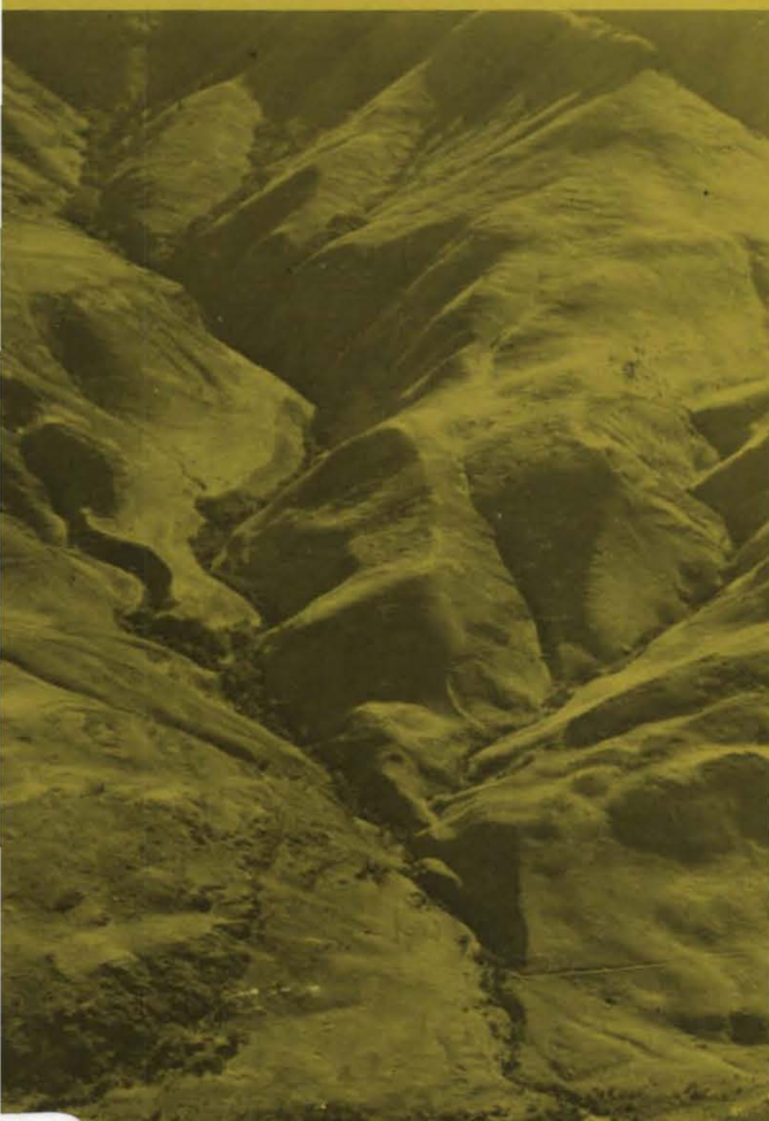
April 1976 Bulletin Number 11

College of Forestry, Wildlife and Range Sciences

VALUATING RIPARIAN HABITATS ROM AERIAL OLOR PHOTOGRAPHY



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Evaluating Riparian Habitats From Aerial Color Photography

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PROBLEM

White alder *(Alnus rhombifolia)*[1] forms the dominant rstory in many streamside communities in the lower arwater and Salmon rivers, and the middle Snake River Idaho, Washington and Oregon.

This species has little commercial value per se. wever, the riparian communities that white alder minates provide a great attraction for recreationists on these three popular rivers. Streamside vegetation dominated by white alder makes a significant floral contribution to the aesthetics of an outdoor experience; certainly the dense alder stands affect the amount and quality of water delivered to the main streams. Further, these streambottoms, surrounded by grasslands, are important habitats for a wide variety of wildlife. In areas grazed by domestic livestock, heavy use of streambottoms is made by animals seeking water and shade. Both the importance of these white alder dominated streams and potential conflicts in their use are clear.

Land use patterns along the Snake and Salmon rivers, are changing. Each year thousands of people float down the rugged stretches of these canyons. The Middle Snake has been designated a National Recreation Area, while the Salmon is a strong candidate for wild/scenic river status. Recreation use of these rivers will assuredly increase. Land managers are well aware that the prime camping and hiking areas for boaters are the perennial side streams. These tributaries often contain the only trails providing access in and out of the canyons. Campers concentrate their activities on the side streams, seeking water and shade as well as fishing opportunities and a chance to observe wildlife. Thus, the understanding of the ecological tolerance of while alder and other riparian vegetation will become increasingly essential to land management decisions.

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research reported here was supported by the Stillinger Foun-on Trust projects on the Ecology, Distribution and Utilization daho Woody Plants and on the Ecology of White Alder. Pub-ed with the approval of Director, Forest, Wildlife and Range eriment Station as Contribution No. 22.

hors are respectively: Graduate Research Assistant, Research essor, Associate Professor and Professor; Forest, Wildlife and ge Experiment Station, University of Idaho, Moscow.

entific and common names follow Hitchcock and Cronquist 3.

er Photo: Riparian vegetation can be readily indentified this black and white print from color 35 mm oblique-le photography obtained during an aerial survey of the ke River.

Aerial photography may provide a rapid and relatively inexpensive means of collecting data on the species and the communities it inhabits. Color aerial photography seems to have the most promising potential.

Although much work has been done in the field of color aerial photographic interpretation, no aerial photo interpretation studies have been conducted specifically on white alder. One study using multispectral color aerial photography in California (Yost and Wenderoth 1969) did report identification of white alder by color differences on a multispectral photograph. However, this study was mainly concerned with differentiation of three other species, two of which were coniferous.

OBJECTIVES

The primary goal of this study was to objectively evaluate the feasibility of using 70 mm vertical aerial photography to locate populations of white alder in tributaries to the Snake, Salmon, and Clearwater river drainages. In addition, if the 70 mm format proved useful, then the best scale to use, the type of film (true color or color IR), and the feasibility of using Munsell Color Chart descriptions to identify alder and associated species would be determined. Realization of the objectives of this study would provide basic information on the proper aerial photographic methods for determining the presence of white alder in riparian communities. This information would hopefully reduce the cost of ground data acquisition in studies of these areas.

STUDY AREA

Allison Creek in the Salmon River drainage was chosen as the tributary to be sampled. This drainage is located approximately 15 km (9 river miles) due east of Riggins, Idaho. Allison Creek flows into the Salmon at an elevation of 548 m (1808 ft). The study area included that portion of the creek from the mouth to an elevation 823 m (2700 ft). This represents approximately 4.8 km (3 miles) as measured on the road along the creek.

White alder dominates the overstory of vegetation along the creek to the upper end of the study area. An examination of the creek vegetation beginning at the mouth indicated that white alder is found in association with hackberry *(Celtis reticulata)*, syringa *(Philadelphus lewisii)*, black cottonwood *(Populus trichocarpa)*, western serviceberry *(Amelanchier alnifolia)*, willows *(Salix* red-osier dogwood *(Cornus stolonifera)*, bird c *(Prunus avium)*, Douglas-fir *(Pseudotsuga menziesi* glauca), ponderosa pine *(Pinus ponderosa)*, blueberry *(Sambucus cerulea)*, snowberry *(Symphoricarpos c* Rocky Mountain maple *(Acer glabrum)* black hawtl *(Crataegus douglasii)*, ocean-spray *(Holodiscus disc* and water birch *(Betula occidentalis)*. The presence abundance of these species change on an elevat gradient. Adjacent to the riparian vegetation of the st bottom, the communities vary in composition from b grass at the mouth of the creek to Grand fir/*Clin uniflora* habitat type[2] at the upper end of the study

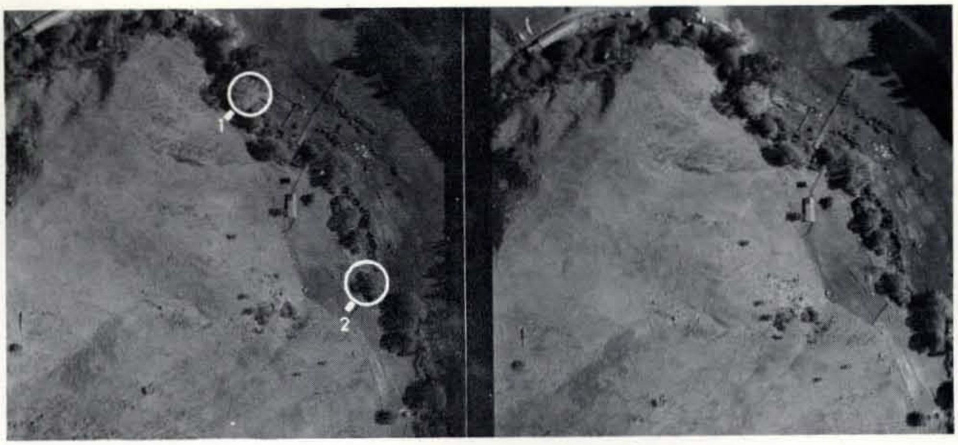
Douglas-fir, grand fir, ponderosa pine, white water birch, bird cherry, black cottonwood, blue elder and black hawthorne were chosen as the species because of their abundance in rip communities. Test trees were located in a m designed to reduce the possibility of introduced bia to their relation with physiographic or cultural fea

Aerial Photography

The study area was photographed on 23 Oc 1974. Field experience indicated that the fall of the was the optimum time for obtaining color and colo imagery for identifying white alder. Because alder rer in green leaf stage longer than any of the associated species in riparian communities, color differences bet species would be maximized during this season.

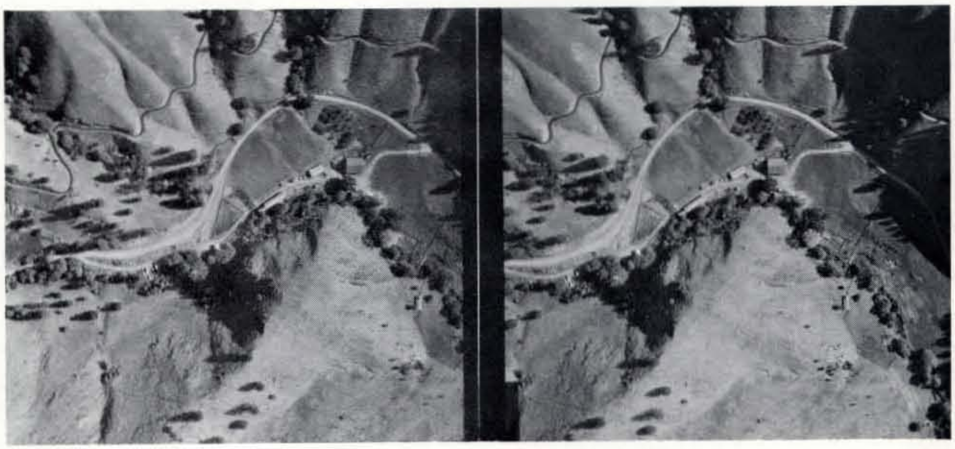
A Graflex-XL camera with 100 mm lens and 70 film back was used. The films used were K aerochrome 2448 (true color) and Kodak aeroch infrared 2443 (color IR). The aircraft flown was a C 206, equipped with a porthole over which a hand mount was placed for obtaining vertical photography overflights of the area were made to gather true imagery at four scales and color IR imagery at 1: and 1:3960 scales. The photographic scales for true were 1:3960, 1:7920, 1:15,840, and 1:31,680 (Fig These scales were ground checked for accuracy. Pl were exposed to obtain a 60 percent overlap for s viewing. The film was developed locally.

[2]Habitat types follow Steele et al. 1975.



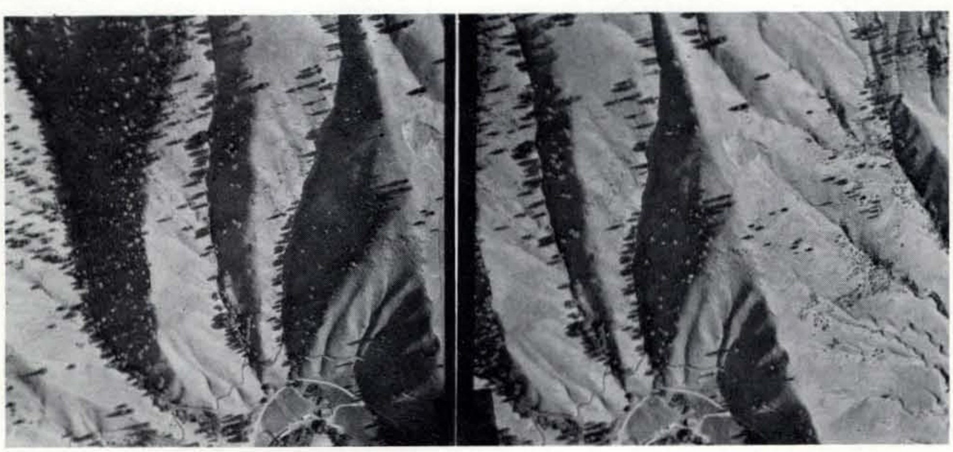
A

1:3960



B

1:7920



C

1:15,840

Fig. 1. Photos A,B,C are prints of 70 mm stereo pairs taken over the same location on Allison Creek. Pairs similar to this were used for interpretation in the study. The effect of increasing scale can be readily noted by the change in building size. The circle 1 denotes a cottonwood tree, while 2 is an alder. The pairs can be viewed with a pocket stereoscope.

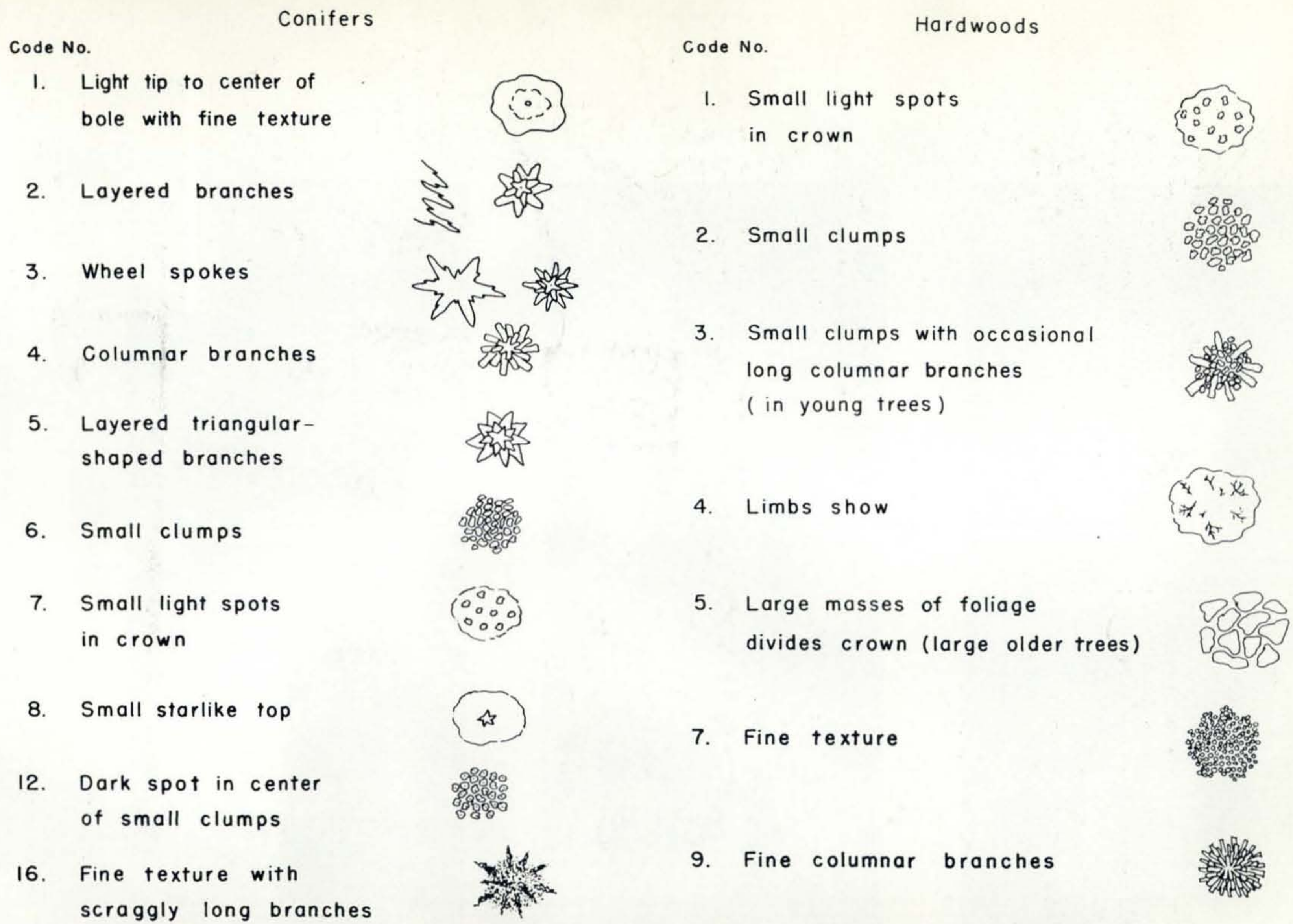


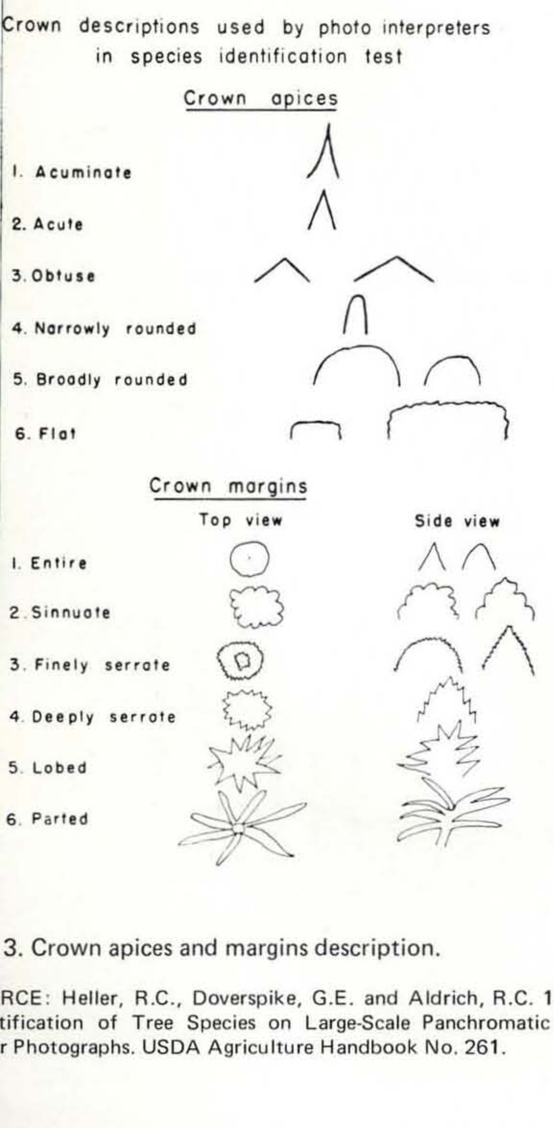
Fig. 2. Foliage characteristics of tree species.

SOURCE: Heller, RC., Doverspike, G.E. and Aldrich, R.C. 1964.

ction of Data

After the color transparencies were developed, the ipal author, who is familiar with the flora of Allison k, checked his ability to differentiate between species all the imagery. Large-scale black and white prints made from the 70 mm color transparencies and used ground checking in the area. Ground descriptions of test species were made to facilitate the development photo interpretation key.

Field experience in the study area clearly indicated species determination by aerial photography within genera *Alnus, Betula, Prunus, Sambucus,* and *aegus* would be difficult due to morphological and nological similarities. For example, the close similarlity



3. Crown apices and margins description.

RCE: Heller, R.C., Doverspike, G.E. and Aldrich, R.C. 1964. tification of Tree Species on Large-Scale Panchromatic and r Photographs. USDA Agriculture Handbook No. 261.

between white alder and thinleaf alder *(Alnus incana)* seemed to preclude exact differentiation with aerial photography. However, this fact would not negate the results of the experiment, because known ecological tolerances help delimit the species. For example, in Idaho, present studies indicate that white alder does not occur above 940 m (3100 ft) whereas thinleaf alder occurs primarily above this elevation. This fact provides information as to the identity of white alder in the imagery.

Photo Interpretation

By utilizing the ground data checked with the black and white prints, test species were marked on acetate overlays placed on the 70 mm transparencies.

An interpretation handbook was prepared utilizing botanical descriptions useful in identifying northern Minnesota tree species (Heller et al. 1964). Although the species were different in Minnesota, the descriptions of crown apices, crown margins and foliage characteristics were readily adaptable to this study (Figs. 2 and 3).

A dichotomous key for true color and color IR was prepared utilizing vegational characteristics and color differences (Tables 1 and 2).

Three inexperienced aerial photo interpreters were selected and given 1 hour of training in the use of the interpretation handbook and stereo viewing techniques. Since these interpreters were without experience and had minimum training, they represent the supposed lower limit of interpreter ability in a study of this type.

A color-comparator (Heller et al. 1964) consisting of Munsell color charts on 35 mm transparencies and a reflection system that gathers the same kind of light passing through the 70 mm transparencies, was used to determine the proper Munsell hue/value/chroma of each test tree. This represents a method of color determination superior to the use of Munsell color chips and reflected light.

The transparencies were viewed with a 2.25-power stereoscope on a fluorescent light-table. Each interpreter used the same light source and stereoscope for all interpretation. Data were recorded on prepared forms.

Table 1. Key to Species: On True Color Aerial Photography.

I. Color of foliage green

- a. Crown acuminate, acute or obtuse...Coniferous
  - aa. Small clumps of foliate with a dark spot in center of clump...ponderosa pine
  - aa. Not above
    - 1. Layered, dense branches...grand fir
    - 1. Columnar, open branches...Douglas-fir
- a. Crown narrowly rounded, broadly rounded or flat...Deciduous
  - aa. Generally obligate riparian
    - 1. Tree-like form, tall, small light spots in crown foliage, sinuate shape...alder
  - aa. Not necessarily obligate riparian
    - 1. Shrub-like form, short, clumped foliage, sinuate shape...blueberry elder

I. Color of Foliage Not Green

- a. Color yellow and tree-like form
  - 1. Limbs show...black cottonwood
  - 1. Limbs don't show
    - aa. Fine columnar branches...bird cherry
    - aa. Fine serrate foliage...water birch
- a. Color not yellow and shrublike form
  - 1. Burnt orange color...hawthorne

Table 2. Key to Species: On Color - IR Aerial Photography.

I. Color of foliage purple

- a. Crown acuminate, acute or obtuse...Coniferous
  - 1. Small clumps of foliage with dark spot in each clump...ponderosa pine
  - 1. Not above
    - aa. Layered, dense branches...grand fir
    - aa. Columnar, open branches...Douglas-fir
- a. Crown narrowly rounded, broadly rounded or flat...Deciduous
  - 1. Tree-like form, tall, small light spots in crown foliage, sinuate shape...alder

I. Color of foliage not purple

- a. Color green shrublike form sinuate shape...blueberry elder
- a. Color not green
  - 1. Color white
    - aa. Fine columnar branches...bird cherry
    - aa. Limbs show, large tree-like form...black cottonwood
  - 1. Color yellow...hawthorne

RESULTS

The correct-incorrect responses from the prepared ns were tabulated (Tables 3, 4, 5).

Because some of the planned imagery was not :ained due to camera malfunctions, sufficient lications for all the test species were not available. The est (Sokal and Rohlf 1969) was selected as an ropriate nonparametric statistic for evaluation of the a.

Examination of the tables indicated that significant iation between interpreters existed. For each erpreter the following comparisons were made: for or film, three scales (1:15,840, 1:7920, 1:3960) were npared for each of seven species. The 1:31,540 color agery was interpreted by the principal author and jectively analyzed for usefulness. These analyses vided a basis for accepting or rejecting the following potheses:

1. Is there any statistical difference in accuracy between true color film and color IR? On the basis of correct-incorrect responses for the five species common between the tables for true color and color IR film (Table 5), the G-test showed a statistically valid improvement in interpreter 1's responses with color IR. However, with only white alder under consideration, the statistical analysis showed no basis for a significant difference between true color and color IR film.

   Comparison of correct-incorrect responses in Table 5 shows that interpreter 2 had problems differentiating ponderosa pine and bird cherry regardless of film type. Interpreter 3 had difficulty in identifying bird cherry on true color film and ponderosa pine on color IR.

   True color film is recommended to reduce costs and to increase utility of photos (transparencies) for other purposes.

2. Does any one scale provide a statistically valid improvement in accuracy? The G-test shows that for the five species marked with an asterisk in Tables 3 and 4, interpreters 1 and 2 did not improve their determination accuracy at any one scale. The same test shows that interpreter 3 did significantly better at the 1:7920 scale.

3. Is there any difference in accuracy between the 1:3960 and 1:7920 scales? For the seven species marked X in Table 4, the G-test shows that interpreter 3 did significantly better at the 1:7920 scale; interpreters 1 and 2 had equal results for both scales. The correct-incorrect responses in the tables show that interpreters 1 and 2 had difficulty determining birch and cherry regardless of scale (Table 4).

4. Is there a difference in correct determination of white alder for any one scale? Evaluation of the white alder correct-incorrect responses (Tables 3 and 4) by the G-tests shows that interpreters 1 and 3 did not perform significantly better at any one scale. Interpreter 2 did improve in identifying alder at the 1:3960 scale. The correct-incorrect responses for white alder in Tables 3, 4, and 5 show that white alder is more consistently identified than the other species.

5. Is the 1:31,540 scale useful for identification of species? Subjective evaluation of correct-incorrect responses of the principal author's interpretation for this scale indicates that the 1:31,540 scale is too small for consistent determination of any species common in riparian communities or even major forest types. Although this test had no statistical control, this indication is supported by experiences of others using small-scale aerial photos for species distribution.

6. Table 6 indicates the general areas on a Munsell Hue/Chroma graph where the interpreters designated each species. These points indicate that alder only broadly compares in color with the coniferous species. This fact should improve accuracy of species determination, since the vegetative characteristics of white alder and the coniferous species are vastly different.

Table 3. Comparison of three interpreters at 1:15,840 scale.

	GROUND \ PHOTO	DF	GF	PP	ALDER	BIRCH	CHERRY	COTTONWOOD
*	1 DF		1					
*	2 GF	1	1					
*	3 PP	1		2				
*	4 ALDER	2			2			
*	5 BIRCH				1	3		2

Interpreter 1

	GROUND \ PHOTO	DF	GF	PP	ALDER	BIRCH	CHERRY	COTTONWOOD
*	1 DF	1						
*	2 GF	1	1					
*	3 PP			3				
*	4 ALDER				4			
*	5 BIRCH						3	2

Interpreter 2

	GROUND \ PHOTO	DF	GF	PP	ALDER	BIRCH	CHERRY	COTTONWOOD
*	1 DF		1					
*	2 GF	1		1				
*	3 PP			3				
*	4 ALDER	1			3			
*	5 BIRCH					2	1	2

Interpreter 3

NOTE: Asterisk indicates species used in comparison of three scales. Numbers indicate interpreter responses.

Table 4. Comparison of 1:7920 and 1:3960 scales by three interpreters.

GROUND \ PHOTO	DF	GF	PP	ALDER	BIRCH	CHERRY	COTTONWOOD	ELDER	HAWTHORNE	
10 DF	7		3							*x
12 GF	2	10								*x
10 PP	1		9							*x
10 ALDER	1		1	8						*x
10 BIRCH					8		2			*x
10 CHERRY					7	3				x
0 COTTONWOOD							0			
0 ELDER								0		
10 HAWTHORNE									10	x

GROUND \ PHOTO	DF	GF	PP	ALDER	BIRCH	CHERRY	COTTONWOOD	ELDER	HAWTHORNE
10 DF	6		4						
9 GF	3	4	2						
8 PP			8						
11 ALDER			1	10					
11 BIRCH					9	1	1		
10 CHERRY	1				7	2			
1 COTTONWOOD							1		
1 ELDER								1	
10 HAWTHORNE						1			9

Interpreter 1

GROUND \ PHOTO	DF	GF	PP	ALDER	BIRCH	CHERRY	COTTONWOOD	ELDER	HAWTHORNE	
10 DF	3	2	5							*x
12 GF	2	7	3							*x
10 PP	2	3	4	1						*x
10 ALDER			4	6						*x
10 BIRCH					3	2	5			*x
10 CHERRY			1	1	3	0	5			x
0 COTTONWOOD							0			
0 ELDER								0		
10 HAWTHORNE									10	x

GROUND \ PHOTO	DF	GF	PP	ALDER	BIRCH	CHERRY	COTTONWOOD	ELDER	HAWTHORNE
10 DF	6	1	3						
9 GF		4	3	2					
8 PP		2	5	1					
11 ALDER				11					
11 BIRCH					6		5		
10 CHERRY					4	2	4		
1 COTTONWOOD						1			
1 ELDER				1					
10 HAWTHORNE							10		

Interpreter 2

GROUND \ PHOTO	DF	GF	PP	ALDER	BIRCH	CHERRY	COTTONWOOD	HAWTHORNE	
10 DF	10								*x
12 GF	1	11							*x
10 PP			10						*x
10 ALDER				10					*x
10 BIRCH					9	1			*x
10 CHERRY					5	2	3		x
COTTONWOOD									
10 HAWTHORNE								10	x

GROUND \ PHOTO	DF	GF	PP	ALDER	BIRCH	CHERRY	COTTONWOOD	ELDER	HAWTHORNE
10 DF	6	1	3						
9 GF	2	5	2						
8 PP			8						
11 ALDER				11					
11 BIRCH	1				7	2	1		
10 CHERRY					5	5			
1 COTTONWOOD							1		
1 ELDER				1					
10 HAWTHORNE									10

Interpreter 3

NOTE: Asterisk indicates species used in comparison of three scales. X indicates species used in comparison of two scales. Numbers indicate interpreter responses.

Table 5. Comparison of two film types by three interpreters at 1:3960.

Interpreter 1

GROUND \ PHOTO	DF	GF	PP	ALDER	BIRCH	CHERRY	COTTONWOOD	ELDER	HAWTHORNE
10 DF	6		4						
9 GF	3	4	2						
8 PP			8						
11 ALDER			1	10					
11 BIRCH					9	1	1		
10 CHERRY	1				7	2			
1 COTTONWOOD							1		
1 ELDER								1	
10 HAWTHORNE						1			9

GROUND \ PHOTO	DF	PP	ALDER	CHERRY	HAWTHORNE
1 DF	1				
9 PP		9			
10 ALDER		1	9		
10 CHERRY				10	
10 HAWTHORNE					10

Interpreter 2

GROUND \ PHOTO	DF	GF	PP	ALDER	BIRCH	CHERRY	COTTONWOOD	ELDER	HAWTHORNE
10 DF	6	1	3						
9 GF		4	3	2					
8 PP		2	5	1					
11 ALDER				11					
11 BIRCH					6		5		
10 CHERRY					4	2	4		
1 COTTONWOOD						1			
1 ELDER				1					
10 HAWTHORNE							10		

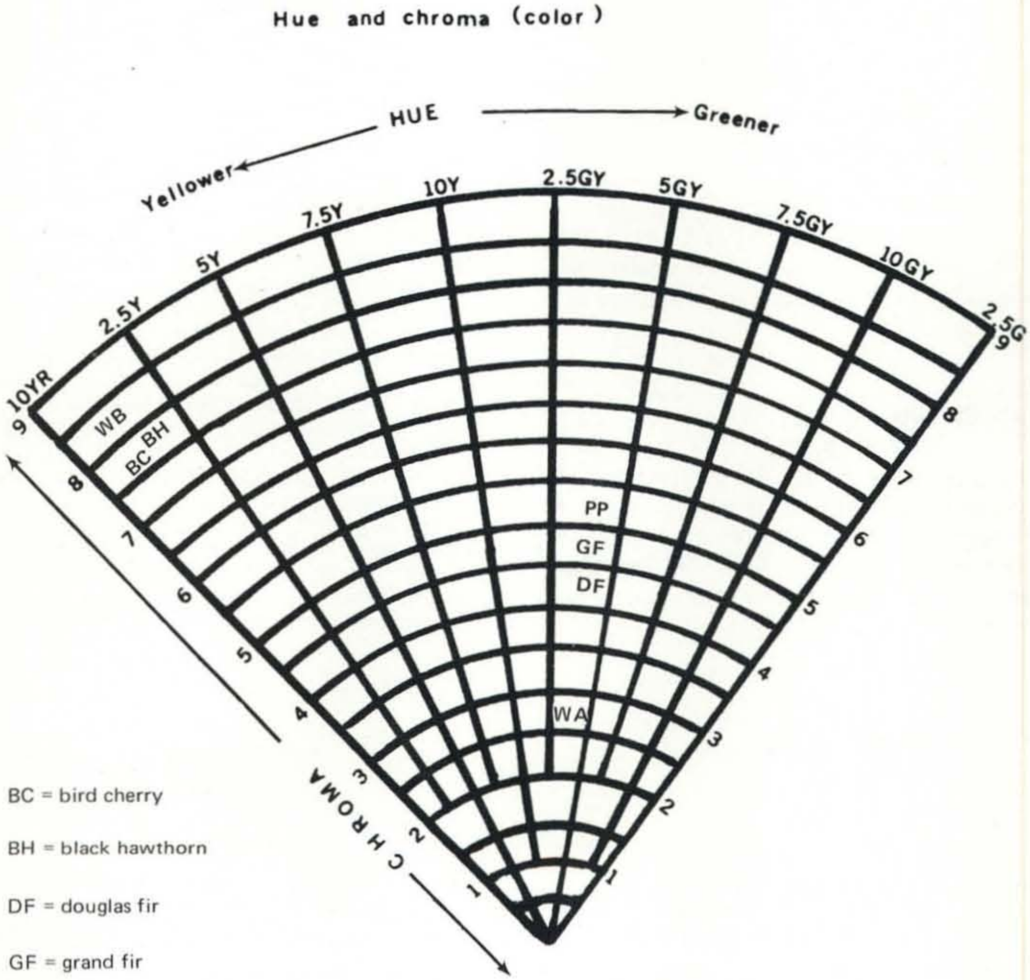
GROUND \ PHOTO	DF	GF	PP	ALDER	BIRCH	CHERRY	COTTONWOOD	ELDER	HAWTHORNE
1 DF	1								
9 PP		2	6	1					
10 ALDER				10					
10 CHERRY			1				8	1	
10 HAWTHORNE								10	

Interpreter 3

GROUND \ PHOTO	DF	GF	PP	ALDER	BIRCH	CHERRY	COTTONWOOD	ELDER	HAWTHORNE
10 DF	6	1	3						
9 GF	2	5	2						
8 PP			8						
11 ALDER				11					
11 BIRCH	1				7	2	1		
10 CHERRY					5	5			
1 COTTONWOOD							1		
1 ELDER				1					
10 HAWTHORNE									10

GROUND \ PHOTO	DF	PP	ALDER	CHERRY	COTTONWOOD	ELDER	HAWTHORNE
1 DF	1						
9 PP	6	3					
10 ALDER			10				
10 CHERRY			1	7	2		
10 HAWTHORNE						1	9

Table 6. Hue and chroma determinations for seven species.



BC = bird cherry

BH = black hawthorn

DF = douglas fir

GF = grand fir

PP = ponderosa pine

WA = white alder

WB = water birch

SOURCE: Adapted from Heller et al. 1964.

CONCLUSIONS

It is feasible to utilize 70 mm aerial photography to determine the presence and abundance of white alder in riparian communities and to obtain information regarding composition of these communities. Subjective evaluation of the data indicates that for white alder, the 1:31,540 scale is too small for useful data gathering. Statistical analysis of the data supports the view that for determining the presence of alder in the fall of the year, the 1:15,840 scale and true color film are adequate.

Progressively larger-scale photography coupled with increased interpreter training would be necessary to provide accurate information regarding the composition of communities dominated by alder.

Figure 1 illustrates the differences in image size for three scales.

Regardless of scale or film type, bird cherry and water birch are difficult to differentiate due to their color and structural similarities.

RECOMMENDATIONS

For an aerial survey to determine the presence of white alder in riparian communities, 70 mm vertical true color aerial photography taken in the fall of the year at 1:15,840 scale would be adequate for identifying white alder with nearly 100 percent accuracy if experienced interpreters were used.

For detailed information regarding vegeta composition of white alder dominated communitie density of alder stands, a larger scale, such as 1: would be more accurate.

Thanks to the following forestry students for patient interpretation: Jay Dorr, Bryan Fraser, and Johnson.

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