

**AN INITIAL ASSESSMENT OF
GOPHER TORTOISES IN THE
NORTH SEBASTIAN CONSERVATION AREA
INDIAN RIVER COUNTY, FLORIDA**

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SUMMARY An initial assessment of adult gopher tortoise (*Gopherus polyphemus*) densities within the North Sebastian Conservation Area (NSCA) was performed in order to evaluate the site's suitability for receiving relocated tortoises. Ten areas within NSCA, identified as Management Units (MU) 1-10, were chosen for initial survey on the basis of aerial photo-interpretation and prior reconnaissance. Initial assessment was conducted according to standard protocol, and tortoise densities were calculated for each MU.

Our results indicate that MU-1, MU-2, MU-3, MU-4, MU-5, MU-6, and MU-10 contain potential high-quality tortoise habitat. These MU's are likely to include suitable restocking sites, and will require minimal land management actions prior to relocation. Currently, five MU's possess limited potential for restocking, either because they already support capacity levels of 3 to 4 tortoises per acre (MU-2, MU-5, and MU-9), or because they contain unsuitable habitat (MU-7, and part of MU-8).

Our results further indicate NSCA has suitable potential tortoise habitat to accept relocated tortoises. The total number of gopher tortoises that can currently be relocated onto the site based on unused capacity in MU-1, MU-3, MU-4, and MU-6 is between 61 to 94 animals, resulting in a tortoise density of either 3 or 4 animals per acre, respectively. We recommend restocking MU-1 initially, and estimate that 10 to 20 tortoises can be relocated on this site without requiring prior land management actions. Such relocation would result in a tortoise density of between 3 to 4 animals per acre.

Similarly, MU-3, MU-4, and MU-6 contain high quality habitat and require no land management actions prior to tortoise relocation. An additional 7 to 11 tortoises can be placed into MU-3, resulting in a final tortoise density of between 3 to 4 animals per acre. Likewise, MU-4 can accept 28 to 39 animals with a resultant density in the same range of 3 to 4 tortoises per acre. Between 16 to 24 tortoises can be relocated into MU-6, resulting in a final density of between 3 to 4 animals per acre.

Management Units 7, 8, and 10 require management actions prior to tortoise relocation to enhance habitat suitability. The most efficient way to effectively increase the capacity of the NSCA to receive tortoises would be to manage the vegetation in MU-7 and MU-8. This would allow an additional 82 to 105 tortoises to be relocated onto those two areas.

Future study of the easternmost corner of the NSCA, where high elevation and coarse sand potentially indicate more high quality habitat, may reveal additional available capacity for relocating tortoises there. Analysis of the soil characteristics to estimate the depth to water table is recommended for MU's 3, 4, 7, 8, and 10 prior to relocating tortoises in these areas.

BACKGROUND

Indian River Land Trust is an active participant in the Indian River Gopher Tortoise Coalition, and is interested in fostering conservation of tortoises and their habitats. To achieve those ends, the Land Trust contracted with David Cox Consulting, LLC and CivaTerra, Inc. to provide the County with an initial assessment of potential gopher tortoise habitat in selected areas of the North Sebastian Conservation Area so those areas might be used as receiving sites for relocated gopher tortoises.

INTRODUCTION

The North Sebastian Conservation Area (NSCA) is located at the northeast corner of the City of Sebastian, and includes about 407 acres of uplands and wetlands, as shown in Figure 1. The parcels that comprise the NSCA were purchased by Indian River County during 1995-1999, with the primary goals being to preserve native vegetation areas, especially scrub, serving as core habitat of the Florida Scub Jay (*Aphelocoma coerulescens coerulescens*) and the gopher tortoise (*Gopherus polyphemus*).

Habitat requirements of gopher tortoises include well-drained, loose soil of sufficient depth for burrows (Landers and Speake, 1980; McRae *et al.*, 1981; Auffenberg and Franz, 1982; Diemer, 1986), and suitable herbaceous cover (Auffenberg and Iverson, 1979; Garner and Landers, 1981). However, there is no simple, one-to-one correlation, much less causal relationship, between soil type and vegetation, soil type and tortoise abundance, or for that matter, between vegetation type and tortoise abundance.

Eight soil types occur within the NSCA (see Figure 2): Immokalee fine sand; St. Lucie sand; Pomello sand; Astatula sand; Satellite fine sand; Myakka fine sand; Pompano fine sand; and Arents. Immokalee fine sand, Pompano fine sand and Myakka fine sand are poorly-drained soils, the last typical of depressional wetlands. Pomello sand, St. Lucie sand, and Astatula sand soils all typically support sand pine scrub or sand pine forest, while Satellite fine sand soils typically underlay scrubby flatwoods (Wettstein *et al.*, 1987). Arents soil consists of fill material dug from several different areas that have different kinds of soils. Arents soil is typical of urban development, although it can support natural vegetation typical of adjacent areas. Topographic relief on NSCA ranges from approximately 16 to 23 feet.

Table I presents the minimum depth to the water table for each of the soil types within the NSCA (Wettstein *et al.*, 1987). The values are typical “for most years, under natural conditions,” and are not intended to replace more precise field measurements. Gopher tortoises end their burrows in the upper groundwater table, and this microhabitat provides necessary moisture and relative humidity, subject to the constraint of potential flooding.

Soil Type	Minimum Depth to Water Table (inches)
Arents	24
Astatula	72
Immokalee	< 10
Myakka	0
Pomello	32
Pompano	10
Satellite	21
St. Lucie	72

TABLE I. Minimum depth to water table in inches for each soil type within the North Sebastian Conservation Area (data from Wettstein *et al.*, 1987).

A mosaic of natural vegetation covers the NSCA, and 12 community types (as classified by Florida Natural Areas Inventory, 2000) have been described for the site in the *Management Plan for the North Sebastian Conservation Area* (2001). Active management since acquisition of the NSCA has extensively altered the vegetation. Currently, scrub (including both oak scrub and sand pine scrub), and pine flatwoods (including wet, mesic, and scrubby flatwoods) are the major upland communities, with seasonally flooded freshwater marshes and mixed wetland forest interspersed within this upland matrix.

Scrub on NSCA has a dense shrub layer dominated by myrtle oak (*Quercus myrtifolia*), and sand live oak (*Q. geminata*) on drier sites, and by these oaks and saw palmetto (*Serenoa repens*) on wetter sites. Areas previously described as sand pine scrub or sand pine forest retain scattered smaller sand pine (*Pinus clausa*), along with scrub oaks, palmettos, and ericaceous shrubs. Revegetation following management of these sand pine areas, and of the mesic flatwoods, by scrub species has resulted in scrub that appears different from scrub in both the relative abundance of scrub plants and vegetational structure (Breininger and Schmalzer, 1990).

It is often assumed that animals prefer higher quality habitat and then it is inferred that density decreases from more suitable to less suitable sites (Andrewartha and Birch, 1954; Wynne-Edwards, 1962). This is not always true, and better measures of habitat quality include demographic parameters like survival and reproductive success (Van Horne, 1983; Breininger *et al.*, 1995). Likewise, focusing on within patch attributes as indicators of habitat quality, like amount of herbaceous cover available to tortoises, may be misleading if nearby areas, like marshes, provide abundant food resources (Breininger *et al.*, 1994).

Our goal in this study was to provide an initial assessment of adult gopher tortoise (*Gopherus polyphemus*) densities within the North Sebastian Conservation Area in order to evaluate the site suitability for receiving relocated tortoises. The assessment of juvenile

and hatchling gopher tortoise densities, and estimation of tortoise demographics must await future study.

METHODS

We conducted an initial assessment of adult tortoise densities on areas within NSCA according to the protocol recommended for tortoise relocations and described in Appendix 8 of Draft 2 Gopher Tortoise Management Plan, released by the Florida Fish and Wildlife Conservation Commission (FFWCC or FWC) on May 7, 2007.

A 3-pronged approach is recommended to identify potential recipient sites: 1.) remote sensing to identify potential tortoise habitat; 2.) initial rough assessment to identify areas with low tortoise densities in apparently good habitat; and 3.) verification of low densities via more intensive surveys. In this study, we report on the first two stages of site characterization for all surveyed habitat patches; characterization of a single patch, Management Unit 1, was carried through all three recommended steps.

FWC currently recommends counting all burrows that are identifiable as being dug by a gopher tortoise, and not recording burrow size classes or status categories, such as active, inactive, and abandoned. Burrow counts are now to be combined for the purpose of density estimation. On the basis of extensive surveys in various habitats throughout Florida, Ashton and Ashton (*in press*) found an overall occupancy rate of 50% (i.e., 2 burrows per tortoise) for active, inactive, and abandoned burrows combined. Hence, FWC now recommends the simple conversion factor of 1 tortoise for every 2 identifiable tortoise burrows, rather than the old 0.614 conversion factor described by Auffenberg and Franz (1982).

Briefly, habitat patches were included for survey on the basis of prior site knowledge, conversations with the land manager, and careful aerial photo-interpretation. Patches of interest (here referred to as “Management Units” or MU’s) were surveyed by belt transects 6 m (20 ft) wide x 250 m (820 ft) long, or approximately 0.37 acre in area. In smaller MU’s, transect length was adjusted to remain within the patch. A single person walked the centerline of the transect, using a GPS unit or compass to navigate, and recorded all burrows observed within 3 m (about 10 ft) on either side of the centerline. In especially dense, obstructing vegetation, burrow detectability was significantly decreased. In these cases, the belt-transect width was decreased, and area sampled adjusted either by lengthening transect or performing additional transects. The centerlines of all transects were separated by at least 20 m to avoid overlap. At least fifteen percent of the area of a habitat patch was surveyed, and areas of patches were estimated by GIS-spatial analysis of georeferenced photos. Fieldwork for this study spanned January – April, 2007.

Tortoise densities were calculated per acre for each patch or Management Unit. For the purpose of mapping, Management Units were assigned to one of five tortoise density categories that encompass the range of observed densities.

In the case of Management Unit 1, in the northeast corner of the NSCA, intensive surveys of tortoise densities were conducted. The entire area of MU-1 was surveyed by a team of trained personnel, and all burrows were marked and located using GPS.

In the course of surveying NSCA for tortoise burrows, several characteristics of sites were systematically observed and noted, for example: extent of canopy cover; height and density of shrub layer; extent of sandy, open areas; presence of herbaceous cover; proximity to marsh; presence of edges or ecotones.

RESULTS

The location and size of Management Units surveyed within NSCA are shown in Figure 3. The soil types of Management Units are presented in Figure 4. Gopher tortoise burrows were found in all MU's surveyed, and the density of tortoises in each is given in Table I and shown on an aerial photo in Figure 5.

	MANAGEMENT UNITS									
	1	2	3	4	5	6	7	8	9	10
Size (Acres)	11.8	14.4	4.1	11.9	9.6	8.6	18.8	13.2	8.1	3.0
Tortoise Density (tortoises per acre)	2.2	3.0	1.25	0.66	3.5	1.1	0.8	0.63	5.63	1.25

TABLE II. North Sebastian Conservation Area Management Units size and estimated gopher tortoise density (tortoises per acre).

Tortoise densities range from under one per acre (MU's 4, 7 and 8) to more than 5.6 per acre (MU-9). For simple visualization, this range of densities has been assigned to 5 density classes, and then shaded accordingly in Figure 5. MU-4, MU-7, and MU-8 have tortoise densities less than one individual per acre, while MU-3, MU-6, and MU-10 tortoise densities are slightly above one per acre. Four Management Units have tortoise densities greater than 2 individuals per acre: MU-1 is close to 2; MU-2 is 3; MU-5 is 3.5; and MU-9 is 5.6 tortoises per acre.

Gopher tortoise densities are shown in relation to soil type and minimum depth to water table in Figure 6. Inspection of this map suggests a possible relationship of tortoise density with minimum depth to water table. Further investigation is needed to determine the nature and extent of this possibility. Also, note that some soil types present within the NSCA were excluded by this study.

Figure 7 presents the locations of all tortoise burrows in Management Unit 1. It can be seen that burrows are concentrated in the northern portion of this patch, as well as along its edges, especially along the northern fenceline where there is a fire-break/trail with an associated berm.

CONCLUSIONS

We report an initial assessment of adult gopher tortoise (*Gopherus polyphemus*) densities within the North Sebastian Conservation Area. Tortoise densities vary over the entire site from less than one individual per acre (MU-4, MU-7, and MU-8) to 5.6 per acre (MU-9). Tortoise densities in the range of 2 to 4 animals per acre are common within the NSCA.

Our results indicate that MU-1, MU-2, MU-3, MU-4, MU-5, MU-6, and MU-10 contain potential high-quality tortoise habitat. These patches of potential tortoise habitat are likely to be suitable restocking sites with minimal management required prior to relocation. Management Units 7, 8, and 10 require management actions prior to tortoise relocation to enhance habitat suitability. Currently, five MU's possess limited potential for restocking, either because they already support capacity levels of 3 to 4 tortoises per acre (MU-2, MU-5, and MU-9), or because they contain unsuitable habitat (MU-7, and part of MU-8).

Our results further indicate NSCA has suitable potential tortoise habitat to accept relocated tortoises. The total number of gopher tortoises that can currently be relocated onto the site based on unused capacity in MU-1, MU-3, MU-4, and MU-6 is between 61 to 94 animals, resulting in a tortoise density of either 3 or 4 animals per acre, respectively. We recommend restocking MU-1 initially, and estimate that an additional 10 to 20 tortoises can be relocated on this site without requiring prior land management actions. Such relocation would result in a tortoise density of between 3 to 4 animals per acre, which is within the observed range of densities supported within NSCA.

Similarly, MU-3, MU-4, and MU-6 are recommended tortoise relocation sites having high quality habitat requiring no prior enhancement actions. An additional 7 to 11 tortoises can be placed into MU-3, resulting in a final tortoise density of between 3-4 animals per acre. Likewise, MU-4 can accept 28 to 39 animals with a resultant density in the same range of 3 to 4 tortoises per acre. Between 16 to 24 tortoises can be relocated into MU-6, resulting in a final density of between 3 to 4 animals per acre.

Management Units 7, 8, and 10 require management actions prior to tortoise relocation to enhance habitat suitability. The most efficient way to effectively increase the capacity of the NSCA to receive tortoises would be to manage the vegetation in MU-7 and MU-8. This would allow an additional 82 to 105 tortoises to be relocated onto those two areas.

Management Units proposed as tortoise receiving sites have sufficient herbaceous forage and open, sandy areas for burrows. However, additional soil analysis to estimate more precisely the depth to water table is recommended prior to relocating tortoises, especially for MU's 3, 4, 7, 8, and 10. We also recommend future study of the easternmost corner of the NSCA, where high elevation and coarse sand potentially indicate more high quality habitat, and may reveal additional available capacity for relocating tortoises there.

The North Sebastian Conservation Area contains habitat patches suitable for receiving relocated gopher tortoises. Tortoise relocations will be regulated by FWC, and will provide an important element in future conservation efforts of this declining species.

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