



GOPHER TORTOISE RECIPIENT SITE ANALYSIS

Southwest District

Charlotte Harbor Region
Terra Ceia Preserve State Park

Gopher Tortoise Recipient Site Analysis

The feasibility of using a portion of a state park, or any other state lands, as a gopher tortoise recipient site in accordance with 259.032 F.S. is dependent upon the following criteria:

- The site contains a minimum of 40 acres of contiguous suitable upland tortoise habitat that meet the criteria for soil and vegetation listed below:
 - Soil Criteria: An area on site of at least 40 contiguous acres must meet *acceptable* criteria per the Gopher Tortoise Permitting Guidelines (July 2020, subsequent revisions). *Acceptable* soils include those moderately well-drained to excessively drained, with a midpoint of the upper limit of the water table (DWT) value of 45 centimeters (18 inches) or greater.
 - Vegetation Criteria: An area on site of at least 40 contiguous acres must meet *acceptable* habitat features, including average herbaceous cover of at least 30% and average canopy cover of 60% or less. Improved pasture cannot exceed 40% of the total expected recipient site unit and must include a minimum of 10% patchy shrub cover if improved pasture is present.

Should a portion of a state park, or any other state lands in question, meet the above criteria in its current state, the FWC would consider those areas to be feasible as a potential gopher tortoise recipient site. Should a portion of a state park, or any other state lands have the potential to meet the above listed criteria in the future with appropriate habitat management, the FWC may consider those areas to be potentially feasible as a gopher tortoise recipient site at that time. Should habitat conditions improve through proper management on a public lands site to the point that those lands meet the *acceptable* criteria listed above, the public lands manager should contact FWC staff at that time. The managing agency should make the determination that gopher tortoise recipient site management does not conflict with the primary management objectives of the lands under review. If the lands meet the acceptable criteria listed above, coordinate with FWC staff on this determination.

The following Gopher Tortoise Survey Prioritization Blueprint for State Conservation Lands was prepared in September of 2018. Line Transect Distance Sampling (LTDS) surveys that have been conducted for Northeast District parks are also included in this appendix.

For further details regarding these criteria, please see pages 30-36 of the [FWC Gopher Tortoise Permitting Guidelines](#).

DRP Southwest District Gopher Tortoise Recipient Site Analysis					
PARK	40+ ACRES OF CONTIGUOUS SUITABLE HABITAT	PRIORITIZED TIER FOR ADDITIONAL SURVEY 1 HIGHEST 10 LOWEST	CONFLICT WITH MANAGEMENT PRIORITIES	FEASIBILITY OF RECIPIENT SITE	COMMENTS
Terra Ceia Preserve	no	NA			
Cayo Costa	yes	5	no	no	EVP
Charlotte Harbor Preserve	yes	2	no	no	EVP
Don Pedro Island	yes	Not Evaluated by FWC - No Prioritization Assigned	no	no	VO
Gasparilla Island	no	NA			
Stump Pass Beach	no	NA			

Comments

LPD – Low Population Density

HRR – Habitat Restoration Required

CRS – Cultural Resource Sensitivity

EVP – Existing Viable Population

SIH – Small Isolated Habitat

MSR - Marginal Substrate Requirements

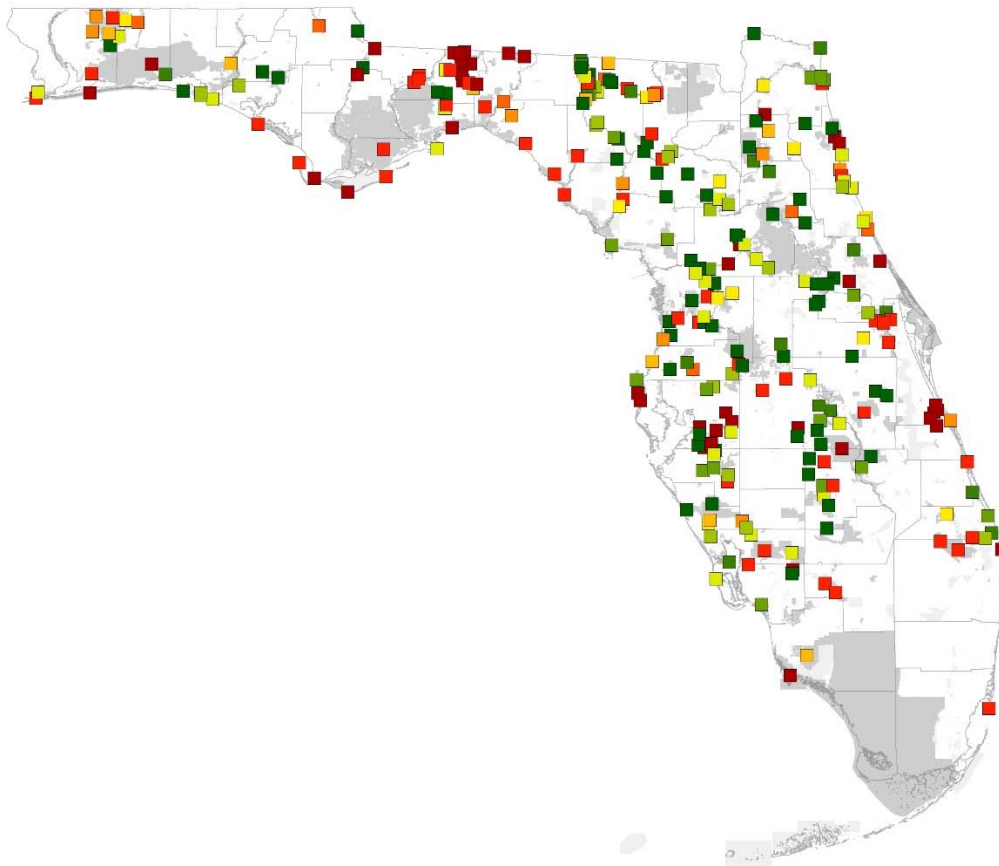
RF – Recruitment Feasible

VO – Vulnerable to Overwash

Gopher Tortoise Survey Prioritization Blueprint for State Conservation Lands

Gopherus polyphemus

September 2018



Florida Fish and Wildlife
Conservation Commission

MyFWC.com

Introduction and Purpose

The gopher tortoise (*Gopherus polyphemus*) is currently a candidate species for federal listing under the Endangered Species Act in the eastern portion of its range. Assessing gopher tortoise population status using a standardized approach range-wide is critical to determine if the species warrants federal protection. In 2012, participants in the Candidate Conservation Agreement for the Gopher Tortoise adopted line transect distance sampling (LTDS) with burrow scoping (Smith et al. 2009) as the standardized methodology to examine gopher tortoise populations (Candidate Conservation Agreement, 2012). Population survey and monitoring results using LTDS will be used to inform land management decisions, and also help inform the Florida Fish and Wildlife Conservation Commission (FWC) and the U.S. Fish and Wildlife Service (USFWS) on the status of the gopher tortoise in Florida.

The Gopher Tortoise Survey Prioritization Blueprint is intended to assist state agencies in determining where survey efforts and resources should be allocated based on each conservation land's prioritized tier rank; prioritization tiers were determined with input from multiple agencies including Florida Fish and Wildlife Conservation Commission, Florida Forest Service, Florida Park Service, Northwest Florida Water Management District (WMD), South Florida WMD, Southwest Florida WMD, St. Johns River WMD, Suwannee River WMD, and the Florida Natural Areas Inventory.

Survey Prioritization Blueprint

Included in the Survey Prioritization Blueprint are state-owned or managed conservation lands that contain more than 250 acres of potential gopher tortoise habitat, as these lands have the potential to support viable populations (≥ 250 adult tortoises, ≥ 0.16 tortoises per acre, ≥ 250 acres of quality habitat; [Gopher Tortoise Council, 2013](#)). Sites that meet the habitat requirement but not population or density criteria are considered support populations, which may have the potential to become viable with habitat and/or population restoration ([Gopher Tortoise Council, 2014](#)). While still important to the recovery of the species, sites with < 250 acres of tortoise habitat were excluded from this effort as they may not be viable long-term.

State conservation lands were prioritized using a 10-tiered approach, with tier 1 being the highest priority for future surveys, and 10 being the lowest priority for future surveys. Each tier ideally includes a heterogeneous mix of habitat quality, habitat type, size, and spatial distribution to produce a sample representative of conservation lands in Florida. The overall goal is to determine the population status of gopher tortoises in Florida even if surveys on all state conservation lands cannot be completed. Conducting population surveys only on lands known to have superb habitat or a high tortoise density is not conducive to that task. Some state conservation lands were not prioritized. Most often this was because the conservation land, though state-owned, is managed by a local government entity. Other conservation lands that are not state-owned or managed but have received an LTDS survey are also included in this Blueprint with a tier rank of "not prioritized".

Updates and Revisions

The Survey Prioritization Blueprint is a living document and can be altered as new information becomes available. With input from cooperating state agencies, FWC will update the Blueprint annually to include survey progress and determine if changes are needed in prioritization tiers. Cooperation between state agencies is imperative to this effort, and annual updates to this Blueprint will allow agencies to provide progress on gopher tortoise surveys.

September 2017 Summary

There are 268 conservation lands included in the Survey Prioritization Blueprint. Below is a summary of conservation lands within each Tier (Table 1). The Blueprint also includes lands that have been surveyed prior to this effort, most of which were also prioritized with input from multiple state agencies. Also included are state-owned conservation lands that are not managed by state agencies, and previously surveyed sites that are not state owned; these are included in the NA tier, or not prioritized tier.

Table 1. Number of conservation lands within each prioritization tier as of 20 September 2017. Surveyed sites refer to conservation lands that have received a line transect distance sampling (LTDS) survey, or in cases of low population density, a belt transect survey with burrow scoping. Also included are pilot survey results that concluded the site had a gopher tortoise density too low to warrant an LTDS survey. These populations likely will not meet the density criteria for a viable population, but may be reconsidered for surveys following population augmentation or habitat improvement.

Tier	Surveyed	Pilot survey (low density)	Conservation lands (total)
1	30	0	59
2	4	1	14
3	2	0	18
4	3	2	24
5	2	1	25
6	0	0	14
7	0	1	9
8	1	0	11
9	0	0	7
10	4	8	47
NA	13	1	40
Total	59	14	268

September 2018 Summary

Large conservation lands with multiple tracts of land (e.g., Twin Rivers State Forest) were divided by tract to facilitate prioritization rankings as separate tracts may represent individual populations and thus, should be surveyed separately. Therefore, 280 conservation lands are included in the 2018 Survey Prioritization Blueprint update. Ten conservation lands were surveyed between September 2017 and September 2018, population statuses of which have been updated in the Blueprint. An additional three sites received pilot LTDS surveys, but results indicated insufficient habitat or density to be viable and did not warrant full surveys. Below is a summary of conservation lands within each Tier (Table 2). Of the 280 conservation lands included in the Survey Prioritization Blueprint, 69 (25%) have received an LTDS or belt transect survey with burrow scoping. The majority of those surveys (52%) were conducted on sites listed as Tier 1 priorities to receive an LTDS survey.

As of 18 September 2018, 37 viable, 23 primary support, and 8 secondary support populations have been documented on conservation lands in Florida via LTDS or belt transect surveys with burrow scoping. As O'Leno State Park and River Rise Preserve State Park are contiguous, this gopher tortoise population was considered a single population and received one combined survey.

Table 2. Number of conservation lands within each prioritization tier that have received a line transect distance sampling (LTDS) pilot or full survey, or comprehensive belt transect survey (with burrow scoping) as of 18 September 2018.

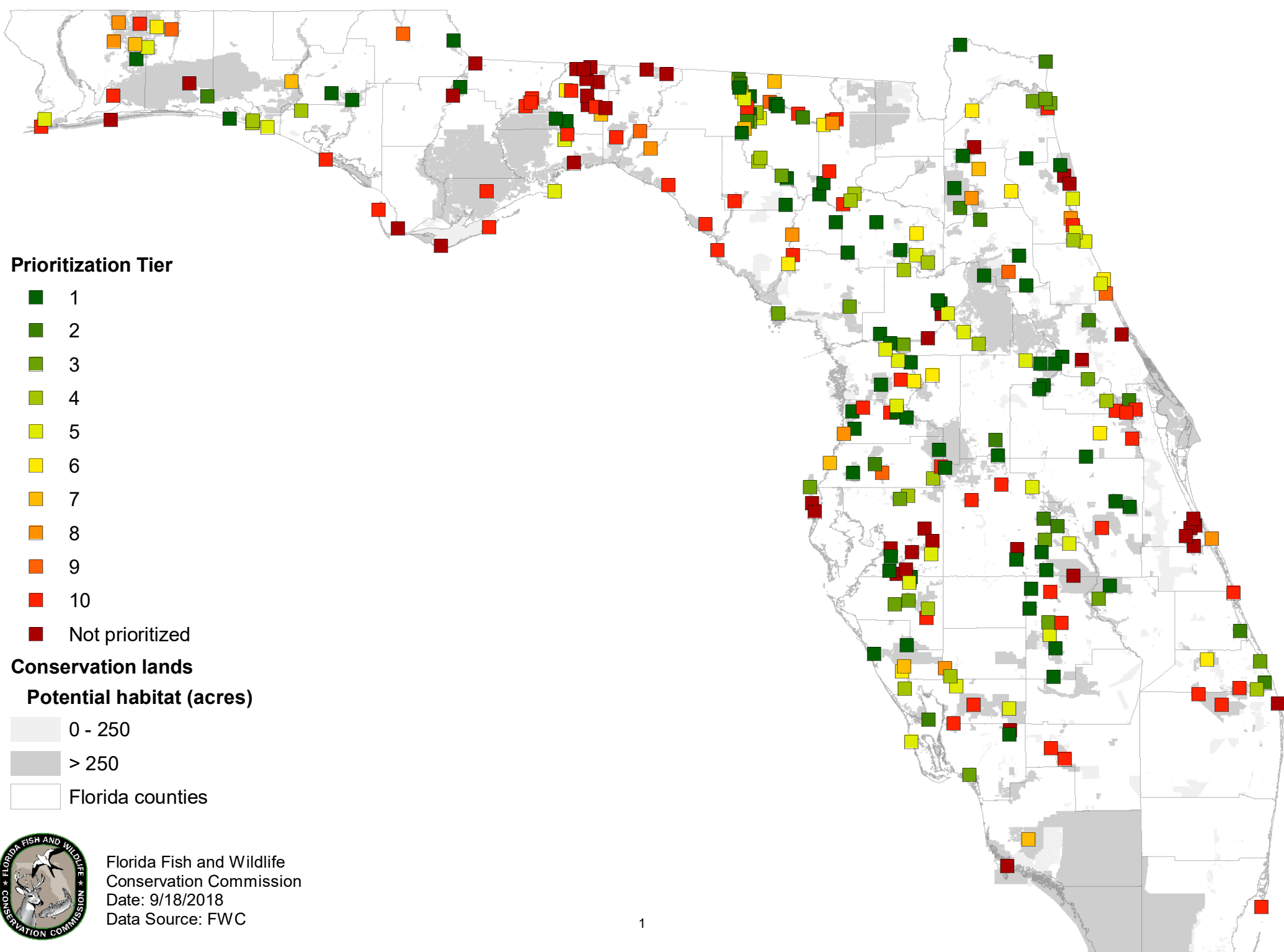
Tier	Surveyed	Pilot survey (low density)	Conservation lands (total)
1	36	0	66
2	4	2	17
3	2	2	18
4	3	2	20
5	2	1	27
6	0	0	14
7	0	0	9
8	1	0	10
9	0	0	7
10	6	9	50
NA	15	1	42
Total	69	17	280

Literature Cited

- Candidate Conservation Agreement for the Gopher Tortoise. 2008. Candidate Conservation Agreement for the Gopher Tortoise (*Gopherus polyphemus*): Eastern Population. Revised 2012.
- Gopher Tortoise Council. 2013. Gopher Tortoise Minimum Viable Population and Minimum Reserve Size Working Group Report. 7 pp.
- Gopher Tortoise Council. 2014. Gopher Tortoise Minimum Viable Population and Minimum Reserve Size Working Group Report II. 7 pp.
- Smith, L.L, and J.M. Stober. 2009. Gopher Tortoise Survey Handbook. Final report to US Army Corps of Engineers, Engineer Research and Development Center, Construction Engineering Research Laboratory. Report # ERDC/CERL TR-09-7.

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Map Label	Population Estimate?	Site Name	Prioritization Tier	Potential habitat (acres)	Predominant Natural Community	Survey Year	Population Status	Managing Agency
239	N	Alafia River Corridor	NA	1237	Mixed Hardwood-Coniferous			Hillsborough County
122	N	Alafia River State Park	5	685	Xeric Hammock			FL Dept. of Environmental Protection, Div. of Recreation and Parks
189	N	Alfred B. MacIay Gardens State Park	10	755	Mixed Hardwood-Coniferous			FL Dept. of Environmental Protection, Div. of Recreation and Parks
149	N	Allapattah Flats	6	589	Mesic Flatwoods			South Florida Water Management District
67	N - pilot survey indicates low density	Allen David Broussard Catfish Creek Preserve State Park	2	2736	Scrub			FL Dept. of Environmental Protection, Div. of Recreation and Parks
123	N	Anastasia State Park	5	849	Beach Dune, Maritime Hammock			FL Dept. of Environmental Protection, Div. of Recreation and Parks
84	N	Anclote Key Preserve State Park	3	473	Beach Dune			FL Dept. of Environmental Protection, Div. of Recreation and Parks
190	N	Andrews Wildlife Management Area	10	2938	Upland Hardwood Forest			FL Fish and Wildlife Conservation Commission
191	N	Annettella Hammock	10	1873	Sandhill			Southwest Florida Water Management District
240	N	Apalachee Correctional Institution	NA	1320	Coniferous Plantations, Mixed Hardwood-Coniferous			PRIDE Enterprises, Inc.
1	Y	Apalachee Wildlife Management Area	1	3068	Upland Pine, Sandhill	2017	Viable	FL Fish and Wildlife Conservation Commission
241	Y	Apalachicola Bluffs and Ravines Preserve	NA	3929	Sandhill, Mixed Hardwood-Coniferous	2014	Primary Support	The Nature Conservancy
2	Y	Apalachicola National Forest - Munson East	1	3600	Sandhill	2015	Viable	US Dept. of Agriculture, Forest Service
3	Y	Apalachicola National Forest - Munson West	1	14032	Sandhill	2015	Primary Support	US Dept. of Agriculture, Forest Service
192	N	Aucilla Wildlife Management Area	10	1327	Upland Hardwood Forest, Coniferous Plantations, Mesic Flatwoods	2012		FL Fish and Wildlife Conservation Commission
193	N – Insufficient suitable habitat	Avalon State Park	10	371	Maritime Hammock, Coastal Strand			FL Dept. of Environmental Protection, Div. of Recreation and Parks
242	Y	Avon Park Air Force Range	NA	33979	Mesic Flatwoods, Scrub, Dry Prairie, Scrubby Flatwoods	2015	Viable	US Dept. of Defense, Air Force
124	N	Babcock Ranch Preserve	5	31589	Mesic Flatwoods			FL Dept. of Agriculture and Consumer Services, FL Forest Service
125	N	Bald Point State Park	5	1240	Coniferous Plantation, Scrubby Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
243	N	Balm-Boyette Scrub	NA	2012	Mesic Flatwoods, Scrub			Hillsborough County
150	N	Bayard Conservation Area	6	856	Mesic Flatwoods			St. Johns River Water Management District
4	Y	Bell Ridge Longleaf Wildlife and Environmental Area	1	716	Sandhill	2014	Viable	FL Fish and Wildlife Conservation Commission
172	N	Belmore State Forest	8	2110	Coniferous Plantations	2011		FL Dept. of Agriculture and Consumer Services, FL Forest Service
194	N - pilot survey indicates low density	Big Bend Wildlife Management Area - Jena	10	2224	Mesic Flatwoods			FL Fish and Wildlife Conservation Commission
195	Y	Big Bend Wildlife Management Area - Spring Creek	10	722	Coniferous Plantations, Sandhill	2016	Primary Support	FL Fish and Wildlife Conservation Commission
196	Y	Big Bend Wildlife Management Area - Tide Swamp	10	342	Coniferous Plantations	2016	Primary Support	FL Fish and Wildlife Conservation Commission
197	N	Big Lagoon State Park	10	312	Scrubby Flatwoods, Coastal Scrub			FL Dept. of Environmental Protection, Div. of Recreation and Parks
198	N	Big Shoals State Forest	10	576	Mesic Flatwoods			FL Dept. of Agriculture and Consumer Services, FL Forest Service
173	N	Big Shoals State Park	8	588	Mesic Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
85	N	Big Talbot Island State Park	3	1392	Maritime Hammock, Coastal Strand			FL Dept. of Environmental Protection, Div. of Recreation and Parks
199	N	Bill Baggs Cape Florida State Park	10	253	Coastal Strand			FL Dept. of Environmental Protection, Div. of Recreation and Parks
163	N	Black Creek Ravines Conservation Area	7	449	Sandhill, Xeric Hammock			St. Johns River Water Management District
126	N	Blackwater River State Forest - Bone Creek Unit	5	9347	Upland Pine, Sandhill			FL Dept. of Agriculture and Consumer Services, FL Forest Service
174	N	Blackwater River State Forest - Coldwater Unit	8	8754	Upland Pine			FL Dept. of Agriculture and Consumer Services, FL Forest Service
164	N	Blackwater River State Forest - Floridale Unit	7	15814	Upland Pine			FL Dept. of Agriculture and Consumer Services, FL Forest Service
182	N	Blackwater River State Forest - Horse Creek Unit	9	4853	Upland Pine			FL Dept. of Agriculture and Consumer Services, FL Forest Service
5	Scheduled 2018/2019	Blackwater River State Forest - Juniper Creek Unit (includes Hutton Unit and Blackwater River State Park)	1	14331	Upland Pine, Sandhill			FL Dept. of Agriculture and Consumer Services, FL Forest Service
151	N	Blackwater River State Forest - Rock Creek Unit	6	19205	Upland Pine			FL Dept. of Agriculture and Consumer Services, FL Forest Service
200	N - pilot survey indicates low density	Blackwater River State Forest - Sweetwater Unit	10	21400	Upland Pine			FL Dept. of Agriculture and Consumer Services, FL Forest Service
175	Y	Blackwater River State Forest - West Boundary Unit	8	6984	Upland Pine	2016	Primary Support	FL Dept. of Agriculture and Consumer Services, FL Forest Service
6	Scheduled 2018/2019	Blue Spring State Park	1	1089	Scrub			FL Dept. of Environmental Protection, Div. of Recreation and Parks
244	Y	Branan Field Wildlife and Environmental Area	NA	94	Sandhill	2017	Secondary Support	FL Fish and Wildlife Conservation Commission
68	N	Buck Lake Conservation Area	2	2142	Mesic Flatwoods			St. Johns River Water Management District
7	Y	Bullfrog Creek Wildlife and Environmental Area	1	560	Mesic Flatwoods	2016	Viable	FL Fish and Wildlife Conservation Commission
127	N	Bulow Creek State Park	5	851	Mesic Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks

Map Label	Population Estimate?	Site Name	Prioritization Tier	Potential habitat (acres)	Predominant Natural Community	Survey Year	Population Status	Managing Agency
245	N - pilot survey indicates low density	Caladesi Island State Park	NA	246	Cabbage Palm, Maritime Hammock			FL Dept. of Environmental Protection, Div. of Recreation and Parks
246	N	Caloosahatchee Regional Park	NA	491	Improved Pasture, Mesic Flatwoods, Shrub and Brushland	2014		Lee County
8	N	Camp Blanding Military Reservation	1	34072	Sandhill, Pine Flatwoods and Dry Prairie			FL Dept. of Military Affairs
201	N	Camp Branch Conservation Area	10	527	Sandhill, Mesic Flatwoods, Scrubby Flatwoods			Suwannee River Water Management District
247	N	Cape St. George State Reserve	NA	816	Coastal Scrub, Scrubby Flatwoods			FL Dept. of Environmental Protection, Florida Coastal Office
152	N	Cary State Forest	6	1023	Coniferous Plantations	2011		FL Dept. of Agriculture and Consumer Services, FL Forest Service
128	Y	Cayo Costa State Park	5	1653	Maritime Hammock, Coastal Grasslands	2015	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks
86	N - pilot survey indicates low density	Cedar Key Scrub State Reserve	3	1033	Scrubby Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
202	N	Charles H. Bronson State Forest	10	908	Mesic Flatwoods			FL Dept. of Agriculture and Consumer Services, FL Forest Service
69	N	Charlotte Harbor Preserve State Park	2	4979	Mesic Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
9	Y	Chassahowitzka Wildlife Management Area	1	8130	Sandhill	2017	Viable	FL Fish and Wildlife Conservation Commission
248	Y	Cherokee Plantation Conservation Easement	NA	1269	Upland Coniferous	2015	Secondary Support	Tall Timbers Research, Inc.
203	N	Chinsegut Wildlife and Environmental Area	10	550	Sandhill			FL Fish and Wildlife Conservation Commission
165	N	Choctawhatchee River Water Management Area	7	6372	Coniferous Plantation			Northwest Florida Water Management District
10	N	Colt Creek State Park	1	1906	Mesic Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
70	N	Conner Preserve	2	773	Mesic Flatwoods, Sandhill			Southwest Florida Water Management District
249	N	Crooked Lake West - Stuart Tract	NA	1180	Mesic Flatwoods			Polk County
11	Y	Crooked Lake Wildlife and Environmental Area	1	281	Sandhill, Mesic Flatwoods	2016	Primary Support	FL Fish and Wildlife Conservation Commission
102	Scheduled 2018/2019	Cypress Creek and Loxahatchee River Management Area	4	1615	Mesic Flatwoods			South Florida Water Management District
183	N	Cypress Creek Flood Detention Area	9	1341	Mesic Flatwoods			Southwest Florida Water Management District
204	N	Deep Creek Conservation Area (SRWMD)	10	332	Coniferous Plantation, Mesic Flatwoods			Suwannee River Water Management District
129	N - pilot survey indicates low density	Deer Lake State Park	5	1079	Mesic Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
153	N	Deer Prairie Creek Preserve	6	4038	Mesic Flatwoods	2008		Southwest Florida Water Management District
250	Y	Dixie Plantation Conservation Easement	NA	4615	Unimproved/Woodland Pasture, Coniferous Plantations	2015	Primary Support	Suwannee River Water Management District
251	N	Doris Leeper Spruce Creek Preserve	NA	1277	Scrub, Mixed Hardwood-Coniferous, Scrubby Flatwoods			Volusia County
205	N	Dr. Julian G. Bruce St. George Island State Park	10	1134	Coastal Grassland			FL Dept. of Environmental Protection, Div. of Recreation and Parks
12	N	Dunns Creek State Park	1	2479	Scrub, Sandhill			FL Dept. of Environmental Protection, Div. of Recreation and Parks
206	N	Dupuis Reserve	10	11581	Mesic Flatwoods			South Florida Water Management District
176	N	Econfina Conservation Area	8	920	Coniferous Plantations			Suwannee River Water Management District
13	N	Econfina Creek Water Management Area	1	20181	Coniferous Plantations			Northwest Florida Water Management District
14	Y	Econfina Creek WMA - Fitzhugh Carter Tract	1	948	Coniferous Plantations	2017	Primary Support	Northwest Florida Water Management District
130	Y	Edward Ball Wakulla Springs State Park	5	4817	Upland Pine, Mixed Hardwood Coniferous	2015	Primary Support	FL Dept. of Environmental Protection, Div. of Recreation and Parks
87	N	Edward Chance Reserve	3	3976	Mesic Flatwoods, Scrub			Southwest Florida Water Management District
252	N	Edward Medard Park and Reservoir	NA	320	Mixed Hardwood-Coniferous			Hillsborough County
253	Y	Eglin Air Force Base	NA	353116	Sandhill, Coniferous Plantations	2016	Secondary Support	US Dept. of Defense, Air Force
254	Y	El Destino Plantation	NA	1525	Upland Coniferous	2015	Primary Support	
154	N	Elinor Klapp-Phipps Park	6	411	Upland Hardwood Forest, Mixed Hardwood-Coniferous			City of Tallahassee
207	N - pilot survey indicates low density	Escribano Point Wildlife Management Area	10	454	Sandhill, Scrubby Flatwoods			FL Fish and Wildlife Conservation Commission
88	N	Estero Bay Preserve State Park	3	484	Mesic Flatwoods, Scrubby Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
71	Y	Etoniah Creek State Forest	2	4716	Sandhill, Scrub	2015	Viable	FL Dept. of Agriculture and Consumer Services, FL Forest Service
131	N	Falmouth Spring Conservation Area	5	265	Upland Pine			Suwannee River Water Management District
132	N	Faver-Dykes State Park	5	2005	Mesic Flatwoods, Coniferous Plantations, Maritime Hammock			FL Dept. of Environmental Protection, Div. of Recreation and Parks
255	N	Florida Horse Park	NA	499	Improved Pasture, Sandhill			Florida Agriculture and Horse Park Authority
155	N	Flying Eagle Preserve	6	1208	Ruderal pasture, some sandhill and scrub. Much of the habitat consists of large basin marshes			Southwest Florida Water Management District

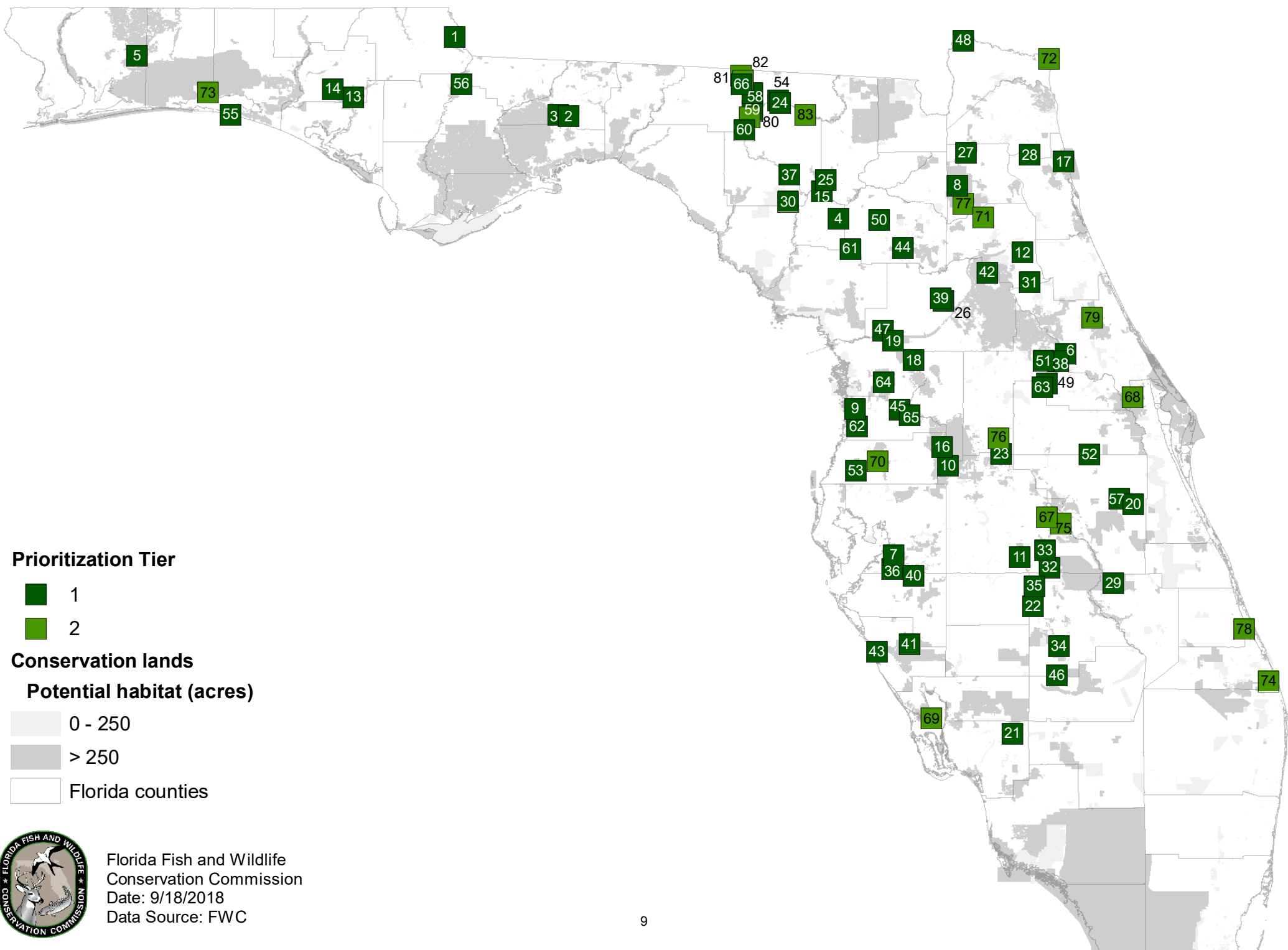
Map Label	Population Estimate?	Site Name	Prioritization Tier	Potential habitat (acres)	Predominant Natural Community	Survey Year	Population Status	Managing Agency
72	Scheduled 2018/2019	Fort Clinch State Park	2	1118	Maritime Hammock			FL Dept. of Environmental Protection, Div. of Recreation and Parks
208	N	Fort Cooper State Park	10	373	Sandhill			FL Dept. of Environmental Protection, Div. of Recreation and Parks
209	N	Fort George Island Cultural State Park	10	625	Maritime Hammock			FL Dept. of Environmental Protection, Div. of Recreation and Parks
15	Y	Fort White Wildlife and Environmental Area	1	1277	Sandhill	2014	Viable	FL Fish and Wildlife Conservation Commission
256	Y	Foshalee Plantation Conservation Easement	NA	1463	Upland Coniferous	2015	Secondary Support	Tall Timbers Research, Inc.
210	N	Fred C. Babcock-Cecil M. Webb Wildlife Management Area	10	39621	Mesic Flatwoods			FL Fish and Wildlife Conservation Commission
73	N	Fred Gannon Rocky Bayou State Park	2	284	Scrub			FL Dept. of Environmental Protection, Div. of Recreation and Parks
89	Y	Goethe State Forest	3	11200	Sandhill	2014	Viable	FL Dept. of Agriculture and Consumer Services, FL Forest Service
257	N	Golden Aster Scrub Nature Preserve	NA	959	Mesic Flatwoods, Scrub, Scrubby Flatwoods			Hillsborough County
103	N - pilot survey indicates low density	Grayton Beach State Park	4	1302	Scrub, Scrubby Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
16	Y	Green Swamp West	1	13806	Sandhill, Improved Pasture	2018	Viable	Southwest Florida Water Management District
258	N	GTMNERR - Guana River Site	NA	1531	Maritime Hammock, Coastal Scrub			FL Dept. of Environmental Protection, Florida Coastal Office
17	Y	Guana River Wildlife Management Area	1	2003	Maritime Hammock, Scrub, Scrubby Flatwoods	2015	Primary Support	FL Fish and Wildlife Conservation Commission
259	N	Guana Tolomato Matanzas National Estuarine Research Reserve	NA	433	Coastal Uplands			FL Dept. of Environmental Protection, Florida Coastal Office
260	N	Gulf Islands National Seashore	NA	1772	Coastal Scrub			US Dept. of the Interior, National Park Service
156	N	Hal Scott Regional Preserve and Park	6	5482	Mesic Flatwoods			St. Johns River Water Management District
18	Y	Half Moon Wildlife Management Area	1	2396	Improved Pasture, Mesic Flatwoods	2016	Viable	FL Fish and Wildlife Conservation Commission
19	Scheduled 2018/2019	Halpata Tastanaki Preserve	1	1700	Sandhill, Scrub, Mesic Hammock, Rural Open	2007		Southwest Florida Water Management District
20	Scheduled 2018/2019	Herky Huffman/Bull Creek Wildlife Management Area	1	13481	Mesic Flatwoods			FL Fish and Wildlife Conservation Commission
21	Y	Hickey Creek Wildlife and Environmental Area	1	410	Mesic Flatwoods, Scrubby Flatwoods	2016	Primary Support	FL Fish and Wildlife Conservation Commission
22	Y	Highlands Hammock State Park	1	3971	Scrub, Scrubby Flatwoods, Mesic Flatwoods	2017	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks
104	N	Hillsborough River State Park	4	298	Mesic Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
23	Y	Hilochee Wildlife Management Area	1	1634	Mesic Flatwoods, Coniferous Plantations	2015	Primary Support	FL Fish and Wildlife Conservation Commission
24	N	Holton Creek Conservation Area	1	1404	Upland Hardwood Forest, Coniferous Plantations			Suwannee River Water Management District
261	Y	Honeymoon Island State Park	NA	354	Beach Dune, Mesic Flatwoods, Coastal Strand	2017	Secondary Support	FL Dept. of Environmental Protection, Div. of Recreation and Parks
262	Y	Horseshoe Plantation Conservation Easement	NA	3896	Upland Coniferous	2015	Primary Support	Tall Timbers Research, Inc.
25	Y	Ichetucknee Springs State Park	1	2200	Sandhill, Upland Pine	2014	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks
211	N	Ichetucknee Trace	10	345	Coniferous Plantations			FL Dept. of Environmental Protection, Div. of Recreation and Parks
26	Scheduled 2018/2019	Indian Lake State Forest	1	4074	Sandhill, Improved Pasture			FL Dept. of Agriculture and Consumer Services, FL Forest Service
263	N	J. R. Alford Greenway	NA	331	Mixed Hardwood-Coniferous			Leon County
212	N	J. W. Corbett Wildlife Management Area	10	17532	Mesic Flatwoods			FL Fish and Wildlife Conservation Commission
90	N	Jack Creek	3	464	Scrub			Southwest Florida Water Management District
27	Y	Jennings State Forest	1	11655	Sandhill	2017	Viable	FL Dept. of Agriculture and Consumer Services, FL Forest Service
213	Y	Joe Budd Wildlife Management Area	10	1137	Upland Pine	2014	Primary Support	FL Fish and Wildlife Conservation Commission
214	N	John C. and Mariana Jones/Hungryland Wildlife and Environmental Area	10	2993	Mesic Flatwoods			FL Fish and Wildlife Conservation Commission
74	Y	Jonathan Dickinson State Park	2	4559	Scrub, Scrubby Flatwoods, Mesic Flatwoods	2015	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks
264	N	Jordan Scrub Sanctuary	NA	532	Mesic Flatwoods, Scrubby Flatwoods, Scrub			Brevard County
28	Y	Julington-Durbin Preserve	1	542	Sandhill	2017	Viable	St. Johns River Water Management District
265	N	Juno Dunes Natural Area	NA	369	Scrub			Palm Beach County
29	Y	Kissimmee Prairie Preserve State Park	1	23387	Dry Prairie	2017	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks
91	N	Kissimmee River	3	4038	Dry Prairie, Mesic Flatwoods			South Florida Water Management District
215	N - pilot survey indicates low density	L. Kirk Edwards Wildlife and Environmental Area	10	441	Upland Pine			FL Fish and Wildlife Conservation Commission
30	Y	Lafayette Forest Wildlife and Environmental Area	1	759	Coniferous Plantations	2016	Viable	FL Fish and Wildlife Conservation Commission
31	Scheduled 2018/2019	Lake George Conservation Area	1	1660	Scrub, Scrubby Flatwoods, Sand Pine Scrub			St. Johns River Water Management District
133	N	Lake June-in-Winter Scrub State Park	5	640	Scrub			FL Dept. of Environmental Protection, Div. of Recreation and Parks

Map Label	Population Estimate?	Site Name	Prioritization Tier	Potential habitat (acres)	Predominant Natural Community	Survey Year	Population Status	Managing Agency
75	Scheduled 2018/2019	Lake Kissimmee State Park	2	1294	Mesic Flatwoods, Scrubby Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
76	Y	Lake Louisa State Park	2	1385	Unimproved/Woodland Pasture, Coniferous Plantations	2015	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks
92	N	Lake Manatee State Park	3	503	Mesic Flatwoods, Scrub, Scrubby Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
93	N	Lake Monroe Conservation Area	3	562	Scrubby Flatwoods			St. Johns River Water Management District
134	N	Lake Norris Conservation Area	5	468	Improved Pasture			St. Johns River Water Management District
157	N	Lake Panasoffkee	6	1869	Improved Pasture, Mesic Hammock, Scrubby Flatwoods	2009		Southwest Florida Water Management District
216	N - pilot survey indicates low density	Lake Talquin State Forest	10	10145	Upland Pine			FL Dept. of Agriculture and Consumer Services, FL Forest Service
217	N	Lake Talquin State Park	10	295	Sandhill, Upland Hardwood Forest			FL Dept. of Environmental Protection, Div. of Recreation and Parks
32	N	Lake Wales Ridge State Forest - Arbuckle	1	1006	Scrub, Mesic Flatwoods, Sandhill			FL Dept. of Agriculture and Consumer Services, FL Forest Service
94	N	Lake Wales Ridge State Forest - Hesperides	3	418	Scrub, Sandhill, Mesic Flatwoods			FL Dept. of Agriculture and Consumer Services, FL Forest Service
135	N	Lake Wales Ridge State Forest - Prairie	5	1635	Dry Prairie			FL Dept. of Agriculture and Consumer Services, FL Forest Service
33	N	Lake Wales Ridge State Forest - Walk-in-Water	1	745	Sandhill			FL Dept. of Agriculture and Consumer Services, FL Forest Service
218	Y	Lake Wales Ridge Wildlife and Environmental Area - Carter Creek	10	1939	Scrub, Scrubby Flatwoods	2015	Primary Support	FL Fish and Wildlife Conservation Commission
34	Scheduled 2018/2019	Lake Wales Ridge Wildlife and Environmental Area - Lake Placid/McJunkin	1	2002	Scrub, Scrubby Flatwoods, Sandhill, Mesic Flatwoods			FL Fish and Wildlife Conservation Commission
219	N - pilot survey indicates low density	Lake Wales Ridge Wildlife and Environmental Area - Royce/Clements	10	1152	Improved Pasture, Scrub, Scrubby Flatwoods			FL Fish and Wildlife Conservation Commission
35	Y	Lake Wales Ridge Wildlife and Environmental Area - Silver Lake	1	353	Scrubby Flatwoods, Mesic Flatwoods, Scrub, Sandhill	2015	Viable	FL Fish and Wildlife Conservation Commission
105	N	Little Big Econ State Forest	4	1108	Scrubby Flatwoods, Scrub, Mesic Flatwoods			FL Dept. of Agriculture and Consumer Services, FL Forest Service
220	N	Little Gator Creek Wildlife and Environmental Area	10	316	Mesic Flatwoods			FL Fish and Wildlife Conservation Commission
136	N	Little Manatee River (SWFWMD)-Southfork	5	493	Unimproved/Woodland Pasture, Scrub			Southwest Florida Water Management District
266	N	Little Manatee River Corridor	NA	1308	Mesic Flatwoods			Hillsborough County
36	Y	Little Manatee River State Park	1	1430	Mesic Flatwoods, Scrub	2018	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks
37	Scheduled 2018/2019	Little River Conservation Area	1	1849	Sandhill			Suwannee River Water Management District
95	Y	Little Talbot Island State Park	3	1199	Maritime Hammock, Coastal Strand	2014	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks
106	N	Lochloosa Wildlife Conservation Area	4	1518	Coniferous Plantations, Scrubby Flatwoods			St. Johns River Water Management District
137	N	Longleaf Flatwoods Reserve	5	848	Coniferous Plantations			St. Johns River Water Management District
184	N	Lower Alapaha Conservation Area	9	423	Coniferous Plantations			Suwannee River Water Management District
96	N	Lower Hillsborough Flood Detention Area	3	4200	Mesic Flatwoods			Southwest Florida Water Management District
107	N	Lower Peace River Corridor (Deep Creek Tract)	4	1111	Mesic Flatwoods			Southwest Florida Water Management District
38	N	Lower Wekiva River Preserve State Park	1	846	Mesic Flatwoods, Sandhill			FL Dept. of Environmental Protection, Div. of Recreation and Parks
267	N	Lyonia Preserve	NA	308	Scrub			Volusia County
158	N	Manatee Springs State Park	6	1434	Mixed Hardwood-Coniferous, Upland Mixed Woodland			FL Dept. of Environmental Protection, Div. of Recreation and Parks
39	One tract scheduled 2018/2019	Marjorie Harris Carr Cross Florida Greenway State Recreation and Conservation Area	1	14359	Sandhill			FL Dept. of Environmental Protection, Div. of Recreation and Parks
221	N	Matanzas State Forest	10	696	Coniferous Plantations, Maritime Hammock			FL Dept. of Agriculture and Consumer Services, Florida Forest Service
268	Y	Merrily Plantation Conservation Easement	NA	1457	Upland Coniferous	2015	Secondary Support	Tall Timbers Research, Inc.
269	N	Micco Scrub Sanctuary	NA	506	Mesic Flatwoods, Scrubby Flatwoods			Brevard County
270	N	Miccosukee Canopy Road Greenway	NA	348	Upland Coniferous, Coniferous Plantations, Oak Scrub			Leon County
185	N	Middle Aucilla Conservation Area	9	1453	Coniferous Plantations			Suwannee River Water Management District
77	Y	Mike Roess Gold Head Branch State Park	2	1896	Sandhill	2014	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks
40	Y	Moody Branch Wildlife and Environmental Area	1	574	Scrub, Scrubby Flatwoods, Mesic Flatwoods	2015	Viable	FL Fish and Wildlife Conservation Commission
177	N	Moses Creek Conservation Area	8	1044	Mixed Hardwood-Coniferous, Shrub and Brushland			St. Johns River Water Management District
166	N	Myakka River (Schewe tract)	7	2553	Mesic Flatwoods			Southwest Florida Water Management District
41	N	Myakka River State Park	1	19669	Dry Prairie			FL Dept. of Environmental Protection, Div. of Recreation and Parks

Map Label	Population Estimate?	Site Name	Prioritization Tier	Potential habitat (acres)	Predominant Natural Community	Survey Year	Population Status	Managing Agency
108	N	Myakka State Forest	4	4886	Mesic Flatwoods			FL Dept. of Agriculture and Consumer Services, FL Forest Service
159	N	Newnans Lake Conservation Area	6	541	Coniferous Plantations, Mesic Flatwoods			St. Johns River Water Management District
160	N	North Peninsula State Park	6	390	Coastal Scrub			FL Dept. of Environmental Protection, Div. of Recreation and Parks
42	Y	Ocala National Forest - Riverside Island Sandhill	1	286725	Sand Pine Scrub	2015	Primary Support	US Dept. of Agriculture, Forest Service
138	N	Ocklawaha Prairie Restoration Area	5	539	Coniferous Plantations			St. Johns River Water Management District
222	N	Okaloacoochee Slough State Forest	10	7431	Mesic Flatwoods			FL Dept. of Agriculture and Consumer Services, FL Forest Service
109	Y	O'leno State Park	4	1574	Scrub, Mesic Flatwoods	2014	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks
43	Scheduled 2018/2019	Oscar Scherer State Park	1	1171	Mesic Flatwoods, Scrubby Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
223	N	Osprey Unit	10	1055	Mesic Flatwoods			FL Fish and Wildlife Conservation Commission
44	N	Paynes Prairie Preserve State Park	1	1647	Mixed Hardwood Coniferous, Upland Pine, Mesic Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
110	N	Peacock Springs Conservation Area	4	618	Coniferous Plantations			Suwannee River Water Management District
111	N	Pellicer Creek Conservation Area	4	1173	Coniferous Plantations			St. Johns River Water Management District
45	Y	Perry Oldenburg Wildlife and Environmental Area	1	336	Sandhill	2015	Primary Support	FL Fish and Wildlife Conservation Commission
167	N	Picayune Strand State Forest	7	1505	Mesic Flatwoods			FL Dept. of Agriculture and Consumer Services, FL Forest Service
112	N	Pine Log State Forest	4	2984	Sandhill, Mesic Flatwoods	2015		FL Dept. of Agriculture and Consumer Services, FL Forest Service
46	Y	Platt Branch Wildlife and Environmental Area	1	921	Mesic Flatwoods, Scrub, Improved Pasture	2017	Viable	FL Fish and Wildlife Conservation Commission
113	N - pilot survey indicates low density	Point Washington State Forest	4	4936	Sandhill, Mesic Flatwoods, Scrubby Flatwoods, Scrub	2014		FL Dept. of Agriculture and Consumer Services, Florida Forest Service
139	N	Potts Preserve	5	1267	Scrub, Scrubby Flatwoods, Ruderal			Southwest Florida Water Management District
140	N	Prairie/Shell Creek	5	316	Mesic Flatwoods and Scrub/Scrubby FW			Southwest Florida Water Management District
114	N	Price's Scrub	4	399	Scrubby Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
97	N - pilot survey indicates low density	Pumpkin Hill Creek Preserve State Park	3	581	Scrubby Flatwoods, Coniferous Plantations			FL Dept. of Environmental Protection, Div. of Recreation and Parks
47	Y	Rainbow Springs State Park	1	999	Sandhill	2018	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks
48	Y	Ralph E. Simmons State Forest	1	787	Sandhill	2017	Viable	FL Dept. of Agriculture and Consumer Services, FL Forest Service
115	Y	River Rise Preserve State Park	4	2341	Upland Pine, Sandhill	2014	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks
49	N	Rock Springs Run State Reserve	1	2247	Scrubby Flatwoods, Scrub			FL Dept. of Environmental Protection, Div. of Recreation and Parks
271	N	Rookery Bay National Estuarine Research Reserve	NA	1709	Scrub, Mesic Flatwoods, Maritime Hammock			FL Dept. of Environmental Protection, Florida Coastal Office
98	N	Ross Prairie State Forest	3	2679	Sandhill, Scrubby Flatwoods			FL Dept. of Agriculture and Consumer Services, FL Forest Service
178	N	RV Griffin Reserve (GDC)	8	1191	Dry Prairie, Mesic Flatwoods			Southwest Florida Water Management District
224	N - pilot survey indicates low density	Salt Lake Wildlife Management Area	10	992	Mesic Flatwoods	2010		FL Fish and Wildlife Conservation Commission
50	N	San Felasco Hammock Preserve State Park	1	4039	Mixed Hardwood Coniferous, Upland Pine			FL Dept. of Environmental Protection, Div. of Recreation and Parks
225	N	Santa Fe Springs Conservation Area	10	584	Coniferous Plantations			Suwannee River Water Management District
78	N - pilot survey indicates low density	Savannas Preserve State Park	2	3282	Mesic Flatwoods, Scrub			FL Dept. of Environmental Protection, Div. of Recreation and Parks
99	Scheduled 2018/2019	Seabranh Preserve State Park	3	611	Scrub, Scrubby Flatwoods, Mesic Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
179	N	Sebastian Inlet State Park	8	251	Maritime Hammock, Coastal Strand			FL Dept. of Environmental Protection, Div. of Recreation and Parks
226	N	Seminole Ranch Conservation Area	10	559	Mesic Flatwoods			St. Johns River Water Management District
51	N	Seminole State Forest	1	8791	Scrub			FL Dept. of Agriculture and Consumer Services, FL Forest Service
272	N	Silver Springs Conservation Area	NA	317	Sandhill, Mixed Hardwood-Coniferous			Marion County
141	N	Silver Springs State Park	5	955	Sandhill, Scrubby Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
142	N	Southfork State Park	5	577	Scrub, Mixed Hardwood-Coniferous, Mesic Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
227	N	Spirit of the Wild Wildlife Management Area	10	1425	Mesic Flatwoods			FL Fish and Wildlife Conservation Commission
52	Scheduled 2019/2020	Split Oak Forest Wildlife and Environmental Area	1	931	Scrubby Flatwoods, Mesic Flatwoods			FL Fish and Wildlife Conservation Commission
228	N	St. Andrews State Park	10	601	Coastal Scrub, Maritime Hammock, Beach Dune			FL Dept. of Environmental Protection, Div. of Recreation and Parks
273	N	St. Joseph Bay State Buffer Preserve	NA	421	Scrubby Flatwoods, Scrub			FL Dept. of Environmental Protection, Florida Coastal Office
274	Y	St. Marks National Wildlife Refuge	NA	8422	Sandhill	2011	Viable	US Dept. of the Interior, Fish and Wildlife Service
168	N	St. Marks River Preserve State Park	7	1027	Coniferous Plantations, Mesic Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
275	Y	St. Sebastian River Preserve State Park	NA	13686	Mesic Flatwoods, Scrubby Flatwoods	2015	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks

Map Label	Population Estimate?	Site Name	Prioritization Tier	Potential habitat (acres)	Predominant Natural Community	Survey Year	Population Status	Managing Agency
53	N	Starkey Wilderness Preserve	1	10485	Mesic Flatwoods, Scrubby Flatwoods, Scrub			Southwest Florida Water Management District
116	N	Sunnyhill Restoration Area	4	345	Scrub, Unimproved/Woodland Pasture			St. Johns River Water Management District
54	Y	Suwannee Ridge Wildlife and Environmental Area	1	1136	Sandhill	2016	Viable	FL Fish and Wildlife Conservation Commission
117	N	Suwannee River State Park	4	1163	Mixed Hardwood Coniferous, Sandhill, Upland Pine			FL Dept. of Environmental Protection, Div. of Recreation and Parks
161	N	Suwannee Valley Conservation Area	6	706	Coniferous Plantations, Mesic Flatwoods, Scrubby Flatwoods			Suwannee River Water Management District
229	N	T. H. Stone Memorial St. Joseph Peninsula State Park	10	1439	Coastal Scrub			FL Dept. of Environmental Protection, Div. of Recreation and Parks
276	Y	Tall Timbers Research Station and Land Conservancy	NA	2091	Upland Coniferous	2015	Secondary Support	Tall Timbers Research, Inc.
143	N	Tarkiln Bayou Preserve State Park	5	707	Mesic Flatwoods, Sandhill			FL Dept. of Environmental Protection, Div. of Recreation and Parks
230	Y	Tate's Hell State Forest	10	3474	Coniferous Plantations	2017	Secondary Support	FL Dept. of Agriculture and Consumer Services, FL Forest Service
231	N	Tenoroc Fish Management Area	10	778	Unimproved/Woodland Pasture, Coniferous Plantations, (Cropland/Pasture)			FL Fish and Wildlife Conservation Commission
232	N - pilot survey indicates low density	Three Lakes Wildlife Management Area	10	36121	Mesic Flatwoods, Dry Prairie			FL Fish and Wildlife Conservation Commission
79	N	Tiger Bay State Forest	2	1011	Scrub	2017		FL Dept. of Agriculture and Consumer Services, FL Forest Service
186	N	Tomoka State Park	9	462	Xeric Hammock, Maritime Hammock, Scrubby Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
55	N	Topsail Hill Preserve State Park	1	671	Beach Dune, Scrubby Flatwoods, Coastal Scrub			FL Dept. of Environmental Protection, Div. of Recreation and Parks
56	Y	Torrey State Park	1	8104	Coniferous Plantations, Upland Pine	2017	Primary Support	FL Dept. of Environmental Protection, Div. of Recreation and Parks
233	N	Tosohatchee Wildlife Management Area	10	2810	Mesic Flatwoods			FL Fish and Wildlife Conservation Commission
57	Scheduled 2018/2019	Triple N Ranch Wildlife Management Area	1	8823	Mesic Flatwoods			FL Fish and Wildlife Conservation Commission
100	N	Troy Spring Conservation Area	3	1447	Coniferous Plantations, Mesic Hammock, Upland Pine,			Suwannee River Water Management District
101	N	Twin Rivers State Forest - Anderson Springs Tract	3	719	Coniferous Plantations, Upland Pine			FL Dept. of Agriculture and Consumer Services, FL Forest Service
80	N	Twin Rivers State Forest - Black/Damascus Tract	2	862	Coniferous Plantations, Upland Pine			FL Dept. of Agriculture and Consumer Services, FL Forest Service
58	Y	Twin Rivers State Forest - Blue Springs Tract	1	845	Upland Pine, Coniferous Plantations	2017	Viable	FL Dept. of Agriculture and Consumer Services, FL Forest Service
162	N	Twin Rivers State Forest - Chitty Bend West Tract	6	291	Upland Pine, Clearcut			FL Dept. of Agriculture and Consumer Services, FL Forest Service
59	Y	Twin Rivers State Forest - Ellaville Tract	1	2570	Coniferous Plantations	2017	Viable	FL Dept. of Agriculture and Consumer Services, FL Forest Service
169	N	Twin Rivers State Forest - Mill Creek North Tract	7	362	Coniferous Plantations			FL Dept. of Agriculture and Consumer Services, FL Forest Service
60	N	Twin Rivers State Forest - Mill Creek South Tract	1	1110	Coniferous Plantations			FL Dept. of Agriculture and Consumer Services, FL Forest Service
234	N	Twin Rivers State Forest - Nekoosa Tract	10	332	Coniferous Plantations, Upland Pine, Mesic Hammock			FL Dept. of Agriculture and Consumer Services, FL Forest Service
81	N	Twin Rivers State Forest - Sullivan Tract	2	334	Coniferous Plantations, Upland Pine, Mesic Hammock			FL Dept. of Agriculture and Consumer Services, FL Forest Service
82	N	Twin Rivers State Forest - Westwood East Tract	2	374	Upland Pine, Sandhill, Mesic Hammock			FL Dept. of Agriculture and Consumer Services, FL Forest Service
118	N	Twin Rivers State Forest - Westwood West Tract	4	413	Coniferous Plantations			FL Dept. of Agriculture and Consumer Services, FL Forest Service
144	N	Twin Rivers State Forest - Withlacoochee Tract	5	896	Coniferous Plantations, Upland Pine			FL Dept. of Agriculture and Consumer Services, FL Forest Service
170	N	Upper Alapaha Conservation Area	7	1003	Mixed Hardwood-Coniferous, Coniferous Plantations, Mesic Flatwoods			Suwannee River Water Management District
187	N	Upper Chipola River Water Management Area	9	863	Coniferous Plantations			Northwest Florida Water Management District
119	N	Upper Hillsborough	4	4120	Mesic Flatwoods			Southwest Florida Water Management District
145	N	Upper Lakes Basin Watershed	5	1549	Mesic Flatwoods, Scrub			South Florida Water Management District
277	N	Upper Little Manatee River	NA	450	Mesic Flatwoods, Scrubby Flatwoods			Hillsborough County
235	N	Upper Myakka River Watershed	10	286	Mesic Flatwoods			Southwest Florida Water Management District
236	N	Upper Steinhatchee Conservation Area	10	673	Coniferous Plantations			Suwannee River Water Management District
278	N	Valkaria Expansion	NA	456	Mesic Flatwoods			Brevard County
279	N	Valkaria Scrub Sanctuary	NA	625	Mesic Flatwoods, Scrub, Scrubby Flatwoods			Brevard County
237	Y	Wakulla State Forest	10	4126	Coniferous Plantations, Upland Hardwood Forest	2016	Primary Support	FL Dept. of Agriculture and Consumer Services, FL Forest Service
180	N	Wannee Conservation Area	8	1014	Upland Hardwood Forest, Mixed Hardwood-Coniferous			Suwannee River Water Management District
146	N	Washington Oaks Gardens State Park	5	358	Maritime Hammock, Coastal Scrub, Coastal Strand			FL Dept. of Environmental Protection, Div. of Recreation and Parks
61	Y	Watermelon Pond Wildlife and Environmental Area	1	727	Xeric Hammock, Sandhill, Improved Pasture, Coniferous Plantations	2014	Primary Support	FL Fish and Wildlife Conservation Commission
62	N	Weeki Wachee Springs State Park	1	328	Scrub, Coastal Scrub			FL Dept. of Environmental Protection, Div. of Recreation and Parks

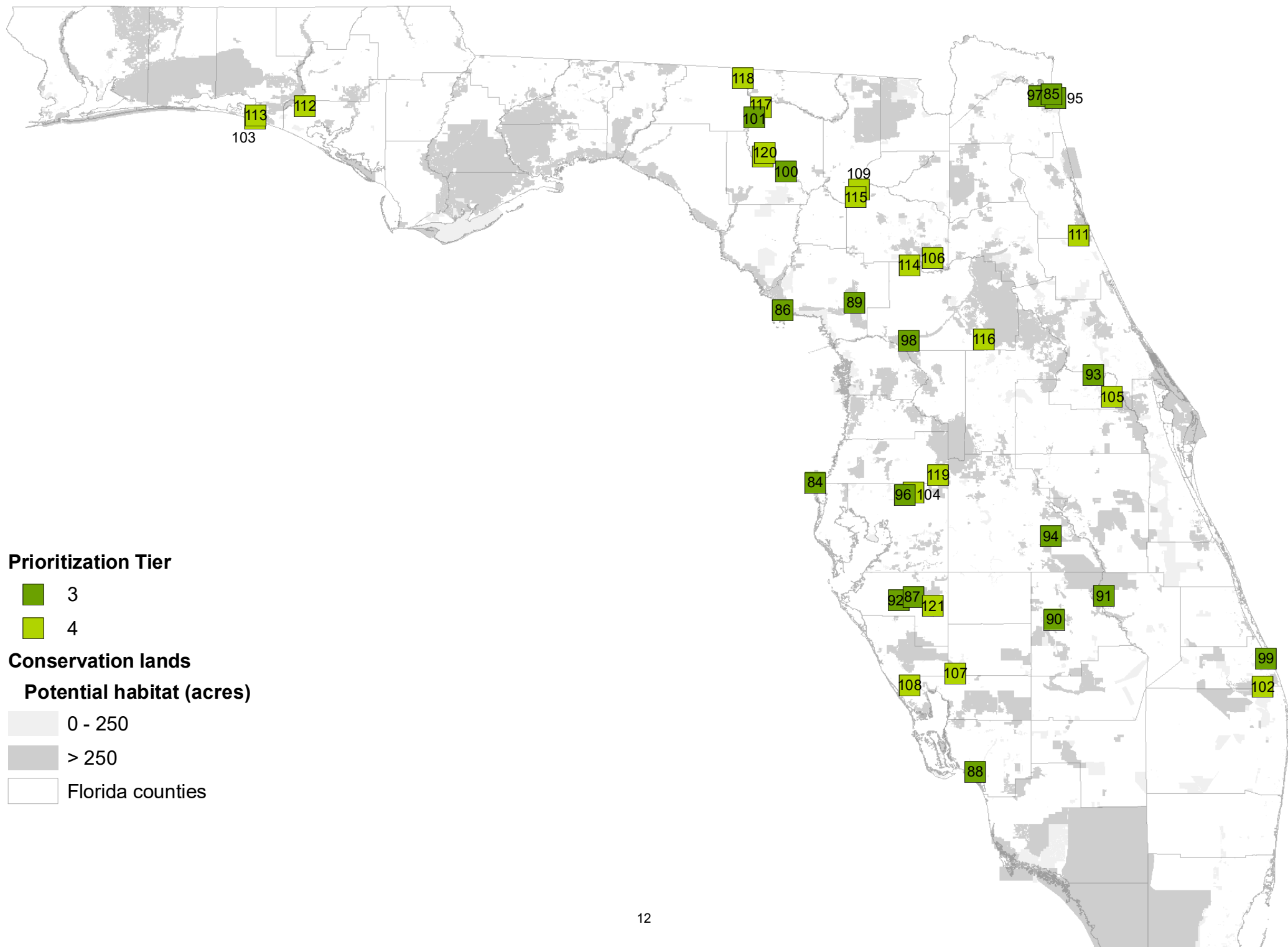
Map Label	Population Estimate?	Site Name	Prioritization Tier	Potential habitat (acres)	Predominant Natural Community	Survey Year	Population Status	Managing Agency
181	N	Weekiwachee Preserve	8	1692	Scrubby Flatwoods, Mesic Flatwoods,			Southwest Florida Water Management District
63	N	Wekiwa Springs State Park	1	3223	Sandhill, Scrubby Flatwoods	2009		FL Dept. of Environmental Protection, Div. of Recreation and Parks
188	N	Welaka State Forest	9	630	Sandhill, Scrubby Flatwoods	2011		FL Dept. of Agriculture and Consumer Services, FL Forest Service
171	N	Werner-Boyce Salt Springs State Park	7	584	Maritime Hammock, Mesic Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
120	N	Wes Skiles Peacock Springs State Park	4	625	Coniferous Plantations, Upland Pine, Mixed Hardwood-Coniferous			FL Dept. of Environmental Protection, Div. of Recreation and Parks
121	Y	Wingate Creek State Park	4	398	Scrubby Flatwoods, Mesic Flatwoods, Scrub	2015	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks
64	Y	Withlacoochee State Forest - Citrus Tract	1	44229	Sandhill	2015	Viable	FL Dept. of Agriculture and Consumer Services, FL Forest Service
65	Y	Withlacoochee State Forest - Croom Tract	1	12762	Sandhill	2016	Viable	FL Dept. of Agriculture and Consumer Services, FL Forest Service
147	N	Withlacoochee State Forest - Headquarters Tract	5	1753	Sandhill			FL Dept. of Agriculture and Consumer Services, FL Forest Service
148	N	Withlacoochee State Forest - Two-mile Prairie Tract	5	2350	Coniferous Plantations			FL Dept. of Agriculture and Consumer Services, FL Forest Service
66	Y	Withlacoochee West Conservation Area - Quail Farms Tract	1	697	Coniferous Plantations, Upland Pine	2018	Primary Support	Suwannee River Water Management District
280	Y	Woodfield Springs Plantation Conservation Easement	NA	1743	Upland Coniferous	2015	Primary Support	Tall Timbers Research, Inc.
83	N	Woods Ferry Conservation Area	2	1321	Sandhill, Scrubby Flatwoods			Suwannee River Water Management District
238	N	Yucca Pens Unit	10	8190	Mesic Flatwoods			FL Fish and Wildlife Conservation Commission



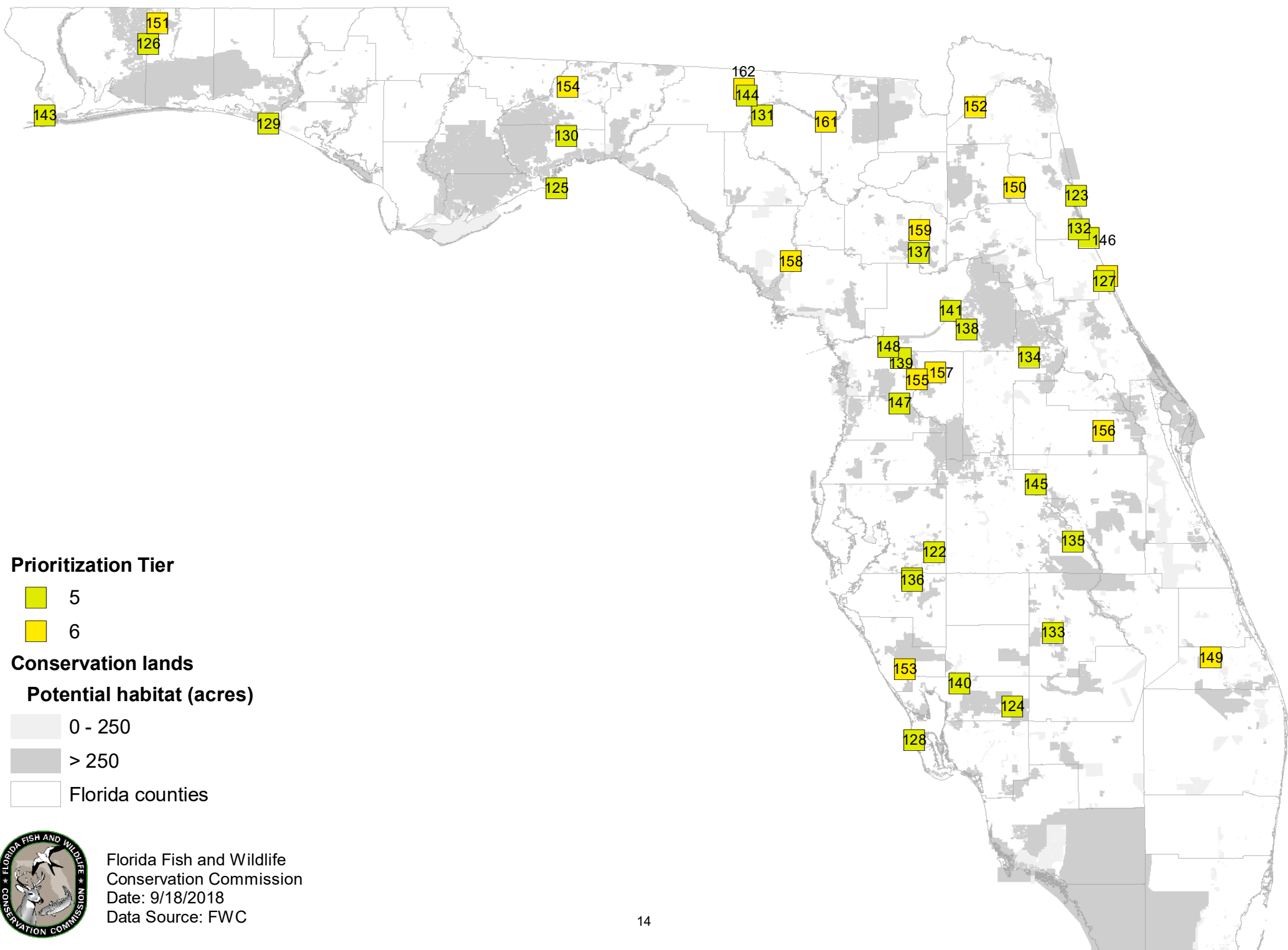
Florida Fish and Wildlife
Conservation Commission
Date: 9/18/2018
Data Source: FWC

Map Label	Population Estimate?	Site Name	Prioritization Tier	Potential habitat (acres)	Predominant Natural Community	Survey Year	Population Status	Managing Agency
1	Y	Apalachee Wildlife Management Area	1	3068	Upland Pine, Sandhill	2017	Viable	FL Fish and Wildlife Conservation Commission
2	Y	Apalachicola National Forest - Munson East	1	3600	Sandhill	2015	Viable	US Dept. of Agriculture, Forest Service
3	Y	Apalachicola National Forest - Munson West	1	14032	Sandhill	2015	Primary Support	US Dept. of Agriculture, Forest Service
4	Y	Bell Ridge Longleaf Wildlife and Environmental Area	1	716	Sandhill	2014	Viable	FL Fish and Wildlife Conservation Commission
5	Scheduled 2018/2019	Blackwater River State Forest - Juniper Creek Unit (includes Hutton Unit and Blackwater River State Park)	1	14331	Upland Pine, Sandhill			FL Dept. of Agriculture and Consumer Services, FL Forest Service
6	Scheduled 2018/2019	Blue Spring State Park	1	1089	Scrub			FL Dept. of Environmental Protection, Div. of Recreation and Parks
7	Y	Bullfrog Creek Wildlife and Environmental Area	1	560	Mesic Flatwoods	2016	Viable	FL Fish and Wildlife Conservation Commission
8	N	Camp Blanding Military Reservation	1	34072	Sandhill, Pine Flatwoods and Dry Prairie			FL Dept. of Military Affairs
9	Y	Chassahowitzka Wildlife Management Area	1	8130	Sandhill	2017	Viable	FL Fish and Wildlife Conservation Commission
10	N	Colt Creek State Park	1	1906	Mesic Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
11	Y	Crooked Lake Wildlife and Environmental Area	1	281	Sandhill, Mesic Flatwoods	2016	Primary Support	FL Fish and Wildlife Conservation Commission
12	N	Dunns Creek State Park	1	2479	Scrub, Sandhill			FL Dept. of Environmental Protection, Div. of Recreation and Parks
13	N	Econfina Creek Water Management Area	1	20181	Coniferous Plantations			Northwest Florida Water Management District
14	Y	Econfina Creek WMA - Fitzhugh Carter Tract	1	948	Coniferous Plantations	2017	Primary Support	Northwest Florida Water Management District
15	Y	Fort White Wildlife and Environmental Area	1	1277	Sandhill	2014	Viable	FL Fish and Wildlife Conservation Commission
16	Y	Green Swamp West	1	13806	Sandhill, Improved Pasture	2018	Viable	Southwest Florida Water Management District
17	Y	Guana River Wildlife Management Area	1	2003	Maritime Hammock, Scrub, Scrubby Flatwoods	2015	Primary Support	FL Fish and Wildlife Conservation Commission
18	Y	Half Moon Wildlife Management Area	1	2396	Improved Pasture, Mesic Flatwoods	2016	Viable	FL Fish and Wildlife Conservation Commission
19	Scheduled 2018/2019	Halpata Tastanaki Preserve	1	1700	Sandhill, Scrub, Mesic Hammock, Rural Open	2007		Southwest Florida Water Management District
20	Scheduled 2018/2019	Herky Huffman/Bull Creek Wildlife Management Area	1	13481	Mesic Flatwoods			FL Fish and Wildlife Conservation Commission
21	Y	Hickey Creek Wildlife and Environmental Area	1	410	Mesic Flatwoods, Scrubby Flatwoods	2016	Primary Support	FL Fish and Wildlife Conservation Commission
22	Y	Highlands Hammock State Park	1	3971	Scrub, Scrubby Flatwoods, Mesic Flatwoods	2017	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks
23	Y	Hilochee Wildlife Management Area	1	1634	Mesic Flatwoods, Coniferous Plantations	2015	Primary Support	FL Fish and Wildlife Conservation Commission
24	N	Holton Creek Conservation Area	1	1404	Upland Hardwood Forest, Coniferous Plantations			Suwannee River Water Management District
25	Y	Ichetucknee Springs State Park	1	2200	Sandhill, Upland Pine	2014	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks
26	Scheduled 2018/2019	Indian Lake State Forest	1	4074	Sandhill, Improved Pasture			FL Dept. of Agriculture and Consumer Services, FL Forest Service
27	Y	Jennings State Forest	1	11655	Sandhill	2017	Viable	FL Dept. of Agriculture and Consumer Services, FL Forest Service
28	Y	Julington-Durbin Preserve	1	542	Sandhill	2017	Viable	St. Johns River Water Management District
29	Y	Kissimmee Prairie Preserve State Park	1	23387	Dry Prairie	2017	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks
30	Y	Lafayette Forest Wildlife and Environmental Area	1	759	Coniferous Plantations	2016	Viable	FL Fish and Wildlife Conservation Commission
31	Scheduled 2018/2019	Lake George Conservation Area	1	1660	Scrub, Scrubby Flatwoods, Sand Pine Scrub			St. Johns River Water Management District
32	N	Lake Wales Ridge State Forest - Arbuckle	1	1006	Scrub, Mesic Flatwoods, Sandhill			FL Dept. of Agriculture and Consumer Services, FL Forest Service
33	N	Lake Wales Ridge State Forest - Walk-in-Water	1	745	Sandhill			FL Dept. of Agriculture and Consumer Services, FL Forest Service
34	Scheduled 2018/2019	Lake Wales Ridge Wildlife and Environmental Area - Lake Placid/McJunkin	1	2002	Scrub, Scrubby Flatwoods, Sandhill, Mesic Flatwoods			FL Fish and Wildlife Conservation Commission
35	Y	Lake Wales Ridge Wildlife and Environmental Area - Silver Lake	1	353	Scrubby Flatwoods, Mesic Flatwoods, Scrub, Sandhill	2015	Viable	FL Fish and Wildlife Conservation Commission
36	Y	Little Manatee River State Park	1	1430	Mesic Flatwoods, Scrub	2018	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks
37	Scheduled 2018/2019	Little River Conservation Area	1	1849	Sandhill			Suwannee River Water Management District
38	N	Lower Wekiva River Preserve State Park	1	846	Mesic Flatwoods, Sandhill			FL Dept. of Environmental Protection, Div. of Recreation and Parks
39	One tract scheduled 2018/2019	Marjorie Harris Carr Cross Florida Greenway State Recreation and Conservation Area	1	14359	Sandhill			FL Dept. of Environmental Protection, Div. of Recreation and Parks
40	Y	Moody Branch Wildlife and Environmental Area	1	574	Scrub, Scrubby Flatwoods, Mesic Flatwoods	2015	Viable	FL Fish and Wildlife Conservation Commission
41	N	Myakka River State Park	1	19669	Dry Prairie			FL Dept. of Environmental Protection, Div. of Recreation and Parks
42	Y	Ocala National Forest - Riverside Island Sandhill	1	286725	Sand Pine Scrub	2015	Primary Support	US Dept. of Agriculture, Forest Service
43	Scheduled 2018/2019	Oscar Scherer State Park	1	1171	Mesic Flatwoods, Scrubby Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
44	N	Paynes Prairie Preserve State Park	1	1647	Mixed Hardwood Coniferous, Upland Pine, Mesic Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
45	Y	Perry Oldenburg Wildlife and Environmental Area	1	336	Sandhill	2015	Primary Support	FL Fish and Wildlife Conservation Commission

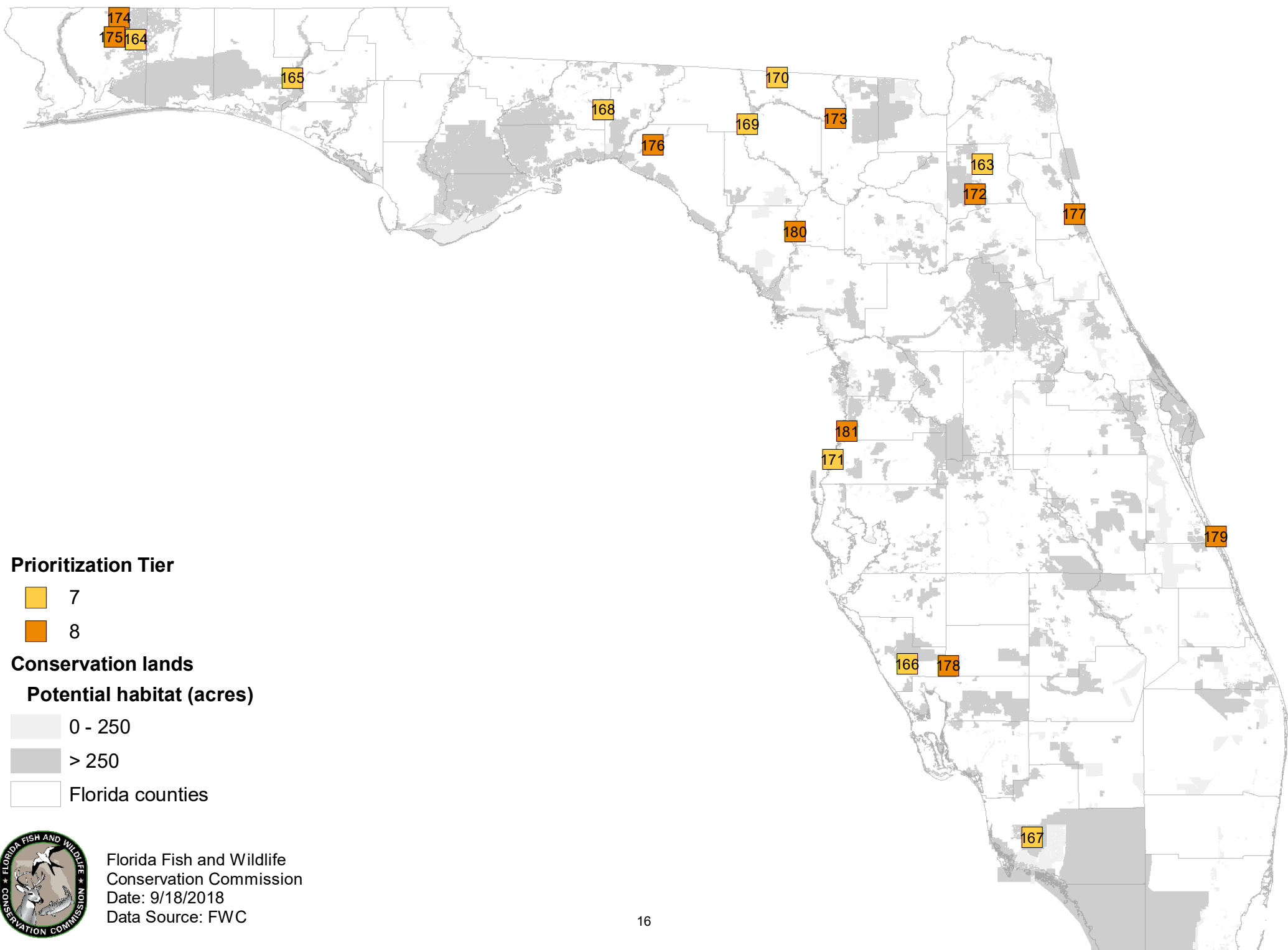
Map Label	Population Estimate?	Site Name	Prioritization Tier	Potential habitat (acres)	Predominant Natural Community	Survey Year	Population Status	Managing Agency
46	Y	Platt Branch Wildlife and Environmental Area	1	921	Mesic Flatwoods, Scrub, Improved Pasture	2017	Viable	FL Fish and Wildlife Conservation Commission
47	Y	Rainbow Springs State Park	1	999	Sandhill	2018	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks
48	Y	Ralph E. Simmons State Forest	1	787	Sandhill	2017	Viable	FL Dept. of Agriculture and Consumer Services, FL Forest Service
49	N	Rock Springs Run State Reserve	1	2247	Scrubby Flatwoods, Scrub			FL Dept. of Environmental Protection, Div. of Recreation and Parks
50	N	San Felasco Hammock Preserve State Park	1	4039	Mixed Hardwood Coniferous, Upland Pine			FL Dept. of Environmental Protection, Div. of Recreation and Parks
51	N	Seminole State Forest	1	8791	Scrub			FL Dept. of Agriculture and Consumer Services, FL Forest Service
52	Scheduled 2019/2020	Split Oak Forest Wildlife and Environmental Area	1	931	Scrubby Flatwoods, Mesic Flatwoods			FL Fish and Wildlife Conservation Commission
53	N	Starkey Wilderness Preserve	1	10485	Mesic Flatwoods, Scrubby Flatwoods, Scrub			Southwest Florida Water Management District
54	Y	Suwannee Ridge Wildlife and Environmental Area	1	1136	Sandhill	2016	Viable	FL Fish and Wildlife Conservation Commission
55	N	Topsail Hill Preserve State Park	1	671	Beach Dune, Scrubby Flatwoods, Coastal Scrub			FL Dept. of Environmental Protection, Div. of Recreation and Parks
56	Y	Torrey State Park	1	8104	Coniferous Plantations, Upland Pine	2017	Primary Support	FL Dept. of Environmental Protection, Div. of Recreation and Parks
57	Scheduled 2018/2019	Triple N Ranch Wildlife Management Area	1	8823	Mesic Flatwoods			FL Fish and Wildlife Conservation Commission
58	Y	Twin Rivers State Forest - Blue Springs Tract	1	845	Upland Pine, Coniferous Plantations	2017	Viable	FL Dept. of Agriculture and Consumer Services, FL Forest Service
59	Y	Twin Rivers State Forest - Ellaville Tract	1	2570	Coniferous Plantations	2017	Viable	FL Dept. of Agriculture and Consumer Services, FL Forest Service
60	N	Twin Rivers State Forest - Mill Creek South Tract	1	1110	Coniferous Plantations			FL Dept. of Agriculture and Consumer Services, FL Forest Service
61	Y	Watermelon Pond Wildlife and Environmental Area	1	727	Xeric Hammock, Sandhill, Improved Pasture, Coniferous Plantations	2014	Primary Support	FL Fish and Wildlife Conservation Commission
62	N	Weeki Wachee Springs State Park	1	328	Scrub, Coastal Scrub			FL Dept. of Environmental Protection, Div. of Recreation and Parks
63	N	Wekiwa Springs State Park	1	3223	Sandhill, Scrubby Flatwoods	2009		FL Dept. of Environmental Protection, Div. of Recreation and Parks
64	Y	Withlacoochee State Forest - Citrus Tract	1	44229	Sandhill	2015	Viable	FL Dept. of Agriculture and Consumer Services, FL Forest Service
65	Y	Withlacoochee State Forest - Croom Tract	1	12762	Sandhill	2016	Viable	FL Dept. of Agriculture and Consumer Services, FL Forest Service
66	Y	Withlacoochee West Conservation Area - Quail Farms Tract	1	697	Coniferous Plantations, Upland Pine	2018	Primary Support	Suwannee River Water Management District
67	N - pilot survey indicates low density	Allen David Broussard Catfish Creek Preserve State Park	2	2736	Scrub			FL Dept. of Environmental Protection, Div. of Recreation and Parks
68	N	Buck Lake Conservation Area	2	2142	Mesic Flatwoods			St. Johns River Water Management District
69	N	Charlotte Harbor Preserve State Park	2	4979	Mesic Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
70	N	Conner Preserve	2	773	Mesic Flatwoods, Sandhill			Southwest Florida Water Management District
71	Y	Etoniah Creek State Forest	2	4716	Sandhill, Scrub	2015	Viable	FL Dept. of Agriculture and Consumer Services, FL Forest Service
72	Scheduled 2018/2019	Fort Clinch State Park	2	1118	Maritime Hammock			FL Dept. of Environmental Protection, Div. of Recreation and Parks
73	N	Fred Gannon Rocky Bayou State Park	2	284	Scrub			FL Dept. of Environmental Protection, Div. of Recreation and Parks
74	Y	Jonathan Dickinson State Park	2	4559	Scrub, Scrubby Flatwoods, Mesic Flatwoods	2015	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks
75	Scheduled 2018/2019	Lake Kissimmee State Park	2	1294	Mesic Flatwoods, Scrubby Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
76	Y	Lake Louisa State Park	2	1385	Unimproved/Woodland Pasture, Coniferous Plantations	2015	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks
77	Y	Mike Roess Gold Head Branch State Park	2	1896	Sandhill	2014	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks
78	N - pilot survey indicates low density	Savannas Preserve State Park	2	3282	Mesic Flatwoods, Scrub			FL Dept. of Environmental Protection, Div. of Recreation and Parks
79	N	Tiger Bay State Forest	2	1011	Scrub	2017		FL Dept. of Agriculture and Consumer Services, Florida Forest Service
80	N	Twin Rivers State Forest - Black/Damascus Tract	2	862	Coniferous Plantations, Upland Pine			FL Dept. of Agriculture and Consumer Services, FL Forest Service
81	N	Twin Rivers State Forest - Sullivan Tract	2	334	Coniferous Plantations, Upland Pine, Mesic Hammock			FL Dept. of Agriculture and Consumer Services, FL Forest Service
82	N	Twin Rivers State Forest - Westwood East Tract	2	374	Upland Pine, Sandhill, Mesic Hammock			FL Dept. of Agriculture and Consumer Services, FL Forest Service
83	N	Woods Ferry Conservation Area	2	1321	Sandhill, Scrubby Flatwoods			Suwannee River Water Management District



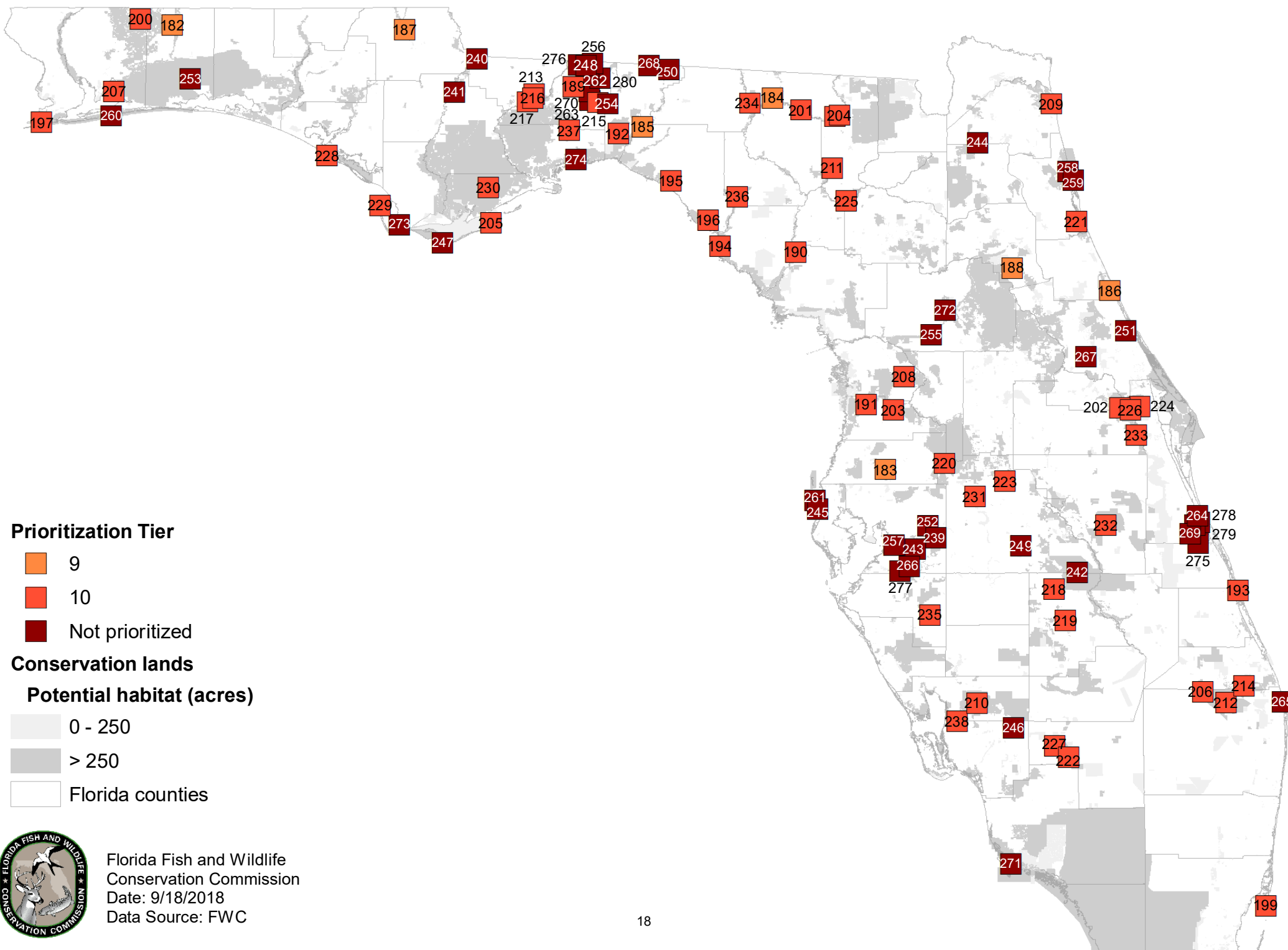
Map Label	Population Estimate?	Site Name	Prioritization Tier	Potential habitat (acres)	Predominant Natural Community	Survey Year	Population Status	Managing Agency
84	N	Anclote Key Preserve State Park	3	473	Beach Dune			FL Dept. of Environmental Protection, Div. of Recreation and Parks
85	N	Big Talbot Island State Park	3	1392	Maritime Hammock, Coastal Strand			FL Dept. of Environmental Protection, Div. of Recreation and Parks
86	N - pilot survey indicates low density	Cedar Key Scrub State Reserve	3	1033	Scrubby Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
87	N	Edward Chance Reserve	3	3976	Mesic Flatwoods, Scrub			Southwest Florida Water Management District
88	N	Estero Bay Preserve State Park	3	484	Mesic Flatwoods, Scrubby Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
89	Y	Goethe State Forest	3	11200	Sandhill	2014	Viable	FL Dept. of Agriculture and Consumer Services, FL Forest Service
90	N	Jack Creek	3	464	Scrub			Southwest Florida Water Management District
91	N	Kissimmee River	3	4038	Dry Prairie, Mesic Flatwoods			South Florida Water Management District
92	N	Lake Manatee State Park	3	503	Mesic Flatwoods, Scrub, Scrubby Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
93	N	Lake Monroe Conservation Area	3	562	Scrubby Flatwoods			St. Johns River Water Management District
94	N	Lake Wales Ridge State Forest - Hesperides	3	418	Scrub, Sandhill, Mesic Flatwoods			FL Dept. of Agriculture and Consumer Services, FL Forest Service
95	Y	Little Talbot Island State Park	3	1199	Maritime Hammock, Coastal Strand	2014	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks
96	N	Lower Hillsborough Flood Detention Area	3	4200	Mesic Flatwoods			Southwest Florida Water Management District
97	N - pilot survey indicates low density	Pumpkin Hill Creek Preserve State Park	3	581	Scrubby Flatwoods, Coniferous Plantations			FL Dept. of Environmental Protection, Div. of Recreation and Parks
98	N	Ross Prairie State Forest	3	2679	Sandhill, Scrubby Flatwoods			FL Dept. of Agriculture and Consumer Services, FL Forest Service
99	Scheduled 2018/2019	Seabranck Preserve State Park	3	611	Scrub, Scrubby Flatwoods, Mesic Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
100	N	Troy Spring Conservation Area	3	1447	Coniferous Plantations, Mesic Hammock, Upland Pine			Suwannee River Water Management District
101	N	Twin Rivers State Forest - Anderson Springs Tract	3	719	Coniferous Plantations, Upland Pine			FL Dept. of Agriculture and Consumer Services, FL Forest Service
102	Scheduled 2018/2019	Cypress Creek and Loxahatchee River Management Area	4	1615	Mesic Flatwoods			South Florida Water Management District
103	N - pilot survey indicates low density	Grayton Beach State Park	4	1302	Scrub, Scrubby Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
104	N	Hillsborough River State Park	4	298	Mesic Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
105	N	Little Big Econ State Forest	4	1108	Scrubby Flatwoods, Scrub, Mesic Flatwoods			FL Dept. of Agriculture and Consumer Services, FL Forest Service
106	N	Lochloosa Wildlife Conservation Area	4	1518	Coniferous Plantations, Scrubby Flatwoods			St. Johns River Water Management District
107	N	Lower Peace River Corridor (Deep Creek Tract)	4	1111	Mesic Flatwoods			Southwest Florida Water Management District
108	N	Myakka State Forest	4	4886	Mesic Flatwoods			FL Dept. of Agriculture and Consumer Services, FL Forest Service
109	Y	O'leno State Park	4	1574	Scrub, Mesic Flatwoods	2014	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks
110	N	Peacock Springs Conservation Area	4	618	Coniferous Plantations			Suwannee River Water Management District
111	N	Pellicer Creek Conservation Area	4	1173	Coniferous Plantations			St. Johns River Water Management District
112	N	Pine Log State Forest	4	2984	Sandhill, Mesic Flatwoods	2015		FL Dept. of Agriculture and Consumer Services, FL Forest Service
113	N - pilot survey indicates low density	Point Washington State Forest	4	4936	Sandhill, Mesic Flatwoods, Scrubby Flatwoods, Scrub	2014		FL Dept. of Agriculture and Consumer Services, FL Forest Service
114	N	Price's Scrub	4	399	Scrubby Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
115	Y	River Rise Preserve State Park	4	2341	Upland Pine, Sandhill	2014	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks
116	N	Sunnyhill Restoration Area	4	345	Scrub, Unimproved/Woodland Pasture			St. Johns River Water Management District
117	N	Suwannee River State Park	4	1163	Mixed Hardwood Coniferous, Sandhill, Upland Pine			FL Dept. of Environmental Protection, Div. of Recreation and Parks
118	N	Twin Rivers State Forest - Westwood West Tract	4	413	Coniferous Plantations			FL Dept. of Agriculture and Consumer Services, Florida Forest Service
119	N	Upper Hillsborough	4	4120	Mesic Flatwoods			Southwest Florida Water Management District
120	N	Wes Skiles Peacock Springs State Park	4	625	Coniferous Plantations, Upland Pine, Mixed Hardwood-Coniferous			FL Dept. of Environmental Protection, Div. of Recreation and Parks
121	Y	Wingate Creek State Park	4	398	Scrubby Flatwoods, Mesic Flatwoods, Scrub	2015	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks



Map Label	Population Estimate?	Site Name	Prioritization Tier	Potential habitat (acres)	Predominant Natural Community	Survey Year	Population Status	Managing Agency
122	N	Alafia River State Park	5	685	Xeric Hammock			FL Dept. of Environmental Protection, Div. of Recreation and Parks
123	N	Anastasia State Park	5	849	Beach Dune, Maritime Hammock			FL Dept. of Environmental Protection, Div. of Recreation and Parks
124	N	Babcock Ranch Preserve	5	31589	Mesic Flatwoods			FL Dept. of Agriculture and Consumer Services, FL Forest Service
125	N	Bald Point State Park	5	1240	Coniferous Plantation, Scrubby Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
126	N	Blackwater River State Forest - Bone Creek Unit	5	9347	Upland Pine, Sandhill			FL Dept. of Agriculture and Consumer Services, FL Forest Service
127	N	Bulow Creek State Park	5	851	Mesic Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
128	Y	Cayo Costa State Park	5	1653	Maritime Hammock, Coastal Grasslands	2015	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks
129	N - pilot survey indicates low density	Deer Lake State Park	5	1079	Mesic Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
130	Y	Edward Ball Wakulla Springs State Park	5	4817	Upland Pine, Mixed Hardwood Coniferous	2015	Primary Support	FL Dept. of Environmental Protection, Div. of Recreation and Parks
131	N	Falmouth Spring Conservation Area	5	265	Upland Pine			Suwannee River Water Management District
132	N	Faver-Dykes State Park	5	2005	Mesic Flatwoods, Coniferous Plantations, Maritime Hammock			FL Dept. of Environmental Protection, Div. of Recreation and Parks
133	N	Lake June-in-Winter Scrub State Park	5	640	Scrub			FL Dept. of Environmental Protection, Div. of Recreation and Parks
134	N	Lake Norris Conservation Area	5	468	Improved Pasture			St. Johns River Water Management District
135	N	Lake Wales Ridge State Forest - Prairie	5	1635	Dry Prairie			FL Dept. of Agriculture and Consumer Services, FL Forest Service
136	N	Little Manatee River (SWFWMD)-Southfork	5	493	Unimproved/Woodland Pasture, Scrub			Southwest Florida Water Management District
137	N	Longleaf Flatwoods Reserve	5	848	Coniferous Plantations			St. Johns River Water Management District
138	N	Ocklawaha Prairie Restoration Area	5	539	Coniferous Plantations			St. Johns River Water Management District
139	N	Potts Preserve	5	1267	Scrub, Scrubby Flatwoods, Ruderal			Southwest Florida Water Management District
140	N	Prairie/Shell Creek	5	316	Mesic Flatwoods and Scrub/Scrubby FW			Southwest Florida Water Management District
141	N	Silver Springs State Park	5	955	Sandhill, Scrubby Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
142	N	Southfork State Park	5	577	Scrub, Mixed Hardwood-Coniferous, Mesic Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
143	N	Tarkiln Bayou Preserve State Park	5	707	Mesic Flatwoods, Sandhill			FL Dept. of Environmental Protection, Div. of Recreation and Parks
144	N	Twin Rivers State Forest - Withlacoochee Tract	5	896	Coniferous Plantations, Upland Pine			FL Dept. of Agriculture and Consumer Services, FL Forest Service
145	N	Upper Lakes Basin Watershed	5	1549	Mesic Flatwoods, Scrub			South Florida Water Management District
146	N	Washington Oaks Gardens State Park	5	358	Maritime Hammock, Coastal Scrub, Coastal Strand			FL Dept. of Environmental Protection, Div. of Recreation and Parks
147	N	Withlacoochee State Forest - Headquarters Tract	5	1753	Sandhill			FL Dept. of Agriculture and Consumer Services, FL Forest Service
148	N	Withlacoochee State Forest - Two-mile Prairie Tract	5	2350	Coniferous Plantations			FL Dept. of Agriculture and Consumer Services, FL Forest Service
149	N	Allapattah Flats	6	589	Mesic Flatwoods			South Florida Water Management District
150	N	Bayard Conservation Area	6	856	Mesic Flatwoods			St. Johns River Water Management District
151	N	Blackwater River State Forest - Rock Creek Unit	6	19205	Upland Pine			FL Dept. of Agriculture and Consumer Services, FL Forest Service
152	N	Cary State Forest	6	1023	Coniferous Plantations	2011		FL Dept. of Agriculture and Consumer Services, FL Forest Service
153	N	Deer Prairie Creek Preserve	6	4038	Mesic Flatwoods	2008		Southwest Florida Water Management District
154	N	Elinor Klapp-Phipps Park	6	411	Upland Hardwood Forest, Mixed Hardwood-Coniferous			City of Tallahassee
155	N	Flying Eagle Preserve	6	1208	Ruderal pasture, some sandhill and scrub. Much of the habitat consists of large basin marshes			Southwest Florida Water Management District
156	N	Hal Scott Regional Preserve and Park	6	5482	Mesic Flatwoods			St. Johns River Water Management District
157	N	Lake Panasoffkee	6	1869	Improved Pasture, Mesic Hammock, Scrubby Flatwoods	2009		Southwest Florida Water Management District
158	N	Manatee Springs State Park	6	1434	Mixed Hardwood-Coniferous, Upland Mixed Woodland			FL Dept. of Environmental Protection, Div. of Recreation and Parks
159	N	Newnans Lake Conservation Area	6	541	Coniferous Plantations, Mesic Flatwoods			St. Johns River Water Management District
160	N	North Peninsula State Park	6	390	Coastal Scrub			FL Dept. of Environmental Protection, Div. of Recreation and Parks
161	N	Suwannee Valley Conservation Area	6	706	Coniferous Plantations, Mesic Flatwoods, Scrubby Flatwoods			Suwannee River Water Management District
162	N	Twin Rivers State Forest - Chitty Bend West Tract	6	291	Upland Pine, Clearcut			FL Dept. of Agriculture and Consumer Services, FL Forest Service



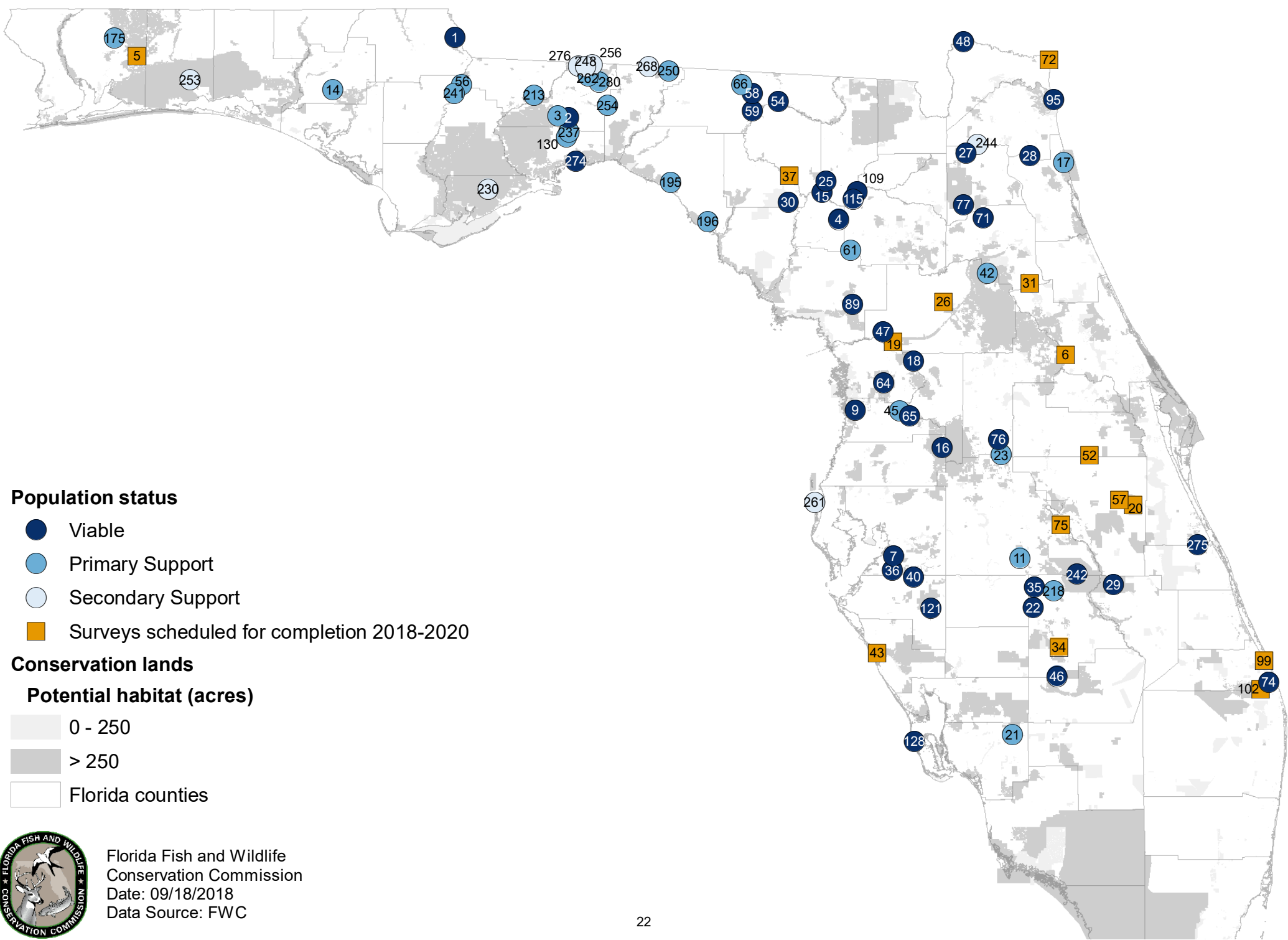
Map Label	Population Estimate?	Site Name	Prioritization Tier	Potential habitat (acres)	Predominant Natural Community	Survey Year	Population Status	Managing Agency
163	N	Black Creek Ravines Conservation Area	7	449	Sandhill, Xeric Hammock			St. Johns River Water Management District
164	N	Blackwater River State Forest - Floridale Unit	7	15814	Upland Pine			FL Dept. of Agriculture and Consumer Services, FL Forest Service
165	N	Choctawhatchee River Water Management Area	7	6372	Coniferous Plantation			Northwest Florida Water Management District
166	N	Myakka River (Schewe tract)	7	2553	Mesic Flatwoods			Southwest Florida Water Management District
167	N	Picayune Strand State Forest	7	1505	Mesic Flatwoods			FL Dept. of Agriculture and Consumer Services, FL Forest Service
168	N	St. Marks River Preserve State Park	7	1027	Coniferous Plantations, Mesic Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
169	N	Twin Rivers State Forest - Mill Creek North Tract	7	362	Coniferous Plantations			FL Dept. of Agriculture and Consumer Services, FL Forest Service
170	N	Upper Alapaha Conservation Area	7	1003	Mixed Hardwood-Coniferous, Coniferous Plantations, Mesic Flatwoods			Suwannee River Water Management District
171	N	Werner-Boyce Salt Springs State Park	7	584	Maritime Hammock, Mesic Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
172	N	Belmore State Forest	8	2110	Coniferous Plantations	2011		FL Dept. of Agriculture and Consumer Services, FL Forest Service
173	N	Big Shoals State Park	8	588	Mesic Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
174	N	Blackwater River State Forest - Coldwater Unit	8	8754	Upland Pine			FL Dept. of Agriculture and Consumer Services, FL Forest Service
175	Y	Blackwater River State Forest - West Boundary Unit	8	6984	Upland Pine	2016	Primary Support	FL Dept. of Agriculture and Consumer Services, FL Forest Service
176	N	Econfina Conservation Area	8	920	Coniferous Plantations			Suwannee River Water Management District
177	N	Moses Creek Conservation Area	8	1044	Mixed Hardwood-Coniferous, Shrub and Brushland			St. Johns River Water Management District
178	N	RV Griffin Reserve (GDC)	8	1191	Dry Prairie, Mesic Flatwoods			Southwest Florida Water Management District
179	N	Sebastian Inlet State Park	8	251	Maritime Hammock, Coastal Strand			FL Dept. of Environmental Protection, Div. of Recreation and Parks
180	N	Wannee Conservation Area	8	1014	Upland Hardwood Forest, Mixed Hardwood-Coniferous			Suwannee River Water Management District
181	N	Weekiwachee Preserve	8	1692	Scrubby Flatwoods, Mesic Flatwoods,			Southwest Florida Water Management District



Map Label	Population Estimate?	Site Name	Prioritization Tier	Potential habitat (acres)	Predominant Natural Community	Survey Year	Population Status	Managing Agency
182	N	Blackwater River State Forest - Horse Creek Unit	9	4853	Upland Pine			FL Dept. of Agriculture and Consumer Services, FL Forest Service
183	N	Cypress Creek Flood Detention Area	9	1341	Mesic Flatwoods			Southwest Florida Water Management District
184	N	Lower Alapaha Conservation Area	9	423	Coniferous Plantations			Suwannee River Water Management District
185	N	Middle Aucilla Conservation Area	9	1453	Coniferous Plantations			Suwannee River Water Management District
186	N	Tomoka State Park	9	462	Xeric Hammock, Maritime Hammock, Scrubby Flatwoods			FL Dept. of Environmental Protection, Div. of Recreation and Parks
187	N	Upper Chipola River Water Management Area	9	863	Coniferous Plantations			Northwest Florida Water Management District
188	N	Welaka State Forest	9	630	Sandhill, Scrubby Flatwoods	2011		FL Dept. of Agriculture and Consumer Services, FL Forest Service
189	N	Alfred B. Maclay Gardens State Park	10	755	Mixed Hardwood-Coniferous			FL Dept. of Environmental Protection, Div. of Recreation and Parks
190	N	Andrews Wildlife Management Area	10	2938	Upland Hardwood Forest			FL Fish and Wildlife Conservation Commission
191	N	Annettella Hammock	10	1873	Sandhill			Southwest Florida Water Management District
192	N	Aucilla Wildlife Management Area	10	1327	Upland Hardwood Forest, Coniferous Plantations, Mesic Flatwoods	2012		FL Fish and Wildlife Conservation Commission
193	N – Insufficient suitable habitat	Avalon State Park	10	371	Maritime Hammock, Coastal Strand			FL Dept. of Environmental Protection, Div. of Recreation and Parks
194	N - pilot survey indicates low density	Big Bend Wildlife Management Area - Jena	10	2224	Mesic Flatwoods			FL Fish and Wildlife Conservation Commission
195	Y	Big Bend Wildlife Management Area - Spring Creek	10	722	Coniferous Plantations, Sandhill	2016	Primary Support	FL Fish and Wildlife Conservation Commission
196	Y	Big Bend Wildlife Management Area - Tide Swamp	10	342	Coniferous Plantations	2016	Primary Support	FL Fish and Wildlife Conservation Commission
197	N	Big Lagoon State Park	10	312	Scrubby Flatwoods, Coastal Scrub			FL Dept. of Environmental Protection, Div. of Recreation and Parks
198	N	Big Shoals State Forest	10	576	Mesic Flatwoods			FL Dept. of Agriculture and Consumer Services, FL Forest Service
199	N	Bill Baggs Cape Florida State Park	10	253	Coastal Strand			FL Dept. of Environmental Protection, Div. of Recreation and Parks
200	N - pilot survey indicates low density	Blackwater River State Forest - Sweetwater Unit	10	21400	Upland Pine			FL Dept. of Agriculture and Consumer Services, FL Forest Service
201	N	Camp Branch Conservation Area	10	527	Sandhill, Mesic Flatwoods, Scrubby Flatwoods			Suwannee River Water Management District
202	N	Charles H. Bronson State Forest	10	908	Mesic Flatwoods			FL Dept. of Agriculture and Consumer Services, FL Forest Service
203	N	Chinsegut Wildlife and Environmental Area	10	550	Sandhill			FL Fish and Wildlife Conservation Commission
204	N	Deep Creek Conservation Area (SRWMD)	10	332	Coniferous Plantation, Mesic Flatwoods			Suwannee River Water Management District
205	N	Dr. Julian G. Bruce St. George Island State Park	10	1134	Coastal Grassland			FL Dept. of Environmental Protection, Div. of Recreation and Parks
206	N	Dupuis Reserve	10	11581	Mesic Flatwoods			South Florida Water Management District
207	N - pilot survey indicates low density	Escribano Point Wildlife Management Area	10	454	Sandhill, Scrubby Flatwoods			FL Fish and Wildlife Conservation Commission
208	N	Fort Cooper State Park	10	373	Sandhill			FL Dept. of Environmental Protection, Div. of Recreation and Parks
209	N	Fort George Island Cultural State Park	10	625	Maritime Hammock			FL Dept. of Environmental Protection, Div. of Recreation and Parks
210	N	Fred C. Babcock-Cecil M. Webb Wildlife Management Area	10	39621	Mesic Flatwoods			FL Fish and Wildlife Conservation Commission
211	N	Ichetucknee Trace	10	345	Coniferous Plantations			FL Dept. of Environmental Protection, Div. of Recreation and Parks
212	N	J. W. Corbett Wildlife Management Area	10	17532	Mesic Flatwoods			FL Fish and Wildlife Conservation Commission
213	Y	Joe Budd Wildlife Management Area	10	1137	Upland Pine	2014	Primary Support	FL Fish and Wildlife Conservation Commission
214	N	John C. and Mariana Jones/Hungryland Wildlife and Environmental Area	10	2993	Mesic Flatwoods			FL Fish and Wildlife Conservation Commission
215	N - pilot survey indicates low density	L. Kirk Edwards Wildlife and Environmental Area	10	441	Upland Pine			FL Fish and Wildlife Conservation Commission
216	N - pilot survey indicates low density	Lake Talquin State Forest	10	10145	Upland Pine			FL Dept. of Agriculture and Consumer Services, FL Forest Service
217	N	Lake Talquin State Park	10	295	Sandhill, Upland Hardwood Forest			FL Dept. of Environmental Protection, Div. of Recreation and Parks
218	Y	Lake Wales Ridge Wildlife and Environmental Area - Carter Creek	10	1939	Scrub, Scrubby Flatwoods	2015	Primary Support	FL Fish and Wildlife Conservation Commission
219	N - pilot survey indicates low density	Lake Wales Ridge Wildlife and Environmental Area - Royce/Clements	10	1152	Improved Pasture, Scrub, Scrubby Flatwoods			FL Fish and Wildlife Conservation Commission
220	N	Little Gator Creek Wildlife and Environmental Area	10	316	Mesic Flatwoods			FL Fish and Wildlife Conservation Commission
221	N	Matanzas State Forest	10	696	Coniferous Plantations, Maritime Hammock			FL Dept. of Agriculture and Consumer Services, FL Forest Service
222	N	Okaloacoochee Slough State Forest	10	7431	Mesic Flatwoods			FL Dept. of Agriculture and Consumer Services, FL Forest Service
223	N	Osprey Unit	10	1055	Mesic Flatwoods			FL Fish and Wildlife Conservation Commission

Map Label	Population Estimate?	Site Name	Prioritization Tier	Potential habitat (acres)	Predominant Natural Community	Survey Year	Population Status	Managing Agency
224	N - pilot survey indicates low density	Salt Lake Wildlife Management Area	10	992	Mesic Flatwoods	2010		FL Fish and Wildlife Conservation Commission
225	N	Santa Fe Springs Conservation Area	10	584	Coniferous Plantations			Suwannee River Water Management District
226	N	Seminole Ranch Conservation Area	10	559	Mesic Flatwoods			St. Johns River Water Management District
227	N	Spirit of the Wild Wildlife Management Area	10	1425	Mesic Flatwoods			FL Fish and Wildlife Conservation Commission
228	N	St. Andrews State Park	10	601	Coastal Scrub, Maritime Hammock, Beach Dune			FL Dept. of Environmental Protection, Div. of Recreation and Parks
229	N	T. H. Stone Memorial St. Joseph Peninsula State Park	10	1439	Coastal Scrub			FL Dept. of Environmental Protection, Div. of Recreation and Parks
230	Y	Tate's Hell State Forest	10	3474	Coniferous Plantations	2017	Secondary Support	FL Dept. of Agriculture and Consumer Services, FL Forest Service
231	N	Tenoroc Fish Management Area	10	778	Unimproved/Woodland Pasture, Coniferous Plantations, (Cropland/Pasture)			FL Fish and Wildlife Conservation Commission
232	N - pilot survey indicates low density	Three Lakes Wildlife Management Area	10	36121	Mesic Flatwoods, Dry Prairie			FL Fish and Wildlife Conservation Commission
233	N	Tosohatchee Wildlife Management Area	10	2810	Mesic Flatwoods			FL Fish and Wildlife Conservation Commission
234	N	Twin Rivers State Forest - Nekoosa Tract	10	332	Coniferous Plantations, Upland Pine, Mesic Hammock			FL Dept. of Agriculture and Consumer Services, FL Forest Service
235	N	Upper Myakka River Watershed	10	286	Mesic Flatwoods			Southwest Florida Water Management District
236	N	Upper Steinhatchee Conservation Area	10	673	Coniferous Plantations			Suwannee River Water Management District
237	Y	Wakulla State Forest	10	4126	Coniferous Plantations, Upland Hardwood Forest	2016	Primary Support	FL Dept. of Agriculture and Consumer Services, FL Forest Service
238	N	Yucca Pens Unit	10	8190	Mesic Flatwoods			FL Fish and Wildlife Conservation Commission
239	N	Alafia River Corridor	NA	1237	Mixed Hardwood-Coniferous			Hillsborough County
240	N	Apalachee Correctional Institution	NA	1320	Coniferous Plantations, Mixed Hardwood-Coniferous			PRIDE Enterprises, Inc.
241	Y	Apalachicola Bluffs and Ravines Preserve	NA	3929	Sandhill, Mixed Hardwood-Coniferous	2014	Primary Support	The Nature Conservancy
242	Y	Avon Park Air Force Range	NA	33979	Mesic Flatwoods, Scrub, Dry Prairie, Scrubby Flatwoods	2015	Viable	US Dept. of Defense, Air Force
243	N	Balm-Boyette Scrub	NA	2012	Mesic Flatwoods, Scrub			Hillsborough County
244	Y	Branan Field Wildlife and Environmental Area	NA	94	Sandhill	2017	Secondary Support	FL Fish and Wildlife Conservation Commission
245	N - pilot survey indicates low density	Caladesi Island State Park	NA	246	Cabbage Palm, Maritime Hammock			FL Dept. of Environmental Protection, Div. of Recreation and Parks
246	N	Caloosahatchee Regional Park	NA	491	Improved Pasture, Mesic Flatwoods, Shrub and Brushland	2014		Lee County
247	N	Cape St. George State Reserve	NA	816	Coastal Scrub, Scrubby Flatwoods			FL Dept. of Environmental Protection, Florida Coastal Office
248	Y	Cherokee Plantation Conservation Easement	NA	1269	Upland Coniferous	2015	Secondary Support	Tall Timbers Research, Inc.
249	N	Crooked Lake West - Stuart Tract	NA	1180	Mesic Flatwoods			Polk County
250	Y	Dixie Plantation Conservation Easement	NA	4615	Unimproved/Woodland Pasture, Coniferous Plantations	2015	Primary Support	Suwannee River Water Management District
251	N	Doris Leeper Spruce Creek Preserve	NA	1277	Scrub, Mixed Hardwood-Coniferous, Scrubby Flatwoods			Volusia County
252	N	Edward Medard Park and Reservoir	NA	320	Mixed Hardwood-Coniferous			Hillsborough County
253	Y	Eglin Air Force Base	NA	353116	Sandhill, Coniferous Plantations	2016	Secondary Support	US Dept. of Defense, Air Force
254	Y	El Destino Plantation	NA	1525	Upland Coniferous	2015	Primary Support	
255	N	Florida Horse Park	NA	499	Improved Pasture, Sandhill			Florida Agriculture and Horse Park Authority
256	Y	Foshalee Plantation Conservation Easement	NA	1463	Upland Coniferous	2015	Secondary Support	Tall Timbers Research, Inc.
257	N	Golden Aster Scrub Nature Preserve	NA	959	Mesic Flatwoods, Scrub, Scrubby Flatwoods			Hillsborough County
258	N	GTMNERR - Guana River Site	NA	1531	Maritime Hammock, Coastal Scrub			FL Dept. of Environmental Protection, Florida Coastal Office
259	N	Guana Tolomato Matanzas National Estuarine Research Reserve	NA	433	Coastal Uplands			FL Dept. of Environmental Protection, Florida Coastal Office
260	N	Gulf Islands National Seashore	NA	1772	Coastal Scrub			US Dept. of the Interior, National Park Service
261	Y	Honeymoon Island State Park	NA	354	Beach Dune, Mesic Flatwoods, Coastal Strand	2017	Secondary Support	FL Dept. of Environmental Protection, Div. of Recreation and Parks
262	Y	Horseshoe Plantation Conservation Easement	NA	3896	Upland Coniferous	2015	Primary Support	Tall Timbers Research, Inc.
263	N	J. R. Alford Greenway	NA	331	Mixed Hardwood-Coniferous			Leon County
264	N	Jordan Scrub Sanctuary	NA	532	Mesic Flatwoods, Scrubby Flatwoods, Scrub			Brevard County
265	N	Juno Dunes Natural Area	NA	369	Scrub			Palm Beach County
266	N	Little Manatee River Corridor	NA	1308	Mesic Flatwoods			Hillsborough County
267	N	Lyonia Preserve	NA	308	Scrub			Volusia County

Map Label	Population Estimate?	Site Name	Prioritization Tier	Potential habitat (acres)	Predominant Natural Community	Survey Year	Population Status	Managing Agency
268	Y	Merrily Plantation Conservation Easement	NA	1457	Upland Coniferous	2015	Secondary Support	Tall Timbers Research, Inc.
269	N	Micco Scrub Sanctuary	NA	506	Mesic Flatwoods, Scrubby Flatwoods			Brevard County
270	N	Miccosukee Canopy Road Greenway	NA	348	Upland Coniferous, Coniferous Plantations, Oak Scrub			Leon County
271	N	Rookery Bay National Estuarine Research Reserve	NA	1709	Scrub, Mesic Flatwoods, Maritime Hammock			FL Dept. of Environmental Protection, Florida Coastal Office
272	N	Silver Springs Conservation Area	NA	317	Sandhill, Mixed Hardwood-Coniferous			Marion County
273	N	St. Joseph Bay State Buffer Preserve	NA	421	Scrubby Flatwoods, Scrub			FL Dept. of Environmental Protection, Florida Coastal Office
274	Y	St. Marks National Wildlife Refuge	NA	8422	Sandhill	2011	Viable	US Dept. of the Interior, Fish and Wildlife Service
275	Y	St. Sebastian River Preserve State Park	NA	13686	Mesic Flatwoods, Scrubby Flatwoods	2015	Viable	FL Dept. of Environmental Protection, Div. of Recreation and Parks
276	Y	Tall Timbers Research Station and Land Conservancy	NA	2091	Upland Coniferous	2015	Secondary Support	Tall Timbers Research, Inc.
277	N	Upper Little Manatee River	NA	450	Mesic Flatwoods, Scrubby Flatwoods			Hillsborough County
278	N	Valkaria Expansion	NA	456	Mesic Flatwoods			Brevard County
279	N	Valkaria Scrub Sanctuary	NA	625	Mesic Flatwoods, Scrub, Scrubby Flatwoods			Brevard County
280	Y	Woodfield Springs Plantation Conservation Easement	NA	1743	Upland Coniferous	2015	Primary Support	Tall Timbers Research, Inc.



**GOPHER TORTOISE (*GOPHERUS POLYPHEMUS*) SURVEYS AND
POPULATION EVALUATIONS**

FINAL REPORT

**Lora L. Smith and Jennifer M. Howze
Joseph W. Jones Ecological Research Center
Contract #13161**

To

Florida Fish and Wildlife Conservation Commission

24 June 2016



Abstract

We conducted pilot surveys for gopher tortoises at 35 Florida state conservation lands and used line transect distance sampling (LTDS) to estimate population size and density at 26 of these sites. Gopher tortoise populations at 19 sites clearly met the criteria for minimum viable populations [MVP; ≥ 250 adult tortoises (within 95% confidence intervals) and >0.40 tortoises/ha; Gopher Tortoise Council 2013] and occurred in high to medium quality habitat. Upper confidence intervals of estimates at four additional sites overlapped the MVP standards and these sites may also support minimum viable populations. Population estimates ranged from 66 (34-125 95% CI) at Joe Budd Wildlife Management Area to 8221 (6308-10,714 95% CI) tortoises at the Withlacoochee State Forest, Croom tract. We trained a total of 58 individuals from the Florida Fish and Wildlife Conservation Commission (FFWCC), Florida Park Service (FPS), Florida Forest Service (FFS), Florida Department of Environmental Protection, Florida Natural Areas Inventory, St. Johns River Water Management District, Hillsborough County, Polk County, and private consultants in LTDS methodology for gopher tortoises.

Introduction

The objective of this project was to provide gopher tortoise population estimates for 35 priority Florida state conservation lands using the standard survey methodology recommended in the Candidate Conservation Agreement for the Gopher Tortoise (2012). In the first phase of the project we conducted site assessments and pilot surveys (March-August 2014). In the second phase, we implemented LTDS on 26 of the sites (August 2014-April 2016). We initiated, but were unable to complete LTDS survey at Platt

Branch Wildlife Environmental Area because of flooding in burrows. We used a rapid assessment method to evaluate habitat structure at the sites during LTDS surveys and used this information, along with tortoise survey results, to rank the sites by habitat quality and to provide recommendations for management of the sites, where appropriate. We trained FFWCC, Florida Park Service, and other staff in LTDS methods for gopher tortoises through training workshops.

Methods

PHASE I- Site Assessments, Pilot Surveys, and Full Survey Designs.

We created ArcGIS (ESRI, Redlands, CA) shape files of potentially suitable gopher tortoise habitat for 35 Florida conservation lands using the following information provided by FFWCC: a potential habitat model, Florida cooperative land cover (CLC) data, and natural community data (Fig.1). We considered the following land cover types as potentially suitable for gopher tortoises: upland pine, sandhill, scrub, scrubby flatwoods, beach dune/coastal grassland, some mesic flatwoods, and pine plantations. Wetlands, rural lands, pasture, hardwood forest, wet flatwoods, and urban land cover types generally were not considered suitable habitat. Mesic flatwoods were excluded from the suitable habitat shape files when signs of inundation were present.

We visited each site to meet area staff, assess the accuracy of the potential habitat maps (hereafter referred to as sampling frames), and to conduct pilot surveys. Pilot surveys were used to determine the overall transect length required to derive a population estimate of a predetermined level of precision (Buckland et al. 1993). During pilot surveys, we sampled transects at points that were randomly distributed across the

sampling frame to capture variability in habitat quality and tortoise occurrence across each site. Transects were generally 200-500 m in length and were distributed across 10-15 random points for a minimum of 2000-3000 m of transect at each site. Additional transects were surveyed at sites with low tortoise densities or at very large sites.

Pilot surveys were conducted with three observers and burrows were searched with a burrow camera scope (Environmental Management Services, Canton, GA) to determine whether or not a tortoise was present (Smith et al. 2009, Stober and Smith 2010). The tortoise encounter rate (length of transect sampled per tortoise observed; L_o/n_o) for each site was calculated based on observations during pilot surveys and was used to estimate the total length of transect (L) needed to obtain a population estimate with a targeted coefficient of variation (< 20% CV). The formula used to calculate L was:

$$L = (b/cv(D)^2) \times (L_o/n_o)$$

Where L_o is the total length of transects, and n_o is the number of tortoises encountered, D = density, and $cv(D)$ is the desired cv for the density estimate. b is the dispersion parameter ($b=3$); Buckland et al. 1993.

Following pilot surveys we revised the sampling frames if needed and created survey designs for each site in Program Distance v. 6.2 (<http://www.ruwpa.st-and.ac.uk/distance/>). We used a systematic-random transect design, which generated evenly spaced parallel transects with a total length that targeted a 15 or 17% CV for each site. In the case of the Citrus and Croom tracts in Withlacoochee State Forest, we designed surveys using a systematic pseudo-circuit design in Program Distance to capture potential spatial variation in tortoise distribution across the very large sampling frames (17899 and 5164 ha, respectively). Because of low encounter rates, several sites (e.g.,

Joe Budd Wildlife Management Area, Watermelon Pond Wildlife Environmental Area) required repeated sampling with two sets of transects oriented perpendicular to one another (Stober and Smith 2010). We were unable to generate LTDS survey designs for sites where no tortoises were observed during pilot surveys: Blackwater River State Forest (Bone Creek, Horse Creek Sweetwater, and Yellow River units), Deer Lake State Park, Grayton Beach State Park, and St. Sebastian River State Park, SW tract. We recommend additional pilot surveys be conducted at these sites to verify low encounter rates.

PHASE II- LTDS Sampling: Line transect distance sampling was initiated in August 2014 following completion of the pilot surveys. We used LTDS methods for gopher tortoises as outlined in the Gopher Tortoise Survey Handbook (Smith et al., 2009) and Stober and Smith (2010). We used three observers and all burrows were scoped using a burrow camera to determine occupancy. Data were collected using a Nomad 900B Hand Held Computer (Trimble Navigation, Ltd., Sunnyvale, CA) with a Hemisphere Crescent A101 smart GPS antenna (CSI Wireless, Calgary, Alberta), which had sub-meter accuracy and real-time data collection.

During surveys, the crew leader navigated the transect center line with the Nomad, which had an ArcPad™ (ESRI, Redland, CA) project containing CLC land cover data, the sample frame, and transects as well as shape files for data collection that included transect start and end points, burrow observations, habitat assessments and field notes. During field surveys, the primary responsibility of the person on the center-line was to navigate with the Nomad and detect all burrows on or close to the center-line; the second

and third observers thoroughly surveyed the area on each side of the centerline, taking care to observe all burrows between themselves and the centerline. GPS locations were taken at the start and endpoints of each transect, which allowed us to calculate the actual transect length surveyed and to correct for minor discrepancies in transect placement in the field. GPS locations were collected for any tortoises observed above ground and at the entrance of all burrows. Burrows were searched for tortoises with a camera equipped with a 6.4 cm diameter head for adult burrows and 2.5 cm diameter camera head for juvenile burrows (Environmental Management Systems, Canton, GA). We categorized each burrow as either: 1) scoped, tortoise observed; 2) scoped, no tortoise observed for entire length of burrow; or 3) scoped, unable to determine if occupied (e.g., burrow was flooded, washed in with sand, or an obstruction was present). Thus, we had a record of the burrow occupancy rate and the number of burrows for which occupancy could not be determined. To minimize risk of spreading pathogens, the burrow camera head and cables were disinfected using Clorox Disinfecting Wipes™ at the end of each day and between sites.

Burrow width was measured (to the nearest 1 cm) 50 cm inside the opening using burrow calipers. We measured straight-line carapace length of tortoises observed above ground and these data, along with the width of occupied tortoise burrows, were used to describe the demographic structure of the populations (adults versus juveniles; Alford, 1980). We also used burrow width and carapace length measurements as a covariate in one set of models to estimate population size because detection probability of burrows/tortoises decreases with size (Ballou, 2013). Distance sampling relies on the assumption that all objects on the transect are detected. However, because of the extreme

difficulty in detecting very small burrows (Ballou, 2013) abundance estimates derived with this survey method should be considered to underestimate juveniles in the populations.

We recorded vertebrate commensal species observed with the camera scope in the “burrow observation” shape file in the Nomad GPS/PDA. Other noteworthy species encountered above ground during surveys including rare vertebrate species, sick, or dead tortoises, were recorded in a “field notes” shape file on the Nomad GPS/PDA.

For the analyses, transect end points and burrow/tortoise observation shape files were downloaded from the Nomad into ArcGIS projects for each site. Transects were created by converting start and end points from a point shape file to a line in ArcGIS and perpendicular distances from the line to burrow openings or tortoises above ground were determined using the NEAR tool in ArcGIS. Final transect lengths, perpendicular distances to occupied burrows and tortoises above ground, and burrow width data for occupied burrows were uploaded into Program Distance ver. 6.2. We ran a series of models to estimate population size and density using both the conventional distance sampling engine (CDS) and the multiple covariate distance sampling engine (MCDS) in Program Distance (Buckland et al., 2001 and 2004). Burrow width was included as a covariate in the MCDS engine (Buckland et al., 2001; Marques et al., 2007). For Blackwater River SF West Boundary Unit, which had an extremely low tortoise density and burrow occupancy rate and Bullfrog Creek WMA, which had a similarly low occupancy rate, we ran CDS models in Distance with a cluster size analysis (Thomas et al. 2010). Cluster size analysis incorporated all “usable” tortoise burrows (occupied, unoccupied, and undetermined) into the models (Stober et al., in review). Usable burrows

(those with a clear opening, i.e., not heavily modified by an armadillo or collapsed) are the primary search objects in surveys and by including all usable burrows in the models, we increased the number of observations used to derive the detection function and encounter rate, thus potentially increasing the precision of our estimates. Occupied burrows were coded as a cluster size of 1, unoccupied burrows had a cluster size of 0, and burrows for which we could not determine occupancy were coded as a -1. An additional benefit of using cluster analysis is that the mean cluster size is used to estimate occupancy of undetermined burrows, thus adjusting for the potential bias associated with scoping (Stober et al. *In review*).

We ran both CDS and MCDS analysis engines for all sites, but report output of the analysis engine that produced estimates with the lowest coefficient of variation [D(CV)]. Within a candidate set of models we used Akaike's Information Criteria (AIC; Akaike, 1974) for model selection (Burnham and Anderson, 2010). When AIC values of two or more models were within <2 AIC units, we selected the model with the lowest coefficient of variation (D CV).

Habitat Assessments: We collected data on habitat structure at randomly selected points (generated in ArcGIS) along transects at each site during full LTDS surveys. Data collected at habitat points included: basal area measured with a 10 factor prism (Forestry Suppliers, Inc., Jackson, MS) held at a height of 4.5 ft and percent canopy cover measured with a concave spherical densiometer (Forestry Suppliers, Inc., Jackson, MS). We estimated percent cover of perennial woody vegetation 1-3 m in height within a 5 m radius of the point. We also categorized the major components of the overstory, midstory and ground cover and recorded the dominant ground cover type within a 1 m radius of the

point (Appendix 1). We summarized data for each of the three strata as the percent of all habitat points for each component. Digital photographs were taken in four cardinal directions at each habitat point. A more detailed description of the habitat assessment methods is included in Appendix 1.

Upon completion of full surveys, we categorized sites as high, medium, or low quality as described below:

- 1) **High quality:** Likely a viable population in suitable habitat. Site requires continued management, but no population manipulation/augmentation is necessary.
- 2) **Medium quality- viable:** Likely a viable population, but habitat needs management/restoration of natural vegetation. No population manipulation necessary.
- 3) **Medium quality- not viable:** Population likely not viable at current size and demographic conditions, but habitat is suitable without need of extensive restoration. Augmentation with translocated tortoises should be considered.
- 4) **Low quality-** Population likely not viable at current size or demographic conditions and habitat is in need of extensive restoration to support more tortoises. Site should be considered for future augmentation with translocated tortoises.

Results

PHASE I: Pilot survey results including tortoise encounter rates and projected full survey effort data for Florida state conservation lands are presented in Table 1. We created survey designs targeting a CV<20% at all sites where tortoises were observed on

pilot surveys. For large sites, e.g., Goethe State Forest, Lake Wales Ridge State Forest, Lake Wales Ridge Wildlife Environmental Area, St. Sebastian River State Park, and Withlacoochee State Forest, following pilot surveys, we were asked to design surveys for individual tracts of habitat separated by major roads or > 3 km. Because of the patchy distribution of tortoises and low overall encounter rate (2081 m/tortoise) at Blackwater River State Forest, we were asked to provide separate survey designs for individual management units. We did not observe tortoises on pilot surveys at the Sweetwater, Bone Creek, or Horse Creek Units of Blackwater River State Forest, and no pilot surveys were run at the Yellow Creek Unit. We did not observe tortoises at Deer Lake State Park or Grayton Beach State Park despite sampling 3075 m and 5080 m of pilot survey transects, respectively.

PHASE II: We completed LTDS at 26 Florida state conservation lands between August 2014 and February 2016 (Table 2). Population size and density estimates are presented in Table 3; output for all candidate models is included in Appendix 2. Little Talbot Island State Park had the highest population density (4.36 tortoises/ha, 95% CI= 3.80-5.00, CV= 0.07). The lowest density population occurred at Blackwater River State Forest West Boundary Unity (0.10 tortoises/ha, 95% CI= 0.06-0.18, CV= 0.31). Withlacoochee State Forest Croom tract had the largest population size of the sites surveyed (N= 8221 tortoises, 95% CI= 6308-10714, CV= 0.14). Nineteen sites clearly met the criteria for a minimum viable population (Gopher Tortoise Council 2013, Table 3). The upper confidence limits of four sites, Guana River Wildlife Management Area, Hilochee Wildlife Management Area, Lake Wales Ridge Wildlife Environmental Area, and Perry Oldenberg Wildlife Environmental Area, overlapped the density and/or population size of

a minimum viable population and may meet the standards, particularly with additional habitat management.

Burrow occupancy ranged from 20% at Blackwater River State Forest West Boundary Unit to 71% at Hilochee Wildlife Management Area (Table 4). Low burrow occupancy also was observed at Bullfrog Creek Wildlife Environmental Area (21%) and St. Sebastian River State Park- NE tract (24%); we were unable to confirm occupancy at 6.9 and 7.1% of burrows at the two sites, respectively, due to flooding. We were unable to complete full surveys at Platt Branch Wildlife Environmental Area due to flooding in burrows.

Burrow size class histograms indicated a predominance of adult burrows (>23 cm in width) detected in most populations (Figure 2a-y). However, juvenile tortoises (<23 cm burrow width) were observed at all sites except for Joe Budd Wildlife Management Area and Hilochee Wildlife Management Area. Perry Oldenberg Wildlife Environmental Area had very low numbers of juvenile tortoises (3.8% of occupied burrows were ≤ 23 cm in width). The majority (57%, 8 of 14) of occupied burrows at Blackwater River State Forest West Boundary Unit were between 12 and 23 cm in width.

Habitat assessments revealed that basal area (BA) ranged from as low as 4 ft²/ac at Lake Wales Ridge Wildlife Environmental Area- Silver Lake tract to as high as 91.1 ft²/ac at Joe Budd Wildlife Management Area (Table 5). Canopy cover was lowest at Guana River Wildlife Management Area (8%) and highest at Joe Budd Wildlife Management Area (71.8%). Preliminary population evaluations and habitat suitability rankings are presented in Table 6. Based on estimates of population size, density, demographic structure and habitat characteristics, the following sites could be

categorized as of high quality (Ranking 1): Bell Ridge Wildlife Environmental Area, Bullfrog Creek Wildlife Environmental Area, Cayo Costa State Park, Etoniah Creek State Forest, Ft. White Wildlife Environmental Area, Gold Head Branch State Park, Ichetucknee Springs State Park, Little Talbot Island State Park, Moody Branch Wildlife Environmental Area, St. Sebastian River State Park (NE tract), and Withlacoochee State Forest- Citrus and Croom tracts.

An unusually large number of tortoise shells and shell fragments were found during surveys at Lake Louisa State Park the week of 17 August 2015. All shells/shell fragment locations (N= 38) were recorded as field notes in the GPS. Intact shells were from adult tortoises (25-32 cm). Florida Fish and Wildlife Conservation Commission and Florida Park Service staff were notified and followed up with additional surveys the week of August 24th.

Amphibians, reptiles, and mammal species observed in burrows and other noteworthy observations of vertebrate species observed during surveys are listed in Tables 7 and 8. An eastern indigo snake (*Drymarchon corais*) was observed during the pilot survey at Beker State Park. Gopher frogs (*Lithobates capito*) were observed in tortoise burrows at 16 sites and were particularly abundant at Ft. White Wildlife Environmental Area (n = 80), Etoniah Creek State Forest (63), Gold Head Branch State Park (n = 55), Watermelon Pond Wildlife Environmental Area (n = 78), Jonathan Dickinson State Park (n = 23), and St. Sebastian River State Park (NE) (n = 19). Eastern diamond-back rattlesnakes (*Crotalus adamanteus*) were observed at 10 sites: Blackwater River State Forest West Boundary Unit, Bullfrog Creek Wildlife Environmental Area, EB Wakulla Springs State Park, Guana River WMA, Joe Budd Wildlife Management Area, Jonathan Dickinson

State Park, Little Talbot Island State Park, O'Leno SP/River Rise Preserve State Park, Watermelon Pond Wildlife Environmental Area, and Wingate Creek State Park. Florida pine snakes (*Pituophis melanoleucus*) were observed at four sites: Blackwater River State Forest West Boundary Unit, Jonathan Dickinson State Park, Lake Louisa State Park and St. Sebastian River State Park (NE tract).

Three training workshops on the LTDS method for gopher tortoises were completed, the first took place at Goldhead Branch State Park (June 2014), the second was held at Withlacoochee State Forest (May 2015), and the third and final workshop took place on 3-5 May 2016 at Archbold Biological Station in Lake Placid, Florida. Workshop participants included 58 individuals from the Florida Fish and Wildlife Conservation Commission, Florida Park Service, Florida Forest Service, Florida Department of Environmental Protection, Florida Natural Areas Inventory, St. Johns River Water Management District, Hillsborough County, Polk County, and private consultants. The roster of participants in the May 2016 workshop is included in Appendix 3.

Acknowledgments

We thank Deborah Burr, Dan Sullivan, Scott Cooney, Greg Kaufman, and Brian Camposano for assistance with all aspects of this project. We greatly appreciate logistical support provided by staff with the Florida Fish and Wildlife Conservation Commission, Florida Park Service, Florida Forest Service including Barbara Almario, Travis Blunden, Scott Crosby, Norberto Fernandez, Craig Iverson, Tabitha Merkley, Ginger Morgan, Vince Morris, Jennifer Myers, Dan Pearson, and Scotland Talley, among many others. We especially thank the field crew leaders: Jennifer Heemeyer, Jennifer

Staiger, Eric Sievers, and Michelina Dziadzio and crew members: Rachel (King) Holton, Nathan Schwartz, Conner Egan, Jeff Folkerts, Kodiak Hengstebeck, Chris Murphy, Billy Moore, Dylan Kelly, and Dan Knapp. Jean Brock provided much needed assistance with GIS. We thank staff at Goldhead Branch State Park, Withlacoochee State Forest, and Archbold Biological Station for hosting the three training workshops.

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Table 1. Gopher tortoise pilot survey results for Florida state conservation lands (March –August 2014). Full surveys were conducted at sites in bold.

	Final Sampling Frame	No. Transects	Tortoises Observed	Total Length (m)	Encounter Rate	Estimated Transect Length (km)			Comments
Site	(ha)		<i>n_o</i>	<i>L_o</i>	<i>L_o/n_o</i>	L for 15% CV	L for 17% CV	L for 20% CV	
ADB Catfish Creek Preserve SP	998	13	1	2580	2580	344.0	267.8	193.5	
Beker SP	138	4	3	1950	650	86.7	67.5	48.8	Repeated survey design necessary
Bell Ridge WEA	292	10	30	2000	67	8.9	6.9	5.0	
Blackwater River SF:									
Coldwater Unit	3542.7	4	1	1700	1700	226.7	176.5	127.5	
Sweetwater Unit	8660.2	2	0	1000	--	--	--	--	No survey design
Bone Creek Unit	3782.5	3	0	1170	--	--	--	--	No survey design
Rock Creek Unit	7772.0	3	1	1500	1500	200.0	155.7	112.5	
Horse Creek Unit	1964	1	0	500	--	--	--	--	No survey design
West Boundary Unit	2826.5	5	2	1900	950	126.7	98.6	71.3	
Floridale Unit	6399.9	5	2	2500	1250	166.7	129.8	93.8	
Juniper Creek (+ state park) Unit	5799.6	12	5	5185	1037	138.3	107.6	77.8	
Yellow River Unit	90.4	0	0	--	--	--	--	--	No pilot surveys done in this unit
Blackwater River SP	53	3	4	900	225	30.0	23.4	16.9	Design included in Juniper Creek Unit
Bullfrog Creek WEA	185.1	5	6	2500	417	55.6	43.3	31.3	
Cayo Costa SP	163.5	6	9	2400	267	35.6	27.7	20.0	
Deer Lake SP	223.7	16	0	3075	--	--	--	--	Additional pilot surveys needed

	Final Sampling Frame	No. Transects	Tortoises Observed	Total Length (m)	Encounter Rate	Estimated Transect Length (km) Comments			Comments
Site	(ha)		n_o	L_o	L_o/n_o	L for 15% CV	L for 17% CV	L for 20% CV	
E.B. Wakulla Springs SP	449.9	11	4	2210	553	73.7	57.4	41.4	
Etoniah Creek SF	1496.1	15	4	2900	725	96.7	75.3	54.4	
Ft. White WEA	327.9	10	11	2000	182	24.2	18.9	13.6	
Goethe SF:									
Watermelon Pond-1 (N 24)	877	2	2	400	200	26.7	20.8	15.0	
Watermelon Pond-2 (S 24)	546	3	0	600	--	--	--	--	No pilot surveys done in this unit
Levy County- Main tract	1912	12	8	2100	262.5	35.0	27.2	19.7	
Goldhead Branch SP	754.8	13	13	2600	200	26.7	20.8	15.0	
Grayton Beach SP	368.1	29	0	5080	--	--	--	--	No survey design
Guana River WMA	381.2	15	3	2585	862	114.9	89.4	64.6	
Hilochee WMA (non-Osprey unit)	526.5	10	14	3450	246	32.9	25.6	18.5	
Ichetucknee Springs SP	319.8	14	37	2800	76	10.1	7.9	5.7	
Joe Budd WMA	258.2	6	8	1100	138	18.3	14.3	10.3	Repeated survey design necessary
Jonathan Dickinson SP	1130.7	14	8	6470	809	107.8	84.0	60.7	
Lake Louisa SP	750.1	9	8	3600	450	60.0	46.7	33.8	
Lake Talquin SF	2273.5	17	2	3370	1685	224.7	174.9	126.4	

	Final Sampling Frame	No. Transects	Tortoises Observed	Total Length (m)	Encounter Rate	Estimated Transect Length (km) Comments			Comments
Site	(ha)		n_o	L_o	L_o/n_o	L for 15% CV	L for 17% CV	L for 20% CV	
Lake Wales Ridge WEA:									
Carter Creek Tract	784.8	3	3	600	200	26.7	20.8	15.0	
Clements Tract	No data	2	1	900	900	120.0	93.4	67.5	Too fragmented to delineate sample frame
Lake Placid Scrub & McJunkin Tract	810	6	1	2100	2100	280.0	218.0	157.5	Too fragmented to delineate sample frame
Royce Tract	319	2	1	700	700	93.3	72.7	52.5	Too fragmented to delineate sample frame
Silver Lake Tract	143	2	3	700	233.3	31.1	24.2	17.5	
Lake Wales Ridge SF:									
Arbuckle Tract	986	9	3	3880	1293.3	172.4	134.3	97.0	
Babson Tract	132.2	2	3	1000	333.3	44.4	34.6	25.0	Repeated survey necessary
Boy Scout Tract	65.8	2	2	400	200	26.7	20.8	15.0	Repeated survey necessary
Walk-in-Water Tract	300.6	5	8	1300	162.5	21.7	16.9	12.2	
Little Talbot Island SP	173	12	10	2400	240	32.0	24.9	18.0	
Moody Branch WEA	181.5	4	8	2000	250	33.3	26.0	18.8	
O'Leno/River Rise SP	464.2	23	28	4380	156	20.9	16.2	11.7	
Perry Oldenburg WEA	134.8	4	12	2000	167	22.2	17.3	12.5	

	Final Sampling Frame	No. Transects	Tortoises Observed	Total Length (m)	Encounter Rate	Estimated Transect Length (km) Comments			Comments
Site	(ha)		n_o	L_o	L_o/n_o	L for 15% CV	L for 17% CV	L for 20% CV	
Platt Branch WEA	308.5	9	17	3300	194	25.9	20.2	14.6	
Point Washington SF	1785.2	13	1	4300	4300	573.3	446.4	322.5	Repeated survey design necessary
Pumpkin Hill Preserve SP	646.4	16	2	2900	1450	193.3	150.5	108.8	Repeated survey design necessary
Split Oak Forest WEA	194.7	9	2	4500	2250	300.0	233.6	168.8	20%CV design
St. Sebastian River SP:									
NE Tract	1140	4	9	2500	277.8	83.3	37.0	28.8	
SE Tract	1447	4	1	2000	2000.0	266.67	207.61	150.00	
NW Tract	1088	3	1	1500	1500.0	200.0	155.7	112.5	
SW Tract	1273	6	0	2940	--	--	--	--	More pilot surveys needed
Watermelon Pond WEA	133.4	12	7	2400	343	45.7	35.6	25.7	Repeated survey design necessary
Wingate Creek SP	152.2	3	6	1500	250	33.3	26.0	18.8	
Withlacoochee SF:									
Headquarters Tract	350	1	3	200	66.7	8.9	6.9	5.0	Additional pilot surveys needed
Citrus Tract	17899	13	13	4400	338.5	45.1	35.1	25.4	
Croom Tract	5164.4	8	6	1600	266.7	35.6	27.7	20.0	Habitat east of Croom- Nobleton Rd. not included
Two-mile Prairie Tract	758	3	7	1500	214.3	28.6	22.2	16.1	
Richloam Tract	No data	--	--	--	--	--	--	--	Too wet to sample

Table 2. Status of line transect distance sampling (LTDS) surveys at priority Florida state conservation lands as of June 2016.

	Site	Final Sampling Frame (ha)	Date of completion of Full survey
1	Bell Ridge Wildlife Environmental Area	292.0	8/29/14
2	Blackwater River State Forest, West Boundary Unit	2826.5	2/12/16
3	Bullfrog Creek Wildlife Environmental Area	185.1	1/12/16
4	Cayo Costa State Park	163.5	5/8/15
5	Edward Ball Wakulla Springs State Park	449.9	5/19/15
6	Etoniah Creek State Forest	1496.1	11/6/15
7	Ft. White Wildlife Environmental Area	327.9	9/10/14
8	Goethe SF Levy County, Main tract	1912.0	12/31/14
9	Goldhead Branch State Park	754.8	10/2/14
10	Guana River Wildlife Management Area	381.2	5/12/15
11	Hilochee Wildlife Management Area (non-Osprey unit)	526.5	6/23/15
12	Ichetucknee Springs State Park	319.8	9/22/14
13	Joe Budd Wildlife Management Area	258.2	11/21/14
14	Jonathan Dickinson State Park	1130.7	8/13/15
15	Lake Louisa State Park	750.1	8/28/15
16	Lake Wales Ridge Wildlife Environmental Area, Carter Creek	784.8	6/9/15
17	Lake Wales Ridge Wildlife Environmental Are, Silver Lake	143.0	3/27/15
18	Little Talbot Island State Park	173.0	11/14/14
19	Moody Branch Wildlife Environmental Area	181.5	4/23/15
20	O'Leno/River Rise State Park	464.2	12/15/14
21	Perry Oldenburg Wildlife Environmental Area	134.8	2/25/15
22	St. Sebastian River State Park, NE tract	1140.0	7/17/15
23	Watermelon Pond Wildlife Environmental Area	133.4	12/5/14
24	Wingate Creek State Park	152.2	7/29/15
25	Withlacoochee State Forest, Citrus tract	17,899.0	4/24/15
26	Withlacoochee State Forest, Croom tract	5164.4	4/7/16
	Total area surveyed	38,144.6	

Table 3. Summary of line transect distance sampling (LTDS) results for gopher tortoise populations on state conservation lands in Florida, August 2014 – April 2016. Analyses were run using Distance software v 6.2 (Buckland et al. 2001). Best fitted models were selected using Akaike’s Information Criteria (AIC; Akaike 1974) and consideration of the coefficient of variation (D CV) and detection probability (P). # obs= number of tortoises in burrows or above ground and observed from transects, Effort= total length of transect surveyed, D= Density (tortoises/hectare), N= abundance, LCL= lower confidence limit for D and N, UCL= upper confidence limit for density and abundance estimate. Output for all models is presented in Appendix I. *Cluster analysis was used; number of tortoise burrows observed is indicated parenthetically. †Site meets criteria for a minimum viable population (MVP) based on estimates of density (>0.4 tortoises/ha) and population size (N>250 adult tortoises) (Gopher Tortoise Council 2013). §Sites have D UCL and/or N UCL overlapping MVP thresholds.

Site	Model	# obs	Effort (m)	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
Bell Ridge WEA†	HN 5%	118	9516.1	729.499	4.101	2.578	6.523	0.182	1197	753	1905	0.626
Blackwater River SF West Boundary Unit*	UN cos 5%	14(67)	82516.2	332.52	0.100	0.055	0.182	0.308	284	156	514	0.577
Bullfrog Creek WEA*†	UN simp 5%	73(323)	21033.5	1529.91	2.042	1.584	2.633	0.130	378	293	487	0.683
Cayo Costa SP†	HR cos 5%	107	20597.0	637.185	2.095	1.597	2.750	0.139	343	261	450	0.592
E.B. Wakulla Spring SP	UN 5%	28	50914.9	158.250	0.163	0.101	0.264	0.247	73	45	119	1.000
Etoniah Creek SF†	HN 5%	127	50591.4	751.134	1.028	0.733	1.442	0.173	1538	1096	2157	0.521
Ft. White WEA†	HN 5%	142	18444.9	840.957	2.969	2.361	3.734	0.116	974	774	1224	0.587
Goethe SF Levy Co. Main Tract†	UN cos 5%	99	23393.7	670.292	1.067	0.721	1.579	0.198	2039	1378	3017	0.607
Goldhead Branch SP†	HN 5%	88	19907.1	565.391	1.116	0.783	1.591	0.176	843	591	1201	0.769
Guana River§	HN 5%	52	53557.9	261.816	0.575	0.403	0.822	0.183	219	154	313	0.617
Hilochee WMA§	HN 5%	27	22829.8	182.456	0.333	0.191	0.581	0.285	176	101	306	0.474
Ichetucknee Springs SP†	HN 5%	121	13561.7	665.481	3.970	3.008	5.240	0.138	1269	962	1675	0.658
Joe Budd WMA	UN 5%	28	27478.2	167.930	0.254	0.133	0.486	0.336	66	34	125	1.000
Jonathan Dickinson SP†	HR 5%	141	60288.2	855.485	0.769	0.580	1.021	0.144	870	656	1154	0.553
Lake Louisa SP†	UN 5%	226	42393.6	1342.853	2.168	1.580	2.975	0.161	1626	1185	2232	0.497
Lake Wales Ridge WEA Carter Crk§	UN 5%	13	9685.2	80.032	0.309	0.173	0.551	0.294	243	136	433	1.000
Lake Wales Ridge WEA Silver Lake†	HR 5%	38	21614.6	163.210	2.068	1.314	3.255	0.231	296	188	465	0.380
Little Talbot Island SP†	HR 5%	301	22252.7	1844.606	4.356	3.796	4.999	0.070	754	657	865	0.654
Moody Branch WEA†	HN 5%	104	23906.8	517.640	2.636	2.030	3.422	0.132	478	369	621	0.620
O’Leno River Rise SP†	HN 5%	190	21486.9	1308.974	2.178	1.603	2.960	0.155	1011	744	1374	0.546
Perry Oldenberg WEA§	HN 5%	75	17370.3	466.449	1.579	1.173	2.127	0.149	213	158	287	0.469
St. Sebastian River SP NE†	HN 5%	64	33284.0	362.806	0.857	0.564	1.301	0.213	977	644	1483	0.588
Watermelon Pond WEA†	HN 5%	173	36421.1	1090.596	1.378	1.118	1.697	0.106	184	149	226	0.706
Wingate Creek SP†	HN 5%	89	21955.9	477.390	1.994	1.537	2.586	0.132	303	234	394	0.648
Withlacoochee SF- Citrus Tract†	HN 5%	51	29667.6	350.785	0.401	0.268	0.601	0.205	7179	4789	10761	0.654
Withlacoochee SF- Croom Tract†	HN 5%	125	35083.7	720.950	1.592	1.221	2.075	0.135	8221	6308	10714	0.498

Table 4. Burrow scoping results during line transect distance sampling surveys (LTDS) at gopher tortoise populations on state conservation lands in Florida, August 2014 – April 2016. Counts do not include collapsed burrows or tortoises observed above ground.

Site	Burrows scoped	Tortoises in burrows	% occupied	No. unknown occupancy	% unknown occupancy
Bell Ridge Wildlife Environmental Area	358	124	35	11	3.1
Blackwater River State Forest West Boundary Unit	70	14	20	1	1.4
Bullfrog Creek Wildlife Environmental Area	340	73	21	24	7.1
Cayo Costa State Park	392	113	29	5	1.3
Edward Ball Wakulla Springs State Park	89	28	31	6	6.7
Etoniah Creek State Forest	368	134	36	18	4.9
Ft. White Wildlife Environmental Area	79	53	67	0	0.0
Goethe State Forest - Levy Co. Main Tract	236	104	44	9	3.8
Goldhead Branch State Park	61	38	62	0	0.0
Guana River Wildlife Management Area	81	55	68	5	6.2
Hilochee Wildlife Management Area	45	32	71	3	6.7
Ichetucknee Springs State Park	291	129	44	2	0.7
Joe Budd Wildlife Management Area	49	17	35	2	4.1
Jonathan Dickinson State Park	367	146	40	10	2.7
Lake Louisa State Park	509	240	47	13	2.6
Lake Wales Ridge Wildlife Environmental Area - Carter Creek Tract	35	13	37	2	5.7
Lake Wales Ridge Wildlife Environmental Area - Silver Lake Tract	98	39	40	3	3.1
Little Talbot Island State Park	502	345	69	7	1.4
Moody Branch Wildlife Environmental Area	275	108	39	11	4.0
Oleno River Rise State Park	354	198	56	9	2.5
Perry Oldenberg Wildlife Environmental Area	120	80	67	3	2.5
St. Sebastian River State Park, NE tract	277	66	24	19	6.9
Watermelon Pond Wildlife Environmental Area	145	76	52	5	3.4
Wingate Creek State Park	331	93	28	6	1.8
Withlacoochee State Forest - Citrus Tract	117	56	48	2	1.7
Withlacoochee State Forest- Croom Tract	268	132	49	2	0.7
Total	5857	2506			

Table 5. Habitat data for 26 state conservation lands in Florida collected in conjunction with line transect distance surveys (LTDS) for gopher tortoises, August 2014- April 2016.

	Bell Ridge WEA	Blackwater River SF West Boundary Unit	Bullfrog Creek WEA	Cayo Costa SP	EB Wakulla Springs SP
# of Habitat points	5	33	18	48	17
Mean basal area (ft2/ac)	22	44	25	69	63
Canopy cover (%)	33	58	40	13	47
Overstory composition (% of all habitat points)					
pine	60	61	61	0	59
oak	40	0	6	0	6
mixed	0	33	22	0	29
other	0	0	0	6	0
none	0	6	11	94	6
Midstory (%)	19	28	28	23	30
Midstory composition (% of all habitat points)					
pine	0	12	0	0	18
oak	100	21	11	0	18
shrubs	0	30	0	44	24
palmetto	0	0	78	29	0
mixed	0	21	0	2	35
other	0	15	0	4	0
none	0	0	11	21	6
Ground cover composition (% of all habitat points)					
bare ground	0	0	0	58	6
litter	0	33	17	8	71
grass	60	33	44	8	0
woody	0	0	17	4	0
vines	0	0	0	0	0
mixed	40	33	22	21	24

	Etoniah Creek SF	Ft. White WEA	Goethe SF	Goldhead Branch SP	Guana River WMA
# of Habitat points	36	19	28	10	24
Mean basal area (ft²/ac)	51	40	51	47	5
Canopy cover (%)	57	56	57	51	8.0
Overstory composition (% of all habitat points)					
pine	44	63	71	20	4
oak	8	16	7	40	0
mixed	25	16	18	40	0
other	0	0	0	0	0
none	22	5	4	0	96
Midstory (%)	30	26	63	47	22
Midstory composition (% of all habitat points)					
pine	0	0	0	0	0
oak	19	47	25	80	0
shrubs	25	11	0	10	50
palmetto	8	11	4	0	0
mixed	42	26	71	10	8
other	3	5	0	0	8
none	3	0	0	0	33
Ground cover composition (% of all habitat points)					
bare ground	6	16	4	10	8
litter	61	42	75	30	13
grass	14	11	4	10	17
woody	3	0	0	0	17
vines	0	0	0	0	0
mixed	17	32	18	50	46

	Hilochee WMA	Ichetucknee Springs SP	Joe Budd WMA	Jonathan Dickinson SP	Lake Louisa SP
# of Habitat points	34	17	14	47	33
Mean basal area (ft ² /ac)	41	41	91	17	25
Canopy cover (%)	31.0	49	72	15	22
Overstory composition (% of all habitat points)					
pine	21	24	64	9	18
oak	3	29	0	0	6
mixed	0	47	36	0	0
other	3	0	0	0	0
none	74	0	0	91	76
Midstory (%)	32	33	34	26	14
Midstory composition (% of all habitat points)					
pine	0	6	0	2	9
oak	0	29	14	2	0
shrubs	41	6	7	51	30
palmetto	21	0	7	19	0
mixed	15	47	64	4	12
other	6	6	0	0	15
none	18	6	7	21	33
Ground cover composition (% of all habitat points)					
bare ground	6	0	0	26	6
litter	35	24	50	21	15
grass	35	53	7	26	39
woody	9	0	0	2	0
vines	0	0	0	0	6
mixed	15	24	43	26	33

	Lake Wales Ridge WEA Carter Creek Tract	Lake Wales Ridge WEA- Silver Lake Tract	Little Talbot Island SP	Moody Branch WEA	O'Leno River Rise SP
# of Habitat points	13	36	84	32	36
Mean basal area (ft ² /ac)	6	4	17	8	84
Canopy cover (%)	24	10	22	14	69
Overstory composition (% of all habitat points)					
pine	0	3	1	0	28
oak	8	0	0	6	11
mixed	0	0	19	0	61
other	0	6	24	0	0
none	92	92	56	94	0
Midstory (%)	51	24	30	26	42
Midstory composition (% of all habitat points)					
pine	0	0	0	3	3
oak	0	8	0	0	8
shrubs	77	50	21	44	3
palmetto	0	8	1	19	8
mixed	15	6	48	13	53
other	0	6	11	3	14
none	8	22	19	19	11
Ground cover composition (% of all habitat points)					
bare ground	15	25	42	25	8
litter	54	50	23	44	64
grass	0	11	11	3	17
woody	0	0	0	3	0
vines	0	0	1	0	0
mixed	31	14	24	25	14

	Perry Oldenberg WEA	St. Sebastian SP NE	Watermelon Pond WEA	Wingate Creek SP	Withlacoochee SF Citrus Tract
# of Habitat points	21	14	71	27	24
Mean basal area (ft²/ac)	69	44	41	33	66
Canopy cover (%)	61	22	47	36	56
Overstory composition (% of all habitat points)					
pine	19	21	21	11	42
oak	29	0	37	19	25
mixed	14	0	30	0	4
other	5	0	1	0	0
none	33	79	11	70	29
Midstory (%)	25	15	32	36	15
Midstory composition (% of all habitat points)					
pine	0	14	0	0	4
oak	5	0	61	11	38
shrubs	29	0	0	15	8
palmetto	0	43	0	22	4
mixed	14	0	28	41	8
other	29	0	1	0	0
none	24	43	10	11	38
Ground cover composition (% of all habitat points)					
bare ground	10	0	11	19	13
litter	71	21	59	56	42
grass	14	36	7	11	13
woody	0	0	0	0	0
vines	0	0	0	0	0
mixed	5	43	22	15	33

	Withlacoochee SF Croom Tract
# of Habitat points	40
Mean basal area (ft²/ac)	65
Canopy cover (%)	80
Overstory composition (% of all habitat points)	
pine	30
oak	12
mixed	58
other	0
none	0
Midstory (%)	17
Midstory composition (% of all habitat points)	
pine	0
oak	65
shrubs	10
palmetto	5
mixed	5
other	2
none	12
Ground cover composition (% of all habitat points)	
bare ground	10
litter	68
grass	15
woody	2
vines	0
mixed	5

Table 6. Population evaluation and habitat suitability rankings for gopher tortoise surveys sites in Florida August 2014-April 2016. (1) High quality: Likely a viable population in suitable habitat. Site requires continued management, but no population manipulation/augmentation is necessary; (2) Medium quality- viable: Likely a viable population, but habitat needs management/restoration of natural vegetation. No population manipulation necessary; (3) Medium quality- not viable: Population likely not viable at current size and demographic conditions, but habitat is suitable without need for extensive restoration. Augmentation with translocated tortoises should be considered; (4) Low quality: Population likely not viable at current size or demographic conditions and habitat is in need of extensive restoration to support more tortoises. Site should be considered for future augmentation with translocated tortoises. †Meets MVP criteria (Gopher Tortoise Council 2013). §Sites have D UCL and/or N UCL overlapping MVP thresholds.

Site	Ranking	Comments
Bell Ridge WEA†	1	Open canopy pine habitat with native ground cover dominated by grasses; habitat condition is excellent (Fig. 3a).
Blackwater River SF- West Boundary Unit	3	The low density (0.1 tortoises/ha) and high proportion of subadult tortoises (57%) suggests slow recovery from loss of adults in the population from harvest or another unidentified source of mortality. Habitat includes some open canopy pine with herbaceous understory but few tortoises. Despite the apparently suitable vegetation structure in some areas, soils in some areas may be inappropriate for tortoises. The northwestern and southwestern portions of the unit have a dense midstory. Habitat could be improved in these parcels with increased frequency of prescribed fire.
Bullfrog Creek WEA†	1	Open canopy mesic flatwoods with ground cover dominated by saw palmetto and grasses provide highly suitable tortoise habitat.
Cayo Costa SP†	1	Cabbage palm savanna with patchy shrub cover including sea grapes and abundant grasses. Likely a viable population and juvenile size class burrows were detected.
Edward Ball Wakulla Springs SP	4	Much of the habitat (upland pine and mixed hardwood coniferous land cover) is unsuitable for tortoises in its current condition (Fig. 3b). The habitat will require restoration to reduce the canopy and midstory cover to support a viable population. Additionally, extant tortoises are concentrated in three disparate areas in the park and it is unlikely they can move among these habitat patches.
Etoniah Creek SF†	1	The sandhill habitat is in good condition with an open canopy, and supports a large tortoise population with evidence of recruitment. Tortoise densities are lower in the unburned scrub and mesic pine flatwoods, particularly in the Manning tract.
Ft. White WEA†	1	Open canopy pine habitat with patches of native ground cover dominated by grasses. Habitat is in excellent condition.
Goethe SF Levy Co. Main Tract†		Northeastern parcels within tract contain highly suitable open canopy pine habitat and ground cover dominated by grasses. Parcels in the south and western portion of

	1-2	the site occur on less well-drained soils with greater midstory shrub cover.
Gold Head Branch SP †	1	Open canopy pine habitat with patches of native ground cover dominated by grasses. Habitat is in excellent condition.
Guana River WMA§	3	Observations of tortoises were largely confined to the scrub habitat because the mesic flatwoods are too wet to support tortoises. Increased frequency of prescribed fire or mechanical reduction of scrub canopy would improve habitat for tortoises. The tortoise density at the site (0.575 tortoises/ha) meets the criteria for a minimum viable population, and although the population estimate of 219 tortoises the 95% CI overlapped 250 so this population may be viable. We also saw evidence of recruitment in this population.
Hilochee WMA§	3	Survey area includes thinned pine plantations and mesic flatwoods. Most tortoises were observed in pine plantations, likely as a result of the more appropriate (well drained) soils, herbaceous cover and an open canopy. Continued management with prescribed fire is needed to maintain the habitat. The adult-biased burrow size class distribution suggests recruitment may be low.
Ichetucknee Springs SP†	1	Open canopy pine habitat with patches of native ground cover dominated by grasses. Isolated parcels to the north contain greater midstory hardwood cover.
Joe Budd WMA	3	Habitat varies from open canopy with dense herbaceous ground cover to more closed canopy pine stands with an understory of woody forbs and vines. Portions of the site on more well drained soil types could likely support more tortoises. The population is skewed toward adults (Figure 1m). Given the overall low tortoise density and lack of juveniles this population might benefit from augmentation.
Jonathan Dickinson SP†	1-2	The site is actively managed with prescribed fire, which is reflected in the low basal area (17 ft ² /ac) and abundance of grasses and other herbaceous plants in the understory. While this site supports a large population of tortoises, the overall density is relatively low (0.77 tortoises/ha). Tortoises are clustered in the scrub habitat in the east and the mesic flatwoods in the southwestern part of the Park (Figure 2). These two populations are separated by natural features including distance (5 km), unsuitable habitat (i.e. wetlands and a river) and the railroad tracks.
Lake Louisa SP†	2	Site supports a large, high density tortoise population. However, much of the habitat is in old field with some areas in planted pine and the site would benefit from restoration of native vegetation. A large number of tortoise carcasses were observed during the survey; cause of mortality could not be determined based in remains, which were in various decay states.
Lake Wales Ridge WEA- Carter Creek Tract§		The scrub and scrubby flatwoods habitat will require more frequent prescribed fire to create openings for gopher tortoises to burrow. Very few tortoises were detected

	3	on transects in the interior of the survey area; however, additional tortoises were observed along roadsides and were not represented in the survey. Low density suggests this population may not reach MVP standards, but the upper confidence intervals overlap the MVP standards.
Lake Wales Ridge WEA- Silver Lake Tract†	2	Open canopy scrubby flatwoods and sandhill habitat. Dense patches of shrubs and palmetto in some areas. Tortoise density and population estimate indicates this is a small, but likely viable population.
Little Talbot Island SP†	1	Coastal scrub with numerous openings with bare sand and sparse ground cover vegetation (Fig .3b)
Moody Branch WEA†	1	Open canopy scrub, scrubby flatwoods and mesic flatwoods provide highly suitable tortoise habitat.
O'Leno SP/River Rise Preserve SP†	1-2	Mostly open canopy pine habitat with patches of dense herbaceous ground cover, but many areas have a more closed hardwood canopy and dense midstory of oaks and holly (<i>Ilex sp.</i>). Areas with hardwood encroachment could benefit from mechanical removal and more frequent prescribed fire.
Perry Oldenberg WEA§	3	Oak forests and pine stands with relatively open canopy managed with both prescribed fire and mechanical hardwood reduction. The upper confidence interval of the population estimate exceeds the threshold for a minimum viable population of 250 adults and the site has a reasonable tortoise density (1.5 tortoises/ha). However, the very low numbers of juveniles indicate potentially low recruitment. Given the documentation of a mortality event at this site (Gates et al., 2002), translocation is not recommended. Methods to increase recruitment should be explored.
St. Sebastian River SP NE†	1	Open canopy pine flatwoods; frequently burned. Site supports a large tortoise population on suitable to marginally suitable soils.
Watermelon Pond WEA	3	Some open canopy pine with native ground cover vegetation dominated by grasses. But much of the site is under restoration and has an open canopy with dense midstory of oaks. Although the population estimate falls slightly below the MVP threshold (Gopher Tortoise Council 2013), the population density meets the MVP criteria and habitat restoration could enable this population to increase.
Wingate Creek SP†	2	Small site with relatively high tortoise density. Portions of the site are in sand pine and dense palmetto, could benefit from more frequent prescribed fire.
Withlacoochee SF- Citrus tract†	1	Open canopy pine habitat (mostly sandhill) with a hardwood component. The site supports a very large, but low density population.
Withlacoochee SF- Croom Tract†	1	Open canopy pine habitat (mostly sandhill) with a lesser hardwood component. The site supports a very large, robust population.

Table 7. Amphibians and reptiles observed during pilot and full line transect distance sampling (LTDS) surveys for gopher tortoises on Florida state conservation lands from March 2014 –February 2016. Most observations occurred using a burrow camera scope; counts in parentheses indicate individuals observed outside of tortoise burrows.

	Beker SP	Bell Ridge WEA	Blackwater SF WBU	Bullfrog Creek WEA	Cayo Costa SP	EB Wakulla Springs SP	Etoniah Creek SF	Ft. White WEA	Goethe SF Levy Co.	Goldhead Branch SP	Guana River WMA	Hilochee WMA	Ichetucknee Springs SP	Joe Budd WMA	Jonathan Dickinson SP
<i>Acris gryllus</i>												(1)			
<i>Agkistrodon contortrix</i>			(1)												
<i>Agkistrodon piscivorus</i>											(3)				
<i>Anaxyrus quercicus</i>											1				1
<i>Anaxyrus terrestris</i>		5	1				1	6	1	2					1
<i>Anolis carolinensis</i>															
<i>Anolis sagrei</i>					4										
<i>Apalone ferox</i>															
<i>Aspidoscelis sexlineatus</i>		1		(1)	(1)										
<i>Coluber constrictor</i>			(1)		(1)		(3)				(2)	(2)			1(2)
<i>Coluber flagellum</i>					8(3)		(1)								1(2)
<i>Crotalus adamanteus</i>			1	1		3(3)					(1)			3	(1)
<i>Ctenosaura similis</i>					(5)										
<i>Drymarchon corais</i>	1														
<i>Eleutherodactylus planirostris</i>		3		1	4		1	2	1	4			7		
<i>Gastrophryne carolinensis</i>							(1)								
<i>Hyla cinerea</i>											(1)				
<i>Hyla femoralis</i>			(1)	(4)			(3)				(3)				(3)
<i>Lithobates capito</i>							63	80	12	55		1			23
<i>Lithobates sphenoccephalus</i>		2										(1)			
<i>Micrurus fulvius</i>															
<i>Opheodrys aestivalis</i>							(2)								
<i>Osteopilus septentrionalis</i>															
<i>Pantherophis alleghaniensis</i>															
<i>Pantherophis guttatus</i>						(1)									
<i>Pituophis melanoleucus</i>			(2)												1
<i>Plestiodon laticeps</i>											(1)				
<i>Pseudacris nigrita</i>															
<i>Sceloporus undulatus</i>												2			
<i>Sceloporus woodi</i>															(1)
<i>Scincella lateralis</i>							(1)								
<i>Sistrurus miliarius</i>							(2)		1		(6)				
<i>Storeria occipitomaculata</i>											(1)				
<i>Terrapene carolina</i>						(1)	(2)								1(1)
<i>Thamnophis sauritus</i>											(1)				
<i>Thamnophis sirtalis</i>											(2)				

	Lake Louisa SP	Lake Wales Ridge SF	LWR WEA Carter Creek	LWR WEA Silver Lake	Little Talbot Island SP	Moody Branch WEA	O'Leno River Rise SP	Perry Oldenberg WEA	St. Sebastian River SP	Watermelon Pond WEA	Wingate Creek SP	Withlacoochee SF	Withlacoochee SF Citrus	Withlacoochee SF Croom
<i>Acris gryllus</i>														
<i>Agkistrodon contortrix</i>														
<i>Agkistrodon piscivorus</i>														
<i>Anaxyrus quercicus</i>													1	
<i>Anaxyrus terrestris</i>	13		(1)											
<i>Anolis carolinensis</i>														(2)
<i>Anolis sagrei</i>														
<i>Apalone ferox</i>	(1)													
<i>Aspidoscelis sexlineatus</i>			(1)	(1)					1					(1)
<i>Coluber constrictor</i>	(1)			(5)					(1)					(1)
<i>Coluber flagellum</i>	(2)			(1)	2	(1)	1 (1)		1					
<i>Crotalus adamanteus</i>					1(2)		11(1)			1	(1)			
<i>Ctenosaura similis</i>														
<i>Drymarchon corais</i>														
<i>Eleutherodactylus planirostris</i>										1				
<i>Gastrophryne carolinensis</i>														
<i>Hyla cinerea</i>	(1)													
<i>Hyla femoralis</i>											(1)			
<i>Lithobates capito</i>		3	4			3		3	19	78	3	1	1	4
<i>Lithobates sphenoccephalus</i>														
<i>Micrurus fulvius</i>							(1)				(1)			
<i>Opheodrys aestivalis</i>	(1)													
<i>Osteopilus septentrionalis</i>											(1)			
<i>Pantherophis alleghaniensis</i>				(1)							(1)			
<i>Pantherophis guttatus</i>										(1)				
<i>Pituophis melanoleucus</i>	1								1					
<i>Plestiodon laticeps</i>														
<i>Pseudacris nigrata</i>												2		
<i>Sceloporus undulatus</i>														
<i>Sceloporus woodi</i>			(2)											
<i>Scincella lateralis</i>														
<i>Sistrurus miliarius</i>										(1)				
<i>Storeria occipitomaculata</i>														
<i>Terrapene carolina</i>					(1)									(1)
<i>Thamnophis sauritus</i>														
<i>Thamnophis sirtalis</i>														(1)

Table 8. Mammals observed during pilot and full line transect distance sampling (LTDS) surveys for gopher tortoises on Florida state conservation lands from March 2014 –June 2016. Most observations occurred using a burrow camera scope; counts in parentheses indicate individuals observed outside of tortoise burrows. Black bear, *Ursus americanus*, tracks and a den site were observed at Etoniah Creek SF.

	Bell Ridge WEA	Bullfrog Creek WEA	Cayo Costa SP	Etoniah Creek SF	Goethe SF Levy Co.	Goldhead Branch SP	Ichetucknee Springs SP	Joe Budd WMA	Jonathan Dickinson SP	O'Leno River Rise SP	St. Sebastian River SP	Watermelon Pond WEA	Withlacoochee SF Croom
<i>Canis latrans</i>				2									
<i>Dasyus novemcinctus</i>	1		2								1		1
<i>Didelphis virginianus</i>				1	1		1	1		3		1	1
<i>Mephitis mephitis</i>							1		1	1		2	
<i>Podomys floridanus</i>					3	1				1		1	
<i>Sigmodon hispidus</i>		1											
<i>Sylvilagus sp.</i>	1									1			2
<i>Ursus americanus</i>				(2)									

Figure 1. Location of Florida conservation lands sampled for gopher tortoise population estimates using line transect distance sampling (LTDS).

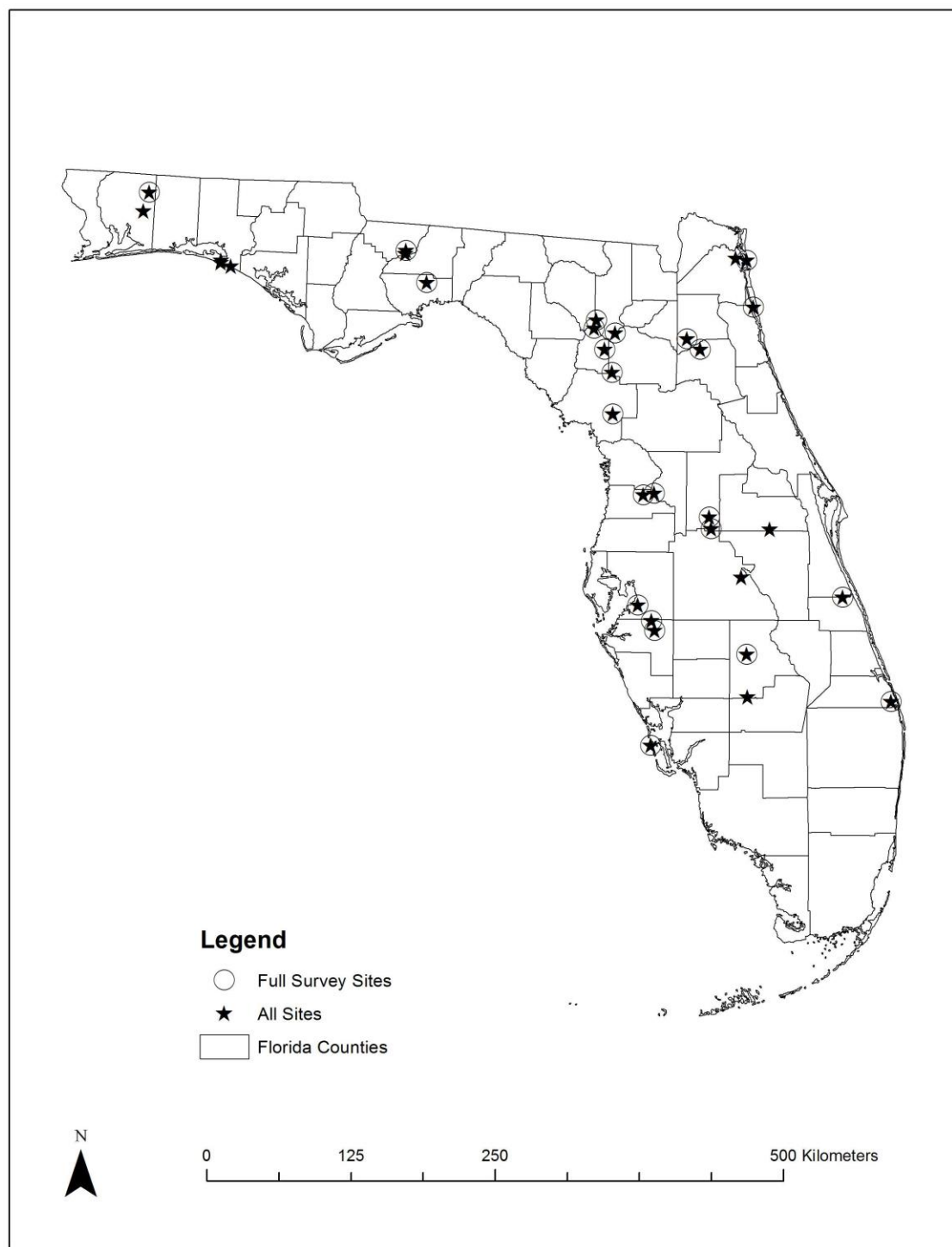
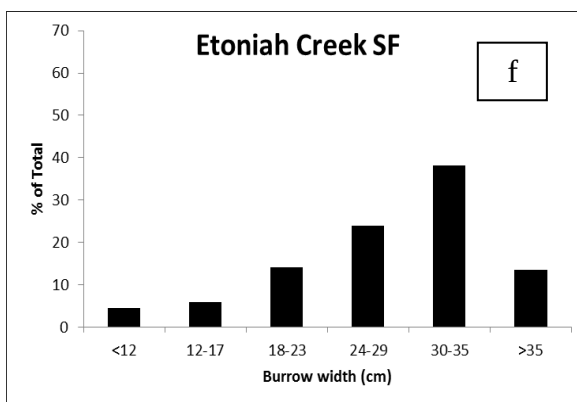
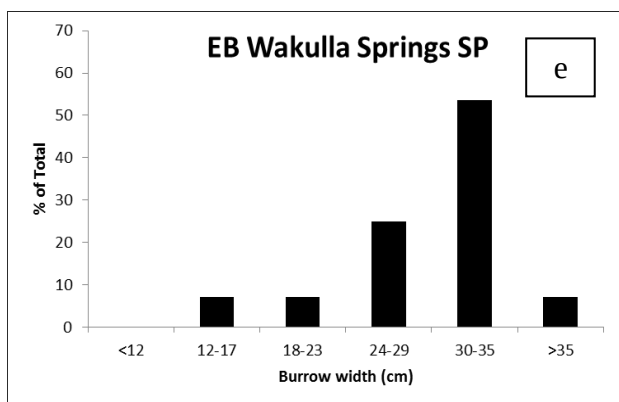
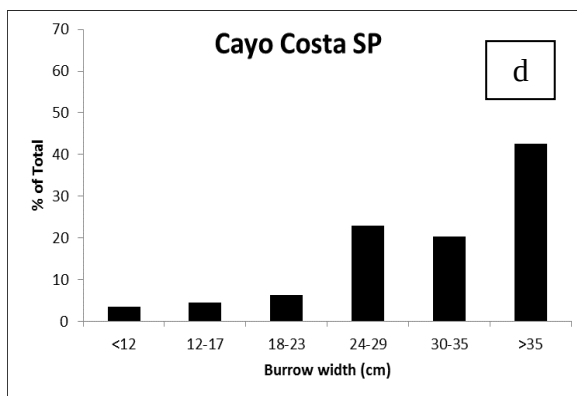
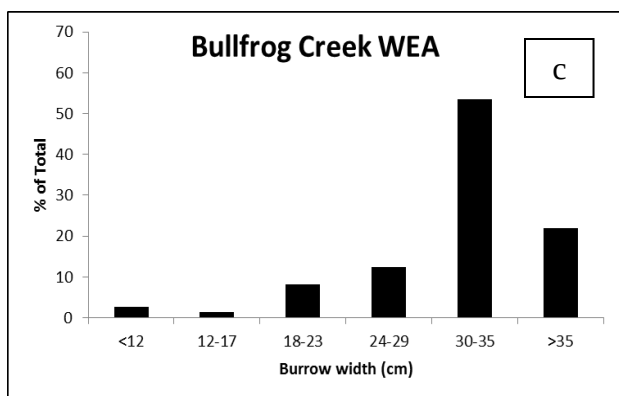
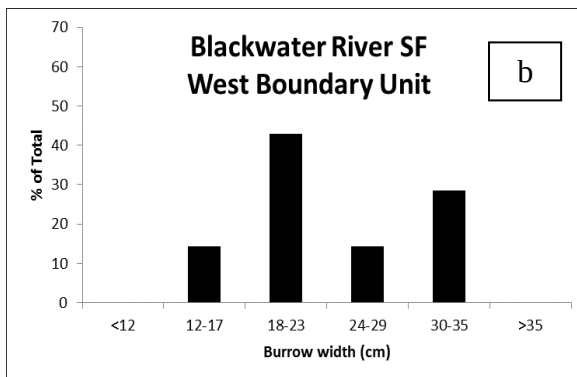
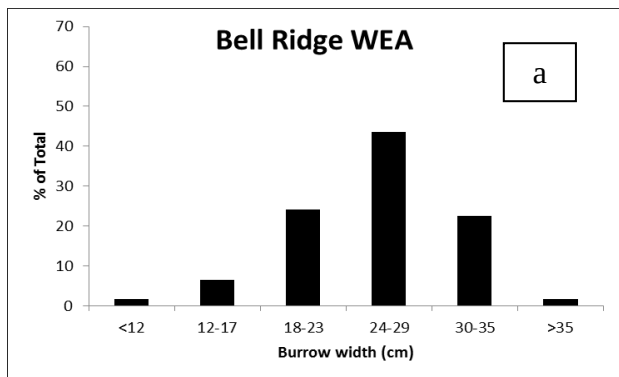
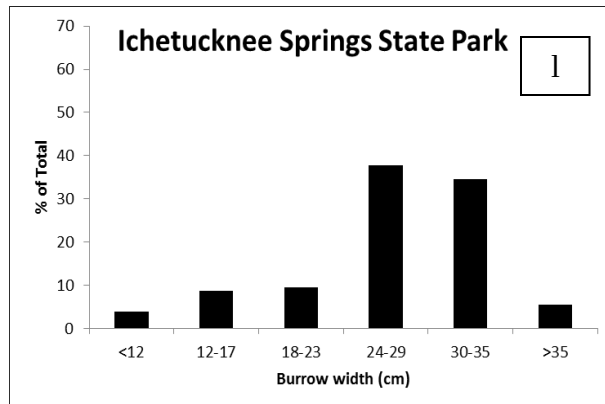
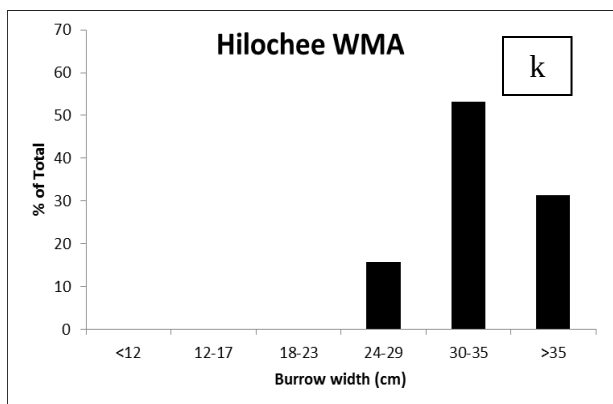
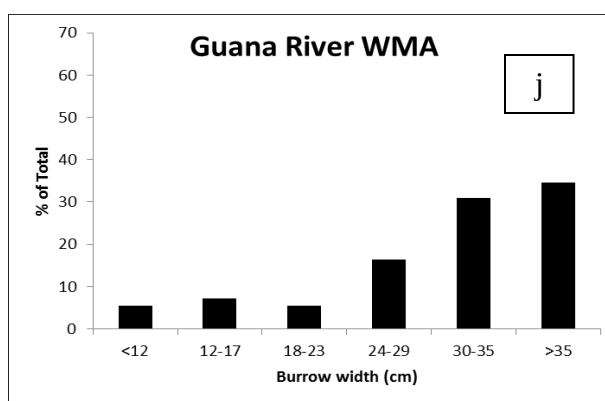
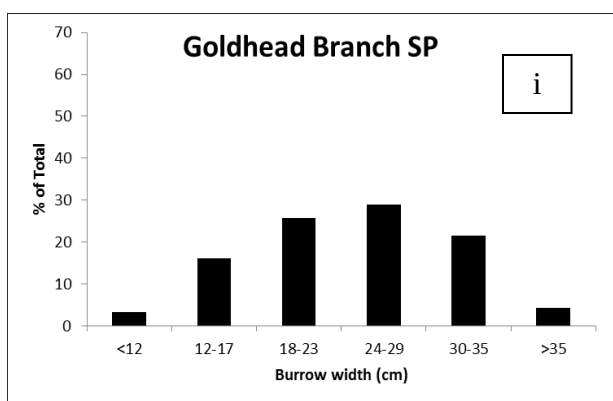
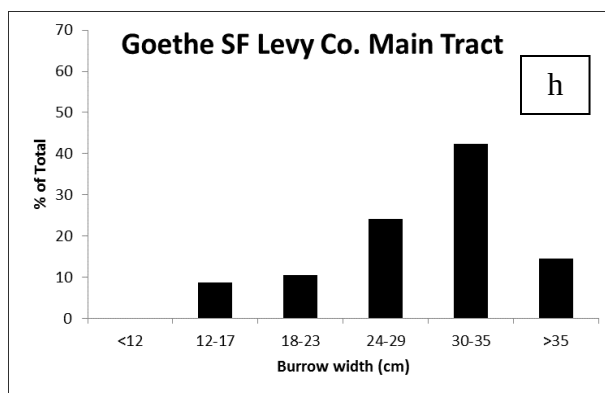
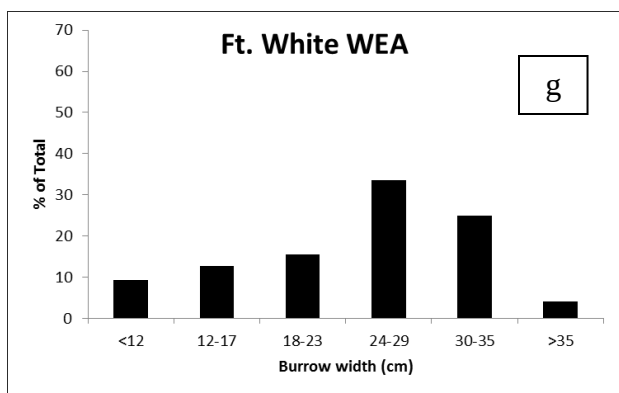
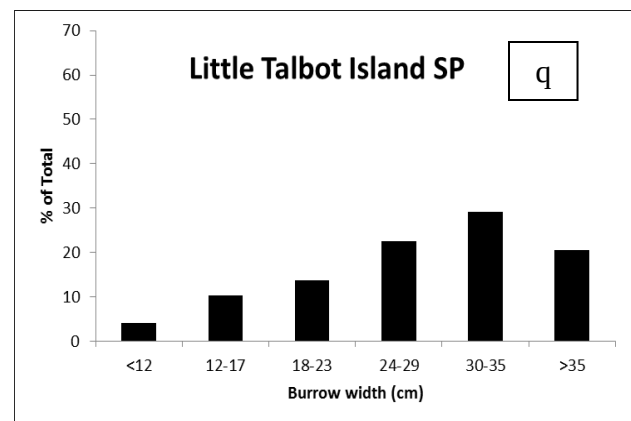
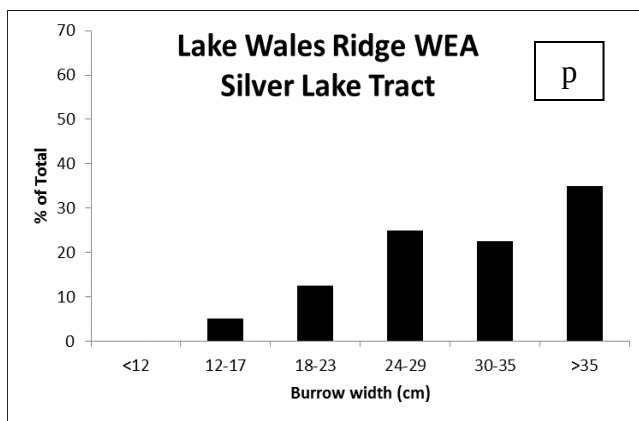
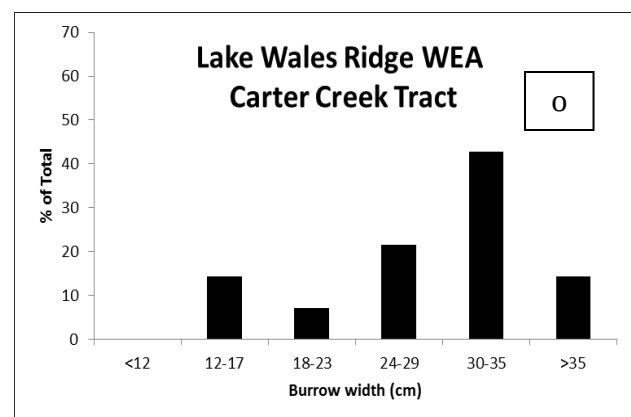
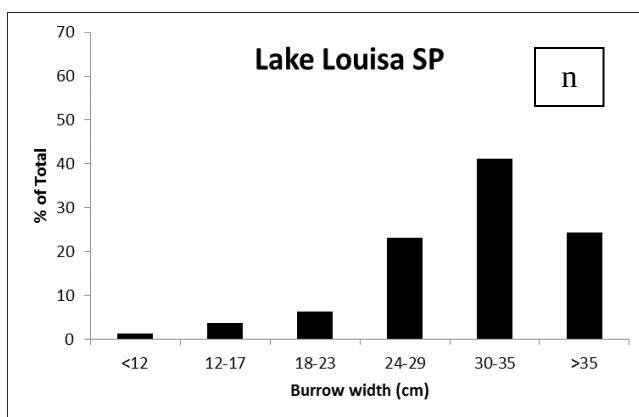
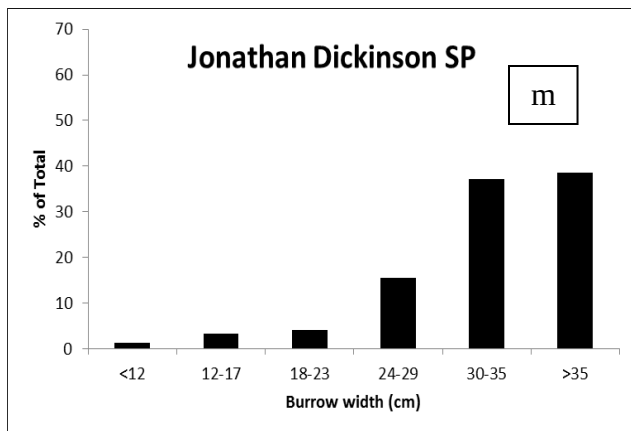
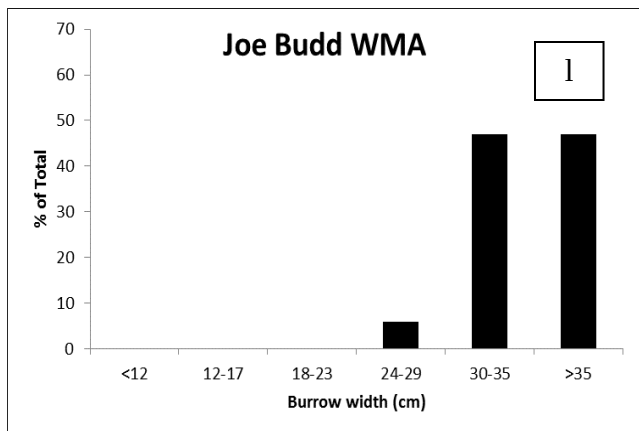
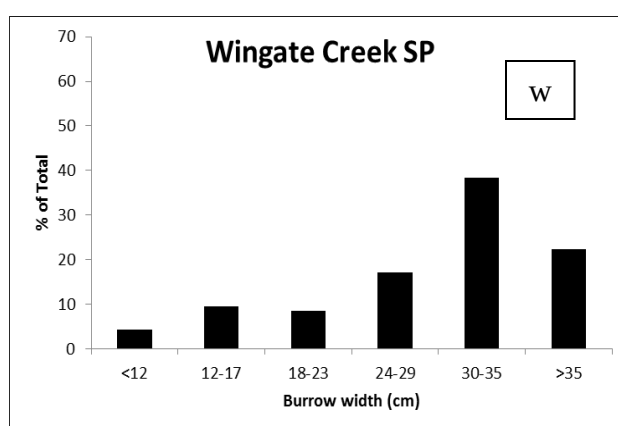
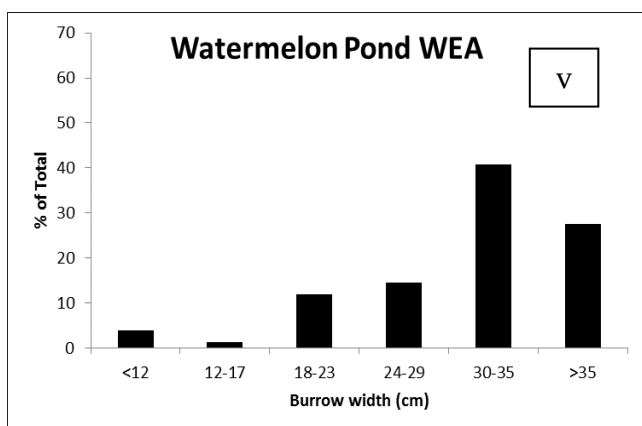
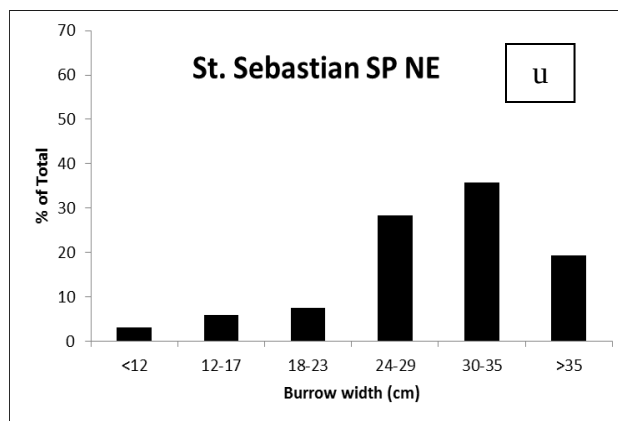
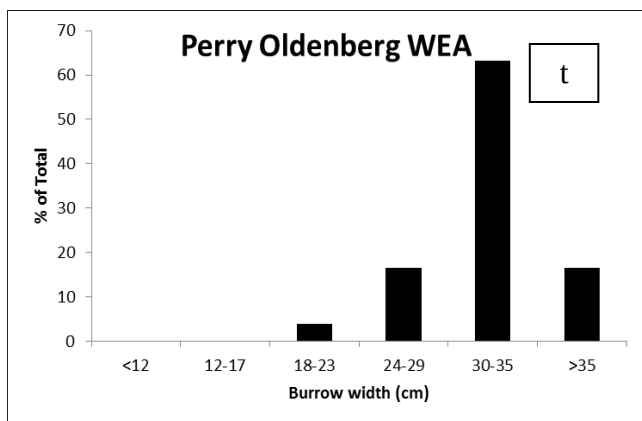
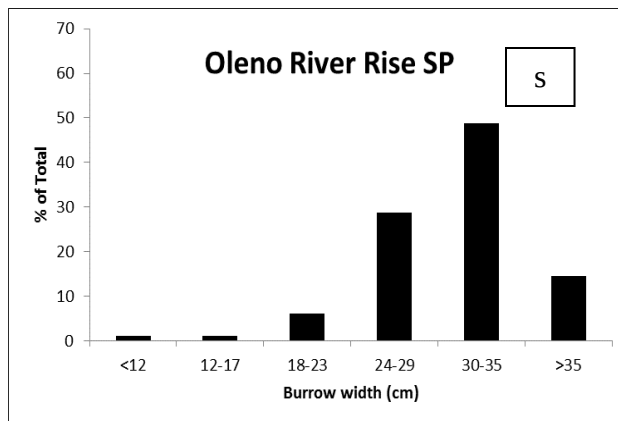
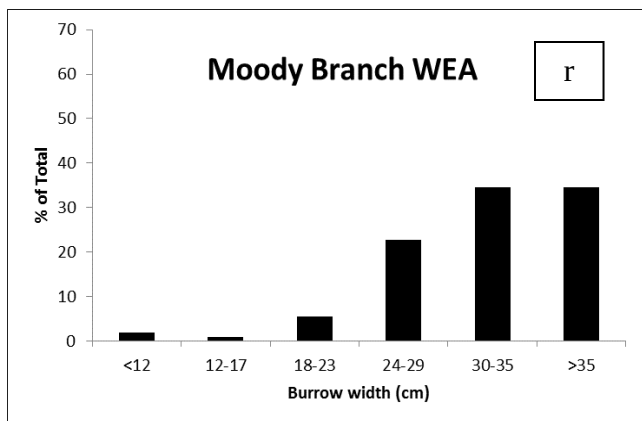


Figure 2a-y. Size class distribution of occupied gopher tortoise burrows at 25 Florida conservation lands surveyed using line transect distance sampling (LTDS) from August 2014-June 2016.









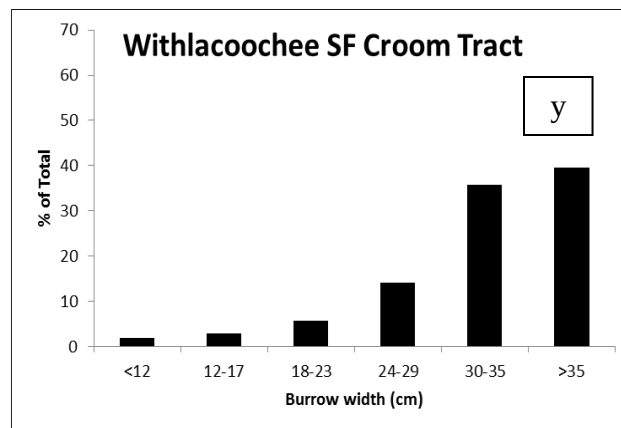
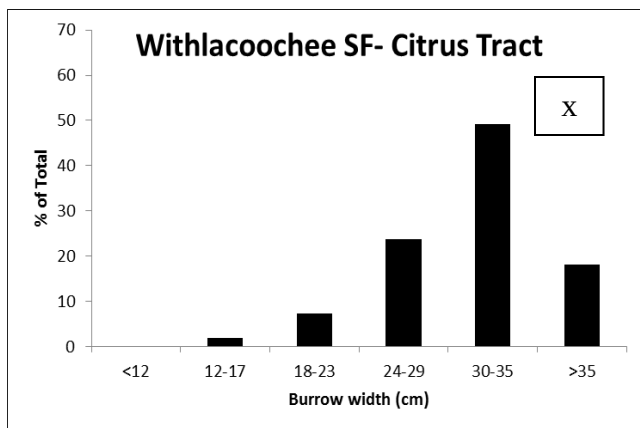


Figure 3a-c. High quality gopher tortoise habitat at Bell Ridge Wildlife Environmental Area (a), a tortoise burrow on the dunes at Little Talbot Island State Park (b), and fire suppressed habitat at Wakulla Springs State Park (c).



a



b



c

Appendix 1. Florida gopher tortoise survey rapid habitat assessment protocol.

Habitat sampling points were randomly selected (1 per transect) in ArcGIS. At each point, we sampled the following:

Basal Area:

- Collected using a 10 factor prism horizontally at a height of 4.5 ft.
- Trees were counted (referred to as "in") if the displaced part of the trunk overlapped what could be seen above or below.
- Counted trees where just the borderline overlapped as half a tree.
- If the image did not overlap, the tree was out (not counted).
- Reported the raw counts in Nomad (multiplied these by 10 in Excel database for final reporting).

Canopy cover:

- Used a concave spherical densiometer, visualized 4 dots per square (up to 96 potential dots), counted the number of dots that were OPEN (not covered by any forest canopy).
- Took 4 readings, one in each cardinal direction holding the densiometer at the same height and orientation.
- Recorded all 4 readings or the mean of the 4 readings.
- Reported % canopy cover as: The number of open dots multiplied by 1.04 to obtain the percent of overhead area not occupied by canopy. The difference between this percentage and 100% is the estimated overstory density in percent, e.g., 100% (72 open dots x 1.04) = 25.12 or 25% canopy cover.

Overstory composition:

- Selected the dominant overstory type at the point (pine, oak, mixed, other, none).

% Midstory:

- Estimated the % cover of woody perennial vegetation 1-3 m tall within a 5 m radius of point.

Midstory composition:

- Selected the woody perennial vegetation from 1-3 m tall (pine, oak, shrubs, palmetto, mixed, other, none).

% Ground Cover:

- Selected the dominant ground cover type within a 1 m radius of the point (bare ground, litter, grass, woody, vines, mixed).

Photos:

- Took landscape oriented digital photos N, W, S, and E at each point.
- After taking above 4 photos, take photo denoting transect number.

Appendix 2. Model output for distance sampling for gopher tortoise populations on state conservation lands in Florida, August 2014– May 2016. Methods included conventional distance sampling (CDS), CDS with cluster analysis, and multiple covariate distance sampling (MCDS). Analyses were run using Distance software v.6.2 (Buckland et al. 2001). Burrow diameter was used as a covariate in all MCDS models. Best fitted models (highlighted in yellow) were selected using Akaike’s Information Criteria (AIC; Akaike 1974) and consideration of the coefficient of variation (D CV) and detection probability (P). # obs= number of tortoises in burrows or at large observed from transects, Effort= total length of transect surveyed, D= Density (tortoises/hectare), N= abundance, LCL= lower confidence limit for D and N, UCL= upper confidence limit for density and abundance estimate.

Method: MCDS

Bell Ridge WEA	Models	# obs	Effort	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
Survey dates	HN 5%	118	9516.1	729.499	4.101	2.578	6.523	0.182	1197	753	1905	0.626
8/26-8/29/14	HR 5%	118	9516.1	735.258	4.398	2.767	6.991	0.184	1284	808	2041	0.583

Method: Cluster CDS

Blackwater River SF West Boundary Unit	Models	# obs	Effort	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
Survey dates	UN cos 5%	67(14)	82516.2	332.52	0.100	0.055	0.182	0.308	284	156	514	0.577
9/21-9/25/15, 1/18-2/12/16	HR 5%	67(14)	82516.2	333.17	0.101	0.053	0.193	0.335	286	150	546	0.571
	HN 5%	67(14)	82516.2	333.40	0.101	0.055	0.186	0.314	286	156	525	0.571

Method: Cluster CDS

Bullfrog Creek WEA	Models	# obs	Effort	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
Survey dates	UN simp 5%	323	21033.5	1529.91	2.042	1.584	2.633	0.130	378	293	487	0.683
9/14-9/16/15, 1/5-1/12/16	HN simp 5%	323	21033.5	1530.55	2.154	1.634	2.839	0.141	399	302	525	0.648
	HR 5%	323	21033.5	1532.32	1.985	1.520	2.594	0.137	367	281	480	0.702

Method: MCDS

Cayo Costa SP	Models	# obs	Effort	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
Survey dates	HN 5%	107	20597.0	639.526	1.791	1.374	2.335	0.135	293	225	382	0.693
4/27-5/1/15, 5/4/-5/8/15	HR cos 5%	107	20597.0	637.185	2.095	1.597	2.750	0.139	343	261	450	0.592

Method: CDS

E.B. Wakulla Spring SP	Models	# obs	Effort	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
Survey dates	HN 5%	28	50914.9	160.233	0.167	0.090	0.310	0.319	75	41	140	0.973
1/20-1/22/15; 2/10-2/13/15,	UN 5%	28	50914.9	158.250	0.163	0.101	0.264	0.247	73	45	119	1.000
5/19/2015	HR 5%	28	50914.9	162.250	0.163	0.101	0.264	0.247	73	45	119	1.000

Method: MCDS

Etoniah Creek SF	Models	# obs	Effort	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
Survey dates	HN 5%	127	50591.45	751.134	1.028	0.733	1.442	0.173	1538	1096	2157	0.521
6/10-6/12/15, 6/25-6/26/16, 8/31-9/4/15, 9/24-/9/25/15, 11/3- 11/6/15	HR 5%	127	50591.45	751.530	1.114	0.792	1.566	0.174	1667	1186	2343	0.480

Method: MCDS

Ft. White WEA	Models	# obs	Effort	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
Survey dates	HN 5%	142	18444.9	840.957	2.969	2.361	3.735	0.116	974	774	1224	0.587
9/2-9/5/14, 9/9-9/10/14	HR 5%	142	18444.9	842.754	2.684	2.141	3.364	0.114	880	702	1103	0.650

Method: CDS

Goethe SF Levy Co. Main Tract	Models	# obs	Effort	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
Survey dates	HN 5%	99	23393.7	670.973	1.042	0.698	1.556	0.203	1991	1333	2974	0.622
12/16-12/19/14, 12/22-12/23/14,	UN cos 5%	99	23393.7	670.292	1.067	0.721	1.579	0.198	2039	1378	3017	0.607
12/29-12/31/14	HR 5%	99	23393.7	673.554	1.114	0.687	1.807	0.248	2129	1312	3454	0.582

Method: MCDS

Goldhead Branch SP	Models	# obs	Effort	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
Survey dates	HN 5%	88	19907.1	565.391	1.116	0.783	1.591	0.176	843	591	1201	0.769
9/24-9/26/14, 9/30-10/2/14	HR 5%	88	19907.1	570.169	1.044	0.744	1.463	0.166	788	562	1105	0.822

Method: MCDS

Guana River	Models	# obs	Effort	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
Survey dates	HN 5%	52	53557.9	261.816	0.575	0.403	0.822	0.183	219	154	313	0.617
3/16-3/20/15, 4/13-4/17/15, 5/11-5/12/15	HR 5%	52	53557.9	263.358	0.667	0.461	0.964	0.189	254	176	368	0.532

Method: CDS

Hilochee WMA	Models	# obs	Effort	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
Survey dates	HN 5%	27	22829.8	182.456	0.333	0.191	0.581	0.285	176	101	306	0.474
2/26-2/27/15, 3/2-3/4/15,	UN 5%	27	22829.8	182.455	0.374	0.208	0.671	0.301	197	110	353	0.422
6/22-6/23/15	HR 5%	27	22829.8	181.928	0.350	0.180	0.681	0.344	184	95	359	0.451

Method: MCDS

Ichetucknee Springs SP	Models	# obs	Effort	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
Survey dates	HN 5%	121	13561.7	665.481	3.970	3.008	5.240	0.138	1269	962	1675	0.658
9/12/14, 9/15-9/16/14, 9/18-9/19/14, 9/22/14	HR 5%	121	13561.7	670.061	3.878	2.941	5.114	0.137	1240	940	1635	0.673

Method: CDS

Joe Budd WMA	Models	# obs	Effort	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
Survey dates	UN 5%	28	27478.2	167.930	0.254	0.133	0.486	0.336	66	34	125	1.00
10/20-10/23/14,	HN 5%	28	27478.2	169.330	0.254	0.120	0.536	0.391	66	31	138	1.00
11/17-11/21/14	HR 5%	28	27478.2	171.930	0.254	0.133	0.486	0.336	66	34	125	1.00

Method: MCDS

Jonathan Dickinson SP	Models	# obs	Effort	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
Survey dates	HR 5%	141	60288.2	855.485	0.769	0.580	1.021	0.144	870	656	1154	0.553
3/9-3/13/15, 4/6-4/10/15, 6/1-6/6/15, 8/10-8/13/15	HN 5%	141	60288.2	857.544	0.905	0.680	1.204	0.146	1023	769	1361	0.4704

Method: MCDS

Lake Louisa SP	Models	# obs	Effort	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
8/3-8/7/15, 8/17-8/20/15, 8/24-8/28/15	HN 5%	226	42393.6	1342.853	2.168	1.580	2.975	0.161	1626	1185	2232	0.4974
	HR 5%	226	42393.6	1350.206	1.926	1.406	2.637	0.160	1445	1055	1978	0.5599

Method: CDS

Lake Wales Ridge WEA Carter Creek	Models	# obs	Effort	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
Survey dates	HN 5%	13	9685.2	81.633	0.373	0.180	0.775	0.376	293	141	609	0.828
5/13-5/14/15, 6/8-6/9/15	UN 5%	13	9685.2	80.032	0.309	0.173	0.551	0.294	243	136	433	1.000
	HR 5%	13	9685.2	82.964	0.517	0.139	1.922	0.685	406	109	1509	0.598

Method: MCDS

Lake Wales Ridge WEA Silver Lake	Models	# obs	Effort	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
Survey dates	HN 5%	38	21614.6	164.590	1.700	1.093	2.645	0.225	243	156	378	0.460
3/23-3/27/15	HR 5%	38	21614.6	163.210	2.068	1.314	3.255	0.231	296	188	465	0.380

Method: MCDS

Little Talbot Island SP	Models	# obs	Effort	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
Survey dates	HN 5%	301	22252.7	1846.763	4.504	3.924	5.169	0.070	779	679	894	0.632
10/6-10/10/14, 11/10-11/14/14	HR 5%	301	22252.7	1844.606	4.356	3.796	4.999	0.070	754	657	865	0.654

Method: MCDS

Moody Branch WEA	Models	# obs	Effort	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
Survey dates	HN 5%	104	23906.8	517.640	2.636	2.030	3.422	0.132	478	369	621	0.620
3/30-4/3/15, 4/20-4/23/15	HR 5%	104	23906.8	519.140	2.977	2.280	3.888	0.135	540	414	706	0.550

Method: MCDS

O'Leno River Rise SP	Models	# obs	Effort	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
Survey dates	HN 5%	190	21486.9	1308.974	2.178	1.603	2.960	0.155	1011	744	1374	0.546
11/24/14, 12/8-12/12/14, 10/13-10/17/14, 12/15/2014	HR 5%	190	21486.9	1311.508	2.318	1.703	3.154	0.156	1076	791	1464	0.513

Method: MCDS

Perry Oldenberg WEA	Models	# obs	Effort	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
Survey dates	HN 5%	75	17370.31	466.449	1.579	1.173	2.127	0.149	213	158	287	0.469
2/23-2/25/15	HR 5%	75	17370.31	466.601	2.130	1.553	2.921	0.159	287	209	394	0.348

Method: MCDS

St. Sebastian SP	Models	# obs	Effort	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
Survey dates	HN 5%	64	33284.0	362.806	0.857	0.564	1.301	0.213	977	644	1483	0.588
6/29-7/3/15, 7/13-7/17/15	HR 5%	64	33284.0	368.083	0.928	0.608	1.415	0.216	1058	694	1614	0.543

Method: MCDS

Watermelon Pond WEA	Models	# obs	Effort	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
Survey dates	HN 5%	173	36421.06	1090.596	1.378	1.118	1.697	0.106	184	149	226	0.706
10/27-10/28/14, 11/3-11/7/14, 12/1/14, 12/4-12/5/14	HR 5%	173	36421.06	1092.987	1.218	0.993	1.493	0.104	162	132	199	0.799

Method: MCDS												
Wingate SP	Models	# obs	Effort	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
Survey dates	HN 5%	89	21955.85	477.390	1.9938	1.537	2.586	0.132	303	234	394	0.648
7/20-7/24/15, 7/27-7/29/15	HR 5%	89	21955.85	479.368	2.2742	1.735	2.981	0.137	346	264	454	0.568
Method: MCDS												
Withlacoochee SF Citrus Tract*	Models	# obs	Effort	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
Survey dates	HN 5%	51	29667.61	350.785	0.4011	0.268	0.601	0.205	7179	4789	10761	0.654
2/16-2/20/15, 4/24/15	HR 5%	51	29667.61	352.005	0.3688	0.248	0.548	0.201	6600	4440	9813	0.711
Method: MCDS												
Withlacoochee SF Croom Tract	Models	# obs	Effort	AIC	D	D LCL	D UCL	D CV	N	N LCL	N UCL	P
Survey dates	HN 5%	125	35083.7	720.950	1.592	1.221	2.075	0.135	8221	6308	10714	0.498
2/24-2/26/16, 4/4-4/7/16	HR 5%	125	35083.7	722.232	1.537	1.182	1.998	0.134	7938	6106	10320	0.516

Appendix 3. Roster of participants in the Gopher Tortoise Line Transect Distance Sampling Workshop held at Archbold Biological Station, Lake Placid, Florida on 5-7 May 2016.

Name	Agency/location
Rachel King	FWC GT biologist/South Region
Samantha Dupree	FWC GT Biologist/NE Region
Eric Seckinger	FWC GT Biologist/NC & NW Region
Mehan Harris	FPS District 2
Andi Christman	FPS District 2
Chris Becker	FPS District 4
Rosalind Rowe	FPS District 4
Allegra Buyer	FPS District 3
Bernie Kaiser	Hillsborough County
Candace Donato	DEP/GTMNERR NE Region
Joe Burgess	DEP/GTMNERR NE Region
Matt Corby	Camp Blanding
Tabitha Biehl	Polk County
Alex Kalfin	FWC GT Local Government Coordinator
Michelina Dziadzio	FWC GT GIS and Monitoring Coordinator
Tyler Mosteller	St. Johns River Water Mgmt District
Betsie Rothermel	Archbold
Instructors	
Eric Sievers	FWC GT Biologist/SW Region
Lora Smith	JWJERC
Jennifer Howze	JWJERC
Workshop organizer	
Deborah Burr	FWC

GOPHER TORTOISE SURVEY OF CAYO COSTA STATE PARK

Final Report to the Florida Fish and Wildlife Conservation Commission

April 2024

Contract #102446



Florida Natural Areas Inventory
Florida Resources and Environmental Assessment Center
Institute of Science and Public Affairs
Florida State University



Florida
Natural Areas
Inventory

Cover Photograph: Beach dune habitat at Cayo Costa State Park (Anna Koon)

Brinegar, Kerri: Data Curation

Damm, Emma: Investigation

DeVos, Tyler: Investigation, Formal Analysis, Data Curation, Writing – Original Draft, Visualization, Supervision, Project Administration

East, Mitch: Software

Hipes, Dan: Investigation

Koon, Anna: Investigation

NeSmith, Katy: Writing – Review & Editing, Supervision

Price, Frank: Funding Acquisition, Supervision

Recommended citation: Florida Natural Areas Inventory (FNAI). 2023. Gopher tortoise survey of Cayo Costa State Park. Report to Florida Fish and Wildlife Conservation Commission. Florida Natural Areas Inventory, Tallahassee, FL.

ACKNOWLEDGMENTS

We thank Katherine Richardson (Florida Fish and Wildlife Conservation Commission [FWC]) for requesting this survey. Nicole DeSha (FWC) and Michelina Dziadzio (FWC) provided administrative support. We thank Jacob Wozny (Florida Department of Environmental Protection [FDEP]), Tracey Barnhardt (FDEP), Gunther Naylor (FDEP), and Joshua Slaughter (FDEP) for providing access to Cayo Costa State Park and participating in the field survey.

ABSTRACT

The Jones Center conducted a line transect distance sampling (LTDS) survey for gopher tortoises at Cayo Costa State Park in 2015. This report is an eight-year follow-up and describes a second LTDS survey, which occurred 4-7 December 2023. The total transect distance surveyed was 20,292.0 m within a sample frame of 163.3 ha. A total of 323 burrows were scoped, resulting in 81 gopher tortoise observations (25.1% burrow occupancy). Based on Distance (v7.3) analyses, the estimated total tortoise population at this site is 349 individuals (95% confidence interval = 264-462) at a density of 2.1 tortoises per ha. Carapace lengths (estimated by width of occupied burrows) ranged from 10.7-42.3 cm, with 6.2% of observations recorded as juveniles. The sample frame included coastal grassland, coastal strand, beach dune, maritime hammock, and coastal scrub community types. Survey and model results collectively indicate that the gopher tortoise population at Cayo Costa State Park meets all criteria for a viable population.

INTRODUCTION

The Florida Natural Areas Inventory (FNAI) is part of the Florida Resources and Environmental Analysis Center at Florida State University. Our mission is to gather, interpret, and disseminate information that is critical to the conservation of Florida's biological diversity. FNAI was founded in 1981 as a member of The Nature Conservancy's international network of natural heritage programs. With funding provided through contracts and grants, FNAI works cooperatively with state, federal, and other agencies on inventory and monitoring projects. FNAI has conducted gopher tortoise surveys on many state and federal conservation lands throughout Florida and has adopted line transect distance sampling (LTDS) as the standard method for survey design.

The gopher tortoise (*Gopherus polyphemus*) is a moderately sized tortoise found in upland habitats characterized by dry soils, sparse tree canopy, and abundant herbaceous vegetation in the southeastern United States (Ernst and Lovich 2009). The vast majority of the gopher tortoise's geographic range is contained within the state of Florida, where it is listed as a threatened species. Gopher tortoises fulfill a keystone role in the ecosystems they inhabit by digging and maintaining subterranean burrows; these burrows are used as shelter by over 60 vertebrate and 300 invertebrate commensal species, some of which are also listed as threatened or endangered (Jackson and Milstrey 1989). In Florida and throughout the southeast, gopher tortoises are threatened by habitat destruction, habitat fragmentation, habitat degradation, road mortality, and disease (Gopher Tortoise Management Plan 2012). As anthropogenic factors (including development, agriculture, mining, and introduction of invasive plants) continue to exacerbate these threats, it is critical to monitor remaining gopher tortoise populations for long-term viability.

Wildlife population monitoring can be conducted efficiently and accurately by applying the survey method known as line transect distance sampling (LTDS; Buckland et al. 2004). This method has been accepted as standard by the Gopher Tortoise Candidate Conservation Agreement team and is routinely used to estimate the size and density of gopher tortoise populations. Because LTDS surveys are designed to be repeatable, data from past, present, and future LTDS surveys of a given tortoise population can be

compared to identify population trends over time. Identification of temporal shifts in tortoise population size, density, and age structure can inform and facilitate effective management and conservation of this keystone species.

Before a full LTDS survey can be designed and conducted, a pilot survey must be performed to determine the tortoise encounter rate (average meters of transect walked per tortoise encountered) at the site of interest. The encounter rate is then used to calculate the sampling intensity required to conduct a full LTDS survey (i.e., the cumulative length of transect required to estimate population parameters with a reasonable level of statistical confidence). Smith and Howze (2016) determined that at least 60 tortoise observations are needed to achieve a coefficient of variation between 15 and 20 percent; this is considered a reasonable standard for LTDS surveys. In order to calculate an accurate encounter rate and corresponding sampling intensity for a given tortoise population, a pilot survey must account for variation in habitat characteristics and spatial distribution of tortoises by placing transects randomly throughout the extent of suitable habitat (i.e., the sample frame) at the survey site. The sample frame is initially delineated based on known soil characteristics, natural community composition, and land use history, but can be further refined during the pilot survey to reflect habitat conditions as observed in the field. Ultimately, the revised sample frame and sampling intensity value determined during the pilot survey are used in conjunction with the program Distance (v7.3; Thomas et al. 2010) to design a full LTDS survey that will allow accurate inference of tortoise population size and density within the surveyed area (Smith and Howze 2016).

The Jones Center conducted a full LTDS survey at Cayo Costa State Park on 27-30 April, 1 May, and 4-8 May 2015, which produced a baseline tortoise population estimate of 343 individuals at a density of 2.1 tortoises/ha (Smith and Howze 2016b). This report describes a follow-up LTDS survey conducted with the primary goals of (1) estimating updated site-wide gopher tortoise population size, density, and demographic metrics and (2) assessing long-term population viability status based on criteria developed by FWC. This information is intended to support and inform conservation and management decisions pertaining to the gopher tortoise population at Cayo Costa State Park.

METHODS

LTDS Sampling

The sample frame and transects used for the survey reported herein were initially exact replicates of those used during the 2015 survey (Smith and Howze 2016b) but were slightly refined based on observations made in the field. The starting sample frame was 163.3 ha with transects spaced 58.2 m apart. Florida Natural Areas Inventory staff (with assistance from Florida Department of Environmental Protection staff) surveyed each transect using the 3-person method described by Smith and Howze (2016), which employs one observer navigating the transect center line with a sub-meter GPS while searching for tortoise burrows and one observer on each side of the central observer searching for tortoise burrows from the transect centerline outward (these peripheral observers increase the effective transect width). Data were collected using Trimble Geo7 dataloggers, which record positions with sub-meter accuracy and facilitate accurate navigation of the transect centerline. All potentially

inhabited burrows observed were searched using a burrow camera scope to determine occupancy. The location of each scoped burrow was recorded along with data on burrow width, length, visual status (active or inactive), and occupancy (occupied, unoccupied, or undetermined). Burrow occupancy was recorded as undetermined only when surveyors were unable to reach the back of a burrow; this may occur when a burrow is curved too sharply, is waterlogged, or (in rare cases) the scope is not long enough to reach the end of the burrow. All burrow scoping was conducted 4-7 December 2023.

Following completion of the survey, submeter GPS tracks were imported to ArcGIS Pro (v3.2) to confirm the surveyed portion(s) of each transect. Any unsurveyed portions (e.g., small wetlands) were clipped from the transects. Additionally, any unsuitable habitat observed within the sample frame during the survey was removed to produce a final sample frame. Transect lengths were calculated in ArcGIS Pro (v3.2) and the perpendicular distance from each burrow to the nearest transect center line was calculated using the Near function. Each tortoise encounter was represented by a single data point in the input file with two metrics: the length of the transect the burrow was found on and the perpendicular distance from the burrow to the transect center line. Lengths of transects where no tortoises were observed were also retained as model input, but without associated perpendicular distances.

A series of models were run in Distance (v7.3) to estimate tortoise population size and density using both conventional distance sampling (CDS) and multiple covariate distance sampling (MCDS) with burrow width as a covariate (Smith and Howze 2016). Each model was run twice—once with all burrows and once with occupied burrows only. Akaike's Information Criterion (AIC; Akaike 1974) was used for model selection. If AIC values were within two units, the model with the lowest coefficient of variation (CV) was selected.

For occupied burrows, burrow width measurements were converted to approximate tortoise carapace lengths using the formula in Alford et al. (1980):

$$\log_{10}(\text{carapace length}) = 0.879 \log_{10}(\text{burrow width}) + 0.149$$

Carapace length values were then used to classify each observed tortoise as either a hatchling (<5.5 cm), juvenile (5.5-13.5 cm), subadult (13.5-22.0 cm), or adult (>22 cm). A stable gopher tortoise population will have an even sex ratio and mixed demographics (hatchlings, juveniles, subadults and adults) indicating recruitment of younger tortoises into the population.

Habitat Assessments

Following the survey, a rapid habitat assessment protocol was applied to document habitat structure and quality throughout the sample frame. Data were collected at two types of habitat suitability points: random points and burrow points. Random points were generated in ArcGIS Pro (v3.2) by selecting one random location along each survey transect over 100 m in length. Burrow points were defined as the first occupied burrow observed along each survey transect greater than 100 m in length. At burrow

points, habitat data were recorded at least 2 m away from the burrow apron to avoid skewing the data with a higher bare sand percent cover.

At each habitat point, gopher tortoise suitability, basal area, percent canopy cover, overstory composition, percent midstory, midstory composition, shrub height, ground cover composition, percent herbaceous cover, percent bare sand, and woody encroachment were recorded along with a north-facing photo. Gopher tortoise suitability was ranked as good, fair, poor, or unsuitable. Basal area was measured using a 10-factor prism. Shrub height and all percent cover classes were estimated within a radius of 2 m. Total canopy cover was estimated visually by an observer looking upward from the center of each habitat plot; only trees with a DBH greater than or equal to four inches were considered contributors to canopy cover. Dominant overstory composition was recorded as either pine, oak, mixed, other, or none. Midstory percent cover included all woody perennial vegetation ranging from 1-3 m in height. Dominant midstory cover was recorded as either pine, oak, shrub, palmetto, mixed, or other. Shrub height was estimated as an average. Dominant ground cover type was recorded as bare ground, litter, grass, woody, vine, or mixed. Percent herbaceous cover included all non-woody species. Percent cover for bare sand was noted separately from bare ground as a dominant ground cover type. Woody encroachment was estimated as the increase in density, cover, and biomass of woody species and was recorded as low, medium, or high. At each habitat point, a georeferenced north-facing photo was taken using an Olympus Stylus TG-4 digital camera.

RESULTS

During the full survey, only a few negligible additions were made to the initial sample frame to include areas where burrows were observed just beyond the 2015 boundaries. The final sample frame was 163.3 ha and the total transect distance walked was 20,292.0 m. A total of 323 burrows were scoped: 81 occupied, 239 unoccupied, and 3 undetermined (occupancy rate = 25.1%; Table 1; Figure 1). Remains of 33 dead tortoises (eight male, nine female, 11 undetermined adult, two juvenile, three subadult) were encountered in various states of decomposition, ranging from fully disarticulated and sun-bleached shells to intact shells with keratin scutes and bits of dried limbs remaining. No hatchling tortoises were documented but juveniles and subadults were observed (6.2% and 18.5% of the population, respectively), indicating recent breeding and continued recruitment of young tortoises into the Cayo Costa population (Figure 2).

Burrow associates encountered included four coachwhips (*Masticophis flagellum*), one southern ringneck snake (*Diadophis punctatus*), one brown anole (*Anolis sagrei*), one unknown anole (either *A. carolinensis* or *A. sagrei*), four non-native greenhouse frogs (*Eleutherodactylus planirostris*), and three black spiny-tailed iguanas (*Ctenosaura similis*). Invasive Brazilian pepper (*Schinus terebinthifolia*) plants were observed throughout the northern half of the sample frame.

For occupied burrows only (i.e., gopher tortoise observations) the best fitting model was the MCDS Hazard Rate/Cosine model. This model produced a count estimate of 349 gopher tortoises within the sample frame and a density estimate of 2.1 tortoises per hectare (CV = 14.2%). The 95% confidence interval for the tortoise count estimate ranges from 264 to 462 tortoises (Table 2; Appendix A). A

separate model for the full burrow dataset (including all burrow observations regardless of occupancy status) estimates that 1,509 gopher tortoise burrows are present within the sample frame (Appendix B).

Data were collected for a total of 100 rapid habitat assessment points: 64 random points and 36 burrow points (Table 3; Figure 3). Of the random points, 45.3% were reported as good, 40.6% as fair, and 14.1% as poor for gopher tortoises. Of the burrow points, 52.8% were reported as good, 44.4% as fair, and 2.8% as poor for gopher tortoises. The average basal area was 45.3 ft²/ac for random points and 36.1 ft²/ac for burrow points. The mean midstory percent cover was 6.2% for random points and 5.9% for burrow points. Mean herbaceous cover was 8.5% for random points and 12.5% for burrow points.

DISCUSSION

In assessing gopher tortoise population viability, it is important to consider both the condition of the available habitat—including habitat size, continuity, quality, and management—as well as tortoise population demography (Tuberville et al. 2009). Cayo Costa State Park is a medium-sized site (1,080.7 ha), 15.1% (163.3 ha) of which consists of habitat with both soils and natural communities suitable for gopher tortoise occupancy. Most of this suitable habitat (75.4%) is categorized as coastal grassland and, based on rapid habitat assessment data, an estimated 85.9% of the available habitat is currently in good or fair condition for gopher tortoises. Habitat within site boundaries is generally contiguous, although movement of tortoises to and from the coastal strand and beach dune habitats on the south end of the island may be somewhat restricted by adjacent mangrove swamp; however, tortoises may still enter and exit these areas along a ca. 750 m stretch of sand beach running north into the main coastal grassland habitat.

The previous LTDS survey conducted by the Jones Center at Cayo Costa State Park in 2015 estimated a gopher tortoise population of 343 individuals (95% confidence interval = 261-450; CV = 13.9%) at a density of 2.1 tortoises per hectare. The nearly identical FNAI 2023 LTDS results of 349 tortoises (95% confidence interval = 264-462; CV = 14.2%) at a density of 2.1 tortoises per hectare suggest that the Cayo Costa tortoise population has remained stable over the past eight years, neither increasing nor decreasing in size. The model produced with data from the current survey also had a very similar coefficient of variation to that associated with the 2015 survey (14.2% vs. 13.9%), indicating no major difference in statistical power between the two estimates.

For a gopher tortoise population to be considered viable it must contain ≥250 adult tortoises at a density of no less than 0.4 tortoises/ha (approx. 0.16 tortoises/acre). The population should also contain an approximate male-female ratio of 1:1, show evidence of juvenile recruitment into the population, and show variability in size classes. The associated site should include ≥100 ha (approx. 250 acres) of contiguous suitable gopher tortoise habitat and must not have major constraints to tortoise movement (GTC 2013, 2014). The FNAI LTDS survey of Cayo Costa State Park produced a population estimate of 349 tortoises (95% confidence interval = 264-462; CV = 14.2%) at a density of 2.1 tortoises/ha; demographic evidence of recent breeding and subsequent recruitment suggest conditions are sufficient for maintenance of this population. Based on these results, the gopher tortoise population at Cayo Costa

State Park meets the criteria for viability and, if current management continues or improves, has a high probability of long-term persistence.

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Table 1. Gopher tortoise burrow scoping results from the line transect distance sampling survey conducted at Cayo Costa State Park in 2023.

Sample frame (ha)	Burrows scoped (total)	Occupied burrows	Percent occupied	Undetermined burrows	Percent undetermined
163.3	323	81	25.1	3	0.9

Table 2. Gopher tortoise population and density estimates (as modeled in Distance v7.3) from the line transect distance sampling survey conducted at Cayo Costa State Park in 2023.

Model	# obs	Effort (m)	AIC	D	D LCL	D UCL	CV (%)	N	N LCL	N UCL	P
MCDS HR Cos 5%	77	20,291.96	373.53	2.140	1.619	2.828	14.2	349	264	462	0.731

Model = model selected, # obs = occupied burrows minus 5% truncation of outliers, Effort (m) = total length of transect in meters, AIC = Akaike's Information Criterion, D = density of tortoises, D LCL = 95% lower confidence limit for density, D UCL = 95% upper confidence limit for density, CV = coefficient of variation, N = number of tortoises, N LCL = 95% lower confidence limit for number of tortoises, N UCL = 95% upper confidence limit for number of tortoises, P = detection probability.

Table 3. Summary of habitat data collected from n = 100 rapid habitat assessment points at Cayo Costa State Park in 2023.

Point type	Random	Burrow
Total habitat points	64	36
Gopher tortoise habitat suitability	(% of all habitat points)	
<i>good</i>	45.3	52.8
<i>fair</i>	40.6	44.4
<i>poor</i>	14.1	2.8
<i>unsuitable</i>	N/A	N/A
Mean basal area (ft²/ac)	45.3	36.1
Mean canopy cover (%)	7.8	7.3
Dominant overstory composition	(% of all habitat points)	
<i>pine</i>	N/A	2.8
<i>oak</i>	1.6	2.8
<i>mixed</i>	3.1	5.6
<i>other</i>	48.4	41.7
<i>none</i>	46.9	47.2
Mean midstory cover (%)	6.2	5.9
Dominant midstory composition	(% of all habitat points)	
<i>oak</i>	3.1	N/A
<i>pine</i>	N/A	N/A
<i>shrubs</i>	23.4	16.7
<i>palmetto</i>	4.7	2.8
<i>mixed</i>	N/A	5.6
<i>other</i>	28.1	30.6
<i>none</i>	40.6	44.4
Mean shrub height (m)	0.9	0.9

Point type	Random	Burrow
Dominant ground cover composition	(% of all habitat points)	
<i>bare ground</i>	12.5	19.4
<i>litter</i>	1.6	N/A
<i>grass</i>	7.8	11.1
<i>woody</i>	39.1	27.8
<i>vines</i>	N/A	N/A
<i>mixed</i>	39.1	41.7
Herb cover (%)	8.5	12.5
Bare sand (%)	29.4	33.8
Woody encroachment level	(% of all habitat points)	
<i>low</i>	50.0	58.3
<i>medium</i>	40.6	38.9
<i>high</i>	9.4	2.8

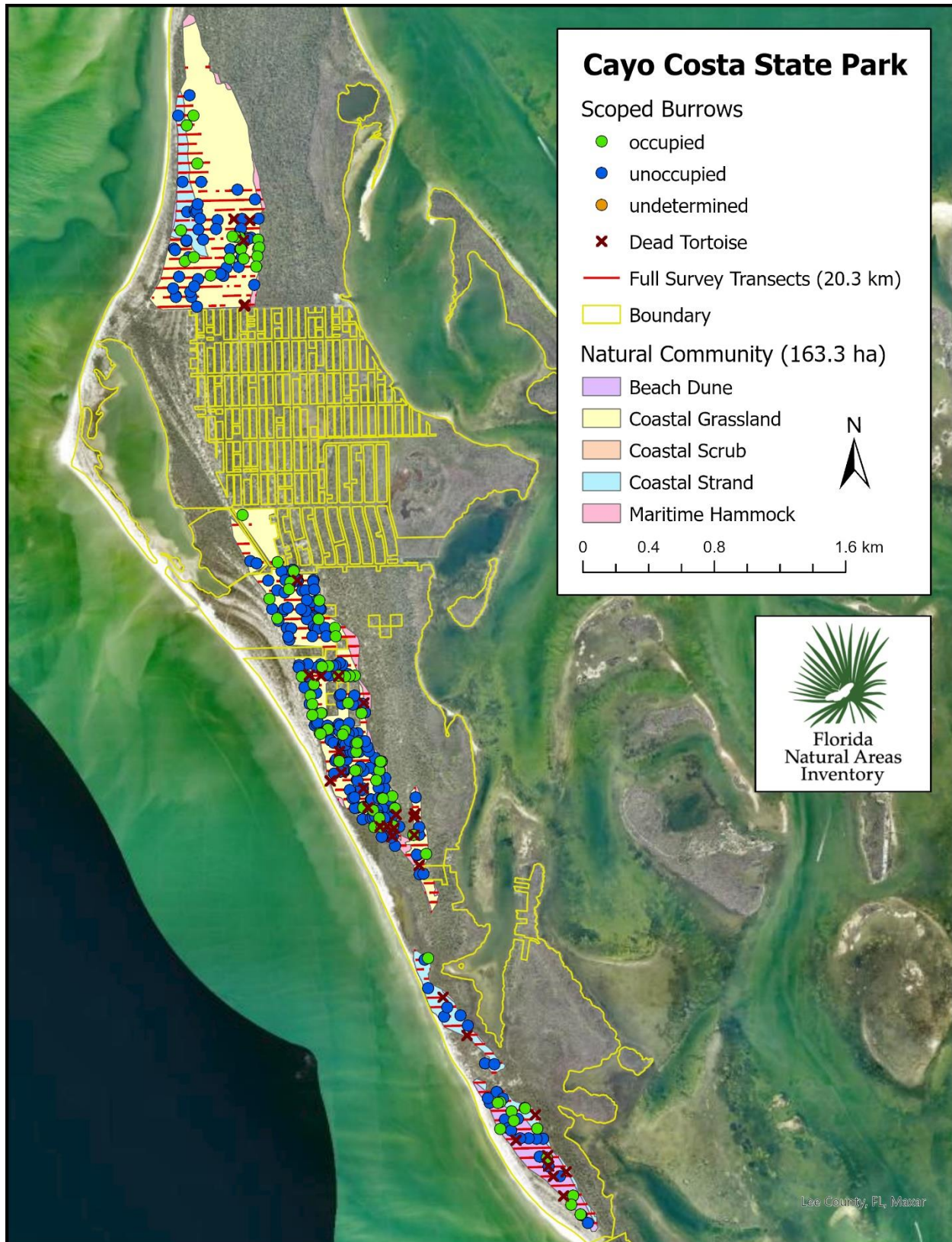


Figure 1. Location of scoped burrows, dead tortoises, survey transects, and natural community types within the final sample frame at Cayo Costa State Park in 2023.

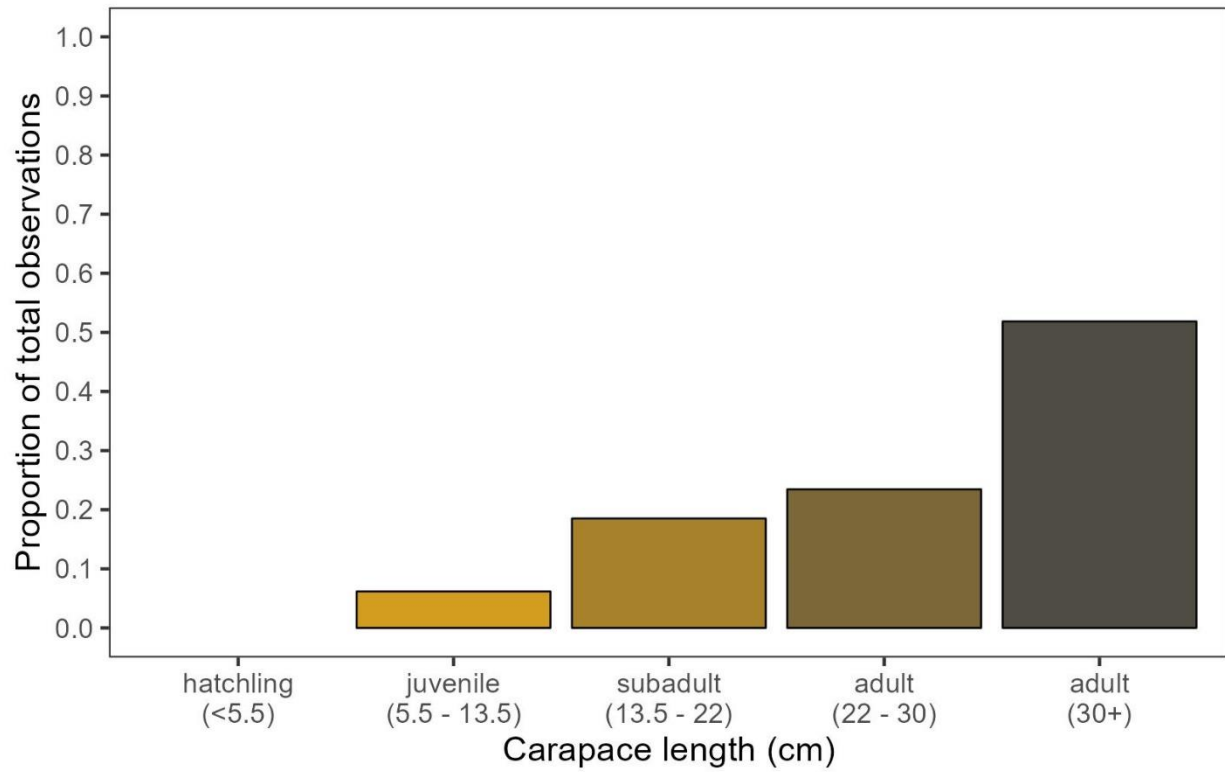


Figure 2. Size and age class distribution (based on carapace lengths estimated from burrow widths) of occupied gopher tortoise burrows encountered during the 2023 LTDS survey at Cayo Costa State Park.

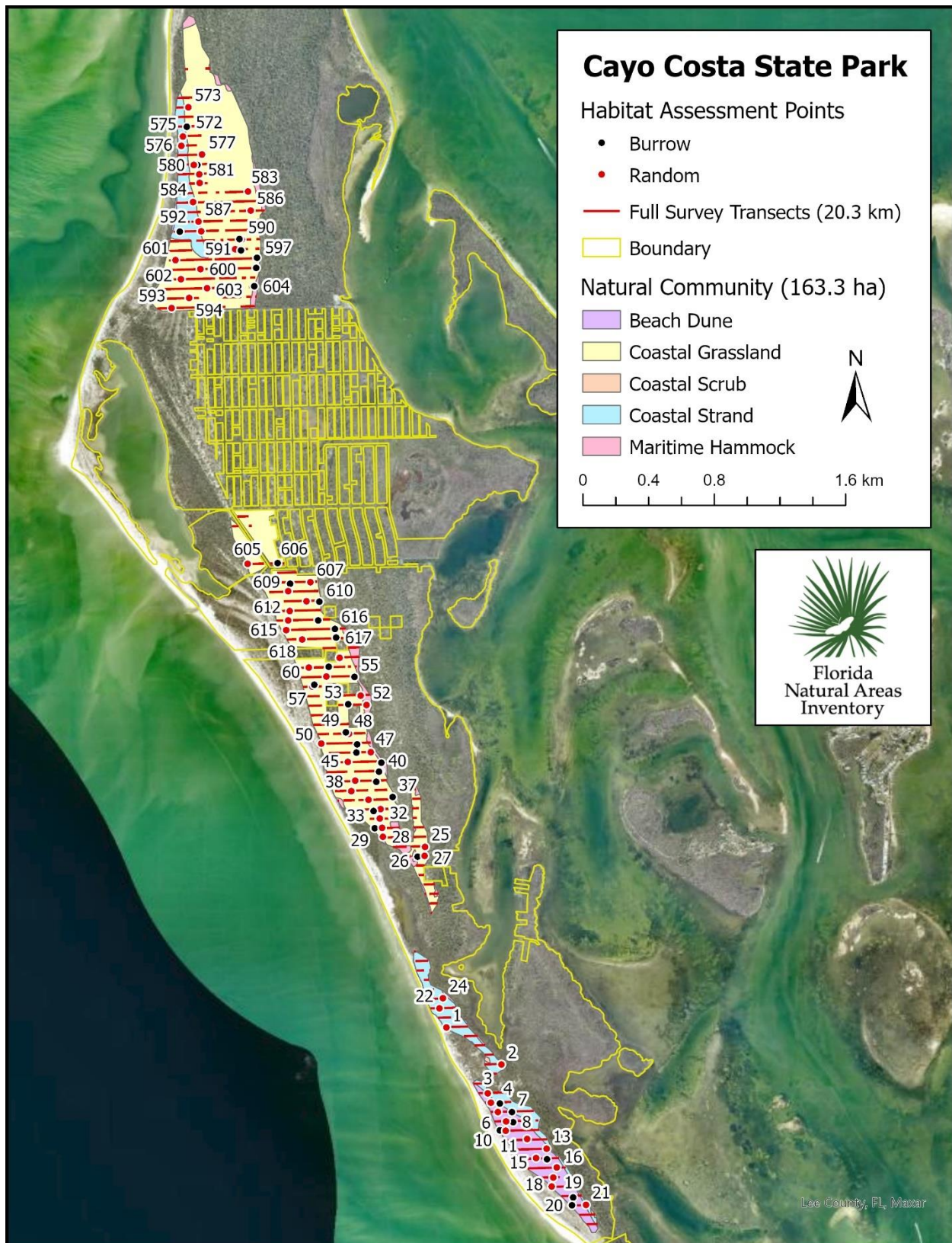


Figure 3. Location of rapid habitat assessment points, survey transects, and natural community types within the final sample frame at Cayo Costa State Park in 2023.

APPENDIX A

Cayo Costa State Park Distance (v7.3) model results: tortoise population estimate

Selected model: Multiple Covariate Distance Sampling (MCDS) Hazard Rate/Cosine, 5% truncation

Parameter Estimation Specification

Encounter rate for all data combined
Detection probability for all data combined
Density for all data combined

Distances:

Analysis based on exact distances
Width: use measurement/interval endpoint which represents 95.0 percentile.

Estimators:

Estimator 1
Key: Hazard Rate
No adjustment terms

Covariates: DIAMETER

Estimator selection: Choose estimator with minimum AIC
Estimation functions: not constrained to be monotone

Variances:

Variance of n: Empirical estimate from sample
(design-derived estimator R2/P2)
Variance of f(0): MLE estimate

Goodness of fit:

Cut points chosen by program

Glossary of terms

Data items:

n - number of observed objects (single or clusters of animals)
L - total length of transect line(s)
k - number of samples
K - point transect effort, typically $K=k$
T - length of time searched in cue counting
ER - encounter rate (n/L or n/K or n/T)
W - width of line transect or radius of point transect
 $x(i)$ - distance to i-th observation
 $s(i)$ - cluster size of i-th observation
r-p - probability for regression test
chi-p - probability for chi-square goodness-of-fit test

Parameters or functions of parameters:

m - number of parameters in the model
 $A(I)$ - i-th parameter in the estimated probability density function(pdf)
 $f(0)$ - $1/u$ = value of pdf at zero for line transects
u - $W \cdot p$ = ESW, effective detection area for line transects
 $h(0)$ - $2 \cdot \pi / v$
v - $\pi \cdot W \cdot W \cdot p$, is the effective detection area for point transects
p - probability of observing an object in defined area
ESW - for line transects, effective strip width = $W \cdot p$
EDR - for point transects, effective detection radius = $W \cdot \sqrt{p}$
 ρ - for cue counts, the cue rate
DS - estimate of density of clusters

```

E(S) - estimate of expected value of cluster size
D    - estimate of density of animals
N    - estimate of number of animals in specified area

Effort      :    20291.96
# samples   :    164
Width       :    12.13049
# observations:    77

Model
Hazard Rate key,  $k(y) = 1 - \text{Exp}(-(y/s)**-A(2))$ 

s = A(1) *
Exp(fcn(A(3)))
Parameter A(1) is the intercept of the scale parameter s.
Parameter A(2) is the power parameter.
Parameter A(3) is the coefficient of covariate DIAMETER.
A( 1) bounds = (0.12130      , 0.10000E+07 )
A( 2) bounds = ( 1.0000      , 20.000      )

      Iter    LN(likelihood)    Parameter Values
-----
      1    -186.744          8.68260          5.00000          0.000000
      2    -184.340          4.00027          5.49927          0.235520E-01
      3    -184.166          4.02912          2.84246          0.237084E-01
      4    -183.779          3.91969          3.60932          0.233101E-01
      5    -183.767          3.91968          3.83747          0.234680E-01
      6    -183.764          3.92510          3.71122          0.235515E-01
      7    -183.764          3.92510          3.71122          0.235515E-01
-----

Results:
Convergence was achieved with      7 function evaluations.
Final Ln(likelihood) value = -183.76417
Akaike information criterion =   373.52835
Bayesian information criterion =   380.55975
AICc =   373.85712

Effort      :    20291.96
# samples   :    164
Width       :    12.13049
# observations:    77

Model
Hazard Rate key,  $k(y) = 1 - \text{Exp}(-(y/s)**-A(2))$ 

s = A(1) *
Exp(fcn(A(3)))
Parameter A(1) is the intercept of the scale parameter s.
Parameter A(2) is the power parameter.
Parameter A(3) is the coefficient of covariate DIAMETER.

      Parameter      Point      Standard      Percent Coef.      95 Percent
      Estimate      Error      of Variation      Confidence Interval
-----
      A( 1)          3.925          0.9208
      A( 2)          3.711           6.178
      A( 3)          0.2355E-01    0.1101E-01
      f(0)          0.11278          0.72695E-02          6.45          0.99197E-01    0.12822
      p             0.73097          0.47118E-01          6.45          0.64295          0.83104
      ESW           8.8671          0.57156           6.45          7.7993          10.081
-----

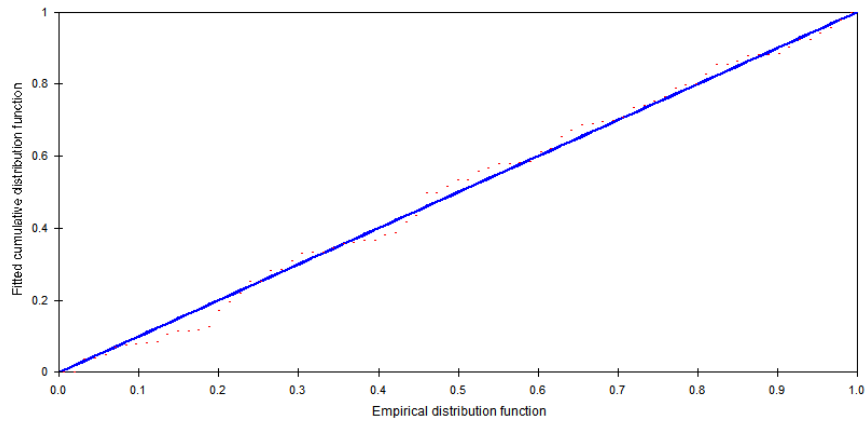
Sampling Correlation of Estimated Parameters
      A( 1)    A( 2)    A( 3)
A( 1)  1.000    0.078   -0.939
A( 2)  0.078    1.000   -0.129
A( 3) -0.939   -0.129    1.000

```

Distribution of estimated detection probabilities given covariates, $p(z)$

$p(z)$	Number	Proportion
0.0-0.1	0	0.0000
0.1-0.2	0	0.0000
0.2-0.3	0	0.0000
0.3-0.4	0	0.0000
0.4-0.5	2	0.0260
0.5-0.6	9	0.1169
0.6-0.7	13	0.1688
0.7-0.8	20	0.2597
0.8-0.9	29	0.3766
0.9-1.0	4	0.0519

Smallest value of $p(z)$: 0.4994



Kolmogorov-Smirnov test

$D_n = 0.0673$ $p = 0.8767$

Cramer-von Mises family tests

W-sq (uniform weighting) = 0.0368 $0.900 < p \leq 1.000$

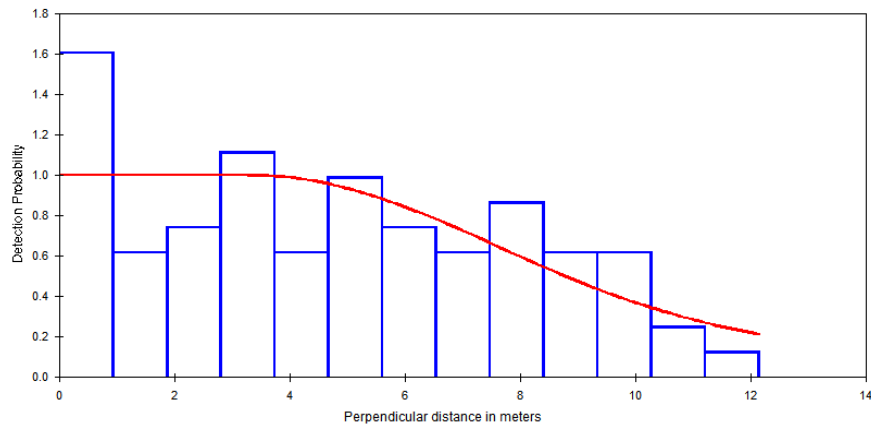
Relevant critical values:

W-sq crit(alpha=0.900) = 0.0000

C-sq (cosine weighting) = 0.0279 $0.900 < p \leq 1.000$

Relevant critical values:

C-sq crit(alpha=0.900) = 0.0000



Cell i	Cut Points		Observed Values	Expected Values	Chi-square Values
1	0.000	0.933	13	8.10	2.960
2	0.933	1.87	5	8.10	1.188
3	1.87	2.80	6	8.10	0.546
4	2.80	3.73	9	8.09	0.102
5	3.73	4.67	5	7.94	1.091
6	4.67	5.60	8	7.48	0.035
7	5.60	6.53	6	6.77	0.087
8	6.53	7.46	5	5.88	0.132
9	7.46	8.40	7	4.91	0.885
10	8.40	9.33	5	3.98	0.260
11	9.33	10.3	5	3.17	1.064
12	10.3	11.2	2	2.49	0.098
13	11.2	12.1	1	1.96	0.474

Total Chi-square value = 8.9216 Degrees of Freedom = 9.00

Probability of a greater chi-square value, $P = 0.44454$

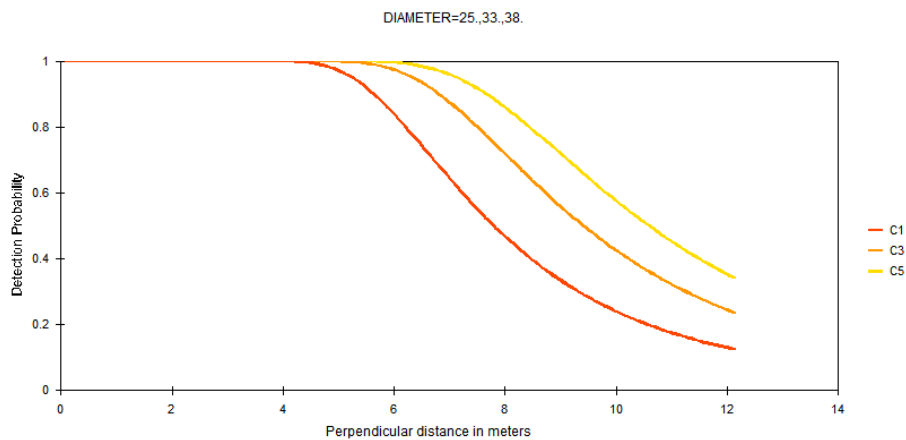
The program has limited capability for pooling. The user should judge the necessity for pooling and if necessary, do pooling by hand.

Goodness of Fit Testing with some Pooling

Cell i	Cut Points		Observed Values	Expected Values	Chi-square Values
1	0.000	0.933	13	8.10	2.960
2	0.933	1.87	5	8.10	1.188
3	1.87	2.80	6	8.10	0.546
4	2.80	3.73	9	8.09	0.102
5	3.73	4.67	5	7.94	1.091
6	4.67	5.60	8	7.48	0.035
7	5.60	6.53	6	6.77	0.087
8	6.53	7.46	5	5.88	0.132
9	7.46	8.40	7	4.91	0.885
10	8.40	9.33	5	3.98	0.260
11	9.33	10.3	5	3.17	1.064
12	10.3	12.1	3	4.46	0.478

Total Chi-square value = 8.8275 Degrees of Freedom = 8.00

Probability of a greater chi-square value, $P = 0.35706$



Effort : 20291.96
 # samples : 164
 Width : 12.13049
 # observations: 77

Model

Hazard Rate key, $k(y) = 1 - \text{Exp}(-(y/s)**-A(2))$

$s = A(1) *$

$\text{Exp}(\text{fcn}(A(3)))$

Parameter A(1) is the intercept of the scale parameter s.

Parameter A(2) is the power parameter.

Parameter A(3) is the coefficient of covariate DIAMETER.

Parameter	Point Estimate	Standard Error	Percent Coef. of Variation	95% Percent Confidence Interval	
f(0)	0.11278	0.72695E-02	6.45	0.99197E-01	0.12822
p	0.73097	0.47118E-01	6.45	0.64295	0.83104
ESW	8.8671	0.57156	6.45	7.7993	10.081
n/L	0.37946E-02	0.48121E-03	12.68	0.29570E-02	0.48695E-02
D	2.1397	0.30439	14.23	1.6189	2.8281
N	349.00	49.647	14.23	264.00	462.00

Measurement Units

Density: Numbers/hectares

ESW: meters

Component Percentages of Var(D)

Detection probability : 20.5

Encounter rate : 79.5

	Estimate	%CV	df	95% Confidence Interval	
n	77.000				
k	164.00				
L	20292.				
n/L	0.37946E-02	12.68	163.00	0.29570E-02	0.48695E-02
Left	0.0000				
Width	12.130				

	Estimate	%CV	df	95% Confidence Interval	
Hazard/Cosine					
m	3.0000				
LnL	-183.76				
AIC	373.53				
AICc	373.86				
BIC	380.56				
f(0)	0.11278	6.45	74.00	0.99197E-01	0.12822
p	0.73097	6.45	74.00	0.64295	0.83104
ESW	8.8671	6.45	74.00	7.7993	10.081

	Estimate	%CV	df	95% Confidence Interval	
Hazard/Cosine					
D	2.1397	14.23	225.02	1.6189	2.8281
N	349.00	14.23	225.02	264.00	462.00

APPENDIX B

For the full burrow dataset (including all burrow observations regardless of occupancy status) the best fitting model was the MCDS Half-normal/Cosine model. This model produced a count estimate of 1,509 gopher tortoise burrows within the sample frame and a density estimate of 9.2 burrows (occupancy not accounted for) per hectare (CV = 8.9%). The 95% confidence interval for the burrow count estimate ranges from 1,267 to 1,797 burrows (Table B1).

Table B1. Gopher tortoise burrow abundance and density estimates (as modeled in Distance v7.3) from the line transect distance sampling survey conducted at Cayo Costa State Park in 2023.

Model	# obs	Effort (m)	AIC	D	D LCL	D UCL	CV (%)	N	N LCL	N UCL	P
MCDS HN Cos 5%	307	20,291.96	1,564.73	9.239	7.758	11.003	8.9	1,509	1,267	1,797	0.520

Model = model selected, # obs = total burrows observed minus 5% truncation of outliers (occupied, unoccupied and undetermined), Effort (m) = total length of transect in meters, AIC = Akaike's Information Criterion, D = density of burrows, D LCL = 95% lower confidence limit for density, D UCL = 95% upper confidence limit for density, CV = coefficient of variation, N = number of burrows, N LCL = 95% lower confidence limit for number of burrows, N UCL = 95% upper confidence limit for number of burrows, P = detection probability.

Cayo Costa State Park Distance (v7.3) model results: burrow count estimate

Selected model: Multiple Covariate Distance Sampling (MCDS) Half-normal/Cosine, 5% truncation

Parameter Estimation Specification

Encounter rate for all data combined
Detection probability for all data combined
Density for all data combined

Distances:

Analysis based on exact distances
Width: use measurement/interval endpoint which represents 95.0 percentile.

Estimators:

```
Estimator 1
Key: Half-normal
No adjustment terms
```

Covariates: DIAMETER

```
Estimator selection: Choose estimator with minimum AIC
Estimation functions: not constrained to be monotone
```

Variances:

Variance of n : Empirical estimate from sample
(design-derived estimator R^2/P^2)
Variance of $f(0)$: MLE estimate

Goodness of fit:

Cut points chosen by program

Glossary of terms

Data items:

n - number of observed objects (single or clusters of animals)
L - total length of transect line(s)
k - number of samples
K - point transect effort, typically $K=k$
T - length of time searched in cue counting
ER - encounter rate (n/L or n/K or n/T)
W - width of line transect or radius of point transect
 $x(i)$ - distance to i -th observation
 $s(i)$ - cluster size of i -th observation
r-p - probability for regression test
chi-p- probability for chi-square goodness-of-fit test

Parameters or functions of parameters:

m - number of parameters in the model
 $A(I)$ - i -th parameter in the estimated probability density function(pdf)
 $f(0)$ - $1/u$ = value of pdf at zero for line transects
u - $W*p$ = ESW, effective detection area for line transects
 $h(0)$ - $2*PI/v$
v - $PI*W*W*p$, is the effective detection area for point transects
p - probability of observing an object in defined area
ESW - for line transects, effective strip width = $W*p$
EDR - for point transects, effective detection radius = $W*\sqrt{p}$
 ρ - for cue counts, the cue rate
DS - estimate of density of clusters
 $E(S)$ - estimate of expected value of cluster size
D - estimate of density of animals
N - estimate of number of animals in specified area

Effort : 20291.96
samples : 164
Width : 15.74572
observations: 307

Model

Half-normal key, $k(y) = \text{Exp}(-y**2/(2*s**2))$

$s = A(1) *$

$\text{Exp}(\text{fcn}(A(2)))$

Parameter A(1) is the intercept of the scale parameter s.

Parameter A(2) is the coefficient of covariate DIAMETER.

A(1) bounds = (0.15746 , 0.10000E+07)

Iter	LN(likelihood)	Parameter Values	
1	-784.689	6.31534	0.000000
2	-780.539	4.01040	0.157933E-01
3	-780.365	4.08588	0.161412E-01
4	-780.363	4.12031	0.159089E-01
5	-780.363	4.12003	0.159166E-01
6	-780.363	4.12022	0.159147E-01
7	-780.363	4.12020	0.159150E-01

Results:

Convergence was achieved with 7 function evaluations.

Final Ln(likelihood) value = -780.36347

Akaike information criterion = 1564.7269

Bayesian information criterion = 1572.1807

AICc = 1564.7664

```
Effort      :    20291.96
# samples   :    164
Width       :    15.74572
# observations:  307
```

Model

Half-normal key, $k(y) = \text{Exp}(-y^2/(2*s^2))$

$s = A(1) *$

$\text{Exp}(\text{fcn}(A(2)))$

Parameter A(1) is the intercept of the scale parameter s.

Parameter A(2) is the coefficient of covariate DIAMETER.

Parameter	Point Estimate	Standard Error	Percent Coef. of Variation	95 Percent Confidence Interval	
A(1)	4.120	0.5286			
A(2)	0.1591E-01	0.6133E-02			
f(0)	0.12214	0.49271E-02	4.03	0.11282	0.13222
p	0.51999	0.20977E-01	4.03	0.48032	0.56293
ESW	8.1875	0.33029	4.03	7.5630	8.8637

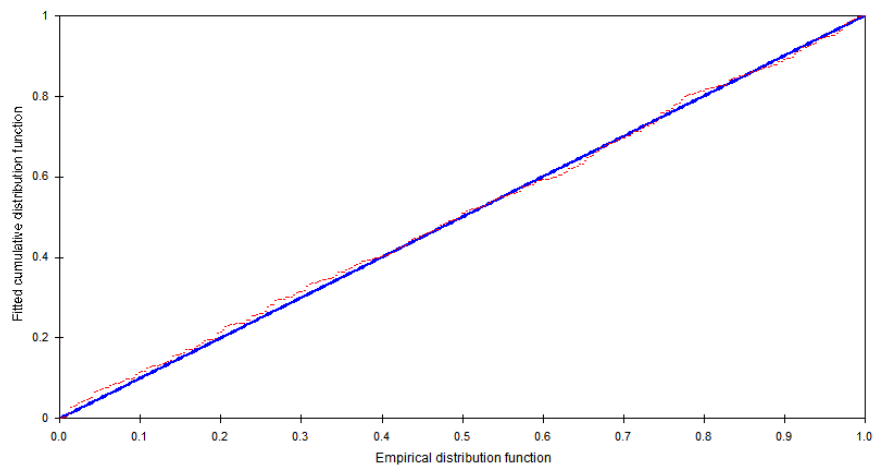
Sampling Correlation of Estimated Parameters

```
      A( 1)  A( 2)
A( 1)  1.000 -0.957
A( 2) -0.957  1.000
```

Distribution of estimated detection probabilities given covariates, $p(z)$

p(z)	Number	Proportion
0.0-0.1	0	0.0000
0.1-0.2	0	0.0000
0.2-0.3	0	0.0000
0.3-0.4	10	0.0326
0.4-0.5	69	0.2248
0.5-0.6	201	0.6547
0.6-0.7	27	0.0879
0.7-0.8	0	0.0000
0.8-0.9	0	0.0000
0.9-1.0	0	0.0000

Smallest value of $p(z)$: 0.3722



Kolmogorov-Smirnov test

D_n = 0.0273 p = 0.9760

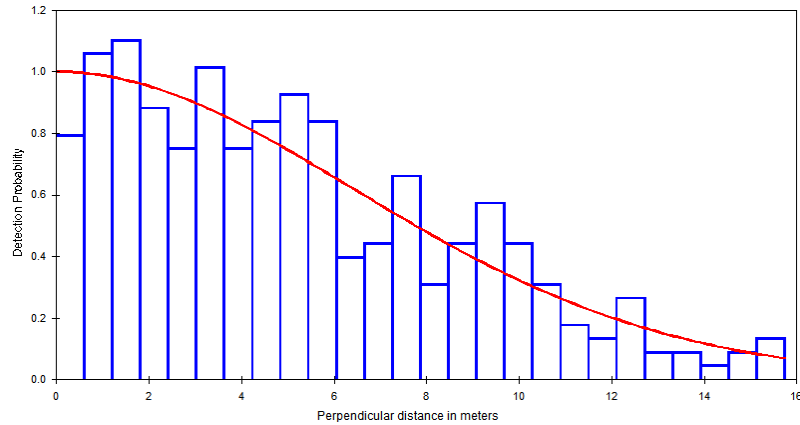
Cramer-von Mises family tests

W-sq (uniform weighting) = 0.0375 0.900 < p <= 1.000

Relevant critical values:
W-sq crit(alpha=0.900) = 0.0000

C-sq (cosine weighting) = 0.0279 0.900 < p <= 1.000

Relevant critical values:
C-sq crit(alpha=0.900) = 0.0000



Cell i	Cut Points	Observed Values	Expected Values	Chi-square Values
1	0.000	0.606	18	22.67
2	0.606	1.21	24	22.48
3	1.21	1.82	25	22.09
4	1.82	2.42	20	21.53
5	2.42	3.03	17	20.80
6	3.03	3.63	23	19.93
7	3.63	4.24	17	18.93
8	4.24	4.84	19	17.84
9	4.84	5.45	21	16.67
10	5.45	6.06	19	15.45
11	6.06	6.66	9	14.22
12	6.66	7.27	10	12.98
13	7.27	7.87	15	11.76
14	7.87	8.48	7	10.57
15	8.48	9.08	10	9.44
16	9.08	9.69	13	8.37
17	9.69	10.3	10	7.37
18	10.3	10.9	7	6.44
19	10.9	11.5	4	5.60
20	11.5	12.1	3	4.83
21	12.1	12.7	6	4.14
22	12.7	13.3	2	3.53
23	13.3	13.9	2	2.99
24	13.9	14.5	1	2.52
25	14.5	15.1	2	2.11
26	15.1	15.7	3	1.76

Total Chi-square value = 18.0003 Degrees of Freedom = 23.00

Probability of a greater chi-square value, P = 0.75747

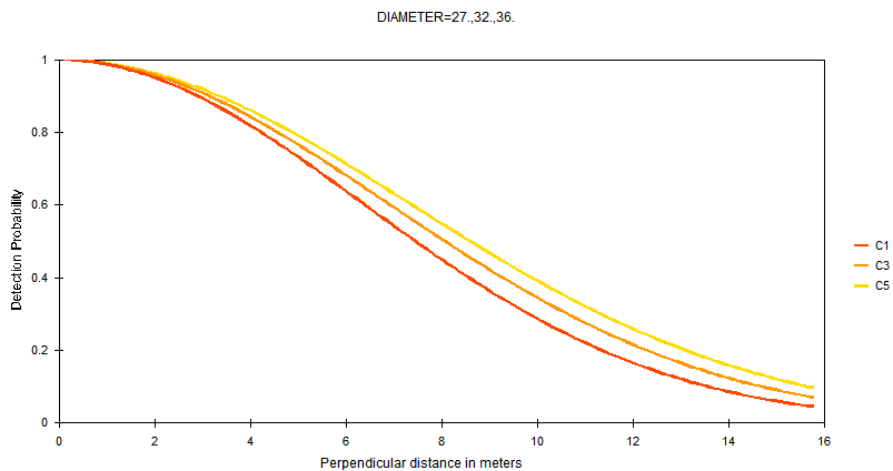
The program has limited capability for pooling. The user should judge the necessity for pooling and if necessary, do pooling by hand.

Goodness of Fit Testing with some Pooling

Cell i	Cut Points		Observed Values	Expected Values	Chi-square Values
1	0.000	0.606	18	22.67	0.963
2	0.606	1.21	24	22.48	0.103
3	1.21	1.82	25	22.09	0.383
4	1.82	2.42	20	21.53	0.108
5	2.42	3.03	17	20.80	0.694
6	3.03	3.63	23	19.93	0.474
7	3.63	4.24	17	18.93	0.197
8	4.24	4.84	19	17.84	0.076
9	4.84	5.45	21	16.67	1.125
10	5.45	6.06	19	15.45	0.813
11	6.06	6.66	9	14.22	1.914
12	6.66	7.27	10	12.98	0.683
13	7.27	7.87	15	11.76	0.895
14	7.87	8.48	7	10.57	1.207
15	8.48	9.08	10	9.44	0.033
16	9.08	9.69	13	8.37	2.565
17	9.69	10.3	10	7.37	0.942
18	10.3	10.9	7	6.44	0.048
19	10.9	11.5	4	5.60	0.455
20	11.5	12.1	3	4.83	0.693
21	12.1	12.7	6	4.14	0.833
22	12.7	13.3	2	3.53	0.664
23	13.3	13.9	2	2.99	0.329
24	13.9	14.5	1	2.52	0.917
25	14.5	15.7	5	3.87	0.332

Total Chi-square value = 17.4471 Degrees of Freedom = 22.00

Probability of a greater chi-square value, P = 0.73822



Effort : 20291.96
 # samples : 164
 Width : 15.74572
 # observations: 307

Model

Half-normal key, $k(y) = \text{Exp}(-y^2/(2*s^2))$

$s = A(1) *$

$\text{Exp}(\text{fcn}(A(2)))$

Parameter A(1) is the intercept of the scale parameter s.

Parameter A(2) is the coefficient of covariate DIAMETER.

Parameter	Point Estimate	Standard Error	Percent Coef. of Variation	95% Percent Confidence Interval	
f(0)	0.12214	0.49271E-02	4.03	0.11282	0.13222
p	0.51999	0.20977E-01	4.03	0.48032	0.56293
ESW	8.1875	0.33029	4.03	7.5630	8.8637
n/L	0.15129E-01	0.11981E-02	7.92	0.12942E-01	0.17686E-01
D	9.2391	0.82111	8.89	7.7582	11.003
N	1509.0	134.11	8.89	1267.0	1797.0

Measurement Units

Density: Numbers/hectares
ESW: meters

Component Percentages of Var(D)

Detection probability : 20.6
Encounter rate : 79.4

	Estimate	%CV	df	95% Confidence Interval	
n	307.00				
k	164.00				
L	20292.				
n/L	0.15129E-01	7.92	163.00	0.12942E-01	0.17686E-01
Left	0.0000				
Width	15.746				

	Estimate	%CV	df	95% Confidence Interval	
Half-normal/Cosine					
m	2.0000				
LnL	-780.36				
AIC	1564.7				
AICc	1564.8				
BIC	1572.2				
f(0)	0.12214	4.03	305.00	0.11282	0.13222
p	0.51999	4.03	305.00	0.48032	0.56293
ESW	8.1875	4.03	305.00	7.5630	8.8637

	Estimate	%CV	df	95% Confidence Interval	
Half-normal/Cosine					
D	9.2391	8.89	249.59	7.7582	11.003
N	1509.0	8.89	249.59	1267.0	1797.0