

Social Sciences

Wildfire and Family Forest Owners: Concern, Advice, and Wildfire Reduction Behaviors from the United States National Woodland Owner Survey

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Abstract

Extreme wildfire is an increasing threat to lives, property, and ecosystems across the United States and many parts of the world. Family forest owners (FFOs) own a large percentage of forestland in the United States, and actions and behaviors on their forestland have a large impact on wildfire prevention and mitigation across the landscape. Using data from the USDA Forest Service's 2018 National Woodland Owner Survey, we investigated national and regional FFO wildfire attitudes and behaviors. We see that concern for wildfire is relatively high across the United States; however, this concern does not always lead to wildfire reduction activities on the landscape. There is some variation among regions, with concern about wildfire and past wildfire reduction activities highest in the western US (76% and 37%, respectively), followed by the South (63% and 11%, respectively), and lowest in the northern region (50% and 8%, respectively). Understanding these aspects of wildfire and FFOs on a national level provides a broader context for the more focused studies across the country and acts as a launch point for more in-depth research in the future.

Study Implications: This study assesses family forest owner (FFO) wildfire concern, information needs, and action, both past and intended, at national and regional levels across the United States. As wildfire is predicted to increase in frequency and severity into the future due to climate change, this research provides a reference line and a launch point for future studies. Understanding current concern levels and landowner characteristics can inform programs and policies aimed at mitigating severe wildfires. For example, the disconnect between concerns and actions can be used as an entry point for motivating additional owners to take steps towards active management. Concentrating efforts in fire-prone areas is important, but seeing that wildfire is a concern of family forest owners across much of the country suggests that this can be an important issue for starting conversations with many owners and possibly increasing their engagement with conservation efforts.

Keywords: wildfire behavior, wildfire attitudes, forest management, private landowners

The extent, severity, and impact of wildfires has increased across the United States and many parts of the world in recent years and is expected to increase into the future. Multiple interacting dynamics have led to this increase, including climate change increasing the aridity of landscapes and the length of wildfire seasons, past fire suppression leading to a buildup of fuels, and more people moving to wildfire-prone areas (Abatzoglou and Williams 2016; Westerling et al. 2006). Forest management activities, such as thinning stands, controlled burns, and other fuel reduction actions, can decrease the impact of wildfires (Ager et al. 2020; Barros et al. 2017), but these activities are often not conducted due to lack of time, resources, assistance, and knowledge about how to manage for fire safety (Brenkert-Smith et al. 2012; Hodgson 1995). In 2022, the USDA Forest Service identified the wildfire crisis as a priority focus, developing a wildfire crisis strategy (USDA Forest Service 2022a) and a 10-year implementation plan (USDA Forest Service 2022b). A key com-

ponent of the strategy and implementation plan is to collaborate across public, private, and tribal boundaries to decrease the impact of increasing wildfire across the landscape (USDA Forest Service 2022b).

Family forest owners (FFOs) hold 39% of forest land in the United States (Butler et al. 2021). The decisions FFOs make about management on their lands can affect wildfire mitigation and prevention across the landscape. Understanding FFO attitudes, information needs, and behaviors concerning wildfire will inform strategies to decrease the impact of wildfires in the United States.

A range of studies have investigated wildfire and FFOs at the regional and local levels. However, understanding general characteristics about FFOs values, needs, and actions related to wildfire across the United States is less well studied (Danley et al. 2021) but is important in gaining a broad perspective on the issue. One study at the national scale investigated the relationship between modeled fire risk and wildfire concern

for FFOs (Danley et al. 2021). However, little is known about FFO information needs, behaviors, and intended behaviors related to wildfire on the national scale. Although wildfire risk is higher in the West and South, climate change is forecasted to increase wildfire risk in certain northern and eastern regions of the country. (Barbero et al. 2015; Liu et al. 2013). Gaining a broad understanding of FFOs attitudes and behaviors related to wildfire can inform national-level policies and programs.

Previous work at the regional or local level has studied FFO attitudes and behaviors towards wildfire. Residents and/or FFOs in the West and South (i.e., California, Oregon, and Mississippi) generally have a high level of concern related to wildfire that is conducive for carrying out wildfire mitigation activities (Abscher et al. 2009; Fischer and Charnley 2012; Shrestha et al., 2021a). Several factors have been related to landowner concerns and behaviors about wildfire, including real or perceived risk (Danley et al. 2021; Fischer et al. 2014); landowner demographics, including gender, education, and income (Shrestha et al., 2021a); and experience with wildfire in the past (Jarrett et al. 2009). Wildfire management behaviors have also been linked to some land characteristic variables (e.g., size of holdings, forest composition), landowner attitudes and perceptions (i.e., attachment to home, perceptions about wildfire), and having a management plan (Abscher et al. 2009; Kyle et al. 2010; Shrestha et al., 2021b). Although perception of wildfire risk can be an important precursor to fire risk management behavior (Fischer 2011), FFOs' positive attitudes towards fire management do not always translate into actions. Instead, previous work has found that owners who actively manage their land are much more likely to conduct wildfire mitigation activities than those who are not active (Carroll et al. 2004; Shrestha et al. 2021b). Similarly, FFOs who have previously performed wildfire-prevention activities are much more likely to do these activities in the future (Abscher et al. 2009).

Current wildfire literature generally focuses on specific programs or policies at the local or regional scale; in this article, we aim to capture a broader picture of FFOs' wildfire attitudes, information needs, and behaviors across the country. Specifically, we will use data from the Forest Service's National Woodland Owner Survey (NWOS) to (1) get a broad national picture of FFO wildfire attitudes and behaviors; (2) determine what FFO land or ownership characteristics, if any, are related to wildfire attitudes and behaviors; and (3) determine what changes, if any, there have been in FFO wildfire attitudes and behaviors over time.

This work provides a foundational understanding about the relationship between FFO concerns, information, and action related to wildfire, providing broader context for the more

focused studies across the country and a launch point for more in-depth research in the future.

Methods

The NWOS aims to understand private forest owners' attitudes, behaviors, and characteristics across the United States. The survey is administered by the Forest Service's Forest Inventory and Analysis (FIA) program and is implemented in conjunction with the Family Forest Research Center based at the University of Massachusetts–Amherst. The data used in the analyses presented here were derived from the 2017–2018 iteration of the survey (herein referred to as the 2018 NWOS) (Butler et al. 2021). Here, we focus on FFOs, or forests owned by families, individuals, trusts, estates, and family partnerships with 4 + ha (10 + ac) of forestland. The sample frame for the survey is derived from FIA sample points, as well as additional points, using an area-based sample design that results in inclusion probabilities proportional to the size of forest holdings (Butler et al. 2021). Survey implementation follows the Dillman method (Dillman et al. 2014) and includes a four-wave mailing approach, where owners are sent a postcard introducing the survey, followed by the survey packet, followed by a thank you/reminder postcard, and finally another follow-up survey. A total of 8,639 FFOs with 4 + ha responded to the 2018 NWOS with an overall cooperation rate of 40% (Butler et al. 2021). To test for nonresponse bias, telephone follow-up interviews were conducted with 1,048 nonrespondents and compared with mail responses, using χ^2 tests and Mann-Whitney U tests, and effect sizes were calculated using Cohen's d statistic (Butler et al. 2021). No clear nonresponse biases were found. Missing data were dropped from analyses that use the raw, unweighted data. Population level estimates were calculated for FFOs with 4 + ha, with missing data imputed (see Butler and Caputo 2021). For detailed information on the NWOS sampling, implementation, and estimation procedures, please refer to Butler et al. (2021).

This study focuses on the five variables directly related to wildfire in the 2018 NWOS (Table 1). We present the population-level estimates of each of the variables as the percentage of FFOs with 4 + ha (Table 1). Yes/no questions were coded a 1 for “yes” and 0 for “no.” The Likert-scale question about wildfire concern was recoded as a 1 for owners who responded that wildfire was a great concern or concern and 0 otherwise.

We then present the descriptive statistics related to the five variables at the regional level, with regions defined as “North,” “South,” and “West” following Butler et al. (2021),¹ and the χ^2 statistic with a Bonferroni correction factor to

Table 1. Dependent variables related to wildfire from the 2018 NWOS used for analyses presented in this paper.

Variable name	Description	Coding
Concern_wildfire	What is your level of concern about wildfire	Great concern or concern = 1; Moderate to no concern = 0
Past_advice_wildfire	Talked with someone or received information/advice about fire safety in the past 5 years	Yes = 1; No = 0
Future_info_wildfire	Information/advice about wildfire would be helpful	Yes = 1; No = 0
Past_wildfire_activities	Reduced fire hazard in the past 5 years	Yes = 1; No = 0
Future_wildfire_activities	Plan to reduce fire hazard in the next 5 years	Yes = 1; No = 0

determine whether there are significant differences among these variables by region using the raw, unweighted data for FFOs with 4 + ha. There was one χ^2 test per variable. The starting alpha was 0.05, with the final corrected Bonferroni corrected alpha at 0.01.

We used pairwise correlations with χ^2 tests and Cramer's V, as well as variance inflation factors (VIF), to assess multicollinearity in our study. We fit logistic regression models with each of these variables as a dependent variable and demographic, attitudinal, behavioral, and fire-related variables from the 2018 NWOS as independent variables using the raw, unweighted data. The independent variables were chosen based on statistically significant findings from the published literature or variables we hypothesized as being potentially important or useful when thinking about the implications of these models. Variables in the models include region (Danley et al. 2021), size of forest holdings (Shrestha et al., 2021b), landowner age (Fischer 2011; Fischer et al. 2014; Jarrett et al. 2009), landowner education (Danley et al. 2022), landowner gender (Danley et al. 2022), whether the FFOs live on their land (Fischer 2011; Fischer et al. 2014; Gan et al. 2015), whether the FFOs are amenity-focused (Fischer 2012), whether the FFOs are timber or investment focused (Fischer 2012; Fischer et al. 2014), whether the FFOs have cut timber for sale in the past 5 years (Gan et al. 2015), whether the FFOs are enrolled in one or more management/policy programs (tax program, cost-share program, carbon program, forest certification, or easement), whether the FFOs want their land to stay forested, and whether the landowner has a strong emotional attachment to their land (Danley et al. 2021). We also include the four other wildfire variables as independent variables in each model.

Three questions related to wildfire (wildfire concern, past wildfire advice, and past wildfire reduction activities) were asked on the 2013 NWOS ($n = 7,391$) and the 2018 NWOS. Estimates for these variables were compared between years, using a bootstrapping approach (Butler and Caputo 2021; Efron and Tibshirani 1986; Sass et al. 2023) with 1,000

bootstraps per estimate to determine variability. Previous work using bootstraps to calculate variability of NWOS estimates found that 1,000 replicates was the point at which fluctuations substantially attenuated (Butler and Caputo 2021). Alaska, Nevada, and Wyoming were not surveyed in 2013 and were excluded from the trend analysis. Differences between 2013 and 2018 estimates were calculated for each bootstrap (i.e., 1,000 times), and the 95% confidence interval of the difference was determined by the 25th to the 975th value. If the 95% confidence interval of the difference did not include zero, the estimates for 2013 and 2018 were considered significant.

Results

Broad Picture of Wildfire Attitudes and Behaviors

Across the United States, an estimated 59% of FFOs with 4 + ha of wooded land believe that wildfire is a concern or great concern for their wooded land, with that number ranging from 50% in the North to 76% in the West (figure 1 and Table 2). Although concerns are high across the country, a much lower percentage of FFOs have received information or advice about wildfire in the past 5 years (1%, 3%, and 12% in the North, South, and West, respectively). However, 37% of FFOs in the West would find information or advice on wildfires helpful, as would 15% of FFOs in the South and 10% of FFOs in the North. Across the country, 13% of FFOs have reduced fire hazards on their forestland in the past 5 years, with that number ranging from 8% in the North to 37% in the West. In the West, a higher percentage of FFOs plan to reduce fire hazards in the next 5 years (46%) than FFOs in the South and North (15% and 7%, respectively) (figure 1). All standard errors are less than 5%.

Based on the raw NWOS data, five wildfire variables are positively and significantly correlated with each other, but most of the relationships are relatively weak (Table 3). The two variables that are strongly correlated with each other

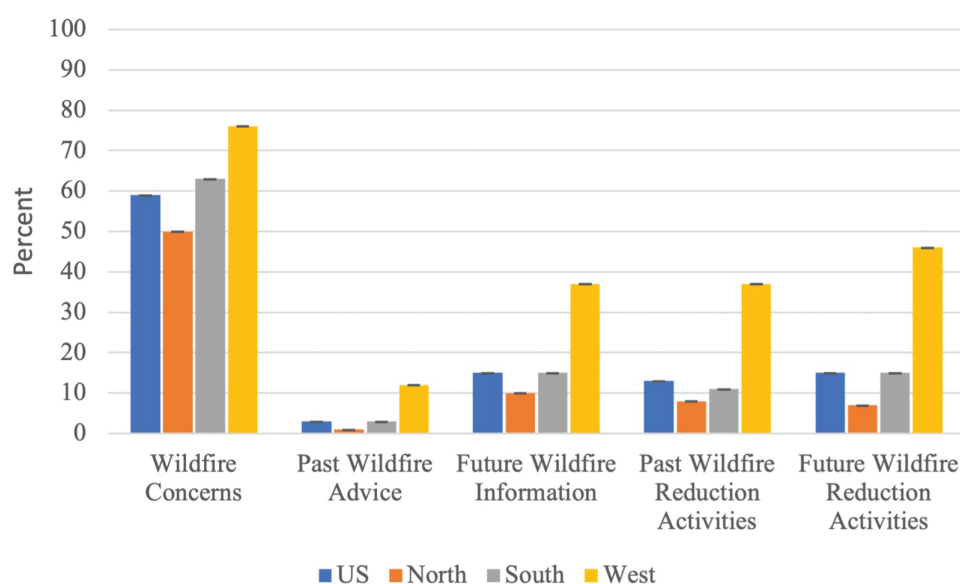


Figure 1 Percentage of FFOs with 4 + ha in the United States North, South, and West and standard errors from the population-level estimates for FFOs who have concern or great concern about wildfire, have received advice or information about wildfire in the past 5 years, would like information/advice about wildfire, have done an activity to reduce fire hazard in the past 5 years, and/or plan to reduce fire hazards in the next 5 years.

are past and future wildfire reduction activities (Cramer's V statistic = 0.71).

There are significant differences between all five wildfire variables across regions, based on a χ^2 metric on the raw data. The West has the highest percentage of FFOs who have great concern about wildfire, have received wildfire advice in the past 5 years, want information/advice about wildfire, have reduced fire hazard in the past 5 years, and plan to reduce fire hazard in the next 5 years (figure 2). These values are lower in the South and the lowest in the North (figure 2). States where more than 85% of FFO respondents are concerned or greatly concerned about wildfire on their wooded land include California, Colorado, Idaho, and Oregon. Oregon has the highest percentage of FFOs who have received past wildfire advice (>32%). The states with the highest percentage of FFOs who want information or advice about wildfire (>45%) include California, Colorado, and Nevada. Over 50% of FFOs in California, Colorado, Montana, and Oregon have done wildfire reduction activities in the past; more than 50% of FFOs in those states as well as Nevada plan to conduct wildfire reduction activities in the future (figure 2).

FFO Characteristics Related to Wildfire Attitudes and Behaviors

After removing observations with missing data, the sample size of the models is 7,659. The models' Tjur's R^2 values range from 0.14 to 0.57. We did not detect problematic multicollinearity of the variables within the models, with all variable inflation factors (VIFs) below 2.5. Additionally, none of the pairwise χ^2 tests or Cramer's V statistics run on the models' independent variables suggested problematic multicollinearity; therefore, all chosen independent variables were included in the models. All the models have western region and past wildfire advice as significant positive predictors (Table 4).

Looking at the odds ratios, FFOs who own forestland in the West are 1.9–2.9 times more likely than FFOs living in the North to have wildfire concerns, to have gotten wildfire advice in the past 5 years, to want wildfire information and

advice, to have done wildfire reduction activities in the past 5 years, and to intend to do them in the next 5 years (Table 4). FFOs in the South are also over 2 times more likely to have wildfire concerns and to plan to do wildfire reduction activities in the future than FFOs living in the North. FFOs enrolled in at least one program are over 2.5 times more likely to have received advice about wildfire than FFOs not enrolled in at least one program (Table 4). If an FFO has concern or great concern about wildfire, they are 2.8 times more likely to want more information or advice about wildfire than if they are not concerned. If an FFO has received advice about wildfire in the past 5 years, they are almost 3 times more likely to want more wildfire information, 2.8 times more likely to have done wildfire reduction activities in the past 5 years, and 2.2 times more likely to plan on doing future wildfire reduction activities than FFOs who have not received wildfire advice in the past 5 years. FFOs who want wildfire information and advice are over 3 times more likely to plan to do wildfire reduction activities in the future than FFOs who are not interested in wildfire information or advice. FFOs who have done wildfire reduction activities in the past 5 years are over 40 times more likely to intend to do wildfire reduction activities in the next 5 years than those FFOs who have not done wildfire reduction activities in the past 5 years (Table 4).

Changes in FFO Wildfire Attitudes and Behaviors Through Time

Comparing the 2013 and 2018 variables in common, we see no significant differences in receiving wildfire advice or having conducted wildfire reduction activities in the preceding 5 years. However, FFO concern about wildfire on their wooded land decreased over this period (64% of FFOs were concerned or greatly concerned in 2013 compared with 59% in 2018). At the regional level, both the South and North have a significant decrease in this variable (Table 5).

Discussion

Across the country, FFO concern over wildfire on their wooded land is relatively high even in states where wildfire risk is relatively low. These relationship between wildfire concern, wildfire hazard potential, and FFO sensitivity to wildfire potential both near and far from their forestland using NWOS data were explored by Danley et al. (2021), and our results mirror theirs, with FFOs in the West having the highest levels of concern, followed by the South and the North, respectively. However, even in the North, where wildfire risk is lower (Danley et al. 2021), half of FFOs have concern or great concern over wildfire on their forestland, which signals the widespread impact of wildfires on the perceptions of owners across the country. Although concern is highest in the most fire-prone states, it is interesting that not all FFOs

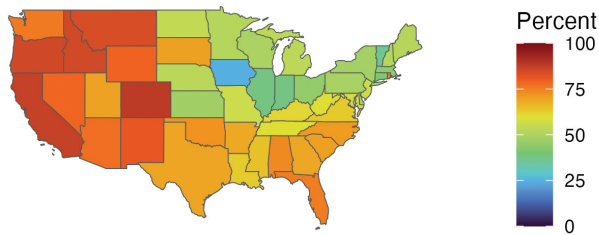
Table 2. Percentage of FFOs in different regions of the United States who have varying levels of concern about wildfire on their wooded land (population-level estimate data). Standard deviation in parentheses.

	Low concern	High concern
United States	39.8 (0.01)	59 (0.01)
North	48.7 (0.02)	49.9 (0.02)
South	35.4 (0.02)	63.3 (0.02)
West	23.1 (0.02)	76.2 (0.03)

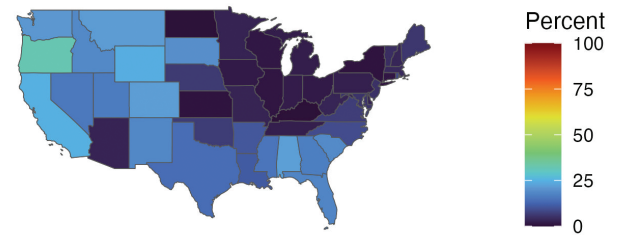
Table 3. Correlation matrix (Cramer's V) of the five 2018 NWOS wildfire-related variables. All relationships are significant at the $p < .005$ level after Bonferroni adjustment.

	Wildfire concerns	Past wildfire advice	Future wildfire information	Past wildfire reduction activities
Past wildfire advice	0.15			
Future wildfire advice	0.24	0.30		
Past wildfire reduction activities	0.16	0.36	0.27	
Future wildfire reduction activities	0.18	0.36	0.34	0.71

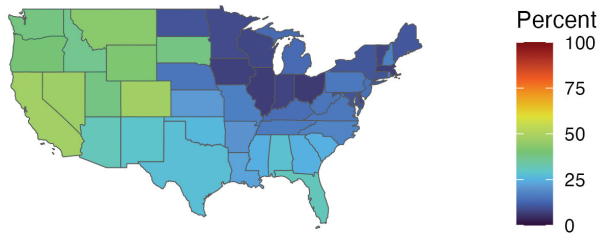
Wildfire Concern



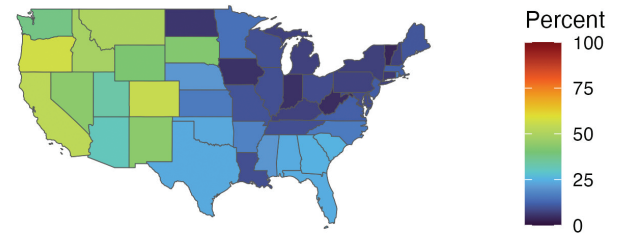
Past Wildfire Advice



Future Wildfire Information



Past Wildfire Reduction Activities



Future Wildfire Reduction Activities

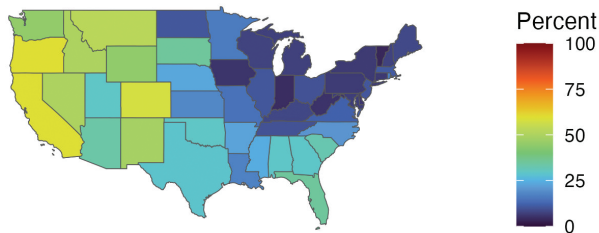


Figure 2 Maps of wildfire variables by state. Percentage of FFOs who have concern or great concern about wildfire, have received advice or information about wildfire in the past 5 years, would like information/advice about wildfire, have done an activity to reduce fire hazard in the past 5 years, and/or plan to reduce fire hazards in the next 5 years.

in these states have great concern about wildfire. Reasons for this are unclear but could be due to a subset of FFOs having forestland that is buffered from wildfire, FFOs being unaware of the wildfire risk, or FFOs not caring about the risk. It is also interesting to note that wildfire concern has decreased over time in the South (2013 vs. 2018), the reasons for which are unclear and warrant more research. Regardless of the reasons, wildfire is a substantial concern of FFOs nationwide, and outreach focused on channeling owners' concerns into action should be the first step (McCaffrey et al. 2011).

Wildfire concern is not a significant predictor of past fuel reduction behavior or intended behavior in the models. A majority of the FFOs who have concerns about wildfire have done no activities to reduce wildfire hazards in the past 5 years (75%). This varies regionally, as FFOs in the West who are concerned about wildfire are more likely (45%) to have done fuel-reducing activities in the past than wildfire-concerned FFOs in the North (11%). FFO fire prevention and mitigation behaviors from the literature range from building fire lines to prescribed/controlled burning to chemical or mechanical vegetation control and removal. The NWOS asks FFOs generally about "fuel reduction activities" done in the past 5 years, which could include the range of behaviors listed above but does not specify the extent and intensity of the treatments. Detailed information on the fire prevention or mitigation behaviors FFOs are doing at the national level is lacking and is a prime topic for future research.

Resource professionals provide FFOs with information related to wildfire and wildfire programs to increase awareness and wildfire-prevention actions on their forestlands. Jarrett et al. (2009) found that FFOs' lack of awareness of wildfire prevention or mitigation programs available in their areas limited wildfire-prevention actions by FFOs. Does linking FFOs with high levels of concern about wildfire to information and advice about wildfire prevention and mitigation lead to action? Forty percent of FFOs concerned about wildfire have received advice about wildfire in the past 5 years. Within that group, 67% of FFOs who have concern about wildfire and have received advice about wildfire have done activities related to fuel reduction on their wooded land in the past 5 years. This result suggests that providing information and advice related to wildfire reduction to FFOs with high concern about wildfire may lead to increased fuel-reduction behaviors on the landscape, but we cannot be sure of the causal relationship given the available data.

One successful method to increase impact is to target education and outreach towards specific groups of FFOs following large-scale fire events (Metcalf et al. 2018). From our model, FFOs who have done fuel-reduction activities on their land in the past 5 years tend to be younger, have smaller forest holdings, have cut trees for sale in the past 5 years, be enrolled in at least one program (tax, cost share, forest certification, easement, or carbon program), or have received advice about wildfire in the past 5 years. Targeting outreach to FFOs in

Table 4. Logistic models with wildfire-related variables as the dependent variable for each model. Model odds ratios (OR), 95% confidence interval (CI), and *p*-value (*p*) listed for each model.

	Wildfire concerns			Past wildfire advice			Future wildfire information			Past wildfire reduction activities			Future wildfire reduction activities		
	OR	CI	<i>p</i>	OR	CI	<i>p</i>	OR	CI	<i>p</i>	OR	CI	<i>p</i>	OR	CI	<i>p</i>
(Intercept)	0.13	(0.09–0.19)	<.001	0.00	(0.00–0.00)	<.001	0.05	(0.03–0.08)	<.001	0.04	(0.02–0.09)	<.001	0.02	(0.01–0.03)	<.001
Region—South	2.01	(1.78–2.27)	<.001	1.69	(1.25–2.30)	.001	1.57	(1.33–1.86)	<.001	1.04	(0.82–1.31)	.759	2.12	(1.70–2.65)	<.001
Region—West	2.67	(2.31–3.09)	<.001	2.65	(1.94–3.65)	<.001	1.93	(1.62–2.31)	<.001	2.58	(2.05–3.25)	<.001	2.96	(2.35–3.74)	<.001
Size of forest holdings (log)	0.98	(0.95–1.01)	.170	1.18	(1.12–1.25)	<.001	1.05	(1.01–1.09)	0.13	0.97	(0.92–1.02)	.186	1.08	(1.02–1.13)	.005
Age	1.02	(1.01–1.02)	<.001	1.00	(0.99–1.01)	.753	0.99	(0.98–0.99)	<.001	0.99	(0.98–1.00)	.003	0.99	(0.98–0.99)	<.001
Education	0.64	(0.58–0.72)	<.001	1.47	(1.19–1.83)	<.001	1.16	(1.02–1.32)	.024	1.15	(0.96–1.37)	.122	1.16	(0.97–1.38)	.097
Gender	1.37	(1.20–1.55)	<.001	1.34	(1.05–1.69)	0.15	0.84	(0.72–0.98)	.029	1.02	(0.82–1.26)	.882	0.75	(0.60–0.92)	.007
Home	0.93	(0.83–1.03)	.152	0.83	(0.68–1.01)	0.61	0.86	(0.76–0.98)	.019	1.15	(0.97–1.37)	.112	1.35	(1.13–1.60)	.001
Cut trees for sale past 5 years	0.99	(0.87–1.13)	.844	1.92	(1.52–2.43)	<.001	0.78	(0.66–0.92)	.003	1.47	(1.18–1.83)	.001	1.04	(0.84–1.29)	.731
Enrolled in at least 1 program	0.76	(0.68–0.85)	<.001	2.67	(2.18–3.28)	<.001	0.96	(0.83–1.10)	.520	1.43	(1.18–1.73)	<.001	1.03	(0.85–1.24)	.784
Amenity objectives	1.69	(1.36–2.10)	<.001	0.84	(0.53–1.36)	.457	1.94	(1.38–2.77)	<.001	1.13	(0.73–1.76)	.595	1.90	(1.23–3.01)	.005
Financial objectives	1.44	(1.27–1.64)	<.001	1.41	(1.12–1.79)	.004	1.01	(0.87–1.18)	.876	0.80	(0.64–1.00)	.047	1.17	(0.95–1.44)	.144
Want wooded land to stay wooded	1.49	(1.27–1.75)	<.001	0.97	(0.71–1.36)	.876	0.96	(0.78–1.19)	.731	0.98	(0.75–1.30)	.092	1.20	(0.97–1.50)	.978
Emotional attachment to woods	1.28	(1.13–1.45)	<.001	1.50	(1.13–2.01)	.005	1.30	(1.10–1.53)	.002	1.21	(0.97–1.52)	.092	1.27	(1.05–1.53)	.103
Wildfire concerns	—	—	—	1.99	(1.55–2.56)	<.001	2.85	(2.46–3.32)	<.001	1.19	(0.98–1.44)	.078	1.27	(1.05–1.53)	.012
Past wildfire advice	1.18	(0.97–1.43)	.096	—	—	—	3.12	(2.57–3.79)	<.001	2.85	(2.20–3.71)	<.001	2.20	(1.68–2.87)	<.001
Future wildfire information	1.28	(1.06–1.55)	.012	2.90	(2.25–3.73)	<.001	—	—	—	0.89	(0.72–1.08)	.226	3.25	(2.71–3.91)	<.001
Past wildfire reduction activities	1.81	(1.43–2.31)	.000	2.29	(1.77–2.97)	<.001	0.93	(0.76–1.12)	.431	—	—	—	40.50	(33.95–48.49)	<.001
Future wildfire reduction activities	2.86	(2.46–3.33)	<.001	3.39	(2.79–4.13)	<.001	3.19	(2.65–3.82)	<.001	40.78	(34.17–48.85)	<.001	—	—	—
N	2128			2128			2128			2128			2128		
Tjur Statistic	0.14			0.31			0.20			0.55			0.57		

Table 5. Percentage (95% CI) of FFOs with Concern or Great Concern about wildfire.

	2013	2018
West	76.8% (72.2–80.9)	77.5% (73.8–80.7)
South	70.7% (67.9–73.2) ^a	63.6% (60.6–66.5) ^b
North	54.0% (51.4–56.1) ^a	50.4% (48.4–52.4) ^b
Total US	63.9% (62.2–65.5) ^a	59.6% (57.9–61.0) ^b

^{a,b}Significant difference between FFOs with concern or great concern between 2013 and 2018.

fire-prone areas who meet these criteria may lead to more success on the ground.

Encouraging FFOs who have done fire-prevention actions to continue to do these activities can lead to added protection and decreased risk on their land. Eighty-two percent of FFOs who have reduced fuel on their woodland in the past 5 years also intend to do these activities in the next 5 years. In this case, past action can lead to planned future action. Resource professionals who follow up with FFOs who have done fire-prevention activities in the past and encourage them to do future action is important in continuing to decrease fire risk.

Understanding the basic questions related to FFOs and wildfire gives us a launch point for more in-depth future studies. Future work could investigate whether there is a time lag for FFO attitudes and behaviors compared with the increasing threat of wildfires, or whether there is a tipping point of wildfire risk that will engender action. Future studies could focus on specific aspects of FFO experience related to wildfire; for example, determining whether FFOs' experience with wildfire include witnessing wildfires on their own woodland or neighboring lands, loss or damage of structures from wildfires on their land, or health effects of smoke can contribute to understanding how experience informs attitudes, intentions, and actions related to wildfire. Future work could also investigate the barriers to taking action. Additionally, linking the financial costs of reducing fire risk to the benefits is important when thinking about the practicalities of outreach and action. By continuing to track FFO wildfire attitudes and behaviors through time, we can better understand how increases in risk influence action and how to develop more effective policies and programs and inform FFOs' role in adapting to and mitigating climate change.

Conclusions

This study provides a baseline understanding of FFOs' wildfire level of concern, information and advice experience and needs, and past and future wildfire-reduction behaviors at the national scale. We found significant links among these wildfire-related variables measured by the NWOS. Although there are regional differences, wildfire concern is high across the country. Concern is not a significant predictor of past or intended wildfire-reduction behavior, but FFOs with high concern who have received wildfire-related information or advice were also more likely to have done wildfire-reduction activities on their wooded land. FFOs are much more likely to plan wildfire-reduction activities in the future if they have done them in the past. Finally, from 2013 to 2018, we found a consistent trend through time of FFO wildfire concern, advice seeking, and wildfire reduction behaviors, which will be

important to follow into the future as wildfires are predicted to increase nationally. Finally, this baseline FFO data is critical in the context of the Forest Service's Wildfire Crisis Strategy (USDA Forest Service 2022a), which will implement fuels and forest health treatments across landownerships. FFO land is one of the key landownerships in the implementation plan, and we believe that understanding the attitudes and behaviors of FFOs will be critical to implementing effective wildfire reduction treatments.

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Conflict of Interest

The authors have no conflicts of interest to declare.

Endnotes

¹North includes Connecticut, Delaware, Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, and Wisconsin; South includes Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia; West includes Alaska-Coastal, Arizona, California, Colorado, Hawaii, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming.

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