Creating Economically and Ecologically Sustainable Pollinator Habitat

District 2 Demonstration Research Project – Updated November 2017

Investigators

Rick Johnstone and Robin Haggie (IVM Partners, 501-C-3 non-profit; http://www.ivmpartners.org/); John Nettles, District 2 Wildflower Coordinator; Jeff Norcini, FDOT State Wildflower Specialist

Objective

Evaluate a cost-effective strategy for creating habitat for pollinators/beneficial insects in the ROW beyond the back-slope.

Rationale

- Will aid FDOT in developing a strategy to create pollinator habitat per the federal *BEE Act* and FDOT's Wildflower Program
- Will demonstrate that FDOT can simultaneously
  - Create sustainable pollinator habitat in an economical and ecological manner
  - Reduce mowing costs
- Part of national effort coordinated by IVM Partners, who has
  - Established or will establish similar projects on roadside or utility ROWS in Alabama, Arkansas, Maryland, New Mexico, Oklahoma, Idaho, Montana, Virginia, West Virginia, and Tennessee; studies previously conducted in Arizona, Delaware, Michigan, and New Jersey
  - Developed partnerships with US Fish & Wildlife Service, Army Corps of Engineers, US Geological Survey, New Jersey Institute of Technology, Rutgers University, Chesapeake Bay Foundation, Chesapeake Wildlife Heritage, The Navajo Nation, The Wildlife Habitat Council, The Pollinator Partnership, Progressive Solutions, Bayer Crop Sciences, Universities of Maryland, Ohio, West Virginia, and the EPA.

Methods

Strategy to be Evaluated: Create habitat for pollinators/beneficial insects in the ROW area beyond the backslope by eliminating mowing (including fall cleanup mowing) and allowing germination of the seed bank, then selectively removing woody, invasive and undesirable species through periodic application of backpack directed herbicides.

In March 2016, three sites were selected by District 2 and clearly marked as such:

- **Site 1**: State Road 121; Raiford, Union County; approx. 3 miles north of SR-16; coordinates Lat. 30º 5' 8.98"N / Long. 82º 12' 57.19"W (30.085828, -82.215886)

  Description (April 2016) – Moist soil; at wooded edge vegetation resembles a native community remnant, with a narrow transition area between remnant and >95% bahiagrass turf in remainder of site

- **Site 2**: State Road 25 (US-41); Lake City, Columbia County; approx. 10 miles north of Lake City / 3 miles south of Suwannee River; coordinates Lat. 30º 18' 52.54"N / Long. 82º 43' 0.39"W (30.31405, -82.71617)

  Description (April 2016) – Mesic to upland; bahiagrass covered >95% of the area; most diversity was along and immediately adjacent to fence line

- **Site 3**: State Road 51 (US-41); Jasper, Hamilton County; approx. 15 miles north of Site 2; Coordinates Lat. 30º 27' 36.02"N / Long. 82º 53' 47.27"W (30.4600056, -82.8964639)

  Description (April 2016) – Mesic; more species diversity than Site 2

Services Provided by IVM Partners

- Baseline and restored vegetation surveys
- One selective herbicide application (via subcontractor, Progressive Solutions)
- Final Report June 2018

Services Provided by FDOT

- District 2: Site selection and delineation; take appropriate measures to prevent mowing of sites
- Jeff Norcini: Seasonal site visits and species monitoring

Project Status

- March 2016: Sites selected
- April 2016: Site visits conducted by J. Norcini and IVM Partners – overview survey and site descriptions conducted by J. Norcini; formal vegetation survey conducted by IVM Partners
- August 2016: At request of District 2 and IVM Partners, J. Norcini visited sites to determine which woody and undesirable species were to be sprayed; recommendations conveyed to IVM Partners and District 2

  NOTE – Site 1 was accidentally mowed sometime in summer 2016, consequently herbicide treatments postponed
- October 2016: Site visits conducted by J. Norcini, R. Johnstone, and J. Nettles – overview survey and site status update
- February 2017: Site visits by IVM Partners noting that herbicide treatments not yet necessary
- April 2017: Site visits conducted by J. Norcini; met with J. Nettles at Site 2 to discuss project
- July/August 2017: Rick Owen, a member of the Imperiled Butterflies of Florida Work Group – North, conducted a baseline butterfly/invertebrate survey of all sites. Results will be included in a future update.
- August 2017: Site visits conducted by J. Norcini; increased diversity at all sites
- October 2017: Site visits conducted by J. Norcini; increased diversity at all sites

Potential Benefits

- Cost effective strategy for creating native pollinator habitat without expensive landscaping that could be evaluated and implemented statewide
- Pollination and beneficial insect services to ag crops adjacent to ROW
- Improved highway aesthetics

- Reduced mowing costs

  Mowing costs (information provided by Kevin Couey, FDOT Contracts Manager, August 2017)

  - Regular Large Machine Mowing: $14.66 per acre
    5 cycles x 1 acre@$14.66 = $73.30
  - Large Herbicide Mowing: $32.00 per acre
    1 cycle x 1 acre@$32.00 = $32.00 per year

  Total cost per acre/year = $105.30

  Site 1 = 0.5 acres x 2 years no mowing x $105.30 = $105.30

  Site 2 = 1 acre x 2 years no mowing x $105.30 = $210.60

  Site 3 = 1 acre x 2 years no mowing x $105.30 = $210.60

  Total cost savings = $526.50 over 2 years; or $210.60 per acre per year

Site 1 – SR 121, Union County

Site 2 – US 41, Columbia County

Site 3 – US 41, Hamilton County

Site 1 – Updated October 2017 (new species [2016 vs 2017] marked with asterisks when first observed in 2017)

Table 1a. FDOT #1 NORTH Rte 121	30° 5' 8.98"N / 82° 12' 57.19"W (30.085828, -82.215886)			Year/month								
Roadside, Raiford, Union Co., Florida				2016			2017			2018		
				Ap	Au	Oc	Ap	Au	Oc			
Trees/shrubs/herbs/VS/species	BASELINE	ITIS										
Latin name	Common name	Code	VT	##								
TREES – TLa, TLg & TS												
***Pinus* sp**. L.	Pine	PINUS	TLg				x*	x	x			
SHRUBS – SL & SS												
***Baccharis* sp**. L.	Baccharis	BACCH						x*	x			
Hypericum crux-andreae (L.) Crantz	St. Peters-wort	HYCR3	SS	x			x	x	x			
Rubus cuneifolius Pursh	Sand blackberry	RUCU	SS	x	x	x	x	x	x			
Toxicodendron (pubescens) Mill. OR ***Toxicodendron (radicans)*** (L.) Kuntze	(Atlantic poison oak) (Eastern poison ivy)	TOPU2 TORA2	SS				x*		x			
WOODY VINES – armed												
Smilax (auriculata) Walter OR *Smilax (bona-nox)* L.	(Earleaf) greenbrier OR (Saw) greenbrier	SMAS SMBO2	VW	x	x	x	x	x	x			
WOODY VINES – unarmed												
Vitis rotundifolia Michx.	Muscadine	VIR03	VW				x*	x	x			
HERBACEOUS – forbs												
***Agalinis* sp**. Raf.	False foxglove	AGALI	HF			x						
Allium canadense L.	Meadow garlic	ALCA3	HF				x*					
Bidens alba	Beggarticks; Spanish needles	BIAL	HF						x*			
Buchnera americana	American bluehearts	BUAM	HF					x*				
Campanula floridana S. Watson ex A. Gray	Florida bellflower	CAFL18	HF				x*					

Carphephorus paniculatus (J.F. Gmel.) Herb.	Hairy Chaffhead	CAPA53	HF					x*	x			
Cerastium glomeratum Thuill.	Mouse-ear chickweed	CEGL2	HF	x								
Chaptalia tomentosa Vent.	Pineland daisy	CHTO	HF	x								
***Cirsium* (*horridulum*)** Michx.	(Yellow) thistle	(CIHO2)	HF				x*		x			
Conyza canadensis (L.) Cronquist	Canadian horseweed	COCA5	HF					x*				
Diodia virginiana L.	Virginia buttonweed	DIVI3	HF					x*				
***Elephantopus* sp**. L.	Elephantsfoot	ELEPH	HF	x	x	x	x	x	x			
Erigeron sp. L.	Fleabane	ERIGE2	HF	x			x		x			
Eupatorium capillifolium (Lam.) Small	Dogfennel	EUCA5	HF		x	x		x	x			
Eupatorium pilosum Walter	Rough boneset	EUPI2	HF			x		x	x			
Galium sp. L.	Bedstraw	GALIU	HF	x								
Gamochaeta sp. Weddell	Cudweed	GAMOC	HF	x			x					
Geranium carolinianum L.	Carolina geranium, cranesbill	GECA5	HF	x			x					
Helianthus radula (Pursh) Torr. & A. Gray	Rayless sunflower	HERA	HF	x	x	x			x			
***Helianthus angustifolius* L**.	Swamp sunflower	HEAN2	HF						x*			
Hieracium sp. L.	Hawkweed	HIERA	HF			x			x			
Hyptis alata (Raf.) Shinners	Clustered bushmint	HYAL	HF						x*			
Krigia virginica (L.) Willd.	Virginia dwarfdandelion	KRVI	HF	x			x					
Lobelia glandulosa Walter	Glade lobelia	LOGL	HF			x			x			
Lobelia paludosa Nutt.	White lobelia	LOPA3	HF				x*					
Mitreola petiolata (J. F. Gmel.)Torr. & A. Gray	Lax hornpod		HF					x*				
Oenothera (simulans) (Small) W. L. Wagner & Hoch	Southern beeblossom	OESI	HF	x								
Oxalis corniculata L.	Common yellow woodsorrel	OXCO	HF				x*					
Phyllanthus urinaria L.	Chamberbitter	PHUR	HF	x	x	x		x	x			
***Physostegia* (*leptophylla*)** Small	(Slender) false dragonhead	PHLE9	HF					x*				
***Pityopsis* (*graminifolia*)** (Michx.) Nutt.	(Narrowleaf silkgrass)	PIGR4	HF	x	x	x			x			
Plantago virginica L.	Virginia plantain	PLVI	HF				x*					
Polygala nana (Michx.) DC.	Candyroot	PONA2	HF	x								
Pterocaulon pycnostachyum (Michx.) Elliott	Blackroot	PTPY2	HF					x*				
Rhexia mariana L.	Pale meadowbeauty	RHMA	HF		x	x		x				
Salvia lyrata L.	Lyreleaf sage	SALY2	HF	x			x					

Sisyrinchium (angustifolium) Mill. or *Sisyrinchium (nashii)* E.P. Bicknell	(Narrowleaf) blue-eyed grass (Nash's) blue-eyed grass	SIAN3 SINA	HF	x			x					
***Solidago canadensis* L.**	Canada goldenrod	SOCA6	HF						x*			
Solidago stricta Aiton	Wand goldenrod	SOST	HF			x						
Stachys floridana Shuttlw. ex Benth.	Florida betony	STFL4	HF	x			x					
Valerianella radiata (L.) Dufr.	Beaked cornsalad	VARA	HF				x*					
Viola sp. L.	Violet	VIOLA	HF	x								
***Xyris* sp**. L.	Yellow-eyed grass	XYRIS	HF		x	x						
HERBACEOUS – Fabaceae												
Chamaecrista fasciculata (Michx.) Greene	Partridge pea	CHFA2	HFf		x	x		x				
Trifolium campestre Schreb.	Hop clover	TRCA5	HFf	x			x					
Trifolium repens L.	White clover	TRRE3	HFf	x			x					
HERBACEOUS – vines												
Centrosema virginianum (L.) Benth.	Spurred butterfly pea	CEVI2	VH					x*				
GRASSES – graminoid MOs												
Andropogon glomeratus (Walter) Britton, Sterns & Poggenb.	Bushy bluestem	ANGL2	GR			x		x	x			
Andropogon virginicus L.	Broomsedge bluestem	ANVI2	GR	x	x	x	x		x			
Briza minor L.	Little quakinggrass	BRMI2	GR	x								
(***Coleataenia anceps*)** (Michx.) Soreng	(Beaked Panicum)	COAn2	GR						x*			
***Eragrostis* sp.** von Wolf	Lovegrass	ERAGR	GR			x			x			
Paspalum notatum Flueggé	Bahiagrass	PANO2	GR	x	x	x	x	x	x			
Paspalum urvillei Steud.	Vaseygrass	PAUR2	GR			x		x	x			
***Setaria* sp.** P. Beauv.	Foxtail	SETAR	GR		x	x		x	x			
(Sorghum halepense) L. Purs.	(Johnsongrass)	SOHA	GR					x*				
RUSHES & SEDGES												
***Cyperus* (*esculentus*)** L.	(Yellow) nutsedge	CYES	SG					x*				
Total all sp. #	59			25	13	21	25	25	29			

NOTES:

1. Species observed not based on a formal survey; does not include “standing dead” (like brown shoots of native grasses).
2. Species in bold font were observed only by J. Norcini; all others were observed by J. Norcini and R. Haggie/ R. Johnstone.
3. Most natives at back edge of plot at wooded edge, with a small transition zone between area where most natives occurred and the wide area where bahiagrass predominated (>95%, by area).
4. Site mowed sometime during July to early August 2016.
5. *Sisyrinchium angustifolia = Sisyrinchium atlanticum*
6. April 2017
    a. Two pine seedlings occurred about midway between edge of pavement and edge of woods; should be removed, which can be easily done by hand.
    b. 10 new species, all of which are native to Florida; however, same number of species as in April 2016 (25).
    c. Bahia turf dense
    d. *Trifolium* spp. and *Geranium* were predominant near edge of pavement
7. August 2017
    a. 11 new species, 10 of which are native to Florida
    b. Species diversity increased from August 2016 (13 vs 25)
    c. Bahia turf dense
    d. *Buchnera americana* occurred throughout
    e. *Phyllanthus urinaria* mainly observed at north and south ends where bahiagrass density was less dense
    f. Long broken row of *Paspalum urvillei* at bottom of front slope; parallel to road
8. October 2017
    a. Compared to October 2016, 5 new species observed, all of which are native to Florida
    b. Species diversity increased from October 2016 (21 vs 29)
    c. Bahia turf remains dense
    d. *Lobelia glandulosa* occurred throughout

Site 2 – Updated October 2017 (new species [2016 vs 2017] marked with asterisks when first observed in 2017)

Table 1a. FDOT #2, BAHIA plot, US 41	30º 18' 52.54"N / 82º 43' 4"W (30.31405, -82.71617)			Year/Month								
BAHIA plot, Columbia County, Florida (south of White Springs, which is in Hamilton County)				2016			2017			2018		
				Ap	Au	Oc	Ap	Au	Oc			
Trees/shrubs/herbs/VS/species	BASELINE	ITIS										
Latin name	Common name	Code	VT	##								
TREES – TLa, TLg & TS												
Diospyros virginiana L.	Common persimmon	DIVI5	TLa	x	x	x	x	x	x			
***Quercus* (*nigra*)** L.	(Water) oak	QUNI	Tla						x*			
Quercus virginiana. L.	Live oak	QUERC	TLa	x	x	x	x	x	x			
(*Prunus angustifolia*) Marshall	(Chickasaw plum)	PRAN3	TSa						x*			
Rhus copallinum L.	Winged Sumac	RHUS	TSa				x*	x	x			
SHRUBS – SL & SS												
Asimina incana (W. Bartram) Exell	Wooly pawpaw	ASIN12	SS		x	x	x	x				
Asimina angustifolia Raf.	Slimleaf pawpaw	ASAN6	SS		x	x	x	x	x			
Rubus cuneifolius Pursh	Sand blackberry	RUCU	SS		x	x	x	x	x			
Serenoa repens (W. Bartram) Small	Saw palmetto	SERE2	SS		x	x	x	x	x			
Vaccinium stamineum L.	Deerberry	VAST	SS				x*	x	x			
WOODY VINES – armed												
***Rubus* (*pensilvanicus*)** Poir. OR ***Rubus* (*trivalis*)** Michx.	(Sawtooth) dewberry (Southern) dewberry	RUPE5 RUTR	VW	x								
***Smilax* sp**. L.	Greenbrier	SMILA2	VW	x				x				
WOODY VINES – unarmed												
***Vitis* sp.** L.	Grape	VITIS	VW				x*	x				
HERBACEOUS - forbs												

(Asteraceae)	Composite TBID	UNAST	HF										
Ambrosia artemisiifolia L.	Common ragweed	AMAR2	HF	x	x	x		x	x				
Cantinoa mutabilis (Rich.) Harley & J.F.B. Pastore	Tropical bushmint	CAMU2	HF						x*				
Cnidoscolus stimulosus (Michx.) Engelm. & A. Gray	Tread softly	CNURS	HF		x	x	x	x	x				
Conyza canadensis (L.) Cronquist	Canadian horseweed	COCA5	HF			x			x				
Coreopsis basalis (A. Dietr.) S.F. Blake	Goldenmane tickseed	COBA2	HF	x			x						
Crocanthemum corymbosum (Michx.) Britton	Pinebarren frostweed	CRCO28	HF						x*				
Croptilon divaricatum (Nutt.) Raf.	Slender scratchdaisy	CRDI17	HF			x							
Croton glandulosus var. septentrionalis Müll. Arg.	Vente conmigo	CRGLS	HF		x								
Descurainia pinnata (Walter) Britton	Western tansymustard	DEPI	HF				x*						
***Erigeron* sp**. L.	Fleabane	ERIGE2	HF		x			x	x				
Eupatorium capillifolium (Lam.) Small	Dogfennel	EUCA5	HF		x	x	x	x	x				
Eupatorium compositifolium Walter	Yankeeweed	EUCO7	HF						x*				
Froelichia floridana (Nutt.) Moq.	Cottonweed	FRFL	HF		x	x			x				
***Galium* sp.** L.	Bedstraw	GALIU	HF	x									
Krigia virginica (L.) Willd.	Virginia dwarfdandelion	KRVI	HF	x									
Ludwigia (maritima) Harper	(Seaside) primrosewillow	LUMA4	HF		x			x					
Ludwigia suffruticosa Walter	Shrubby primrosewillow	LUSU11	HF		x			x	x				
Monarda punctata L.	Spotted beebalm	MOPU	HF	x	x	x			x				
***Oenothera* sp**. L.	Evening primrose	OENOT	HF	x	x								
Oenothera (simulans) (Small)W.L. Wagner & Hoch	(Southern beeblossom)	OESI	HF	x				x					
***Opuntia* sp.** Mill.	Pricklypear	OPUNT	HF	x	x	x		x	x				
Oxalis sp. L.	Woodsorrel	OXCO	HF	x				x	x				
Penstemon multiflorus Chapm. ex Benth.	Manyflower beardtongue	PEMU9	HF		x			x	x				
Phlox drummondii Hook.	Drummond phlox	PHDR	HF	x			x	x					
Physalis arenicola Kearney	Cypresshead groundcherry	PHAR14	HF		x	x	x	x	x				
Piriqueta cissoids (L.) Grebe.	Pitted stripeseed	PICI	HF		x		x						
Pityopsis graminifolia (Michx.) Nutt.	Narrowleaf silkgrass	PIGR4	HF	x	x	x	x	x	x				
***Plantago* sp**. L.	Plantain	PLANT	HF	x									
Pseudognaphalium obtusifolium (L.) Hilliard & B.L. Burtt	Rabbit tobacco	PSOB3	HF			x			x				
Pyrrhopappus carolinianus (Walter) DC.	Carolina desertchicory	PYCA2	HF	x									

***Richardia* (*brasiliensis*)** Gomes AND/OR ***Richardia* (*scabra*)** L.	(Tropical) Mexican clover (Rough) Mexican clover	RIBR2 RISC	HF	x	x			x	x			
Rumex hastatulus Baldw.	Heartwing dock	RUHA2	HF	x			x					
Salvia lyrata L.	Lyreleaf sage	SALY2	HF	x								
(*Seymeria pectinata*) Pursh	(Piedmont blacksenna)	SEPE2	HF						x*			
Trichostema dichotomum L.	Forked bluecurls	TRID2	HF						x*			
Verbena officinalis* subsp. *halei (Small) Barber	Texas vervain	VEOFH	HF		x							
Wahlenbergia marginata (Thunb.) A. DC.	Southern rockbell	WAMA	HF		x			x				
HERBACEOUS – Fabaceae												
Chamaecrista fasciculata (Michx.) Greene	Partridge pea	CHFA2	HFf		x	x		x	x			
Indigofera hirsuta L.	Hairy indigo	INHI	HFf						x*			
***Lespedeza* sp. 1**	Lespedeza	LESPE	HFf					x*				
***Lespedeza* sp. 2**	Lespedeza	LESPE	HFf					x*	x			
Zornia bracteata J.F. Gmel.	Viperina	ZOBR	HFf					x*				
HERBACEOUS VINES												
***Ipomoea* sp.** L. (white flowers)	Morning-glory	IPAL	VH					x*				
Passiflora incarnata L.	Purple passionflower	PAIN6	VH					x*				
Mimosa quadrivalvis L.	Sensitive brier	MIQU2	VH					x*				
GRASSES – graminoid MOs												
Andropogon virginicus L.	Broomsedge bluestem	ANVI2	GR		x	x		x	x			
Andropogon L. ***virginicus var. glaucus*** Hack.	Chalky bluestem	ANVIG2	GR					x*	x			
Paspalum notatum Flueggé	Bahiagrass	PANO2	GR	x	x	x	x	x	x			
Paspalum urvillei Steud.	Vaseygrass	PAUR2	GR		x	x			x			
Piptochaetium avenaceum (L.) Parodi	Blackseed needlegrass	PIAV	GR				x*					
RUSHES & SEDGES												
Cyperus ovatus Baldw.	Pinebarren flatsedge	CYOV3	SG					x*				
Total all sp. #	57			21	28	22	20	35	36			

NOTES:

1. Species observed not based on a formal survey; does not include "standing dead" (like brown shoots of native grasses).
2. Species in bold font were observed only by J. Norcini; all others were observed by J. Norcini and R. Haggie/ R. Johnstone.
3. High concentration of natives along the fence line
4. The unknown Asteraceae observed by J. Norcini in October 2016 probably was not the same unknown observed by R. Haggie in April 2016 as the one J. Norcini observed did not flower until fall.
5. April 2017
   a. Fence line (underneath powerline) is now separated from demo plot by 10-ft mowed strip created by power company between October 2016 and April 2017.
   b. Much less diversity than in April 2016, which is at least partially due to mowed strip created by power company.
   c. 5 new species, all of which are native to Florida; *Asimina* spp. identified.
   d. Bahia turf dense
   e. Oak near edge of clear zone may need to be eradicated (see image).
   f. As of April 2017, no longer including powerline ROW in survey, which may reduce the number of species observed.

6. August 2017
   a. *Ipomoea* – white flowers; probably native
   b. *Physalis arenicola* widespread.
   c. 8 new species; at least 5 are native to Florida
   d. Despite not including powerline ROW in survey, species diversity increased from August 2016 (28 vs 35)
   e. Bahia turf dense
7. October 2017
   a. 8 new species, 6 of which are native
   b. Despite not including powerline ROW in survey, species diversity increased from October 2016 (22 vs 36)
   c. Bahia turf remains dense
   d. *Indigofera hirsuta* – species of concern

   From: Nettles, John [mailto:John.Nettles@dot.state.fl.us]
   Sent: Wednesday, November 08, 2017 1:52 PM

   Jeff, I have visited sites #2 and #3. I have removed (by hand) all the Hairy indigo I could find and disposed of it off site. I know I probably left some at site #2. The indigo was growing off FDOT R/W on adjacent property, and there was some further down the property line as well. I did try to get all of it that was within the limits of our test plot site.

Site 3 – Updated October 2017 (new species [2016 vs 2017] marked with asterisks when first observed in 2017)

Table 1a FDOT #3 HOP CLOVER plot, US 41	30º 27' 37"N/82º 53' 49"W (30.4600056, -82.8964639)			Year/month								
Hop clover TRCA5 plot, Jasper, Hamilton County, Florida				2016			2017			2018		
				Ap	Au	Oc	Ap	Au				
Trees/shrubs/herbs/VS/species	BASELINE	ITIS										
Latin name	Common name	Code	VT	##								
TREES – TLa, TLg & TS												
SHRUBS – SL & SS												
***Hypericum* sp.** L.	St. Johnswort	HYPER	SS				x*					
***Lyonia* sp.** Nutt.	Staggerbush	LYONI	SS				x*	x	x			
Rubus cuneifolius Pursh	Sand blackberry	RUCU	SS	x	x		x	x	x			
Toxicodendron (pubescens) Mill. OR ***Toxicodendron (radicans)*** (L.) Kuntze	(Atlantic) poison oak (Eastern) poison ivy	TOPU2 TORA2	SS	x								
WOODY VINES – armed												
Rubus* (*pensilvanicus*)** Poir. OR ***Rubus (trivalis) Michx.	(Sawtooth) dewberry (Southern) dewberry	RUPE5 RUTR	VW	x					x			
WOODY VINES – unarmed												
(*Campsis radicans*) (L.) Seem. ex Bureau OR **(*Ampelopsis arborea*)** (L.) Koehne	(Trumpet creeper) (Peppervine)	CARA2 AMAR5	VW				x*		x			
HERBACEOUS – forbs												
Acalypha gracilens A. Gray	Slender Threeseed Mercury	ACGR2	HF						x*			
***Agalinis* sp.** Raf.	False foxglove	AGALI	HF			x						
Allium canadense L.	Meadow garlic	ALCA3	HF	x			x					
Ambrosia artemisiifolia L.	Common ragweed	AMAR2	HF		x	x	x	x	x			
Buchnera americana L.	American bluehearts	BUAM	HF		x			x				
Cirsium horridulum Michx.	Purple or Scottish thistle	CIHO2	HF	x			x	x	x			
Conyza canadensis (L.) Cronquist	Canadian horseweed	COCA5	HF			x	x	x	x			

Coreopsis basalis (A. Dietr.) S.F. Blake	Goldenmane tickseed	COBA2	HF	x			x					
Diodia virginiana L.	Virginia buttonweed	DIVI3	HF					x*				
Erigeron quercifolius Lam.	Oakleaf fleabane	ERQU	HF	x	x			x				
Eupatorium capillifolium (Lam.) Small	Dogfennel	EUCA5	HF				x*	x	x			
Euthamia caroliniana (L.) Greene ex Porter & Britton	Slender flattop goldenrod	EUCA26	HF						x*			
***Gamochaeta* sp.** Weddell	Cudweed	GAMOC	HF	x								
Geranium carolinianum L.	Carolina geranium, cranesbill	GECA5	HF	x								
Helianthus angustifolius L.	Swamp sunflower	HEAN2	HF					x*	x			
Heterotheca subaxillaris (Lam.) Britton & Rusby	Camphorweed	HESU3	HF		x	x		x	x			
Krigia virginica (L.) Willd.	Virginia dwarfdandelion	KRVI	HF	x								
Ludwigia (maritima) Harper	(Seaside) primrosewillow	LUMA4	HF		x			x				
Monarda punctata L.	Spotted beebalm	MOPU	HF		x							
Oenothera (simulans) (Small)W.L. Wagner & Hoch	(Southern beeblossom)	OESI	HF		x							
Phyla nodiflora (L.) Greene	Fog fruit	PHNO2	HF					x*				
Plantago sp. L.	Plantain	PLANT	HF		x							
Pseudognaphalium obtusifolium (L.) Hilliard & B.L. Burtt	Rabbit tobacco	PSOB3	HF			x						
Pyrrhopappus carolinianus (Walter) DC.	Carolina desertchicory	PYCA2	HF	x								
Rhexia mariana L.	Pale meadowbeauty	RHMA	HF		x			x				
Rumex hastatulus Baldw.	Heartwing dock	RUHA2	HF	x								
Salvia lyrata L.	Lyreleaf sage	SALY2	HF	x			x					
Sisyrinchium (angustifolium) Mill. OR *Sisyrinchium (nashii)* E.P. Bicknell	(Narrowleaf) blue-eyed grass (Nash's) blue-eyed grass	SIAN3 SINA	HF	x								
Solidago canadensis. L.	Canada goldenrod	SOCA6	HF			x			x			
***Spermolepis* sp.** Raff.	Scaleseed	SPERM2	HF				x*					
Stachys floridana Shuttlw. ex Benth.	Florida betony	STFL4	HF	x			x		x			
Symphyotrichum sp. Nees	Aster	SYMPH4	HF			x			x			
Tradescantia ohiensis Raf.	Ohio spiderwort	TROH	HF	x			x	x	x			
Trichostema dichotomum L.	Forked bluecurls	TRID2	HF						x*			
Valerianella radiata (L.) Dufr.	Beaked cornsalad	VARA	HF				x*					

Verbena brasiliensis Vell.	Brazilian vervain	VEBR2	HF	x	x	x	x	x	x			
Wahlenbergia marginata (Thunb.) A. DC.	Southern rockbell	WAMA	HF			x			x			
HERBACEOUS - Fabaceae												
Crotalaria sp. L.	Rattlebox	CROTA	HFf		x							
Indigofera hirsuta L.	Hairy indigo	INHI	HFf			x			x			
Desmodium paniculatum (L.) DC.	Panicled ticktrefoil	DEPA6	HFf					x*	x			
Desmodium tortuosum (Sw.) DC.	Dixie ticktrefoil	DETO	HFf		x*			x				
Trifolium campestre Schreb.	Hop clover	TRCA5	HFf	x			x					
***Vicia* sp**. L.	Vetch	VICIA	HFf	x								
HERBACEOUS VINES												
Ipomoea cordatotriloba Dennst.	Tievine	IPCO8	VH						x*			
Ipomoea hederifolia L.	Scarletcreeper	IPHE2	VH			x			x			
***Ipomoea* sp.** L. (white flowers)	Morning-glory	IPAL	VH					x*				
GRASSES – graminoid MOs												
(***Amphicarpum muehlenbergianum***) (Schult.) Hitchc.	(Blue maidencane)	AMMU2	GR						x*			
Andropogon glomeratus (Walter) Britton, Sterns & Poggenb.	Bushy bluestem	ANGL2	GR			x		x	x			
Andropogon virginicus L.	(Broomsedge) bluestem	ANVI2	GR	x	x	x		x	x			
Paspalum notatum Flueggé	Bahiagrass	PANO2	GR	x	x	x	x	x	x			
Paspalum urvillei Steud.	Vaseygrass	PAUR2	GR						x*			
(*Sorghum halepense*) L. Pers.	(Johnsongrass)	SOHA	GR					x*				
RUSHES & SEDGES												
***Cyperus* sp. 1** L.	Flatsedge	CYPER	SG					x*				
***Cyperus* sp. 2** L.	Flatsedge	CYPER	SG					x*				
Unknown1 – see Note 5f					x*			x				
Total all sp. #	55			21	16	14	18	26	28			

NOTES:

1. Species observed not based on a formal survey; does not include “standing dead” (like brown shoots of native grasses).
2. Species in bold font were observed only by J. Norcini; all others were observed by J. Norcini and R. Haggie/ R. Johnstone.
3. *Sisyrinchium angustifolium = Sisyrinchium atlanticum*
4. April 2017
   a. Slightly less diversity than in April 2016
   b. 6 new species, all of which are native to Florida
   c. *Campsis/Ampelopsis* mainly near back edge of clear zone; locally abundant
      - *Ampelopsis arborea* now *Nekemias arborea* per USDA (but not Florida Plant Atlas [http://florida.plantatlas.usf.edu])
   d. Bahia turf locally dense
5. August 2017
   a. Species diversity increased from August 2016 (16 vs 26)
   b. 8 new species; at least 4 are native to Florida
   c. *Ambrosia* and *Verbena* widespread and are the two most prevalent species (not including bahiagrass)
   d. New *Ipomoea* sp. – same species as Site 2
   e. Bahia turf locally dense
   f. Unknown 1 – observed August 2016/2017 – ID'd as *Desmodium tortuosum*



6. October 2017
   a. Species diversity increased from October 2016 (14 vs 28)
   b. 6 new species; 5 are native to Florida
   c. Nearly all *Verbena* had senesced
   d. *Ambrosia* and *Heterotheca* were the most widespread, non-senesced species
   e. Did not observe white-flowered *Ipomoea* sp. (same species as Site 2)
   f. Bahia turf remains locally dense, unlike other two sites where bahia turf was dense nearly throughout
   g. *Indigofera hirsuta* – species of concern; occurs mainly in northern half of plot

   From: Nettles, John [mailto:John.Nettles@dot.state.fl.us]
   Sent: Wednesday, November 08, 2017 1:52 PM

   Jeff, I have visited sites #2 and #3. I have removed (by hand) all the Hairy indigo I could find and disposed of it off site. I know I probably left some at site #2. The indigo was growing off FDOT R/W on adjacent property, and there was some further down the property line as well. I did try to get all of it that was within the limits of our test plot site.

An invertebrate comparison among three Florida Department of Transportation roadside easements: Hamilton, Columbia and Union County, Florida in 2017.

By Richard Owen
15 January 2018

Southern red-legged grasshopper, *Melanoplus propinquus*
Columbia County, Florida 19 October 2017

Common long-horned bee, *Melissodes communis*
Columbia County, Florida 12 August 2017

Hamilton County, Florida 12 August 2017

Hanging thief, *Diogmites esiriens*
Union County, Florida 5 July 2017

Barred yellow, *Eurema daira*
Union County, Florida 19 October 2017

INTRODUCTION

The objective of this work was to conduct invertebrate surveys at three Florida Department of Transportation (FDOT) roadside study sites.

METHODS

Study sites

There were three different roadside study sites chosen for this work, one site in each of the three counties, including Hamilton, Union, and Columbia. In general, each study site had very unique habitat characteristics, but the most similar attribute was that each site was located immediately adjacent to a fairly busy state highway. The available survey area of the Union site was the smallest (ca. 0.6 ac), Columbia site was second largest (ca. 1.39 ac), and Hamilton site was the largest (ca. 1.79 ac). The area surveyed at each site was from the paved roadway to the fence and to the boundary of each site that were marked by FDOT signs designated as "Test Site Project End".

Plant species are being documented and assessed by others involved with a separate study at these test sites. Nonetheless, Bahia grass (*Paspalum notatum*) was the dominant vegetation at all three sites. At all three sites, mowing beyond the backslope was excluded since the beginning of spring 2016.

The Columbia County Site was historically a sandhill natural community, characterized by Alpin fine sand soils (Howell 1984, Soil survey of Columbia County, Florida). One sandhill indicator species that was observed at the site was active pocket gopher mounds. Adjacent to the site was an abandoned agricultural field with abundant local native groundcover and was a pine plantation at least through 2014. This site lies within a half mile radius of several publicly protected to natural lands including Gar and Horse Ponds (Suwannee River Water Management District), Little and Big Shoals (Florida Fish and Wildlife Conservation Commission (FWC), SRWMD, Florida Forest Service (FFS), Florida Park Service (FPS)), as well as the state designated Outstanding Florida Water (OFW), namely the Suwannee River.

The Union County Site was historically a pine flatwoods natural community, characterized by Pelham-Pelham wet fine sands (Dearstyne, Leach and Sullivan 1991, Soil Survey of Union County, Florida). Adjacent to the site is a large plantation area of young pine. This site lies within a 0.5-mile radius of numerous relatively undisturbed marshes and forested wetlands, and is less than two miles in proximity from a significant tributary of the Santa Fe River (i.e. New River). In addition, this site falls within a nearly 7,500-acre piece of mostly undeveloped public property that is managed by Florida (i.e. Raiford State Prison).

The Hamilton County Site was historically a pine flatwoods natural community, characterized by Mascotte sands (Weatherspoon, Howell, and Baldwin 2004, Soil survey of Hamilton County, Florida). Immediately adjacent to the site is the largest open phosphate mine pit found in north Florida (i.e. White Springs PCS phosphate). The extent of mining associated from this facility is nearly 150 square miles and it has been actively producing mined earthen minerals since the 1960s. The site is also nearly five miles northeast of the Suwannee River. A significant drainage ditch ran parallel to the western boundary of this site.

Each study site was visited once a month between the period from 5 July 2017 to 19 October 2017. As many invertebrates as possible that were encountered during each sampling effort were identified to their lowest taxon. Photographs were taken of any species that could not be identified during the survey for later assessment. For invertebrate surveys, the entire area of each study site was systematically walked with a survey distance that ranged from 0.5 mile to 1.0 mile each visit. Each site was surveyed for at least one hour, but no more than 2 hours.

RESULTS

During this study, the abundance of a few of the taxa encountered at some sites (e.g., bees and grasshoppers) was so dense that it was difficult to identify every individual, therefore undoubtedly some were missed and counts were low for these species. Additionally, during this study many taxa were only identified by using photographic data. Some grasshopper species, for example, are morphologically similar and must be individually inspected in hand for positive identification. For this reason, some species names in this report are tentative, and could change with additional information. A complete list of species observed during this study is listed in Appendix I.

The total amount of invertebrate survey effort across all sites was close to 16 hours, with Hamilton and Columbia each receiving approximately 23 more minutes of survey time. Table 1 summarizes the total number of species observed at each of the three study sites.

Table 1. Invertebrate monitoring in Union, Hamilton, and Columbia Counties, Florida, in 2017

		Total # Species by Taxa		
Site	**Total # Species**	**Lepidoptera**	**Odonata**	**Orthoptera**
Hamilton	68	20	**13**	17
Union	52	19	8	14
Columbia	72	**23**	10	**19**
	Total # Individuals	492	428	386

The Columbia Site had greatest total number of species observed during this five-month study. Additionally, Columbia also had the greatest total number of species within two of the three most diverse taxa observed during the study.

Figure 1 summarizes the overall number of species observed during the study. The greatest number of

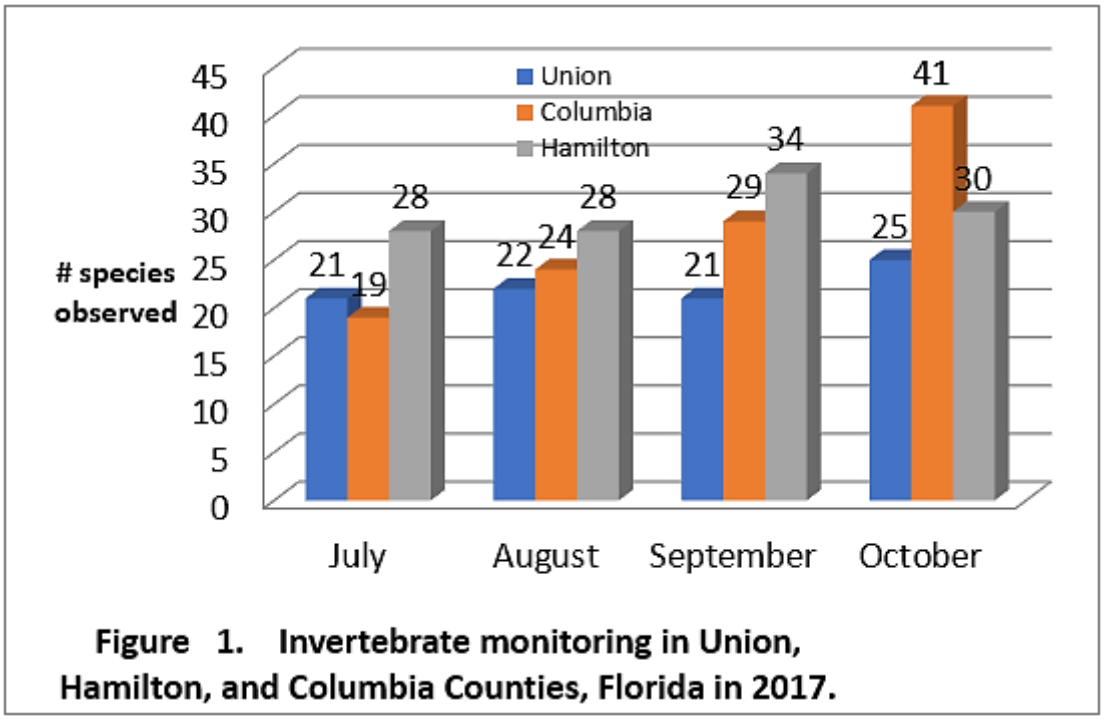

Figure 1. Invertebrate monitoring in Union, Hamilton, and Columbia Counties, Florida in 2017.

species was observed in October. A total of 120 invertebrate species were identified during this study. In general, the number of observed invertebrate species gradually increased from July to October.

Figure 2 summarizes the total number of individual invertebrates observed during the study. The

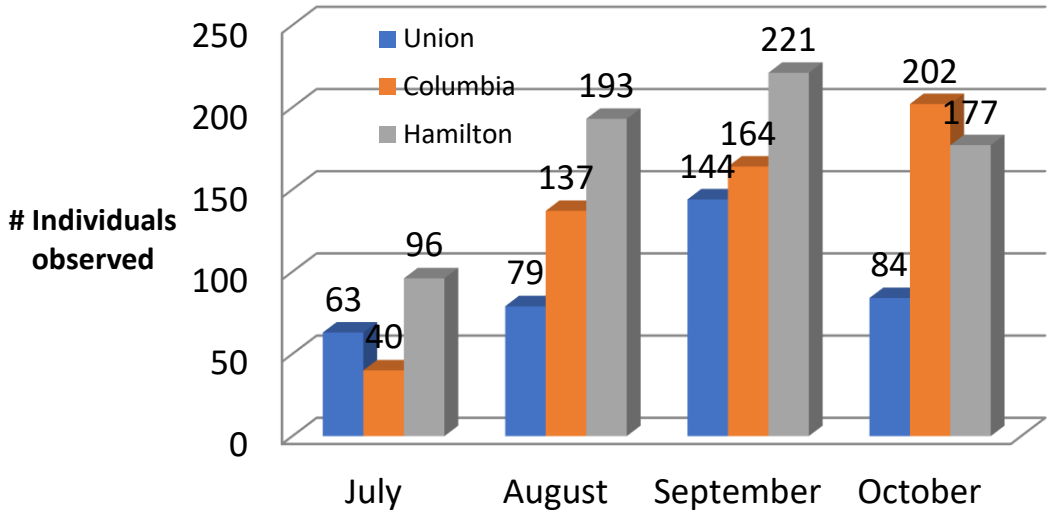

Figure 2. Invertebrate monitoring in Union, Hamilton , and Columbia Counties, Florida in 2017.

greatest number of individuals that were observed occurred during the month of September (i.e. 529), and the lowest occurred in July (i.e. 199). The most abundant species observed on any one day during the study was 150 Love bugs (*Plecia nearctica*) in September. Roseate skimmers (*Orthemis ferruginea*) were the second most abundant invertebrate overall during the study with a total of 147 individuals observed. However, more butterflies (i.e. 492) were observed than any other taxa during the study. The two most abundantly observed butterflies were the Barred yellow (*Eurema daira*) and Gulf fritillary (*Agraulis vanilla*). The most abundant grasshopper during the study was American bird grasshopper (*Schistocerca americana*).

CONCLUSIONS

During this FDOT roadside monitoring study there was a total of 120 different invertebrate species identified from the period July 5 to October 19, 2017. There were no imperiled invertebrates observed during this study. The three study sites chosen were each unique in their own respects, but the invertebrate diversity was highest at the Columbia Site. Columbia also appeared to have an abundance of adjacent local wildflower diversity much more than the other two study sites, especially along the fence line. The smaller survey area of the Union Site may have played a role in decreased numbers of species and individuals observed. Additionally, at this site, the amount of survey area was also constrained by the large amount of dense vegetation (e.g., impenetrable wall of *Smilax*, *Rubus*…) along the entire fence line throughout the study. The drainage ditch adjacent to the Hamilton site probably played a significant role with some species, such as one of the most abundant invertebrates (i.e. Roseate skimmer).

Appendix I. Invertebrate monitoring species list for surveys in Union, Hamilton, and Columbia Counties, Florida in 2017.

Groups	Species
Butterflies (Lepidoptera)	
Swallowtails (Papilionidae)	
	Zebra *Eurytides marcellus*
	Palamedes *Papilio palamedes*
Sulphurs (Coliadinae)	
	Barred yellow *Eurema daira*
	Sleepy orange *Abaeis nicippe*
	Cloudless sulphur *Phoebis sennae*
	Little yellow sulphur *Pyrisitia lisa*
Hairstreaks (Theclinae)	
	Gray hairstreak *Strymon melinus*
	Red-banded hairstreak *Calycopis cecrops*
Blues (Polyamatinae)	
	Ceraunus blue *Hemiargus ceraunus*
Heliconians (Heliconiinade)	
	Gulf fritillary *Agraulis vanillae*
	Zebra heliconian *Heliconius charithonia*
	Varigated fritillary *Euptoieta claudia*
Brushfoots (Nymphalinae)	
	Phaon crescent *Phyciodes phaon*
	Buckeye *Junonia coenia*
	Pearl crescent *Phyciodes tharos*
Saytrs (Satyrinae)	
	Carolina saytr *Hermeuptychia sosybia*
Milkweed type (Danainae)	
	Viceroy *Limenitis archippus*
	Monarch *Danaus plexippus*
Dicot skippers (Eudaminae)	
	Long-tailed skipper *Urbanus proteus*
	Dorantes longtail *Urbanus dorantes*
Spread-wing skippers (Pyrginae)	
	Confused cloudywing *Thorybes confusis*
	Horaces duskywing *Erynnis horatius*
	Common checkered skipper *Pyrgus communis*
Grass skippers (Hesperiinae)	
	Whirlabout *Polites vibex*
	Fiery skipper *Hylephila phyleus*
	Baracoa skipper *Polites baracoa*
	Crossline skipper *Polites origenes*
	Southern broken dash *Wallengrenia otho*
	Sachem *Atalopedes campestris*
	Dunn skipper *Polites peckius*

Grass skippers (Hesperiinae) *continued*

Eufala skipper *Lerodea eufala*

Ocola skipper *Panoquina ocola*

Grasshopper, katydid, & cricket (Orthoptera)

Grasshoppers (Caelifera)

Short-horned grasshopper (Acrididae)

Slant-faced (Gomphocerinae)

Amblytropida type

Brown winter grasshopper *Amblytropidia mysteca*

Admirable grasshopper *Syrbula admirabilis*

Orphulella type

Short-winged green grasshopper *Dichromorpha viridis*

Toothpick (Mermiria type)

Eastern mermiria *Mermiria intertexta*

Lively mermiria *Mermiria picta*

Longrasshoppereaded grasshopper *Achurum carinatum*

Band-winged (Oedipodinae)

Southern green-striped grasshopper *Chortophaga viridifasciata*

Carolina grasshopper *Dissosteira carolina*

Wrinkled grasshopper *Hippiscus ocelote*

Marbled grasshopper *Spharagemon marmorata*

Ridgeback sand grasshopper *Spharagemon cristatum*

Longhorn bandwing grasshopper *Psinidia fenestralis*

Southern yellow-wing grasshopper *Arphia granulata*

Bird (Cyrtacanthacridinae)

American bird grasshopper *Schistocerca americana*

Mischievous grasshopper *Schistocerca damnifica*

Spur-throated (Melanoplinae)

Two-spined grasshopper *Melanoplus bispinosus*

Keeler's grasshopper *Melanoplus keeleri*

Southern red-legged grasshopper *Melanoplus propinquus*

Roundwinged grasshopper *Melanoplus rotundipennis*

Migratory grasshopper *Melanoplus sanguinipes*

Small spur-throated

Linearwinged grasshopper *Aptenopedes sphenarioides*

Atlantic grasshopper *Paroxya atlantica*

Long horned orthoptera (Ensifera)

Katydids (Tettigoniidae)

SE bush katydid *Scudderia cuneata*

Handsome meadow katydid *Orchelimum puchellum*

Red-headed meadow katydid *Orchelimum erythrocephalum*

Lesser meadow katydid *Conocephalu*s sp.

Crickets (Gryllidea)

Unknown tree cricket

Dragonflies & damselflies (Ondonata)

Dragonflies (Anisoptera)

Darners (Aeshnidae)

Common green darner *Anax junius*

Skimmers (Libellulidae)

Great blue skimmer *Libellula vibrans*
Eastern amberwing *Perithemis tenera*
Little blue dragonlet *Erythrodiplax minuscula*
Blue dasher *Pachydiplax longipennis*
Eastern pondhawk *Erythemissimplicicolli*
Halloween pennant *Celithemis eponina*
Amanda's pennant *Celithemis amanda*
Black saddlebags *Tramea lacerate*
Carolina saddlebags *Tramea carolina*
Wandering glider *Pantala flavescens*
Roseate skimmer *Orthemis ferruginea*

Damselflies (Zygoptera)

Familiar bluet *Enallagma civile*
Rambur's forktail *Ischnura ramburii*
Fragile forktail *Ischnura posita*
Citrine forktail *Ischnura hastata*
Southern sprite *Nehalennia integricollis*

Flies (Diptera)

Deer flies (Tabanidae)

Yellow fly *Diachlorus ferrugatus*

Robberflies (Asilidae)

Bearded robberfly *Efferia albibarbis*
Hanging thief robberfly *Diogmites esiriens*
Unknown robberfly
Unknown Sphyrid bee-looking fly

Other flies

Firefly *Pyractomena borealis*
Love bug *Plecia nearctica*

Bees & wasps (Hymenoptera)

Bumble bees

Common eastern bumblebee *Bombus impatiens*
American bumblebee *Bombus pensylvanicus*
Unknown bumble bee

Carpenter bees (Xylocopinae)

Eastern carpenter bee *Xylocopa virginica*
Southern carpenter bee *Xylocopa micans*

Other bees

Common long-horned bee *Melissodes communis*
Western honeybee *Apis mellifera*
Unknown bee
Brown-winged striped sweat bee *Agapostemon splendens*
Dilemma orchid bee *Euglossa dilemma*

Wasps

Great black wasp *Sphex pensylvanicus*
Blue-wing wasp *Scolia nobilitata*
Thread-waisted wasp *Ammophila procera*
Polistes paper wasp *Polistes* sp.
Red wasp *Polistes carolina*
Five-banded Thynnid wasp *Myzinum quinquecinctum*
Mole cricket hunter *Larra bicolor*
Potter wasp *Eumenes fraternus*
Unknown wasp

Bembicini wasp

Unknown sand wasp

Beetles(Coleoptera)

Flat-headed bald cypress borer *Acmaeodera pulchella*
Hairy darkling beetle *Epitragodes tomentosus*
Darkling beetle Bothrotes *canaliculatus canaliculatus*
Punctuated tiger beetle *Cicindelidia punctulata*
Ground beetle *Patrobis longicolis*

Tumbling flower beetles (Mordellidae)

Unknown tumbling flower beetle

True bugs (Hemiptera)

Florida bee asassain *Apiomerus floridensis*

Stinkbugs (Pentatomidae)

One-spotted stinkbug *Euschistus variolarius*
Unknown stinkbug

Shield-backed bugs (Scuteleridae)

Shield-backed bug *Orsilochides guttata*
Assassin bug *Doldina interjungens*
Large milkweed bug *Oncopeltus fasciatus*

Leaf-footed bugs

Eastern leaf-footed bug *Leptoglossus phyllopus*
Leaf-footed bug *Leptoglossus oppositus*

Spiders (Arachnida)

Banded argiope *Argiope trifasciata*
Black and yellow argiope *Argiope aurantia*
Green lynx *Peucetia viridans*