# Improvements GeoArea Recommendations Summary

*No specific recommendations in GeoArea Reports for GeoAreas 3, 4 or 5*

**Summarization of GeoArea Recommendations**

- Smith/Reid input as of 21 October
- Improved (more accurate and thorough) geographic range focus and distribution information in the auto-key, including not just physical location, but also location in the moisture and elevation gradients (latter may be similar to landscape position below)
    - This is often an issue related to our poor knowledge or documentation about the distribution of ecological systems- both geographically and "landscape setting". For example, we know the 2 Rocky Mountain spruce-fir systems occur from New Mexico north into Montana and Idaho (and even eastern Washington & the east Cascades), but from north to south, east to west we do not know [have documented in the descriptions] the entire suite of plant species occurring (and even dominant in some areas) within each system, nor do we know how the elevations where they are found shift from north to south [e.g. at the USFS section level] or how elevation and aspect are related. So while these environmental variables can be included in the auto-key, applying them is difficult without investing in additional work on the concepts of the systems and documentation of the shifts. And these are some of the better known and understood systems.
    - But we do encourage some thought be put into how to incorporate more "topographic setting" or landscape position kinds of data into the auto-keys.
- Disturbance, invasion and land use change cause confusion in the auto-keys. Ruderal vegetation tends to be highly variable, often a mix of native and exotic or native increaser/noxious species, and tend to not follow any easily discernible patterns in floristics, landscape setting or structure. Hence disturbed & ruderal plots are difficult to key in an auto-key process.
    - Some of these issues could be more effectively addressed in the system concepts, whereby rules for distinguishing ruderal and disturbed vegetation could be explained in the systems concepts.
    - Ruderal and non-natural land cover classes were included in both auto-keys and the LF legend, but remain difficult to key because they often are transitional b/wn natural and disturbed/non-natural types.
    - New NVC Groups have been defined for many Ruderal types, and those concepts might help inform auto-key revisions.
- Include non-floristic descriptors in the auto-key, such as
    - Location [FS Section and FS Subsection]. Subsections would be especially helpful, since they are very locally scaled. However distribution for many ecological systems at the subsection scale is currently not well developed or known.
    - Substrate. However, substrate data are often not available in the original source data for the plots, and hence for many plots would need to be derived from the coordinates overlaid on a soils or geologic map, both of which are typically too coarse to be of much benefit.
        - Is this consistently tracked across plot sources? What happens when there is data missing from the criteria in a sequence table – does the plot get kicked out or assigned based on remaining information?
    - Landscape location, physiognomy
- Some system concepts need further work—Alaska was mentioned specifically but other ES from both coterminous states and Hawai'i need additional work to describe floristic composition, as well

as biophysical setting information such as elevational limits across its range, or aspect, slope, and topographic position.

- More complete vegetation information in the field plots with associated inclusion in the auto-key, including non-dom/codom woody species, shrubs and herbs. More explicitly- many plots were not collected with complete floristic data, for example GAP training sites often only have the top 3 to 5 most abundant species listed. Complete species lists are necessary to distinguish between ecological systems in an auto-key process (e.g. spruce-fir could be dominated by the same 2 or 3 tree species, but without having the shrub and herbaceous component it is almost impossible to key between the several spruce-fir systems).
    - As more and more plot data become available for use, there may need to be a process to winnow out those plots where the field data collection protocol did not include complete species lists. Currently many of them are included in the LFRDB and AA datasets, due to insufficient plots available for mapping or AA.
    - Is there data available in the source plot data that is not carried into the lfrdb and used in sequence tables. Can the Auto-Key be a multi-step process?
    - Marion Reid comment: The LFRDB contains most of the original source data if it was provided. The problem is many plots do not have some subsets of the data we'd like to use, such as soils, geology, percent cover of rock in the plot. Hence these would need to be derived by overlaying the plot on some other spatial dataset, which has many issues that result in errors and hence are not going to help much. Physiognomy is calculated from the species cover in the plot (and plots without species cover are rejected for use in the LFRDB). So all plots used in the auto-key have some sort of physiognomic data (tree cover, shrub cover, herb or grass cover). But typically height of the different life forms was not collected or provided in the original source plot data, so this is an attribute that would be helpful but generally is not going to be available.
    - Run the plots through the auto-key, and identify those that have low confidence. Have an expert review all these plots, or a sample.
        - This would require some thought as to how "low confidence" would be assigned; currently it is assigned only for the geo-referencing issues of the plot, or I think maybe for plots with issues related to physiognomy. But low confidence in auto-keying to a system is not assigned.
    - Key a plot to a general group in the first step [could be a general type such as Lodgepole Pine, or perhaps a Macrogroup], and then develop more refined keys to attribute the plot at a finer thematic level. Keying to Macrogroup and then to system could help narrow the list of possibilities for a set of plots. This approach will not generally help distinguish the Ruderal/non-natural types.

## Individual GeoArea Recommendations

- Cut and pasted as-is from each report-no editing
- "Boiler-plate" guidance was not copied unless comments were added

GeoArea 1/7E

- In the southeast U.S., rapid land use change and past management are huge drivers of vegetation. There are instances where land use change had occurred between the date of the plot data collection and the taking of the aerial photograph.
- There is a need to standardize the concepts for ruderal and managed types.

GeoArea 2E/2W

- Can we include a pre-processing step that makes sure the physiognomic class indicated by the vegetation in the plot is consistent with what is currently on the ground? This should help identify areas where the vegetation has changed significantly since the data was collected through logging or other methods and should help identify plots that may be inaccurate (due to location errors, data collection errors, or misunderstanding of field data when applying the auto-keys)
- Some systems, for example the Rocky Mountain Poor-Site Lodgepole Pine Forest may be benefited from a two-step auto-key process. Run the plots through the auto-key and see which key to the Rocky Mountain Lodgepole Pine Forest. Then for appropriate FS Sections where poor site conditions are thought to occur pull in other variables such as soil information and expert review to identify the poor site plots.
- When first considering the addition of variables like slope and elevation to the auto-key process it seems that the addition of these variables would be beneficial but with further consideration it is difficult to envision general rules using these variables that would not end up eliminating correct points from type classes. In order to work the rules would need to be fairly location specific and would therefore be time intensive to develop. Perhaps it would be better to include these variables in a check process which would flag plots that seem outside of the normal range for the system for additional review.
    - *It might be reasonable to look for patterns between systems & these attributes – but need to be careful about potential for circular thinking – would the slope/elevation have to come from the reported plot data or would it be derived from the ancillary data? If a pattern between a type and an ancillary layer is consistent it will fall out if there are sufficient samples. I think the suggestion for the Hawai'I montane vs. lowland is a good example of the issue. It seem like the use of the FS Sections would help to improve auto-key accuracy in GeoArea 2E. There use would help to prevent points getting to assigned to systems outside their range of occurrence, for example Middle Rocky Mountain Montane Douglas-fir Forest and Woodland plots assigned adjacent to Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest in the Northern Rockies. The use of FS Sections would also help identify where two similar systems co-occur. In these areas additional variables could be pulled in to differentiate the two systems or additional expert review could be employed. Being able to more easily identify limited areas where two systems may be confused would help to conserve review resources and direct them to the most problematic areas.*
- It is important to make sure that when vegetation data is collected information on non-vegetative elements is also collected and considered. Obviously a site where aspen is the only plant species recorded and aspen covers 80% of the canopy is very different than a site where aspen is the only vegetation recorded but it provides 5% canopy coverage and the majority of the site is bedrock.
    - *I thought relative and absolute cover were provided. If it is possible to include the non-veg component – is that generally available?*
- Expert review should be incorporated into the auto-key process where possible. Perhaps experts could review some percentage of all plots (5-20%) and look for patterns in where the auto-key may be mislabeling. Then the autokeys could be revised and improvement looked for. If improvement was not possible for certain systems or geographic areas could be flagged for more extensive review by experts. In GeoArea 2E systems that probably benefited the most from expert review were the alpine, wetland, riparian, bare ground, avalanche, and subalpine parkland systems. These systems seem to present challenges to the auto-key that can often be resolved by experts through the review of photos and other context information.

GeoArea 6

- Adjustments to Auto-key procedures – inclusion of locational/biophysical (landform, soils, geology, landscape position) information for pre-processing plots and/or inclusion of features in auto-keys.

Adding substrate type and geology information is especially relevant is sparsely vegetated systems are to be labeled by the auto-key. Sparsely vegetated systems typically have the low vegetation cover, variable species composition, and are often defined more based on substrate (e.g., sand dunes, rock outcrop). Percent cover of ground cover, such as bedrock, bare ground, litter would further help differentiate certain types.

- Narrowing vs. broadening the geographic application of the auto-key – Using USFS Subsections would help when there is accurate distributional information on the system. In certain areas, such as transition zones between analogous systems such as Apacherian-Chihuahuan Mesquite Upland Scrub and Western Great Plains Mesquite Woodland and Shrubland, labeling plots using complete floristic information may lead to greater accuracy.
- Adjustment to auto-keys – additional requirements for a more complete species list of vegetation sample data; e.g., ground cover data, and a greater percentage of woody species (not just dominant and co-dominant species) would help improve accuracy for some systems, but limit the number of total plots for mapping. On the other hand some systems can be confidently labeled by a single dominant species in certain parts of their range, such as *Pinus edulis* of the Southern Rocky Mountain Pinyon-Juniper Woodland in Colorado.
- A limitation of the simplified auto key methodology (and to a lesser extent Expert Labeling) is not consistently addressing disturbance, invasion (by native species, such as (mesquite), drought, seral stage, and grazing history - factors that affect species composition that the Autokey results are based on.
- Expert review and labeling of plots for types of low confidence from auto-key, would reduce labeling errors with less expense. Using a similar expert review database, high confidence labeled plots could be identified and sorted out quickly to focus on the more difficult plots.
- More thoroughly collected field data would help to distinguish a number of ecological system types; a lack of complete florisitic information for plots that could represent 2 or 3 different types makes it impossible to key them either in a sequence table, or for an expert to assign with high confidence.
- Adjustments to Map Legends such as moving to Group/Macrogroup concepts where systems level remains challenging is an option, but has the risk of making map classes thematically too broad. This remedy could be reviewed and applied on a case-by-case basis.
    - *I am not sure I agree with the recommendation – mixing and matching classification systems. The map legend <> a vegetation classification, but for vegetated type should probably be thematically consistent in what it portrays.*
- Coping with uncertainty about what proportion of types could NOT be adequately handled through any of the above adjustments should to be addressed during auto-key improvement.

<u>GeoArea 7W</u>

- Adjustments to Auto-key procedures – inclusion of locational/biophysical information for pre-processing plots and/or inclusion of features in auto-keys. In this GeoArea there are many highly disturbed or managed sites that may be dominated by native trees but that do not fit the criteria for a natural System. These include farm woodlots, old fields, pastures, tree plantations, drainage ditches, fencerows, wooded yards in suburbs/exurbs or cities, etc. These can all appear to fit the auto-key if it considers just dominant overstory species. Some kind of landscape analysis might screen these out without requiring a complete species list. Some kind of analysis incorporating proximity to a river/stream of a certain size might also assist in assigning a site to a floodplain System versus a basin wetland (the same associations can occur in either).
- Narrowing vs. broadening the geographic application of the auto-key – FS Sections? In certain areas? Would this likely lead to greater accuracy? FS Section data would not be very helpful. Subsection data is much more useful. Some GeoAreas also used EPA Level IV Ecoregions.

- Adjustment to auto-keys – additional requirements for vegetation sample data; primarily ground cover data. Auto-keys need to accurately reflect the potential geographic range of types. Several types were attributed using auto-keys outside of their range. Subsection and ecoregion data can help with this.

GeoArea 8

- The ecological systems classification for Alaska would benefit from some additional investments in compilation of field-based vegetation data, improvement of the concepts of the systems based on these data, and possibly some revisions to the systems classification itself (combining some systems into more thematically broad types for example).
- Latitudinal and elevational gradients from north to south in Alaska have not been clearly described in relation to the distribution of the ecological systems. Breaks between "arctic" and "boreal" vegetation are not well related to either the MRLC map zones, the Nowacki et al. (2001) level III ecoregions, or the TNC-defined ecoregions, which are the 3 ecoregional distribution units that were available for the auto-key and the expert to use. Further development of more locally-scaled distribution data for the Alaska ecological systems (e.g. Nowacki level 4 ecoregions, or USFS Sections if they were available) would help with this.
- Adjustments to Auto-key procedures – inclusion of locational/biophysical information for pre-processing plots and/or inclusion of features in auto-keys. This is mentioned above in relation to the difficulty of keying black ecological systems that are distinguished along moisture and peat development gradients, when complete floristics are lacking or not understood, micro- or meso-scale topographic information would help improve auto-key results.
- Narrowing vs. broadening the geographic application of the auto-key – FS Sections? In certain areas? Would this likely lead to greater accuracy? This might be a helpful thing to consider for Alaska- the 4 sets of auto-keys of necessity had to include many ecological systems that were peripheral to the key. For example, the "boreal" map zones cover a huge area of interior Alaska, including the southern slopes of the Brooks Range on the north (with some arctic types), the northern slopes of the Alaska Range on the south (including some maritime types), the Cook Inlet region, and then extending west into western arctic areas.
- Adjustment to auto-keys – additional requirements for vegetation sample data; primarily ground cover data. Again, for ecological systems where the bryophytes and other non-vascular species are particularly important indicators yet are rarely recorded for plots, this is an important issue.
- Adjustments to Map Legends – moving to Group/Macrogroup concepts where systems level remains challenging – which ones? Many ecological systems in Alaska are grouped into a single NVC Group concept; 121 nest cleanly within 44 NVC Groups suggesting that some of the NVC Groups may be somewhat broader in concept, and might prove to be improved units for mapping and auto-keys.

GeoArea HI

- Verify that the elevation and moisture zone indicator species are working in light of new information on species distribution in the Hawaiian Islands. Although ecologically there is a transition zone between lowland and montane vegetation, in general plots above 1000 m elevation are considered montane ecological systems and plots below 1000 m are considered lowland ecological systems. In auto-key, an overlapping elevation break was used to more represent the transition zone, however it would reduce confusion and auto-key to expert mis-matches if a 1000 m elevation break was used in the auto-key, at least until more reliable montane and lowland indicator species can be identified. If the transitional elevation criteria are to be used e.g., montane > 950 m elevation and lowland <1050 m elevation, then assigning montane –subalpine plots first in auto-key would work better.

Another way would be to treat the elevation transition zone separately (900-1100 m) and use re-assessed montane and lowland indicator species to label plots.

- Review the Price et al. 2007 moisture zones, in light of new information. Some plots occurring in moisture zone 5 (mesic) would be better labeled wet forest rather than mesic forest. Should we include plots in moisture zone 5 with the wet forest systems (moisture zones 6 and 7) under certain environmental conditions (elevation) or presence of certain wet habitat indicator species? Plots that occur in moisture zone 5 need to be addressed separately.
- Introduced, invasive species are a significant problem in Hawai'i. Review how these invasive species were addressed in auto-key to assess stands degraded by introduced invasive species in upper canopy, but not converted to a non-native, ruderal type.
    - *There was a map by Jacobi (USGS) that might be helpful in trying to sort out from one perspective what to call "ruderal". So the implication here is that there were mismatches – where experts assigned a native type, but the plot data indicated invasive above. How to set that threshold?*
- Additional adjustments to Auto-key procedures – inclusion of location/biophysical (landform, soils, geology, landscape position) information for pre-processing plots and/or inclusion of features in auto-keys need review. For example, soil salinity would help with Northern Polynesia Tidal Salt Marsh. Adding substrate type and geology information is especially relevant is sparsely vegetated systems are to be labeled by the auto-key. Sparsely vegetated systems typically have low vegetation cover, variable species composition, and are often defined more based on substrate (e.g., beach, coastal dunes, rock outcrop). Percent cover of ground cover, such as bedrock, bare ground, litter would further help differentiate certain types.
- Adjustment to auto-keys – additional requirements for a more complete species list of vegetation sample data; e.g., ground cover data, and a greater percentage of woody species (not just dominant and co-dominant species) would help improve accuracy for some systems, but limit the number of total plots for mapping. On the other hand some systems can be confidently labeled by a single dominant species in Hawai'i such as *Marsilea villosa* indicating Hawai'i Ihiihiluakea Vernal Pool.
- Expert review and labeling of plots for types of low confidence from auto-key would reduce labeling errors with less expense. Using a similar expert review database, high confidence labeled plots could be identified and sorted out quickly to focus on the more difficult plots.
- Adjustments to Map Legends such as moving to Group/Macrogroup concepts where systems level remains challenging is an option, but has the risk of making map classes thematically too broad. This remedy could be reviewed and applied on a case-by-case basis.