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PLAN FOR THE UNIFORM MAPPING OF EARTH RESOURCES AND  
ENVIRONMENTAL COMPLEXES FROM SKYLAB IMAGERY

EREP INVESTIGATION #510

Period Covered: March 1, 1974 to March 31, 1974

Contract Number: NAS 9-13286

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COMPLEXES FROM SKYLAB IMAGERY	Monthly	
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Monthly Plans and Progress Report

PLAN FOR THE UNIFORM MAPPING OF EARTH RESOURCES AND  
ENVIRONMENTAL COMPLEXES FROM SKYLAB IMAGERY

OVERALL STATUS

Natural Vegetation Analog Study

To prepare photointerpreters for testing on Skylab III S190A color infrared photography, a description of each vegetation type to be included in the test was compiled. Table I lists each analog along with associated data on color values, topographic position, elevational range, and ecological boundary information. A dichotomous image interpretation key was prepared for use in actual testing. Appendix I includes the key as it will be used for interpretation testing of Skylab III S190A imagery of the Colorado Plateau test area.

Rice Analog Studies

Only one type of data has been received which has been duplicated for SL-2 and SL-3 missions. It is all we have for a multirate analysis, but unfortunately this data is in 70mm negative form. For human interpretation procedures, this imagery is not the most useful, therefore machine aided evaluation has been the major input during the last reporting period.

This evaluation has utilized the microdensitometric capability of a VP8 image analyzer system. One of the subsampling units covered by both SL-2 and SL-3 was utilized. Of the approximately 400 total fields, 16 fields of four different categories (7 fields of rice, 5 of stubble, 3 of bare ground and 1 fallow field) were sampled. Each field was sampled at six different spots in order to include as much of the within field

variation as possible. Care was taken to sample the same points on each band and date as precisely as possible in order to have the readings comparable. The means and standard deviations of readings for each field were then calculated and compiled to derive a mean and variability statistic for each subject. Table 1 lists this group of statistics by band and date. Before prediction accuracies can be stated, further statistical analysis to determine related powers (beta values) must be completed. However, an indication of the capability of discrimination is given by the density ranges and overlap for each group. Table 2 lists the extremes of each group by field, category, band and date. For ease of interpretation these data are compiled in Figures 1 and 2. A perusal of these two figures indicates severe difficulties of differentiation because of overlapping density values except on the IR bands 37 and 38 for September 1973 (Figure 3). The non-overlap of density values of the rice fields with the other three field conditions on this date indicates the ability to discriminate rice utilizing merely black-and-white photography in these bands. More rigorous statistical testing has been completed so these apparent discrimination capabilities must be taken as tentative. It should also be recognized that these limited dates do not permit a thorough test of the influence of multirate analysis, or time of photography, on the problem of rice discrimination. We anticipated September's being a good date, but which dates, other than preemergence flooding cannot really be anticipated and will be testable only with ERTS data.

Figure 3 shows a combination of the two dates of readings, June and September 1973. The graphs show strong shifts in spectral reflectance of the non-rice categories. The ranges suggest a statistically significant shift in most cases. The rice ranges tended to shrink in breadth but to stay in essentially the same negative density area.

## PLANS FOR NEXT REPORTING PERIOD

S190A black-and-white transparencies of the Colorado Plateau will be analyzed for transmittance characteristics of selected interregional vegetation-environmental analogs. We hope to move forward with interpretation testing.

### TRAVEL PLANS

No travel is planned.

### PERSONNEL

No changes in personnel have occurred.

### PROBLEMS

No unreported problems with the vegetation analog phase are evident at this time. We have not had a response on the photo image quality problem and to the sample frames of S190A data returned with the hope of getting Johnson Space Center to provide more closely matching color balance (see letter to Faulkner of 21 February 1974).

Table 1

DENSITOMETRIC READINGS FOR BUTTE SUBSAMPLING UNIT BY FIELD CONDITION,  
BAND AND DATE. READINGS WERE MADE ON A VP8 IMAGE ANALYZER  
USING 70MM BLACK-AND-WHITE NEGATIVES

Band	Field Crop/ Condition	June '73		Sept. '73	
		$\bar{x}$	$\sigma$	$\bar{x}$	$\sigma$
0.5 - 0.6 $\mu$ Pan X (roll #42)	Rice	374.19	26.0583	442.77	28.4187
	Stubble	284.3	24.3359	456.9	20.1458
	Fallow	349.8	41.0483	457.3	5.3166
	Bare Ground	348.1	38.6064	459.9	27.9340
0.6 - 0.7 $\mu$ Pan X (roll #41)	Rice	415.31	58.3026	455.1	56.794
	Stubble	198.47	26.4272	413.2	30.9192
	Fallow	278.33	57.8366	400.3	5.125
	Bare Ground	295.89	56.5913	414.8	33.8310
0.7 - 0.8 $\mu$ B&W IR (roll #37)	Rice	329.95	90.1108	371.6	9.4740
	Stubble	293.0	18.5938	484.2	42.2538
	Fallow	356.67	42.7255	483.8	7.4410
	Bare Ground	395.4	60.3530	485.1	34.4194
0.8 - 0.9 $\mu$ B&W IR (roll #38)	Rice	435.76	92.9306	444.31	14.9152
	Stubble	343.3	17.3546	536.6	27.6026
	Fallow	427.5	35.3200	586.5	14.1244
	Bare Ground	451.6	62.9922	569.8	29.4390

Table 2

THE RANGE OF DENSITOMETRIC VALUES FOR FOUR FIELD CATEGORIES  
ON TWO DATES AND FOR FOUR DIFFERENT BANDS

<u>Band</u>	<u>Field Crop/Condition</u>	<u>June 1973</u>	<u>September 1973</u>
0.5 - 0.6 $\mu$ Pan X (neg) (roll #42)	Rice	288 - 413	399 - 493
	Stubble	237 - 334	427 - 490
	Fallow	299 - 403	451 - 463
	Bare Ground	279 - 404	415 - 500
0.6 - 0.7 $\mu$ Pan X (neg) (roll #41)	Rice	273 - 493	380 - 547
	Stubble	150 - 245	355 - 461
	Fallow	210 - 354	396 - 410
	Bare Ground	203 - 383	359 - 449
0.7 - 0.8 $\mu$ B&W IR (neg) (roll #37)	Rice	190 - 489	348 - 388
	Stubble	265 - 327	420 - 552
	Fallow	295 - 398	476 - 496
	Bare Ground	275 - 478	436 - 534
0.8 - 0.9 $\mu$ B&W IR (neg) (roll #38)	Rice	269 - 553	419 - 472
	Stubble	306 - 380	490 - 580
	Fallow	376 - 472	568 - 602
	Bare Ground	334 - 515	497 - 616

Figure 1

June 1973

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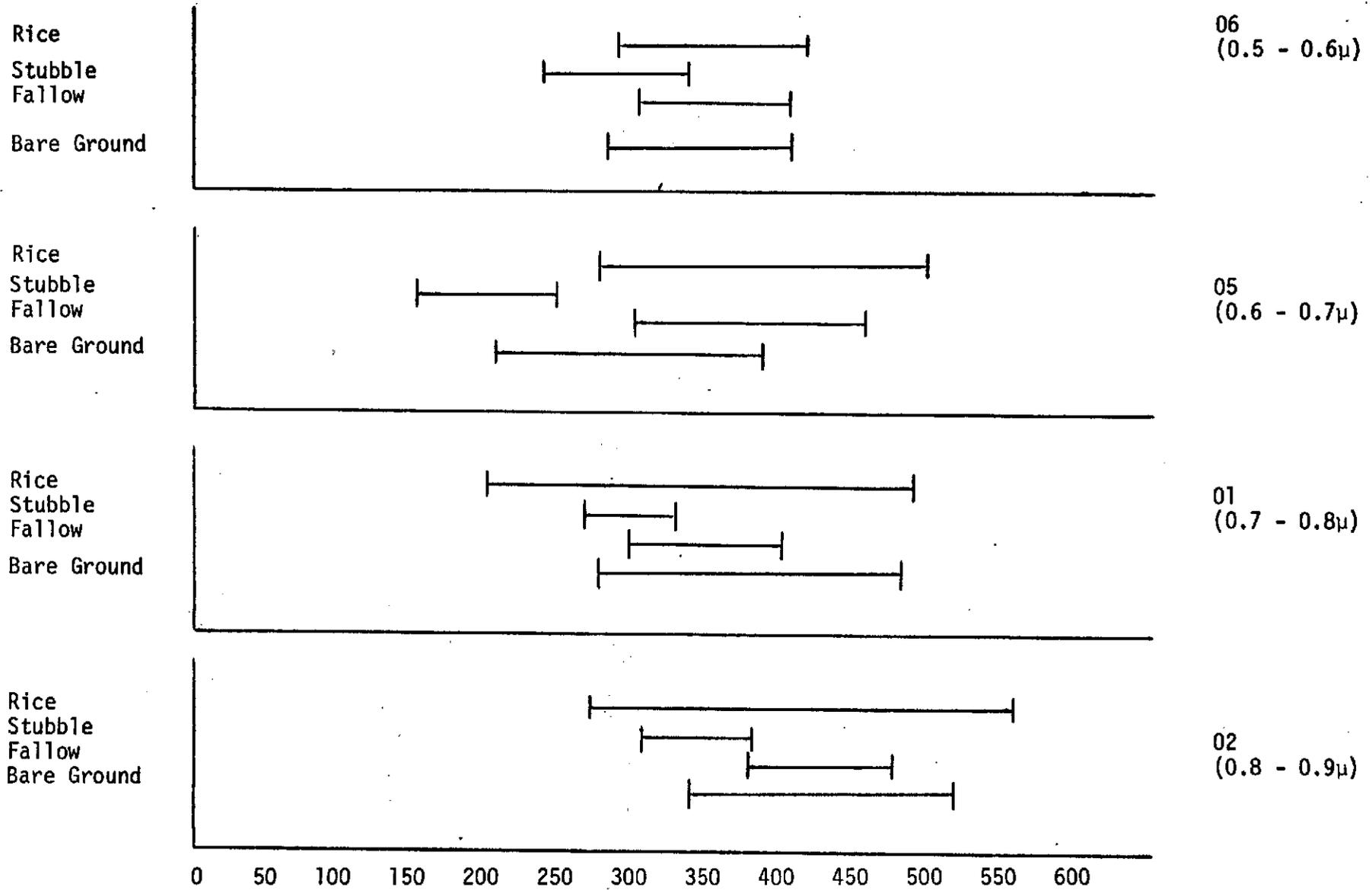
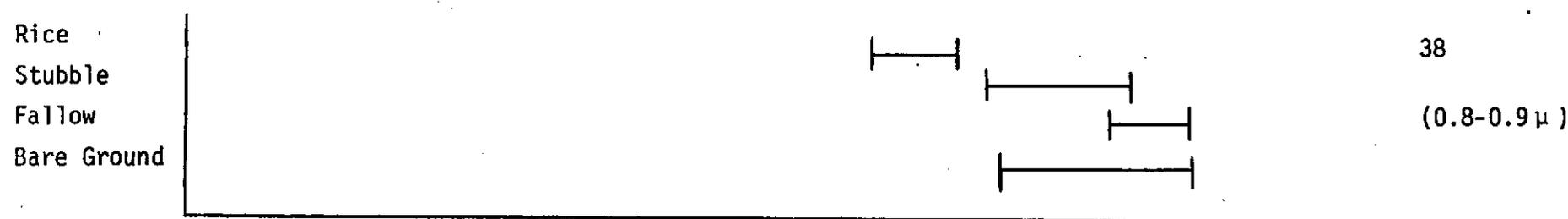
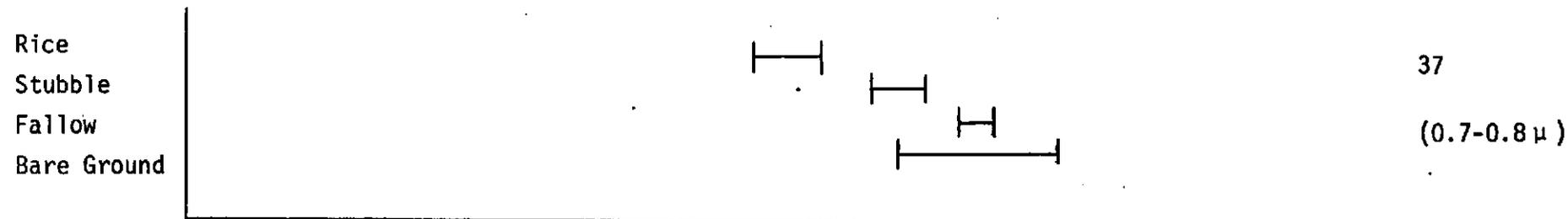
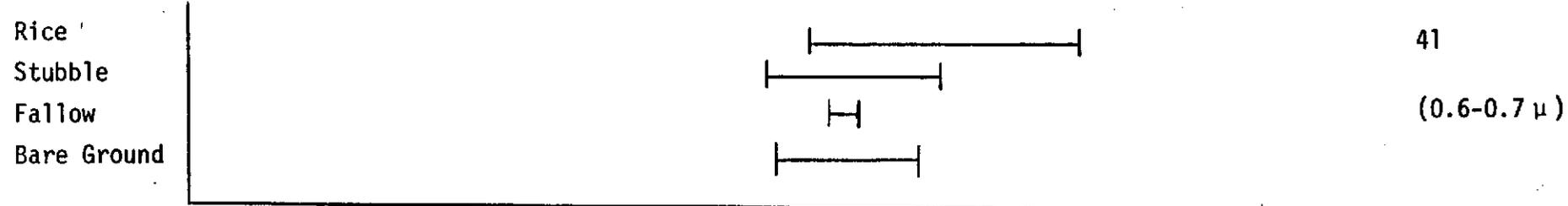
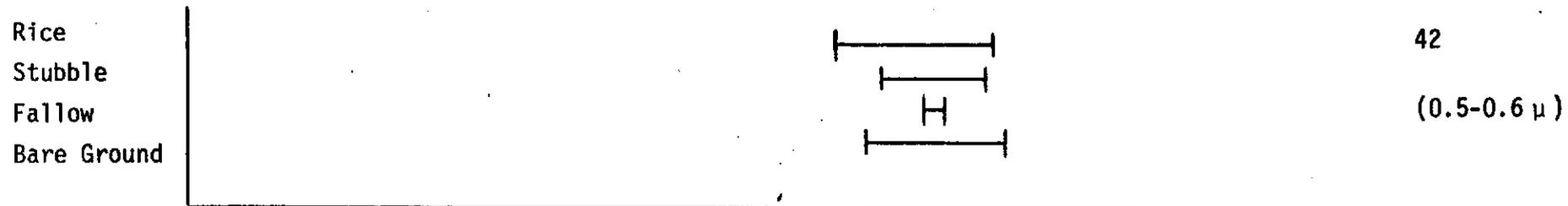


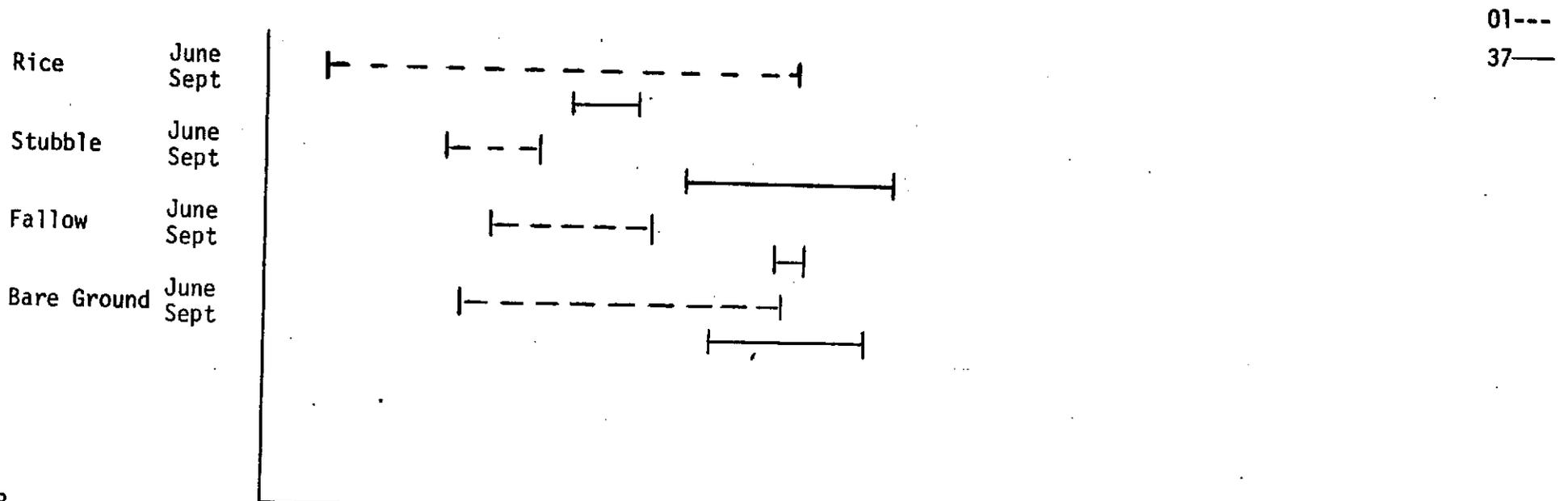
Figure 2

September 1973

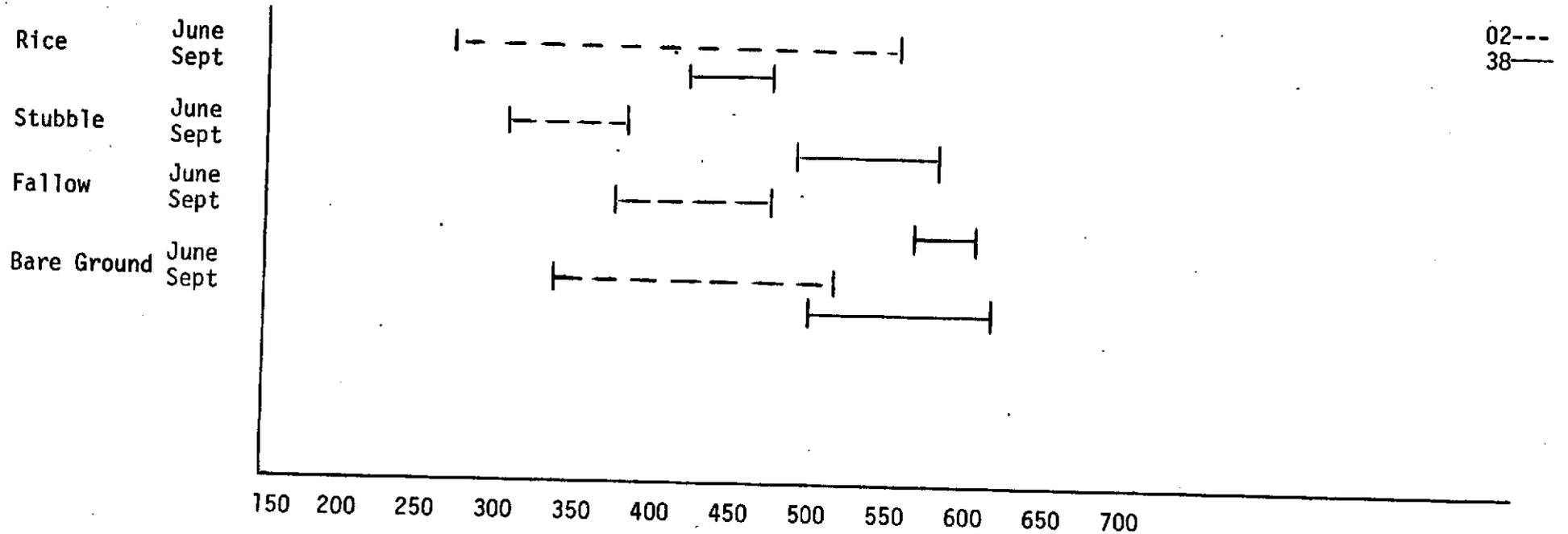


0 50 100 150 200 250 300 350 400 450 500 550 600

Figure 3



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DICHOTOMOUS IMAGE KEY FOR SEVENTEEN VEGETATION ANALOGS  
 OCCURRING IN THE COLORADO PLATEAU TEST AREA

(Based on Skylab III, S190A, Color Infrared Imagery)

- 1. Color White or Pink (7, 8, 9, 10 or 263);  
low elevations . . . . . 2
- 1. Colors various, not White or Pink; higher  
elevations . . . . . 3
  - 2. Color White; broad areas . . . . . Saltbush shrublands
  - 2. Color Pink; narrow stringers along  
stream channels. . . . . Greasewood shrublands
- 3. Color Orange (34, 35, 36, 37, 38, 39  
40, 43, 44, 53, 54). . . . . 4
- 3. Colors Blacks, Browns (not dark reddish  
Brown), Grays, Olives, Greens or Blues . . . . . 10
  - 4. Color deep reddish Orange to strong  
reddish Brown (36, 37, 38, 39, 40) . . . . . 5
  - 4. Color vivid-to-strong reddish  
Orange (34, 35) and moderate-to-  
brownish Orange (53, 54); 9,800'  
to 10,800' elevation . . . . . Subalpine Aspen forests
- 5. Low elevations, along stream courses;  
color moderate-to-dark reddish  
Orange (37, 38). . . . . Riparian Cottonwood--  
Willow forests
- 5. Moderate-to-high elevations, not  
restricted to stream courses . . . . . 6
- 6. A vegetation mosaic composed of  
at least two major components;  
colors moderate, dark, or grayish  
reddish Orange (37, 38, and 39)  
with strong components of Gray  
(264, 265), bluish Gray (190, 191),  
or moderate-to-dark reddish Brown  
(43, 44) . . . . . 7

- 6. "Pure vegetation types; color reddish Orange to strong reddish Brown (36, 37, 38, 39, 40) . . . . . 8
- 7. Low-to-medium elevation; color with Oranges and Grays and bluish Grays (190, 191, 264, 265) . . . . . Pinyon-juniper/  
Oakbrush woodlands
- 7. High elevations; color with Oranges and reddish Browns (43, 44). . . . . Spruce-fir/Aspen forests
- 8. Color moderate or grayish reddish Orange (37, 39). . . . . Oakbrush woodlands
- 8. Color deep or dark reddish Orange (36, 38) or strong reddish Brown (40). . . . . 9
- 9. Widespread common vegetation in all topographic positions at moderate-to-high elevations; color predominately deep reddish Orange (36) with some strong reddish Brown (40). . . . . Aspen forests
- 9. Localized vegetation adjacent to lakes or in wet depressional sites; color predominately deep and dark reddish Orange (36, 38) with some strong reddish Brown (40) . . . . . Sedge meadows
- 10. Colors Black or Brown . . . . . 11
- 10. Colors Grays, Blues, Greens or Olives . . . . . 13
- 11. Color Black (24, 65) . . . . . Spruce-fir forests
- 11. Color Brown. . . . . 12
- 12. A vegetation mosaic composed of at least 2 major components; high elevation; color reddish Orange or reddish Brown (38, 43, 44). . . . . Spruce-fir/Aspen forests
- 12. Medium elevations; color predominately Brown (59, 62) with some dark grayish reddish Brown (47). . . . . Ponderosa pine forests
- 13. High elevation sites, color Blue (168, 169, 171, 177, 180, 181) . . . . . Alpine sites
- 13. Medium-to-low elevation sites; colors Grays, grayish Blue, Greens or Olives. . . . . 14

- 14. Low-to-medium elevation (not above 8000'); color Olives, Grays, grayish yellow Green (122) or grayish Blue (186, 187) . . . . .15
- 14. Medium-to-high elevations (above 8000'); color Green to bluish Green 149, 150, 164, 165) . . . . . Grass meadows
- 15. A vegetation mosaic; color Gray, bluish Gray, and grayish Blue (185, 186, 187, 190, 191, 264, 265) mixed with reddish Orange (37, 39). . . . . Pinyon-juniper/Oakbrush woodlands
- 15. "Pure" vegetation types; color Olive, Gray, Blue or grayish yellow Green (122); low-to-medium elevations . . . . .16
- 16. Color grayish Blue (186, 187) . . . . . Dense pinyon-juniper woodlands
- 16. Color Olive, Gray or grayish yellow Green (122), not grayish Blue . . . . .17
- 17. Linear boundaries evident; color grayish Olive and grayish yellow Green (109, 110, 122) . . . . .Cabled pinyon-juniper woodlands
- 17. Linear boundaries not evident; color Olive or Gray. . . . .18
- 18. Color grayish Olive, olive Gray or grayish yellow Green (109, 110, 112, 122). . . . .Big sagebrush shrublands
- 18. Color Gray, bluish Gray or pale Blue (185, 190, 191, 264, 265). . . . .Sparse pinyon-juniper woodlands

VEGETATION ANALOGS FROM SKYLAB III S190A COLOR INFRARED PHOTOGRAPHY OF THE  
 COLORADO PLATEAU TEST AREA, 3 AUGUST 1973

Analog	I.S.C.C.		Topography	Boundaries
	Color	N.B.S.		
1. Saltbush shrublands	263. White 9. pinkish White 10. pinkish Gray		Flats, benches	Common and widespread at low elevations (4600' to 5900') on light-colored shales and sandstone bedrock
2. Greasewood shrublands	7. pale Pink 8. grayish Pink 10. pinkish Gray		Intermittent stream bottoms and depressional areas, floodplains and benches	Low-to-medium elevations (<6500'). Adjacent to and mixing with saltbush shrublands.
3. Riparian Cottonwood-Willow forests	38. dark reddish Orange 37. moderate reddish Orange		Along streams on banks and floodplains immediately adjacent to the streams	Low-to-medium elevations (<7000'). Occur as stringers through big sagebrush shrublands and pinyon-juniper types down to the saltbush shrublands.
4. Big sagebrush shrublands	109. light grayish Olive 110. grayish Olive 112. light olive Gray 122. grayish yellow Green		Low-to-medium elevation slopes, plateaus, ridges, and gullies	Lower boundary grades into saltbush shrublands; upper boundary grades into sparse (< 40%) pinyon-juniper types (5600' to 6500').
5. Sparse pinyon-juniper woodlands	185. pale Blue 190. light bluish Gray 191. bluish Gray 264. light Gray 265. medium Gray		Lower mountain slopes, gullies, ridges and plateaus, medium elevation on south-facing slopes	5900' to 7400' elevation. Lower boundary grades into big sagebrush type; upper boundary grades into denser pinyon-juniper
7. Dense pinyon-juniper woodlands	186. grayish Blue 187. dark grayish Blue		Low-to-medium elevation mountain slopes, gullies, ridges and benches	6500' to 8000' elevation. Lower boundary grades into sparser pinyon-juniper type; upper boundary is with oakbrush and ponderosa pine types
8. Pinyon-juniper/Oakbrush Woodlands	Mosaic of sparse pinyon-juniper and oakbrush types		Steep slopes, ridges and benches in moderate elevation	7000' to 8400' elevation. Broad transitional zone between pinyon-juniper types and oakbrush type

Analog	Color	I.S.C.C. N.B.S.	Topography	Boundaries
9. Oakbrush Woodlands	37. 39.	moderate reddish Orange grayish reddish Orange	Steep north-facing slopes at low elevations; extensive areas on gentle-to-moderate slopes at higher elevations	7100' to 9400' elevation. Contact and transition broad with pinyon-juniper types at lower elevation; upper boundary sharp with aspen type
10. Ponderosa pine forests	62. 59. 47.	dark grayish Brown dark Brown dark grayish reddish Brown	Benches and gentle slopes	7500' to 8400' elevation. Intermixed in the oakbrush type, often contacting pinyon-juniper on the lower boundary
6. Cabled pinyon-juniper woodlands	109. 110. 122.	light grayish Olive grayish Olive grayish yellow Green	Low-to-medium elevation mountain slopes, ridges and plateaus	6000' to 7500' elevation. Within the pinyon-juniper types where the woody overstory has been destroyed. Big sagebrush often becomes the dominant understory vegetation along with seeded grasses.
11. Aspen forests	36. 40.	deep reddish Orange strong reddish Brown	Upper mountain slopes	8500' to 9800' elevation. Contacts spruce-fir forests on the upper zone and oakbrush woodlands on the lower.
12. Spruce-fir /Aspen Forests	38. 43. 44.	dark reddish Orange moderate reddish Brown dark reddish Brown	Upper mountain slopes and ridges	8800' to 10,800' elevation. Anywhere the spruce-fir forest has been destroyed by fire aspen takes over and spruce-fir seedlings eventually invade and overtop the aspen without further disturbance
13. Sedge Meadows	36. 38. 40.	deep reddish Orange dark reddish Orange strong reddish Brown	Depressions at moderate-to-high elevations. Surrounding water bodies, seeps, and springs	8500' to 10,000' elevation. Moderate-sized inclusions within all vegetation types throughout this elevational range
14. Grass Meadows	149. 150. 164. 165.	pale Green grayish Green moderate bluish Green dark bluish Green	Gentle slopes and dry-site depressions (well-drained) at moderate elevations	8000' to 9000' elevation. Common as openings adjacent to oakbrush and aspen types.
16. Subalpine Aspen forests	34. 35. 53. 54.	vivid reddish Orange strong reddish Orange moderate Orange brownish Orange	High elevations on steep mountain slopes	9800' to 10,800' elevation. Adjacent to spruce-fir forests and alpine sites

Analog	Color	I.S.C.C. N.S.B.	Topography	Boundaries
17. Alpine	168. brilliant greenish Blue		High elevations on rocky ridge tops and mountain summits	Above 11,000' elevation. Spruce-fir and aspen forests contact on its lower zone and it extends to tops of all mountains higher than 11,000'
	169. strong greenish Blue			
	171. very light greenish Blue			
	177. brilliant Blue			
	180. very light Blue			
	181. light Blue			
15. Spruce-fir forests	24. reddish Black		High elevations on all topographic positions	8800' to 10,800' elevation. Upper contact with alpine type; lower contact with aspen
	65. brownish Black			