

New Mexico Rangeland Ecological Assessment (REA)

Read Me – REA Geodatabase and REA Data Exploration Tool

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The REA geodatabase and REA Data Exploration Tool are provided on CD-ROM and can be downloaded from The Nature Conservancy in New Mexico's conservation website, <http://nmconservation.org>.

1. CRITICAL BACKGROUND INFORMATION

A number of important considerations should be taken into account when reviewing and analyzing REA spatial data. For example, the REA mapped some areas more completely than others, the REA was mapped at approximately mid-scale and its spatial accuracy has not been validated, so applying the REA at fine-scale or at specific locations is not advised without corroborative data, ecological site descriptions, the basis for the REA, vary in consistency in their details about management options for restoration and other information, and each REA category has a different size area in unresolved "complexes", which complicates analyses that compare results. Section G-1, A Primer for Understanding Results, in the accompanying REA final report, provides critical background information about these and other topics.

2. REA GEODATABASE AND SHAPEFILE

Overview

In the REA experts mapped states that represent ecological condition and restoration opportunity. Spatial layers of these states and their attributes are provided in the accompanying REA geodatabase and shapefile for use in a geographic information system (GIS). These layers can be displayed, queried and edited. We recommend that the original layers be archived as back-ups, and that copied versions should be edited. Both the geodatabase and shapefile are projected in Zone 13 of the Universal Transverse Mercator (UTM), North American Datum 1983. Suggestions for how to maintain and update REA spatial data are discussed in the accompanying REA final report, Section H-3, Enhancing and Updating the REA.

REA Shapefile

The shapefile, *rea_0308_1383.shp*, can be copied to a server or local computer and accessed in several GIS programs, including ArcView and ArcMap (ESRI). Metadata for that shapefile, including descriptions of its fields and their values, and guidance on use, are contained in the file *rea_0308_1383_metadata.htm*.

REA Geodatabase

The REA geodatabase, *REA.gdb*, was constructed in ArcMap 9.2 to be easily maintained and updated by users. To use the REA geodatabase: (1) copy *REA.gdb* (in the *Appendix2* folder) to a server or local computer, and (2) open ArcMap and using the Add Data function browse to *REA.gdb* and add the feature class, *REASStates*. For general information about geodatabases see the Help in ArcMap. For guidance about REA spatial accuracy and appropriate application, and descriptions of fields and values, see the REA geodatabase metadata (accessed by selecting *REASStates* in ArcCatalog).

The REA geodatabase uses so-called subtypes and domains to help users maintain and update the REA spatial data. Subtypes are records in the geodatabase feature class, *REASStates*, that were grouped based on an attribute field. Domains are standard values. These geodatabase features allow users to modify or add attribute information for existing REA state polygons by choosing standard values or creating user-defined values. Users can also edit or create attribute information when spatially modifying or deleting existing state polygons, or adding new polygons. Subtypes and domains are accessed through standard editing functions in ArcMap. For example, users can select polygons in *REASStates* and then edit their attribute information by choosing drop-down values in the attribute table.

Each LRU and corresponding ecological site (ES) form the subtypes of the *REASStates* feature class. 134 combinations were identified for the REA-mapped area. Each subtype has a corresponding domain that defines the states identified. For example, the SD2 Sandy LRU_ES has a defined CP2 Sandy states domain. Values in that domain are Black Grama Dominated Grassland (R), Mesquite Shrubland, etc. The editable fields listed above each have a defined domain. Values and field definitions can be found in the metadata of *REASStates* in the REA geodatabase (accessed by selecting *REASStates* in ArcCatalog). User defined values will not be allowed. To add additional subtype or domains, the user must first add the value in ArcCatalog in the subtypes tab, then these values will be available while editing in ArcMap.

Fields with the suffix “_Orig” are the original REA fields. This allows editable field values to be modified while retaining the original information for reference. These original REA fields also display the component values of complexes, which contain multiple conflicting values, separated by underscores “_”, that can be resolved in the editable fields based on available or new information (complexes are explained below).

The states in the REA geodatabase are based on the hierarchical NRCS land resource classification. From broad to finer scale this classification includes: Major Land Resource Areas (MLRA) > Land Resource Units (LRU) > ecological sites > states (see <http://www.nm.nrcs.usda.gov/technical/fotg/section-2/esd.html> and the accompanying REA final report for more information). For example for the SD2 Sandy Mesquite Shrubland state, SD is the MLRA (Southern Desertic Basins, Plains and Mountains), SD2 is the LRU, Sandy is the ecological site, and Mesquite Shrubland is the state. Due to naming constraints geodatabase field names sometimes omit “MLRA” or other members of a class.

Complexes

The mapped states in the REA are based on NRCS ecological site descriptions (ESDs) or on expert mapper knowledge. In certain instances complexes, which are multiple values that spatially overlap and conflict, were mapped and are indicated by values separated by underscores “_”. State complexes are where more than one state was mapped at the same location. This occurred: (1) if experts mapping the same area disagreed on the state, (2) if experts were unsure of the state and assigned more than one alternative state, (3) if states could not be spatially distinguished, e.g. due to lack of information or mapping scale, or (4) where ecological sites could not be spatially distinguished, e.g. some soil map units in NRCS soil surveys, used as templates for mapping, are associated with more than one soil map unit component, which in turn are associated with more than one ecological site. In addition to these state complexes there are state attribute complexes. This is where attributes associated with states mapped at the same location conflict. For example, two reference condition states mapped at the same location do not conflict for the reference/non-reference condition attribute. However, reference and non-reference condition states mapped at the same location have conflicting values for that attribute. See Box 3 in the accompanying REA final report for important background about this “unresolved class”.

Examples of Queries Using the REA Geodatabase*

The REA geodatabase and shapefile can be spatially queried to display and analyze diverse information about REA-mapped states and associated information. Results of such queries are presented in the accompanying REA final report (e.g. most figures with maps and Boxes 4 and 9). The REA Data Exploration Tool, described in the next section, is a custom query application that produces tabular results in terms of area and percent-area. Three example queries using the REA geodatabase follow; see REA geodatabase metadata for field and value definitions:

1. Where are current reference condition grasslands mapped in the REA? Query *reference/non-reference condition* for reference condition AND *current vegetation* for grassland: "Reference" = '1' AND "Cur_Dom_Veg_CS" = 'G'. Alternatively query

* These queries exclude complexes – multiple states with conflicting values mapped at the same location.

ecological dynamics for reference condition grassland: "Eco_Dyn_CS" = 'RG'. [example is for coarse scale]

2. Evaluate the extent of shrub encroachment in historic grass/shrub savannas. Query *vegetation under reference condition* for grass/woody vegetation AND *ecological dynamics* for increased shrubs: ("Ref_Dom_Veg_FS" = 'GS') AND ("Eco_Dyn_FS" = 'SD' OR "Eco_Dyn_FS" = 'SA'). [example is for fine scale]

3. Evaluate former grasslands that can be restored with fire. Query *vegetation under reference condition* for grass AND *restoration management* for fire management: ("Ref_Dom_Veg_CS" = 'G') AND ("Restoration_Mngt" LIKE '%F%') [example is for coarse scale]

3. REA DATA EXPLORATION TOOL

The REA Data Exploration Tool is a beta application produced by Elliott Software (<http://ellsoft.us/>) for the REA. It is intended to assist users with area calculations of REA spatial data overlaid with other spatial layers in a geographic information system (GIS) environment. The tool was developed for ArcMap 9.2 (ESRI) and it is not certain if it will run correctly in other versions. It has not been tested for compatibility with ArcMap extensions and is known to have problems with the Fire Regime Condition Class (FRCC) mapping tool (<http://frames.nbii.gov/frcc/>). Users should test the tool by comparing results to manual calculations to ensure that results are accurate and to better understand what the tool does. The speed of the tool's calculations depends on the size and complexity of inputs and computer processing speed. Raster layers do not currently work with this tool and the Help button has not been implemented. This document currently serves as the only documentation for the REA Data Exploration Tool.

To access the REA Data Exploration Tool, extract the contents of the Calcareas7-31.zip file, located in the *Appendix2* folder, into an empty folder. This will extract an ArcMap map project, *Calcareas.mxd*, and a folder called Data containing a working geodatabase. Open *Calcareas.mxd* in ArcMap. The REA Data Exploration Tool will be available from a new menu bar item called Calculate and its submenu item, Calculate Areas. Add spatial layers to the map project, including the REA spatial data (*REASates* or *rea_0308_1383.shp*) and other feature class or shapefile boundary layers, such as counties, resource management plan boundaries and watersheds. Running the tool on the REA spatial data in combination with other layers produces output tables that calculate acres and percent-area of REA data categories for these boundary layers. For example, the acres and percent-area of REA-mapped reference and non-reference condition states in each of three USGS 8-digit hydrologic unit code watersheds, or all three watersheds, can be calculated. Additional information about the REA Data

Exploration Tool is provided below. To update or add more functionality to this tool, or to create customized applications similar to this tool, contact the software developer.

Setup Information

All application programming for the REA Data Exploration Tool is located in the *Calcareas.mxd* file. The geodatabase in the Data subfolder, *current.gdb*, is used by the application for calculating new layers and for temporary data. This subfolder should be moved along with *Calcareas.mxd*. The REA Data Exploration Tool's current workspace (where all temporary and results files are placed) defaults to "*data\current.gdb*" in the same folder as *Calcareas.mxd*. This setting can be modified by opening *Calcareas.mxd* in ArcMap and going to Tools > Options > Geoprocessing tab, selecting Environments, then Environment Settings under General Settings and editing the Current Workspace path.

The path of the current workspace setting is also influenced by the Data Source Options setting in the Document Properties of *Calcareas.mxd* (with the map project open go to File > Document Properties > Data Source Options). The "Store relative path names to data sources" option was pre-selected for the *calcareas.mxd* file, which causes the path to *current.gdb* to remain relative (see ArcMap Help about geodatabases for more information).

Choosing Layers and Fields for Input

When the application is first opened no map layers are present. Layers such as feature classes or shapefiles will have to be added to the map project, *Calcareas.mxd*, for the REA Data Exploration Tool to function. Once layers are present, the application can be run from the Calculate menu and its submenu, Calculate Areas. It is advised to save *Calcareas.mxd* as a new map project, which will retain the REA Data Exploration Tool.

The Area of Interest (AOI) layer is used to determine the geographic boundary of the calculations. If the AOI layer has an active selection it will be used, otherwise the entire layer will be used. The AOI layer must be entered in the Calculate Areas dialogue. The AOI layer can be the same as the Context layer or one of the Focus layers (explained below).

The Context layer is the "denominator" layer for the percent-area calculations on the Focus layers. The Value and Description fields identify fields of the Context layer whose attributes will be used to group features in order to calculate areas.

-- Total acres and percentages calculated are relative to the Context layer selection (after being clipped by the AOI layer, see below).

-- The Context layer fields entered in the Value and Description fields should represent the same groupings, such as county code and name. The grouping levels of these fields should correspond to the input features. For example, if the Context layer is counties

the Value and Description fields should be by county, and not for groups of western or eastern counties. The same field can be entered in both Value and Description fields, and the field can be either a numeric or string type. If the same field is entered for both Value and Description it will appear only once in the output table.

- Any active selection in the Context layer that falls inside the AOI will be used; otherwise all parts of the layer that falls inside the AOI will be used.
- The Context layer and Value and Description fields must be entered.

The Focus layers are the "numerator" layers in the percent-area calculations.

- The Value and Description fields identify fields in the Focus Layers whose attributes will be used to group features and calculate percentages in relation to the Context Layers groupings.
- As with the Context layer, the Value and Description fields should represent the same groupings, such as a code and its description. The same field can be entered in both Value and Description fields and it can be numeric or string. If the same field is entered it will appear only once in the output table.
- Any active selection in the Focus Layers that falls inside the AOI will be used; otherwise all parts of the layers that fall inside the AOI will be used.
- At least one Focus layer and its Value and Description fields must be entered.
- After selecting a Focus layer and its Value, and Description fields, press Add Layer to add the layer to the list of Focus layers. Repeat to add additional Focus layers.

Calculation and Results

When the button Calculate Areas is pressed a popup window summarizing the active selection in all referenced layers is presented. The user has an opportunity to cancel the calculation at this point.

When the calculation starts:

- The AOI Layer is used to clip the Context and Focus layers. If a selection is active in the AOI it is used to clip, otherwise the whole layer is used to clip.
- The new clipped Context layer becomes the basis for acres totals and percentages. If a feature is clipped in the Context layer (by the AOI layer) this could lead to misleading results. For example, if watersheds are the Context layer and a watershed extends beyond the AOI, it will be clipped to the AOI and results will be relative only to the clipped part of the watershed, and not to the entire watershed.
- After clipping, the Focus layers are intersected with each other and with the Context layer to create an Intersected layer.
- Total acres are then calculated on the Context attributes alone (as a basis for percentages of context) and then on all selected attributes for all Focus layers in relation to the Context layer attributes.

If the calculation takes a very long time to complete it is likely that the clipping process is complicated, e.g. that the AOI, Context and Focus layers have features with very different shapes. Clipping can be simplified by choosing layers with similar or matching

feature boundaries, or creating an AOI whose boundary matches that of the features in the Context and Focus layers.

When the calculation is finished a table of results is displayed. A new layer is also added to the map called “intersect”. **Important: The results table and intersect layer along with any other temporary files will be deleted and reused when another calculation is run. The user must save any desired results to a new location.**

Examples of Calculations using the REA Data Exploration Tool

Open calcareas.mxd in ArcMap and add *REASates* from the REA geodatabase.

1. To calculate reference/non-reference condition for three selected 8-digit hydrologic code unit (HUC) watersheds: (a) add the watershed boundary layer to the map, (b) select the three watersheds, (c) enter the watershed layer as the AOI, (d) enter the watershed layer as the Context layer, the 8-digit HUC code field (e.g. HUC8_ID) as its Value field and the 8-digit HUC name as the Description field, (e) enter *REASates* as the Focus layer, Reference as its Value field and Reference as its Description field, and (d) press Calculate Areas. The output table will show acres and percent-area of all reference/non-reference condition classes for each selected 8-digit HUC.
2. To calculate the same as #1 above, but across all three selected 8-digit HUCs, and not individually for each: (a) add the watershed boundary layer to the map, (b) select the three watersheds, (c) enter the watershed layer as the AOI, (d) enter the watershed layer as the Context layer, enter a field that contains the same value for each selected HUC as its Value field and the Description field, (e) enter *REASates* as the Focus layer, Reference as its Value field and Reference as its Description field, and (d) press Calculate Areas. If there is no field that contains the same values for each selected HUC add this field to the watersheds layer and populate it, or add it to a copy of that layer (e.g. add the field Classify and populate it with “all”). The output table will show acres and percent-area of all reference/non-reference condition classes for the combined selected 8-digit HUCs.
3. To calculate the same as #2 above, but for REA-mapped reference/non-reference condition combined with soil types from a separate soils layer, add the soils layer to the map, follow steps a-e in #2, then enter the soils layer as a second Focus layer and a soil type field as its Value field and Description field. If there are separate soil type code and name fields these may be entered. The output table will show acres and percent-area of reference/non-reference condition classes by soil type classes for the combined selected 8-digit HUCs. For example, it will show acres and percent-area of reference condition states on sandy soils within these combined states, etc.