Bees of the Big Thicket National Preserve Phase II: 2021 Annual Report

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Summary

This report summarizes recent research conducted on bees of the Big Thicket National Preserve (BITH), Texas from 2017–summer 2021 made possible by funding from by the Big Thicket Association, Texas Commission on Environmental Quality, and Stephen F. Austin State University (SFA). The project has thus far documented 130 species variously occurring among a several habitats including mesic pine-hardwood forest, wet savanna, xeric longleaf pine savanna, and sandylands. Preliminary comparisons of samples made before and after a flooding event caused by Hurricane Harvey (referred to hereafter as “Harvey”) indicate that most species of bees found before the flood were present in the second year after the flood. The full extent of the significance of our findings are ongoing, and we aim to submit final report by the end of the calendar year 2021.

Introduction

The first phase of this project began in 2017 with the objective of comparing the diversity of bees among various habitats of the BITH. Goals of this project changed due to a major interruption caused by Harvey in summer 2017. Much data was collected that year and numerous species of bees were recognized, many for the first time, from the preserve. Late summer and fall collecting continued after the storm in 2017, but not to the degree initially planned due to the storm’s impact on BITH infrastructure. Due to this interruption, phase I of this project ended early and plans were made for a new project.

Phase II of this project began in 2019 with goals of adding to the list of species known for BITH and searching for evidence of an impact of Harvey on bees. Since one of the 2017 field sites (Sand Loop Trail in the southern portion of the Turkey Creek Unit) flooded extensively during the storm, potentially killing ground-nesting bees, a rare opportunity presented itself to document flooding effects on insect populations. The hypothesis that ground-nesting bees suffered higher casualties than above-ground nesting bees was tested by comparing samples before and after the storm by SFA master’s student Archie Sauls. His analysis culminated in a thesis completed May 2021, which is currently under embargo until May 2022 while he prepares his work for publication. Our purpose here is to provide a progress report with an updated checklist of bee species discovered in both the 2017 and 2019 surveys and provide some key points regarding our investigation into Harvey's impact on bees.

Methods

In 2017, three localities were selected for sampling with a standard array of insect traps: (1) a mesic, mixed pine-hardwood forest near Pitcher Plant Trail at the north end of Turkey Creek Unit (30.58636° -94.33606°; referred to herein as "PPT"); (2) a longleaf pine restoration area with a wet savanna understory near preserve headquarters on FM 420 (30.4596° -94.38316°; referred to herein as "HQ"); and (3) a longleaf pine, xeric savanna/sandyland near Sand Loop, Kirby Nature Trail (30.47388° -94.33773°; referred to herein as "SL-1"). In 2019 a fourth site was added that had received minor, exploratory collecting in 2017: (4) a longleaf pine, xeric sandyland near FM 1493 (30.47269° -94.33649°: referred to herein as "SL-2"). Minor bouts of exploratory collecting occurred at various other sites in the preserve, including a few samples taken in 2018. In 2017 and 2019 sampling began late February and lasted through early November (2017) or mid-October (2019), with the exception of SL-1 in 2017, where collecting ceased at the end of August due closure of a bridge over Turkey Creek resulting from Harvey's impacts.

At each of the main sites, one Malaise trap (Fig. 1) and two blue-vane traps (Fig. 2) were in continuous use during the sampling period and serviced roughly every other weekend. In addition, pan traps (Figs 3–4), which consist of small colored cups filled with soapy water, were utilized. Pan traps were set along two, ca. 50–150 m transects. Each transect contained 9 ground-level pans, each separated by ca. 5–10 m. At sites HQ and SL-1, an additional 9 pan traps were placed atop 0.3 m pvc poles. Pans were left in place for about 24 h before samples were gathered. Pan traps were usually deployed every other weekend during the sampling period; in some cases, pan traps were not set or their placement was delayed due to poor weather conditions. An aerial net and direct searching were often employed, but this method was not conducted in a standardized manner. In 2017, yellow vane traps and pan traps at additional heights were used.

Fieldwork was carried out by principal investigator Daniel Bennett and SFA graduate student Archie Sauls. Bennett supervised initial processing of samples. Sauls and SFA undergraduate student Amethyst Haynes sorted bees from bulk samples and prepared label files. Principal investigator John Pascarella identified specimens and supervised pinning and labeling activities by Sam Houston State University (SH) students Melanie Quinchiguango and Cindy Botero. Bennett and Sauls analyzed the data as the basis of Sauls' thesis project. Select beetle families, orthopterans, neuropterans, manitds, and select wasps that accumulated as trap bycatch were pinned, labeled, and analyzed by SFA undergraduate student Xander Haynes as part of a supplemental undergraduate research project. An additional supplemental project involved work on ants that accumulated as bycatch by Sauls prior to his graduate work on bees.

Results and Discussion

All samples taken during both phases of this project have been processed for bees and currently represent 130 species based on 8898 specimen records (Tables 1–2). Of these records, nearly all specimens were labeled, identified to species, and archived in museum cabinets and drawers. Some were discarded (mainly honey bees) after the data were recorded and not archived. Many males of the genus *Lasioglossum* and a few specimens of other genera could not be identified with confidence. A few samples made in 2018 that fall outside the scope of the project as originally planned remain to be added to the list.

The SL-1 site produced 84 species (62 in 2017, 61 in 2019), PPT produced 74 species (54 in 2017, 59 in 2019), SL-2 produced 68 species (27 in 2017, 64 in 2019), and HQ produced 54 species (42 in 2017, 39 in 2019; Tables 1–2). Total values per site reflect different levels of effort, and thus the data needs to be adjusted before firm comparisons can be made regarding habitat differences. Nonetheless, after accounting for the limited collecting at SL-2 in 2017, it is worth noting that xeric habitats yielded more species and far more specimens of bees than moister habitats, a pattern expected prior to the study. It is also notable, however, that the the mesic forest site (PPT) was found to be nearly as rich in species as SL-1 on the basis of far fewer specimens, suggesting the site likely supports fewer individuals of bees though perhaps as many or more species than the xeric sites.

Once Mr. Sauls' thesis is released, detailed results comparing samples taken before and after Harvey will be available. Highlights from that work include the following: (1) overall species richness values for adjusted data are nearly identical before and after the storm; (2) median species richness values of the collection intervals were narrowly but statistically significantly higher prior to the storm; (3) abundance differences across years for all bees were not statistically significant; (4) Shannon's diversity index values were significantly higher before the storm; and (5) Shannon's diversity index differences were more pronounced for ground nesting bees than above ground nesting bees. In short, no evidence was found for a widespread, large decline for a multitude of bee species due to flooding caused storm. Some evidence points to a slight, yet significant decline among ground nesting bees but not for above ground nesting bees. On a per species basis, different patterns were evident, including both large declines and increases after the storm. Overall, most species of bees showed resilience to this particular flooding event either through continuity of populations through the disturbance or through recolonization from other areas after the storm.

Current work includes the following: ongoing literature and museum searches to establish which records are new for the preserve and beyond; adding minor collections made in 2018 to the results; and providing a list of archived specimens list to the National Park Service. Furthermore, a substantial amount of bycatch representing other insect groups remains unprocessed and is available for additional research. As time, funds, and interest from students and collaborators allow, further groups of insects from this project will be processed in the coming years, shedding additional light on the biodiversity of the Big Thicket National Preserve.

Acknowledgements

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Table 1. Number of specimens and species of bees collected at sites in the Big Thicket National Preserve from surveys made in 2017 and 2019.

	2017: Pitcher Plant Trail (PPT)	2019: Pitcher Plant Trail (PPT)	2017: Near headquarters (HQ)	2019: Near headquarters (HQ)	2017: Sand Loop (SL-1)	2019: Sand Loop (SL-1)	2017: FM 1493 (SL-2)	2019: FM 1493 (SL-2)	2017: Other sites	2019: Other sites	2017 Total	2019 Total
No. specimens by year	526	784	886	665	1950	1776	255	1742	275	39	3892	5006
No. specimens both years	1310		1551		3726		1997		314		8898	
No. species by year	54	59	42	39	62	61	27	64	26	16	89	106
No. species both years	74		54		84		68		39		130	

Table 2. Species and numbers of specimens of bees collected at sites in the Big Thicket National Preserve from surveys made in 2017 and 2019. Undetermined morphospecies are indicated by "sp. #" and contribute to the total number of species recognized. "Sp." and "spp." indicate unidentified specimens that do not contribute to the total number of species recognized.

Family	Genus	Species	2017: Pitcher Plant Trail (PPT)	2019: Pitcher Plant Trail (PPT)	2017: Near head-quarters (HQ)	2019: Near head-quarters (HQ)	2017: Sand Loop (SL-1)	2019: Sand Loop (SL-1)	2017: FM 1493 (SL-2)	2019: FM 1493 (SL-2)	2017: Other sites	2019: Other sites	2017 Total	2019 Total
Andrenidae	Andrena	cressonii	1	1								1	1	2
Andrenidae	Andrena	dollomellea								1			0	1
Andrenidae	Andrena	forbesii		2									0	2
Andrenidae	Andrena	fulvipennis			1				4	2			5	2
Andrenidae	Andrena	gardineri					1						1	0
Andrenidae	Andrena	hippotes										3	0	3
Andrenidae	Andrena	ilicis										10	0	10
Andrenidae	Andrena	imitatrix		1			1						1	1
Andrenidae	Andrena	miserabilis						2		1			0	3
Andrenidae	Andrena	rubi ?										1	0	1
Andrenidae	Andrena	veracunda				1							0	1
Andrenidae	Andrena	violae		2				1					0	3
Andrenidae	Calliopsis	andreniformis						1					0	1
Andrenidae	Perdita	bishoppi	1			1	3	53	5	534			9	588
Andrenidae	Perdita	cambarella						10		1			0	11
Andrenidae	Perdita	halictoides								1			0	1
Andrenidae	Perdita	ignota	1		4	1	3		8	8			16	9
Andrenidae	Perdita	obscurata		1			74	244		44			74	289
Apidae	Anthophora	abrupta	1	1			1			5			2	6
Apidae	Apis	mellifera	83	48	476	357	39	25		66	85		683	496
Apidae	Bombus	griseocollis	1	2			1						2	2
Apidae	Bombus	impatiens	3	3	3	1	3	2		2	10		19	8
Apidae	Bombus	pensylvanicus	11	22	24	17	14	25	6	16	1		56	80
Apidae	Bombus	sp.		1									0	1
Apidae	Ceratina	calcarata		1					21	11			21	12
Apidae	Ceratina	cockerelli	1	3	4	7	8	4	2	3	1	1	16	18
Apidae	Ceratina	shinnersi								1			0	1
Apidae	Ceratina	sp.					1	1		3			1	4
Apidae	Ceratina	strenua		4				3	1	15			1	22
Apidae	Epeolus	ilicis						2					0	2
Apidae	Epeolus	lectoides					2	11		4			2	15

Apidae	Habropoda	laboriosa	40	45	25	18	30	49		32			95	144
Apidae	Holcopasites	illinoiensis					1						1	0
Apidae	Melissodes	agilis			1								1	0
Apidae	Melissodes	bimaculata	5	10			1	10	4	5			10	25
Apidae	Melissodes	communis	37	22	20	29	454	634	75	385	2		588	1070
Apidae	Melissodes	comptoides ?						1					0	1
Apidae	Melissodes	dentiventris	2		5								7	0
Apidae	Melissodes	druriellus								1			0	1
Apidae	Melissodes	sp. 1	1										1	0
Apidae	Melissodes	sp. 2						1					0	1
Apidae	Melissodes	tepaneca	1				3						4	0
Apidae	Melitoma	taurea	4	3		1	13		2	5			19	9
Apidae	Nomada	armatella ?										3	0	3
Apidae	Nomada	rubicunda						1				2	0	3
Apidae	Nomada	vincta								1			0	1
Apidae	Peponapis	pruinosa				1							0	1
Apidae	Ptilothrix	bombiformis	78	28	50	26	27	17	1	1	5		161	72
Apidae	Svastra	atripes	3	2	6	11	5	10	2	1			16	24
Apidae	Svastra	compta			1		1						2	0
Apidae	Triepeolus	luantus						14		1			0	15
Apidae	Triepeolus	simplex	1				1	1					2	1
Apidae	Xylocopa	micans			1	2					1		2	2
Apidae	Xylocopa	virginica	9	13	9	8	2	13		4	2		22	38
Colletidae	Colletes	inaequalis						1		2		2	0	5
Colletidae	Colletes	nudus						1					0	1
Colletidae	Colletes	productus						1					0	1
Colletidae	Colletes	thoracicus	1				1	1		1			2	2
Colletidae	Hylaeus	affinis	1	5	1					1			2	6
Colletidae	Hylaeus	confluens			3								3	0
Colletidae	Hylaeus	floridanus	2	1				1		1			2	3
Colletidae	Hylaeus	georgicus								1			0	1
Halictidae	Agapostemon	splendens	3	1			8	2	1	2	5		17	5
Halictidae	Agapostemon	texanus					1						1	0
Halictidae	Agapostemon	texanus ?	1		5		1				1		8	0
Halictidae	Augochlora	pura		1	1			1					1	2
Halictidae	Augochlorella	karankawa					208	12	1				209	12
Halictidae	Augochloropsis	metallica	2	19	7	6	5	3		8	5		19	36
Halictidae	Augochloropsis	sumptuosa		1				1		1			0	3
Halictidae	Halictus	ligatus	1	1	1	2			2		1		5	3
Halictidae	Lasioglossum	apopkense	29	188	4	6	170	209	4	117	21	1	228	521
Halictidae	Lasioglossum	batya		3		3	14	3	9	3			23	12
Halictidae	Lasioglossum	birkmanni	1	2				3		2	1		2	7
Halictidae	Lasioglossum	bruneri	24	96	25	5	56	13	5	23	17		127	137
Halictidae	Lasioglossum	callidum	8	2	8	3				1			16	6
Halictidae	Lasioglossum	cinctipes	1	2			8	6					9	8
Halictidae	Lasioglossum	coreopsis	46	55	37	41	10	12		9	4	1	97	118
Halictidae	Lasioglossum	creberrimum	17	18	19	18	4	8		5			40	49
Halictidae	Lasioglossum	disparile		1	7		2						9	1
Halictidae	Lasioglossum	fedorense					18	16	9	94			27	110
Halictidae	Lasioglossum	floridanum	10	3	1	4	182	58	15	56	2		210	121
Halictidae	Lasioglossum	illinoense	6	2	3	1	6	4	1				16	7
Halictidae	Lasioglossum	imitatum				1					85		85	1
Halictidae	Lasioglossum	longifrons				8							0	8
Halictidae	Lasioglossum	lustrans					1						1	0
Halictidae	Lasioglossum	pectorale	3										3	0
Halictidae	Lasioglossum	pruinosum					4						4	0
Halictidae	Lasioglossum	reticulatum	1	2									1	2
Halictidae	Lasioglossum	semicaeruleum		1									0	1
Halictidae	Lasioglossum	spp.		45	6	24	50	11		21	2		58	101
Halictidae	Lasioglossum	tarponense					4	2	7	1			11	3
Halictidae	Lasioglossum	tegulare	17	19	15	9	145	61	19	123	2		198	212
Halictidae	Lasioglossum	trigeminum	1	7	4	2				1	1		6	10
Halictidae	Lasioglossum	vierecki	5		1		203	58	46	52		2	255	112
Halictidae	Lasioglossum	weemsi	40	30	63	4	1		3	1	10		117	35
Halictidae	Nomia	nortoni			1					1			1	1
Halictidae	Sphecodes	atlantis	2	2				1		5			2	8
Halictidae	Sphecodes	brachycephalus		1			47	70		3			47	74
Halictidae	Sphecodes	sp. 1								1			0	1

Megachilidae	Anthidiellum	notatum	2	1		1	3	2		1			5	5
Megachilidae	Coelioxys	immaculata					2						2	0
Megachilidae	Coelioxys	mexicana	1										1	0
Megachilidae	Coelioxys	octodentata								1			0	1
Megachilidae	Coelioxys	sayi					1						1	0
Megachilidae	Dianthidium	curvatum			2			2		3	1		3	5
Megachilidae	Heriades	carinata			1								1	0
Megachilidae	Hoplitis	pilosifrons		1									0	1
Megachilidae	Hoplitis	simplex										4	0	4
Megachilidae	Hoplitis	truncata	1	1		1	2						3	2
Megachilidae	Megachile	albitarsis		1	1	1					2		3	2
Megachilidae	Megachile	deflexa					1						1	0
Megachilidae	Megachile	frugalis		2			1	4					1	6
Megachilidae	Megachile	georgica	7	19	27	32	29	39		24	2		65	114
Megachilidae	Megachile	lippiae					1						1	0
Megachilidae	Megachile	melanophoea					1						1	0
Megachilidae	Megachile	mendica	2	4	8	2	10	6		4	5		25	16
Megachilidae	Megachile	mucida		1			2	1		3			2	5
Megachilidae	Megachile	petulans						1		1			0	2
Megachilidae	Megachile	policaris	1										1	0
Megachilidae	Megachile	pseudobrevis	1			2	3	2		6			4	10
Megachilidae	Megachile	rugifrons		1				7		1			0	9
Megachilidae	Megachile	texana	1		1	1	50	6	1	5			53	12
Megachilidae	Megachile	xylocopoides	1				2				1		4	0
Megachilidae	Osmia	atriventris		6			1			2		2	1	10
Megachilidae	Osmia	chalybea	1	3	1		1					1	3	4
Megachilidae	Osmia	georgica				1						1	0	2
Megachilidae	Osmia	juxta		1									0	1
Megachilidae	Osmia	sandhouseae	2	17	1	3	2	10	1			4	6	34
Megachilidae	Osmia	sp.		1									0	1
Megachilidae	Osmia	texana		2				2					0	4
Megachilidae	Stelis	lateralis								1			0	1
Megachilidae	Stelis	louisae			2	3							2	3

Figures 1–4: (1) Malaise trap, (2) vane trap, (3) elevated pan traps in wet savanna, (4) ground pan traps in wet savanna recently subjected to a prescribed burn.