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VEGETATION BOUNDARIES ON ERTS-1 IMAGERY*

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Abstract

Comparison of systems corrected ERTS-1 imagery and microdensitometer scan printouts derived from them with base vegetation maps and current 1:120,000 and 1:60,000 scale imagery of the Great Smoky Mountains is in progress. It reveals good separation of the spruce-fir forest from the other forest areas but band seven does not distinguish between hardwood and heath dominated vegetation.

Introduction

This paper compares apparent boundaries of vegetation types in restricted portions of the Southern Appalachians with various levels of ground, other image, and map truth. Within the Southern Appalachians are extensive wildlands of which most are forested; in Tennessee, for example, 47 per cent of the land area is forested and counties along the Tennessee-North Carolina boundary average 53 per cent forested but counties are as high as 81 per cent forest covered.[1] In several counties National Forests, and in two counties the Great Smoky Mountains National Park, and other forms of federal ownerships are high proportions.[1] The forest landscape is used for wood products, recreation and aesthetics but increasing pressure is being applied for use as recreational-home - summer home developments. In the Cumberland

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Mountains and Plateau to the west, deep pit and strip mining is devastating extensive areas. The biota of these areas serve as a gene pool from which we will doubtless extract organisms which produce fibers and chemicals needed in future centuries. Monitoring of this landscape resource is an essential feature of our national activities.[2]

This study centers on vegetation interfaces in the Southern Appalachians - particularly in the Blue Ridge Physiographic province of East Tennessee and western North Carolina. Of particular interest is the Tennessee-North Carolina state line ridge extending northeast-southwest through the Great Smokies, and the Balsam Mountain ridges extending southeast from Tricorner Knob on the state line ridge. The topography is rugged and mountainous, slopes, and stream gradients are steep. Most of the above crests areas are about 1372 m (4500 ft) and elevation to 2018 m (6621 ft) occur. The area is underlaid by intensively folded faulted and usually metamorphosed Precambrian rocks, Thunderhead sandstone, the silty to argillaceous slates, phyllites and schists of the Anakeesta Formation, and by muskovite and other schists and gneisses.[3,4] Soils are spodosols and Ultisols: Hapludults, Paleudults and Dystrochrepts.[5] They are shallow, stony , sandy, acid and of low fertility. Rooting is commonly shallow - often in contact with litter layers which occur to 117 mt/ha (48 tons/acre) in the spruce vegetation.[6] Climates of the mountain axes vary with elevation, exposure and position relative to sheltering from radiation and prevailing winds. They fall within the Caf and Cb types of Koppen[7] and those at 1219 - 1524 m (4000 - 5000 ft) are similar to those in the eastern Great Lakes area and New England. Those higher approach the low elevation climates of Maine and the Canadian Maritime provinces.[8,9] During one five year study a mean temperature decrease of 1.3C (2.3F) and 17.37 cm (6.84 in) of precipitation with each 305 m (1000 ft.) upward. Annual soil temperatures varied with air temperatures but averaged ca.4.5F low.[8,10] High elevation vegetation is of several types: 1) heath slicks, 2) northern hardwood forests, 3) spruce-fir forests, and 4) intergrades among those above.[11,12]

Methods

This study has used bulk (systems corrected) 70 mm and 24 cm ERTS-1 imagery dated 15 October, 1972: 1084-15431, band 7. It has been compared visually with base data: base and vegetation maps and 1:60,000 and 1:120,000 scale imagery.

VEGETATION BOUNDARIES

Microdensitometer scan print outs of a portion of the 70 mm imagery are compared qualitatively and quantitatively with the base data.[13,14]

Results and Discussion

The first question that arises is what is represented on the ERTS-1 imagery; photographic copy in Fig. 1. The darker central area is the one of chief interest and it corresponds in general with land above 1372 m (4500 ft) elevation, it has lower air and soil temperatures and higher precipitation than is experienced on lower slopes. It seems possible that this represents the microthermal climatic regime found by Shanks in the high Smokies. However, the dark area does not appear on all ridges above 1372 m (4500 ft), for example, Thomas Divide does not appear dark - nor does this ridge possess the spruce-fir vegetation which caps most crests.

Comparison of Figs. 1 and 2 suggests a general relationship between the extent of spruce-fir and the dark area. The area "S" on Fig. 2 is a sketch of the boundary of spruce-fir forest but includes small bodies of other vegtation. It was prepared from 1:60,000 scale NASA RB-57 imagery, obtained April 1972. Differences in scale and skew in imagery make direct imparisons difficult. However, more feasible comparisons may be made by scanning the imagery (Fig. 3). The larger scale print out is of a scale similar to that of the RB-57 imagery, as well as those of our base and vegetation maps. It is apparent that density levels greater than 107 (θ and denser symbols) approximates spruce-fir forest although certain areas mapped as continuous boreal forest are here discontinuous and the reverse is also true. Types appeared to exhibit density ranges as suggested in Table 1.

Clouds and their shadows appear (Fig. 3). Large valleys (V on Figs. 2 and 3) simulate spruce. Small valleys are often represented by X (densities 91-98) intermediate between hardwood forest and heath peaks. Hardwood forest and heath cover, gray versus pink on false color imagery are not well separated here.

Conclusions

The ERTS-1 imagery offers unparallelled opportunity to examine landscape characteristics. Certain vegetation interfaces are susceptible to analysis - especially ones exhibiting

major morphological, emission or reflectance differences. The spruce-fir versus hardwood vegetation interface visible on bands 4, 5, 6, and 7 is well distinguished on band 7 but adjacent heath vegetation is not well distinguished there. Refinements using scene-corrected, color ERTS imagery and increased map precision from e.g., 1:120,000 scale modern imagery are current.

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	Density Range								
Vegetation	58-65	66-73	74-81	82-90	91-98	99-106	107-132	133-156	157-256
Spruce-Fir	0.0	0.0	0.0	0.9	2.6	7.0	11.3	7.0	6.1
Spruce-Hardwoods	0.0	0.0	0.0	0.0	0.9	6.1	8.7	3.5	0.9
Hardwoods	2.6	6.1	2.6	1.7	0.9	0.0	5.2	0.0	0.0
Heath	0.0	12.2	4.3	5.2	2.6	0.9	0.9	0.0	0.0

Table 1. Comparison of microdensitometer print out density scale division groups and vegetation types on RB-57 imagery.

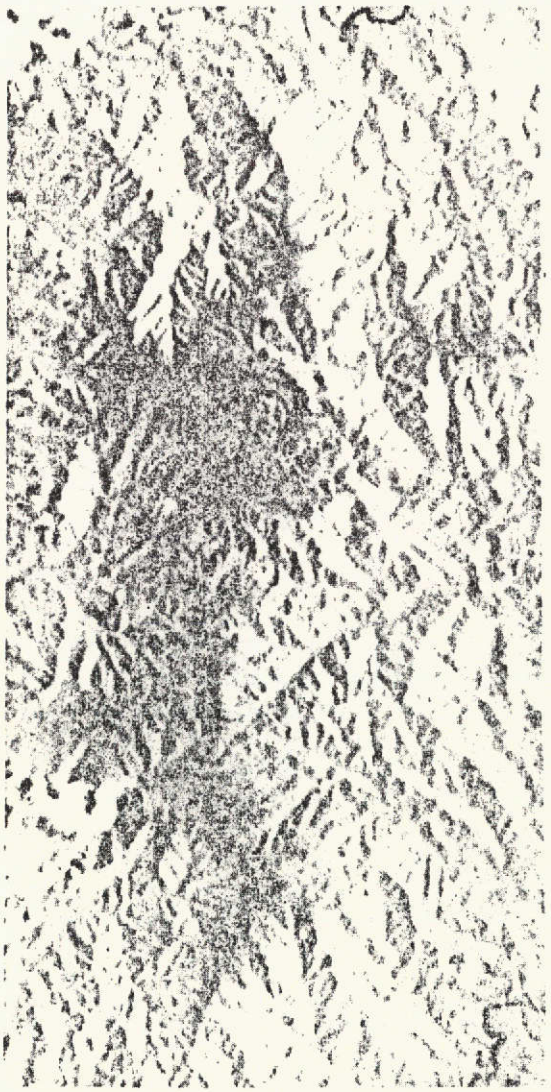

Figure 1. Photographic positive copy of ERTS-1 imagery of 15 October 1972 over the crest of the Great Smoky Mountains.

Figure 2. Sketch of boundary of mountain crest area chiefly in spruce forest (S). Big Creek valley is also outlined (V).

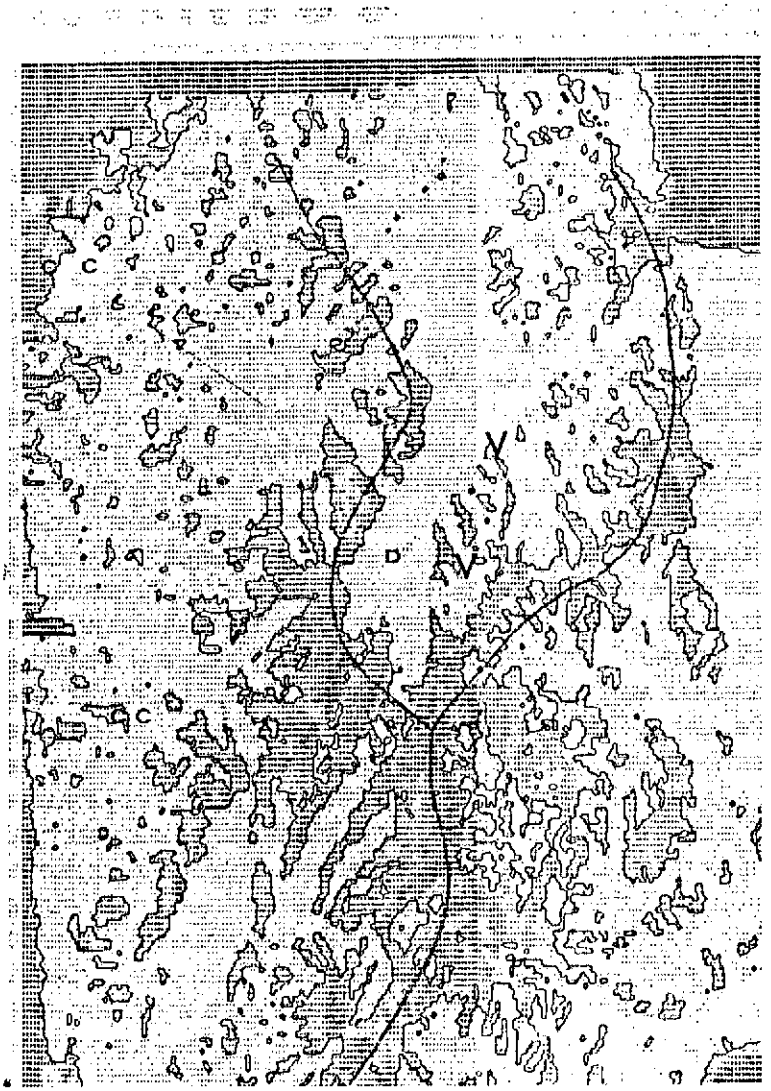

Figure 3. Printout of microdensitometer scan of the original of which Figure 1 was derived. Clouds and their shadows (C), Big Creek valley (V), and small valleys (D) appear. The main dark area is spruce forest. The highest ridges are shown as a heavy line.