POPULATION STATUS AND MANAGEMENT OF THE GOPHER TORTOISE ON THE FITZHUGH CARTER TRACT OF ECONFINA CREEK WILDLIFE MANAGEMENT AREA

2015 STATUS REPORT

Prepared by:
Aubrey Pawlikowski, Wildlife Technician
Patrick McElhone, Wildlife Biologist
Division of Habitat and Species Conservation
Wildlife and Habitat Management Section

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INTRODUCTION

The Fitzhugh Carter Tract (hereafter referred to as the Carter Tract) was purchased by the Northwest Florida Water Management District (NWFWMD) in October 2003 and established as a tract of Econfina Creek Wildlife Management Area (WMA). A mitigation bank permit from the Florida Department of Environmental Protection (DEP) was issued to the NWFWMD in August 2005 to manage the property. Management objectives identified by the NWFWMD include wetlands restoration, preservation and management, aquatic habitat preservation, erosion control, and uplands restoration and management. In June 2005, the Florida Fish and Wildlife Conservation Commission (FWC) entered into a cost-share agreement with NWFWMD to develop and implement a comprehensive fish and wildlife management program for the Carter Tract. As part of this agreement, an annual survey and monitoring program for the gopher tortoise (*Gopherus polyphemus*) has continued since 2005.

The goal of this project is the continuation of surveying, monitoring, and assessing the status of the gopher tortoise population on the Carter Tract. Equally important is our commitment to providing management recommendations to the NWFWMD for gopher tortoises on the Carter Tract. Changes in gopher tortoise population status can be an indicator of the health of xeric plant communities in this region. Therefore, monitoring the status of such populations can aid land managers in gauging the efficacy of management and restoration efforts.

Monitoring for the gopher tortoise, a protected imperiled species, is important because it is a keystone species for sandhill communities of the southeastern coastal plain. Tortoise burrows have been known to support hundreds of obligate and non-obligate species (Jackson and Milstrey 1989; Cox et al. 1987). Sixty vertebrate and 302 invertebrate species are known to utilize gopher tortoise burrows in Florida to varying degrees (Jackson and Milstrey 1989; Figure 1). Gopher tortoise are commonly found in the sandhills (upland areas with well-drained, sandy soils) and are commonly associated with longleaf pine (*Pinus palustrus*) and xeric oak (*Quercus spp*.) communities. Ideal gopher tortoise foraging habitat are areas of open canopy where plants have ample access to sunlight, promoting the growth of grasses and herbaceous groundcover (Ashton and Ashton 2008). These habitat types are

found on the Carter Tract and are actively managed through the use of prescribed fire, and mechanical and chemical plant control methods (Enge et al 2006).

Figure 1. Vertebrate species are often observed utilizing gopher tortoise burrows on the Carter Tract, including this Eastern hognose (Heterodon platyrhinos) demonstrating the defense mechanism of "playing dead".

Moreover, gopher tortoise burrows provide a refuge for state and federally listed species (Speake 1981). Four noteworthy burrow commensals include the Federally Threatened eastern indigo snake (*Drymarchon couperi*), the State Species of Special Concern (SSC) gopher frog (*Lithobates capito*), the State SSC Florida pine snake (*Pituophis melanoleucus mugitus*) (Witz et al. 1992; Moler 1992; Ashton and Ashton 2008), and, the eastern diamondback rattlesnake (*Crotalus adamanteus*), which is currently under review for federal listing (US Fish and Wildlife Service 2012). The Florida pine snake and eastern diamondback rattlesnake have both been documented on the Carter Tract.

Legal status of the gopher tortoise across the southeastern coastal plain varies by region. It was listed as a Florida SSC in 1979, but it was not until 1988 that the harvest of tortoises was prohibited statewide. In November 2007, the gopher tortoise in Florida was uplisted from a SSC to Threatened status and is now protected by state law, Chapter 68A–27,

Florida Administrative Code (F.A.C.). Regionally, populations west of Mobile Bay are federally protected as threatened. On 27 July 2011, the US Fish and Wildlife Service (USFWS) added gopher tortoise populations east of Mobile Bay to the list of candidate species eligible for protection under the Endangered Species Act. The USFWS issued a finding of "warranted but precluded" for the species in the eastern portion of its range, including Florida, Georgia, and South Carolina (US Fish and Wildlife Service 2011). The USFWS concluded that listing of the gopher tortoise was warranted but that higher priority listing actions currently take precedence over the gopher tortoise.

The primary threat to the gopher tortoise population in Florida is habitat loss due to development of sandhill communities and habitat degradation due predominantly to fire suppression and incompatible forestry practices (Auffenberg and Franz 1982; McCoy and Mushinsky 2002). Over the past 25 years, selective timber harvests have largely been replaced by pulpwood production; this usage demands dense, deeply shaded stands of sand (*Pinus clausa*) and slash pine (*Pinus elliotti*), unsuitable habitat for gopher tortoises. The total area of suitable gopher tortoise habitat in Florida is estimated to have declined by more than 60% since 1910 (Enge et al. 2006), with just 44,000 hectares (ha) of original gopher tortoise habitat remaining in Washington County, Florida (Auffenberg and Franz 1982).

It has been estimated that only 1-3% of gopher tortoise eggs eventually produce breeding adults (Landers et al. 1980; Enge et al. 2006). The majority of predation occurs on gopher tortoise eggs and hatchlings with 80-90% of nests being depredated and less than 10% of hatchlings surviving past their first year (Landers et al. 1980, Witz et al. 1992, Butler and Sowell 1996, Epperson and Heise 2003) . Native and non-native predators alike can have detrimental impacts on vulnerable tortoise populations. Native predators of gopher tortoises include the raccoon (*Procyon lotor*), Virginia opossum (*Didelphis virginiana*), gray fox (*Urocyon cinereoargenteus*), and Florida cottonmouth (*Agkistrodon piscivorus conanti*; Ernst et al. 1994, Butler and Sowell 1996). Non-native predators include the nine-banded armadillo (*Dasypus novemcinctus*), domestic dog (*Canis lupus familiaris*), and red imported fire ant (*Solenopsis invicta*)(Epperson and Heise 2003, Enge et al 2006, Moore et al. 2006, Smith et al. 2013). The additive pressure from non-native predators may further reduce gopher tortoise survival rates.

Exotic plants can also present a threat to gopher tortoises. For example, cogon grass (*Imperata cylindrica*), an aggressive exotic, can negatively impact gopher tortoises by

increasing fire intensity (Brooks et al. 2004) and replacing native groundcover plants with lower-quality forage (Basiotis 2007). Given a general depletion of panhandle tortoise populations due to habitat loss and fragmentation (Diemer and Moler 1992; Landers and Speake 1980), human exploitation (Diemer 1987), and the introduction of non-native species, it has been postulated that by the year 2025 only scattered tortoise populations on fully protected lands will remain (Auffenberg and Franz 1982). This stresses the importance of maintaining viable tortoise populations on protected land like the Carter Tract.

AREA DESCRIPTION

Overview

The Carter Tract is a 2,175 acre parcel located in south-central Washington County, approximately five miles north of State Road 20 and one mile west of State Road 77. The physiographic region in which the Carter Tract is located is classified by the Florida Natural Areas Inventory (FNAI) as xeric upland sandhill (FNAI 2010). It is characterized by relatively high, rolling topography with sandy soils overlaying limestone and containing numerous small solution ponds. Much of the area's sandhill community, historically dominated by longleaf pine (*Pinus palustris*), has been harvested and converted to sand or slash pine plantation or developed for home sites and small farms. The surrounding land uses are primarily pine plantation, undeveloped open lands, sod farms, small residential developments, and a nearby Department of Corrections facility.

The Carter Tract lies within the Choctawhatchee River Basin, near the watershed divide to the St. Andrews Bay Basin. Most surface water flows through area ponds and Pine Log Creek to the Choctawhatchee River, but much of the groundwater flow is toward the east into the Econfina Creek watershed of the St. Andrews Bay Basin. Interspersed within the 1,150 acres of uplands are approximately 875 acres of mesic and hydric habitats. The remaining 150 acres are natural Sinkholes and Sinkhole Lakes (isolated, steep-sided karst ponds and shallow, gently-sloping lakes). These land cover types occur across several soil types. Swamp soils are strongly acidic mineral soils containing large amounts of organic matter. Lakeland and Blanton soil types dominate the upland habitat of the Carter Tract. Lakeland soils are deep, well-drained, strongly acidic sandy and loamy soils while Blanton soils are sandy and acidic in nature (Huckle 1962).

Historical Land Use

The Carter Tract represents several distinct ecological communities. A significant portion of the property (1,150 acres) was historically logged for longleaf pine and replanted in sand or slash pine plantations or left to regenerate with pine (*Pinus* spp.), live oak (*Quercus virginiana*), and scrub oaks (*Quercus* spp.). Prior to NWFWMD acquisition of the property, the essential element of maintaining this community, periodic prescribed fire, had been absent for years. Therefore few of the vegetative communities which constitute historic sandhills, including the longleaf pine/wiregrass (*Aristida spp*.) community, remained. As a result, wiregrass was replaced with shrubs and taller understory species, and longleaf pine was outcompeted by hardwoods and other pine species. Prior to 2007, the uplands contained 750 acres of upland hardwood forest (xeric oak and live oak) and 400 acres of sand and slash pine plantation.

Restoration Efforts

NWFWMD began habitat restoration on the Carter Tract in 2007 with the logging of the pine plantations, and thinning of the upland hardwood forests. Prescribed burning followed logging and thinning operations, and subsequent planting of longleaf pine seedlings and wiregrass tublings followed site preparation burns. Planted upland areas were then broadcast treated via helicopter using Velpar®, a broad spectrum herbicide, to control scrub oaks. Restoration efforts on the Carter Tract continue to be aggressive in nature with continued prescribed fire, mechanical removal and herbicide of encroaching shrubs and regenerating sandpine. Such restoration efforts are documented annually via photo plots and provide a snapshot of habitat improvement over time (Figure 2). When managing for gopher tortoises it is essential to manage for the integrity of the forest system that supports the tortoise population, specifically the sandhills longleaf-turkey oak-wiregrass association. These restoration efforts are a necessary first step and directly benefit the gopher tortoise and thus have the potential to positively affect future burrow occupancy rates (Figure 3).

Figure 2. Photos from Photo Plot #3 in gopher tortoise Cluster 1 show vegetative changes between 2014 and 2015 resulting from prescribed burn in May 2015 on the Carter Tract of Econfina Creek WMA, Washington County, Florida.

Figure 3. A gopher tortoise entering a burrow one year after a burn on the Carter Tract of Econfina Creek WMA, Washington County, Florida.

GOPHER TORTOISE SURVEY METHODOLOGY

Comprehensive burrow counts were used to determine the relative abundance of tortoise populations. Surveys were conducted in May 2015, corresponding with a warmer month of the year when tortoises are prone to leave their burrows more frequently, leaving tracks and freshly disturbed sand as indicators of activity. Survey methods followed those outlined in Martin and McElhone 2014. Soil maps and aerial photographs facilitated the prioritization of survey efforts, with areas classified as having excessively drained soils being surveyed first.

Burrow clusters were defined by boundaries around mapped concentrations of tortoises (Figure 4). These boundaries do not necessarily coincide with forest stand boundaries and often include multiple stands. Clusters were primarily delineated for devising management options and no attempt to group burrows using stringent behavioral or spatial criteria was made. Cluster numbers simply denote location and are used for accounting and management purposes.

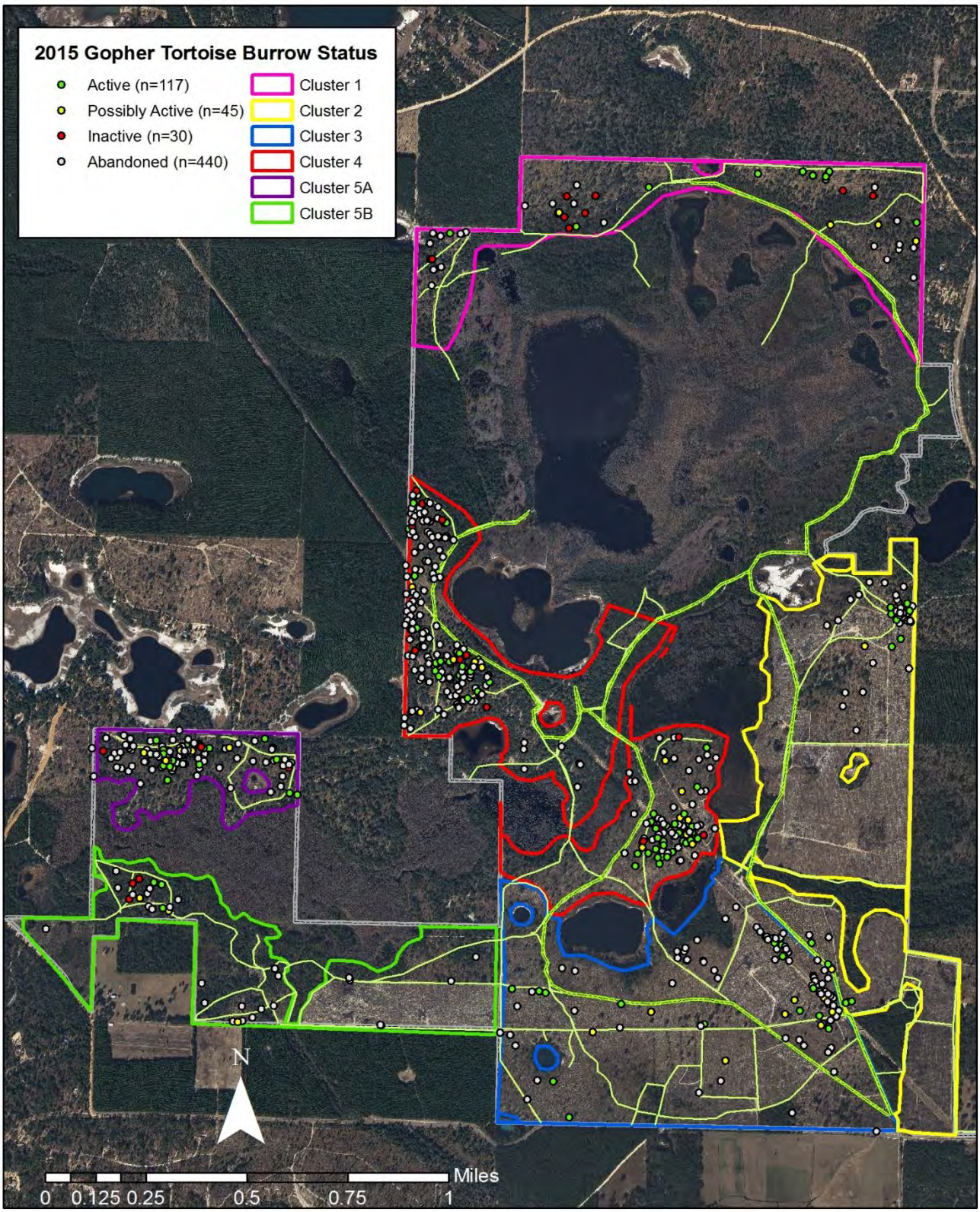

Figure 4. Distribution of gopher tortoise survey Clusters 1 – 5B and burrows with activity status located via visual searches using systematic transects across suitable habitat on the Carter Tract of Econfina Creek WMA, Washington County, Florida, May 2015.

Distinguishing activity status followed Breininger et al. (1986) and Diemer (1992a). Activity status attributes are described below and illustrated in Figure 5:

1. Active- recent slide marks and footprints; soil at entrance has recently been disturbed by tortoises.
2. Possibly Active- difficult to determine whether activity was recent or caused by a tortoise.
3. Inactive- Soil undisturbed; lacks fresh sign of tortoise use but appears to be maintained.
4. Old/abandoned- partly or completely filled with litter, caved in, or dilapidated.

Figure 5. Example of each gopher tortoise burrow status category from top left clockwise: active, possibly active, old/abandoned, and inactive.

Given the relationship between gopher tortoise body size and burrow width (Wilson 1991), burrow size class distribution data obtained during comprehensive surveys were examined as an indirect estimate of the demographic structure of the tortoise population. Burrow widths correlate strongly with age and carapace lengths of tortoises inhabiting them

(Alford 1980; Martin and Layne 1987), allowing burrow widths to reflect the size distribution of carapace lengths of resident gopher tortoises. Subsequently, carapace length can be used as a characterization of reproductive potential in individual tortoises. However, resulting biases must be considered such as small tortoises occurring in large burrows and obscurity of hatchlings. The width of each identified burrow was measured to the nearest five centimeters at a depth of 50 cm with the aid of specially fabricated calipers (Martin and Layne 1987; Wilson 1991). Abandoned burrows with collapsed tunnels were not measured.

RESULTS AND DISCUSSION

Activity Status

A total of 632 burrows were documented across Carter Tract during the 2015 sampling season. Eighteen percent (n=117) of burrows were found to be active, 7% (n=45) were possibly active, 5% (n=30) were inactive, and 70% (n=440) were old or abandoned (Figure 6). Appendix I outlines detailed burrow counts by cluster and activity status across the Carter Tract from 2005-2015.

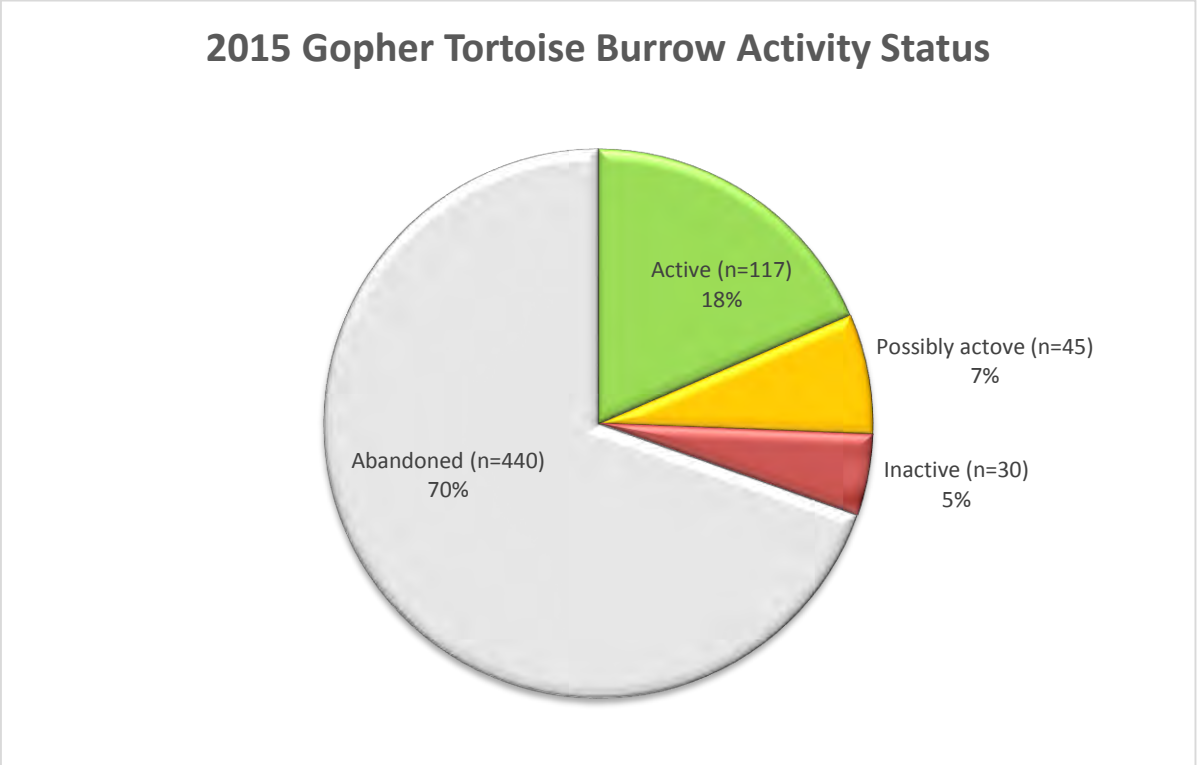

Figure 6. Activity status of gopher tortoise burrows (n=632) located during 2015 surveys on the Carter Tract of Econfina Creek WMA, Washington County, Florida.

The total number of active and possibly active burrows increased by 32 in 2015. Figure 7 illustrates how activity status of burrows has changed annually since the inception of the monitoring program. Due to the complexity of gopher tortoise behavior, frequent burrow status changes are natural and expected (Mushinsky and Esman 1994). Burrow occupancy rates vary over time and space (Nomani et al. 2008) and burrow creation and abandonment is highly dynamic. Therefore it is not uncommon to see steady and sometimes increasing numbers of abandoned burrows, even following habitat improvement activities. During a five-year study, Aresco and Guyer (1999) found that gopher tortoises in southern Alabama abandoned their burrows at a rate of 22% per year. Because FWC staff return to all burrows marked during previous years without regard for past activity status, a subsequent increase in abanonded burrow numbers is anticipated.

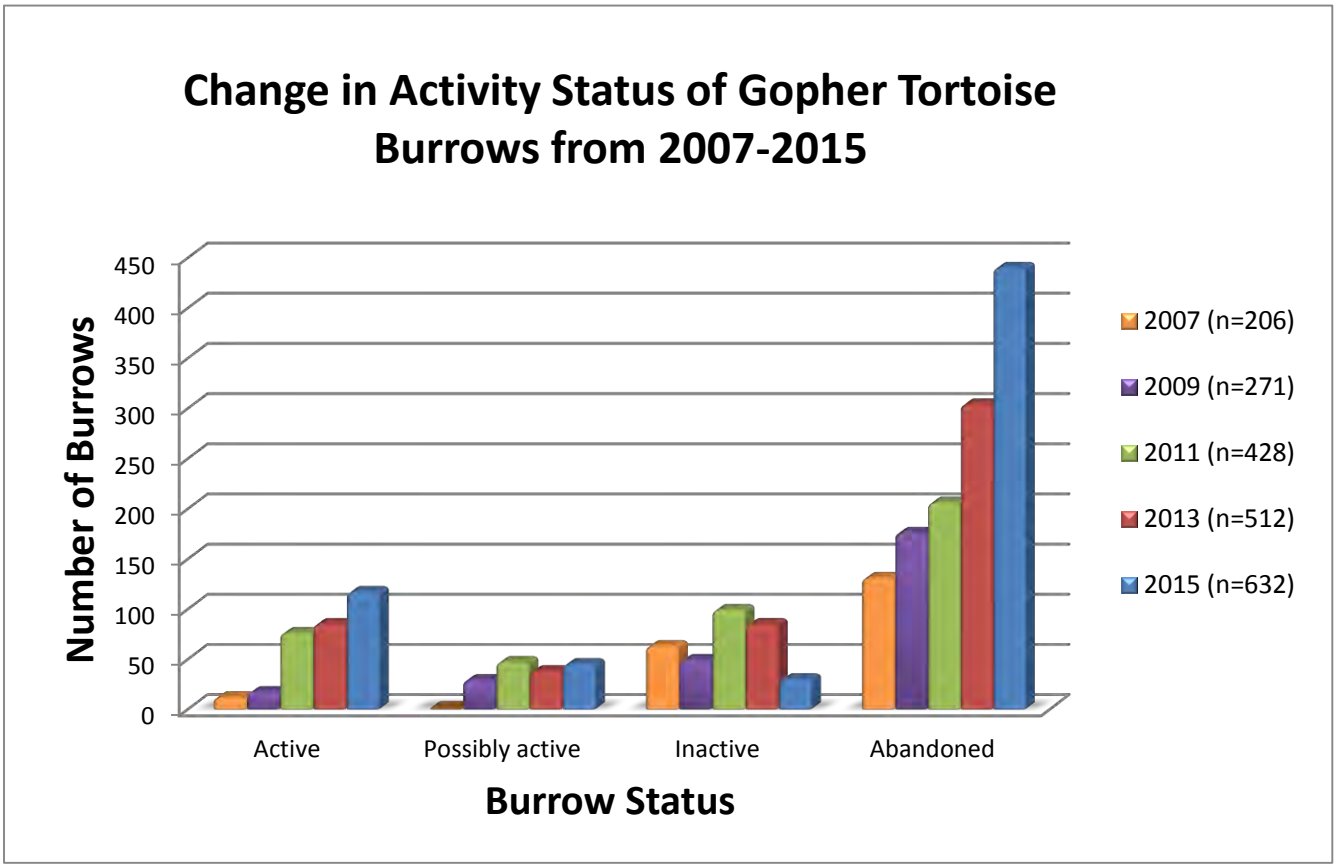

Figure 7. Annual change in activity status of gopher tortoise burrows from 2007-2015 on the Carter Tract of Econfina Creek WMA, Washington County, Florida.

Burrow counts prove a useful tool for monitoring relative population changes. Estimating actual tortoise populations from burrow counts is challenging. The number of burrows may increase or decrease without a corresponding change in actual population (Carthy et al. 2005). Gopher tortoise burrow surveys on the Carter Tract have revealed a continuous cycle of burrow creation and abandonment over time. For example, some burrows fill with debris, cave in, and effectively disappear, while new ones are excavated. Often, tortoises use more burrows including those that were previously unoccupied and are more likely to excavate new ones during the summer months (May – September) when surveys are conducted (Ott Eubanks et al. 2003). The number of burrows in use per tortoise does not remain constant with burrow occupancy rates influenced by region, season, and population density as well as habitat quality (Carthy et al. 2005; Nomani et al. 2008). Depending on habitat quality, male gopher tortoises may use as many as 10 burrows and females as many as 5 burrows per year (Ott Eubanks et al. 2003). In northern Florida, Diemer (1992b) found that on average adult male tortoises use 5.5 burrows, and adult female tortoises use 2.7 burrows during the active season (April-December). In Georgia, male and female tortoises were reported to use 7 and 4 burrows respectively (McRae et al. 1981). Mean annual burrow use by juvenile tortoises ranged from 1.1 by 0- to 1-year olds, 2.2 by 2-year olds, and 1.7 by 4- to 5-year olds in a southern Georgia population (McRae et al. 1981). Whereas, in a central Florida population, by 1- to 4-years of age, juvenile tortoises used an average of 4.4 burrows annually (Wilson et al. 1994). Suggested reasons for differences in burrow use among populations include differences in ground cover composition and structure, soil composition, temperature extremes at different latitudes, and number of disturbances to burrows. Although younger tortoises use several burrows, they spend most of their time in one primary burrow. Annual use of the primary burrow for younger tortoises in a central Florida population was 75% of all burrow use (Wilson et al. 1994).

Cluster Use

Survey results from 2015 found the majority of burrows were located in Cluster 4 (45% of total burrows; Figure 8), which is consistent with previous years findings. The greatest number of active and possibly active burrows were also located in Cluster 4 (n=73; Figure 9). The primary habitat type characterizing this cluster is xeric oak sandhills, which is one of the preferred habitats for the gopher tortoise (Auffenberg and Franz 1982; Diemer

1992a). We would expect greater concentrations of burrows in this area. Habitat restoration efforts in previous years opened the canopy considerably and successfully promoted herbaceous groundcover.

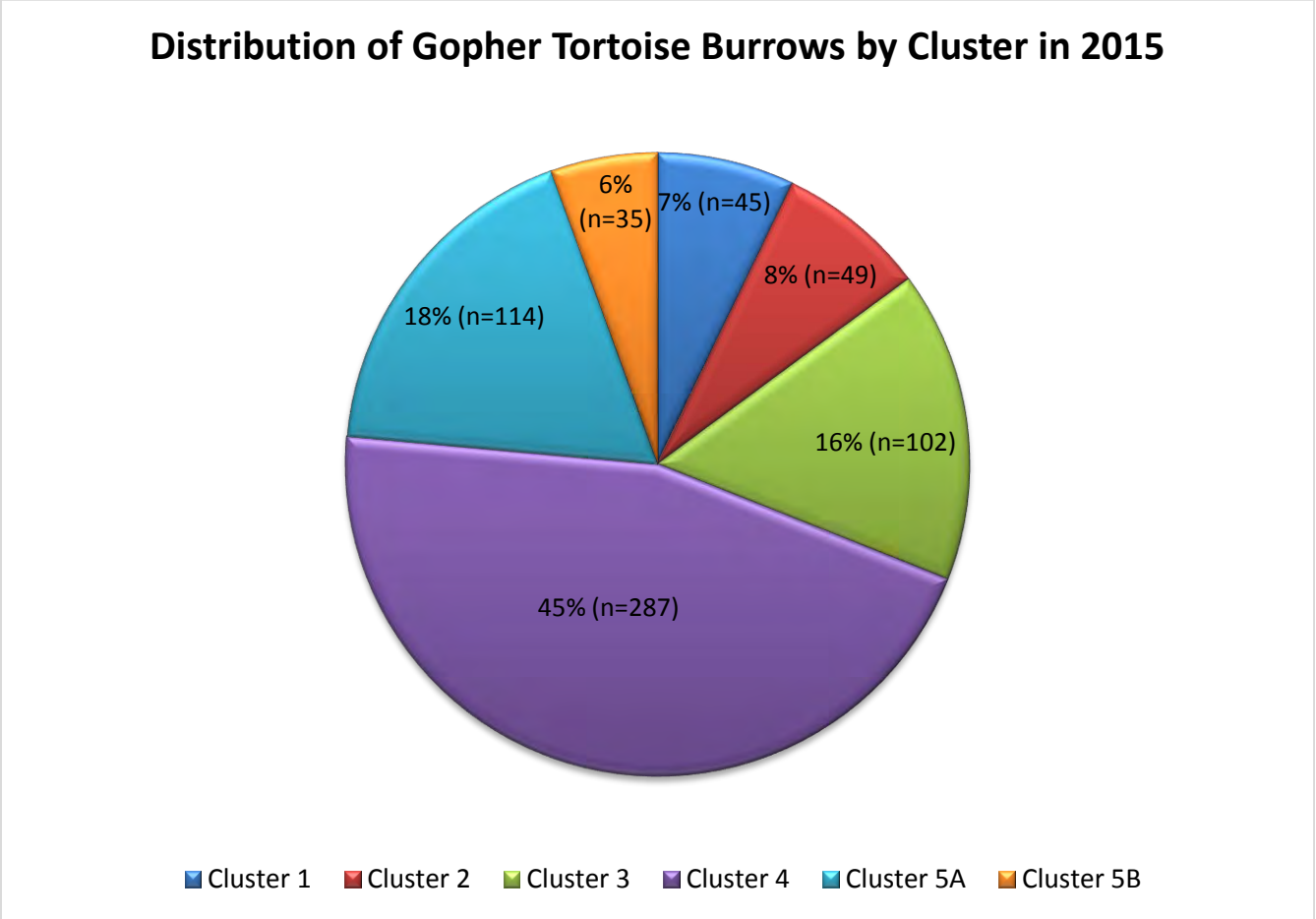

Figure 8. Distribution of gopher tortoise burrows by cluster on the Carter Tract of Econfina Creek WMA, Washington County, Florida, 2015.

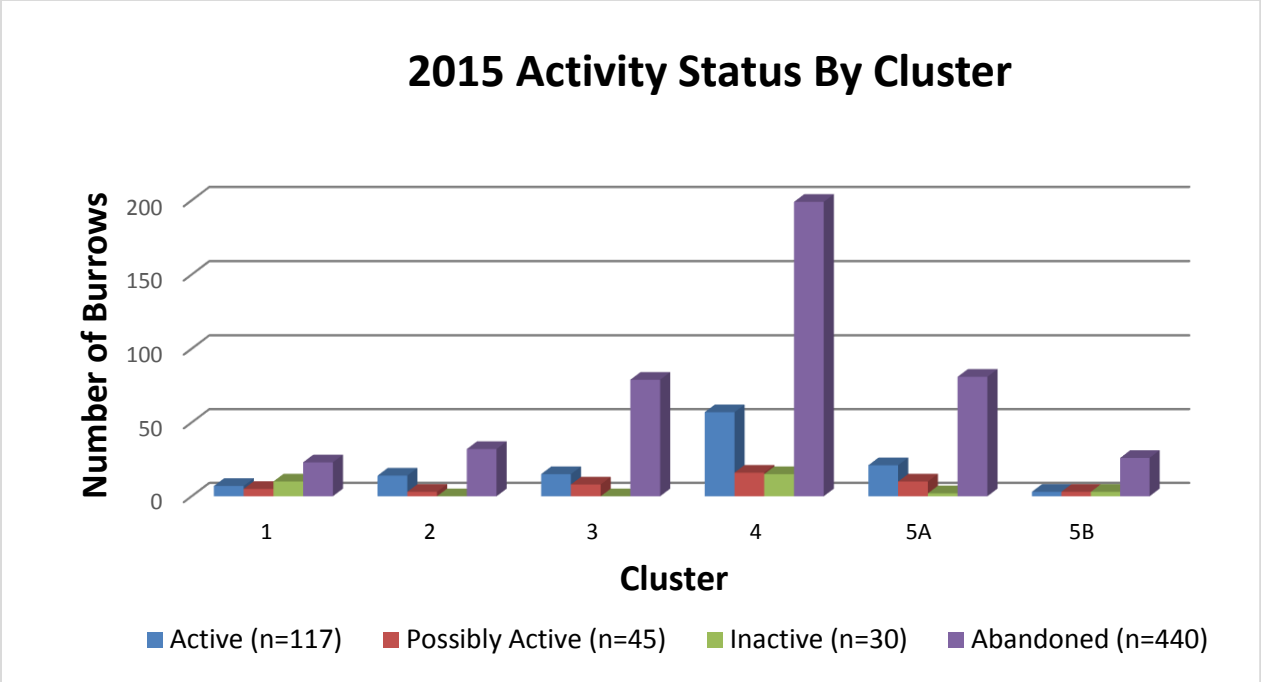

Figure 9. Activity status by cluster of burrows on the Carter Tract of Econfina Creek WMA, Washington County, Florida, 2015.

Xeric oak sandhills also comprise nearly the entire habitat of Cluster 5A; however, other than a 53 acre prescribed burn in November 2013 there have been no habitat restoration efforts in this area since 2010. Historically, Cluster 5A is a reasonably productive gopher tortoise cluster on the Carter Tract and increased in the number of active and possibly active burrows for the first time in four years this season. Burrow activity within this cluster will likely improve with the application of growing season fires. Burning during the growing season not only topkills undesired hardwoods but also stimulates flowering of wiregrass and native ground cover. This helps to maintain the grass-like savannah preferred by tortoises and provides substantial herbaceous forage.

Cluster 3 is a moderately productive site, supporting 16% (n=102) of tortoise burrows with 23 active or possibly active burrows in 2015. This area is a combination of xeric oak habitat and previous slash and sand pine plantations. Habitat restoration efforts have restored this cluster to a system that contains an open canopy and thriving herbaceous groundcover. A two year prescribed burn regime will reduce any encroaching hardwoods, keep the canopy open, and promote native groundcover expansion.

Cluster 2 is an area which previously consisted of large stands of sand pine plantation with two small patches of xeric oak sandhill. Habitat restoration efforts in this area since

2007 followed those implemented in Cluster 3, with selective timbering, prescribed fire, hand-cutting of regenerating sand pine and hardwoods, herbicide application, and replanting of wiregrass tublings and longleaf seedlings. The southern portion of Cluster 2 will require additional treatment efforts and an aggressive growing season prescribed burn regime before native groundcover will re-establish successfully and increase suitability of this area for gopher tortoises in the future. Still, this year, eight percent (n=49) of total tortoise burrows on Carter were found in Cluster 2.

Since surveys began in 2005, Cluster 1 was continually proven to be the least robust area for gopher tortoise burrows on the Carter Tract. However, our 2015 survey results showed an increase in gopher tortoise usage, finding 7% (n=45) of all burrows in this area, and increase of 3% from 2014. The northeast and northwest corners of Cluster 1, along with the western edge, contain suitable xeric oak habitat. A narrow travel corridor connecting Cluster 1 to Cluster 4 (along the western boundary) has opened in recent years as a response to land management activities. Habitat restoration, including mechanical reduction of hardwoods and prescribed burning, in the northwest portion of Cluster 1 has helped reduce scrub oak densities and encouraged establishment of wiregrass. While there are currently few active or possibly active burrows, maintenance of a 1-2 year burn regime could encourage expansion of the gopher tortoise population from Cluster 4 into this area over time.

Observations of active and possibly active gopher tortoise burrows on the Carter Tract tend to be along the powerline right-of-way bisecting Clusters 2, 3, and 4, or the edges of dirt roads. Because these areas typically contain fewer trees and a more open canopy, a higher percentage of bare ground and more herbaceous species are common. Structural changes in ground cover due to recent mechanical removal of sand pine and hardwoods, herbicide application, and prescribed burning, in conjunction with past timber harvests, have begun to provide the sparse overstory and savannah-like grassy understory that gopher tortoises prefer. Recent plantings and eventual regeneration of native food sources, aided by the maintenance of a regular prescribed fire regime, should help to sustain our local population and expedite the restoration process.

Burrow Size Classes

Given the relationship between gopher tortoise age, body size, and burrow width, size class distribution data obtained during our comprehensive survey were examined as an indirect estimate of the demographic structure of the tortoise population. Since we know that burrow widths correlate strongly with the carapace lengths (CL) of tortoises inhabiting them (Alford 1980; Martin and Layne 1987), the size distribution of burrow widths may reflect the size distribution of CL of resident gopher tortoises. Still, smaller tortoises have been known to utilize burrows abandoned by larger individuals, thus some bias is inherent in our relative estimate (Ashton and Ashton 2008).

Alford (1980) established that tortoise burrow width and CL are highly correlated according to the following equation: $\log_{10}y=0.879 \log_{10}x + 0.149$, where *y* is CL in centimeters and *x* is burrow width in centimeters. We used this formula to calculate size classes from measured burrow widths for all active (n=117) and possibly active (n=45) burrows found during 2015 surveys (Table 1).

Table 1. Size class distribution of active (n=117) and possibly active (n=45) gopher tortoise burrows surveyed May 2015 on the Carter Tract of Econfina Creek WMA, Washington County, Florida. Carapace length was predicted from burrow width following Alford (1980).

Burrow Width (cm)	Predicted Carapace Length (cm)	Number of Burrows	% of Active and Possibly Active Burrows
<5	< 5.80	0	0
5	5.80	11	7
10	10.67	27	17
15	15.23	40	25
20	19.62	36	22
1925	23.87	31	19
30	28.01	9	6
35	32.08	8	5
40	36.08	0	0

Depending upon latitude and location, adult gopher tortoises reach sexual maturity between 18-24 cm CL for males and 21-28 cm CL for females (Diemer and Moore 1994; Mushinsky et al. 1994). Using Alford's (1980) approximation method (1.8 cm/yr), these CL correspond to ages 10-15 years. Among active and possibly active burrows measured on the Carter Tract this year, 29.6% (n=48) resulted in a CL corresponding to sexual maturity (CL $\geq$ 19.62 cm) or potential breeders (Figure 10).

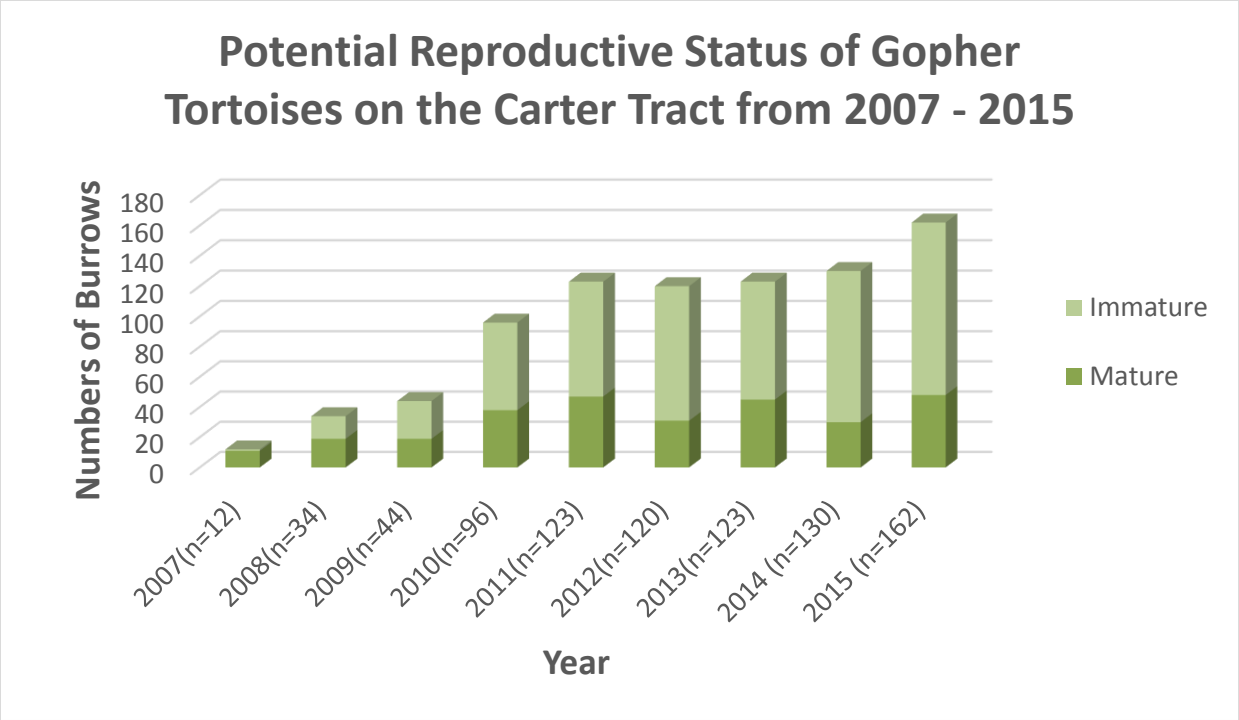

Figure 10. Potential reproductive status of gopher tortoises determined by burrow width of active and possibly active burrows found on the Carter Tract of Econfina Creek WMA, Washington Count,Florida, from 2007 to 2015.

Making definitive statements about the specific demographics of the gopher tortoise population on the Carter Tract is tenuous at best . This is due to biases in detection frequency of large (subadult and adult) versus small (juvenile) tortoises, as well as a relatively poor understanding of juvenile gopher tortoise behavior such as how and where to look for juveniles specifically (Auffenberg and Weaver 1969; Douglass 1978; Alford 1980; Landers et al. 1982; Pike 2006; Ashton and Ashton 2008). Variations in hatchling survival and possible adult predation also make age structure and recruitment analysis difficult. However, continued monitoring and annual comparative data assessments aid in future demographic mapping as well as demonstrate the effects of habitat restoration.

Soil Types

Certainly, soil type is an important limiting factor for gopher tortoises. The soil must be friable enough to allow excavation, yet firm enough to prevent burrows from collapsing. Martin and McElhone 2014 presents in detail the soil type distribution present on the Carter Tract.

MANAGEMENT RECOMMENDATIONS

Overview

Improvements have been made over the last nine years within the 1,144 acres of potential gopher tortoise habitat and travel corridors on the Carter Tract. Stands of slash and sand pine have been logged and scrub oak encroachment and sand pine regeneration have been mitigated using herbicide and mechanical thinning. Native herbaceous groundcover species have been planted, and a frequent prescribed burning regime has been established across most of the area. All of these activities were identified as beneficial to gopher tortoises in our previous management recommendations. Future work will continue to provide comparative data on tortoise population trends on the Carter Tract, which will enable FWC staff to make informed management decisions.

Continuation of management activities is imperative to the restoration and health of the Carter Tract landscape. Prescribed burning is the most important habitat enhancing element in sandhill communities, improving and increasing the herbaceous food supply and decreasing woody species. Continued suppression of scrub oak and sand pine regeneration is most important at this stage in the restoration process. This can be accomplished most effectively by burning during the growing season. The contracted prescribed fire plan for the previous year included 301 acres of dormant season burns and 185 acres of growing season burns for a total of 486 acres. Dormant season burns included the entirety of Clusters 5B. Growing season burns encompassed the majority of Cluster 1 and the North Warmouth Pond portion of Cluster 4, although this section was not completed. This growing season burn regime is critical to continuing improvements within gopher tortoise clusters of the Carter Tract (Figure 11). Summer burns can be more detrimental to oak recruitment compared to other seasons, while significantly increasing the composition of herbaceous cover (Glitzenstein et al. 1995; Lewis and Harshbarger 1976).

Viewing the landscape as a whole is essential for maintaining connectivity for dispersal and immigration routes for gopher tortoises., However, our continuing focus on habitat characteristics within individual clusters will allow us to better observe isolated changes in habitat structure. Our guidelines continue to closely follow recommendations by Landers and Speake (1980), Diemer (1987), and the 2012 Gopher Tortoise Management Plan (Florida Fish and Wildlife Conservation Commission 2012). Our methods address such

management considerations as midstory hardwood management, regeneration, and implementation of a regular prescribed burning regime on a site-specific basis (Figure 11).

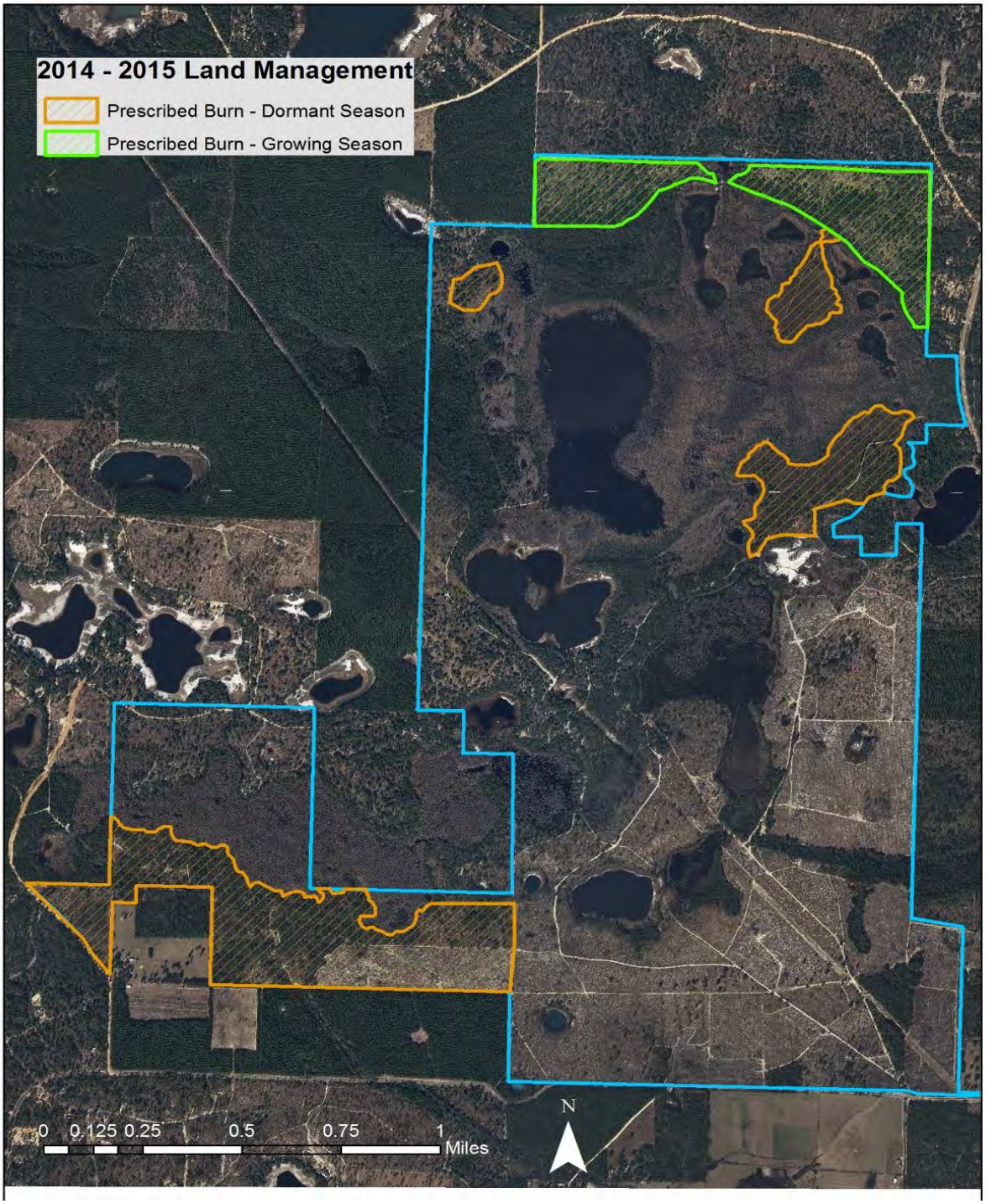

Figure 11. Land management activities implemented by NWFWMD from 2014-2015 on the Carter Tract of Econfina Creek WMA, Washington County, Florida.

Cluster 1

Cluster 1 is the northernmost cluster and the second least active on the Carter Tract. Although still relatively inactive compared to other clusters, it has improved from the least productive cluster for the first time since the inception of gopher tortoise surveys on the property. The northwest and northeast corners of Cluster 1 currently contain the better tortoise habitat within this cluster. Wiregrass establishment to the northeast of Green Pond Road has improved. Annual prescribed dormant season burns since 2010, in combination with intensive mechanical and herbicide treatments during summer and fall 2011, have reduced the woody understory and should encourage existing groundcover to spread and longleaf pines to advance out of the grass stage. Prescribed growing season burns in 2012 and 2013 were patchy and did little to suppress hardwood regrowth. During May 2015, 124 acres of Cluster 1 underwent a growing season prescribed burn. This burn was successful in removing a considerable amount of the encroaching woody understory and promoting the growth of native groundcover. We suggest continuation of growing season burns on a two year rotation in an effort to maintain hardwood supression and continue to promote native groundcover. This strategy may help to promote immigration of offsite tortoises north of the Carter Tract into this cluster and will encourage expansion across the cluster by the current population. Tortoise dispersal to this cluster from within the property is difficult given its separation from other clusters by a mix of wet hardwoods and hydric pine flatwoods.

CLUSTER 1—Past and Suggested Future Management Activities

Year	*Prescribed growing season burn*	*Prescribed dormant season burn*	*Herbicide*	*Mechanical reduction*	*Wiregrass Planting*	*Longleaf Planting*	*Timber removal*
2007							
2008							
2009							
2010		X			X	X	
2011		X	X	X	X		
2012	X	X					
2013	X	X					
2014							
2015	X						
*2016			X	X			

* Denotes *suggested* management activities for 2016

Cluster 2

There continues to be little gopher tortoise activity documented in Cluster 2. Multiple habitat restoration efforts have been made to date to improve suitability for gopher tortoises (Martin and McElhone 2014).

Although most of Cluster 2 was a former slash pine plantation, timber removal, longleaf pine/wiregrass plantings, and prescribed burns have encouraged native groundcover to return in the northern two thirds of the cluster. However, there is currently little to no native groundcover in the southernmost portion. Still additional site preparation and direct seeding will be required before native plants propagate heavily. We recommend establishment of a two year burn regime throughout this cluster until sufficient herbaceous groundcover is established, at which time extending intervals between burns could be entertained.

CLUSTER 2—Past and Suggested Future Management Activities

Year	Prescribed growing season burn	Prescribed dormant season burn	Herbicide	Mechanical reduction	Wiregrass Planting	Longleaf Planting	Timber removal
2007							X
2008		X			X	X	
2009							
2010	X		X	X	X		
2011	X		X	X	X		
2012	X		X	X			
2013		X					
2014	X		X	X			
2015							
*2016	X				X		

* Denotes *suggested* management activities for 2016

Cluster 3 – PRIORITY AREA

Cluster 3 is a priority cluster for management due to high gopher tortoise activity along the power line right-of-way. Since the logging of slash and sand pine in 2007, prescribed burns, herbicide treatments, and wiregrass plug installation have been used to improve the habiitat (Martin and McElhone 2014). Given the success of herbicide applications in 2009 and 2013, both dormant and growing season burns can be used to maintain suitable habitat within this cluster. However, in the event of excessive hardwood

regeneration, growing season burns should be re-established to topkill scrub oaks and reduce shrub competition. Growing season burns promote wiregrass flowering, which increases herbaceous groundcover and potentially encourages expansion of tortoises into areas outside the power line right-of-way. Due to the amount of tortoise activity along the power line right-of-way, all mechanized equipment (mowers, bush-hogs, etc.) should be prohibited during breeding season months (March-August) and hatchling season (September and October; Ashton and Ashton 2008), and operators should take care to avoid collapsing established burrows if using equipment outside of the breeding season in these areas.

CLUSTER 3—Past and Suggested Future Management Activities							
Year	*Prescribed growing season burn*	*Prescribed dormant season burn*	*Herbicide*	*Mechanical reduction*	*Wiregrass Planting*	*Longleaf Planting*	*Timber removal*
2007							X
2008		X			X	X	
2009			X				
2010	X	X	X	X			
2011		X	X	X	X		
2012							
2013			X	X			
2014	X		X	X	X		
2015							
*2016	X						
* Denotes *suggested* management activities for 2016							

Cluster 4 – PRIORITY AREA

Habitat improvement activities to date within Cluster 4 have successfully transformed this area into quality gopher tortoise habitat. Prescribed dormant season burns conducted annually between 2010 and 2013, resulted in excellent current herbaceous groundcover, with wiregrass becoming well established. Because groundcover is well established, dormant or growing season burning within Cluster 4 is acceptable. In summer 2014, a prescribed burn was conducted on the eastern portion of Cluster 4 successfully topkilling most of the remaining hardwood regeneration. Burning during the growing season promoted wiregrass flowering , increasing the amount of herbaceous groundcover in this location, and may encourage tortoises to continue expanding away from the powerline right of way. Although a growing season burn was planned, Cluster 4 received no management treatments in 2015. We recommend a two-year burn regime to maintain groundcover levels and consume

residual brush reduction debris. The western portion of Cluster 4, North of Warmouth Pond would greatly benefit from the application of a growing season burn to reduce shrubby understory competition as well as mechanical reduction in the northermost portion to eliminate thick hardwood growth. Cluster 4 supports the largest number of total burrows on the Carter Tract, as well as the most active and potentially active burrows; we therefore consider it a high priority cluster for management. The power line right-of-way is an important feature within this cluster as an area of high burrow density. Therefore, as was suggested for Cluster 3, mechanized cutting equipment should not be used during breeding season months and operators should be aware of existing burrows and prevent collapsing them.

CLUSTER 4—Past and Suggested Future Management Activities

Year	*Prescribed growing season burn*	*Prescribed dormant season burn*	*Herbicide*	*Mechanical reduction*	*Wiregrass Planting*	*Longleaf Planting*	*Timber removal*
2007							
2008							
2009			X				
2010	X	X					
2011		X	X	X			
2012		X					
2013		X					
2014	X						
2015							
*2016	X			X			

* Denotes *suggested* management activities for 2016

Cluster 5A – PRIORITY AREA

Although Cluster 5A is spatially separated from other clusters on the area, it is an important, active cluster. Given that Cluster 5A harbors 18% (n=114) of all burrows on the area, we consider it a high priority cluster for management. In 2014, Cluster 5A supported only 11% (n=15) of all active and possibly active burrows, while in 2015 we found 19% (n=31) of all active and possibly active burrows in this cluster. Since the last prescribed growing season burn in 2010, encroaching hardwoods have begin to degrade this cluster. In November 2013, 53 acres of cluster 5A were burned as part of a training exercise. While some habitat improvement occurred as a result of the burn further management will be required to

eliminate hardwood encroachment due to less frequent prescribed fire. We suggest a combination of mechanical reduction and herbicide application to reduce competing hardwoods in addition to maintaining this cluster on a two-year burn rotation, utilizing growing season burns. Growing season burns will help control the hardwood component and further consume residual downed woody debris throughout the cluster and promote the flowering and spread of wiregrass. Following additional wiregrass estasblishment, the burn regime could be adjusted to once every 2-3 years, as habitat quality dictates. These efforts should facilitate movement of dispersing tortoises from adjacent offsite sandhills habitat into this cluster.

CLUSTER 5A—Past and Suggested Future Management Activities

Year	*Prescribed growing season burn*	*Prescribed dormant season burn*	*Herbicide*	*Mechanical reduction*	*Wiregrass Planting*	*Longleaf Planting*	*Timber removal*
2007							
2008							
2009							
2010	X						
2011							
2012							
2013		X					
2014							
2015							
*2016	X		X	X			

* Denotes *suggested* management activities for 2016

Cluster 5B

Cluster 5B supports 6% (n=35) of all burrows on the Carter Tract. While the majority of burrows are currently abandoned, three active and three potentially active burrows were identified in the extreme western portion of this cluster, south of Pine Log Creek (Figure 5). While this area contains pockets of oak hammocks, the overstory is not excessively dense and is not detrimental to current tortoise populations or future recruitment in this area.

In contrast to the western section of cluster 5B, the eastern section is an old clearcut that currently contains only abandoned and inactive burrows (Figure 4). A dormant season burn in 2015 across all of Cluster 5B successfully consumed a fair amount of residual

logging debris and promoted wiregrass growth. This eastern portion of Cluster 5B has the potential to become excellent gopher tortoise habitat, as well as provide room for expansion from nearby Cluster 3 in the future. We suggest mechanical reduction and herbicide application for encroaching scrub oaks and regenerating sand pine to open the understory for wiregrass and longleaf pine development. We also suggest maintaining a two-year growing season burn regime to further consume logging debris and promote the flowering and spread of planted wiregrass and other native groundcover species.

CLUSTER 5B—Past and Suggested Future Management Activities

Year	*Prescribed growing season burn*	*Prescribed dormant season burn*	*Herbicide*	*Mechanical reduction*	*Wiregrass Planting*	*Longleaf Planting*	*Timber removal*
2007							
2008		X			X	X	
2009							
2010	X						
2011		X					
2012					X		
2013		X					
2014							
2015		X					
*2016							

* Denotes *suggested* management activities for 2016

AREAS OF CONCERN

Several significant factors threaten the long-term maintenance of gopher tortoise populations on the Carter Tract. Our primary concern is the poor suitability of the habitat comprising the connective areas between and among current suitable tortoise habitat. Without habitat improvement in these 'connective corridors', the likelihood of tortoises dispersing from one subpopulation to another is low and increases susceptibility of subpopulations to disease outbreaks and low genetic variability. As urban and residential areas expand, the suitability of dispersal habitat may decline to the point that successful dispersal is restricted within the confines of the Carter Tract. In this event, the Carter Tract population must then survive demographically on its own or otherwise decline. Therefore, the importance of quality habitat within the Carter Tract cannot be over-emphasized. While

the 41,424-acre Econfina Creek Wildlife Management Area is located just to the east, plans to continue the widening of State Road 77 through Washington County will increase hazards for individuals dispersing from this area.

The second level of concern is at the scale of the individual cluster. The greatest threat to the persistence of the gopher tortoise population is a subtle but continual decline in habitat quality on a site-by-site basis. Therefore, management recommendations for each cluster should continue to be reviewed closely and revised annually following comprehensive burrow surveys and habitat assessment.

FUTURE PLANS AND EXPECTATIONS

Comprehensive gopher tortoise burrow surveys will continue annually during the summer months. Specific habitat and management recommendations will continue to be developed per cluster and adjusted as surveying and monitoring results dictate. Clusters will be prioritized based on existing gopher tortoise activity, habitat restoration improvement efforts, and potential tortoise expansion. The maintenance of a current and complete GIS database of burrow and cluster information will be essential. Plans are to incorporate general observations related to habitat structure, as well as habitat restoration activities, upon completion of summer burrow surveys. This will allow us to make appropriate management recommendations at the cluster level.

ALTERNATIVE SURVEY METHODS

In an attempt to better understand gopher tortoise burrow dynamics on the Carter Tract, a burrow scope was deployed in December 2014 and January 2015. Burrow scoping surveys are conducted during the cooler months as gopher tortoises are less active and more likely to be in their burrows. A lighted camera attached to a 28 foot reinforced cable was inserted into the gopher tortoise burrow until the burrow terminated, an obstruction prevented the cable from going any further, or a tortoise was identified. The camera was attached to a battery powered monitor enabling staff to view any occupancies within the burrow (Figure 12).

One hundred three burrows identified to be active or possibly active during the 2014 summer survey season were scoped. Gopher tortoises were confirmed in 26 burrows (25 %

tortoise occupancy) and 10 commensals were identified: 4 pygmy rattlesnakes, 4 eastern diamondback rattlesnakes, an eastern hognose, and an unidentified rodent (Figure 13). Of the remaining burrows, we could not confirm presence or absence of gopher tortoises in 18 burrows due to obstructions within the burrow or not having enough cord length to complete the survey.

Burrow scoping proved to be an invaluable tool in identifying presence or absence of gopher tortoise in their burrows, particularly during the cooler months. For example, five burrows were classified as abandoned during the previous summer session, but were found to have confirmed presence of gopher tortoise during the burrow scoping surveys five months later. In the future, it would be beneficial to continue to conduct both survey methods in conjunction with one another to confirm the efficacy of census surveys and alleviate potential visual bias between staff members from year to year (Figure 14).

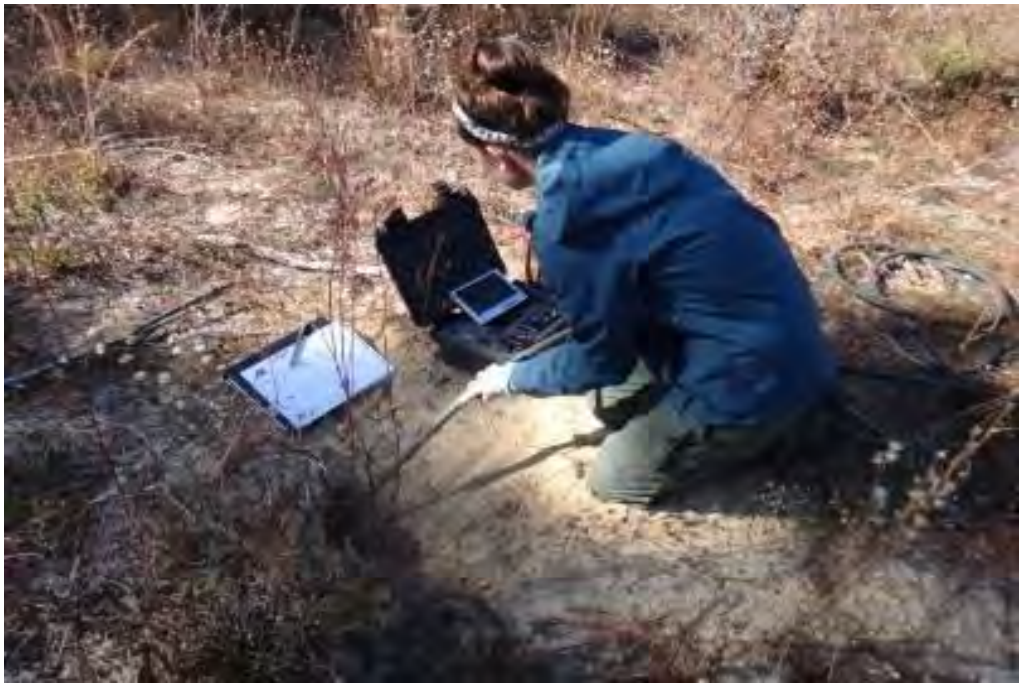

Figure 12. Technician conducting a burrow scope using a handheld video monitor and portable scope on the Carter Tract of Econfina Creek WMA, Washington County, Florida.

Figure 13. Gopher tortoise occupying a burrow that was successfully scoped on the Carter Tract of Econfina Creek WMA, Washington County, Florida.

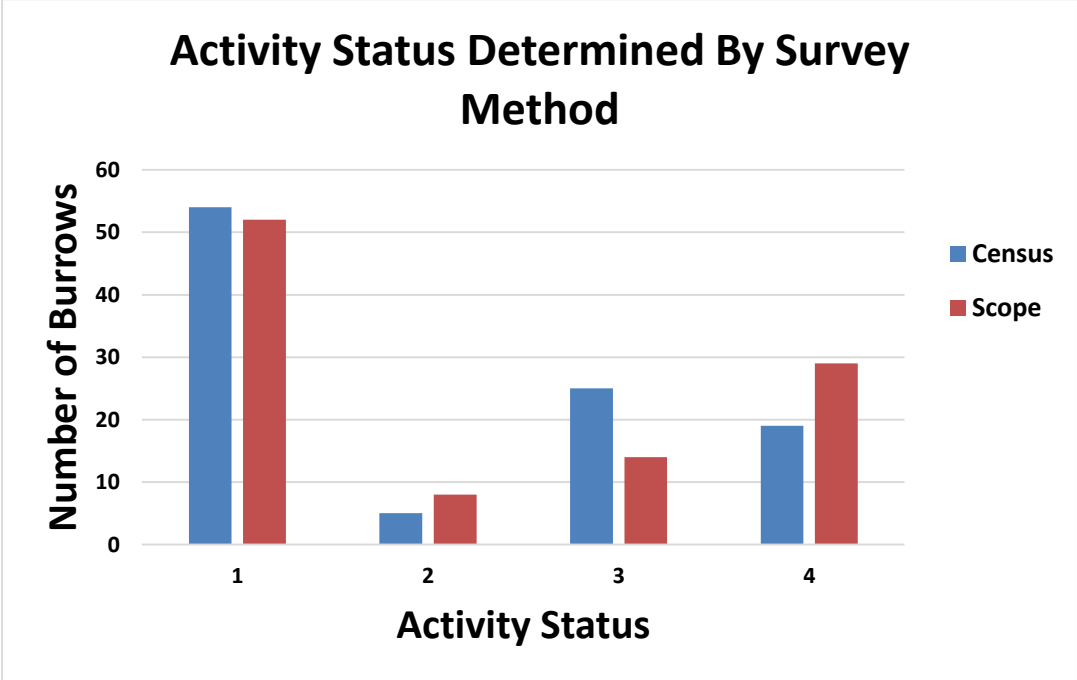

Figure 14. Activity Status of gopher tortoise burrows determined by summer census and winter burrow scoping methods on the Carter Tract of Econfina, Washington County, Florida 2015 (1 = active, 2 = possibly active, 3 = inactive, 4 = abandoned).

RELOCATION CONSIDERATIONS

In concert with recent re-evaluation of gopher tortoise relocations statewide, we will explore the benefits and feasibility of tortoise relocation onto the Carter Tract as a mechanism for future population recovery and expansion across the forest as habitat improvements make available more suitable tortoise habitat. Relocation as an avenue of gopher tortoise management should proceed cautiously. Historically, relocations as an effective management tool have been controversial (Dodd and Seigel 1991; Burke 1991; Reinert 1991). Due to a shortage of long term studies, little conclusive work has investigated the persistence of translocated gopher tortoises. However, one long term study by Ashton and Burke (2007) found an initial retention rate of 42% for the first year of the study and 92-100% retention rate for years 2-17. As research on the conservation of this species advances, tortoise relocation methods and retention rates continue to improve.

One issue of concern when dealing with habitat fragmentation and the potential relocation of tortoises is the increased risk of disease introduction and outbreak within subpopulations. Risk can be high for the spread of disease between gopher tortoise colonies and therefore should not be underestimated (Florida Fish and Wildlife Conservation Commission 2008). In light of the still tenuous facts and abiding concern for disease in tortoises, it is recommended that any potential tortoise relocations to the Carter Tract in the future only be done following thorough physiological screening, with an emphasis on URTD testing and following closely the recommendations of Wendland et al. (2009).

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Appendix I. Activity status of gopher tortoise burrows by cluster from 2005-2015 on the Carter Tract of Econfina Creek WMA, Washington County, Florida.

	Year									
Cluster 1	05/06	07	08	09	10	11	12	13	14	15
Active	3	0	0	0	3	1	1	1	0	7
Possibly Active	0	0	0	0	0	2	1	3	1	5
Inactive	1	0	1	1	11	3	4	2	2	10
Abandoned	0	4	0	3	4	13	17	18	21	23
Total	4	4	1	4	18	19	23	24	24	45
Cluster 2										
Active	5	2	1	0	9	6	7	11	12	14
Possibly Active	0	0	1	6	3	8	4	2	0	3
Inactive	2	6	3	5	2	8	5	3	0	0
Abandoned	2	3	12	11	14	12	20	22	30	32
Total	9	11	17	22	28	34	36	38	42	49
Cluster 3										
Active	3	1	4	4	14	13	16	10	14	15
Possibly Active	1	0	2	4	8	9	3	6	1	8
Inactive	5	4	10	11	3	14	16	16	5	0
Abandoned	3	13	25	25	30	36	53	58	73	79
Total	12	18	41	44	55	72	88	90	93	102
Cluster 4										
Active	35	6	15	8	30	40	42	46	58	57
Possibly Active	2	0	4	14	8	17	10	19	15	16
Inactive	35	25	9	13	15	38	37	38	2	15
Abandoned	22	54	97	78	103	98	119	137	164	199
Total	94	85	125	113	156	193	208	240	260	287
Clusters 5A and 5B										
Active	7	3	6	5	17	16	26	17	18	24
Possibly Active	9	0	3	5	4	11	10	8	11	13
Inactive	52	28	17	19	33	36	21	26	10	5
Abandoned	7	57	45	59	63	47	60	69	94	107
Total	75	88	71	88	117	110	117	120	133	149
All Clusters Combined	194	206	255	271	374	428	472	512	552	632