On October 29, Stu Herkenhoff and I took some reconnaissance level measurements of soil bulk density at four locations on this allotment. This information was wanted to help monitor the potential vegetative production on the allotment, versus actual production.

The four areas sampled were Issac Meadows, Cow Creek, West Fork Ruby, and Sawpit. Only one to two points were sampled at each location because of a limited number of weighing cans. Surface soil at these points was excavated to a depth of about 10 cm, and the volume of the excavation was determined with a volume-displacement apparatus. From 10-25 cm, a cylinder was driven, and a relatively undisturbed core was extracted. The soil from each was sealed in weighing cans for determination of oven dry weight; bulk densities were then calculated for each depth. Particle size and organic matter determinations were not made, but I estimated both from the soil collected in the weighing cans. Total % pore space was derived from the bulk density and a particle density constant of 2.60 g/cubic cm. No determination can be made of pore size distribution without additional sampling data.

In the range of soils sampled in these areas, the growth limiting bulk density is between 1.40 and 1.45 grams per cubic centimeter for the textural classes encountered. However, these limiting densities were derived from research on soils with less than three percent organic matter. Some of the allotment soils have an estimated organic matter fraction of 10%, or more. Because organic rich soils have low bulk density, the actual growth limiting bulk density for these soils would be closer to 0.9 to about 1.2 g/cubic cm.

Examining the table, it can be seen that Issac Meadows probably has had little or no impact from soil bulk density increases. The bulk density is fairly low, and total pore space (TPS) at 72% is high, although the pore size distribution (percentage of macro and micro pore space) is not known. For a soil in this taxonomic family, 60-65 TPS would still be in the normal range.

Some of the other sites did not look as good, however. The Cow Creek sample appears to be compacted in the 0-10 cm depth. Bulk density of 1.34 and TPS at less than 50%, is of concern. The subsoil (10-25 cm) doesn't look too bad. The second site at Cow Creek is similar to the first. The West Fork Ruby samples, especially the second site, is significantly compacted in the surface 10 cm. The Sawpit site surface 10 cm has had some increase in bulk density.
To determine the extent of compaction in the allotment, a more rigorous and statistically valid sampling is recommended, along with a search for an acceptable benchmark soil to serve as a control. The effect on potential vegetative production should then be quantified. This field season, I will collect the data needed to input the Cannon/Nielsen model. The model gives the long term potential production for Mollisols, which most of these soils are. Eventually, compaction will not only result in a reduction of annual biomass, but also will directly influence the composition of the plant community that the soil will support.

Soil compaction is a long term impact on productivity. Research in Region 4 has shown that compacted soils had not reverted to their natural density after 60 years. In grazing management, we certainly don't want to cause further compaction, or impact any more area. Preferably, the allotment management plan should allow complete rest for one or more pastures annually. The soil on June 16 (the normal on-date), in most years, is probably too damp to begin grazing without increasing soil density, with the exception of Issac Meadows. I recommend setting the on-date back to early July and utilizing the Issac Meadows areas first. If a three-pasture deferred rotation system is implemented, the on-date should be moved back at least two weeks in most years. A two pasture deferred rotation system probably wouldn't help much in preventing compaction, and so is not recommended.

### Average Bulk Density (db) and Total Pore Space (TPS) by Depth

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DAN SVOBODA  
Soil Scientist
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USFS
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| 13. E. FORK RUBY CREEK TOP | 0962 | 1.170 | 10.4 | 0.17 | 96.5 | 86.1 | 1.38 | 10.9 |
|---|---|---|---|---|---|---|---|---|---|
| | AVERAGE | 0984 | 1.153 | 10.9 | 0.17 | 93.0 | 82.1 | 1.32 | 8.5 |
| | | 10.7 | 0.17 | 94.8 | 84.1 | 1.35 | 9.7 |

| 14. E. FORK RUBY CREEK 6' DEPTH | 0969 | 1.168 | 10.5 | 0.17 | 96.0 | 85.5 | 1.37 | 10.9 |
|---|---|---|---|---|---|---|---|---|---|
| | | 0947 | 1.222 | 9.7 | 0.16 | 106.5 | 106.6 | 106.5 | --VOID-- |

| 15. E. FORK RUBY CREEK ABOVE TOP | 1006 | 1.053 | 11.5 | 0.18 | 73.3 | 61.3 | 0.99 | 15.7 |
|---|---|---|---|---|---|---|---|---|---|
| | AVERAGE | 1044 | 1.038 | 12.6 | 0.20 | 70.3 | 57.7 | 0.92 | 17.9 |
| | | 12.1 | 0.19 | 71.8 | 59.8 | 0.96 | 16.8 |

| 16. E. FORK RUBY CREEK ABOVE 6' DEPTH | 1063 | 1.110 | 13.3 | 0.22 | 84.5 | 71.7 | 1.16 | 15.7 |
|---|---|---|---|---|---|---|---|---|---|
| | AVERAGE | 1033 | 1.108 | 12.2 | 0.20 | 84.5 | 72.3 | 1.16 | 14.4 |
| | | 12.8 | 0.21 | 84.5 | 71.8 | 1.15 | 15.1 |

| 17. DRY FAWN CREEK GRASS TOP | 0953 | 1.017 | 10.0 | 0.16 | 66.2 | 56.2 | 0.90 | 15.1 |
|---|---|---|---|---|---|---|---|---|---|
| | AVERAGE | 0909 | 1.014 | 8.7 | 0.14 | 65.6 | 56.9 | 0.91 | 13.3 |
| | | 9.4 | 0.15 | 65.9 | 56.6 | 0.91 | 14.2 |

| 18. DRY FAWN CREEK GRASS 6' DEPTH | 0923 | 1.099 | 9.3 | 0.15 | 80.5 | 71.2 | 1.14 | 11.6 |
|---|---|---|---|---|---|---|---|---|---|
| | | 0877 | 1.150 | 8.4 | 0.15 | 92.5 | 80.1 | 0.96 | 16.0 |

| 19. DRY FAWN CREEK SAGE TOP | 0932 | 1.000 | --VOID, ORGANICS-- |
|---|---|---|---|---|---|---|---|---|---|
| | | 0919 | 1.008 | --VOID-- |

| 20. DRY FAWN CREEK SAGE TOP | 0886 | 1.057 | 8.2 | 0.13 | 74.1 | 65.9 | 1.06 | 11.1 |
|---|---|---|---|---|---|---|---|---|---|
| | AVERAGE | 0947 | 1.036 | 9.8 | 0.16 | 69.9 | 60.1 | 0.96 | 14.0 |
| | | 9.0 | 0.15 | 72.0 | 63.0 | 1.01 | 12.6 |

| 21. DRY FAWN CREEK SAGE 6' DEPTH | 0906 | 1.081 | 8.6 | 0.14 | 79.6 | 71.0 | 1.14 | 10.8 |
|---|---|---|---|---|---|---|---|---|---|
| | AVERAGE | 0935 | 1.083 | 9.5 | 0.15 | 79.8 | 70.3 | 1.13 | 11.9 |
| | | 9.1 | 0.15 | 79.7 | 70.7 | 1.14 | 11.4 |
**Job Title:** United States Forest Service  
**By:** William H. Anderson  
**Date:** October 30, 1990  
**Job No.:** N/A  
**Checked Sheet:** 1 of 3

**Subject:** Soil Moisture and Density

**NOTES:**
- **Equipment:** C-100, Seaman Nuclear, Untouchable Mode  
  - 60 Sec. Count.  
  - Air Gap Method  
  - AASHTO T238, T239  
- **Tests:**
  - Op. Moisture N/A  
  - Maximum Density N/A

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Maximum Density: N/A*
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### Soil Moisture and Density

**NOTES:**
- **Equipment:** C-100, Seaman Nuclear
- **Mode:** Sec. Count.
- **Air Gap Method:**
- **TESTS:** AASHTO T238, T239

**Op. Moisture**

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