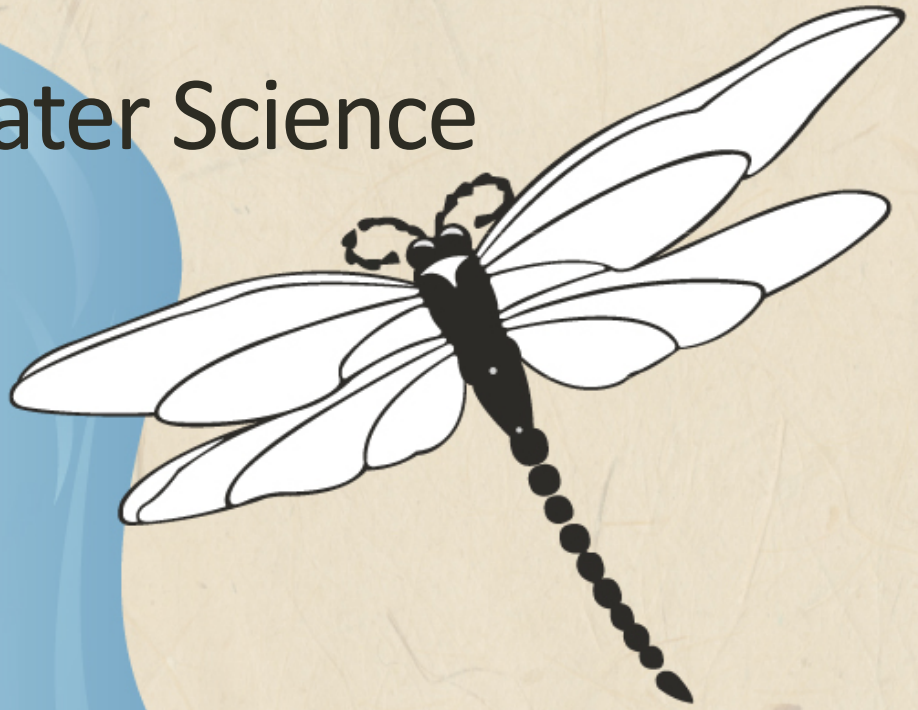


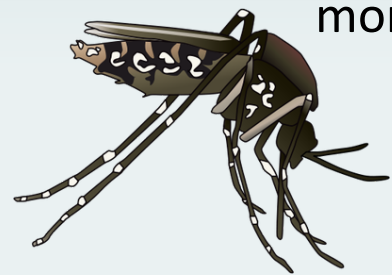
Update: Mosquito Surveillance

Phinizy Center for Water Science



Project Scope

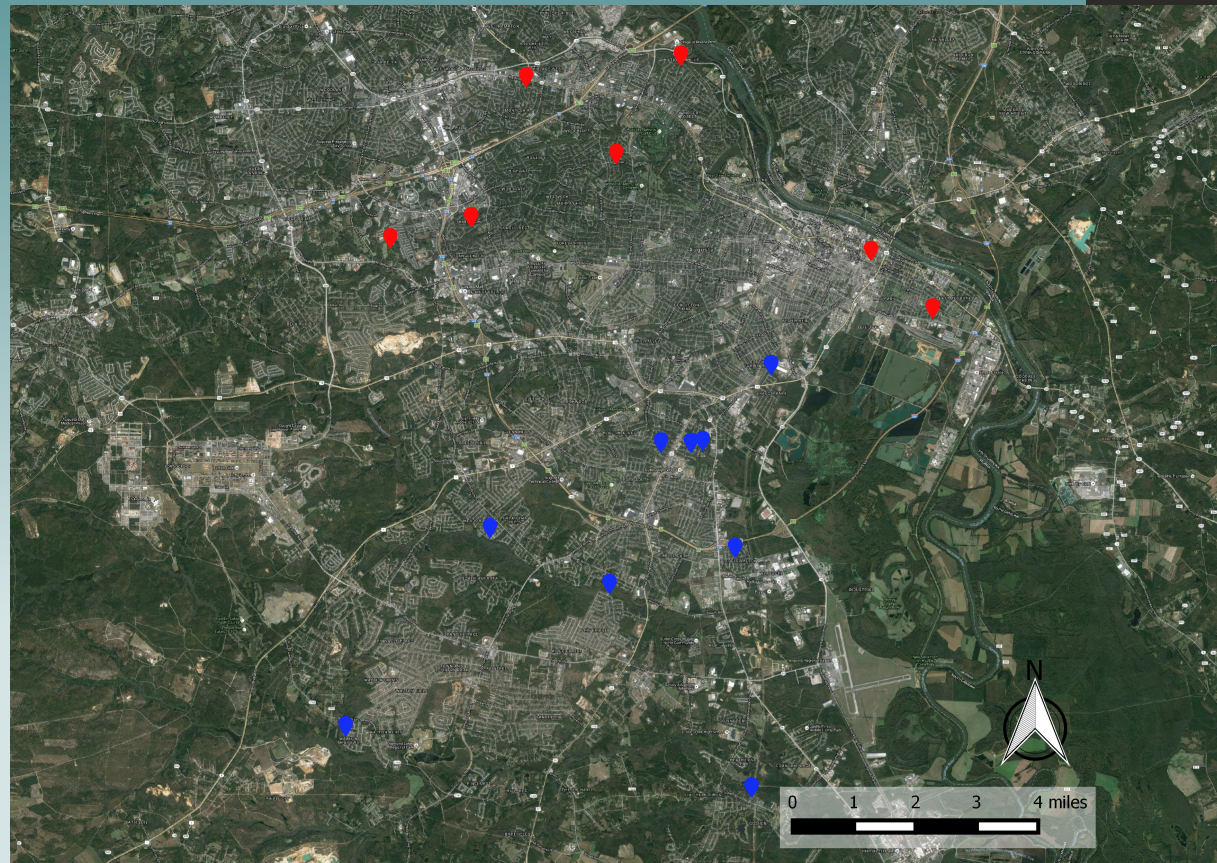
- Mosquito surveillance is conducted to support Richmond County Control Program
 - Must target problem species for effective control
 - Requires species identification and monitoring
- 14 sites selected county-wide in addition to the constructed wetland
 - Represent a variety of habitat types including swamps, rivers, and urban streams
- Each site is trapped every two weeks using a light trap and a gravid trap
 - Typical life cycle takes two weeks; can range from few days to a month



Richmond County

15 Sites

- North Route - 7
- South Route – 7
- Wetland - 1



- Wetland sampled weekly
- North/South Route sampled every 2 weeks

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Program Objectives

Current:

- Describe species assemblage at each site
- Compare relative abundance at each site
 - Support targeted control
- Conduct virus testing as early warning system
- Track activity Patterns
 - Time of year, temperature, rainfall, other environmental cues

Future:

- Identify factors influencing community composition
- Prevalence of arboviruses
 - Early warning system

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Results

(Jan 2014-Aug 2016)

30 species (56 in Ga)

188,777 Caught & Identified

Aedes

- *albopictus*
- *vexans*

Anopheles

- *crucians* complex
- *punctipennis* complex
- *quadrimaculatus*

Coquillettidia

- *perturbans*

Culex

- *coronator*
- *erraticus*
- *nigripalpus*
- *quinquefasciatus*
- *restuans*
- *salinarius*
- *territans*

Culiseta

- *inornata*
- *melanura*

Mansonia

- *titillans*

Ochlerotatus

- *atlanticus*
- *canadensis*
- *Infirmatus*
- *japonicus*
- *sollicitans*
- *triseriatus*

Orthopodomyia

- *signifera*

Genus	Number
Aedes	24,207
Anopheles	31,326
Coquillettidia	6,723
Culex	121,724
Culiseta	1,823
Male	820
Mansonia	3
Ochlerotatus	872
Orthopodomyia	50
Psorophora	587
Toxorhynchites	19
Unidentified	457
Uranotaenia	166
Total	188,777

Psorophora

- *ciliata*
- *columbiae*
- *ferox*
- *howardii*

Toxorhynchites

- *rutilus septentrionalis*

Uranotaenia

- *lowii*
- *sapphirina*

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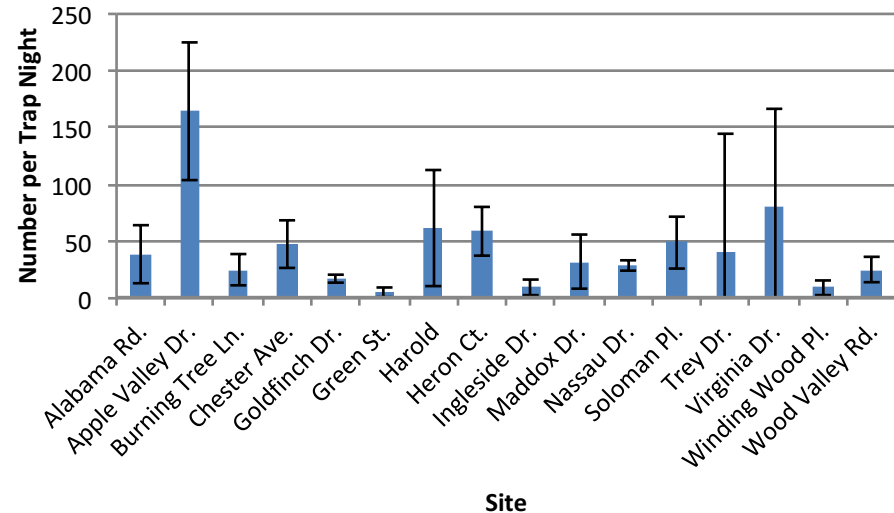
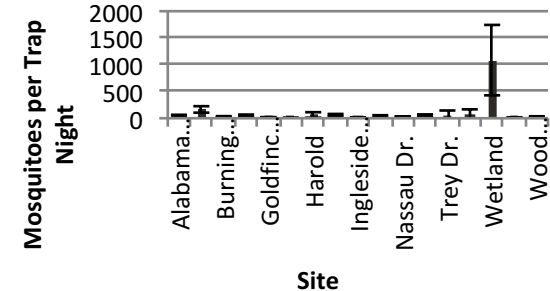
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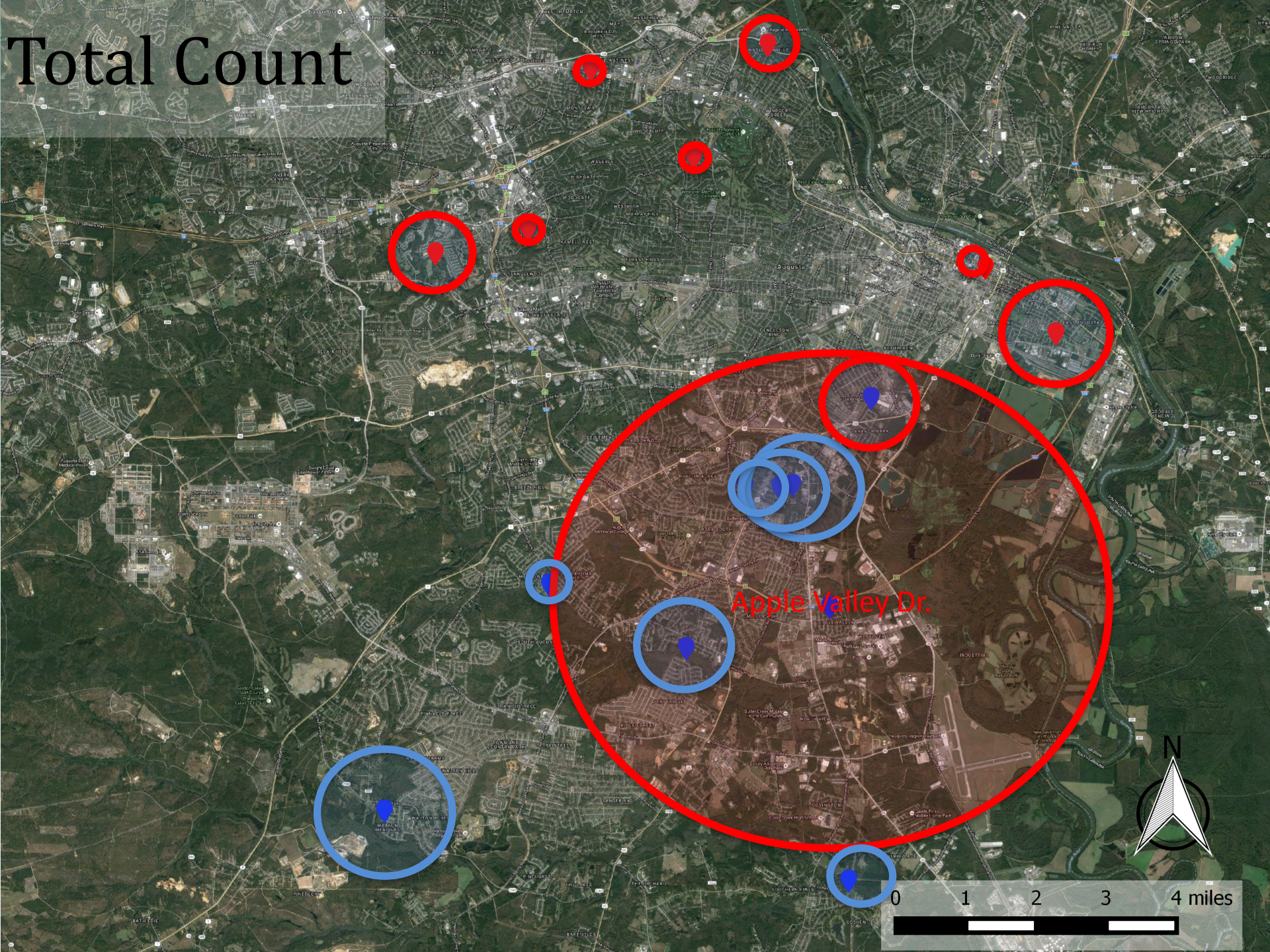
Results – Total Counts

Site	2014	2015	2016	Total
Alabama Rd.	898	1047	651	2596
Apple Valley Dr.	2445	8244	4438	15127
Burning Tree Ln.	501	840	344	1685
Chester Ave.	1154	1038	999	3191
Goldfinch Dr.	255	683	217	1155
Green St.	148	125	x	273
Harold	x	731	936	1667
Heron Ct.	894	1502	1551	3947
Ingleside Dr.	160	265	228	653
Maddox Dr.	290	1143	760	2193
Nassau Dr.	232	1239	x	1471
Soloman Pl.	491	1891	945	3327
Trey Dr.	449	1952	385	2786
Virginia Dr.	x	450	1716	2166
Wetland	34856	72139	35231	142226
Winding Wood Pl.	150	320	158	628
Wood Valley Rd.	447	921	352	1720
Total	43,370	94,530	48,911	186,811

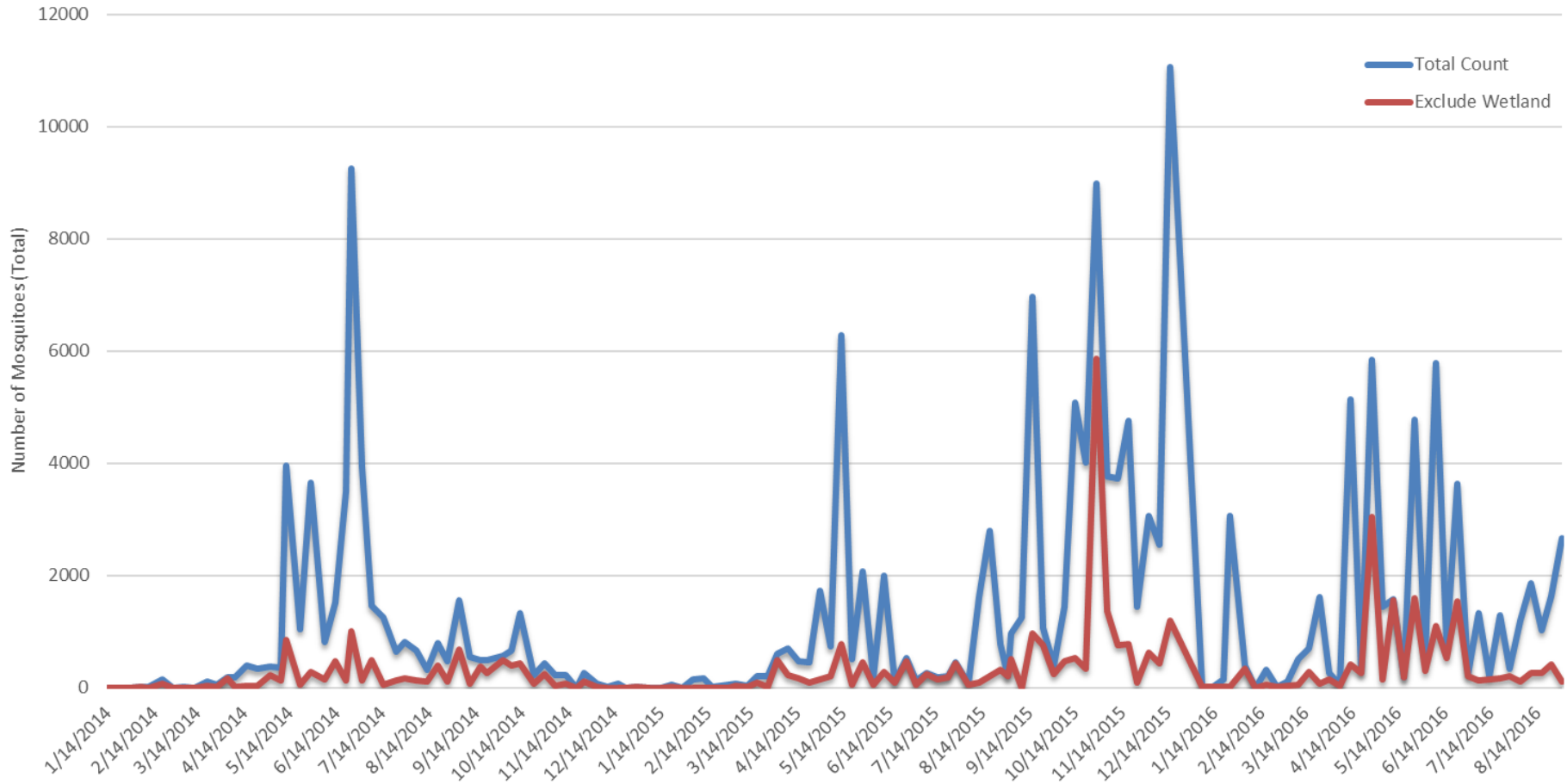


- Wetland: 1085 ± 657 mosquitoes/night

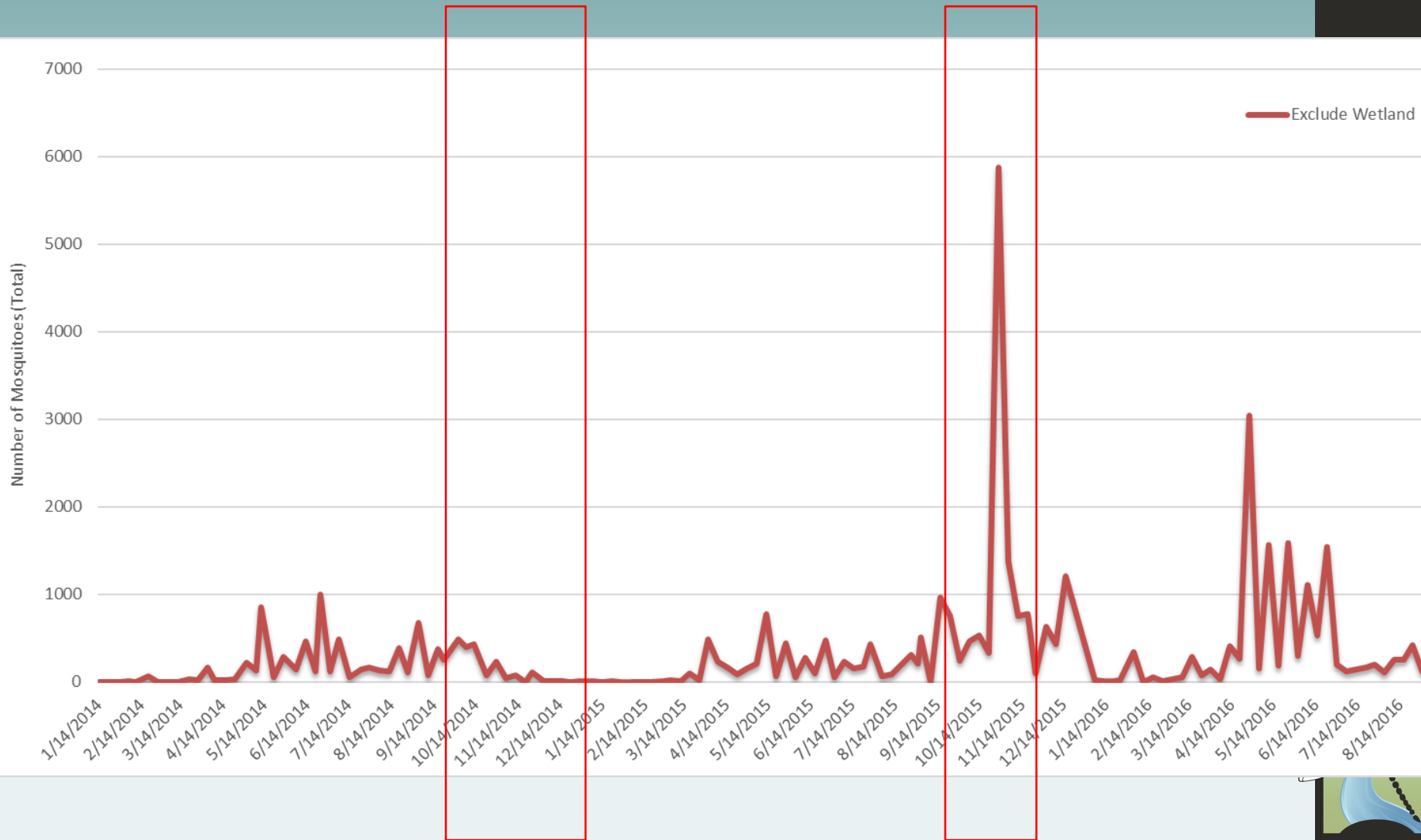
Total Count



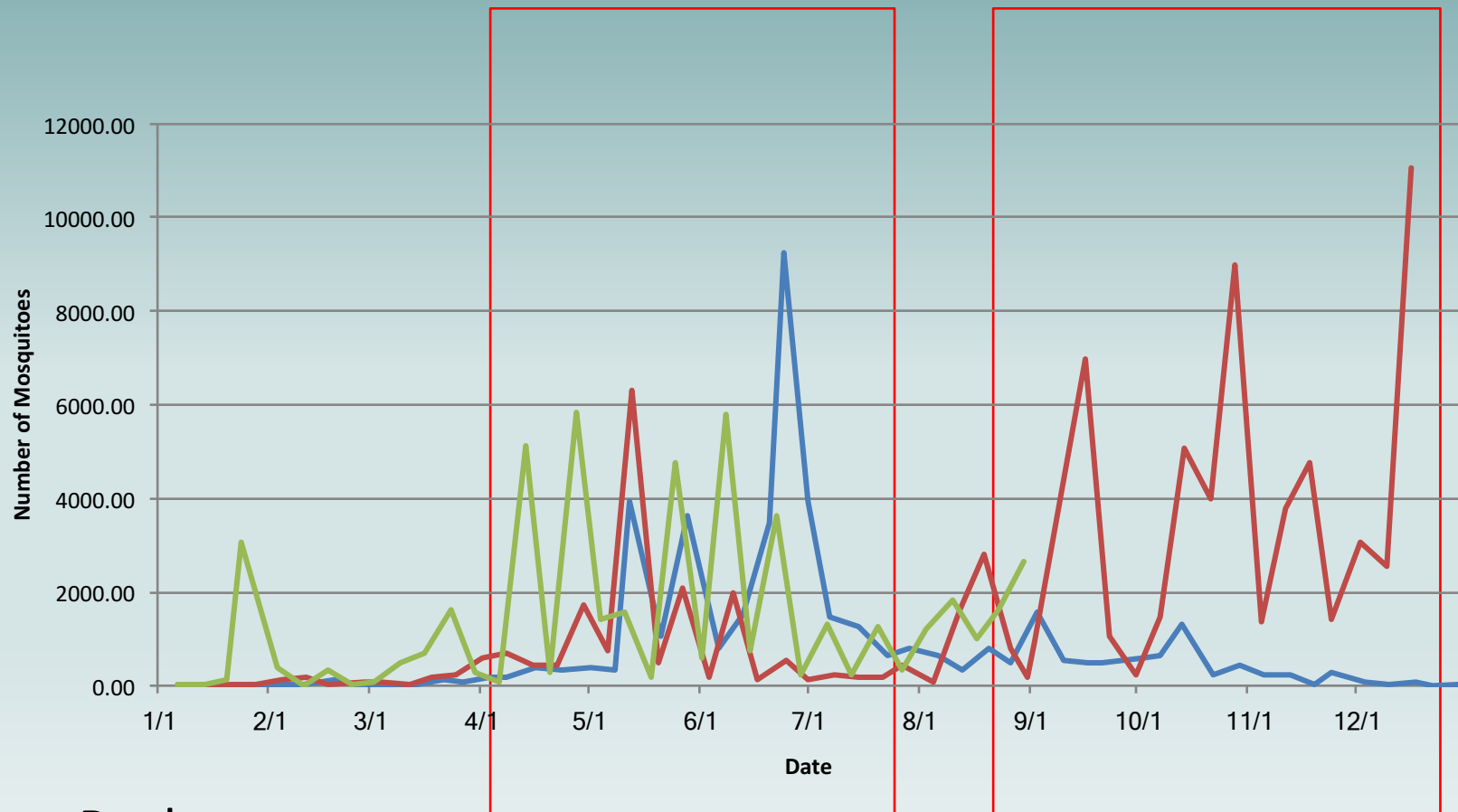
Seasonal Abundance



Seasonal Abundance



Seasonal Abundance



Peak

Primary: May-Jun

Secondary?: Sept-Oct

Blue line- 2014

Red Line- 2015

Green line- 2016

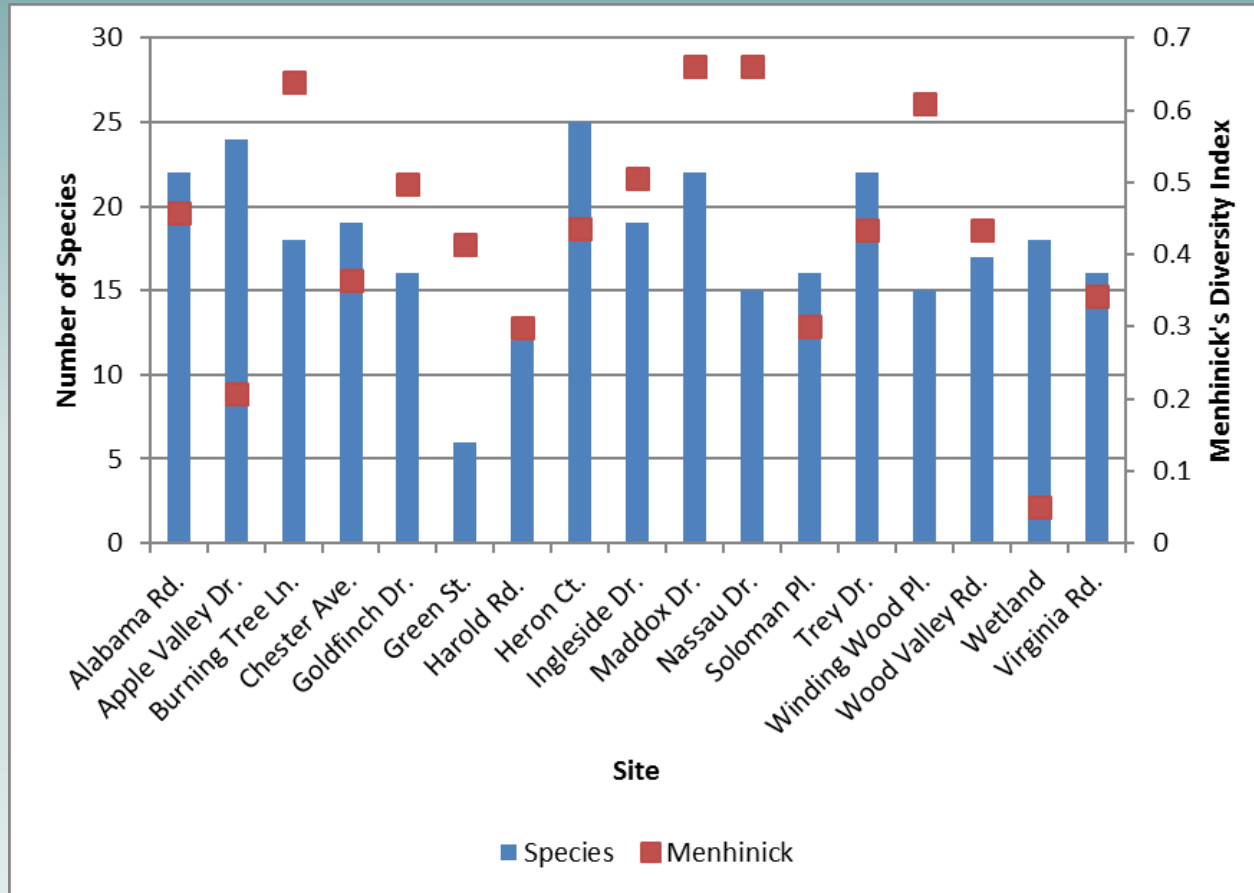
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Diversity – Species Richness



Number of Species

Min: 6 (Green St.)

Max: 25 (Heron Ct.)

Avg: 17.8

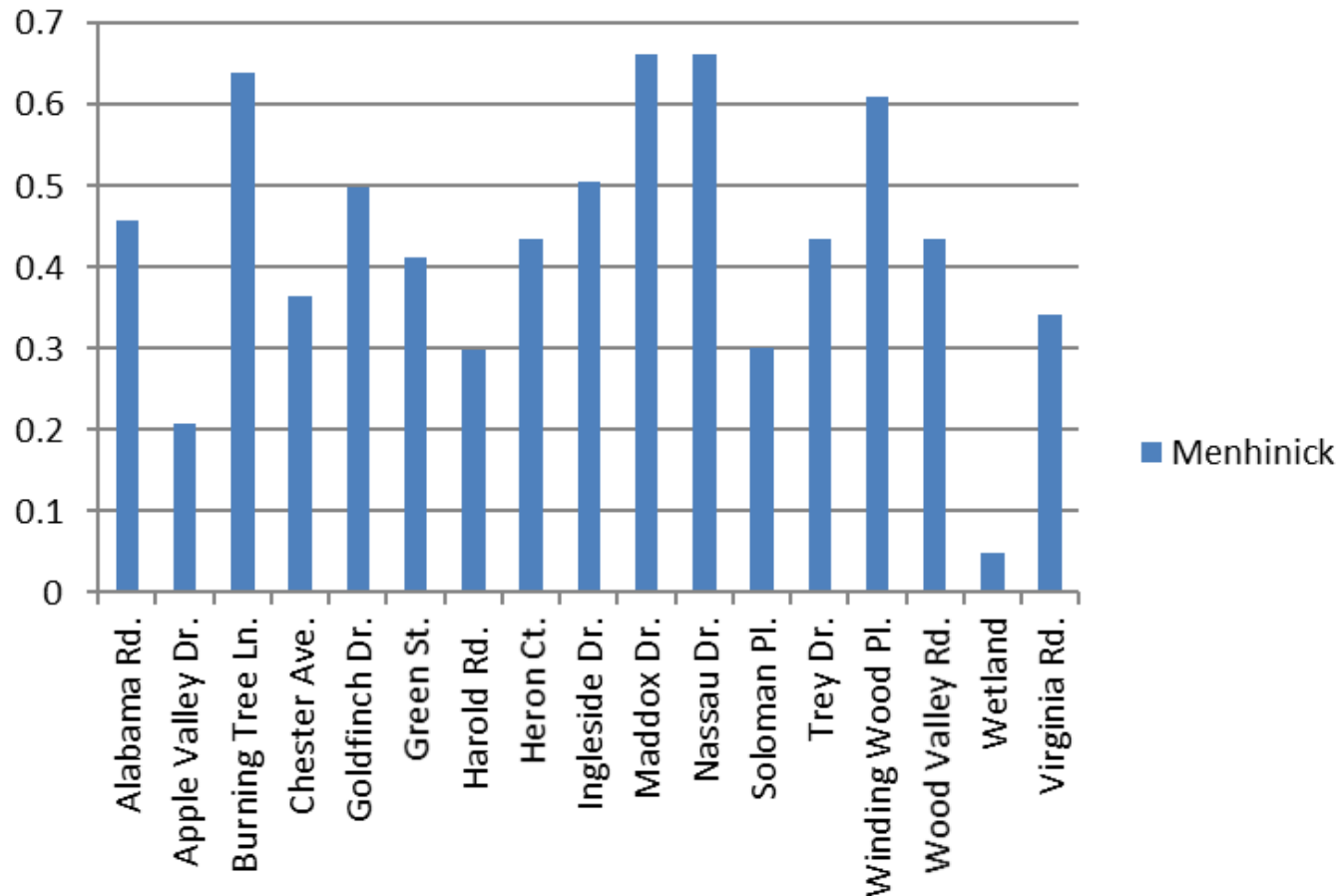
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Menhinick



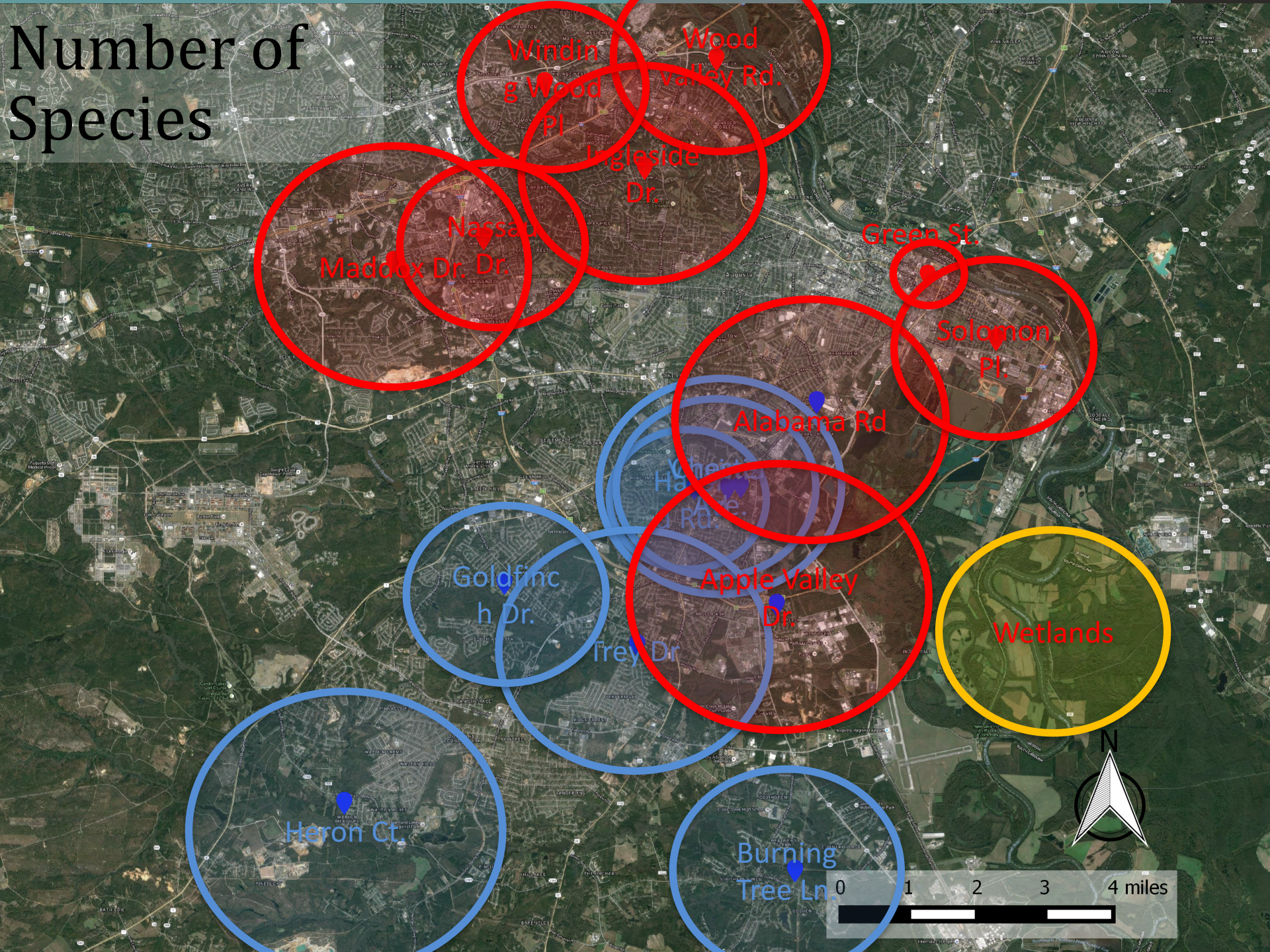
Menhinick's Diversity Index

- Corrects for high sample size

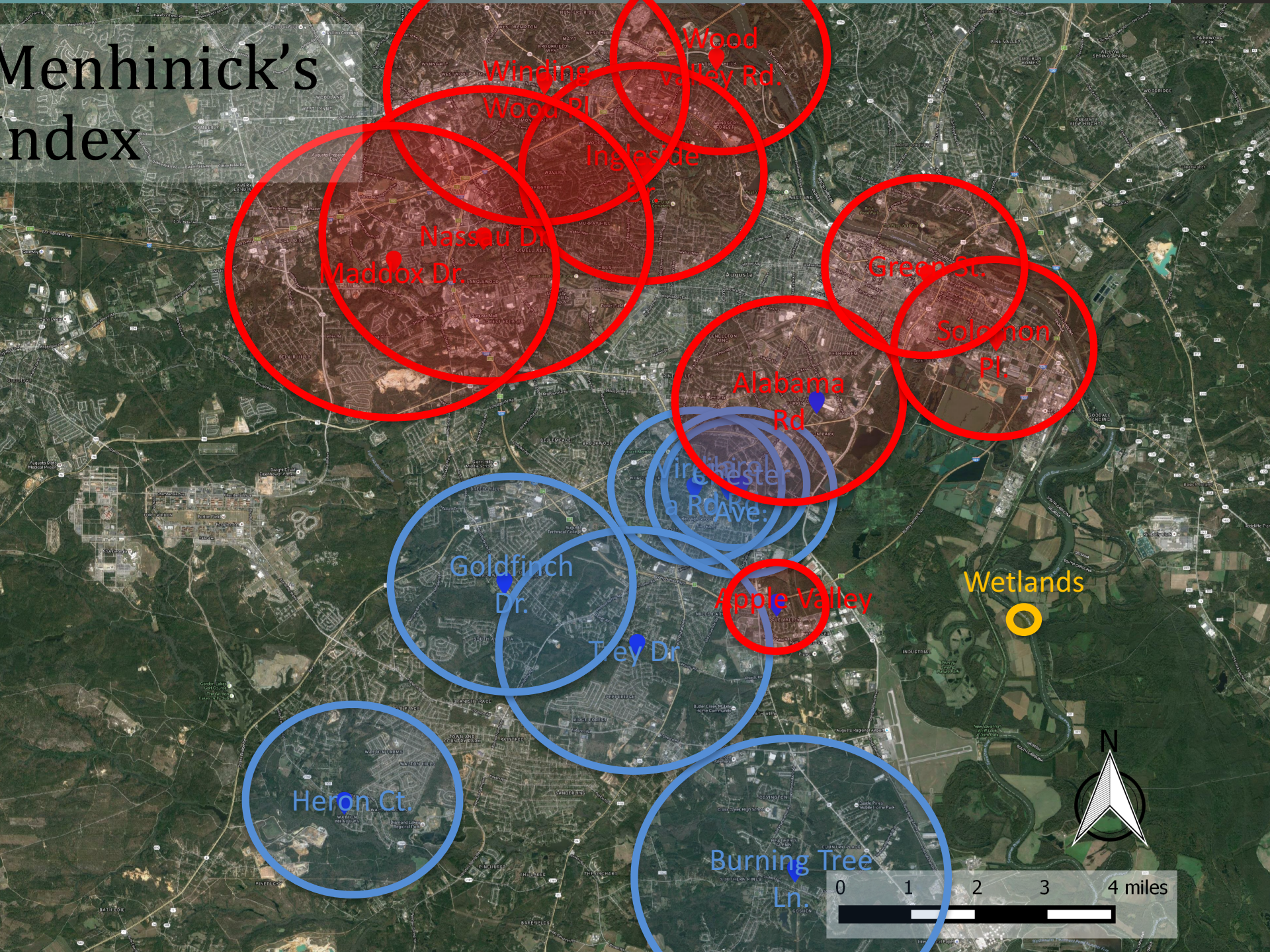
Min: 0.04 (Wetlands)

Max: 0.66 (Nassau & Maddox)

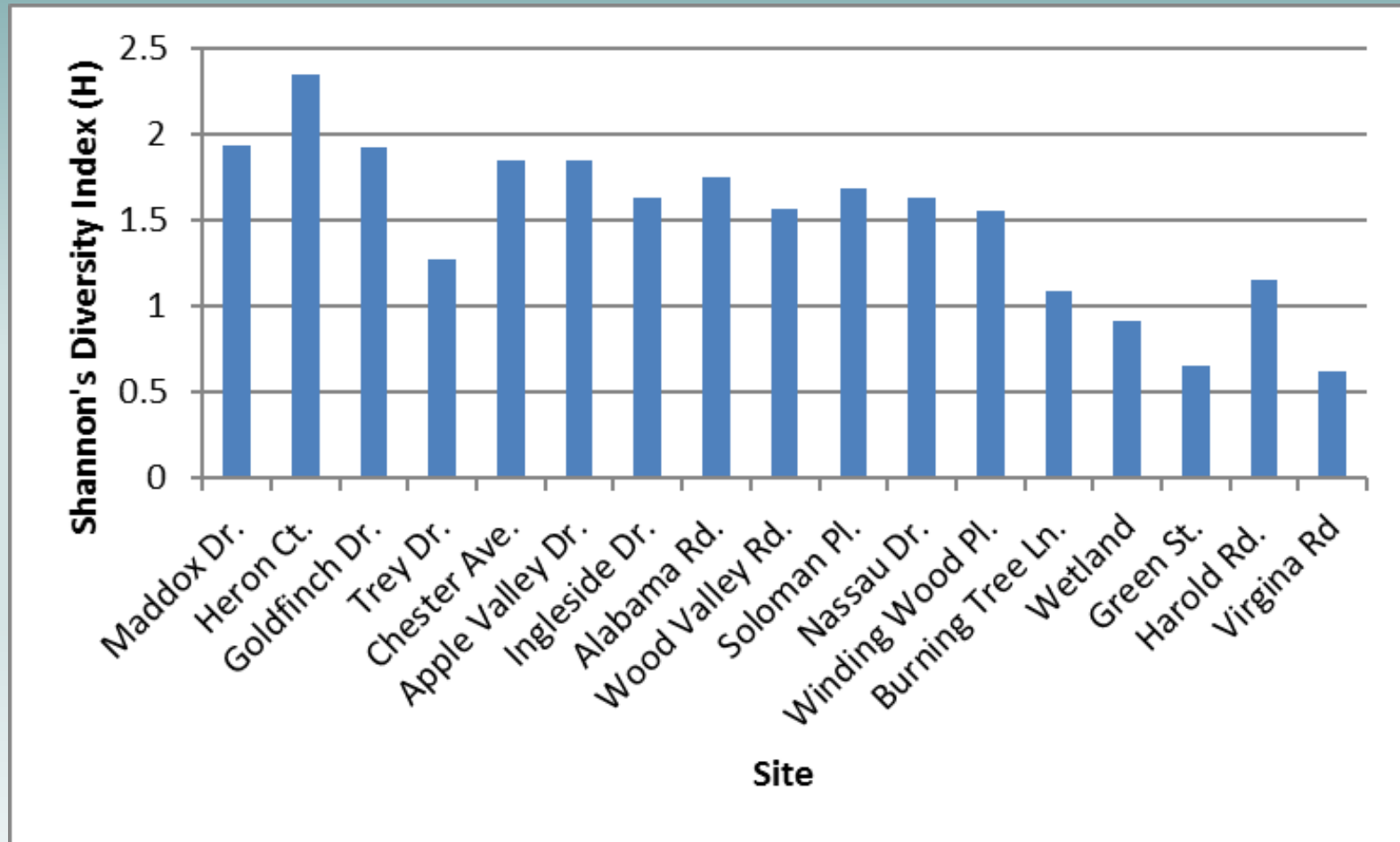
Number of Species



Menhinick's Index



Diversity- Shannon Wiener



2014-2016

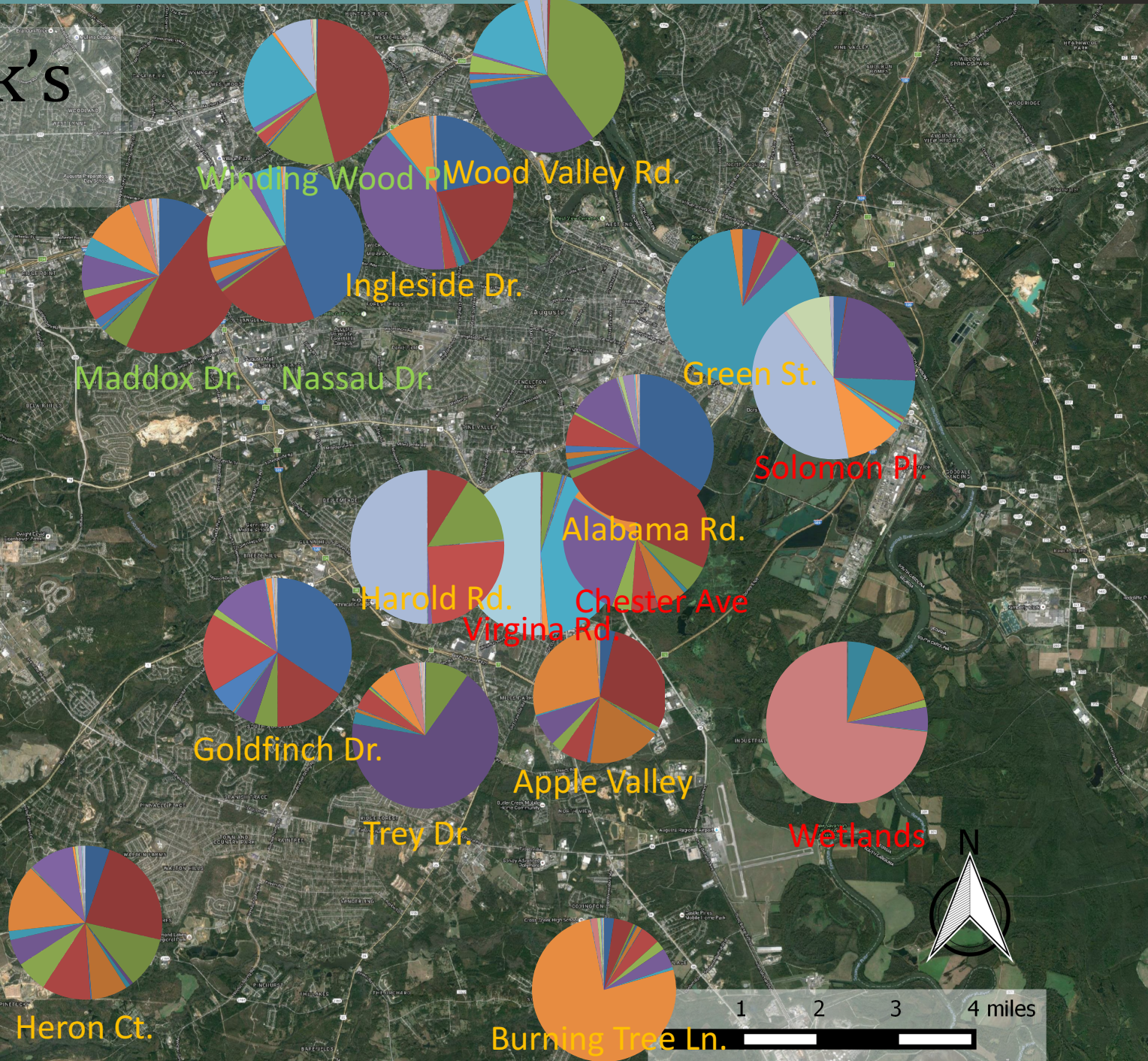
PHINIZY

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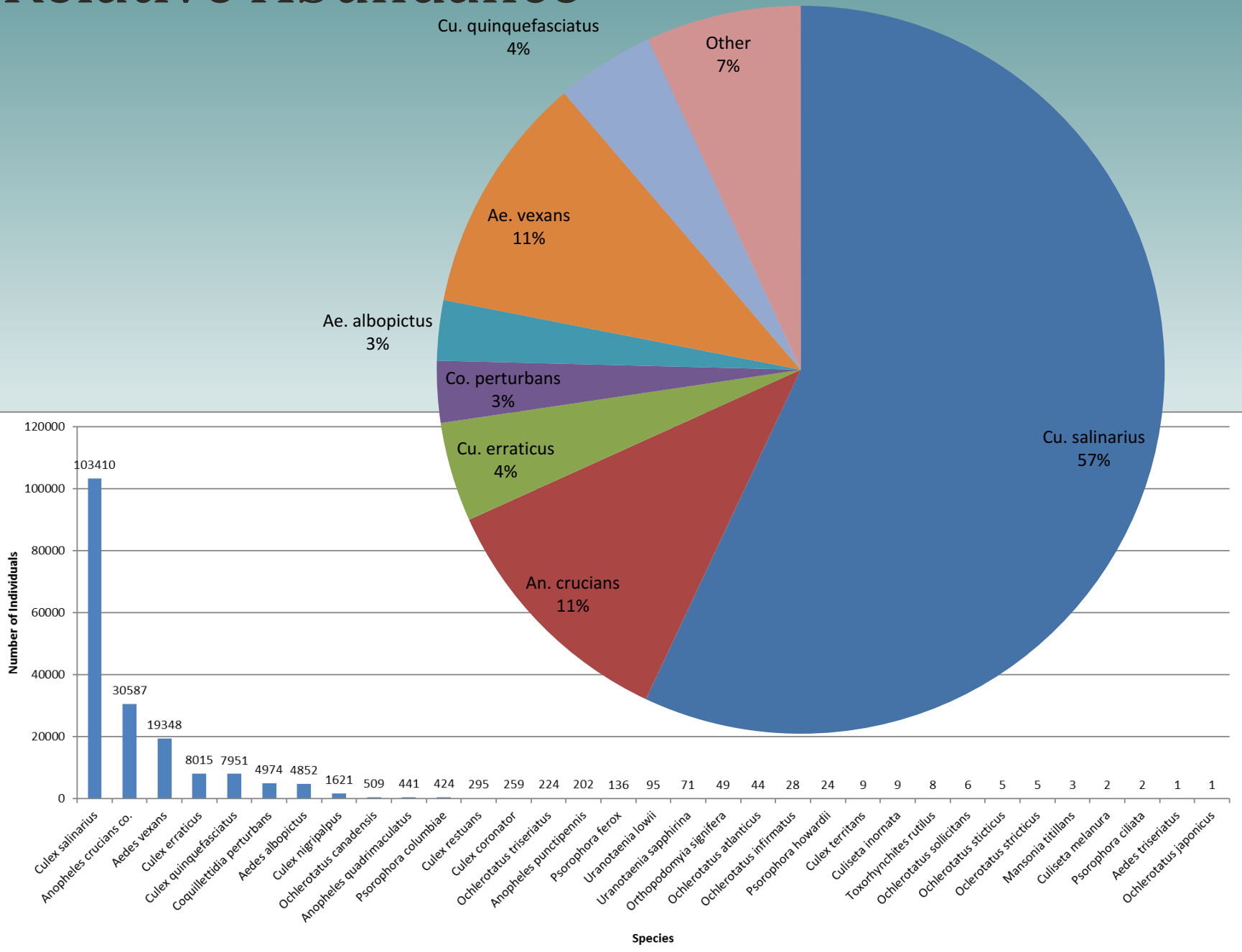


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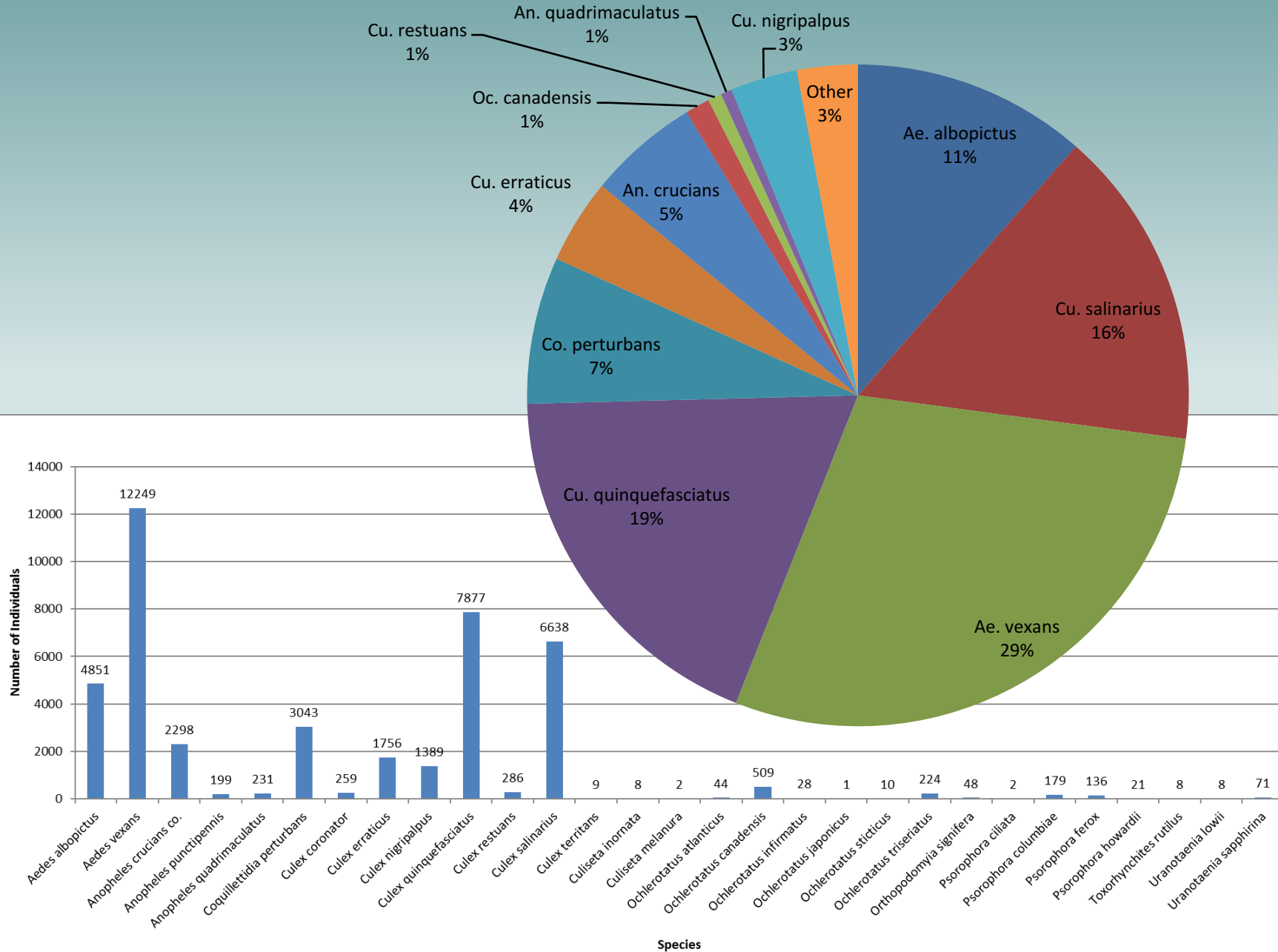
Menhinick's Index



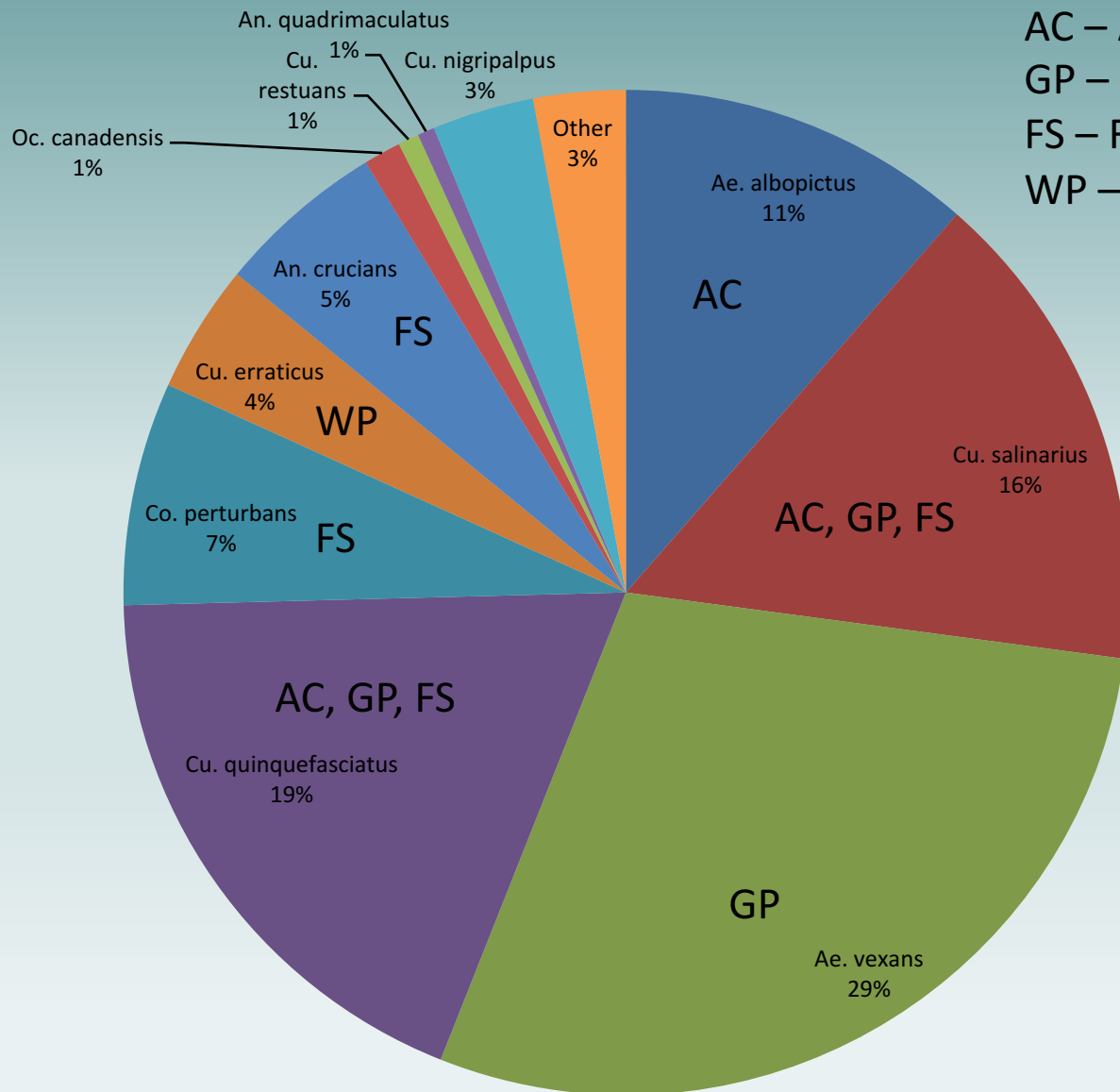
Relative Abundance



Relative Abundance – Exclude Wetland



Relative Abundance – Exclude Wetland



AC – Artificial Container
GP – Grassland Pool
FS – Freshwater Swamp
WP – Woodland Pool

PHINIZY

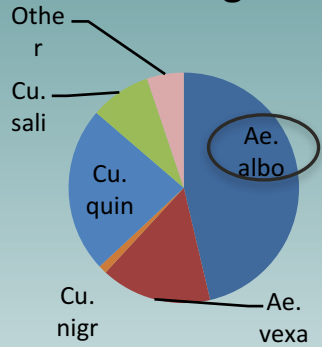
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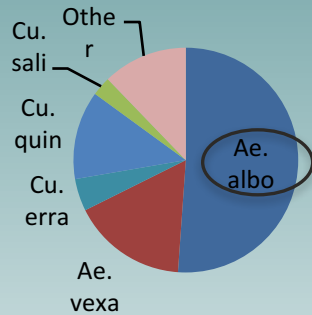
SWAMP
&
NATURE PARK

Top 5

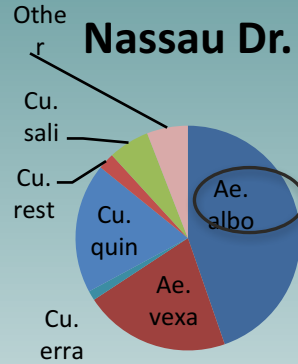
Winding Wood



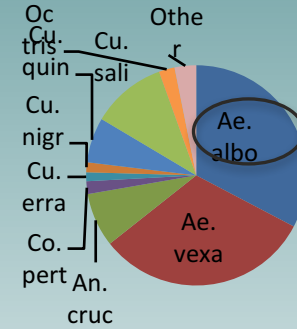
Wood Valley



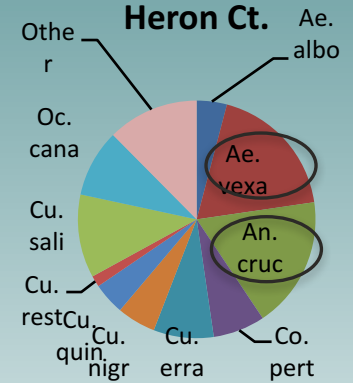
Nassau Dr.



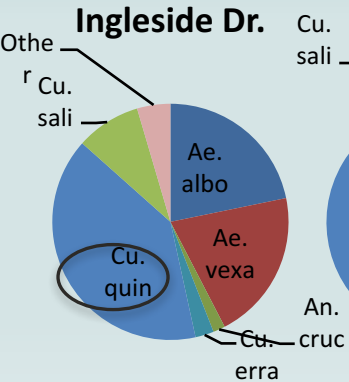
Alabama Rd.



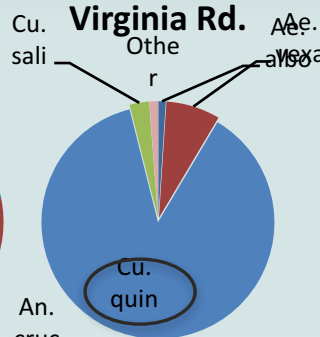
Heron Ct.



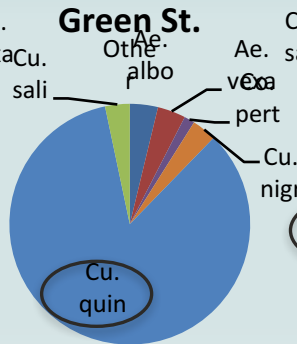
Ingleside Dr.



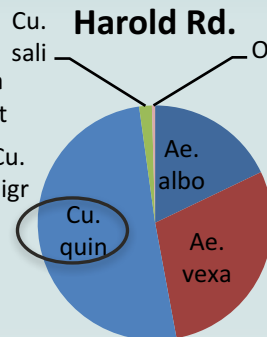
Virginia Rd.



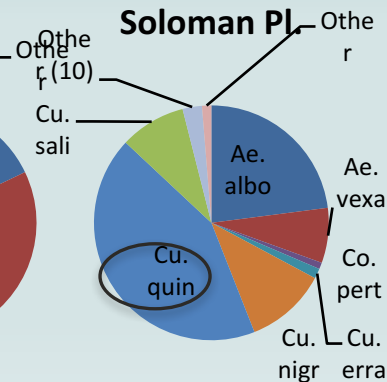
Green St.



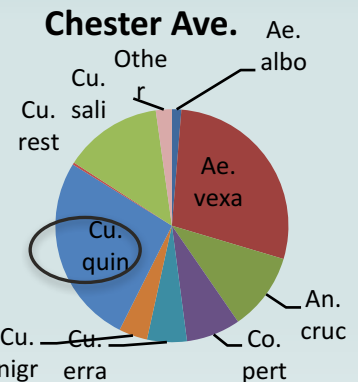
Harold Rd.



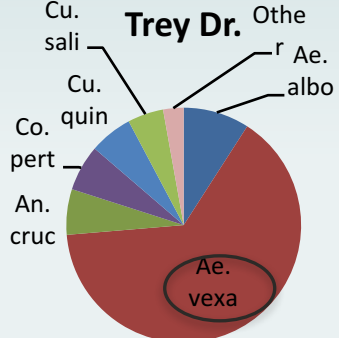
Soloman Pl.



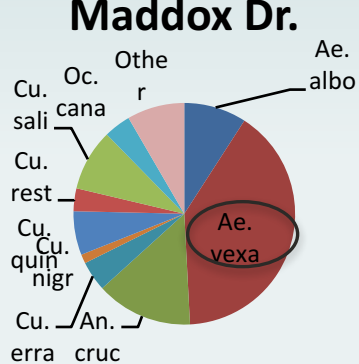
Chester Ave.



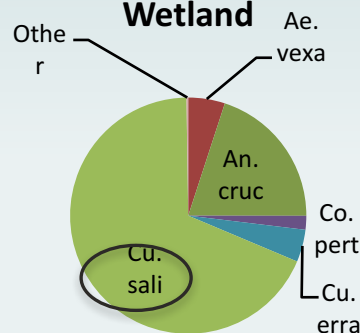
Trey Dr.



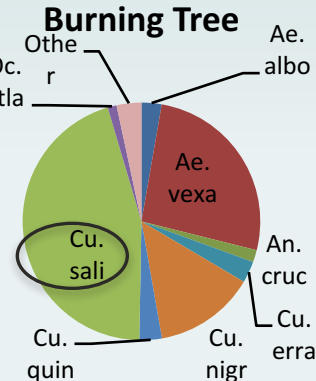
Maddox Dr.



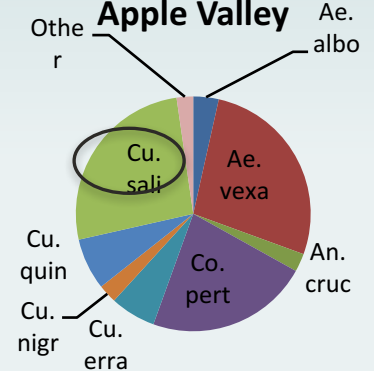
Wetland



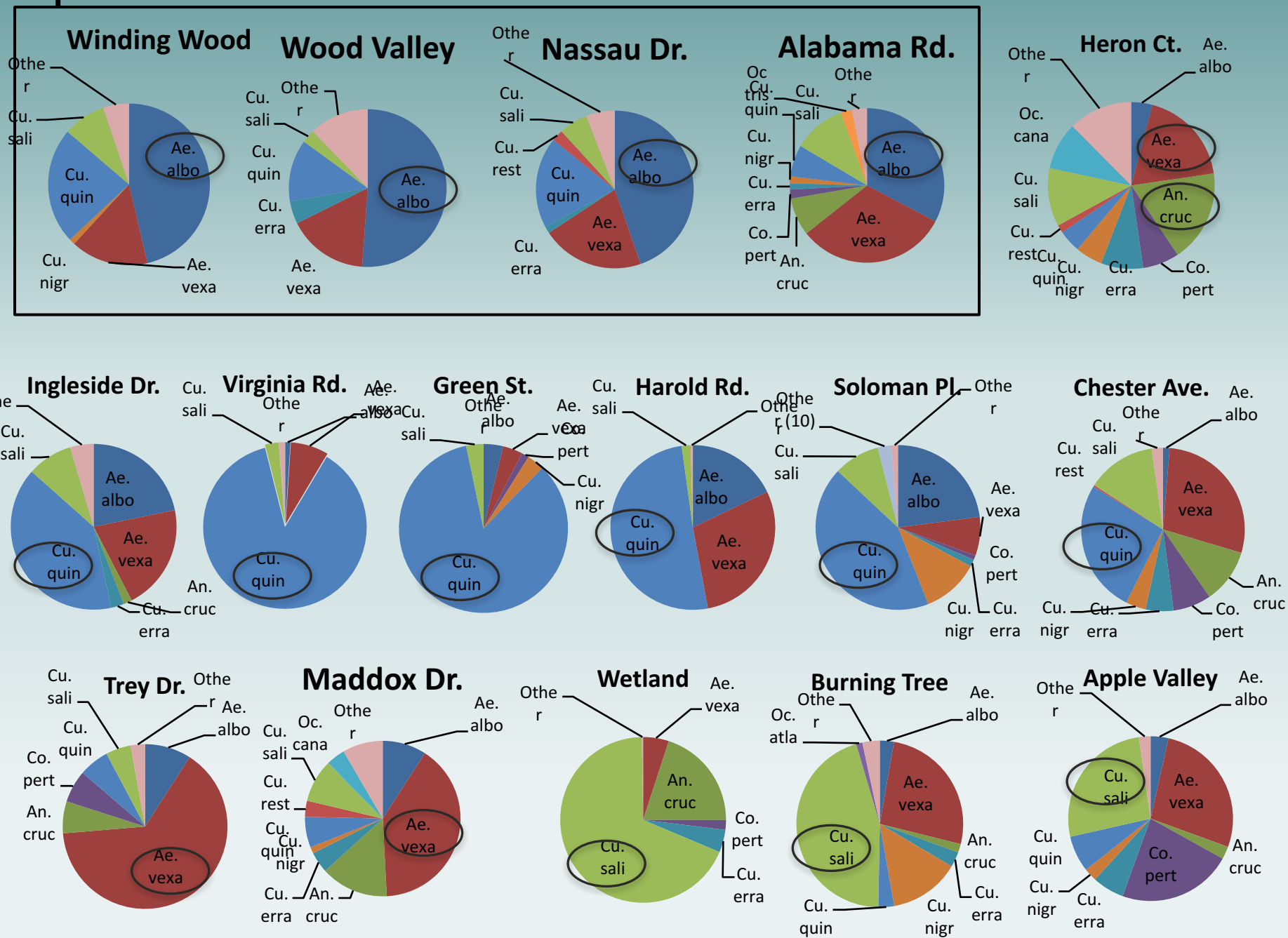
Burning Tree



Apple Valley

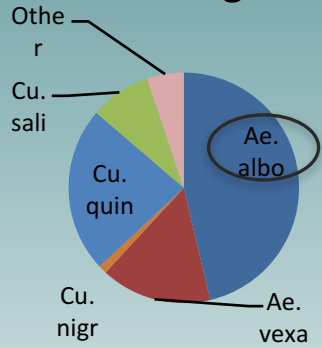


Top 5

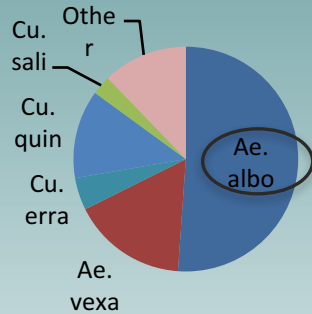


Top 5

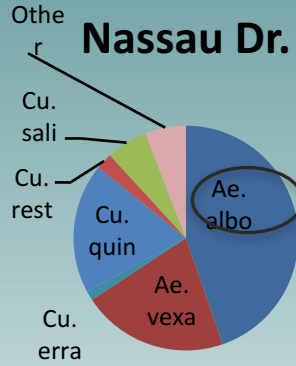
Winding Wood



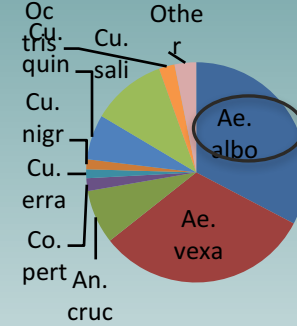
Wood Valley



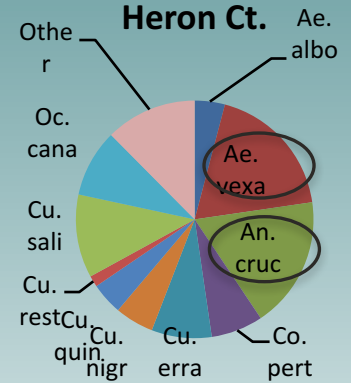
Nassau Dr.



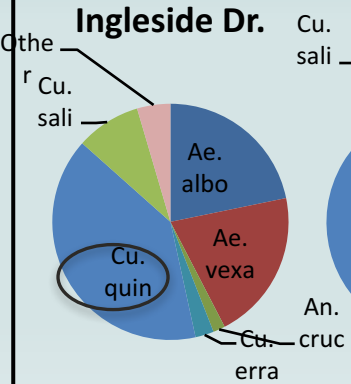
Alabama Rd.



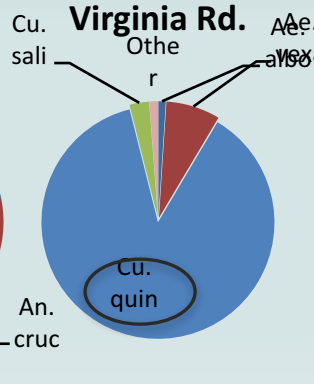
Heron Ct.



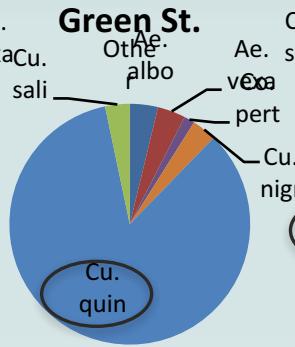
Ingleside Dr.



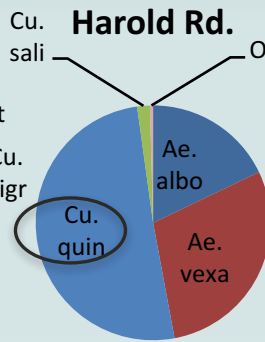
Virginia Rd.



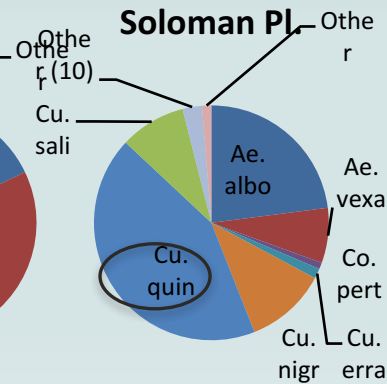
Green St.



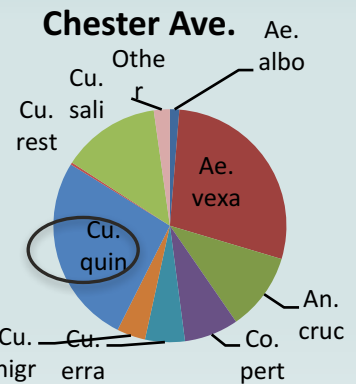
Harold Rd.



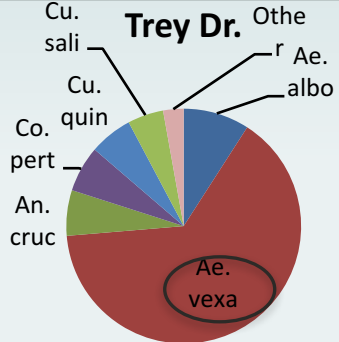
Soloman Pl.



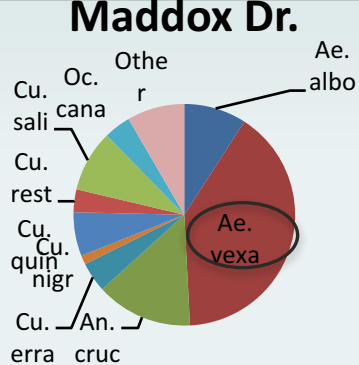
Chester Ave.



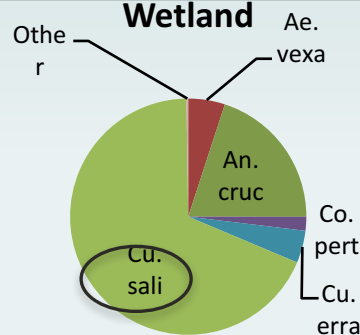
Trey Dr.



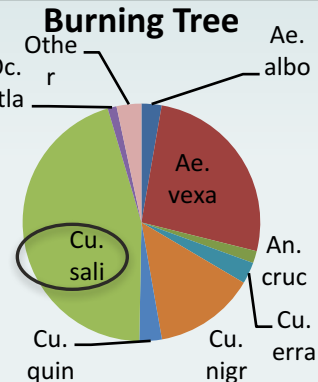
Maddox Dr.



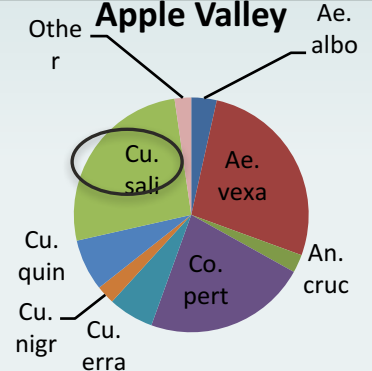
Wetland



Burning Tree

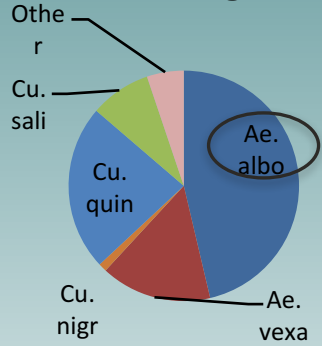


Apple Valley

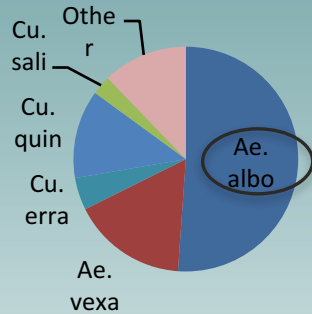


Top 5

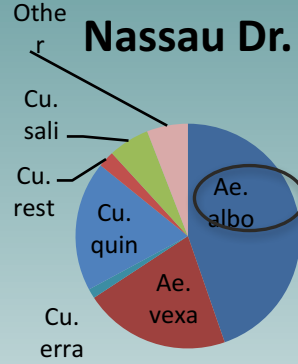
Winding Wood



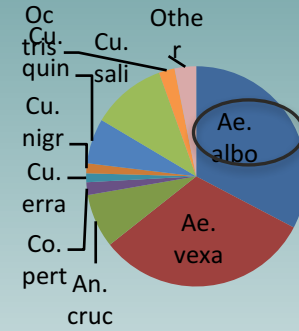
Wood Valley



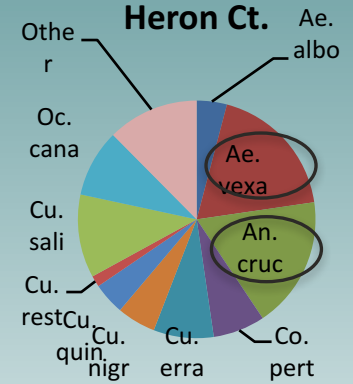
Nassau Dr.



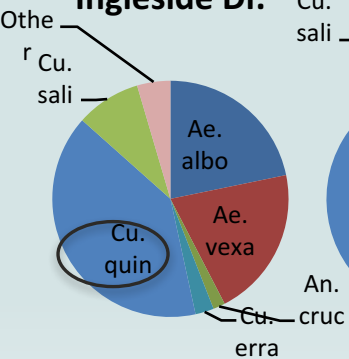
Alabama Rd.



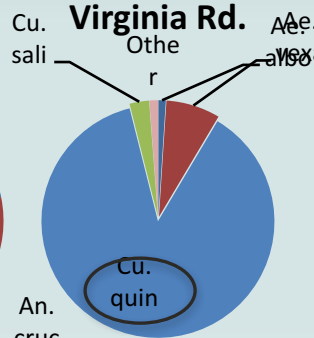
Heron Ct.



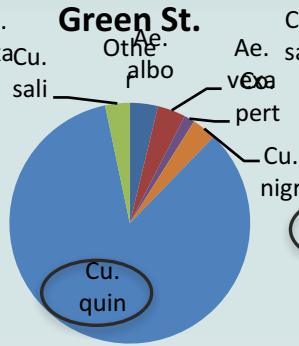
Ingleside Dr.



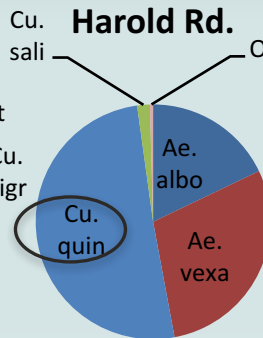
Virginia Rd.



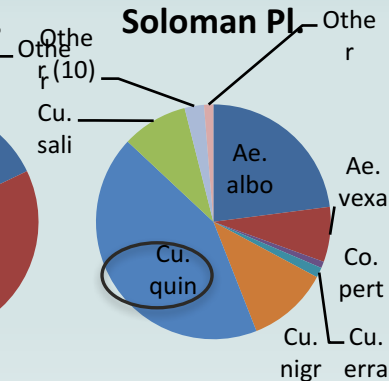
Green St.



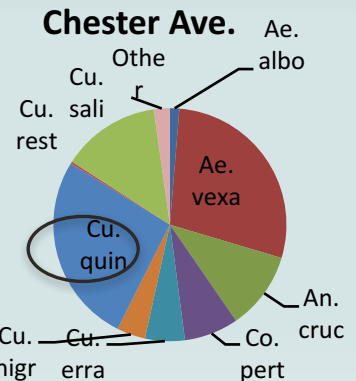
Harold Rd.



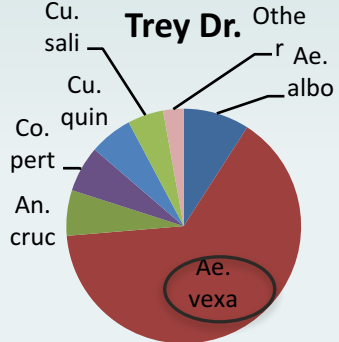
Soloman Pl.



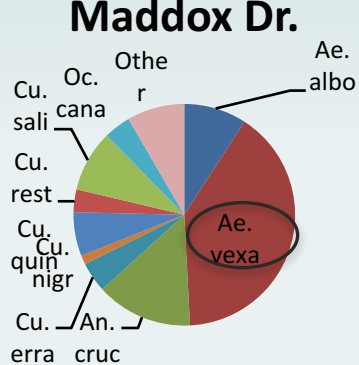
Chester Ave.



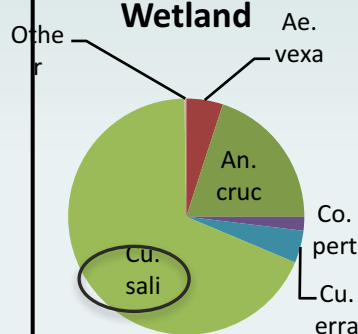
Trey Dr.



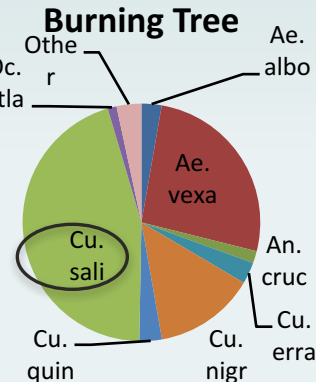
Maddox Dr.



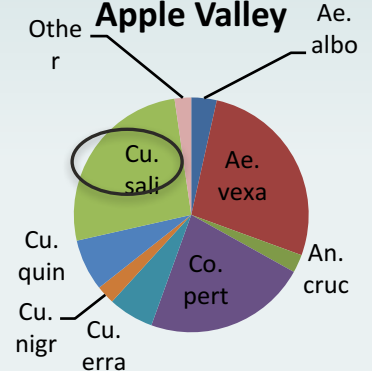
Wetland



Burning Tree

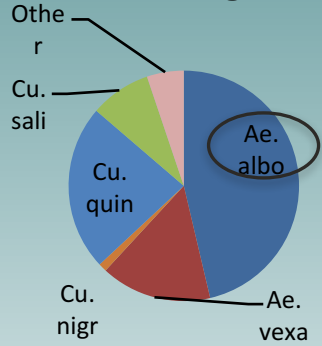


Apple Valley

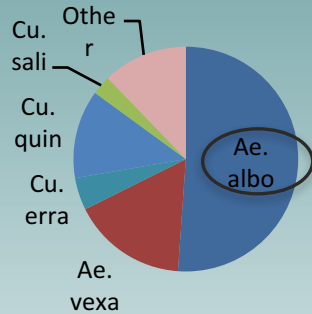


Top 5

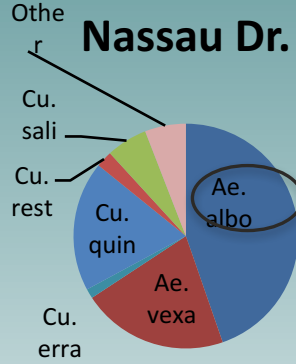
Winding Wood



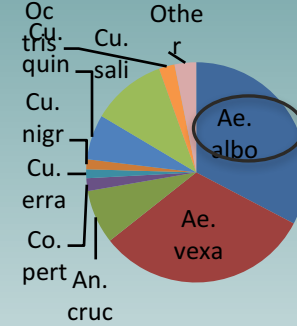
Wood Valley



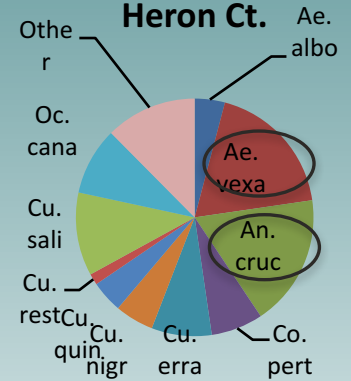
Nassau Dr.



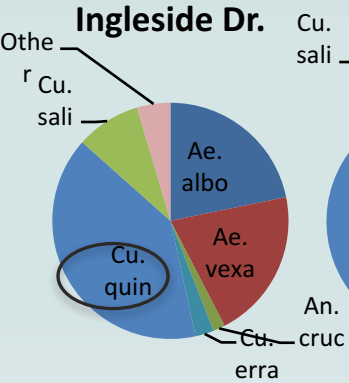
Alabama Rd.



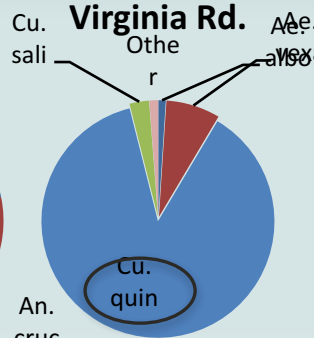
Heron Ct.



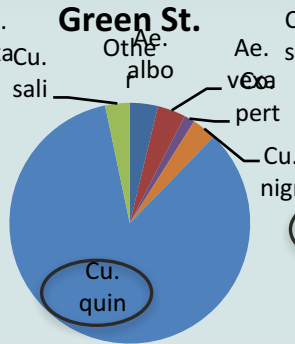
Ingleside Dr.



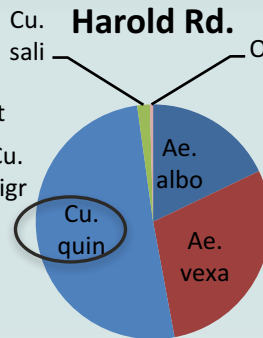
Virginia Rd.



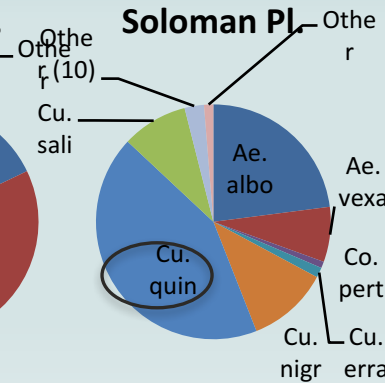
Green St.



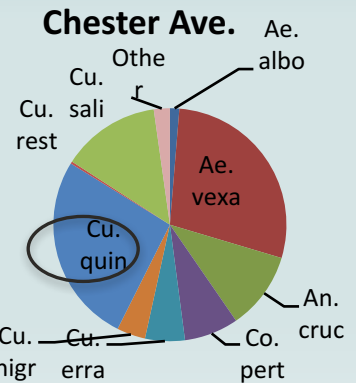
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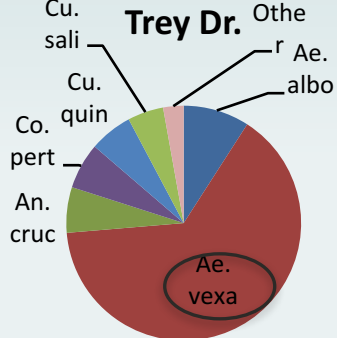
Soloman Pl.



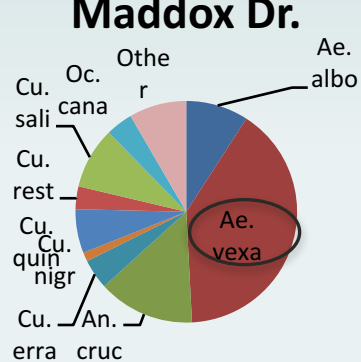
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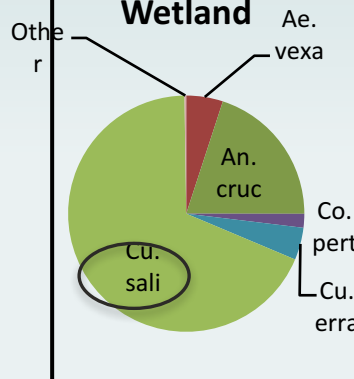
Trey Dr.



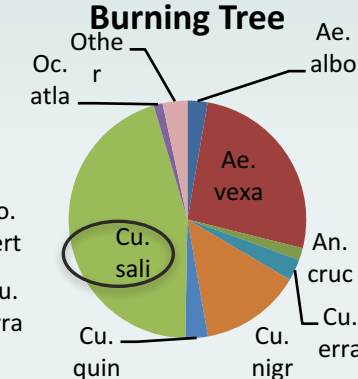
Maddox Dr.



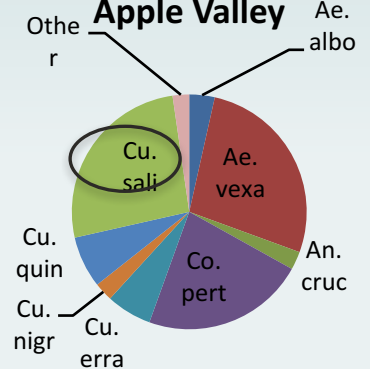
Wetland



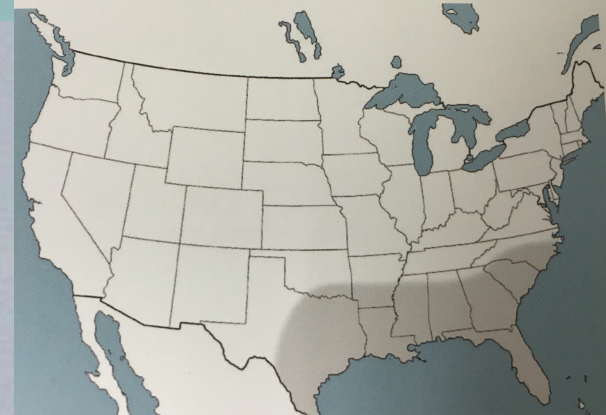
Burning Tree



Apple Valley



Uranotaenia lowii



- Feeds on frogs and toads
- Found in the southeastern gulf and Atlantic states but is most common in the southernmost part of its range, particularly in Florida and southern Louisiana

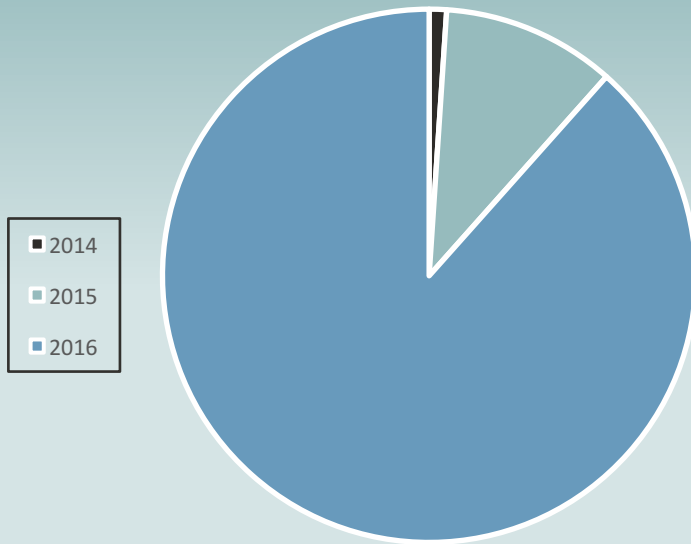
PHINIZY

CENTER FOR
WATER
SCIENCES



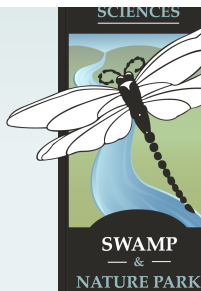
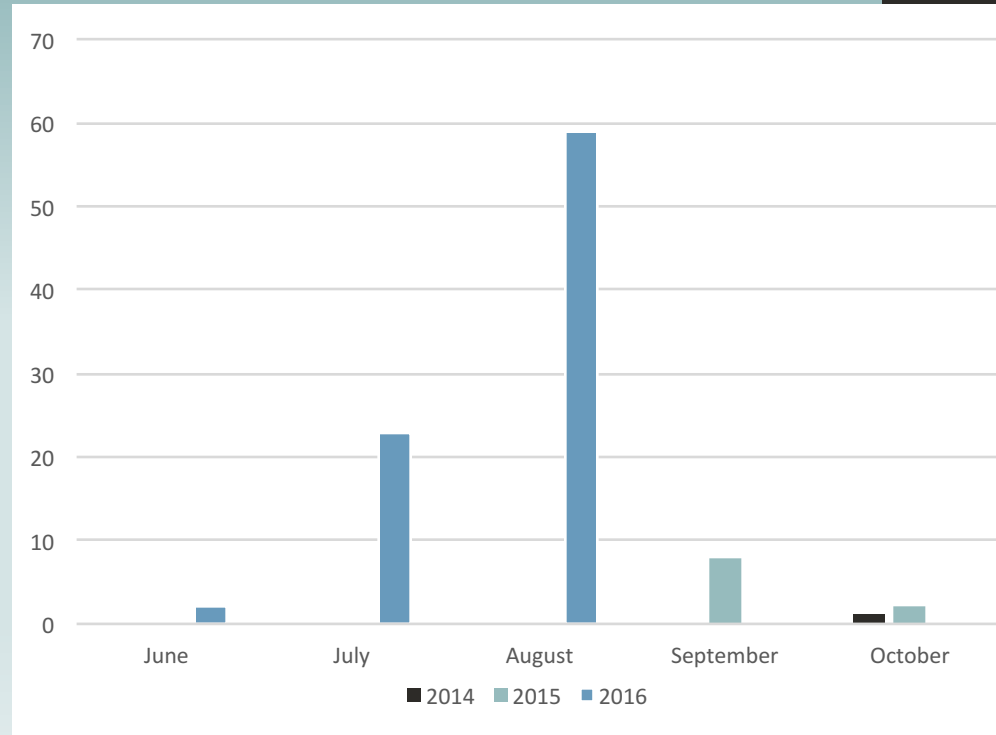
SWAMP
— & —
NATURE PARK

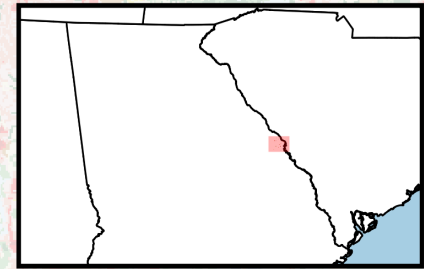
Uranotaenia lowii yearly abundance



Year	Abundance
2014	1
2015	10
2016	84

Uranotaenia lowii Monthly Abundance

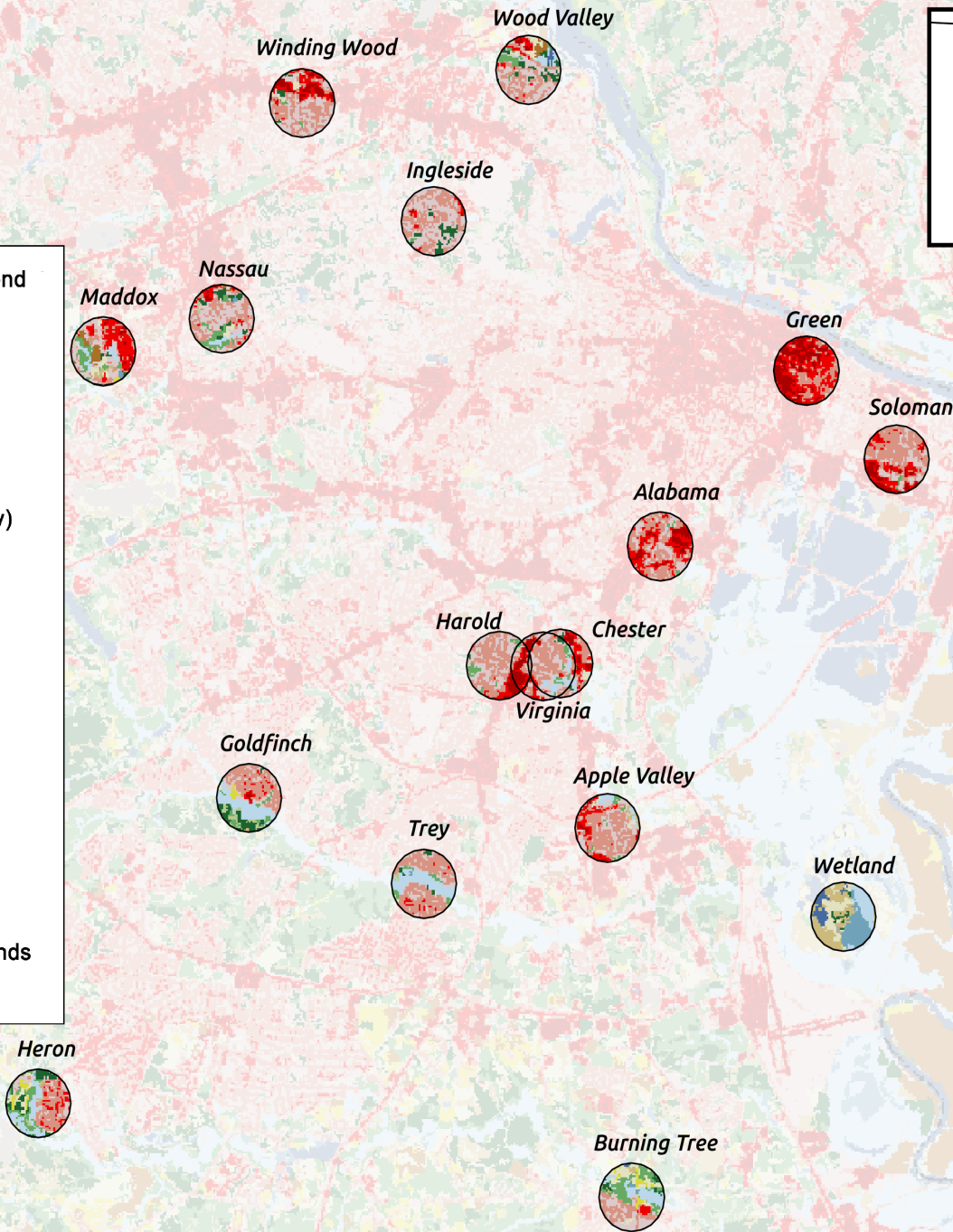




NLCD Land Cover Classification Legend

- 11 Open Water
- 12 Perennial Ice/ Snow
- 21 Developed, Open Space
- 22 Developed, Low Intensity
- 23 Developed, Medium Intensity
- 24 Developed, High Intensity
- 31 Barren Land (Rock/Sand/Clay)
- 41 Deciduous Forest
- 42 Evergreen Forest
- 43 Mixed Forest
- 51 Dwarf Scrub*
- 52 Shrub/Scrub
- 71 Grassland/Herbaceous
- 72 Sedge/Herbaceous*
- 73 Lichens*
- 74 Moss*
- 81 Pasture/Hay
- 82 Cultivated Crops
- 90 Woody Wetlands
- 95 Emergent Herbaceous Wetlands

* Alaska only

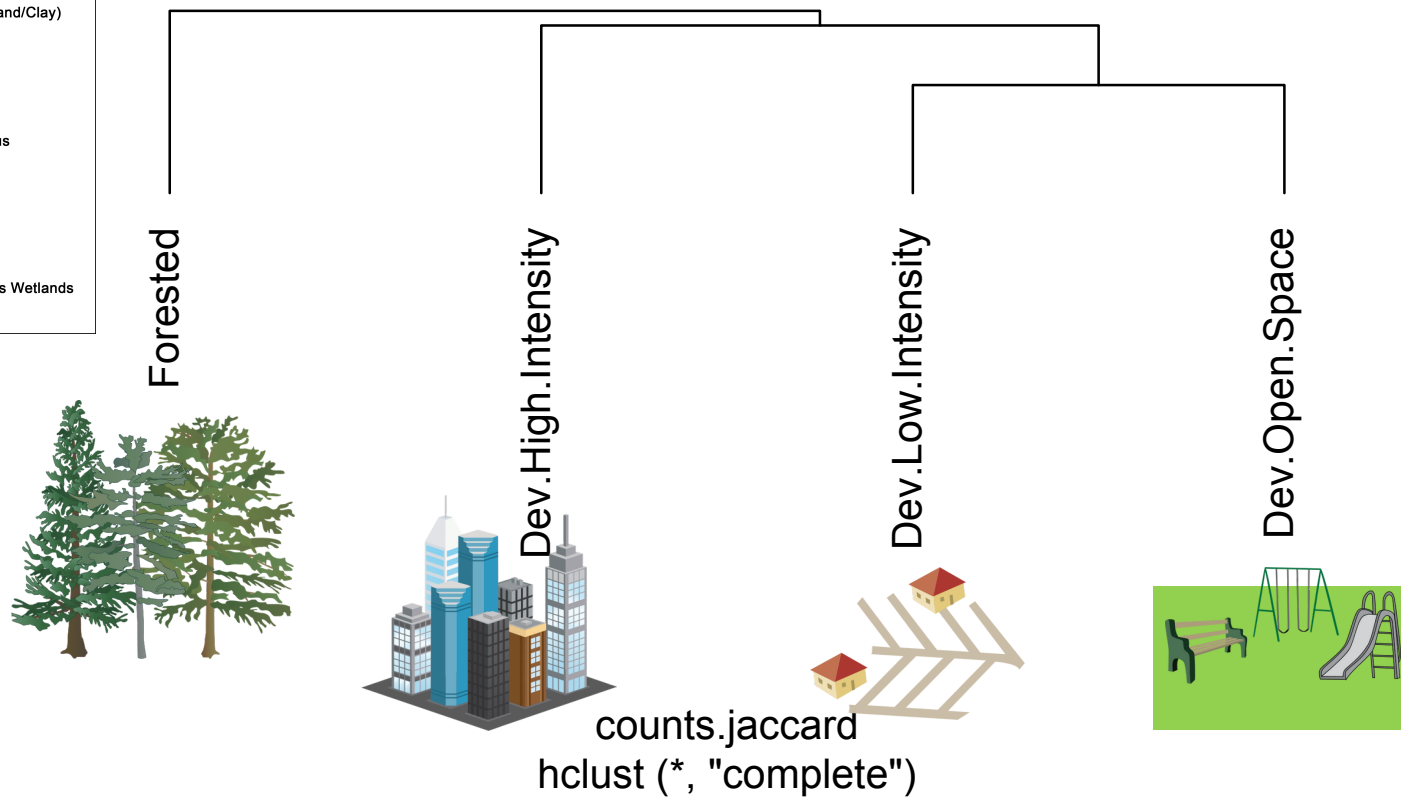


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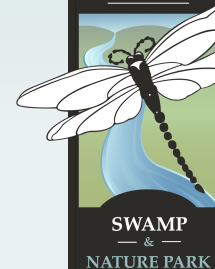
Land Use Clustered by Jaccard Similarity



JS(DLI,DHI)= 0.858
JS(FOR,DHI)=0.989*
JS(FOR,DLI)=0.936

JS(DOS,DHI)=0.909
JS(DOS,DLI)=.5863
JS(FOR,DOS)=0.911

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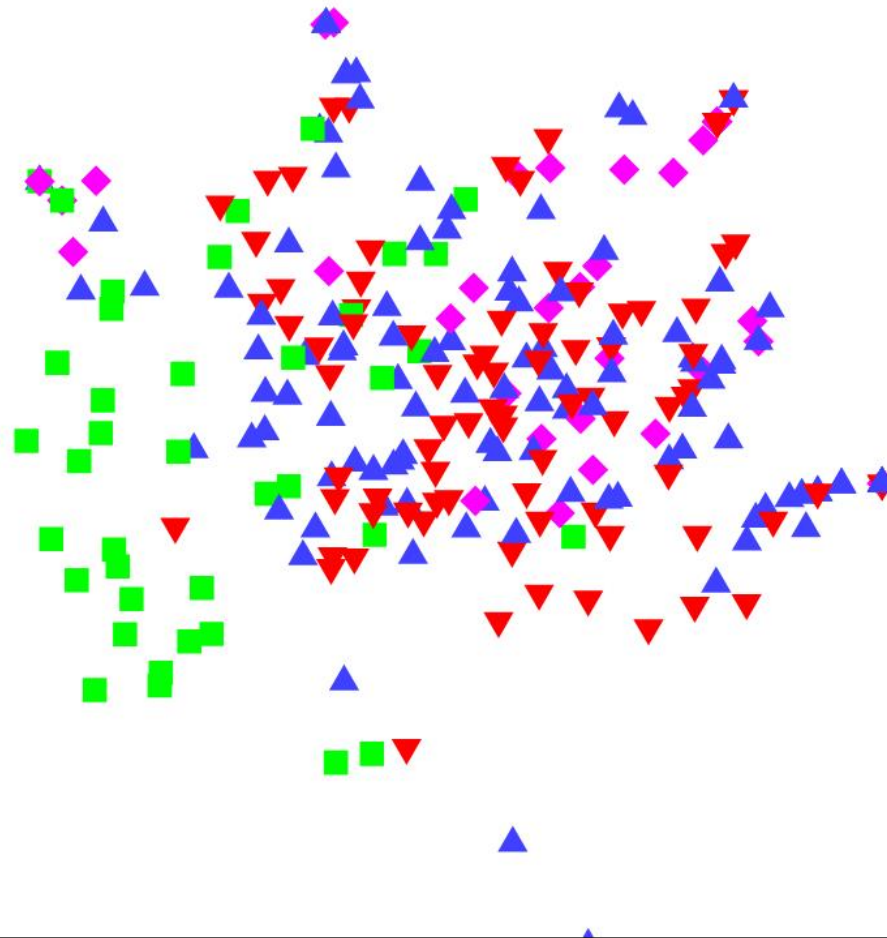
Non-metric MDS

Transform: Square root
Resemblance: S17 Bray-Curtis similarity

2D Stress: 0.2

Land

- ▲ DOS
- ▼ DLI
- FOR
- ◆ DHI

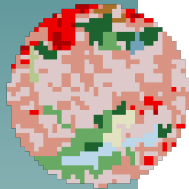


Driving species for land use similarities

Land Use	Species	% Contribution
Developed Open Space	<i>Aedes albopictus</i>	45.85
	<i>Aedes vexans</i>	26.51
Developed Low Intensity	<i>Aedes albopictus</i>	34.93
	<i>Culex quinquefasciatus</i>	24.20
	<i>Aedes vexans</i>	21.95
Forested	<i>Culex salinarius</i>	64.33
	<i>Aedes vexans</i>	13.14
Developed High Intensity	<i>Culex quinquefasciatus</i>	55.66
	<i>Aedes albopictus</i>	24.14



Least dissimilar sites and driving species



Nassau

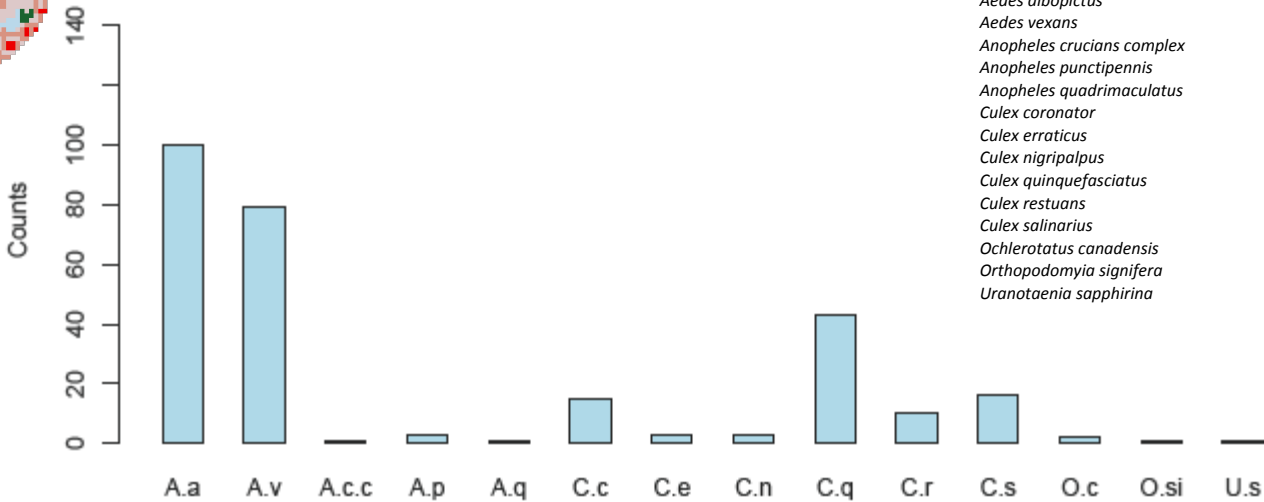
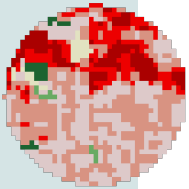


Table 10. Nassau abundances

Species	Count
<i>Aedes albopictus</i>	100
<i>Aedes vexans</i>	79
<i>Anopheles crucians complex</i>	1
<i>Anopheles punctipennis</i>	3
<i>Anopheles quadrimaculatus</i>	1
<i>Culex coronator</i>	15
<i>Culex erraticus</i>	3
<i>Culex nigripalpus</i>	3
<i>Culex quinquefasciatus</i>	43
<i>Culex restuans</i>	10
<i>Culex salinarius</i>	16
<i>Ochlerotatus canadensis</i>	2
<i>Orthopodomyia signifera</i>	1
<i>Uranotaenia sapphirina</i>	1

Species Driving Dissimilarity between Nassau and Winding Wood



WindingWood

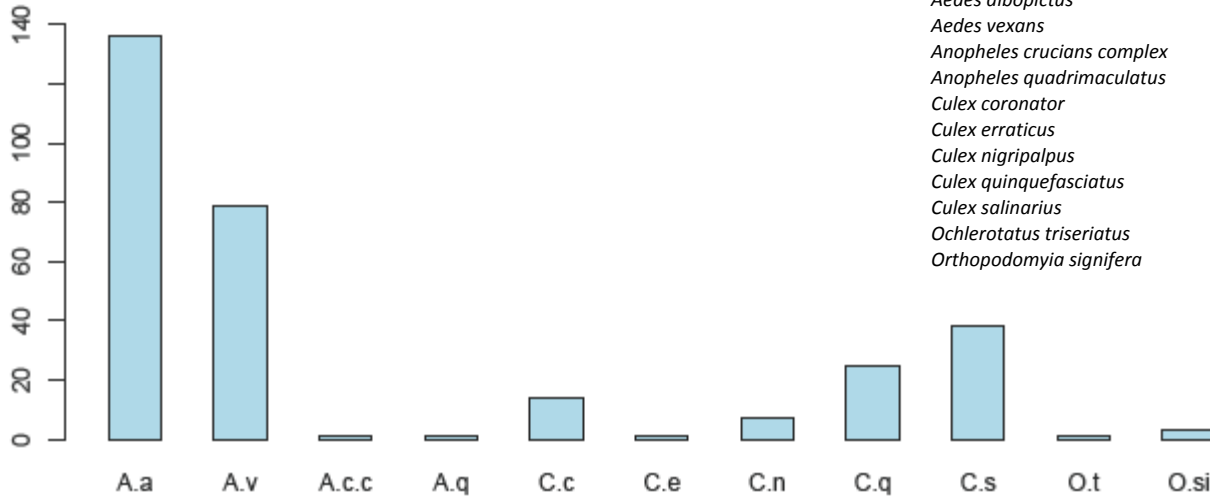
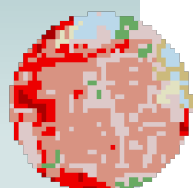
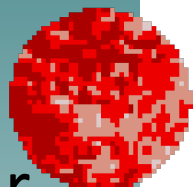


Table 14. Winding Wood abundances

Species	Count
<i>Aedes albopictus</i>	136
<i>Aedes vexans</i>	79
<i>Anopheles crucians complex</i>	1
<i>Anopheles quadrimaculatus</i>	1
<i>Culex coronator</i>	14
<i>Culex erraticus</i>	1
<i>Culex nigripalpus</i>	7
<i>Culex quinquefasciatus</i>	25
<i>Culex salinarius</i>	38
<i>Ochlerotatus triseriatus</i>	1
<i>Orthopodomyia signifera</i>	3

Species	% Contribution
<i>Aedes albopictus</i>	40.02
<i>Aedes vexans</i>	23.83
<i>Culex quinquefasciatus</i>	13.43

Most dissimilar sites and driving species



Green

Table 6. Green abundances

Species	Count
<i>Aedes albopictus</i>	5
<i>Aedes vexans</i>	8
<i>Coquilleltidia perturbans</i>	3
<i>Culex nigripalpus</i>	7
<i>Culex quinquefasciatus</i>	68
<i>Culex salinarius</i>	7
<i>Ochlerotatus triseriatus</i>	1

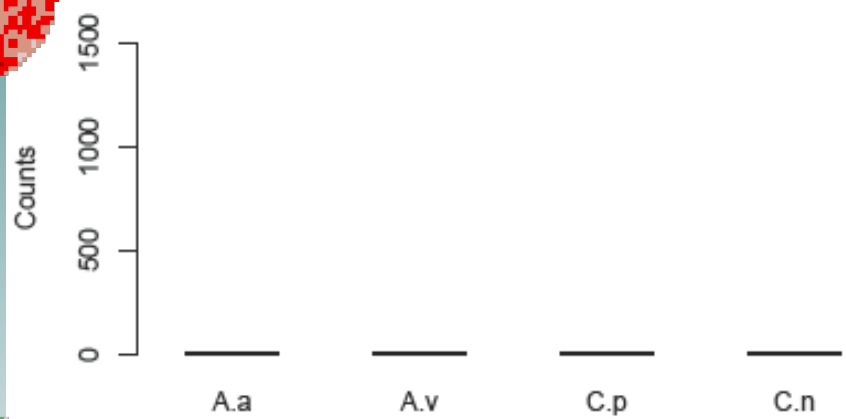
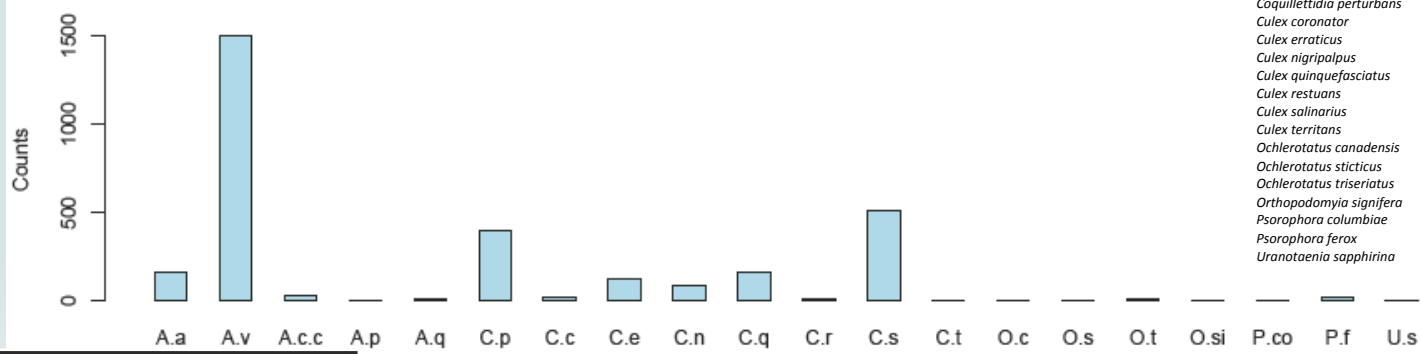


Table 2. Apple Valley abundances

Species	Count
<i>Aedes albopictus</i>	165
<i>Aedes vexans</i>	1503
<i>Anopheles crucians complex</i>	35
<i>Anopheles punctipennis</i>	7
<i>Anopheles quadrimaculatus</i>	15
<i>Coquilleltidia perturbans</i>	402
<i>Culex coronator</i>	22
<i>Culex erraticus</i>	124
<i>Culex nigripalpus</i>	87
<i>Culex quinquefasciatus</i>	163
<i>Culex restuans</i>	14
<i>Culex salinarius</i>	516
<i>Culex territans</i>	1
<i>Ochlerotatus canadensis</i>	1
<i>Ochlerotatus sticticus</i>	1
<i>Ochlerotatus triseriatus</i>	12
<i>Orthopodomyia signifera</i>	1
<i>Psorophora columbiae</i>	9
<i>Psorophora ferox</i>	20
<i>Uranotaenia sapphirina</i>	8

Apple Valley



Species	% contribution
<i>Aedes vexans</i>	28.92
<i>Culex salinarius</i>	18.70
<i>Culex quinquefasciatus</i>	13.56
<i>Coquilleltidia perturbans</i>	11.91

Table: Species driving dissimilarity between Apple Valley and Green



Most dissimilar sites and driving species

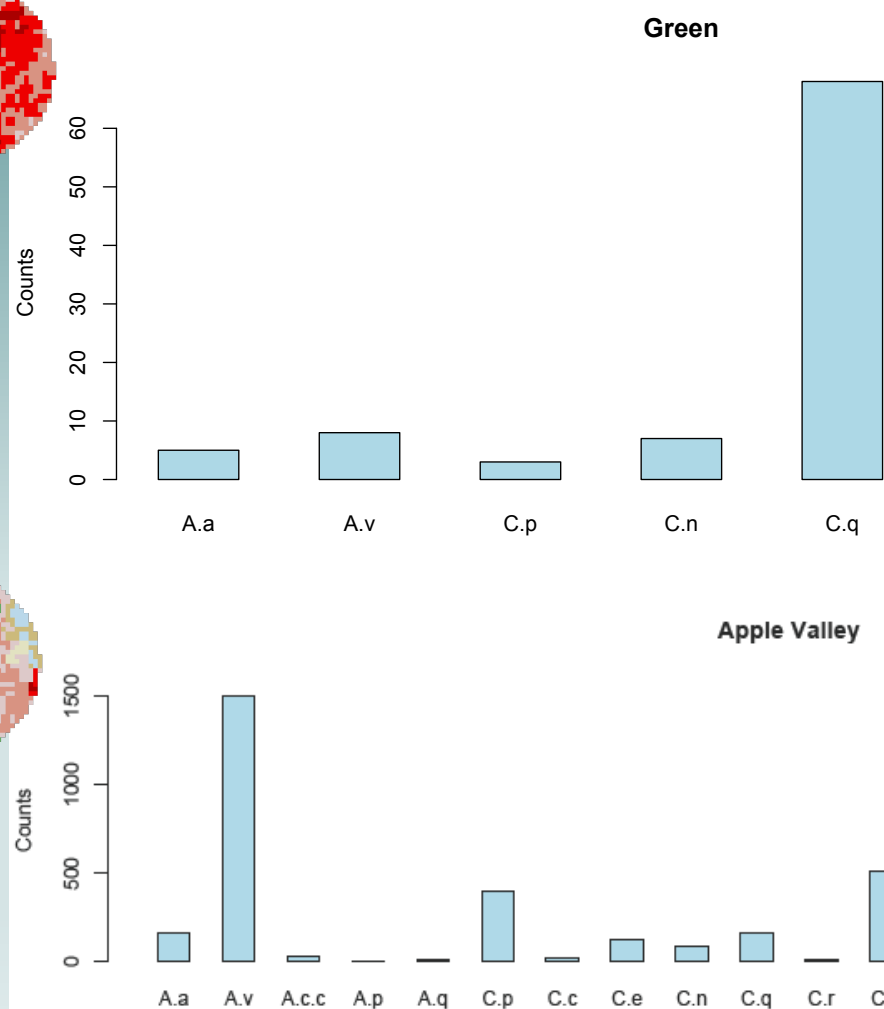
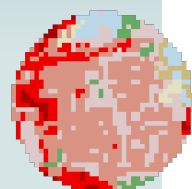
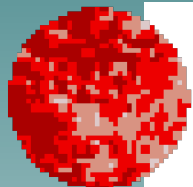


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Species	Count
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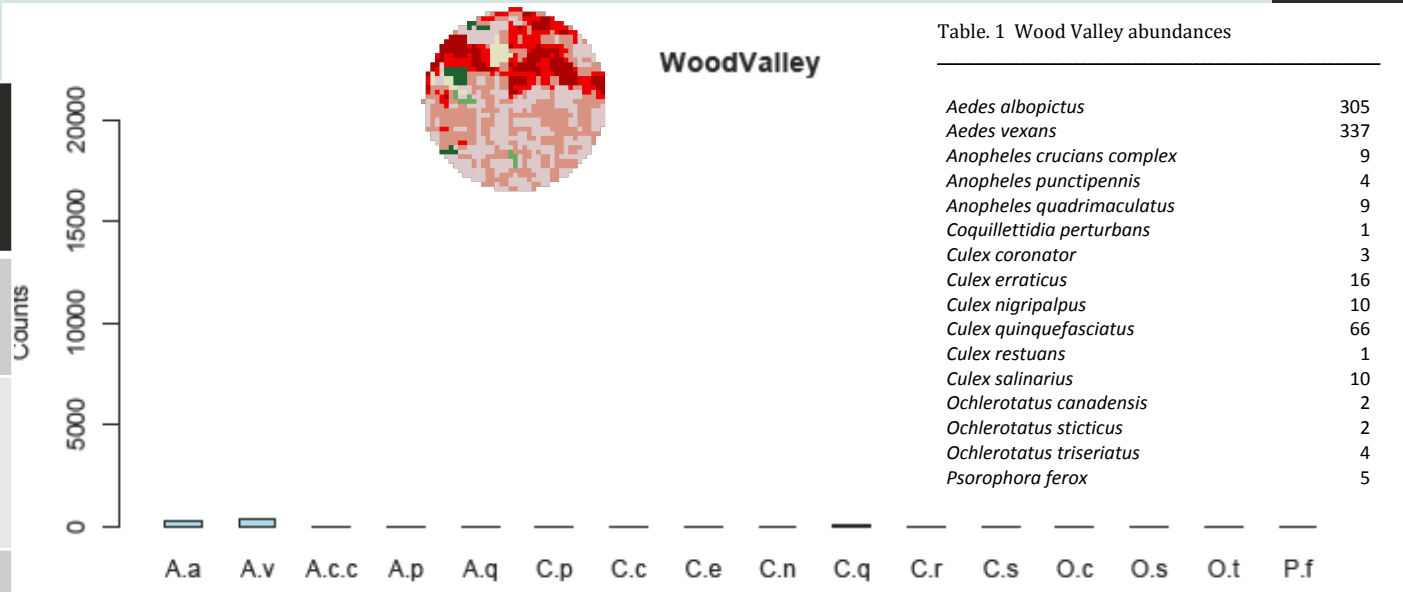
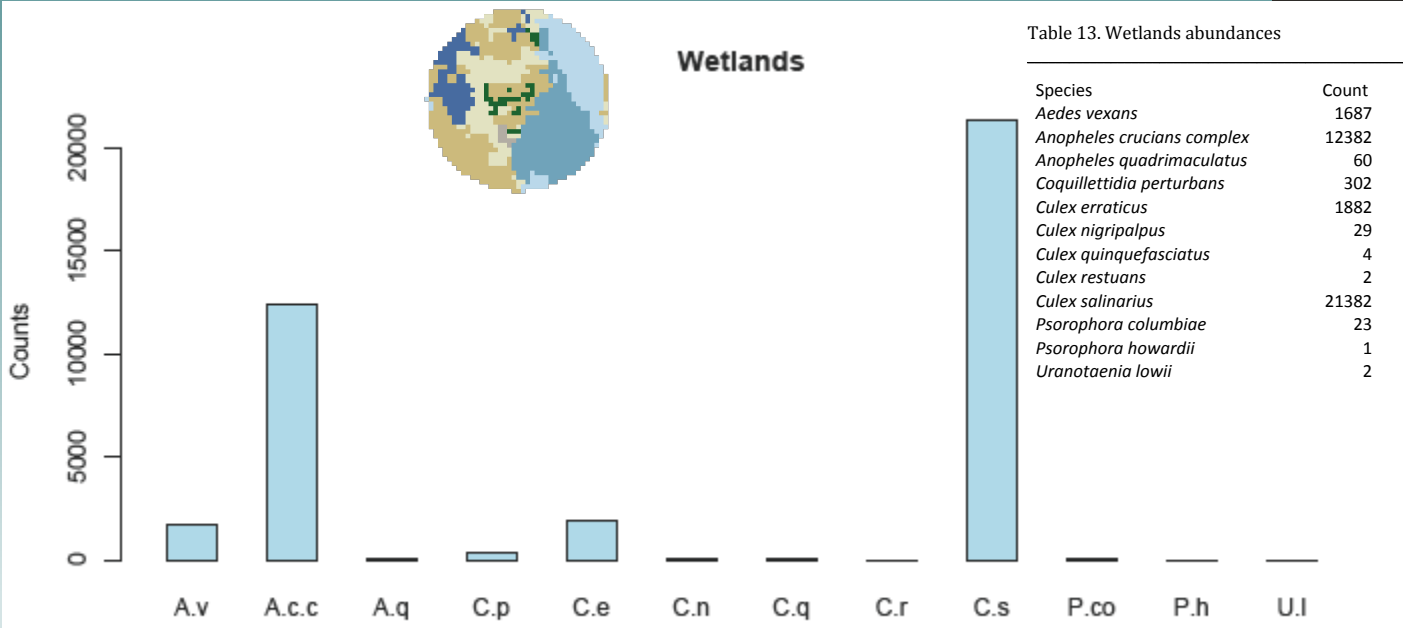
Table: Species driving dissimilarity between Apple Valley and Green



Most dissimilar sites and driving species

Species driving dissimilarity between Wetlands and Wood Valley

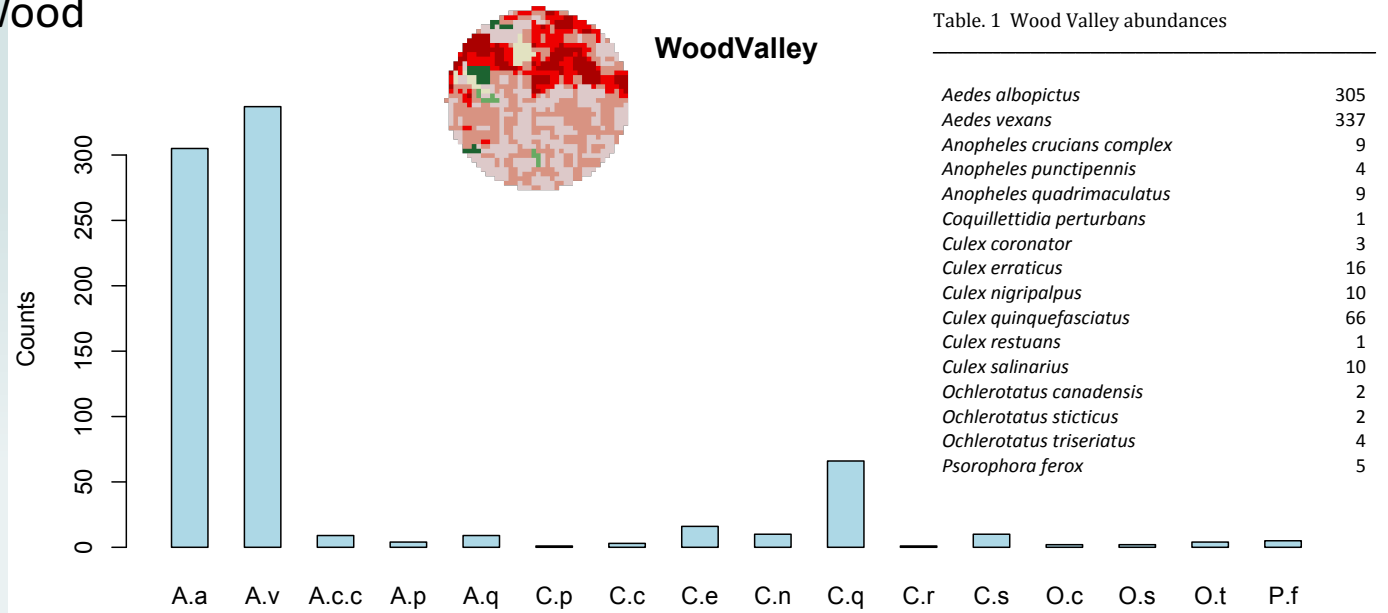
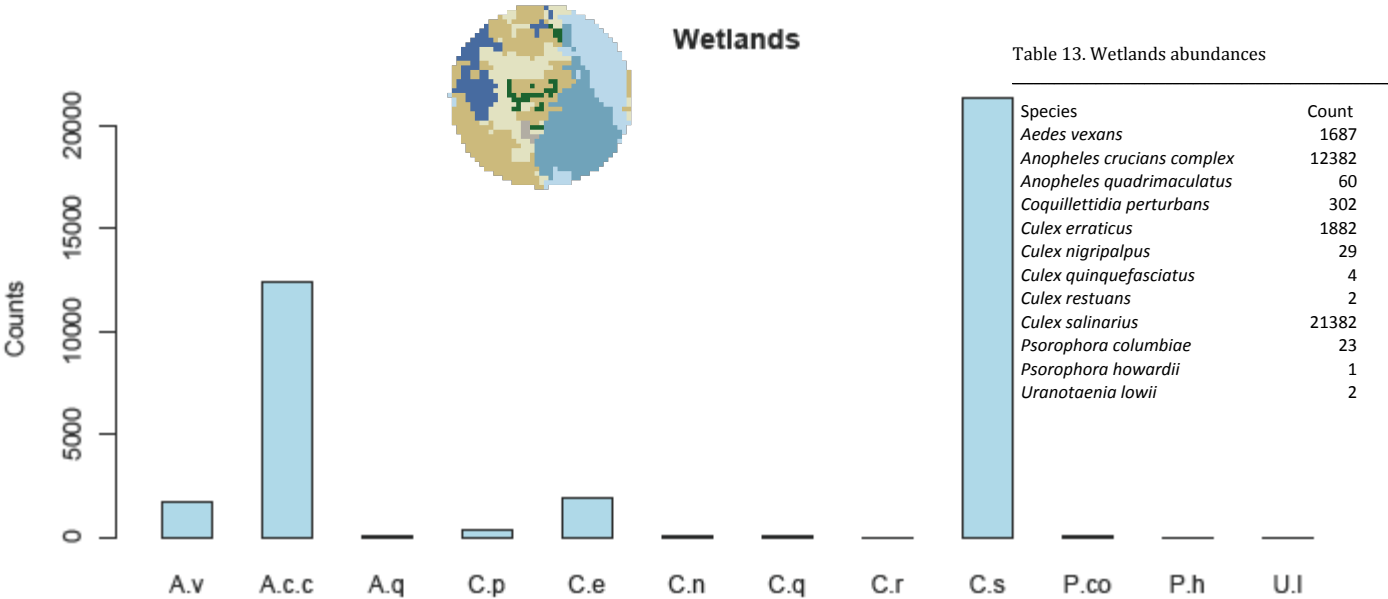
Species	% Contribution
<i>Culex salinarius</i>	57.19
<i>Anopheles crucians complex</i>	12.60
<i>Aedes vexans</i>	9.05



Most dissimilar sites and driving species

Species driving dissimilarity between Wetlands and Wood Valley

Species	% Contribution
<i>Culex salinarius</i>	57.19
<i>Anopheles crucians complex</i>	12.60
<i>Aedes vexans</i>	9.05



Acknowledgements

Fred Koehle

Richmond County Mosquito Control

Rosmarie Kelly

Georgia Department of Public Health

Knox Foundation

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NATURE PARK