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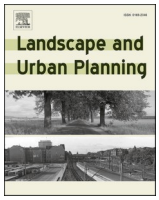

Place, loss, and landowner response to the restoration of a rapidly changing forest landscape

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HIGHLIGHTS

- Sense of place was a key lens through which landowners experienced landscape change.
- Change was experienced through multiple, cumulative drivers.
- Drastic and abrupt changes resulted in solastalgia.
- Most favored restoring recent cultural landscape character instead of historic ecological conditions.

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ABSTRACT

Landscape change occurs as a result of both human and natural forces. When changes are abrupt and drastic, they can negatively impact people who had become attached to a landscape's prior character. Place-based models of landscape change assert that the strength of people's attachments can influence their experience of and response to change. We apply a qualitative deductive-inductive approach to examine rapid change experienced by family forest owners in the northern Great Lakes region of the U.S. (N = 17), whose densely forested property was in the path of a major windstorm and near an ongoing pine barrens restoration. Through in-depth interviews we found that landowners had a strong sense of place for the Northwoods, a culturally-constructed landscape character of big trees and continuous canopy of relatively recent origin in our study area. This sense of place acted as a lens through which they experienced multiple and sometimes cumulative drivers of change resulting in a spectrum of losses, including solastalgia. Sense of place affected how they responded to change on their own property, with most wanting to assist or let "Mother Nature take its course" in returning the land to its Northwoods character rather than its more open, ecologically-based conditions. Responses to the pine barrens restoration ranged from negative to somewhat positive, with those expressing positive feelings mentioning aesthetic, ecological, and functional reasons. Implications for management and place-based model development are discussed.

1. Introduction

People's "sense of place" is established in large part by the meanings and attachments they associate with a landscape's natural and cultural character (Stedman, 2003). People who feel a strong sense of place for a landscape can thus be impacted when that character changes, and their experience of impacts can in turn affect the ways in which they respond to landscape changes (Higginbotham et al., 2006). Some landscape changes can be incremental and gradual, such as the parcelization and conversion of forestland from timber production to second home development. In these cases, long-time residents and visitors may be able to adjust and continue to appreciate the essential qualities of the

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forest even while some opportunities, such as hunting access, may no longer be available (e.g., Gobster & Rickenbach, 2004). But landscape changes that are drastic and happen abruptly, such as a wildfire or windstorm, can result in a perceived loss of place when essential qualities disappear from the landscape (Deuffic & Ní Dhubháin, 2020; Waks et al., 2019). "Solastalgia," the emotional distress or inability to seek solace from a home environment or other place for which people hold strong attachments, is increasingly being identified as a mental health problem associated with drastic, negatively experienced environmental and landscape changes (Albrecht, 2005; Galway et al., 2019). How landowners perceive and respond to radical changes in the surrounding landscape and deal with them on their own land is the subject of this paper.

Since 2015 we have been part of an interdisciplinary team of scientists and practitioners involved in a landscape-scale effort to restore pine barrens and associated northern dry forests in a national forest within the northern Great Lakes region of the U.S. These open and semi-open natural communities have largely disappeared from the regional landscape, and when tree removals and prescribed burning activities began on the first treatment sites in the project area in 2015, concerns raised by nearby family forest owners spurred a series of investigations into how the restoration effort could institute ecological changes while addressing social goals (Floress et al., 2018; Gobster et al., 2021a; Gobster et al., 2021b). As our work began to inform the design of treatment sites and communication to constituents, restoration activities were greatly accelerated and expanded when in 2019 a severe windstorm occurred, resulting in a near-total tree blowdown across a wide swath of public and private lands within the project area and partial-to-extensive damage across a much larger adjacent area. While cleanup and salvage logging efforts were ongoing as of December 2021, public lands activities to date have resulted in a starkly different landscape. For family forest owners, this raises important questions about what "restoration" means to them, on their own land and in the public lands surrounding them.

In this paper we report the results of qualitative in-depth interviews with a targeted sample of family forest owners confronted by abrupt and drastic changes to a familiar, cherished landscape. We frame our work using a novel, hybrid model of landscape change that builds upon previous deductive ecological and place-based models. We then employ an inductive coding process to uncover key themes and relationships between sense of place and other model components. Our findings support previous research hypothesizing that sense of place plays an important mediating role in the experience of landscape change (Galway, et al., 2019). Further, our findings explicate how multiple, cumulative drivers of change can have a range of impacts upon people, including solastalgia. Solastalgia is a concept receiving increased attention in the environmental change literature (e.g., natural hazards), but to our knowledge has not been discussed in the context of ecological restoration activity. These findings have important implications for the restoration of both public landscapes, where major changes could affect existing landscape character, and for anticipating how landowners will respond to similar changes on their own forest land. On a more theoretical level, our findings provide a potential explanation for the observed disconnect between ecological and aesthetic values in previous research (Gobster et al., 2007), and suggest that sense of place can act as a barrier to people's appreciation of an "ecological aesthetic" when existing landscape character is significantly altered.

2. Background and questions for research

Change has long been a focus of landscape research and planning (e.g., Antrop, 2013; Steinitz, 2012). Various models of landscape change have been proposed, most of which examine how forces or "drivers" of change impact an initial condition and produce an outcome condition (e.g., Baker, 1989). Ecological models often conceive change in terms of negative impacts to natural systems and the species or habitats they provide (e.g., Brudvig et al., 2017), with people included mainly as the change drivers. Landscape and land-use change models developed for environmental planning and management follow a similar positioning but tend to focus on social and economic factors as the major drivers of change (e.g., Verburg et al., 2004). Gobster et al. (2000) describe a simple loop model of development-oriented landscape change that incorporates the main aspects of ecological and planning models. The four-component model (Fig. 1) examines how various social and economic drivers of change affect existing landscape character, defined as the "physical, biological, and social patterns in the landscape at the regional or subregional level" (p. 11). These drivers result in actual and perceived effects, positive and negative, spurring planning and policy response strategies to address change, which in turn feed back into the alteration or stabilization of future landscape character.

While these models include people as agents in both driving and addressing change, most focus on the biophysical landscape. By contrast, place-based models of landscape and environmental change put people in central focus, and examine how various drivers of change impact the lives and livelihoods of individuals and communities (Davenport & Anderson, 2005). While place-based research often defines place in different ways, including place attachment (Scannell & Gifford, 2010), sense of place (Williams & Stewart, 1998), and place identity (Peng et al., 2020), place-based studies of landscape change share a common finding that people's connections to place play a critical role in how they experience and respond to changes. For example, Devine-Wright (2009) conceptualizes development-oriented landscape change as a place-centered psychological process that begins with awareness of ongoing or proposed changes, interpreting and evaluating their potential impacts, and developing coping and protective actions for minimizing disruptions to place attachment. Glover et al. (2008) present a model of landscape change in the context of community-based landscape values that positions sense of place as a fundamental component in negotiating how diverse values are represented in planning for community landscape change. In both models, the strength of people's connections to place are seen as a key influence on how they perceive, experience, and respond to change.

This same strength of attachment to place also figures prominently in stress-coping models (Lazarus & Folkman, 1984) applied to issues of environmental change. This work examines natural disasters and other drastic or existentially-threatening drivers of change such as wildfire (Eisenman et al., 2015), storms (Deuffic & Ní Dhubháin, 2020), and climate change (Tschakert et al., 2019) and aims to understand the effects of loss that people incur and how they cope with or respond to loss and change. Of particular interest has been understanding how people experience and cope with solastalgia, the high emotional distress of losing their home environment or other cherished landscapes (Albrecht et al., 2007; Galway et al., 2019). Here the strength of people's

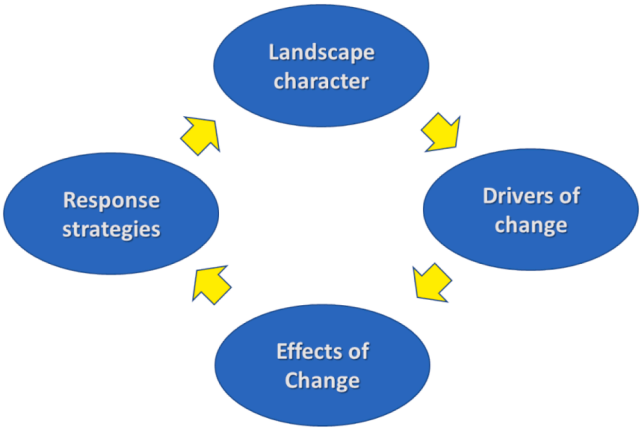

Fig. 1. Model for understanding landscape change (from Gobster et al., 2000).

connection to place is often cited as a key factor in whether they experience solastalgia and the actions they take to address the grief stemming from environmental change (Comtesse et al., 2021). Higginbotham et al. (2006) present a four-stage model of environmental distress based upon prior stress-coping models (e.g., Lazarus & Folkman, 1984). In their model (Fig. 2), environmental changes are perceived by an individual or group for their severity and appraised in terms of their degree of threat and impact, which determine how people respond. Sense of place is positioned as a key mediating variable that helps determine the degree of threat and type and magnitude of impact the change will have on the individual and/or group (i.e., greater sense of place = more impact).

One important distinction between ecological and planning models of change and those grounded in social science and place is that the former more explicitly include the landscape as a model component. Gobster et al. (2000) describe this component as landscape character, the unique qualities that distinguish landscapes from each other. In the context of the place literature, this uniqueness, along with the personal and shared meanings and values people associate with that landscape, contributes to a landscape's sense of place (Stedman, 2003). Because the concept effectively connects people and place, landscape character has become a foundational part in planning for landscape change in scenic and heritage landscape assessments in the U.S., U.K., and E.U. (Butler & Berglund, 2014; Swanwick, 2002; USDA Forest Service, 1995).

Models that integrate place and landscape character also hold potential in understanding how people perceive, experience, and respond to restoration activities resulting in landscape change. For example, Gordon et al. (2020) found that place attachment and ecological knowledge helped predict support for restoring fire-dependent longleaf pine savannas. Our earlier work (Gobster et al., 2021a) found that while a minority of landowners showed a similar preference for the more open conditions of pine barrens restorations, the majority preferred mature, closed-forest conditions that typified the dominant existing landscape character. While our work could not effectively explain the differences between the minority and majority segments, we suspected that a strong attachment to the regional landscape played a role. In this follow-up study we used the windstorm and subsequent expansion of pine barrens restoration activity to explore these questions:

1) How do landowners identify their sense of place for the landscape?
2) What experiences of loss and change have they felt from natural and management activities on their own land and on the surrounding landscape?
3) How do their experiences of place and loss shape how they respond to change on their own land and on the surrounding landscape?

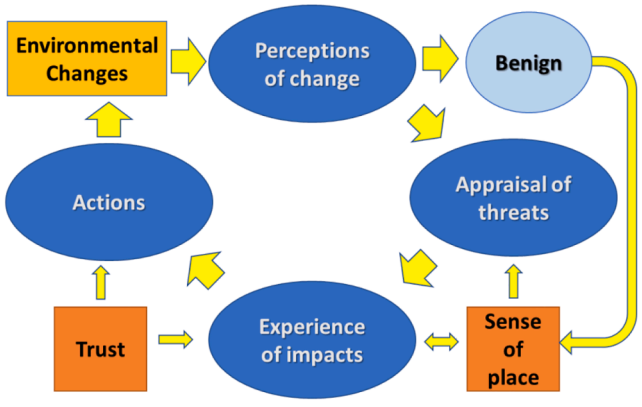

Fig. 2. Environmental distress-response model (from Higginbotham et al 2006).

3. Methods

3.1. Study setting

Our national forest project area comprises a 15,000 ha area of sandy, glacial outwash that prior to European settlement and logging activities during the "Cutover" period (1860–1930) was part of the historical center of red (*Pinus resinosa*) and jack pine (*Pinus banksiana*) barrens in the northern Great Lakes region (Pregitzer & Saunders, 1999; Radeloff et al., 1999). Pine barrens are characterized by a relatively open canopy of trees growing in a patchy mosaic of grasses, forbs, and shrubs. These fire-dependent natural communities were maintained by lightning and intentional burning by Indigenous peoples, resulting in a landscape with a high diversity of plant species; open habitat for grassland birds and an abundance of nuts and berries for other game and non-game species; and a desirable landscape character for subsistence livelihoods (Kimmerer & Lake, 2001; Wisconsin DNR, 2015). Once covering more than 20,000 km^2 of the northern Great Lakes region, fire suppression and afforestation management over the past century reduced pine barrens occurrence to a few isolated remnants, mainly on public lands, and they are now classified as globally imperiled (Quigley et al., 2020). This type of management, driven by the then-prevailing U.S. forestry knowledge and ideology of the day aimed at economic productivity, treated pine barrens much the same as the northern hardwood forests growing on richer soils surrounding them, resulting in a dominant contemporary character of relatively dense, continuous forest cover. Further driven by a tourist industry which since the initial cutover has promoted the "Northwoods" as a homogeneous region of forest and lake scenery, most current residents and visitors see this culturally-constructed condition as "natural" (Shapiro, 2013; Stedman, 2003). Efforts to restore pine barrens thus must reacquaint people with this lost landscape, communicating the values of change verbally through contact with stakeholders and experientially through on-the-ground management.

Pine barrens restoration commenced in 2015, focusing on two main sites within the project boundaries of about 300 ha each. Activities included clearcutting in units of various sizes and patterns and selective tree removals of varying densities to provide spatial diversity, followed by mastication of slash and prescribed burning to reduce brush and shrubby regrowth and stimulate the dormant seed bed of barrens grasses and forbs. Besides describing the biodiversity, sustainability and recreation benefits of restoration, managerial communications have stressed how restoration treatments would help reduce wildfire hazards for nearby private landowners, whose woodlands and residences lie within this very fire-prone landscape.

The 2019 windstorm, or derecho, traveled along a 5–15 km wide corridor, impacting most of the project area and nearby public and private lands (Fig. 3). While much progress has been made through 2021, forestry experts estimate cleanup and recovery will take a full ten years (Parnass, 2019).

For national forest managers, salvage logging has been a major tool in the recovery and provided an opportunity to greatly accelerate and expand pine barrens restoration within the project area. As for the family forest owners, field observations in 2020 and 2021 revealed varied recovery activity, with the majority focused on cleanup around homes and cabins and removal of individual downed and damaged trees, while a few owners engaged in major salvage efforts, logging a substantial portion of their trees (Fig. 4).

3.2. Landowner sampling and interview protocol

To address our research questions, we defined our population as family forest owners of property 1 ha or larger located within the path of the windstorm and in within 5 km of the pine barrens restoration sites (n = 197). Within these criteria we drew a one-third sample (N = 58), and used October 2019 aerial and June 2020 field photography to oversample individuals in the immediate vicinity of the restorations and who

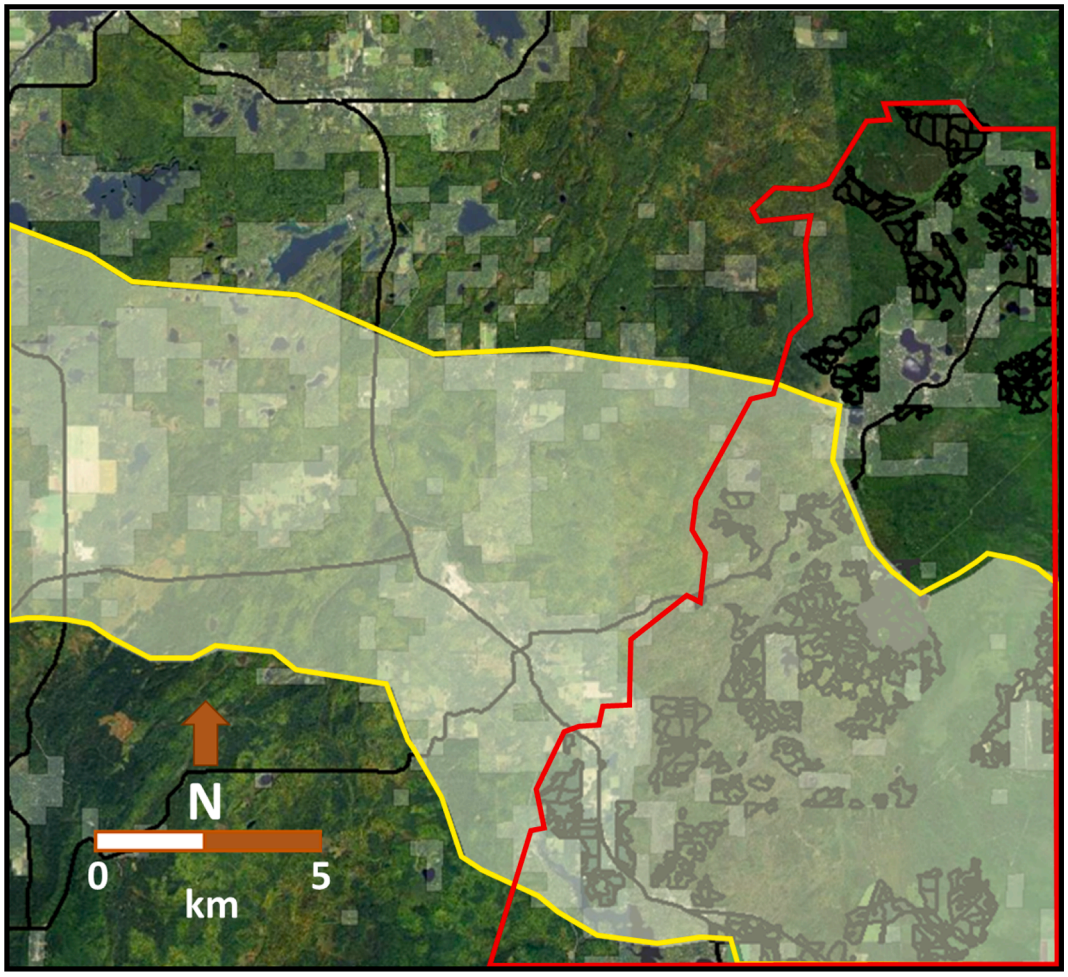

Fig. 3. Aerial image of a portion of the national forest with the yellow shaded area showing the path of the 2019 windstorm where heavy tree blowdown occurred. The restoration project boundary is shown in red; the dark polygons within the project area are restoration treatment units under active management. Lighter shaded blocks are private lands within the national forest boundary and dark, irregular shapes are lakes.

appeared to have undertaken storm recovery actions. From this sample, we identified landowner names and mailing addresses using county land information records. A two-wave mailing began in July 2020, with a cover letter inviting participation in a 30–45 min web-video or phone interview to "find out how landowners are managing their woodlands in the wake of last summer's windstorm." In addition, we worked with the local Chamber of Commerce, using their Facebook page to solicit participation.

Our final sample included 17 landowners, all of whom had taken at least minimal restorative action since the storm. Their property averaged 7 ha in size (range 1–32 ha) and average length of ownership was 20 years. Most parcels had some form of dwelling on them; six participants were permanent residents while the remainder used their property as a leisure-time getaway. A few nonpermanent residents lived in rural areas close to the project area, but most came from medium-sized cities $<$ 2hr to the south, visiting their property at least once per month and some nearly every weekend in all seasons of the year. Three, 1 ha parcels were zoned residential and larger parcels were zoned forestry except for the area around a dwelling. Two of the largest properties had state-approved forestry management plans. Our qualitative research design aimed to represent the range of family forest owner types, and our participant sample broadly parallels that of our previous research which revealed few statistical differences between permanent, seasonal, and non-resident owners in their reasons for owning their land (Gobster et al., 2021a).

Interviews were conducted online over Zoom (n = 14) or by telephone. Interviews averaged 30 min and were recorded with participant permission, using the Zoom auto-transcript feature to assist with transcription. Individuals were given a $50 debit card in appreciation for their participation. The research was approved under the University of Minnesota IRB's expedited review procedures for activities classified as posing minimal risk to human subjects.

Paralleling our initial research questions above, an inverted funnel interview protocol consisted of open-ended questions that asked landowners:

1) About their land, how long they owned it, and how they used and managed it before the windstorm.
2) How they and their land were affected by the storm, and their perceptions and experience of storm effects and related management on lands surrounding their property. For the latter part of this question, we were particularly interested in whether they noticed and how they felt about the salvage logging and expansion of pine barrens restoration in the national forest.
3) What actions they had taken to respond to the effects of the storm, and whether their experience had led them to rethink how they would manage their property moving forward. Probes focused on how they felt about managing their property in a more open condition than the typical dense forest, and we also directly asked about their awareness and perceptions of the pine barrens restoration efforts if it did not come out in the previous question.

Fig. 4. Top photos: Windstorm damage (left, 2019) and pine barrens restoration treatment (right, 2021) of plantation red pine stands on the national forest. Bottom photos: storm damage (left, 2020) and cleanup activity (right, 2021- notice cabin roof center horizon, see arrow) on family forest land adjacent to a national forest restoration site (photos by USDA Forest Service).

3.3. Conceptual model

Our analysis builds upon the models of landscape change discussed in Section 2. Our deductive model (Fig. 5) comports with previous work on landscape assessment (e.g., Swanwick, 2002; USDA Forest Service, 1995) and like Gobster et al.'s (2000) model (Fig. 1), positions landscape character as a starting point. Like Higginbotham et al.'s (2006) model (Fig. 2), we viewed sense of place as a key mediating variable, though we centralized its position in our model. Further, we viewed sense of place as a relational concept that mediates all aspects of the landscape change process (e.g., Foo et al., 2013), and use bidirectional arrows to indicate how it affects and is affected by each of the other model components.

We used this model in the initial phase of our analysis to code text from the interview transcripts, with guidance from the relevant literature:

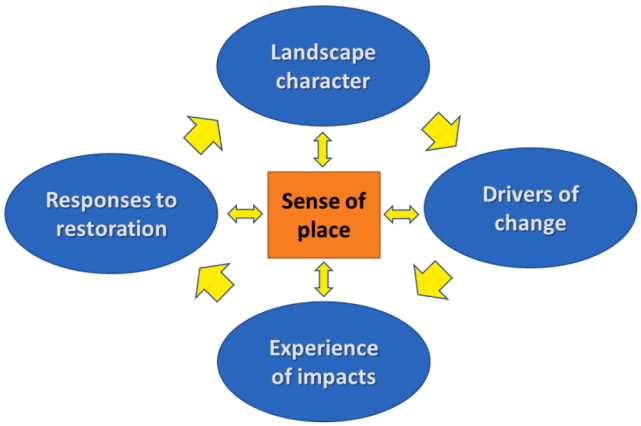

Fig. 5. Conceptual model of family forest owners' responses to landscape changes.

- ***Sense of place:*** Sense of place (Williams & Stewart, 1998) and related concepts constitute a vast literature relating to people's connections to place (Williams, 2014). We took a broad view in identifying statements by participants related to sense of place, drawing on place-based research on personal, symbolic, and other meanings of the landscape and its physical characteristics (Stedman, 2003); affective/emotional attachments to place (Scannell & Gifford, 2010), place as an integral part of a person's identity and sense-of-self (Peng et al., 2020), and via place-dependent work and leisure activities expressed by participants (Eanes et al., 2018). As suggested by its position as a mediating variable in our model, we were especially interested in how these various aspects of sense of place were expressed by participants in relation to the other model components.
- ***Landscape character:*** Following conceptual definitions by the USDA Forest Service (1995), Swanwick (2002), and others (e.g., Eanes, et al., 2018), we sought to understand how landowners characterized the landscape in terms of its biophysical and cultural features and patterns. We were particularly interested in whether participants identified distinct biophysical characteristics related to the openness of pine barrens and to what extent they were seen as part of a desired future condition through restoration of their property and/or the surrounding public landscape.
- ***Drivers of change:*** While singular drivers such as wind farm projects or windstorms are frequently the focus of place-based studies of landscape and environmental change (e.g., Deuffic & Ní Dhubháinin, 2020; Devine-Wright, 2009), multiple agents can work together to affect change (Agarwal et al., 2002). In our interviews the windstorm itself was conveyed to participants as the principal agent of landscape change, but we were also interested in how national forest pine barrens restoration efforts before and after the windstorm served as a driver of change. In reviewing the transcripts, we also sought to identify additional natural and human-influenced drivers of landscape change.
- ***Experience of impacts:*** Studies of loss and grief in response to landscape and environmental change often focus on emotional reactions of distress or solastalgia over the destruction or radical

transformation of a home environment or other cherished landscape including shock, sadness, anxiety, and feelings of powerlessness (e.g., Albrecht, 2005; Askland & Bunn, 2018). But the spectrum of loss can be great and can include material and financial elements like property or future income (e.g., Andersson et al., 2018; Cox & Perry, 2011), cognitive and mental aspects such as disorientation and diminished identity and wellbeing (e.g., Comtesse et al., 2021; Galway et al., 2019), and social and behavioral dimensions such as weakened social connections and loss of access to open space (e.g., López Meza & Brito-Peña, 2020; Paveglio et al., 2016). We were interested in all of the ways in which participants experienced impacts from the storm and the broader range of drivers of change to their land and the surrounding landscape.

- ***Responses to restoration:*** To address this element in our conceptual model we sought to identify the range of actions taken by landowners to restore their property as well as how they perceived the pine barrens restoration activity taking place on nearby public lands. The literature on stress and coping suggests a range of strategies, from doing nothing or leaving to expressing opinions and support to taking direct physical action (e.g., Higginbotham et al., 2006; Lai et al., 2017). With respect to these strategies, we were particularly interested in how people's sense of place and experience of impacts might lead to adaptive responses toward more sustainable management such as reducing fire risk on their own land or a favorable perception toward pine barrens restoration on public lands (e.g., Andersson et al., 2018; Sousa-Silva et al., 2018).

3.4. Coding and analytical procedures

Qualitative data analysis occurred in two phases: a deductive phase to identify how participants talked about the various components of landscape change as guided by our model and the literature, followed by an inductive phase to identify key themes within the components and the range of responses among participants (Fereday & Muir-Cochrane, 2006). During the initial phase of coding, two of the investigators independently read the transcripts of individual interviews and block coded text strings associated with one or more of the model components. They then reviewed each other's work and discussed incidences of divergence to confirm intercoder reliability and consistency. In the second phase, pattern coding was applied to identify and clarify themes (Miles et al., 2014) and select quotations to illustrate key ideas and insights (Eldh et al., 2020; Lingard, 2019). Refinement of the working model was an iterative part of the analytical process, continuously informed by and informing the development of codes and exploration of variability among respondents.

The final model and analysis were presented to the full group of investigators and discussed as part of the writing and editing of this paper. Throughout this process, detailed memos were used to record code definitions and rationales, as well as document researcher discourse related to guiding literature, emerging theories, and model development (Miles et al., 2014).

4. Results

The results of our analysis are summarized in Table 1, which shows the main themes identified in our inductive coding for each of the components in our model. To understand and illustrate the mediating role of sense of place, the table and text highlight how sense of place themes were discussed in relation to the other model components and themes.

4.1. Landscape character

When describing their property, it was clear that for most landowners the key physical characteristics of their land were the trees, especially the big trees and dense growth that provided the continuous forest cover they desired. These characteristics were talked about in ways that reflected the deep, personal and symbolic meanings and emotional attachments participants felt about their land:

> *hey're a good eighty or hundred years old, you know, huge trees. A lot of places the sun never came in, it was so thick.* (6)

> *I love the forest, you know I just love the trees, I love to see the trees… So it's just kind of my release to get up there. That's how I feel about seeing that woods– I can't wait to get in my driveway, park my truck, get my dogs out, go for a walk, you know, have a beer out there. It's the best feeling that I can get.* (8)

For many landowners, their recreational use reflected a dependence on the physical characteristics of their land and the surrounding landscape:

> *I'm a deer hunter, a bow hunter, especially. That's what I bought the woods for and that's what I want to do…* (8)

> *We do ATV, UTV, and that's basically because we're on the county trail system where our property is. We do not hunt, but I know our kids and grandkids really enjoy hiking through the woods.* (10)

It was these desired characteristics that most participants clearly associated with a Northwoods aesthetic, a landscape character that is

Table 1
Themes and examples of landowner responses identified through inductive coding of landscape change model components.

Model Components	Themes (examples)	Associated sense of place themes (examples)
Landscape character	• Biophysical features (trees, dense woods) • Northwoods aesthetic (recent cultural) • Intrinsic vs. desired conditions (pine barrens qualities, landscape modifications)	• Meaning (huge/old trees) • Attachment (love, emotional release) • Dependence (recreation activities) • Identity (a constant in my life)
Drivers of change	• Windstorm (fallen and leaning trees) • Pine barrens restoration (tree removal, open landscape) • Windstorm "echo" effects (oak wilt, weakened trees, cleanup/salvage operations)	• Meaning (loss of big/ historic trees)
Experience of impacts	• Material and financial (loss of trees, damage to buildings/infrastructure) • Social and behavioral (blocked access, all leisure time now spent on cleanup) • Cognitive (don't like restoration "look" but understand its wildfire protection benefits) • Affective and emotional (lost beauty and solitude; hurt and loss of cherished landscape)	• Attachment (affective and emotional loss of cherished landscape: "it doesn't look nice," "it hurt so much"; cumulative drivers amplified feelings of loss: "it's just never-ending") • Identity (place I knew from birth will never be the same)
Responses to restoration	• Cleanup (remove hazards, cut firewood, make area around house more fire resistant) • Return to "natural" conditions (some planting, mostly let Mother Nature take its course) • Ambivalent adoption and appreciation of pine barrens treatments (create a mini pine barrens on property; balancing barrens with woods to provide a nice mix)	• Meaning (keep it sacred, natural; restoration goes against the way things should be; manage for future generations) • Attachment (barrens restoration is a godawful idea vs. it does look nice, park-like; appreciation more intellectual than aesthetic • Dependence (want dense forest for hunting) • Identity (it's our getaway, up north)

qualitatively different than more open landscapes such as pine barrens:

> *I like the dense (forest), that's just my personal opinion… I picture something like Colorado with big open spaces, that doesn't appeal to me. Not that I don't like pines, I like pines but dense pines…We call it God's country up here and have for years, we chose to give up our jobs in the city to live in the woods for a reason.* (14)

While most considered this Northwoods aesthetic to be the natural ecological character of the landscape, some acknowledged and accepted its more recent cultural origins:

> *…you go up north to be in the woods, not in the barrens, or the prairies. Granted, back in the 1800 s it might have looked like that, but you know, this is our modern-day life. So up north and the woods were always associated together.* (10)

Operating within this Northwoods cultural context, ownership gave some participants license to manage their land to provide them with the landscape character they desired and felt was "natural," even if the modifications they introduced were inconsistent with the ecological realities of the area:

> *We basically want it for wildlife… My husband's done some planting of clover for wildlife. But yeah, other than that it's just to keep it natural for wildlife.* (2)

> *We have a lawn that's landscaped and a pond in our backyard. And the reason we built that pond is because I wanted a natural habitat for the animals…We don't really live near a body of water so I said let's make our own and we planted clover out there.* (12)

At the same time, other landowners recognized the landscape they so strongly identified with and were attached to had unique, intrinsic characteristics that set it apart from commonly shared images of the Northwoods. Of these characteristics, participants most often mentioned the sandy soils, the dryness of the landscape and the risk of wildfire, and the vulnerability of trees—particularly the more shallow-rooted pines—to windthrow:

> *We're on a ridge overlooking the lake that was pretty glaciated so it's very sandy, rocky soil, so I think it doesn't hold the roots system all that great.* (14)

> *It's a place that's been a constant in my life in the sense that, for whatever reason, it doesn't seem to change that much since I was a kid there… It's weird; because of the sandy soil or whatever it is there, stuff doesn't really seem to decay. Like literally, there'll be like a rusty beer can in the woods from back in the '60s and it just stays there, because of the way the climate is. And there are tree stumps around there that are from when it was logged 100+ years ago where you can still see the hand-saw marks.* (5)

4.2. Drivers of change and experience of impacts

While our conceptual model (Fig. 5) and those from which it was derived present drivers and impacts as separate components, participants nearly always talked about them together and so we present our findings that way. The windstorm was the expressed focus of our interviews, and its impacts on participants' properties included partial to near-complete blowdown of trees, with other trees snapped off or left fractured and leaning, creating hazardous conditions and damage to homes and outbuildings, blocking access to roads and trails, and taking out powerlines that in some cases took more than a week to be repaired. But while damage to personal property was a major issue for a few participants, nearly everyone emphasized damage to their woodlands, especially the larger oaks and pines that figured significantly in the sense of place they held for their land and the surrounding landscape:

> *75% of our woods was gone. And I'm talking about mature trees that you couldn't fit your arms around, either twisted or snapped off.* (8)

> *Of the 50 acres I'm estimating I lost about 30 acres. The entire red pine plantation was flattened. The entire white pine plantation was flattened. There were a couple 100+ year oak trees that tipped over. You know, I counted the rings and put their age to roughly 1922 when the loggers came through and did their initial cutting of this part of the state.* (13)

Expressions of loss from the storm were diverse and ranged from aesthetic to highly emotional statements associated with solastalgia. Of the former:

> *It doesn't look nice. You know, I'm used to nice trees all over…I used to like to look at my woods and once my wife said, "we should cut some trees to get more sun so I can sit out by the cabin." She's got the sun; not my choice.* (7)

> *One thing I noticed because our neighbor's trees were so wiped out—now I can hear the traffic from the highway and I used to not hear the traffic. It's just very quiet when you're sleeping at night—we used to be able to hear the river, but now I hear cars going by.* (15)

Solastalgic-type accounts were described by about two-thirds of interviewees, who expressed feelings of sadness, disbelief, withdrawal, and heartbreak over the damage incurred to their property and the surrounding landscape they cherished and feared would never see again:

> *Right after the windstorm passed, we went out in the dark and shined the light and couldn't even recognize what we saw out our front door. We couldn't see the treeline and my heart just fell…[The next morning] once we got ourselves out we tried to walk around our land and it was impossible. We were climbing over and under trees and then I started to cry and I was like, "I've been coming up here since I was born in 1963 and I've been here forever," and [my husband] said, "don't worry, it will grow back." But it hurt so much to see it and I know I won't live long enough to see it grow back. My kids might but I won't and that's just a hard feeling, it's just not something that can replaced.* (14)

> *For both my wife and myself, it's still kind of heartbreaking that Mother Nature did that type of damage. In a matter of hours, you know, literally, the amount. Like I said, with us doing our ATV rides, we cover a lot of ground and the trails will never, the forest will never look the same.* (10)

For some landowners with property adjacent to or near the pine barrens sites, restoration before and salvage activity after the storm was viewed as another major driver of change, with mixed opinions about its effects on their land:

> *There's a piece of property right behind our 10 acres that is national forest. And we had known that their plan was to clearcut this [for the restoration project], which they did, I believe, in 2018. So when the storm came through a year later in 2019, our logger told us that, because all that open area was right up against our woods … we got the worst of [the blowdown]. In that respect, we're not too happy about it.* (2)

> *Right next to us, where the lot line is for the national forest, they are just finishing up turning it into a savanna, and I guess some of the opinions were, "I don't like to see it." But I was kind of glad to see it… because if there was ever a forest fire… I don't want to see another __ fire [historic wildfire in the region]. Well, and the pines over there were toppling down on their own. It was time for the pines to go, to be honest, and put something new in there.* (3)

Finally, our interviews uncovered additional drivers of change that together amplified losses for some landowners. One of these was oak wilt, an accidentally introduced fungal disease that infects and kills oak trees and had recently spread to the area (O'Brien et al., 2017). Landowners had begun losing oak trees prior to the storm, and the wounding of trees from the storm left many remaining oaks vulnerable to further

mortality:

Because of our history with oak wilt and it being a greater problem up here than it has ever been before, I'm wondering how, when that storm went through in July when you're not supposed to cut an oak, how that's going to affect the woods in the future. Is it going to create more oak wilt or create other diseases on the trees we have left? (13)

Increased oak wilt was just one "echo effect" from the storm; leaning trees and unseen damage such as stress fractures led to waves of further damage from more ordinary wind and snow events:

It's just, it's just never-ending because like I said like, even during the middle of the winter a tree fell, and there was no reason for it to fall, I think it was just so tipped over. And then the snow got on it and it just fell over and it just ticked the house again… (17)

Lastly, the cleanup process itself added to the distress. For example, one couple got swindled by unscrupulous contractors that took advantage of their situation:

…they came in and tore the living hell out of the place, they took 340 cords, 100 more than they had originally contracted for… They tore up our road,…they left a mess, any logs that were gnarly or not straight as a whistle they just left lay. So we ended up with all that mess… I'm 82, my wife's almost 79. And we've been up every Thursday until Monday, cleaning up this mess….And I don't think we ever will get it cleaned up in our lifetime. (6)

Individually and cumulatively, these drivers radically changed landowners' properties and the surrounding landscape and, in most cases, led to an array of negative impacts.

4.3. Responses to restoration

Across all of the landowners we interviewed, the overwhelming response to the damage caused from the storm and related drivers of change was to clean up the mess and return the land to its previous well-wooded condition. In the two years between the storm and our interviews, most landowners had at least begun cleanup activities, removing hazard trees and downed limbs and branches from around their dwelling and outdoor living area, clearing trails, and selling salvaged timber or, more frequently, stacking what seemed would be a nearly endless supply of firewood:

Aside from maybe maintaining a slightly larger clear space (around the cabin) than we had before, I don't plan to do anything beyond cleaning up the debris around there…at least piling it into certain areas off the ground and things to keep it a more open for space to reduce fire hazards. (5)

And you know, I'm 70 years old and I worked for four or five weeks, cutting up huge trees and dragging the stuff out with my ATV and trailer. We split it all, and I had to build a woodshed because it was so much—I think I've got firewood for eight years for burning, so yeah, it was a lot of work. (8)

During this cleanup period, sunlight entering into newly opened areas ignited a surge of tree regeneration, and for many landowners, previous thoughts of replanting dissolved as they saw "nature take its course":

Mother Nature, there's a lot of new regrowth. We haven't put any real plans into place to do any replanting on either of these pieces of land. (2)

Well I'm going to let nature do itself, you know. I do have some oak left, a couple of them, and I usually get a whole heck of a lot of acorns. So I'm hoping acorns landing out in the clearings, and with the rain and snows, that nature does it cycle and gets little seedlings going… (7)

For most landowners, their concept of restoration was not informed by the ecological conditions of the landscape but by the strength of their sense of place for the cultural landscape of the Northwoods and its meanings, sense of identity, and uses they depend upon from it:

We want to keep it sacred. Yeah, get it back to natural again. (3)

I would like it to be back more dense because it's our getaway, you know, for up north. (4)

The denser forest is more attractive… We're primarily hunters so that's why we want the denser woods—I want the wildlife back. (14)

While landowners with larger properties also desired to return their land to fully forested conditions, they were more inclined than those with small holdings to take an active role in replanting. One had applied for and received a state grant to copay for pine and oak seedlings (16), while another wanted to replant their pine plantation that was devasted by the storm (2). An exception to this sentiment was one landowner, whose experience of the storm and awareness of the landscape's capabilities led them to question such a return to previous conditions:

I'm a little concerned, very concerned, about climate change. And what that is going to mean for forests throughout the nation, but especially in the northern tier here. Would it be smarter to plant some different trees than are currently growing there, because maybe in 20 years the climate will be different? …Maybe doing a mini—I don't know how many acres you would need to have an effective pine barrens ecosystem—but maybe that would be a better route for me to go. (11)

With respect to the national forest pine barrens restoration effort, participants held varied perceptions. For some, the project was a direct affront to their sense of place and how things should be:

It's godawful that they're taking all this lumber and they're not figuring on replanting. Years ago it was always preached that when you take a tree, you plant a tree. Trees create oxygen. Now [after the storm] they're taking 100 s of acres of woods and… they're not going replant. They're going to make barrens and savannahs and I don't know how they could possibly come up with this solution. I would have never bought my place if it was a barrens; I bought my place for woods to be around and the deer hunting. [The project manager] said, "you'll see all kinds of butterflies." I don't care about seeing butterflies, I care about deer. (1)

It's just to me, it's taking habitat away from some of the wildlife…It doesn't look good. It looks like a few sticks standing, and then grass, tiny shrubs, I don't even know, weeds…It just kind of looks like desert… [or] like a subdivision is about to be built. Just makes me love our woods. Makes me want to just sit outside and look at our woods. (9)

Others had more positive perceptions about the appearance of the restoration, though with some reservations about losing the Northwoods aesthetic they knew and loved:

Yes, we have seen it and it does look nice… it just kind of looks park-like. It took me a little bit to get used to it because I've been up there for years, my parents have a cottage up there, too, and you get used to the area and the trees and everything, and the first time you go through you're like, "Okay; where am I now?" No, it looks very nice. (4)

I mean everywhere you look, there's open fields now where there wasn't before…. We still have a lot of woods so, you know, it's kind of a nice mix at the moment. But I don't know how, I don't know when they're going to stop. I'd hate to see them take all the trees, that's for sure, but right now it's kind of nice. (6)

Still others did not particularly like the changed landscape aesthetically but intellectually appreciated the reasons for doing it:

Like I said it looks pretty rough at first, but then you know, you don't plant a tree for yourself, you plant a tree for future generations, so everything's looking good. (3)

So I guess it's ultimately a good thing. I understand that this area shouldn't be a great big pine forest on dry sand, because ultimately you're asking for fire problems. And so I do appreciate that proactive attempt to keep it generally a safer area….At this point, it's not that you like [the pine barrens]—it was just that before, I could go up there because I viewed it as dense forest, a cabin that's up in the middle of the forest. And now it's still a cabin, by all means up in the middle of the forest, it's just a different forest. (5)

5. Discussion

In this study, we examined how a major windstorm impacted family forest owners, how they responded through restoration of their own property, and how they perceived changes on nearby public land where post-storm ecological restoration of a former pine barrens landscape was greatly accelerated and expanded. Our working model of landscape change (Fig. 5) positioned sense of place as a central variable mediating how landowners perceived, experienced, and responded to changes and their effects on landscape character. Building on previous studies of place-based landscape and environmental change (e.g., Devine-Wright, 2009; Higginbotham et al., 2006), our qualitative analysis supports this assertion, showing that sense of place acts as a lens through which landowners see their land and the surrounding landscape, a culturally-constructed landscape of the Northwoods that is well-wooded, familiar, and desirable, even if it may be out of sync with the past and future ecological realities of its location.

Our findings also contribute to a more complex and nuanced understanding of place-based landscape and environmental change as identified by the themes within our model components (Table 1). Mirroring past research, our study participants expressed sense of place as a multi-dimensional concept of how people are connected with the landscape, from their long history of use and family ties across generations (Peng et al., 2020), through varied economic and recreational activities upon which they depend (Eanes et al., 2018), and through the varied affective, emotional, and symbolic meanings and values that attach them to the landscape and its physical and cultural characteristics (Stedman, 2003).

Unlike most studies of landscape and environmental change, we considered both the windstorm and the pine barrens restoration as drivers of change, and our analysis uncovered additional drivers that acted individually and sometimes cumulatively in their impact on landowners. Cumulative impacts are an increasingly important consideration in environmental assessments (e.g., Solomon et al., 2015) and future studies of place-based landscape and environmental change should consider looking more broadly at how multiple drivers affect people's experiences and responses to change.

Likewise, our analysis found that the impacts landowners experienced were varied and ranged from financial to recreational and aesthetic to high levels of emotional distress that align with previous work on solastalgia (e.g., Albrecht, 2007). Solastalgia connected to sense of place in various ways for participants—through the loss of big trees that had great meaning or the radical transformation of areas central to their identity—and these and other impacts demonstrate the importance of place in understanding the human dimensions of landscape and environmental change (Galway et al., 2019). While in some cases the cumulative impacts of change drivers (e.g., oak wilt, then windstorm, then botched salvage logging) heightened feelings of solastalgia, this was not always the case. For example, our study sample had only a few large property landowners, but it seemed that they responded more pragmatically to their losses, and it would be useful in future work to explore such differences with a bigger and more diverse sample of forest owners.

On a broader level, across our entire sample we saw evidence that, even when devasted by their losses, most landowners had begun to address impacts to their land, on their own and with the help of others. Cox and Perry (2011) argue that individual and social capacities to successfully cope with loss are often anchored by a strong sense of place, which they see as critical in understanding community disaster resilience. While shared attachment and sense of belonging are viewed by Cox and Perry (2011) as important at the community level, our work suggests that landowner resilience at the individual and family level may also be grounded in sense of place.

Perhaps most importantly with respect to our previous work (Gobster et al., 2021a), we discovered that landowners for the most part held different ideas about restoration than forest managers and ecologists seeking to restore the native pine barrens of the region. Nearly all landowners sought to return their land to its recent landscape character, assisting through replanting or simply letting "Mother Nature" take its course to bring back the dense forest cover. This desired landscape character was strongly tied to their sense of place and the deep meanings they attached to the pine and oak trees on their land. For most landowners, if there were any restorative actions undertaken to their property in recognition of its ecological constraints, it was to provide a bit more openness around their dwellings to reduce wildfire risk. And while there was a larger awareness and some aesthetic appreciation among landowners for the pine barrens restoration on nearby public lands, for others this acceptance appeared to be more of an intellectual or functional response to the ecological nature of the landscape than an aesthetic preference. These findings relate to a key debate in the research literature on the relationship between ecology and aesthetics (Gobster et al., 2007), and more work needs to be done to understand aesthetic preferences for landscapes and management practices that prioritize ecological goals. A clearer and more in-depth understanding that sudden landscape change can negatively impact landowner social and emotional states could lead public land managers to rethink their restoration approaches for natural communities such as pine barrens, where ecological restoration will result in major changes in landscape character.

6. Conclusion

Sense of place is key concept in understanding the human dimensions of landscape change and deserves increased attention from landscape planners and managers. The findings from this study underscore the importance for managers to communicate with stakeholders about the needs for and benefits of restoration, particularly for natural communities such as pine barrens where there is likely to be a radical transformation of a landscape for which people have a strong sense of place. Likewise, planners and managers need to recognize that people's sense of place is a fundamental lens through which they see the landscape and changes that happen to it, whether through natural disasters or by management intent. As our model suggests, sense of place is integral to all aspects of the process of landscape change, and as place-based studies become more common they can better inform how we plan for and manage change in the landscape.

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