

UPDATED COUNTY MOSQUITO SPECIES RECORDS FOR NORTHWEST FLORIDA

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ABSTRACT

This report updates the mosquito species composition for Santa Rosa, Okaloosa, Walton, Holmes, Washington, Jackson, Calhoun, Liberty, Gadsden, Leon, Wakulla, Jefferson, Madison, and Taylor Counties, through collections made in a centralized surveillance program operated from 2002-2020 in northwest Florida. 91 county species records were documented. The most notable discoveries included finding *Mansonia titillans* (Walker) in eleven of the fourteen surveyed counties, *Psorophora horrida* (Dyar and Knab) in nine, *Anopheles perplexens* Ludlow in eight and *Culex erraticus* (Dyar and Knab) and *Uranotaenia lowii* Theobald in seven. *Psorophora mathesoni* Belkin and Heinemann and *Aedes japonicus japonicus* (Theobald) were found in six new counties. *Culex pilosus* (Dyar and Knab) was found solely in Calhoun and Liberty Cos., while *Culex peccator* Dyar and Knab and *Culex tarsalis* Coquillett were recovered in Calhoun Co. and Santa Rosa Co., respectively. *Mansonia titillans*, *Cx. erraticus*, *Cx. tarsalis* and *Ae. j. japonicus* are known arbovirus vectors, thus increasing the disease risk in this region.

Key Words: mosquitoes, surveillance, species composition, distribution, northwest Florida

INTRODUCTION

County-level mosquito species distributions in Florida have been published by

Darsie and Morris (2003). Since then, several new introductions and county range expansions have been reported. *Anopheles grabhammi* (Theobald) and *Aedes condoles-*

cens (Dyar and Knab) were discovered in Monroe County (Darsie et al. 2002 and Darsie 2003). *Culex declarator* Dyar and Knab was found in Indian River and Monroe Counties (Darsie and Shroyer, 2004). In northwest Florida, *Culex coronator* Dyar and Knab was originally discovered in Okaloosa, Santa Rosa, Washington and Walton Counties and later recovered in Bay and Holmes Counties (Smith et al. 2006, and Smith 2008). Additional surveillance found this species in all remaining Florida counties except Gulf, Franklin and Monroe Counties (Connelly et al. 2016). In 2009, collections of *Culex erraticus* (Dyar and Knab) were reported from Walton County (Vander Kellen et al. 2012). *Aedes pertinex* (Grabham) was discovered in 2011 in Indian River County (Shroyer et al. 2015) and *Culex interrogator* (Dyar and Knab) was originally found in Broward, Indian River, Okeechobee, and Citrus Counties (Shin et al. 2016). *Aedes japonicus japonicus* (Theobald) was first reported in a collection from Okaloosa Co. in 2012 and later in Bay, Leon, Santa Rosa and Walton Counties (Riles et al. 2017). Larvae and adults of the tropical mosquitoes *Culex (Melanocnion) panocossa* and *Aedeomyia squamipennis* (Lynch Arribalzaga) were discovered near Homestead, FL in Miami-Dade County (Blosser and Burkett-Cadena 2017, and Burkett-Cadena and Blosser 2017). This

article documents additional records from surveillance conducted in 14 of 18 northwest Florida counties from 2002-2020.

MATERIALS AND METHODS

From 2002 through 2020, mosquito surveillance was conducted in Santa Rosa, Okaloosa, Walton, Holmes, Washington, Jackson, Calhoun, Liberty, Gadsden, Leon, Wakulla, Jefferson, Madison, and Taylor Counties in northwest Florida (Table 1). Mosquito Magnet X (MMX) traps a.k.a. “counterflow or pickle-jar traps” (Woodstream Corporation, Lancaster, PA) supplemented with 200 cc/min. compressed carbon dioxide (CO₂) gas were operated year-round once per week during crepuscular and nocturnal hours to capture host-seeking mosquitoes at 12 sites per county except for Leon County. Leon County submitted collections from BG Sentinel traps (Biogents USA, Moorefield, WV) supplemented with octenol (Woodstream Corporation, Lancaster, PA), BG Lure (Biogents USA, Moorefield, WV), and dry ice at varying locations within the county.

Container-breeding mosquitoes were also surveyed by deploying one sixteen-ounce black ovicup (4imprint USA, Oshkosh, WI) supplied with red velour paper strip (Hygloss Products, Inc., Wallington, NJ 07057) or seed germination paper (Anchor Paper Co., St. Paul MN, 55101) at each MMX

Table 1. County, years, and funding source for mosquito surveillance.

County	Years	Funding Source
Calhoun	2004, 2015-2019	County and State
Gadsden	2017-2020	County and State
Holmes	2004, 2015-2019	County and State
Jackson	2004, 2017-2019	County and State
Jefferson	2017-2019	State
Leon	2016-2020	County
Liberty	2004, 2015-2019	County and State
Madison	2017-2019	State
Walton	2002-2011	County
Okaloosa	2002-2019	County
Santa Rosa	2002-2020	County
Taylor	2017-2019	State
Wakulla	2015-2019	County and State
Washington	2002-2007, 2015, 2017-2019	County and State

sites during 2017-18 in all counties except for Leon, Okaloosa, Santa Rosa, and Walton.

Adult mosquito traps were operated depending on available funding. The most intensive surveillance occurred 2017-2019 when the Florida Legislature funded the program through a Florida Department of Health (FDOH) – Florida State University (FSU) contract. The most consistent surveillance was in Santa Rosa and Okaloosa Counties where the program was continuously funded by the counties for 18 and 16 years, respectively. Other counties provided funding on an intermittent basis (Table 1). Santa Rosa, Gadsden, and Leon Cos. continued surveillance and/or identification services in 2020.

RESULTS

Ninety-one new county mosquito species records were documented from fourteen NW Florida counties (Tables 2 & 3). Multiple collections of these species were made at several sites within each county. Table 3 provides collection details for specific sites with the most specimens collected. The greatest number of new county records were reported from Washington, Santa Rosa and Liberty Counties with sixteen, eleven, and ten, respectively. Okaloosa, Jefferson, and Calhoun Counties each had eight. The remaining counties ranged from one to seven new county records. Including these new records, the total known species for most counties ranged from 43-48. Based on our surveillance and review of the published literature for northwest Florida counties, Jackson and Leon Counties have the greatest known diversity with 57 and 53 species, respectively. The most notable observations in county range distributions included *Mansonia titillans* (Walker) in eleven of the fourteen surveyed counties, *Psorophora horrida* (Dyar and Knab) in nine, *Anopheles perplexens* Ludlow in eight and *Cx. erraticus* and *Uranotaenia lowii* Theobald in seven. *Psorophora mathesoni* Belkin and Heinemann and *Ae. j. japonicus* (Theobald) were found in six new counties. *Culex pilosus* (Dyar and Knab) was found solely in Calhoun and Liberty Cos.,

while *Culex peccator* Dyar and Knab and *Culex tarsalis* Coquillett were recovered in Calhoun Co. and Santa Rosa Co., respectively.

Ovitrap surveillance in Holmes, Washington, Jackson, Calhoun, Liberty, Gadsden, Wakulla, Jefferson, Madison, and Taylor Counties found only *Aedes albopictus*, *Aedes triseriatus*, and *Ae. j. japonicus*. *Aedes aegypti* was not collected in any of the surveyed northwest Florida counties by either adult traps or ovitraps.

DISCUSSION

In Florida, arboviruses that cause West Nile virus, Eastern equine encephalitis, and Venezuelan equine encephalitis, annually circulate among competent mosquito vectors and vertebrate reservoirs and are transmitted to humans and equine as dead-end hosts (Florida Department of Health 2019). This study documented in several northwest Florida counties the first occurrence of *Mn. titillans*, *Cx. erraticus*, *Ae. j. japonicus*, and *Cx. tarsalis* that serve as vectors of these diseases. The first three species were found in 79%, 50%, and 43% of the 14 counties surveyed. This is a significant expansion of the recorded county species composition, thus increasing our knowledge of the distribution of vectors and mosquito-borne disease in this region.

Some species collected in this surveillance program could be easily overlooked because of similarity to more commonly collected species. *Culex tarsalis* and *Ps. horrida* can be easily confused with *Cx. coronator* and *Ps. ferox*, respectively. Connelly and O'Meara (2008) provide a helpful checklist of characteristics to aid in the identification of the *Culex*. Harrison and Whitt (1996) provide a similar checklist for the *Psorophora*.

Many of the species recovered in this program were likely present much earlier, but not detected due to the lack of surveillance throughout much of this region. More species could have been recovered by including additional surveillance methods beyond host-seeking adult traps and ovitraps such as: larval surveys, light trapping, resting box collections, and other adult aspiration methods.

Table 2. Newly documented mosquito species recovered during 2002-2020 surveillance conducted in Northwest Florida. "X" denotes presence of new county species record recorded here.

Species	Northwest Florida Counties													
	Santa Rosa	Okaloosa	Walton	Holmes	Washington	Jackson	Calhoun	Gadsden	Liberty	Wakulla	Leon	Jefferson	Madison	Taylor
<i>Aedes atlanticus</i> Dyar and Knab					X				X		X			
<i>Aedes fulvus pallens</i> Ross				X	X	X**	X			X				
<i>Aedes japonicus japonicus</i>					X					X				
<i>Aedes thibaulti</i> Dyar and Knab					X		X					X		
<i>Aedes triseriatus</i> (Say)					X									
<i>Anopheles atropos</i> Dyar and Knab		X		X	X			X	X					
<i>Anopheles perplexans</i>	X	X			X			X		X	X	X	X	X
<i>Anopheles punctipennis</i> (Say)					X									
<i>Culex erraticus</i>	X	X		X	X		X		X		X			
<i>Culex peccator</i>							X							
<i>Culex pilosus</i>							X		X					
<i>Culex tarsalis</i>	X													
<i>Mansonia dyari</i> Belkin, Heinemann, and Page	X	X			X									
<i>Mansonia titillans</i>	X	X			X		X	X	X	X	X	X	X	X
<i>Psorophora ciliata</i> (Fabricius)					X									
<i>Psorophora cyanoescens</i>	X		X		X				X	X				
<i>Psorophora horrida</i>	X	X		X	X		X		X	X	X	X	X	X
<i>Psorophora howardii</i> (Coquillett)					X								X	
<i>Psorophora mathesoni</i>	X		X		X		X			X		X		
<i>Toxorhynchites rutilus</i>	X	X									X			
<i>Uranotaenia lowii</i>	X	X		X	X			X	X		X			
<i>Uranotaenia sapphirina</i> Lynch Arribalzaga	X				X				X					
<i>Wyeomyia smithii</i> (Coquillett)										X				X
# Species previously published*	34	38	44	41	30	56	40	43	37	41	51	35	35	39
# New species records	11	8	2	5	16	1	8	5	10	7	2	8	4	4
Total # species	45	46	46	46	46	57	48	48	47	48	53	43	39	43

*Sources: Darsie and Morris (2003), Smith et al. 2006, Smith 2008, Vander Kelen et al. 2012, Connelly et al. 2016, and Riles et al. 2017.

**Ovitrap collection

Table 3. Collection information for new county records.

Record #	Species	Date	County	Location	GPS Coordinates	# Collected
1	<i>Aedes atlanticus</i>	26 Jul., 2016	Leon	E. Joe Thomas	30.426989 -84.531742	49
2	<i>Aedes fuscus pallens</i>	16 Aug., 2002	Washington	Vernon	30.620817 -85.718669	24
3		23 Jun., 2018	Liberty	Civic Center	30.424100 -84.975900	104
4	<i>Aedes japonicus japonicus</i>	15 May, 2018	Holmes	Esto Park	30.987722 -85.643999	4
5		22 May, 2018	Jackson	Spring Creek	30.752222 -85.193056	Ovitraps
6		17 May, 2018	Washington	Wausau Park	30.636169 -85.589847	4
7		3 May, 2018	Calhoun	D. Parrish	30.453355 -85.149347	1
8		2 May, 2019	Gadsden	Mt. Pleasant VFD	30.662778 -84.694444	2
9		17 Jul., 2018	Wakulla	Panacea VFD	30.03184 -84.3899	4
10	<i>Aedes thibaulti</i>	10 May, 2018	Washington	Chipley WT	30.781202 -85.551530	1
11		9 Jun., 2018	Calhoun	Abe Springs	30.393984 -85.15821	8
12		19 Mar., 2018	Liberty	Torreya State Park	30.567417 -84.945600	12
13		28 Mar., 2019	Jefferson	Fulford	30.63916 -83.8308	1
14	<i>Aedes triseriatus</i>	15 May, 2003	Washington	Caryville	30.774974 -85.815457	76
15	<i>Anopheles atropos</i>	14 May, 2002	Okaloosa	Kelly Plantation	30.393783 -86.440133	13
16		11 Sep., 2018	Holmes	Noma Park	30.9801030 -85.6155860	1
17		11 Sep., 2003	Washington	Sunny Hills	30.546214 -85.597628	24
18		30 Aug., 2018	Gadsden	Mitchell	30.611111 -84.570556	2
19		8 May, 2018	Liberty	Hosford Health Dept.	30.382067 -84.797833	2
20	<i>Anopheles peplexens</i>	20 Jan., 2017	Santa Rosa	Hendrix	30.978283 -87.119417	192
21		9 Apr., 2015	Okaloosa	Milligan	30.774333 -86.629167	12
22		12 Apr., 2018	Washington	Sunny Hills	30.546214 -85.597628	16
23		1 Mar., 2018	Gadsden	Central Rd.	30.478333 -84.466944	24
24		27 Feb., 2018	Wakulla	Sopchop Park	30.05023 -84.5002	8
25		19 Apr., 2018	Jefferson	Wacissa	30.37445 -84.0005	8
26		15 Mar., 2018	Madison	Pinetta Trail	30.612185 -83.357794	1
27		1 Jun., 2018	Taylor	Keaton Beach	29.88302 -83.61893	64
28	<i>Anopheles punctipennis</i>	19 Apr., 2018	Washington	Old Spanish Trail Bridge	30.774572 -85.811492	88
29		10 Aug., 2005	Santa Rosa	Turkey Bluff Road	30.431089 -86.862264	96
30	<i>Culex erraticus</i>	16 Aug., 2005	Okaloosa	Shady Lane	30.781967 -86.564167	137
31		18 Jul., 2005	Holmes	Bonifay-French Rd.	30.849396 -85.806192	84
32		9 Oct., 2003	Washington	Sunny Hills	30.546214 -85.597628	72
33		24 Aug., 2016	Calhoun	Blountstown	30.456659 -85.044778	44
34		4 Mar., 2015	Liberty	Outside Lake	30.315800 -85.021283	32

Table 3. (Continued) Collection information for new county records.

Record #	Species	Date	County	Location	GPS Coordinates	# Collected
35		15 Feb., 2018	Jefferson	Dump Lamont	30.380140 -83.813830	138
36	<i>Culex peccator</i>	8 Oct., 2004	Calhoun	Fannin Avenue	30.442471 -85.042985	2
37	<i>Culex pilosus</i>	19 Oct., 2004	Calhoun	Fawn Lane	30.273458 -85.140377	1
38		19 Oct., 2004	Liberty	Orange	30.244600 -85.008117	1
39	<i>Culex tarsalis</i>	18 Sep., 2007	Santa Rosa	Soundview	30.354450 -87.161767	21
40	<i>Mansonia dyari</i>	27 Aug., 2008	Santa Rosa	Soundview	30.354450 -87.161767	32
41		2 Nov., 2004	Okaloosa	Valpariso	30.519533 -86.507183	200
42		21 Oct., 2004	Washington	Vernon	30.620817 -85.718669	1
43	<i>Mansonia titillans</i>	25 Jul., 2017	Santa Rosa	Hendrix	30.978283 -87.119417	32
44		14 Sep., 2017	Okaloosa	Fedex	30.421450 -86.667733	4
45		11 Apr., 2019	Washington	Sunny Hills	30.546214 -85.597628	8
46		1 Nov., 2018	Calhoun	Mossy Pond	30.511497 -85.31233	1
47		3 May, 2018	Gadsden	Central Road	30.478333 -84.466944	4
48		14 Jul., 2018	Liberty	Blue Creek O'Neal	30.372150 -84.689417	1
49		9 Oct., 2018	Wakulla	Sopchop Park	30.05023 -84.5002	8
50		23 Aug., 2016	Leon	Landfill South	30.42524 -84.14592	216
51		30 Aug., 2018	Jefferson	Letchworth	30.520900 -83.991940	16
52		28 Aug., 2018	Madison	Greenville 221	30.461927 -83.627462	24
53		2 Aug., 2018	Taylor	Shady Grove	30.29156 -83.68505	32
54	<i>Psorophora ciliata</i>	26 Apr., 2002	Washington	Sunny Hills	30.546214 -85.597628	20
55	<i>Psorophora cyanescens</i>	23 Aug., 2005	Santa Rosa	Horn Road	30.838546 -87.066617	106
56		4 Nov., 2004	Walton	Bruce	30.474309 -85.963366	2
57		11 Jan., 2005	Washington	Caryville	30.774974 -85.815457	1
58		12 Jul., 2017	Liberty	Outside Lake	30.315800 -85.021283	120
59		7 Aug., 2018	Wakulla	Appalach Bay VFD	30.06388 -84.2944	2
60	<i>Psorophora horrida</i>	12 Jun., 2018	Santa Rosa	Hendrix	30.978283 -87.119417	112
61		12 Jun., 2018	Okaloosa	Baker	30.800100 -86.682617	24
62		26 Jun., 2018	Holmes	Dogwood Lake	30.8572490 -85.7580000	72
63		9 June, 2018	Calhoun	Blountstown Library	30.456659 -85.044778	12
64		16 Jun., 2018	Liberty	Outside Lake	30.315800 -85.021283	48
65		14 Aug., 2018	Wakulla	Panacea VFD	30.03184 -84.3899	32
66		16 Aug., 2018	Jefferson	Wacissa	30.37445 -84.0005	40
67		26 June, 2018	Madison	Greenville RR	30.463823 -83.632394	12
68		27 Jul., 2018	Taylor	Woods Creek	30.12432 -83.62506	2

Table 3. (Continued) Collection information for new county records.

Record #	Species	Date	County	Location	GPS Coordinates	# Collected
69	<i>Psorophora howardii</i>	26 Apr., 2002	Washington	Sunny Hills	30.546214 -85.597628	80
70		30 May, 2018	Madison	City Ravine	30.455782 -83.421928	7
71	<i>Psorophora mathesoni</i>	24 Jul., 2018	Santa Rosa	Berrydale	30.889783 -87.047750	8
72		30 Sep., 2004	Walton	Bruce	30.474309 -85.963366	39
73		30 Sep., 2004	Washington	Caryville	30.774974 -85.815457	34
74		23 Jun., 2018	Calhoun	Tower Road Church	30.331427 -85.224345	8
75		5 Jun., 2018	Wakulla	Panacea VFD	30.03184 -84.3899	1
76		7 Jun., 2018	Jefferson	Dump Office	30.52304 -83.8715	1
77		19 Jul., 2016	Santa Rosa	Soundview	30.354450 -87.161767	1
78	<i>Toxorhynchites nitilus</i>	11 Jun., 2015	Okaloosa	Milligan	30.774333 -86.629167	1
79		16 Jul., 2018	Jefferson	Dump Office	30.52304 -83.8715	1
80	<i>Uranotaenia lovi</i>	23 Aug., 2012	Santa Rosa	Soundview	30.354450 -87.161767	64
81		5 Sep., 2012	Okaloosa	Baker	30.800100 -86.682617	32
82		11 Sep., 2015	Holmes	Vortex Springs	30.77032 -85.94838	8
83		31 Jul., 2003	Washington	Ebro Dog Track	30.44568 -85.8765	10
84		20 Dec., 2018	Gadsden	Mt. Pleasant VFD	30.662778 -84.694444	1
85		30 Oct., 2018	Liberty	Telogia Sewell	30.359517 -84.817117	8
86		7 Sep., 2018	Jefferson	New Monticello	30.54862 -83.9031	8
87	<i>Uranotaenia sapphirina</i>	28 Jun., 2005	Santa Rosa	Soundview	30.354450 -87.161767	12
88		23 Aug., 2002	Washington	Ebro Dog Track	30.44568 -85.8765	8
89		2 Dec., 2015	Liberty	Sumatra B. Creek	30.025917 -84.982750	16
90	<i>Wyeomyia smithii</i>	29 May, 2019	Wakulla	Smith Creek	30.20352 -84.6646	1
91		14 Jun., 2018	Taylor	Steinhatchee	29.675683 -83.385377	2

Mosquito surveillance is the foundation necessary for building and maintaining integrated mosquito control programs (EPA 2017). Rural counties that dominate most of northwest Florida do not have resources to provide surveillance without supplanting control operations. Faced with this choice, most forego or provide minimal surveillance. Determining species composition and quantifying population levels effectively aids in targeting/prioritizing control efforts and assessing program efficacy. The welfare of Florida citizens and visitors would benefit greatly if sustained support for comprehensive surveillance was provided throughout the State.

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REFERENCES CITED

- Blosser EM, Burkett-Cadena ND. 2017. *Culex (Melanocnion) panocossa* from peninsular Florida, USA. *Acta Trop* 167: 59-63.
- Burkett-Cadena ND and Blosser EM. 2017. *Aedeomyia squamipennis* (Diptera: Culicidae) in Florida, USA, a new state and county record. *J Med Entomol* 54: 788-792.
- Connelly CR, Alto BW, O'Meara GF. 2016. The spread of *Culex coronator* (Diptera: Culicidae) throughout Florida. *J Vec Ecol* 41: 195-199.
- Connelly CR, O'Meara GF. 2008. Is it *Culex tarsalis* or *Culex coronator*? *Buzz Words* Sep/Oct.
- Darsie RF Jr, Vlach JJ, and Fussell EM. 2002. New addition to the mosquito fauna of United States, *Anopheles grabhamii* (Diptera: Culicidae). *J Med Entomol* 39: 430-431.
- Darsie RF Jr. 2003. First report of *Ochlerotatus condole-scens* (Dyar and Knab) (Diptera: Culicidae) in the United States. *Proc Entomol Soc Wash* 105: 1067-1068.
- Darsie RF Jr, Morris CD. 2003. Keys to the Adult Females and Fourth Instar Larvae of the Mosquitoes of Florida (Diptera: Culicidae). *Tech Bull FL Mosq Control Assoc* 1: 1-159.
- Darsie RF Jr, Shroyer DA. 2004. *Culex (Culex) declarator*, a mosquito species new to Florida. *J Am Mosq Control Assoc* 20:224-227.
- EPA. 2017. Success in Mosquito Control: An Integrated Approach. <https://www.epa.gov/mosquitocontrol/success-mosquito-control-integrated-approach>
- Florida Department of Health. 2019. *Mosquito-Borne Disease Guidebook*. Ch. 2. <http://www.floridahealth.gov/diseases-and-conditions/mosquito-borne-diseases/guidebook.html>.
- Harrison BA, Parker BW. 1996. Identifying *Psorophora horrida* females in North Carolina (Diptera: Culicidae). *J Am Mosq Control Assoc* 12:725-727.
- Riles M, Smith JP, Burkett-Cadena ND, Rutledge-Connelly CR. 2017. First Record of *Aedes japonicus* In Florida. *J Am Mosq Control Assoc* 33:340-344.
- Shin D, O'Meara GF, Civana A, Shroyer DA, Miqueli E. *Culex interrogator* (Diptera: Culicidae), a mosquito species new to Florida. *J Vec Ecol* 41:316-319.
- Shroyer DA, Harrison BA, Bintz BJ, Wilson MR, Sither CB, Byrd BD. 2015. *Aedes pertinax*, a newly recognized mosquito species in the United States. *J Am Mosq Control Assoc* 31: 97-100.

- Smith JP. 2008. Spread, larval habitat, seasonal abundance and vector status of *Culex coronator*: A new invasive vector species in Florida. Report to the FL Dept of Ag and Cons Srvs. <http://www.freshfrom-florida.com/content/download/3174/19965/Coronator%20Final%20FDACS%20Report.pdf>
- Smith JP, Walsh JD, Cope EH, Tennant Jr. RA, Kozak III JA, and Darsie Jr. RF. 2006. *Culex coronator* Dyar and Knab: a new Florida species record. *J Am Mosq Control Assoc* 22: 330-332.
- Vander Kelen PT, Downs JA, Burkett-Cadena ND, Otendorfer CL, Hill K, Sickerman S, Hernandez J, Jinright J, Hunt B, Lusk J, Hoover V, Armstrong K, Unnasch RS, Stark LM, and Unnasch TR. 2012. Habitat associations of Eastern Equine Encephalitis transmission in Walton County, Florida. *J Med Entomol* 49(3): 746-756.