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Research Article

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Spatially Explicit Assessment of the USDA Forest Service as a Representative Bureaucracy

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Abstract

Diverse workforce representation helps organizations achieve their goals and is important for government agencies that seek to gain public trust. Prior research has examined patterns of representation in the USDA Forest Service (Forest Service) and found an overall lack of representation despite advances at leadership levels. Federal agencies are required to report total workforce demographics; however, representation relative to local communities is rarely known. Using data from the US Census Bureau, we examined demographic profiles of populations within a 1-hour drive time around Forest Service workplaces relative to workforce demographics at each workplace. The Forest Service had a greater proportion of white employees than the US population as a whole, and racial/ethnicity diversity was lower than surrounding communities at 99.7% of Forest Service workplaces. Region-level summaries reinforce this pattern, suggesting the Forest Service is not a representative bureaucracy in any region or at any geographic scale. Given the Forest Service's size, role in natural resources management, and geographic distribution of its workforce, disparities between demographic composition of the agency's workforce and surrounding communities are striking. These results set a standard for spatially explicit assessments of workforce diversity as it relates to representative bureaucracy in geographically dispersed organizations like the Forest Service.

Study Implications: Prior research showed that the USDA Forest Service had proportionally fewer Black/African American (~3 times fewer) and Asian (~2 times fewer) employees than the US civilian labor force as a whole. However, aggregate agency-level statistics and national comparisons may conceal local and regional level variation. To understand how the racial and ethnic diversity at each workplace compared with its surrounding geographic area's local population, 690 workplaces were examined. Results were consistent across multiple drive times and levels of aggregation; the Forest Service's workforce is less diverse than surrounding communities, which may potentially affect its ability to serve its many stakeholders.

Keywords: diversity, inclusion, drive time, natural resources careers, public trust, census, GIS

The USDA Forest Service (Forest Service) is a federal agency with a large workforce dispersed across the country. Like most other public-serving organizations, the Forest Service seeks to achieve a representative workforce and has had both successes and failures in this and related diversity goals (Brown et al. 2010; USDA Forest Service 1991; Westphal et al. 2022a, 2022b). With over 30,000 employees working in remote areas like Moose Pass, Alaska, rural areas like Gallatin, Montana, and urban areas including Washington, DC, and New York City, the vastness of the Agency makes action towards diversifying the workforce important for the entire country and a useful case study for a more detailed look at representativeness nationwide. In fact, the Forest Service has long been used for analysis of dispersed government agencies (Fleischman 2017; Kauffman 1960).

Several studies have explored trends in Forest Service employee race, ethnicity, and gender demographics, allowing a partial assessment of the Forest Service's progress towards building a multicultural organization. For example, others assessed Forest Service employment data from 1983 to 1995, and found that the Forest Service increased the number and percentage of female employees and employees of color, but that growth was uneven across job types, with continued low numbers in positions that develop into leadership roles (Thomas and Mohai 1995). In more recent analyses covering 1995–2017, it was found that the Forest Service workforce still skews white (e.g., 85% in 1995 and 83% in 2017) and male (62% in 1995 and 66% in 2017); (Westphal et al. 2022b). However, increased diversity in leadership levels and a notable increase in women employed in higher-level positions has been found; the ratio of male to female employees declined from 3.6:1 in 1995 to 1.4:1 in the three highest pay tiers (Westphal et al. 2022b).

Such agency-level descriptive statistics tell part of the story. Assessing rate of advancement, length of service, and other career metrics in the Forest Service at the individual level adds

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additional critical information. One such analysis found that Black, Indigenous, and People of Color (BIPOC) employees had significantly slower advancement, shorter lengths of service, and higher rates of termination than their white counterparts (Sachdeva et al. 2023). Note that, mirroring Sachdeva et al. (2023), we use BIPOC as an abbreviation for employees of color not because it is perfect, but because it does not center white people or make assumptions about population proportions the way that words like "majority" and "minority" do (Cronin et al. 2021, Box 1). Moreover, we recognize the diversity of experiences for members of different groups included within BIPOC, and do not wish to assert that BIPOC is a monolith.

Paid internships provide one potential pathway for diversifying the agency, since most convert to permanent employees. An analysis from 1996 to 2017 showed Black and Hispanic interns were three and five times more likely than white interns to become permanent (Dockry et al. 2022). However, interns represent a very small proportion of all hiring actions and those who became permanent employees had significantly shorter Forest Service careers than those hired as permanent employees (Dockry et al. 2022).

Westphal et al. (2022b) also provided some evidence of the representation of the American public in the Forest Service workforce. Using comparisons between the federal workforce and the civilian labor force, Westphal et al. (2022b) found that the Forest Service had proportionally fewer Black/African American (~3 times fewer) and Asian (~2 times fewer) employees than the civilian labor force. In other categories, Forest Service employment diversity surpassed that of the civilian labor force at the national level; specifically, American Indian/Alaska Natives, Native Hawai'ian/Pacific Islander and employees selecting two or more race/ethnicity groups. However, national-level civilian labor force summaries do not consider local and regional variation, an important consideration for agencies with employees spread across the country. The work presented here adds to these previous within-agency, and per individual analyses with a new point of comparison, that is, to those living near Forest Service workplaces. The populations surrounding workplaces may represent a potential hiring pool to increase diversity and representation. A spatially explicit lens is thus needed to examine diversity in Forest Service employment patterns; in other words, to assess the extent to which individual Forest Service workplaces reflect the diversity of their surrounding populations.

Representative Bureaucracy and Benefits of Diversity

Diversity can be measured within an organization and benchmarked to a metric of representativeness—that is, how diverse an organization is relative to how diverse it could be. For public agencies like the Forest Service, having a workforce that matches the general population on major facets of diversity such as gender, race, and ethnicity is often an explicit goal (Selden and Selden 2001). It is also the law (U.S. Merit Systems Protection Board 1978); the Forest Service and all US federal agencies are required to be representative of the people served. More diverse organizations are more efficient and exhibit improved decision-making (Herring 2009; Page 2007). Because more diverse groups are more aware of their own biases, they tend to be more fact-oriented and simultaneously more creative (David Rock and Heidi Grant 2016). The mere existence of a more diverse workforce may also increase legitimacy and trust in the public. As Selden and Selden (2001) state: "Representative bureaucracy offers a means of reconciling bureaucratic government with democratic values by ensuring that public organizations are responsive to the public through employee representation and subsequently are more effective" (Selden and Selden 2001, 309). Additionally, Riccucci and Van Ryzin state, "the social origins of a bureaucrat can produce a sense of trust and legitimacy among citizens who share those social origins, thereby resulting in cooperation from the citizens and ultimately the production of more effective policy outcomes, *without* any action by the bureaucrat (in other words, without active representation)" (2017, 25). Other research shows, even without active representation, where policies reflect the interests of those being represented, representative bureaucracy is premised on the belief that representation may lead to active representation (Selden and Selden 2001). Symbolic representation therefore enhances legitimacy, which garners trust (Riccucci and Van Ryzin 2017). The symbolic value of a representative workforce in the public sector is hard to overstate, as more representative agencies show increased public trust, resulting in greater perceived legitimacy, more compliance with regulations, and more effective policy-making (Riccucci and Van Ryzin 2017).

The Forest Service, like other environmental and natural resource management agencies, also has a stated goal of promoting environmental justice, ensuring that all people in their jurisdiction have equal access to public resources, are represented fairly and equitably in public policy, and that their environments are not adversely affected by agency actions (Clinton 1994). Research has suggested that having a more representative workforce may be critical to promoting environmental justice (Liang et al. 2020). In the US Environmental Protection Agency, for instance, a larger percentage of "full-time minority administrators" was associated with more administrative enforcement actions under the national air pollution control statute (Liang et al. 2020, 406). Moreover, this effect of a more representative bureaucracy was amplified for more socially vulnerable neighborhoods, suggesting that for historically marginalized populations, having a representative government may be more likely to lead to environmental equity (Liang et al. 2020). Active representation means values and actions will be more likely to reflect the groups represented, whereas symbolic representation means there is a greater belief that active representation will be sought, and therefore creates trust and legitimacy between the public and bureaucrats (Riccucci and Van Ryzin 2017; Selden and Selden 2001).

The primary purpose of the study was to understand whether Forest Service workplaces match the diversity of the local geographic area and work pools and consequently, how close the agency is to achieving its goal of having a representative workforce at local and regional levels. Comparing workplaces with their surrounding communities is particularly salient, given the geographically dispersed nature of the Forest Service and the agency's diversity goals, and because diversity can improve public trust. Gaining public trust is particularly important for an agency tasked with addressing multiple and often conflicting land management goals, which oftentimes have broad impacts on the local economy, ecosystem services, and quality of life for Americans. Although much of the evidence thus far suggests that the Forest Service's diversification efforts are still a work in progress (Westphal et al. 2022b), the analysis reported in this article

could help identify areas, regions, and workplaces that may outperform the rest of the agency in building a representative organization. Workplaces are what are internally referred to as "duty stations" and include National Forest district offices, research stations and laboratories, administrative offices, and many more types of locations where Forest Service employees work. We compare the demographic profiles of each workplace with the comparable demographic profiles of their surrounding areas using the 2013–2017 American Community Survey (ACS). In this way, we compare the local Forest Service workforce with geographically nearby residents within a reasonable commuting distance.

Methods

Study Area and Data

Our dataset had individual-level records for each Forest Service employee hired after 1995 that included race/ethnicity, gender, and workplace location. We selected the most recent 5-year span for which data on race/ethnicity per workplace were available (2013–2017). A 5-year span was chosen so abrupt changes that may have happened in a particular workplace, year, or both would not unduly influence results; 5-year aggregates are more stable than a single year, especially for locations with fewer employees. Exploratory visualizations without pooling across years were not substantively different from the 5-year span from 2013 to 2017 (Figure S2).

To keep personally identifying information anonymous and to protect against potentially spurious results from small workplaces when reported on a percentage basis, only workplaces with more than five employees in all 5 years were retained. Drive time calculations (described below) and/or census demographic data (described next) are not available for workplaces beyond the fifty states, Washington, DC, and Puerto Rico. The result was six hundred ninety workplaces in forty-one states plus Washington, DC, and Puerto Rico (Figure 1).

Census block group spatial boundaries and count data of individuals per race/ethnicity category (table B03002: Hispanic or Latino Origin by Race) from the US Census Bureau's 2013–2017 5-year ACS were accessed via the tidycensus R package using the get_acs function (Walker and Herman 2021). Civilian labor force data, which exclude the unemployed, those enlisted in the military, and those aged 16 years and younger and 65 years and older were not considered because tallies are only released at the census tract level, which is far less precise than census block groups. To retain precision, the ACS at the block group was chosen. Block groups are the smallest spatial scale for which counts of the population by race and ethnicity jointly are made available. The Forest Service's racial categories include Hispanic/Latino, whereas they are typically collected as separate questions on ethnicity in the ACS. The ACS data were therefore regrouped to match the Forest Service human resources racial categories. We report using the Forest Service's labels such as Hispanic/Latino because that is how employee data were collected; employees self-identified into those categories and could not chose other categories such as Latinx. The ACS is like the Decennial Census but with larger margins of error, collected monthly via sampling, and disseminated via 1-, 3-, and 5-year aggregates. Larger temporal aggregates were selected due their smaller associated margins of error.

Drive time polygons, also known as "isochrones", were created for each Forest Service workplace using the Mapbox API accessed via the mb_isochrone function in the mapboxapi package (Walker 2020). Drive time durations included 15, 30, 45, and 60 minutes, where each greater duration includes the shorter ones (e.g., 30-minute drive time polygons represent all distances less than 30 minutes). Drive times more realistically reflect access by car than "as the crow flies" distance. In mountainous areas, for example, census-derived estimates of demographics using linear buffers would include far more land than is actually accessible by car in relatively flat areas or areas with denser street networks, and would thus distort the derived demographic profiles.

We were interested to know whether the demographic profiles of various nonoverlapping buffer distances altered the demographic makeup of populations at these varying distances (e.g., are the communities 46 to 60 minutes away from a Forest Service workplace demographically different from those 16 to 30 minutes away?). Three additional drive time polygons were thus created by erasing the shorter duration polygons from the longer (16 to 30, 31 to 45, and 46 to 60 minutes). Erasing is like removing the donut hole from a donut. In this case, the donut is the remaining 16 to 30, 31 to 45, and 46 to 60 drive time polygons; this was achieved using a combination of the st_difference, st_union, and st_combine functions in the sf package (Pebesma 2018). The result was seven drive time polygons for each of the six hundred ninety workplaces (n = 4,830; see Figure S1 for an example). The demographic profiles derived from operationalizing access via seven different drive times did not substantially change the estimates (Figure S2), so analyses focused on 1-hour drive times.

The amount of overlap from each block group in the drive time polygon to apportion people per racial category (e.g., if half of a block group overlapped with a drive time polygon, then half of its people would be attributed to that drive time polygon and by extension, half of the counts per race/ethnicity category) (Goodchild et al. 1993; Logan et al. 2014; Prener and Revord 2019). The approach implicitly assumes a spatially uniform population distribution. Focusing only the residential areas of census geographies (Boone 2008) was not done because the requisite residential land use data were not available for the entire study area.

Apportioning population based on area of overlap requires knowing the areas of both sets of intersecting polygons' areas. Water polygons representing "ponds, lakes, oceans, swamps, glaciers, and the area covered by large streams" (U.S. Census Bureau 2019, 3–34) were erased from all block groups so that a more precise area calculation could be obtained using st_area in the sf package. Downloading water polygons and erasing was computationally intensive and processed using parallelization; additional details including reproducible code can be found in (Locke 2022).

A final pre-processing step was used to manage multipart polygons before apportioning population by proportion of overlap. Census block groups can be made up of spatially noncontiguous areas; that is, multiple polygon shapes on a map can be linked to just one row in the tabular data, rather than one row per polygon. In addition to multipart polygons delivered by the Census Bureau, erasing water may create multipart polygons. When multipart block groups are intersected with drive time polygons, their areas may not reflect true overlap. Multipart polygons were therefore

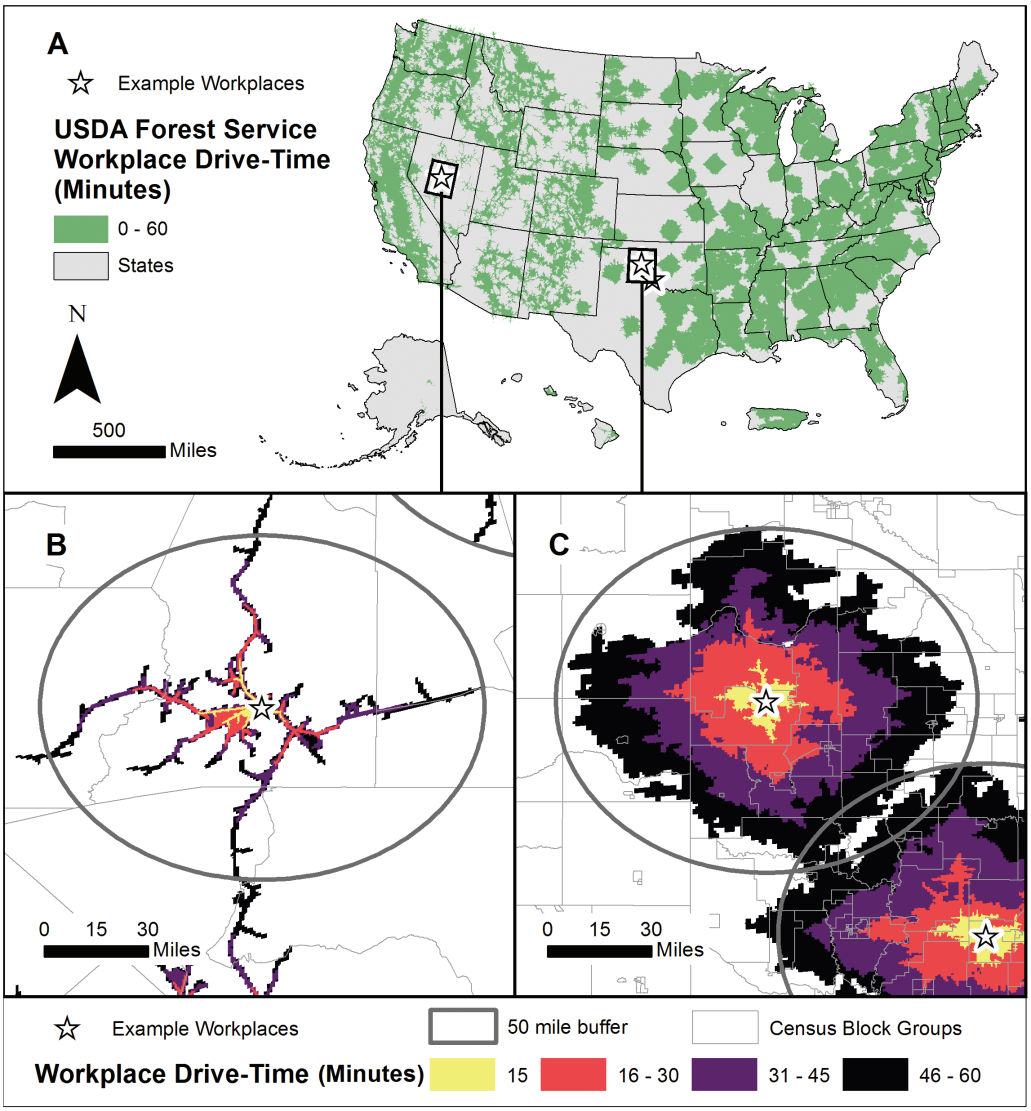

Figure 1. One-hour drive time polygons around select USDA Forest Service workplaces from 2013-2017 (A). Workplace 15-, 30-, 45-, and 60-minute drive time polygons are better representations of access than linear Euclidean distance-based buffers (B, C), because they take into account the street network and speeds one can drive.

converted to single part polygons before interpolation, and area was calculated for each individual polygon. Importantly, the race/ethnicity counts were attributed from each multipart polygon to its individual polygon proportionally according to area and area of overlap (Locke 2022).

Statistical Analyses

First, the proportion of each race/ethnicity group within the total United States (via the ACS), at Forest Service workplaces, and the seven types of drive time polygons were visually compared. Second, for each workplace and race/ethnicity group, the proportion of employees was plotted against the corresponding proportion from the surrounding 1-hour drive time. These scatter plots per race/ethnicity group depict which workplaces have higher or lower representation, aided visually with the 45-degree line to indicate parity. A best-fit line was also added via a cubic spline.

Third, several social and ecological diversity indices were considered. Ultimately a diversity index called rarefaction, which was adapted from ecological measures of biodiversity, was used to show how overall diversity at each workplace compares with its surrounding community (Hurlbert 1971). Higher scores indicate greater diversity. Among the indices considered, the number of race/ethnicity groups was not chosen because it is bounded by 1 and 7 and provides no information about the balance across race/ethnicity groups within a workplace nor its surrounding population. Shannon's index, although commonly used in ecology, combines the number of groups and the evenness across groups, making interpretations challenging because values are a mix of number of groups and their evenness. The commonly used dissimilarity index from demography and sociology was deemed insufficient for these analyses because it compares how much of population would have to change across units to achieve a greater overall mix (U.S. Census Bureau 2000). In this way, dissimilarity indices imply a fixed number of people within Forest Service workplaces and surrounding areas, and then compare how many people of each group would have to move to achieve an equitable mix. However, the number of employees and community members can and does

change. Social segregation indices that are not bounded (i.e., between 0 and 1) can make cross-site comparisons a challenge (Elbers 2021). Rarefaction is like evenness but accounts for differences in sample size and is therefore best-suited to these questions. Rarefaction was therefore deemed the most appropriate measure. The per race/ethnicity group analyses (Figures 2, 3A, and S2) and summaries (Figure 4) corroborate the findings when using the rarefaction index that combines race/ethnicity groups (Figures 3B, 5, and S3).

Fourth, the demographic makeup of workplaces and their surrounding 1-hour drive times was aggregated to the Forest Service's regions by race/ethnicity group to see how local differences between workplace and surrounding communities may vary by a policy-relevant division within the agency. Finally, rarefaction was computed for Forest Service regions. When taken together, the simple proportions, scatterplots, diversity indices, and regional summaries show how the agency's demographic profiles relate to those in the immediate geographic vicinity. All data preparation, visualization, spatial, and statistical analyses were conducted using R version 4.1.2 (R Core Team 2021) and the following packages: tidyverse metapackage (Wickham 2017; Wickham et al. 2019), tidylog (Elbers 2020), sf (Pebesma 2018), janitor (Firke 2021), patchwork (Pedersen 2022), geofacet (Hafen 2020), and vegan (Oksanen et al. 2022).

Results

Is the Forest Service a representative bureaucracy? Representative bureaucracy was operationalized by comparing race/ethnicity diversity of employees at its workplaces with race/ethnicity composition of the surrounding populations. The final analytic dataset included six hundred ninety workplaces across the United States from fiscal year 2013 to 2017. On average, workplaces had 207.6 employees ranging from 7 to 5,585 with a median of 141.5 and an interquartile range of 83 to 240.8.

How do the demographic profiles of the entire United States compare with those found in Forest Service workplaces and surrounding drive time areas? Although 63.9% of the US population is white, 83.9% of the Forest Service workforce is composed of white employees, an overrepresentation of twenty percentage points. The chosen drive time polygons do not substantially vary in the estimates they provide nor in substantive patterns (Figure 2). In all cases, the proportion of white is greater than other racial categories. As a whole, the Forest Service is less diverse on aggregate than the US population, and the Forest Service's workforce is less diverse than the communities in the geographic vicinity of their locations.

The percentage of each race/ethnicity group in the 1-hour drive times at each Forest Service workplace was also compared with the percentage of employees in each race/ethnicity group at that corresponding workplace via scatter plots. Workplaces on the dashed 1-to-1 line with a 45-degree slope are where each race/ethnicity category is equally represented on a percentage basis (Figure 4). Although there are some individual workplaces where the percentage of a race/ethnicity group is greater than the percentage of that same racial/ethnic group in surrounding communities (above and left of dotted line), the overall pattern is clear; the majority of workplaces do not show parity with the surrounding areas' population. Members of every race/ethnicity group tend to be less common than in the surrounding areas on a per workplace basis except for the white group, which is almost always overrepresented. On average, when drive time areas are composed of ~50% white population, workplaces are ~75% white (bottom right). The relationship between workplace demographics does not vary with the different ways drive times were operationalized (Figure S2); no matter how drive time polygons were derived, the white population in Forest Service workplaces usually exceeds the proportion in the nearby area, and other race/ethnicity groups tend to fall below the 1-to-1 line.

Although the analyses above look at parity between race/ethnicity of employees at Forest Service workplaces and their surrounding communities on a 1-to-1 basis (e.g., parity between African-Americans in an area versus extent of representation in the Forest Service workforce within that area), the rarefaction index used to evaluate overall race/ethnicity diversity of each workplace relative to its surrounding populations shows similar trends. As Figure 5 shows, 688 out of 690 workplaces are less diverse than their surrounding

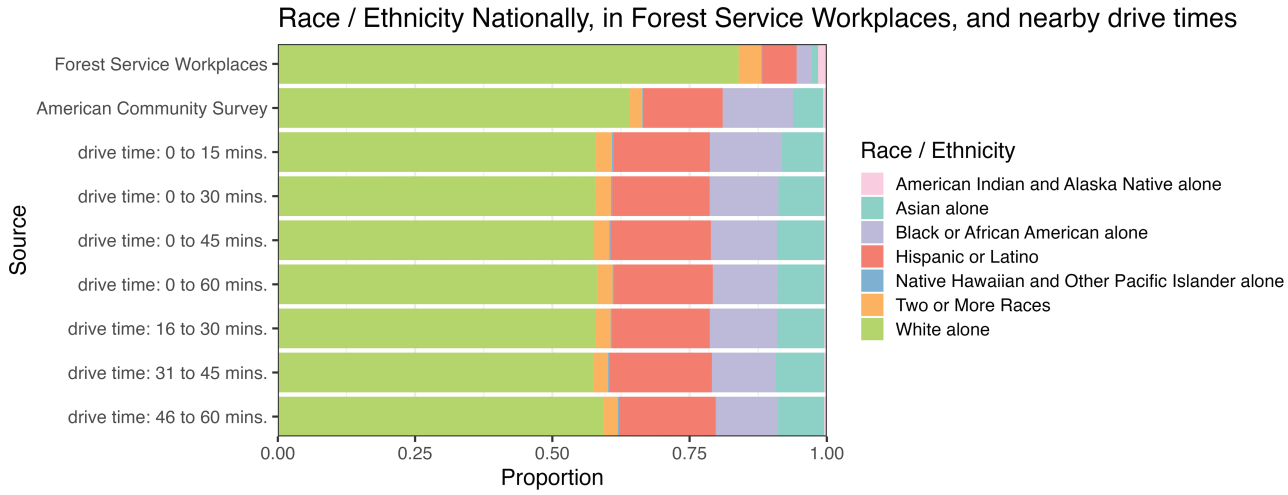

Figure 2. The percentage of people in each race/ethnicity group at each Forest Service workplace (vertical axes) is compared with the percentage of people in that group within 1-hour dive times (horizontal axes) for six hundred ninety workplaces. The dotted line shows parity; points along the 45-degree line have an equal percentage of people per group in both the workplace and that workplace's 1-hour drive time.

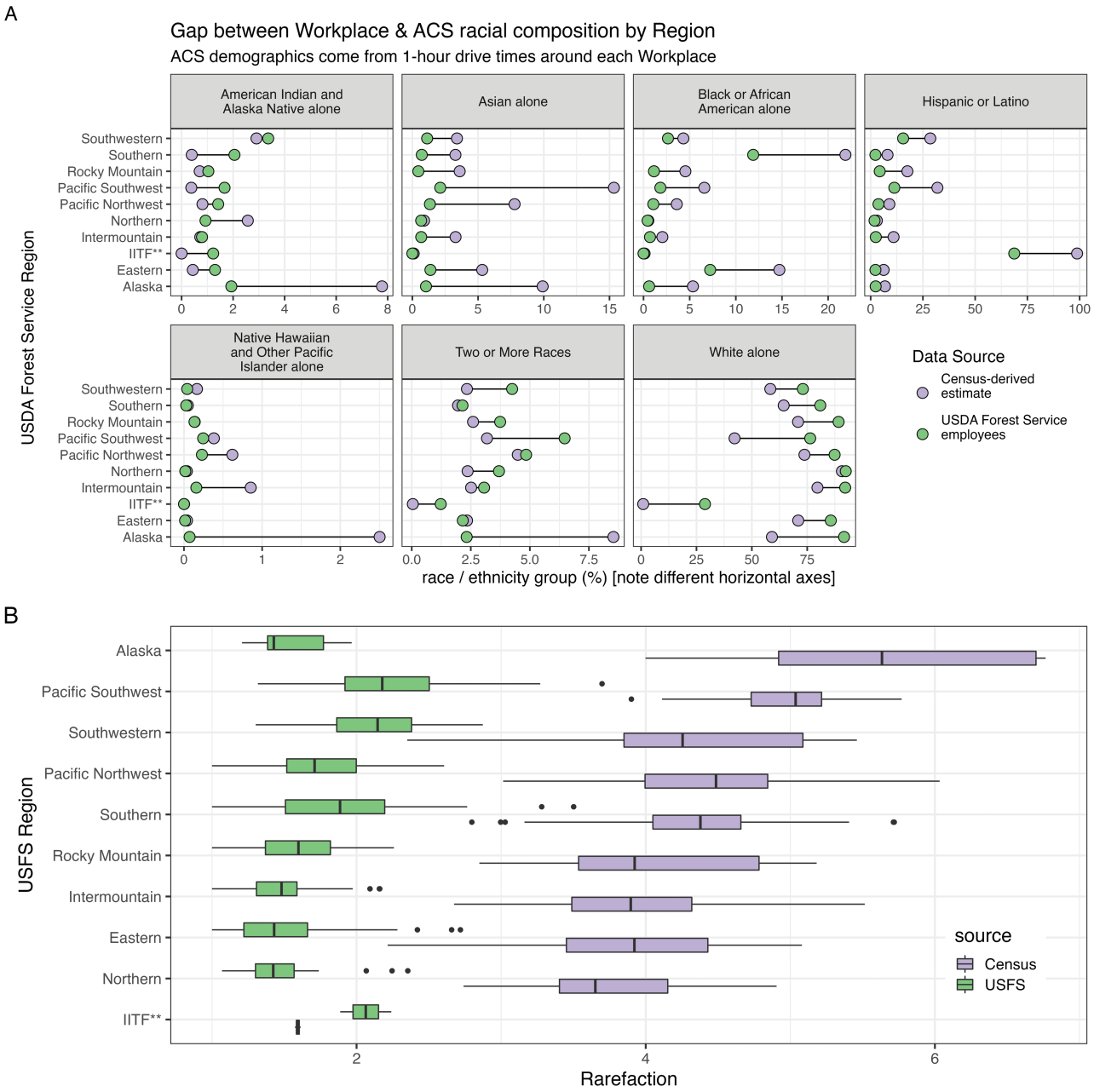

Figure 3. The gap between the race/ethnicity composition of Forest Service workplaces and the surrounding population is parsed by Forest Service region for each race/ethnicity group (A), and a diversity index (B). *American Community Survey, ** ITF, International Institute of Tropical Forestry.

populations as operationalized with 1-hour drive times. Points along the 45-degree line have equal rarefaction values for both the workplace and that workplace's 1-hour drive time. The two exceptions are workplaces in Puerto Rico, where the Forest Service workforce has more non-Hispanic white employees than the surrounding population, and thus is more diverse according to the index used than the surrounding geographic area. Although perhaps counterintuitive, adding non-Hispanic white employees to a predominantly Hispanic workplace increases the diversity index because more race/ethnic groups are present.

When aggregated by Forest Service region, the gap between race/ethnicity make-up of the workplaces' surrounding communities does vary. For instance, the gap between drive time percentage of white populations and workplace representation of white employees is smallest in the Northern Region and largest in the Pacific Southwest, indicating a larger overrepresentation of white employees in the latter than the former (Figure 3). Conversely, although the percentage of people identifying as Hispanic or Latino alone is relatively high at the International Institute of Tropical Forestry (IITF) in Puerto Rico, the fraction surrounding the workplaces is higher, indicating an underrepresentation of Hispanic populations in that region's workplace. American Indian and Alaskan Natives make up ~8% of the population around Alaskan workplaces but only ~2% of the employees. Another large gap can be found in the Southern Region, where people identifying as Black/African American alone make up ~22% of the surrounding 1-hour drive time area but only ~12% of Forest Service employees.

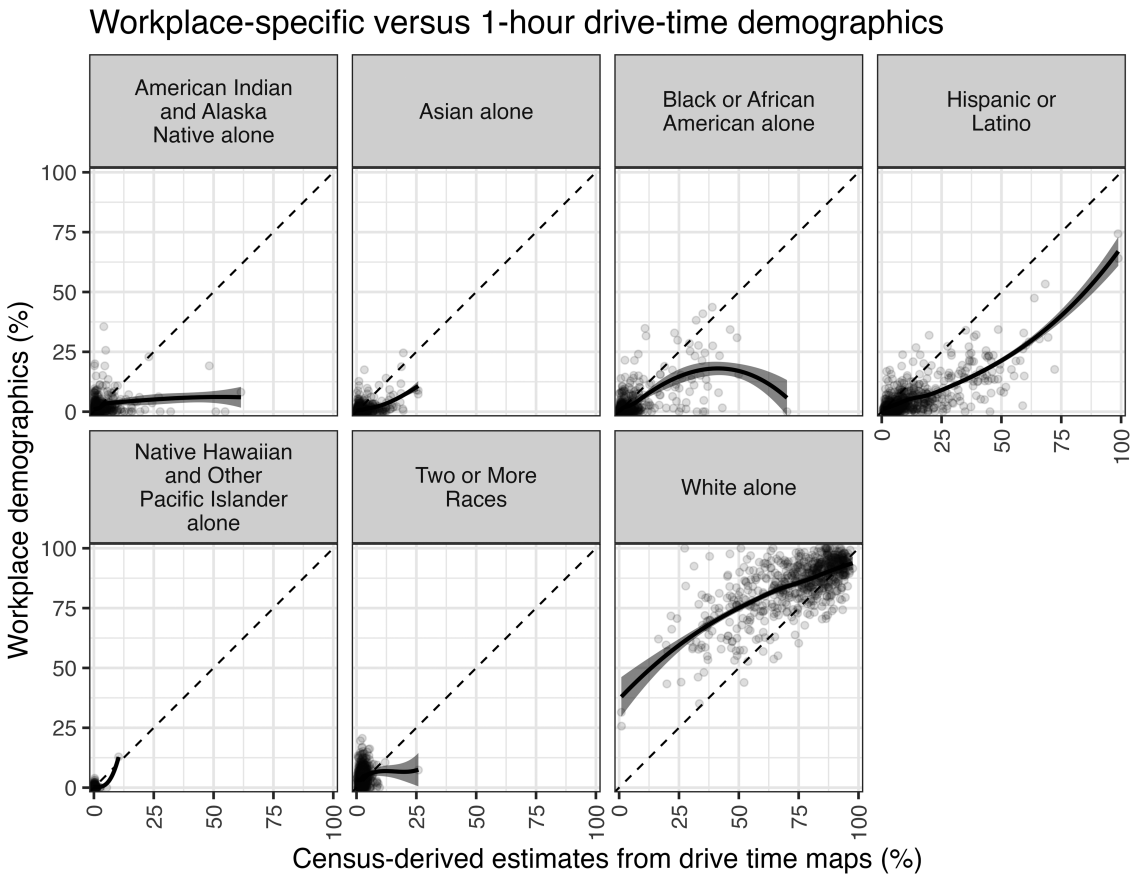

Figure 4. Race/ethnicity for all block groups (top bar) show a smaller proportion of white people than the USDA Forest Service workplaces (second bar). The third through seventh bars show the racial/ ethnic make-up of the drive times around each workplace.

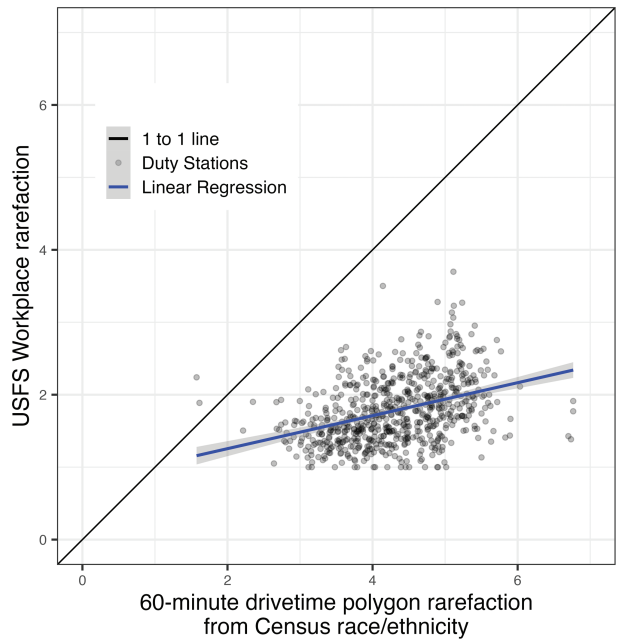

Figure 5. The diversity index rarefaction was computed using the counts of people per race/ethnicity group in both workplaces and their surrounding 1-hour drive time polygons.

Discussion

Comparison to the civilian labor force is required for all US agencies as part of tracking progress towards the required goal of matching the demographics of the country within an agency (U.S. Merit Systems Protection Board 1978). The Forest Service shares this goal not only because it is law but because of the myriad reported benefits of being a representative bureaucracy, including increasing public trust (Riccucci and Van Ryzin 2017). Trust in a public agency is crucial for gaining public support and acceptance, and the Forest Service is no exception with public trust mediating acceptance on topics and issues such as fuels management (Vaske et al. 2007), wildlife management (Cvetkovich and Winter 2003), recreation (Davenport et al. 2007), and climate change mitigation (Meyer 2010). This need for public trust and support in communities across the country underscores the value of a representative workforce at the workplace level.

Our analysis compares diversity of a workforce with the surrounding population in commuting distance of the workplace. Because the Forest Service has actively worked to build a diverse workforce for decades (Westphal et al. 2022b) and because staff move frequently within the Forest Service, there was a chance that rural Forest Service workplaces might be more diverse than the immediate surrounding communities. But this was not the case. Rather, we found that the Forest Service is consistently less diverse and is therefore not a representative bureaucracy when viewed from the perspective of individual workplaces. Additional research could examine how employees relocate geographically within the agency to move up the pay scale. These relationships could be further complicated by job type, where positions in technical fields could be filled by current employees from different places rather than by locals.

Failing to achieve a representative workforce locally may have repercussions for locally provided services. In the case of the Forest Service, these services include recreation; foraging, fishing, and hunting for subsistence and to support cultural traditions; and logging by firms large and small. These workplaces across the country also serve visitors who might be coming from farther away than the 1-hour drive catchment. The finding that Forest Service staff is comprised of significantly higher numbers of white employees than the communities they are in, and the communities that may travel to the area, suggests a lack of effective representation and therefore diminished benefits of a representative bureaucracy (see above) (Riccucci and Van Ryzin 2017). However, as important as a representative bureaucracy is at the national level (as reflected in national level comparisons to the civilian labor force), it is insufficient for a truly representative workforce. For large and dispersed organizations such as the Forest Service, representative bureaucracy is reflected at local and regional levels, too.

National aggregate estimates show that the Forest Service has an ~20 percentage point higher white workforce than the US population as a whole. However, the proportions of the population in a given race/ethnicity group vary across the country, making the local areas potentially a more suitable reference. When comparing each workplace with its surrounding population, that 20 percentage point gap widens to ~25 to 27 percentage points depending on the chosen drive time duration (Figure 2). Hiring locally could be one opportunity to close the gap. There are exceptions, however, as shown in Figure 4; in some workplaces, members of BIPOC groups are present in proportions greater than their surrounding drive time areas. By making data from this larger project freely available (Sachdeva et al. 2022), further inquiry is invited and encouraged. The findings are ripe for additional qualitative research in particular, and we hope the pattern-based findings can provide a platform for additional process-oriented inquiry. There is a clear need to understand why the diverse communities surrounding duty stations do not work for the Forest Service. Another opportunity for future research is in-depth examination of specific workplaces and their surrounding communities via case studies. In addition to gaining more a mechanistic understanding of what may lead to these patterns, such a close look may also provide a more precise tabulation of small rural communities' demographic composition than the national ACS can provide.

Creating more inclusive, just, and equitable natural resource management policies remains a challenging goal, but one that there is a growing push to achieve. A representative workforce in a federal agency like the Forest Service, which serves people at all scales from local (fire safety, recreation activities) to national (managing 193 million acres of forests and grasslands), can have real impact—by building trust, increasing plurality of values and beliefs, and designing effective policies that address multi-scalar problems. Our detailed analysis of Forest Service workplaces, widely distributed from fly-in-only Alaska locations to those adjacent to the National Mall in Washington DC, suggests that work remains to be done to achieve a representative workforce. These data and analyses also suggest that the representativeness gap could be closed in part by hiring locally so that workplaces more directly reflect their surrounding population. Some positions may not require specialized training or experience. However, confronting these issues and understanding where the largest gaps in representation exist is a crucial step to address systemic inequities and creating inclusive and effective conversation policy.

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Additional details on the geoprocessing including reproducible code are found in Locke, D.H.. (2022). United States census block groups converted to single part polygons and with water removed, 2013–2017. Fort Collins, CO: Forest Service Research Data Archive. https://doi.org/10.2737/RDS-2022-0054

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Conflict of Interest

None declared.

Supplementary Materials

Supplementary data are available at *Forest Science* online.

Literature Cited

Boone, C.G. 2008. Improving Resolution of Census Data in Metropolitan Areas Using a Dasymetric Approach: Applications for the Baltimore Ecosystem Study. *Cities and Environment* 1 (1): 3. http://digitalcommons.lmu.edu/cate/vol1/iss1/3/; last accessed September 15, 2011.

Brown, G., C. Harris, and T. Squirrell. 2010. Gender Diversification in the U.S. Forest Service: Does It Still Matter? *Review of Public Personnel Administration* 30 (3): 268–300.

Clinton, W. 1994. Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. *Federal Register* 59 (1): 1–5. https://www.archives.gov/files/federal-register/executive-orders/pdf/12898.pdf.

Cronin, M.R., S.H. Alonzo, S.K. Adamczak, D.N. Baker, R.S. Beltran, A.L. Borker, A.B. Favilla, *et al*. 2021. Anti-Racist Interventions to Transform Ecology, Evolution and Conservation Biology Departments. *Nature Ecology and Evolution* 5 (9): 1213–1223.

Cvetkovich, G., and P.L. Winter. 2003. Trust and Social Representations of the Management of Threatened and Endangered Species. *Environment and Behavior* 35 (2): 286–307.

Davenport, M.A., J.E. Leahy, D.H. Anderson, and P.J. Jakes. 2007. Building Trust in Natural Resource Management within Local Communities: A Case Study of the Midewin National Tallgrass Prairie. *Environmental Management* 39 (3): 353–368.

Dockry, M.J., S.S. Sachdeva, C.L. Fisher, L.S. Kenefic, D.H. Locke, and L.M.Westphal. 2022. Student Trainee and Paid Internship Programs Have Positive Results but Do Little to Influence Long-Term Employee Diversity in the USDA Forest Service:1–17. doi:10.1371/journal.pone.0277423.

Elbers, B. 2020. tidylog: Logging for "dplyr" and "tidyr" Functions. https://cran.r-project.org/package=tidylog.

Elbers, B. 2021. A Method for Studying Differences in Segregation Across Time and Space. *Sociological Methods & Research* 51 (1): 1–38. doi:10.1177/0049124121986204.

Firke, S. 2021. Janitor: Simple Tools for Examining and Cleaning Dirty Data. https://cran.r-project.org/package=janitor.
Fleischman, F. 2017. Questioning Kaufman: How Cross-Level Political Coalitions Interact with Organizational Structure. *Public Administration Review* 77 (5): 743–751.
Goodchild, M.F., L. Anselin, and U. Deichmann. 1993. A Framework for the Areal Interpolation of Socioeconomic Data. *Environment and Planning A* 25(3): 383–397.
Hafen, R. 2020. geofacet: "ggplot2" Faceting Utilities for Geographical Data. https://github.com/hafen/geofacet.
Herring, C. 2009. Does Diversity Pay?: Race, Gender, and the Business Case for Diversity. *American Sociological Review* 74(2):208–224 doi:10.1177/000312240907400203.
Hurlbert, S.H. 1971. The Nonconcept of Species Diversity: A Critique and Alternative Parameters. *Ecology* 52 (4): 577–586.
Kauffman, H. 1960. *The Forest Ranger: A Study in Administrative Behavior*. RFF. 310 p.
Liang, J., S. Park, and T. Zhao. 2020. Representative Bureaucracy, Distributional Equity, and Environmental Justice. *Public Administration Review* 80 (3): 402–414.
Locke, D.H. 2022. United States Census Block Groups Converted to Singlepart Polygons And With Water Removed, 2013–2017. doi:10.2737/RDS-2022-0054.
Logan, J.R., Z. Xu, and B.J. Stults. 2014. Interpolating U.S. Decennial Census Tract Data from as Early as 1970 to 2010: A Longitudinal Tract Database. *Professional Geographer* 66 (3): 412–420.
Meyer, J. 2010. Using the Public Trust Doctrine To Ensure the National Forests Protect the Public from Climate Change. *West-Northwest Journal of Environ. Law Policy* 16 (c): 1–31. https://repository.uchastings.edu/hastings_environmental_law_journal/vol16/iss1/12.
Oksanen, J., G.L. Simpson, G.F. Blanchet, R. Kindt, P. Legendre, P.R. Minchin, R.B. O'Hara, *et al.* 2022. vegan: Community Ecology Package. https://github.com/vegandevs/vegan.
Page, S.E. 2007. Making the Difference: Applying a Logic of Diversity. *Academy of Management Perspectives* 21(4):6–20. doi:10.5465/amp.2007.27895335.
Pebesma, E. 2018. Simple features for R: Standardized Support for Spatial Vector Data. *R Journal* 10 (1): 439–446. https://journal.r-project.org/archive/2018/RJ-2018-009/RJ-2018-009.pdf.
Pedersen, T. 2022. patchwork: The Composer of Plots. https://patchwork.data-imaginist.com, https://github.com/thomasp85/patchwork.
Prener, C., and C. Revord. 2019. areal: An R package for Areal Weighted Interpolation. *Journal of Open Source Software* 4 (37): 1221.
R Core Team. 2021. R: A language and environment for statistical computing.
Riccucci, N.M., and G.G. Van Ryzin. 2017. Representative Bureaucracy: A Lever to Enhance Social Equity, Coproduction, and Democracy. *Public Administration Review* 77 (1): 21–30.
Rock, D. and H. Grant. 2016. Why Diverse Teams Are Smarter. *Harvard Business Review*. Available online at: https://hbr.org/2016/11/why-diverse-teams-are-smarter.
Sachdeva, S.S., L.M. Westphal, L.S. Kenefic, M.J. Dockry, C.L. Fisher, and D.H. Locke. 2023. Despite Workforce Diversity Efforts, Career Metrics Differ for Some Demographic Groups in the USDA Forest Service. *Society & Natural Resources*.
Sachdeva, S.S., L.M. Westphal, L.S. Kenefic, D.H. Locke, M.J. Dockry, and C.L. Fisher. 2022. USDA Forest Service Employee Demographic Data for Diversity and Inclusion Analysis, 1995–2017. doi:10.2737/RDS-2022-0053.
Selden, S.C., and F. Selden. 2001. Rethinking Diversity in Public Organizations for the 21st Century: Moving Toward a Multicultural Model. *Administration & Society* 33 (3): 303–329.
Thomas, J.C., and P. Mohai. 1995. Racial, Gender, and Professional Diversification in the Forest Service from 1983 to 1992. *Policy Studies Journal* 23 (2): 296–309.
U.S. Census Bureau. 2000. Appendix B. Measures of Residential Segregation. *Racial and Ethnics Residential Segregation in the United States 1980-2000* (1988): 119–123. https://www.census.gov/content/dam/Census/library/publications/2002/dec/censr-3.pdf.
U.S. Merit Systems Protection Board. 1978. Merit System Principles (5 USC § 2301). https://www.govinfo.gov/app/details/USCODE-2010-title5/USCODE-2010-title5-partIII-subpartA-chap23-sec2301.
US Census Bureau. 2019. 2019 TIGER/Line Shapefiles Technical Documentation.:138 https://www2.census.gov/geo/pdfs/maps-data/data/tiger/tgrshp2019/TGRSHP2019_TechDoc.pdf.
USDA Forest Service. 1991. Toward a Multicultural Organization: A Report of the USDA Forest Service Task Force on Work Force Diversity.
Vaske, J.J., J.D. Absher, and A.D. Bright. 2007. Salient Value Similarity, Social Trust And Attitudes Toward Wildland Fire Management Strategies. *Human Ecology Review* 14 (2): 223–232. http://www.jstor.org/stable/24707708.
Walker, K. 2020. mapboxapi: R Interface to "Mapbox" Web Services. https://cran.r-project.org/package=mapboxapi.
Walker, K., and M. Herman. 2021. tidycensus: Load US Census Boundary and Attribute Data as "tidyverse" and'sf'-Ready Data Frames. https://cran.r-project.org/package=tidycensus.
Westphal, L.M., M.J. Dockry, L. Bramwell, H. Brown, J. Lootens-White, L.S. Kenefic, S.S. Sachdeva, D.H. Locke, and C.L. Fisher. 2022a. Forest Service Diversity in Context: An Interactive Timeline. doi:10.2737/FS-Diversity-Inclusion-Timeline.
Westphal, L.M., M.J. Dockry, L.S. Kenefic, S.S. Sachdeva, A. Rhodeland, D.H. Locke, C.C. Kern, H.R. Huber-Stearns, and M.R. Coughlan. 2022b. USDA Forest Service Employee Diversity During a Period of Workforce Contraction. *Journal of Forestry* 120(4): 434–452. doi:10.1093/jofore/fvab071.
Wickham, H. 2017. tidyverse: Easily Install and Load the "Tidyverse".
Wickham, H., AVerick Mara, Bryan Jennifer, Chang Winston, McGowan Lucy D., Francois Romain, Grolemund Garrett, *et al.* 2019. Welcome to the tidyverse. *Journal of Open Source Software* 4(43):1686. Available online at: doi:10.21105/joss.01686.