



Environmental and Social Factors Influencing the Price of Land in Southwestern Virginia, USA, 1786–1830

Authors: Copenheaver, Carolyn A., Kidd, Kathryn R., Shockey, Melissa D., and Stephens, Bradley A.

Source: Mountain Research and Development, 34(4) : 386-395

Published By: International Mountain Society

URL: <https://doi.org/10.1659/MRD-JOURNAL-D-12-00124.1>

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

Environmental and Social Factors Influencing the Price of Land in Southwestern Virginia, USA, 1786–1830

Carolyn A. Copenheaver*, Kathryn R. Kidd, Melissa D. Shockey, and Bradley A. Stephens

* Corresponding author: ccopenhe@vt.edu

Department of Forest Resources and Environmental Conservation, Virginia Tech, Blacksburg, Virginia 24060, USA

Open access article: please credit the authors and the full source.



Topographically isolated communities of the southern Appalachian Mountains provide an ideal area in which to examine the impact of environmental and social connections on the economy of land sales. Our objective was to

identify whether the price of land in a small Appalachian county of southwestern Virginia, USA, from 1786 to 1830, was influenced by area, month or year of sale, water availability, presence of tree species that were proxies of site quality, grantor/grantee residency, or familial relationship between grantor and grantee. The multiple regression model identified four significant factors that influenced the price of

land during early European settlement of the southern Appalachian Mountains. Larger areas of land sold for lower prices. Landowners sold land to relatives at a lower price than to nonrelatives. The presence of surface water or red maple (*Acer rubrum*) on the property was associated with lower land prices. The negative relationship between water and price of land was likely a reflection that the parcels sold at the highest prices were in towns where streams or rivers were no longer relied upon as a water source. The model explained 39% of the variation and demonstrated a blend of environmental and social factors that influenced land sale patterns during early European settlement of the Appalachian Mountains.

Keywords: Public land surveys; early European settlement; Appalachian Mountains; United States.

Peer-reviewed: June 2014 **Accepted:** August 2014

Introduction

Historically, land value in agrarian communities was determined by a number of environmental and social factors. Close proximity to an urban area and access to transportation generally increased land value because improved infrastructure provided easier access to markets (Craig et al 1998; Decker and Flynn 2007). Land under long-term local ownership rather than absentee ownership had higher value because long-term local owners experienced fewer challenges to ownership and had made such improvements as building houses or outbuildings or clearing agricultural fields (Goodstein 1989; Merry et al 2008). Larger parcels received lower prices per unit area than smaller parcels because they had fewer structural improvements per unit area and were less accessible (Lin and Evans 2000). Historically, land used for agriculture and forestry had a higher value if soil fertility was higher (Huang et al 2006); however, land managers can now improve inherent site fertility with fertilizers, and this relationship no longer exists (Lopez et al 2010).

Understanding the relationships between economic land value, soil conditions, and the social status of grantors (sellers) and grantees (buyers) can provide insight into patterns of human land use and links between current environmental conditions and historical

activities. European colonization resulted in the migration of settlers, in many regions around the world, into landscapes that had recently been depopulated or had low human populations (Snow and Lanphear 1989). The physical and biotic conditions of the land before settlement determined how much capital and work new settlers had to invest to clear land for agriculture or industry and determined the price new settlers were willing to pay for land (Simard and Bouchard 1996). Expensive lands were often used more intensively for agriculture or industry than lower-valued lands. This pattern is manifest in today's landscape; areas that were valued historically have a disproportionately low landscape-level biodiversity and a high likelihood of conversion to second-growth forest (Foster et al 1998; Ireland et al 2011). Thus, land conditions before European settlement, land value, intensity of human land use, and the economic value of commodities produced on the land are linked to current conditions (Simard and Bouchard 1996; Lutts 2004). Understanding connections in this linked system helps identify causes for current landscape conditions and provides a better model of how to manage landscapes for desired future conditions (Swetnam et al 1999; Foster et al 2003).

One valuable source of data on historical land values in the United States is provided by land surveys included

in deeds from land sales. Metes-and-bounds land surveys, in which surveyors established a boundary of surveyed points and lines to identify a land parcel, were used in the original colonies of the eastern United States. Most survey lines followed an easily navigable path, such as a ridgeline, valley, stream, or old trail (Black and Abrams 2001; Figure 1). Land surveys included in deeds provide a unique combination of environmental and economic data that reveal how land was valued; however, to the best of our knowledge, these historical records have never been applied to economic questions.

The objective of this study was to use historical land deeds and the survey information recorded within them to quantify how the price of land in a small agrarian county in southwestern Virginia, between the years 1786 and 1830, was influenced by (1) total area of parcel sold, (2) month and year of sale, (3) presence of surface water on the property, (4) site fertility and quality as determined by tree species that serve as proxies for site characteristics, (5) grantor's residency status, (6) grantee's residency status, and (7) familial relationship between grantor and grantee. In the region covered by the land surveys, unlike many other places in the southern Appalachian Mountains, coal mining was never part of the local economy (Snidow and McComas 1927); therefore, mining potential would not have been an important factor in determining land value. However, the site offers a unique opportunity to examine economic drivers within a topographically isolated community in the southern Appalachian Mountains. The steep ridges, narrow valleys, and lack of railroads have been cited as reasons why these mountain communities were not fully integrated into the larger economic market (Weise 1991).

Methods

Study area

Giles County (93,900 ha) was formed in 1806 from parts of Montgomery and Tazewell counties in Virginia and part of Monroe County in what is now West Virginia. The county's capital is Pearisburg (37.32°N, 80.73°W); the land lies within the Ridge and Valley physiographic province of the Appalachian Mountains (Fenneman 1938). Presently, the George Washington and Jefferson National Forests occupy 25,100 ha of the county. Cultivated and grazing lands cover 6% of the total area, and oak-hickory forest covers 73% (Swecker et al 1985). Elevations range from 455 m along the banks of the New River to 1,236 m at the top of Salt Pond Mountain. Common bedrock geology includes shale, limestone, siltstone, and sandstone. Giles County has an average winter temperature of 0° C and an average summer temperature of 21° C. Total annual precipitation averages 1,000 mm with an average snowfall of 610 mm (Swecker et al 1985).

Periodic hunting was the only form of human land use along the New River during the Archaic Period. However,

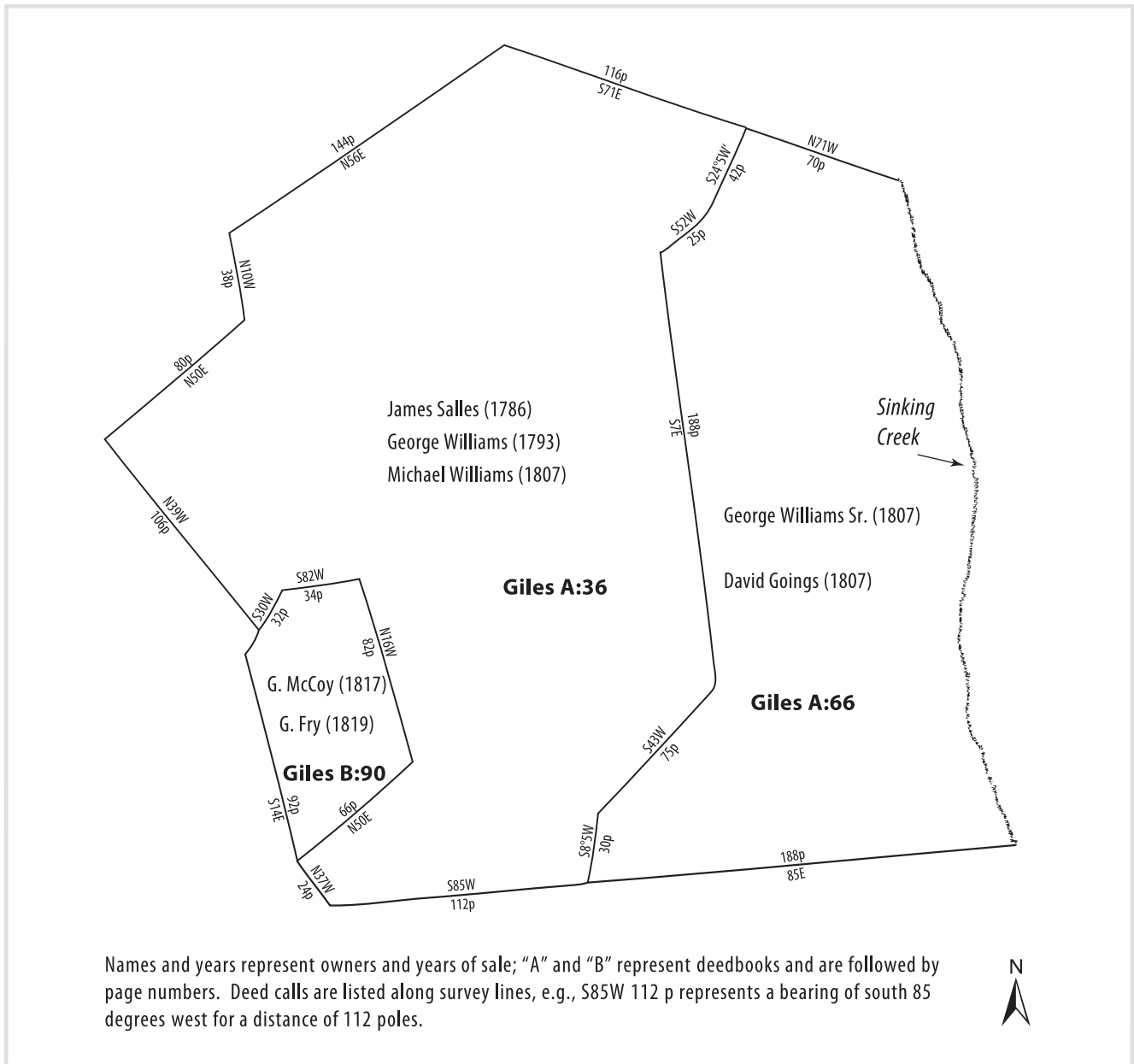
by the Woodland Period (1000 BCE to AD 1000), Native Americans had established a number of permanent residences along the New River (Collins 1973; Collins 1989). European explorers reached the area that is now Giles County in 1748, but permanent settlement did not occur until the late 1700s and early 1800s (Johnston 1906). Initially, Giles County had a largely agrarian economy, and land settlement patterns matched the needs of agriculture; the first areas settled had fertile soil, water, and access to trade routes (Dunn 1988; Copenheaver et al 2007). Trade routes were limited by the steep, parallel ridges and valleys that covered the area and made transportation easier within valleys than between them (Hsiung 1997). The topography also segregated agricultural practices; settlers in the valley relied upon cultivated crops and those along the ridges raised livestock (MacMaster 1991). By the late 1800s and early 1900s, the introduction of railroads to this region allowed market access to the region's natural resources, and cutting timber and quarrying limestone became important industries (Snidow and McComas 1927; Lewis 1998).

Data set

We identified 553 land deeds, spanning the period from 1786 to 1830, at the Montgomery County and Giles County courthouses. Montgomery County holds deeds that predate the founding of Giles County in 1806. We sequentially transcribed 553 deeds from Giles County Deedbook A and a portion of Deedbook B to provide electronic access to these handwritten documents and to create a searchable database. Using references to neighboring landowners mentioned in several of the deeds, we were able to identify 50 additional deeds archived at the Montgomery County Courthouse that represent land sales in Giles County before 1806. We discarded 25 of the 553 deeds because they lacked the price of transaction or area of sale. This left a total of 528 land sale deeds from the period of early European settlement. Twenty percent of the land parcels were sold using old currency in the form of pounds. We used a historical commodity price index to convert pounds to dollars (McCusker 2001). The data set included several parcels that were sold more than once. We included these resales, even though they typically used the same metes-and-bounds description, because the year and month of sale, price, and characteristics of the grantor and grantee were different.

Deeds to adjoining properties occasionally make it possible to form a partial connected map (Figure 1); however, because not all land in the county was sold during the time covered by the study, we were unable to construct a countywide map. Two other causes of missing deeds were vandalism of land records during the US Civil War and destruction of deeds in the 1888 Bland County courthouse fire (Bland County was formerly part of Giles

FIGURE 1 Example of the types of land parcels described in the deeds from Giles County, based on three adjoining deeds. (Source: Giles County, Virginia Deedbooks)



County) (Anonymous 2010). Thus, it was impossible to reconstruct the spatial arrangement of all land ownership in Giles County for the study period, and a spatial analysis was not included in this study.

Although land records have a number of limitations, in many regions they are an invaluable source of information about historical environmental conditions, land ownership patterns, and human and natural disturbances. The limitations and potential sources of

error that have been identified in previous studies that are most relevant to this study include land surveying inaccuracy, misidentification of witness trees (trees blazed to "witness" a survey point), inconsistency in taxon naming of witness trees, species-based biases in the selection of witness trees, and errors that occurred when land sales were written into the courthouse records (Schulte and Mladenoff 2001; Wang 2005; Kronenfeld and Wang 2007).

Data analysis

To quantify site quality for a given parcel of land, we used surveying witness trees as proxy species to represent the parcel's soil fertility and moisture availability. The use of a proxy species as a witness tree in a land survey does not imply that the entire parcel of land was uniform in site quality; however, the presence of a proxy species does indicate that a portion of a given parcel had the site-quality characteristics indicated by that species. To identify suitable proxy species, we performed detrended correspondence analysis (DCA) on the witness trees associated with each deed description using the multivariate analysis package Canoco 4.5 (Biometris, Wageningen, Netherlands). The 528 deeds referenced a total of 2894 trees of 48 different species (Table 1). For the DCA, we eliminated rare species (those present in fewer than 15 deeds) because they would have little value as proxy species but could unduly influence the ordination. Species identified as rare and eliminated from the DCA are marked with an asterisk in Table 1. This reduced the total number of species in the data set from 48 to 29. Although species often occurred more than once within a deed description, we opted to code only presence (1) or absence (0) for each deed. Thus, there was no need to transform the data because abundance data were not included.

Proxy species were then selected based on their spatial orientation within the DCA ordination and verified with existing literature. We identified 11 proxy species based on their location along the edges of the ranges in variance (as indicated by DCA axes 1 and 2). As a whole, these proxy species represented opposites along an environmental spectrum of site quality. Once a species was identified with the DCA, its relationship to site quality was gathered from existing scientific literature and the US Wetland Indicator Status database (USDA-NRCS 2014).

To identify the environmental and social factors that were important influences on land value, we used a multiple linear regression model. The dependent variable was contemporary land value (\$/ha). The land-value data were highly skewed; therefore, we used a Box-Cox power transformation to normalize these values. We initially used the following independent variables:

1. Log of the area of land sold—area data were log transformed due to the highly skewed distribution of area values, that is, there were very few large parcels and many small parcels.
2. Month of sale, which was coded as 1 through 12 for January through December.
3. Year of sale—dates ranged from 1786 to 1830.
4. Presence of water was coded as 1 if a stream or river was present on the property and 0 if there was no apparent water source.
5. Grantor's residency was coded as 1 for Giles County, 2 for other counties in Virginia (which, given the

pre-Civil War period of our analysis, also included counties in present-day West Virginia), and 3 for counties outside Virginia. Grantors living in Montgomery County before 1806, when Giles County was included in Montgomery County, were also coded as 1. In 3% of the deeds, the grantors were representatives of the town or county government, and we coded these grantors as 1.

6. Grantee's residency was coded using the same system as grantor's residency.
7. Familial relationship between grantor and grantee was coded as 1 if land was sold between family members and 0 if the grantor and grantee were unrelated. Familial relationship was determined by common last names or explicit references to a familial relationship in the deed.
8. Presence or absence of the following proxy species: beech (*Fagus grandifolia*), black locust (*Robinia pseudo-acacia*), chestnut (*Castanea dentata*), chestnut oak (*Quercus prinus*), cucumber tree (*Magnolia acuminata*), hophornbeam (*Ostrya virginiana*), pine (*Pinus* sp), red elm (*Ulmus rubra*), red maple (*Acer rubrum*), sourwood (*Oxydendrum arboretum*), and sycamore (*Platanus occidentalis*).

We evaluated the results of the initial regression model and selected a subset of the best independent variables, those variables that were significant at $P < 0.05$. In the next version of the model, we continued to use the transformed land values as the dependent variable and used the following independent variables: log of the area sold, presence of water, familial relationship between grantor and grantee, and presence of red maple.

Results

Characteristics of the land survey records

The historical deeds described land sales for parcels that ranged in size from 0.2 ha to 1983 ha. The average parcel size was 68 ha, and the median parcel size was 46 ha. The parcel size that occurred most frequently (mode) was 40 ha, and 7% of the deeds involved land sales of 40 ha. The price paid in land sales recorded by the deeds varied from \$0.83 to \$3154.00 with a mean of \$265.12 and a median of \$131.67. Most grantors (78%) were from Giles County; very few (3%) were from out of state, most commonly from Kentucky. Most grantees (90%) were from Giles County. Land sales occurred in all months but were most frequent immediately before or after the agricultural growing season; 18% of sales occurred in April and 13% in October. Relatively few sales occurred during the growing season (3% in May and 5% in July) or during the winter (4% in December). A majority (91%) of the parcels either crossed or bordered a river, stream, or creek. The most frequently mentioned water sources were Walker Creek (27% of land sales included properties bordering or crossing it), Sinking Creek (15%), and New

TABLE 1 Witness trees identified in Giles County surveys. (Table continued on next page.)

Scientific name	Name used by surveyor	Current common name	Wetland indicator status ^{a)}
<i>Acer negundo</i> L ^{b)}	Boxelder	Boxelder	FAC
<i>Acer rubrum</i> L	Maple	Red maple	FAC
<i>Acer saccharum</i> Marshall	Sugar tree	Sugar maple	FACU
<i>Aesculus flava</i> Aiton	Buckeye	Yellow buckeye	FACU
<i>Amelanchier arborea</i> (Michx. f.) Fern. ^{b)}	Serviceberry	Downy serviceberry	FAC
<i>Betula lenta</i> L	Birch	Sweet birch	FACU
<i>Buxus</i> sp L ^{b)}	Boxwood	Boxwood	na
<i>Carya</i> spp	Hickory	Hickory	na
<i>Castanea dentata</i> (Marshall) Borkh	Chestnut	Chestnut	UPL
<i>Castanea pumila</i> (L) Miller ^{b)}	Chinkapin	Chinquapin	na
<i>Celtis occidentalis</i> L ^{b)}	Hackberry	Hackberry	FACU
<i>Cercis canadensis</i> L ^{b)}	Redbud	Redbud	FACU
<i>Cornus florida</i> L	Dogwood	Flowering dogwood	FACU
<i>Fagus grandifolia</i> Ehrh	Beech	Beech	FACU
<i>Fraxinus nigra</i> Marshall.	Hoop ash	Black ash	FACW
<i>Hamamelis virginiana</i> L ^{b)}	Wichhasle (<i>sic</i>)	Witch hazel	FACU
<i>Juglans cinerea</i> L	White walnut	Butternut	FACU
<i>Juglans nigra</i> L	Black walnut	Black walnut	FACU
<i>Juniperus virginiana</i> L ^{b)}	Cedar	Eastern red cedar	FACU
<i>Larix laricina</i> (Du Roi) K Koch ^{b)}	Larch	Tamarack	FACW
<i>Liriodendron tulipifera</i> L	Poplar	Tulip poplar	FACU
<i>Magnolia acuminata</i> (L) L	Cucumber	Cucumber tree	FACU
<i>Magnolia tripetala</i> (L) L ^{b)}	Umbrella magnolia	Umbrella tree	FACU
<i>Morus rubra</i> L	Mulberry	Red mulberry	FACU
<i>Nyssa sylvatica</i> Marshall	Gum	Blackgum	FAC
<i>Ostrya virginiana</i> (Miller) K Koch	Ironwood	Hophornbeam	FACU
<i>Oxydendrum arboreum</i> (L) DC.	Sowerwood	Sourwood	UPL
<i>Picea rubens</i> Sarg ^{b)}	Spruce pine	Red spruce	FACU
<i>Pinus</i> spp	Pine	Pine	na
<i>Pinus strobus</i> L ^{b)}	White pine	White pine	FACU
<i>Platanus occidentalis</i> L	Sycamore	Sycamore	FACW
<i>Prunus serotina</i> Ehrh ^{b)}	Cherry	Black cherry	FACU
<i>Pyrus malus</i> L ^{b)}	Apple	Apple	na
<i>Quercus alba</i> L	White oak	White oak	FACU

TABLE 1. Continued. (First part of Table 1 on previous page.)

Scientific name	Name used by surveyor	Current common name	Wetland indicator status ^{a)}
<i>Quercus bicolor</i> Willd	Swamp white oak	Swamp white oak	FACW
<i>Quercus coccinea</i> Muenchh	Spanish oak	Scarlet oak	UPL
<i>Quercus ilicifolia</i> Wangenh ^{b)}	Bear oak	Bear oak	UPL
<i>Quercus palustris</i> Muenchh ^{b)}	Pin oak	Pin oak	FACW
<i>Quercus prinus</i> L	Chestnut oak	Chestnut oak	UPL
<i>Quercus rubra</i> L	Red oak	Northern red oak	FACU
<i>Quercus stellata</i> Wangenh ^{b)}	Post oak	Post oak	UPL
<i>Quercus velutina</i> Lam	Black oak	Black oak	UPL
<i>Robinia pseudoacacia</i> L	Locust	Black locust	FACU
<i>Salix</i> spp L	Willow	Willow	na
<i>Sassafras albidum</i> (Nutt) Nees ^{b)}	Sassafras	Sassafras	FACU
<i>Thuja occidentalis</i> L ^{b)}	Cypress	Northern white cedar	FACW
<i>Tilia americana</i> L	Lynn	American basswood	FACU
<i>Ulmus rubra</i> Muhl	Elm	Red elm	FAC

^{a)}FACW, facultative wetland hydrophyte (usually occurs in wetlands but may occur in non-wetlands); FAC, facultative hydrophyte (occurs in wetlands and non-wetlands); FACU, facultative nonhydrophyte (usually occurs in non-wetlands but may occur in wetlands); UPL, obligate upland nonhydrophyte (almost never occurs in wetlands); na, not available. Source: USDA-NRCS 2014.

^{b)}Species had fewer than 15 occurrences in the deed descriptions.

River (13%). From 1786 to 1830, land sales in Giles County had a mean sale price of \$18.70 ha⁻¹. The minimum price paid was <\$0.01 ha⁻¹, and the maximum was \$2,471.05 ha⁻¹ for a 0.2 ha town lot along the main street in the county seat. The median price of land was \$3.74 ha⁻¹, and the mode was \$2.47 ha⁻¹.

The deeds mentioned 48 species used by surveyors as witness trees in land descriptions (Table 1), ranging from early successional black locust and eastern red cedar (*Juniperus virginiana*) to late successional sugar maple (*Acer saccharum*) and basswood (*Tilia americana*). Witness trees covered a broad range of moisture tolerances and included hydric sycamores, mesic tulip poplars (*Liriodendron tulipifera*), and xeric post oaks (*Quercus stellata*). Although land survey records typically have a bias against small-diameter trees (Bourdo 1956), our data set included several understory, small-diameter trees such as witch hazel (*Hamamelis virginiana*) and flowering dogwood (*Cornus florida*). The DCA ordination was used to identify 11 suitable proxy species based on their locations along the edges of the ordination (Figure 2). Species in the center of the ordination have a wide distribution, whereas species on the edges of the ordination space are more specialized in their distribution. Proxy species identified in the ordination represented the following environmental conditions: hophornbeam, red elm, and sycamore indicate fertile, mesic sites, typically in riparian zones; beech indicates mesic sites in mid-slope positions;

red maple and cucumber tree are common to mesic sites but tend to have a broader topographic distribution; and chestnut, chestnut oak, sourwood, and pine indicate xeric, ridgetop sites (Abrams and McCay 1996; Dix and Percy 1997; Everson and Boucher 1998; McEwan et al 2005; Horsley et al 2008).

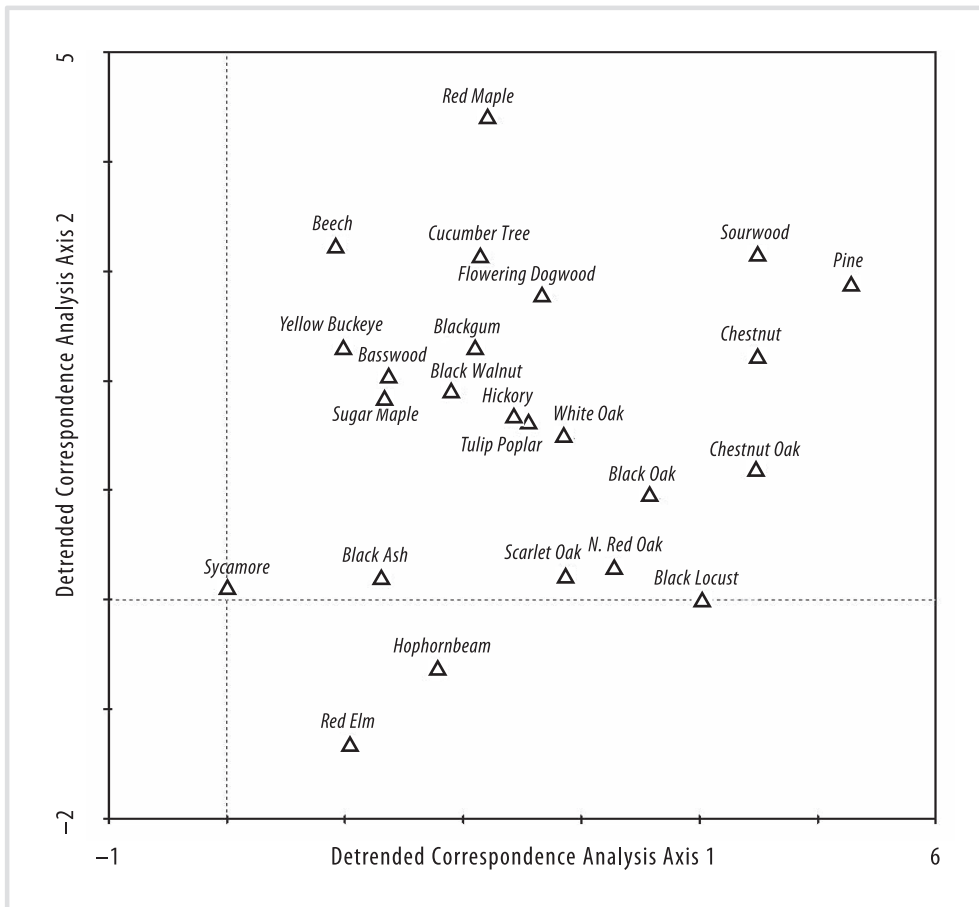
Regression model of land value

The initial regression model (Model 1 in Table 2), which included 18 independent variables, explained 38% of the variance of land value. The model found that land sold for less in sales between relatives (mean = \$3.71 ha⁻¹) than in sales between nonrelatives (mean = \$23.90 ha⁻¹).

Additionally, land parcels with no streams or rivers sold at higher prices (mean = \$155.10 ha⁻¹) than those with streams or rivers identified in the deed (mean = \$5.37 ha⁻¹). Larger parcels sold for less than smaller parcels (Figure 3), and land with red maple present sold for less (mean = \$2.87 ha⁻¹) than land without red maple (mean = \$20.07 ha⁻¹).

The final multiple regression model (Model 2 in Table 2) explained 39% of the variance of land value. The following independent variables were identified as significant: familial relationship between grantor and grantee ($P < 0.0001$), area of land sold ($P < 0.0001$), presence of surface water on the parcel ($P = 0.0004$), and presence of red maple ($P = 0.03$). This model demonstrated that grantors sold land to relatives at lower

FIGURE 2 Detrended correspondence analysis of witness trees used in land surveys in Giles County during early European settlement.



prices than to nonrelatives; parcels without water were more expensive than those with streams or rivers; larger parcels were less expensive than smaller parcels; and land with red maple present was less expensive than land without red maple (Figure 3; Table 2).

Discussion

In the southern Appalachian Mountains, the most frequently sold property size was 40 ha. In contrast to the rectangular survey system, the metes-and-bounds system created parcels with highly varied shapes and irregular sizes (Bain and Brush 2004); therefore, the high number of 40 ha parcels was unexpected. The frequency of 40 ha parcels may have represented land that had historically been granted by the government as a “head right” to encourage settlement. Before 1616, Virginia granted head rights of 40 ha (100 acres) to people willing to establish farms and improve land (Price 1995). After 1616, the head right granted to settlers was reduced to 20 ha for a single man, but married couples were awarded 40 ha. It may be that some of the 40 ha parcels sold during the period of

this study were originally granted as head rights. However, it is equally likely that the 40 ha was simply an approximation of the amount of land being sold. Errors in land area being sold through the metes-and-bounds system were common, and the difference between actual area and granted area was regularly off by up to 20% (Bain and Brush 2004).

The economic importance of a familial relationship between buyer and seller during early European settlement of the Appalachian Mountains was not limited to land sales. Currency was relatively rare during this period; therefore, property and labor exchanges often occurred within a barter system (West 1978; Henretta 1998). In the Appalachian Mountains, where travel and trade were more geographically limited, the barter system was conducted primarily within kinship groups (Salstrom 1992). The combination of limited cash and strong kinship-based economic ties may have caused early settlers to sell land to family members at below-market prices (Figure 3).

The connection between land value and area of land sold was likely a reflection of improvements, which

TABLE 2 Multiple regression models of environmental and social influences on land values in Giles County, 1786–1830.

	Model 1		Model 2		
	Coefficient (SE)	P value		Coefficient (SE)	P value
Intercept	4.27 (18.50)	0.69	Intercept	4.17 (0.25)	<0.0001
Family ^{a)}	−1.08 (0.16)	<0.0001	Family*	−1.07 (0.15)	<0.0001
Water ^{a)}	−0.97 (0.27)	0.0004	Area*	−1.44 (0.13)	<0.0001
Month	0.00 (0.02)	0.86	Red maple*	−0.51 (0.24)	0.03
Year	0.00 (0.01)	0.99	Water*	−0.91 (0.26)	0.0004
Grantor	0.11 (0.13)	0.39			
Grantee	−0.10 (0.20)	0.63			
Area ^{a)}	−1.42 (0.14)	<0.0001			
Beech	−0.05 (0.24)	0.85			
Chestnut	0.24 (0.16)	0.14			
Chestnut oak	−0.19 (0.17)	0.26			
Hophornbeam	0.03 (0.36)	0.94			
Magnolia tree	0.09 (0.32)	0.77			
Red elm	0.04 (0.27)	0.89			
Red maple ^{a)}	−0.53 (0.25)	0.04			
Sycamore	−0.09 (0.24)	0.72			
Black locust	−0.14 (0.21)	0.52			
Pine	−0.04 (0.21)	0.84			
Sourwood	−0.07 (0.30)	0.82			
Adjusted R^2	0.38		Adjusted R^2	0.39	
F ratio	18.09		F ratio	84.01	
P value	<0.001		P value	<0.0001	

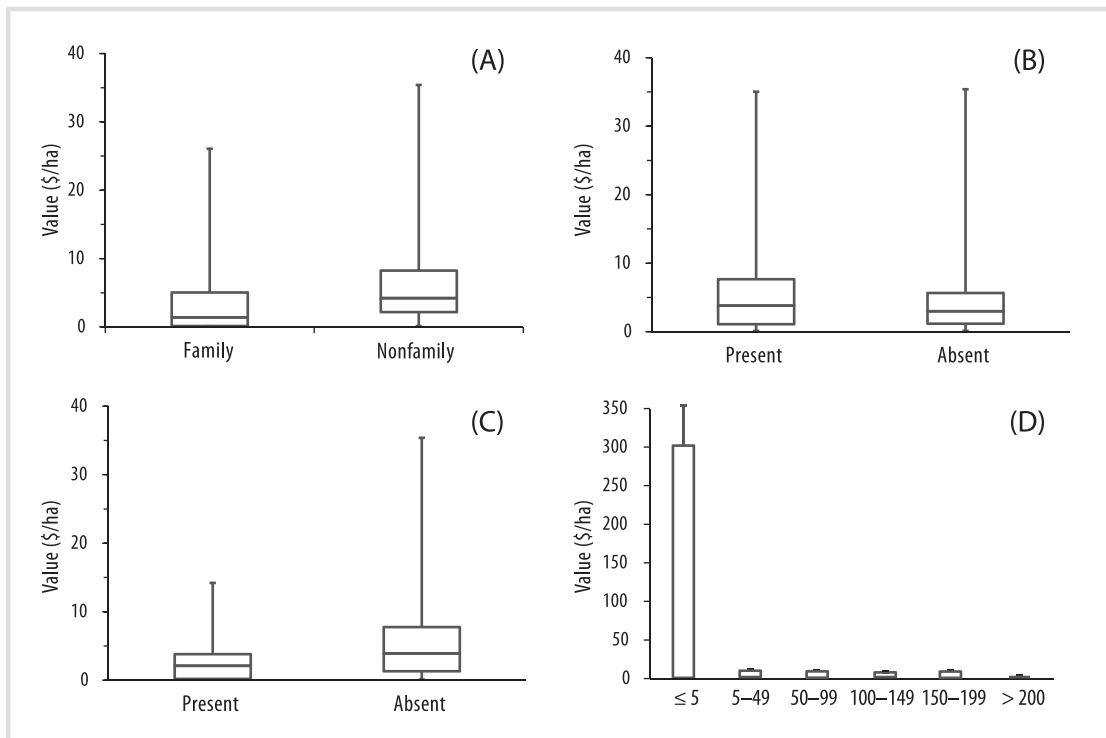
^{a)}Significant relationship ($P > 0.05$).

tended to be more common on smaller land parcels (Merry et al 2008). Another study that examined the impact of agricultural improvements on land costs found that some improvements (eg establishment of agricultural fields) significantly increased land value, whereas other improvements (eg cattle pens) did not (Reid and Ryden 2013). Unfortunately, the frequency with which improvements were mentioned in land descriptions from Giles County was too irregular for us to be able to do a comparable analysis. The land sales with the highest prices involved town lots in the county seat of Pearisburg; these properties would have been small and would have had good commercial access and likely a number of improvements.

Deeds from Giles County that did not reference creeks or rivers were associated with more expensive land sales than deeds that mentioned a natural water source

(Figure 3; Table 2). In North America, sources of clean water for working farms were vital, and development of water infrastructure in the form of wells, ponds, or spring houses was typically the first task for a settler on a new homestead (Wood 2010). However, it is likely that most of the land sales in our data set were of property where water access had already been constructed by a previous owner. Most (97%) of the land sales were between private individuals and thus did not represent the first European settlement of an unimproved area; instead, they took place during a period of early European settlement. Therefore, natural surface water sources may have been less important to a farmer's valuation of land because water infrastructure was already in place. Mill ponds, dams, and water wheels on local creeks also already existed by this time; thus, for the small number of commercial land sales, presence of surface water did not

FIGURE 3 Current land values as influenced by (A) relationship between grantor and grantee; (B) presence of water; (C) presence of red maple; (D) parcel size (ha). Box plots A, B, and C show median values (horizontal line in box), interquartile range or difference between third and first quartiles (box), lower and upper quartiles along with minimum and maximum values (whiskers). Twenty outlier observations were omitted from box plots to increase distribution resolution. Plot D shows the mean value and standard error (upper error bar).



increase land value (Davis 2000; Copenheaver et al 2007). For property located within the county seat of Pearisburg, no creeks or rivers were mentioned in the deed descriptions, although these parcels received the highest prices, which likely explains why water had a significant negative influence on land value.

Red maple is a generalist species that grows in a range of topographic positions and moisture levels; however, this widespread distribution is relatively recent. Before European settlement, red maple was more limited in its range and was found almost exclusively on hydric sites, which led to its other common name, “swamp maple”

(Abrams 1998). Based on the significant negative relationship between the presence of red maple and land value, red maple was likely an indication of sites that were too wet to be well suited for agriculture.

Overall, our work revealed that a mixture of cultural and environmental factors determined land value in the southern Appalachian Mountains during early European settlement. Some of these factors are likely to be common to other regions within North America during early European settlement, but others may be unique to the environment and culture of the southern Appalachian Mountains.

REFERENCES

- Abrams MD.** 1998. The red maple paradox. *Bioscience* 48:355–363.
- Abrams MD, McCay DM.** 1996. Vegetation–site relationships of witness trees (1780–1856) in the presettlement forests of eastern West Virginia. *Canadian Journal of Forest Research* 26:217–224.
- Anonymous.** 2010. Lost records localities: Counties and cities with missing records. *Library of Virginia Research Notes Number 30*. Richmond, VA: Library of Virginia.
- Bain DJ, Brush GS.** 2004. Placing the pieces: Reconstructing the original property mosaic in a warrant and patent watershed. *Landscape Ecology* 19: 843–856.
- Black BA, Abrams MD.** 2001. Influences of Native Americans and surveyor biases on metes and bounds witness-tree distribution. *Ecology* 82:2574–2586.
- Bourdo EA.** 1956. A review of the General Land Office Survey and its use in quantitative studies of former forests. *Ecology* 37:754–768.
- Collins LD.** 1973. Lurich Site, Giles County, Virginia. *Quarterly Bulletin of the Archeological Society of Virginia* 28:24–40.
- Collins LD.** 1989. The Snidow Site, Giles County, Virginia. *Quarterly Bulletin of the Archeological Society of Virginia* 44:66–97.
- Copenheaver CA, Priskey SP, Pittman JR, Yonce ME, Issem CMS, Jensen KA.** 2007. The geography of grist, flour, and saw mills: Indicators of land-use history in Virginia. *Southeastern Geographer* 47:138–154.
- Craig LA, Palmquist RB, Weiss T.** 1998. Transportation improvements and land values in the Antebellum United States: A hedonic approach. *Journal of Real Estate, Finance, and Economics* 16:173–189.
- Davis DE.** 2000. *Where There Are Mountains: An Environmental History of the Southern Appalachians*. Athens, GA: University of Georgia Press.

- Decker CS, Flynn DT.** 2007. The railroad's impact on land values in the Upper Great Plains at the closing of the frontier. *Historical Methods* 40:28–38.
- Dix DM, Percy JN.** 1997. Forest ecosystems of the Marietta Unit, Wayne National Forest, southeastern Ohio: Multifactor classification and analysis. *Canadian Journal of Forest Research* 27:1117–1131.
- Dunn D.** 1988. *Cades Cove: The Life and Death of a Southern Appalachian Community, 1818–1937*. Knoxville, TN: University of Tennessee Press.
- Everson DA, Boucher DH.** 1998. Tree species-richness and topographic complexity along the riparian edge of the Potomac River. *Forest Ecology and Management* 109:305–314.
- Fenneman NM.** 1938. *Physiography of the Eastern United States*. New York, NY: McGraw-Hill.
- Foster D, Swanson F, Aber J, Burke I, Brokaw N, Tilman D, Knapp A.** 2003. The importance of land-use legacies to ecology and conservation. *Bioscience* 53: 77–88.
- Foster DR, Motzkin G, Slater B.** 1998. Land-use history as long-term, broad-scale disturbance: Regional forest dynamics in central New England. *Ecosystems* 1:96–116.
- Goodstein E.** 1989. Landownership, development, and poverty in southern Appalachia. *Journal of Developing Areas* 23:519–534.
- Hennetta JA.** 1998. The “market” in the early Republic. *Journal of the Early Republic* 18:289–304.
- Horsley SB, Bailey SW, Ristau TE, Long RE, Hallett RA.** 2008. Linking environmental gradients, species composition, and vegetation indicators of sugar maple health in the northeastern United States. *Canadian Journal of Forest Research* 38:1761–1774.
- Hsiung DC.** 1997. *Two Worlds in the Tennessee Mountains: Exploring the Origins of Appalachian Stereotypes*. Lexington, KY: University Press of Kentucky.
- Huang H, Miller GY, Sherrick BJ, Gomez MI.** 2006. Factors influencing Illinois farmland values. *American Journal of Agricultural Economics* 88:458–470.
- Ireland AW, Oswald WW, Foster DR.** 2011. An integrated reconstruction of recent forest dynamics in a New England cultural landscape. *Vegetation History and Archaeobotany* 20:245–252.
- Johnston DE.** 1906. *A History of Middle New River Settlements and Contiguous Territory*. Huntington, WV: Standard Printing and Publishing Company.
- Kronenfeld BJ, Wang YC.** 2007. Accounting for surveyor inconsistency and bias in estimation of tree density from presettlement land survey records. *Canadian Journal of Forest Research* 37:2365–2379.
- Lewis RL.** 1998. *Railroads, Deforestation, and Social Change in West Virginia, 1880–1920*. Chapel Hill, NC: University of North Carolina Press.
- Lin TC, Evans AW.** 2000. The relationship between price of land and size of plot when plots are small. *Land Economics* 76:386–394.
- Lopez J, DeLaTorre R, Cubbage F.** 2010. Effect of land prices, transportation costs, and site productivity on timber investment returns for pine plantations in Columbia. *New Forests* 39:313–328.
- Lutts RH.** 2004. Like manna from God: The American chestnut trade in southwestern Virginia. *Environmental History* 9:497–525.
- MacMaster RK.** 1991. The cattle trade in western Virginia, 1760–1830. In: Mitchell RD, editor. *Appalachian Frontiers: Settlement, Society, and Development in the Preindustrial Era*. Lexington, KY: University Press of Kentucky, pp 127–149.
- McCusker JJ.** 2001. *How Much Is That in Real Money? A Historical Commodity Price Index for Use as a Deflator of Money Values in the Economy of the United States*. Worcester, MA: American Antiquarian Society.
- McEwan RW, Muller RN, McCarthy BC.** 2005. Vegetation–environment relationships among woody species in four canopy-layers in an old-growth mixed mesophytic forest. *Castanea* 70:32–46.
- Merry F, Amacher G, Lima E.** 2008. Land values in frontier settlements of the Brazilian Amazon. *World Development* 36:2390–2401.
- Price ET.** 1995. *Dividing the Land: Early American Beginnings of Our Private Property Mosaic*. Chicago, IL: University of Chicago Press.
- Reid A, Ryden DB.** 2013. Sugar, land markets and the Williams thesis: Evidence from Jamaica's property sales, 1750–1810. *Slavery & Abolition* 34: 401–424.
- Salstrom P.** 1992. Subsistence-barter-and-borrow systems: An approach to West Virginia's economic history. *West Virginia History* 51:45–53.
- Schulte LA, Mladenoff DJ.** 2001. The original US public land survey records: Their use and limitations in reconstructing presettlement vegetation. *Journal of Forestry* 99:5–10.
- Simard H, Bouchard A.** 1996. The precolonial 19th century forest of the upper St. Lawrence region of Quebec: A record of its exploitation and transformation through notary deeds of wood sales. *Canadian Journal of Forest Research* 26: 1670–1676.
- Snidow FA, McComas FW.** 1927. *An Economic and Social Survey of Giles County*. Charlottesville, VA: University of Virginia Record Extension Series, volume 11, no. 8.
- Snow DR, Lanphear KM.** 1989. European contact and Indian depopulations in the Northeast: The timing of the first epidemics. *Ethnohistory* 35:15–31.
- Swecker PL, Cauley PM, vanDine JW, Conner RK.** 1985. *Soil Survey of Giles County, Virginia*. Washington, DC: US Department of Agriculture, Soil Conservation Service.
- Swetnam TW, Allen CD, Betancourt JL.** 1999. Applied historical ecology: Using the past to manage for the future. *Ecological Applications* 9:1189–1206.
- USDA-NRCS [United States Department of Agriculture, Natural Resources Conservation Service].** 2014. *Plants Database*. Washington, DC: USDA-NRCS. <http://plants.usda.gov/>; accessed on 29 September 2014.
- Wang YC.** 2005. Presettlement land survey records of vegetation: Geographic characteristics, quality and modes of analysis. *Progress in Physical Geography* 29:568–598.
- Weise R.** 1991. Big Stone Gap and the New South, 1880–1900. In: Ayers EL, Willis JC, editors. *The Edge of the South: Life in Nineteenth Century Virginia*. Charlottesville, VA: University Press of Virginia, pp 171–193.
- West RC.** 1978. Money in the colonial economy. *Economic Inquiry* 16:1–15.
- Wood P.** 2010. Rural water systems, Part I. *Chronicle of the Early American Industries Association* 63:91–105.