional forest assessments (AS_5, each an individual action situation connected to AS_1) of the area that were used to inform the Sierra Cascades dialog (AS_4, another new action situation connected to AS_1), a series of meetings with stakeholders to develop a vision for the region. Following this process, the Inyo and neighboring Sierra and Sequoia national forests initially produced a joint draft plan (AS_3). Ultimately, the Inyo decided to prepare a separate plan that included pre-scoping meetings with tribes and the public to help develop an initial set of plan alternatives.

The draft plan identified four alternatives, including retaining the 1988 plan with minimal updates to protect newly listed endangered species; an alternative designed to add wilderness and restore fire as an ecosystem process; an alternative that would not add any new wilderness and would involve more active ecosystem restoration and wildfire prevention activities; and the preferred alternative, which would create new fire management zones based on different levels of fire risk, emphasize resilience and protection for endangered species, and add new wilderness zones. The draft plan received over 32,000 comments and prompted the development of a new preferred alternative that adjusted the new fire management zone based on new data; created larger conservation watershed districts; and established three general recreation management areas, distinguishing between destination recreation, general recreation, and "challenging backroad areas." An objection period was held for 60 days after the revised plan was released, and 22 objections were reviewed by the USFS's Pacific Southwest regional office. During a resolution meeting, seven working groups were established in which objectors were encouraged to find common ground and resolve their objections. The reviewing office incorporated working group results into the draft, largely updating scientific information and correcting errors.

The 2019 forest plan takes a more regional tone than the 1988 plan, noting the interdependent impacts of forest management on adjacent lands managed by the Bureau of Land Management, private owners, and the Los Angeles Department of Water and Power. The more recent plan demonstrates a clearer understanding of the holistic nature of land management such that "cumulative effects across boundaries" exist (e.g., pathogens and insects can spread across jurisdictions). In particular, wildfire management and restoration treatments are presented as problems requiring coordination with local and state fire agencies, Bureau of Land Management, tribal liaisons, and adjacent communities. Similar to the 1988 plan, recreation and tourism activities continue to sustain communities surrounding the Inyo and

affect quality of life for locals and people "further removed from the plan area". While the forest supplies municipal water and electric power to Los Angeles, Fresno, and surrounding communities, the plan notes that these benefits impact people across the state "even if they do not live near the national forest nor ever plan to visit there".

Cross-case comparison of the effect of public engagement on plan outcomes

In both LTBMU's 2015 and Inyo's 2019 plans and their accompanying EISs, there is significantly more evidence of an extensive public engagement effort that had meaningful impacts on the forest planning process. This is evidence of the increasing importance of diverse actors on forest plan outcomes and an indicator of the influence of shifting public attitudes on USFS decision making. In both cases, the public participation process resulted in substantive changes to the forest plan as evidenced by the addition and adoption of a new plan alternative between the draft and final EISs, something that had not occurred in the 1980 planning processes. Changes to the Lake Tahoe Basin plan focused on recreation while changes to the Inyo plan focused on wildfire, recreation, and ecosystem restoration.

The two cases also illustrate how underlying contextual factors may shape planning processes in different ways. In the LTBMU, where demand for environmental amenities outstrips the basin's sustainable carrying capacity, the TRPA has developed ecological thresholds that constrain the LTBMU's possible range of activities. In the Sierra Nevada, concerns about regional forest management prompted scientific assessment and shared development of a vision for the region, but these activities inform, rather than legally constrain, the Inyo's management.

In both cases the USFS is cognizant of its national and international impact beyond the spatial confines of the forest. However, typically, outreach and plan outputs are limited in their geographic reach, emphasizing immediately surrounding counties, communities, and lands. The 2019 Inyo plan was notably comprehensive in its outreach to regional players and understanding of the plan's impact beyond forest confines. For example, the plan refers to an interdependent relationship with regional fire managers and reliance of Los Angeles and Fresno on the forest.

The two cases also illustrate the complexity of the forest planning process, particularly during the study period when forest planning was delayed and rules were changing. Regardless of which planning rule was in effect, the outcome of the forest planning process in all four cases was a detailed forest plan that clearly articulated how the USFS intended to manage these forests for the next 10–15 years. The older plans had different formats, which arguably make it more difficult to link management actions to specific places on a forest. Substantive changes are also evident. These changes indicate a shift in planning approach from a purely technical process to planning as a technical process that also must include and be responsive to the public. The change toward public engagement and its effect on plan scope, content, and outcomes had already started before the 2012 planning rule went into effect, as is evidenced by the Lake Tahoe Basin plan, which was developed under the 1982 rule but had little resemblance to its 1988 forest plan. Some of this change is likely the result of changing collective choice institutions in the form of Forest Service Handbooks and Manuals. This could also be seen as an indicator of an agency evolving to recognize the importance of public engagement, or to avoid the impacts of expensive lawsuits over forest plans that were not seen as responsive to the public, or a combination of these and perhaps other factors. Regardless, the 2012 planning rule appears to have institutionalized a change that had already begun.

This brief case study provides an illustration of how institutional and socio-economic conditions interact to shape not only the scope but also the content of forest plans. The procedural rules that shape forest planning—here, the forest planning rules and the NEPA process—had no independent, substantive effects on the scope or content of the forest plans, but nonetheless provided stakeholders with opportunities to influence forest plans in meaningful ways. The changes that the Forest Service made to the Lake Tahoe Basin and Inyo plans during their development show stakeholders had a significant influence on the content of the final plans.

Process rules allowed stakeholders to exert influence on the plan, suggesting that forest plans can be substantially shaped by stakeholders who have the motivation and capacity to engage with the process. The current planning processes and outreach activities allow a wide range of stakeholders like county governments, tribes, and wildlife experts to engage with forest planners via diverse modes of participation like public workshops, formal consultation, and public commenting intended to influence the content of forest plans. Although we do not have detailed data on the resource and organizational capacity of stakeholders, in a few instances we can infer motivation to participate based on the way that the public involvement process unfolded. For instance, the Washoe Tribe has a stake in maintaining their cultural traditions at Lake Tahoe by advancing traditional environmental management practices. To achieve this goal and cultivate a relationship with USFS, the Tribe was formally solicited for input on the forest plan. Meanwhile, the Los Angeles Department of Water and Power maintains a direct economic stake in the Inyo forest plan as the forest supplies water and electric power to LA. In contrast, substantive laws seemed to shape the scope, but not the content of plans.

Discussion and conclusions

This study is not the first to observe that the Forest Service has made a deliberate effort to engage and respond to shifting public demands and uses for forests. Our novel contribution, however, is using institutional analysis to explore how the USFS executed this effort in practice. In particular, we mobilize a set of methods in the NAS approach that allow for fine-grained, systematic, qualitative empirical analysis of institutional variation in the forest planning process. Doing so allows us to see that in both forests, stakeholder engagement has not only increased overall, but has increased early on in the forest planning process, when the plan's scope and alternatives are still malleable. It also allows us to see how the details of this early engagement can and do vary across forests in response to the biophysical and social context. Thus, we use NAS not only to describe a complex governance arrangement, but also to answer specific questions about how the process has changed over time and across cases.

Through our comparative case study, we track changes in forest planning from the late 1980s to the 2010s in two forests. The 2012 forest planning rule certainly prompted some changes, most notably the objection review process observed in both the LTBMU and the Inyo's revised planning processes. But our case study also shows that even without the 2012 rule changes, the USFS had begun to offer greater opportunities for the public to engage in forest planning. By the 2010s, both forests had initiated extensive prescoping and scoping opportunities for public engagement in their latter planning processes, and compared to the initial 1988 plans, engaged relevant stakeholders in the process of identifying possible plan alternatives. In the 1980s, the public was invited to comment on plan drafts; but by the 2010s, the public was invited to forums where stakeholders could help develop a shared vision for the region, to workshops where plan alternatives were developed, and to public hearings presenting draft plans.

We also asked how changes to the planning process affected forest plan outcomes, specifically the plan's (i) scope, (ii) content of preferred alternatives, and (iii) spatial impacts. In both forests, changes to the planning process helped shift USFS from its initial emphasis on timber management and resource extraction to its current focus on recreation and ecosystem management. Our case study suggests that changes to the process have allowed the public and other stakeholders to exert considerably more influence over the process at a time when the public was increasingly interested in non-timber uses of national forests and surrounding communities were becoming increasingly dependent on recreation, rather than timber, for economic development. The combination of institutional changes to forest planning and social/political systems confronting sustainability issues, regional forest fires, and climate change (Fleischman 2017; Kessler et al. 1992) may have resulted in later forest plans better tackling ecological resilience and holistic management (e.g., sustainable recreation, forest health and fire risks).

Changes to the planning process also allowed stakeholders to affect the substantive content of forest plans. In the 1980s, the public had little role in plan development, and the plans' preferred alternatives did not change in response to public comment. In the 2010s, in contrast, the public was given many opportunities to provide input as plans were developed, and both plans' preferred alternatives were ultimately modified in response to public comments. The institutional changes that solicited public participation were likely motivated by increasing demand for participatory processes and citizen empowerment in decision making (Fung 2003, 2015; Nabatchi and Amsler 2014; Portney and Berry 2010). A particular participatory renaissance occurred in the field of environmental management, placing emphasis on the normative and instrumental value of public participation (Portney 2005; Rydin and Pennington 2000; Hawkins and Wang 2012; MacArthur 2016). Not only were the preferred alternatives for both forests modified, but the changes seemingly reflected the social and environmental demands of the public (i.e., create new wildfire management zones and conservation watershed districts, increase ski areas). Our case study suggests that stakeholders can leverage these participatory opportunities to have significant effects on both scope and substance of forest plans. These findings also speak directly to research that condemns elite decision makers for practicing tokenism, utilizing stakeholder engagement as a gimmick that still perpetuates power and resource asymmetries (Arnstein 1969; Rowe and Frewer 2000; Fung 2015; Scott and Thomas 2017; Angst et al. 2021). Our work shows that institutional structures adopted by USFS offer stakeholders *real* opportunities to have a substantial impact on forest plans.

Finally, changes to the planning process provided stakeholders a platform to encourage more regional coordination. In both cases the USFS is aware of its impact beyond the spatial confines of the forest; however, outreach and plan outputs tended to be limited in their geographic reach. The 2019 Inyo plan, though, more specifically notes the interdependent nature of forest management on adjacent lands and counties. The more regional emphasis in the Inyo plan likely reflects the economic reliance of surrounding counties and Los Angeles to the forest, as well as its wider range of resource management concerns. Whereas the LTBMU was established specifically to manage the recreation and water quality issues associated with the vacation destination of Lake Tahoe.

Ultimately, our data and methods prohibit us from concluding that the combination of social and biophysical conditions and process change were the *only* drivers of shifting USFS priorities. Other possible factors include broader trends of declining timber production, changing attitudes among USFS employees, increasing demand for public participation mechanisms, and a deeper understanding of climate change. Nonetheless, changing social and institutional conditions and new opportunities for public engagement clearly played a role in this shift, and continue to play a role as USFS shifts to broader questions about how to best manage for resilience in the face of a changing climate.

The substantive and theoretical implications of this paper also contribute to public participation literatures. The use of public participation in policymaking is increasingly widespread, especially in the field of environmental policy. Abundant research extols the importance of public participation in institutional contexts characterized by high levels of fragmentation, decentralization, and complexity (e.g., watershed governance: Fung 2015; Emerson et al. 2012; Mewhirter et al. 2019). Here, public participation may improve the effectiveness of decision making and stimulate innovation with place-based knowledge (Fung 2015; Yang and Callahan 2007; Baldwin 2020; Portney 2005). In this article, we examine public participation and diverse stakeholder engagement in an institutional context traditionally characterized by hierarchy and centralized decision-making structures. However, we find that to construct and implement resilient forest plans, it is increasingly important to incorporate diverse stakeholder interests. While traditionally centralized institutions still guide much of USFS decision-making on public lands, our work shows that even the USFS has moved toward participatory institutions that highlight inclusivity and transparency.

This paper is also motivated by an interest in understanding whether the USFS's current planning process can facilitate a second shift in USFS priorities from a focus on within-forest conditions to a focus on how forests contribute to regional or national conditions. Our analysis shows a limited but increasing effort to consider how national forest management activities affect conditions outside forest boundaries. In early forest plans, consideration of the effects of timber management decisions on economic conditions in nearby communities and the nationwide supply of timber was common. Lake Tahoe Basin, owing to its unique biophysical setting also considered its impacts on water quality and regional development. However, it was relatively uncommon to consider the effects of resource management beyond forest boundaries. By the 2010s this had changed. Consideration of national forest management on adjacent communities (timber, recreation, and tourism), the region as a whole (wildfire, water quality), and even distant connected places (water supply and quality) is seen throughout our case study plans. Forests that provide essential water supply and quality ecosystem services are acutely aware that their management activities can affect communities and the region. While the effects of forest management on wildfire regimes and habitat networks beyond forest boundaries was also common, these considerations were generally focused on geographically adjacent areas rather than the larger regions.

Nonetheless, it is not clear that regional or national stakeholders would wield the same influence in the planning process. The current USFS planning process allows a wide range of stakeholders to participate in forest planning, but in practice both forests have developed processes that focus on engaging local communities and USFS staff are clearly responsive to local economic conditions. This suggests that while the planning process could be used by regional or national stakeholders to push for particular forest outcomes, it is unlikely that these more distant stakeholders will be the target of outreach activities in the planning process. An important next step is dissecting the types of stakeholders who maintain influence in participation processes, including which stakeholders are more adept at prompting changes from draft to final plans, and assessing what kinds of comments USFS perceives as substantive and influential.

Finally, this study also seeks to develop and advance use of NAS for analysis of complex governance arrangements (see Kimmich et al. 2022). While frameworks and methods currently exist for assessing complex social relationships within governance processes (e.g., Lubell 2013; Lubell et al. 2010; McLaughlin et al. 2021; Mewhirter and McLaughlin 2021), methods for understanding institutional relationships are more nascent. Here, we synthesize existing work and present a detailed set of instructions for identifying and analyzing relationships among interconnected action situations, as well as for visualizing these networks by mapping Networks of Action Situations. We expect that the basic approach described here could be combined with a wide range of qualitative and quantitative techniques, including formal modeling, network analysis, and large-n hypothesis testing, particularly as machine learning and natural language processing techniques have been developed to reduce some of the burden and time needed to parse archived policy documents for the kinds of information required in NAS analysis.

In conclusion, our study provides a unique empirical analysis of the forest planning process in California over the last 30 years, highlighting the way that substantive laws, procedural requirements, and stakeholder demands interact to transform the USFS from an agency devoted primarily to timber production to an agency focused on ecosystem management. We find that substantive policy requirements are at best a partial driver of this major transformation; a more significant driver are the changing demands of stakeholders, in combination with procedural requirements that

allow stakeholders to engage in the planning process. While this combination of factors was effective at driving the agency's historic shift from timber production to ecosystem management, it is less clear that the same combination of factors is likely to prompt widespread consideration of challenges associated with global change such as ecoclimate teleconnections.

Funding This work was funded by National Science Foundation (Grant no. 1824796).

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