Report

Analysis of the Effects of Fire, Grazing, and the Distance to Wetlands on Grassland Bird Abundance

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Análisis de los efectos que los incendios, el pastoreo y la distancia respecto a los humedales tienen en la abundancia de aves de pastizal

Resumen ejecutivo

La Comisión para la Cooperación Ambiental (CCA) contrató los servicios de Apropos para evaluar los efectos que los incendios, el pastoreo y la distancia de los humedales tienen en los niveles de abundancia de las aves de pastizal en el Área Nacional de Vida Silvestre (National Wildlife Area, NWA), ubicada dentro de los límites de la Base Suffield de las Fuerzas Armadas Canadienses (Canadian Forces Base, CFB). La información que nutrió este proyecto es aportación del ministerio de Medio Ambiente (Environment Canada, EC) y el Departamento de la Defensa Nacional (Department of National Defence, DND) de Canadá.

En lo que respecta a los temas de incendios y pastoreo, se encontró que análisis simples realizados con anterioridad arrojaron resultados más claros, de hecho, que el método de modelos estadísticamente más complejos utilizado para los estudios encomendados por la CCA. Sin embargo, el trabajo efectuado para la CCA permitió abordar inquietudes respecto a que los factores de perturbación por incendios y pastoreo no estaban distribuidos de manera uniforme en todas las secciones ecológicas, por lo que cabe la posibilidad de que las respuestas a aspectos clave del hábitat —como los arbustos— estuviesen generando cierta distorsión. La repetición del análisis mediante el presente estudio tuvo el propósito de incluir aspectos de topografía y el tamaño de las partículas de suelo con miras a tomar en cuenta los efectos que ejercen en el hábitat. Al final, aunque se siguieron presentando los mismos problemas que entorpecieron el análisis inicial, resultó más fácil cuantificarlos y quedó claro que, con niveles de pastoreo e incendios moderados —similares a los patrones históricos—, el control de factores topográficos y de suelo en el hábitat reviste, para numerosas especies, mayor importancia que los factores de perturbación mismos.

En el análisis de la distancia respecto a los humedales, la mayoría de las especies mostró respuestas más contundentes con relación a los arbustos, el suelo y los factores topográficos —que influyen en el tipo y cantidad de vegetación que crece dentro del área de estudio—, en comparación con las respuestas que generaron para las mediciones de los factores de perturbación, como conteos de materia fecal, número de incendios, años transcurridos desde el último incendio o distancia respecto a posibles fuentes de agua o bordes de humedales visibles. Esto sugiere lo siguiente:

Es de suma importancia tomar en cuenta los factores que influyen en el crecimiento del hábitat incluso en un experimento de perturbaciones controladas, puesto que pocos sitios guardarán absoluta uniformidad en términos de suelos o topografía y, por ende, de la comunidad vegetal.

En áreas semiáridas con pastoreo moderado, todo un conjunto de aves de pastizal puede

persistir durante periodos prolongados sin perturbaciones de incendios.

Las respuestas de las aves respecto de los humedales varían en función del uso del suelo y el tipo de humedal de que se trata.

La precipitación puede ser un importante indicador de la selección de hábitat y los niveles de abundancia de las aves de pastizal en el transcurso del tiempo y es muy probable que las medidas de grandes distancias a los humedales se hayan visto significativamente influidas por la dinámica de precipitaciones en general. La información sobre el tipo de humedal, per se, no aporta datos históricos sobre precipitaciones, y el tipo de humedal está apenas relacionado con el relieve y otros factores como la presencia de arbustos. El desempeño combinado o mixto que registran algunos de los modelos de humedal puede responder a lo complejo de estas dinámicas.

Las distancias respecto a los humedales se calcularon con base en información de dos años similares, pero no como medidas directas de cada uno de estos años. Habría sido de gran utilidad limitar las mediciones de los humedales a escalas más pequeñas y, para reflejar mejor una parte de la compleja dinámica en juego, haber incluido algunas mediciones de la precipitación, como los efectos que la precipitación histórica ejerce en la profundidad de los depósitos de residuos vegetales sin descomponerse en la superficie del suelo.

Los resultados con posibles implicaciones en términos de manejo son los siguientes:

En pastizales semiáridos, los regímenes de incendios que se aproximan a los regímenes naturales en términos de frecuencia y alcance del fuego tal vez no ejerzan un efecto tan significativo al examinarse en una zona extendida o un periodo prolongado. Sus efectos inmediatos pueden ser catastróficos, pero no serán duraderos.

La distancia respecto a vaguadas, fosas y ocasionalmente suelos húmedos y humedales a cielo abierto influyó en la abundancia de algunas especies en conformidad con su respuesta al pastoreo. Lo anterior sugiere que la distribución y la abundancia de las fuentes de agua pueden servir como herramienta de manejo de particular importancia para especies que requieren mayor cubierta o una cubierta irregular, con remanentes de pastizal (por ejemplo, el gorrión sabanero pálido [Ammodramus bairdii], la bisbita llanera [Anthus spragueii], el zarapito ganga [Bartramia longicauda] y, posiblemente, el gorrión zacatero coliblanco [Pooecetes gramineus]).

La extensión del terreno influyó a menudo en la abundancia de la avifauna, aunque este resultado deberá interpretarse con cautela, puesto que los terrenos de mayor extensión se encontraron en zonas en su mayor parte sin arbustos, con suelos menos densos y una topografía poco accidentada. Un indicio más sólido que sustenta la conveniencia de los terrenos de gran extensión en ambientes semiáridos es el hecho de que algunas especies prefieren alejarse de las fuentes de agua del ganado, lo cual sólo es posible en terrenos de gran magnitud.

Analyse des effets du feu, du broutage, et de la distance observée relativement aux terres humides sur l'abondance des oiseaux de prairies

Sommaire de rapport

La Commission de coopération environnementale (CCE) a mandaté Apropos pour évaluer les effets du feu, du pâturage et des zones humides sur l'abondance des oiseaux des prairies dans la réserve nationale de faune, à la Base des Forces canadiennes Suffield. Les données relatives au projet ont été fournies par Environnement Canada et le ministère de la Défense nationale.

Dans le cas du travail relatif au feu et au pâturage, les analyses simples effectuées précédemment avaient en fait donné des résultats plus clairs que l'approche fondée sur un modèle plus statistiquement perfectionné qui a été utilisée pour les analyses exécutées sur demande de la CCE, mais le travail effectué par la Commission a aidé à traiter les préoccupations selon lesquelles les perturbations causées par le feu et le pâturage n'étaient pas réparties également entre les écosections (classification fondée sur l'aménagement du sol et la topographie), de sorte qu'il était possible que les réactions aux principales caractéristiques de l'habitat, telles que les arbustes, puissent créer un biais. La nouvelle analyse actuelle avait pour objet d'inclure la granulométrie du sol et la topographie afin d'en contrôler les effets liés à l'habitat. En fin de compte, les problèmes qui gênaient l'analyse initiale se sont encore une fois manifestés, mais ils étaient plus faciles à quantifier et il était évident que, lorsque le pâturage et le feu étaient modérés, et à des niveaux semblables aux modèles historiques, l'habitat qui tient compte du sol et de la topographie était plus important pour de nombreuses espèces que les facteurs de perturbation.

Dans le cas de l'analyse de la distance des zones humides, la plupart des espèces ont réagi aux arbustes, au sol et à la topographie, qui influencent le type et la quantité de végétation qui pousse dans la zone d'étude; elles ont réagi plus fortement qu'elles ne l'ont fait aux mesures de la perturbation, telles que les comptes de pelotes de réjection, le nombre de feux, les années écoulées depuis le feu, ou la distance des sources d'eau possibles ou des bords de zone humide visibles. Cela semble indiquer ce qui suit :

Il est très important de prendre en compte les facteurs qui influencent la croissance de l'habitat, même dans le cadre d'une expérience de perturbation contrôlée, car peu de sites sont parfaitement uniformes pour ce qui est du sol ou de la topographie et donc, de la communauté végétale.

Dans les zones semi arides modérément pâturées, une suite complète d'oiseaux des prairies peut persister pendant longtemps, à condition de ne pas être perturbée par le feu.

Les réactions des oiseaux aux zones humides doivent tenir compte de l'utilisation des terres et du type de zone humide.

La précipitation peut être un important indicateur prévisionnel du choix de l'habitat et de

l’abondance des oiseaux des prairies au fil du temps, et il était probable que les mesures de grande distance des zones humides seraient fortement influencées par la dynamique générale des précipitations. En soi, l’information sur le type de zone humide ne fournit pas l’histoire des précipitations, et la corrélation entre le type de zone humide et les formes de relief, ainsi que d’autres facteurs tels que les arbustes, est faible. Les résultats mitigés fournis par certains des modèles de zone humide pourraient être le résultat de cette dynamique, qui est source de complications.

Les distances de zone humide ont été calculées pour deux années semblables, mais non comme mesures directes pour chaque année. Il aurait peut être été avantageux de limiter les mesures de zone humide aux petites échelles et d’inclure certaines mesures de précipitation, telles que les incidences de l’histoire des précipitations sur l’épaisseur de la litière, pour mieux tenir compte d’une partie de la dynamique complexe qui est en cause.

Les résultats ayant des répercussions possibles sur la gestion ont été les suivants :

Dans les prairies semi arides, il se peut que les régimes des feux qui s’apparentent aux régimes naturels en ce qui a trait à la fréquence et à l’étendue du feu n’aient que peu de conséquences lorsqu’on les examine sur une grande aire ou au cours d’une longue période. Les conséquences immédiates peuvent être dramatiques, mais elles ne sont pas durables.

La distance des cuvettes, des mares réservoirs et occasionnellement des terres humides et des marécages a influé sur l’abondance de certaines espèces de façon compatible avec la réaction de ces dernières au pâturage. Cela laisse entendre que la répartition et l’abondance des sources d’eau peuvent servir d’outils de gestion particulièrement importants dans le cas des espèces qui requièrent un abri plus important ou épars (le bruant de Baird, le pipit de Sprague, la maubèche des champs et peut être le bruant vespéral).

Les dimensions du champ étaient souvent liées à l’abondance des oiseaux, mais ce résultat doit être considéré avec prudence, car les grands champs se trouvaient dans des aires en grande partie sans arbustes, au sol fin et à la topographie d’une grande douceur. Le fait que certaines espèces préfèrent être loin des sources d’eau destinées au bétail, ce qui ne peut avoir lieu que dans un grand champ, est la meilleure preuve de l’attrait des champs de grandes dimensions dans les environnements semi arides.

1. Introduction & Study Area

The Commission for Environmental Cooperation (CEC) contracted Apropos to assess the effects of fire, grazing and wetlands on grassland bird abundance at Canadian Forces Base (CFB) Suffield. The data for this project were provided by Environment Canada (EC) and the Department of National Defence (DND). The original schedule for this project was to be completed in 2012, but unforeseen delays in acquiring the wetland data delayed the project. This report covers the analysis of the fire and grazing data in section 4 and the wetland data in section 5. The data and analysis were partitioned because not all input variables were available for all years.

In 1994 and 1995 EC conducted a biophysical inventory of a portion of CBF Suffield in response to a plan for a proposed National Wildlife Area (NWA). The proposed NWA was off limits for military training but had pasture areas and until the winter of 1993/1994 had feral horses. This area had also experienced greater than average fires in modern time due to previous military training in the area. The NWA itself is an area along the eastern edge of CFB Suffield where the border follows the South Saskatchewan River and is treated as two parts, the North Block where there is more shrub and topographic variation and no cattle grazing, and the South Block which has ongoing grazing and more variety in terms of topographic profiles and habitat types. An overview map of the Suffield NWA is included as Figure 1.

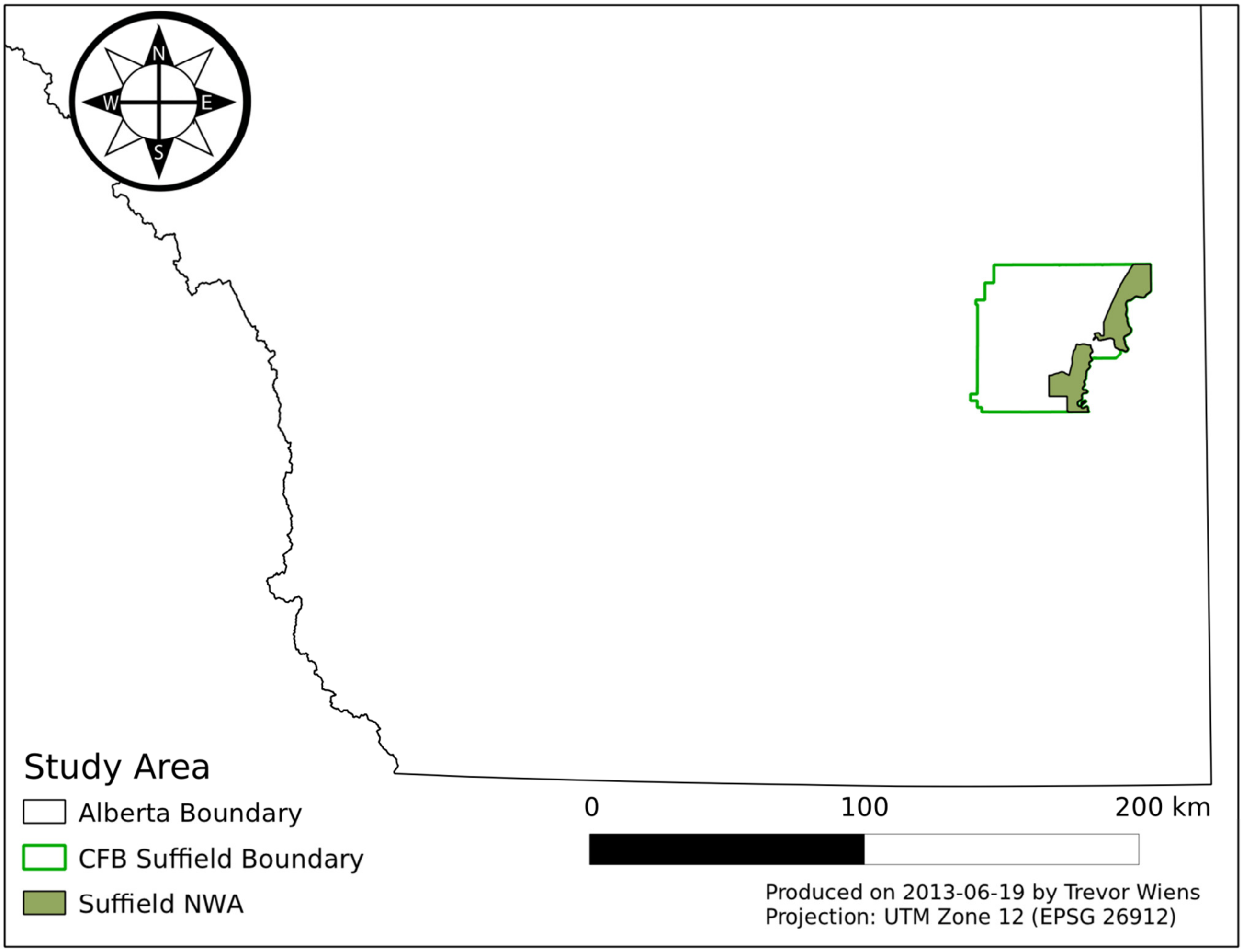
A number of research initiatives were undertaken including wetland studies (Adams et al. 1998), vegetation studies (Adams et al. 1997), ungulate studies (Shandruk et al. 1998) and avifauna (Dale et al. 1999). For this project we used the bird data, grazing, fire and shrub data generated from those reports.

The bird data used were gathered using 1000m spaced transects with 500m spaced locations to conduct 5 minute point counts (Dale et al. 1999). Birds were identified as either inside or outside a 100m radius up to 250m from the point count center. The original study examined bird abundance in relation to ecosites as well as fire and grazing using simple statistical methods. The authors of the 1999 study wished to revisit those data with more sophisticated statistical methods and this was in part the impetus for this study. In this analysis we used both inside and outside bird counts added together but did not use the ecosite information.

The fire data were provided as a GIS layer (Adams et al. 1997). In the report it states that fires had been mapped since 1983 and it is assumed that the map data were provided by CFB Suffield, but no information about the methods used to create the fire maps was provided.

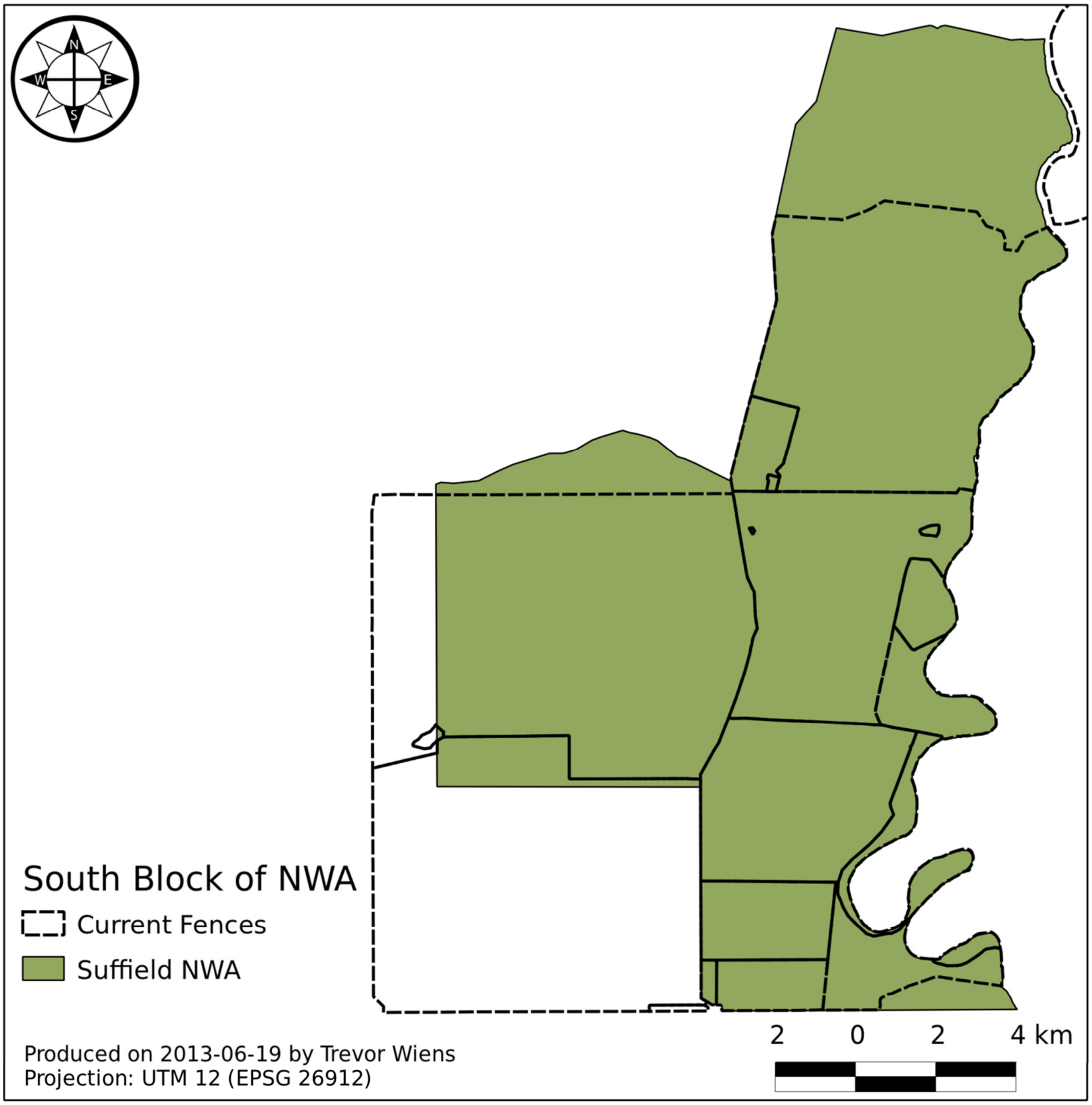
The shrub data were collected as part of the vegetation cover mapping (Adams et al. 1997). The vegetation mapping was done with both detailed sampling of the entire NWA using regularly spaced survey locations and infrared photo interpretation. From photos, polygons were created and assigned to classes and on the ground visits using microplots were used to estimate shrub and tree cover.

Figure 1: Location of the Suffield NWA



Pellet counts are a rapid and economical method for identifying general habitat use by cattle and other ungulates (Shandruk et al. 1998). Shandruk et al. (1998) completed 925 pellet group transects within the NWA. These transects were spaced 500 - 1000m apart and each consisted of a strip plot 2m by 100m which was traversed by two observers to determine which pellets were within the plot and how many and what type of pellets they were. For this study, we choose locations where both pellet counts and bird counts co-occurred. Shandruk et al. (1998) note that the stocking rates within the NWA were moderate, which limited the range of grazing effects we could explore. It is also worth noting that older pellets were included in the counts so that these data represented both recent use and grazing history.

Figure 2: South Block of NWA



Beginning in 1999, the Suffield Grazing Advisory Committee approved an increase in grazing intensity in the community pasture which included part of the NWA and an adjacent area as shown in Figure 2. EC had concerns that an increase in grazing might have some influence on the bird community, so monitoring was conducted from 2000 through 2005 on a subset of the points used in the biophysical work done in 1994 and 1995 in the South Bock of the NWA. Some new points were added to cover the new areas using the same field methods as before. This work was able to document high year to year variability in bird numbers and showed no adverse effects with the change to the minimal stocking rate. The stocking rates for the NWA continued to be well regulated and adjusted yearly when needed following fall site inspections.

From 2006 through 2009, subsets of points in the North Block were also surveyed. The 2000 through 2006 data were previously used to create and validate habitat models using variables that included remote sensing based indices, soil particle size or soil coarseness, topography and precipitation (Wiens et al. 2008).

Another change to the area began in 1999 with the infill drilling of natural gas wells. This was initiated in 1999 prior to the designation of the area as a National Wildlife Area. The biophysical and grazing monitoring data were used to test for effects of gas well density and this information was used in hearings to consider further drilling proposed by EnCana (CEAA) and later published with additional information (Dale et al. 2009). Gas well density data and shrub data from the biophysical were used to improve the model for Sprague's Pipit developed in Wiens et al. (2008) to identify Critical Habitat protected under the Canadian Species at Risk Act. Long term data sets are valuable and although this one has been used for many analyses, it can still provide more useful information. Distance to water is an example of that. During the biophysical analyses, the authors speculated that larger fields were ideal for a variety of birds because the grazing was likely to be more uneven due to varying distances to water sources for cattle (Dale et al. 1999). At that time, no layer with wetland and well location data was available. The data are now available and thus, the response of birds to distance to water at Suffield can be tested.

3. Existing research on Fire and Grazing

A variety of papers on burning and grazing were reviewed to guide the analytical approach take to this data set. This section provides a very brief review of that material.

The main points from the reviewed literature are summarized in Table 1.

Table 1: Bird specific responses to fire and grazing

Species	Effect	Habitat Associations	Citation
Baird's Sparrow (*Ammodramus bairdii*)	Fire reduced shrub which increased habitat suitability	+ grass + native grass - shrub - visual obstruction	Madden et al. 2000
	Grazing in drought reduces abundance	- shrub	Dale 1983
	Heavy grazing reduced numbers	+ veg height & thickness (drier site than in Madden et al. 2000)	Kantrud 1981, Davis et al. 1999
Brewer's Sparrow (*Spizella breweri*)	Shrub dependent so reduction of shrub is negative	+ shrub	Rotenberry et al. 1999
Brown-headed Cowbird (*Molothrus ater*)	No clear response to grazing		Kantrud 1981, Dale 1983
	No response to fire		Grant et al. 2010
Chestnut-collared Longspur (*Calcarius ornatus*)	Early seral stage preferred so areas with recent fires or heavy grazing likely preferred	+ bare ground - forbs	Fritcher et al. 2004
	Preferred grazed to ungrazed	+ bare ground litter vegetation height and thickness	Dale 1983
	Increased with grazing intensity		Kantrud 1981

Table 1 continued

Species	**Effect**	**Habitat Associations**	**Citation**
Clay-colored Sparrow (*Spizella pallida*)	Fire reduced nest abundance year after fire. Recovered in 3 years	+ litter depth + standing dead (did not measure shrub)	Grant et al. 2011
	Grazing had no effect on abundance	+ shrub, grass cover, litter depth	Dale 1983
	Decreased in heavily grazed		Kantrud 1981
Grasshopper Sparrow (*Ammodramus savannarum*)	Lower abundance in recently burned plots	+ shrub	Bock and Bock 1992
	Preference for later seral stages, thus areas with more temporally distant fires		Fritcher et al. 2004
	Fire effect not clear	+ exotic grasses - visual obstruction	Madden et al. 2000
	Fire had little effect		Grant et al. 2011
	Reduced abundance with heavy grazing		Kantrud 1981
Horned Lark (*Eremophila alpestris*)	Higher abundance in recently burned plots	- grass - litter	Bock and Bock 1992
	Early seral stage preferred so areas with recent fires or heavy grazing likely preferred	- litter depth	Fritcher et al. 2004
	Increased with heavy grazing		Kantrud 1981
	Prefers grazed to ungrazed		Dale 1983
Lark Bunting (*Calamospiza melanocorys*)	Highest in moderate grazing		Kantrud 1981
	Heavy grazing detrimental Fire that reduces shrub detrimental		Shane 2000

Table 1 continued

Species	Effect	Habitat Associations	Citation
Long-billed Curlew (*Numenius americanus*)	Recent burn and heavy grazing associations	+ spatial variation in structure suggests a preference for larger grazing areas	Derner et al. 2009
Sprague's Pipit (*Anthus spragueii*)	Fire reduced cover which has a positive effect	- visual obstruction	Madden et al. 2000
	Preferred ungrazed to grazed		Dale 1983
	No response to grazing intensity		Kantrud 1981
	Heavy grazing reduces abundance		Davis et al. 1999
Upland Sandpiper (*Bartramia longicauda*)	Avoid grazing for nesting but forage in grazed areas	+ spatial variation in structure suggests a preference for larger grazing areas or mosaic of grazed and ungrazed areas	Derner et al. 2009
	Preferred heavy grazing		Kantrud 1981
Vesper Sparrow (*Pooecetes gramineus*)	Higher abundance in recently burned plots	- grass - litter	Bock and Bock 1992
	Highest in moderate but no clear response to grazing intensity		Kantrud 1981
Western Meadowlark (*Sturnella neglecta*)	No clear response to grazing		Kantrud 1981, Dale 1983
	Fire had little effect		Grant et al. 2011

Researchers in the field generally agree that fire and grazing are important management mechanisms to be employed by land managers. Fuhlendorf et al. 2006 argued that burning and grazing mimic natural cycles and therefore merit re-introduction in their study areas. However, Curtin in 2002 argued that grazing plans need to consider ongoing environmental effects so that areas are not over-grazed in very dry years. McGranahan et al. in 2012 argued that these tools need to be used together to create distinct patches. Wendtland and Dodd in

1990 suggest that the pre-settlement fire cycle in the USA was about 15 to 30 years long and that high-intensity fires have greater environment benefits. Roberts et al. in 2012 argued that during a fire, the species composition changes but returned to normal within a few years. Finally, Wakimoto et al. 2004 reviewed historical literature and suggested fire cycle repeat frequency ranged from 5 to 12 years.

A largely agreed upon theme in the literature was that drier locations would have longer fire intervals, which is an important consideration in applying recommended intervals to areas outside those for a particular area in which a study was conducted. Recommended stocking rates vary with soil and moisture because these influence forage productivity so again recommendations for grazing to benefit avian management are likely to vary.

We also reviewed the methods of analysis employed which generally involved the use of standard non-parametric and parametric methods.

4. Analysis of EC Fire and Grazing Data

4.1 Data preparation

Data files from EC in the format of spreadsheet files and GIS files of burn, bird and pellet count locations were integrated as follows:

1. Spatial data were imported into GRASS GIS 6.4 (GRASS Development Team, 20102) using PostgreSQL (The PostgreSQL Global Development Group, 2012) for attribute management.

2. For soils AGRASID data from the region were also imported into GRASS GIS 6.4 and SQL queries were constructed to calculate the Mean Relative soil Particle Size (MRPS) as per Wiens et al.2008 and the script mrps_creation.sql found in the deliverable_2/scripts folder. Similarly a 30m pixel size DEM provided by EC was used to calculate a topographic roughness index based on the differences between plan and surface areas using the GRASS extension script r.roughness.window.area2 available on the GRASS GIS Wiki in the extensions section. Topographic roughness is equivalent to the flatness index described in Wiens et al. 2008 with values near 1 for flat areas and areas with increasing topographic variation having values greater than 1.

3. Pellet count sites were then used with the v.sample.buffer2 script (also available on the GRASS GIS Wiki site) was used to sample the mean values of the topographic roughness and MRPS values within 250 metres of the site centroids to match the areas included in the point counts.

4. Shrub data were derived from a Canadian Wildlife Service habitat classification which divided the Suffield NWA into a series of habitat class polygons with a unit-less mean shrub value ranging from 0 to 30. This layer was converted to a raster and then using the v.sample.buffer2 script the mean of the shrub value within 250m of the site centroids was used as a shrub measure.

5. Lastly a Fire Index value as calculated using the number of years since a fire and the number of fires information provided by CWS. The formula used as based on the work of Madden et al. (1999) as follows:

Fire Index = Number of Fires / Years Since Last Fire

In cases where the fire had been in the current year prior to our sampling, the Years Since Last Fire was set to 0.5 as it seemed ecologically reasonable that with little or no time for recovery the effect of a fire on habitat structure for the species in questions would be twice as powerful than if the fire had occurred in the previous year. For example, if there were no fires the index would be 0, if there was 1 fire last year the index would be 1 and if there have been 5 fires and the last one was in the spring of the sample year the index would be 10.

Using SQL queries, bird survey locations were merged with bird site list using the EC bird point count "siteid" variable. Pellet counts were also linked in this fashion. Burn data however, were linked by line and plot to pellet counts which thus enabled linkage to the bird count data. The bird data were cross-tabulated to create a bird records table with one species per column.

These final data were then linked and exported in CSV format for analysis in R (R Core Team, 2012). Initial analysis indicated that there may be some merit in also examining the bird observations as presence data, so the original data was re-accessed to also create bird presence variables. These queries are included in the deliverable_2/scripts folder script create_species_tables.sql.

4.2 Examination of data

First, the distribution of species and predictors were assessed through the use of histograms. Species with less than 20 observations were removed from consideration. Remaining species and predictors were then assessed for outliers and collinearity. Graphs from this initial assessment work are included in Appendix A. Collinearity tests showed that species were sufficiently independent so that one species could not be used as a proxy for another. The relationships between the predictor variables showed independence except between the two fire measures had a Kendall tau of -0.76 ($p < 0.001$).

An assessment of year to year differences for species and predictors using a Wilcox test to assess similarity in distributions was conducted. Although most predictors and species showed no differences, a few did so it was decided that subsequent parametric analyses would include year to account for the variation and provide a consistent method across all species. The inclusion of year also allowed for variation in precipitation other unknown external variations between years that could not otherwise be accounted for.

Outlier detection noted two records in the topographic roughness measures and two records for species BCHO that had outliers. Removing these records resulted in the total sites across the two years being reduced from 413 to 409 records.

4.3 Non-parametric Analysis

We calculated the Kendall rank correlation coefficient to examine the relationship between fire and grazing patterns in relation to topography and soil coarseness. This test was chosen because it makes no assumptions about the distribution of the variables being compared. These results are summarized in Table 2.

The disturbance vs. structural measures might suggest that horses and cattle respond differently to topographic roughness and soil coarseness. The differences observed between horses and cattle are presented in Table 2; however differences are largely because most of the horses were limited to the north with greater topographic variation, coarser soil and more shrub and the cattle were restricted to the south block with less shrub, finer soils and fewer hills. There was no measurable difference in fire patterns in relation to soil or topography.

Table 2: Kendall Rank correlations between predictors (**bold for p <= 0.01**)

Measure	Statistic	Topographic Roughness	MRPS
Shrub	tau	-0.062	**0.298**
	p-value	0.061	**< 0.001**
Years Since Fire	tau	-0.032	-0.035
	p-value	0.372	0.344
Total Burns	tau	0.002	0.063
	p-value	0.962	0.132
Fire Index	tau	0.046	-0.001
	p-value	0.215	0.974
All Pellets	tau	**-0.184**	0.010
	p-value	**< 0.001**	0.786
Old Cattle Pellets	tau	0.024	**-0.310**
	p-value	0.522	**< 0.001**
New Horse Pellets	tau	-0.052	**0.155**
	p-value	0.182	**< 0.001**
Old Horse Pellets	tau	**-0.155**	**0.289**
	p-value	**< 0.001**	**< 0.001**

We also calculated the Kendall rank correlation coefficient for pairs of species and predictors. Tests against new horse pellets were restricted to 1994 data, as horses were removed from Suffield at the beginning of 1994. The correlation results are summarized in Table 3.

In this simple test, topographic roughness and years since fire were in most cases weakly or not significantly correlated with species abundance. The fire index however, took into account both the years since fire and total burns and was thus deemed the most useful management and analytical metric and was used for subsequent analyses. In the case of topographic roughness, it continued to be used on the possibility that although weak in on its own, it might provide useful additional information in regression analyses especially given it had proved a useful predictor in habitat models (Wiens et al. 2008).

Table 3: Kendall Rank Correlations between species and predictors (**bold for p <= 0.01**)

Species (values are tau & p-value)	Shrub	All Pellets	Old Cattle Pellets	New Horse Pellets	Old Horse Pellets	MRPS	Topo	Total Burns	Years Since Fire	Fire Index
Baird's Sparrow	**-0.341**	**0.158**	**0.275**	-0.120	**-0.122**	-0.069	**-0.129**	-0.122	0.100	-0.100
	< **0.001**	< **0.001**	< **0.001**	0.062	**0.004**	0.091	**0.001**	0.011	0.021	0.032
Brown-headed Cowbird	**0.279**	-0.028	**-0.165**	0.034	**0.158**	**0.111**	-0.035	**0.168**	-0.055	0.087
	< **0.001**	0.500	< **0.001**	0.601	< **0.001**	**0.008**	0.383	< **0.001**	0.212	0.056
Brewers Sparrow	**0.174**	-0.069	**-0.239**	**0.204**	**0.170**	**0.256**	-0.014	-0.119	0.065	**-0.130**
	< **0.001**	0.091	< **0.001**	**0.001**	< **0.001**	< **0.001**	0.729	0.013	0.133	**0.004**
Chestnut-colored Longspur	**-0.376**	**0.259**	**0.495**	**-0.211**	**-0.264**	**-0.214**	**-0.100**	0.010	-0.039	0.072
	< **0.001**	< **0.001**	< **0.001**	< **0.001**	< **0.001**	< **0.001**	**0.010**	0.841	0.362	0.103
Clay-colored Sparrow	**0.386**	-0.046	**-0.251**	**0.207**	**0.199**	**0.176**	-0.070	0.065	-0.006	-0.006
	< **0.001**	0.262	< **0.001**	**0.001**	< **0.001**	< **0.001**	0.078	0.180	0.892	0.892
Grasshopper Sparrow	**-0.174**	0.055	0.059	-0.045	0.032	**0.124**	-0.030	**-0.275**	**0.275**	**-0.254**
	< **0.001**	0.161	0.168	0.476	0.426	**0.002**	0.426	< **0.001**	< **0.001**	< **0.001**
Horned Lark	**-0.392**	0.092	**0.264**	**0.173**	**-0.181**	**-0.225**	0.029	**-0.173**	0.071	-0.085
	< **0.001**	0.018	< **0.001**	**0.004**	< **0.001**	< **0.001**	0.437	< **0.001**	0.082	0.046
Long-billed Curlew	-0.172	0.022	**0.146**	-0.019	-0.106	**-0.173**	0.013	0.082	**-0.163**	**0.144**
	< **0.001**	0.602	**0.001**	0.776	0.014	< **0.001**	0.750	0.094	< **0.001**	**0.002**
Lark Bunting	**0.330**	**-0.135**	**-0.271**	0.030	0.104	**0.237**	**-0.086**	**0.250**	**-0.186**	**0.207**
	< **0.001**	< **0.001**	< **0.001**	0.635	0.014	< **0.001**	**0.027**	< **0.001**	< **0.001**	< **0.001**
Sprague's Pipit	**-0.437**	0.075	**0.288**	-0.151	**-0.174**	**-0.211**	0.012	**-0.245**	**0.254**	**-0.186**
	< **0.001**	0.056	< **0.001**	0.016	< **0.001**	< **0.001**	0.748	< **0.001**	< **0.001**	< **0.001**
Upland Sandpiper	**0.225**	-0.047	-0.090	0.056	0.047	**0.107**	0.030	0.048	-0.008	0.037
	< **0.001**	0.255	0.048	0.379	0.279	**0.009**	0.451	0.323	0.859	0.416
Vesper Sparrow	**0.312**	-0.063	**-0.298**	0.087	**0.271**	**0.186**	0.005	0.078	-0.049	0.030
	< **0.001**	0.110	< **0.001**	0.163	< **0.001**	< **0.001**	0.886	0.092	0.237	0.493
Western Meadowlark	0.032	0.023	**-0.152**	**0.169**	**0.169**	**0.124**	-0.039	**-0.176**	**0.112**	**-0.172**
	0.388	0.540	< **0.001**	**0.004**	< **0.001**	**0.001**	0.284	< **0.001**	**0.005**	< **0.001**

As part of our interest is total grazing history, we also tried combining all pellets. In most cases bird abundances had opposite correlations to horse and cattle grazing measures so combining all pellets negated most detectable effects. The differences as noted above may be a result of the differences between the north where most of the horses had been and the south with cattle. The cattle and horse differences may also be confounded by the north block having much more shrub. In subsequent analyses both the merged pellets and the individual pellet counts were assessed with the shrub measure which was generally more strongly correlated with bird abundance than any other measure.

4.4 Parametric Analysis

The non-parametric analysis results demonstrated that although relationships between the species abundance and most the predictors, grazing and fire in particular, existed, these were not strong predictors on their own. Considering that the data were not explicitly collected for this purpose caution was warranted so a p-value of <=0.01 was used as an indicator of statistical significance. For results that made ecological sense p-values 0.05 to 0.01 were treated as weakly significant.

The survey data were collected along regular spaced stations on transect lines so spatial auto-correlation had to be taken into consideration to ensure that any patterns observed were not artifacts of the spatially correlated nature of landscapes. This dynamic in relation to bird habitat selection is usually manifest as the simple observation that individuals of one species tend to be found in proximity to others of that same species. In the case of transect based point counts, this means that if you observe species x at station y in a transect, the likelihood of observing species x and station y+1 is greater than if you had not observed species x at station y. This obvious state of affairs can create problems in modeling species habitat selection and introduce the possibility of Type-1 error, detecting a phenomenon that is not actually true. In statistical terms, this spatial correlation means that spatially correlated data tend to reduce variance in the data set which in turn can produce artificially low p-values and potentially false conclusions (Lennon 1999).

When a model is created, one of the tests of the model is to examine the distribution of the model residuals; effectively the input variance not explained by the predictors. If the residuals show no pattern, then the modeler knows that the model was adequately defined (Zuur et al. 2009). However, if the model residuals display spatial, temporal or other forms of correlation, then important predictive factors are missing from the model. Spatial or other forms of auto-correlation are not in themselves, bad and are to be expected in ecological observation data. The question before ecologists is can we specify models that adequately explain the variation observed.

Although some methods in spatial statistics are well established, the means to include effective adjustment of spatial dynamics in regression models in ecology is still evolving. Dormann et al. (2007) provide an excellent overview of statistical methods to manage spatial auto-correlation. For data with a Poisson distribution, count data being the classic example, Generalized Linear Mixed Models, along with Generalized Estimating Equations and Spatial Eigenvector Mapping, are all methods that are known to perform well.

A less mathematically sophisticated but also effective method occasionally used with point count data is considering the presence or absence of the same species in adjacent stations along a transect. The downside of this approach is that it provides no ecological understanding of why the birds are clustering together and it also prevents the creation of habitat selection maps from the resulting models. For the purposes of this project these aforementioned limitations were not a problem, as the purpose here was to test and document the effect size of disturbances and wetland distribution on species abundance not to predict responses in new areas. It is worth noting that for this project, the purpose of the models was only examine the relative importance of various predictor variables so the data were not split into training and validation sets and model validation procedures, other than the use of stepwise AIC model simplification, were not undertaken.

Initially, we chose to work with Generalized Linear Mixed Models, but later realized that this made creation of effects graphs more difficult so we switched to Generalized Linear Models with this simpler adjacency variable as a means to handle spatial correlation in the models.

Species adjacency was calculated by assessing if the same species was present in the one or two adjacent count stations. If the same species was not present in adjacent stations, then the value of this variable was 0. If the same species was adjacent in an adjacent station then a value of 1 was assigned.

In our first round of analysis (in our draft report) we created normalized (z-score) values for all predictors so that we could more easily compare the relative importance of different predictors in models; these variables were given the prefix of a letter s and an underscore character. Later, when we considered the importance of reporting effects in the units of the predictor variables we abandoned this approach and developed subsequent models using the original untransformed variables. As such, it is important that predictor variable coefficients in model results not be compared against each other; examination of their p-values and effect graphs will be more informative and reliable in assessing their relative importance.

In our initial analysis for the draft report we lacked a shrub layer and had used a north / south factor variable to account for the marked difference in shrub distribution in the NWA. For the second round of analysis we obtained a shrub layer from EC based on their habitat classification work.

Zuur et al. (2009) provide an excellent overview of mixed effect models for a variety of different data types including Poisson distributed data. After all initial data evaluation and removal of outliers for the non-parametric analysis described in section 4.3 we adapted the methods outlined from Zuur et al. (2009) and used the following procedure during for the draft report:

1. An initial model format was developed to account for known factors and the available predictor variables.
2. The initial models for each species were expressed as Poisson distributed Generalized Linear Models. If both the regular and squared term had the same direction, the models were simplified to the linear term.
3. This initial model was then simplified using the step function in R which applies backward AIC selection. This procedure would then eliminate non-linear measures if they were not effective.
4. The residuals from the simplified model were then assessed for spatial correlation using a spline correlogram as implemented in the R ncf library.

5. If correlation was found in the residuals, the species observations were checked for a similar pattern, also using a spline correlogram.
6. If the source data and residuals displayed a similar correlation pattern it was assumed that the correlation in the residuals was a reflection of the source data and not a result of miss-specified model parameters and that use of a GLMM was needed to account for the spatial correlation.
7. A GLMM model, clustering site observations by transect using the R glmmML package was used and again residuals were checked for spatial correlation using a spline correlogram.
8. If the resulting residuals showed no sign of spatial correlation the new model was then used to construct a series of sub-models which were assessed using AIC weights and evidence ratios.
9. The selected model or models were then used to describe the observed relationships between species abundance and the predictors in question.

In this final report our procedure was modified and was as follows:

1. An initial model format was developed to account for known factors and the available predictor variables. During this initial formulation for those variables we thought may not have a linear response we included them as quadratic terms to assess if non-linear responses produced more effective models.
2. The initial models for each species was expressed as a Poisson distributed Generalized Linear Model. If both the regular and squared term had the same direction, the models were simplified to the linear term. We also calculated and included a species adjacency predictor variable.
3. This initial model was then simplified using the step function in R which applies backward AIC selection. This procedure would then eliminate non-linear measures if they were not effective.
4. This residuals from the simplified model were then assessed for spatial correlation using a spline correlogram as implemented in the R ncf library.
5. If correlation was found in the residuals, the species observations were checked for a similar pattern, also using a spline correlogram.
6. If the source data and residuals displayed a similar correlation pattern it was assumed that the correlation in the residuals was a reflection of the source data and not a result of miss-specified model parameters and that use of a GLMM was needed to account for the spatial correlation. This was only necessary in the case of Western Meadowlark and steps 7 through 9 from the above procedure were followed.
7. The final model was selected and effects graphs were plotted using the R “Effects” library version 2.2-3. Om the case of Western Meadowlark the GLM and GLMM model parameters and p-values were comparable so the effects from the GLM model were produced to assist the reader in understanding the results.

4.5 Results and Discussion

4.5.1 Baird's Sparrow

Following the procedure outlined in section 4.4, two models were specified for this species with common factors except in one case including all pellets and in another including horse and cattle pellets separately. In both initial models grazing and shrub measures were included as quadratic terms. AIC stepwise selection of these two models led to a common model which was then tested for, and found not to have any spatial auto-correlation. The final model showed other features were more important predictors than fire and grazing history (Table 4). Effects graphs are included in Figure 3.

Table 4: Baird's Sparrow Poisson GLM Model Results

	coef	**se(coef)**	**z**	**$Pr(>\lvert z\rvert)$**
(Intercept)	368.14269	113.08550	3.255	0.00113
shrub^2	-0.05049	0.01287	-3.922	8.79e-05
topo	-369.04988	112.98548	-3.266	0.00109
adjacency	0.96655	0.21529	4.490	7.14e-06

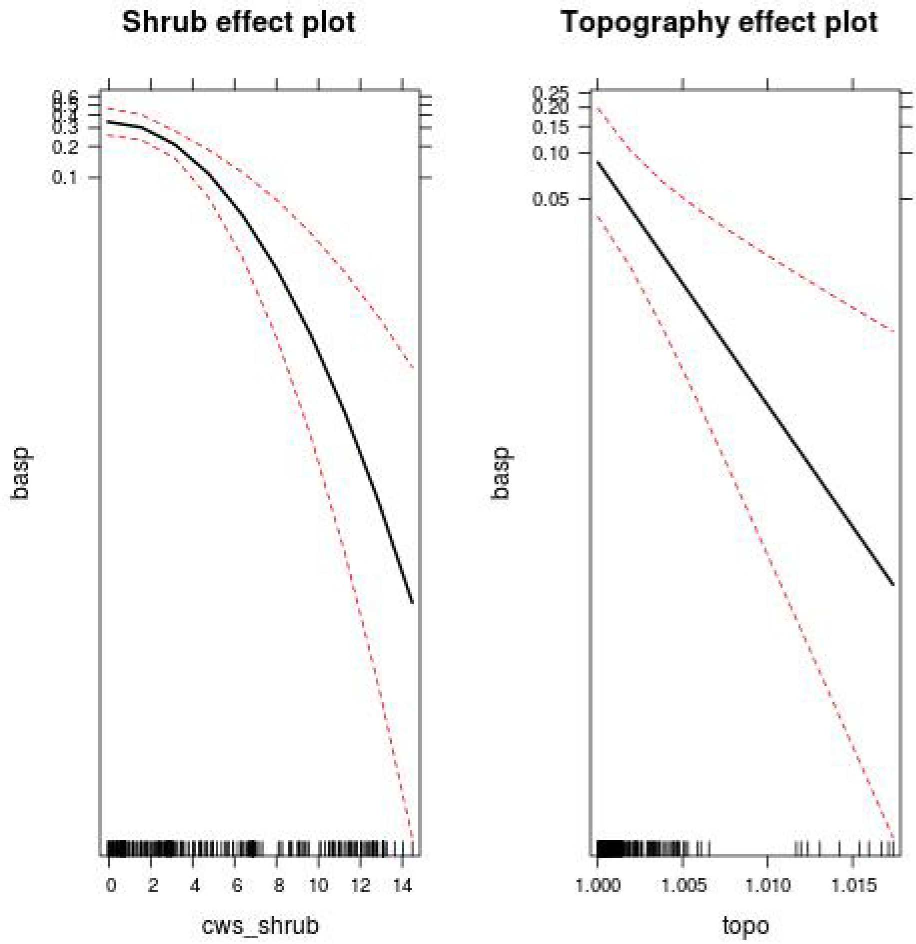
The correlations in Table 4 are consistent with the previous simple analysis that showed a positive response to moderate grazing and a negative response to fire (Dale et al. 1999).

The inclusion of shrub as a squared term in our final model and the effect graphs clearly show that when shrub values are in the higher two thirds of what was assessed in the model, habitat is no longer suitable for Baird's Sparrow. Similarly increases in topographic roughness reduces habitat suitability which is consistent with Wiens et al. 2008. The wider confidence intervals around the topography measure create some reasonable doubt as to the true strength of the response, but it is clearly not a positive relationship.

Other studies have concluded that habitat suitability for Baird’s Sparrow recovers quickly following fire and may even improve if shrub was reduced (Madden et al. 2000) and since only about 10% of our study sites had been subjected to fire within the previous 3 years it is perhaps not surprising that the model did not include fire variables even though the species showed a negative response to fire variables (Table 2, a positive correlation to time since fire is a negative response to fire) in this analysis and a negative response in the simpler analysis undertaken in Dale et al. 1999.

Grazing as a quadratic was included in the initial models because it is consistent with the species preference for moderate grazing. Other studies have found the species avoids heavy grazing or may respond negatively to grazing in drought (Kantrud 1981, Dale 1983, Davis et al. 1999) but given the moderate stocking rates, even the areas in the NWA with the highest pellet counts do not represent heavy grazing. This light to moderate grazing provides a reasonable explanation why grazing had little explanatory power and was removed during the stepwise simplification of the model.

Figure 3: Baird's Sparrow Fire & Grazing Model Effects



4.5.2 Brown-headed Cowbird

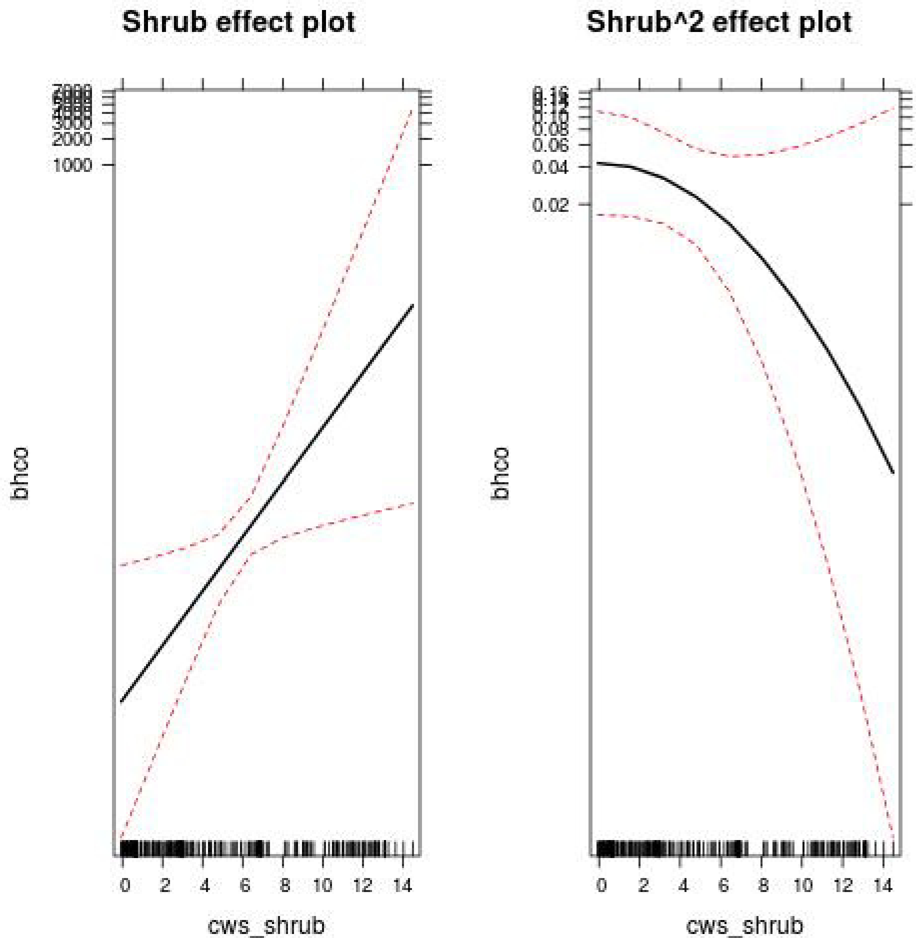
Following the procedure outlined in section 4.4, two models were specified for this species with common factors except in one case including all pellets and in another including horse and cattle pellets separately. In both initial models grazing and shrub measures were included as quadratic terms. AIC stepwise selection of these two models generated two simpler models that were subsequently compared with a global model using AIC weights. AIC evidence ratios clearly indicated the one model which was then tested for and found to have no spatial auto-correlation. The final model is summarized in Table 5. Effects graphs are included in Figure 4.

The results show very weak correlations which is clearly illustrated by the very wide confidence intervals seen in Figure 4. What can be reasonably concluded is that shrub has a positive effect on the habitat selection and abundance of this species in the NWA, but the strength of that relationship is unclear. Display groups prefer perches and female cowbirds require a perch to observe other nesting birds in order to identify a host nest to place their egg in. Shrubs could serve as such a perch although Davis (2004) found they preferred areas with dispersed shrub rather than a lot of shrub which might fit with the quadratic response in both the initial and final model. Neither fire nor grazing remained in the models after AIC stepwise selection suggesting that if they do have an effect, it is sufficiently small to be overwhelmed by other factors. Previous studies (Table 1) also found no clear response to grazing intensity or fire.

Table 5: Brown-headed Cowbird GLM Model Results

<table>
<tr><th></th><th>coef</th><th>se(coef)</th><th>z</th><th>Pr(>|z|)</th></tr>
<tr><td>(Intercept)</td><td>-6.38332</td><td>1.26109</td><td>-5.062</td><td>4.15e-07</td></tr>
<tr><td>shrub</td><td>0.72238</td><td>0.30690</td><td>2.354</td><td>0.0186</td></tr>
<tr><td>shrub^2</td><td>-0.02736</td><td>0.01747</td><td>-1.566</td><td>0.1173</td></tr>
<tr><td>adjacency</td><td>0.85644</td><td>0.42079</td><td>2.035</td><td>0.0418</td></tr>
</table>

Figure 4: Brown-headed Cowbird Fire & Grazing Model Effects



4.5.3 Brewer's Sparrow

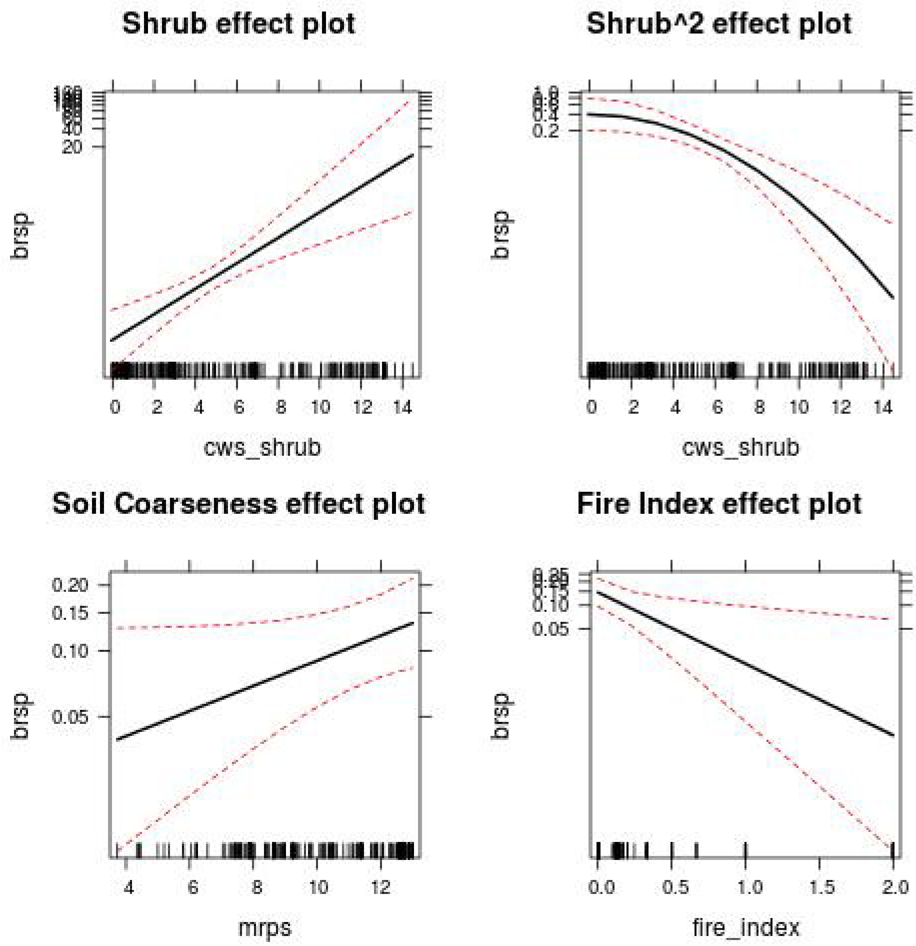
Following the procedure outlined in section 4.4, two models were specified for this species with common factors except in one case including all pellets and in another including horse and cattle pellets separately. In both initial models grazing and shrub measures were included as quadratic terms. AIC stepwise selection of these two models generated two simpler models that were subsequently compared with a global model using AIC weights. AIC evidence ratios clearly indicated the one model which was then tested for and found to have no spatial auto-correlation. Effects graphs are included in Figure 5.

Table 6: Brewer's Sparrow GLM Model Results

	coef	se(coef)	z	Pr(>|z|)
(Intercept)	-4.221776	0.898604	-4.698	2.63e-06
cattle	-0.169191	0.089811	-1.884	0.0596
cattle^2	0.003537	0.001934	1.829	0.0674
horse	0.103647	0.061007	1.699	0.0893
shrub	0.487571	0.112856	4.320	1.56e-05
shrub^2	-0.036657	0.008652	-4.237	2.27e-05
mrps	0.132892	0.070684	1.880	0.0601
fire index	-2.091903	0.879970	-2.377	0.0174
adjacency	1.115637	0.230079	4.849	1.24e-06

The effects graphs in Figure 5 clearly demonstrate the non-linear nature of the response to shrub as positive at lower quadratic values and then flattening and becoming negative at higher values. Shrub is needed for both nesting and foraging (Rotenberry et al. 1999) so that would not seem to explain the response. However, the authors also indicate they use larger sage for singing posts and possibly more shrub is not necessarily higher sage at Suffield as shrub there is snowberry in some places and sage in others. We have no spatial data on shrub heights or species. The response to soil is inconclusive as clearly seen by the wide confidence intervals. Fire appears to have a negative effect but the magnitude of that effect cannot be clearly established because of wide confidence intervals but the direction of the response is consistent with Bock and Bock (1992) and the species need for shrub as a nest substrate. The species had enough data for analysis but almost all observations were in the north block and in a small area of vegetated sand dunes in the south block on eolian and morainal formations (Dale et al. 1999).

Figure 5: Brewer's Sparrow Fire & Grazing Model Effects



4.5.4 Chestnut-collared Longspur

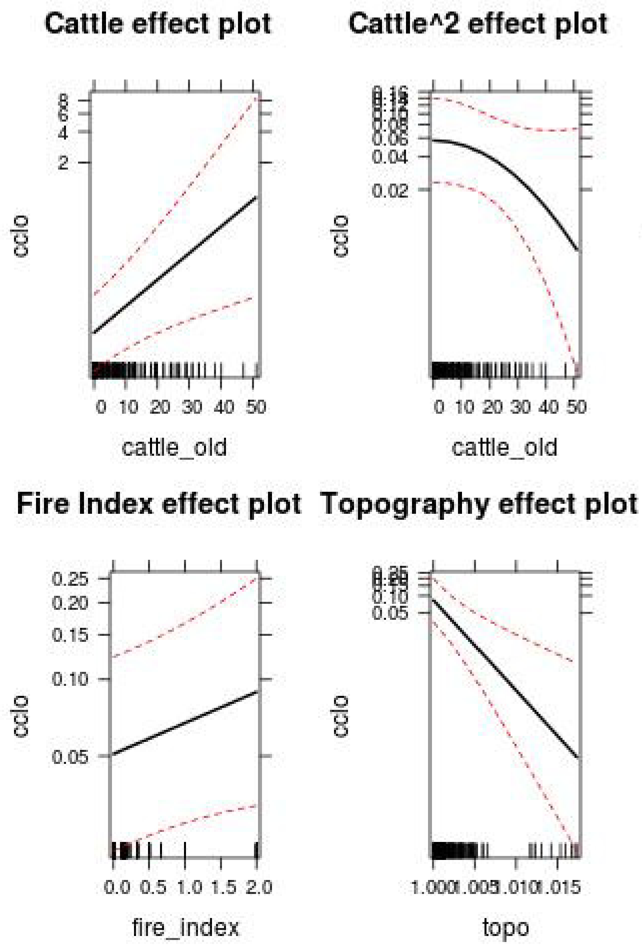
Following the procedure outlined in section 4.4, two models were specified for this species with common factors except in one case including all pellets and in another including horse and cattle pellets separately. In both initial models grazing and shrub measures were included as quadratic terms. AIC stepwise selection of these two models generated two simpler models. The creation of a global model was not possible because in both cases grazing measures had been retained. Without some statistical means to select a single model, the model with the most statistically significant terms was chosen to better understand the relative importance of the different predictors. This final model was assessed for spatial auto-correlation and none was found. The final model is summarized in Table 7. Effects graphs are included in Figure 6.

Table 7: Chestnut-collared Longspur GLM Model Results

	coef	**se(coef)**	**z**	**Pr(>|z|)**
(Intercept)	3.564e+02	1.094e+02	3.258	0.00112
cattle	5.971e-02	2.022e-02	2.953	0.00314
cattle^2	-8.933e-04	5.219e-04	-1.712	0.08696
shrub^2	-3.764e-02	1.369e-02	-2.749	0.00597
fire index	2.803e-01	1.593e-01	1.759	0.07851
topo	-3.583e+02	1.093e+02	-3.279	0.00104
adjacency	2.034e+00	2.844e-01	7.152	8.57e-13

The grazing effects suggest that grazing is generally a positive factor for this species. Shrub is a negative factor for this species but the extent of its negative impact at higher levels of shrub is unclear. Fire had no statistically significant effect. Increased topographic roughness is also seen to have a negative effect but due to wide confidence intervals, the steepness of this slope of this effect is not discernible. Chestnut-collared Longspurs are semi-colonial in that where there is one there are usually several and they engage in chases and display vigorously against each other so it is not surprising that adjacency was highly significant.

Figure 6: Chestnut-collared Longspur Fire & Grazing Model Effects



4.5.5 Clay-colored Sparrow

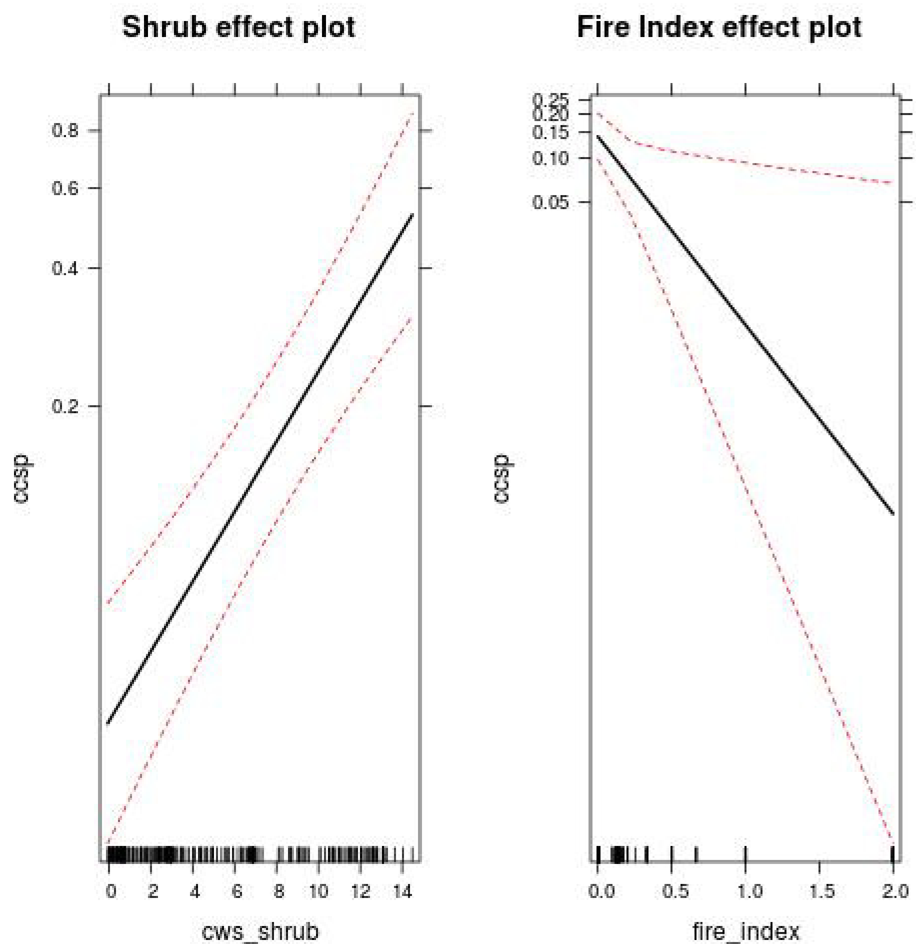
Following the procedure outlined in section 4.4, two models were specified for this species with common factors except in one case including all pellets and in another including horse and cattle pellets separately. In both initial models grazing and shrub measures were included as quadratic terms. AIC stepwise selection of these two models generated two simpler models. In this case one of the models was the global model and the use of AIC weight comparison found the global model was considered better. Unfortunately this model had no significant results and was not useful to us so we selected the simpler and still somewhat supported model with significant results. The final model was assessed for spatial auto-correlation and none was found. The final model is summarized in Table 8. Effects graphs are included in Figure 7.

Table 8: Clay-colored Sparrow GLM Model Results

	coef	**se(coef)**	**z**	**Pr(>|z|)**
(Intercept)	-3.15302	0.27078	-11.644	< 2e-16
shrub	0.17607	0.02724	6.463	1.03e-10
fire index	-2.96472	1.35259	-2.192	0.0284
adjacency	1.47447	0.27303	5.400	6.65e-08

Both the values in Table 8 and the graphs in Figure 7 clearly demonstrate that shrub is a positive predictor for this species. Fire is weakly significant and clearly negative but due to large confidence intervals it is not possible to clearly indicate the strength of this relationship. Since they are a shrub obligate species that nests in shrub it is not surprising that a disturbance that reduces shrub or shrub foliage even if only for a year or two would have a negative influence. The effect graph is quite clear that sites with no fires or at least two years since a single fire (index of 0.5) are preferred. Because shrub cover appears in a clumped distribution it is not surprising that this species as well as Brewer’s returns adjacency as highly significant.

Figure 7: Clay-colored Sparrow Fire & Grazing Model Effects



4.5.6 Grasshopper Sparrow

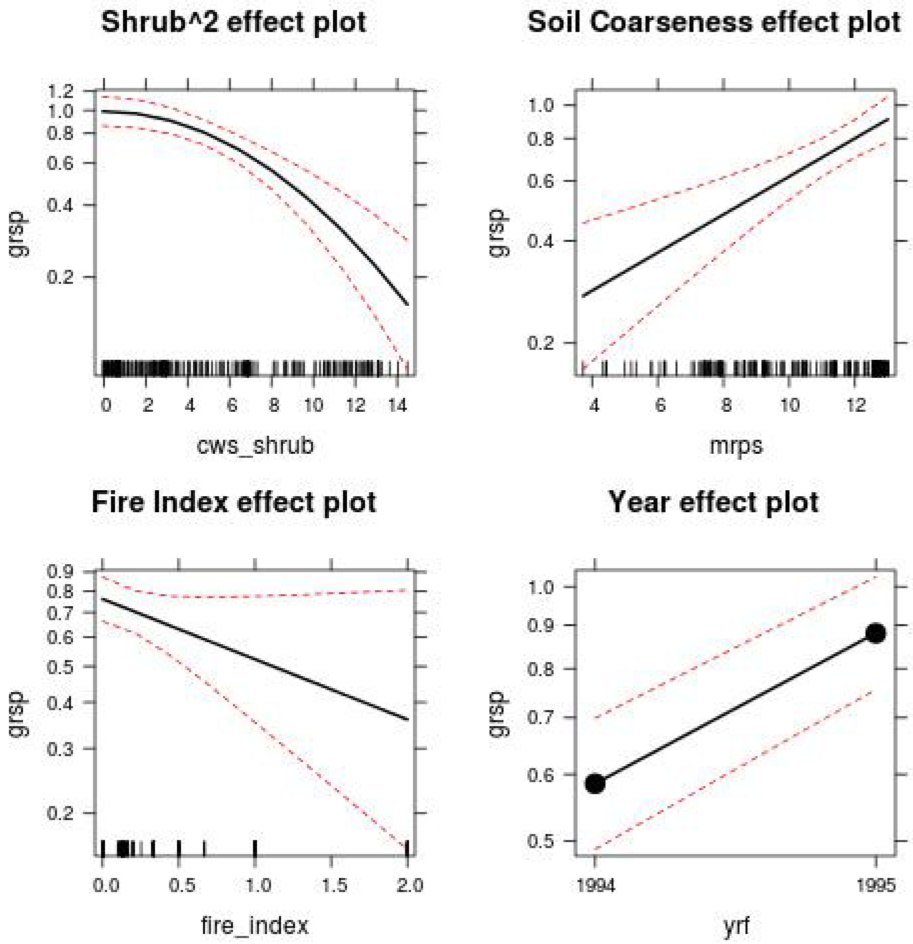
Following the procedure outlined in section 4.4, two models were specified for this species with common factors except in one case including all pellets and in another including horse and cattle pellets separately. In both initial models grazing and shrub measures were included as quadratic terms. AIC stepwise selection of these two models generated a single simpler solution. This final model was assessed for spatial auto-correlation and none was found. The results of the final model are reported in Table 9. Effects graphs are included in Figure 8.

The results indicate a non-linear negative relationship to shrub and a positive relationship with coarser soils. For reasons unknown, 1995 was a better year for this species in terms of abundance which may not be related to anything happening in the NWA as this species is not resident in the NWA for the entire year. No grazing or fire effect was detected so it appears that if any fire or grazing effects exist for this species that they are not detectable in comparison to other effects like shrub or soil texture.

Table 9: Grasshopper Sparrow GLM Model Results

	coef	**se(coef)**	**z**	**Pr(>|z|)**
(Intercept)	-2.021052	0.375582	-5.381	7.40e-08
shrub^2	-0.008871	0.001660	-5.343	9.13e-08
mrps	0.128929	0.031183	4.135	3.56e-05
fire index	-0.375474	0.217167	-1.729	0.083816
Year 1995	0.409327	0.109230	3.747	0.000179
adjacency	0.590004	0.181467	3.251	0.001149

Figure 8: Grasshopper Sparrow Fire & Grazing Model Effects



4.5.7 Horned Lark

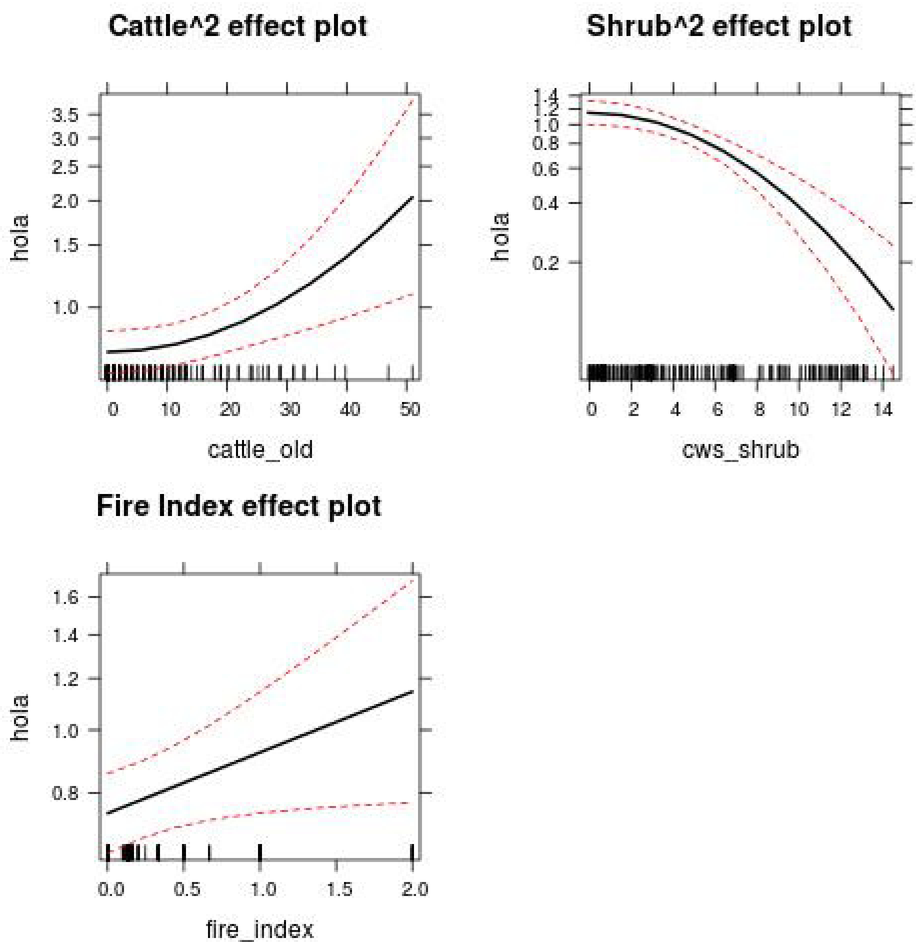
Following the procedure outlined in section 4.4, two models were specified for this species with common factors except in one case including all pellets and in another including horse and cattle pellets separately. In both initial models grazing and shrub measures were included as quadratic terms. AIC stepwise selection of these two models generated two simpler models. These simplified models were compared using AIC weights with a global model and were found to have near equal support. We selected model with the more highly significant predictor variables which was tested for spatial auto-correlation and none was found. The results of the final model are reported in Table 10. Effects graphs are included in Figure 9.

Table 10: Horned Lark GLM Model Results

	coef	**se(coef)**	**z**	**Pr(>|z|)**
(Intercept)	-0.5707321	0.1947943	-2.930	0.00339
cattle^2	0.0003855	0.0001243	3.102	0.00192
shrub^2	-0.0109569	0.0019686	-5.566	2.61e-08
fire index	0.2145890	0.1029537	2.084	0.03713
adjacency	0.8825514	0.1926576	4.581	4.63e-06

The effect of cattle grazing is positive, but in a non-linear fashion which is consistent with the species affinity for bare ground and reduced litter values. Shrub response is also non-linear but in this case negative which is also consistent with the species preference for an open environment. The model suggests the possibility of a weak positive effect to fire, but that cannot be determined with confidence.

Figure 9: Horned Lark Fire & Grazing Model Effects



4.5.8 Long-billed Curlew

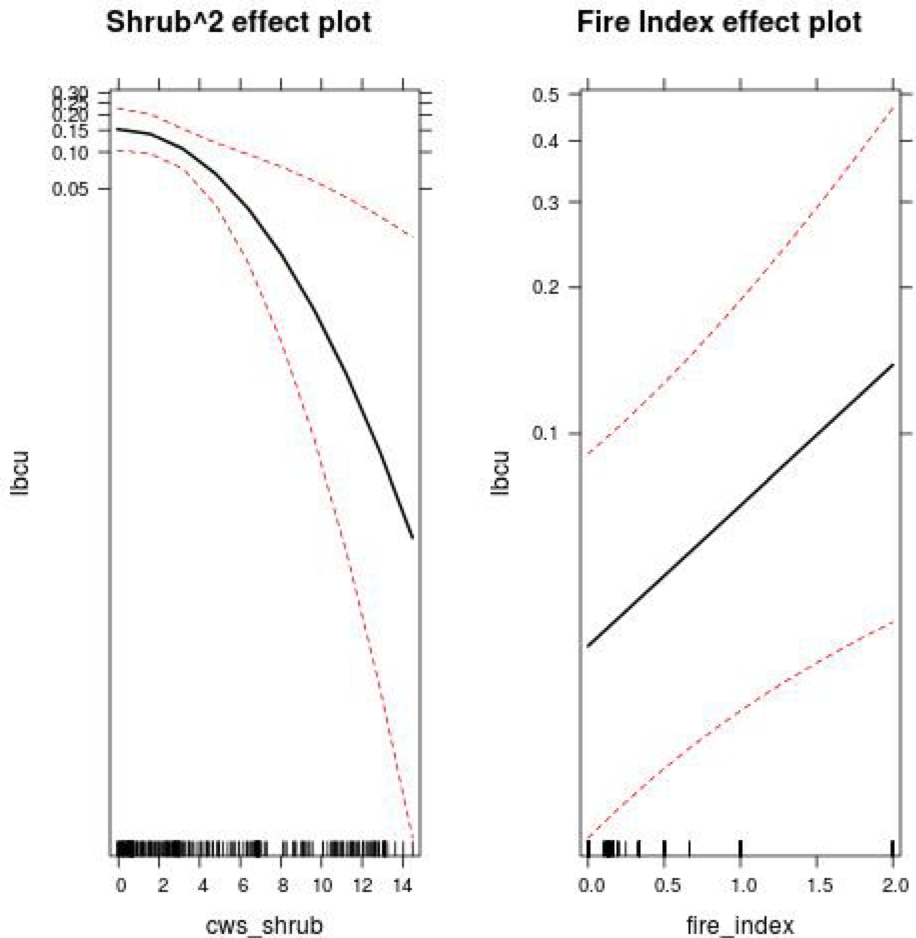
Following the procedure outlined in section 4.4, two models were specified for this species with common factors except in one case including all pellets and in another including horse and cattle pellets separately. In both initial models grazing and shrub measures were included as quadratic terms. AIC stepwise selection of these two models generated two simpler models. A reasonable global model could not be constructed as pellet measures remained in both models. Both models also displayed similar ecological implications so the model with most significant predictor variables was selected. The final model was tested for spatial auto-correlation and none was found. The results of the final model are reported in Table 11. Effects graphs are included in Figure 10.

Table 11: Long-billed Curlew GLM Model Results

	coef	**se(coef)**	**z**	**Pr(>|z|)**
(Intercept)	-2.3710401	0.2578022	-9.197	< 2e-16
cattle^2	0.0005683	0.0002831	2.008	0.04469
horse	0.6308740	0.3144459	2.006	0.04482
horse^2	-0.1024746	0.0717384	-1.428	0.15316
shrub^2	-0.0364029	0.0140352	-2.594	0.00950
fire index	0.6651990	0.2334735	2.849	0.00438
adjacency	1.3935970	0.2704989	5.152	2.58e-07

Unlike models for many other species most of the quadratic variables were retained. For this species the results in Table 11 suggest a weak positive relationship to cattle grazing but a negative response to horse grazing which might be more influenced by the occurrence of horse grazing mainly in the shrubby portions of the study area. Shrub is clearly negative and there appears to be a positive relationship to fire (which would reduce shrub), but the large confidence intervals make it impossible to determine the magnitude of this response.

Figure 10: Long-billed Curlew Fire & Grazing Model Effects



4.5.9 Lark Bunting

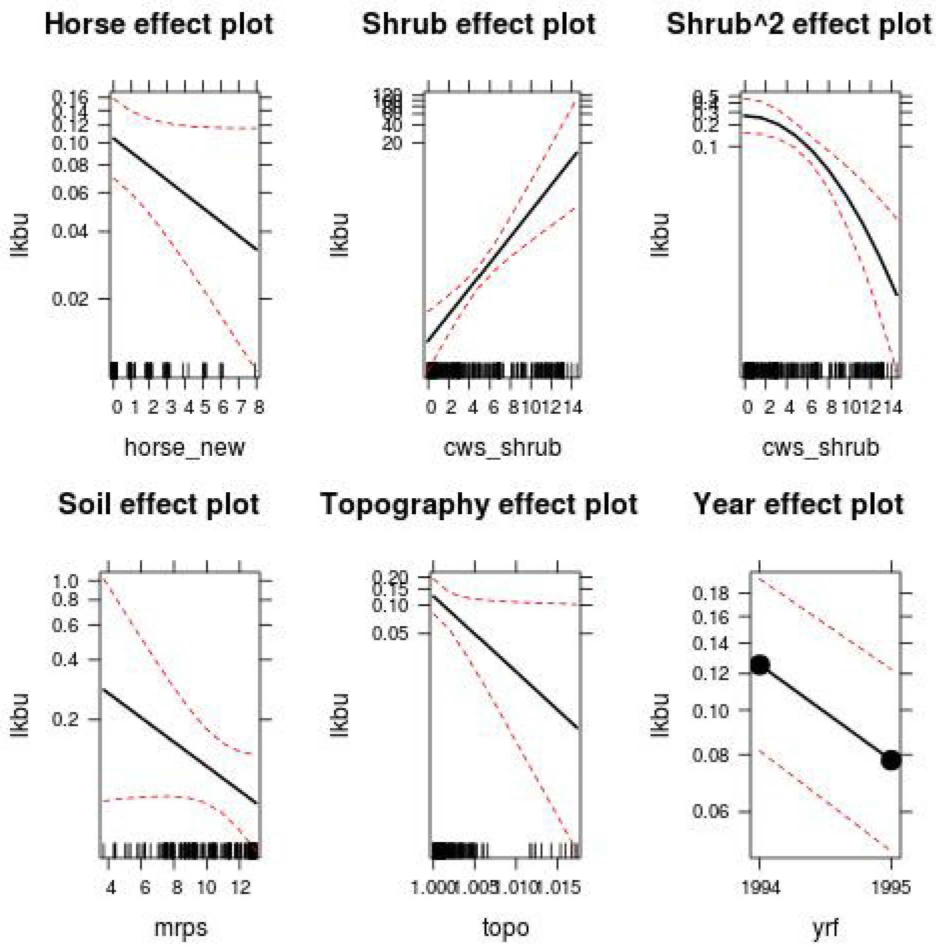
Following the procedure outlined in section 4.4, two models were specified for this species with common factors except in one case including all pellets and in another including horse and cattle pellets separately. In both initial models grazing and shrub measures were included as quadratic terms. AIC stepwise selection of these two models generated two simpler models. One of these models was a global model and AIC weight comparison demonstrated greater support for the global model. The final model was tested for spatial auto-correlation and none was found. The results of the final model are reported in Table 12. Effects graphs are included in Figure 11.

A quadratic response to shrub is found in the model suggesting a preference for moderate levels of shrub in the NWA and this is consistent with their use of shrubs as overhead cover for nests and with the use of shrubs as display perches (Shane 2000). The response to soil was not significant but there was a very weakly significant negative response to topography. The topography response is at odds with simpler analysis on a larger data-set that examined percent occurrence by ecosection and found Lark Bunting was most common in Eolian and Morainal with Eolian features which were areas with high topographic variation (Dale et al. 1999). Lark Buntings show virtually no site fidelity (Shane 2000) and there is large variability in year to year occurrence of the species in Canada. In 1994 the species occurred on 23.3% of counts but in 1995 it was present on only 11.5% (Dale et al. 1999). This certainly complicates understanding their relationships with habitat or disturbance factors. As with other species, if there is a grazing or fire effect it is clearly subtle compared to other predictors.

Table 12: Lark Bunting GLM Model Results

	coef	**se(coef)**	**z**	**Pr(>|z|)**
(Intercept)	1.832e+02	9.286e+01	1.973	0.04846
horse_new^2	-1.434e-01	7.798e-02	-1.839	0.06593
shrub	4.878e-01	1.066e-01	4.576	4.73e-06
shrub^2	-2.733e-02	6.758e-03	-4.045	5.24e-05
mrps	-1.414e-01	8.803e-02	-1.607	0.10812
topo	-1.854e+02	9.234e+01	-2.007	0.04472
Year 1995	-4.782e-01	1.727e-01	-2.768	0.00564
adjacency	2.803e+00	3.104e-01	9.029	< 2e-16

Figure 11: Lark Bunting Fire & Grazing Model Effects



4.5.10 Sprague's Pipit

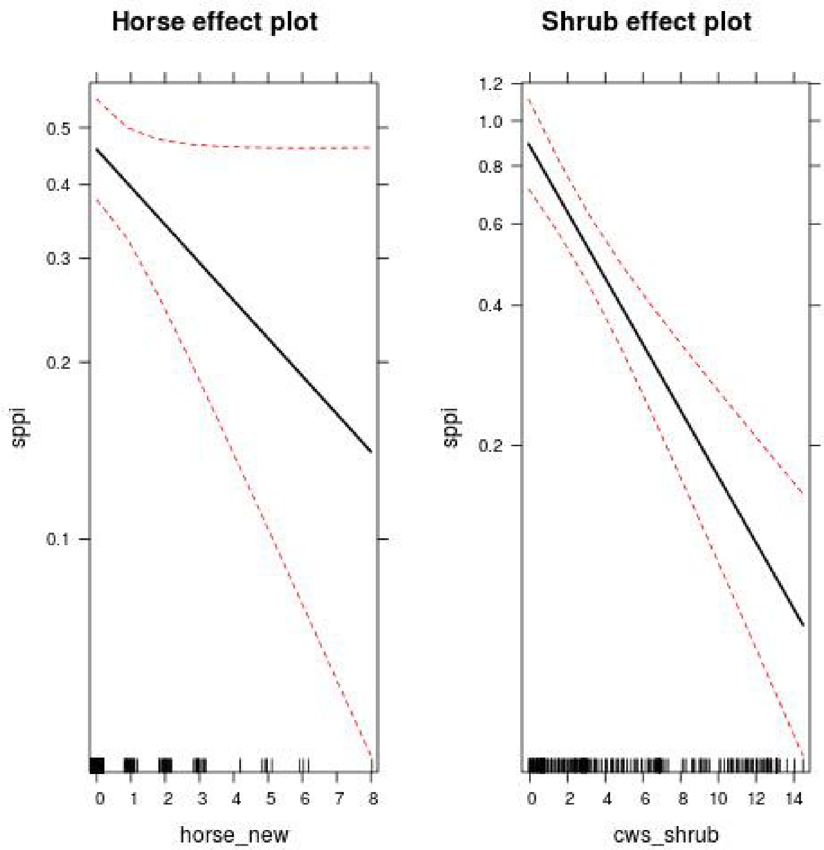
Following the procedure outlined in section 4.4, two models were specified for this species with common factors except in one case including all pellets and in another including horse and cattle pellets separately. In both initial models grazing and shrub measures were included as quadratic terms. AIC stepwise selection of these two models generated two simpler models. These two models were then compared against a global model using AIC weights and both models, along with the global model had strong support. We selected the model with the strongest support and a grazing rather than a year measure. This model was then tested for spatial auto-correlation and none was found. The results of the final model are reported in Table 13. Effects graphs are included in Figure 12.

Table 13: Sprague's Pipit GLM Model Results

	coef	**se(coef)**	**z**	**Pr(>|z|)**
(Intercept)	-0.88711	0.21773	-4.074	4.62e-05
horse_new	-0.14777	0.07714	-1.916	0.0554
shrub	-0.16378	0.02687	-6.095	1.09e-09
adjacency	1.41806	0.20797	6.819	9.20e-12

The quadratic effect of grazing in the initial model would be consistent with some grazing being positive but too much being negative as has been consistently found (Kantrud 1981, Dale 1983, Davis et al. 1999) but in the final model grazing effect for new horse pellets was not significant. Because of large confidence intervals it is not possible to determine if the observed grazing effect is artefactual or real. It appears that other grazing or fire effects, if any, were too subtle to be undetected. Shrub was strongly negative which is again consistent with previous studies. In a moister location in North Dakota where ungrazed cover was tall and thick and shrubs were common, fire had a positive effect (Madden et al. 2000) but fire was not included in our final model and the correlation tests (Table 2) show pipits responding negatively to fire.

Figure 12: Sprague's Pipit Fire & Grazing Model Effects



4.5.11 Upland Sandpiper

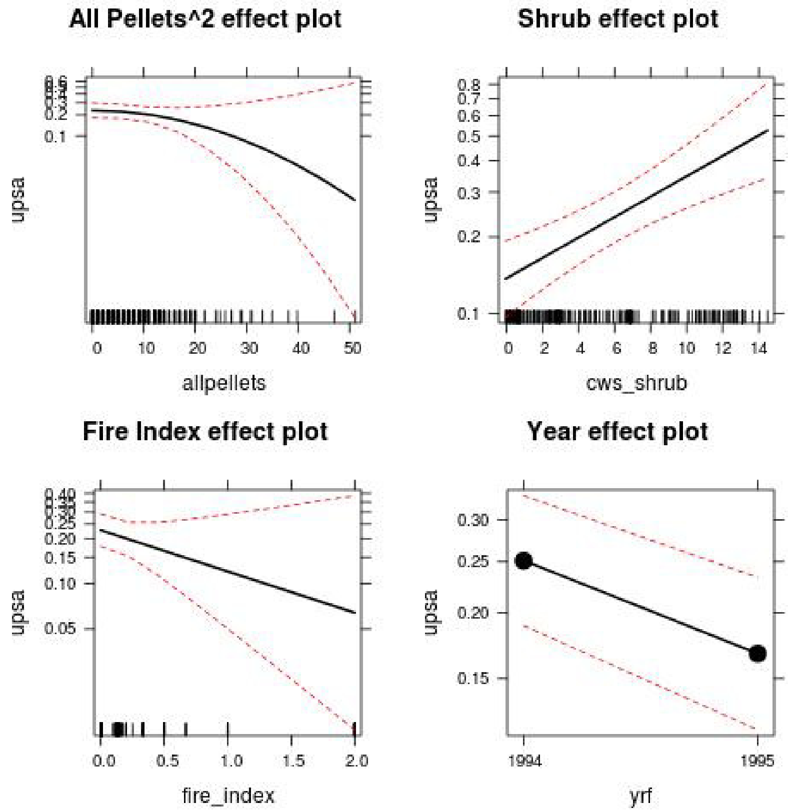
Following the procedure outlined in section 4.4, two models were specified for this species with common factors except in one case including all pellets and in another including horse and cattle pellets separately. In both initial models grazing and shrub measures were included as quadratic terms. AIC stepwise selection of these two models generated two simpler models. A global model was then constructed and used to compare with AIC weights the relative support for these different models. No model came out clearly more supported than the others, so we selected the model with both fire and grazing variables. This model was then assessed for spatial auto-correlation and found to have none. The results of the final model are reported in Table 14. Effects graphs are included in Figure 13.

Table 14: Upland Sandpiper GLM Model Results

	coef	se(coef)	t-value	p-value
(Intercept)	-1.7681602	0.2214830	-7.983	1.42e-15
all_pellets^2	-0.0011389	0.0007763	-1.467	0.14234
shrub	0.0926650	0.0219035	4.231	2.33e-05
fire index	-0.6325326	0.4763787	-1.328	0.18425
Year 1995	-0.4059104	0.1994539	-2.035	0.04184
adjacency	0.6282932	0.2066134	3.041	0.00236

A positive response to shrub is the only effect of interest for this model. A negative response for both grazing and fire are suggested by the data but the confidence intervals are too large to determine if these effects are real. If they are real this response would be counter to the studies summarized in Table 1. However, those studies may be in moister locations where grazing and fire may be needed to create heterogeneity such that foraging and nesting areas can have very different structure.

Figure 13: Upland Sandpiper Fire & Grazing Model Effects



4.5.12 Vesper Sparrow

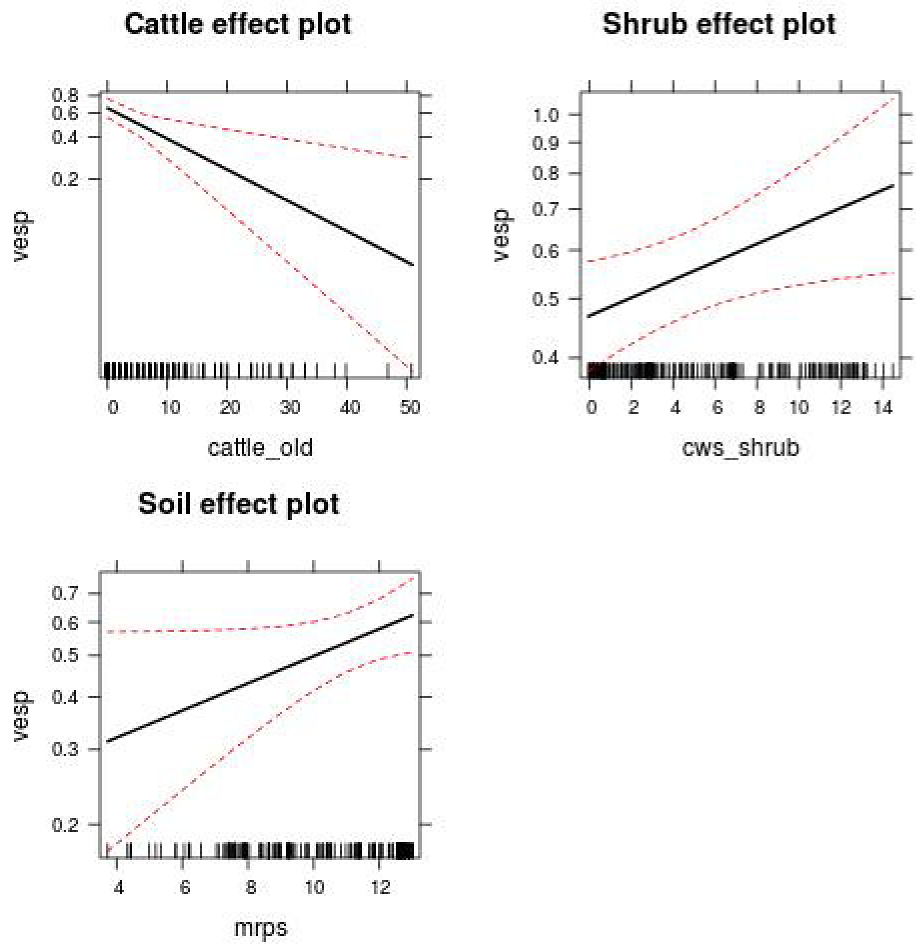
Following the procedure outlined in section 4.4, two models were specified for this species with common factors except in one case including all pellets and in another including horse and cattle pellets separately. In both initial models grazing and shrub measures were included as quadratic terms. AIC stepwise selection of these two models generated two simpler models. These models were then compared against a global model with AIC weights to determine which model to use. In this case there was strong support for one of the models so it was tested for spatial auto-correlation and none was found. The results of the final model are reported in Table 15. Effects graphs are included in Figure 14.

Table 15: Vesper Sparrow GLM Model Results

	coef	**se(coef)**	**t-value**	**p-value**
(Intercept)	-1.92959	0.44819	-4.305	1.67e-05
cattle	-0.05137	0.01839	-2.794	0.00521
shrub	0.03382	0.01481	2.283	0.02242
mrps	0.07388	0.03852	1.918	0.05513
adjacency	0.85556	0.17664	4.844	1.28e-06

Grazing had negative effect but the slope or strength of this effect is difficult to determine because of the wide confidence intervals which is consistent with Kantrud (1981) who found higher counts in areas of moderate grazing but no really clear directional response to grazing. They are an edge species that needs at least a little shrub so it may not be too important how the grass mixed with shrub is managed so long as that management does not result in total removal of shrub. This habitat preference is consistent with the finding that shrub and soil coarseness had weakly significant positive results. Any fire effects that might exist for this species could not be detected. Shrub recovers from fire in just a few years unless fires are severe or repeated frequently so the majority of the Suffield sampling sites would not be burned enough to eliminate shrub altogether. After one fire at Suffield Vesper Sparrows and other shrub associated species were heard singing in blackened shrubs with few, if any leaves (Brenda Dale, Personal Communication).

Figure 14: Vesper Sparrow Model Fire & Grazing Effects



4.5.13 Western Meadowlark

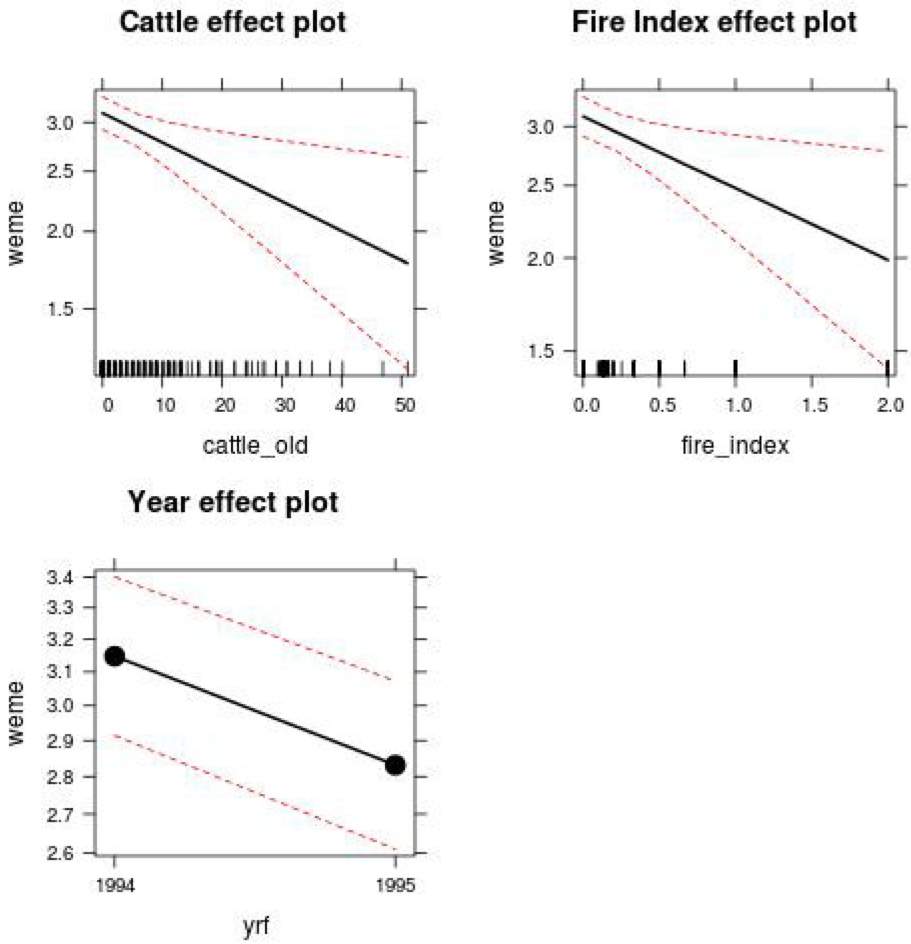
Following the procedure outlined in section 4.4, two models were specified for this species with common factors except in one case including all pellets and in another including horse and cattle pellets separately. In both initial models grazing and shrub measures were included as quadratic terms. AIC stepwise selection of these two models generated two simpler models with the species adjacency parameter was removed. These models were then compared against a global model using AIC weights and the simplest model had the strongest support. The residuals of the final GLM showed spatial correlation but adding the species adjacency parameter back into the model did not resolve the spatial correlation so a GLMM model was created. The resulting GLMM model had reduced spatial correlation but some still remained. The scale and significance of the predictors was similar to the GLM model so, the GLM model is displayed here to examine the effect sizes, but caution is needed in the interpretation of these results. The results of the final model are reported in Table 16. Effects graphs are included in Figure 15.

Table 16 Western Meadowlark GLM Model Results

	coef	**se(coef)**	**t-value**	**p-value**
(Intercept)	1.220417	0.043157	28.278	< 2e-16
cattle	-0.010935	0.004125	-2.651	0.00802
fire index	-0.221207	0.090441	-2.446	0.01445
Year 1995	-0.105929	0.057147	-1.854	0.06379

The results indicate that cattle grazing is negative. The spatial correlation and wide confidence intervals however suggest that although statistically significant, the strength of this relationship is uncertain. Similarly for fire the negative response is weakly significant and has wide confidence margins (due to paucity of samples with high fire or grazing values) suggesting that we don't have sufficient signal to assert this as a real relationship. The negative response to grazing should be viewed with caution as the negative relationship to cattle pellets is offset by a positive relationship to horse pellets (Table 3) indicating it might be more about a preference for the north block which also shows in a positive response to coarser soils. A negative response to grazing is the opposite of previous studies and to the simpler analysis of Dale et al. (1999) which found they occurred more frequently in grazed than ungrazed sites. They showed more variation in numbers per point than any of the other species analyzed which may have resulted in different results utilizing abundance than were found with frequency of occurrence studies.

Figure 15: Western Meadowlark Fire & Grazing Model Effects



4.6 Summary

The original simple analyses for fire and grazing (Dale et al. 1999) actually had clearer results than the more statistically sophisticated model approach taken here, but the authors were concerned because they recognized that fire and grazing disturbances were not equally distributed across ecosections (classification based on soil development and topography) so that it was possible that responses to key habitat features such as shrub, might be creating bias. For example, grazing by cattle was confined to the south block of the proposed NWA which was topographically and vegetatively different from the north block with its vegetated dunes and higher shrub cover and patchy grazing by feral horses. The purpose of the current re-analysis was to include soil particle size and topography in order to control for their habitat related effects. Broad confidence intervals often diminished our certainty of fire and grazing effects but were not surprising given both heavy grazing and frequent or recent fire occurred at relatively few of our samples. This is one of the drawbacks of a mensurative study, but given how rare it is to find an area with semi-regular fire it was worth exploring. However, nothing can replace a controlled study where a range of disturbance levels are applied to sites that are otherwise similar. In the end, the same issues that hampered the initial analysis still occurred, but we were better able to quantify them and it was clear that with moderate grazing and fire at levels similar to historic patterns the soil and topographic controlled habitat was more important for many species than the disturbance factors.

5 Analysis of EC Wetland Distance Data

5.1 Background

The influence of distance to wetlands and wetlands in the landscape has been little studied with only two published and two as yet unpublished studies. Cattle water sources in particular have the potential to be management tools and responses to wetland edges may need to be considered in area management.

Fontaine et al. (2004) examined the abundance of grassland birds up to 800m from cattle water sources (a mix of permanent wetlands, dugouts, and water tanks). They found vegetation height and thickness increased with distance from water and two species that prefer shorter cover were more abundant near the water source. They observed that effects for additional species might have been detectable if they had been able to sample farther from water.

A southern Alberta study did multiple linear analyses of abundance and productivity in relation to edges including water (Koper and Schmiegelow 2006 a and b) and later nonlinear analyses (Champagne et al., Sliwinski and Koper 2012). Their wetlands were a mix of types including dugouts and not all were used as a water source by grazers and a few fields were not grazed at all. Given the mix of wetland types and management, it is unsurprising they found vegetation height had little relationship to distance to wetland. Most of their study species responded negatively to wetland edge even at substantial distances including Horned Lark which Fontaine et al. (2004) had found more abundant near water.

A study conducted in two years in both southern Saskatchewan and Alberta (Fisher et al. in Review) found vegetation decreased with increasing distance to water, but most of their wetlands were grassy non-permanent wetlands (Ryan Fisher Pers. Comm. with Brenda Dale). They found Western Meadowlark and Savannah Sparrow less common within 100 m of wetlands and the negative effect extended to 400 m for Sprague's Pipit. They also found no consistent responses to water between study areas by any species. They questioned the possibility espoused by Sliwinski and Koper (2012) that an edge process could have influence at a scale of multiple kilometers.

These three studies produced contrasting results,, but either involved a mix of natural and artificial water sources or did not take wetland type or use into account. A study conducted in four years (every other year during a 7 year period) at the Agriculture and Agri-food Research sub-station at Onefour, AB was able to separate distance to cattle water source from distance to wetland (Dale and Wiens In Preparation). Each of 6 fields had one single cattle water source and all wetlands were fenced to prevent cattle use. Similar to Fontaine et al. (2004) they found vegetation height increased with distance to cattle water source. No species responded to distance to wetland but they found both abundance responses for 4 species (2 negative and 2 positive) at distances up to 1800 m from cattle water sources. They concluded that limiting the number of cattle water sources and provision of large fields in the dry-mixed grasslands was necessary to provide habitat suitable for the full suite of grassland birds.

It seems birds may respond differently to different types of wetlands whether because some are more perceptible as edge or because some are more attractive or accessible to cattle.

The long-term data set from Suffield provides an opportunity to further examine the potentially important habitat factors of naturally occurring wetlands and artificial water sources.

5.2 Data preparation

A subset of the data provided by EC as described in section 4.1 were used together with additional information on bird observations from 2001 and 2005. See Dale et al. (1999) for a full description of the sampling strategy and avian point count methods employed in 1994 and 1995. Monitoring using the same methods as in 2001 and 2005 was limited to a subset of the south block lines so we used only south block observations from the biophysical study (Dale et al. 199) for the water related analysis. The initial plan had been to use 2006 data, but only the ungrazed north block was surveyed in 2006 which would have complicated analyses if different areas and treatments were used in different years. Again GRASS GIS 6.4 and GRASS GIS 6.5 were used for processing the spatial data along with PostGIS 1.5 (PostGIS Core Team 2009).

The Department of Defense (DND) and Brent Smith from Canadian Forces Base Suffield provided imagery which contained the spatial and temporal state of wetlands, dugouts and watering troughs for 1997, 2001 and 2011. The wetland data were classified into four groups:

1. Saline wetland / barren ground
2. Moist (no standing water); dominated by low growing perennial forbs and grasses
3. Herbaceous / shrub / deciduous; dominated by highly productive vegetation including terrestrial and emergent vegetation including rushes, shrubs, and tall trees
4. Open water; dominated by open water with nil to sparse emergent vegetation

The numbering does not bear any relationship to standard wetland classification such as used in Adams et al. (1998) and there is no implication that the type number is related to permanency. Using recommendations from Brent Smith, we used the 1997 wetland data for the 1994 and 1995 bird data; these were considered normal precipitation years. The 2001 wetland data were used for the 2001 and 2005 bird data which were considered drought years.

DND also provided a shapefile of fence lines which were used to create a polygon layer to calculate field size and constrain some wetland distance measures to within the boundaries of the field where the bird observation was made.

Pellet and fire data were not available for 2001 and 2005, but shrub, mean relative particle size and topographic roughness remained valid and potentially useful variables. The value of the last two variables as surrogates for habitat measures such as vegetation height and thickness, litter, and shrub has recently been confirmed (Dale and Wiens ,in preparation).

We wished to look at how wetlands in the landscape as well as cattle water sources within fields, might influence bird occurrence.

For each bird count location the distance to all wetlands within 10km by type (four classes of wetlands, dugouts and troughs) was calculated in PostgreSQL / PostGIS using the recalc_wetland_distances.sql and recalc_wetland_distances_infield.sql scripts which both depend on the functions defined in calc_nearest_neighbors_by_type.sql script all found in the deliverable 3 scripts folder. In this actual distance was used unlike Fisher et al (in review) which used the log of distances because review of the distribution of this variable did not indicate that transformation of this variable was necessary.

It is important to note that for many wetlands, if they had standing water, they would have been fenced and were thus unavailable to cattle. The one exception is the South Saskatchewan River which was not fenced to prevent cattle use at the time of our surveys. Because of cattle use, dugouts and troughs are features of importance within a field and were thus only measured within a field, not across fence lines. For the other four types of wetlands however, both in-field and field independent distances and counts were calculated. Count was calculated in two ways. First, all wetlands at any distance up to 10km by type were counted for each bird count location. Second, wetlands within 500m, wetlands from 500 to 1000m, from 1000 to 2500m and from 2500 to 5000m were counted. The reason for this method was to estimate both the broad scale effect of wetland presence close to a bird count location, but also to determine if certain distances more closely correlated to bird abundances than others; in other words to assess the scale of the effect.

After the initial analysis of the full data set using parametric and non-parametric methods, we extracted the centroids of each of the original pixels to create a wetland point map. From this layer we used the GRASS GIS v.neighbors function to generate surfaces of point density layer at 500, 1000, 2500 and 5000m radii. The resulting measures indicated not only the overall distribution of wetlands within the specified distance bands, but also the amount of the landscape within those distance bands covered by wetlands of a particular type. These data were sampled for each bird count location centroid using the v.what.rast module in GRASS GIS.

A summary of variable names and their definitions is included in Table 45 in Appendix C.

As noted earlier, it was not possible to include both fire and grazing along with wetlands variables in a single analysis because not all variables were available for all years. Still it was deemed worthwhile to generate that limited data set to determine what, if any, relationships could be established between wetland measures and grazing and disturbance measures. Using the script pull_wetland_n_fire.sql found in the deliverable_3/scripts folder we pulled 132 records all from 1994 and 1995 into R to conduct a simple correlation anlysis.

The final merging of data and extraction of the main data set for import into R was done using the pull_wetland_data.sql and repull_wetland_data.sql script also found in deliverable_3/scripts. The number of records used for this analysis was 1271.

5.2 Initial examination of data

The distribution of species records and predictor variables was assessed through the use of histograms and the same species list used in the fire and grazing analysis was used for this phase. Histograms of the wetland variables are found in Appendix D.

An examination of potential collinearity in models was conducted by testing the correlation between different predictor variables via a Kendall rank correlation test. The expected correlations between moist and herbaceous wetlands was confirmed as well as correlations within wetland types at similar spatial scales. Also of note is that all wetland types except herbaceous wetlands were positively related to soil particle size so that the number of such wetlands and the area occupied increases with coarse soils while the abundance and extent of herbaceous wetlands is negatively related to topography because they are most likely to occur in flatter area with only slight undulations. Further troughs and dugouts were significantly more prevalent in finer soils. These associations definitely need to be considered in interpreting model results where the species has previously shown a response to soil or topography. These tables were referenced in the creation of possible models. The full results of this analysis can be found in Appendix G.

The correlation between the wetland and fire and grazing measures is included in Appendix H. No strong correlations were found. The correlations tests show positive correlations between field size and cattle pellets and numbers of dugouts and water troughs as expected. Barren / saline wetlands are shown to be negatively correlated with cattle pellets as well as shrub. Total burns and the fire index were positively correlated to moist and herbaceous wetlands from 2.5 to 10km. Troughs and dugouts were negatively correlated with total burns and the fire index. Overall these results are not surprising but do lend mild support for the use of wetlands as a partial surrogate for grazing information when and where no grazing data are available.

In past work (Wiens et al. 2008) annual precipitation had proven to be a valuable predictor variable. Were were interested in understanding how this would be reflected in the wetland data obtained from DND. The total area classified as wetlands remained the same between years but we examined the change in composition of this area over time. These results are presented in Table 17. The results, as would be expected, show a shift from moist wetlands to open water from drought to normal and on to wet conditions. The change in barren / saline wetland is not consistent across years nor does it show a meaningful trend; the reason for this is unknown. The largest shifts however are, as expected, between moist and herbaceous wetlands.

Table 17: Wetland Composition by Year

Wetland Type / Year	2001 (drought)	1997 (normal precipitation)	2011 (wet)
Type 1 – Barren / Saline Wetland	6.4%	9.0%	5.2%
Type 2 – Moist Wetland	57.5%	32.4%	10.9%
Type 3 – Herbaceous Wetland	30.0%	44.4%	67.3%
Type 4 – Open Water Wetland	6.1%	14.2%	16.6%

5.3 Non-parametric Analysis

As in section 4.3, the Kendall rank correlation coefficient was used to compare the relationship between species abundance and the different wetland measures. We used this same approach with the variety of wetland variables to assess the nature of the relationships between individual predictors and species abundance. The results are presented in section 5.5 by species.

5.4 Parametric Analysis

Poisson Generalized Linear Models were employed a similar method as described in section 4.4. Again we used the regression analysis as a means to assess the relative predictive power of different measures. As found in Appendix G, many variables were correlated to each other. To avoid collinearity in the model we followed the conservative approach and did not include predictor variables in the same model if the tau value, which is functionally equivalent to a Pearson's r, was equal to 0.7 or higher (Mason and Perrault, 1991). These model results are presented together with the non-parametric results by species in section 5.5.

5.5 Results & Discussion

In this section the combination of the non-parametric and parametric analysis results are presented together by species. The non-parametric tests were used to determine the relative strength of the different predictors and if the data were sufficient to adequately model species abundance. Relevant results of the non-parametric results are mentioned in the text and the details of the non-parametric analysis, which were extensive, are found in tables in Appendix E. All correlograms used for testing spatial auto-correlation in the model residuals are included in Appendix F.

5.5.1 Baird's Sparrow

In section 4.5.1 we found that shrub had a powerful negative relationship to the abundance of this species along with topographic roughness. The wetland non-parametric analysis found similar relationships as well as negative relationships to barren / saline wetlands, a positive relationship to the amount or number herbaceous wetlands at distances greater of 500m to 2.5km and a positive relationship to water trough distance.

Using this information and the predictor correlations found in Appendix G, a Poisson generalized linear model (GLM) was constructed and using AIC stepwise selection a simplified model as created and is presented in Table 18. This was then tested for spatial auto-correlation of residuals to test if other factors were missing from the model. Minimal spatial auto-correlation was detected and thus it was suitable for our needs. The most influential predictor was herbaceous wetlands and topography was also highly significant.

Table 18: Baird's Sparrow Wetland Predictors Poisson GLM

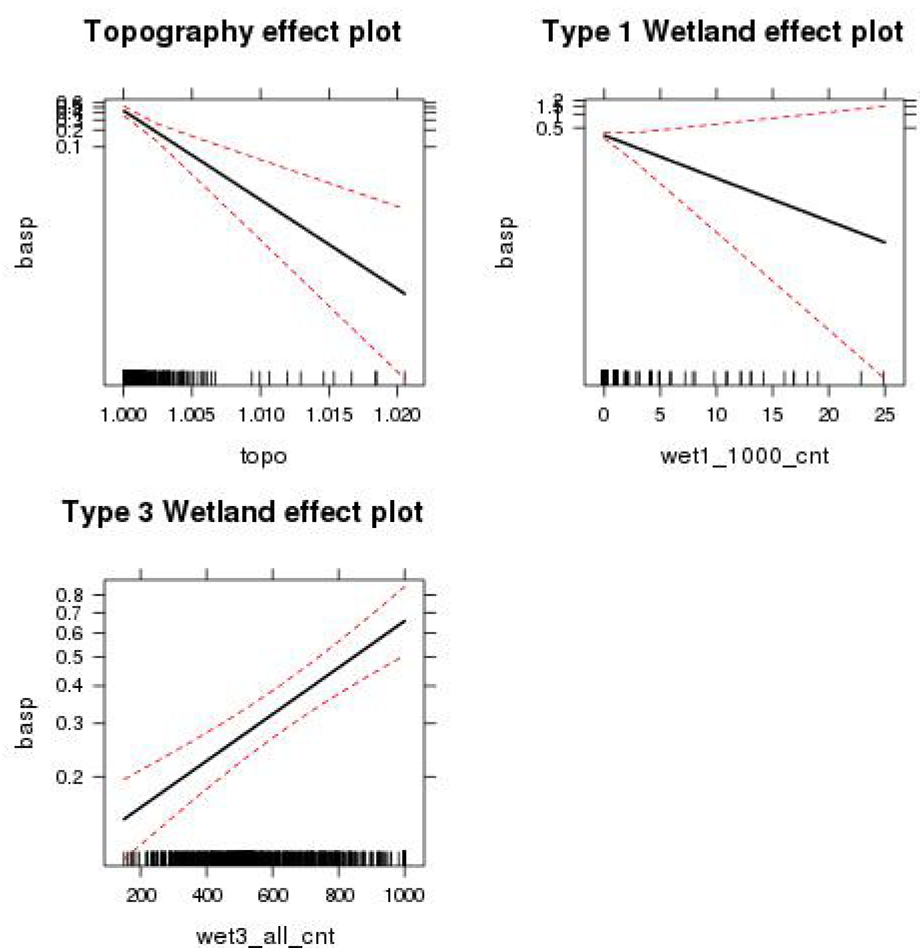
	Estimate	**Std. Error**	**z value**	**Pr(>|z|)**
(Intercept)	3.600e+02	8.813e+01	4.085	4.4e-05
topo	-3.618e+02	8.808e+01	-4.108	4.0e-05
wet1_1000_cnt	-2.163e-01	1.411e-01	-1.532	0.125
wet3_all_cnt	1.782e-03	2.628e-04	6.780	1.2e-11

The positive relationship to the number of herbaceous wetlands (type 3) may be surprising given negative distance responses observed in Sliwinski and Koper (2012) and response to water tanks but not wetlands in Dale and Wiens (in preparation). However, as observed in Table 18 and Figure 16, during drought years there was significant shift from herbaceous to moist wetlands, so it is likely that the areas during drought years with appropriate levels of cover were near but not directly adjacent to herbaceous wetlands.

The negative relationship to topography is consistent with the results in section 4 and with the model presented in Wiens et al. (2008) and is not surprising given that areas of high topographic roughness usually have shrub which reduces habitat suitability for this species.

These results emphasize the importance of considering the local situation in terms of climate, soil and topography in setting grazing management strategies to ensure that moderate cover is maintained for this species. The positive correlation to water trough distance was significant and is consistent with the increase in Baird’s Sparrow abundance at greater distances observed at Onefour (Dale and Wiens In Preparation) which suggests that large fields with few water sources may benefit this species.

Figure 16: Baird's Sparrow Wetland Model Effects



5.5.2 Brown-headed Cowbird

In section 4.5.2 this species was found to have a weak and probably positive correlation to shrub as expected. There were only 10 observations for this data set as this species primarily occurs in the northern part of the Suffield NWA. With so few observations, it was not possible to analyze this species for wetland effects.

5.5.3 Brewer's Sparrow

In section 4.5.3 it was observed that species had a negative relationship to fire and a quadratic relationship to shrub and an unclear relationship to soil texture. The wetland non-parametric analysis found a simple positive relationship to shrub and a positive relationship to topographic roughness. Additionally a negative relationship was found for barren / saline wetlands at distances from 1 to 5km, a positive relationship to distance from herbaceous wetlands within fields and a positive relationship to open water wetlands within 10km.

The positive relationship to shrub and topographic roughness are both congruous with this species preference for shrub. Similarly avoidance of barren / saline wetland areas and a positive relationship to distance from herbaceous wetlands are not surprising. Open water wetlands are rare in the NWA but include the South Saskatchewan River which is the east boundary of the NWA. Sage, an important habitat component for this species is prevalent in the river flats.

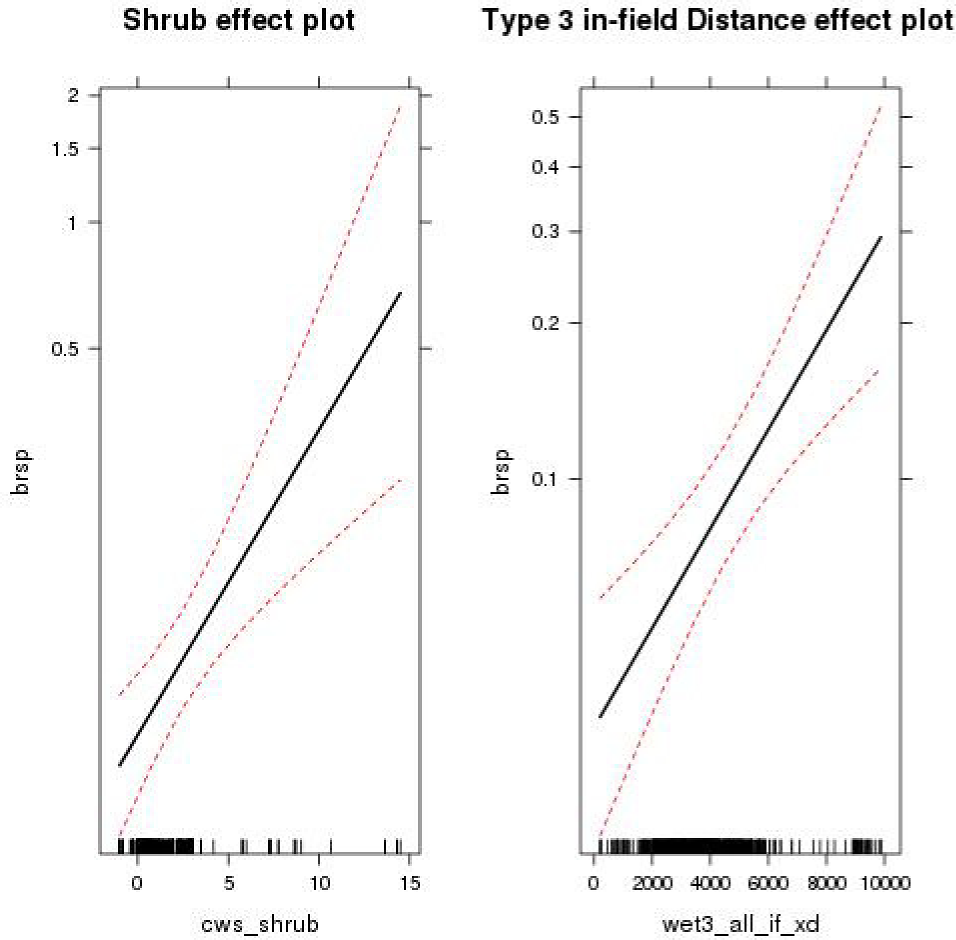
Using this information with the predictor correlation information found in Appendix G a Poisson GLM was created and simplified using stepwise AIC selection. The resulting model is summarized in Table 19 and Figure 17. This model was evaluated for spatial auto-correlation in the residuals to ensure correct interpretation of the model and to determine if other predictors were missing. The residuals showed no significant spatial auto-correlation.

In the model distance from herbaceous wetlands within fields was the most significant factor followed closely by shrub. It is interesting to note that in the non-parametric analysis the distance effect for herbaceous wetlands was not observed independent of field boundaries and within field boundaries the effect was most pronounced at 1 to 2.5km. This in-field dynamic may indicate some sensitivity to grazing as suggested by the cattle pellet response found in Table 2.

Table 19: Brewer's Sparrow Wetland Predictors Poisson GLM

	Estimate	**Std. Error**	**z value**	**Pr(>|z|)**
(Intercept)	-3.655e+00	2.901e-01	-12.600	< 2e-16
cws_shrub	1.675e-01	4.180e-02	4.006	6.16e-05
wet3_all_if_xd	2.206e-04	5.173e-05	4.265	2.00e-05

Figure 17: Brewer's Sparrow Wetland Model Effects



5.5.4 Chestnut-collared Longspur

In section 4.5.4 it was found that topographic roughness and shrub were negatively correlated with this species abundance but fire and grazing effects were inconclusive. The wetland non-parametric analysis found strong negative correlations to shrub and topography. A negative response to barren / saline wetlands and open water wetlands and a positive to moist wetlands. A positive relationship to distance from water troughs and dugouts was also found.

The avoidance of shrub and topographic roughness is consistent with this species habitat requirements. The preference for moist wetlands is also consistent with the litter depth requirements of this species and similarly its avoidance of barren / saline wetlands. The avoidance of water troughs and dugouts is consistent with a need for grazing but not excessive grazing as they are associated with good range conditions (Fisher et al. In Review).

Using the non-parametric results together with the predictor correlation information found in Appendix G a Poisson GLM was constructed for this species. The model was simplified using stepwise AIC selection and it was evaluated for spatial auto-correlation. The residuals from the model showed significant spatial correlation so an adjacency parameter was added to the model and the process was repeated. The final model, summarized in Table 20 and Figure 18, showed only minimal spatial auto-correlation in the residuals indicating that an important predictor was missing from the model formulation.

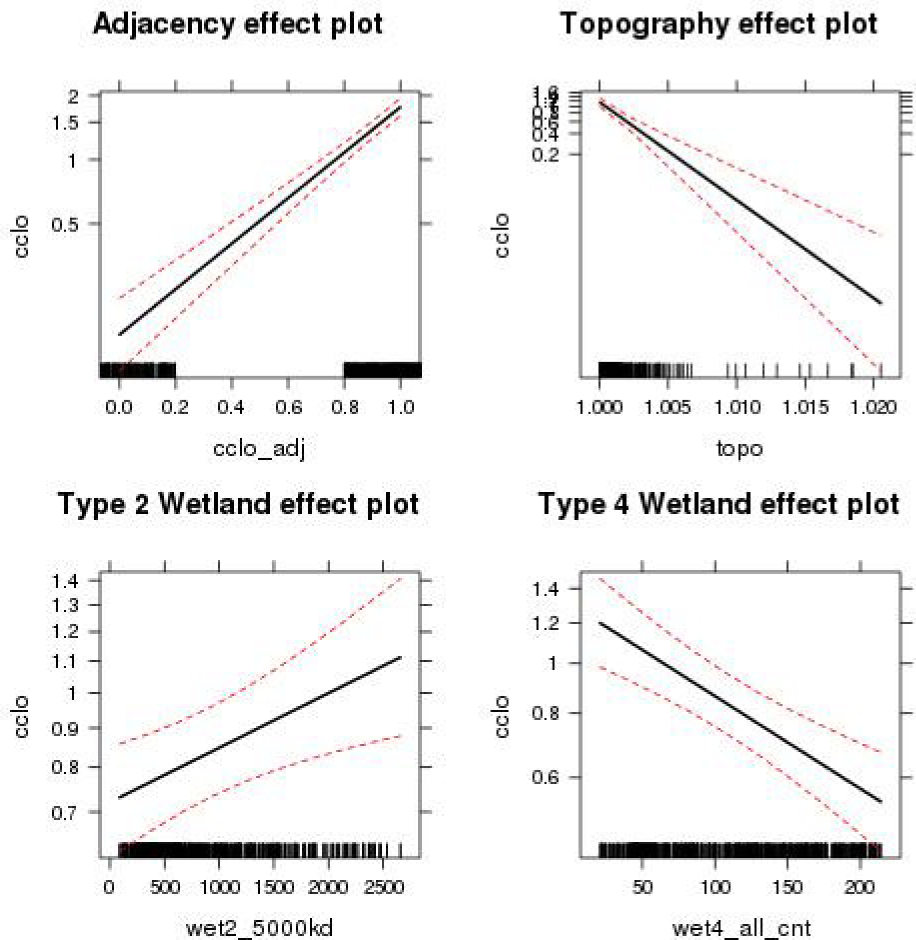
Table 20: Chestnut-collared Longspur Wetland Predictors Poisson GLM

	Estimate	**Std. Error**	**z value**	**Pr(>|z|)**
(Intercept)	3.293e+02	5.852e+01	5.627	1.83e-08
cclo_adj	2.460e+00	2.094e-01	11.745	< 2e-16
topo	-3.306e+02	5.848e+01	-5.653	1.58e-08
wet2_5000kd	1.634e-04	5.567e-05	2.935	0.00334
wet4_all_cnt	-4.147e-03	8.469e-04	-4.897	9.73e-07

Ignoring adjacency, the most significant variable was topographic roughness, followed by numbers of open water wetlands within 10km and the amount of moist wetland within 5km.

For management purposes the analysis suggests that larger fields with well regulated grazing provide a suitable habitat for this species.

Figure 18: Chestnut-collared Longspur Wetland Model Effects



5.5.5 Clay-colored Sparrow

In section 4.5.5 it would found that shrub was positively correlated with this species abundance and fire was a negative factor. The wetland non-parametric analysis also found a positive correlation with shrub as well as positive relationships to topographic roughness and the number of open water wetlands within 10km. The non-parametric results are consistent with the species preference for shrub and moderate cover.

Using the results from the non-parametric analysis and the predictor correlation information found in Appendix G, a Poisson GLM was specified. This model was then simplified using AIC stepwise selection and the resulting model was assessed for spatial auto-correlation and none was found. This final model is presented in Table 21 and Figure 19.

Table 21: Clay-colored Sparrow Wetland Predictors Poisson GLM

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-3.98599	0.26064	-15.29	< 2e-16
cws_shrub	0.24544	0.04545	5.40	6.66e-08

The AIC selection process removed all variables except for shrub, which surprisingly was able to predict species distribution without any spatial correlation in the model residuals. Clearly this is a very strong determinant for this species in the NWA.

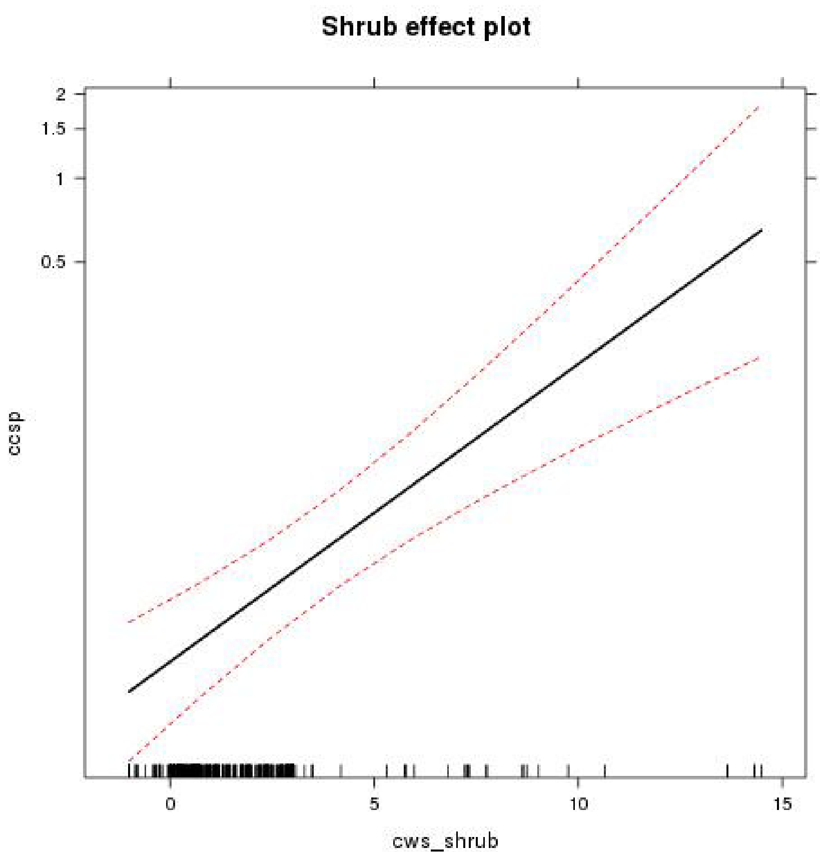


Figure 19: Clay-colored Sparrow Wetland Model Effects

5.5.6 Grasshopper Sparrow

In section 4.5.6 it was reported that this species as negatively correlated with shrub and positively correlated with soil coarseness. The species likes moderate height clumped grasses with low amounts of litter and tolerates bare ground. These later characteristics differ from some of the other birds that like moderate height such as Baird's Sparrow or Sprague's Pipit which prefer the finer soils which have less bare ground. The wetland non-parametric analysis found no relationship to shrub, but positive relationships to soil coarseness and topographic roughness. In addition, a negative relationship to moist wetlands was found.

The negative relationship to moist wetlands were more pronounced at shorter distances indicating that proximity to wetlands is undesirable for this species which was confirmed by a positive relationship to distance from moist wetlands. Open water wetlands were found to have a positive relationship at distances greater than 2.5km. Numbers of barren / saline wetlands within 10km were also found to have a positive relationship to this species. Overall these results are not surprising given this species preference for moderate cover.

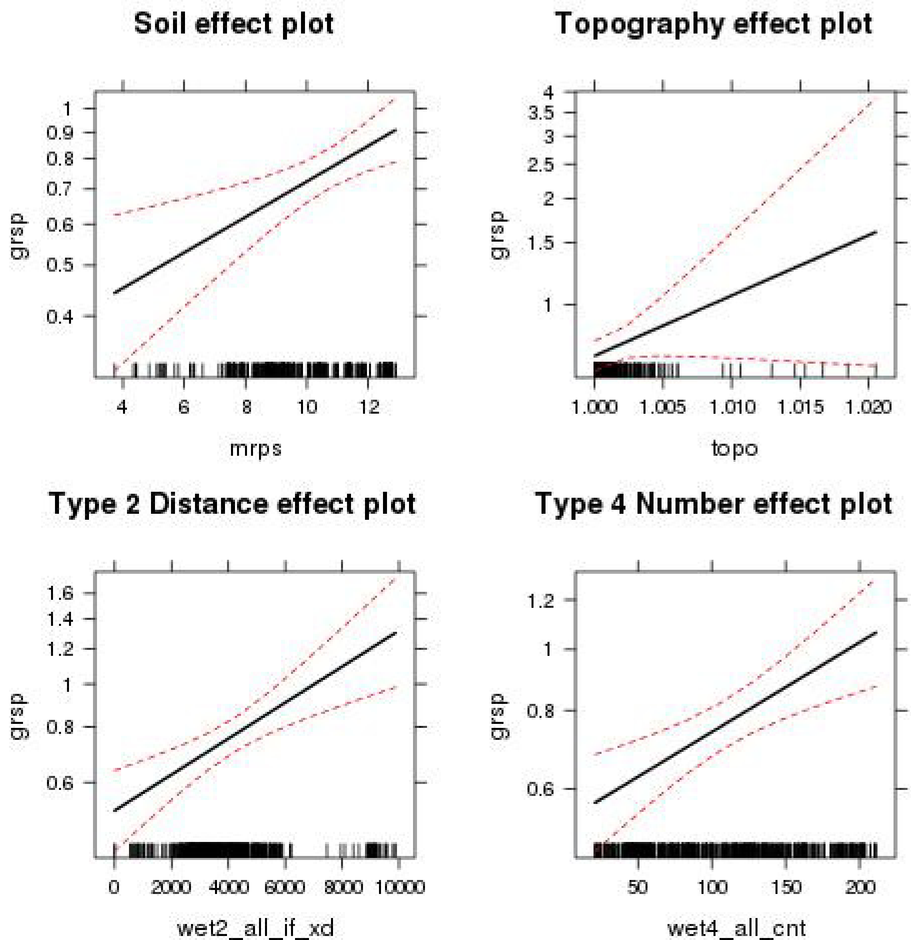
The initial results were used together with the predictor correlation information found in Appendix G to specify a Poisson GLM, which was simplified using AIC stepwise selection and subsequently evaluated for spatial auto-correlation. The residuals from this model displayed only minor spatial auto-correlation and the final model is summarized in Table 22 and Figure 20.

Table 22: Grasshopper Sparrow Wetland Predictors Poisson GLM

	Estimate	**Std. Error**	**z value**	**Pr(>|z|)**
(Intercept)	-4.106e+01	2.281e+01	-1.800	0.071912
mrps	7.845e-02	2.464e-02	3.184	0.001454
topo	3.922e+01	2.269e+01	1.728	0.083952
wet2_all_if_xd	9.352e-05	2.371e-05	3.945	7.99e-05
wet4_all_cnt	3.285e-03	8.924e-04	3.681	0.000232

The most significant predictor was distance from moist wetlands followed by numbers of open water wetlands within 10km and soil coarseness. These results are congruous with the non-parametric analysis and the species biology but have no new management implications.

Figure 20: Grasshopper Sparrow Wetland Model Effects



5.5.7 Horned Lark

In section 4.5.7 this species was found to have positive correlations with grazing and fire and negative correlations with shrub as expected from a species that prefers sparse cover with little woody vegetation. The wetland non-parametric analysis found negative relationships to shrub, barren / saline wetlands, open water wetlands and distance from dugouts. There was also a positive relationship found to moist wetlands at distances up to 1km.

These findings are consistent with a strongly positive relationship to grazing activity agrees with section 4.5.7. The negative response to increased distance from dugouts is similar to what was found in North Dakota and at Onefour, Alberta (Fontaine et al. 2004, Dale and Wiens In Preparation). A negative correlation was also found with open water wetlands that had no to sparse emergent vegetation. This correlation makes sense because most of these wetlands are fenced off from cattle access and we can therefore reasonably assume that these wetlands would have more cover near them. Surprisingly however positive correlations were found with moist wetlands, but it is possible that with over half of the data coming from drought years, these slightly wetter areas were better relative to other areas available to this species. As the reason for this moist wetland correlation was not clear, it was not included in the initial model specification.

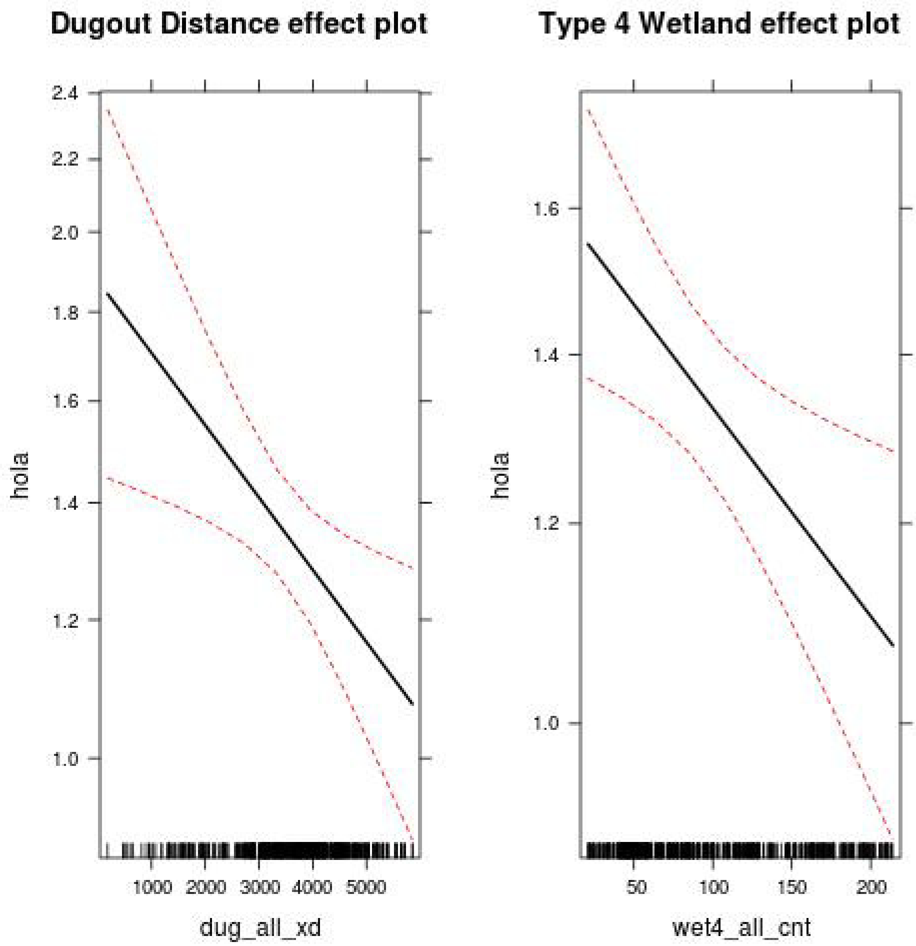
Using the information from the non-parametric analysis and the predictor correlations found in Appendix G, a Poisson GLM was constructed and simplified using stepwise AIC selection. The module residuals were then tested for spatial auto-correlation to assess if the p-values could be trusted and if the model specification was sufficient or if important predictors were missing. No spatial auto-correlation was found and the final model is summarized in Table 23 and Figure 21.

Table 23: Horned Lark Wetland Predictors Poisson GLM

	Estimate	**Std. Error**	**z value**	**Pr(>|z|)**
(Intercept)	8.180e-01	1.662e-01	4.922	8.57e-07
dug_all_xd	-9.514e-05	3.584e-05	-2.655	0.00794
wet4_all_cnt	-1.896e-03	7.041e-04	-2.692	0.00710

The results from the model were similar in significance and the effect plots found in Figure 21 clearly support the grazing relationship found in section 4.5.7.

Figure 21: Horned Lark Wetland Model Effects



5.5.8 Long-billed Curlew

In section 4.5.8 this species was found to be negatively correlated with shrub. The wetland non-parametric analysis found no relationship to shrub or topography and few other significant correlations. An interesting relationship was found with moist wetlands where independent of field boundaries a negative relationship at the scale of 5km was found. However within field boundaries, positive relationships were found with numbers of moist wetlands within 500m and the complementary negative relationship to distance within field boundaries. Open water wetlands, at the scale of 1 to 2.5km within field boundaries, was also found to be positive. Weak negative relationships were found to soil coarseness and distance to water troughs.

This species is known to prefer a mixture of vegetation heights and so within the bounds of a single field moist wetlands might be useful, but over a larger area, too many of them is not suitable.

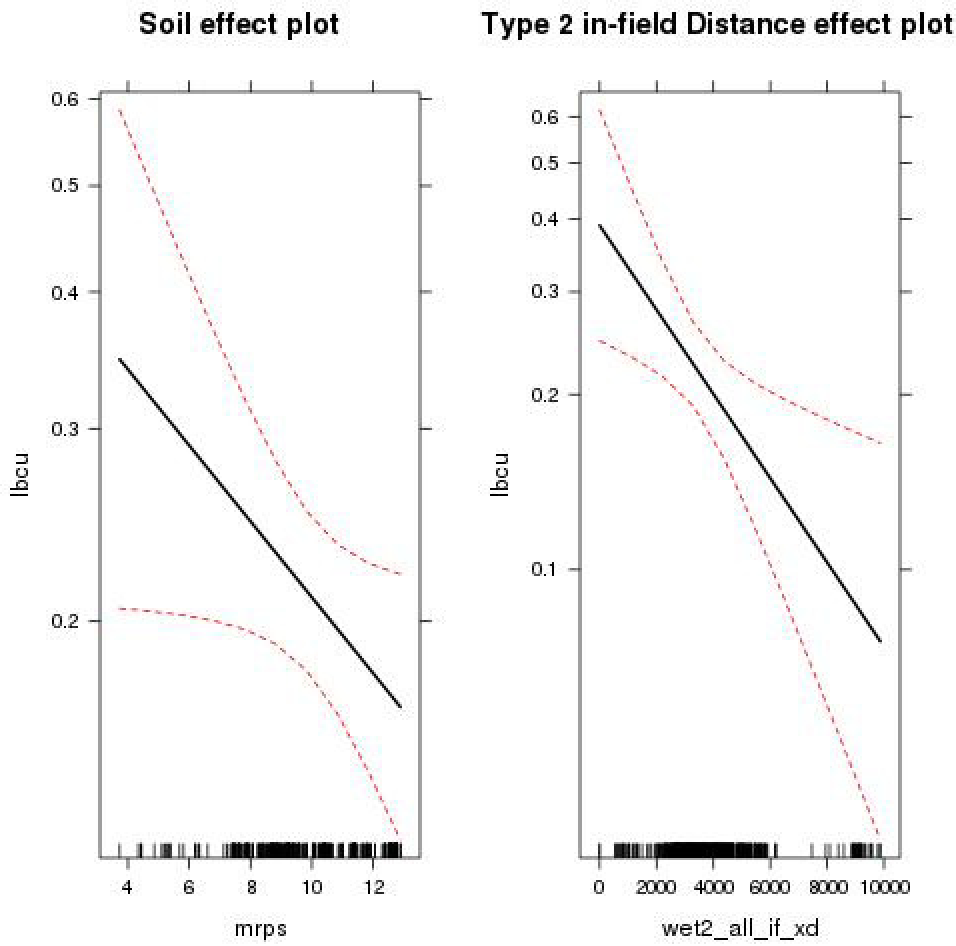
Using the correlations found in the non-parametric analysis and the predictor correlations found in Appendix G a Poisson GLM was created and simplified using stepwise AIC selection. This model was then evaluated for spatial auto-correlation and only minimal amounts were found (Table 24 and Figure 22).

Table 24: Long-billed Curlew Wetland Predictors Poisson GLM Model

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-1.143e-01	4.405e-01	-0.259	0.79531
mrps	-7.991e-02	4.017e-02	-1.990	0.04664
wet2_all_if_xd	-1.666e-04	6.169e-05	-2.701	0.00691

The model results show that distance to moist wetlands within a field are significant. These results have no new management implications.

Figure 22: Long-billed Curlew Wetland Model Effects



5.5.9 Lark Bunting

In section 4.5.9 this species was reported to have a quadratic relationship to shrub. In the wetland non-parametric analysis found a simple positive relationship to shrub as well as to soil coarseness and topographic roughness. Examining the distance to barren / saline wetlands at different distances suggested a possibly quadratic relationship. Herbaceous wetlands showed a negative relationship at distances from 1 to 2.5km as well as a positive relationship to distance within a field. These results are congruous with this species preference for some shrub and low to moderate cover.

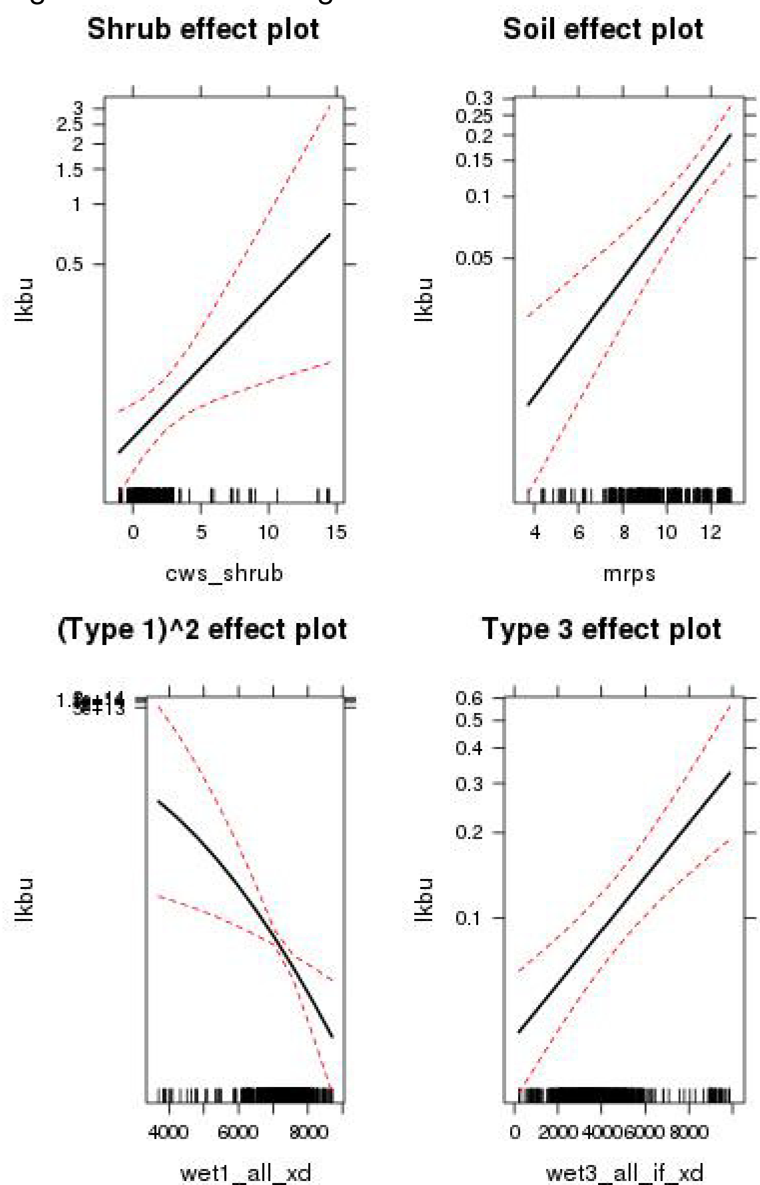
These correlations (Appendix G) were not strong enough to preclude the combination of input variables when selecting predictors to specify a Poisson GLM. This model was then simplified using stepwise AIC selection. The simplified model was then assessed for spatial auto-correlation. Minimal spatial auto-correlation was found so some caution should be employed in considering the model (Table 25 and Figure 23).

Table 25: Lark Bunting Wetland Predictors Poisson GLM Model

	Estimate	**Std. Error**	**z value**	**Pr(>|z|)**
(Intercept)	-2.527e+01	8.056e+00	-3.136	0.00171
cws_shrub	1.617e-01	5.967e-02	2.710	0.00673
mrps	3.306e-01	6.297e-02	5.250	1.52e-07
wet1_all_xd	6.415e-03	2.374e-03	2.702	0.00690
wet1_all_xd^2	-5.313e-07	1.743e-07	-3.047	0.00231
wet3_all_if_xd	2.189e-04	4.557e-05	4.804	1.55e-06

The most significant variable was soil coarseness (mrps) followed by distance to herbaceous wetlands (type 3) within a field. Shrub and the barren / saline variables included in quadratic form were also significant. The tolerance for some bare ground along with some cover and shrub is in agreement with the non-parametric analysis results and the species documented habitat preferences. There are no new management implications to these results.

Figure 23: Lark Bunting Wetland Model Effects



5.5.10 Sprague's Pipit

In section 4.5.10, shrub was reported as negatively correlated with this species abundance. The wetland non-parametric analysis also found negative correlations with shrub as well as negative correlations with moist wetlands (type 2) at all distance ranges. Positive relationships were found to the number open water wetlands (type 4) within 10km and to barren / saline wetlands from 2.5 to 5km. These results are congruous for a species with preferring cover of intermediate height and density.

These factors were used together with the predictor correlation information found in Appendix G to form a Poisson GLM which was simplified using stepwise AIC selection. This model was then evaluated for spatial auto-correlation to assess if the resulting p-values could be trusted and if the model as lacking any major predictive factors. The model was found to have significant spatial auto-correlation and so a spatial adjacency measure was added and the process was repeated. The AIC stepwise selection of this adjusted model removed the adjacency measure which suggests that simple adjacency was insufficient to explain the pattern found in the data. The initial model is presented in Table 26 and Figure 24 and it must be interpreted with caution.

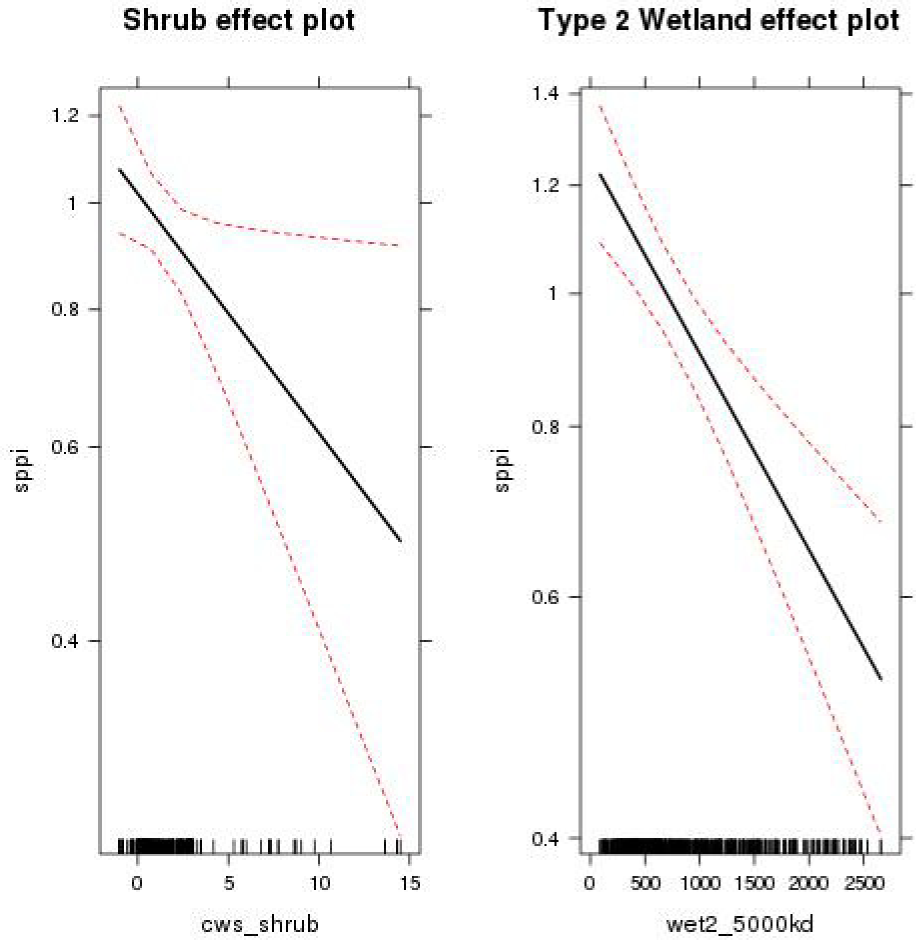
Table 26: Sprague's Pipit Wetland Predictors Poisson GLM Model

	Estimate	**Std. Error**	**z value**	**Pr(>|z|)**
(Intercept)	3.059e-01	7.113e-02	4.300	1.71e-05
cws_shrub	-5.014e-02	2.386e-02	-2.102	0.0356
wet2_5000kd	-3.306e-04	6.827e-05	-4.843	1.28e-06

In the cautious interpretation of the model only the amount of moist wetland within 5km can be considered significant. The avoidance of areas with large amounts of moist wetlands and sparse shrub is congruous with a species that avoids shrub and seeks out intermediate cover.

The fact that significant spatial auto-correlation was found and that AIC stepwise selection removed simple adjacency strongly indicates that important predictor variables are missing in the model specification. Precipitation in previous years, as a potential indicator of litter depth, was an important predictor in Wiens et al. (2008) and might have improved this model. Other unpublished work done by CWS on this species suggests that well density may be one of those missing predictors as additional wells had been drilled in some portions of the study area by 2001.

Figure24: Sprague's Pipit Wetland Model Effects



5.5.11 Upland Sandpiper

In section 4.5.12 this species was found to be positively correlated with shrub. The wetland non-parametric analysis did not find a significant relationship with shrub, but did find positive relationships to topographic roughness and distances to moist (type 2) and herbaceous (type 3) wetlands within a field. Positive relationships were also found with distance from moist and herbaceous wetlands within a field. Positive relationships were also found with barren / saline (type 1), herbaceous and open water (type 4) wetlands within 10km. These results are congruous with the known habitat preferences of this species for habitat heterogeneity at a larger scale (Derner et al. 2009).

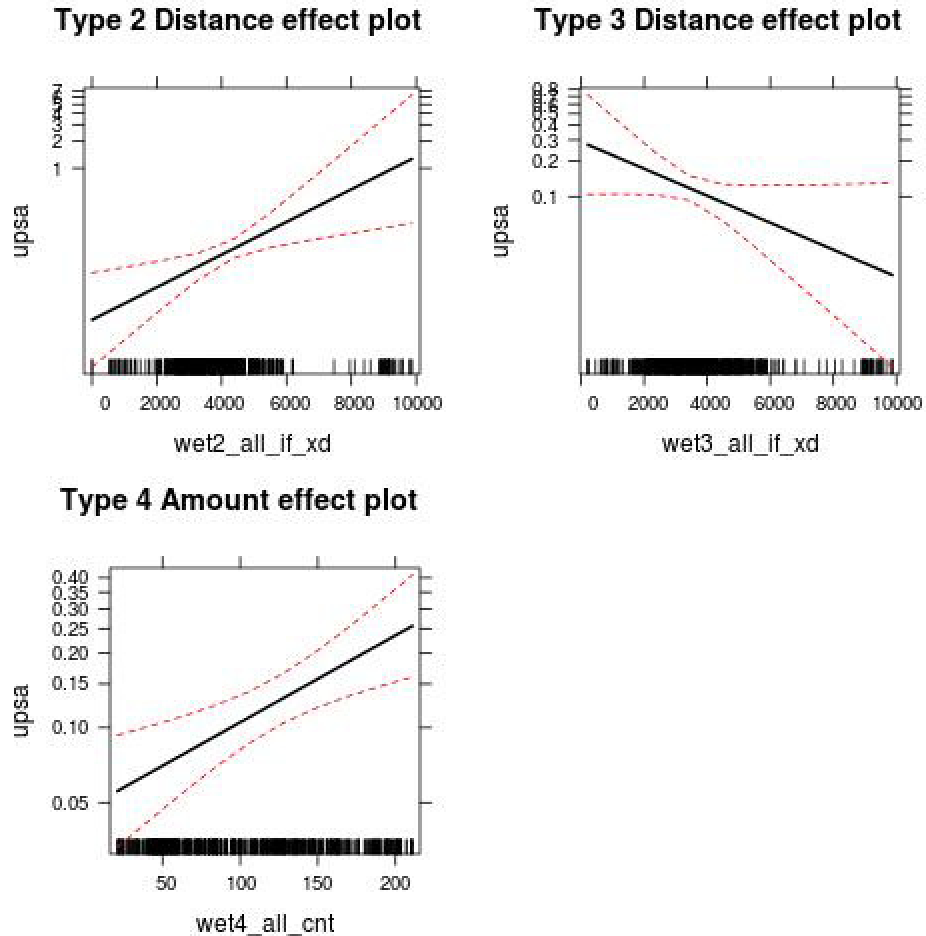
These correlations together with the predictor correlation information found in Appendix G were used to formulate a Poisson GLM which was simplified using AIC stepwise selection. The model was then assessed for spatial auto-correlation and none was found. The final model is summarized in Table 27 and Figure 25.

Table 27: Upland Sandpiper Wetland Predictors Poisson GLM Model

	Estimate	**Std. Error**	**z value**	**Pr(>|z|)**
(Intercept)	-3.6567290	0.3088654	-11.839	< 2e-16
wet2_all_if_xd	0.0004119	0.0001433	2.874	0.004054
wet3_all_if_xd	-0.0002621	0.0001431	-1.831	0.067087
wet4_all_cnt	0.0080464	0.0023615	3.407	0.000656

The most significant predictor was number of open water wetlands within 10km followed by the distance to moist wetlands. Distance to herbaceous wetlands was not significant. The large scale of the selected predictors in the model suggests that in the existing data, the large scale measure of habitat heterogeneity has more predictive power than the other finer scale measures for this species. There are no new management implications from these results.

Figure 25: Upland Sandpiper Wetland Model Effects



5.5.12 Vesper Sparrow

In section 4.5.13 this species was found to be negatively correlated with grazing and positively correlated with shrub and soil coarseness. The wetland non-parametric analysis found positive correlations to shrub, topographic roughness and the number open water wetlands (type 4) within 10km. Negative relationships were found to barren / saline (type 1), moist (type 2) and herbaceous (type 3) wetlands at a variety of scales. Distance from moist wetlands was positively correlated with species abundance.

The results are largely consistent with this edge species preference for shrubby areas that are not heavily grazed. Open water wetlands at large scales are positively related to both topography and soil texture because of the prevalence of this type of wetland near the river. The river flats, valley walls and coulees are prime habitat for this species.

Using these correlations and the predictor correlation information found in Appendix G a Poisson GLM was specified and processed using stepwise AIC selection. The resulting model was then assess for spatial auto-correlation. The resulting model has minimal spatial auto-correlation so it could be used and is summarized in Table 28 and Figure 26.

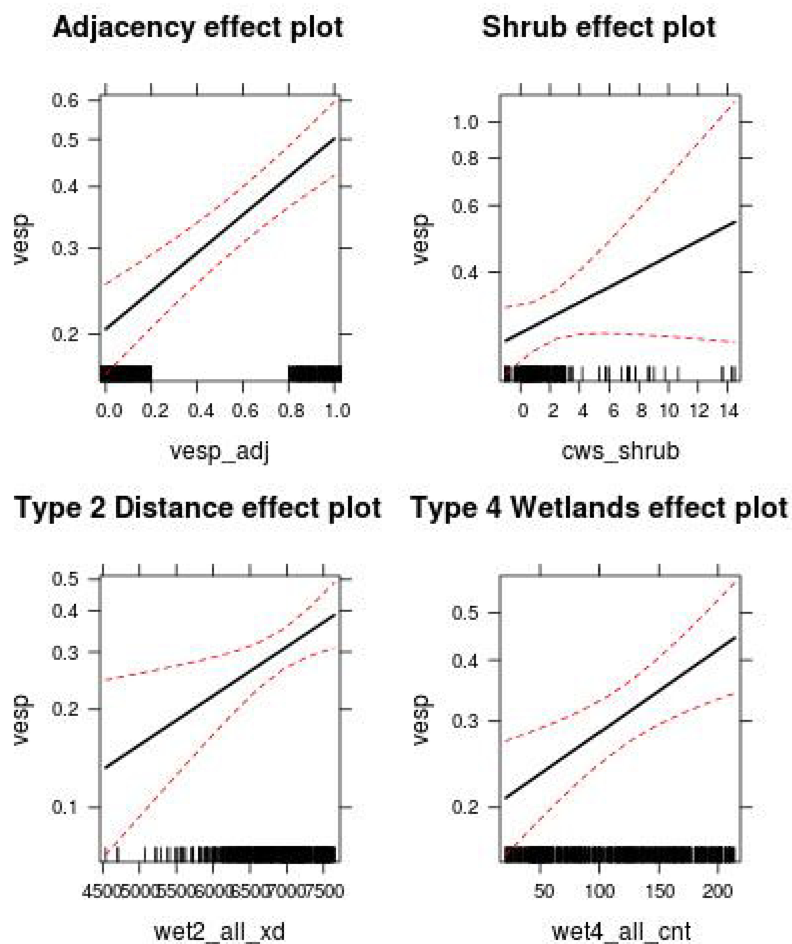
Table 28: Vesper Sparrow Wetland Predictors Poisson GLM Model

	Estimate	**Std. Error**	**z value**	**Pr(>|z|)**
(Intercept)	-8.604e+01	1.794e+01	-4.797	1.61e-06
vesp_adj	8.959e-01	1.428e-01	6.273	3.54e-10
cws_shrub	4.684e-02	2.856e-02	1.640	0.10093
topo	8.150e+01	1.781e+01	4.576	4.73e-06
wet2_all_xd	3.464e-04	1.288e-04	2.689	0.00717
wet4_all_cnt	3.900e-03	1.187e-03	3.285	0.00102

After adjacency, the most significant predictor was topographic roughness followed by open water wetlands with 10km and distance from moist wetlands.

These results suggest that topography is a very powerful predictor for this species. It is interesting that although shrub is commonly associated with this species that the factors of topography, distance from moist wetlands and presence of open water wetlands are significant and together suggest shrubby areas within the NWA but that shrub itself in this model was not statistically significant.

Figure 26: Vesper Sparrow Wetland Model Effects



5.5.13 Western Meadowlark

In section 4.5.14 grazing was reported as negatively correlated with this species. The wetland non-parametric analysis found positive correlations to shrub, topographic roughness and open water wetlands (type 4). Negative correlations were found with moist wetlands (type 2) and distance from water troughs and open water wetlands.

This species is found throughout the Suffield NWA and expected to occur in a variety of cover regimes, shunning only extremely sparse or tall cover. This on the ground knowledge is congruous with these results.

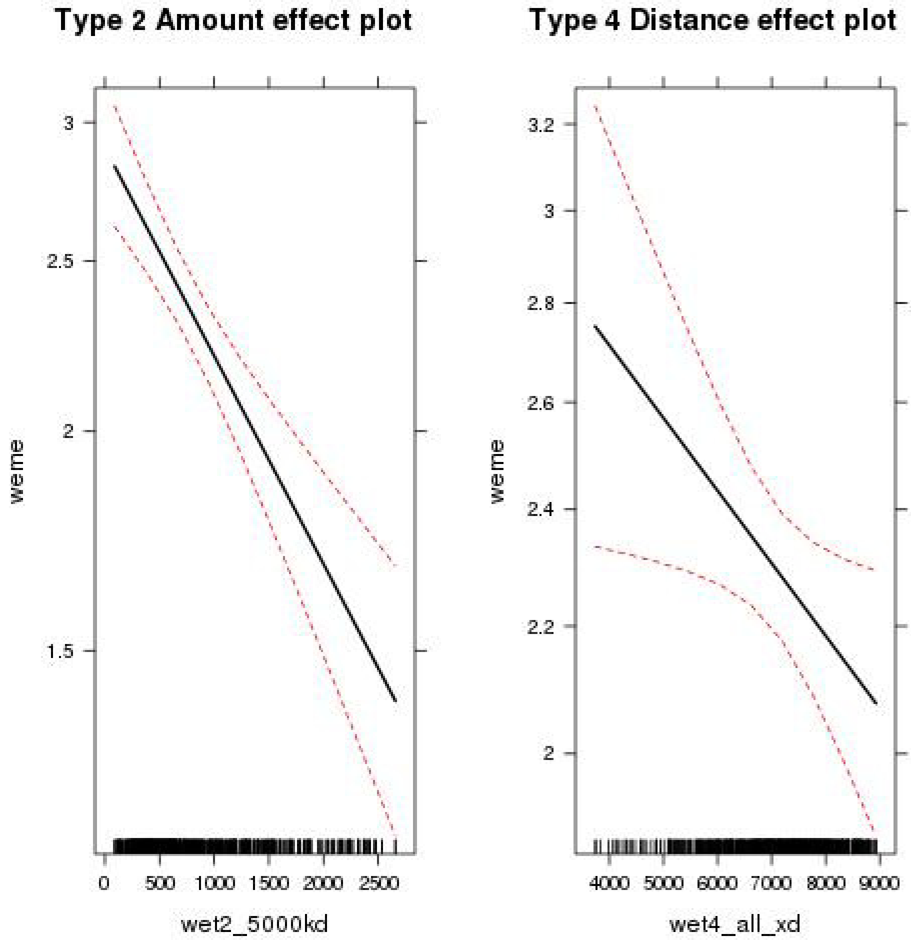
Using the non-parametric results and the predictor correlation information from Appendix G a Poisson GLM was formulated and processed using stepwise AIC selection. The resulting model was evaluated for spatial auto-correlation. Minimal spatial auto-correlation was found and the final model is summarized in Table 29 and Figure 27.

Table 29: Western Meadowlark Wetland Predictors Poisson GLM Model

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	1.451e+00	1.608e-01	9.024	< 2e-16
wet2_5000kd	-2.730e-04	4.661e-05	-5.858	4.69e-09
wet4_all_xd	-5.420e-05	2.404e-05	-2.255	0.0241

The significant predictor was the amount of moist wetlands within 5km. As with some of the other species these results suggest that larger scale dynamics are at play for determining suitable habitat for this species which might be an important perspective from both a management and modeling perspective.

Figure 27: Western Meadowlark Wetland Model Effects



6 Summary

In this mensurative study, most species showed stronger responses to shrub, soil, and topography, which influence the type and amount of vegetation growing in the study area, than they did to measures of disturbance such as pellet counts, number of fires, years since fire, or distance to potential water sources or visible wetland edges. This suggests:

1. It is very important to consider factors that influence habitat growth even in a controlled disturbance experiment as few sites will be completely uniform in terms of soil or topography and thus vegetative community.
2. In moderately grazed semi-arid areas a full suite of grassland birds may persist for long periods of time without fire disturbance.
3. Responses of birds to wetlands need to consider land-use and the type of wetland.
4. Precipitation can be an important predictor of grassland bird habitat selection and abundances over time (Niemuth et al 2008, Wiens et al. 2008) and large distance measures of wetlands were likely to be strongly influenced by general precipitation dynamics. Wetland type information on its own does not provide precipitation history and wetland type is weakly correlated with landforms and other factors such as shrub. The mixed performance of some of wetland models could be a result of these complicating dynamics.
5. The wetland distances were calculated from two similar years, but not as direct measures from each year. It might have been beneficial to limit wetland measures to smaller scales and have included some precipitation measures to better account for some of the complex dynamics, such as precipitation history effects on litter depth, that are involved.

The results with potential management implications were:

1. In semi-arid grasslands, fire regimes that approach natural regimes in terms of frequency and extent of fire may not have much effect when examined over a large area or long period of time. Immediate effects may be dramatic, but are not lasting.
2. Distance to troughs, dugouts, and occasionally moist and open water wetlands influenced some species abundance in ways consistent with their response to grazing. This suggests that the distribution and abundance of water sources can be used as a management tool that is particularly important for species requiring more or patchy cover (Baird’s Sparrow, Sprague’s Pipit, Upland Sandpiper and possibly Vesper Sparrow).
3. Field size was often related to bird abundance but this result should be viewed with caution as larger fields occurred in largely shrubless areas with finer soils and gentle topography. Stronger evidence for the desirability of large field sizes in semi-arid environments is the fact some species prefer to be far from cattle water sources which can only be achieved in large fields.

7 Acknowledgments

I want to thank both Environment Canada and the Department of Defense and their respective staff who provided the data that made this study possible. The most significant contribution to this study however was Brenda Dale's sharing of her time and knowledge without reserve. Brenda provided on the ground knowledge of Suffield as well a deep knowledge of the grassland bird ecology necessary to guide the interpretation of results. Despite the contribution of others, all mistakes and errors in interpretation are the fault of the author alone.

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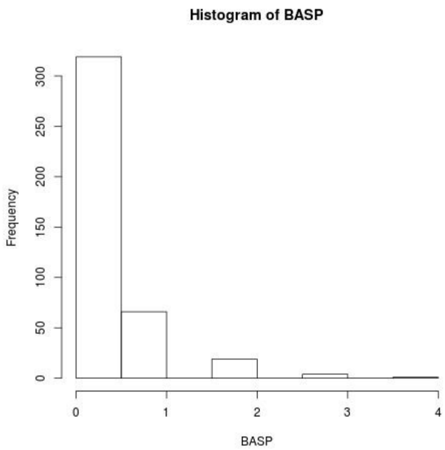
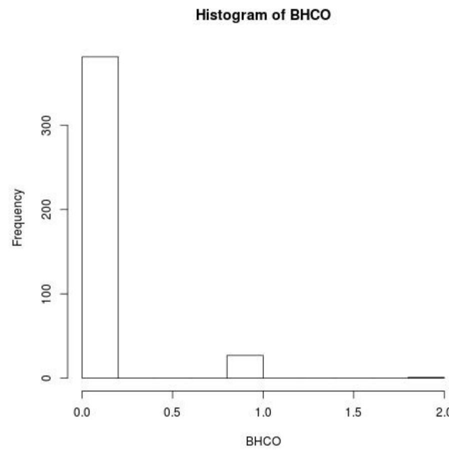
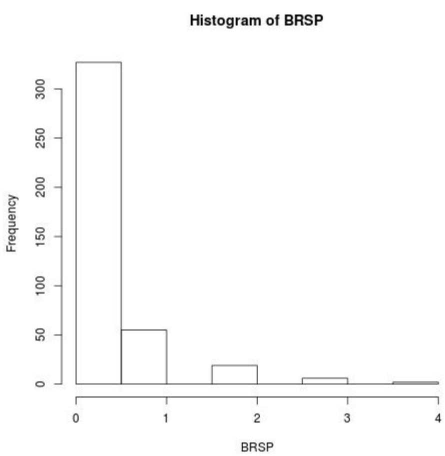
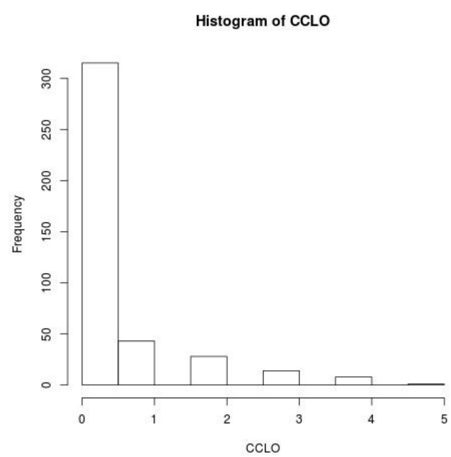
Appendix A – Descriptive graphs of fire & grazing data

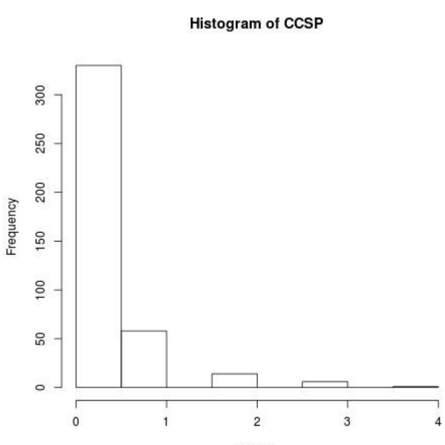
A.1 Species Distributions

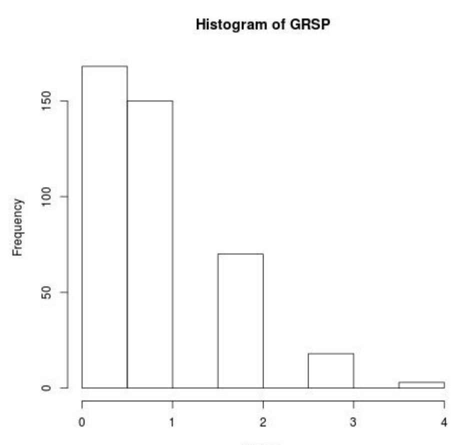


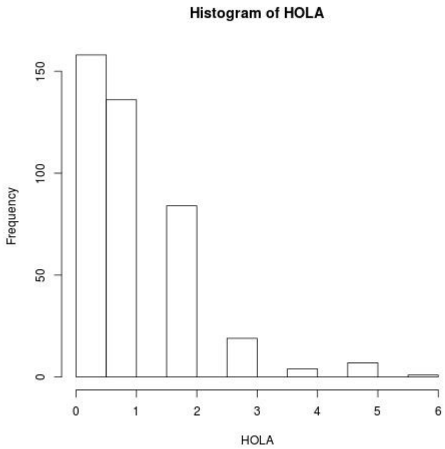


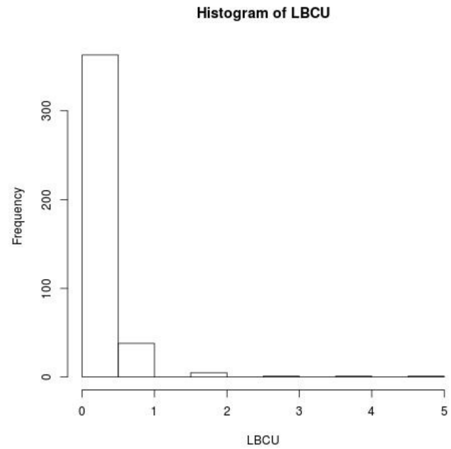


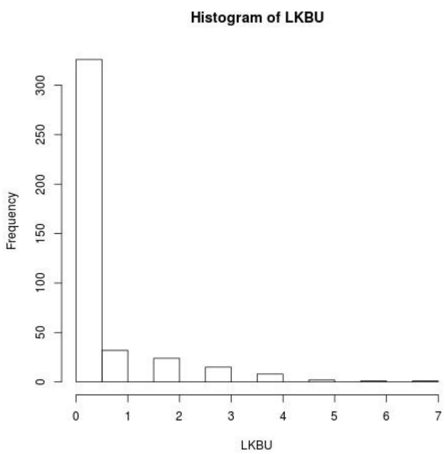


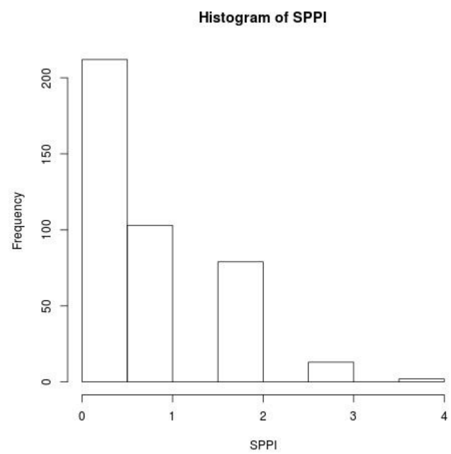


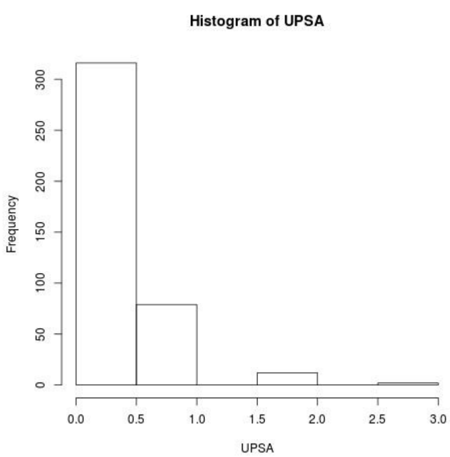


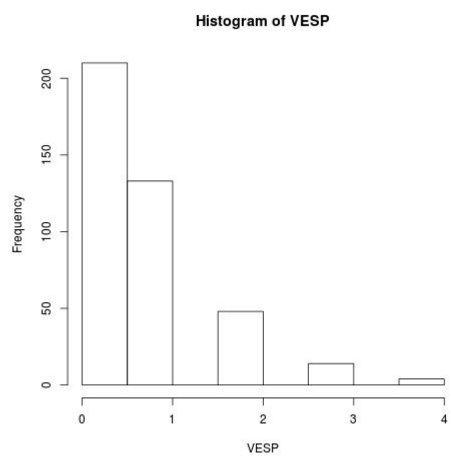

Histogram of HOLA
Frequency
0
50
100
150
0 1 2 3 4 5 6
HOLA

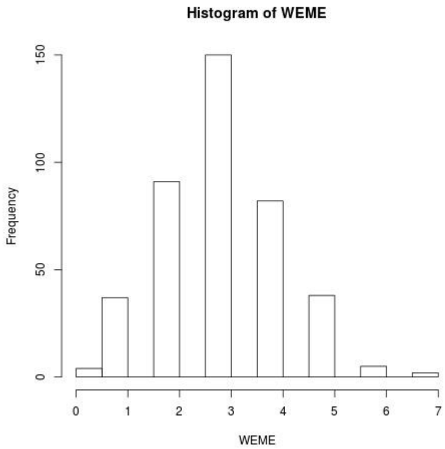

Histogram of LBCU
Frequency
0
100
200
300
0 1 2 3 4 5
LBCU


Histogram of LKBU
Frequency
0
50
100
150
200
250
300
0 1 2 3 4 5 6 7
LKBU

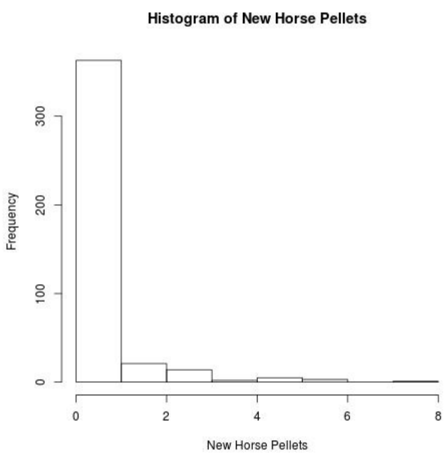

Histogram of SPPI
Frequency
0
50
100
150
200
0 1 2 3 4
SPPI

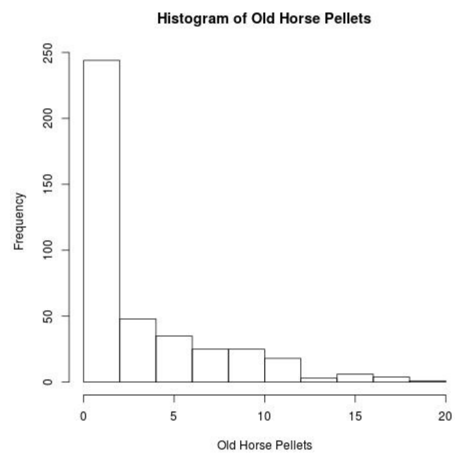

Histogram of UPSA
Frequency
0
50
100
150
200
250
300
0.0 0.5 1.0 1.5 2.0 2.5 3.0
UPSA

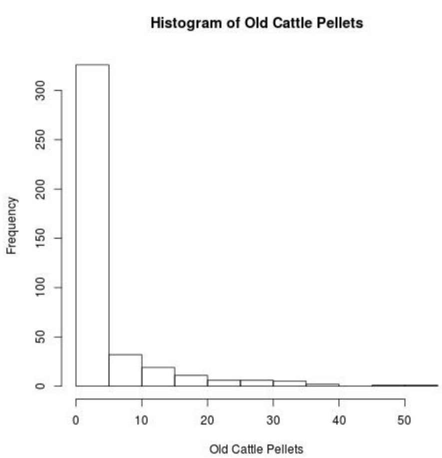

Histogram of VESP
Frequency
0
50
100
150
200
0 1 2 3 4
VESP

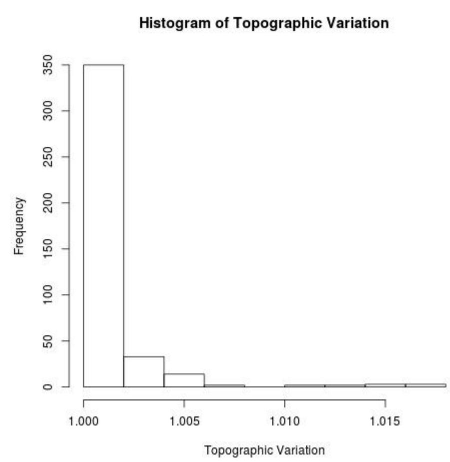


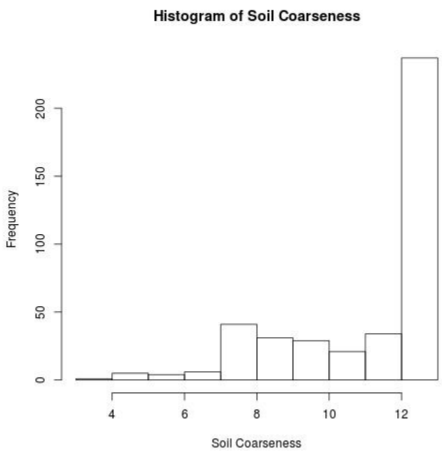
A.2 Predictor Distributions

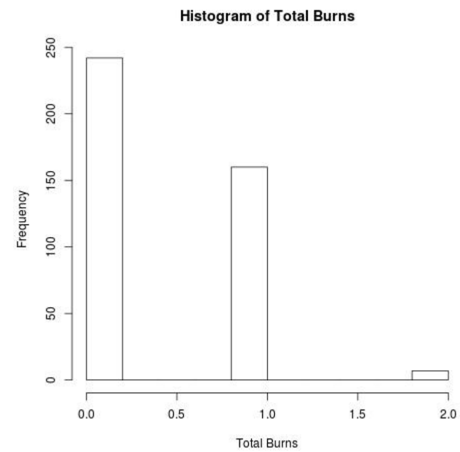


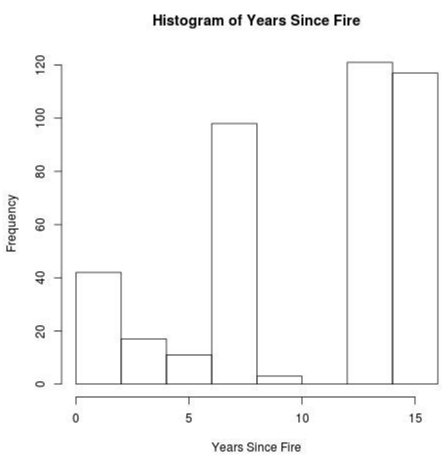


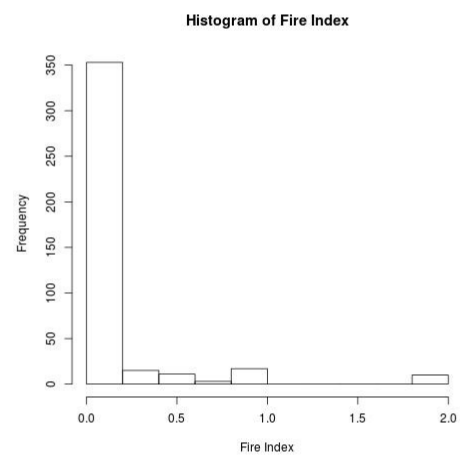


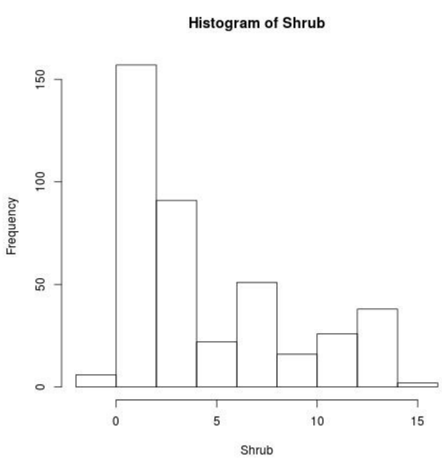



Histogram of Soil Coarseness
Frequency
0
50
100
150
200
4
6
8
10
12
Soil Coarseness


Histogram of Total Burns
Frequency
0
50
100
150
200
250
0.0
0.5
1.0
1.5
2.0
Total Burns


Histogram of Years Since Fire
Frequency
0
20
40
60
80
100
120
0
5
10
15
Years Since Fire


Histogram of Fire Index
Frequency
0
50
100
150
200
250
300
350
0.0
0.5
1.0
1.5
2.0
Fire Index


Histogram of Shrub
Frequency
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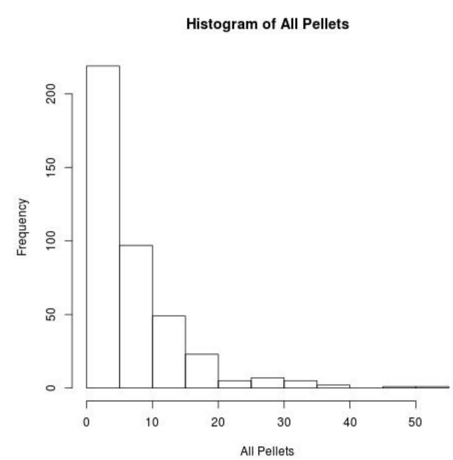
50
100
150
0
5
10
15
Shrub


Histogram of All Pellets
Frequency
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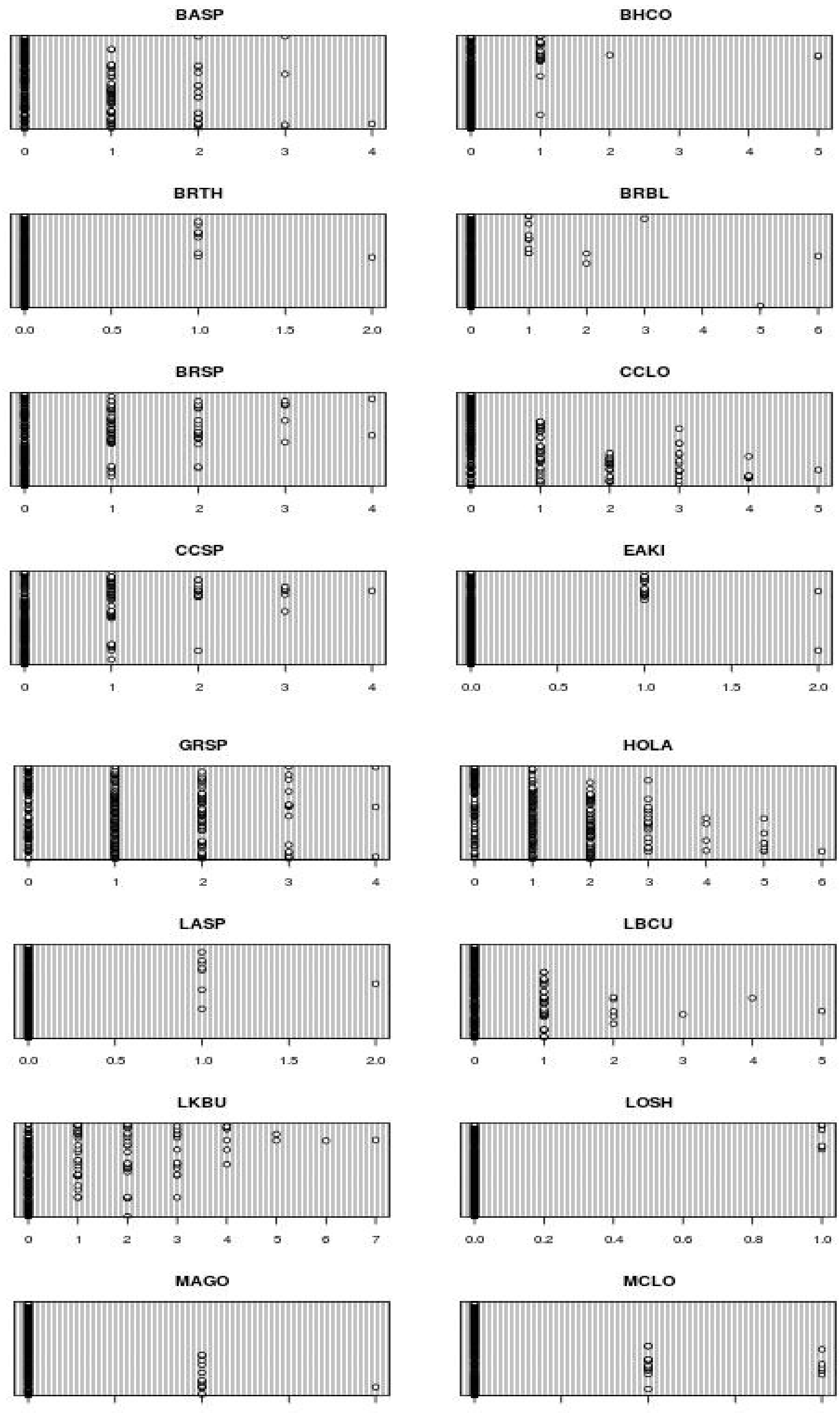
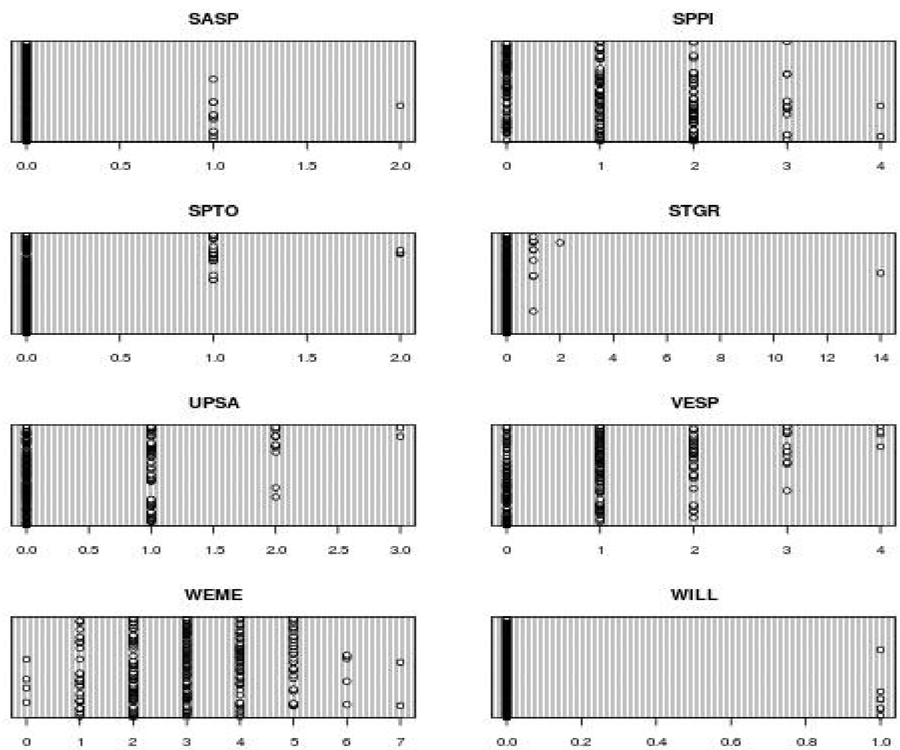
50
100
150
200
0
10
20
30
40
50
All Pellets

A.3 Species Outlier Detection Graphs (dot charts)




SASP
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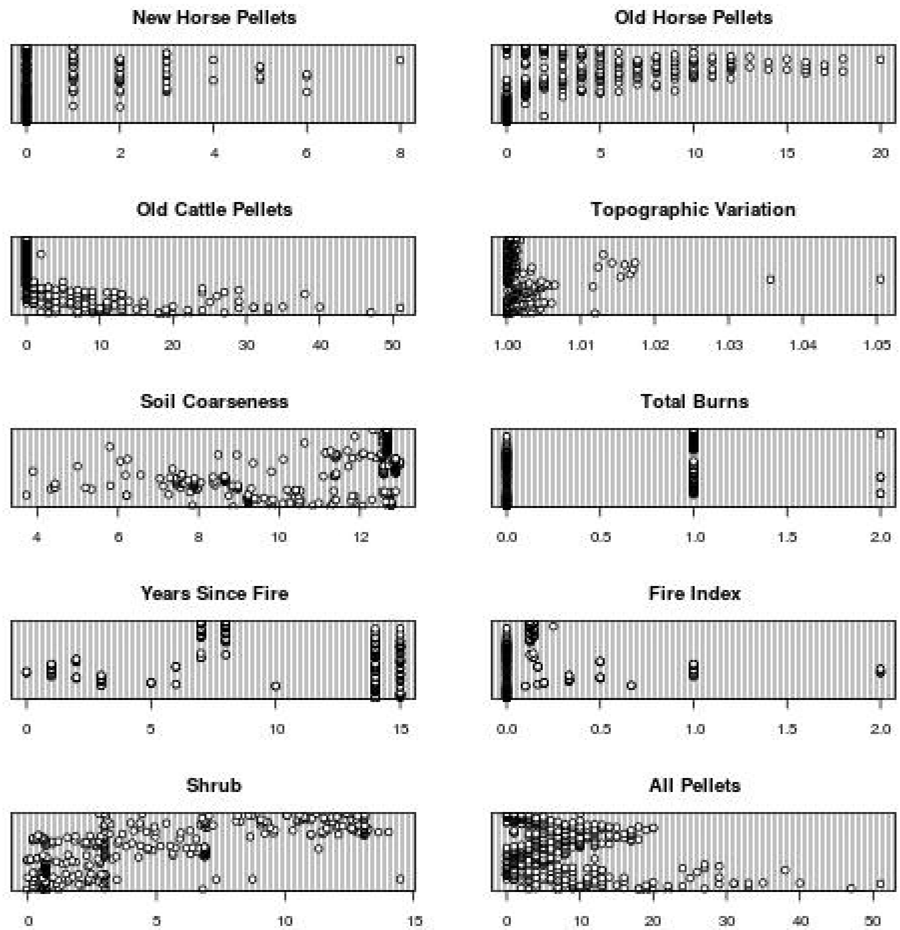
0.5
1.0
1.5
2.0
SPPI
0
1
2
3
4
SPTO
0.0
0.5
1.0
1.5
2.0
STGR
0
2
4
6
8
10
12
14
UPSA
0.0
0.5
1.0
1.5
2.0
2.5
3.0
VESP
0
1
2
3
4
WEME
0
1
2
3
4
5
6
7
WILL
0.0
0.2
0.4
0.6
0.8
1.0

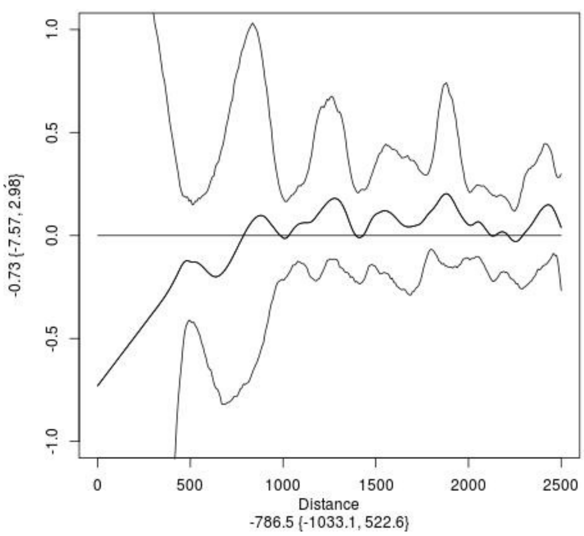
A.4 Predictor Outlier Detection Graphs (dot charts)



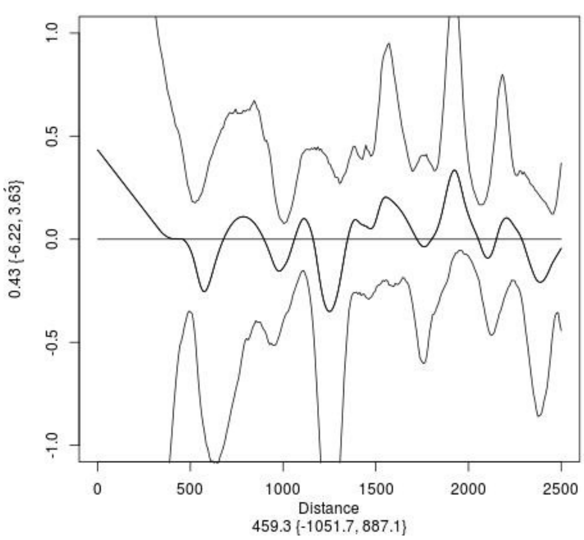
Appendix B – Correlograms from fire & grazing parametric analysis

Interpretation of the correlograms merits some explanation. On the y-axis is a scale from -1 to 1 providing a measure of correlation equivalent to a Pearson's r or Kendall's tau. Along the x-axis is distance. In the case of the correlogram for Baird's Sparrow, the central line tracks quite close to 0, indicating very low correlation. The confidence intervals do not cross the zero line, thus the weak correlation that exists, is not statistically significant. In the case of Western Meadowlark however there is a spike at 500m where both the central line and the lower confidence interval are above zero indicating spatial auto-correlation in the model residuals.

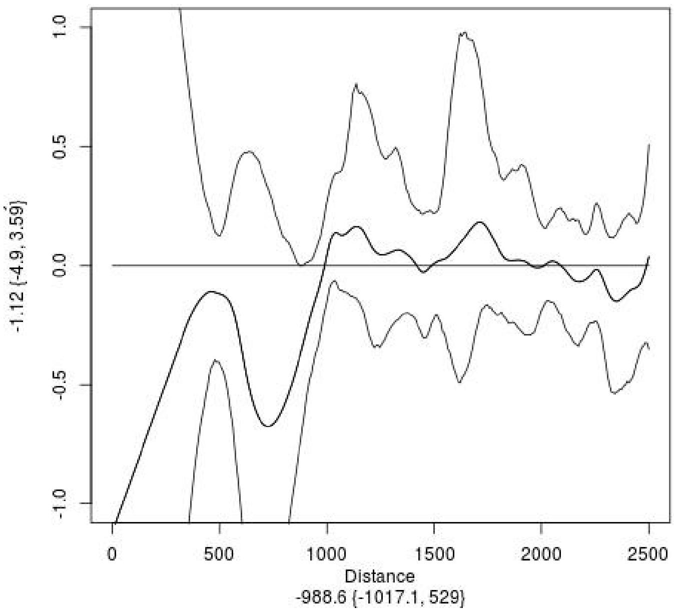
B.1 Baird's Sparrow GLM Model Residuals



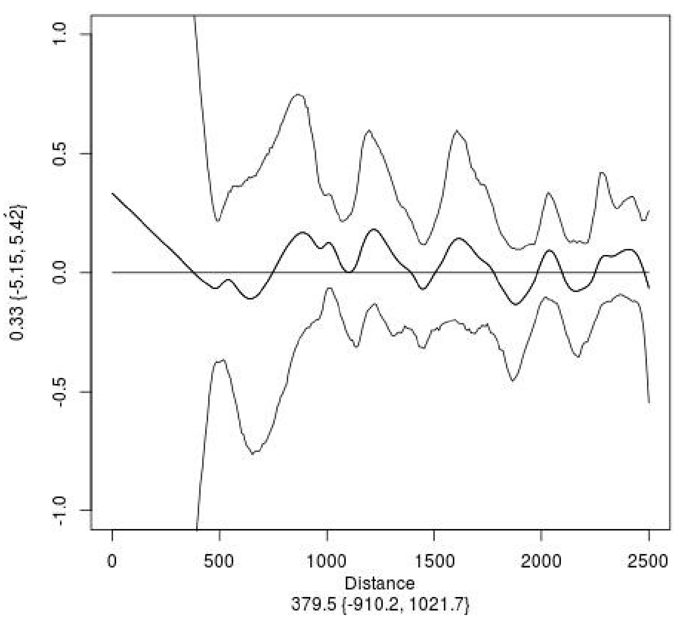
B.2 Brown-headed Cowbird GLM Model Residuals



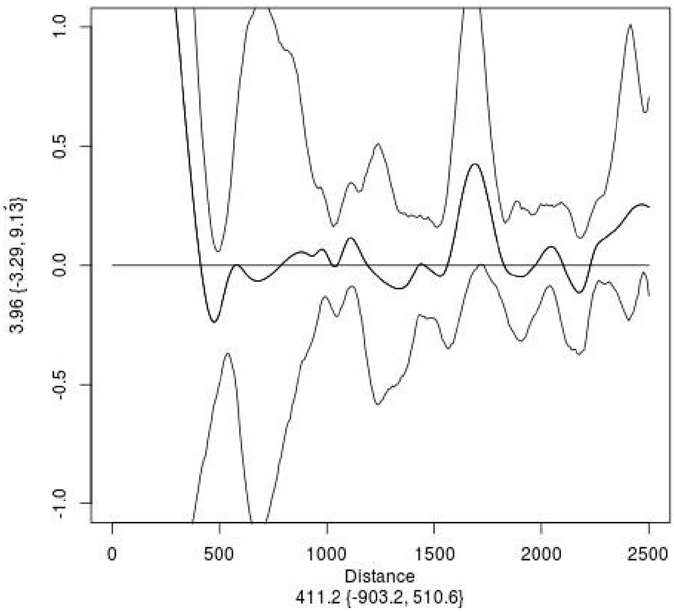
B.3 Brewer's Sparrow GLM Model Residuals



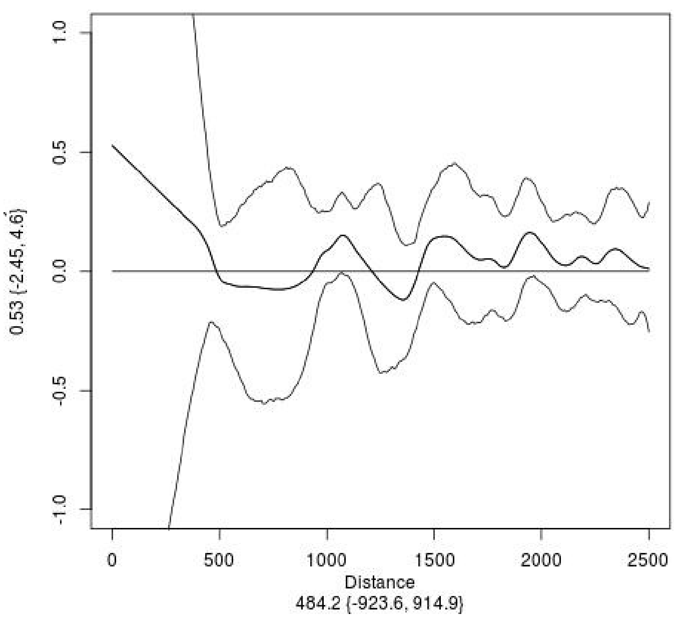
B.4 Chestnut-colored Longspur GLM Model Residuals



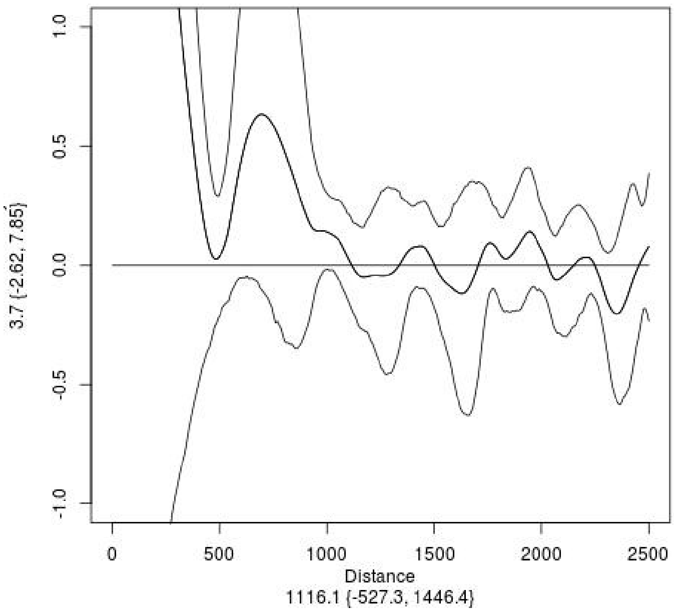
B.5 Clay-colored Sparrow GLM Model Residuals



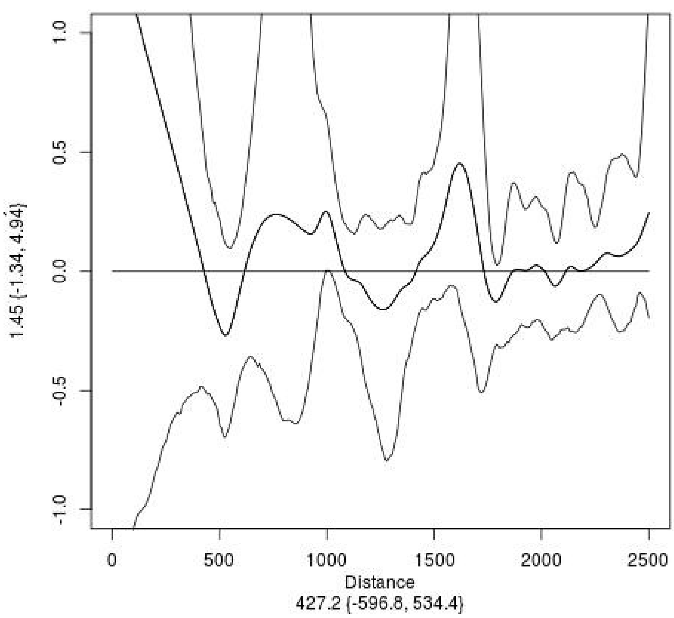
B.6 Grasshopper Sparrow GLM Model Residuals



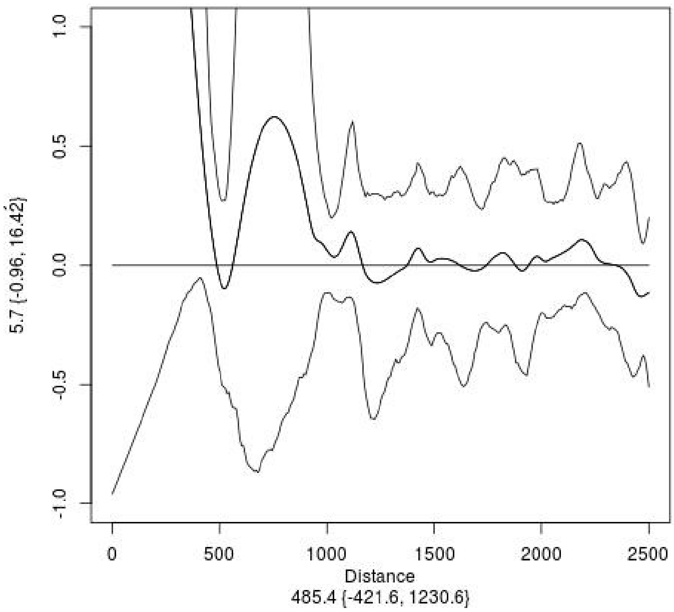
B.7 Horned Lark GLM Model Residuals



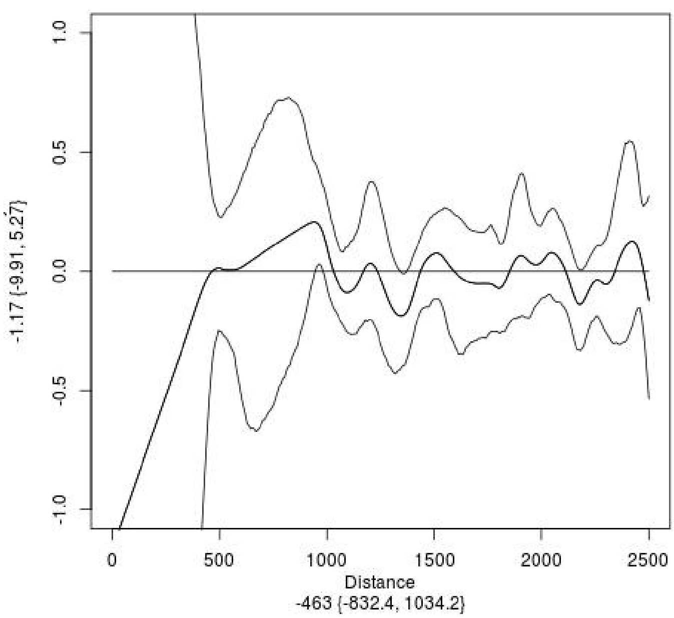
B.8 Long-billed Curlew GLM Model Residuals



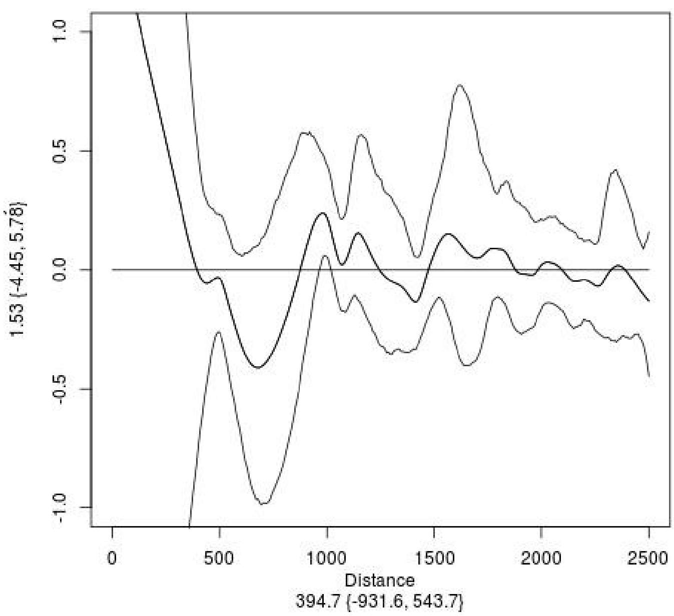
B.9 Lark Bunting GLM Model Residuals



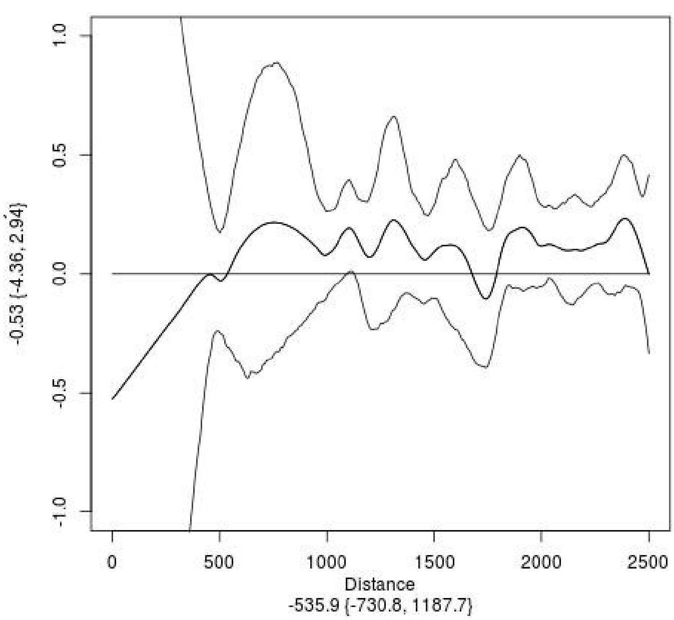
B.10 Sprague's Pipit GLM Model Residuals



B.12 Upland Sandpiper GLM Model Residuals

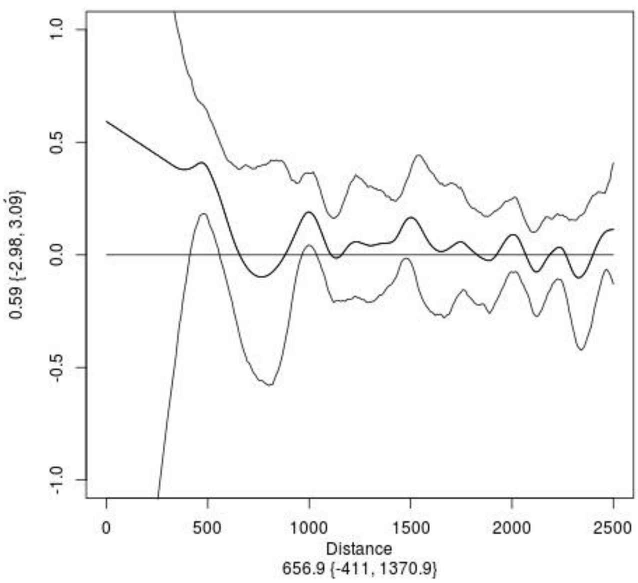


B.12 Vesper Sparrow GLM Model Residuals

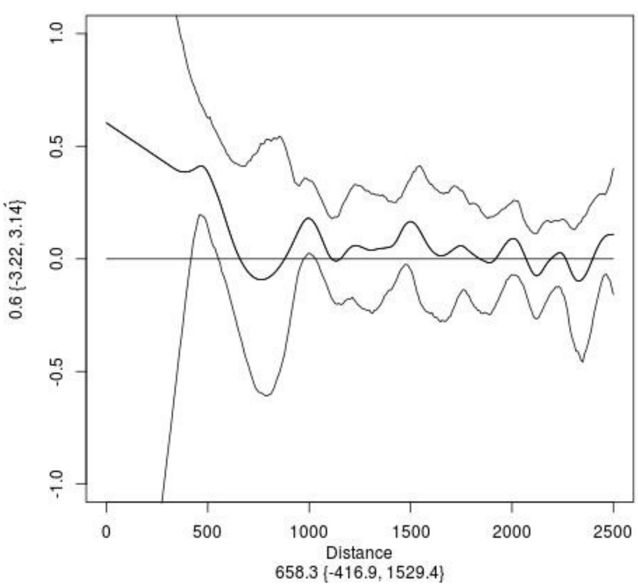


B.13 Western Meadowlark Model Residuals

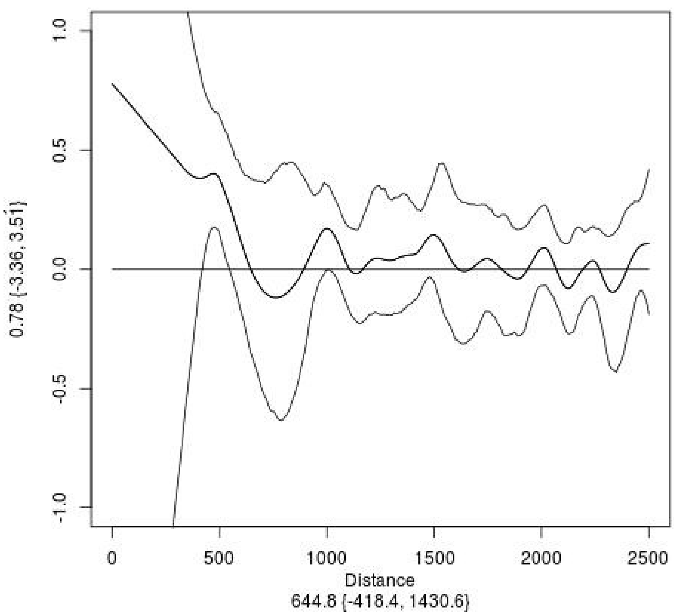
B.13.1 Initial GLM



B.13.2 GLM with adjacency parameter



B.13.3 GLMM without adjacency parameter



Appendix C – Wetland analysis variable description

Table 45: Wetland analysis variable definitions

Variable	Description
wet1_500kd	Amount of saline / barren wetland within 500m
wet1_1000kd	Amount of saline / barren wetland within 1000m
wet1_2500kd	Amount of saline / barren wetland within 2500m
wet1_5000kd	Amount of saline / barren wetland within 5000m
wet2_500kd	Amount of moist wetland within 500m
wet2_1000kd	Amount of moist wetland within 1000m
wet2_2500kd	Amount of moist wetland within 2500m
wet2_5000kd	Amount of moist wetland within 5000m
wet3_500kd	Amount of herbaceous wetland within 500m
wet3_1000kd	Amount of herbaceous wetland within 1000m
wet3_2500kd	Amount of herbaceous wetland within 2500m
wet3_5000kd	Amount of herbaceous wetland within 5000m
wet4_500kd	Amount of open water within 500m
wet4_1000kd	Amount of open water within 1000m
wet4_2500kd	Amount of open water within 2500m
wet4_5000kd	Amount of open water within 5000m
wet1_500_cnt	Number of saline / barren wetlands within 500m
wet1_1000_cnt	Number of saline / barren wetlands from 500 to 1000m
wet1_2500_cnt	Number of saline / barren wetlands from 1000 to 2500m
wet1_5000_cnt	Number of saline / barren wetlands from 2500 to 5000m
wet2_500_cnt	Number of moist wetlands within 500m
wet2_1000_cnt	Number of moist wetlands from 500 to 1000m
wet2_2500_cnt	Number of moist wetlands from 1000 to 2500m
wet2_5000_cnt	Number of moist wetlands from 2500 to 5000m
wet3_500_cnt	Number of herbaceous wetlands within 500m
wet3_1000_cnt	Number of herbaceous wetlands from 500 to 1000m
wet3_2500_cnt	Number of herbaceous wetlands from 1000 to 2500m
wet3_5000_cnt	Number of herbaceous wetlands from 2500 to 5000m
wet4_500_cnt	Number of open water wetlands within 500m
wet4_1000_cnt	Number of open water wetlands from 500 to 1000m
wet4_2500_cnt	Number of open water wetlands from 1000 to 2500m
wet4_5000_cnt	Number of open water wetlands from 2500 to 5000m

Table 45 continued

Variable	Description
wet1_all_cnt	Number of saline / barren wetlands within 10,000m
wet2_all_cnt	Number of moist wetlands within 10,000m
wet3_all_cnt	Number of herbaceous wetlands within 10,000m
wet4_all_cnt	Number of open water wetlands within 10,000m
tro_all_cnt	Number of water troughs within a field
dug_all_cnt	Number of dugouts within a field
wet1_all_xd	Mean distance of saline / barren wetlands within 10,000m
wet2_all_xd	Mean distance of moist wetlands within 10,000m
wet3_all_xd	Mean distance of herbaceous wetlands within 10,000m
wet4_all_xd	Mean distance of open water wetlands within 10,000m
tro_all_xd	Mean distance of water troughs within a field
dug_all_xd	Mean distance of dugouts within a field
wet1_500_if_cnt	Number of saline / barren wetlands within a field and within 500m
wet1_1000_if_cnt	Number of saline / barren wetlands within a field and from 500 to 1000m
wet1_2500_if_cnt	Number of saline / barren wetlands within a field and from 100 to 2500m
wet1_5000_if_cnt	Number of saline / barren wetlands within a field and from 2500 to 5000m
wet2_500_if_cnt	Number of moist wetlands within a field and within 500m
wet2_1000_if_cnt	Number of moist wetlands within a field and from 500 to 1000m
wet2_2500_if_cnt	Number of moist wetlands within a field and from 1000 to 2500m
wet2_5000_if_cnt	Number of moist wetlands within a field and from 2500 to 5000m
wet3_500_if_cnt	Number of herbaceous wetlands within a field and within 500m
wet3_1000_if_cnt	Number of herbaceous wetlands within a field and from 500 to 1000m
wet3_2500_if_cnt	Number of herbaceous wetlands within a field and from 1000 to 2500m
wet3_5000_if_cnt	Number of herbaceous wetlands within a field and from 2500 to 5000m

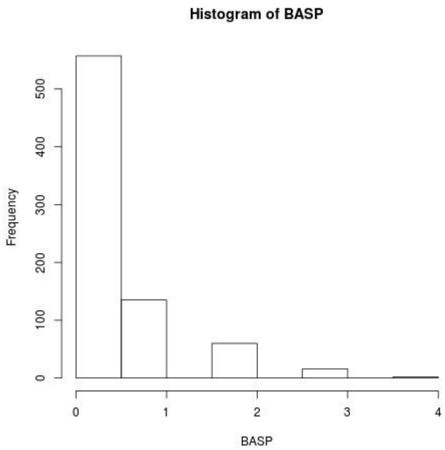
Variable	Description
wet4_500_if_cnt	Number of open water wetlands within a field and within 500m
wet4_1000_if_cnt	Number of open water wetlands within a field and from 500 to 1000m
wet4_2500_if_cnt	Number of open water wetlands within a field and from 1000 to 2500m
wet4_5000_if_cnt	Number of open water wetlands within a field and from 2500 to 5000m
wet1_all_if_cnt	Number of saline / barren wetlands within a field
wet2_all_if_cnt	Number of moist wetlands within a field
wet3_all_if_cnt	Number of herbaceous wetlands within a field

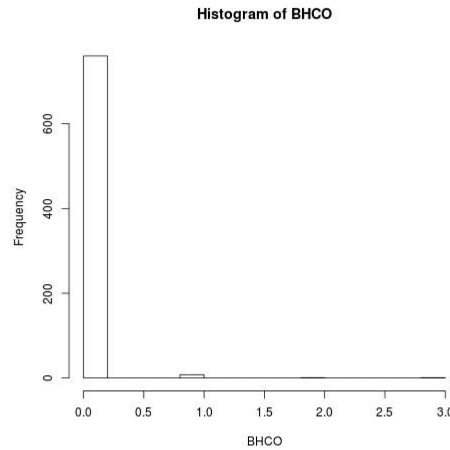
Table 45 continued

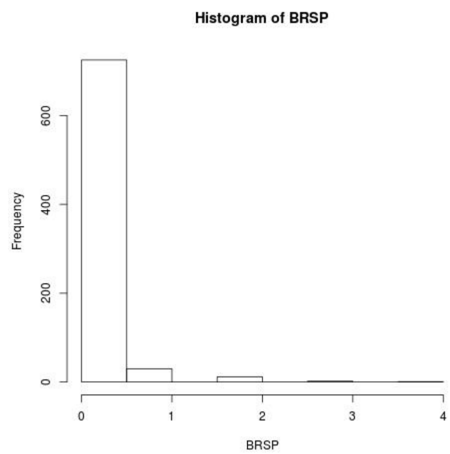
Variable	Description
wet4_all_if_cnt	Number of open water wetlands within a field
wet1_all_if_xd	Mean distance of saline / barren wetlands within a field
wet2_all_if_xd	Mean distance of moist wetlands within a field
wet3_all_if_xd	Mean distance of herbaceous wetlands within a field
wet4_all_if_xd	Mean distance of open water wetlands within a field

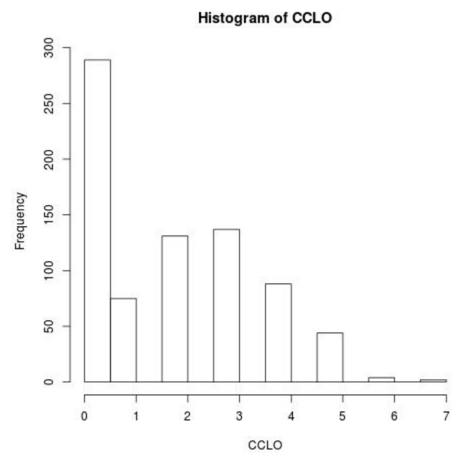
Appendix D – Descriptive graphs of wetland data

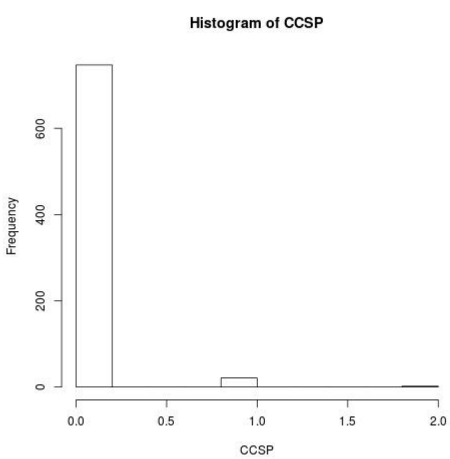
D.1 Species Distributions

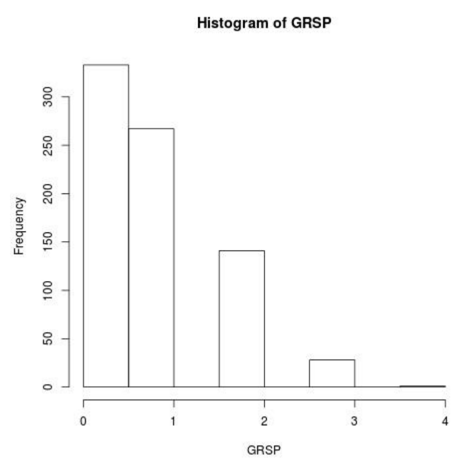


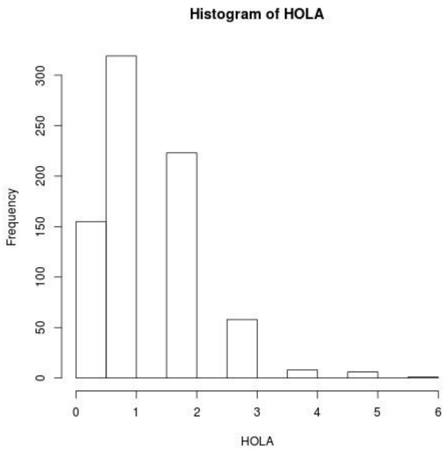


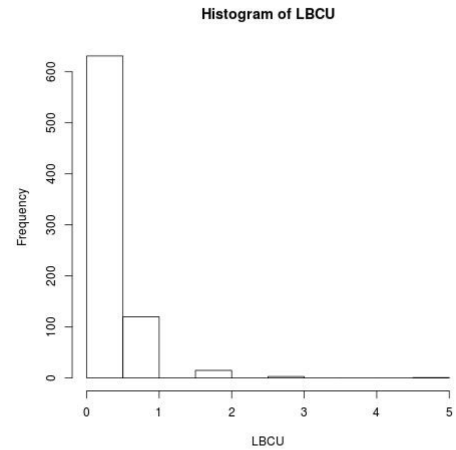


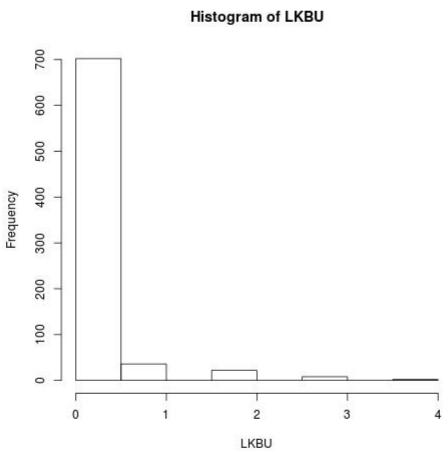


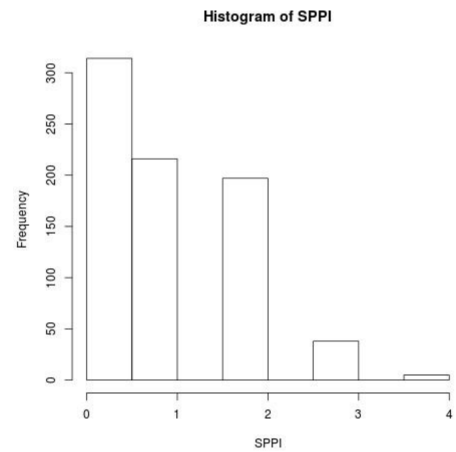


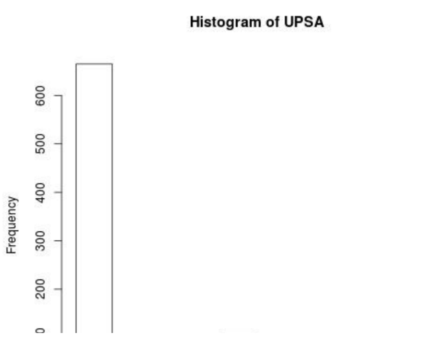


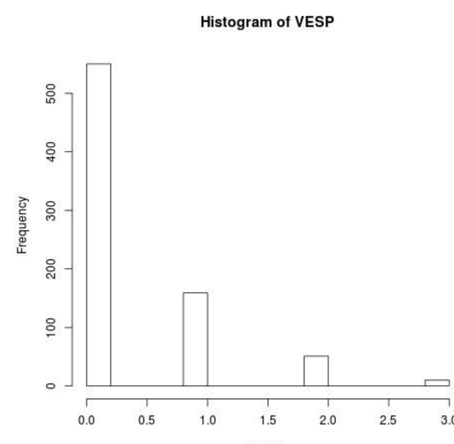

Histogram of HOLA
Frequency
HOLA

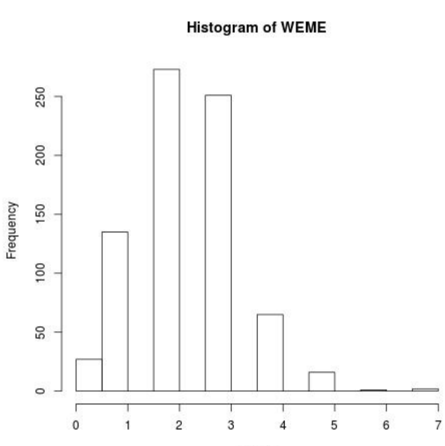

Histogram of LBCU
Frequency
LBCU


Histogram of LKBU
Frequency
LKBU


Histogram of SPPI
Frequency
SPPI

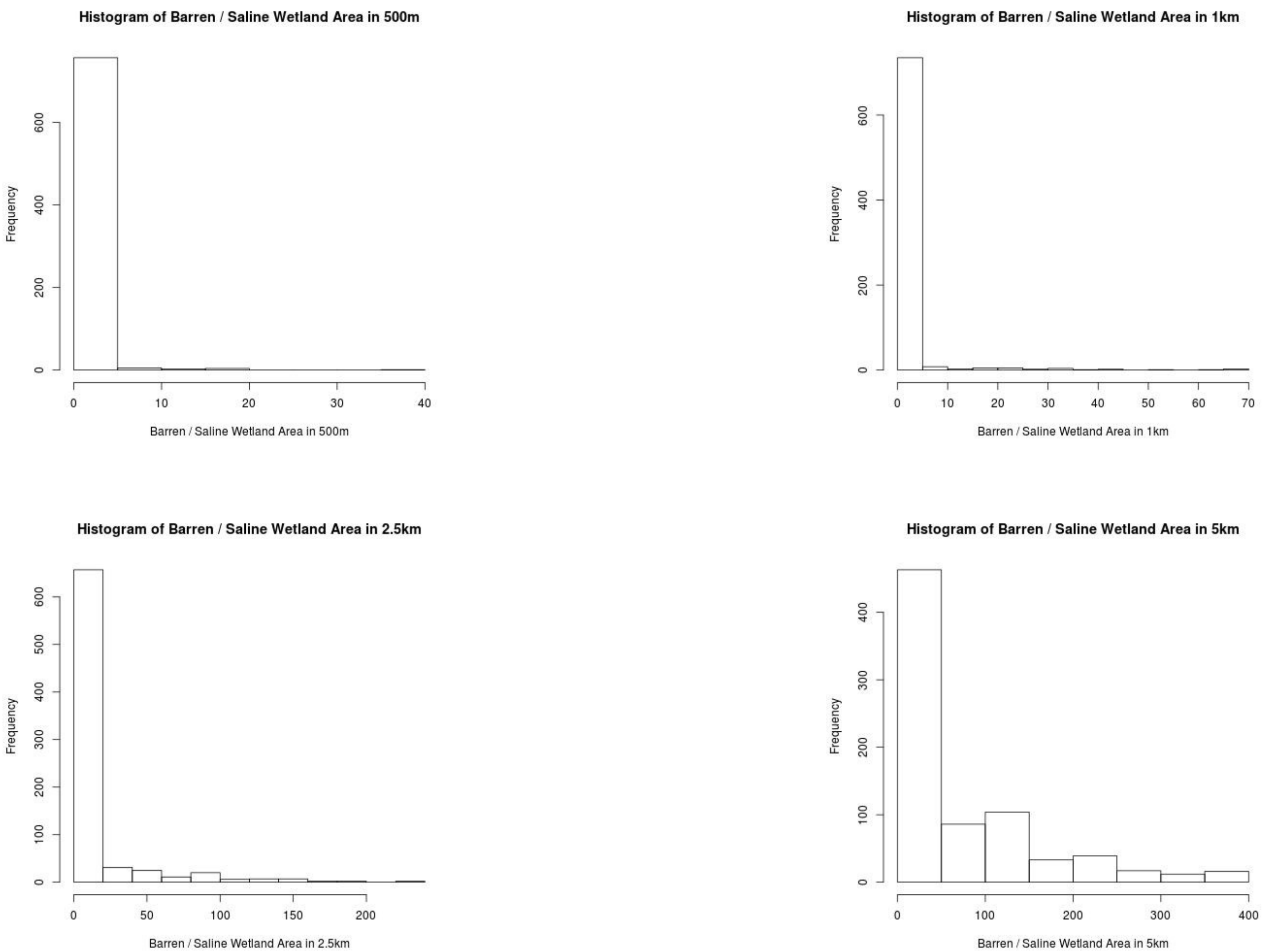

Histogram of UPSA
Frequency

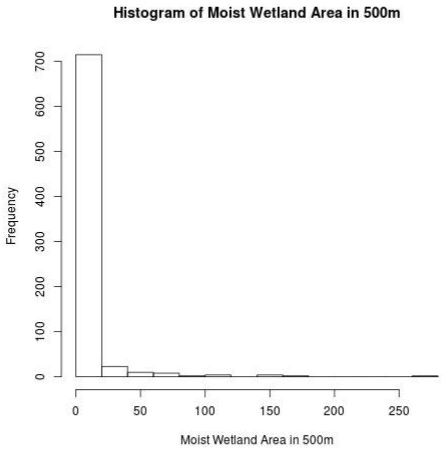

Histogram of VESP
Frequency
VESP

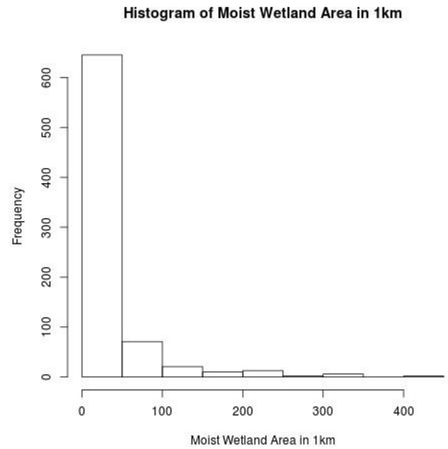

Histogram of WEME
Frequency
WEME

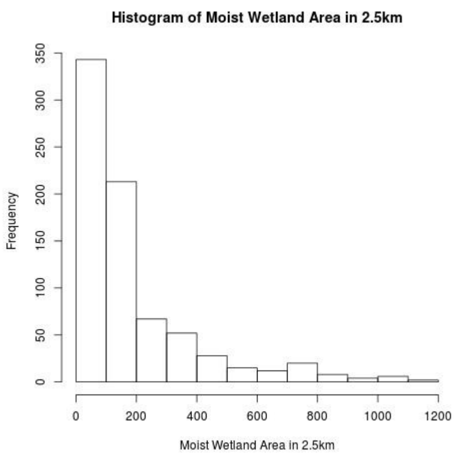
D.2 Predictor Distributions

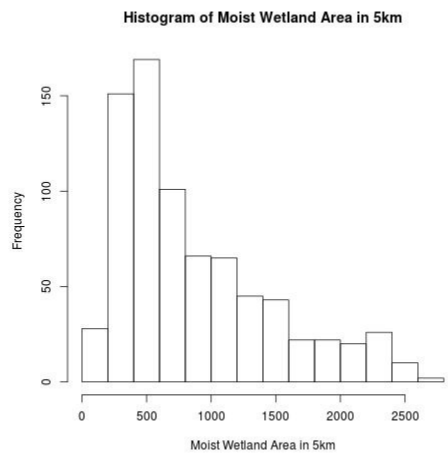
D.2.1 Wetland Area (# of 30m x 30m units) within Distances

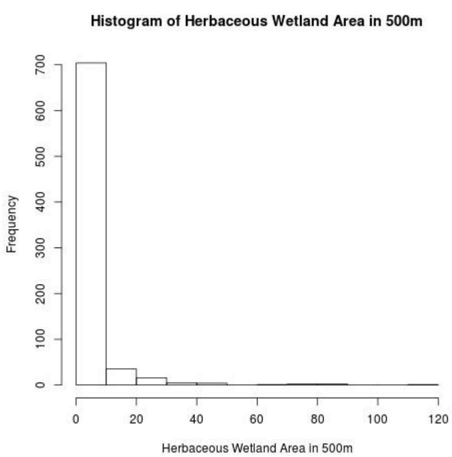


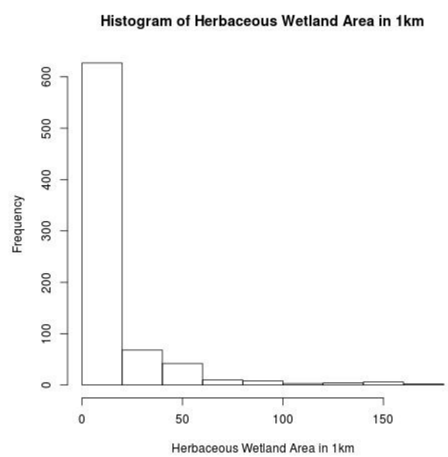

Histogram of Moist Wetland Area in 500m
Frequency
Moist Wetland Area in 500m

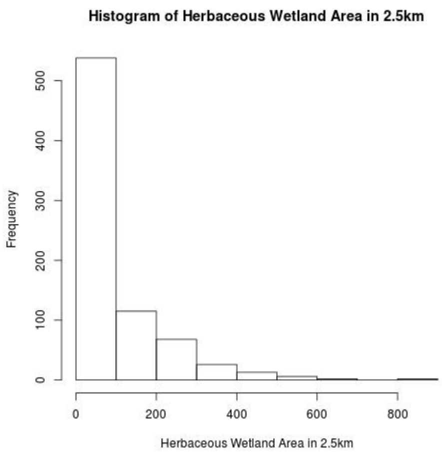

Histogram of Moist Wetland Area in 1km
Frequency
Moist Wetland Area in 1km

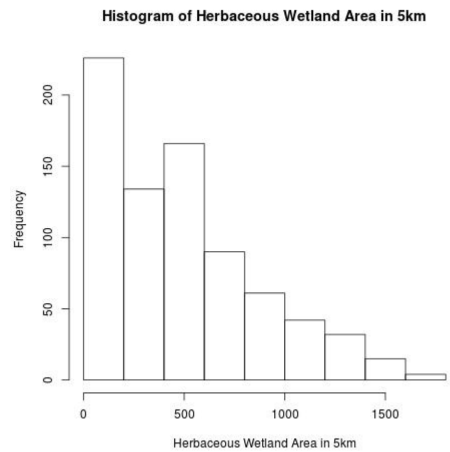

Histogram of Moist Wetland Area in 2.5km
Frequency
Moist Wetland Area in 2.5km

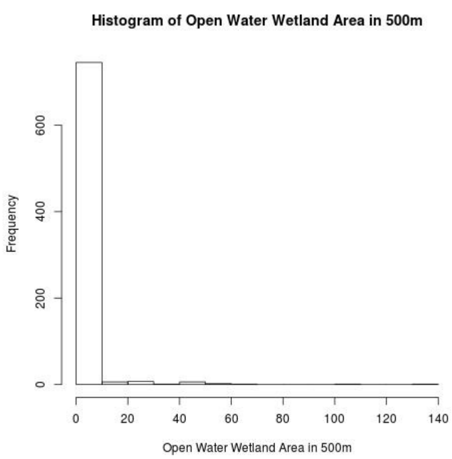

Histogram of Moist Wetland Area in 5km
Frequency
Moist Wetland Area in 5km

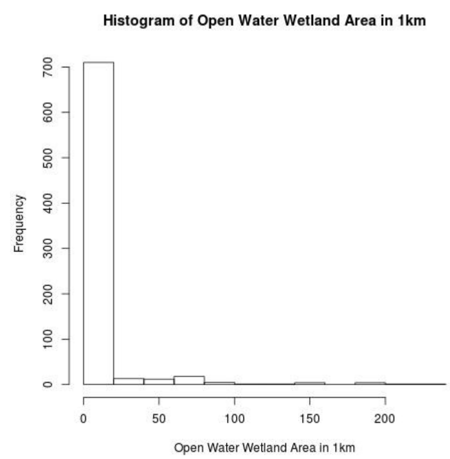

Histogram of Herbaceous Wetland Area in 500m
Frequency
Herbaceous Wetland Area in 500m

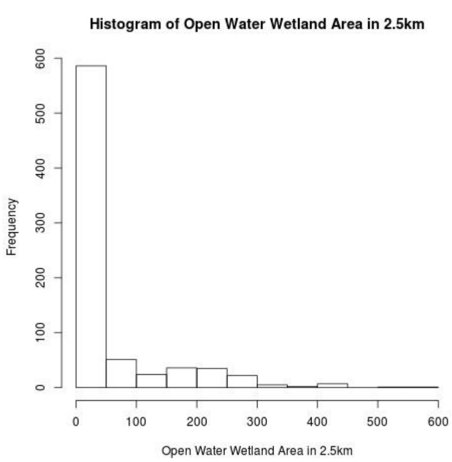

Histogram of Herbaceous Wetland Area in 1km
Frequency
Herbaceous Wetland Area in 1km

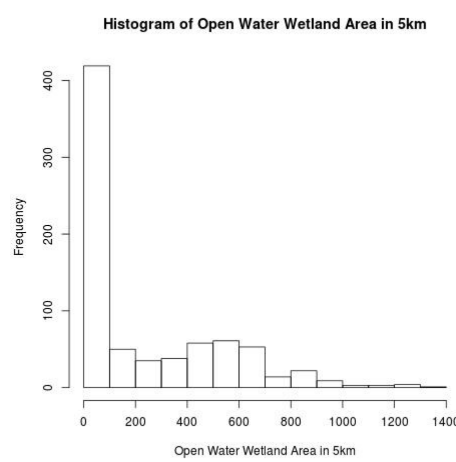

Histogram of Herbaceous Wetland Area in 2.5km
Frequency
0
100
200
300
400
500
0
200
400
600
800
Herbaceous Wetland Area in 2.5km


Histogram of Herbaceous Wetland Area in 5km
Frequency
0
50
100
150
200
0
500
1000
1500
Herbaceous Wetland Area in 5km

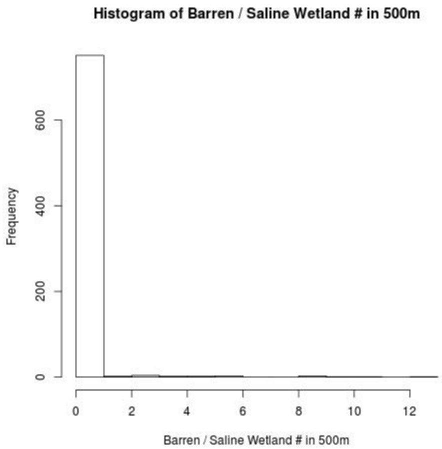

Histogram of Open Water Wetland Area in 500m
Frequency
0
200
400
600
0
20
40
60
80
100
120
140
Open Water Wetland Area in 500m

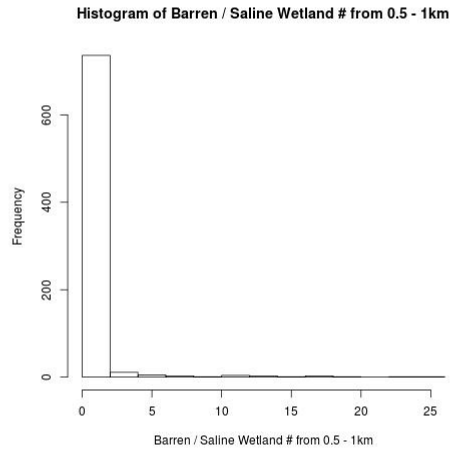

Histogram of Open Water Wetland Area in 1km
Frequency
0
100
200
300
400
500
600
700
0
50
100
150
200
Open Water Wetland Area in 1km

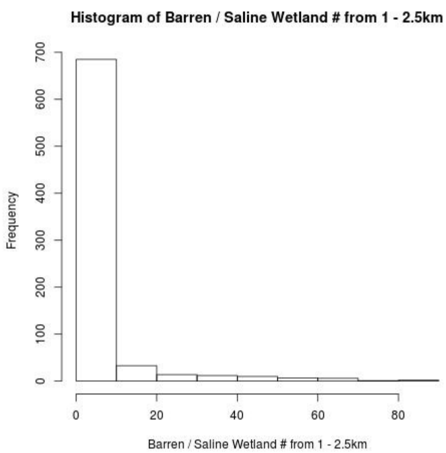

Histogram of Open Water Wetland Area in 2.5km
Frequency
0
100
200
300
400
500
600
0
100
200
300
400
500
600
Open Water Wetland Area in 2.5km

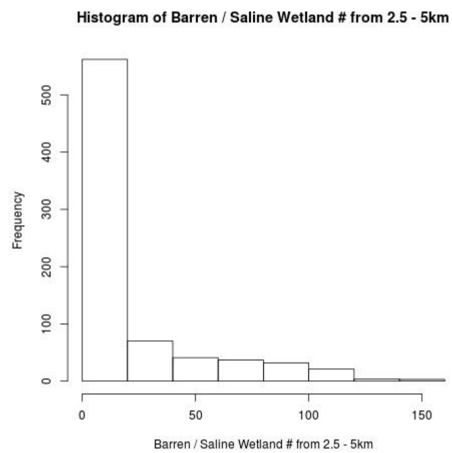

Histogram of Open Water Wetland Area in 5km
Frequency
0
100
200
300
400
0
200
400
600
800
1000
1200
1400
Open Water Wetland Area in 5km

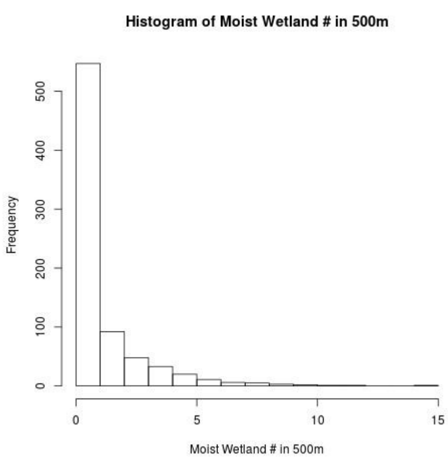
D.2.2 Wetland Number within Distance Ranges

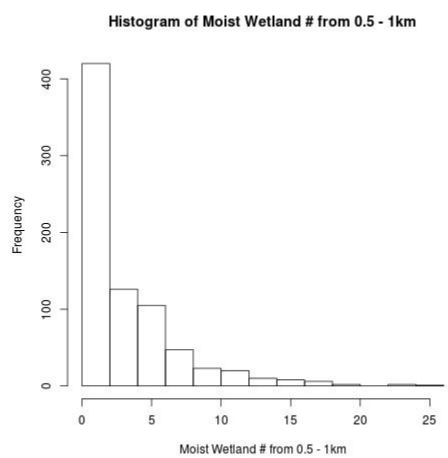


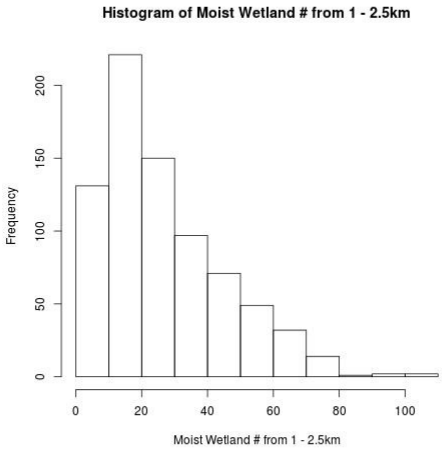


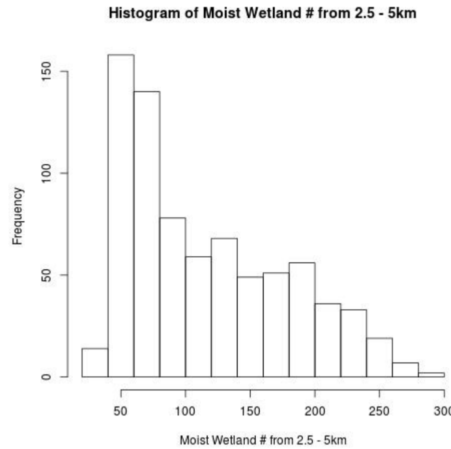


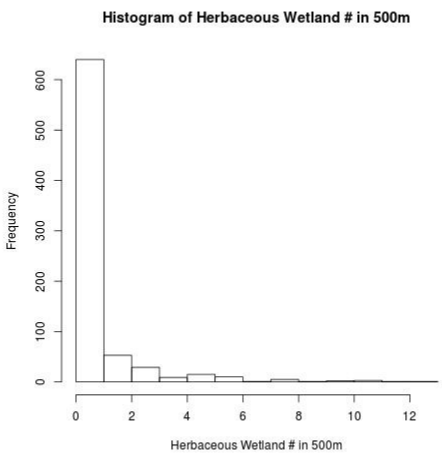


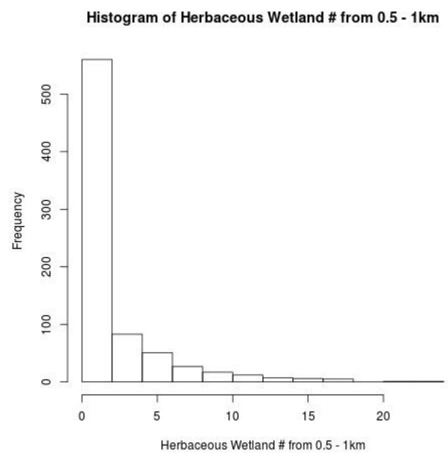


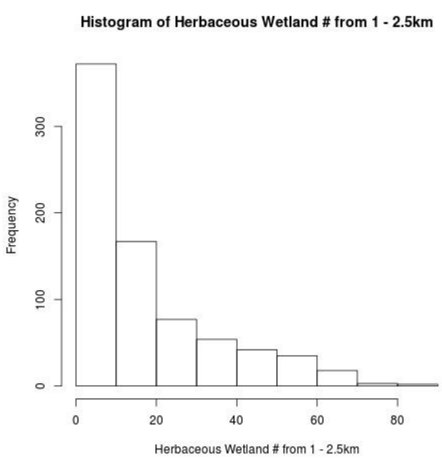


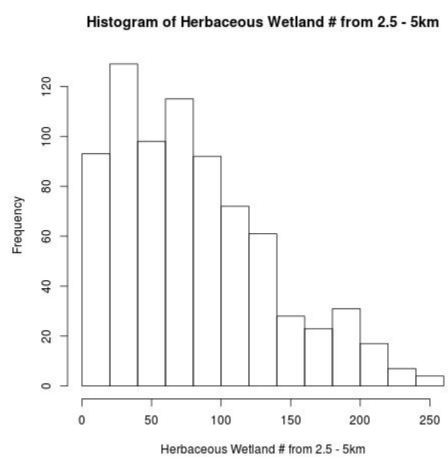

Histogram of Moist Wetland # from 1 - 2.5km
Frequency
0
50
100
150
200
0
20
40
60
80
100
Moist Wetland # from 1 - 2.5km

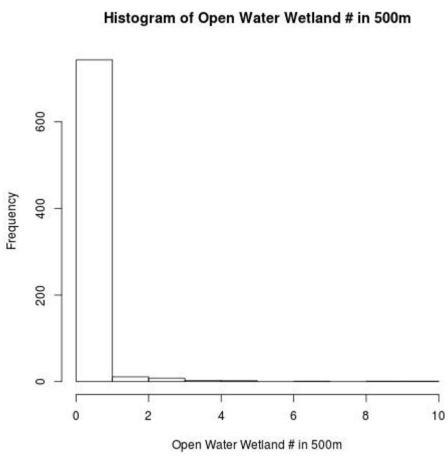

Histogram of Moist Wetland # from 2.5 - 5km
Frequency
0
50
100
150
50
100
150
200
250
300
Moist Wetland # from 2.5 - 5km

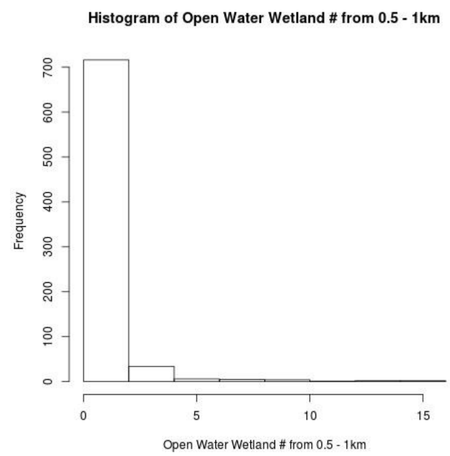

Histogram of Herbaceous Wetland # in 500m
Frequency
0
100
200
300
400
500
600
0
2
4
6
8
10
12
Herbaceous Wetland # in 500m

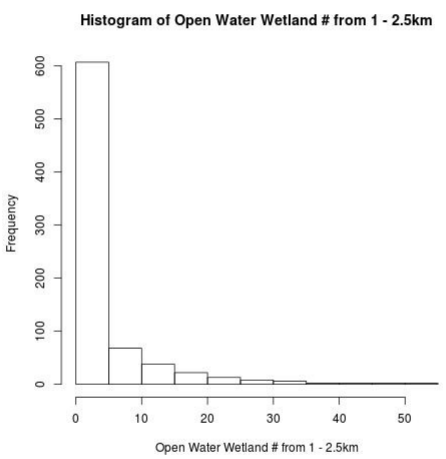

Histogram of Herbaceous Wetland # from 0.5 - 1km
Frequency
0
100
200
300
400
500
0
5
10
15
20
Herbaceous Wetland # from 0.5 - 1km

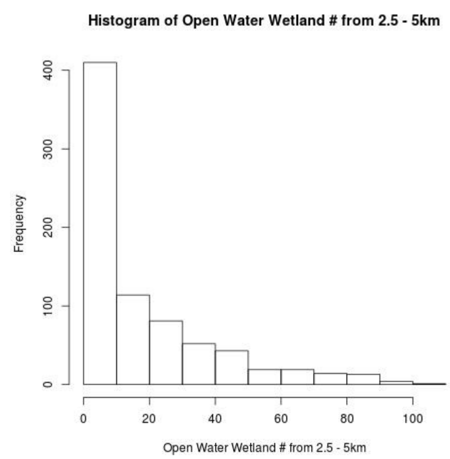

Histogram of Herbaceous Wetland # from 1 - 2.5km
Frequency
0
100
200
300
0
20
40
60
80
Herbaceous Wetland # from 1 - 2.5km


Histogram of Herbaceous Wetland # from 2.5 - 5km
Frequency
0
20
40
60
80
100
120
0
50
100
150
200
250
Herbaceous Wetland # from 2.5 - 5km

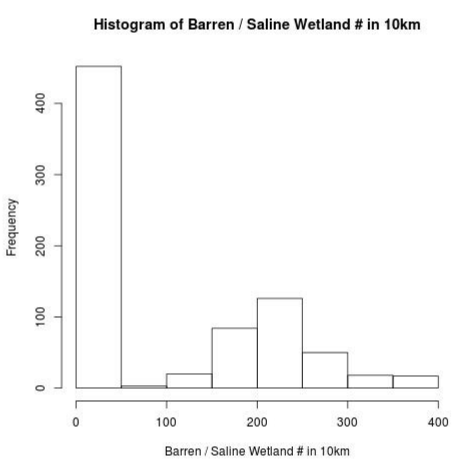


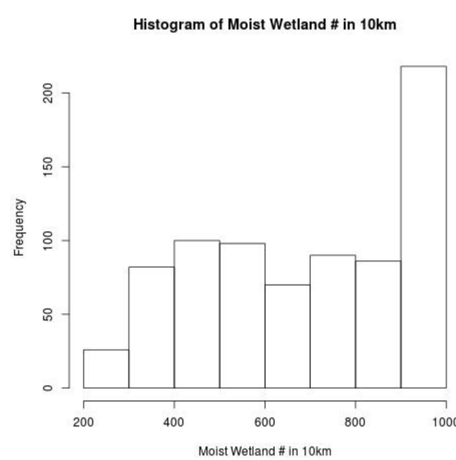


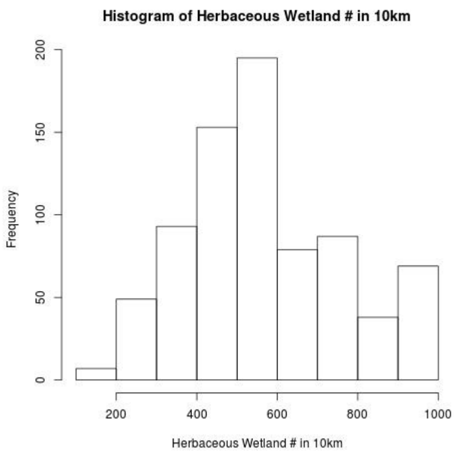


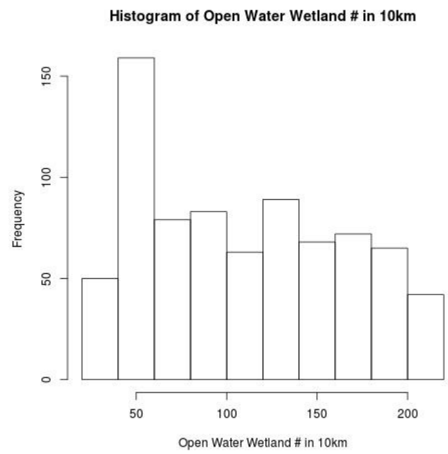


D.2.3 Wetland Number within 10 km

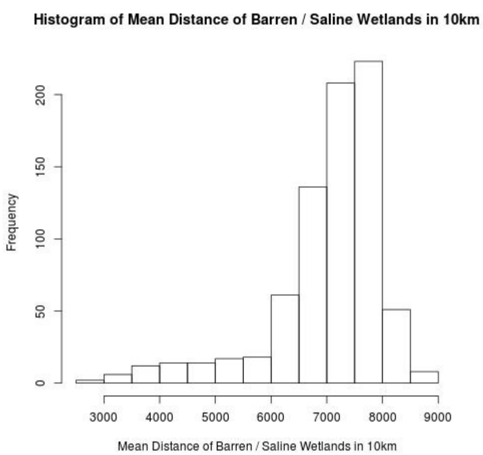


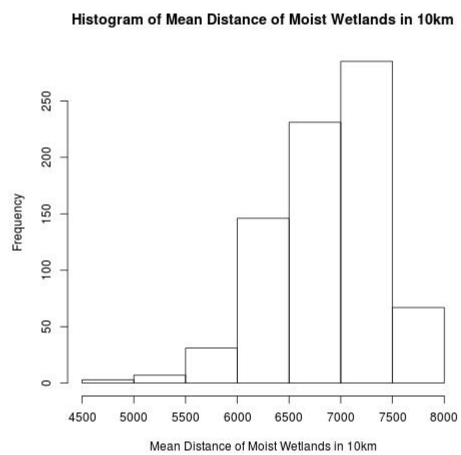


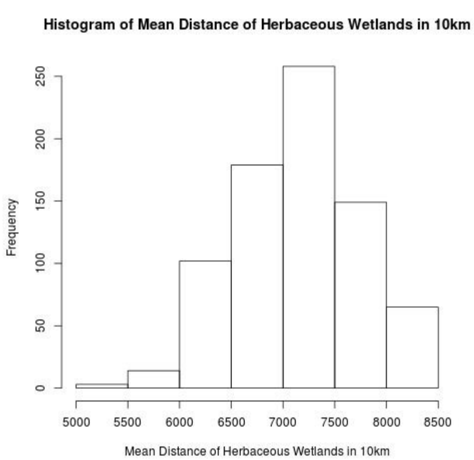


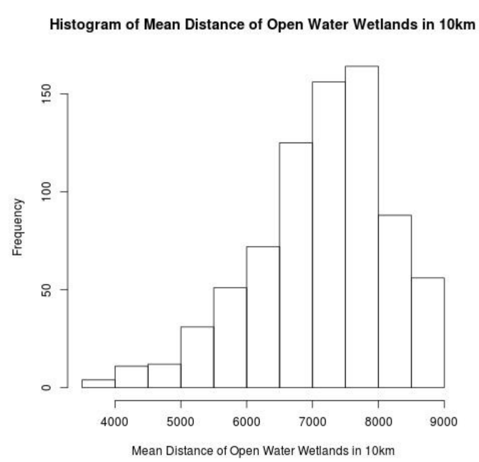


D.2.4 Wetland Mean Distances within 10 km



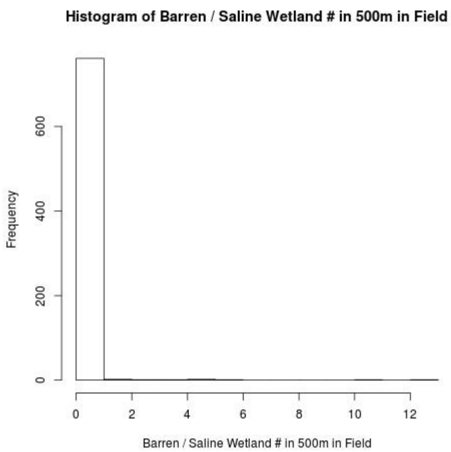


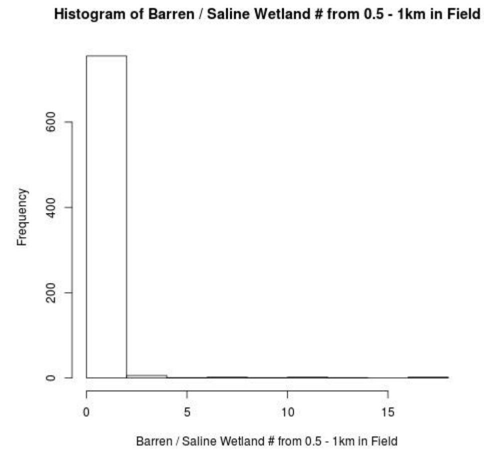


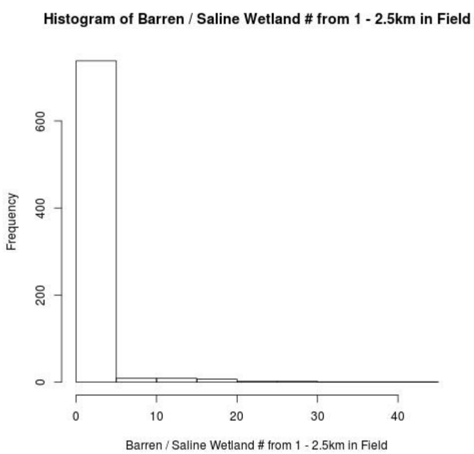


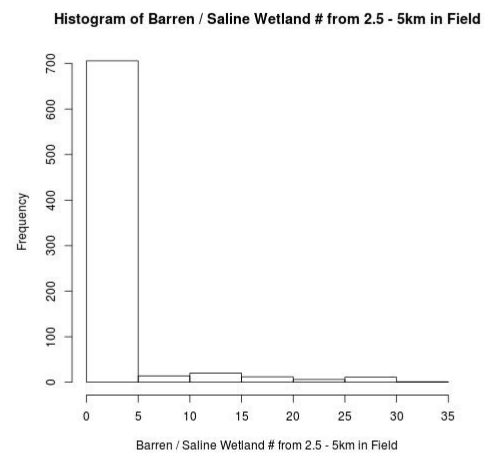
D.2.5 Wetland Number

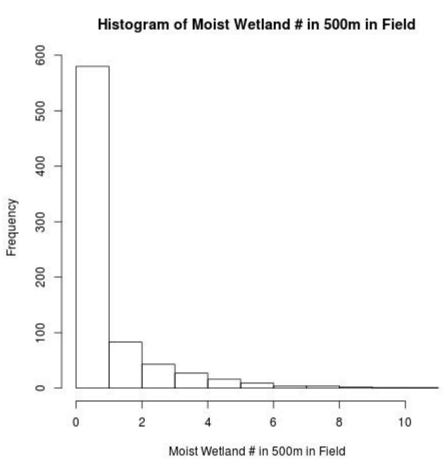
within Distance Ranges in Field

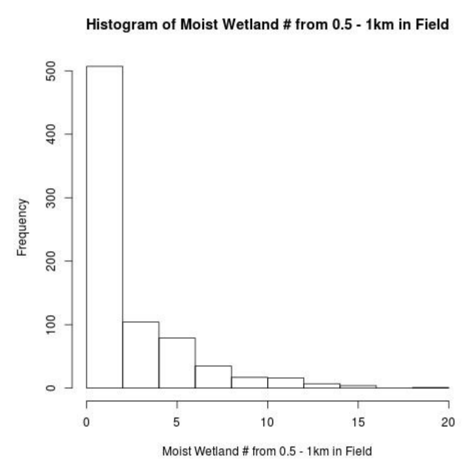


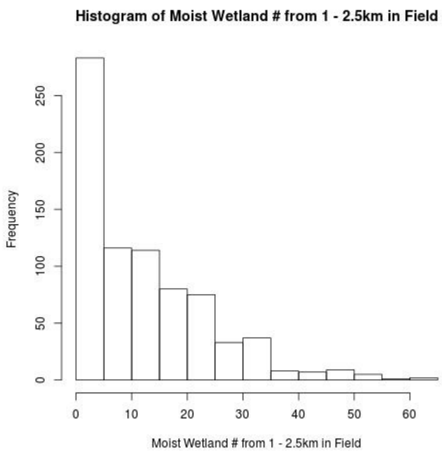


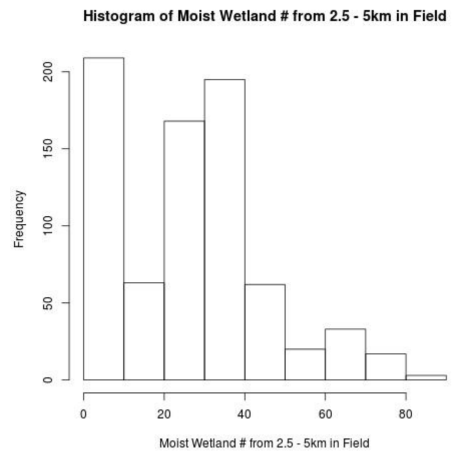


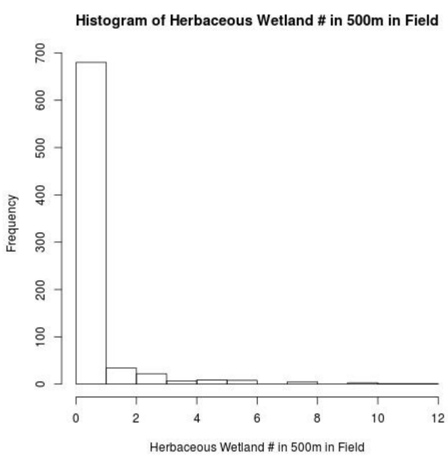


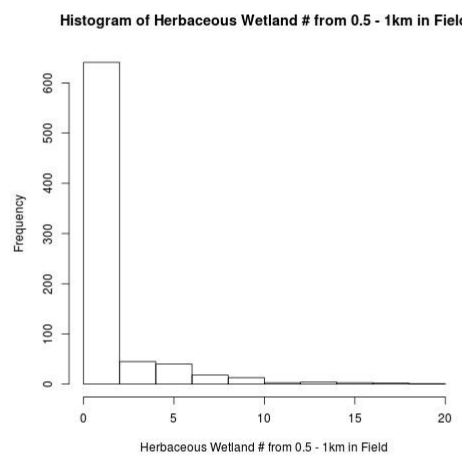


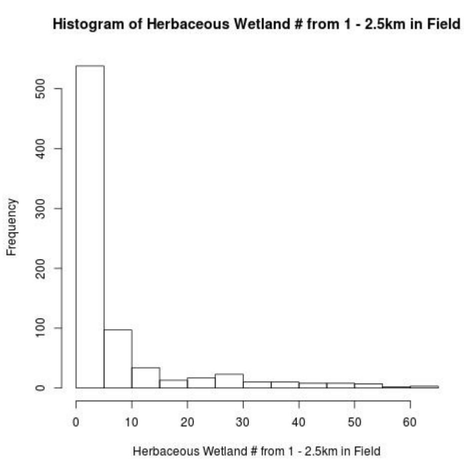


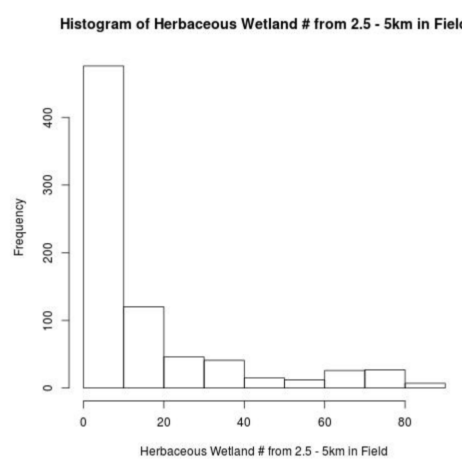

Histogram of Moist Wetland # from 1 - 2.5km in Field
Frequency
Moist Wetland # from 1 - 2.5km in Field

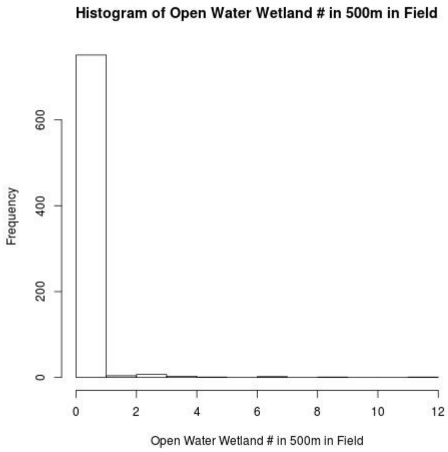

Histogram of Moist Wetland # from 2.5 - 5km in Field
Frequency
Moist Wetland # from 2.5 - 5km in Field

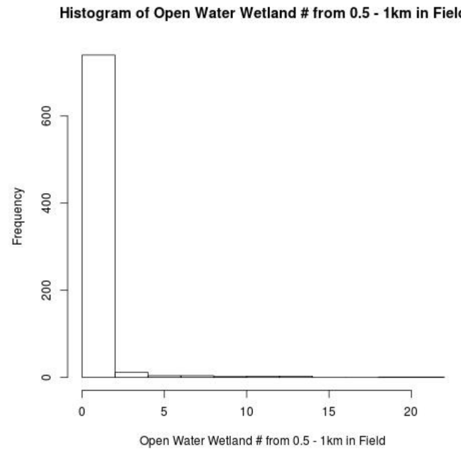

Histogram of Herbaceous Wetland # in 500m in Field
Frequency
Herbaceous Wetland # in 500m in Field

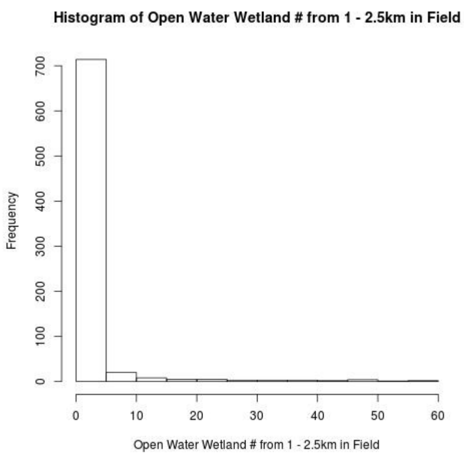

Histogram of Herbaceous Wetland # from 0.5 - 1km in Field
Frequency
Herbaceous Wetland # from 0.5 - 1km in Field

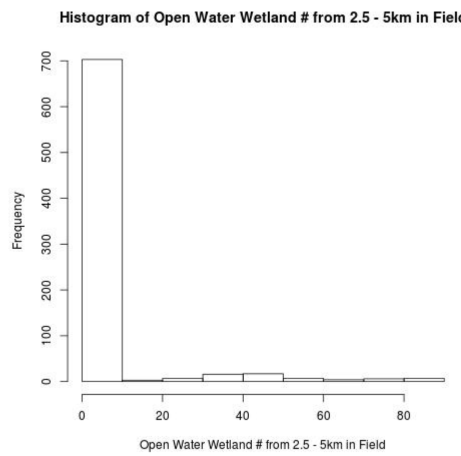

Histogram of Herbaceous Wetland # from 1 - 2.5km in Field
Frequency
Herbaceous Wetland # from 1 - 2.5km in Field


Histogram of Herbaceous Wetland # from 2.5 - 5km in Field
Frequency
Herbaceous Wetland # from 2.5 - 5km in Field

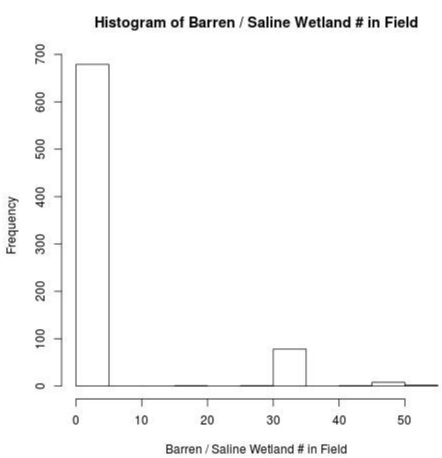


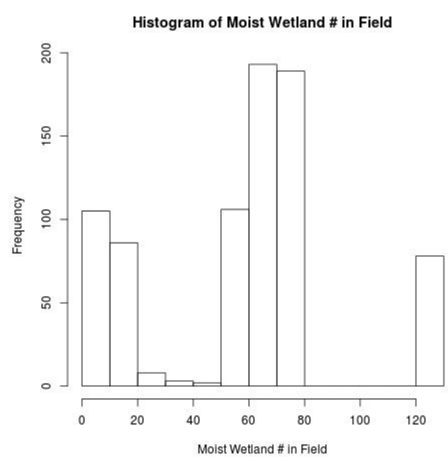


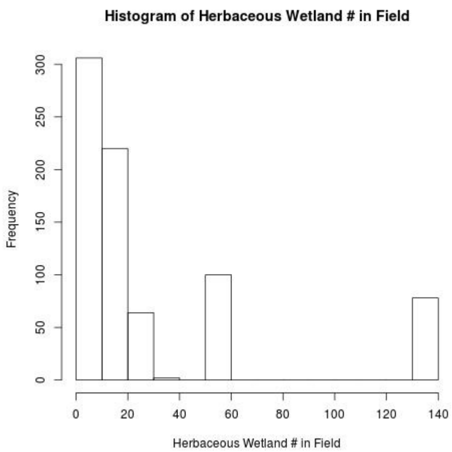


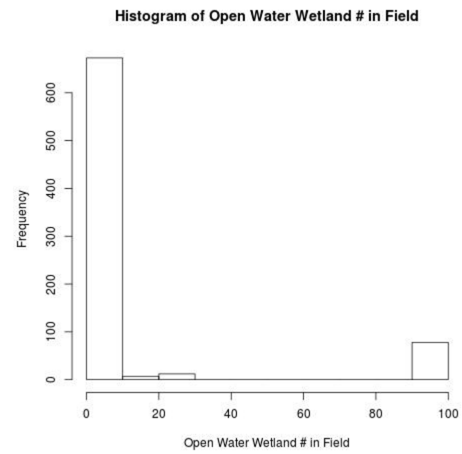


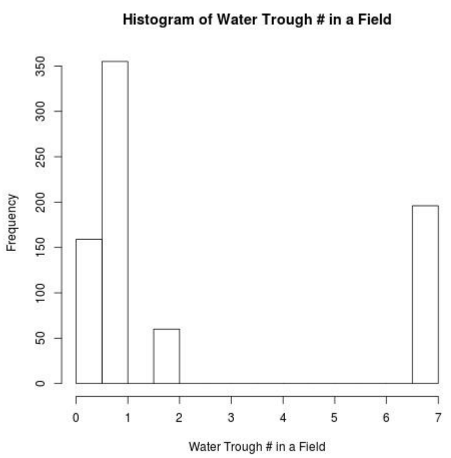
D.2.6 Wetland Number in Field

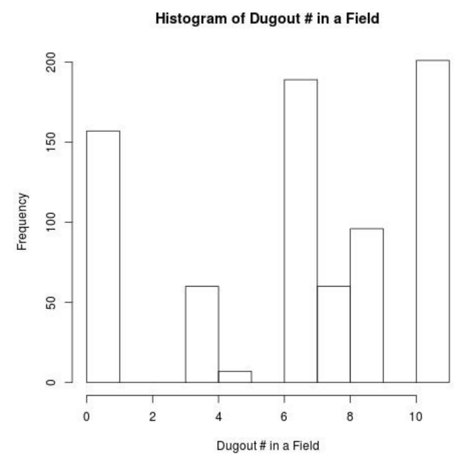




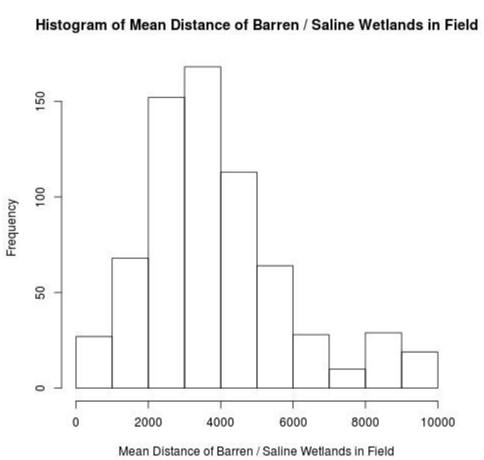


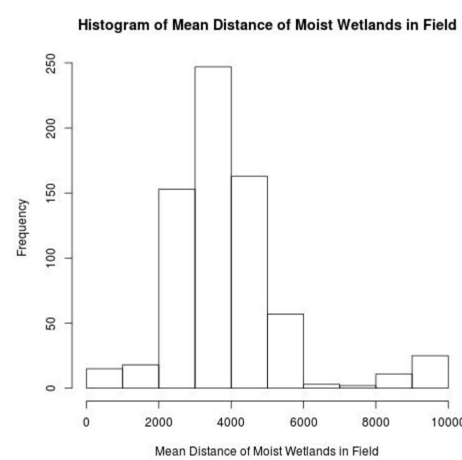


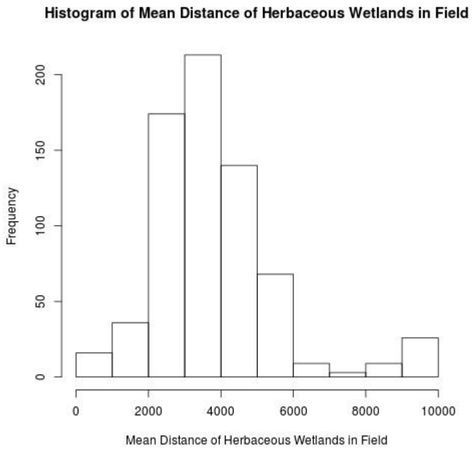


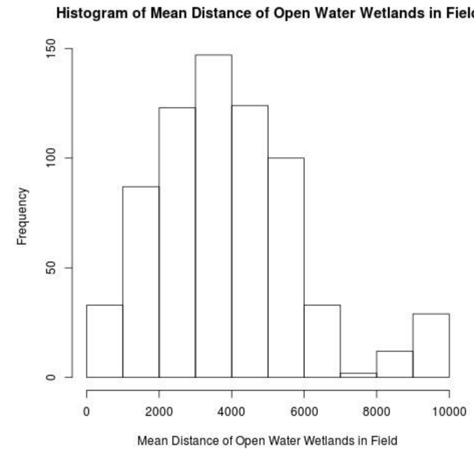


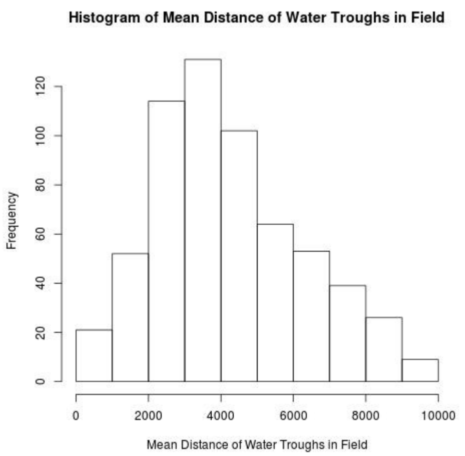
D.2.7 Wetland Distance in Field

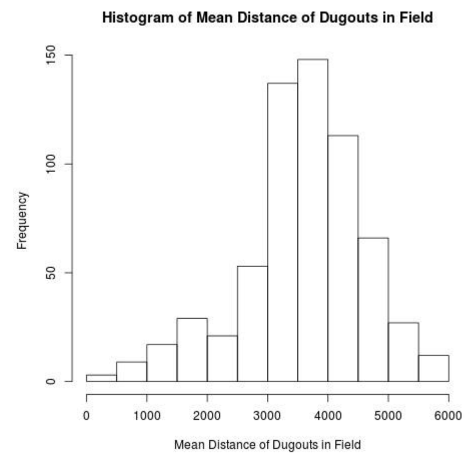




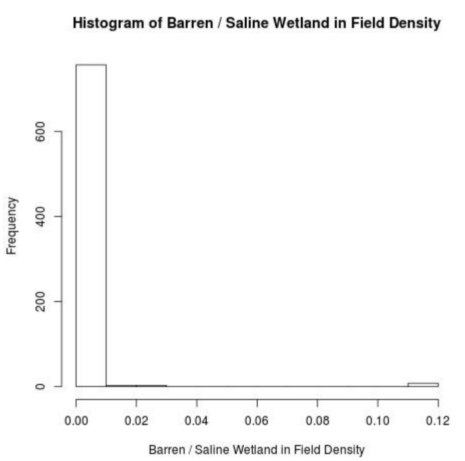


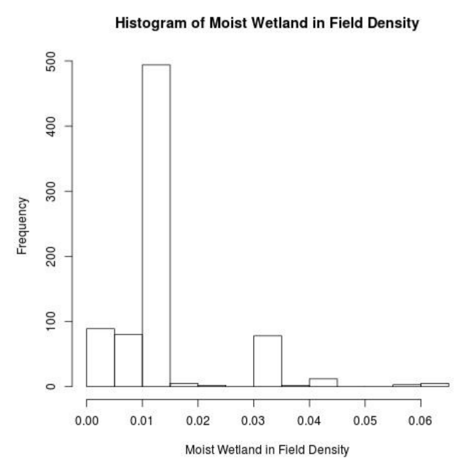


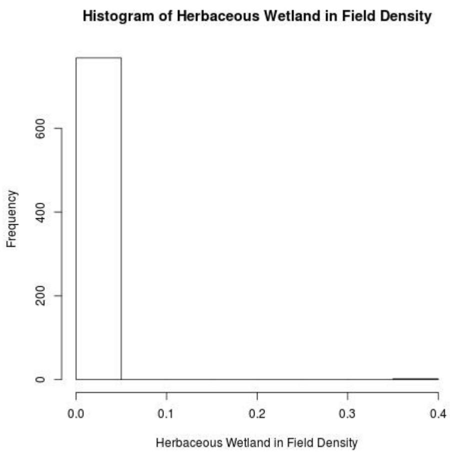


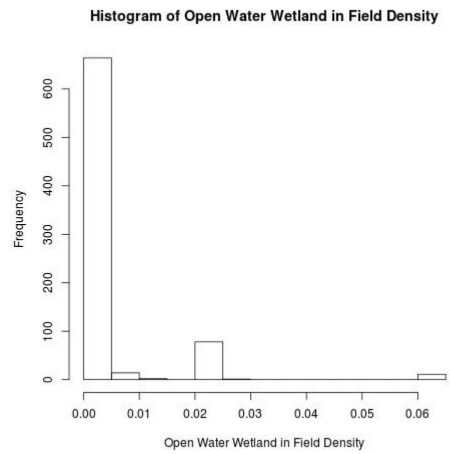


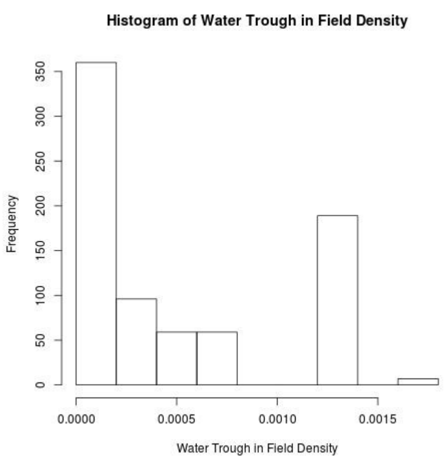
D.2.8 In Field Wetland Density

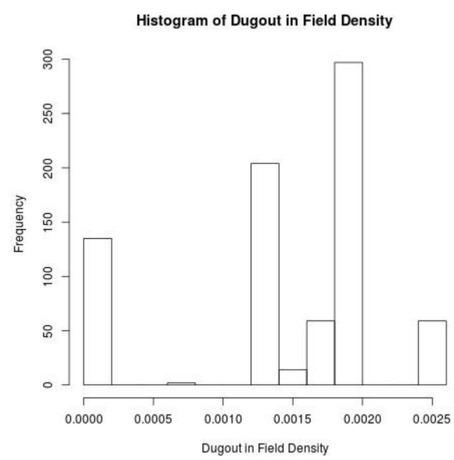




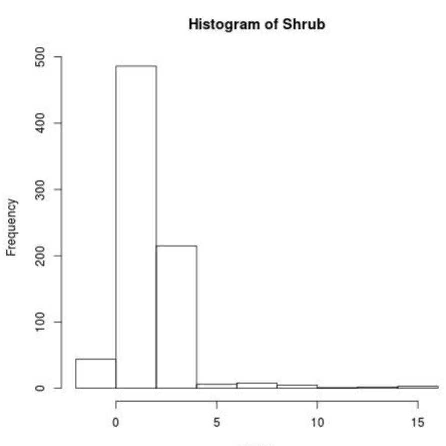


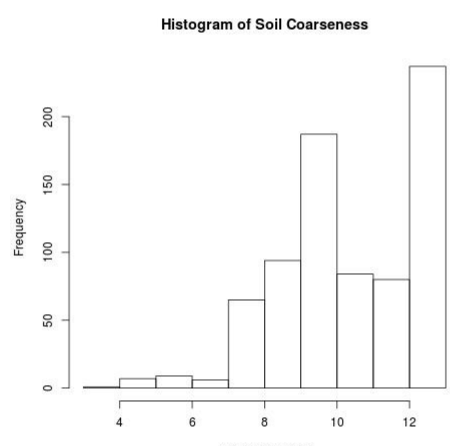


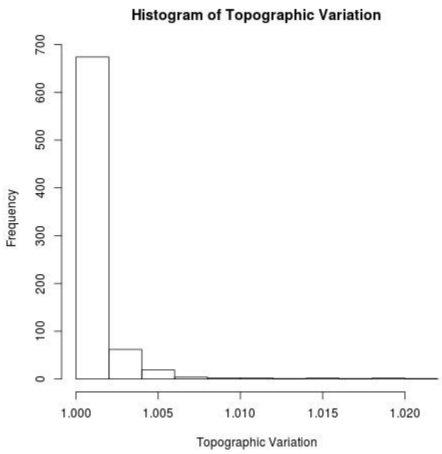


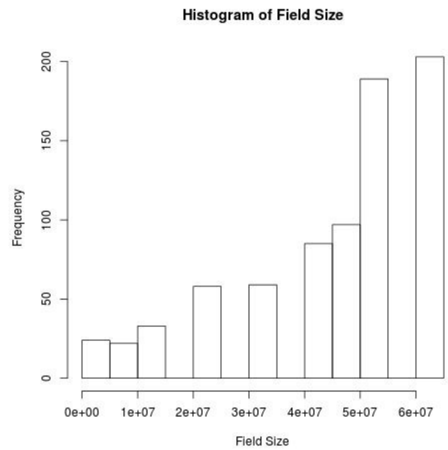


D.2.9 Other Measures

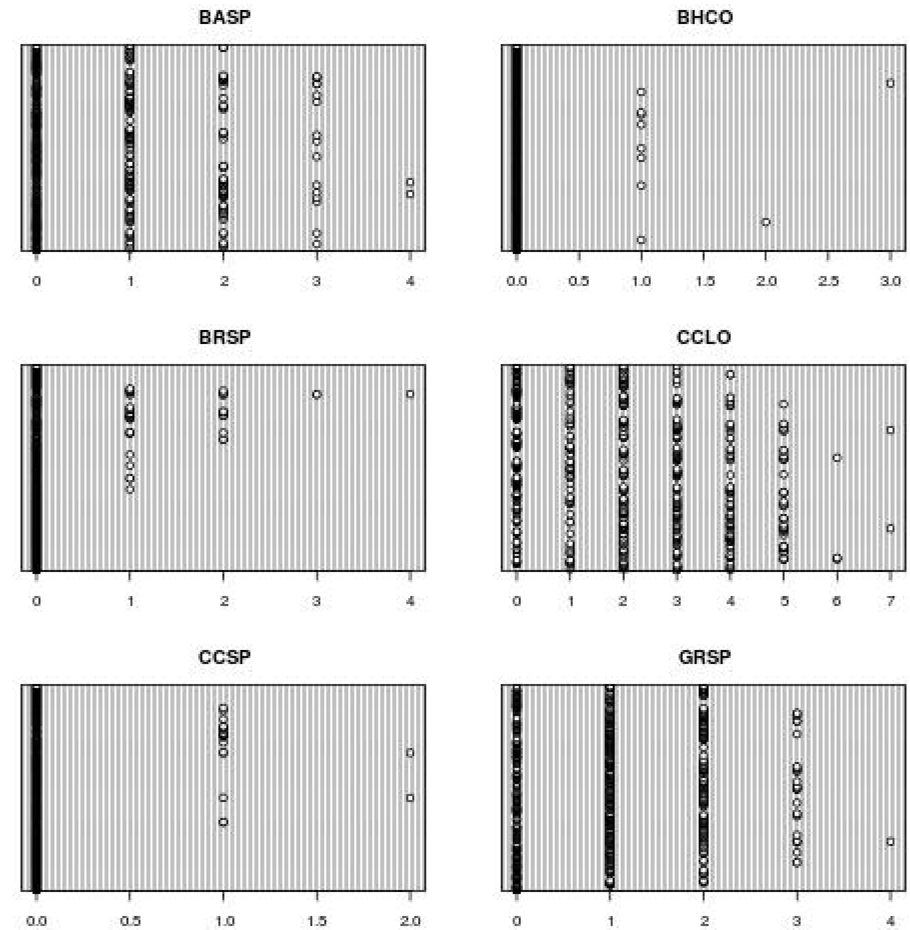


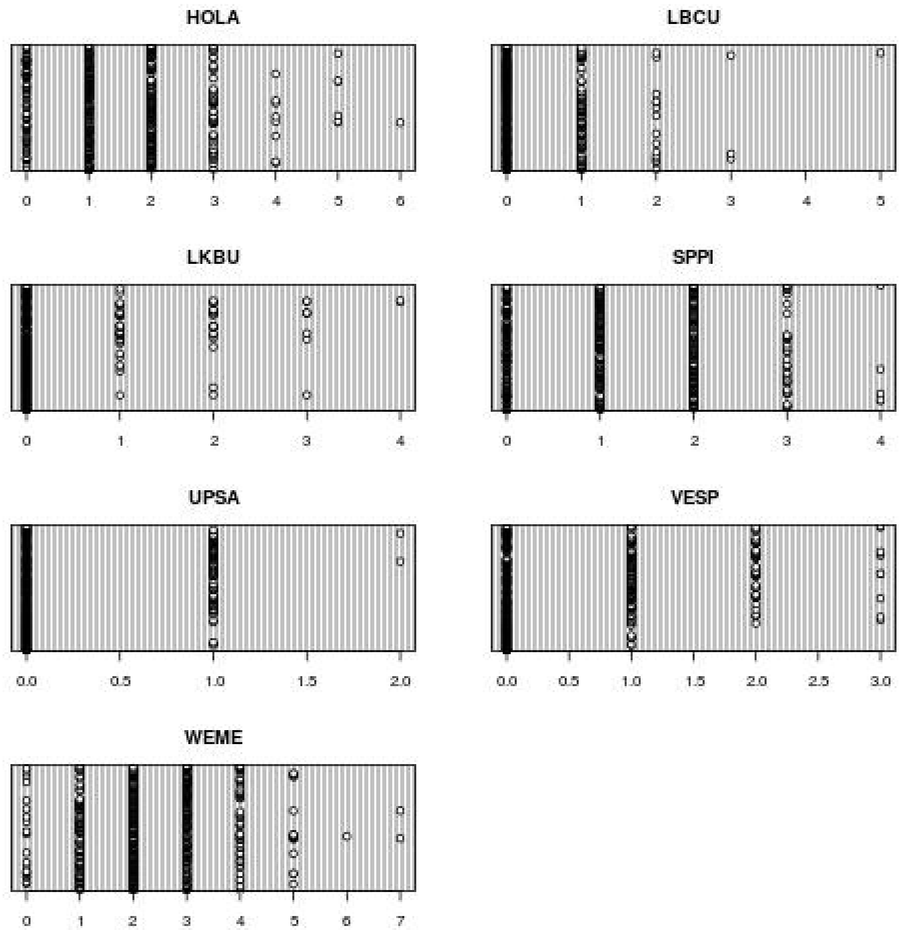



Histogram of Topographic Variation
Frequency
0
100
200
300
400
500
600
700
1.000
1.005
1.010
1.015
1.020
Topographic Variation


Histogram of Field Size
Frequency
0
50
100
150
200
0e+00
1e+07
2e+07
3e+07
4e+07
5e+07
6e+07
Field Size

D.3 Species Outlier Detection Graphs (dot charts)

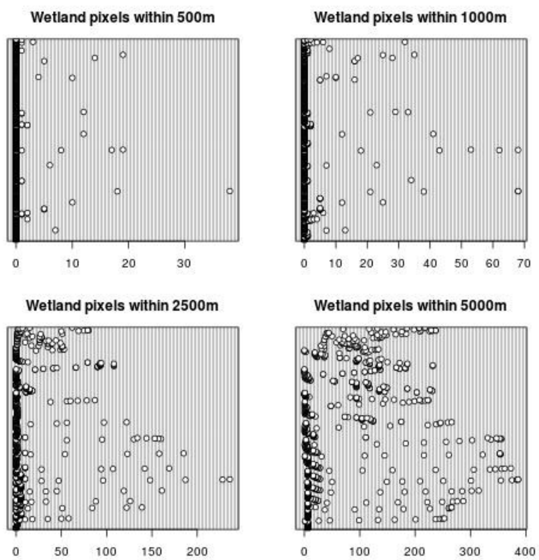



HOLA
0 1 2 3 4 5 6
LBCU
0 1 2 3 4 5
LKBU
0 1 2 3 4
SPPI
0 1 2 3 4
UPSA
0.0 0.5 1.0 1.5 2.0
VESP
0.0 0.5 1.0 1.5 2.0 2.5 3.0
WEME
0 1 2 3 4 5 6 7

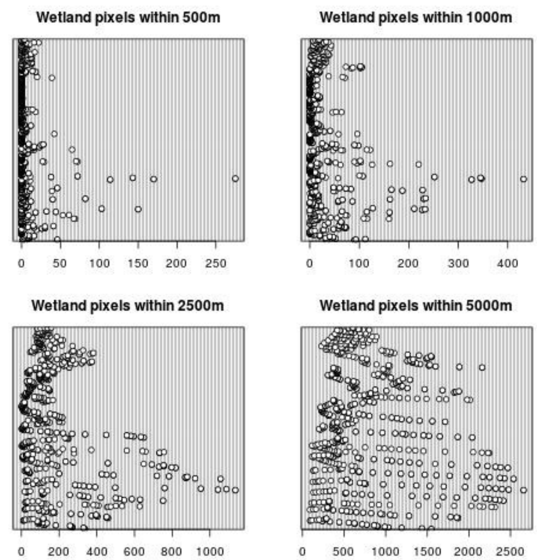
D.4 Predictor Outlier Detection Graphs (dot charts)

D.4.1 Wetland Area (# of 30 x 30 pixels) within Distances

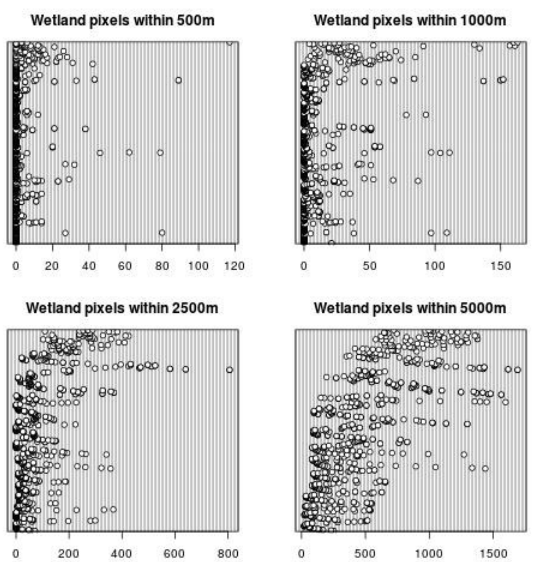
Barren / Saline Wetlands



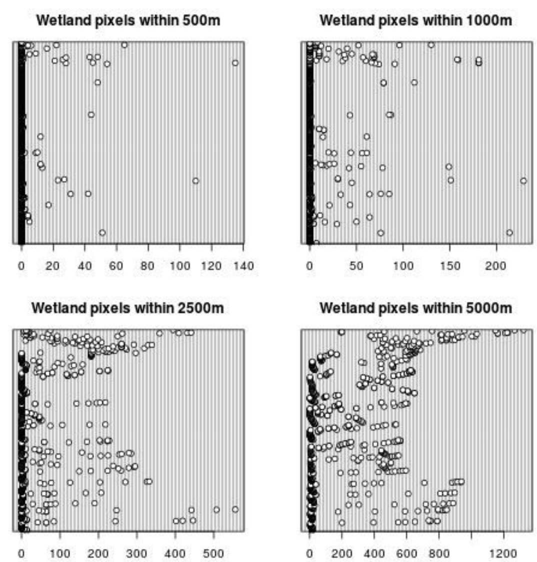
Moist Wetlands



Herbaceous Wetlands

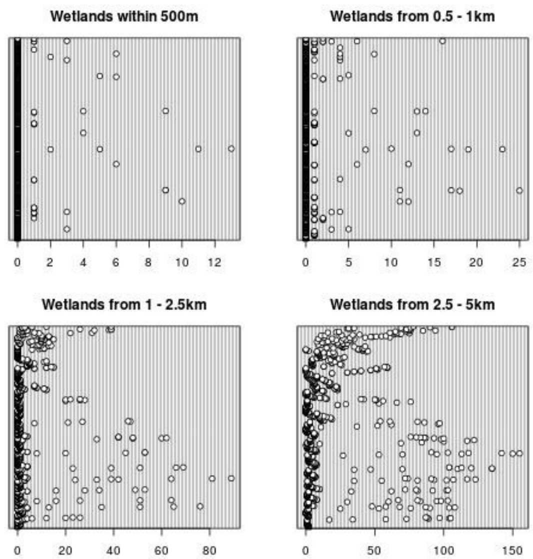


Open Water Wetlands

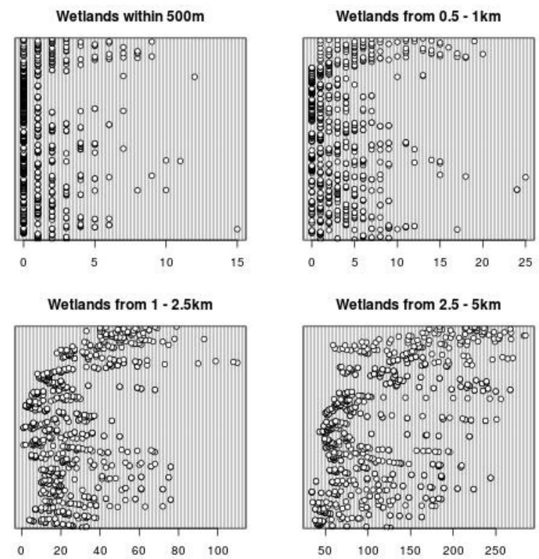


D.4.2 Wetland Number within Distance Ranges

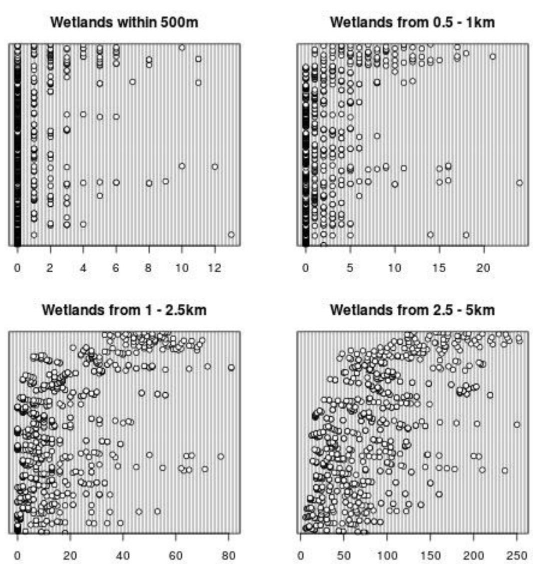
Barren / Saline Wetlands



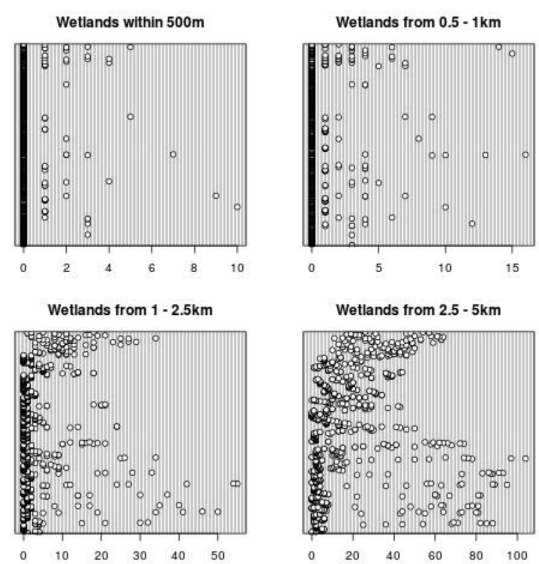
Moist Wetlands



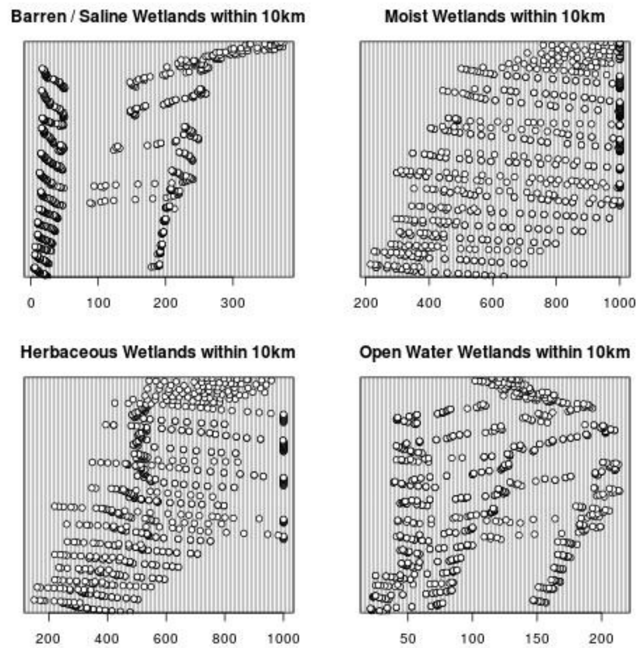
Herbaceous Wetlands



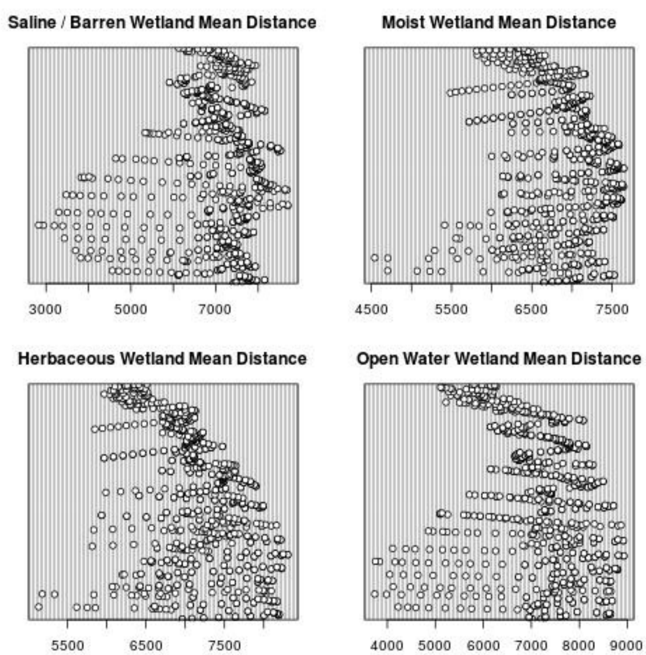
Open Water Wetlands



D.4.3 Wetland Number within 10 km

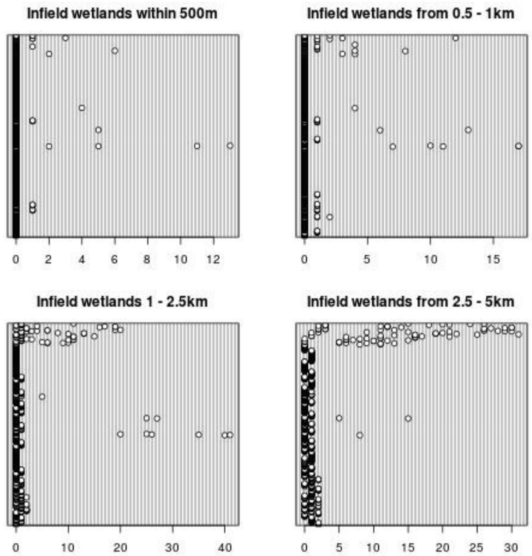


D.4.4 Mean Wetland Distances within 10km

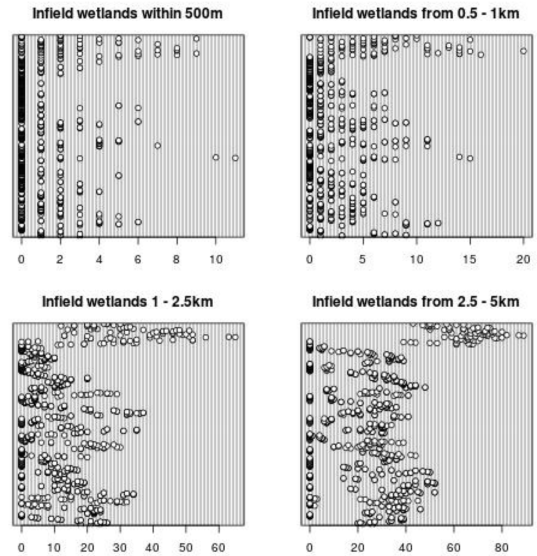


D.4.5 Wetland Number within Distance Ranges in Field

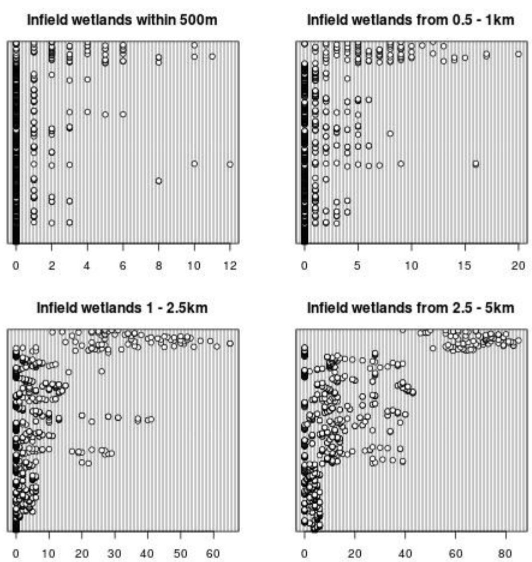
Barren / Saline Wetlands



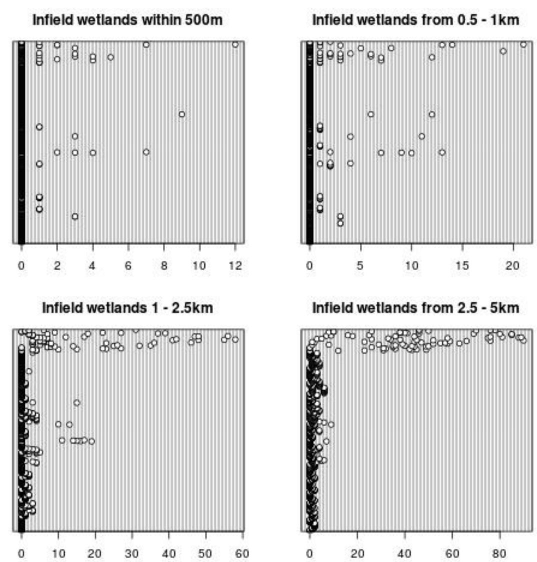
Moist Wetlands



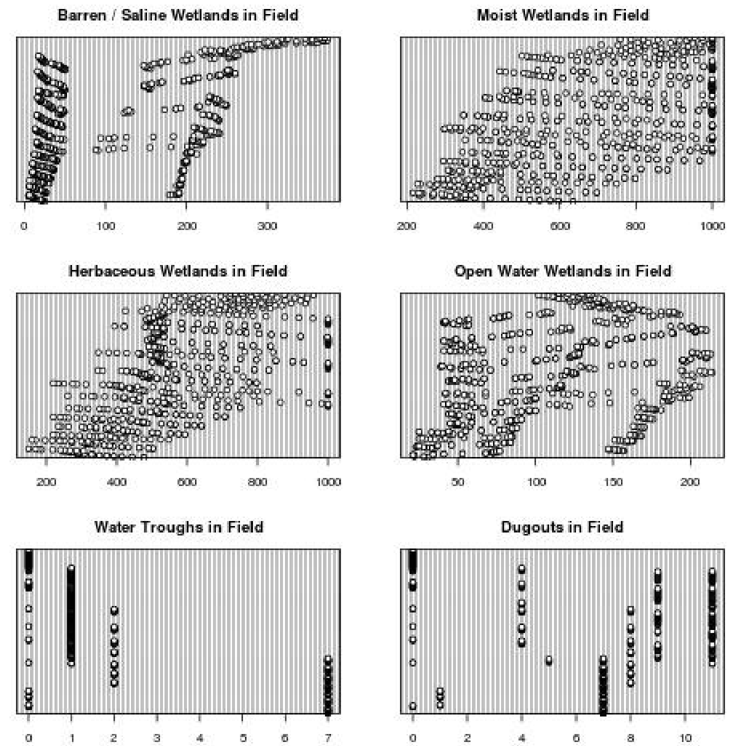
Herbaceous Wetlands



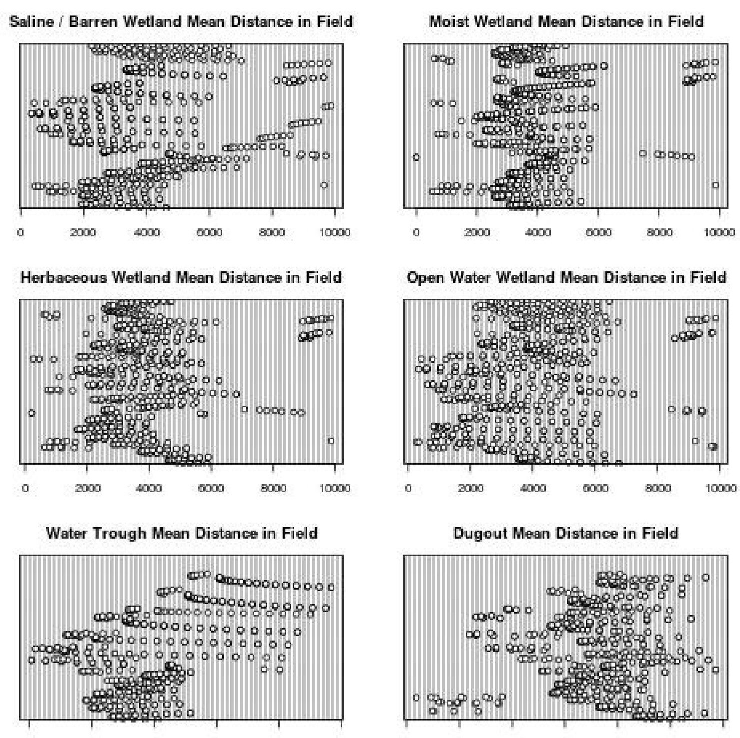
Open Water Wetlands



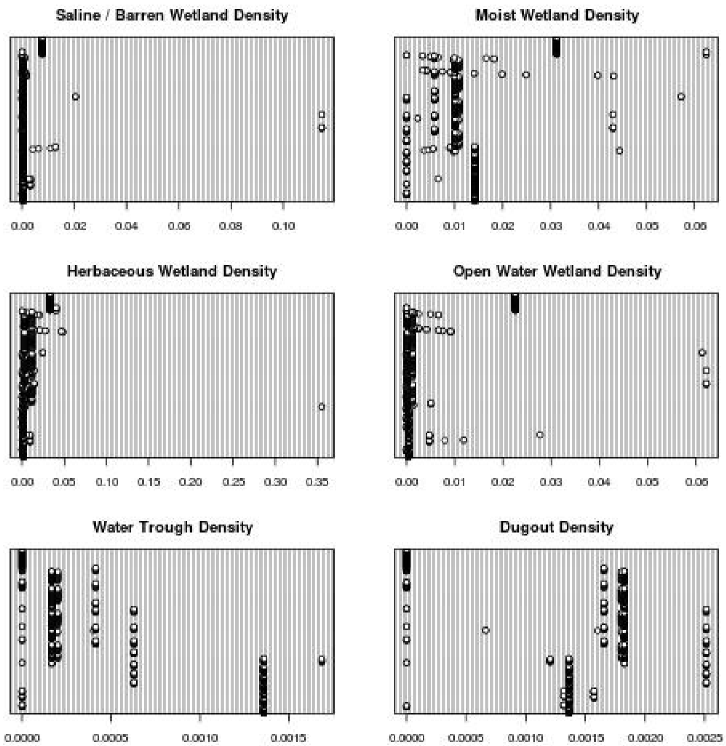
D.4.6 Wetland Number in Field



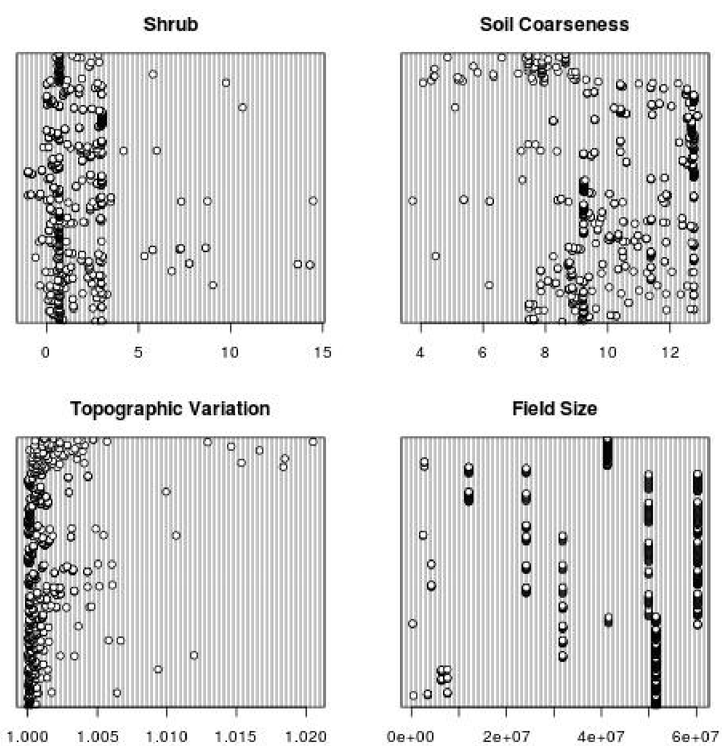
D.4.7 Wetland Distance in Field



D.4.8 In Field Wetland Density



D.4.9 Other Measures



Appendix E – Wetland Non-

parametric Results

Table E.1: Baird's Sparrow abundance correlation to wetland predictors*

Measure	tau, p value	Measure	tau, p value	Measure	tau, p value
cws_shrub	**-0.145; <0.001**	mrps	**0.117; <0.001**	topo	**-0.137; <0.001**
wet1_500kd	-0.047; 0.173	wet1_1000kd	**-0.108; 0.001**	wet1_2500kd	0.004; 0.903
wet1_5000kd	0.039; 0.178	wet2_500kd	-0.059; 0.060	wet2_1000kd	**-0.083; 0.005**
wet2_2500kd	0.015; 0.594	wet2_5000kd	0.017; 0.554	wet3_500kd	0.019; 0.561
wet3_1000kd	0.016; 0.592	wet3_2500kd	0.050; 0.079	wet3_5000kd	**0.078; 0.007**
wet4_500kd	-0.045; 0.185	wet4_1000kd	**-0.089; 0.007**	wet4_2500kd	0.007; 0.813
wet4_5000kd	0.007; 0.817	wet1_500_cnt	-0.056; 0.107	wet1_1000_cnt	**-0.116; <0.001**
wet1_2500_cnt	-0.000; 0.996	wet1_5000_cnt	0.020; 0.488	wet2_500_cnt	-0.065; 0.043
wet2_1000_cnt	**-0.080; 0.008**	wet2_2500_cnt	0.046; 0.107	wet2_5000_cnt	**0.138; <0.001**
wet3_500_cnt	0.026; 0.430	wet3_1000_cnt	0.017; 0.578	wet3_2500_cnt	**0.103; <0.001**
wet3_5000_cnt	**0.119; <0.001**	wet4_500_cnt	-0.055; 0.113	wet4_1000_cnt	**-0.101; 0.003**
wet4_2500_cnt	0.010; 0.747	wet4_5000_cnt	-0.027; 0.354	wet1_all_cnt	0.021; 0.453
wet2_all_cnt	**0.177; <0.001**	wet3_all_cnt	**0.177; <0.001**	wet4_all_cnt	0.012; 0.662
field_size	0.063; 0.039	tro_all_cnt	**0.097; 0.003**	dug_all_cnt	**0.114; <0.001**
wet1_all_xd	**0.083; 0.004**	wet2_all_xd	-0.040; 0.158	wet3_all_xd	-0.029; 0.303
wet4_all_xd	**0.100; <0.001**	tro_all_xd	**0.115; <0.001**	dug_all_xd	0.042; 0.175
wet1_500_if_cnt	-0.038; 0.270	wet1_1000_if_cnt	-0.079; 0.022	wet1_2500_if_cnt	-0.037; 0.277
wet1_5000_if_cnt	0.024; 0.460	wet2_500_if_cnt	-0.079; 0.015	wet2_1000_if_cnt	**-0.077; 0.012**
wet2_2500_if_cnt	-0.005; 0.874	wet2_5000_if_cnt	**0.097; <0.001**	wet3_500_if_cnt	0.003; 0.925
wet3_1000_if_cnt	0.018; 0.588	wet3_2500_if_cnt	**0.100; <0.001**	wet3_5000_if_cnt	**0.096; 0.001**
wet4_500_if_cnt	-0.063; 0.066	wet4_1000_if_cnt	-0.069; 0.042	wet4_2500_if_cnt	-0.018; 0.574
wet4_5000_if_cnt	**0.127; <0.001**	wet1_all_if_xd	0.010; 0.729	wet2_all_if_xd	**0.082; 0.006**
wet3_all_if_xd	-0.009; 0.770	wet4_all_if_xd	0.010; 0.749	wet1_if_density	0.034; 0.264
wet2_if_density	0.040; 0.197	wet3_if_density	0.038; 0.209	wet4_if_density	0.006; 0.850

*Kendall's Rank Correlation Test. **Bold** indicates p-values <= 0.01

Table E.2: Brewer's Sparrow abundance correlation to wetland predictors*

Measure	tau, p value	Measure	tau, p value	Measure	tau, p value
cws_shrub	**0.199; <0.001**	mrps	0.047; 0.119	topo	**0.114; <0.001**
wet1_500kd	0.020; 0.571	wet1_1000kd	-0.035; 0.312	wet1_2500kd	**-0.119; <0.001**
wet1_5000kd	-0.058; 0.052	wet2_500kd	-0.075; 0.019	wet2_1000kd	-0.042; 0.160
wet2_2500kd	0.000; 0.988	wet2_5000kd	-0.025; 0.389	wet3_500kd	-0.010; 0.778
wet3_1000kd	0.010; 0.754	wet3_2500kd	0.005; 0.875	wet3_5000kd	0.060; 0.042
wet4_500kd	-0.024; 0.495	wet4_1000kd	-0.029; 0.402	wet4_2500kd	-0.066; 0.032
wet4_5000kd	**0.083; 0.005**	wet1_500_cnt	0.042; 0.236	wet1_1000_cnt	-0.023; 0.505
wet1_2500_cnt	**-0.104; 0.001**	wet1_5000_cnt	0.005; 0.871	wet2_500_cnt	-0.076; 0.021
wet2_1000_cnt	-0.039; 0.214	wet2_2500_cnt	-0.069; 0.019	wet2_5000_cnt	0.022; 0.451
wet3_500_cnt	-0.022; 0.510	wet3_1000_cnt	-0.012; 0.707	wet3_2500_cnt	-0.021; 0.480
wet3_5000_cnt	0.062; 0.034	wet4_500_cnt	-0.005; 0.879	wet4_1000_cnt	-0.006; 0.858
wet4_2500_cnt	**-0.088; 0.006**	wet4_5000_cnt	**0.087; 0.004**	wet1_all_cnt	0.022; 0.463
wet2_all_cnt	-0.014; 0.628	wet3_all_cnt	0.049; 0.097	wet4_all_cnt	**0.143; <0.001**
field_size	**-0.125; <0.001**	tro_all_cnt	**-0.124; <0.001**	dug_all_cnt	-0.045; 0.153
wet1_all_xd	-0.046; 0.115	wet2_all_xd	-0.008; 0.783	wet3_all_xd	-0.033; 0.253
wet4_all_xd	0.005; 0.856	tro_all_xd	**0.093; 0.005**	dug_all_xd	0.022; 0.500
wet1_500_if_cnt	0.046; 0.193	wet1_1000_if_cnt	-0.013; 0.722	wet1_2500_if_cnt	-0.087; 0.012
wet1_5000_if_cnt	**-0.091; 0.007**	wet2_500_if_cnt	**-0.093; 0.005**	wet2_1000_if_cnt	-0.070; 0.028
wet2_2500_if_cnt	**-0.162; <0.001**	wet2_5000_if_cnt	**-0.172; <0.001**	wet3_500_if_cnt	-0.021; 0.542
wet3_1000_if_cnt	-0.053; 0.113	wet3_2500_if_cnt	**-0.118; <0.001**	wet3_5000_if_cnt	0.032; 0.291
wet4_500_if_cnt	0.016; 0.657	wet4_1000_if_cnt	0.030; 0.397	wet4_2500_if_cnt	**-0.097; 0.004**
wet4_5000_if_cnt	0.010; 0.746	wet1_all_if_xd	0.024; 0.447	wet2_all_if_xd	0.073; 0.018
wet3_all_if_xd	**0.113; <0.001**	wet4_all_if_xd	**0.095; 0.002**	wet1_if_density	-0.072; 0.023
wet2_if_density	**-0.091; 0.004**	wet3_if_density	**0.133; <0.001**	wet4_if_density	**0.119; <0.001**

*Kendall's Rank Correlation Test, **Bold** indicates p-values <= 0.01

Table E.3: Chestnut-collared Longspur abundance correlation to wetland predictors*

Measure	tau, p value	Measure	tau, p value	Measure	tau, p value
cws_shrub	**-0.170; <0.001**	mrps	**0.078; 0.004**	topo	**-0.428; <0.001**
wet1_500kd	**-0.104; 0.001**	wet1_1000kd	**-0.119; <0.001**	wet1_2500kd	-0.017; 0.549
wet1_5000kd	**-0.088; 0.001**	wet2_500kd	0.167; <0.001	wet2_1000kd	**0.289; <0.001**
wet2_2500kd	**0.324; <0.001**	wet2_5000kd	**0.423; <0.001**	wet3_500kd	-0.066; 0.030
wet3_1000kd	-0.030; 0.295	wet3_2500kd	0.002; 0.939	wet3_5000kd	**-0.086; 0.001**
wet4_500kd	**-0.090; 0.005**	wet4_1000kd	-0.067; 0.029	wet4_2500kd	**-0.149; <0.001**
wet4_5000kd	**-0.345; <0.001**	wet1_500_cnt	**-0.120; <0.001**	wet1_1000_cnt	**-0.135; <0.001**
wet1_2500_cnt	**-0.123; <0.001**	wet1_5000_cnt	**-0.239; <0.001**	wet2_500_cnt	**0.117; <0.001**
wet2_1000_cnt	**0.182; <0.001**	wet2_2500_cnt	**0.161; <0.001**	wet2_5000_cnt	**0.111; <0.001**
wet3_500_cnt	-0.072; 0.020	wet3_1000_cnt	-0.032; 0.271	wet3_2500_cnt	-0.004; 0.875
wet3_5000_cnt	-0.055; 0.037	wet4_500_cnt	-0.081; 0.011	wet4_1000_cnt	**-0.084; 0.008**
wet4_2500_cnt	**-0.169; <0.001**	wet4_5000_cnt	**-0.409; <0.001**	wet1_all_cnt	**-0.214; <0.001**
wet2_all_cnt	**0.209; <0.001**	wet3_all_cnt	**0.083; 0.002**	wet4_all_cnt	**-0.478; <0.001**
field_size	**0.427; <0.001**	tro_all_cnt	**0.323; <0.001**	dug_all_cnt	**0.231; <0.001**
wet1_all_xd	**0.152; <0.001**	wet2_all_xd	-0.032; 0.220	wet3_all_xd	**0.146; <0.001**
wet4_all_xd	**0.310; <0.001**	tro_all_xd	**0.181; <0.001**	dug_all_xd	**0.109; <0.001**
wet1_500_if_cnt	-0.067; 0.039	wet1_1000_if_cnt	-0.010; 0.767	wet1_2500_if_cnt	0.046; 0.140
wet1_5000_if_cnt	**0.145; <0.001**	wet2_500_if_cnt	**0.206; <0.001**	wet2_1000_if_cnt	0.307; <0.001
wet2_2500_if_cnt	**0.354; <0.001**	wet2_5000_if_cnt	**0.296; <0.001**	wet3_500_if_cnt	-0.007; 0.816
wet3_1000_if_cnt	0.036; 0.234	wet3_2500_if_cnt	**0.175; <0.001**	wet3_5000_if_cnt	0.004; 0.873
wet4_500_if_cnt	-0.015; 0.649	wet4_1000_if_cnt	0.002; 0.950	wet4_2500_if_cnt	0.023; 0.457
wet4_5000_if_cnt	0.009; 0.766	wet1_all_if_xd	**-0.113; <0.001**	wet2_all_if_xd	**-0.166; <0.001**
wet3_all_if_xd	**-0.227; <0.001**	wet4_all_if_xd	**-0.130; <0.001**	wet1_if_density	0.056; 0.049
wet2_if_density	**0.233; <0.001**	wet3_if_density	**-0.183; <0.001**	wet4_if_density	**-0.153; <0.001**

*Kendall's Rank Correlation Test, **Bold** indicates p-values <= 0.01

Table E.4: Clay-colored Sparrow abundance correlation to wetland predictors*

Measure	tau, p value	Measure	tau, p value	Measure	tau, p value
cws_shrub	**0.127; <0.001**	mrps	0.006; 0.855	topo	**0.081; 0.006**
wet1_500kd	0.034; 0.344	wet1_1000kd	-0.003; 0.935	wet1_2500kd	-0.019; 0.543
wet1_5000kd	-0.007; 0.817	wet2_500kd	-0.067; 0.040	wet2_1000kd	**-0.081; 0.007**
wet2_2500kd	-0.029; 0.329	wet2_5000kd	-0.059; 0.046	wet3_500kd	-0.009; 0.799
wet3_1000kd	-0.001; 0.966	wet3_2500kd	0.028; 0.345	wet3_5000kd	0.038; 0.193
wet4_500kd	0.041; 0.249	wet4_1000kd	-0.021; 0.533	wet4_2500kd	-0.007; 0.830
wet4_5000kd	0.072; 0.015	wet1_500_cnt	0.030; 0.397	wet1_1000_cnt	0.006; 0.874
wet1_2500_cnt	-0.010; 0.768	wet1_5000_cnt	0.024; 0.434	wet2_500_cnt	-0.078; 0.018
wet2_1000_cnt	-0.068; 0.030	wet2_2500_cnt	-0.037; 0.209	wet2_5000_cnt	0.004; 0.898
wet3_500_cnt	-0.023; 0.510	wet3_1000_cnt	-0.029; 0.375	wet3_2500_cnt	0.006; 0.841
wet3_5000_cnt	0.032; 0.272	wet4_500_cnt	0.040; 0.263	wet4_1000_cnt	-0.005; 0.883
wet4_2500_cnt	0.001; 0.968	wet4_5000_cnt	**0.079; 0.009**	wet1_all_cnt	0.061; 0.038
wet2_all_cnt	-0.013; 0.666	wet3_all_cnt	0.013; 0.666	wet4_all_cnt	**0.121; <0.001**
field_size	**-0.117; <0.001**	tro_all_cnt	**-0.103; 0.002**	dug_all_cnt	**-0.087; 0.006**
wet1_all_xd	-0.011; 0.710	wet2_all_xd	0.022; 0.454	wet3_all_xd	-0.012; 0.684
wet4_all_xd	-0.005; 0.873	tro_all_xd	0.057; 0.085	dug_all_xd	-0.003; 0.923
wet1_500_if_cnt	0.055; 0.125	wet1_1000_if_cnt	0.006; 0.875	wet1_2500_if_cnt	-0.057; 0.104
wet1_5000_if_cnt	**-0.091; 0.007**	wet2_500_if_cnt	-0.071; 0.033	wet2_1000_if_cnt	-0.076; 0.017
wet2_2500_if_cnt	**-0.121; <0.001**	wet2_5000_if_cnt	**-0.131; <0.001**	wet3_500_if_cnt	-0.033; 0.342
wet3_1000_if_cnt	-0.043; 0.200	wet3_2500_if_cnt	-0.076; 0.015	wet3_5000_if_cnt	-0.031; 0.308
wet4_500_if_cnt	0.027; 0.442	wet4_1000_if_cnt	-0.006; 0.873	wet4_2500_if_cnt	-0.074; 0.029
wet4_5000_if_cnt	-0.008; 0.817	wet1_all_if_xd	0.056; 0.072	wet2_all_if_xd	**0.091; 0.003**
wet3_all_if_xd	**0.095; 0.002**	wet4_all_if_xd	**0.093; 0.003**	wet1_if_density	0.003; 0.926
wet2_if_density	-0.047; 0.138	wet3_if_density	0.081; 0.011	wet4_if_density	**0.099; 0.002**

*Kendall's Rank Correlation Test, **Bold** indicates p-values <= 0.01

Table E.5: Grasshopper Sparrow abundance correlation to wetland predictors*

Measure	tau, p value	Measure	tau, p value	Measure	tau, p value
cws_shrub	-0.036; 0.199	mrps	**0.104; <0.001**	topo	**0.118; <0.001**
wet1_500kd	-0.049; 0.145	wet1_1000kd	-0.050; 0.125	wet1_2500kd	-0.008; 0.782
wet1_5000kd	0.032; 0.265	wet2_500kd	**-0.238; <0.001**	wet2_1000kd	**-0.233; <0.001**
wet2_2500kd	**-0.171; <0.001**	wet2_5000kd	**-0.194; <0.001**	wet3_500kd	-0.067; 0.034
wet3_1000kd	-0.031; 0.299	wet3_2500kd	-0.030; 0.279	wet3_5000kd	0.006; 0.818
wet4_500kd	-0.050; 0.133	wet4_1000kd	-0.083; 0.011	wet4_2500kd	0.007; 0.814
wet4_5000kd	0.068; 0.014	wet1_500_cnt	-0.043; 0.198	wet1_1000_cnt	-0.048; 0.148
wet1_2500_cnt	0.042; 0.171	wet1_5000_cnt	**0.085; 0.003**	wet2_500_cnt	**-0.223; <0.001**
wet2_1000_cnt	**-0.184; <0.001**	wet2_2500_cnt	**-0.138; <0.001**	wet2_5000_cnt	-0.036; 0.200
wet3_500_cnt	-0.071; 0.028	wet3_1000_cnt	-0.024; 0.426	wet3_2500_cnt	0.002; 0.944
wet3_5000_cnt	-0.014; 0.618	wet4_500_cnt	-0.051; 0.131	wet4_1000_cnt	-0.079; 0.017
wet4_2500_cnt	0.024; 0.428	wet4_5000_cnt	**0.088; 0.002**	wet1_all_cnt	**0.098; <0.001**
wet2_all_cnt	-0.017; 0.535	wet3_all_cnt	0.031; 0.270	wet4_all_cnt	**0.216; <0.001**
field_size	-0.046; 0.126	tro_all_cnt	-0.053; 0.095	dug_all_cnt	**0.091; 0.003**
wet1_all_xd	-0.062; 0.025	wet2_all_xd	**0.098; <0.001**	wet3_all_xd	0.014; 0.618
wet4_all_xd	-0.013; 0.636	tro_all_xd	-0.026; 0.395	dug_all_xd	0.020; 0.511
wet1_500_if_cnt	-0.012; 0.727	wet1_1000_if_cnt	-0.058; 0.085	wet1_2500_if_cnt	-0.048; 0.145
wet1_5000_if_cnt	**-0.115; <0.001**	wet2_500_if_cnt	**-0.250; <0.001**	wet2_1000_if_cnt	**-0.214; <0.001**
wet2_2500_if_cnt	**-0.255; <0.001**	wet2_5000_if_cnt	**-0.118; <0.001**	wet3_500_if_cnt	**-0.098; 0.003**
wet3_1000_if_cnt	-0.069; 0.028	wet3_2500_if_cnt	-0.064; 0.031	wet3_5000_if_cnt	-0.030; 0.299
wet4_500_if_cnt	-0.050; 0.134	wet4_1000_if_cnt	**-0.096; 0.004**	wet4_2500_if_cnt	-0.066; 0.038
wet4_5000_if_cnt	-0.042; 0.170	wet1_all_if_xd	0.044; 0.135	wet2_all_if_xd	**0.232; <0.001**
wet3_all_if_xd	0.075; 0.011	wet4_all_if_xd	-0.007; 0.824	wet1_if_density	-0.047; 0.115
wet2_if_density	**-0.154; <0.001**	wet3_if_density	0.014; 0.634	wet4_if_density	-0.053; 0.076

*Kendall's Rank Correlation Test, **Bold** indicates p-values <= 0.01

Table E.6: Horned Lark abundance correlation to wetland predictors*

Measure	tau, p value	Measure	tau, p value	Measure	tau, p value
cws_shrub	**-0.086; 0.002**	mrps	-0.036; 0.200	topo	-0.062; 0.023
wet1_500kd	**-0.086; 0.009**	wet1_1000kd	**-0.096; 0.003**	wet1_2500kd	0.013; 0.648
wet1_5000kd	0.003; 0.907	wet2_500kd	**0.101; <0.001**	wet2_1000kd	**0.135; <0.001**
wet2_2500kd	0.070; 0.011	wet2_5000kd	**0.093; <0.001**	wet3_500kd	-0.014; 0.665
wet3_1000kd	0.004; 0.890	wet3_2500kd	-0.016; 0.568	wet3_5000kd	-0.002; 0.939
wet4_500kd	-0.048; 0.147	wet4_1000kd	-0.014; 0.666	wet4_2500kd	-0.024; 0.410
wet4_5000kd	-0.078; 0.005	wet1_500_cnt	**-0.095; 0.004**	wet1_1000_cnt	**-0.116; <0.001**
wet1_2500_cnt	0.014; 0.655	wet1_5000_cnt	-0.029; 0.299	wet2_500_cnt	**0.108; <0.001**
wet2_1000_cnt	**0.141; <0.001**	wet2_2500_cnt	0.069; 0.012	wet2_5000_cnt	0.046; 0.090
wet3_500_cnt	-0.005; 0.871	wet3_1000_cnt	0.035; 0.239	wet3_2500_cnt	0.013; 0.637
wet3_5000_cnt	0.012; 0.671	wet4_500_cnt	-0.057; 0.082	wet4_1000_cnt	-0.037; 0.251
wet4_2500_cnt	-0.016; 0.579	wet4_5000_cnt	**-0.078; 0.005**	wet1_all_cnt	-0.008; 0.762
wet2_all_cnt	**0.100; <0.001**	wet3_all_cnt	0.054; 0.050	wet4_all_cnt	**-0.127; <0.001**
field_size	**0.097; <0.001**	tro_all_cnt	**0.099; 0.001**	dug_all_cnt	0.072; 0.015
wet1_all_xd	**0.078; 0.004**	wet2_all_xd	-0.022; 0.413	wet3_all_xd	0.035; 0.205
wet4_all_xd	0.042; 0.123	tro_all_xd	-0.031; 0.310	dug_all_xd	**-0.097; 0.001**
wet1_500_if_cnt	-0.065; 0.051	wet1_1000_if_cnt	-0.080; 0.015	wet1_2500_if_cnt	0.075; 0.020
wet1_5000_if_cnt	0.038; 0.222	wet2_500_if_cnt	**0.147; <0.001**	wet2_1000_if_cnt	**0.188; <0.001**
wet2_2500_if_cnt	**0.211; <0.001**	wet2_5000_if_cnt	**0.094; <0.001**	wet3_500_if_cnt	0.032; 0.318
wet3_1000_if_cnt	0.071; 0.023	wet3_2500_if_cnt	**0.126; <0.001**	wet3_5000_if_cnt	0.023; 0.415
wet4_500_if_cnt	-0.022; 0.498	wet4_1000_if_cnt	-0.018; 0.578	wet4_2500_if_cnt	**0.090; 0.004**
wet4_5000_if_cnt	-0.018; 0.548	wet1_all_if_xd	-0.011; 0.711	wet2_all_if_xd	**-0.191; <0.001**
wet3_all_if_xd	**-0.136; <0.001**	wet4_all_if_xd	-0.074; 0.011	wet1_if_density	0.031; 0.289
wet2_if_density	0.055; 0.061	wet3_if_density	-0.062; 0.033	wet4_if_density	**-0.091; 0.002**

*Kendall's Rank Correlation Test, **Bold** indicates p-values <= 0.01

Table E.7: Long-billed Curlew abundance correlation to wetland predictors*

Measure	tau, p value	Measure	tau, p value	Measure	tau, p value
cws_shrub	-0.037; 0.210	mrps	-0.064; 0.031	topo	-0.037; 0.208
wet1_500kd	-0.043; 0.223	wet1_1000kd	-0.035; 0.306	wet1_2500kd	-0.026; 0.401
wet1_5000kd	-0.061; 0.042	wet2_500kd	0.056; 0.080	wet2_1000kd	0.055; 0.067
wet2_2500kd	-0.012; 0.680	wet2_5000kd	-0.041; 0.162	wet3_500kd	-0.019; 0.574
wet3_1000kd	-0.011; 0.717	wet3_2500kd	-0.073; 0.013	wet3_5000kd	-0.073; 0.013
wet4_500kd	0.010; 0.769	wet4_1000kd	0.039; 0.251	wet4_2500kd	0.033; 0.289
wet4_5000kd	-0.015; 0.601	wet1_500_cnt	-0.049; 0.166	wet1_1000_cnt	-0.019; 0.587
wet1_2500_cnt	-0.021; 0.507	wet1_5000_cnt	-0.039; 0.197	wet2_500_cnt	0.079; 0.016
wet2_1000_cnt	0.061; 0.049	wet2_2500_cnt	-0.003; 0.932	wet2_5000_cnt	**-0.094; 0.001**
wet3_500_cnt	-0.011; 0.748	wet3_1000_cnt	0.011; 0.726	wet3_2500_cnt	-0.050; 0.090
wet3_5000_cnt	-0.030; 0.306	wet4_500_cnt	0.003; 0.923	wet4_1000_cnt	0.032; 0.354
wet4_2500_cnt	0.011; 0.732	wet4_5000_cnt	-0.031; 0.293	wet1_all_cnt	-0.053; 0.072
wet2_all_cnt	-0.067; 0.023	wet3_all_cnt	-0.072; 0.014	wet4_all_cnt	-0.027; 0.349
field_size	-0.011; 0.731	tro_all_cnt	0.003; 0.933	dug_all_cnt	-0.048; 0.131
wet1_all_xd	0.091; 0.002	wet2_all_xd	0.024; 0.412	wet3_all_xd	-0.021; 0.471
wet4_all_xd	-0.035; 0.231	tro_all_xd	-0.065; 0.046	dug_all_xd	0.013; 0.675
wet1_500_if_cnt	-0.029; 0.407	wet1_1000_if_cnt	0.011; 0.760	wet1_2500_if_cnt	0.025; 0.461
wet1_5000_if_cnt	0.025; 0.460	wet2_500_if_cnt	**0.126; <0.001**	wet2_1000_if_cnt	0.123; <0.001
wet2_2500_if_cnt	**0.091; 0.002**	wet2_5000_if_cnt	-0.028; 0.348	wet3_500_if_cnt	0.030; 0.386
wet3_1000_if_cnt	0.068; 0.041	wet3_2500_if_cnt	0.016; 0.613	wet3_5000_if_cnt	-0.018; 0.543
wet4_500_if_cnt	0.031; 0.386	wet4_1000_if_cnt	0.075; 0.033	wet4_2500_if_cnt	**0.093; 0.006**
wet4_5000_if_cnt	-0.019; 0.550	wet1_all_if_xd	0.001; 0.987	wet2_all_if_xd	**-0.083; 0.007**
wet3_all_if_xd	-0.020; 0.521	wet4_all_if_xd	-0.052; 0.090	wet1_if_density	0.030; 0.333
wet2_if_density	0.041; 0.185	wet3_if_density	-0.026; 0.410	wet4_if_density	0.007; 0.828

*Kendall's Rank Correlation Test, **Bold** indicates p-values <= 0.01

Table E.8: Lark Bunting abundance correlation to wetland predictors*

Measure	tau, p value	Measure	tau, p value	Measure	tau, p value
cws_shrub	**0.088; 0.003**	mrps	**0.104; <0.001**	topo	0.062; 0.034
wet1_500kd	-0.049; 0.169	wet1_1000kd	**-0.115; <0.001**	wet1_2500kd	**-0.148; <0.001**
wet1_5000kd	**-0.126; <0.001**	wet2_500kd	**-0.111; <0.001**	wet2_1000kd	**-0.104; <0.001**
wet2_2500kd	-0.037; 0.203	wet2_5000kd	0.043; 0.142	wet3_500kd	-0.057; 0.086
wet3_1000kd	-0.078; 0.013	wet3_2500kd	**-0.093; 0.002**	wet3_5000kd	0.006; 0.828
wet4_500kd	-0.067; 0.056	wet4_1000kd	**-0.113; <0.001**	wet4_2500kd	**-0.154; <0.001**
wet4_5000kd	-0.039; 0.182	wet1_500_cnt	-0.052; 0.140	wet1_1000_cnt	**-0.117; <0.001**
wet1_2500_cnt	**-0.134; <0.001**	wet1_5000_cnt	**-0.093; 0.002**	wet2_500_cnt	**-0.113; <0.001**
wet2_1000_cnt	**-0.128; <0.001**	wet2_2500_cnt	**-0.114; <0.001**	wet2_5000_cnt	-0.053; 0.067
wet3_500_cnt	-0.061; 0.072	wet3_1000_cnt	-0.065; 0.042	wet3_2500_cnt	**-0.106; <0.001**
wet3_5000_cnt	-0.023; 0.422	wet4_500_cnt	-0.070; 0.048	wet4_1000_cnt	**-0.103; 0.003**
wet4_2500_cnt	**-0.150; <0.001**	wet4_5000_cnt	-0.019; 0.532	wet1_all_cnt	**-0.103; <0.001**
wet2_all_cnt	-0.061; 0.039	wet3_all_cnt	0.010; 0.742	wet4_all_cnt	0.026; 0.372
field_size	-0.005; 0.882	tro_all_cnt	-0.069; 0.036	dug_all_cnt	0.025; 0.434
wet1_all_xd	**-0.077; 0.008**	wet2_all_xd	0.040; 0.169	wet3_all_xd	0.017; 0.553
wet4_all_xd	0.037; 0.207	tro_all_xd	0.027; 0.417	dug_all_xd	0.023; 0.480
wet1_500_if_cnt	-0.032; 0.371	wet1_1000_if_cnt	**-0.093; 0.008**	wet1_2500_if_cnt	**-0.128; <0.001**
wet1_5000_if_cnt	**-0.111; <0.001**	wet2_500_if_cnt	**-0.094; 0.004**	wet2_1000_if_cnt	**-0.121; <0.001**
wet2_2500_if_cnt	**-0.140; <0.001**	wet2_5000_if_cnt	**-0.132; <0.001**	wet3_500_if_cnt	-0.072; 0.035
wet3_1000_if_cnt	**-0.117; <0.001**	wet3_2500_if_cnt	**-0.129; <0.001**	wet3_5000_if_cnt	0.028; 0.358
wet4_500_if_cnt	-0.053; 0.132	wet4_1000_if_cnt	-0.088; 0.012	wet4_2500_if_cnt	**-0.121; <0.001**
wet4_5000_if_cnt	-0.055; 0.087	wet1_all_if_xd	0.064; 0.040	wet2_all_if_xd	**0.080; 0.009**
wet3_all_if_xd	**0.140; <0.001**	wet4_all_if_xd	**0.093; 0.002**	wet1_if_density	**-0.185; <0.001**
wet2_if_density	**-0.171; <0.001**	wet3_if_density	0.058; 0.065	wet4_if_density	-0.003; 0.927

*Kendall's Rank Correlation Test, **Bold** indicates p-values <= 0.01

Table E.9: Sprague's Pipit abundance correlation to wetland predictors*

Measure	tau, p value	Measure	tau, p value	Measure	tau, p value
cws_shrub	-0.071; 0.011	mrps	0.024; 0.382	topo	-0.011; 0.678
wet1_500kd	-0.013; 0.687	wet1_1000kd	0.032; 0.319	wet1_2500kd	0.027; 0.362
wet1_5000kd	0.049; 0.083	wet2_500kd	**-0.092; 0.002**	wet2_1000kd	**-0.127; <0.001**
wet2_2500kd	**-0.137; <0.001**	wet2_5000kd	**-0.143; <0.001**	wet3_500kd	0.016; 0.621
wet3_1000kd	0.008; 0.792	wet3_2500kd	-0.051; 0.064	wet3_5000kd	-0.007; 0.800
wet4_500kd	-0.039; 0.240	wet4_1000kd	-0.009; 0.775	wet4_2500kd	0.035; 0.230
wet4_5000kd	0.070; 0.012	wet1_500_cnt	-0.015; 0.653	wet1_1000_cnt	0.018; 0.576
wet1_2500_cnt	0.036; 0.239	wet1_5000_cnt	**0.075; 0.008**	wet2_500_cnt	-0.074; 0.017
wet2_1000_cnt	-0.074; 0.011	wet2_2500_cnt	-0.070; 0.011	wet2_5000_cnt	0.017; 0.547
wet3_500_cnt	0.016; 0.610	wet3_1000_cnt	0.016; 0.601	wet3_2500_cnt	0.010; 0.725
wet3_5000_cnt	0.017; 0.530	wet4_500_cnt	-0.046; 0.167	wet4_1000_cnt	-0.035; 0.290
wet4_2500_cnt	0.030; 0.317	wet4_5000_cnt	**0.075; 0.007**	wet1_all_cnt	0.077; 0.005
wet2_all_cnt	-0.006; 0.832	wet3_all_cnt	0.016; 0.568	wet4_all_cnt	**0.118; <0.001**
field_size	-0.051; 0.084	tro_all_cnt	0.024; 0.445	dug_all_cnt	-0.015; 0.618
wet1_all_xd	0.004; 0.876	wet2_all_xd	0.017; 0.528	wet3_all_xd	-0.001; 0.977
wet4_all_xd	0.006; 0.831	tro_all_xd	-0.043; 0.165	dug_all_xd	-0.044; 0.146
wet1_500_if_cnt	0.010; 0.771	wet1_1000_if_cnt	0.035; 0.287	wet1_2500_if_cnt	0.064; 0.051
wet1_5000_if_cnt	0.021; 0.506	wet2_500_if_cnt	**-0.080; 0.010**	wet2_1000_if_cnt	**-0.098; <0.001**
wet2_2500_if_cnt	-0.052; 0.063	wet2_5000_if_cnt	0.050; 0.072	wet3_500_if_cnt	0.026; 0.413
wet3_1000_if_cnt	0.024; 0.451	wet3_2500_if_cnt	0.032; 0.276	wet3_5000_if_cnt	0.034; 0.235
wet4_500_if_cnt	-0.044; 0.187	wet4_1000_if_cnt	-0.040; 0.228	wet4_2500_if_cnt	0.041; 0.193
wet4_5000_if_cnt	**0.082; 0.007**	wet1_all_if_xd	-0.026; 0.381	wet2_all_if_xd	**0.086; 0.003**
wet3_all_if_xd	0.006; 0.831	wet4_all_if_xd	-0.032; 0.269	wet1_if_density	**0.100; <0.001**
wet2_if_density	0.022; 0.456	wet3_if_density	0.008; 0.794	wet4_if_density	0.012; 0.681

*Kendall's Rank Correlation Test, **Bold** indicates p-values <= 0.01

Table E.10: Upland Sandpiper abundance correlation to wetland predictors*

Measure	tau, p value	Measure	tau, p value	Measure	tau, p value
cws_shrub	0.060; 0.046	mrps	0.053; 0.079	topo	**0.141; <0.001**
wet1_500kd	-0.020; 0.580	wet1_1000kd	-0.048; 0.169	wet1_2500kd	-0.030; 0.349
wet1_5000kd	-0.003; 0.918	wet2_500kd	-0.089; 0.006	wet2_1000kd	**-0.144; <0.001**
wet2_2500kd	**-0.114; <0.001**	wet2_5000kd	**-0.126; <0.001**	wet3_500kd	0.056; 0.100
wet3_1000kd	0.014; 0.655	wet3_2500kd	0.062; 0.036	wet3_5000kd	**0.077; 0.009**
wet4_500kd	-0.007; 0.847	wet4_1000kd	-0.039; 0.260	wet4_2500kd	0.039; 0.207
wet4_5000kd	**0.095; 0.001**	wet1_500_cnt	-0.026; 0.471	wet1_1000_cnt	-0.039; 0.274
wet1_2500_cnt	0.010; 0.766	wet1_5000_cnt	0.039; 0.193	wet2_500_cnt	-0.066; 0.047
wet2_1000_cnt	-0.091; 0.004	wet2_2500_cnt	-0.036; 0.224	wet2_5000_cnt	0.004; 0.894
wet3_500_cnt	0.054; 0.113	wet3_1000_cnt	0.012; 0.705	wet3_2500_cnt	0.051; 0.087
wet3_5000_cnt	0.053; 0.075	wet4_500_cnt	-0.013; 0.707	wet4_1000_cnt	-0.055; 0.115
wet4_2500_cnt	0.048; 0.128	wet4_5000_cnt	**0.109; <0.001**	wet1_all_cnt	**0.096; 0.001**
wet2_all_cnt	0.025; 0.394	wet3_all_cnt	**0.079; 0.007**	wet4_all_cnt	**0.170; <0.001**
field_size	-0.077; 0.015	tro_all_cnt	**-0.121; <0.001**	dug_all_cnt	0.022; 0.485
wet1_all_xd	-0.034; 0.244	wet2_all_xd	0.052; 0.075	wet3_all_xd	-0.029; 0.322
wet4_all_xd	-0.046; 0.115	tro_all_xd	-0.000; 0.998	dug_all_xd	0.031; 0.336
wet1_500_if_cnt	-0.052; 0.143	wet1_1000_if_cnt	-0.066; 0.065	wet1_2500_if_cnt	-0.085; 0.015
wet1_5000_if_cnt	**-0.132; <0.001**	wet2_500_if_cnt	**-0.118; <0.001**	wet2_1000_if_cnt	**-0.158; <0.001**
wet2_2500_if_cnt	**-0.190; <0.001**	wet2_5000_if_cnt	**-0.131; <0.001**	wet3_500_if_cnt	-0.025; 0.472
wet3_1000_if_cnt	-0.083; 0.013	wet3_2500_if_cnt	-0.064; 0.043	wet3_5000_if_cnt	0.002; 0.957
wet4_500_if_cnt	-0.045; 0.205	wet4_1000_if_cnt	-0.071; 0.046	wet4_2500_if_cnt	**-0.092; 0.007**
wet4_5000_if_cnt	-0.040; 0.224	wet1_all_if_xd	0.095; 0.002	wet2_all_if_xd	**0.152; <0.001**
wet3_all_if_xd	**0.112; <0.001**	wet4_all_if_xd	0.087; 0.005	wet1_if_density	**-0.095; 0.003**
wet2_if_density	**-0.135; <0.001**	wet3_if_density	0.077; 0.016	wet4_if_density	-0.022; 0.489

*Kendall's Rank Correlation Test, **Bold** indicates p-values <= 0.01

Table E.11: Vesper Sparrow abundance correlation to wetland predictors*

Measure	tau, p value	Measure	tau, p value	Measure	tau, p value
cws_shrub	**0.166; <0.001**	mrps	0.036; 0.223	topo	**0.235; <0.001**
wet1_500kd	-0.020; 0.563	wet1_1000kd	-0.019; 0.568	wet1_2500kd	**-0.116; <0.001**
wet1_5000kd	**-0.109; <0.001**	wet2_500kd	**-0.177; <0.001**	wet2_1000kd	**-0.200; <0.001**
wet2_2500kd	**-0.183; <0.001**	wet2_5000kd	**-0.141; <0.001**	wet3_500kd	-0.075; 0.023
wet3_1000kd	**-0.084; 0.006**	wet3_2500kd	-0.050; 0.082	wet3_5000kd	0.017; 0.555
wet4_500kd	-0.010; 0.780	wet4_1000kd	-0.048; 0.148	wet4_2500kd	-0.047; 0.117
wet4_5000kd	0.068; 0.018	wet1_500_cnt	-0.004; 0.902	wet1_1000_cnt	0.002; 0.950
wet1_2500_cnt	-0.070; 0.029	wet1_5000_cnt	-0.028; 0.334	wet2_500_cnt	**-0.167; <0.001**
wet2_1000_cnt	**-0.164; <0.001**	wet2_2500_cnt	**-0.200; <0.001**	wet2_5000_cnt	**-0.102; <0.001**
wet3_500_cnt	-0.076; 0.022	wet3_1000_cnt	**-0.090; 0.005**	wet3_2500_cnt	**-0.084; 0.004**
wet3_5000_cnt	-0.004; 0.876	wet4_500_cnt	-0.004; 0.917	wet4_1000_cnt	-0.011; 0.753
wet4_2500_cnt	-0.046; 0.141	wet4_5000_cnt	**0.106; <0.001**	wet1_all_cnt	0.026; 0.366
wet2_all_cnt	-0.085; 0.003	wet3_all_cnt	-0.002; 0.952	wet4_all_cnt	**0.213; <0.001**
field_size	**-0.131; <0.001**	tro_all_cnt	**-0.198; <0.001**	dug_all_cnt	-0.055; 0.078
wet1_all_xd	0.022; 0.442	wet2_all_xd	**0.144; <0.001**	wet3_all_xd	0.018; 0.530
wet4_all_xd	-0.018; 0.522	tro_all_xd	-0.069; 0.032	dug_all_xd	-0.034; 0.278
wet1_500_if_cnt	0.012; 0.724	wet1_1000_if_cnt	-0.030; 0.386	wet1_2500_if_cnt	-0.068; 0.044
wet1_5000_if_cnt	**-0.174; <0.001**	wet2_500_if_cnt	**-0.188; <0.001**	wet2_1000_if_cnt	**-0.197; <0.001**
wet2_2500_if_cnt	**-0.222; <0.001**	wet2_5000_if_cnt	**-0.189; <0.001**	wet3_500_if_cnt	-0.081; 0.016
wet3_1000_if_cnt	**-0.106; 0.001**	wet3_2500_if_cnt	**-0.100; 0.001**	wet3_5000_if_cnt	0.020; 0.505
wet4_500_if_cnt	0.008; 0.816	wet4_1000_if_cnt	-0.020; 0.554	wet4_2500_if_cnt	-0.056; 0.089
wet4_5000_if_cnt	-0.028; 0.384	wet1_all_if_xd	0.020; 0.520	wet2_all_if_xd	**0.180; <0.001**
wet3_all_if_xd	**0.155; <0.001**	wet4_all_if_xd	0.077; 0.011	wet1_if_density	**-0.155; <0.001**
wet2_if_density	**-0.161; <0.001**	wet3_if_density	**0.152; <0.001**	wet4_if_density	**0.109; <0.001**

*Kendall's Rank Correlation Test, **Bold** indicates p-values <= 0.01

Table E.12: Western Meadowlark abundance correlation to wetland predictors*

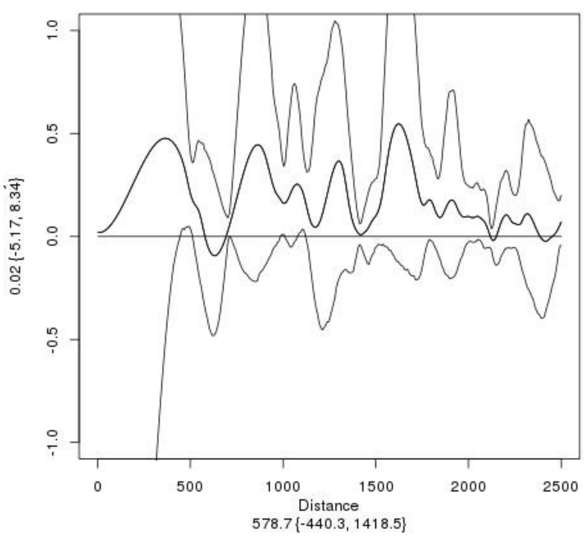
Measure	tau, p value	Measure	tau, p value	Measure	tau, p value
cws_shrub	**0.075; 0.006**	mrps	-0.031; 0.261	topo	**0.204; <0.001**
wet1_500kd	0.045; 0.170	wet1_1000kd	0.006; 0.854	wet1_2500kd	0.021; 0.467
wet1_5000kd	**0.074; 0.007**	wet2_500kd	**-0.124; <0.001**	wet2_1000kd	**-0.177; <0.001**
wet2_2500kd	**-0.201; <0.001**	wet2_5000kd	**-0.294; <0.001**	wet3_500kd	0.039; 0.204
wet3_1000kd	0.001; 0.977	wet3_2500kd	0.004; 0.874	wet3_5000kd	0.040; 0.136
wet4_500kd	0.017; 0.611	wet4_1000kd	0.013; 0.669	wet4_2500kd	**0.121; <0.001**
wet4_5000kd	**0.225; <0.001**	wet1_500_cnt	0.066; 0.044	wet1_1000_cnt	0.000; 0.990
wet1_2500_cnt	**0.087; 0.004**	wet1_5000_cnt	**0.164; <0.001**	wet2_500_cnt	**-0.093; 0.002**
wet2_1000_cnt	**-0.113; <0.001**	wet2_2500_cnt	**-0.117; <0.001**	wet2_5000_cnt	-0.056; 0.040
wet3_500_cnt	0.047; 0.136	wet3_1000_cnt	-0.005; 0.865	wet3_2500_cnt	0.025; 0.354
wet3_5000_cnt	0.049; 0.070	wet4_500_cnt	0.027; 0.399	wet4_1000_cnt	-0.006; 0.862
wet4_2500_cnt	**0.130; <0.001**	wet4_5000_cnt	**0.249; <0.001**	wet1_all_cnt	**0.154; <0.001**
wet2_all_cnt	**-0.100; <0.001**	wet3_all_cnt	-0.013; 0.629	wet4_all_cnt	**0.340; <0.001**
field_size	**-0.280; <0.001**	tro_all_cnt	**-0.175; <0.001**	dug_all_cnt	**-0.160; <0.001**
wet1_all_xd	**-0.086; 0.001**	wet2_all_xd	0.044; 0.099	wet3_all_xd	**-0.078; 0.004**
wet4_all_xd	**-0.184; <0.001**	tro_all_xd	**-0.132; <0.001**	dug_all_xd	-0.048; 0.108
wet1_500_if_cnt	0.052; 0.113	wet1_1000_if_cnt	-0.018; 0.584	wet1_2500_if_cnt	0.024; 0.461
wet1_5000_if_cnt	-0.055; 0.079	wet2_500_if_cnt	**-0.143; <0.001**	wet2_1000_if_cnt	**-0.189; <0.001**
wet2_2500_if_cnt	**-0.219; <0.001**	wet2_5000_if_cnt	**-0.145; <0.001**	wet3_500_if_cnt	0.007; 0.832
wet3_1000_if_cnt	-0.059; 0.058	wet3_2500_if_cnt	-0.070; 0.015	wet3_5000_if_cnt	0.030; 0.276
wet4_500_if_cnt	0.035; 0.286	wet4_1000_if_cnt	-0.007; 0.833	wet4_2500_if_cnt	0.032; 0.304
wet4_5000_if_cnt	0.049; 0.097	wet1_all_if_xd	0.067; 0.019	wet2_all_if_xd	**0.128; <0.001**
wet3_all_if_xd	**0.144; <0.001**	wet4_all_if_xd	0.066; 0.021	wet1_if_density	0.048; 0.100
wet2_if_density	-0.060; 0.039	wet3_if_density	**0.146; <0.001**	wet4_if_density	**0.148; <0.001**

*Kendall's Rank Correlation Test, **Bold** indicates p-values <= 0.01

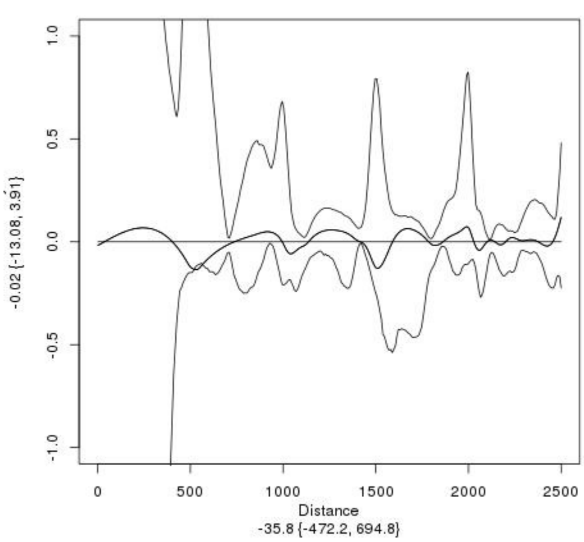
Appendix F –Correlograms from Wetland Analysis

Interpretation of the correlograms merits some explanation. On the y-axis is a scale from -1 to 1 providing a measure of correlation equivalent to a Pearson's r or Kendall's tau. Along the x-axis is distance. In the case of the correlogram for Brewer's Sparrow, the central line tracks quite close to 0, indicating very low correlation. The confidence intervals do not cross the zero line, thus the weak correlation that exists, is not statistically significant. In the case of Baird's Sparrow however there is a small spike at 500m where both the central line and the lower confidence interval are above zero indicating minor spatial auto-correlation in the model residuals.

F.1 Baird's Sparrow GLM Model Residuals

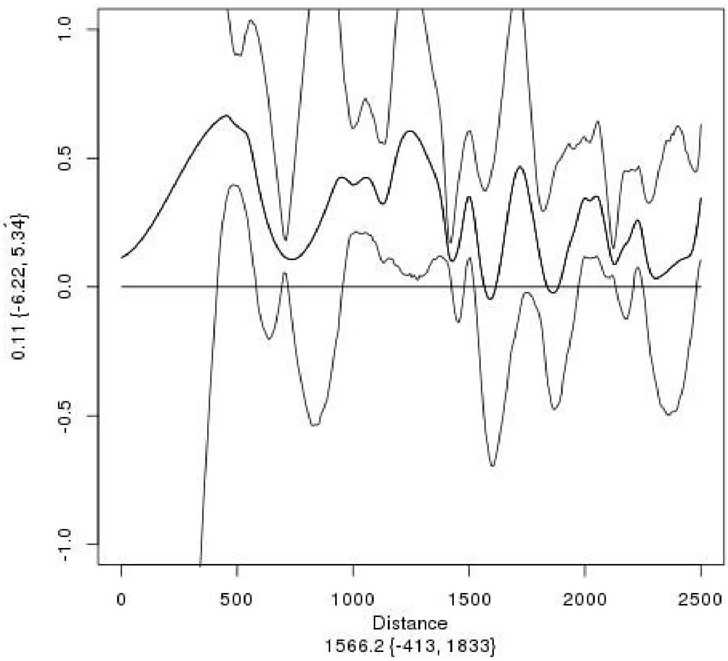


F.2 Brewer's Sparrow GLM Model Residuals

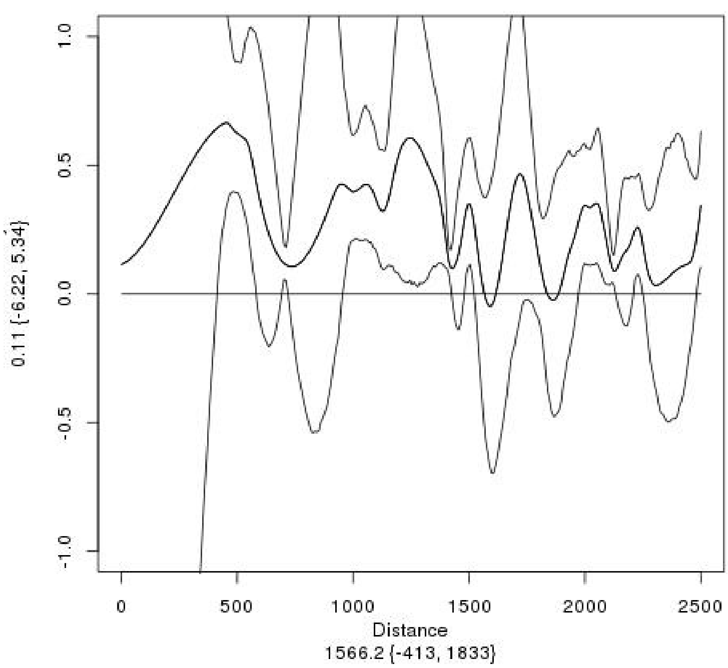


F.3 Chestnut-collared Longspur GLM Model Residuals

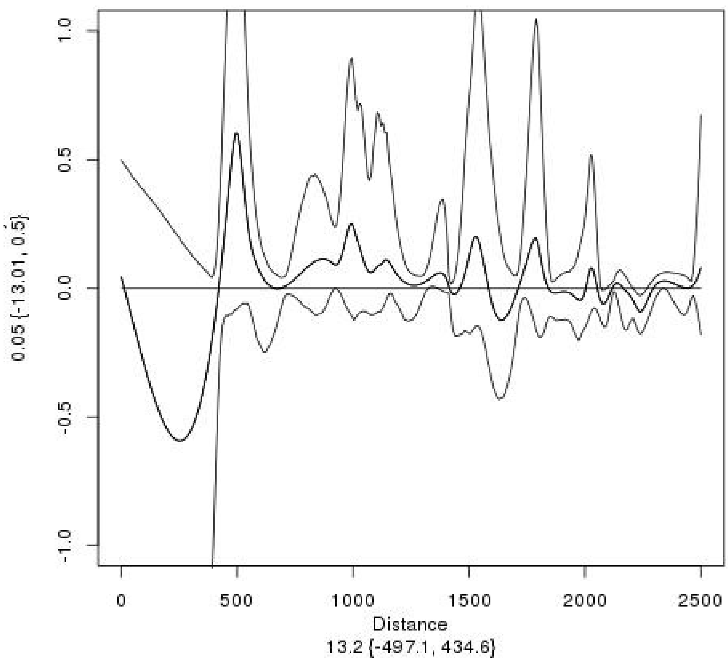
F.3.1 Chestnut-collared Longspur GLM without adjacency measure



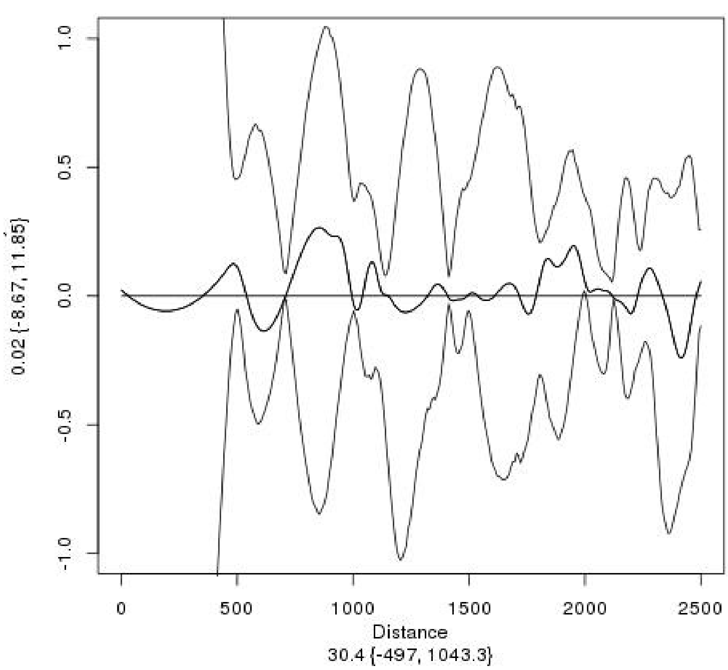
F.3.2 Chestnut-collared Longspur GLM with adjacency measure



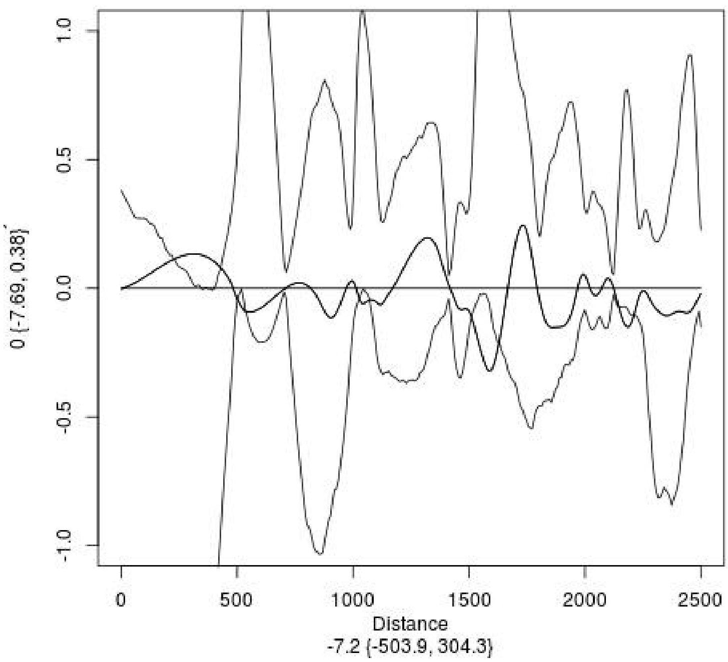
F.4 Clay-colored Sparrow GLM Model Residuals



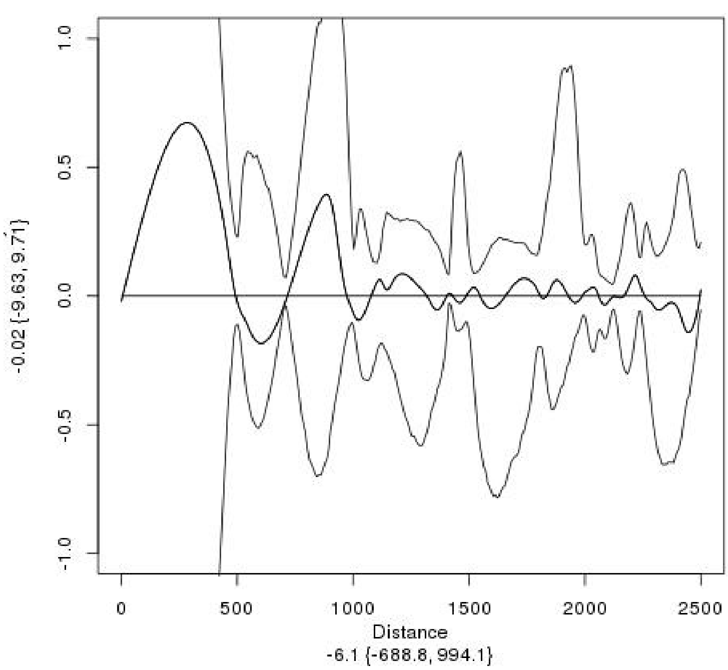
F.5 Grasshopper Sparrow GLM Model Residuals



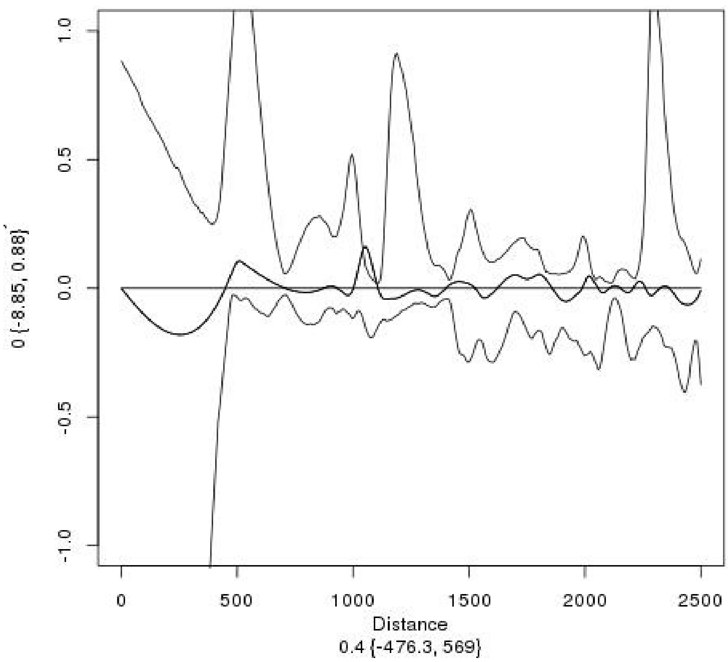
F.6 Horned Lark GLM Model Residuals



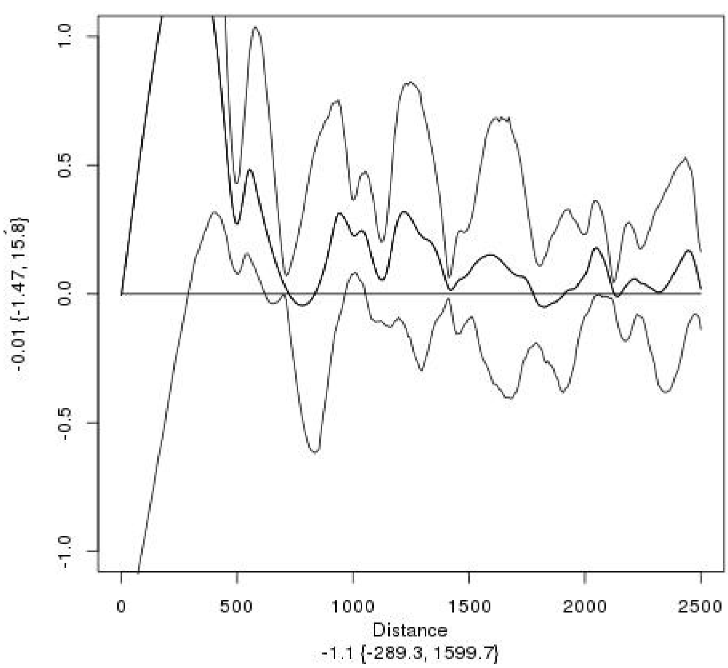
F.7 Long-billed Curlew GLM Model Residuals



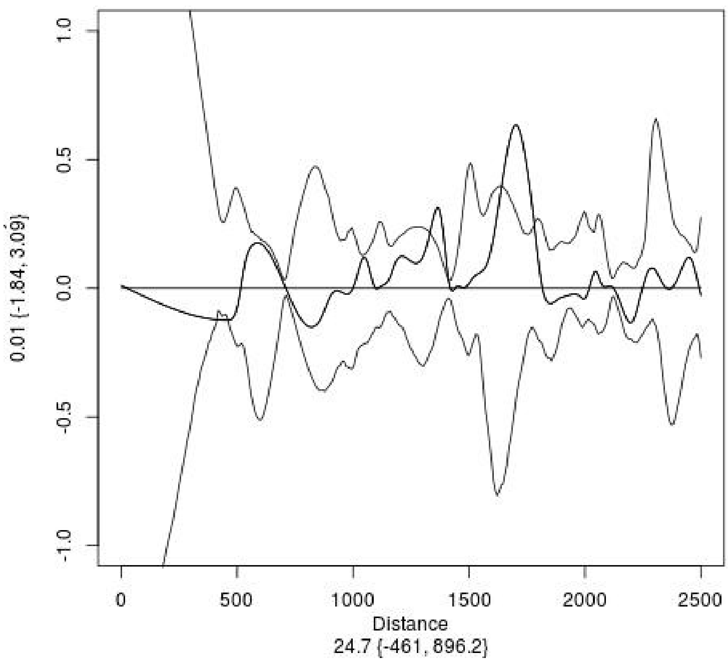
F.8 Lark Bunting GLM Model Residuals



F.9 Sprague's Pipit GLM Model Residuals

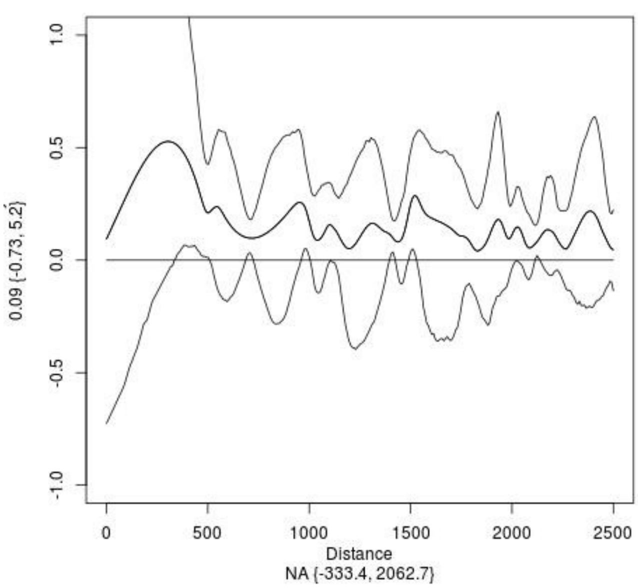


F.10 Upland Sandpiper GLM Model Residuals

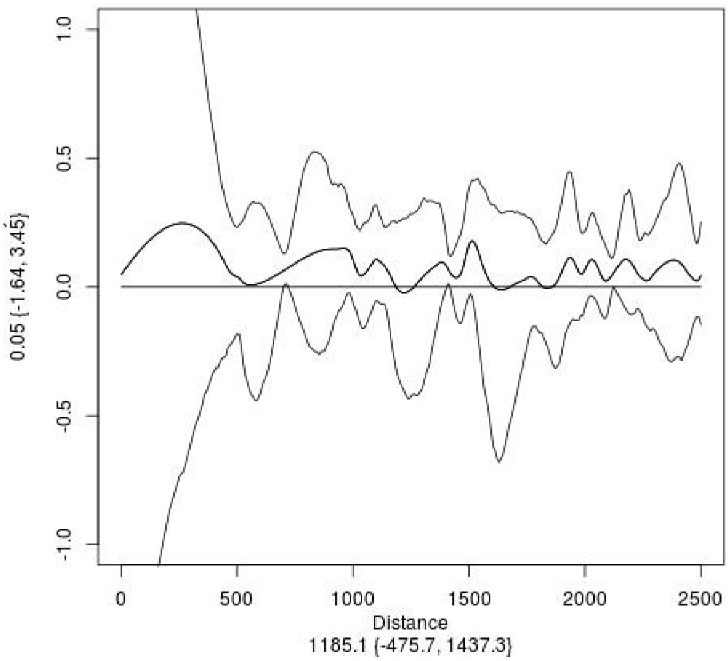


F.11 Vesper Sparrow GLM Model Residuals

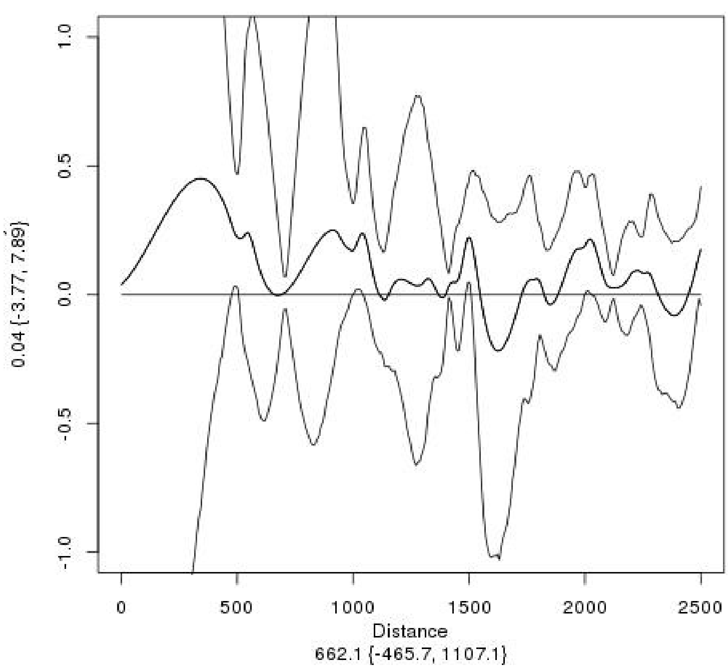
F.11.1 Vesper Sparrow GLM without adjacency measure



F.11.2 Vesper Sparrow GLM with adjacency measure



F.12 Western Meadowlark Sparrow GLM Model Residuals



Appendix G – Correlations between wetland predictors

Tau values > 0.7 are in **bold**.

Table G.1: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	cws_shrub	mrps	topo	wet1_500kd
cws_shrub	**1.000;<0.001**	-0.122;<0.001	0.152;<0.001	0.053; 0.074
mrps	-0.122;<0.001	**1.000;<0.001**	-0.292;<0.001	-0.086; 0.004
topo	0.152;<0.001	-0.292;<0.001	**1.000;<0.001**	0.122;<0.001
wet1_500kd	0.053; 0.074	-0.086; 0.004	0.122;<0.001	**1.000;<0.001**
wet1_1000kd	0.021; 0.466	-0.119;<0.001	0.186;<0.001	0.543;<0.001
wet1_2500kd	-0.138;<0.001	-0.069; 0.010	0.127;<0.001	0.253;<0.001
wet1_5000kd	-0.054; 0.033	0.045; 0.076	0.028; 0.250	0.171;<0.001
wet2_500kd	-0.020; 0.459	-0.128;<0.001	-0.059; 0.026	0.190;<0.001
wet2_1000kd	-0.009; 0.717	-0.167;<0.001	-0.081; 0.001	0.103;<0.001
wet2_2500kd	0.030; 0.230	-0.118;<0.001	-0.130;<0.001	0.026; 0.382
wet2_5000kd	0.010; 0.678	0.041; 0.096	-0.247;<0.001	-0.116;<0.001
wet3_500kd	-0.061; 0.032	-0.057; 0.045	0.146;<0.001	0.273;<0.001
wet3_1000kd	-0.106;<0.001	-0.004; 0.891	0.126;<0.001	0.209;<0.001
wet3_2500kd	-0.121;<0.001	0.058; 0.018	0.044; 0.073	0.120;<0.001
wet3_5000kd	-0.023; 0.344	0.128;<0.001	0.059; 0.015	0.022; 0.451
wet4_500kd	0.080; 0.007	-0.161;<0.001	0.135;<0.001	0.554;<0.001
wet4_1000kd	0.091; 0.001	-0.206;<0.001	0.171;<0.001	0.320;<0.001
wet4_2500kd	-0.022; 0.390	-0.126;<0.001	0.157;<0.001	0.210;<0.001
wet4_5000kd	0.072; 0.004	-0.069; 0.005	0.260;<0.001	0.151;<0.001
wet1_500_cnt	0.063; 0.035	-0.104;<0.001	0.140;<0.001	**0.955;<0.001**
wet1_1000_cnt	0.042; 0.153	-0.133;<0.001	0.184;<0.001	0.301;<0.001
wet1_2500_cnt	-0.125;<0.001	-0.084; 0.002	0.133;<0.001	0.186;<0.001
wet1_5000_cnt	0.022; 0.376	0.005; 0.843	0.133;<0.001	0.152;<0.001
wet2_500_cnt	-0.019; 0.500	-0.147;<0.001	-0.025; 0.350	0.207;<0.001
wet2_1000_cnt	-0.038; 0.150	-0.175;<0.001	-0.012; 0.631	0.072; 0.020
wet2_2500_cnt	-0.120;<0.001	-0.113;<0.001	-0.005; 0.828	0.075; 0.011
wet2_5000_cnt	-0.020; 0.409	0.065; 0.008	-0.066; 0.006	-0.027; 0.357
wet3_500_cnt	-0.067; 0.019	-0.071; 0.013	0.155;<0.001	0.277;<0.001
wet3_1000_cnt	-0.125;<0.001	-0.019; 0.489	0.132;<0.001	0.127;<0.001
wet3_2500_cnt	-0.099;<0.001	0.029; 0.248	0.035; 0.148	0.058; 0.052
wet3_5000_cnt	0.007; 0.788	0.023; 0.342	0.023; 0.343	-0.054; 0.066

Table G.1 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	cws_shrub	mrps	topo	wet1_500kd
wet4_500_cnt	0.097; 0.001	-0.170;<0.001	0.133;<0.001	0.569;<0.001
wet4_1000_cnt	0.093; 0.002	-0.202;<0.001	0.167;<0.001	0.187;<0.001
wet4_2500_cnt	-0.037; 0.164	-0.115;<0.001	0.185;<0.001	0.206;<0.001
wet4_5000_cnt	0.078; 0.002	-0.026; 0.300	0.274;<0.001	0.146;<0.001
wet1_all_cnt	-0.059; 0.017	-0.013; 0.599	0.195;<0.001	0.125;<0.001
wet2_all_cnt	-0.172;<0.001	0.140;<0.001	-0.126;<0.001	-0.110;<0.001
wet3_all_cnt	-0.109;<0.001	0.104;<0.001	-0.035; 0.148	-0.127;<0.001
wet4_all_cnt	0.091;<0.001	-0.021; 0.397	0.294;<0.001	0.119;<0.001
field_size	-0.200;<0.001	0.166;<0.001	-0.306;<0.001	-0.166;<0.001
tro_all_cnt	0.044; 0.114	-0.031; 0.262	-0.239;<0.001	-0.105; 0.002
dug_all_cnt	-0.205;<0.001	0.400;<0.001	-0.276;<0.001	-0.110;<0.001
wet1_all_xd	-0.056; 0.024	-0.043; 0.083	-0.040; 0.094	-0.165;<0.001
wet2_all_xd	-0.007; 0.766	0.062; 0.012	0.010; 0.685	-0.128;<0.001
wet3_all_xd	-0.007; 0.763	0.029; 0.242	-0.082;<0.001	-0.075; 0.010
wet4_all_xd	-0.048; 0.049	0.087;<0.001	-0.215;<0.001	-0.159;<0.001
tro_all_xd	-0.090; 0.001	0.306;<0.001	-0.317;<0.001	-0.035; 0.286
dug_all_xd	-0.096;<0.001	-0.049; 0.075	-0.161;<0.001	-0.129;<0.001
wet1_500_if_cnt	0.021; 0.489	-0.080; 0.008	0.072; 0.014	**0.747;<0.001**
wet1_1000_if_cnt	-0.035; 0.247	-0.117;<0.001	0.077; 0.009	0.155;<0.001
wet1_2500_if_cnt	-0.046; 0.114	-0.246;<0.001	0.082; 0.004	0.042; 0.225
wet1_5000_if_cnt	-0.030; 0.283	-0.236;<0.001	-0.018; 0.511	-0.069; 0.039
wet2_500_if_cnt	-0.043; 0.129	-0.147;<0.001	-0.091;<0.001	0.127;<0.001
wet2_1000_if_cnt	-0.049; 0.067	-0.187;<0.001	-0.095;<0.001	-0.008; 0.791
wet2_2500_if_cnt	-0.083;<0.001	-0.184;<0.001	-0.136;<0.001	-0.033; 0.272
wet2_5000_if_cnt	-0.145;<0.001	-0.164;<0.001	-0.108;<0.001	-0.089; 0.003
wet3_500_if_cnt	-0.088; 0.002	-0.081; 0.005	0.094;<0.001	0.239;<0.001
wet3_1000_if_cnt	-0.144;<0.001	-0.064; 0.024	0.083; 0.003	0.115;<0.001
wet3_2500_if_cnt	-0.156;<0.001	-0.004; 0.871	-0.028; 0.284	-0.006; 0.856
wet3_5000_if_cnt	-0.076; 0.003	-0.037; 0.141	0.016; 0.507	-0.101;<0.001
wet4_500_if_cnt	0.064; 0.033	-0.154;<0.001	0.082; 0.005	0.369;<0.001
wet4_1000_if_cnt	0.034; 0.243	-0.196;<0.001	0.106;<0.001	0.133;<0.001
wet4_2500_if_cnt	-0.042; 0.138	-0.248;<0.001	0.126;<0.001	0.091; 0.006
wet4_5000_if_cnt	-0.087; 0.001	-0.109;<0.001	0.060; 0.025	-0.051; 0.112

Table G.1 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	cws_shrub	mrps	topo	wet1_500kd
wet1_all_if_xd	0.124;<0.001	-0.060; 0.021	0.100;<0.001	-0.094; 0.003
wet2_all_if_xd	0.044; 0.089	0.053; 0.041	0.060; 0.018	-0.136;<0.001
wet3_all_if_xd	0.103;<0.001	-0.036; 0.168	0.062; 0.015	-0.143;<0.001
wet4_all_if_xd	0.093;<0.001	-0.045; 0.084	0.079; 0.002	-0.121;<0.001
wet1_if_density	0.051; 0.056	-0.334;<0.001	0.074; 0.004	0.103; 0.001
wet2_if_density	-0.001; 0.976	-0.320;<0.001	-0.034; 0.194	0.026; 0.411
wet3_if_density	-0.029; 0.267	-0.022; 0.415	0.156;<0.001	0.012; 0.713
wet4_if_density	0.132;<0.001	-0.227;<0.001	0.191;<0.001	0.065; 0.038

Table G.2: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet1_1000kd	wet1_2500kd	wet1_5000kd	wet2_500kd
cws_shrub	0.021; 0.466	-0.138;<0.001	-0.054; 0.033	-0.020; 0.459
mrps	-0.119;<0.001	-0.069; 0.010	0.045; 0.076	-0.128;<0.001
topo	0.186;<0.001	0.127;<0.001	0.028; 0.250	-0.059; 0.026
wet1_500kd	0.543;<0.001	0.253;<0.001	0.171;<0.001	0.190;<0.001
wet1_1000kd	**1.000;<0.001**	0.367;<0.001	0.209;<0.001	0.139;<0.001
wet1_2500kd	0.367;<0.001	**1.000;<0.001**	0.429;<0.001	0.059; 0.039
wet1_5000kd	0.209;<0.001	0.429;<0.001	**1.000;<0.001**	0.037; 0.178
wet2_500kd	0.139;<0.001	0.059; 0.039	0.037; 0.178	**1.000;<0.001**
wet2_1000kd	0.161;<0.001	0.051; 0.057	0.042; 0.101	0.546;<0.001
wet2_2500kd	0.007; 0.806	0.087;<0.001	0.034; 0.167	0.341;<0.001
wet2_5000kd	-0.181;<0.001	-0.086;<0.001	-0.045; 0.066	0.194;<0.001
wet3_500kd	0.269;<0.001	0.270;<0.001	0.227;<0.001	0.376;<0.001
wet3_1000kd	0.319;<0.001	0.285;<0.001	0.299;<0.001	0.200;<0.001
wet3_2500kd	0.154;<0.001	0.343;<0.001	0.413;<0.001	0.049; 0.067
wet3_5000kd	-0.007; 0.815	0.136;<0.001	0.387;<0.001	-0.027; 0.312
wet4_500kd	0.354;<0.001	0.181;<0.001	0.155;<0.001	0.199;<0.001
wet4_1000kd	0.551;<0.001	0.263;<0.001	0.197;<0.001	0.132;<0.001
wet4_2500kd	0.289;<0.001	0.466;<0.001	0.365;<0.001	0.049; 0.080
wet4_5000kd	0.190;<0.001	0.244;<0.001	0.474;<0.001	-0.036; 0.182
wet1_500_cnt	0.565;<0.001	0.268;<0.001	0.187;<0.001	0.200;<0.001
wet1_1000_cnt	**0.896;<0.001**	0.340;<0.001	0.215;<0.001	0.081; 0.010
wet1_2500_cnt	0.199;<0.001	**0.829;<0.001**	0.499;<0.001	0.021; 0.484

Table G.2 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet1_1000kd	wet1_2500kd	wet1_5000kd	wet2_500kd
wet1_5000_cnt	0.184;<0.001	0.271;<0.001	**0.763;<0.001**	0.004; 0.884
wet2_500_cnt	0.163;<0.001	0.107;<0.001	0.097;<0.001	**0.830;<0.001**
wet2_1000_cnt	0.183;<0.001	0.116;<0.001	0.141;<0.001	0.352;<0.001
wet2_2500_cnt	0.098;<0.001	0.300;<0.001	0.373;<0.001	0.214;<0.001
wet2_5000_cnt	-0.060; 0.037	0.128;<0.001	0.352;<0.001	0.039; 0.139
wet3_500_cnt	0.267;<0.001	0.271;<0.001	0.237;<0.001	0.390;<0.001
wet3_1000_cnt	0.278;<0.001	0.261;<0.001	0.303;<0.001	0.124;<0.001
wet3_2500_cnt	0.053; 0.070	0.279;<0.001	0.424;<0.001	0.043; 0.113
wet3_5000_cnt	-0.100;<0.001	-0.003; 0.906	0.244;<0.001	0.002; 0.927
wet4_500_cnt	0.361;<0.001	0.179;<0.001	0.159;<0.001	0.206;<0.001
wet4_1000_cnt	0.522;<0.001	0.260;<0.001	0.183;<0.001	0.079; 0.012
wet4_2500_cnt	0.249;<0.001	0.500;<0.001	0.402;<0.001	0.032; 0.259
wet4_5000_cnt	0.187;<0.001	0.218;<0.001	0.471;<0.001	-0.074; 0.006
wet1_all_cnt	0.183;<0.001	0.305;<0.001	0.482;<0.001	-0.036; 0.181
wet2_all_cnt	-0.154;<0.001	0.031; 0.237	0.206;<0.001	0.017; 0.532
wet3_all_cnt	-0.186;<0.001	-0.040; 0.123	0.112;<0.001	-0.039; 0.144
wet4_all_cnt	0.151;<0.001	0.116;<0.001	0.176;<0.001	-0.221;<0.001
field_size	-0.222;<0.001	-0.174;<0.001	-0.232;<0.001	0.022; 0.446
tro_all_cnt	-0.156;<0.001	-0.153;<0.001	-0.246;<0.001	0.099;<0.001
dug_all_cnt	-0.187;<0.001	-0.138;<0.001	-0.095;<0.001	-0.129;<0.001
wet1_all_xd	-0.171;<0.001	-0.249;<0.001	-0.486;<0.001	0.013; 0.622
wet2_all_xd	-0.129;<0.001	-0.269;<0.001	-0.426;<0.001	-0.155;<0.001
wet3_all_xd	-0.061; 0.033	-0.124;<0.001	-0.331;<0.001	-0.037; 0.168
wet4_all_xd	-0.172;<0.001	-0.220;<0.001	-0.448;<0.001	0.001; 0.965
tro_all_xd	-0.109;<0.001	0.004; 0.883	0.345;<0.001	0.007; 0.825
dug_all_xd	-0.196;<0.001	-0.164;<0.001	-0.065; 0.017	-0.034; 0.244
wet1_500_if_cnt	0.441;<0.001	0.176;<0.001	0.094; 0.002	0.180;<0.001
wet1_1000_if_cnt	0.678;<0.001	0.194;<0.001	0.050; 0.091	0.095; 0.003
wet1_2500_if_cnt	0.027; 0.420	0.386;<0.001	0.018; 0.547	0.123;<0.001
wet1_5000_if_cnt	-0.041; 0.209	-0.100;<0.001	0.065; 0.022	0.104;<0.001
wet2_500_if_cnt	0.088; 0.007	0.041; 0.165	-0.008; 0.786	**0.749;<0.001**
wet2_1000_if_cnt	0.077; 0.013	0.026; 0.365	-0.021; 0.428	0.315;<0.001
wet2_2500_if_cnt	0.012; 0.694	0.051; 0.055	-0.059; 0.019	0.224;<0.001

Table G.2 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet1_1000kd	wet1_2500kd	wet1_5000kd	wet2_500kd
wet2_5000_if_cnt	-0.043; 0.145	0.135;<0.001	-0.009; 0.720	0.058; 0.031
wet3_500_if_cnt	0.237;<0.001	0.205;<0.001	0.147;<0.001	0.355;<0.001
wet3_1000_if_cnt	0.262;<0.001	0.183;<0.001	0.151;<0.001	0.120;<0.001
wet3_2500_if_cnt	0.018; 0.559	0.162;<0.001	0.092;<0.001	0.032; 0.258
wet3_5000_if_cnt	-0.109;<0.001	-0.101;<0.001	-0.112;<0.001	-0.068; 0.013
wet4_500_if_cnt	0.250;<0.001	0.111;<0.001	0.093; 0.002	0.195;<0.001
wet4_1000_if_cnt	0.372;<0.001	0.161;<0.001	0.065; 0.027	0.093; 0.004
wet4_2500_if_cnt	0.156;<0.001	0.221;<0.001	0.021; 0.455	0.112;<0.001
wet4_5000_if_cnt	-0.013; 0.670	-0.005; 0.853	-0.012; 0.667	-0.013; 0.651
wet1_all_if_xd	-0.181;<0.001	-0.010; 0.716	0.322;<0.001	-0.037; 0.186
wet2_all_if_xd	-0.205;<0.001	-0.147;<0.001	-0.033; 0.205	-0.242;<0.001
wet3_all_if_xd	-0.204;<0.001	-0.205;<0.001	-0.078; 0.003	-0.135;<0.001
wet4_all_if_xd	-0.183;<0.001	-0.068; 0.014	0.144;<0.001	-0.027; 0.331
wet1_if_density	0.157;<0.001	0.226;<0.001	0.217;<0.001	0.159;<0.001
wet2_if_density	0.059; 0.056	0.090; 0.001	0.012; 0.655	0.196;<0.001
wet3_if_density	-0.005; 0.881	-0.036; 0.204	0.016; 0.558	-0.061; 0.033
wet4_if_density	0.096; 0.002	0.018; 0.527	-0.036; 0.172	0.042; 0.142

Table G.3: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet2_1000kd	wet2_2500kd	wet2_5000kd	wet3_500kd
cws_shrub	-0.009; 0.717	0.030; 0.230	0.010; 0.678	-0.061; 0.032
mrps	-0.167;<0.001	-0.118;<0.001	0.041; 0.096	-0.057; 0.045
topo	-0.081; 0.001	-0.130;<0.001	-0.247;<0.001	0.146;<0.001
wet1_500kd	0.103;<0.001	0.026; 0.382	-0.116;<0.001	0.273;<0.001
wet1_1000kd	0.161;<0.001	0.007; 0.806	-0.181;<0.001	0.269;<0.001
wet1_2500kd	0.051; 0.057	0.087;<0.001	-0.086;<0.001	0.270;<0.001
wet1_5000kd	0.042; 0.101	0.034; 0.167	-0.045; 0.066	0.227;<0.001
wet2_500kd	0.546;<0.001	0.341;<0.001	0.194;<0.001	0.376;<0.001
wet2_1000kd	**1.000;<0.001**	0.490;<0.001	0.319;<0.001	0.185;<0.001
wet2_2500kd	0.490;<0.001	**1.000;<0.001**	0.562;<0.001	0.041; 0.137
wet2_5000kd	0.319;<0.001	0.562;<0.001	**1.000;<0.001**	-0.099;<0.001
wet3_500kd	0.185;<0.001	0.041; 0.137	-0.099;<0.001	**1.000;<0.001**
wet3_1000kd	0.274;<0.001	0.091;<0.001	-0.074; 0.004	0.604;<0.001

Table G.3 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet2_1000kd	wet2_2500kd	wet2_5000kd	wet3_500kd
wet3_2500kd	0.077; 0.002	0.144;<0.001	0.032; 0.190	0.325;<0.001
wet3_5000kd	-0.038; 0.130	0.033; 0.167	0.097;<0.001	0.224;<0.001
wet4_500kd	0.100;<0.001	0.024; 0.407	-0.127;<0.001	0.312;<0.001
wet4_1000kd	0.143;<0.001	0.023; 0.419	-0.194;<0.001	0.338;<0.001
wet4_2500kd	0.001; 0.957	-0.039; 0.127	-0.261;<0.001	0.328;<0.001
wet4_5000kd	-0.078; 0.002	-0.142;<0.001	-0.299;<0.001	0.243;<0.001
wet1_500_cnt	0.113;<0.001	0.029; 0.326	-0.121;<0.001	0.291;<0.001
wet1_1000_cnt	0.141;<0.001	-0.000; 0.995	-0.187;<0.001	0.209;<0.001
wet1_2500_cnt	-0.018; 0.517	0.013; 0.636	-0.164;<0.001	0.264;<0.001
wet1_5000_cnt	-0.007; 0.778	-0.076; 0.002	-0.193;<0.001	0.237;<0.001
wet2_500_cnt	0.479;<0.001	0.272;<0.001	0.112;<0.001	0.477;<0.001
wet2_1000_cnt	0.618;<0.001	0.309;<0.001	0.118;<0.001	0.258;<0.001
wet2_2500_cnt	0.285;<0.001	0.435;<0.001	0.240;<0.001	0.246;<0.001
wet2_5000_cnt	0.120;<0.001	0.205;<0.001	0.271;<0.001	0.187;<0.001
wet3_500_cnt	0.202;<0.001	0.039; 0.161	-0.104;<0.001	**0.923;<0.001**
wet3_1000_cnt	0.275;<0.001	0.093;<0.001	-0.057; 0.032	0.436;<0.001
wet3_2500_cnt	0.070; 0.005	0.162;<0.001	0.038; 0.119	0.274;<0.001
wet3_5000_cnt	0.006; 0.817	0.029; 0.229	0.064; 0.008	0.169;<0.001
wet4_500_cnt	0.109;<0.001	0.023; 0.438	-0.126;<0.001	0.321;<0.001
wet4_1000_cnt	0.147;<0.001	0.030; 0.300	-0.188;<0.001	0.259;<0.001
wet4_2500_cnt	-0.032; 0.234	-0.048; 0.065	-0.264;<0.001	0.322;<0.001
wet4_5000_cnt	-0.155;<0.001	-0.236;<0.001	-0.336;<0.001	0.192;<0.001
wet1_all_cnt	-0.054; 0.032	-0.131;<0.001	-0.231;<0.001	0.288;<0.001
wet2_all_cnt	0.063; 0.013	0.120;<0.001	0.212;<0.001	0.156;<0.001
wet3_all_cnt	-0.011; 0.668	0.037; 0.128	0.109;<0.001	0.151;<0.001
wet4_all_cnt	-0.312;<0.001	-0.418;<0.001	-0.588;<0.001	0.138;<0.001
field_size	0.093;<0.001	0.198;<0.001	0.416;<0.001	-0.176;<0.001
tro_all_cnt	0.158;<0.001	0.239;<0.001	0.286;<0.001	-0.277;<0.001
dug_all_cnt	-0.117;<0.001	-0.013; 0.616	0.201;<0.001	-0.184;<0.001
wet1_all_xd	-0.006; 0.799	-0.048; 0.049	-0.039; 0.104	-0.082; 0.003
wet2_all_xd	-0.229;<0.001	-0.283;<0.001	-0.204;<0.001	-0.237;<0.001
wet3_all_xd	-0.048; 0.053	-0.039; 0.108	0.042; 0.079	-0.237;<0.001
wet4_all_xd	0.057; 0.022	0.145;<0.001	0.257;<0.001	-0.214;<0.001

Table G.3 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet2_1000kd	wet2_2500kd	wet2_5000kd	wet3_500kd
tro_all_xd	0.081; 0.004	0.194;<0.001	0.305;<0.001	0.112;<0.001
dug_all_xd	0.036; 0.185	0.103;<0.001	0.151;<0.001	-0.122;<0.001
wet1_500_if_cnt	0.113;<0.001	0.017; 0.567	-0.087; 0.003	0.258;<0.001
wet1_1000_if_cnt	0.150;<0.001	0.010; 0.742	-0.106;<0.001	0.166;<0.001
wet1_2500_if_cnt	0.113;<0.001	0.068; 0.017	-0.059; 0.038	0.166;<0.001
wet1_5000_if_cnt	0.178;<0.001	0.136;<0.001	0.097;<0.001	0.044; 0.168
wet2_500_if_cnt	0.462;<0.001	0.297;<0.001	0.183;<0.001	0.348;<0.001
wet2_1000_if_cnt	0.520;<0.001	0.293;<0.001	0.190;<0.001	0.165;<0.001
wet2_2500_if_cnt	0.270;<0.001	0.273;<0.001	0.260;<0.001	0.077; 0.006
wet2_5000_if_cnt	0.133;<0.001	0.177;<0.001	0.266;<0.001	0.039; 0.168
wet3_500_if_cnt	0.208;<0.001	0.036; 0.199	-0.072; 0.011	**0.771;<0.001**
wet3_1000_if_cnt	0.204;<0.001	0.015; 0.584	-0.081; 0.003	0.359;<0.001
wet3_2500_if_cnt	0.053; 0.043	0.060; 0.020	0.035; 0.173	0.190;<0.001
wet3_5000_if_cnt	-0.070; 0.006	-0.077; 0.002	0.011; 0.657	0.061; 0.031
wet4_500_if_cnt	0.107;<0.001	0.015; 0.615	-0.086; 0.003	0.294;<0.001
wet4_1000_if_cnt	0.131;<0.001	0.028; 0.340	-0.134;<0.001	0.239;<0.001
wet4_2500_if_cnt	0.094; 0.001	-0.027; 0.330	-0.159;<0.001	0.279;<0.001
wet4_5000_if_cnt	0.025; 0.363	0.028; 0.301	0.001; 0.969	0.068; 0.026
wet1_all_if_xd	-0.025; 0.338	0.054; 0.034	0.080; 0.002	0.040; 0.172
wet2_all_if_xd	-0.239;<0.001	-0.149;<0.001	-0.083; 0.001	-0.118;<0.001
wet3_all_if_xd	-0.165;<0.001	-0.138;<0.001	-0.124;<0.001	-0.172;<0.001
wet4_all_if_xd	-0.012; 0.638	0.054; 0.034	0.083; 0.001	-0.036; 0.226
wet1_if_density	0.203;<0.001	0.127;<0.001	-0.072; 0.006	0.203;<0.001
wet2_if_density	0.272;<0.001	0.235;<0.001	0.119;<0.001	0.186;<0.001
wet3_if_density	-0.093;<0.001	-0.143;<0.001	-0.179;<0.001	0.232;<0.001
wet4_if_density	0.042; 0.120	-0.023; 0.383	-0.163;<0.001	0.172;<0.001

Table G.4: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet3_1000kd	wet3_2500kd	wet3_5000kd	wet4_500kd
cws_shrub	-0.106;<0.001	-0.121;<0.001	-0.023; 0.344	0.080; 0.007
mrps	-0.004; 0.891	0.058; 0.018	0.128;<0.001	-0.161;<0.001
topo	0.126;<0.001	0.044; 0.073	0.059; 0.015	0.135;<0.001
wet1_500kd	0.209;<0.001	0.120;<0.001	0.022; 0.451	0.554;<0.001

Table G.4 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet3_1000kd	wet3_2500kd	wet3_5000kd	wet4_500kd
wet1_1000kd	0.319;<0.001	0.154;<0.001	-0.007; 0.815	0.354;<0.001
wet1_2500kd	0.285;<0.001	0.343;<0.001	0.136;<0.001	0.181;<0.001
wet1_5000kd	0.299;<0.001	0.413;<0.001	0.387;<0.001	0.155;<0.001
wet2_500kd	0.200;<0.001	0.049; 0.067	-0.027; 0.312	0.199;<0.001
wet2_1000kd	0.274;<0.001	0.077; 0.002	-0.038; 0.130	0.100;<0.001
wet2_2500kd	0.091;<0.001	0.144;<0.001	0.033; 0.167	0.024; 0.407
wet2_5000kd	-0.074; 0.004	0.032; 0.190	0.097;<0.001	-0.127;<0.001
wet3_500kd	0.604;<0.001	0.325;<0.001	0.224;<0.001	0.312;<0.001
wet3_1000kd	**1.000;<0.001**	0.489;<0.001	0.319;<0.001	0.244;<0.001
wet3_2500kd	0.489;<0.001	**1.000;<0.001**	0.575;<0.001	0.174;<0.001
wet3_5000kd	0.319;<0.001	0.575;<0.001	**1.000;<0.001**	0.068; 0.019
wet4_500kd	0.244;<0.001	0.174;<0.001	0.068; 0.019	**1.000;<0.001**
wet4_1000kd	0.400;<0.001	0.271;<0.001	0.092; 0.001	0.566;<0.001
wet4_2500kd	0.384;<0.001	0.466;<0.001	0.227;<0.001	0.290;<0.001
wet4_5000kd	0.287;<0.001	0.361;<0.001	0.437;<0.001	0.185;<0.001
wet1_500_cnt	0.227;<0.001	0.135;<0.001	0.031; 0.282	0.554;<0.001
wet1_1000_cnt	0.291;<0.001	0.155;<0.001	0.000; 0.988	0.277;<0.001
wet1_2500_cnt	0.257;<0.001	0.355;<0.001	0.179;<0.001	0.173;<0.001
wet1_5000_cnt	0.302;<0.001	0.366;<0.001	0.385;<0.001	0.166;<0.001
wet2_500_cnt	0.293;<0.001	0.122;<0.001	0.038; 0.156	0.274;<0.001
wet2_1000_cnt	0.427;<0.001	0.231;<0.001	0.087;<0.001	0.164;<0.001
wet2_2500_cnt	0.349;<0.001	0.550;<0.001	0.371;<0.001	0.128;<0.001
wet2_5000_cnt	0.284;<0.001	0.441;<0.001	0.570;<0.001	0.015; 0.608
wet3_500_cnt	0.604;<0.001	0.337;<0.001	0.236;<0.001	0.323;<0.001
wet3_1000_cnt	**0.821;<0.001**	0.496;<0.001	0.359;<0.001	0.168;<0.001
wet3_2500_cnt	0.412;<0.001	**0.750;<0.001**	0.597;<0.001	0.135;<0.001
wet3_5000_cnt	0.242;<0.001	0.426;<0.001	0.695;<0.001	0.016; 0.590
wet4_500_cnt	0.247;<0.001	0.164;<0.001	0.054; 0.062	**0.954;<0.001**
wet4_1000_cnt	0.377;<0.001	0.266;<0.001	0.096;<0.001	0.284;<0.001
wet4_2500_cnt	0.341;<0.001	0.468;<0.001	0.239;<0.001	0.245;<0.001
wet4_5000_cnt	0.202;<0.001	0.263;<0.001	0.393;<0.001	0.129;<0.001
wet1_all_cnt	0.388;<0.001	0.481;<0.001	0.413;<0.001	0.148;<0.001
wet2_all_cnt	0.268;<0.001	0.431;<0.001	0.470;<0.001	-0.051; 0.083

Table G.4 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet3_1000kd	wet3_2500kd	wet3_5000kd	wet4_500kd
wet3_all_cnt	0.233;<0.001	0.361;<0.001	0.437;<0.001	-0.053; 0.068
wet4_all_cnt	0.143;<0.001	0.107;<0.001	0.125;<0.001	0.126;<0.001
field_size	-0.151;<0.001	-0.116;<0.001	-0.134;<0.001	-0.165;<0.001
tro_all_cnt	-0.346;<0.001	-0.443;<0.001	-0.463;<0.001	-0.126;<0.001
dug_all_cnt	-0.134;<0.001	-0.061; 0.021	-0.045; 0.085	-0.195;<0.001
wet1_all_xd	-0.096;<0.001	-0.161;<0.001	-0.178;<0.001	-0.099;<0.001
wet2_all_xd	-0.300;<0.001	-0.368;<0.001	-0.399;<0.001	-0.115;<0.001
wet3_all_xd	-0.332;<0.001	-0.457;<0.001	-0.584;<0.001	-0.125;<0.001
wet4_all_xd	-0.212;<0.001	-0.294;<0.001	-0.370;<0.001	-0.188;<0.001
tro_all_xd	0.237;<0.001	0.432;<0.001	0.433;<0.001	-0.015; 0.637
dug_all_xd	-0.092; 0.002	-0.019; 0.486	-0.084; 0.002	-0.088; 0.006
wet1_500_if_cnt	0.204;<0.001	0.084; 0.005	0.001; 0.981	0.389;<0.001
wet1_1000_if_cnt	0.239;<0.001	0.067; 0.022	-0.047; 0.104	0.154;<0.001
wet1_2500_if_cnt	0.109;<0.001	0.058; 0.042	-0.096;<0.001	0.111; 0.001
wet1_5000_if_cnt	0.065; 0.030	0.034; 0.219	0.020; 0.473	0.076; 0.023
wet2_500_if_cnt	0.210;<0.001	0.065; 0.018	0.003; 0.909	0.186;<0.001
wet2_1000_if_cnt	0.241;<0.001	0.087;<0.001	-0.007; 0.789	0.081; 0.010
wet2_2500_if_cnt	0.093;<0.001	0.092;<0.001	0.007; 0.787	0.017; 0.558
wet2_5000_if_cnt	0.047; 0.076	0.066; 0.008	0.027; 0.278	-0.006; 0.852
wet3_500_if_cnt	0.517;<0.001	0.279;<0.001	0.195;<0.001	0.266;<0.001
wet3_1000_if_cnt	0.597;<0.001	0.345;<0.001	0.244;<0.001	0.145;<0.001
wet3_2500_if_cnt	0.252;<0.001	0.370;<0.001	0.224;<0.001	0.068; 0.028
wet3_5000_if_cnt	0.083; 0.002	0.140;<0.001	0.220;<0.001	-0.020; 0.499
wet4_500_if_cnt	0.215;<0.001	0.117;<0.001	0.025; 0.397	**0.783;<0.001**
wet4_1000_if_cnt	0.312;<0.001	0.190;<0.001	0.051; 0.076	0.230;<0.001
wet4_2500_if_cnt	0.257;<0.001	0.174;<0.001	-0.003; 0.912	0.193;<0.001
wet4_5000_if_cnt	0.068; 0.017	0.090;<0.001	0.162;<0.001	-0.010; 0.749
wet1_all_if_xd	0.049; 0.077	0.153;<0.001	0.255;<0.001	0.023; 0.453
wet2_all_if_xd	-0.102;<0.001	-0.059; 0.022	-0.019; 0.451	-0.029; 0.344
wet3_all_if_xd	-0.187;<0.001	-0.131;<0.001	0.013; 0.612	-0.062; 0.044
wet4_all_if_xd	0.001; 0.981	0.117;<0.001	0.288;<0.001	-0.069; 0.024
wet1_if_density	0.188;<0.001	0.076; 0.004	-0.071; 0.007	0.175;<0.001
wet2_if_density	0.169;<0.001	0.056; 0.031	-0.055; 0.034	0.091; 0.004

Table G.4 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet3_1000kd	wet3_2500kd	wet3_5000kd	wet4_500kd
wet3_if_density	0.272;<0.001	0.332;<0.001	0.390;<0.001	0.068; 0.030
wet4_if_density	0.165;<0.001	0.147;<0.001	0.177;<0.001	0.128;<0.001

Table G.5: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet4_1000kd	wet4_2500kd	wet4_5000kd	wet1_500_cnt
cws_shrub	0.091; 0.001	-0.022; 0.390	0.072; 0.004	0.063; 0.035
mrps	-0.206;<0.001	-0.126;<0.001	-0.069; 0.005	-0.104;<0.001
topo	0.171;<0.001	0.157;<0.001	0.260;<0.001	0.140;<0.001
wet1_500kd	0.320;<0.001	0.210;<0.001	0.151;<0.001	**0.955;<0.001**
wet1_1000kd	0.551;<0.001	0.289;<0.001	0.190;<0.001	0.565;<0.001
wet1_2500kd	0.263;<0.001	0.466;<0.001	0.244;<0.001	0.268;<0.001
wet1_5000kd	0.197;<0.001	0.365;<0.001	0.474;<0.001	0.187;<0.001
wet2_500kd	0.132;<0.001	0.049; 0.080	-0.036; 0.182	0.200;<0.001
wet2_1000kd	0.143;<0.001	0.001; 0.957	-0.078; 0.002	0.113;<0.001
wet2_2500kd	0.023; 0.419	-0.039; 0.127	-0.142;<0.001	0.029; 0.326
wet2_5000kd	-0.194;<0.001	-0.261;<0.001	-0.299;<0.001	-0.121;<0.001
wet3_500kd	0.338;<0.001	0.328;<0.001	0.243;<0.001	0.291;<0.001
wet3_1000kd	0.400;<0.001	0.384;<0.001	0.287;<0.001	0.227;<0.001
wet3_2500kd	0.271;<0.001	0.466;<0.001	0.361;<0.001	0.135;<0.001
wet3_5000kd	0.092; 0.001	0.227;<0.001	0.437;<0.001	0.031; 0.282
wet4_500kd	0.566;<0.001	0.290;<0.001	0.185;<0.001	0.554;<0.001
wet4_1000kd	**1.000;<0.001**	0.447;<0.001	0.246;<0.001	0.348;<0.001
wet4_2500kd	0.447;<0.001	**1.000;<0.001**	0.417;<0.001	0.225;<0.001
wet4_5000kd	0.246;<0.001	0.417;<0.001	**1.000;<0.001**	0.166;<0.001
wet1_500_cnt	0.348;<0.001	0.225;<0.001	0.166;<0.001	**1.000;<0.001**
wet1_1000_cnt	0.545;<0.001	0.278;<0.001	0.198;<0.001	0.322;<0.001
wet1_2500_cnt	0.223;<0.001	0.508;<0.001	0.334;<0.001	0.206;<0.001
wet1_5000_cnt	0.220;<0.001	0.367;<0.001	0.617;<0.001	0.169;<0.001
wet2_500_cnt	0.230;<0.001	0.140;<0.001	0.045; 0.098	0.224;<0.001
wet2_1000_cnt	0.326;<0.001	0.169;<0.001	0.092;<0.001	0.092; 0.003
wet2_2500_cnt	0.188;<0.001	0.346;<0.001	0.254;<0.001	0.083; 0.005
wet2_5000_cnt	0.012; 0.683	0.131;<0.001	0.277;<0.001	-0.017; 0.558
wet3_500_cnt	0.343;<0.001	0.343;<0.001	0.257;<0.001	0.299;<0.001

Table G.5 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet4_1000kd	wet4_2500kd	wet4_5000kd	wet1_500_cnt
wet3_1000_cnt	0.364;<0.001	0.376;<0.001	0.312;<0.001	0.141;<0.001
wet3_2500_cnt	0.206;<0.001	0.436;<0.001	0.419;<0.001	0.066; 0.026
wet3_5000_cnt	0.018; 0.521	0.153;<0.001	0.444;<0.001	-0.044; 0.132
wet4_500_cnt	0.573;<0.001	0.291;<0.001	0.177;<0.001	0.569;<0.001
wet4_1000_cnt	**0.842;<0.001**	0.400;<0.001	0.245;<0.001	0.223;<0.001
wet4_2500_cnt	0.344;<0.001	**0.846;<0.001**	0.408;<0.001	0.221;<0.001
wet4_5000_cnt	0.167;<0.001	0.285;<0.001	**0.761;<0.001**	0.157;<0.001
wet1_all_cnt	0.223;<0.001	0.393;<0.001	0.539;<0.001	0.142;<0.001
wet2_all_cnt	-0.045; 0.112	0.030; 0.245	0.103;<0.001	-0.105;<0.001
wet3_all_cnt	-0.053; 0.059	0.026; 0.301	0.178;<0.001	-0.122;<0.001
wet4_all_cnt	0.208;<0.001	0.327;<0.001	0.422;<0.001	0.124;<0.001
field_size	-0.241;<0.001	-0.375;<0.001	-0.552;<0.001	-0.178;<0.001
tro_all_cnt	-0.200;<0.001	-0.332;<0.001	-0.447;<0.001	-0.126;<0.001
dug_all_cnt	-0.258;<0.001	-0.319;<0.001	-0.394;<0.001	-0.128;<0.001
wet1_all_xd	-0.100;<0.001	-0.156;<0.001	-0.230;<0.001	-0.179;<0.001
wet2_all_xd	-0.151;<0.001	-0.235;<0.001	-0.351;<0.001	-0.133;<0.001
wet3_all_xd	-0.161;<0.001	-0.290;<0.001	-0.506;<0.001	-0.082; 0.005
wet4_all_xd	-0.237;<0.001	-0.379;<0.001	-0.567;<0.001	-0.174;<0.001
tro_all_xd	-0.022; 0.503	0.044; 0.131	0.022; 0.421	-0.035; 0.291
dug_all_xd	-0.155;<0.001	-0.106;<0.001	-0.218;<0.001	-0.130;<0.001
wet1_500_if_cnt	0.249;<0.001	0.152;<0.001	0.094; 0.001	**0.779;<0.001**
wet1_1000_if_cnt	0.361;<0.001	0.142;<0.001	0.059; 0.047	0.168;<0.001
wet1_2500_if_cnt	0.121;<0.001	0.119;<0.001	0.004; 0.884	0.067; 0.052
wet1_5000_if_cnt	0.063; 0.051	0.049; 0.093	0.003; 0.911	-0.055; 0.102
wet2_500_if_cnt	0.142;<0.001	0.036; 0.214	-0.051; 0.066	0.147;<0.001
wet2_1000_if_cnt	0.196;<0.001	0.006; 0.822	-0.077; 0.003	0.013; 0.675
wet2_2500_if_cnt	0.059; 0.041	0.000; 0.985	-0.163;<0.001	-0.025; 0.398
wet2_5000_if_cnt	-0.030; 0.301	-0.068; 0.009	-0.191;<0.001	-0.081; 0.006
wet3_500_if_cnt	0.285;<0.001	0.257;<0.001	0.189;<0.001	0.268;<0.001
wet3_1000_if_cnt	0.322;<0.001	0.244;<0.001	0.206;<0.001	0.134;<0.001
wet3_2500_if_cnt	0.140;<0.001	0.154;<0.001	0.053; 0.041	0.004; 0.909
wet3_5000_if_cnt	-0.037; 0.202	-0.045; 0.086	0.097;<0.001	-0.092; 0.002
wet4_500_if_cnt	0.479;<0.001	0.220;<0.001	0.109;<0.001	0.380;<0.001

Table G.5 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet4_1000kd	wet4_2500kd	wet4_5000kd	wet1_500_cnt
wet4_1000_if_cnt	0.663;<0.001	0.287;<0.001	0.143;<0.001	0.181;<0.001
wet4_2500_if_cnt	0.284;<0.001	0.407;<0.001	0.077; 0.006	0.116;<0.001
wet4_5000_if_cnt	-0.060; 0.055	-0.083; 0.003	0.186;<0.001	-0.039; 0.229
wet1_all_if_xd	-0.002; 0.953	0.175;<0.001	0.263;<0.001	-0.103;<0.001
wet2_all_if_xd	-0.131;<0.001	-0.047; 0.082	-0.047; 0.067	-0.136;<0.001
wet3_all_if_xd	-0.177;<0.001	-0.075; 0.006	0.123;<0.001	-0.142;<0.001
wet4_all_if_xd	-0.152;<0.001	-0.016; 0.555	0.311;<0.001	-0.129;<0.001
wet1_if_density	0.226;<0.001	0.293;<0.001	0.170;<0.001	0.125;<0.001
wet2_if_density	0.146;<0.001	0.110;<0.001	-0.041; 0.114	0.048; 0.123
wet3_if_density	0.106;<0.001	0.168;<0.001	0.353;<0.001	0.033; 0.288
wet4_if_density	0.166;<0.001	0.211;<0.001	0.356;<0.001	0.088; 0.005

Table G.6: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet1_1000_cnt	wet1_2500_cnt	wet1_5000_cnt	wet2_500_cnt
cws_shrub	0.042; 0.153	-0.125;<0.001	0.022; 0.376	-0.019; 0.500
mrps	-0.133;<0.001	-0.084; 0.002	0.005; 0.843	-0.147;<0.001
topo	0.184;<0.001	0.133;<0.001	0.133;<0.001	-0.025; 0.350
wet1_500kd	0.301;<0.001	0.186;<0.001	0.152;<0.001	0.207;<0.001
wet1_1000kd	**0.896;<0.001**	0.199;<0.001	0.184;<0.001	0.163;<0.001
wet1_2500kd	0.340;<0.001	**0.829;<0.001**	0.271;<0.001	0.107;<0.001
wet1_5000kd	0.215;<0.001	0.499;<0.001	**0.763;<0.001**	0.097;<0.001
wet2_500kd	0.081; 0.010	0.021; 0.484	0.004; 0.884	**0.830;<0.001**
wet2_1000kd	0.141;<0.001	-0.018; 0.517	-0.007; 0.778	0.479;<0.001
wet2_2500kd	-0.000; 0.995	0.013; 0.636	-0.076; 0.002	0.272;<0.001
wet2_5000kd	-0.187;<0.001	-0.164;<0.001	-0.193;<0.001	0.112;<0.001
wet3_500kd	0.209;<0.001	0.264;<0.001	0.237;<0.001	0.477;<0.001
wet3_1000kd	0.291;<0.001	0.257;<0.001	0.302;<0.001	0.293;<0.001
wet3_2500kd	0.155;<0.001	0.355;<0.001	0.366;<0.001	0.122;<0.001
wet3_5000kd	0.000; 0.988	0.179;<0.001	0.385;<0.001	0.038; 0.156
wet4_500kd	0.277;<0.001	0.173;<0.001	0.166;<0.001	0.274;<0.001
wet4_1000kd	0.545;<0.001	0.223;<0.001	0.220;<0.001	0.230;<0.001
wet4_2500kd	0.278;<0.001	0.508;<0.001	0.367;<0.001	0.140;<0.001
wet4_5000kd	0.198;<0.001	0.334;<0.001	0.617;<0.001	0.045; 0.098

Table G.6 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet1_1000_cnt	wet1_2500_cnt	wet1_5000_cnt	wet2_500_cnt
wet1_500_cnt	0.322;<0.001	0.206;<0.001	0.169;<0.001	0.224;<0.001
wet1_1000_cnt	**1.000;<0.001**	0.208;<0.001	0.192;<0.001	0.111;<0.001
wet1_2500_cnt	0.208;<0.001	**1.000;<0.001**	0.368;<0.001	0.092; 0.002
wet1_5000_cnt	0.192;<0.001	0.368;<0.001	**1.000;<0.001**	0.075; 0.007
wet2_500_cnt	0.111;<0.001	0.092; 0.002	0.075; 0.007	**1.000;<0.001**
wet2_1000_cnt	0.205;<0.001	0.100;<0.001	0.127;<0.001	0.414;<0.001
wet2_2500_cnt	0.087; 0.003	0.297;<0.001	0.291;<0.001	0.240;<0.001
wet2_5000_cnt	-0.070; 0.016	0.133;<0.001	0.349;<0.001	0.062; 0.022
wet3_500_cnt	0.198;<0.001	0.271;<0.001	0.252;<0.001	0.493;<0.001
wet3_1000_cnt	0.269;<0.001	0.235;<0.001	0.314;<0.001	0.210;<0.001
wet3_2500_cnt	0.055; 0.061	0.327;<0.001	0.430;<0.001	0.109;<0.001
wet3_5000_cnt	-0.098;<0.001	0.051; 0.059	0.338;<0.001	0.045; 0.099
wet4_500_cnt	0.285;<0.001	0.172;<0.001	0.169;<0.001	0.288;<0.001
wet4_1000_cnt	0.580;<0.001	0.227;<0.001	0.212;<0.001	0.155;<0.001
wet4_2500_cnt	0.240;<0.001	0.572;<0.001	0.388;<0.001	0.117;<0.001
wet4_5000_cnt	0.195;<0.001	0.311;<0.001	0.624;<0.001	-0.001; 0.971
wet1_all_cnt	0.179;<0.001	0.380;<0.001	0.578;<0.001	0.047; 0.081
wet2_all_cnt	-0.169;<0.001	0.028; 0.309	0.165;<0.001	0.044; 0.112
wet3_all_cnt	-0.199;<0.001	-0.022; 0.402	0.160;<0.001	-0.007; 0.783
wet4_all_cnt	0.154;<0.001	0.205;<0.001	0.347;<0.001	-0.149;<0.001
field_size	-0.226;<0.001	-0.242;<0.001	-0.397;<0.001	-0.027; 0.348
tro_all_cnt	-0.177;<0.001	-0.240;<0.001	-0.364;<0.001	0.013; 0.673
dug_all_cnt	-0.197;<0.001	-0.152;<0.001	-0.209;<0.001	-0.164;<0.001
wet1_all_xd	-0.173;<0.001	-0.303;<0.001	-0.427;<0.001	-0.006; 0.814
wet2_all_xd	-0.128;<0.001	-0.276;<0.001	-0.405;<0.001	-0.182;<0.001
wet3_all_xd	-0.074; 0.010	-0.198;<0.001	-0.425;<0.001	-0.097;<0.001
wet4_all_xd	-0.185;<0.001	-0.325;<0.001	-0.528;<0.001	-0.079; 0.003
tro_all_xd	-0.092; 0.005	0.039; 0.206	0.245;<0.001	0.023; 0.459
dug_all_xd	-0.163;<0.001	-0.110;<0.001	-0.092;<0.001	-0.059; 0.051
wet1_500_if_cnt	0.219;<0.001	0.095; 0.003	0.091; 0.002	0.191;<0.001
wet1_1000_if_cnt	**0.758;<0.001**	0.030; 0.352	0.038; 0.205	0.103; 0.002
wet1_2500_if_cnt	0.051; 0.140	0.449;<0.001	-0.054; 0.065	0.172;<0.001
wet1_5000_if_cnt	-0.035; 0.286	-0.099; 0.001	0.092; 0.001	0.121;<0.001

Table G.6 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet1_1000_cnt	wet1_2500_cnt	wet1_5000_cnt	wet2_500_cnt
wet2_500_if_cnt	0.050; 0.127	0.006; 0.837	-0.039; 0.167	**0.866;<0.001**
wet2_1000_if_cnt	0.097; 0.002	-0.011; 0.708	-0.057; 0.034	0.356;<0.001
wet2_2500_if_cnt	-0.006; 0.829	-0.003; 0.900	-0.149;<0.001	0.241;<0.001
wet2_5000_if_cnt	-0.053; 0.074	0.060; 0.028	-0.111;<0.001	0.056; 0.043
wet3_500_if_cnt	0.163;<0.001	0.191;<0.001	0.169;<0.001	0.441;<0.001
wet3_1000_if_cnt	0.236;<0.001	0.136;<0.001	0.171;<0.001	0.194;<0.001
wet3_2500_if_cnt	0.012; 0.696	0.165;<0.001	0.066; 0.012	0.083; 0.004
wet3_5000_if_cnt	-0.108;<0.001	-0.087; 0.002	-0.042; 0.101	-0.039; 0.166
wet4_500_if_cnt	0.207;<0.001	0.092; 0.005	0.106;<0.001	0.271;<0.001
wet4_1000_if_cnt	0.413;<0.001	0.113;<0.001	0.097; 0.001	0.151;<0.001
wet4_2500_if_cnt	0.141;<0.001	0.222;<0.001	0.012; 0.671	0.177;<0.001
wet4_5000_if_cnt	-0.017; 0.594	-0.019; 0.530	0.045; 0.098	-0.004; 0.884
wet1_all_if_xd	-0.164;<0.001	0.049; 0.087	0.374;<0.001	-0.015; 0.593
wet2_all_if_xd	-0.183;<0.001	-0.093; 0.001	0.018; 0.483	-0.265;<0.001
wet3_all_if_xd	-0.174;<0.001	-0.135;<0.001	0.008; 0.749	-0.140;<0.001
wet4_all_if_xd	-0.166;<0.001	-0.027; 0.347	0.231;<0.001	-0.032; 0.260
wet1_if_density	0.157;<0.001	0.213;<0.001	0.225;<0.001	0.189;<0.001
wet2_if_density	0.058; 0.063	0.044; 0.129	-0.011; 0.676	0.208;<0.001
wet3_if_density	0.003; 0.921	0.008; 0.770	0.147;<0.001	-0.003; 0.908
wet4_if_density	0.105;<0.001	0.025; 0.393	0.089;<0.001	0.076; 0.009

Table G.7: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet2_1000_cnt	wet2_2500_cnt	wet2_5000_cnt	wet3_500_cnt
cws_shrub	-0.038; 0.150	-0.120;<0.001	-0.020; 0.409	-0.067; 0.019
mrps	-0.175;<0.001	-0.113;<0.001	0.065; 0.008	-0.071; 0.013
topo	-0.012; 0.631	-0.005; 0.828	-0.066; 0.006	0.155;<0.001
wet1_500kd	0.072; 0.020	0.075; 0.011	-0.027; 0.357	0.277;<0.001
wet1_1000kd	0.183;<0.001	0.098;<0.001	-0.060; 0.037	0.267;<0.001
wet1_2500kd	0.116;<0.001	0.300;<0.001	0.128;<0.001	0.271;<0.001
wet1_5000kd	0.141;<0.001	0.373;<0.001	0.352;<0.001	0.237;<0.001
wet2_500kd	0.352;<0.001	0.214;<0.001	0.039; 0.139	0.390;<0.001
wet2_1000kd	0.618;<0.001	0.285;<0.001	0.120;<0.001	0.202;<0.001

wet2_2500kd	0.309;<0.001	0.435;<0.001	0.205;<0.001	0.039; 0.161

Table G.7 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet2_1000_cnt	wet2_2500_cnt	wet2_5000_cnt	wet3_500_cnt
wet2_5000kd	0.118;<0.001	0.240;<0.001	0.271;<0.001	-0.104;<0.001
wet3_500kd	0.258;<0.001	0.246;<0.001	0.187;<0.001	**0.923;<0.001**
wet3_1000kd	0.427;<0.001	0.349;<0.001	0.284;<0.001	0.604;<0.001
wet3_2500kd	0.231;<0.001	0.550;<0.001	0.441;<0.001	0.337;<0.001
wet3_5000kd	0.087;<0.001	0.371;<0.001	0.570;<0.001	0.236;<0.001
wet4_500kd	0.164;<0.001	0.128;<0.001	0.015; 0.608	0.323;<0.001
wet4_1000kd	0.326;<0.001	0.188;<0.001	0.012; 0.683	0.343;<0.001
wet4_2500kd	0.169;<0.001	0.346;<0.001	0.131;<0.001	0.343;<0.001
wet4_5000kd	0.092;<0.001	0.254;<0.001	0.277;<0.001	0.257;<0.001
wet1_500_cnt	0.092; 0.003	0.083; 0.005	-0.017; 0.558	0.299;<0.001
wet1_1000_cnt	0.205;<0.001	0.087; 0.003	-0.070; 0.016	0.198;<0.001
wet1_2500_cnt	0.100;<0.001	0.297;<0.001	0.133;<0.001	0.271;<0.001
wet1_5000_cnt	0.127;<0.001	0.291;<0.001	0.349;<0.001	0.252;<0.001
wet2_500_cnt	0.414;<0.001	0.240;<0.001	0.062; 0.022	0.493;<0.001
wet2_1000_cnt	**1.000;<0.001**	0.330;<0.001	0.149;<0.001	0.273;<0.001
wet2_2500_cnt	0.330;<0.001	**1.000;<0.001**	0.439;<0.001	0.270;<0.001
wet2_5000_cnt	0.149;<0.001	0.439;<0.001	**1.000;<0.001**	0.204;<0.001
wet3_500_cnt	0.273;<0.001	0.270;<0.001	0.204;<0.001	**1.000;<0.001**
wet3_1000_cnt	0.463;<0.001	0.387;<0.001	0.327;<0.001	0.454;<0.001
wet3_2500_cnt	0.216;<0.001	0.603;<0.001	0.548;<0.001	0.295;<0.001
wet3_5000_cnt	0.100;<0.001	0.340;<0.001	0.627;<0.001	0.192;<0.001
wet4_500_cnt	0.169;<0.001	0.116;<0.001	0.004; 0.885	0.330;<0.001
wet4_1000_cnt	0.330;<0.001	0.179;<0.001	0.011; 0.706	0.256;<0.001
wet4_2500_cnt	0.112;<0.001	0.341;<0.001	0.122;<0.001	0.336;<0.001
wet4_5000_cnt	0.006; 0.826	0.131;<0.001	0.197;<0.001	0.203;<0.001
wet1_all_cnt	0.125;<0.001	0.290;<0.001	0.377;<0.001	0.314;<0.001
wet2_all_cnt	0.126;<0.001	0.350;<0.001	0.572;<0.001	0.170;<0.001
wet3_all_cnt	0.071; 0.005	0.266;<0.001	0.518;<0.001	0.168;<0.001
wet4_all_cnt	-0.137;<0.001	-0.126;<0.001	0.008; 0.728	0.144;<0.001
field_size	-0.045; 0.103	-0.031; 0.240	-0.005; 0.847	-0.189;<0.001
tro_all_cnt	-0.043; 0.140	-0.158;<0.001	-0.225;<0.001	-0.295;<0.001
dug_all_cnt	-0.203;<0.001	-0.138;<0.001	-0.022; 0.406	-0.204;<0.001

Predictors	wet2_1000_cnt	wet2_2500_cnt	wet2_5000_cnt	wet3_500_cnt
wet1_all_xd	-0.010; 0.707	-0.152;<0.001	-0.160;<0.001	-0.080; 0.005

Table G.7 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet2_1000_cnt	wet2_2500_cnt	wet2_5000_cnt	wet3_500_cnt
wet2_all_xd	-0.268;<0.001	-0.488;<0.001	-0.520;<0.001	-0.250;<0.001
wet3_all_xd	-0.168;<0.001	-0.379;<0.001	-0.465;<0.001	-0.255;<0.001
wet4_all_xd	-0.087;<0.001	-0.186;<0.001	-0.162;<0.001	-0.224;<0.001
tro_all_xd	0.097;<0.001	0.337;<0.001	0.414;<0.001	0.108;<0.001
dug_all_xd	-0.029; 0.311	0.083; 0.002	0.069; 0.009	-0.136;<0.001
wet1_500_if_cnt	0.090; 0.004	0.036; 0.227	-0.004; 0.883	0.265;<0.001
wet1_1000_if_cnt	0.177;<0.001	0.011; 0.710	-0.052; 0.076	0.155;<0.001
wet1_2500_if_cnt	0.184;<0.001	0.078; 0.007	-0.030; 0.303	0.176;<0.001
wet1_5000_if_cnt	0.202;<0.001	0.217;<0.001	0.176;<0.001	0.063; 0.051
wet2_500_if_cnt	0.386;<0.001	0.207;<0.001	0.051; 0.063	0.360;<0.001
wet2_1000_if_cnt	**0.734;<0.001**	0.211;<0.001	0.087;<0.001	0.174;<0.001
wet2_2500_if_cnt	0.276;<0.001	0.319;<0.001	0.118;<0.001	0.096;<0.001
wet2_5000_if_cnt	0.118;<0.001	0.160;<0.001	0.226;<0.001	0.052; 0.070
wet3_500_if_cnt	0.277;<0.001	0.223;<0.001	0.188;<0.001	**0.822;<0.001**
wet3_1000_if_cnt	0.363;<0.001	0.225;<0.001	0.224;<0.001	0.384;<0.001
wet3_2500_if_cnt	0.169;<0.001	0.265;<0.001	0.269;<0.001	0.214;<0.001
wet3_5000_if_cnt	0.003; 0.909	0.069; 0.006	0.231;<0.001	0.073; 0.011
wet4_500_if_cnt	0.173;<0.001	0.070; 0.017	0.016; 0.580	0.303;<0.001
wet4_1000_if_cnt	0.289;<0.001	0.110;<0.001	0.010; 0.738	0.233;<0.001
wet4_2500_if_cnt	0.201;<0.001	0.148;<0.001	-0.005; 0.856	0.301;<0.001
wet4_5000_if_cnt	0.055; 0.053	0.118;<0.001	0.247;<0.001	0.087; 0.005
wet1_all_if_xd	-0.000; 0.990	0.217;<0.001	0.272;<0.001	0.052; 0.082
wet2_all_if_xd	-0.274;<0.001	-0.128;<0.001	0.008; 0.766	-0.123;<0.001
wet3_all_if_xd	-0.171;<0.001	-0.083; 0.001	-0.035; 0.175	-0.175;<0.001
wet4_all_if_xd	-0.023; 0.385	0.191;<0.001	0.297;<0.001	-0.027; 0.356
wet1_if_density	0.250;<0.001	0.226;<0.001	0.134;<0.001	0.224;<0.001
wet2_if_density	0.293;<0.001	0.214;<0.001	0.173;<0.001	0.205;<0.001
wet3_if_density	0.054; 0.048	0.127;<0.001	0.265;<0.001	0.254;<0.001
wet4_if_density	0.130;<0.001	0.113;<0.001	0.135;<0.001	0.189;<0.001

Table G.8: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet3_1000_cnt	wet3_2500_cnt	wet3_5000_cnt	wet4_500_cnt
cws_shrub	-0.125;<0.001	-0.099;<0.001	0.007; 0.788	0.097; 0.001
mrps	-0.019; 0.489	0.029; 0.248	0.023; 0.342	-0.170;<0.001
topo	0.132;<0.001	0.035; 0.148	0.023; 0.343	0.133;<0.001
wet1_500kd	0.127;<0.001	0.058; 0.052	-0.054; 0.066	0.569;<0.001
wet1_1000kd	0.278;<0.001	0.053; 0.070	-0.100;<0.001	0.361;<0.001
wet1_2500kd	0.261;<0.001	0.279;<0.001	-0.003; 0.906	0.179;<0.001
wet1_5000kd	0.303;<0.001	0.424;<0.001	0.244;<0.001	0.159;<0.001
wet2_500kd	0.124;<0.001	0.043; 0.113	0.002; 0.927	0.206;<0.001
wet2_1000kd	0.275;<0.001	0.070; 0.005	0.006; 0.817	0.109;<0.001
wet2_2500kd	0.093;<0.001	0.162;<0.001	0.029; 0.229	0.023; 0.438
wet2_5000kd	-0.057; 0.032	0.038; 0.119	0.064; 0.008	-0.126;<0.001
wet3_500kd	0.436;<0.001	0.274;<0.001	0.169;<0.001	0.321;<0.001
wet3_1000kd	**0.821;<0.001**	0.412;<0.001	0.242;<0.001	0.247;<0.001
wet3_2500kd	0.496;<0.001	**0.750;<0.001**	0.426;<0.001	0.164;<0.001
wet3_5000kd	0.359;<0.001	0.597;<0.001	0.695;<0.001	0.054; 0.062
wet4_500kd	0.168;<0.001	0.135;<0.001	0.016; 0.590	**0.954;<0.001**
wet4_1000kd	0.364;<0.001	0.206;<0.001	0.018; 0.521	0.573;<0.001
wet4_2500kd	0.376;<0.001	0.436;<0.001	0.153;<0.001	0.291;<0.001
wet4_5000kd	0.312;<0.001	0.419;<0.001	0.444;<0.001	0.177;<0.001
wet1_500_cnt	0.141;<0.001	0.066; 0.026	-0.044; 0.132	0.569;<0.001
wet1_1000_cnt	0.269;<0.001	0.055; 0.061	-0.098;<0.001	0.285;<0.001
wet1_2500_cnt	0.235;<0.001	0.327;<0.001	0.051; 0.059	0.172;<0.001
wet1_5000_cnt	0.314;<0.001	0.430;<0.001	0.338;<0.001	0.169;<0.001
wet2_500_cnt	0.210;<0.001	0.109;<0.001	0.045; 0.099	0.288;<0.001
wet2_1000_cnt	0.463;<0.001	0.216;<0.001	0.100;<0.001	0.169;<0.001
wet2_2500_cnt	0.387;<0.001	0.603;<0.001	0.340;<0.001	0.116;<0.001
wet2_5000_cnt	0.327;<0.001	0.548;<0.001	0.627;<0.001	0.004; 0.885
wet3_500_cnt	0.454;<0.001	0.295;<0.001	0.192;<0.001	0.330;<0.001
wet3_1000_cnt	**1.000;<0.001**	0.446;<0.001	0.298;<0.001	0.160;<0.001
wet3_2500_cnt	0.446;<0.001	**1.000;<0.001**	0.535;<0.001	0.119;<0.001
wet3_5000_cnt	0.298;<0.001	0.535;<0.001	**1.000;<0.001**	-0.001; 0.972
wet4_500_cnt	0.160;<0.001	0.119;<0.001	-0.001; 0.972	**1.000;<0.001**
wet4_1000_cnt	0.362;<0.001	0.197;<0.001	0.030; 0.297	0.286;<0.001

Table G.8 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet3_1000_cnt	wet3_2500_cnt	wet3_5000_cnt	wet4_500_cnt
wet4_2500_cnt	0.322;<0.001	0.440;<0.001	0.140;<0.001	0.248;<0.001
wet4_5000_cnt	0.226;<0.001	0.307;<0.001	0.381;<0.001	0.123;<0.001
wet1_all_cnt	0.406;<0.001	0.517;<0.001	0.389;<0.001	0.136;<0.001
wet2_all_cnt	0.307;<0.001	0.469;<0.001	0.494;<0.001	-0.067; 0.024
wet3_all_cnt	0.277;<0.001	0.437;<0.001	0.539;<0.001	-0.070; 0.017
wet4_all_cnt	0.134;<0.001	0.118;<0.001	0.149;<0.001	0.126;<0.001
field_size	-0.135;<0.001	-0.137;<0.001	-0.183;<0.001	-0.168;<0.001
tro_all_cnt	-0.364;<0.001	-0.401;<0.001	-0.388;<0.001	-0.118;<0.001
dug_all_cnt	-0.131;<0.001	-0.091;<0.001	-0.135;<0.001	-0.200;<0.001
wet1_all_xd	-0.089;<0.001	-0.167;<0.001	-0.038; 0.117	-0.111;<0.001
wet2_all_xd	-0.325;<0.001	-0.442;<0.001	-0.412;<0.001	-0.111;<0.001
wet3_all_xd	-0.373;<0.001	-0.553;<0.001	-0.621;<0.001	-0.111;<0.001
wet4_all_xd	-0.224;<0.001	-0.313;<0.001	-0.293;<0.001	-0.187;<0.001
tro_all_xd	0.265;<0.001	0.419;<0.001	0.314;<0.001	-0.016; 0.629
dug_all_xd	-0.056; 0.060	0.023; 0.405	-0.055; 0.040	-0.092; 0.005
wet1_500_if_cnt	0.139;<0.001	0.023; 0.441	-0.024; 0.407	0.416;<0.001
wet1_1000_if_cnt	0.231;<0.001	-0.013; 0.654	-0.070; 0.016	0.169;<0.001
wet1_2500_if_cnt	0.086; 0.006	0.024; 0.404	-0.087; 0.002	0.117;<0.001
wet1_5000_if_cnt	0.120;<0.001	0.101;<0.001	0.097;<0.001	0.081; 0.016
wet2_500_if_cnt	0.150;<0.001	0.055; 0.047	0.043; 0.120	0.205;<0.001
wet2_1000_if_cnt	0.267;<0.001	0.069; 0.009	0.042; 0.108	0.092; 0.004
wet2_2500_if_cnt	0.122;<0.001	0.090;<0.001	0.071; 0.004	0.018; 0.545
wet2_5000_if_cnt	0.087; 0.001	0.089;<0.001	0.084;<0.001	-0.013; 0.663
wet3_500_if_cnt	0.392;<0.001	0.243;<0.001	0.192;<0.001	0.282;<0.001
wet3_1000_if_cnt	0.686;<0.001	0.272;<0.001	0.230;<0.001	0.143;<0.001
wet3_2500_if_cnt	0.277;<0.001	0.370;<0.001	0.219;<0.001	0.063; 0.043
wet3_5000_if_cnt	0.133;<0.001	0.159;<0.001	0.307;<0.001	-0.029; 0.327
wet4_500_if_cnt	0.142;<0.001	0.076; 0.011	0.012; 0.673	**0.836;<0.001**
wet4_1000_if_cnt	0.306;<0.001	0.132;<0.001	0.040; 0.170	0.239;<0.001
wet4_2500_if_cnt	0.247;<0.001	0.140;<0.001	-0.004; 0.890	0.208;<0.001
wet4_5000_if_cnt	0.121;<0.001	0.138;<0.001	0.274;<0.001	-0.024; 0.449
wet1_all_if_xd	0.089; 0.002	0.258;<0.001	0.240;<0.001	0.013; 0.667
wet2_all_if_xd	-0.088; 0.002	-0.022; 0.388	-0.024; 0.349	-0.036; 0.247

Table G.8 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet3_1000_cnt	wet3_2500_cnt	wet3_5000_cnt	wet4_500_cnt
wet3_all_if_xd	-0.146;<0.001	-0.077; 0.003	0.083; 0.001	-0.078; 0.011
wet4_all_if_xd	0.045; 0.107	0.198;<0.001	0.358;<0.001	-0.093; 0.003
wet1_if_density	0.194;<0.001	0.133;<0.001	0.019; 0.465	0.186;<0.001
wet2_if_density	0.175;<0.001	0.086; 0.001	0.074; 0.004	0.105;<0.001
wet3_if_density	0.301;<0.001	0.315;<0.001	0.471;<0.001	0.063; 0.043
wet4_if_density	0.185;<0.001	0.151;<0.001	0.301;<0.001	0.133;<0.001

Table G.9: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet4_1000_cnt	wet4_2500_cnt	wet4_5000_cnt	wet1_all_cnt
cws_shrub	0.093; 0.002	-0.037; 0.164	0.078; 0.002	-0.059; 0.017
mrps	-0.202;<0.001	-0.115;<0.001	-0.026; 0.300	-0.013; 0.599
topo	0.167;<0.001	0.185;<0.001	0.274;<0.001	0.195;<0.001
wet1_500kd	0.187;<0.001	0.206;<0.001	0.146;<0.001	0.125;<0.001
wet1_1000kd	0.522;<0.001	0.249;<0.001	0.187;<0.001	0.183;<0.001
wet1_2500kd	0.260;<0.001	0.500;<0.001	0.218;<0.001	0.305;<0.001
wet1_5000kd	0.183;<0.001	0.402;<0.001	0.471;<0.001	0.482;<0.001
wet2_500kd	0.079; 0.012	0.032; 0.259	-0.074; 0.006	-0.036; 0.181
wet2_1000kd	0.147;<0.001	-0.032; 0.234	-0.155;<0.001	-0.054; 0.032
wet2_2500kd	0.030; 0.300	-0.048; 0.065	-0.236;<0.001	-0.131;<0.001
wet2_5000kd	-0.188;<0.001	-0.264;<0.001	-0.336;<0.001	-0.231;<0.001
wet3_500kd	0.259;<0.001	0.322;<0.001	0.192;<0.001	0.288;<0.001
wet3_1000kd	0.377;<0.001	0.341;<0.001	0.202;<0.001	0.388;<0.001
wet3_2500kd	0.266;<0.001	0.468;<0.001	0.263;<0.001	0.481;<0.001
wet3_5000kd	0.096;<0.001	0.239;<0.001	0.393;<0.001	0.413;<0.001
wet4_500kd	0.284;<0.001	0.245;<0.001	0.129;<0.001	0.148;<0.001
wet4_1000kd	**0.842;<0.001**	0.344;<0.001	0.167;<0.001	0.223;<0.001
wet4_2500kd	0.400;<0.001	**0.846;<0.001**	0.285;<0.001	0.393;<0.001
wet4_5000kd	0.245;<0.001	0.408;<0.001	**0.761;<0.001**	0.539;<0.001
wet1_500_cnt	0.223;<0.001	0.221;<0.001	0.157;<0.001	0.142;<0.001
wet1_1000_cnt	0.580;<0.001	0.240;<0.001	0.195;<0.001	0.179;<0.001
wet1_2500_cnt	0.227;<0.001	0.572;<0.001	0.311;<0.001	0.380;<0.001
wet1_5000_cnt	0.212;<0.001	0.388;<0.001	0.624;<0.001	0.578;<0.001
wet2_500_cnt	0.155;<0.001	0.117;<0.001	-0.001; 0.971	0.047; 0.081

Table G.9 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet4_1000_cnt	wet4_2500_cnt	wet4_5000_cnt	wet1_all_cnt
wet2_1000_cnt	0.330;<0.001	0.112;<0.001	0.006; 0.826	0.125;<0.001
wet2_2500_cnt	0.179;<0.001	0.341;<0.001	0.131;<0.001	0.290;<0.001
wet2_5000_cnt	0.011; 0.706	0.122;<0.001	0.197;<0.001	0.377;<0.001
wet3_500_cnt	0.256;<0.001	0.336;<0.001	0.203;<0.001	0.314;<0.001
wet3_1000_cnt	0.362;<0.001	0.322;<0.001	0.226;<0.001	0.406;<0.001
wet3_2500_cnt	0.197;<0.001	0.440;<0.001	0.307;<0.001	0.517;<0.001
wet3_5000_cnt	0.030; 0.297	0.140;<0.001	0.381;<0.001	0.389;<0.001
wet4_500_cnt	0.286;<0.001	0.248;<0.001	0.123;<0.001	0.136;<0.001
wet4_1000_cnt	**1.000;<0.001**	0.316;<0.001	0.173;<0.001	0.231;<0.001
wet4_2500_cnt	0.316;<0.001	**1.000;<0.001**	0.316;<0.001	0.388;<0.001
wet4_5000_cnt	0.173;<0.001	0.316;<0.001	**1.000;<0.001**	0.476;<0.001
wet1_all_cnt	0.231;<0.001	0.388;<0.001	0.476;<0.001	**1.000;<0.001**
wet2_all_cnt	-0.036; 0.218	0.021; 0.431	0.026; 0.300	0.440;<0.001
wet3_all_cnt	-0.043; 0.133	0.006; 0.827	0.094;<0.001	0.425;<0.001
wet4_all_cnt	0.204;<0.001	0.307;<0.001	0.448;<0.001	0.406;<0.001
field_size	-0.239;<0.001	-0.358;<0.001	-0.563;<0.001	-0.302;<0.001
tro_all_cnt	-0.222;<0.001	-0.322;<0.001	-0.436;<0.001	-0.503;<0.001
dug_all_cnt	-0.238;<0.001	-0.283;<0.001	-0.338;<0.001	-0.179;<0.001
wet1_all_xd	-0.083; 0.004	-0.190;<0.001	-0.284;<0.001	-0.184;<0.001
wet2_all_xd	-0.146;<0.001	-0.237;<0.001	-0.295;<0.001	-0.245;<0.001
wet3_all_xd	-0.160;<0.001	-0.294;<0.001	-0.463;<0.001	-0.343;<0.001
wet4_all_xd	-0.228;<0.001	-0.428;<0.001	-0.602;<0.001	-0.359;<0.001
tro_all_xd	-0.030; 0.353	0.030; 0.314	0.004; 0.875	0.166;<0.001
dug_all_xd	-0.135;<0.001	-0.105;<0.001	-0.269;<0.001	-0.135;<0.001
wet1_500_if_cnt	0.176;<0.001	0.136;<0.001	0.078; 0.009	0.105;<0.001
wet1_1000_if_cnt	0.396;<0.001	0.097; 0.002	0.049; 0.097	0.092; 0.002
wet1_2500_if_cnt	0.132;<0.001	0.149;<0.001	-0.035; 0.227	0.088; 0.002
wet1_5000_if_cnt	0.033; 0.311	0.055; 0.066	-0.092; 0.001	0.005; 0.860
wet2_500_if_cnt	0.087; 0.007	0.017; 0.558	-0.107;<0.001	-0.037; 0.177
wet2_1000_if_cnt	0.196;<0.001	-0.030; 0.291	-0.155;<0.001	-0.009; 0.731
wet2_2500_if_cnt	0.046; 0.114	0.002; 0.928	-0.232;<0.001	-0.052; 0.036
wet2_5000_if_cnt	-0.038; 0.197	-0.060; 0.024	-0.220;<0.001	-0.018; 0.478
wet3_500_if_cnt	0.214;<0.001	0.240;<0.001	0.122;<0.001	0.258;<0.001

Table G.9 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet4_1000_cnt	wet4_2500_cnt	wet4_5000_cnt	wet1_all_cnt
wet3_1000_if_cnt	0.316;<0.001	0.202;<0.001	0.137;<0.001	0.308;<0.001
wet3_2500_if_cnt	0.134;<0.001	0.165;<0.001	-0.003; 0.910	0.256;<0.001
wet3_5000_if_cnt	-0.031; 0.288	-0.033; 0.222	0.069; 0.006	0.099;<0.001
wet4_500_if_cnt	0.224;<0.001	0.168;<0.001	0.054; 0.071	0.100;<0.001
wet4_1000_if_cnt	**0.770;<0.001**	0.201;<0.001	0.065; 0.028	0.160;<0.001
wet4_2500_if_cnt	0.250;<0.001	0.441;<0.001	-0.013; 0.652	0.141;<0.001
wet4_5000_if_cnt	-0.039; 0.217	-0.078; 0.007	0.157;<0.001	0.138;<0.001
wet1_all_if_xd	-0.020; 0.513	0.155;<0.001	0.243;<0.001	0.207;<0.001
wet2_all_if_xd	-0.137;<0.001	-0.054; 0.049	-0.063; 0.016	-0.031; 0.231
wet3_all_if_xd	-0.161;<0.001	-0.094;<0.001	0.089;<0.001	-0.053; 0.038
wet4_all_if_xd	-0.122;<0.001	-0.027; 0.324	0.288;<0.001	0.175;<0.001
wet1_if_density	0.199;<0.001	0.265;<0.001	0.076; 0.004	0.239;<0.001
wet2_if_density	0.131;<0.001	0.073; 0.009	-0.162;<0.001	0.046; 0.077
wet3_if_density	0.121;<0.001	0.142;<0.001	0.285;<0.001	0.359;<0.001
wet4_if_density	0.168;<0.001	0.171;<0.001	0.273;<0.001	0.145;<0.001

Table G.10: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet2_all_cnt	wet3_all_cnt	wet4_all_cnt	field_size
cws_shrub	-0.172;<0.001	-0.109;<0.001	0.091;<0.001	-0.200;<0.001
mrps	0.140;<0.001	0.104;<0.001	-0.021; 0.397	0.166;<0.001
topo	-0.126;<0.001	-0.035; 0.148	0.294;<0.001	-0.306;<0.001
wet1_500kd	-0.110;<0.001	-0.127;<0.001	0.119;<0.001	-0.166;<0.001
wet1_1000kd	-0.154;<0.001	-0.186;<0.001	0.151;<0.001	-0.222;<0.001
wet1_2500kd	0.031; 0.237	-0.040; 0.123	0.116;<0.001	-0.174;<0.001
wet1_5000kd	0.206;<0.001	0.112;<0.001	0.176;<0.001	-0.232;<0.001
wet2_500kd	0.017; 0.532	-0.039; 0.144	-0.221;<0.001	0.022; 0.446
wet2_1000kd	0.063; 0.013	-0.011; 0.668	-0.312;<0.001	0.093;<0.001
wet2_2500kd	0.120;<0.001	0.037; 0.128	-0.418;<0.001	0.198;<0.001
wet2_5000kd	0.212;<0.001	0.109;<0.001	-0.588;<0.001	0.416;<0.001
wet3_500kd	0.156;<0.001	0.151;<0.001	0.138;<0.001	-0.176;<0.001
wet3_1000kd	0.268;<0.001	0.233;<0.001	0.143;<0.001	-0.151;<0.001
wet3_2500kd	0.431;<0.001	0.361;<0.001	0.107;<0.001	-0.116;<0.001
wet3_5000kd	0.470;<0.001	0.437;<0.001	0.125;<0.001	-0.134;<0.001

Table G.10 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet2_all_cnt	wet3_all_cnt	wet4_all_cnt	field_size
wet4_500kd	-0.051; 0.083	-0.053; 0.068	0.126;<0.001	-0.165;<0.001
wet4_1000kd	-0.045; 0.112	-0.053; 0.059	0.208;<0.001	-0.241;<0.001
wet4_2500kd	0.030; 0.245	0.026; 0.301	0.327;<0.001	-0.375;<0.001
wet4_5000kd	0.103;<0.001	0.178;<0.001	0.422;<0.001	-0.552;<0.001
wet1_500_cnt	-0.105;<0.001	-0.122;<0.001	0.124;<0.001	-0.178;<0.001
wet1_1000_cnt	-0.169;<0.001	-0.199;<0.001	0.154;<0.001	-0.226;<0.001
wet1_2500_cnt	0.028; 0.309	-0.022; 0.402	0.205;<0.001	-0.242;<0.001
wet1_5000_cnt	0.165;<0.001	0.160;<0.001	0.347;<0.001	-0.397;<0.001
wet2_500_cnt	0.044; 0.112	-0.007; 0.783	-0.149;<0.001	-0.027; 0.348
wet2_1000_cnt	0.126;<0.001	0.071; 0.005	-0.137;<0.001	-0.045; 0.103
wet2_2500_cnt	0.350;<0.001	0.266;<0.001	-0.126;<0.001	-0.031; 0.240
wet2_5000_cnt	0.572;<0.001	0.518;<0.001	0.008; 0.728	-0.005; 0.847
wet3_500_cnt	0.170;<0.001	0.168;<0.001	0.144;<0.001	-0.189;<0.001
wet3_1000_cnt	0.307;<0.001	0.277;<0.001	0.134;<0.001	-0.135;<0.001
wet3_2500_cnt	0.469;<0.001	0.437;<0.001	0.118;<0.001	-0.137;<0.001
wet3_5000_cnt	0.494;<0.001	0.539;<0.001	0.149;<0.001	-0.183;<0.001
wet4_500_cnt	-0.067; 0.024	-0.070; 0.017	0.126;<0.001	-0.168;<0.001
wet4_1000_cnt	-0.036; 0.218	-0.043; 0.133	0.204;<0.001	-0.239;<0.001
wet4_2500_cnt	0.021; 0.431	0.006; 0.827	0.307;<0.001	-0.358;<0.001
wet4_5000_cnt	0.026; 0.300	0.094;<0.001	0.448;<0.001	-0.563;<0.001
wet1_all_cnt	0.440;<0.001	0.425;<0.001	0.406;<0.001	-0.302;<0.001
wet2_all_cnt	**1.000;<0.001**	**0.786;<0.001**	-0.042; 0.087	0.185;<0.001
wet3_all_cnt	**0.786;<0.001**	**1.000;<0.001**	0.102;<0.001	0.066; 0.011
wet4_all_cnt	-0.042; 0.087	0.102;<0.001	**1.000;<0.001**	-0.504;<0.001
field_size	0.185;<0.001	0.066; 0.011	-0.504;<0.001	**1.000;<0.001**
tro_all_cnt	-0.234;<0.001	-0.280;<0.001	-0.379;<0.001	0.288;<0.001
dug_all_cnt	0.201;<0.001	0.090;<0.001	-0.259;<0.001	0.641;<0.001
wet1_all_xd	0.077; 0.002	0.115;<0.001	-0.096;<0.001	0.143;<0.001
wet2_all_xd	-0.191;<0.001	-0.164;<0.001	0.003; 0.898	0.194;<0.001
wet3_all_xd	-0.219;<0.001	-0.254;<0.001	-0.174;<0.001	0.303;<0.001
wet4_all_xd	0.032; 0.188	0.023; 0.347	-0.298;<0.001	0.428;<0.001
tro_all_xd	0.443;<0.001	0.353;<0.001	-0.162;<0.001	0.290;<0.001
dug_all_xd	0.111;<0.001	0.075; 0.005	-0.155;<0.001	0.438;<0.001

Table G.10 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet2_all_cnt	wet3_all_cnt	wet4_all_cnt	field_size
wet1_500_if_cnt	-0.053; 0.077	-0.067; 0.023	0.055; 0.063	-0.118;<0.001
wet1_1000_if_cnt	-0.068; 0.022	-0.090; 0.002	0.037; 0.207	-0.094; 0.003
wet1_2500_if_cnt	-0.010; 0.728	-0.022; 0.443	-0.043; 0.135	-0.013; 0.665
wet1_5000_if_cnt	0.114;<0.001	0.067; 0.017	-0.166;<0.001	0.125;<0.001
wet2_500_if_cnt	0.076; 0.006	0.021; 0.453	-0.252;<0.001	0.079; 0.007
wet2_1000_if_cnt	0.138;<0.001	0.073; 0.006	-0.278;<0.001	0.118;<0.001
wet2_2500_if_cnt	0.211;<0.001	0.144;<0.001	-0.368;<0.001	0.224;<0.001
wet2_5000_if_cnt	0.279;<0.001	0.225;<0.001	-0.284;<0.001	0.262;<0.001
wet3_500_if_cnt	0.201;<0.001	0.203;<0.001	0.080; 0.005	-0.122;<0.001
wet3_1000_if_cnt	0.279;<0.001	0.257;<0.001	0.083; 0.003	-0.071; 0.017
wet3_2500_if_cnt	0.399;<0.001	0.362;<0.001	-0.035; 0.171	0.106;<0.001
wet3_5000_if_cnt	0.329;<0.001	0.386;<0.001	0.064; 0.010	0.122;<0.001
wet4_500_if_cnt	-0.024; 0.423	-0.022; 0.456	0.074; 0.011	-0.109;<0.001
wet4_1000_if_cnt	0.039; 0.189	0.040; 0.168	0.119;<0.001	-0.120;<0.001
wet4_2500_if_cnt	0.042; 0.134	0.055; 0.049	0.105;<0.001	-0.092; 0.002
wet4_5000_if_cnt	0.251;<0.001	0.295;<0.001	0.011; 0.673	-0.084; 0.003
wet1_all_if_xd	0.137;<0.001	0.159;<0.001	0.140;<0.001	-0.220;<0.001
wet2_all_if_xd	-0.007; 0.785	0.036; 0.160	0.134;<0.001	0.115;<0.001
wet3_all_if_xd	-0.046; 0.077	0.026; 0.308	0.129;<0.001	-0.104;<0.001
wet4_all_if_xd	0.198;<0.001	0.243;<0.001	0.088;<0.001	-0.234;<0.001
wet1_if_density	0.019; 0.468	0.023; 0.379	0.060; 0.021	-0.224;<0.001
wet2_if_density	0.149;<0.001	0.149;<0.001	-0.139;<0.001	-0.060; 0.030
wet3_if_density	0.356;<0.001	0.456;<0.001	0.314;<0.001	-0.145;<0.001
wet4_if_density	0.075; 0.004	0.178;<0.001	0.219;<0.001	-0.524;<0.001

Table G.11: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	tro_all_cnt	dug_all_cnt	wet1_all_xd	wet2_all_xd
cws_shrub	0.044; 0.114	-0.205;<0.001	-0.056; 0.024	-0.007; 0.766
mrps	-0.031; 0.262	0.400;<0.001	-0.043; 0.083	0.062; 0.012
topo	-0.239;<0.001	-0.276;<0.001	-0.040; 0.094	0.010; 0.685
wet1_500kd	-0.105; 0.002	-0.110;<0.001	-0.165;<0.001	-0.128;<0.001
wet1_1000kd	-0.156;<0.001	-0.187;<0.001	-0.171;<0.001	-0.129;<0.001
wet1_2500kd	-0.153;<0.001	-0.138;<0.001	-0.249;<0.001	-0.269;<0.001

Table G.11 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	tro_all_cnt	dug_all_cnt	wet1_all_xd	wet2_all_xd
wet1_5000kd	-0.246;<0.001	-0.095;<0.001	-0.486;<0.001	-0.426;<0.001
wet2_500kd	0.099;<0.001	-0.129;<0.001	0.013; 0.622	-0.155;<0.001
wet2_1000kd	0.158;<0.001	-0.117;<0.001	-0.006; 0.799	-0.229;<0.001
wet2_2500kd	0.239;<0.001	-0.013; 0.616	-0.048; 0.049	-0.283;<0.001
wet2_5000kd	0.286;<0.001	0.201;<0.001	-0.039; 0.104	-0.204;<0.001
wet3_500kd	-0.277;<0.001	-0.184;<0.001	-0.082; 0.003	-0.237;<0.001
wet3_1000kd	-0.346;<0.001	-0.134;<0.001	-0.096;<0.001	-0.300;<0.001
wet3_2500kd	-0.443;<0.001	-0.061; 0.021	-0.161;<0.001	-0.368;<0.001
wet3_5000kd	-0.463;<0.001	-0.045; 0.085	-0.178;<0.001	-0.399;<0.001
wet4_500kd	-0.126;<0.001	-0.195;<0.001	-0.099;<0.001	-0.115;<0.001
wet4_1000kd	-0.200;<0.001	-0.258;<0.001	-0.100;<0.001	-0.151;<0.001
wet4_2500kd	-0.332;<0.001	-0.319;<0.001	-0.156;<0.001	-0.235;<0.001
wet4_5000kd	-0.447;<0.001	-0.394;<0.001	-0.230;<0.001	-0.351;<0.001
wet1_500_cnt	-0.126;<0.001	-0.128;<0.001	-0.179;<0.001	-0.133;<0.001
wet1_1000_cnt	-0.177;<0.001	-0.197;<0.001	-0.173;<0.001	-0.128;<0.001
wet1_2500_cnt	-0.240;<0.001	-0.152;<0.001	-0.303;<0.001	-0.276;<0.001
wet1_5000_cnt	-0.364;<0.001	-0.209;<0.001	-0.427;<0.001	-0.405;<0.001
wet2_500_cnt	0.013; 0.673	-0.164;<0.001	-0.006; 0.814	-0.182;<0.001
wet2_1000_cnt	-0.043; 0.140	-0.203;<0.001	-0.010; 0.707	-0.268;<0.001
wet2_2500_cnt	-0.158;<0.001	-0.138;<0.001	-0.152;<0.001	-0.488;<0.001
wet2_5000_cnt	-0.225;<0.001	-0.022; 0.406	-0.160;<0.001	-0.520;<0.001
wet3_500_cnt	-0.295;<0.001	-0.204;<0.001	-0.080; 0.005	-0.250;<0.001
wet3_1000_cnt	-0.364;<0.001	-0.131;<0.001	-0.089;<0.001	-0.325;<0.001
wet3_2500_cnt	-0.401;<0.001	-0.091;<0.001	-0.167;<0.001	-0.442;<0.001
wet3_5000_cnt	-0.388;<0.001	-0.135;<0.001	-0.038; 0.117	-0.412;<0.001
wet4_500_cnt	-0.118;<0.001	-0.200;<0.001	-0.111;<0.001	-0.111;<0.001
wet4_1000_cnt	-0.222;<0.001	-0.238;<0.001	-0.083; 0.004	-0.146;<0.001
wet4_2500_cnt	-0.322;<0.001	-0.283;<0.001	-0.190;<0.001	-0.237;<0.001
wet4_5000_cnt	-0.436;<0.001	-0.338;<0.001	-0.284;<0.001	-0.295;<0.001
wet1_all_cnt	-0.503;<0.001	-0.179;<0.001	-0.184;<0.001	-0.245;<0.001
wet2_all_cnt	-0.234;<0.001	0.201;<0.001	0.077; 0.002	-0.191;<0.001
wet3_all_cnt	-0.280;<0.001	0.090;<0.001	0.115;<0.001	-0.164;<0.001
wet4_all_cnt	-0.379;<0.001	-0.259;<0.001	-0.096;<0.001	0.003; 0.898

Table G.11 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	tro_all_cnt	dug_all_cnt	wet1_all_xd	wet2_all_xd
field_size	0.288;<0.001	0.641;<0.001	0.143;<0.001	0.194;<0.001
tro_all_cnt	**1.000;<0.001**	0.106;<0.001	0.088; 0.001	0.155;<0.001
dug_all_cnt	0.106;<0.001	**1.000;<0.001**	0.049; 0.061	0.214;<0.001
wet1_all_xd	0.088; 0.001	0.049; 0.061	**1.000;<0.001**	0.331;<0.001
wet2_all_xd	0.155;<0.001	0.214;<0.001	0.331;<0.001	**1.000;<0.001**
wet3_all_xd	0.415;<0.001	0.245;<0.001	0.235;<0.001	0.569;<0.001
wet4_all_xd	0.373;<0.001	0.315;<0.001	0.402;<0.001	0.345;<0.001
tro_all_xd	-0.219;<0.001	0.317;<0.001	-0.217;<0.001	-0.294;<0.001
dug_all_xd	0.076; 0.014	0.344;<0.001	-0.056; 0.034	0.014; 0.596
wet1_500_if_cnt	-0.147;<0.001	-0.142;<0.001	-0.093; 0.001	-0.082; 0.005
wet1_1000_if_cnt	-0.151;<0.001	-0.165;<0.001	-0.015; 0.613	-0.039; 0.180
wet1_2500_if_cnt	-0.097; 0.003	-0.192;<0.001	0.121;<0.001	0.006; 0.839
wet1_5000_if_cnt	0.045; 0.159	-0.113;<0.001	-0.021; 0.453	-0.163;<0.001
wet2_500_if_cnt	0.009; 0.762	-0.121;<0.001	0.077; 0.005	-0.131;<0.001
wet2_1000_if_cnt	0.010; 0.734	-0.114;<0.001	0.127;<0.001	-0.129;<0.001
wet2_2500_if_cnt	0.039; 0.168	-0.010; 0.713	0.218;<0.001	-0.082;<0.001
wet2_5000_if_cnt	0.055; 0.051	0.040; 0.137	0.126;<0.001	-0.080; 0.001
wet3_500_if_cnt	-0.308;<0.001	-0.195;<0.001	0.013; 0.658	-0.178;<0.001
wet3_1000_if_cnt	-0.363;<0.001	-0.122;<0.001	0.078; 0.005	-0.157;<0.001
wet3_2500_if_cnt	-0.271;<0.001	0.054; 0.053	0.167;<0.001	-0.081; 0.002
wet3_5000_if_cnt	-0.298;<0.001	0.083; 0.002	0.160;<0.001	-0.051; 0.040
wet4_500_if_cnt	-0.152;<0.001	-0.201;<0.001	-0.053; 0.070	-0.066; 0.023
wet4_1000_if_cnt	-0.228;<0.001	-0.192;<0.001	0.023; 0.436	-0.057; 0.050
wet4_2500_if_cnt	-0.199;<0.001	-0.245;<0.001	0.144;<0.001	0.013; 0.628
wet4_5000_if_cnt	-0.158;<0.001	-0.132;<0.001	0.107;<0.001	-0.127;<0.001
wet1_all_if_xd	0.012; 0.685	-0.174;<0.001	-0.308;<0.001	-0.245;<0.001
wet2_all_if_xd	0.052; 0.080	0.106;<0.001	-0.047; 0.062	0.130;<0.001
wet3_all_if_xd	0.002; 0.948	-0.066; 0.019	-0.024; 0.350	0.025; 0.318
wet4_all_if_xd	-0.118;<0.001	-0.199;<0.001	-0.095;<0.001	-0.284;<0.001
wet1_if_density	0.170;<0.001	-0.562;<0.001	-0.045; 0.083	-0.190;<0.001
wet2_if_density	0.014; 0.644	-0.391;<0.001	0.140;<0.001	-0.154;<0.001
wet3_if_density	-0.641;<0.001	-0.198;<0.001	0.164;<0.001	-0.103;<0.001
wet4_if_density	-0.318;<0.001	-0.579;<0.001	0.151;<0.001	-0.154;<0.001

Table G.12: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet3_all_xd	wet4_all_xd	tro_all_xd	dug_all_xd
cws_shrub	-0.007; 0.763	-0.048; 0.049	-0.090; 0.001	-0.096;<0.001
mrps	0.029; 0.242	0.087;<0.001	0.306;<0.001	-0.049; 0.075
topo	-0.082;<0.001	-0.215;<0.001	-0.317;<0.001	-0.161;<0.001
wet1_500kd	-0.075; 0.010	-0.159;<0.001	-0.035; 0.286	-0.129;<0.001
wet1_1000kd	-0.061; 0.033	-0.172;<0.001	-0.109;<0.001	-0.196;<0.001
wet1_2500kd	-0.124;<0.001	-0.220;<0.001	0.004; 0.883	-0.164;<0.001
wet1_5000kd	-0.331;<0.001	-0.448;<0.001	0.345;<0.001	-0.065; 0.017
wet2_500kd	-0.037; 0.168	0.001; 0.965	0.007; 0.825	-0.034; 0.244
wet2_1000kd	-0.048; 0.053	0.057; 0.022	0.081; 0.004	0.036; 0.185
wet2_2500kd	-0.039; 0.108	0.145;<0.001	0.194;<0.001	0.103;<0.001
wet2_5000kd	0.042; 0.079	0.257;<0.001	0.305;<0.001	0.151;<0.001
wet3_500kd	-0.237;<0.001	-0.214;<0.001	0.112;<0.001	-0.122;<0.001
wet3_1000kd	-0.332;<0.001	-0.212;<0.001	0.237;<0.001	-0.092; 0.002
wet3_2500kd	-0.457;<0.001	-0.294;<0.001	0.432;<0.001	-0.019; 0.486
wet3_5000kd	-0.584;<0.001	-0.370;<0.001	0.433;<0.001	-0.084; 0.002
wet4_500kd	-0.125;<0.001	-0.188;<0.001	-0.015; 0.637	-0.088; 0.006
wet4_1000kd	-0.161;<0.001	-0.237;<0.001	-0.022; 0.503	-0.155;<0.001
wet4_2500kd	-0.290;<0.001	-0.379;<0.001	0.044; 0.131	-0.106;<0.001
wet4_5000kd	-0.506;<0.001	-0.567;<0.001	0.022; 0.421	-0.218;<0.001
wet1_500_cnt	-0.082; 0.005	-0.174;<0.001	-0.035; 0.291	-0.130;<0.001
wet1_1000_cnt	-0.074; 0.010	-0.185;<0.001	-0.092; 0.005	-0.163;<0.001
wet1_2500_cnt	-0.198;<0.001	-0.325;<0.001	0.039; 0.206	-0.110;<0.001
wet1_5000_cnt	-0.425;<0.001	-0.528;<0.001	0.245;<0.001	-0.092;<0.001
wet2_500_cnt	-0.097;<0.001	-0.079; 0.003	0.023; 0.459	-0.059; 0.051
wet2_1000_cnt	-0.168;<0.001	-0.087;<0.001	0.097;<0.001	-0.029; 0.311
wet2_2500_cnt	-0.379;<0.001	-0.186;<0.001	0.337;<0.001	0.083; 0.002
wet2_5000_cnt	-0.465;<0.001	-0.162;<0.001	0.414;<0.001	0.069; 0.009
wet3_500_cnt	-0.255;<0.001	-0.224;<0.001	0.108;<0.001	-0.136;<0.001
wet3_1000_cnt	-0.373;<0.001	-0.224;<0.001	0.265;<0.001	-0.056; 0.060
wet3_2500_cnt	-0.553;<0.001	-0.313;<0.001	0.419;<0.001	0.023; 0.405
wet3_5000_cnt	-0.621;<0.001	-0.293;<0.001	0.314;<0.001	-0.055; 0.040
wet4_500_cnt	-0.111;<0.001	-0.187;<0.001	-0.016; 0.629	-0.092; 0.005
wet4_1000_cnt	-0.160;<0.001	-0.228;<0.001	-0.030; 0.353	-0.135;<0.001

Table G.12 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet3_all_xd	wet4_all_xd	tro_all_xd	dug_all_xd
wet4_2500_cnt	-0.294;<0.001	-0.428;<0.001	0.030; 0.314	-0.105;<0.001
wet4_5000_cnt	-0.463;<0.001	-0.602;<0.001	0.004; 0.875	-0.269;<0.001
wet1_all_cnt	-0.343;<0.001	-0.359;<0.001	0.166;<0.001	-0.135;<0.001
wet2_all_cnt	-0.219;<0.001	0.032; 0.188	0.443;<0.001	0.111;<0.001
wet3_all_cnt	-0.254;<0.001	0.023; 0.347	0.353;<0.001	0.075; 0.005
wet4_all_cnt	-0.174;<0.001	-0.298;<0.001	-0.162;<0.001	-0.155;<0.001
field_size	0.303;<0.001	0.428;<0.001	0.290;<0.001	0.438;<0.001
tro_all_cnt	0.415;<0.001	0.373;<0.001	-0.219;<0.001	0.076; 0.014
dug_all_cnt	0.245;<0.001	0.315;<0.001	0.317;<0.001	0.344;<0.001
wet1_all_xd	0.235;<0.001	0.402;<0.001	-0.217;<0.001	-0.056; 0.034
wet2_all_xd	0.569;<0.001	0.345;<0.001	-0.294;<0.001	0.014; 0.596
wet3_all_xd	**1.000;<0.001**	0.539;<0.001	-0.273;<0.001	0.046; 0.087
wet4_all_xd	0.539;<0.001	**1.000;<0.001**	-0.082; 0.002	0.077; 0.004
tro_all_xd	-0.273;<0.001	-0.082; 0.002	**1.000;<0.001**	0.229;<0.001
dug_all_xd	0.046; 0.087	0.077; 0.004	0.229;<0.001	**1.000;<0.001**
wet1_500_if_cnt	-0.034; 0.240	-0.098;<0.001	-0.054; 0.105	-0.144;<0.001
wet1_1000_if_cnt	0.012; 0.673	-0.032; 0.269	-0.082; 0.013	-0.117;<0.001
wet1_2500_if_cnt	0.105;<0.001	0.095;<0.001	-0.154;<0.001	-0.130;<0.001
wet1_5000_if_cnt	-0.115;<0.001	-0.088; 0.001	0.131;<0.001	0.391;<0.001
wet2_500_if_cnt	-0.044; 0.108	0.012; 0.666	0.061; 0.048	-0.007; 0.826
wet2_1000_if_cnt	-0.028; 0.277	0.061; 0.019	0.088; 0.003	-0.021; 0.477
wet2_2500_if_cnt	0.040; 0.103	0.179;<0.001	0.096;<0.001	-0.027; 0.320
wet2_5000_if_cnt	0.046; 0.064	0.215;<0.001	0.132;<0.001	0.132;<0.001
wet3_500_if_cnt	-0.195;<0.001	-0.136;<0.001	0.150;<0.001	-0.118;<0.001
wet3_1000_if_cnt	-0.206;<0.001	-0.082; 0.003	0.194;<0.001	-0.157;<0.001
wet3_2500_if_cnt	-0.110;<0.001	0.078; 0.002	0.274;<0.001	-0.116;<0.001
wet3_5000_if_cnt	-0.180;<0.001	-0.027; 0.269	0.210;<0.001	0.188;<0.001
wet4_500_if_cnt	-0.064; 0.029	-0.123;<0.001	-0.006; 0.853	-0.073; 0.025
wet4_1000_if_cnt	-0.078; 0.007	-0.106;<0.001	0.005; 0.876	-0.096; 0.003
wet4_2500_if_cnt	0.015; 0.597	-0.011; 0.696	-0.046; 0.147	-0.131;<0.001
wet4_5000_if_cnt	-0.168;<0.001	-0.041; 0.124	0.092; 0.002	0.096; 0.001
wet1_all_if_xd	-0.275;<0.001	-0.350;<0.001	0.174;<0.001	0.158;<0.001
wet2_all_if_xd	0.032; 0.214	0.031; 0.229	0.084; 0.003	0.464;<0.001

Table G.12 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet3_all_xd	wet4_all_xd	tro_all_xd	dug_all_xd
wet3_all_if_xd	-0.073; 0.004	-0.150;<0.001	-0.072; 0.011	0.390;<0.001
wet4_all_if_xd	-0.333;<0.001	-0.262;<0.001	0.080; 0.005	0.138;<0.001
wet1_if_density	-0.038; 0.143	-0.082; 0.002	-0.128;<0.001	0.021; 0.472
wet2_if_density	-0.003; 0.923	0.121;<0.001	0.017; 0.579	0.167;<0.001
wet3_if_density	-0.346;<0.001	-0.177;<0.001	0.223;<0.001	-0.006; 0.836
wet4_if_density	-0.258;<0.001	-0.184;<0.001	-0.064; 0.034	-0.199;<0.001

Table G.13: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet1_500_if_cnt	wet1_1000_if_cnt	wet1_2500_if_cnt	wet1_5000_if_cnt
cws_shrub	0.021; 0.489	-0.035; 0.247	-0.046; 0.114	-0.030; 0.283
mrps	-0.080; 0.008	-0.117;<0.001	-0.246;<0.001	-0.236;<0.001
topo	0.072; 0.014	0.077; 0.009	0.082; 0.004	-0.018; 0.511
wet1_500kd	**0.747;<0.001**	0.155;<0.001	0.042; 0.225	-0.069; 0.039
wet1_1000kd	0.441;<0.001	0.678;<0.001	0.027; 0.420	-0.041; 0.209
wet1_2500kd	0.176;<0.001	0.194;<0.001	0.386;<0.001	-0.100;<0.001
wet1_5000kd	0.094; 0.002	0.050; 0.091	0.018; 0.547	0.065; 0.022
wet2_500kd	0.180;<0.001	0.095; 0.003	0.123;<0.001	0.104;<0.001
wet2_1000kd	0.113;<0.001	0.150;<0.001	0.113;<0.001	0.178;<0.001
wet2_2500kd	0.017; 0.567	0.010; 0.742	0.068; 0.017	0.136;<0.001
wet2_5000kd	-0.087; 0.003	-0.106;<0.001	-0.059; 0.038	0.097;<0.001
wet3_500kd	0.258;<0.001	0.166;<0.001	0.166;<0.001	0.044; 0.168
wet3_1000kd	0.204;<0.001	0.239;<0.001	0.109;<0.001	0.065; 0.030
wet3_2500kd	0.084; 0.005	0.067; 0.022	0.058; 0.042	0.034; 0.219
wet3_5000kd	0.001; 0.981	-0.047; 0.104	-0.096;<0.001	0.020; 0.473
wet4_500kd	0.389;<0.001	0.154;<0.001	0.111; 0.001	0.076; 0.023
wet4_1000kd	0.249;<0.001	0.361;<0.001	0.121;<0.001	0.063; 0.051
wet4_2500kd	0.152;<0.001	0.142;<0.001	0.119;<0.001	0.049; 0.093
wet4_5000kd	0.094; 0.001	0.059; 0.047	0.004; 0.884	0.003; 0.911
wet1_500_cnt	**0.779;<0.001**	0.168;<0.001	0.067; 0.052	-0.055; 0.102
wet1_1000_cnt	0.219;<0.001	**0.758;<0.001**	0.051; 0.140	-0.035; 0.286
wet1_2500_cnt	0.095; 0.003	0.030; 0.352	0.449;<0.001	-0.099; 0.001
wet1_5000_cnt	0.091; 0.002	0.038; 0.205	-0.054; 0.065	0.092; 0.001
wet2_500_cnt	0.191;<0.001	0.103; 0.002	0.172;<0.001	0.121;<0.001

Table G.13 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet1_500_if_cnt	wet1_1000_if_cnt	wet1_2500_if_cnt	wet1_5000_if_cnt
wet2_1000_cnt	0.090; 0.004	0.177;<0.001	0.184;<0.001	0.202;<0.001
wet2_2500_cnt	0.036; 0.227	0.011; 0.710	0.078; 0.007	0.217;<0.001
wet2_5000_cnt	-0.004; 0.883	-0.052; 0.076	-0.030; 0.303	0.176;<0.001
wet3_500_cnt	0.265;<0.001	0.155;<0.001	0.176;<0.001	0.063; 0.051
wet3_1000_cnt	0.139;<0.001	0.231;<0.001	0.086; 0.006	0.120;<0.001
wet3_2500_cnt	0.023; 0.441	-0.013; 0.654	0.024; 0.404	0.101;<0.001
wet3_5000_cnt	-0.024; 0.407	-0.070; 0.016	-0.087; 0.002	0.097;<0.001
wet4_500_cnt	0.416;<0.001	0.169;<0.001	0.117;<0.001	0.081; 0.016
wet4_1000_cnt	0.176;<0.001	0.396;<0.001	0.132;<0.001	0.033; 0.311
wet4_2500_cnt	0.136;<0.001	0.097; 0.002	0.149;<0.001	0.055; 0.066
wet4_5000_cnt	0.078; 0.009	0.049; 0.097	-0.035; 0.227	-0.092; 0.001
wet1_all_cnt	0.105;<0.001	0.092; 0.002	0.088; 0.002	0.005; 0.860
wet2_all_cnt	-0.053; 0.077	-0.068; 0.022	-0.010; 0.728	0.114;<0.001
wet3_all_cnt	-0.067; 0.023	-0.090; 0.002	-0.022; 0.443	0.067; 0.017
wet4_all_cnt	0.055; 0.063	0.037; 0.207	-0.043; 0.135	-0.166;<0.001
field_size	-0.118;<0.001	-0.094; 0.003	-0.013; 0.665	0.125;<0.001
tro_all_cnt	-0.147;<0.001	-0.151;<0.001	-0.097; 0.003	0.045; 0.159
dug_all_cnt	-0.142;<0.001	-0.165;<0.001	-0.192;<0.001	-0.113;<0.001
wet1_all_xd	-0.093; 0.001	-0.015; 0.613	0.121;<0.001	-0.021; 0.453
wet2_all_xd	-0.082; 0.005	-0.039; 0.180	0.006; 0.839	-0.163;<0.001
wet3_all_xd	-0.034; 0.240	0.012; 0.673	0.105;<0.001	-0.115;<0.001
wet4_all_xd	-0.098;<0.001	-0.032; 0.269	0.095;<0.001	-0.088; 0.001
tro_all_xd	-0.054; 0.105	-0.082; 0.013	-0.154;<0.001	0.131;<0.001
dug_all_xd	-0.144;<0.001	-0.117;<0.001	-0.130;<0.001	0.391;<0.001
wet1_500_if_cnt	**1.000;<0.001**	0.215;<0.001	0.140;<0.001	0.026; 0.436
wet1_1000_if_cnt	0.215;<0.001	**1.000;<0.001**	0.108; 0.002	0.078; 0.021
wet1_2500_if_cnt	0.140;<0.001	0.108; 0.002	**1.000;<0.001**	0.036; 0.279
wet1_5000_if_cnt	0.026; 0.436	0.078; 0.021	0.036; 0.279	**1.000;<0.001**
wet2_500_if_cnt	0.222;<0.001	0.144;<0.001	0.253;<0.001	0.210;<0.001
wet2_1000_if_cnt	0.105;<0.001	0.244;<0.001	0.314;<0.001	0.320;<0.001
wet2_2500_if_cnt	0.090; 0.003	0.157;<0.001	0.410;<0.001	0.385;<0.001
wet2_5000_if_cnt	0.012; 0.698	0.104;<0.001	0.327;<0.001	0.463;<0.001
wet3_500_if_cnt	0.331;<0.001	0.222;<0.001	0.296;<0.001	0.191;<0.001

Table G.13 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet1_500_if_cnt	wet1_1000_if_cnt	wet1_2500_if_cnt	wet1_5000_if_cnt
wet3_1000_if_cnt	0.217;<0.001	0.356;<0.001	0.298;<0.001	0.252;<0.001
wet3_2500_if_cnt	0.089; 0.004	0.131;<0.001	0.419;<0.001	0.271;<0.001
wet3_5000_if_cnt	-0.017; 0.566	0.027; 0.366	0.113;<0.001	0.378;<0.001
wet4_500_if_cnt	0.501;<0.001	0.225;<0.001	0.195;<0.001	0.184;<0.001
wet4_1000_if_cnt	0.236;<0.001	0.532;<0.001	0.228;<0.001	0.150;<0.001
wet4_2500_if_cnt	0.200;<0.001	0.235;<0.001	0.587;<0.001	0.267;<0.001
wet4_5000_if_cnt	0.032; 0.326	0.100; 0.002	0.195;<0.001	0.495;<0.001
wet1_all_if_xd	-0.185;<0.001	-0.254;<0.001	-0.353;<0.001	0.074; 0.012
wet2_all_if_xd	-0.157;<0.001	-0.212;<0.001	-0.273;<0.001	0.030; 0.303
wet3_all_if_xd	-0.161;<0.001	-0.201;<0.001	-0.302;<0.001	-0.005; 0.857
wet4_all_if_xd	-0.164;<0.001	-0.216;<0.001	-0.297;<0.001	-0.013; 0.658
wet1_if_density	0.182;<0.001	0.237;<0.001	0.370;<0.001	0.415;<0.001
wet2_if_density	0.166;<0.001	0.227;<0.001	0.417;<0.001	0.515;<0.001
wet3_if_density	0.128;<0.001	0.138;<0.001	0.164;<0.001	0.112;<0.001
wet4_if_density	0.172;<0.001	0.198;<0.001	0.265;<0.001	0.209;<0.001

Table G.14: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet2_500_if_cnt	wet2_1000_if_cnt	wet2_2500_if_cnt	wet2_5000_if_cnt
cws_shrub	-0.043; 0.129	-0.049; 0.067	-0.083;<0.001	-0.145;<0.001
mrps	-0.147;<0.001	-0.187;<0.001	-0.184;<0.001	-0.164;<0.001
topo	-0.091;<0.001	-0.095;<0.001	-0.136;<0.001	-0.108;<0.001
wet1_500kd	0.127;<0.001	-0.008; 0.791	-0.033; 0.272	-0.089; 0.003
wet1_1000kd	0.088; 0.007	0.077; 0.013	0.012; 0.694	-0.043; 0.145
wet1_2500kd	0.041; 0.165	0.026; 0.365	0.051; 0.055	0.135;<0.001
wet1_5000kd	-0.008; 0.786	-0.021; 0.428	-0.059; 0.019	-0.009; 0.720
wet2_500kd	**0.749;<0.001**	0.315;<0.001	0.224;<0.001	0.058; 0.031
wet2_1000kd	0.462;<0.001	0.520;<0.001	0.270;<0.001	0.133;<0.001
wet2_2500kd	0.297;<0.001	0.293;<0.001	0.273;<0.001	0.177;<0.001
wet2_5000kd	0.183;<0.001	0.190;<0.001	0.260;<0.001	0.266;<0.001
wet3_500kd	0.348;<0.001	0.165;<0.001	0.077; 0.006	0.039; 0.168
wet3_1000kd	0.210;<0.001	0.241;<0.001	0.093;<0.001	0.047; 0.076
wet3_2500kd	0.065; 0.018	0.087;<0.001	0.092;<0.001	0.066; 0.008
wet3_5000kd	0.003; 0.909	-0.007; 0.789	0.007; 0.787	0.027; 0.278

Table G.14 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet2_500_if_cnt	wet2_1000_if_cnt	wet2_2500_if_cnt	wet2_5000_if_cnt
wet4_500kd	0.186;<0.001	0.081; 0.010	0.017; 0.558	-0.006; 0.852
wet4_1000kd	0.142;<0.001	0.196;<0.001	0.059; 0.041	-0.030; 0.301
wet4_2500kd	0.036; 0.214	0.006; 0.822	0.000; 0.985	-0.068; 0.009
wet4_5000kd	-0.051; 0.066	-0.077; 0.003	-0.163;<0.001	-0.191;<0.001
wet1_500_cnt	0.147;<0.001	0.013; 0.675	-0.025; 0.398	-0.081; 0.006
wet1_1000_cnt	0.050; 0.127	0.097; 0.002	-0.006; 0.829	-0.053; 0.074
wet1_2500_cnt	0.006; 0.837	-0.011; 0.708	-0.003; 0.900	0.060; 0.028
wet1_5000_cnt	-0.039; 0.167	-0.057; 0.034	-0.149;<0.001	-0.111;<0.001
wet2_500_cnt	**0.866;<0.001**	0.356;<0.001	0.241;<0.001	0.056; 0.043
wet2_1000_cnt	0.386;<0.001	**0.734;<0.001**	0.276;<0.001	0.118;<0.001
wet2_2500_cnt	0.207;<0.001	0.211;<0.001	0.319;<0.001	0.160;<0.001
wet2_5000_cnt	0.051; 0.063	0.087;<0.001	0.118;<0.001	0.226;<0.001
wet3_500_cnt	0.360;<0.001	0.174;<0.001	0.096;<0.001	0.052; 0.070
wet3_1000_cnt	0.150;<0.001	0.267;<0.001	0.122;<0.001	0.087; 0.001
wet3_2500_cnt	0.055; 0.047	0.069; 0.009	0.090;<0.001	0.089;<0.001
wet3_5000_cnt	0.043; 0.120	0.042; 0.108	0.071; 0.004	0.084;<0.001
wet4_500_cnt	0.205;<0.001	0.092; 0.004	0.018; 0.545	-0.013; 0.663
wet4_1000_cnt	0.087; 0.007	0.196;<0.001	0.046; 0.114	-0.038; 0.197
wet4_2500_cnt	0.017; 0.558	-0.030; 0.291	0.002; 0.928	-0.060; 0.024
wet4_5000_cnt	-0.107;<0.001	-0.155;<0.001	-0.232;<0.001	-0.220;<0.001
wet1_all_cnt	-0.037; 0.177	-0.009; 0.731	-0.052; 0.036	-0.018; 0.478
wet2_all_cnt	0.076; 0.006	0.138;<0.001	0.211;<0.001	0.279;<0.001
wet3_all_cnt	0.021; 0.453	0.073; 0.006	0.144;<0.001	0.225;<0.001
wet4_all_cnt	-0.252;<0.001	-0.278;<0.001	-0.368;<0.001	-0.284;<0.001
field_size	0.079; 0.007	0.118;<0.001	0.224;<0.001	0.262;<0.001
tro_all_cnt	0.009; 0.762	0.010; 0.734	0.039; 0.168	0.055; 0.051
dug_all_cnt	-0.121;<0.001	-0.114;<0.001	-0.010; 0.713	0.040; 0.137
wet1_all_xd	0.077; 0.005	0.127;<0.001	0.218;<0.001	0.126;<0.001
wet2_all_xd	-0.131;<0.001	-0.129;<0.001	-0.082;<0.001	-0.080; 0.001
wet3_all_xd	-0.044; 0.108	-0.028; 0.277	0.040; 0.103	0.046; 0.064
wet4_all_xd	0.012; 0.666	0.061; 0.019	0.179;<0.001	0.215;<0.001
tro_all_xd	0.061; 0.048	0.088; 0.003	0.096;<0.001	0.132;<0.001
dug_all_xd	-0.007; 0.826	-0.021; 0.477	-0.027; 0.320	0.132;<0.001

Table G.14 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet2_500_if_cnt	wet2_1000_if_cnt	wet2_2500_if_cnt	wet2_5000_if_cnt
wet1_500_if_cnt	0.222;<0.001	0.105;<0.001	0.090; 0.003	0.012; 0.698
wet1_1000_if_cnt	0.144;<0.001	0.244;<0.001	0.157;<0.001	0.104;<0.001
wet1_2500_if_cnt	0.253;<0.001	0.314;<0.001	0.410;<0.001	0.327;<0.001
wet1_5000_if_cnt	0.210;<0.001	0.320;<0.001	0.385;<0.001	0.463;<0.001
wet2_500_if_cnt	**1.000;<0.001**	0.466;<0.001	0.376;<0.001	0.177;<0.001
wet2_1000_if_cnt	0.466;<0.001	**1.000;<0.001**	0.494;<0.001	0.300;<0.001
wet2_2500_if_cnt	0.376;<0.001	0.494;<0.001	**1.000;<0.001**	0.460;<0.001
wet2_5000_if_cnt	0.177;<0.001	0.300;<0.001	0.460;<0.001	**1.000;<0.001**
wet3_500_if_cnt	0.497;<0.001	0.314;<0.001	0.259;<0.001	0.197;<0.001
wet3_1000_if_cnt	0.264;<0.001	0.469;<0.001	0.349;<0.001	0.283;<0.001
wet3_2500_if_cnt	0.176;<0.001	0.315;<0.001	0.521;<0.001	0.441;<0.001
wet3_5000_if_cnt	0.080; 0.005	0.155;<0.001	0.291;<0.001	0.433;<0.001
wet4_500_if_cnt	0.307;<0.001	0.196;<0.001	0.130;<0.001	0.093; 0.002
wet4_1000_if_cnt	0.192;<0.001	0.335;<0.001	0.201;<0.001	0.118;<0.001
wet4_2500_if_cnt	0.256;<0.001	0.329;<0.001	0.459;<0.001	0.291;<0.001
wet4_5000_if_cnt	0.089; 0.003	0.185;<0.001	0.297;<0.001	0.488;<0.001
wet1_all_if_xd	-0.129;<0.001	-0.194;<0.001	-0.248;<0.001	-0.079; 0.002
wet2_all_if_xd	-0.321;<0.001	-0.405;<0.001	-0.469;<0.001	-0.073; 0.005
wet3_all_if_xd	-0.183;<0.001	-0.289;<0.001	-0.341;<0.001	-0.187;<0.001
wet4_all_if_xd	-0.103;<0.001	-0.179;<0.001	-0.238;<0.001	-0.066; 0.010
wet1_if_density	0.199;<0.001	0.263;<0.001	0.250;<0.001	0.286;<0.001
wet2_if_density	0.320;<0.001	0.427;<0.001	0.473;<0.001	0.510;<0.001
wet3_if_density	0.081; 0.006	0.121;<0.001	0.126;<0.001	0.129;<0.001
wet4_if_density	0.140;<0.001	0.181;<0.001	0.166;<0.001	0.153;<0.001

Table G.15: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet3_500_if_cnt	wet3_1000_if_cnt	wet3_2500_if_cnt	wet3_5000_if_cnt
cws_shrub	-0.088; 0.002	-0.144;<0.001	-0.156;<0.001	-0.076; 0.003
mrps	-0.081; 0.005	-0.064; 0.024	-0.004; 0.871	-0.037; 0.141
topo	0.094;<0.001	0.083; 0.003	-0.028; 0.284	0.016; 0.507
wet1_500kd	0.239;<0.001	0.115;<0.001	-0.006; 0.856	-0.101;<0.001
wet1_1000kd	0.237;<0.001	0.262;<0.001	0.018; 0.559	-0.109;<0.001
wet1_2500kd	0.205;<0.001	0.183;<0.001	0.162;<0.001	-0.101;<0.001

Table G.15 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet3_500_if_cnt	wet3_1000_if_cnt	wet3_2500_if_cnt	wet3_5000_if_cnt
wet1_5000kd	0.147;<0.001	0.151;<0.001	0.092;<0.001	-0.112;<0.001
wet2_500kd	0.355;<0.001	0.120;<0.001	0.032; 0.258	-0.068; 0.013
wet2_1000kd	0.208;<0.001	0.204;<0.001	0.053; 0.043	-0.070; 0.006
wet2_2500kd	0.036; 0.199	0.015; 0.584	0.060; 0.020	-0.077; 0.002
wet2_5000kd	-0.072; 0.011	-0.081; 0.003	0.035; 0.173	0.011; 0.657
wet3_500kd	**0.771;<0.001**	0.359;<0.001	0.190;<0.001	0.061; 0.031
wet3_1000kd	0.517;<0.001	0.597;<0.001	0.252;<0.001	0.083; 0.002
wet3_2500kd	0.279;<0.001	0.345;<0.001	0.370;<0.001	0.140;<0.001
wet3_5000kd	0.195;<0.001	0.244;<0.001	0.224;<0.001	0.220;<0.001
wet4_500kd	0.266;<0.001	0.145;<0.001	0.068; 0.028	-0.020; 0.499
wet4_1000kd	0.285;<0.001	0.322;<0.001	0.140;<0.001	-0.037; 0.202
wet4_2500kd	0.257;<0.001	0.244;<0.001	0.154;<0.001	-0.045; 0.086
wet4_5000kd	0.189;<0.001	0.206;<0.001	0.053; 0.041	0.097;<0.001
wet1_500_cnt	0.268;<0.001	0.134;<0.001	0.004; 0.909	-0.092; 0.002
wet1_1000_cnt	0.163;<0.001	0.236;<0.001	0.012; 0.696	-0.108;<0.001
wet1_2500_cnt	0.191;<0.001	0.136;<0.001	0.165;<0.001	-0.087; 0.002
wet1_5000_cnt	0.169;<0.001	0.171;<0.001	0.066; 0.012	-0.042; 0.101
wet2_500_cnt	0.441;<0.001	0.194;<0.001	0.083; 0.004	-0.039; 0.166
wet2_1000_cnt	0.277;<0.001	0.363;<0.001	0.169;<0.001	0.003; 0.909
wet2_2500_cnt	0.223;<0.001	0.225;<0.001	0.265;<0.001	0.069; 0.006
wet2_5000_cnt	0.188;<0.001	0.224;<0.001	0.269;<0.001	0.231;<0.001
wet3_500_cnt	**0.822;<0.001**	0.384;<0.001	0.214;<0.001	0.073; 0.011
wet3_1000_cnt	0.392;<0.001	0.686;<0.001	0.277;<0.001	0.133;<0.001
wet3_2500_cnt	0.243;<0.001	0.272;<0.001	0.370;<0.001	0.159;<0.001
wet3_5000_cnt	0.192;<0.001	0.230;<0.001	0.219;<0.001	0.307;<0.001
wet4_500_cnt	0.282;<0.001	0.143;<0.001	0.063; 0.043	-0.029; 0.327
wet4_1000_cnt	0.214;<0.001	0.316;<0.001	0.134;<0.001	-0.031; 0.288
wet4_2500_cnt	0.240;<0.001	0.202;<0.001	0.165;<0.001	-0.033; 0.222
wet4_5000_cnt	0.122;<0.001	0.137;<0.001	-0.003; 0.910	0.069; 0.006
wet1_all_cnt	0.258;<0.001	0.308;<0.001	0.256;<0.001	0.099;<0.001
wet2_all_cnt	0.201;<0.001	0.279;<0.001	0.399;<0.001	0.329;<0.001
wet3_all_cnt	0.203;<0.001	0.257;<0.001	0.362;<0.001	0.386;<0.001
wet4_all_cnt	0.080; 0.005	0.083; 0.003	-0.035; 0.171	0.064; 0.010

Table G.15 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet3_500_if_cnt	wet3_1000_if_cnt	wet3_2500_if_cnt	wet3_5000_if_cnt
field_size	-0.122;<0.001	-0.071; 0.017	0.106;<0.001	0.122;<0.001
tro_all_cnt	-0.308;<0.001	-0.363;<0.001	-0.271;<0.001	-0.298;<0.001
dug_all_cnt	-0.195;<0.001	-0.122;<0.001	0.054; 0.053	0.083; 0.002
wet1_all_xd	0.013; 0.658	0.078; 0.005	0.167;<0.001	0.160;<0.001
wet2_all_xd	-0.178;<0.001	-0.157;<0.001	-0.081; 0.002	-0.051; 0.040
wet3_all_xd	-0.195;<0.001	-0.206;<0.001	-0.110;<0.001	-0.180;<0.001
wet4_all_xd	-0.136;<0.001	-0.082; 0.003	0.078; 0.002	-0.027; 0.269
tro_all_xd	0.150;<0.001	0.194;<0.001	0.274;<0.001	0.210;<0.001
dug_all_xd	-0.118;<0.001	-0.157;<0.001	-0.116;<0.001	0.188;<0.001
wet1_500_if_cnt	0.331;<0.001	0.217;<0.001	0.089; 0.004	-0.017; 0.566
wet1_1000_if_cnt	0.222;<0.001	0.356;<0.001	0.131;<0.001	0.027; 0.366
wet1_2500_if_cnt	0.296;<0.001	0.298;<0.001	0.419;<0.001	0.113;<0.001
wet1_5000_if_cnt	0.191;<0.001	0.252;<0.001	0.271;<0.001	0.378;<0.001
wet2_500_if_cnt	0.497;<0.001	0.264;<0.001	0.176;<0.001	0.080; 0.005
wet2_1000_if_cnt	0.314;<0.001	0.469;<0.001	0.315;<0.001	0.155;<0.001
wet2_2500_if_cnt	0.259;<0.001	0.349;<0.001	0.521;<0.001	0.291;<0.001
wet2_5000_if_cnt	0.197;<0.001	0.283;<0.001	0.441;<0.001	0.433;<0.001
wet3_500_if_cnt	**1.000;<0.001**	0.511;<0.001	0.362;<0.001	0.219;<0.001
wet3_1000_if_cnt	0.511;<0.001	**1.000;<0.001**	0.511;<0.001	0.309;<0.001
wet3_2500_if_cnt	0.362;<0.001	0.511;<0.001	**1.000;<0.001**	0.391;<0.001
wet3_5000_if_cnt	0.219;<0.001	0.309;<0.001	0.391;<0.001	**1.000;<0.001**
wet4_500_if_cnt	0.374;<0.001	0.225;<0.001	0.160;<0.001	0.073; 0.015
wet4_1000_if_cnt	0.309;<0.001	0.432;<0.001	0.266;<0.001	0.126;<0.001
wet4_2500_if_cnt	0.435;<0.001	0.464;<0.001	0.520;<0.001	0.235;<0.001
wet4_5000_if_cnt	0.228;<0.001	0.331;<0.001	0.392;<0.001	0.624;<0.001
wet1_all_if_xd	-0.103;<0.001	-0.185;<0.001	-0.232;<0.001	-0.103;<0.001
wet2_all_if_xd	-0.213;<0.001	-0.265;<0.001	-0.237;<0.001	-0.028; 0.279
wet3_all_if_xd	-0.276;<0.001	-0.355;<0.001	-0.430;<0.001	0.041; 0.113
wet4_all_if_xd	-0.146;<0.001	-0.199;<0.001	-0.260;<0.001	0.044; 0.092
wet1_if_density	0.259;<0.001	0.248;<0.001	0.187;<0.001	-0.019; 0.481
wet2_if_density	0.338;<0.001	0.349;<0.001	0.349;<0.001	0.196;<0.001
wet3_if_density	0.355;<0.001	0.426;<0.001	0.402;<0.001	0.569;<0.001
wet4_if_density	0.282;<0.001	0.297;<0.001	0.227;<0.001	0.295;<0.001

Table G.16: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet4_500_if_cnt	wet4_1000_if_cnt	wet4_2500_if_cnt	wet4_5000_if_cnt
cws_shrub	0.064; 0.033	0.034; 0.243	-0.042; 0.138	-0.087; 0.001
mrps	-0.154;<0.001	-0.196;<0.001	-0.248;<0.001	-0.109;<0.001
topo	0.082; 0.005	0.106;<0.001	0.126;<0.001	0.060; 0.025
wet1_500kd	0.369;<0.001	0.133;<0.001	0.091; 0.006	-0.051; 0.112
wet1_1000kd	0.250;<0.001	0.372;<0.001	0.156;<0.001	-0.013; 0.670
wet1_2500kd	0.111;<0.001	0.161;<0.001	0.221;<0.001	-0.005; 0.853
wet1_5000kd	0.093; 0.002	0.065; 0.027	0.021; 0.455	-0.012; 0.667
wet2_500kd	0.195;<0.001	0.093; 0.004	0.112;<0.001	-0.013; 0.651
wet2_1000kd	0.107;<0.001	0.131;<0.001	0.094; 0.001	0.025; 0.363
wet2_2500kd	0.015; 0.615	0.028; 0.340	-0.027; 0.330	0.028; 0.301
wet2_5000kd	-0.086; 0.003	-0.134;<0.001	-0.159;<0.001	0.001; 0.969
wet3_500kd	0.294;<0.001	0.239;<0.001	0.279;<0.001	0.068; 0.026
wet3_1000kd	0.215;<0.001	0.312;<0.001	0.257;<0.001	0.068; 0.017
wet3_2500kd	0.117;<0.001	0.190;<0.001	0.174;<0.001	0.090;<0.001
wet3_5000kd	0.025; 0.397	0.051; 0.076	-0.003; 0.912	0.162;<0.001
wet4_500kd	**0.783;<0.001**	0.230;<0.001	0.193;<0.001	-0.010; 0.749
wet4_1000kd	0.479;<0.001	0.663;<0.001	0.284;<0.001	-0.060; 0.055
wet4_2500kd	0.220;<0.001	0.287;<0.001	0.407;<0.001	-0.083; 0.003
wet4_5000kd	0.109;<0.001	0.143;<0.001	0.077; 0.006	0.186;<0.001
wet1_500_cnt	0.380;<0.001	0.181;<0.001	0.116;<0.001	-0.039; 0.229
wet1_1000_cnt	0.207;<0.001	0.413;<0.001	0.141;<0.001	-0.017; 0.594
wet1_2500_cnt	0.092; 0.005	0.113;<0.001	0.222;<0.001	-0.019; 0.530
wet1_5000_cnt	0.106;<0.001	0.097; 0.001	0.012; 0.671	0.045; 0.098
wet2_500_cnt	0.271;<0.001	0.151;<0.001	0.177;<0.001	-0.004; 0.884
wet2_1000_cnt	0.173;<0.001	0.289;<0.001	0.201;<0.001	0.055; 0.053
wet2_2500_cnt	0.070; 0.017	0.110;<0.001	0.148;<0.001	0.118;<0.001
wet2_5000_cnt	0.016; 0.580	0.010; 0.738	-0.005; 0.856	0.247;<0.001
wet3_500_cnt	0.303;<0.001	0.233;<0.001	0.301;<0.001	0.087; 0.005
wet3_1000_cnt	0.142;<0.001	0.306;<0.001	0.247;<0.001	0.121;<0.001
wet3_2500_cnt	0.076; 0.011	0.132;<0.001	0.140;<0.001	0.138;<0.001
wet3_5000_cnt	0.012; 0.673	0.040; 0.170	-0.004; 0.890	0.274;<0.001
wet4_500_cnt	**0.836;<0.001**	0.239;<0.001	0.208;<0.001	-0.024; 0.449
wet4_1000_cnt	0.224;<0.001	**0.770;<0.001**	0.250;<0.001	-0.039; 0.217

Table G.16 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet4_500_if_cnt	wet4_1000_if_cnt	wet4_2500_if_cnt	wet4_5000_if_cnt
wet4_2500_cnt	0.168;<0.001	0.201;<0.001	0.441;<0.001	-0.078; 0.007
wet4_5000_cnt	0.054; 0.071	0.065; 0.028	-0.013; 0.652	0.157;<0.001
wet1_all_cnt	0.100;<0.001	0.160;<0.001	0.141;<0.001	0.138;<0.001
wet2_all_cnt	-0.024; 0.423	0.039; 0.189	0.042; 0.134	0.251;<0.001
wet3_all_cnt	-0.022; 0.456	0.040; 0.168	0.055; 0.049	0.295;<0.001
wet4_all_cnt	0.074; 0.011	0.119;<0.001	0.105;<0.001	0.011; 0.673
field_size	-0.109;<0.001	-0.120;<0.001	-0.092; 0.002	-0.084; 0.003
tro_all_cnt	-0.152;<0.001	-0.228;<0.001	-0.199;<0.001	-0.158;<0.001
dug_all_cnt	-0.201;<0.001	-0.192;<0.001	-0.245;<0.001	-0.132;<0.001
wet1_all_xd	-0.053; 0.070	0.023; 0.436	0.144;<0.001	0.107;<0.001
wet2_all_xd	-0.066; 0.023	-0.057; 0.050	0.013; 0.628	-0.127;<0.001
wet3_all_xd	-0.064; 0.029	-0.078; 0.007	0.015; 0.597	-0.168;<0.001
wet4_all_xd	-0.123;<0.001	-0.106;<0.001	-0.011; 0.696	-0.041; 0.124
tro_all_xd	-0.006; 0.853	0.005; 0.876	-0.046; 0.147	0.092; 0.002
dug_all_xd	-0.073; 0.025	-0.096; 0.003	-0.131;<0.001	0.096; 0.001
wet1_500_if_cnt	0.501;<0.001	0.236;<0.001	0.200;<0.001	0.032; 0.326
wet1_1000_if_cnt	0.225;<0.001	0.532;<0.001	0.235;<0.001	0.100; 0.002
wet1_2500_if_cnt	0.195;<0.001	0.228;<0.001	0.587;<0.001	0.195;<0.001
wet1_5000_if_cnt	0.184;<0.001	0.150;<0.001	0.267;<0.001	0.495;<0.001
wet2_500_if_cnt	0.307;<0.001	0.192;<0.001	0.256;<0.001	0.089; 0.003
wet2_1000_if_cnt	0.196;<0.001	0.335;<0.001	0.329;<0.001	0.185;<0.001
wet2_2500_if_cnt	0.130;<0.001	0.201;<0.001	0.459;<0.001	0.297;<0.001
wet2_5000_if_cnt	0.093; 0.002	0.118;<0.001	0.291;<0.001	0.488;<0.001
wet3_500_if_cnt	0.374;<0.001	0.309;<0.001	0.435;<0.001	0.228;<0.001
wet3_1000_if_cnt	0.225;<0.001	0.432;<0.001	0.464;<0.001	0.331;<0.001
wet3_2500_if_cnt	0.160;<0.001	0.266;<0.001	0.520;<0.001	0.392;<0.001
wet3_5000_if_cnt	0.073; 0.015	0.126;<0.001	0.235;<0.001	0.624;<0.001
wet4_500_if_cnt	**1.000;<0.001**	0.309;<0.001	0.302;<0.001	0.057; 0.076
wet4_1000_if_cnt	0.309;<0.001	**1.000;<0.001**	0.365;<0.001	0.086; 0.007
wet4_2500_if_cnt	0.302;<0.001	0.365;<0.001	**1.000;<0.001**	0.162;<0.001
wet4_5000_if_cnt	0.057; 0.076	0.086; 0.007	0.162;<0.001	**1.000;<0.001**
wet1_all_if_xd	-0.058; 0.061	-0.122;<0.001	-0.224;<0.001	-0.078; 0.006
wet2_all_if_xd	-0.078; 0.011	-0.173;<0.001	-0.244;<0.001	-0.080; 0.004

Table G.16 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet4_500_if_cnt	wet4_1000_if_cnt	wet4_2500_if_cnt	wet4_5000_if_cnt
wet3_all_if_xd	-0.122;<0.001	-0.204;<0.001	-0.334;<0.001	-0.031; 0.260
wet4_all_if_xd	-0.148;<0.001	-0.211;<0.001	-0.363;<0.001	0.088; 0.002
wet1_if_density	0.246;<0.001	0.264;<0.001	0.397;<0.001	0.224;<0.001
wet2_if_density	0.243;<0.001	0.273;<0.001	0.445;<0.001	0.382;<0.001
wet3_if_density	0.160;<0.001	0.242;<0.001	0.284;<0.001	0.406;<0.001
wet4_if_density	0.216;<0.001	0.264;<0.001	0.361;<0.001	0.441;<0.001

Table G.17: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet1_all_if_xd	wet2_all_if_xd	wet3_all_if_xd	wet4_all_if_xd
cws_shrub	0.124;<0.001	0.044; 0.089	0.103;<0.001	0.093;<0.001
mrps	-0.060; 0.021	0.053; 0.041	-0.036; 0.168	-0.045; 0.084
topo	0.100;<0.001	0.060; 0.018	0.062; 0.015	0.079; 0.002
wet1_500kd	-0.094; 0.003	-0.136;<0.001	-0.143;<0.001	-0.121;<0.001
wet1_1000kd	-0.181;<0.001	-0.205;<0.001	-0.204;<0.001	-0.183;<0.001
wet1_2500kd	-0.010; 0.716	-0.147;<0.001	-0.205;<0.001	-0.068; 0.014
wet1_5000kd	0.322;<0.001	-0.033; 0.205	-0.078; 0.003	0.144;<0.001
wet2_500kd	-0.037; 0.186	-0.242;<0.001	-0.135;<0.001	-0.027; 0.331
wet2_1000kd	-0.025; 0.338	-0.239;<0.001	-0.165;<0.001	-0.012; 0.638
wet2_2500kd	0.054; 0.034	-0.149;<0.001	-0.138;<0.001	0.054; 0.034
wet2_5000kd	0.080; 0.002	-0.083; 0.001	-0.124;<0.001	0.083; 0.001
wet3_500kd	0.040; 0.172	-0.118;<0.001	-0.172;<0.001	-0.036; 0.226
wet3_1000kd	0.049; 0.077	-0.102;<0.001	-0.187;<0.001	0.001; 0.981
wet3_2500kd	0.153;<0.001	-0.059; 0.022	-0.131;<0.001	0.117;<0.001
wet3_5000kd	0.255;<0.001	-0.019; 0.451	0.013; 0.612	0.288;<0.001
wet4_500kd	0.023; 0.453	-0.029; 0.344	-0.062; 0.044	-0.069; 0.024
wet4_1000kd	-0.002; 0.953	-0.131;<0.001	-0.177;<0.001	-0.152;<0.001
wet4_2500kd	0.175;<0.001	-0.047; 0.082	-0.075; 0.006	-0.016; 0.555
wet4_5000kd	0.263;<0.001	-0.047; 0.067	0.123;<0.001	0.311;<0.001
wet1_500_cnt	-0.103;<0.001	-0.136;<0.001	-0.142;<0.001	-0.129;<0.001
wet1_1000_cnt	-0.164;<0.001	-0.183;<0.001	-0.174;<0.001	-0.166;<0.001
wet1_2500_cnt	0.049; 0.087	-0.093; 0.001	-0.135;<0.001	-0.027; 0.347
wet1_5000_cnt	0.374;<0.001	0.018; 0.483	0.008; 0.749	0.231;<0.001
wet2_500_cnt	-0.015; 0.593	-0.265;<0.001	-0.140;<0.001	-0.032; 0.260

Table G.17 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet1_all_if_xd	wet2_all_if_xd	wet3_all_if_xd	wet4_all_if_xd
wet2_1000_cnt	-0.000; 0.990	-0.274;<0.001	-0.171;<0.001	-0.023; 0.385
wet2_2500_cnt	0.217;<0.001	-0.128;<0.001	-0.083; 0.001	0.191;<0.001
wet2_5000_cnt	0.272;<0.001	0.008; 0.766	-0.035; 0.175	0.297;<0.001
wet3_500_cnt	0.052; 0.082	-0.123;<0.001	-0.175;<0.001	-0.027; 0.356
wet3_1000_cnt	0.089; 0.002	-0.088; 0.002	-0.146;<0.001	0.045; 0.107
wet3_2500_cnt	0.258;<0.001	-0.022; 0.388	-0.077; 0.003	0.198;<0.001
wet3_5000_cnt	0.240;<0.001	-0.024; 0.349	0.083; 0.001	0.358;<0.001
wet4_500_cnt	0.013; 0.667	-0.036; 0.247	-0.078; 0.011	-0.093; 0.003
wet4_1000_cnt	-0.020; 0.513	-0.137;<0.001	-0.161;<0.001	-0.122;<0.001
wet4_2500_cnt	0.155;<0.001	-0.054; 0.049	-0.094;<0.001	-0.027; 0.324
wet4_5000_cnt	0.243;<0.001	-0.063; 0.016	0.089;<0.001	0.288;<0.001
wet1_all_cnt	0.207;<0.001	-0.031; 0.231	-0.053; 0.038	0.175;<0.001
wet2_all_cnt	0.137;<0.001	-0.007; 0.785	-0.046; 0.077	0.198;<0.001
wet3_all_cnt	0.159;<0.001	0.036; 0.160	0.026; 0.308	0.243;<0.001
wet4_all_cnt	0.140;<0.001	0.134;<0.001	0.129;<0.001	0.088;<0.001
field_size	-0.220;<0.001	0.115;<0.001	-0.104;<0.001	-0.234;<0.001
tro_all_cnt	0.012; 0.685	0.052; 0.080	0.002; 0.948	-0.118;<0.001
dug_all_cnt	-0.174;<0.001	0.106;<0.001	-0.066; 0.019	-0.199;<0.001
wet1_all_xd	-0.308;<0.001	-0.047; 0.062	-0.024; 0.350	-0.095;<0.001
wet2_all_xd	-0.245;<0.001	0.130;<0.001	0.025; 0.318	-0.284;<0.001
wet3_all_xd	-0.275;<0.001	0.032; 0.214	-0.073; 0.004	-0.333;<0.001
wet4_all_xd	-0.350;<0.001	0.031; 0.229	-0.150;<0.001	-0.262;<0.001
tro_all_xd	0.174;<0.001	0.084; 0.003	-0.072; 0.011	0.080; 0.005
dug_all_xd	0.158;<0.001	0.464;<0.001	0.390;<0.001	0.138;<0.001
wet1_500_if_cnt	-0.185;<0.001	-0.157;<0.001	-0.161;<0.001	-0.164;<0.001
wet1_1000_if_cnt	-0.254;<0.001	-0.212;<0.001	-0.201;<0.001	-0.216;<0.001
wet1_2500_if_cnt	-0.353;<0.001	-0.273;<0.001	-0.302;<0.001	-0.297;<0.001
wet1_5000_if_cnt	0.074; 0.012	0.030; 0.303	-0.005; 0.857	-0.013; 0.658
wet2_500_if_cnt	-0.129;<0.001	-0.321;<0.001	-0.183;<0.001	-0.103;<0.001
wet2_1000_if_cnt	-0.194;<0.001	-0.405;<0.001	-0.289;<0.001	-0.179;<0.001
wet2_2500_if_cnt	-0.248;<0.001	-0.469;<0.001	-0.341;<0.001	-0.238;<0.001
wet2_5000_if_cnt	-0.079; 0.002	-0.073; 0.005	-0.187;<0.001	-0.066; 0.010
wet3_500_if_cnt	-0.103;<0.001	-0.213;<0.001	-0.276;<0.001	-0.146;<0.001

Table G.17 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet1_all_if_xd	wet2_all_if_xd	wet3_all_if_xd	wet4_all_if_xd
wet3_1000_if_cnt	-0.185;<0.001	-0.265;<0.001	-0.355;<0.001	-0.199;<0.001
wet3_2500_if_cnt	-0.232;<0.001	-0.237;<0.001	-0.430;<0.001	-0.260;<0.001
wet3_5000_if_cnt	-0.103;<0.001	-0.028; 0.279	0.041; 0.113	0.044; 0.092
wet4_500_if_cnt	-0.058; 0.061	-0.078; 0.011	-0.122;<0.001	-0.148;<0.001
wet4_1000_if_cnt	-0.122;<0.001	-0.173;<0.001	-0.204;<0.001	-0.211;<0.001
wet4_2500_if_cnt	-0.224;<0.001	-0.244;<0.001	-0.334;<0.001	-0.363;<0.001
wet4_5000_if_cnt	-0.078; 0.006	-0.080; 0.004	-0.031; 0.260	0.088; 0.002
wet1_all_if_xd	**1.000;<0.001**	0.369;<0.001	0.350;<0.001	0.571;<0.001
wet2_all_if_xd	0.369;<0.001	**1.000;<0.001**	0.467;<0.001	0.294;<0.001
wet3_all_if_xd	0.350;<0.001	0.467;<0.001	**1.000;<0.001**	0.563;<0.001
wet4_all_if_xd	0.571;<0.001	0.294;<0.001	0.563;<0.001	**1.000;<0.001**
wet1_if_density	0.152;<0.001	-0.006; 0.838	-0.080; 0.004	-0.020; 0.463
wet2_if_density	-0.066; 0.018	-0.122;<0.001	-0.196;<0.001	-0.102;<0.001
wet3_if_density	-0.101;<0.001	-0.069; 0.012	0.028; 0.314	0.129;<0.001
wet4_if_density	-0.055; 0.051	-0.078; 0.005	0.107;<0.001	0.204;<0.001

Table G.18: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet1_if_density	wet2_if_density	wet3_if_density	wet4_if_density
cws_shrub	0.051; 0.056	-0.001; 0.976	-0.029; 0.267	0.132;<0.001
mrps	-0.334;<0.001	-0.320;<0.001	-0.022; 0.415	-0.227;<0.001
topo	0.074; 0.004	-0.034; 0.194	0.156;<0.001	0.191;<0.001
wet1_500kd	0.103; 0.001	0.026; 0.411	0.012; 0.713	0.065; 0.038
wet1_1000kd	0.157;<0.001	0.059; 0.056	-0.005; 0.881	0.096; 0.002
wet1_2500kd	0.226;<0.001	0.090; 0.001	-0.036; 0.204	0.018; 0.527
wet1_5000kd	0.217;<0.001	0.012; 0.655	0.016; 0.558	-0.036; 0.172
wet2_500kd	0.159;<0.001	0.196;<0.001	-0.061; 0.033	0.042; 0.142
wet2_1000kd	0.203;<0.001	0.272;<0.001	-0.093;<0.001	0.042; 0.120
wet2_2500kd	0.127;<0.001	0.235;<0.001	-0.143;<0.001	-0.023; 0.383
wet2_5000kd	-0.072; 0.006	0.119;<0.001	-0.179;<0.001	-0.163;<0.001
wet3_500kd	0.203;<0.001	0.186;<0.001	0.232;<0.001	0.172;<0.001
wet3_1000kd	0.188;<0.001	0.169;<0.001	0.272;<0.001	0.165;<0.001
wet3_2500kd	0.076; 0.004	0.056; 0.031	0.332;<0.001	0.147;<0.001
wet3_5000kd	-0.071; 0.007	-0.055; 0.034	0.390;<0.001	0.177;<0.001

Table G.18 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet1_if_density	wet2_if_density	wet3_if_density	wet4_if_density
wet4_500kd	0.175;<0.001	0.091; 0.004	0.068; 0.030	0.128;<0.001
wet4_1000kd	0.226;<0.001	0.146;<0.001	0.106;<0.001	0.166;<0.001
wet4_2500kd	0.293;<0.001	0.110;<0.001	0.168;<0.001	0.211;<0.001
wet4_5000kd	0.170;<0.001	-0.041; 0.114	0.353;<0.001	0.356;<0.001
wet1_500_cnt	0.125;<0.001	0.048; 0.123	0.033; 0.288	0.088; 0.005
wet1_1000_cnt	0.157;<0.001	0.058; 0.063	0.003; 0.921	0.105;<0.001
wet1_2500_cnt	0.213;<0.001	0.044; 0.129	0.008; 0.770	0.025; 0.393
wet1_5000_cnt	0.225;<0.001	-0.011; 0.676	0.147;<0.001	0.089;<0.001
wet2_500_cnt	0.189;<0.001	0.208;<0.001	-0.003; 0.908	0.076; 0.009
wet2_1000_cnt	0.250;<0.001	0.293;<0.001	0.054; 0.048	0.130;<0.001
wet2_2500_cnt	0.226;<0.001	0.214;<0.001	0.127;<0.001	0.113;<0.001
wet2_5000_cnt	0.134;<0.001	0.173;<0.001	0.265;<0.001	0.135;<0.001
wet3_500_cnt	0.224;<0.001	0.205;<0.001	0.254;<0.001	0.189;<0.001
wet3_1000_cnt	0.194;<0.001	0.175;<0.001	0.301;<0.001	0.185;<0.001
wet3_2500_cnt	0.133;<0.001	0.086; 0.001	0.315;<0.001	0.151;<0.001
wet3_5000_cnt	0.019; 0.465	0.074; 0.004	0.471;<0.001	0.301;<0.001
wet4_500_cnt	0.186;<0.001	0.105;<0.001	0.063; 0.043	0.133;<0.001
wet4_1000_cnt	0.199;<0.001	0.131;<0.001	0.121;<0.001	0.168;<0.001
wet4_2500_cnt	0.265;<0.001	0.073; 0.009	0.142;<0.001	0.171;<0.001
wet4_5000_cnt	0.076; 0.004	-0.162;<0.001	0.285;<0.001	0.273;<0.001
wet1_all_cnt	0.239;<0.001	0.046; 0.077	0.359;<0.001	0.145;<0.001
wet2_all_cnt	0.019; 0.468	0.149;<0.001	0.356;<0.001	0.075; 0.004
wet3_all_cnt	0.023; 0.379	0.149;<0.001	0.456;<0.001	0.178;<0.001
wet4_all_cnt	0.060; 0.021	-0.139;<0.001	0.314;<0.001	0.219;<0.001
field_size	-0.224;<0.001	-0.060; 0.030	-0.145;<0.001	-0.524;<0.001
tro_all_cnt	0.170;<0.001	0.014; 0.644	-0.641;<0.001	-0.318;<0.001
dug_all_cnt	-0.562;<0.001	-0.391;<0.001	-0.198;<0.001	-0.579;<0.001
wet1_all_xd	-0.045; 0.083	0.140;<0.001	0.164;<0.001	0.151;<0.001
wet2_all_xd	-0.190;<0.001	-0.154;<0.001	-0.103;<0.001	-0.154;<0.001
wet3_all_xd	-0.038; 0.143	-0.003; 0.923	-0.346;<0.001	-0.258;<0.001
wet4_all_xd	-0.082; 0.002	0.121;<0.001	-0.177;<0.001	-0.184;<0.001
tro_all_xd	-0.128;<0.001	0.017; 0.579	0.223;<0.001	-0.064; 0.034
dug_all_xd	0.021; 0.472	0.167;<0.001	-0.006; 0.836	-0.199;<0.001

Table G.18 continued: Kendall wetland predictor correlations (Kendall's tau & p-value shown)

Predictors	wet1_if_density	wet2_if_density	wet3_if_density	wet4_if_density
wet1_500_if_cnt	0.182;<0.001	0.166;<0.001	0.128;<0.001	0.172;<0.001
wet1_1000_if_cnt	0.237;<0.001	0.227;<0.001	0.138;<0.001	0.198;<0.001
wet1_2500_if_cnt	0.370;<0.001	0.417;<0.001	0.164;<0.001	0.265;<0.001
wet1_5000_if_cnt	0.415;<0.001	0.515;<0.001	0.112;<0.001	0.209;<0.001
wet2_500_if_cnt	0.199;<0.001	0.320;<0.001	0.081; 0.006	0.140;<0.001
wet2_1000_if_cnt	0.263;<0.001	0.427;<0.001	0.121;<0.001	0.181;<0.001
wet2_2500_if_cnt	0.250;<0.001	0.473;<0.001	0.126;<0.001	0.166;<0.001
wet2_5000_if_cnt	0.286;<0.001	0.510;<0.001	0.129;<0.001	0.153;<0.001
wet3_500_if_cnt	0.259;<0.001	0.338;<0.001	0.355;<0.001	0.282;<0.001
wet3_1000_if_cnt	0.248;<0.001	0.349;<0.001	0.426;<0.001	0.297;<0.001
wet3_2500_if_cnt	0.187;<0.001	0.349;<0.001	0.402;<0.001	0.227;<0.001
wet3_5000_if_cnt	-0.019; 0.481	0.196;<0.001	0.569;<0.001	0.295;<0.001
wet4_500_if_cnt	0.246;<0.001	0.243;<0.001	0.160;<0.001	0.216;<0.001
wet4_1000_if_cnt	0.264;<0.001	0.273;<0.001	0.242;<0.001	0.264;<0.001
wet4_2500_if_cnt	0.397;<0.001	0.445;<0.001	0.284;<0.001	0.361;<0.001
wet4_5000_if_cnt	0.224;<0.001	0.382;<0.001	0.406;<0.001	0.441;<0.001
wet1_all_if_xd	0.152;<0.001	-0.066; 0.018	-0.101;<0.001	-0.055; 0.051
wet2_all_if_xd	-0.006; 0.838	-0.122;<0.001	-0.069; 0.012	-0.078; 0.005
wet3_all_if_xd	-0.080; 0.004	-0.196;<0.001	0.028; 0.314	0.107;<0.001
wet4_all_if_xd	-0.020; 0.463	-0.102;<0.001	0.129;<0.001	0.204;<0.001
wet1_if_density	**1.000;<0.001**	0.674;<0.001	0.068; 0.014	0.403;<0.001
wet2_if_density	0.674;<0.001	**1.000;<0.001**	0.228;<0.001	0.435;<0.001
wet3_if_density	0.068; 0.014	0.228;<0.001	**1.000;<0.001**	0.521;<0.001
wet4_if_density	0.403;<0.001	0.435;<0.001	0.521;<0.001	**1.000;<0.001**

Appendix H: Correlations between Wetland and Fire & Grazing Predictors

Table H.1: Correlations between Wetland and Fire & Grazing Variables*

Predictors	Horse old	Cattle old	Total burns	Years since fire	Fire index	All pellets
cws_shrub	0.022; 0.764	-0.224;<0.001	-0.091; 0.208	-0.058; 0.380	-0.076; 0.267	-0.219;<0.001
mrps	-0.142; 0.048	0.178; 0.004	-0.172; 0.016	0.201; 0.002	-0.214; 0.002	0.179; 0.003
topo	0.039; 0.584	-0.334;<0.001	-0.050; 0.476	-0.013; 0.843	0.007; 0.917	-0.338;<0.001
wet1_500kd	-0.057; 0.502	-0.125; 0.082	-0.109; 0.200	0.037; 0.638	-0.106; 0.191	-0.131; 0.068
wet1_1000kd	-0.030; 0.723	-0.138; 0.050	-0.039; 0.641	0.007; 0.928	-0.021; 0.790	-0.143; 0.042
wet1_2500kd	0.053; 0.474	-0.098; 0.118	-0.105; 0.154	0.062; 0.357	-0.074; 0.291	-0.098; 0.116
wet1_5000kd	0.010; 0.892	-0.146; 0.015	-0.015; 0.829	0.024; 0.711	-0.014; 0.841	-0.145; 0.016
wet2_500kd	0.034; 0.666	0.054; 0.421	-0.085; 0.280	0.057; 0.431	-0.040; 0.593	0.050; 0.457
wet2_1000kd	0.107; 0.147	-0.009; 0.882	0.067; 0.360	-0.073; 0.278	0.128; 0.067	-0.012; 0.848
wet2_2500kd	0.186; 0.009	-0.056; 0.354	0.179; 0.012	-0.156; 0.016	0.188; 0.005	-0.059; 0.329
wet2_5000kd	0.232; 0.001	-0.027; 0.652	0.464;<0.001	-0.386;<0.001	0.471;<0.001	-0.020; 0.743
wet3_500kd	0.017; 0.827	-0.017; 0.797	-0.036; 0.641	0.046; 0.517	0.000; 1.000	-0.023; 0.724
wet3_1000kd	0.084; 0.248	-0.040; 0.513	0.091; 0.211	-0.056; 0.397	0.134; 0.052	-0.044; 0.474
wet3_2500kd	0.264;<0.001	-0.027; 0.649	0.313;<0.001	-0.294;<0.001	0.352;<0.001	-0.020; 0.740
wet3_5000kd	0.224; 0.002	-0.051; 0.398	0.460;<0.001	-0.388;<0.001	0.477;<0.001	-0.046; 0.439
wet4_500kd	-0.083; 0.325	0.051; 0.472	0.028; 0.741	-0.030; 0.697	0.035; 0.660	0.045; 0.526
wet4_1000kd	0.029; 0.712	0.126; 0.059	0.066; 0.401	-0.070; 0.332	0.093; 0.213	0.124; 0.062
wet4_2500kd	0.017; 0.811	-0.015; 0.801	0.023; 0.745	0.012; 0.850	0.038; 0.570	-0.011; 0.859
wet4_5000kd	-0.067; 0.346	-0.298;<0.001	0.156; 0.027	-0.102; 0.115	0.131; 0.051	-0.300;<0.001
wet1_500_cnt	0.065; 0.448	-0.134; 0.064	-0.122; 0.151	0.035; 0.654	-0.117; 0.145	-0.136; 0.059
wet1_1000_cnt	-0.097; 0.244	-0.116; 0.101	-0.040; 0.631	0.025; 0.741	-0.019; 0.809	-0.123; 0.082
wet1_2500_cnt	0.045; 0.550	-0.074; 0.237	-0.120; 0.106	0.099; 0.147	-0.102; 0.147	-0.075; 0.230
wet1_5000_cnt	-0.008; 0.909	-0.178; 0.003	-0.065; 0.363	0.031; 0.633	-0.037; 0.581	-0.176; 0.004
wet2_500_cnt	0.045; 0.574	0.043; 0.524	-0.067; 0.395	0.042; 0.565	-0.022; 0.770	0.038; 0.571
wet2_1000_cnt	0.109; 0.146	-0.034; 0.590	0.102; 0.172	-0.085; 0.213	0.155; 0.028	-0.036; 0.564
wet2_2500_cnt	0.231; 0.001	-0.026; 0.673	0.290;<0.001	-0.203; 0.002	0.294;<0.001	-0.021; 0.730
wet2_5000_cnt	0.196; 0.006	-0.003; 0.964	0.495;<0.001	-0.401;<0.001	0.508;<0.001	0.001; 0.984
wet3_500_cnt	0.012; 0.878	-0.002; 0.976	0.009; 0.910	0.014; 0.846	0.045; 0.550	-0.008; 0.902
wet3_1000_cnt	0.135; 0.071	0.012; 0.853	0.216; 0.004	-0.139; 0.042	0.249;<0.001	0.010; 0.868
wet3_2500_cnt	0.196; 0.006	0.001; 0.986	0.323;<0.001	-0.244;<0.001	0.327;<0.001	0.003; 0.956

* Kendall's tau & p-value shown

Table H1 continued: Correlations between Wetland and Fire & Grazing Variables*

Predictors	Horse old	Cattle old	Total burns	Years since fire	Fire index	All pellets
wet3_5000_cnt	0.218; 0.002	0.087; 0.151	0.437;<0.001	-0.346;<0.001	0.454;<0.001	0.091; 0.130
wet4_500_cnt	-0.086; 0.310	0.036; 0.609	0.015; 0.859	-0.041; 0.595	0.025; 0.756	0.030; 0.672
wet4_1000_cnt	0.052; 0.520	0.125; 0.067	0.023; 0.775	-0.058; 0.432	0.068; 0.371	0.127; 0.063
wet4_2500_cnt	0.059; 0.418	-0.089; 0.151	-0.147; 0.043	0.122; 0.068	-0.087; 0.208	-0.088; 0.155
wet4_5000_cnt	-0.082; 0.250	-0.185; 0.002	0.004; 0.959	-0.004; 0.951	-0.000; 0.998	-0.190; 0.002
wet1_all_cnt	0.138; 0.052	-0.365;<0.001	0.296;<0.001	-0.318;<0.001	0.356;<0.001	-0.361;<0.001
wet2_all_cnt	0.185; 0.011	0.133; 0.032	0.408;<0.001	-0.345;<0.001	0.416;<0.001	0.135; 0.029
wet3_all_cnt	0.153; 0.033	0.200;<0.001	0.301;<0.001	-0.238;<0.001	0.294;<0.001	0.204;<0.001
wet4_all_cnt	-0.180; 0.012	-0.077; 0.203	-0.203; 0.004	0.132; 0.043	-0.235;<0.001	-0.074; 0.220
tro_all_cnt	-0.162; 0.046	0.363;<0.001	-0.429;<0.001	0.472;<0.001	-0.445;<0.001	0.355;<0.001
dug_all_cnt	-0.126; 0.119	0.430;<0.001	-0.301;<0.001	0.206; 0.005	-0.325;<0.001	0.425;<0.001
wet1_all_xd	-0.004; 0.952	0.125; 0.037	0.159; 0.024	-0.120; 0.064	0.136; 0.043	0.125; 0.036
wet2_all_xd	-0.213; 0.003	-0.020; 0.744	-0.294;<0.001	0.244;<0.001	-0.319;<0.001	-0.018; 0.761
wet3_all_xd	-0.221; 0.002	-0.028; 0.641	-0.387;<0.001	0.307;<0.001	-0.405;<0.001	-0.027; 0.648
wet4_all_xd	-0.012; 0.867	0.154; 0.010	0.057; 0.422	-0.043; 0.505	0.014; 0.831	0.160; 0.008
tro_all_xd	0.142; 0.140	0.041; 0.614	0.409;<0.001	-0.349;<0.001	0.402;<0.001	0.045; 0.578
dug_all_xd	0.160; 0.097	0.113; 0.163	-0.009; 0.924	-0.079; 0.390	-0.014; 0.883	0.118; 0.143
field_size	-0.005; 0.951	0.238;<0.001	0.092; 0.237	-0.059; 0.405	0.069; 0.348	0.233;<0.001

* Kendall's tau & p-value shown