Compare ESD and ESG Quantitative Benchmarks

Introduction

The development of Ecological Sites (ES) and their descriptions (ESD's) represent an enormous effort on behalf of the Natural Resources Conservation Service (NRCS) (Bestelmeyer (2015)). As mentioned in section XX, they do not yet form a continuous coast to coast, nor even across the field office data set (Twidwell et al. (2013)). In order to allay the significant amounts of effort required to develop these, and to make land management decisions in the interim alternative classification systems have been proposed (CITE). One system which incorporates the NRCS ESDs, and which provides continuous coverage across our study area, are the Ecological Site Groups (Nauman et al. (2022)).

The Ecological Site Groups developed largely by United States Geological Survey (USGS) researchers at the Southwest Biological Science Center in Moab [Utah], with assistance from BLM Colorado State Office Staff, are meant to both bridge the spatial gap in ESD development, and to provide a framework for land management decisions at a scale larger than that which generally occurs at a BLM Field Office. The Ecological Site Groups were developed by grouping together similar ESD's, akin to the strictly interpretive approach - which seeks to reduce conceptual fineness - in section XX, and which will respond in a similar fashion to management actions (Duniway et al. (2016)). To these initial groups the field data which largely informed the ESD creation, most notably soil physical parameters, and with the use of an objective and quantitative approaches, which make use of simple *Machine Learning (ML)* method *Random Forest* **section XX** were used to identify recurring themes in the dataset into groups, and then project these onto a 'map' which covers the Upper Colorado River Basin.

While for most land management decisions at the UFO ESD's, when available, represent the best available scientific evidence upon which to inform decisions, ESG's provide the best alternative for much of the field office, and in the future are likely to maintain influence for large scale decisions at the UFO. Herein we address questions regarding the similarity of estimates arising from ESG's and ESD's. In this report, we are using ESD's for the *reference state benchmarks* which they contain, in other words quantitative goals which we seek to compare land to, and seek to visualize the relationship between the standards of ESD's and ESG's. We also hope to understand which ecological sites are contained in which ES groups, in other words, where do our groups map out to?

Methods

The mean fractional cover of vegetation was manually transcribed from Table 3 of Appendix A from Nauman et al. 2022. The spatial data product which the study which was the outcome of the study was accessed from sciencebase.gov catalog on (Dec. 16, 2022). ESD quantitative benchmarks values, and AIM plot locations were cleaned in previous work (Section XX ESD Completion). All anaylses were performed in R version XX using RStudio VERSION on Linux Ubuntu 22.04 LTS.

Their were two major objectives in this section. The first is to determine which ESD's map to which ESG's. In theory the ESD's had a one to one relationship with the ESG, in other words an ESD has a single ESG to which it is related (but see). However, not all of these relationships were noted in the appendices or supplemental materials.

The second objective was to reaffirm the accuracy of the predicted surface map in the UFO. In publication the accuracy of the final product was calculated as being 57.4% (Nauman et al. (2022)). However, due to certain features which are more difficult to reliably classify, certain products may score higher in certain areas without these harder to identify features.

The study utilized 18 of the UFO's (NUMBER) ecosites. We can determine how often the spatial product mapped to the appropriate ESG under multiple circumstances. 1) How often did the PREDOMINANT ESG get returned by the ESD 2) what proportion of all plots were matched correctly to an ESG from the spatial product ?

To test whether we were extracting and processing the correct ESG from the gridded surface two comparisons of raster extraction methods were attempted. The first, is typically performed at UFO, is to buffer the point to represent the entire AIM plot and extract to that area, and chose the categorical class with the most cells per value. The other option is to extract from the gridded surface directly to the point geometry. The proportion of correctly classified points from a subset of ESD's for which the ESG's are definitively known is reported, and the higher performing method, buffering, was used for the duration of the analyses.

To determine whether the raster dataset gives a higher or lower performance accuracy in the UFO portion of it's range the AIM plots with ESD's which are known to map directly to ESG's were utilized. These plots were extracted from the ESG gridded surface and the proportion of each ESG which was correctly and incorrectly mapped were calculated.

To determine the accuracy of mapping individual ESDs directly to ESG's a bipartite network was created using all AIM Plots with verified ESD's, all statistics were calculated using the package 'bipartite' (@ DORRRRRRRRRRRRMAN). This approach was used to search for patterns in these data, given both the high number of ESG's and ESD's.

While the final output classification gridded surface had a classification accuracy of 67% the next two output layers, have slightly different predictions and 86% of the time will contain the correct ESG. Each of the three layers were extracted to a site, and the most commonly occurring ESG across all combinations was selected as the soil geomorphic group. All climate zones were also extracted to the points, and most commonly occurring climate zone was selected as the climate zone to classify these sites in the SGU framework.

A final ESD - ESG lookup table was assembled using these criteria.

Compare ESG benchmarks to ESD benchmarks

Results

The method of extracting the ESG from the gridded surface to plot had virtually no influence on the accuracy of the ESG. Regardless the method of buffering the point to the real size of the AIM plot was used as it slightly outperformed plot centers on the 157 known sites, 0.6369427 to 0.6496815.

157 AIM points were in the look up values for ESG… XX of these ESDs were included directly in the making of XX ESGs . The ESG gridded surface was able to correctly place 0.64968152866242 plots to the appropriate ESG, rather than the 57.4% reported for the entire study area.

Of the 157 AIM plots with classified ESD's, 18 which are included in the ESG reference materials, the number of ESG's erroneously included are 12, while the number of accurately extracted ESG's is 7, while 11 were not returned at all (???).

The initial extraction of ESG to AIM points was problematic (Figure 2). We were able to improve upon these results via multiple steps in sequential order. 1) Look up table values form publication (as mentioned 157 plots, 18 esds, and 10 ESGs), 2) 8 plots/ESD's had a sole representative, 3) 9 plots where all ESDs were in one ESG where > 2 plots per ESD 2, 4) 9 plots where > 65% of the 2 (Figure 3).

The remaining 11 ESD's were all mapped to 6 ESG via the methods of summarizing both the SGU and climate zones. The final lookup table of ESD to ESG mapping is in Figure 4.

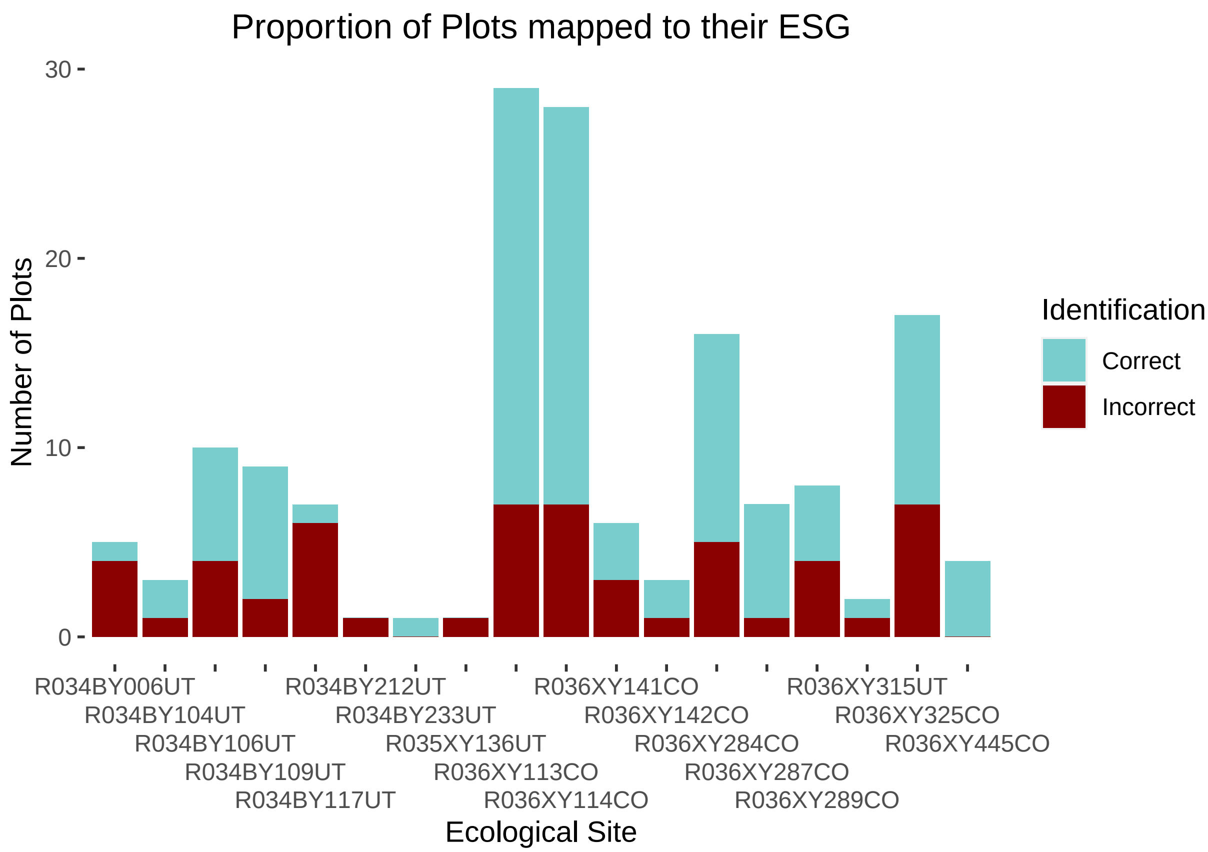


Figure 1: Proportion of Plots in ESDs which were included in the ESGS and should map over unequivocally to an ESG

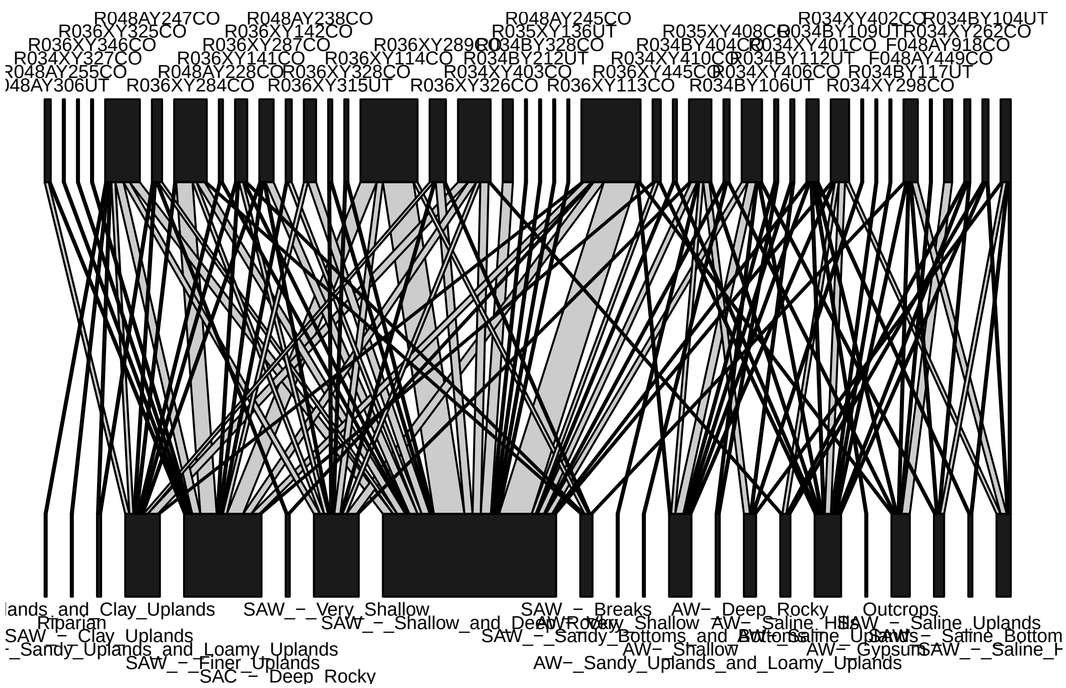
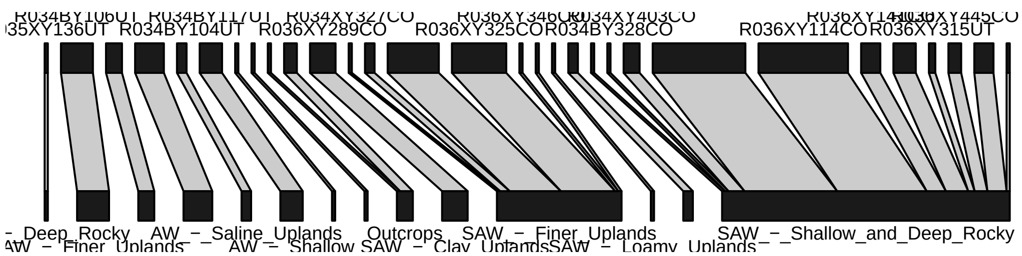


Figure 2: Initial Relationship Between Field Verified ESD and ESG extracted from the gridded surface



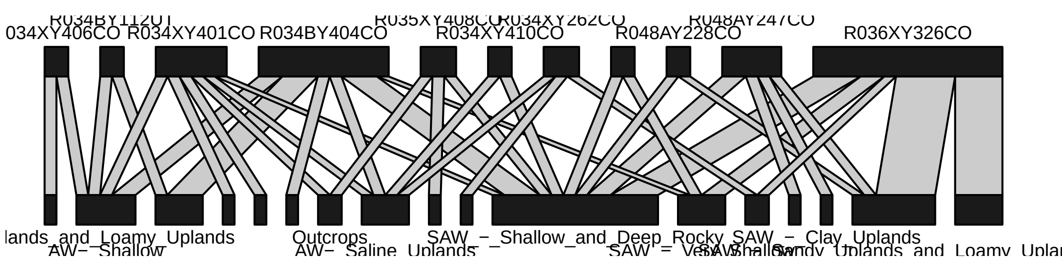


Figure 3: Relationships Between ESDs and ESGs midway through the cleaning process

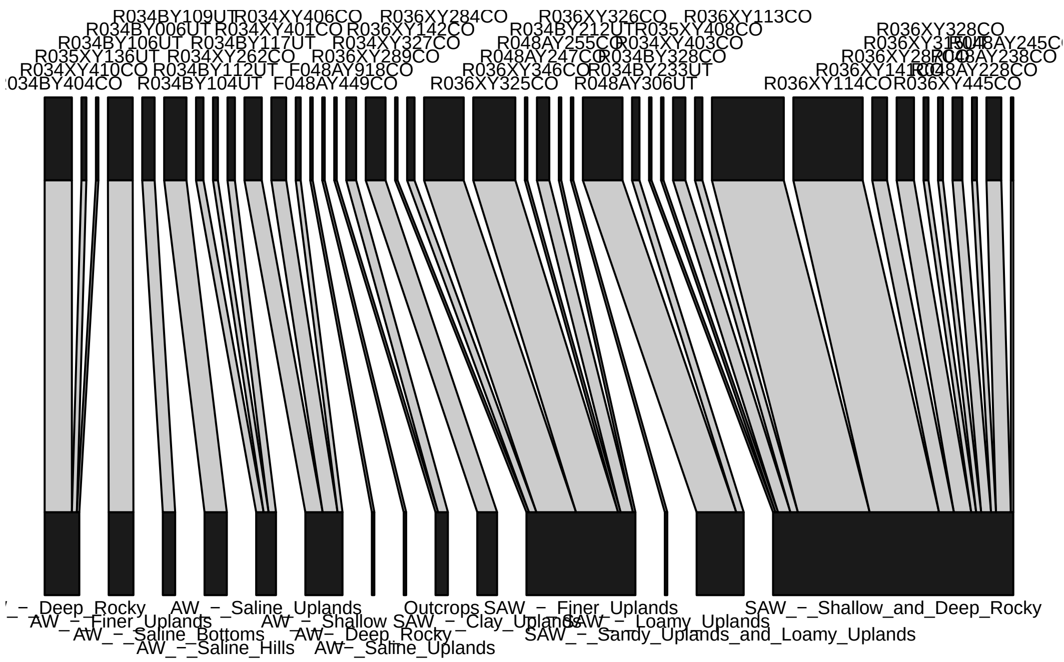


Figure 4: Relationship between ESDs and ESGs at end of process

Conclusions

The relationship between the novel ESG's and the ESD's...

For best accuracy using the ESG's it is best practice to verify the ESD using traditional methods rather than spatial operations.

References

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