United States
Department of
Agriculture

Forest Service

**Northeastern
Research Station**

Research Paper NE-709

FIA Photointerpretation in Southern New England: A Tool to Determine Forest Fragmentation and Proximity to Human Development

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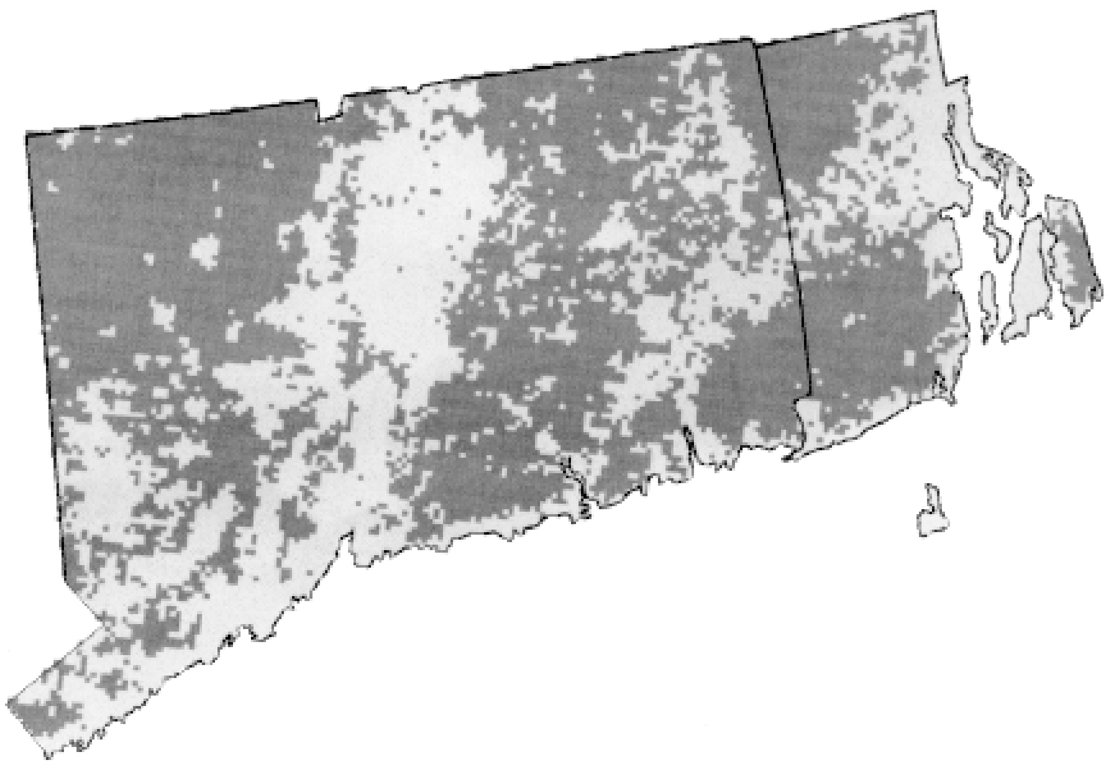

Abstract

The increasing proximity of human development to forest lands and the extent of forest fragmentation caused by this development are major concerns for natural resource managers. Forest fragmentation affects the biodiversity of native flora and fauna, hydrologic processes, and management opportunities. Knowing the extent and location of forest fragmentation and proximity to human development is important in understanding these impacts. In southern New England, the Northeastern Forest Inventory and Analysis unit has initiated data collection on the extent and location of forest fragmentation and proximity to human development during phase one (photointerpretation) of the inventory process. These data include: a) the size of the continuous forested area in which the point falls, b) the distance from that point to the nearest developed land use, and c) the category of the nearest developed land use. This point sample interpretation, from 1:40,000 aerial photography, allows for the identification and "mapping" of some detailed distance and land use variables that are not currently available from other sources. At a sampling intensity of approximately 1 point for every 285 acres, these points provide a relatively continuous picture of the location of forest land across a state, the extent of forest fragmentation and distribution of patch sizes, and the extent and proximity of human development. In this paper we describe the procedure and preliminary results for Rhode Island and Connecticut.

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Manuscript received for publication 9 October 1998

Published by:

USDA FOREST SERVICE
5 RADNOR CORP CTR SUITE 200
RADNOR PA 19087-4585

October 1999

For additional copies:

USDA Forest Service
Publications Distribution
359 Main Road
Delaware, OH 43015
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Introduction

The issues of forest fragmentation and the increasing proximity of forest land to human disturbances and land uses are frequently acknowledged throughout the United States as growing concerns for natural resource managers (for example, Birch and Moulton 1997; Broderick et al. 1991; Kitteredge 1992; Rudis 1992; Thompson et al. 1996). The expansion of urban areas and suburban development, and the influx of residential and recreational development into previously forested areas are substantially affecting those forests (Zipperer 1993a). Development intrusion reduces forest interior habitat (for example, Franzreb and Rosenberg 1997; Robbins et al. 1989; Zipperer 1993b); increases the proximity of forest land to human development of all types (roads, residential, industrial); and increases the use of the forest by people for recreation and other activities, such as harvesting of timber and non-timber forest products (Dawson and Zipperer 1992; Emery 1998). It also alters the types of forest management that can be used, such as fire, harvesting techniques, and spraying (Liu and Scrivani 1997; Zipperer 1993c); changes local hydrology (Zipperer and Andersen 1991); and enhances the invasion of exotic species (Pouyat and Zipperer 1992; Zipperer and Pouyat 1995).

These impacts of development are not fully understood. For example, many fundamental questions need to be answered. Is there a relationship between changes in forest composition and type and extent of human development? Does the proximity and pattern of human development affect a forest's species composition, structure, plant and animal biodiversity, and forest health? What are the indicators or features that could be used to measure and monitor this potential impact? Are human density or forest patch size important factors? Do certain developed land uses have more effect on forest structure and processes than others? Is there a certain threshold of patch size, distance to land use, or percent distribution/cover below which there is essentially no effect on the forest, or above which forests begin to dramatically change? And how can we begin to measure these indicators over both large and small areas? Answers to these questions and others are needed to allow natural resource managers to assess the status of forest lands in increasingly populated states and to plan for their management. This study focuses on one technique used to identify some of these indicators over large areas.

Forest Inventory and Analysis (FIA) of the USDA Forest Service is responsible for providing periodic assessments of the Nation's forest resources. FIA units conduct inventories by state, or groups of states, in cycles that range from 8 to 15 years. These inventories provide information on the amount, status, and character of the forest resources of the state and, collectively, of the Nation. Data are collected at a sampling intensity of between 3,000 and 8,000 acres per plot. Plots are chosen via a double-sampling strategy, consisting of both a photointerpretation stage (phase one) and ground inventory (phase two). Phase one, an intensive sample grid of photointerpretation points (one point for every 285 acres), is used to stratify sample points. Phase two consists of remeasured plots supplemented by a subset of points from that grid (Alerich 1998). As a source of forest information over large areas, FIA data represent a unique source. Current pressures on and interests in forested areas have increased the demands for and uses of forest inventory information, such as that which can yield additional fragmentation and context information. The accuracy of context information, such as the size of the forested patch surrounding a plot or the distance to certain features, can be very much affected by the direction a field crew uses to get to a plot, and is not easily measured on the ground. Remote sensing can be used to gather or support the collection of such context information.

To determine type and degree of fragmentation and human influence on forest land and to begin to determine the indicators that might effectively provide that information, efforts have been initiated by several FIA units. To date, efforts are on a regional scale, having been inspired by regional concerns, but each effort provides an example of the kinds of information regarding the proximity of forested areas to human development that could be gathered on a national level. For example, the Pacific Northwestern unit (PNW) has been measuring the proximity and density of development (number of buildings or other man-made structures) around each FIA ground plot.[1] Both the PNW and North Central (NC) units have been measuring the percentage of each of six cover types within fixed areas around each ground plot: 10-, 40-, 160- and 640-ha areas in PNW, and 5- and 50-ha areas in NC.[2] The North Central unit has also been looking at forest fragmentation using a combination of ground inventory and photointerpreted information, such as stand area, size of ownership, disturbance, and distance to nearest road (Schmidt and Raile 1998). In the Northeast, the FIA unit has been measuring the size of the forested patch at each photointerpretation point location, the distance from that point to the nearest developed land use, and what that nearest land use is for each photointerpretation point. In this paper we describe the procedure used by the Northeast FIA unit for two states in the Northeast, Rhode Island and Connecticut, and present initial results. With these data available, additional studies will be possible to investigate how strongly these variables relate to real changes in the forest, and investigate further which remote sensing methods and sensors are most effective at measuring those features/indicators.

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[1]Dale Baer, personal communication, PNW-FIA, Portland, OR.

[2]Elizabeth Collins, personal communication, NC-FIA, St. Paul, MN. Ken Winterberger, personal communication, PNW-FIA, Anchorage, AK. Dale Baer, personal communication, PNW-FIA, Portland, OR.

Data/Methods

During the last forest inventory of Connecticut and Rhode Island, data on additional fragmentation/proximity information were obtained by photointerpretation from 1:40,000 color infrared (CIR) spring photography (March and April, 1992-1993) at all phase one photointerpretation points. As part of the current inventory in each state, these points are established on the most recent photography from the National Aerial Photography Program (NAPP) at a sampling intensity of roughly one point for every 285 acres. A grid of 16 points covering the center portion of each photograph is burned into the imagery in the form of open crosshairs when the photography is printed, allowing each point to be both accurately located and free of obstruction for photointerpretation. The center of the crosshairs is 1 acre in size. With only a few exceptions due to missing photography, there is complete coverage of each state. Gaps and overlaps do occur between flight lines, resulting in an approximate instead of a fixed regular grid of points across the state (Fig. 1).

We interpreted each point as being either forest or nonforest using FIA's definition of forest land (at least 1 acre in size, at least 120 feet in width, at least 10% stocked, and not developed for a nonforest land use) (Alerich 1998[3]). Each nonforested plot was interpreted for land use using a slight modification of MacConnell's land use classification scheme (Table 1) (MacConnell et al. 1991). In addition, each forested point was interpreted for three indicators of fragmentation or human land use: a) the size of the continuous forested tract in which that point falls, b) the distance from that point to the nearest developed land use, and c) the category of the nearest developed land use. The distance and area information were recorded as discrete classes (Tables 2, 3, and 4).

Long linear stretches of tree cover were not included in the size of a continuous forested area unless they were greater than 120 feet in width. Roads constituted an edge or interruption in the forest patch only if they were greater than 220 feet wide (a transportation corridor) or had houses along them (residential). Narrower and non-residential roads were not considered a developed land use in this study. The size of the forested patch was measured using a dot grid overlaid on the photography. Distance to nearest developed land use was measured as the shortest distance from the forested point to the nearest edge of that land use.

Photointerpreted points were digitized with estimated location errors of +/- 100m.

Results and Discussion

Rhode Island and Connecticut are 56 percent and 59 percent forested, respectively (Table 5).[4] Results from the photointerpretation of Rhode Island and Connecticut illustrate the spatial distribution of forest patch size, distance to nearest developed land use, type of nearest developed land use, and land use encountered at each photointerpreted point (Figs. 2, 3, 4, and 5). In general, Rhode Island is most developed to the east, around Naragansett Bay, and the largest patches of forest remain along the western edge. Connecticut is most developed in the southwestern corner and up the Connecticut River Valley, with the largest patches of forest remaining in the northwest corner of the state. Very few forested points are more than one half mile from the nearest developed land use, and most are less than one-eighth of a mile (660 feet) (Tables 6, 7, and 8).

Residential is the dominant land use nearest to forested points (61% of the points) (Fig. 4 and Table 8). Cropland/Pasture is second (22%), and transportation routes do show up occasionally as the developed land use that is encroaching on forest land. This variable—type of nearest developed land use—does show the type and location of land uses which are potentially affecting forest land most. It does not, however, provide any information on how much impact or what kind of impact those different land uses have, only their extent and where they occur. Combined with knowledge of the impact of different land uses, the spatial information could furnish substantial information for regional planning. For example, Figure 5 illustrates the land uses at each photointerpreted point. More than half the points are considered forested by FIA's definition. However, because of their proximity to developed land uses, most of that forest land is also subject to probable human influence.

Our analysis indicated that several different indicators of fragmentation and proximity to human development are necessary to assess effectively the effects of each on forest lands. Each indicator reflected a slightly different component of the landscape context. To use any one of them alone as a generic indication of where fragmentation is undesirable would almost certainly be misleading. For example, the maps of "size of forested patch" (Fig. 2 and Table 6) and "distance to nearest land use" (Fig. 3 and Table 7) could each illustrate how fragmented an area is. However, when taken separately, they yield two slightly different impressions. The first map reveals that relatively large patches of continuous forest area exist in Rhode Island and Connecticut. By contrast, the second map shows that all areas are in close proximity to developed land uses and

[3]Alerich, D. 1998. Field instructions for the fourth inventories of southern New England: Massachusetts, Rhode Island, Connecticut. Unpublished report on file at U.S. Department of Agriculture, Forest Service, Northeastern Research Station, Forest Inventory and Analysis Unit, Radnor, PA. 96 p. plus appendices.

[4]This is a preliminary look at area breakdowns based on the photointerpretation. The actual ground data are used to calculate forest area in the published FIA statistical reports. Due to different levels of error in the photointerpretation, these values may differ slightly.

human activities, thus probably influencing both management options and ecological processes. In general, each photointerpreted variable provides slightly different information about the current situation. Which impact we are particularly interested in—whether it is the invasion of the forest by exotic plant species, reduction in the suitability of habitat for interior forest species, or restrictions on forest management—will determine which indicator or combination of indicators are most useful in any one analysis.

Although not every forest patch is identified using this point sample approach, delineating each forest patch is an extremely time-consuming photointerpretation process, and most likely prohibitive for statewide periodic assessments. Also, delineation is subject to greater interpreter error, as more error occurs in delineating stand boundaries than in point interpretation. When a continuous map is desired, rather than mapping all stands from the photography, a geostatistically modeled map can be created relatively easily from the high density of sampled point data using existing geostatistical techniques.

Point-sample interpretation provides data on patch size, proximity, and land use measurements that are not currently available in other spatial datasets. The accuracy, spatial resolution, and/or classification (attribute) resolution of forest cover derived from satellite imagery is not yet available for local or regional planning. Neither are land use, street, and population databases all available with the necessary accuracy and resolution to perform such context analyses. With the point-sample interpretations, regional patterns can be assessed. For example, at least 60 percent of the forested plots were less than one-eighth of a mile (660 feet) from a nonforested land use. When such spatial data are available with the desired accuracy and currency necessary for planning, some proximity and context information may be effectively and more quickly acquired through the spatial analysis of forested plots with existing spatial databases. Until then, point-sample interpretation from aerial photography yields critical data concerning the magnitude, extent, and location of fragmentation and human development pressures on the forest. This information is important towards understanding the effects of these conditions on the native biodiversity of flora and fauna, forest structure, and ecological processes. Collecting the information now, in conjunction with the current inventory, will provide a useful benchmark against which to assess future changes.

Table 1.—The MacConnell land use classification system (MacConnell et al. 1991).

Code	Description	
10	R0	Multifamily residential (apartments and tenements)
11	R1	High-density residential (<= 1/4-acre house lots)
12	R2	Medium-density residential (<= 1/2-acre house lots)
13	R3	Low-density residential (> 1/2-acre house lots)
15	UC	Commercial (city buildings, shopping centers, “business parks”, etc.
16	UI	Industrial (manufacturing facilities)
17	UO	Urban open (schools & colleges, churches, cemeteries, city parks, etc.)
18	UT	Transportation (airports, docks, railroads roadways > 220' in width)
05	M	Mining (sand, gravel, etc.)
19	UW	Waste disposal (landfills, junkyards, sewage plants)
01	AC	Cropland (tilled & untilled fields, farm buildings)
02	AP	Pasture
21	WP	Woody perennials (orchards, Christmas trees, nurseries)
23	CB	Cranberry bog
06	O	Open land (abandoned fields & orchards, right-of-ways > 100' in width, dunes, heath)
20	W	Water (lakes and ponds >= 1 acre, rivers & streams >= 120 feet in width)
04	FW	Inland water (flood plain, bog, swamp, meadow, marsh, beaver pond)
14	SW	Salt wetland (salt marsh & meadow)
03	F	All forest land (>= 1 acre and 120 feet in width)
30	OC	Ocean

Table 2.—The discrete classes used to record the size of the continuous forested area.

Code	Acres
0	point center is nonforest
1	<= 2.5
2	2.6 - 25
3	26 - 125
4	126 - 250
5	251 - 1,250
6	1,251 - 2,500
7	>= 2,501

Table 3.—The discrete classes used to record the distance to nearest developed land use.

Code	Miles	Feet
0	point center is nonforest	
1	<= .125	<= 660
2	.125 - .25	661 - 1320
3	.25 - .50	1,321 - 2,640
4	.50 - 1.0	2,641 - 5,280
5	1.0 - 1.5	5,281 - 7,920
6	1.5 - 2.0	7,921 - 10,560
7	2.0 - 2.5	10,561 - 13,200
8	2.5 - 3.0	13,201 - 15,840
9	> 3.0	> 15,840

Table 4.—The land use groups used to record the type of nearest developed land use.

Code	Description
0	point center is nonforest
1	R0,R1,R2,R3 (residential)
2	UC,UI (urban commercial or industrial
3	UO (urban open)
4	UT (transportation/roads)
5	M, UW (mining/waste)
6	AC, P (agriculture crops/pasture)
7	WP (woody perennials
8	CB (cranberry bog)
9	O (open)

Table 5.—Summary statistics regarding the land use classes encountered at each photointerpretation point.

	Rhode Island		Connecticut	
Land use	Number of points	Total points, percent	Number of points	Total points, percent
Forest	1,444	56	6,744	59
Residential	498	19	2,302	20
Commercial/industrial	72	3	289	3
Urban open	62	2	218	2
Transportation	49	2	155	1
Mining/waste	14	1	52	0
Cropland/pasture	134	5	907	8
Orchards/nurseries	3	0	42	0
Cranberry bog	0	0	0	0
Open	78	3	215	2
Water/wetland	221	9	493	4
Total points interpreted	2,575	100	11,417	99

Table 6.—Summary statistics regarding the size of forested patch across each state.

Size of forested patch (acres)	Rhode Island		Connecticut	
	Number of points	Total forested points, percent	Number of points	Total forested points, percent
<= 2.5	62	4	535	8
2.6 - 25	90	6	643	9.5
26 - 125	191	13	1,143	17
126 - 250	225	16	846	12.5
251 - 1250	535	37	2,282	34
1251 - 2500	153	11	684	10
> 2501	188	13	611	9
Total forested points	1,444	100	6,744	100

Table 7.—Summary statistics regarding the distance to nearest developed land use across each state.

Distance (miles)	Rhode Island		Connecticut	
	Number of points	Total forested points, percent	Number of points	Total forested points, percent
<= .125	898	62	4,582	68
.125 - .25	333	23	1,234	18
.25 - .50	162	11	689	10
.50 - 1.0	49	3	219	3
1.0 - 1.5	1	0	18	0
1.5 - 2.0	1	0	2	0
Total forested points	1,444	99	6,744	99

Table 8.—Summary statistics regarding the nearest developed land use encountered across each state.

Land use	Rhode Island		Connecticut	
	Number of points	Total forested points, percent	Number of points	Total forested points, percent
Residential	877	61	4,036	60
Commercial/industrial	31	2	143	2
Urban open	27	2	112	2
Transportation	56	4	203	3
Mining/waste	19	1	108	2
Cropland/pasture	313	22	1,618	24
Orchards/nurseries	8	0.5	67	1
Cranberry bog	4	0	0	0
Open	109	7.5	457	7
Total forested points	1,444	100	6,744	101

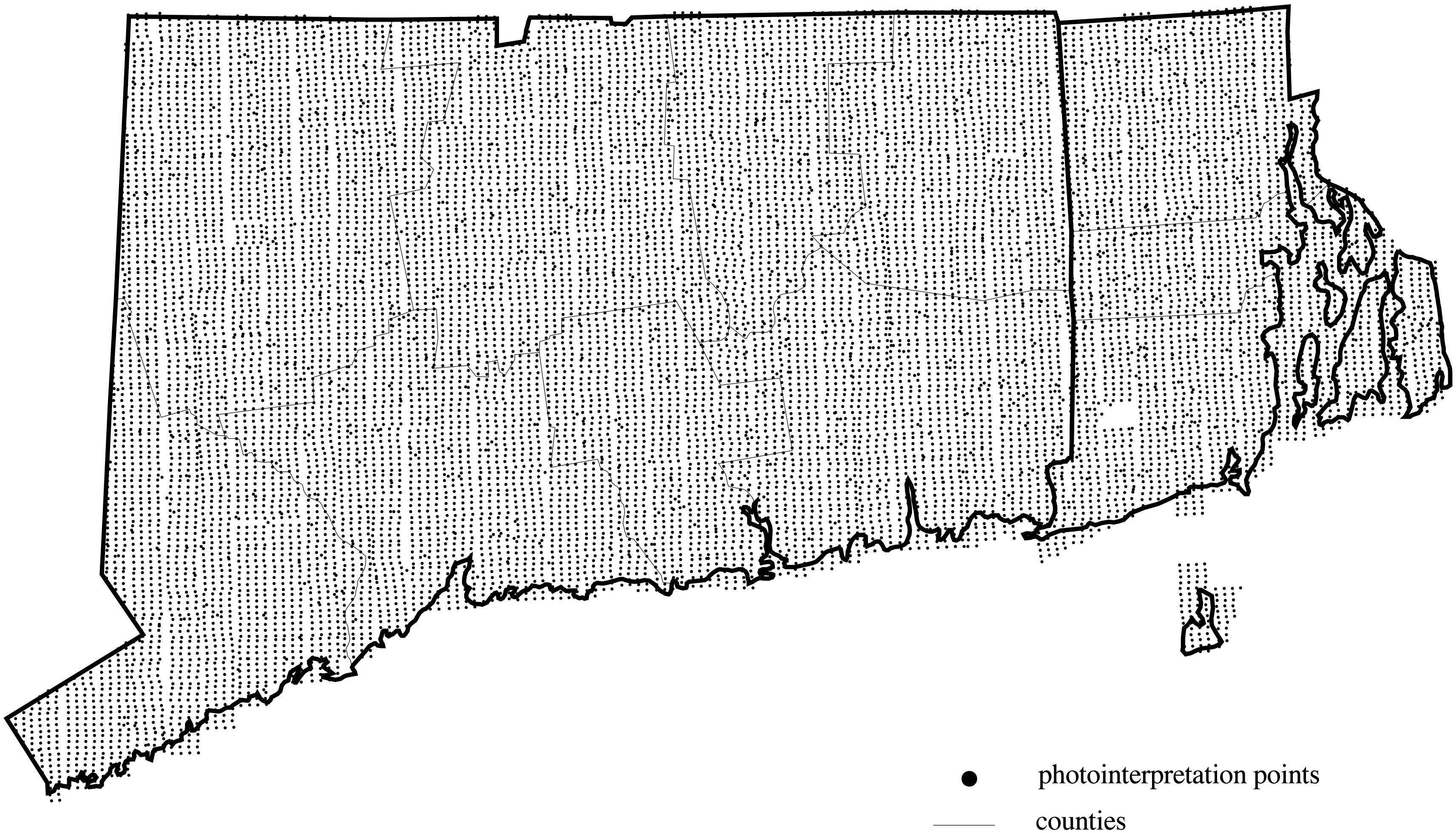

Figure 1.—The FIA photointerpretation points, Connecticut and Rhode Island.

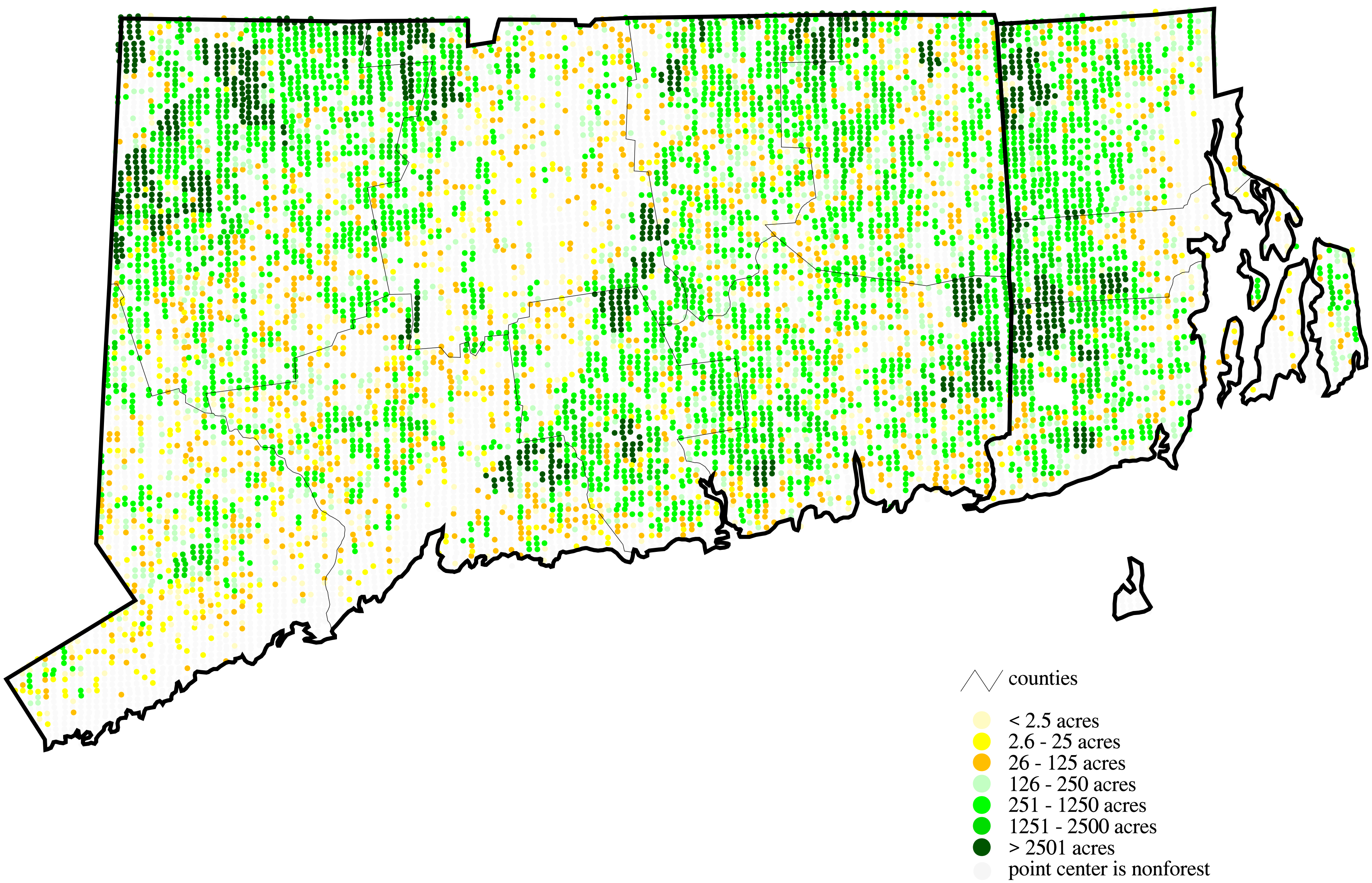

Figure 2.—Patch size of forested areas, Connecticut and Rhode Island.

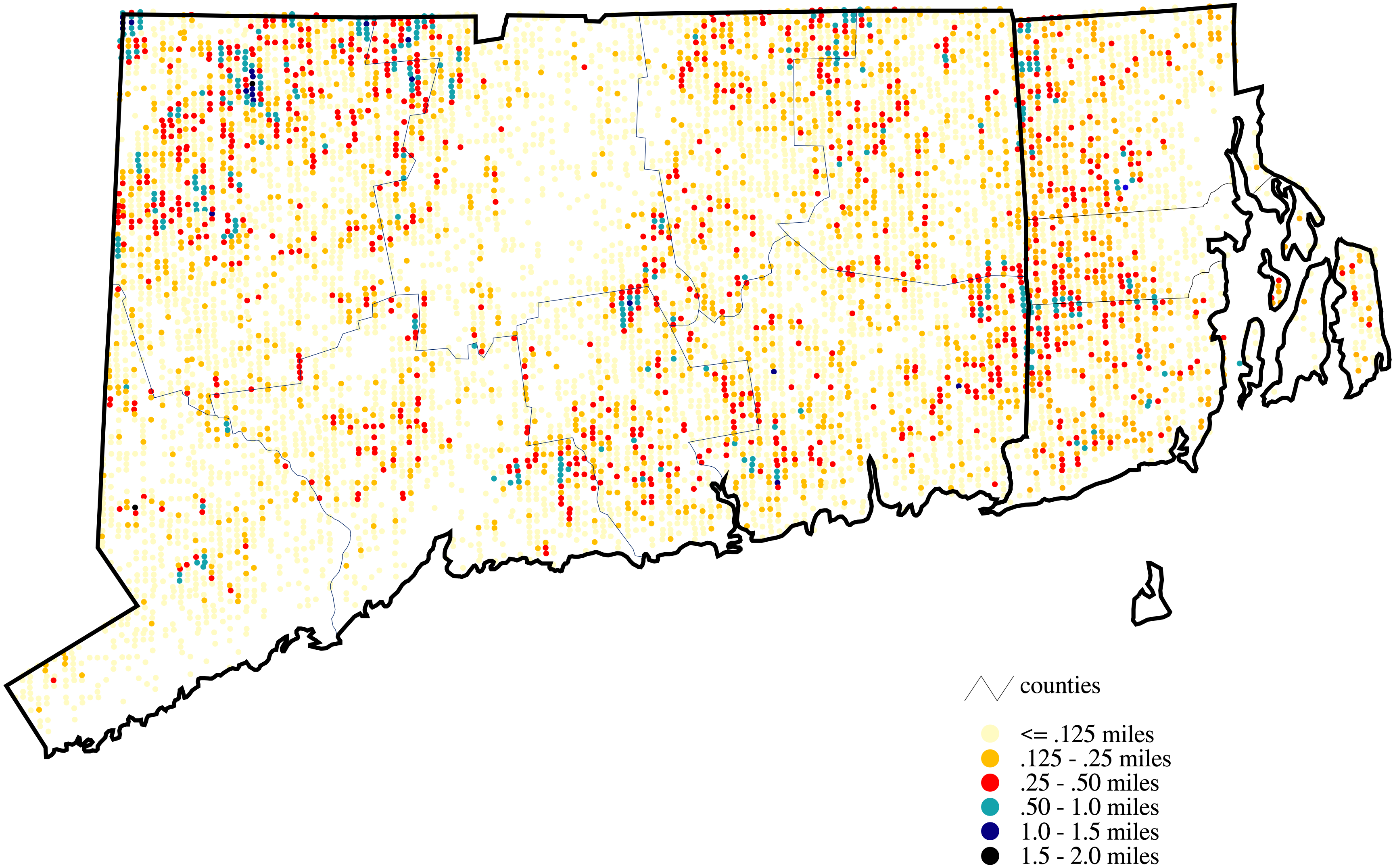

Figure 3.—Distance from each forested point to the nearest developed land use, Connecticut and Rhode Island.

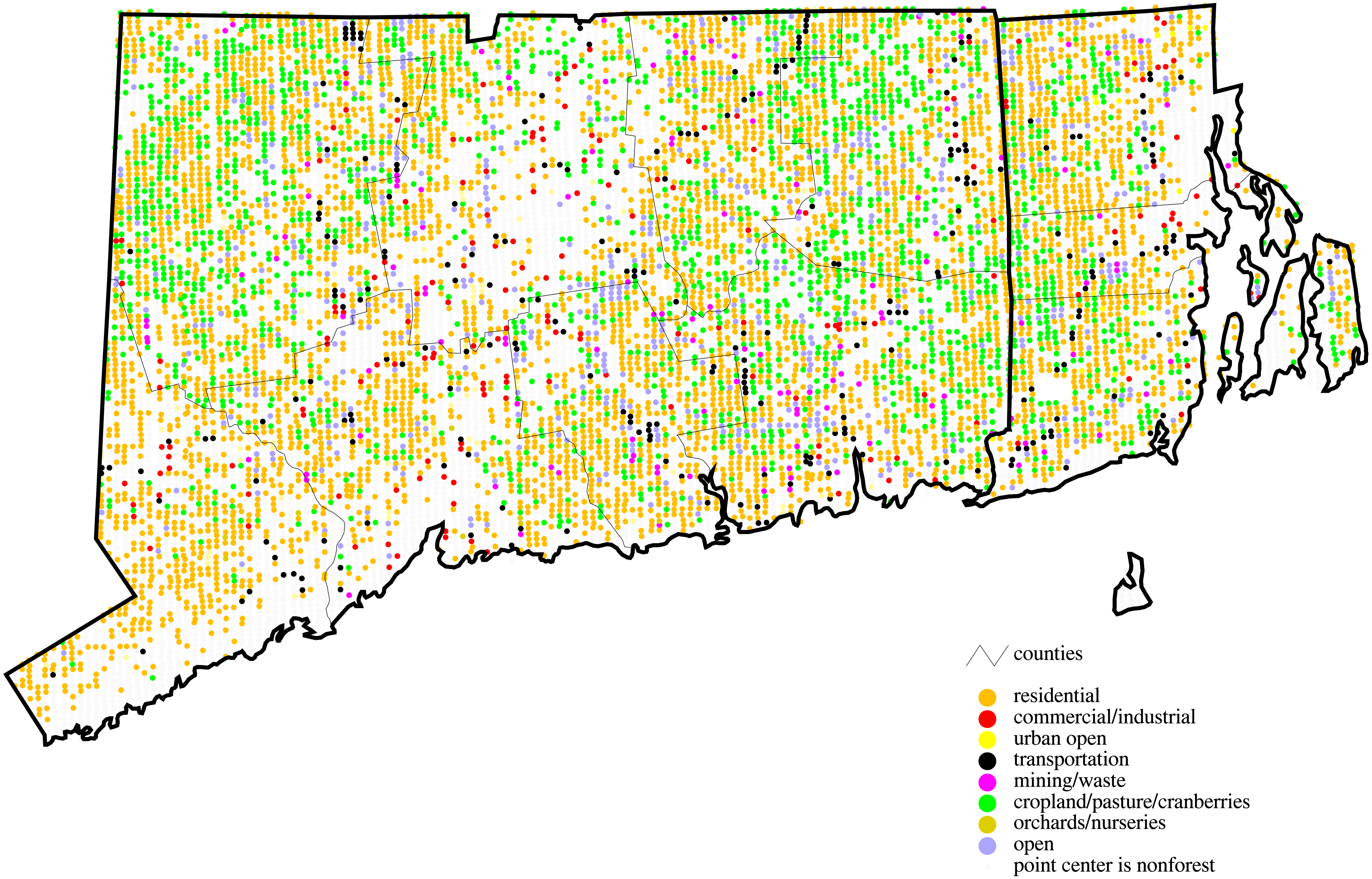

Figure 4.—The type of land use encountered nearest each forested point, Connecticut and Rhode Island.

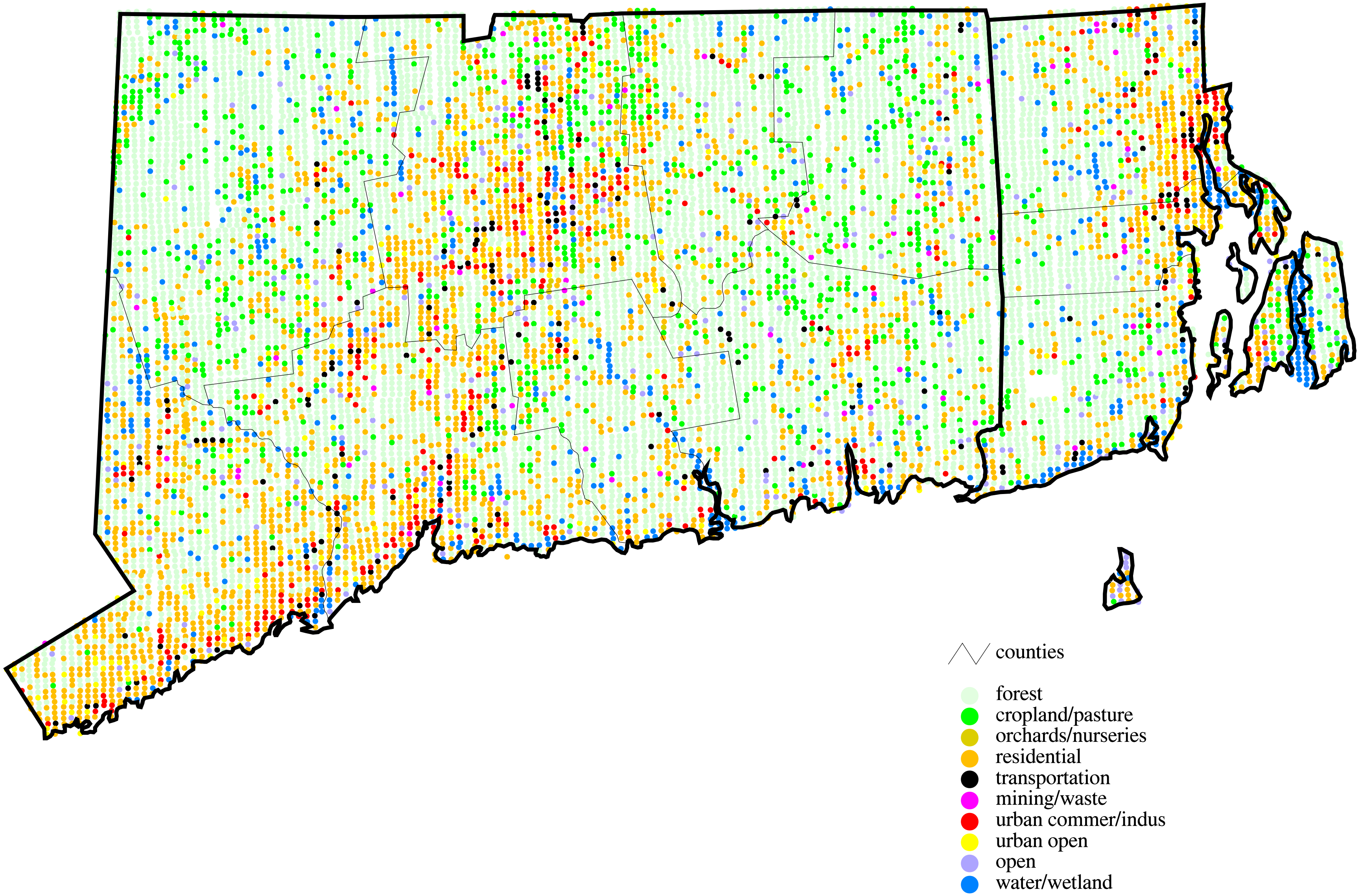

Figure 5.—The type of land use encountered at each photointerpreted point, Connecticut and Rhode Island.

Conclusions

Each indicator—forest patch size, distance to nearest land use, and type of land use—provides a slightly different context of forest-land dynamics. Which one or combination of these indicators relates most directly to changes in the forest, to changes in its use by wildlife species, to changes in management opportunities, or to changes in the importance of the forest land to people, is yet to be determined and will be the subject of future studies. Preliminary information on site conditions can be acquired by local managers and landowners. More detailed data on changes in site conditions must be obtained from FIA data over time, and long-term field research. For example, current research being established by the two new urban Long Term Ecological Research (LTER) sites in Phoenix, Arizona, and Baltimore, Maryland, will yield much needed data on the impacts of human activities on forest ecosystems. The approach used here provides some information regarding the status of forest lands via several indicators of fragmentation and proximity. This information can be used in conjunction with local knowledge, additional research, and comparison with other information to address the questions above, and to assess the impacts of and plan for future development.

Future Research

Investigations will continue to determine and examine: a) whether the variables collected identify characteristics of fragmentation and proximity to human development that are of interest, b) what is an appropriate sampling intensity to yield needed data, and c) whether other data sets such as population and housing densities from the Census Bureau can be combined with FIA sample data to give additional information on land use patterns and effects on natural resources management and ecological processes.

Other future investigations will involve comparing the inventory approaches and databases used by the NC, NE, and PNW units. Each FIA unit sampling approach uses different sampling intensities, different sampling strategies (point sample vs. area estimate sample), and different sample variables to determine what is the best approach or series of approaches to assess the effect of development on forest lands. The results of these photointerpretation efforts have not yet been exhaustively analyzed.

The data collected for this study are available for further analysis and use with your own data, and can be accessed via the NEFIA web page at (www.fs.fed.us/ne/data/pipoints.html).

Literature Cited

Birch, T.W.; Moulton, R.J. 1997. **Northern forest landowners: a profile.** National Woodlands. January.

Broderick, S.H.; Kittredge, D.B.; Decker, D.J.; Connelly, N.A. 1991. **Practicing foresters identify research needs.** Journal of Forestry. 89(8):27-32, 35.

Dawson, C.P.; Zipperer, W.C. 1992. **Impacts of land use changes on recreation and open space in the New York-New Jersey Highlands Region.** In: Chavez, D., tech. coord.. Proceedings of the symposium on social aspects and recreation research; 1992 February 19-22, Ontario, CA. Gen. Tech. Rep. PSW-GTR-132. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station: 67-68.

Emery, M.R. 1998. **Invisible livelihoods: non-timber forest products in Michigan's Upper Peninsula.** Rutgers, NJ: Rutgers, The State University of New Jersey, Department of Geography. Ph.D. dissertation. 291 p.

Franzreb, K.E.; Rosenberg, K.V. 1997. **Are forest songbirds declining? Status assessment from the Southern Appalachians and Northeastern forests.** In: Wadsworth, K.G., ed. Transactions of the 62nd North American Wildlife and Natural Resources Conference; 1997 March 14-18; Washington, DC. Washington, DC: Wildlife Management Institute: 264-279.

Kittredge, D.B., Jr. 1992. **Regional cooperation in forestry.** Journal of Extension, Research in Brief. 30(3).

Liu, R.; Scrivani, J.A. 1997. **Virginia forest land assessment: phase one project report.** Charlottesville, VA: Virginia Department of Forestry. 18 p.

MacConnell, W.P.; Goodwin, D.W.; Jones, K.M.L. 1991. **Land use update for Cape Cod with area statistics for 1971, 1984 and 1990.** Res. Bull. 737. Amherst, MA: Massachusetts Agricultural Experiment Station, College of Food and Natural Resources, University of Massachusetts at Amherst.

Pouyat, R.V.; Zipperer, W.C. 1992. **The uses and management of urban woodlands.** In: Rodbell, P.D., ed. Proceedings of the 5th national urban forestry conference; 1991 November 12-17; Los Angeles, CA. Washington, DC: American Forestry Association: 26-29.

Robbins, C.S.; Dawson, D.K.; Dowell, B.A. 1989. **Habitat area requirements of breeding forest birds of the Middle Atlantic Status.** Wildlife Monograph. 103. 34 p.

Rudis, V.A. 1992. **Forest fragmentation of southern U.S. bottomland hardwoods.** In: Brissette, J.C., ed. Proceedings of the 7th biennial southern silvicultural research conference; 1992 November 17-19; Mobile, AL. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station: 35-46.

Schmidt, T.L.; Raile, G.K. 1998. **Forest fragmentation in the Lake States.** In: Proceedings of the Society of American Foresters 1998 national convention; 1998 September 19-23; Traverse City, MI. Washington, DC: Society of American Foresters: 107-115.

Thompson, M.T.; Johnson, T.G. 1996. **A forested tract-size profile of Virginia's NIPF landowners.** Res. Pap. SRS-1. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 8 p.

Zipperer, W.C. 1993a. **Deforestation patterns and their effect on the forest edge and interior.** Landscape Ecology. 8:177-184.

Zipperer, W.C. 1993b. **Effects of urbanization on natural resource management.** In: Briggs, R.D.; Krohn, W.B., eds. Nurturing the northeastern forest: proceedings of a joint meeting of the New England Society of American Foresters and Maine Chapter of the Wildlife Society; 1993 March 3-5; Portland, ME. CFRU Inf. Rep. 33; Misc. Rep. 382. SAF Pub. 93-05. Portland, ME: Maine Agricultural and Forestry Experiment Station: 153-165.

Zipperer, W.C. 1993c. **Analysis of population growth and forest loss.** In: Neville, L.R; Zipperer, W.C., tech. coords. New York-New Jersey Highlands regional study: analysis of selected resources. NA-TP-04-93. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Area State and Private Forestry: 71-81.

Zipperer, W.C.; Andersen, C.G. 1991. **An assessment of residential development in a rural community.** In: Technical papers from the 1991 ACSM-ASPRS annual convention. Bethesda, MD: American Congress on Surveying and Mapping and American Society of Photogrammetry and Remote Sensing. 4: 257-263.

Zipperer, W.C. and R.V. Pouyat. 1995. **Urban and suburban woodlands: a changing forest ecosystem.** Journal of American Association of Botanical Gardens and Arboreta. 10:18-20.

Riemann, Rachel; Tillman, Kathy. 1999. **FIA photointerpretation in Southern New England: a tool to determine forest fragmentation and proximity to human development.** Res. Pap. NE-709. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station. 12 p.

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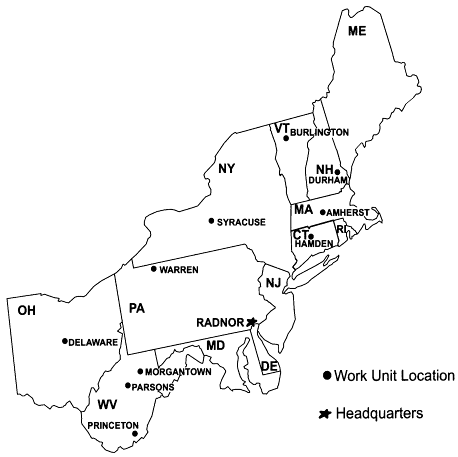

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Amherst, Massachusetts, in cooperation with the University of Massachusetts

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