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Wetlands Regulatory Assistance Program (WRAP)

Assessing the Validity and Accuracy of Wetland Indicator Status Ratings for Eight Species in Alaska Subregions

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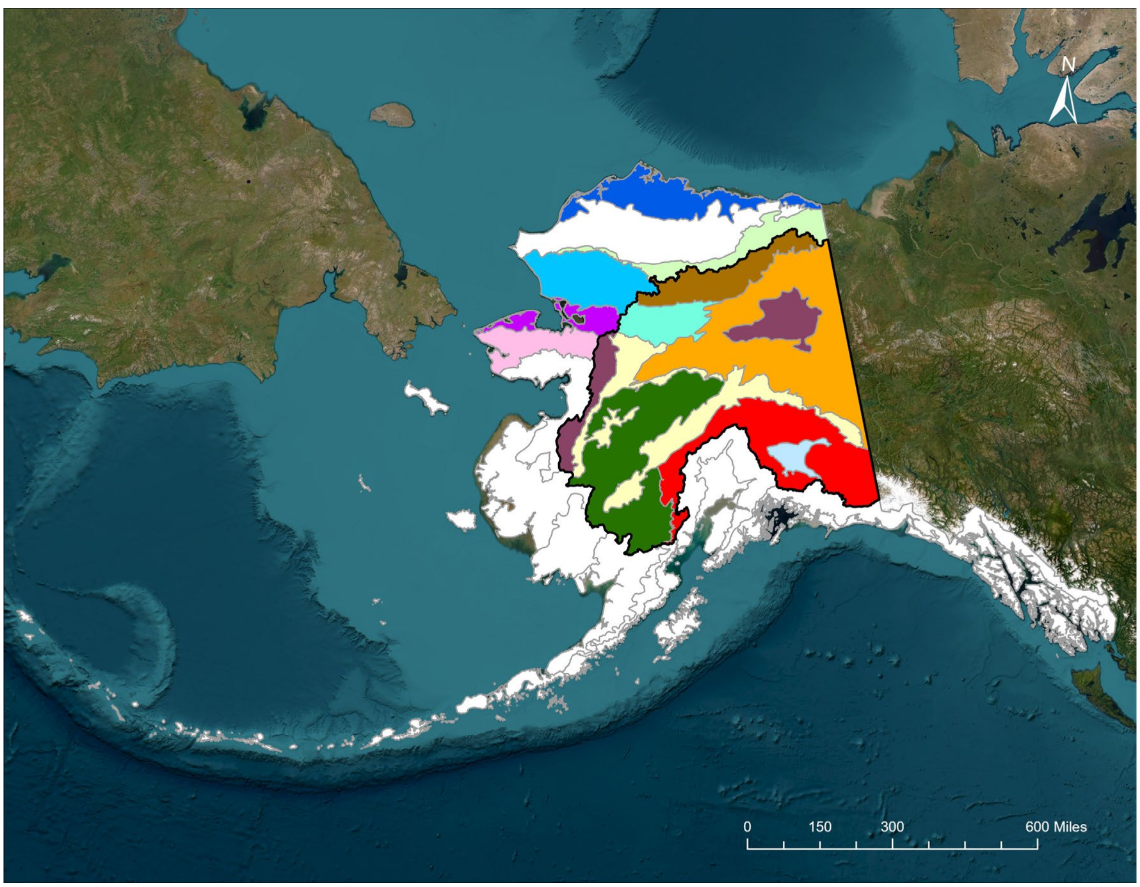
December 2024



Engineer Research and Development Center

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3909 Halls Ferry Road
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Abstract

Preexisting ecological information and plant species occurrence data were used to determine the accuracy and validity of the present regional and subregional wetland indicator status ratings for eight species: *Andromeda polifolia, Arctous rubra, Carex canescens, Rhododendron tomentosum, Rubus arcticus, Salix arctica, Salix pulchra,* and *Viola palustris*. Technical documentation was developed to either (1) support the current National Wetland Plant List (NWPL) subregion boundaries and wetland indicator status ratings for the NWPL Alaska Region or (2) support a proposed change to the subregions or wetland indicator status ratings for the NWPL Alaska Region, for inclusion into the next NWPL update. The project developed repeatable, quantitative methods for assignment of wetland indicator status rating. Analyses included multiple correspondence analysis (MCA), analysis of similarities (ANOSIM), nonmetric multidimensional scaling (NMDS), and principal component analysis (PCA). Prevalence index (PI) was used as a numeric approximation of wetland status for comparing observations across subregions. A pilot study on *S. pulchra* data evaluated regional assignments by machine learning and assessed the feasibility of correlation network analysis and Louvain clustering for wetland indicator status rating assignment as dictated by co-occurring species. The methods developed for this Alaska-specific study may be applied to any future regional or subregional updates to the NWPL.

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Preface

This study was conducted for the Wetlands Regulatory Assistance Program under AMSCO 088893, Funding Account Code U4396434 “National Wetland Plant List—Alaska Subregions.”

The work was performed by the Biogeochemical Sciences Branch of the Research and Engineering Division, US Army Engineer Research and Development Center–Cold Regions Research and Engineering Laboratory (ERDC-CRREL). At the time of publication, Mr. Nathan J. Lamie was branch chief; and Dr. Orian Z. Welling was division chief. The acting deputy director of ERDC-CRREL was Ms. M. Kelly Swiderski, and the director was Dr. Ivan P. Beckman.

The work was also performed by the Wetlands and Coastal Ecology Branch of the Ecosystem Evaluation and Engineering Division and the Environmental Processes Branch of the Environmental Processes and Engineering Division, ERDC–Environmental Laboratory (EL). At the time of publication, Mr. Robert McComas and Mr. Will Jones were branch chiefs; and Mr. Mark Farr and Mr. Warren Lorentz were division chiefs. The deputy director of ERDC-EL was Dr. Brandon J. Lafferty, and the director was Dr. Edmond J. Russo, Jr.

Thank you and recognition goes to the Kickoff Workshop attendees without whose input and generosity this project would not have been possible. Participants included (in alphabetical order): Leah Barrett, US Army Corps of Engineers (USACE), Estrella Campellone (USACE), Hayley Farrer (USACE), Kyle Gordon (USACE), Gwendolyn Jacobson (USACE), Charlene Johnson (USAF), Joni Johnson (USDA), Kelly McDonald (EPA), Paul Minkin (USACE), Kevin Philley (USACE), Karin Sonnen (NRCS), Blaine Spellman, National Resources Conservation Service (NRCS), Anjanette Steer (University of Alaska), Sydney Thielke, US Fish and Wildlife Service (USFWS), Amy Tippery (USFWS), Simone Whitecloud (USACE), Mark Winterstein (University of Alaska), and Nicole Wuerslin (USACE). A special thanks goes to those who helped with data acquisition: Timm Nawrocki, database manager at the Alaska Vegetation Plots Database, Blaine Spellmon (NRCS) and Kate Beattie at

Colorado State University-Center for Environmental Management of Military Lands.

COL Christian Patterson was commander of ERDC, and Dr. David W. Pittman was the director.

1 Introduction

1.1 Background

The US Army Corps of Engineers (USACE) Regulatory Program is responsible for the administration of the National Wetland Plant List (NWPL). As administrator, USACE is federally mandated to consider additions to the plant list and update ratings every two years, along with maintaining a publicly accessible, interactive website providing the most up-to-date wetland indicator status ratings and related wetland plant science applications. These wetland indicator status ratings represent a plant species' estimated frequency of occurrence in wetlands and are used in determining whether the hydrophytic vegetation factor is met when conducting wetland delineations under the Clean Water Act and wetland determinations under the Wetland Conservation Provisions of the Food Security Act. Wetland indicator status ratings defined by Lichvar et al. (2012) and used throughout this document can be found in Table 1.

Table 1. Definitions of wetland indicator status ratings.

Wetland Indicator Status Rating (Abbreviation)	Definition
Obligate (OBL)	Almost always occur in wetlands
Facultative Wetland (FACW)	Usually occur in wetlands, but may occur in uplands
Facultative (FAC)	Occur in wetlands and uplands
Facultative Upland (FACU)	Usually occur in uplands, but may occur in wetlands
Upland (UPL)	Almost never occur in wetlands

The NWPL is also regionalized to account for variability in ecological factors affecting plant species distribution and includes 10 regions across the US and its territories. The NWPL is led by the NWPL National Panel and supported by Regional Panels, all of which are chaired by USACE, and include members from the EPA, the US Fish and Wildlife Service (USFWS), and the US Department of Agriculture Natural Resources Conservation Service (NRCS).

The NWPL Alaska Region covers the entire state of Alaska. Included within this region are 13 subregions, including Alaska Interior, which overlaps with several other subregions (Figure 1). Eight plant species have a different wetland indicator status rating in one or more subregions than in the overall NWPL Alaska Region, for a total 32 individual subregional wetland indicator status ratings (Table 2). For those 8 species, the state-wide rating applies when a unique rating is not specified for a given subregion (Table 2). For instance, *Rhododendron tomentosum* is FAC (facultative) in the Pebble, Donlin, Anlin (PDA) subregion while the state rating is FACW (facultative wetland). The FACW rating applies to all other subregions because a unique rating is not identified. The Alaska subregions and subregional wetland indicator status ratings have not been examined in depth since the NWPL 2012 update, which was the first produced under USACE's leadership. Those subregional wetland indicator status ratings and subregion boundaries have caused confusion among USACE, other Federal agencies, practitioners, and the public. In response, the Alaska NWPL Regional Panel expressed interest in reviewing the current subregions and subregional wetland indicator status ratings, with a goal of increasing the technical accuracy and potentially reducing the complexity of the Alaska NWPL.

Figure 1. The National Wetland Plant List (NWPL) subregions in Alaska. *Hatch marks* over all colors and *plain white* represent the Alaska Land Resource Regions (LRR) Interior Alaska subregion; *hatch marks* over just *white* depict the Major Land Resource Areas (MLRA 230 and 232) Alaska Interior subregion. See Section 3.1 for details.

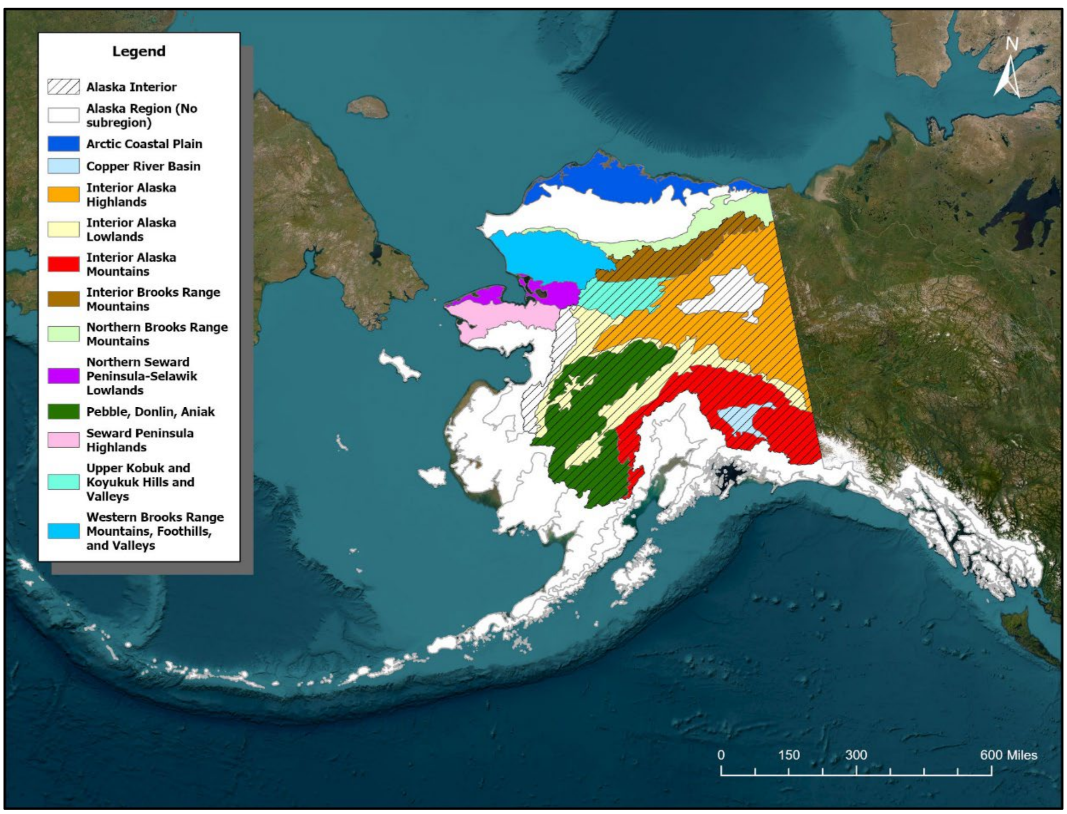


Table 2. Plant species and NWPL wetland indicator status ratings by subregion. Subregions for which there is no differing wetland status indicator rating listed are the same as the state. Total number of subregions indicates the number of subregions per species that differ in wetland indicator status ratings from the state.

Location	Abbreviation	*Arctous rubra*	*Andromeda polifolia*	*Carex canescens*	*Rhododendron tomentosum*	*Rubus arcticus*	*Salix arctica*	*Salix pulchra*	*Viola palustris*
ALASKA	ALASKA	FAC	FACW	FACW	FACW	FAC	FACU	FACW	FACW
Arctic Coastal Plain	ACP	—	—	—	—	—	FAC	—	—
Alaska Interior	AKI	—	—	—	—	—	—	—	FAC
Interior Alaska Highlands	IAH	—	—	—	—	FACU	—	—	FAC
Interior Alaska Lowlands	IAL	—	OBL	FAC	—	FACU	—	—	FAC
Interior Alaska Mountains	IAM	—	OBL	FAC	—	FACU	—	—	FAC
Copper River Basin	CRB	—	OBL	FAC	—	FACU	—	—	FAC
Western Brooks Range	WBR	FACW	—	—	—	—	FAC	FAC	—
Northern Brooks Range	NBR	FACW	—	—	—	—	—	—	—
Interior Brooks Range	IBR	—	OBL	FAC	—	FACU	—	—	FAC
Northern Seward Peninsula	NSL	FACW	—	—	—	—	FAC	—	—
Seward Peninsula Highlands	SPH	FACW	—	—	—	—	FAC	—	—
Pebble/Donlin/Aniak	PDA	—	—	—	FAC	—	—	FAC	FAC
Upper Kobuk-Koyukuk	UKK	—	OBL	FAC	—	—	—	—	—
Total number of subregions	—	4 subregions	5 subregions	5 subregions	1 subregion	5 subregions	4 subregions	2 subregions	7 subregions

1.2 Objectives

The overall objective of this work was to develop technical documentation to either (1) support the current NWPL subregion boundaries and wetland indicator status ratings for the NWPL Alaska Region or (2) support a proposed change to the subregions or wetland indicator status ratings for the NWPL Alaska Region, which will be incorporated into the next NWPL update. A third objective was added following the kickoff workshop, where participants expressed the desire for a quantitative rather than qualitative assessment of wetland indicator status rating and highlighted the need for greater transparency regarding rating assignment. Ecological information and plant species occurrence data were used to address these concerns and determine the accuracy and validity of the present regional and subregional indicators for these species. The methods developed here are quantitative, repeatable, transparent, and can be transferred to other regions and subregions with similar data. In anticipation of future needs to reevaluate ratings for other species and other regions, details regarding methods documented at the kickoff meeting are included here despite not being applied.

1.3 Approach

A variety of novel applications of methods and analyses were used to characterize the subregions and wetland indicator status ratings in question. Because of the enormity of the state of Alaska, the need for large amounts of data, and the expense of fieldwork in remote locations, preexisting data were used to evaluate the accuracy and validity of the wetland indicator status ratings and subregions for the eight species. Data were culled from online databases, herbaria, the literature, and the generosity of other Federal agencies. Datasets were analyzed independently and joined, when possible, for additional analyses. Prevalence index (PI) was calculated for all datasets and included in subsequent analyses. The analysis of similarities test (ANOSIM), a nonparametric statistical test of rank dissimilarity values, tested the null hypotheses of no difference between subregions and no difference between wetland indicator status ratings for each of the eight species. Ordination methods were used to identify patterns in these diverse datasets. Lastly, two pilot studies on *Salix pulchra* data assessed the possibility of using machine learning to identify if clustering reflected subregion assignments and if correlation analyses with co-occurring species could be used to shed light on wetland indicator status rating assignment.

PI was selected as a calculated, numeric approximation of wetland status for comparing observations across subregions (USACE 2007). The index is a weighted average calculated using percent cover and the assigned wetlands status indicator rating for of all plant species present in a plot. An index score equal to or less than 3 indicates the sampled plant community has a positive indicator of hydrophytic vegetation. In wetland delineation, the dominance test is used most often but may be less informative of the overall plant community because it focuses exclusively on the dominant plant species within a sample. Compared to the dominance test, PI provides a more holistic representation of the plant community in which the species of interest occurs and was selected for this reason. The index has also shown to be the least likely to overestimate the presence of hydrophytic vegetation in nonwetlands (Photos et al. 2019). An analysis of PI over time across all subregions was provided for each species to determine whether there are changes to the hydrophytic vegetation of plots over time, which could be driving the need for subregion or rating reevaluation. The authors recognize that this analysis represents trends for the entire state and not changes within a given subregion over time. A second comparison of PI by subregions and wetland indicator status rating provided insights into how the subregions in question compare to other subregions regarding presence or absence of the hydrophytic vegetation indicator and weighting related to wetland indicator status rating. The comparison was run twice—once with the species in question included, and a second time with the species dropped. Some regional supplements allow the user to exclude cover data for specific Facultative Upland (FACU) rated species that are known to be problematic in the region (USACE 2011). This approach was applied more broadly here, regardless of current indicator rating and PI score, to examine a species importance in sampled plant communities and subregions. Using the Alaskan Vegetation Plots Database (AKVEG) dataset, the species in question was dropped to determine how much influence that species has on the hydrophytic vegetation criterion outcome. Species importance could then be considered in wetland status indicator recommendations.

The ANOSIM test is a nonparametric test that uses a dissimilarity matrix of ranked dissimilarities to determine whether two or more groups are significantly different (Clarke and Green 1988). ANOSIM was used to test for difference between two groupings, the wetland indicator status ratings (obligate [OBL], FACW, FAC, FACU, upland [UPL]) and the 13 NWPL subregions, providing two null hypotheses for testing. The first is that there is no difference between the two currently accepted wetland status indicator ratings. The second is that there are no differences between the NWPL Alaska subregions, therefore a single wetland indicator status rating can be considered for the state. The ANOSIM statistic R describes the strength of differences between groups, it is bound between −1 and +1 with values closer to ±1 being strongest and zero being no difference between groups (Bakker 2024). To maintain consistency across species, the following thresholds were applied: $0.75 < R < 1$ = highly different; $0.5 < R < 0.75$ = different; $0.25 < R < 0.5$ = different with some overlap; $0.1 < R < 0.25$ = similar with some differences (or high overlap); $R < 0.1$ = similar (Goss-Souza 2015). A significance value less than or equal to 0.05 is considered significant.

Ordination methods reduce dimensionality of large datasets to summarize and describe patterns within the data (Peres-Neto et al. 2003). They are typically used for data exploration as opposed to hypothesis testing (Peres-Neto et al. 2003). Explanation of ordination output requires subjective interpretation. To provide transparency regarding the results of this Technical Report, the graphic output for each ordination on every dataset is provided in appendices, one for each species. The following paragraphs describe the ordination techniques applied to all species and the justifications for their selection.

Multiple correspondence analysis (MCA) is an ordination technique that explores patterns of relationships between nominal categorical variables. It is the only ordination technique applied here that is nonnumeric. Because the AKVEG dataset identifies the entity responsible for data collection, MCA was used to determine whether observer bias influenced patterns of clustering.

Nonmetric multidimensional scaling (NMDS) is a multivariate ordination technique used in plant ecology to visualize and interpret patterns in observational data, such as plant community composition, by reducing the data to a few representative dimensions. The method is *nonmetric* because it uses the rank order of observations. NMDS is particularly useful for exploring complex relationships among multiple variables and can be used to identify groups of similar plant communities, assess the effects of environmental gradients, and track changes in plant communities over time (Buttigieg and Ramette 2014).

Principal component analysis (PCA) combines the original variables into new, linear dimensions that summarize the predominant patterns, or trends in variation (Peres-Neto et al. 2003). Observations are then assigned multivariate scores along these new dimensions, or ordination axes. By reducing the dimensionality, or number of variables, PCAs shed light on relationships while minimizing the effect of random variation (Peres-Neto et al. 2003).

The methods listed above were applied to all datasets. Machine learning unsupervised clustering technique and correlation analyses were conducted as pilot studies on the *Salix pulchra* data to gauge the feasibility and value of incorporating novel applications of techniques from other research areas. *S. pulchra* was prioritized by the NWPL Alaska Regional Panel because it is widely distributed throughout Alaska and it is a dominant species in some wetland classes, including floodplains, slope wetlands, and wetlands with Black Histic hydric soil indicator; it is also a dominant species along mountainous drainages. Although this species may be present in mesic to drier areas within some subregions, it is not as dominant a species as is found in wetter areas. Because *S. pulchra* is not dominant in drier habitats, the rationale behind this species having a FAC indicator in some subregions is unclear.

Machine learning has been used in classification and predictive applications in many fields. There are hundreds of machine learning techniques that use statistical methods to uncover patterns in data. Supervised machine learning methods involve developing a model and training it using a dataset with a *base truth*. This labeled dataset is used to train a model so that the model can then be used to predict information about unlabeled data (Hastie et al. 2009). To address the validity and accuracy of ratings within subregions for the eight species of interest, there was no dataset with a base truth. The use of machine learning here was to inform the decision-making process of classifying the data, so an unsupervised machine learning method was required that would be blind to any region or subregion labels currently assigned by the NWPL. Clustering analysis was the unsupervised machine learning technique chosen. The goal of clustering analysis is to subset a dataset into groups based on properties of the data so that each group has maximum similarity of observations within the group while being maximally different from other groups (Hastie et al. 2009). Two of the most popular clustering techniques were used: k-means clustering and hierarchical clustering. Validity measurements of the clustering algorithms used are presented as well as clustering outputs from the data as suggested by these techniques.

Methods for correlation analyses originally created for discerning patterns in cellular and molecular biology were used to identify patterns of species co-occurrence. Correlation network analysis creates correlation coefficients based on a dis/similarity index that indicate the strength of relationships between different features (Toubiana et al. 2020), which in this case are co-occurring species. In a correlation network, each feature represents a node and links between nodes represent correlations. The goal for applying these methods here was to determine if there were patterns of co-occurrence between *Salix pulchra* and either FAC or FACW species to inform a rating assignment.

2 Kickoff Workshop Outcomes

Early in this study, participants from USACE, NRCS, USFWS, University of Alaska Anchorage and University of Alaska Fairbanks convened virtually in January 2023 to prioritize research efforts regarding NWPL Alaska subregions, identify available ecological and plant species occurrence data, and identify best approaches for maximizing project success.

Participants emphasized the need for transparency and quantitative analyses for assigning wetland indicator status ratings. It was suggested that ordination techniques be included in the evaluation of indicator ratings. Three research priorities were identified, (1) species that are the most frequent in wetland delineation; (2) species that have the most absolute cover within individual wetland delineation plots; and (3) species or subregions that are most problematic for practitioners, which could be done via surveys. In discussions with the USACE Alaska District (POA), two species, *Salix pulchra* and *Rhododendron tomentosum,* were highlighted as the most pressing of the eight species addressed here. Regarding *R. tomentosum*, POA specified they do not have the means to do field investigations on soil conditions for in the PDA ecoregion, nor do they have information in their files to support the decision for a FAC indicator status for PDA ecoregion. Regulators with extensive wetland delineation field experience in Interior Alaska find that the species is a reliable indicator of hydric soils, which is at odds with a FAC rating in PDA. *S. pulchra* was selected for the pilot studies because refuting two subregions for the species posed a greater challenge than refuting one for *R. tomentosum*. POA also specified there are other species in need of clarification as well as the eight considered here.

Several digital and analogue datasets and databases were identified and offered to be shared by participants. Digital datasets ranged from agency-held spreadsheets to publicly accessible databases that can be queried for a variety of factors including species and location. Analogue data were either in notebooks or wetland delineation forms submitted to the Alaska District. A table with descriptions of each and links, when available, can be found in Appendix I.

Participants also made recommendations for methods that may address the questions of subregions and wetland indicator status rating accuracy and validity if field work was feasible:

1. Relevé (uses cover classes)
2. Follow the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Alaska Region* (USACE 2007)
3. Paired point-intercept transects run from wet to dry
4. Paired upland and lowland quick ocular survey with similar soils and landscape position
5. Step-point method (based on point sampling method to determine cover: https://rangelandsgateway.org/inventorymonitoring/pointstep). The problem with identifying what is and is not above the sample point can be reduced by using a densitometer that gives a bubble-level and crosshairs to identify which species in the overhead strata are *in* (https://www.grsgis.com/densitometer.html).

Other tips that were shared for consideration during field work include the following:

- Work in a group of three so one member can act as a tie-breaker for close-call judgements.
- Go during the normal wet part of the growing season. June is too early for permafrost regions.
- Use soil maps to identify exactly where you want to be.
- Use species area curve from literature to determine plot size.

Guidance was also offered for data analysis considerations. Participants ranked data importance to wetland indicator status rating reevaluation into primary and secondary factors. Primary factors included species name, GPS coordinates, subregion of the specimen or plot as assigned by GPS, and soil data. The associated or co-occurring species and the wetland indicator status rating of those species were ranked secondary factors. Incorporation of the guidance is reflected by the relegation of co-occurring species analysis to a pilot study for a single species (*S. pulchra)*, while primary factors were used for all analyses across all species.

The workshop also identified challenges that would need to be addressed to complete the wetland indicator status ratings assessment. Because certain species are small and often occur as a single individual, minimum percent cover for inclusion within analyses of a plot need to be identified, and it is possible that this could vary by region or subregion. For instance, *Carex canescens* is often documented as *trace* for percent cover (see Section 3.3 for how this was addressed). A second challenge is how to convert ecological data such as mesic or hydric into wetland data such as FAC, FACW, or OBL ratings. Because of the nature of the analyses and the quality of the datasets selected here, conversions were not required.

3 Methods

3.1 Regions and Subregions

In preparing for the workshop, it became evident the origins of the NWPL Alaska subregions were not documented. The *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Alaska Region (Alaska Regional Supplement)* was published in 2007 and contained 6 subregions based on the NRCS 2006 Land Resource Regions (LRR, see Figure 2). The 13 subregions were added at some point afterward, but it is unclear what was used as a guideline for the 13 subregions in geographic space. Comparison of a *.kmz* file of the 13 subregions housed at the Alaska District to various technical reports and NRCS mapping layers identified the 2006 major land resource areas (MLRA) as the most likely source of subregions used for the NWPL (Figure 3). The MLRA 2006 further subdivides the LRR 2006 Interior Alaska subregion into 7 subregions; Alaska Interior (AKI), Interior Alaska Highlands (IAH), Interior Alaska Lowlands (IAL), Interior Alaska Mountains (IAM), Interior Brooks Range (IBR), Upper Kobuk and Koyukuk Hills and Valleys (UKK), and PDA. Important to note is that the NWPL Alaska map provided by POA did not include UKK in the hatch-marked region that delineates the LRR Interior Alaska region included in the Alaska Regional Supplement. It is possible that the omission was intentional: Estrella Campellone, Project Manager from POA Regulatory, notes that in aerial imagery UKK appears more like subregions in the west (Northern Seward Peninsula [NSL] and Western Brooks Range [WBR]) than to those in the LRR Interior Alaska. However, this report includes UKK in the LRR Interior Alaska subregion in recognition of the NRCS mapping.

Figure 2. Six subregions used in the 2007 *Alaska Regional Supplement*. (Image reproduced from USACE 2007; public domain.)

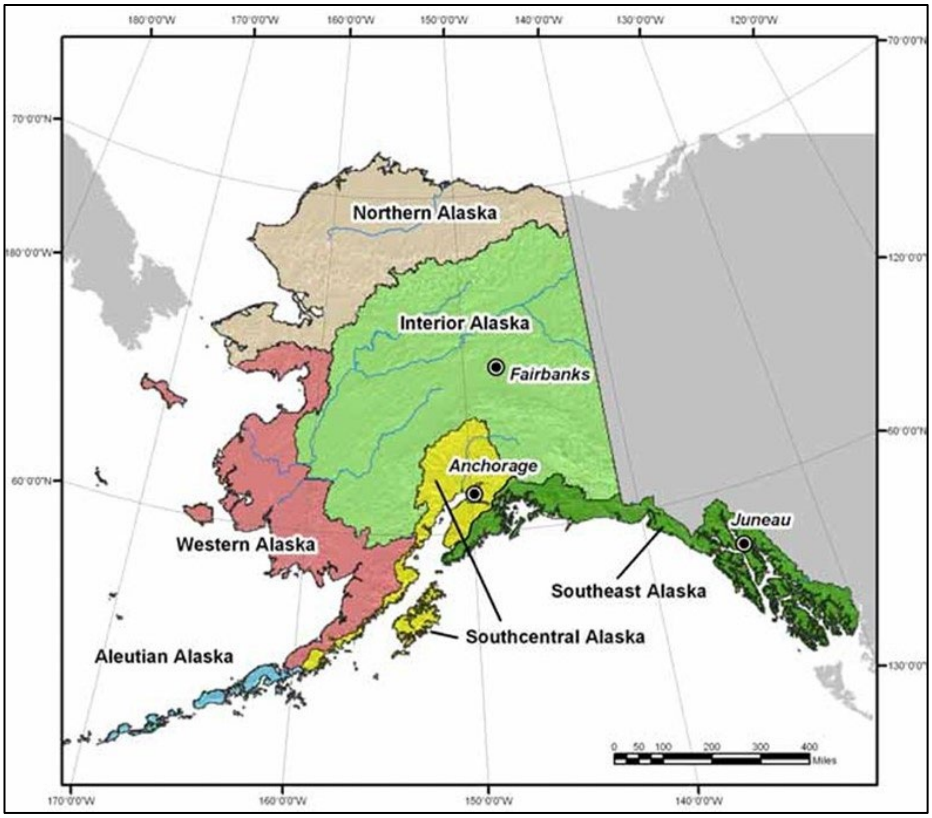
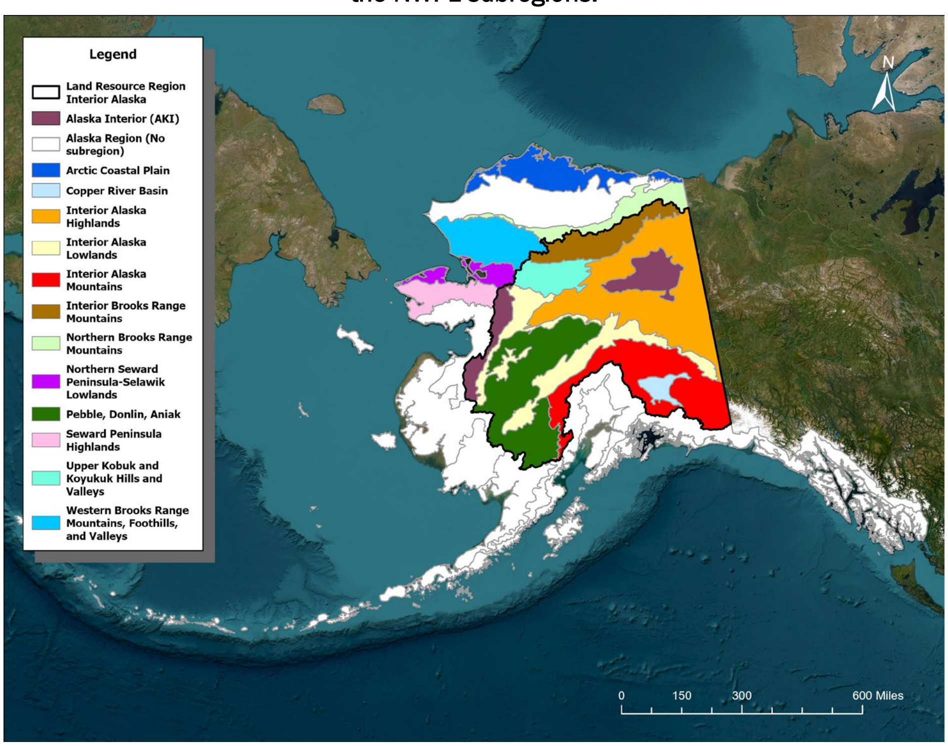


Figure 3. Major Land Resource Areas (MLRA) 2006 outlined in *gray* overlaid on the NWPL subregions.



3.2 Taxonomy and Synonymy

The taxonomy of plant species discussed herein predominantly utilizes nomenclature presented in the *National Wetland Plant List* 2020 edition. Some names are described as synonyms in literature and other online databases, and do not reflect the currently accepted name based on a memorandum of agreement between USACE, NRCS, EPA, and USFWS requiring the NWPL to use USDA PLANTS database for all nomenclature and synonymy (USACE 2017). A synonymy crosswalk was created to ensure that each taxon was accurately reflected in the NWPL along with its wetland indicator rating (see Appendix J).

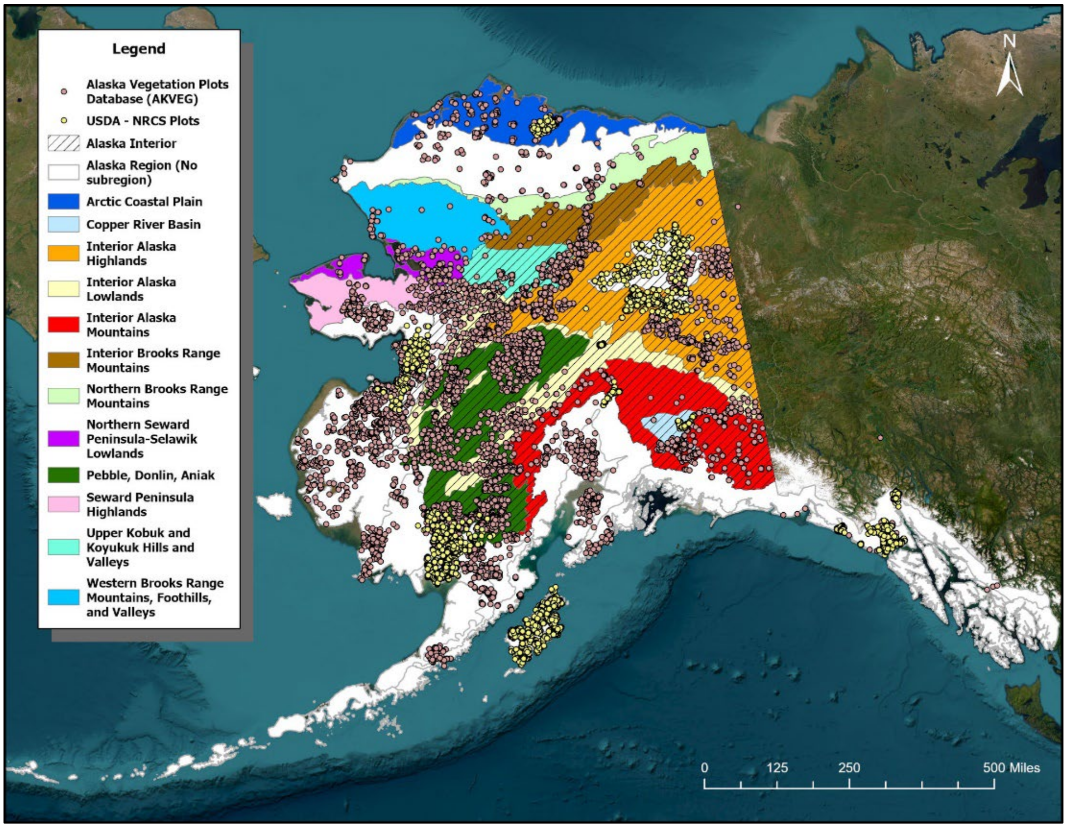
Arctous ruber appears in the NWPL as an orthographic variant used by the Biota of North America Program (BONAP 2015). This spelling is not included in the synonymy found in USDA PLANTS, Plants of the World Online (POWO), or most other sources of taxonomic information. The currently accepted name is *Arctous rubra* (Rehd. & Wilson) Nakai although USDA PLANTS lists this name as a synonym of *Arctostaphylos rubra* (Rehder & Wilson) Fernald. *A. rubra* is used here in anticipation of future updates. is used here in anticipation of future updates.

Much of the current taxonomic treatment within the *Viola* genus is tenuous. Recent molecular studies by Marcussen et al. (2022) have demonstrated the apparent need for numerous taxonomic shifts that include elevation of subspecific and varietal entities to species, combining some taxa within single species concepts, and description of many new cryptic species. *Viola palustris* L. is a species of interest within this study. Occurrences of *Viola palustris* var. *epipsila* (Ledeb.) Maxim. (=*V. epipsila* Ledeb.), *V. epipsila* Ledebour var. *repens* (W. Becker) R. J. Little, and *V. epipsiloides* Á. Löve & D. Löve were included in data searches out of an abundance of caution. The NWPL currently lists *Viola epipsila* ssp. *repens* and *V. epipsiloides* as synonyms of *V. palustris*. The AKVEG does not list any records of *V. palustris* or *V. epipsiloides* when searched in the query tool. Records of *Viola epipsila* and *Viola epipsila* var. *repens* were used instead. For the NRCS data, records for *V. palustris* were included. Records for *Viola epipsila* ssp. *repens* were renamed and included as *V. palustris*. *Viola epipsila* and *Viola epipsila* ssp. *repens* were included as co-occurring species. Most of the plant material from Alaska that has been assigned with the taxonomic determinations mentioned above may move to *Viola suecica* Fr. if recommendations by Marcussen et al. (2022) are accepted.

3.3 Data Acquisition and Compilation

Data were initially collected through a literature review and from digital herbarium records. Additional datasets were identified during the kickoff workshop (Appendix H). Factors considered for down-selection were geographic range, presence of hydric soil indicators or hydrology in addition to vegetation characterization, and existence in a digitized form. Although several options exist, two were analyzed here; data downloaded from the AKVEG and data shared from the NRCS (Figure 4). Although the species co-occurrence data were compiled for AKVEG and NRCS plots to calculate the PI for plots, the patterns of species co-occurrence by ratings were evaluated for only *S. pulchra* as a pilot study due to time constraints. Each dataset required compilation, reorganizing, or transforming prior to analysis. The two completed datasets were further compiled into a combined dataset for separate analyses. Once data were acquired, the National Wetland Plant List subregions and LRR and MLRA data from 2006, 2012, and 2022 were added as layers to all datasets. Mean elevation above sea level and the NRCS hydric soil rating were retrieved from the ESRI ArcGIS Online Portal and added to the plots through spatial joins. The hydric soil rating is defined as the total representative percentage of each map unit that the hydric components comprise (USDA NRCS). The percent estimates tend to be clustered at the low end and the high end. Typical upland soils have small inclusions of hydric soil (i.e., depressions, <15% hydric). A typical hydric soil unit will have a small percentage of nonhydric inclusions (>90% hydric). Most available soil series are not 50%/50% hydric/nonhydric; the values for this attribute on a graph usually show a pronounced bimodal distribution near the ends. One relevant dataset from the Center for Environmental Management of Military Lands (CEMML) was acquired but not included, also due to time constraints.

Figure 4. Plot locations for the datasets accessed.



3.3.1 Literature Review

Literature review began prior to the kickoff meeting and was initially envisioned as the primary source of plot data. It was hoped that in addition to geographical locations, the literature would provide ecological and community data. Journal articles were identified using the scientific and common names of the eight species as key words, as wells as *wetlands* and *Alaska*. Thirty-six out of the 46 publications identified were selected for having an abstract indicating one or more of the following: vegetation mapping, the collection of ecological data, specific mention of a species of interest. The search function was used to find data within a paper for each of the eight species, including their synonyms.

3.3.2 Herbarium Records and Mapping Layers

Herbarium records were also queried prior to the January kickoff meeting. The goal of these data was to augment plot data used in analysis and provide a more complete representation of where these species occur, and which subregions may contain samples. Digitized preserved specimens of the plant species of interest were retrieved from the Integrated Digitized

Biocollections portal (iDigBio 2023; https://www.idigbio.org/portal) for the state of Alaska. Records were then filtered to include only those with known locality information. There are two caveats to consider about the data: many times, a species would be collected by the same individual at the same site at different times of the year or over multiple years; and secondly, the same species may have been collected at the same locality but by different collectors. These data were not included in the analyses described below. However, pairing additional spatially derived data with these occurrences may allow for further analysis where plot-based records are scant or absent.

3.3.3 Alaska Vegetation Plots Database (AKVEG)

AKVEG is an open access resource of spatially explicit vegetation plot studies and monitoring surveys (https://akveg.uaa.alaska.edu/). The AKVEG database structure required three separate query and download packages for each of the eight species of interest. These included *Site* for locality, *Vegetation Cover* for estimates of abundance by species for PI calculation, and *Environmental Characteristics* for additional physical and chemical attributes if available. The three download packages were joined using the *Site Code* unique to each sample. The AKVEG database was undergoing updates during data acquisition and contained numerous blank placeholder values for environmental characteristics that had not been populated. Prioritization of other subsets of the database (i.e., site and vegetation cover) were cited by the database manager.* Results presented here for AKVEG could be enhanced by the addition of these missing variables. A total of 7,822 observations and 50 variables, not including the 897 co-occurring species, across all species were compiled before any data were excluded for missing entries.

The data structure of AKVEG database outputs results as all species displayed on rows sorted by site code. A specialized PI calculator was constructed to accommodate this arrangement. A wetland indicator status rating was populated from the NWPL based on the plant species name used in the synonymy crosswalk referenced above, cover values were sorted to one of five columns (OBL, FACW, FAC, FACU, UPL), total weighted cover was calculated by indicator rating, and a plot-level PI was derived. The PI values along with percent cover by species were transposed to a plots-on-rows data structure for statistical analysis using a two-way lookup and

* T. Nawrocki, pers. comm., 22 January 2023.

match function (find matching site codes, retrieve cover values from rows that match plant species name on column headers).

3.3.4 Natural Resources Conservation Service (NRCS)

NRCS provided a dataset of 5,877 georeferenced sites and 117 variables from the Alaska region (no subregion) and five subregions—IAH, IAM, CRB (Copper River Basin), PDA, and AKI. A table of the variables used in analyses can be found in Appendix K. Data were concatenated from a dataset regarding site features such as soil type and a second dataset which included standardized USDA plant species codes with percent cover estimates representing a total of 415 taxa. For PI to be calculated, the plant codes needed to be assigned a binomial scientific name and wetland indicator status rating (OBL, FAC, FACU, FACW, or UPL). USDA plant code species translation tables were combined into source worksheets in Microsoft Excel. The VLOOKUP function was used to find and replace the codes with their corresponding species names. Since some of the replacements also contained subspecies or naming authorities, the replaced names were trimmed to only genus and specific epithet. Any codes not found in the source worksheets were manually retrieved from https://plants.usda.gov/. The same method was used to assign the wetland indicator status rating and lifeform to each co-occurring species. Any wetland indicator status ratings not found in the source worksheets were manually retrieved from https://wetland-plants.usace.army.mil/. Nonvascular species or genus only codes were assigned a NR (not rated) status rating. The scientific names, plant codes, lifeforms, and wetland indicator status rating data were aggregated into a master reference table to mitigate potential errors in data manipulation (Table 3).

Table 3. Example of NRCS co-occurring species reference table.

Number	1	2	3	4	5
Name_accepted	Moss	Athyrium filix-femina	Carex	Chamerion angustifolium	Dicranum
Plant Code	2MOSS	ATFI	CAREX	CHAN9	DICRA8
AK_region	NR	FAC	NR	FACU	NR
Lifeform	Nonvascular	Vascular	Vascular	Vascular	Nonvascular
Rating	NRNonvascular	FAC	NRVascular	FACU	NRNonvascular

Note: NR—not rated (no wetland indicator status rating assigned).

The NRCS data analysis focused on the eight species of interest. Since the original dataset had Vegetation Plot IDs on rows and co-occurring species on columns, the percent cover data were filtered by values for each species of interest to retrieve all plots containing that species.

To calculate the PI for each plot, calculation columns were added to the end of the filtered data. A *Rating* row was added to combine *AK_region* and *Lifeform* to eliminate nonvascular lifeforms and plants identified to genus but not species. A SUMIF function was used to search the *Rating* row in the reference table for each wetland indicator status rating category to calculate total cover before applying the rating multiplier (Table 4). The final PI was calculated by dividing total weighted percent cover by total unweighted percent cover. Any column containing a *not rated* species or species code was omitted from the PI calculations.

Table 4. Wetland indicator status rating table for prevalence index (PI) calculations.

Abbreviation	Wetland Indicator Status Rating	Multiplier
OBL	Obligate Wetland	1
FACW	Facultative Wetland	2
FAC	Facultative	3
FACU	Facultative Upland	4
UPL	Upland	5
NR	Not Rated	N/A

Note: N/A—not applicable.

3.3.5 Combined AKVEG/NRCS Dataset

Following data compilation, the AKVEG and NRCS datasets were combined manually in Microsoft Excel. The variables in common between the two datasets included Accepted Name, Cover, Wetland Subrating, Observation Date, Latitude, Longitude, PI, NWPL Subregion, MLRA 2006, LRR 2006, MLRA 2012, LRR 2012, MLRA 2022, LRR 2022, Hydric Soil Rating, and Elevation. A variable describing Interior as true or false based on the LRR 2006 label was added. Observations from both datasets for these 17 variables were copied and pasted into an Excel sheet.

3.4 Prevalence Index (PI) Calculation

The following description is adapted from the USACE (2007) report, *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Alaska Region (Version 2.0)* (ERDC/EL TR-07-24).

For the purpose of wetland delineation, PI is calculated when there are indicators of hydric soil and wetland hydrology but the vegetation fails the dominance test. The calculation is a weighted-average of wetland indicator status that includes all species in the sampling plot and their respective cover to determine whether hydrophytic vegetation is present. According to wetland delineation protocol, at least 80% of species cover must be identified to species for PI calculation to be applicable for a site. Since this study focused on biogeographic regions and other ecological conditions generally considered outside the context of wetland delineation, data presented in this report were not filtered to eliminate plots that did not meet this 80% requirement. Departure from the typical wetland delineation protocols for other hydrophytic vegetation studies have been utilized in the past, including studies using landscape-scale data (Lichvar and Goulet 2017; Wakeley and Lichvar 1997). PI ranges from 1 to 5; a value of 3.0 or less indicates that hydrophytic vegetation is present.

$$PI = \frac{1(OBL)+2(FACW)+3(FAC)+4(FACU)+5(UPL)}{(OBL+FACW+FAC+FACU+UPL)} \quad (1)$$

The authors acknowledge a caveat to using PI to assess the accuracy and validity of a wetland indicator status rating. Calculating the PI of a site using the currently accepted wetland indicator status rating of the species in question can shift the results up or down relative to the wetland indicator status rating against which the species is being compared. For instance, the PI results from the PDA subregion might be influenced by *S. pulchra*'s individual indicator status rating of FAC (score of 3 for that subregion instead of FACW (score of 2 as would be used in the other subregions). The results of the calculation would be inflated by the inclusion of a 3 rather than a 2 in the calculation. To avoid inflation or deflation, particularly for species with more than one subregion in question which each warrant independent evaluation, PI was calculated assuming no difference between subregions and state-wide ratings. For the example described above, PI for *S. pulchra* was calculated using the state-wide rating of FACW for plots in PDA. Possible effects of this assumption are addressed in the corresponding Appendix for each species. Ideally, PI would be calculated twice for the subregions in questions, once with the species rated as it currently stands, and a second time with the state-wide rating. This comparison was not made due to time constraints. However, PI was calculated a second time dropping the species in question entirely. The omission provided a means to evaluate the importance of the species in determining the PI within each plot.

For the purposes of this study, it is possible to have a positive indicator of hydrophytic vegetation (i.e., PI ≤ 3.0) and lack one or both of the remaining factors of hydrology and hydric soil that are required to positively identify a wetland. Portions of the analysis lean heavily on the determination of whether the plant community is hydrophytic in the absence of available data that includes all three factors at state-wide for plots in which the species of interest are found.

3.5 Analyses

Data were manipulated as needed for each individual species; details for each are in the respective Appendices. The goal was to maximize the number of observations and variables while maintaining data integrity. Variables reporting zeros were converted to N/A (not applicable) values when appropriate. Values reported as trace amounts but shown as zeros in the datasets were converted to 0.09 to avoid confusion with true zero values. Variables containing no values were excluded. One variable was added; Interior, a true or false value indicating whether the plot occurred in the LRR Interior Alaska (=true) to ease interpretation in figures. When possible, numeric variables were imputed to provide data for missing cells (see Section 3.5.2 for details). Individual observations were excluded as needed. Co-occurring species data were not included in any ordination analyses.

3.5.1 The Categorical Ordination

MCA was conducted using four categorical factors for AKVEG: NWPLSubregion (National Wetland Plant List Subregion), WetlandSubRate (wetland indicator status rating), LRR_2012 (2012 version, USDA-NRCS 2022), and Project. The NWPL subregion factor represents the 13 subregions to which each part of Alaska is assigned and is based on the MLRA 2006 (Figure 1 and Section 3.1). The LRR_2012 was included to assess if the 5 LRR subregions better represent the geographic classifications for a wetland indicator status rating rather than the 13 subregions. Specifically, is it more valid to consider Interior Alaska as a subregion rather than further divide this subregion into seven subregions? The *Project* variable indicated by whom the plot data were collected, such as specific wetland practitioners or agencies. The first three factors were selected because they presented a means of understanding the relationship between two different ways of subdividing the state and how those relate to wetland indicator status rating, all with respect to the Project variable. Project assessed if there were strong biases for estimated characteristics such as percent cover. MCA was not conducted for NRCS or the combined AKVEG and NRCS dataset because Project was not included in the NRCS data. Analysis without Project did not offer insight to the data because it created a circular argument wherein the MCA was conducted solely on variables that were assigned for the analysis.

3.5.2 Quantitative Analyses

The percent number of missing values for each variable was calculated in Microsoft Excel. Variables with more than 60% values missing were automatically excluded from analysis. If there were variables remaining in the dataset with missing values between 0% and 60%, missRanger package version 2.4.0 was used to combine random forest imputation with predictive means matching to impute those missing values (Mayer 2023). One thousand trees were used. To determine the percentage of missing values that was acceptable to include a variable in analysis, the distribution of the variable observations was plotted before and after imputation and visualized using the ggpairs() function in GGally package version 2.2.1 (Schloerke 2024). The comparison of the distribution of values informed the percent cut-off of missing values appropriate for an imputed variable to be included in analysis if the distribution of values looked similar before and after imputation for a given variable. If values were able to be imputed, the percent cut-off threshold was determined to be 40% in all cases. Data imputation and manipulation is described in detail on a species level in each corresponding Appendix. The observations for the remaining factors were scaled using the built-in scale() function in R Studio.

Correlation analysis was conducted on AKVEG and NRCS datasets for each of the 8 species. The analysis was not necessary as a variable reducing method for the combined dataset because only 4 numeric variables were shared across the datasets. Correlation analysis was done using the built-in cor() function on the scaled data. The cor() function calculates the Pearson correlation coefficient between each combination of factors in the dataset. A correlation plot was generated using the corrplot package version 0.92 to visualize the results of the correlation analysis (Wei 2021). The analysis informed which numeric variables to down select due to high correlations before performing statistical tests, quantitative ordination and machine learning tests.

3.5.2.1 Analysis of Similarities (ANOSIM)

ANOSIM was conducted for the AKVEG dataset, the NRCS dataset, and the combined dataset for each of the 8 species. A data frame was created that included observations for only those variables that were determined to be appropriate following the correlation analysis. The data frame was then converted into a matrix using the built in as.matrix() function.

The ANOSIM test was conducted twice using the anosim() function from the vegan package version 2.6-4: once with NWPL subregion as a grouping and once with wetland indicator status rating as a grouping (Oksanen et al. 2022). The input into the ANOSIM tests was the same matrix of observations and numeric variables that was used as input into the NMDS. The distance metric chosen for the ANOSIM was bray. One hundred permutations were used for each test. The ANOSIM statistic R and the significance value was reported for each test in the Appendix for each species. Interpretation of the R statistic was as follows: $0.75 < R < 1$—highly different; $0.5 < R < 0.75$—different; $0.25 < R < 0.5$—different with some overlap; $0.1 < R < 0.25$—similar with some differences (or high overlap); $R < 0.1$—similar (Goss-Sauza 2015).

Because ANOSIM tests only if the groups are different but not which groups differ, pair-wise ANOSIM comparisons were used to identify which subregions were significantly different.

3.5.2.2 Nonmetric Multidimensional Scaling (NMDS)

NMDS was conducted for the AKVEG dataset, the NRCS dataset, and the combined dataset for each of the 8 species. Using the matrix created in 2.5.3, the NMDS was conducted using the metaMDS() function with the dissimilarity index parameter set to *bray*. The seed was set to 123 to ensure repeatability of the NMDS. The default of $k = 2$ dimensions were used. The metaMDS() function is a part of the vegan package version 2.6-4 (Oksanen et al. 2022). The NMDS scores were extracted from the NMDS output as x and y coordinates for each observation. These coordinates were converted into a data frame using the built in as.data.frame() function. The results of the NMDS were visualized by plotting these coordinates using the ggplot() function from the ggplot2 package version

3.4.2 (Wickham 2016). The goodness of fit of the NMDS is reported as a stress value between 0 and 1 with lower values indicating better fit. Here we adhere to the recommendations of Clarke (1993) to interpret how closely the NMDS matches actual dissimilarities; stress > 0.20 is a poor fit and basically random; <0.15 is good; <0.10 is excellent (Dove 2017).

3.5.2.3 Principal Component Analysis (PCA)

PCA was conducted for the AKVEG dataset, the NRCS dataset, and the combined dataset for each of the 8 species. Numeric data were imputed following the methods described in Section 3.5.2. A data frame was created that included only the observations for those variables that were determined to be appropriate to use for ordination following the correlation analysis. Because the data were scaled, values that equaled zero were converted to N/A. The data frame was then converted into a matrix using the built in as.matrix() function. The PCA was performed on this matrix using the built in prcomp() function with the scaling parameter set to true. The plot to visualize the results of the individual observations following the PCA was created using the fviz_pca_ind() function from the factoextra package version 1.0.7 (Kassambara and Mundt 2020).

3.6 Machine Learning (*Salix pulchra*)

The purpose of using unsupervised machine learning algorithms for categorical classification was to identify if patterns emerged that mirrored wetland indicator status rating assignments or subregional (at the LRR or MLRA level) assignments. Alignment of machine learning results, evidenced in clustering patterns and categorical assignments, to wetland indicator status rating or subregion would provide unbiased, nonarbitrary evidence supporting such assignments. Misalignments would refute the assignments. Analyses were conducted on the AKVEG dataset.

3.6.1 Assessing Clustering Tendency

To assess the dataset’s innate tendency to cluster, the Hopkin’s statistic was calculated using the Hopkins() function from the R package clustertend version 1.7 (Wright et al. 2023). The Hopkin’s statistic tests the null hypothesis that the data do not form meaningful clusters, or the data follow a normal distribution (Bhalla 2016). Following data scaling using the built in R function scale(), the Hopkin’s statistic was calculated for the scaled dataset.

3.6.2 Internal Clustering Validation

The optimal number of clusters and clustering algorithm were calculated using the clValid() function from the R package clValid version 0.7. The scaled dataset was input into the clValid() function (Brock et al. 2008). The clustering methods *k*-means, hierarchical, and pam were tested with the number of clusters between 2 and 15 and the validation method of internal. The measurements calculated with this function are connectivity, average silhouette width, and Dunn index. The connectivity relates to the connectedness of datapoints within the same cluster and should be minimized. The average silhouette width and Dunn index are measures of the separation of the clusters, and they should both be maximized (Brock et al. 2008; Poulinakis 2022).

3.6.3 K-Means Clustering

The optimal number of *k*-means clusters was calculated using the fviz_nbclust() function from the factoextra package version 1.0.7 (Kassambara and Mundt 2020). The scaled dataset was input and the output total within sum of squares and average silhouette width score was visualized. The average silhouette width describes the separation of the clusters. The total within sum of squares describes the variability within a given cluster. It is calculated as the distance between a point in the cluster to the centroid of the cluster. The optimal number of clusters is visualized at the *elbow*, or the point in the graph where the slope begins to decrease drastically.

The optimal number of *k*-means clusters can also be calculated by using the NbClust() function from the package NbClust version 3.0.1 (Charrad et al. 2014). The scaled dataset was used as input, and the parameters were set to distance method *euclidean* and method *kmeans*. The function NbClust() also assigns a cluster to each individual observation within the dataset. Since two or three clusters were determined to be optimal with tied scores, the function assigned each observation a label of 1 through 2 or 1 through 3. These assignments were visualized using the fviz_cluster() function from the package factoextra version 1.0.7 (Kassambara and Mundt 2020). The individual observation’s clustering assignment within the two or three clusters was mapped with other variables to see if any patterns emerged.

To determine what variables were driving the *k*-means clustering algorithm, a Random Forest model was generated (Alghofaili 2021; Ho 1995). The cluster assignment determined by the NbClust() function was appended to the original data frame of 888 observations with 4 variables. Using the randomForest() function from the package randomForest version 4.7-1.1, a random forest model was developed to predict the cluster assignment based on the 14 environmental variables (Liaw and Wiener 2002). The varImpPlot() function from the package randomForest version 4.7-1.1 generated the output (Liaw and Wiener 2002).

3.6.4 Hierarchical Clustering

The optimal number of hierarchical clusters was calculated using the fviz_nbclust() function from the factoextra package version 1.0.7 (Kassambara and Mundt 2020). The scaled dataset was input and the output total within sum of squares and silhouette score was visualized.

The optimal number of hierarchical clusters can also be calculated by using the NbClust() function from the package NbClust version 3.0.1 (Charrad et al. 2014). The scaled dataset was used as input, and the parameters were set to distance method *euclidean* and method *ward.D2*. Since three clusters were determined to be optimal, the NbClust() function assigned each observation a label of 1 through 3. These assignments were visualized using the fviz_dend() function from the package factoextra version 1.0.7 (Kassambara and Mundt 2020).

The variables driving the hierarchical clustering algorithm were determined by generating a Random Forest model. The hierarchical cluster assignment determined by the NbClust() function was appended to the original dataframe of 888 observations with 4 variables. Using the randomForest() function from the package randomForest version 4.7-1.1, a random forest model was developed to predict the cluster assignment based on the 4 environmental variables (Liaw and Wiener 2002). The varImpPlot() function from the package randomForest version 4.7-1.1 generated the output (Liaw and Wiener 2002).

3.7 Co-occurring Species Analyses for *Salix pulchra*

3.7.1 Correlation Network Analysis

Using the AKVEG dataset, the correlation network analysis was applied and visualized in R with the dplyr, corrplot, igraph, and vegan packages to all species that co-occurred with *Salix pulchra*. Correlations were applied across all subregions rather than within subregions due to the small sample size within each subregion. Numeric variables used were Elevation, Cover, Hydric Soil Rating, Depth_water, Depth_Moss_Duff, Depth_Restictive_Layer, Restrictive_Layer, Soil_pH_10, Soil_pH_30, Conductivity_10, Conductivity_30, Temperature_10, Temperature_30, Water_pH, Water_conductivity, and Water_temperature. Data were scaled prior to analysis. Plots missing data were excluded, the data set consisted of 352 observations across 894 variables. An adjacency matrix was created based on the correlation threshold. Multiple correlation network analyses were run, varying the threshold of correlations to include in the plot. Another analysis removed circular correlations and instances where the only correlation was to itself.

3.7.2 Louvain Clustering

The AKVEG dataset was used for the Louvain clustering analysis. The data set used included the percent cover data for 888 observations of the 904 species that co-occur with *Salix pulchra*. Ten species were removed from the analysis due to having no occurrence in any of the 888 observations resulting in 895 total species.

Two methods were used to calculate the correlation coefficient between all species—the parametric Pearson's correlation coefficient and the nonparametric Spearman's rank correlation coefficient. To calculate the Pearson correlation coefficient ρ, the data were first normalized by data scaling using the built in R function scale(). Then, the Pearson correlation coefficient ρ was calculated using the cor() function from the R package stats version 3.6.2 (R Core Team 2023) between each pair of species and stored with its p-value in a matrix. To calculate the Spearman correlation coefficient ρ, the cor() function was used specifying the method as "spearmans" from the R package stats version 3.6.2 (R Core Team 2023) between each pair of species and stored with its p-value in a matrix.

To build a correlation network, the correlation matrices were filtered to include only those data points that had a $\rho > 0.2$ and a p-value < 0.05. The authors recognize that this ρ is considered to represent weak correlations, as typically strong correlations are considered to have a $\rho > 0.5$, however; to visualize *Salix pulchra* in the network, the cut-off threshold was lowered to accommodate weaker correlations. A weighted, undirected graph was created from these filtered Pearson or Spearman correlation matrices using the graph_from_adjacency_matrix() function from the R package igraph version 2.1.2 (Csárdi et al. 2024). Self-loops were deleted by setting diag to FALSE. The edge lists were extracted from the graph objects and visualized using the gephi software (Bastian et al. 2009). The entire network was analyzed, however; only those nodes that connected with *Salix pulchra* are reported here.

4 Results and Recommendations

Recommendations for wetland status indicator rating for each species is below. Results and interpretations for each analysis that was conducted for all species is included in a separate Appendix for each species (Appendix A–Appendix H). Results for the two pilot studies, machine learning and species correlation analyses for *Salix pulchra*, are presented below.

4.1 Literature Review

Twenty-four publications were identified as containing one or more species in question and environmental data. Table 5 provides the total number of publications in which a given species was referenced. Additionally, GPS coordinates for a species observation, plot soil and hydrology data, and species co-occurrence were recorded in an Excel spreadsheet, when provided. Thirty species observations included GPS coordinates; most species had four or fewer mappable observations (Table 5). Plot dimensions and site-specific environmental data were available for only a handful of these observations. It was concluded that the literature does not provide the type of data needed for quantitative analyses of wetland indicator status rating and subregion accuracy. Because of the lack of environmental data, data compiled from the literature were not included in the analyses described below.

Table 5. Number of publications in which a species was referenced and number of species observations with GPS coordinates.

Species	Publication Count	GPS Provided
Andromeda polifolia	12	2
Arctous rubra	10	0
Carex canescens	4	3
Rhododendron tomentosum	18	4
Rubus arcticus	8	2
Salix arctica	11	6
Salix pulchra	17	10
Viola palustris	2	3
Species observations with GPS	–	30

4.2 Herbarium Records

Maps of specimen data for each species are included in the respective Appendix.

4.3 Synthesis by Species

Recommendations for wetland status indicator ratings by species and subregion are based on the results from the multiple analyses described above and are summarized in Table 6. Results interpreted here included a minimum threshold for imputing missing values. Recommendations support 14 changes to the current NWPL subregion wetland indicator status ratings while maintaining 10 (Table 6). *A. polifolia, C. canescens, R. arcticus, S. arctica,* and *V. palustris* would benefit from reanalyses with a larger dataset (see each respective Appendix Section 3 results for a table of samples size by subregion). See below for summary recommendations by species and respective appendices for detailed results. Because *S. pulchra* was the subject of the pilot study of machine learning and cospecies analysis, it is reported first.

Table 6. Summary of recommendations by subregion and wetland indicator status rating. Subregions for which there is no differing wetland status indicator rating listed are the same as the state. Total number of subregions indicates the number of subregions per species that differ in wetland indicator status ratings from the state.

	1	2	3	4	5	6	7	8
Location	*Arctous rubra*	*Andromeda polifolia*	*Carex canescens*	*Rhododendron tomentosum*	*Rubus arcticus*	*Salix arctica*	*Salix pulchra*	*Viola palustris*
ALASKA	FAC, +	FACW, +	FACW, +	FACW, +	FAC, +	FACU, +	FACW, +	FACW, +
Arctic Coastal Plain (ACP)	+	+	—	+	+	FAC	+	
Alaska Interior (AKI) •	+	+	+	+	+	+	+	FAC→FACW
Interior Alaska Highlands (IAH) •	+	+	+	+	FACU	+	+	FAC
Interior Alaska Lowlands (IAL) •	+	OBL→FACW	FAC	+	FACU	+	+	FAC
Interior Alaska Mountains (IAM) •	+	OBL	FAC*	+	FACU	+	+	FAC
Copper River Basin (CRB) •	+	OBL→FACW*	FAC*	+	FACU		+	FAC*
Western Brooks Range (WBR)	FACW→FAC	+	—	+	+	FAC→FACU	FAC→FACW	+
Northern Brooks Range (NBR)	FACW→FAC	+	—	+	+	+	+	
Interior Brooks Range (IBR) •	+	OBL→FACW*	FAC	+	FACU	+	+	FAC
Northern Seward Peninsula (NSL)	FACW→FAC	+	+	+	+	FAC	+	
Seward Peninsula Highlands (SPH)	FACW→FAC	+	—	+	+	FAC→FACU	+	
Pebble/Donlin/Aniak (PDA) •	+	+	—	FAC→FACW	+	+	FAC→FACW	FAC
Upper Kobuk-Koyukuk (UKK) •	+	OBL→FACW	FAC	+	+		+	
Total number of subregions	4 subregions	5 subregions	5 subregions	1 subregion	5 subregions	4 subregions	2 subregions	7 subregions

Note: + is subregion included in analyses but not in question, em dash indicates no data available, *—small sample size [$n < 10$], *yellow*—change recommended, *orange*—change not recommended, *gray*—little to no data, $n \leq 3$

4.3.1 *Salix pulchra* (Appendix A)

For the AKVEG dataset, calculating PI both with and without *S. pulchra* included highlighted that this species influences the hydrophytic vegetation indicator status for the sites in which it was sampled.

Data for *S. pulchra* within WBR was robust for the AKVEG analysis (*n* = 47) but contained no observations in the NRCS data. All analyses suggest that **WBR does not warrant a different wetland indicator status rating than the rest of the Alaska Region**. Pairwise ANOSIM comparisons and the NMDS stress test of all subregions do not support lumping the eight subregions within LRR Interior Alaska into a subregion separate from the state.

Interpretation of the PDA subregion is hampered by the small sample size available from AKVEG (*n* = 7) and NRCS (*n* = 3). However, results for all analyses except the comparison of mean PI values suggest that **PDA does not warrant a wetland indicator status rating different from that of other NWPL subregions or the Alaska Region**. Comparison of the mean PI by subregion neither supports nor refutes changing the FAC wetland indicator status rating for *S. pulchra* to FACW in PDA. Results for both subregions are supported by the machine learning results (Section 4.4) which do not support splitting *S. pulchra* into multiple groupings across the state. A detailed discussion of all results presented here is available in Appendix A.

4.3.2 *Rhododendron tomentosum* (Appendix B)

For the AKVEG dataset, calculating PI both with and without *R. tomentosum* highlighted that this species influences the hydrophytic vegetation indicator status for the sites in which it was sampled.

This species had the largest dataset of any species (total AKVEG = 4917, (PDA = 1013); total NRCS = 54 but none from PDA). **All analyses support a single rating for the state of Alaska.** It is possible that recalculating PI for PDA with a value of 3 (FAC, as it is currently assigned) could change the results of that analysis and show that PDA differs from all other subregions. However, all other analyses would still support that PDA be assigned a FACW wetland indicator status rating. A detailed discussion of all results presented here is available in Appendix B.

4.3.3 *Andromeda polifolia* (Appendix C)

For the AKVEG dataset, calculating PI both with and without *A. polifolia* included in the PI calculations as did not influence the hydrophytic vegetation indicator status for the sites in which it was sampled.

All results suggest that CRB, IAL, IBR, and UKK warrant the same wetland indicator status rating as the rest of the Alaska Region (FACW). ANOSIM and ANOSIM pairwise comparisons indicate that IAM is significantly different from the state and all subregions so should remain OBL. However, reliability of CRB and IBR data interpretation is reduced by the small sample size available from AKVEG (n = 5 and n = 6, respectively). Also, the species was not well-represented by the inclusion of the NRCS dataset: of the five subregions in question, IAM was the only subregion that included occurrences of *A. polifolia* (n = 2). Results do not support the creation of an LRR Interior Alaska subregion. A detailed discussion of all results presented here is available in Appendix C.

4.3.4 *Arctous rubra* (Appendix D)

For the AKVEG dataset, calculating PI both with and without *A. rubra* included in the PI calculations did not influence the hydrophytic vegetation indicator status for the sites in which it was sampled.

Analyses were conducted on only the AKVEG dataset (n = 506) because the NRCS dataset contained one observation. **All results support a single wetland indicator status rating for the Alaska Region (FAC) with no separate subregional indicator (FACW) for WBR, NBR (Northern Brooks Range), NSL, and SPH.** A detailed discussion of all results presented here is available in Appendix D.

4.3.5 *Carex canescens* (Appendix E)

For the AKVEG dataset, calculating PI both with and without *C. canescens* included in the PI calculations did not influence the hydrophytic vegetation indicator status for the sites in which it was sampled.

Results presented for *C. canescens* come with two caveats. First, the species is challenging to identify and often occurs as trace for percent cover so it could easily be underestimated or overlooked during field surveys. As a result, the datasets are relatively small (AKVEG = 65, NRCS = 27), and only IAM and CRB are present of the five subregions in question; both are poorly represented (IAM—AKVEG n = 3 and NRCS n = 1; CRB—AKVEG n = 5 and NRCS n = 0). IAL, IBR, and UKK are not evaluated here. **All results support the continued use of a subregional wetland indicator status rating of FAC for IAM and CRB. Results also suggest the formation of an LRR Interior Alaska subregion may be appropriate. However, more research is needed due to small sample size.** A detailed discussion of all results presented here is available in Appendix E. At a gross scale for the ANOSIM test, the addition of the NRCS data to the AKVEG data decreased differences between subregions and FAC versus FACW ratings compared to AKVEG data alone. The magnitude of difference between plots also decreased for pairwise comparisons (Table E-4 and Table E-6). The decrease in differences highlights the need for more data to clearly understand the nature of subregions and wetland indicator status ratings for *C. canescens*. It is possible that the statistically significant differences found here could be eliminated with more data and negate the need for subregions. Because the species occurs at trace levels, the case could be made for eliminating subregions to streamline wetland delineation methods. A small number of observations from the subregions in question are available in the herbaria data, but this dataset would need to be augmented for further analysis. Inclusion of the CEMML dataset may also improve resolution.

4.3.6 *Rubus arcticus* (Appendix F)

For the AKVEG dataset, calculating PI both with and without *R. arcticus* included in the PI calculations did not influence the hydrophytic vegetation indicator status for the sites in which it was sampled.

Analyses were conducted on the AKVEG and combined AKVEG and NRCS dataset but not independently on the NRCS dataset because there were no observations from the five subregions in question. Of the subregions of interest, IAL and IBR were not analyzed for lack of data (n = 3 and n = 1, respectively) but their data points are included. The same is true for PDA (n = 1), which is not under examination for wetland status indicator reassignment. **ANOSIM, ANOSIM pairwise comparisons and NMDS results for both datasets support IAM, IAH and CRB remaining FACU.** Mean PI results from the AKVEG and the combined datasets could support changing the subregional wetland indicator status rating (FACU) in IAH, IAM, and CRB to match the Alaska Region wetland indicator status rating (FAC). Recalculating PI values with IAH, IAM, and IAM assigned a 4 rather than a 3 could increase the means and provide support for maintaining a FACU rating. Both datasets support changing IAH, IAM, and CRB to FAC in the PCA. Preference is given to the ANOSIM test results because they are statistical rather than exploratory. A detailed discussion of all results presented here is available in Appendix F.

4.3.7 *Salix arctica* (Appendix G)

For the AKVEG dataset, calculating PI both with and without *S. arctica* included highlighted that the species has minor influence on the hydrophytic vegetation indicator status for the sites in which it was sampled.

Analyses were conducted on only the AKVEG dataset (n = 337) and the combined AKVEG and NRCS dataset (n = 345) because the NRCS dataset contained only eight observations, all of which were from the state of Alaska. NSL was not evaluated due to a lack of data. **All results except those from the mean PI data support changing the current subregional wetland indicator status rating for WBR and SPH (FAC) to match that of Alaska Region's wetland indicator status rating (FACU). All results indicate ACP (Arctic Coastal Plain) should remain FAC.** The PI over time suggests that plots may be getting wetter. The mean value for all subregions in the state is closer to 3, thus weighted by FAC rather than FACU species. These results suggest that a FAC rating is more appropriate for ACP, WBR, and SPH. The PI results are outweighed because the data reflect only the cover of co-occurring species and do not include environmental factors. The kickoff workshop concluded that rating of co-occurring species is a secondary factor for evaluating wetland status indicator rating, while environmental factors such as soil are primary factors. Additionally, PI is included in the ordinations and was not a primary contributor to the PCA loadings, which demonstrates that PI is not as strong an influence as other environmental variables on wetland indicator status rating or subregion patterns. A detailed discussion of all results presented here is available in Appendix G.

4.3.8 *Viola palustris* (Appendix H)

For the AKVEG dataset, calculating PI both with and without *V. palustris* included in the PI calculations did influence the hydrophytic vegetation indicator status for four sites in which it was sampled. However, these sites had PI scores of 3.0, so barely met the positive criterion for hydrophytic vegetation when calculated with *V. palustris*. When the species was removed, they no longer met the criterion. Otherwise, removing the species did not influence hydrophytic vegetation criterion status.

Analyses were conducted on only the combined dataset due to a lack of data. There was no data for IAL or IBR; results for CRB are not reliable due to small sample size (*n* = 5) and PDA had too few data points to be analyzed (*n* = 2). **ANOSIM results suggest that *V. palustris* should have the same wetland indicator status rating in AKI as the rest of the state (FACW) but warrants a FAC rating in IAM and IAH.** However, this recommendation should be reassessed with PI recalculated with IAH, IAM, and AKI rated as FAC. The IAH data represents half of entire dataset so recalculation could change this outcome. Because the data for all LRR Interior Alaska subregions analyzed here behaved the same, it may be possible to extrapolate these results to other Interior subregions for which there was little to no data (IAL, IBR, and PDA). A detailed discussion of all results presented here is available in Appendix H.

4.4 Machine Learning: *Salix pulchra*

4.4.1 Assessing Clustering Tendency

The Hopkin's statistic was calculated for the scaled dataset as 0.188. Since the statistic was about halfway between 0 and the threshold of 0.5, this statistic suggested that the data innately show some tendency to cluster, however a strong conclusion could not be formed since the value was not leaning to 0.0 or 0.5.

4.4.2 Internal Clustering Validation

Using internal validation methods from the clValid package, hierarchical clustering with two clusters was determined to be the optimal number of clusters and the optimal algorithm (Figure 5). Both *k*-means and hierarchical clustering were chosen as machine learning techniques tested to try to uncover meaningful clusters based on the four numeric variables in the dataset.

Figure 5. Internal validation of clustering.

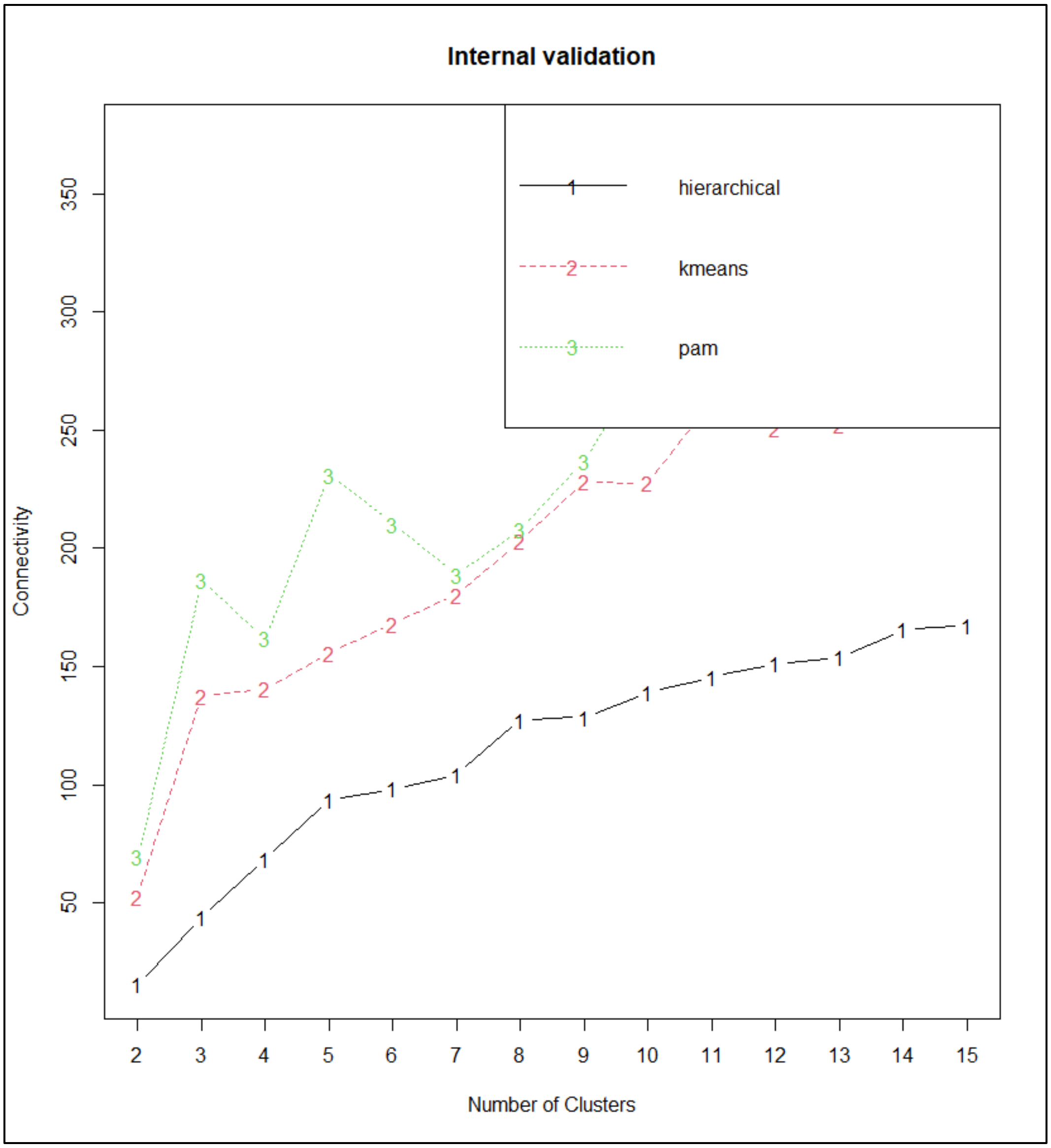


Figure 5 (cont.). Internal validation of clustering.

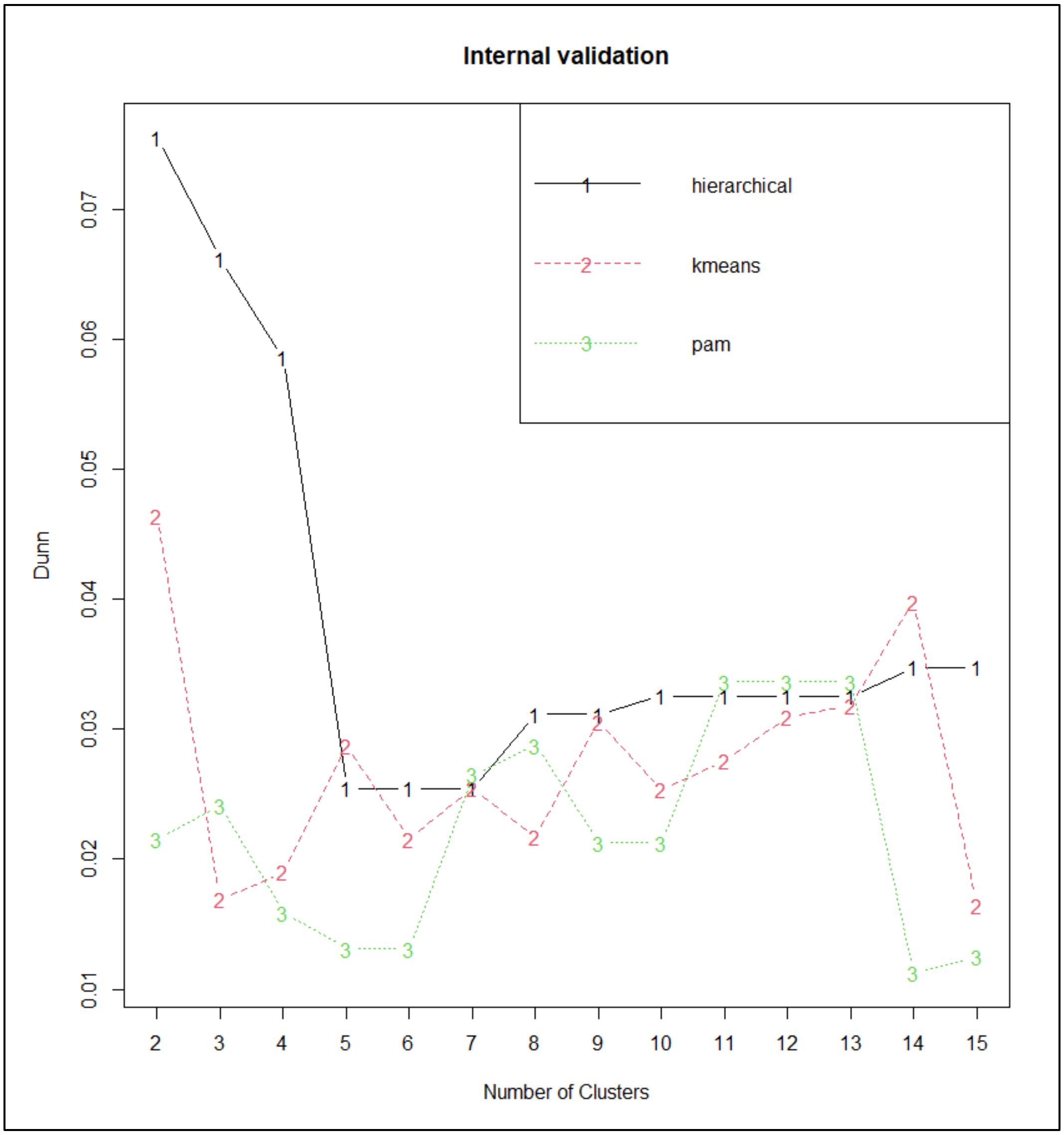
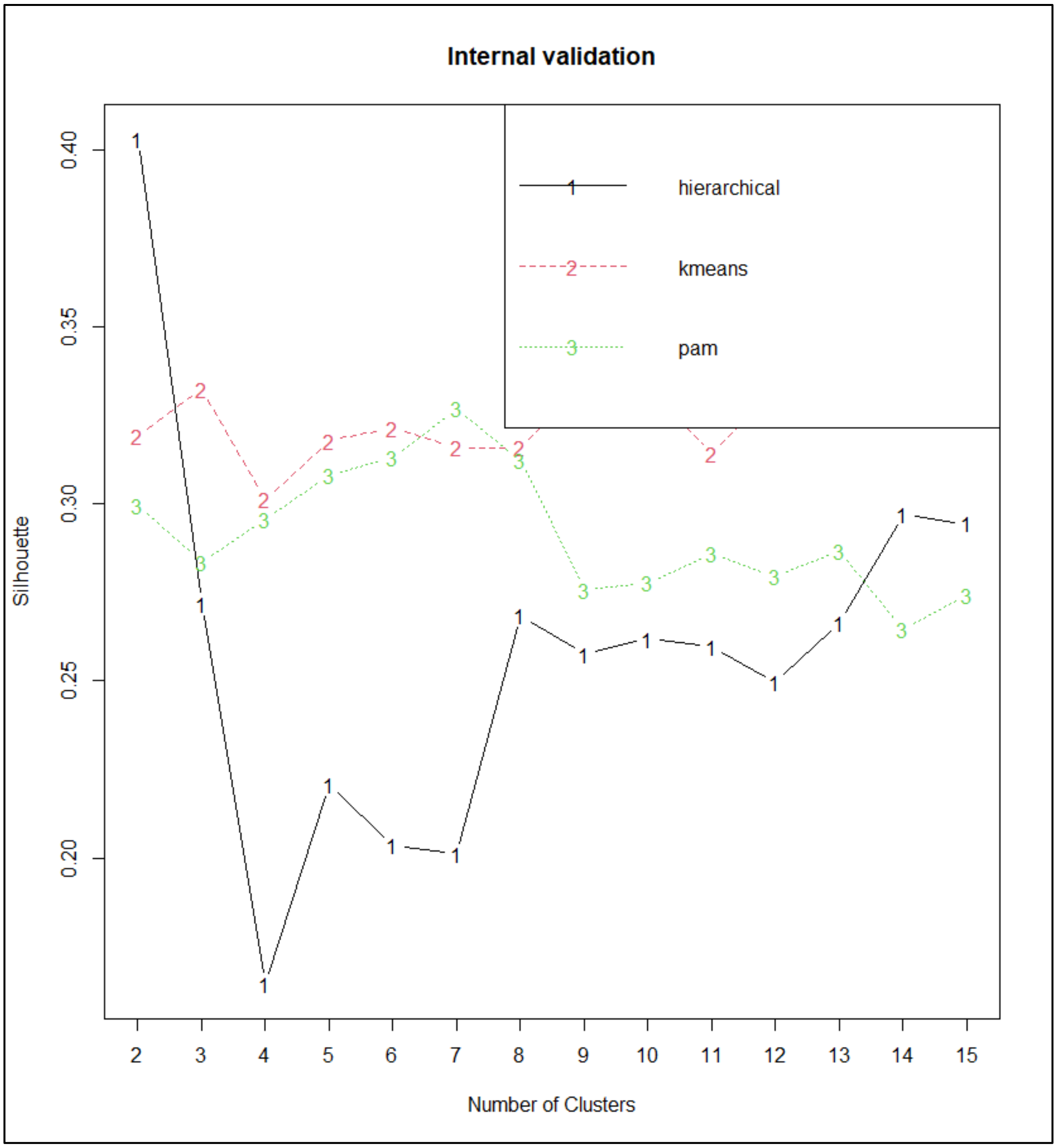


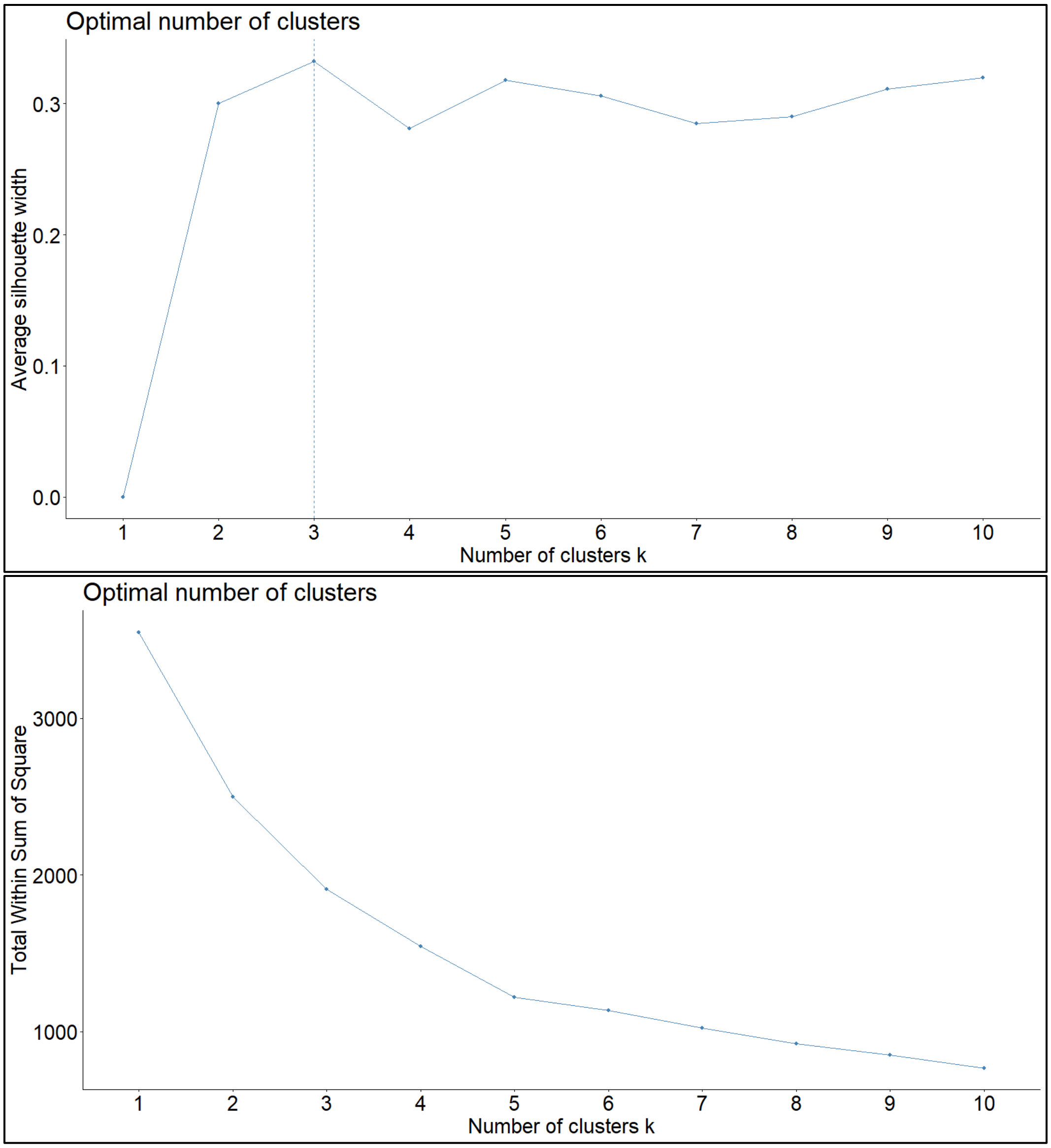
Figure 5 (cont.). Internal validation of clustering.



4.4.3 K-Means Clustering

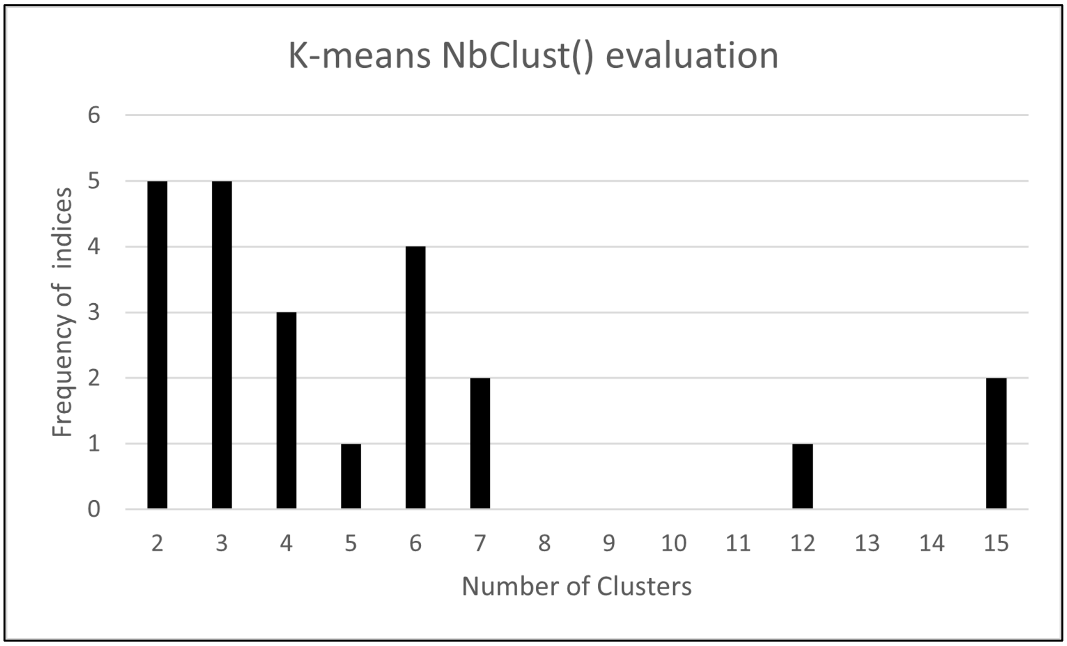
The function fviz_nbclust() draws a vertical line pointing to the optimal number of clusters to achieve a maximum silhouette score, which is shown at three (Figure 6). The optimal number of clusters based on total within sum of squares is shown as the point where the graph rapid changes, or the “elbow” in the total sum of squares plot which is not clear in the plot, suggesting indistinct clustering (Figure 6).

Figure 6. Optimal number of *k*-means clusters determined by average silhouette width and total within sum of squares.



The NbClust() function calculates twenty-three indices that test *k*-means clusters from two to fifteen. These indices are the criteria the function uses to suggest an optimal number of clusters. Results indicate that either 2 or 3 clusters are appropriate: five indices out of twenty-three determined that two clusters were the optimal number of *k*-means clusters; five indices determined three was the optimal number of *k*-means clusters (Figure 7).

Figure 7. Frequency of calculated indices for optimal *k*-means clusters between 2 and 15.



An individual observation's location within the either two or three ideal clusters was assigned by the NbClust() (Figure 8). The wetland indicator status rating was not consistent within any of the clusters assigned by NbClust() because the circles and triangles appear in all of clusters (Figure 9). The LRR 2012 distribution in the clusters also seemed to be random as the shapes representing the four subregions appeared in each cluster (Figure 10).

Figure 8. Individual observation's location in 2 or 3 *k*-means clusters (n = 888).

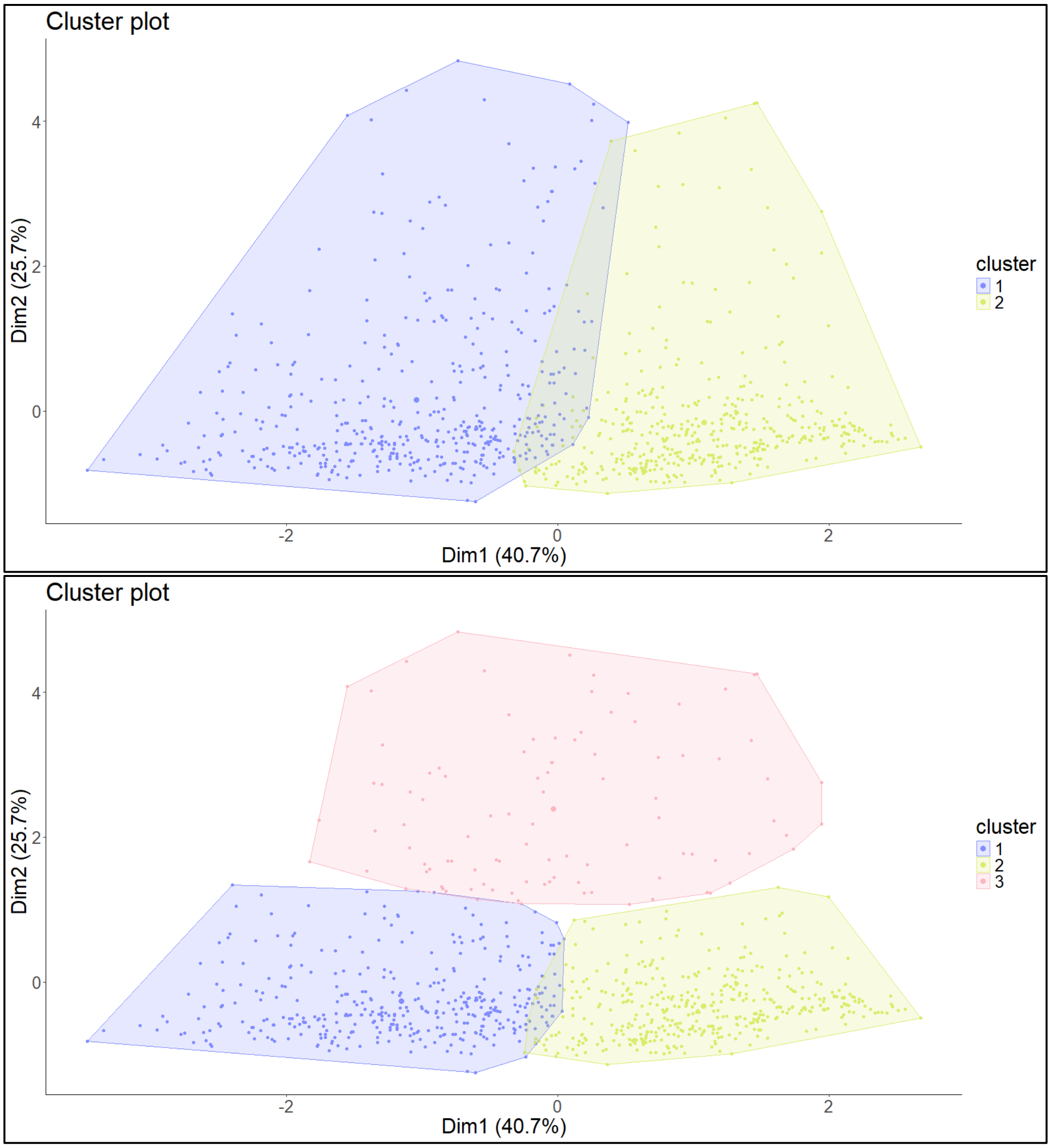


Figure 9. Individual observation's location in 2 or 3 *k*-means clusters coded by wetland indicator status rating (*n* = 888).

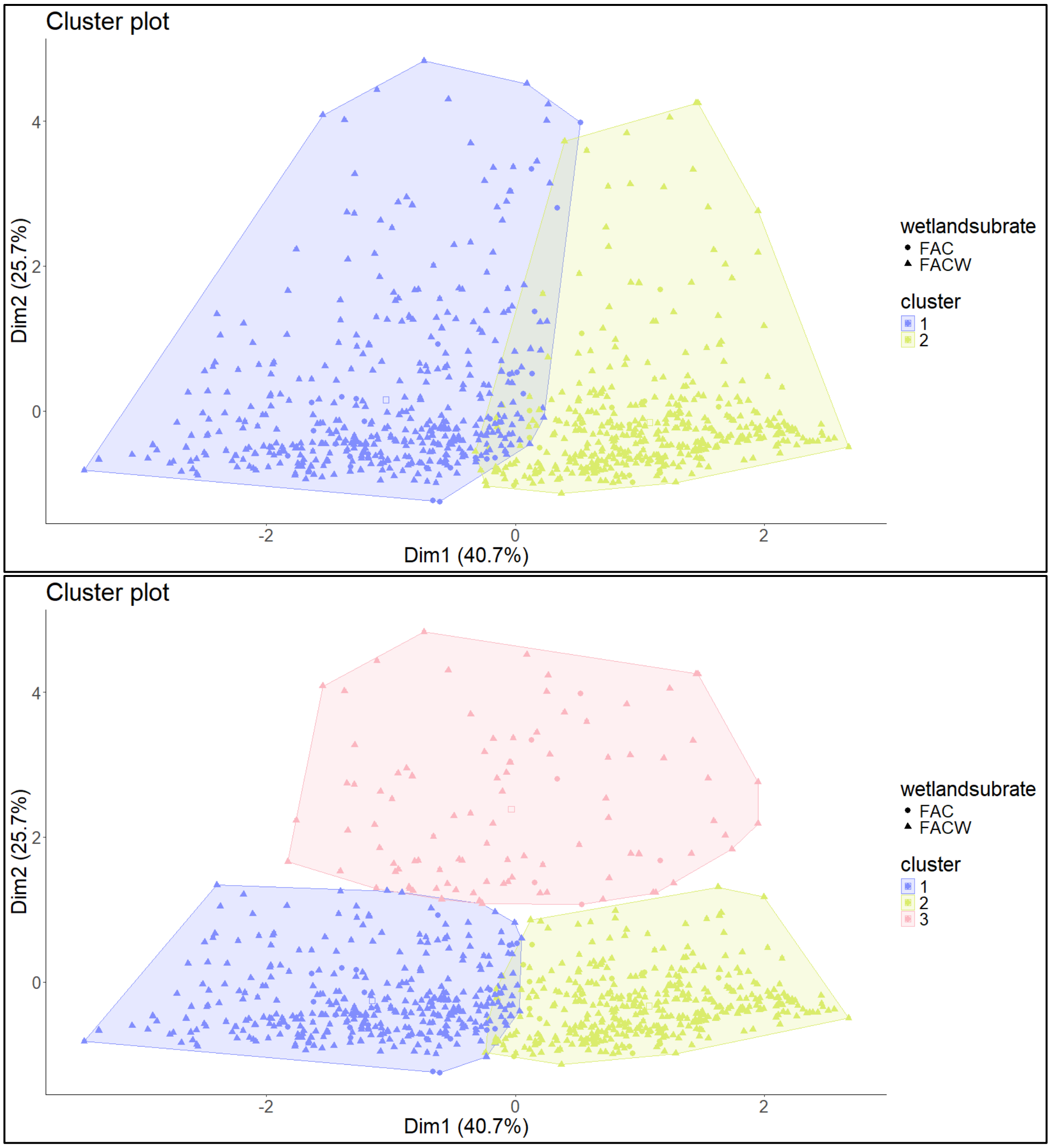
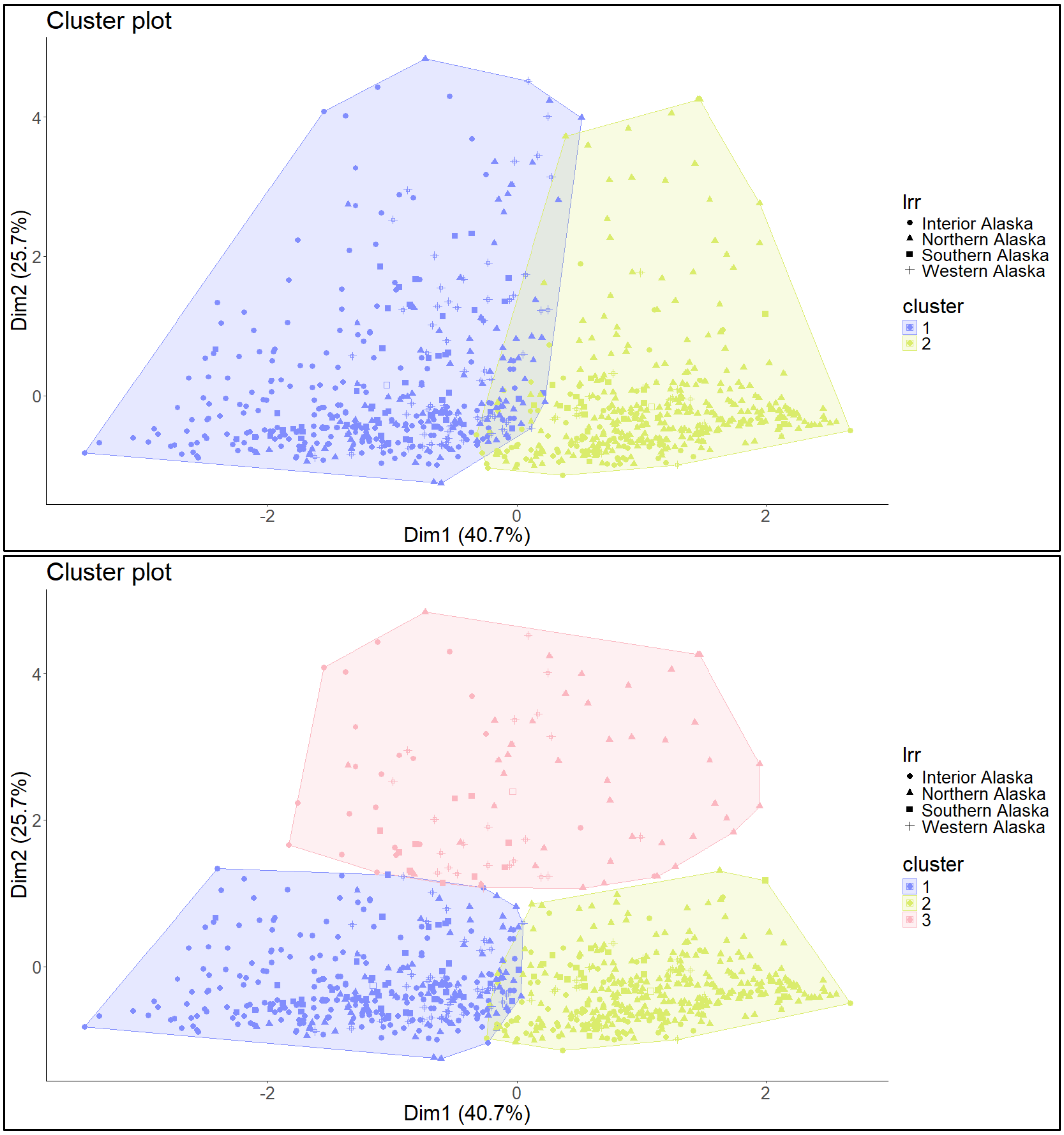


Figure 10. Individual observation's location in 2 or 3 *k*-means clusters coded by LRR 2012 (n = 888).

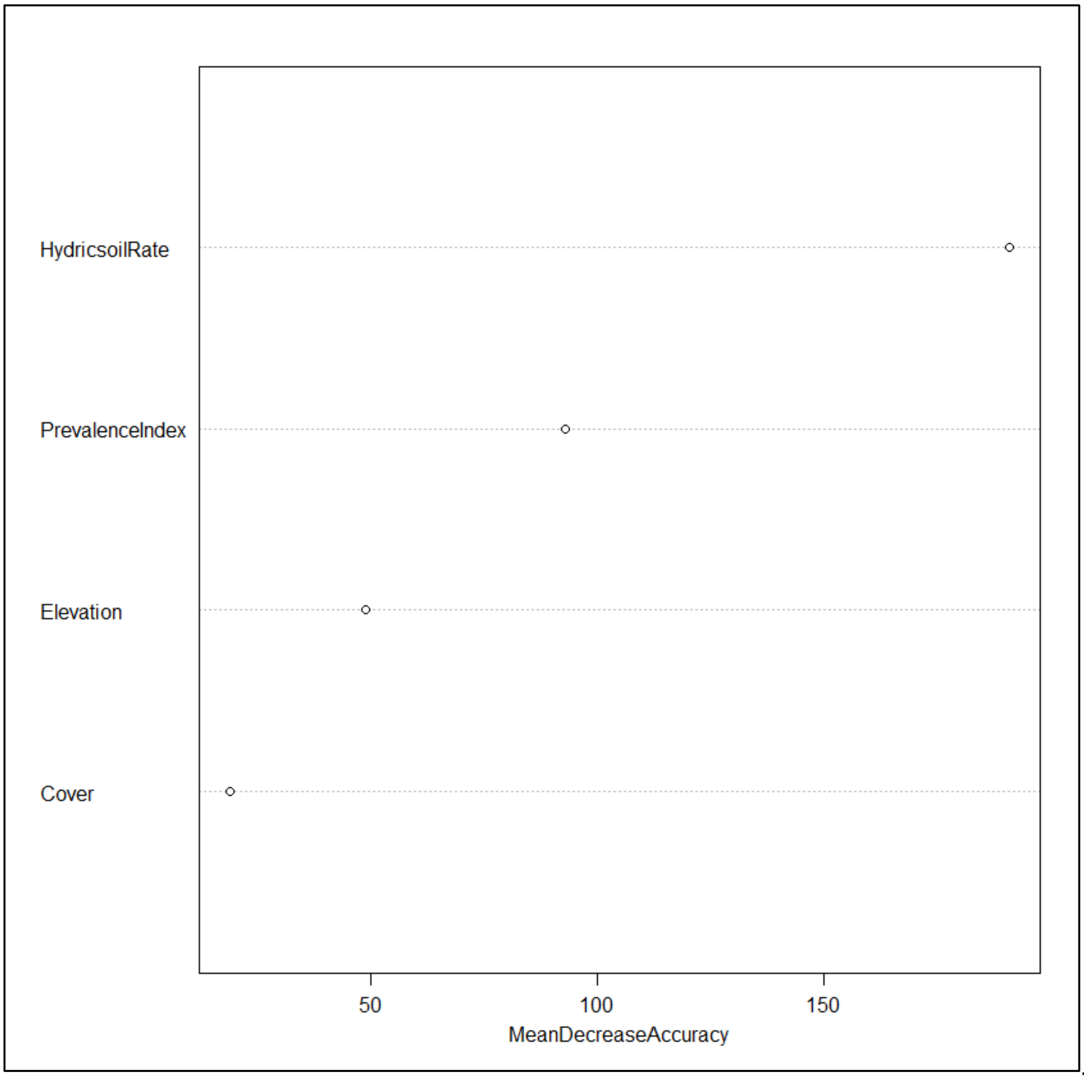


The variable driving the *k*-means clustering algorithm is Hydric Soil Rate (Figure 11). The variables at the top of the figure predict the cluster assignment with the most accuracy, which decreases from top to bottom of the list. The Hydric Soil Rate variable is assigned by NRCS as an estimate of the percent of a pixel that meet the criteria for hydric soils at a very coarse scale. While hydric soil ratings range from Hydric, Predominantly Hydric, Partially Hydric, Predominantly Nonhydric, and Nonhydric, assignments are typically at either end of the spectrum, creating a bimodal distribution.* Results imply that the hydric soil rating explains the most

* K. Philley, pers. comm., March 2023.

variance in the data, while cover by *S. pulchra* explains the least. Because neither the assignment by subregion or wetland indicator status rating reflects the clustering patterns, results imply that a single region and rating is appropriate for *S. pulchra*.

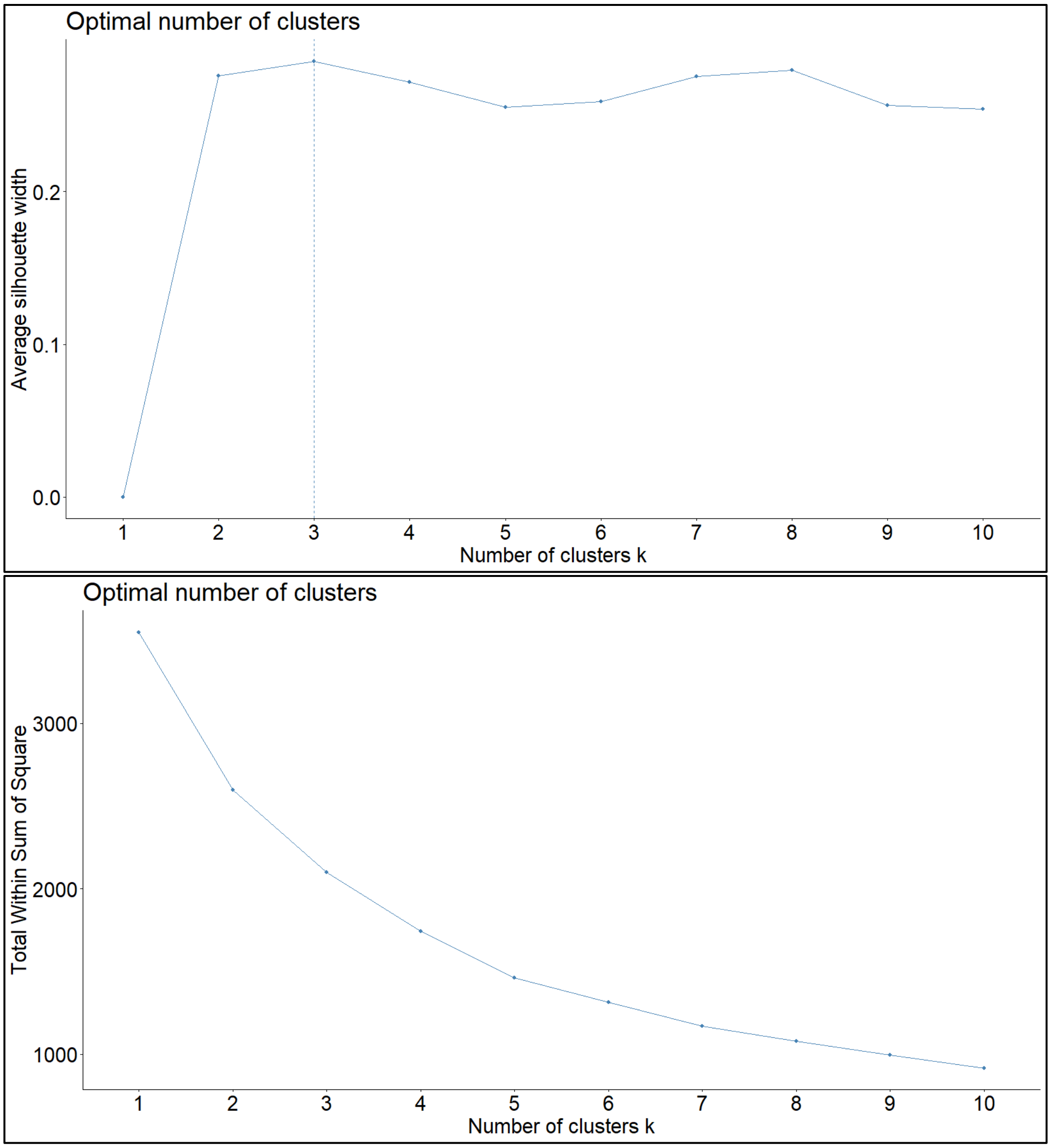
Figure 11. Variables driving *k*-means clustering.



4.4.4 Hierarchical Clustering

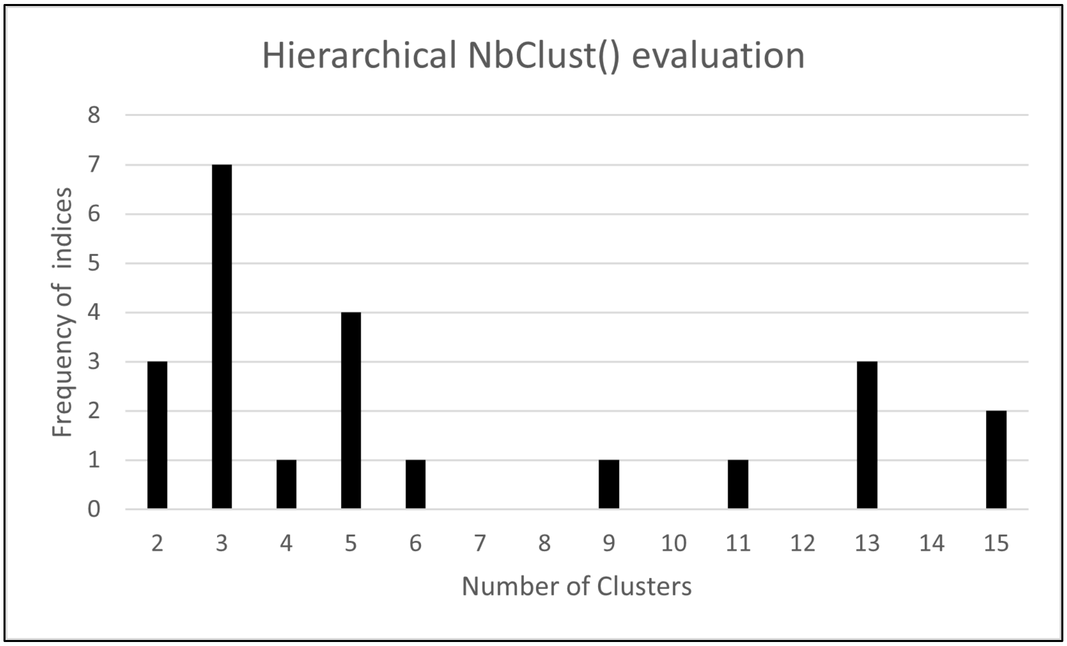
The function fviz_nbclust() draws a vertical line pointing to the optimal number of clusters to achieve a maximum silhouette score, which is shown at three (Figure 12). The optimal number of clusters based on total within sum of squares is unclear (Figure 12).

Figure 12. Optimal number of hierarchical clusters determined by average silhouette width and total within sum of squares.



The NbClust() function for hierarchical clusters calculates twenty-three indices that test hierarchical clusters from two to fifteen. These indices are the criteria the function uses to suggest an optimal number of clusters. Seven indices out of twenty-three determined that three clusters were the optimal number of hierarchical clusters, and this was the majority of the indices for clustering options between two and fifteen (Figure 13).

Figure 13. Frequency of calculated indices for optimal hierarchical clusters between 2 and 15.



The results of the hierarchical clustering in dendrogram format (Figure 14) are difficult to visualize, so the cluster assignment was appended to the AKVEG dataset. The number of observations within each cluster was charted to see if a pattern was apparent in the data. Figure 15 shows that the distribution of observations in the clusters cannot be described using the wetland indicator status rating variable.

Figure 14. Individual observation's location in 3 hierarchical clusters (shown in *yellow*, *blue*, and *pink*, *n* = 888).

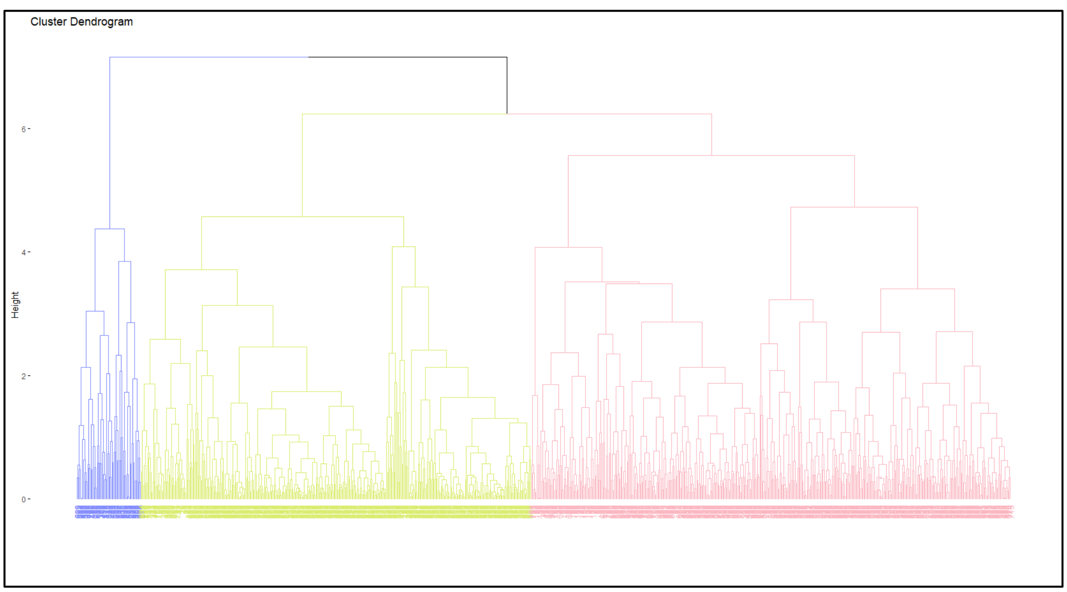
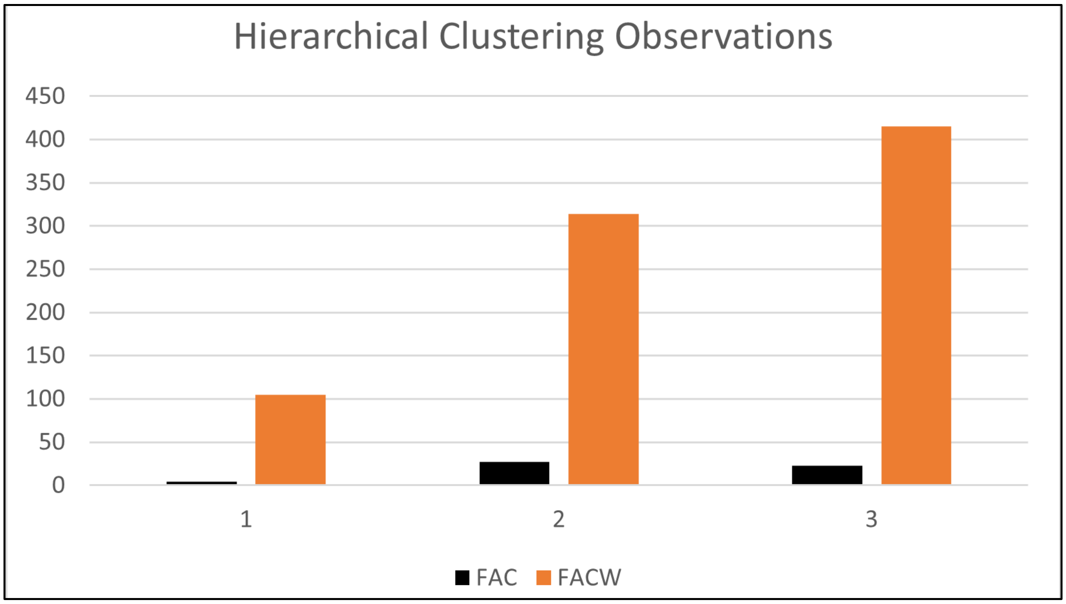
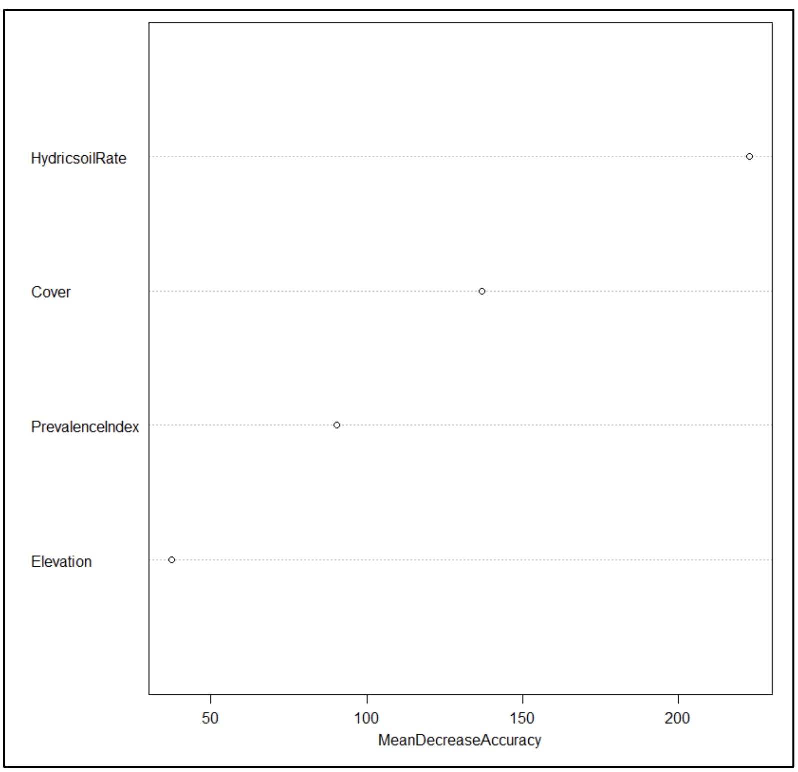


Figure 15. Summary of individual observation's location in 3 hierarchical clusters coded by wetland indicator status rating.



Hydric Soil Rate is the strongest driver of the hierarchical clustering algorithm (Figure 16). The variables at the top predict the cluster assignment with the most accuracy, so they are shown as the most important and this decreases downward.

Figure 16. Variables driving hierarchical clustering.



Based on the results of this machine learning study, a recommendation to classify *S. pulchra* in multiple groups cannot be made. A caveat to using the machine learning techniques described here is that they do not consider classifying the data into just one cluster, therefore the data are forced into at least two clusters as a default. The *k*-means clustering algorithm determined that two or three clusters were optimal for the dataset. The hierarchical clustering algorithm determined that three clusters were optimal for the dataset. The clusters were determined from these machine learning algorithms by using 4 environmental variables. When combining these clustering assignments with the categorical labels the observations were given originally such as wetland indicator status rating or 2012 LRR, no meaningful connection can be made. These results support the conclusion drawn from other analyses that the *S. pulchra* does not need to be subdivided into multiple ratings or subregions.

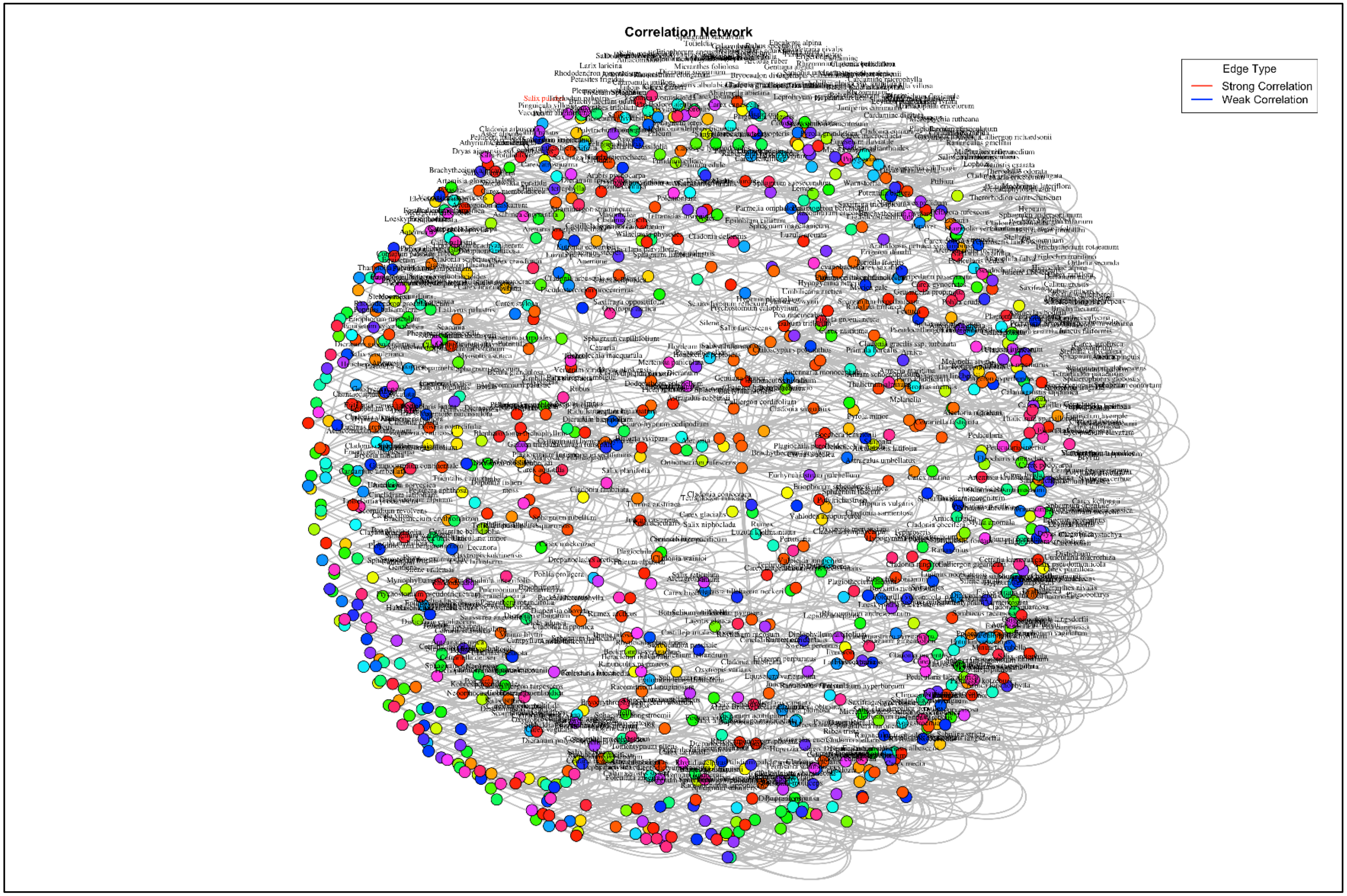
4.5 Co-occurring Species Analyses for *Salix pulchra*

4.5.1 Correlation Network Analysis

Correlation network analyses showed no correlation between species when analyzed using the variables described above. Figure 17 is a representative plot that demonstrates the lack of correlation found regardless of the correlation threshold set.

The authors conclude that a correlation network analysis by co-occurring species with datasets of this size is not a good candidate for assessing wetland indicator status rating assignment for *S. pulchra*. These methods were developed for much larger datasets and may be transferrable to other NWPL regions.

Figure 17. Correlation network analysis for *Salix pulchra*, identified in *red* text in the *upper left-hand corner*. *Gray lines* indicate no correlation.



4.5.2 Louvain Clustering

Louvain clustering showed very weak correlations between *Salix pulchra* and co-occurring species when analyzed using either Pearson's correlation or Spearman's correlation. Figure 18 shows the results of the Pearson's correlation analysis with only those nodes that connect to *S. pulchra*. While all the correlations are weak, it is noteworthy that the strongest correlation (*Petasites frigidus*, $r = 0.31$) is with a species that is FACW. These results support changing the species from FAC to FACW. However, *S. pulchra* is more often correlated, albeit weakly, with FAC species ($n = 4$) than with FACW species ($n = 2$). Figure 19 shows the results of the Spearman's correlation analysis with only those nodes that connect to *S. pulchra*. Results support maintaining *S. pulchra* as FAC because, as with Pearson's correlation, the species most often correlates with FAC species and the strongest correlation is with a FAC species. Results for both analyses were not included in the recommendation because correlation values are below the $r \geq 0.5$ threshold indicating a strong relationship.

The authors conclude that Louvain analysis by co-occurring species cover data is not a good candidate for assessing wetland indicator status rating assignment for *S. pulchra*. Future work may focus on utilizing co-occurring species data in conjunction with environmental data for more informative analysis. It may also be informative to assess species by presence or absence rather than percent cover.

Figure 18. Louvain analysis for *Salix pulchra*. Nodes are labeled with the species correlated to *S. pulchra* with their edges labeled with the Pearson's correlation coefficient.

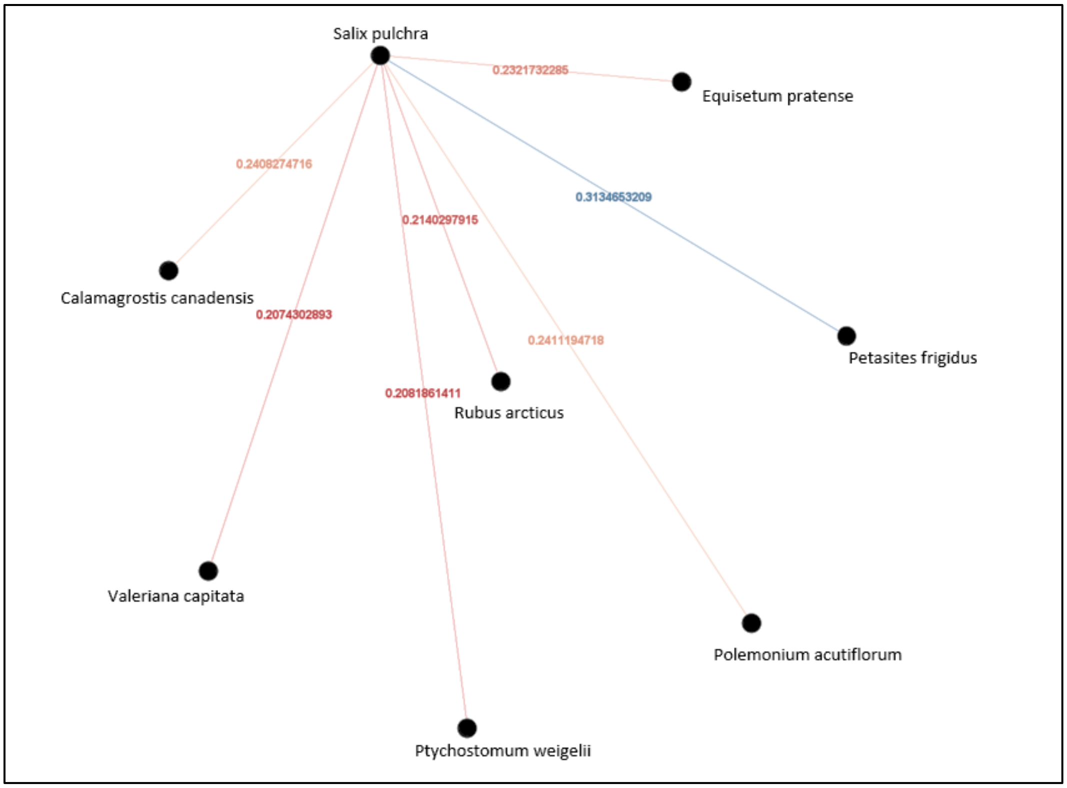
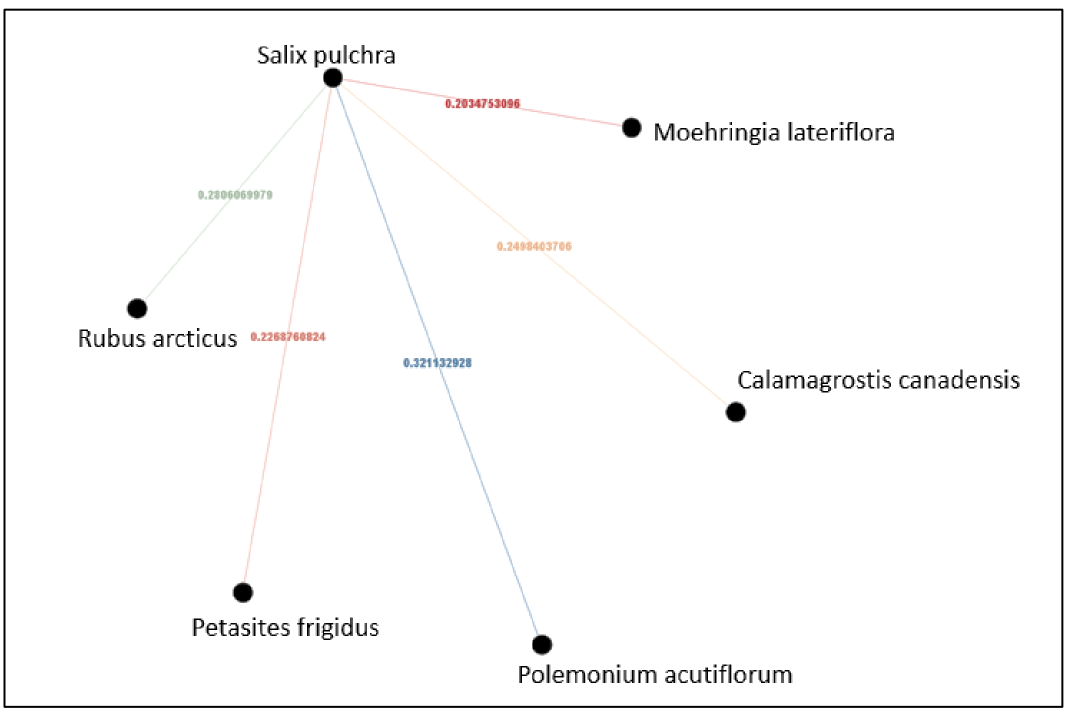


Figure 19. Louvain clustering analysis for *Salix pulchra*. Nodes are labeled with the species correlated to *S. pulchra* with their edges labeled with the Spearman's correlation coefficient.



5 Discussion

The challenge of organizing nature into human-delineated categories cannot be understated. The NWPL has built into it a system of operations for continual reevaluation and improvement informed by practitioners and the public. The work presented here is the first within USACE to use advanced statistical and ordination techniques to assess the validity and accuracy of wetland indicator status ratings to build upon feedback on the NWPL. It demonstrates the benefits of leveraging preexisting data to avoid costly field work and supports the work of USACE to move to a digitized system for collecting wetland delineation data. A large portion of this effort was compiling and preparing data for analysis; readily accessible, digitized wetland delineation data will eliminate the need for such a task. The project pulled from a wide breadth of expertise—multiple agencies and stakeholders, as well as professional fields including botany, ecology, genomics, and computer science. The result is a novel, quantitative approach to solving issues of wetland indicator status ratings.

This work would not have been possible without access to a robust dataset of spatially explicit vegetation data and highlights the utility of publicly accessible plot-level information. The emerging capabilities of global-scale geospatial analyses coupled with machine-learning could be employed in future work to uncover patterns in wetland plant ecology and distribution and predict changes to wetland community assemblages relative to climate change, anthropogenic disturbance, and stochastic natural processes.

Although clear guidance was produced for all species reevaluated here, more analyses could be conducted if greater clarity is needed for justifying wetland indicator status ratings and subregions. Only two of the many datasets identified were analyzed in this report and all are available if more information is required. The lowest hanging fruit is the CEMML dataset, which was already acquired and would not require calculation of PI values. PI calculation for the AKVEG dataset was labor and time intensive, so the evaluation of stand-alone CEMML data would likely take half the time. Incorporating it into the “combined dataset” that already includes AKVEG and NRCS would require additional time.

AKVEG data were incomplete for many of the plots because the website development is still in progress. Much of the environmental data were missing or incomplete, which limited the number of factors that could be analyzed within the AKVEG dataset, but also within the combined dataset since any variables that were not shared by NRCS and AKVEG were excluded. Results presented here would be enhanced by addition of those variables.

The machine learning output could be improved in a few ways. First, the methods used required 2 as the minimum number of clusters, which could potentially force divisions where perhaps they did not exist. Understanding of the data would be improved if another algorithm could be applied that will also test for a single cluster. Second, the analysis here did not include species co-occurrence data, which could inform clustering. Third, the data for all species could be combined to identify patterns relevant to more than just one species. Results from such an analysis would more closely match the needs of the NWPL for assessing regional and subregional divisions. Lastly, no categorical variables were included.

The species co-occurrence data were collected and compiled for all species but was analyzed for only *S. pulchra*. As a result, this report can only conclude that correlation network analysis and Louvain clustering do not show patterns for this species, but this finding cannot be extrapolated to any other species. It could be informative to rerun PI calculations using the subregional ratings rather than state-wide ratings to reassess comparisons between the two. If the datasets were large enough, it would also be informative to plot PI over time within rather than across subregions. Results could identify how changing climate effects hydrophytic vegetation classification over time for the different ecotones resented by each LRR and MLRA. Additionally, running a statistical test such as an ANOVA on the PI values by wetland indicator status rating by subregion would provide significance values to clearly delineate differences and interactions between each.

There were also lessons learned in writing results. For a given species, the data for co-occurring species should have included all possible co-occurring species, not just the species with which it co-occurred. This change would allow compilation of the eight species for co-occurrence and machine learning analyses. Both methods would benefit from larger datasets. Lastly, MCA dimension contributions were low for all species, indicating that the variables selected did not explain much of the variance in the data. Analysis with other categorical data such as the NRCS soils data could help identify more relevant variables.

The results presented here represent only a few of the pieces needed to assemble the puzzle that is wetland indicator status rating and subregion assignment. Although the analyses were all quantitative, results for ordination require interpretation, which introduces subjectivity. The species-specific appendices contain outputs of all analyses to encourage the reader to interpret findings. Methods are intentionally detailed to be repeated, refined and extended to other regions. Maintenance of the NWPL is an iterative process and it is hoped that this work will serve as a building block towards subregions and ratings that accurately reflect the complexity and diversity of the natural world.

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Appendix A: *Salix pulchra*

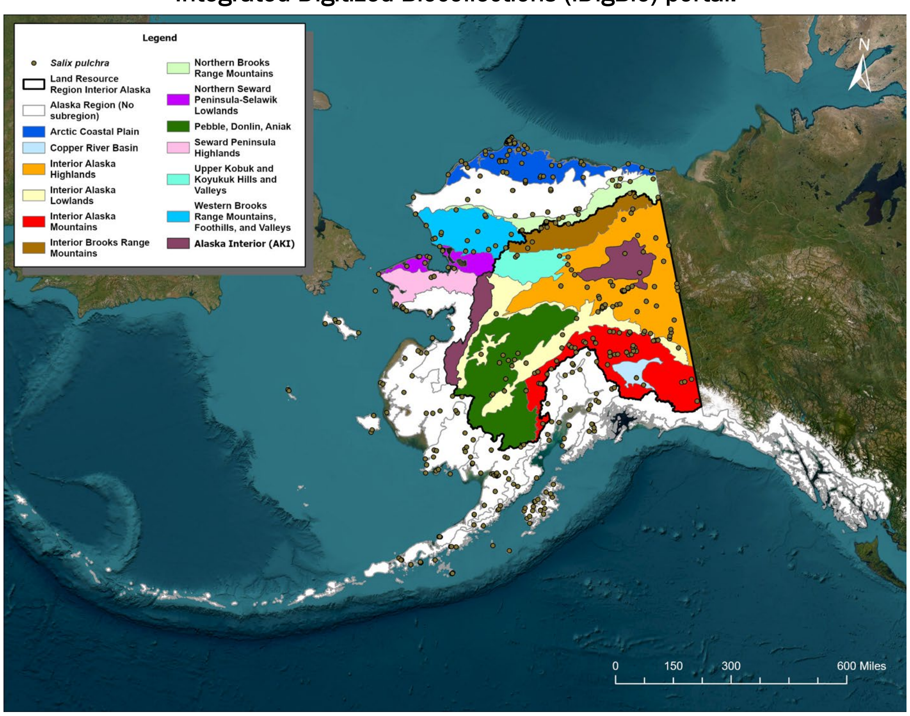
On the National Wetland Plant List (NWPL) *Salix pulchra* has a wetland indicator status rating of facultative wetland (FACW) species for the state of Alaska, and facultative (FAC) for two subregions: Western Brooks Range Mountains, Foothills, Valleys (WBR) and Pebble, Donlin, Aniak (PDA). This appendix evaluates the results of multiple analyses to determine whether WBR or PDA should be reclassified to match the state-wide rating of FACW, and if a larger subregion based on the Land Resource Regions (LRR) 2012 Interior Alaska subregion is warranted.

Data were analyzed in three ways. First, the data from the Alaska Vegetation Plots Database (AKVEG) and the Natural Resource Conservation Service (NRCS) data were analyzed independently. Second, the datasets were combined for analysis. The variables and number of plots varied between datasets; sample size by subregion and dataset is reported in Section A.3.

A.1 Herbaria Specimens Data

Five hundred seventeen specimens contained locality data; 167 of these were collected in LRR Interior Alaska (Figure A-1).

Figure A-1. *Salix pulchra* specimens with known locality information from the Integrated Digitized Biocollections (iDigBio) portal.

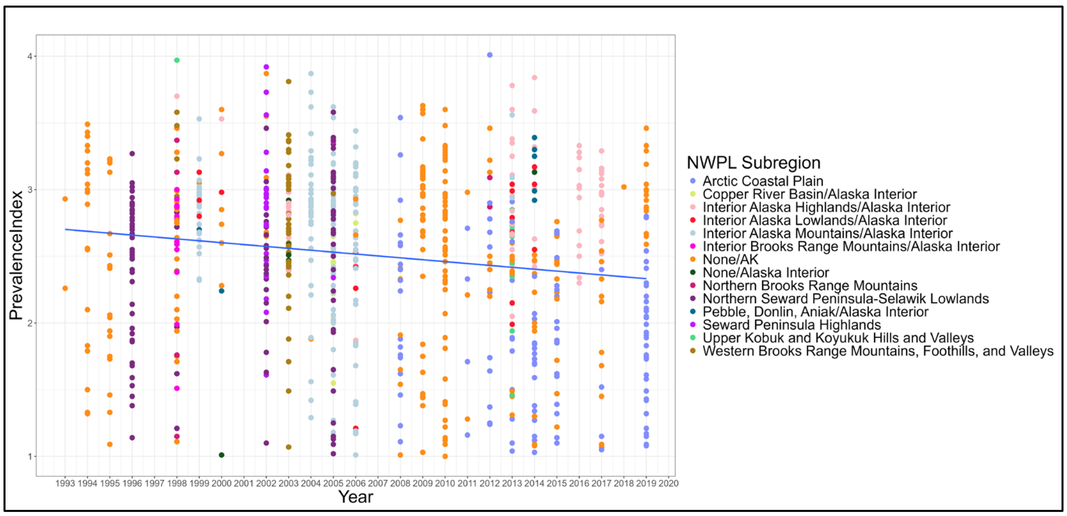


A.2 Prevalence Index (PI) Over Time by Alaska Subregion

A.2.1 Alaskan Vegetation Plots Database (AKVEG)

Prevalence index (PI) shows a slight decrease from 1993 to 2019. The trend line remains below a value of 3, implying that the plots' hydrophytic vegetation factor for wetland delineation (hydrophytic, ≤3, versus nonhydrophytic, >3) has not changed (Figure A-2). A decrease over time indicates that plots are weighted more heavily by FACW or obligate (OBL) species than FAC, FACU or upland (UPL) species over time, which could be due to an increase in the number or percent cover of FACW or OBL species. This observation could imply that plots in which *Salix pulchra* occur are becoming wetter, which would supports reassigning WBR and PDA to FACW. However, it is also possible that research interests over time have changed and there is now greater interest in wetter areas.

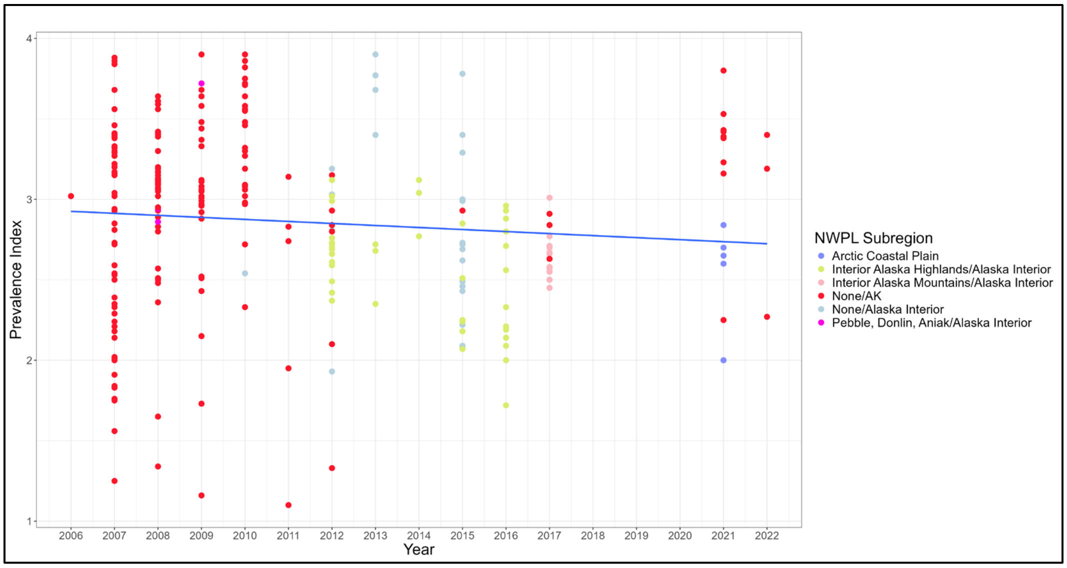
Figure A-2. Change in prevalence index (PI) over time by the National Wetland Plant List (NWPL) wetland indicator status rating for plots containing *Salix pulchra* from the Alaskan Vegetation Plots Database (AKVEG) data (n = 891).



A.2.2 Natural Resource Conservation Service (NRCS)

PI shows a slight decrease from 2006 to 2022. The trend line remains below a value of 3, implying that plots' hydrophytic vegetation factor for wetland delineation (hydrophytic, ≤3, versus nonhydrophytic, >3) has not changed (Figure A-3).

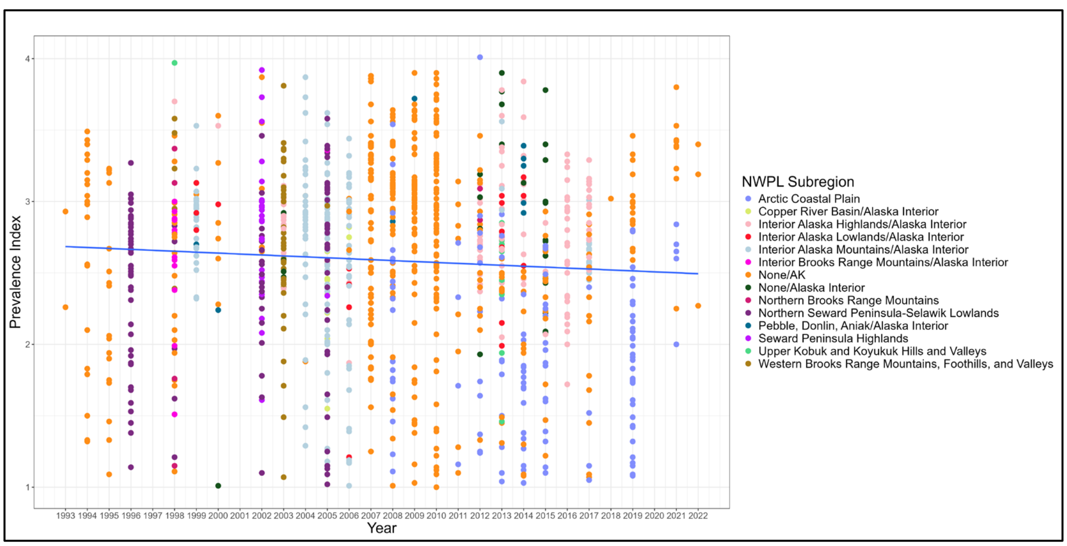
Figure A-3. Change in PI over time by the NWPL wetland indicator status rating for plots containing *Salix pulchra* from the Natural Resource Conservation Service (NRCS) data (n = 265).



A.2.3 Combined Datasets

PI shows a slight decrease from 1993 to 2022. The trend line remains below a value of 3, implying that plots' hydrophytic vegetation factor for wetland delineation (hydrophytic, ≤3, versus nonhydrophytic, >3) has not changed (Figure A-4).

Figure A-4. Change in the PI over time by the NWPL wetland indicator status rating for plots containing *Salix pulchra* from the combined the AKVEG and the NRCS data (n = 1,153).



A.3 PI by Wetland Status Indicator Rating and Subregion

A.3.1 AKVEG

PI is below 3 for FAC subregions and FACW subregions (Figure A-5; Table A-1). Results indicate that in WBR and PDA, *Salix pulchra* occurs in sites that would meet the hydrophytic vegetation factor. The mean PI for WBR (2.71 ± 0.55) falls below that of two subregions in which *Salix pulchra* has a FACW rating, IAH (2.88 ± 0.40) and SPH (2.78 ± 0.49), implying that FACW may be a more appropriate indicator status rating in WBR. It is possible the mean value for WBR would increase if recalculated with a FAC rating of 3 for the species rather than 2. The results for PDA (2.97 ± 0.40) less clearly support a change of rating from FAC to FACW because the value is closer to 3 and higher than all other subregions. It is possible the mean value for PDA would increase if recalculated with a FAC rating of 3 for the species rather than 2 and a rating of FAC would be deemed appropriate from this analysis.

Figure A-5. Bar chart comparing the mean PI for each subregion by wetland status indicator rating (AKVEG, *n* = 888).

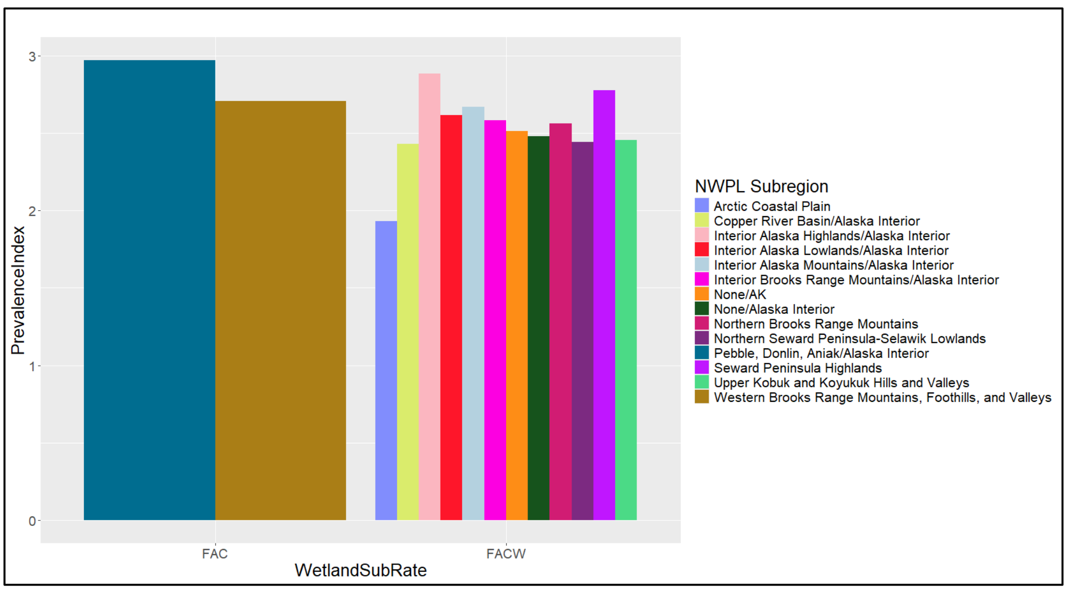


Table A-1. Sample size, mean, and standard deviation of the PI for the 13 NWPL subregions and the rest of the state of Alaska (None/AK) for plots from the AKVEG dataset. *Yellow* fill indicates subregions considered here for reassignment.

NWPL Subregion	Number of Observations	Average PI Value	Standard Deviation of PI Values
Arctic Coastal Plain (ACP)	120	1.93	0.59
Copper River Basin (CRB)/Alaska Interior (LRR)	18	2.43	0.49
Interior Alaska Highlands (IAH) /Alaska Interior (LRR)	70	2.88	0.40
Interior Alaska Lowlands (IAL)/Alaska Interior (LRR)	21	2.62	0.46
Interior Alaska Mountains (IAM)/Alaska Interior (LRR)	160	2.67	0.59
Interior Brooks Range Mountains (IBR)/Alaska Interior (LRR)	17	2.58	0.50
None/AK	263	2.51	0.66
None/Alaska Interior (AKI in LRR)	7	2.48	0.69
Northern Brooks Range Mountains (NBR)	6	2.56	0.89
Northern Seward Peninsula-Selawik Lowlands (NSL)	112	2.44	0.65
Pebble, Donlin, Aniak (PDA)/Alaska Interior (LRR)	7	2.97	0.40
Seward Peninsula Highlands (SPH)	28	2.78	0.49
Upper Kobuk and Koyukuk Hills and Valleys (UKK)	12	2.45	0.73
Western Brooks Range Mountains, Foothills, and Valleys (WBR)	47	2.71	0.55

A.3.2 NRCS

The NRCS dataset contains no observations from WBR. Mean PI is above 3 for PDA (3.17 ± 0.48) and below 3 for the rest of the subregions, indicating that in PDA, *Salix pulchra* occurs in sites that would not meet the hydrophytic vegetation factor using the PI (Figure A-6; Table A-2). The data do not support or refute maintaining PDA as a different rating than the rest of the state. The lack of clarity is likely due to the small sample size for PDA (n = 3). However, it is interesting to note that the rest of the state outside of the NWPL subregions is also close to being higher than 3 (2.96 ± 0.61), implying that PDA does not differ from the rest of the state.

Figure A-6. Bar chart comparing the mean PI for each subregion by wetland status indicator rating (NRCS, *n* = 265).

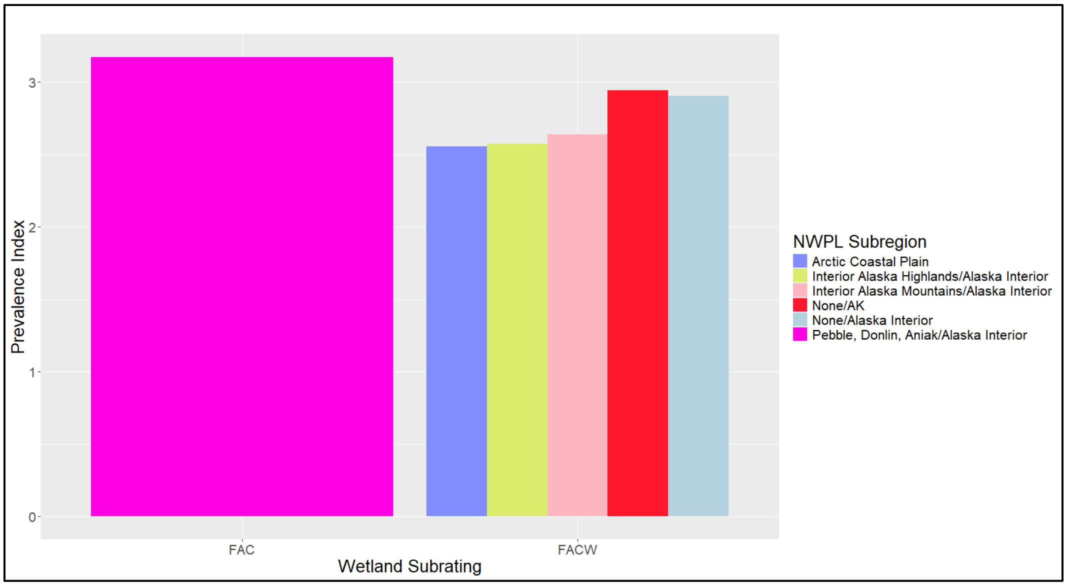


Table A-2. Sample size, mean, and standard deviation of the PI for the 5 NWPL subregions and the rest of the state of Alaska (None/AK) for plots from the NRCS dataset. *Yellow* fill indicates the subregion considered here for reassignment.

NWPL Subregion	Number of Observations	Average PI Value	Standard Deviation of PI Values
Arctic Coastal Plain (ACP)	5	2.56	0.32
Interior Alaska Highlands (IAH)/Alaska Interior (LRR)	43	2.58	0.34
Interior Alaska Mountains (IAM)/Alaska Interior (LRR)	13	2.64	0.15
None/AK	175	2.94	0.61
None/Alaska Interior (AKI in LRR)	26	2.90	0.58
Pebble, Donlin, Aniak (PDA)/Alaska Interior (LRR)	3	3.17	0.48

A.3.3 Combined Datasets

Combining datasets increases the mean PI for PDA to above 3 while the rest of the state falls below 3, implying that *Salix pulchra* in PDA deserves a rating that differs from the rest of the state and should be maintained as FAC (Figure A-7; Table A-3). This difference could be more pronounced if recalculated with a FACW assignment for PDA. Combined WBR results are not changed from the AKVEG results due to the lack of WBR plots in the NRCS dataset.

Figure A-7. Bar chart comparing the mean PI for each subregion by wetland status indicator rating (combined datasets, *n* = 1153).

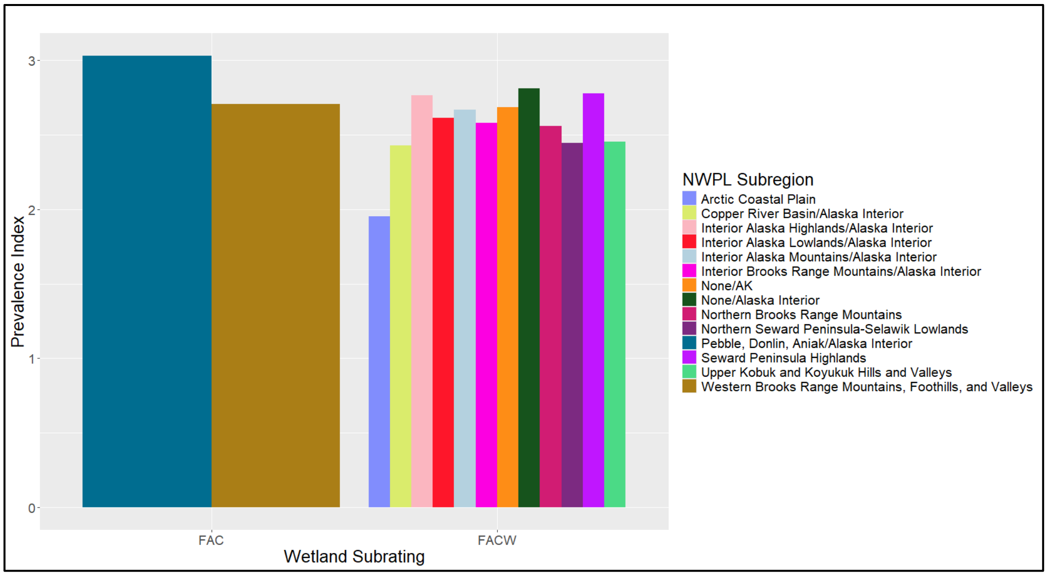


Table A-3. Sample size, mean, and standard deviation of the PI for the 13 NWPL subregions and the rest of the state of Alaska (None/AK) for plots from the combined AKVEG/NRCS dataset. *Yellow* fill indicates subregions considered here for reassignment.

NWPL Subregion	Number of Observations	Average PI Value	Standard Deviation of PI Values
Arctic Coastal Plain (ACP)	125	1.95	0.59
Copper River Basin (CRB)/Alaska Interior (LRR)	18	2.43	0.49
Interior Alaska Highlands (IAH)/Alaska Interior (LRR)	113	2.77	0.41
Interior Alaska Lowlands (IAL)/Alaska Interior (LRR)	21	2.62	0.46
Interior Alaska Mountains (IAM)/Alaska Interior (LRR)	173	2.67	0.56
Interior Brooks Range Mountains (IBR)/Alaska Interior (LRR)	17	2.58	0.50
None/AK	438	2.69	0.67
None/Alaska Interior (AKI in LRR)	33	2.81	0.62
Northern Brooks Range Mountains (NBR)	6	2.56	0.89
Northern Seward Peninsula-Selawik Lowlands (NSL)	112	2.44	0.65
Pebble, Donlin, Aniak (PDA)/Alaska Interior (LRR)	10	3.03	0.41
Seward Peninsula Highlands (SPH)	28	2.78	0.49
Upper Kobuk and Koyukuk Hills and Valleys (UKK)	12	2.45	0.73
Western Brooks Range Mountains, Foothills, and Valleys (WBR)	47	2.71	0.55

A.4 Importance of *S. pulchra* for PI Calculation

When data are reanalyzed with *S. pulchra* dropped from each plot in the AKVEG dataset, 81 plots (11.6% of plots with PI ≤ 3) lost the positive hydrophytic vegetation criterion, and no plots gained the positive criterion. (As previously stated, PI was calculated using the Alaska state rating of FACW for *S. pulchra* for all PI calculations.) Mean change in PI score was +0.062 where 605 plots (68.0%) received a higher score, 150 plots (16.9%) remained the same, and 135 plots (15.2%) received a lower score. The largest decrease in PI score was −0.33 while the largest increase was +1.02. *S. pulchra* appears to be an important component in most of the wetland communities that were sampled with a considerable majority shifting to a higher PI score with omission. This effect was most pronounced in the Interior Alaska Mountains subregion but also across portions of Alaska that do not currently have a designated subregion.

A.5 Data Preparation for Analyses

A.5.1 AKVEG

The original data from AKVEG contained 50 variables (not including cospecies data) with 891 observations. Twenty-one variables had zeros transformed to N/A values: Strata, Physiography, Geomorphology, Macrotopography, Microtopography, Microrelief, Drainage, Moisture, Restrictive Layer, Disturbance, Depth Water, Depth Moss Duff, Depth Restrictive Layer, Soil pH 10, Conductivity 10, Temperature 10, Soil pH 30, Conductivity 30, Temperature 30, Water pH, and Water Conductivity. Two variables were removed due to having no values: Soil class and Water temperature. One variable was added: Interior—true or false value. Of the 49 variables, 20 were numeric; of these 20 variables, 8 variables contained enough values for inclusion in the analyses; the remaining 12 had missing values exceeding the cut-off threshold of 60%. Three observations were excluded; one had no PI, and two had outlier hydric soil rating values of −9999, indicating a placeholder for no value. The remaining 888 observations and 8 variables were used for the correlation analysis, which informed selection of 4 variables (cover, elevation, hydric soil rating, and PI) for the ANOSIM, NMDS, PCA and machine learning.

A.5.2 NRCS

The original data from NRCS contained 117 variables with 265 observations. After deleting duplicate variables, 96 variables remain. For 15 variables, zeros were transformed to N/A values: Restrict_t, Restrict_b, O_thickness, O_pH, surf_pH, bottom_pH, surf_hor, Clay_low, Clay_high, Silt_low, Silt_high, sand_low, sand_high, redox dept, sub_frag. One variable was added: Interior—true or false value. Of the 97 variables, 33 were numeric. Of these, 27 met the missing value requirement of less than 60% of values missing. Following visualization of data distribution for each of these 27 variables, a threshold of 40% percent missing values was determined to be acceptable. Twenty-two variables met these criteria. Two hundred sixty-five observations and 22 variables were used for the correlation analysis, which informed selection of 17 variables (see Section A.10.2, Figure A-19 for a list of the variables) for the ANOSIM, NMDS, and PCA.

A.5.3 Combined AKVEG/NRCS Dataset

The AKVEG and NRCS datasets share 17 variables in common, of which 6 variables are numeric. The combined dataset has 1,153 observations. Four variables (cover, elevation, hydric soil rating, and PI) were determined to be appropriate for ANOSIM, NMDS and PCA; correlation analysis was skipped due to the small number of variables.

A.6 Multiple Correspondence Analysis (MCA) on AKVEG Dataset

Neither dimension strongly explains the variance in the data nor is strongly influenced by Project, indicating there is no Project effect within the data (Figures A-8, A-9, and A-10).

Figure A-8. Multiple correspondence analysis (MCA) plot of AKVEG data by NWPL subregion and Interior (*triangles*) versus the rest of Alaska (*dots*; *n* = 888). Each symbol represents the centroid of multiple observations.

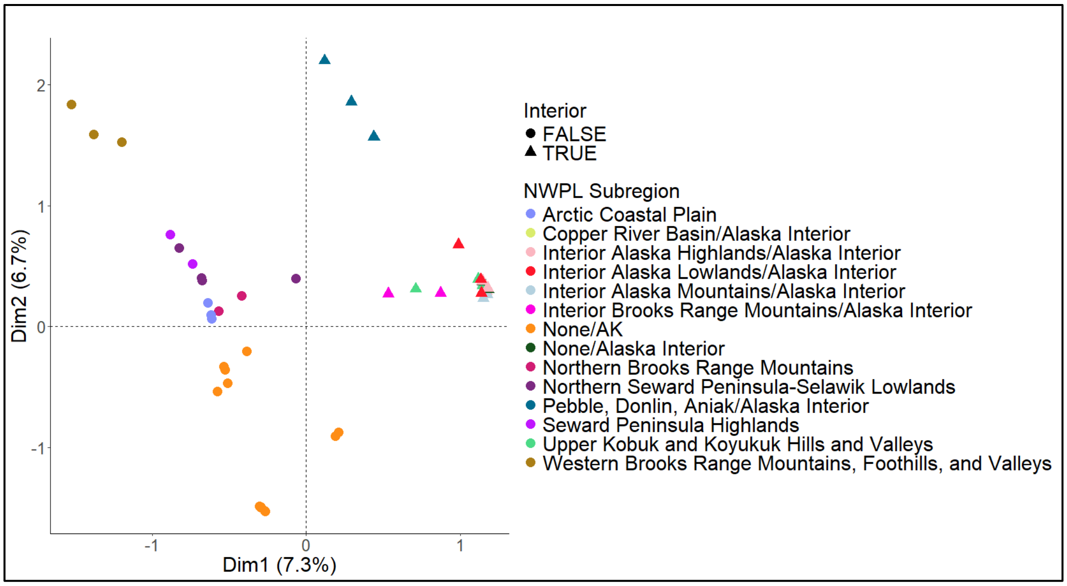


Figure A-9. Percent contribution of MCA factors to Dimension 1 for AKVEG data.

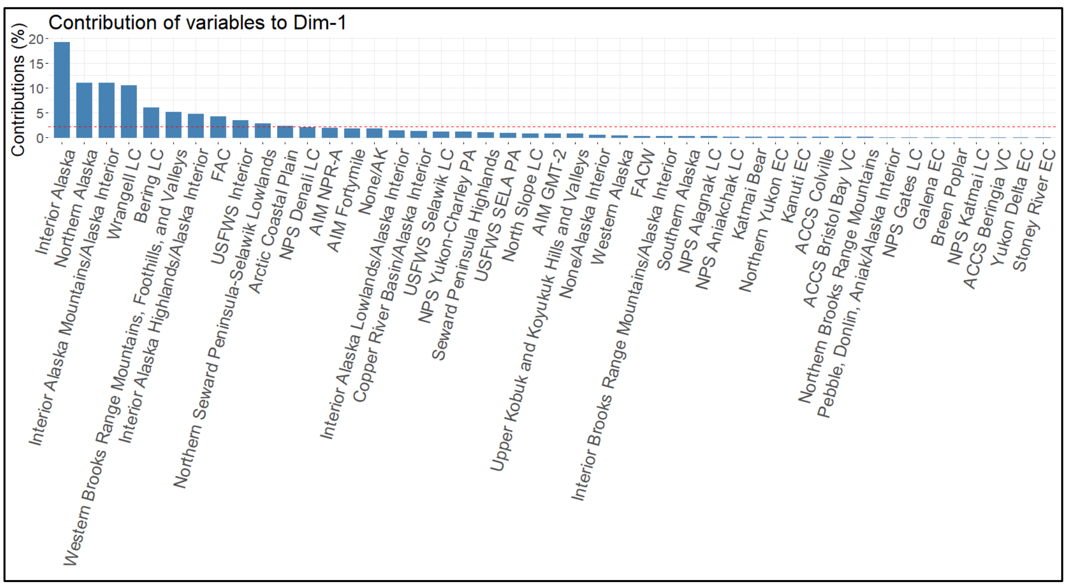
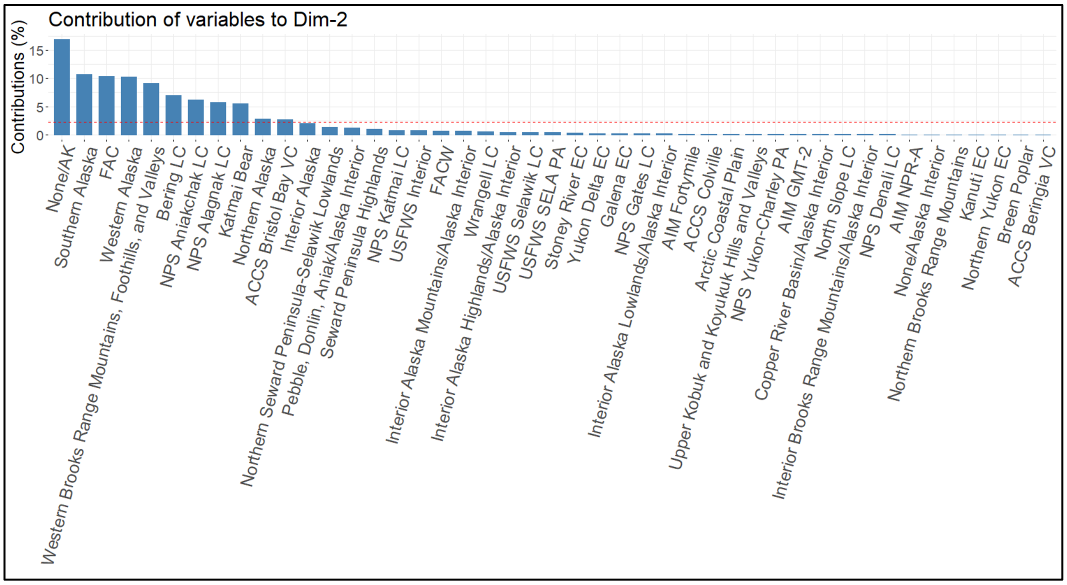


Figure A-10. Percent contribution of MCA factors to Dimension 2 for AKVEG data.

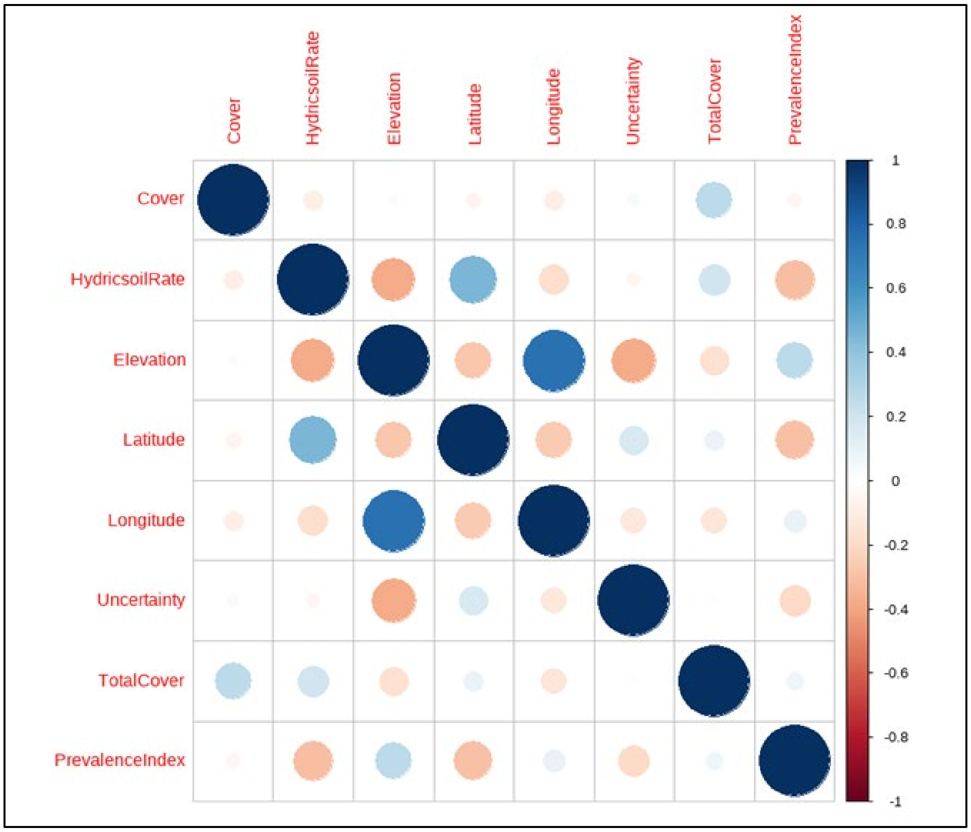


A.7 Correlation Matrices

A.7.1 AKVEG

The 888 observations and 8 variables used for the correlation analysis informed selection of 4 variables for ANOSIM, NMDS, PCA and machine learning analyses (Figure A-11). Because of strong correlations with other variables, latitude, longitude, uncertainty, and TotalCover were excluded. Cover, elevation, hydric soil rating and PI were included for analyses.

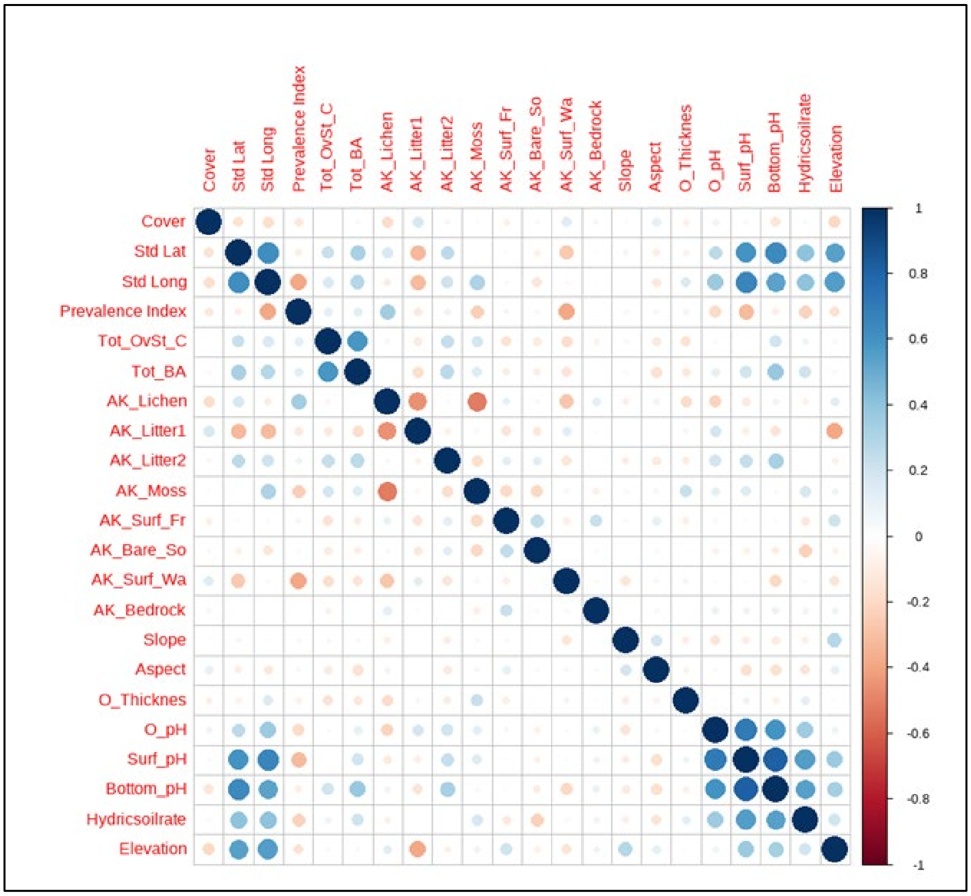
Figure A-11. Correlation matrix for *Salix pulchra* AKVEG data (n = 888).



A.7.2 NRCS

The 265 observations and 22 variables used for the correlation analysis informed selection of 17 variables for ANOSIM, NMDA and PCA Figure A-12). Variables included in the analyses are shown in Section A.10.2, Figure A-19.

Figure A-12. Correlation matrix for *Salix pulchra* NRCS data (n = 265).



A.8 The ANOSIM Test

A.8.1 AKVEG

For the four variables tested, subregions are significantly different with some overlapping (R = 0.4251, p < 0.01). Plots with FAC versus FACW ratings overlap completely (R = -0.036, p = 0.99). Pairwise comparisons of subregions show that while there are strong significant differences between some subregions that likely drive the overall difference (e.g., CRB and ACP, R = 0.99, p < 0.01), the differences between PDA/state of Alaska (R = 0.05, p = 0.19) and WBR/state of Alaska (R = 0.02, p = 0.29) are not significant and PDA/WBR have significantly high overlap (R = 0.16, p < 0.01). These results do not support two ratings within the state for *S. pulchra*. Additionally, no clear pattern arose for significant differences between ratings of subregions in LRR-based Interior Alaska (*dotted* subregions in Table A-4) compared to the rest of the state and other subregions. These results do not support combining the eight subregions found in LRR Interior Alaska into one larger subregion.

Table A-4. Analysis of similarities (ANOSIM) pairwise tests for all subregions from the AKVEG dataset (n = 888).

—	ALASKA	ACP	AKI •	IAH •	IAL •	IAM •	CRB •	WBR	NBR	IBR •	NSL	SPH	PDA •	UKK •
ALASKA	N/A	—	—	—	—	—	—	—	—	—	—	—	—	—
Arctic Coastal Plain (ACP)	0.24**	N/A	—	—	—	—	—	—	—	—	—	—	—	—
Alaska Interior (AKI) •	0, 0.70	0.93**	N/A	—	—	—	—	—	—	—	—	—	—	—
Interior Alaska Highlands (IAH) •	0.20**	0.99**	0.43**	N/A	—	—	—	—	—	—	—	—	—	—
Interior Alaska Lowlands (IAL) •	0.05, 0.08	0.82**	0.08, 0.15	0.24**	N/A	—	—	—	—	—	—	—	—	—
Interior Alaska Mountains (IAM) •	0.46**	1**	0.77**	0.22**	0.43**	N/A	—	—	—	—	—	—	—	—
Copper River Basin (CRB) •	0.12**	0.99**	0.76**	−0.1, 0.92	0.09**	0.35**	N/A	—	—	—	—	—	—	—
Western Brooks Range (WBR)	0.02, 0.29	0.48**	0, 0.44	0.61**	0.14**	0.83**	0.30**	N/A	—	—	—	—	—	—
Northern Brooks Range (NBR)	0.19*	0.99**	0.87*	-0.1, 0.89	-0.1, 0.76	0.05, 0.26	0.27*	0.30**	N/A	—	—	—	—	—
Interior Brooks Range (IBR) •	0.05, 0.13	0.98**	0.20*	0.14*	0.13*	0.49**	0.24**	0.22**	0.09, 0.2	N/A	—	—	—	—
Northern Seward Peninsula (NSL)	0.27**	0.08**	0.87**	0.96**	0.82**	0.99**	0.94**	0.44**	0.95**	0.94**	N/A	—	—	—
Seward Peninsula Highlands (SPH)	−0.1, 0.99	0.71**	−0.1, 0.81	0.56**	0.12*	0.78**	0.28*	0.04*	0.19*	0.1, 0.06	0.72**	N/A	—	—
Pebble/Donlin/Aniak (PDA) •	0.05, 0.19	0.93**	0.36**	0.19, 0.06	0.06, 0.32	0.62**	0.43**	0.16**	0.47**	0, 0.47	0.91**	0.03, 0.28	N/A	—
Upper Kobuk-Koyukuk (UKK) •	−0.2, 1	0.82**	0.55**	0.75**	0.25*	0.93**	0.95**	−0.1, 1	0.96**	0.55**	0.79**	−0.1, 0.96	0.73**	N/A

Note: ** is p-value ≤ 0.01; * is p-value ≤ 0.05; *bold*—$R \geq 0.5$, <0.75 (significantly different); *bold* with *gray* fill—$R \geq 0.75$, (highly significantly different); negative values are rounded to the nearest tenths to save space; N/A—not applicable. *Yellow* indicates subregions under investigation for reassignment, *blue dots* indicate subregions that fall within the LRR Interior Alaska subregion.

A.8.2 NRCS

For the variables considered here, there is a significant difference between subregions, but relevant to the objective of this report, the pairwise results show no difference between PDA and the state of Alaska ($R = 0.31$, $p = 0.39$). There is no significant difference between FAC and FACW ($R = 0.1351$, $p = 0.84$) indicating high overlap for FAC versus FACW. Results suggest that while there is a significant difference between the 6 different subregions considered here, the physical characteristics do not separate sites by rating. Additionally, no clear pattern exists for significant differences between ratings of subregions in LRR-based Interior Alaska (dotted subregions in Table A-5) compared to the rest of the state and other subregions. These results do not support combining the 4 subregions test here that are found in LRR Interior Alaska into one larger subregion. However, the small sample size of PDA for this dataset ($n = 7$) may have reduced the power to detect a difference.

Table A-5. ANOSIM pairwise tests for all subregions from the NRCS dataset (n = 265).

–	ALASKA	ACP	AKI •	IAH •	IAL •	IAM •	CRB •	WBR	NBR	IBR •	NSL	SPH	PDA •	UKK •
ALASKA	N/A	–	–	–	–	–	–	–	–	–	–	–	–	–
Arctic Coastal Plain (ACP)	0, 0.62	N/A	–	–	–	–	–	–	–	–	–	–	–	–
Alaska Interior (AKI) •	0.16**	**0.82****	N/A	–	–	–	–	–	–	–	–	–	–	–
Interior Alaska Highlands (IAH) •	0.44**	**0.98****	**0.84****	N/A	–	–	–	–	–	–	–	–	–	–
Interior Alaska Lowlands (IAL) •	–	–	–	–	N/A	–	–	–	–	–	–	–	–	–
Interior Alaska Mountains (IAM) •	0.43**	**1****	**0.93****	0, 0.68	–	N/A	–	–	–	–	–	–	–	–
Copper River Basin (CRB) •	–	–	–	–	–	–	N/A	–	–	–	–	–	–	–
Western Brooks Range (WBR)	–	–	–	–	–	–	–	N/A	–	–	–	–	–	–
Northern Brooks Range (NBR)	–	–	–	–	–	–	–	–	N/A	–	–	–	–	–
Interior Brooks Range (IBR) •	–	–	–	–	–	–	–	–	–	N/A	–	–	–	–
Northern Seward Peninsula (NSL)	–	–	–	–	–	–	–	–	–	–	N/A	–	–	–
Seward Peninsula Highlands (SPH)	–	–	–	–	–	–	–	–	–	–	–	N/A	–	–
Pebble/Donlin/Aniak (PDA) •	0.03, 0.39	**0.77****	0.69**	0.66**	–	**1****	–	–	–	–	–	–	N/A	–
Upper Kobuk-Koyukuk (UKK) •	–	–	–	–	–	–	–	–	–	–	–	–	–	N/A

Note: * is $p \leq 0.05$, ** is $p \leq 0.01$; for significant p-values, *bold* text indicates $0.5 \leq R < 0.75$ (significantly different); *bold* and *gray* fill indicates $0.75 \leq R \leq 1$ (significantly highly different). *Yellow* indicates subregions under investigation for reassignment, *blue dots* indicate subregions that fall within the LRR Interior Alaska subregion.

A.8.3 Combined Datasets

The variables included for this analysis were cover, elevation, hydric soil rating, and PI. For these four variables, subregions are significantly different with some overlapping ($R = 0.358$, $p < 0.01$). Plots with FAC versus FACW ratings overlap completely ($R = 0.046$, $p = 1.0$). Pairwise comparisons of subregions show that while there are strong significant differences between some subregions (e.g., ACP is significantly highly different from 10 of the 13 possible combinations, Table A-6), there is significant overlap between PDA/state of Alaska ($R = 0.12$, $p = 0.03$), WBR/state of Alaska ($R = 0.06$, $p = 0.05$), and PDA/WBR ($R = 0.16$, $p < 0.01$). These results do not support two ratings within the state for *S. pulchra*. Additionally, no clear pattern exists for significant differences between ratings of subregions in LRR-based Interior Alaska (dotted subregions in Table A-6) compared to the rest of the state and other subregions. Results do not support combining the eight subregions found in LRR Interior Alaska into one larger subregion with a separate rating from the state.

Table A-6. ANOSIM pairwise tests for all subregions from the combined datasets (n = 1,153).

—	ALASKA	ACP	AKI •	IAH •	IAL •	IAM •	CRB •	WBR	NBR	IBR •	NSL	SPH	PDA •	UKK •
ALASKA	N/A	—	—	—	—	—	—	—	—	—	—	—	—	—
Arctic Coastal Plain (ACP)	0.18**	N/A	—	—	—	—	—	—	—	—	—	—	—	—
Alaska Interior (AKI) •	-0.1, 1	0.82**	N/A	—	—	—	—	—	—	—	—	—	—	—
Interior Alaska Highlands (IAH) •	0.33**	0.99**	0.78**	N/A	—	—	—	—	—	—	—	—	—	—
Interior Alaska Lowlands (IAL) •	0.15**	0.80**	0.53**	0.27**	N/A	—	—	—	—	—	—	—	—	—
Interior Alaska Mountains (IAM) •	0.51**	1**	0.93**	0.16**	0.39**	N/A	—	—	—	—	—	—	—	—
Copper River Basin (CRB) •	0.27**	0.98**	0.81**	0, 0.83	0.09*	0.27**	N/A	—	—	—	—	—	—	—
Western Brooks Range (WBR)	0.06*	0.46**	0.12**	0.69**	0.14**	0.83**	0.30**	N/A	—	—	—	—	—	—
Northern Brooks Range (NBR)	0.34**	0.99**	0.87**	-0.1, 0.96	-0.1, 0.8	0, 0.51	0.27*	0.30**	N/A	—	—	—	—	—
Interior Brooks Range (IBR) •	0.17**	0.97**	0.58**	0.14**	0.13*	0.46**	0.24**	0.22**	0.09, 0.13	N/A	—	—	—	—
Northern Seward Peninsula (NSL)	0.25**	0.08**	0.82**	0.97**	0.82**	0.99**	0.94**	0.44**	0.95**	0.94**	N/A	—	—	—
Seward Peninsula Highlands (SPH)	0, 0.56	0.70**	0.22**	0.59**	0.12*	0.77**	0.28**	0.04, 0.09	0.19*	0.1*	0.72**	N/A	—	—
Pebble/Donlin/Aniak (PDA) •	0.12*	0.93**	0.54**	0.34**	0.11, 0.11	0.68**	0.49**	0.16**	0.34**	0.03, 0.24	0.91**	0.01, 0.31	N/A	—
Upper Kobuk-Koyukuk (UKK) •	-0.1, 0.96	0.79**	-0.1, 0.76	0.72**	0.25*	0.92**	0.95**	-0.1, 0.99	0.96**	0.55**	0.79**	-0.1, 0.99	0.57**	N/A

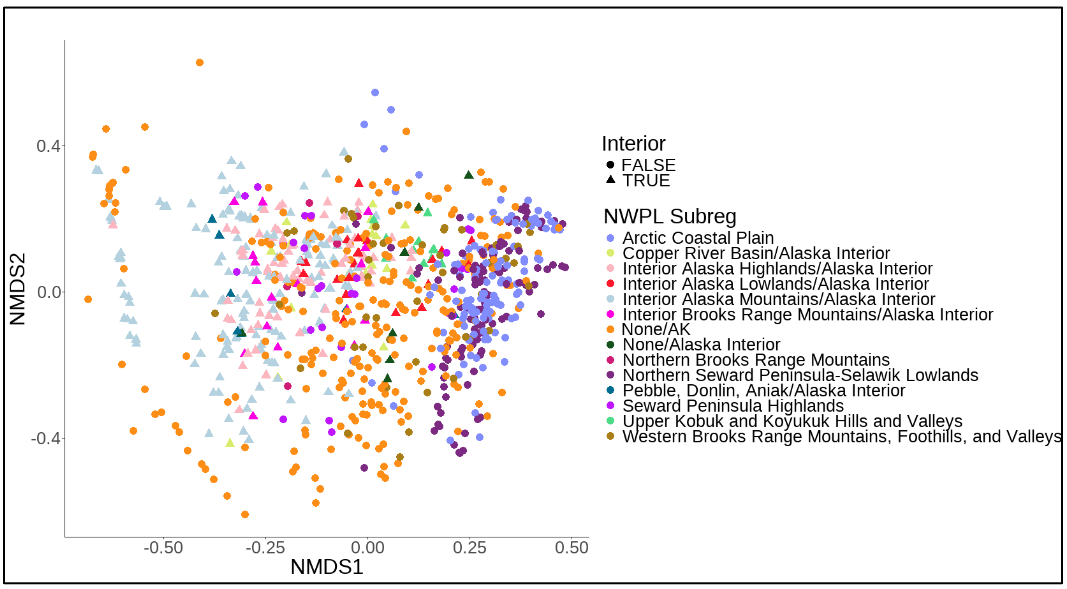
Note: *is $p \le 0.05$, ** is $p \le 0.01$; *bold* indicates $R \ge 0.5$. Pairwise results that did not change when datasets were combined are shown in *white* (R <0.75) or *gray* ($R \ge 0.75$). New results from combining datasets are indicated by *orange hatching*; when combined with *gray*, $R \ge 0.75$. *Yellow* indicates subregions under investigation for reassignment, *blue dots* indicate subregions that fall within the LRR Interior Alaska subregion.

A.9 Nonmetric Multidimensional Scaling (NMDS)

A.9.1 AKVEG

At question here is the accuracy and validity of the wetland indicator status ratings for *Salix pulchra*—FACW for the state of Alaska and FAC for WBR and PDA. Given that neither WBR or PDA are clustered separately from the rest of the state, and in fact appear in the center of the cloud, this analysis suggests that there is no need for a unique wetland indicator status rating for either subregion. LRR Interior sites cluster further to the left of Dimension 1, but points from the state of Alaska overlay this pattern, implying no difference between LRR Interior and the State. Stress test results below 0.15 indicate the NMDS provides a good representation of the data, supporting the change of WBR and PDA from FAC to FACW and refuting the creation of an LRR Interior Alaska subregion (Clarke 1993; Figure A-13).

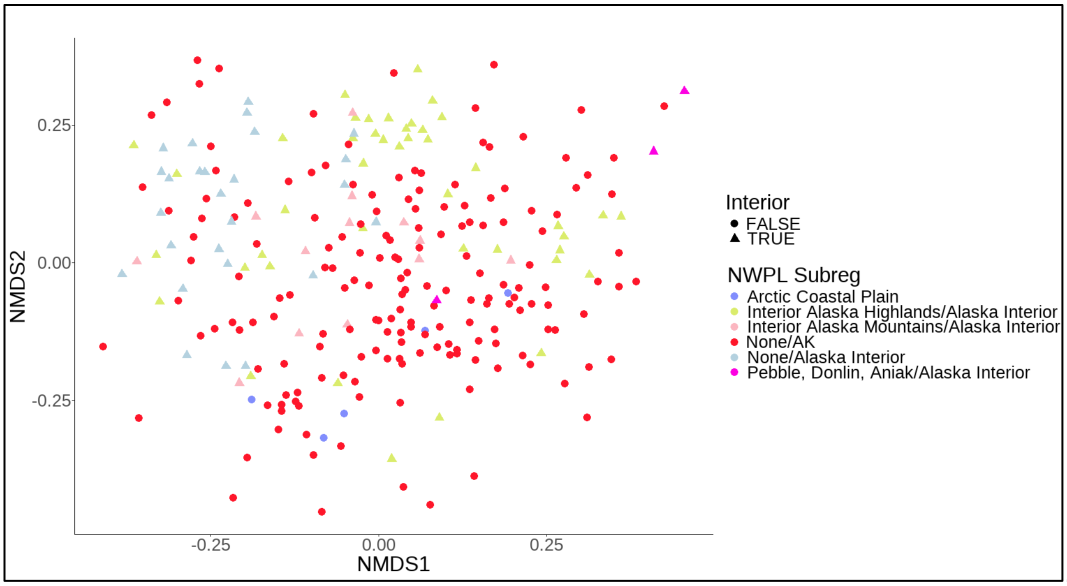
Figure A-13. Nonmetric multidimensional scaling (NMDS) of *Salix pulchra* AKVEG data (n = 88), stress = 0.1456341.



A.9.2 NRCS

Points from PDA do not form a separate cluster along either Dimension 1 or Dimension 2 (Figure A-14). LRR Interior sites overlap with plots from the other subregions. The stress value is greater than 0.2, indicating the NMDS does not accurately represent the data (Clarke 1993; Figure A-14). Recommendations do not include NMDS results from NRCS data.

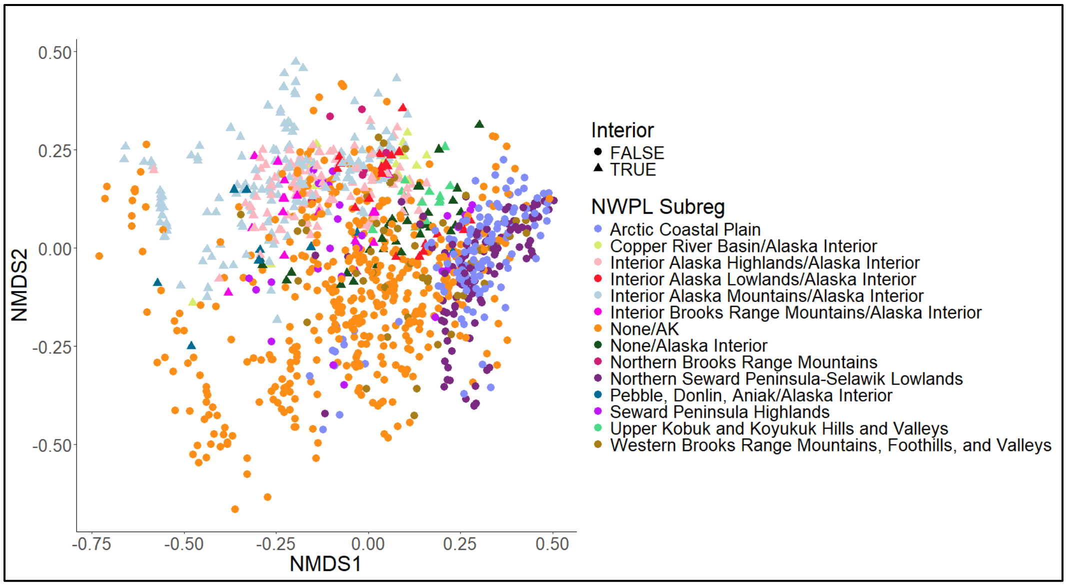
Figure A-14. NMDS of *Salix pulchra* NRCS data (n = 265), stress = 0.2568951.



A.9.3 Combined Datasets

The variables included for this analysis were cover, elevation, hydric soil rating, and PI. There is a trend for LRR Interior Alaska plots to cluster in the upper, left side of the NMDS and for LRR Northern Alaska sites from SPH and ACP to cluster along Dimension 1. However, there is overlap of all subregions along Dimensions 1 and 2. Neither WBR nor PDA clusters separately from the other points (Figure A-15). Stress test results between 0.15 and 0.2 indicate the NMDS provides a poor representation of the data, so results are not considered for the recommendation (Clarke 1993; Figure A-15).

Figure A-15. NMDS of *Salix pulchra* from combined AKVEG/NRCS data (*n* = 1,153), stress = 0.1711471.



A.10 Principal Component Analysis (PCA)

A.10.1 AKVEG

There is no clear clustering of WBR or PDA that separates the two subregions from the rest of the state (Figure A-16). Dimension 1 is strongly influenced by hydric soil rating, while Dimension 2 is influenced by cover (Figure A-17).

Figure A-16. Principal component analysis (PCA) plot of *Salix pulchra* AKVEG dataset (*n* = 888).

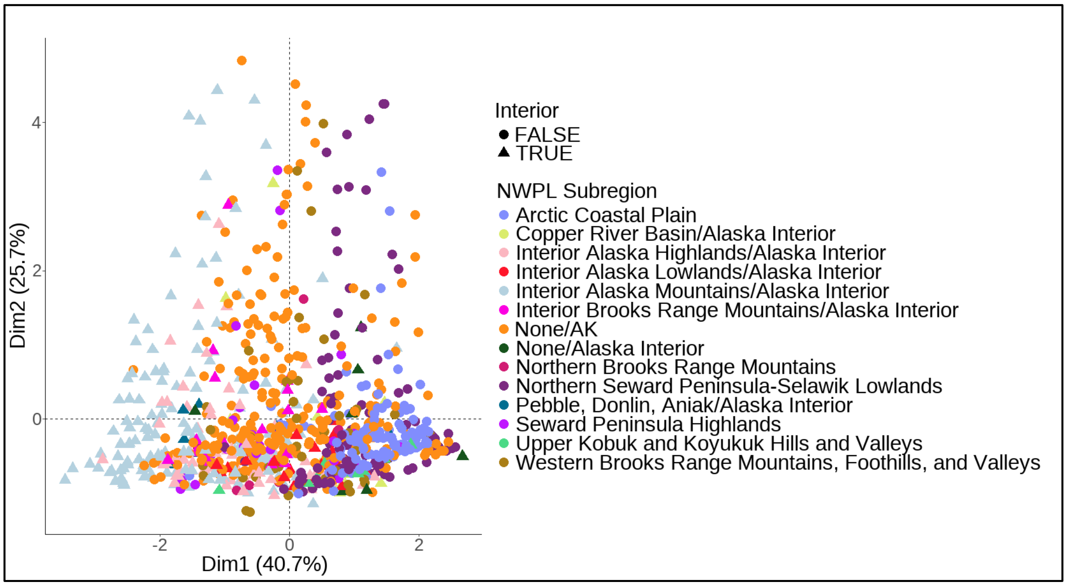
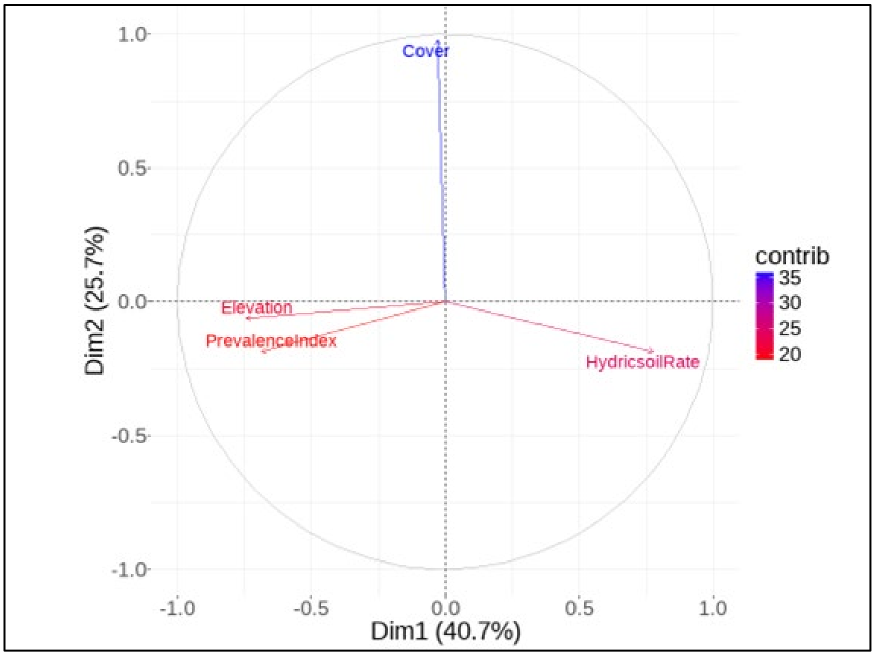


Figure A-17. PCA loading plot of AKVEG data.



A.10.2 NRCS

There is no clear clustering of PDA that separates the subregion from the rest of the state (Figure A-18). However, points do fall on the low end of Dimension 1 (Figure A-19).

Figure A-18. PCA plot of *Salix pulchra* NRCS dataset (*n* = 265).

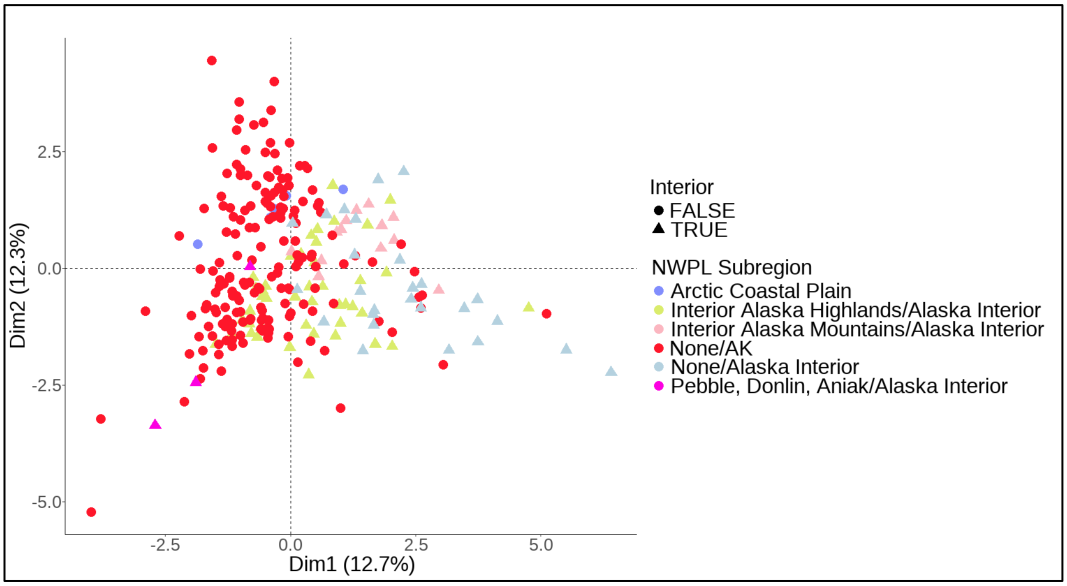
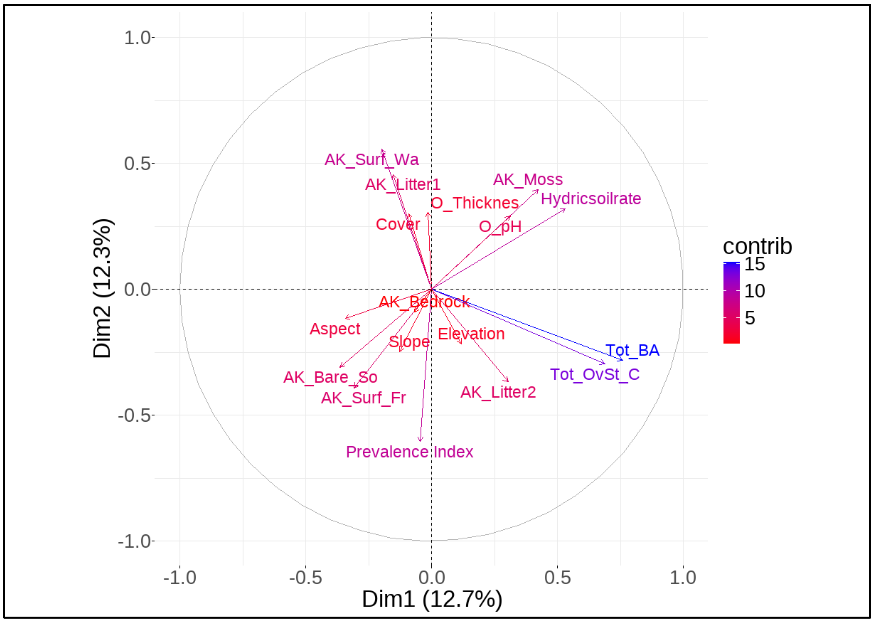


Figure A-19. PCA loading plot of NRCS data.



A.10.3 Combined Datasets

Neither PDA or WBR cluster separately from the rest of the subregions when plotted on along Dimensions 1 and 2, suggesting that for the environmental variables considered, plots within both subregions are similar to plots from other subregions (Figure A-20). Dimension 1 represents 37.4% of the variance and is influenced predominately by hydric soil rating (Figure A-21). Dimension 2 explains 25.6% of the data variance and is dominated by cover (Figure A-21).

Figure A-20. PCA plot of *Salix pulchra* combined AKVEG/NRCS dataset (n = 1,153).

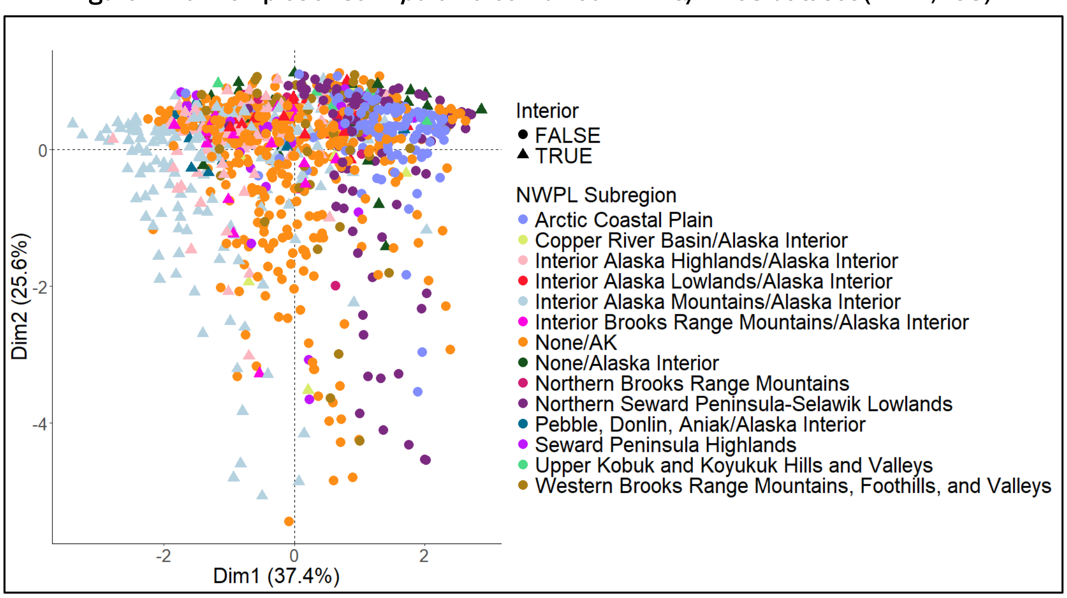
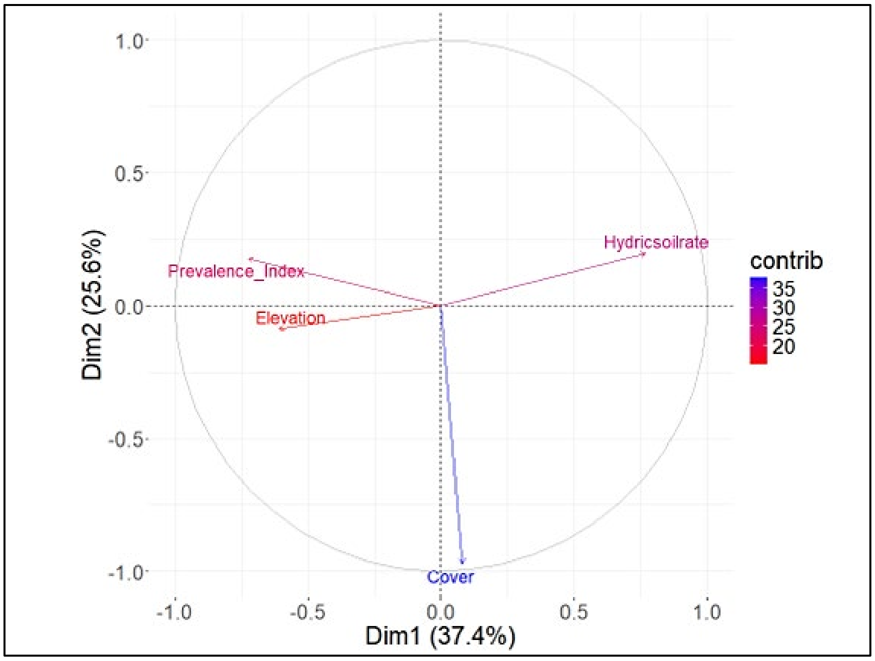


Figure A-21. PCA loading plot of combined AKVEG/NRCS data.



Appendix B: Rhododendron tomentosum

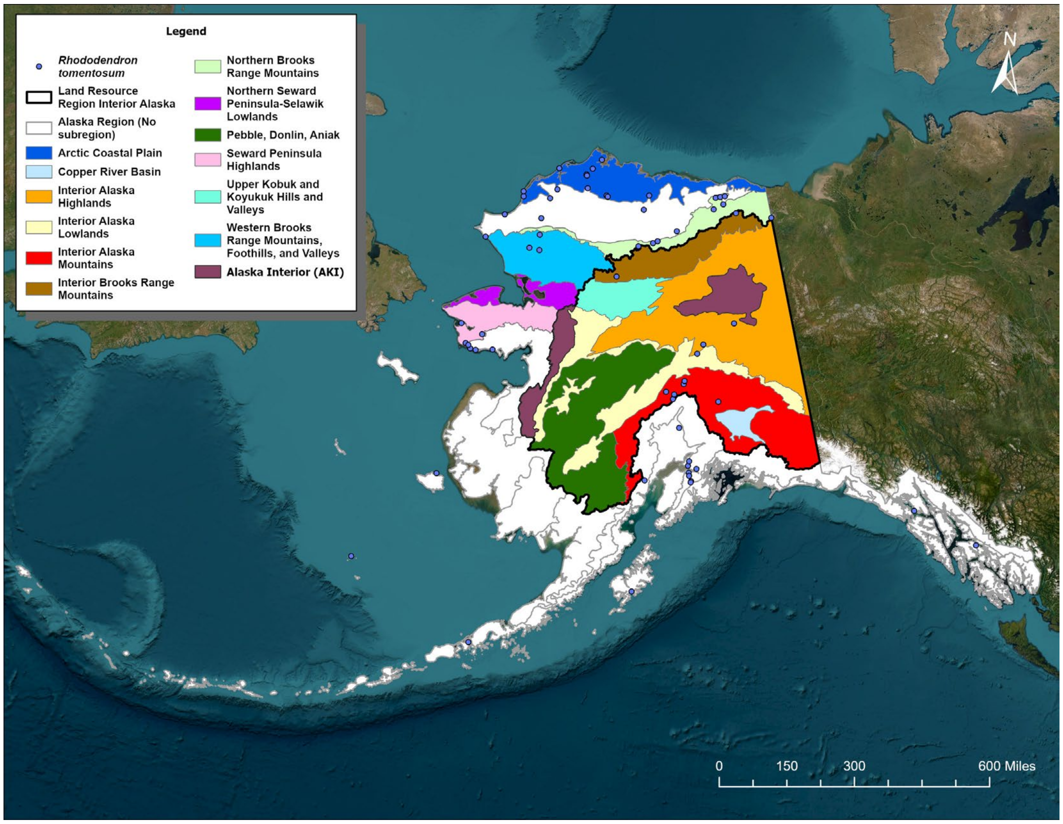
Rhododendron tomentosum (=*Ledum palustre*/*L. decumbens*) has an indicator status rating of FACW for the state of Alaska, and facultative FAC for one subregion; PDA. The species is well distributed across Alaska and is a codominant species on bogs and black spruce wetlands in Southcentral Alaska. It intermingles with *R. groenlandicum* at the edges of wetlands, phasing out as conditions become drier. As per Hultén (1968), it can be found in heaths, and dry, rocky places in the mountains to at least 1,800 meters. The Alaska District and stakeholders who attended the kickoff meeting question if *R. tomentosum,* which is a reliable indicator of saturation in the upper inches of the soil in the rest of Alaska, warrants a FAC rating in the PDA ecoregion. The District notes that there is insufficient data to determine that it behaves as FAC in PDA. This appendix evaluates the results of multiple analyses to determine whether PDA should be reclassified to match the state-wide rating of FACW.

The NRCS data did not include sites containing *R. tomentosum* from PDA, which limited the analyses performed on that dataset. The combined datasets were analyzed despite the lack of NRCS PDA observations because the combination of the two datasets did increase the number of observations from other subregions for comparing against the PDA observations from the AKVEG data. Sample size by subregion and dataset is reported in Section B.3.

B.1 Herbaria Specimens Data

Seventy-three specimens contained locality data; 15 of these were collected in LRR Interior Alaska (Figure B-1).

Figure B-1. *Rhododendron tomentosum* specimens with known locality information from the iDigBio portal.

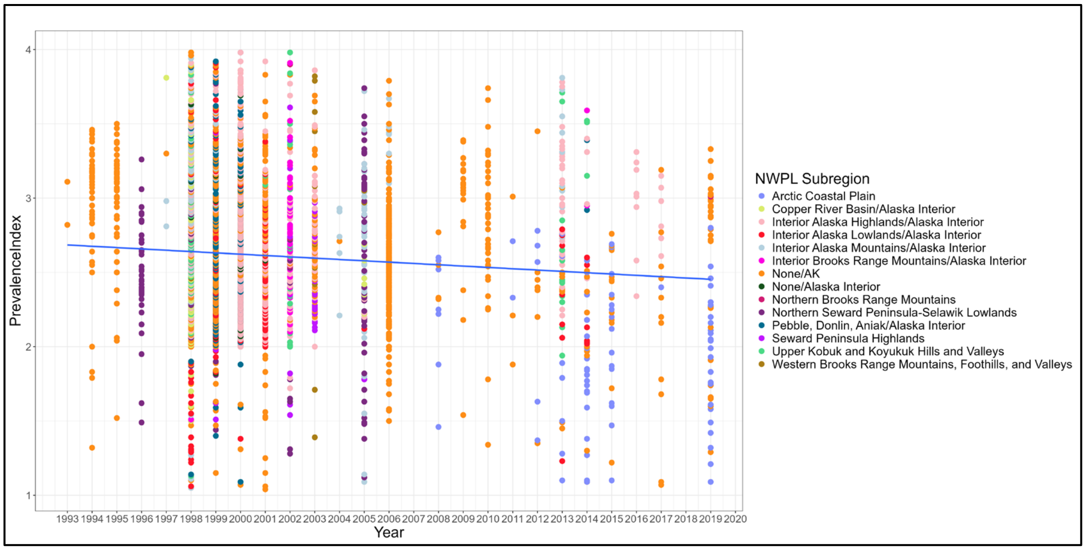


B.2 PI over Time by Alaska Subregion

B.2.1 AKVEG

PI shows a slight decrease from 1993 to 2019. The trend line remains below a PI value of 3, implying that plots' hydrophytic vegetation factor for wetland delineation (hydrophytic, ≤3, versus nonhydrophytic, >3) has not changed over time (Figure B-2).

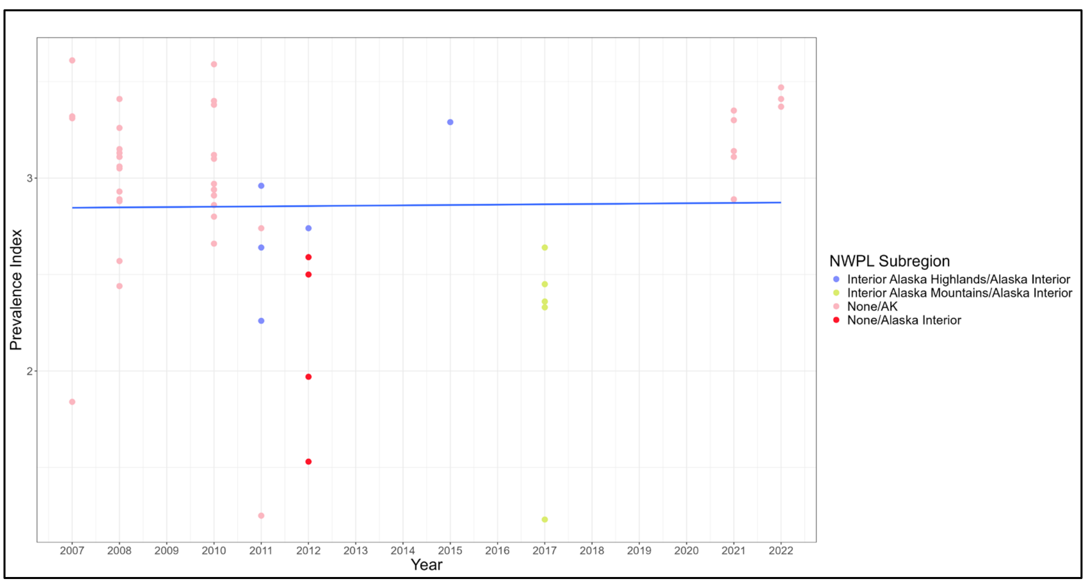
Figure B-2. Change in PI over time by NWPL wetland indicator status rating for plots containing *Rhododendron tomentosum* from AKVEG data (n = 4,917).



B.2.2 NRCS

PI shows no change from 2007 to 2022. The trend is below a PI value of 3, indicating that plots' hydrophytic vegetation factor for wetland delineation (hydrophytic, ≤3, versus nonhydrophytic, >3) has not changed over time (Figure B-3).

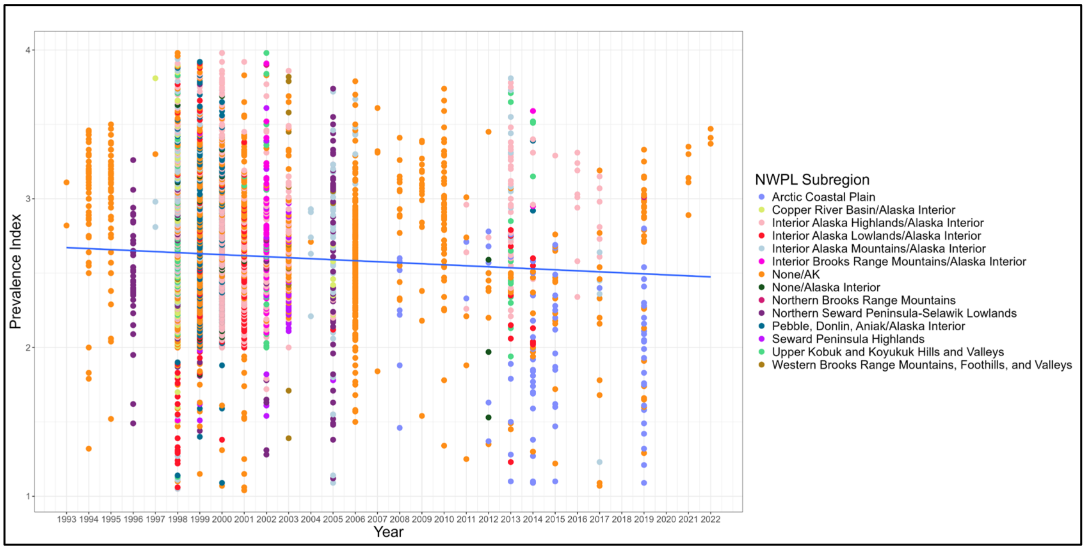
Figure B-3. Change in PI over time by NWPL wetland indicator status rating for plots containing *Rhododendron tomentosum* from NRCS data (n = 54).



B.2.3 Combined Datasets

PI shows a slight decrease from 1993 to 2022. The trend line remains below a PI value of 3, implying that plots' hydrophytic vegetation factor for wetland delineation (hydrophytic, ≤3, versus nonhydrophytic, >3) has not changed over time (Figure B-4).

Figure B-4. Change in PI over time by NWPL wetland indicator status rating for plots containing *Rhododendron tomentosum* from combined AKVEG/NRCS data (n = 4,971).



B.3 PI by Wetland Status Indicator Rating and Subregion

B.3.1 AKVEG

PI is below 3 for FAC and FACW ratings across all subregions (Figure B-5, Table B-1). Results indicate that in PDA, *Rhododendron tomentosum* occurs in sites that would meet the hydrophytic vegetation factor. The mean PI for PDA (2.61 ± 0.40, n = 1,013) falls below that of several FACW subregions, the highest being Northern Brooks Range Mountains (2.93 ± 0.58), implying that the wetland indicator status rating for *Rhododendron tomentosum* in PDA is also FACW. It is possible the mean value for PDA would increase if recalculated with a FAC rating of 3 for the species rather than 2.

Figure B-5. Bar chart comparing the PI for each subregion by wetland status indicator rating (AKVEG, *n* = 4,917).

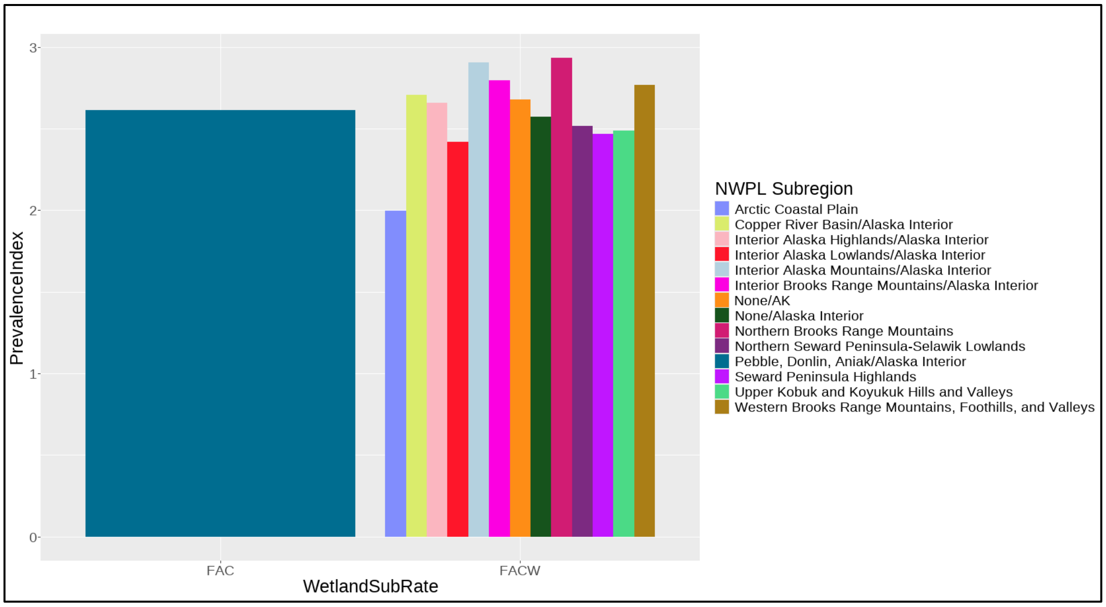


Table B-1. Sample size, mean, and standard deviation of the PI for the 13 NWPL subregions and the rest of the state of Alaska (None/AK) for plots from the AKVEG dataset. *Yellow* fill indicates the subregion considered here for reassignment.

NWPL Subregion	Number of Observations	Average PI Value	Standard Deviation of PI Values
Arctic Coastal Plain (ACP)	89	2.00	0.47
Copper River Basin (CRB)/Alaska Interior (LRR)	57	2.71	0.59
Interior Alaska Highlands (IAH)/Alaska Interior (LRR)	705	2.66	0.48
Interior Alaska Lowlands (IAL)/Alaska Interior (LRR)	478	2.42	0.41
Interior Alaska Mountains (IAM)/Alaska Interior (LRR)	194	2.90	0.51
Interior Brooks Range Mountains (IBR)/Alaska Interior (LRR)	80	2.80	0.41
None/AK	1622	2.68	0.45
None/Alaska Interior (AKI in LRR)	203	2.57	0.42
Northern Brooks Range Mountains (NBR)	5	2.93	0.58
Northern Seward Peninsula-Selawik Lowlands (NSL)	163	2.52	0.52
Pebble, Donlin, Aniak (PDA)/Alaska Interior (LRR)	1013	2.61	0.40
Seward Peninsula Highlands (SPH)	88	2.47	0.48
Upper Kobuk and Koyukuk Hills and Valleys (UKK)	192	2.49	0.46
Western Brooks Range Mountains, Foothills, and Valleys (WBR)	28	2.77	0.54

B.3.2 NRCS

The NRCS data contained no observations from the PDA subregion. The None/AK subregion (rest of Alaska outside of the 13 NWPL subregions) has a mean PI of 3.02 (±0.44, n = 40), implying that the average plot in this subregion straddles the requirement having hydrophytic vegetation (Figure B-6; Table B-2).

Figure B-6. Bar chart comparing the mean PI for each subregion by wetland status indicator rating (NRCS, n = 54).

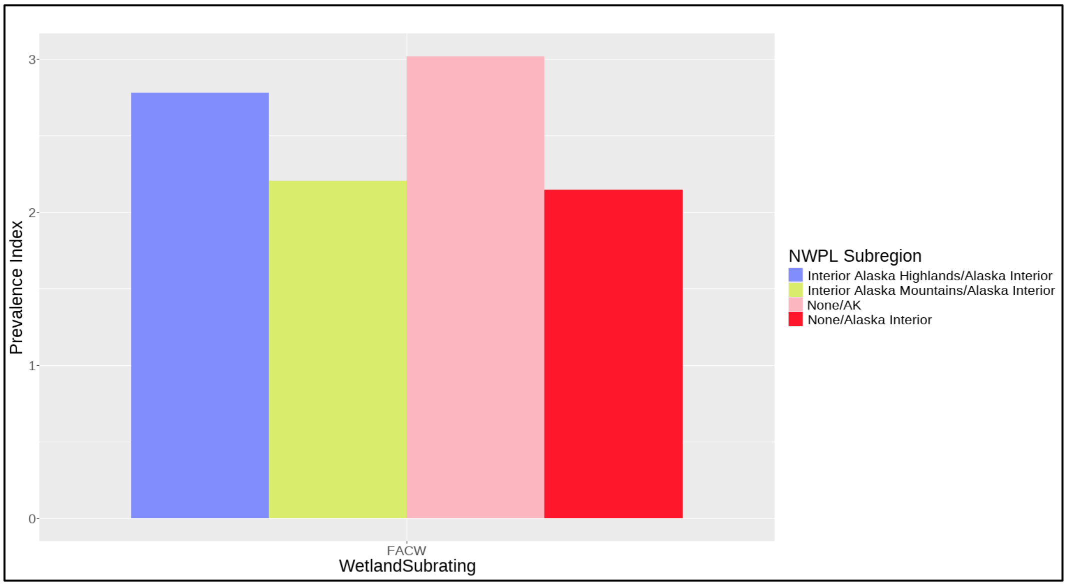


Table B-2. Sample size, mean, and standard deviation of the PI for the 5 NWPL subregions and the rest of the state of Alaska (None/AK) for plots from the NRCS dataset.

NWPL Subregion	Number of Observations	Average PI Value	Standard Deviation of PI Values
Interior Alaska Highlands (IAH)/Alaska Interior (LRR)	5	2.78	0.38
Interior Alaska Mountains (IAM)/Alaska Interior (LRR)	5	2.20	0.56
None/AK	40	3.02	0.44
None/Alaska Interior (AKI in LRR)	4	2.15	0.49

B.3.3 Combined Datasets

Because the NRCS dataset contained no observations from PDA, combining the datasets does not change the mean PI value for this subregion. However, combining the datasets does lower the mean PI value for the None/AK subregion (2.68 ± 0.45) which shifts the mean and standard deviation more into the range for sites identified as containing hydrophytic vegetation Figure B-7; Table B-3).

Figure B-7. Bar chart comparing the mean PI for each subregion by wetland status indicator rating (combined datasets, *n* = 4,971).

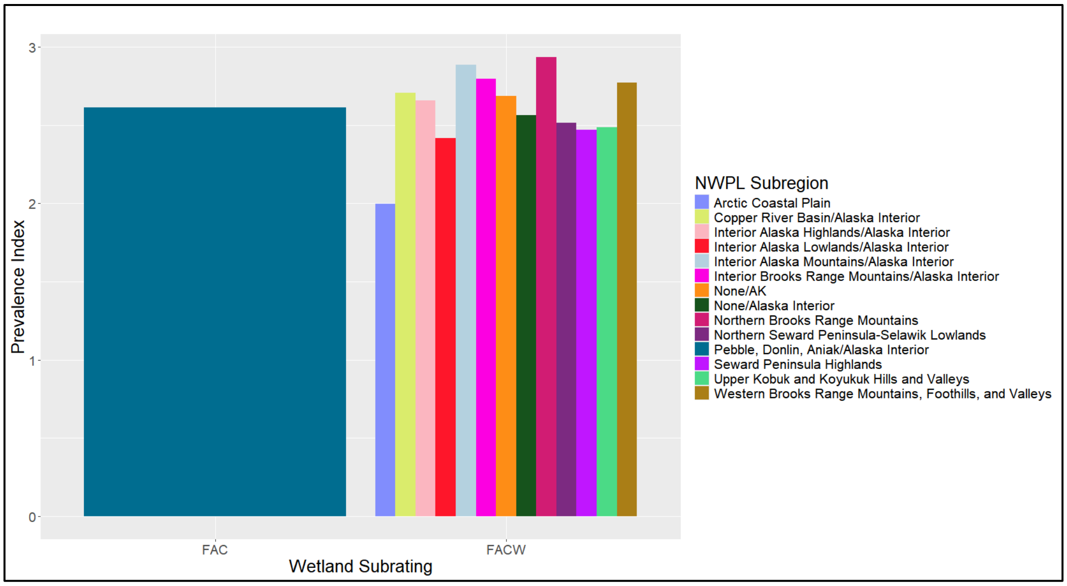


Table B-3. Sample size, mean, and standard deviation of the PI for the 13 NWPL subregions and the rest of the state of Alaska (None/AK) for plots from the combined AKVEG/NRCS dataset. *Yellow* fill indicates the subregion considered here for reassignment.

NWPL Subregion	Number of Observations	Average PI Value	Standard Deviation of PI Values
Arctic Coastal Plain (ACP)	89	2.00	0.47
Copper River Basin (CRB)/Alaska Interior (LRR)	57	2.71	0.59
Interior Alaska Highlands (IAH)/Alaska Interior (LRR)	710	2.66	0.48
Interior Alaska Lowlands (IAL)/Alaska Interior (LRR)	478	2.42	0.41
Interior Alaska Mountains (IAM)/Alaska Interior (LRR)	199	2.89	0.52
Interior Brooks Range Mountains/Alaska Interior	80	2.80	0.41
None/AK	1662	2.68	0.45
None/Alaska Interior (AKI in LRR)	207	2.57	0.43
Northern Brooks Range Mountains (NBR)	5	2.93	0.58
Northern Seward Peninsula-Selawik Lowlands (NSL)	163	2.52	0.52
Pebble, Donlin, Aniak (PDA)/Alaska Interior (LRR)	1013	2.61	0.40
Seward Peninsula Highlands (SPH)	88	2.47	0.48
Upper Kobuk and Koyukuk Hills and Valleys (UKK)	192	2.49	0.46
Western Brooks Range Mountains, Foothills, and Valleys (WBR)	28	2.77	0.54

B.4 Importance of *R. tomentosum* for PI Calculation

With the omission of *R. tomentosum* in the AKVEG dataset, most of the plots received a higher PI value, with 4,189 (88.3%) increasing, 414 with no change (8.73%), and 141 (3.0%) scoring lower. The average change in PI was +0.14 and ranged from −0.5 to +1.9. Six hundred thirty-five plots (13.5%) were no longer positive for the hydrophytic vegetation criterion. Most of the plots that lost positive status were in subregions that make up the Alaska Interior LRR, totaling 397, while 218 were in portions of Alaska that lack a designated subregion. The remaining 20 plots were scattered across various subregions. *R. tomentosum* appears to be an important component in most of the wetland communities that were sampled with a considerable majority shifting to a higher PI score with omission.

B.5 Data Preparation for Analyses

B.5.1 AKVEG

The original data contained 50 variables (not including cospecies data) with 4,917 observations. Twenty-one variables had zeros transformed to N/A values; Strata, Physiography, Geomorphology, Macrotopography, Microtopography, Microrelief, Drainage, Moisture, Restrictive Layer, Disturbance, Depth Water, Depth Moss Duff, Depth Restrictive Layer, Soil pH 10, Conductivity 10, Temperature 10, Soil pH 30, Conductivity 30, Temperature 30, Water pH, and Water Conductivity. Three variables were removed due to having no values; Soil class, water temperature and water conductivity. One variable was added; Interior—true or false value. Of the 48 variables, 19 were numeric. Of these 19 variables, 8 met the 60% missing values cut-off threshold.

B.5.2 NRCS

Original data contained 117 variables with 54 observations. After deleting duplicate variables, 96 variables remain. For 15 variables, zeros were transformed to N/A values; Restrict_t, Restrict_b, O_thickness, O_pH, surf_pH, bottom_pH, surf_hor, Clay_low, Clay_high, Silt_low, Silt_high, sand_low, sand_high, redox dept, sub_frag. One variable was added; Interior—true or false value. Of the 97 variables, 33 were numeric. Of these, 18 met the missing values cut-off rate of below 40%. The 54 observations and 18 variables were used for the correlation analysis, which informed selection of 15 variables for the ANOSIM, NMDS and PCA (see Section B.10.2, Figure B-19 for a list of the variables).

B.5.3 ANOSIM, Combined AKVEG/NRCS Dataset

The AKVEG and NRCS datasets share 17 variables in common, of which 6 variables are numeric. The combined dataset has 4,971 observations. Four variables—Cover, Elevation, Hydric soil rating, and PI—were determined to be appropriate for ANOSIM, NMDS, and PCA and correlation analysis was skipped due to the small number of variables.

B.6 Multiple Correspondence Analysis (MCA) on AKVEG Dataset

Neither dimension strongly explains the variance in the data nor is strongly influenced by Project, indicating there is no Project effect within the data (Figures B-8, B-9, and B-10).

Figure B-8. MCA plot of AKVEG data by NWPL subregion and Interior (*triangles*) versus the rest of Alaska (*dots*; *n* = 4,917). Each *symbol* represents the centroid of multiple observations.

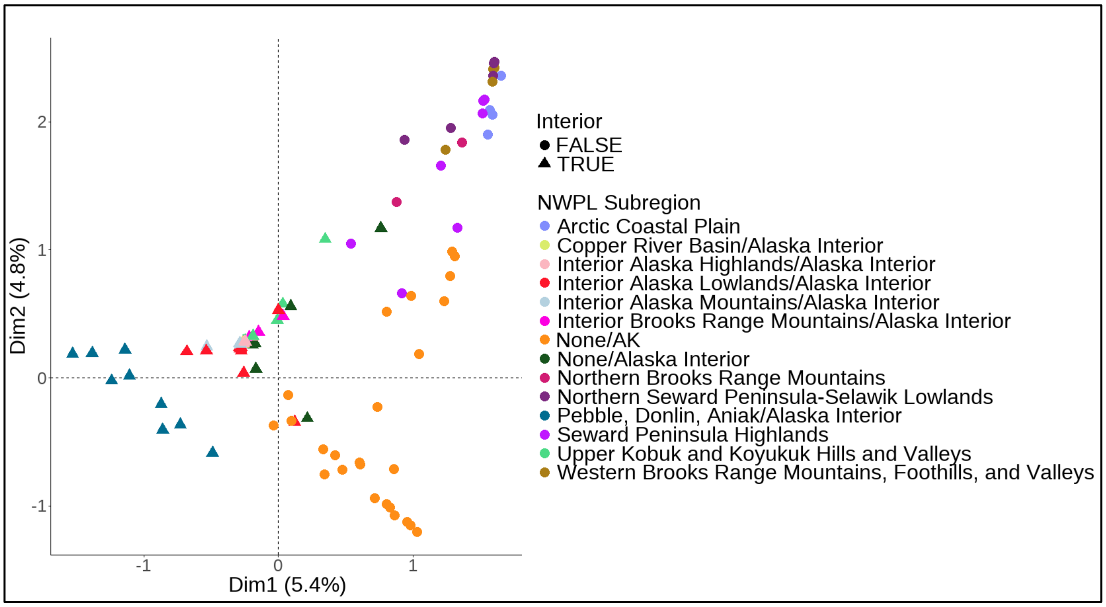


Figure B-9. Percent contribution of MCA factors to Dimension 1 for AKVEG data.

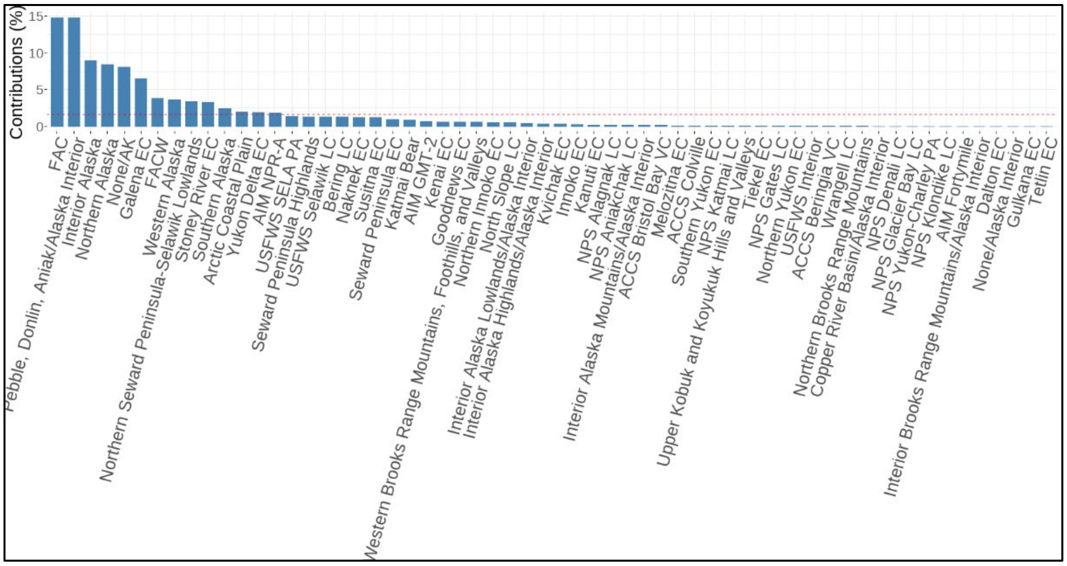
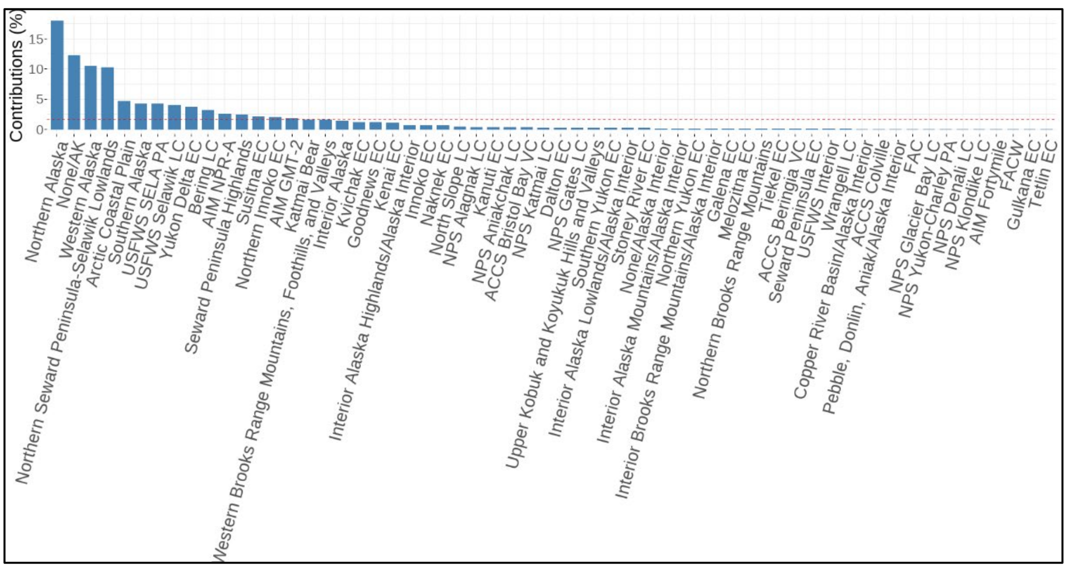


Figure B-10. Percent contribution of MCA factors to Dimension 2 for AKVEG data.

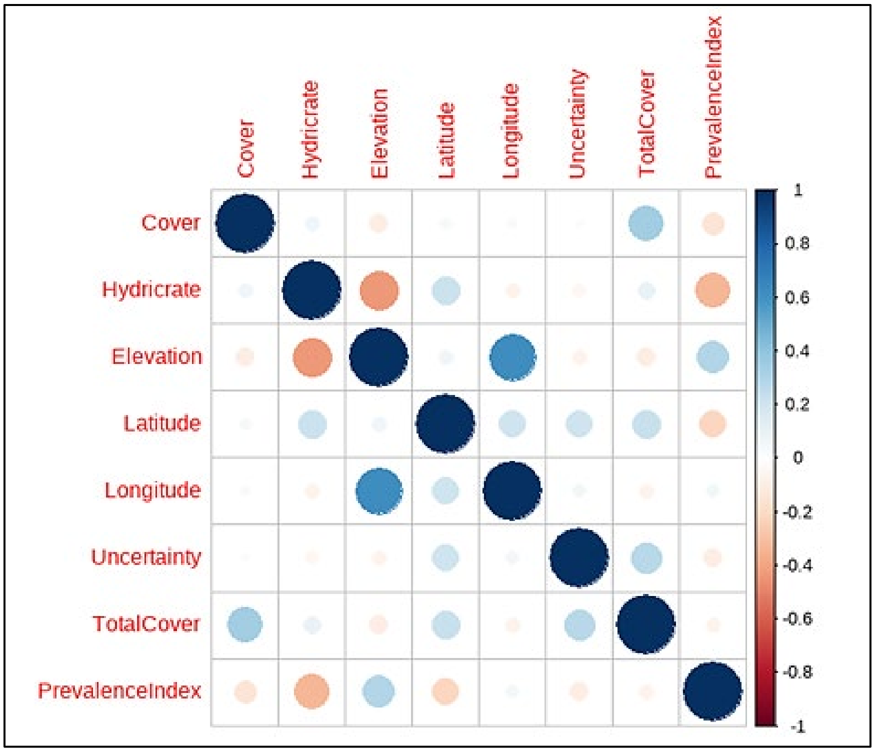


B.7 Correlation Matrices

B.7.1 AKVEG

The 4917 observations and 8 variables used for the correlation analysis informed selection of 4 variables for the ANOSIM, NMDS and PCA. Because of strong correlations with other variables, latitude, longitude, uncertainty, and TotalCover were excluded (Figure B-11). Cover, elevation, hydric soil rating and PI were included for analyses.

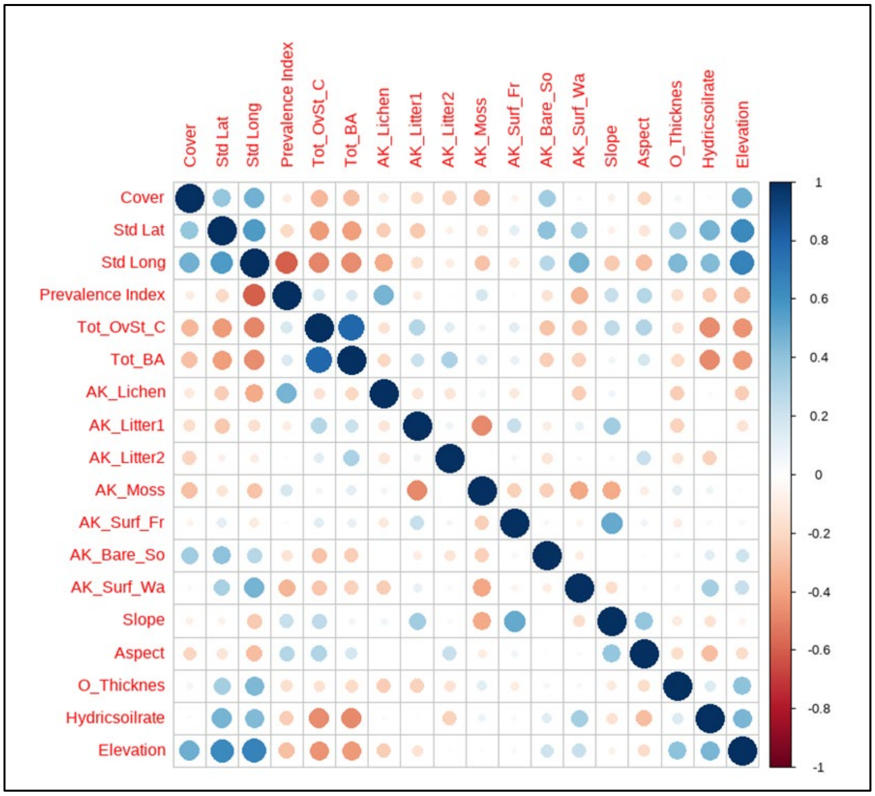
Figure B-11. Correlation matrix for *R. tomentosum* AKVEG data (*n* = 4,917).



B.7.2 NRCS

Categorical variables and variables deemed irrelevant to the research question were excluded, yielding 18 variables. Because of strong correlations with other variables, latitude, longitude, Alaska_Bedrock and Tot_BA, were excluded for ANOSIM, NMDS and PCA, leaving 15 variables for analysis (Figure B-12).Variables included in the analyses are shown in Section B.10.2 and Figure B-19.

Figure B-12. Correlation matrix for *Rhododendron tomentosum* National Resources Conservation Service (NRCS) data (n = 54).



B.8 The ANOSIM Test

B.8.1 AKVEG

For the four variables tested, subregions are significantly similar with high overlap (R = 0.1727, p < 0.01). Plots with FAC versus FACW ratings overlap completely (R = −0.093, p = 1). Pairwise comparison of PDA and Alaska show significant overlap, or no difference (R = 0.05, p <0.01; Table B-4). These results do not support two ratings within the state for *R. tomentosum.*

Table B-4. ANOSIM pairwise tests for all subregions from the AKVEG dataset (n = 4,917).

–	ALASKA	ACP	AKI •	IAH •	IAL •	IAM •	CRB •	WBR	NBR	IBR •	NSL	SPH	PDA •	UKK •
ALASKA	N/A	–	–	–	–	–	–	–	–	–	–	–	–	–
Arctic Coastal Plain (ACP)	0.06**	N/A	–	–	–	–	–	–	–	–	–	–	–	–
Alaska Interior (AKI) •	−0.1, 1	**0.63****	N/A	–	–	–	–	–	–	–	–	–	–	–
Interior Alaska Highlands (IAH) •	0.26**	**0.95****	0.36**	N/A	–	–	–	–	–	–	–	–	–	–
Interior Alaska Lowlands (IAL) •	−0.1, 1	0.13**	0.24**	**0.69****	N/A	–	–	–	–	–	–	–	–	–
Interior Alaska Mountains (IAM) •	0.48**	**1****	**0.77****	0.12**	**0.87****	N/A	–	–	–	–	–	–	–	–
Copper River Basin (CRB) •	0.23**	**1****	0.39**	−0.1, 1	**0.72****	0.25**	N/A	–	–	–	–	–	–	–
Western Brooks Range (WBR)	0.05, 0.14	**0.70****	0.29**	0.43**	0.38**	**0.76****	**0.56****	N/A	–	–	–	–	–	–
Northern Brooks Range (NBR)	**0.54****	**1****	**0.77****	0.17*	**0.89****	−0.1, 0.81	**0.66****	0.31*	N/A	–	–	–	–	–
Interior Brooks Range (IBR) •	0.30**	**1****	0.47**	−0.1, 1	**0.77****	0.17**	0.15**	**0.55****	0.27*	N/A	–	–	–	–
Northern Seward Peninsula (NSL)	0.11**	0, 0.73	**0.57****	**0.88****	0.24**	**0.97****	**0.88****	0.48**	**0.95****	**0.92****	N/A	–	–	–
Seward Peninsula Highlands (SPH)	−0.1, 1	**0.57****	0.07**	0.43**	0.21**	**0.82****	0.49**	0.18**	**0.70****	**0.55****	0.49**	N/A	–	–
Pebble/Donlin/Aniak (PDA) •	0.05**	**0.69****	0.02*	0.18**	0.32**	**0.53****	0.19**	0.27**	**0.64****	0.25**	**0.63****	0.11**	N/A	–
Upper Kobuk–Koyukuk (UKK) •	−0.1,1	**0.83****	0.05**	0.33**	0.23**	**0.83****	**0.62****	**0.51****	**0.87****	**0.66****	**0.68****	0.24**	−0.1, 1	N/A

Note: * is $p \leq 0.05$, ** is $p \leq 0.01$; for significant p values, *bold* text indicates $0.5 \leq R < 0.75$ (significantly different); *bold* and *gray* fill indicates $0.75 \leq R \leq 1$ (significantly highly different). *Yellow* indicates subregions under investigation for reassignment, *blue dots* indicate subregions that fall within the LRR Interior Alaska subregion.

B.8.2 NRCS

Subregions are significantly different ($R = 0.5454$, $p < 0.01$). Because no sites from PDA occur in this dataset, the issue of wetland indicator status rating cannot be assessed (Table B-5).

Table B-5. ANOSIM pairwise tests for all subregions from the NRCS dataset (n = 54).

—	ALASKA	ACP	AKI •	IAH •	IAL •	IAM •	CRB •	WBR	NBR	IBR •	NSL	SPH	PDA •	UKK •
ALASKA	N/A	—	—	—	—	—	—	—	—	—	—	—	—	—
Arctic Coastal Plain (ACP)	—	N/A	—	—	—	—	—	—	—	—	—	—	—	—
Alaska Interior (AKI) •	0.44**	—	N/A	—	—	—	—	—	—	—	—	—	—	—
Interior Alaska Highlands (IAH) •	**0.61****	—	**0.86***	N/A	—	—	—	—	—	—	—	—	—	—
Interior Alaska Lowlands (IAL) •	—	—	—	—	N/A	—	—	—	—	—	—	—	—	—
Interior Alaska Mountains (IAM) •	**0.74****	—	**0.98***	0.29**	—	N/A	—	—	—	—	—	—	—	—
Copper River Basin (CRB) •	—	—	—	—	—	—	N/A	—	—	—	—	—	—	—
Western Brooks Range (WBR)	—	—	—	—	—	—	—	N/A	—	—	—	—	—	—
Northern Brooks Range (NBR)	—	—	—	—	—	—	—	—	N/A	—	—	—	—	—
Interior Brooks Range (IBR) •	—	—	—	—	—	—	—	—	—	N/A	—	—	—	—
Northern Seward Peninsula (NSL)	—	—	—	—	—	—	—	—	—	—	N/A	—	—	—
Seward Peninsula Highlands (SPH)	—	—	—	—	—	—	—	—	—	—	—	N/A	—	—
Pebble/Donlin/Aniak (PDA) •	—	—	—	—	—	—	—	—	—	—	—	—	N/A	—
Upper Kobuk-Koyukuk (UKK) •	—	—	—	—	—	—	—	—	—	—	—	—	—	N/A

Note: * is $p \leq 0.05$, ** is $p \leq 0.01$; for significant p values, *bold* text indicates $0.5 \leq R < 0.75$ (significantly different); *bold* and *gray* fill indicates $0.75 \leq R \leq 1$ (significantly highly different). *Yellow* indicates subregions under investigation for reassignment, *blue dots* indicate subregions that fall within the LRR Interior Alaska subregion.

B.8.3 Combined Datasets

For the four variables tested, the subregions are significantly similar with high overlap ($R = 0.167$, $p < 0.01$). Plots with FAC versus FACW are similar ($R = -0.096$, $p = 1.00$). The pairwise comparison of PDA to the state of Alaska indicates that PDA overlaps significantly with Alaska ($R = 0.05$, $p < 0.01$). Results do not support a unique rating for PDA (Table B-6).

Table B-6. ANOSIM pairwise tests for all subregions from the combined datasets (n = 4,971).

—	ALASKA	ACP	AKI •	IAH •	IAL •	IAM •	CRB •	WBR	NBR	IBR •	NSL	SPH	PDA •	UKK •
ALASKA	N/A	—	—	—	—	—	—	—	—	—	—	—	—	—
Arctic Coastal Plain (ACP)	0.05*	N/A	—	—	—	—	—	—	—	—	—	—	—	—
Alaska Interior (AKI) •	−0.1, 1	**0.63****	N/A	—	—	—	—	—	—	—	—	—	—	—
Interior Alaska Highlands (IAH) •	0.25**	**0.95****	0.36**	N/A	—	—	—	—	—	—	—	—	—	—
Interior Alaska Lowlands (IAL) •	−0.1, 1	0.13**	0.24**	**0.69****	N/A	—	—	—	—	—	—	—	—	—
Interior Alaska Mountains (IAM) •	0.48**	**1****	**0.77****	0.11**	**0.86****	N/A	—	—	—	—	—	—	—	—
Copper River Basin (CRB) •	0.23**	**1****	0.39**	−0.1, 1	**0.72****	0.24**	N/A	—	—	—	—	—	—	—
Western Brooks Range (WBR)	0.05, 0.13	**0.70****	0.29**	0.43**	0.37**	**0.76****	**0.56****	N/A	—	—	—	—	—	—
Northern Brooks Range (NBR)	**0.54****	**1****	**0.78****	0.17*	**0.89****	−0.1, 0.77	**0.66****	0.31*	N/A	—	—	—	—	—
Interior Brooks Range (IBR) •	0.30**	**1****	0.48**	−0.1, 1	**0.77****	0.17**	0.15**	**0.55****	0.27*	N/A	—	—	—	—
Northern Seward Peninsula (NSL)	0.11**	0, 0.72	**0.57****	**0.88****	0.24**	**0.97****	**0.88****	0.48**	**0.95****	**0.92****	N/A	—	—	—
Seward Peninsula Highlands (SPH)	−0.1, 1	**0.57****	0.07**	0.43**	0.21**	**0.83****	0.49**	0.18**	**0.70****	**0.55****	0.49**	N/A	—	—
Pebble/Donlin/Aniak (PDA) •	0.05**	**0.69****	0.02, 0.06	0.18**	0.32**	**0.53****	0.19**	0.27**	**0.64****	0.25**	**0.63****	0.11**	N/A	—
Upper Kobuk-Koyukuk (UKK) •	−0.1, 1	**0.83****	0.04**	0.33**	0.23**	**0.83****	**0.62****	**0.51****	**0.87****	**0.66****	**0.68****	0.24**	−0.1, 1	N/A

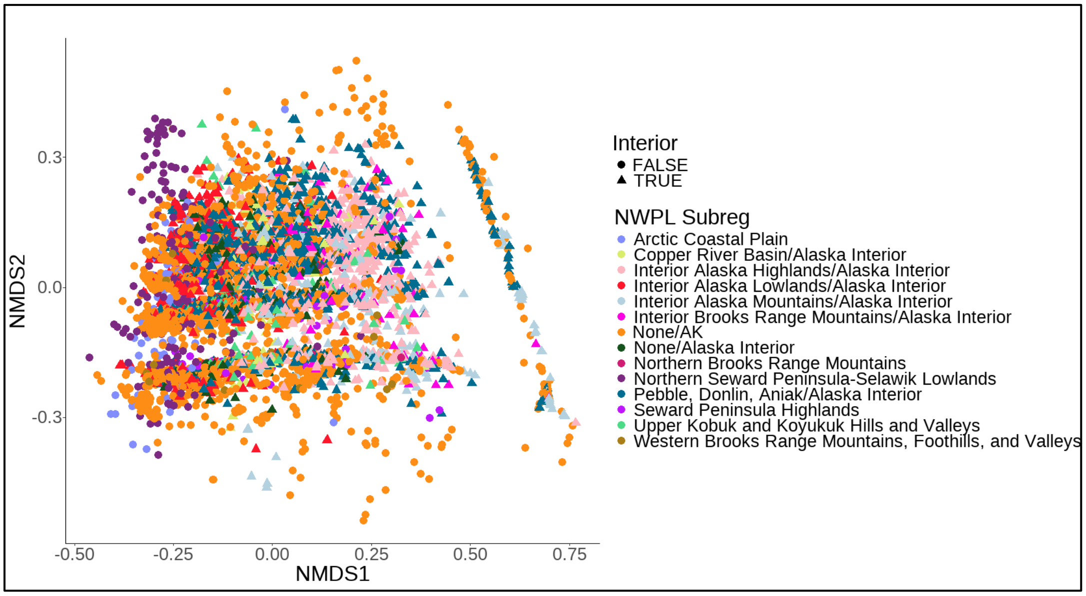
Note: * is $p \le 0.05$, ** is $p \le 0.01$; *bold* indicates $R \ge 0.5$. Pairwise results that did not change when datasets were combined are shown in *white* ($R < 0.75$) or *gray* ($R \ge 0.75$). New results from combining datasets are indicated by *orange hatching*; when combined with *gray*, $R \ge 0.75$. *Yellow* indicates subregions under investigation for reassignment, *blue* dots indicate subregions that fall within the LRR Interior Alaska subregion.

B.9 NMDS

B.9.1 AKVEG

PDA does not cluster separately from the rest of the state, and in fact appears in the center of the cloud, suggesting that there is no need for a unique wetland indicator status rating for the subregion (Figure B-13). All subregions do form clusters, although overlapping, along Dimension 1 (Figure B-13). Stress test values between 0.1 and 0.15 indicate the NMDS provides a good representation of the data (Clarke 1993; Figure B-13) and supports changing the wetland indicator status rating for PDA.

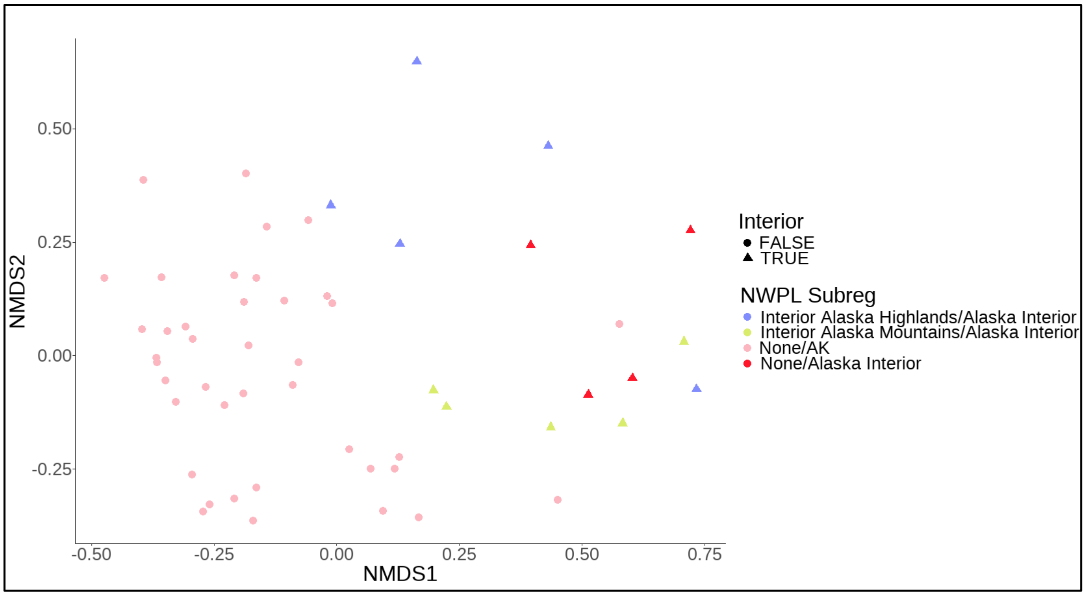
Figure B-13. NMDS of *R. tomentosum* AKVEG data (*n* = 4917), stress = 0.1216232.



B.9.2 NRCS

Sites outside of the NWPL subregions (None/AK) fall on the left of Dimension 1 while Interior sites fall on the right (Figure B-14). A stress value between 0.15 and 0.2 indicates the NMDS can be misleading and interpretation requires caution. NMDS for NRCS results are not included in the recommendations made here (Figure B-14).

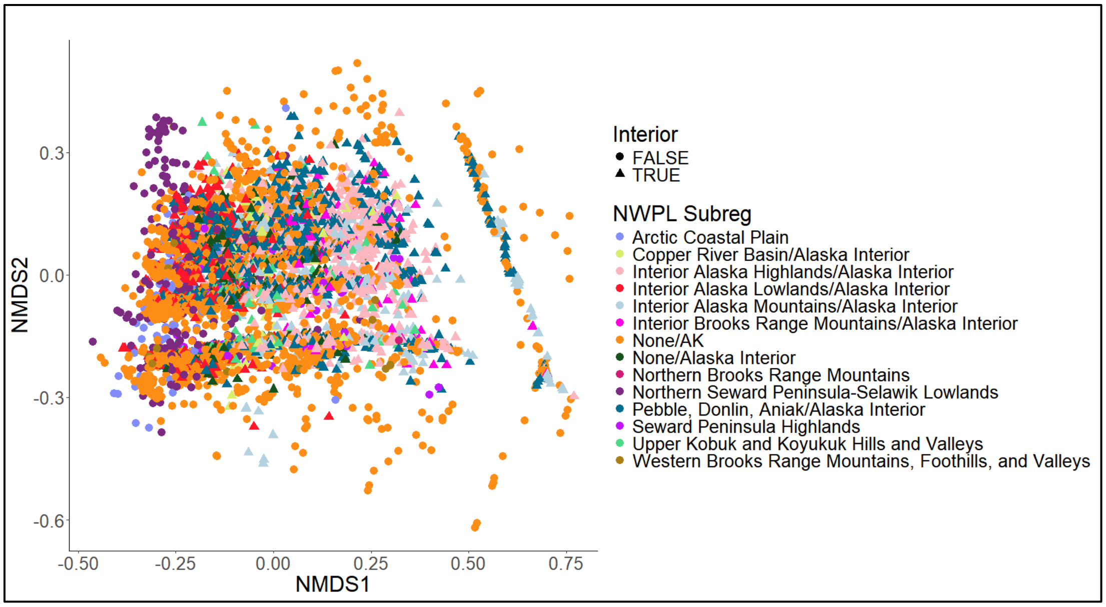
Figure B-14. NMDS of *R. tomentosum* NRCS data (*n* = 54), stress = 0.1511342.



B.9.3 Combined Datasets

Along Dimension 1, subregions cluster with themselves and overlap (Figure B-15). None/AK points overlay the entire figure, meaning points within the state share similarities with all subregions. There is no evident pattern along Dimension 2. PDA does not cluster separately from the rest of the state and most points appear in the center of the cloud, suggesting there is no need for a unique wetland indicator status rating for the subregion (Figure B-15). Stress test results between 0.1 and 0.15 indicate the NMDS provides a good representation of the data and supports changing PDA from FAC to FACW like the rest of the state.

Figure B-15. NMDS of *R. tomentosum* from combined AKVEG/NRCS data (*n* = 4,971), stress = 0.125113.



B.10 PCA

B.10.1 AKVEG

There is no clear clustering of PDA that separates the subregion from the rest of the state (Figure B-16). Dimension 1 explains most of the variance (43.8%) and is strongly influenced by hydric soil rating, which is negatively correlated with PI and elevation (Figure B-17). Dimension 2 explains 24.4% of the variance and is highly influenced by cover. Results indicate that PDA is similar to all other subregions.

Figure B-16. PCA plot of *R. tomentosum* AKVEG dataset (*n* = 4,917).

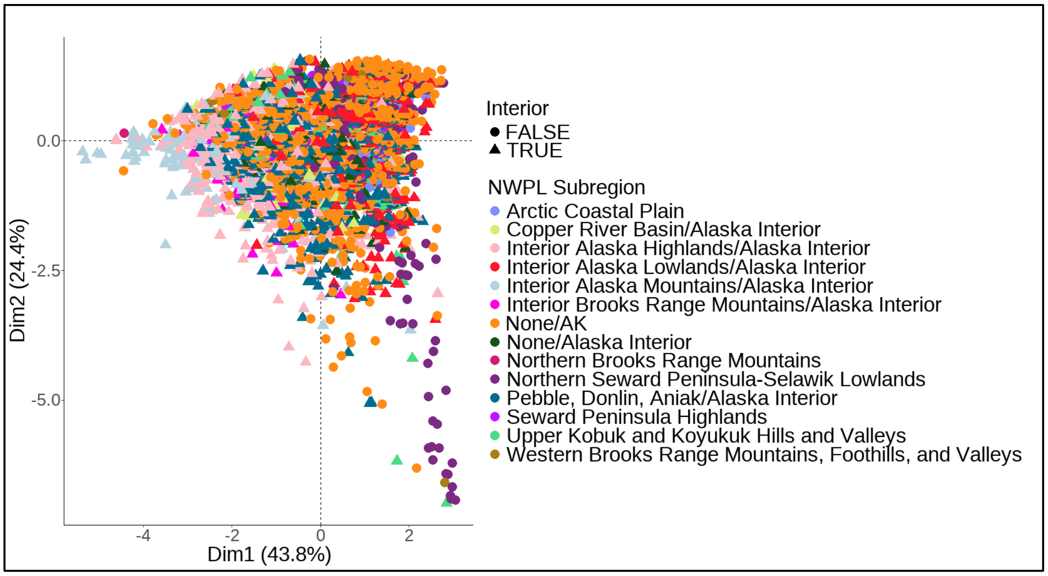
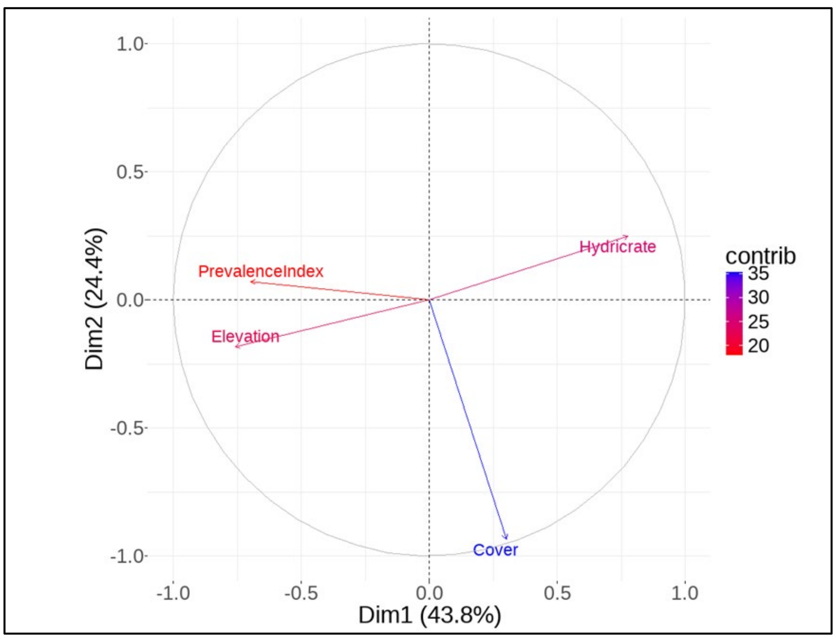


Figure B-17. PCA loading plot of AKVEG data.



B.10.2 NRCS

Interior Alaska sites cluster separately from those of the rest of the state along Dimension 1 (21.1%), which is most influenced by Total overstory cover and Elevation (Figures B-18 and B-19). Along Dimension 2 (14.8%), which is influenced Alaska_Moss and Alaska_Litter1, the Interior sites cluster in the center and None/AK spans the length of the axis. Results imply that Interior Alaska differs from the rest of the state along Dimension 1 but not Dimension 2.

Figure B-18. PCA plot of *R. tomentosum* NRCS dataset (n = 54).

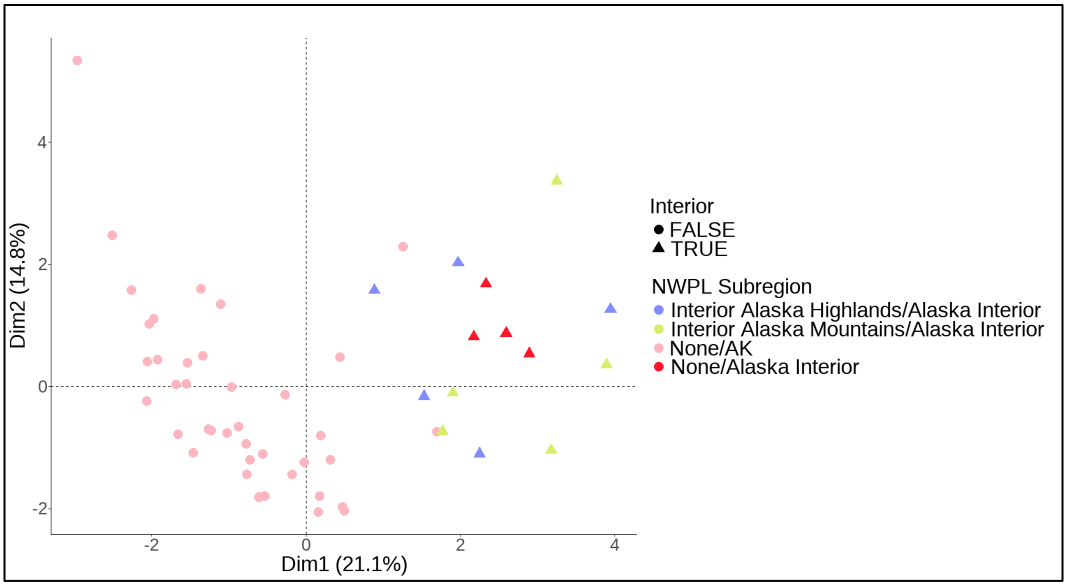
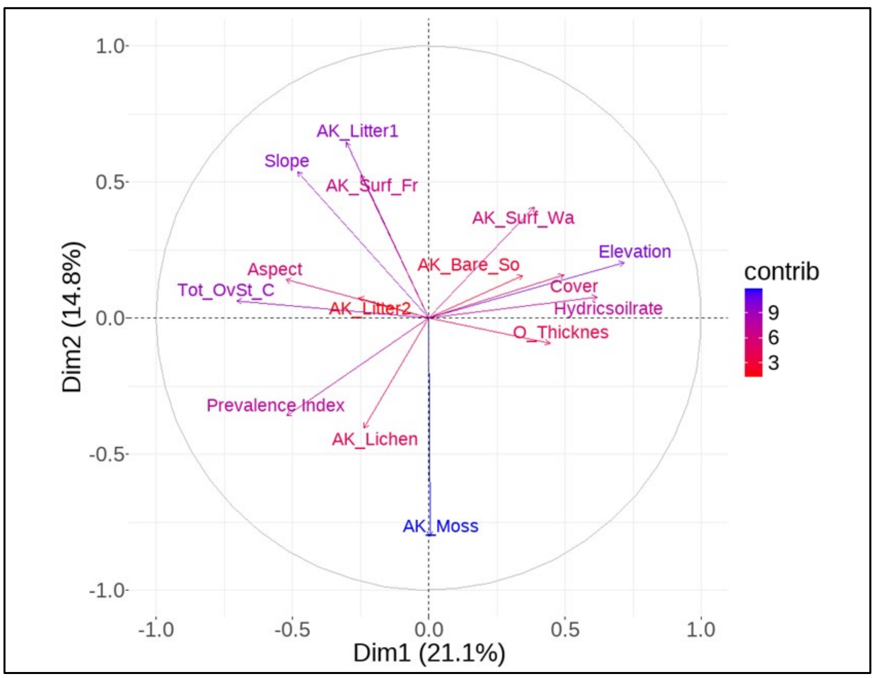


Figure B-19. PCA loading plot of NRCS data.



B.10.3 Combined Datasets

Combining the datasets increases the variance explained by Dimensions 1 and 2 (43.5% and 24.4%, respectively, Figure B-20). There is no evident clustering of PDA separately from other subregions. Along Dimension 1, AKI sites fall to the left, all other subregions except None/AK fall to the right and IAL points overlap most with the non-Interior sites. Dimension 1 is influenced by elevation and PI, which are positively correlated, and also by hydric soil rating, which is negatively correlated with the previously mentioned factors (Figure B-21). NSL falls out slightly separate from the rest of the subregions along Dimension 2, which is influenced by cover (FigureB-21).

Figure B-20. PCA plot of *Rhododendron tomentosum* combined AKVEG/NRCS dataset (n = 4,971).

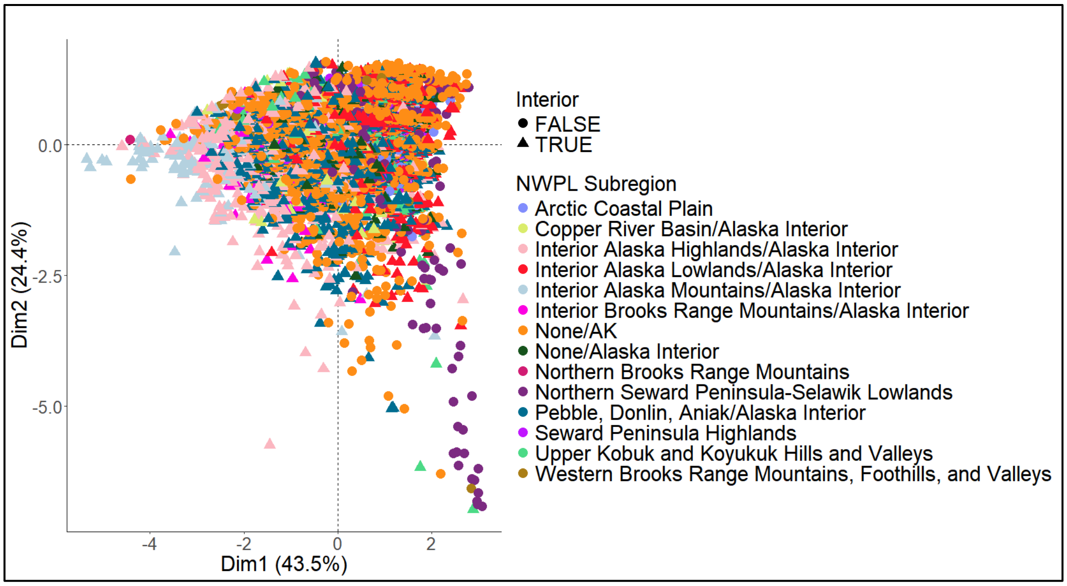
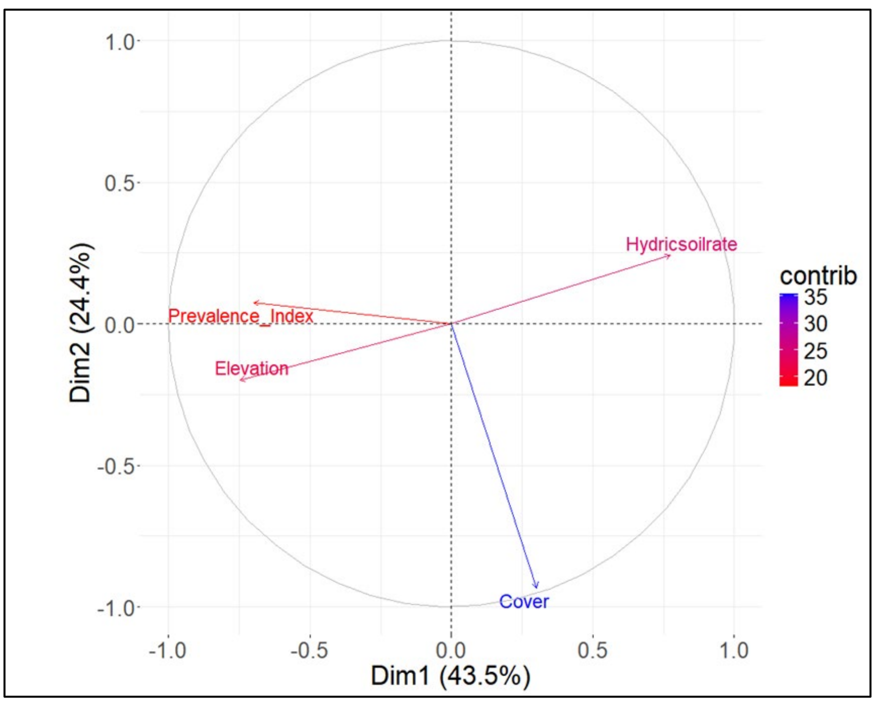


Figure B-21. PCA loading plot of combined AKVEG/NRCS data.



Appendix C: *Andromeda polifolia*

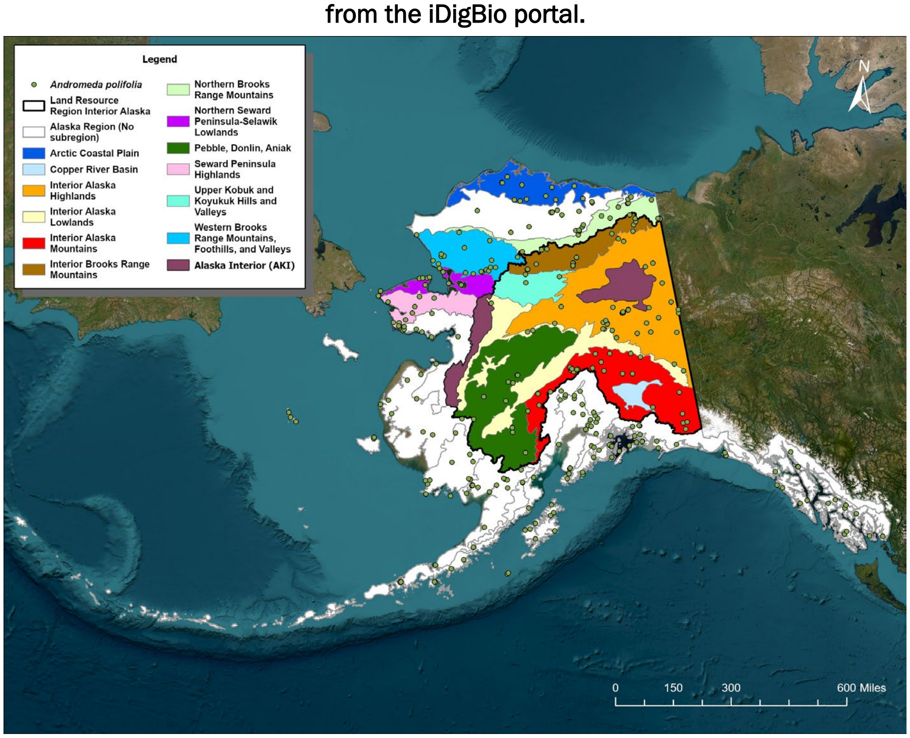
On the NWPL *Andromeda polifolia* has a wetland indicator status rating of a FACW species for the state of Alaska and OBL for 5 subregions; IAL, IAM, CRB, IBR, and UKK. This appendix evaluates the results of multiple analyses to determine whether the wetland indicator status rating of *A. polifolia* in any of these five subregions (IAL, IAM, CRB, IBR, and UKK) should be reclassified from OBL to match the state-wide rating of FACW, or if a larger subregion based on the LRR 2012 Interior Alaska subregion is warranted.

Data were analyzed in three ways. First, the data from the Alaska Vegetation Plots Database (AKVEG) and the Natural Resource Conservation Service (NRCS) data were analyzed independently. Second, the datasets were combined for analysis. The variables and number of plots varied between datasets; sample size by subregion and dataset is reported in Section C.3.

C.1 Herbaria Specimens Data

Three hundred fifty-nine specimens contained locality data; 108 of these were collected in LRR Interior Alaska (Figure C-1).

Figure C-1. *Andromeda polifolia* specimens with known locality information from the iDigBio portal.

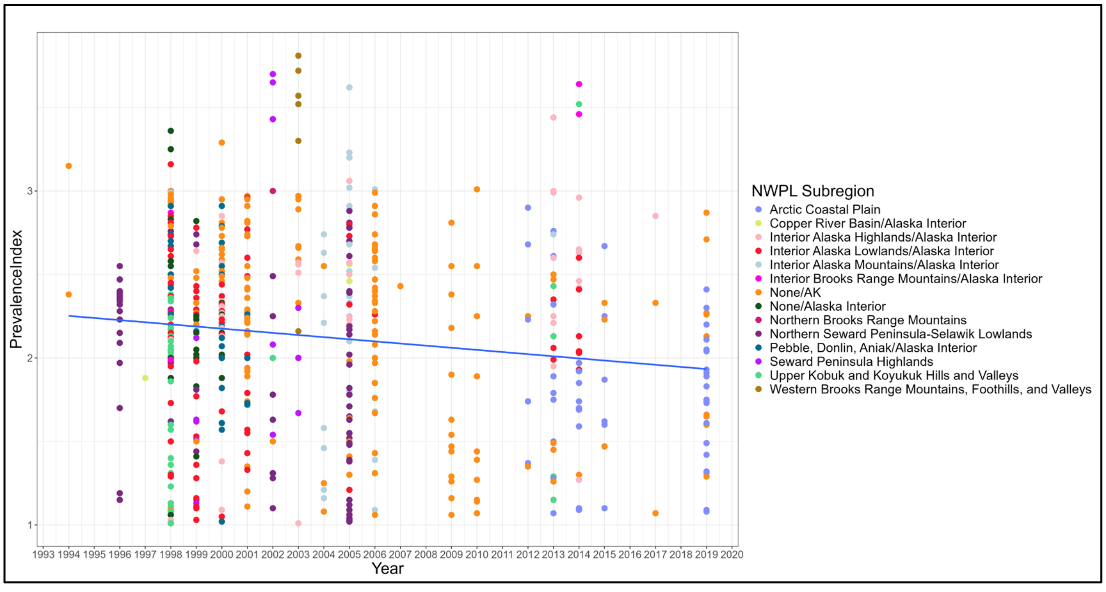


C.2 PI over Time by Alaska Subregion

C.2.1 AKVEG

PI shows a decrease from 1994 to 2019. The trend line remains below a value of 3, implying that the plots' hydrophytic vegetation factor for wetland delineation (hydrophytic, ≤3, versus nonhydrophytic, >3) has not changed (Figure C-2). A decrease over time indicates that plots are weighted more heavily by FACW or OBL species than FAC, FACU or UPL species over time, which could be due to an increase in the number or percent cover of FACW or OBL species. This observation implies that plots in which *A. polifolia* occurs could be becoming wetter but does not inform whether the wetland indicator status ratings for the 5 subregions in question warrant change.

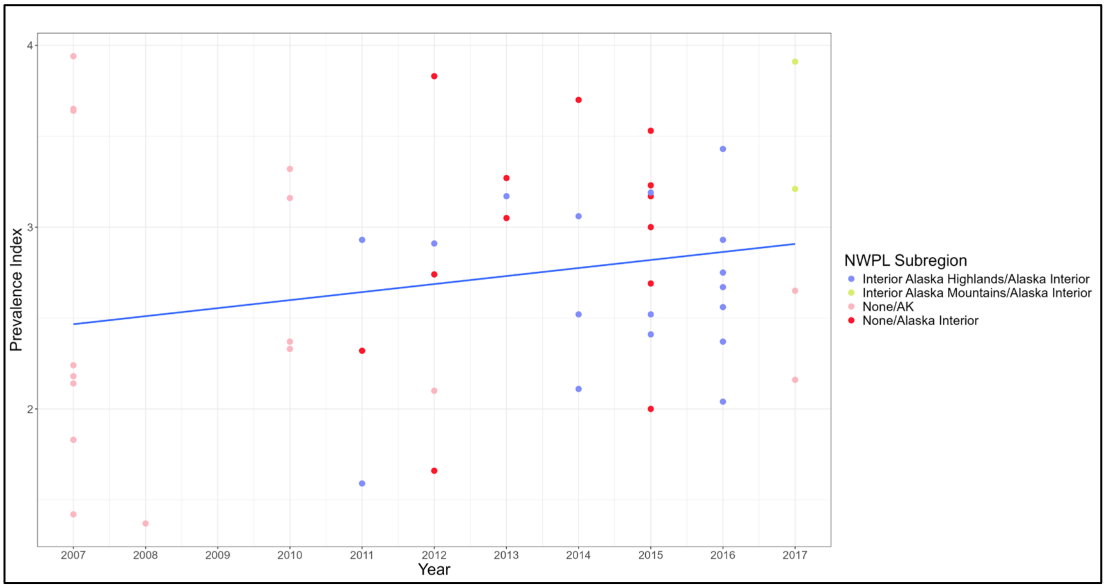
Figure C-2. Change in PI over time by NWPL wetland indicator status rating for plots containing *Andromeda polifolia* from AKVEG data (n = 612).



C.2.2 NRCS

PI shows an increase from 2007 to 2017. The trend line remains below a value of 3, implying that the plots' hydrophytic vegetation factor for wetland delineation (hydrophytic, ≤3, versus nonhydrophytic, >3) has not changed (Figure C-3). An increase over time indicates that plots are weighted more heavily by FAC, FACU or UPL species than FACW or OBL species over time, which could be due to an increase in the number or percent cover of FAC, FACU or UPL species. This observation implies that plots in which *A. polifolia* occurs are becoming drier which supports reassigning the wetland indicator status rating for *A. polifolia* within IAM, the only subregion in question that is included in the NRCS dataset, to FACW. The small sample size (IAM only contains 2 data points) provides weak support for the change, but interestingly both points have a PI above 3, indicating that the plots do not meet the requirements for classification as containing hydrophytic vegetation.

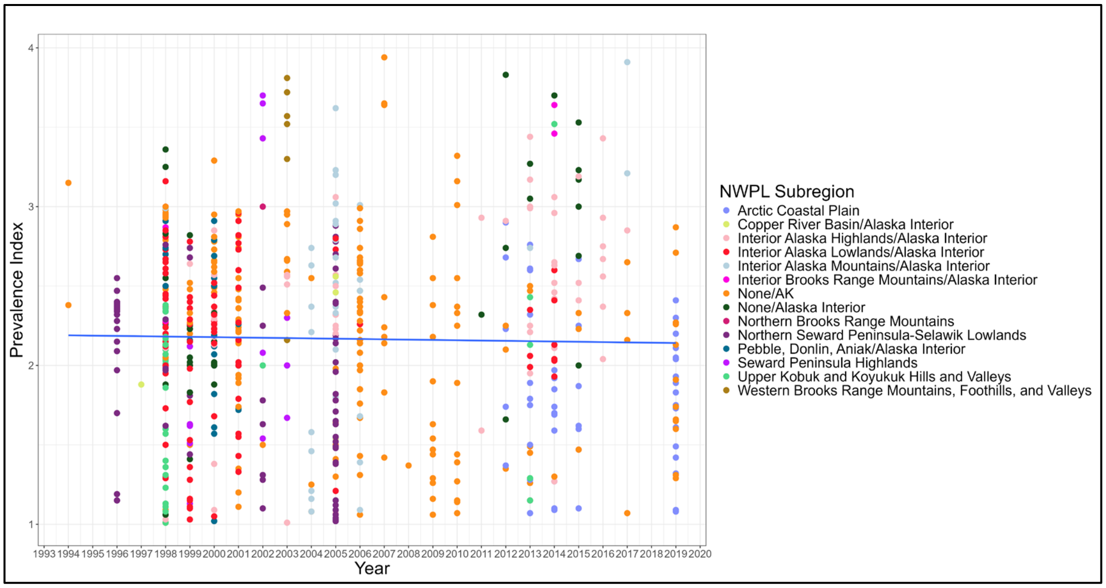
Figure C-3. Change in PI over time by NWPL wetland indicator status rating for plots containing *A. polifolia* from NRCS data (n = 49).



C.2.3 Combined Datasets

PI shows an almost imperceptible decrease from 1994 to 2019. The trend line remains below a value of 3, implying that the plots' hydrophytic vegetation factor for wetland delineation (hydrophytic, ≤3, versus nonhydrophytic, >3) has not changed (Figure C-4). Results neither support nor refute rating changes for the 5 subregions in question.

Figure C-4. Change in PI over time by NWPL wetland indicator status rating for plots containing *A. polifolia* from combined AKVEG and NRCS data (n = 661).



C.3 PI by Wetland Status Indicator Rating and Subregion

C.3.1 AKVEG

None of the 5 OBL subregions in question have PI values that differ from the values for the FACW subregions (Figure C-5; Table C-1). The values for the FACW subregions span the values of 4 of the 5 OBL subregions. UKK (1.80 ± 0.55) is the exception, falling below the lowest FACW PI, Arctic Coastal Plain (1.83 ± 0.47). However, there is overlap between both when the standard deviation is considered. Results indicate that sites where *A. polifolia* occurs in IAL, IAM, CRB, IBR, and UKK do not differ in hydrophytic vegetation factor from those where it occurs in other subregions, implying no need for an OBL rating for the 5 subregions. Although it is possible the mean value for the 5 species in question would decrease if recalculated with an OBL rating of 1 for *Andromeda polifolia* rather than 2 (FACW) and a rating of OBL would be deemed appropriate from this analysis, cover data for the species is dominated by small values and would not likely change the results (see Section C.4).

Figure C-5. Bar chart comparing the mean PI for each subregion by wetland status indicator rating (AKVEG, *n* = 612).

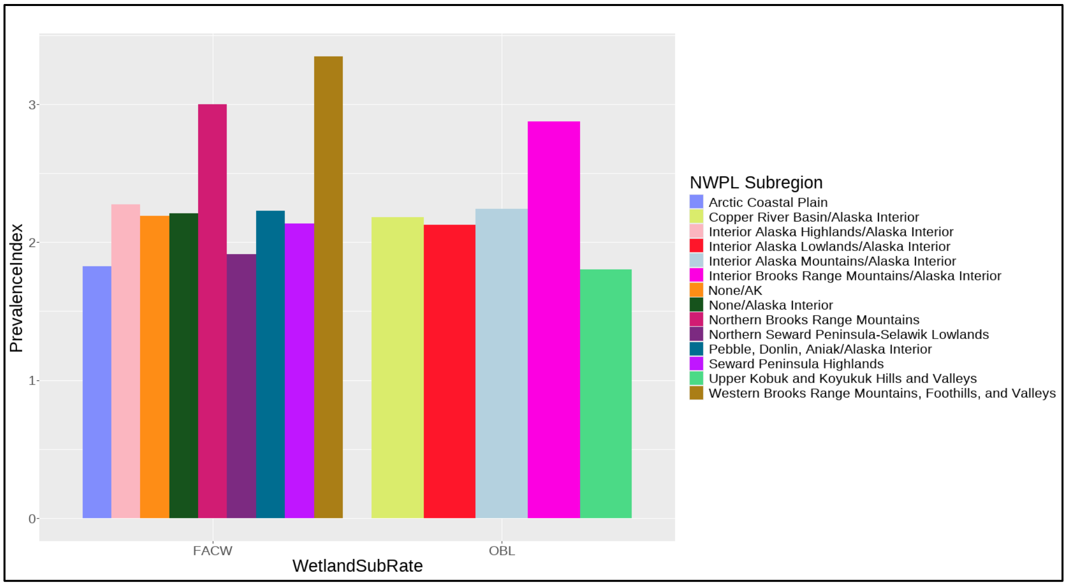


Table C-1. Sample size, mean, and standard deviation of the PI for the 13 NWPL subregions and the rest of the state of Alaska (None/AK) for plots from the AKVEG dataset. *Yellow* indicates subregions under investigation for reassignment.

NWPL Subregion	Number of Observations	Average PI Value	Standard Deviation of PI Values
Arctic Coastal Plain (ACP)	52	1.83	0.47
Copper River Basin (CRB)/Alaska Interior (LRR)	5	2.18	0.45
Interior Alaska Highlands (IAH)/Alaska Interior (LRR)	54	2.28	0.50
Interior Alaska Lowlands (IAL)/Alaska Interior (LRR)	94	2.13	0.51
Interior Alaska Mountains (IAM)/Alaska Interior (LRR)	35	2.24	0.73
Interior Brooks Range Mountains (IBR)/Alaska Interior (LRR)	6	2.87	0.65
None/AK	182	2.19	0.61
None/Alaska Interior (AKI in LRR)	28	2.21	0.49
Northern Brooks Range Mountains (NBR)	1	3.00	N/A
Northern Seward Peninsula-Selawik Lowlands (NSL)	69	1.91	0.56
Pebble, Donlin, Aniak (PDA)/Alaska Interior (LRR)	28	2.23	0.46
Seward Peninsula Highlands (SPH)	15	2.13	0.81
Upper Kobuk and Koyukuk Hills and Valleys (UKK)	37	1.80	0.55
Western Brooks Range Mountains, Foothills, and Valleys (WBR)	6	3.35	0.61

C.3.2 NRCS

The NRCS dataset contains 2 observations from 1 of the 5 NWPL subregions in question, IAM (Figure C-6). Mean PI is above 3 for IAM (3.56 ± 0.49) and below 3 for the rest of the subregions, indicating that in IAM, *A. polifolia* occurs in sites that would not meet the hydrophytic vegetation factor using the PI (Figure C-6; Table C-2). However, because sample size is small (n = 2) and calculating PI with the species assigned a value of 1 rather than 2 could decrease the outcome, these results do not make a strong case for reassignment of IAM to FACW.

Figure C-6. Bar chart comparing the mean PI for each subregion by wetland status indicator rating (NRCS, n = 49).

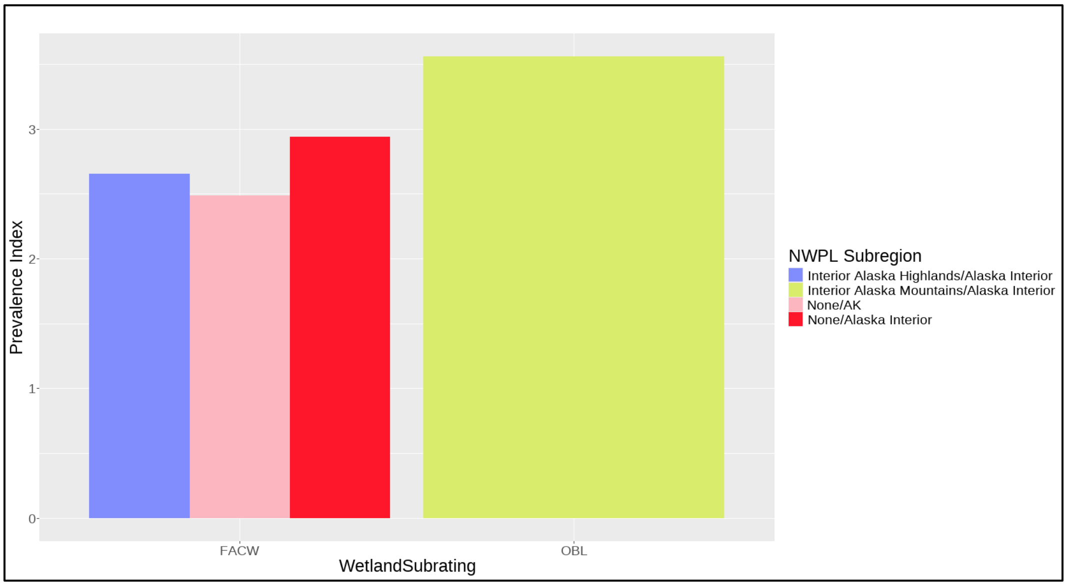


Table C-2. Sample size, mean, and standard deviation of the PI for the 5 NWPL subregions and the rest of the state of Alaska (None/AK) for plots from the NRCS dataset. *Yellow* indicates subregions under investigation for reassignment.

NWPL Subregion	Number of Observations	Average PI Value	Standard Deviation of PI Values
Interior Alaska Highlands (IAH)/Alaska Interior (LRR)	17	2.66	0.47
Interior Alaska Mountains (IAM)/Alaska Interior (LRR)	2	3.56	0.49
None/AK	17	2.49	0.78
None/Alaska Interior (AKI in LRR)	13	2.94	0.64

C.3.3 Combined Datasets

Because the NRCS dataset is small, combining the datasets did not greatly affect interpretation of the outcome. Results indicate that the PI of sites where *A. polifolia* occurs in IAL, IAM, CRB, IBR and UKK does not differ from those where it occurs in other subregions (Figure C-7, Table C-3). Although it is possible the mean value for the five subregions in question would decrease if recalculated with an OBL rating of 1 for *A. polifolia* rather than 2 and a rating of OBL would be deemed appropriate from this analysis, cover data for the species is dominated by small values and would not likely change the results (see Section C.4).

Figure C-7. Bar chart comparing the mean PI for each subregion by wetland status indicator rating (combined datasets, *n* = 661).

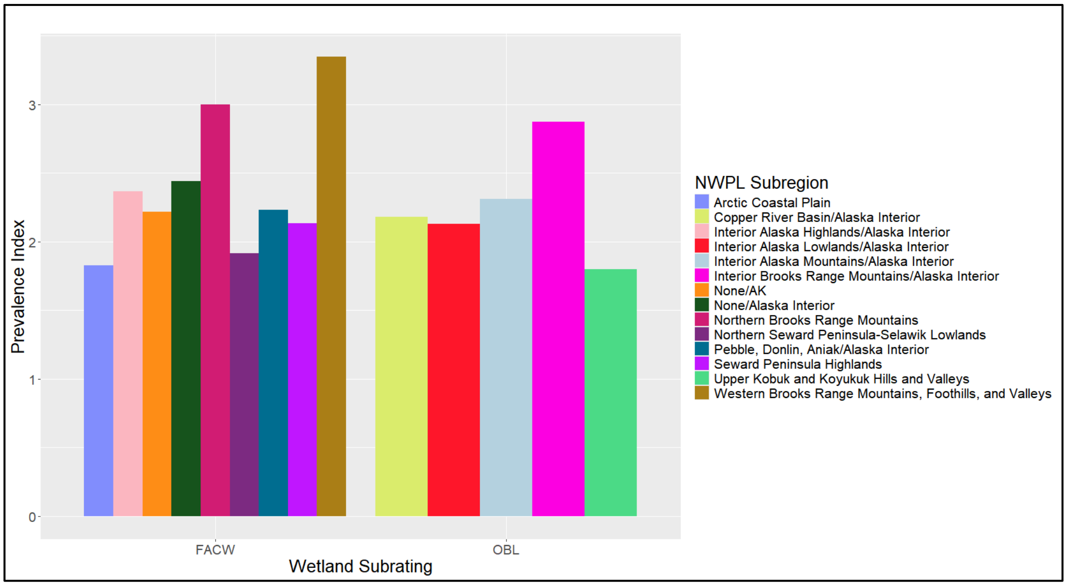


Table C-3. Sample size, mean, and standard deviation of the PI for the 13 NWPL subregions and the rest of the state of Alaska (None/AK) for plots from the combined AKVEG/NRCS dataset. *Yellow* indicates subregions under investigation for reassignment.

NWPL Subregion	Number of Observations	Average PI Value	Standard Deviation of PI Values
Arctic Coastal Plain (ACP)	52	1.83	0.47
Copper River Basin (CRB)/Alaska Interior (LRR)	5	2.18	0.45
Interior Alaska Highlands (IAH)/Alaska Interior (LRR)	71	2.37	0.52
Interior Alaska Lowlands (IAL)/Alaska Interior (LRR)	94	2.13	0.51
Interior Alaska Mountains (IAM)/Alaska Interior (LRR)	37	2.31	0.78

Table C-3 (cont.). Sample size, mean, and standard deviation of the PI for the 13 NWPL subregions and the rest of the state of Alaska (None/AK) for plots from the combined AKVEG/NRCS dataset. *Yellow* indicates subregions under investigation for reassignment.

NWPL Subregion	Number of Observations	Average PI Value	Standard Deviation of PI Values
Interior Brooks Range Mountains (IBR)/Alaska Interior (LRR)	6	2.87	0.65
None/AK	199	2.21	0.63
None/Alaska Interior (AKI in LRR)	41	2.44	0.63
Northern Brooks Range Mountains (NBR)	1	3.00	N/A
Northern Seward Peninsula-Selawik Lowlands (NSL)	69	1.91	0.56
Pebble, Donlin, Aniak (PDA)/Alaska Interior (LRR)	28	2.23	0.46
Seward Peninsula Highlands (SPH)	15	2.13	0.81
Upper Kobuk and Koyukuk Hills and Valleys (UKK)	37	1.80	0.55
Western Brooks Range Mountains, Foothills, and Valleys (WBR)	6	3.35	0.61

C.4 Importance of *A. polifolia* for PI Calculation

With the omission of *A. polifolia* in the AKVEG dataset, 145 plots (23.7%) received a higher PI score, 222 plots (36.3%) remained the same, and 244 plots (39.9%) received a lower score. The mean change in PI score was −0.01 and the median change in PI was zero. The largest decrease in PI score was by −1.0 while the largest increase was +1.08. Four plots (0.68% of plots with positive PI) were no longer positive for the hydrophytic vegetation criterion, and no plots gained positive criterion status. *A. polifolia* appears to occur at relatively low levels of total cover in the sampled plant communities. Average total cover reported in the AKVEG database was 3.4%. Dropping this species from the PI calculation had limited effect on the final PI value for each plot.

C.5 Data Preparation for Analyses

C.5.1 AKVEG

The original data from AKVEG contained 50 variables (not including co-occurring species data) with 616 observations. Twenty-one variables had zeros transformed to N/A values; Strata, Physiography, Geomorphology, Macrotopography, Microtopography, Microrelief, Drainage, Moisture, Restrictive Layer, Disturbance, Depth Water, Depth Moss Duff, Depth Restrictive Layer, Soil pH 10, Conductivity 10, Temperature 10, Soil pH

30, Conductivity 30, Temperature 30, Water pH, and Water Conductivity. Three variables were removed due to having no values: Soil class, Water conductivity and Water temperature. One variable was added: Interior—true or false value. Of the 49 variables, 19 were numeric; of these 19, 8 variables met the cut-off criteria of no more than 60% missing values. Four observations were excluded due to having no PI value. The remaining 612 observations and 8 variables were used for the correlation analysis, which informed selection of 4 variables for the ANOSIM, NMDS, and PCA.

C.5.2 NRCS

The original data from NRCS contained 117 variables with 49 observations. After deleting duplicate variables, 96 variables remain. For 15 variables, zeros were transformed to N/A values; Restrict_t, Restrict_b, O_thickness, O_pH, surf_pH, bottom_pH, surf_hor, Clay_low, Clay_high, Silt_low, Silt_high, sand_low, sand_high, redox dept, and sub_frag. One variable was added: Interior—true or false value. Of the 97 variables, 33 were numeric. Of these, 24 met the 40% cut-off of missing values threshold and were imputed. Forty-nine observations and 24 variables were used for the correlation analysis, which informed selection of 18 variables for the ANOSIM, NMDS and PCA (see Section C.10.2, Figure C-19 for a list of the variables).

C.5.3 Combined AKVEG/NRCS Dataset

The AKVEG and NRCS datasets share 17 variables in common, of which 6 variables are numeric. The combined dataset has 661 observations. Four variables, cover, elevation, hydric soil rating, and PI, were determined to be appropriate for ANOSIM, NMDS, and PCA. Correlation analysis was skipped due to the small number of variables.

C.6 MCA on AKVEG Dataset

Neither dimension strongly explains the variance in the data nor is strongly influenced by Project, indicating there is no Project effect within the data (Figures C-8, C-9, and C-10).

Figure C-8. MCA plot of AKVEG data by NWPL subregion and Interior (*triangles*) versus the rest of Alaska (*dots*; *n* = 612). Each *symbol* represents the centroid of multiple observation points.

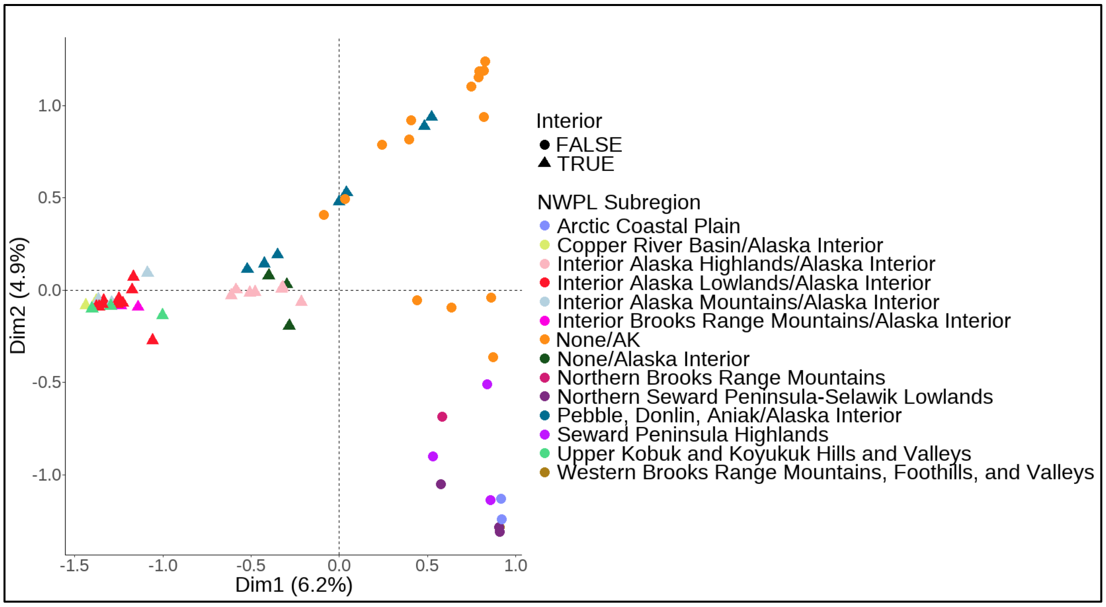


Figure C-9. Percent contribution of MCA factors to Dimension 1 for AKVEG data.

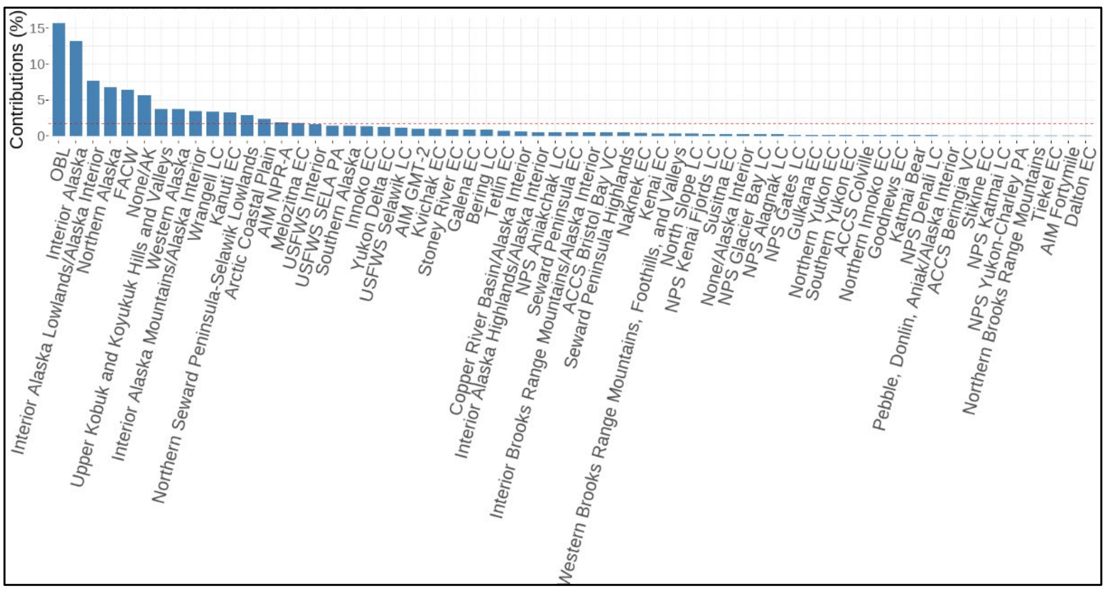
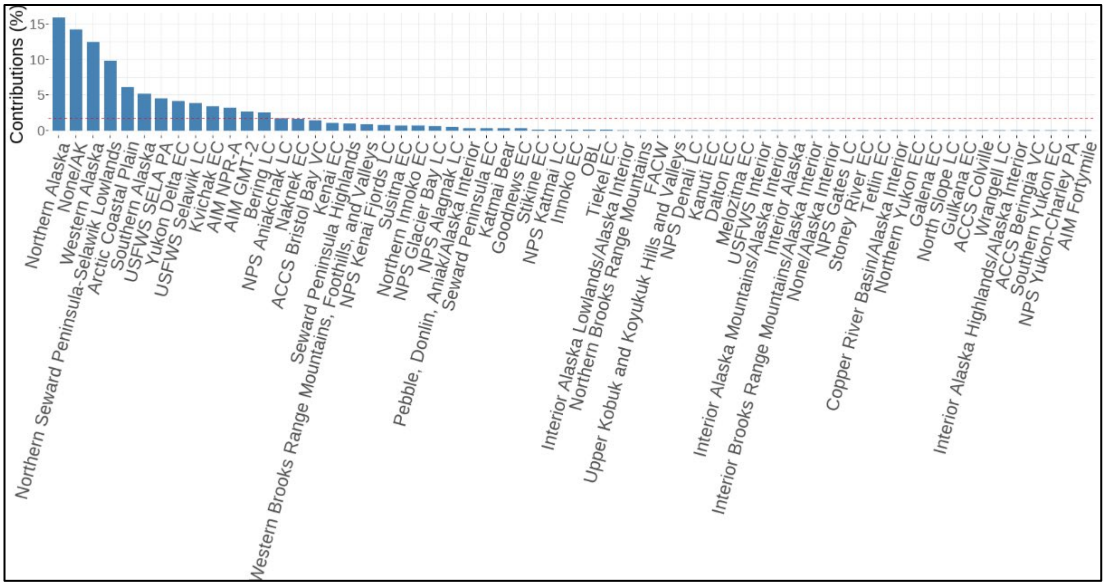


Figure C-10. Percent contribution of MCA factors to Dimension 2 for AKVEG data.

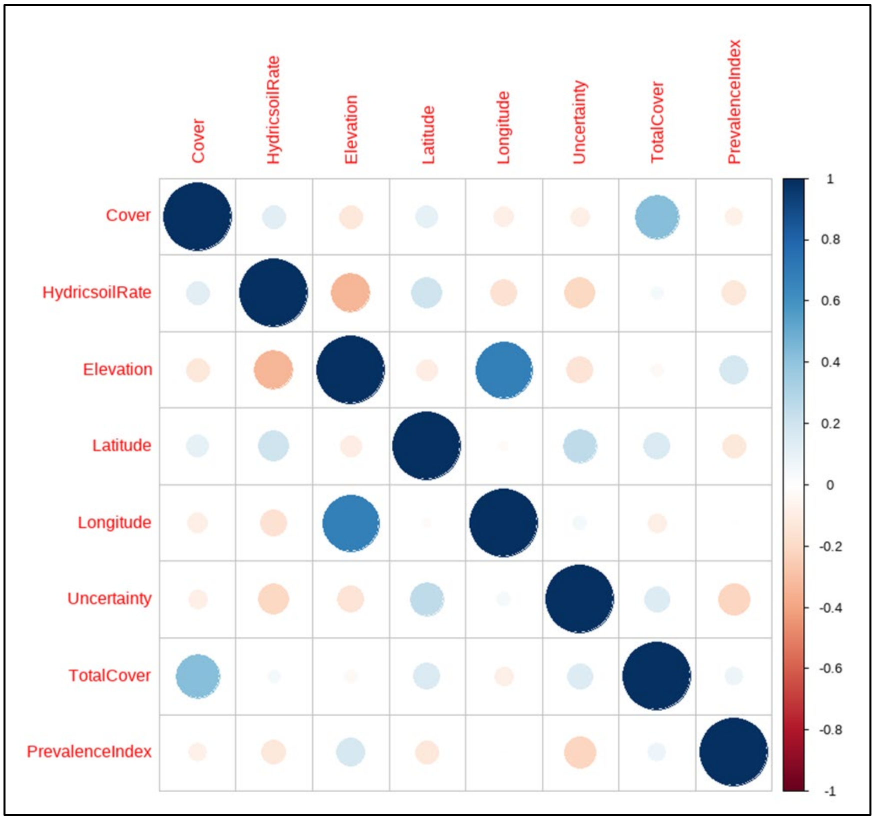


C.7 Correlation Matrices

C.7.1 AKVEG

The original dataset had 49 categorical and numeric variables. For correlation analysis, categorical variables and variables deemed irrelevant to the research question were excluded, yielding 8 variables and 613 observations (Figure C-11). Because of strong correlations with other variables, latitude, longitude, uncertainty and TotalCover were excluded. Cover, hydric soil rating, elevation and PI were included for ANOSIM, PCA, and NMDS analyses.

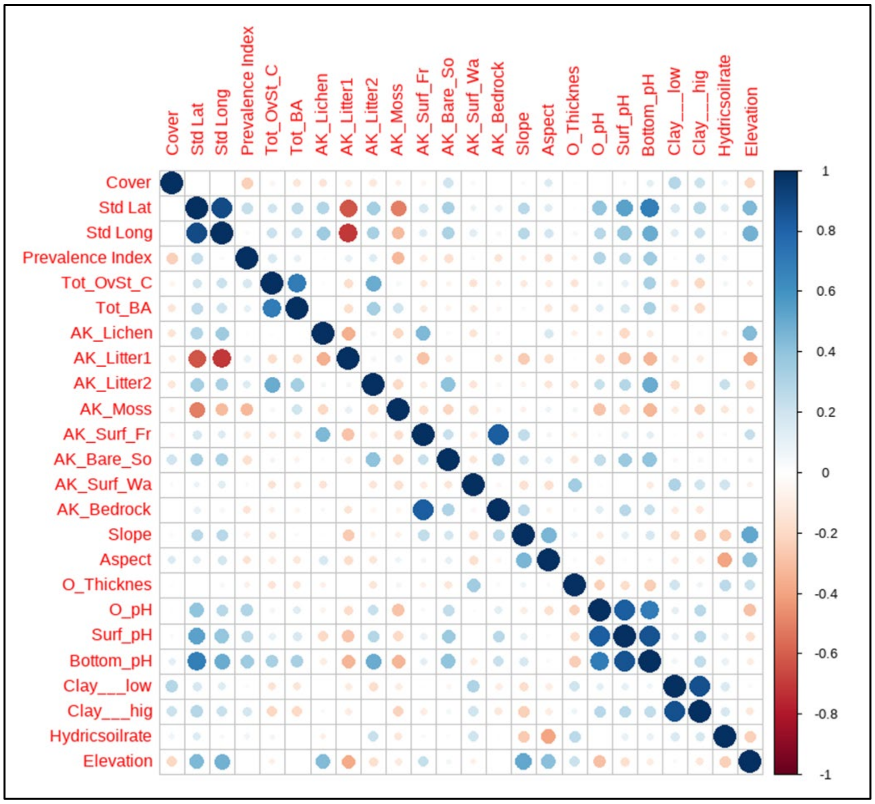
Figure C-11. Correlation matrix for *Andromeda polifolia* AKVEG data (n = 612).



C.7.2 NRCS

The original dataset had 97 categorical and numeric variables. For correlation analysis, categorical variables and variables deemed irrelevant to the research question were excluded, yielding 24 variables (Figure C-12). Data were imputed for observations missing values, resulting in 49 observations. Because of strong correlations with other variables, latitude, longitude, Tot_BA, Bottom_pH, Alaska_Surf_Fr, and slope were excluded for ANOSIM, NMDS, and PCA analyses. Variables included in the analyses are shown in Section C.10.2, Figure C-19.

Figure C-12. Correlation matrix for *Andromeda polifolia* NRCS data (n = 49).



C.8 The ANOSIM Test

C.8.1 AKVEG

For the four variables tested, subregions are significantly similar, or highly overlapping (R = 0.259, p<0.01). Pairwise comparisons of subregions indicate that all but one of the subregions in question overlap with Alaska (Table C-4). IAL and UKK are statistically similar (R = 0 and R = −0.1, respectively, p = 1 for both). CRB and IBR are significantly different with some overlapping (R = 0.45 and 0.41, respectively, p < 0.01 for both) but sample size is small (n = 5 and 6, respectively). The exception is IAM, for which there are no clear pattern of differences. Regarding the 4 other subregions in question here, IAM is highly significantly different from IAL (R = 0.81, p < 0.01) and UKK (R = 0.93, p < 0.01), trends toward significant overlap with CRB (R = 0.19, p = 0.07), and is different with some overlap compared to IBR (R = 0.30, p < 0.01). These results imply that IAM could be either FACW or OBL. However, IAM is significantly different from the state (R = 0.59, p < 0.01) and significantly highly different from 6 of the 8 subregions not in question here (PDA, SPH [Seward Peninsula Highlands], NSL, WBR, ACP, and AKI; Table C-4), implying that IAM warrants a different rating than the state and these six subregions. The retention of OBL for IAM is further supported by the difference previously mentioned from IAL and UKK. IAM is similar to NBR ($R = -0.2$, $p = 0.54$), and significantly highly overlapping with IAH ($R = 0.13$, $p < 0.01$). If the number of dissimilar subregions ($n = 9$) is compared to the number of subregions similar to IAM ($n = 4$), the tabulation indicates that there are more subregions from which IAM is different from to which it is similar, implying an OBL rating is appropriate from IAM.

There is a trend of no difference between the plots with OBL versus FACW ratings ($R = 0.025$, $p = 0.07$). Results suggest that IAM, IAL, UKK, CRB, and IBR do not warrant a separate rating from Alaska. However, because the results of the ANOSIM test for dissimilarity of subregions assessing IAM were ambiguous, we ran a second ANOSIM to test for dissimilarity between IAM and all other subregions plus Alaska lumped together. IAM is significantly different from all other subregions for the 4 variables considered here ($R = 0.52$, $p < 0.01$), suggesting IAM warrants a unique wetland status indicator rating. Results from IAM are robust due to the large sample size ($n = 35$) in this dataset.

No clear pattern arose for significant differences between ratings of subregions in LRR-based Interior Alaska (*dotted* subregions in Table C-4) compared to the rest of the state and other subregions. These results do not support combining the eight subregions found in LRR Interior Alaska into one larger subregion.

Table C-4. ANOSIM pairwise tests for all subregions from the AKVEG dataset (n = 612).

—	ALASKA	ACP	AKI •	IAH •	IAL •	IAM •	CRB •	WBR	NBR	IBR •	NSL	SPH	PDA •	UKK •
ALASKA	N/A	—	—	—	—	—	—	—	—	—	—	—	—	—
Arctic Coastal Plain (ACP)	−0.1, 0.98	N/A	—	—	—	—	—	—	—	—	—	—	—	—
Alaska Interior (AKI) •	−0.1, 1	0.58**	N/A	—	—	—	—	—	—	—	—	—	—	—
Interior Alaska Highlands (IAH) •	0.39**	0.94**	0.58, **	N/A	—	—	—	—	—	—	—	—	—	—
Interior Alaska Lowlands (IAL) •	0, 1	0.18**	0.20**	0.65**	N/A	—	—	—	—	—	—	—	—	—
Interior Alaska Mountains (IAM) •	0.59**	1**	0.95**	0.13**	0.81**	N/A	—	—	—	—	—	—	—	—
Copper River Basin (CRB) •	0.45**	0.99**	0.87**	−0.2, 1	0.63**	0.19, 0.07	N/A	—	—	—	—	—	—	—
Western Brooks Range (WBR)	0.06, 0.19	0.75**	0.33**	0.47**	0.45**	0.9**	0.63*	N/A	—	—	—	—	—	—
Northern Brooks Range (NBR)	0.55*	1*	0.99*	−0.1, 0.66	0.76**	−0.2, 0.54	1, 0.13	0.44, 0.31	N/A	—	—	—	—	—
Interior Brooks Range (IBR) •	0.41**	0.97**	0.72**	0, 0.5	0.68**	0.30**	0.27*	0.30*	−0.2, 0.66	N/A	—	—	—	—
Northern Seward Peninsula (NSL)	0.11**	0.28**	0.86**	0.98**	0.37**	1**	1**	0.79**	1*	1**	N/A	—	—	—
Seward Peninsula Highlands (SPH)	−0.1, 0.95	0.67**	0.08, 0.06	0.34**	0.26**	0.91**	0.94**	0.40*	0.99, 0.1	0.63**	0.92**	N/A	—	—
Pebble/Donlin/Aniak (PDA) •	0, 0.87	0.54**	0.06, 0.06	0.44**	0.20**	0.75**	0.44**	0.05, 0.34	0.57*	0.33**	0.75**	0, 0.77	N/A	—
Upper Kobuk-Koyukuk (UKK) •	−0.1, 1	0.73**	0.18**	0.53**	0.30**	0.93**	0.89**	0.60**	0.95**	0.78**	0.91**	0.22**	0.25**	N/A

Note: * is $p \leq 0.05$, ** is $p \leq 0.01$; for significant p, *bold* text indicates $0.5 \leq R < 0.75$ and (significantly different), *bold* and *gray* fill indicates $0.75 \leq R \leq 1$ (significantly highly different). *Yellow* indicates subregions under investigation for reassignment, *blue dots* indicate subregions that fall within the LRR Interior Alaska subregion.

C.8.2 NRCS

For the 24 variables tested, the 4 subregions (IAM, IAL, AKI, and the state of Alaska) were significantly different ($R = 0.6037$, $p < 0.01$, Table C-5). Pairwise comparisons between IAM and the state of Alaska indicate significantly little overlap, suggesting the need for a separate IAM subregion ($R = 0.69$, $p < 0.05$). There is complete overlap for OBL versus FACW ratings ($R = -0.08005$, $p = 0.62376$), implying no need for a unique rating for IAM. However, these results are not robust due to the small sample size for IAM ($n = 2$) and were not included in the recommendation.

Table C-5. ANOSIM pairwise tests for all subregions from the NRCS dataset (n = 49).

—	ALASKA	ACP	AKI •	IAH •	IAL •	IAM •	CRB •	WBR	NBR	IBR •	NSL	SPH	PDA •	UKK •
ALASKA	N/A	—	—	—	—	—	—	—	—	—	—	—	—	—
Arctic Coastal Plain (ACP)		N/A	—	—	—	—	—	—	—	—	—	—	—	—
Alaska Interior (AKI) •	0.37**	—	N/A	—	—	—	—	—	—	—	—	—	—	—
Interior Alaska Highlands (IAH) •	**0.69****	—	**0.84****	N/A	—	—	—	—	—	—	—	—	—	—
Interior Alaska Lowlands (IAL) •	—	—	—	—	N/A	—	—	—	—	—	—	—	—	—
Interior Alaska Mountains (IAM) •	0.49**	—	**0.95***	−0.14, 0.71	—	N/A	—	—	—	—	—	—	—	—
Copper River Basin (CRB) •	—	—	—	—	—	—	N/A	—	—	—	—	—	—	—
Western Brooks Range (WBR)	—	—	—	—	—	—	—	N/A	—	—	—	—	—	—
Northern Brooks Range (NBR)	—	—	—	—	—	—	—	—	N/A	—	—	—	—	—
Interior Brooks Range (IBR) •	—	—	—	—	—	—	—	—	—	N/A	—	—	—	—
Northern Seward Peninsula (NSL)	—	—	—	—	—	—	—	—	—	—	N/A	—	—	—
Seward Peninsula Highlands (SPH)	—	—	—	—	—	—	—	—	—	—	—	N/A	—	—
Pebble/Donlin/Aniak (PDA) •	—	—	—	—	—	—	—	—	—	—	—	—	N/A	—
Upper Kobuk-Koyukuk (UKK) •	—	—	—	—	—	—	—	—	—	—	—	—	—	N/A

Note: * is $p \leq 0.05$, ** is $p \leq 0.01$; for significant p, *bold* text indicates $0.5 \leq R < 0.75$ and (significantly different), *bold* and *gray fill* indicates $0.75 \leq R \leq 1$ (significantly highly different). *Yellow* indicates subregions under investigation for reassignment.

C.8.3 Combined Datasets

Subregions are significantly overlapping ($R = 0.260$, $p < 0.01$; Table C-6). Because of the small sample size of IAM ($n = 2$) added from the NRCS dataset, pairwise comparisons are similar to those of the AKVEG dataset and indicate a significant difference between IAM and Alaska ($R = 0.58$, $p < 0.01$; Table C–6). There is no difference between OBL versus FACW ratings ($R = 0.008$, $p = 0.287$). However, when all subregions are lumped as for the AKVEG dataset, IAM is significantly different from the state and all other subregions ($R = 0.47$, $p < 0.01$). Results indicate there is a need for two ratings within the state of Alaska; OBL for IAM and FACW for all other subregions and the state.

Table C-6. ANOSIM pairwise tests for all subregions from the combined dataset (n = 661).

—	ALASKA	ACP	AKI •	IAH •	IAL •	IAM •	CRB •	WBR	NBR	IBR •	NSL	SPH	PDA •	UKK •
ALASKA	N/A	—	—	—	—	—	—	—	—	—	—	—	—	—
Arctic Coastal Plain (ACP)	−0.1, 0.99	N/A	—	—	—	—	—	—	—	—	—	—	—	—
Alaska Interior (AKI) •	−0.1, 1	**0.63****	N/A	—	—	—	—	—	—	—	—	—	—	—
Interior Alaska Highlands (IAH) •	0.42**	**0.95****	**0.63****	N/A	—	—	—	—	—	—	—	—	—	—
Interior Alaska Lowlands (IAL) •	−0.1, 0.99	0.18**	0.26**	**0.69****	N/A	—	—	—	—	—	—	—	—	—
Interior Alaska Mountains (IAM) •	**0.58****	**1****	**0.96, ****	0.06*	**0.80****	N/A	—	—	—	—	—	—	—	—
Copper River Basin (CRB) •	0.45**	**0.99****	**0.92****	−0.1, 0.99	**0.63****	0.15, 0.21	N/A	—	—	—	—	—	—	—
Western Brooks Range (WBR)	0.05, 0.35	**0.75****	0.34**	**0.52****	0.45**	**0.90****	**0.63****	N/A	—	—	—	—	—	—
Northern Brooks Range (NBR)	0.55, 0.09	**1***	**0.99***	−0.2, 0.84	**0.76***	−0.2, 0.71	1, 0.17	0.44, 0.27	N/A	—	—	—	—	—
Interior Brooks Range (IBR) •	0.40**	**0.97****	**0.73****	0, 0.48	**0.68****	0.29*	0.27, 0.06	0.3, 0.07	−0.2, 0.7	N/A	—	—	—	—
Northern Seward Peninsula (NSL)	0.10**	0.28**	**0.88****	**0.98****	0.37**	**1****	**1****	**0.79****	**1****	**1****	N/A	—	—	—
Seward Peninsula Highlands (SPH)	−0.1, 0.95	**0.67****	0.05, 0.16	0.41**	0.26**	**0.92****	**0.94****	0.40*	0.99, 0.07	**0.63****	**0.92****	N/A	—	—
Pebble/Donlin/Aniak (PDA) •	0, 0.80	**0.54****	0.15**	**0.50****	0.20**	**0.76****	0.44**	0.05, 0.32	0.57, 0.06	0.33**	**0.75****	0, 0.8	N/A	—
Upper Kobuk-Koyukuk (UKK) •	−0.1, 0.99	**0.73****	0.07**	**0.56****	0.30**	**0.94****	**0.89****	**0.60****	**0.95***	**0.78****	**0.91****	0.22*	0.25**	N/A

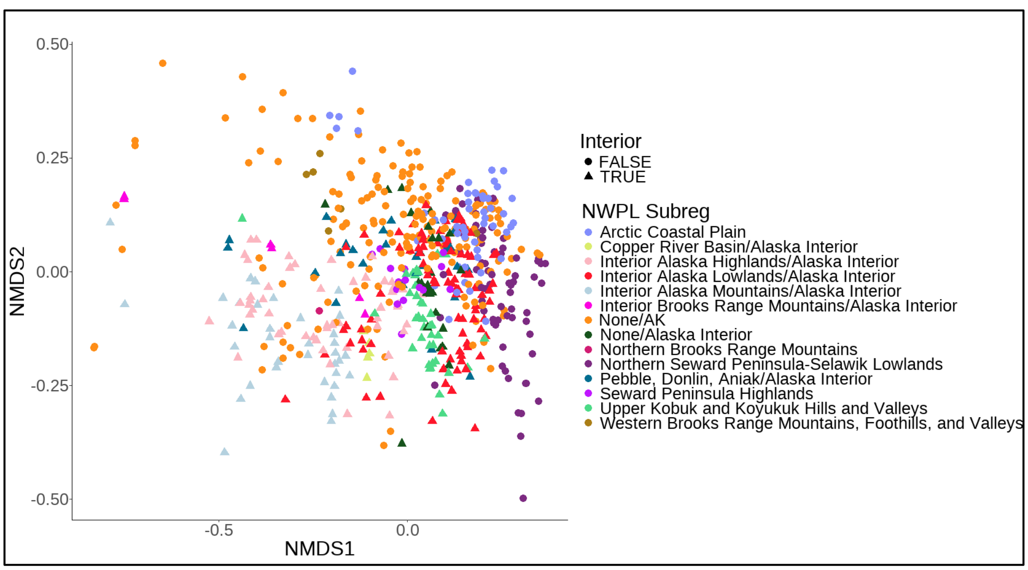
Note: * is $p \leq 0.05$, ** is $p \leq 0.01$; for significant p, *bold* text indicates $0.5 \leq R$ and (significantly different to highly significantly different). New results from combining datasets are indicated by *orange hatching*; when combined with *gray*, $R \geq 0.75$. *Yellow* indicates subregions under investigation for reassignment, *blue dots* indicate subregions that fall within the LRR Interior Alaska subregion.

C.9 Nonmetric Multidimensional Scaling (NMDS)

C.9.1 AKVEG

Interpretation of results is hampered by small sample size for CRB (n = 5) and IBR (n = 6). The remaining subregions in question had robust sample sizes (IAL = 94, IAM = 35, UKK = 37). All subregions do form clusters, although overlapping, along Dimension 1 and the stress test indicates that the fit of the plot is reliable (Clarke 1993; Figure C-13). Of the 5 subregions question, some points from IAM fall furthest to the left on the axis followed by some points from IBR while most points for CRB, IAL, and UKK fall to the right with FACW subregions. IBR does not overlap with ACP and Northern Seward Peninsula (NSL). UKK and IAL overlap with all FACW subregions. Points from None/AK overlap with all subregions. IAM and CRB do not overlap with several FACW subregions: ACP, NSL, Seward Peninsula Highlands (SPH), Alaska Interior or Western Brooks Range (WBR). Both subregions may warrant an OBL rating. However, IAM and CRB do overlap with None/AK, IAH, and PDA, which are all FACW. Given the high amount of overlap, results suggest that a unique rating is not needed.

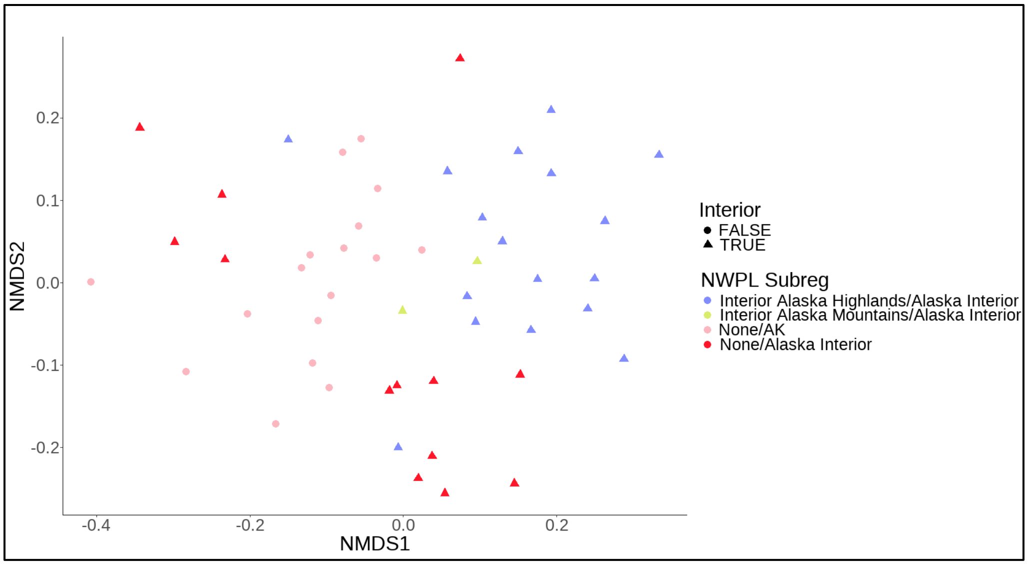
Figure C-13. NMDS of *A. polifolia* AKVEG data (n = 612), stress = 0.1296347.



C.9.2 NRCS

There is no discernable pattern to support changing or refuting a change to IAM, which could be due to the small sample size for this subregion (n = 2; Figure C-14). A stress value >0.2 is considered poor and indicates the placement of datum is basically random (Clarke 1993), so the NMDS results are not included in the recommendations made here (Figure C-14).

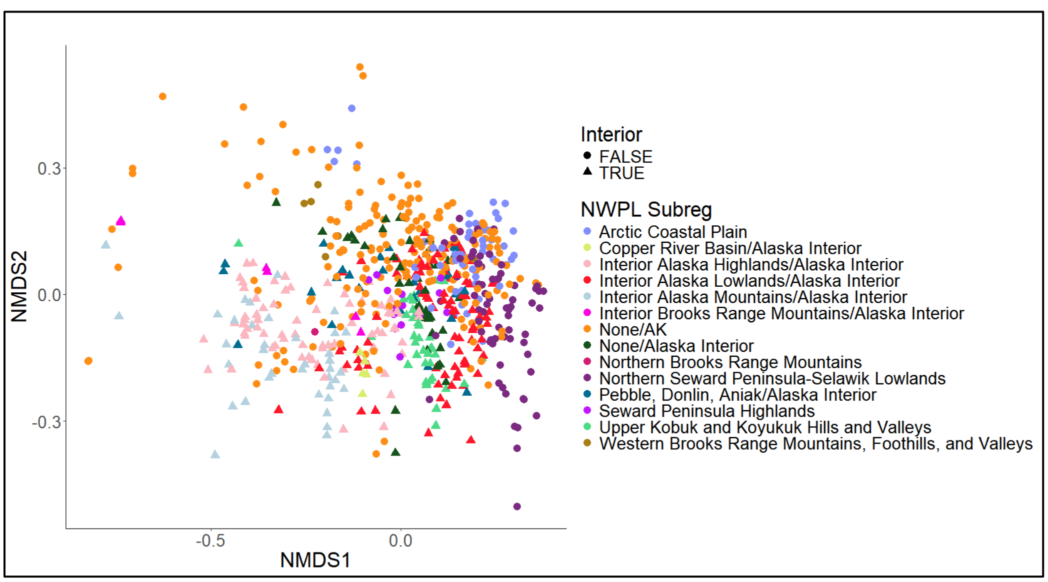
Figure C-14. NMDS of *A. polifolia* NRCS data (n = 49), stress = 0.2144128.



C.9.3 Combined Datasets

Clusters overlap for most subregions along Dimensions 1 and 2 (Figure C-15) and results are similar to those of AKVEG. Stress test results between 0.1–0.15 indicate the NMDS provides a good representation of the data and does not support a unique rating for any subregion (Clarke 1993; Figure C-15).

Figure C-15. NMDS of *A. polifolia* from combined AKVEG/NRCS data (n = 661), stress = 0.1284245.



C.10 PCA

C.10.1 AKVEG

None of the five OBL subregions cluster separately from the FACW subregions (Figure C-16). Dimension 1 is most strongly influenced by cover (approximately 35%, Figure C-17), which implies that the lack of difference between subregions could be due to similar cover by *A. polifolia* across all subregions.

Figure C-16. PCA plot of *A. polifolia* AKVEG dataset (*n* = 612).

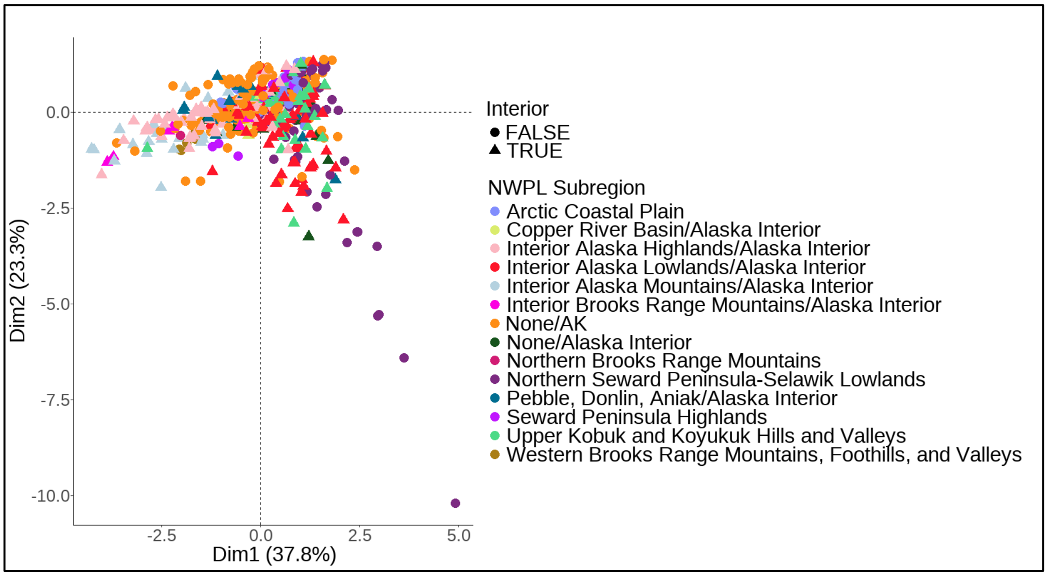
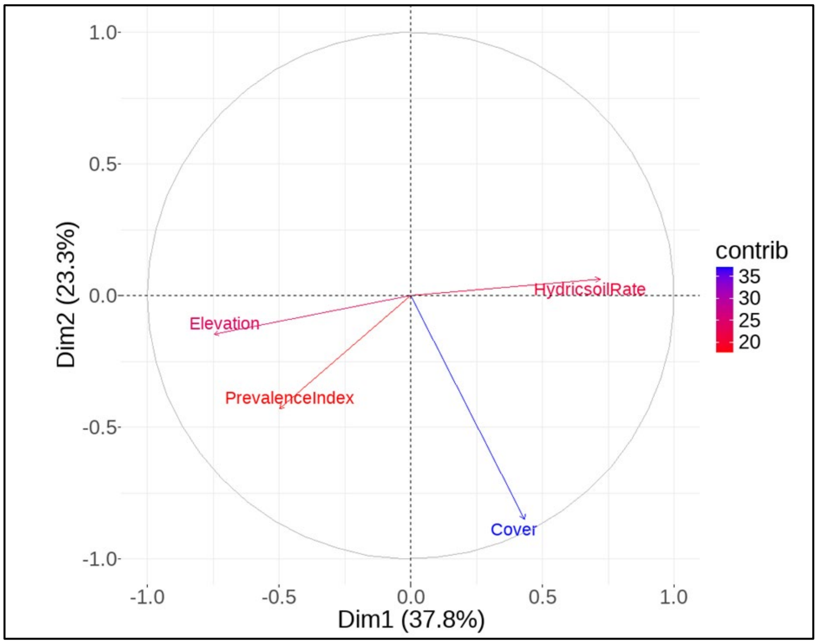


Figure C-17. PCA loading plot of AKVEG data.



C.10.2 NRCS

There is no clear clustering of IAM that separates the subregion from the rest of the state (Figure C-18). Dimension 1 explains only 16.5% of the variance and the highest contribution from the variables is only 12.5% (surface pH, Figure C-19).

Figure C-18. PCA plot of *A. polifolia* NRCS dataset (n = 49).

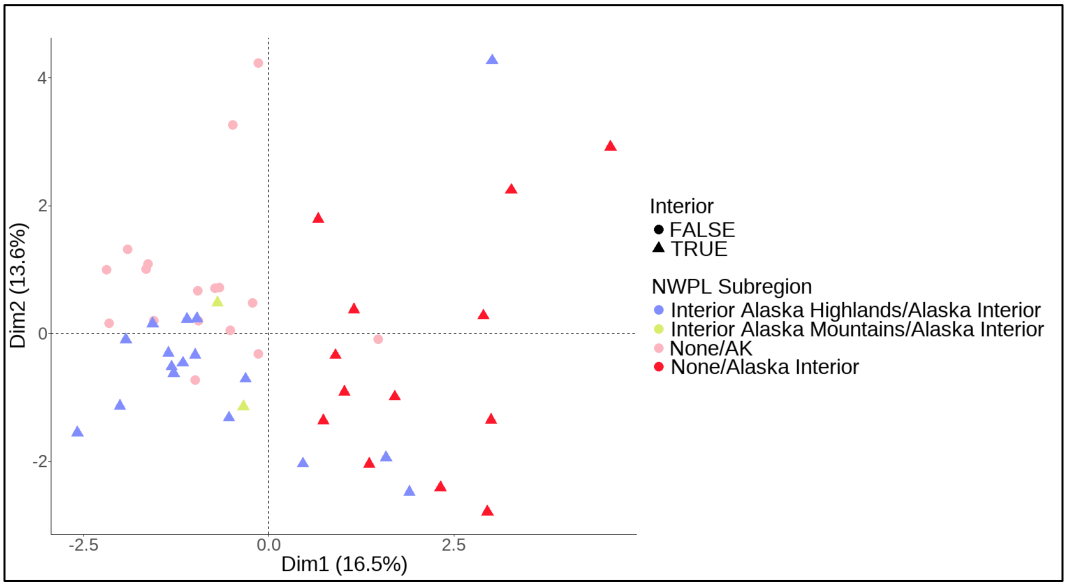
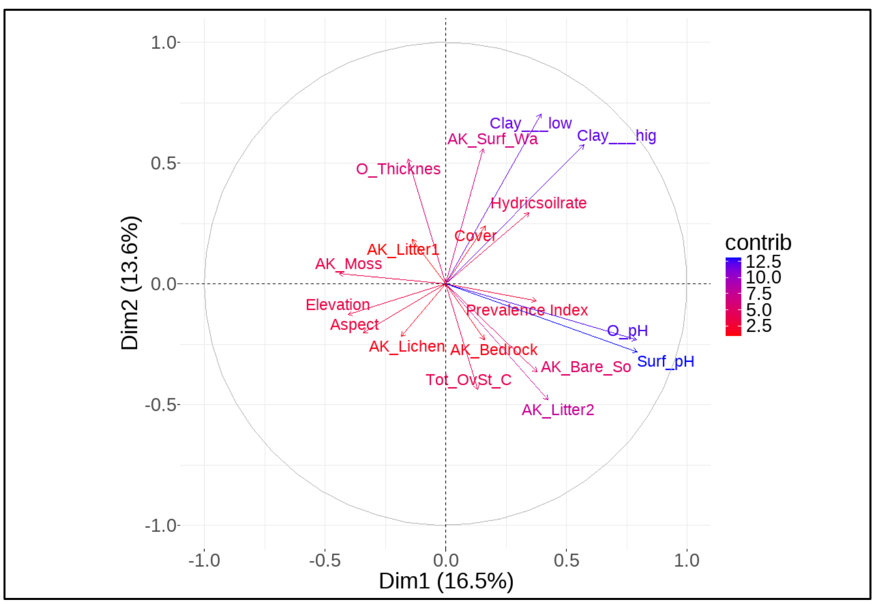


Figure C-19. PCA loading plot of NRCS data.



C.10.3 Combined Datasets

Together, Dimension 1 (38.4%) and Dimension 2 (23.1%) explain more than 50% of the variance in the dataset. Cover is the strongest contributor to both dimensions. Elevation and hydric soil rating are negatively correlated; most points follow the vectors created by these two variables (Figures C-20 and C-21). However, there are no clear clusters of the 5 subregions in question. As in AKVEG, the lack of difference between subregions could be due to similar cover by *A. polifolia* across all subregions.

Figure C-20. PCA plot of *A. polifolia* combined AKVEG/NRCS dataset (n = 661).

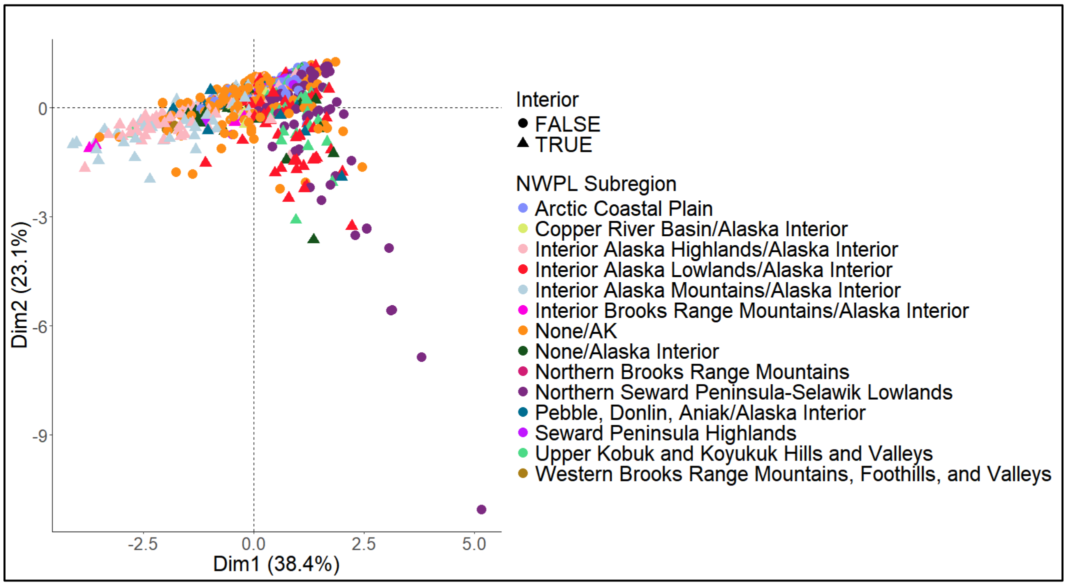
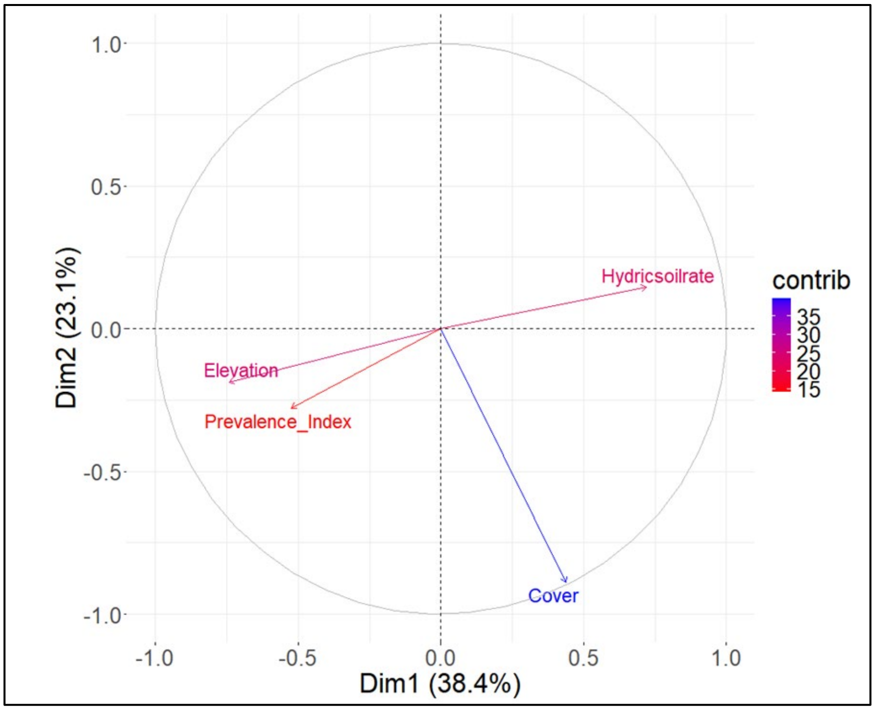


Figure C-21. PCA loading plot of combined AKVEG/NRCS data.



Appendix D: *Arctous rubra*

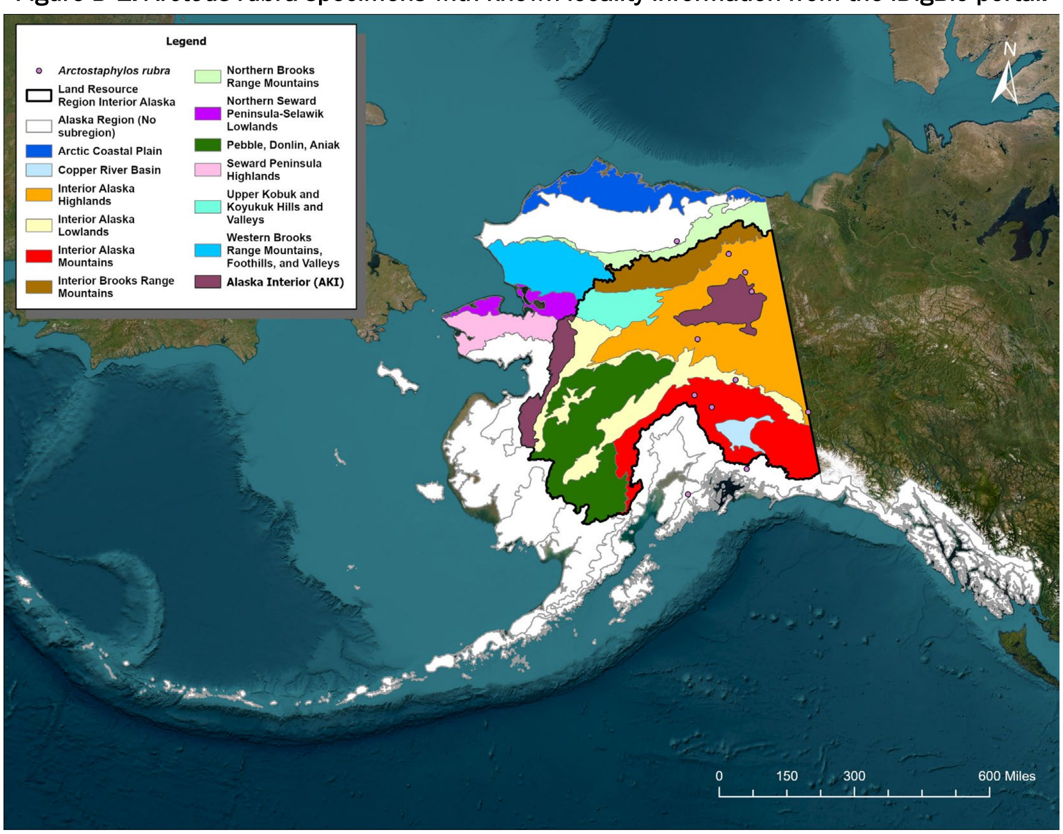
On the NWPL, *Arctous rubra* has a wetland indicator status rating of FAC for the state of Alaska, and FACW for four subregions; WBR, NBR, SPH, and NSL. This appendix evaluates the results of multiple analyses to determine whether WBR, NBR, SPH, or NSL should be reclassified to match the state-wide wetland indicator status rating of FAC. Because none of the subregions occur in the LRR Interior Alaska subregions, the validity of creating such a subregion is not considered.

The NRCS dataset contained one observation, so only the AKVEG data were analyzed for this species. Sample size by subregion is reported in Section D.3.

D.1 Herbaria Specimens Data

Eleven specimens contained locality data; 8 of these were collected in LRR Interior Alaska (Figure D-1).

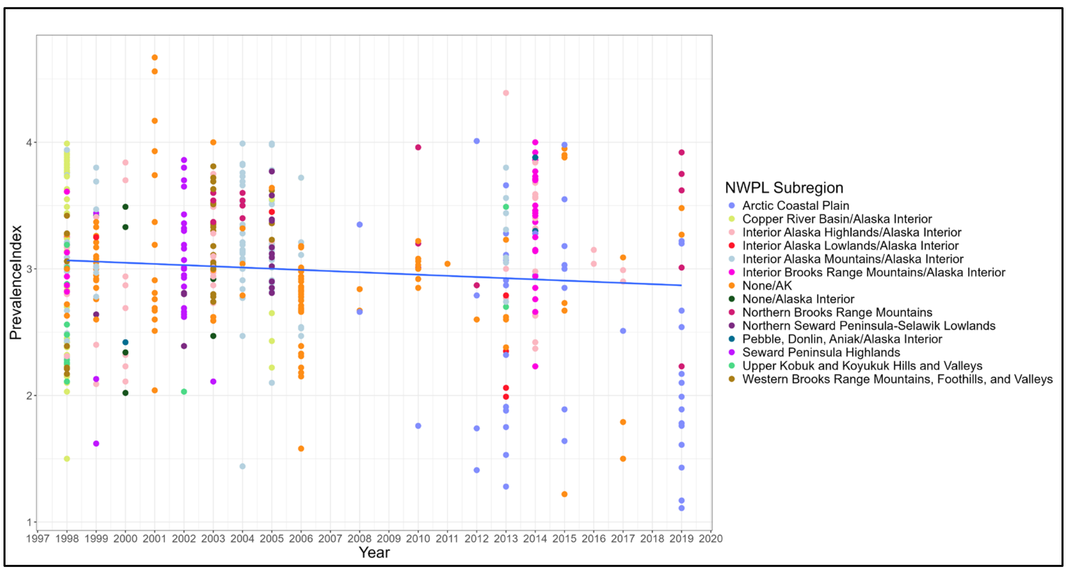
Figure D-1. *Arctous rubra* specimens with known locality information from the iDigBio portal.



D.2 PI over Time by Alaska Subregion—AKVEG

PI shows a slight decrease from 1998 to 2019. The trend line begins above a value of 3 but falls below 3 over time, implying that the plots' hydrophytic vegetation factor for wetland delineation (hydrophytic, ≤3, versus nonhydrophytic, >3) has changed (Figure D-2). A decrease over time indicates that plots are weighted more heavily by FACW or OBL species than FAC, FACU, or UPL species over time, which could be due to an increase in the number or percent cover of FACW or OBL species. This observation implies that plots in which *A. rubra* occur are becoming wetter, which could support maintaining WBR, NBR, NSL, and SPH as FACW. However, the change is slight and the trend line remains near 3, implying that the mean PI most closely aligns with the FAC rating. It is also possible that other factors are driving the change, such as research interests changing over time to a greater interest in wetter areas.

Figure D-2. Change in PI over time by NWPL wetland indicator status rating for plots containing *A. rubra* from AKVEG data (*n* = 543).



D.3 PI by Wetland Status Indicator Rating and Subregion—AKVEG

None of the four subregions in question has PI values that differ from the values for the other subregions (Figure D-3). The FAC subregions range from Interior Brooks Range (3.32 ± 0.42) to Arctic Coastal Plain (2.45 ± 0.79, Table D-1). Results indicate that sites where *A. rubra* occurs in WBR, NBR, NSL, and SPH do not differ in hydrophytic vegetation factor from those where it occurs in other subregions. Although it is possible the mean PI for each of the four subregions in question would decrease if recalculated with a FACW rating of 2 for *A. rubra* rather than the currently used FAC rating, it is unlikely the values would fall below those of the FAC subregions.

Figure D-3. Bar chart comparing the PI for each subregion by wetland status indicator rating.

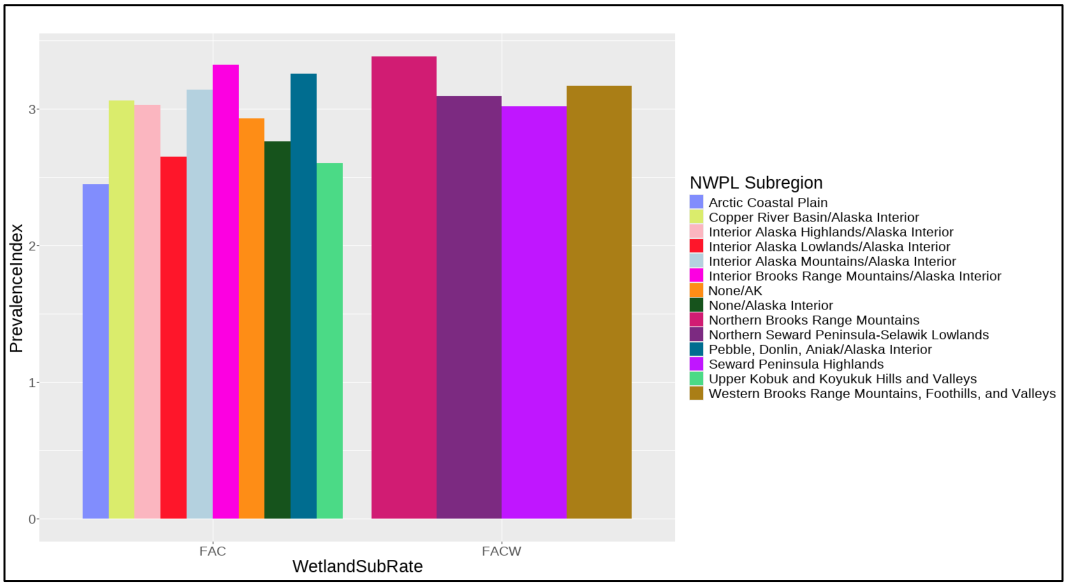


Table D-1. Sample size, mean, and standard deviation of the PI for the 13 NWPL subregions and the rest of the state of Alaska (None/AK) for plots from the AKVEG dataset. *Yellow* indicates subregions under investigation for reassignment..

NWPL Subregion	Number of Observations	Average PI Value	Standard Deviation of PI Values
Arctic Coastal Plain (ACP)	46	2.45	0.79
Copper River Basin (CRB)/Alaska Interior (LRR)	54	3.06	0.68
Interior Alaska Highlands (IAH)/Alaska Interior (LRR)	51	3.03	0.50
Interior Alaska Lowlands (IAL)/Alaska Interior (LRR)	6	2.65	0.62
Interior Alaska Mountains (IAM)/Alaska Interior (LRR)	87	3.14	0.46
Interior Brooks Range Mountains (IBR)/Alaska Interior (LRR)	32	3.32	0.42
None/AK	118	2.93	0.50
None/Alaska Interior (AKI in LRR)	7	2.76	0.53
Northern Brooks Range Mountains (NBR)	16	3.38	0.44
Northern Seward Peninsula-Selawik Lowlands (NSL)	16	3.09	0.40
Pebble, Donlin, Aniak (PDA)/Alaska Interior (LRR)	4	3.26	0.61
Seward Peninsula Highlands (SPH)	25	3.02	0.54
Upper Kobuk and Koyukuk Hills and Valleys (UKK)	12	2.60	0.46
Western Brooks Range Mountains, Foothills, and Valleys (WBR)	32	3.17	0.45

D.4 Importance of *A. rubra* for PI Calculation

With the omission of *A. rubra* in the AKVEG dataset, about one-third of the plots (131, 37.3%) had no change in PI while 126 plots (35.9%) received a lower PI value and 94 plots (26.8%) received a higher PI value. The average change in PI value was −0.01 but ranged from −1.0 to +0.43. Average cover per plot was relatively low at 4.5%. Dropping *A. rubra* from the plot data did not cause any significant effects on PI outcomes.

D.5 Data Preparation for Analyses—AKVEG

The original dataset from AKVEG contained 50 variables (not including co-occurring species data) with 506 observations. Twenty-one variables had zeros transformed to N/A values; Strata, Physiography, Geomorphology, Macrotopography, Microtopography, Microrelief, Drainage, Moisture, Restrictive Layer, Disturbance, Depth Water, Depth Moss Duff, Depth Restrictive Layer, Soil pH 10, Conductivity 10, Temperature 10, Soil pH 30, Conductivity 30, Temperature 30, Water pH, and Water Conductivity. Three variables were removed due to having no values: Water Temperature, Water Conductivity, and Soil Class. One variable was added: Interior—true or false value. Of the 48 variables, 19 were numeric; of these 19 variables, 8 were used as the other 11 had missing values exceeding the cut-off threshold of 60%. The 506 observations and 8 variables were used for the correlation analysis, which informed selection of 4 variables for the ANOSIM, NMDS and PCA.

D.6 MCA on AKVEG Dataset

Neither dimension strongly explains the variance in the data nor is strongly influenced by Project, indicating there is no Project effect within the data (Figures C-4, C-5, and C-6).

Figure D-4. MCA plot of AKVEG data by NWPL subregion and Interior (*triangles*) versus the rest of Alaska (*dots*; *n* = 506). Each symbol represents the centroid of multiple observations.

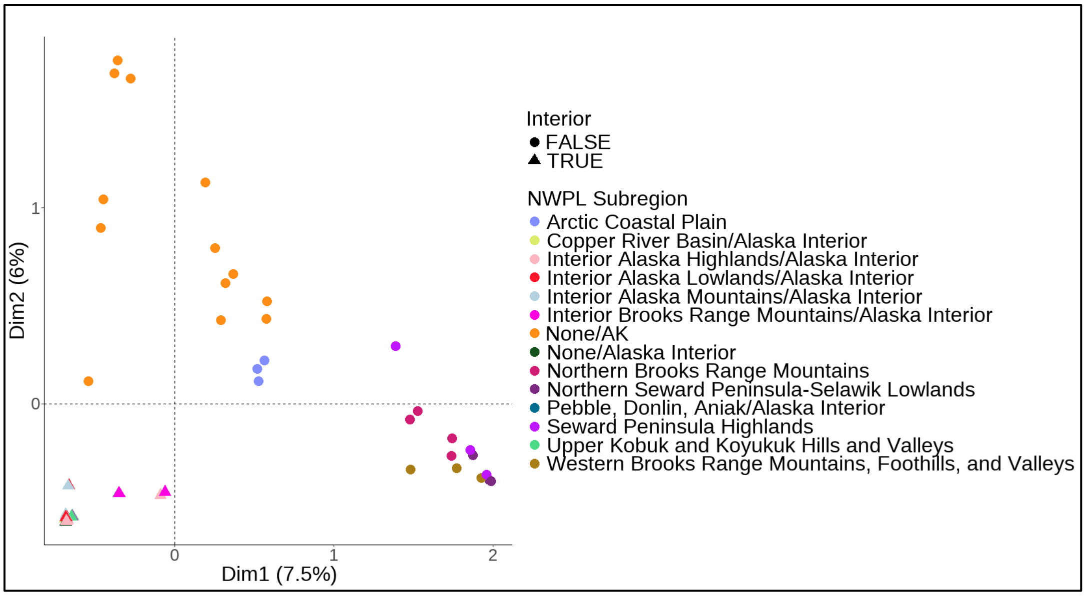


Figure D-5. Percent contribution of MCA factors to Dimension 1 for AKVEG.

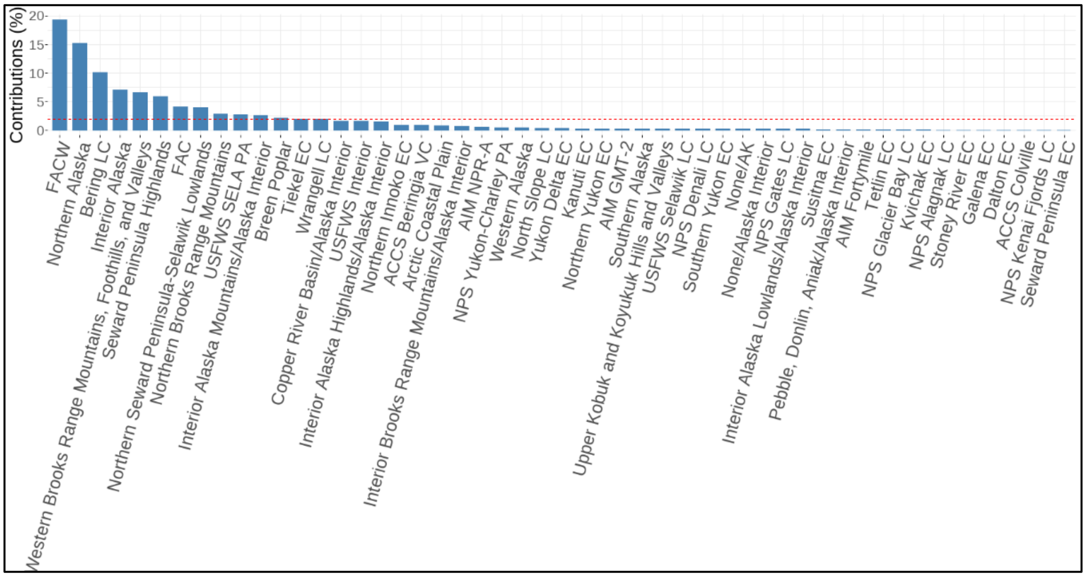
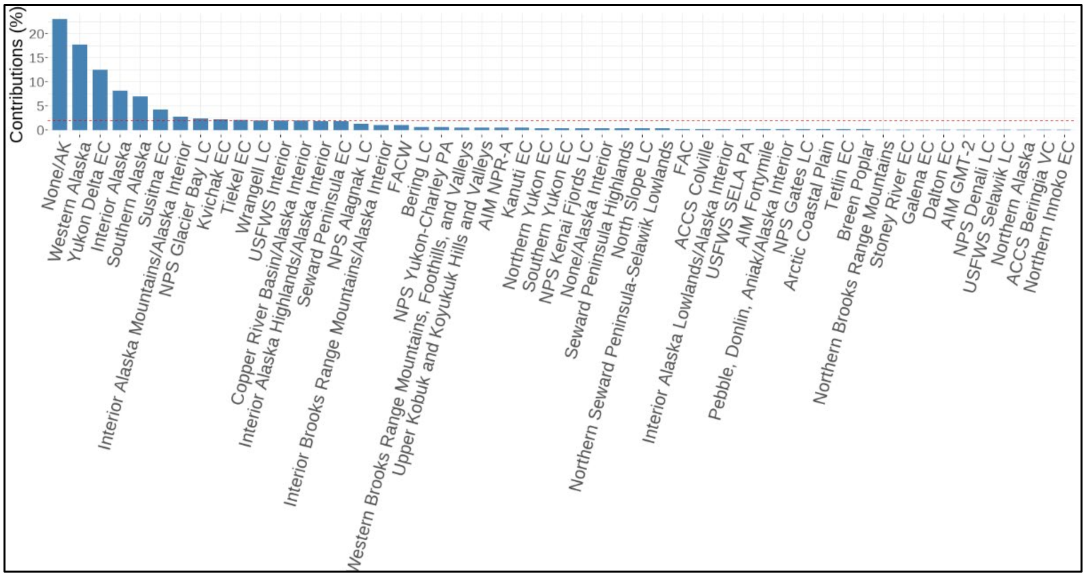


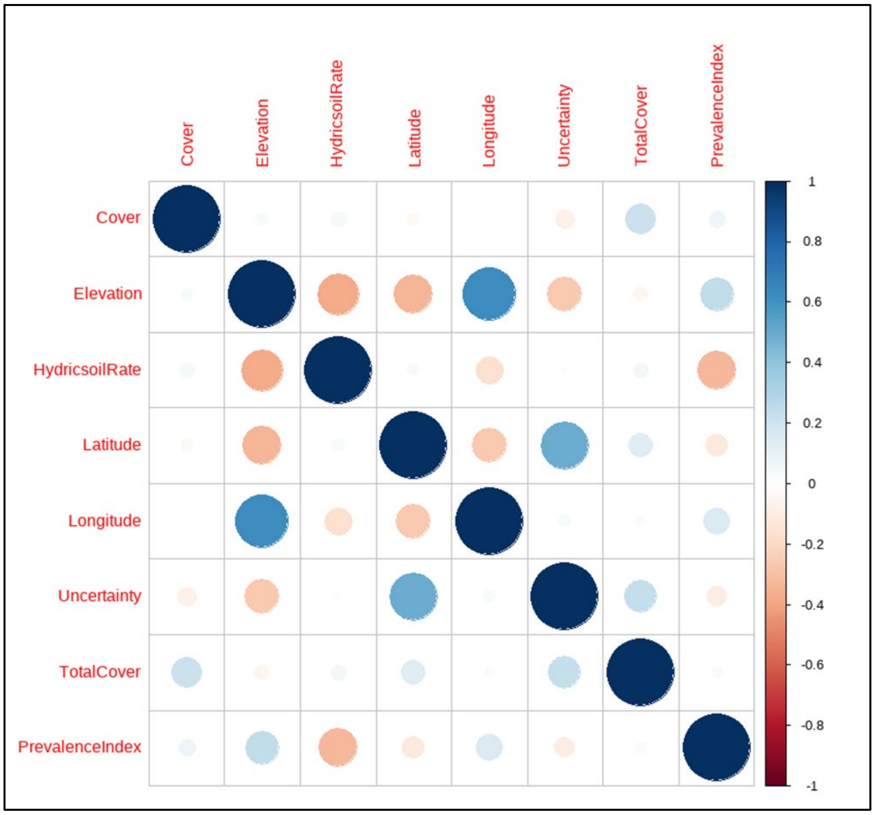
Figure D-6. Percent contribution of MCA factors to Dimension 2 for AKVEG.



D.7 Correlation Matrix—AKVEG

The original dataset had 48 categorical and numeric variables. For correlation analysis, categorical variables and variables deemed irrelevant to the research question were excluded, yielding 8 variables with 506 observations (Figure D-7). Because of strong correlations with other variables, latitude, longitude, uncertainty, and TotalCover were excluded. Cover, hydric soil rating, elevation, and PI were included for ANOSIM, NMDS, and PCA analyses.

Figure D-7. Correlation matrix for *A. rubra* AKVEG data (n = 506).



D.8 The ANOSIM Test—AKVEG

For the 4 variables tested, subregions are significantly different with some overlapping ($R = 0.311$, $p < 0.01$). Plots with FAC versus FACW indicators overlap significantly ($R = 0.118$, $p < 0.01$). Pairwise comparisons of WBR, NBR, and SPH to the state indicate high overlap (Table D-2). NSL is significantly different with some overlap, but the R value is near the threshold for high overlap ($R = 0.26$, $p < 0.01$). Results support the elimination of FACW subregions for *A. rubra*.

Table D-2. ANOSIM pairwise tests for all subregions from the AKVEG dataset (n = 506).

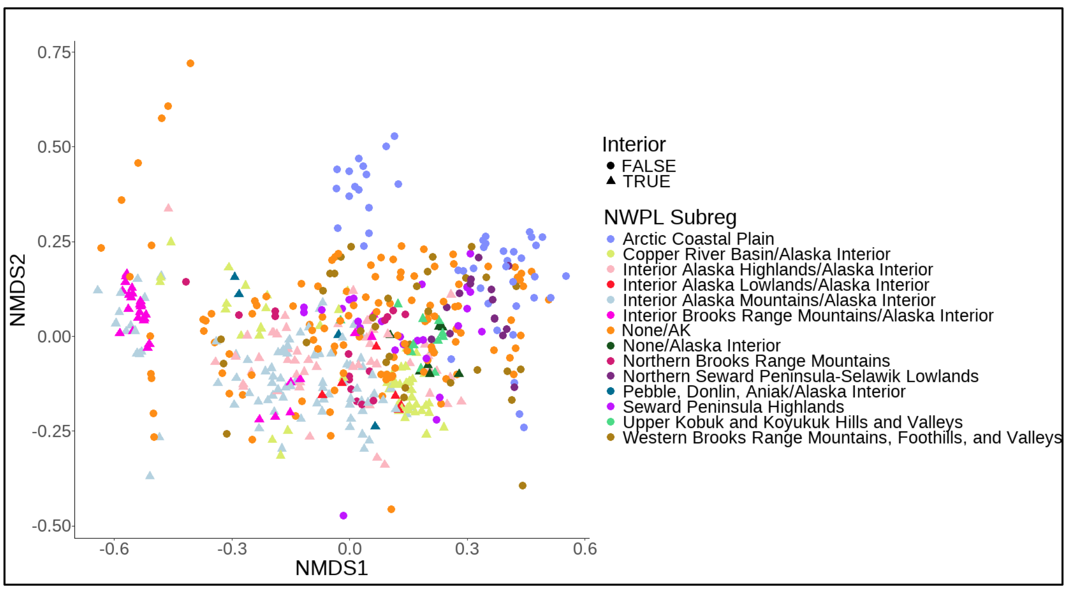
–	ALASKA	ACP	AKI •	IAH •	IAL •	IAM •	CRB •	WBR	NBR	IBR •	NSL	SPH	PDA •	UKK •
ALASKA	N/A	–	–	–	–	–	–	–	–	–	–	–	–	–
Arctic Coastal Plain (ACP)	0.41**	N/A	–	–	–	–	–	–	–	–	–	–	–	–
Alaska Interior (AKI) •	−0.2, 1	0.74**	N/A	–	–	–	–	–	–	–	–	–	–	–
Interior Alaska Highlands (IAH) •	0.01, 0.31	0.95**	0.16*	N/A	–	–	–	–	–	–	–	–	–	–
Interior Alaska Lowlands (IAL) •	−0.1, 0.81	0.96**	0.70**	−0.1, 0.96	N/A	–	–	–	–	–	–	–	–	–
Interior Alaska Mountains (IAM) •	0.28**	1**	0.72**	0.18**	0.09, 0.17	N/A	–	–	–	–	–	–	–	–
Copper River Basin (CRB) •	0.01, 0.38	0.98**	0.58**	0.25**	0.11, 0.20	0.38**	N/A	–	–	–	–	–	–	–
Western Brooks Range (WBR)	0.04, 0.17	0.39**	−0.2, 1	0.37**	0.06, 0.25	0.67**	0.53**	N/A	–	–	–	–	–	–
Northern Brooks Range (NBR)	−0.1, 0.91	0.95**	0.60**	−0.1, 1	0, 0.67	0.11**	0.28**	0.15**	N/A	–	–	–	–	–
Interior Brooks Range (IBR) •	0.15**	0.99**	0.85**	0.14*	0.62**	0, 0.48	0.75**	0.53**	0.45**	N/A	–	–	–	–
Northern Seward Peninsula (NSL)	0.26**	0.01, 0.52	0.86**	0.93**	0.98**	0.99**	0.99**	0.13**	0.98**	0.99**	N/A	–	–	–
Seward Peninsula Highlands (SPH)	−0.1, 0.99	0.52**	0, 0.64	0.42**	0.48**	0.83**	0.75**	0, 0.4	0.52**	0.80**	0.49**	N/A	–	–
Pebble/Donlin/Aniak (PDA) •	−0.1, 0.89	0.97**	0.74*	−0.1, 0.92	0.05, 0.40	0.20*	−0.1, 0.69	0.01, 0.35	0, 0.49	0.65**	0.99**	0.38**	N/A	–
Upper Kobuk–Koyukuk (UKK) •	−0.2, 1	0.59**	0.29*	0.38**	0.95**	0.87**	0.89**	−0.1, 1	0.85**	0.92**	0.80**	−0.1, 0.95	0.98**	N/A

Note: * is $p \leq 0.05$, ** is $p \leq 0.01$; for significant p, *bold* text indicates $0.5 \leq R < 0.75$ and (significantly different), *bold* and *gray* fill indicates $0.75 \leq R \leq 1$ (significantly highly different). *Yellow* indicates subregions under investigation for reassignment, *blue dots* indicate subregions that fall within the LRR Interior Alaska subregion.

D.9 NMDS—AKVEG

Datasets for each subregion ranged were moderately sized, with WBR being the most robust; NSL (n = 16), NBR (n = 16), WBR (n = 32), and SPH (n = 25). Along Dimension 1 and Dimension 2 WBR is widely dispersed and overlaps completely with None/AK and partially with all other subregions (Figure D-8). This implies that WBR warrants the same rating (FAC) as None/AK. Along Dimension 1, the SPH cluster is broad and overlaps with a portion of several FAC subregions; ACP, IAH, IAM, CRB, None/Interior Alaska, IAL, and all of Upper Kobuk and Koyukuk Hills and Valleys (UKK) but does not overlap with the majority of Interior Brooks Range (IBR). NBR overlaps with IAM, IAH, IBR, IAL, PDA, and does not overlap with ACP or None/Interior Alaska. NSL overlaps almost completely with ACP but does not overlap with IAM, CRB, IBR. Results indicate FAC is valid for the entire state, and conclusions are supported by results from the stress test (Clarke 1993; Figure D-8).

Figure D-8. NMDS of *A. rubra* AKVEG data (n = 506). Stress = 0.1200647.



D.10 PCA—AKVEG

Dimension 1 (40.7%) is most strongly influenced by hydric soil rating and Dimension 2 (25.5%) is influenced almost entirely by cover (Figures D-9 and D-10). Most plots from LRR Interior Alaska fall on the left side of Dimension 1, but many points from the rest of the state overlap with them. No pattern among the subregions is evident along Dimension 2. Results indicate there is no clear separation of the 4 FACW subregions in question from the FAC subregions.

Figure D-9. PCA plot of *A. rubra* AKVEG dataset (n = 506).

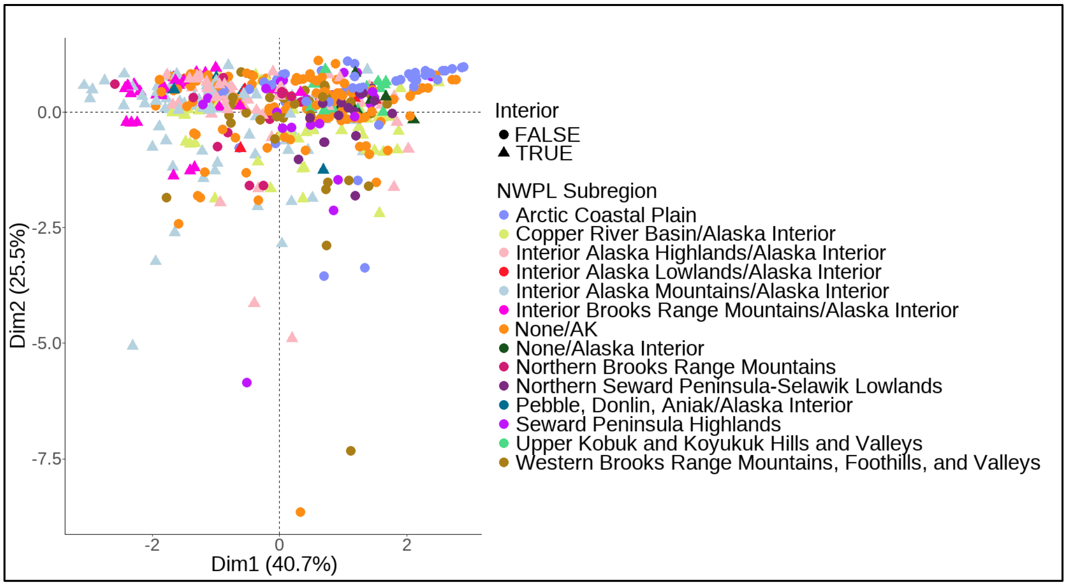
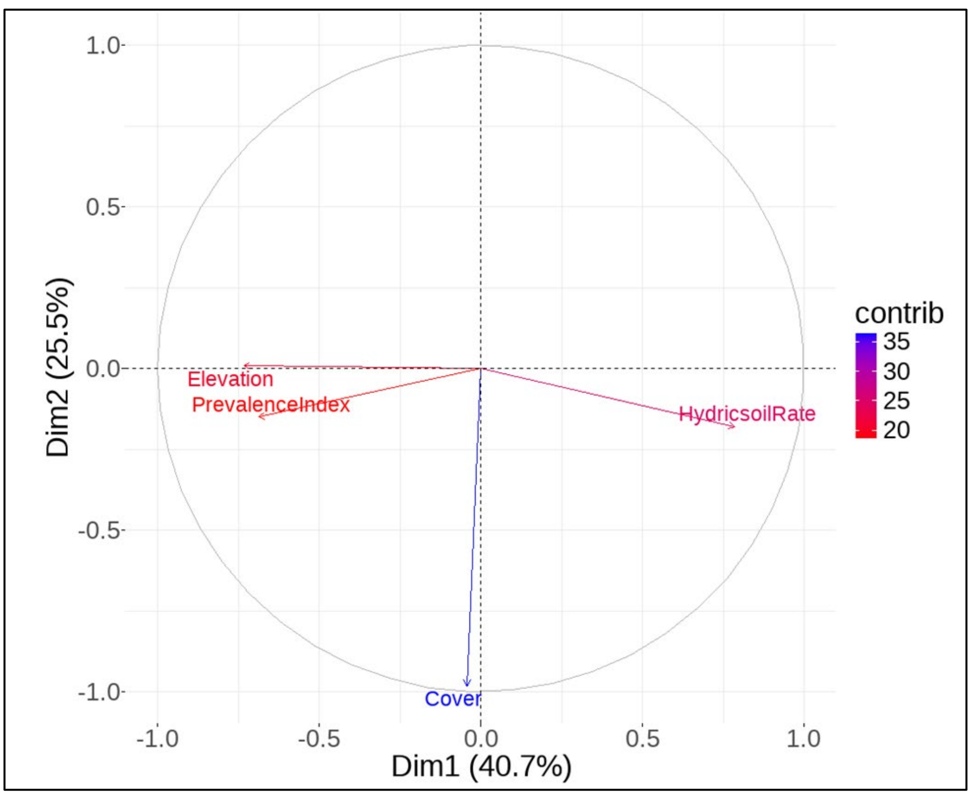


Figure D-10. PCA loading plot of AKVEG data.



Appendix E: *Carex canescens*

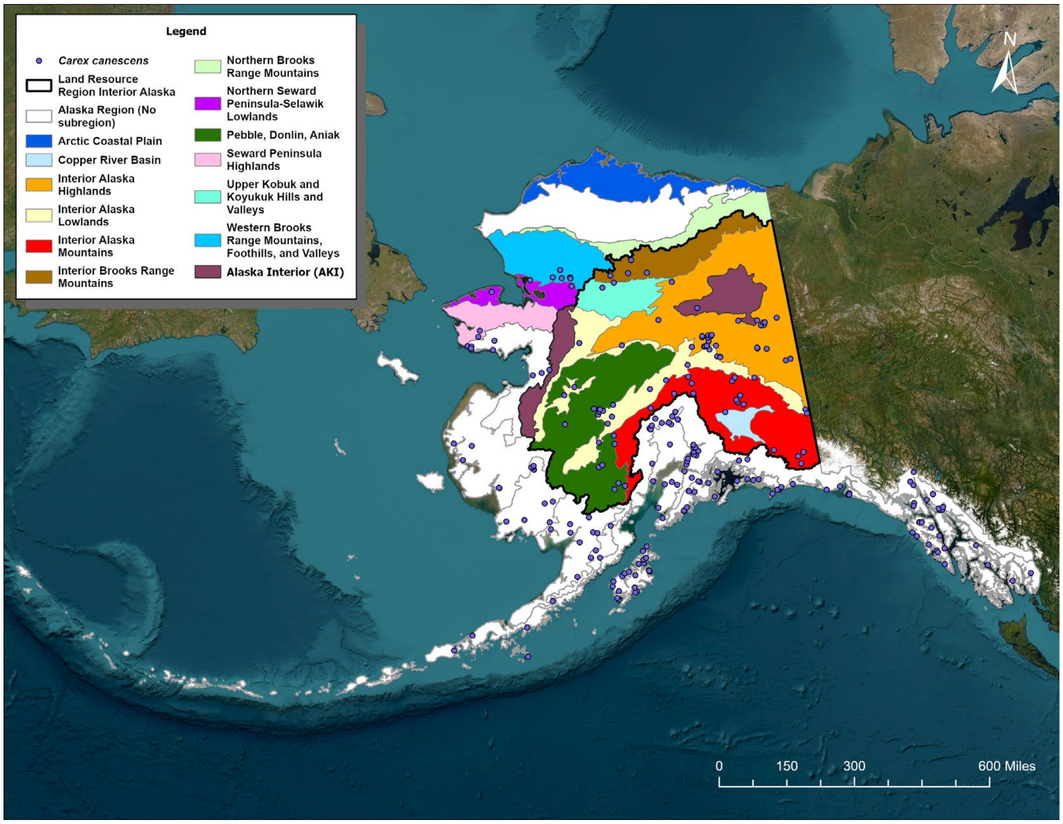
On the NWPL, *Carex canescens* has a wetland indicator status rating of FACW for the state of Alaska, and facultative FAC for 5 subregions; IAL, IAM, CRB, IBR, and UKK. Unfortunately, the datasets used here did not contain observations from three subregions; IAL, IBR, and UKK. This appendix evaluates the results of multiple analyses to determine whether CRB or IAM should be reclassified to match the state-wide rating of FACW. However, the datasets were small for each subregion (IAM n = 4 and CRB n = 5) and conclusions drawn from them may not adequately represent the ecological needs of *C. canescens* populations within the 2 subregions. Additionally, only 4 FACW subregions are represented; IAH, None/AK, None/Alaska Interior, and NSL, so comparisons made here do not represent the entire state. All results should be considered preliminary and more data are required to definitively assess the validity and accuracy of current subregions and wetland indicator status ratings.

Datasets (AKVEG and NRCS) were analyzed independently, then combined for analysis. The variables and number of plots varied between datasets; sample size by subregion and dataset is reported in Section E.3.

E.1 Herbarium Specimens Data

Two hundred seventy-seven specimens contained locality data; 91 of these were collected in LRR Interior Alaska (Figure E-1).

Figure E-1. *Carex canescens* specimens with known locality information from the iDigBio portal.

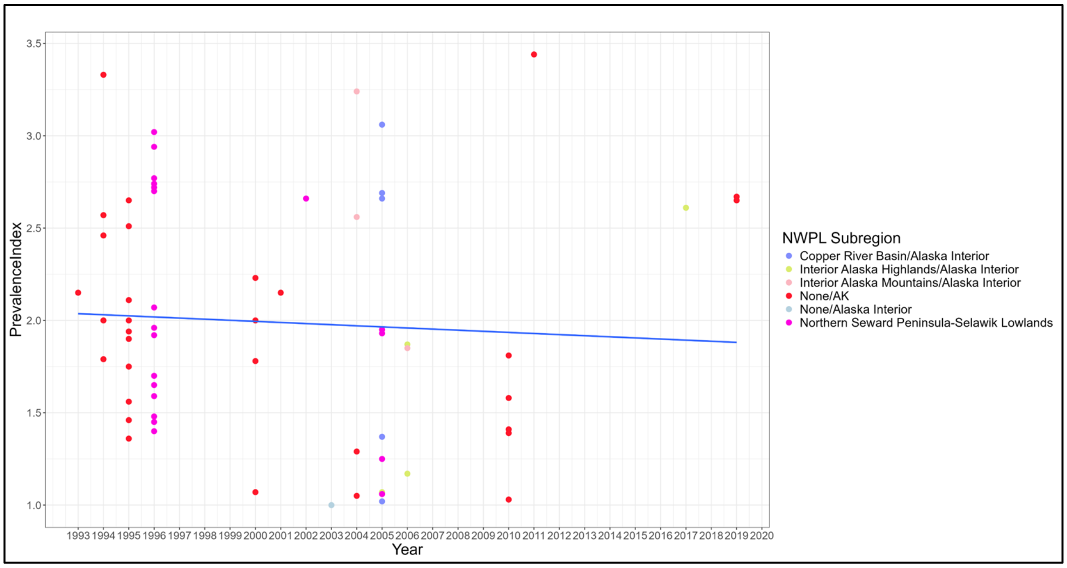


E.2 PI over Time by Alaska Subregion

E.2.1 AKVEG

PI shows a slight decrease from 1993 to 2019. The trend line remains below a value of 3, implying that the plots' hydrophytic vegetation factor for wetland delineation (hydrophytic, ≤3, versus nonhydrophytic, >3) has not changed (Figure E-2). A decrease over time indicates that plots are weighted more heavily by FACW or OBL species than FAC, FACU, or UPL species over time, which could be due to an increase in the number or percent cover of FACW or OBL species. This observation implies that plots in which *C. canescens* occur are becoming wetter, which supports reassigning IAM and CRB to FACW. However, it is also possible that research interests over time have changed and there is now greater interest in wetter areas.

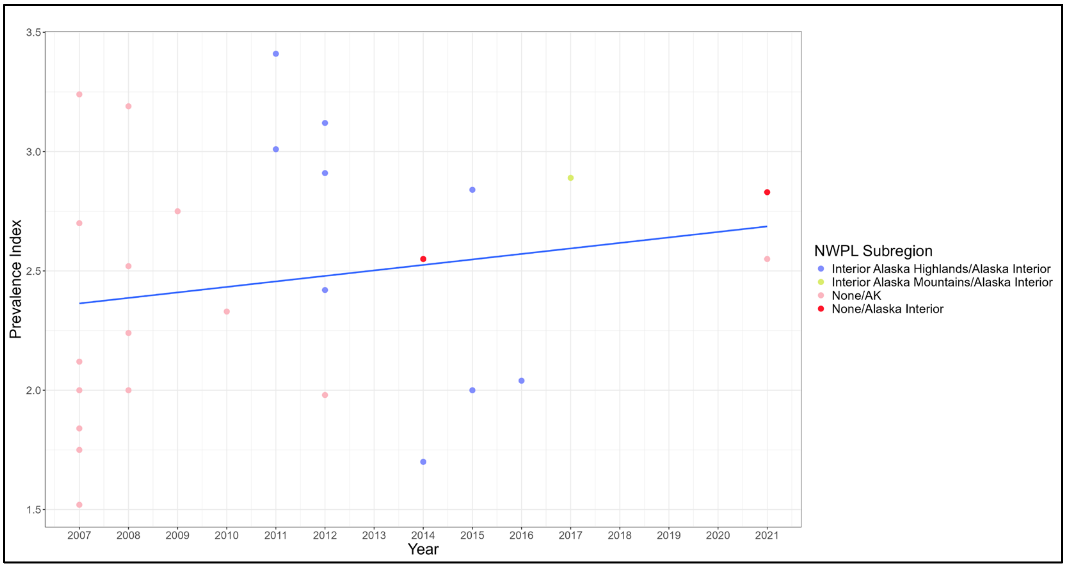
Figure E-2. Change in PI over time by NWPL wetland indicator status rating for plots containing *C. canescens* from AKVEG data (n = 65).



E.2.2 NRCS

PI shows an increase from 2007 to 2021. The trend line remains below a value of 3, implying that plots' hydrophytic vegetation factor for wetland delineation (hydrophytic, ≤3, versus nonhydrophytic, >3) has not changed (Figure E-3). The increasing trendline implies that sites where *C. canescens* is found are getting drier over time and IAM could warrant a FAC rating. However, the trend line is still below 3, which does not support upholding the current listing of IAM as FAC. It is possible that calculating values using a value of 3 for *C. canescens* would increase the PI for plots within IAM. However, these results are unreliable because the dataset is small and IAM has only one observation. Results are not considered in the species recommendation.

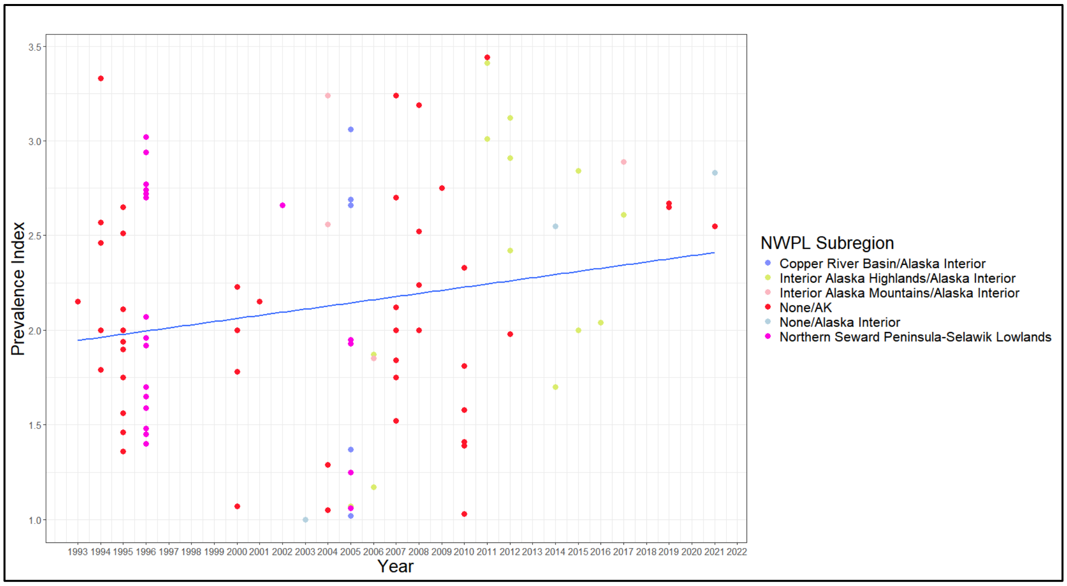
Figure E-3. *C. canescens* from NRCS data (n = 27).



E.2.3 Combined Datasets

PI shows an increase from 1993 to 2021. The trend line remains below a value of 3, implying that plots' hydrophytic vegetation factor for wetland delineation (hydrophytic, ≤3, versus nonhydrophytic, >3) has not changed (Figure E-4). An increase over time indicates that plots are weighted more heavily by species that FAC, FACU, or UPL species over time, which could be due to an increase in the number of species or percent cover of species that are rated as FAC, FACU, or UPL. This observation implies that plots in which *C. canescens* occur are becoming drier, but the trend line is still below 3, which does not support upholding the current listing of IAM and CRB as FAC. It is possible that calculating values using a rating of 3 for *C. canescens* would increase the PI for plots within IAM and CRB.

Figure E-4. Change in PI over time by NWPL wetland indicator status rating for plots containing *C. canescens* from combined AKVEG and NRCS data (n = 92).



E.3 PI by Wetland Status Indicator Rating and Subregion

E.3.1 AKVEG

PI is below 3 for both FAC and FACW ratings across all subregions (Figure E-5; Table E-1). Results indicate that in all 6 represented subregions, *C. canescens* occurs in sites that would meet the hydrophytic vegetation criterion. The mean PI for both IAM (2.55 ± 0.70) and CRB (2.16 ± 0.90) is higher than those with a FACW rating, which range from None/Alaska Interior (1, n = 1) to NSL (2 ± 0.64), implying that plots in IAM and CRB tend to be dryer than in the FACW subregions but there is overlap between the values when standard deviation is considered. IAM and CRB do not differ enough from the other subregions to warrant a different rating. It is possible the mean value for IAM and CRB would increase if recalculated with a FAC rating of 3 for *C. canescens* rather than 2 (=FACW, like the rest of the state except the 5 subregions in question here).

Figure E-5. Bar chart comparing the mean PI for each subregion by wetland status indicator rating (AKVEG, *n* = 65).

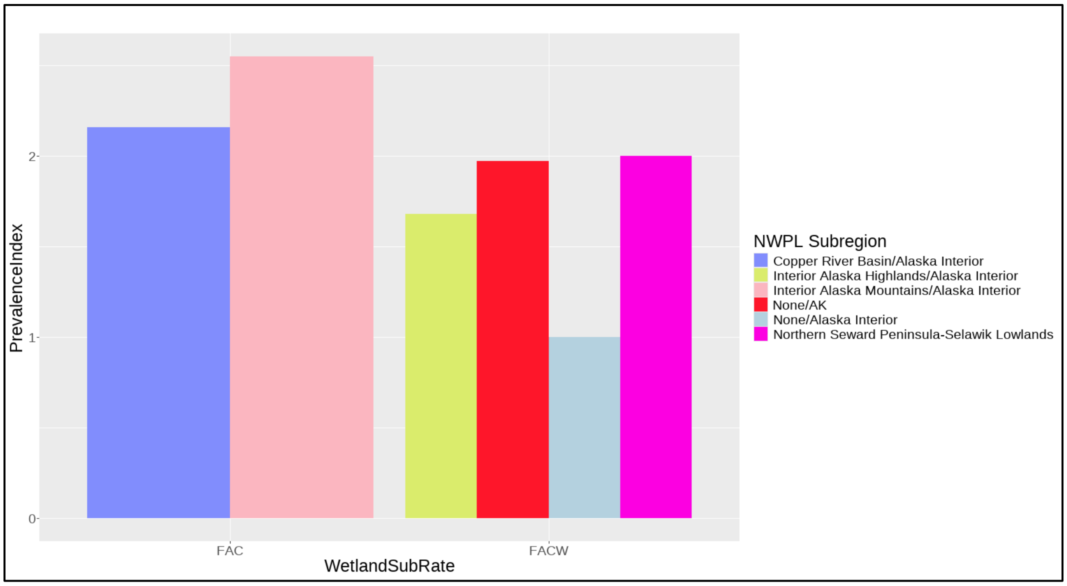


Table E-1. Sample size, mean, and standard deviation of the PI for the 13 NWPL subregions and the rest of the state of Alaska (None/AK) for plots from the AKVEG dataset. *Yellow* indicates subregions under investigation for reassignment.

NWPL Subregion	Number of Observations	Average PI Value	Standard Deviation of PI Values
Copper River Basin (CRB)/Alaska Interior (LRR)	5	2.16	0.90
Interior Alaska Highlands (IAH)/Alaska Interior (LRR)	4	1.68	0.71
Interior Alaska Mountains (IAM)/Alaska Interior (LRR)	3	2.55	0.70
None/AK	31	1.97	0.61
None/Alaska Interior (AKI in LRR)	1	1.00	N/A
Northern Seward Peninsula-Selawik Lowlands (NSL)	21	2.00	0.64

E.3.2 NRCS

The sole PI value for IAM is below 3 (2.89) and above the value for the rest of the subregions, indicating that this site meets the hydrophytic vegetation factor using the PI (Figure E-6; Table E-2). The data do not support or refute maintaining IAM as a different rating than the rest of the state due to the small sample size for IAM (n = 1).

Figure E-6. Bar chart comparing the mean PI for each subregion by wetland status indicator rating (NRCS, *n* = 27).

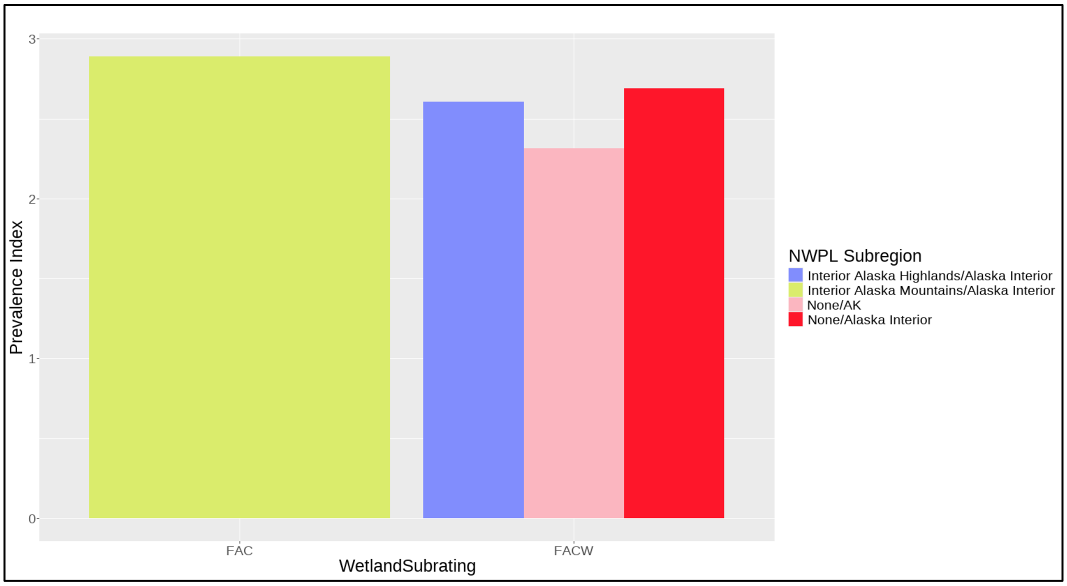


Table E-2. Sample size, mean, and standard deviation of the PI for the 5 NWPL subregions and the rest of the state of Alaska (None/AK) for plots from the NRCS dataset. *Yellow* indicates subregions under investigation for reassignment.

NWPL Subregion	Number of Observations	Average PI Value	Standard Deviation of PI Values
Interior Alaska Highlands (IAH)/Alaska Interior (LRR)	9	2.61	0.59
Interior Alaska Mountains (IAM)/Alaska Interior (LRR)	1	2.89	N/A
None/AK	15	2.32	0.51
None/Alaska Interior (AKI in LRR)	2	2.69	0.20

E.3.3 Combined Datasets

PI is below 3 for both FAC and FACW ratings across all subregions (Figure E-7; Table E-3). Results indicate that in all six represented subregions, *C. canescens* occurs in sites that would meet the hydrophytic vegetation factor. The mean PI for both IAM (2.64 ± 0.59) and CRB (2.16 ± 0.90) is higher than those with a FACW rating, which range from NSL (2 ± 0.64) to IAH (2.32 ± 0.75), implying that IAM and CRB tend to be dryer than the FACW subregions but there is overlap between the values when standard deviation is considered. IAM and CRB do not differ enough from the other subregions to warrant a different rating. It is possible the mean value for IAM and CRB would increase if recalculated with a FAC rating of 3 for *C. canescens* rather than 2 (=FACW, like the rest of the state except the 5 subregions in question here).

Figure E-7. Bar chart comparing the mean PI for each subregion by wetland status indicator rating (combined datasets, *n* = 92).

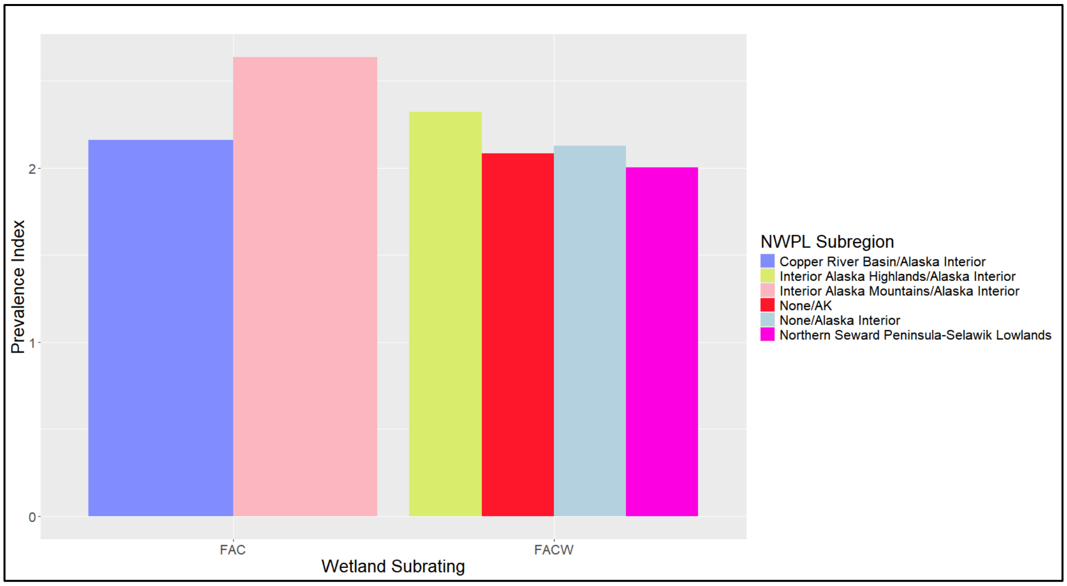


Table E-3. Sample size, mean, and standard deviation of the PI for the 13 NWPL subregions and the rest of the state of Alaska (None/AK) for plots from the combined AKVEG/NRCS dataset. *Yellow* indicates subregions under investigation for reassignment.

NWPL Subregion	Number of Observations	Average PI Value	Standard Deviation of PI Values
Copper River Basin (CRB)/Alaska Interior (LRR)	5	2.16	0.90
Interior Alaska Highlands (IAH)/Alaska Interior (LRR)	13	2.32	0.75
Interior Alaska Mountains (IAM)/Alaska Interior (LRR)	4	2.64	0.59
None/AK	46	2.08	0.60
None/Alaska Interior (AKI in LRR)	3	2.13	0.99
Northern Seward Peninsula-Selawik Lowlands (NSL)	21	2.00	0.64

E.4 Importance of *C. canescens* for the Prevalence Index (PI) Calculation

When *C. canescens* was omitted, no plots changed hydrophytic vegetation criterion status. The mean change in PI score was +0.001, where 18 plots (27.7%) displayed a slightly higher PI value, 19 plots (19.2%) remained the same, and 28 plots (43.1%) scored slightly lower. Most plots shift to a lower score or remain the same (62.3% total) suggesting that *C. canescens* primarily occurred in sample locations as a minor component.

E.5 Data Preparation for Analyses

E.5.1 AKVEG

The original data from AKVEG contained 50 variables (not including cospecies data) with 66 observations. Twenty-one variables had zeros transformed to N/A values; Strata, Physiography, Geomorphology, Macrotopography, Microtopography, Microrelief, Drainage, Moisture, Restrictive Layer, Disturbance, Depth Water, Depth Moss Duff, Depth Restrictive Layer, Soil pH 10, Conductivity 10, Temperature 10, Soil pH 30, Conductivity 30, Temperature 30, Water pH, and Water Conductivity. Ten variables were removed due to having no values: Water Temperature, Water Conductivity, Temperature 30, Conductivity 30, Temperature 10, Restrictive Layer, Depth Restrictive Layer, Soil Class, Drainage, and Microrelief. One variable was added: Interior—true or false value. Of the 41 variables, 14 were numeric; of these 14 variables, 8 met the 60% missing values cut-off threshold. One observation was excluded due to having no PI value. The remaining 65 observations and 8 variables were used for the correlation analysis, which informed selection of 4 variables for the ANOSIM, NMDS, and PCA.

E.5.2 NRCS

The original data from NRCS contained 117 variables with 27 observations. After deleting duplicate variables, 96 variables remain. For 15 variables, zeros were transformed to N/A values; Restrict_t, Restrict_b, O_thickness, O_pH, surf_pH, bottom_pH, surf_hor, Clay_low, Clay_high, Silt_low, Silt_high, sand_low, sand_high, redox dept, and sub_frag. One variable was added: Interior—true or false value. Of the 97 variables, 33 were numeric. Of these, 19 met the 40% missing values threshold criteria. Twenty-seven observations and 19 variables were used for the correlation analysis, which informed selection of 17 variables for the ANOSIM, NMDS, and PCA. See Section E.10.2, Figure E-19 for a list of the variables.

E.5.3 Combined AKVEG/NRCS Dataset

The AKVEG and NRCS datasets share 17 variables in common, of which 6 variables are numeric. The combined dataset has 92 observations. Four variables; cover, elevation, hydric soil rating, and PI, were determined to be appropriate for ANOSIM, NMDS and PCA. Correlation analysis was skipped due to the small number of variables.

E.6 MCA on AKVEG Dataset

Dimension 1 (17.8%) and Dimension 2 (14.9%) together explain more than a third of the variance in the dataset. One project, Wrangell LC, is the third strongest contributor to Dimension 1, and contributes only 5% less than the strongest contributor, indicating there is a Project effect within the data (Figures E-8, E-9, and E-10). However, CRB is very different from the other subregions along Dimension 1 and data for all 5 sites in the AKVEG dataset was collected by this project, which is the cause of the strong contribution. The IAM points are not visible because they align with other points on the plot.

Figure E-8. MCA plot of AKVEG data by NWPL subregion and Interior (*triangles*) versus the rest of Alaska (*dots*; *n* = 65). Each symbol represents the centroid of multiple observations.

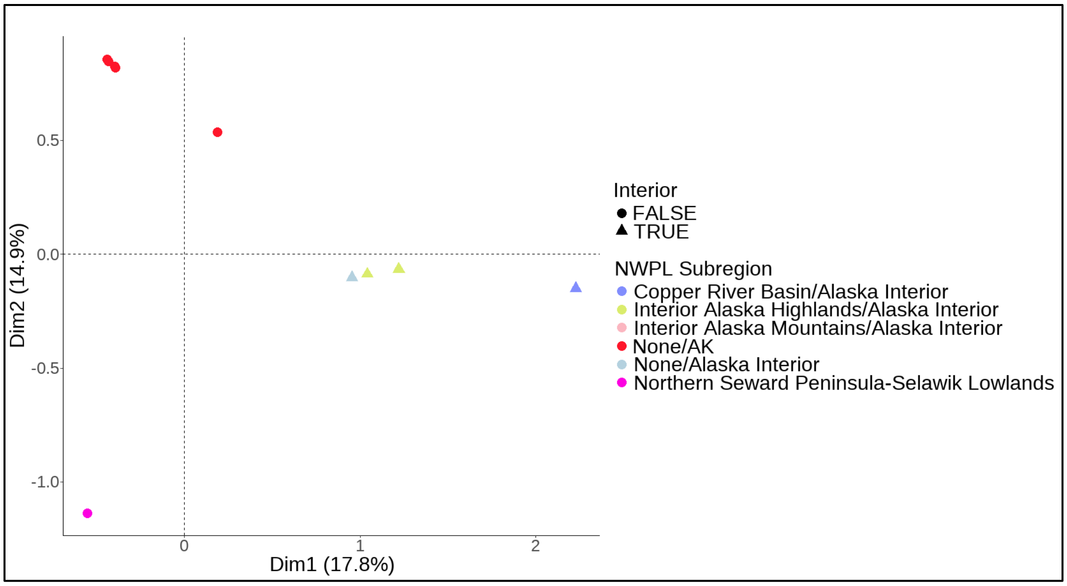


Figure E-9. Percent contribution of MCA factors to Dimension 1 for AKVEG data.

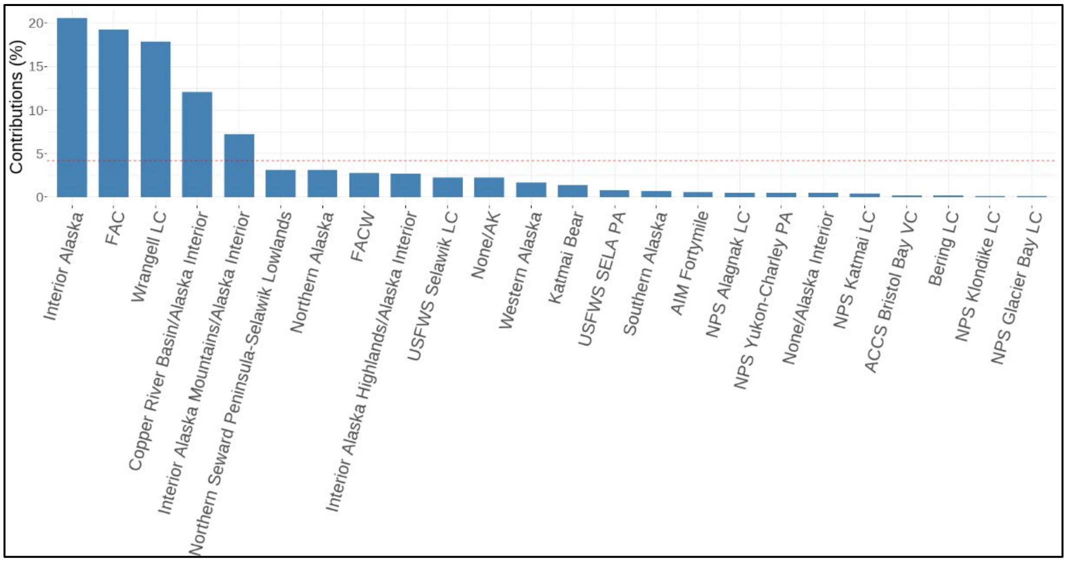
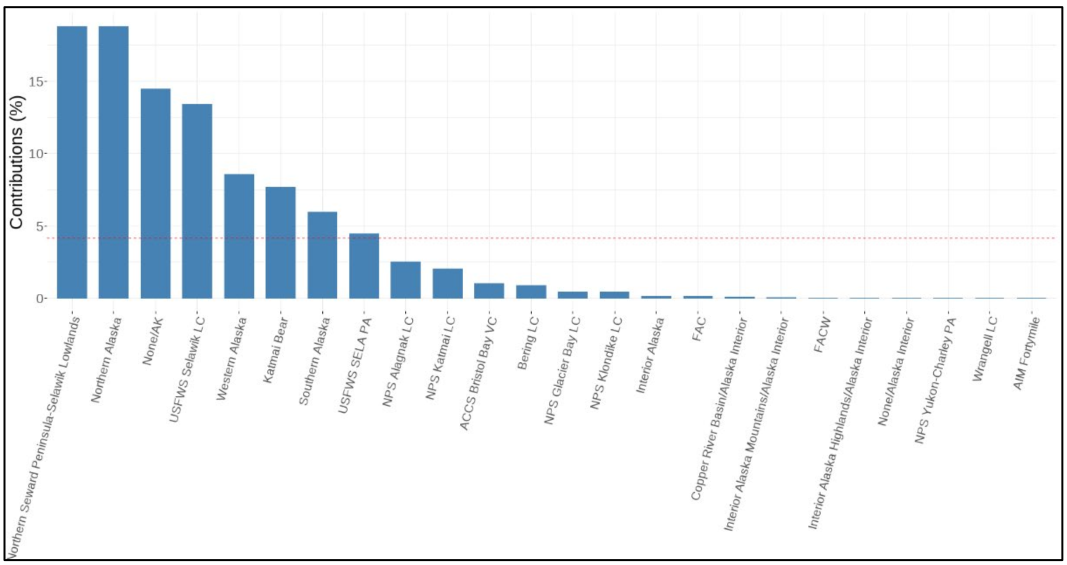


Figure E-10. Percent contribution of MCA factors to Dimension 2 for AKVEG data.

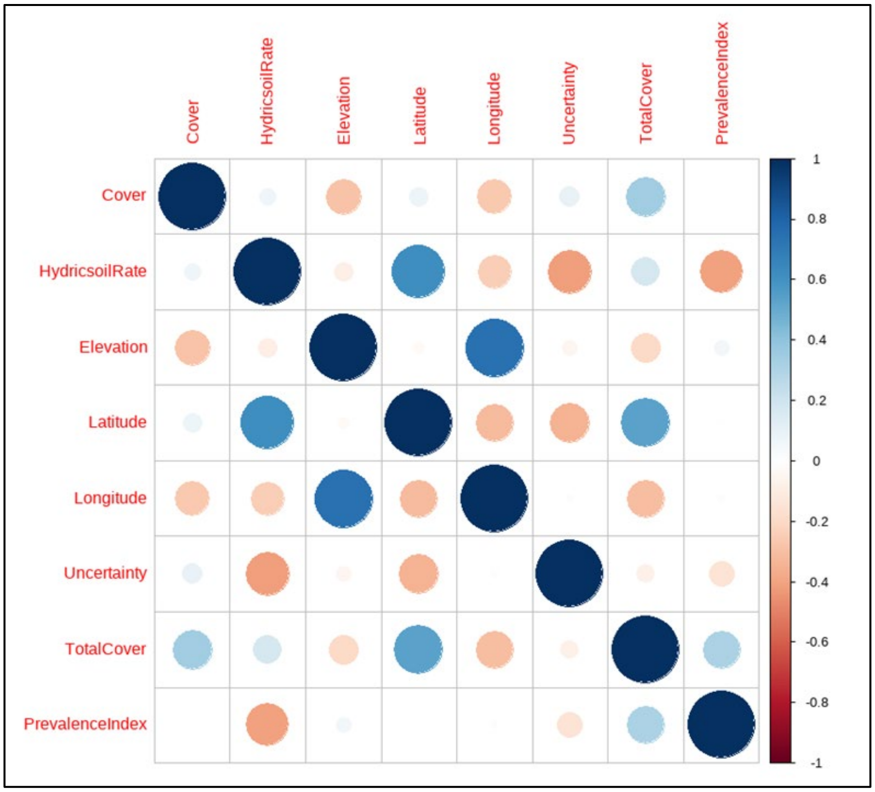


E.7 Correlation Matrices

E.7.1 AKVEG

The 65 observations and 8 variables used for the correlation analysis informed selection of 4 variables for ANOSIM, NMDS and PCA analyses (Figure E-11). Because of strong correlations with other variables, latitude, longitude, Uncertainty, and TotalCover were excluded.

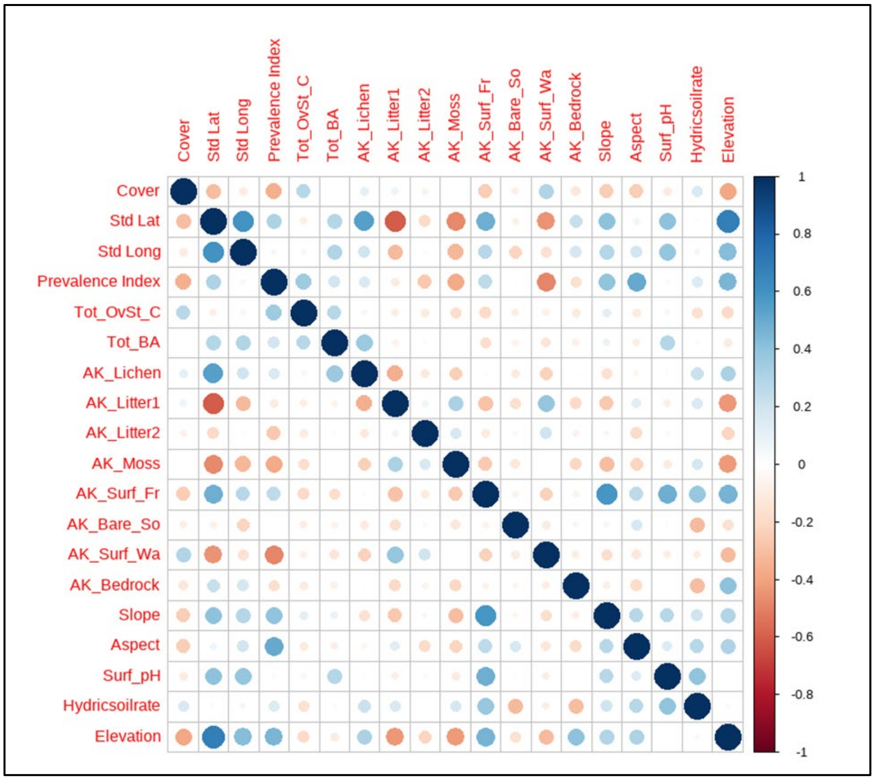
Figure E-11. Correlation matrix for *Carex canescens* AKVEG data (n = 65).



E.7.2 NRCS

The 27 observations and 19 variables used for the correlation analysis informed selection of 17 variables for ANOSIM, NMDS, and PCA analyses (Figure E-12). Because of strong correlations with other variables, latitude and longitude were excluded.

Figure E-12. Correlation matrix for *Carex canescens* NRCS data (n = 27).



E.8 The ANOSIM Test

E.8.1 AKVEG

For the four variables tested, subregions and plots with FAC versus FACW ratings are significantly different ($R = 0.522$, $p < 0.01$, $R = 0.597$, $p < 0.01$, respectively). For pairwise comparisons, IAM and CRB are significantly different from the state, implying a different rating is warranted for these two subregions. Alternatively, the data also suggest that the creation of a single, LRR Interior Alaska subregion could be appropriate. All LRR Interior Alaska subregions differ from the state (IAH is significantly highly different from the state, and AKI trends toward significance for being different from the state (Table E-4). NSL, the only non-LRR Alaska Interior subregion analyzed, is significantly highly different from the 4 LRR Alaska Interior subregions and has high overlap with the state of Alaska (Table E-4). This recommendation is further supported by the lack of significant difference between the subregions found within LRR Interior Alaska (CRB versus IAH is the exception, $R = 0.41$, $p < 0.05$).

Table E-4. ANOSIM pairwise tests for all subregions from the AKVEG dataset ($n = 65$).

—	ALASKA	ACP	AKI •	IAH •	IAL •	IAM •	CRB •	WBR	NBR	IBR •	NSL	SPH	PDA •	UKK •
ALASKA	N/A	—	—	—	—	—	—	—	—	—	—	—	—	—
Arctic Coastal Plain (ACP)	—	N/A	—	—	—	—	—	—	—	—	—	—	—	—
Alaska Interior (AKI) •	0.52, 0.07	—	N/A	—	—	—	—	—	—	—	—	—	—	—
Interior Alaska Highlands (IAH) •	**0.76****	—	1, 0.23	N/A	—	—	—	—	—	—	—	—	—	—
Interior Alaska Lowlands (IAL) •	—	—	—	—	N/A	—	—	—	—	—	—	—	—	—
Interior Alaska Mountains (IAM) •	**0.69***	—	0.11, 0.5	0.24, 0.18	—	N/A	—	—	—	—	—	—	—	—
Copper River Basin (CRB) •	**0.70****	—	0.72, 0.2	0.41*	—	0.1, 0.18	N/A	—	—	—	—	—	—	—
Western Brooks Range (WBR)	—	—	—	—	—	—	—	N/A	—	—	—	—	—	—
Northern Brooks Range (NBR)	—	—	—	—	—	—	—	—	N/A	—	—	—	—	—
Interior Brooks Range (IBR) •	—	—	—	—	—	—	—	—	—	N/A	—	—	—	—
Northern Seward Peninsula (NSL)	0.26**	—	**1***	**1****	—	**1****	**1****	—	—	—	N/A	—	—	—
Seward Peninsula Highlands (SPH)	—	—	—	—	—	—	—	—	—	—	—	N/A	—	—
Pebble/Donlin/Aniak (PDA) •	—	—	—	—	—	—	—	—	—	—	—	—	N/A	—
Upper Kobuk-Koyukuk (UKK) •	—	—	—	—	—	—	—	—	—	—	—	—	—	N/A

Note: * is $p \leq 0.05$, ** is $p \leq 0.01$; for significant p values, *bold* text indicates $0.5 \leq R < 0.75$ (significantly different); *bold* and *gray* fill indicates $0.75 \leq R \leq 1$ (significantly highly different). *Yellow* indicates subregions under investigation for reassignment, *blue dots* indicate subregions that fall within the LRR Interior Alaska subregion.

E.8.2 NRCS

Subregions differ significantly with some overlap ($R = 0.342$, $p < 0.01$) and there is no difference between FAC and FACW ($R = -0.115$, $p = 0.653$). However, results are likely skewed due to differences in sample size (IAM/FAC = 1, AKI/FAC = 2, IAH/FACW = 9, Alaska/FACW = 15). Results imply that IAM and CRB can be rerated as FACW and hint at an LRR subregion as appropriate (Table E-5) but are not considered in the recommendation due to small sample size.

Table E-5. ANOSIM pairwise tests for all subregions from the NRCS dataset (n = 27, but IAM = 1).

—	ALASKA	ACP	AKI •	IAH •	IAL •	IAM •	CRB •	WBR	NBR	IBR •	NSL	SPH	PDA •	UKK •
ALASKA	N/A	—	—	—	—	—	—	—	—	—	—	—	—	—
Arctic Coastal Plain (ACP)	—	N/A	—	—	—	—	—	—	—	—	—	—	—	—
Alaska Interior (AKI) •	0.26, 0.13	—	N/A	—	—	—	—	—	—	—	—	—	—	—
Interior Alaska Highlands (IAH) •	0.47**	—	0.09, 0.28	N/A	—	—	—	—	—	—	—	—	—	—
Interior Alaska Lowlands (IAL) •	—	—	—	—	N/A	—	—	—	—	—	—	—	—	—
Interior Alaska Mountains (IAM) •	0.4, 0.18	—	0, 0.67	−0.2, 0.48	—	N/A	—	—	—	—	—	—	—	—
Copper River Basin (CRB) •	—	—	—	—	—	—	N/A	—	—	—	—	—	—	—
Western Brooks Range (WBR)	—	—	—	—	—	—	—	N/A	—	—	—	—	—	—
Northern Brooks Range (NBR)	—	—	—	—	—	—	—	—	N/A	—	—	—	—	—
Interior Brooks Range (IBR) •	—	—	—	—	—	—	—	—	—	N/A	—	—	—	—
Northern Seward Peninsula (NSL)	—	—	—	—	—	—	—	—	—	—	N/A	—	—	—
Seward Peninsula Highlands (SPH)	—	—	—	—	—	—	—	—	—	—	—	N/A	—	—
Pebble/Donlin/Aniak (PDA) •	—	—	—	—	—	—	—	—	—	—	—	—	N/A	—
Upper Kobuk-Koyukuk (UKK) •	—	—	—	—	—	—	—	—	—	—	—	—	—	N/A

Note: * is $p \leq 0.05$, ** is $p \leq 0.01$; for significant p values, *bold* text indicates $0.5 \leq R < 0.75$ (significantly different); *bold* and *gray* fill indicates $0.75 \leq R \leq 1$ (significantly highly different). *Yellow* indicates subregions under investigation for re-assignment, *blue dots* indicate subregions that fall within the LRR Interior Alaska subregion.

E.8.3 Combined Datasets

The variables included for this analysis were cover, elevation, hydric soil rating, and PI. For these four variables, subregions are significantly different with some overlapping as are plots with FAC versus FACW ratings ($R = 0.470$, $p < 0.01$, $R = 0.336$, $p < 0.01$, respectively). IAM, CRB, and IAH are significantly different from the state, and AKI is significantly different with some overlap (Table E-6). NSL, the only non-LRR Alaska Interior subregion analyzed, is significantly highly different from the 4 LRR Alaska Interior subregions and has significantly high overlap with the state of Alaska (Table E-6). All LRR Interior Alaska subregions differ from the state, implying the creation of a single, larger Interior Alaska subregion may be appropriate. This recommendation is further supported by the lack of significant difference between the subregions found within LRR Interior Alaska. However, more data are needed to draw robust conclusions for either a unique rating for IAM and CRB or the creation of an LRR Interior Alaska subregion. Importantly, available data were for only 4 of the 8 subregions within the LRR Interior Alaska.

Table E-6. ANOSIM pairwise tests for all subregions from the combined datasets ($n = 92$).

—	ALASKA	ACP	AKI •	IAH •	IAL •	IAM •	CRB •	WBR	NBR	IBR •	NSL	SPH	PDA •	UKK •
ALASKA	N/A	—	—	—	—	—	—	—	—	—	—	—	—	—
Arctic Coastal Plain (ACP)	—	N/A	—	—	—	—	—	—	—	—	—	—	—	—
Alaska Interior (AKI) •	0.37**	—	N/A	—	—	—	—	—	—	—	—	—	—	—
Interior Alaska Highlands (IAH) •	**0.63****	—	0.16, 0.17	N/A	—	—	—	—	—	—	—	—	—	—
Interior Alaska Lowlands (IAL) •	—	—	—	—	N/A	—	—	—	—	—	—	—	—	—
Interior Alaska Mountains (IAM) •	**0.67****	—	0.02, 0.6	−0.2, 0.77	—	N/A	—	—	—	—	—	—	—	—
Copper River Basin (CRB) •	**0.67****	—	0.29, 0.08	−0.1, 0.63	—	−0.1, 0.61	N/A	—	—	—	—	—	—	—
Western Brooks Range (WBR)	—	—	—	—	—	—	—	N/A	—	—	—	—	—	—
Northern Brooks Range (NBR)	—	—	—	—	—	—	—	—	N/A	—	—	—	—	—
Interior Brooks Range (IBR) •	—	—	—	—	—	—	—	—	—	N/A	—	—	—	—
Northern Seward Peninsula (NSL)	0.18**	—	1**	**0.99****	—	**1****	**1****	—	—	—	N/A	—	—	—
Seward Peninsula Highlands (SPH)	—	—	—	—	—	—	—	—	—	—	—	N/A	—	—
Pebble/Donlin/Aniak (PDA) •	—	—	—	—	—	—	—	—	—	—	—	—	N/A	—
Upper Kobuk-Koyukuk (UKK) •	—	—	—	—	—	—	—	—	—	—	—	—	—	N/A

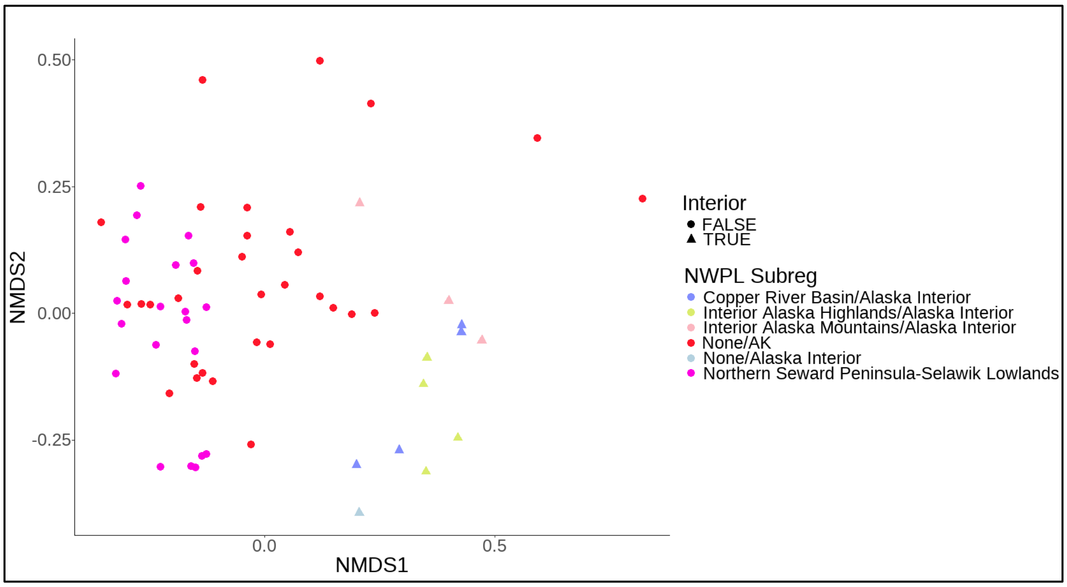
Note: * is $p \leq 0.05$, ** is $p \leq 0.01$; *bold* indicates $R \geq 0.5$. Pairwise results that did not change when datasets were combined are shown in *white* ($R < 0.75$) or *gray* ($R \geq 0.75$). New results from combining datasets are indicated by *orange hatching*; when combined with *gray*, $R \geq 0.75$. *Yellow* indicates subregions under investigation for reassignment, *blue dots* indicate subregions that fall within the LRR Interior Alaska subregion.

E.9 NMDS

E.9.1 AKVEG

Points from the LRR Interior Alaska subregion cluster further in the lower right-hand quadrant compared to None/AK and NSL implying that for the variables considered, there is a difference between the LRR subregion and those two subregions (Figure E-13). The creation of a single LRR subregion is further supported by the clustering of IAH, CRB, and IAM along Dimension 1. Along Dimension 2 all subregions overlap. Stress test results between 0.1 and 0.15 indicate the NMDS provides a good representation of the data and supports the creation of a single LRR subregion (Figure E-13).

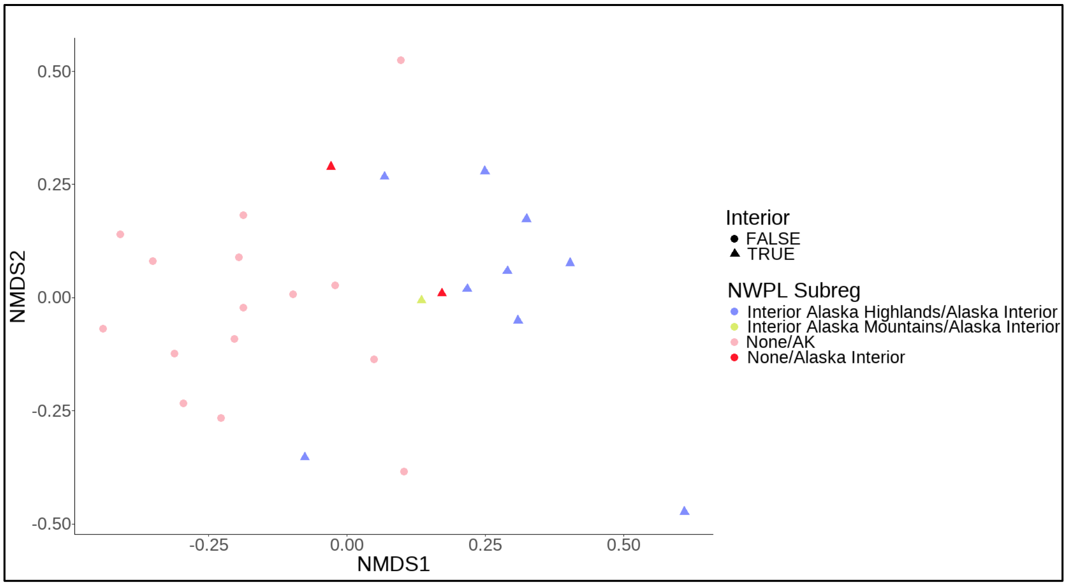
Figure E-13. NMDS of *C. canescens* AKVEG data (*n* = 65). Stress = 0.1245976.



E.9.2 NRCS

Points from the LRR Interior Alaska subregion cluster to the right on Dimension 1, implying that for the variables considered, there is a difference between the LRR subregion and None/AK (Figure E-14). However, stress values between 0.15 and 0.2 indicate the NMDS provides a poor representation of the data and requires caution when interpreting the data so results are not considered for the recommendation (Clarke 1993; Figure E-14).

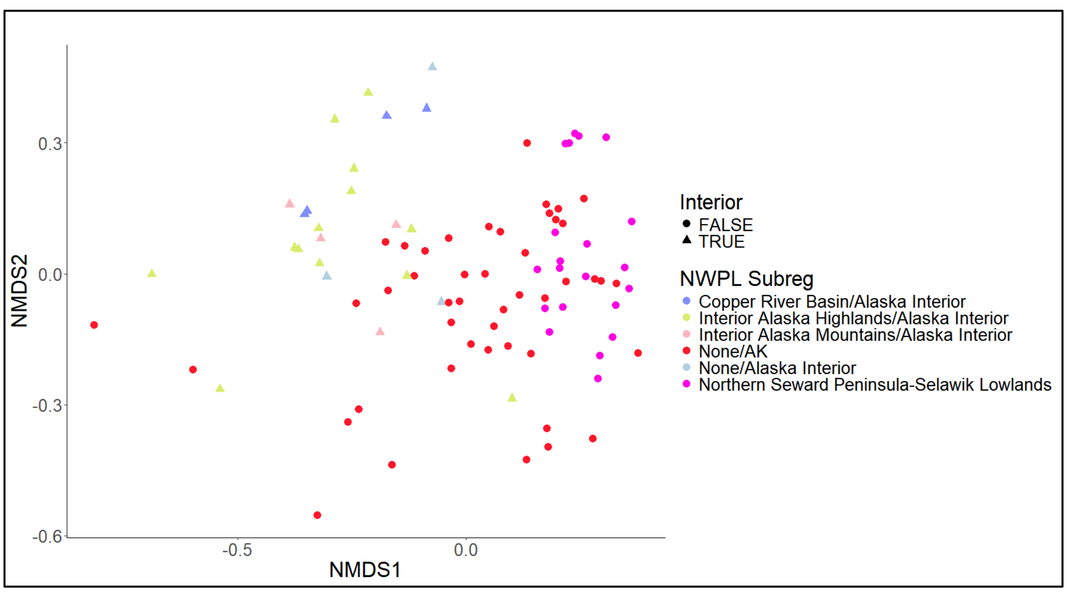
Figure E-14. NMDS of *C. canescens* NRCS data (n = 27). Stress = 0.1804834.



E.9.3 Combined Datasets

The variables included for this analysis were cover, elevation, hydric soil rating, and PI. There is a trend for LRR Interior Alaska plots to cluster in the upper, left side of the NMDS and for None/AK and NSL to cluster to the right along Dimension 1. No LRR Interior Alaska sites overlap with NSL (Figure E-15). Results imply a FAC rating may be appropriate for IAM and CRB or potentially an LRR Interior Alaska subregion. Stress test indicates robust results (Clarke 1993; Figure E-15).

Figure E-15. NMDS of *C. canescens* from combined AKVEG/NRCS data (n = 92). Stress = 0.1247935.



E.10 PCA

E.10.1 AKVEG

There is no clear clustering of IAM or CRB along Dimension 1, but the majority of points from the LRR Interior Alaska subregion, including IAM and CRB, are separate from None/AK and NSL along Dimension 2 (Figure E-16). Dimensions 1 and 2 are strongly influenced by hydric soil rating and PI, which are negatively correlated. Elevation and cover are negatively correlated and also influence both Dimensions (Figure E-17). Because the Interior Alaska points cluster, there is a case for a separate rating for an LRR Interior Alaska subregion, or IAM or CRB to remain FAC.

Figure E-16. PCA plot of *C. canescens* AKVEG dataset (n = 65).

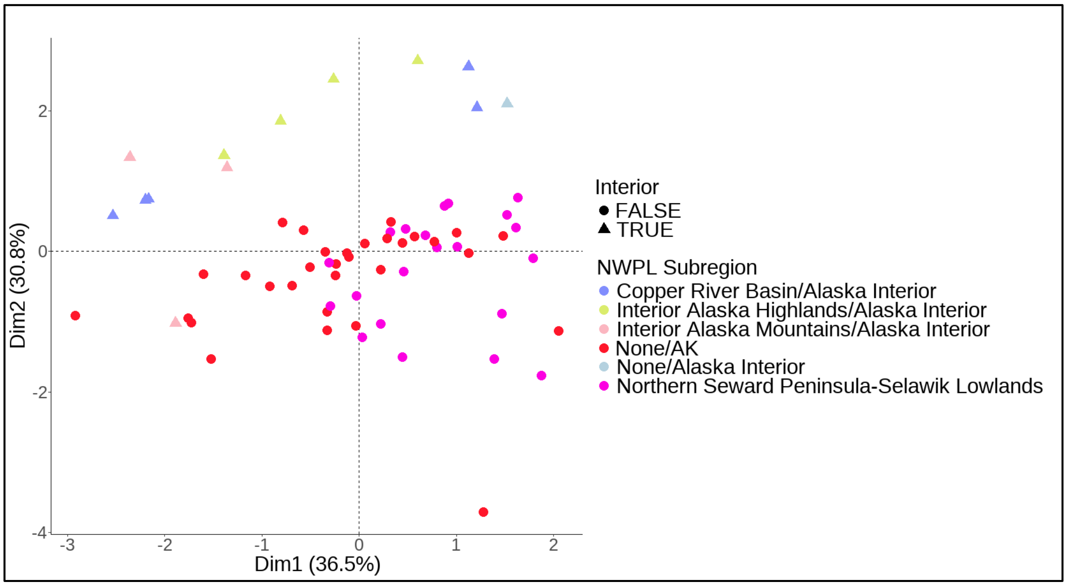
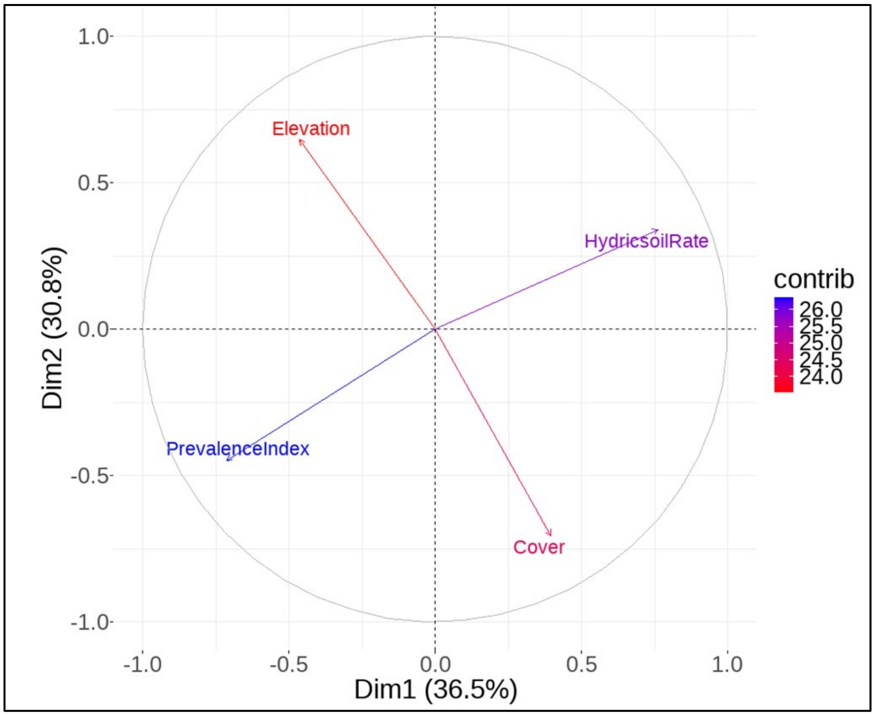


Figure E-17. PCA loading plot of AKVEG data.



E.10.2 NRCS

The majority of LRR Interior Alaska sites fall along the left side of Dimension 1 while rest of the state falls to the right (Figure E-18). There is no clear patter along Dimension 2. Elevation and hydric soil rating are the strongest contributors to both Dimensions and are not correlated (Figure E-19). Because IAM sample size is small (n = 1), NRCS is not considered in recommendations for the subregion.

Figure E-18. PCA plot of *C. canescens* NRCS dataset (*n* = 27).

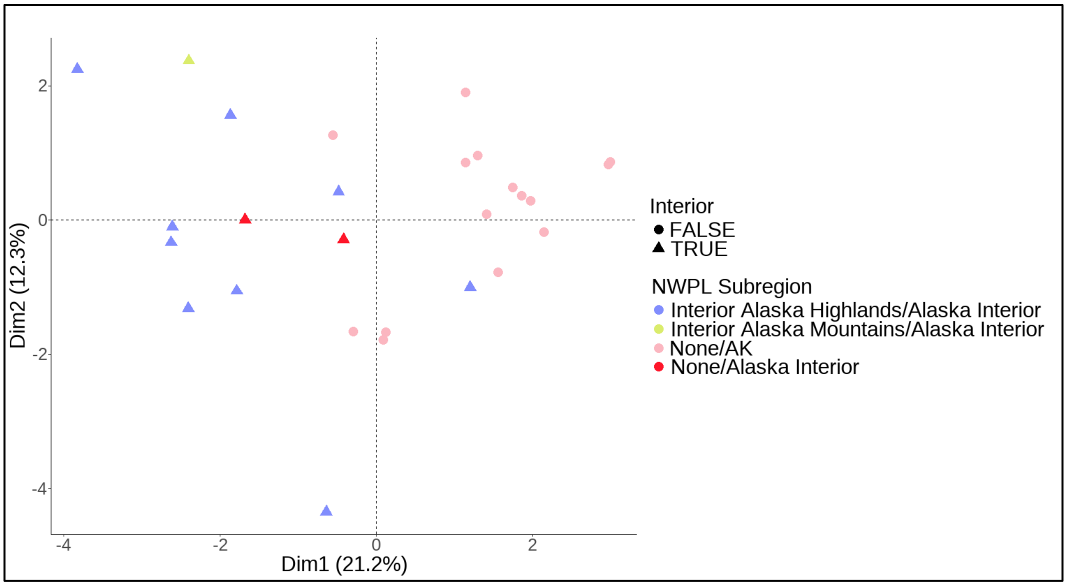
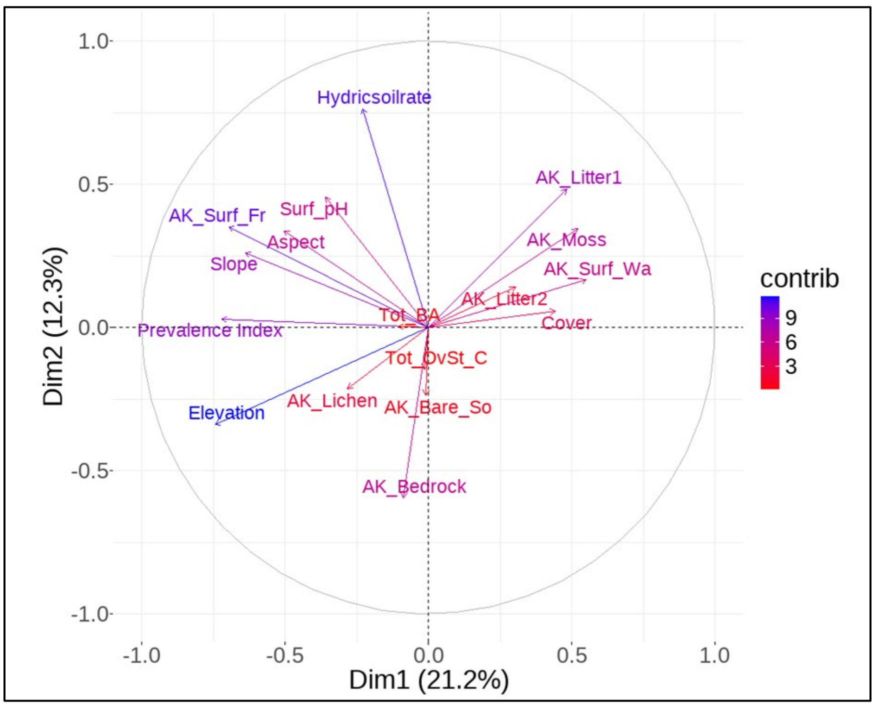


Figure E-19. PCA loading plot of NRCS data.



E.10.3 Combined Datasets

IAM and CRB cluster separately in the upper left corner with some overlap with other subregions along Dimensions 1 (39%) and 2 (28.1%), which together explain almost 70% of the variance in the dataset. Results suggest that for the 4 variables considered, plots within both subregions are similar to plots from other subregions (Figure E-20). Cover is the strongest contributor to both Dimensions and is weakly correlated with PI and hydric soil rating and negatively correlated with elevation (Figure E-21). Because the Interior Alaska points cluster, there is a case for a separate rating for an LRR Interior Alaska subregion, or IAM or CRB, to remain FAC.

Figure E-20. PCA plot of *C. canescens* combined AKVEG/NRCS dataset (*n* = 92).

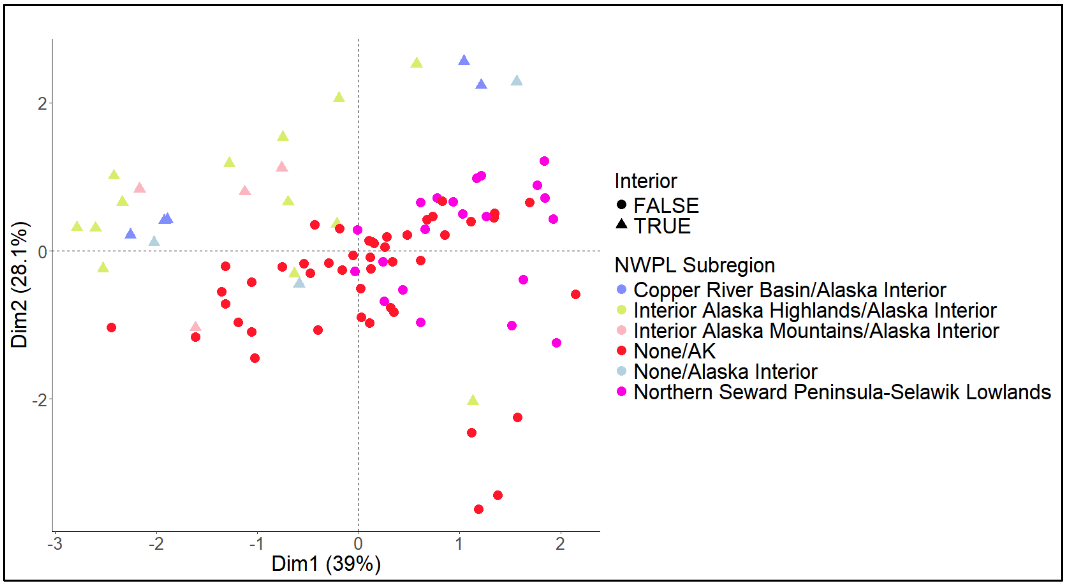
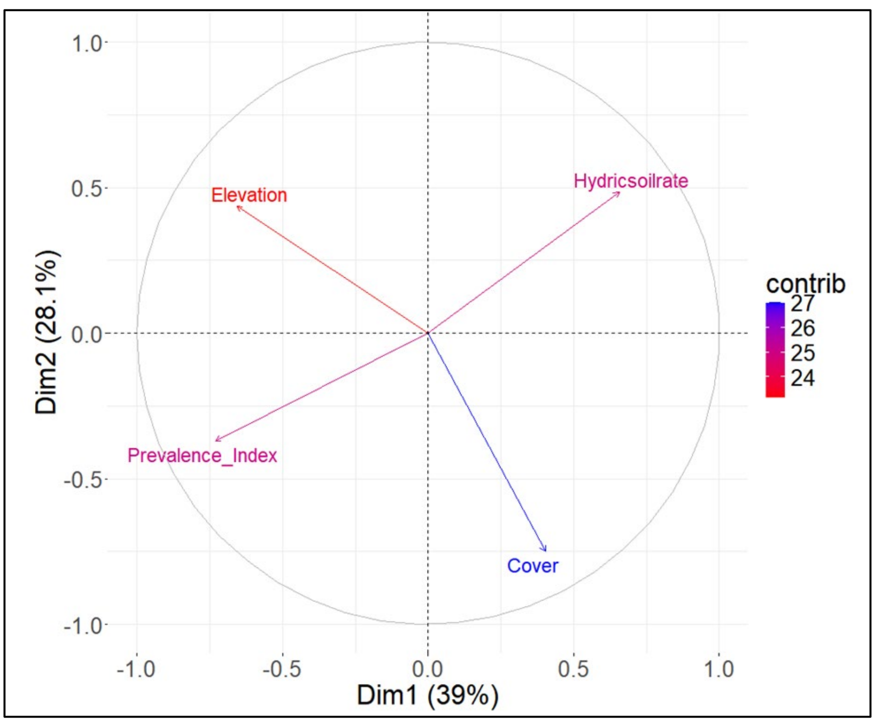


Figure E-21. PCA loading plot of combined AKVEG/NRCS data.



Appendix F: *Rubus arcticus*

On the NWPL *Rubus arcticus* has a wetland indicator status rating of FAC for the state of Alaska, and FACU for 5 subregions; IAH, IAL, IAM, CRB, and IBR.

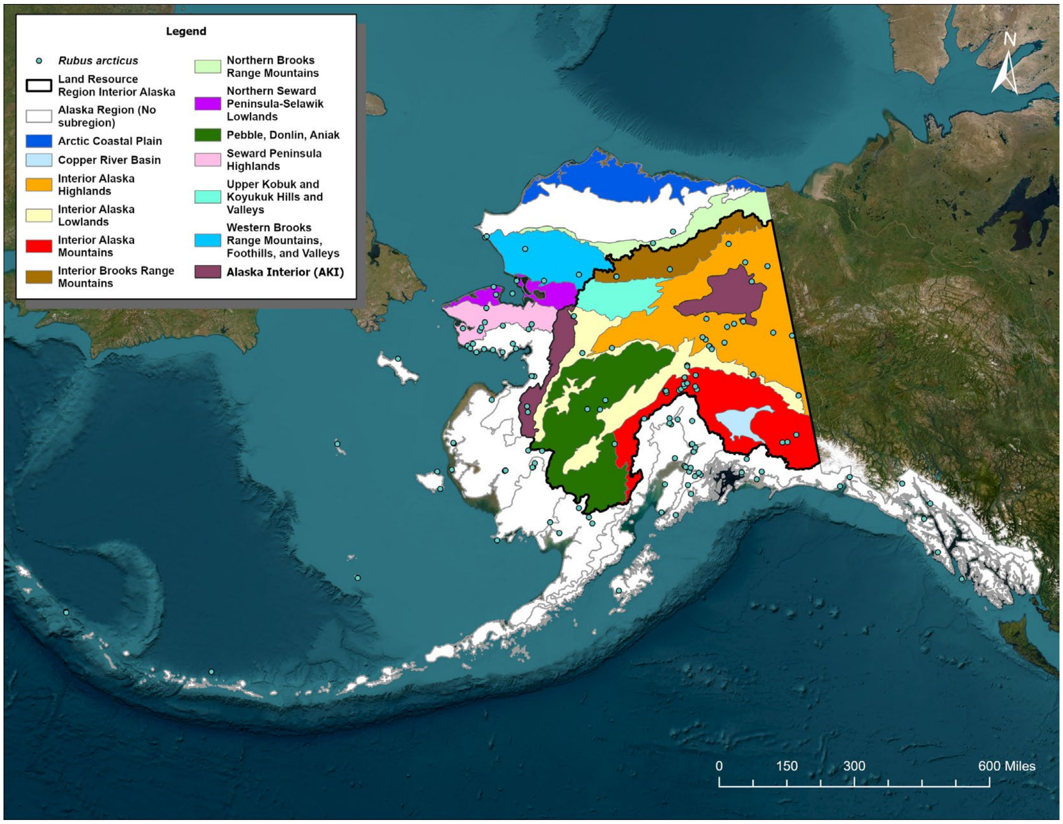
Unfortunately, the AKVEG dataset was small for these subregions (IAH n = 9, IAL n = 3, CRB n = 11, and IBR n = 1) except IAM (n = 32). The NRCS dataset did not contain observations from any of the five subregions in question and only 3 FAC subregions are represented; None/AK (n = 350), None/Alaska Interior (n = 7), and PDA (n = 1). This appendix evaluates the results of multiple analyses to determine whether IAH, CRB, or IAM should be reclassified to match the state-wide rating of FAC. IAL and IBR cannot be analyzed for lack of data, but their data points are included, as is PDA. Conclusions drawn for IAH and CRB may not represent the ecological needs of *R. arcticus* populations within the two subregions due to the small sample size of each.

The data from AKVEG was analyzed independently, then combined with the NRCS dataset for analysis. The variables and number of plots varied between datasets; sample size by subregion and dataset is reported in Section F.3.

F.1 Herbaria Specimens Data

One hundred and fifty specimens contained locality data; 53 of these were collected in LRR Interior Alaska (Figure F-1).

Figure F-1. *Rubus arcticus* specimens with known locality information from the iDigBio portal.

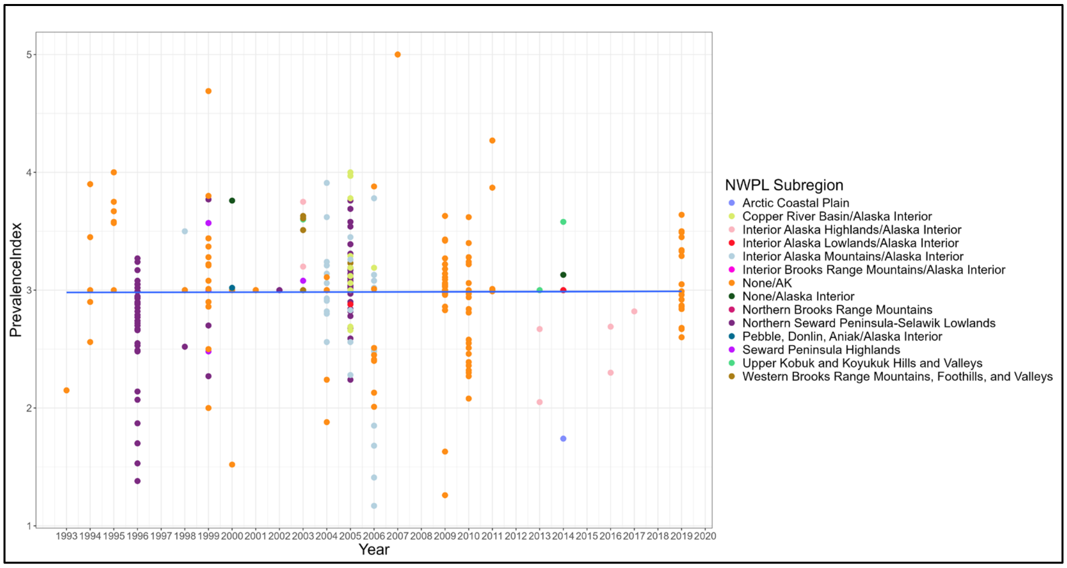


F.2 PI over Time by Alaska Subregion

F.2.1 AKVEG

PI does not change from 1993 to 2019. The trend line remains just below 3 until approaching 3 in 2019, indicating that the plots' hydrophytic vegetation factor for wetland delineation (hydrophytic, ≤3, versus nonhydrophytic, >3) has not changed (Figure F-2). Results imply that plots in which *R. arcticus* occur are becoming imperceptibly drier and could have a nonhydrophytic factor rating in the future. It is also possible that other factors are driving the change, such as research interests changing over time to a greater interest in drier areas.

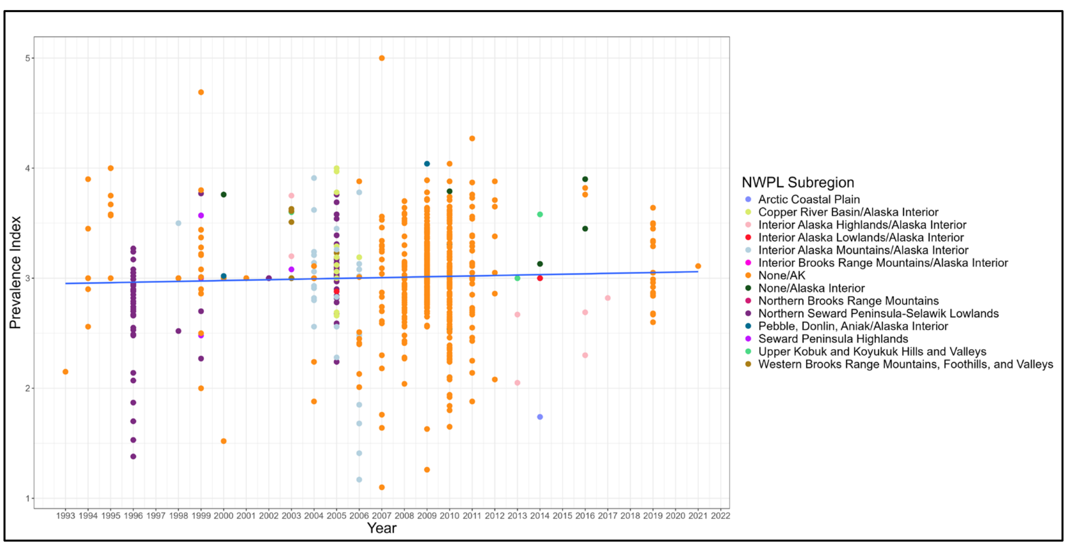
Figure F-2. Change in PI over time by NWPL wetland indicator status rating for plots containing *R. arcticus* from AKVEG data (*n* = 403).



F.2.2 Combined Datasets

PI shows a slight increase from 1993 to 2021. The trend line ranges from below a value of 3 to above it, implying that plots' hydrophytic vegetation factor for wetland delineation (hydrophytic, ≤3, versus nonhydrophytic, >3) has changed and plots in which *R. arcticus* occurs are getting drier (Figure F-3). However, it is also possible that research interests over time have changed and there is now greater interest in drier areas.

Figure F-3. Change in PI over time by NWPL wetland indicator status rating for plots containing *R. arcticus* from combined AKVEG and NRCS data (*n* = 761).



F.3 PI by Wetland Status Indicator Rating and Subregion

F.3.1 AKVEG

PI is above 3 for CRB but below 3 for IAH and IAM, which mirrors the distribution of FAC subregions, with mean prevalence values above and below 3 (Figure F-4; Table F-1). These results do not support a unique rating of FACU for CRB, IAH, or IAM. However, recalculating PI values with IAH, IAM, and IAM assigned a 4 rather than a 3 could increase the means and provide support for maintaining a FACU rating.

Figure F-4. Bar chart comparing the mean PI for each subregion by wetland status indicator rating (AKVEG, *n* = 403).

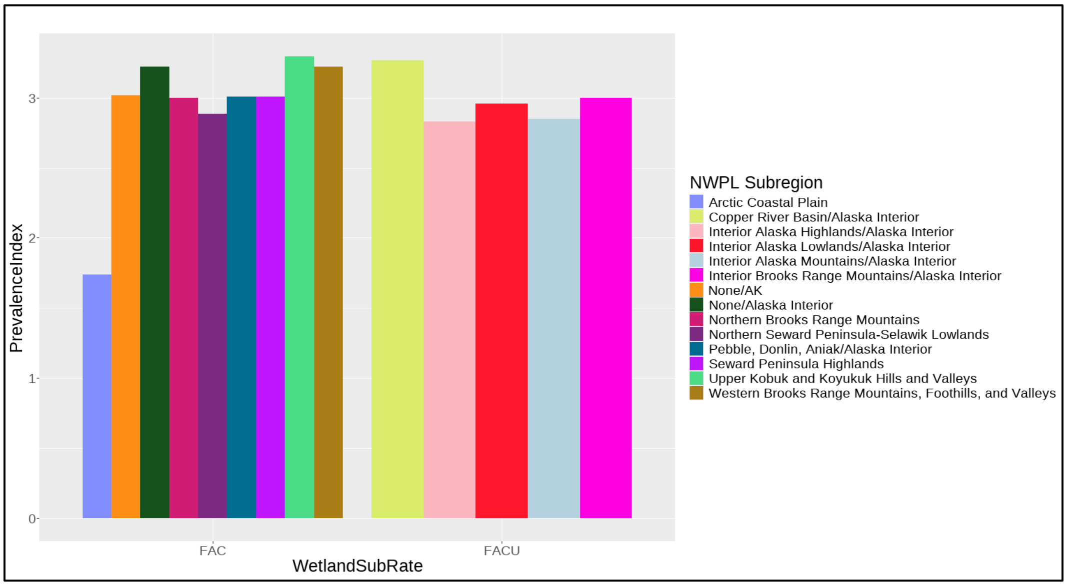


Table F-1. Sample size, mean, and standard deviation of the PI for the 13 NWPL subregions and the rest of the state of Alaska (None/AK) for plots from the AKVEG dataset. *Yellow* indicates subregions under investigation for reassignment.

NWPL Subregion	Number of Observations	Average PI Value	Standard Deviation of PI Values
Arctic Coastal Plain (ACP)	1	1.74	N/A
Copper River Basin (CRB)/Alaska Interior (LRR)	11	3.27	0.46
Interior Alaska Highlands (IAH)/Alaska Interior (LRR)	9	2.83	0.50
Interior Alaska Lowlands (IAL)/Alaska Interior (LRR)	3	2.96	0.07
Interior Alaska Mountains/Alaska Interior (LRR)	32	2.85	0.63
Interior Brooks Range Mountains (IBR)/Alaska Interior (LRR)	1	3.00	N/A
None/AK	226	3.02	0.44
None/Alaska Interior (AKI in LRR)	4	3.22	0.36

Table F-1 (cont.). Sample size, mean, and standard deviation of the PI for the 13 NWPL subregions and the rest of the state of Alaska (None/AK) for plots from the AKVEG dataset. *Yellow* indicates subregions under investigation for reassignment.

NWPL Subregion	Number of Observations	Average PI Value	Standard Deviation of PI Values
Northern Brooks Range Mountains (NBR)	2	3.00	0.00
Northern Seward Peninsula-Selawik Lowlands (NSL)	85	2.88	0.45
Pebble, Donlin, Aniak (PDA)/Alaska Interior (LRR)	3	3.01	0.01
Seward Peninsula Highlands (SPH)	13	3.01	0.22
Upper Kobuk and Koyukuk Hills and Valleys (UKK)	4	3.30	0.34
Western Brooks Range Mountains, Foothills, and Valleys (WBR)	9	3.22	0.28

F.3.2 Combined Datasets

Combining datasets increases the mean PI for several FAC subregions (Figure F-5; Table F-2), which further supports one rating for the state. However, recalculating PI values with CRB, IAH, and IAM assigned a 4 rather than a 3 could increase the means and provide support for maintaining a FACU rating.

Figure F-5. Bar chart comparing the mean PI for each subregion by wetland status indicator rating (combined datasets, *n* = 761).

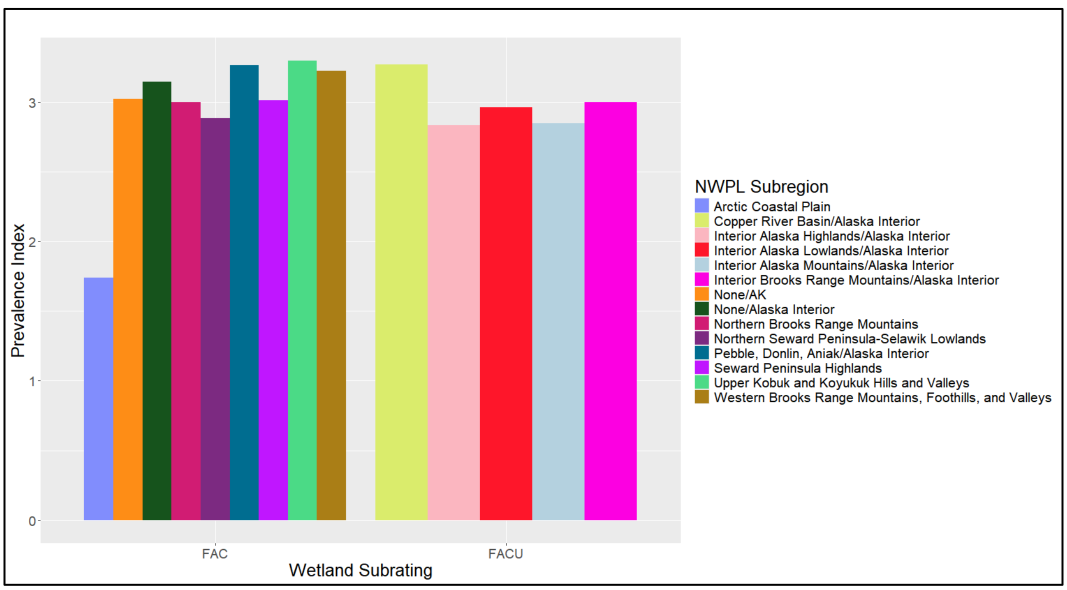


Table F-2. Sample size, mean, and standard deviation of the PI for the 13 NWPL subregions and the rest of the state of Alaska (None/AK) for plots from the combined AKVEG/NRCS dataset. *Yellow* indicates subregions under investigation for reassignment.

NWPL Subregion	Number of Observations	Average PI Value	Standard Deviation of PI Values
Arctic Coastal Plain (ACP)	1	1.74	N/A
Copper River Basin (CRB)/Alaska Interior (LRR)	11	3.27	0.46
Interior Alaska Highlands (IAH)/Alaska Interior (LRR)	9	2.83	0.50
Interior Alaska Lowlands (IAL)/Alaska Interior (LRR)	3	2.96	0.07
Interior Alaska Mountains (IAM)/Alaska Interior (LRR)	32	2.85	0.63
Interior Brooks Range Mountains (IBR)/Alaska Interior (LRR)	1	3.00	N/A
None/AK	576	3.02	0.43
None/Alaska Interior (AKI in LRR)	11	3.15	0.57
Northern Brooks Range Mountains (NBR)	2	3.00	0.00
Northern Seward Peninsula-Selawik Lowlands (NSL)	85	2.88	0.45
Pebble, Donlin, Aniak (PDA)/Alaska Interior (LRR)	4	3.27	0.52
Seward Peninsula Highlands (SPH)	13	3.01	0.22
Upper Kobuk and Koyukuk Hills and Valleys (UKK)	4	3.30	0.34
Western Brooks Range Mountains, Foothills, and Valleys (WBR)	9	3.22	0.28

F.4 Importance of *R. arcticus* for PI Calculation

When *R. arcticus* was omitted from the AKVEG dataset, 71 plots (23.3%) received a higher PI value, 159 plots (52.1%) did not change, and 75 plots (24.6%) scored lower. Mean change in PI was relatively low at +0.001 but ranged from −1.32 to +0.5. One plot from a total of 305 lost hydrophytic vegetation indicator status, and none gained the criterion. Average cover per plot was 3.5% and did not show a significant effect on PI outcomes.

F.5 Data Preparation for Analyses

F.5.1 AKVEG

The original data from AKVEG contained 50 variables (not including cospecies data) with 407 observations. Twenty-one variables had zeros transformed to N/A values; Strata, Physiography, Geomorphology, Macrotopography, Microtopography, Microrelief, Drainage, Moisture, Restrictive Layer, Disturbance, Depth Water, Depth Moss Duff, Depth Restrictive Layer, Soil pH 10, Conductivity 10, Temperature 10, Soil pH 30, Conductivity 30, Temperature 30, Water pH, and Water Conductivity. Seven variables were removed due to having no values: Water

Temperature, Water Conductivity, Temperature 30, Conductivity 30, Temperature 10, Soil Class, and Microrelief. One variable was added: Interior—true or false value. Of the 44, 15 variables were numeric; of these 15 variables, 8 met the missing values cut-off threshold of 60%. Four observations were excluded due to having outlier hydric soil rating values of −9999. The remaining 403 observations and 8 variables were used for the correlation analysis, which informed selection of 4 variables for the ANOSIM, NMDS, and PCA analyses.

F.5.2 NRCS

The original data from NRCS contained 117 variables with 358 observations. The NRCS dataset did not contain observations from any of the five subregions in question, so it was not analyzed independently.

F.5.3 Combined AKVEG/NRCS Dataset

The AKVEG and NRCS datasets share 17 variables in common, of which 6 variables are numeric. The combined dataset has 761 observations. Four variables; cover, elevation, hydric soil rating, and PI, were determined to be appropriate for ANOSIM, NMDS, and PCA. Correlation analysis was skipped due to the small number of variables.

F.6 MCA on AKVEG Dataset

Neither dimension strongly explains the variance in the data nor is strongly influenced by Project, indicating there is no Project effect within the data (Figures F-6, F-7, and F-8).

Figure F-6. MCA plot of AKVEG data by NWPL subregion and Interior (*triangles*) versus the rest of Alaska (*dots*; *n* = 403). Each symbol represents the centroid of multiple observations.

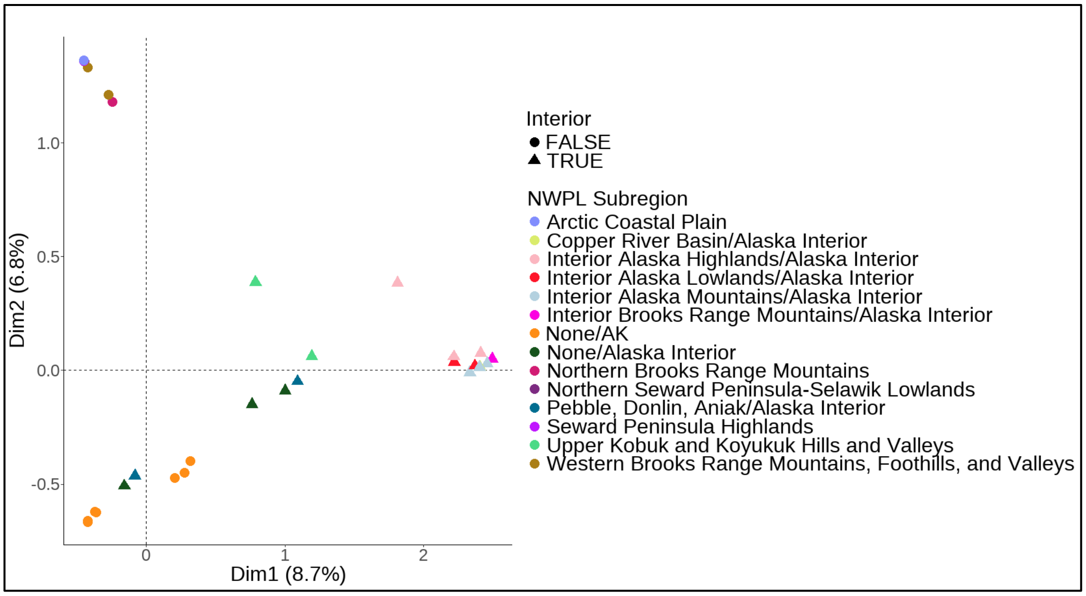


Figure F-7. Percent contribution of MCA factors to Dimension 1.

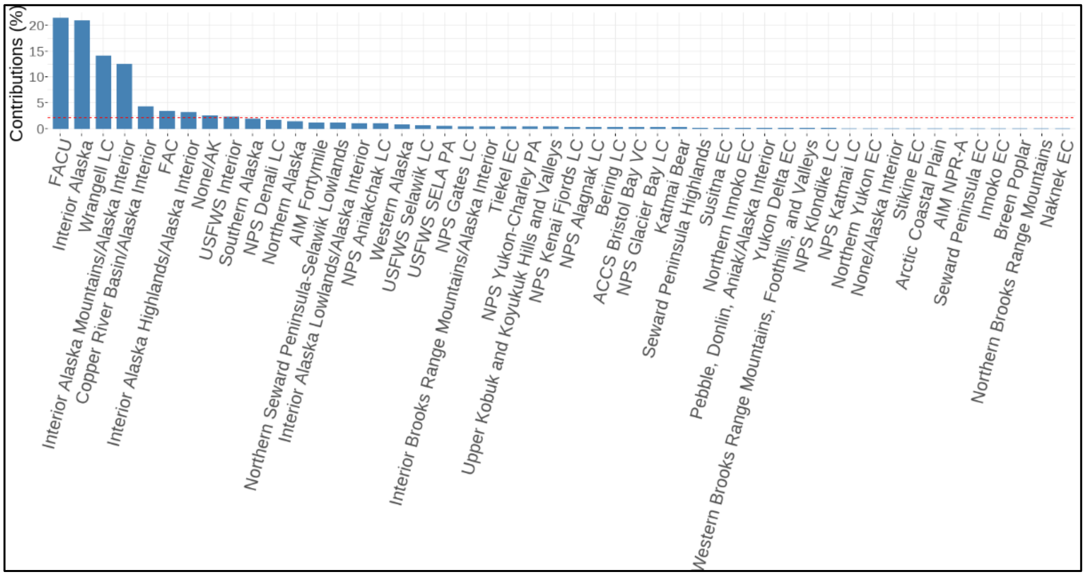
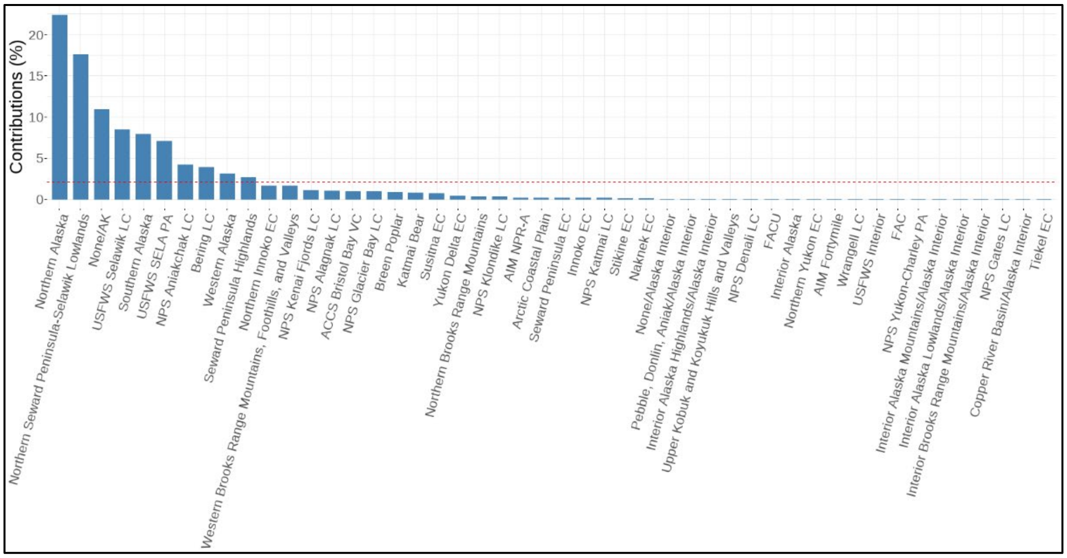


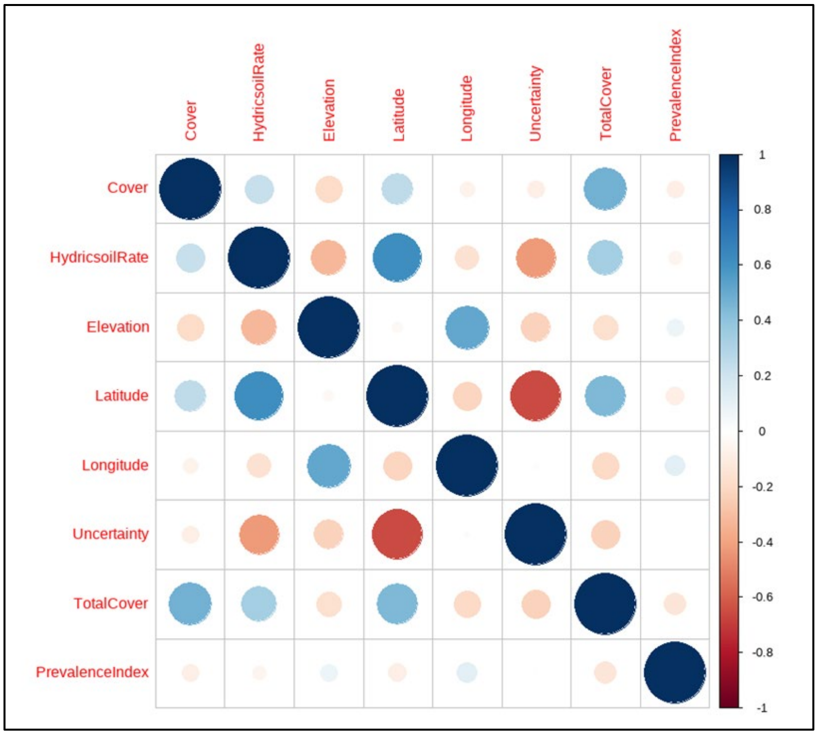
Figure F-8. Percent contribution of MCA factors to Dimension 2.



F.7 Correlation Matrices—AKVEG

The original dataset had 48 categorical and numeric variables. For correlation analysis, categorical variables and variables deemed irrelevant to the research question were excluded, yielding 8 variables (Figure F-9). Because of strong correlations with other variables, latitude, longitude, uncertainty, and TotalCover were excluded for ANOSIM, NMDS, and PCA analyses.

Figure F-9. Correlation matrix for *Rubus arcticus* AKVEG data (n = 403).



F.8 The ANOSIM Test

F.8.1 AKVEG

For the four variables tested, subregions are significantly similar with high overlap (R = 0.236, $p < 0.01$). Plots with FAC versus FACU ratings are significantly different with some overlap (R = 0.307, $p < 0.01$). Pairwise comparisons indicate that IAM, which has the highest sample size (n = 32) of the 3 subregions evaluated, is significantly different with some overlap from the state (R = 0.32, $p < 0.01$). IAM is also significantly different (NBR, AKI) or significantly highly different (ACP, WBR, NSL, SPH, and UKK) from 6 of the 7 FAC subregions (PDA is not considered here because n = 1, Table F-3). These results imply that IAM may warrant the different, FACU rating.

For IAH and CRB, pairwise comparisons indicate that the subregions are significantly similar to each other (R = 0.08, $p < 0.05$) and have high overlap with the state of Alaska (R = 0.16, p <0.05; R = 0.18, $p < 0.01$, respectively; Table F–3). These results do not support a FACU rating for IAH or CRB. However, several other comparisons do indicate that IAH and CRB are different from other subregions and warrant a unique rating. Similarity to IAM supports a FACU rating for both (IAM is significantly similar to IAH with some overlap (R = 0.28, p < 0.01) and significantly similar with high overlap to CRB (R = 0.23, p < 0.01)). Additionally, CRB is significantly different from more subregions than to which it is similar (AKI, IAL, WBR, NBR, NSL, and UKK; Table F-3). IAH is significantly different with some overlap from IAL, SPH, UKK, significantly highly different from WBR and NSL, and the remaining subregional comparisons are not statistically significant due to small sample sizes (ACP, AKI, NBR, IBR, and PDA). Increased sample size for CRB and IAH could increase the resolution for detection of differences with other subregions. Additionally, recalculating PI with a FACU value of 4 for CRB, IAH and IAM could magnify the differences between these three subregions and those in the rest of the state and Alaska. No change is recommended for IAH or CRB.

The similarity of the three Interior Alaska subregions supports the possibility of an LRR Interior Alaska subregion, however the other LRR Interior Alaska subregions included here, IAL, AKI, IBR, PDA and UKK, do not differ from the state, which counters this possibility (see dotted subregions in Table F-3). Significant differences between LRR Interior Alaska subregions also refute the need for a combined LRR subregion (e.g., AKI versus CRB and IAM versus UKK).

Table F-3. ANOSIM pairwise tests for all subregions from the AKVEG dataset (n = 403).

—	ALASKA	ACP	AKI •	IAH •	IAL •	IAM •	CRB •	WBR	NBR	IBR •	NSL	SPH	PDA •	UKK •
ALASKA	N/A	—	—	—	—	—	—	—	—	—	—	—	—	—
Arctic Coastal Plain (ACP)	0.34, 0.07	N/A	—	—	—	—	—	—	—	—	—	—	—	—
Alaska Interior (AKI) •	0, 0.41	1, 0.21	N/A	—	—	—	—	—	—	—	—	—	—	—
Interior Alaska Highlands (IAH) •	0.16*	1, 0.14	0.06, 0.30	N/A	—	—	—	—	—	—	—	—	—	—
Interior Alaska Lowlands (IAL) •	0.01, 0.48	0.11, 0.5	__0.57*__	0.48*	N/A	—	—	—	—	—	—	—	—	—
Interior Alaska Mountains (IAM) •	0.32**	__1*__	__0.70**__	0.28**	__0.62*__	N/A	—	—	—	—	—	—	—	—
Copper River Basin (CRB) •	0.18**	1, 0.1	__0.54*__	0.08*	__0.70**__	0.23**	N/A	—	—	—	—	—	—	—
Western Brooks Range (WBR)	−0.1, 1	0.28, 0.43	__0.58**__	__0.78**__	0.15, 0.24	__0.98**__	__0.87**__	N/A	—	—	—	—	—	—
Northern Brooks Range (NBR)	0.07, 0.25	1, 0.33	-0.2, 0.61	0, 0.61	0.33, 0.29	__0.54*__	__0.59*__	__0.72**__	N/A	—	—	—	—	—
Interior Brooks Range (IBR) •	−0.1, 0.67	—	−0.3, 0.62	0.1, 0.35	−0.3, 1	__0.85*__	0.64, 0.16	0.40, 0.18	1, 0.33	N/A	—	—	—	—
Northern Seward Peninsula (NSL)	0.23**	0.23, 0.23	__0.83**__	__0.89**__	__0.52*__	__0.96**__	__0.94**__	0.46**	__0.89**__	__0.78*__	N/A	—	—	—
Seward Peninsula Highlands (SPH)	−0.1, 0.93	0.62, 0.06	0.01, 0.35	0.28**	0.22, 0.09	__0.81**__	0.46**	0.21*	0.14, 0.24	−0.2, 0.63	__0.58**__	N/A	—	—
Pebble/Donlin/Aniak (PDA) •	0.12, 0.14	1, 0.25	0.24, 0.15	−0.1, 0.68	0.56, 0.2	0.41**	0.15, 0.34	__0.78**__	0.17, 0.32	0.56, 0.25	__0.92**__	0.23, 0.19	N/A	—
Upper Kobuk-Koyukuk (UKK) •	−0.1, 0.86	0.75, 0.22	0.18, 0.23	0.41*	0.06, 0.31	__0.89**__	__0.80**__	0.2, 0.11	0.29, 0.34	−0.3, 0.82	__0.67**__	0.02, 0.39	0.39, 0.07	N/A

Note: * is $p \leq 0.05$, ** is $p \leq 0.01$; for significant p, *bold* text indicates $0.5 \leq R < 0.75$ and (significantly different), *bold* and *gray* fill indicates $0.75 \leq R \leq 1$ (significantly highly different). *Yellow* indicates subregions under investigation for reassignment, *blue dots* indicate subregions that fall within the LRR Interior Alaska subregion.

F.8.2 Combined Datasets

For the four variables tested, subregions and FAC versus FACU ratings are significantly different with some overlap ($R = 0.286$, $p < 0.01$; $R = 0.347$, $p < 0.01$, respectively). Pairwise comparisons indicate IAH, CRB, and IAM are significantly different with some overlap from the state of Alaska ($R = 0.29$, $p < 0.01$, $R = 0.31$, $p < 0.01$, and $R = 0.46$, $p < 0.01$, respectively). IAH versus CRB trends toward significantly similar ($R = 0.08$, $p = 0.06$), CRB versus IAM has significantly high overlap ($R = 0.23$, $p < 0.01$), and IAH versus IAM is significantly different with some overlap ($R = 0.28$, $p < 0.05$). Comparing just these 3 subregions to each other and the state, the 3 subregions all significantly overlap with each other to some degree yet all 3 differ from Alaska, so results support a unique FACU rating for IAH, IAM, and CRB.

In comparison to subregions other than the state of Alaska, for 6 of the 7 subregions that are not under consideration for reassignment (ACP comparisons are not considered here because $n = 1$), IAM is significantly different (NBR, $R = 0.54$, $p < 0.05$; AKI, $R = 0.71$, $p < 0.01$) or highly different (WBR, $R = 0.98$, $p < 0.01$; NSL, $R = 0.96$, $p < 0.01$; SPH, $R = 0.81$, $p < 0.01$; UKK, $R = 0.89$, $p < 0.01$; Table F-4). It is different with some overlap from the 7th subregion, PDA ($R = 0.54$, $p < 0.01$). These results imply that IAM may warrant a different rating than all other regions. IAM is significantly similar to IAH with some overlap ($R = 0.28$, $p < 0.01$) and significantly similar with high overlap to CRB ($R = 0.23$, $p < 0.01$). IAM similarity to the 2 other subregions in question implies CRB and IAH could warrant a FACU rating. Increased sample size for both subregions would increase resolution for detecting differences. Additionally, recalculating PI with all three subregions assigned a value of 4 for FACU would also magnify differences.

The similarity of the three Interior Alaska subregions supported the possibility of an LRR Interior Alaska subregion, however IAL, AKI, IBR, PDA, and UKK do not differ from the state, which counters this possibility (*dotted* subregions in Table F-4). Additionally, there are significantly strong differences between LRR Interior Alaska subregions that refute the need for a combined LRR subregion (e.g., AKI versus CRB and IAM versus UKK).

Table F-4. ANOSIM pairwise tests for all subregions from the combined dataset (*n* = 761).

—	ALASKA	ACP	AKI •	IAH •	IAL •	IAM •	CRB •	WBR	NBR	IBR •	NSL	SPH	PDA •	UKK •
ALASKA	N/A	—	—	—	—	—	—	—	—	—	—	—	—	—
Arctic Coastal Plain (ACP)	0.58*	N/A	—	—	—	—	—	—	—	—	—	—	—	—
Alaska Interior (AKI) •	0.02, 0.39	0.94, 0.08	N/A	—	—	—	—	—	—	—	—	—	—	—
Interior Alaska Highlands (IAH) •	0.29**	1, 0.08	0.19*	N/A	—	—	—	—	—	—	—	—	—	—
Interior Alaska Lowlands (IAL) •	0.18, 0.19	0.11, 0.5	0.48*	0.48, 0.07	N/A	—	—	—	—	—	—	—	—	—
Interior Alaska Mountains (IAM) •	0.46**	1, 0.07	0.71**	0.28*	0.62**	N/A	—	—	—	—	—	—	—	—
Copper River Basin (CRB) •	0.31**	1, 0.12	0.39**	0.08, 0.06	0.70**	0.23**	N/A	—	—	—	—	—	—	—
Western Brooks Range (WBR)	0, 0.53	0.28, 0.28	0.44**	0.78**	0.15, 0.25	0.98**	0.87**	N/A	—	—	—	—	—	—
Northern Brooks Range (NBR)	0.17, 0.18	1, 0.33	0, 0.45	0, 0.54	0.33, 0.29	0.54*	0.59, 0.07	0.72*	N/A	—	—	—	—	—
Interior Brooks Range (IBR) •	0, 0.37	—	−0.2, 1	0.1, 0.43	−0.3, 1	0.85*	0.64, 0.19	0.40, 0.13	1, 0.33	N/A	—	—	—	—
Northern Seward Peninsula (NSL)	0.34**	0.23, 0.16	0.79**	0.89**	0.52*	0.96**	0.94**	0.46**	0.89**	0.78, 0.1	N/A	—	—	—
Seward Peninsula Highlands (SPH)	0.01, 0.34	0.62, 0.12	0.06, 0.19	0.28**	0.22, 0.06	0.81**	0.46**	0.21*	0.14, 0.18	−0.2, 0.65	0.58**	N/A	—	—
Pebble/Donlin /Aniak (PDA) •	0.14, 0.17	1, 0.21	0.07, 0.19	0, 0.38	0.5, 0.07	0.54**	0.27, 0.08	0.71**	−0.1, 0.58	−0.1, 0.59	0.91**	0.18, 0.13	N/A	—
Upper Kobuk-Koyukuk (UKK) •	0, 0.57	0.75, 0.20	0, 0.48	0.41**	0.06, 0.33	0.89**	0.80**	0.2, 0.11	0.29, 0.24	−0.3, 0.77	0.67**	0.02, 0.29	0.25, 0.18	N/A

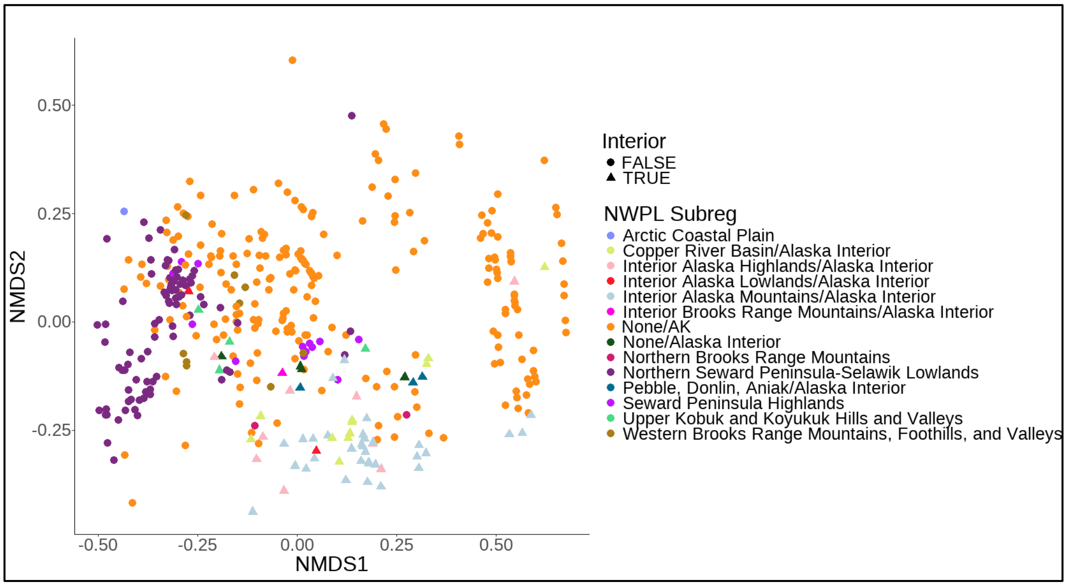
Note: * is $p \leq 0.05$, ** is $p \leq 0.01$; for significant *p*, **bold** text indicates $0.5 \leq R$ and (significantly different to highly significantly different). New results from combining datasets are indicated by *orange hatching*; when combined with *gray*, $R \geq 0.75$. *Yellow* indicates subregions under investigation for reassignment, *blue dots* indicate subregions that fall within the LRR Interior Alaska subregion.

F.9 NMDS

F.9.1 AKVEG

IAH, IAL, and CRB form clusters that overlap somewhat with the other subregions, but they are centered together and appear most similar to each other. This interpretation is supported by the stress test results below 0.15, which indicate the NMDS provides a good representation of the data. (Figure F-10).

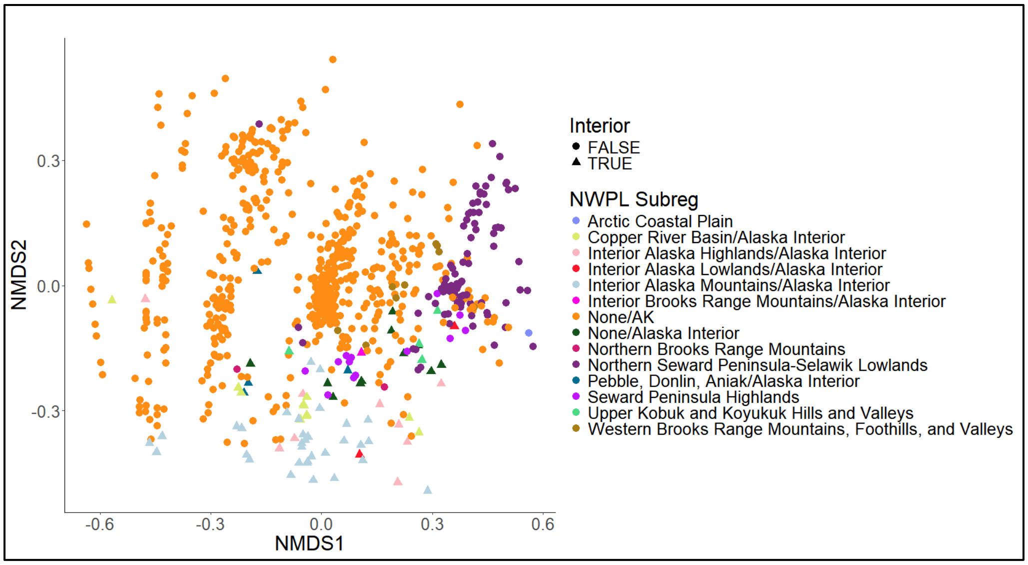
Figure F-10. NMDS of *R. arcticus* AKVEG data (*n* = 403). Stress = 0.1244075.



F.9.2 Combined Datasets

IAL, IAM, and CRB cluster together with each other and are separate from the other subregions along Dimension 2 and are centered on Dimension 1, although CRB and IAH each have an outlier on the left side of that Dimension (Figure F-11). Points from None/AK form a cloud spread throughout the plot. The stress test results are below 0.15, which indicate the NMDS provides a good representation of the data and support a FACU rating for the IAL, IAM, and CRB.

Figure F-11. NMDS of *R. arcticus* from combined AKVEG/NRCS data (*n* = 761). Stress = 0.1367001.



F.10 PCA

F.10.1 AKVEG

IAM clusters in the left upper corner, and less so IAH and CRB, but all three overlap with FAC subregions (Figure F-12). Dimension 1 is strongly influenced by Elevation and Hydric soil rating which are negatively correlated, while PI influences Dimension 2, so these variables contribute to the difference between IAM, IAH, and CRB (Figure F-13). Results do not support a unique rating for the three subregions.

Figure F-12. PCA plot of *Rubus arcticus* AKVEG dataset (*n* = 403).

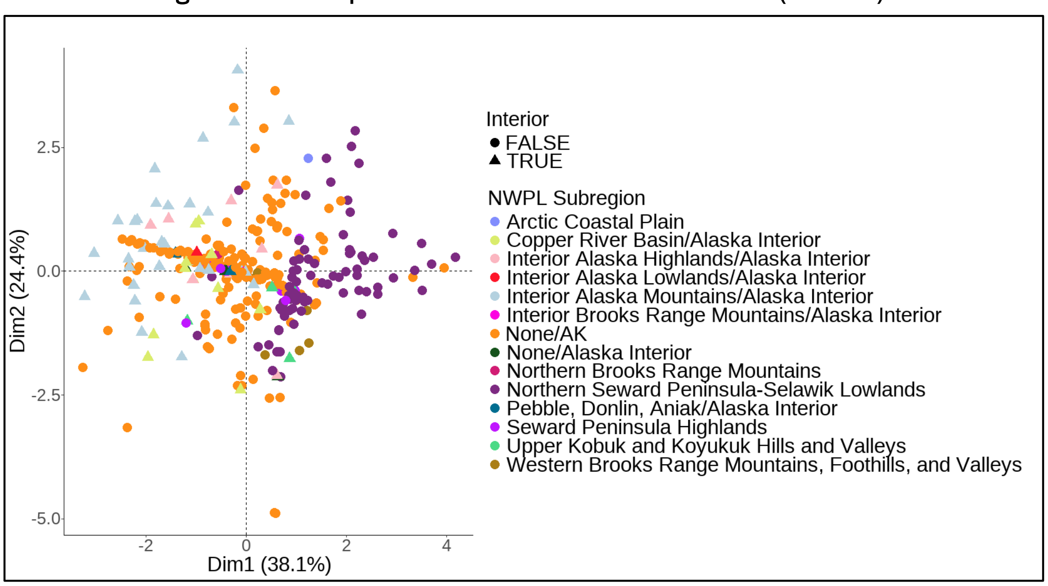
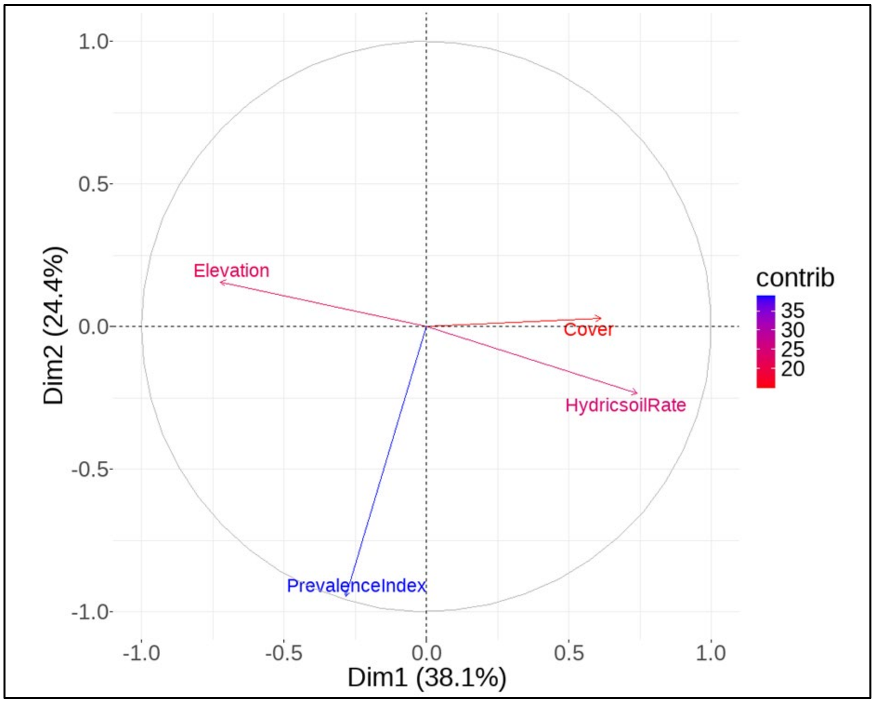


Figure F-13. PCA loading plot of AKVEG data.



F.10.2 Combined Datasets

IAH, IAM, and CRB do not cluster separately from the rest of the subregions when plotted on Dimensions 1 and 2, suggesting that for the environmental variables considered, plots within these three subregions are similar to plots from other subregions (Figure 12). NSL and IAM are the most distant plots along a gradient of Elevation, Hydric Soil Rating, and Cover. Dimension 1 represents 33.7% of the variance and is influenced predominately by Elevation, which is negatively correlated with Hydric Soil Rating and Cover along Dimension 1. (Figure F-14). Dimension 2 explains 24.3% of the data variance and is dominated by PI (Figure F-15). Results do not support a unique rating for IAH, IAM, or CRB.

Figure F-14. PCA plot of *R. arcticus* combined AKVEG/NRCS dataset (*n* = 761).

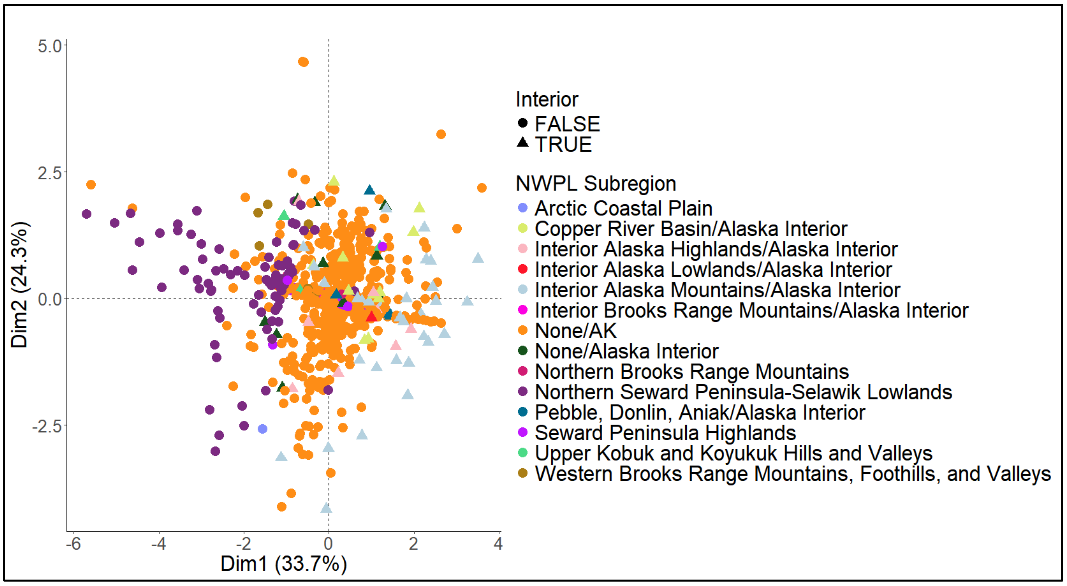
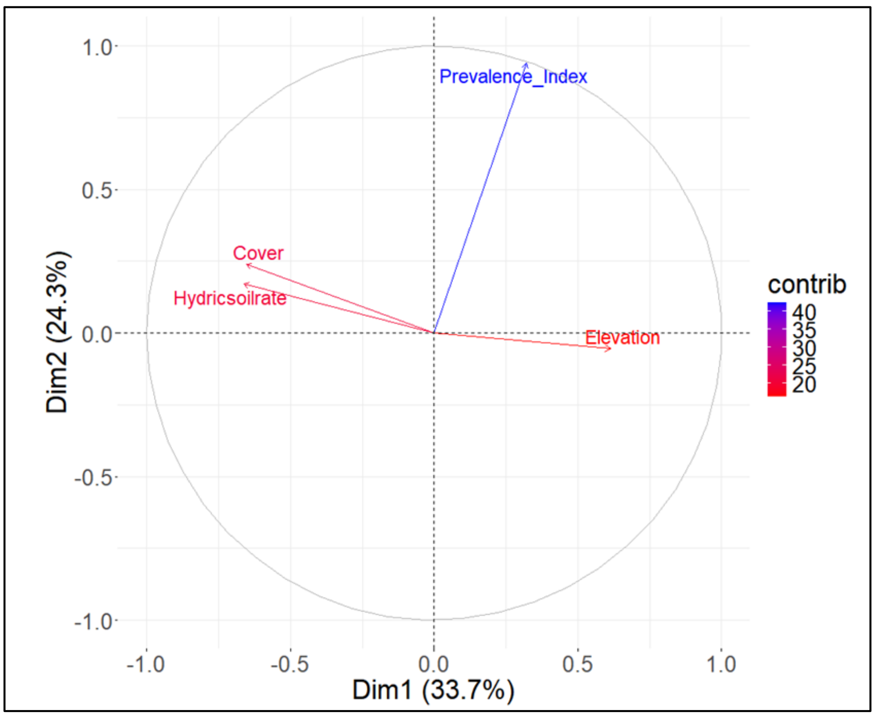


Figure F-15. PCA loading plot of combined AKVEG/NRCS data.



Appendix G: *Salix arctica*

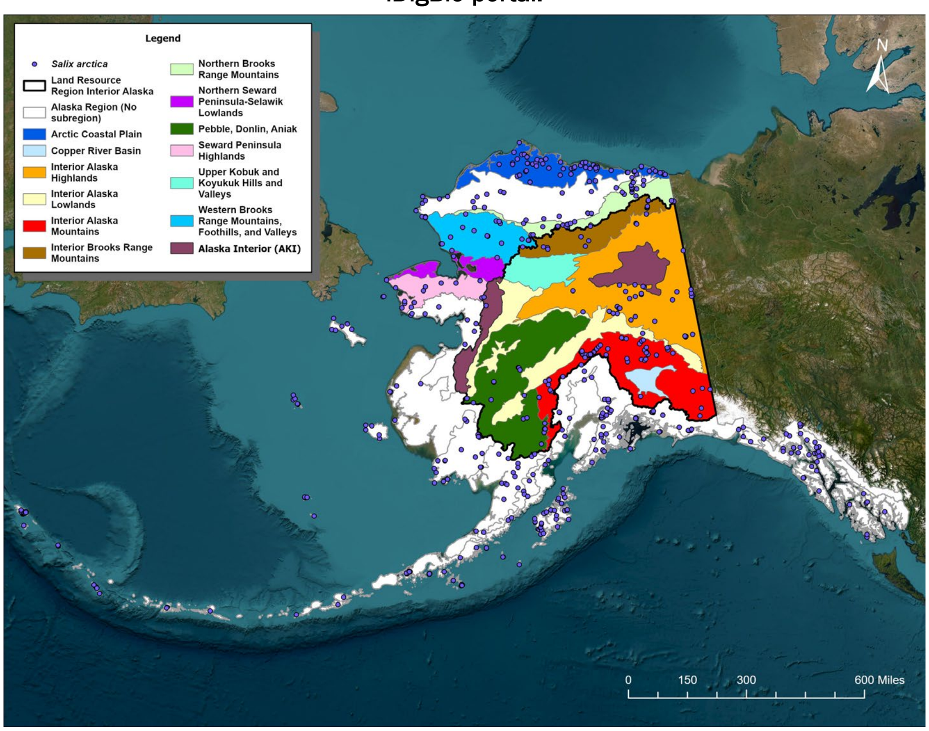
On the NWPL, *Salix arctica* has a wetland indicator status rating of FACU for the state of Alaska, and FAC for 4 subregions; ACP, WBR, Northern Seward Peninsula (NSL), and Seward Peninsula Highlands (SPH). Unfortunately, the AKVEG dataset was small for NSL (n = 1), but moderate for WBR (n = 18), SPH (n = 24), and ACP (n = 24). The NRCS data contained only 8 observations, all from None/AK. This appendix evaluates the results of multiple analyses to determine whether WBR, SPH, or ACP should be reclassified to match the state-wide rating of FACU. NSL cannot be analyzed for lack of data but is included in analyses.

The data from the AKVEG was analyzed independently, then combined with the NRCS dataset for analysis. The variables and number of plots varied between datasets; sample size by subregion and dataset is reported in Section G.3.

G.1 Herbaria Specimens Data

Six hundred and sixty-one specimens contained locality data; 147 of these were collected in LRR Interior Alaska (Figure G-1).

Figure G-1. *Salix arctica* specimens with known locality information from the iDigBio portal.

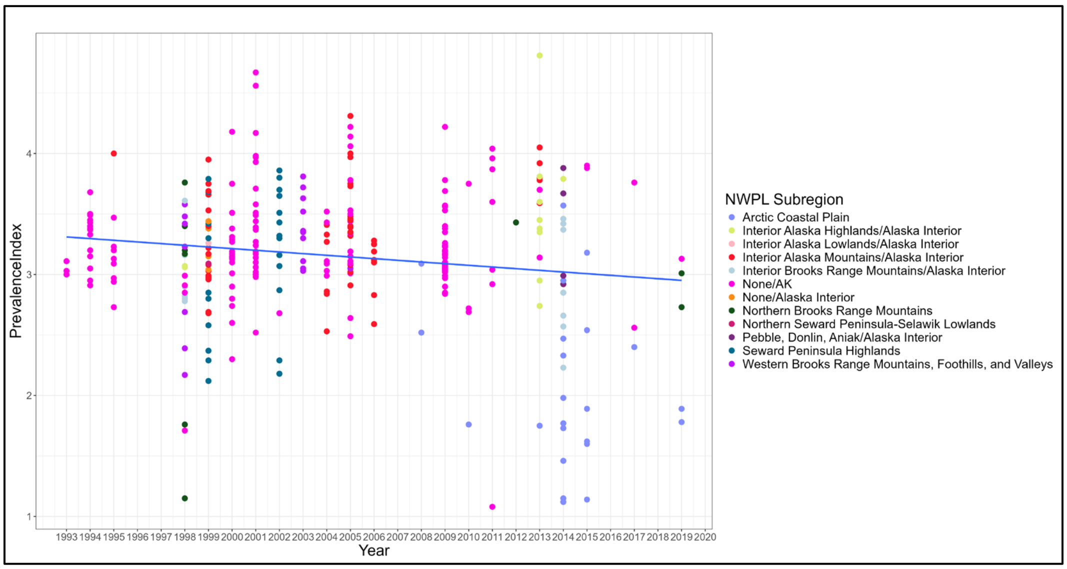


G.2 PI over Time by Alaska Subregion

G.2.1 AKVEG

PI shows a decrease from 1993 to 2019. The trend line begins above a value of 3 then crosses below 3, implying that the wetland status of the plots' hydrophytic vegetation factor for wetland delineation (hydrophytic, ≤3, versus nonhydrophytic, >3) has changed from nonhydrophytic to hydrophytic, or the plots are becoming wetter over time (Figure G-1 and Figure G-2). It is also possible that other factors are driving the change, such as research interests changing over time to a greater interest in wetter areas.

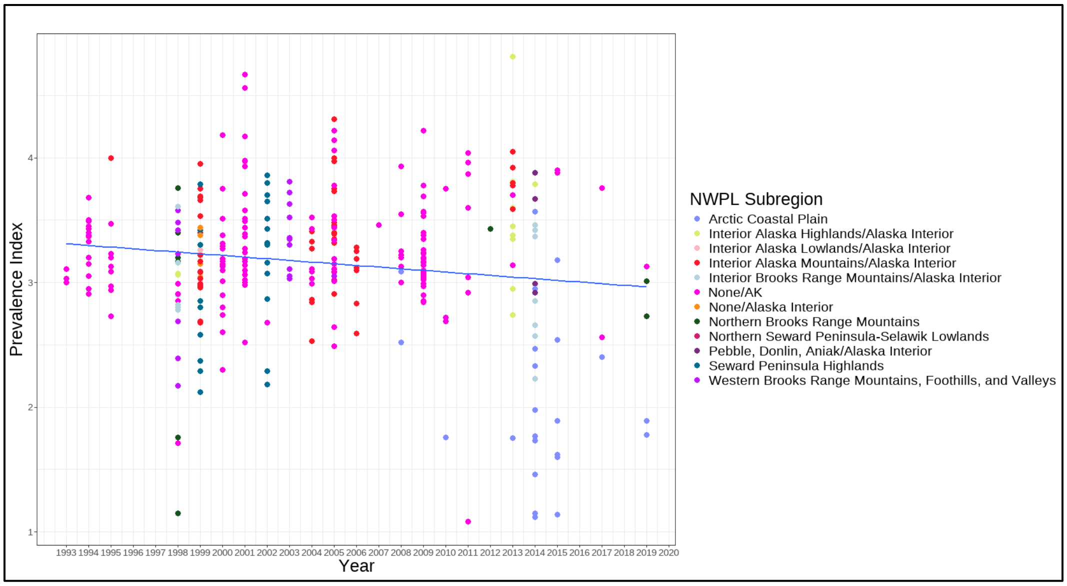
Figure G-2. Change in PI over time by NWPL wetland indicator status rating for plots containing *S. arctica* from AKVEG data (n = 335).



G.2.2 Combined Datasets

Results are the same as above (Figure G-3).

Figure G-3. Change in PI over time by NWPL wetland indicator status rating for plots containing *Salix arctica* from combined AKVEG and NRCS data (n = 343).



G.3 PI by Wetland Status Indicator Rating and Subregion

G.3.1 AKVEG

PI is above 3 for ACP, WBR, and SPH, which mirrors the distribution of FACU subregions, with mean PI values above and below 3, mirroring the subregions from the rest of the state (Figure G-4; Table G-1). However, a value near 3 indicates that all plots are weighted by FAC. These results support a FAC rating for ACP, WBR, and SPH. Recalculating PI values with ACP, WBR, and SPH assigned a FAC rating of 3 rather than a FACU rating of 4 could decrease the means and further support maintaining a FAC rating (Figure G-4; Table G-1).

Figure G-4. Bar chart comparing the mean PI for each subregion by wetland status indicator rating (AKVEG, *n* = 335).

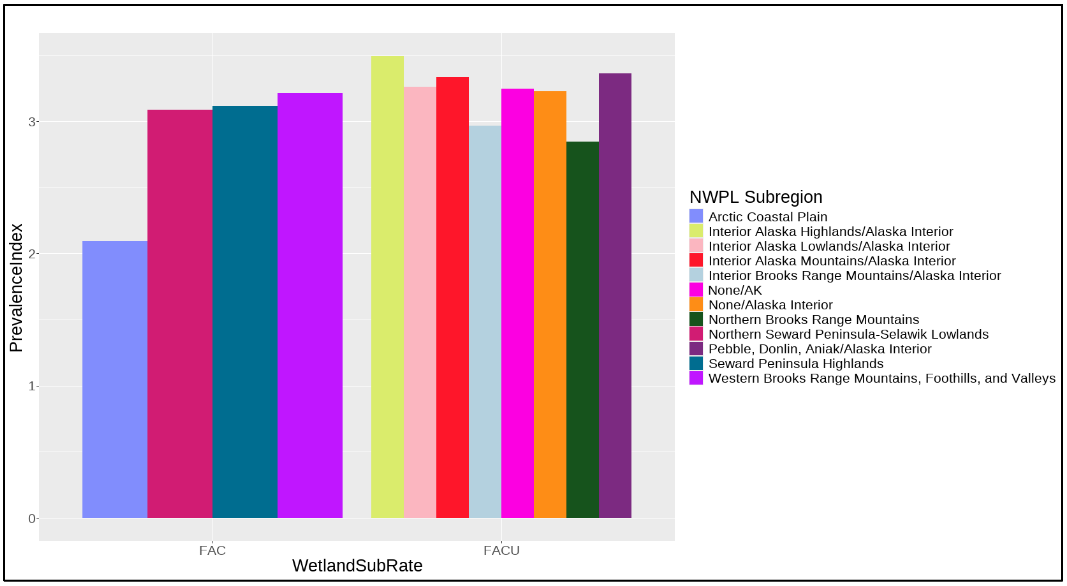


Table G-1. Sample size, mean, and standard deviation of PI for the 13 NWPL subregions and the rest of the state of Alaska (None/AK) for plots from the AKVEG dataset.

NWPL Subregion	Number of Observations	Average PI Value	Standard Deviation of PI Values
Arctic Coastal Plain (ACP)	24	2.09	0.67
Interior Alaska Highlands (IAH)/Alaska Interior (LRR)	12	3.23	1.10
Interior Alaska Lowlands (IAL)/Alaska Interior (LRR)	1	3.26	N/A
Interior Alaska Mountains (IAM)/Alaska Interior (LRR)	56	3.33	0.41
Interior Brooks Range Mountains (IBR)/Alaska Interior (LRR)	16	2.97	0.42
None/AK	164	3.24	0.46
None/Alaska Interior (AKI in LRR)	6	3.23	0.19
Northern Brooks Range Mountains (NBR)	9	2.85	0.85
Northern Seward Peninsula-Selawik Lowlands (NSL)	1	3.09	N/A
Pebble, Donlin, Aniak (PDA)/Alaska Interior (LRR)	4	3.37	0.48
Seward Peninsula Highlands (SPH)	24	3.12	0.56
Western Brooks Range Mountains, Foothills, and Valleys (WBR)	18	3.22	0.44

G.3.2 Combined Datasets

Results are the same as above in Section G.3.1 (Figure G-5, Table G-2).

Figure G-5. Bar chart comparing the mean PI for each subregion by wetland status indicator rating (combined datasets, n = 343).

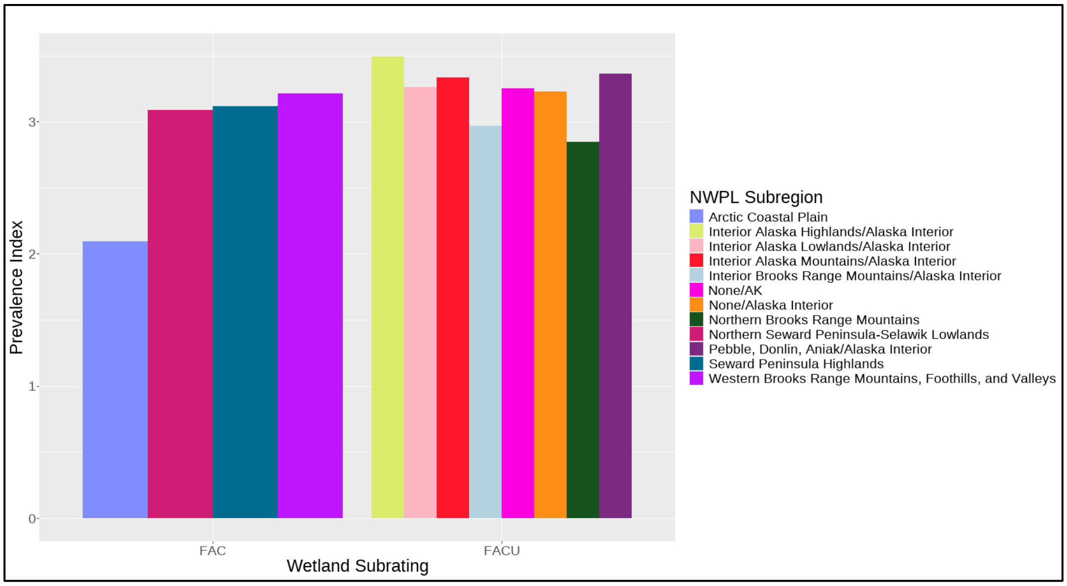


Table G-2. Sample size, mean, and standard deviation of PI for the 13 NWPL subregions and the rest of the state of Alaska (None/AK) for plots from the combined AKVEG/NRCS dataset.

NWPL Subregion	Number of Observations	Average PI Value	Standard Deviation of PI Values
Arctic Coastal Plain (ACP)	24	2.09	0.67
Interior Alaska Highlands (IAH)/Alaska Interior (LRR)	12	3.23	1.10
Interior Alaska Lowlands (IAL)/Alaska Interior (LRR)	1	3.26	N/A
Interior Alaska Mountains (IAM)/Alaska Interior (LRR)	56	3.33	0.41
Interior Brooks Range Mountains (IBR)/Alaska Interior (LRR)	16	2.97	0.42
None/AK	172	3.25	0.45
None/Alaska Interior (AKI in LRR)	6	3.23	0.19
Northern Brooks Range Mountains (NBR)	9	2.85	0.85
Northern Seward Peninsula-Selawik Lowlands (NSL)	1	3.09	N/A
Pebble, Donlin, Aniak (PDA)/Alaska Interior (LRR)	4	3.37	0.48
Seward Peninsula Highlands (SPH)	24	3.12	0.56
Western Brooks Range Mountains, Foothills, and Valleys (WBR)	18	3.22	0.44

G.4 Importance of *S. arctica* for PI Calculation

Omission of *S. arctica* from PI calculations in the AKVEG dataset did not result in the loss of hydrophytic vegetation indicator status for any plots; however, 23 plots gained the criterion. Eleven of these plots were in the Alaska region (no designated subregion) and the remainder ranged from 1 to 3 plots in 6 subregions. The largest change in score was −0.74. and +0.56. The average and median change in PI score was relatively small at −0.05 and −0.03, respectively. Average total cover reported in the AKVEG dataset was 3%. These results suggest that *S. arctica* was infrequently an important component of hydrophytic plant communities that were sampled in the Alaska region. The species was a minor component in most of the plot data and did not contribute significantly to plot PI scores.

G.5 Data Preparation for Quantitative Analyses

G.5.1 AKVEG

The original data from AKVEG contained 50 variables (not including cospecies data) with 349 observations. Twenty-one variables had zeros transformed to N/A values; Strata, Physiography, Geomorphology, Macrotopography, Microtopography, Microrelief, Drainage, Moisture, Restrictive Layer, Disturbance, Depth Water, Depth Moss Duff, Depth Restrictive Layer, Soil pH 10, Conductivity 10, Temperature 10, Soil pH 30, Conductivity 30, Temperature 30, Water pH, and Water Conductivity. Four variables were removed due to having no values: Soil Class, Water Temperature, Water Conductivity, and Temperature 30. One variable was added: Interior—true or false value. Of the 47 variables, 18 were numeric; of these 18 variables, 8 met the less than 60% missing values cut-off threshold criteria. Thirteen observations were excluded due to having no PI or outlier hydric soil rating values of −9999. The remaining 335 observations and 8 variables were used for the correlation analysis, which informed selection of 4 variables for the ANOSIM, NMDS, and PCA analyses.

G.5.2 NRCS

The original data from NRCS contained 117 variables with 8 observations. After deleting duplicate variables, 96 variables remain. Other analyses were not completed due to a lack of data points.

G.5.3 Combined AKVEG/NRCS Dataset

The AKVEG and NRCS datasets share 17 variables in common, of which 6 variables are numeric. The combined dataset has 343 observations. Four variables; Cover, Elevation, Hydric soil rating, and PI, were determined to be appropriate for ANOSIM, NMDS, and PCA and correlation analysis was skipped due to the small number of variables.

G.6 MCA on AKVEG Dataset

Neither dimension strongly explains the variance in the data nor is strongly influenced by Project, indicating there is no Project effect within the data (Figures G-6, G-7, and G-8).

Figure G-6. MCA plot of AKVEG data by NWPL subregion and Interior (*triangles*) versus the rest of Alaska (*dots*; *n* = 335). Each symbol represents the centroid of multiple observations.

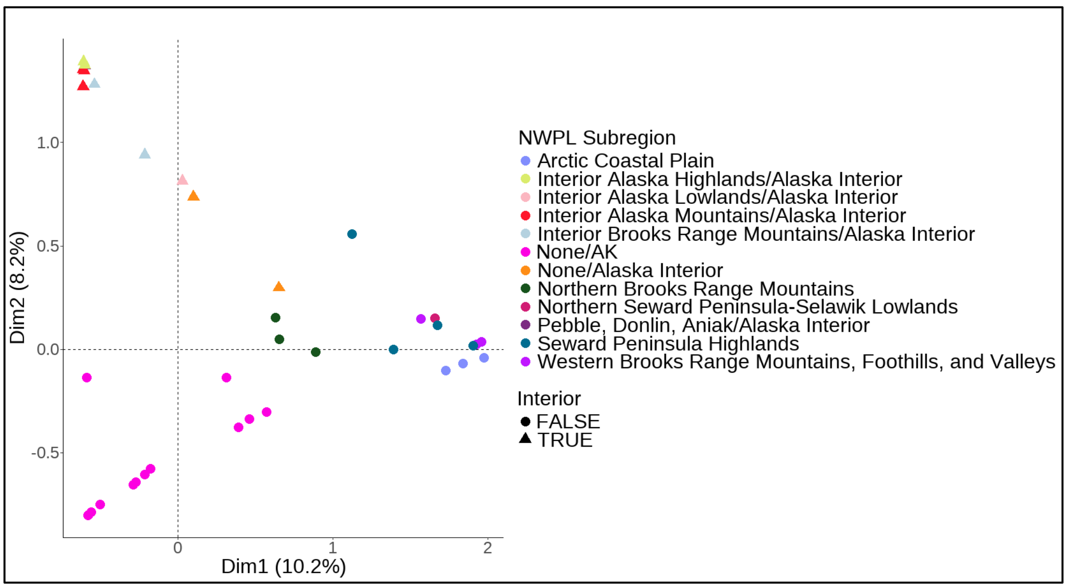


Figure G-7. Percent contribution of MCA factors to Dimension 1 for AKVEG data.

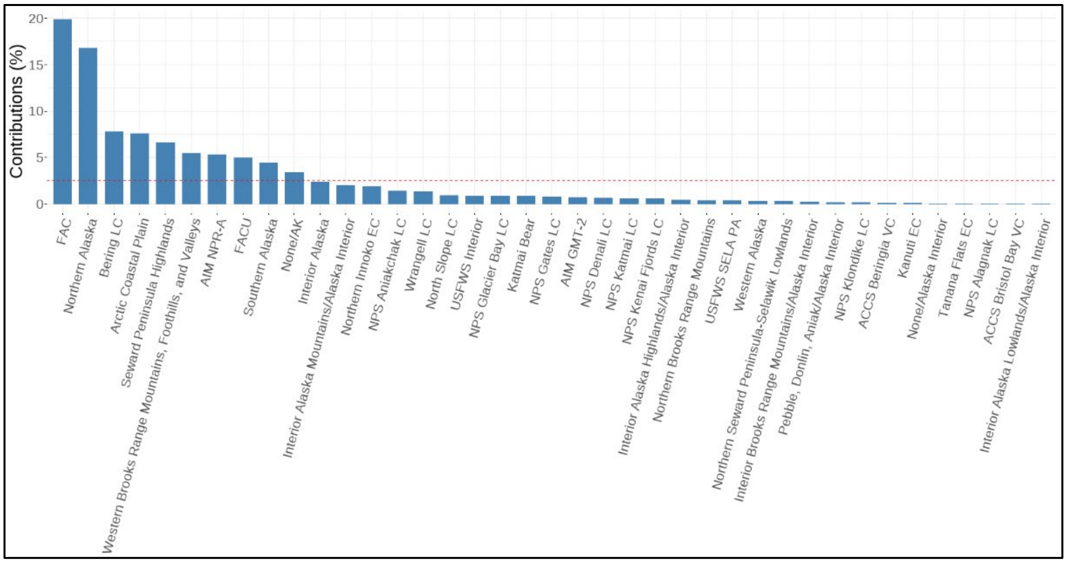
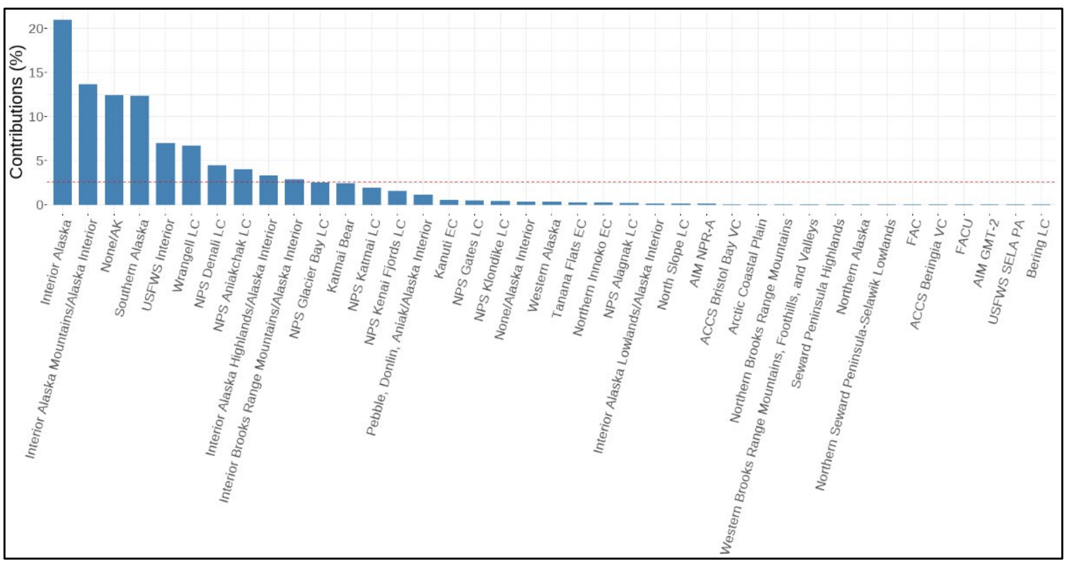


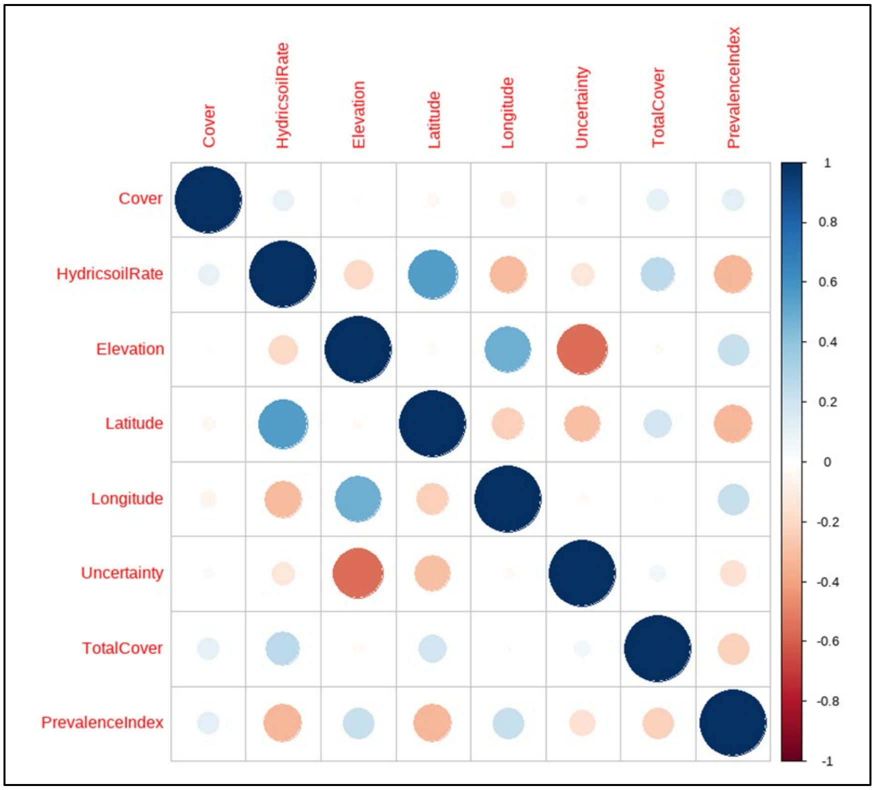
Figure G-8. Percent contribution of MCA factors to Dimension 2 for AKVEG data.



G.7 Correlation Matrices on AKVEG

The 335 observations and 8 variables used for the correlation analysis informed selection of 4 variables for PCA and NMDS analyses (Figure G-9). Because of strong correlations with other variables, latitude, longitude, uncertainty, and TotalCover were excluded for PCA and NMDS ordination.

Figure G-9. Correlation matrix for *Salix arctica* AKVEG data (n = 335).



G.8 The ANOSIM Test

G.8.1 AKVEG

For the four variables tested, the subregions and FAC versus FACU ratings are significantly different with some overlap (R = 0.282, p < 0.01, R = 0.345, p < 0.01, respectively). Pairwise comparisons indicate that ACP is the only subregion in question that is highly different from the state (R = 0.82, p < 0.01). All other subregions are similar to the state except WBR, which is trending toward similar with high overlap (Table G-3). ACP is significantly highly different from AKI, IAH, IAM, NBR, IBR, SPH, and PDA (Table G-3). It is trending toward significantly highly different from IAL and NSL and is significantly different from WBR. SPH and WBR are different with some overlap (R = 0.33, p < 0.01), and SPH is significantly highly different from IAM, NBR, IBR (Table G-3). WBR is also significantly highly different from IAM. Pairwise comparisons indicate that SPH and WBR, while different with some subregions, do not warrant a rating separate from the state but ACP does.

Table G-3. ANOSIM pairwise tests for all subregions from the AKVEG dataset (n = 335).

—	ALASKA	ACP	AKI •	IAH •	IAL •	IAM •	CRB •	WBR	NBR	IBR •	NSL	SPH	PDA •	UKK •
ALASKA	N/A	—	—	—	—	—	—	—	—	—	—	—	—	—
Arctic Coastal Plain (ACP)	0.82**	N/A	—	—	—	—	—	—	—	—	—	—	—	—
Alaska Interior (AKI) •	−0.2, 0.98	0.96**	N/A	—	—	—	—	—	—	—	—	—	—	—
Interior Alaska Highlands (IAH) •	−0.1, 0.84	0.95**	0.19*	N/A	—	—	—	—	—	—	—	—	—	—
Interior Alaska Lowlands (IAL) •	−0.1, 0.48	0.85, 0.06	0, 0.63	0.41, 0.24	N/A	—	—	—	—	—	—	—	—	—
Interior Alaska Mountains (IAM) •	0.35**	1**	0.94**	0.69**	0.98*	N/A	—	—	—	—	—	—	—	—
Copper River Basin (CRB) •	—	—	—	—	—	—	N/A	—	—	—	—	—	—	—
Western Brooks Range (WBR)	0.12, 0.09	0.72**	−0.1, 0.78	0.07, 0.12	−0.2, 1	0.84**	—	N/A	—	—	—	—	—	—
Northern Brooks Range (NBR)	0.07, 0.24	0.99**	0.96**	0.23*	1, 0.11	0.36**	—	0.21*	N/A	—	—	—	—	—
Interior Brooks Range (IBR) •	0, 0.66	0.99**	0.88**	0.31**	0.99, 0.09	0.56**	—	0.37**	0.37**	N/A	—	—	—	—
Northern Seward Peninsula (NSL)	−0.2, 0.91	0.97, 0.07	−0.4, 1	−0.1, 0.43		0.92*	—	−0.2, 0.97	1, 0.12	0.89, 0.06	N/A	—	—	—
Seward Peninsula Highlands (SPH)	−0.1, 0.95	0.92**	0.08, 0.2	0.55**	−0.2, 0.71	0.97**	—	0.33**	0.90**	0.87**	0.07, 0.33	N/A	—	—
Pebble/Donlin/Aniak (PDA) •	−0.2, 1	0.98**	0.07, 0.16	−0.1, 0.62	1, 0.2	0.90**	—	−0.1, 0.82	0.97*	0.80*	0.25, 0.38	0.32*	N/A	—
Upper Kobuk-Koyukuk (UKK) •	—	—	—	—	—	—	—	—	—	—	—	—	—	N/A

Note: * is $p \le 0.05$, ** is $p \le 0.01$; for significant p, *bold* text indicates $0.5 \le R < 0.75$ and (significantly different), *bold* and *gray* fill indicates $0.75 \le R \le 1$ (significantly highly different). *Yellow* indicates subregions under investigation for reassignment, *blue dots* indicate subregions that fall within the LRR Interior Alaska subregion.

G.8.2 Combined Datasets

The addition of 8 points from the NRCS dataset does not impact the interpretation of results. The subregions and FAC versus FACU ratings are significantly different with some overlap ($R = 0.286$, $p < 0.01$; $R = 0.343$, $p < 0.01$, respectively). Pairwise comparisons indicate that ACP is the only subregion in question that is highly different from the state ($R = 0.83$, $p < 0.01$). All other subregions are similar to the state except WBR (Table G-4). Results indicate that SPH and WBR do not warrant a rating separate from the state but ACP does.

Table G-4. ANOSIM pairwise tests for all subregions from the combined dataset (n = 343).

—	ALASKA	ACP	AKI •	IAH •	IAL •	IAM •	CRB •	WBR	NBR	IBR •	NSL	SPH	PDA •	UKK •
ALASKA	N/A	—	—	—	—	—	—	—	—	—	—	—	—	—
Arctic Coastal Plain (ACP)	**0.83****	N/A	—	—	—	—	—	—	—	—	—	—	—	—
Alaska Interior (AKI) •	−0.2, 0.95	**0.96****	N/A	—	—	—	—	—	—	—	—	—	—	—
Interior Alaska Highlands (IAH) •	−0.1, 0.72	**0.95****	0.19, 0.11	N/A	—	—	—	—	—	—	—	—	—	—
Interior Alaska Lowlands (IAL) •	−0.1, 0.5	**0.85***	0, 0.59	0.41, 0.22	N/A	—	—	—	—	—	—	—	—	—
Interior Alaska Mountains (IAM) •	0.36**	**1****	**0.94****	**0.69****	**0.98***	N/A	—	—	—	—	—	—	—	—
Copper River Basin (CRB) •	—	—	—	—	—	—	N/A	—	—	—	—	—	—	—
Western Brooks Range (WBR)	0.13, 0.07	**0.72****	−0.1, 0.81	0.07, 0.16	−0.2, 1	**0.84****	—	N/A	—	—	—	—	—	—
Northern Brooks Range (NBR)	0.09, 0.2	**0.99****	**0.96****	0.23*	1, 0.14	0.36**	—	0.21**	N/A	—	—	—	—	—
Interior Brooks Range (IBR) •	0, 0.58	**0.99****	**0.88****	0.31**	0.99, 0.11	**0.56****	—	0.37**	0.37**	N/A	—	—	—	—
Northern Seward Peninsula (NSL)	−0.2, 0.94	0.97**	−0.4, 1	−0.1, 0.4	—	0.92**	—	−0.2, 0.93	1, 0.13	0.89, 0.08	N/A	—	—	—
Seward Peninsula Highlands (SPH)	−0.1, 0.89	**0.92****	0.08, 0.25	**0.55****	−0.2, 0.69	**0.97****	—	0.33**	**0.90****	**0.87****	0.07, 0.34	N/A	—	—
Pebble/Donlin/Aniak (PDA) •	−0.2, 1	**0.98****	0.07, 0.26	−0.1, 0.59	1, 0.22	**0.90****	—	−0.1, 0.77	**0.97****	**0.80****	0.25, 0.34	0.32*	N/A	—
Upper Kobuk-Koyukuk (UKK) •	—	—	—	—	—	—	—	—	—	—	—	—	—	N/A

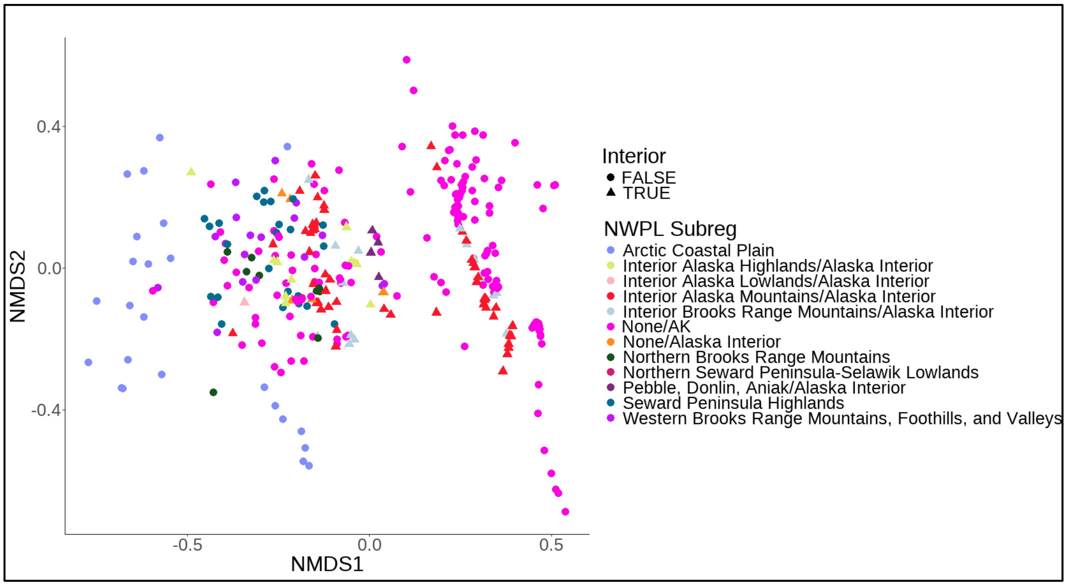
Note: * is $p \leq 0.05$, ** is $p \leq 0.01$; for significant p, **bold** text indicates $0.5 \leq R$ and (significantly different to highly significantly different). New results from combining datasets are indicated by *orange hatching*; when combined with *gray*, $R \geq 0.75$. *Yellow* indicates subregions under investigation for reassignment, *blue dots* indicate subregions that fall within the LRR Interior Alaska subregion.

G.9 NMDS

G.9.1 AKVEG

ACP does not overlap with IAM, IAH, IBR, NBR, PDA, nor None/Alaska Interior along Dimension 1 (Figure G-10). However, there is no clustering along Dimension 2 that differentiates ACP, WBR, or SPH. Results indicate that ACP clusters differently with some overlap from the other subregions and the state. This interpretation is supported by the stress test results below 0.15, which indicate the NMDS provides a good representation of the data.

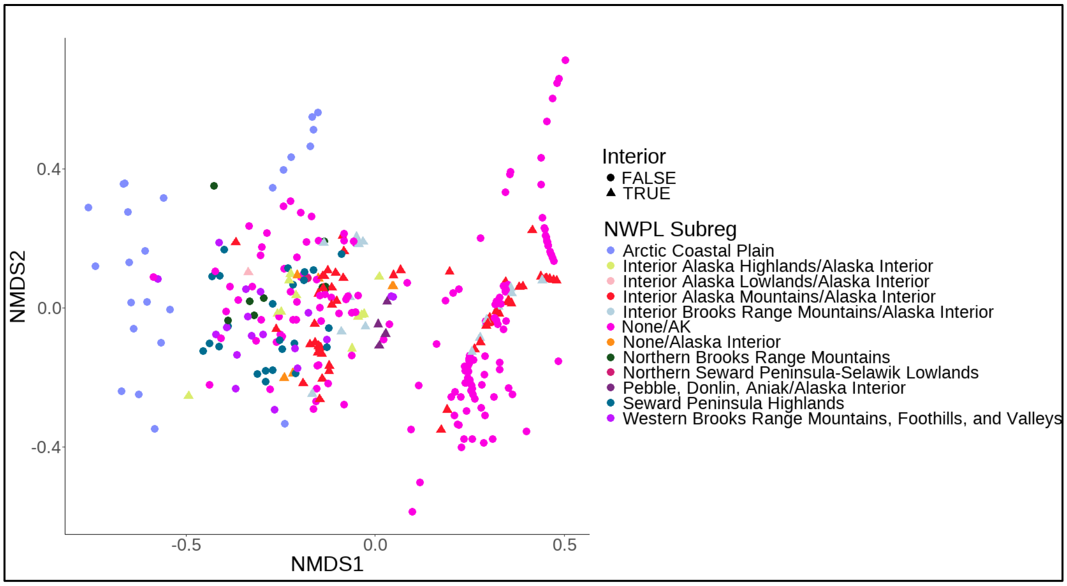
Figure G-10. NMDS of *S. arctica* AKVEG data (*n* = 335). Stress = 0.1395425.



G.9.2 Combined Datasets

Results are similar to the AKVEG dataset, although the stress test is slightly higher but still within the range that indicates the NMDS provides a good representation of the data (Figure G-11).

Figure G-11. NMDS of *S. arctica* from combined AKVEG/NRCS data (*n* = 343). Stress = 0.1402243.



G.10 PCA

G.10.1 AKVEG

There is no clear clustering of ACP, WBR, or SPH that separates the 3 subregions from the rest of the state (Figure G-12). Dimensions 1 and 2 are strongly influenced by Soil_pH_10 and Soil_pH_30, which are positively correlated (Figure G-13). Results do not support multiple ratings for the state.

Figure G-12. PCA plot of *S. arctica* AKVEG dataset (*n* = 335).

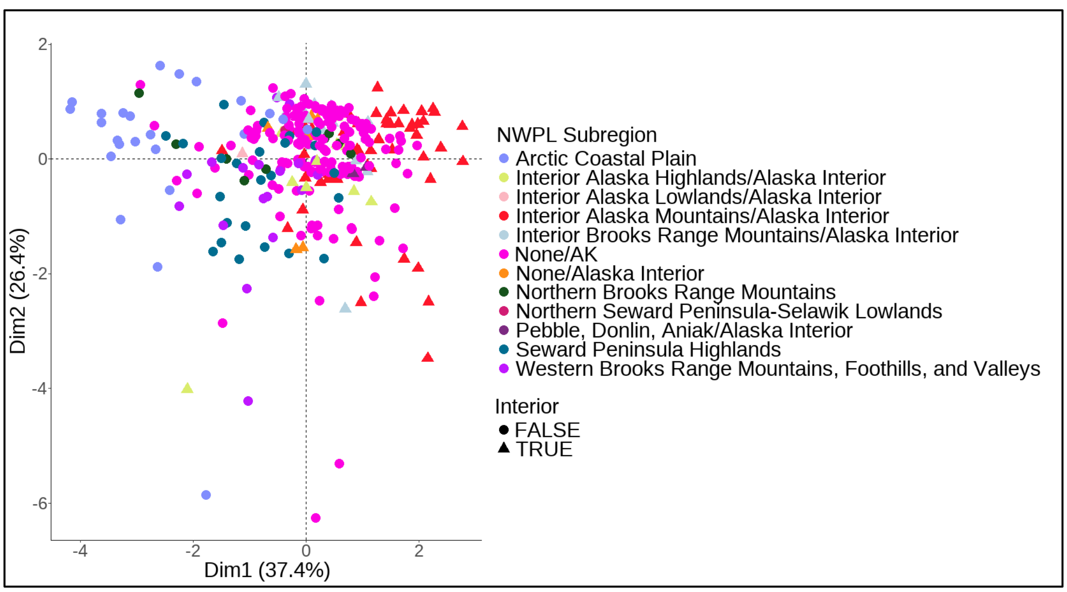
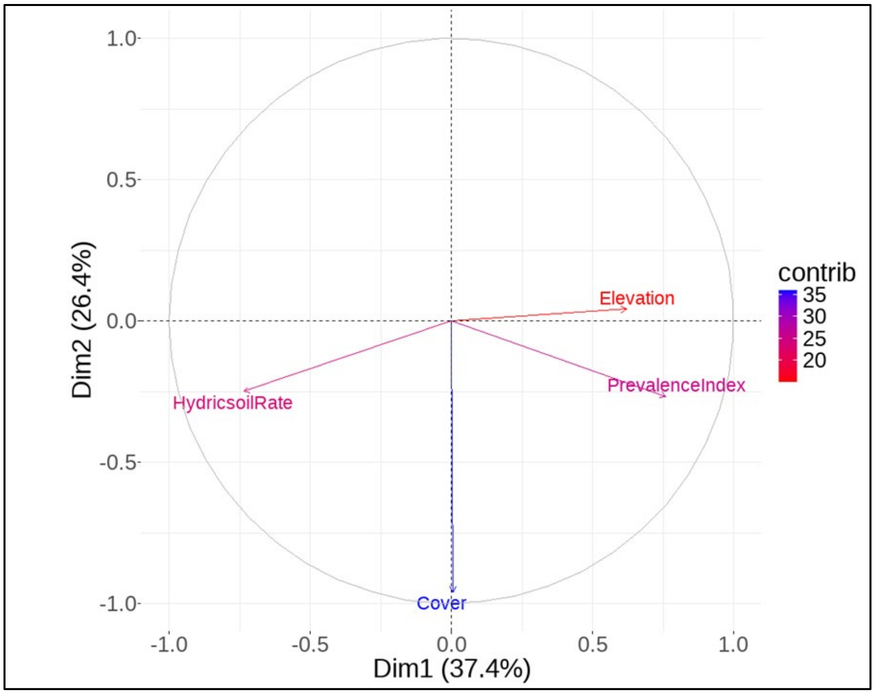


Figure G-13. PCA loading plot of AKVEG data.



G.10.2 Combined Datasets

Neither ACP, SPH, nor WBR cluster separately from the rest of the subregions when plotted on along Dimensions 1 and 2, suggesting that for the environmental variables considered, plots within these subregions are similar to plots from other subregions (Figure G-14). Dimension 1 represents 37.4% of the variance and is influenced predominately by Hydric soil rating and PI, which are negatively correlated (Figure G-15). Dimension 2 explains 26.5% of the data variance and is dominated by Cover (Figure G-15). Results do not support multiple ratings for the state.

Figure G-14. PCA plot of *S. arctica* combined AKVEG/NRCS dataset (*n* = 343).

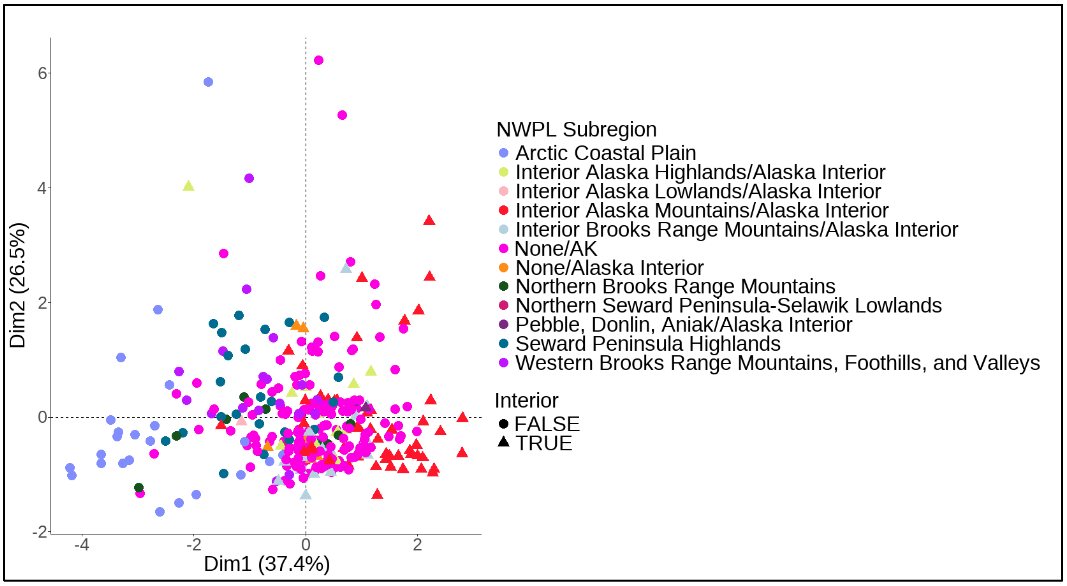
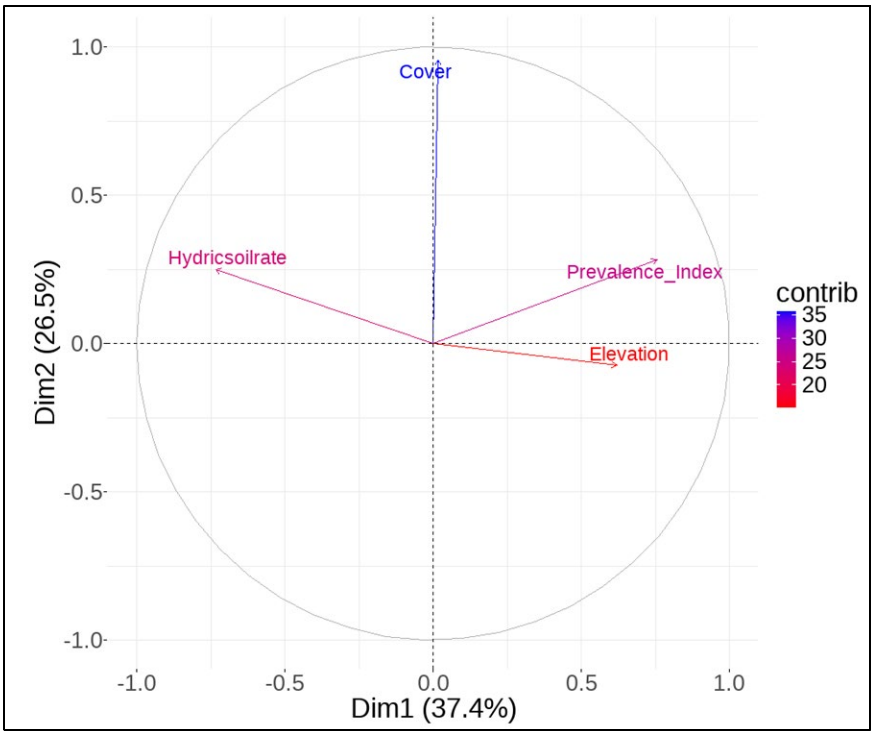


Figure G-15. PCA loading plot of combined AKVEG/NRCS data.



Appendix H: *Viola palustris*

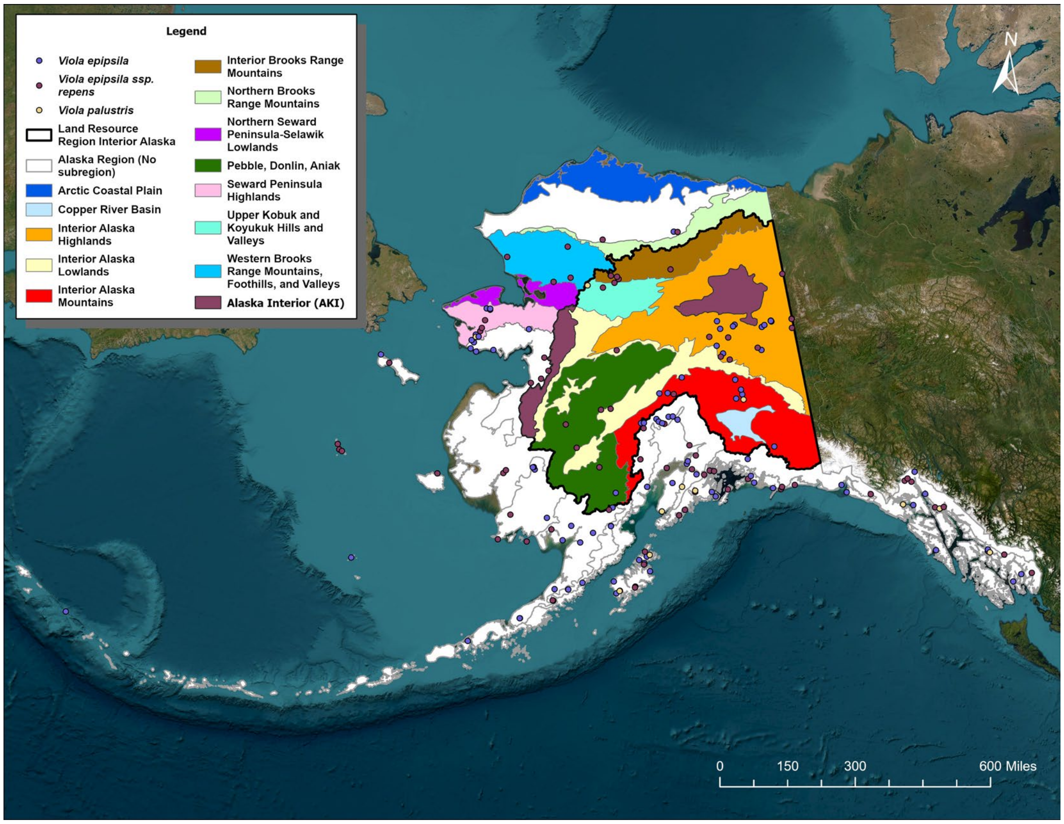
On the NWPL, *Viola palustris* has a wetland indicator status rating of FACW for the state of Alaska, and FAC for 7 subregions; Alaska Interior (referred to as None/Interior Alaska to differentiate from LRR Interior Alaska), IAH, IAL, IAM, CRB, IBR, and PDA. Unfortunately, the AKVEG dataset as whole was small (n = 70 total) and small for CRB (n = 5), IAH (n = 4), and IAM (n = 2). AKVEG contained no data for IAL, None/Alaska Interior, PDA, and IBR. The NRCS dataset was large for IAH (n = 216), IAM (n = 63) and None/Alaska Interior (n = 37) but small for PDA (n = 2). NRCS contained no data for IAL, CRB, or IBR. Because of the number of subregions missing data, only the combined AKVEG/NRCS dataset is analyzed here. Only 2 FACW subregions represent the state, None/AK and WBR.

This appendix evaluates the results of multiple analyses to determine whether AKI, IAH, or IAM should be reclassified to match the state-wide rating of FACW. There are no observations for IAL or IBR, and too few observations from CRB and PDA to provide sound evaluation of their ratings; sample size by subregion is reported in Section H.3.

H.1 Herbaria Specimens Data

Eleven specimens determined as *Viola palustris* contained locality data; 2 of these were collected in LRR Interior Alaska. Figure H-1 shows locations that include *V. epipsila* (n = 101) and *V. epipsila* ssp. *repens* (n = 85).

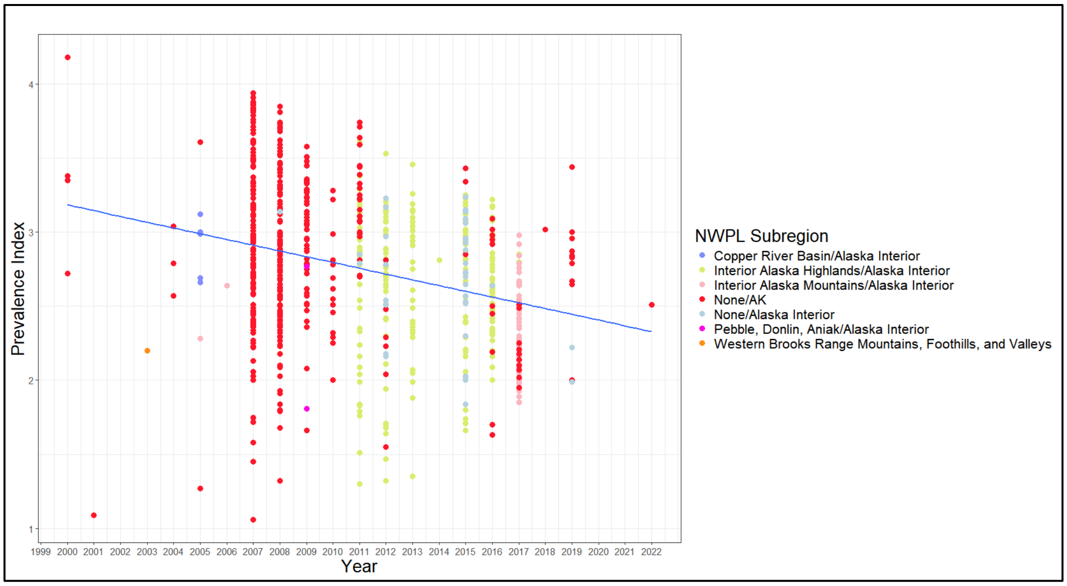
Figure H-1. *Viola palustris* and *V. epipsila* specimens with known locality information from the iDigBio portal.



H.2 PI Over Time by Alaska Subregion—Combined Datasets

The trend line for PI decreases from over 3 to below 2.5 between 2000 to 2022, implying that plots' hydrophytic vegetation factor for wetland delineation (hydrophytic, ≤3, versus nonhydrophytic, >3) has changed and sites are becoming wetter (Figure H-2). It is also possible that other factors are driving the change, such as research interests changing over time to a greater interest in wetter areas. These results imply that sites are more weighted by OBL or FACW plants over time and supports a single rating for the state. Recalculating PI values with None/Alaska Interior, IAH, and IAM assigned a FAC rating of 3 rather than a FACW rating of 2 could increase the means and change the trend line, particularly because IAH represents half the sample size. Results could potentially support a FAC rating for the 3 subregions in question.

Figure H-2. Change in PI over time by NWPL wetland indicator status rating for plots containing *V. palustris* from combined AKVEG and NRCS data (n = 764).



H.3 PI by Wetland Status Indicator Rating and Subregion—Combined Datasets

The mean PI for IAH, IAM, and None/Alaska Interior falls between the mean for None/AK (2.87 ± 0.54) and WBR (2.20, n = 1), implying the subregions in question are not different from the rest of the state and in fact are wetter than None/AK sites. (Figure H-3; Table H-1). These results support a single rating for the state. Recalculating PI values with IAH, IAM, and None/Alaska Interior assigned a FAC rating of 3 rather than a FACW rating of 2 could increase the means and possibly support maintaining a FAC rating.

Omission from PI calculations resulted in a mean change in score by +0.01 with four plots narrowly losing a positive PI indicator, moving from 3.0 to 3.01—3.03. This equated to 9.3% of plots that had a positive indicator score. Forty-one plots received a higher score, 28 were unchanged, and one plot received a lower score. The largest change was −0.09 and +0.09. Viola occurred in sample locations as a minor component and only influenced the four plots mentioned above due to their initial PI score of 3.0.

Figure H-3. Bar chart comparing the mean PI for each subregion by wetland status indicator rating (combined datasets, n = 764).

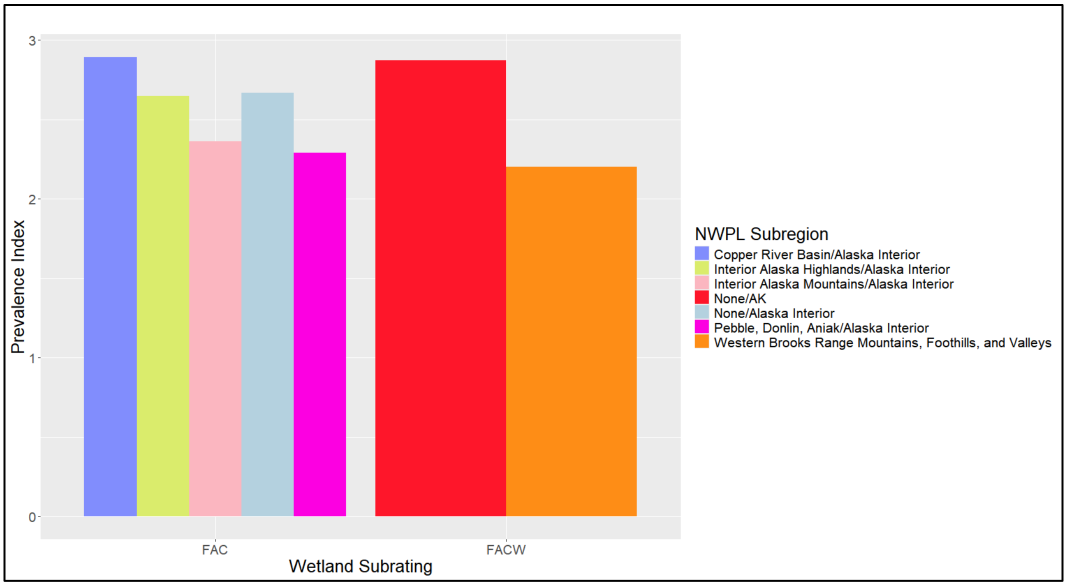


Table H-1. Sample size, mean, and standard deviation of PI for the 13 NWPL subregions and the rest of the state of Alaska (None/AK) for plots from the combined AKVEG/NRCS dataset.

NWPL Subregion	Number of Observations	Average PI Value	Standard Deviation of PI Values
Copper River Basin (CRB)/Alaska Interior (LRR)	5	2.89	0.20
Interior Alaska Highlands (IAH)/Alaska Interior (LRR)	220	2.65	0.45
Interior Alaska Mountains (IAM)/Alaska Interior (LRR)	65	2.36	0.26
None/AK	434	2.87	0.54
None/Alaska Interior (AKI in LRR)	37	2.67	0.40
Pebble, Donlin, Aniak (PDA)/Alaska Interior (LRR)	2	2.29	0.68
Western Brooks Range Mountains, Foothills, and Valleys (WBR)	1	2.20	N/A

H.4 Importance of *V. palustris* for PI Calculation

Omission from PI calculations resulted in a mean change in score by +0.01 with 4 plots narrowly losing the positive hydrophytic vegetation status indicator, moving from 3.0 to 3.01—3.03. This equated to 9.3% of plots that met the positive indicator criterion. Forty-one plots received a higher score, 28 were unchanged, and one plot received a lower score. The largest change was −0.09 and +0.09. *V. palustris* occurred in sample locations as a minor component and only influenced the four plots mentioned above due to their initial PI score of 3.0.

H.5 Data Preparation for Analyses—Combined Dataset

The AKVEG and NRCS datasets share 17 variables in common, of which 6 variables are numeric. The combined dataset has 764 observations. Four variables; Cover, Elevation, Hydric Soil Rating, and PI, were determined to be appropriate for ANOSIM, NMDS, and PCA and correlation analysis was skipped due to the small number of variables.

H.6 The ANOSIM Test—Combined Dataset

For the four variables considered here—Cover, Elevation, Hydric Soil Rating, and PI—the subregions are significantly different with some overlap ($R = 0.444$, $p < 0.01$) and FAC versus FACW ratings are significantly different ($R = 0.601$, $p < 0.01$). Pairwise comparisons indicate that IAH, IAM, and CRB are significantly different from the state of Alaska, but AKI is significantly similar. AKI is also statistically highly different from IAH, IAM, and CRB (Table H-2). Results suggest that AKI resembles the state of Alaska and should be FACW while IAH, IAM, and CRB warrant a different rating of FAC.

Table H-2. ANOSIM pairwise tests for all subregions from the combined dataset (n = 764).

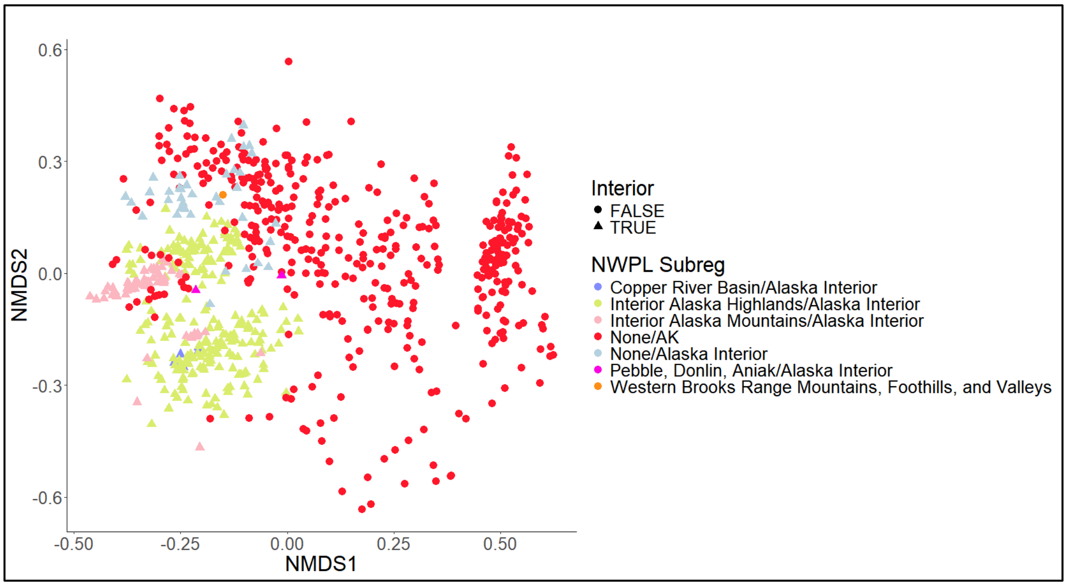
—	ALASKA	ACP	AKI •	IAH •	IAL •	IAM •	CRB •	WBR	NBR	IBR •	NSL	SPH	PDA •	UKK •
ALASKA	N/A	—	—	—	—	—	—	—	—	—	—	—	—	—
Arctic Coastal Plain (ACP)	—	N/A	—	—	—	—	—	—	—	—	—	—	—	—
Alaska Interior (AKI) •	0.09*	—	N/A	—	—	—	—	—	—	—	—	—	—	—
Interior Alaska Highlands (IAH) •	0.59**	—	0.83**	N/A	—	—	—	—	—	—	—	—	—	—
Interior Alaska Lowlands (IAL) •	—	—	—	—	N/A	—	—	—	—	—	—	—	—	—
Interior Alaska Mountains (IAM) •	0.61**	—	1**	0, 0.98	—	N/A	—	—	—	—	—	—	—	—
Copper River Basin (CRB) •	0.60**	—	0.98**	−0.2, 0.99	—	0.77**	N/A	—	—	—	—	—	—	—
Western Brooks Range (WBR)	−0.2, 0.72	—	0.84, 0.06	1**	—	1**	1, 0.19	N/A	—	—	—	—	—	—
Northern Brooks Range (NBR)	—	—	—	—	—	—	—	—	N/A	—	—	—	—	—
Interior Brooks Range (IBR) •	—	—	—	—	—	—	—	—	—	N/A	—	—	—	—
Northern Seward Peninsula (NSL)	—	—	—	—	—	—	—	—	—	—	N/A	—	—	—
Seward Peninsula Highlands (SPH)	—	—	—	—	—	—	—	—	—	—	—	N/A	—	—
Pebble/Donlin/Aniak (PDA) •	0.13, 0.28	—	0.37*	0.76**	—	1**	1*	1, 0.33	—	—	—	—	N/A	—
Upper Kobuk-Koyukuk (UKK) •	—	—	—	—	—	—	—	—	—	—	—	—	—	N/A

Note: * is $p \leq 0.05$, ** is $p \leq 0.01$; for significant p, *bold* text indicates $0.5 \leq R < 0.75$ and (significantly different), *bold* and *gray* fill indicates $0.75 \leq R \leq 1$ (significantly highly different). *Yellow* indicates subregions under investigation for reassignment, *blue dots* indicate subregions that fall within the LRR Interior Alaska subregion.

H.7 NMDS—Combined Datasets

The LRR Interior Alaska points cluster to the left of Dimension 1 while None/AK partially overlaps this cluster and spreads to occupy the right side of Dimension 1 (Figure H-4). IAH and IAM form tight clusters with little overlap from None/AK while AKI shows greater overlap. Results imply that IAH and IAM are most similar to each other and are less similar to AKI and the state. However, the stress test results are above 0.15, which indicate the NMDS interpretation requires caution because the figure may not be a good representation of the data.

Figure H-4. NMDS of *V. palustris* from combined AKVEG/NRCS data (*n* = 764). Stress = 0.1712689.



H.8 PCA—Combined Datasets

There is a trend for a difference between None/AK, which falls on the left-hand side of Dimension 1, and IAH, IAM or None/Alaska Interior, which fall on the right side. There are no clusters along Dimension 2 (Figure H-5). Dimension 1 represents 35.6% of the variance and is influenced by Hydric Soil Rating, PI, and Elevation (Figure H-6). Dimension 2 explains 26.6% of the data variance and is dominated by Cover (Figure H-6). The PCA does not support 2 ratings for the state.

Figure H-5. PCA plot of *V. palustris* combined AKVEG/NRCS dataset (*n* = 764).

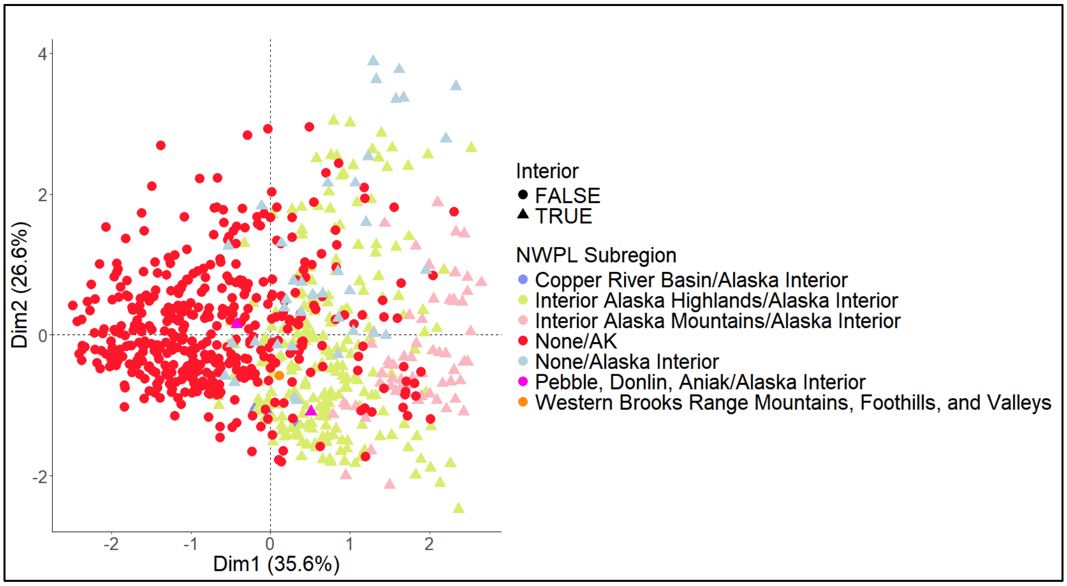
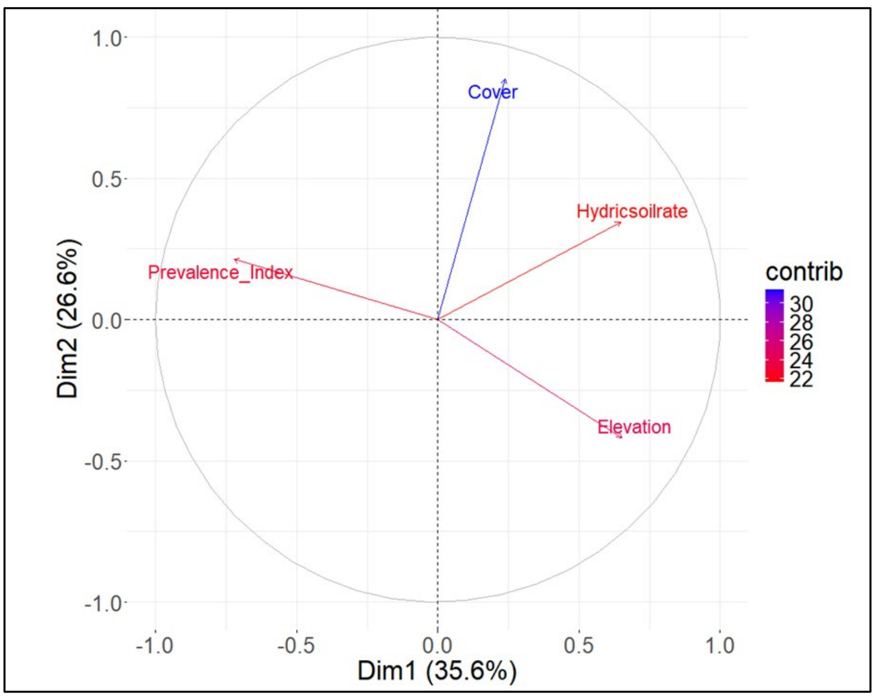


Figure H-6. PCA loading plot of combined AKVEG/NRCS data.



Appendix I: Table of Available Datasets.

Table I-1 below includes a list of potential datasets identified during the Kickoff workshop. AKVEG and NRCS were selected because they were already digitized and included information on both vegetation and soils.

Table I-1. List of preexisting datasets available for analysis to assess the accuracy and validity of the wetland indicator status ratings of the 8 species and 13 subregions included in this report. Datasets were identified during the kickoff workshop.

POC	Data Source	Format	URL	Hydric Soils Data (Y/N)	Hydrology Data (Y/N)	Hydrophytic Vegetation (Y/N)	GPS Coordinates (Y/N)	Associated Species (Y/N)	Subregions	Notes
National Resource for Advancing Digitization of Biodiversity Collections	iDigBio	digital database	https://www.idigbio.org/portal/search	N	N	N	Y	Y		Not plot-based
Ecological Society of America	VegBank	digital database	http://vegbank.org/vegbank/index.jsp	N	N	Y	Y	Y		Soil descriptions optional; has records from 1980s that are not on AKVEG
Estrella Campellone/USACE Alaska District	Wetland delineation forms	analogue/ pdfs		Y	Y	Y				pdfs, some handwritten
Blaine Spellman/USDA NRCS	National Soil Information System (NASIS)	digital database		Y	Y	Y	Y		IAH, IAM, CRB, PDA, AKI	data were just shared with the AK Center for Conservation Science for inclusion in AKVEG but data aren't showing up on AKVEG as of 1/20/23
Sydney Thielke/USFWS	Arctic coastal plain data								ACP	not currently shared with any databases
Sydney Thielke/USFWS	?	analogue		N	N	N		Y		much of what they have is already with ACCS (can we assume it is on AKVEG, then?
Sydney Thielke/USFWS	National Wetlands Inventory (USFWS)									wetland mapping at the landscape scale (5 acres plots) collected by flyovers. Datamining is unrealistic due to limited staffing. Hopes to increase species specific data collection in the coming years. Only 42% of state has been mapped. *Could possibly overlay herbarium data with these maps to get hydrology data*
Karin Sonnen/USDA NRCS		analogue/ notebooks		N	N	Y	Y		Seward	primarily uplands
Anjanette Steer/Alaska Center for Conservation Science	AKVEG	digital database	https://akveg.uaa.alaska.edu/	possibly	possibly	possibly	Y	possibly		1998-2021. Site code is the common relatable field.
Gwen Jacobson/USACE Alaska District	CEMML; Colorado State University	digital database								
Kyle Gordon/USACE WRAP	Survey123			Y	Y	Y				We're exploring opportunities to deploy that survey to the public and maintain a database of consultant data. If it happens, it'll be too late for this study, but having data from wetland determination data forms in a searchable and useable database would be awesome to have for projects like this
Charlene Johnson/US Air Force--JBER	Alpine Chugach habitat assessment	digital spreadsheet, some analogue forms								
Charlene Johnson/US Air Force--JBER	Long term data			Y	N	Y				120 long term veg monitoring sites in 4 climate zones
Joni Johnson/USFS		some digital, some analogue		Y	N	Y			Southeast and south central AK	non-forested vegetation data paired with pedon data

Appendix J: Synonymy Crosswalk

Table J-1. Synonymy table defining the scientific names used in the 2 datasets analyzed in this report, as well as the USDA-PLANTS website and the Army Corps National Wetland Plant List (NWPL). Species included are all those that occurred in plots with the 8 species focal to this report.

AKVEG/NRCS	USDA—PLANTS	USACE—NWPL
Achillea alpina ssp. multiflora	*Achillea alpina*	NOT LISTED/NR
Agrostis alaskana	*Agrostis exarata*	*Agrostis exarata*
Alnus alnobetula	*Alnus viridis ssp. sinuata*	*Alnus viridis*
Alopecurus borealis	*Alopecurus magellanicus*	*Alopecurus magellanicus*
Alopecurus glaucus	*Alopecurus magellanicus Lam*	*Alopecurus magellanicus*
Anemonastrum richardsonii	*Anemone richardsonii*	*Anemone richardsonii*
Anemonastrum sibiricum	*Anemone narcissiflora var. monantha*	*Anemone narcissiflora*
Anemone lithophila	*Anemone lithophila*	NOT LISTED/NR
Anemone multifida	*Anemone multifida*	NOT LISTED/NR
Angelica gmelinii	*Angelica lucida*	*Angelica lucida*
Antennaria friesiana	*Antennaria alpina*	*Antennaria alpina*
Antennaria monocephala	*Antennaria monocephala*	NOT LISTED/NR
Antennaria rosea	*Antennaria rosea*	NOT LISTED/NR
Arabidopsis kamchatica	*Arabidopsis lyrata*	*Arabidopsis lyrata*
Arabidopsis petraea ssp. umbrosa	*Arabis lyrata*	NOT LISTED/NR
Arctagrostis arundinacea	*Arctagrostis latifolia ssp. arundinacea*	*Arctagrostis latifolia*
Arcteranthis cooleyae	*Kumlienia cooleyae*	*Kumlienia cooleyae*
Arctopoa eminens	*Poa eminens*	*Poa eminens*
Arctous alpina	*Arctostaphylos alpina var. alpina*	*Arctous alpinus*
Arctous rubra	*Arctostaphylos rubra*	*Arctous ruber*
Arenaria longipedunculata	*Arenaria longipedunculata*	NOT LISTED/NR
Armeria scabra	*Armeria maritima ssp. sibirica*	*Armeria maritima*
Arnica angustifolia	*Arnica angustifolia*	NOT LISTED/NR
Arnica frigida	*Arnica frigida*	NOT LISTED/NR
Arnica lessingii	*Arnica lessingii*	NOT LISTED/NR
Arnica lonchophylla	*Arnica lonchophylla*	NOT LISTED/NR
Artemisia arctica	*Artemisia arctica*	*Artemisia norvegica*
Artemisia borealis	*Artemisia campestris L. ssp. borealis*	*Artemisia campestris*
Artemisia furcata	*Artemisia furcata*	NOT LISTED/NR
Artemisia globularia	*Artemisia globularia*	NOT LISTED/NR

Table J-1 (cont.). Synonymy table defining the scientific names used in the 2 datasets analyzed in this report, as well as the USDA-PLANTS website and the Army Corps National Wetland Plant List (NWPL). Species included are all those that occurred in plots with the 8 species focal to this report.

AKVEG/NRCS	USDA—PLANTS	USACE—NWPL
Artemisia glomerata	*Artemisia glomerata*	NOT LISTED/NR
Artemisia kruhsiana ssp. *alaskana*	*Artemisia alaskana*	NOT LISTED/NR
Artemisia senjavinensis	*Artemisia senjavinensis*	NOT LISTED/NR
Askellia elegans	*Crepis elegans*	NOT LISTED/NR
Askellia pygmaea	*Crepis nana*	NOT LISTED/NR
Asplenium viride	*Asplenium trichomanes-ramosum*	NOT LISTED/NR
Aster alpinus	*Aster alpinus*	NOT LISTED/NR
Astragalus lepagei	*Astragalus australis*	NOT LISTED/NR
Astragalus umbellatus	*Astragalus umbellatus*	NOT LISTED/NR
Athyrium distentifolium ssp. *americanum*	*Athyrium americanum*	*Athyrium americanum*
Athyrium filix-femina	*Athyrium filix-femina*	*Athyrium cyclosorum*
Betula nana ssp. *exilis*	*Betula nana ssp. exilis*	*Betula nana*
Blitum capitatum	*Chenopodium capitatum*	NOT LISTED/NR
Botrychium alaskense	*Botrychium alaskense*	NOT LISTED/NR
Botrychium minganense	*Botrychium minganense*	*Botrychium lunaria*
Bromopsis pumpelliana	*Bromus inermis ssp. pumpellianus*	*Bromus inermis*
Bromus pumpellianus var. *arcticus*	*Bromus inermis* ssp. *pumpellianus* var. *arcticus*	*Bromus inermis*
Bupleurum americanum	*Bupleurum americanum*	NOT LISTED/NR
Calamagrostis inexpansa	*Calamagrostis stricta* ssp. *inexpansa*	*Calamagrostis stricta*
Calamagrostis neglecta	*Calamagrostis stricta*	*Calamagrostis stricta*
Calamagrostis purpurascens	*Calamagrostis purpurascens*	NOT LISTED/NR
Campanula aurita	*Campanula aurita*	NOT LISTED/NR
Campanula medium	*Campanula medium*	NOT LISTED/NR
Cardamine polemonioides	*Cardamine pratensis* var. *angustifolia*	*Cardamine nymanii*
Carex borealipolaris	*Kobresia sibirica*	*Kobresia sibirica*
Carex circinata	*Carex circinata*	NOT LISTED/NR
Carex concolor	*Carex aquatilis*	*Carex aquatilis*
Carex filifolia	*Carex filifolia*	NOT LISTED/NR
Carex glacialis	*Carex glacialis*	NOT LISTED/NR
Carex krausei	*Carex krausei*	*Carex capillaris*
Carex myosuroides	*Kobresia myosuroides*	*Kobresia myosuroides*
Carex obtusata	*Carex obtusata*	NOT LISTED/NR

Table J-1 (cont.). Synonymy table defining the scientific names used in the 2 datasets analyzed in this report, as well as the USDA-PLANTS website and the Army Corps National Wetland Plant List (NWPL). Species included are all those that occurred in plots with the 8 species focal to this report.

AKVEG/NRCS	USDA—PLANTS	USACE—NWPL
Carex paupercula	*Carex magellanica ssp. irrigua*	*Carex magellanica*
Carex petricosa	*Carex petricosa*	NOT LISTED/NR
Carex simpliciuscula	*Kobresia simpliciuscula*	*Kobresia simpliciuscula*
Carex sitchensis	*Carex aquatilis var. dives*	*Carex aquatilis*
Carex supina	*Carex supina*	NOT LISTED/NR
Cassiope lycopodioides	*Cassiope lycopodioides*	NOT LISTED/NR
Castilleja caudata	*Castilleja caudata var. caudata*	*Castilleja pallida*
Castilleja elegans	*Castilleja elegans*	*Castilleja pallida*
Castilleja hyperborea	*Castilleja hyperborea*	NOT LISTED/NR
Cerastium maximum	*Cerastium maximum*	NOT LISTED/NR
Chamaepericlymenum canadense	*Cornus canadensis*	*Cornus canadensis*
Chamaepericlymenum suecicum	*Cornus suecica*	*Cornus suecica*
Chamerion angustifolium	*Chamerion angustifolium*	*Chamaenerion angustifolium*
Chamerion latifolium	*Chamerion latifolium*	*Chamaenerion latifolium*
Cherleria arctica	*Minuartia arctica*	NOT LISTED/NR
Cherleria biflora	*Minuartia biflora*	NOT LISTED/NR
Cherleria obtusiloba	*Minuartia obtusiloba*	*Minuartia obtusiloba*
Claytonia eschscholtzii	*Claytonia eschscholtzii*	*Claytonia acutifolia*
Cochlearia arctica	*Cochlearia groenlandica*	*Cochlearia groenlandica*
Cornus sericea	*Cornus sericea*	*Cornus alba*
Cornus unalaschkensis	*Cornus unalaschkensis*	NOT LISTED/NR
Crepis tectorum	*Crepis tectorum*	NOT LISTED/NR
Crucihimalaya bursifolia	*Halimolobos mollis*	*Transberingia bursifolia*
Cryptogramma acrostichoides	*Cryptogramma acrostichoides*	NOT LISTED/NR
Cryptogramma sitchensis	*Cryptogramma sitchensis*	NOT LISTED/NR
Cypripedium guttatum	*Cypripedium guttatum*	NOT LISTED/NR
Delphinium chamissonis	*Delphinium chamissonis*	NOT LISTED/NR
Deschampsia beringensis	*Deschampsia beringensis*	*Deschampsia caespitosa*
Deschampsia cespitosa ssp. *cespitosa*	*Deschampsia cespitosa*	*Deschampsia caespitosa*
Deschampsia sukatschewii	*Deschampsia cespitosa*	*Deschampsia caespitosa*

Table J-1 (cont.). Synonymy table defining the scientific names used in the 2 datasets analyzed in this report, as well as the USDA-PLANTS website and the Army Corps National Wetland Plant List (NWPL). Species included are all those that occurred in plots with the 8 species focal to this report.

AKVEG/NRCS	USDA—PLANTS	USACE—NWPL
Descurainia sophioides	*Descurainia sophioides*	NOT LISTED/NR
Dianthus repens	*Dianthus repens*	NOT LISTED/NR
Diapensia obovata	*Diapensia lapponica var. obovata*	NOT LISTED/NR
Diphasiastrum sitchense	*Lycopodium sitchense*	*Diphasiastrum complanatum*
Douglasia gormanii	*Douglasia gormanii*	NOT LISTED/NR
Douglasia ochotensis	*Douglasia ochotensis*	NOT LISTED/NR
Draba cinerea	*Draba cinerea*	NOT LISTED/NR
Draba corymbosa	*Draba corymbosa*	NOT LISTED/NR
Draba glabella	*Draba glabella*	NOT LISTED/NR
Draba juvenilis	*Draba juvenilis*	NOT LISTED/NR
Draba lactea	*Draba lactea*	NOT LISTED/NR
Draba palanderiana	*Draba palanderiana*	NOT LISTED/NR
Draba pilosa	*Draba alpina*	NOT LISTED/NR
Dryas ajanensis ssp. *beringensis*	*Dryas octopetala* ssp. *octopetala*	NOT LISTED/NR
Dryas alaskensis	*Dryas octopetala* ssp. *alaskensis*	NOT LISTED/NR
Dryopteris fragrans	*Dryopteris fragrans*	NOT LISTED/NR
Eleocharis suksdorfiana	*Eleocharis suksdorfiana*	NOT LISTED/NR
Elymus violaceus	*Elymus alaskanus ssp. latiglumis*	*Elymus alaskanus*
Erigeron caespitosus	*Erigeron caespitosus*	NOT LISTED/NR
Erigeron caespitosus	*Erigeron caespitosus*	NOT LISTED/NR
Erigeron elatus	*Erigeron elatus*	*Erigeron acris*
Erigeron hyperboreus	*Erigeron hyperboreus*	NOT LISTED/NR
Erigeron purpuratus	*Erigeron purpuratus*	NOT LISTED/NR
Eriophorum triste	*Eriophorum angustifolium* ssp. *triste*	*Eriophorum angustifolium*
Eritrichium aretioides	*Eritrichium nanum* var. *aretioides*	NOT LISTED/NR
Erysimum inconspicuum	*Erysimum inconspicuum*	NOT LISTED/NR
Erysimum pallasii	*Erysimum pallasii*	NOT LISTED/NR
Euphrasia mollis	*Euphrasia mollis*	NOT LISTED/NR
Festuca baffinensis	*Festuca baffinensis*	NOT LISTED/NR
Festuca brachyphylla	*Festuca brachyphylla*	NOT LISTED/NR
Festuca brevissima	*Festuca brevissima*	NOT LISTED/NR

Table J-1 (cont.). Synonymy table defining the scientific names used in the 2 datasets analyzed in this report, as well as the USDA-PLANTS website and the Army Corps National Wetland Plant List (NWPL). Species included are all those that occurred in plots with the 8 species focal to this report.

AKVEG/NRCS	USDA—PLANTS	USACE—NWPL
Festuca saximontana	*Festuca saximontana*	NOT LISTED/NR
Festuca viviparoidea	*Festuca viviparoidea*	NOT LISTED/NR
Festuca viviparoidea ssp. *viviparoidea*	*Festuca viviparoidea* ssp. *viviparoidea*	NOT LISTED/NR
Gagea serotina	*Lloydia serotina*	*Lloydia serotina*
Galearis rotundifolia	*Amerorchis rotundifolia*	*Platanthera rotundifolia*
Gentiana platypetala	*Gentiana platypetala*	NOT LISTED/NR
Geum glaciale	*Geum glaciale*	NOT LISTED/NR
Gymnocarpium continentale	*Gymnocarpium jessoense ssp. parvulum*	NOT LISTED/NR
Hedysarum americanum	*Hedysarum alpinum*	*Hedysarum alpinum*
Hedysarum hedysaroides	*Hedysarum alpinum*	*Hedysarum alpinum*
Hedysarum mackenziei	*Hedysarum boreale ssp. mackenziei*	NOT LISTED/NR
Heracleum lanatum	*Heracleum maximum*	*Heracleum maximum*
Heuchera glabra	*Heuchera glabra*	NOT LISTED/NR
Hieracium albiflorum	*Hieracium albiflorum*	NOT LISTED/NR
Hierochloë alpina	*Anthoxanthum monticola ssp. alpinum*	NOT LISTED/NR
Hierochloë odorata	*Anthoxanthum monticola ssp. alpinum*	NOT LISTED/NR
Hierochloë pauciflora	*Hierochloë pauciflora*	*Anthoxanthum arcticum*
Hulteniella integrifolia	*Hulteniella integrifolia*	NOT LISTED/NR
Huperzia arctica	*Huperzia selago*	NOT LISTED/NR
Huperzia continentalis	*NOT LISTED/NR*	NOT LISTED/NR
Huperzia miyoshiana	*Huperzia miyoshiana*	NOT LISTED/NR
Huperzia selago	*Huperzia selago*	NOT LISTED/NR
Juncus leucochlamys	*Juncus castaneus ssp. leucochlamys*	*Juncus castaneus*
Kalmia procumbens	*Loiseleuria procumbens*	*Loiseleuria procumbens*
Kindbergia oregana	*Eurhynchium oreganum*	NOT LISTED/NR
Koeleria asiatica	*Koeleria asiatica*	NOT LISTED/NR
Lagotis glauca	*Lagotis glauca*	NOT LISTED/NR
Lepidotheca suaveolens	*Matricaria discoidea*	*Matricaria discoidea*
Leymus innovatus	*Leymus innovatus*	NOT LISTED/NR

Table J-1 (cont.). Synonymy table defining the scientific names used in the 2 datasets analyzed in this report, as well as the USDA-PLANTS website and the Army Corps National Wetland Plant List (NWPL). Species included are all those that occurred in plots with the 8 species focal to this report.

AKVEG/NRCS	USDA—PLANTS	USACE—NWPL
Leymus innovatus	*Leymus innovatus*	NOT LISTED/NR
Ligusticum scothicum	*Ligusticum scoticum*	*Ligusticum scoticum*
Linum lewisii ssp. lewisii	*Linum lewisii var. lewisii*	NOT LISTED/NR
Listera borealis	*Listera borealis*	*Neottia borealis*
Listera convallarioides	*Listera convallarioides*	*Neottia convallarioides*
Listera cordata	*Listera cordata*	*Neottia cordata*
Luzula piperi	*Luzula piperi*	NOT LISTED/NR
Lysimachia europaea	*Trientalis europaea*	*Trientalis europaea*
Lysimachia europaea ssp. arctica	*Trientalis europaea* ssp. *arctica*	*Trientalis europaea*
Melanocalyx uniflora	*Campanula uniflora*	*Campanula uniflora*
Mertensia drummondii	*Mertensia drummondii*	NOT LISTED/NR
Mertensia eastwoodae	*Mertensia paniculata* var. *eastwoodiae*	*Mertensia eastwoodiae*
Micranthes calycina	*Saxifraga calycina*	NOT LISTED/NR
Micranthes nivalis	*Saxifraga nivalis*	NOT LISTED/NR
Micranthes razshivinii	*Saxifraga razshivinii*	*Micranthes razshivinii*
Micranthes reflexa	*Saxifraga reflexa*	NOT LISTED/NR
Montia vassilievii ssp. *vassilievii*	*NOT LISTED/NR*	NOT LISTED/NR
Myosotis alpestris	*Myosotis asiatica*	*Myosotis asiatica*
Noccaea arctica	*Noccaea arctica*	NOT LISTED/NR
Oreopteris quelpaertensis	*Thelypteris quelpaertensis*	NOT LISTED/NR
Orthilia obtusata	*Orthilia secunda*	*Orthilia secunda*
Oxycoccus microcarpus	*Vaccinium oxycoccos*	*Vaccinium oxycoccos*
Oxytropis arctica	*Oxytropis arctica*	NOT LISTED/NR
Oxytropis borealis	*Oxytropis borealis*	NOT LISTED/NR
Oxytropis huddelsonii	*Oxytropis huddelsonii*	NOT LISTED/NR
Oxytropis jordalii	*Oxytropis campestris*	NOT LISTED/NR
Oxytropis kobukensis	*Oxytropis kobukensis*	NOT LISTED/NR
Oxytropis kokrinensis	*Oxytropis kokrinensis*	NOT LISTED/NR
Oxytropis maydelliana	*Oxytropis maydelliana*	NOT LISTED/NR
Oxytropis mertensiana	*Oxytropis mertensiana*	NOT LISTED/NR
Oxytropis roaldii	*Oxytropis campestris* var. *roaldii*	NOT LISTED/NR
Oxytropis scammaniana	*Oxytropis scammaniana*	NOT LISTED/NR

Table J-1 (cont.). Synonymy table defining the scientific names used in the 2 datasets analyzed in this report, as well as the USDA-PLANTS website and the Army Corps National Wetland Plant List (NWPL). Species included are all those that occurred in plots with the 8 species focal to this report.

AKVEG/NRCS	USDA—PLANTS	USACE—NWPL
Oxytropis varians	*Oxytropis campestris* var. *varians*	NOT LISTED/NR
Oxytropis viscida	*Oxytropis borealis*	NOT LISTED/NR
Packera hyperborealis	*Packera hyperborealis*	NOT LISTED/NR
Packera ogotorukensis	*Packera ogotorukensis*	NOT LISTED/NR
Papaver alaskanum	*Papaver radicatum* ssp. *alaskanum*	NOT LISTED/NR
Papaver hultenii	*Papaver lapponicum*	NOT LISTED/NR
Papaver keelei	*Papaver macounii*	*Papaver macounii*
Papaver nudicaule ssp. *americanum*	*Papaver nudicaule* ssp. *americanum*	NOT LISTED/NR
Parrya nudicaulis	*Parrya nudicaulis*	NOT LISTED/NR
Pedicularis oederi	*Pedicularis oederi*	NOT LISTED/NR
Pedicularis pennellii	*Pedicularis parviflora ssp. pennellii*	*Pedicularis parviflora*
Petasites sagittatus	*Petasites sagittatus*	*Petasites frigidus*
Phlox alaskensis	*Phlox richardsonii Hook. ssp. alaskensis*	NOT LISTED/NR
Phlox hoodii	*Phlox hoodii*	NOT LISTED/NR
Phlox richardsonii	*Phlox richardsonii*	NOT LISTED/NR
Physaria arctica	*Lesquerella arctica*	NOT LISTED/NR
Platanthera dilatata	*Platanthera dilatata*	*Piperia dilatata*
Platanthera unalascensis	*Piperia unalascensis*	*Piperia unalascensis*
Poa glauca	*Poa glauca*	NOT LISTED/NR
Poa hartzii ssp. *alaskana*	*Poa hartzii* ssp. *alaskana*	NOT LISTED/NR
Poa laxiflora	*Poa laxiflora*	*Poa leptocoma*
Poa sublanata	*NOT LISTED/NR*	NOT LISTED/NR
Polemonium boreale	*Polemonium boreale*	NOT LISTED/NR
Polemonium pulcherrimum	*Polemonium pulcherrimum*	NOT LISTED/NR
Populus trichocarpa	*Populus balsamifera L.* ssp. *trichocarpa*	*Populus balsamifera*
Potentilla arenosa ssp. *arenosa*	*Potentilla nivea var. nivea*	NOT LISTED/NR
Potentilla biflora	*Potentilla biflora*	NOT LISTED/NR
Potentilla bimundorum	*Potentilla bimundorum*	NOT LISTED/NR
Potentilla elegans	*Potentilla elegans*	NOT LISTED/NR
Potentilla furcata	*Potentilla furcata*	NOT LISTED/NR
Potentilla hyparctica	*Potentilla nana*	NOT LISTED/NR

Table J-1 (cont.). Synonymy table defining the scientific names used in the 2 datasets analyzed in this report, as well as the USDA-PLANTS website and the Army Corps National Wetland Plant List (NWPL). Species included are all those that occurred in plots with the 8 species focal to this report.

AKVEG/NRCS	USDA—PLANTS	USACE—NWPL
Potentilla nana	*Potentilla nana*	NOT LISTED/NR
Potentilla nivea	*Potentilla nivea*	NOT LISTED/NR
Potentilla subvahliana	*Potentilla vahliana*	NOT LISTED/NR
Potentilla villosa	*Potentilla villosa*	NOT LISTED/NR
Potentilla vulcanicola	NOT LISTED/NR	NOT LISTED/NR
Prenanthes alata	*Prenanthes alata*	NOT LISTED/NR
Primula borealis	*Primula borealis*	NOT LISTED/NR
Pseudocherleria macrocarpa	*Minuartia macrocarpa*	NOT LISTED/NR
Puccinellia borealis	*Puccinellia arctica*	*Puccinellia arctica*
Puccinellia geniculata	*Puccinellia phryganodes ssp. geniculata*	*Puccinellia phryganodes*
Pulsatilla multiceps	*Anemone multiceps*	NOT LISTED/NR
Pulsatilla nuttalliana	*Pulsatilla patens ssp. multifida*	NOT LISTED/NR
Ranunculus pacificus	*Ranunculus pacificus*	NOT LISTED/NR
Ranunculus reptans	*Ranunculus flammula*	*Ranunculus flammula*
Rhododendron menziesii	*Menziesia ferruginea*	*Menziesia ferruginea*
Rubus stellatus	*Rubus arcticus ssp. stellatus*	*Rubus arcticus*
Rumex aureostigmaticus	*Rumex graminifolius*	NOT LISTED/NR
Rumex beringensis	*Rumex beringensis*	NOT LISTED/NR
Sabulina dawsonensis	*Minuartia dawsonensis*	NOT LISTED/NR
Sabulina elegans	*Minuartia elegans*	NOT LISTED/NR
Sabulina rossii	*Minuartia rossii*	NOT LISTED/NR
Sabulina rubella	*Minuartia rubella*	*Minuartia rubella*
Sabulina stricta	*Minuartia michauxii* var. *michauxii*	NOT LISTED/NR
Salix niphoclada	*Salix niphoclada*	NOT LISTED/NR
Salix pseudomyrsinites	*Salix pseudomyrsinites*	*Salix myrtillifolia*
Salix stolonifera	*Salix stolonifera*	NOT LISTED/NR
Saxifraga bracteata	*Saxifraga sibirica*	NOT LISTED/NR
Saxifraga cespitosa	*Saxifraga caespitosa*	*Saxifraga caespitosa*
Saxifraga eschscholtzii	*Saxifraga eschscholtzii*	NOT LISTED/NR
Saxifraga serpyllifolia	*Saxifraga serpyllifolia*	NOT LISTED/NR
Saxifraga setigera	*Saxifraga flagellaris* ssp. *setigera*	NOT LISTED/NR
Selaginella sibirica	*Selaginella sibirica*	NOT LISTED/NR
Silene involucrata	*Silene involucrata*	NOT LISTED/NR

Table J-1 (cont.). Synonymy table defining the scientific names used in the 2 datasets analyzed in this report, as well as the USDA-PLANTS website and the Army Corps National Wetland Plant List (NWPL). Species included are all those that occurred in plots with the 8 species focal to this report.

AKVEG/NRCS	USDA—PLANTS	USACE—NWPL
Silene repens	*Silene repens*	NOT LISTED/NR
Silene williamsii	*Silene menziesii* ssp. *williamsii*	*Silene menziesii*
Smelowskia porsildii	*Smelowskia calycina*	NOT LISTED/NR
Stereocaulon alpinum	*Stereocaulon alpinum*	NOT LISTED/NR
Struthiopteris spicant	*Blechnum spicant*	*Blechnum spicant*
Swertia obtusa	*Swertia perennis*	*Swertia perennis*
Tanacetum bipinnatum	*Tanacetum bipinnatum*	NOT LISTED/NR
Taraxacum alaskanum	*Taraxacum phymatocarpum*	NOT LISTED/NR
Taraxacum phymatocarpum	*Taraxacum phymatocarpum*	NOT LISTED/NR
Tephroseris kjellmanii	*Tephroseris kjellmanii*	*Tephroseris atropurpurea*
Tephroseris lindstroemii	*Tephroseris lindstroemii*	NOT LISTED/NR
Therorhodion camtschaticum	*Rhododendron camtschaticum*	NOT LISTED/NR
Trichophorum cespitosum	*Trichophorum cespitosum*	*Trichophorum caespitosum*
Trisetum canescens	*Trisetum canescens*	*Trisetum cernuum*
Utricularia vulgaris ssp. *macrorhiza*	*Utricularia macrorhiza*	*Utricularia macrorhiza*
Vahlodea latifolia	*Vahlodea atropurpurea*	*Vahlodea atropurpurea*
Veratrum oxysepalum	*Veratrum album* ssp. *oxysepalum*	NOT LISTED/NR
Veronica alaskensis	*Synthyris borealis*	NOT LISTED/NR
Viola langsdorffii	*Viola langsdorffii*	*Viola langsdorfii*
Viola selkirkii	*Viola selkirkii*	NOT LISTED/NR
Woodsia alpina	*Woodsia alpina*	NOT LISTED/NR
Woodsia glabella	*Woodsia glabella*	NOT LISTED/NR
Woodsia ilvensis	*Woodsia ilvensis*	NOT LISTED/NR

Appendix K: Definitions of AKVEG Variables

Table K-1 is taken from the Database Schema from the AKVEG website.

Table K-1. Definitions of the variable headings used in the AKVEG dataset.

Variable	Description
ID	Unique integer key value per site, where site is the unique combination of physical location, plot size, and survey methods.
Project	Full title of the project.
SiteCode	Unique alpha-numeric identifier assigned to the site or plot in the project.
Date	Date of observation.
Observer	Foreign key value that identifies primary vegetation observer.
Recorder	Foreign key value that identifies secondary vegetation observer (e.g., recorder).
CoverType	One to several word descriptor of cover type.
Cover	“Percentage foliar cover” = absolute cover
Elevation	Meters above sea level
HydricsoilRate	The total representative percentage of each map unit that the hydric components comprise
PlotDimensions	Unique integer key value per plot size and shape.
Datum	Five character EPSG geographic horizontal datum abbreviation.
Latitude	Latitude in decimal degrees with up to 6 decimal places.
Longitude	Longitude in decimal degrees with up to 6 decimal places.
Uncertainty	—
Strata	Stratification unit as defined in the original project.
Physiography	One to two word general description of landscape position and form.
Geomorphology	One to two word descriptor of primary geomorphic surface form and deposition process.
Macrotopography	One to several word descriptor of surface shape and texture on a scale larger than the plot (hundreds of meters).
Microtopography	One to several word descriptor of surface shape and texture on a scale smaller than the plot (meters or less).
Microrelief	Approximate mean deviation from neutral in within-site surface elevation measured in centimeters (cm).
Drainage	One to two word description of water drainage regime.
Moisture	One to two word description of moisture regime.
Soil Class	Several word descriptor for general soil class based on soil taxonomy.
Depth Water	Mean depth of water table from soil surface measured in centimeters (cm) with positive values indicating above surface depth and negative values indicating below surface depth.
Depth Moss Duff	Mean depth of live moss and/or lichen (including both live and undecomposed dead) and duff (recognizable decomposed dead vegetation) measure in centimeters (cm).
Depth Restrictive Layer	Mean depth to restrictive layer (if present within uppermost meter of soil) from soil surface measured in centimeters (cm).
Restrictive Layer	Full name of type of restrictive layer.

Table K-1 (cont.). Definitions of the variable headings used in the AKVEG dataset.

Variable	Description
Soil pH 10	Soil pH at 10 cm.
Conductivity 10	Soil conductivity at 10 cm.
Temperature 10	Soil temperature (°C) at 10 cm.
Soil pH 30	Soil pH at 30 cm.
Conductivity 30	Soil conductivity at 30 cm.
Temperature 30	Soil temperature in °C at 30 cm.
Water pH	Surface water pH (if water above soil surface is present).
Water Conductivity	Surface water conductivity (if water above soil surface is present).
Water Temperature	Surface water temperature in °C (if water above soil surface is present).
Disturbance	One to two word description of primary disturbance processes.
Homogenous	Boolean value with 0 representing sites with nonhomogenous vegetation and 1 representing sites where the dominant vegetation is homogenous.
PrevalenceIndex	A weighted average calculated using percent cover and the assigned wetlands status indicator rating for of all plant species present in a plot. An index score equal to or less than 3 indicates the sampled plant community has a positive indicator of hydrophytic vegetation.

Appendix L: Definitions of NRCS Variables

Table L-1 below is adapted from information provided by NRCS.

Table L-1. Definitions of variable headers used in the analysis of the NRCS data.

Abbreviation	Variable	Description
—	Cover	Absolute percent cover
—	Elevation	Meters above sea level
Hydricsoilrate	Hydric soil rating	The total representative percentage of each map unit that the hydric components comprise
Prevalence Index	Prevalence Index	A weighted average calculated using percent cover and the assigned wetlands status indicator rating for of all plant species present in a plot. An index score equal to or less than 3 indicates the sampled plant community has a positive indicator of hydrophytic vegetation.
Tot_Oversust_C	Total Overstory Canopy Cover %	The canopy cover percent of all species in the overstory stratum (percent)
Tot_BA	Total Basal Area	Total basal area for the plot (ft^2/acre)
AK_Lichen	Alaska Total Lichen Cover Pct	The total lichen cover in percent. It is proposed as a state (AK) specific attribute. This attribute is to be used to accommodate only the respective attribute included in Alaska's, Alaska, SITE databases (percent)
AK_Litter1	Alaska Total Litter1 Cover Pct	The total herbaceous litter and mulch cover in percent. It is proposed as a state (AK) specific attribute. This attribute is to be used to accommodate only the respective attribute included in Alaska's, Alaska, SITE databases (percent)
AK_Litter2	Alaska Total Litter2 Cover Pct	The total woody litter and debris > 2.5 cm cover in percent. It is proposed as a state (AK) specific attribute. This attribute is to be used to accommodate only the respective attribute included in Alaska's, Alaska, SITE databases (percent)
AK_Moss	Alaska Total Moss Cover Pct	The total bryophyte cover in percent. It is proposed as a state (AK) specific attribute. This attribute is to be used to accommodate only the respective attribute included in Alaska's, Alaska, SITE databases (percent)
AK_Surf_Fr	Alaska Total Rock Cover Pct	The total surface rock fragment cover in percent. It is proposed as a state (AK) specific attribute. This attribute is to be used to accommodate only the respective attribute included in Alaska's, Alaska, SITE databases (percent)
AK_Bare_So	Alaska Total Soil Cover Pct	The total bare soil cover in percent. It is proposed as a state (AK) specific attribute. This attribute is to be used to accommodate only the respective attribute included in Alaska's, Alaska, SITE databases (percent)
AK_Surf_Wa	Alaska Total Water Cover Pct	The total surface water cover in percent. It is proposed as a state (AK) specific attribute. This attribute is to be used to accommodate only the respective attribute included in Alaska's, Alaska, SITE databases (percent)

Table L-1 (cont.). Definitions of variable headers used in the analysis of the NRCS data.

Abbreviation	Variable	Description
AK_Bedrock	Alaska Total Bedrock Cover Pct	The total surface bedrock cover in percent. It is proposed as a state (AK) specific attribute. This attribute is to be used to accommodate only the respective attribute included in Alaska's, Alaska, SITE databases (percent)
Slope	Slope Gradient	The difference in elevation between two points, expressed as a percentage of the distance between those points (percent)
Aspect	Aspect	The direction toward which the surface of the soil faces, expressed as an angle between 0 and 360 degrees, inclusive, measured clockwise from true north (degrees)
Restrict_t	OSD Restriction Thickness	The distance from the top to bottom of a restrictive layer (cm)
O_Thicknes	Thickness	The distance from the upper to lower boundary of the identified diagnostic horizon or feature (cm)
O_pH	pH Oxidized	The negative common logarithm of the hydrogen ion activity in the soil using the oxidized pH method. It is used as an indicator of the presence of sulfidic materials. This is the final pH measured after several moist/dry cycles when using SSIR51 V1-7.1.3.1 Hydrogen Peroxide Test, Delta pH test for Acid Sulfate Soils.
Surf_pH	Water pH–Upper	The negative common logarithm, of the hydrogen ion activity in the in the upper 10 cm. of the water column at a subaqueous soil site using field test methods. A numerical expression of the relative acidity or alkalinity of a soil sample.
Bottom_pH	OSD Water pH–Lower	The negative common logarithm, of the hydrogen ion activity in the in the bottom 10 cm. of the water column at a subaqueous soil site using field test methods. A numerical expression of the relative acidity or alkalinity of a soil sample.
Sub_frag_	OSD SAS Core Length	The measured length of the subaqueous soil core (cm)
Clay___low	Clay Fine Measured	Fine clay is the soil separate with <0.0002 mm particle diameter. It is reported as a gravimetric percent of the <2 mm fraction (percent)
Clay___hig	Total Clay–Measured	Total clay is the soil separate with <0.002 mm particle diameter. Clay size carbonate is included. It is reported as a gravimetric percent of the <2 mm fraction (percent)
Sand___Low	Fine Sand–Measured	Fine sand is the soil separate with 0.10 to 0.25 mm diameter particles. It is reported as a gravimetric percent of the <2 mm fraction (percent)
Sand___hig	Total Sand–Measured	Total sand is the soil separate with 0.05 to 2.0 mm particle diameter. It is reported a gravimetric percent of the <2 mm fraction (percent)
Silt___low	Fine Silt–Measured	Fine silt is the soil separate with 0.002 to 0.02 mm particle diameter. It is reported as a gravimetric percent of the <2 mm fraction.
Silt___hig	Total Silt–Measured	Total silt is the soil separate with 0.002 to 0.05 mm particle size. It is reported as a gravimetric percent of the <2 mm fraction.
Redox_dept	Depth of redox soil	The depth from the top of the soil core to the redox layer

Table L-1 (cont.). Definitions of variable headers used in the analysis of the NRCS data.

Abbreviation	Variable	Description
Surf_hor_f	OSD Horizon Depth to Top Range	The distance from the top of the soil to the top of the soil horizon. The range in the depth to the top of the horizon expressed from the soil surface obtained from observed pedons used in determining the range in characteristics for a soil series (cm)
Restrict_t	OSD Restriction Thickness	The distance from the top to bottom of a restrictive layer.
Restrict_b	OSD Restriction Bottom Depth	The distance from the soil surface to the lower boundary of the restrictive layer.

Abbreviations

ACP	Arctic Coastal Plain
AKI	Alaska Interior, also referred to as None/Alaska Interior; includes MLRA subregions 230 and 232
AKVEG	Alaska Vegetation Plots Database
ANOSIM	Analysis of similarities
BONAP	Biota of North America Program
CEMML	Center for Environmental Management of Military Lands
CRB	Copper River Basin
FAC	Facultative
FACU	Facultative Upland
FACW	Facultative Wetland
IAH	Interior Alaska Highlands
IAL	Interior Alaska Lowlands
IAM	Interior Alaska Mountains
IBR	Interior Brooks Range
iDigBio	Integrated Digitized Biocollections
LRR	Land resource regions
MCA	Multiple correspondence analysis
MLRA	Major land resource areas
N/A	Not Applicable
NBR	Northern Brooks Range
NMDS	Nonmetric multidimensional scaling

NR	Not rated
NRCS	National Resources Conservation Service
NSL	Northern Seward Peninsula
NWPL	National Wetland Plant List
NWPLSubregion	National Wetland Plant List subregion (a variable header)
OBL	Obligate
PCA	Principal component analysis
PDA	Pebble, Donlin, Aniak
PI	Prevalence Index
POA	USACE Alaska District
POWO	Plants of the World Online
SPH	Seward Peninsula Highlands
UKK	Upper Kobuk-Koyokuk
UPL	Upland
USACE	US Army Corps of Engineers
USFWS	US Fish and Wildlife Services
WBR	Western Brooks Range
WetlandSubRate	Wetland indicator status rating (a variable header)

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14. ABSTRACT
Preexisting ecological information and plant species occurrence data were used to determine the accuracy and validity of the present regional and subregional wetland indicator status ratings for eight species: Andromeda polifolia, Arctous rubra, Carex canescens, Rhododendron tomentosum, Rubus arcticus, Salix arctica, Salix pulchra, and Viola palustris. Technical documentation was developed to either (1) support the current National Wetland Plant List (NWPL) subregion boundaries and wetland indicator status ratings for the NWPL Alaska Region or (2) support a proposed change to the subregions or wetland indicator status ratings for the NWPL Alaska Region, for inclusion into the next NWPL update. The project developed repeatable, quantitative methods for assignment of wetland indicator status rating. Analyses included multiple correspondence analysis (MCA), analysis of similarities (ANOSIM), nonmetric multidimensional scaling (NMDS), and principal component analysis (PCA). Prevalence index (PI) was used as a numeric approximation of wetland status for comparing observations across subregions. A pilot study on S. pulchra data evaluated regional assignments by machine learning and assessed the feasibility of correlation network analysis and Louvain clustering for wetland indicator status rating assignment as dictated by co-occurring species. The methods developed for this Alaska-specific study may be applied to any future regional or subregional updates to the NWPL.

15. SUBJECT TERMS
Alaska; *Andromeda polifolia*; *Arctous rubra*; *Carex canescens*; Environmental indicators; National Wetland Plant List; Plant indicators; *Rhododenron tomentosum*; *Rubus arcticus*; *Salix arctica*; *Salix pulchra*; *Viola palustris*; Wetlands; Wetland indicator status rating; Wetland plants

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