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Annotated Bibliography of Selected Literature on the USF Forest Preserve

May 2021

Abd-Elrahman, A. H., Thornhill, M. E., Andreu, M. G., & Escobedo, F. (2010). A community-based urban forest inventory using online mapping services and consumer-grade digital images. *International Journal of Applied Earth Observation and Geoinformation*, *12*(4), 249–260. https://doi.org/10.1016/j.jag.2010.03.003

Community involvement in gathering and submitting spatially referenced data via web mapping applications has recently been gaining momentum. Urban forest inventory data analyzed by programs such as the i-Tree ECO inventory method is a good candidate for such an approach. In this research, we tested the feasibility of using spatially referenced data gathered and submitted by non-professional individuals through a web application to augment urban forest inventory data. We examined the use of close-range photogrammetry solutions of images taken by consumer-grade cameras to extract quantitative metric information such as crown diameter, tree heights and trunk diameters. Several tests were performed to evaluate the accuracy of the photogrammetric solutions and to examine their use in addition to existing aerial image data to supplement or partially substitute for standard i-Tree ECO field measurements. Digital images of three sample sites were acquired using different consumer-grade cameras. Several photogrammetric solutions were performed using the acquired image sets. Each model was carried out using a relative orientation process followed by baseline model scaling. Several distances obtained through this solution were compared to the corresponding distances obtained through direct measurements in order to assess the quality of the model scaling approach. Measured i-Tree ECO field plot inventory data, online aerial image measurements and photogrammetric observations were compared. The results demonstrate the potential for using aerial image digitizing in addition to ground images to assist in participatory urban forest inventory efforts.

Associations among ground-surface spiders (Araneae) and other arthropods in mesic flatwoods on JSTOR. (n.d.). Retrieved April 27, 2021, from https://www-jstor-org.ezproxy.lib.usf.edu/stable/23268547?seq=1#metadata_info_tab_contents

Mesic flatwoods in Florida are increasingly threatened by anthropogenic activities, and although they are known to be important for many species of macrofauna, little is known of the arthropod assemblages that inhabit them. As arthropods can be utilized as indicator taxa, we characterized the assemblages of ground-surface spiders (Araneae) and other arthropods at 2 mesic flatwood sites in

Hillsborough County, Florida, and used the Chao 2, ICE (incidence-based coverage estimator), and Michaelis-Menten means species richness estimators to extrapolate the true species richness of ground-surface spiders. Sampling was conducted over a 4-month period at the sites using pitfall traps, with spiders being identified to the level of genus or species, and other arthropods to the level of order. We identified 31 spider species from 27 genera in 12 families, with Lycosidae being the dominant spider family at both sites. However, Collembola and Formicidae were the most abundant arthropod taxa. Ground-surface spiders were not strongly associated with any typical prey groups, indicating that environmental factors might also be important in structuring this community. Our results indicate that more intensive sampling of these habitats would be required to comprehensively sample and identify all of the species present, but from a management perspective, our results appear to be relatively consistent with previous surveys elsewhere.

Bell, S. S., McCoy, E. D., & Mushinsky, H. R. (2012). *Habitat structure: The physical arrangement of objects in space*. Springer Science & Business Media.

We conceived the idea for this book after teaching a graduate seminar on "Habitat Complexity" at The University of South Florida. Discussions during the seminar led us to conclude that similar goals were to be found in studies of the topic that spanned the breadth of ecological research. Yet, the exact meaning of "habitat structure", and the way in which it was measured, seemed to differ widely among subdisciplines. Our own research, which involves several sorts of ecology, convinced us that the differences among subdisciplines were indeed real ones, and that they did inhibit communication. We decided that interchange of ideas among researchers working in marine ecology, plant-animal interactions, physiological ecology, and other more-or-less independent fields would be worthwhile, in that it might lead to useful generalizations about "habitat structure". To foster this interchange of ideas. we organized a symposium to attract researchers working with a wide variety of organisms living in many habitats, but united in their interest in the topic of "habitat structure". The symposium was held at The University of South Florida's Chinsegut Hill Conference Center, in May. 1988. We asked participants to think about "habitat structure" in new ways; to synthesize important, but fragmented, information; and. perhaps. to consider ways of translating ideas across systems. The chapters contained in this book reflect the participants' attempts to do so. The book is divided into four parts, by major themes that we have found useful categorizations.

Cicchetti, G., & Greening, H. (2011). Estuarine biotope mosaics and habitat management goals: An application in Tampa Bay, FL, USA. *Estuaries and Coasts*, *34*(6), 1278–1292. https://doi.org/10.1007/s12237-011-9408-

SEP Many types of anthropogenic stress to estuaries lead to destruction and conversion of habitats, thus altering habitat landscapes and changing the "arena" in which the life history interactions of native fauna take place. This can lead to decreased populations of valued fauna and other negative consequences. The Tampa Bay Estuary Program (TBEP) pioneered a system-wide management framework that develops estuarine habitat restoration and protection goals based on supporting estuarine-dependent species and the habitat landscapes they require (for example, the extent of seagrass beds, mangrove forests, oyster reefs, or oligohaline marshes) within an estuary. We describe this framework and provide related statistics as methods to help managers set system-wide ecological goals using larger conceptual approaches that are easily communicated to stakeholders and the public; we also discuss applications of the approach to existing and evolving paradigms of estuarine management. The TBEP and partners used this framework to combine a simple and unifying vision with a diverse and complex set of management tools, resulting in greatly improved environmental conditions within Tampa Bay.

Dinh, E. T. N., & Novak, R. J. (2018). Diversity and abundance of mosquitoes inhabiting waste tires in a subtropical swamp in urban Florida. *Journal of the American Mosquito Control Association*, *34*(1), 47–49. https://doi.org/10.2987/17-6689.1

Automobile tires discarded in urban forest fragments may be a public health hazard, as they can support a population of vector mosquitoes. However, little is known about what factors may affect mosquito abundance and diversity within waste tires in a freshwater wetland forest. This study aimed to determine whether mosquito population dynamics in this environment in Florida differed over a year due to the site of collection and variation in vegetation greenness and elevation. We constructed negative binomial regression models to determine which of these characteristics were significant ($\alpha = 0.05$) in affecting mosquito count data. Our findings suggest that in this specific environment, none of the covariates scrutinized had significant impacts on modulating overall mosquito and Aedes albopictus (the dominant species) abundance; waste tire habitats in urban freshwater wetland forests may be a year-round public health hazard.

Ford, C. R. F. R., Minor, E. S. M. S., & Fox, G. A. F. A. (2010). Long-term effects of fire and fire-return interval on population structure and growth of longleaf pine (Pinus palustris). *Canadian Journal of Forest Research*. https://doi.org/10.1139/X10-080

We investigated the effect of fire and fire frequency on stand structure and longleaf pine (Pinus palustris P. Mill.) growth and population demography in an experimental research area in a southwest Florida sandhill community. Data were collected from replicated plots that had prescribed fire-return intervals of 1, 2, 5, or 7 years or were left un-burned. Experimental treatment burns have been ongoing since 1976. Plots were sampled to estimate species distribution, stand structure, and longleaf pine density in four developmental stage classes: grass, bolting, small tree, and large tree. Tree-ring growth measurements in combination with burn history were used to evaluate the effects of fire and fire-return interval on basal area increment growth. Fire-return interval impacted stand structure and longleaf pine population structure. Our results suggest that recruitment from the bolting stage to later stages may become adversely affected with very frequent fires (e.g., every 1 or 2 years). Although adult tree productivity was negatively impacted during fire years, tree growth during years between fire events was resilient such that growth did not differ significantly among fire-return intervals. Our study shows that the longleaf pine population as a whole is strongly regulated by fire and fire-return interval plays a key role in structuring this population.

Kaczor, S.A., & Hartnett, D.C. (1990). Gopher tortoise (Gopherus polyphemus) effects on soils and vegetation in a Florida sandhill community. *The American Midland Naturalist, 123*(1):100-111. Retrieved April 27, 2021, from https://www-jstor-org.ezproxy.lib.usf.edu/stable/2425763?seq=1#metadata_info_tab_contents
Burrowing and mound-building activities of gopher tortoises generated significant environmental heterogeneity in an oak-pine sandhill forest in Florida. Mounds were characterized by lower soil nutrient and organic matter concentrations, higher light intensities and greater diurnal temperature fluctuations than adjacent undisturbed areas. Temperatures during prescribed spring fires were significantly lower on mounds and near burrow openings relative to the surrounding undisturbed vegetation. Changes in plant species composition and relative abundances between recently abandoned mounds, old mounds and undisturbed areas indicated that mounds undergo microsuccession and contribute toward increased plant species diversity in the forest understory. Old mounds had the highest species richness per unit area. Mound size had no effect on plant population dynamics or community structure. Gopher tortoise disturbances increased the frequency of recruitment by seed relative to vegetative reproduction in the common rhizomatous forb, Pityopsis graminifolia.

Gov, R. (2015). *Patterns in the presence of respiratory tract mycoplasmas in four species of North American tortoises* [Thesis]. https://scholarworks.unr.edu//handle/11714/542

There are two known pathogens Mycoplasma agassizii and M. testudineum that cause upper respiratory tract disease (URTD) in some species of tortoises. Here, we sought to determine the presence and frequency of these bacteria among four North American tortoise species: Gopherus polyphemus (gopher tortoise), G. berlandieri (Texas tortoise),G. morafkai (Sonoran desert tortoise), and G. agassizii (Mojave desert tortoise) in populations that were sampled in three replicate sites. We assessed the presence of mycoplasmas using quantitative polymerase chain reactions (qPCR) on DNA extractions from nasal flushes. The qPCR process showed that both Mycoplasma pathogens were present in the four species of tortoises. Statistical analyses indicated that "species" and "sample site" were significantly associated with the presence of M. agassizii, while only site was significant for the presence of M. testudineum. The Mojave desert tortoise populations had the greatest frequency (70%) of M. agassizii, and Texas tortoise populations had the greatest percentage (31%) of M. testudineum. Variation among sites for M. agassizii was extreme (0% - 88%), but variance was not as prominent for M.testudineum (0% - 53%). Additionally, the presence of mycoplasmas in the nasal cavity was not a significant predictor for clinical signs of URTD. We conclude that collecting samples from more sites could have led to different conclusions, and including additional sites would allow for a better picture of current pathogen-tortoise interactions. We also recommend including climate data and population density in future analyses. Additionally, we suggest rerecording clinical signs of URTD of the tortoises after eight weeks from the initial nasal lavage and recording because appearance of clinical signs of the disease may not show for eight weeks in tortoises (Guthrie et al., 2013).

Halstead, B. J., McCoy, E. D., Stilson, T. A., & Mushinsky, H. R. (2007). Alternative foraging tactics of juvenile gopher tortoises (Gopherus polyphemus) examined using correlated random walk models. *Herpetologica*, *63*(4), 472–481. https://doi.org/10.1655/0018-0831(2007)63[472:AFTOJG]2.0.CO;2

Most animals forage under the risk of predation. An animal may balance the benefits gained from obtaining adequate nutritious forage with the risk of falling prey to a predator by employing alternative, adaptive foraging tactics. We examined the foraging tactics employed by a central place forager, Gopherus polyphemus, as it foraged away from a refuge. We directly observed foraging paths of juvenile G. polyphemus and analyzed them using correlated random walk models. We also compared the sinuosity of foraging paths to the sinuosity of an optimal central place forager. Observed net squared displacement was greater than expected for outbound foraging paths and inbound return paths, but these paths could not be distinguished statistically from a correlated random walk. Sinuosity was less than expected for an optimal central place

forager. Juvenile tortoises direct movement away from their burrows while foraging. Juveniles may give up the security of remaining near their burrows to forage until satiation.

Hayden, J., & Dickel, T. S. (2015). A new Antaeotricha species from Florida sandhills and scrub (Lepidoptera, Depressariidae, Stenomatinae). *ZooKeys*, *533*, 133–150. https://doi.org/10.3897/zookeys.533.6004
Antaeotricha floridella sp. n. is described and diagnosed from the closely similar *Antaeotricha albulella* (Walker). The species is distributed in xeric sandhill and scrub habitats in peninsular Florida, USA, and larvae feed on *Quercus* species. Keys are given for pale-winged *Stenomatinae* and similar *Gelechioidea* based on external characters and genitalia.

Haymes, K. L., & Fox, G. A. (2012). Variation among individuals in cone production in Pinus palustris (Pinaceae). *American Journal of Botany*, *99*(4), 640–645. https://doi.org/10.3732/ajb.1100339
 Premise of the study: Reproductive output varies considerably among individuals within plant populations, and this is especially so in cone production of conifers. While this variation can have substantial effects on populations, little is known about its magnitude or causes. • Methods: We studied variation in cone production for 2 years within a population of Pinus palustris Mill. (longleaf pine; Pinaceae). Using hurdle models, we evaluated the importance of burn treatments, tree size (dbh), canopy status (open, dominant, subordinate), and number of conspecific neighbors within 4 m (N4). • Key results: Cone production of individuals—even after accounting for other variables—was strongly correlated between years. Trees in plots burned every 1, 2, or 5 years produced more cones than those burned every 7 years, or unburned. Larger trees tend to produce more cones, but the large effects of the other factors studied caused substantial scatter in the dbh-cone number relationship. Among trees in the open, dbh had little explanatory power. Subordinate trees with three neighbors produced no cones. • Conclusions: Tree size alone was a weak predictor of cone production. Interactions with neighbors play an important role in generating reproductive heterogeneity, and must be accounted for when relating cone production to size. The strong between-year correlation, together with the large variance in cone production among trees without neighbors, suggests that still more of the variance may be explainable, but requires factors outside of our study.

Jackson, K., Brooks, G. R., & Larson, R. A. (2021). Of marsh and mangrove: Coupled biophysical and anthropogenic drivers of 20th century wetland conversion in Tampa Bay Estuary, Florida (USA). *Anthropocene*, 100295. https://doi.org/10.1016/j.ancene.2021.100295

Dense mangrove swamps currently dominate tidal wetlands of the Tampa Bay Estuary System on the central peninsular Gulf Coast of Florida (USA). Late-19th century Coast and Geodetic Survey topographical charts and Government Land Office surveys, however, depict wetland systems dominated by salt marsh—therefore suggesting mangrove dominance as a product of 20th century encroachment. To clarify the primary drivers of ecosystem change, this study integrates sedimentological, paleobotanical, and radiometric analyses of sediment cores collected in 2018 with analyses of aerial photography taken between 1940 and 1997. Results empirically ground truth the wetland conversions inferred through analytical comparisons of historical and modern mapping and establish a high-resolution chronology for coastal environmental change. These results showed that salt marsh and salt prairie habitats persisted within Tampa Bay study areas until the mid-20th century. Mangrove forest rapidly encroached the study areas over a 20 year interval, between 1960 and 1980, immediately following intensive ditching for mosquito control. The findings demonstrate how coastal geoengineering, mangrove autoecology, and sea-level rise interacted across the late-20th century to accelerate the creation of novel seascapes.

Jennings, D. E., Edwards, G. B., & Rohr, J. R. (2012). Associations among ground-surface spiders (Araneae) and other arthropods in mesic flatwoods. *The Florida Entomologist*, *95*(2), 290–296. Mesic flatwoods in Florida are increasingly threatened by anthropogenic activities, and although they are known to be important for many species of macrofauna, little is known of the arthropod assemblages that inhabit them. As arthropods can be utilized as indicator taxa, we characterized the assemblages of ground-surface spiders (Araneae) and other arthropods at 2 mesic flatwood sites in Hillsborough County, Florida, and used the Chao 2, ICE (incidence-based coverage estimator), and Michaelis-Menten means species richness estimators to extrapolate the true species richness of ground-surface spiders. Sampling was conducted over a 4-month period at the sites using pitfall traps, with spiders being identified to the level of genus or species, and other arthropods to the level of order. We identified 31 spider species from 27 genera in 12 families, with Lycosidae being the dominant spider family at both sites. However, Collembola and Formicidae were the most abundant arthropod taxa. Ground-surface spiders were not strongly associated with any typical prey groups, indicating that environmental factors might also be important in structuring this community. Our results indicate that more intensive sampling of these habitats would be required to comprehensively sample and identify all of the species present, but from a management perspective, our results appear to be relatively consistent with previous surveys elsewhere.

Jennings, D. E., Krupa, J. J., Raffel, T. R., & Rohr, J. R. (2010). Evidence for competition between carnivorous plants and spiders. *Proceedings of the Royal Society B: Biological Sciences*, *277*(1696), 3001–3008. https://doi.org/10.1098/rspb.2010.0465

Several studies have demonstrated that competition between disparate taxa can be important in determining community structure, yet surprisingly, to our knowledge, no quantitative studies have been conducted on competition between carnivorous plants and animals. To examine potential competition between these taxa, we studied dietary and microhabitat overlap between pink sundews (Drosera capillaris) and wolf spiders (Lycosidae) in the field, and conducted a laboratory experiment examining the effects of wolf spiders on sundew fitness. In the field, we found that sundews and spiders had a high dietary overlap with each other and with the available arthropod prey. Associations between sundews and spiders depended on spatial scale: both sundews and spiders were found more frequently in quadrats with more abundant prey, but within quadrats, spiders constructed larger webs and located them further away from sundews as the total sundew trapping area increased, presumably to reduce competition. Spiders also constructed larger webs when fewer prey were available. In the laboratory, our experiment revealed that spiders can significantly reduce sundew fitness. Our findings suggest that members of the plant and animal kingdoms can and do compete.

Karl, S. A., & Wilson, D. S. (2001). Phylogeography and systematics of the mud turtle, Kinosternon baurii. *Copeia*, *2001*(3), 797–801. https://doi.org/10.1643/0045-8511(2001)001[0797:PASOTM]2.0.CO;2

Mitochondrial control region DNA sequence data were examined to determine levels and patterns of variation in 36 striped mud turtles, Kinosternon baurii, from 10 geographic locations across the species' range. Levels of sequence divergence were low, and 20 variable sites defined 18 haplotypes. Although unique haplotypes were found at most locations, several haplotypes were distributed rangewide. In particular, the putatively isolated population of the lower Florida Keys did not significantly differ genetically from the upper Florida Keys or mainland populations. Based on our analysis of 415 bp, the lower Florida Keys population either is not isolated or is very recently isolated from the remainder of the range. The lower Florida Keys population is classified as endangered by the Florida Fish and Wildlife Conservation Commission and extirpation of this population through loss of habitat seems likely. Efforts to protect suitable habitat for K. baurii, however, may increase the risk of extinction of other endangered species, such as the Key deer (Odocoileus virginianus clavium).

McCoy, E. D., & Kaiser, B. W. (1990). Changes in foraging activity of the southern harvester ant Pogonomyrmex badius (Latreille) in response to fire. *The American Midland Naturalist*, *123*(1), 112–123. https://doi.org/10.2307/2425764

The southern harvester ant Pogonomyrmex badius (Latreille) is common in the sandhill habitat of Florida, a habitat strongly influenced by fire. We documented changes in foraging activity of the ant in response to a planned burn in an area of sandhill. Measurements related to foraging activity were made several times before and after burning: number of foraging trunks and direction and length of each trunk, to estimate foraging area; number of individuals emerging from colony entrances; number of individuals outside colony entrances; number of individuals engaged in foraging; and number of items returned to colonies. Only number of individuals emerging from colony entrances and foraging area changed in response to the burn: both increased. We suggest that ecological conditions in the plots, namely the unfavorable ambient conditions often present and the low densities of colonies, in large part dictated the way in which foraging activity could change after the burn. The changes observed may be a general response of the southern harvester ant to changes in resource availability; however, other causes, such as alteration of physical structure in the vicinity of colonies, may underlie changes in foraging activity and these need to be examined.

McCoy, Earl D., Basiotis, K. A., Connor, K. M., & Mushinsky, H. R. (2013). Habitat selection increases the isolating effect of habitat fragmentation on the gopher tortoise. *Behavioral Ecology and Sociobiology*, *67*(5), 815–821. https://doi.org/10.1007/s00265-013-1505-x

Habitat selection requires choice, which differentiates it from habitat use, and choice, in turn, is dependent upon the responses of organisms to the environmental, social, and other cues that they perceive. Habitat selection by the gopher tortoise (Gopherus polyphemus) was investigated by translocating tortoises and monitoring their movements within two sites in central Florida. The first site supported a stable preponderance of high-quality habitat, and tortoises avoided areas with a dense tree canopy cover caused by fire exclusion. The second site was badly invaded by an introduced weed, and tortoises avoided areas where the weed had formed a dense monoculture. At both sites, individuals appeared to be responding to visual cues to avoid areas that were relatively dark. In landscapes with relatively large amounts of high-quality habitat, this avoidance behavior serves the gopher tortoise well by keeping individuals within the dominant habitat type. In degraded areas, high-quality habitat often becomes increasingly uncommon, and the avoidance behavior exhibited by the tortoises will result in individuals becoming confined to small patches, causing a significant reduction in fitness and hence questioning their long-term survival in such

areas. The results from our study show that in order to maintain viable tortoise populations in areas increasingly subjected to human fragmentation and degradation, it is crucial not only to suppress tree canopy cover continually and prevent invasion by exotic weeds, but also to be mindful that the avoidance behavior of the gopher tortoise could prevent individuals from fully occupying a high-quality habitat in response to restoration and management efforts.

McCoy, Earl D., & Mushinsky, H. R. (2007). Estimates of minimum patch size depend on the method of estimation and the condition of the habitat. *Ecology*, *88*(6), 1401–1407. https://doi.org/10.1890/06-1188

Minimum patch size for a viable population can be estimated in several ways. The density–area method estimates minimum patch size as the smallest area in which no new individuals are encountered as one extends the arbitrary boundaries of a study area outward. The density–area method eliminates the assumption of no variation in density with size of habitat area that accompanies other methods, but it is untested in situations in which habitat loss has confined populations to small areas. We used a variant of the density–area method to study the minimum patch size for the gopher tortoise (Gopherus polyphemus) in Florida, USA, where this keystone species is being confined to ever smaller habitat fragments. The variant was based on the premise that individuals within populations are likely to occur at unusually high densities when confined to small areas, and it estimated minimum patch size as the smallest area beyond which density plateaus. The data for our study came from detailed surveys of 38 populations of the tortoise. For all 38 populations, the areas occupied were determined empirically, and for 19 of them, duplicate surveys were undertaken about a decade apart. We found that a consistent inverse density–area relationship was present over smaller areas. The minimum patch size estimated from the density–area relationship was at least 100 ha, which is substantially larger than previous estimates. The relative abundance of juveniles was inversely related to population density for sites with relatively poor habitat quality, indicating that the estimated minimum patch size could represent an extinction threshold. We concluded that a negative density–area relationship may be an inevitable consequence of excessive habitat loss. We also concluded that any detrimental effects of an inverse density–area relationship may be exacerbated by the deterioration in habitat quality that often accompanies habitat loss. Finally, we concluded that the value of any estimate of minimum patch size as a conservation tool is compromised by excessive habitat loss.

McCoy, Earl D., Mushinsky, H. R., & Lindzey, J. (2006). Declines of the gopher tortoise on protected lands. *Biological Conservation*, *128*(1), 120–127. https://doi.org/10.1016/j.biocon.2005.09.021

We compared two assessments of the status of gopher tortoise populations at 10 protected sites in Florida, taken about a decade apart. We assessed status indirectly, using surveys of burrows along belt transects. Transect placement and timing were identical between surveys. We compared numbers of burrows, relative numbers of burrows of different activity conditions, and size distributions of burrows between surveys. The comparisons indicated that populations had declined at as many as eight of the sites. We found no strong connection between population decline and decline in habitat quality, as reflected in decreased ground cover and/or increased canopy cover between surveys. The response of a population to decline in habitat quality may depend on initial habitat structure, the degree of change in habitat structure, the period of time over which change is measured, the amount of habitat involved, and the level of habitat management.

McCoy, Earl D., Mushinsky, H. R., & Lindzey, J. (2007). Conservation strategies and emergent diseases: The case of upper respiratory tract disease in the gopher tortoise. *Chelonian Conservation and Biology*, *6*(2), 170. https://doi.org/10.2744/1071-8443(2007)6[170:CSAEDT]2.0.CO;2
We obtained demographic data on more than 60 gopher tortoise (*Gopherus polyphemus*) populations in Florida before the emergence of upper respiratory tract disease (URTD). We later resurveyed 10 populations to compare demographic profiles at sites where antibodies to *Mycoplasma agassizii* were detected subsequently and at sites where they were not. We screened for antibodies and checked for potential biases in studying URTD by determining whether individuals caught above ground were representative of a population as a whole and whether the probability of detection of seropositive (plus serologically suspect) individuals is a function of sample size. Some sites with no indication of decline had relatively high percentages of seropositive individuals, and some sites exhibiting substantial population decline had no or low percentages of seropositive individuals; therefore, our results do not unambiguously implicate the presence of URTD in the population declines. Seropositive individuals occurred at 4 sites not known previously to have them; therefore, our results indicate that exposure to *Mycoplasma agassizii* has been more widespread than heretofore suspected. The percentage of individuals determined to be seropositive (plus suspect) tends to be related positively to number of individuals tested and the sizes of individuals caught above ground were not always expected from the size distribution of a population; therefore, our results indicate that sampling method can influence the estimate of percentage of seropositive individuals in the population. We suggest that the simplistic conservation response that we have taken to the emergence of URTD may need to be reconsidered and that maintaining or creating conditions necessary to minimize the chance of

re-emergence of URTD, to prevent URTD from reaching epidemic proportions, and to allow populations to recover from URTD is important.

Moon, J. C., McCoy, E. D., Mushinsky, H. R., & Karl, S. A. (2006). Multiple paternity and breeding system in the gopher tortoise, Gopherus polyphemus. *Journal of Heredity*, *97*(2), 150–157. https://doi.org/10.1093/jhered/esj017

Little is known about the reproductive behaviors and the actual outcomes of mating attempts in the gopher tortoise (Gopherus polyphemus). We examined the mating system and reproductive behaviors of a population of gopher tortoises in central Florida. Using microsatellite markers, we assigned fathers to the offspring of seven clutches and determined that multiple fathers were present in two of the seven clutches examined. We found that gopher tortoises exhibited a promiscuous mating system with larger males fertilizing the majority of clutches. The advantage of larger males over smaller males in fertilizing females may be a result of larger males winning access to females in aggressive bouts with other males or larger males may be more attractive to females. Clutches produced by larger females tended to be sired by a single male, whereas clutches of smaller females tended to be sired by multiple males.

Mushinsky, H. R., & Gibson, D. J. (1991). The influence of fire periodicity on habitat structure. In Susan S. Bell, E. D. McCoy, & H. R. Mushinsky (Eds.), *Habitat structure: The physical arrangement of objects in space* (pp. 237–259). Springer Netherlands. https://doi.org/10.1007/978-94-011-3076-9_12

Numerous biotic and abiotic agents of disturbance operating at different scales influence the diversity, composition, architecture, spatial patterning, and productivity of a variety of community types (e.g., Loucks, 1970; Dayton, 1971; Grubb, 1977; Connell, 1978; Greig-Smith, 1979; White, 1979; Pickett, 1980; Paine and Levin, 1981; Runkle, 1981; Bazzaz, 1984). Disturbance can play a significant role as an agent of selection (Pickett, 1976). Specific characteristics of disturbance which influence community ecology include frequency, time, intensity, and spatial context of disturbance agents (e.g., Sousa, 1979; Abugov, 1982; Miller, 1982; Bazzaz, 1984). Fire is a significant abiotic agent of disturbance that influences the structure of many communities around the world and the evolution of species' strategies.

Mushinsky, Henry R. (1985). Fire and the Florida sandhill herpetofaunal community: With special attention to tesponses of Cnemidophorus sexlineatus. *Herpetologica*, *41*(3), 333–342.

A system of drift fences and pitfall traps was used over a 2-yr period to monitor the herpetofaunal community on four plots of land (1 ha each) maintained on different burn schedules. Experimental plots were burned every year (1E), every 2 yr (2E), or every 7 yr (7E); the control plot (CE) has not burned for 20 yr. A total of 1236 amphibians and reptiles of 27 species were captured during 1983 and 1984. Severe cold in December 1983 may have caused a large decline in herpetofauna in 1984; over two-thirds of the animals were captured in the first year of the study. Both Shannon-Weiner and Simpson's diversity indexes indicated that plot 2E had the lowest diversity each year. The greatest diversity was found on 1E or 7E. The 2-yr fire periodicity produced a dense layer of grasses and herbaceous plants that was not readily occupied by sandhill herpetofauna. The most abundant reptile was the six-lined racerunner, Cnemidophorus sexlineatus, which comprised about 33% of all captures. The highest density of racerunners was found on 1E, while lizards on 7E showed the greatest philopatric tendencies (especially in 1983, the year 7E was burned). The results indicated that burning increased diversity and abundance of amphibians and reptiles over control plots, and some fire periodicities were better than others for maintaining high diversity.

Mushinsky, Henry R. (1992). Natural history and abundance of southeastern five-lined skinks, Eumeces inexpectatus, on a periodically burned sandhill in Florida. *Herpetologica*, *48*(3), 307–312.
The southeastern five-lined skink, Eumeces inexpectatus, occurs in a wide range of habitats throughout Florida, but it is most abundant in scrub and sandhill (high pine) habitats. Both the scrub and sandhill habitats are fire maintained, and resident animals respond to the frequency of burning. During 7 yr of study, adult males were trapped most often in March and April and adult females most often after nesting and hatching of young, from late June to mid-July. As judged by the number of individuals captured, I determined that plots of sandhill protected from fire for about two decades or burned on 5 or 7 yr cycles support more individuals than plots burned on either 1 or 2 yr cycles. Differences in the number of skinks found in plots subjected to the three burn frequencies likely reflect the structure of the habitat. Frequent burning reduces the amount of litter and tree canopy, produces patches of open ground, and promotes the growth of herbaceous plants. Plots protected from fire have thick layers of litter which provide shelter and foraging habitat for southeastern five-lined skinks. Plots burned on 5 or 7 yr cycles have sufficient time to accumulate litter between fires to provide good quality habitat for this species.

Mushinsky, Henry R., & McCoy, E. D. (2017). Partners in three decades of conservation research in Florida. *Journal of Herpetology*, *51*(3), 287–296. https://doi.org/10.1670/16-015

How have we managed to maintain our research partnership for more than 30 yr? We have come to think that personal respect for one another and trust that our core values and motivations are immutable have been key. Our partnership began with a project to gather much-needed information on Gopherus polyphemus (Daudin) (Gopher Tortoise). We soon realized that the species was in peril. The enormous pressures put upon species and habitats by the exploding human population of Florida fueled our desire not only to accumulate information about basic biology and ecology, but also information relevant to effective conservation and management. Our interest in the Gopher Tortoise expanded naturally to other inhabitants of the xeric uplands, particularly Plestidon reynoldsi Stejneger (Florida Sand Skink). This species inhabits the pyrogenic scrub habitat on the central ridges, which has been mostly lost to development. We present previously unpublished data that cautiously suggest that clear-cutting would be an effective tool for managing small habitat fragments when burning is not a reasonable option. Although we have worked closely with businesses and agencies, we understand that their motivations for facilitating conservation research are not necessarily the same as our motivations for conducting the research; however, we would not have been able to accomplish what we have without the cooperation and support of these entities. Regardless, destruction of xeric uplands has continued apace, and our inability to forestall species' decline is the most frustrating aspect of our partnership. Despite our frustration, we remain motivated by our conviction that we are doing the right thing.

Northrop, Robert John (2020) "Organization and support of long-term collaborative relationships between private citizens, government institutions and universities to conduct inventories and ecological analyses across the Tampa Bay watershed; development of strategic plans for forest conservation; and ongoing support for ecologically based management," *Cities and the Environment (CATE)*: Vol. 13: Iss. 1, Article 20. DOI: 10.15365/cate.2020.130120. Available at: https://digitalcommons.lmu.edu/cate/vol13/iss1/20

Successful conservation of forested natural areas within a matrix of urban land uses requires an ongoing collaborative relationship between private citizens, their governments, and scientists. Such collaboration requires an understanding of the social values which drive political decision making, an understanding of the function and processes that govern the natural area, and ecosystem management.

Poor, N., Pollman, C., Tate, P., Begum, M., Evans, M., & Campbell, S. (2006). Nature and magnitude of atmospheric fluxes of total inorganic nitrogen and other inorganic species to the Tampa Bay watershed, FL, USA. *Water, Air, and Soil Pollution*, *170*(1), 267–283. https://doi.org/10.1007/s11270-006-3055-6

We estimated the total inorganic fluxes of nitrogen (N), sulfur (S), chloride (Cl−, sodium (Na+, calcium (Ca2+, magnesium (Mg2+, potassium (K+ and hydronium (H+. The resistance deposition algorithm that is programmed as part of the CALMET/CALPUFF modeling system was used to generate spatially-distributed deposition velocities, which were then combined with measurements of urban and rural concentrations of gas and particle species to obtain dry deposition rates. Wet deposition rates for each species were determined from rainfall concentrations and amounts available from the National Acid Deposition Program (NADP) monitoring network databases. The estimated total inorganic nitrogen deposition to the Tampa Bay watershed (excluding Tampa Bay) was 17 kg-N ha−1 yr−1 or 9,700 metric tons yr−1, and the ratio of dry to wet deposition rates was ~2.3 for inorganic nitrogen. The largest contributors to the total N flux were ammonia (NH3 and nitrogen oxides (NOxat 4.6 kg-N ha−1 yr−1 and 5.1 kg-N ha−1 yr−1, respectively. Averaged wet deposition rates were 2.3 and 2.7 kg-N ha−1 yr−1 for NH4+ and NO3−, respectively.

McCoy, E.D., & Witz, B.A. (1994). Population ecology of two species of pasimachus (Coleoptera: Carabidae) in the sandhill habitat of Florida. *The Florida Entomologist, 77*(1): 155-163. Retrieved April 27, 2021, from https://www-jstor-org.ezproxy.lib.usf.edu/stable/3495882?seq=1#metadata_info_tab_contents

The population ecology of Pasimachus subsulcatus Say and of P. strenuus LeConte was studied with beetles captured by pitfall trapping. We searched for patterns in: (1) activity/density, (2) reproduction, (3) body size, and (4) parasitization. Females and males of both species were most active/dense in spring and autumn; females of both species were especially active/dense, relative to males, in late summer-early autumn; few females of both species bore post-vitellogenic eggs in summer; and males of P. subsulcatus produced mature sperm in spring and autumn. It was concluded that mating occurs in spring and autumn for both species, and oviposition in summer-early autumn. Our data suggest that relatively high percentages of both female and male P. subsulcatus trapped in late summer-early autumn were relatively large. In most months, females of P. subsulcatus were, on average, larger than males, but the two sexes of P. strenuus were similar in size. About 1.4% of P. subsulcatus and 3.3% of P. strenuus were parasitized by tachinid flies. Parasitization of both species peaked in late summer-autumn, and there was no evidence that parasitization was influenced by sex, size, or female gravidity,

with one exception. Small individuals of P. subsulcatus were parasitized more often than one would expect from their representation among captured individuals.

Pu, R. (2011). Mapping urban forest tree species using IKONOS imagery: Preliminary results. *Environmental Monitoring and Assessment*, *172*(1), 199–214. https://doi.org/10.1007/s10661-010-1327-5

A stepwise masking system with high-resolution IKONOS imagery was developed to identify and map urban forest tree species/groups in the City of Tampa, Florida, USA. The eight species/groups consist of sand live oak (Quercus geminata), laurel oak (Quercus laurifolia), live oak (Quercus virginiana), magnolia (Magnolia grandiflora), pine (species group), palm (species group), camphor (Cinnamomum camphora), and red maple (Acer rubrum). The system was implemented with soil-adjusted vegetation index (SAVI) threshold, textural information after running a low-pass filter, and brightness threshold of NIR band to separate tree canopies from non-vegetated areas from other vegetation types (e.g., grass/lawn) and to separate the tree canopies into sunlit and shadow areas. A maximum likelihood classifier was used to identify and map forest type and species. After IKONOS imagery was preprocessed, a total of nine spectral features were generated, including four spectral bands, three hue–intensity–saturation indices, one SAVI, and one texture image. The identified and mapped results were examined with independent ground survey data. The experimental results indicate that when classifying all the eight tree species/ groups with the high-resolution IKONOS image data, the identifying accuracy was very low and could not satisfy a practical application level, and when merging the eight species/groups into four major species/groups, the average accuracy is still low (average accuracy = 73%, overall accuracy = 86%, and κ = 0.76 with sunlit test samples). Such a low accuracy of identifying and mapping the urban tree species/groups is attributable to low spatial resolution IKONOS image data relative to tree crown size, to complex and variable background spectrum impact on crown spectra, and to shadow/shaded impact. The preliminary results imply that to improve the tree species identification accuracy and achieve a practical application level in urban area, multi-temporal (multi-seasonal) or hyperspectral data image data should be considered for use in the future.

Pu, R. (2012a). Comparing canonical correlation analysis with partial least squares regression in estimating forest leaf area index with multitemporal Landsat TM imagery. *GIScience & Remote Sensing*, *49*(1), 92–116. https://doi.org/10.2747/1548-1603.49.1.92

The leaf area index (LAI) of plant canopies is an important structural variable for assessing terrestrial ecosystems. This research examined the use of multitemporal Landsat TM imagery to estimate and map LAI in mixed natural forests in the southeastern USA. The performances of canonical correlation analysis (CCA) and partial least squares (PLS) regression techniques were evaluated for feature extraction to estimate forest LAI. The experimental results indicate that use of multitemporal TM imagery can improve the accuracy of estimating the forest LAI, and that CCA analysis outperforms PLS regression for feature extraction.

Pu, R. (2012b). Mapping leaf area index over a mixed natural forest area in the flooding season using ground-based measurements and Landsat TM imagery. *International Journal of Remote Sensing*, *33*(20), 6600–6622. https://doi.org/10.1080/01431161.2012.692887

Leaf area index (LAI) is an important structural parameter in terrestrial ecosystem modelling and management. Therefore, it is necessary to conduct an investigation on using moderate-resolution satellite imagery to estimate and map LAI in mixed natural forests in southeastern USA. In this study, along with ground-measured LAI and Landsat TM imagery, the potential of Landsat 5 TM data for estimating LAI in a mixed natural forest ecosystem in southeastern USA was investigated and a modelling method for mapping LAI in a flooding season was developed. To do so, first, 70 ground-based LAI measurements were collected on 8 April 2008 and again on 1 August 2008 and 30 July 2009; TM data were calibrated to ground surface reflectance. Then univariate correlation and multivariate regression analyses were conducted between the LAI measurement and 13 spectral variables, including seven spectral vegetation indices (VIs) and six single TM bands. Finally, April 08 and August 08 LAI maps were made by using TM image data, a multivariate regression model and relationships between April 08 and August 08 LAI measurements. The experimental results indicate that Landsat TM imagery could be used for mapping LAI in a mixed natural forest ecosystem in southeastern USA. Furthermore, TM4 and TM3 single bands ($R^2 > 0.45$) and the soil adjusted vegetation index, transformed soil adjusted vegetation index and non-linear vegetation index ($R^2 > 0.64$) have produced the highest and second highest correlation with ground-measured LAI. A better modelling result ($R^2 = 0.78$, accuracy = 73%, root mean square error (RMSE) = 0.66) of the 10-predictor multiple regression model was obtained for estimating and mapping April 08 LAI from TM data. With a linear model and a power model, August 08 LAI maps were successfully produced from the April 08 LAI map (accuracy = 79%, RMSE = 0.57), although only 58–65% of total variance could be accounted for by the linear and non-linear models.

Pu, R., & Cheng, J. (2015). Mapping forest leaf area index using reflectance and textural information derived from WorldView-2 imagery in a mixed natural forest area in Florida, US. *International Journal of Applied Earth Observation and Geoinformation*, *42*, 11–23. https://doi.org/10.1016/j.jag.2015.05.004

The leaf area index (LAI) of plant canopies is an important structural parameter that controls energy, water, and gas exchanges of plant ecosystems. Remote sensing techniques may offer an alternative for measuring and mapping forest LAI at a landscape scale. Given the characteristics of high spatial/spectral resolution of the WorldView-2 (WV2) sensor, it is of significance that the textural information extracted from WV2 multispectral (MS) bands will be first time used in estimating and mapping forest LAI. In this study, LAI mapping accuracies would be compared from (a) spatial resolutions between 2-m WV2 MS data and 30-m Landsat TM imagery, (b) the nature of variables between spectrum-based features and texture-based features, and (c) sensors between TM and WV2. Therefore spectral/textural features (SFs) were first selected and tested; then a canonical correlation analysis was performed with different data sets of SFs and LAI measurement; and finally linear regression models were used to predict and map forest LAI with canonical variables calculated from image data. The experimental results demonstrate that for estimating and mapping forest LAI, (i) using high resolution data (WV2) is better than using relatively low resolution data (TM); (ii) extracted from the same WV2 data, texture-based features have higher capability than that of spectrum-based features; (iii) a combination of spectrum-based features with texture-based features could lead to even higher accuracy of mapping forest LAI than their either one separately; and (iv) WV2 sensor outperforms TM sensor significantly. However, we need to address the possible overfitting phenomenon that might be brought in by using more input variables to develop models. In addition, the experimental results also indicate that the red-edge band in WV2 was the worst on estimating LAI among WV2 MS bands and the WV2 MS bands in the visible range had a much higher correlation with ground measured LAI than that red-edge and NIR bands did.

Pu, R., & Landry, S. (2019). Evaluating seasonal effect on forest leaf area index mapping using multi-seasonal high resolution satellite pléiades imagery. *International Journal of Applied Earth Observation and Geoinformation*, *80*, 268–279. https://doi.org/10.1016/j.jag.2019.04.020

The forest canopy leaf area index (LAI) is an important structural variable directly affecting functions and structures of terrestrial plant ecosystems. Optical remote sensing techniques may provide an alternative in estimating and mapping plant LAI. However, existing studies on using very high resolution (VHR) multitemporal satellite imagery to map and investigate the seasonal

effect on plant LAI at a landscape scale are rare. In this study, we proposed to map and analyze forest LAI using four seasonal Pléiades images and corresponding in situ seasonal LAI measurements collected over a natural forest area in the City of Tampa, Florida, USA. A subset of selected spectral/textural features was used to develop pixel-based seasonal LAI regression models through a two-step feature selection procedure and a canonical correlation analysis. Finally, seasonal changes of the mapped LAIs were analyzed and assessed. Several interesting experimental results were created through this study, including: (i) a set of optimal texture parameters for extracting the 1st- and 2nd-order grey level statistical textures from the Pléiades imagery was determined as a window size 5×5, a direction 90° and pixel displacement 4 pixels; (ii) textural features were more important than spectral features in estimating and mapping forest LAI, and red band has a higher power in mapping forest LAI than other three multispectral bands; (iii) the late spring Pleiades image resulted in the highest accuracy for estimating and mapping forest LAI; and (iv) there exists a significant seasonal change of forest LAI in the study area and the seasonal effect on forest LAI mapping can be assessed by using the multi-seasonal VHR satellite imagery at a landscape scale. A novel significance for this study is that it is the first time using both spectral and textural information extracted from the multi-seasonal VHR satellite images to assess the seasonal effect on forest LAI mapping at a landscape scale. Since the experimental results and findings were derived from a relatively small study area, further testing and validation work is needed over different forest ecosystems at a landscape scale.

Rains, M. C., Landry, S., Rains, K. C., Seidel, V., & Crisman, T. L. (2013). Using net wetland loss, current wetland condition, and planned future watershed Condition for wetland conservation planning and prioritization, Tampa Bay Watershed, Florida. *Wetlands*, *33*(5), 949–963. https://doi.org/10.1007/s13157-013-0455-4

The Tampa Bay Watershed is emblematic of moderately sized coastal watersheds in the US, particularly along the Gulf Coast: one-third of the wetlands were lost between the 1950s and 2007; numerous wetland remain, though many have been impacted; most of the remaining wetlands are hydrologically connected to downstream wetlands and waterbodies; there are future constraints to wetland conservation; and the spatial complexity of these factors make it difficult to coordinate watershed-scale wetland conservation planning. Therefore, the Tampa Bay Watershed can serve as a model system for studying ways to coordinate watershed-scale wetland conservation planning efforts. The development of a technical framework to support coordinated, watershed-scale wetland conservation planning requires that spatially explicit information be obtained, analyzed, and organized so customizable queries can be run by stakeholder agencies.

The approach described herein does so by using readily available data to create a geodatabase organized into a set of screening layers that can be intersected hierarchically to identify areas where wetland preservation and restoration might be best used to accomplish overarching goals. The information and tools described herein were developed in conjunction with stakeholder input and are in the process of being integrated into a watershed master plan for freshwater wetland conservation.

Russell, M., & Greening, H. (2015). Estimating benefits in a recovering estuary: Tampa Bay, Florida. *Estuaries and Coasts*, *38*(1), 9–18. https://doi.org/10.1007/s12237-013-9662-8
Restoration and preservation of riparian forests and coastal marshes provides nutrient removal and other biochemical and physical functions which may preclude, reduce, or delay the need for additional water treatment, while also protecting human health. We examined the ecosystem goods and related potential cost savings for the Tampa Bay community from seagrass expansion (more than 3,100 ha since 1990), coastal marsh, and mangrove restoration/recovery (more than 600 ha since 1990), and habitat that has been maintained or preserved. Habitats in and around Tampa Bay provide nutrient reductions equivalent to just over US$22 million per year in avoided wastewater treatment plant costs. Future accrual of value associated with maintaining the ecosystem good of usable clean water could rapidly increase to as high as ~US$3 billion per year, when one takes into account the additional costs of water treatment and storm water diversion infrastructure that is likely as the region's population continues to grow. There is additional value accrual close to a quarter million dollars per year based on avoided social costs to the global community due to greenhouse gases sequestered by bay habitats. Most human beneficiaries associated with the maintenance of usable clean water in Tampa Bay are part of the surrounding regional community. The large current and future cost savings for the community surrounding Tampa Bay and additional benefits for the global community speak to the value of maintaining a healthy bay through past and continued restoration and preservation efforts.

Russell, M., Rogers, J., Jordan, S., Dantin, D., Harvey, J., Nestlerode, J., & Alvarez, F. (2011). Prioritization of ecosystem services research: Tampa Bay demonstration project. *Journal of Coastal Conservation*, *15*(4), 647–658. https://doi.org/10.1007/s11852-011-0158-z
The Tampa Bay Ecosystem Services Demonstration Project (TBESDP) is part of the U.S. Environmental Protection Agency's Ecosystem Services Research Program. The principal objectives of TBESDP are to (1) quantify the ecosystem services of the Tampa Bay watershed, (2) determine the value of ecosystem services to society, (3) predict the supply of ecosystem

services under future scenarios of population growth and climate change, and (4) apply this knowledge through models and tools that will support the best informed environmental decisions possible. The scope and complexity of this project required intensive effort to establish which services can be quantified by applying existing models, data, and scientific literature and which services will require supporting research. Research priorities were assessed by: (1) developing and refining conceptual models of major ecosystems in the Tampa Bay region, (2) gathering input from stakeholders about the relative importance and values of various ecosystem services, (3) preparing and reviewing a bibliometric analysis of the volume of scientific literature relevant to the ecosystems and services of interest, and (4) evaluating an integrated analysis of importance, value, and availability of scientific information. This analysis led us to focus on two research priorities, seagrass-habitat functions as support for fishery production, and wetlands as regulators of water quality.

Schaberg, S. J., Patterson, J. T., Hill, J. E., Guindon, K. Y., & Tuckett, Q. M. (2019). Fish community composition and diversity at restored estuarine habitats in Tampa Bay, Florida, United States. *Restoration Ecology*, *27*(1), 54–62. https://doi.org/10.1111/rec.12712

Estuary restoration in Tampa Bay, Florida, United States, is an ongoing focus of natural resource managers because of pressure from an increasing coastal population, historic habitat loss, and restoration's importance to economic development, recreational activities, and fish habitat. A growing population can also limit future large-scale restorations due to associations with cost and land availability. This limitation might be overcome by applying the habitat mosaic approach to restoration, which creates distinct habitat types at small spatial scales. This approach was applied to create three types of estuarine habitat, reconnected tidal creek, salt marsh, and tidal pond. The objectives of this study were to (1) initiate monitoring of a restored wetland mosaic and (2) determine how fish diversity and community structure vary among restored habitat types. Replicated sampling using a 3-mm mesh seine was used to characterize the fish communities. Our results indicate that the habitat mosaic approach creates suitable habitat for a variety of fish species where 37% of fish species were captured in just one habitat type. In particular, the recreationally important Centropomus undecimalis (common snook) was more common in the mangrove-lined creek and the non-native Sarotherodon melanotheron (blackchin tilapia) was common in the tidal pond. Greater emphasis should be placed on applied restoration research to identify how habitat types within a larger restoration mosaic contribute to local species diversity and recreationally and commercially important fishes, while limiting non-natives. This emphasis

could reveal how restoration approaches can be modified to include habitat mosaics, maximizing their contribution to productive fish habitat.

Schulz, K., Stevens, P. W., Hill, J. E., Trotter, A. A., Ritch, J. L., Williams, K. L., Patterson, J. T., & Tuckett, Q. M. (2020). Coastal wetland restoration improves habitat for juvenile sportfish in Tampa Bay, Florida, U.S.A. *Restoration Ecology*, *28*(5), 1283–1295. https://doi.org/10.1111/rec.13215

Increasing human populations and urban development have led to losses of estuarine habitats for fish and wildlife. Where resource managers are restoring coastal wetlands, in addition to meeting goals related to hydrologic connectivity, biodiversity, and recreational opportunities, efforts are being made to provide habitat that is suitable for juvenile sportfish. An 18-month study was conducted to compare juvenile sportfish use of natural, restored, and impacted sites along Tampa Bay, Florida, shorelines. Juvenile sportfish densities at restored sites were broadly comparable to natural sites and greater than at impacted sites. However, site-specific differences in sportfish use did occur within site types. For example, one restored site had significantly higher densities of red drum Sciaenops ocellatus than any other site, while black drum Pogonias cromis were found exclusively at another restored site. To evaluate whether the restored sites are providing suitable habitat for juvenile fish, we assessed growth (estimated from counts of daily rings on otoliths) and condition (determined by lipid analyses) of juvenile common snook Centropomus undecimalis, an archetypal coastal wetland-dependent species. Growth (0.43–0.56 mm SL/day) and condition (4.6–6.1% lipid of dry weight) exhibited only site-specific differences and did not vary among natural, restored, and impacted site types. Although mortality rates of juvenile sportfish were not determined, use of a 40-m seine found that densities of potential piscine predators in these coastal wetlands were relatively low compared to published studies of open estuarine shorelines. The restoration and creation of coastal wetlands in Tampa Bay provides improved habitat for juvenile sportfish.

Schwartz, T. S., & Karl, S. A. (2005). Population and conservation genetics of the gopher tortoise (Gopherus polyphemus). *Conservation Genetics*, *6*(6), 917–928. https://doi.org/10.1007/s10592-005-9078-5

The gopher tortoise (Gopherus polyphemus) is an important member of the sandhill, longleaf pine, and scrub ecosystems in the southeastern United States. Even though it is currently protected throughout its range, tortoise populations continue to decline. We assessed genetic diversity at nine microsatellite loci in 300 individuals from 21 locations throughout Florida and

southern Georgia. Tortoise populations are clearly subdivided into at least eight genetic assemblages with an $\bar{F}_{\rm ST}=0.24\pm 0.11$. Furthermore, we found indications of anthropogenic effects in the form of population bottlenecks in five populations and putative admixture in four. From these data, we recommend that the populations be managed to maintain existing genetic structure without further isolation of populations and the establishment of a holistic database to include genetic and demographic information useful for relocation and management purposes.

Sheehan, L., Sherwood, E. T., Moyer, R. P., Radabaugh, K. R., & Simpson, S. (2019). Blue carbon: An additional driver for restoring and preserving ecological services of coastal wetlands in Tampa Bay (Florida, USA). *Wetlands*, *39*(6), 1317–1328. https://doi.org/10.1007/s13157-019-01137-y
Coastal habitats, including mangroves, salt marsh, and seagrass meadows, provide numerous ecosystem services, including improved water quality, shoreline stabilization, and essential fish habitat. Over the past few decades, the quantification of greenhouse gas fluxes in wetlands has improved, leading to the recognition of these habitats as long-term carbon sinks. Quantifying this "blue carbon" as an ecosystem service provides added value for wetland protection and restoration and serves as a useful management tool when implementing plans for sustained ecosystem health and productivity. Tampa Bay (Florida, USA), a highly urbanized estuary, provides an interesting case study to assess the role of blue carbon in supporting management and informing restoration decisions. This review provides results from the Tampa Bay Blue Carbon Assessment, which quantified existing carbon stocks and identified the future carbon sequestration trajectories of coastal habitats with respect to climate change and sea-level rise. Examples are provided of how these data can be used to prioritize restoration efforts, support and enhance management decisions, and potentially attract new partners to support wetland restoration projects that offer additional climate change mitigation and adaptation benefits. This added valuation can help drive investment towards additional wetland restoration activities to help meet management targets in estuaries worldwide.

Sherwood, E. T., Greening, H. S., Janicki, A. J., & Karlen, D. J. (2016). Tampa Bay estuary: Monitoring long-term recovery through regional partnerships. *Regional Studies in Marine Science*, *4*, 1–11. https://doi.org/10.1016/j.rsma.2015.05.005
Historically, significant impacts to Tampa Bay's water quality (e.g. chlorophyll-a concentrations) and ecosystem (e.g. seagrass coverage) have been documented as a result of early coastal development and urban expansion that occurred between the 1950s and 1980s. Since this time,

Tampa Bay's estuarine water quality and ecosystems have significantly recovered. A long-term water quality monitoring program, first established by the Environmental Protection Commission of Hillsborough County (EPCHC) in 1972, was instrumental in the development of water quality management targets and regulatory thresholds related to the recovery of seagrass that helped guide restoration activities in the Bay from the 1980s to present. The EPCHC monitoring program has provided over 40 years of consistent and quality assured data that have been used to document Tampa Bay's ecosystem recovery, as well as, guide future research, monitoring, and management actions. Forecasted future pressures of continuing coastal population growth and climate change impacts further necessitate the need to maintain long-term water quality monitoring efforts in the Tampa Bay estuary. Maintenance of a robust estuarine monitoring program will not only help to identify future risks to the important environmental assets represented in the Tampa Bay estuary, but also help to identify potential risks to Tampa Bay's economic vitality that are garnered from maintaining a "healthy" Tampa Bay.

Smiley, S. A., McCoy, E. D., Schrey, A. W., & Mushinsky, H. R. (2012). Utilizing a multifaceted approach to assess the current distribution and conservation status of an uncommon species: The golden mouse (Ochrotomys nuttalli) in Florida. *Diversity and Distributions*, *18*(11), 1120–1129. https://doi.org/10.1111/j.1472-4642.2012.00905.x
Aim Our goal was to assess the conservation status of the understudied and naturally uncommon habitat specialist, the golden mouse (Ochrotomys nuttalli), at the edge of its range where its historically fragmented habitat has been subjected to severe loss. Location Peninsular Florida, north of approximately 27° latitude, USA. Methods We used data gathered from museum collections, regional biologists, geographic information systems (GIS) layers, field surveys and DNA sequencing to determine the habitats that best explain the distribution of the species, examine changes in the geographic extent of both the species and its habitats, and compare genetic differentiation between populations occupying disjunct regions. The results from these multiple analyses were combined to assess the conservation status of the species. Results Golden mouse occurrence records align well with the distribution of hardwood habitats in Florida. These habitats occur naturally as 'islands', but have become increasingly fragmented by anthropogenic land use. Despite habitat loss, the location of the southern range periphery has remained relatively unchanged in location over the past century. Genetic analysis reveals a history of limited dispersal of females among habitat 'islands' that likely predates anthropogenic landscape fragmentation. This pattern suggests that isolated populations that are extirpated will have little to no chance of successful recolonization. Main conclusions The combined results from multiple

analyses produced a more complete picture of the threats faced by this previously data-deficient species than any single analysis would have. Although the species' southern range limit cannot be shown to have retracted in the face of human expansion, habitat fragmentation clearly has put the species at increased risk. Conservation and management of hardwood habitats are critical to the persistence of the golden mouse at the edge of its range.

Witz, B.W. (1996). *The functional response of Cnemidophorus sexlineatus: Laboratory versus field measurements. Journal of Herpetology, 30*(4): 498-506. Retrieved April 27, 2021, from https://www-jstor-org.ezproxy.lib.usf.edu/stable/1565692?seq=1#metadata_info_tab_contents
I measured the functional response and several related behavioral characteristics of the widely-foraging teiid lizard Cnemidophorus sexlineatus, using domestic crickets as prey, in the laboratory. The foraging behaviors of individuals observed in the laboratory were compared with those of free-ranging individuals and individuals observed in a semi-natural field enclosure. In the laboratory, both attack and ingestion rates by the predator increased with prey densities from 0.25 to 1-2 prey/m^2 and reached a plateau of 4-5 prey attacked per hour at the highest prey densities. Attack rate, consumption rate, and several other behavioral variables (foraging velocity, handling time, move rate, move duration) differed between field and laboratory situations. Many of these differences may be explained by an increased edge effect in small, laboratory test arenas. I conclude that using functional response information obtained in the laboratory to predict the predator/prey dynamics of free-ranging, widely-foraging lizards such as Cnemidophorus sexlineatus should be done with caution.

Ward, K. T., & Johnson, G. R. (2007). Geospatial methods provide timely and comprehensive urban forest information. *Urban Forestry & Urban Greening*, *6*(1), 15–22. https://doi.org/10.1016/j.ufug.2006.11.002
Urban forests are unique and highly valued resources. However, trees in urban forests are often under greater stress than those in rural or undeveloped areas due to soil compaction, restricted growing spaces, high temperatures, and exposure to air and water pollution. In addition, conditions change more quickly in urban as opposed to rural and undeveloped settings. Subsequently, proactive management of urban forests can be challenging and requires the availability of current and comprehensive information. Geospatial tools, such as, geographic information systems (GIS), global positioning systems (GPS) and remote sensing, work extremely well together for gathering, analyzing, and reporting information. Many urban forest management questions could be quickly and effectively addressed using geospatial methods and tools. The geospatial tools can provide timely and extensive spatial data from which urban forest

attributes can be derived, such as land cover, forest structure, species composition and condition, heat island effects, and carbon storage. Emerging geospatial tools that could be adapted for urban forest applications include data fusion, virtual reality, three-dimensional visualization, Internet delivery, modeling, and emergency response.

Wilson, D. S., Mushinsky, H. R., & McCoy, E. D. (1999). Nesting behavior of the striped mud turtle, Kinosternon baurii (Testudines: Kinosternidae). *Copeia*, *1999*(4), 958–968. https://doi.org/10.2307/1447971

The nesting ecology of Kinosternon baurii was studied on a sandhill in central Florida from September 1991 through February 1995. Gravid females were marked and tracked to their nest sites using thread bobbins attached to the carapace. Peak nesting season was September through November with a second minor peak in June. Females laid 1-3 clutches per year. When left unprotected from predators, egg predation was 100%; however, when nests were protected from predators, 88% of the nests had full or partial embryo survival to hatching. Nesting females moved an average of 137 m from the wetland to their nest sites and showed fidelity to a particular nesting area among years. Movements to and from nest sites coincided with rainfall. As documented for other kinosternid species, females of K. baurii prolonged their stays on the sandhill after nesting by burying underground near their nest sites. Deterrence of egg predators from the nest site as a result of the female's presence has been suggested as a possible explanation for why females do not return to the wetland immediately after nest completion; however, physiological limitations caused by energy expenditure and/or evaporative water loss also may aid in explaining this behavior.

Wolfe, S. H., & Drew, R. D. (1990). *An ecological characterization of the Tampa Bay Watershed*. U.S. Department of the Interior, Fish and Wildlife Service. http://www.tampabay.wateratlas.usf.edu/upload/documents/EcologicalCharTampaBayWatershedPt1.pdf

This report is one in a series that provides an ecological description of Florida's gulf coasts. The watersheds described herein, with their myriad subtropical communities, produce many benefits. The maintenance of this productivity through enlightened resource management is a major goal of this series. 1111S report will be useful to the many people who have to make decisions regarding the use of the natural resources of the area.

Xian, G., & Crane, M. (2005). Assessments of urban growth in the Tampa Bay watershed using remote sensing data. *Remote Sensing of Environment*, *97*(2), 203–215. https://doi.org/10.1016/j.rse.2005.04.017

Urban development has expanded rapidly in the Tampa Bay area of west-central Florida over the past century. A major effect associated with this population trend is transformation of the landscape from natural cover types to increasingly impervious urban land. This research utilizes an innovative approach for mapping urban extent and its changes through determining impervious surfaces from Landsat satellite remote sensing data. By 2002, areas with subpixel impervious surface greater than 10% accounted for approximately 1800 km2, or 27 percent of the total watershed area. The impervious surface area increases approximately three-fold from 1991 to 2002. The resulting imperviousness data are used with a defined suite of geospatial data sets to simulate historical urban development and predict future urban and suburban extent, density, and growth patterns using SLEUTH model. Also examined is the increasingly important influence that urbanization and its associated imperviousness extent have on the individual drainage basins of the Tampa Bay watershed.

Xian, G., Crane, M., & Su, J. (2007). An analysis of urban development and its environmental impact on the Tampa Bay watershed. *Journal of Environmental Management*, *85*(4), 965–976. https://doi.org/10.1016/j.jenvman.2006.11.012

Urbanization has transformed natural landscapes into anthropogenic impervious surfaces. Urban land use has become a major driving force for land cover and land use change in the Tampa Bay watershed of west-central Florida. This study investigates urban land use change and its impact on the watershed. The spatial and temporal changes, as well as the development density of urban land use are determined by analyzing the impervious surface distribution using Landsat satellite imagery. Population distribution and density are extracted from the 2000 census data. Non-point source pollution parameters used for measuring water quality are analyzed for the sub-drainage basins of Hillsborough County. The relationships between 2002 urban land use, population distribution and their environmental influences are explored using regression analysis against various non-point source pollutant loadings in these sub-drainage basins. The results suggest that strong associations existed between most pollutant loadings and the extent of impervious surface within each sub-drainage basin in 2002. Population density also exhibits apparent correlations with loading rates of several pollutants. Spatial variations of selected non-point source pollutant loadings are also assessed.

Yu, Q., Acheampong, M., Pu, R., Landry, S. M., Ji, W., & Dahigamuwa, T. (2018). Assessing effects of urban vegetation height on land surface temperature in the City of Tampa, Florida, USA. *International Journal of Applied Earth Observation and Geoinformation*, *73*, 712–720. https://doi.org/10.1016/j.jag.2018.08.016

Urban vegetation can mitigate urban heat island (UHI) due to its ability to regulate temperature by directly or indirectly influencing water vapor transport, shading effect, and wind speed and direction. Mechanisms of effects of vegetation cover on land surface temperature (LST) have been extensively documented. Few studies, however, have examined the role of vegetation height in controlling LST. In this study, we examined the relationship between LST and vegetation height by using Light Detection and Range (LiDAR) data from the city of Tampa, Florida, USA. The results revealed that vegetation height has significant impact on LST. Additionally, we also identified the optimal height and fractional cover at which vegetation can exert the greatest influence on LST. In particular, we found that the maximum cooling effect of vegetation can only be achieved when vegetation cover is above 93.33%, an amount of which is nearly impossible to have in most of the cities. On the other hand, LST decreases at an increasing rate with vegetation height, and is optimized at 20 m. This shows that vegetation height can play an important role in regulating UHI in contributing to effect maximization with least cover possible in a city. Findings derived from this study could provide urban planners with critical insights on precise and efficient urban vegetation management in the purpose of UHI mitigation.