Arthropod Ecology in Longleaf Savanna Ecosystems: Examples from North Carolina

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Why Insects?

- Tremendous diversity allows for fine scale assessments
 - Many specialists
 - Many species-rich groups
- Tremendous abundance allows for abundant data
- Ability to collect large samples that can be archived and analyzed later
- Reduced regulation working with inverts
- Ecologically significant interactions with other taxa of interest
- They are just really cool...

Biodiversity in North Carolina

- 121 species of mammals
- 460 species of birds
- 160 species of herptiles
- Ca. 4,000 species of vascular plants
- >20,000 species of insects, plus other arthropods!

Five Examples

- Dragonfly survey (Ft. Bragg and Camp Mackall)
- Effects of prescribed fire on native bees (Walthaur-Moss Foundation)

K # 13 %

- Impacts of pine straw raking on soil-dwelling insects (Ft. Bragg)
- Pollination ecology of three endangered species of Sandhills plants (Fort Bragg)
- Pollination ecology of the Venus flytrap (Holly Shelter and other sites)

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A Survey of Spring-flying Dragonflies on Two Blackwater Streams on Fort Bragg and Camp Mackall, NC



Why Gomphid dragonflies?

- Most Gomphids (clubtails) are restricted to stream habitats
- Many are habitat specialists within streams
- All demand high quality, well oxygenated waters
- May be useful surrogates for EPT in waters where those taxa are poorly represented.

Experimental Design

Surveys conducted on Little River along northern border of Fort Bragg and on Drowning Creek
Fall nymphal survey
Spring survey of adults





Little River Nymphal Results

- 334 nymphs of 10 species; of these, 6 were Gomphids
- Common Sanddragon, Progomphus obscurus, was most common species recovered
- Other Gomphids include Black-shouldered Spinyleg, Dromogomphus spinosus; Banner clubtail, Gomphus apomyius; Dragonhunter, Hagenius brevistylus; Piedmont clubtail G. parvidens; and Diminutive clubtail, G. diminutus





Species recovered on adult survey:

- Banner Clubtail, Gomphus apomyius
- Lancet Clubtail, G. exilis
- Sely's Sundragon, Helocordulia selysii
- Springtime Darner, Basiaeschna janata
- Swamp Darner, Epiaeschna heros
- Harlequin Darner, Gomphaeschna furcillata
- Blue Corporal, Ladona deplanata
- Blue Dasher, Pachydiplax longipennis
- Stream Cruiser, Didymops transversa

Banner Clubtail



Other Insects of Significance



Sparkling Jewelwing, *Calopteryx dimidiata*

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Appalachian Jewelwing, Calopteryx angustipennis

Dolania americana



The effect of prescribed burning on native bee communities in Longleaf pine (*Pinus palustris* Mill.) savannas in the North Carolina Sandhills



Megachile mucida Cresson USGS Bee Inventory and Monitoring Lab



Augochloropsis sumptuosa (Smith) USGS Bee Inventory and Monitoring Lab

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Treatment levels

• Newly burned



• 2 years post-fire



• 1 year post-fire



Control (>50 yrs. since burn)





- 4 replicates*4 treatments = 16 transects
- 15 bee bowls/ transect
- 7-9 hours

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Bee bowls \rightarrow



- 2,146 bees collected
- 106 species in 29 genera
- ~20 % of NC bee diversity recorded

	Individuals			Species		
1 3/6 8	2012	2013	Pooled	2012	2013	Pooled
0 years	301	428	729	52	53	82
1 year	290	252	572	47	44	72
2 years	251	357	608	47	43	67
Control	181	227	408	28	29	40

. Areas burned on a three year rotation will support greater bee diversity

and the greatest diversity will be in the first two years post-fire











Estimated species richness 2012



Effects of Pine Straw Harvest in Longleaf Savannas

-Pine straw is an important secondary revenue stream for many Sandhills landowners
-Impacts of raking poorly understood



Effects of Pine Straw Harvest in Longleaf Savannahs: Methods

-Conducted vegetation, soil-surface dwelling arthropod surveys, wood roach surveys, and other surveys on four burned/ hand raked and four burned not raked sites in each of up to three years:

*Sampling herbaceous plants with modified Carolina nested vegetation survey

*Sampling epigean arthropods with linear pitfalls -2017 Conducted manipulative experiment comparing pitfall traps in hand raked vs. unraked plots -2017 Conducted intensive sampling for effects of raking on herbaceous plants using image analysis

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Results

-Three year survey found little effect on epigeal arthropods greater than 3mm in length

-Small Diptera more abundant in unraked areas, small Hymenoptera and spiders more abundant in raked areas -Small plot manipulative study found no change in insect abundance following raking



Results









Results

-No change in plant species richness with raking in large plots
-Image analysis suggests some loss of blueberry, huckleberry, and damage to horsenettle, following raking
-No effect of raking on wood roach abundance
-Were not able to measure effects on Bachman's sparrow and herpetofauna



Reproductive Ecology of Three Endangered Plant Species on Fort Bragg

Michaux's Sumac Pollination



- Diverse community of generalist pollinators, mainly bees
- Most visitors pick up pollen on male flowers; fewer deliver to females
- "Best" pollinators likely Colletes nudus, Megachile texana
- Attracts high proportion of locally available visitors
- And yet, all-females sites never received pollen or set seed (~300 m from mixed site)

Michaux's Sumac Pollination—Wrapping these up



- Pollen limitation; success of within-site versus distant pollen
- Pollinator movement; how far apart is too far?
- Population genetic structure and paternity analysis
- Do we need to garden?

American Chaffseed Pollination and Population Structure

- Low visitation rates
- Mostly bumblebees and sweat bees
- Very little genetic diversity in populations across the post
- Dependence on recent burn to instigate flowering significant factor



Rough-leaved Loosestrife Pollination and Population Structure



- Extremely low visitation rates
- Currently completing analysis of population genetic structure

Reproductive Ecology of the Venus Flytrap

Who carried flytrap pollen?



Common visitors (in order of importance)



Green sweat bee (1)



Checkered beetle (2)



Longhorned beetle (3)



Soldier beetle (5)



Flower scarab (6)



Tumbling flower beetle (7)

Venus flytrap is pollen limited for seed set







Little overlap between flowervisitor and prey communities

87% can fly

20% can fly

Publications

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