Evaluation of Priority Game Species Use and Propagation Feasibility of High Value Sandhills Native Wildlife Plants

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NCSU Masters of Fisheries and Wildlife Final Examination Report

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Executive Summary

Restoration of native plant communities is a priority for many land managers. On public lands, restoration of these communities must be balanced with public use and input. On lands where public hunting is a component, land managers may be pressed to provide wildlife openings (i.e., food plots) that contain primarily non-native plantings. Although some managers have advocated openings consisting of native plants rather than the more traditional non-native species, the relative value of the different plant communities to wildlife has not been studied extensively. We compared white-tailed deer (*Odocoileus virginianus*), wild turkey (*Meleagris gallapavo*), and coyote (*Canis latrans*) use of 4 different wildlife opening types: non-native cool season openings, non-native warm season openings, naturalized plant community openings, and naturalized plant communities supplemented with seeds of native, wildlife forage species. We quantified wildlife use of these 4 opening types and reference (hereafter control) sites in adjacent forests using camera traps. The number of white-tailed deer photos per trap day was greater in cool season and warm season openings than in controls, native, or native supplemented openings, but relative use of each opening type peaked during the season of peak vegetation production. Eastern wild turkey photos per trap day were greater in cool season openings during the spring and winter and greater in warm season openings during the winter than in the control plots or in the native plant openings. Coyote photos per trap day did not vary among opening types.

Although openings planted with non-native plants were most attractive to deer and wild turkey, we suggest openings managed for native plant species also can provide unique food and cover resources for hunted wildlife, especially in forested landscapes with sparse understory vegetation.

Introduction

Restoration, enhancement, and maintenance of native plant communities is of interest to land managers for their role in ecosystem services (Maunder 1992, Foley et al. 2005, Rey Benayas and Bullock 2012, Turner et al. 2015). Because wildlife species evolved with native plant communities and depend on the ecological services they provide, conservation of native plant communities is vital to many animal species. Additionally, sensitive wildlife species often are associated with particular native plant communities for at least part of their life cycle and decline or disappear entirely when these communities are degraded or destroyed (Hansen and Urban 1992, Conner et al. 2002, Bonesi and Macdonald 2004). White-tailed deer (*Odocoileus virginianus*) and other game species are able to use a wide range of plant community types, but these species still rely on specific species of plants or seral stages for food and cover important to survival and reproduction. Non-native plant species may provide some of these ecological services, but more often they are associated with ecological degradation and decreased biodiversity (Waring et al. 1993, Goodwin et al. 1999, Stohlgren et al. 1999). Therefore, many land managers are making efforts to restore native plant communities and remove non-native species to promote healthy wildlife populations.

Considering the benefits of native plant restoration, conservation efforts have focused on silvicultural practices that promote floral biodiversity (Mitchell et al. 2006, King et al. 2009, Lashley et al. 2011). Open-canopy forests with abundant shrub and herbaceous layers, such as the longleaf pine (*Pinus palustris*)-wiregrass (*Aristida purpurea*) forests of the Southeast, are a prime example of this restoration strategy. These longleaf pine-wiregrass communities support declining species such as the red-cockaded woodpecker (*Picoides borealis*), eastern diamondback rattlesnake (*Crotalus adamanteus*), and Bachman's sparrow (*Peucaea aestivalis*)

(Brockway and Lewis 1997, Plentovich et al. 1998, Conner et al. 2002, Waldron et al. 2008, Addington et al. 2015). However, frequent prescribed fire, and the timing of those burns, can negatively affect some species such as white-tailed deer (Landers et al. 1995, Brockway and Lewis 1997, Edwards et al. 2004, Lashley et al. 2014, 2015), which may be important for land managers that must consider hunting opportunity in their management strategies.

Food plots are one strategy used by land managers to provide supplemental food and cover for hunted wildlife species, especially where natural foods may be limited. Food plots often are planted in artificially created wildlife openings and are seeded with a variety of non-native agricultural plant species to provide forage and improved opportunities for hunters. Although the benefits of food plots have been noted (e.g., Johnson et al. 1973, Mcbryde 1973, Hehman and Fulbright 1997, Edwards et al. 2004), the practice of planting non-native species may conflict with goals of restoring native plant communities.

Alternatively, wildlife openings many be established in high quality native plants as a method to provide wildlife attraction and forage without the introduction of non-native plants (Chandler et al. 2009, King et al. 2009, Lashley et al. 2011). Common ragweed (*Ambrosia artemisiifolia*), partridge pea (*Chamaecrista fasciculata*), pokeweed (*Phytolacca americana*), native lespedezas (*Lespedeza* spp.), and beggar's lice (*Desmodium* spp.) are all examples of high quality native plants that occur in disturbed wildlife openings (Lashley et al. 2011, 2015). Inexpensive and relatively easy maintenance of these species in openings can be a benefit over the maintenance of non-native agrarian based openings (Mcbryde 1973, Kuijper et al. 2009). Disking and burning to promote native plants are relatively easy and inexpensive management strategies compared to planting and fertilizing non-native species. Additionally, these "native openings" are consistent with the restoration objectives of most management agencies. However, little is known about the relative value of wildlife openings established with fallow or planted native species compared to conventional food plots planted with non-native plants. Hence, our objectives were to compare wildlife use among wildlife openings established with native plants in a managed longleaf pine forest in the Sandhills of North Carolina. We used camera traps to quantify use of openings by white-tailed deer, eastern wild turkey (*Meleagris gallapavo*), and coyote (*Canis latrans*) across various seasons in the year.

Study Area

We conducted the research on Fort Bragg Military Installation in Hoke, Cumberland, Harnett, and Moore counties of North Carolina. The Fort Bragg landscape was dominated by an open overstory of longleaf pine and an understory of grasses, forbs, and shrubs and was maintained with frequent prescribed burns on a 3-year fire interval. Densely vegetated drainages occurred in low-lying areas and were burned less frequently. Approximately 1280 wildlife openings were present on the landscape; the plant communities in the openings varied because of past soil disturbance, fire history, and planting history.

Regulated hunting occurred on Fort Bragg in compliance with state law and additional local restrictions from the installation. White-tailed deer densities were relatively low and in decline (Chitwood et al. 2015). Also, eastern wild turkeys on Fort Bragg were subjected to harvest, whereas coyotes were common but not harvested during the study.

Methods

Planting: We selected 40 wildlife openings and 10 control sites in recently burned longleaf pine forest on the north portion of Fort Bragg to decrease travel distance among sites. We randomly assigned wildlife openings to 1 of 4 treatments, with 10 openings per treatment; openings ranged in size from $1214m^2$ to $5261m^2$. The treatments included cool season agrarian, warm season agrarian, naturalized non-supplemented seed bank, and naturalized supplemented seed bank. Warm season openings averaged $2537m^2$, cool season openings averaged $2040m^2$, naturalized openings averaged $2048m^2$, and naturalized supplemented openings averaged $2339m^2$. No area was associated with control sites as these were not in discrete openings.

In September of 2013 and 2014, we collected soil samples from each of the 10 cool season locations and analyzed the sample for nutrient levels. Openings were disked in September 2013 and again in September 2014. Cool season planting began in October 2013 and again in September 2014. We applied all appropriate fertilizers and soil amendments according to soil test results. After disking, we cultipacked the openings to ensure proper seedbed preparation. We sowed 5lbs/acre of arrowleaf clover (*Trifolium vesiculosum*), 20lbs/acre of crimson clover (*Trifolium incarnatum*), and 40lbs/acre of winter wheat (*Triticum aestivum*) using a broadcast spreader and cultipacked after seeding.

We disked, planted, and cultipacked warm season openings in May 2014 and 2015. Fertilizers and soil amendments were applied to each opening according to soil tests from samples taken in April. We planted soybeans (*Glycine max*) at a rate of 100lbs per acre using a broadcast spreader and cultipacked immediately following broadcast. We recognized possible competition from herbaceous weeds during the 2014 season, so we planted Round-up Ready Soybeans ™ in 2015 and applied glyphosate in June of the same year.

We collected local seed for the naturalized supplemented seedbank treatment. We used only seeds collected on Fort Bragg to ensure use of preexisting genotypes from the landscape. Seeds were collected from high-value forage species that occur in the southeastern United States following Lashley et al (2011). We collected common ragweed, native lespedeza, partridge pea, and pokeweed. We disked the openings in January 2014, broadcast seeds in February, and cultipacked following planting. We did not repeat the planting in year two because we used a mix of perennial and annual species. We did not apply fertilizers because enrichment will decrease native plant diversity (Suding et al. 2005).

We disked and cultipacked naturalized non-supplemented openings in January 2014. We did not apply fertilizer to these openings and did not disk them during year two.

We placed the control locations in the longleaf pine forest on sites that had been burned less than a month before. We randomly chose recently burned sites with similar understory succession and close proximity to the wildlife openings.

Camera traps: In December 2013, we placed one Reconyx PC800 camera in the 40 openings and 10 forest control sites. We placed cameras facing north to avoid accidental trigger by the sun and placed them just above the herbaceous level to prevent obstructed views. We set all cameras to take 3 pictures per trigger with a quiet period of 3 minutes between each trigger event. During June 2014, we switched to Bushnell HD cameras and used 6 cameras per opening type. In October 2014, we deployed 50 Reconyx PC800 cameras once again. In June of 2015, we switched back to Bushnell HD cameras (and 6 treatment units with cameras) until the study ended in August 2015.

Camera trap photos were stored and converted to digital data. We limited duplicate captures by counting only individuals that were new to each frame. We avoided counting the same individuals multiple times by excluding individuals that had not moved or were in logical progression from a previous location in the rapid 3 burst photo series. Animals that were not in logical progression within the 3-second lapse between photos were counted as new individuals.

After the 3-minute quiet period, all individuals were and counted as new individuals, regardless of whether they appeared to be the same individuals from the series of photos. We focused on presence of white-tailed deer, eastern wild turkey, and coyote for analyses, because they represented the most captures and were present in all opening types.

Data Analyses: We used a multi-way ANOVA type III with Satterthwaite approximation for degrees of freedom to compare captures (i.e., photos) per trap day by species across all 5 opening types. We used year, season, opening type, and interaction between season and opening type as fixed effects and individual opening as a random effect. We defined seasons as spring (March 21 – June 20), summer (June 21 – September 20), fall (September 21 – December 20), and winter (December 21 – March 20). We fit to a linear mixed model package "lmer" in program R to compare simple interaction effects when present.

Results

There was a significant main effect of opening type on the number of white-tailed deer photos per trap day ($F=14.34$; $DF= 4, 216.89$; $p<0.001$) and a significant interaction between the effects of opening type and season ($F = 6.87$; $DF=12, 215.67$; $p<0.001$) (Figures 1, 2, and 3). No significant main effect occurred due to season ($F=2.01$; $DF=3, 217.14$; $p=0.11$). Across all seasons combined, we recorded more photos of white-tailed deer per trap day in cool season ($\mu= 1.892$) and warm season ($\mu= 1.744$) openings than in controls ($\mu= 0.201$), native ($\mu= 0.622$), or native supplemented openings ($\mu= 0.495$). Although deer use of native and native supplemented openings was not significantly different than forest controls, the native openings had more photos per trap day than controls in all seasons across both years; the differences were greatest during the spring and summer seasons.

During the fall, cool season openings (μ= 2.069) had significantly more deer photos than control (μ= 0.303), native (μ=0.581), and native supplemented (μ= 0.424) openings. During the winter, cool season openings (μ=4.208) had more deer photos per trap day than naturalized supplemented (μ=0.600), naturalized (μ=0.434), warm season (μ=0.639), and control openings (μ=0.336). During summer, warm season openings (μ =3.410) had more photos of white-tailed deer than cool season (μ=0.746) openings. Deer use of the various opening types in each season was similar between the 2 years of the study.

Opening type affected the number of eastern wild turkey photos but there was no interaction effect (F = 3.394; DF=4, 216.83; p=0.01). Eastern wild turkey photos were more abundant in cool season openings during the spring (μ =3.749) and winter (μ=2.735) and in warm season openings during the winter (μ =0.1710). The number of coyote photos did not vary among opening types.

Discussion

Warm season and cool season wildlife openings attracted white-tailed deer during peak vegetative production. This is likely because arrowleaf clover, crimson clover, winter wheat, and soybeans all are plant species known to be highly selected by white-tailed deer (Johnson et al. 1973, Hehman and Fulbright 1997). Warm season and cool season openings likely provided forage at times when natural foods were scarce or relatively unpalatable, including the late dormant-season and late summer months when browse palatability is low (Johnson et al. 1973, Hehman and Fulbright 1997, Lashley et al. 2011, 2015). White-tailed deer used naturalized and naturalized supplemented openings at rates statistically similar to the controls, but photos per trap day in the native openings always exceeded that in forest controls, and the differences were most extreme during the growing season when the native openings likely had their greatest forage value. Palatable and nutritious native forage was located throughout forest on the military installation, but forage availability generally is at much lower densities than in the openings (Lashley 2009, Lashley et al. 2014, 2015).

Eastern wild turkeys selected warm season and cool season openings in the winter but used the control at similar rates to the openings during the other seasons. Cool season openings contained quality forage during the winter when warm season openings were dormant. However, it is possible that turkey use of all openings was more related to the open, treeless conditions rather than composition or availability of forage. The warm and cool season openings contained less standing plant debris than naturalized and naturalized supplemented openings during the late winter and early spring and therefore may have offered more suitable conditions for strutting turkeys. Turkeys use forest openings for breeding display during mid-to-late winter, which is consistent with our results (Glover et al. 2007); moreover, we collected multiple photos of turkeys displaying in openings during the study.

Given their apparent attractiveness to deer, openings planted with non-native forages may provide critical hunting opportunities despite interest in more emphasis on native plant communities (Moorman et al. 2006). However, even native openings may provide important resources for white-tailed deer or eastern wild turkey because forest gaps provide critical food and cover for wildlife in forest landscapes with limited understory (Kuijper et al. 2009, Lashley et al. 2011). Additionally, native openings may prove less expensive than planting non-natives (Mcbryde 1973). Non-native food plots require yearly planting, herbicide application, and soil amendments, whereas naturalized openings may only require biennial to triennial disturbance to reset natural succession and possibly herbicide application to remove unwanted plants (e.g., woody species or non-native invaders). Also, using native species may reduce the risk of introducing non-native, invasive plants to sensitive natural areas. Agricultural seed has been cited as a source of invasive plant introduction via contaminated seed sources (Goodwin et al. 1999, Reichard and White 2001).

Establishing and maintaining naturalized openings may prove to be challenging for many landowners. Existing soil seed banks may provide quality forages following disturbance, but quality management and effort are needed to provide optimal forage diversity and limit succession to woody plants (Buckner and Landers 1979, Brown and Venable 1986, Eriksson and Eriksson 1997, Lashley et al. 2011). In some cases, landowners may wish to add supplemental seed to the preexisting seed bank when high quality forage species are underrepresented. This may be difficult, as collecting wild seed may prove to be tedious and produce low yields, and purchasing native seeds can be cost prohibitive. Unlike most non-native forages, native seed germination rates and requirements are sometimes unknown. Ultimately, these reasons are why many landowners choose simple non-native forage plots to attract white-tailed deer even when native forage species may provide comparable nutrition, have lower long-term establishment costs, and match local restoration goals (Edwards et al. 2004, Lashley et al. 2011, 2015).

We suggest future research should investigate native plant species that can be propagated easily and inexpensively for use in wildlife openings. Many species of plants we collected are not readily available to land managers, especially local genotypes, without significant investment for obtaining seed. Also, information on which species are most beneficial (i.e., most nutritious or most selected) to target wildlife like white-tailed deer is still lacking in many locations.

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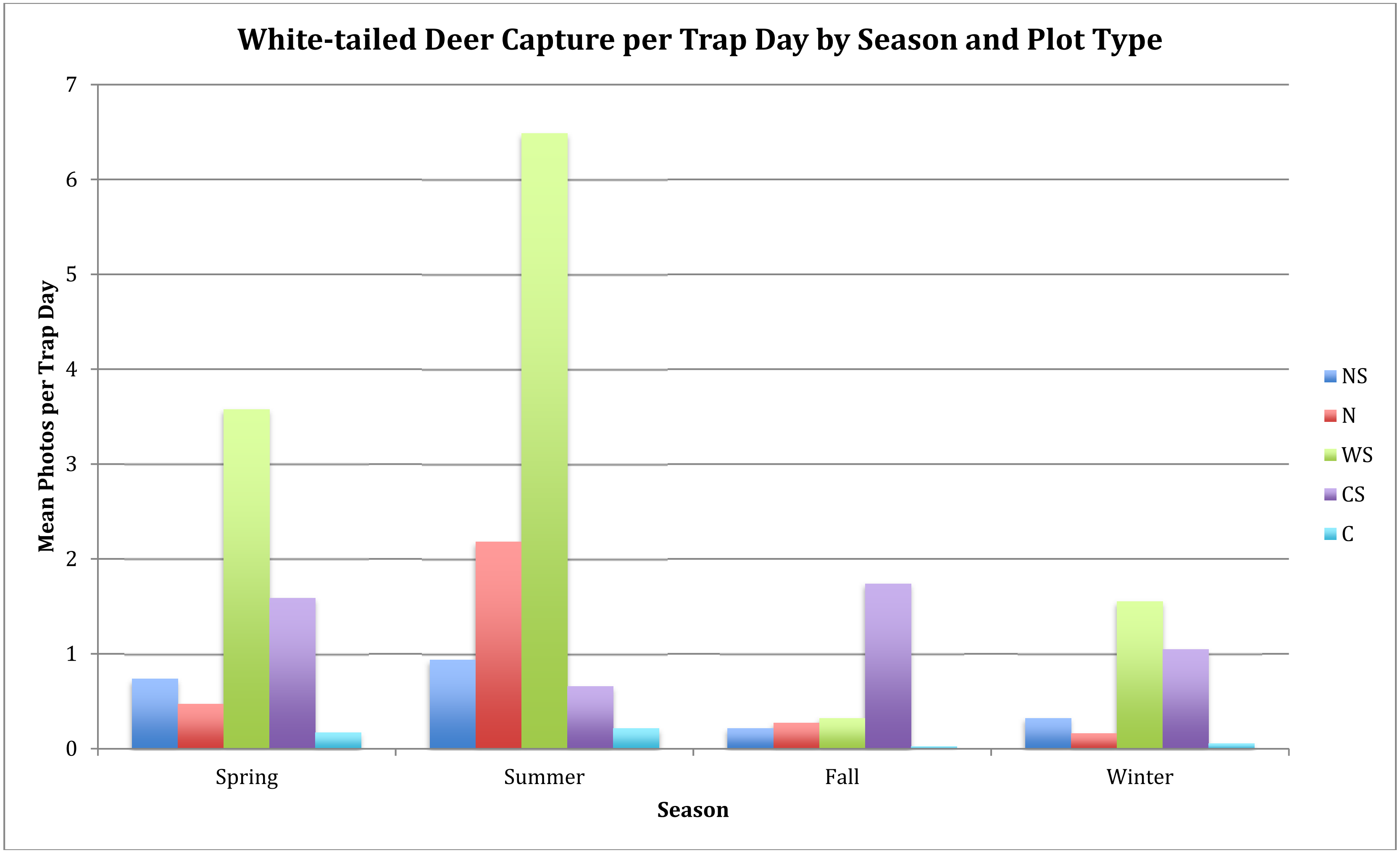

Figure 1. White-tailed deer use (i.e., means for photos per trap day) of control, cool season, warm season, naturalized non-supplemented, and naturalized supplemented openings across season, Fort Bragg Military Installation, North Carolina.

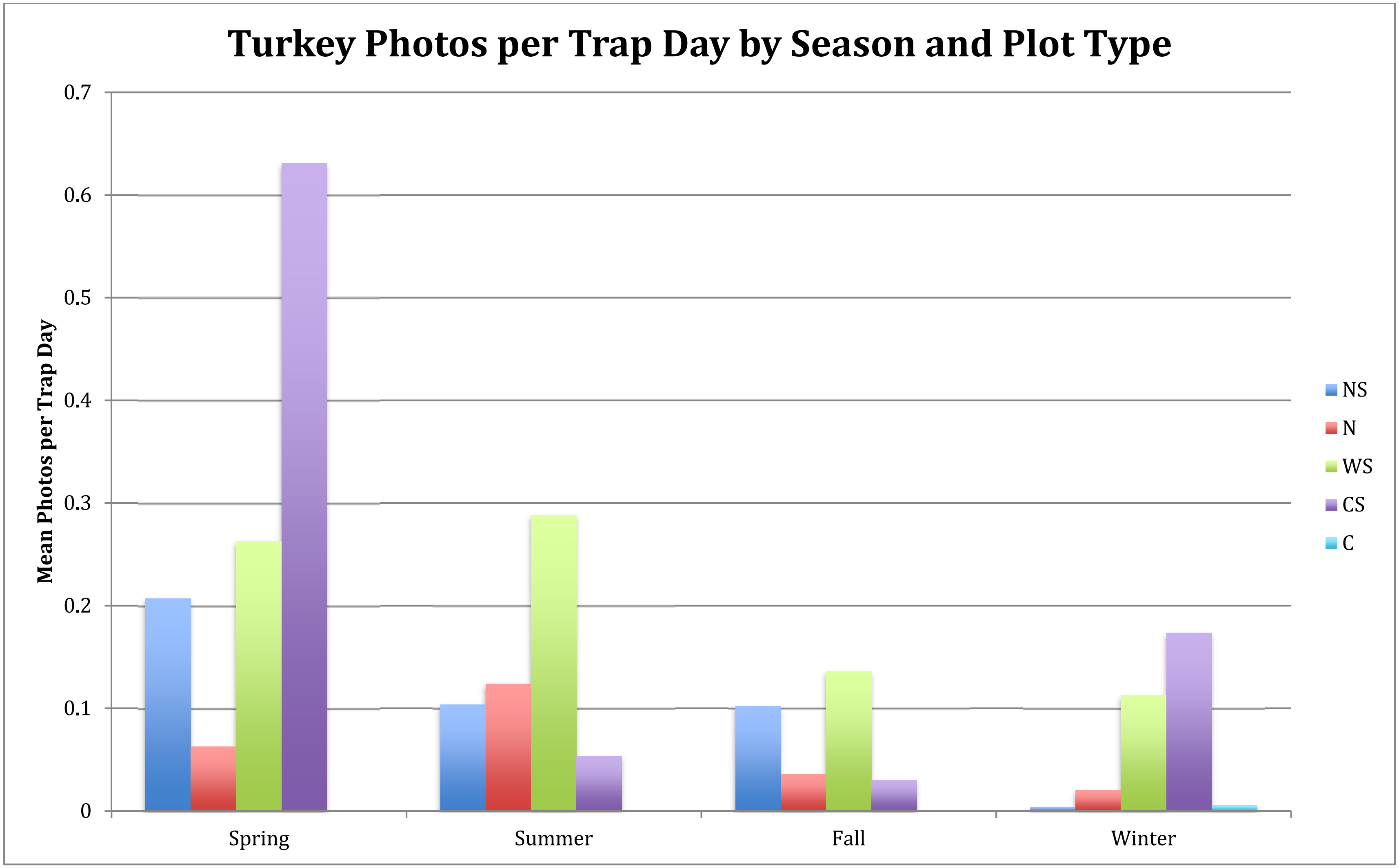

Figure 2. Eastern wild turkey use (i.e., means for photos per trap day) of control, cool season, warm season, naturalized non-supplemented, and naturalized supplemented openings across season, Fort Bragg Military Installation, North Carolina.

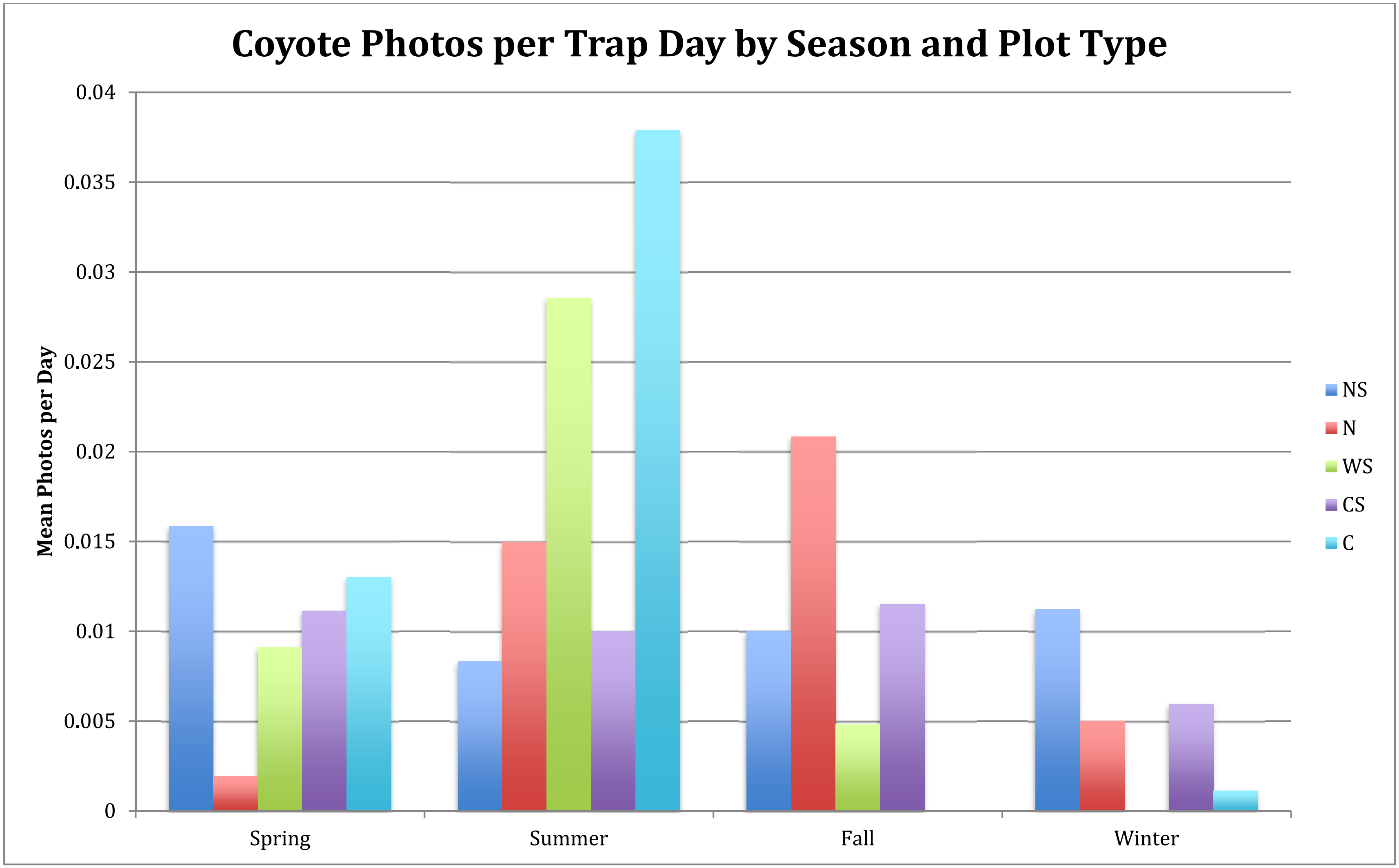

Figure 3. Coyote (i.e., means for photos per trap day) of control, cool season, warm season, naturalized non-supplemented, and naturalized supplemented openings across season, Fort Bragg Military Installation, North Carolina.

Appendix 1. Location and mean camera photos per trap day for white-tailed deer, wild turkey, and coyote in 10 replicate openings of 5 types [control (C), cool season (CS), warm season (WS), naturalized non-supplemented (N), and naturalized supplemented openings (NS)] averaged across 4 seasons and 2 years (2013-2015, Fort Bragg Military Installation, NC).

Appendix 2. Camera photos per trap day for white-tailed deer, wild turkey, and coyote in 5 opening types [control (C), cool season (CS), warm season (WS), naturalized non-supplemented (N), and naturalized supplemented openings (NS)] by season and year (2014 is year 1 and 2015 is year 2) on Fort Bragg Military Installation, NC.

Field type	Field name	Deer	Turkey	Coyote	Latitude	Longitude
C	CM1	0.1402	0.0000	0.0041	35.16259722	-79.09620833
C	CM2	0.0100	0.0000	0.0000	35.13305000	-79.10225556
C	CNN1	0.2017	0.0000	0.0467	35.15125833	-79.23854167
C	CNN2	0.0284	0.0000	0.0000	35.13686111	-79.23342500
C	CT1	0.0077	0.0000	0.0000	35.17512222	-79.16890833
C	CT2	0.0060	0.0000	0.0000	35.16327222	-79.16771944
C	CW1	0.0000	0.0000	0.0000	35.19136389	-79.17365000
C	CX1	0.1005	0.0000	0.0167	35.18757500	-79.23342222
C	CY1	0.1212	0.0094	0.0059	35.17616389	-79.27500000
C	CY2	0.0021	0.0000	0.0000	35.18433611	-79.27402500
CS	M16	1.5021	0.0447	0.0077	35.14919722	-79.12425278
CS	N40	0.8333	0.0590	0.0071	35.15795556	-79.10407222
CS	P3	0.9163	0.0307	0.0000	35.12635833	-79.13641667
CS	W14	1.8549	0.3969	0.0166	35.18150278	-79.20129444
CS	X24	3.0407	0.2254	0.0029	35.19665000	-79.24838611
CS	M32	1.1129	0.1347	0.0287	35.14413611	-79.10911389
CS	N41	0.3552	0.0872	0.0136	35.15135000	-79.10315556
CS	Q9	0.1102	0.2712	0.0000	35.15331111	-79.14992778
CS	T3	2.9162	0.0806	0.0000	35.16272500	-79.18923056
N	AA38	0.5984	0.0125	0.0375	35.16674444	-79.27838889
N	N7	0.3552	0.0872	0.0136	35.16678889	-79.11312778
N	NN10	0.1632	0.0000	0.0000	35.16020556	-79.24995000
N	NN14	0.1632	0.0000	0.0000	35.16413611	-79.23878333
N	S1	1.3291	0.1333	0.0000	35.17171111	-79.15091667
N	S14	1.3291	0.1333	0.0000	35.17146389	-79.17954444
N	V23	0.1186	0.0357	0.0000	35.17230556	-79.20271944
N	X17	0.4632	0.0354	0.0108	35.20595833	-79.23936389
N	X3	0.2828	0.0167	0.0000	35.18585556	-79.22677222
N	Y32	0.0584	0.0076	0.0000	35.17726944	-79.26646111
NS	AA34	0.1982	0.0000	0.0000	35.17494444	-79.29221667
NS	M24	0.2018	0.0022	0.0196	35.13546667	-79.11933333
NS	N1	1.9533	0.4421	0.0251	35.17526389	-79.09373056
NS	NN18	0.4808	0.0000	0.0000	35.15066389	-79.25222778
NS	NN9	0.2749	0.0880	0.0160	35.15471944	-79.24279167
NS	S21	0.7389	0.0105	0.0100	35.15486944	-79.16894444
NS	S30	0.8000	0.3200	0.0000	35.14879444	-79.16447778
NS	T13	0.1639	0.0435	0.0000	35.16200556	-79.17381389
NS	V8	0.2510	0.0277	0.0000	35.17143889	-79.22586667
NS	X28	0.2074	0.3465	0.0048	35.20881944	-79.23266389

NS	Y34	0.8879	0.0870	0.0407	35.17963056	-79.24803611
WS	AA30	5.5236	0.1245	0.0051	35.19198889	-79.28212778
WS	AA44	3.2736	0.2371	0.0022	35.14769722	-79.29718333
WS	NN1	0.5113	0.0000	0.0038	35.14230556	-79.23733333
WS	Q13	1.8270	0.1763	0.0079	35.16606111	-79.13184167
WS	S9	0.6381	0.0000	0.0000	35.16492222	-79.15903333
WS	U17	0.8755	0.0545	0.0213	35.13182222	-79.20731389
WS	W22	1.3125	0.1625	0.0000	35.19395278	-79.19417500
WS	X9	1.2346	0.0479	0.0096	35.19555000	-79.22691111
WS	Y30	1.3049	0.1238	0.0091	35.19081667	-79.27264444
WS	Z14	1.2520	0.1412	0.0000	35.12366944	-79.21609722

Year	field type	season	Field ID	Deer	Turkey	Coyote
1	NS	spring	S21	1.421052632	0.052631579	0
1	NS	spring	M24	0.1875	0	0.0625
1	NS	spring	X28	0.095238095	1.476190476	0
1	NS	spring	AA34	0.523809524	0	0
1	NS	spring	S30	0.8	0.32	0
1	NS	spring	T13	0.64	0	0
1	NS	spring	NN18	0	0	0
1	NS	spring	NN9	0	0	0
1	NS	spring	V8	0.210526316	0	0
1	N	spring	Y32	0	0	0
1	N	spring	AA38	0.285714286	0	0
1	N	spring	X17	0	0	0
1	N	spring	X3	0.3	0.1	0
1	N	spring	S1	0.222222222	0.388888889	0
1	N	spring	S14	0.055555556	0	0
1	N	spring	V23	0.157894737	0	0
1	N	spring	NN10	0	0	0
1	N	spring	NN14	0.1	0	0
1	N	spring	N7	0	0	0
1	WS	spring	Q13	3	0	0
1	WS	spring	U17	1.409090909	0.136363636	0.045454545
1	WS	spring	W22	0.7	0	0
1	WS	spring	Z14	1.636363636	0	0
1	WS	spring	NN1	1.176470588	0	0
1	WS	spring	S9	1	0	0
1	WS	spring	AA30	7	0.333333333	0
1	WS	spring	X9	0.25	0	0
1	WS	spring	Y30	4	0.409090909	0.045454545
1	WS	spring	AA44	0.095238095	0.619047619	0
1	CS	spring	M16	0.252747253	0.043956044	0
1	CS	spring	P3	1.41	0.11	0
1	CS	spring	N40	0.455555556	0.177777778	0.011111111
1	CS	spring	N41	0.044444444	0.055555556	0
1	CS	spring	M32	2.183673469	0.367346939	0.040816327
1	CS	spring	T3	0.173333333	0.226666667	0
1	CS	spring	X24	0.083333333	0.5	0
1	CS	spring	N1	0.444444444	0.283950617	0
1	CS	spring	Q9	0.220338983	0.542372881	0
1	CS	spring	W14	0.151898734	2.265822785	0
1	C	spring	CM1	0.25	0	0
1	C	spring	CM2	0.05	0	0
1	C	spring	CNN1	0.35	0	0.05
1	C	spring	CNN2	0	0	0

1	C	spring	CT1	0	0	0
1	C	spring	CT2	0	0	0
1	C	spring	CW1	0	0	0
1	C	spring	CX1	0.05	0	0
1	C	spring	CY1	0.1	0	0
1	C	spring	CY2	0	0	0
1	NS	summer	S21	1.05	0	0.05
1	NS	summer	M24	0.487804878	0	0
1	NS	summer	T13	0.291666667	0.083333333	0
1	NS	summer	NN18	2.322580645	0	0
1	NS	summer	NN9	0.45	0	0
1	NS	summer	V8	0.375	0	0
1	N	summer	Y32	0.105263158	0	0
1	N	summer	AA38	2.484848485	0	0
1	N	summer	X17	0.523809524	0	0
1	N	summer	X3	0.764705882	0	0
1	N	summer	S1	6.777777778	0.277777778	0
1	N	summer	N7	0.530612245	0.367346939	0.020408163
1	WS	summer	Q13	4.857142857	0	0
1	WS	summer	U17	1.734693878	0.040816327	0.06122449
1	WS	summer	W22	2.95	0.6	0
1	WS	summer	Z14	2.882352941	0.705882353	0
1	WS	summer	S9	0.714285714	0	0
1	WS	summer	AA30	12.77777778	0	0
1	WS	summer	AA44	15.27272727	0	0
1	CS	summer	M16	2.387755102	0	0
1	CS	summer	P3	0.083333333	0	0
1	CS	summer	N40	0.219512195	0.073170732	0.024390244
1	CS	summer	N1	1.549295775	0	0
1	CS	summer	W14	0.523809524	0	0
1	C	summer	CM1	0.428571429	0	0.020408163
1	C	summer	CM2	0	0	0
1	C	summer	CNN1	0.2	0	0.125
1	C	summer	CNN2	0	0	0
1	C	summer	CT1	0	0	0
1	C	summer	CX1	0.2	0	0.1
1	C	summer	CY1	0.024390244	0	0.024390244
1	C	summer	CY2	0	0	0
2	NS	fall	S21	0.144927536	0	0
2	NS	fall	M24	0.126984127	0	0
2	NS	fall	X28	0.25	0	0
2	NS	fall	Y34	0.794117647	0.235294118	0
2	NS	fall	T13	0.028985507	0	0
2	NS	fall	NN18	0.125	0	0

2	NS	fall	NN9	0.16	0.44	0.08
2	NS	fall	V8	0.09375	0.140625	0
2	N	fall	Y32	0.0625	0	0
2	N	fall	AA38	0.1875	0.0625	0.1875
2	N	fall	X17	0.984375	0.125	0
2	N	fall	X3	0.0625	0	0
2	N	fall	S1	0.355555556	0.133333333	0
2	N	fall	S14	0.111111111	0	0
2	N	fall	V23	0.117647059	0	0
2	N	fall	NN10	0.238095238	0	0
2	N	fall	N7	0.303030303	0	0
2	WS	fall	Q13	0.5	0	0
2	WS	fall	U17	0.19047619	0	0
2	WS	fall	Z14	0.5	0	0
2	WS	fall	NN1	0.112903226	0	0
2	WS	fall	S9	0.2	0	0
2	WS	fall	AA30	0.078125	0	0
2	WS	fall	X9	4.0625	0.171875	0
2	WS	fall	Y30	1.5	0	0
2	WS	fall	AA44	0.5	0	0
2	CS	fall	M16	1.576923077	0	0.038461538
2	CS	fall	P3	1.372093023	0	0
2	CS	fall	N40	1.11627907	0.023255814	0
2	CS	fall	N41	1.710144928	0.057971014	0
2	CS	fall	M32	0.984615385	0	0
2	CS	fall	T3	1.727272727	0.015151515	0
2	CS	fall	X24	4.275362319	0.144927536	0.014492754
2	CS	fall	N1	1.246376812	0.028985507	0.014492754
2	CS	fall	W14	1.618181818	0	0.036363636
2	C	fall	CM1	0	0	0
2	C	fall	CM2	0	0	0
2	C	fall	CNN1	0	0	0
2	C	fall	CNN2	0	0	0
2	C	fall	CT1	0	0	0
2	C	fall	CT2	0.023809524	0	0
2	C	fall	CW1	0	0	0
2	C	fall	CX1	0	0	0
2	C	fall	CY1	0.160714286	0	0
2	C	fall	CY2	0.037735849	0	0
2	NS	winter	S21	1.078651685	0	0
2	NS	winter	M24	0.078651685	0.011235955	0.02247191
2	NS	winter	X28	0.224719101	0	0
2	NS	winter	AA34	0.02247191	0	0
2	NS	winter	Y34	0.449438202	0.011235955	0.078651685

2	NS	winter	T13	0.02247191	0.011235955	0
2	NS	winter	NN18	0.325842697	0	0
2	NS	winter	NN9	0.134831461	0	0
2	NS	winter	V8	0.561797753	0	0
2	N	winter	Y32	0.04494382	0.011235955	0
2	N	winter	AA38	0.033707865	0	0
2	N	winter	X17	0.213483146	0.04494382	0.02247191
2	N	winter	X3	0.168539326	0	0
2	N	winter	S1	0.176470588	0	0
2	N	winter	S14	0.011235955	0	0
2	N	winter	V23	0.04494382	0.123595506	0
2	N	winter	NN10	0.388888889	0	0
2	N	winter	N7	0.370786517	0	0.02247191
2	WS	winter	Q13	0.033707865	0.629213483	0
2	WS	winter	U17	0.471910112	0	0
2	WS	winter	W22	0	0	0
2	WS	winter	Z14	0.921348315	0	0
2	WS	winter	X9	0.584269663	0.06741573	0.02247191
2	WS	winter	Y30	0.224719101	0.08988764	0
2	WS	winter	AA44	0	0.166666667	0.011111111
2	CS	winter	M16	2.078651685	0.179775281	0
2	CS	winter	P3	1.651685393	0.011235955	0
2	CS	winter	N40	2.375	0.020833333	0
2	CS	winter	N41	0.569767442	0	0
2	CS	winter	M32	0.45	0.1	0.05
2	CS	winter	T3	6.848101266	0	0
2	CS	winter	X24	6.090909091	0.246753247	0
2	CS	winter	N1	4.146067416	1.292134831	0.112359551
2	CS	winter	W14	8.835443038	0	0.063291139
2	C	winter	CM1	0.02247191	0	0
2	C	winter	CM2	0	0	0
2	C	winter	CNN1	0	0	0
2	C	winter	CNN2	0.247191011	0	0
2	C	winter	CT1	0.038461538	0	0
2	C	winter	CT2	0	0	0
2	C	winter	CW1	0	0	0
2	C	winter	CX1	0.02247191	0	0
2	C	winter	CY1	0.191011236	0.056179775	0.011235955
2	C	winter	CY2	0	0	0
2	NS	spring	S21	0	0	0
2	NS	spring	M24	0.128205128	0	0.012820513
2	NS	spring	X28	0.261904762	0	0.023809524
2	NS	spring	AA34	0.08	0	0
2	NS	spring	Y34	1.420289855	0.014492754	0.043478261

2	NS	spring	T13	0	0	0
2	NS	spring	NN18	0.111111111	0	0
2	NS	spring	NN9	0.62962963	0	0
2	NS	spring	V8	0.111111111	0	0
2	N	spring	Y32	0	0	0
2	N	spring	AA38	0	0	0
2	N	spring	X17	0.461538462	0	0
2	N	spring	X3	0.144927536	0	0
2	N	spring	S1	0.442307692	0	0
2	N	spring	S14	0.518518519	0	0
2	N	spring	V23	0.153846154	0.019230769	0
2	N	spring	NN10	1.442307692	0	0.019230769
2	N	spring	NN14	0.226415094	0	0
2	N	spring	N7	0.196078431	0.117647059	0
2	WS	spring	Q13	1.952380952	0	0
2	WS	spring	U17	0.571428571	0.095238095	0
2	WS	spring	W22	1.6	0.05	0
2	WS	spring	Z14	0.32	0	0
2	WS	spring	AA30	6.428571429	0.238095238	0
2	WS	spring	X9	0.225	0	0
2	WS	spring	Y30	0.8	0.12	0
2	WS	spring	AA44	0.5	0.4	0
2	CS	spring	M16	1.214285714	0	0
2	CS	spring	P3	0.064516129	0.032258065	0
2	CS	spring	N40	0	0	0
2	CS	spring	N41	0.125	0	0
2	CS	spring	M32	0.833333333	0.071428571	0.023809524
2	CS	spring	X24	1.794117647	0.235294118	0
2	CS	spring	N1	4.333333333	1.047619048	0.023809524
2	CS	spring	W14	0	0	0
2	C	spring	CM1	0	0	0
2	C	spring	CM2	0	0	0
2	C	spring	CNN1	0.56	0	0.08
2	C	spring	CNN2	0.16	0	0
2	C	spring	CT1	0	0	0
2	C	spring	CT2	0	0	0
2	C	spring	CW1	0	0	0
2	C	spring	CX1	0.074074074	0	0
2	C	spring	CY1	0.071428571	0	0
2	C	spring	CY2	0	0	0
2	NS	summer	X28	0.205128205	0.256410256	0
2	NS	summer	AA34	0.166666667	0	0
2	NS	summer	T13	0	0.166666667	0
2	NS	summer	NN18	0	0	0

2	NS	summer	V8	0.153846154	0.025641026	0
2	N	summer	Y32	0.137931034	0.034482759	0
2	N	summer	X17	0.595744681	0.042553191	0.042553191
2	N	summer	X3	0.256410256	0	0
2	N	summer	S1	0	0	0
2	N	summer	S14	0	0	0
2	N	summer	NN10	0.487179487	0	0
2	N	summer	N7	0.730769231	0.038461538	0.038461538
2	WS	summer	Q13	0.619047619	0.428571429	0.047619048
2	WS	summer	NN1	0	0	0
2	WS	summer	AA30	1.333333333	0.051282051	0.025641026
2	WS	summer	X9	1.051282051	0	0.025641026
2	WS	summer	Y30	0	0	0
2	CS	summer	T3	0.256410256	0.128205128	0.025641026
2	CS	summer	X24	2.96	0	0
2	CS	summer	N1	0	0	0
2	CS	summer	Q9	0	0	0
2	CS	summer	W14	0	0.115384615	0
2	C	summer	CNN1	0.1	0	0.025
2	C	summer	CNN2	0.103448276	0	0
2	C	summer	CW1	0	0	0
2	C	summer	CX1	0.256410256	0	0
2	C	summer	CY1	0.179487179	0	0
2	C	summer	CY2	0	0	0