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Availability of plot data from the Carolinas and Virginias for documenting the US National Vegetation Classification

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Abstract

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US Federal Geographic Data Committee (FGDC) standards prescribe that definitions of associations and alliances in the US National Vegetation Classification (NVC) include reference to high-quality, publicly available vegetation plots across the range of occurrence. We investigated sources of publicly available vegetation plots to determine the degree to which their extent, quality, and quantity would allow association authors to follow these rules. We found that VegBank, a publicly available database, contained the largest number of plots from the US, with 98,147 US plots total and 13,794 plots from North Carolina, South Carolina, Virginia, and West Virginia. Of the plots in VegBank, 43% were of sufficient quality to be FGDC "classification plots," whereas over 99% of plots in the four-state focal region were "classification plots." Of the NVC associations listed as occurring in these four states, 59% had at least five plots attributed to the type, while 83% of associations had at least one plot. This level of coverage was much higher than for surrounding states in the southeastern US and is sufficient for documentation and revision of associations in most macrogroups that occur in North Carolina, Virginia, and West Virginia. We found similar levels of plot representation for the Mountain, Piedmont, and Coastal Plain physiographic provinces within the four-state region. The most common associations not well represented were 1) those that consist of ruderal (weedy) vegetation and 2) those that are rare on the landscape and/or difficult to inventory. In order to meet the requirements of the FGDC standard, additional plots are needed from poorly represented associations in the Carolinas and Virginias, and this need is much greater for surrounding states.

Key words: community classification; Federal Geographic Data Committee; U.S. National Vegetation Classification; North Carolina; ruderal vegetation; South Carolina; VegBank; vegetation plots; Virginia; West Virginia.

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Introduction

The US National Vegetation Classification (NVC) provides a framework for documentation, inventory, monitoring, and study of vegetation in the United States. It thereby creates a scientific foundation to support conservation and resource management activities, as well as a tool for organizing and interpreting basic research (Jennings et al. 2009, Peet and Roberts 2013, Faber-Langendoen et al. 2014, Franklin et al. 2015). The NVC's eight-level hierarchy provides fine-scale, species-based associations and alliances as well as broad-scale higher levels informed by the physiognomic structure and ecology of the vegetation. Middle levels of the hierarchy (groups and macrogroups) consider floristics, geographic region, and physiognomic structure, and these levels are useful for aggregating similar, fine-level associations and alliances for analysis and for mapping broad units over a large landscape.

The US Federal Geographic Data Committee (FGDC) Standard for the NVC specifies that revisions to the classification content (such as creation of new associations, splitting or merging of associations, and similar modifications to higher-level units) be "based on plot data, using publicly accessible data wherever possible" (FGDC 2008). A plot-based classification would result in more data-driven evaluations of proposed changes, reduce duplicative and unsubstantiated associations, and in the process make available the underlying plot data, which could have many additional uses and benefits for the scientific community.

Here we assess the near-term feasibility of a plot-based revision system for the NVC. The FGDC standard defines "classification plots" as having data that are complete enough to help define types, and it differentiates these from "occurrence plots," which are less complete, but which have sufficient information to document the occurrence of a vegetation type. The standard mandates that for high confidence, associations must be "…based on quantitative analysis of classification plots…" and those "classification plots shall represent the geographic distribution and habitat range of the type as known from classification and occurrence plots" (FGDC 2008). If plot data are to be used to support proposals for revision of the NVC as mandated in the FGDC Standard, it is essential that sufficient plot data be available. Although we examine plot availability across the U.S., we focus on the Carolinas and Virginias owing to the relatively large amount of plot data known to be available from this region, as well as the relative maturity of the NVC content from this region (Peet et al. 2012a, Schafale 2012, Vanderhorst et al. 2012, Fleming et al. 2016). If sufficient plot data are available for this region, the FGDC implementation group could use it for demonstration and proof-of-concept purposes and thereby potentially accelerate implementation of the NVC across the rest of the country.

Methods

We identified and queried plot databases listed in the Global Index of Vegetation-Plot Databases (GIVD; GIVD 2015, see Dengler et al. 2011). In December 2015, GIVD listed eight vegetation plot databases that contained vegetation plots in North America and that were publicly available in some manner. Two databases contained a wide geographic range of plots where all occurring vascular plants were recorded during inventory: the Forest Inventory and Analysis Database, Diversity and Structure Indicator (FIA-VEG) (Schulz et al. 2009) and VegBank, the Ecological Society of America's (ESA's) online vegetation plot repository, which is open to public submission of plot data (Peet et al. 2012b; ESA 2015). At that time, the amount of data available in VegBank (98,147 plots, 43% of which were "classification plots") far exceeded that available in the FIA-VEG database (2,564 plots), and as such offered the best consistent source of plot data with which we could assess the feasibility of immediate implementation of the new FGDC Standard. Additionally, the FIA-VEG plots were not classified to NVC associations when we obtained the data, something we would have needed in order to test how well associations were represented by plots. The full FIA database contains a much larger set of plots (Gray et al. 2012), but most of these do not have full floristic data and, while useful for many other purposes, do not meet the federal standards for plots used as a basis for documentation of associations in the NVC.

We identified a few additional regional sources of data of potential significance in implementation of the NVC, yet not explicitly reported in GIVD. The US National Park Service (NPS) has a large, high-quality set of park-specific NPS-PLOTS databases (NPS 2016). However, most of the key NPS datasets from National Parks in the Carolinas and Virginias are already included in VegBank (e.g., Bluestone, Blue Ridge Parkway, Cape Hatteras, Congaree, Gauley, Great Smoky Mountains, Harpers Ferry, New River Gorge, Shenandoah). The US Forest Service (USFS) LANDFIRE Program (USFS 2016; Zahn 2015) also has a set of large regional databases. These include almost 5,000 plots from the Carolinas and 2,000+ plots from West Virginia that are also deposited in VegBank, but otherwise have only a few plots in our target area.

Working with a regional subset of the nation's vegetation types seemed more feasible than testing the entire NVC because we wished to examine the results manually to search for patterns in the gaps in plot coverage. A large, regional sample seemed more appropriate than a smaller, local subset because many different types of vegetation would be included. A good test-case region would ideally have a large amount of available plot data and would have a moderately high number of known community types. The highest plot counts in VegBank for southeastern U.S. states were North Carolina (NC: 6,299), South Carolina (SC: 1,523), Virginia (VA: 4,758), and West Virginia (WV: 4,382), and over 99% of these plots were marked as high quality FGDC "classification plots" (Table 1). Furthermore, we selected these states because we wanted the region of analysis to be familiar to the authors of this paper so that we could better evaluate the patterns and reasons behind communities lacking plot coverage. The fact that these four states are geographically contiguous was an additional advantage because this allowed summarization by both ecological vegetation units (association, macrogroups) and state. By focusing on state-level summaries, we could determine if associations are well represented throughout an extended multi-state region.

Table 1: Plot counts by state, with each level of data completeness and quality.

State	Plots	Plots Attributed to NVC Types	Classification Quality Plots (FGDC Classification Plots)	Classification Quality Plots Attributed to NVC Types
Alabama	378	344	378	344
Florida	670	649	670	649
Georgia	771	711	771	711
New Jersey	526	515	0	0
North Carolina	6299	5159	6299	5159
South Carolina	1523	1300	1523	1300
Tennessee	770	722	770	722
Virginia	4758	4396	4758	4396
West Virginia	4382	2939	4331	2892

We downloaded plots collected in the four-state focal region from VegBank (Peet et al. 2013; accessed December 17, 2015). Plots from nearby states not in the four-state region were also downloaded for comparison. In total, we downloaded from VegBank 20,077 unique plots from the southeastern US, along with their attributions to NVC associations. Of these, 16,735 had been classified to current NVC associations. Of the plots attributed to NVC types, 13,794 were from the target four-state area (see Table 1 for breakdowns by state). Using the NVC classification of each plot as recorded in VegBank, we tallied how well associations and higher-level units were represented by plots, paying particular attention to those macrogroups having no plots or consisting of many associations without plot representation. We considered two levels of plot representation: associations with one or more plots, and associations with at least five plots. Because the FGDC Standard (FGDC 2008) mandates that association descriptions include a floristic table listing all species that occur with a frequency of 20% or higher, we adopted a benchmark of five high-quality plots for our analysis. We downloaded the list of associations, higher-level units, and their distributions by state from the NVC website (USNVC 2016).

We analyzed each state separately for representation of associations at the level of presence (one or more plots) and our proposed minimum representation for classification revision (five or more plots). This provided a rough indication of how well the plots assigned to an association span its range. While five plots in each state are not required of multi-state associations, such coverage would be an indication that an association is well represented by data. However, an association with no plots in a state to which it is attributed is likely not to be adequately represented by data throughout its range. Such an assessment was important because, for example, five plots clustered in one small location might not be sufficient to document the compositional variation encompassed by an association with a large range. In addition, we analyzed the level of plot representation by macrogroup within each state.

Results

The median association frequency reported by usnvc.org (USNVC 2016) in the contiguous 48 US states was 264 associations per state. Three states in our focal area fell into the more diverse half of states (North Carolina ranked 13th with 467 associations, South Carolina 15th with 417 associations, and Virginia 17th with 381 associations), whereas West Virginia ranked 30th with 203 associations. This variation in number of associations per state, falling on both sides of the median, further indicated the region to be an appropriate test case.

Treating the four-state region as a single combined area, 59% (505/856) of associations had at least five assigned plots, and 83% (711/856) of associations had one or more plots (Table 2). These percentages varied significantly by state (Figure 1). Some associations were assigned low confidence in a state by the NVC, such as "Reported but unconfirmed," "Reported but doubtful," or "Potential." We considered removing these 46 lower confidence associations and doing so would have improved coverage slightly: 62% (502/810) of expected high confidence associations had at least five plots and 86% (698/810) had at least one. We chose to analyze the data assuming the presence of all attributed associations, while noting that the results would improve slightly if these uncertain assertions are incorrect. We chose not to rely on confidence values assigned to associations because they attempt to combine many disparate attributes (e.g., quality of data, quantity of data, uncertainty in the data, thoroughness of analysis, methodology of assigning plots to types, estimated quantity of vegetation, etc.) into a simple, and therefore potentially misleading, rating. Indeed, three of the lower confidence associations had five or more assigned plots in those states, reinforcing our hesitation to rely on this rating, as well as reflecting the multiple and non-synchronized sources of data.

Table 2: Association plot coverage and Macrogroup metrics in the four-state focal region. Association total = the number of association/state combinations in the current USNVC. 1+ plots = percentage of combinations that have at least one plot. 5+ plots = percentage of combinations that have 5+ plots. E.g., for the 4 states row, of the 856 combinations, 83% of the associations meet the 1+ plots threshold, 59% meet the 5+ plots threshold. Macrogroup total = the number of macrogroup/state combinations in the current USNVC. "Moderate documentation" macrogroups have at least half their associations with one or more plots, "Better documentation" macrogroups have at least 75% of their associations with one or more plots, and "Repeated documentation" macrogroups have at least half their associations having five or more plots.

	Associations			Macrogroups			
State(s)	**Total**	**1+ plots**	**5+ plots**	**Total**	**Moderate documentation**	**Better documentation**	**Repeated documentation**
4 states	856	83%	59%	42	90%	74%	69%
NC	467	79%	49%	37	78%	62%	43%
SC	417	54%	20%	34	59%	15%	3%
VA	381	75%	54%	37	81%	59%	57%
WV	203	81%	63%	26	96%	77%	73%

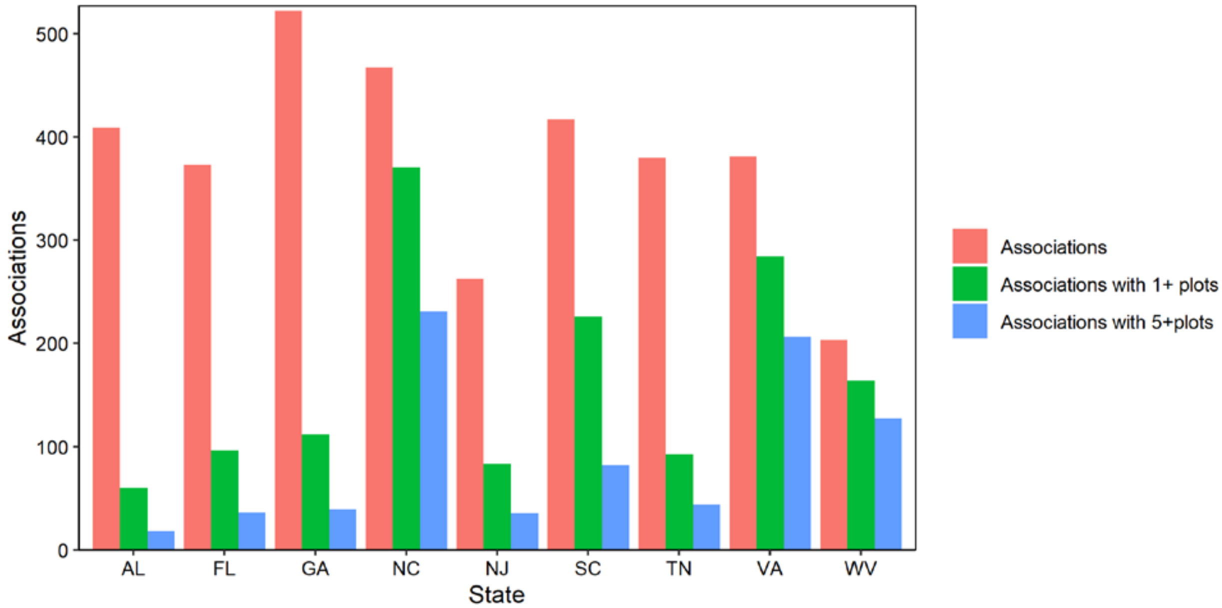

Fig. 1. Plot and association occurrence by state showing the relatively similar numbers of associations across the region and the highest plot coverage in North Carolina (NC), South Carolina (SC), Virginia (VA), and West Virginia (WV).

We also considered the higher levels of the NVC hierarchy to assess how well plots covered those coarser-level vegetation types. At a relatively high level in the hierarchy, NVC macrogroups combine ecologically and floristically similar associations into broad types. West Virginia, Virginia, North Carolina, and South Carolina together have 42 distinct macrogroups, with representation ranging from only one association expected to occur in the four-state region (four macrogroups) to 74 associations (one macrogroup: M031, *Quercus michauxii* - *Taxodium distichum* - *Carya illinoinensis* Southern Floodplain Forest Macrogroup), and a median of 16 associations per macrogroup. Macrogroups thus provide ecologically-based vegetation units for describing how well associations are represented by plots. The upper levels of the hierarchy are harder to characterize in terms of plot representation because the total number of plots could be large but still only represent a small portion of the component associations. Adequate plot representation in a macrogroup would require sufficient plots for many of the associations within it. Although a precise level of necessary plot representation may not be possible to determine, we established three rough metrics to estimate minimal macrogroup plot representation: a) "moderate documentation," macrogroups with at least *half* their associations having *one* or more plots, b) "better documentation," macrogroups with at least *75%* of their associations having *one* or more plots, and c) "repeated documentation," macrogroups with at least *half* their associations having *five* or more plots. We note that these metrics are not mutually exclusive, and that the latter two build on the first in different ways. Some

macrogroups meet the "better documentation" metric but not "repeated documentation" and vice versa. For the four-state region treated as a single unit, these metrics were:

- Moderate documentation: 90% (38/42) of macrogroups (half of their locally occurring associations represented by at least one plot).
- Better documentation: 74% (31/42) of macrogroups (75% of their associations represented by at least one plot).
- Repeated documentation: 69% (29/42) of macrogroups (half of their associations represented by at least five plots).

The metrics applied to West Virginia, Virginia, and North Carolina were similar to those of the entire four-state region. South Carolina's associations and macrogroups had lower plot documentation. Figure 2 shows these metrics by state. Table 2 shows the breakdown of these metrics by state for associations and macrogroups. The results for the four-state region were quite similar when applied at the alliance and group levels (levels between association and macrogroup):

- Moderate documentation: 90% of groups and 89% of alliances
- Better documentation: 73% of groups and 74% of alliances
- Repeated documentation: 63% of groups and 62% of alliances

Three macrogroups lacked plots in our four-state region entirely: M123 (*Dactylis glomerata* - *Solidago canadensis* - *Rosa multiflora* Eastern North American Ruderal Grassland & Shrubland Macrogroup), M162 (*Serenoa repens* - *Quercus myrtifolia / Aristida beyrichiana* Scrub & Dry Prairie Macrogroup), and M308 (*Sporobolus vaginiflorus* - *Schizachyrium scoparium* - *Clinopodium spp*. Southern Barrens & Glade Macrogroup).

We also analyzed the data by physiographic province within the four-state region (Coastal Plain, Piedmont, and Mountains, the last combining the more traditional Blue Ridge, Ridge and Valley, Allegheny Plateau, and Cumberland Plateau provinces). Of the Mountain associations, 87% had plots assigned to them, compared with 81% of Piedmont associations and 80% of Coastal Plain associations. Of the Mountain associations, 75% met the benchmark of five plots for minimum representation, compared with 67% of Piedmont associations and 64% of Coastal Plain associations (Figure 3).

Most macrogroups in WV, VA, and NC had a mean number of plots per association exceeding our benchmark of five plots. In West Virginia, nearly 75% of the macrogroups reached this criterion. Indeed, the mean number of plots per association exceeded six for most of the macrogroups in WV, VA, and NC, with medians of 10.3, 6.5, and 6.3, respectively. Their lower quartiles were 4.0, 2.4, and 2.0, and their upper quartiles were 18, 12, and 12. The numbers in South Carolina's macrogroups were the lowest within the four-state region, with a median of 1.6 plots per association and lower and upper quartiles of 0.25 and 3.3. South Carolina's numbers were, nevertheless, higher than those for the other southeastern states and New Jersey (which was included for comparison to other regions as a non-southeastern state with a relatively high count of plots linked to NVC types in VegBank), where the mean number of plots per association within macrogroups did not exceed 0.2 plots per association (Figure 4).

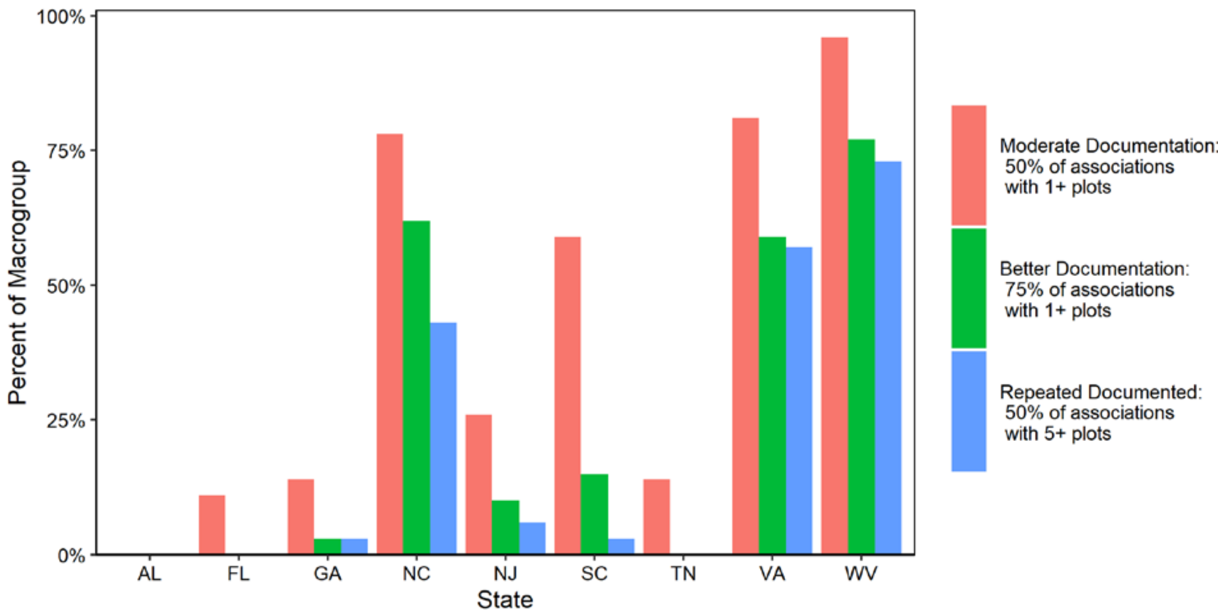

Fig. 2. Plot coverage for macrogroups by state show North Carolina (NC), South Carolina (SC), Virginia (VA), and West Virginia (WV) with the highest plot documentation levels.

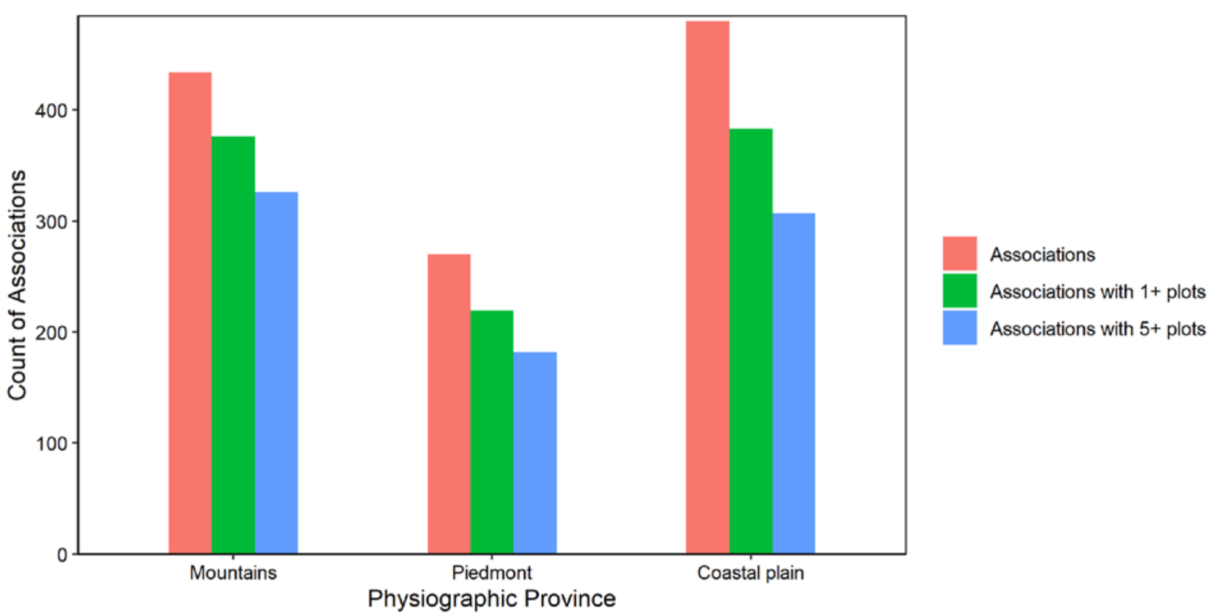

Fig. 3. Plot coverage for associations in the four-state focal region by physiographic province, with similar proportions of plot coverage.

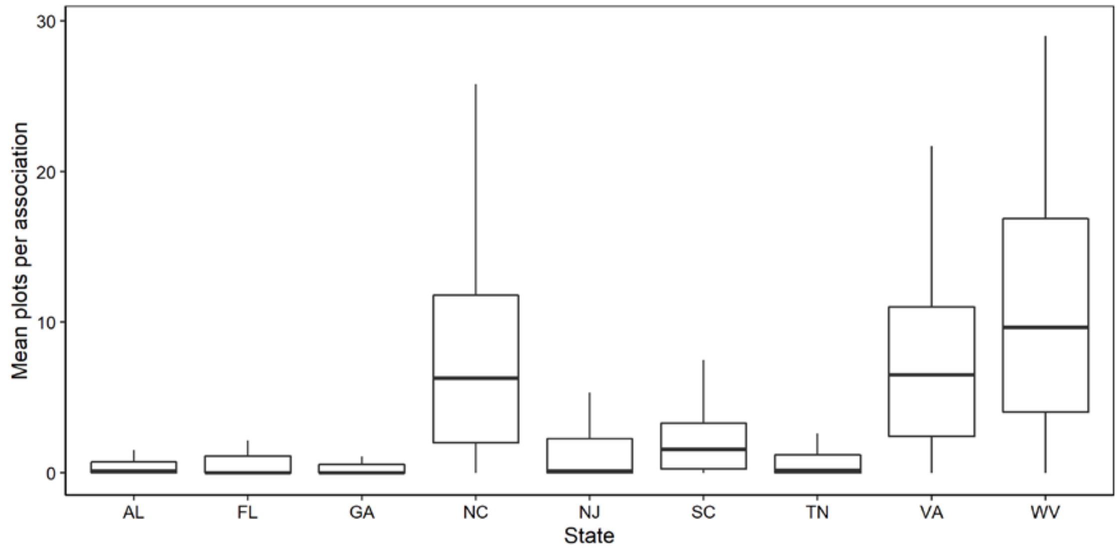

Fig. 4. Mean number of plots per association, grouped by macrogroup. Boxes represent the 25th to 75th percentiles. The highest plot documentation per association is shown in North Carolina, Virginia, and West Virginia.

Discussion

The FGDC Standard requires vegetation plot data to support proposals to add or change NVC associations. We found that one publicly available plot database, VegBank, provides robust support for the NVC for more than half of the associations in the four-state US region of the Carolinas and Virginias.

The explanation for South Carolina's lower level of plot representation in associations and macrogroups relative to the other southeastern states is almost certainly the smaller number of plots overall; South Carolina had only 25% the number of plots in North Carolina, and still well under 50% of the plots in either of the Virginias.

Both in South Carolina and throughout the NVC, associations were defined in one region or state and then asserted by the association authors to potentially occur in adjacent regions or states. Alternatively, because of unclear and potentially overlapping definitions of some associations, ecologists in different states may have interpreted the vegetation in their respective states as belonging to different associations. Such duplication of, or miscommunication about, association concepts may lead to lower coverage. We suspect this effect could be partially addressed in our analysis by removing associations flagged as low confidence, and their removal does increase the level of coverage by about 3% in the overall region, indicating a somewhat trivial effect at a large scale. The effect may be somewhat larger in that such ambiguities may not be confined to associations flagged as low confidence. We noted that a process of review and clarification of the NVC by local experts had taken place in North Carolina, Virginia, and West Virginia and had led to the removal of a number of associations previously asserted to occur in those states. This analysis had not yet been completed for South Carolina, and the number of associations currently attributed to but not documented in that state was higher than likely would be the case after careful review, a process that would improve South Carolina's plot representation, even without new plot data. Additional work of this type in the form of collaboration between adjacent states should lead to a better classification with fewer near-duplicate types that change slightly between states, and fewer erroneous assertions of community presence in states. Indeed, Virginia has its own list of associations and it tracks nearly 50 fewer associations than are purported to occur in Virginia by the NVC. If this perspective were accepted by the NVC, it would lead to 95% of associations having at least one plot, and 62% having at least five, far above the current NVC levels of plot coverage shown in Table 2. Ultimately, having associations defined by plot data will greatly reduce problems of this type.

Our benchmark of five plots per association was derived from the required constancy level of 20% set by the FGDC Standard, but both numbers are admittedly arbitrary. The amount of plot data needed to achieve robust quantitative classification is likely variable and complex to determine. Homogeneous or geographically narrow associations may need few plots to characterize them as distinct from other associations, and some rare associations may have so few sites that a benchmark of five plots would be difficult to achieve. For example, there is only one known occurrence of the Bluff Mountain Fen (CEGL004167: *Cladium mariscoides - Sanguisorba canadensis* / *Sphagnum subsecundum* Herbaceous Vegetation), an association that is indisputably distinctive and worthy of recognition. Conversely, a wide-ranging and heterogeneous association may need many plots for adequate characterization. Determining the distinctness of associations from related associations, or assessing the need to split associations, often will require more than five plots.

We discerned two patterns in the list of associations with little or no plot representation within macrogroups. The first was poor plot representation for associations in ruderal (weedy) macrogroups, types that largely have not been prioritized by the conservation and academic organizations that provided the data. Of the associations expected in states but without plot representation, 24% (35 of 145) were members of ruderal macrogroups, and 67% (8 of 12) of macrogroups not meeting our "moderate documentation" metric (less than half of their associations represented by plots) were ruderal macrogroups (Table 3). We do not mean to attach lesser importance to the study of ruderal types in general, but we simply note that these systems have been inventoried with less intensity. We recognize that there are many difficulties associated with the study of ruderal, semi-natural, and successional vegetation, specifically due to the stochastic nature of these systems and the potentially large and lasting impacts of unpredictable events. One solution leads to very broad types such as the *Pinus virginiana* Ruderal Forest (CEGL002591), while another leads to a myriad of highly split, local types. Both solutions present difficulties for integration with the rest of the NVC because of the variation in breadth of associations.

Aside from ruderal macrogroups, the other macrogroups with low plot representation in VegBank were those that are rare on the contemporary vegetation landscape, difficult to inventory, sparsely vegetated, or are odd enough that some researchers simply do not recognize them as vegetation types (often more than one of these conditions apply to an association). Rare associations of our focal region include barrens,

Table 3: Ruderal macrogroups with more than half of component associations undocumented by plots. Total = the number of ruderal association /state combinations for the macrogroup in the current USNVC. Blank cells mean that no associations are reported from the macrogroup in the state, so no plots are expected.

				Association/State Combinations without plots				
Code	**Macrogroup name**	**Total # of Association / State combinations**	**Percent without Plots**	**4 states**	**NC**	**SC**	**VA**	**WV**
M013	*Robinia pseudoacacia - Liriodendron tulipifera - Acer platanoides* Ruderal Forest Macrogroup	49	51%	25	8	2	9	6
M123	*Dactylis glomerata - Solidago canadensis - Rosa multiflora* Eastern North American Ruderal Grassland & Shrubland Macrogroup	9	100%	9	2		4	3
M302	*Acer rubrum - Acer negundo - Platanus occidentalis* Eastern North American Ruderal Flooded & Swamp Forest Macrogroup	3	67%	2		1	1	0
M303	*Juncus effusus - Lythrum salicaria - Phalaris arundinacea* Eastern North American Ruderal Wet Meadow & Marsh Macrogroup	34	71%	24	8	13	2	1
M305	*Liquidambar styraciflua - Pinus taeda - Triadica sebifera* Ruderal Forest Macrogroup	27	52%	14	4	7	3	
M307	*Andropogon virginicus - Rubus* spp. *- Ambrosia artemisiifolia* Southeastern Ruderal Grassland & Shrubland Macrogroup	24	67%	16	3	6	6	1
M310	*Acer rubrum - Liriodendron tulipifera - Celtis laevigata* Ruderal Flooded & Swamp Forest Macrogroup	15	73%	11	3	5	3	
M401	*Eichhornia crassipes - Egeria densa - Alternanthera philoxeroides* Ruderal Aquatic Vegetation Macrogroup	5	60%	3	2	1		0

glades, cliffs, prairies, and some small-patch wetlands. We hypothesize that there are few plots in these communities simply because many of the types exist at only a few sites, or only at a single site. Most or all of the existing sites may have been adequately inventoried such that no additional distinct plots are possible. Difficult types to inventory include aquatic and cliff vegetation (Table 4), where the need for specialized equipment and expertise may limit the number of plots established by researchers. Vegetation types that researchers may not think to inventory but that may have associations conceptually defined for them include sparsely vegetated beach communities, estuarine mud and sand flats, narrow estuarine shoreline communities, and some types of aquatic vegetation. Figure 5 shows the count of associations in each plot category and how these combine to reflect differences between macrogroups.

Table 4: Non-ruderal macrogroups with more than half of component associations undocumented by plots. Key words underlined and in boldface indicate the distinctive characteristic of the type that may have led to limited inventory efforts. Total = the number of association /state combinations for the macrogroup in the current USNVC. Blank cells mean that no associations are reported from the macrogroup in the state, so no plots are expected.

				Association/State Combinations without plots				
Code	**Macrogroup name**	**Total # of Association / State combinations**	**Percent without Plots**	**4 states**	**NC**	**SC**	**VA**	**WV**
M108	*Ceratophyllum* spp. - *Nuphar* spp. - *Potamogeton* spp. Eastern North American **Freshwater Aquatic** Vegetation Macrogroup	30	63%	19	6	9	3	1
M111	Eastern North American **Cliff & Rock** Vegetation Macrogroup	48	65%	31	8	9	12	2
M162	*Serenoa repens - Quercus myrtifolia / Aristida beyrichiana* **Scrub & Dry Prairie** Macrogroup	2	100%	2		2		
M308	*Sporobolus vaginiflorus - Schizachyrium scoparium - Clinopodium* spp. **Southern Barrens & Glade** Macrogroup	2	100%	2	1	1		

Finally, we note that the numbers of plots per association reported in the present analysis depends on the accuracy of the assignment of individual plots to associations, and thus must be considered approximate. In some but not all cases, plot assignment was done by inspection, and its accuracy depends on both the classifier's familiarity with the NVC and the adequacy of the plot data. Rare associations may appear rarer than they actually are owing to subjective classifiers being less likely to be familiar with them. Increased availability of plots to document association composition should reduce this problem because it will increase classifiers' ability to use quantitative tools for initial assignments to types. Moreover, classification of plots may not have kept up with changes in the NVC since the time of assignment. We did not investigate the accuracy of assignment of individual plots to associations for this analysis, but our work with some of the same plot data for other analyses has led to frequent revisions in plot assignments to NVC types. Thus, our assessment represents a most optimistic scenario for data and classification quality, and further research could be undertaken into assessment of the classification and reclassification of existing plots.

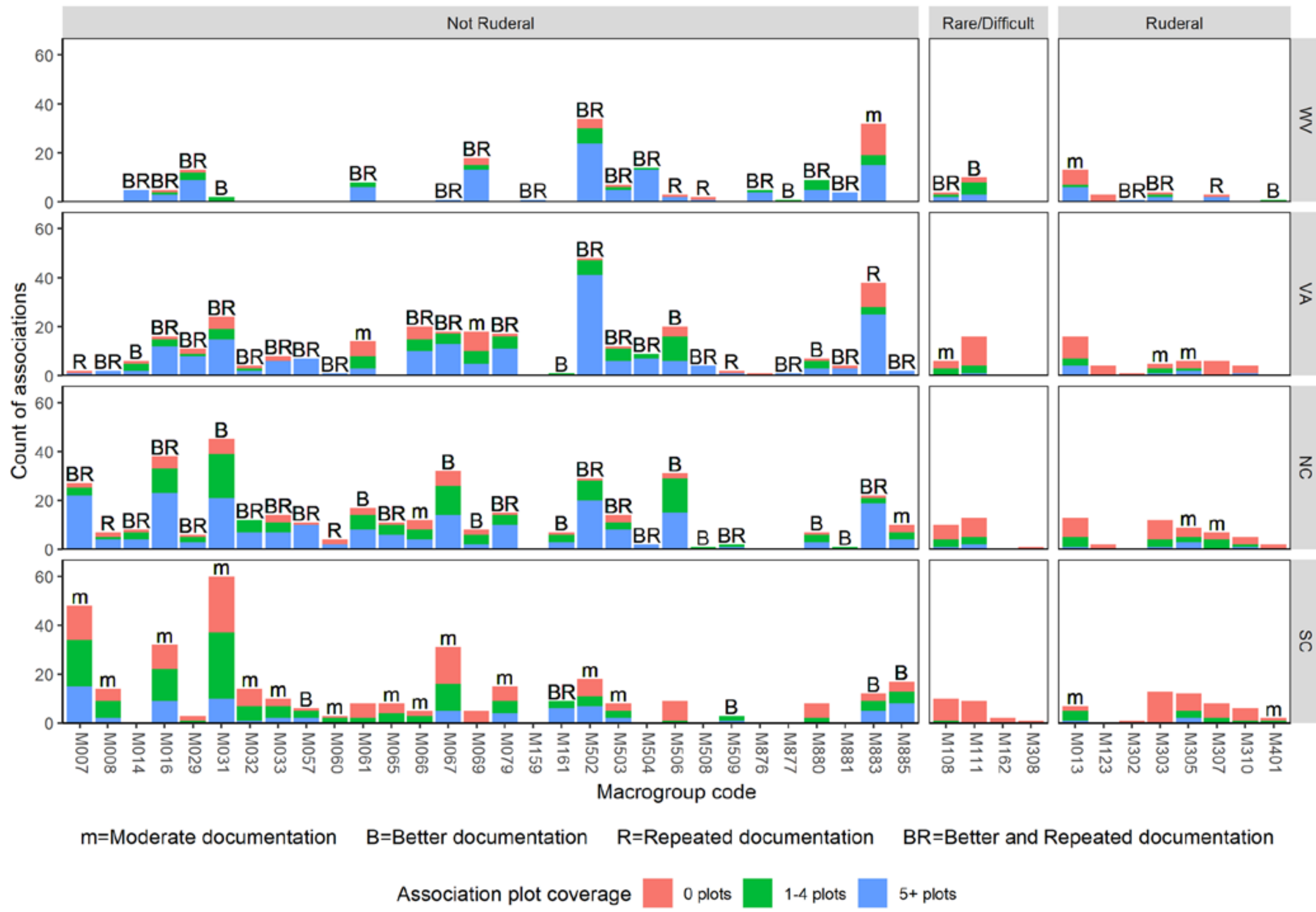

Fig. 5. Count of associations in each plot count category (0 plots, 1-4 plots, 5 plots), by state and macrogroup type. Metric scores for macrogroups are marked with letters and show decreased documentation in Rare/Difficult (to inventory) and Ruderal (weedy) macrogroups.

A major challenge faced by those implementing the NVC is to find a balance between the forward-looking mandate of the FGDC standard for a plot-based approach and the more subjective approach used in the original construction of the NVC content. Although many of the original association and alliance concepts were built, at least in part, using plot data, these plot data were often not made publicly available. Moreover, the original concepts were in many cases synthesized through expert judgment informed by field experience and multiple published papers, all of which were integrated into type concepts. Thus, at least in the short term, a major challenge in the implementation and application of the NVC is that, in most cases, analyses cannot be based simply on the available plot data but must be conducted in conversation with multiple experts and data users. We look forward to improvements in the quality and usability of the NVC as vegetation ecologists accumulate more plot data, take advantage of existing and emerging plot databases to better document and refine the recognized vegetation types, and make their data publicly available through websites such as VegBank.

Conclusions

Although our analysis demonstrates that a substantial portion of the NVC associations in our focal, four-state region appear adequately represented by plot data, many associations remain underrepresented. We note that the amount of data necessary for quantitative classification is likely to depend on many factors, including the area occupied and variability of each association across its range. Systematic efforts to merge duplicate associations and remove erroneous range assertions in several of the states have probably increased the proportion of associations that are well represented by plots, and such efforts would improve plot representation in other states as well. We found that the largest gaps in plot representation in the Carolinas and Virginias were in ruderal associations, and in associations that are rare, difficult to inventory, and/or are overlooked as potential inventory sites.

Despite these caveats, we are encouraged by the availability of plot data to support the NVC, at least in the four-state region of the Carolinas and Virginias. Cursory inspection of adjacent states in the southeastern US reveals that more work is needed to address shortfalls of plot representation necessary to adequately support the NVC across the broader region within which these states are embedded.

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Appendix (Digital Supplement)

List of plot counts by association and macrogroup. A value of 0 indicates that the association has been at least tentatively attributed to the state, whereas a blank indicates that it is not expected in the state. The macrogroups and associations indicated by the codes in the table can be queried at http://usnvc.org/explore-classification/, using the advanced search option for Classification Code.

Macrogroup	Association	NC	SC	VA	WV	total
M007	CEGL003578	21	2			23
M007	CEGL004083		18			18
M007	CEGL007511	9	1			10
M007	CEGL007767		1			1
M007	CEGL003595	18	3			21
M007	CEGL003599	6	10			16
M007	CEGL003570	12	0			12
M007	CEGL003573	8				8
M007	CEGL003664	23	0			23
M007	CEGL004084		19			19
M007	CEGL004496		28			28
M007	CEGL007738		19			19
M007	CEGL003577	7	2			9
M007	CEGL003584	12	2			14
M007	CEGL003586	25	1			26
M007	CEGL003589	5	5			10
M007	CEGL003590	16	10			26
M007	CEGL003591	8	5			13
M007	CEGL003592	4		7		11
M007	CEGL007125		0			0
M007	CEGL007126	0	0			0
M007	CEGL003593		13			13
M007	CEGL004488		2			2
M007	CEGL004492		0			0
M007	CEGL007127		0			0
M007	CEGL007129		0			0
M007	CEGL007842		7			7
M007	CEGL007844		8			8
M007	CEGL008491		0			0
M007	CEGL004689	0	0			0

Macrogroup	Association	NC	SC	VA	WV	total
M007	CEGL003659	9	1			10
M007	CEGL003660	6	4			10
M007	CEGL003663	6	0			6
M007	CEGL004085		5			5
M007	CEGL004086		4			4
M007	CEGL004495		6			6
M007	CEGL004497		2			2
M007	CEGL004498		5			5
M007	CEGL004499		5			5
M007	CEGL004500	2				2
M007	CEGL004501	17	2			19
M007	CEGL004502	9				9
M007	CEGL004790		2			2
M007	CEGL004814		2			2
M007	CEGL003643		0			0
M007	CEGL003653		0			0
M007	CEGL004486		2			2
M007	CEGL004658		3			3
M007	CEGL004791		1			1
M007	CEGL004969		0			0
M007	CEGL003647	4		0		4
M007	CEGL003648	47	4			51
M007	CEGL003649	12				12
M007	CEGL003658	9	0			9
M007	CEGL003661	17				17
M008	CEGL007459		2			2
M008	CEGL007225	24	11			35
M008	CEGL003859		0			0
M008	CEGL004091		0			0
M008	CEGL006493			10		10
M008	CEGL007206	17	3			20
M008	CEGL007210		1			1
M008	CEGL007211	25	16	19		60
M008	CEGL007321	4	1			5
M008	CEGL007845		0			0
M008	CEGL007863	0				0
M008	CEGL007866		0			0

Macrogroup	Association	NC	SC	VA	WV	total
M008	CEGL004321	22	2			24
M008	CEGL007278		1			1
M008	CEGL007862	0				0
M008	CEGL004092		4			4
M008	CEGL004747		0			0
M013	CEGL002591	1	0	6	6	13
M013	CEGL006024			0	0	0
M013	CEGL006327	0	2		0	2
M013	CEGL007124	0	0	0		0
M013	CEGL007944	1	3	0	16	20
M013	CEGL004096	0		0		0
M013	CEGL004184	0		0		0
M013	CEGL007184	0			0	0
M013	CEGL007219	2	11	0		13
M013	CEGL007220			9	14	23
M013	CEGL007221	5	2	2	13	22
M013	CEGL007279	0		12	6	18
M013	CEGL007281			0	1	1
M013	CEGL007879	1	2	1	5	9
M013	CEGL006599			10	0	10
M013	CEGL008503			3	0	3
M013	CEGL003687	0		0		0
M013	CEGL007191	0		0	0	0
M014	CEGL006049	9		1		10
M014	CEGL006308	1				1
M014	CEGL007130	7		1		8
M014	CEGL007131	14		9	13	36
M014	CEGL004983	1		1		2
M014	CEGL006029				36	36
M014	CEGL006152	2		0	14	16
M014	CEGL006254				14	14
M014	CEGL006256	23				23
M014	CEGL007128	0				0
M014	CEGL008501			7	42	49
M016	CEGL004446	6				6
M016	CEGL004447	4				4
M016	CEGL003560	0				0

Macrogroup	Association	NC	SC	VA	WV	total
M016	CEGL003765	0	2			2
M016	CEGL003993	9	3			12
M016	CEGL004445			2		2
M016	CEGL004761				0	0
M016	CEGL007078	2	0			2
M016	CEGL007119	28	0		14	42
M016	CEGL007493	7	12			19
M016	CEGL007496	0	0			0
M016	CEGL008427	3	12			15
M016	CEGL008500	10	1			11
M016	CEGL008437	7	2			9
M016	CEGL003708		3			3
M016	CEGL004415	13	1			14
M016	CEGL004416	5	3			8
M016	CEGL006490			2		2
M016	CEGL007268				97	97
M016	CEGL007720	3		1		4
M016	CEGL008515			53	1	54
M016	CEGL007244	50	11			61
M016	CEGL008567	0				0
M016	CEGL007231	0	0			0
M016	CEGL008553		1			1
M016	CEGL004232	1	0			1
M016	CEGL004542	10	4			14
M016	CEGL006192	32	4			36
M016	CEGL007230	116	38	11		165
M016	CEGL007232	36	6	19		61
M016	CEGL007233			15		15
M016	CEGL007237	1	0			1
M016	CEGL007240			0		0
M016	CEGL007692	101	12			113
M016	CEGL008475	99	16	138		253
M016	CEGL008518			75	8	83
M016	CEGL003558	5				5
M016	CEGL003711	4	6			10
M016	CEGL003713	13	2			15
M016	CEGL003714	19	7	19		45

Macrogroup	Association	NC	SC	VA	WV	total
M016	CEGL003722	10	1	7		18
M016	CEGL004413	4				4
M016	CEGL007246	3	0			3
M016	CEGL007773	30	0			30
M016	CEGL007766		0			0
M016	CEGL007699			9		9
M016	CEGL008458			5		5
M016	CEGL003684	4				4
M016	CEGL003721			5		5
M016	CEGL003752	25				25
M016	CEGL004443	20		8		28
M016	CEGL004541	8				8
M016	CEGL008489		3			3
M016	CEGL008499		0			0
M029	CEGL002586				86	86
M029	CEGL005014				13	13
M029	CEGL006495			3		3
M029	CEGL002086			0	6	6
M029	CEGL007334				7	7
M029	CEGL006217			20	2	22
M029	CEGL002103				14	14
M029	CEGL003725				91	91
M029	CEGL003896			13	1	14
M029	CEGL006976			7		7
M029	CEGL007312	6	1			7
M029	CEGL004073			33	9	42
M029	CEGL006255			16		16
M029	CEGL006458				40	40
M029	CEGL006466				20	20
M029	CEGL006476			5	0	5
M029	CEGL006492			22		22
M029	CEGL006548			5	4	9
M029	CEGL004031	16	0	0		16
M029	CEGL004420	2				2
M029	CEGL004691	28	0			28
M029	CEGL007339	0				0
M029	CEGL007880	3				3

Macrogroup	Association	NC	SC	VA	WV	total
M031	CEGL004800	1	0			1
M031	CEGL007054			19		19
M031	CEGL007392		0			0
M031	CEGL007393		0			0
M031	CEGL007864		2			2
M031	CEGL002419		1			1
M031	CEGL007429	3	1			4
M031	CEGL002420	3	2	0		5
M031	CEGL004289	0	0			0
M031	CEGL004733	21	2			23
M031	CEGL007394		4			4
M031	CEGL007422		0			0
M031	CEGL007431	28	31	25		84
M031	CEGL007432	22	14	24		60
M031	CEGL007719	27	13			40
M031	CEGL003739		0			0
M031	CEGL004231	2	0			2
M031	CEGL004484	35	6			41
M031	CEGL004651			19		19
M031	CEGL004654	0		3		3
M031	CEGL004655			1		1
M031	CEGL004958		2			2
M031	CEGL006850			6		6
M031	CEGL004079	3		1		4
M031	CEGL004082	8	2	21		31
M031	CEGL004088		0			0
M031	CEGL004695	7		14		21
M031	CEGL007329		0			0
M031	CEGL007848		0			0
M031	CEGL004418	49	3	26	4	82
M031	CEGL004900	8	0	0		8
M031	CEGL004606	4	13	0		17
M031	CEGL007732	2	30			32
M031	CEGL007846		3			3
M031	CEGL004282	1	0			1
M031	CEGL004736	1	0	0		1
M031	CEGL004737	12	1			13

Macrogroup	Association	NC	SC	VA	WV	total
M031	CEGL007142	0	0			0
M031	CEGL007348	0	0			0
M031	CEGL007350	14	1			15
M031	CEGL007544		2			2
M031	CEGL007548	6	1			7
M031	CEGL004735	12	3			15
M031	CEGL007397	3	3	13		19
M031	CEGL007356	32	1			33
M031	CEGL008487		4			4
M031	CEGL004678	31	4	14		49
M031	CEGL007737	3	3			6
M031	CEGL006498	2		27		29
M031	CEGL006605			22		22
M031	CEGL007006	42	3	21		66
M031	CEGL007551		0			0
M031	CEGL004676		0			0
M031	CEGL007039		2			2
M031	CEGL007851		0			0
M031	CEGL004222	2	1			3
M031	CEGL006348	2		2		4
M031	CEGL007373	0	0			0
M031	CEGL007343	0	0			0
M031	CEGL007346		0			0
M031	CEGL007410		0			0
M031	CEGL007731	3	5		1	9
M031	CEGL007734	1	2			3
M031	CEGL004483	1				1
M031	CEGL004698	2				2
M031	CEGL006287			42		42
M031	CEGL007166	9	1			10
M031	CEGL004740	16	6			22
M031	CEGL006603			0		0
M031	CEGL007013	71	9	8		88
M031	CEGL007727		2			2
M031	CEGL007728		2			2
M031	CEGL007730	14	11			25
M031	CEGL007806	27	0			27

Macrogroup	Association	NC	SC	VA	WV	total
M032	CEGL004410		0			0
M032	CEGL007044	4	0			4
M032	CEGL007049		2			2
M032	CEGL006146	16	0	3		19
M032	CEGL007563	4	4			8
M032	CEGL004645		3			3
M032	CEGL007558	2		6		8
M032	CEGL003669	6	0	0		6
M032	CEGL003670	6	1			7
M032	CEGL003671	18	1			19
M032	CEGL004433	1	0			1
M032	CEGL004434	7	0			7
M032	CEGL004435	10	2			12
M032	CEGL004652	6		13		19
M032	CEGL007040	3	5			8
M032	CEGL007784		0			0
M033	CEGL004427		12			12
M033	CEGL004428	0		0		0
M033	CEGL004429	5		10		15
M033	CEGL004679	14				14
M033	CEGL004734	8	1			9
M033	CEGL004104	0	0			0
M033	CEGL004550	1				1
M033	CEGL004641		0			0
M033	CEGL007434	1	1			2
M033	CEGL004424	6				6
M033	CEGL006110			27		27
M033	CEGL006137	6		5		11
M033	CEGL006223			35		35
M033	CEGL004228		0			0
M033	CEGL004481	4				4
M033	CEGL004631	0	2			2
M033	CEGL004644			38		38
M033	CEGL007447	1	3	0		4
M033	CEGL007316	6	12			18
M033	CEGL007449	11		22		33
M033	CEGL007849		2			2

Macrogroup	Association	NC	SC	VA	WV	total
M057	CEGL003881	5		7		12
M057	CEGL003950	9		9		18
M057	CEGL004043	8		24		32
M057	CEGL004397	6				6
M057	CEGL004097	12		19		31
M057	CEGL004240	5		7		12
M057	CEGL004039	14	8	8		30
M057	CEGL004040	59	7			66
M057	CEGL004234	0	4			4
M057	CEGL003813		0			0
M057	CEGL003833	14	2	7		23
M057	CEGL004784		1			1
M057	CEGL003885	5				5
M060	CEGL004400	5		11		16
M060	CEGL004406	0	4			4
M060	CEGL004401	19	3			22
M060	CEGL007009	0	0			0
M061	CEGL004296	6	0	0		6
M061	CEGL007062	0	0		46	46
M061	CEGL003909	1	0			1
M061	CEGL003913	5		6		11
M061	CEGL003915	2				2
M061	CEGL003916	18	0			18
M061	CEGL004156		0	0		0
M061	CEGL004157	7				7
M061	CEGL004158	12		0		12
M061	CEGL008408			6		6
M061	CEGL004293	6	0	1		7
M061	CEGL007043	0	1			1
M061	CEGL007697	11		0		11
M061	CEGL007771			0	8	8
M061	CEGL008438	3	1			4
M061	CEGL003914	2				2
M061	CEGL003918	6				6
M061	CEGL003917	1		12		13
M061	CEGL004167	1				1
M061	CEGL004252	0		4		4

Macrogroup	Association	NC	SC	VA	WV	total
M061	CEGL006249			2		2
M061	CEGL006193				12	12
M061	CEGL006597			0	7	7
M061	CEGL006552				23	23
M061	CEGL006570				62	62
M061	CEGL008534			1	4	5
M061	CEGL006258			2		2
M061	CEGL006567				1	1
M065	CEGL003844	6	0			6
M065	CEGL003846	16	4			20
M065	CEGL004449	0				0
M065	CEGL007829		1			1
M065	CEGL003843	5	0			5
M065	CEGL003851	4	0			4
M065	CEGL003943	16	0			16
M065	CEGL003944	8	4			12
M065	CEGL004458	6	3			9
M065	CEGL004163	4				4
M065	CEGL004164	2				2
M065	CEGL004165	2				2
M066	CEGL004656	9		13		22
M066	CEGL004789		4			4
M066	CEGL006846			0		0
M066	CEGL004202	1	1	65		67
M066	CEGL004627	0	0			0
M066	CEGL004705	3	3	7		13
M066	CEGL004472	2		17		19
M066	CEGL006094	0		0		0
M066	CEGL006913			1		1
M066	CEGL006058	0		0		0
M066	CEGL006352	0	0	0		0
M066	CEGL006027			0		0
M066	CEGL006048			3		3
M066	CEGL004189	7				7
M066	CEGL004314	1				1
M066	CEGL004628	7		42		49
M066	CEGL004660	9		4		13

Macrogroup	Association	NC	SC	VA	WV	total
M066	CEGL004706			35		35
M066	CEGL006177			3		3
M066	CEGL006181			25		25
M066	CEGL006325			32		32
M066	CEGL006578			23		23
M066	CEGL006579			1		1
M066	CEGL006833			11		11
M067	CEGL004127	48	5			53
M067	CEGL003869		0			0
M067	CEGL003954	1				1
M067	CEGL004047	26				26
M067	CEGL004132	9	2			11
M067	CEGL004384	0	0			0
M067	CEGL004463	1				1
M067	CEGL004509		1			1
M067	CEGL004752		1			1
M067	CEGL007718		5			5
M067	CEGL007744			1		1
M067	CEGL007745			8		8
M067	CEGL004100	17	0			17
M067	CEGL004105	38	3			41
M067	CEGL004131	1	1			2
M067	CEGL004120	0	0			0
M067	CEGL004475	18	1			19
M067	CEGL006608			1		1
M067	CEGL007858			31		31
M067	CEGL004467	4	0			4
M067	CEGL004468	11	0			11
M067	CEGL006499			12		12
M067	CEGL004139	1	0			1
M067	CEGL004510			1	28	29
M067	CEGL004273	0	0			0
M067	CEGL004341	2	0	0		2
M067	CEGL007052	0	0			0
M067	CEGL006310			8		8
M067	CEGL004307	10				10
M067	CEGL007859			1		1

Macrogroup	Association	NC	SC	VA	WV	total
M067	CEGL007860	1	0			1
M067	CEGL004111			14		14
M067	CEGL003839	39	5	11		55
M067	CEGL003840			7		7
M067	CEGL004635	7	3			10
M067	CEGL007384	6				6
M067	CEGL004129	3		10		13
M067	CEGL006342			7		7
M067	CEGL006350			5		5
M067	CEGL003907	1	0			1
M067	CEGL004533	2				2
M067	CEGL006242			18		18
M067	CEGL004620	0	2			2
M067	CEGL003790	7	2			9
M067	CEGL004117			14		14
M067	CEGL006840	0		13		13
M067	CEGL007713		6			6
M067	CEGL004138	3	1			4
M067	CEGL004125	1	0			1
M067	CEGL004724		1			1
M067	CEGL004960	7	0			7
M067	CEGL004051	32	6			38
M067	CEGL004257		0			0
M069	CEGL004150	0	0	0	8	8
M069	CEGL006153	1		0	0	1
M069	CEGL006245			5		5
M069	CEGL006275				2	2
M069	CEGL002026			0	12	12
M069	CEGL006102			2		2
M069	CEGL006244			6		6
M069	CEGL007696	1		10	13	24
M069	CEGL003836	5	0	0	2	7
M069	CEGL002191	1	0		26	27
M069	CEGL003905	0	0			0
M069	CEGL004075	7	0			7
M069	CEGL005089				0	0
M069	CEGL006069			2		2

Macrogroup	Association	NC	SC	VA	WV	total
M069	CEGL006843			5		5
M069	CEGL002381				51	51
M069	CEGL005082			0		0
M069	CEGL006305				13	13
M069	CEGL006464			0	36	36
M069	CEGL008474	1				1
M069	CEGL003746			19	6	25
M069	CEGL007857			1		1
M069	CEGL008542			1		1
M069	CEGL006349			0	25	25
M069	CEGL006461			0	35	35
M069	CEGL006568				29	29
M069	CEGL005448				0	0
M069	CEGL006412				25	25
M069	CEGL006595				7	7
M069	CEGL006234			2		2
M079	CEGL004178	15	1			16
M079	CEGL004188			3		3
M079	CEGL004193	0	0			0
M079	CEGL004195	13	0	24		37
M079	CEGL004201	13	1	10		24
M079	CEGL006416			16		16
M079	CEGL006418			13		13
M079	CEGL006847			2		2
M079	CEGL007741	4		11		15
M079	CEGL003920	7	2			9
M079	CEGL003921	5	0	7		12
M079	CEGL006848	3	0	2		5
M079	CEGL003924	17	10			27
M079	CEGL004194		0			0
M079	CEGL004197	45	10	13		68
M079	CEGL006150	2		0		2
M079	CEGL006611			2		2
M079	CEGL006612	2	0	12		14
M079	CEGL004186	27	4	4		35
M079	CEGL004191	35	11			46
M079	CEGL004192			7		7

Macrogroup	Association	NC	SC	VA	WV	total
M079	CEGL006586			8		8
M079	CEGL002278		4			4
M079	CEGL004308	24	21	12		57
M108	CEGL004331	2	0	0		2
M108	CEGL008457		0			0
M108	CEGL002386	0	0	1	4	5
M108	CEGL004297	1				1
M108	CEGL004323	0	0	0		0
M108	CEGL004326	5	2			7
M108	CEGL004328	2	0			2
M108	CEGL004527		0			0
M108	CEGL004661	0		2		2
M108	CEGL004725	0	0		7	7
M108	CEGL004333	0	0	0	5	5
M108	CEGL005451	0	0	1	0	1
M111	CEGL004387	0	0	0	2	2
M111	CEGL004391			0	1	1
M111	CEGL004392			0		0
M111	CEGL004980	13	0	0		13
M111	CEGL006435				6	6
M111	CEGL004395	0				0
M111	CEGL006479			3	1	4
M111	CEGL008435			2		2
M111	CEGL004394			0	1	1
M111	CEGL004476	0	0	0	0	0
M111	CEGL002596			1	5	6
M111	CEGL008426			5	0	5
M111	CEGL004302	58	0			58
M111	CEGL004515	1				1
M111	CEGL007723		0			0
M111	CEGL003982	0	0	0		0
M111	CEGL004759	0				0
M111	CEGL003979	2	0	0		2
M111	CEGL004388	0	0	0		0
M111	CEGL004779	0	0			0
M111	CEGL004142			0	3	3
M111	CEGL004143			0		0

Macrogroup	Association	NC	SC	VA	WV	total
M111	CEGL004385	0				0
M111	CEGL004389			0	7	7
M111	CEGL004454	1				1
M123	CEGL004018	0		0		0
M123	CEGL006107			0	0	0
M123	CEGL005461	0		0	0	0
M123	CEGL006451			0	0	0
M159	CEGL006108				7	7
M161	CEGL004465	2				2
M161	CEGL004466	2				2
M161	CEGL004653			2		2
M161	CEGL003734	6	4			10
M161	CEGL004441	20	14			34
M161	CEGL007418	0	1			1
M161	CEGL007420	4	6			10
M161	CEGL004087		17			17
M161	CEGL004089		15			15
M161	CEGL007419		4			4
M161	CEGL003733	84	15			99
M161	CEGL004090		10			10
M162	CEGL003864		0			0
M162	CEGL003946		0			0
M302	CEGL005033		0	0	17	17
M303	CEGL006044			1	12	13
M303	CEGL004141	0	0	0	0	0
M303	CEGL004187	2	0	7		9
M303	CEGL008472	0	0	0		0
M303	CEGL006571				2	2
M303	CEGL003837	0	0			0
M303	CEGL004918		0			0
M303	CEGL004288	0	0			0
M303	CEGL003910	0	0			0
M303	CEGL003866	0	0			0
M303	CEGL004099	0	0			0
M303	CEGL004112	2	0	2	7	11
M303	CEGL004134	1	0			1
M303	CEGL007852		0			0

Macrogroup	Association	NC	SC	VA	WV	total
M303	CEGL008433	5				5
M303	CEGL004019	0	0			0
M305	CEGL007037		0			0
M305	CEGL003620			2		2
M305	CEGL004766			28		28
M305	CEGL006011	83	1	0		84
M305	CEGL007109	0	0			0
M305	CEGL007114	0	0			0
M305	CEGL007171	0	0			0
M305	CEGL007521	13	0	0		13
M305	CEGL008462	45	6	50		101
M305	CEGL004638	1	3			4
M305	CEGL004854		0			0
M305	CEGL007216	3	4	0		7
M305	CEGL007217		0			0
M305	CEGL007726	0	11			11
M307	CEGL004044	1	0	0	6	7
M307	CEGL004048	4	2	0	15	21
M307	CEGL004700		0			0
M307	CEGL004732	2	3	0		5
M307	CEGL003882	0	0	0	0	0
M307	CEGL008568	1	0	0		1
M307	CEGL008560	0	0	0		0
M307	CEGL003807	0	0			0
M308	CEGL004269	0	0			0
M310	CEGL007330	0	1	0		1
M310	CEGL007411	0	0			0
M310	CEGL007445	3	0	0		3
M310	CEGL004649	0		7		7
M310	CEGL007546	8	0	0		8
M310	CEGL007560		0			0
M310	CEGL007412		0			0
M401	CEGL007671	0	0			0
M401	CEGL004702	0	1			1
M401	CEGL007835				1	1
M502	CEGL005023				32	32
M502	CEGL006271	114	23	32	83	252

Macrogroup	Association	NC	SC	VA	WV	total
M502	CEGL006281	38	1			39
M502	CEGL006282			27	10	37
M502	CEGL006299			104	20	124
M502	CEGL008431		4			4
M502	CEGL008524			12	10	22
M502	CEGL003890	3				3
M502	CEGL004817	2		32	1	35
M502	CEGL006057			63	9	72
M502	CEGL006286	58	3	3	16	80
M502	CEGL007267	75	16	15	124	230
M502	CEGL008523			26	5	31
M502	CEGL006565			14	9	23
M502	CEGL008526			13	0	13
M502	CEGL004098	6				6
M502	CEGL006018				0	0
M502	CEGL007691	10	13			23
M502	CEGL008521		0	85	0	85
M502	CEGL007100	7	3			10
M502	CEGL007517	27	23			50
M502	CEGL007519	40	11			51
M502	CEGL008539			22	45	67
M502	CEGL004256	3				3
M502	CEGL007295	12	0			12
M502	CEGL007298	28				28
M502	CEGL007299	41	0	6		47
M502	CEGL007300	88		22	2	112
M502	CEGL008506			57	25	82
M502	CEGL004793			13	21	34
M502	CEGL006017			25	3	28
M502	CEGL007215	2	0			2
M502	CEGL007748			25		25
M502	CEGL006030			17		17
M502	CEGL006231			19	10	29
M502	CEGL006037			26	4	30
M502	CEGL003768	7				7
M502	CEGL004968			3		3
M502	CEGL007721	1				1

Macrogroup	Association	NC	SC	VA	WV	total
M502	CEGL006178	4				4
M502	CEGL007138	17				17
M502	CEGL007139	7	0	4		11
M502	CEGL003617			0		0
M502	CEGL004821			5	3	8
M502	CEGL004985	8				8
M502	CEGL004996			79	67	146
M502	CEGL006557				6	6
M502	CEGL007097	81	15	1		97
M502	CEGL003624	2	0			2
M502	CEGL006288			11	24	35
M502	CEGL006562			21	28	49
M502	CEGL008525			12	8	20
M502	CEGL008530			15		15
M502	CEGL008540			29	11	40
M502	CEGL006624				12	12
M502	CEGL008449			5	6	11
M502	CEGL006212			3		3
M502	CEGL006319			2		2
M502	CEGL006040			37		37
M502	CEGL006052			11		11
M502	CEGL007540	13		6		19
M502	CEGL003683			36	1	37
M502	CEGL006209			5		5
M502	CEGL006216			52		52
M502	CEGL008514			90	8	98
M502	CEGL008516			54	10	64
M502	CEGL004549	0	0			0
M502	CEGL006075			147		147
M502	CEGL006144				0	0
M502	CEGL006919			30		30
M502	CEGL008465	53	6			59
M502	CEGL006269	1		34		35
M502	CEGL006354			5		5
M503	CEGL003667	2				2
M503	CEGL004426	21	0			21
M503	CEGL004551	20	1			21

Macrogroup	Association	NC	SC	VA	WV	total
M503	CEGL004781	5				5
M503	CEGL004994	0		6		6
M503	CEGL006132			4	15	19
M503	CEGL007031	14	1			15
M503	CEGL007041	8	6			14
M503	CEGL007388	1				1
M503	CEGL007443	0				0
M503	CEGL007565	16	0	2		18
M503	CEGL007853	0		26	30	56
M503	CEGL008416			24		24
M503	CEGL004643			17	1	18
M503	CEGL006240			4		4
M503	CEGL006497			13	7	20
M503	CEGL007399				40	40
M503	CEGL002432				15	15
M503	CEGL008473			2		2
M503	CEGL004037	4		1		5
M503	CEGL004042	5	0	0		5
M503	CEGL007403	33	9	17		59
M503	CEGL008484		2			2
M503	CEGL006453				0	0
M504	CEGL007056			12	7	19
M504	CEGL006219			2		2
M504	CEGL006238			31		31
M504	CEGL006279				10	10
M504	CEGL008533			14		14
M504	CEGL006277	6		3	20	29
M504	CEGL006556			6	23	29
M504	CEGL006587				6	6
M504	CEGL006588				19	19
M504	CEGL006590				7	7
M504	CEGL006591				12	12
M504	CEGL006592				12	12
M504	CEGL006593				6	6
M504	CEGL006594				16	16
M504	CEGL006406			12		12
M504	CEGL006413			18		18

Macrogroup	Association	NC	SC	VA	WV	total
M504	CEGL006606	23		22		45
M504	CEGL002472				5	5
M504	CEGL006003				12	12
M504	CEGL007441				4	4
M506	CEGL006084			1		1
M506	CEGL006215			8		8
M506	CEGL006294			13		13
M506	CEGL008529			14		14
M506	CEGL007045	1				1
M506	CEGL007296	1				1
M506	CEGL004999			0		0
M506	CEGL004991	7	0	1		8
M506	CEGL004992	7				7
M506	CEGL004238	6		3		9
M506	CEGL008508	1		13		14
M506	CEGL008536			15		15
M506	CEGL003892	0		0		0
M506	CEGL003893	4		0		4
M506	CEGL007293	0				0
M506	CEGL004094	9				9
M506	CEGL004242	9		2		11
M506	CEGL004760			2	0	2
M506	CEGL003814	14		2		16
M506	CEGL003816	2				2
M506	CEGL003818	16		3		19
M506	CEGL003951	8	0			8
M506	CEGL004516	3				3
M506	CEGL004819			3		3
M506	CEGL007876	1				1
M506	CEGL003891	3				3
M506	CEGL004074	14				14
M506	CEGL004277	29				29
M506	CEGL004278	1				1
M506	CEGL004279	40				40
M506	CEGL004523	6	0			6
M506	CEGL004524	4	0	1		5
M506	CEGL004989	1	0			1

Macrogroup	Association	NC	SC	VA	WV	total
M506	CEGL008509			3		3
M506	CEGL004386	1		0		1
M506	CEGL007010	1				1
M506	CEGL004910	15	0			15
M506	CEGL004990	3	0			3
M506	CEGL004283	48	0			48
M506	CEGL007690	6	4			10
M506	CEGL003939			7	6	13
M506	CEGL003958				18	18
M508	CEGL006572			6		6
M508	CEGL004276	2				2
M508	CEGL004738			6		6
M508	CEGL005131			11	0	11
M508	CEGL006047			7	6	13
M509	CEGL008470			0		0
M509	CEGL004342		3			3
M509	CEGL003857			13		13
M509	CEGL004298	6	1			7
M509	CEGL004344	2	5			7
M876	CEGL006545				60	60
M876	CEGL006596				46	46
M876	CEGL006589				4	4
M876	CEGL007856			0	26	26
M876	CEGL006549				9	9
M877	CEGL006170			5	4	9
M880	CEGL003895	9	1	1		11
M880	CEGL003901	1	0		16	17
M880	CEGL004033	2				2
M880	CEGL006463				3	3
M880	CEGL006484			3		3
M880	CEGL004285		3			3
M880	CEGL004286	14	0	14	25	53
M880	CEGL006554				5	5
M880	CEGL006480				16	16
M880	CEGL006481			10	4	14
M880	CEGL004103	7	0	4	7	18
M880	CEGL006447			0	4	4

Macrogroup	Association	NC	SC	VA	WV	total
M880	CEGL004140		0			0
M880	CEGL006483			17	3	20
M880	CEGL004290	1	0			1
M880	CEGL008555	0	0			0
M881	CEGL006283			5	12	17
M881	CEGL006477			0	10	10
M881	CEGL006478			10		10
M881	CEGL006491			11		11
M881	CEGL006623				40	40
M881	CEGL004459	2				2
M881	CEGL006598				6	6
M883	CEGL005222				185	185
M883	CEGL006237			19	0	19
M883	CEGL006472			25	0	25
M883	CEGL007291	15	27			42
M883	CEGL007695	103		17		120
M883	CEGL007710	90		46	1	137
M883	CEGL007711	11	6			17
M883	CEGL007878	17				17
M883	CEGL008412			33	4	37
M883	CEGL002411				0	0
M883	CEGL006055			32		32
M883	CEGL006186			33	0	33
M883	CEGL007881			0		0
M883	CEGL003949	0	1			1
M883	CEGL004539	11	0	11		22
M883	CEGL006227		1			1
M883	CEGL007181			24		24
M883	CEGL008466	38	11	15		64
M883	CEGL003819	1	0	0		1
M883	CEGL006474			20	0	20
M883	CEGL006620				21	21
M883	CEGL006923				12	12
M883	CEGL007102	16	9	0		25
M883	CEGL007136	47	3			50
M883	CEGL007143	20	2	0		22
M883	CEGL007543	112	30	23	76	241

Macrogroup	Association	NC	SC	VA	WV	total
M883	CEGL007693	34				34
M883	CEGL008405			14	3	17
M883	CEGL008407			2	17	19
M883	CEGL008512			29		29
M883	CEGL004503	3	0			3
M883	CEGL004973	32		5	3	40
M883	CEGL004982	7		0		7
M883	CEGL006124	11		3	0	14
M883	CEGL006130	16				16
M883	CEGL007285	36		29		65
M883	CEGL007861	24		9	17	50
M883	CEGL008504			7	10	17
M883	CEGL008558	5		0		5
M883	CEGL006045			20	45	65
M883	CEGL006445				5	5
M883	CEGL006459			4		4
M883	CEGL006473			0	0	0
M883	CEGL006637			0	0	0
M883	CEGL005043				23	23
M883	CEGL006206			0	20	20
M883	CEGL006304			38	9	47
M883	CEGL006639			0	0	0
M883	CEGL008513			5		5
M883	CEGL002059				0	0
M883	CEGL006125				28	28
M883	CEGL006462				8	8
M883	CEGL008517			26	10	36
M883	CEGL006471			14	0	14
M883	CEGL008502			26	0	26
M883	CEGL008528			21	0	21
M885	CEGL003564		0			0
M885	CEGL007028		3			3
M885	CEGL003619	3	0			3
M885	CEGL004787		3			3
M885	CEGL007022	5	3			8
M885	CEGL004633		0			0
M885	CEGL004788		10			10

Macrogroup	**Association**	**NC**	**SC**	**VA**	**WV**	**total**
M885	CEGL007470	1	9			10
M885	CEGL007850		4			4
M885	CEGL003525	0	21			21
M885	CEGL003526		5			5
M885	CEGL003750			9		9
M885	CEGL004095		1			1
M885	CEGL004399	0	0			0
M885	CEGL007026	5	5			10
M885	CEGL007027	40	8	13		61
M885	CEGL007032	0	6			6
M885	CEGL007282	5				5
M885	CEGL007813	4	6			10

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