Plant-Pollinator Networks in Fire-Maintained Sandhills

Research Study (2019-2020)

Bell Ridge WEA & Canaan Ranch

Site-specific results

CR1

BR2

BR3

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Introduction

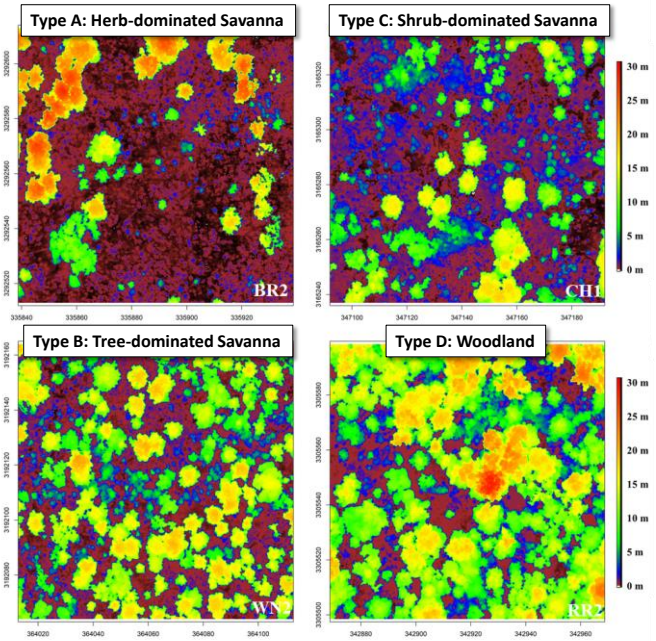
In Florida's fire-dependent longleaf pine savannas, as in terrestrial ecosystems worldwide, the mutualistic interaction networks formed by flowering plants and pollinators are of fundamental importance for the maintenance of biodiversity (Bascompte and Jordano 2007). Florida is part of the North American Coastal Plain floristic province, which is considered a global biodiversity hotspot due to unusually high vascular plant diversity and endemism (Noss et al. 2015). The pollinating insects of longleaf pine savannas likely play a central role in maintaining this high overall biodiversity, and they are also a diverse group in their own right, representing several prominent insect orders: Lepidoptera (butterflies and moths), Hymenoptera (bees and wasps), Coleoptera (beetles), and Diptera (flies) (Spiesman & Inouye 2013). Despite their ecological importance, the plant-pollinator networks of longleaf pine savannas have received little study (Spiesman & Inouye 2013). The purpose of this project is to begin filling critical baseline data gaps regarding plant-pollinator networks in Florida's fire-maintained uplands and their relationships to vegetation management.

Methods

24 1-hectare (2.5-acre) study plots were located at nine different fire-managed sandhill preserves in North-Central Florida: Ft. White WEA, Bell Ridge WEA, River Rise Preserve State Park, Jennings State Forest, Black Creek Ravines Conservation Area, Ordway-Swisher Biological Preserve, two separate tracts of Withlacoochee State Forest, and Chassahowitzka WEA. The study sites were carefully selected according to several criteria, including: 1) Frequent and ongoing prescribed fire, in most cases upwards of 20 years; 2) No history of intensive agriculture or plantation forestry; 3) Old growth species in the understory indicative of low soil disturbance (i.e. wiregrass, various wildflowers); and 4) Approximately one year since the last prescribed fire.

Within each preserve, two to three 1ha sampling plots were established at least 1km apart. Plant species composition was assessed in a grid of 25 5m x 5m quads. Species-specific flower abundance counts were conducted monthly from March 2019 – October 2019 along two transects (E-W and N-S) and in five 10m x 10m quads. Plant-pollinator interactions were sampled monthly using a 2hr timed transect sampling method. Every time the observer encountered an insect interacting with a flower, he or she captured the insect for identification and noted the plant species upon which it was encountered. Vegetation structure and surrounding landscape composition were assessed using LiDAR and aerial imagery via the GatorEye Unmanned Flying Laboratory.

One of the primary objectives of this study was to identify relationships between fire, vegetation structure, and plant-pollinator networks. To that end, we used LiDAR-derived Leaf Area Index (LAI) values to assess the density of four canopy strata beginning at 0.5m, which is the lowest height at which LAI can be reliably calculated from LiDAR: understory (0.5m – 1m), lowstory (1m – 3m), midstory (3m – 6m), and overstory (6m+). We used these data in conjunction with ground-collected percent herbaceous cover estimates to approximate the overall structure of each plot.

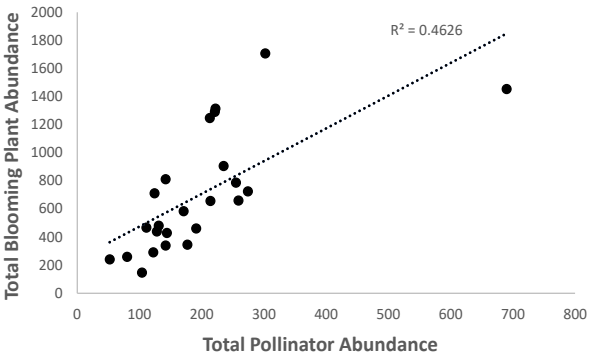


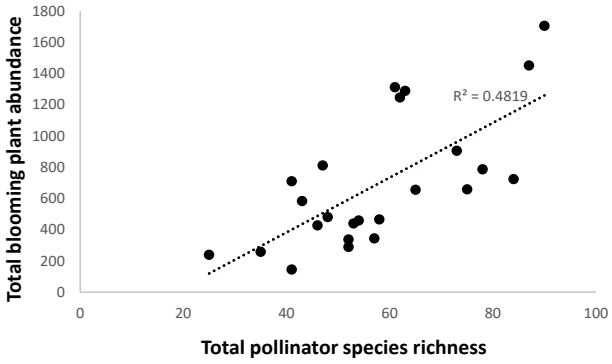
Overall Study Results: Vegetation Structure

Using multivariate statistical techniques to analyze the relative proportions of ground layer, shrub layer, and tree layer LAI, we identified four significantly different types of fire-maintained sandhill structures: Type A (herb-dominated savannas), Type B (tree-dominated savannas), Type C (shrub-dominated savannas), and Type D (woodlands). The images at left are visualizations of the LiDAR data, showing representative 1-ha plots belonging to each category.

Overall Study Results: Flower and Pollinator Abundance

Across the whole study, we found that flowering plant abundance was strongly correlated with total annual pollinator abundance and total pollinator species richness, and varied greatly across plots and seasons, with total flower abundance ranging from 145 to 1,707 blooming plants per plot.

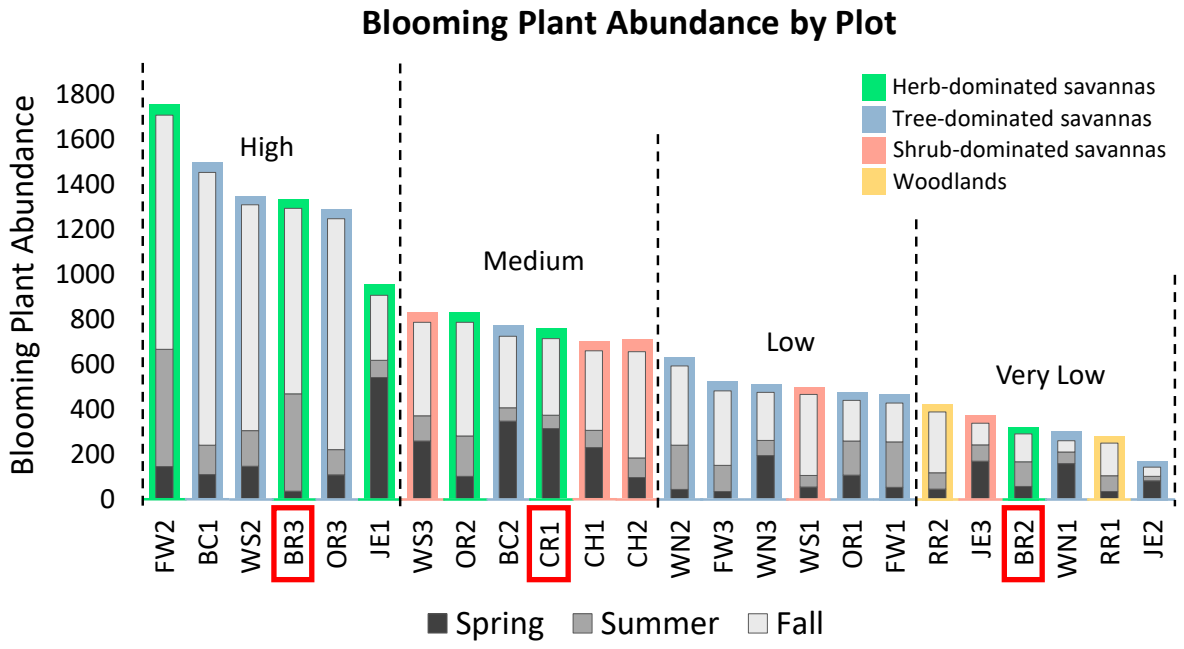




We found that the spring bloom season in longleaf pine sandhills is dominated by shrubs (particularly saw palmetto and blueberries), while the fall bloom season is dominated by herbaceous plants (especially members of the Asteraceae or sunflower family). Most of the herb-dominated plots in the study fell at the moderate to high end of the flower abundance range. Tree-dominated savanna plots had highly variable flower abundance, ranging from the lowest flower abundance to the second-highest, while shrub-dominated and woodland plots were somewhat less variable, ranging from very low to moderate flower abundance. Our habitat models showed that the abundance of individual flower-producing plants was only one predictor of actual flower production; tree-layer LAI had a significant negative influence on flower production, suggesting that even where appropriate understory plants are present, their flower production may be suppressed by higher levels of tree canopy LAI. *For a more detailed accounting of data analysis, conclusions, and management recommendations, check our FWRI/Upland Habitat website for publications and reports, which will be uploaded* https://myfwc.com/research/habitat/upland/.

Bell Ridge/Canaan Ranch Results: Stand Structure and Flower Abundance

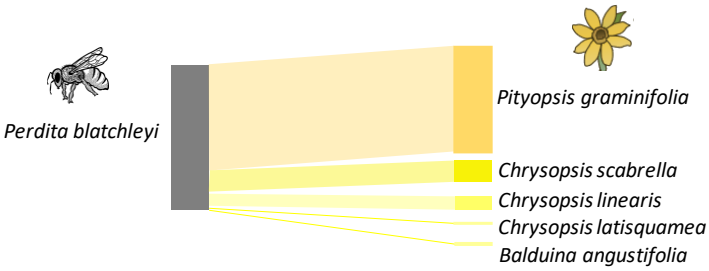
All three of the Bell Ridge/Canaan Ranch plots are herb-dominated savannas. The three plots varied greatly in flower abundance, with plot BR3 falling into the highest flower abundance quantile, plot CR1 falling in the moderate flower abundance quantile, and plot BR2 falling in the very low flower abundance quantile. Plot BR2 is unusual in being the only herbaceous-dominated plot in the study that did not have moderate to high flower abundance. The reasons for this are unclear, but may have to do with a very high abundance of grasses in this plot, which could be competitors for pollinator-attracting wildflowers.



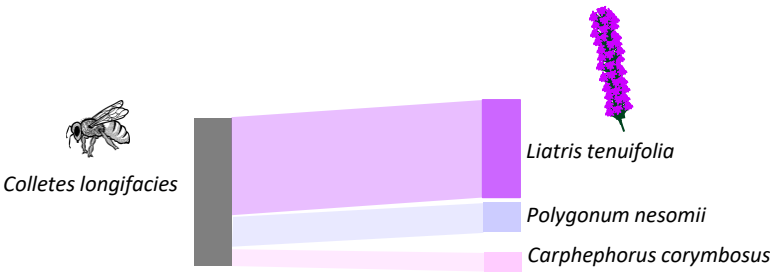
Bell Ridge/Canaan Ranch Results: Pollinator Overview

Total pollinator species richness was above the study average in all three plots, but total pollinator abundance was below the study average in plots CR1 and BR2. Hymenoptera (Bee & Wasp) abundance and species richness were very low in plot CR1, low in plot BR2, and moderate in plot BR3. Diptera (Fly) abundance and species richness was generally low across all three plots, with the exception of plot BR3 which had moderate Dipteran abundance. Lepidoptera (Butterfly and Moth) abundance and species richness varied greatly between plots, being very low in plot CR1, low in plot BR2, and very high in plot BR3. Beetle abundance and species richness were generally high across all three plots, particularly in plot CR1, which had very high beetle abundance.

Two individuals of a bee Species of Greatest Conservation Need (SGCN), *Colletes longifacies*, were collected in the Canaan ranch plot. Another SGCN bee, *Perdita blatchleyi,* was found in very high abundance in the BR3 plot. We recorded enough observations of *P. blatchleyi* and *C. longifacies* in the overall study to draw conclusions about their flower preferences and make preliminary management recommendations. *P. blatchleyi* is a specialist on the closely-related plant genera *Pityopsis* and *Chrysopsis*, while *C. longifacies* appears to be less of a specialist, as we observed it interacting with the unrelated genera *Liatris* and *Polygonum*. Given the prevalence of interactions for the two SGCN bee species on *P. graminifolia* and *L. tenuifolia*, promoting flowering in these two plant species may be a good conservation target for improving *C. longifacies and P. blatchleyi* habitat. P. graminifolia's flower production and reproductive success are fire-induced and strongly influenced by season of burn, with spring and summer fires stimulating more flowers than winter fires (Brewer and Platt 1994). Both P. graminifolia and L. tenuifolia are sensitive to vegetation structure and become locally extirpated when shrub and tree cover become excessive. Management regimes that emphasize growing season fire and decrease woody dominance can be expected to favor these two SGCN bees.

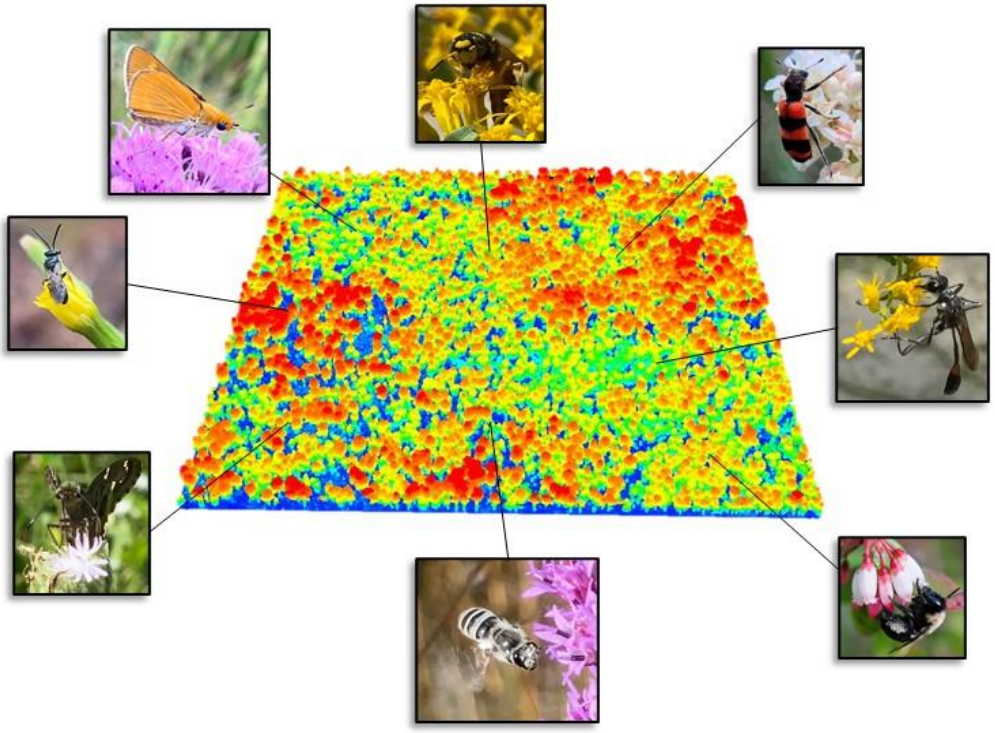


Flower interactions of *Perdita blatchleyi*, based on 103 observations recorded during the project.



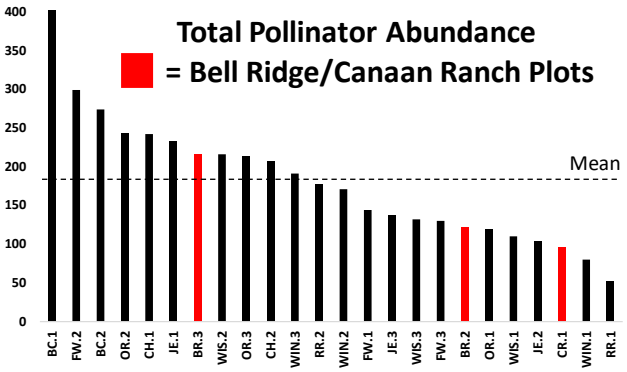
Flower interactions of *Colletes longifacies*, based on 24 observations recorded during the project.

Bell Ridge/Canaan Ranch Results
Pollinator Abundance and Species Richness



Pollinator Abundance and Species Richness

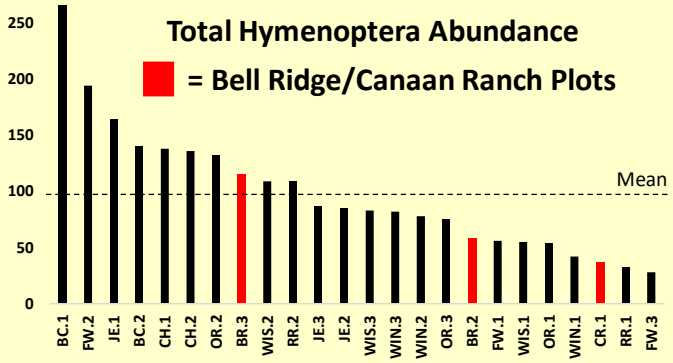
	Abundance # of individuals		Species Richness	
	Total	Rank	Total	Rank
Plot **CR1**	**96**	**Low**	**40**	**Low**
Plot **BR2**	**122**	**Med-Low**	**51**	**Med-Low**
Plot **BR3**	**216**	**Med-High**	**62**	**Med-High**
Study Average	181.6		57.6	
Study Range	52 - 402		25 - 90	



The above table shows the total pollinator abundance (number of individual insects caught) and total pollinator species richness for the three study plots at Bell Ridge/Canaan Ranch, along with their rank relative to the entire 24-plot study. Plots within one Standard Deviation (SD) above the mean were ranked "**Medium-High**," and plots within one SD below the mean were ranked "**Medium-Low**." Plots >1 SD above the mean were ranked "**High**," and >1 SD below the mean were ranked "**Low**." Pollinator abundance and species richness were high in plot BR3, and moderate in plots CR1 and BR2. These differences are likely due to the types of flowering plant species present and the amount of flowers they produced, as well as insect populations in the surrounding areas. In the following sections, the same method is used to assess pollinator abundance and species richness within insect groups (Bees/Wasps, Butterflies/Moths, Beetles, and Flies) for each plot.

Hymenoptera (Bees & Wasps)

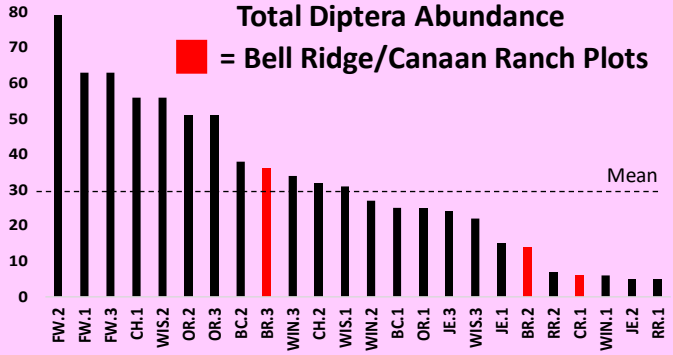
	Abundance # of individuals		Species Richness	
	Total	Rank	Total	Rank
Plot **CR1**	37	Low	21	Low
Plot **BR2**	58	Med-Low	33	Med-Low
Plot **BR3**	115	Med-High	35	Med-High
Study Average	98.1		33.6	
Study Range	28 - 266		12 - 61	



Bee & Wasp abundance and species richness were above the study average in plot BR3, and below the study average in plots CR1 and BR2. Among the most abundant Hymenopteran species at Bell Ridge/Canaan Ranch were *Perdita blatchleyi* (a Fairy Bee), *Megachile brevis* (Short Leafcutter Bee), *Lasioglossum nymphale* (a Sweat Bee), *Dielis plumipes* (Feather-Legged Scoliid Wasp), and *Augochloropsis metallica* (Northeastern Sweat Bee).

Diptera (Flies)

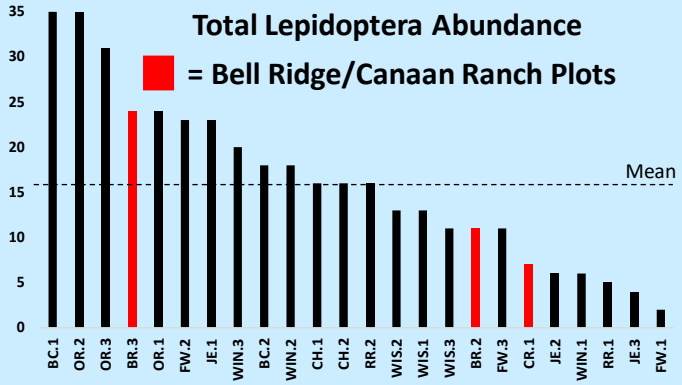
	Abundance # of individuals		Species Richness	
	Total	Rank	Total	Rank
Plot **CR1**	6	Low	5	Med-Low
Plot **BR2**	14	Med-Low	2	Low
Plot **BR3**	41	Med-High	7	Med-Low
Study Average	30.1		7.6	
Study Range	5 - 79		2 - 18	



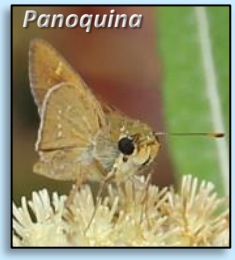
Native Dipteran pollinator abundance and species richness were generally low to medium-low throughout Bell Ridge and the Canaan Ranch, with the exception of medium-high species richness in plot BR3. The most frequent native Dipteran pollinators at Bell Ridge/Canaan Ranch were *Poecilognathus sulphureus* (Sulphurus Bee Fly), *Geron holosericeus* (Silky Bee Fly), *Allograpta exotica* (Exotic Streak Tail), *Ocyptamus fuscipennis* (Dusky-Winged Hover Fly), and *Exoprosopa fasciata* (Banded Bee Fly). *Photo credits for non-FWRI photos on last page.

Lepidoptera (Butterflies & Moths)

	Abundance # of individuals		Species Richness	
	Total	Rank	Total	Rank
Plot **CR1**	7	Med-Low	5	Med-Low
Plot **BR2**	11	Med-Low	9	Med-High
Plot **BR3**	24	Med-High	11	Med-High
Study Average	16.2		8.1	
Study Range	2 - 35		2 - 14	

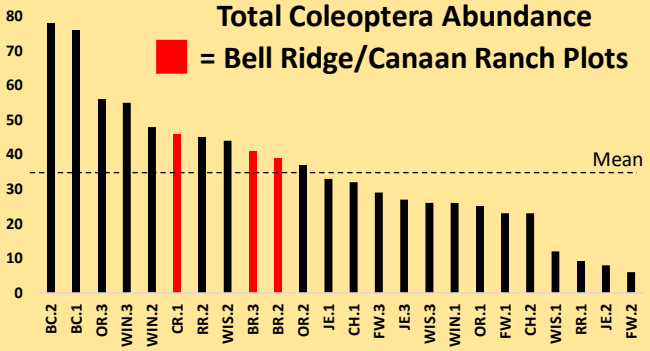


Butterfly & Moth abundance and species richness were medium-high in plot BR3, and medium-low in plot CR1. Plot BR2 was in between, with medium-high richness and medium-low abundance. Some of the most abundant Lepidopterans were *Panoquina ocola* (Ocola Skipper), *Junonia coenia* (Common Buckeye), *Hylephila phyleus* (Fiery Skipper), *Erynnis horiatus* (Horace's Duskywing), *Hemiargus ceraunus* (Ceraunus Blue). *Credits for non-FWRI photos on last page.



Results: Coleoptera (Beetles)

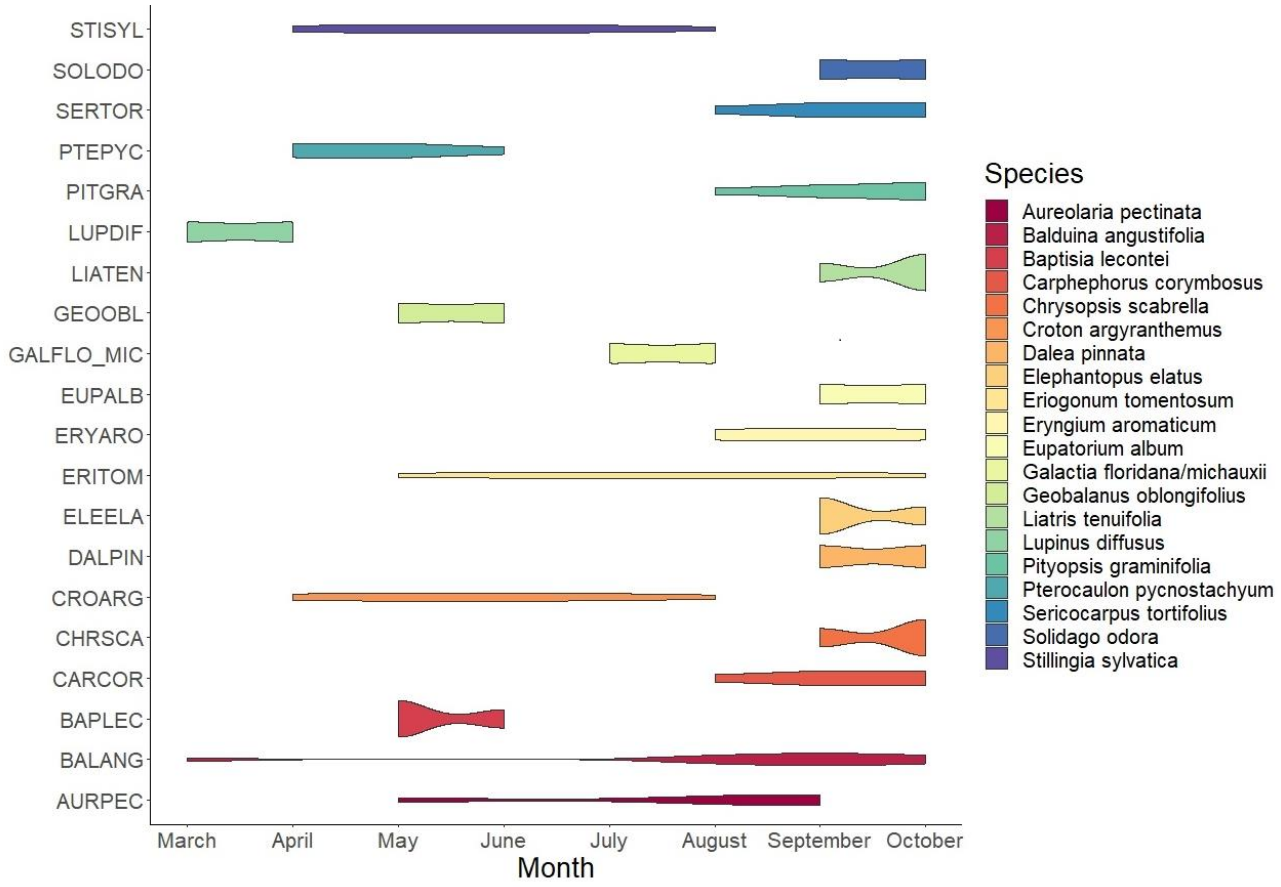
	Abundance # of Individuals		Species Richness	
	Total	Rank	Total	Rank
Plot **CR1**	46	Med-High	9	Med-High
Plot **BR2**	39	Med-High	7	Med-Low
Plot **BR3**	41	Med-High	9	Med-High
Study Average	35.2		8.0	
Study Range	6 - 78		4 - 14	



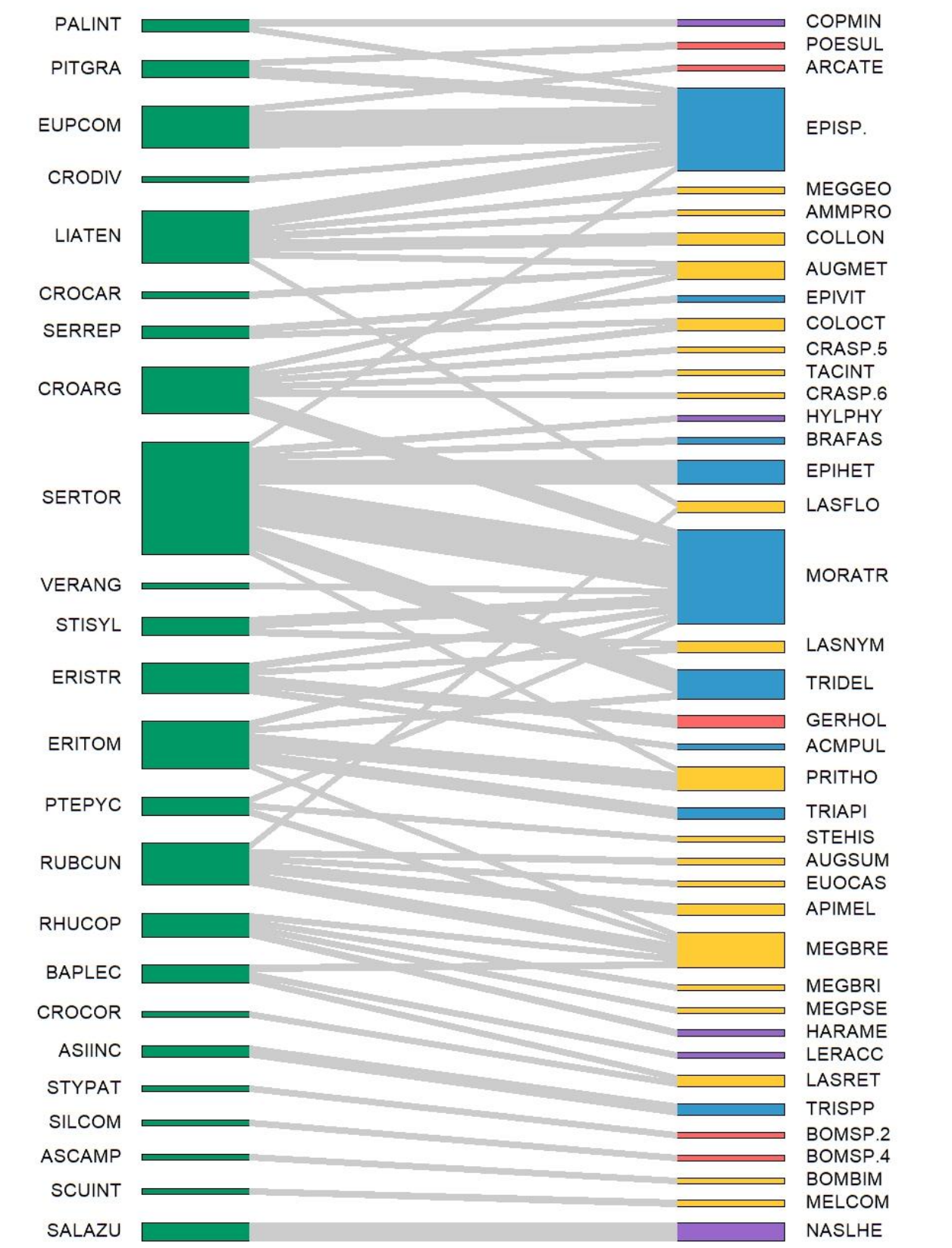
Beetle abundance and species richness were above the study average in plots CR1 and BR3. BR2 also had abundance above the study average, but species richness in BR2 was medium-low. Some of the most abundant beetle pollinators at Bell Ridge/Canaan Ranch were *Mordella atrata* (Tumbling Flower Beetle), *Epicauta sp.* (Blister Beetle), *Acmaeodera pulchella* (Bald-Cypress Sapwood Beetle), *Belotus abdominalis* (A Soldier Beetle), and *Trigonopeltastes delta* (Delta Flower Scarab). *Credits for non-FWRI photos on last page.

Key flowering plant species

We identified 20 of the most important herbaceous flowering species that were present on multiple sites and had high pollinator interaction rates throughout the study. Many of these species, shown in the graphic below with their blooming time/duration, were prevalent in the Bell Ridge and Canaan Ranch sandhills.

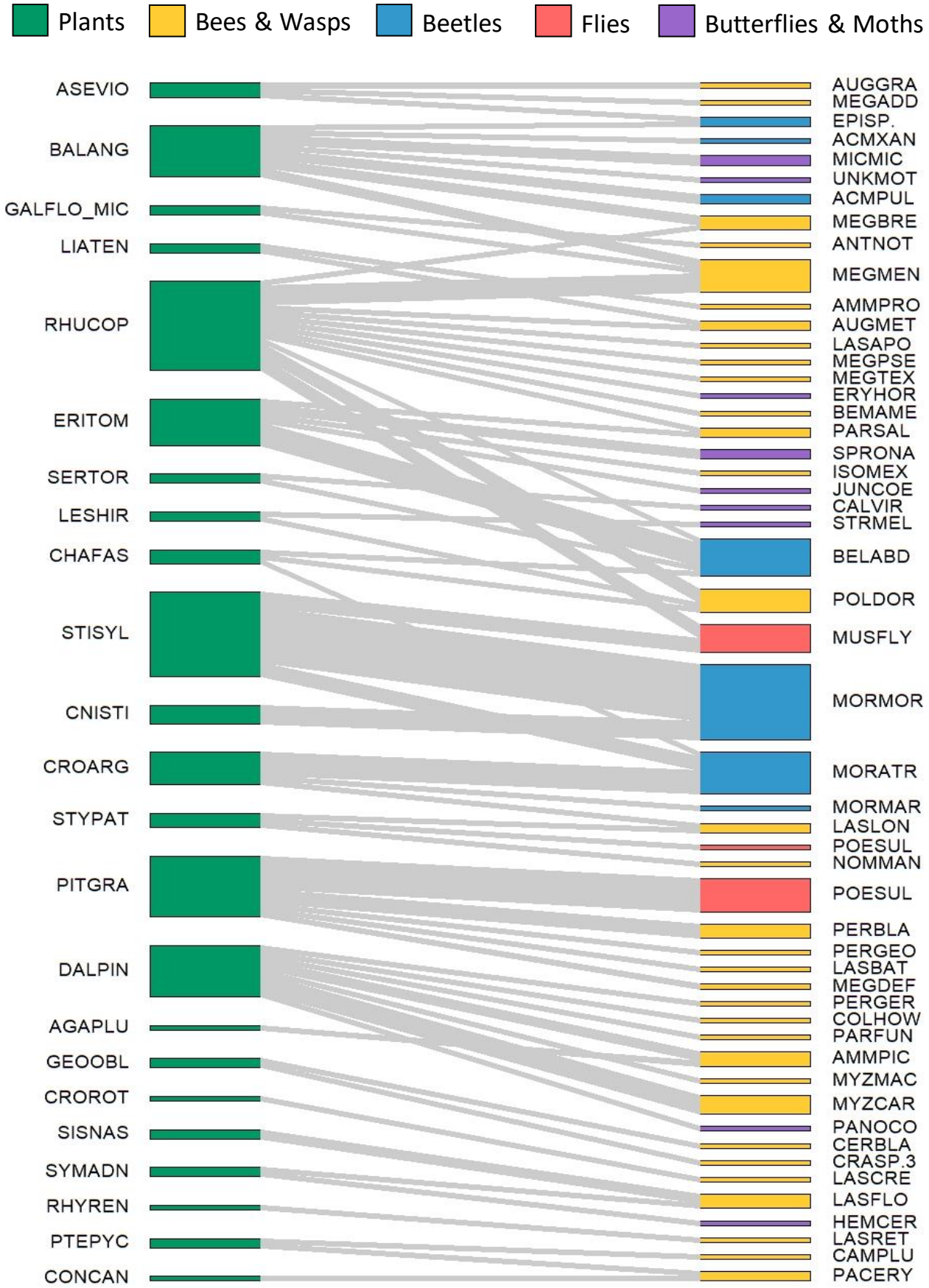


CR1 Plant-Pollinator Network *Plant and insect code key included at end of report

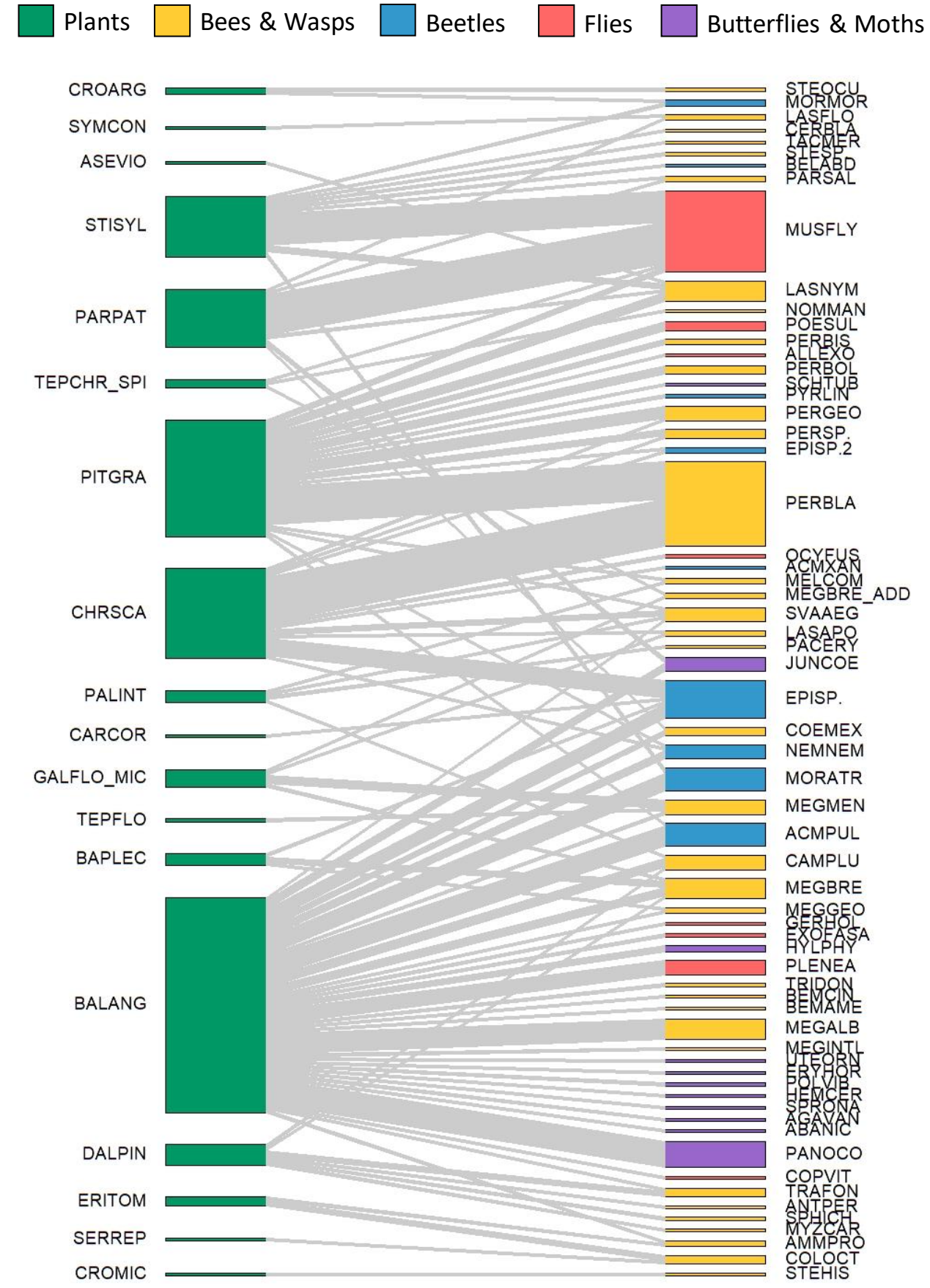


BR2 Plant-Pollinator Network

*Plant and insect code key included at end of report



BR3 Plant-Pollinator Network *Plant and insect code key included at end of report



Most abundant native pollinator genera of Bell Ridge/Canaan Ranch

Insect Code Key for network diagrams, with plot occurrence data

		Number Caught			
Code	Species	CR-1	BR-2	BR-3	Insect Type
ABANIC	*Abaeis nicippe*	0	0	1	Butterflies & Moths
ACMPUL	*Acmaeodera pulchella*	1	2	8	Beetles
ACMXAN	*Acmaeodera xanthosticta*	0	1	1	Beetles
AGAVAN	*Agaulis vanillae*	0	0	1	Butterflies & Moths
ALLEXO	*Allograpta exotica*	0	0	1	Flies
AMMPIC	*Ammophila pictipennis*	0	3	0	Bees & Wasps
AMMPRO	*Ammophila procera*	1	1	2	Bees & Wasps
ANTNOT	*Anthidiellum notatum*	0	1	0	Bees & Wasps
ANTPER	*Anthidiellum perplexum*	0	0	1	Bees & Wasps
APIMEL	*Apis mellifera*	2	0	0	Bees & Wasps
ARCATE	*Archytas aterrimus*	1	0	0	Flies
AUGGRA	*Augochlorella gratiosa*	0	1	0	Bees & Wasps
AUGMET	*Augochloropsis metallica*	3	2	0	Bees & Wasps
AUGSUM	*Augochloropsis sumptuosa*	1	0	0	Bees & Wasps
BELABD	*Belotus abdominalis*	0	8	1	Beetles
BEMAME	*Bembix americana spinolae*	0	1	1	Bees & Wasps
BEMCIN	*Bembix cinerea*	0	0	1	Bees & Wasps
BOMBIM	*Bombus bimaculatus*	1	0	0	Bees & Wasps
BOMSP.2	*Bombyliidae sp. 2*	1	0	0	Flies
BOMSP.4	*Bombyliidae sp. 4*	1	0	0	Flies
BRAFAS	*Brachys fasciferus*	1	0	0	Beetles
CALVIR	*Calephelis virginiensis*	0	1	0	Butterflies & Moths
CAMPLU	*Campsomeris plumipes fossulana*	0	1	5	Bees & Wasps
CERBLA	*Cerceris blakei*	0	1	1	Bees & Wasps
COEMEX	*Coelioxys mexicanus*	0	0	3	Bees & Wasps
COLHOW	*Colletes howardi*	0	1	0	Bees & Wasps
COLLON	*Colletes longifacies*	2	0	0	Bees & Wasps
COLOCT	*Colpa octomaculata*	2	0	3	Bees & Wasps
COPMIN	*Copaeodes minima*	1	0	0	Butterflies & Moths
COPVIT	*Copestylum vittatum*	0	0	1	Flies
CRASP.3	*Crabronidae sp. 3*	0	1	0	Bees & Wasps
CRASP.5	*Crabronidae sp. 5*	1	0	0	Bees & Wasps
CRASP.6	*Crabronidae sp. 6*	1	0	0	Bees & Wasps
EPIHET	*Epicauta heterodera*	4	0	0	Beetles
EPISP.	*Epicauta sp.*	14	2	13	Beetles
EPISP.2	*Epicauta sp. 2*	0	0	2	Beetles
EPIVIT	*Epicauta vittata*	1	0	0	Beetles
ERYHOR	*Erynnis horatius*	0	1	1	Butterflies & Moths

Insect Code Key for network diagrams, with plot occurrence data

		Number Caught			
Code	Species	CR-1	BR-2	BR-3	Insect Type
EUOCAS	*Euodynerus castigatus*	1	0	0	Bees & Wasps
EXOFASA	*Exoprosopa fasciata*	0	0	1	Flies
GERHOL	*Geron holosericeus*	2	0	1	Flies
HARAME	*Harrisina americana*	1	0	0	Butterflies & Moths
HEMCER	*Hemiargus ceraunus*	0	1	1	Butterflies & Moths
HYLPHY	*Hylephila phyleus*	1	0	2	Butterflies & Moths
ISOMEX	*Isodontia mexicana*	0	1	0	Bees & Wasps
JUNCOE	*Junonia coenia*	0	1	5	Butterflies & Moths
LASAPO	*Lasioglossum apopkense*	0	1	2	Bees & Wasps
LASBAT	*Lasioglossum batya*	0	1	0	Bees & Wasps
LASCRE	*Lasioglossum creberrimum*	0	1	0	Bees & Wasps
LASFLO	*Lasioglossum floridanum*	2	3	2	Bees & Wasps
LASLON	*Lasioglossum longifrons*	0	2	0	Bees & Wasps
LASNYM	*Lasioglossum nymphale*	2	0	7	Bees & Wasps
LASRET	*Lasioglossum reticulatum*	2	1	0	Bees & Wasps
LERACC	*Lerema accius*	1	0	0	Butterflies & Moths
MEGADD	*Megachile addenda*	0	1	0	Bees & Wasps
MEGALB	*Megachile albitarsis*	0	0	7	Bees & Wasps
MEGBRE	*Megachile brevis*	6	3	7	Bees & Wasps
MEGBRE_ADI	*Megachile brevis/addenda*	0	0	2	Bees & Wasps
MEGBRI	*Megachile brimleyi*	1	0	0	Bees & Wasps
MEGDEF	*Megachile deflexa/albitarsis*	0	1	0	Bees & Wasps
MEGGEO	*Megachile georgica*	1	0	2	Bees & Wasps
MEGINTL	*Megachile integrella*	0	0	1	Bees & Wasps
MEGMEN	*Megachile mendica*	0	7	5	Bees & Wasps
MEGPSE	*Megachile pseudobrevis*	1	1	0	Bees & Wasps
MEGTEX	*Megachile texana*	0	1	0	Bees & Wasps
MELCOM	*Melissodes communis*	1	0	2	Bees & Wasps
MICMIC	*microlep*	0	2	0	Butterflies & Moths
MORATR	*Mordella atrata*	16	9	8	Beetles
MORMAR	*Mordella marginata*	0	1	0	Beetles
MORMOR	*Mordellidae*	0	16	2	Beetles
MUSFLY	*muscoid fly*	0	6	28	Flies
MYZCAR	*Myzinum carolinianum*	0	4	1	Bees & Wasps
MYZMAC	*Myzinum maculatum*	0	1	0	Bees & Wasps
NASLHE	*Nastra lherminier*	3	0	0	Butterflies & Moths
NEMNEM	*Nemognatha nemorensis*	0	0	5	Beetles
NOMMAN	*Nomia maneei*	0	1	1	Bees & Wasps
OCYFUS	*Ocyptamus fuscipennis*	0	0	1	Flies
PACERY	*Pachodynerus erynnis*	0	2	1	Bees & Wasps
PANOCO	*Panoquina ocola*	0	1	9	Butterflies & Moths

Insect Code Key for network diagrams, with plot occurrence data

		Number Caught			
Code	Species	CR-1	BR-2	BR-3	Insect Type
PARFUN	*Paracyphononyx funereus*	0	1	0	Bees & Wasps
PARSAL	*Parancistrocerus salcularis*	0	2	2	Bees & Wasps
PERBIS	*Perdita bishoppi*	0	0	2	Bees & Wasps
PERBLA	*Perdita blatchleyi*	0	3	29	Bees & Wasps
PERBOL	*Perdita boltoniae*	0	0	3	Bees & Wasps
PERGEO	*Perdita georgica*	0	1	5	Bees & Wasps
PERGER	*Perdita gerardiae*	0	1	0	Bees & Wasps
PERSP.	*Perdita sp.*	0	0	3	Bees & Wasps
PLENEA	*Plecia nearctica*	28	0	5	Flies
POESUL	*Poeciliognathus sulphureus*	1	8	3	Flies
POLDOR	*Polistes dorsalis*	0	5	0	Bees & Wasps
POLVIB	*Polites vibex*	0	0	1	Butterflies & Moths
PRITHO	*Prionyx thomae*	4	0	0	Bees & Wasps
PYRLIN	*Pyrota lineata*	0	0	1	Beetles
SCHTUB	*Schinia tuberculum*	0	0	1	Butterflies & Moths
SPHICH	*Sphex ichneumoneus*	0	0	1	Bees & Wasps
SPRONA	*Spragueia onagrus*	0	2	1	Butterflies & Moths
STEHIS	*Stenodynerus histrionalis*	1	0	1	Bees & Wasps
STEOCU	*Stenodynerus oculeus*	0	0	1	Bees & Wasps
STESP.	*Stenodynerus sp.*	0	0	1	Bees & Wasps
STRMEL	*Strymon melinus*	0	1	0	Butterflies & Moths
SVAAEG	*Svastra aegis*	0	0	5	Bees & Wasps
TACINT	*Tachytes intermedius*	1	0	0	Bees & Wasps
TACMER	*Tachytes mergus*	0	0	1	Bees & Wasps
TRAFON	*Trachusa fontemvitae*	0	0	3	Bees & Wasps
TRIAPI	*Trichodes apivorus*	2	0	0	Beetles
TRIDEL	*Trigonopeltastes delta*	5	0	0	Beetles
TRIDON	*Triepeolus donatus*	0	0	1	Bees & Wasps
TRISPP	*Trichiotinus spp.*	2	0	0	Beetles
UNKMOT	*unknown moth*	0	1	0	Butterflies & Moths
UTEORN	*Utetheisa ornatrix*	0	0	1	Butterflies & Moths

Plant Code Key for network diagrams, with plot occurrence data

		Relative Frequency (% of quads in which present)			
	Species	CR1	BR2	BR3	Plant Type
AGAPLU	Agalinis plukenettii	0	2	12	Forb
AGEJUC	Ageratina jucunda	1	24	5	Forb
ASCVER	Asclepias verticillata	1	0	1	Forb
ASEVIO	Asemia violacea	1	1	1	Forb
AURPEC	Aureolaria pectinata	0	0	1	Forb
BALANG	Balduina angustifolia	0	2	21	Forb
BAPLEC	Baptisia lecontei	0	10	4	Forb
CARCOR	Carphephorus corymbosus	2	8	60	Forb
CENVIR	Centrosema virginianum	0	24	2	Forb
CHANIC	Chamaecrista nictitans	5	3	0	Forb
CHRSCA	Chrysopsis scabrella	0	0	54	Forb
CNISTI	Cnidoscolus stimulosus	14	8	1	Forb
COMERE	Commelina erecta	3	0	0	Forb
CONCAN	Conyza canadensis	24	0	3	Forb
CROARG	Croton argyranthemus	5	1	4	Forb
CROCOR	Crocantheumum corymbosum	22	21	2	Forb
CRODIV	Croptilon divaricatum	1	0	0	Forb
CROMIC	Croton michauxii	3	0	1	Forb
CROROT	Crotalaria rotundifolia	1	9	0	Forb
DALPIN	Dalea pinnata	0	42	29	Forb
DIOSVI	Diospyros virginiana	18	50	14	Shrub
ERITOM	Eriogonum tomentosum	3	4	2	Forb
EUPALB	Eupatorium album	0	6	1	Forb
EUPCOM	Eupatorium compositifolium	44	7	5	Forb
GALFLO_M	Galactia floridana/michauxii	0	27	30	Forb
GEOOBL	Geobalanus oblongifolius	0	23	0	Forb
HIEMEG	Hieracium megacephalon	0	0	3	Forb
HYPSUF	Hypericum suffruticosum	0	1	2	Shrub
LESHIR	Lespedeza hirta	0	11	4	Forb
LESREP	Lespedeza repens	0	2	0	Forb
LIATEN	Liatris tenuifolia	13	3	13	Forb
LYGAPH	Lygodesmia aphylla	1	2	0	Forb
OPUHUM	Opuntia humifusa	0	2	4	Forb
PALINT	Palafoxia integrifolia	13	0	1	Forb
PARPAT	Paronychia patula	0	0	15	Forb
PENMUL	Penstemon multiflorus	2	0	0	Forb
PIRCIS	Piriqueta cistoides	0	7	0	Forb
PITGRA	Pityopsis graminifolia	19	26	88	Forb
POLPIN	Polygonum pinicola	1	0	3	Forb
PTEPYC	Pterocaulon pycnostachyum	3	7	0	Forb
RHUCOP	Rhus copallinum	69	84	39	Shrub
RHYREN	Rhynchosia reniformis	15	27	2	Forb

Plant Code Key for network diagrams, with plot occurrence data

RUBCUN	Rubus cuneifolius	63	28	0	Shrub
RUECAR	Ruellia caroliniensis	0	15	0	Forb
RUECIL	Ruellia ciliosa	6	5	2	Forb
SALAZU	Salvia azurea	2	23	0	Forb
SCUINT	Scutellaria integrifolia	1	2	6	Forb
SERREP	Serenoa repens	7	0	3	Shrub
SERTOR	Sericocarpus tortifolius	20	13	8	Forb
SILCOM	Silphium compositum	2	0	2	Forb
SISNAS	Sisyrinchium nashii	0	1	0	Forb
SMIAUR	Smilax auriculata	12	0	4	Shrub
SOLODO	Solidago odora	7	8	4	Forb
STISYL	Stillingia sylvatica	9	23	22	Forb
STYBIF	Stylosanthes biflora	0	2	1	Forb
STYPAT	Stylisma patens	21	0	3	Forb
SYMCON	Symphyotrichum concolor	0	3	0	Forb
TEPCHR_S	Tephrosia chrysophylla/spicata	19	18	94	Forb
TEPFLO	Tephrosia florida	0	4	0	Forb
TRIDIC	Trichostema dichotomum	0	6	0	Forb
VACARB	Vaccinium arboreum	6	3	0	Shrub
VACMYR	Vaccinium myrsinites	0	21	0	Shrub
YUCFIL	Yucca filamentosa	1	4	2	Shrub

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Additional Resources

For more information on the natural history and identification of the insects we found at Bell Ridge and the Canaan Ranch, these are good places to start:

BugGuide.net: https://bugguide.net/node/view/15740

Discover Life: https://www.discoverlife.org/

For more information on the natural history and identification of the pollinator plants at Bell Ridge and the Canaan Ranch, start with these resources:

Flora of North America: http://floranorthamerica.org/Main_Page

Atlas of Florida Vascular Plants: https://florida.plantatlas.usf.edu/

For a more detailed accounting of data analysis, conclusions, and management recommendations, check our FWRI/Upland Habitat website for publications and reports, which will be uploaded as they are finalized: https://myfwc.com/research/habitat/upland/.

Feel free to contact FWRI's Upland Habitat Research & Monitoring team with plant and pollinator questions any time, if we don't have the answer we can find out or point you in the right direction:

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