

Article

The PING Project: Using Ecological Momentary Assessments to Better Understand When and How Woodland Owner Group Members Engage with Their Woodlands

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Abstract: Research Highlights: Ecological momentary assessments (EMAs) are a fresh approach to measuring behavior by querying the subject in real time. Typical studies of FFO behavior use self-reported survey data. FFOs across the United States collectively own more forested land than any other ownership category, and their actions will impact the public goods these forests provide. Thus, better measures of FFO actions are critical to understanding how these public goods may be affected. Background and Objectives: In this pilot study, we evaluated the potential of ecological momentary assessments to understand family forest owner (FFO) engagement with their woods. We sought to test recruitment, attrition, and participant reaction to the method. Materials and Methods: FFOs belong to woodland owner associations were sent the same questions weekly for a month, asking about woodland engagement. Results: Nearly 90% of participants completed all four surveys and the majority found the method reasonable. Most participants thought about their woods weekly, but a longer time period is needed to measure temporal management trends. Conclusions: This approach may yield real-time and useful information about natural resource engagement to inform conservation-based programming and outreach.

Keywords: conservation behavior; ecological momentary assessment; family forests; recall bias; survey methods

1. Introduction

Ecological momentary assessments (EMAs) are repeated samples of behavior in real time, most commonly used in health science research [1,2]. The approach is based on the theoretical foundations of behavioral medicine, which try to understand the relationships between social, psychological, and behavioral factors at the individual level [1]. Traditional data collection methods in the social sciences (e.g., retrospective questionnaires) are subject to limitations in external validity, and uncertainties in how far the findings can be generalized beyond the investigation [3]. Additionally, survey results are subject to recall bias and do not capture specific intra-subject variability, particularly when respondents have to generalize an experience or behavior to a certain timeframe [4,5]. Smartphone technology has largely taken the place of other devices, such as pagers or beepers, to collect real time data and remind a respondent to answer a question or phone the study coordinator [6,7]. However, any means of collecting data in real time or near real time is considered an EMA. To our knowledge, EMAs have not been used in forestry research to date.

We tested the EMA approach on family forest owners (FFOs) because families and individuals own over 40% of U.S. forestland and thus control the public goods and ecosystem services provided by these forests [8]. These FFOs make stewardship and management decisions, which range in intensity from deciding to harvest timber from their woods, deciding to bird watch, or doing nothing in or with their woods. A long, rich history of scholarship has been devoted to understanding how and why family forest owners make these decisions (for a review, see [9]). One conclusion from this body of research is that behavioral intentions do not always match actual behavior (e.g., [10,11]) possibly due to methodological and theoretical issues. Methodologically, measurement error and potential recall biases occur with self-report retrospective survey methods, which may impede measurement of actual behavior. Theoretically, the length of time between the setting of the intention and the expression of the behavior for most forest-related behaviors may make frameworks like the Theory of Planned Behavior [12] a mismatch for the behavioral outcome of interest. Existing environmental behavior models may not adequately account for the relevance of forest management activities to a private woodland owner. Often, major forest management decisions (e.g., timber harvesting) are made infrequently, and involve complex issues. Exploratory research shows that landowners have high psychological distance, meaning forest management decisions are often abstract and lack detail [13].

For infrequent decisions, understanding the entire decision-making context is important. This includes the antecedent internal cognitive factors that influence an individual's decisions as well as the external social and contextual factors that may contribute to the decision [14]. Internal and external factors in decision-making have been studied across a wide range of natural resource disciplines, with the general conclusion that both must influence decision making and therefore both be considered [15,16]. Choosing the right behavioral theory is important, but methodological issues must also be addressed. Addressing these barriers could involve measuring decisions on a regular basis over a long period of time to better understand the antecedent factors that lead to a decision, as suggested by Hujala et al. [14]. This allows a glimpse into the decision-making cycle including length of time between decisions, and what preliminary actions are taken before a decision is made.

In addition to improving current FFO behavior measurement methods, EMAs may provide insight into FFO engagement with their woods. The terms 'behavior', 'action/activity', 'decision', and 'engagement' are often used interchangeably in the FFO literature. While behavior and action/activity are nearly synonyms, decisions are more appropriately compared to a behavioral intention. While making a decision can be defined as an outcome of interest, it is more typically the setting of an intention which may or may not manifest in a behavior. Finally, we define natural resource engagement on a spectrum. In forestry, engagement can involve thinking about one's woods to activities/behaviors like enrolling in a cost-share program or conducting a timber harvest [17]. Woodland engagement is important for several reasons, including receptiveness to professional advice about best practices and conservation strategies. Engaged woodland owners may not actively manage their woods, but they are potentially open to information and intentionally considering their options, including leaving the forest alone. Policymakers and natural resource professionals can provide better outreach and more efficient programming to engaged woodland owners [17].

The scholarship has explored traits of more engaged FFOs, but not yet shed light on how to better engage FFOs who might be receptive to a variety of actions, but are not yet undertaking any [11]. Thus, it is imperative that new methods are explored. Given this need, this study sought to test the EMA method for its potential in understanding FFO decisions and overcoming the methodological issues inherent in traditional self-report retrospective surveys. Woodland owners in the U.S. are older than the general population and tend to live in more rural areas [8], so we did not restrict our study to smartphone technology, given that there is still a lag in smartphone use among older and rural populations [18], but we did explore e-mail as a digital advance from traditional mail-based surveys. The overall research goal was to determine whether or not EMAs were reasonable for data collection on FFO behaviors and to measure FFO engagement with an EMA approach. Our specific objectives were to (1) determine if any forest landowners would participate in a real time digital survey process,

(2) measure the attrition rate and reaction to real time surveys, and (3) explore levels of FFO activities and engagement using EMAs. Given that the EMA approach has not yet been used in forestry, our hypotheses are based on prior methodological approaches. For example, we expected that FFOs would participate in a digital survey as this approach has been successful, but that we would lose some participants during the process. We expected to find a range of activities undertaken by FFOs, based on the National Woodland Owner Survey [18], but had no evidence to hypothesize how activities would change on a weekly basis. The National Woodland Owners Survey is administered by the US Forest Service approximately every 5 years and is the most comprehensive source of data on private woodland owners in the United States [18], focusing on their management actions, ownership objectives, participation in programs, and demographics.

2. Materials and Methods

2.1. Feasibility Test

We first explored the logistical feasibility and ideal length of ecological momentary assessments with a landowner audience in the fall of 2015. We purposively contacted 100 FFOs from existing extension and association e-mail lists in Massachusetts and successfully recruited 45 to participate in a month-long survey process (45% cooperation rate). We placed 19 participants into Group A, who received a weekly survey that asked if they had engaged in a long list of activities. This list matched the list of activities from the National Woodland Owner Survey [8] to facilitate comparison of results. Group B participants ($n = 23$) received a weekly survey that asked them only if they had (1) walked in, (2) thought about, (3) talked about, or (4) made a decision about their woods. We also clarified that: “By think, we mean ponder or consider the current or future condition of your woods, contemplate your next visit, or recall and reflect on past experiences”. Participants were also asked to fill out an initial and evaluation survey separate from the weekly contacts to measure demographics (initial) and reactions to the method (evaluation). Results from the feasibility test indicated that the majority of respondents felt the method of contact (e-mail and text message) and the frequency of contact was reasonable. Results also indicated that while more Group B respondents were more likely to stay in the study (responding to all four weekly surveys) the difference was not statistically significant. The shorter list of options, when paired with an ‘other’ open-response field yielded more detailed information about woodland engagement, while still allowing for quantitative assessment of engagement level. However, the longer list facilitated more rigorous quantitative analysis, but was not deemed overly burdensome by participants, and was thus chosen for the subsequent pilot study.

2.2. Pilot Study

2.2.1. Participant Recruitment

In an attempt to broaden the sample beyond woodland owner association members, participants were recruited via two pathways: mailed postcards and state woodland owner association list serves. For the mailed postcards, addresses and names of potential participants were gathered from public tax records in four randomly-chosen towns, one each in New Hampshire, Vermont, and two in Maine. In New England, towns range in size and are the most common level of local government besides cities; we did not stratify the sample based on town size. Our sample included owners with ten or more acres of woodland, a threshold that may differentiate owners that have the ability to perform small-scale forest management activities [8], selected based on existing forest cover GIS layers. 510 random FFO addresses were chosen from tax record lists that had been filtered for forest ownership and were sent recruitment postcards asking them to e-mail their interest in participating. We required participants to have e-mail, social media, or text message capability. The state woodland owner associations in Vermont, New Hampshire, and Maine forwarded recruitment text on our behalf to their e-mail list serves.

2.2.2. Survey Design

the weekly surveys were designed in Qualtrics to track individual participants and link their unique ID to their response over the course of a month spanning both June and July. We asked one multi-part question in the weekly survey, eight in the initial survey, and six in the evaluation survey (Table 1). These questions are based on the National Woodland Owner Survey (Initial Survey) and based on our research questions and the author team expertise (Weekly and Evaluation Surveys). Based on the feasibility test, we asked if they had (1) walked in, (2) thought about, (3) talked about, or (4) made a decision about their woods and if they had engaged in the list of activities found on the National Woodland Owner Survey [8].

Table 1. Survey questions.

Survey	Question	Answer Choices
Initial survey	How many acres of wooded land do you own?	Open response
	Is your home or primary residence on or within your wooded land?	Yes/no/not applicable
	Which of the following have occurred on your wooded land in the past 5 years?	Cut or removed trees for sale, cut or removed trees for personal use, collected nontimber forest products, reduced fire hazard, controlled burn/prescribed fire, eliminated or reduced invasive plants or insects, road/trail construction or maintenance, improved wildlife habitat, livestock grazing, none of the above, other
	In what year were you born?	Open response
	What gender do you identify as?	Male, female, agender, other, prefer not to answer
	What is the highest level of education you have completed?	High school, some college, Associate's degree, Vocational degree, Bachelor's degree, Master's degree, Doctorate's degree, other
	How do you prefer to receive weekly survey questions?	E-mail, Facebook, Twitter, withdraw participation
	How did you hear about this study?	Open response
Weekly Survey	Which of the following have occurred on your wooded land in the past 48 h?	List of activities above and made a decision about my woodland, talked to someone about my woodland, walked in my woodland, thought about my woodland
Evaluation survey	Did this project make you think more about your woods than you would have otherwise?	Yes/no/please explain
	How representative were your answers of the typical week?	1–5 Likert scale
	Was your answer affected by the season we are currently in?	Yes/no, If so, how?
	Are there any activities related to your woodlands that you participate in but weren't included in the survey questions?	Open response
	Please select all that apply regarding the burden level of this study.	I found the multiple, weekly contacts burdensome, I found the number of questions burdensome, I found the method of contact burdensome, I found the multiple, weekly contacts reasonable, I found the number of questions reasonable, I found the method of contact reasonable.
	Please share any further thoughts about this online survey method and/or your engagement with your woods below.	Open response

2.2.3. Ecological Momentary Assessments

Participants were sent a welcome e-mail describing project details including that they would receive the first preliminary survey within the week, the basic timeline for the rest of the pings (so named for the sound of an e-mail or message ping and to avoid using the word ‘survey’), what e-mail account the Qualtrics surveys would be coming from, and that they may need to check their spam folder for the surveys. Participants who had been sent the welcome e-mail were next sent the initial survey, which gathered demographic information and how they wished to receive their weekly survey (e-mail, text, social media platform). After the participants had responded to the initial survey, they were sent the first survey within a week. We chose two days a week as the starting points for weekly pings: Tuesdays and Fridays. This was done to determine if a mid-week or end-of-week survey yielded a higher response rate. The participants were sent the weekly survey for four weeks, followed immediately by an evaluation survey. Each contact included an opt out option.

3. Results

3.1. Initial Survey

the majority of participants in the study indicated that they heard of the study from e-mails sent to the woodland owner associations in all three states (approximately 500 contacts) (Figure 1). This recruitment channel yielded 75 respondents for an approximate response rate of 15%, while only 8 respondents indicated that they learned about the study from postcards (1.6% response rate). All participants elected to continue in the study through e-mail links to PINGs, none chose text message or social media alerts. Due to the low response rate from non-woodland owner association members, the remainder of this paper focuses only on woodland owner association members. It was determined that mailed postcards were not an effective way to recruit participants for this digital survey effort.

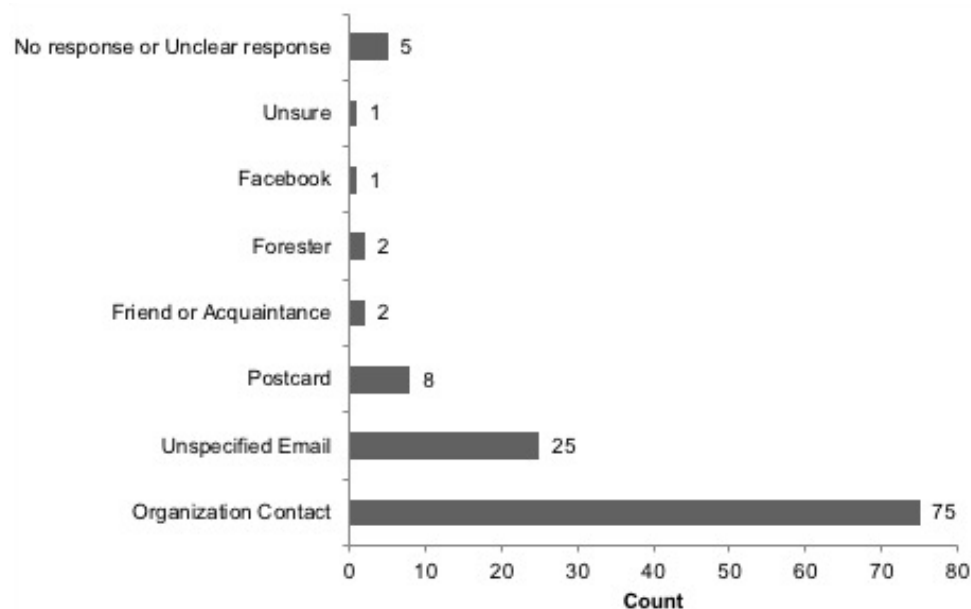


Figure 1. Recruitment channels for respondents.

The most common activities woodland owner association respondents undertook in their woods in the previous five years, as measured by the initial survey, were improving wildlife habitat, trail construction or maintenance, eliminating or reducing invasive plants, and cutting or removing trees for personal use (Figure 2). Slightly over 50% had also cut or removed trees for sale. Respondents were mostly male (62%), lived on their woodland (69%), had a median of 66 acres, were well educated (68% had a bachelor’s degree or higher), and had an average age of 63.

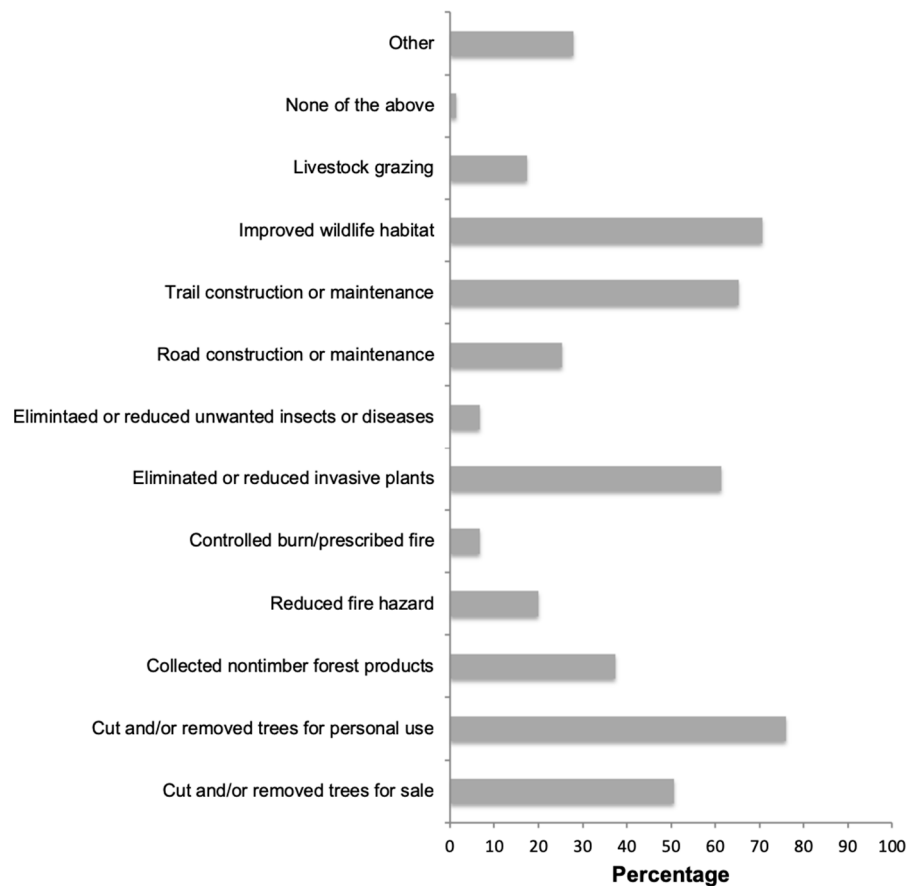


Figure 2. Activities from the past five years from all pre-survey respondents.

3.2. Weekly Contacts

Response rates for the woodland owner association respondents for each week were 87% (mid-June), 95% (late-June), 95% (early July), and 96% (mid-July) (Figure 3). Of the 75 responses to the pre-survey, 67 participants completed the entire study for an overall completion rate of 89%. The subsequent results are based on the 67 complete cases.

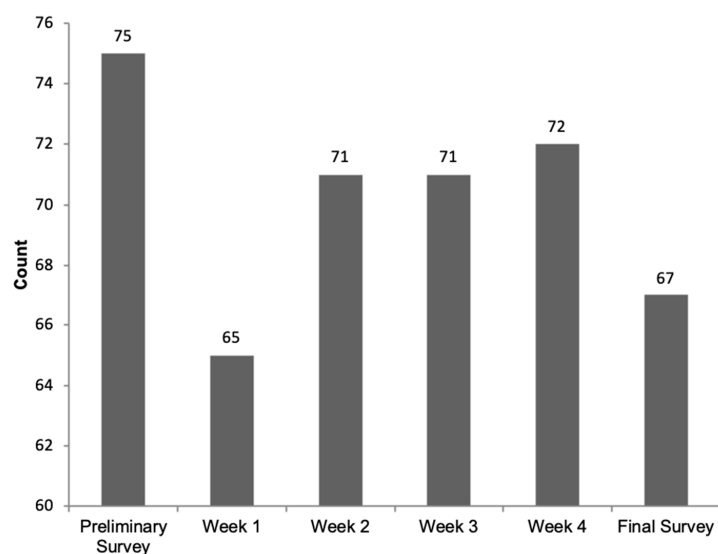


Figure 3. Total responses to each survey contact for woodland association members only.

Activities did not vary greatly by week (Table 2). Nearly half of woodland owner association respondents walked in their woods and/or thought about their woods each week, but only 6.9–13.7% made a decision about their woodland in any given week. About one third of the respondents talked about their woods with another person(s) in each week. The most common activities during the weekly contact periods were eliminating or reducing invasive plants, trail construction or maintenance, and improving wildlife habitat. This was consistent with what all respondents had done in the past five years, as measured by the pre-survey (Figure 2). Cutting timber for personal use declined over the month-long study period, while collecting non-timber forest products was fairly stable. The ‘other’ activities (open response) reported by woodland owner association respondents included stone wall repairs, wildlife observation, planning a woodlands tour, processing previously cut wood, erosion control, horseback riding, and camping.

Table 2. Frequency of reported Family Forest Owner Activities by week considering the complete cases (participated all four weeks) and with only the woodland owner association member respondents.

Management Activities	Week 1 (%)	Week 2 (%)	Week 3 (%)	Week 4 (%)
Cut timber for sale	5.5	2.7	2.7	4.1
Cut timber for personal use	13.7	8.2	6.9	2.7
Collected nontimber products	5.5	2.7	1.4	6.9
Reduced fire hazard	4.1	6.8	4.1	0.0
Controlled burn/prescribed fire	1.4	0.0	0.0	0.0
Eliminated/reduced invasive plants	20.5	21.9	23.3	16.4
Eliminated/reduced unwanted insects/diseases	1.4	0.0	2.7	2.7
Road construction or maintenance	9.6	5.5	6.8	4.1
Trail construction or maintenance	17.8	16.4	8.2	9.6
Improved wildlife habitat	15.1	12.3	12.3	8.2
Livestock grazing	4.1	4.1	5.5	6.8
Decision about woodland	13.7	9.6	6.9	13.7
Talked about woodland	31.5	37.0	31.5	32.9
Walked in woodland	46.6	49.3	34.2	39.7
Thought about woodland	47.9	50.7	48.0	41.1
Other	4.1	6.8	6.8	16.4
None of the above	10.96	0.00	12.33	10.96

3.3. Evaluation Survey

Participants did not find the process overly burdensome. Of the completed responses, 83% found the method reasonable, 83% found the number of questions reasonable, and 75% found the multiple contacts reasonable. Respondents commented in the open-response field that the surveys were fast and easy. This was representative of all positive open responses. Negative comments pertained to the perceived usability of the results. One respondent commented “I thought the questions were trivial as they seemed to relate to the current week rather than yearly forestry activities”. A different respondent commented that they thought the number of questions was too few and were “willing to give this more time and thought”. Comments from participants also indicated that when the past 48 h included either only weekends or only weekdays, their response differed from activities they typically perform on their woodland. Some reported that they mostly do activities on the weekend and others said that they do all of their work on the weekdays because they are retired and not time constrained.

Slightly over half of the respondents responded ‘yes’ to the question “Did this project make you think more about your woods than you would have otherwise?” We asked whether the season influenced responses (survey was administered in June and July), and 66% responded that the season influenced the activities they selected. The majority (77%) reported that their responses were either Very or Somewhat typical of any given week throughout the year. An open-response field was provided for this question and respondents commented that it influenced their thoughts. One example response was “It was a weekly reminder of the importance of my woods to me and my family. It also had suggestions

for things we might want to start doing.” A different respondent commented “It made me realize I don’t think about my woods very much.”

4. Discussion

4.1. Recruitment and Attrition

In general, we found this method to be useful in obtaining real time data from FFOs from woodland owner associations, with respect to their woodland engagement. Recruitment and continued response rates, once enrolled, were generally higher than many mail surveys. Connelly, Brown, and Decker (2010) found that survey response rates have been declining over time for natural resource-focused surveys [19]. This method could provide a modified means of obtaining self-reported data, critical to understanding both internal and external factors that influence decision-making. The most frequently reported recruitment pathway in both the 2015 pilot and 2016 study was existing listserves from woodland owner associations. This is somewhat problematic for generalizability to all family forest owners, since membership in a woodland owner organization is evidence of a FFO who is already more engaged with their woods than others. Research demonstrates that members of woodland owner associations are more likely to engage in a wide variety of management activities, such as cross-boundary collaborative management [20] and participation in tax incentive programs [21,22]. However, once recruited, participants generally completed the entire study, which indicates that this method could be useful for measuring trends over time, if random recruitment strategies were employed and barriers to recruitment are overcome. Despite limiting the analysis to woodland owner association members, some participant demographics (age, average acreage, level of education, gender) were still consistent with national statistics for FFOs [8].

4.2. Levels of FFO Engagement

Averaged responses were consistent across the four weeks in each activity category. Specific prevalent activities included ongoing maintenance (e.g., trails and roads) or annual needs (e.g., cutting wood for personal use). The dominance of recurring activities among FFOs could indicate that situational factors drive FFO engagement (e.g., the need for home heating) or that habits drive these behaviors. The prevailing literature suggests that knowledge sharing and behavioral change strategies will shift if situational factors were more important than, for example, social learning or norms [23]. In decreasing order, respondents thought about, walked around, and talked about their woods with others. Decisions about the woods were made by approximately 6.9–13.7% of respondents each week, but without knowing what types of decisions were made, we cannot conclusively say if this is higher or lower than other reported studies.

4.3. Evaluation

Given that over half of respondents considered their woods more often as a result of participating in the project, there is a high potential for a measurement or priming bias [24], particularly if ‘thought about woods’ is a primary measure of early engagement. Therefore, using ‘thought’ as a measure of engagement is not recommended, when using an EMA approach. The activities on the more engaged end of the spectrum (talking to others about their woods and making decisions) would be more useful to measure with an EMA approach). It is important not to overstate the magnitude of FFO woodland owner association member engagement from these and future results, nor to assume that evidence of engagement is solely due to other measured attributes, as the study itself may have some contribution. However, this finding also suggests that ‘pings’ could be a useful outreach and engagement tool, serving as a regular reminder of activities that a FFO could consider undertaking in their woods. Generally, respondents did not find the method overly burdensome, consistent with evaluation of EMAs used in health sciences [4].

4.4. Study Limitations and Future Research

This study was limited by the length of time, and the recruitment pathways. Future versions of this study would ideally contact participants at monthly intervals for a year or more. Alternately, participants could report about a longer period of time (e.g., one week) but only respond biweekly or monthly. This will better capture the long time horizons inherent to forest management decisions and could partially ameliorate the finding that seasonality affects results, as reported by the survey respondents. This will also better capture the critical decision-making context of landowners that this approach is best suited for. This context can only be understood if enough data is gathered to determine what factors immediately precede management decisions, and so must be performed over long periods of time, given how infrequent forest management decisions tend to be. This study reports from the ‘already engaged’ landowner pool; an improved study would draw randomly from a list of landowners. Using EMAs will be limited by a participants’ access to technology and comfort-level with technology. In rural areas with poor cell coverage and slow or nonexistent internet, this approach will not work. However, Federal Communications Commission data suggest that rural internet services reach over 50% of households and that this increasing trend will continue with improved satellite and mobile provider coverage [25]. It is also worth noting that many landowners found the process confusing, commenting that they must have accidentally received the same survey each week. It may be advantageous to clearly explain (and repeat) that the same questions are repeated at each contact to avoid respondent frustration. Finally, EMA data in forestry could be compared to retrospective survey data, and to actual behaviors (e.g., a timber harvest notice) collected from the same participants, to determine if EMAs actually moderate or eliminate recall bias. The National Woodland Owner Survey, now in the third iteration with the same survey instrument, could be a basis of comparison against this approach, to see if the sample is indeed representative of woodland owners nationally, or at the scale desired by the researcher and to see if trends over time differ depending on the mode and frequency of contact.

5. Conclusions

This novel method has potential, if expanded, to collect quality data about direct antecedents and the decision-making context for FFOs, shedding much needed insight on what takes place before a forest management decision is made. Over time, the data could show that those landowners who thought about their woods consistently, or engaged in certain activities were more or less likely to engage in other perhaps larger and more consequential activities, such as a timber harvest or selling and subdividing. The actual questions that are asked in an EMA should be adapted to better reflect the antecedents to an important land management decision of interest. As new generations of FFOs take ownership of forest land, it is likely that comfort and familiarity with technology (e.g., smartphones) will increase [18]. The technique could be deployed via a smartphone application and could include information and links to technical service provider information, making it a dual-purpose research and behavior change tool. An EMA approach could also be used to experiment with outreach and engagement strategies. For example, a FFO who is thinking about their woods versus talking about their woods to others may necessitate different outreach strategies. Additionally, FFOs who are consistently undertaking certain activities compared to those who do activities sporadically or seasonally may need different outreach methods and topics. This novel (in natural resources) method will help shed light on the variability of a single decision-maker through time and the general patterns of decision-making across a broader population, helping natural resource managers better predict the public benefits and services that natural resources provide. Other examples of research topics that could be explored using an EMA include recreation decisions, restoration activities, invasive species control and prevention, defensible space and fire prevention behavior, and a broad range of environmental and sustainability behaviors (e.g., recycling). Finally, the EMA approach could also be applied to other areas of forest science and forest management, such as community-based natural resource management, disturbance ecology, and utility maximization modeling in forest

economics. EMAs are particularly useful when (1) rates and frequencies of a behavior or a decision are of interest and (2) when it is important to know what happens for prior to a decision, behavior, or action, particularly if there is a suspected sequence of events or factors that precede this decision or action. It is also useful when complete monitoring is not possible, but temporal factors are critical to measure and understand.

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