Characterizing Microsite Conditions of the Endangered

Wenatchee Mountains Checkermallow (*Sidalcea oregana* var. *calva*)

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Abstract

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To effectively protect and recover rare species, we must understand their ecological niches and habitat requirements. My research focused on Wenatchee Mountains checkermallow (*Sidalcea oregana* var. *calva*; “SIORC”), an endangered plant taxon found in central Washington. There are currently only five known populations of SIORC, and these populations are highly vulnerable to extirpation from demographic factors or stochastic events due to the limited abundance and range of remaining populations. Successful conservation of this species requires understanding the conditions this plant needs to survive and reproduce. During 2022 and 2023, I conducted a microsite study on the SIORC population at Camas Meadows and measured a variety of fine-scale characteristics in SIORC habitats throughout the meadow. These microsite characteristics included soil moisture, canopy density, Leaf Area Index (LAI), soil texture, and associated vegetation. I used cluster analyses and PERMANOVAs to relate SIORC presence and abundance

to each of these microsite variables. I did not find support for any significant relationships between SIORC and physical microsite variables (soil moisture, canopy density, LAI, soil texture). However, an analysis using more precise, lab-based soil texture data from 2023 found that soil clay vs silt content significantly affected SIORC presence in 2023. Analysis of vegetation characteristics found significant relationships with SIORC presence and SIORC abundance. Species richness, forb cover, and grouping based on overall vegetation characteristics significantly related to SIORC presence. Grouping based on vegetation characteristics did not significantly affect SIORC abundance, but total cover on its own was strongly associated with SIORC abundance. Indicator Species Analyses identified *Achillea millefolium* as an indicator for SIORC presence. Additionally, I installed 30 continuous soil moisture sensors and measured soil moisture during the growing season. I used a cluster analysis to identify groups of sensors based on soil moisture characteristics and found that, while SIORC abundance was higher for the wettest groups of sensors in July and August, SIORC presence and number of SIORC were the same across all groups. These results suggest that physical microsite characteristics are not driving SIORC distribution, and that other factors such as vegetation characteristics, seed predation, and fire suppression likely play a stronger role in determining SIORC presence and abundance.

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Introduction

Understanding the habitat needs of rare species is crucial for their conservation. This is especially true for endangered taxa like Wenatchee Mountains checkermallow (*Sidalcea oregana* var. *calva*; “SIORC”), which has a very narrow distribution. My research seeks to understand SIORC’s habitat requirements by relating microsite characteristics to SIORC distribution. Chapter 1 examines the relationship between various physical and vegetation microsite characteristics and the presence and abundance of SIORC. This research sought to determine if physical factors such as soil moisture, soil texture, Leaf Area Index, and canopy density, or vegetation characteristics such as species richness, total cover, and cover of different functional groups influence where SIORC thrives and how abundant it is. Chapter 2 builds upon this investigation by focusing on temporal soil moisture dynamics and their impact on SIORC. Utilizing data collected from 30 continuous soil moisture sensors, this chapter aims to uncover whether soil moisture patterns—such as timing and extent of wet and dry periods—are important for SIORC's presence and abundance. Together, these chapters emphasize the value of microsite studies for understanding rare species' habitat requirements, and reveal that, while physical properties may be less important for SIORC distribution, vegetation characteristics and dynamic soil moisture patterns do influence SIORC's distribution.

Chapter 1

Effects of physical and vegetation microsite characteristics on SIORC presence and abundance

Introduction

Endangered species play an important role in ecosystem biodiversity and function. As many as 36% of plant species are considered "extremely rare," making up a significant portion of global biodiversity (Enquist et al., 2019). Species rarity is generally assessed based on local abundance, geographic range, and habitat specificity (Rabinowitz, 1981). In comparison to common species, rare species may have smaller population sizes, more restricted geographic ranges, and/or greater habitat specificity. Due to these characteristics, rare species tend to be at higher risk of extinction (Sykes et al., 2020). Conserving rare species is important for maintaining overall ecosystem function and biodiversity, as well as ecosystem resilience and resistance to change (Mouillot et al., 2013; Walker et al., 2006). Multiple studies have also shown that rare species may have a disproportionate effect on ecosystem function (Dee et al., 2019; Leitão et al., 2016).

Climate change and other anthropogenic activities have greatly increased the rate of extinction events, making conservation efforts all the more urgent (Cowie et al., 2022). To protect and recover vulnerable species, we must first understand why species occur where they do. Ecological tolerance, here defined as the conditions under which a species may persist or increase in abundance, is a key factor determining where species exist. Understanding a species' ecological tolerance is critical for managing sites where it occurs and identifying viable sites for introduction efforts. To this end, microsite studies are a valuable tool for characterizing habitat requirements and growing conditions. Microsite studies investigate various fine-scale habitat attributes such as local vegetation, soil conditions, and light availability. This strategy is particularly helpful for understanding germination and establishment as these processes are often sensitive to fine-scale variation (Cervera et al., 2006; Orea et al., 2019; Schott et al., 2014). While the microsite characteristics under consideration vary according to the study species, soil (moisture, texture, temperature, microtopography) and light conditions were frequently found to be important for seed germination (Cervera et al., 2006; Orea et al., 2019; Schott et al., 2014; Titus & del Moral, 1998). Studying a variety of microsite characteristics simultaneously also allows for exploration of interactive effects among these factors (Titus & del Moral, 1998).

Microsite studies are particularly useful for rare plant species, as rare plants often have more specific habitat requirements than common species (Dunwiddie & Martin, 2016; Frei et al., 2012; Wendelberger & Maschinski, 2016). Additionally, microsite studies can be conducted in the field with minimal disturbance. In this project, I assess microsite conditions including soil moisture, soil texture, foliage density, canopy cover, and associated vegetation composition in order to characterize the required habitat conditions of a rare plant species. By relating microsite characteristics to species presence, abundance, and morphologic characteristics, we will better understand this species' ecological tolerance.

My research focuses on Wenatchee Mountains checkermallow (*Sidalcea oregana* var. *calva* "SIORC"), an endangered plant found in the Wenatchee Mountains region of Washington state. SIORC was identified as a state endangered plant by the Washington Natural Heritage Program in 1981 and became a federally listed endangered species in 1999. SIORC's primary threats are seed predation, landscape-level fire suppression, competition from non-native species, and loss of habitat due to forest encroachment, human use, and changing hydrologic conditions (Fertig, 2022). SIORC was also designated as "highly vulnerable" to climate change based on the Climate Change Vulnerability Index (Fertig, 2019). This taxon is susceptible to extirpation from demographic factors or stochastic events due to the limited abundance and range of remaining populations. The largest remaining population occurs in Camas Meadows Natural Area Preserve near Leavenworth, Washington, where annual census efforts from 2012 to 2021 mapped SIORC individuals throughout the meadow (Fertig, 2022).

My microsite study took place at Camas Meadows from 2022 to 2023 and aimed to empirically assess fine-scale habitat conditions where SIORC occurs. The overall aim for this project was to understand what vegetation composition and microsite characteristics were associated with SIORC presence and abundance. This aim can be further refined into the following research questions:

1. Do physical microsite properties affect SIORC presence or SIORC abundance?
2. Do vegetation characteristics affect SIORC presence or SIORC abundance?
3. Are any species observed at Camas Meadows indicators for SIORC presence or absence?

By relating physical microsite properties and vegetation characteristics to SIORC presence and abundance, I hope to develop a better understanding of this species' ecological niche and tolerances. In addition, identifying any species that are associated with SIORC presence or absence would be helpful for identifying suitable outplanting sites. This analysis will help to inform recovery efforts for the species, including introduction efforts where suitable microsite selection can have a significant impact on seedling establishment and survival (Dunwiddie & Martin, 2016; Titus & del Moral, 1998).

Methods

Sidalcea oregana var. calva

Wenatchee Mountains checkermallow (*Sidalcea oregana* var. *calva*; "SIORC") is a perennial forb endemic to central Washington. SIORC is a narrowly distributed taxon that occurs primarily in meadows and forest edges with seasonal surface water or saturated soils in spring into early summer (Callaway & Kurz, 2020; Caplow et al., 2004; Fertig, 2022). There are currently only five known populations of SIORC ranging in size from just 5 individuals in Camas Creek tributary to over 40,000 individuals in Camas Meadows Natural Area Preserve ("Camas Lands") (Fertig, 2022). We have limited information about historic population abundance and range.

Camas Meadows Natural Area Preserve

Data collection took place at Camas Meadows Natural Area Preserve ("Camas Meadows"), Chelan County, Washington, United States. Camas Meadows is owned by Washington Department of Natural Resources (WA-DNR) and contains the largest population of SIORC with over 41,000 individuals censused between 2012 and 2022 (Fertig, 2022).[1] SIORC habitat at Camas Meadows ranges from open meadow to closed, second-growth coniferous forest, with most SIORC found in more open habitats (Fertig, 2022; Zimmerman & Reichard, 2005). SIORC also appear to occur more often in areas of the meadow where moisture persists later into summer. Forested areas of Camas Meadows are dominated by *Pseudotsuga menziesii* or *Pinus ponderosa* var. *ponderosa*; there are also riparian *Populus tremuloides* stands located

[1] >35,500 flowering individuals counted in censuses of Camas Meadows NAP from 2012-2021. Additional >5,500 flowering plants were censused during this time period in the adjacent areas of Brushy Creek and Poison Creek.

centrally and on the periphery of the meadow. Camas Meadows is a historic lakebed where the P'Squosa (Wenatchi) people harvested *Camassia quamash* and other plants for generations, including limited harvesting during the 21st century. When settlers arrived during the late 1800s, they altered the hydrology and ecology of Camas Meadows and the surrounding area. Ranchers channelized the lake in order to drain standing water and create better grazing land for their cattle and sheep. The current hydrology of the meadow is heavily influenced by these channels, but past and ongoing restoration efforts aim to restore Camas Meadow's historic hydrology (Wilderman, 2015; M Holland, personal communication, 2023). Moisture conditions are highly variable depending on the season and location within Camas Meadows. General hydrologic patterns consist of snow cover during winter and early spring, followed by standing and running water in many parts of the meadow later in spring, with most areas drying up in early summer and remaining dry until rain returns in the fall.

Transects

In summer 2022, we established 3 transects at Camas Meadows and conducted a pilot study for this project. We established 10 additional transects in 2023 using similar protocols. Transects were placed across the predominant soil moisture gradient and through a patch of SIORC, thereby covering a range of soil moisture conditions and SIORC abundances. I used elevation and soil maps, as well as aerial imagery and on-the-ground visual assessment, to estimate soil moisture gradients in Camas Meadows (USGS). I identified likely SIORC habitats using census data from WA-DNR, then re-evaluated these areas in person (Fertig, 2022; WA-DNR, unpublished). Transects were designed to run through a patch of SIORC (such that either end did not include SIORC) and across the moisture gradient (from dry to wet or vice versa)

(Figure 1.1). Transects were established in a variety of habitat types, including forest, forest edge, aspen-riparian, and open meadow (Figures 1.3 to 1.15).

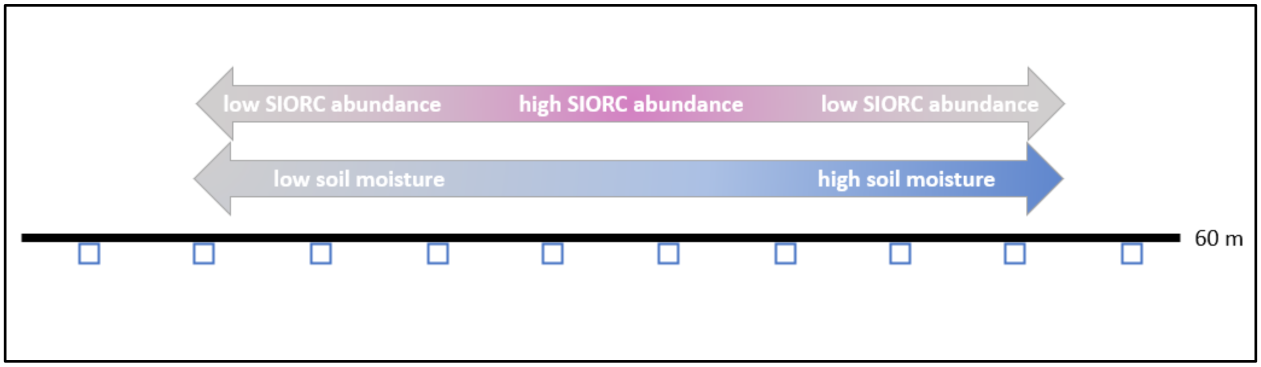

Figure 1.1 2023 transect design with an example of ideal SIORC abundance and soil moisture gradients.

In 2022, transects had variable lengths, number of plots, and intervals between plots based on the size and density of the local SIORC patch (Table 1.1). In 2023, transects were 60 m long with 10 plots at 6 m intervals. Plots size for all transects was 1x1 m. Coordinates for transects and plots are provided in Appendix A.

Table 1.1 Lengths, intervals, and number of plots for 2022 transects.

transect	length	interval	no. plots
1	48 m	4 m	12
2	48 m	4 m	12
3	66 m	6 m	11

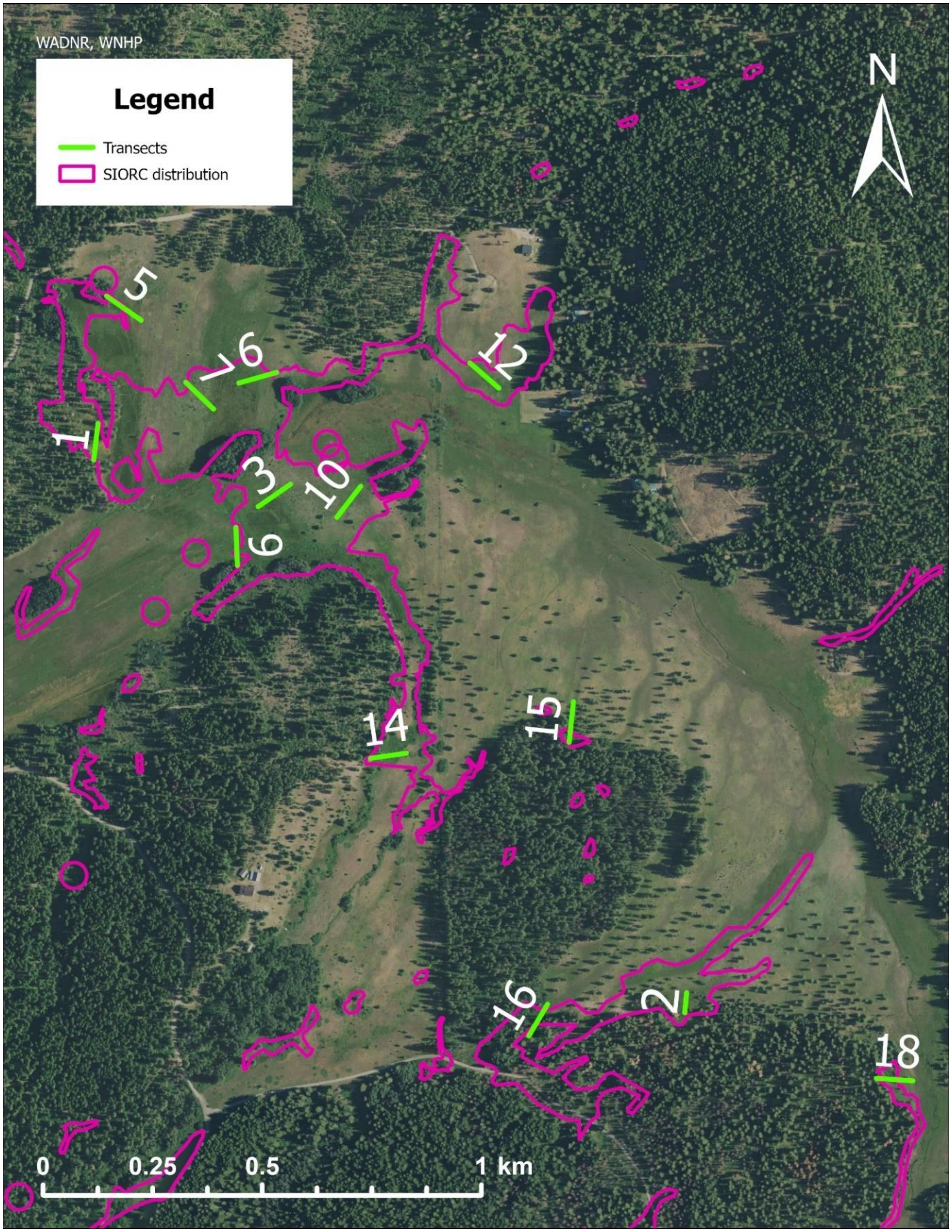

Figure 1.2 SIORC occurrences at Camas Meadows outlined in magenta based on census data collected from 2012 to 2021 (WA-DNR, unpublished). Transects from 2022 and 2023 are shown as green lines. Missing numbers (e.g., 4, 8, 11, 13, 17) were identified as potential transects but were not ultimately established.

Figure 1.3 Photos of transect 1, June 2022. The left photo is taken from the start of the transect facing south. The right photo is taken from the end of the transect facing north.

Transect 1 was established in a sparsely wooded *Pinus ponderosa* var. *ponderosa* forest edge with minimal shrub cover in the understory. Vegetation was dominated by *Wyethia amplexicaulis.*

Figure 1.4 Photos of transect 2, June 2022. The left photo is taken from the start of the transect facing south. The right photo is taken from the end of the transect facing north.

Transects 2 occurred in a narrow meadow between forest edges, beginning in a drier area closer to the wider meadow and ending in a wetter area closer to forest edge and shrubs.

Figure 1.5 Photos of transect 3, July 2022. The left photo is taken from the start of the transect facing northeast. The right photo is taken from the end of the transect facing southwest.

Transect 3 was in a central, wide-open part of the meadow. It started within 30 m of a historic, man-made channel, and most of the first half of the transect consisted of a flat, wet area dominated by moss and *Wyethia amplexicaulis*. *Symphoricarpos albus* was distributed throughout, becoming more frequent towards the end of the transect.

Figure 1.6 Photos of transect 5, June 2023. The left photo is taken about 20 m from the start of the transect facing northwest. The right photo is taken from the same position facing the end of the transect (southeast).

Transect 5 started in open meadow with grass and *Madia* sp., but the majority of the transect was heavily dominated by *Wyethia amplexicaulis.* The transect ended uphill with the last plot located in a grove of *Populus tremuloides*. This is not a true riparian zone, but the area was flooded with both running and standing water until relatively late in the season (late spring/early summer).

Figure 1.7 Photos of transect 6, May 2023. The left photo is taken from the start of the transect facing west. The right photo is taken from the end of the transect facing east.

Transect 6 began in a drier, open meadow about 50 m upslope of a small grove of *Populus tremuloides*. The middle of the transect transitioned into moderately shrubby vegetation (*Symphoricarops albus*) and ended in a wetter, less shrubby area dominated by *Wyethia amplexicaulis.* This area was burned by WA-DNR in fall 2014, and a cold burn took place in fall 2022 (Wilderman, 2015; D. Wilderman, personal communication, 2022).

Figure 1.8 Photos of transect 7, July 2023. The left photo is taken at the data logger, about 40 m from the start of the transect, facing northwest. The right photo is taken from the same position facing southeast.

Transect 7 started within 200 m of a large riparian grove of *Populus tremuloides*, then extended upslope away from the grove, with the second half heavily dominated by grasses. Like transect 6, transect 7 was burned by in fall 2014 and again in fall 2022 (Wilderman, 2015; D. Wilderman, personal communication, 2022).

Figure 1.9 Photos of transect 9, June 2023. The left photo is taken clear of the trees, about 20 m from the start of the transect, facing north. The right photo is taken from the end of the transect facing south.

Transect 9 was within 100 m of a permanent stream, as well as downstream from a French drain installed by WA-DNR. The surrounding area including transect 9 was flooded until early summer, later than any other transect areas. The transect started in a dense riparian grove of *Populus tremuloides*, then quickly transitioned into open meadow dominated by mosses and grasses and becoming increasingly dry with less moss cover heading away from the *Populus tremuloides* grove.

Figure 1.10 Photos of transect 10, May 2023. The left photo is taken from the start of the transect facing northeast. The right photo is taken from the end of the transect facing southwest.

Transect 10 was located in a wide section of open meadow and appeared drier earlier than other transects. Vegetation was dominated by grasses, interspersed with occasional *Symphoricarpus albus,* and relatively sparse compared to other transects.

Figure 1.11 Photos of transect 12, June 2023. The left photo is taken from the start of the transect facing southeast. The right photo is taken from the end of the transect facing northwest.

Transect 12 started in dry, open meadow and ended in a wet, mossy area. Vegetation was denser in the second half of the transect.


Figure 1.12 Photos of transect 14, July 2023. The left photo is taken from the start of the transect facing east. The right photo is taken from the end of the transect facing west.

Transect 14 began in a sparsely wooded *Pinus ponderosa* var. *ponderosa* forest edge with minimal understory, then entered meadow edge dominated by forbs, then crossed a narrow, man-made channel with running water year-round before entering extremely dense *Amelanchier alnifolia* for the last half of the transect.

Figure 1.13 Photos of transect 15, July 2023. The left photo is taken clear of the trees, about 10 m past the start of the transect, facing north. The right photo is taken from the end of the transect facing south.

Transect 15 began in a dense, mixed-forest edge, transitioned into forb-dominated vegetation, passed through a seasonal stream, then ended in a drier, sparsely wooded and manually thinned *Pinus ponderosa* var. *ponderosa* forest edge.

Figure 1.14 Photos of transect 16, July 2023. The left photo is taken near the mid-point of the transect facing southwest. The right photo is taken from same position facing northeast.

Transect 16 started in a mixed-deciduous-coniferous forest, then proceeded along a deer path into a small, seasonally flooded, shallow basin dominated by *Wyethia amplexicaulis* and bordered by a grove of *Populus tremuloides.* The transect ended in a drier, grass-dominated meadow within 10 m of a *Populus tremuloides* and mixed-deciduous-coniferous forest.

Figure 1.15 Photos of transect 18, June 2023. The left photo is taken from the start of the transect facing east. The right photo is taken from the end of the transect facing west.

Transect 18 began in a relatively open *Pinus ponderosa* var. *ponderosa* forest with limited understory, passed through a dense patch of *Amelanchier alnifolia* and immature *Populus tremuloides*, then ended in a drier, open meadow with occasional shrubs.

Data Collection Overview

The bulk of data collection took place in 1x1 m plots located at regular intervals along each transect (Figure 1.1). For each plot, I collected data about the number, reproductive stage and size of SIORC individuals; soil moisture; soil texture; light availability and Leaf Area Index at SIORC foliage height; canopy density; and associated species and species cover. Vegetation composition data are provided in Appendix C, and physical property data are provided in Appendix D.

Individual SIORC Measurements

For each plot, I counted the total number of SIORC individuals, and for each individual I assessed reproductive stage as either seedling, pre-flowering, or flowering, then took several measurements. In both years, I counted the number of flowering stems and measured the height of the tallest one. In 2022, I measured basal foliage width, whereas in 2023 I counted the number of basal leaves up to 10. In both years, I measured the caudex length/diameter, but my methods differed between years. In this context, we define "caudex" as the woody base of the stem. Deciding whether nearby SIORC plants are parts of the same individual would require time-consuming and disruptive excavation to determine whether the caudexes of nearby plants join underground. In 2022, we attempted to determine whether plants were connected underground by visually evaluating plant proximity and caudex characteristics (such as direction as it enters the ground). To minimize soil disturbance and ensure more efficient data collection, in 2023 we decided that any SIORC within 6 in of each other would be classified as the same individual. For this reason, count data are not comparable between 2022 and 2023.

Soil Moisture Measurements

I collected instantaneous measurements of volumetric water content (VWC) at each plot during peak flowering. VWC is the most commonly used measurement of the amount of water present in soil. In both years, I used a dielectric soil moisture sensor to measure VWC. In 2022, I measured the top 6 cm of soil using a Dynamax TH_2O portable soil moisture probe, which has a ML3 ThetaProbe soil moisture sensor and HH2 display. In 2023, I measured the top 20 cm of soil using the Spectrum TDR 150 Soil Moisture Meter. Soil moisture is averaged along the entire length of the probe, so the resulting VWC measurements are comparable to the average soil moisture at 3 cm depth in 2022, and at 10 cm depth in 2023. All measurements were made between 11 am and 3:30 pm. In 2022, I took measurements for all plots on July 6th. In 2023, I measured soil moisture for the majority of transects on June 29, but measurements for transects 16 and 18 were made on June 30 so as not to exceed the 11 am to 3:30 pm timeframe.

Soil Texture Measurements

I assessed soil texture in the field using a soil ribbon test and sent samples to Kansas State Soil Lab for a lab-based analysis. I measured soil ribbon length and grittiness for every plot using soil collected from the top 10 cm to minimize potential disturbance. Unfortunately, the presence of plant roots—particularly dense grass roots—in the soil made it difficult to accurately assess soil ribbon length. Roots in the soil can add structure, allowing for longer ribbons than would be possible with a pure soil sample. This gives the impression of a higher clay content than is accurate. In my analyses, I do not use soil ribbon length to assign soil texture. Instead, I relativize ribbon length measurements before any analysis.

For lab-based testing, I collected soil samples from each transect or plot. In 2022, I collected a composite sample for transects 1 and 3 using samples from each plot. Transect 2 was located near a culturally sensitive area, so I collected a composite sample from a somewhat similar area nearby. In 2023, I collected individual soil samples from the top 10 cm of soil adjacent to each plot. Soil samples were allowed to dry at room temperature and were sent to Kansas State Soil Lab for further preparation and analysis. The KSU Soil Lab assessed samples using a hydrometer method, wherein pre-treated soil samples are dispersed into an aqueous solution, and the rate of settling determines the proportion of particles sizes present in the soil sample. These data were reported to me as percent sand, percent silt, and percent clay for each sample.

Leaf Area Index

For each plot, I used a Meter ACCUPAR LP-80 light meter to measure photosynthetically active radiation (PAR) above and below foliage height; I took two measurements at each level, resulting in an average 'above' and an average 'below' PAR measurement for each plot. From the average above and below PAR measurements, the light meter automatically calculates Leaf Area Index (LAI), which describes the density of foliage cover in an area. All measurements were taken during peak flowering between 10:45 am and 3:00 pm. In 2022, all measurements were taken on July 6th. In 2023, Measurements for most plots were taken on July 6 under a clear sky. However, due to the sudden appearance of clouds on July 6, measurements for transects 14, 16, and 18 were taken on July 7.

Canopy Density

I assessed canopy density for each plot by using a convex, spherical densiometer to measure canopy density for each cardinal direction, then averaging those measurements to get a single value for each plot. In 2022, I measured canopy density for every plot. In 2023, I measured canopy density at the plots on either end of the transect, plus at two or three additional plots (based on the locations of continuous soil moisture sensors discussed in chapter 2). I linearly interpolated canopy density for the remaining plots.

Vegetation Composition

For each plot, I identified all plants present to the species level then estimated cover class for each species. Unknown species were identified using dichotomous keys, primarily "Flora of the Pacific Northwest" (Hitchcock & Cronquist, 2018). Species that could not be definitively identified to the species level were recorded at the genus level (e.g., *Poa* spp.). Similarly, specimens that could not be identified to the genus level were recorded at the family level (e.g., Poaceae spp.). The few plants (typically very young shoots or seedlings) that could not be identified even to the family level were lumped into an unknown forb or unknown graminoids group. Using the same cover class system, I also estimated ground cover for each plot, consisting of bare soil, moss, litter, and plant basal area (e.g., cross-section of the stem where it enters the ground). Cover estimates used the system described in Table 1.2

Table 1.2 Cover class estimates used the below system, which is a variation of the scale described by Braun-Blanquet (1932).

Class	Percent Cover Estimate	Percent Midpoint
0	0%	0%
1	0-1%	0.5%
2	1-5%	3%
3	5-15%	7%
4	15-25%	20%
5	25-50%	37.5%
6	50-75%	62.5%
7	75-100%	87.5%

All cover estimates took place during SIORC flowering. Estimates were recorded by class to avoid data entry and quality control errors but were converted to percent midpoint for data analyses. Data adjustments included removing any species with no observations and converting cover class data to percent midpoint data. A list of species observed during this study is provided in Appendix B, and vegetation composition data are provided in Appendix C.

Analysis

Data Preparation

Data were entered into Excel, and most data cleaning and organization also took place in Excel. Several data adjustments are described in more detail below. All analyses and subsequent data adjustments took place in R. I used the packages "dplyr" and "vegan" throughout for data adjustments and analyses. I used "hclust" from the "stats" package and "scree" from the "Momocs" package for conducting and assessing cluster analyses. I used the "dendextend" package for dendrogram visualization. For analysis and visualization of 2023 lab-based soil texture data, I used the “prcomp” function from the “stats” package in R along with the “ggbiplot” function from the “ggplot2” package and “TT.plot” function from “the soil texture wizard.” I used “indicspecies” from the “multipatt” package for Indicator Species Analyses.

In 2023, I was unable to measure soil moisture at 9 plots because the ground was too hard to safely and/or fully insert the sensor probes. Since the hardness of the ground was due to lack of moisture, I assigned the lowest soil moisture value measured at a particular transect to any plots in that transect where soil moisture could not be measured.

Comparing my ribbon length measurements to the results from KSU revealed that my ribbon length results were overestimated, implying a higher clay content than was accurate. In my analyses, I did not use soil ribbon length to assign soil texture. Instead, I first reduced any excessively long measurements (>10 cm) to 10 cm, which would indicate extremely high clay, and then relativized ribbon length measurements by range. These values are still not accurate, as KSU soil texture analysis did not reveal any plots with a percent clay content greater than 29%, which would correspond with no more than 5 cm soil ribbon length. Nonetheless, reducing exceptionally high values made the field-based data more accurate to the lab-based data without greatly reducing the overall range of measurements. Relativizing ribbon length measurements by range allowed me to assess relative soil texture for all plots in 2022 and 2023 without making any claims about the soil texture categorization for each plot.

Cluster Analysis

Agglomerative, hierarchical cluster analysis combines plots based on distance measures for input variables. I performed two cluster analyses: the first identified groups based on physical properties: soil moisture, canopy density, LAI, soil ribbon length and grittiness; the second identified groups based on vegetation characteristics: species richness, total cover, percent shrub cover, and percent forb cover. In each case, I relativized all variables by range and used Euclidian distance to generate distance matrices. Percent functional group cover (i.e., shrub, forb, or graminoid) for each plot was calculated by summing cover for each functional group, relativizing by total, then multiplying by 100. Since the sum of shrub, forb, and graminoid cover was 100%, graminoid cover was implicitly included in the cluster analyses due to the inclusion of forb and shrub cover in the analyses. Explicitly adding graminoid cover as a variable would weight the analysis more heavily towards functional group cover as opposed to species richness and total cover.

For each analysis, I compared single, complete, average, and Ward's minimum variance linkage methods to identify groupings with minimal chaining. Ward's method produced the most even groupings without excessive chaining and is recommended in the literature (McCune & Grace, 2002; Singh et al., 2011). I used scree plots to identify the optimal number of groups for each cluster analysis. The optimal number of groups is represented on the scree plot as the point where additional groupings do not appear to explain additional variation.

Principal Component Analysis

Principal Component Analysis (PCA) reduces data dimensionality by synthesizing new variables called principal components, which are composites of the original variables (Bakker, 2024). PCA sequentially and repeatedly rotates the data cloud and identifies an axis that explains as much variation as possible. Each of these axes is a principal component, which can be used for data reduction. PCA works better with highly correlated variables.

I performed a PCA of my soil texture percent data from 2023 (derived from the lab-based analysis at KSU) to produce principal components that represent soil texture as a whole. PC1 explained about 61% of the observed variation, and PC2 explained the remaining 39% of variation (Appendix F). Lab-based soil texture data from 2022 were not included in these analyses as we did not sample individual plots.

Permutational Multivariate Analysis of Variance

Permutational Multivariate Analysis of Variance (PERMANOVA) is a robust, permutation-based statistical test that does not require assumptions about multivariate normality or homogeneity of variances (Bakker, 2024). PERMANOVA compares the variation between groups to variation among groups (Bakker, 2024). Results of the test include degrees of freedom, R-squared value, F-statistic, and a p-value for each explanatory variable, the residual, and the total.

I used PERMANOVA throughout my analyses to test for relationships between SIORC presence or SIORC abundance and microsite variables. When SIORC presence was the response variable, all plots were included. When using SIORC abundance as a univariate response variable, I subset the data to include only plots where SIORC were present. Explanatory variables consisted of groups produced by each cluster analysis (i.e., physical property groups and vegetation characteristics groups), as well as the microsite variables the cluster analyses were based on (soil moisture, LAI, canopy density, ribbon length and grittiness). For 2023 data, I also used principal components 1 and 2 from my soil texture PCA as explanatory variables. To control for spatial correlation among sensors, I also added coordinates for each sensor (easting and northing relativized by range) as the first and second explanatory variable of all PERMANOVAs.

I report full results for my PERMANOVA tests in Appendix F. As a default, I used $p < 0.05$ as the threshold for significance, and interpreted $p < 0.1$ as indicating marginal significance. Many of my PERMANOVAs used only a single response variable (SIORC presence or SIORC abundance), in which case I used Euclidian distances. In these instances, my PERMANOVA tests were equivalent to Analysis of Variance (ANOVA). I used Type I Sums of Squares (SS) for all PERMANOVA tests. Type I SS tests each explanatory variable sequentially, assigns as much variation as possible to the first variable, then the second, and so on. All tests included easting and northing for each plot as the first two explanatory variables. This ensured that any spatial correlation was accounted for before assigning variation to the final explanatory variable(s). I used Bray-Curtis distance measurements when my response variables were multivariate and based on abundance data. Each PERMANOVA test had 9999 permutations.

Indicator Species Analysis

Indicator Species Analysis (ISA) is a test that identifies species that are indicators for one or more groups (Bakker, 2024). ISA calculates a test statistic called an Indicator Value, which is based on specificity (relative abundance) and fidelity (relative frequency) relative to some grouping variable (Bakker, 2024).

I conducted an ISA on my species abundance data (other than SIORC) against grouping according to presence or absence of SIORC. I tested abundance data from 2022 and 2023 together, then tested abundance data separately for 2022 and 2023 since cover estimates may vary year-to-year according to phenology and observer bias or error.

Results

Physical Microsite Properties

I performed an agglomerative, hierarchical cluster analysis to identify groups of plots based on physical properties: soil moisture, canopy density, LAI, and soil texture (ribbon length and grittiness) (Figure 1.16). Visual assessment of a scree plot showed that, beyond 4 groups, adding additional groups did not greatly increase the amount of variation explained (Appendix E). Using 4 groups, I calculated mean values for each physical property (Table 1.3).

Table 1.3 Mean physical property values for each physical properties cluster analysis group.

group	n	LAI (m^2/m^2)	canopy density	% soil moisture	ribbon length (cm)	grittiness
Wet Meadow	55	2.15	3.2	30.5	4.4	2.1
Dry Understory	20	1.62	42.7	15.9	4.2	1.9
Sandier	32	1.01	12.5	18.9	4.6	3.4
Higher Clay	28	1.19	2.6	25.7	7.7	2.0

The groups identified may be described as wet meadow, dry understory, sandier, and higher clay. Wet meadow was the largest group; it had the highest LAI and soil moisture, as well as low canopy density. The smallest group was dry understory, which was characterized by the highest canopy density and the lowest soil moisture. The remaining two groups were similar in size—the sandier group had the lowest LAI and the highest grittiness; the higher clay group had the lowest canopy density, relatively high soil moisture, and by far the highest ribbon length. These patterns are consistent with what I observed in the field. The meadow of Camas Meadows is a basin that retains water for longer than the surrounding forested areas, hence the division between wet meadow and dry understory. Additionally, the highest clay content in Camas Meadows is likely in the basin, which was historically a lake and is now a seasonally flooded meadow. The higher clay group had the lowest canopy density, reflecting an association with the meadow. The higher clay group also had a higher average soil moisture than the sandier group. Soil moisture measurements were made in early July after a month and a half with less than half an inch of precipitation. The amount of soil moisture therefore likely reflects that smaller clay particles retain moisture more readily than sand.

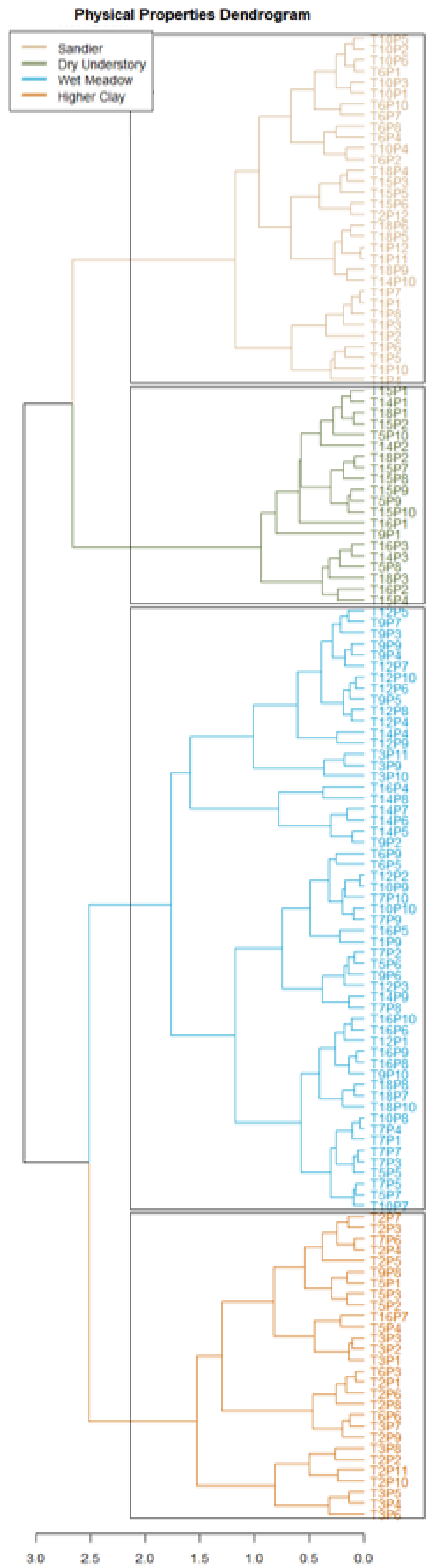

Figure 1.16 Dendrogram of groups based on physical properties.

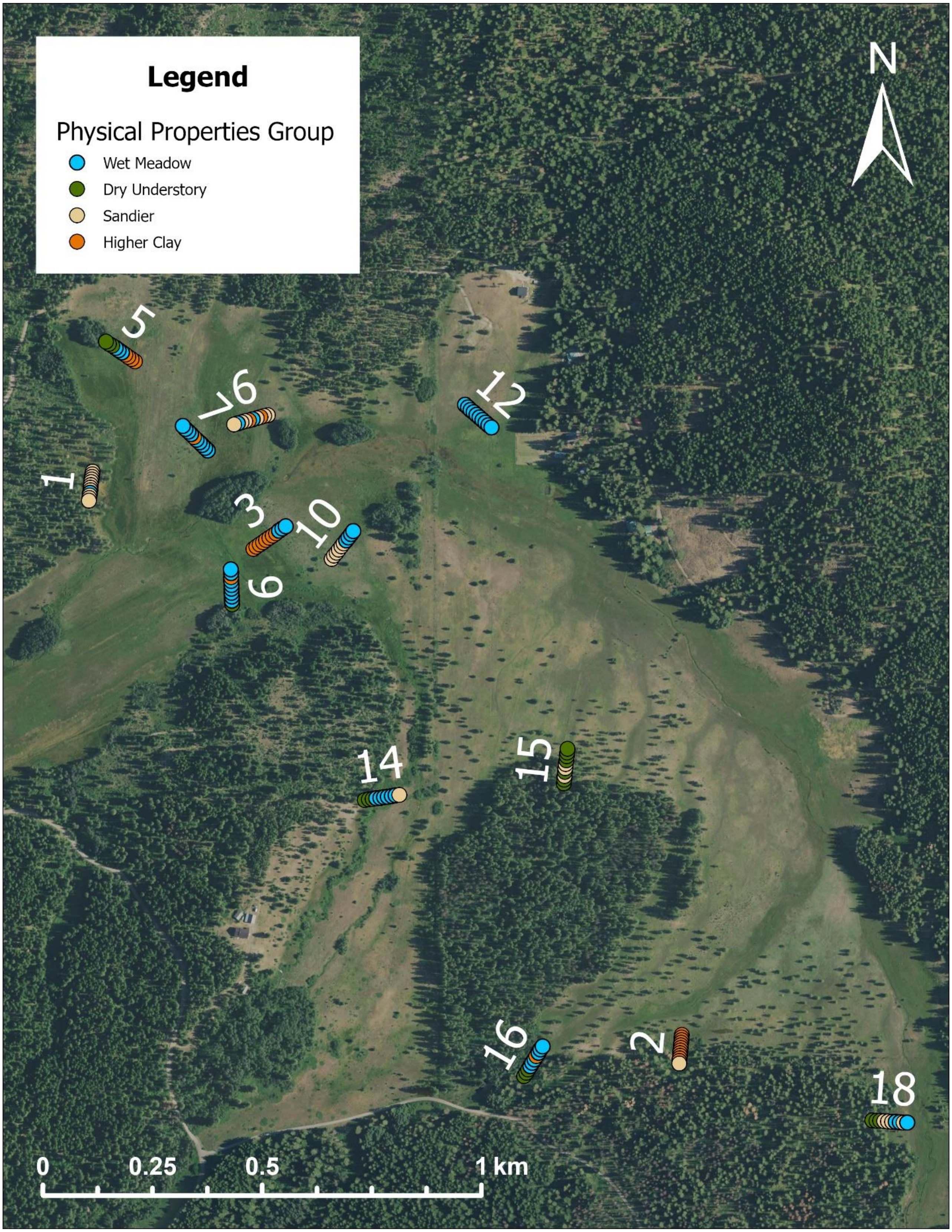

Figure 1.17 Map showing the physical properties groups for each plot for all transects.

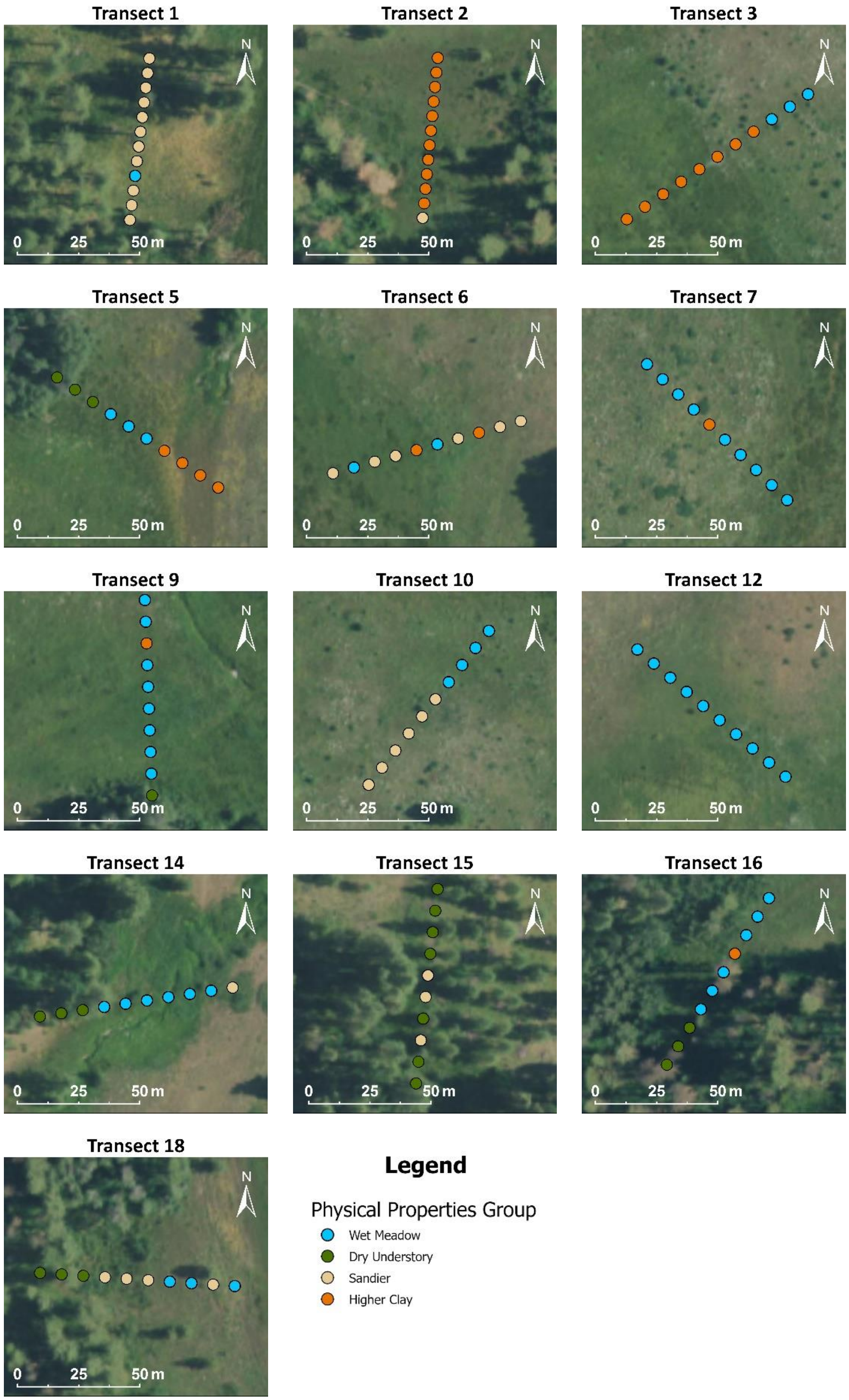

Figure 1.18 Individual maps showing the physical properties group for each plot for each transect.

Following this cluster analysis, I conducted PERMANOVAs to individually compare SIORC abundance and presence to physical property groups. I controlled for spatial correlation among plots by adding the coordinates for each plot as explanatory variables. In both cases, I found no significant relationship to physical property groups (Appendix F).

Lab-based Soil Texture Analyses

Lab-based techniques are much more accurate at assessing soil texture than field-based techniques. However, due to differences in sampling protocols between 2022 and 2023, lab-based analysis of soil texture is only available at the plot level for transects established in 2023. Although analysis of these soil texture data is limited to 2023, these data are highly valuable due to their improved accuracy relative to field-based assessments of soil texture.

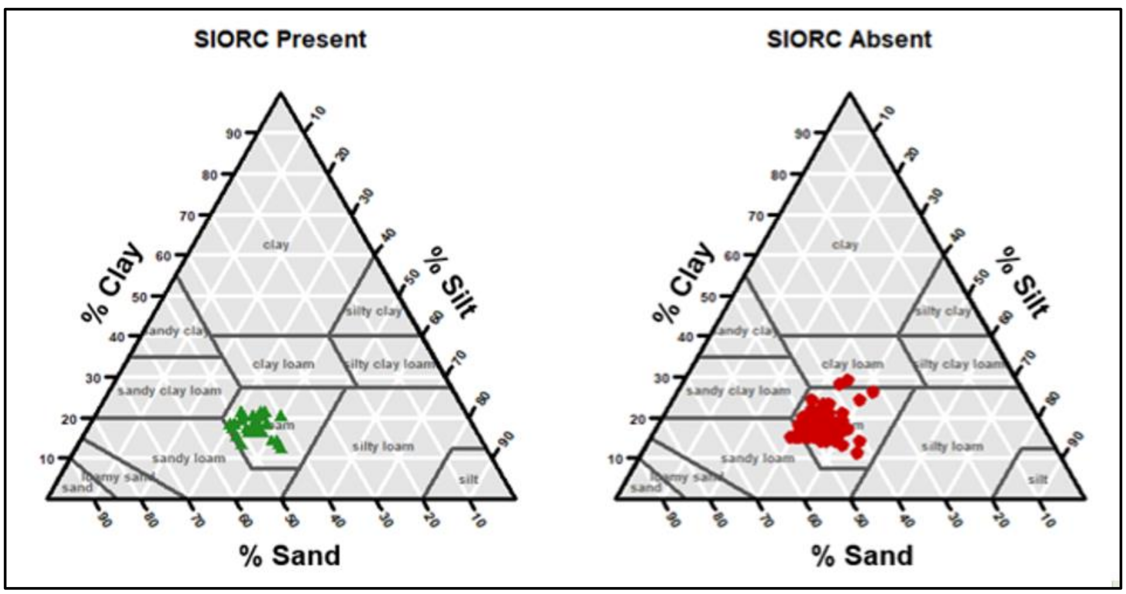

Figure 1.19 Soil texture for each plot superimposed onto a soil texture triangle. Plots where SIORC was present are shown on the left, and plots where SIORC was absent are shown on the right. All plots containing SIORC had loam soil texture. Figure created using “The soil texture wizard” package in R, created by Julien Moeys.

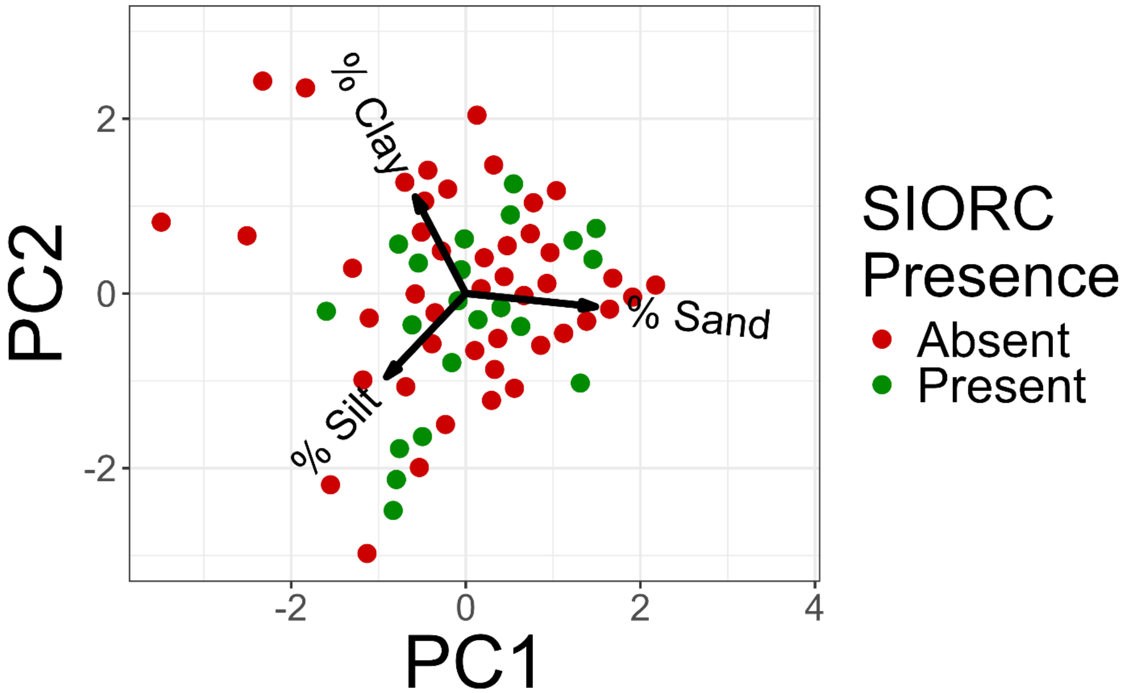

Figure 1.20 Biplot of both principal components from a PCA of 2023 soil texture percent data. Soil texture for each plot in 2023 is symbolized according to SIORC presence. Vectors for texture percents point towards increasing values. Higher PC1 scores are associated with a greater percentage of sand. Higher PC2 scores indicate greater clay content, whereas lower PC2 scores indicate greater silt content.

PC2 had a significant effect on SIORC presence *($F = 5.32$, $p < 0.05$)*, but PC1 did not (Table 1.4). Neither principal component significantly affected SIORC abundance in plots that contained SIORC (Appendix F). Average percent clay was slightly lower (17.2%) and percent silt was slightly higher (36.1%) for plots with SIORC than for plots without SIORC (clay = 18.5%; silt = 35.3%).

Table 1.4 PERMANOVA results examining the variance explained and significance of soil texture principal component 2 on SIORC presence.

	Df	**SS**	**R2**	**F**	**Pr(>F)**
easting	1	0.23	0.01	1.11	0.288
northing	1	0.56	0.03	2.64	0.104
PC2	1	1.12	0.05	5.32	0.024
Residual	96	20.20	0.91		
Total	99	22.11	1.00		

Vegetation Characteristics

I performed an agglomerative, hierarchical cluster analysis to identify groups of plots based on vegetation characteristics: species richness, total vegetation cover, percent forbs cover, and percent shrubs cover (Figure 1.21). Since percent forbs cover, percent shrubs cover, and percent graminoid cover sum to 100%, it would be repetitive to include all three. As with the physical properties cluster analysis, Ward's minimum variance (ward.D2 in R) produced the most even groups with the least chaining, and is recommended by Singh et al. (2011) as well as McCune and Grace (2002). Visual assessment of a scree plot supported 5 groups (Appendix E).

Table 1.5 Mean vegetation characteristic values for each vegetation characteristic cluster analysis group.

group	n	species richness	total cover	% forb cover	% shrub cover
Sparse	61	11.8	37.4	82.1	2.4
Dense	27	12.4	94.8	89.4	3.8
Species-rich	22	18.5	68.2	85.0	4.8
Grassy	9	10.3	54.7	22.7	0.2
Shrubby	16	11.8	53.3	24.5	69.0

The groups identified may be described as "sparse," "dense," "species-rich," "grassy," and "shrubby." Three groups, "sparse," "dense", and "species-rich," were dominated by forbs, had low grass cover, and had very low shrub cover. The "sparse" group was by far the largest group with over 45% of all plots. The "dense" and "species-rich" groups were similar in size, accounting for 20% and 16% of plots, respectively. The smallest group was the "grassy" group, which had the highest graminoid cover, lowest species richness, lowest forb cover, and the lowest shrub cover of all the groups. The last group was the "shrubby" group, which had by far the highest shrub cover, and had low total cover and forbs cover.

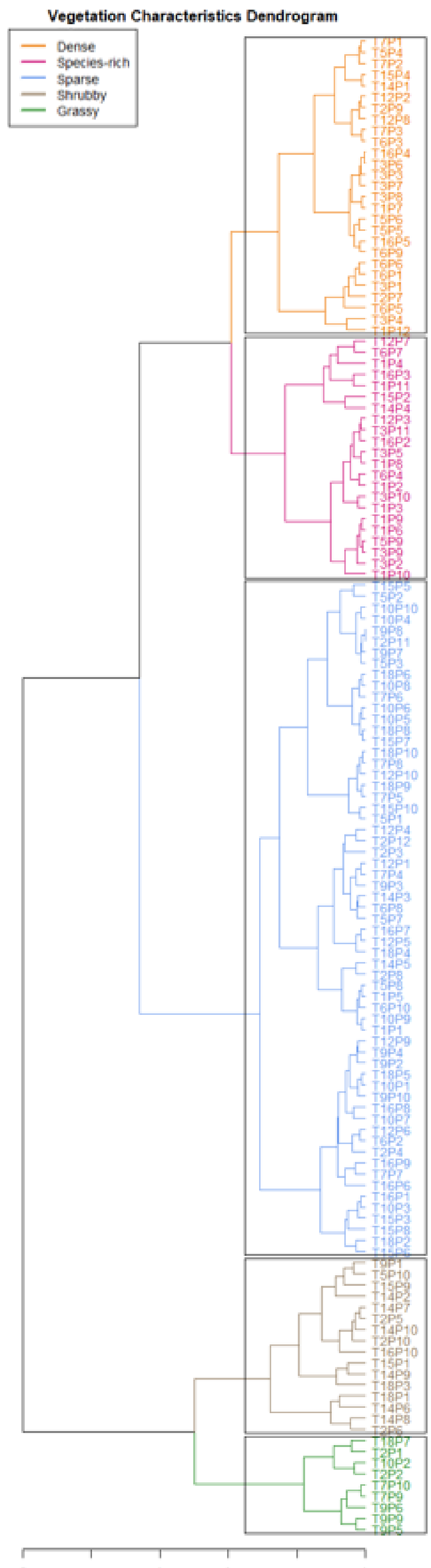

Figure 1.21 Dendrogram of groups based on vegetation characteristics.

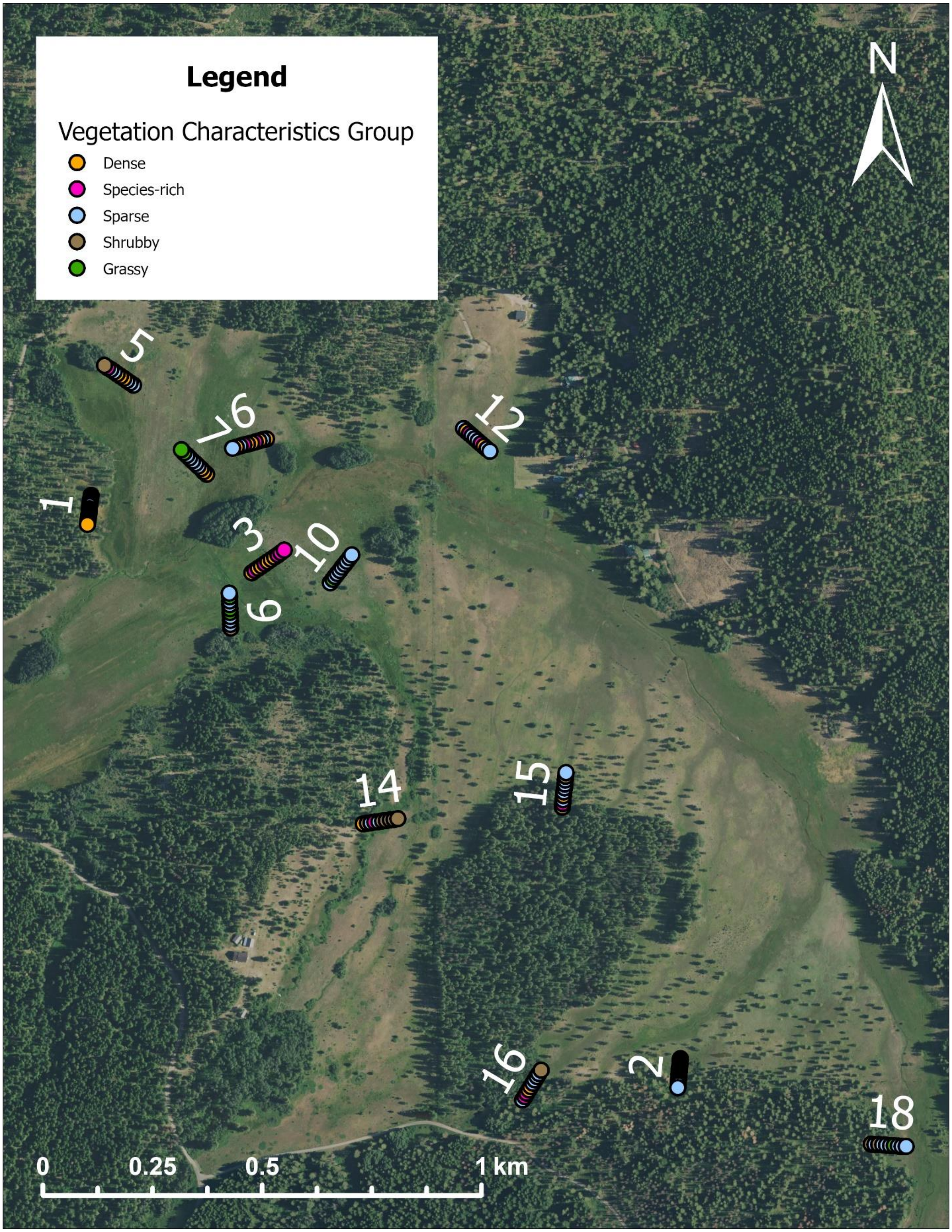

Figure 1.22 Map showing the vegetation characteristics group for each plot for all transects.

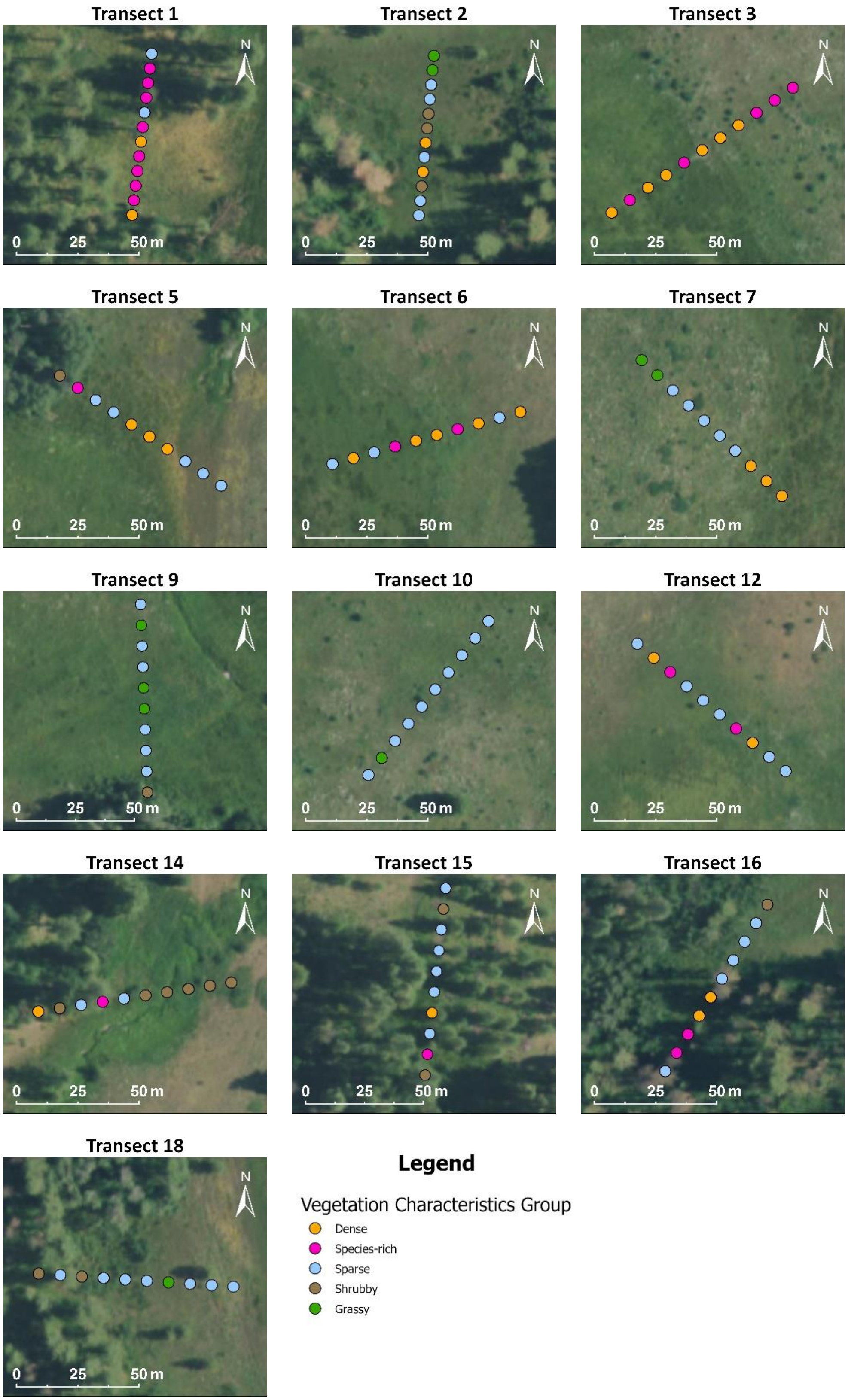

Figure 1.23 Individual maps showing the vegetation characteristics group for each plot for each transect.

For each group, I calculated the number of plots where SIORC were present, the proportion of plots where SIORC were present, and the average abundance of SIORC in plots with SIORC. Shrubby and grassy plots had the lowest number of plots with SIORC and the lowest proportion of plots with SIORC. Dense and species-rich plots had the highest proportion of plots with SIORC. Dense plots had the highest SIORC abundance and shrubby plots had the lowest SIORC abundance. PERMANOVA analyses did not indicate a relationship between SIORC abundance (in plots where SIORC were present) and grouping based on vegetation characteristics (Appendix F).

Table 1.6 Summary of SIORC distribution per group: number of plots with SIORC; percentage of plots with SIORC; and mean SIORC abundance in plots where SIORC is present.

group	n	No. plots w/SIORC	% plots w/SIORC	Mean SIORC abundance
Sparse	61	19	31.1	1.9
Dense	27	14	51.9	9.4
Species-rich	22	14	63.6	3.5
Grassy	9	2	22.2	3.0
Shrubby	16	2	12.5	0.5

I also used PERMANOVA to test for a relationship between SIORC presence and grouping according to vegetation characteristics. I controlled for spatial correlation among plots by adding the easting and northing for each plot as explanatory variables. Vegetation group explained about 9% of the observed variation ($F = 3.110, p < 0.05$) (Table 1.7). Easting also had a marginally significant effect on SIORC presence and explained 2% of the observed variation as the first term in a Type I Sums of Squares approach (Table 1.7).

Table 1.7 PERMANOVA results examining the variance explained and significance of vegetation characteristic groups on SIORC presence.

	Df	SS	R2	F	Pr(>F)
easting	1	0.78	0.02	3.54	0.059
northing	1	0.24	0.01	1.08	0.312
group	4	2.72	0.09	3.11	0.016
Residual	128	28.00	0.88		
Total	134	31.7	1		

Pairwise comparisons showed that SIORC presence in sparse vs dense groups were the only significant comparison, with SIORC more likely to occur in dense plots (*$F = 6.58, p<0.05$*) (Table 1.8).

Table 1.8 Pairwise comparison results comparing the variance explained and significance of pairs of vegetation characteristic groups on SIORC presence.

pairs	Df	SS	F.model	R2	p-value	adj p-value
Sparse vs Species-rich	1	19.20	2.84	0.08	0.107	1
Sparse vs Dense	1	450.01	6.58	0.18	0.004*	0.04*
Sparse vs Shrubby	1	3.65	0.73	0.04	0.464	1
Sparse vs Grassy	1	2.11	0.42	0.02	0.528	1
Species-rich vs Dense	1	246.04	2.99	0.10	0.109	1
Species-rich vs Shrubby	1	15.38	1.89	0.12	0.233	1
Species-rich vs Grassy	1	0.38	0.05	0.00	1.000	1
Dense vs Shrubby	1	138.40	0.96	0.06	0.308	1
Dense vs Grassy	1	71.52	0.49	0.03	0.607	1
Shrubby vs Grassy	1	6.25	Inf	1.00	0.333	1

Following this cluster analyses, I performed PERMANOVAs individually assessing the relationship between SIORC presence and each vegetation characteristic (Tables 1.9, 1.10, and Appendix F). Species richness *($F = 11.01, p < 0.01$)* and forb cover *($F = 4.70, p < 0.05$)* significantly affected SIORC presence (Tables 1.9 and 1.10). Total cover and shrub cover marginally significantly affected SIORC presence *($p < 0.1$)* (Appendix F).

Table 1.9 PERMANOVA results examining the variance explained and significance of species richness on SIORC presence.

	Df	SS	R2	F	Pr(>F)
easting	1	0.77	0.02	3.58	0.058
northing	1	0.24	0.01	1.09	0.309
species richness	1	2.38	0.08	11.01	0.002
Residual	131	28.34	0.89		
Total	134	31.73	1.00		

Table 1.10 PERMANOVA results examining the variance explained and significance of forb cover on SIORC presence.

	Df	SS	R2	F	Pr(>F)
easting	1	0.77	0.02	3.42	0.063
northing	1	0.24	0.01	1.04	0.320
forb cover	1	1.06	0.03	4.70	0.032
Residual	131	29.66	0.93		
Total	134	31.73	1.00		

I also used PERMANOVA to test abundance in plots containing SIORC versus each vegetation characteristic (Table 1.11 and Appendix F). Of these, total cover had a highly significant effect on SIORC abundance ($F = 10.73, p < 0.001$) (Table 1.11). No other vegetation characteristic significantly affected SIORC abundance (Appendix F).

Table 1.11 PERMANOVA results examining the variance explained and significance of total cover on SIORC abundance in plots where SIORC is present.

	Df	SS	R2	F	Pr(>F)
easting	1	1.21	0.00	0.03	0.877
northing	1	33.64	0.01	0.72	0.376
total cover	1	503.66	0.18	10.73	0.0005
Residual	47	2206.29	0.80		
Total	50	2744.79	1.00		

Indicator Species Analysis

I conducted an Indicator Species Analysis (ISA) for all species abundance data from 2022 and 2023. This analysis identified 1 species that was an indicator for SIORC absence and multiple species that were indicators for SIORC presence. However, only *Achillea millefolium* had an indicator value above the typical 0.5 cut-off *(IndVal = 0.529, $p < 0.05$)* (Table 1.13). All indicator species identified with p-values < 0.05 are included for completeness, but only *Achillea millefolium* is supported based on both its p-value and indicator value (Table 1.12 and 1.13).

Table 1.12 Indicators of SIORC absence based on an ISA using data from both 2022 and 2023.

Scientific Name	**Species Code**	**IndVal**	**Pr(>F)**
Amelanchier alnifolia	AMALN	0.181	0.025

Table 1.13 Indicators of SIORC presence based on an ISA using data from both 2022 and 2023.

Scientific Name	**Species Code**	**IndVal**	**p-value**
Achillea millefolium	ACMIL	0.529	0.025
Wyethia amplexicaulis	WYAMP	0.345	0.045
Viola adunca	VIADU	0.218	0.01
Taraxcum officinale	TAOFF	0.210	0.045
Bistorta bistortoides	BIBIS	0.206	0.005
Festuca idahoensis	FEIDA	0.119	0.015
Geum triflorum	GETRI	0.115	0.01

Because vegetation cover estimates can differ by year depending on phenology, observer calibration, and observer error, I also conducted separate ISAs for 2022 and 2023. When abundance data from 2022 were analyzed, no statistically significant indicator species were detected. For 2023, the ISA identified 1 significant indicator for SIORC absence and 1 significant indicator for SIORC presence.

Table 1.14 Indicators of SIORC absence based on an ISA using data from 2023.

Scientific Name	Species Code	IndVal	p-value
Amelanchier alnifolia	AMALN	0.221	0.045

Table 1.15 Indicators of SIORC presence based on an ISA using data from 2023.

Scientific Name	Species Code	IndVal	p-value
Taraxcum officinale	TAOFF	0.242	0.025

Discussion

This research attempted to identify SIORC's habitat requirements by assessing whether physical microsite properties or vegetation characteristics affected the presence and abundance of SIORC. It investigated how these site-specific conditions influenced where SIORC occurs and, if it is present, how abundant it was in those locations.

Physical Microsite Properties

The hierarchical cluster analysis of physical microsite characteristics, including soil moisture, canopy density, LAI (Leaf Area Index), and soil texture (ribbon length and grittiness), successfully identified four distinct groups: wet meadow, dry understory, sandier, and higher clay (Figure1.16). The wet meadow group, characterized by high LAI and soil moisture as wells low canopy density, contained over 40% of plots. This group's characteristics align with conditions typically found in the basin of Camas Meadows, where SIORC occurs more frequently (Fertig, 2022). In contrast, the dry understory group exhibited the highest canopy density and lowest soil moisture, reflecting more typical understory conditions. With an average canopy density of around 43%, this degree of canopy cover seems more similar to forest-edge conditions than full forest. The last two groups, which were similar in size, were differentiated by their soil characteristics. The "sandier" group had a greater sand content, and the "higher clay" group had a greater clay content. The higher clay group also exhibited higher average soil moisture, presumably due to its finer particles that retain water more readily than coarser sandy soil.

Despite these clear physical distinctions among groups of plots, subsequent PERMANOVA analyses showed no significant relationships between SIORC presence or abundance and the physical property groups (Appendix F). This lack of significant correlation suggests that SIORC presence and abundance are not driven by these physical properties. SIORC distribution may instead be governed by some other variable, such as vegetation or other biotic interactions, or by physical characteristics over time. This study of physical microsite characteristics represents a brief period in the lives of these long-lived individuals, and it is likely that longer trends over time have a stronger effect on SIORC's distribution.

Lab-based Soil Texture Analyses

The PCA of soil texture data constructed two principal components that explain 100% of variation. PC1 was associated with percent sand, while PC2 indicated both clay and silt content. PERMANOVA results showed that PC2 had a significant effect on SIORC presence ($F = 5.32$, $p < 0.05$), suggesting that clay content might be a relevant factor for SIORC presence (Table 1.4). However, neither principal component significantly affected SIORC abundance in plots containing SIORC (Appendix F). These results are in contrast to the results described above, in which soil texture based on ribbon length and grittiness did not explain variation in SIORC presence and abundance. This lab-based assessment of soil texture is much more accurate than field-based methods and may reveal more subtle relationships between SIORC and soil texture.

However, the data are limited to 2023 and may not represent the full variation of SIORC microsite conditions.

Vegetation Characteristics

The cluster analysis of vegetation characteristics yielded five groups: sparse, dense, species-rich, grassy, and shrubby (Figure 1.21). Over 45% of plots fell into the sparse group, which had the lowest total cover of any group and was dominated by forbs. The dense group had the highest total cover and was also dominated by forbs. The species-rich group had the second-highest total cover and was also dominated by forbs. The remaining two groups both had moderate total cover and were differentiated by the dominant cover type: shrubs vs graminoids. The shrubby group had the highest shrub cover with low forb cover and minimal graminoid cover. The grassy group had the lowest species richness of all the groups, was the smallest group, and was characterized by high graminoid cover, moderate forb cover, and extremely low shrub cover. These groupings reflect the dominance of forb cover in the plots sampled at Camas Meadows—over 80% of plots sampled were dominated by forbs, which aligns perfectly with the number of plots identified with forb-dominant groups. Within the forb-dominated plots, some were further distinguished by higher or lower total cover, while others were classified based on greater species richness, highlighting the significant role of forb cover in defining vegetation characteristics at Camas Meadows.

PERMANOVA analysis indicated that grouping based on vegetation characteristics significantly explained about 9% of the variation in SIORC presence *($F = 3.110, p < 0.05$)* (Table 1.7). In particular, pairwise comparisons revealed a significant difference between sparse and dense groups *($F = 6.58, p < 0.05$)*, suggesting that vegetation density strongly correlates with SIORC presence (Table 1.8). However, because SIORC are included in the total cover of each plot, this relationship is somewhat circular. PERMANOVA analyses of individual vegetation characteristics also revealed significant effects of species richness and forb cover on SIORC presence, with species richness showing a particularly strong relationship *($p < 0.01$)* (Table 1.9). While total cover did not significantly affect SIORC presence, it strongly affected SIORC abundance ($p < 0.001$) (Table 1.11). Comparing these results to the presence and abundance of SIORC in each group of plots suggests that areas with higher species richness and forb cover are more likely to support SIORC, whereas areas dominated by shrubs may be less likely to contain SIORC.

Indicator Species Analysis

The Indicator Species Analysis (ISA) identified several species associated with SIORC presence and one species associated with SIORC absence. In 2023, as well as in the combined analysis of data from both years, *Amelanchier alnifolia* was an indicator of SIORC absence. In contrast, another shrub, *Symphoricarpos albus*, was slightly more abundant and widespread, but was not identified as an indicator species for SIORC absence. This suggests that there may be some underlying factor that causes *Amelanchier alnifolia* not to co-occur with SIORC, whereas *Symphoricarpos albus* does not exhibit such a relationship. However, *Amelanchier alnifolia* had a low indicator value (< 0.5) in both analyses and a relatively high p-value in for the analysis of just 2023 data *($p = 0.045$)* (Tables 1.12 and 1.14). Further research is needed to clarify the relationship between *Amelanchier alnifolia* and SIORC.

Of the indicators for SIORC presence, *Achillea millefolium* stands out based on its high indicator value and low p-value. *Achillea millefolium* had the highest indicator value of any species as well as a low p-value (*IndVal = 0.528,* $p < 0.05$), which makes it a compelling indicator for SIORC presence (Table 1.13). Another species, *Taraxacum officinale*, appeared as an indicator for SIORC presence in the ISA analysis for just 2023 data as well as the analysis for both years of data (Tables 1.13 and 1.15). However, *Taraxacum officinale* had low indicator values in both analyses (<0.25) and a relatively high p-value in the ISA for both years of data ($p = 0.045$) (Tables 1.13 and 1.15).

The lack of consensus between ISAs based on just 2022, just 2023, and both years data suggests that these results should be interpreted cautiously. *Achillea millefolium* has the strongest support based on the combination of high indicator value and low p-value, but it only appeared as an indicator in the analysis of both years of data. Additional analyses and additional data collection might help to clarify which species should be used as indicators for the presence or absence of SIORC.

Conclusion

Hierarchical cluster analyses identified clear groupings based on physical and vegetation microsite characteristics, though these groupings did not necessarily relate to SIORC abundance or presence. No single physical property or grouping based on physical properties significantly affected either SIORC presence or abundance. However, when examining just data from 2023, PC2 of the soil Principal Component Analysis (associated with silt vs clay) did significantly affect SIORC presence. Regarding vegetation characteristics, vegetation grouping did significantly affect SIORC presence, as did species richness and forb cover. Total cover did not affect SIORC presence but was strongly correlated with SIORC abundance. Indicator Species Analyses using data from 2022 alone, 2023 alone, plus 2022 and 2023 together identified potential indicator species for SIORC presence and absence. While there was no consensus among the three tests, *Achillea millefolium* appears to be an indicator for SIORC presence based on the analysis of both years of data.

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Chapter 2

Effects of dynamic soil moisture patterns on SIORC presence and abundance

Introduction

Understanding soil moisture dynamics is critical for the conservation and management of rare plant species as it directly influences their survival, growth, and distribution. Soil moisture availability governs ecological processes such as photosynthesis, seed germination, and nutrient uptake, all of which are crucial for the persistence of rare plant populations (Schott et al., 2014; Titus & del Moral, 1998; Varty & Zedler, 2008). These fluctuations can be particularly pronounced in western meadows, where snowmelt and summer drought create periods of high and low moisture availability (Albano et al., 2019; Evans & Fonda, 1990). The timing and duration of these moisture periods are critical for plant species that rely on specific moisture conditions for different life stages. In order to understand how SIORC populations are affected by soil moisture, it is essential that we understand temporal soil moisture patterns at Camas Meadows.

Despite the recognized importance of soil moisture for plant survival, detailed studies on the temporal dynamics of soil moisture have yet to be applied to study rare plant species in the field. While many studies investigate soil moisture thresholds for seed germination, and other studies examine the effects of climate and soil microsite characteristics on plants more generally, no published paper has assessed the effects of temporal soil moisture patterns on rare plants in situ (Butterfield et al., 2016; Frindte et al., 2019; Jiménez-Alfaro et al., 2024; Lee et al., 2017; Rühl et al., 2015; Walter, 2018). Research into soil moisture conditions is often limited to single points in time at a large scale rather than examining how soil moisture changes throughout the growing season. In this study, I used 30 continuous soil moisture sensors to investigate fine-scale relationships between soil moisture temporal patterns SIORC at Camas Meadows. My research focuses on several key questions:

1. How does soil moisture change over time at Camas Meadows?
2. Is there a relationship between SIORC presence and soil moisture characteristics?
3. Is there a relationship between the number of SIORC individuals and soil moisture characteristics?
4. Is there a relationship between SIORC abundance and soil moisture characteristics?

Understanding the temporal patterns of soil moisture is crucial for identifying critical periods of moisture availability and scarcity. By analyzing soil moisture data throughout the growing season, I aim to characterize these patterns and their potential impact on SIORC. In particular, I will investigate whether SIORC distribution is influenced by the timing of steep declines in soil moisture or the timing of soil moisture availability more generally. This aspect of the study will help determine if SIORC has specific moisture requirements that influence its distribution and abundance.

To address these questions, I employed locally estimated scatterplot smoothing (LOESS) to model non-linear soil moisture data and fill in gaps caused by missing data points. Following this, I used a cluster analysis to identify groups sensors with similar soil moisture characteristics, and compared both the soil moisture groups and the soil moisture variables themselves to SIORC presence, count, and abundance. This approach allowed me to capture the temporal dynamics of soil moisture and relate them to the ecological patterns observed in SIORC populations. By combining soil moisture analyses with ecological data, we aim to provide a comprehensive understanding of how moisture availability influences the distribution and abundance of this rare plant species at Camas Meadows.

Methods

Transects

In spring 2023, I established 10 transects at Camas Meadows that ran across the predominant soil moisture gradient and through a patch of SIORC. I used elevation and soil maps, as well as aerial imagery and on-the-ground visual assessment, to estimate soil moisture gradients in Camas Meadows (USGS). I identified likely SIORC habitats using census data from WA-DNR, then re-evaluated these areas in person (Fertig, 2022; WA-DNR, unpublished). Transects were designed to run through a patch of SIORC (such that either end did not include SIORC) and across the moisture gradient (from dry to wet or vice versa), thereby covering a range of soil moisture conditions and SIORC abundances. All transects were 60 m long with 10, 1x1 m plots at 6 m intervals. Each transect also had a 2 x 60 m strip transect divided into 2 m bins. The only data collected in this strip transect were count of flowering SIORC.[2]

[2] SIORC count for each transect took place on the first date of vegetation cover data collection (around peak SIORC flowering).

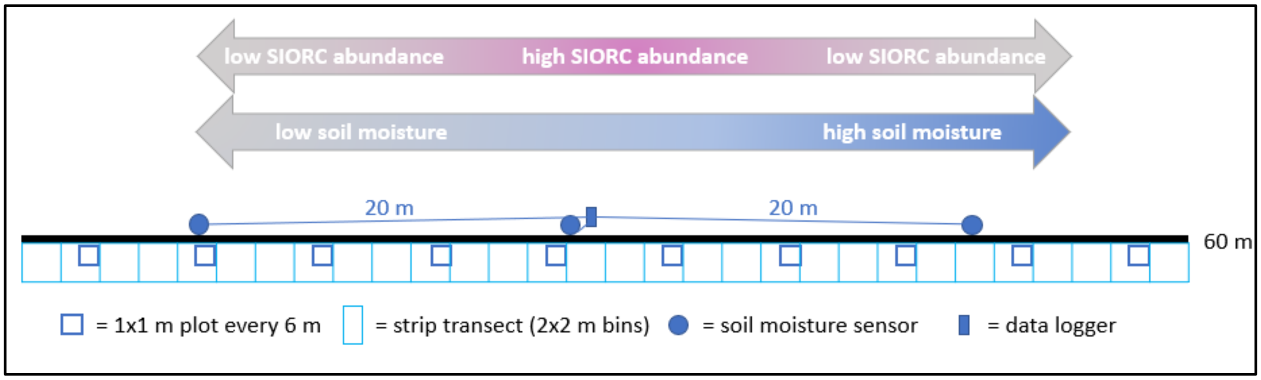

Figure 2.1 2023 transect design with continuous soil moisture sensors and an example of ideal SIORC abundance and soil moisture gradients.

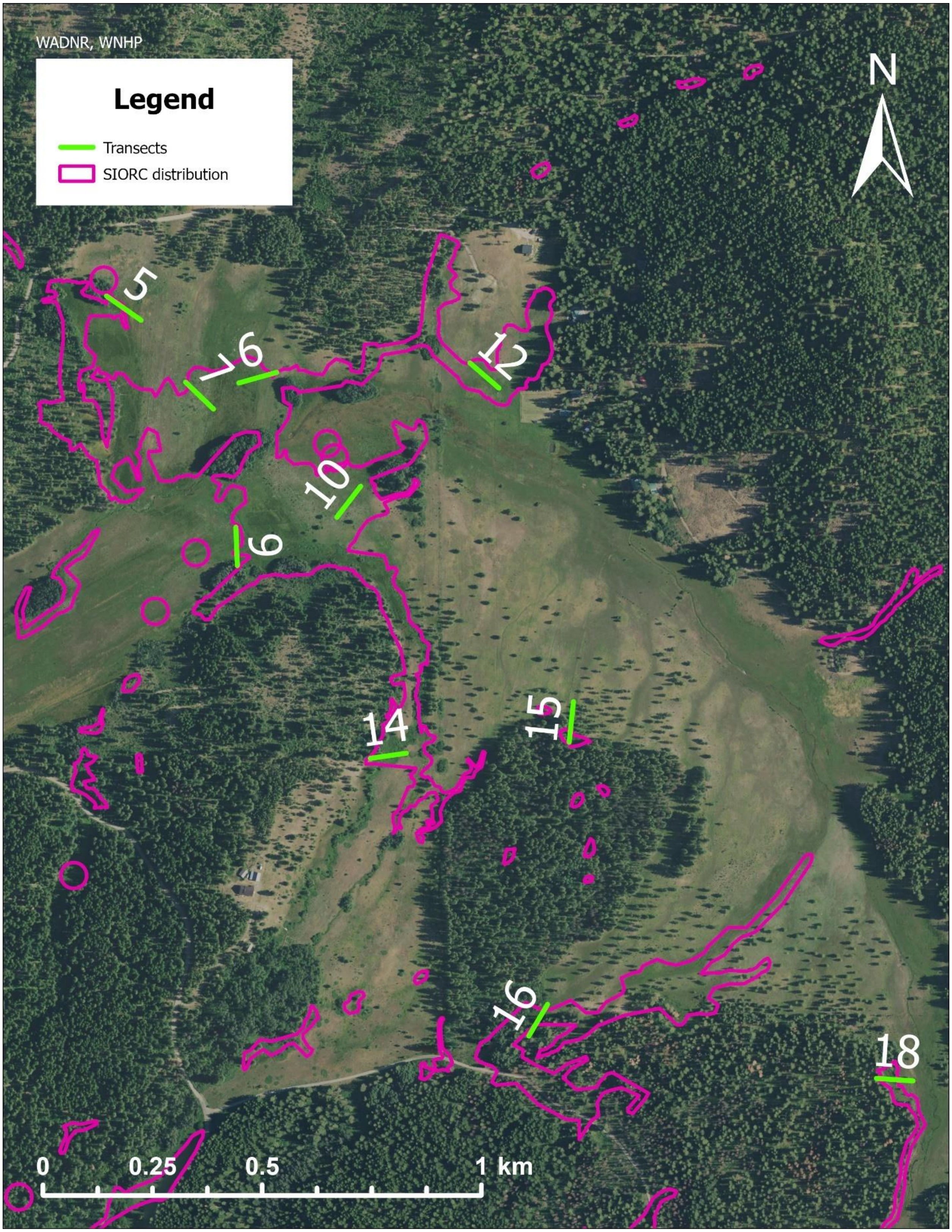

Figure 2.2 SIORC occurrences at Camas Meadows outlined in pink based on census data collected from 2012 to 2021 (WA-DNR, unpublished). 2023 transects are shown as green lines.

SIORC Measurements

For each 1x1 m plot, I counted the number of SIORC individuals and estimated the total cover of SIORC vegetation. For each 2x2 m bin, I counted just the number of flowering SIORC individuals. SIORC individuals may be connected by shared root systems that are not readily visible above ground. To minimize soil disturbance and ensure efficient data collection, we counted SIORC individuals based on the distance between SIORC stems where they exited the ground. Any SIORC with aboveground origins within 6 in of each other were classified as the same individual. All estimates of SIORC cover took place during SIORC flowering. Estimates were recorded by class to avoid data entry errors. Cover estimates used the system described in Table 2.1.

Table 2.1 Variation of the scale described by Braun-Blanquet (1932).

Class	Percent Cover Estimate	Percent Midpoint
0	0%	0%
1	0-1%	0.5%
2	1-5%	3%
3	5-15%	7%
4	15-25%	20%
5	25-50%	37.5%
6	50-75%	62.5%
7	75-100%	87.5%

From these measurements, I identified three response variables that describe SIORC distribution at Camas Meadows:

- SIORC presence (for the 1x1 m plot closest to each sensor)
- , SIORC count (number of SIORC in the 2x2 m bin closest to each sensor)
- SIORC abundance (cover for the 1x1 m plot closes to each sensor)

Soil Moisture Measurements

Continuous collection of soil moisture data makes it possible to assess both temporal and spatial soil moisture patterns. By monitoring soil moisture over extended periods, we gain insight into how soil moisture changes seasonally and in response to precipitation events. By monitoring soil moisture at different locations in Camas Meadows, we can assess whether variation in soil moisture affects SIORC distribution or abundance.

In spring 2023, I installed 30 capacitance sensors across 10 transects at Camas Meadows (Figure 2.1, Figure 2.2). Capacitance sensors estimate soil moisture by detecting changes in dielectric permittivity (also called capacitance), which is the ability of a material to store an electric charge. I used a combination of 4 TEROS 12 sensors and 26 TEROS 10 sensors from METER Group Inc., which are accurate to ±3 – 4% without calibration. While these sensors may not be as accurate as some time-domain reflectometry (TDR) sensors, capacitance sensors are relatively inexpensive, which makes it possible to assess a greater spatial extent than would be possible otherwise (Kizito et al., 2008; Sharma et al., 2020).

These sensors continuously measured Volumetric Water Content (VWC), with dataloggers recording data every 5 minutes from installation until November 4, 2023. To minimize soil disturbance, the sensors were installed vertically; consequently, each VWC measurement represents an average across the length of the probe. The root depth and profile of SIORC has not been characterized, so I installed the sensors at a depth that would likely overlap with the lateral root depth of SIORC. The lateral roots likely make up the majority of the root mass and would be the primary source of nutrients and water. Weaver (1915, 1958) described the root systems of two individuals identified as *Sidalcea oregana*, stating that "in both numerous strong laterals were thrown off within 4 inches of the surface. At 24 inches the tap broke up into three nearly equal parts, the largest and longest part reaching a depth of only 3 feet and 1 inch. The other plant reached a depth of 4 feet and 1 inch" (Weaver, 1915, p. 285). Based on this limited information and in the interest of minimizing disturbance, I installed sensors at a depth of 10 cm.[3]

I installed 3 sensors at each transect, with the two furthest sensors spanning up to 40 m of the total transect length, and a third sensor located at the approximate midpoint between them (Figure 2.1). The maximum cable length of each sensor was 20 m, so, with a single Decagon EM50 data logger per transect, 40 m was the maximum distance between sensors. Each sensor was associated with a nearby 1x1 m plot where we measured SIORC count and abundance. On average, the distance between a sensor and its associated plot was 0.34 meters. 10 sensors were 0 meters from their associated plot, and only one plot was more than 1 meter away.

Not all sensors were installed at the same time; 18 sensors were installed on May 13-14, 2023, and the remaining 12 were installed on June 1-3, 2023. When the first set of sensors were installed in mid-May, many parts of Camas Meadows still had standing water. TEROS 10 and

[3] Probe length was 2.5 cm, so each sensor was installed at 7.75 cm depth such that the center of each probe was situated at 10 cm. Each measurement is an average from 7.75 to 11.25 cm depth, resulting in an average reading that is comparable to 10 cm depth.

TEROS 12 sensors cannot be installed under these conditions as, once the water recedes, the probes would no longer be in contact with the soil and would instead be in contact with air. The remaining sensors were installed in early June when installation locations no longer had standing water.

Figure 2.3 Data logger affixed to t-post with sensors installed.

Through this study, we encountered substantial interference from wildlife. On multiple occasions, sensors were chewed through by elk, deer, and rodents. When possible, I repaired and reinstalled severed soil moisture sensors, but this often resulted in significant gaps in data collection. Additionally, elk or deer would sometimes push over the t-posts that data loggers were affixed to, often resulting in the sensor probes coming unplugged and halting data collection. The addition of chicken wire and an olfactory repellant reduced the frequency of these issues but did not halt them entirely. Consequently, very few sensors have complete data.

Figure 2.4 Chicken wire added to protect data logger and sensors from wildlife.

Weather Data

Daily precipitation was retrieved from the National Weather Service via NOAA Online Weather Data (NOWData). The Leavenworth 3 S station is about 7.25 mi direct line distance from Camas Meadows.

Table 2.2 Precipitation events from May to August 2023 measured in inches. All other days received no precipitation.

date	precipitation (in)
2023-05-01	0.13
2023-05-04	0.1
2023-05-08	0.12
2023-05-15	0.02
2023-05-16	0.23
2023-05-17	0.01
2023-05-18	0.01
2023-05-20	0.04
2023-05-24	0.02
2023-06-09	0.2
2023-06-10	0.03
2023-06-24	0.2
2023-06-25	0.04
2023-07-10	0.05
2023-08-07	0.63
2023-08-28	0.03
2023-08-29	0.37

Analysis

Data Preparation

Data from each data logger were downloaded directly as an Excel spreadsheet. Each data logger recorded measurements for 3 sensors installed at a single transect. All soil moisture data were subset to the period from installation until the end of August. This timeframe was chosen to focus on the spring and summer months when soil moisture declines at Camas Meadows. Moisture conditions during this period are more relevant for assessing SIORC growth and flowering compared to fall moisture conditions, when SIORC have already gone to seed and seeds are dormant. Limiting the analysis to spring and summer also avoided some periods of missing data caused by wildlife interference.

Most data cleaning took place in R using a combination of plotting and more fine-scale data exploration to identify and omit incorrect readings. Incorrect readings were typically identifiable because they were either outside of the possible accurate range of soil moisture readings (proportions; 0 to 1), or because the readings changed dramatically from one 5-minute interval to the next. Errors were typically caused by sensors coming unplugged or being chewed through (partially or fully), but some errors had an unknown cause. If readings rapidly increased, I referenced National Weather Service daily weather data for the Leavenworth 3 S station to check for recorded precipitation events that would explain a rapid increase in soil moisture. The Leavenworth 3 S weather station is only 7.25 mi from Camas Meadows, however, minor or hyper-local weather events may not have been picked up by the weather station.

The second sensor at transect 14 failed within a few days of installation and could not be repaired or replaced. It is removed from all analyses due to insufficient data. Excluding this sensor, 25% of sensors had missing data for less than 3% of the total possible data points (5-

minute interval data points), and 50% of sensors were missing less than 15% of data points. However, all 3 sensors at transect 5 were missing nearly 65% of data points due to a ~3-week data logger failure from mid-June to early July, followed by a ~2-week data logger failure in August. The first failure was caused by a corrupt battery, and the second occurred when wildlife dislodged a battery in the data logger. Additionally, the third sensor at transect 16 was repeatedly chewed through by rodents, resulting in over 70% of data being missing. Despite the large proportions of missing data for these sensors, subsequent modeling was able to accurately interpolate missing values.

Analysis took place in R, using "dplyr," "tidyr," and "vegan" for data cleaning and adjustments. I used the "stats" package and "mgcv" packages for modeling, and "ggplot2" for graphing.

Model Selection

The original soil moisture data contained missing data points that would make it difficult to compare results across sensors. To address this, I modeled each sensor's data and interpolated missing values.

I compared two modelling techniques: Locally Weighted Scatterplot Smoothing (LOESS) and Generalized Additive Models (GAM). LOESS is a non-parametric technique that fits multiple local regressions, creating a smoothed curve through a scatterplot. It is particularly well-suited to complex, non-linear patterns and makes no assumptions about the data's underlying structure. GAM is an additive modeling technique where the relationship between the response variable and explanatory variables is expressed as a sum of smooth functions of each predictor. Much like LOESS, GAM is well-suited for modelling complex, non-linear relationships. However, GAM creates global models, whereas LOESS fits data locally. LOESS tends to be more robust to outliers, but its goodness-of-fit depends on parameter selection, particularly bandwidth.

I cross validated LOESS and GAM models using Leave-One-Out-Cross-Validation (LOOCV). LOOCV is a model evaluation method where each data point is used as a test set exactly once, and the remaining data are used to train the model. This makes LOOCV well-suited for small data sets, and it is considered to have less bias because it is trained on almost all of the dataset. Modeling at 5-minute or hourly intervals was too computationally demanding for my chosen cross-validation method. Instead, I divided each day into four equal periods of 6 hours each: 0:00 to 5:59 ("early morning"), 6:00 to 11:59 ("late morning"), 12:00 to 17:59 ("afternoon"), and 18:00 to 23:59 ("evening"). For every period with at least one measurement, I calculated the average soil moisture value. Given that soil moisture typically fluctuates by no more than a few percentage points within a 6-hour span, even a single measurement was considered representative of the entire period if no other data were available.

For LOESS, I used a second-degree polynomial throughout, which is the highest order polynomial available through the “loess” function in R. Given the complex, non-linear relationships observed in the data, a second-degree polynomial allowed the model to capture quadratic trends and curvature in the data that a linear model would not adequately represent. Two other parameters, bandwidth and family, strongly affect LOESS performance. Bandwidth is generally considered to be the most influential parameter affecting LOESS fit, so I evaluated bandwidths ranging from 0.1 to 1 in increments of 0.5 for every sensor. The loess function offers two family parameters: “gaussian” (default) and “symmetric.” “Gaussian” weights data points according to a normal distribution such that points closer to the target points are weighted higher than points further away. “Symmetric” weights points symmetrically around the target point such that all points within the specified bandwidth are weighted equally, regardless of their distance from the target point. I compared loess models at each bandwidth using both “gaussian” and “symmetric” families.

For GAM, I used Thin Plate Regression Splines as the smoothing basis function, which is a flexible spline that is good at capturing complex, non-linear relationships. I selected “gaussian” for the family parameter in the gam function from the “mgcv” package. For the number of basis functions, I tested values of from 5 to 30 by increments of 5.

While GAM models can be evaluated using Akaike Information Criterion (AIC), LOESS is non-parametric and does not provide a likelihood function, making it unsuitable for AIC evaluation. Instead, I used Mean Squared Error (MSE) to assess each model’s predictive accuracy and compare LOESS vs GAM models. For each LOOCV fold (i.e. each leave-one-out iteration), I calculated the squared error, then averaged these to find the MSE for each model. Next, I identified the model with the lowest average MSE and visually inspected the model fit against the data. I repeated this process for every soil moisture sensor and every combination of parameters, identifying the best LOESS model and best GAM model for each sensor. Finally, for each sensor, I compared the average MSE of the best LOESS model vs the best GAM model and selected the model with the smaller MSE. In all cases, LOESS outperformed GAM models in minimizing MSE. For all sensors, “gaussian” resulted in a better fit than “symmetric,” and a bandwidth of 0.1 resulted in the lowest MSE.

Table 2.3 Average MSE results for LOESS and GAM models according to LOOCV. LOESS minimized MSE for all sensors.

sensor	Average MSE	
	LOESS	GAM
T10P2_S1	0.655361	0.742295
T10P5_S2	0.013696	0.014817
T10P8_S3	0.03965	0.047824
T12P2_S1	0.013476	0.015452
T12P5_S2	0.013514	0.015581
T12P8_S3	0.011921	0.013903
T14P1_S1	0.366956	0.452056
T14P7_S3	0.418532	0.46769
T15P2_S1	0.476859	0.544931
T15P5_S2	0.577551	0.680534
T15P8_S3	0.041315	0.050072
T16P1_S3	0.550788	0.655322
T16P4_S2	0.133426	0.162551
T16P7_S1	0.754809	0.887618
T18P1_S1	0.514885	0.653266
T18P4_S2	1.193336	1.415508
T18P7_S3	0.014467	0.015841
T5P10_S3	0.219281	0.250355
T5P4_S1	0.032582	0.033096
T5P7_S2	0.01217	0.014318
T6P1_S1	0.019572	0.020772
T6P4_S2	0.043113	0.044317
T6P7_S3	0.008381	0.010178
T7P3_S1	0.038784	0.0444
T7P6_S2	0.004574	0.005066
T7P9_S3	0.061314	0.069999
T9P2_S1	0.0824	0.098638
T9P5_S2	0.171876	0.217218
T9P8_S3	0.057034	0.065625

Interpolating Missing Data

Observed soil moisture values were used whenever available, but I used LOESS models to predict average soil moisture for any period with no observed data points. LOESS is designed for interpolation, enabling me to predict soil moisture values including for time periods with no previous measurements. However, LOESS is expressly not suitable for extrapolation, so I was not able to extend soil moisture measurements prior to the start of data collection. Most sensors (n = 17) began collecting data in mid-May, while the remaining sensors were installed in early June. Consequently, the start date and duration of data collection vary among sensors. For many of the sensors installed in mid-May, late May marked a critical period when soil moisture sharply declined. Rather than excluding this important data, I conducted a separate cluster analysis for May data but excluded May data from the "overall" cluster analysis. Although the May data does not represent all sensors, it captures a crucial transition period for sensors installed before June.

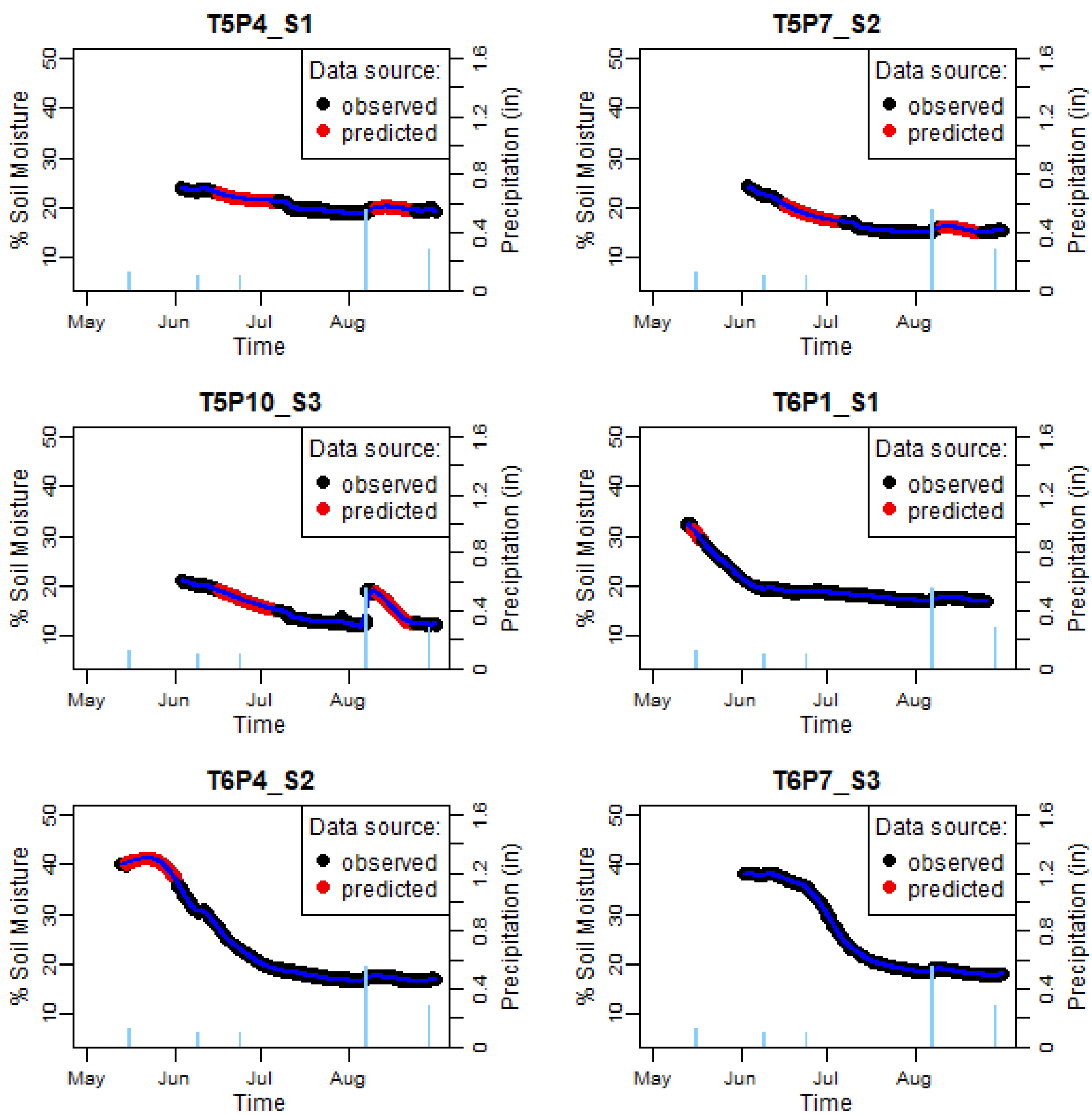

Figure 2.5 (continued on next page) Soil moisture data is provided for each sensor from the beginning of data collection until August 31, 2023. The label for each month is placed at the beginning of that month. The average soil moisture for each period of each day is displayed, with observed data points indicated in black and predicted data points in red. LOESS fit is represented by a dark blue line. Precipitation is depicted in light blue, with the scale of the axis showing the maximum daily precipitation recorded in 2023 (1.6 in).

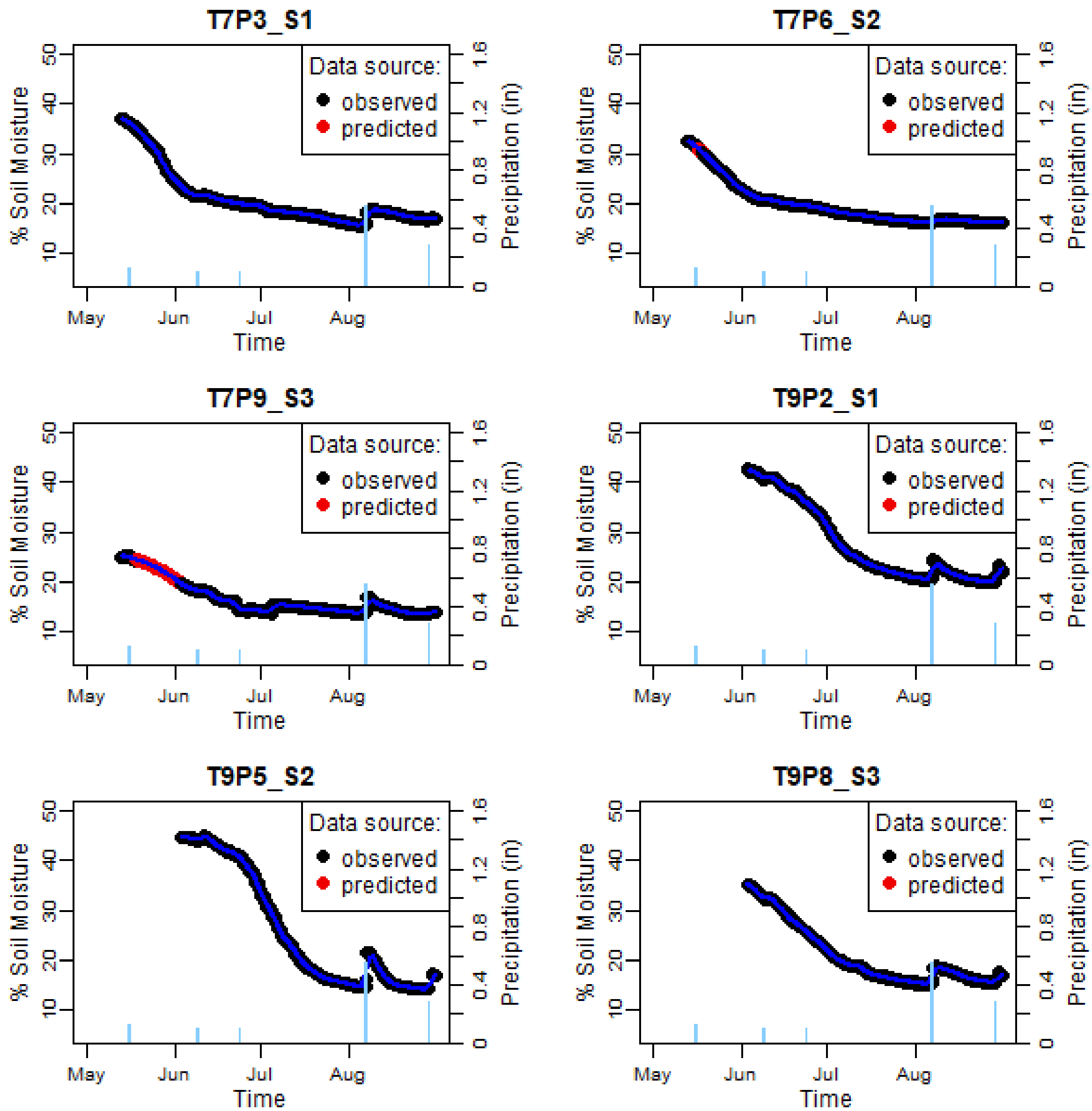

Figure 2.5 (continued on next page) Soil moisture data is provided for each sensor from the beginning of data collection until August 31, 2023. The label for each month is placed at the beginning of that month. The average soil moisture for each period of each day is displayed, with observed data points indicated in black and predicted data points in red. LOESS fit is represented by a dark blue line. Precipitation is depicted in light blue, with the scale of the axis showing the maximum daily precipitation recorded in 2023 (1.6 in).

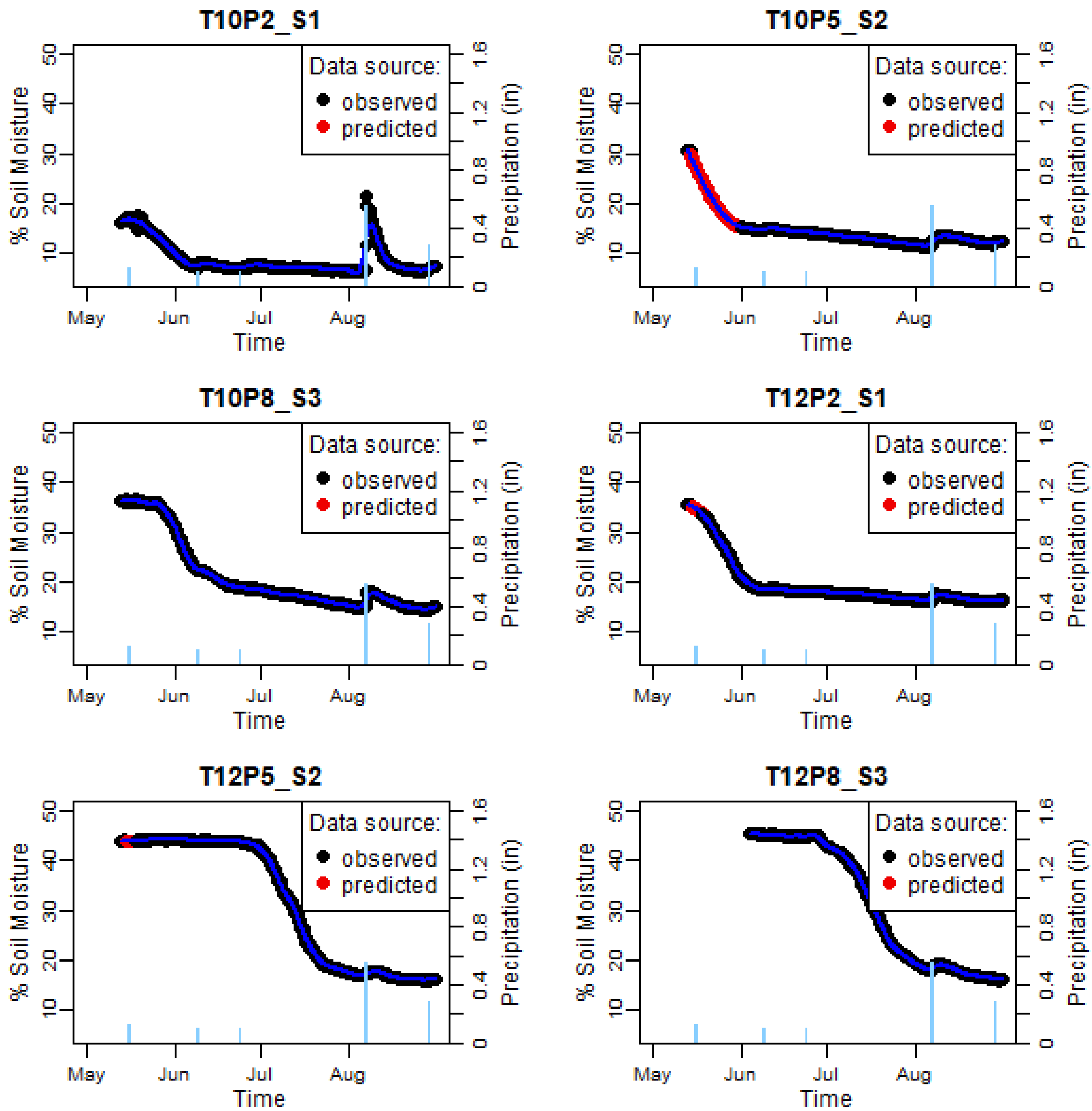

Figure 2.5 (continued on next page) Soil moisture data is provided for each sensor from the beginning of data collection until August 31, 2023. The label for each month is placed at the beginning of that month. The average soil moisture for each period of each day is displayed, with observed data points indicated in black and predicted data points in red. LOESS fit is represented by a dark blue line. Precipitation is depicted in light blue, with the scale of the axis showing the maximum daily precipitation recorded in 2023 (1.6 in).

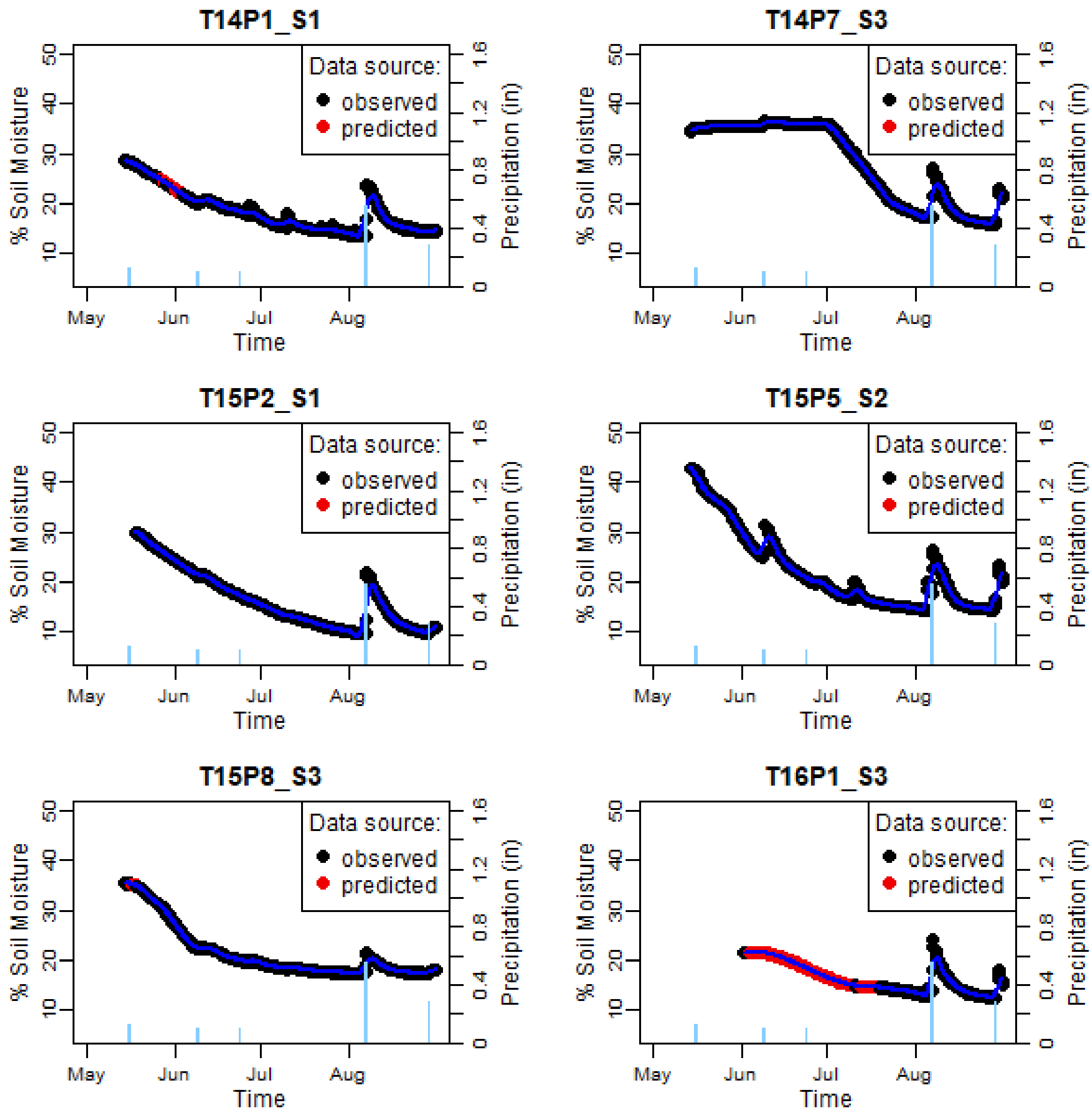

Figure 2.5 (continued on next page) Soil moisture data is provided for each sensor from the beginning of data collection until August 31, 2023. The label for each month is placed at the beginning of that month. The average soil moisture for each period of each day is displayed, with observed data points indicated in black and predicted data points in red. LOESS fit is represented by a dark blue line. Precipitation is depicted in light blue, with the scale of the axis showing the maximum daily precipitation recorded in 2023 (1.6 in).

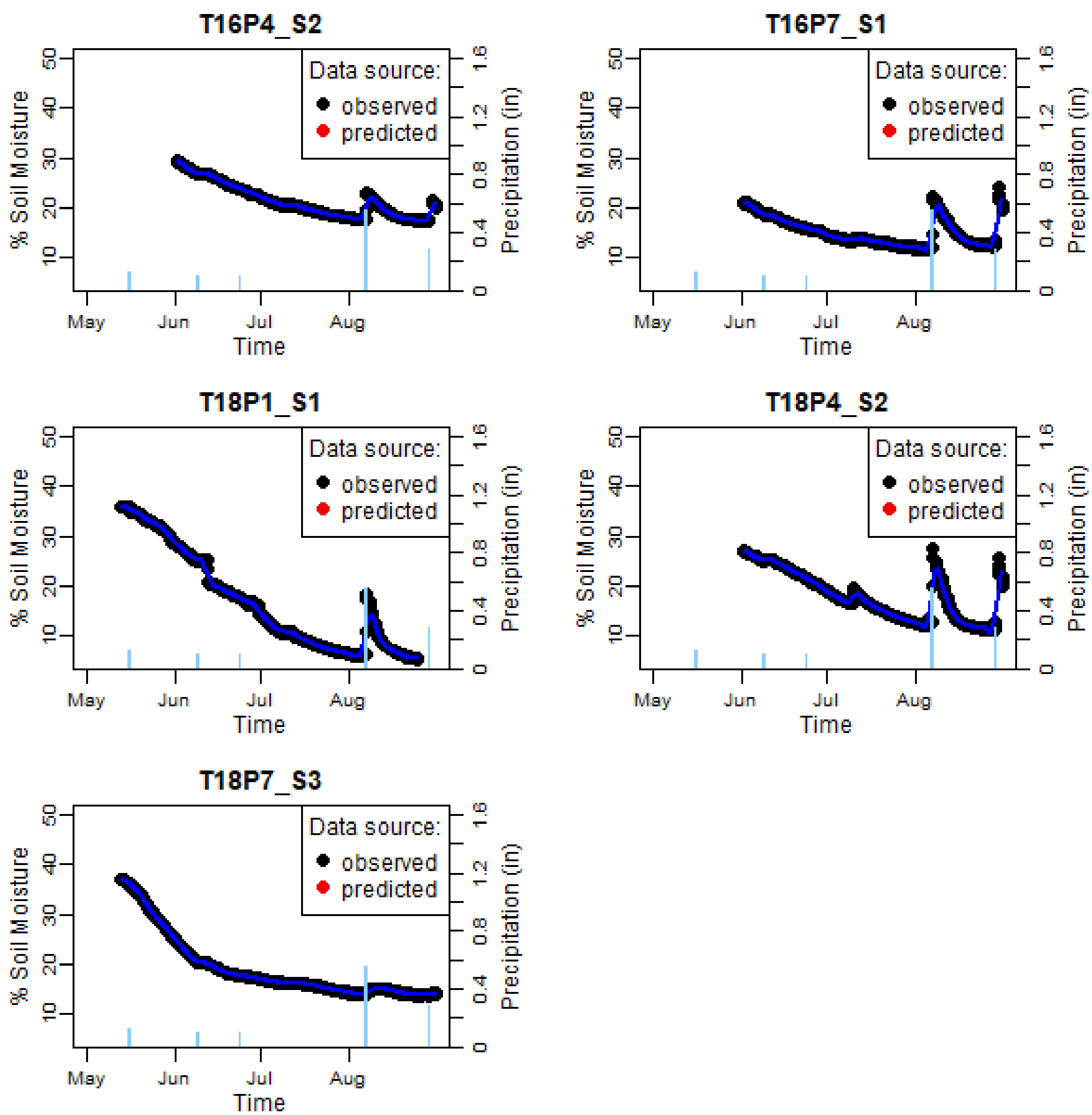

Figure 2.55 (continued from previous page) Soil moisture data is provided for each sensor from the beginning of data collection until August 31, 2023. The label for each month is placed at the beginning of that month. The average soil moisture for each period of each day is displayed, with observed data points indicated in black and predicted data points in red. LOESS fit is represented by a dark blue line. Precipitation is depicted in light blue, with the scale of the axis showing the maximum daily precipitation recorded in 2023 (1.6 in).

Soil Moisture Variables

To test for effects of continuous soil moisture on SIORC, I used several variables to characterize and differentiate soil moisture patterns. These variables consisted of:

- Mean soil moisture
- Maximum soil moisture
- Minimum soil moisture
- Standard deviation of soil moisture
- Wettest date
- Driest date
- Average rate of change
- Percent of wet days
- Percent of dry days

In total, these variables describe the central tendency, range, timing, rate of change, and frequency of soil moisture patterns at Camas Meadows. I calculated each of these soil moisture characteristics for 5 different time periods: May, June, July, August, and overall (excluding May). The wettest date corresponded with the date when the maximum value was measured, and the driest date corresponded with the date of the minimum value. This partially captures the timing of wetness and dryness for each sensor. The average rate of change was calculated between the wettest and driest periods for each sensor. Average rate of change describes how quickly soil moisture changed for a particular sensor, particularly how quickly soil moisture declined from spring into summer. In PERMANOVA results tables, average rate of change is not scaled but is reported as change in percent soil moisture per day. This maintains the absolute accuracy of this variable. Percent wet days and percent dry days represent the frequency of above average wetness or below average dryness for a particular sensor. To calculate percents of wet and dry days, I identified global wet and dry thresholds based on all data for the relevant study period (i.e. based on overall data for the overall soil moisture variables, based on May data for May soil moisture variables, etc.). The wet global threshold was equal to the 75^{th} percentile, and the dry global threshold was equal to the 25^{th} percentile. Percents of wet and dry days were then calculated for each sensor:

$$\%\text{ wet days} = \frac{\text{days with soil moisture } > \text{wet threshold}}{\text{total days}} * 100$$

$$\%\text{ dry days} = \frac{\text{days with soil moisture} < \text{dry threshold}}{\text{total days}} * 100$$

The percent wet and dry days will not necessarily sum to 100% as moderate soil moisture values fall between the two thresholds.

Soil moisture characteristic variables were also used as both response and explanatory variables in different PERMANOVA tests. I performed PERMANOVAs testing whether individual soil moisture variables affect SIORC response variables. I also used individual soil moisture variables as response variables to test whether they varied significantly according to cluster analysis groups.

Cluster Analyses

To identify groupings in the soil moisture data, I performed hierarchical cluster analyses using the “hclust” function from the “stats” package in R. The analyses were conducted based on overall soil moisture data as well as data for each month: May, June, July, and August. May data were excluded from the "overall" analysis because 12 sensors were not installed until June. All data were relativized by range, and distance matrices used Euclidian distances. For each analysis, I employed Ward's minimum variance linkage method, which is known for producing well-defined clusters without excessive chaining, as recommended in the literature (McCune and Grace, 2002; Singh et al., 2011). For each analysis, I used a scree plot to determine the optimal number of groups. The "elbow" of the scree plot represents the point at which additional clusters do not significantly reduce within-group variance. For the overall cluster analysis, the scree plot indicated that the optimal number of groups was either 4 or 5, but the fifth group was comprised of just one sensor, so I elected to proceed with 4 groups (Appendix E). For the monthly cluster analyses, scree plots supported using 4 groups for May, 5 groups for June, 4 or 6 groups for July, and 3 or 6 groups for August (Appendix E). I chose to use 5 groups for my July cluster analysis in order to improve interpretability. The identified clusters were later used as explanatory variables in PERMANOVAs to test for relationships between SIORC response variables and soil moisture patterns.

Permutational Multivariate Analysis of Variance

Permutation Multivariate Analysis of Variance (PERMANOVA) is a robust, non-parametric statistical test used to assess differences among groups. Unlike traditional Analysis of Variance (ANOVA), PERMANOVA can be applied to both univariate or multivariate data. In addition, PERMANOVA does not require data to be normally distributed and it is relatively robust unequal variances. PERMANOVA relies on permutation methods to test hypotheses, which involves repeatedly shuffling the data to generate a distribution of the test statistic under the null hypothesis.

I used PERMANOVAs primarily to examine the relationships between SIORC presence, SIORC abundance, and SIORC count and various explanatory variables.

- SIORC Presence: binary response variable indicating SIORC presence or absence from a plot
- SIORC Abundance: discrete response variable representing the percent of SIORC cover in each plot where SIORC were present (midpoint of cover classes)
- SIORC Count: discrete response variable representing the number of individual SIORC in a plot

Explanatory variables included cluster analysis groups and soil moisture variables. To control for spatial correlation among sensors, I also added coordinates for each sensor (easting and northing relativized by range) as the first and second explanatory variable of all PERMANOVAs. To standardize explanatory variables measured in different units or scales, I relativized all explanatory variables by range. I used Type I Sums of Squares in my PERMANOVA analyses to evaluate the contribution of each explanatory variable sequentially, starting with spatial coordinates to control for spatial correlation. All PERMANOVA tests were conducted with 9999 permutations. I used a significance level of $p < 0.05$ with marginal significance indicated by $p < 0.1$. All PERMANOVAs had only one response variable, so I used Euclidian distance, which makes this equivalent is equivalent to an ANOVA.

Results

Change in Soil Moisture Over Time at Camas Meadows

Each sensor showed a general decrease in soil moisture between the start of data collection and the end of August. Many sensors exhibited a plateau in soil moisture followed by a sharp decline in soil moisture (transects 6, 9, 10 12, 14), whereas others exhibited a sharp decline without a previously observed plateau (transects 7, 15, 18). Only transects 5 and 16 showed a more gradual decline with no previously observed plateau in soil moisture. In addition, every sensor showed a peak in soil moisture around August 7th, when the largest precipitation event of the study period occurred, producing 0.63 in of rain.

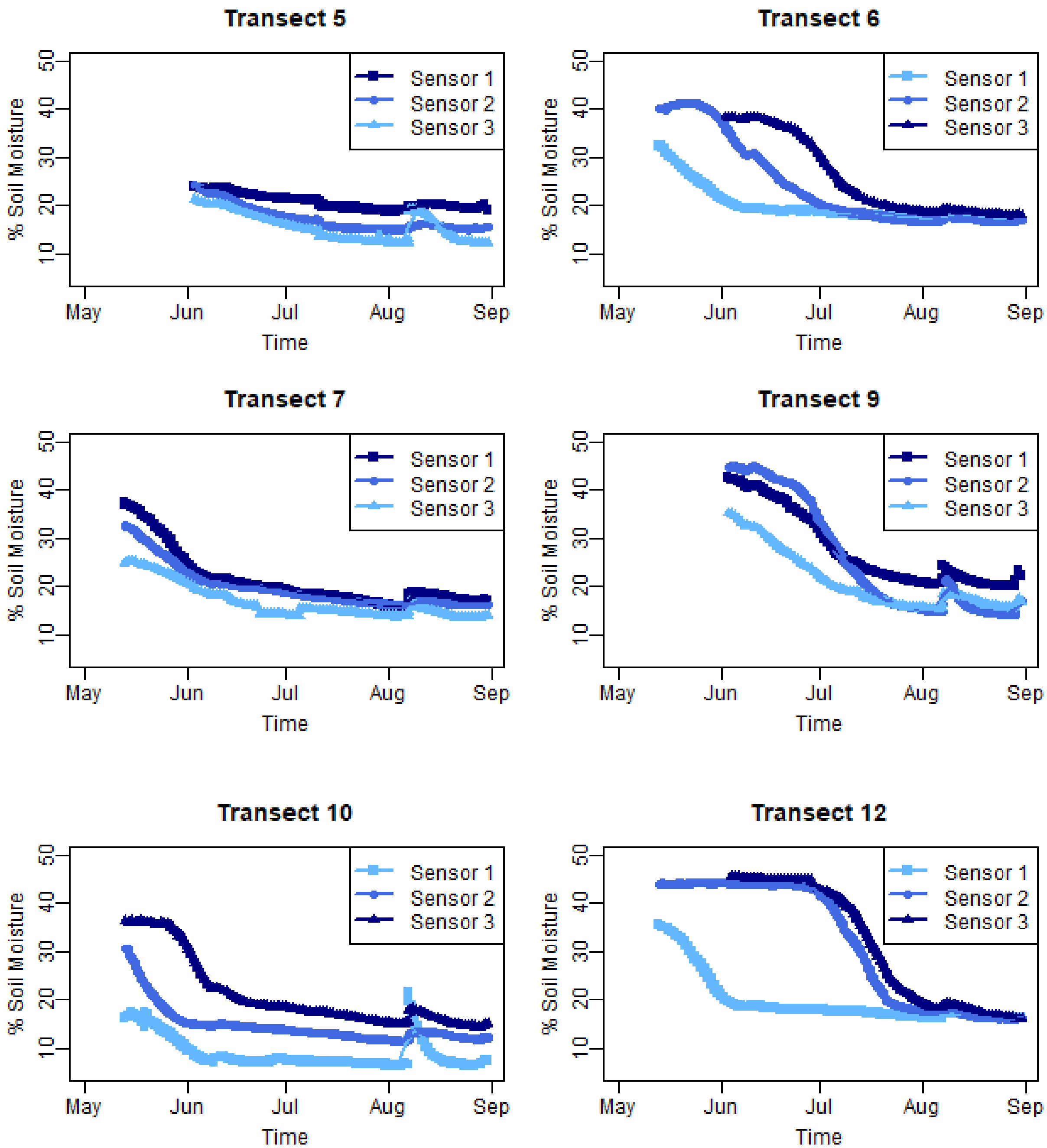

Figure 2.6 (continued on next page) Soil moisture data and a LOESS fitted line are shown for each sensor for each transect. Shades of blue correspond with overall average moisture levels of the sensors, with the wettest soil moisture for each transect shown in darker blue, and the driest soil moisture shown in lighter blue.

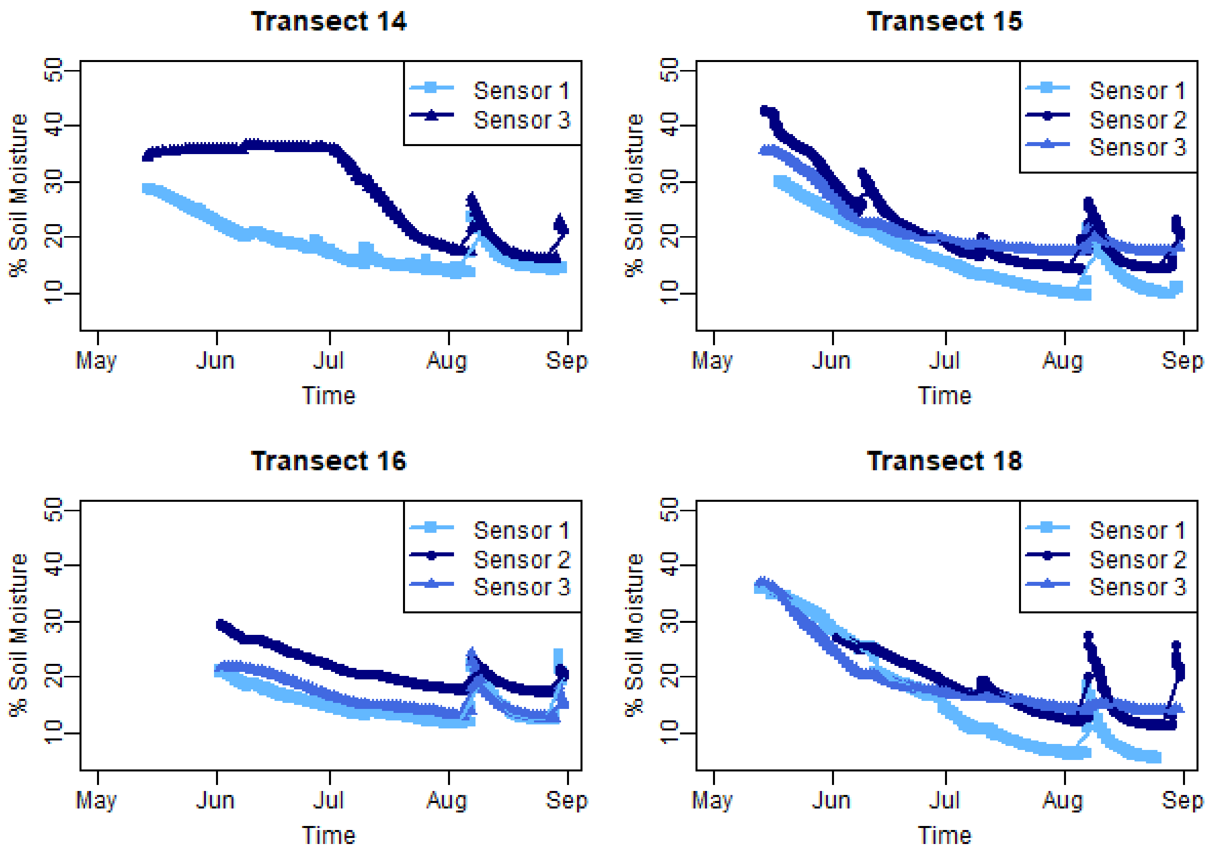

Figure 2.6 (continued from previous page) Soil moisture data and a LOESS fitted line are shown for each sensor for each transect. Shades of blue correspond with overall average moisture levels of the sensors, with the wettest soil moisture for each transect shown in darker blue, and the driest soil moisture shown in lighter blue.

Soil Moisture Cluster Analyses

May Cluster Analysis

The cluster analysis of May soil moisture variables produced 4 groups: “driest,” “intermediate,” “wet decreasing,” and “wet increasing.” Importantly, due to when the soil moisture sensors were installed, this cluster analysis only covered the second half of May, and only included 17 sensors.

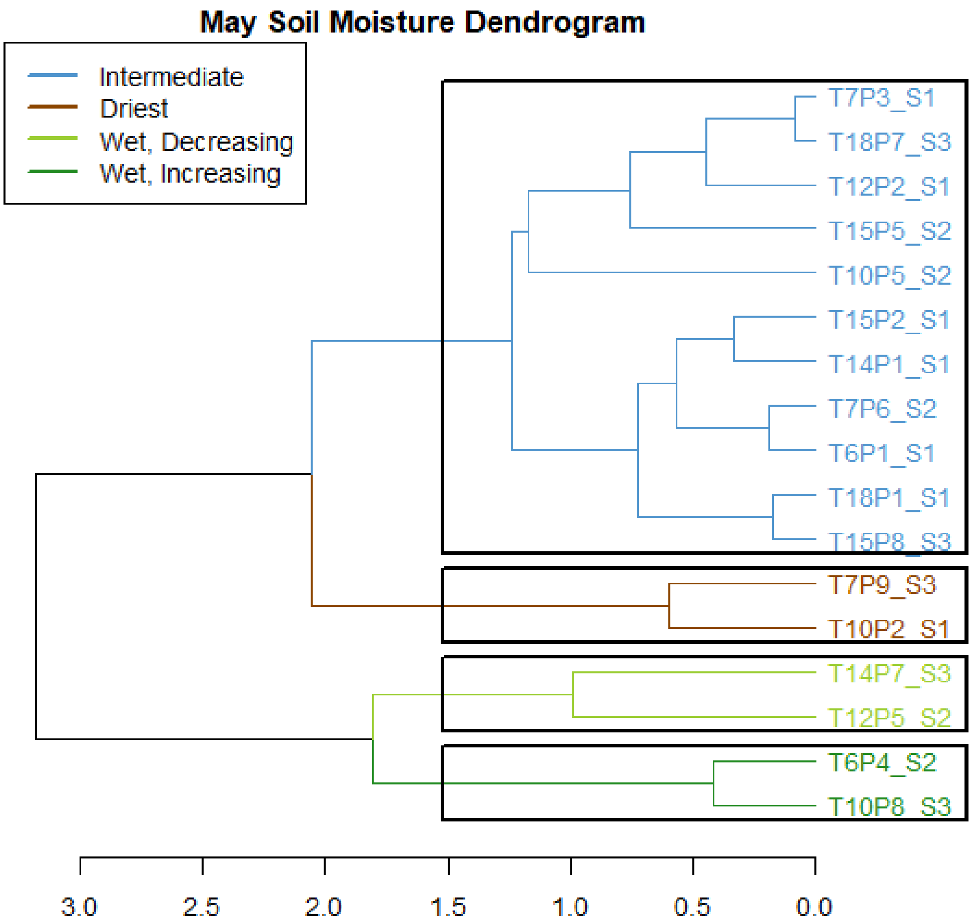

Figure 2.7 Dendrogram of groups based on May soil moisture characteristics.

Table 2.4 Summary statistics for May soil moisture groups.

group	n	mean	min	max	sd	wettest day	driest day	% wet days	% dry days	rate of change
driest	3	19.8	15.4	24.6	2.8	05-16	05-31	0.0	91.1	-0.61
wet, decreasing	2	37.9	34.8	38.9	1.0	05-20	05-31	80.7	0.0	-0.38
intermediate	10	30.5	25.2	34.8	2.9	05-14	05-31	12.1	13.7	-0.56
wet, increasing	2	39.8	39.1	40.1	0.2	05-28	05-17	64.0	0.0	0.10

The four groups consist of one dry group, one intermediate group, and two wet groups. The "driest" group had the lowest mean, minimum, and maximum, as well as the greatest percent dry days and lowest percent wet days. The "intermediate" group was the largest and had intermediate values between the "driest" group and the two wet groups: "wet, decreasing" and “wet, increasing.” The “driest” group, “intermediate” group, and “wet, decreasing” group all had declining soil moisture—the “increasing moisture” group was the only group that had an increase in soil moisture over time. The two wet groups had similar values for mean, minimum, and maximum, but the “wet, decreasing” group had greater standard deviation and percent wet days than the “wet, increasing group.” Also, the decline in soil moisture in the “wet, decreasing” group was steeper than the increaser in soil moisture of the “wet, increasing” group.

Overall Cluster Analysis

The cluster analysis of overall soil moisture (excluding May) produced 4 groups which can be described as “driest,” “extended drying,” “wettest,” and “intermediate.”

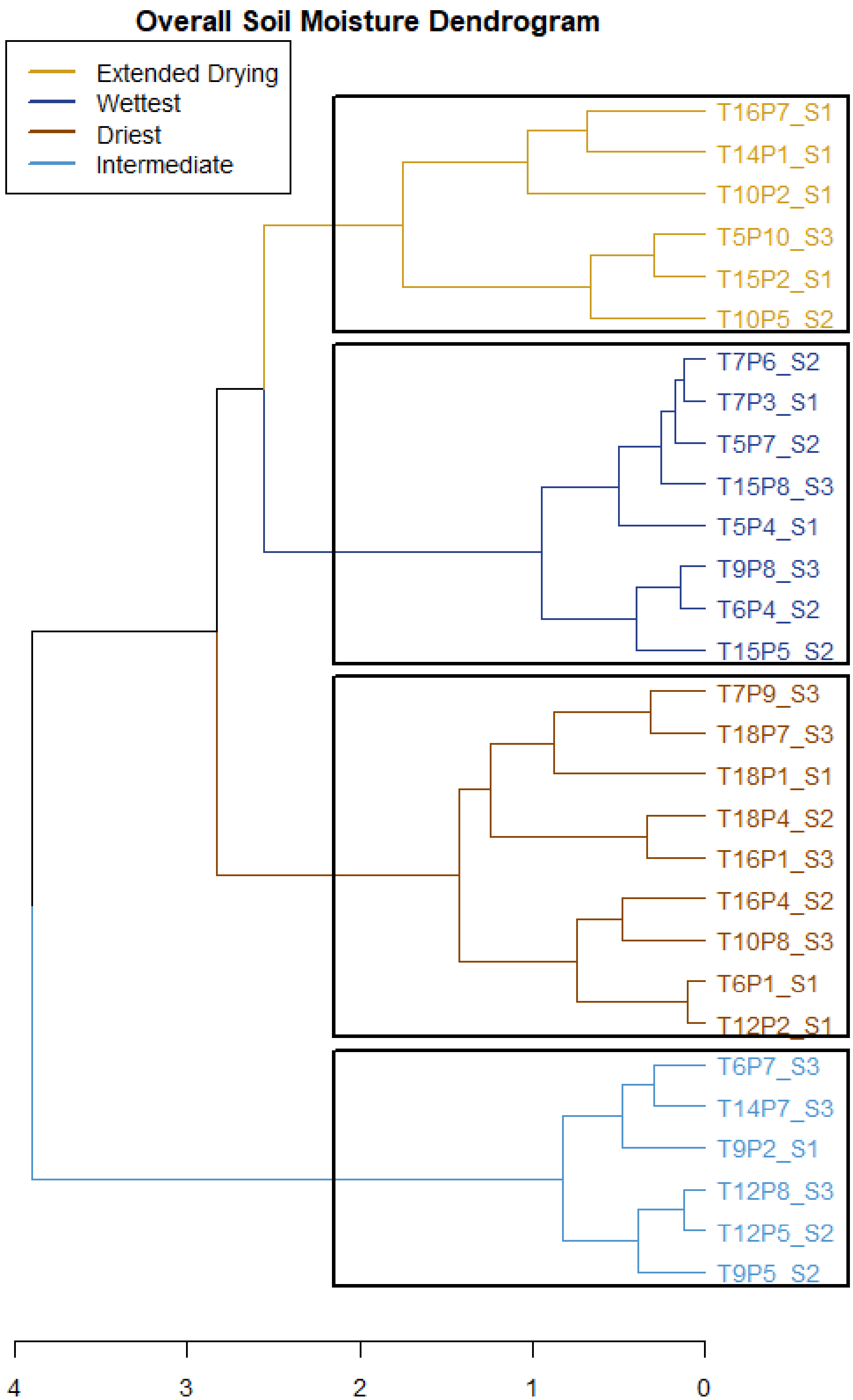

Figure 2.8 Dendrogram of groups based on overall soil moisture characteristics (excluding May).

Table 2.5 Summary statistics for overall soil moisture groups

group	n	mean	min	max	sd	wettest day	driest day	% wet days	% dry days	rate of change
driest	6	13.9	10.7	21.7	2.6	07-08	08-04	5.5	66.1	0.94
extended drying	9	17.2	13.4	25.6	3.1	06-16	08-27	14.5	29.5	-0.25
wettest	6	27.6	16.6	42.1	10.0	06-05	08-28	58.7	3.3	-0.31
intermediate	8	19.4	16.1	28.6	3.3	06-02	08-04	24.9	4.2	-0.20

In general, the four groups correspond with four levels of moisture. The "driest" group had the lowest mean, minimum, and maximum, while the "wettest" group had the highest values in these metrics. The "intermediate" group had values between the "driest" and "wettest" groups, whereas the "extended drying" group had values between the "driest" and "intermediate" groups. The percent wet days and dry days follow the same pattern such that the "driest" group had the high percent dry days and the lowest percent wet days, the "wettest" group had the greatest wet days and the least dry days, the "intermediate" group had intermediate percent wet and dry days, and the "extended drying" group had percent wet and dry days between the "driest" and "intermediate" groups. Interestingly, standard deviation and rate of change also ranked against moisture level such that higher moisture corresponded with greater standard deviation and faster rate of change. This pattern reflects that maximum soil moisture has a wider range than minimum soil moisture, such that increased moisture influences soil moisture range and variability more so than limited moisture.

June Soil Moisture

The cluster analysis of June soil moisture variables produced 5 groups which can be described as "driest," "wettest," "intermediate moisture, high variability," "intermediate moisture, low variability," and one group that consisted of just a single sensor: sensor 3 at transect 14 (T14P7_S3).

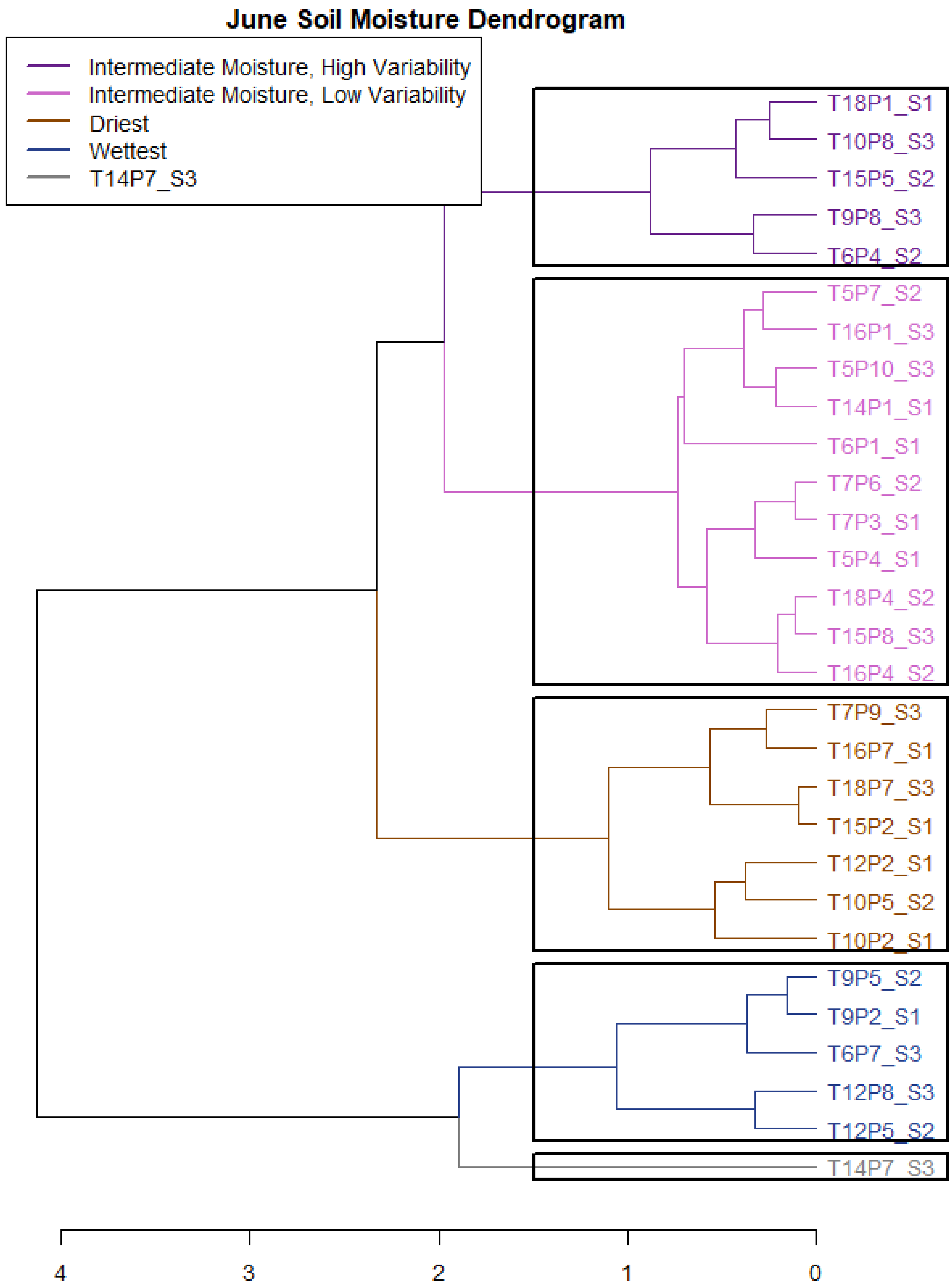

Figure 2.9 Dendrogram of groups based on June soil moisture characteristics.

Table 2.6 Summary statistics for June soil moisture groups.

group	n	mean	min	max	sd	wettest day	driest day	% wet days	% dry days	rate of change
driest	5	15.1	13.5	17.7	1.1	06-01	06-27	0.0	87.2	-0.16
intermediate, high variability	5	24.9	19.0	33.0	4.0	06-03	06-30	25.7	11.3	-0.52
wettest	5	41.1	36.5	43.2	1.7	06-04	06-30	93.5	0.0	-0.28
intermediate, low variability	13	21.0	18.5	24.5	1.7	06-01	06-28	0.7	16.3	-0.22
T14P7_S3	1	36.0	35.6	36.6	0.2	06-09	06-08	100.0	0.0	0.97

As with the overall and May soil moisture cluster analyses, the "driest" group had the lowest mean, minimum, maximum, and percent wet days, with the highest percent dry days, whereas the "wettest" group had the highest values for mean, minimum maximum, and percent wet days, with the lowest percent dry days. Two additional groups had intermediate levels of moisture but were separated according to high variability and steeply negative rate of change vs low variability and moderate rate of change. The "intermediate moisture, low variability" group was the largest group. The last group consisted of just one sensor and was the fifth group added to the dendrogram. Typically, cluster analyses aim to find relatively evenly sized groups and avoid groups with only a single member. However, the scree plot for this cluster analysis shows that adding this fifth group greatly increases the amount of variance explained. During the month of June, senor T14P7_S3 had much higher soil moisture values than other groups of sensors and surpassed the 75th percentile wet threshold for the month 100% of the time. Additionally, soil moisture at this location increased over the course of the month, in opposition to the other groups of sensors. This stark contrast may be explained by sensor T14P7_S3's proximity to a channel with running water less than 15 m away. No other site had running water at such close proximity during June, so grouping this sensor on its own recognizes the major differences in soil moisture characteristics between this sensor and all other sensors.

July Soil Moisture

The cluster analysis of July soil moisture variables produced 4 groups: “driest,” “intermediate, decreasing,” “intermediate increasing,” and “wettest.” The scree plot shows that 4 or 6 groups is optimal. I chose to proceed with 4 groups as opposed to 6 in order to prioritize interpretability of the results.

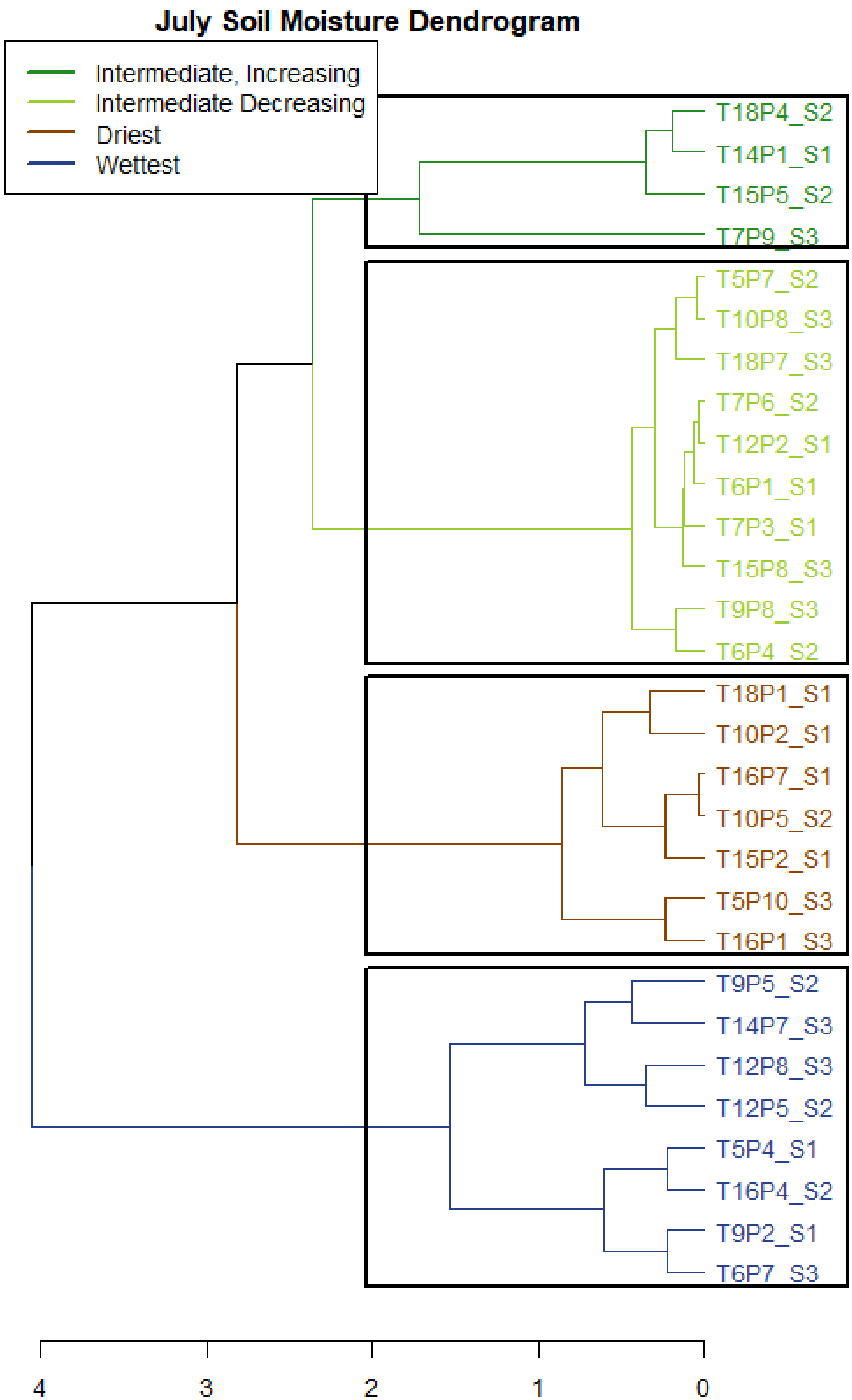

Figure 2.10 Dendrogram of groups based on July soil moisture characteristics.

Table 2.7 Summary statistics for July soil moisture groups.

group	n	mean	min	max	sd	wettest day	driest day	% wet days	% dry days	rate of change
driest	7	11.9	10.3	14.2	1.1	07-01	07-31	0.0	85.9	-0.13
intermediate, decreasing	10	17.3	15.9	19.1	0.9	07-01	07-31	6.0	1.3	-0.10
wettest	8	24.1	18.3	32.7	4.6	07-01	07-31	82.2	0.0	-0.48
intermediate, increasing	4	15.6	13.8	18.3	1.2	07-09	07-24	2.0	27.6	0.26

The "driest" group had the lowest mean, minimum, maximum, and percent wet days, with the highest percent dry days, whereas the "wettest" group had the highest values for mean, maximum, and percent wet days. The two intermediate groups had values between the wettest and driest groups and were differentiated by their rates of change. The "intermediate, decreasing" group was slightly wetter than the "intermediate, increasing" group.

August Soil Moisture

The cluster analysis of August soil moisture variables produced 3 groups: "driest," "wet, increasing," and "wet, decreasing." The scree plot suggested either 3 or 6 groups was optimal, so for the sake of parsimony and ease of interpretation I proceeded with 3 groups.

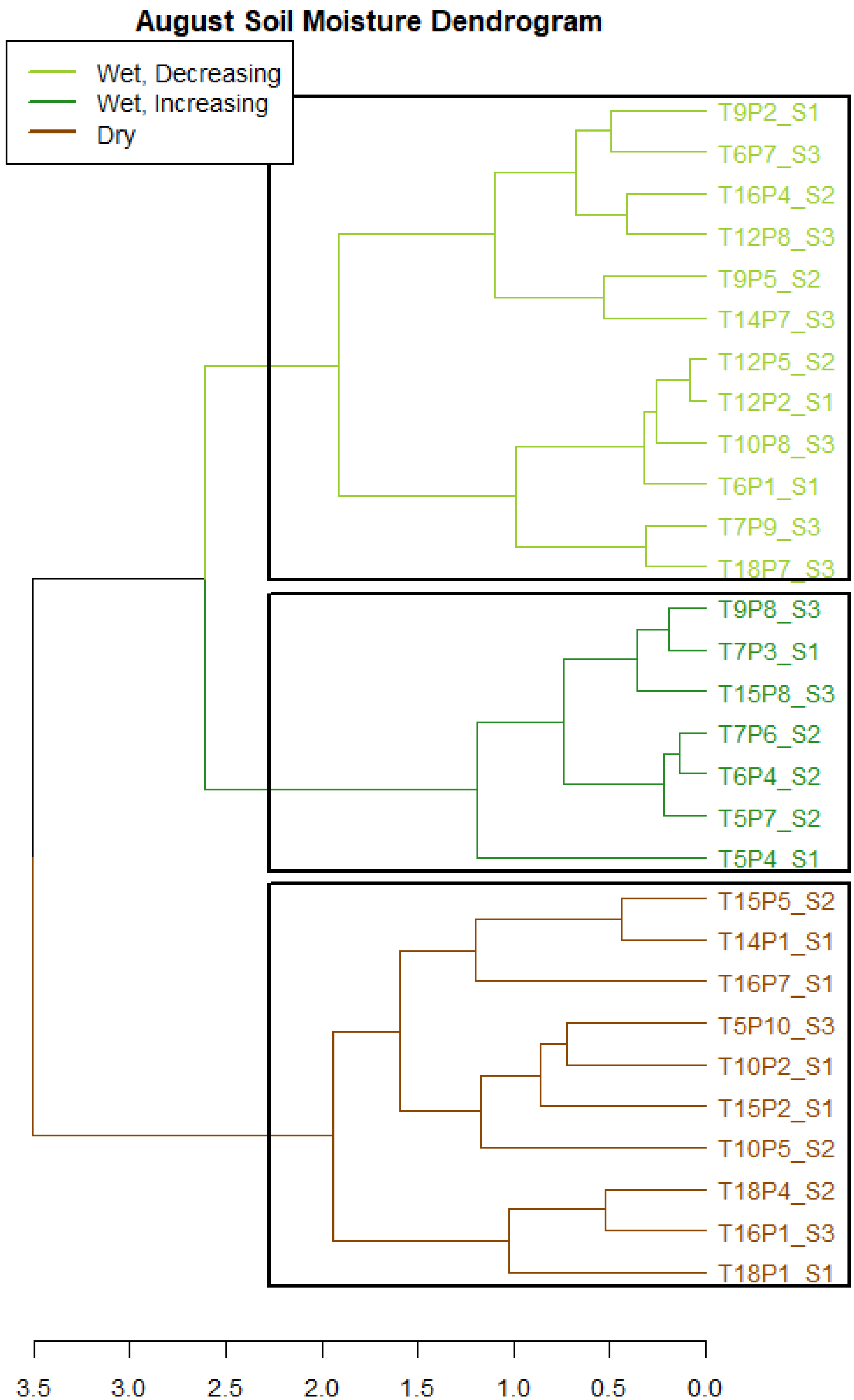

Figure 2.11 Dendrogram of groups based on August soil moisture characteristics.

Table 2.8 Summary statistics for August soil moisture groups.

group	n	mean	min	max	sd	wettest day	driest day	% wet days	% dry days	rate of change
dry	10	13.3	10.8	22.1	2.9	08-09	08-11	13.7	60.7	2.51
wet, decreasing	12	17.1	15.9	19.9	1.1	08-08	08-27	31.6	9.1	-0.19
wet, increasing	7	17.3	16.3	18.6	0.6	08-09	08-03	28.6	0.0	0.53

Much like the previous cluster analyses based on other months of soil moisture data, the August soil moisture cluster analysis produced groups with varying levels of moisture. The "dry" group had the lowest mean, minimum, maximum, and percent wet days, with the highest percent dry days. The two wet groups had higher values for mean, minimum, maximum, and percent wet days, as well as lower percent dry days. The two wet groups are primarily differentiated by rate of change. The "wet, decreasing" group is slightly more variable than the "wet, increasing" group and had a larger period between wettest and driest days. In August, there were three rain events (Table 2.2). The largest rain event of the study period occurred on August 7 and resulted in a recorded 0.63 in or precipitation in Leavenworth. This event was so significant that every sensor at Camas Meadows shows a pronounced spike in readings around this time, although the degree of response varies from sensor to sensor (Figure 2.6). Additionally, there were two rain events in late August—a very minor 0.03 in on August 28, and an additional 0.37 in on August 29. This pair of rain events is also distinguishable in all sensor readings. In contrast to data from June and July, which primarily showed declining soil moisture, August soil moisture patterns were influenced by the two most substantial rain events during the entire study period. This likely explains why two of the groups exhibit increasing soil moisture, and two exhibit decreasing soil moisture.

SIORC Presence and Soil Moisture

I conducted PERMANOVA tests to assess which soil moisture groups affect SIORC for those areas where SIORC were present. I tested groups from the June, July, August, and overall cluster analyses. Only 4 sensors with May soil moisture data had associated plots where SIORC were present. Due to the small number of sensors included in the May data and the even smaller number of sensors that had SIORC present, I was not able to test May soil moisture groups or characteristics as explanatory variables against SIORC presence. For all cluster analyses, soil moisture groups did not significantly affect SIORC presence (Tables 2.9 to 2.12). I also tested each soil moisture characteristic from the overall dataset and found that individual soil moisture characteristics did not significantly affect SIORC presence (Appendix K).

Table 2.9 PERMANOVA results examining the variance explained and significance of overall soil moisture groups on SIORC presence.

	Df	SS	R2	F	Pr(>F)
easting	1	0.05	0.01	0.20	0.654
northing	1	0.02	0.00	0.09	0.773
overall groups	3	0.27	0.04	0.33	0.797
Residual	23	6.21	0.95		
Total	28	6.55	1.00		

Table 2.10 PERMANOVA results examining the variance explained and significance of June soil moisture groups on SIORC presence.

	Df	SS	R2	F	Pr(>F)
easting	1	0.05	0.01	0.19	0.661
northing	1	0.02	0.00	0.08	0.778
June groups	4	0.28	0.04	0.24	0.942
Residual	22	6.20	0.95		
Total	28	6.55	1.00		

Table 2.11 PERMANOVA results examining the variance explained and significance of July soil moisture groups on SIORC presence.

	Df	SS	R2	F	Pr(>F)
easting	1	0.05	0.01	0.20	0.657
northing	1	0.02	0.00	0.09	0.774
July groups	3	0.19	0.03	0.23	0.866
Residual	23	6.28	0.96		
Total	28	6.55	1.00		

Table 2.12 PERMANOVA results examining the variance explained and significance of August soil moisture groups on SIORC presence.

	Df	SS	R2	F	Pr(>F)
easting	1	0.05	0.01	0.21	0.648
northing	1	0.02	0.00	0.09	0.769
August groups	2	0.24	0.04	0.47	0.616
Residual	24	6.23	0.95		
Total	28	6.55	1.00		

SIORC Count and Soil Moisture

Next, I used PERMANOVA to test which soil moisture groups affect SIORC count. As before, I tested groups from the June, July, August, and overall cluster analyses (May was excluded due to low sample size). For all cluster analyses, soil moisture groups did not significantly affect SIORC count (Tables 2.13 to 2.16). I also tested each soil moisture characteristic from the overall dataset and found that individual soil moisture characteristics did not significantly affect SIORC count (Appendix K).

Table 2.13 PERMANOVA results examining the variance explained and significance of overall soil moisture groups on SIORC count.

	Df	SS	R2	F	Pr(>F)
easting	1	102.21	0.62	18.30	0.014
northing	1	21.12	0.13	3.78	0.126
overall groups	3	20.43	0.12	1.22	0.407
Residual	4	22.35	0.13		
Total	9	166.10	1.00		

Table 2.14 PERMANOVA results examining the variance explained and significance of June soil moisture groups on SIORC count.

	Df	SS	R2	F	Pr(>F)
easting	1	102.21	0.62	23.81	0.011
northing	1	21.12	0.13	4.92	0.093
June groups	3	25.60	0.15	1.99	0.261
Residual	4	17.17	0.10		
Total	9	166.10	1.00		

Table 2.15 PERMANOVA results examining the variance explained and significance of July soil moisture groups on SIORC count.

	Df	SS	R2	F	Pr(>F)
easting	1	102.21	0.62	21.90	0.012
northing	1	21.12	0.13	4.52	0.102
July groups	3	24.11	0.15	1.72	0.297
Residual	4	18.67	0.11		
Total	9	166.10	1.00		

Table 2.16 PERMANOVA results examining the variance explained and significance of August soil moisture groups on SIORC count.

	Df	SS	R2	F	Pr(>F)
easting	1	102.21	0.62	25.65	0.006
northing	1	21.12	0.13	5.30	0.067
August groups	2	22.85	0.14	2.87	0.141
Residual	5	19.92	0.12		
Total	9	166.10	1.00		

SIORC Abundance and Soil Moisture

Finally, I conducted PERMANOVA analyses testing which soil moisture groups affect SIORC count. Once again, I tested groups from the June, July, August, and overall cluster analyses (May was excluded due to low sample size). Soil moisture groups for June and the overall dataset did not significantly affect SIORC abundance (Tables 2.17 and 2.18).

Table 2.17 PERMANOVA results examining the variance explained and significance of overall soil moisture groups on SIORC abundance in plots where SIORC were present.

	Df	SS	R2	F	Pr(>F)
easting	1	12.12	0.17	4.14	0.089
northing	1	20.95	0.29	7.15	0.088
overall groups	3	28.31	0.39	3.22	0.154
Residual	4	11.72	0.16		
Total	9	73.10	1.00		

Table 2.18 PERMANOVA results examining the variance explained and significance of June soil moisture groups on SIORC abundance in plots where SIORC were present.

	Df	SS	R2	F	Pr(>F)
easting	1	12.12	0.17	3.80	0.094
northing	1	20.95	0.29	6.57	0.079
June groups	3	27.27	0.37	2.85	0.186
Residual	4	12.76	0.17		
Total	9	73.10	1.00		

However, soil moisture groups for July and August did significantly affect SIORC abundance *($p < 0.01$)* (Tables 2.20, 2.21, 2.23 and 2.24). For the July soil moisture group, SIORC abundance was greatest in the wettest group and lowest in the driest group; SIORC abundance was higher in the intermediate, increasing group than the intermediate, decreasing group (Table 2.19). This pattern was repeated for the August soil moisture groups, where SIORC abundance was greatest for the wet, increasing group and lowest for the dry group (Table 2.22).

Table 2.19 Average SIORC abundance per group for July soil moisture groups.

group	n	no. present plots	avg. SIORC abundance in present plots
driest	7	2	0.5
intermediate, decreasing	10	3	1.3
wettest	8	3	5.3
intermediate, increasing	4	2	3

Table 2.20 PERMANOVA results examining the variance explained and significance of July soil moisture groups on SIORC abundance in plots where SIORC were present.

	Df	SS	R2	F	Pr(>F)
easting	1	12.12	0.17	18.23	0.008
northing	1	20.95	0.29	31.51	0.020
July groups	3	37.37	0.51	18.73	0.004
Residual	4	2.66	0.04		
Total	9	73.10	1.00		

Table 2.21 Multiple pairwise comparisons of examining the variance explained and significance of July soil moisture groups on SIORC abundance in plots where SIORC were present.

pairs	Df	SS	R2	F	Pr(>F)	P adj.
driest vs wettest	1	28.03	2.57	0.46	0.3	1
driest vs intermediate, increasing	1	6.25	Inf	1.00	0.333	1
driest vs intermediate, decreasing	1	0.83	0.60	0.17	1	1
wettest vs intermediate, increasing	1	6.53	0.60	0.17	1	1
wettest vs intermediate, decreasing	1	24.00	2.61	0.39	0.3	1
intermediate, increasing vs intermediate, decreasing	1	3.33	2.40	0.44	0.4	1

Table 2.22 Average SIORC abundance per group for August soil moisture groups.

group	n	no. present plots	avg. SIORC abundance in present plots
dry	10	4	0.5
wet, decreasing	12	3	1.3
wet, increasing	7	3	5.3

Table 2.23 PERMANOVA results examining the variance explained and significance of August soil moisture groups on SIORC abundance in plots where SIORC were present.

	Df	SS	R2	F	Pr(>F)
easting	1	12.12	0.17	21.47	0.008
northing	1	20.95	0.29	37.12	0.01
August groups	2	37.20	0.51	32.95	0.003
Residual	5	2.82	0.04		
Total	9	73.10	1.00		

Table 2.24 Multiple pairwise comparisons of examining the variance explained and significance of August soil moisture groups on SIORC abundance in plots where SIORC were present.

pairs	Df	SS	R2	F	Pr(>F)	P adj.
dry vs wet, decreasing	1	22.01	2.83	0.36	0.175	0.525
dry vs wet, increasing	1	0.30	0.14	0.03	1	1
wet, decreasing vs wet, increasing	1	24.00	2.61	0.39	0.3	0.9

I also tested each soil moisture characteristic from the overall dataset individually. Mean, max, standard deviation, percent wet days, and driest day all significantly affected SIORC abundance (Tables 2.25 to 2.29 and Appendix K).

Table 2.25 PERMANOVA results examining the variance explained and significance of overall mean on SIORC abundance in plots where SIORC were present.

	Df	SS	R2	F	Pr(>F)
easting	1	12.12	0.17	18.91	0.006
northing	1	20.95	0.29	32.68	0.005
overall mean	1	36.18	0.49	56.44	0.001
Residual	6	3.85	0.05		
Total	9	73.10	1.00		

Table 2.26 PERMANOVA results examining the variance explained and significance of overall max on SIORC abundance in plots where SIORC were present.

	Df	SS	R2	F	Pr(>F)
easting	1	12.12	0.17	5.79	0.050
northing	1	20.95	0.29	10.02	0.045
overall max	1	27.48	0.38	13.13	0.006
Residual	6	12.55	0.17		
Total	9	73.10	1.00		

Table 2.27 PERMANOVA results examining the variance explained and significance of overall standard deviation on SIORC abundance in plots where SIORC were present.

	Df	SS	R2	F	Pr(>F)
easting	1	12.12	0.17	5.30	0.056
northing	1	20.95	0.29	9.17	0.063
overall sd	1	26.32	0.36	11.52	0.039
Residual	6	13.71	0.19		
Total	9	73.10	1.00		

Table 2.28 PERMANOVA results examining the variance explained and significance of overall % wet days on SIORC abundance in plots where SIORC were present.

	Df	SS	R2	F	Pr(>F)
easting	1	12.12	0.17	15.48	0.011
northing	1	20.95	0.29	26.76	0.008
overall % wet days	1	35.33	0.48	45.13	0.001
Residual	6	4.70	0.06		
Total	9	73.10	1.00		

Table 2.29 PERMANOVA results examining the variance explained and significance of the overall driest day on SIORC abundance in plots where SIORC were present.

	Df	SS	R2	F	Pr(>F)
easting	1	12.12	0.17	5.49	0.050
northing	1	20.95	0.29	9.48	0.071
Overall driest day	1	26.77	0.37	12.12	0.026
Residual	6	13.26	0.18		
Total	9	73.10	1.00		

Discussion

This project aimed to evaluate the spatial and temporal soil moisture patterns present at Camas Meadows and relate those moisture patterns to SIORC abundance and distribution. LOESS modeling was used to address the non-linear soil moisture data and to handle gaps caused by missing data points. From these data, I calculated soil moisture variables that represent important soil moisture characteristics: mean, minimum, maximum, standard deviation, wettest day, driest day, percent of wet days, percent of dry days, and average rate of change from the wettest day to the driest day. I then used these variables to conduct cluster analyses for the whole growing season as well as each month, individually.

Change in Soil Moisture Over Time at Camas Meadows

Sensor data confirmed that soil moisture at Camas Meadows declines in spring or early summer and remains low until the fall when precipitation becomes more frequent. Different areas in the meadow exhibited different timing and rate of decrease in soil moisture, with some sensors suggesting declining soil moisture before mid-May (transect 7 sensors), and others showing soil moisture decline beginning as late as mid-June (T6P7_S3) (Figure 2.6). These differences in the timing of soil moisture decline partially reflect the logistics of sensor installation, as sensors that were installed in early June may not have captured peak moisture conditions that occurred May. For example, transect 5 had standing water across most of the transect in mid-May, so sensors could not be installed until early-June. By the time the transect 5 sensors were installed, transect 5 was noticeably drier than other transects. Following sensor installation at transect 5, soil moisture did not exhibit any peak or plateau but instead declined slowly (Figure 2.6). This suggests that soil moisture at transect 5 rapidly decreased between mid-May and early-June, prior to sensor installation. This may be related to the location of this transect on a relatively steep slope less than 50 meters from a riparian grove of *Populus tremuloides.* Much like transect 5, transect 9 was located partially within a riparian grove of *Populus tremuloides* and had standing water in mid-May. However, transect 9 exhibited a plateau followed by rapid decline in soil moisture, unlike transect 5 (Figure 2.6). This illustrates that even transects with similar habitat types (riparian *Populus tremuloides* and flooded in mid-May) exhibited different soil moisture patterns. Without microsite-level continuous soil moisture monitoring, it would be difficult to identify the important differences in soil moisture patterns between these transects that otherwise appear quite similar.

Sensors in a given transect tended to follow similar patterns regarding timing and rate of change in soil moisture. However, some sensors exhibited notably different soil moisture patterns in contrast to other sensors in the same transect. For example, sensor 1 of transect 12 was much generally drier than sensors 2 and 3, and it reached its minimum soil moisture nearly 2 months before sensors 2 and 3, despite being only 20 and 40 m away, respectively (Figure 2.6). This striking difference again emphasizes the value of microsite studies like this one—even nearby sites can have important differences in soil moisture characteristics.

Cluster Analyses and SIORC Distribution

All cluster analyses consistently identified groups based on amount of wetness, with most analyses identifying at least one wettest and driest group. In addition to differentiating between very dry and very wet conditions, various analyses picked up on characteristics such as variability, rate of change, and especially direction of change. The cluster analyses for May, June, July, and August all identified groups characterized by how variable vs consistent moisture levels were, and/or based on whether soil moisture was increasing or decreasing. The overall analysis also included a group that was defined by a more prolonged decline in soil moisture in comparison to groups with similar mean, maximum, and minimum soil moisture values. These cluster analyses reveal distinct soil moisture patterns present at Camas Meadows that are differentiated not only based on amount of soil moisture, but also based on change in soil moisture over time.

Using groupings based on the soil moisture variables as well as the soil moisture variables themselves, I assessed the relationship between SIORC distribution and soil moisture. Overall, I did not find support for the effect of soil moisture variables or groupings on SIORC presence and count. This is likely in large part due to limited sample size. Of the 30 plots associated with sensors, only 10 contained SIORC. In these plots, the highest number of SIORC individuals was 4, and the highest average abundance was 10%. While the soil moisture measurements were extensive, limited sample size and SIORC distribution result in limited power. Despite this, PERMANOVA tests found that soil moisture groups based on July and August soil moisture data significantly affected SIORC abundance (July: $F = 18.73, p < 0.01$, August: $F = 32.95, p < 0.01$) (Tables 2.20 and 2.23). For the July cluster analysis, the highest abundance of SIORC was present in the wettest group, and the lowest abundance was in the driest group, with a greater abundance in the intermediate, increasing group than the intermediate, decreasing group (Table 2.19). This pattern persists with the August cluster analysis, with the greatest abundance of SIORC in the wet, increasing group, and the lowest SIORC abundance in the dry group (Table 2.22). These findings support that SIORC abundance is positively affected by soil moisture. In comparison to other months, August was overall drier than other months, despite a rain event on August 7, and another rain event on August 28 to 29 (Table 2.2). As such, all 3 August groups have relatively similar values for mean, min, and max in contrast to other months when soil moisture was more variable. However, the driest group still had over 60% dry days in August in contrast to about 9% dry days in the wet, decreasing group and zero dry days in the wet, increasing group. Given that July and especially August are the driest months for most of these sensor locations, this could suggest that timing and degree of dryness have more effect on SIORC abundance than early-season wetness.

Comparing groups from the July cluster analysis to groups from the August cluster analysis, there are clearly some sensors that are grouped together in both analyses. For example, all 7 sensors in the driest group in July are placed into the driest group in August, with just 3 new sensors added to the August driest group that were previously in July intermediate increasing group (the drier of the two intermediate groups). Similarly, 7 of the 8 sensors in the July wettest group were found in the August wet, decreasing group (which was the wetter of the two intermediate groups. Just one wettest sensor from July ended up in the August wet, increasing group. This shows that, even when looking at a month of soil moisture data at a time, some of the overall, enduring soil moisture patterns are clearly visible.

Table 2.30 July and August soil moisture groups for each sensor.

sensor	July	August
T5P10_S3	driest	dry
T5P4_S1	wettest	wet, increasing
T5P7_S2	intermediate, decreasing	wet, increasing
T6P1_S1	intermediate, decreasing	wet, decreasing
T6P4_S2	intermediate, decreasing	wet, increasing
T6P7_S3	wettest	wet, decreasing
T7P3_S1	intermediate, decreasing	wet, increasing
T7P6_S2	intermediate, decreasing	wet, increasing
T7P9_S3	intermediate, increasing	wet, decreasing
T9P2_S1	wettest	wet, decreasing
T9P5_S2	wettest	wet, decreasing
T9P8_S3	intermediate, decreasing	wet, increasing
T10P2_S1	driest	dry
T10P5_S2	driest	dry
T10P8_S3	intermediate, decreasing	wet, decreasing
T12P2_S1	intermediate, decreasing	wet, decreasing
T12P5_S2	wettest	wet, decreasing
T12P8_S3	wettest	wet, decreasing
T14P1_S1	intermediate, increasing	dry
T14P7_S3	wettest	wet, decreasing
T15P2_S1	driest	dry
T15P5_S2	intermediate, increasing	dry
T15P8_S3	intermediate, decreasing	wet, increasing
T16P1_S3	driest	dry
T16P4_S2	wettest	wet, decreasing
T16P7_S1	driest	dry
T18P1_S1	driest	dry
T18P4_S2	intermediate, increasing	dry
T18P7_S3	intermediate, decreasing	wet, decreasing

I also found evidence for significant relationships between SIORC abundance and individual, overall soil moisture characteristics. Overall mean, max, standard deviation, percent wet days, and driest day all significantly affected SIORC abundance (Tables 2.25 to 2.29). Of these, mean and max soil moisture as well as percent of wet days were the strongest predictors of SIORC abundance. This is consistent with the overall cluster analyses, which showed that amount of soil moisture was consistently a defining factor for soil moisture patterns at Camas

Meadows. This is also promising as it suggests that instantaneous measures of soil moisture do capture an important aspect of soil moisture with respect to SIORC abundance. Percent of wet days was also found to significantly affect SIORC abundance, which indicates that having more, very wet days positively affects SIORC abundance. This suggests that duration and consistency of moisture, not just average moisture, are also important for SIORC abundance.

The distinct patterns of soil moisture characteristics observed in this project underscore the dynamic nature of soil moisture. Continuously measuring soil moisture made it possible to assess how soil moisture changes at Camas Meadows throughout the growing season, and to relate those conditions to SIORC abundance. We found that only SIORC abundance was significantly affected by soil moisture variables or soil moisture groupings. This could be partially due to the small sample of SIORC present across the 29 plots in this study. It could also indicate that soil moisture variables are more influential in determining how well or how much SIORC can grow (cover) as opposed to whether SIORC will be able to become established and reproduce in a certain area (presence and count). As discussed in Chapter 1, other physical microsite variables could be more important in determining SIORC distribution, although I did not find evidence for that conclusion. Vegetation characteristics also seem to influence SIORC distribution, although it is sometimes difficult to determine causality vs correlation. Additionally, other factors outside of the scope of this thesis, such as seed predation and fire suppression, are likely to affect SIORC's distribution.

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Conclusion

Evaluating microsite conditions of Wenatchee Mountains checkermallow (*Sidalcea oregana* var. *calva*) reveals a complex combination of physical, vegetative, and soil moisture characteristics. Chapter 1 focused on the impact of physical and vegetation microsite characteristics on SIORC presence and abundance at Camas Meadows. This research found that while physical microsite variables such as soil moisture, soil texture, Leaf Area Index, and canopy density did not significantly influence SIORC distribution, vegetation characteristics played a more critical role. In particular, high species richness and forb cover were strongly associated with SIORC presence, and total cover was closely linked to SIORC abundance. Following an Indicator Species Analysis, *Achillea millefolium* emerged as an indicator for SIORC presence, and *Amelanchier alnifolia* was identified as a potential indicator for SIORC absence, underscoring the importance of vegetation composition in understanding this rare plant's habitat needs.

Chapter 2 extended this investigation by exploring the effects of dynamic soil moisture patterns on SIORC distribution. This analysis of temporal soil moisture patterns shows that timing, amount, and variability of soil moisture in July and August significantly affect SIORC abundance, but not SIORC presence or count. Additionally, SIORC abundance had significant relationships with overall soil moisture variables such as mean and maximum soil moisture, and the percentage of wet days. These results suggest that while SIORC presence might be more influenced by vegetation characteristics, SIORC abundance is significantly affected by soil moisture dynamics over time.

These findings have valuable implications for recovery efforts for this taxon. First and foremost, it appears that SIORC can tolerate a wide range of conditions (at least within the range of conditions present at Camas Meadows). While instantaneous soil moisture, field-based soil texture, Leaf Area Index, and canopy density did not significantly affect SIORC in this study, it remains true that the majority of SIORC populations found at Camas Meadows occur in more open parts of the meadow, and the results from Chapter 2 strongly support that SIORC abundance is positively associated with increased soil moisture. Additionally, soil texture data from 2023 show that SIORC may be restricted to loamy soil (although most soil at Camas Meadows is loam or similar) and may prefer soil with relatively less clay and more silt. There is still much to be explored regarding SIORC's relationship with vegetation, but it appears that SIORC tends to grow in areas with higher forb cover and lower shrub and grass cover. Given that SIORC seems to tolerate a wide range of conditions at Camas Meadows, other factors such as seed predation and fire suppression may be driving SIORC distribution.

Future research should integrate these dimensions to provide a more holistic understanding of SIORC's habitat needs. Long-term studies that track interactions between vegetation dynamics and soil moisture over extended periods could offer deeper insights. Additionally, exploring other potential ecological factors, such as seed predation or competition with invasive species, would further enhance our understanding of the complexities affecting SIORC. Addressing these research gaps will be crucial for developing effective conservation strategies and ensuring the continued viability of SIORC populations.

Together, this research underscores the multifaceted and fine-scale nature of SIORC's habitat requirements. Future research should seek to further explore the effects of physical properties on SIORC distribution, especially with respect to soil texture. While field-based soil texture data did not reveal a significant relationship to SIORC, lab-based data from 2023 found that the clay vs silt content of soil significantly affects SIORC presence. Additional studies examining vegetation dynamics with SIORC could offer insight into which species might be indicators for SIORC presence or absence. Identifying compelling indicator species for SIORC would especially be helpful for identifying suitable microsites for outplanting efforts. Finally, expanding research to focus on other variables, such as seed predation, competition from invasive species, and fire, could further elucidate what factors are driving SIORC's distribution. Continued research into SIORC's habitat requirements is crucial for developing effective conservation strategies and ensuring the recovery of SIORC populations.

Appendix A: Chapter 1 Plot Coordinates

UTM coordinates were measured for either end of each transect. Plot coordinates were estimated in ArcGIS Pro based on transect coordinates and known linear distances between plots.

Table A.1 Transect start and end coordinates, UTM Zone 10T. Start coordinates are closest to plot 1 for each transect, and end coordinates are closest to the last plot.

transect	start coordinate	end coordinate
1	0682227 5260768	0682222 5260712
2	0683163 5259921	0683161 5259890
3	0682478 5260684	0682527 5260648
5	0682287 5260930	0682232 5260965
6	0682499 5260856	0682441 5260838
7	0682359 5260837	0682403 5260797
9	0682448 5260557	0682444 5260616
10	0682599 5260636	0682635 5260685
12	0682797 5260880	0682843 5260843
14	0682717 5260277	0682662 5260267
15	0682968 5260301	0682973 5260364
16	0682920 5259848	0682948 5259897
18	0683459 5259799	0683515 5259797

Table A.2 UTM Zone 10T coordinates for each plot and transect.

transect	plot	easting	northing
1	1	682226.19	5260758.88
1	2	682225.82	5260754.82
1	3	682225.46	5260750.76
1	4	682225.10	5260746.70
1	5	682224.74	5260742.63
1	6	682224.37	5260738.57
1	7	682224.01	5260734.51
1	8	682223.65	5260730.45
1	9	682223.29	5260726.39
1	10	682222.92	5260722.33
1	11	682222.56	5260718.27
1	12	682222.20	5260714.21
2	1	683163.00	5259921.00
2	2	683162.75	5259916.98
2	3	683162.49	5259912.96
2	4	683162.24	5259908.94
2	5	683161.99	5259904.93

transect	plot	easting	northing
2	6	683161.73	5259900.91
2	7	683161.48	5259896.89
2	8	683161.23	5259892.87
2	9	683160.97	5259888.85
2	10	683160.72	5259884.83
2	11	683160.47	5259880.81
2	12	683160.22	5259876.80
3	1	682478.00	5260648.00
3	2	682482.90	5260651.60
3	3	682487.80	5260655.20
3	4	682492.70	5260658.80
3	5	682497.60	5260662.40
3	6	682502.50	5260666.00
3	7	682507.40	5260669.60
3	8	682512.30	5260673.20
3	9	682517.20	5260676.80
3	10	682522.10	5260680.40
3	11	682527.00	5260684.00
5	1	682286.26	5260930.75
5	2	682281.20	5260933.97
5	3	682276.14	5260937.19
5	4	682271.07	5260940.41
5	5	682266.01	5260943.63
5	6	682260.95	5260946.85
5	7	682255.89	5260950.07
5	8	682250.83	5260953.29
5	9	682245.76	5260956.51
5	10	682240.70	5260959.74
6	1	682494.10	5260854.42
6	2	682488.37	5260852.64
6	3	682482.64	5260850.86
6	4	682476.91	5260849.08
6	5	682471.18	5260847.31
6	6	682465.45	5260845.53
6	7	682459.72	5260843.75
6	8	682453.99	5260841.97
6	9	682448.26	5260840.19
6	10	682442.53	5260838.41
7	1	682403.36	5260797.05
7	2	682398.94	5260801.06
7	3	682394.50	5260805.10
7	4	682390.06	5260809.13
7	5	682385.62	5260813.17
7	6	682381.18	5260817.21
7	7	682376.74	5260821.24
7	8	682372.30	5260825.28
7	9	682367.87	5260829.31
7	10	682363.43	5260833.35

transect	plot	easting	northing
9	1	682448.05	5260561.64
9	2	682447.64	5260567.63
9	3	682447.23	5260573.61
9	4	682446.83	5260579.60
9	5	682446.42	5260585.58
9	6	682446.02	5260591.57
9	7	682445.61	5260597.56
9	8	682445.20	5260603.54
9	9	682444.80	5260609.53
9	10	682444.39	5260615.51
10	1	682599.65	5260636.45
10	2	682603.21	5260641.29
10	3	682606.76	5260646.12
10	4	682610.31	5260650.96
10	5	682613.86	5260655.79
10	6	682617.41	5260660.63
10	7	682620.97	5260665.46
10	8	682624.52	5260670.30
10	9	682628.07	5260675.13
10	10	682631.62	5260679.97
12	1	682797.75	5260879.74
12	2	682802.42	5260875.98
12	3	682807.10	5260872.22
12	4	682811.77	5260868.46
12	5	682816.45	5260864.70
12	6	682821.12	5260860.93
12	7	682825.80	5260857.17
12	8	682830.47	5260853.41
12	9	682835.15	5260849.65
12	10	682839.82	5260845.89
14	1	682662.36	5260267.05
14	2	682668.26	5260268.13
14	3	682674.17	5260269.20
14	4	682680.07	5260270.27
14	5	682685.97	5260271.35
14	6	682691.88	5260272.42
14	7	682697.78	5260273.49
14	8	682703.68	5260274.57
14	9	682709.58	5260275.64
14	10	682715.49	5260276.71
15	1	682968.44	5260302.05
15	2	682968.91	5260308.03
15	3	682969.39	5260314.01
15	4	682969.86	5260319.99
15	5	682970.34	5260325.97
15	6	682970.81	5260331.96
15	7	682971.28	5260337.94
15	8	682971.76	5260343.92

transect	plot	easting	northing
15	9	682972.23	5260349.90
15	10	682972.71	5260355.88
16	1	682921.55	5259850.14
16	2	682924.53	5259855.35
16	3	682927.50	5259860.56
16	4	682930.48	5259865.77
16	5	682933.46	5259870.98
16	6	682936.43	5259876.19
16	7	682939.41	5259881.40
16	8	682942.39	5259886.60
16	9	682945.36	5259891.81
16	10	682948.34	5259897.02
18	1	683461.36	5259798.99
18	2	683467.35	5259798.77
18	3	683473.35	5259798.56
18	4	683479.35	5259798.34
18	5	683485.34	5259798.13
18	6	683491.34	5259797.92
18	7	683497.33	5259797.70
18	8	683503.33	5259797.49
18	9	683509.33	5259797.27
18	10	683515.32	5259797.06

Appendix B: Species List

Functional groups, scientific names, species codes, percent of plots where present, and average cover where present for all taxa observed during vegetation cover estimates. Species codes for this study were created using the first two letters of the genus (or, if genus could not be identified, the family) and the first three letters of the species (if species was sp., the species code used only the first two letters). Species that were in the 75th percentile for both percent of plots where present and average cover where present are shown in bold.

functional group/species	species code	% of plots where present	avg. cover where present
shrubs and trees			
Amelanchier alnifolia	AMALN	16.3	13.3
Crataegus douglasii	CRDOU	1.5	6.5
Crataegus monogyna	CRMON	0.7	10
Pinus ponderosa var. *ponderosa*	PIPON	14.1	0.5
Populus tremuloides	POTRE	3.7	10.3
Pseudotsuga menziesii	PSMEN	1.5	0.5
Rosa sp.	ROSP	3	1.1
Spiraea sp.	SPSP	6.7	15.2
Symphoricarpos albus	**SYALB**	**18.5**	**12.8**
forbs			
Aconitum columbianum	ACCOL	1.5	1.8
Achillea millefolium	**ACMIL**	**71.9**	**3.5**
Angelica sp.	ANSP	5.2	1.9
Asteraceae spp.	ASSPP	42.2	2.7
Bistorta bistortoides	BIBIS	17	1.5
Calochortus lyallii	CALYA	0.7	0.5
Cryptantha miniata	CAMIM	0.7	0.5
Castilleja miniata	CAMIN	3	0.5
Camassia quamash	CAQUA	14.8	0.5
Caryophyllaceae sp.	CASP	4.4	0.5
Castilleja tenuis	CATEN	6.7	0.5
Cirsium sp.	CISP	0.7	0.5
Convolvulus arvensis	COARV	12.6	3.2
Collomia linearis	COLIN	20	0.7
Cuscuta sp.	CUSP	0.7	3
Delphinium viridescens	DEVIR	17	2

functional group/species	species code	% of plots where present	avg. cover where present
Dianthus armeria	DIARM	4.4	0.5
forbs			
Drymocallis sp.	DRSP	14.1	2.2
Epilobium brachycarpum	EPBRA	0.7	0.5
Epilobium glandulosum	EPGLA	0.7	0.5
Epilobium minutum	EPMIN	9.6	0.5
Epilobium spp.	EPSPP	35.6	1.5
Equisetum laevigatum	EQLAE	13.3	0.5
Equisetum sp.	EQSP	1.5	0.5
Fabaceae sp.	FASP	3	1.8
Fritillaria affinis	FRAFF	1.5	0.5
Fragaria virginiana	FRVIR	20.7	1.5
Galium aperine	GAAPE	0.7	0.5
Geum triflorum	GETRI	5.9	3.2
Geranium viscosissimum	GEVIS	7.4	1.5
Lomatium nudicaule	LONUD	22.2	1.2
Lupinus sericeus	**LUSER**	**59.3**	**8.5**
Madia exigua	MAEXI	0.7	0.5
Madia gracilis	**MAGRA**	**51.1**	**6.1**
Maianthemum stellatum	MASTE	1.5	3
Microsteris gracilis	MIGRA	5.2	0.5
Microsesis nutans	MINUT	5.9	0.5
Montia linearis	MOLIN	12.6	1.5
Navarretia intertexta	NAINT	8.9	0.5
Ozmorhiza berteroi	OZBER	2.2	0.5
Penstemon confertus	**PECON**	**22.2**	**6.5**
Perideridia montana	PEMON	63	0.5
Potentilla gracilis	**POGRA**	**54.1**	**7.2**
Polygonum polygaloides	POPOL	5.2	0.9
Potentilla recta	**POREC**	**42.2**	**3.7**
Prunella vulgaris	PRVUL	1.5	0.5
Ranunculus uncinatus	RAUNC	5.2	0.9
Rumex spp.	RUSPP	0.7	0.5
Senecio hydrophilus	SEHYD	2.2	0.5
Sidalcea oregana var. calva	**SIORC**	**37.8**	**4.4**
Solidago sp.	SOSP	3.7	1
Symphyotrichum sp.	SYSP	15.6	2.1
Taraxacum officinale	TAOFF	19.3	1.2
Thalictrum occidentale	THOCC	6.7	1.3
Tragopogon dubius	TRDUB	2.2	0.5

functional group/species	**species code**	**% of plots where present**	**avg. cover where present**
Trifolium hybridum	TRHYB	14.8	2.8
Trifolium longipes	TRLON	23	1.1
forbs			
Trifolium spp.	TRSPP	8.1	1.9
Unknown spp.	UNSPP	41.5	5.2
Veratrum californicum	VECAL	3	1.8
Viola adunca	VIADU	17	3.4
Vicia americana	**VIAME**	**25.2**	**3.1**
Wyethia amplexicaulis	**WYAMP**	**45.2**	**28.9**
graminoids			
Agrostis sp.	AGSP	3	0.5
Alopecurus pratensis	ALPRA	0.7	3
Bromus inermis	BRINE	3	0.5
Carex pachystachya	CAPAC	19.3	1.1
Carex spp.	CASPP	23.7	1.1
Elymus repens	**ELREP**	**41.5**	**7.2**
Festuca idahoensis	FEIDA	7.4	2
Juncus ensifolius	JUENS	3	0.5
Juncus spp.	JUSPP	19.3	1.7
Pascopyron smithii	PASMI	2.2	1.3
Phleum pratense	**PHPRA**	**58.5**	**3.5**
Poa spp.	POASP	16.3	0.5
Poaceae spp.	POSPP	60	3.2

Appendix C: Cover Estimates

Percent cover midpoint corresponding with the recorded cover class for each taxon. Tables are organized according to vegetation functional group.

Table C.1 Cover data for shrubs and trees.

transect	plot	AMALN	CRDOU	CRMON	PIPON	POTRE	PSMEN	ROSP	SPSP	SYALB
1	1	0	0	0	0.5	0	0	0	0	0
1	2	0	0	0	0.5	0	0	0	0	0
1	3	0	0	0	0	0	0.5	0	0	0
1	4	0	0	0	0	0	0	0	0	0
1	5	0	0	0	0.5	0	0	0	0	0
1	6	0	0	0	0	0	0	0	0	0
1	7	0	0	0	0	0	0	0	0	0
1	8	0	0	0	0.5	0	0	0	0	0
1	9	0	0	0	0	0	0	0	0	0
1	10	0	0	0	0.5	0	0	0	0	0
1	11	20	0	0	0.5	0	0	0	0	0
1	12	0	0	0	0.5	0	0	0	0	37.5
2	1	0	0	0	0	0	0.5	0	0	0
2	2	0	0	0	0	0	0	0	0	0
2	3	0	0	0	0.5	0	0	0	0	0
2	4	0	0	0	0	0	0	0	0	0
2	5	0	0	0	0	0	0	0	37.5	0
2	6	3	0	0	0.5	0	0	0	20	0
2	7	0	0	0	0.5	0	0	0	0	0
2	8	0	0	0	0	0	0	0	0	0
2	9	0	0	0	0	0	0	0	0.5	0
2	10	0	0	0	0	0	0	0	37.5	0
2	11	0	0	0	0	0	0	0	0	0
2	12	0	0	0	0	0	0	0	0	0
3	1	0	0	0	0	0	0	0	0	10
3	2	0	0	0	0	0	0	0	0	0
3	3	0	0	0	0	0	0	0	0	0.5
3	4	37.5	0	0	0	0	0	0	0	0
3	5	0	0	0	0	0	0	0	0	0
3	6	0	0	0	0	0	0	0	0	0
3	7	0	0	0	0	0	0	0	0	0
3	8	0	0	0	0	0	0	0	0	0
3	9	0	0	0	0	0	0	0	0	0
3	10	0	0	0	0	0	0	0	0	0
3	11	0	0	0	0	0	0	0	0	0
5	1	0	0	0	0	0	0	0	0	0
5	2	0	0	0	0	0	0	0	0	0
5	3	0	0	0	0	0	0	0	0	0
5	4	0	0	0	0	0	0	0	0	0

transect	plot	AMALN	CRDOU	CRMON	PIPON	POTRE	PSMEN	ROSP	SPSP	SYALB
5	5	3	0	0	0	0	0	0	0	0
5	6	0	0	0	0	0	0	0	0	0
5	7	0	0	0	0	0	0	0	0	0
5	8	0	0	0	0	0	0	0	0	0
5	9	3	0	0	0	0	0	0	0	0.5
5	10	0	0	0	0	0	0	0	0	10
6	1	0	0	0	0	0	0	0	0	0
6	2	0	0	0	0	0	0	0	0	0
6	3	0	0	0	0	0	0	0	0	0
6	4	0	0	0	0	0	0	0	0	3
6	5	0	0	0	0	0	0	0	0	20
6	6	0	0	0	0	0	0	0	0	0
6	7	0	0	0	0	0	0	0	0	0
6	8	0	0	0	0	0	0	0	0	0
6	9	0	0	0	0	0	0	0	0	0
6	10	0	0	0	0	0	0	0	0	0
7	1	0	0	0	0	0	0	0	0	0
7	2	0	0	0	0	0	0	0	0	0
7	3	0	0	0	0	0	0	0	0	0
7	4	0	0	0	0	0	0	0	0	0
7	5	0	0	0	0	0	0	0	0	0
7	6	0	0	0	0	0	0	0	0	0
7	7	0	0	0	0	0	0	0	0	0
7	8	0	0	0	0	0	0	0	0	0
7	9	0	0	0	0	0	0	0	0	0
7	10	0	0	0	0	0	0	0	0	0
9	1	0.5	3	0	0	10	0	0	0	3
9	2	0	0	0	0	3	0	0	0	0
9	3	0	0	0	0	0	0	0	0	0
9	4	0	0	0	0	0	0	0	0	0
9	5	0	0	0	0	0	0	0	0	0
9	6	0	0	0	0	0	0	0	0	0
9	7	0	0	0	0	0	0	0	0	0
9	8	0	0	0	0	0	0	0	0	0
9	9	0	0	0	0	0	0	0	0	0
9	10	0	0	0	0	0	0	0	0	0
10	1	0	0	0	0	0	0	0	0	0
10	2	0	0	0	0	0	0	0	0	0
10	3	0	0	0	0	0	0	0	0	0
10	4	0	0	0	0	0	0	0	0	0
10	5	0	0	0	0	0	0	0	0	0
10	6	0	0	0	0	0	0	0	0	0.5
10	7	0	0	0	0	0	0	3	0	0
10	8	0	0	0	0	0	0	0	0	0
10	9	0	0	0	0	0	0	0	0	0.5
10	10	0	0	0	0	0	0	0	0	0.5
12	1	0	0	0	0	0	0	0	0	0
12	2	0	0	0	0	0	0	0	0	0
12	3	0	0	0	0	0	0	0	0	0

transect	plot	AMALN	CRDOU	CRMON	PIPON	POTRE	PSMEN	ROSP	SPSP	SYALB
12	4	0	0	0	0	0	0	0	0	0
12	5	0	0	10	0	0	0	0	0	0
12	6	0	0	0	0	0	0	0	0	0
12	7	0	0	0	0	0	0	0	0	0
12	8	0	0	0	0	0	0	0	0	0
12	9	0	0	0	0	0	0	0	0	0
12	10	0	0	0	0	0	0	0	0	0
14	1	0	0	0	0.5	0	0	0	0	0
14	2	37.5	0	0	0	0	0	0	0	0.5
14	3	3	0	0	0	0	0	0	0	0.5
14	4	3	10	0	0	0	0	0	0	0.5
14	5	0	0	0	0	0	0	0	0	3
14	6	3	0	0	0	0	0	0	0	37.5
14	7	0	0	0	0	0	0	0	0	37.5
14	8	0	0	0	0	0	0	0	0	37.5
14	9	0	0	0	0	0	0	0	0	62.5
14	10	10	0	0	0	0	0	0	0	20
15	1	37.5	0	0	0	0	0	0.5	0	20
15	2	3	0	0	0.5	0	0	0	0	0.5
15	3	0	0	0	0.5	0	0	0	0	0
15	4	0	0	0	0	0	0	0	0	0.5
15	5	0	0	0	0	0	0	0	0	0
15	6	0	0	0	0	0	0	0	0	0
15	7	0	0	0	0.5	0	0	0	0	0
15	8	3	0	0	0.5	0	0	0	0	0
15	9	20	0	0	0.5	0	0	0	0	0
15	10	0	0	0	0.5	0	0	0	0	0
16	1	0.5	0	0	0	0	0	0	0	0
16	2	0	0	0	0	0	0	0	0	3
16	3	10	0	0	0	0	0	0	0	0
16	4	0	0	0	0	0	0	0	0	0
16	5	3	0	0	0	0	0	0	0	0
16	6	0	0	0	0	0	0	0	0	0
16	7	0.5	0	0	0	0	0	0	0	10
16	8	3	0	0	0	0.5	0	0	0	0
16	9	0	0	0	0	0	0	0	0	0
16	10	0	0	0	0	37.5	0	0	0	0
18	1	0.5	0	0	0.5	0.5	0	0.5	20	0
18	2	0	0	0	0	0	0	0	0.5	0
18	3	87.5	0	0	0	0	0	0	10	0
18	4	0	0	0	0.5	0	0	0	10	0
18	5	0	0	0	0	0	0	0	0.5	0
18	6	0	0	0	0	0	0	0	0	0
18	7	0	0	0	0	0	0	0	0	0
18	8	0	0	0	0	0	0	0	0	0
18	9	0	0	0	0	0	0	0.5	0	0
18	10	0	0	0	0	0	0	0	0	0

Table C.2 Cover data for forbs, part I.

transect	plot	ACCOL	ACMIL	ANSP	ASSPP	BIBIS	CALYA	CAMIM	CAMIN
1	1	0	0.5	0	0	0.5	0	0	0
1	2	0	0.5	0	0	0	0	0	0
1	3	0	0.5	0	0	3	0	0	0
1	4	0	0.5	0	0	3	0	0	0
1	5	0	10	0	0	0.5	0	0	0
1	6	0	0.5	0	0	0.5	0	0	0
1	7	0	0.5	0	0	0.5	0	0	0
1	8	0	3	0	0	0	0	0	0
1	9	0	0.5	0	0	3	0	0.5	0
1	10	0	3	0	0	3	0	0	0
1	11	0	3	0	0	3	0	0	0
1	12	0	0.5	10	0	0	0.5	0	0
2	1	0	0.5	0	0	0	0	0	0
2	2	0	0	0	0	0	0	0	0
2	3	0	0	0	0	0	0	0	0
2	4	0	0	0	0	0	0	0	0
2	5	0	0	0	0	0	0	0	0
2	6	0	0	0	0	0	0	0	0
2	7	0	0	0	0	3	0	0	0
2	8	0	0	0	0	0.5	0	0	0
2	9	0	0.5	0	0	0.5	0	0	0
2	10	0	0.5	0	0	0.5	0	0	0
2	11	0	0	0	0	0.5	0	0	0
2	12	0	0	0	0	3	0	0	0
3	1	0	20	0	10	0	0	0	0
3	2	0	20	0	3	0	0	0	0
3	3	0	20	0	10	0	0	0	0
3	4	0	20	0	20	0	0	0	0
3	5	0	3	0	3	0	0	0	0
3	6	0	37.5	0	0	0	0	0	0
3	7	0	20	0	0	0.5	0	0	0
3	8	0	0	0	0.5	0	0	0	0
3	9	0	0	0	3	0.5	0	0	0
3	10	0	0	0	10	3	0	0	0
3	11	0	0	0	10	3	0	0	0
5	1	0	0	0	0	0	0	0	0
5	2	0	0	0	0	0	0	0	0
5	3	0	0	0	0	0	0	0	0
5	4	0	0	0	0	0	0	0	0
5	5	0	0.5	0	0	0	0	0	0
5	6	0	0.5	0	0.5	0	0	0	0
5	7	0	0.5	0	0	0	0	0	0
5	8	0	3	0	0.5	0	0	0	0
5	9	0	3	0	0.5	0	0	0	0
5	10	0	0.5	0	0	0	0	0	0
6	1	0	3	0	0.5	0	0	0	0
6	2	0	10	0	0	0	0	0	0

transect	plot	ACCOL	ACMIL	ANSP	ASSPP	BIBIS	CALYA	CAMIM	CAMIN
6	3	0	0.5	0	0	0	0	0	0
6	4	0	3	0	0.5	0	0	0	0
6	5	0	10	0	0	0.5	0	0	0
6	6	0	3	0	0	0	0	0	0
6	7	0	0.5	0	0	0	0	0	0
6	8	0	0	0	3	0	0	0	0
6	9	0	0	0	3	0	0	0	0
6	10	0	0.5	0	0	0	0	0	0
7	1	0	0.5	0	3	0	0	0	0
7	2	0	0	0	0	0	0	0	0
7	3	0	10	0	0	0	0	0	0
7	4	0	0.5	0	0	0	0	0	0
7	5	0	0.5	0	3	0	0	0	0
7	6	0	3	0	0.5	0	0	0	0
7	7	0	10	0	0	0	0	0	0
7	8	0	10	0	0	0	0	0	0
7	9	0	10	0	0	0	0	0	0
7	10	0	0.5	0	0	0	0	0	0
9	1	0	0	0	0	0	0	0	0
9	2	0	0	0	0	0	0	0	0
9	3	0	0	0	0	0	0	0	0
9	4	0	0.5	0	3	0	0	0	0
9	5	0	0.5	0	3	0	0	0	0
9	6	0	0	0	0.5	0	0	0	0
9	7	0	0.5	0	0	0	0	0	0
9	8	0	0.5	0	3	0	0	0	0
9	9	0	0.5	0	3	0	0	0	0
9	10	0	3	0	0	0	0	0	0
10	1	0	10	0	0.5	0	0	0	0
10	2	0	0	0	0	0	0	0	0
10	3	0	0.5	0	0	0	0	0	0
10	4	0	3	0	3	0	0	0	0
10	5	0	0.5	0	0.5	0	0	0	0
10	6	0	0.5	0	3	0	0	0	0
10	7	0	3	0	0.5	0	0	0	0
10	8	0	0.5	0	0.5	0	0	0	0
10	9	0	0.5	0	0.5	0	0	0	0
10	10	0	3	0	0	0	0	0	0
12	1	0	3	0	0	0	0	0	0
12	2	0	3	0	0	0	0	0	0
12	3	0	3	0	0	0	0	0	0
12	4	0	3	0	0	0	0	0	0
12	5	0	0.5	0	0	0	0	0	0
12	6	0	3	0	0	0	0	0	0
12	7	0	10	0	0	0	0	0	0
12	8	0	10	0	0	0	0	0	0
12	9	0	0.5	0	0	0	0	0	0
12	10	0	3	0	0	0	0	0	0
14	1	0	0.5	0	0	0	0	0	0

transect	plot	ACCOL	ACMIL	ANSP	ASSPP	BIBIS	CALYA	CAMIM	CAMIN
14	2	0	0	0	0	0	0	0	0
14	3	0	0.5	0	3	0	0	0	0
14	4	0	0.5	0	3	0	0	0	0
14	5	0	3	0.5	3	0	0	0	0
14	6	0	0.5	0	3	0	0	0	0
14	7	3	0.5	0	0	0	0	0	0.5
14	8	0.5	0.5	0.5	0	0.5	0	0	0
14	9	0	0.5	0.5	3	0	0	0	0
14	10	0	0	0.5	3	0	0	0	0
15	1	0	0	0.5	0.5	0	0	0	0
15	2	0	0.5	0.5	0.5	0	0	0	0.5
15	3	0	0	0	0.5	0	0	0	0.5
15	4	0	0.5	0	0.5	0	0	0	0
15	5	0	0	0	0.5	0	0	0	0
15	6	0	0.5	0	0.5	0	0	0	0
15	7	0	0.5	0	0.5	0	0	0	0
15	8	0	0.5	0	0.5	0	0	0	0
15	9	0	0.5	0	0.5	0	0	0	0
15	10	0	0	0	3	0	0	0	0
16	1	0	0.5	0	3	0	0	0	0
16	2	0	0.5	0	3	0	0	0	0
16	3	0	10	0	0.5	0	0	0	0
16	4	0	0.5	0	3	0	0	0	0
16	5	0	0.5	0	3	0	0	0	0
16	6	0	0	0	3	0	0	0	0
16	7	0	0	0	3	0	0	0	0
16	8	0	0	0	3	0	0	0	0
16	9	0	0.5	0	0.5	0	0	0	0
16	10	0	0	0	0	0	0	0	0
18	1	0	0.5	0	0	0.5	0	0	0.5
18	2	0	0	0	0	0.5	0	0	0
18	3	0	0.5	0	0	0	0	0	0
18	4	0	0	0	0.5	0	0	0	0
18	5	0	0	0	0	0	0	0	0
18	6	0	0.5	0	0	0	0	0	0
18	7	0	0.5	0	0	0	0	0	0
18	8	0	0.5	0	0	0	0	0	0
18	9	0	3	0	0	0	0	0	0
18	10	0	0.5	0	0	0	0	0	0

Table C.3 Cover data for forbs, part II.

transect	plot	CAQUA	CASP	CATEN	CISP	COARV	COLIN	CUSP	DEVIR
1	1	0	0	0	0	0	0.5	0	0
1	2	0.5	0	0	0	0	0	0	0
1	3	0.5	0	0	0	0	0	0	0
1	4	0.5	0	0	0	0	0	0	0
1	5	0.5	0	0	0	0	0.5	0	0
1	6	0.5	0	0	0	0	0	0	0
1	7	0	0	0	0	0	0	0	0
1	8	0.5	0	0	0	0	0.5	0	0
1	9	0.5	0	0	0	0	0.5	0	0
1	10	0	0	0	0	0	0.5	0	0
1	11	0.5	0	0	0	0	0.5	0	0
1	12	0	0	0	0	0	0.5	0	0
2	1	0	0	0.5	0	0	0	0	0
2	2	0	0	0	0	0	0	0	3
2	3	0	0	0.5	0	0	0	0	0
2	4	0	0	0.5	0	0	0	0	0
2	5	0.5	0	0	0	0	0	0	0
2	6	0	0	0.5	0	0	0	0	0
2	7	0	0	0.5	0	0	0	0	0
2	8	0	0	0.5	0	0	0.5	0	0
2	9	0	0	0	0	0	3	0	0
2	10	0.5	0	0	0	0	0	0	0
2	11	0	0	0	0	0	0	0	0
2	12	0	0	0	0	0	3	0	0
3	1	0.5	0	0	0	0	0	0	0.5
3	2	0	0	0	0	0	0	0	0
3	3	0	0	0	0	0	0	0	0
3	4	0	0	0	0	0	0	0	0
3	5	0	0	0	0	0	0	0	0
3	6	0	0	0	0	0	0	0	0
3	7	0	0	0	0	0	0	0	0
3	8	0.5	0.5	0	0.5	0	0	0	0
3	9	0.5	0.5	0	0	0	0	0	0
3	10	0.5	0.5	0	0	0	0	0	0
3	11	0.5	0.5	0	0	0	0	0	0
5	1	0	0	0.5	0	0	0	0	0
5	2	0	0.5	0	0	0	0	0	0
5	3	0	0	0	0	0	0	0	0
5	4	0	0	0	0	0	0	0	0
5	5	0	0	0	0	0	0	0	0
5	6	0	0	0	0	0	0	0	0
5	7	0	0	0	0	0	0	0	0
5	8	0	0	0	0	3	0	0	0
5	9	0	0	0	0	0.5	0	0	0
5	10	0	0	0	0	0	0	0	0.5
6	1	0	0	0	0	0	0.5	0	0
6	2	0	0	0	0	0.5	0.5	0	0

transect	plot	CAQUA	CASP	CATEN	CISP	COARV	COLIN	CUSP	DEVIR
6	3	0	0	0	0	0	0	0	0
6	4	0	0.5	0	0	0.5	0	0	0.5
6	5	0	0	0	0	0	0	0	3
6	6	0.5	0	0	0	0	0	0	0.5
6	7	0	0	0	0	0	0	0	3
6	8	0	0	0	0	0	0	0	0.5
6	9	0	0	0	0	0	0	0	0.5
6	10	0	0	0	0	0	0	0	0.5
7	1	0	0	0	0	0	0	0	10
7	2	0	0	0	0	0	0.5	0	3
7	3	0	0	0	0	0.5	0.5	0	10
7	4	0	0	0	0	0	0.5	3	0
7	5	0	0	0	0	0.5	0.5	0	0
7	6	0	0	0	0	3	0.5	0	3
7	7	0	0	0	0	10	0.5	0	0
7	8	0	0	0	0	20	0.5	0	0
7	9	0	0	0	0	3	0.5	0	0.5
7	10	0	0	0	0	3	0.5	0	3
9	1	0	0	0	0	0	0	0	0
9	2	0	0	0	0	0	0	0	0.5
9	3	0.5	0	0	0	0	0	0	0
9	4	0.5	0	0	0	0	0	0	0
9	5	0	0	0	0	0	0	0	0
9	6	0	0	0	0	0	0	0	0
9	7	0	0	0	0	0	0	0	0
9	8	0	0	0	0	0	0	0	0
9	9	0	0	0	0	0	0.5	0	0.5
9	10	0	0	0	0	0	0.5	0	0
10	1	0	0	0	0	0.5	0.5	0	0
10	2	0	0	0	0	3	0.5	0	0
10	3	0	0	0	0	0	0	0	0
10	4	0	0	0	0	0	0	0	0
10	5	0	0	0	0	3	0	0	0
10	6	0	0	0	0	0	0	0	0
10	7	0	0	0	0	0	0	0	0
10	8	0	0	0	0	3	0	0	0
10	9	0	0	0	0	0.5	0	0	0
10	10	0	0	0	0	0.5	0	0	0
12	1	0	0	0	0	0	0	0	0
12	2	0	0	0	0	0	0	0	0
12	3	0	0	0.5	0	0	0	0	0
12	4	0	0	0.5	0	0	0	0	0
12	5	0	0	0	0	0	0	0	0
12	6	0	0	0	0	0	0	0	0
12	7	0	0	0	0	0	0	0	0.5
12	8	0	0	0	0	0	0	0	0.5
12	9	0	0	0	0	0	0	0	0.5
12	10	0	0	0	0	0	0	0	0.5
14	1	0	0	0	0	0	0	0	0

transect	plot	CAQUA	CASP	CATEN	CISP	COARV	COLIN	CUSP	DEVIR
14	2	0	0	0	0	0	0	0	0
14	3	0	0	0	0	0	0	0	0
14	4	0	0	0	0	0	0	0	0
14	5	0	0	0	0	0	0	0	0
14	6	0	0	0	0	0	0	0	0
14	7	0	0	0	0	0	0	0	0
14	8	0	0	0	0	0	0	0	0.5
14	9	0	0	0	0	0	0	0	0
14	10	0	0	0	0	0	0.5	0	0
15	1	0	0	0	0	0	0	0	0
15	2	0	0	0	0	0	0	0	0
15	3	0	0	0	0	0	0	0	0
15	4	0	0	0	0	0	0	0	0
15	5	0	0	0	0	0	0	0	0
15	6	0	0	0	0	0	0	0	0
15	7	0	0	0	0	0	0	0	0
15	8	0	0	0	0	0	0	0	0
15	9	0	0	0	0	0	0	0	0
15	10	0	0	0	0	0	0	0	0
16	1	0	0	0	0	0	0	0	0
16	2	0.5	0	0	0	0	0	0	0
16	3	0	0	0	0	0	0	0	0
16	4	0	0	0	0	0	0	0	0
16	5	0	0	0	0	0	0	0	0
16	6	0.5	0	0	0	0	0	0	0
16	7	0	0	0	0	0	0	0	0
16	8	0	0	0	0	0	0	0	0
16	9	0	0	0	0	0	0	0	0
16	10	0	0	0	0	0	0	0	0
18	1	0	0	0	0	0	0	0	0
18	2	0	0	0	0	0	0	0	0
18	3	0	0	0	0	0	0	0	0
18	4	0	0	0	0	0	0	0	0
18	5	0	0	0	0	0	0	0	0
18	6	0	0	0	0	0	0	0	0
18	7	0	0	0	0	0	0	0	0
18	8	0	0	0	0	0	0.5	0	0
18	9	0	0	0	0	0	0	0	0
18	10	0	0	0	0	0	0	0	0

Table C.4 Cover data for forbs, part III.

transect	plot	DEVIR	DIARM	DRSP	EPBRA	EPGLA	EPMIN	EPSPP	EQLAE
1	1	0	0	0	0	0	0.5	0	0
1	2	0	0	0	0	0	0.5	0	0
1	3	0	0	0	0	0	0.5	0	0
1	4	0	0	0	0	0	0.5	0	0
1	5	0	0	0	0	0	0.5	0	0
1	6	0	0	0	0	0	0.5	0	0
1	7	0	0	0	0	0	0.5	0	0
1	8	0	0	0	0	0	0	0.5	0
1	9	0	0	0	0	0	0	0.5	0
1	10	0	0	0	0	0	0	0.5	0
1	11	0	0	0	0.5	0	0	0.5	0
1	12	0	0	0	0	0	0	0.5	0
2	1	0	0	0	0	0	0.5	0	0
2	2	3	0	0	0	0	0	0.5	0
2	3	0	0	0	0	0	0	20	0
2	4	0	0	0	0	0	0	3	0
2	5	0	0	0	0	0	0.5	0	0
2	6	0	0	0	0	0	0.5	0	0
2	7	0	0	0	0	0	0	0	0
2	8	0	0	0	0	0	0	0.5	0
2	9	0	0	0	0	0	0	0	0
2	10	0	0	0	0	0	0	0.5	0
2	11	0	0	0	0	0	0	0	0
2	12	0	0	0	0	0	0	0.5	0
3	1	0.5	0	3	0	0	0	0	0
3	2	0	0	0.5	0	0	0	0	0
3	3	0	0	0	0	0	0	0	0
3	4	0	0	3	0	0	0	0	0
3	5	0	0	0.5	0	0	0	0	0
3	6	0	0	0	0	0	0	0	0
3	7	0	0	0	0	0	0	0	0
3	8	0	0	0	0	0	0	0	0
3	9	0	0	0	0	0	0	0	0
3	10	0	0	0	0	0	0	0	0
3	11	0	0	0	0	0	0	0.5	0
5	1	0	0	0	0	0	0	0	0
5	2	0	0	0	0	0	0	0	0
5	3	0	0	0	0	0	0	0	0
5	4	0	0.5	0	0	0	0	0	0
5	5	0	0	0	0	0	0	0.5	0
5	6	0	0.5	0	0	0	0	0.5	0
5	7	0	0.5	0	0	0	0	0.5	0
5	8	0	0.5	0	0	0	0	0	0
5	9	0	0.5	0	0	0	0	0.5	0
5	10	0.5	0	0	0	0	0	0	0

transect	plot	DEVIR	DIARM	DRSP	EPBRA	EPGLA	EPMIN	EPSPP	EQLAE
6	1	0	0	0	0	0	0	20	0.5
6	2	0	0	0	0	0	0	0.5	0
6	3	0	0	0	0	0	0	0.5	0
6	4	0.5	0	0	0	0	0	3	0
6	5	3	0	0	0	0	0.5	0	0
6	6	0.5	0	0	0	0	0	0	0.5
6	7	3	0	0	0	0	0	0.5	0.5
6	8	0.5	0	0	0	0	0	0	0.5
6	9	0.5	0	0	0	0	0	0.5	0
6	10	0.5	0	0	0	0	0	0	0.5
7	1	10	0	0	0	0	0	0	0
7	2	3	0	0	0	0	0	0	0
7	3	10	0	0	0	0	0	0.5	0
7	4	0	0	0	0	0	0	0.5	0
7	5	0	0	0	0	0	0	0	0
7	6	3	0	0	0	0	0	0.5	0
7	7	0	0	0	0	0	0.5	0	0
7	8	0	0	0	0	0	0	0.5	0
7	9	0.5	0	0	0	0	0	0	0
7	10	3	0	0	0	0	0	0	0
9	1	0	0	0	0	0	0	0	0
9	2	0.5	0	0	0	0	0	0.5	0
9	3	0	0	0	0	0	0	0.5	0
9	4	0	0	0	0	0	0	0	0
9	5	0	0	0	0	0	0	0	0
9	6	0	0	0	0	0	0	0	0.5
9	7	0	0	0	0	0	0	0.5	0.5
9	8	0	0	0	0	0	0	0.5	0
9	9	0.5	0	0	0	0	0	0	0
9	10	0	0	0	0	0	0	0.5	0
10	1	0	0	0	0	0	0	0.5	0
10	2	0	0	0	0	0	0	0.5	0.5
10	3	0	0	0	0	0	0.5	0.5	0
10	4	0	0	0	0	0	0	0	0.5
10	5	0	0	0	0	0	0	0.5	0.5
10	6	0	0	0	0	0	0	0.5	0.5
10	7	0	0	0	0	0	0	0	0
10	8	0	0	0	0	0	0	0	0.5
10	9	0	0	0	0	0	0	0	0.5
10	10	0	0	0	0	0	0	0	0
12	1	0	0	0	0	0	0	0	0
12	2	0	0	0	0	0	0	0	0.5
12	3	0	0	0	0	0	0	0	0.5
12	4	0	0	0	0	0	0	0	0.5
12	5	0	0	0	0	0	0	0	0
12	6	0	0	0	0	0	0	0	0
12	7	0.5	0.5	0	0	0	0	0	0.5
12	8	0.5	0	0	0	0	0	3	0
12	9	0.5	0	0	0	0	0	0.5	0

transect	plot	DEVIR	DIARM	DRSP	EPBRA	EPGLA	EPMIN	EPSPP	EQLAE
12	10	0.5	0	0	0	0	0	0.5	0
14	1	0	0	0	0	0	0	0	0
14	2	0	0	0	0	0	0	0	0
14	3	0	0	0	0	0	0	0	0
14	4	0	0	0	0	0	0	0	0.5
14	5	0	0	0	0	0	0	0	0
14	6	0	0	0	0	0	0	0	0
14	7	0	0	0	0	0	0	0	0
14	8	0.5	0	0	0	0	0	0	0
14	9	0	0	0	0	0	0	0	0
14	10	0	0	0	0	0	0	0	0
15	1	0	0	0.5	0	0	0	0	0
15	2	0	0	3	0	0	0	0	0
15	3	0	0	0	0	0	0	0	0
15	4	0	0	0.5	0	0	0	0	0
15	5	0	0	0	0	0	0	0	0
15	6	0	0	0	0	0.5	0	0.5	0
15	7	0	0	0.5	0	0	0	0.5	0
15	8	0	0	0	0	0	0	0	0
15	9	0	0	0	0	0	0	0.5	0
15	10	0	0	0	0	0	0	0	0
16	1	0	0	3	0	0	0	0	0
16	2	0	0	3	0	0	0	0	0
16	3	0	0	3	0	0	0	0	0
16	4	0	0	0	0	0	0	0	0
16	5	0	0	0.5	0	0	0	0	0
16	6	0	0	0	0	0	0	0	0
16	7	0	0	0	0	0	0	0.5	0
16	8	0	0	0	0	0	0	0.5	0
16	9	0	0	0	0	0	0	0.5	0
16	10	0	0	0	0	0	0	0	0
18	1	0	0	3	0	0	0	0	0
18	2	0	0	0.5	0	0	0	0	0
18	3	0	0	0.5	0	0	0	0	0
18	4	0	0	10	0	0	0	0.5	0
18	5	0	0	3	0	0	0	0	0
18	6	0	0	0	0	0	0	0.5	0
18	7	0	0	0	0	0	0	0	0
18	8	0	0	3	0	0	0	0.5	0
18	9	0	0	0.5	0	0	0	0	0
18	10	0	0	0	0	0	0	0	0

Table C.5 Cover data for forbs, part IV.

transect	plot	EQSP	FASP	FRAFF	FRVIR	GAAPE	GETRI	GEVIS	LONUD
1	1	0	0	0	0	0	0	0	3
1	2	0	0	0	0.5	0	0	0	3
1	3	0	0	0	0	0	10	0	0.5
1	4	0	0	0	0	0	0	0	0.5
1	5	0	0	0	0	0	0	0	0
1	6	0	0	0	0	0	0.5	0	3
1	7	0	0	0	0	0	0	0	3
1	8	0	0	0	0	0	0	0	0.5
1	9	0	0	0	0	0	0	0	0.5
1	10	0	0	0	3	0	3	0	0.5
1	11	0	0	0	0	0	0	0.5	0.5
1	12	0	0	0	10	0	0	0	3
2	1	0	0	0	0	0	0	0	0
2	2	0	0	0	0	0	0	0	0
2	3	0	0	0	0	0	0	0	0
2	4	0	0	0.5	0	0	0	0	0
2	5	0	0	0	0	0	0	0	0
2	6	0	0	0	0.5	0	0	0	0
2	7	0	0	0	0.5	0	0	0	0
2	8	0	0	0.5	0	0	10	0	0
2	9	0	0	0	0	0	0	0	0
2	10	0	0	0	0	0	0	0	0
2	11	0	0	0	10	0	0	0	0
2	12	0	0	0	0	0	0	0	0
3	1	0	0	0	0	0	0	0	0.5
3	2	0	0	0	0	0	0	0	3
3	3	0	0	0	0	0	0	0	3
3	4	0	0	0	0	0	0	0	0
3	5	0.5	0	0	0	0	0	0	0.5
3	6	0.5	0	0	0	0	0	0	0
3	7	0	0	0	0	0	0	0	0
3	8	0	0	0	0.5	0	0	0	0
3	9	0	0	0	0	0	0	0	0
3	10	0	0	0	0	0	0	0	0
3	11	0	0	0	0	0	0	0	0
5	1	0	0	0	0	0	0	0	0
5	2	0	0	0	0	0	0	0	0
5	3	0	0	0	0	0	0	0	0
5	4	0	0	0	0	0	0	0	0
5	5	0	0	0	0	0	0	0	0
5	6	0	0	0	0	0	0	0	0
5	7	0	0	0	0	0	0	0	0
5	8	0	0	0	0	0	0	0	0
5	9	0	0	0	0	0	0	0	0
5	10	0	0	0	0	0	0	0	0
6	1	0	0	0	0	0	0	0	0
6	2	0	0	0	0	0	0	0	0

transect	plot	EQSP	FASP	FRAFF	FRVIR	GAAPE	GETRI	GEVIS	LONUD
6	3	0	0	0	0	0	0	0	0
6	4	0	0	0	0	0	0	0	0
6	5	0	0	0	0	0	0	0	0
6	6	0	0	0	0	0	0	0	0
6	7	0	0	0	0	0	0	0	0
6	8	0	0	0	0	0	0	0	0
6	9	0	0	0	0	0	0	0	0
6	10	0	0	0	0	0	0	0	0
7	1	0	0	0	0	0	0	0	0
7	2	0	0	0	0	0	0	0	0
7	3	0	0	0	0	0	0	0	0
7	4	0	0	0	0	0	0	0	0
7	5	0	0	0	0	0	0	0	0
7	6	0	0	0	0	0	0	0	0
7	7	0	0	0	0	0	0	0	0
7	8	0	0	0	0	0	0	0	0
7	9	0	0	0	0	0	0	0	0
7	10	0	0	0	0	0	0	0	0
9	1	0	0	0	0	0	0	0	0
9	2	0	0	0	0	0	0	0	0
9	3	0	0	0	0	0	0	0	0
9	4	0	0	0	0	0	0	0	0
9	5	0	0	0	0	0	0	0	0
9	6	0	0	0	0	0	0	0	0
9	7	0	0	0	0	0	0	0	0
9	8	0	0	0	0	0	0	0	0
9	9	0	0	0	0	0	0	0	0
9	10	0	0	0	0	0	0	0	0
10	1	0	3	0	0	0	0	0	0
10	2	0	0	0	0	0	0	0	0
10	3	0	3	0	0	0	0	0	0
10	4	0	0	0	0	0	0	0	0.5
10	5	0	0.5	0	0	0	0	0	0
10	6	0	0	0	0	0	0	0	0.5
10	7	0	0	0	0	0	0	0	0
10	8	0	0	0	0	0	0	0	0
10	9	0	0	0	0	0	0	0	0
10	10	0	0	0	0	0	0	0	0
12	1	0	0	0	0	0	0	0	3
12	2	0	0	0	0	0	0	0	0
12	3	0	0	0	0	0	0	0	0.5
12	4	0	0	0	0.5	0	0	0	0
12	5	0	0	0	0.5	0	0	0	0
12	6	0	0	0	0	0	0	0	0
12	7	0	0	0	0	0	0	0	0
12	8	0	0	0	0	0	0	0	0
12	9	0	0	0	0	0	0	0	0
12	10	0	0	0	0	0	0	0	0
14	1	0	0	0	0	0	0	0	0.5

transect	plot	EQSP	FASP	FRAFF	FRVIR	GAAPE	GETRI	GEVIS	LONUD
14	2	0	0	0	0	0	0	0	0.5
14	3	0	0	0	0	0	0	0	0
14	4	0	0	0	0.5	0	0	0	0
14	5	0	0	0	0.5	0	0	0	0
14	6	0	0	0	0	0	0	0.5	0
14	7	0	0	0	0	0	0	0.5	0
14	8	0	0.5	0	0.5	0	0	0	0
14	9	0	0	0	0	0	0	0	0
14	10	0	0	0	0	0	0	0	0
15	1	0	0	0	0.5	0	0	0.5	0
15	2	0	0	0	0.5	0	0	3	0.5
15	3	0	0	0	0.5	0	0	3	0.5
15	4	0	0	0	3	0	0	0	0
15	5	0	0	0	0.5	0	0	0.5	0
15	6	0	0	0	0.5	0	0	0	0
15	7	0	0	0	0	0	0	0	0.5
15	8	0	0	0	3	0	0	0	0.5
15	9	0	0	0	0	0	0	0	0.5
15	10	0	0	0	0	0	0	0	0.5
16	1	0	0	0	0.5	0	0	0.5	0
16	2	0	0	0	3	0	0	0	0
16	3	0	0	0	0	0.5	0	0	0
16	4	0	0	0	0.5	0	0	0	0
16	5	0	0	0	0.5	0	0	0	0
16	6	0	0	0	0	0	0	0	0
16	7	0	0	0	0.5	0	0	0	0
16	8	0	0	0	0	0	0	0	0
16	9	0	0	0	0	0	0	0	0
16	10	0	0	0	0	0	0	0	0
18	1	0	0	0	0.5	0	0.5	3	0
18	2	0	0	0	0	0	0.5	0	0.5
18	3	0	0	0	0.5	0	0.5	0	0
18	4	0	0	0	0	0	0.5	3	0.5
18	5	0	0	0	0.5	0	0	0	0
18	6	0	0	0	0	0	0	0	0
18	7	0	0	0	0.5	0	0	0	0
18	8	0	0	0	0	0	0	0	0.5
18	9	0	0	0	0	0	0	0	0
18	10	0	0	0	0	0	0	0	0

Table C.6 Cover data for forbs, part V.

transect	plot	LUSER	MAEXI	MAGRA	MASTE	MIGRA	MINUT	MOLIN	NAINT
1	1	10	0	0	0	0	0.5	3	0.5
1	2	3	0	0	0	0	0.5	3	0
1	3	0.5	0	0	0	0	0.5	0.5	0
1	4	0	0	0	0	0	0.5	3	0.5
1	5	0.5	0	0	0	0	0	0.5	0
1	6	3	0	0	0	0	0.5	0.5	0
1	7	3	0	0	0	0	0.5	3	0
1	8	20	0	0	0	0.5	0.5	3	0
1	9	20	0	0	0	0.5	0	3	0
1	10	20	0	0	0	0	0	3	0.5
1	11	0.5	0	0	0	0	0.5	0.5	0
1	12	0.5	0	0	0	0	0	0	0
2	1	0.5	0.5	0.5	0	0	0	0.5	0
2	2	0	0	3	0	0	0	0	0
2	3	0	0	0	0	0	0	0.5	0
2	4	0	0	0	0	0	0	0.5	0
2	5	0	0	3	0	0	0	0.5	0
2	6	0.5	0	3	0	0	0	0.5	0
2	7	0.5	0	0	0	0	0	0	0
2	8	10	0	0.5	0	0	0	0	0
2	9	0.5	0	0.5	0	0	0	0	0
2	10	0	0	3	0	0	0	0	0
2	11	3	0	0	0	0	0	0	0
2	12	0	0	10	0	0	0	0.5	0
3	1	0.5	0	3	0	0	0	0	0
3	2	20	0	0.5	0	0	0	0	0
3	3	10	0	10	0	0	0	0	0
3	4	10	0	10	0	0	0	0	0
3	5	0.5	0	10	0	0	0	0	0
3	6	0	0	0	0	0	0	0	0
3	7	0	0	0	0	0	0	0	0
3	8	0	0	0	0	0	0	0	0
3	9	0	0	3	0	0	0	0	0
3	10	0	0	0.5	0	0	0	0	0
3	11	0	0	0.5	0	0	0	0	0
5	1	0	0	10	0	0	0	0	0
5	2	0	0	10	0	0	0	0	0
5	3	0	0	20	0	0	0	0	0.5
5	4	0	0	62.5	0	0	0	0	0
5	5	3	0	0	0	0	0	0	0
5	6	0.5	0	0	0	0	0	0	0
5	7	0	0	0.5	0	0	0	0	0
5	8	0	0	0	0	0	0	0	0
5	9	0	0	0.5	0	0.5	0	0	0
5	10	0	0	0	0	0	0	0	0
6	1	10	0	20	0	0.5	0	0	0
6	2	0.5	0	0.5	0	0.5	0	0	0

transect	plot	LUSER	MAEXI	MAGRA	MASTE	MIGRA	MINUT	MOLIN	NAINT
6	3	0	0	3	0	0	0	0	0
6	4	10	0	20	0	0	0	0	0
6	5	20	0	0.5	0	0	0	0	0
6	6	3	0	0	0	0	0	0	0
6	7	0	0	3	0	0	0	0	0
6	8	0	0	10	0	0	0	0	0
6	9	0	0	3	0	0	0	0	0
6	10	0	0	3	0	0	0	0	0.5
7	1	10	0	0.5	0	0	0	0	0
7	2	20	0	0	0	0	0	0	0
7	3	37.5	0	0	0	0	0	0	0
7	4	37.5	0	0.5	0	0	0	0	0
7	5	37.5	0	0	0	0	0	0	0
7	6	10	0	0	0	0	0	0	0
7	7	3	0	0	0	0.5	0	0	0
7	8	20	0	0	0	0	0	0	0
7	9	0.5	0	0	0	0	0	0	0
7	10	3	0	0	0	0	0	0	0
9	1	0.5	0	0	0	0	0	0	0
9	2	0	0	0	0	0	0	0	0
9	3	0	0	0.5	0	0	0	0	0
9	4	0	0	0.5	0	0	0	0	0
9	5	0	0	0.5	0	0	0	0	0
9	6	0	0	0	0	0	0	0	0
9	7	0	0	10	0	0	0	0	0
9	8	0	0	3	0	0	0	0	0
9	9	0	0	0.5	0	0	0	0	0
9	10	0	0	3	0	0	0	0	0
10	1	0	0	0.5	0	0.5	0	0	0
10	2	0.5	0	0	0	0	0	0	0
10	3	0	0	0.5	0	0	0	0	0
10	4	10	0	3	0	0	0	0	0
10	5	3	0	3	0	0	0	0	0
10	6	0	0	10	0	0	0	0	0
10	7	3	0	10	0	0	0	0	0
10	8	0.5	0	10	0	0	0	0	0
10	9	20	0	10	0	0	0	0	0
10	10	20	0	0.5	0	0	0	0	0
12	1	10	0	20	0	0	0	0	0
12	2	37.5	0	10	0	0	0	0	0
12	3	10	0	20	0	0	0	0	0
12	4	3	0	10	0	0	0	0	0
12	5	0.5	0	0.5	0	0	0	0	0
12	6	0	0	0	0	0	0	0	0
12	7	0	0	0.5	0	0	0	0	0
12	8	0	0	20	0	0	0	0	0
12	9	0	0	3	0	0	0	0	0
12	10	0	0	37.5	0	0	0	0	0
14	1	0.5	0	0	0	0	0	0	0

transect	plot	LUSER	MAEXI	MAGRA	MASTE	MIGRA	MINUT	MOLIN	NAINT
14	2	10	0	0	0	0	0	0	0
14	3	0.5	0	0	0	0	0	0	0
14	4	0	0	0.5	0	0	0	0	0
14	5	0	0	0	3	0	0	0	0
14	6	0	0	0	3	0	0	0	0
14	7	0	0	0	0	0	0	0	0
14	8	0	0	0	0	0	0	0	0
14	9	0.5	0	0	0	0	0	0	0
14	10	0.5	0	0	0	0	0	0	0
15	1	0.5	0	0	0	0	0	0	0
15	2	0.5	0	0	0	0	0	0	0
15	3	3	0	0	0	0	0	0	0
15	4	0.5	0	0	0	0	0	0	0
15	5	0.5	0	0	0	0	0	0	0
15	6	3	0	0	0	0	0	0	0.5
15	7	10	0	0	0	0	0	0	0
15	8	3	0	0	0	0	0	0	0
15	9	3	0	0	0	0	0	0	0
15	10	37.5	0	0	0	0	0	0	0.5
16	1	0	0	0	0	0	0	0	0
16	2	0.5	0	0	0	0	0	0	0
16	3	0	0	0	0	0	0	0	0
16	4	0	0	0.5	0	0	0	0	0
16	5	0	0	0.5	0	0	0	0	0
16	6	0	0	0.5	0	0	0	0	0.5
16	7	0	0	0.5	0	0	0	0	0.5
16	8	20	0	0.5	0	0	0	0	0
16	9	10	0	0.5	0	0	0	0	0
16	10	3	0	0	0	0	0	0	0
18	1	3	0	0.5	0	0	0	0	0
18	2	3	0	0	0	0	0	0	0
18	3	0	0	0	0	0	0	0	0
18	4	10	0	0	0	0	0	0	0
18	5	3	0	0.5	0	0	0	0	0
18	6	10	0	3	0	0	0	0	0.5
18	7	3	0	0.5	0	0	0	0	0.5
18	8	3	0	0	0	0	0	0	0.5
18	9	37.5	0	0	0	0	0	0	0
18	10	20	0	0	0	0	0	0	0

Table C.7 Cover data for forbs, part VI.

transect	plot	OZBER	PECON	PEMON	POGRA	POPOL	POREC	PRVUL	RAUNC
1	1	0	10	0.5	0	0.5	0	0	0
1	2	0	10	0.5	0.5	0.5	0	0	0
1	3	0	10	0.5	3	0.5	0	0	0
1	4	0	0.5	0.5	0	0.5	0	0	0
1	5	0	0	0.5	3	0	0	0	0
1	6	0	0	0.5	10	0	0	0	0
1	7	0	0	0.5	10	0	0	0	0
1	8	0	10	0.5	0	0.5	0	0	0
1	9	0	3	0.5	0	0	0.5	0	0
1	10	0	20	0.5	0	0.5	0	0	0
1	11	0	3	0.5	0	0	0	0	0
1	12	0	3	0.5	0	0	0	0	0
2	1	0	0	0	0.5	0	3	0	0
2	2	0	0	0	3	0	0	0	0
2	3	0	0	0	10	0	0	0	0
2	4	0	0	0	3	0	0	0	0
2	5	0	0	0.5	0	0	0	0	0
2	6	0	0.5	0.5	3	0	3	0	0
2	7	0	10	0.5	0	0	0	0	0
2	8	0	0	0.5	0.5	0	3	0	0
2	9	0	0	0	0.5	0	0	0	0
2	10	0	0	0	0	0	3	0	0
2	11	0	0.5	0	0	0	10	0	0
2	12	0	0	0.5	0	3	10	0	0
3	1	0	0	0.5	0	0	3	0	0
3	2	0	0	0.5	0.5	0	0	0	0
3	3	0	0	0.5	0	0	10	0	0
3	4	0	0	0.5	10	0	3	0	0
3	5	0	37.5	0.5	3	0	3	0	0
3	6	0	0	0.5	3	0	0	0	0
3	7	0	0	0.5	10	0	10	0	0
3	8	0	0	0	20	0	3	0	0
3	9	0	0	0.5	0.5	0	20	0	0.5
3	10	0	0	0.5	20	0	10	0	0.5
3	11	0	0	0.5	0.5	0	20	0	0
5	1	0	0	0	3	0	0	0	0
5	2	0	0	0.5	0.5	0	0	0	0
5	3	0	0	0.5	3	0	0	0	0
5	4	0	0	0.5	0	0	3	0	0
5	5	0	0	0	3	0	0	0	0
5	6	0	0	0.5	0	0	0	0	0
5	7	0	0	0.5	3	0	0.5	0	0
5	8	0	0	0.5	3	0	3	0	0
5	9	0	0	0.5	3	0	0.5	0	0
5	10	0	0	0.5	0	0	3	0	0
6	1	0	3	0.5	10	0	0	0	0
6	2	0	10	0.5	10	0	0	0	0

transect	plot	OZBER	PECON	PEMON	POGRA	POPOL	POREC	PRVUL	RAUNC
6	3	0	37.5	0	10	0	3	0	0
6	4	0	10	0.5	10	0	0.5	0	0
6	5	0	0.5	3	3	0	0	0	0
6	6	0	0	0	37.5	0	0	0	3
6	7	0	0	0.5	10	0	0	0	0.5
6	8	0	0	0	20	0	0	0	0
6	9	0	0	0.5	3	0	0	0	0.5
6	10	0	0.5	0.5	10	0	0	0	0
7	1	0	0	0.5	0	0	0	0	0
7	2	0	0	0.5	3	0	0	0	0
7	3	0	0	0.5	0	0	3	0	0
7	4	0	0	0.5	3	0	0.5	0	0
7	5	0	0	0.5	0	0	3	0	0
7	6	0	0	0.5	0	0	0	0	0
7	7	0	0	0.5	0	0	0	0	0
7	8	0	0	0.5	0	0	0	0	0
7	9	0	0	0.5	0	0	0	0	0
7	10	0	0	0.5	0	0	0.5	0	0
9	1	0	0	0	0	0	0	0	0
9	2	0	0	0.5	3	0	3	0	0
9	3	0	0	0.5	37.5	0	0	0	0
9	4	0	0	0.5	10	0	0	0	0
9	5	0	0	0.5	3	0	0	0	0
9	6	0	0	0.5	3	0	0	0	0
9	7	0	0	0.5	10	0	0	0	0
9	8	0	0	0.5	20	0	0	0	0
9	9	0	0	0.5	10	0	0	0	0
9	10	0	0	0.5	0.5	0	3	0	0
10	1	0	0	0	0	0	3	0	0
10	2	0	0	0	0	0	0.5	0	0
10	3	0	0.5	0	0	0	3	0	0
10	4	0	0	0	0	0	3	0	0
10	5	0	0	0.5	0	0	3	0	0
10	6	0	0	0.5	3	0	0.5	0	0
10	7	0	0	0	3	0	0	0	0
10	8	0	0	0	0	0	3	0	0
10	9	0	0	0	3	0	3	0	0
10	10	0	0	0.5	3	0	0.5	0	0
12	1	0	3	0	0.5	0	0.5	0	0
12	2	0	0.5	0.5	10	0	0.5	0	0
12	3	0	0.5	0.5	3	0	3	0	0
12	4	0	0.5	0	10	0	3	0	0
12	5	0	0	0	37.5	0	0	0	0
12	6	0	0	0	10	0	0	0	0
12	7	0	0	0.5	20	0	0	0	0
12	8	0	0	0	20	0	0	0	0
12	9	0	0	0.5	0	0	0	0	0.5
12	10	0	0	0.5	10	0	0	0	0
14	1	0	0	0	0	0	3	0	0

transect	plot	OZBER	PECON	PEMON	POGRA	POPOL	POREC	PRVUL	RAUNC
14	2	0	0	0	0.5	0	3	0	0
14	3	0	0	0.5	10	0	0	0	0
14	4	0	3	0.5	3	0	0.5	0	0
14	5	0	0	0.5	10	0	0	0	0
14	6	0	0	0	0.5	0	0.5	0	0
14	7	0	0	0	0	0	0	0	0
14	8	0	0	0	0	0	3	0	0
14	9	0	0	0	0	0	0.5	0	0
14	10	0	0	0	0	0	0	0	0
15	1	0	0	0	0	0	0	0	0
15	2	0	0.5	0	0	0	0	0	0
15	3	0	0	0.5	0	0	0	0	0
15	4	0	0	0	0	0	0	0	0
15	5	0	0	0	0	0	0	0	0
15	6	0	0	0	0	0	0	0	0
15	7	0	3	0.5	0	0	0.5	0	0
15	8	0	0.5	0.5	0	0	3	0	0
15	9	0	0.5	0.5	0	0	3	0	0
15	10	0	0	0.5	0	0	0.5	0	0
16	1	0.5	0	0	0	0	0	0	0
16	2	0.5	0	0	0.5	0	0	0	0
16	3	0.5	0	0	0	0	10	0.5	0.5
16	4	0	0	0	0	0	3	0	0
16	5	0	0	0	0.5	0	0	0.5	0
16	6	0	0	0	0	0	0	0	0
16	7	0	0	0	3	0	0.5	0	0
16	8	0	0	0.5	0	0	0	0	0
16	9	0	0	0.5	0	0	0	0	0
16	10	0	0	0	0	0	0	0	0
18	1	0	0	0.5	0.5	0	0	0	0
18	2	0	0	0.5	0	0	0	0	0
18	3	0	0	0	0	0	0	0	0
18	4	0	0	0	0	0	0	0	0
18	5	0	0	0	0	0	0	0	0
18	6	0	0	0.5	0.5	0	3	0	0
18	7	0	0	0.5	0.5	0	0	0	0
18	8	0	0	0	0	0	0	0	0
18	9	0	3	0.5	0	0	0	0	0
18	10	0	0	0.5	0	0	10	0	0

Table C.8 Cover data for forbs, part VII.

transect	plot	RUSPP	SEHYD	SIORC	SOSP	SYSP	TAOFF	THOCC	TRDUB
1	1	0	0	0	0	0	0	0	0
1	2	0	0	0	0	0	0	0	0
1	3	0	0	3	0	0	0	0	0
1	4	0	0	0	0	0	0	0	0
1	5	0	0	0	0	0	0	0	0
1	6	0	0	10	0	0	0	0	0
1	7	0	0	10	0	0	0	0	0
1	8	0	0	3	0	0	0	0	0
1	9	0	0	10	0	0	0	0	0
1	10	0	0	3	0	0	0	0	0
1	11	0	0	3	0	0	0	0	0
1	12	0	0	0	0	0	0	0	0
2	1	0	0	0	0	0	0	0	0
2	2	0	0	0	0	0	0	0	0
2	3	0	0	0	0	0	0	0	0
2	4	0	0	0.5	0	0	0	0	0
2	5	0	0	0	0	0	0	0	0
2	6	0	0	0	0	0	0	0	0
2	7	0	0	37.5	0	0	0	0	0
2	8	0	0	3	0	0	0	0	0
2	9	0	0	0.5	0	0	0	0	0
2	10	0	0	0	0	0	0	0	0
2	11	0	0	0	0	0	0	0	0
2	12	0	0	0	0	0	0	0	0
3	1	0	0	0	0	0	0	0	0
3	2	0	0	3	0	0	0.5	0	0
3	3	0	0	37.5	0	0	0.5	0	0
3	4	0	0	0	0	0	0	0	0
3	5	0	0	3	0	0	0	0	0
3	6	0	0	10	0	0	0	0	0
3	7	0	0	0.5	0	0	0	0	0
3	8	0	0	0	0	0	0.5	0	0
3	9	0	0	0.5	0	0	0.5	0	0
3	10	0	0	0.5	0	0	0.5	0	0
3	11	0	0	0	0	0	0.5	0	0
5	1	0	0	0	0	0	0	0	0
5	2	0	0	0	0	0	0	0	0
5	3	0	0	0	0	0	0	0	0
5	4	0	0	0	0	0	0	0	0
5	5	0	0	3	0	0	0	0	0
5	6	0	0	0	0	0	0	0	0
5	7	0	0	0.5	0	0	0	0	0
5	8	0	0	3	0	0	0	0	0
5	9	0	0	0	0	0	3	0	0
5	10	0	0	0.5	0	0	0	0	0
6	1	0	0	0	0	0	0	0	0
6	2	0	0	0	0	0	0	0	0

transect	plot	RUSPP	SEHYD	SIORC	SOSP	SYSP	TAOFF	THOCC	TRDUB
6	3	0	0	3	0	0	0	0	0
6	4	0	0	3	0	0	0	0	0
6	5	0	0	10	0	0	0.5	0	0
6	6	0	0	0.5	0	0	0.5	0	0
6	7	0	0	0	0	0	0.5	0	0
6	8	0	0	0	0	0	0	0	0
6	9	0	0.5	0	0	0	0	0	0
6	10	0	0	10	0	0	0	0	0
7	1	0	0	0	0	0	0	0	0
7	2	0	0	3	0	0	0	0	0
7	3	0	0	0	0	3	0	0	0
7	4	0	0	0	0	0	0	0	0
7	5	0	0	0.5	0	0	0	0	0
7	6	0	0	0.5	0	3	0	0	0
7	7	0	0	0	0	0	0	0	0
7	8	0	0	0	0	3	0	0	0
7	9	0	0	0	0	0	0.5	0	0
7	10	0	0	0	0	0	0	0	0
9	1	0	0	0	0	0	0.5	0	0
9	2	0	0	0	0	3	0	0	0
9	3	0	0	0	0	0.5	0	0	0
9	4	0	0	3	0	3	3	0	0
9	5	0	0	3	0	0.5	0.5	0	0
9	6	0	0	3	0.5	0	0	0	0
9	7	0	0	0	0	0.5	0	0	0
9	8	0	0	0	0	0	0	0	0
9	9	0	0	0	0	0	0.5	0	0
9	10	0	0	0.5	0	0.5	0	0	0
10	1	0	0	0.5	0	0	0	0	0.5
10	2	0	0	0	0	0	0	0	0.5
10	3	0	0	0	0	0	0	0	0.5
10	4	0	0	0	0	0	0	0	0
10	5	0	0	0.5	0	0	0.5	0	0
10	6	0	0	0	0	0	0.5	0	0
10	7	0	0	0.5	0	0	0	0	0
10	8	0	0	0	0	0	0.5	0	0
10	9	0	0	0.5	0	0	0	0	0
10	10	0	0	0	0	0	0	0	0
12	1	0	0	0	0	0	0	0	0
12	2	0	0	0	0	0	0	0	0
12	3	0	0	3	0	0	0.5	0	0
12	4	0	0	0	0	0	0	0	0
12	5	0	0	0	0	0	0	0	0
12	6	0	0	3	0	0	0.5	0	0
12	7	0	0.5	0.5	0	0	0	0	0
12	8	0	0.5	10	0	0	10	0	0
12	9	0	0	0	0	0	0	0	0
12	10	0	0	0	0	0	0	0	0
14	1	0	0	0	0	0	0	0	0

transect	plot	RUSPP	SEHYD	SIORC	SOSP	SYSP	TAOFF	THOCC	TRDUB
14	2	0	0	0	0	0	0	0	0
14	3	0	0	0	0	0	0	0	0
14	4	0	0	3	0	0	0.5	0	0
14	5	0	0	0	0.5	0	0.5	0.5	0
14	6	0	0	0.5	0.5	0	0	3	0
14	7	0	0	0	0.5	0	0	0.5	0
14	8	0	0	0	3	0	0	3	0
14	9	0	0	0	0	0	0	0.5	0
14	10	0	0	0	0	0	0	3	0
15	1	0	0	0	0	0	0	0	0
15	2	0	0	0	0	0	0	0.5	0
15	3	0	0	0	0	0	0	0	0
15	4	0	0	3	0	0	0	0	0
15	5	0	0	3	0	0	0	0	0
15	6	0	0	0.5	0	3	0	0	0
15	7	0	0	0	0	0.5	0	0	0
15	8	0	0	0	0	0.5	0	0	0
15	9	0	0	0	0	0	0	0	0
15	10	0	0	0	0	0	0	0	0
16	1	0.5	0	0	0	0	0	0	0
16	2	0	0	0	0	0	3	0.5	0
16	3	0	0	0	0	0	0.5	0.5	0
16	4	0	0	3	0	0	3	0	0
16	5	0	0	0	0	0	0	0	0
16	6	0	0	0	0	0	0	0	0
16	7	0	0	0	0	0	0	0	0
16	8	0	0	0	0	3	0	0	0
16	9	0	0	0	0	0.5	0	0	0
16	10	0	0	0	0	0	0	0	0
18	1	0	0	0	0	0.5	0	0	0
18	2	0	0	0.5	0	0.5	0	0	0
18	3	0	0	0	0	0	0	0	0
18	4	0	0	3	0	0	0	0	0
18	5	0	0	0	0	0.5	0	0	0
18	6	0	0	3	0	3	0	0	0
18	7	0	0	0	0	0	0	0	0
18	8	0	0	0	0	10	0	0	0
18	9	0	0	0	0	3	0	0	0
18	10	0	0	0	0	3	0	0	0

Table C.9 Cover data for forbs, part VIII.

transect	plot	TRHYB	TRLON	TRSPP	UNSPP	VECAL	VIADU	VIAME	WYAMP
1	1	0	0	0	0.5	0	0	0	20
1	2	3	0	0	3	0	0	0	37.5
1	3	3	0	0	0.5	0	0	0	20
1	4	3	0	0	3	0	0	0	3
1	5	0.5	0	0	3	0	0	0	37.5
1	6	10	0	0	0	0	0.5	0	37.5
1	7	3	0	0	3	0	0.5	0	62.5
1	8	0.5	0	0	0	0	0	0	20
1	9	0	0	0	0.5	0	0	0	37.5
1	10	10	0	0	3	0	0	0	20
1	11	0	0	0	0.5	0	0	0.5	37.5
1	12	0	0	0	3	0	0	0	37.5
2	1	0	0	0	3	0	0	0	0
2	2	0	0	0	0	0	0	0	0
2	3	3	0	0	10	0	0	0	0
2	4	10	0	0	3	0	0	0	0
2	5	0	0	0	0.5	0	0	0	0
2	6	0	0	3	10	0	0	0	0
2	7	0	0	3	3	0	0	0	0
2	8	0	3	0	3	0	0	0	3
2	9	0	3	0	3	0	0	0	62.5
2	10	0	0	0	3	0	0	0	0
2	11	0	3	0	0.5	0	0	0	0
2	12	0	3	0	10	0	0	0	0
3	1	0	0	0	20	0	3	0	0
3	2	0	0	0	20	0	10	0.5	0
3	3	0	0	0	3	0	0.5	0	0
3	4	0	0	0	0	0	0	0	0
3	5	0	0	0	0.5	0	3	0	0
3	6	0	0	0	3	0	10	3	37.5
3	7	0	0	0	0	0	20	10	37.5
3	8	0	0	3	0	0	10	0.5	62.5
3	9	0	0	0.5	0	0	10	3	37.5
3	10	0	0	0.5	0.5	0	0.5	3	3
3	11	0	0	0.5	0.5	0	0.5	0.5	20
5	1	0	0	0	3	0	0	0	20
5	2	0	0	0	3	0	0	0	0
5	3	0	0.5	0	3	0	0	0	0
5	4	0	0.5	0	0	0	0	0	20
5	5	0.5	0	0	3	0	0	0	87.5
5	6	0	0	0	3	0	0	0	87.5
5	7	0	0.5	0	10	0	0	0	37.5
5	8	0	0.5	0	3	0	0	0	37.5
5	9	0	0.5	0	3	0	0	0	62.5
5	10	0	0	0	0	0	0	0	0
6	1	0	0	0	0	0	0.5	0.5	0
6	2	0	0	0.5	0	0	0.5	0.5	0

transect	plot	TRHYB	TRLON	TRSPP	UNSPP	VECAL	VIADU	VIAME	WYAMP
6	3	0	0	0	3	0	0.5	3	0
6	4	0	0.5	0	10	0	0	0	0
6	5	0	0	0	0	0	0.5	0	37.5
6	6	0	0.5	3	10	0	0	0.5	10
6	7	0	0	3	20	0	0	3	3
6	8	0	0.5	0.5	10	0	0	0	0.5
6	9	0	0	3	10	0	0	0	62.5
6	10	0	3	0	0	0	0	0	20
7	1	0.5	0	0	0	0	0	62.5	0
7	2	0	0	0	0	0	0	0	62.5
7	3	0	0	0	0.5	0	0	0	3
7	4	0	0	0	0	0	0	0	0
7	5	0	0	0	0	0	0	0	0
7	6	0	0	0	0	0	0	0	0
7	7	0	0	0	0.5	0	0	0	0
7	8	0	0	0	0.5	0	0	0	0
7	9	0	0	0	0	0	0	0	0
7	10	0	0	0	0	0	0	0	0
9	1	0	0	0	0	0	0	0	10
9	2	0	0.5	0	0	0	0	0.5	10
9	3	0	0	0	0	0	0	0.5	0
9	4	0.5	0	0	0	0	0	0.5	0
9	5	0.5	0	0	0	0	0	0.5	0
9	6	0.5	0	0	0	0	0	0.5	3
9	7	0.5	0	0	0	0	0	0	0
9	8	0.5	0	0	0	0	0	0	0
9	9	0.5	0	0	0	0	0	0	0
9	10	0	0	0	0	0	0	0	0
10	1	0	0	0	0	0	0	0	0
10	2	0	0	0	0	0	0	0	0
10	3	0	0	0	0	0	0	0	0
10	4	0	0	0	0	0	0	0	0
10	5	0	0	0	0	0	0	0	0
10	6	0	0	0	0	0	0	0.5	0
10	7	0	0	0	0	0	0	0	0
10	8	0	0	0	0	0	0	0.5	3
10	9	0	0	0	0	0	0	0.5	10
10	10	0	0	0	0	0	0	0	0
12	1	0	0	0	10	0	0	0	0
12	2	0	0	0	10	0	0	0	0
12	3	0	0	0	10	0	0	0	0
12	4	0	3	0	10	0	0	0.5	0
12	5	0	0	0	3	0	0	0.5	0
12	6	0	3	0	10	0	0	0.5	0
12	7	0	0	0	10	0	0	0.5	0
12	8	0	0	0	0	0	0	3	0
12	9	3	0	0	10	0	0	3	0
12	10	0	0	0	0	0	0	0	0
14	1	0	0	0	0	0	0	0.5	62.5

transect	plot	TRHYB	TRLON	TRSPP	UNSPP	VECAL	VIADU	VIAME	WYAMP
14	2	0	0	0	0	0	0	0.5	10
14	3	0	0.5	0	0	0	0	0	37.5
14	4	0	0.5	0	0	0	3	0	10
14	5	3	0	0	0	0	0	0.5	10
14	6	0	0	0	0	0	0	0.5	0
14	7	0	0	0	0	0	0.5	0.5	0
14	8	0	0	0	0	3	0	0	20
14	9	0	0	0	0	0	0	0	0
14	10	0	0	0	0	0	0	0	0
15	1	0	0	0	0	3	0	0	10
15	2	0	0	0	0	0.5	0	0	3
15	3	0	0	0	0	0	0	0	0
15	4	0	0	0	0	0	0	0	62.5
15	5	0	0	0	0	0	0	0	0.5
15	6	0	0	0	0	0	0	0	0
15	7	0	0	0	0	0	0	0	0
15	8	0	0	0	0	0	0	0	0
15	9	0	0.5	0	0	0	0	0	0
15	10	0	0	0	0	0	0	0	0
16	1	0	0	0	3	0	0	0	0
16	2	0	0.5	0	0	0.5	0.5	0	37.5
16	3	0	0.5	0	0.5	0	0.5	0	20
16	4	0	3	0	0	0	3	0	87.5
16	5	0	0.5	0	0	0	0.5	0	87.5
16	6	0	0	0	0	0	0	0	0.5
16	7	0	0.5	0	0	0	0	0	37.5
16	8	0	0	0	0	0	0	0	0
16	9	0	0	0	3	0	0	0	0
16	10	0	0	0	0	0	0	0.5	0
18	1	0	0.5	0	0	0	0.5	0	0
18	2	0	0.5	0	0	0	0	0	0.5
18	3	0	0	0	0	0	0	0	3
18	4	0	0.5	0	0	0	0	0	10
18	5	0	0	0	0	0	0	0	10
18	6	0	0.5	0	0	0	0	0	0
18	7	0	0.5	0	0	0	0	0	0
18	8	0	0.5	0	0	0	0	0	0
18	9	0	0	0	0	0	0	0	0
18	10	0	0.5	0	0	0	0	0	20

Table C.10 Cover data for graminoids, part I.

transect	plot	AGSP	ALPRA	BRINE	CAPAC	CASPP	ELREP	FEIDA
1	1	0	0	0	0	0.5	0	0
1	2	0.5	0	0	0	0.5	0	0
1	3	0	0	0	0	0	0	3
1	4	0.5	0	0	0	0	0	3
1	5	0	0	0	0.5	0	0	0
1	6	0	0	0	0.5	0	0	0
1	7	0	0	0	0	0	0	3
1	8	0	0	0	0	0	0	0.5
1	9	0	0	0	0	0	0	0.5
1	10	0	0	0	0	0.5	0	3
1	11	0.5	0	0	0	0	0	3
1	12	0	0	0	0	0	0	0.5
2	1	0	0	0	0	0.5	0	0
2	2	0	0	0	0	0	0	0
2	3	0	0	0	0	0	0	0
2	4	0.5	0	0	0	3	0.5	0
2	5	0	0	0	0	0.5	0	0
2	6	0	0	0	0	0	0	0
2	7	0	0	0	0	0.5	0	0
2	8	0	0	0	0	0	0	0
2	9	0	0	0	0	0	0	0
2	10	0	0	0	0	0	0	0
2	11	0	0	0	0	0.5	0	0
2	12	0	0	0	0	0.5	0	0
3	1	0	0	0	0	0	0	0
3	2	0	0	0	0	0	0.5	0
3	3	0	0	0	0	0	0.5	0
3	4	0	0	0	0	0	0	0
3	5	0	0	0	0	0	0	0
3	6	0	0	0	0	0	0	0
3	7	0	0	0	0	0	0	0
3	8	0	0	0	0	0	0	0
3	9	0	0	0	0	0	0	0
3	10	0	0	0	0	0	0	0
3	11	0	0	0	0	0	0	0
5	1	0	0	0	0	0	0.5	0
5	2	0	0	0	0	0	0	0
5	3	0	0	0	0	0	0.5	0
5	4	0	0	0	0	0	0	0
5	5	0	0	0	0	0	0	0
5	6	0	0	0	0	0	0.5	0
5	7	0	0	0	0	0	0	0
5	8	0	0	0	0	0	0.5	0
5	9	0	0	0	0	0	0	0
5	10	0	0	0	0	0	3	0
6	1	0	0	0.5	0	0	20	0
6	2	0	0	0	0	0	20	0

transect	plot	AGSP	ALPRA	BRINE	CAPAC	CASPP	ELREP	FEIDA
6	3	0	0	0	0	0	3	0
6	4	0	0	0	0	0	0.5	0
6	5	0	0	0	0	0	0.5	0
6	6	0	0	0	0	0	0	0
6	7	0	0	0	0.5	0.5	0	0
6	8	0	0	0.5	0	0	0	0
6	9	0	0	0	0	0	0	0
6	10	0	0	0	0	0	0	0
7	1	0	0	0	0	0	0	0
7	2	0	0	0	0	0	0.5	0
7	3	0	0	0	0	0	0.5	0
7	4	0	0	0	0	0	10	0
7	5	0	0	0	0	0	3	0
7	6	0	0	0	0	0	0.5	0
7	7	0	0	0	0	0	10	0
7	8	0	0	0	0	0	3	0
7	9	0	0	0	0	0	62.5	0
7	10	0	0	0	0	0	62.5	0
9	1	0	0	0	0	0	0	0
9	2	0	0	0	3	3	0	0
9	3	0	0	0	0	0	3	0
9	4	0	0	0	0	0	0.5	0
9	5	0	0	0	0	0	20	0
9	6	0	0	0	0	0	62.5	0
9	7	0	0	0	0	0	0	0
9	8	0	0	0	0	0	0.5	0
9	9	0	0	0	0	0	3	0
9	10	0	0	0	0	0	3	0
10	1	0	0	0	0	0	10	0
10	2	0	0	0	0	0	20	0
10	3	0	0	0	0	0	3	0
10	4	0	0	0	0	0	3	0
10	5	0	0	0	0	0	0.5	0
10	6	0	0	0	0	0	0.5	0
10	7	0	0	0	0	0	0.5	0
10	8	0	0	0	0	0	0	0
10	9	0	0	0	0	0	0.5	0
10	10	0	0	0	0	0	0.5	0
12	1	0	0	0	0	0	10	0
12	2	0	0	0	0	0	0	0
12	3	0	0	0	0.5	0.5	3	0
12	4	0	0	0	3	3	0	0
12	5	0	0	0	0.5	0.5	0	0
12	6	0	0	0	0.5	0.5	3	0
12	7	0	0	0	3	3	10	0
12	8	0	0	0	0	0	3	3
12	9	0	3	0	0	0	0.5	0
12	10	0	0	0	0.5	0	0.5	0.5
14	1	0	0	0	0	0	0	0

transect	plot	AGSP	ALPRA	BRINE	CAPAC	CASPP	ELREP	FEIDA
14	2	0	0	0	0	0	0	0
14	3	0	0	0	0	0	0	0
14	4	0	0	0.5	0	0	0	0
14	5	0	0	0	0.5	0.5	0	0
14	6	0	0	0	0.5	0.5	0.5	0
14	7	0	0	0	0	0	3	0
14	8	0	0	0	0.5	0.5	0.5	0
14	9	0	0	0.5	0	0	0	0
14	10	0	0	0	0	0	0	0
15	1	0	0	0	0.5	0.5	0	0
15	2	0	0	0	0	0	0	0
15	3	0	0	0	0.5	0.5	0	0
15	4	0	0	0	0	0	0	0
15	5	0	0	0	0	0	0	0
15	6	0	0	0	0.5	0.5	0	0
15	7	0	0	0	0	0	0.5	0
15	8	0	0	0	0	0	0	0
15	9	0	0	0	0	0	0.5	0
15	10	0	0	0	0	0	0	0
16	1	0	0	0	0	0	0	0
16	2	0	0	0	0	0	0.5	0
16	3	0	0	0	3	3	0.5	0
16	4	0	0	0	0	0	0	0
16	5	0	0	0	0	0	0	0
16	6	0	0	0	0.5	0.5	3	0
16	7	0	0	0	0	0	0	0
16	8	0	0	0	0	0	10	0
16	9	0	0	0	0	0	10	0
16	10	0	0	0	0	0	10	0
18	1	0	0	0	0.5	3	0	0
18	2	0	0	0	0.5	0.5	0	0
18	3	0	0	0	0.5	0.5	0	0
18	4	0	0	0	0.5	0.5	0	0
18	5	0	0	0	3	3	0	0
18	6	0	0	0	0.5	0.5	0	0
18	7	0	0	0	3	3	0	0
18	8	0	0	0	0.5	0.5	0	0
18	9	0	0	0	0	0	0	0
18	10	0	0	0	0	0	0	0

Table C.11 Cover data for graminoids, part II.

transect	plot	JUENS	JUSPP	PASMI	PHPRA	POASP	POSPP
1	1	0	0	0	0	0	0
1	2	0.5	0	0	0	0	0
1	3	0.5	0	0	0.5	0	0.5
1	4	0.5	0	0	0.5	0	20
1	5	0	0.5	0	0	0	0
1	6	0.5	0.5	0	0	0	0
1	7	0	0	0	0	0	0
1	8	0	0	0	0	0	0
1	9	0	0	0	0	0	0
1	10	0	0.5	0	0	0	0
1	11	0	0	0	0	0	0.5
1	12	0	0	0	0	0	10
2	1	0	0.5	0	20	0	0.5
2	2	0	10	3	0	0	3
2	3	0	10	0	0.5	0	10
2	4	0	3	0	3	0	10
2	5	0	0	0	0.5	0	0
2	6	0	0.5	0	0.5	0	10
2	7	0	0	0	0.5	0	37.5
2	8	0	0	0	0.5	0	3
2	9	0	0	0	0.5	0	3
2	10	0	0	0	0.5	0	3
2	11	0	0	0	0.5	0	0.5
2	12	0	0	0	3	0	10
3	1	0	0	0	20	0.5	0.5
3	2	0	0	0	3	0.5	0
3	3	0	0	0	0	0	0
3	4	0	0	0	0.5	0	3
3	5	0	0	0.5	0.5	0	0
3	6	0	0	0.5	0.5	0	0.5
3	7	0	0.5	0	3	0	0.5
3	8	0	0	0	0.5	0	3
3	9	0	0.5	0	0.5	0	3
3	10	0	0.5	0	0.5	0.5	3
3	11	0	0.5	0	0.5	0	3
5	1	0	0	0	0	0.5	0
5	2	0	0	0	0	0	0.5
5	3	0	0.5	0	0	0.5	0
5	4	0	3	0	0.5	0	0.5
5	5	0	0	0	0	0.5	0.5
5	6	0	0	0	0.5	0	0.5
5	7	0	0	0	0	0.5	0
5	8	0	0	0	0	0.5	0.5
5	9	0	0	0	0	0.5	0.5
5	10	0	0	0	0.5	0	0.5
6	1	0	0	0	3	0	0
6	2	0	0	0	0	0	0

transect	plot	JUENS	JUSPP	PASMI	PHPRA	POASP	POSPP
6	3	0	0	0	0	0	0.5
6	4	0	0	0	0.5	0	0.5
6	5	0	0	0	0	0	0.5
6	6	0	0	0	10	0	20
6	7	0	0.5	0	0.5	0	20
6	8	0	0	0	3	0	3
6	9	0	0	0	0.5	0	3
6	10	0	0.5	0	3	0	0.5
7	1	0	0	0	0.5	0.5	0
7	2	0	0	0	0	0	0
7	3	0	0	0	0	0	0
7	4	0	0	0	0	0	0
7	5	0	0	0	0	0	0
7	6	0	0	0	0	0	0
7	7	0	0	0	10	0	0
7	8	0	0	0	0	0	0
7	9	0	0	0	0	0	0
7	10	0	0	0	0	0	0
9	1	0	0	0	0	0	0.5
9	2	0	0	0	0.5	0	3
9	3	0	0	0	3	0	0.5
9	4	0	0	0	10	0	0
9	5	0	0	0	37.5	0	0
9	6	0	0	0	20	0	0
9	7	0	0	0	0.5	0	0.5
9	8	0	0	0	0.5	0	0.5
9	9	0	0	0	37.5	0	3
9	10	0	0	0	3	0	0.5
10	1	0	0	0	0	0	0
10	2	0	0	0	0	0	0
10	3	0	0	0	0.5	0	0
10	4	0	0	0	0.5	0	0
10	5	0	0	0	0.5	0	0
10	6	0	0	0	0.5	0	0
10	7	0	0	0	3	0.5	0
10	8	0	0	0	0.5	0	0.5
10	9	0	0	0	0.5	0.5	0
10	10	0	0	0	3	0	0
12	1	0	0.5	0	0	0	0.5
12	2	0	0.5	0	3	0	3
12	3	0	0	0	0	0	3
12	4	0	0	0	3	0	0
12	5	0	0	0	3	0	0.5
12	6	0	0	0	10	0.5	3
12	7	0	0	0	10	0	0
12	8	0	0	0	3	0	0.5
12	9	0	3	0	3	0.5	0.5
12	10	0	0	0	0	0	3
14	1	0	0	0	0	0	0.5

transect	plot	JUENS	JUSPP	PASMI	PHPRA	POASP	POSPP
14	2	0	0	0	0	0	0
14	3	0	0	0	0.5	0	0.5
14	4	0	0	0	3	0.5	0
14	5	0	0	0	3	0	0.5
14	6	0	0	0	0.5	0.5	0.5
14	7	0	0	0	0	0	0
14	8	0	0	0	0	0	0
14	9	0	0	0	0.5	0.5	0.5
14	10	0	0	0	0	0	0.5
15	1	0	0	0	0	0	0.5
15	2	0	0	0	0.5	0	0.5
15	3	0	0	0	0.5	0	0.5
15	4	0	0	0	0	0	0.5
15	5	0	0	0	0	0.5	0.5
15	6	0	3	0	0.5	0.5	0
15	7	0	0	0	0	0.5	0
15	8	0	0	0	0	0.5	0
15	9	0	0	0	0	0	0.5
15	10	0	0	0	0	0.5	0
16	1	0	0	0	0.5	0	3
16	2	0	0	0	3	0	0.5
16	3	0	0	0	3	0	3
16	4	0	0	0	0.5	0	0.5
16	5	0	0	0	0.5	0	0.5
16	6	0	0.5	0	0.5	0	0.5
16	7	0	0	0	3	0	0.5
16	8	0	0	0	0.5	0	0.5
16	9	0	3	0	3	0	0
16	10	0	0	0	0	0	0
18	1	0	0	0	0.5	0	0.5
18	2	0	0.5	0	0	0	0.5
18	3	0	0	0	0	0	0
18	4	0	0	0	0	0	0
18	5	0	0.5	0	0.5	0	3
18	6	0	0	0	0	0	0
18	7	0	0.5	0	0	0	20
18	8	0	0.5	0	0	0	0.5
18	9	0	0	0	0	0	3
18	10	0	0	0	0.5	0	0.5

Appendix D: Physical Property Data

Tables containing physical property data for all plots: instantaneous soil moisture (Table D.1), relativized, field-based soil texture (Table D.2), lab-based soil texture (Table D.3), and light and canopy density measurements (Table D.4).

Table D.1 Instantaneous soil moisture (Volumetric Water Content) as measured on July 6, 2022 (transects 1-3), June 29, 2023 (transects 5-15), and June 30 (transects 16 and 18). Soil moisture could not be measured for 9 plots due to the hardness of the ground, so each plot with a missing soil moisture value was assigned the lowest value for that transect (Chapter 1, Methods). These values are italicized in the table below.

transect	plot	% soil moisture
1	1	14.1
1	2	20.3
1	3	20.1
1	4	18.6
1	5	27.2
1	6	19.7
1	7	15.8
1	8	13.8
1	9	13.1
1	10	16.4
1	11	12.7
1	12	11.0
2	1	27.1
2	2	26.5
2	3	28.1
2	4	24.4
2	5	27.6
2	6	28.1
2	7	25.2
2	8	35.1
2	9	43.8
2	10	31.3
2	11	39.9
2	12	18.3
3	1	7.9
3	2	4.7
3	3	9.9
3	4	14.7
3	5	14.0
3	6	19.3
3	7	42.6
3	8	43.3

transect	plot	% soil moisture
3	9	58.2
3	10	68.0
3	11	66.4
5	1	27.3
5	2	32.9
5	3	34.4
5	4	*12.4*
5	5	23.9
5	6	28.6
5	7	24.4
5	8	19.3
5	9	20.9
5	10	12.4
6	1	19.0
6	2	19.8
6	3	25.3
6	4	29.4
6	5	33.5
6	6	39.7
6	7	37.3
6	8	37.5
6	9	35.1
6	10	30.3
7	1	31.3
7	2	29.6
7	3	20.1
7	4	25.9
7	5	27.2
7	6	19.8
7	7	22.9
7	8	17.9
7	9	21.4
7	10	21.0
9	1	32.2
9	2	40.4
9	3	41.5
9	4	38.5
9	5	38.7
9	6	23.8
9	7	36.1
9	8	20.3
9	9	36.6
9	10	19.1
10	1	19.3
10	2	16.7
10	3	20.7
10	4	17.7
10	5	20.2

transect	**plot**	**% soil moisture**
10	6	22.8
10	7	26.7
10	8	25.7
10	9	23.5
10	10	23.7
12	1	*23.5*
12	2	23.5
12	3	33.5
12	4	39.9
12	5	42.6
12	6	40.0
12	7	44.9
12	8	46.0
12	9	44.9
12	10	41.0
14	1	*8.4*
14	2	8.6
14	3	15.5
14	4	40.9
14	5	44.7
14	6	39.7
14	7	41.5
14	8	24.7
14	9	14.3
14	10	8.4
15	1	11.4
15	2	10.5
15	3	18.4
15	4	22.9
15	5	20.3
15	6	23.0
15	7	*10.5*
15	8	14.2
15	9	16.4
15	10	24.9
16	1	16.0
16	2	22.9
16	3	18.1
16	4	21.6
16	5	17.7
16	6	21.2
16	7	*14.7*
16	8	14.7
16	9	18.4
16	10	24.9
18	1	13.5
18	2	12.7
18	3	6.4

transect	plot	% soil moisture
18	4	16.4
18	5	*6.4*
18	6	*6.4*
18	7	11.3
18	8	11.2
18	9	*6.4*
18	10	*6.4*

Table D.2 Field-based soil texture data for each plot for each transect. Ribbon length data are relativized by range (Chapter 1, Methods).

transect	plot	ribbon length	grittiness
1	1	0.200	4
1	2	0.314	5
1	3	0.314	4
1	4	0.657	4
1	5	0.543	4
1	6	0.429	4
1	7	0.200	4
1	8	0.200	4
1	9	0.314	3
1	10	0.543	4
1	11	0.314	3
1	12	0.314	3
2	1	0.543	3
2	2	1.000	2
2	3	0.429	2
2	4	0.314	2
2	5	0.657	2
2	6	0.543	3
2	7	0.543	2
2	8	0.657	3
2	9	0.543	3
2	10	0.771	1
2	11	0.886	1
2	12	0.314	3
3	1	0.657	2
3	2	0.543	2
3	3	0.543	2
3	4	1.000	2
3	5	1.000	2
3	6	1.000	3
3	7	0.543	3
3	8	1.000	2
3	9	0.314	3
3	10	0.543	2
3	11	0.429	3

transect	plot	ribbon length	grittiness
5	1	0.371	1
5	2	0.509	1
5	3	0.531	1
5	4	0.520	1
5	5	0.109	2
5	6	0.269	2
5	7	0.303	2
5	8	0.211	2
5	9	0.200	2
5	10	0.143	2
6	1	0.314	3
6	2	0.371	4
6	3	0.474	3
6	4	0.360	4
6	5	0.371	3
6	6	0.600	3
6	7	0.131	3
6	8	0.257	4
6	9	0.143	3
6	10	0.000	3
7	1	0.131	2
7	2	0.246	2
7	3	0.166	2
7	4	0.131	2
7	5	0.246	2
7	6	0.349	2
7	7	0.166	2
7	8	0.120	2
7	9	0.109	3
7	10	0.257	3
9	1	0.326	2
9	2	0.451	2
9	3	0.291	2
9	4	0.154	2
9	5	0.417	2
9	6	0.349	2
9	7	0.291	2
9	8	0.383	1
9	9	0.234	2
9	10	0.166	2
10	1	0.074	3
10	2	0.177	3
10	3	0.189	3
10	4	0.246	4
10	5	0.189	3
10	6	0.257	3
10	7	0.314	2
10	8	0.131	2

transect	plot	ribbon length	grittiness
10	9	0.291	3
10	10	0.177	3
12	1	0.086	2
12	2	0.257	3
12	3	0.269	2
12	4	0.349	2
12	5	0.223	2
12	6	0.280	2
12	7	0.120	2
12	8	0.394	2
12	9	0.097	1
12	10	0.349	2
14	1	0.246	2
14	2	0.131	1
14	3	0.143	2
14	4	0.086	1
14	5	0.406	2
14	6	0.394	2
14	7	0.269	2
14	8	0.177	2
14	9	0.223	2
14	10	0.200	3
15	1	0.166	2
15	2	0.120	2
15	3	0.246	3
15	4	0.360	2
15	5	0.097	3
15	6	0.326	3
15	7	0.257	2
15	8	0.097	2
15	9	0.200	2
15	10	0.223	2
16	1	0.543	1
16	2	0.291	2
16	3	0.200	2
16	4	0.189	1
16	5	0.314	3
16	6	0.166	2
16	7	0.474	1
16	8	0.211	2
16	9	0.189	2
16	10	0.154	2
18	1	0.143	2
18	2	0.234	2
18	3	0.120	2
18	4	0.246	3
18	5	0.234	3
18	6	0.166	3

transect	plot	ribbon length	grittiness
18	7	0.200	2
18	8	0.280	2
18	9	0.257	3
18	10	0.257	2

Table D.3 Percent sand, silt, and clay as measured by Kansas State Soil Lab using hydrometer analysis. Soil texture for transects 1-3 was based on composite samples for each transect, whereas soil texture for transects 5-18 was assessed for each plot. Transect 2 was located near a culturally sensitive site, so the composite soil sample was taken from a different, nearby location.

transect	plot	% sand	% silt	% clay
1	--	52	35	13
2	--	46	34	20
3	--	43	38	19
5	1	41	38	21
5	2	38	34	28
5	3	38	34	28
5	4	36	35	29
5	5	40	40	20
5	6	42	41	17
5	7	44	42	14
5	8	45	41	14
5	9	32	42	26
5	10	44	43	13
6	1	45	37	18
6	2	47	35	18
6	3	44	36	20
6	4	48	36	16
6	5	49	35	16
6	6	46	36	18
6	7	45	37	18
6	8	48	35	17
6	9	46	36	18
6	10	46	36	18
7	1	44	37	19
7	2	44	38	18
7	3	42	39	19
7	4	44	34	22
7	5	43	36	21
7	6	46	36	18
7	7	44	37	19
7	8	47	35	18
7	9	46	36	18
7	10	45	38	17
9	1	46	30	24
9	2	48	31	21

transect	plot	% sand	% silt	% clay
9	3	43	34	23
9	4	44	35	21
9	5	51	31	18
9	6	52	31	17
9	7	44	35	21
9	8	36	40	24
9	9	36	40	24
9	10	46	36	18
10	1	44	38	18
10	2	48	34	18
10	3	45	35	20
10	4	46	35	19
10	5	46	35	19
10	6	46	34	20
10	7	46	34	20
10	8	44	33	23
10	9	48	31	21
10	10	50	30	20
12	1	46	40	14
12	2	45	38	17
12	3	48	35	17
12	4	46	36	18
12	5	50	33	17
12	6	52	33	15
12	7	52	35	13
12	8	46	38	16
12	9	44	40	16
12	10	45	37	18
14	1	48	36	16
14	2	52	30	18
14	3	50	32	18
14	4	52	30	18
14	5	45	33	22
14	6	46	36	18
14	7	55	30	15
14	8	48	33	19
14	9	49	31	20
14	10	49	32	19
15	1	53	32	15
15	2	52	33	15
15	3	53	31	16
15	4	49	32	19
15	5	48	32	20
15	6	49	34	17
15	7	54	31	15
15	8	50	35	15
15	9	51	34	15
15	10	51	34	15

transect	plot	% sand	% silt	% clay
16	1	47	37	16
16	2	51	34	15
16	3	49	34	17
16	4	47	36	17
16	5	49	34	17
16	6	49	32	19
16	7	47	31	22
16	8	49	31	20
16	9	47	34	19
16	10	45	35	20
18	1	43	46	11
18	2	44	43	13
18	3	41	45	14
18	4	44	44	12
18	5	45	42	13
18	6	46	38	16
18	7	48	36	16
18	8	49	37	14
18	9	48	38	14
18	10	48	37	15

Table D.4 Leaf Area Index (LAI) and Photosynthetically Active Radiation (PAR) were measured at the same time for each plot. PAR was measured above and below SIORC foliage height but only LAI was assessed in subsequent analyses. Canopy density was measured for every plot in 2022 but only certain plots in 2023; canopy density for the remaining plots was linearly interpolated (Chapter 1, Methods). Canopy density measurements that were actually observed are shown in bold.

transect	plot	LAI	PAR above	PAR below	% canopy
1	1	0.59	659	431	**24.4**
1	2	0.78	828	486	**21.3**
1	3	0.40	835	591	**19.0**
1	4	0.11	631	804	**27.8**
1	5	1.29	594	239	**27.8**
1	6	1.17	562	253	**29.1**
1	7	0.45	944	822	**26.0**
1	8	0.72	786	490	**17.4**
1	9	2.37	1483	402	**13.3**
1	10	1.34	710	288	**12.0**
1	11	0.95	514	253	**12.5**
1	12	0.89	412	204	**14.3**
2	1	0.80	1143	700	**0.0**
2	2	1.63	1254	358	**0.0**
2	3	0.57	482	295	**0.0**
2	4	0.22	621	618	**0.0**
2	5	1.37	1134	593	**2.3**
2	6	0.11	735	729	**4.4**

transect	plot	LAI	PAR above	PAR below	% canopy
2	7	0.36	752	552	**6.0**
2	8	0.34	529	390	**7.5**
2	9	1.08	372	157	**11.7**
2	10	0.73	356	206	**11.7**
2	11	1.62	300	100	**17.7**
2	12	0.32	273	210	**23.1**
3	1	1.60	433	112	**0.0**
3	2	1.26	648	241	**0.0**
3	3	1.61	615	176	**0.0**
3	4	3.24	454	36	**0.0**
3	5	2.39	432	70	**0.0**
3	6	2.28	431	76	**0.0**
3	7	1.28	399	136	**0.0**
3	8	1.50	400	126	**0.0**
3	9	1.28	429	154	**0.0**
3	10	1.42	470	141	**0.0**
3	11	1.45	485	143	**0.0**
5	1	0.37	1352	1122	**0.0**
5	2	0.16	1370	1220	0.0
5	3	1.06	1386	771	0.0
5	4	1.32	1376	700	**0.0**
5	5	2.31	1390	326	0.3
5	6	3.26	1394	281	0.7
5	7	1.43	1395	675	**1.0**
5	8	1.65	1389	601	22.5
5	9	1.17	1368	719	44.0
5	10	1.03	907	588	**65.5**
6	1	0.85	1498	918	**0.0**
6	2	1.23	1516	727	0.0
6	3	0.89	1512	878	0.0
6	4	0.18	1516	1365	**0.0**
6	5	1.96	1484	663	0.0
6	6	1.92	1514	503	0.0
6	7	0.86	1531	951	**0.0**
6	8	1.39	1534	671	0.0
6	9	2.59	1535	392	0.0
6	10	1.62	1526	669	**0.0**
7	1	1.48	1383	628	**0.0**
7	2	3.74	1402	249	0.0
7	3	2.19	1406	425	**0.0**
7	4	1.52	1416	627	0.0
7	5	1.56	1431	625	0.0
7	6	0.42	1431	1129	**0.0**
7	7	1.93	1434	444	0.0
7	8	3.03	1442	247	0.0
7	9	2.26	1438	361	**0.0**
7	10	3.07	1442	240	**0.0**
9	1	0.32	53	56	**85.3**

transect	plot	LAI	PAR above	PAR below	% canopy
9	2	3.40	1464	365	**17.4**
9	3	1.32	1749	858	11.6
9	4	1.75	1787	756	5.8
9	5	1.95	1792	656	**0.0**
9	6	3.35	1804	354	0.0
9	7	0.38	1748	1459	0.0
9	8	1.03	1757	1035	**0.0**
9	9	1.75	1735	680	0.0
9	10	1.49	1719	782	**0.0**
10	1	1.56	1610	699	**0.0**
10	2	0.82	1604	614	**0.0**
10	3	1.46	1598	708	0.1
10	4	1.80	1605	689	0.2
10	5	0.39	1588	1293	**0.3**
10	6	1.00	1637	963	0.2
10	7	1.92	1641	641	0.1
10	8	1.25	1641	877	**0.0**
10	9	2.12	1633	560	0.0
10	10	2.53	1641	448	**0.0**
12	1	0.50	1511	891	**0.0**
12	2	2.27	1627	497	**0.0**
12	3	2.78	1548	350	0.0
12	4	1.44	1531	706	0.0
12	5	0.86	1532	1000	**0.0**
12	6	2.20	1541	493	0.0
12	7	1.52	1544	704	0.0
12	8	1.36	1540	807	**0.0**
12	9	1.50	1528	677	0.0
12	10	2.01	1537	577	**0.0**
14	1	1.81	221	47	**53.8**
14	2	2.29	672	105	42.6
14	3	2.34	1426	461	31.3
14	4	1.78	1445	628	**20.0**
14	5	3.70	1456	176	14.2
14	6	4.37	1463	133	8.4
14	7	4.54	1467	93	**2.6**
14	8	6.32	1467	38	1.9
14	9	3.39	1483	271	1.2
14	10	1.77	1506	285	**0.5**
15	1	1.37	132	27	**54.3**
15	2	1.71	677	238	**40.8**
15	3	1.42	300	80	36.3
15	4	2.46	197	38	31.8
15	5	2.15	1320	580	**27.3**
15	6	0.35	1296	1089	30.9
15	7	0.34	1299	1113	34.6
15	8	0.24	1391	1212	**38.2**
15	9	1.05	1422	828	35.8

transect	plot	LAI	PAR above	PAR below	% canopy
15	10	1.16	1436	767	**33.3**
16	1	1.26	468	142	**50.2**
16	2	3.73	255	21	40.2
16	3	2.87	826	143	30.2
16	4	5.35	1517	137	**20.3**
16	5	3.65	1070	122	17.2
16	6	0.87	1525	950	14.2
16	7	2.27	349	65	**11.2**
16	8	1.43	1528	696	9.5
16	9	1.27	1547	790	7.9
16	10	0.86	1583	1069	**6.2**
18	1	1.66	891	457	**47.3**
18	2	0.62	1482	1138	39.7
18	3	3.40	980	93	32.1
18	4	1.71	422	117	**24.4**
18	5	0.84	1720	1264	16.6
18	6	0.92	1741	1061	8.8
18	7	0.49	1754	1302	**1.0**
18	8	0.38	1733	1414	1.0
18	9	0.89	1651	1296	0.9
18	10	1.37	1696	879	**0.8**

Appendix E: Chapter 1 Scree Plots

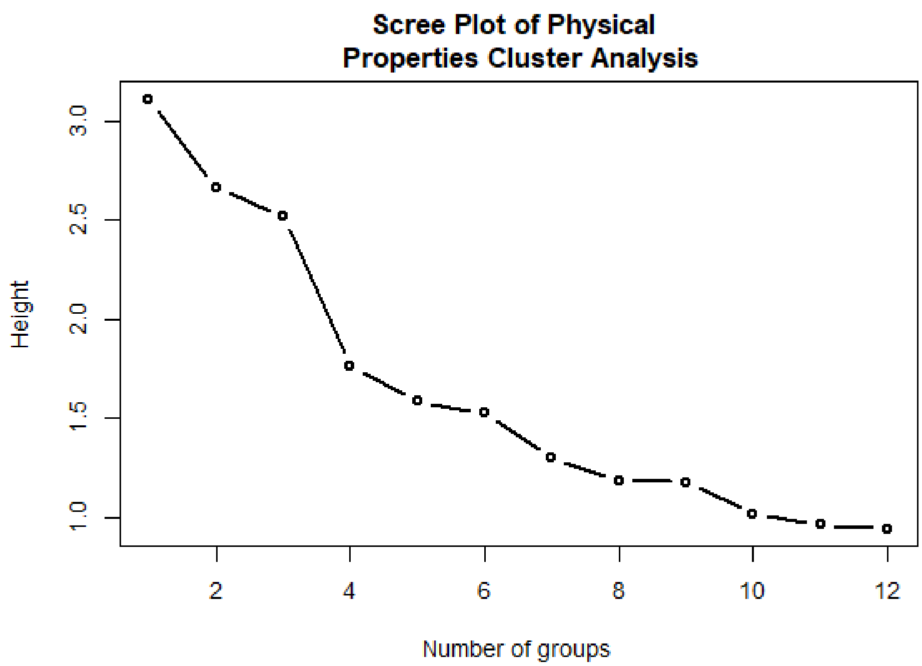

Figure E.1 Scree plot for physical properties cluster analysis.

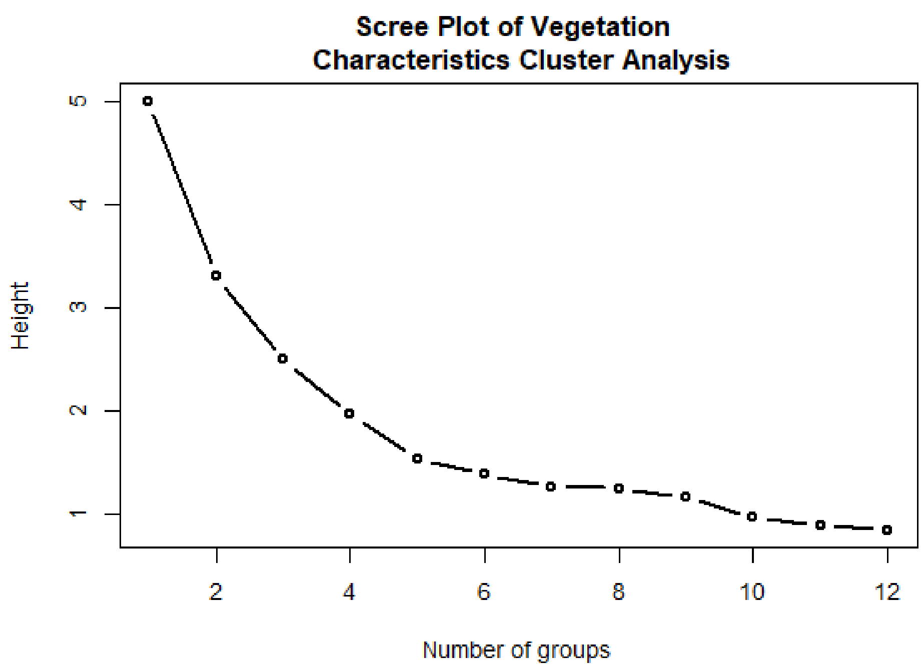

Figure E.2 Scree plot for vegetation characteristics cluster analysis.

Appendix F: Chapter 1 Supplemental Tables

Physical Properties

Table F.1 PERMANOVA results examining the variance explained and significance of physical property groups on SIORC abundance.

	Df	SS	R2	F	Pr(>F)
easting	1	1.21	0.00	0.02	0.882
northing	1	33.64	0.01	0.61	0.414
group	3	233.85	0.09	1.42	0.246
Residual	45	2476.10	0.90		
Total	50	2744.79	1		

Table F.2 PERMANOVA results examining the variance explained and significance of physical property groups on SIORC presence.

	Df	SS	R2	F	Pr(>F)
easting	1	0.78	0.02	3.31	0.067
northing	1	0.24	0.01	1.01	0.328
group	3	0.58	0.02	0.82	0.484
Residual	45	30.15	0.95		
Total	50	31.73	1		

Lab-based Soil Texture Analysis

Table F.3 Importance of components for Principal Component Analysis of 2023 lab-based soil texture data.

	PC1	PC2
Standard deviation	4.93	3.94
Proportion of variance	0.61	0.39
Cumulative proportion of variance	0.61	1.00

Table F.4 PERMANOVA results examining the variance explained and significance of soil texture PC1 on SIORC presence.

	Df	SS	R2	F	Pr(>F)
easting	1	0.23	0.01	1.06	0.299
northing	1	0.56	0.03	2.53	0.111
PC2	1	0.17	0.01	0.78	0.384
Residual	96	21.15	0.96		
Total	99	22.11	1.00		

Table F.5 PERMANOVA results examining the variance explained and significance of soil texture PC1 on SIORC abundance.

	Df	SS	R2	F	Pr(>F)
easting	1	0.00	0.00	0.00	0.990
northing	1	11.42	0.05	1.54	0.224
PC2	1	1.91	0.01	0.26	0.618
Residual	29	215.23	0.94		
Total	32	228.56	1.00		

Table F.6 PERMANOVA results examining the variance explained and significance of soil texture PC2 on SIORC abundance.

	Df	SS	R2	F	Pr(>F)
easting	1	0.00	0.00	0.00	0.990
northing	1	11.42	0.05	1.53	0.225
PC2	1	0.266	0.00	0.04	0.853
Residual	29	216.87	0.95		
Total	32	228.56	1.00		

Vegetation Characteristics

Table F.7 PERMANOVA results examining the variance explained and significance of total cover on SIORC presence.

	Df	SS	R2	F	Pr(>F)
easting	1	0.77	0.02	3.39	0.064
northing	1	0.24	0.01	1.04	0.322
total cover	1	0.82	0.03	3.60	0.059
Residual	131	29.90	0.94		
Total	134	31.73	1.00		

Table F.8 PERMANOVA results examining the variance explained and significance of shrub cover on SIORC presence.

	Df	SS	R2	F	Pr(>F)
easting	1	0.77	0.02	3.39	0.064
northing	1	0.24	0.01	1.03	0.323
shrub cover	1	0.79	0.02	3.46	0.062
Residual	131	29.93	0.94		
Total	134	31.73	1.00		

Table F.9 PERMANOVA results examining the variance explained and significance of species richness on SIORC abundance in plots where SIORC is present.

	Df	SS	R2	F	Pr(>F)
easting	1	1.21	0.00	0.02	0.888
northing	1	33.64	0.01	0.58	0.424
species richness	1	3.65	0.00	0.06	0.813
Residual	47	2706.30	0.99		
Total	50	2744.79	1.00		

Table F.10 PERMANOVA results examining the variance explained and significance of forbs cover on SIORC abundance in plots where SIORC is present.

	Df	SS	R2	F	Pr(>F)
easting	1	1.21	0.00	0.02	0.887
northing	1	33.64	0.01	0.59	0.421
forbs cover	1	28.42	0.01	0.50	0.486
Residual	47	2681.53	0.98		
Total	50	2744.79	1.00		

Table F.11 PERMANOVA results examining the variance explained and significance of shrub cover on SIORC abundance in plots where SIORC is present.

	Df	SS	R2	F	Pr(>F)
easting	1	1.21	0.00	0.02	0.887
northing	1	33.64	0.01	0.59	0.420
shrub cover	1	44.14	0.02	0.78	0.242
Residual	47	2665.81	0.97		
Total	50	2744.79	1.00		

Appendix G: Chapter 2 Sensor Coordinates

Plot coordinates for the plot closest to each sensor were estimated in ArcGIS Pro based coordinates for transect ends and known linear distances between plots.

Table G.1 Distance from each sensor to the nearest plot.

transect	plot	sensor label	minimum distance (m)
5	4	T5P4_S1	0
5	7	T5P7_S2	0
5	10	T5P10_S3	0.1
6	1	T6P1_S1	0
6	4	T6P4_S2	0.3
6	7	T6P7_S3	0.7
7	3	T7P3_S1	0.1
7	6	T7P6_S2	0.3
7	9	T7P9_S3	0.6
9	2	T9P2_S1	0
9	5	T9P5_S2	0.4
9	8	T9P8_S3	0.9
10	2	T10P2_S1	0.3
10	5	T10P5_S2	0.4
10	8	T10P8_S3	0.3
12	2	T12P2_S1	0.1
12	5	T12P5_S2	0
12	8	T12P8_S3	0.5
14	1	T14P1_S1	0
14	4	T14P4_S2	0.8
14	7	T14P7_S3	0.8
15	2	T15P2_S1	0.1
15	5	T15P5_S2	0
15	8	T15P8_S3	0.6
16	1	T16P1_S3	0
16	4	T16P4_S2	0
16	7	T16P7_S1	1.9
18	1	T18P1_S1	0
18	4	T18P4_S2	0.5
18	7	T18P7_S3	0.6

Table G.2 Transect start and end coordinates, UTM Zone 10T. Start coordinates are closest to sensor 1 for each transect, and end coordinates are closest to sensor 3.

transect	start coordinate	end coordinate
5	0682287 5260930	0682232 5260965
6	0682499 5260856	0682441 5260838
7	0682359 5260837	0682403 5260797
9	0682448 5260557	0682444 5260616
10	0682599 5260636	0682635 5260685
12	0682797 5260880	0682843 5260843
14	0682717 5260277	0682662 5260267
15	0682968 5260301	0682973 5260364
16	0682920 5259848	0682948 5259897
18	0683459 5259799	0683515 5259797

Table G.3 UTM Zone 10T coordinates for each plot.

transect	plot	sensor label	easting	northing
5	4	T5P4_S1	682271.07	5260940.41
5	7	T5P7_S2	682255.89	5260950.07
5	10	T5P10_S3	682240.70	5260959.74
6	1	T6P1_S1	682494.10	5260854.42
6	4	T6P4_S2	682476.91	5260849.08
6	7	T6P7_S3	682459.72	5260843.75
7	3	T7P3_S1	682394.50	5260805.10
7	6	T7P6_S2	682381.18	5260817.21
7	9	T7P9_S3	682367.87	5260829.31
9	2	T9P2_S1	682447.64	5260567.63
9	5	T9P5_S2	682446.42	5260585.58
9	8	T9P8_S3	682445.20	5260603.54
10	2	T10P2_S1	682603.21	5260641.29
10	5	T10P5_S2	682613.86	5260655.79
10	8	T10P8_S3	682624.52	5260670.30
12	2	T12P2_S1	682802.42	5260875.98
12	5	T12P5_S2	682816.45	5260864.70
12	8	T12P8_S3	682830.47	5260853.41
14	1	T14P1_S1	682662.36	5260267.05
14	4	T14P4_S2	682680.07	5260270.27
14	7	T14P7_S3	682697.78	5260273.49
15	2	T15P2_S1	682968.91	5260308.03
15	5	T15P5_S2	682970.34	5260325.97
15	8	T15P8_S3	682971.76	5260343.92
16	1	T16P1_S3	682921.55	5259850.14
16	4	T16P4_S2	682930.48	5259865.77
16	7	T16P7_S1	682939.41	5259881.40
18	1	T18P1_S1	683461.36	5259798.99
18	4	T18P4_S2	683479.35	5259798.34
18	7	T18P7_S3	683497.33	5259797.70

Appendix H: Continuous Soil Moisture Data

Continuous soil moisture averages for each period of each day. Values based on observed measurements are shown in grey, and predicted values are highlighted in red.

Table H.1 Percent soil moisture (VWC) for sensors from transects 5 and 6.

day	period	T5P4_S1	T5P7_S2	T5P10_S3	T6P1_S1	T6P4_S2	T6P7_S3
2023-05-13	late morning	NA	NA	NA	32.1	40.0	NA
2023-05-13	afternoon	NA	NA	NA	32.4	40.1	NA
2023-05-13	evening	NA	NA	NA	32.4	40.1	NA
2023-05-14	early morning	NA	NA	NA	32.3	40.1	NA
2023-05-14	late morning	NA	NA	NA	32.2	40.2	NA
2023-05-14	afternoon	NA	NA	NA	32.4	40.2	NA
2023-05-14	evening	NA	NA	NA	32.0	40.0	NA
2023-05-15	early morning	NA	NA	NA	31.7	39.9	NA
2023-05-15	late morning	NA	NA	NA	31.4	40.3	NA
2023-05-15	afternoon	NA	NA	NA	31.2	40.4	NA
2023-05-15	evening	NA	NA	NA	31.1	40.4	NA
2023-05-16	early morning	NA	NA	NA	30.9	40.5	NA
2023-05-16	late morning	NA	NA	NA	30.7	40.5	NA
2023-05-16	afternoon	NA	NA	NA	30.5	40.6	NA
2023-05-16	evening	NA	NA	NA	30.4	40.6	NA
2023-05-17	early morning	NA	NA	NA	30.2	40.7	NA
2023-05-17	late morning	NA	NA	NA	30.0	40.7	NA
2023-05-17	afternoon	NA	NA	NA	29.9	40.8	NA
2023-05-17	evening	NA	NA	NA	29.7	40.8	NA
2023-05-18	early morning	NA	NA	NA	29.5	40.8	NA
2023-05-18	late morning	NA	NA	NA	29.3	40.9	NA
2023-05-18	afternoon	NA	NA	NA	29.2	40.9	NA
2023-05-18	evening	NA	NA	NA	29.0	41.0	NA
2023-05-19	early morning	NA	NA	NA	28.8	41.0	NA
2023-05-19	late morning	NA	NA	NA	28.7	41.0	NA
2023-05-19	afternoon	NA	NA	NA	28.8	41.1	NA
2023-05-19	evening	NA	NA	NA	28.6	41.1	NA
2023-05-20	early morning	NA	NA	NA	28.2	41.1	NA
2023-05-20	late morning	NA	NA	NA	27.7	41.1	NA
2023-05-20	afternoon	NA	NA	NA	27.8	41.2	NA
2023-05-20	evening	NA	NA	NA	27.6	41.2	NA
2023-05-21	early morning	NA	NA	NA	27.4	41.2	NA
2023-05-21	late morning	NA	NA	NA	27.3	41.2	NA
2023-05-21	afternoon	NA	NA	NA	27.3	41.2	NA

day	period	T5P4_S1	T5P7_S2	T5P10_S3	T6P1_S1	T6P4_S2	T6P7_S3
2023-05-21	evening	NA	NA	NA	27.1	41.2	NA
2023-05-22	early morning	NA	NA	NA	26.9	41.2	NA
2023-05-22	late morning	NA	NA	NA	26.7	41.2	NA
2023-05-22	afternoon	NA	NA	NA	26.6	41.2	NA
2023-05-22	evening	NA	NA	NA	26.4	41.2	NA
2023-05-23	early morning	NA	NA	NA	26.2	41.2	NA
2023-05-23	late morning	NA	NA	NA	26.1	41.2	NA
2023-05-23	afternoon	NA	NA	NA	26.1	41.2	NA
2023-05-23	evening	NA	NA	NA	25.9	41.2	NA
2023-05-24	early morning	NA	NA	NA	25.8	41.2	NA
2023-05-24	late morning	NA	NA	NA	25.7	41.1	NA
2023-05-24	afternoon	NA	NA	NA	25.7	41.1	NA
2023-05-24	evening	NA	NA	NA	25.5	41.1	NA
2023-05-25	early morning	NA	NA	NA	25.4	41.0	NA
2023-05-25	late morning	NA	NA	NA	25.3	41.0	NA
2023-05-25	afternoon	NA	NA	NA	25.3	40.9	NA
2023-05-25	evening	NA	NA	NA	25.1	40.9	NA
2023-05-26	early morning	NA	NA	NA	24.9	40.8	NA
2023-05-26	late morning	NA	NA	NA	24.9	40.8	NA
2023-05-26	afternoon	NA	NA	NA	24.9	40.7	NA
2023-05-26	evening	NA	NA	NA	24.7	40.6	NA
2023-05-27	early morning	NA	NA	NA	24.5	40.5	NA
2023-05-27	late morning	NA	NA	NA	24.4	40.5	NA
2023-05-27	afternoon	NA	NA	NA	24.4	40.4	NA
2023-05-27	evening	NA	NA	NA	24.2	40.3	NA
2023-05-28	early morning	NA	NA	NA	24.0	40.2	NA
2023-05-28	late morning	NA	NA	NA	23.9	40.1	NA
2023-05-28	afternoon	NA	NA	NA	23.9	40.0	NA
2023-05-28	evening	NA	NA	NA	23.6	39.8	NA
2023-05-29	early morning	NA	NA	NA	23.4	39.7	NA
2023-05-29	late morning	NA	NA	NA	23.3	39.6	NA
2023-05-29	afternoon	NA	NA	NA	23.3	39.5	NA
2023-05-29	evening	NA	NA	NA	22.9	39.3	NA
2023-05-30	early morning	NA	NA	NA	22.7	39.2	NA
2023-05-30	late morning	NA	NA	NA	22.6	39.0	NA
2023-05-30	afternoon	NA	NA	NA	22.6	38.8	NA
2023-05-30	evening	NA	NA	NA	22.3	38.7	NA
2023-05-31	early morning	NA	NA	NA	22.1	38.5	NA
2023-05-31	late morning	NA	NA	NA	22.0	38.3	NA
2023-05-31	afternoon	NA	NA	NA	22.0	38.1	NA
2023-05-31	evening	NA	NA	NA	21.8	37.9	NA
2023-06-01	early morning	NA	NA	NA	21.6	37.7	NA
2023-06-01	late morning	NA	NA	NA	21.6	37.5	NA

day	period	T5P4_S1	T5P7_S2	T5P10_S3	T6P1_S1	T6P4_S2	T6P7_S3
2023-06-01	afternoon	NA	NA	NA	21.6	37.3	NA
2023-06-01	evening	NA	NA	NA	21.4	37.0	NA
2023-06-02	early morning	NA	NA	NA	21.2	36.8	NA
2023-06-02	late morning	NA	NA	NA	21.1	36.6	NA
2023-06-02	afternoon	NA	NA	NA	21.2	36.0	38.2
2023-06-02	evening	NA	NA	NA	21.0	35.7	38.3
2023-06-03	early morning	NA	NA	NA	20.8	35.7	38.4
2023-06-03	late morning	24.0	24.4	21.3	20.7	35.8	38.4
2023-06-03	afternoon	24.1	24.3	21.2	20.8	35.5	38.4
2023-06-03	evening	24.0	24.2	21.1	20.6	34.9	38.4
2023-06-04	early morning	23.8	24.1	21.1	20.4	34.8	38.4
2023-06-04	late morning	23.8	24.1	21.1	20.4	34.9	38.4
2023-06-04	afternoon	23.9	24.0	21.0	20.5	34.6	38.3
2023-06-04	evening	23.8	23.8	20.9	20.3	33.8	38.2
2023-06-05	early morning	23.6	23.7	20.9	20.1	33.5	38.3
2023-06-05	late morning	23.6	23.7	20.9	20.0	33.6	38.2
2023-06-05	afternoon	23.7	23.6	20.8	20.2	33.5	38.1
2023-06-05	evening	23.6	23.5	20.7	20.0	32.8	38.1
2023-06-06	early morning	23.5	23.3	20.7	19.8	32.4	38.1
2023-06-06	late morning	23.4	23.3	20.7	19.8	32.4	38.0
2023-06-06	afternoon	23.6	23.2	20.5	19.9	32.5	37.9
2023-06-06	evening	23.5	23.1	20.4	19.8	32.0	37.9
2023-06-07	early morning	23.3	23.0	20.4	19.6	31.6	37.9
2023-06-07	late morning	23.3	22.9	20.4	19.5	31.5	37.9
2023-06-07	afternoon	23.5	22.9	20.3	19.7	31.6	37.8
2023-06-07	evening	23.4	22.7	20.2	19.6	31.2	37.8
2023-06-08	early morning	23.3	22.6	20.2	19.4	30.9	37.9
2023-06-08	late morning	23.2	22.6	20.2	19.4	30.8	37.7
2023-06-08	afternoon	23.4	22.6	20.1	19.5	30.9	37.7
2023-06-08	evening	23.4	22.5	20.0	19.4	30.6	37.8
2023-06-09	early morning	23.4	22.5	20.0	19.4	30.4	37.9
2023-06-09	late morning	23.4	22.4	20.0	19.3	30.3	38.0
2023-06-09	afternoon	23.7	22.5	20.1	19.5	30.5	38.3
2023-06-09	evening	23.9	22.6	20.3	19.5	30.5	38.4
2023-06-10	early morning	23.8	22.6	20.3	19.5	30.5	38.3
2023-06-10	late morning	23.8	22.5	20.3	19.5	30.6	38.3
2023-06-10	afternoon	23.8	22.5	20.3	19.5	30.7	38.3
2023-06-10	evening	23.8	22.5	20.3	19.5	30.8	38.3
2023-06-11	early morning	23.6	22.4	20.3	19.4	30.7	38.3
2023-06-11	late morning	23.6	22.3	20.2	19.4	30.7	38.3
2023-06-11	afternoon	23.8	22.3	20.2	19.6	30.9	38.2
2023-06-11	evening	23.8	22.3	20.1	19.6	30.5	38.2
2023-06-12	early morning	23.7	22.2	20.1	19.5	30.3	38.3

day	period	T5P4_S1	T5P7_S2	T5P10_S3	T6P1_S1	T6P4_S2	T6P7_S3
2023-06-12	late morning	23.6	22.1	20.1	19.4	30.2	38.1
2023-06-12	afternoon	23.7	22.1	20.0	19.6	30.4	38.1
2023-06-12	evening	23.7	22.0	19.9	19.6	30.0	38.1
2023-06-13	early morning	23.6	21.9	19.9	19.4	29.6	38.1
2023-06-13	late morning	23.5	21.8	19.9	19.4	29.5	38.0
2023-06-13	afternoon	23.6	21.7	19.8	19.5	29.6	37.9
2023-06-13	evening	23.5	21.6	19.7	19.4	29.2	37.9
2023-06-14	early morning	23.4	21.5	19.7	19.2	28.8	37.9
2023-06-14	late morning	23.2	21.4	19.6	19.2	28.7	37.7
2023-06-14	afternoon	23.3	21.3	19.5	19.4	28.9	37.7
2023-06-14	evening	23.2	21.1	19.5	19.2	28.4	37.6
2023-06-15	early morning	23.2	21.1	19.5	19.1	28.1	37.6
2023-06-15	late morning	23.0	21.0	19.4	19.1	28.1	37.6
2023-06-15	afternoon	23.1	21.0	19.3	19.3	28.2	37.4
2023-06-15	evening	23.1	20.8	19.3	19.2	27.8	37.4
2023-06-16	early morning	23.0	20.8	19.2	19.0	27.5	37.4
2023-06-16	late morning	22.9	20.7	19.2	19.0	27.4	37.3
2023-06-16	afternoon	22.9	20.6	19.1	19.2	27.5	37.2
2023-06-16	evening	22.8	20.5	19.1	19.1	27.1	37.2
2023-06-17	early morning	22.8	20.5	19.0	18.9	26.8	37.2
2023-06-17	late morning	22.7	20.4	19.0	18.9	26.7	37.1
2023-06-17	afternoon	22.7	20.3	18.9	19.1	26.8	37.0
2023-06-17	evening	22.7	20.2	18.9	19.0	26.3	36.9
2023-06-18	early morning	22.6	20.2	18.8	18.8	26.0	36.9
2023-06-18	late morning	22.6	20.1	18.8	18.8	25.9	36.8
2023-06-18	afternoon	22.5	20.0	18.7	18.9	25.9	36.7
2023-06-18	evening	22.5	20.0	18.7	18.8	25.6	36.6
2023-06-19	early morning	22.5	19.9	18.6	18.7	25.2	36.6
2023-06-19	late morning	22.4	19.8	18.5	18.7	25.2	36.6
2023-06-19	afternoon	22.4	19.8	18.5	18.9	25.4	36.5
2023-06-19	evening	22.4	19.7	18.4	18.8	25.0	36.4
2023-06-20	early morning	22.3	19.6	18.4	18.7	24.7	36.3
2023-06-20	late morning	22.3	19.6	18.3	18.7	24.6	36.3
2023-06-20	afternoon	22.3	19.5	18.3	18.8	24.7	36.3
2023-06-20	evening	22.2	19.5	18.2	18.8	24.5	36.3
2023-06-21	early morning	22.2	19.4	18.2	19.0	24.2	36.2
2023-06-21	late morning	22.2	19.4	18.1	19.0	24.2	36.1
2023-06-21	afternoon	22.1	19.3	18.1	19.0	24.4	36.1
2023-06-21	evening	22.1	19.2	18.0	19.0	24.1	36.1
2023-06-22	early morning	22.1	19.2	17.9	18.9	23.8	36.1
2023-06-22	late morning	22.1	19.1	17.9	18.8	23.8	36.0
2023-06-22	afternoon	22.0	19.1	17.8	19.0	23.9	36.0
2023-06-22	evening	22.0	19.0	17.8	19.0	23.6	35.8

day	period	T5P4_S1	T5P7_S2	T5P10_S3	T6P1_S1	T6P4_S2	T6P7_S3
2023-06-23	early morning	22.0	19.0	17.7	18.9	23.4	35.8
2023-06-23	late morning	22.0	18.9	17.7	18.8	23.3	35.7
2023-06-23	afternoon	21.9	18.9	17.6	19.0	23.5	35.7
2023-06-23	evening	21.9	18.8	17.6	19.0	23.2	35.5
2023-06-24	early morning	21.9	18.8	17.5	18.9	23.0	35.5
2023-06-24	late morning	21.9	18.7	17.4	18.8	22.9	35.4
2023-06-24	afternoon	21.8	18.7	17.4	19.0	23.1	35.3
2023-06-24	evening	21.8	18.7	17.3	19.0	22.8	35.0
2023-06-25	early morning	21.8	18.6	17.3	18.8	22.5	34.9
2023-06-25	late morning	21.8	18.6	17.2	18.8	22.4	34.8
2023-06-25	afternoon	21.8	18.5	17.2	19.0	22.6	34.6
2023-06-25	evening	21.7	18.5	17.1	19.0	22.3	34.4
2023-06-26	early morning	21.7	18.4	17.1	18.8	22.0	34.2
2023-06-26	late morning	21.7	18.4	17.0	18.8	22.0	34.1
2023-06-26	afternoon	21.7	18.4	17.0	19.0	22.2	33.9
2023-06-26	evening	21.7	18.3	16.9	19.0	21.9	33.6
2023-06-27	early morning	21.7	18.3	16.8	18.8	21.6	33.5
2023-06-27	late morning	21.7	18.2	16.8	18.8	21.5	33.3
2023-06-27	afternoon	21.6	18.2	16.7	19.0	21.8	33.1
2023-06-27	evening	21.6	18.2	16.7	19.1	21.6	33.2
2023-06-28	early morning	21.6	18.1	16.6	18.9	21.3	33.0
2023-06-28	late morning	21.6	18.1	16.6	18.9	21.2	32.9
2023-06-28	afternoon	21.6	18.1	16.5	19.2	21.5	32.8
2023-06-28	evening	21.6	18.0	16.5	19.1	21.2	32.6
2023-06-29	early morning	21.6	18.0	16.4	18.8	20.7	32.4
2023-06-29	late morning	21.5	18.0	16.4	18.8	20.7	32.2
2023-06-29	afternoon	21.5	17.9	16.3	19.0	21.0	31.9
2023-06-29	evening	21.5	17.9	16.3	19.0	20.7	31.7
2023-06-30	early morning	21.5	17.9	16.2	18.8	20.4	31.5
2023-06-30	late morning	21.5	17.8	16.2	18.7	20.3	31.2
2023-06-30	afternoon	21.5	17.8	16.1	19.0	20.7	31.0
2023-06-30	evening	21.5	17.8	16.1	18.9	20.4	30.7
2023-07-01	early morning	21.5	17.8	16.1	18.7	20.1	30.5
2023-07-01	late morning	21.5	17.7	16.0	18.6	20.0	30.3
2023-07-01	afternoon	21.5	17.7	16.0	18.9	20.4	30.0
2023-07-01	evening	21.4	17.7	15.9	18.8	20.1	29.7
2023-07-02	early morning	21.4	17.6	15.9	18.6	19.8	29.4
2023-07-02	late morning	21.4	17.6	15.8	18.5	19.8	29.2
2023-07-02	afternoon	21.4	17.6	15.8	18.8	20.1	29.0
2023-07-02	evening	21.4	17.6	15.7	18.8	19.9	28.7
2023-07-03	early morning	21.4	17.5	15.7	18.6	19.5	28.5
2023-07-03	late morning	21.4	17.5	15.7	18.5	19.5	28.3
2023-07-03	afternoon	21.4	17.5	15.6	18.8	19.9	28.1

day	period	T5P4_S1	T5P7_S2	T5P10_S3	T6P1_S1	T6P4_S2	T6P7_S3
2023-07-03	evening	21.4	17.5	15.6	18.8	19.6	27.8
2023-07-04	early morning	21.4	17.4	15.5	18.5	19.3	27.6
2023-07-04	late morning	21.4	17.4	15.5	18.4	19.3	27.4
2023-07-04	afternoon	21.4	17.4	15.5	18.7	19.7	27.2
2023-07-04	evening	21.4	17.4	15.4	18.7	19.4	26.9
2023-07-05	early morning	21.4	17.4	15.4	18.5	19.1	26.7
2023-07-05	late morning	21.3	17.3	15.4	18.4	19.1	26.5
2023-07-05	afternoon	21.3	17.3	15.3	18.6	19.5	26.3
2023-07-05	evening	21.3	17.3	15.3	18.6	19.2	26.1
2023-07-06	early morning	21.3	17.3	15.3	18.4	18.9	25.9
2023-07-06	late morning	21.3	17.2	15.2	18.3	19.0	25.7
2023-07-06	afternoon	21.3	17.2	15.2	18.6	19.3	25.5
2023-07-06	evening	21.3	17.2	15.2	18.6	19.1	25.3
2023-07-07	early morning	21.3	17.2	15.1	18.4	18.8	25.1
2023-07-07	late morning	21.2	17.1	15.1	18.3	18.8	24.9
2023-07-07	afternoon	21.4	17.2	15.1	18.6	19.2	24.7
2023-07-07	evening	21.4	17.1	15.0	18.6	19.0	24.5
2023-07-08	early morning	21.2	17.0	15.0	18.3	18.7	24.3
2023-07-08	late morning	21.1	17.0	15.0	18.3	18.7	24.1
2023-07-08	afternoon	21.3	17.1	15.0	18.6	19.1	24.0
2023-07-08	evening	21.4	17.0	14.9	18.6	18.9	23.7
2023-07-09	early morning	21.1	16.9	14.9	18.3	18.6	23.5
2023-07-09	late morning	21.0	17.0	14.9	18.2	18.6	23.4
2023-07-09	afternoon	21.1	17.0	14.9	18.3	18.7	23.3
2023-07-09	evening	21.1	17.0	14.8	18.3	18.6	23.2
2023-07-10	early morning	21.0	17.0	14.8	18.2	18.5	23.1
2023-07-10	late morning	21.0	17.1	14.8	18.1	18.5	23.1
2023-07-10	afternoon	21.2	17.2	14.8	18.4	18.8	23.1
2023-07-10	evening	21.2	17.1	14.7	18.3	18.6	23.0
2023-07-11	early morning	21.0	17.0	14.7	18.1	18.4	22.8
2023-07-11	late morning	20.9	17.0	14.7	18.1	18.5	22.7
2023-07-11	afternoon	20.4	16.4	14.0	18.4	18.8	22.7
2023-07-11	evening	20.1	16.0	13.7	18.4	18.6	22.5
2023-07-12	early morning	19.9	15.9	13.6	18.2	18.3	22.4
2023-07-12	late morning	19.8	16.0	13.7	18.1	18.4	22.3
2023-07-12	afternoon	20.1	16.1	13.7	18.4	18.7	22.3
2023-07-12	evening	20.1	15.9	13.6	18.3	18.5	22.1
2023-07-13	early morning	19.8	15.8	13.5	18.1	18.2	21.9
2023-07-13	late morning	19.7	15.9	13.6	18.0	18.2	21.8
2023-07-13	afternoon	20.0	16.0	13.6	18.4	18.7	21.9
2023-07-13	evening	20.1	15.9	13.5	18.4	18.5	21.7
2023-07-14	early morning	19.7	15.7	13.4	18.1	18.1	21.5
2023-07-14	late morning	19.7	15.8	13.5	18.0	18.1	21.4

day	period	T5P4_S1	T5P7_S2	T5P10_S3	T6P1_S1	T6P4_S2	T6P7_S3
2023-07-14	afternoon	20.0	15.9	13.6	18.3	18.6	21.5
2023-07-14	evening	20.0	15.8	13.4	18.3	18.4	21.4
2023-07-15	early morning	19.7	15.7	13.3	18.0	18.0	21.2
2023-07-15	late morning	19.6	15.7	13.4	17.9	18.0	21.1
2023-07-15	afternoon	20.0	15.8	13.5	18.3	18.5	21.2
2023-07-15	evening	20.0	15.7	13.3	18.3	18.2	21.0
2023-07-16	early morning	19.6	15.6	13.2	18.0	17.9	20.9
2023-07-16	late morning	19.6	15.6	13.3	17.9	17.9	20.8
2023-07-16	afternoon	19.9	15.7	13.4	18.2	18.3	20.9
2023-07-16	evening	19.9	15.6	13.2	18.2	18.1	20.8
2023-07-17	early morning	19.6	15.5	13.1	17.9	17.8	20.6
2023-07-17	late morning	19.5	15.5	13.2	17.8	17.8	20.5
2023-07-17	afternoon	19.8	15.6	13.2	18.1	18.2	20.6
2023-07-17	evening	19.8	15.5	13.1	18.0	17.9	20.5
2023-07-18	early morning	19.5	15.3	13.0	17.8	17.6	20.3
2023-07-18	late morning	19.4	15.4	13.1	17.7	17.6	20.3
2023-07-18	afternoon	19.9	15.6	13.1	18.0	18.1	20.4
2023-07-18	evening	19.8	15.4	13.0	18.0	17.8	20.3
2023-07-19	early morning	19.4	15.3	12.9	17.7	17.5	20.1
2023-07-19	late morning	19.4	15.4	13.0	17.6	17.5	20.1
2023-07-19	afternoon	19.9	15.5	13.1	18.0	18.0	20.2
2023-07-19	evening	19.8	15.4	12.9	18.0	17.8	20.1
2023-07-20	early morning	19.4	15.3	12.8	17.7	17.5	20.0
2023-07-20	late morning	19.4	15.3	12.8	17.6	17.5	19.9
2023-07-20	afternoon	19.8	15.5	12.9	18.0	17.9	20.1
2023-07-20	evening	19.8	15.4	12.8	17.9	17.7	20.0
2023-07-21	early morning	19.5	15.3	12.8	17.7	17.4	19.9
2023-07-21	late morning	19.5	15.4	12.9	17.6	17.4	19.9
2023-07-21	afternoon	19.9	15.5	13.0	17.9	17.9	20.0
2023-07-21	evening	19.8	15.4	12.9	17.9	17.6	19.9
2023-07-22	early morning	19.4	15.3	12.8	17.6	17.3	19.7
2023-07-22	late morning	19.3	15.3	12.9	17.5	17.3	19.6
2023-07-22	afternoon	19.8	15.5	13.0	17.8	17.7	19.8
2023-07-22	evening	19.7	15.4	12.9	17.8	17.5	19.7
2023-07-23	early morning	19.3	15.2	12.7	17.5	17.1	19.6
2023-07-23	late morning	19.3	15.3	12.8	17.4	17.1	19.5
2023-07-23	afternoon	19.7	15.5	12.9	17.8	17.6	19.7
2023-07-23	evening	19.7	15.4	12.8	17.8	17.4	19.6
2023-07-24	early morning	19.3	15.2	12.7	17.5	17.1	19.4
2023-07-24	late morning	19.2	15.2	12.8	17.4	17.1	19.3
2023-07-24	afternoon	19.5	15.4	12.8	17.6	17.4	19.5
2023-07-24	evening	19.4	15.3	12.7	17.5	17.2	19.4
2023-07-25	early morning	19.2	15.2	12.6	17.3	17.0	19.3

day	period	T5P4_S1	T5P7_S2	T5P10_S3	T6P1_S1	T6P4_S2	T6P7_S3
2023-07-25	late morning	19.1	15.2	12.6	17.2	17.0	19.3
2023-07-25	afternoon	19.4	15.3	12.7	17.5	17.3	19.4
2023-07-25	evening	19.3	15.2	12.6	17.5	17.1	19.3
2023-07-26	early morning	19.0	15.1	12.6	17.2	16.8	19.2
2023-07-26	late morning	19.0	15.1	12.7	17.1	16.9	19.1
2023-07-26	afternoon	19.4	15.4	12.7	17.5	17.4	19.3
2023-07-26	evening	19.3	15.3	12.6	17.5	17.2	19.2
2023-07-27	early morning	19.0	15.1	12.5	17.3	16.9	19.1
2023-07-27	late morning	18.9	15.2	12.7	17.2	16.9	19.1
2023-07-27	afternoon	19.3	15.3	12.7	17.4	17.3	19.3
2023-07-27	evening	19.1	15.2	12.6	17.3	17.0	19.2
2023-07-28	early morning	18.9	15.1	12.7	17.1	16.8	19.0
2023-07-28	late morning	18.9	15.1	12.8	17.1	16.8	19.0
2023-07-28	afternoon	19.3	15.3	12.7	17.4	17.3	19.2
2023-07-28	evening	19.2	15.2	12.6	17.4	17.1	19.1
2023-07-29	early morning	18.9	15.1	12.5	17.2	16.7	18.8
2023-07-29	late morning	18.9	15.1	12.8	17.1	16.8	18.8
2023-07-29	afternoon	19.3	15.4	14.0	17.4	17.3	19.0
2023-07-29	evening	19.3	15.2	12.6	17.4	17.1	19.0
2023-07-30	early morning	19.0	15.1	12.5	17.2	16.8	18.8
2023-07-30	late morning	18.9	15.1	12.5	17.1	16.8	18.8
2023-07-30	afternoon	19.3	15.3	12.7	17.4	17.2	19.0
2023-07-30	evening	19.2	15.2	12.5	17.4	17.0	18.9
2023-07-31	early morning	18.8	15.0	12.3	17.1	16.6	18.7
2023-07-31	late morning	18.8	15.0	12.8	17.0	16.6	18.6
2023-07-31	afternoon	19.2	15.3	12.5	17.3	17.2	18.8
2023-07-31	evening	19.2	15.2	12.3	17.3	16.9	18.8
2023-08-01	early morning	18.8	15.0	12.1	17.0	16.6	18.6
2023-08-01	late morning	18.8	15.0	12.3	16.9	16.6	18.5
2023-08-01	afternoon	19.2	15.3	13.0	17.3	17.1	18.8
2023-08-01	evening	19.2	15.1	12.2	17.3	16.9	18.7
2023-08-02	early morning	18.8	15.0	12.0	17.0	16.5	18.5
2023-08-02	late morning	18.7	15.0	12.2	16.9	16.5	18.4
2023-08-02	afternoon	19.2	15.3	12.4	17.3	17.1	18.7
2023-08-02	evening	19.2	15.1	12.2	17.3	16.9	18.6
2023-08-03	early morning	18.8	14.9	12.0	17.0	16.5	18.4
2023-08-03	late morning	18.7	15.0	12.2	16.8	16.5	18.4
2023-08-03	afternoon	19.2	15.2	12.5	17.2	17.0	18.6
2023-08-03	evening	19.2	15.1	12.2	17.2	16.8	18.6
2023-08-04	early morning	18.8	14.9	12.0	17.0	16.5	18.4
2023-08-04	late morning	18.8	14.9	12.1	16.8	16.5	18.3
2023-08-04	afternoon	19.1	15.2	12.3	17.2	16.9	18.5
2023-08-04	evening	19.1	15.1	12.1	17.1	16.7	18.5

day	period	T5P4_S1	T5P7_S2	T5P10_S3	T6P1_S1	T6P4_S2	T6P7_S3
2023-08-05	early morning	18.9	14.9	12.0	16.9	16.5	18.4
2023-08-05	late morning	18.8	14.9	12.0	16.8	16.5	18.3
2023-08-05	afternoon	19.0	15.1	12.2	17.0	16.8	18.4
2023-08-05	evening	19.1	15.1	12.2	17.0	16.9	18.5
2023-08-06	early morning	19.0	15.1	12.1	16.9	16.8	18.4
2023-08-06	late morning	18.9	15.1	12.2	16.9	16.8	18.5
2023-08-06	afternoon	19.2	15.3	12.5	17.2	17.1	18.7
2023-08-06	evening	19.1	15.2	12.3	17.1	16.9	18.7
2023-08-07	early morning	19.0	15.2	12.2	17.0	16.8	18.6
2023-08-07	late morning	19.2	15.4	13.2	17.2	17.1	18.7
2023-08-07	afternoon	19.6	15.8	18.8	17.7	17.7	19.1
2023-08-07	evening	19.7	15.8	19.2	17.7	17.7	19.2
2023-08-08	early morning	19.6	15.7	19.1	17.5	17.6	19.1
2023-08-08	late morning	19.5	15.7	19.0	17.4	17.5	19.0
2023-08-08	afternoon	19.8	15.9	19.4	17.8	17.8	19.3
2023-08-08	evening	19.9	15.9	19.0	17.8	17.8	19.3
2023-08-09	early morning	19.8	15.9	18.5	17.6	17.6	19.2
2023-08-09	late morning	19.7	15.9	18.7	17.5	17.5	19.1
2023-08-09	afternoon	19.9	16.0	19.3	17.8	17.8	19.2
2023-08-09	evening	20.0	16.0	18.4	17.8	17.7	19.2
2023-08-10	early morning	20.0	16.1	19.0	17.6	17.4	19.1
2023-08-10	late morning	20.0	16.1	18.9	17.5	17.4	19.0
2023-08-10	afternoon	20.0	16.1	18.9	17.8	17.8	19.2
2023-08-10	evening	20.1	16.1	18.8	17.8	17.7	19.1
2023-08-11	early morning	20.1	16.2	18.7	17.6	17.4	19.0
2023-08-11	late morning	20.1	16.2	18.6	17.5	17.4	18.9
2023-08-11	afternoon	20.1	16.2	18.5	17.9	17.8	19.1
2023-08-11	evening	20.1	16.2	18.4	17.9	17.6	19.0
2023-08-12	early morning	20.2	16.2	18.3	17.7	17.4	18.9
2023-08-12	late morning	20.2	16.2	18.2	17.6	17.4	18.8
2023-08-12	afternoon	20.2	16.2	18.1	17.9	17.8	19.0
2023-08-12	evening	20.2	16.2	17.9	17.9	17.7	18.9
2023-08-13	early morning	20.2	16.2	17.8	17.7	17.4	18.8
2023-08-13	late morning	20.2	16.2	17.7	17.6	17.4	18.7
2023-08-13	afternoon	20.2	16.2	17.5	17.9	17.8	18.9
2023-08-13	evening	20.2	16.1	17.4	17.9	17.6	18.8
2023-08-14	early morning	20.2	16.1	17.3	17.6	17.3	18.6
2023-08-14	late morning	20.2	16.1	17.1	17.5	17.3	18.6
2023-08-14	afternoon	20.2	16.1	17.0	17.9	17.8	18.8
2023-08-14	evening	20.2	16.1	16.8	17.9	17.6	18.7
2023-08-15	early morning	20.2	16.0	16.7	17.6	17.3	18.6
2023-08-15	late morning	20.2	16.0	16.5	17.5	17.3	18.5
2023-08-15	afternoon	20.2	16.0	16.3	17.9	17.7	18.7

day	period	T5P4_S1	T5P7_S2	T5P10_S3	T6P1_S1	T6P4_S2	T6P7_S3
2023-08-15	evening	20.2	16.0	16.2	17.9	17.6	18.7
2023-08-16	early morning	20.2	15.9	16.0	17.6	17.2	18.5
2023-08-16	late morning	20.2	15.9	15.9	17.5	17.2	18.4
2023-08-16	afternoon	20.2	15.9	15.7	17.8	17.6	18.6
2023-08-16	evening	20.1	15.8	15.6	17.8	17.5	18.6
2023-08-17	early morning	20.1	15.8	15.4	17.5	17.1	18.4
2023-08-17	late morning	20.1	15.8	15.2	17.4	17.1	18.3
2023-08-17	afternoon	20.1	15.7	15.1	17.7	17.5	18.5
2023-08-17	evening	20.1	15.7	14.9	17.6	17.3	18.5
2023-08-18	early morning	20.1	15.7	14.8	17.4	17.0	18.3
2023-08-18	late morning	20.0	15.6	14.6	17.3	17.0	18.2
2023-08-18	afternoon	20.0	15.6	14.5	17.6	17.4	18.4
2023-08-18	evening	20.0	15.6	14.3	17.6	17.2	18.3
2023-08-19	early morning	20.0	15.5	14.2	17.3	16.8	18.4
2023-08-19	late morning	20.0	15.5	14.1	17.2	16.8	18.3
2023-08-19	afternoon	19.9	15.5	13.9	17.4	17.2	18.3
2023-08-19	evening	19.9	15.4	13.8	17.3	17.0	18.2
2023-08-20	early morning	19.9	15.4	13.7	17.1	16.7	18.2
2023-08-20	late morning	19.9	15.4	13.6	17.0	16.7	18.1
2023-08-20	afternoon	19.8	15.4	13.4	17.3	17.1	18.2
2023-08-20	evening	19.8	15.3	13.3	17.2	16.9	18.2
2023-08-21	early morning	19.8	15.3	13.2	17.0	16.7	18.1
2023-08-21	late morning	19.8	15.3	13.1	16.9	16.6	18.1
2023-08-21	afternoon	19.8	15.2	13.0	17.2	17.0	18.2
2023-08-21	evening	19.7	15.2	13.0	17.2	16.9	18.2
2023-08-22	early morning	19.7	15.2	12.9	17.0	16.7	18.1
2023-08-22	late morning	19.7	15.2	12.8	16.9	16.7	18.1
2023-08-22	afternoon	19.7	15.2	12.7	17.3	17.2	18.3
2023-08-22	evening	19.6	15.2	12.7	17.3	17.0	18.3
2023-08-23	early morning	19.6	15.1	12.6	17.0	16.6	18.2
2023-08-23	late morning	19.6	15.1	12.6	16.9	16.6	18.1
2023-08-23	afternoon	19.6	15.1	12.6	17.2	17.0	18.3
2023-08-23	evening	19.6	15.1	12.5	17.1	16.8	18.2
2023-08-24	early morning	19.5	15.1	12.5	16.9	16.5	18.0
2023-08-24	late morning	19.4	15.2	12.7	16.8	16.6	18.2
2023-08-24	afternoon	19.6	15.2	12.4	17.2	17.0	18.0
2023-08-24	evening	19.6	15.1	12.5	17.2	16.8	17.9
2023-08-25	early morning	19.4	15.0	12.5	16.9	16.6	17.7
2023-08-25	late morning	19.3	15.0	12.5	16.8	16.6	17.7
2023-08-25	afternoon	19.5	15.2	12.6	17.1	16.9	17.9
2023-08-25	evening	19.5	15.2	12.5	17.1	16.8	17.9
2023-08-26	early morning	19.3	15.1	12.4	16.9	16.5	17.8
2023-08-26	late morning	19.3	15.1	12.5	16.8	16.6	17.7

day	period	T5P4_S1	T5P7_S2	T5P10_S3	T6P1_S1	T6P4_S2	T6P7_S3
2023-08-26	afternoon	19.6	15.4	12.6	17.1	17.1	18.0
2023-08-26	evening	19.6	15.3	12.4	NA	16.9	18.0
2023-08-27	early morning	19.3	15.2	12.3	NA	16.5	17.8
2023-08-27	late morning	19.3	15.2	12.4	NA	16.6	17.7
2023-08-27	afternoon	19.7	15.4	12.5	NA	17.1	18.0
2023-08-27	evening	19.6	15.3	12.3	NA	16.9	17.9
2023-08-28	early morning	19.4	15.1	12.2	NA	16.5	17.8
2023-08-28	late morning	19.3	15.1	12.2	NA	16.6	17.7
2023-08-28	afternoon	19.7	15.4	12.4	NA	17.0	18.0
2023-08-28	evening	19.6	15.2	12.2	NA	16.8	17.9
2023-08-29	early morning	19.6	15.2	12.1	NA	16.7	17.8
2023-08-29	late morning	19.9	15.4	12.2	NA	16.8	17.8
2023-08-29	afternoon	19.9	15.4	12.2	NA	16.9	17.9
2023-08-29	evening	19.9	15.4	12.2	NA	16.8	17.9
2023-08-30	early morning	20.0	15.7	12.2	NA	17.0	17.9
2023-08-30	late morning	19.9	15.6	12.3	NA	17.0	17.9
2023-08-30	afternoon	20.1	15.7	12.4	NA	17.2	18.2
2023-08-30	evening	19.6	15.7	12.3	NA	17.0	18.1
2023-08-31	early morning	19.2	15.6	12.3	NA	16.9	18.0
2023-08-31	late morning	19.1	15.5	12.3	NA	16.9	17.9
2023-08-31	afternoon	19.2	15.6	12.3	NA	17.0	18.1
2023-08-31	evening	19.1	15.5	12.2	NA	16.9	18.0

Table H.2 Percent soil moisture (VWC) for sensors from transects 7 and 9.

day	period	T7P3_S1	T7P6_S2	T7P9_S3	T9P2_S1	T9P5_S2	T9P8_S3
2023-05-13	late morning	37.1	32.6	24.9	NA	NA	NA
2023-05-13	afternoon	37.3	32.6	25.1	NA	NA	NA
2023-05-13	evening	37.0	32.5	25.1	NA	NA	NA
2023-05-14	early morning	36.8	32.5	25.1	NA	NA	NA
2023-05-14	late morning	36.8	32.5	25.2	NA	NA	NA
2023-05-14	afternoon	37.0	32.4	25.3	NA	NA	NA
2023-05-14	evening	36.7	32.2	25.2	NA	NA	NA
2023-05-15	early morning	36.5	32.2	25.2	NA	NA	NA
2023-05-15	late morning	36.5	32.2	25.2	NA	NA	NA
2023-05-15	afternoon	36.7	32.0	25.3	NA	NA	NA
2023-05-15	evening	36.4	31.8	25.2	NA	NA	NA
2023-05-16	early morning	36.2	31.7	25.1	NA	NA	NA
2023-05-16	late morning	36.1	31.6	25.1	NA	NA	NA
2023-05-16	afternoon	36.3	31.5	25.2	NA	NA	NA
2023-05-16	evening	36.1	31.4	25.0	NA	NA	NA
2023-05-17	early morning	35.9	31.3	24.6	NA	NA	NA
2023-05-17	late morning	35.9	31.0	24.6	NA	NA	NA

day	period	T7P3_S1	T7P6_S2	T7P9_S3	T9P2_S1	T9P5_S2	T9P8_S3
2023-05-17	afternoon	36.1	30.9	24.7	NA	NA	NA
2023-05-17	evening	35.9	30.8	24.6	NA	NA	NA
2023-05-18	early morning	35.6	30.6	24.4	NA	NA	NA
2023-05-18	late morning	35.5	30.4	24.3	NA	NA	NA
2023-05-18	afternoon	35.0	30.2	24.6	NA	NA	NA
2023-05-18	evening	34.8	30.1	24.5	NA	NA	NA
2023-05-19	early morning	34.6	30.0	24.5	NA	NA	NA
2023-05-19	late morning	34.5	29.9	24.4	NA	NA	NA
2023-05-19	afternoon	34.6	29.7	24.4	NA	NA	NA
2023-05-19	evening	34.5	29.6	24.3	NA	NA	NA
2023-05-20	early morning	34.4	29.6	24.3	NA	NA	NA
2023-05-20	late morning	34.3	29.6	24.2	NA	NA	NA
2023-05-20	afternoon	34.3	29.4	24.2	NA	NA	NA
2023-05-20	evening	34.1	29.1	24.1	NA	NA	NA
2023-05-21	early morning	33.9	29.0	24.0	NA	NA	NA
2023-05-21	late morning	33.8	28.9	24.0	NA	NA	NA
2023-05-21	afternoon	33.7	28.7	23.9	NA	NA	NA
2023-05-21	evening	33.3	28.4	23.9	NA	NA	NA
2023-05-22	early morning	33.0	28.4	23.8	NA	NA	NA
2023-05-22	late morning	32.8	28.3	23.8	NA	NA	NA
2023-05-22	afternoon	32.8	28.0	23.7	NA	NA	NA
2023-05-22	evening	32.5	27.8	23.6	NA	NA	NA
2023-05-23	early morning	32.2	27.8	23.6	NA	NA	NA
2023-05-23	late morning	32.1	27.7	23.5	NA	NA	NA
2023-05-23	afternoon	32.1	27.5	23.4	NA	NA	NA
2023-05-23	evening	31.9	27.3	23.4	NA	NA	NA
2023-05-24	early morning	31.7	27.3	23.3	NA	NA	NA
2023-05-24	late morning	31.7	27.3	23.2	NA	NA	NA
2023-05-24	afternoon	31.6	27.0	23.2	NA	NA	NA
2023-05-24	evening	31.3	26.8	23.1	NA	NA	NA
2023-05-25	early morning	31.1	26.8	23.0	NA	NA	NA
2023-05-25	late morning	31.0	26.8	23.0	NA	NA	NA
2023-05-25	afternoon	30.9	26.6	22.9	NA	NA	NA
2023-05-25	evening	30.7	26.4	22.8	NA	NA	NA
2023-05-26	early morning	30.6	26.4	22.7	NA	NA	NA
2023-05-26	late morning	30.5	26.4	22.7	NA	NA	NA
2023-05-26	afternoon	30.5	26.1	22.6	NA	NA	NA
2023-05-26	evening	30.0	25.9	22.5	NA	NA	NA
2023-05-27	early morning	29.6	25.9	22.4	NA	NA	NA
2023-05-27	late morning	29.4	25.8	22.4	NA	NA	NA
2023-05-27	afternoon	29.2	25.5	22.3	NA	NA	NA
2023-05-27	evening	28.9	25.3	22.2	NA	NA	NA
2023-05-28	early morning	28.3	25.2	22.1	NA	NA	NA
2023-05-28	late morning	28.2	25.2	22.0	NA	NA	NA
2023-05-28	afternoon	28.0	24.9	22.0	NA	NA	NA
2023-05-28	evening	27.5	24.6	21.9	NA	NA	NA
2023-05-29	early morning	27.1	24.6	21.8	NA	NA	NA
2023-05-29	late morning	27.0	24.6	21.7	NA	NA	NA

day	period	T7P3_S1	T7P6_S2	T7P9_S3	T9P2_S1	T9P5_S2	T9P8_S3
2023-05-29	afternoon	26.8	24.3	21.6	NA	NA	NA
2023-05-29	evening	26.3	24.0	21.5	NA	NA	NA
2023-05-30	early morning	26.1	24.0	21.4	NA	NA	NA
2023-05-30	late morning	26.0	24.0	21.4	NA	NA	NA
2023-05-30	afternoon	26.0	23.7	21.3	NA	NA	NA
2023-05-30	evening	25.8	23.4	21.2	NA	NA	NA
2023-05-31	early morning	25.7	23.5	21.1	NA	NA	NA
2023-05-31	late morning	25.6	23.5	21.0	NA	NA	NA
2023-05-31	afternoon	25.4	23.2	20.9	NA	NA	NA
2023-05-31	evening	25.1	23.0	20.8	NA	NA	NA
2023-06-01	early morning	24.9	23.1	20.7	NA	NA	NA
2023-06-01	late morning	24.9	23.1	20.6	NA	NA	NA
2023-06-01	afternoon	24.8	22.8	20.5	NA	NA	NA
2023-06-01	evening	24.5	22.7	20.4	NA	NA	NA
2023-06-02	early morning	24.3	22.7	20.3	NA	NA	NA
2023-06-02	late morning	24.2	22.7	20.2	NA	NA	NA
2023-06-02	afternoon	24.2	22.4	20.1	NA	NA	NA
2023-06-02	evening	23.9	22.3	20.0	NA	NA	NA
2023-06-03	early morning	23.7	22.3	19.9	NA	NA	NA
2023-06-03	late morning	23.7	22.3	19.7	NA	NA	NA
2023-06-03	afternoon	23.6	22.1	19.7	42.6	44.8	35.3
2023-06-03	evening	23.3	21.9	19.6	42.4	44.8	35.2
2023-06-04	early morning	23.2	21.9	19.5	42.2	44.8	35.0
2023-06-04	late morning	23.1	21.9	19.4	42.3	44.9	35.1
2023-06-04	afternoon	23.1	21.7	19.5	42.4	44.9	35.2
2023-06-04	evening	22.8	21.6	19.3	42.2	44.8	34.9
2023-06-05	early morning	22.6	21.6	19.1	42.0	44.8	34.6
2023-06-05	late morning	22.6	21.6	19.1	42.1	44.9	34.6
2023-06-05	afternoon	22.6	21.4	19.2	42.3	44.8	34.8
2023-06-05	evening	22.3	21.3	19.0	42.0	44.7	34.4
2023-06-06	early morning	22.2	21.3	18.8	41.8	44.7	34.0
2023-06-06	late morning	22.1	21.3	18.8	42.0	44.8	34.1
2023-06-06	afternoon	22.2	21.2	18.8	42.1	44.6	34.2
2023-06-06	evening	22.0	21.1	18.7	41.9	44.5	33.8
2023-06-07	early morning	21.8	21.1	18.5	41.6	44.5	33.4
2023-06-07	late morning	21.8	21.1	18.5	41.8	44.5	33.3
2023-06-07	afternoon	21.9	20.9	18.6	41.9	44.4	33.5
2023-06-07	evening	21.7	20.8	18.4	41.5	44.2	33.2
2023-06-08	early morning	21.5	20.8	18.3	41.3	44.2	32.8
2023-06-08	late morning	21.5	20.8	18.3	41.3	44.3	32.8
2023-06-08	afternoon	21.6	20.7	18.3	40.9	44.1	32.8
2023-06-08	evening	21.5	20.7	18.2	40.6	43.9	32.5
2023-06-09	early morning	21.5	20.6	18.2	40.5	43.9	32.4
2023-06-09	late morning	21.5	20.6	18.2	40.5	44.0	32.3
2023-06-09	afternoon	21.6	20.7	18.3	40.7	44.1	32.6
2023-06-09	evening	21.7	20.8	18.4	40.7	44.3	32.6
2023-06-10	early morning	21.7	20.8	18.3	40.8	44.4	32.5
2023-06-10	late morning	21.7	20.8	18.3	40.8	44.6	32.5

day	period	T7P3_S1	T7P6_S2	T7P9_S3	T9P2_S1	T9P5_S2	T9P8_S3
2023-06-10	afternoon	21.7	20.8	18.3	40.9	44.7	32.5
2023-06-10	evening	21.7	20.7	18.3	40.8	44.8	32.4
2023-06-11	early morning	21.6	20.7	18.2	40.7	44.8	32.3
2023-06-11	late morning	21.6	20.7	18.2	40.9	44.9	32.3
2023-06-11	afternoon	21.8	20.7	18.3	41.1	44.8	32.5
2023-06-11	evening	21.7	20.6	18.3	40.9	44.7	32.3
2023-06-12	early morning	21.6	20.6	18.1	40.8	44.7	32.1
2023-06-12	late morning	21.5	20.6	18.1	40.9	44.8	32.0
2023-06-12	afternoon	21.7	20.6	18.2	41.0	44.6	32.1
2023-06-12	evening	21.6	20.5	18.1	40.9	44.4	32.0
2023-06-13	early morning	21.4	20.5	18.0	40.7	44.4	31.6
2023-06-13	late morning	21.4	20.5	17.9	40.7	44.4	31.5
2023-06-13	afternoon	21.5	20.4	18.0	40.7	44.3	31.6
2023-06-13	evening	21.3	20.3	17.8	40.4	44.0	31.3
2023-06-14	early morning	21.2	20.3	17.7	40.1	44.0	30.9
2023-06-14	late morning	21.1	20.3	17.2	40.0	44.0	30.8
2023-06-14	afternoon	21.3	20.2	17.0	39.9	43.8	30.9
2023-06-14	evening	21.1	20.2	16.9	39.6	43.7	30.6
2023-06-15	early morning	21.0	20.2	16.8	39.4	43.6	30.3
2023-06-15	late morning	20.9	20.2	16.7	39.5	43.4	30.2
2023-06-15	afternoon	21.1	20.1	16.8	39.5	43.3	30.3
2023-06-15	evening	20.9	20.1	16.7	39.3	43.1	30.1
2023-06-16	early morning	20.8	20.1	16.6	39.0	43.1	29.8
2023-06-16	late morning	20.8	20.1	16.6	39.1	43.1	29.7
2023-06-16	afternoon	20.9	20.0	16.7	39.1	42.9	29.7
2023-06-16	evening	20.8	20.0	16.6	38.9	42.7	29.5
2023-06-17	early morning	20.7	20.0	16.5	38.8	42.7	29.2
2023-06-17	late morning	20.6	20.0	16.4	38.8	42.7	29.1
2023-06-17	afternoon	20.8	19.9	16.5	38.8	42.4	29.2
2023-06-17	evening	20.6	19.9	16.4	38.5	42.3	28.8
2023-06-18	early morning	20.5	19.9	16.3	38.4	42.3	28.6
2023-06-18	late morning	20.5	19.9	16.3	38.4	42.3	28.5
2023-06-18	afternoon	20.5	19.8	16.3	38.4	42.2	28.4
2023-06-18	evening	20.4	19.8	16.2	38.2	42.1	28.2
2023-06-19	early morning	20.3	19.8	16.1	38.1	42.1	27.9
2023-06-19	late morning	20.3	19.8	16.1	38.2	42.1	27.9
2023-06-19	afternoon	20.5	19.8	16.2	38.3	42.0	28.0
2023-06-19	evening	20.3	19.8	16.1	38.1	41.8	27.7
2023-06-20	early morning	20.2	19.8	16.0	38.0	41.8	27.5
2023-06-20	late morning	20.2	19.8	16.0	38.0	41.9	27.4
2023-06-20	afternoon	20.3	19.8	16.1	38.1	41.8	27.4
2023-06-20	evening	20.3	19.8	16.0	37.9	41.6	27.2
2023-06-21	early morning	20.2	19.8	16.1	37.8	41.6	27.0
2023-06-21	late morning	20.2	19.8	16.1	37.9	41.7	27.0
2023-06-21	afternoon	20.3	19.7	16.2	37.9	41.5	27.0
2023-06-21	evening	20.2	19.7	16.2	37.1	41.4	26.8
2023-06-22	early morning	20.1	19.7	16.1	36.5	41.4	26.6
2023-06-22	late morning	20.1	19.7	16.1	36.5	41.4	26.6

day	period	T7P3_S1	T7P6_S2	T7P9_S3	T9P2_S1	T9P5_S2	T9P8_S3
2023-06-22	afternoon	20.3	19.7	16.2	36.5	41.2	26.6
2023-06-22	evening	20.1	19.6	15.5	36.3	41.1	26.4
2023-06-23	early morning	19.9	19.6	14.3	36.2	41.1	26.1
2023-06-23	late morning	19.8	19.7	14.4	36.2	41.1	26.1
2023-06-23	afternoon	20.0	19.6	14.5	36.2	40.9	26.2
2023-06-23	evening	19.9	19.6	14.4	36.1	40.8	26.0
2023-06-24	early morning	19.8	19.6	14.3	35.9	40.8	25.7
2023-06-24	late morning	19.8	19.6	14.3	36.0	40.8	25.7
2023-06-24	afternoon	20.0	19.5	14.4	35.9	40.4	25.7
2023-06-24	evening	19.9	19.5	14.3	35.6	40.1	25.4
2023-06-25	early morning	19.7	19.5	14.2	35.4	40.0	25.2
2023-06-25	late morning	19.8	19.5	14.2	35.5	40.0	25.1
2023-06-25	afternoon	19.9	19.4	14.4	35.4	39.7	25.2
2023-06-25	evening	19.8	19.4	14.3	35.1	39.4	24.9
2023-06-26	early morning	19.7	19.4	14.1	35.0	39.3	24.6
2023-06-26	late morning	19.7	19.4	14.2	35.0	39.4	24.6
2023-06-26	afternoon	19.9	19.3	14.3	34.9	39.0	24.6
2023-06-26	evening	19.8	19.3	14.2	34.5	38.6	24.3
2023-06-27	early morning	19.7	19.3	14.1	34.3	38.4	24.1
2023-06-27	late morning	19.7	19.2	14.2	34.2	38.4	24.0
2023-06-27	afternoon	19.9	19.2	14.3	34.1	38.0	24.0
2023-06-27	evening	19.9	19.2	14.5	34.1	37.9	23.9
2023-06-28	early morning	19.7	19.2	14.4	34.0	37.9	23.8
2023-06-28	late morning	19.7	19.2	14.4	34.0	38.0	23.7
2023-06-28	afternoon	19.9	19.2	14.5	34.0	37.7	23.8
2023-06-28	evening	19.8	19.1	14.4	33.7	37.2	23.6
2023-06-29	early morning	19.7	19.1	14.3	33.5	37.0	23.4
2023-06-29	late morning	19.7	19.1	14.3	33.5	36.8	23.3
2023-06-29	afternoon	19.8	19.0	14.5	33.2	36.3	23.3
2023-06-29	evening	19.7	19.0	14.4	32.9	35.8	23.0
2023-06-30	early morning	19.5	18.9	14.2	32.6	35.6	22.7
2023-06-30	late morning	19.5	18.9	14.3	32.5	35.4	22.7
2023-06-30	afternoon	19.7	18.9	14.4	32.3	34.9	22.7
2023-06-30	evening	19.6	18.9	14.3	31.9	34.3	22.4
2023-07-01	early morning	19.4	18.8	14.1	31.5	34.1	22.1
2023-07-01	late morning	19.3	18.8	14.1	31.4	34.0	22.1
2023-07-01	afternoon	19.5	18.7	14.3	31.2	33.5	22.0
2023-07-01	evening	19.4	18.7	14.1	30.9	33.0	21.7
2023-07-02	early morning	19.2	18.6	14.0	30.6	32.8	21.5
2023-07-02	late morning	19.2	18.6	14.0	30.5	32.7	21.5
2023-07-02	afternoon	19.4	18.6	14.2	30.3	32.3	21.5
2023-07-02	evening	19.2	18.6	14.1	29.9	31.9	21.2
2023-07-03	early morning	18.8	18.5	13.9	29.6	31.7	20.9
2023-07-03	late morning	18.7	18.5	13.9	29.6	31.7	20.9
2023-07-03	afternoon	18.9	18.5	14.1	29.4	31.2	21.0
2023-07-03	evening	18.8	18.4	14.0	29.0	30.8	20.7
2023-07-04	early morning	18.6	18.4	13.8	28.8	30.7	20.5
2023-07-04	late morning	18.6	18.4	13.8	28.7	30.7	20.5

day	period	T7P3_S1	T7P6_S2	T7P9_S3	T9P2_S1	T9P5_S2	T9P8_S3
2023-07-04	afternoon	18.8	18.3	14.0	28.5	30.2	20.5
2023-07-04	evening	18.7	18.3	13.9	28.2	29.8	20.3
2023-07-05	early morning	18.5	18.2	13.8	28.0	29.7	20.1
2023-07-05	late morning	18.5	18.2	13.8	28.0	29.6	20.1
2023-07-05	afternoon	18.6	18.3	15.4	27.9	29.2	20.1
2023-07-05	evening	18.6	18.2	15.5	27.6	28.8	19.9
2023-07-06	early morning	18.4	18.2	15.4	27.3	28.7	19.7
2023-07-06	late morning	18.4	18.2	15.4	27.3	28.6	19.7
2023-07-06	afternoon	18.6	18.2	15.6	27.1	28.0	19.9
2023-07-06	evening	18.6	18.2	15.5	26.8	27.5	19.7
2023-07-07	early morning	18.4	18.1	15.4	26.7	27.4	19.5
2023-07-07	late morning	18.4	18.1	15.4	26.6	27.3	19.5
2023-07-07	afternoon	18.6	18.1	15.5	26.6	26.8	19.6
2023-07-07	evening	18.5	18.1	15.4	26.3	26.3	19.4
2023-07-08	early morning	18.3	18.0	15.3	26.1	26.2	19.2
2023-07-08	late morning	18.3	18.0	15.3	26.1	26.2	19.2
2023-07-08	afternoon	18.6	18.0	15.4	26.0	25.6	19.4
2023-07-08	evening	18.5	18.0	15.4	25.8	25.1	19.2
2023-07-09	early morning	18.3	17.9	15.2	25.6	25.0	19.0
2023-07-09	late morning	18.2	17.8	15.2	25.5	24.9	19.0
2023-07-09	afternoon	18.3	17.9	15.3	25.5	24.6	19.0
2023-07-09	evening	18.3	17.8	15.3	25.4	24.2	19.0
2023-07-10	early morning	18.2	17.8	15.2	25.3	24.2	18.8
2023-07-10	late morning	18.2	17.8	15.2	25.2	24.2	18.9
2023-07-10	afternoon	18.4	17.8	15.3	25.3	23.9	19.0
2023-07-10	evening	18.3	17.8	15.2	25.2	23.7	19.0
2023-07-11	early morning	18.2	17.7	15.1	25.1	23.7	18.8
2023-07-11	late morning	18.1	17.7	15.1	25.2	23.7	18.8
2023-07-11	afternoon	18.4	17.8	15.3	25.2	23.3	19.0
2023-07-11	evening	18.3	17.8	15.2	25.1	23.0	18.9
2023-07-12	early morning	18.1	17.7	15.1	25.0	22.9	18.7
2023-07-12	late morning	18.1	17.7	15.1	24.5	22.9	18.7
2023-07-12	afternoon	18.3	17.7	15.2	24.6	22.5	18.9
2023-07-12	evening	18.2	17.7	15.2	24.4	22.2	18.7
2023-07-13	early morning	18.0	17.6	15.0	24.3	22.1	18.5
2023-07-13	late morning	18.0	17.6	15.0	24.3	22.1	18.5
2023-07-13	afternoon	18.3	17.6	15.2	24.3	21.7	18.7
2023-07-13	evening	18.2	17.6	15.1	24.1	21.3	18.6
2023-07-14	early morning	17.9	17.5	15.0	24.0	21.2	18.3
2023-07-14	late morning	17.9	17.5	15.0	24.0	21.2	18.0
2023-07-14	afternoon	18.2	17.6	15.2	24.0	20.9	17.9
2023-07-14	evening	18.1	17.6	15.1	23.9	20.6	17.7
2023-07-15	early morning	17.9	17.4	14.9	23.7	20.4	17.4
2023-07-15	late morning	17.8	17.4	14.9	23.7	20.4	17.4
2023-07-15	afternoon	18.1	17.5	15.1	23.7	20.2	17.7
2023-07-15	evening	18.0	17.5	15.0	23.6	19.8	17.5
2023-07-16	early morning	17.8	17.4	14.8	23.5	19.7	17.2
2023-07-16	late morning	17.7	17.3	14.8	23.5	19.6	17.2

day	period	T7P3_S1	T7P6_S2	T7P9_S3	T9P2_S1	T9P5_S2	T9P8_S3
2023-07-16	afternoon	18.0	17.4	15.0	23.5	19.4	17.5
2023-07-16	evening	17.9	17.4	15.0	23.4	19.1	17.3
2023-07-17	early morning	17.7	17.3	14.8	23.2	19.0	17.1
2023-07-17	late morning	17.7	17.2	14.8	23.2	18.9	17.1
2023-07-17	afternoon	17.9	17.3	14.9	23.2	18.8	17.3
2023-07-17	evening	17.8	17.3	14.8	23.1	18.6	17.1
2023-07-18	early morning	17.5	17.2	14.7	22.9	18.5	16.8
2023-07-18	late morning	17.5	17.1	14.6	22.9	18.4	16.9
2023-07-18	afternoon	17.8	17.2	14.8	23.0	18.4	17.1
2023-07-18	evening	17.7	17.2	14.7	22.9	18.1	16.9
2023-07-19	early morning	17.5	17.1	14.6	22.7	18.0	16.7
2023-07-19	late morning	17.4	17.1	14.6	22.8	18.0	16.7
2023-07-19	afternoon	17.8	17.2	14.8	22.8	17.9	17.0
2023-07-19	evening	17.6	17.2	14.7	22.7	17.7	16.8
2023-07-20	early morning	17.4	17.0	14.6	22.5	17.6	16.6
2023-07-20	late morning	17.4	17.0	14.6	22.6	17.6	16.6
2023-07-20	afternoon	17.7	17.1	14.8	22.6	17.5	16.9
2023-07-20	evening	17.6	17.1	14.7	22.5	17.4	16.7
2023-07-21	early morning	17.4	17.0	14.6	22.4	17.3	16.5
2023-07-21	late morning	17.3	17.0	14.6	22.4	17.2	16.5
2023-07-21	afternoon	17.6	17.0	14.8	22.5	17.2	16.8
2023-07-21	evening	17.5	17.0	14.6	22.3	17.0	16.6
2023-07-22	early morning	17.2	16.9	14.4	22.1	16.9	16.3
2023-07-22	late morning	17.1	16.8	14.4	22.1	16.8	16.3
2023-07-22	afternoon	17.4	16.9	14.6	22.2	16.8	16.6
2023-07-22	evening	17.3	16.9	14.6	22.1	16.7	16.4
2023-07-23	early morning	17.0	16.8	14.4	22.0	16.6	16.2
2023-07-23	late morning	17.0	16.8	14.4	22.0	16.5	16.2
2023-07-23	afternoon	17.3	16.9	14.6	22.1	16.5	16.5
2023-07-23	evening	17.2	16.9	14.5	21.9	16.4	16.3
2023-07-24	early morning	16.9	16.7	14.3	21.8	16.3	16.1
2023-07-24	late morning	16.9	16.7	14.3	21.8	16.3	16.1
2023-07-24	afternoon	17.1	16.8	14.4	21.9	16.3	16.3
2023-07-24	evening	17.0	16.8	14.4	21.8	16.2	16.2
2023-07-25	early morning	16.8	16.7	14.2	21.7	16.1	16.0
2023-07-25	late morning	16.7	16.6	14.2	21.7	16.1	15.9
2023-07-25	afternoon	16.9	16.7	14.3	21.7	16.1	16.2
2023-07-25	evening	16.8	16.7	14.3	21.6	16.1	16.0
2023-07-26	early morning	16.5	16.6	14.1	21.5	16.0	15.7
2023-07-26	late morning	16.5	16.5	14.1	21.5	15.9	15.8
2023-07-26	afternoon	16.8	16.6	14.3	21.6	16.0	16.1
2023-07-26	evening	16.7	16.7	14.3	21.5	15.9	16.0
2023-07-27	early morning	16.5	16.5	14.1	21.4	15.8	15.7
2023-07-27	late morning	16.5	16.5	14.1	21.4	15.8	15.8
2023-07-27	afternoon	16.7	16.6	14.2	21.5	15.8	16.0
2023-07-27	evening	16.6	16.6	14.2	21.4	15.8	15.8
2023-07-28	early morning	16.4	16.5	14.0	21.3	15.7	15.6
2023-07-28	late morning	16.4	16.5	14.1	21.1	15.7	15.7

day	period	T7P3_S1	T7P6_S2	T7P9_S3	T9P2_S1	T9P5_S2	T9P8_S3
2023-07-28	afternoon	16.7	16.6	14.3	21.2	15.8	16.0
2023-07-28	evening	16.5	16.6	14.2	21.1	15.7	15.8
2023-07-29	early morning	16.3	16.5	14.0	21.0	15.6	15.5
2023-07-29	late morning	16.3	16.4	14.0	21.0	15.6	15.6
2023-07-29	afternoon	16.6	16.6	14.3	21.1	15.6	16.0
2023-07-29	evening	16.5	16.6	14.2	21.0	15.6	15.8
2023-07-30	early morning	16.2	16.4	14.0	20.9	15.4	15.5
2023-07-30	late morning	16.2	16.4	14.0	21.0	15.4	15.6
2023-07-30	afternoon	16.4	16.5	14.2	21.0	15.5	15.8
2023-07-30	evening	16.3	16.5	14.1	20.9	15.4	15.7
2023-07-31	early morning	16.0	16.3	13.9	20.8	15.3	15.3
2023-07-31	late morning	16.0	16.3	13.9	20.8	15.2	15.4
2023-07-31	afternoon	16.3	16.4	14.1	20.9	15.3	15.7
2023-07-31	evening	16.2	16.5	14.0	20.8	15.3	15.6
2023-08-01	early morning	15.9	16.3	13.8	20.7	15.1	15.3
2023-08-01	late morning	15.9	16.3	13.8	20.7	15.1	15.3
2023-08-01	afternoon	16.2	16.4	14.1	20.8	15.2	15.7
2023-08-01	evening	16.1	16.4	14.0	20.7	15.1	15.5
2023-08-02	early morning	15.8	16.3	13.7	20.6	15.0	15.2
2023-08-02	late morning	15.8	16.2	13.7	20.7	15.0	15.3
2023-08-02	afternoon	16.1	16.4	14.0	20.8	15.1	15.6
2023-08-02	evening	16.0	16.4	13.9	20.7	15.0	15.4
2023-08-03	early morning	15.7	16.2	13.7	20.5	14.9	15.1
2023-08-03	late morning	15.7	16.2	13.7	20.6	14.9	15.2
2023-08-03	afternoon	16.0	16.3	14.0	20.7	14.9	15.6
2023-08-03	evening	15.9	16.3	13.9	20.6	14.9	15.4
2023-08-04	early morning	15.6	16.2	13.7	20.5	14.8	15.1
2023-08-04	late morning	15.6	16.2	13.7	20.5	14.7	15.2
2023-08-04	afternoon	15.9	16.3	13.9	20.6	14.8	15.5
2023-08-04	evening	15.8	16.3	13.8	20.5	14.8	15.3
2023-08-05	early morning	15.6	16.2	13.7	20.4	14.7	15.1
2023-08-05	late morning	15.6	16.1	13.7	20.4	14.7	15.1
2023-08-05	afternoon	15.8	16.2	13.9	20.5	14.8	15.4
2023-08-05	evening	15.9	16.2	14.0	20.6	14.9	15.5
2023-08-06	early morning	15.8	16.2	13.9	20.6	14.8	15.4
2023-08-06	late morning	15.8	16.2	13.9	20.6	14.8	15.4
2023-08-06	afternoon	16.0	16.3	14.1	20.7	14.9	15.7
2023-08-06	evening	15.9	16.2	14.0	20.7	14.9	15.6
2023-08-07	early morning	15.8	16.2	13.9	20.6	14.9	15.5
2023-08-07	late morning	16.4	16.3	14.6	21.6	16.4	16.3
2023-08-07	afternoon	18.2	16.5	17.1	24.4	21.4	18.5
2023-08-07	evening	18.5	16.5	17.0	24.2	21.6	18.6
2023-08-08	early morning	18.5	16.5	16.8	24.0	21.5	18.4
2023-08-08	late morning	18.5	16.5	16.7	24.0	21.5	18.5
2023-08-08	afternoon	18.8	16.6	16.7	23.9	21.2	18.7
2023-08-08	evening	18.9	16.7	16.5	23.6	21.0	18.6
2023-08-09	early morning	18.7	16.7	16.3	23.5	20.9	18.4
2023-08-09	late morning	18.7	16.6	16.3	23.5	20.9	18.4

day	period	T7P3_S1	T7P6_S2	T7P9_S3	T9P2_S1	T9P5_S2	T9P8_S3
2023-08-09	afternoon	18.8	16.8	16.2	23.4	20.6	18.6
2023-08-09	evening	18.8	16.8	16.0	23.2	20.2	18.5
2023-08-10	early morning	18.7	16.7	15.8	23.0	20.1	18.3
2023-08-10	late morning	18.6	16.7	15.8	23.0	20.1	18.3
2023-08-10	afternoon	18.8	16.8	15.8	22.9	19.7	18.5
2023-08-10	evening	18.7	16.8	15.7	22.7	19.4	18.3
2023-08-11	early morning	18.6	16.7	15.5	22.6	19.3	18.1
2023-08-11	late morning	18.5	16.7	15.5	22.5	19.2	18.1
2023-08-11	afternoon	18.7	16.8	15.5	22.5	18.8	18.3
2023-08-11	evening	18.6	16.8	15.4	22.3	18.4	18.1
2023-08-12	early morning	18.5	16.7	15.3	22.2	18.2	18.0
2023-08-12	late morning	18.4	16.7	15.2	22.1	18.1	18.0
2023-08-12	afternoon	18.6	16.8	15.3	22.1	17.8	18.1
2023-08-12	evening	18.6	16.8	15.2	21.9	17.4	18.0
2023-08-13	early morning	18.4	16.7	15.1	21.8	17.3	17.8
2023-08-13	late morning	18.3	16.7	15.0	21.8	17.2	17.8
2023-08-13	afternoon	18.5	16.8	15.2	21.8	16.9	18.0
2023-08-13	evening	18.5	16.8	15.1	21.6	16.7	17.8
2023-08-14	early morning	18.3	16.7	14.9	21.5	16.5	17.5
2023-08-14	late morning	18.2	16.7	14.9	21.5	16.4	17.6
2023-08-14	afternoon	18.5	16.8	15.0	21.6	16.3	17.8
2023-08-14	evening	18.4	16.8	14.9	21.4	16.1	17.6
2023-08-15	early morning	18.2	16.7	14.7	21.3	16.0	17.3
2023-08-15	late morning	18.2	16.7	14.7	21.3	15.9	17.4
2023-08-15	afternoon	18.4	16.8	14.9	21.4	15.8	17.6
2023-08-15	evening	18.4	16.8	14.8	21.3	15.6	17.4
2023-08-16	early morning	18.1	16.7	14.6	21.1	15.5	17.1
2023-08-16	late morning	18.1	16.6	14.5	21.1	15.4	17.1
2023-08-16	afternoon	18.3	16.8	14.7	21.2	15.4	17.4
2023-08-16	evening	18.3	16.8	14.6	21.0	15.3	17.1
2023-08-17	early morning	18.0	16.6	14.4	20.9	15.2	16.9
2023-08-17	late morning	18.0	16.6	14.4	20.9	15.1	16.9
2023-08-17	afternoon	18.2	16.7	14.5	21.0	15.2	17.1
2023-08-17	evening	18.1	16.7	14.4	20.9	15.1	16.9
2023-08-18	early morning	17.9	16.6	14.2	20.8	15.0	16.6
2023-08-18	late morning	17.8	16.5	14.2	20.8	14.9	16.7
2023-08-18	afternoon	18.0	16.7	14.4	20.8	15.0	16.9
2023-08-18	evening	17.9	16.6	14.2	20.6	14.9	16.6
2023-08-19	early morning	17.7	16.5	14.0	20.5	14.8	16.3
2023-08-19	late morning	17.6	16.4	13.9	20.5	14.7	16.3
2023-08-19	afternoon	17.8	16.5	14.1	20.6	14.8	16.6
2023-08-19	evening	17.7	16.5	14.0	20.5	14.7	16.4
2023-08-20	early morning	17.5	16.4	13.8	20.4	14.6	16.1
2023-08-20	late morning	17.5	16.3	13.8	20.4	14.6	16.2
2023-08-20	afternoon	17.6	16.5	14.0	20.5	14.7	16.4
2023-08-20	evening	17.6	16.4	13.9	20.4	14.6	16.2
2023-08-21	early morning	17.4	16.3	13.7	20.3	14.5	16.0
2023-08-21	late morning	17.3	16.3	13.7	20.3	14.5	16.0

day	period	T7P3_S1	T7P6_S2	T7P9_S3	T9P2_S1	T9P5_S2	T9P8_S3
2023-08-21	afternoon	17.5	16.4	13.9	20.4	14.6	16.3
2023-08-21	evening	17.5	16.4	13.8	20.4	14.6	16.2
2023-08-22	early morning	17.3	16.3	13.7	20.3	14.5	16.0
2023-08-22	late morning	17.3	16.3	13.7	20.3	14.5	16.0
2023-08-22	afternoon	17.5	16.4	13.9	20.4	14.6	16.3
2023-08-22	evening	17.4	16.4	13.8	20.3	14.5	16.1
2023-08-23	early morning	17.2	16.3	13.6	20.2	14.4	15.8
2023-08-23	late morning	17.1	16.2	13.6	20.2	14.4	15.8
2023-08-23	afternoon	17.3	16.4	13.8	20.3	14.5	16.1
2023-08-23	evening	17.2	16.3	13.7	20.2	14.5	15.9
2023-08-24	early morning	17.1	16.2	13.5	20.1	14.4	15.7
2023-08-24	late morning	17.0	16.2	13.5	20.1	14.3	15.7
2023-08-24	afternoon	17.3	16.3	13.7	20.2	14.4	16.0
2023-08-24	evening	17.2	16.3	13.6	20.1	14.4	15.8
2023-08-25	early morning	17.0	16.2	13.5	20.1	14.3	15.6
2023-08-25	late morning	17.0	16.2	13.5	20.0	14.3	15.6
2023-08-25	afternoon	17.2	16.3	13.7	20.2	14.4	15.9
2023-08-25	evening	17.1	16.3	13.6	20.1	14.4	15.8
2023-08-26	early morning	16.9	16.2	13.4	20.0	14.3	15.5
2023-08-26	late morning	16.9	16.2	13.5	20.0	14.3	15.6
2023-08-26	afternoon	17.2	16.3	13.7	20.2	14.4	15.9
2023-08-26	evening	17.1	16.3	13.6	20.1	14.4	15.7
2023-08-27	early morning	16.9	16.2	13.4	20.0	14.3	15.5
2023-08-27	late morning	16.8	16.2	13.5	20.0	14.2	15.6
2023-08-27	afternoon	17.1	16.3	13.7	20.1	14.3	15.9
2023-08-27	evening	17.0	16.3	13.6	20.0	14.3	15.7
2023-08-28	early morning	16.8	16.2	13.4	19.9	14.2	15.4
2023-08-28	late morning	16.8	16.1	13.4	20.0	14.2	15.5
2023-08-28	afternoon	17.1	16.3	13.7	20.1	14.3	15.8
2023-08-28	evening	16.9	16.3	13.6	20.0	14.3	15.6
2023-08-29	early morning	16.8	16.2	13.5	20.2	14.2	15.4
2023-08-29	late morning	17.0	16.2	13.7	21.1	14.3	15.6
2023-08-29	afternoon	17.0	16.2	13.8	21.1	14.4	15.8
2023-08-29	evening	16.9	16.2	13.7	21.2	14.5	15.9
2023-08-30	early morning	17.2	16.3	14.0	23.4	17.3	17.6
2023-08-30	late morning	17.2	16.2	14.0	23.0	17.3	17.3
2023-08-30	afternoon	17.3	16.3	14.1	22.8	17.2	17.4
2023-08-30	evening	17.1	16.3	14.0	22.5	17.1	17.1
2023-08-31	early morning	17.0	16.2	13.9	22.4	17.0	16.9
2023-08-31	late morning	17.0	16.2	13.9	22.3	17.0	16.8
2023-08-31	afternoon	17.1	16.2	14.0	22.2	16.9	16.9
2023-08-31	evening	17.0	16.2	13.9	22.1	16.8	16.8

Table H.3 Percent soil moisture (VWC) for sensors from transects 10 and 12.

day	period	T10P2_S1	T10P5_S2	T10P8_S3	T12P2_S1	T12P5_S2	T12P8_S3
2023-05-13	late morning	NA	NA	NA	NA	NA	NA
2023-05-13	afternoon	16.3	30.7	36.4	35.5	44.1	NA
2023-05-13	evening	16.2	30.8	36.3	35.5	44.0	NA
2023-05-14	early morning	16.6	30.8	36.1	35.5	44.2	NA
2023-05-14	late morning	16.7	30.1	36.1	35.5	44.3	NA
2023-05-14	afternoon	16.8	29.7	36.3	35.4	44.1	NA
2023-05-14	evening	16.7	29.4	36.2	35.2	44.0	NA
2023-05-15	early morning	17.1	29.1	36.0	35.1	44.1	NA
2023-05-15	late morning	17.4	28.7	36.0	35.1	44.1	NA
2023-05-15	afternoon	17.1	28.4	36.6	35.0	44.0	NA
2023-05-15	evening	16.8	28.1	36.1	35.0	44.0	NA
2023-05-16	early morning	16.9	27.8	36.0	34.9	44.0	NA
2023-05-16	late morning	17.2	27.4	36.1	34.8	44.0	NA
2023-05-16	afternoon	17.0	27.1	36.2	34.7	44.0	NA
2023-05-16	evening	16.7	26.8	36.1	34.5	44.0	NA
2023-05-17	early morning	16.7	26.5	36.0	34.4	44.0	NA
2023-05-17	late morning	16.7	26.2	36.0	34.3	44.0	NA
2023-05-17	afternoon	16.5	25.9	36.2	34.2	44.0	NA
2023-05-17	evening	16.3	25.6	36.1	34.1	44.0	NA
2023-05-18	early morning	16.3	25.3	36.0	33.9	44.0	NA
2023-05-18	late morning	16.3	25.0	36.1	33.8	44.0	NA
2023-05-18	afternoon	16.1	24.7	36.6	33.6	44.0	NA
2023-05-18	evening	15.4	24.4	36.4	33.4	43.9	NA
2023-05-19	early morning	14.5	24.2	36.2	33.3	43.9	NA
2023-05-19	late morning	17.3	23.9	36.2	33.2	44.2	NA
2023-05-19	afternoon	17.6	23.6	36.3	33.0	44.0	NA
2023-05-19	evening	17.4	23.3	36.3	32.9	44.0	NA
2023-05-20	early morning	17.2	23.1	36.2	32.7	44.0	NA
2023-05-20	late morning	16.2	22.8	35.9	32.6	44.2	NA
2023-05-20	afternoon	16.0	22.5	36.1	32.5	44.0	NA
2023-05-20	evening	15.8	22.3	36.0	32.2	43.9	NA
2023-05-21	early morning	15.5	22.0	36.0	32.0	44.1	NA
2023-05-21	late morning	15.6	21.8	36.0	31.9	44.1	NA
2023-05-21	afternoon	15.3	21.6	36.1	31.7	44.0	NA
2023-05-21	evening	15.1	21.3	35.8	31.3	43.9	NA
2023-05-22	early morning	15.2	21.1	35.6	31.0	44.1	NA
2023-05-22	late morning	15.3	20.8	35.6	30.9	44.3	NA
2023-05-22	afternoon	15.0	20.6	35.8	30.6	44.1	NA
2023-05-22	evening	14.8	20.4	35.6	30.2	44.0	NA
2023-05-23	early morning	14.9	20.2	35.4	30.0	44.2	NA
2023-05-23	late morning	15.0	20.0	35.4	29.9	44.4	NA
2023-05-23	afternoon	14.6	19.8	35.6	29.6	44.2	NA
2023-05-23	evening	14.3	19.5	35.6	29.3	44.1	NA
2023-05-24	early morning	14.4	19.3	35.6	29.1	44.2	NA
2023-05-24	late morning	14.4	19.1	35.8	29.0	44.4	NA
2023-05-24	afternoon	14.1	19.0	36.1	28.8	44.2	NA

day	period	T10P2_S1	T10P5_S2	T10P8_S3	T12P2_S1	T12P5_S2	T12P8_S3
2023-05-24	evening	13.8	18.8	36.0	28.5	44.2	NA
2023-05-25	early morning	14.0	18.6	35.9	28.3	44.3	NA
2023-05-25	late morning	14.0	18.4	35.9	28.1	44.4	NA
2023-05-25	afternoon	13.7	18.2	35.9	27.9	44.3	NA
2023-05-25	evening	13.4	18.0	35.8	27.6	44.2	NA
2023-05-26	early morning	13.5	17.9	35.7	27.4	44.3	NA
2023-05-26	late morning	13.6	17.7	35.8	27.3	44.4	NA
2023-05-26	afternoon	13.3	17.6	36.0	27.1	44.3	NA
2023-05-26	evening	13.0	17.4	35.7	26.8	44.2	NA
2023-05-27	early morning	13.0	17.3	35.6	26.6	44.2	NA
2023-05-27	late morning	13.1	17.1	35.4	26.4	44.4	NA
2023-05-27	afternoon	12.7	17.0	35.4	26.1	44.3	NA
2023-05-27	evening	12.4	16.8	34.9	25.7	44.2	NA
2023-05-28	early morning	12.4	16.7	34.6	25.6	44.2	NA
2023-05-28	late morning	12.5	16.6	34.5	25.4	44.3	NA
2023-05-28	afternoon	12.1	16.5	34.4	25.0	44.2	NA
2023-05-28	evening	11.9	16.3	34.2	24.6	44.2	NA
2023-05-29	early morning	11.8	16.2	34.0	24.4	44.2	NA
2023-05-29	late morning	11.9	16.1	34.0	24.2	44.3	NA
2023-05-29	afternoon	11.5	16.0	33.8	23.8	44.2	NA
2023-05-29	evening	11.2	15.9	33.3	23.3	44.1	NA
2023-05-30	early morning	11.2	15.8	33.3	23.1	44.2	NA
2023-05-30	late morning	11.3	15.8	33.4	22.9	44.4	NA
2023-05-30	afternoon	11.0	15.7	33.3	22.6	44.3	NA
2023-05-30	evening	10.6	15.6	32.9	22.2	44.1	NA
2023-05-31	early morning	10.6	15.5	32.6	22.0	44.2	NA
2023-05-31	late morning	10.8	15.5	32.5	21.8	44.4	NA
2023-05-31	afternoon	10.5	15.4	32.2	21.6	44.3	NA
2023-05-31	evening	10.1	15.4	31.6	21.3	44.2	NA
2023-06-01	early morning	10.1	15.3	31.4	21.1	44.3	NA
2023-06-01	late morning	10.2	15.3	31.3	21.0	44.4	NA
2023-06-01	afternoon	9.9	15.3	31.0	20.9	44.3	NA
2023-06-01	evening	9.6	15.2	30.4	20.7	44.2	NA
2023-06-02	early morning	9.7	15.1	30.2	20.5	44.3	NA
2023-06-02	late morning	9.8	15.2	30.1	20.4	44.4	NA
2023-06-02	afternoon	9.8	15.2	29.7	20.4	44.3	NA
2023-06-02	evening	9.4	15.0	29.1	20.2	44.2	NA
2023-06-03	early morning	9.2	15.0	28.9	20.0	44.2	NA
2023-06-03	late morning	9.2	15.1	28.7	19.9	44.4	NA
2023-06-03	afternoon	9.0	15.1	28.3	19.9	44.3	NA
2023-06-03	evening	8.6	15.0	27.7	19.7	44.2	NA
2023-06-04	early morning	8.6	14.9	27.4	19.6	44.2	NA
2023-06-04	late morning	8.6	15.0	27.3	19.5	44.3	45.5
2023-06-04	afternoon	8.5	15.0	26.9	19.5	44.2	45.6
2023-06-04	evening	8.1	14.9	26.4	19.4	44.1	45.5
2023-06-05	early morning	8.1	14.9	26.1	19.2	44.2	45.4
2023-06-05	late morning	8.2	14.9	25.9	19.1	44.3	45.4
2023-06-05	afternoon	8.1	14.9	25.6	19.2	44.2	45.5

day	period	T10P2_S1	T10P5_S2	T10P8_S3	T12P2_S1	T12P5_S2	T12P8_S3
2023-06-05	evening	7.8	14.8	25.0	19.0	44.1	45.5
2023-06-06	early morning	7.8	14.8	24.8	18.9	44.1	45.3
2023-06-06	late morning	7.9	14.8	24.6	18.8	44.3	45.3
2023-06-06	afternoon	7.8	14.9	24.4	18.9	44.1	45.5
2023-06-06	evening	7.5	14.7	23.9	18.8	44.0	45.4
2023-06-07	early morning	7.5	14.6	23.7	18.7	44.0	45.3
2023-06-07	late morning	7.6	14.7	23.6	18.6	44.2	45.3
2023-06-07	afternoon	7.6	14.8	23.4	18.7	44.0	45.4
2023-06-07	evening	7.4	14.7	23.0	18.7	43.9	45.3
2023-06-08	early morning	7.3	14.6	22.8	18.5	44.0	45.2
2023-06-08	late morning	7.4	14.7	22.7	18.5	44.1	45.1
2023-06-08	afternoon	7.4	14.7	22.6	18.6	44.0	45.3
2023-06-08	evening	7.2	14.7	22.4	18.6	43.9	45.2
2023-06-09	early morning	7.2	14.6	22.3	18.5	43.9	45.2
2023-06-09	late morning	7.2	14.6	22.3	18.5	44.0	45.1
2023-06-09	afternoon	7.8	14.9	22.4	18.6	44.0	45.2
2023-06-09	evening	8.1	15.0	22.5	18.6	44.1	45.2
2023-06-10	early morning	8.1	15.0	22.4	18.6	44.1	45.2
2023-06-10	late morning	8.0	15.0	22.4	18.6	44.1	45.2
2023-06-10	afternoon	8.1	15.0	22.4	18.7	44.2	45.2
2023-06-10	evening	8.0	15.0	22.3	18.7	44.1	45.2
2023-06-11	early morning	8.0	15.0	22.2	18.6	44.2	45.1
2023-06-11	late morning	8.0	15.0	22.1	18.6	44.2	45.1
2023-06-11	afternoon	8.2	15.1	22.2	18.8	44.2	45.3
2023-06-11	evening	8.1	15.0	22.1	18.8	44.0	45.3
2023-06-12	early morning	8.0	15.0	22.0	18.7	44.1	45.1
2023-06-12	late morning	8.1	15.0	21.9	18.6	44.1	45.1
2023-06-12	afternoon	8.2	15.1	22.0	18.8	44.0	45.3
2023-06-12	evening	8.1	15.0	21.8	18.8	43.9	45.2
2023-06-13	early morning	8.0	14.9	21.7	18.7	43.9	45.1
2023-06-13	late morning	8.0	15.0	21.6	18.6	44.0	45.1
2023-06-13	afternoon	8.0	15.0	21.6	18.7	43.9	45.2
2023-06-13	evening	7.8	14.9	21.4	18.6	43.9	45.1
2023-06-14	early morning	7.8	14.9	21.3	18.5	43.9	45.1
2023-06-14	late morning	7.8	14.9	21.2	18.4	44.0	45.0
2023-06-14	afternoon	7.8	14.9	21.2	18.6	43.9	45.1
2023-06-14	evening	7.6	14.8	21.0	18.5	43.8	44.9
2023-06-15	early morning	7.6	14.7	20.9	18.4	43.9	44.9
2023-06-15	late morning	7.7	14.8	20.8	18.4	44.0	44.9
2023-06-15	afternoon	7.7	14.8	20.8	18.5	43.9	45.1
2023-06-15	evening	7.5	14.7	20.6	18.5	43.8	44.9
2023-06-16	early morning	7.5	14.6	20.5	18.3	43.9	44.9
2023-06-16	late morning	7.5	14.7	20.4	18.3	43.9	44.9
2023-06-16	afternoon	7.6	14.7	20.5	18.5	43.8	45.0
2023-06-16	evening	7.5	14.6	20.3	18.4	43.8	44.9
2023-06-17	early morning	7.4	14.6	20.1	18.3	43.8	44.8
2023-06-17	late morning	7.5	14.6	20.1	18.2	43.9	44.8
2023-06-17	afternoon	7.6	14.7	20.1	18.4	43.8	44.9

day	period	T10P2_S1	T10P5_S2	T10P8_S3	T12P2_S1	T12P5_S2	T12P8_S3
2023-06-17	evening	7.3	14.5	19.9	18.3	43.8	44.9
2023-06-18	early morning	7.3	14.5	19.8	18.2	43.8	44.9
2023-06-18	late morning	7.4	14.5	19.7	18.2	43.9	44.9
2023-06-18	afternoon	7.4	14.5	19.7	18.2	43.9	44.9
2023-06-18	evening	7.2	14.4	19.6	18.2	43.8	44.9
2023-06-19	early morning	7.2	14.4	19.5	18.1	43.9	44.8
2023-06-19	late morning	7.3	14.5	19.4	18.0	44.0	44.8
2023-06-19	afternoon	7.4	14.5	19.5	18.2	43.9	45.0
2023-06-19	evening	7.1	14.4	19.4	18.2	43.8	44.9
2023-06-20	early morning	7.1	14.4	19.3	18.1	43.9	44.9
2023-06-20	late morning	7.2	14.4	19.3	18.0	43.9	44.9
2023-06-20	afternoon	7.3	14.4	19.3	18.1	43.9	44.9
2023-06-20	evening	7.1	14.4	19.2	18.1	43.9	44.9
2023-06-21	early morning	7.1	14.3	19.1	18.0	43.9	44.9
2023-06-21	late morning	7.1	14.4	19.1	18.0	44.0	44.9
2023-06-21	afternoon	7.2	14.4	19.2	18.2	43.9	44.9
2023-06-21	evening	7.1	14.4	19.1	18.1	43.8	44.9
2023-06-22	early morning	7.1	14.3	19.0	18.0	43.9	44.9
2023-06-22	late morning	7.1	14.3	19.0	18.0	43.9	44.9
2023-06-22	afternoon	7.2	14.3	19.1	18.2	43.9	44.9
2023-06-22	evening	7.0	14.3	19.0	18.1	43.8	44.9
2023-06-23	early morning	7.0	14.2	18.9	18.0	43.8	44.9
2023-06-23	late morning	7.1	14.2	18.9	18.0	43.9	44.9
2023-06-23	afternoon	7.2	14.3	19.0	18.1	43.9	44.9
2023-06-23	evening	7.1	14.2	18.9	18.1	43.8	44.9
2023-06-24	early morning	7.0	14.2	18.8	18.0	43.8	44.9
2023-06-24	late morning	7.1	14.2	18.8	18.0	43.9	44.9
2023-06-24	afternoon	7.3	14.3	19.0	18.2	43.7	44.9
2023-06-24	evening	7.1	14.2	18.8	18.1	43.6	44.9
2023-06-25	early morning	7.0	14.1	18.7	18.0	43.7	44.9
2023-06-25	late morning	7.1	14.2	18.7	17.9	43.7	44.9
2023-06-25	afternoon	7.3	14.2	18.8	18.2	43.6	45.0
2023-06-25	evening	7.1	14.1	18.7	18.1	43.5	44.9
2023-06-26	early morning	7.2	14.1	18.6	18.0	43.6	44.9
2023-06-26	late morning	7.2	14.1	18.6	17.9	43.6	44.9
2023-06-26	afternoon	7.5	14.2	18.7	18.1	43.5	45.0
2023-06-26	evening	7.4	14.1	18.6	18.1	43.4	44.9
2023-06-27	early morning	7.3	14.1	18.5	18.0	43.4	44.9
2023-06-27	late morning	7.4	14.1	18.5	17.9	43.5	45.0
2023-06-27	afternoon	7.5	14.1	18.7	18.1	43.3	45.1
2023-06-27	evening	7.7	14.0	18.7	18.1	43.3	44.9
2023-06-28	early morning	7.6	13.9	18.6	18.0	43.3	44.9
2023-06-28	late morning	7.7	13.9	18.6	18.0	43.4	44.8
2023-06-28	afternoon	8.0	14.1	18.8	18.2	43.2	44.5
2023-06-28	evening	7.8	14.0	18.7	18.2	43.1	44.4
2023-06-29	early morning	7.7	13.9	18.6	18.1	43.1	44.2
2023-06-29	late morning	7.8	13.9	18.6	18.0	43.2	44.2
2023-06-29	afternoon	7.9	14.1	18.8	18.2	43.0	44.2

day	period	T10P2_S1	T10P5_S2	T10P8_S3	T12P2_S1	T12P5_S2	T12P8_S3
2023-06-29	evening	7.8	14.0	18.7	18.2	42.9	43.9
2023-06-30	early morning	7.6	13.9	18.5	18.0	42.9	43.2
2023-06-30	late morning	7.7	13.9	18.5	18.0	43.0	43.2
2023-06-30	afternoon	7.8	14.0	18.7	18.2	42.7	43.2
2023-06-30	evening	7.7	13.9	18.5	18.1	42.5	43.0
2023-07-01	early morning	7.5	13.8	18.4	18.0	42.5	42.9
2023-07-01	late morning	7.6	13.8	18.4	17.9	42.3	42.8
2023-07-01	afternoon	7.8	13.9	18.5	18.1	41.8	42.9
2023-07-01	evening	7.6	13.8	18.4	18.0	41.5	42.8
2023-07-02	early morning	7.5	13.7	18.2	17.9	41.8	42.7
2023-07-02	late morning	7.5	13.7	18.2	17.8	41.9	42.6
2023-07-02	afternoon	7.7	13.8	18.4	18.0	41.6	42.7
2023-07-02	evening	7.5	13.7	18.2	17.9	41.2	42.6
2023-07-03	early morning	7.4	13.6	18.1	17.8	41.3	42.5
2023-07-03	late morning	7.4	13.6	18.1	17.7	41.4	42.4
2023-07-03	afternoon	7.6	13.7	18.2	17.9	40.9	42.4
2023-07-03	evening	7.4	13.6	18.1	17.9	40.5	42.2
2023-07-04	early morning	7.2	13.5	17.9	17.7	40.5	42.1
2023-07-04	late morning	7.3	13.5	17.9	17.7	40.6	42.1
2023-07-04	afternoon	7.5	13.6	18.1	17.9	40.1	42.0
2023-07-04	evening	7.3	13.5	18.0	17.8	39.5	41.9
2023-07-05	early morning	7.2	13.4	17.8	17.7	39.5	41.8
2023-07-05	late morning	7.2	13.5	17.8	17.6	39.5	41.7
2023-07-05	afternoon	7.4	13.5	18.0	17.8	39.0	41.7
2023-07-05	evening	7.2	13.4	17.9	17.7	38.5	41.7
2023-07-06	early morning	7.1	13.3	17.7	17.6	38.4	41.5
2023-07-06	late morning	7.2	13.4	17.7	17.6	38.4	41.5
2023-07-06	afternoon	7.3	13.5	17.9	17.8	37.9	41.4
2023-07-06	evening	7.2	13.4	17.8	17.8	37.3	41.1
2023-07-07	early morning	7.0	13.3	17.6	17.7	37.1	41.1
2023-07-07	late morning	7.1	13.3	17.6	17.6	37.1	41.0
2023-07-07	afternoon	7.5	13.5	17.8	17.8	36.5	40.9
2023-07-07	evening	7.4	13.3	17.7	17.8	35.9	40.6
2023-07-08	early morning	7.1	13.2	17.5	17.6	35.8	40.5
2023-07-08	late morning	7.2	13.2	17.5	17.5	35.7	40.4
2023-07-08	afternoon	7.5	13.4	17.7	17.8	35.1	40.2
2023-07-08	evening	7.4	13.3	17.5	17.7	34.4	39.7
2023-07-09	early morning	7.2	13.1	17.4	17.6	34.2	39.5
2023-07-09	late morning	7.2	13.1	17.3	17.5	34.1	39.5
2023-07-09	afternoon	7.3	13.2	17.4	17.6	33.8	39.3
2023-07-09	evening	7.3	13.1	17.4	17.6	33.4	39.0
2023-07-10	early morning	7.2	13.1	17.3	17.5	33.3	38.8
2023-07-10	late morning	7.1	13.0	17.4	17.5	33.2	38.8
2023-07-10	afternoon	7.3	13.2	17.6	17.7	33.0	38.9
2023-07-10	evening	7.2	13.1	17.6	17.7	32.8	38.7
2023-07-11	early morning	7.1	13.1	17.5	17.6	32.7	38.6
2023-07-11	late morning	7.1	13.1	17.4	17.5	32.7	38.5
2023-07-11	afternoon	7.2	13.3	17.6	17.7	32.3	38.3

day	period	T10P2_S1	T10P5_S2	T10P8_S3	T12P2_S1	T12P5_S2	T12P8_S3
2023-07-11	evening	7.1	13.2	17.6	17.7	31.8	37.7
2023-07-12	early morning	7.0	13.1	17.4	17.6	31.7	37.4
2023-07-12	late morning	7.0	13.1	17.4	17.5	31.6	37.3
2023-07-12	afternoon	7.2	13.2	17.6	17.7	31.1	37.1
2023-07-12	evening	7.1	13.1	17.5	17.7	30.7	36.6
2023-07-13	early morning	7.0	13.0	17.3	17.5	30.6	36.3
2023-07-13	late morning	7.0	13.0	17.3	17.5	30.5	36.2
2023-07-13	afternoon	7.3	13.1	17.5	17.7	30.0	35.9
2023-07-13	evening	7.2	13.1	17.4	17.7	29.5	35.4
2023-07-14	early morning	7.1	12.9	17.2	17.5	29.4	35.1
2023-07-14	late morning	7.1	12.9	17.1	17.4	29.3	34.9
2023-07-14	afternoon	7.3	13.1	17.3	17.6	28.6	34.7
2023-07-14	evening	7.3	13.0	17.2	17.6	28.1	34.2
2023-07-15	early morning	7.1	12.8	17.0	17.4	27.9	33.9
2023-07-15	late morning	7.1	12.9	17.0	17.3	27.8	33.8
2023-07-15	afternoon	7.3	13.0	17.2	17.6	27.1	33.4
2023-07-15	evening	7.2	12.9	17.1	17.5	26.4	32.9
2023-07-16	early morning	7.0	12.8	16.9	17.3	26.3	32.6
2023-07-16	late morning	7.1	12.8	16.9	17.3	26.2	32.4
2023-07-16	afternoon	7.2	12.9	17.1	17.5	25.4	32.1
2023-07-16	evening	7.1	12.8	17.0	17.5	24.8	31.6
2023-07-17	early morning	7.0	12.7	16.8	17.3	24.6	31.3
2023-07-17	late morning	7.0	12.7	16.8	17.2	24.5	31.2
2023-07-17	afternoon	7.2	12.9	16.9	17.4	23.9	30.8
2023-07-17	evening	7.1	12.7	16.8	17.4	23.5	30.3
2023-07-18	early morning	6.9	12.5	16.6	17.2	23.4	30.1
2023-07-18	late morning	7.0	12.6	16.6	17.1	23.4	29.9
2023-07-18	afternoon	7.2	12.8	16.8	17.3	22.9	29.6
2023-07-18	evening	7.0	12.6	16.7	17.3	22.5	29.1
2023-07-19	early morning	6.9	12.5	16.5	17.1	22.4	28.9
2023-07-19	late morning	6.9	12.5	16.5	17.0	22.4	28.8
2023-07-19	afternoon	7.2	12.7	16.7	17.3	21.9	28.4
2023-07-19	evening	7.1	12.6	16.7	17.3	21.5	27.8
2023-07-20	early morning	6.9	12.4	16.5	17.1	21.5	27.6
2023-07-20	late morning	7.0	12.4	16.5	17.0	21.5	27.5
2023-07-20	afternoon	7.1	12.7	16.7	17.2	21.0	27.1
2023-07-20	evening	7.0	12.5	16.6	17.2	20.7	26.5
2023-07-21	early morning	6.9	12.4	16.4	17.1	20.6	26.4
2023-07-21	late morning	6.9	12.4	16.4	17.0	20.6	26.2
2023-07-21	afternoon	7.1	12.6	16.6	17.2	20.2	25.8
2023-07-21	evening	7.0	12.5	16.5	17.2	20.0	25.2
2023-07-22	early morning	6.8	12.3	16.3	17.0	19.9	25.0
2023-07-22	late morning	6.9	12.3	16.2	16.9	19.9	24.9
2023-07-22	afternoon	7.0	12.5	16.4	17.1	19.6	24.6
2023-07-22	evening	6.9	12.4	16.3	17.1	19.4	24.1
2023-07-23	early morning	6.8	12.2	16.1	16.9	19.4	24.0
2023-07-23	late morning	6.8	12.2	16.1	16.8	19.4	23.9
2023-07-23	afternoon	7.0	12.5	16.3	17.0	19.2	23.7

day	period	T10P2_S1	T10P5_S2	T10P8_S3	T12P2_S1	T12P5_S2	T12P8_S3
2023-07-23	evening	6.9	12.3	16.2	17.0	19.0	23.2
2023-07-24	early morning	6.8	12.1	16.0	16.8	19.0	23.1
2023-07-24	late morning	6.8	12.1	16.0	16.7	19.0	23.0
2023-07-24	afternoon	6.9	12.2	16.1	16.9	18.9	22.8
2023-07-24	evening	6.9	12.1	16.0	16.9	18.8	22.6
2023-07-25	early morning	6.7	12.0	15.9	16.7	18.8	22.5
2023-07-25	late morning	6.7	12.0	15.9	16.7	18.8	22.4
2023-07-25	afternoon	6.9	12.2	16.0	16.9	18.7	22.3
2023-07-25	evening	6.7	12.1	15.9	16.8	18.6	22.0
2023-07-26	early morning	6.5	11.9	15.7	16.6	18.6	21.9
2023-07-26	late morning	6.6	11.9	15.6	16.5	18.6	21.8
2023-07-26	afternoon	6.9	12.2	15.9	16.8	18.5	21.7
2023-07-26	evening	6.8	12.0	15.8	16.8	18.4	21.5
2023-07-27	early morning	6.6	11.9	15.6	16.6	18.4	21.3
2023-07-27	late morning	6.7	11.9	15.6	16.5	18.4	21.3
2023-07-27	afternoon	6.8	12.1	15.7	16.7	18.3	21.2
2023-07-27	evening	6.7	11.9	15.7	16.7	18.2	21.1
2023-07-28	early morning	6.6	11.8	15.5	16.5	18.3	21.0
2023-07-28	late morning	6.6	11.8	15.5	16.5	18.3	21.0
2023-07-28	afternoon	6.9	12.0	15.7	16.7	18.2	20.9
2023-07-28	evening	6.7	11.9	15.6	16.7	18.1	20.7
2023-07-29	early morning	6.5	11.7	15.4	16.5	18.1	20.6
2023-07-29	late morning	6.6	11.8	15.4	16.5	18.2	20.5
2023-07-29	afternoon	6.9	12.1	15.7	16.7	18.0	20.5
2023-07-29	evening	6.8	11.9	15.6	16.7	17.9	20.3
2023-07-30	early morning	6.7	11.8	15.4	16.5	17.9	20.2
2023-07-30	late morning	6.7	11.8	15.4	16.5	17.9	20.1
2023-07-30	afternoon	6.9	12.0	15.6	16.7	17.8	20.1
2023-07-30	evening	6.7	11.8	15.4	16.6	17.7	19.9
2023-07-31	early morning	6.5	11.6	15.2	16.4	17.7	19.7
2023-07-31	late morning	6.5	11.6	15.2	16.4	17.8	19.6
2023-07-31	afternoon	6.8	11.9	15.4	16.6	17.6	19.7
2023-07-31	evening	6.7	11.8	15.3	16.6	17.5	19.5
2023-08-01	early morning	6.4	11.6	15.1	16.4	17.5	19.3
2023-08-01	late morning	6.5	11.6	15.1	16.3	17.6	19.3
2023-08-01	afternoon	6.7	11.9	15.3	16.6	17.4	19.3
2023-08-01	evening	6.6	11.7	15.3	16.5	17.3	19.1
2023-08-02	early morning	6.4	11.5	15.0	16.3	17.4	19.0
2023-08-02	late morning	6.2	11.5	15.0	16.2	17.4	18.9
2023-08-02	afternoon	6.6	11.8	15.3	16.5	17.3	19.0
2023-08-02	evening	6.5	11.7	15.2	16.5	17.2	18.8
2023-08-03	early morning	6.3	11.5	14.9	16.3	17.2	18.7
2023-08-03	late morning	6.3	11.5	14.9	16.2	17.2	18.6
2023-08-03	afternoon	6.6	11.8	15.2	16.5	17.1	18.7
2023-08-03	evening	6.5	11.6	15.1	16.5	17.0	18.6
2023-08-04	early morning	6.3	11.4	14.9	16.3	17.0	18.4
2023-08-04	late morning	6.3	11.4	14.8	16.2	17.1	18.3
2023-08-04	afternoon	6.6	11.7	15.1	16.4	17.0	18.4

day	period	T10P2_S1	T10P5_S2	T10P8_S3	T12P2_S1	T12P5_S2	T12P8_S3
2023-08-04	evening	6.5	11.5	15.0	16.4	16.9	18.3
2023-08-05	early morning	6.4	11.4	14.8	16.2	16.9	18.3
2023-08-05	late morning	6.4	11.4	14.8	16.2	17.0	18.2
2023-08-05	afternoon	6.6	11.4	15.0	16.2	17.1	18.1
2023-08-05	evening	6.7	11.5	15.1	16.3	17.1	18.1
2023-08-06	early morning	6.6	11.4	15.0	16.2	17.2	18.0
2023-08-06	late morning	6.6	11.5	15.0	16.2	17.2	18.1
2023-08-06	afternoon	6.9	11.8	15.3	16.5	17.2	18.3
2023-08-06	evening	6.8	11.6	15.2	16.4	17.2	18.2
2023-08-07	early morning	6.7	11.6	15.2	16.3	17.2	18.2
2023-08-07	late morning	11.8	12.0	15.7	16.5	17.3	18.1
2023-08-07	afternoon	21.5	12.8	17.7	17.3	17.4	18.7
2023-08-07	evening	19.8	13.0	17.9	17.5	17.4	18.9
2023-08-08	early morning	19.0	13.0	18.0	17.4	17.5	18.9
2023-08-08	late morning	18.4	13.0	18.0	17.4	17.6	18.9
2023-08-08	afternoon	17.5	13.3	18.1	17.6	17.6	19.2
2023-08-08	evening	16.8	13.3	18.1	17.6	17.6	19.2
2023-08-09	early morning	16.5	13.2	18.0	17.5	17.7	19.2
2023-08-09	late morning	15.9	13.2	18.0	17.4	17.7	19.1
2023-08-09	afternoon	15.1	13.4	18.0	17.5	17.7	19.2
2023-08-09	evening	14.6	13.4	17.9	17.5	17.7	19.2
2023-08-10	early morning	14.6	13.3	17.8	17.3	17.8	19.1
2023-08-10	late morning	14.5	13.3	17.7	17.3	17.8	19.0
2023-08-10	afternoon	13.6	13.5	17.8	17.4	17.7	19.1
2023-08-10	evening	13.1	13.5	17.6	17.4	17.7	19.0
2023-08-11	early morning	13.1	13.4	17.5	17.2	17.7	18.9
2023-08-11	late morning	13.0	13.3	17.4	17.1	17.8	18.9
2023-08-11	afternoon	12.1	13.5	17.4	17.3	17.6	19.0
2023-08-11	evening	11.6	13.4	17.3	17.3	17.6	18.9
2023-08-12	early morning	11.5	13.4	17.1	17.1	17.6	18.8
2023-08-12	late morning	11.3	13.3	17.1	17.1	17.6	18.7
2023-08-12	afternoon	10.6	13.5	17.1	17.2	17.4	18.8
2023-08-12	evening	10.1	13.4	17.0	17.2	17.4	18.7
2023-08-13	early morning	10.0	13.3	16.8	17.0	17.4	18.5
2023-08-13	late morning	9.9	13.3	16.8	16.9	17.4	18.5
2023-08-13	afternoon	9.5	13.4	16.9	17.2	17.2	18.6
2023-08-13	evening	9.1	13.4	16.7	17.1	17.2	18.4
2023-08-14	early morning	8.9	13.2	16.5	16.9	17.2	18.3
2023-08-14	late morning	8.9	13.2	16.5	16.8	17.2	18.3
2023-08-14	afternoon	8.7	13.4	16.6	17.1	17.0	18.4
2023-08-14	evening	8.4	13.3	16.5	17.0	17.0	18.2
2023-08-15	early morning	8.3	13.2	16.3	16.8	17.0	18.1
2023-08-15	late morning	8.3	13.2	16.2	16.8	17.0	18.0
2023-08-15	afternoon	8.2	13.3	16.3	17.0	16.9	18.2
2023-08-15	evening	8.0	13.3	16.2	17.0	16.8	18.0
2023-08-16	early morning	7.8	13.1	16.0	16.7	16.7	17.8
2023-08-16	late morning	7.9	13.1	15.9	16.7	16.8	17.8
2023-08-16	afternoon	7.9	13.2	16.1	16.9	16.6	17.9

day	period	T10P2_S1	T10P5_S2	T10P8_S3	T12P2_S1	T12P5_S2	T12P8_S3
2023-08-16	evening	7.7	13.1	16.0	16.8	16.6	17.8
2023-08-17	early morning	7.5	13.0	15.8	16.6	16.6	17.6
2023-08-17	late morning	7.6	13.0	15.7	16.6	16.6	17.5
2023-08-17	afternoon	7.7	13.1	15.9	16.8	16.5	17.6
2023-08-17	evening	7.5	13.0	15.8	16.7	16.4	17.5
2023-08-18	early morning	7.3	12.8	15.6	16.5	16.4	17.4
2023-08-18	late morning	7.3	12.8	15.5	16.5	16.5	17.4
2023-08-18	afternoon	7.4	13.0	15.7	16.7	16.4	17.5
2023-08-18	evening	7.2	12.8	15.5	16.6	16.3	17.4
2023-08-19	early morning	7.0	12.7	15.3	16.4	16.3	17.2
2023-08-19	late morning	7.1	12.6	15.2	16.3	16.4	17.1
2023-08-19	afternoon	7.2	12.7	15.4	16.5	16.3	17.2
2023-08-19	evening	7.0	12.6	15.3	16.5	16.3	17.1
2023-08-20	early morning	6.8	12.5	15.0	16.3	16.3	17.0
2023-08-20	late morning	6.9	12.5	15.0	16.2	16.3	16.9
2023-08-20	afternoon	7.1	12.6	15.3	16.5	16.2	17.1
2023-08-20	evening	6.9	12.5	15.1	16.4	16.2	17.0
2023-08-21	early morning	6.7	12.4	14.9	16.2	16.3	16.9
2023-08-21	late morning	6.8	12.4	14.9	16.2	16.3	16.9
2023-08-21	afternoon	7.1	12.5	15.1	16.4	16.2	17.0
2023-08-21	evening	7.0	12.4	15.1	16.4	16.2	16.9
2023-08-22	early morning	6.7	12.3	14.9	16.3	16.3	16.8
2023-08-22	late morning	6.8	12.3	14.8	16.2	16.3	16.8
2023-08-22	afternoon	7.0	12.5	15.1	16.5	16.2	17.0
2023-08-22	evening	6.8	12.4	15.0	16.4	16.2	16.9
2023-08-23	early morning	6.6	12.2	14.8	16.2	16.2	16.7
2023-08-23	late morning	6.6	12.2	14.7	16.2	16.2	16.7
2023-08-23	afternoon	7.1	12.4	14.9	16.4	16.2	16.8
2023-08-23	evening	6.7	12.2	14.8	16.3	16.2	16.7
2023-08-24	early morning	6.5	12.1	14.6	16.1	16.2	16.6
2023-08-24	late morning	6.5	12.1	14.6	16.1	16.2	16.6
2023-08-24	afternoon	6.6	12.3	14.9	16.4	16.1	16.7
2023-08-24	evening	6.5	12.1	14.8	16.3	16.1	16.7
2023-08-25	early morning	6.4	12.0	14.6	16.1	16.1	16.5
2023-08-25	late morning	6.5	11.9	14.5	16.1	16.2	16.5
2023-08-25	afternoon	6.6	12.2	14.8	16.3	16.1	16.6
2023-08-25	evening	6.6	12.1	14.7	16.3	16.1	16.6
2023-08-26	early morning	6.5	11.9	14.5	16.1	16.1	16.5
2023-08-26	late morning	6.5	11.9	14.5	16.1	16.2	16.5
2023-08-26	afternoon	6.7	12.2	14.8	16.4	16.1	16.6
2023-08-26	evening	6.7	12.1	14.7	16.3	16.1	16.6
2023-08-27	early morning	6.6	11.9	14.4	16.1	16.1	16.4
2023-08-27	late morning	6.5	11.9	14.4	16.1	16.1	16.4
2023-08-27	afternoon	6.7	12.2	14.7	16.4	16.0	16.6
2023-08-27	evening	6.7	12.0	14.6	16.3	16.0	16.5
2023-08-28	early morning	6.6	11.9	14.3	16.1	16.0	16.3
2023-08-28	late morning	6.5	11.9	14.3	16.1	16.0	16.3
2023-08-28	afternoon	6.7	12.1	14.6	16.3	15.9	16.5

day	period	T10P2_S1	T10P5_S2	T10P8_S3	T12P2_S1	T12P5_S2	T12P8_S3
2023-08-28	evening	6.7	12.0	14.5	16.3	15.9	16.4
2023-08-29	early morning	6.7	11.9	14.3	16.1	15.9	16.2
2023-08-29	late morning	6.8	12.1	14.4	16.1	16.0	16.0
2023-08-29	afternoon	7.0	12.3	14.5	16.2	16.0	16.2
2023-08-29	evening	6.9	12.2	14.5	16.2	16.1	16.1
2023-08-30	early morning	7.5	12.3	14.6	16.2	16.2	15.9
2023-08-30	late morning	7.4	12.3	14.8	16.2	16.3	15.9
2023-08-30	afternoon	7.6	12.5	15.0	16.5	16.2	16.2
2023-08-30	evening	7.5	12.4	15.0	16.4	16.3	16.2
2023-08-31	early morning	7.4	12.2	14.9	16.3	16.3	16.1
2023-08-31	late morning	7.4	12.3	14.9	16.3	16.4	16.1
2023-08-31	afternoon	7.5	12.3	15.1	16.4	16.4	16.2
2023-08-31	evening	7.4	12.2	15.1	16.4	16.4	16.2

Table H.4 Percent soil moisture (VWC) for sensors from transects 14 and 15.

day	period	T14P1_S1	T14P7_S3	T15P2_S1	T15P5_S2	T15P8_S3
2023-05-13	late morning	NA	NA	NA	NA	NA
2023-05-13	afternoon	NA	NA	NA	NA	NA
2023-05-13	evening	NA	NA	NA	NA	NA
2023-05-14	early morning	NA	NA	NA	NA	NA
2023-05-14	late morning	28.7	34.3	NA	42.8	35.6
2023-05-14	afternoon	28.8	34.6	NA	42.8	35.6
2023-05-14	evening	28.7	34.8	NA	42.7	35.5
2023-05-15	early morning	28.7	34.9	NA	42.7	35.5
2023-05-15	late morning	28.7	34.9	NA	42.6	35.5
2023-05-15	afternoon	28.7	34.9	NA	42.5	35.5
2023-05-15	evening	28.5	35.0	NA	42.5	35.4
2023-05-16	early morning	28.4	35.1	NA	42.5	35.4
2023-05-16	late morning	28.4	35.1	NA	42.3	35.4
2023-05-16	afternoon	28.4	35.1	NA	42.0	35.4
2023-05-16	evening	28.3	35.2	NA	42.0	35.4
2023-05-17	early morning	28.2	35.2	NA	42.1	35.4
2023-05-17	late morning	28.2	35.2	NA	40.2	35.3
2023-05-17	afternoon	28.2	35.2	NA	41.0	35.3
2023-05-17	evening	28.1	35.3	NA	40.1	35.2
2023-05-18	early morning	28.0	35.4	NA	39.5	35.2
2023-05-18	late morning	27.9	35.3	NA	40.0	35.1
2023-05-18	afternoon	27.9	35.2	30.0	39.9	34.9
2023-05-18	evening	27.8	35.2	30.0	38.7	34.9
2023-05-19	early morning	27.7	35.2	30.0	38.7	34.9
2023-05-19	late morning	27.6	35.2	29.9	38.6	34.8
2023-05-19	afternoon	27.6	35.2	29.7	38.5	34.8
2023-05-19	evening	27.5	35.3	29.6	38.2	34.6
2023-05-20	early morning	27.4	35.4	29.6	38.1	34.6
2023-05-20	late morning	27.3	35.4	29.5	38.0	34.5

day	period	T14P1_S1	T14P7_S3	T15P2_S1	T15P5_S2	T15P8_S3
2023-05-20	afternoon	27.2	35.3	29.2	37.9	34.4
2023-05-20	evening	27.1	35.4	29.1	37.6	34.2
2023-05-21	early morning	27.0	35.4	29.1	37.5	34.1
2023-05-21	late morning	26.9	35.5	29.0	37.4	34.1
2023-05-21	afternoon	26.8	35.5	28.8	37.4	33.9
2023-05-21	evening	26.7	35.5	28.6	37.2	33.6
2023-05-22	early morning	26.6	35.5	28.6	37.1	33.4
2023-05-22	late morning	26.5	35.5	28.5	37.0	33.3
2023-05-22	afternoon	26.4	35.6	28.3	36.9	33.3
2023-05-22	evening	26.2	35.7	28.2	36.7	33.0
2023-05-23	early morning	26.2	35.6	28.1	36.7	32.9
2023-05-23	late morning	26.1	35.5	28.0	36.6	32.9
2023-05-23	afternoon	26.1	35.6	27.9	36.4	32.8
2023-05-23	evening	25.9	35.5	27.8	36.3	32.6
2023-05-24	early morning	25.9	35.6	27.7	36.2	32.3
2023-05-24	late morning	25.8	35.6	27.6	36.1	32.3
2023-05-24	afternoon	25.8	35.7	27.5	36.1	32.3
2023-05-24	evening	25.6	35.7	27.4	35.9	32.1
2023-05-25	early morning	25.6	35.7	27.3	35.8	31.9
2023-05-25	late morning	25.5	35.7	27.2	35.7	31.8
2023-05-25	afternoon	25.5	35.7	27.1	35.6	31.8
2023-05-25	evening	25.3	35.7	27.0	35.5	31.6
2023-05-26	early morning	25.3	35.7	26.9	35.4	31.5
2023-05-26	late morning	25.3	35.7	26.8	35.4	31.4
2023-05-26	afternoon	25.3	35.7	26.7	35.3	31.5
2023-05-26	evening	25.1	35.7	26.6	35.1	31.3
2023-05-27	early morning	25.0	35.7	26.6	35.0	31.1
2023-05-27	late morning	25.0	35.7	26.4	34.9	31.0
2023-05-27	afternoon	24.8	35.7	26.3	34.8	30.9
2023-05-27	evening	24.7	35.7	26.2	34.5	30.7
2023-05-28	early morning	24.7	35.7	26.1	34.3	30.6
2023-05-28	late morning	24.6	35.7	26.0	34.2	30.4
2023-05-28	afternoon	24.4	35.7	25.8	33.9	30.3
2023-05-28	evening	24.3	35.7	25.7	33.6	30.1
2023-05-29	early morning	24.2	35.7	25.7	33.4	29.9
2023-05-29	late morning	24.1	35.7	25.6	33.2	29.7
2023-05-29	afternoon	24.0	35.7	25.4	32.9	29.6
2023-05-29	evening	23.9	35.7	25.3	32.6	29.3
2023-05-30	early morning	23.8	35.7	25.2	32.3	29.1
2023-05-30	late morning	23.7	35.7	25.1	32.1	28.9
2023-05-30	afternoon	23.6	35.7	25.0	31.9	28.8
2023-05-30	evening	23.5	35.7	24.9	31.6	28.5
2023-05-31	early morning	23.4	35.7	24.8	31.3	28.2
2023-05-31	late morning	23.4	35.7	24.7	31.1	28.0
2023-05-31	afternoon	23.3	35.7	24.6	30.9	28.0
2023-05-31	evening	23.1	35.7	24.5	30.6	27.7
2023-06-01	early morning	23.1	35.8	24.4	30.4	27.5
2023-06-01	late morning	22.9	35.7	24.3	30.2	27.3

day	period	T14P1_S1	T14P7_S3	T15P2_S1	T15P5_S2	T15P8_S3
2023-06-01	afternoon	22.8	35.8	24.2	30.0	27.2
2023-06-01	evening	22.7	35.7	24.1	29.7	27.0
2023-06-02	early morning	22.6	35.7	24.1	29.6	26.8
2023-06-02	late morning	22.5	35.7	24.0	29.4	26.7
2023-06-02	afternoon	22.4	35.7	23.9	29.2	26.6
2023-06-02	evening	22.3	35.7	23.8	28.9	26.4
2023-06-03	early morning	22.2	35.7	23.7	28.8	26.2
2023-06-03	late morning	22.1	35.7	23.6	28.6	26.0
2023-06-03	afternoon	22.0	35.7	23.5	28.3	25.9
2023-06-03	evening	21.9	35.7	23.4	28.1	25.6
2023-06-04	early morning	21.8	35.7	23.3	27.9	25.5
2023-06-04	late morning	21.9	35.7	23.2	27.8	25.3
2023-06-04	afternoon	21.8	35.7	23.1	27.5	25.1
2023-06-04	evening	21.6	35.7	23.0	27.2	24.8
2023-06-05	early morning	21.5	35.7	22.9	27.1	24.6
2023-06-05	late morning	21.5	35.7	22.8	26.9	24.4
2023-06-05	afternoon	21.4	35.7	22.7	26.7	24.3
2023-06-05	evening	21.2	35.7	22.6	26.5	24.0
2023-06-06	early morning	21.1	35.7	22.5	26.4	23.8
2023-06-06	late morning	21.1	35.6	22.4	26.2	23.7
2023-06-06	afternoon	21.0	35.7	22.3	26.0	23.6
2023-06-06	evening	20.8	35.7	22.1	25.8	23.4
2023-06-07	early morning	20.8	35.7	22.1	25.7	23.2
2023-06-07	late morning	20.8	35.6	22.0	25.6	23.1
2023-06-07	afternoon	20.7	35.6	21.8	25.4	23.0
2023-06-07	evening	20.5	35.6	21.7	25.2	22.8
2023-06-08	early morning	20.4	35.7	21.7	25.1	22.6
2023-06-08	late morning	20.5	35.6	21.6	25.0	22.5
2023-06-08	afternoon	20.5	35.6	21.4	24.9	22.4
2023-06-08	evening	20.2	35.7	21.3	24.8	22.3
2023-06-09	early morning	20.1	36.2	21.2	25.6	22.3
2023-06-09	late morning	20.1	36.3	21.2	26.2	22.2
2023-06-09	afternoon	20.3	36.6	21.2	31.6	22.4
2023-06-09	evening	20.4	36.6	21.3	31.3	22.5
2023-06-10	early morning	20.4	36.5	21.3	30.7	22.4
2023-06-10	late morning	20.5	36.4	21.4	30.2	22.5
2023-06-10	afternoon	20.5	36.4	21.4	29.9	22.5
2023-06-10	evening	20.6	36.4	21.4	29.8	22.5
2023-06-11	early morning	20.6	36.4	21.4	29.5	22.5
2023-06-11	late morning	20.8	36.4	21.3	29.3	22.5
2023-06-11	afternoon	20.9	36.4	21.2	28.9	22.5
2023-06-11	evening	20.7	36.4	21.2	28.6	22.5
2023-06-12	early morning	20.6	36.4	21.2	28.4	22.5
2023-06-12	late morning	20.8	36.3	21.1	28.1	22.5
2023-06-12	afternoon	20.9	36.3	21.0	27.7	22.5
2023-06-12	evening	20.8	36.3	20.9	27.3	22.4
2023-06-13	early morning	20.6	36.3	20.8	27.1	22.4
2023-06-13	late morning	20.7	36.3	20.7	26.9	22.3

day	period	T14P1_S1	T14P7_S3	T15P2_S1	T15P5_S2	T15P8_S3
2023-06-13	afternoon	20.7	36.3	20.6	26.6	22.3
2023-06-13	evening	20.5	36.3	20.5	26.3	22.2
2023-06-14	early morning	20.4	36.3	20.4	26.0	22.2
2023-06-14	late morning	20.4	36.2	20.3	25.8	22.1
2023-06-14	afternoon	20.3	36.3	20.2	25.5	22.1
2023-06-14	evening	20.2	36.3	20.1	25.2	22.0
2023-06-15	early morning	20.2	36.3	20.1	25.0	21.9
2023-06-15	late morning	20.1	36.2	20.0	24.9	21.9
2023-06-15	afternoon	20.1	36.2	19.8	24.6	21.9
2023-06-15	evening	20.0	36.2	19.7	24.4	21.8
2023-06-16	early morning	20.0	36.2	19.7	24.3	21.7
2023-06-16	late morning	19.9	36.1	19.6	24.2	21.6
2023-06-16	afternoon	20.0	36.1	19.4	24.0	21.6
2023-06-16	evening	19.8	36.2	19.3	23.8	21.5
2023-06-17	early morning	19.7	36.2	19.3	23.7	21.4
2023-06-17	late morning	19.6	36.1	19.2	23.6	21.3
2023-06-17	afternoon	19.6	36.1	19.1	23.4	21.3
2023-06-17	evening	19.4	36.1	19.0	23.2	21.1
2023-06-18	early morning	19.4	36.1	18.9	23.1	21.0
2023-06-18	late morning	19.3	36.1	18.9	23.0	21.0
2023-06-18	afternoon	19.3	36.1	18.7	22.9	20.9
2023-06-18	evening	19.2	36.1	18.7	22.7	20.8
2023-06-19	early morning	19.1	36.1	18.6	22.6	20.7
2023-06-19	late morning	19.1	36.1	18.6	22.6	20.7
2023-06-19	afternoon	19.1	36.1	18.5	22.4	20.7
2023-06-19	evening	19.1	36.1	18.4	22.2	20.6
2023-06-20	early morning	19.1	36.1	18.3	22.1	20.5
2023-06-20	late morning	18.9	36.1	18.3	22.1	20.5
2023-06-20	afternoon	18.8	36.1	18.2	22.0	20.5
2023-06-20	evening	18.8	36.1	18.1	21.9	20.4
2023-06-21	early morning	18.9	36.1	18.1	21.8	20.4
2023-06-21	late morning	18.9	36.0	18.1	21.8	20.3
2023-06-21	afternoon	18.8	36.1	17.9	21.6	20.4
2023-06-21	evening	18.8	36.1	17.9	21.5	20.3
2023-06-22	early morning	18.9	36.1	17.9	21.5	20.2
2023-06-22	late morning	18.8	36.1	17.8	21.4	20.2
2023-06-22	afternoon	18.8	36.1	17.7	21.3	20.3
2023-06-22	evening	18.7	36.1	17.6	21.2	20.2
2023-06-23	early morning	18.7	36.1	17.6	21.1	20.1
2023-06-23	late morning	18.6	36.0	17.5	21.1	20.1
2023-06-23	afternoon	18.6	36.0	17.4	20.9	20.1
2023-06-23	evening	18.5	36.1	17.3	20.9	20.1
2023-06-24	early morning	18.5	36.1	17.3	20.8	20.0
2023-06-24	late morning	18.5	36.0	17.2	20.8	20.0
2023-06-24	afternoon	18.5	36.0	17.1	20.7	20.0
2023-06-24	evening	18.3	36.0	17.0	20.6	19.9
2023-06-25	early morning	18.2	36.0	17.0	20.5	19.9
2023-06-25	late morning	18.2	36.0	17.0	20.5	19.8

day	period	T14P1_S1	T14P7_S3	T15P2_S1	T15P5_S2	T15P8_S3
2023-06-25	afternoon	18.1	36.0	16.8	20.3	19.9
2023-06-25	evening	18.0	36.0	16.8	20.2	19.8
2023-06-26	early morning	18.0	36.0	16.8	20.1	19.7
2023-06-26	late morning	18.0	36.0	16.7	20.1	19.7
2023-06-26	afternoon	17.9	36.0	16.6	20.0	19.8
2023-06-26	evening	17.8	36.0	16.5	19.9	19.7
2023-06-27	early morning	17.8	36.0	16.5	19.9	19.6
2023-06-27	late morning	17.8	36.0	16.4	19.9	19.6
2023-06-27	afternoon	17.9	36.0	16.3	19.8	19.6
2023-06-27	evening	19.6	36.3	16.4	19.8	20.0
2023-06-28	early morning	19.1	36.2	16.4	20.0	20.0
2023-06-28	late morning	18.9	36.1	16.3	20.1	19.9
2023-06-28	afternoon	18.7	36.1	16.2	20.1	20.0
2023-06-28	evening	18.3	36.1	16.1	20.1	20.0
2023-06-29	early morning	18.2	36.1	16.1	20.1	19.9
2023-06-29	late morning	18.2	36.0	16.1	20.1	19.8
2023-06-29	afternoon	18.1	36.0	15.9	19.9	19.9
2023-06-29	evening	17.6	36.0	15.8	19.8	19.8
2023-06-30	early morning	17.4	36.0	15.8	19.8	19.7
2023-06-30	late morning	17.7	36.0	15.7	19.7	19.6
2023-06-30	afternoon	17.5	35.9	15.6	19.5	19.7
2023-06-30	evening	17.5	36.0	15.6	19.4	19.6
2023-07-01	early morning	17.6	36.0	15.6	19.4	19.5
2023-07-01	late morning	17.3	35.9	15.5	19.3	19.5
2023-07-01	afternoon	17.2	35.8	15.4	19.1	19.5
2023-07-01	evening	17.0	35.8	15.3	18.9	19.4
2023-07-02	early morning	17.0	35.8	15.3	18.9	19.3
2023-07-02	late morning	16.9	35.7	15.3	18.8	19.2
2023-07-02	afternoon	16.9	35.4	15.1	18.6	19.3
2023-07-02	evening	16.7	35.4	15.1	18.5	19.2
2023-07-03	early morning	16.6	35.4	15.1	18.5	19.1
2023-07-03	late morning	16.7	35.3	15.0	18.4	19.0
2023-07-03	afternoon	16.6	34.9	14.8	18.1	19.1
2023-07-03	evening	16.5	34.8	14.8	18.0	19.0
2023-07-04	early morning	16.4	34.8	14.8	18.0	18.9
2023-07-04	late morning	16.3	34.7	14.7	18.0	18.9
2023-07-04	afternoon	16.3	34.1	14.6	17.8	19.0
2023-07-04	evening	16.1	33.9	14.5	17.7	18.9
2023-07-05	early morning	16.1	33.9	14.5	17.7	18.8
2023-07-05	late morning	16.0	33.8	14.5	17.6	18.7
2023-07-05	afternoon	16.0	33.4	14.3	17.5	18.8
2023-07-05	evening	15.9	33.3	14.2	17.5	18.8
2023-07-06	early morning	15.9	33.3	14.3	17.4	18.7
2023-07-06	late morning	15.8	33.1	14.2	17.4	18.6
2023-07-06	afternoon	15.7	32.7	14.0	17.3	18.7
2023-07-06	evening	15.7	32.5	13.9	17.2	18.7
2023-07-07	early morning	15.7	32.5	13.9	17.2	18.6
2023-07-07	late morning	15.8	32.4	13.9	17.2	18.6

day	period	T14P1_S1	T14P7_S3	T15P2_S1	T15P5_S2	T15P8_S3
2023-07-07	afternoon	15.7	31.9	13.7	17.1	18.6
2023-07-07	evening	15.6	31.7	13.7	17.0	18.6
2023-07-08	early morning	15.9	31.7	13.7	17.0	18.5
2023-07-08	late morning	16.0	31.6	13.6	17.0	18.5
2023-07-08	afternoon	15.8	31.0	13.5	16.9	18.5
2023-07-08	evening	15.7	30.7	13.4	16.8	18.5
2023-07-09	early morning	15.8	30.6	13.4	16.8	18.4
2023-07-09	late morning	15.5	30.5	13.4	16.8	18.4
2023-07-09	afternoon	15.4	30.3	13.3	16.8	18.4
2023-07-09	evening	15.3	30.1	13.3	16.8	18.4
2023-07-10	early morning	15.3	30.1	13.2	16.8	18.3
2023-07-10	late morning	15.2	30.1	13.2	16.7	18.3
2023-07-10	afternoon	17.4	30.0	13.2	18.6	18.5
2023-07-10	evening	18.0	30.1	13.2	20.0	18.6
2023-07-11	early morning	17.8	30.1	13.2	19.9	18.5
2023-07-11	late morning	17.3	29.6	13.2	19.6	18.5
2023-07-11	afternoon	16.9	29.0	13.1	19.3	18.6
2023-07-11	evening	16.4	28.8	13.1	18.9	18.6
2023-07-12	early morning	16.4	28.9	13.1	18.7	18.5
2023-07-12	late morning	16.3	28.9	13.1	18.5	18.5
2023-07-12	afternoon	16.2	28.6	13.0	18.0	18.6
2023-07-12	evening	16.0	28.4	13.0	17.7	18.5
2023-07-13	early morning	16.0	28.3	13.0	17.6	18.4
2023-07-13	late morning	15.9	28.2	12.9	17.5	18.4
2023-07-13	afternoon	15.9	27.8	12.8	17.2	18.5
2023-07-13	evening	15.8	27.7	12.8	17.1	18.4
2023-07-14	early morning	15.6	27.7	12.8	17.0	18.3
2023-07-14	late morning	15.6	27.6	12.8	17.0	18.3
2023-07-14	afternoon	15.6	27.2	12.7	16.7	18.4
2023-07-14	evening	15.5	27.0	12.6	16.7	18.4
2023-07-15	early morning	15.5	26.9	12.6	16.7	18.3
2023-07-15	late morning	15.4	26.8	12.6	16.6	18.2
2023-07-15	afternoon	15.4	26.3	12.5	16.4	18.3
2023-07-15	evening	15.3	26.1	12.4	16.4	18.3
2023-07-16	early morning	15.4	26.0	12.4	16.4	18.2
2023-07-16	late morning	15.3	25.9	12.4	16.4	18.1
2023-07-16	afternoon	15.3	25.5	12.3	16.2	18.3
2023-07-16	evening	15.2	25.2	12.2	16.2	18.2
2023-07-17	early morning	15.2	25.2	12.2	16.2	18.1
2023-07-17	late morning	15.2	25.0	12.2	16.1	18.0
2023-07-17	afternoon	15.1	24.7	12.1	16.1	18.1
2023-07-17	evening	15.0	24.5	12.1	16.0	18.1
2023-07-18	early morning	15.0	24.4	12.1	16.0	18.0
2023-07-18	late morning	14.9	24.3	12.0	16.0	17.9
2023-07-18	afternoon	15.0	24.0	11.9	15.9	18.1
2023-07-18	evening	14.9	23.8	11.9	15.8	18.0
2023-07-19	early morning	14.9	23.8	11.9	15.8	17.9
2023-07-19	late morning	14.8	23.6	11.9	15.8	17.9

day	period	T14P1_S1	T14P7_S3	T15P2_S1	T15P5_S2	T15P8_S3
2023-07-19	afternoon	14.9	23.3	11.8	15.8	18.0
2023-07-19	evening	14.8	23.1	11.7	15.7	18.0
2023-07-20	early morning	14.7	23.0	11.7	15.7	17.9
2023-07-20	late morning	14.7	22.9	11.7	15.7	17.9
2023-07-20	afternoon	14.8	22.5	11.6	15.6	18.0
2023-07-20	evening	14.7	22.3	11.6	15.6	17.9
2023-07-21	early morning	14.7	22.2	11.5	15.6	17.9
2023-07-21	late morning	14.7	22.1	11.5	15.6	17.8
2023-07-21	afternoon	15.1	21.7	11.4	15.5	17.9
2023-07-21	evening	14.9	21.5	11.4	15.5	17.9
2023-07-22	early morning	15.3	21.4	11.4	15.5	17.8
2023-07-22	late morning	15.0	21.3	11.3	15.5	17.8
2023-07-22	afternoon	14.8	21.0	11.2	15.4	17.8
2023-07-22	evening	15.0	20.8	11.2	15.4	17.8
2023-07-23	early morning	15.1	20.8	11.2	15.4	17.7
2023-07-23	late morning	14.8	20.7	11.1	15.4	17.7
2023-07-23	afternoon	14.6	20.4	11.1	15.3	17.8
2023-07-23	evening	14.8	20.3	11.0	15.3	17.7
2023-07-24	early morning	14.8	20.2	11.0	15.3	17.7
2023-07-24	late morning	14.5	20.1	11.0	15.3	17.7
2023-07-24	afternoon	14.7	20.0	10.9	15.3	17.7
2023-07-24	evening	14.6	19.9	10.9	15.2	17.7
2023-07-25	early morning	15.0	19.9	10.9	15.2	17.6
2023-07-25	late morning	14.7	19.8	10.8	15.2	17.6
2023-07-25	afternoon	14.3	19.7	10.8	15.2	17.7
2023-07-25	evening	15.0	19.6	10.8	15.1	17.6
2023-07-26	early morning	16.0	19.5	10.8	15.1	17.5
2023-07-26	late morning	14.4	19.4	10.7	15.1	17.5
2023-07-26	afternoon	14.2	19.3	10.7	15.1	17.7
2023-07-26	evening	14.5	19.3	10.6	15.1	17.6
2023-07-27	early morning	14.6	19.2	10.6	15.1	17.5
2023-07-27	late morning	14.4	19.2	10.6	15.1	17.5
2023-07-27	afternoon	14.5	19.1	10.5	15.1	17.6
2023-07-27	evening	14.7	19.0	10.5	15.0	17.6
2023-07-28	early morning	14.6	19.0	10.5	15.0	17.5
2023-07-28	late morning	14.3	18.9	10.4	15.0	17.5
2023-07-28	afternoon	14.4	18.8	10.4	15.0	17.7
2023-07-28	evening	14.4	18.8	10.4	14.9	17.6
2023-07-29	early morning	14.6	18.8	10.4	14.9	17.5
2023-07-29	late morning	14.3	18.7	10.3	14.9	17.5
2023-07-29	afternoon	14.1	18.6	10.4	14.9	17.6
2023-07-29	evening	14.1	18.5	10.3	14.9	17.6
2023-07-30	early morning	14.4	18.5	10.3	14.8	17.5
2023-07-30	late morning	14.0	18.4	10.2	14.9	17.5
2023-07-30	afternoon	14.0	18.4	10.2	14.9	17.6
2023-07-30	evening	14.2	18.3	10.2	14.8	17.5
2023-07-31	early morning	14.4	18.3	10.2	14.7	17.4
2023-07-31	late morning	13.9	18.2	10.1	14.8	17.4

day	period	T14P1_S1	T14P7_S3	T15P2_S1	T15P5_S2	T15P8_S3
2023-07-31	afternoon	14.1	18.1	10.1	14.8	17.6
2023-07-31	evening	14.1	18.1	10.1	14.7	17.5
2023-08-01	early morning	14.4	18.1	10.1	14.7	17.4
2023-08-01	late morning	13.7	18.0	10.0	14.7	17.4
2023-08-01	afternoon	13.7	17.9	10.0	14.7	17.6
2023-08-01	evening	14.2	17.9	10.0	14.6	17.5
2023-08-02	early morning	14.4	17.9	10.0	14.6	17.4
2023-08-02	late morning	13.7	17.8	9.9	14.6	17.4
2023-08-02	afternoon	13.7	17.7	9.9	14.6	17.5
2023-08-02	evening	14.3	17.7	9.9	14.5	17.5
2023-08-03	early morning	14.6	17.7	9.9	14.5	17.4
2023-08-03	late morning	13.5	17.6	9.8	14.5	17.4
2023-08-03	afternoon	13.5	17.6	9.8	14.5	17.5
2023-08-03	evening	14.3	17.5	9.8	14.5	17.5
2023-08-04	early morning	14.3	17.5	9.8	14.4	17.4
2023-08-04	late morning	13.6	17.4	9.7	14.4	17.4
2023-08-04	afternoon	13.5	17.4	9.7	14.4	17.5
2023-08-04	evening	13.9	17.4	9.7	14.4	17.5
2023-08-05	early morning	13.7	17.4	9.7	14.3	17.4
2023-08-05	late morning	13.6	17.3	9.6	14.4	17.4
2023-08-05	afternoon	13.7	17.4	9.6	18.6	17.6
2023-08-05	evening	13.8	17.4	9.7	19.9	17.7
2023-08-06	early morning	14.0	17.4	9.6	19.7	17.7
2023-08-06	late morning	13.9	17.4	9.6	19.2	17.7
2023-08-06	afternoon	14.1	17.4	9.6	19.3	17.8
2023-08-06	evening	14.0	17.4	9.7	18.1	17.8
2023-08-07	early morning	13.7	17.4	9.6	17.8	17.8
2023-08-07	late morning	17.1	21.7	12.3	22.6	19.1
2023-08-07	afternoon	23.7	27.2	21.7	26.6	21.4
2023-08-07	evening	23.5	26.2	21.3	25.5	21.2
2023-08-08	early morning	23.6	25.8	21.0	24.9	21.0
2023-08-08	late morning	23.0	25.4	20.6	24.5	20.8
2023-08-08	afternoon	22.6	24.8	20.3	24.0	20.8
2023-08-08	evening	22.5	24.4	19.9	23.7	20.6
2023-08-09	early morning	22.6	24.3	19.7	23.5	20.5
2023-08-09	late morning	22.0	24.0	19.4	23.3	20.3
2023-08-09	afternoon	21.5	23.5	19.1	22.8	20.2
2023-08-09	evening	21.5	23.1	18.8	22.6	20.1
2023-08-10	early morning	21.3	23.0	18.6	22.4	20.0
2023-08-10	late morning	20.7	22.8	18.3	22.1	19.9
2023-08-10	afternoon	20.4	22.3	18.0	21.6	19.8
2023-08-10	evening	20.3	21.9	17.8	21.3	19.7
2023-08-11	early morning	20.0	21.8	17.6	21.1	19.6
2023-08-11	late morning	19.6	21.6	17.4	20.9	19.5
2023-08-11	afternoon	19.2	21.1	17.1	20.3	19.5
2023-08-11	evening	19.1	20.7	16.8	19.9	19.3
2023-08-12	early morning	19.0	20.6	16.6	19.7	19.2
2023-08-12	late morning	18.4	20.4	16.4	19.4	19.1

day	period	T14P1_S1	T14P7_S3	T15P2_S1	T15P5_S2	T15P8_S3
2023-08-12	afternoon	18.1	20.0	16.1	18.9	19.1
2023-08-12	evening	18.2	19.7	15.8	18.5	19.0
2023-08-13	early morning	18.0	19.6	15.7	18.4	18.9
2023-08-13	late morning	17.7	19.5	15.5	18.1	18.8
2023-08-13	afternoon	17.3	19.2	15.2	17.7	18.8
2023-08-13	evening	17.7	19.0	14.9	17.4	18.7
2023-08-14	early morning	17.1	18.9	14.8	17.3	18.6
2023-08-14	late morning	16.8	18.8	14.6	17.1	18.5
2023-08-14	afternoon	16.7	18.5	14.3	16.8	18.5
2023-08-14	evening	16.5	18.4	14.1	16.6	18.4
2023-08-15	early morning	16.4	18.3	14.0	16.5	18.4
2023-08-15	late morning	16.3	18.2	13.8	16.4	18.3
2023-08-15	afternoon	16.2	18.0	13.5	16.2	18.4
2023-08-15	evening	16.1	17.9	13.3	16.0	18.2
2023-08-16	early morning	16.2	17.8	13.2	15.9	18.1
2023-08-16	late morning	16.1	17.7	13.1	15.9	18.1
2023-08-16	afternoon	16.0	17.6	12.9	15.8	18.1
2023-08-16	evening	15.9	17.5	12.7	15.6	18.1
2023-08-17	early morning	16.3	17.4	12.7	15.6	18.0
2023-08-17	late morning	15.7	17.3	12.5	15.6	17.9
2023-08-17	afternoon	15.6	17.3	12.4	15.5	18.0
2023-08-17	evening	15.6	17.2	12.2	15.4	17.9
2023-08-18	early morning	15.9	17.1	12.2	15.4	17.8
2023-08-18	late morning	15.4	17.1	12.0	15.3	17.8
2023-08-18	afternoon	15.3	17.0	11.9	15.3	17.9
2023-08-18	evening	15.5	16.9	11.8	15.1	17.8
2023-08-19	early morning	15.9	16.9	11.7	15.1	17.7
2023-08-19	late morning	15.3	16.8	11.7	15.1	17.6
2023-08-19	afternoon	15.1	16.7	11.6	15.1	17.8
2023-08-19	evening	15.6	16.7	11.5	15.0	17.7
2023-08-20	early morning	15.4	16.7	11.4	14.9	17.6
2023-08-20	late morning	14.9	16.6	11.3	15.0	17.6
2023-08-20	afternoon	14.9	16.6	11.3	15.0	17.7
2023-08-20	evening	15.2	16.6	11.2	14.9	17.6
2023-08-21	early morning	15.2	16.5	11.1	14.8	17.5
2023-08-21	late morning	14.9	16.5	11.1	14.9	17.5
2023-08-21	afternoon	14.9	16.5	11.0	14.9	17.7
2023-08-21	evening	14.9	16.5	10.9	14.8	17.6
2023-08-22	early morning	15.5	16.4	10.9	14.8	17.5
2023-08-22	late morning	15.0	16.4	10.8	14.8	17.5
2023-08-22	afternoon	15.2	16.4	10.8	14.8	17.6
2023-08-22	evening	15.1	16.4	10.7	14.7	17.6
2023-08-23	early morning	15.2	16.3	10.7	14.7	17.5
2023-08-23	late morning	14.8	16.3	10.6	14.7	17.5
2023-08-23	afternoon	14.7	16.3	10.6	14.7	17.6
2023-08-23	evening	15.0	16.3	10.5	14.6	17.5
2023-08-24	early morning	15.0	16.2	10.5	14.6	17.4
2023-08-24	late morning	14.6	16.2	10.4	14.6	17.4

day	period	T14P1_S1	T14P7_S3	T15P2_S1	T15P5_S2	T15P8_S3
2023-08-24	afternoon	14.6	16.2	10.4	14.7	17.6
2023-08-24	evening	14.5	16.2	10.3	14.6	17.4
2023-08-25	early morning	14.4	16.1	10.3	14.6	17.4
2023-08-25	late morning	14.3	16.1	10.2	14.6	17.4
2023-08-25	afternoon	14.4	16.1	10.2	14.7	17.5
2023-08-25	evening	14.4	16.1	10.2	14.6	17.4
2023-08-26	early morning	14.3	16.1	10.2	14.6	17.4
2023-08-26	late morning	14.4	16.0	10.1	14.6	17.4
2023-08-26	afternoon	14.5	16.1	10.1	14.7	17.6
2023-08-26	evening	14.4	16.1	10.1	14.6	17.5
2023-08-27	early morning	14.3	16.0	10.0	14.5	17.4
2023-08-27	late morning	14.4	16.0	10.0	14.6	17.4
2023-08-27	afternoon	14.6	16.0	10.0	14.7	17.5
2023-08-27	evening	14.3	16.0	10.0	14.5	17.5
2023-08-28	early morning	14.3	15.9	9.9	14.5	17.4
2023-08-28	late morning	14.2	15.8	9.8	14.5	17.4
2023-08-28	afternoon	14.4	15.9	9.8	14.6	17.5
2023-08-28	evening	14.2	15.9	9.8	14.5	17.4
2023-08-29	early morning	14.5	15.8	9.8	14.9	17.4
2023-08-29	late morning	14.5	15.8	9.8	15.9	17.5
2023-08-29	afternoon	14.3	15.9	9.8	16.2	17.6
2023-08-29	evening	14.2	16.5	9.8	16.6	17.6
2023-08-30	early morning	14.5	23.1	10.5	23.5	18.2
2023-08-30	late morning	14.7	22.6	10.7	22.7	18.1
2023-08-30	afternoon	14.5	22.3	10.8	22.2	18.2
2023-08-30	evening	14.5	21.9	11.0	21.7	18.1
2023-08-31	early morning	14.4	21.7	11.0	21.2	18.1
2023-08-31	late morning	14.5	21.5	11.0	20.8	18.1
2023-08-31	afternoon	14.6	21.2	11.0	20.4	18.2
2023-08-31	evening	14.6	21.0	11.1	20.0	18.2

Table H.5 Percent soil moisture (VWC) for sensors from transects 16 and 18.

day	period	T16P7_S1	T16P4_S2	T16P1_S3	T18P1_S1	T18P4_S2	T18P7_S3
2023-05-13	late morning	NA	NA	NA	NA	NA	NA
2023-05-13	afternoon	NA	NA	NA	NA	NA	NA
2023-05-13	evening	NA	NA	NA	35.9	NA	36.9
2023-05-14	early morning	NA	NA	NA	36.0	NA	36.9
2023-05-14	late morning	NA	NA	NA	36.1	NA	37.0
2023-05-14	afternoon	NA	NA	NA	35.9	NA	37.0
2023-05-14	evening	NA	NA	NA	35.8	NA	36.8
2023-05-15	early morning	NA	NA	NA	35.9	NA	36.7
2023-05-15	late morning	NA	NA	NA	36.0	NA	36.7
2023-05-15	afternoon	NA	NA	NA	35.8	NA	36.7
2023-05-15	evening	NA	NA	NA	35.8	NA	36.3
2023-05-16	early morning	NA	NA	NA	35.8	NA	36.2

day	period	T16P7_S1	T16P4_S2	T16P1_S3	T18P1_S1	T18P4_S2	T18P7_S3
2023-05-16	late morning	NA	NA	NA	35.8	NA	36.2
2023-05-16	afternoon	NA	NA	NA	35.6	NA	36.2
2023-05-16	evening	NA	NA	NA	34.9	NA	36.0
2023-05-17	early morning	NA	NA	NA	35.0	NA	35.8
2023-05-17	late morning	NA	NA	NA	35.1	NA	35.9
2023-05-17	afternoon	NA	NA	NA	34.9	NA	35.7
2023-05-17	evening	NA	NA	NA	34.8	NA	35.4
2023-05-18	early morning	NA	NA	NA	34.9	NA	35.2
2023-05-18	late morning	NA	NA	NA	34.9	NA	35.2
2023-05-18	afternoon	NA	NA	NA	34.8	NA	35.0
2023-05-18	evening	NA	NA	NA	34.7	NA	34.8
2023-05-19	early morning	NA	NA	NA	34.7	NA	34.6
2023-05-19	late morning	NA	NA	NA	34.8	NA	34.7
2023-05-19	afternoon	NA	NA	NA	34.6	NA	34.3
2023-05-19	evening	NA	NA	NA	34.5	NA	34.1
2023-05-20	early morning	NA	NA	NA	34.5	NA	34.1
2023-05-20	late morning	NA	NA	NA	34.5	NA	34.0
2023-05-20	afternoon	NA	NA	NA	34.2	NA	33.7
2023-05-20	evening	NA	NA	NA	33.8	NA	33.4
2023-05-21	early morning	NA	NA	NA	33.8	NA	33.3
2023-05-21	late morning	NA	NA	NA	33.8	NA	33.2
2023-05-21	afternoon	NA	NA	NA	33.6	NA	32.9
2023-05-21	evening	NA	NA	NA	33.5	NA	32.5
2023-05-22	early morning	NA	NA	NA	33.5	NA	32.2
2023-05-22	late morning	NA	NA	NA	33.5	NA	32.1
2023-05-22	afternoon	NA	NA	NA	33.3	NA	32.0
2023-05-22	evening	NA	NA	NA	33.1	NA	31.5
2023-05-23	early morning	NA	NA	NA	33.2	NA	31.2
2023-05-23	late morning	NA	NA	NA	33.2	NA	31.2
2023-05-23	afternoon	NA	NA	NA	33.0	NA	31.1
2023-05-23	evening	NA	NA	NA	32.9	NA	30.8
2023-05-24	early morning	NA	NA	NA	32.9	NA	30.5
2023-05-24	late morning	NA	NA	NA	32.9	NA	30.5
2023-05-24	afternoon	NA	NA	NA	32.7	NA	30.5
2023-05-24	evening	NA	NA	NA	32.6	NA	30.1
2023-05-25	early morning	NA	NA	NA	32.6	NA	29.8
2023-05-25	late morning	NA	NA	NA	32.5	NA	29.8
2023-05-25	afternoon	NA	NA	NA	32.3	NA	29.7
2023-05-25	evening	NA	NA	NA	32.2	NA	29.4
2023-05-26	early morning	NA	NA	NA	32.2	NA	29.2
2023-05-26	late morning	NA	NA	NA	32.3	NA	29.1
2023-05-26	afternoon	NA	NA	NA	32.2	NA	29.2
2023-05-26	evening	NA	NA	NA	32.0	NA	28.9
2023-05-27	early morning	NA	NA	NA	32.0	NA	28.7
2023-05-27	late morning	NA	NA	NA	32.0	NA	28.6
2023-05-27	afternoon	NA	NA	NA	31.7	NA	28.6
2023-05-27	evening	NA	NA	NA	31.6	NA	28.3
2023-05-28	early morning	NA	NA	NA	31.5	NA	28.0

day	period	T16P7_S1	T16P4_S2	T16P1_S3	T18P1_S1	T18P4_S2	T18P7_S3
2023-05-28	late morning	NA	NA	NA	31.5	NA	27.9
2023-05-28	afternoon	NA	NA	NA	31.2	NA	27.9
2023-05-28	evening	NA	NA	NA	31.0	NA	27.6
2023-05-29	early morning	NA	NA	NA	31.0	NA	27.4
2023-05-29	late morning	NA	NA	NA	31.0	NA	27.3
2023-05-29	afternoon	NA	NA	NA	30.7	NA	27.2
2023-05-29	evening	NA	NA	NA	30.5	NA	26.9
2023-05-30	early morning	NA	NA	NA	30.4	NA	26.6
2023-05-30	late morning	NA	NA	NA	30.4	NA	26.5
2023-05-30	afternoon	NA	NA	NA	30.2	NA	26.5
2023-05-30	evening	NA	NA	NA	29.5	NA	26.2
2023-05-31	early morning	NA	NA	NA	29.3	NA	25.9
2023-05-31	late morning	NA	NA	NA	29.2	NA	25.8
2023-05-31	afternoon	NA	NA	NA	29.0	NA	25.8
2023-05-31	evening	NA	NA	NA	28.9	NA	25.5
2023-06-01	early morning	NA	NA	NA	28.9	NA	25.2
2023-06-01	late morning	NA	NA	NA	28.9	NA	25.1
2023-06-01	afternoon	NA	NA	NA	28.7	NA	25.1
2023-06-01	evening	NA	NA	NA	28.5	NA	24.9
2023-06-02	early morning	NA	NA	NA	28.5	NA	24.6
2023-06-02	late morning	21.2	29.4	21.6	28.5	NA	24.5
2023-06-02	afternoon	21.1	29.4	21.6	28.2	27.1	24.6
2023-06-02	evening	20.9	29.2	21.6	28.0	27.0	24.3
2023-06-03	early morning	21.0	29.1	21.6	28.0	27.0	24.0
2023-06-03	late morning	21.0	29.1	21.7	28.0	26.9	23.9
2023-06-03	afternoon	20.9	29.1	21.7	27.8	26.8	23.9
2023-06-03	evening	20.6	28.9	21.7	27.6	26.6	23.6
2023-06-04	early morning	20.7	28.8	21.7	27.5	26.6	23.4
2023-06-04	late morning	20.7	28.8	21.7	27.5	26.6	23.2
2023-06-04	afternoon	20.6	28.6	21.7	27.3	26.4	23.3
2023-06-04	evening	20.3	28.5	21.7	27.1	26.3	22.9
2023-06-05	early morning	20.3	28.3	21.7	27.0	26.3	22.6
2023-06-05	late morning	20.3	28.3	21.7	27.0	26.3	22.5
2023-06-05	afternoon	20.2	28.2	21.7	26.7	26.1	22.5
2023-06-05	evening	19.9	28.0	21.7	26.5	26.0	22.3
2023-06-06	early morning	19.9	27.9	21.7	26.5	26.0	22.0
2023-06-06	late morning	19.9	27.8	21.7	26.5	25.9	21.9
2023-06-06	afternoon	19.8	27.8	21.7	26.2	25.8	21.9
2023-06-06	evening	19.4	27.6	21.7	26.0	25.6	21.6
2023-06-07	early morning	19.4	27.4	21.7	25.9	25.6	21.3
2023-06-07	late morning	19.5	27.4	21.6	25.9	25.6	21.2
2023-06-07	afternoon	19.4	27.4	21.6	25.7	25.4	21.2
2023-06-07	evening	19.1	27.2	21.6	25.5	25.3	21.0
2023-06-08	early morning	18.8	27.1	21.6	25.4	25.3	20.7
2023-06-08	late morning	19.1	27.0	21.6	25.4	25.2	20.6
2023-06-08	afternoon	18.8	27.0	21.5	25.2	25.1	20.6
2023-06-08	evening	18.7	26.9	21.5	25.0	25.0	20.5
2023-06-09	early morning	18.6	26.8	21.5	25.1	25.0	20.4

day	period	T16P7_S1	T16P4_S2	T16P1_S3	T18P1_S1	T18P4_S2	T18P7_S3
2023-06-09	late morning	18.4	26.8	21.5	25.1	25.0	20.3
2023-06-09	afternoon	18.6	26.9	21.5	25.2	25.2	20.4
2023-06-09	evening	18.6	26.9	21.4	25.3	25.3	20.4
2023-06-10	early morning	18.7	26.9	21.4	25.3	25.3	20.3
2023-06-10	late morning	18.7	26.9	21.4	25.4	25.3	20.3
2023-06-10	afternoon	18.7	26.9	21.3	25.4	25.4	20.4
2023-06-10	evening	18.5	27.0	21.3	25.4	25.4	20.4
2023-06-11	early morning	18.7	26.9	21.3	25.5	25.4	20.3
2023-06-11	late morning	18.7	26.9	21.2	25.5	25.4	20.3
2023-06-11	afternoon	18.7	27.0	21.2	25.4	25.3	20.5
2023-06-11	evening	18.6	26.9	21.2	25.3	25.3	20.4
2023-06-12	early morning	18.3	26.9	21.1	25.3	25.3	20.3
2023-06-12	late morning	18.5	26.9	21.1	23.5	25.2	20.2
2023-06-12	afternoon	18.5	26.9	21.0	20.9	25.1	20.3
2023-06-12	evening	18.4	26.8	21.0	20.8	25.0	20.2
2023-06-13	early morning	18.2	26.7	21.0	20.8	25.0	20.0
2023-06-13	late morning	18.1	26.7	20.9	20.8	25.0	20.0
2023-06-13	afternoon	18.2	26.7	20.9	20.6	24.9	20.0
2023-06-13	evening	18.0	26.6	20.8	20.5	24.8	19.9
2023-06-14	early morning	17.8	26.4	20.8	20.5	24.7	19.7
2023-06-14	late morning	18.0	26.4	20.7	20.5	24.6	19.6
2023-06-14	afternoon	17.9	26.4	20.7	20.3	24.5	19.7
2023-06-14	evening	17.7	26.2	20.6	20.2	24.4	19.6
2023-06-15	early morning	17.6	26.1	20.6	20.2	24.4	19.4
2023-06-15	late morning	17.8	26.1	20.5	20.2	24.3	19.3
2023-06-15	afternoon	17.6	26.1	20.5	20.1	24.2	19.4
2023-06-15	evening	17.4	26.0	20.4	20.0	24.1	19.3
2023-06-16	early morning	17.3	25.8	20.4	20.0	24.0	19.1
2023-06-16	late morning	17.5	25.8	20.3	19.9	24.0	19.0
2023-06-16	afternoon	17.4	25.8	20.3	19.7	23.9	19.2
2023-06-16	evening	17.3	25.7	20.2	19.6	23.7	19.0
2023-06-17	early morning	17.0	25.6	20.2	19.6	23.7	18.9
2023-06-17	late morning	17.2	25.6	20.1	19.6	23.6	18.8
2023-06-17	afternoon	17.1	25.5	20.1	19.4	23.5	18.9
2023-06-17	evening	17.0	25.4	20.0	19.3	23.4	18.8
2023-06-18	early morning	16.8	25.3	19.9	19.3	23.3	18.6
2023-06-18	late morning	16.9	25.2	19.9	19.2	23.2	18.5
2023-06-18	afternoon	16.8	25.1	19.8	19.1	23.1	18.6
2023-06-18	evening	16.6	25.0	19.8	19.0	23.0	18.5
2023-06-19	early morning	16.7	24.9	19.7	19.0	23.0	18.3
2023-06-19	late morning	16.7	24.9	19.7	19.0	22.9	18.3
2023-06-19	afternoon	16.7	24.9	19.6	18.8	22.8	18.5
2023-06-19	evening	16.4	24.7	19.5	18.7	22.7	18.3
2023-06-20	early morning	16.5	24.6	19.5	18.7	22.6	18.2
2023-06-20	late morning	16.6	24.6	19.4	18.7	22.6	18.1
2023-06-20	afternoon	16.5	24.6	19.3	18.6	22.6	18.3
2023-06-20	evening	16.3	24.5	19.3	18.5	22.4	18.2
2023-06-21	early morning	16.3	24.4	19.2	18.5	22.4	18.0

day	period	T16P7_S1	T16P4_S2	T16P1_S3	T18P1_S1	T18P4_S2	T18P7_S3
2023-06-21	late morning	16.4	24.4	19.2	18.5	22.4	18.0
2023-06-21	afternoon	16.3	24.4	19.1	18.3	22.3	18.2
2023-06-21	evening	16.1	24.3	19.0	18.2	22.2	18.1
2023-06-22	early morning	16.1	24.2	19.0	18.3	22.2	17.9
2023-06-22	late morning	16.3	24.2	18.9	18.3	22.1	17.9
2023-06-22	afternoon	16.2	24.2	18.8	18.1	22.0	18.1
2023-06-22	evening	16.0	24.1	18.8	18.0	21.9	18.0
2023-06-23	early morning	16.0	24.0	18.7	18.0	21.8	17.8
2023-06-23	late morning	16.1	24.0	18.6	18.0	21.8	17.8
2023-06-23	afternoon	16.0	24.0	18.6	17.7	21.7	17.9
2023-06-23	evening	15.9	23.9	18.5	17.6	21.6	17.9
2023-06-24	early morning	15.7	23.8	18.4	17.6	21.6	17.7
2023-06-24	late morning	15.9	23.8	18.4	17.6	21.5	17.7
2023-06-24	afternoon	15.9	23.8	18.3	17.4	21.4	17.9
2023-06-24	evening	15.8	23.7	18.2	17.2	21.3	17.8
2023-06-25	early morning	15.5	23.6	18.2	17.2	21.2	17.6
2023-06-25	late morning	15.7	23.5	18.1	17.2	21.2	17.6
2023-06-25	afternoon	15.8	23.5	18.0	16.9	21.0	17.8
2023-06-25	evening	15.6	23.4	18.0	16.8	20.9	17.7
2023-06-26	early morning	15.4	23.3	17.9	16.8	20.8	17.5
2023-06-26	late morning	15.4	23.2	17.8	16.8	20.8	17.5
2023-06-26	afternoon	15.6	23.2	17.8	16.5	20.7	17.6
2023-06-26	evening	15.5	23.1	17.7	16.4	20.5	17.5
2023-06-27	early morning	15.3	23.0	17.7	16.4	20.5	17.4
2023-06-27	late morning	15.3	23.0	17.6	16.9	20.4	17.4
2023-06-27	afternoon	15.5	22.9	17.5	16.9	20.3	17.6
2023-06-27	evening	15.5	22.9	17.5	16.8	20.3	17.4
2023-06-28	early morning	15.3	22.8	17.4	16.8	20.3	17.3
2023-06-28	late morning	15.3	22.8	17.3	16.8	20.3	17.3
2023-06-28	afternoon	15.5	22.8	17.3	16.6	20.1	17.5
2023-06-28	evening	15.4	22.8	17.2	16.5	20.0	17.4
2023-06-29	early morning	15.2	22.7	17.1	16.5	20.0	17.2
2023-06-29	late morning	15.2	22.7	17.1	16.5	19.9	17.2
2023-06-29	afternoon	15.4	22.7	17.0	16.2	19.8	17.4
2023-06-29	evening	14.9	22.6	17.0	16.0	19.6	17.2
2023-06-30	early morning	14.6	22.5	16.9	16.0	19.4	17.1
2023-06-30	late morning	14.7	22.5	16.8	15.9	19.4	17.0
2023-06-30	afternoon	14.9	22.5	16.8	14.7	19.2	17.3
2023-06-30	evening	14.7	22.4	16.7	14.5	19.1	17.1
2023-07-01	early morning	14.5	22.3	16.7	14.5	19.1	17.0
2023-07-01	late morning	14.5	22.3	16.6	14.5	19.0	16.9
2023-07-01	afternoon	14.7	22.2	16.5	14.2	18.9	17.2
2023-07-01	evening	14.5	22.1	16.5	14.0	18.7	17.0
2023-07-02	early morning	14.3	22.0	16.4	14.0	18.7	16.9
2023-07-02	late morning	14.3	21.9	16.4	14.0	18.7	16.8
2023-07-02	afternoon	14.5	21.9	16.3	13.7	18.5	17.0
2023-07-02	evening	14.3	21.8	16.3	13.5	18.4	16.9
2023-07-03	early morning	14.1	21.7	16.2	13.5	18.4	16.7

day	period	T16P7_S1	T16P4_S2	T16P1_S3	T18P1_S1	T18P4_S2	T18P7_S3
2023-07-03	late morning	14.1	21.7	16.1	13.5	18.3	16.7
2023-07-03	afternoon	14.3	21.6	16.1	13.1	18.2	16.9
2023-07-03	evening	14.1	21.5	16.0	12.9	18.1	16.8
2023-07-04	early morning	13.9	21.4	16.0	12.9	18.0	16.6
2023-07-04	late morning	13.9	21.4	15.9	12.9	18.0	16.6
2023-07-04	afternoon	14.1	21.4	15.9	12.5	17.9	16.8
2023-07-04	evening	14.0	21.3	15.8	12.3	17.8	16.7
2023-07-05	early morning	13.8	21.2	15.8	12.3	17.7	16.6
2023-07-05	late morning	13.8	21.2	15.7	12.3	17.7	16.5
2023-07-05	afternoon	14.0	21.2	15.7	12.0	17.6	16.7
2023-07-05	evening	13.8	21.1	15.6	11.8	17.5	16.5
2023-07-06	early morning	13.6	21.0	15.6	11.8	17.4	16.4
2023-07-06	late morning	13.7	21.0	15.6	11.8	17.4	16.4
2023-07-06	afternoon	13.9	21.0	15.5	11.5	17.3	16.6
2023-07-06	evening	13.7	20.9	15.5	11.3	17.2	16.5
2023-07-07	early morning	13.5	20.8	15.4	11.3	17.2	16.4
2023-07-07	late morning	13.5	20.8	15.4	11.3	17.1	16.4
2023-07-07	afternoon	13.8	20.8	15.3	11.2	17.0	16.6
2023-07-07	evening	13.6	20.7	15.3	11.1	16.9	16.4
2023-07-08	early morning	13.4	20.6	15.3	11.0	16.9	16.3
2023-07-08	late morning	13.4	20.6	15.2	11.1	16.9	16.3
2023-07-08	afternoon	13.7	20.6	15.2	10.8	16.7	16.5
2023-07-08	evening	13.5	20.6	15.2	10.6	16.6	16.4
2023-07-09	early morning	13.3	20.5	15.1	10.6	16.6	16.2
2023-07-09	late morning	13.3	20.5	15.1	10.6	16.6	16.2
2023-07-09	afternoon	13.4	20.5	15.1	10.6	16.6	16.2
2023-07-09	evening	13.3	20.5	15.0	10.5	16.5	16.2
2023-07-10	early morning	13.1	20.4	15.0	10.5	16.6	16.1
2023-07-10	late morning	13.2	20.3	15.0	10.7	16.8	16.2
2023-07-10	afternoon	13.7	20.5	15.0	10.7	18.5	16.3
2023-07-10	evening	13.8	20.6	14.9	10.8	19.6	16.3
2023-07-11	early morning	13.7	20.6	14.9	10.8	19.4	16.2
2023-07-11	late morning	13.7	20.5	14.9	10.8	19.2	16.2
2023-07-11	afternoon	14.0	20.6	15.0	10.8	18.8	16.4
2023-07-11	evening	13.9	20.6	14.8	10.7	18.6	16.3
2023-07-12	early morning	13.8	20.5	14.8	10.7	18.5	16.2
2023-07-12	late morning	13.9	20.5	14.8	10.7	18.4	16.2
2023-07-12	afternoon	14.0	20.6	14.9	10.7	18.1	16.4
2023-07-12	evening	13.9	20.5	14.8	10.6	17.9	16.3
2023-07-13	early morning	13.6	20.4	14.8	10.6	17.9	16.1
2023-07-13	late morning	13.7	20.4	14.8	10.3	17.8	16.1
2023-07-13	afternoon	13.9	20.5	14.8	9.9	17.5	16.4
2023-07-13	evening	13.7	20.4	14.8	9.8	17.4	16.3
2023-07-14	early morning	13.5	20.3	14.8	9.8	17.3	16.1
2023-07-14	late morning	13.5	20.3	14.7	9.8	17.3	16.1
2023-07-14	afternoon	13.8	20.4	14.7	9.8	17.1	16.3
2023-07-14	evening	13.6	20.3	14.7	9.7	16.9	16.2
2023-07-15	early morning	13.4	20.2	14.7	9.6	16.9	16.1

day	period	T16P7_S1	T16P4_S2	T16P1_S3	T18P1_S1	T18P4_S2	T18P7_S3
2023-07-15	late morning	13.4	20.2	14.7	9.7	16.8	16.0
2023-07-15	afternoon	13.7	20.2	14.7	9.6	16.7	16.3
2023-07-15	evening	13.5	20.1	14.7	9.4	16.5	16.2
2023-07-16	early morning	13.3	20.0	14.7	9.3	16.5	16.0
2023-07-16	late morning	13.3	20.0	14.7	9.4	16.4	16.0
2023-07-16	afternoon	13.6	20.1	14.7	9.3	16.3	16.2
2023-07-16	evening	13.4	20.0	14.7	9.1	16.2	16.1
2023-07-17	early morning	13.1	19.9	14.7	9.1	16.1	15.9
2023-07-17	late morning	13.2	19.8	14.7	9.1	16.1	15.9
2023-07-17	afternoon	13.4	19.8	14.7	9.1	16.0	16.1
2023-07-17	evening	13.2	19.7	14.7	8.9	15.8	15.9
2023-07-18	early morning	12.9	19.6	14.7	8.8	15.8	15.8
2023-07-18	late morning	13.0	19.6	14.7	8.8	15.8	15.8
2023-07-18	afternoon	13.3	19.6	14.6	8.8	15.7	16.0
2023-07-18	evening	13.1	19.5	14.6	8.6	15.6	15.9
2023-07-19	early morning	12.9	19.4	14.6	8.6	15.5	15.7
2023-07-19	late morning	12.9	19.5	14.6	8.6	15.5	15.7
2023-07-19	afternoon	13.3	19.5	14.7	8.6	15.4	16.0
2023-07-19	evening	13.1	19.4	14.4	8.4	15.3	15.8
2023-07-20	early morning	12.9	19.3	14.2	8.2	15.2	15.6
2023-07-20	late morning	12.9	19.3	14.5	8.3	15.2	15.6
2023-07-20	afternoon	13.2	19.4	14.5	8.4	15.1	15.8
2023-07-20	evening	13.1	19.3	14.4	8.1	15.0	15.7
2023-07-21	early morning	12.8	19.2	14.3	8.0	15.0	15.5
2023-07-21	late morning	12.9	19.2	14.5	8.1	15.0	15.5
2023-07-21	afternoon	13.2	19.3	14.6	8.1	14.8	15.7
2023-07-21	evening	12.9	19.2	14.3	7.9	14.7	15.6
2023-07-22	early morning	12.6	19.1	14.2	7.8	14.6	15.3
2023-07-22	late morning	12.7	19.0	14.4	7.8	14.6	15.3
2023-07-22	afternoon	13.0	19.1	14.4	7.9	14.6	15.6
2023-07-22	evening	12.8	19.0	14.3	7.7	14.4	15.4
2023-07-23	early morning	12.5	18.9	14.1	7.6	14.4	15.2
2023-07-23	late morning	12.6	18.9	14.3	7.6	14.4	15.2
2023-07-23	afternoon	12.9	18.9	14.4	7.7	14.3	15.4
2023-07-23	evening	12.7	18.9	14.2	7.5	14.2	15.3
2023-07-24	early morning	12.5	18.8	14.1	7.4	14.1	15.1
2023-07-24	late morning	12.5	18.7	14.3	7.4	14.1	15.0
2023-07-24	afternoon	12.7	18.8	14.2	7.5	14.0	15.2
2023-07-24	evening	12.5	18.7	14.0	7.3	13.9	15.1
2023-07-25	early morning	12.3	18.6	13.9	7.2	13.8	14.9
2023-07-25	late morning	12.3	18.6	14.1	7.2	13.8	14.9
2023-07-25	afternoon	12.6	18.7	14.2	7.3	13.8	15.0
2023-07-25	evening	12.4	18.6	14.0	7.1	13.7	14.9
2023-07-26	early morning	12.1	18.5	13.8	7.0	13.6	14.7
2023-07-26	late morning	12.1	18.5	14.1	7.1	13.7	14.7
2023-07-26	afternoon	12.6	18.6	14.0	7.2	13.6	15.0
2023-07-26	evening	12.3	18.5	14.0	7.0	13.5	14.9
2023-07-27	early morning	12.1	18.4	13.8	6.9	13.5	14.7

day	period	T16P7_S1	T16P4_S2	T16P1_S3	T18P1_S1	T18P4_S2	T18P7_S3
2023-07-27	late morning	12.1	18.4	14.0	6.9	13.5	14.7
2023-07-27	afternoon	12.4	18.5	13.8	7.0	13.5	14.9
2023-07-27	evening	12.2	18.4	13.9	6.9	13.4	14.7
2023-07-28	early morning	12.0	18.3	13.8	6.8	13.3	14.6
2023-07-28	late morning	12.1	18.3	13.9	6.8	13.3	14.6
2023-07-28	afternoon	12.4	18.4	13.8	7.0	13.3	14.8
2023-07-28	evening	12.2	18.4	13.9	6.8	13.1	14.7
2023-07-29	early morning	12.0	18.3	13.8	6.7	13.1	14.5
2023-07-29	late morning	12.0	18.3	13.9	6.7	13.1	14.5
2023-07-29	afternoon	12.5	18.4	13.7	6.9	13.1	14.8
2023-07-29	evening	12.2	18.3	13.8	6.7	13.0	14.6
2023-07-30	early morning	12.0	18.2	13.7	6.5	12.9	14.4
2023-07-30	late morning	12.0	18.2	13.8	6.6	12.9	14.4
2023-07-30	afternoon	12.3	18.3	13.6	6.8	12.9	14.6
2023-07-30	evening	12.1	18.2	13.5	6.5	12.8	14.5
2023-07-31	early morning	11.8	18.1	13.4	6.4	12.7	14.3
2023-07-31	late morning	11.8	18.1	13.6	6.4	12.7	14.2
2023-07-31	afternoon	12.3	18.2	13.4	6.6	12.7	14.5
2023-07-31	evening	12.0	18.1	13.4	6.4	12.6	14.4
2023-08-01	early morning	11.7	18.0	13.3	6.2	12.5	14.2
2023-08-01	late morning	11.7	18.0	13.5	6.3	12.6	14.1
2023-08-01	afternoon	12.2	18.1	13.3	6.5	12.6	14.5
2023-08-01	evening	12.0	18.0	13.3	6.3	12.4	14.3
2023-08-02	early morning	11.7	17.9	13.3	6.1	12.4	14.1
2023-08-02	late morning	11.7	17.9	13.4	6.2	12.4	14.1
2023-08-02	afternoon	12.2	18.0	13.2	6.4	12.4	14.4
2023-08-02	evening	11.9	17.9	13.1	6.2	12.3	14.2
2023-08-03	early morning	11.6	17.8	13.0	6.0	12.2	14.0
2023-08-03	late morning	11.7	17.8	13.2	6.1	12.2	14.0
2023-08-03	afternoon	12.1	17.9	13.1	6.3	12.3	14.3
2023-08-03	evening	11.9	17.9	13.1	6.1	12.2	14.1
2023-08-04	early morning	11.6	17.7	13.1	5.9	12.1	13.9
2023-08-04	late morning	11.7	17.7	13.2	6.0	12.1	13.9
2023-08-04	afternoon	12.1	17.8	13.0	6.2	12.1	14.2
2023-08-04	evening	11.9	17.8	12.9	6.1	12.0	14.0
2023-08-05	early morning	11.7	17.7	12.9	5.9	12.0	13.9
2023-08-05	late morning	11.7	17.7	12.9	5.9	12.0	13.9
2023-08-05	afternoon	11.9	17.9	14.0	6.1	12.9	13.9
2023-08-05	evening	12.0	17.9	14.3	6.2	13.2	13.9
2023-08-06	early morning	11.9	17.9	14.1	6.2	13.2	13.8
2023-08-06	late morning	11.9	17.9	14.0	6.3	13.1	13.9
2023-08-06	afternoon	12.2	18.1	14.0	6.5	13.0	14.1
2023-08-06	evening	12.1	18.0	13.9	6.4	12.9	13.9
2023-08-07	early morning	11.9	17.9	13.8	6.3	12.9	13.9
2023-08-07	late morning	14.8	19.6	18.0	10.9	20.2	14.1
2023-08-07	afternoon	22.4	23.2	24.3	18.6	27.6	14.7
2023-08-07	evening	21.7	22.8	22.7	17.4	25.8	14.8
2023-08-08	early morning	21.4	22.6	21.9	16.8	25.1	14.7

day	period	T16P7_S1	T16P4_S2	T16P1_S3	T18P1_S1	T18P4_S2	T18P7_S3
2023-08-08	late morning	21.1	22.4	21.4	16.4	24.6	14.7
2023-08-08	afternoon	21.0	22.4	20.9	15.6	23.9	14.9
2023-08-08	evening	20.4	22.2	20.4	14.9	23.4	14.9
2023-08-09	early morning	20.2	21.9	20.1	14.6	23.0	14.9
2023-08-09	late morning	20.1	21.8	19.9	14.4	22.7	14.8
2023-08-09	afternoon	20.0	21.7	19.4	13.5	22.2	15.0
2023-08-09	evening	19.5	21.5	19.0	12.7	21.7	15.0
2023-08-10	early morning	19.3	21.4	18.8	12.5	21.4	14.9
2023-08-10	late morning	19.2	21.3	18.6	12.4	21.1	14.9
2023-08-10	afternoon	19.1	21.2	18.2	11.5	20.5	15.2
2023-08-10	evening	18.6	21.0	17.8	10.9	20.0	15.1
2023-08-11	early morning	18.5	20.9	17.7	10.8	19.6	14.9
2023-08-11	late morning	18.3	20.8	17.7	10.8	19.3	14.9
2023-08-11	afternoon	18.3	20.7	17.3	10.2	18.7	15.2
2023-08-11	evening	17.7	20.5	17.0	9.7	18.1	15.1
2023-08-12	early morning	17.6	20.4	16.9	9.6	17.8	15.0
2023-08-12	late morning	17.5	20.3	16.8	9.5	17.5	15.0
2023-08-12	afternoon	17.3	20.2	16.5	9.2	16.8	15.2
2023-08-12	evening	16.9	20.1	16.2	8.8	16.3	15.1
2023-08-13	early morning	16.5	19.9	16.1	8.7	16.1	14.9
2023-08-13	late morning	16.6	19.8	16.1	8.7	15.8	14.9
2023-08-13	afternoon	16.5	19.8	15.8	8.5	15.3	15.2
2023-08-13	evening	16.1	19.6	15.6	8.2	14.9	15.0
2023-08-14	early morning	15.7	19.5	15.5	8.0	14.8	14.9
2023-08-14	late morning	15.7	19.4	15.5	8.0	14.6	14.8
2023-08-14	afternoon	15.8	19.4	15.3	8.0	14.3	15.1
2023-08-14	evening	15.4	19.3	15.0	7.7	14.0	14.9
2023-08-15	early morning	15.0	19.1	14.9	7.5	13.9	14.8
2023-08-15	late morning	14.9	19.0	14.9	7.6	13.8	14.7
2023-08-15	afternoon	15.1	19.1	14.9	7.6	13.6	15.0
2023-08-15	evening	14.8	18.9	14.5	7.3	13.3	14.8
2023-08-16	early morning	14.5	18.7	14.4	7.1	13.2	14.6
2023-08-16	late morning	14.3	18.7	14.5	7.2	13.2	14.6
2023-08-16	afternoon	14.5	18.7	14.4	7.3	13.1	14.9
2023-08-16	evening	14.3	18.6	14.2	7.0	12.9	14.7
2023-08-17	early morning	14.0	18.5	14.1	6.8	12.8	14.5
2023-08-17	late morning	13.9	18.4	14.1	6.9	12.8	14.5
2023-08-17	afternoon	14.1	18.5	14.1	7.0	12.7	14.7
2023-08-17	evening	13.9	18.4	13.9	6.8	12.5	14.6
2023-08-18	early morning	13.6	18.3	13.8	6.6	12.4	14.4
2023-08-18	late morning	13.5	18.2	13.8	6.6	12.4	14.3
2023-08-18	afternoon	13.7	18.3	13.8	6.7	12.4	14.6
2023-08-18	evening	13.4	18.1	13.6	6.4	12.2	14.4
2023-08-19	early morning	13.1	18.0	13.5	6.2	12.1	14.2
2023-08-19	late morning	13.1	18.0	13.6	6.2	12.1	14.1
2023-08-19	afternoon	13.3	18.1	13.5	6.4	12.2	14.3
2023-08-19	evening	13.1	17.9	13.4	6.2	12.0	14.2
2023-08-20	early morning	12.8	17.8	13.3	6.0	11.9	14.0

day	period	T16P7_S1	T16P4_S2	T16P1_S3	T18P1_S1	T18P4_S2	T18P7_S3
2023-08-20	late morning	13.0	17.8	13.3	6.0	12.0	14.0
2023-08-20	afternoon	13.1	17.9	13.4	6.2	12.0	14.3
2023-08-20	evening	12.9	17.8	13.2	6.1	11.9	14.2
2023-08-21	early morning	12.6	17.7	13.1	5.9	11.8	14.0
2023-08-21	late morning	12.8	17.7	13.2	5.9	11.8	14.0
2023-08-21	afternoon	12.9	17.8	13.2	6.0	11.9	14.1
2023-08-21	evening	12.8	17.8	13.1	5.8	11.8	14.1
2023-08-22	early morning	12.5	17.7	13.0	5.6	11.7	14.0
2023-08-22	late morning	12.7	17.7	13.1	5.7	11.7	13.9
2023-08-22	afternoon	12.9	17.8	13.1	5.9	11.8	14.2
2023-08-22	evening	12.7	17.7	12.9	5.7	11.6	14.1
2023-08-23	early morning	12.4	17.6	12.8	5.6	11.5	13.9
2023-08-23	late morning	12.6	17.6	12.9	5.6	11.6	13.9
2023-08-23	afternoon	12.7	17.7	13.0	5.7	11.6	14.1
2023-08-23	evening	12.4	17.6	12.8	5.6	11.5	14.0
2023-08-24	early morning	12.4	17.5	12.7	5.4	11.4	13.8
2023-08-24	late morning	12.5	17.5	12.8	5.5	11.5	13.8
2023-08-24	afternoon	12.7	17.6	13.0	5.8	11.6	14.1
2023-08-24	evening	12.4	17.5	12.7	5.6	11.5	14.0
2023-08-25	early morning	12.4	17.4	12.6	5.5	11.4	13.8
2023-08-25	late morning	12.5	17.4	12.6	5.4	11.5	13.8
2023-08-25	afternoon	12.7	17.6	12.9	NA	11.6	14.0
2023-08-25	evening	12.4	17.5	12.6	NA	11.5	13.9
2023-08-26	early morning	12.3	17.4	12.5	NA	11.4	13.7
2023-08-26	late morning	12.5	17.4	12.6	NA	11.4	13.8
2023-08-26	afternoon	12.7	17.6	13.0	NA	11.6	14.1
2023-08-26	evening	12.5	17.5	12.6	NA	11.4	14.0
2023-08-27	early morning	12.3	17.4	12.5	NA	11.3	13.8
2023-08-27	late morning	12.5	17.4	12.6	NA	11.4	13.8
2023-08-27	afternoon	12.7	17.6	13.0	NA	11.5	14.1
2023-08-27	evening	12.5	17.5	12.5	NA	11.4	13.9
2023-08-28	early morning	12.2	17.4	12.4	NA	11.3	13.8
2023-08-28	late morning	12.4	17.4	12.5	NA	11.3	13.8
2023-08-28	afternoon	12.7	17.5	12.9	NA	11.4	14.0
2023-08-28	evening	12.5	17.5	12.4	NA	11.3	13.9
2023-08-29	early morning	12.3	17.4	12.3	NA	11.4	13.8
2023-08-29	late morning	12.3	17.4	12.4	NA	11.8	13.7
2023-08-29	afternoon	12.6	17.5	12.5	NA	11.8	13.9
2023-08-29	evening	13.6	17.7	12.5	NA	13.0	13.8
2023-08-30	early morning	24.1	21.5	18.3	NA	25.9	14.0
2023-08-30	late morning	22.8	21.3	17.7	NA	24.0	14.1
2023-08-30	afternoon	22.3	21.2	17.1	NA	23.1	14.3
2023-08-30	evening	21.6	20.9	16.4	NA	22.3	14.2
2023-08-31	early morning	20.9	20.7	16.0	NA	21.7	14.1
2023-08-31	late morning	20.4	20.5	15.8	NA	21.2	14.1
2023-08-31	afternoon	20.0	20.4	15.4	NA	20.5	14.2
2023-08-31	evening	19.5	20.2	15.0	NA	20.0	14.2

Appendix I: Soil Moisture Characteristics

Un-relativized soil moisture characteristic values based on overall and monthly data sets. “sd” represents standard deviation. Rate of change was calculated between the wettest day and the driest day, so negative rate of change indicates declining soil moisture.

Table I.1 Soil moisture characteristics based on May data.

sensor	mean	min	max	sd	wettest day	driest day	% wet days	% dry days	rate of change
T5P10_S3	14.55	10.12	17.59	2.14	2023-05-19	2023-05-31	0.00	98.67	-0.623
T5P4_S1	21.44	15.36	30.81	4.78	2023-05-14	2023-05-31	0.00	74.67	-0.909
T5P7_S2	35.40	31.65	36.60	1.15	2023-05-18	2023-05-31	61.33	0.00	-0.381
T6P1_S1	29.85	21.33	35.52	4.40	2023-05-13	2023-05-31	0.00	21.33	-0.789
T6P4_S2	44.15	43.90	44.45	0.14	2023-05-26	2023-05-21	98.67	0.00	0.110
T6P7_S3	26.23	23.08	28.80	1.72	2023-05-14	2023-05-31	0.00	36.00	-0.336
T7P3_S1	35.45	34.32	35.75	0.31	2023-05-31	2023-05-14	29.33	0.00	0.084
T7P6_S2	27.28	24.50	30.03	1.67	2023-05-18	2023-05-31	0.00	13.33	-0.426
T7P9_S3	36.96	30.58	42.76	3.42	2023-05-14	2023-05-31	60.00	0.00	-0.717
T9P2_S1	32.69	27.70	35.64	2.40	2023-05-14	2023-05-31	0.00	0.00	-0.467
T9P5_S2	33.18	28.90	36.05	1.99	2023-05-14	2023-05-31	14.67	0.00	-0.421
T9P8_S3	31.72	25.49	37.02	3.66	2023-05-14	2023-05-31	21.33	1.33	-0.678
T10P2_S1	26.99	21.81	32.43	3.16	2023-05-13	2023-05-31	0.00	38.67	-0.590
T10P5_S2	40.45	37.92	41.25	0.83	2023-05-22	2023-05-31	100.00	0.00	-0.370
T10P8_S3	32.23	25.10	37.27	3.72	2023-05-13	2023-05-31	25.33	2.67	-0.676
T12P2_S1	28.13	23.04	32.62	2.93	2023-05-13	2023-05-31	0.00	24.00	-0.532
T12P5_S2	23.47	20.81	25.35	1.35	2023-05-15	2023-05-31	0.00	100.00	-0.284
T12P8_S3	14.55	10.12	17.59	2.14	2023-05-19	2023-05-31	0.00	98.67	-0.623
T14P1_S1	21.44	15.36	30.81	4.78	2023-05-14	2023-05-31	0.00	74.67	-0.909
T14P7_S3	35.40	31.65	36.60	1.15	2023-05-18	2023-05-31	61.33	0.00	-0.381
T15P2_S1	29.85	21.33	35.52	4.40	2023-05-13	2023-05-31	0.00	21.33	-0.789
T15P5_S2	44.15	43.90	44.45	0.14	2023-05-26	2023-05-21	98.67	0.00	0.110
T15P8_S3	26.23	23.08	28.80	1.72	2023-05-14	2023-05-31	0.00	36.00	-0.336
T16P1_S3	35.45	34.32	35.75	0.31	2023-05-31	2023-05-14	29.33	0.00	0.084
T16P4_S2	27.28	24.50	30.03	1.67	2023-05-18	2023-05-31	0.00	13.33	-0.426
T16P7_S1	36.96	30.58	42.76	3.42	2023-05-14	2023-05-31	60.00	0.00	-0.717
T18P1_S1	32.69	27.70	35.64	2.40	2023-05-14	2023-05-31	0.00	0.00	-0.467
T18P4_S2	33.18	28.90	36.05	1.99	2023-05-14	2023-05-31	14.67	0.00	-0.421
T18P7_S3	31.72	25.49	37.02	3.66	2023-05-14	2023-05-31	21.33	1.33	-0.678

Table I.2 Soil moisture characteristics based on overall data set (excluding May).

sensor	mean	min	max	sd	wettest day	driest day	% wet days	% dry days	rate of change
T5P10_S3	15.53	11.99	21.32	2.89	2023-06-03	2023-08-05	2.72	49.73	-0.148
T5P4_S1	20.77	18.74	24.10	1.53	2023-06-03	2023-08-03	41.58	0.00	-0.088
T5P7_S2	17.30	14.92	24.42	2.59	2023-06-03	2023-08-04	14.13	9.51	-0.153
T6P1_S1	18.28	16.83	21.62	1.02	2023-06-01	2023-08-26	2.72	0.00	-0.056
T6P4_S2	20.91	16.48	37.71	5.57	2023-06-01	2023-08-03	30.71	0.00	-0.337
T6P7_S3	25.35	17.72	38.42	8.00	2023-06-04	2023-08-25	48.37	0.00	-0.252
T7P3_S1	18.72	15.57	24.92	2.02	2023-06-01	2023-08-05	17.66	0.00	-0.144
T7P6_S2	18.04	16.12	23.06	1.81	2023-06-01	2023-08-05	9.78	0.00	-0.107
T7P9_S3	15.28	13.40	20.71	1.72	2023-06-01	2023-08-26	0.00	62.23	-0.085
T9P2_S1	27.53	19.92	42.62	7.75	2023-06-03	2023-08-28	79.89	0.00	-0.264
T9P5_S2	25.87	14.18	44.93	11.70	2023-06-11	2023-08-28	47.01	19.57	-0.394
T9P8_S3	20.87	15.10	35.28	6.04	2023-06-03	2023-08-04	32.88	0.82	-0.325
T10P2_S1	7.77	6.23	21.52	2.04	2023-08-07	2023-08-02	0.27	97.55	3.057
T10P5_S2	13.26	11.37	15.31	1.09	2023-06-01	2023-08-05	0.00	98.37	-0.061
T10P8_S3	18.03	14.30	31.39	3.39	2023-06-01	2023-08-28	16.03	17.39	-0.194
T12P2_S1	17.48	16.08	21.14	0.99	2023-06-01	2023-08-28	0.82	0.00	-0.057
T12P5_S2	29.22	15.89	44.43	12.17	2023-06-02	2023-08-28	54.08	0.00	-0.328
T12P8_S3	30.81	15.91	45.61	12.05	2023-06-04	2023-08-30	59.24	0.00	-0.341
T14P1_S1	17.06	13.53	23.73	2.66	2023-08-07	2023-08-03	11.41	33.42	2.550
T14P7_S3	26.75	15.83	36.57	8.10	2023-06-09	2023-08-29	63.86	0.00	-0.256
T15P2_S1	14.79	9.59	24.45	4.28	2023-06-01	2023-08-06	14.13	58.97	-0.225
T15P5_S2	19.28	14.34	31.60	4.56	2023-06-09	2023-08-05	31.79	23.10	-0.303
T15P8_S3	19.42	17.38	27.50	2.24	2023-06-01	2023-08-03	20.92	0.00	-0.161
T16P1_S3	16.37	12.35	24.34	3.00	2023-08-07	2023-08-29	14.40	48.64	-0.545
T16P4_S2	21.34	17.35	29.45	3.35	2023-06-02	2023-08-29	44.29	0.00	-0.137
T16P7_S1	15.08	11.61	24.09	2.83	2023-08-30	2023-08-03	4.35	58.42	0.462
T18P1_S1	13.23	5.40	28.89	6.90	2023-06-01	2023-08-25	13.59	59.51	-0.276
T18P4_S2	17.88	11.25	27.56	4.88	2023-08-07	2023-08-28	30.98	36.96	-0.777
T18P7_S3	16.59	13.75	25.20	2.66	2023-06-01	2023-08-29	7.61	41.03	-0.129

Table I.3 Soil moisture characteristics based on June data.

sensor	mean	min	max	sd	wettest day	driest day	% wet days	% dry days	rate of change
T5P10_S3	7.77	6.96	10.23	0.72	2023-06-01	2023-06-23	0.00	100.00	-0.149
T5P4_S1	14.59	13.88	15.31	0.38	2023-06-01	2023-06-30	0.00	100.00	-0.049
T5P7_S2	21.72	18.50	31.39	3.48	2023-06-01	2023-06-30	8.33	18.33	-0.445
T6P1_S1	18.60	17.94	21.14	0.71	2023-06-01	2023-06-26	0.00	79.17	-0.128
T6P4_S2	43.86	42.47	44.43	0.36	2023-06-02	2023-06-30	100.00	0.00	-0.070
T6P7_S3	44.94	43.04	45.61	0.44	2023-06-04	2023-06-30	89.17	0.00	-0.099
T7P3_S1	19.87	17.40	23.06	1.42	2023-06-01	2023-06-30	0.00	27.50	-0.195
T7P6_S2	36.03	35.60	36.57	0.24	2023-06-09	2023-06-08	100.00	0.00	0.966
T7P9_S3	19.71	15.55	24.45	2.55	2023-06-01	2023-06-30	0.00	41.67	-0.307
T9P2_S1	24.37	19.39	31.60	3.50	2023-06-09	2023-06-30	17.50	0.00	-0.581
T9P5_S2	21.96	19.61	27.50	2.12	2023-06-01	2023-06-27	0.00	0.00	-0.303
T9P8_S3	19.90	16.71	21.72	1.62	2023-06-03	2023-06-30	0.00	27.50	-0.185
T10P2_S1	25.62	22.38	29.45	1.98	2023-06-02	2023-06-30	9.17	0.00	-0.252
T10P5_S2	17.52	14.65	21.19	1.81	2023-06-02	2023-06-30	0.00	74.17	-0.234
T10P8_S3	21.42	14.46	28.89	4.27	2023-06-01	2023-06-30	5.00	38.33	-0.497
T12P2_S1	23.47	19.12	27.07	2.22	2023-06-02	2023-06-30	0.00	0.00	-0.284
T12P5_S2	19.74	17.04	25.20	2.24	2023-06-01	2023-06-30	0.00	44.17	-0.281
T12P8_S3	18.84	16.10	21.32	1.52	2023-06-03	2023-06-30	0.00	42.50	-0.193
T14P1_S1	22.74	21.48	24.10	0.84	2023-06-03	2023-06-30	0.00	0.00	-0.097
T14P7_S3	20.67	17.79	24.42	2.00	2023-06-03	2023-06-30	0.00	23.33	-0.246
T15P2_S1	19.41	18.67	21.62	0.71	2023-06-01	2023-06-19	0.00	5.83	-0.164
T15P5_S2	27.75	20.34	37.71	4.90	2023-06-01	2023-06-30	46.67	0.00	-0.599
T15P8_S3	36.44	30.73	38.42	2.06	2023-06-04	2023-06-30	95.00	0.00	-0.296
T16P1_S3	21.16	19.47	24.92	1.36	2023-06-01	2023-06-30	0.00	0.00	-0.188
T16P4_S2	20.35	18.86	23.06	1.02	2023-06-01	2023-06-30	0.00	0.00	-0.145
T16P7_S1	16.92	14.13	20.71	1.98	2023-06-01	2023-06-26	0.00	82.50	-0.263
T18P1_S1	38.39	31.85	42.62	2.96	2023-06-03	2023-06-30	91.67	0.00	-0.399
T18P4_S2	42.07	34.33	44.93	2.74	2023-06-11	2023-06-30	91.67	0.00	-0.558
T18P7_S3	29.10	22.40	35.28	3.82	2023-06-03	2023-06-30	50.83	0.00	-0.477

Table I.4 Soil moisture characteristics based on July data.

sensor	mean	min	max	sd	wettest day	driest day	% wet days	% dry days	rate of change
T5P10_S3	7.06	6.47	7.75	0.28	2023-07-01	2023-07-31	0.00	100.00	-0.043
T5P4_S1	12.76	11.62	13.92	0.63	2023-07-01	2023-07-31	0.00	100.00	-0.077
T5P7_S2	16.87	15.16	18.51	0.91	2023-07-01	2023-07-31	0.00	0.00	-0.112
T6P1_S1	17.29	16.35	18.07	0.46	2023-07-01	2023-07-31	0.00	0.00	-0.057
T6P4_S2	27.50	17.51	42.50	8.52	2023-07-01	2023-07-31	73.39	0.00	-0.833
T6P7_S3	31.73	19.49	42.89	8.28	2023-07-01	2023-07-31	100.00	0.00	-0.780
T7P3_S1	15.41	13.92	18.03	0.92	2023-07-10	2023-07-31	0.00	24.19	-0.196
T7P6_S2	26.06	18.12	35.98	5.86	2023-07-01	2023-07-31	85.48	0.00	-0.595
T7P9_S3	12.41	10.10	15.57	1.56	2023-07-01	2023-07-31	0.00	88.71	-0.182
T9P2_S1	16.53	14.72	19.98	1.39	2023-07-10	2023-07-31	4.84	0.00	-0.250
T9P5_S2	18.20	17.42	19.51	0.54	2023-07-01	2023-07-31	8.06	0.00	-0.070
T9P8_S3	14.76	13.36	16.65	0.79	2023-07-01	2023-07-31	0.00	45.97	-0.110
T10P2_S1	19.89	18.07	22.28	1.16	2023-07-01	2023-07-31	68.55	0.00	-0.140
T10P5_S2	13.20	11.76	14.69	0.72	2023-07-01	2023-07-31	0.00	100.00	-0.098
T10P8_S3	9.50	6.36	14.52	2.24	2023-07-01	2023-07-31	0.00	100.00	-0.272
T12P2_S1	15.96	12.62	19.59	1.97	2023-07-10	2023-07-31	3.23	32.26	-0.332
T12P5_S2	15.81	14.23	17.17	0.77	2023-07-01	2023-07-31	0.00	12.90	-0.098
T12P8_S3	13.77	12.30	16.05	1.16	2023-07-01	2023-07-31	0.00	66.94	-0.125
T14P1_S1	20.11	18.78	21.48	0.90	2023-07-01	2023-07-31	90.32	0.00	-0.090
T14P7_S3	16.07	15.01	17.76	0.92	2023-07-01	2023-07-31	0.00	0.00	-0.092
T15P2_S1	17.98	16.95	18.87	0.51	2023-07-01	2023-07-31	0.00	0.00	-0.064
T15P5_S2	18.13	16.59	20.38	0.96	2023-07-01	2023-07-31	19.35	0.00	-0.126
T15P8_S3	22.10	18.63	30.51	3.27	2023-07-01	2023-07-31	87.90	0.00	-0.396
T16P1_S3	17.73	15.99	19.54	0.88	2023-07-01	2023-07-31	6.45	0.00	-0.118
T16P4_S2	17.41	16.31	18.79	0.69	2023-07-01	2023-07-31	0.00	0.00	-0.082
T16P7_S1	14.63	13.75	15.55	0.51	2023-07-06	2023-07-05	0.00	54.03	1.801
T18P1_S1	24.24	20.78	31.51	2.89	2023-07-01	2023-07-31	100.00	0.00	-0.358
T18P4_S2	21.43	15.25	34.11	5.71	2023-07-01	2023-07-31	51.61	0.00	-0.629
T18P7_S3	17.86	15.33	22.11	1.87	2023-07-01	2023-07-31	25.81	0.00	-0.226

Table I.5 Soil moisture characteristics based on August data.

sensor	mean	min	max	sd	wettest day	driest day	% wet days	% dry days	rate of change
T5P10_S3	8.49	6.23	21.52	3.30	2023-08-07	2023-08-02	3.23	90.32	3.057
T5P4_S1	12.47	11.37	13.49	0.66	2023-08-11	2023-08-05	0.00	100.00	0.353
T5P7_S2	15.63	14.30	18.15	1.12	2023-08-08	2023-08-28	7.26	0.00	-0.192
T6P1_S1	16.59	16.08	17.61	0.43	2023-08-08	2023-08-28	0.00	0.00	-0.076
T6P4_S2	16.77	15.89	17.80	0.59	2023-08-10	2023-08-28	0.00	0.00	-0.106
T6P7_S3	17.68	15.91	19.33	1.05	2023-08-01	2023-08-30	50.00	0.00	-0.118
T7P3_S1	15.99	13.53	23.73	2.60	2023-08-07	2023-08-03	18.55	14.52	2.550
T7P6_S2	18.46	15.83	27.18	2.71	2023-08-07	2023-08-29	38.71	0.00	-0.516
T7P9_S3	12.41	9.59	21.74	3.28	2023-08-07	2023-08-06	10.48	76.61	12.148
T9P2_S1	17.10	14.34	26.62	3.23	2023-08-07	2023-08-05	31.45	0.00	6.142
T9P5_S2	18.16	17.38	21.44	0.99	2023-08-07	2023-08-03	43.55	0.00	1.016
T9P8_S3	14.70	12.35	24.34	2.51	2023-08-07	2023-08-29	12.90	59.68	-0.545
T10P2_S1	18.82	17.35	23.15	1.55	2023-08-07	2023-08-29	64.52	0.00	-0.264
T10P5_S2	14.70	11.61	24.09	3.28	2023-08-30	2023-08-03	20.16	62.10	0.462
T10P8_S3	7.92	5.40	18.55	3.07	2023-08-07	2023-08-25	0.81	72.58	-0.731
T12P2_S1	14.66	11.25	27.56	4.28	2023-08-07	2023-08-28	21.77	69.35	-0.777
T12P5_S2	14.32	13.75	15.19	0.44	2023-08-12	2023-08-29	0.00	46.77	-0.085
T12P8_S3	14.32	11.99	19.37	2.54	2023-08-08	2023-08-05	17.74	62.10	2.460
T14P1_S1	19.65	18.74	20.23	0.45	2023-08-14	2023-08-03	100.00	0.00	0.136
T14P7_S3	15.51	14.92	16.19	0.40	2023-08-12	2023-08-04	0.00	0.00	0.158
T15P2_S1	17.34	16.83	17.91	0.34	2023-08-14	2023-08-26	10.48	0.00	-0.090
T15P5_S2	17.06	16.48	17.84	0.39	2023-08-08	2023-08-03	1.61	0.00	0.271
T15P8_S3	18.42	17.72	19.29	0.42	2023-08-08	2023-08-25	91.94	0.00	-0.093
T16P1_S3	17.37	15.57	18.86	0.98	2023-08-08	2023-08-05	36.29	0.00	1.095
T16P4_S2	16.44	16.12	16.84	0.23	2023-08-10	2023-08-05	0.00	0.00	0.144
T16P7_S1	14.35	13.40	17.06	0.90	2023-08-07	2023-08-26	0.00	62.10	-0.192
T18P1_S1	21.18	19.92	24.39	1.14	2023-08-07	2023-08-28	100.00	0.00	-0.213
T18P4_S2	15.95	14.18	21.56	2.07	2023-08-07	2023-08-28	16.13	0.00	-0.351
T18P7_S3	16.57	15.10	18.70	1.10	2023-08-08	2023-08-04	18.55	0.00	0.898

Appendix J: Chapter 2 Scree Plots

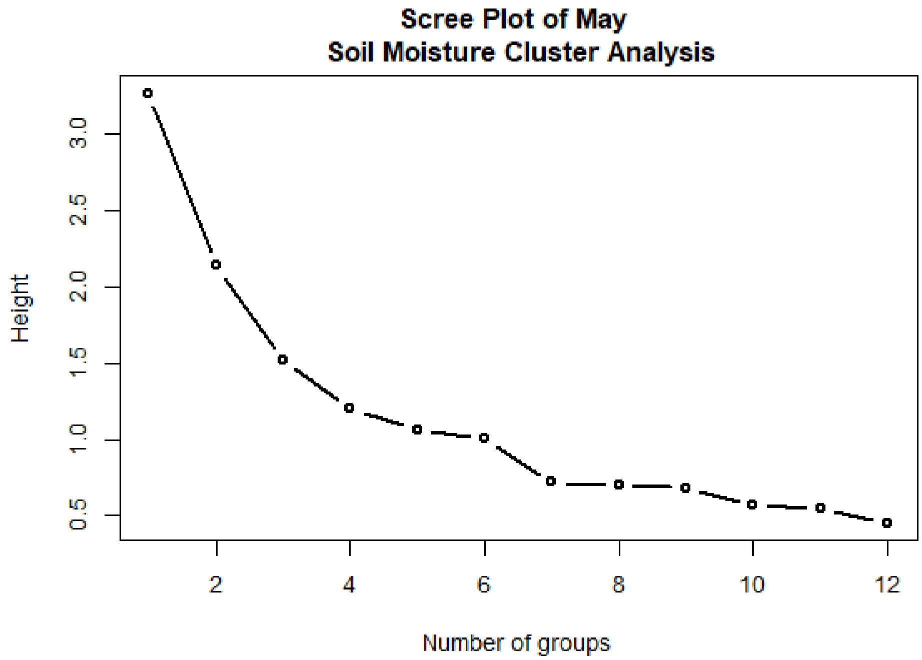

Figure J.1 Scree plot for May soil moisture characteristics cluster analysis.

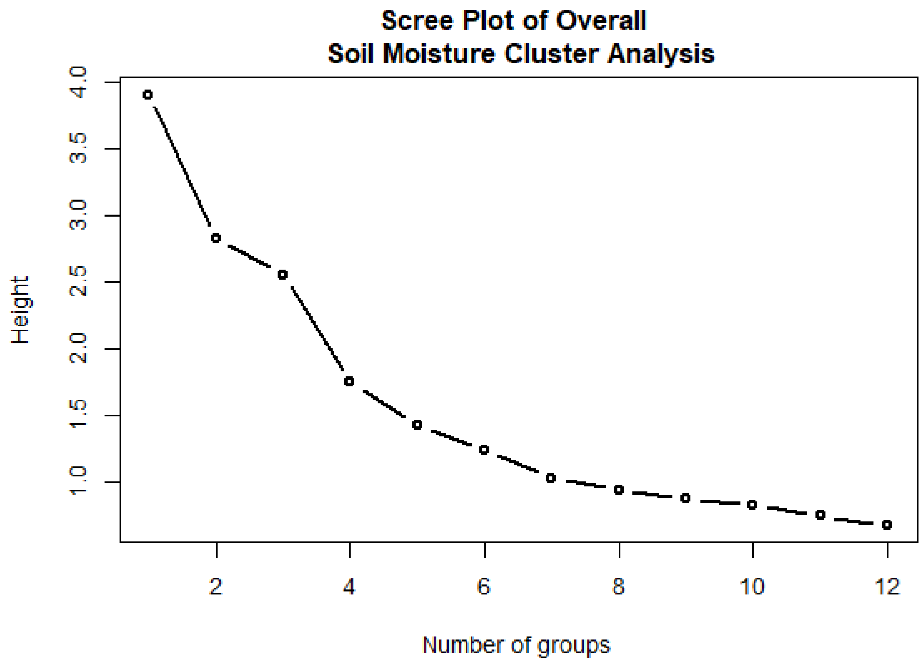

Figure J.2 Scree plot for overall soil moisture characteristics cluster analysis.

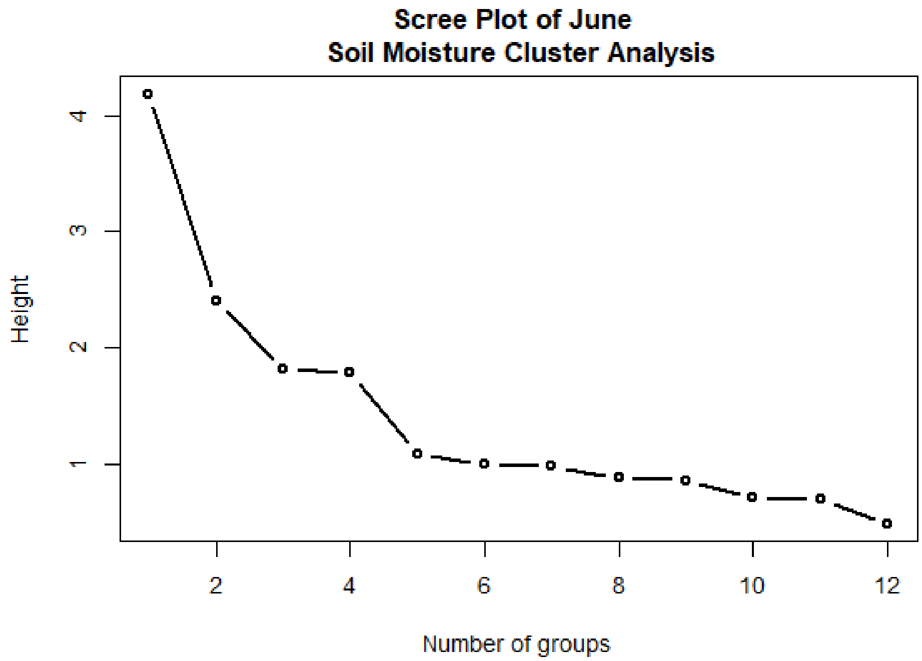

Figure J.3 Scree plot for June soil moisture characteristics cluster analysis.

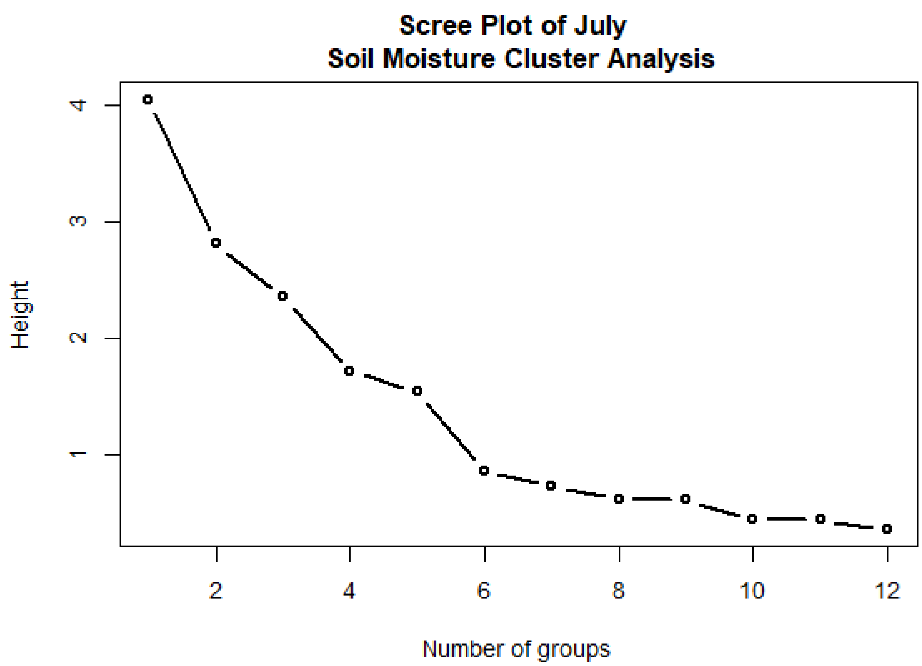

Figure J.4 Scree plot for July soil moisture characteristics cluster analysis.

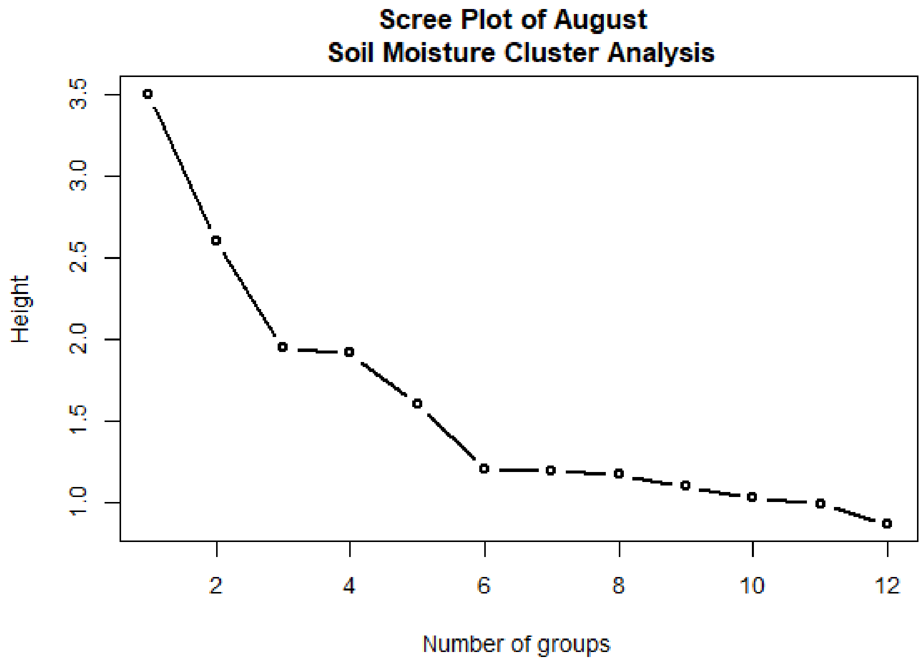

Figure J.5 Scree plot for August soil moisture characteristics cluster analysis.

Appendix K: Chapter 2 Supplemental Tables

Table K.1 Combined PERMANOVA results testing SIORC response variables (presence, count, and abundance) against individual soil moisture characteristics from the overall data set.

soil moisture characteristic	Presence		Count		Abundance	
	R2	F	R2	F	R2	F
mean	0.01	0.18	0.00	0.02	0.49**	56.44**
min	0.00	0.00	0.58	0.47	0.23	4.40
max	0.01	0.19	0.01	0.24	0.38**	13.13**
sd	0.02	0.42	0.00	0.03	0.36*	11.52*
wettest day	0.01	0.18	0.02	0.41	0.12	1.68
driest day	0.01	0.30	0.04	0.96	0.37*	12.12*
% wet days	0.01	0.15	0.00	0.00	0.48**	45.13**
% dry days	0.00	0.00	0.05	1.37	0.18	3.02
rate of change	0.07	1.78	0.06	1.92	0.00	0.00

∗ p-value < 0.05; ∗∗ p-value < 0.01