

# **GOPHER TORTOISE RELOCATION METHODS AND MANAGEMENT**

This chapter deals with the important points and issues that surround the controversial topic of relocation. It also provides straightforward “how to” information on relocation methods and how these relate to overall management of gopher tortoise habitat. In the previous chapters we have covered many of the required techniques that make relocation possible. These include: how to identify suitable forage and monitor that forage (Chapter 3), how to hold and transport tortoises and assess their health (Chapter 4), how to identify and monitor tortoise habitat (Chapter 5), how to identify and survey tortoise burrows and determine population counts (Chapter 6), how to capture tortoises (Chapter 7), how to excavate burrows (Chapter 8), and how to create suitable management and monitoring plans for recipient sites (Chapter 9). This brings us to the important information on relocation that is still needed such as the specific details of how to determine when and where to relocate and how to deal with the concerns and issues of the agencies and stakeholders. Most importantly this chapter deals with the techniques for making sure that a relocation will be done ethically and will be successful.

## **DEFINING RELOCATION**

The IUCN (1998) has provided definitions of various types of relocation. They are:

**Re-introduction:** an attempt to re-establish a species in an area which was once part of its historic range, but from which it has been extirpated or is becoming extinct.

**Translocation:** deliberate and mediated movement of wild individuals to an existing population of conspecifics.

**Re-enforcement/Supplementation:** addition of individuals to an existing population of conspecifics.

**Conservation/Benign Introductions:** an attempt to establish a species, for the purpose of conservation, outside its recorded distribution but within an appropriate habitat and eco-geographic area. This is a feasible conservation tool only when there is no remaining area (habitat) left within a species historic range.

### **Definitions are Based on the Recipient Site Needs**

If one reads the definitions of relocation, it is clear that they refer to the conditions on the recipient site. Basically, conservation based relocation must be based on the recipient site and its tortoise population's needs. If a population has been extirpated and conditions have improved, then a re-introduction is planned. If a population has declined below carrying capacity, then supplementation can be planned and carried out to insure there is sufficient genetic stock. In the practical, on the ground sense, relocation that has been occurring within the range of the gopher tortoise for as long as people have been within its range has encompassed at various times all of these definitions. As discussed previously, it has been shown that from pre-Columbian times through the present, people have moved thousands of tortoises per year throughout the range, with little or no regard for the above definitions or for any regulations or restrictions. The concerns surrounding relocation (by any definition) have continued to be discussed, sometimes most emphatically with proponents on both sides of the issue. First and foremost is the basic issue – to relocate or not to relocate- and the ultimate affects on conservation of the species of either choice. In other words – “what is

the true conservation value for the species of any action?” The concerns are of course much more expansive than just this one issue.

As a result of our many years experience and research with relocation and in response to the increasing concerns and disturbing potential policy changes surrounding relocation we organized the *International Roundtable on Chelonian Relocation and Assurance Colonies* (Roundtable) meeting held September 2000 in Orlando, Florida. The issues raised and recommendations made in this section are based on the results of that Roundtable. In addition we have incorporated the findings and recommendations of more recent research and meetings, many of which arose from that Roundtable. The issues discussed at the Roundtable developed from meetings of the Chelonian Working Group (CWG), a group of 27 gopher tortoise biologists that met at Finca del la Tortuga – Ashton Biological Preserve on August 19, 1999. Many of the important issues to be addressed or refuted were brought up by Seigel and Dodd (2000). This group pondered many of the key topics on how any relocation of turtles or tortoises should be undertaken. Topics included ethics, environmental issues, social and economic needs, morphologic and genetic information, and disease issues. These discussions continued with the contributions of international chelonian experts at the Roundtable. Ashton Biodiversity Research and Preservation Institute hosted the CWG and Roundtable meetings and worked to get the proceedings of both meetings published. The CWG recommendations were published in Meshaka and Babbit (2005). The Roundtable recommendations are in final preparation.

## **The History and Foundations of the Concept of Relocation**

The information provided in this document is important to understanding the concepts regarding the foundations of relocation, its planning, goal setting, management and monitoring. The concept of relocation of gopher tortoises was put into practice officially

following the listing of the gopher tortoise as a Species of Special Concern in 1986. It was later listed as a Federally Threatened Species in parts of Louisiana, Alabama and Mississippi. Human growth and thus development within the tortoise's range continued to boom in the late 1980s through the 1990s and is now at an all time high as we move forward in the 21<sup>st</sup> century. Tortoises on development sites were first allowed to be relocated off-site to appropriate habitats if in fact the recipient site land owner agreed to protect and manage for the tortoises (Cox 1987) but this was rarely followed up on or enforced. Rarely was the recipient site inspected to determine if it had an adequate carrying capacity for the number of tortoises to be relocated. There was usually no follow up to check on the success of the relocation (as per our personal research of FWC records). Studies by Godley (1981), Burke (1987), Dodd and Seigel (1991), Seigel and Dodd (2000) and our own studies indicated that more than 75% of the tortoises relocated on to a site could not be accounted for after one year. Studies conducted at the Savannah River Research Lab in South Carolina have demonstrated that if not enclosed, a similar percentage of tortoises migrated completely off the recipient site (Tuberville 2005) (Ashton and Burke 2006). Landers (1980) indicated that if tortoises were enclosed for several months on a recipient site, that at least 75% of the tortoises demonstrated site fidelity. We have found that if enclosed for three months, less than 75% maintained site fidelity after the enclosure was removed but up to 98% maintained site fidelity if the enclosure was maintained for up to six months. By the early 1990s relocation also involved the concept of mitigation. In many cases this meant that the landowner of the development site was responsible for mitigating for the loss of the tortoises and tortoise habitat on land to be developed. As part of this process the relocation of tortoises to recipient sites evolved into the basic form of relocation we have today. In effect, relocation today is the movement of tortoises that can be found on the donor site to an approved recipient site. The removal and movement of these tortoises can occur through several methods including trapping or excavation of burrows. There are guidelines developed by regulating agencies in each state that apply to relocation activities

but there are no qualifications required for the people carrying out these processes. Relocation has not been viewed by these agencies as a conservation tool but rather as a simple method of not entombing or outright killing tortoises on development sites. An opposite action from relocation is mitigation, referred to as Incidental Take (FWC 1996). The tortoises remained on the development site and were frequently killed outright. By 1996 it was determined that gopher tortoises had a potentially lethal (to themselves) disease known as upper respiratory tract disease (URTD) caused by a bacterium known as *Mycoplasma agassizii* (Brown et al 2002). The concerns grew over this disease which at first was believed to be a tortoise equivalent of "AIDS", a definite death sentence. This doctrine spread through the scientific community and was reinforced by the fact that large numbers of desert tortoises (*Gopherus agassizii*) were dying from URTD (Berry 1997). With the increasing concerns, the call for testing tortoises before relocating them began to be heard, from us, from the Gopher Tortoise Council (GTC) and from the veterinary science community. As more research was completed and time passed, it became apparent that URTD was not "tortoise AIDS" and that healthy individuals could be exposed (positive test) and still live long healthy lives. There was a time lag between research and the FWC creating a rule that tortoises had to test negative in order to be relocated. By the time this rule came into play, research was already showing that URTD was not the deadly disease as first believed. The difficulty of incorporating testing into the relocation process was immediately evident. There was only one lab in the entire State of Florida that could perform the test. There had been at least two to several strains of *Mycoplasma* found and the test could only detect one strain. There was no training available and no requirement for training for the personnel tasked with taking the blood and preparing it appropriately to send for testing (Jacobson pers comm). A single positive test immediately condemned an entire population of tortoises to destruction on-site with no recourse for relocation. On the other hand there was no requirement for testing tortoise populations already in place on the recipient site. Very shortly after testing became the rule, we and other groups began to call

for its elimination, as it served no real purpose for the conservation of the species. This brings us to the status of relocation as it stands at the time of this publication. FWC announced on August 15, 2006 that URTD testing was no longer required before relocation could be considered.

### **Recommended Methods for Relocation**

Our recommended methods for relocation are based on conservation principles that were put together by the Roundtable and take into account the various definitions of relocation as outlined in this chapter. The major issue with the current methods is that the agencies responsible for the species have not defined long-term goals for relocation that will work toward sustaining this species and their commensals in perpetuity. Without clear goals relocation may not fulfill the desired conservation objectives.

### **Defining Long-term Goals of Recipient Sites Before Relocation**

When a form of relocation, as defined in the beginning of this chapter, is to be undertaken, the first steps need to include a determination of the status of both the donor and recipient sites. What is the history of the site including its current and past land use? These questions would need to be researched and answered before a relocation plan with the needed long term goals can be created. A well-designed relocation plan should provide the means by which animals being relocated would have a chance to successfully augment any existing population on the recipient site. However, under the methodologies being used from the beginning of relocation through 2005 by most though not all consultants, it is clear that most tortoises may not have survived on the recipient site. This is based on data provided by 22 consultants conducting relocation doing post relocation follow-up, and in studies on post relocation (Ashton and Burke 2006). The methodologies addressed in this chapter are designed to remedy this situation, helping to ensure survival of relocated tortoises on the recipient site. This should be done within the framework of an Assurance Colony Program.

## **Assurance Colony Programs**

The term “Assurance Colony” was coined at the International Roundtable (2000) and defined in a paper by Ashton, Ashton, Lee and Buhlman (in press.). It refers to a planned system of tracking existing managed populations of tortoises that may be used in the future as part of re-stocking programs. This concept is important when placed perspective, realizing that most tortoise habitat that is not in management in 50 years will not exist and that tortoise populations will no longer exist outside of those managed areas. We have taken the Assurance Colony concept and adapted it to the current conservation needs of the Gopher Tortoise. Thus, the Gopher Tortoise Assurance Colony Program is a way to guide relocation efforts and maximize the conservation value of the recipient sites. Table 10.1 uses the issues and questions set out by the International Roundtable to create and describe the different levels within the Assurance Colony Program.

## **Concerns to be Addressed for Assurance Colony Program Planning**

The following issues and questions came from the Roundtable and subsequent meetings on gopher tortoise relocation. Each major issue section poses some of the questions and concerns that need to be addressed before an Assurance Colony Program is instituted and relocation is carried out.

### Ethics

Who decides what species should be relocated and why? The state and federal agencies are responsible for making decisions on the relocation of tortoises and all of their commensal species. The way in which these decisions are implemented is also an issue related to individual priorities and the individual's sense of what is important including stakeholder and community concerns. Ultimately the ethical decision to relocate tortoises is made by an agency, person, landowner(s) or developers and/or consultant(s).

**Table 10.1 ASSURANCE COLONY PROGRAM LEVELS.**

<b>LEVEL</b>	<b>GOALS</b>	<b>MANAGEMENT</b>	<b>FUNDING</b>
<p>PRIMARY ASSURANCE COLONY (PAC)</p>	<p>To preserve in perpetuity, biologically viable populations of <i>G. polyphemus</i>.</p> <p>This effort includes the need to sustain the most fit wild populations of tortoises that may one day be used to repopulate similar habitats through out the species range.</p> <p>Maintain these populations in representative natural habitats in which this species occupies along with the fauna and flora that makes up this habitat.</p> <p>Sustain natural communities including both flora and fauna – invertebrate and vertebrate.</p>	<p>By state or federal agencies. Site selection will be based on excellent forage and other habitat conditions expected at that type of habitat. A thorough review of the site including potential ground water contaminants, exotic plants and other potential hazards like security and management of tortoises and other species will be evaluated before the site is put into this category. On site baseline studies are to done on resident tortoises to develop a profile against what is “typical for the species” including the presence of native potential pathogens. These studies will create the baseline on which management activities are based.</p> <p>PAC’s receive top priority in spending and staff toward achieving maintaining this goal. Each site will have a detailed Reactive Management Plan and Monitoring program (qualitative and quantitative). The program at each site will be overseen by a biological review committee. Sites have no secondary use except to for demonstration. These sites are not used for research or intensive educational purposes or any other financial goal. Data from standard monitoring programs can be used for research purposes. However monitoring is restricted specifically to criteria related to maintaining an accurate record of overall health and changes in populations. Stress management including working with tortoises is extremely important.</p> <p>These sites must be protected at their boundaries from intrusion or emigration of tortoises.</p>	<p>Funding will come, in part from restructured agency budgets to fund conservation activities and from mitigation lands provided as part of the revised habitat loss mitigation for any habitat lost from development owners.</p> <p>Some mitigation lands currently owned by FWC may be sold (if restoration is too costly or potential soil contaminants may be present) or put into other parts of the Assurance Colony program when they do not meet the high environmental standards for the location of a Primary Assurance Colony.</p> <p>Funding for management would come from mitigation trust funds for the Assurance Colony.</p>

<b>LEVEL</b>	<b>GOALS</b>	<b>MANAGEMENT</b>	<b>FUNDING</b>
<p><b>SECONDARY ASSURANCE COLONY</b></p> <p>(SAC)</p>	<p>The goals for the secondary assurance colony are the same as PAC exempt.</p> <p>These colonies are the primary source of tortoises and other species if and when required to meet the goals of the primary assurance colony (supplementation).</p> <p>Carefully reviewed research directly related to the conservation of the gopher tortoise and species can be done on these properties.</p> <p>Educational programs may be involved as well as human activities that are compatible with the goals.</p>	<p>Over site by agency management staff and scientific oversight will be required.</p> <p>This includes review of activities on the properties supporting the colonies (e.g. silviculture or reclaimed mining sites).</p> <p>Emigration and intrusion barrier fencing may be required.</p>	<p>Same as PAC. However purchase and management may be through state or local conservation lands programs, or in some cases supported by private individuals (example: Nokuse Plantation)</p>
<p><b>TERTIARY ASSURANCE COLONIES (TAC)</b></p> <p>(includes large on-site relocations)</p>	<p>These colonies can be developed on lands where tortoise conservation is not the primary management of the area. This may include parks, forestry lands, pasture lands, and non-exclusionary conservation easements.</p> <p>The primary goal of these sites is to provide a site where tortoises may be relocated to from donor sites where habitat is being destroyed. These are particularly important in heavily populated counties.</p> <p>However, to receive a paid permanent conservation easement or agreement with the managing agency to support habitat conservation management, a set management plan and monitoring program would have to be in place.</p>	<p>Traditional managers of federal, state, or county conservation lands, private landowners with permanent conservation easements specifically for this program. Oversight may be provided by a Nonprofit conservation organization, governmental agencies or state conservation agencies.</p>	<p>Primary funding comes from a secondary source or as part of an agreement with state agencies for funds from mitigation for management and land provided by local developers as part of mitigation for tortoise and habitat loss.</p>
<p><b>HUMANITARIAN AND EDUCATIONAL RECEIVING SITES</b></p> <p>(includes small on-site relocations)</p>	<p>To provide the general public an ability to manage community tortoise programs;</p> <p>To allow large landowners to provide habitat with some protection (safe harbor agreements);</p>	<p>Appropriate state agency (or agencies) would provide a permit and/or a cooperative agreement to one or more conservation or other organizations with the training and the ability to coordinate this program and to provide required</p>	<p>Funding would come from local required mitigation in lieu of take in counties that have passed regulations not allowing take and highly restrictive on site regulations...</p>

<b>LEVEL</b>	<b>GOALS</b>	<b>MANAGEMENT</b>	<b>FUNDING</b>
	<p>To allow educational institutions and willing small landowners to provide habitat and to curate tortoises in a humane way and one that will allow the individual tortoises to live out a healthy life time.</p> <p>This program would be established in a way as to allow individuals or local governments to charge for and insure that tortoises could be removed from management sites, even though an incidental take permit has been issued.</p>	<p>educational programs for participants and to maintain some control through record keeping.</p> <p>Management by local community organizations would be possible with proper oversight.</p> <p>Research facilities would acquire tortoises from take sites or maintain colonies for clinical and other research.</p>	<p>Private funding from organizations and individuals is highly likely. Agencies would provide funding for coordination of the program.</p>

Based on Roundtable on Chelonian Relocation and Assurance Colonies, 2000, especially Ashton, Ashton, Buhlmann, Lee and Collins, Chelonian Survival Network and Assurance Colonies.

The ultimate survival of the tortoise as an individual and/or as a species is the underlying ethical concern that has to be part of the decision to relocate.

Many local communities and counties are becoming involved with conservation lands and species conservation within their areas. In a 2002 conference co-sponsored by the GTCI and the University of Florida Environmental Law Group, it was made clear that many Florida counties are considering or have instituted management regulations under “home rule”. This concept of “home rule” permits local governments to institute regulations that are more stringent than the state regulations. This is a strong indication that community members are expressing their concerns about local wildlife conservation.

Ecological Concerns

In reference to the concept of the ecological needs of the recipient site and its local gopher tortoise population, there are ecological concerns that should be answered before any form of relocation is attempted. Detailed studies and careful monitoring are required to evaluate the ecological impacts. Of course the decisions should be based on our best current understanding of all the ecological parameters and their ramifications for the habitat and

species. The ecological aspects of the choice of a recipient site are vital in the overall future of the species and the population being relocated (Table 10.2). Relocation should not occur if the ecological concerns for the recipient site are not satisfactorily resolved for long term tortoise survival. The smaller the recipient site the greater the need for regular monitoring and long-term management. Management must also take into account all species on the site, not just the gopher tortoise. For example, Florida Scrub Jays needs, Sherman's Fox squirrel needs, Red Cockaded Woodpecker needs and the needs of Indigo Snakes will in some cases be the same and in other cases (like canopy cover) may differ, requiring careful planning and management strategies to keep all populations healthy. Management for a single species may be counterproductive to other species that inhabit the same communities. The overall management of relocation sites should have management plans that clearly manage for natural biodiversity and historic levels of tortoises and other species.

#### Social and Economic Concerns

Do human communities (state, county, and city) around the recipient site support relocation? Is there some social or economic basis for conducting the relocation? Has the community become concerned for the species? Will it support the conservation measures and costs needed for a successful relocation? Is there political will? The greatest concern in this category is that under most scenarios, a landowner willing to take tortoises is actually taking on a liability. Many landowners would be willing to place tortoises on excellent habitat and manage for the tortoises if they could receive payment for a permanent conservation easement or a safe harbor agreement, receive a conservation tax exemption, and some assistance if the management needs are different than those that the landowner has been practicing. The great interest and tremendous public response to the Ashton Biodiversity Research & Preservation Institute website is a good indicator of positive social concern for this and other species. The responses for public input for relocation and the up-listing of the gopher tortoise from species of special concern to

threatened status indicate not only a high level of public interest but also a positive public support for changes in conservation policies for this species including an organized relocation and Assurance Colony Program.

### The Cost of Relocation

There are real costs related to relocation. Is it affordable? Who will pay for the land and the management including the pre-relocation, the relocation, and the post-relocation activities required? All of these costs mount up. The costs as charged by the agencies currently fall far short of meeting the financial needs of successful relocation. Under the development of an Assurance Colony Program the agency responsible can develop an economic plan that will support the species management plan which would include an organized method of relocation (Table 10.6). Under this type of program there would be a plan for distribution of monies to support relocation and management of local conservation lands. This allows for more involvement by the local citizens in the species conservation program. In addition, recipient site landowners can charge fees that pass along real costs to the donor site landowners. Local communities should require of the agencies a system that replaces habitat locally and ensures appropriate long term management of the recipient site as an assurance colony, protecting the populations of tortoises (resident and relocated) in perpetuity.

### Disease

Are we spreading disease from one place to another? Does it make any difference? This is a very big issue since we know so little about diseases in chelonians. How careful must we be to avoid this? What needs to be done to determine the health of the animals to be relocated and to what degree? In the case of augmentation, what do we need to know and why? (see Chapter 1). Shouldn't we be concerned about exotic diseases from other countries rather than about diseases that the tortoise has adapted to and has been living with over time? A health evaluation of tortoises does not necessarily imply a test for URTD

nor does a general health evaluation need to identify disease causing organisms. Environmental stressors in reality are of more concern when handling relocation than extensive testing for disease. In lieu of excessive concern about natural diseases and identifying disease organisms, a program for reducing the stress that all wild tortoises are exposed to during relocation, as well as identifying and mitigating environmental factors like toxins in the soils or ground water, overall may be more beneficial in reducing the chances of disease manifestation. As of August 2006, FWC no longer requires URTD testing for the relocation of gopher tortoises in the state of Florida.

### Morphology and Genetics

No true morphological variations in gopher tortoise populations are currently recognized (Pritchard pers. com.). Current evidence indicates that throughout the range of the gopher tortoise there have been no real barriers over time to isolate any populations until the first railroad was built. We know that tortoises can and do swim so water was never a real barrier to population mixing. So should we be concerned with genetic “purity”? Academics are very concerned that we may mix genetic groups and weaken the local populations especially if the relocation is an augmentation. Are these concerns based on valid models? Shouldn't we relocate the “most fit” animals and therefore be able to relocate the survivors if, for example, a disease (like URTD) passes through a group? Wouldn't the survivors be the most important animals to augment with since they survived the epidemic? Are there truly virgin populations out there that have never been exposed to URTD? Just how much mixing is going on due to the public's involvement (since humans arrived) in moving tortoises all over the range? Does morphological information reflect genetic data? Could this be because the scientists are not looking at the same material (e.g. genes that determine color or scale counts)? Is there any data available to allow anyone to make a determination of the genetic purity of one population? There are no morphologically distinct populations of gopher tortoises found throughout its range. However there are at least two natural

morphological variations to shell and scutes within many populations throughout the range. Genetically the two major studies that have been done are relatively inconclusive and appear to indicate that there has been a mixing of tortoises throughout time and much of their range. If in fact distinct genetic populations are found with differences that may affect long-term survivorship of the species then at that point those issues will need to be taken into account. Until that time relocations should be done on a local basis whenever possible. If it is a re-introduction into an area where the species was extirpated and if a large suitable population of tortoises is available (even if not local) it would make sense to proceed with the relocation. We should place as many tortoises as appropriate on available habitat while we still have that opportunity rather than wait for the genetics to be sorted out.

### **Recommended Requirements for Relocation**

The gopher tortoise is protected to some level in each state where it ranges. In parts of Mississippi, Alabama and Louisiana, the tortoise is federally listed as threatened and falls under FWS management but in certain areas of these states, the state agency responsible for wildlife oversees permitting for tortoise relocation and "Incidental Take". Here we are providing our recommendations for requirements to be met which are far more stringent than those that are being required by any state or FWS at this point. We are not including specific state or federal requirements here because they are all in a state of change.

The recommendations listed are in part based on the International Roundtable on Chelonian Relocations and Assurance Colonies that the Institute coordinated and the subsequent book which is due out in the near future. Scientists, conservation organizations, veterinarians and managers attended and developed a list of best management practices on relocation of turtles and tortoises. These requirements are based on tortoise natural history observations, research, published data and common sense. It is based on a reasonable approach with the idea of sustaining tortoise colonies on designated

reserve lands. The following requirements are designed to protect any resident tortoises on the recipient site as well as helping to insure that the tortoises to be relocated are in good health and the stress of the relocation is kept to a minimum. It should be noted that most environmental consultants are not properly trained in the management and handling of tortoises (Ashton 2006). These people also have limited time and monetary budget under the contract with their client to do proper donor site work. This is due to the fact that most agencies do not require this work and usually the donor site owner wants to keep financial responsibility to a minimum. Without appropriate requirements being made by the responsible agencies of the developer(s) or land owner(s), it is not likely that the necessary methodology for an ethical and successful relocation will be used.

We recommend strongly that the recipient site (preserve) landowner or manager obtain a letter of agreement with the consultant or person conducting the relocation or establish an agreement with the firm or individual doing the relocation. This agreement should cover all the key elements of how preparations and the actual relocation are to be handled.

### **Recipient Site: Costs Considerations, Selection and Preparation**

Landowners or land managers of recipient sites can charge fees for relocation. The fees are based on what the market will bear and should be carefully set to demonstrate real short and long term costs. There are three ways that the land owner of sites to which tortoises will be relocated can receive funds – 1) set-up fees 2) conservation easement fees and 3) relocation fees.

1) SET UP FEES – Paid by the Donor Site Landowners to the Relocation Site Landowners. These are fees that the Donor Site landowners (the land from which the tortoises are coming) will pay. They include:

1. If the landowner of the possible relocation (recipient) site has been contacted to identify specific site or sites on their land to which the donor site tortoises will be relocated then that landowner may include the cost of locating the specific relocation sites on their property in the fees charged to the donor site landowner. Such costs may include the baseline and initial burrow surveys for the recipient site since these are necessary activities for locating suitable recipient sites, as well as the costs of land boundary surveys of the specific site.
2. The relocation site land owner may include the costs of the site preparation needed on the specific relocation site in the fees charged to the donor site landowner. These fees may include the costs of land management activities like some clearing of trees and shrubs and burning or mowing.
3. The cost of enclosing the site with temporary or permanent fencing can also be passed on by inclusion in the fees required from the donor site land owner.
4. The cost of acquisition or preparation of any additional information or data required for the permit application can also be included in fees to the donor site landowner.

2) LAND CONSERVATION FEES – Paid by the Donor Site Landowners to the Relocation Site Landowners for the holding of the conservation easement (an agreement not to allow future development and to manage the habitat) by the regulating agency or by another agency or conservation organization. The regulating agency will require some form of permanent to long term conservation easement or some other legally binding means to protect the habitat and tortoises. Outright purchase of the land by a conservation agency or county or donation of the land is also an option. Because the Donor Site is destroying habitat, the donor site landowner should pay for the habitat loss of all protected species and will likely be required to pay mitigation costs for this loss. At this point, there are no clear guidelines for how much this could amount to or how such costs will be calculated. We recommend that the donor site landowner be responsible for the acreage of tortoise habitat

loss and responsible for replacing one acre for each acre lost. The cost per acre is based on the fair market value at the time the tortoises are being moved. The donor site landowner may be able to work out appropriate land swaps or other equivalent trades to provide the same benefit to the local and overall conservation effort. Fee can either pay for land to swap for the tortoise habitat, pay for a permanent conservation easement, or a wide variety of other methods that work to permanently protect the relocation site and the tortoises. Fees may also pay for some economic losses such as reducing tree canopy cover to 40% on silviculture sites, or dropping the number of grazing cattle within the site or reducing the economic productivity of the site.

The recipient (relocation) site landowner can include in their fees or as a separate agreement costs related to creating conservation protections such conservation easements.

NOTE that we recommend that the Recipient Site Landowner work directly with the Donor Site representatives as you would with any other land buying or selling transaction.

Relocations are commonly done by Environmental Consultants (ECs). Some are great and have the appropriately trained staff to handle this new world of relocation while others should not be in the business. Demand good references and proof of specific capabilities in gopher tortoise relocation and habitat management from anyone you hire or work with to accomplish tasks related to relocations. Relocation work is specialized - a biologist, botanist or someone who has taken environmental science may or may not have ever worked with or been properly trained in relocation techniques. Be sure the trained individual that you hire is actually the person working on your site and not an inexperienced technician (as is often the case).

3) RELOCATION COSTS - These costs are paid for by the Donor Site landowner or developer often as separate fees that are paid to and through an EC. These should cover all costs related to evaluation of the site, data collection for the permit, setting up permanent

monitoring stations, conducting site prep such as thinning, burning, and fencing. A reactive Habitat Management Plan and Monitoring Program should be established and approved by the land owner and regulating agency. There are real costs for this and we recommend that if the EC is going to do it that the landowner require a performance bond and the prorated costs to be put into an escrow account. Or the recipient site landowner can collect the monitoring and management funds and put it into an escrow account. It may be that on large relocation facilities the regulating agency will require a performance bond. We highly recommend to large landowners and agencies that all the work on the recipient sites be done by a selected team of tortoise field biologists and field botanists that have experience with relocation and work with tortoises. Similarly the actual collection and relocation of the tortoises to a relocation site is usually done by a consultant (EC) this work includes:

- 1- the original survey of the tortoises on the donor property
- 2- the excavation of all the burrows and the collection of the tortoises on the donor site which also includes collection of some of the commensal animals living in the burrows
- 3- the health evaluation of the tortoises, weights, size, and other data needed to carry out proper monitoring of the tortoises in the future (should also be provided to the recipient site landowner)
- 4- the permanent marking of the tortoises so they can be identified
- 5- the transportation and release of the tortoises in to the recipient site
- 6- daily checks on the recipient site for a period of time to be sure the tortoises are acclimating well and that the fences are not breeched
- 7- habitat and forage monitoring on a periodic basis, depending upon the specific site conditions

How much should this cost? Figure the average rate charged is for two people with an overall cost of \$120/ hr at the time of publication of this book. Excavation includes a backhoe with the highest rate being \$900/day for the top expert. Surveys should be 100%

on the recipient site and take three people (\$160/hr). All surveys should include GPS locations and flagging of each burrow.

HOW FEES ARE HANDLED - The fee for relocation should be at a level that it is competitive (see Table 10.3). One needs to know if the environmental consultant is taking a cut of the fee as well. Some consultants take up to 50% of the amount. In this case, they should do all of the work on the recipient site (if they are trained and capable). However, there are currently no rules regarding this payment and how it is divided up between the consultant and the recipient site owner. Currently the fee is most often viewed as a PER TORTOISE fee that is paid by the donor site landowner and usually arranged and/or collected by the EC and passed on to the donor site landowner. This ranges from \$300/tortoise to over \$600/ tortoise in some counties in South Florida. This fee has been charged and supposedly paid to the donor site landowner to cover the costs of donating the land and to cover costs for setting up (before fencing) and future management, essentially the costs summarized in parts 1 (Set Up Fees) and 2 (Land Conservation Fees) above. The future of how fees will be charged and collected is dynamic and subject to change. With the increase in demand for relocation sites and the decreasing supply of available lands the cost charged by the recipient site landowners most certainly will go up to whatever the market will bare in that particular area.

There are currently no rules regarding the use of the fees by the recipient site owner as well. They are supposed to be used to pay for long-term management to insure high quality tortoise habitat. This of course has led to abuse where the tortoises are simply dumped on site and nothing is done to monitor habitat or tortoises. Some landowners simply turn around and sell their land since in the past most agencies have not tried to uphold the letter of agreement or inspect the sites. This is gradually changing as the importance of wild habitat and protected species like the gopher tortoise continues to increase with regulation and public pressure for better conservation. However, most landowners know nothing

about tortoise natural history and since there are currently no real requirements on the consultant to provide good information, many recipient site landowner(s) simply have not been providing good management.

The key to insuring good management and monitoring practices is a well designed and specific management plan that covers all aspects from how the taking and moving of the tortoises will be done to the quality of forage management and the procedures for long-term monitoring. Some sites are simple while others require more effort to prepare and sustain habitats. Common sense should be used in the development of the plan and in how it will be carried it out. Landowners of the recipient site should be required to obtain a permanent conservation easement for the lands on which the relocation site exists. Funding for Secondary Assurance Colony (SAC) and Tertiary Assurance Colony (TAC) level relocation site monitoring and management should be guaranteed in some fashion, such as payments into a trust fund.

### **Finding and Evaluating a Recipient Site**

Owners of properties that are willing to take on relocated tortoises are becoming harder to find. As the value of wild habitats increases, the incentives to the landowner not to develop the land but rather to maintain it as a preserve for wildlife must be increased to be competitive with the incentives put forth for development. Often the best way to find sites is by word of mouth. The Ashton Biodiversity Research & Preservation Institute website is also a source for finding potential relocation sites. Counties that have tortoise habitats slated for development will continuously have problems finding space to relocate tortoises unless a plan is made to include this need in conservation land acquisition. Such a plan should include:

1. Requiring upland land purchase mitigation by those local developments and avoid on-site relocation except where there is ample space and ability to manage the population for conservation.

2. Developing an agreement with regulatory agencies to have mitigation funds remain within the county.
3. Counties should stop swapping around development credits from uplands to wetlands.
4. Conservation and recreation lands already owned by government agencies or managed by federal, state or local agencies should be evaluated for tortoise relocation and should be opened to relocation where appropriate.
5. Counties should establish agreements with municipalities to establish a policy of purchasing the natural habitats needed for tortoise and other upland species.
6. Federal and state regulatory agencies should have in their species management or recovery plans a plan for relocation and management of all levels of Assurance Colonies. This plan and the use of mitigation fees would narrow the gap in needed recipient sites.
7. Land managing agencies, including governmental at all levels or private landowners providing recipient sites should require the donor site owner to pay for land lost or land being used for the relocation of tortoises. This could be an outright purchase or a perpetual conservation easement. The easement would be held by the local government or properly credentialed conservation organization.
8. Donor site mitigation should change by:
  - a. Separating the annual relocation costs of tortoises onsite with the loss of tortoise habitat. Costs of relocation should be borne by the donor site manager. Costs should include payment into a management trust fund.
  - b. Fees for loss of habitat should reflect actual acres lost and the quality based on the number of tortoises per acre.
  - c. Donor site owners should be encouraged to work with other local owners to obtain land, or, to pay for perpetual conservation easements within the county of the site.

## What Constitutes A Good Relocation (Recipient) Site?

The most efficient size for a relocation section is 25 - 50 acres, allowing a carrying capacity of 2 tortoises per acre with appropriate forage. On large lands consider multiple sites of 25 - 50 acres if you have the habitat. Table 10.2 outlines the criteria for evaluating a potential recipient site (on or off site), from the ideal to what is not acceptable for relocation purposes.

**Table 10.2 ACCEPTABILITY LEVEL FOR THE RECIPIENT SITE FOR CONSERVATION BASED RELOCATION ACTIVITIES.**

ACCEPTABILITY CRITERIA*	IDEAL	PROBABLE	ACCEPTABLE	NOT ACCEPTABLE*
<b>SIZE</b>	200 acres+(or next to large conservation area	50 acres – secondary assurance colony	25 acres secondary assurance colony	under 25 acres
<b>VEGETATIVE COVER, FORAGE QUALITY AND QUANTITY, AND SOILS</b>	80% or higher presence of forage species with high diversity on site. Vegetative community has no more than 40% canopy cover, soils same & water table same level as donor site (Chapter 5).	80% or higher presence of forage species with high diversity on site. No more than 50% canopy vegetative community similar to the donor site, soils similar, water table near same depth.	80% or higher presence of forage species and moderate diversity on site. No more than 60% canopy cover based on past and current land use (e.g. pasture), soils acceptable for burrows, water table near same depth.	Site not managed for natural habitat or incompatible management practices. No proper forage, soils not suitable for burrow ground water table to high or low. too much canopy cover more than 60%.
<b>LAND USE</b>	hunting, silviculture (saw timber), parks conservation area	hunting, silviculture (saw timber), parks, private residence, pasture, farm	hunting, silviculture, ranch or farm, parks, private residence	open access, no protection or management
<b>PRESENCE OF TORTOISES</b>	Absence or presence if augmentation is goal.	Absence or low population levels due to poor management practices.	Present in numbers below carrying capacity.	Presence, full to capacity or absent due to predation.
<b>FUTURE MANAGEMENT</b>	For overall biodiversity-management plan with responsive to monitoring results.	Multiple use with balance between economics and biodiversity monitoring.	Multiple use monitoring & management plan.	Not planned or mandated no monitoring or management plan.
<b>FUTURE PROTECTION</b>	Conservation land for biodiversity only-gov't or private with permanent conservation easement.	Conservation land for biodiversity primary-gov't or private with permanent conservation easement.	Multiple use with management for biodiversity required-25 year easement.	Not planned or mandated.
<b>IMPORTANCE IN SPECIES SURVIVAL PLAN</b>	Ranked as a key area for protection of regional tortoise population.	Ranked as a prime area for tortoise protection.	Considered as a secondary area for tortoise protection.	Not in plan.

- Based on (Ashton, et al, 2001) and deliberations of International Roundtable on Chelonian Relocation and Assurance Colonies (Sept. 2000).

\* May be acceptable for humanitarian relocation efforts with some protective requirements.

Of the potential sites available to choose from, here are some suggestions for what works and what is less likely to be a good choice for a tortoise preserve.

**Farmland Sites:** The best habitat for tortoises to be found within farmland sites would be 25 acres of old-field Bahia (*Paspalum*) pasture with plenty of “weeds” and some “thickets” of blackberry (*Rubus*) and greenbriar (*Smilax*) and grapevine (*Vitis*) for hatchling and juvenile tortoises within each 25 acre site. A few fruit producing shrubs or trees would also be beneficial as long as they do not shade too much of the acreage (less than 40% canopy cover).

**Tree Farms:** Tortoise Preserves can be established in open areas and where pines have been thinned to no more than 60% canopy cover and where saw timber is being sustained. Surrounding open weedy, grassy edges around tree farms if wide enough can be used if they have ample burrowing sites and appropriate ground cover. Be sure sites have not be previously treated with an aerial herbicide since we don't know how long such chemicals are retained in forage plants or how they affect herbivores like tortoises. Fewer tortoises per acre in this type of habitat due to canopy cover which will reduce forage biomass production.

**Natural Areas:** Any habitat with sufficient open areas for forage growth and that is not flooded for more than a few weeks annually in Florida (tortoises are not just in sandhill habitats) can be gopher tortoise habitat. Habitats must have no more than 60% canopy, shrub, and wiregrass cover or, there must be the ability to reduce the cover in the recipient site. Tortoise prefer deep sandy soils for digging burrows but our data shows burrows and tortoises living in shallow shelly soils, heavy periodically flood soils and rich loamy soils.

Available land in areas where there are currently less than 2 tortoises per acre can be a tortoise preserve and with appropriate management may be augmented up to 3 tortoises per acre if the site is large enough and is managed properly.

Areas adjacent to highways, communities or other development that have open grassy and herbaceous ground cover can become preserves under the right conditions. They should plan to have a permanent fence that will keep tortoises in and humans, dogs, cats, etc out. They must be monitored and managed for forage so that the tortoise population will get the nutrients needed for survival. Long very narrow sites may not be suitable unless there is sufficient overall acreage to provide enough biomass for the tortoises. Other access and use may be planned like passive parks but eliminating ATV use.

Community green spaces that are at least 10 acres if there are less than 15 tortoises can be used as humanitarian preserves. The shape should be circular and provide some high quality forage like bahia (*Paspalum*) and other broadleaf grasses as well as a diversity of weedy herbaceous species and a few fruit producing shrubs or trees.

### **What Is The Management Goal of The Potential Sites?**

Are the economic and conservation goals compatible with tortoise relocation? Is there a compromise based on the new income flow?

1- Agriculture: We have found that bahia pasture that is not sprayed or managed for a secondary crop of sod is one of the best sites for tortoises. However the ground water table should be at least 18inches below the surface. Even then soil piles or berms should be put into place for burrows. We have found that the average of 1.1 cow/calf units per acre work well for both tortoises and burrowing owls creating additional income to help sustain and manage the preserve.

2-Silviculture: Dense tree stands, short cycle forestry, sand pines, are not good places for tortoise relocation. Sites with long cycles, saw timber, areas set aside for natural areas, Red-cockaded woodpecker sites, and expansive open areas are excellent potential sites. Yes, tortoises can live through site preparation and do well in sites after prep. They do until the canopy cover gets more than 60%.

3-Powerline/ pipeline and other right of ways can be good areas for tortoise preserves as long as the habitat has been evaluated for forage species and land use on either side is compatible or is fenced (possibly funded by relocation). Herbicide use should be compatible and safe. Management practices by the agency or institution in charge must also be compatible with tortoises and other species relocated.

4-Protected Lands Programs: State or County lands are frequently excellent sites as long as they do not have their own resident tortoise populations. Major tortoise issues are usually compatible with the management goals of protected lands. But, if for example the site is scrub and has scrub jays, remember that the natural density of tortoises in scrub is 0.8 tortoises/acre unless sufficient bahia or centipede grass patches are present. This may be in opposition to a policy of “no exotics left in natural areas” which means such areas cannot have more than 0.8 tortoises per acre. It is important that recipient sites be found on Federal and State Forestry lands, Water Management District and other public lands or else the conservation and protection of tortoises from development will be extremely difficult.

5-Hunting Lands: Deer, turkey and quail habitats are excellent habitats for tortoises as a rule. Relocating tortoises can in fact increase overall income that may help develop infrastructure and fund overall management of the lands.

6-Smaller Private Lands: Although there is a plan for people to have tortoises in their backyards and the in between areas of less than 25 acres to about 10 acres, such areas should be considered primarily for humanitarian relocations. There are many highly dedicated people who wish to establish sites for tortoises found wandering roads or slated for “incidental” take or judged as sick and unable to be placed a major relocation preserve. These humanitarian relocation preserves will need careful planning and approval. The two major issues are fencing and what will happen to the site after the current landowners are gone. The protection and management of the tortoise preserve in such situations may need to become part of a deed restriction to ensure proper management when the current landowners leave or die.

### **Site Assessment**

The goal of the site assessment of both the recipient and donor sites is to make sure that the needs of the tortoise population will be met by the recipient site in perpetuity (see Chapter 3). In theory, the more similar the two sites and populations are the greater the chances for the relocation to be successful. There are of course, many other factors that come into play regarding success in relocation, particularly how the relocation is carried out.

Many of the points listed below to assess sites and tortoises are those required for permits for the regulating agency. Table 10.3 provides a range of what would be considered ideal verses what is reality or what simply is not acceptable as a relocation site for conservation. The other points in the table indicate the type of data collection and analysis that is required to really know if a site is acceptable or not, or how many tortoises should be released on the site. For example, throughout most of the year, gopher tortoises are active and they feed all year long. This means the herbaceous plants within the feeding range of a tortoise will change several times a year. Our studies and others have shown that tortoises

feed on more than 400 species over the course of a year with individual forage areas usually having around 200 species, indicating again that tortoises travel over the course of the year to obtain sufficient diversity in forage species. The bulk of the species tortoise forage on in volume and by weight is made up of grasses. The vast percentage of this is composed of a wide variety of broad-leafed grasses verses the old idea that most of their diet is made up of wiregrass (see Chapter 3). This was believed for many years because studies were of the tortoise's scat, or what came out, not what went in. Similarly there was little data on the herbaceous plants that were used. Now we know that tortoises not only are highly selective in the plants they eat, but also when they eat them and which parts they choose to ingest. This is very important in determining whether or not forage will be a controlling factor on a given site for determining how many and where tortoises can live in that landscape. Quality and quantity of forage species available are critical to the long term viability of a relocation site.

**Table 10.3 Environmental Assessment of the Recipient Site (ON AND OFF SITE).**

<b>CATEGORY</b>	<b>IDEAL</b>	<b>PROBABLE</b>	<b>ACCEPTABLE</b>	<b>UNACCEPTABLE</b>
<b>ENVIRONMENTAL</b>				
<b>Soils</b>	Same as donor site with ground water table at same depth.	Similar Soils to the donor site with water table at same depth.	Soil type which supports tortoises Water table below 2 ft. (0.6 m).	No study or areas where water table is above 0.5 meters from surface.
<b>Canopy</b>	(20-40%) combined tree and shrub layer.	(20-50%) combined tree and shrub layer.	Canopy open enough to provide forage –no more than 60%.	Closed or canopy covering more than 60%) of the total area.
<b>Forage-Quality and Quantity; major grasses and multiple season diversity of herbaceous primary forage (125+ species). See chapter 3 and 5.</b>	Same as donor site or better. Forage study done over 3-4 seasons. Over 50% Very High Level. Forage Species and 80%+ of overall species are Forage Species.	Forage study done in one season, grasses over 40%. Very High Level and High Level Forage Species. 80%+ of overall species are Forage Species.	Forage study done in one season, key forage grasses and plants identified. 30% or more are Very High Level or High Level Forage Species. May have grasses like Bahia or St. Augustine or centipede grass.	No observations made or limited to general view.  High densities of wire grass tend to exclude the diversity of species needed to keep tortoises healthy year round.
<b>Forage Distribution</b>	Forage has ample density and distribution on site to provide for similar pod structure as recipient site. Good seed source and seed bank.	Forage has ample density and distribution to provide for the number of tortoises being released and seed source next to or around the site.	Forage has ample density and distribution to provide for the number of tortoises being released. Can be maintained mechanically.	Forage distribution is unknown on site-, or is very spotty or restricted.
<b>Tortoises on Recipient Site</b>	If tortoises are not present, why not and has situation changed? If present	Review of land use, current practices history of predation, disease.	Review of land use, current practices history of predation, disease. Check	No survey or health evaluation.

	why is density such that augmentation is called for?	Check residents for disease.	residents for disease.	
<b>Genetic/Morphological</b>	Tortoises are of same genetic group and race as once occupied the area. Based on testing of both on recipient and donor site populations (primary assurance colonies).	Tortoises are of same genetic group and race as once occupied the area or what is currently known about genetic groups or no tortoise onsite.	Tortoises are from within 150-mile radius of site, or there are no tortoises on the site.	Tortoises are moved anywhere.
<b>Climate</b>	Relocations of tortoises from south of the Swanee River into the panhandle or vice versa.	Tortoises will be moved throughout the state only when there is an emergency.	After a three year study of tortoises being moved to colder winters on the panhandle and upper counties.	Tortoises moved to colder winters including out of state before some studies are undertaken and are successful.
<b>PLANNING</b>				
<b>Long Term Management and Monitoring</b>	There is a written plan for habitat and population monitoring and reactive management to sustain goals of the relocation.	There is a written plan for habitat and population monitoring and reactive management to sustain goals of the relocation.	There is a written plan for habitat and population monitoring and management to sustain goals of the relocation.	There is no required habitat or population monitoring and management program.
<b>Funding</b>	Funding for the monitoring and management is perpetual and set by binding agreements. Land protection funded by donor sites.	Funding for the monitoring and management is perpetual through agreements.	There is funding and monitoring is required for at least 5 years.	Less than 5 years of monitoring and management required.
<b>Owner/Manager/</b>	Owner or manager receives economic benefit and support for managing lands for tortoises. Perpetual Conservation Easement.	Owner or manager receives economic benefit and support for managing lands for tortoises. Perpetual Conservation Easement.	Land is in conservation easement and there is appropriate oversight to have management done.	Owner/manager provides a letter saying they agree to accept tortoises.
<b>Community</b>	Local community supports the action and receives educational, esthetic, and possible economic benefit.	Local community supports the action and receives educational, esthetic, and possible economic benefit.	Local community supports the action and receives educational benefits.	No information on Community, its role or benefits.
<b>Individuals</b>	Individuals that meet a list of requirements to insure the tortoises health and safety may receive a permit. Organized method of honoring captives.	Individuals can keep tortoises with no permit or minimal oversight but have to get permission from local governments.	Individuals keep tortoises from take areas without a permit and keep them under FWC permits.	No control; people pick up and keep tortoises from anywhere a market opens for their sale.

Summary of Cox (1987) and International Roundtable on Chelonian Relocation and Assurance Colonies (Sept. 2000)

## Donor Site Assessment

Current requirements center around collecting data on the donor site and are described in Cox, 1987. The primary goal of collecting data at the donor site really has little to do with determining if you should move tortoises from one habitat to another. In reality, the studies on both sites should be used to determine how similar the sites are, especially in forage and soil types and ground water depth. Such studies increase the chances of success in the relocation effort. The goal of most guidelines is simply to determine mitigation levels based on how many tortoises are present (based on the number of animals and quality of the habitat).

### **Donor Site Relocation Effort to Develop a Successful Relocation**

The basic information required by regulating agencies is a start but as previously mentioned, the more information pertaining to forage and other habitat information as outlined in Table 10.3, the better. The following is a list of additional information that we recommend as well.

#### **1- Habitat**

It appears that the success of tortoise relocation can be increased considerably if more concern is placed on reviewing data on how appropriate the recipient site is as well as the level of similarity between the donor site and recipient sites. One should avoid moving tortoises from sandhill to coastal pine flatwoods or beach populations to scrub. To our knowledge, there have been no studies done to determine if tortoises can successfully adapt to new environmental conditions. We have found that exotic tortoises from savannahs from several areas of the world adapt very well to the sandhills of Florida. However taking tortoises from forests to sandhills is not as successful. The following are data that are required.

1. Compare forage species found on both sites and how it relates to the distribution of pods at the donor site and if there are tortoises at the recipient site. In some sites like scrub, tortoises travel much greater distances and have different forage behaviors than those of managed sandhill communities. Be sure to consider the quality (VH, H, M or L level) of the forage species present and the quantity and distribution on the site. Moving pastureland tortoises to scrub may be difficult due to the lack of density and low diversity in scrub (see Chapter 3). This may make adaptation very difficult.
  
2. Edaphic factors should be similar and there should be ample areas for burrow development. For example, relocating tortoises from the clay soils in northern Leon County to the beach strand where the shell sands are frequently used. We are not sure of adaptability on the outer strand; we have no proof that they can adapt.
  
3. The depth of the groundwater table determines the depth of the burrows and possible fluctuations in relative humidity in the burrow. It is helpful but not required that they be similar at both sites.
  
4. Climate may be a factor. We know end chamber temperatures go below 55 degrees F (12.7 C) in winter north of the Suwannee River. This may indicate that the northern tortoises are far more inactive in winter than those in the Florida peninsula. Incubation temperatures may also be different thus the reproductive success of relocated tortoises into radically different climatic zones may be in question.

## 2- Tortoises on Donor and Recipient Sites

1. Consider spatial distribution of the tortoises on the donor site and compare the pod distribution to the distribution of habitat, forage and if present, the distribution of pods on the recipient site. Consider sizes of the pods and distribution of tortoises between pods. Tortoises in pods should be relocated together and not separated.
2. If tortoises are present on the recipient site, what are the sex ratios, size classes, and how are they distributed in the pods? How do these relate to the donor site?
3. How large is the population or populations on the recipient site? How far off site does habitat extend? What is the population estimate for the entire population in contiguous habitat that could support tortoises? What is the size class distribution of both? Any of this information can be helpful in determining how successful relocation will be and may indicate which specific sites would have the greater success rate.
4. What is the health situation with both populations? Or if there is just the donor site population, how is the health of the tortoises? Weight vs. length cubed?  
Veterinarian evaluation of a sample of animals would provide some idea if there are any potential lethal diseases. Unhealthy tortoises (those with obvious serious illness) should not be relocated to the recipient site and are left behind. Sick tortoises should be available for humanitarian relocation, so that if there is a willing humanitarian recipient site, the tortoise can be cared for individually and possibly survive yet it will not be a threat to the success of the overall relocation of its other pod members.

## **RESULTS OF THE RECIPIENT SITE ASSESSMENT - GO OR NO GO**

Site evaluation should not be an academic exercise, but designed to give the managers the data needed in a successful relocation. We estimate that it takes 1.5 times more time involvement on the recipient site than the work required for a donor site of similar size and vegetative cover. The idea of setting up the tables with grids ranging from most acceptable to not acceptable is to give all the people involved an opportunity to determine if the relocation to a certain site can be done within what is acceptable. Under today's circumstances, very little data is required on required recipient site conditions. There is great flexibility between the three standards of acceptability (Cox 1986, FWC guidelines). However, at no time should a site be used if it has one unacceptable category and that cannot be changed to an acceptable level before relocation takes place. Until agencies adopt more stringent standards for relocation (hopefully will happen soon), the burden of ethical behavior is directly placed on the consultant or manager being hired to carry out the relocation.

## **ON SITE RELOCATION**

Ideally, local governments would establish comprehensive development plans that would require developers (who were planning to develop in endangered upland habitat areas) to establish meaningful conservation areas on site. If the plan would require that developments riparian to each other had to connect these areas and tie it into acceptable passive, non-consumptive recreation, it would be even better. Also, if the development was near conservation lands already owned by the government, that situation would be even better. Interestingly enough, many developers have learned that house sites next to natural preserves sell faster and at higher prices than those next to golf courses or hiking trails.

However, we must deal with reality. Most developers do not want to give up lands that they have purchased since each subdivided piece provides excellent opportunities for

profits. Good use of the developable lands could be augmented if the developer would get biologists, agency personnel and land planners together before developing conceptual plans and taking them to investors or to the bank. It is amazing how often a simple environmental assessment map that shows habitats and distribution of protected species and other features can help a developer create a plan that may well off-set all mitigation costs and develop acreages and conserve significant populations of tortoises and other species. Too often, mitigation and relocation needs are an after thought, determined long after the landowner or developer has already created a plan and presented that plan for financing. It then becomes a financial war to protect the bottom line in which both the wildlife and the developer lose. A preemptive plan that provides benefits to the developer and the wildlife conservation needs is more likely to keep both sides happy and result in better long-term conservation success.

### **Current Standards**

We find that there really are no official standards for on site relocation areas. The other option to off site relocation is to keep tortoises on site, especially in counties or regions where the price per acre is in the five-figure range and buying conservation land for off site relocation is so expensive. On site relocations unless done exceptionally well are not sufficient to protect tortoises in perpetuity and to allow for long term population growth. Most isolated, small (less than 50 acres), on-site relocation areas are like putting the animals in a zoo. They may survive out their lifetimes but they cannot be said to live in a dynamic, naturally developing population that normally would increase and have all age classes represented. On-site relocation sites absolutely must have good monitoring and management or the population will not even survive out its normal lifetime. The smaller the site the more critical the need for forage monitoring and management to insure the “captive” population members do not die a slow death from starvation.

## **Size and Shape of On Site Relocation Areas**

The size and shape of the on site “preserves” depends on the number of tortoises needing to be moved on to the site and what arrangements the developer can make with the regulators regarding how it will fit into the site with the least impact on the site plan and profitability. We use the term “preserve” loosely because small on site areas rarely fit the true definition of a preserve. Some agencies are very responsible and make sure that the site is in good to excellent habitat and that the site has enough potential forage to support the proposed tortoise colony within the preserve.

At this point, we must divide on site relocation into two types. The first being totally Humanitarian Relocation, the other is to establish a biologically sustainable population of tortoises. An important issue will be whether there is appropriate habitat available and whether it follows the acceptable standards as outline in Tables 10.2 and 10.3 and is then managed using acceptable standards as in Table 10.4.

## **Humanitarian On Site Relocation**

In selecting an on site humanitarian location the goal is to protect and allow for tortoises to live out their lifetimes in good health. There is little to no hope that they will reproduce successfully and maintain healthy populations over generations, though with good management it is a possibility. Thus when designating the site ideally as many of the resident tortoises as possible should not have to be moved and their ranges should be contained within the on site preserve. Secondly, there should be no more than 2 tortoises per acre in natural habitat and three tortoises per acre in good improved pasture with access to diverse herbaceous forage species. This is based on the medium to long term

ability to provide food to the tortoises in accordance with what is already on the ground and the ability of the Home Owner's Association (HOA) to manage the habitat and forage quality once the development has been completed and that responsibility is passed on to them. The smaller the preserve the greater the requirements for diversity and quality in forage vegetation and thus the greater the intensity of management required. The major long term problem is how to sustain forage without prescribed fire. Once a development is completed, history shows that it is nearly impossible to get a burn permit.

If there is a small number of tortoises and acreage, the tortoise reserve should be maintained in a way that the tortoises have a well balanced diet, good burrow sites with sun and protection from whatever may harm them (wild or domestic predators, vehicles, humans). As previously mentioned, these preserve areas should be totally enclosed with sunken hog wire or chain link fencing to keep tortoises in and predators out. Human access and use must be managed as well and no bikes or motorized vehicles should be allowed (see Table 10.5). Normally management on these small preserves is done by landscape companies that have been hired by the HOA to take care of common areas within the community. These companies usually have limited training for management of tortoises or natural areas. Some basic concepts of management of areas where small populations of tortoises are being sustained on site include the following:

- 1- Forage plant diversity and biomass (amount of plant material versus bare ground) must be monitored and maintained. Since tortoises also eat the plants humans like in gardens (vegetables and flowers), have the lawn management company plant sections of the preserve in butterfly, vegetable and flower garden plants but do not allow use of pesticides or fungicides or herbicides in the preserve area. Also plant a few fruit trees that drop their fruit. Select species that are not likely to take over but that fruit regularly with little special care. Grape vines planted along the fences or on an arbor will

provide fruit and look nice as well. Tortoises eat fallen grape leaves as well as the fruits.

- 2- Have the landscape company mow the grass and weeds (keep weeds in area because these are species tortoises usually love to eat). Ask them to mow at times when tortoises are not usually out so that any potential injury to tortoises is minimized.
- 3- Arrange with a local forester (with a permit) to do a fast, low burn on one part of the site at a time when the smoke will be minimal. If regularly mowed, this burn will be fast and usually with relatively little smoke. It will however stimulate plant growth. Do not burn the entire site at once because tortoises would be left without forage for a period of time.
- 4- In some areas you may be able to put cows and/or horses into the on-site preserve. These grazing animals help keep the grasses and forage plants in good growing form. Shrubbery can be cleared out by putting goats in the area but don't leave them there for long as they will create a bare ground environment.

### **Biologically Sustainable Relocation Preserve**

A biologically sustainable preserve must have sufficient acreage, high quality and sufficient quantity of forage and suitable burrowing sites. It must be in an area of compatible land use and not be adversely impacted by surrounding ground water or surface water pollution.

Such areas need to have some form of protection like a conservation easement or deed restriction that controls future use and management activities. Areas less than 25-50 acres are not suitable for sustainable relocation preserves. Selection of such sites will require a full burrow and forage survey to confirm suitability. Some indicators of potential suitability for a biologically sustainable preserve are:

1- Land of sufficient acreage that is bounded on 1 to 4 sides by conservation lands owned and managed by local, state, or federal agencies or by private conservation organization could be suitable. The shape of the acreage is important. It should be of a shape that does not maximize negative impacts from surrounding lands and that allows natural organization of tortoise pods. Very long and narrow shapes are not optimal.

2- Land that is in natural habitat and of sufficient size and shape can be highly suitable. Natural habitats vary in the carrying capacity of tortoises and other protected species they can sustain. If such lands are also bounded on 1 to 4 sides by conservation lands then they become even more suitable as long term preserves.

3- Old farmlands and pasturelands are often suitable in that they often have a high biodiversity of forage species as well as a high biomass of broadleaf grasses. The past treatments and uses made of these types of lands and the current and proposed future land uses all impact whether such properties are suitable as relocation preserves for long term biological sustainability.

4- Forest lands are rarely suitable as long term preserves unless their management plans allow for sustainability of the appropriate tortoise habitats over the goals related to tree "farming". High intensity forestry is not easily compatible with the biodiversity and low canopy cover required of a long term sustainable gopher tortoise preserve.

## **Relocation Planning and Implementation**

### 1- Seasonality

A well-planned relocation should be done when the tortoises can be released when there are fewer pressures from the environment and from the resident tortoises on the site. The time to move tortoises should be a time after primary mating and nesting occurs and when growth of food and water supplies are ample. This indicates in most areas that any planned relocation should take place during the summer or rainy season. Relocations should not take place during serious droughts or during periods when there may be long stretches of weather induced inactivity (low temperature and sun).

### 2- Release Plan

A well-planned relocation considers how and where to release the tortoises onto the recipient site. We have found that releasing pods together seems to keep the tortoises within a reasonable area (50 acres) of the release site. It appears that many introduced tortoises are remaining in the area after 4 years. If there is a recipient population, it is a good idea to release pod members in good habitat that is between pods. In this case it appears that we have tortoises which establish residency in the area of release while both males and females appear to move to the resident pods. Our work with other species of tortoises such as *Geochelone elegans*, indicate there is a female social structure which is much stronger than in males. We have very little information pertaining to social structure in gopher tortoises. This can be a very important factor in successful relocation.

**Table 10.4 Acceptable Methodology For Preparing Tortoises On The Donor Site And Transporting Them To The Recipient Site**

ACTIVITY	MOST ACCEPTABLE	MODERATELY ACCEPTABLE	NOT ACCEPTABLE
<b>Tortoise Count</b>	<p>Total site survey using 3-person crew with maximum width of 21 feet (6m). Burrows GPS mapped.</p> <p>Definition of burrow activity level using Ashton &amp; Ashton (2001).</p>	<p>Total site survey using less than 3-person crew with maximum width of 21 ft (6m). Burrows mapped on aerial.</p> <p>Definition of burrow activity level using Ashton &amp; Ashton (2001).</p>	<p>One person or windshield surveys or surveys on motorized or horseback, Using FWC definition of burrow activity. OR, sampling 20% or less of the tortoise habitat and estimating total population. OR, use of burrow scope to determine activity of burrow.</p>
<b>Tortoise Capture</b>	<p>Tortoises and commensals taken through burrow excavation of all tortoise burrows on site no matter the apparent activity. The backhoe operator is skilled and uses a toothless bucket.</p> <p>Tortoises captured by the pod (tortoises that are living in close proximity of one another). They are marked according to pod and each tortoise is permanently marked using standard marking procedures on costal scales. This is for long term monitoring.</p> <p>Tortoises are released within one day of capture in hay bale enclosure around release site. The number of acres being enclosed depends on forage and number of tortoises being released.</p> <p>Note if the recipient site is fenced with tortoise excluder fencing then hay bale fence is not needed.</p>	<p>Tortoise burrows are bucket trapped for a minimum of 30 days. Tortoises are released in highly active periods within 12 hrs of capture.</p> <p>Tortoises from the same pod are released in holding areas on the recipient site. Before they are released, they are permanently marked on costal scales using standard marking procedures. This is for long term monitoring.</p> <p>Tortoises are released within one day of capture in hay bale enclosure around release site. The number of acres being enclosed depends on forage and number of tortoises being released.</p> <p>Note if the recipient site is fenced with tortoise excluder fencing then hay bale fence is not needed.</p>	<p>Tortoises are captured and release willy-nilly with no plan. Tortoises are captured and release without concern for roaming off site, time of year, or social structure.</p>

ACTIVITY	MOST ACCEPTABLE	MODERATELY ACCEPTABLE	NOT ACCEPTABLE
<p><b>Disease</b></p> <p>Each tortoise should have a health evaluation.</p>	<p>All tortoises are examined for symptoms of any disease or malnutrition. This should be done by a veterinarian who is familiar with chelonians or by someone who has been trained by a vet to do health evaluations.</p> <p>Length and weight data should be collected and ratios used to help in determining overall health. (This data should be put into the monitoring database.)</p> <p>No sick tortoises are released on to the site. They may be treated and if cured released or are returned to the recipient site.</p>	<p>The consultant does health evaluations that have little or no training.</p> <p>Length and weight data should be collected and ratios used to help in determining overall health. (This data should be put into the monitoring database.)</p> <p>No sick tortoises are released on to the site. They may be treated and if cured released or are returned to the recipient site.</p>	<p>No evaluation. No baseline data taken or permanent marking of individuals prior to release.</p>
<p><b>Handling and Transportation</b></p> <p>Proper handling and management is the key to reducing stress and increasing a successful relocation.</p>	<p>Each tortoise when captured is immediately processed and the placed in a "rubber maid" type container with a lid that closes tightly but allows air to flow (or some holes are drilled). These are maintained below 80 F and above 55 F. They are never put in the sun or kept in a vehicle.</p> <p>If there is a drought, individuals should be soaked for 2-6 hrs in "non-chlorinated water".</p> <p>Lids are kept closed to keep the tortoise in the dark. It helps to reduce stress.</p> <p>Maximum holding time, 8 hrs.</p>	<p>Same as Most Accepted.</p> <p>Maximum holding for 24 hours.</p>	<p>Putting tortoises in the back of pickups, group boxing, exposing them to high or low temperatures and sun. Leaving them in open containers. Or, holding tortoises more than 24 hrs in a holding pen. * Holding tortoises in small holding pens due to stress and possible dehydration.</p>

ACTIVITY	MOST ACCEPTABLE	MODERATELY ACCEPTABLE	NOT ACCEPTABLE
<b>Time of Year</b>	<p>The best time for tortoise relocation is April-June 15, the end of October throughout range and Feb 1-Nov. 30 south of Orlando. The second time is mid to late February through the first week of April. Relocations should not be undertaken except in south Fla., in winter or anywhere in Florida during the breeding season, April through the end of May.</p> <p>Relocation should not take place where there has been no acceptable rainfall for 6 weeks or more.</p>	Same as Most Acceptable.	Not paying attention to high social and breeding periods, cool weather, low levels of forage and other issues that increase stress in the released tortoises. No relocation when there is at least 60 days of drought or extremely cold weather.

**Table 10.5 Relocation Activities-Preparing For And Release Of The Tortoises On The Recipient Site.** Note that these are activities that are done after the site has been evaluated and accepted.

ACTIVITIES	MOST ACCEPTABLE	MODERATELY ACCEPTABLE	NOT ACCEPTABLE
<p><b>Forage Enhancement and reducing canopy to acceptable levels</b></p>	<p>The area should be burned, mowed, grazed or other activities should be undertaken to reduce the shrub layer, enhance grass and herbaceous species in class 1 and 2 forage. This should be done 2-3 months prior to release.</p> <p>Burning or cutting should be undertaken if the canopy level will reduce forage to unacceptable levels based on survey results. (20-40%)</p>	<p>Canopy level is reduced to 60 % wire grass. Cover is more than 50%.</p>	<p>Tortoise forage is not managed before release. Canopy is not addressed.</p>
<p><b>Establishing Safe perimeter barriers</b>            Note: Both resident and relocated tortoises move long distances. Certainly tortoises without burrows will wander a long distance before deciding to burrow. If there are roads, lands with unacceptable habitat or land use (present or future), then some form of barriers should be considered on a temporary or permanent basis.</p>	<p>All boundaries next to highways or high-risk areas should have permanent tortoise excluder fencing. 4 X 4 in hog wire or welded fence, 12-18 in underground, 24-36 in above.</p> <p>All boundaries to adjacent lands with current or probable development should have at least temporary excluder fencing.</p>	<p>Temporary fencing is put in for six months. No permanent fencing on boundaries with roads or development.</p>	<p>Establishing no barriers to keep wandering tortoises out of harm's way.</p>
<p><b>Establishment of Release Sites</b></p> <p>Note, these are pens that are large enough to provide natural forage and an area that would allow tortoises space enough to develop first burrows. The most recommended fencing is hay bales, fastened to the ground and tightly fitted end to end.</p>	<p>The entire boundary of the release area has permanent tortoise excluder fencing where access would put the tortoise into jeopardy. This is for Reserves of 100 acres or less, particularly where there is encroaching development and roadways.</p> <p>Where there are no perimeter fencing hay bale fences should be put in place surrounding the primary relocation area. Internal area should be based on 2-3 tortoises/acre based on forage. Bales stay in place until the rot in place after 3-6 months allowing tortoise orientation. Starter burrows large enough for the largest adult in the pen should be dug (approx 3 ft or 1 m deep, 4:1 slope). Burrows for 25% of the tortoises should be dug.</p>	<p>Only extreme dangerous areas are fenced permanently.</p> <p>Temporary drift fence type-tortoise excluder fences (silt fence) are put up around several acres of prime habitat. (8-10in under ground)/ Starter burrows for up to 25% of the tortoises are provided</p>	<p>Simply releasing the tortoises willy-nilly over the preserve.</p>

ACTIVITIES	MOST ACCEPTABLE	MODERATELY ACCEPTABLE	NOT ACCEPTABLE
	<p>The pens are checked twice a day to see if tortoises are upright and that there are no problems.</p> <p>Two drinking pans should be provided in each pen.</p>		
<b>Tortoise Data</b>	<p>Data is gathered on each tortoise and each tortoise is permanently marked. Data is entered into the monitoring database.</p>	<p>Same as Most Acceptable</p>	<p>Only data is collected that is required by FWS and no database is maintained by tortoise reserve owner.</p>

### 3-Capture and Handling

Of all the species of tortoise that we have worked with over the years, gopher tortoises seem to prefer to be alone or without direct physical contact with other tortoises most of the time and prone to stress. We believe that this is due to the fact that a tortoise's life is tied so closely to its burrow. There are very few true burrowing species of tortoise, most may dig down into the soil in a shallow palate or under a rock but these are nothing compared to the gopher tortoise burrow. Because of this, we recommend the following:

1. Saturate trap or excavate burrows by pods. Remove all the tortoises within a pod and release them at the same time.
2. Tortoises should be captured and released within 24 hours.
3. Tortoises should be released in the morning after the temperature exceeds 21 C (70 F).
4. As soon as a tortoise is captured put it into a covered dark container. This will reduce stress since it resembles the bottom of a burrow. But do not put a tortoise on dry sand because this causes serious rapid dehydration.
5. Keep tortoises separate when transporting and whenever possible while being held.

6. If one must hold a tortoise for more than 24 hours, give them space and a way to avoid each other. It is best to hold them on soil with thick grass and solid walls if the space is less than 10' X 10'.
7. If you are capturing tortoises during dry periods, soak the tortoise in the covered travel container for 1 hour.
8. Tortoises can be held for a week or more with up to 15 tortoises in a quarter acre of grass habitat without becoming overly stressed. After several days however, some burrowing may occur.

#### 4- Fencing is the most important aspect of successful relocation

Given that the recipient site is prepared and has all things listed in the tables as at least acceptable, the one other key element in the success of a relocation effort is to enclose the release area with hay bales or other materials that will hold tortoises on site for at least 3 months and up to 6 months. Our studies as well as several others indicate that up to 80% of the relocated tortoises will leave the site in a matter of a few days or weeks without restraints. If the tortoises are enclosed for at least 3 months, then between 60-70% will remain on the recipient site; if the fence remains 5-6 months, then nearly all the tortoises will remain on the recipient site (Plate 10.1).

About Hay Bales: Hay bales (Plate 10.2) are laid flat against the ground with absolutely no light coming through. They are placed end to end very tightly all around the site. Old hay that cannot be sold for food can be acquired cheaply. Do not place hay bales on top of stiff grass, stumps, roots, or other features that may allow the tortoise a way to push under the hay bale.

An alternative to hay bales is plastic silt fencing (Plate 10.3). This silt fence must be put into the ground a minimum of 20.3 cm (8 in.) and staked securely. No small holes can exist where tortoises can see out or get their claws and feet inside. Any hole in the plastic fencing will be enlarged by the tortoise(s) and they will depart through it.

**Table 10.6 Summary of relocation studies including costs and key points.**

TYPE OF RELOCATION	ENCLOSURE TYPE	LENGTH OF TIME	STATUS OF RELOCATED TORTOISES	COSTS AND PROBLEMS WITH METHODS
On site –3 permanent enclosures (approx. 50 acres ea) surrounded by total build out. FWC oversight, conservation easement, HCP and monitoring program in place	Welded steel wire 18" below and 30' above. Attached to wooden horse fence. Bahia pasture-forage monitored	1992-2004 12 years	No significant decline in adult population- apparently sustainable 2/acre-Data from last 5 years not yet available. Reproduction (nesting and hatching observed in each of the first 3 yrs)	Fencing costs not available. Management costs, less than \$10/acre/. Yr. (Relocation of tortoises \$168.00) Monitoring approx. \$5,000/every two years on 160 acres. Tortoises and forage (Including <i>Rana capito</i> )
On site-200acres temp hay bale partial from 1993 to 2002, then 240 acres and permanent tortoise excluder fencing. Permanent conservation easement to FWC. Funded by US Bureau of Prisons. HCP and monitoring in place (weak on tortoise pop. Other than pop. Estimate.	Hay bale fencing staked. For 9 years, held pop of 460+ tortoises Two years of enclosed fencing	1993-2004 11 yrs`	All indications are that the population is sustainable and likely growing. "Subadults are present. Habitat and management good.	Data on hay bale cost and permanent fencing not available. Original relocation \$164/tortoise. Management under \$3/acre (burning every two years). Monitoring in early years under \$8,000 every 3 years.
Off site-multiple (3) relocations on to one site. Conservation easement pending with DEP. Funded by donor site landowners. One payment of \$350/tortoise to fund management of recipient site	Hay bales around 18 acres.	6 months in enclosure.	Tortoises present within or just outside of the hay barrier which has been lifted in several locations after 6 months. Trapping shows relocated tortoises are showing allegiance to site. Resident mixing and breeding (September)	Hay bales (1.30/bale plus transport and placing approx \$3500. Burn of whole site \$550.  Burn in again in 3 years. Monitoring intense now to evaluate over all behavior of relocated tortoises with residents.) Institute Funded.
Off site-2 locations from one donor site. One is in permanent conservation easement, part of Florida Panther area. Privately owned with biologist land manager. Other site is owned and managed as conservation land by Lee County. Relocation done on both sites as augmentation.	16 acres enclosed with silt fencing. Lee co. site with old hay bales staked with rebar. Approximately 10 acres enclosed. Hay was substandard and most likely did not provide a sixth month block. Monitoring of fence did not follow protocol.	Likely 3 months	A site visit conducted 2 months after relocation showed that there were several new burrows and likely that many if not most of the relocated tortoises are present. The managers have done no monitoring at this point.	The cost of the Private relocation was about \$192/tortoise. The private landowner received approx. \$680/tortoise to cover costs of construction, monitoring and management of the site. Lee County received a lump payment that far exceeded the cost of site prep. No monitoring program exists but Institute has provided a model.

### Some Points on Follow up Studies and Stressing Animals

1. Tortoises tend to leave burrows that have been trapped, despite the effort of the trapper to keep impacts to a minimum. We do not know where they go or if this disrupts social order.
2. Walking or driving ATVs through uplands over the same route repeatedly will cause a change in soils and vegetation.
3. Do not hold a tortoise out of its home range any longer than you have to. We think that this disrupts behavior patterns in some animals for days at least. Try to keep tortoises less than 30 minutes.
4. If the tortoise(s) is being returned to its original range then release the tortoise(s) within 10 m (32.8 ft.) of the site of capture.
5. If one is collecting blood or other samples, clearly mark tortoises in a temporary way so you can see that they have been sampled and they will not be disturbed more than once.

### **Final Thoughts on Relocation**

If in fact people are going to relocate or accept relocated tortoises on their property, then they must assume responsibility for them. It is no less cruel or inhuman to relocate tortoises improperly where they die a slow death due to poor nutrition or other diseases brought about by stress, or if they are killed on a nearby road or shot by a neighbor than it is to leave them on the donor site and allow them to be entombed.

Determining the success of relocation is extremely important. Most biologists would say that in fact the ultimate success of relocation, whether it is an augmentation or restocking, would be to say that the population of tortoises is indeed biologically sustainable. Most would say that this is a genetically viable population which at best guess may be 50 adults on 50 acres. The number of offspring produced by the whole population would be enough to replace each adult in the population once every twenty years. The habitat is maintained to sustain a minimum carrying capacity in perpetuity. Of course as previously stated, a humanitarian relocation would be considered successful if the relocated stock all died of old age and lived a healthy, stress free life until that point. Humanitarian relocations may also serve as stock for re-introduction into newly available lands in the future.

We encourage all those involved in working with tortoises and particularly those involved in relocations to consider ethics and long term sustainability as key factors in all decisions made. It has always been too easy for large companies to demand unethical actions where the bottom line is at stake. Our final words in this text to all biologists, botanists, environmental consultants and landowners are this – if the tortoise and other protected species cannot have lands on which to live in perpetuity then consider what you and your family's quality of life will be like in 10, 20, 30 or 50 years. Biological sustainability as a concept encompasses all of us.