



Research paper

Exploring the relationship between parcelization metrics and natural resource managers' perceptions of forest land parcelization intensity



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HIGHLIGHTS

- Parcelization can adversely impact many forest-derived goods and services.
- Resource managers ranked forest ownership patterns for their impacts.
- Certain ownership patterns are seen as having greater adverse impacts than others.
- Some metrics are strongly correlated with rankings of parcelization impact.

ARTICLE INFO

Article history:

Received 25 August 2015

Received in revised form 16 January 2016

Accepted 3 February 2016

Available online 18 February 2016

Keywords:

Exploded logit
Parcellation
Parcelization
Forest ownership
Subdivision
Ranked data

ABSTRACT

A major challenge associated with forest land parcelization, defined as the subdivision of forest land holdings into smaller ownership parcels, is that little information exists on how to measure its severity and judge its impacts across forest landscapes. To address this information gap, an on-line survey presented field-based public natural resource managers in the Lake States of Minnesota, Wisconsin, and Michigan with four private forest ownership patterns, each containing the same total forest area, number of parcels, and average parcel size. Survey respondents ranked each landscape from most to least parcelized based on the degree to which each ownership pattern was perceived to adversely impact three forest-based goods and services: timber production, recreational access, and wildlife habitat. Using an exploded logit model, respondents' rankings of parcelization impact were found to be consistent, regardless of the forest good or service evaluated. Rankings were also not influenced by the respondent's professional discipline, location, length of professional experience, or employer. Of the four parcelization metrics evaluated, the Gini Coefficient and Adjusted Mean metrics appear to best capture the forest land ownership patterns that natural resource professionals are most concerned about, suggesting those metrics may be useful indicators by which to assess parcelization impact.

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1. Introduction

Forest land parcelization is the subdivision of forest land holdings into smaller parcels. A major challenge associated with understanding the effects of forest land parcelization is that little information exists on when and to what degree forest land ownership patterns diminish the production of forest-based goods

and services. Specifically, the relationship between ownership patterns and forest resource outputs is not well understood, and likely depends on the forest-based good or service in question as well as the actions and management behaviors of the landowners. Forest land parcelization has been linked to the loss of wildlife habitat (e.g., forest land subdivision has been found to be a forerunner to forest habitat fragmentation, land development, and road building), reduced timber availability (e.g., smaller parcel size has been found to be less economical to harvest and associated with a decreased landowner interest in management and investment), and greater restrictions on recreational access (e.g., smaller tracts of forest land have been found to have a greater likelihood of being posted against public access) (Dennis, 1993; Theobald, Miller, & Hobbs, 1997;

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Mehmood & Zhang, 2001; Rickenbach & Gobster, 2003; Brooks, 2003; Gobster & Rickenbach, 2004; LaPierre & Germain, 2005; King & Butler, 2005; Rickenbach & Steele, 2006; Mundell, Taff, Kilgore, & Snyder, 2010). In sum, the parcelization literature makes linkages between smaller parcel size and diminished ecosystem function or output. Yet, related literature in the social sciences also suggests that different forest land ownership *patterns* may impact forest-based goods and services as well (e.g., Vokoun, Amacher, Sullivan, & Wear, 2010).

There is also no agreed-upon measure or metric for judging and comparing the extent to which a landscape has been parcelized, which creates difficulties when determining where and how to prioritize efforts to minimize the effects of parcelization. In a previous study reported in this journal, Kilgore, Snyder, Block-Torgerson, and Taff (2013) evaluated four parcelization metrics with respect to their similarity in quantifying the degree to which a forested landscape is parcelized. Their work illustrated that each metric often describes a different intensity of parcelization for a given pattern of forest ownership, attributed in large part to each metric capturing unique aspects of land tenure arrangements within a landscape. They concluded that the choice of metric used to quantify forest land parcelization within a landscape is a critical choice, but were unable to recommend a universal metric due to the context-specific nature by which ownership patterns need to be evaluated. This finding is in-line with efforts in the field of landscape ecology to identify multiple metrics that can capture various spatial characteristics of landscape composition and pattern (e.g., McGarigal & Marks, 1995).

Additional research that relates forest ownership patterns with their associated impacts on forest-based goods and services is needed. As a step toward addressing this need, we draw on the perspectives and experiences of field-based natural resource managers in relating different forest ownership patterns to their perceived impacts on different forest goods and services. Our research examines the question of whether natural resource professionals perceive differences in parcelization impact among select forest ownership patterns that vary by parcel size and pattern, and whether their perceptions are influenced by their background and experience? Specifically, we report on the findings of a study we conducted that examined rankings of forest land parcelization impact by public natural resource managers. We also examine the relationship between these rankings and several parcelization metrics that have been cited in the literature to examine the metrics' ability (or usefulness) to capture changes in ecosystem goods and services that are associated with changing forest ownership patterns.

2. Data and methods

A questionnaire was developed to solicit rankings from public natural resource managers of select forest land ownership patterns based on the degree to which they believed each pattern adversely impacts several forest resource goods and services. The questionnaire was part of a broader survey that obtained resource manager perspectives and insights on various aspects of forest land parcelization. Using modified Likert scale response items, public natural resource managers provided parcelization-related information such as their familiarity with and degree of parcelization activity in their work area, and important drivers and potential outcomes of parcelization. The questionnaire also collected background information on the respondent (e.g., years of experience, state the respondent worked in, employer, professional discipline).

The questionnaire presented natural resource managers with four different private forest ownership patterns (Fig. 1). The basis for selecting these four patterns and the forest goods and services

evaluated was feedback we received at an interactive scoping session with public natural resource field professionals in MN in 2012. In that session, participants evaluated a number of different stylized and actual land ownership patterns, as well as a range of potential impacts associated with forest land parcelization. With respect to characterizing the impacts of parcelization, participants indicated that stylized ownership patterns were easier to judge than actual patterns, and that the patterns needed to reflect a wide range in individual parcel sizes.

The four patterns depicted include: 13 parcels representing considerable size heterogeneity (Landscape A), 13 parcels of nearly equal size (Landscape B), one very large parcel covering over 90% of the area and 12 equally-sized smaller parcels (Landscape C), and one large parcel covering half of the area and 12 equally-sized smaller parcels (Landscape D). This heterogeneity, particularly with respect to the size of the largest parcel in the landscape, tested whether the degree of impact is associated with the size of the landscape's largest parcel (both the literature and the feedback we received at the scoping session suggests this larger parcels play an important role in mitigating impacts).

To facilitate data analysis and the ability to compare rankings to average parcel size (the most widely-cited parcelization metric), participants were informed that each of the four ownership patterns contains the same total forest area (one section or 640 acres), number of parcels (13) and average parcel size (49 acres) (similar to the average in the region), and that the landscape is completely forested. The questionnaire instructed respondents to rank each landscape in terms of the degree to which its land ownership pattern is perceived to adversely impact each of three forest-based goods and services: timber production, recreational access, and wildlife habitat. These three were selected because they were identified during the interactive scoping session as those goods and services perceived to be most adversely impacted by forest land parcelization.

An on-line version of the questionnaire was developed using SurveyMonkey's Wufoo on-line Form Creator (www.wufoo.com). The questionnaire was tested for functionality and comprehension with three public natural resource professionals. A final version of the questionnaire was prepared based on the feedback provided from the test.

The survey's target population was field-based public natural resource managers in the Lake States, USA (Michigan, Wisconsin, Minnesota). This consisted of forestry, wildlife, recreation, planning, and conservation professionals working for federal (i.e., USDA Forest Service and Natural Resource Conservation Service, USDI Fish and Wildlife Service), state (i.e., state departments of natural resources), and county/local (i.e., county land departments, soil and water conservation districts) agencies. The region was selected due to the importance of its forests as a source of raw materials for a diverse forest products industry and an important land cover in amenity-rich areas (e.g., lakes and rivers) that are attractive for recreation and second-home development. The region also has been documented as an area where forest land parcelization has been occurring (e.g., Gobster & Rickenbach, 2004; Mundell et al., 2010; Kilgore et al., 2013).

Forest cover maps of each state were used to identify those areas in the region that are predominantly forested. Government e-mail addresses for individuals working in the forested regions of each state were obtained by searching agency websites and contacting agency information officers. The final survey mailing list consisted of 773 e-mail addresses and represented, to the best of our knowledge, a census of field-based public land natural resource professionals working in the forested landscapes of the Lake States that met our selection criteria.

The internet survey was administered in fall 2014. Survey administration generally followed the protocols suggested by

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