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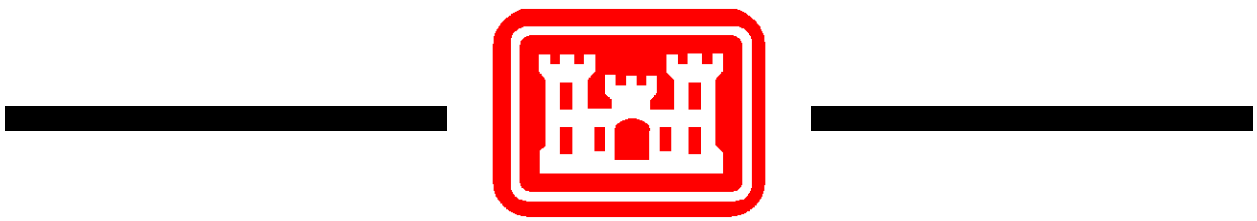
MANAGEMENT GUIDANCE FOR GOPHER TORTOISE RELOCATION



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MANAGEMENT GUIDANCE FOR GOPHER TORTOISE RELOCATION

1. Purpose.

a. This Public Works Technical Bulletin (PWTB) addresses concerns developed through the experience of state wildlife agencies, university studies in veterinary medicine, investigations performed by Army research organizations, and recommendations contained in the interagency Candidate Conservation Agreement (CCA) for the eastern population of the gopher tortoise (*Gopherus polyphemus*) signed by the Army in 2009.

b. The guidance incorporated here summarizes the best professional information on how relocation should be performed and monitored. It is hoped that use of this information will result in improved, on-site management of the species, successfully ensuring its continued survival with minimal adverse affect on the military mission. NOTE: This PWTB does not provide management guidance on whether to perform relocation, nor does it provide guidance on site selection and long-term management of the relocated populations. Instead, this PWTB provides guidelines as to how to perform relocation best IF the decision to relocate has been made following appropriate biological and administrative decision making (which is outside the scope of this PWTB)

c. All PWTBs are available electronically (in Adobe® Acrobat® portable document format) through the World Wide Web at the National Institute of Building Sciences' Whole Building

Design Guide web page, accessible through the following URL:

http://www.wbdg.org/ccb/browse_cat.php?o=31&c=215

2. Applicability. This PWTB applies to all U.S. Army facilities engineering activities. It is designed for use by all natural resource managers, land managers, and private agencies.

3. References.

a. Army Regulation (AR) 200-1, "Environmental Protection and Enhancement," paragraph 4-3d, 13 December 2007.

b. The Sikes Act, 16 United States Code (USC) §§ 670a-670o https://www.denix.osd.mil/denix/Public/ESPrograms/Conservation/Laws/sikes.html

c. Army Species at Risk (SAR) Policy and Implementing Guidance, 15 September 2006.

d. Endangered Species Act of 1973 (PL 93-205; 16 USC 1531 et seq., as amended).

e. Department of Defense Instruction (DoDI) 4715.3, "Environmental Conservation Program," 3 May 1996.

f. Candidate Conservation Agreement for the Gopher Tortoise (*Gopherus polyphemus)*: Eastern Population. November 2008; revised December 2009.

4. Discussion.

a. For numerous reasons, most recently the Army's participation in the CCA, many installations that manage the gopher tortoise are either proposing or already have performed relocation of various numbers of animals from their habitat. While many of these relocations are believed to be successful, overall success has not been well monitored. All such actions must be undertaken with care.

b. AR 200-1 sets forth policy, procedures, and responsibilities for the conservation, management, and restoration of land and natural resources consistent with the military mission and in consonance with national policies. In fulfilling their conservation responsibilities, paragraph 4-3d(5)(v) authorizes installations to participate in regional/habitat-wide efforts to conserve candidate species and Army-designated species at risk (SAR). Paragraph 4-3d(6) provides authority for managing SAR and

their habitats. The gopher tortoise CCA further extends the responsibility to act cooperatively with the numerous entities, public and private, to share the responsibility for managing the tortoise.

c. Management of populations of SAR should always be undertaken with considerable care. The gopher tortoise, in particular, has been the focus of relocation activity for more than 20 years, primarily in Florida, but also in other states in the unlisted range (i.e., east of Mobile, AL). Much has been learned through the formal and informal experience thus acquired, and each of the states and agencies formally involved has developed recommendations (or regulations) as to how these relocations will be permitted (as applicable), conducted, and monitored.

d. Relocation of tortoises within the installation has been undertaken, formally and informally, at most installations with tortoise populations. It is proposed that the Army utilize the experience of other agencies and incorporate into their guidance for tortoise management under the CCA those practices and principles believed best suited to the Army installation environment and needs.

e. Appendix A summarizes those recommendations believed to be reasonable and applicable for Army installation staff and cooperating agency and university personnel when relocating tortoises within the installation or on adjacent Army Compatible Use Buffer (ACUB) lands.

f. In addition to references used in this PWTB, Appendix B lists relevant guidance materials that have been prepared by private groups and various state and federal agencies for management or relocation of SAR and focuses on those materials specifically for the gopher tortoise.

g. Appendix C contains a Gopher Tortoise Record Form that is recommended for use for recording the condition of tortoises collected in the field.

h. Appendix D describes management of commensal species during gopher tortoise relocations. Commensal species live within gopher tortoise burrows, deriving food, refuge, or other benefits from the burrow environment.

i. Appendix E lists acronyms and abbreviations used in this PWTB.

5. Points of Contact (POCs). Headquarters, U.S. Army Corps of Engineers (HQUSACE) is the proponent for this document. The POC at HQUSACE is Mr. Malcolm E. McLeod, CEMP-CEP, 202-761-5696, or e-mail: Malcolm.E.Mcleod@usace.army.mil.

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APPENDIX A

AREAS OF CONCERN AND CONSIDERATION WHEN RELOCATING TORTOISES

This bulletin addresses concerns arising from plans and actions proposed or undertaken at several U.S. Army installations located within the natural range of the gopher tortoise (*Gopherus polyphemus*) to relocate tortoises from their current sites to other places on or off the installation.

The following topics are of varying concern when preparations are being made for relocation of tortoises on Army property. While the relative importance of each topic may vary from installation to installation and state to state, each of these areas should be a part of the evaluation of every relocation plan. Note that they are not in any predefined order of importance. The relative importance will vary with each action and each setting. A summary of recommendations drawn from experience and other publications will be presented for each factor, and references (with links, as appropriate) will be included for the sources of this information.

Viability

Both researchers and managers often raise the question of long-term viability of the local population of tortoises. To address such a question means trying to determine if the group of animals under consideration is likely to survive as a reproducing population for an indefinite length of time or is more likely to decline to the point where it is not self-sustaining. In the case of tortoises with a generation time of 25-35 years, it may be difficult to determine long-term viability. Typically, wildlife management researchers utilize a population viability analysis (PVA) tool, which compares birth rates and adult survival potential. One of the most popular of such tools is the Vortex® program, which is distributed at no cost by the Chicago Zoological Society (www.vortex9.org/vortex.html)[1]. A series of studies performed by the U.S. Army Engineer Research and Development Center (ERDC) and cooperating University of Georgia researchers found that

[1] We note that this software may not be allowed to be installed on official Army computers without local Information Management (IM) approval.

many, if not most, gopher tortoise populations may not be viable in the long term (i.e., 500+ years) (Tuberville et al. 2009).

The root cause of this potential inviability appears to be the very poor survival of hatchlings and juveniles to maturity. See the sections on Headstarting, Canopy Cover, Food Plots, and Predators below for considerations of the potential to improve viability.

Carrying Capacity

The concept of carrying capacity is borrowed from the Range Management sector. Basically, it means “How many animals may be sustained on a given land area?” For cattle, it is usually expressed in terms of how many acres of range are required to sustain one animal. In the case of tortoises, this has often been expressed in terms of how many tortoises may be supported on 1 acre (0.4 hectare) of land. As with cattle, this value is both highly variable and often subject to great controversy. Responsible estimates of carrying capacity range from 2-4 (or more) tortoises per hectare in ideal conditions (approximately 1–2 animals per acre) or 1 tortoise per 2-5 hectares (approximately 5–10 acres per animal) in poor habitat, the latter being a tenfold difference. Styrsky et al. (2010) examined a range of reported carrying-capacity values and concluded that a healthy, viable gopher tortoise population should consist of around 250 animals occupying 750 hectares (approximately 1800 acres). This required area would be possible at many Army installations, but very few private properties; thus, a likely lack of carrying capacity suggests that most observed tortoise populations are slowly declining rather than increasing, almost no matter how good the habitat appears to be. Topics relevant to carrying capacity in this list are Canopy Cover, Food Plots, and Basal Area.

Health Considerations

Questions about tortoise health may be the most perplexing issue of all when considering relocation. Tortoises are generally long-lived once they reach adult size, but they are susceptible to several diseases. The most prominent concern is Upper Respiratory Tract Disease (URTD), associated with infection by *Mycoplasma agasizzii*. The disease has been implicated in several large losses of both desert and gopher tortoises. As a result, some management protocols have recommended (or required) that animals be tested for antibodies to the disease and then euthanized if found to be positive. The tests used for this

purpose, however, have been found to be nonspecific for active disease and likely implicate animals that have been exposed (or recovered) as well as active cases. More recent recommendations in Florida have recommended that populations known to be disease-free simply not receive relocated animals from any source (FWCC 2009). In any case, the actions necessary to draw blood samples and send them for testing add a significant level of complexity to relocation programs. It is recommended, however, that all animals relocated undergo a simple, nontechnical health status examination and the information be recorded. The technical report “Handbook on Gopher Tortoise (*Gopherus polyphemus*): Health Evaluation Procedures for Use by Land Managers and Researchers” (Wendland et al. 2009) was developed specifically for use by Army installations and other agency personnel and contractors to prepare such evaluations. The individual data record form (originally Appendix E in the Wendland et al. report) is reproduced here as Appendix C; its use when relocating animals is highly recommended, as are the other suite of procedures in the Wendland publication.

State Permits

While Army managers have typically considered that, as federal managers, they are in charge of everything within the boundary, this is not strictly true. Precedent shows that the wildlife, including tortoises and other species, are the “property” of the state government agency charged with managing these species, usually the Department of Conservation (or Natural Resources). It is good practice to recognize this authority and to coordinate closely with these officials when planning or conducting relocations. Further, where appropriate, the base personnel and contractors assisting may be required to have collecting, handling, or other permits to collect and transport the animals. It is recommended that, at a minimum, the professional supervising the activity have such a permit. The normal federal policy is that employees carrying out their official duties may acquire these permits, though payment of fees is not required. One area where fees and permits have been determined to be applicable is in Florida relocations to outside installation sites, where the contractors carrying out the relocation need state permits for which there is a published fee structure (FWCC 2009).

Headstarting

The practice of headstarting is simply that of allowing the young animals to grow to an older and larger size before

releasing them into the environment. It does not apply to relocation of tortoises, per se, but may come into play if numerous very young tortoises are found in an area from which all animals must be removed. Various studies have proposed raising them in captivity for 1–5 years. This practice requires some effort, and results may be uncertain and hard to quantify. In theory, this is the best way to assure survival of hatchlings through to less vulnerable stages. This was one of the focus areas in the PVA study of Tuberville et al. (2009). Several ongoing studies concern both gopher tortoises (Harrod 2010) and desert tortoises (Hagan 2009). Neither of these studies has yet had definitive results other than some partial negatives (e.g., 1-year and 2-year animals are not yet free of high risk from predation). Many studies with small numbers of animals (e.g., 10 or 20) have found that none survived more than 2 years. Logically, some must survive; otherwise, there would be no older animals. The survival rate must, however, be very low, possibly as few as 5 or 10 per thousand hatchlings.

Penning

As used here, penning refers to the practice of constructing a temporary holding pen when relocating tortoises to a new habitat. Studies appear to show that confining tortoises to an enclosure for from 3 to 12 months greatly increases the likelihood that the animals will remain in that general area when the enclosure is removed (Tuberville et al. 2005). Aluminum roll flashing 18–24 in. (~45-60 cm) wide, as normally used for roofing, has been used successfully but current practice is to use silt fencing. The Florida Gopher Tortoise Permitting Guidelines (FWCC 2009) recommend a specific silt fencing (Belton Industries #935), a durable fencing that is 36 in. x 75 ft (~0.91 cm x 22.86 m); preassembled, and double-stapled, with oak stakes, but other brands of comparable quality and size will likely be adequate.

The idea with penning is that two types of inherent tortoise actions will be suppressed. The first activity is the tendency to return to the place from which they were taken, and the second is the less predictable movement away in almost any direction, apparently in search of what the animal considers “a better place.” This pen should be large enough so that the animals may forage as normally as possible, i.e., that soft, edible annual grasses and forbs are available for food. In practice, a pen for 20 animals may be 1 acre or more in size, depending on habitat quality. The hope is that the tortoises will dig burrows and begin to feel at home. “Starter” burrows

made with a shovel or posthole digger have been used at times but are not normally necessary if the soil is a loose sandy type.

Commensals

Commensals are animals that live in association with the tortoise, utilizing both active and inactive burrows for shelter. While more than 100 species have been described as utilizing tortoise burrows, only a few vertebrate species are of special concern, since they are also listed or at-risk species. The most important species of concern include the indigo snake (*Drymarchon couperi*), pine snake (*Pituophis* spp.), gopher frog (*Lithobates capito*), and, in Florida, the Florida mouse (*Podomys floridanus*). In general, the guidance given for the snake species is to relocate them at the same time and to the same location as the tortoises, allowing them to locate burrows or other suitable refuges. The gopher frog is a more complex species. They require fish-free ponds within 0.25–0.5 mi (0.4–0.8 km) of the burrow in order to complete their life cycle. There should not be a barrier (e.g., a road) between the new burrow area and the pond. Frogs taken from donor burrows may be placed into recipient burrows, and they will normally be able to locate the new pond in the spring. To present this guidance in more detail, Appendix 9 of the Florida Gopher Tortoise Permitting Guidelines (which details their recommendations for commensal handling) is reproduced as Appendix D of this PWTB.

Genome Considerations

One concern with relocating animals, including tortoises, is that the genetic background of the source population will not be adequately adapted to the relocation environment. The Florida Gopher Tortoise Permitting Guidelines suggest that the tortoises under their regulations not be moved more than 62 mi (100 km) north or south of their original habitat. This will not normally be a problem on Army installations except in a case where the installation is the recipient of animals taken from another location. In practice, this eventuality will be managed in most cases by the entity providing the animals.

Trapping Protocols

While gopher tortoises are sometimes found on the surface and can be collected by picking them up, it is much more normal to trap them at the burrow mouth. This is done in one of two ways, either with buckets or cages. Local protocols seem to show that bucket trapping is prevalent in peninsular Florida, while cage

traps are more commonly used in other states. The bucket trap is simply the use of (usually) a standard 5-gal (~19L) bucket that is dug into the soil at the burrow mouth so the tortoise falls into the bucket when it attempts to enter or leave its burrow. A cloth camouflaged with leaves or twigs may be used so that the opening is not as visible. Wire cage traps may also be used, and are usually placed at or slightly below ground level close to and facing the burrow opening. Shade should be provided for the trapped animals, and all traps of either type should be checked at least twice daily (and preferably more often) for trapped animals. The Florida Gopher Tortoise Permitting Guidelines discuss the procedures required for either type of trapping.

In addition to trapping, tortoises may also be dug out of burrows, either by hand or by backhoe. Hand excavation is very difficult and time-consuming, as burrows may be up to 6–7 ft (1.8–2.1 m) deep and 12–20 ft (3.6–6.1 m) long. Very experienced backhoe operators can safely excavate tortoises, but inexperienced operators may cause tortoise injury or death. The Florida Gopher Tortoise Permitting Guidelines require that operators be trained, tested, and certified to be allowed to perform this task. It is highly recommended that machine excavation not be undertaken except in emergency situations.

During the tortoise’s season of activity, most animals may be trapped within a week or so and with much less risk to animals or personnel. It is critical for success to avoid relocation plans that have strict dates for completion, as these may tempt (or force) operators to use unsafe actions to remove tortoises from burrows.

Handling Conditions

One of the most common causes of tortoise trauma is poor handling by humans following trapping of the tortoises. While many people assume tortoises spend all day in the sun, in reality, they require shade from the direct sun and good ventilation during midsummer conditions. If tortoises are transported in the cages in which they were trapped (a common practice), these traps should not be carried for more than 10 minutes of driving time or held more than 30 minutes in the bed of a pickup truck without shade. For shade, keep them inside a well-ventilated camper top or sport utility vehicle.

Again, the Florida Gopher Tortoise Permitting Guidelines, starting on page 9 in the section entitled “Capture, Handling,

and Transport of Relocated Tortoises," discusses these aspects of tortoise management in some detail.

Survey Methods

Broadly speaking, there are two ways to determine how many tortoises are located on a site. The first, and by far the most common, is to count the number of active burrows and then "correct" this by some factor to account for the fact that tortoises use more than one burrow. The exact value used has varied from 0.25 to 0.61, the latter being the value reported in one detailed study in the past (Auffenberg and Franz 1982), and often used as a default "correction factor." A caution should be stated here, in that this last value has been applied all across the gopher tortoise range without adequate confirmation that it is applicable to local conditions. A local, detailed study would be advisable if reports are to correspond to numbers of tortoises rather than just to numbers of burrows. That said, it may be adequate to monitor burrow numbers when trying to determine if populations in one location are increasing, decreasing, or staying the same. The assumption here is that the occupancy rate will be the same, or similar, across time. (See the section below on Burrow Counts.)

The second method to determine the number of tortoises relies on careful counting of burrows in combination with use of an electronic viewing scope that affords a view down a burrow to verify it is occupied by a tortoise[2]. Applied to the total areas under survey using a statistically appropriate algorithm, a more accurate relationship between burrow number and number of animals may be derived. This technique, called "distance sampling" (http://www.ruwpa.st-and.ac.uk/distance/[3]), is examined in detail in two recent publications developed for this purpose (Nomani et al. 2008 and Smith et al. 2009). The use of distance sampling is not currently required for any purpose, but may be used when it is desired to be able to demonstrate population trends across longer time periods. An interval of 5 or 10 years is likely a reasonable frequency for it to be applied for

[2] Possible sources include Sandpiper Technologies, Inc. of Manteca, CA (www.sandpipertech.com/index.php); Marks Products of Williamsville, VA (www.geovision.org); and Emmett L. Blankenship, DVM, 224 Transart Pkway, Canton, GA. This list in no way implies endorsement of these vendors.

[3] We note that this software may not be allowed to be installed on official Army computers without local IM approval.

species as long-lived as tortoises, since trends will require that long to become visible.

Burrow Counts

It may seem obvious that counting something as conspicuous as a tortoise burrow is simple. Numerous studies across the years have shown, however, that 100-percent detection of the burrows across a large area is almost never achieved; some percentage is almost always overlooked. In the above section (Survey Methods), two recent reports (Nomani et al. 2008 and Smith et al. 2009) examine thoroughly the question of the best way to count burrows accurately in addition to the application of statistically more accurate estimation methodology. One cannot assume that successive surveys of the same area, even by the same observers, will yield the same answer. Thus use of simplistic burrow counts may not be fully reliable for making management decisions.

Monitoring of Results

One of the most serious criticisms of relocation actions is that records are poor or nonexistent and little or no monitoring is performed to allow objective evaluation of the success of the relocation. When no follow-up monitoring of the relocated animals is performed, one really never knows their fate. (Did they all survive? Did any survive? Did they stay in the area? Where did they eventually locate their burrows? Answers to these questions are some of the data not only needed for responsible decision making but also required by the Florida Gopher Tortoise Permitting Guidelines. The use of the record form (Appendix C) will allow appropriate information to be recorded about each relocated animal. With the addition of a means to identify the animal (see Calge 1939), the relocated animals may be recaptured and their condition compared with the condition at the time of their release. For longer-term monitoring, periodic surveys of the number of active burrows and of the resident population are recommended at 5- to 10-year intervals. See the section above on Survey Methods for more information.

Invasive Species

Tortoises face threats from many invasive plant and animal species. Cogon grass (*Imperata cylindrica)*, for example, creates a dense cover of coarse stems which are neither edible nor allow movement of the animals across the grass patch. It is spreading into many tortoise habitats and may become a serious problem for tortoise management in many of these locations. Many of the animal species discussed in the Predators section are invasive

to one degree or another, and some, such as the red imported fire ant (*Solenopsis invicta*) and the armadillo (*Dasypus novemcintus*), have spread to all parts of the tortoise range in the past few decades.

Basal Area

When the term “basal area” is used with respect to habitat considerations, it refers to the forestry measurement which sums the square footage of the cross-sections of all the tree trunks within an acre of habitat. A mature pine plantation may measure well over 100 square feet per acre (sf/acre) or about 22 square meters per hectare (m^2/ha), while a newly harvested site with only a few remaining seed trees might measure only 5 sf/acre (~1.1 m^2/ha). At 100+ sf, the soil surface is in dense shade most of the time, and the herbaceous plants that the tortoise must eat cannot thrive. In the past, and even within some currently published management pamphlets, recommendations are made that tortoise habitat should be maintained in the 60–80 sf/ac (13.3–17.8 m^2/ha) range. This is considered a survivable density for tortoise management but is far from ideal. More current thought about ideal tortoise habitat suggests no more than 40 sf/ac (8.9 m^2/ha) as best. Incidentally, densities in the 20–40 sf (4.4-8.9 m^2/ha) range are considered best for troop training purposes as well, so both goals are met. This is closely related to the topic of Canopy Cover.

Canopy Cover

Canopy cover refers to the percentage of sunlight which is blocked from striking the ground by the vegetation, either trees or shrubs. It is closely related to the Basal Area topic, and high basal areas imply denser tree cover and less available sunlight at ground level. As noted under Basal Area, values for basal area over 100 sf/acre (22 m^2/ha) imply almost no sunlight is available for growth of herbaceous plants. At this density, canopy cover may be 90–100%, and little or no sunlight gets through. Cover densities in the 60% and lower levels are best for tortoises, with values in the 40–50% level close to ideal. In normal managed forestry, these cover values correspond to basal areas in the 30–40 sf/acre (6.7-8.9 m^2/ha) range. See Tuberville (2009) for further discussion. Canopy cover is measured in several ways; one of the simplest is in a nontechnical lesson plan from Portland State University (2010). A more technical description is the subject of Forest Service Publication 108 (Schreuder et al. 2003). In practice, “eyeball” estimates may be adequate to determine if shading is too much.

Shrub cover

Just as canopy cover by the dominant forest trees may cause the forest floor to become too shady, the same may result from dense growth of shrubs. This is usually the result of inadequate use of prescribed fire, which is the most effective way to reduce growth of woody shrubs. Again, as discussed above under canopy cover, management should try to maintain a condition where at least 50% of available sunlight reaches the ground level. If frequent use of fire is not practical, mowing or other shrub suppression measures will be needed. Herbicides can be used, but broadcast application may also affect the herbs and grasses upon which the tortoises depend for food. This balance is a difficult one, and results have not been uniformly satisfactory. Questions have also been raised as to whether some of the persistent herbicides affect tortoise health directly, but no clear answers are apparent at this time.

Herbaceous cover

Equivalent to groundcover, herbaceous cover refers to the number and quality of the forage plants present to feed tortoises. In a dense, shady plantation, almost no herbaceous cover may be found. As discussed below under Food Plots, tortoises eat a very wide variety of grasses and forbs. It has been suggested that herbaceous legumes are important in the diet, and some site-index-suitability evaluations target legumes as a factor in determining habitat suitability. There does not, however, appear to be any firm guidance available in this regard. In very severe habitats, where few or no herbaceous plants grow, a few tortoises may survive for many years, but additional animals will not be able to be added to those locations.

Food Plots

Food plots are a concept borrowed from wildlife management for harvested species, where forages and grains are planted to support higher populations of hunted species. In tortoise context, grasses and legumes have been planted to provide a food source where native species are less abundant. Tortoises do make some use of such plots, although their necessity is not well understood. The gopher tortoise has been reported to consume more than 200 herbaceous species (Ashton and Ashton 2008). A variety of food in the diet is considered necessary, but the exact composition necessary for survival is not known. The most reasonable suggestion would appear to be to rely on habitat improvement (see Basal Area and Canopy Cover) and possibly use

planted forage only in preparation for establishing a holding pen for relocation penning.

Predators

Predation, especially of eggs and hatchling tortoises, may be the single most important factor in achieving successful management. It appears that almost every larger species preys on young tortoises. What are termed “subsidized” predators are the most problematic. These include species such as the raccoon (*Procyon lotor*), opossum (*Didelphis virginiana)*, coyote (*Canis laatrans*), and both feral and domestic cats and dogs. We term them subsidized because they receive some of their food supply from intentional feeding from humans or from human wastes. For this reason, they are able to maintain much higher population density than if they were subsisting totally on natural sources. This increased density of predators, combined with human expansion into tortoise habitat, allows the balance between predator and prey to become weighted against the tortoise, especially in the youngest stages of their growth. Other natural predators include the indigo (*Drymarchon couperi)* and coachwhip (*Masticophis flagellum flagellum*) snakes, red (*Vulpes vulpes*)and gray (*Urocyon cinereoargentus*) foxes, skunks (primarily *Mephitis mephitis*), and even alligators (*Alligator mississipiensis*). All of these predators will destroy nests and eat the eggs prior to their hatching. The loss rate from egg predation is very high in some areas, often approaching 100%. Some managers attempt to bypass this risk by taking clutches into protected areas for hatching. This may be useful in some cases, but involves considerable effort. One invasive predator that may be very hard to manage for is the red imported fire ant (*Solenopsis invicta*). They have been reported (Epperson and Heise 2003) to cause close to 100% mortality of newly hatched tortoises in Mississippi when the tortoise nest was close to a fire ant nest. At the other edge of the range, on the Atlantic coast of Florida, the fire ant was found to be an almost constant associate of tortoise burrows, but the level of predation was not reported (Wetter and Moore 2005).

Armadillos

The nine-banded armadillo (*Dasypus novemcintus*) is invading almost all areas where gopher tortoises are found. They are likely an occasional egg predator, but their greater harm may be in altering the size and shape of tortoise burrows. The change, from a flattened oval to a round opening, opens the burrows to many other species, some of which are likely tortoise predators,

such as raccoons. An armadillo can otherwise modify the burrow in ways that cause tortoises to abandon the burrow. In some habitats, where burrow sites are scarce, this activity may further stress tortoise behavior.

APPENDIX B

RESOURCES AND REFERENCES

Resources

The following reports and publications contain recommendations relevant to many aspects of the management of the gopher tortoise, including guidance on best practices to follow when they must be relocated.

Ashton, Ray E, Jr. and Patricia Sawyer Ashton. 2008. The Natural History and Management of the Gopher Tortoise (*Gopherus polyphemus* Daudin). Malabar, FL: Krieger Publishing Company.

Ashton, R and P. Ashton, ND, *Habitat and Foraging-What Do Tortoises Need?* Available at: http://www.ashtonbiodiversity.org/pdf/habitat-foraging.pdf

DeBerry, Drue, and David Pashley. 2004. *Pine Ecosystem Conservation Handbook for the Gopher Tortoise: A Guide for Family Forest Owners*. Washington, DC: American Forest Foundation. Available at: http://www.affoundation.org/Handbook_Gopher_Tortoise.pdf

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APPENDIX C

GOPHER TORTOISE RECORD FORM
(reproduced from Wendland et al. 2009)

The data sheet shown on the next two pages is one that has proven useful for recording the condition of tortoises collected in the field. Its application for responsible relocation activities is highly recommended. Even if not all the procedures may be accomplished, partial information is better than none at all.

This information record is intended to be used in combination with other information and appendices contained in the referenced Technical Report. The report is available at http://www.cecer.army.mil/techreports/ERDC-CERL_TR-09-1/ERDC-CERL_TR-09-1.pdf. It is highly recommended to have a copy of the report available when completing this information sheet, especially for the color photographs showing different tortoise health problems.

The 2-page record form on the following pages may be reproduced for local use.

Gopher Tortoise Data Sheet

Adapted from Berry and Christopher (2001) and McRae et al. (1981).

Date: _____ Study Site: _____
Time Sampled: _____ Tort. ID: _____
Soil: ☐ Wet ☐ Damp ☐ Dry
Captured: ☐ Trap Trap/Burrow #: _____
☐ Opportunistic Description: Activity/Location (Walking, Basking, Eating, etc.):
_____
Position (in trap): ☐ Face Down ☐ Face Up ☐ Flat ☐ Carapace Down (upside down)
Urine in trap (Yes/ No/ Unknown) Feces in trap (Yes/ No/ Unknown)

HEALTH ASSESSMENT

Behavior: ☐ Alert-responsive ☐ Quiet-responsive ☐ Depressed or Lethargic

Posture: ☐ Can withdraw tightly into shell ☐ Weak limbs ☐ Head drooping or limp

Breathing: ☐ Normal ☐ Abnormal (Wet respiratory sounds / Difficulty Breathing (forelimb pumping, head bobbing). Comments:_____

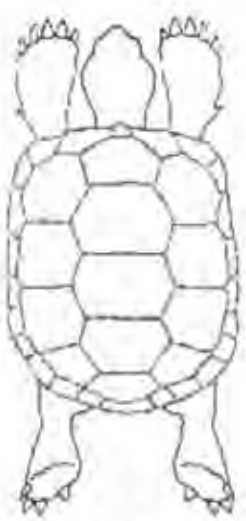
Site	Characteristic (severity: 1=mild; 2=moderate; 3=severe)	Severity	Description
Beak:	Dry / Damp / Wet / Sandy		Frothy saliva, food, other_____
Left Nare:	Normal / Nasal discharge	_____	Clear/ Cloudy/ White/ Yellow/ Green; Sandy/ Occluded
Right Nare:	Normal / Nasal discharge	_____	Clear/ Cloudy/ White/ Yellow/ Green; Sandy/ Occluded
Left Nare Shape:	Normal / Abnormal	_____	Eroded/ Oblong/ Tear-drop shaped
Right Nare Shape:	Normal / Abnormal	_____	Eroded/ Oblong/ Tear-drop shaped
Left Eye:	Normal / Abnormal	_____	Discharge / Dull / Cloudy / Sunken / Sandy / Bulging
Right Eye:	Normal / Abnormal	_____	Discharge / Dull / Cloudy / Sunken / Sandy / Bulging
Left Eyelid:	Normal / Swollen	_____	Upper / Lower
Right Eyelid:	Normal / Swollen	_____	Upper / Lower
Left Periocular:	Normal / Swollen	_____	Upper / Lower
Right Periocular:	Normal / Swollen	_____	Upper / Lower
Left Conjunctiva:	Normal/ Abnormal	_____	Enlarged/ Red
Right Conjunctiva:	Normal/ Abnormal	_____	Enlarged/ Red

Lesions (cuts, scrapes, etc.) on beak, eyes, lids or periocular area: _____

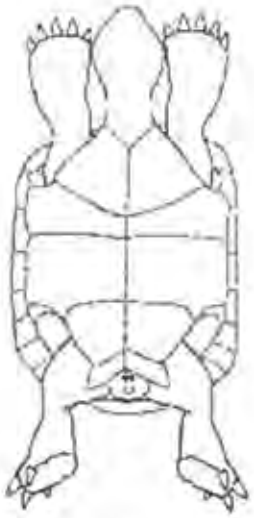
Mouth: ☐ Observed ☐ Not observed
☐ Mouth/tongue pink ☐ Mouth pale pink ☐ Mouth white ☐ Crusts & Plaques ☐ Discharge
Describe any abnormalities:_____

Ticks: Hard bodied #_____(or) ☐ more than 10
Soft bodied #_____ (or) ☐ more than10

Shell/ Body Injuries: ☐ Yes (Draw lesions on diagram) ☐ No
Source: ☐ Trauma ☐ Disease ☐ Unknown_____
Time Span: ☐ New Injury ☐ Apparently old, present for long time (chronic)
Location: ☐ Plastron ☐ Carapace ☐ Front limb ☐ Hind limb ☐ Head ☐ Neck ☐ Other
Lesion description (limbs/head/other): _____
Shell lesion distribution: C=carapace; P=plastron
C P ☐ **Mild** (only at seams, covers < 10%)
C P ☐ **Moderate** (covers 11-40 %)
C P ☐ **Severe** (covers > 40%)
Shell lesion severity:
C P ☐ **Mild** (lightly discolored at edges, little flaking)
C P ☐ **Moderate** (several layers of laminae discolored, more flaking, small superficial holes)
C P ☐ **Severe** (scutes eroded or missing, bone exposed)
Other comments: _____



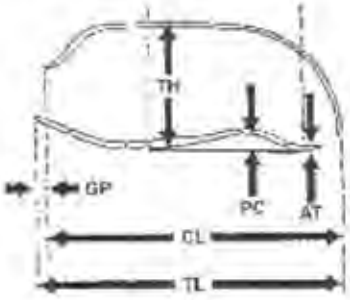
Carapace View

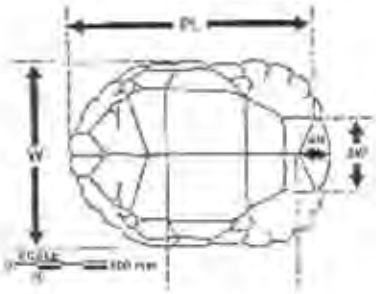


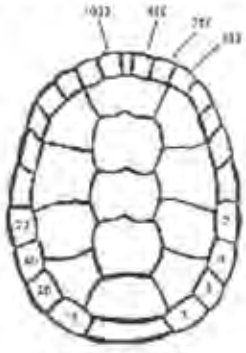
Plastron View

BODY MEASUREMENTS (in mm)
Total Body Length:_____
Carapace Length:_____
Plastron Length:_____
Max. Body Width:_____
Max. Thickness:_____
Anal Width:_____
Anal Notch:_____
Plastron Concavity:_____
Plastron Rings:_____ ☐ Too worn to tell

Sex: Male/ Female/ Adult Unknown/ Juvenile
Body Weight (kg):_____
☐ Urinated (Before/After weight measured)
☐ Defecated (Before/After weight measured)







CARAPACE

Checklist:

☐ **Blood sample/smears**	☐ **Photos**	☐ **Ticks Collected**
☐ **Nasal flush**	☐ **Radiographs**	☐ **Data sheet complete**
☐ **Tortoise Marked**	☐ **Fecal Sample**	☐ **Reviewed by Sup.** _____

APPENDIX D

MANAGEMENT OF COMMENSAL SPECIES DURING GOPHER TORTOISE RELOCATION ACTIONS

(Text has been copied in its entirety from Appendix 9 of the Florida Gopher Tortoise Permitting Guidelines[4])

INTRODUCTION

Commensals are species of animals that live within gopher tortoise burrows, deriving food, refuge, or other benefits from the burrow environment. Threats to commensal species are similar in nature to those faced by the gopher tortoise and have been addressed in the *Gopher Tortoise Management Plan*. These guidelines have been created to provide guidance for authorized agents who capture commensal species during gopher tortoise relocations. Authorized agents conducting activities under gopher tortoise permits are encouraged to minimize the mortality of commensal species and, where possible, to relocate commensals with the tortoises.

RULES PROTECTING COMMENSAL SPECIES

Florida Gopher Frog (*Rana capito*)

The Florida gopher frog is listed as a Species of Special Concern (Rule 68A-27.005, F.A.C.) by the Florida Fish and Wildlife Conservation Commission (FWC). It is illegal to take gopher frogs or their eggs without a permit issued by the FWC Executive Director (Rule 68A-27.002, F.A.C.). The gopher frog is also considered a Species of Concern (SOC) by the U.S. Fish and Wildlife Service (USFWS). The SOC designation is an informal term indicating some degree of concern for the future of the species, but does not impart any Endangered Species Act protection.

Florida Mouse (*Podomys floridana*)

The Florida mouse is listed as a Species of Special Concern (Rule 68A-27.005, F.A.C.) by FWC. It is illegal to take Florida

[4] PWTB author's note: As a government-sponsored publication, the document is in the public domain. Appendix 9 begins on page 47 of the publication, available at http://www.nbbd.com/godo/ef/gtortoise/0804-PermitGuidelines.pdf.

mice or their nests without a permit issued by the FWC Executive Director (Rule 68A-27.002, F.A.C.). The Florida mouse is also considered an SOC by USFWS. The SOC designation is an informal term indicating some degree of concern for the future of the species, but does not impart any Endangered Species Act protection.

Eastern Indigo Snake (*Drymarchon couperi* [= *Drymarchon corais couperi*])

The eastern indigo snake is listed as a Threatened Species (Rule 68A-27.004, F.A.C.) by FWC. It is illegal to take indigo snakes or their eggs without a permit issued by the FWC Executive Director (Rule 68A-27.002, F.A.C.). The indigo snake has also been classified as a Threatened Species by USFWS since 1978. The Threatened Species designation is a formal term indicating a moderately high level of protection provided by the Endangered Species Act. For federally listed species like the indigo snake, federal permits are required to capture, handle, or relocate individuals; therefore, authorized agents should coordinate with USFWS.

Florida Pine Snake (*Pituophis melanoleucus mugitus*)

The Florida pine snake is listed as a Species of Special Concern (Rule 68A-27.005, F.A.C.) by FWC. It is illegal to take pine snakes or their eggs without a permit issued by the FWC Executive Director (Rule 68A-27.002, F.A.C.), but individuals may possess one Florida pine snake without a permit (Rule 68A-25.002[12]).

SPECIES-SPECIFIC GUIDELINES: IDENTIFICATION, HABITAT NEEDS, CAPTURE, and RELOCATION

Eastern Indigo Snake

The eastern indigo snake is a large, nonvenomous snake found throughout Florida. Its color is uniformly lustrous black except for reddish to cream coloring on the chin and throat. Many indigo snakes in northern Florida are completely black with the exception of a white patch in the center of the throat. The indigo snake is most commonly confused with the black racer (*Coluber constrictor*), which is a duller black color, has a white chin and throat (or brown in the central Panhandle), and is smaller and thinner. In northern Florida, eastern indigo snakes are intimately tied to gopher tortoise burrows that protect them from extreme temperatures and moisture loss. In the

milder climates of central and southern Florida, especially in habitats where tortoises are not present, they rely on a wide variety of other shelters, including hollow tree root channels and logs, burrows of rodents and armadillos (*Dasypus novemcintus*), and limestone solution holes. Because indigo snakes have relatively large home ranges (hundreds of acres) and use a variety of upland and wetland habitats, large diverse recipient sites will best provide for their needs.

In northern Florida, eastern indigo snakes are intimately tied to gopher tortoise burrows that protect them from extreme temperatures and moisture loss. In the milder climates of central and southern Florida, especially in habitats where tortoises are not present, they rely on a wide variety of other shelters, including hollow tree root channels and logs, burrows of rodents and armadillos (*Dasypus novemcintus*) and limestone solution holes. Because indigo snakes have relatively large home ranges (hundreds of acres) and use a variety of upland and wetland habitats, large diverse recipient sites will best provide for their needs.

Relocation:
Indigo snakes may be encountered during site surveys, excavation of gopher tortoise burrows, or capture of tortoises. Snakes must be allowed to vacate the work area before conducting additional burrow excavation or other site manipulation in the vicinity. Site work may commence only after the Authorized Agent (or a registered assistant) documents visually observing the snake vacating the area. Indigo snakes may not be handled for any purpose without specific state and federal permitting authorizations.

Florida Pine Snake
The Florida pine snake is a large, nonvenomous snake with dark brown to reddish blotches on a gray to sandy-colored background. The scales on the upper part of the body are strongly keeled (ridged). The head and snout are distinctly cone-shaped and adapted for burrowing. The species is restricted to xeric habitats in the Atlantic and Gulf coastal plains. In Florida, its historic distribution included most of the state north of Lake Okeechobee and coastal ridges to the south. Florida pine snakes spend much of their time underground, often burrowing into the tunnels of pocket gophers (*Geomys pinetis*) and other rodent prey.

Relocation:
Like indigo snakes, pine snakes may be encountered during site surveys, excavation of gopher tortoise burrows, or capture of tortoises. Snakes may be secured by gentle application of snake tongs, a stick, or other device. Unlike indigo snakes, pine snakes will often bite when captured or handled. Secured snakes should be enclosed in a cloth bag such as a pillow case or similar ‘snake bag’ constructed for the purpose. Alternatively, for those not wishing to handle snakes directly, snakes may be picked up with a rake or stick and dropped into a plastic garbage can with a secure lid. Snakes in bags can be placed in the same type container used for a gopher tortoise (without the gopher tortoise) and maintained under the same conditions as the tortoises until release. Snakes should be released with gopher tortoises and will make their own way to suitable cover.

Florida Gopher Frog

The Florida gopher frog is a stout-bodied frog with short legs, a large head and mouth, and prominent eyes that are slightly larger than the ear drums. The gopher frog’s background color and belly are typically light gray. A series of irregular dark spots form rows along the back and side, and the limbs are distinctly striped. A raised ridge (dorsolateral fold) that is yellow or orange colored runs down each side of the back from head to groin.

The species’ distribution corresponds to that of the gopher tortoise; however, unlike the gopher tortoise, the gopher frog appears to be absent from most coastal islands and dunes. This species occurs primarily in native, xeric upland habitats, particularly scrub and sandhill associations. The Florida gopher frog is extremely dependent upon gopher tortoise burrows, more so than the other listed commensals noted in these guidelines. In addition to its dependence on gopher tortoise burrows as an adult, the gopher frog tadpole only lives in isolated wetlands. These temporary water bodies generally have no fish and may have smaller populations of predatory invertebrates than permanent wetlands.

Relocation:
Gopher frogs are most commonly encountered during tortoise capture, either in bucket traps or during burrow excavation. They can also be trapped by drift fences and buckets or funnel traps set to intercept their seasonal breeding migrations to temporary or seasonal ponds and during breeding at those ponds. Frogs may be secured in plastic containers (one frog per

container) with a quantity of moist soil from the burrow. Containers with frogs can be kept under the same conditions as gopher tortoises for transport. Agents who undertake tortoise relocations in central and south Florida should be aware of two exotic amphibians (Cuban tree frog and cane or marine toad) that may be confused with gopher frogs. These exotic species should not be relocated.

Gopher frogs should only be released directly into the mouth of existing tortoise burrows and only when such burrows are located on a recipient site that has temporary or fish-free ponds within 1 km (0.6 mi) distance and without significant barriers to frog movement (e.g., no roads). Several frogs may be released into one burrow.

Florida Mouse

The Florida mouse is distinguished from other rodents by the following: light reddish-tan color; comparatively large eyes, ears, and hind feet; long tail; presence of five instead of six well-developed plantar tubercles on the soles of the hind feet; fragile tail sheath that may slough off during handling; and a distinct, skunk-like odor.

The Florida mouse is endemic to Florida and is restricted largely to the northern two-thirds of the peninsula, where it typically occupies fire-maintained, xeric vegetative communities on deep, well-drained soils. The biology of the Florida mouse is closely tied to the gopher tortoise, whose burrows are used as nesting sites and refuges during dispersal. Florida mice are most common in sandhill, scrub, and scrubby flatwoods, but other xeric upland habitats may be used. These habitats are characterized by the presence of acorn-producing oak trees, especially scrub oaks and other species considered to be in the “white” oak group. The ground cover is usually interspersed with patches of bare sand, but a diverse assemblage of grasses and forbs is typically present. An open tree canopy, typically composed of longleaf or other pines, may be present.

Relocation:
Florida mice can be captured alive in Sherman live traps baited with sunflower seeds and set in or near the gopher burrow entrance. Mice can also be opportunistically captured by hand during burrow excavation. Mice can be retained in Sherman traps for 24 hours, as long as they are carefully protected from extremes of heat and cold. Mice should be released at the mouth of gopher tortoise burrows at the relocation site. To maximize

translocation success, mice should be released into active burrows of adult gopher tortoises. Florida mice should be released only within their known range.

Suitable habitats at the recipient site should primarily be limited to sandhill, scrub, or scrubby flatwoods. A tree layer, typically composed of longleaf or other pines, may be present; percent canopy cover should not exceed 30%. A shrub layer dominated by scrub oaks, other oaks, or other shrubby species (e.g., palmetto) should be present. The shrub layer should be discontinuous, typically 1-3 m (3-10 ft) high and with 30-70% coverage. A diverse ground cover assemblage of grasses and forbs should be present and interspersed with conspicuous patches of bare ground. Active and inactive gopher tortoise burrows should be present. The minimum size of suitable habitat patches for Florida mice probably should be 25 ha (62 acres); bigger is better. Isolated sites supporting suitable xeric upland habitat should be connected by less suitable (degraded) xeric upland or mesic habitats (native or reclaimed) considered capable of supporting tortoises. Because the maximum dispersal distance for Florida mice is not well known, suitable patches of xeric upland habitat probably should not be separated by more than 1-2 km (0.5-1 mi) to maximize the probability that Florida mice would be able to move successfully among patches.

Nonlisted Burrow Commensals

The gopher tortoise is considered to be a keystone species, one whose burrows serve as a shelter from stressful environmental conditions (e.g., cold, heat, fire, dryness), as a site for feeding or reproductive activities, or as a permanent microhabitat for some 350-400 other species. Although FWC does not require nonlisted burrow associates to be relocated, these species, if encountered, may be relocated with the gopher tortoises. This practice has important positive implications for gopher tortoises and all the listed burrow associates. For example, cave crickets (*Ceuthophilus* sp) and other burrow-dwelling invertebrates are important prey of gopher frogs and Florida mice. Few or no data exist regarding relocation effectiveness or success for these nonlisted commensals. However, by relocating the entire suite of burrow associates, the biodiversity of recipient sites will likely be enhanced.

Relocation:
Material from the bottom of a gopher tortoise burrow, including specimens of invertebrate commensals and their larvae, may be transported in any suitable container and deposited at the

relocation site. In addition, burrow soil used in tortoise relocation containers may be deposited at the recipient site.

APPENDIX E

ABBREVIATIONS

Term	Spelled out
ACUB	Army Compatible Use Buffer
AR	Army Regulation
CCA	Candidate Conservation Agreement
CECW	Directorate of Civil Works, USACE
CEMP-CE	Directorate of Military Programs, USACE
CERL	Construction Engineering Research Laboratory
cm	centimeter
ERDC	Engineer Research and Development Center
FAC	Florida Administrative Code
ft	foot/feet
FWCC	Florida Wildlife Conservation Commission; also FWC
gal	gallon
HQUSACE	Headquarters, U.S. Army Corps of Engineers
IM	information management
km	kilometer
L	liter
m	meter
POC	point of contact
PVA	population viability analysis
PWTB	Public Works Technical Bulletin
SAR	species at risk
sf	square foot
SOC	species of concern
URL	universal resource locator
URTD	upper respiratory tract disease
USACE	U.S. Army Corps of Engineers
USFWS	United States Fish and Wildlife Service