

Translocation of Mojave Desert Tortoises from Project Sites: Plan Development Guidance

U.S. FISH AND WILDLIFE SERVICE



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Glossary

Biological samples: Samples collected from desert tortoises (e.g., blood or oral swabs). Refer to the *health assessment* procedures (USFWS 2019) for the samples currently being collected.

Clearance(s)/clearance survey(s): Surveys to locate and remove as many desert tortoises as possible prior to initiation of development at a project site to reduce likelihood of death or injury.

Control tortoises: Desert tortoises at a location separate from the project or *recipient population*, selected for monitoring purposes relative to *translocated* and *resident tortoises*.

Depleted population: Areas where tortoise densities are below a minimally viable level of 3.9 adult tortoises/km². Populations expected to decline to this level within 3 years based on trends estimated in Allison and McLuckie (2018) are also considered depleted. For regions with increasing populations, depleted-population density is set at 3.9 adult tortoises/km². See Table 1.

Development footprint: Boundary of the project within which tortoises will be cleared and *translocated* to another location. The development footprint typically will be fenced with tortoise *exclusion fencing*.

Disposition plan: A specific proposal of the fate of each desert tortoise from the project site (e.g., *translocate* to specific *release area* at *recipient site*, transport to veterinarian for evaluation and treatment, remove from population, etc.). The disposition plan template (Appendix H in USFWS 2019; contact USFWS for most recent version) includes summary health information for all assessments of each tortoise. It must be completed within the season in which translocation is proposed to occur and is one part of the *Translocation Review Package*.

ELISA: Enzyme-linked immunosorbent assay used to detect antibodies in blood plasma to targeted pathogens, in this case antibodies to *Mycoplasma agassizii* and *M. testudineum*.

Exclusion fence/fence/fencing/project fencing/perimeter fence: References to fencing in this document refer to fencing that is impermeable to most tortoises and is used to either confine or exclude them. Specifications can be found in Chapter 8 of the [Desert Tortoise Field Manual](#).

Health assessment: A standardized physical examination, which includes measurements and evaluation for presentation of key clinical signs of disease. *Biological samples* may or may not be collected at the time of a health assessment. See USFWS (2019).

Post-translocation density: Density of the tortoise population at the recipient site immediately following release of tortoises from the project site. Post-translocation density = (estimated # adult *resident tortoises* + # adult tortoises *translocated*) / (area of *recipient site*). Adults are \geq 180 mm midline carapace length.

Post-translocation monitoring: Monitoring of *translocated* and *resident* tortoises in the *recipient population* and one or more associated *control populations* to evaluate the success of the *translocation* (see p. 20).

Pre-project survey(s): Standardized surveys to determine presence/absence and abundance of desert tortoises (<http://www.fws.gov/carlsbad/PalmSprings/DesertTortoise.html>).

Prevalence: The proportion of tortoises within the population that are infected or diseased (Gray *et al.* 2017). For the purposes of this guidance, prevalence includes seroprevalence (*i.e.*, the proportion of tortoises seropositive to antibodies of *Mycoplasma agassizii* or *M. testudineum*, as well as those with clinical signs that disqualify them from being *translocated* (USFWS 2019). Note that presence of antibodies provides an indication of previous pathogen exposure, not current illness.

qPCR: Quantitative polymerase chain reaction technique for detecting DNA of a target organism, in this case *Mycoplasma agassizii*, *M. testudineum*, and Testudinid herpesvirus 2 from oral swabs.

Recipient site/population: The location/population to which desert tortoises removed from a project site will be translocated. This is a larger area than the specific *release site* into which tortoises are physically moved and includes the full, anticipated *release area* (Example 1).

Regional population-augmentation site: Desert tortoise population that the USFWS has determined to be in specific need of augmentation for recovery purposes. Such populations may be used to receive tortoises from development sites within a specified radius.

Release area: The area into which most tortoises are expected to move and settle after release (Le Gouar *et al.* 2012). For tortoises released ≤ 300 m from their points of origin, the release area is a 1.5-km radius around the release points, and for those released > 300 m the radius is 6.5 km.

Release site: The geographic area containing the release locations of *translocated* tortoises (Example 1). Translocated tortoises will move from the release site throughout the *release area*.

Resident tortoises: Desert tortoises living within the *recipient population* prior to the release of tortoises translocated from the project site. Once identified, they continue to be designated as resident tortoises after the *translocation*.

Small number of tortoises: When a regional population-augmentation site is unavailable certain components of the translocation guidance may be relaxed when translocating a small number of tortoises. Determining precisely what constitutes a “small number” will depend on project-specific details, such as the scope and scale of the project, the area across which tortoises will be displaced, and the area within which the tortoises are proposed to be moved. However, relaxing guidance described herein will be based on the principles that translocating few tortoises 1) will negligibly increase the density of a *recipient site*, 2) will minimally disrupt *resident-tortoise* social dynamics and contact rates, and 3) will lack sufficient power to evaluate translocation effectiveness via a detailed monitoring program.

Translocated tortoises: Desert tortoises that have been moved from a *development footprint* to a *recipient site*.

Translocation: The human-mediated movement of living organisms from one area with free release in another (IUCN 2013). Translocation is an overarching term, and synonyms that may have been used previously include “relocation.”

Translocation plan: A document detailing the proposed *translocation* and *post-translocation monitoring*, as per the contents of this guidance. Projects using an established *regional population-augmentation site* need only complete a *translocation review package*, rather than a full translocation plan.

Translocation-review package: Documents submitted to the USFWS for review and final approval of a *translocation*. It includes a *disposition plan* for the project-site tortoises and health summary of *resident* and *control* tortoises; photographs of individual tortoises as specified on the *health assessment* data sheet; health assessment data sheets for *resident*, *control*, and project-site tortoises; maps of the *recipient site*, including digital GIS layers, illustrating health sampling results of the *resident* tortoises, and showing proposed release points of project-site tortoises; maps of the *development footprint* illustrating distribution and health status of project-site tortoises; and any other project-specific information that supports or clarifies translocation decisions.

Introduction

This guidance is based on three overarching principles:

- 1) Once translocation of desert tortoises from a project site has been deemed necessary and appropriate, the first consideration is *how can those tortoises best contribute to recovery of the species*.

Convenience in moving the tortoises out of the way of development is secondary. The guidance prioritizes **regional augmentation sites** to boost **depleted populations** that are important to recovery.

- 2) *Rigorous monitoring* will document the contribution of **translocated tortoises** to recovery as well as the effectiveness of translocation in minimizing impacts to the affected tortoises.

Long-term monitoring of projects with a **small number of tortoises for which a regional augmentation site is not available** lacks statistical power to rigorously evaluate translocation effectiveness. Such projects will be evaluated on a case-by-case basis to determine the appropriate level of monitoring.

- 3) Translocation protocols will *minimize risks to both translocated tortoises and the recipient population*, especially relative to disease transmission.

No wildlife populations are completely free of disease. Therefore, the purpose of disease risk minimization is not to maintain a disease-free state within a population but rather to maintain resilient and self-sustaining populations capable of adequately responding to disease occurrences (Rideout 2015). Diagnostic tests of **biological samples** are used to evaluate populations, not individuals (see **Health assessments: Health-assessment protocols**), so projects requiring translocation of a **small number of tortoises**—when a **regional augmentation site** is not available—may require less invasive **health assessments** that do not include collection of **biological samples**.

This document provides guidance for the development of project-specific **translocation plans** for activities that will impact Mojave desert tortoises (*Gopherus agassizii*; hereafter, “desert tortoise” or simply “tortoise”) when avoidance of these impacts is not feasible. Prior to drafting a **translocation plan**, however, project proponents should discuss with the U.S. Fish and Wildlife Service (USFWS) the most appropriate course of action with regard to disposition of affected desert tortoises. Options include translocation to an augmentation site, moving or reducing **development footprints** within occupied desert tortoise habitat, and designing projects that would allow experimental evaluation of continued occupancy of the site by tortoises, even if at a reduced level.

Although recent research on translocation of desert tortoises has shown potential as a conservation tool at more than a dozen sites, results are generally available only for durations ≤ 5 years, and long-term success has not been documented (Brand *et al.* 2016, Dickson *et al.* 2019, Drake *et al.* 2012, Esque *et al.* 2010, Farnsworth *et al.* 2015, Field *et al.* 2007, Harju *et al.* 2019, Hinderle *et al.* 2015, Nafus *et al.* 2017, Nussear *et al.* 2012). As a result, we do not fully understand the long-term impacts of translocation, including for example, altered disease dynamics (Aiello *et al.* 2014) or changes to effective population size (*i.e.*, recruitment into the adult population as a result of successful reproduction; see Mulder *et al.* 2017). Likewise, impacts on population fragmentation and gene flow as a result of large-scale development within occupied desert tortoise habitat, for which translocation is increasingly used as an impact-minimization tool, are unclear. Nonetheless, new information continues to emerge from recent

translocation projects and related research (*e.g.*, Germano *et al.* 2012, Hall *et al.* 2016, Walde *et al.* 2011). New translocation projects should be designed so that effectiveness monitoring addresses questions related to the success or impacts of the translocation. The information gathered from such efforts can be applied to further reduce incidental take resulting from projects and to improve the success of translocation as a conservation tool (see Germano *et al.* 2015).

If translocation can be justified as the most appropriate course of action, this document should be used as a reference that, when combined with project-specific input from the USFWS and other permitting agencies, will facilitate the completion of a **translocation plan**. This guidance does not constitute a **translocation plan** “template.” Rather, it describes considerations that must be taken into account and steps that must be taken when developing a **translocation plan** and preparing to move tortoises across the landscape. Deviations from the guidance may be appropriate and acceptable if addressed by a project-specific effectiveness-monitoring program within the **translocation plan**.

This guidance is complementary to existing protocols for the desert tortoise that should be referenced when planning and implementing surveys, **translocation plans**, and other activities involving this species. To ensure that you are referring to the most current guidance and protocols, contact your local USFWS field office or download the **Pre-project Survey Protocol** (USFWS 2018a or more recent), Desert Tortoise Field Manual (includes **Clearance Survey** Guidelines, Handling Guidelines, and Exclusion Fence Specifications; USFWS 2009 or more recent), and Responsibilities and Qualifications for Authorized Biologists at <http://www.fws.gov/carlsbad/PalmSprings/DesertTortoise.html>. Health-assessment protocols (USFWS 2016 or more recent) referenced in this document may also be downloaded from http://www.fws.gov/nevada/desert_tortoise/dtro/dtro_trans.html. *In addition to this guidance, project proponents need to confer with the State wildlife agency relevant to the project area to ensure compliance with State-specific policies or protocols.*

Permits and Coordination

This document provides guidance on how to translocate desert tortoises in accordance with the three overarching principles described previously in this section. Proponents will need to develop **translocation plans** that meet the specific needs of their projects. Therefore, we used appropriate wording (*e.g.*, “should”) in describing the general components of these plans that will be developed in coordination with the USFWS.

Section 9 of the Endangered Species Act of 1973, as amended, and Federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species (fish and wildlife) without special exemption. The definition of “take” is to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct, and the implementation of any translocation activity will necessitate take of desert tortoises in some form. Consequently, activities described by this guidance may be undertaken only when the USFWS has issued: *1) a recovery permit pursuant to section 10(a)(1)(A) of the Act; 2) an incidental take permit pursuant to section 10(a)(1)(B) of the Act; or 3a) a biological opinion that contains an incidental take statement under the authorities of section 7(a)(2) of the Act, if an exemption to the prohibitions against take is granted, and 3b) the action agency has issued their decision document.*

Projects will also need approval from the appropriate State wildlife agency to translocate desert tortoises and permission of the relevant landowners or managers. Failure to obtain the review and approval of all involved agencies is likely to delay the project and potentially incur agency-specific penalties. When planning a translocation, ensure that all appropriate agencies are notified early in the process. The **translocation plan**, after approval by the agencies, would then be incorporated into the project design or included in the terms and conditions of the USFWS's biological opinion or incidental take permit. *Without a recovery permit, activities requiring the handling of tortoises can only be conducted in accordance with an incidental take permit or biological opinion.* Separate permits also may be required by other Federal agencies or by State laws and regulations. Because any given project may have unique circumstances, we recommend project proponents and the lead action agency work closely with the appropriate USFWS field office, State wildlife agency, and the relevant land-management agency early in the planning process to determine which of the components and to what degree each of the following should be included in project-specific **translocation plans**.

Document Organization

- The bulk of this document contains detailed protocols and rationale for aspects of the translocation planning and implementation process. Various terms bolded in the text are defined in the glossary (page ii).
- A flowchart (Figure 1) summarizes various actions, key considerations, and decision points throughout the translocation planning process.
- An example illustrating several of the concepts described herein is provided prior to the Literature Cited.

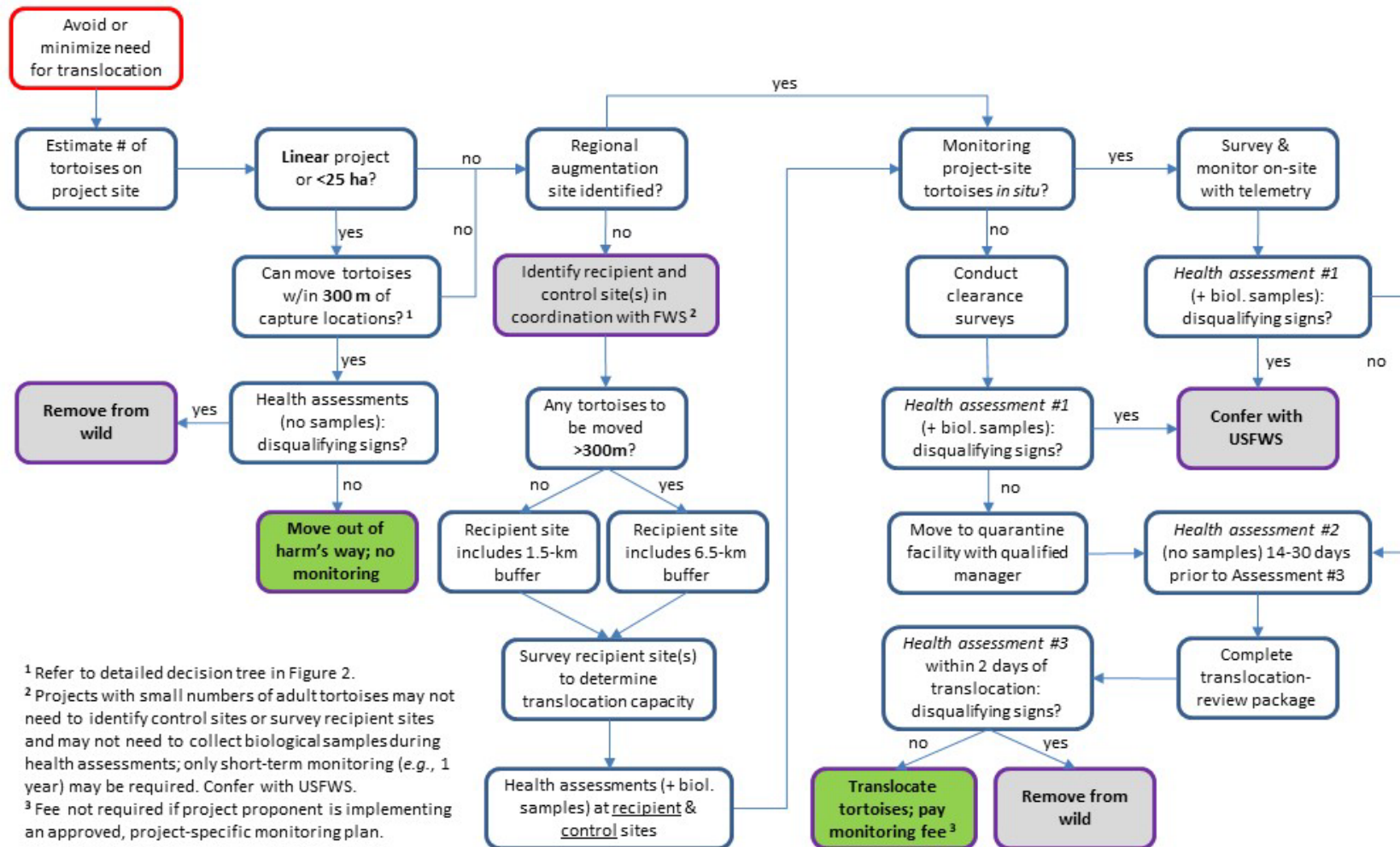


Figure 1. Translocation planning flowchart (see text for details; see also Fig. 2 for more detail on projects moving tortoises < 300 m).

Protocols and Rationale

Development projects within occupied desert tortoise habitat have several required and optional actions to consider. All projects should estimate the number of tortoises on the project site to allow for the development of the most appropriate **translocation plan**. Many projects may be able to move or adjust the **development footprint** to reduce the need to translocate tortoises from harm's way, but two primary scenarios exist for projects with tortoises remaining within the **development footprint**. 1) Preferably, tortoises would be translocated to pre-identified, regional, population-augmentation sites, thereby precluding the need to develop and implement individual translocation and monitoring plans, and specified fees would contribute to post-translocation monitoring. 2) Projects may hire qualified scientists to develop their own translocation and monitoring plan to be approved by the USFWS, including identification of potential **recipient sites**. Details for each of these scenarios follow.

Estimate the number of desert tortoises that will be affected at the project site

Pre-development surveys are important in order to prepare for the three potential outcomes for tortoises located during the ultimate **clearance surveys** (see Figure 1 and ***General clearance protocols*** for more details):

- a. tortoises remain on-site for *in situ* monitoring until health assessments and translocation (preferred option);
- b. transfer tortoises to quarantine facility for holding (*ex situ*) until health assessments and translocation (≤ 6 months);
- c. transfer tortoises that are ineligible for translocation to an agency-approved facility.

We recommend that you work with the local USFWS office to determine the most appropriate method of estimating the number of desert tortoises on site. For most situations, we recommend that you conduct surveys according to the most recent USFWS **Pre-project Survey Protocol** and include data on all tortoise sign observed. For some situations (*e.g.*, linear and small projects, when no large desert tortoises are found during protocol surveys, *etc.*), estimating density may be the best be done by using the density of desert tortoises from the USFWS's range-wide sampling.

Data collected during the surveys should be standardized according to and compatible with the master database to be provided by USFWS and Bureau of Land Management (BLM). Submit survey data and associated maps and GIS shapefiles to the USFWS. These data will be used to estimate the number of desert tortoises expected to be adversely affected or impacted by the project and to assist in identifying potential **recipient** and **control sites** (see glossary) based on the density estimates (see Example 1). Note: when a project occurs within a "no survey" area identified by California's Desert Renewable Energy Conservation Plan or in any land use plan, the project proponent should confer with the California Department of Fish and Wildlife to determine survey requirements. Such projects should prepare to handle tortoises found on the **clearance** site according to the protocols described below for ***Regional population-augmentation sites***.

Regional population-augmentation sites

Given that most development projects will occur outside designated conservation areas or other important habitat, priority is placed on using desert tortoises displaced from development to augment depleted populations specifically identified for their importance to recovery, rather than merely moving them out of the way (*i.e.*, “over the fence”). Note that, hypothetically, habitat adjacent to a development site may be valuable for recovery and may thus qualify as a regional augmentation site. If tortoises from a project qualify for a site in need of augmentation identified by the USFWS, translocation requirements will be simplified to the following four steps:

- At least two health assessments (see *Health assessments*).
- A fee to cover expenses associated with archiving **biological samples** and maintaining the sample bank: \$3000 (2020 dollars; see *Health-assessment protocols* for a description of the archival fee).
- A **translocation-review package** (see *Translocation of desert tortoises following acceptance of translocation-review package*), not including information on **recipient-site** and **control tortoises**.
- Coordinate funding for post-translocation monitoring with the USFWS (see *Post-translocation monitoring*).

Linear and < 25-ha projects

If a regional population-augmentation site is unavailable or the USFWS determines that maintaining tortoises in the vicinity of the project site is desirable (*e.g.*, the project occurs within a population linkage and suitable habitat is available), tortoises may be moved from linear projects, or other projects up to approximately 25 ha (62 acres), up to 300 m from their capture locations into adjacent habitat (Figure 2).¹ Linear projects include infrastructure such as roadways, pipelines, fiber-optic lines, transmission lines, or other buried lines. In these cases, tortoises generally should be moved out of harm’s way into adjacent habitat following **clearance** and handling procedures outlined in Attachment 1 and the current USFWS Desert Tortoise Field Manual. Such tortoises should be moved < 300 m after confirming a lack of significant clinical signs of ill health or recent captivity (*e.g.*, grossly emaciated, severe runny nose, painted or

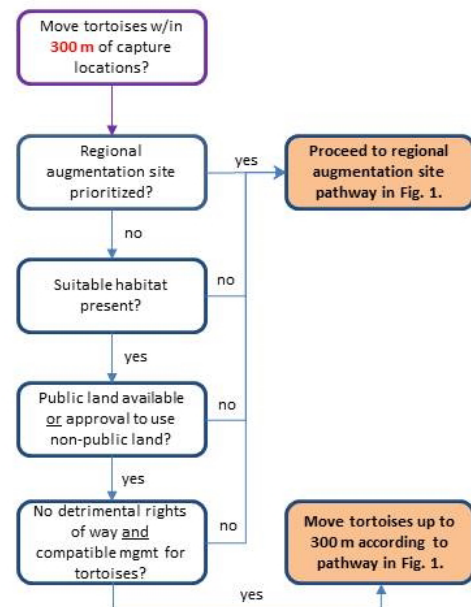


Figure 2. Decision tree for moving tortoises < 300 m on linear or < 25-ha projects.

¹ The 300-m threshold defines an area within which resources and neighboring tortoises are expected to be familiar to the **translocated tortoise**. The area of a moderate-term home range (*ca.* 4 years) is 43 ha, the radius of which is 370 m (Vamstad *et al.* 2013; Harless *et al.* [2010] summarized smaller home ranges estimated over shorter durations). Desert tortoises translocated < 500 m disperse shorter distances than tortoises moved > 500 m (Walde, pers. comm., 2015 [updated from Walde *et al.* 2009]) and are thus less likely to encounter tortoises with which they are unfamiliar and have contact with (*cf.* Aiello *et al.* 2014). To be conservative, we apply a 300-m threshold in this guidance. For non-linear projects, 25 ha conservatively approximates the area of a 300-m radius project.

pyramided scutes), without the need to collect **biological samples**. Post-translocation monitoring (and associated fees) is not recommended for these tortoises. Tortoises with significant clinical signs of ill health should be removed from the wild in coordination with the USFWS (see *Translocation of desert tortoises following acceptance of translocation-review package* for information on disposition of sick tortoises). If suitable habitat is not available within 300 m of the tortoises' capture locations or other land ownership restrictions prevent the release of individuals within 300 m (e.g., privately owned land lacking permission), the remainder of this guidance applies.²

Project-specific translocation plan: identify potential recipient and control sites

If a regional population-augmentation site is not available, **recipient** and **control sites** should be identified. Lands to consider as potential **recipient sites** may include designated critical habitat or lands identified as Desert Tortoise Conservation Areas (TCAs) in the revised recovery plan (USFWS 2011), lands outside TCAs that are important for maintaining habitat and population connectivity, or lands where management actions are being tested. The latter factor especially requires qualified scientific oversight in developing the **translocation plan** to avoid confounding effects. If the area surrounding the project site is suitable (appropriate habitat, large enough to contain likely dispersal distances, and meets other requirements in this guidance), all or some of the tortoises may be released into habitat adjacent to the project. We recommend that the proponent conduct surveys in the potential **recipient** and **control sites** according to the most recent USFWS **Pre-project Survey Protocol**. Provide survey data and associated maps and GIS shapefiles to the USFWS.

Projects with a **small number of tortoises** for which a regional population-augmentation site is unavailable need not survey the **recipient site**. Translocating few tortoises will negligibly increase the density of a **recipient site** and will minimally disrupt **resident-tortoise** social dynamics and contact rates. Monitoring a **small number of tortoises** lacks power to evaluate translocation effectiveness, so identifying a **control site** is unnecessary in this situation. Determining precisely what constitutes a “small number” of tortoises will depend on project-specific details, such as the scope and scale of the project, the area across which tortoises will be displaced, and the area within which the tortoises are proposed to be moved.

Recipient-site selection criteria—The following criteria should be addressed when selecting prospective **recipient sites**.

1. The site supports desert tortoise habitat suitable (including accessible land ownership) for all life stages.
2. The site contains a depleted tortoise population (see *Determination of recipient-site size and quality*).
3. There is no evidence of an active outbreak of disease, such as high prevalence of clinical signs of disease or seropositive responses to disease agents. The USFWS will consult

² If the project and potential **release site** occur in an area the USFWS has determined is less important for recovery of the species (e.g., outside of conservation areas, population linkages, and other contiguous, high-value habitat) and a regional augmentation site is unavailable, it may be acceptable to release the tortoise(s) into suitable habitat > 300 m from its capture location.

with wildlife health professionals to determine whether sites with relatively high disease prevalence are appropriate for translocation.

4. Major unfenced roads (*i.e.*, high traffic volumes/speed limits and no desert tortoise **exclusion fence**), highways, or human development that would pose a risk to desert tortoises, are no closer than 6.5 km to the **release area**. Distances from unfenced hazards may be reduced if proposed monitoring or topographic features justifies a shorter distance.³
5. Unless otherwise approved by the USFWS based on **small numbers of tortoises** to be translocated, the **recipient population** should be on the same side of the southern/western boundary of the Eastern Mojave Recovery Unit as the source population.⁴
6. The site has no detrimental rights-of-way or other encumbrances that would pose ongoing risks to successful establishment of **translocated tortoises**.
7. The site will be managed compatibly with continued desert tortoise occupancy.

Determination of recipient-site size and quality—**Recipient sites** include the **release site** and expected area of dispersal of **translocated tortoises**. Data from recent translocations indicate that desert tortoises moved up to 500 m from their capture location are expected to settle within 1.5 km of their release point, and most tortoises (> 97.5%) moved > 500 m are expected to settle within 6.5 km of their release point within the first year of release (unpublished data analyzed by the Desert Tortoise Recovery Office). However, to further maximize the chance that tortoises moved short distances are familiar with the area and will disperse a minimal distance, we apply a threshold of 300 m for “short-distance translocations.” Therefore,

- For tortoises moved > 300 m: the **recipient site** encompasses the area within a 6.5-km radius of the set of potential release points (see Example 1).
- For tortoises moved ≤ 300 m: the **recipient site** encompasses the area within a 1.5-km radius of the set of potential release points.

Some projects may include tortoises moved both < 300 m and > 300 m adjacent to the project site, in which case the **recipient population** is defined by the larger area. In these cases, all tortoises to be translocated short distances still fall within the complete guidance (health assessments, density requirements, monitoring, etc.) and should be included in the project’s tortoise **disposition plan** (see below).

Little information exists on what constitutes carrying capacity for desert tortoise habitat or what specific variables relate to quantifiable measures of habitat quality. However, project proponents

³ Installation of tortoise barrier fencing along a highway adjacent to a proposed **recipient site** may be considered as part of the project’s proposed action.

⁴ The major genetic difference between Mojave desert tortoise populations occurs across the southern and western boundary of the Eastern Mojave Recovery Unit (Sanchez-Ramirez et al. 2018; Shaffer et al. 2017). On either side of this boundary, populations within a 200-km straight-line distance of each other (249 km measured around topographic barriers) tend to be genetically correlated and may be considered single genetic units for management purposes, and the risks of outbreeding depression due to genetic mixing is low (Averill-Murray and Hagerty 2014). See also Frankham et al. (2017), who stated “Disturbingly, evidence of any genetic differentiation among populations typically leads managers to conclude that the populations should be kept isolated, thereby dooming many to eventual extinction.”

should provide a qualitative assessment of prospective **recipient sites** relative to habitat conditions likely to support the **translocated tortoises**, including perennial cover and density, annual forage, native/non-native plant species diversity, and soil conditions for burrowing or significant areas of other shelter types (*e.g.*, caliche dens). Prospective **recipient sites** should be evaluated relative to potential threats that may affect desert tortoises translocated to the area, including those that may originate nearby (*e.g.*, elevated predator populations [domestic or native], proximity to major highways or OHV high-use areas, historic mining sites or other toxicant sources, and proximity to existing and future utility infrastructure).⁵ We recommend that more than one potential **recipient site** be identified during planning in the event that disease status, desert tortoise densities, or other factors prevent the use of a potential site.

Determine capacity of recipient site to hold translocated tortoises—The density of tortoises in the **recipient site** must be low to minimize risk of disease transmission (Rideout 2015), so translocation typically should be applied to depleted populations, which are defined as < 3.9 adult tortoises/km².⁶ For populations not yet below this threshold, we calculate a depleted-population density as that at which the population is estimated to decline within three years to 3.9 adults/km² based on trends estimated in Allison and McLuckie (2018; Table 1). We use the estimate at the 3-year period before a population is projected to reach 3.9 adults/km² as a means to allow **translocated tortoises** to settle into the population before it reaches the most critical level. For regions containing increasing populations, depleted-population density is set at 3.9 adults/km². At these densities, there is minimal risk from disease outbreaks or other impacts if the risk-minimization measures of this guidance fail. Exceptions to this threshold must be supported by scientific justification and monitoring.

In any case, translocation will increase tortoise densities in **recipient populations**, so for a successful translocation, the **post-translocation density** in any area should not exceed the capacity of the surrounding desert. However, as noted above, information is lacking on specific metrics for determining carrying capacity for desert tortoises. From a statistical standpoint, though, densities described by a single standard deviation of the mean tortoise density for a particular area or region are not unusually high for that area (Figure 3). Therefore, assuming appropriate habitat and management exist, projected density of adult tortoises in the **recipient population** after translocation (**residents plus translocated** adult individuals [≥ 180 mm carapace length]) should not exceed 1 standard deviation above the mean density in the respective recovery unit or specific critical habitat unit, as applicable (Figure 3; Table 1). Note that 1 standard deviation above the mean density is still less than the minimum density threshold of 3.9 adults/km² in many regions (Table 1). In these cases, increasing populations to at least 4 adults/km² is encouraged in conjunction with site-specific recovery actions and associated effectiveness monitoring. The USFWS and partner agencies will evaluate such scenarios on a case-by-case basis to increase the probability that the habitat can support a more robust population. Finally, the number of juvenile tortoises (defined here as < 180 mm carapace length)

⁵ Management of documented threats within the **recipient site** should be considered as part of the project's proposed action to reduce threats to the desert tortoise.

⁶ While updated population viability analyses are needed (USFWS 2011), previous analyses indicated that populations at densities lower than 3.9 adult tortoises/km² are not viable in the long term (USFWS 1994:C25). This provides a density metric below which risk of disease transmission or negative population consequences of transmission is low. Areas below this density are also in need of population augmentation to reach viability.

released should not exceed three times the adult limit (*i.e.*, $\leq 75\%$ of the ultimate **translocated** population could be juveniles).⁷ Contact the USFWS for the most current data on desert tortoise densities within each recovery unit.

Table 1. Density (adult tortoises/km²) thresholds for identifying (A) depleted populations eligible to receive tortoises via translocation and (B) maximum post-translocation densities within recipient populations for each recovery unit and monitoring stratum.

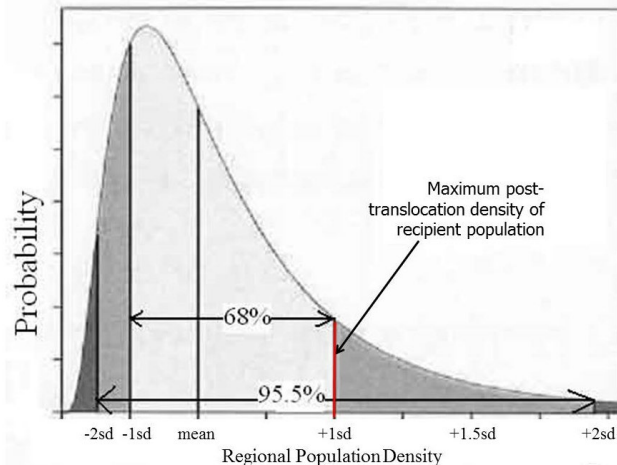
Recovery Unit	2014 Mean Density^a	(A) Maximum Population Density <i>before</i> Translocation^b	(B) Maximum Population Density <i>after</i> Translocation^c
Western Mojave	2.8	3.9	3.6 (4.0)
Fremont-Kramer	2.8	3.9	3.4 (4.0)
Ord-Rodman	3.8	3.9	4.6
Superior-Cronese	2.5	3.9	3.0 (4.0)
Eastern Mojave	1.5	3.9	2.0 (4.0)
Eldorado Valley	1.6	3.9	2.0 (4.0)
Ivanpah Valley	2.5	3.9	3.0 (4.0)
Colorado Desert	3.7	3.9	4.6
Chocolate Mtn	7.6	4.3*	9.1
Chuckwalla	3.6	3.9	4.3
Chemehuevi	2.8	3.9	3.4 (4.0)
Fenner	5.0	4.9*	6.1
Joshua Tree NP	4.1	3.9	4.9
Pinto Mountains	2.7	3.9	3.2 (4.0)
Piute Valley	5.3	3.9	6.3
Northeastern Mojave	4.4	3.9	5.6
Beaver Dam Slope	6.2	3.9	7.9
Coyote Springs	4.2	3.9	5.0
Gold Butte	2.9	3.9	3.5 (4.0)
Mormon Mesa	6.8	3.9	8.2
Upper Virgin River	16.0	4.3*	20.9

^a Mean estimated density from trend analysis through 2014 (from Allison and McLucke 2018).

^b Populations at marked with asterisks are projected to reach 3.9 adult tortoises/km² within 3 years. For regions already below this threshold or that contain increasing populations, depleted-population density is set at 3.9 adult tortoises/km².

^c The upper limit is set at 1 standard deviation above the mean density for that area, as estimated from the range-wide monitoring program (Allison and McLuckie 2018). For regions where the cap is below the minimum viable density of 3.9 adults/km², the population may be increased to at least 4 adults/km² in conjunction with additional on-the-ground recovery actions implemented within the **recipient site** to increase the probability that the habitat can support a more robust population; associated effectiveness monitoring also should be conducted.

⁷ Approximately 74-88% of a wild population consists of tortoises < 180 mm carapace length (Turner *et al.* 1987; Karl 1998), but juvenile desert tortoises have naturally higher mortality rates than adults (Bjurlin and Bissonette 2004). Individuals released in this size category are expected to ultimately add less to the population than, and compete minimally for resources with, adult tortoises.



*Figure 3. Desert tortoise density threshold for **recipient populations** relative to regional estimates from the range-wide monitoring program. The density of most (68%) local populations falls within 1 standard deviation (sd) of the mean density in the surrounding region. Tortoise numbers in the **recipient population** following translocation should not exceed 1 sd above the mean regional density without approved justification (see text).*

Selection and approval of **recipient sites** also depend on the disease status of the tortoises in the potential **recipient population**. If handling tortoises for health assessments has not been approved at this stage, clinical signs of disease that can be observed without handling should be documented. This information might alert you to disease issues at the site that could preclude its approval. See Appendices B and G in USFWS (2019, or more recent) for a datasheet with the clinical signs of interest and an algorithm that identifies the most serious and risky of the clinical signs.

Control-site selection considerations—Potential **control sites** should:

- be similar in habitat type/quality (e.g., level of disturbance), post-translocation population size, and disease status to the **recipient sites**, to the maximum extent possible;
- not have foreseeable development or other impacts precluding tortoise occupancy;
- not have been previously used as a **recipient site** for other projects; and
- be a minimum distance of 10 km away from an unfenced **recipient site** that has no substantial anthropogenic or natural barriers to prevent the interaction of **control**, **resident**, and **translocated desert tortoises**.

Review of recipient and control sites—Once the **recipient** and **control** sites have been surveyed, the information below should be submitted to the USFWS to ensure that the proposed **recipient site** meets the site-selection criteria. This information should be provided as early as possible so the project is not delayed.

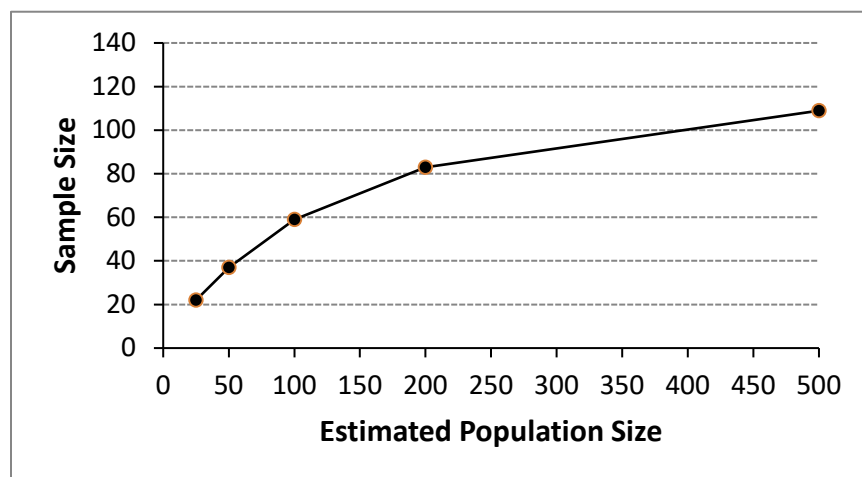
- Summary information, including complete health histories, for sampled tortoises (*i.e.*, follow the **disposition plan** template in Appendix H in USFWS 2019 or more recent);
- Photographs of individual tortoises as specified on the health assessment data sheet;
- Health assessment data sheets;
- Density information, including Table 3 from the *USFWS Pre-project Survey Protocol and calculation of post-translocation density*;
- Maps of the **recipient** and **control** sites, including all relevant digital GIS layers, illustrating distribution and health status of **resident tortoises**, proposed **release areas** for **translocated tortoises** and the appropriate radius of post-release movement, and any mitigated or unmitigated hazards (e.g., Example 1).

Health assessments

Resident and control tortoises—Unless a regional population-augmentation site is already available, health assessments must be performed on desert tortoises in the **recipient** and **control** populations according to the most recent protocols and under a biological opinion, incidental take permit, or recovery permit issued by the USFWS (see **Health-assessment protocols**). If the USFWS has issued a recovery permit for the project, health assessments conducted in accordance with the most recent protocols may be performed concurrent with the protocol surveys of the **recipient** and **control** site. Additional health assessments of the **recipient** and **control** tortoises, not including collection of **biological samples** if previously collected within 1 year, should occur during the same season as the translocation. The final assessments will serve as the baseline condition with which to compare post-translocation assessments.

*Full **health assessments** must be conducted on **resident and control tortoises** during the same season as translocation; however, **biological sample** collection is not necessary if samples previously were collected within 1 year of the translocation season.*

Target sample sizes are estimated as those needed to detect 10% prevalence at the 95% confidence level and 5% precision (Figure 4).⁸ These sample sizes will likely be greater than the minimum number of observations described by the USFWS **Pre-project Survey Protocol** needed to estimate abundance. Project proponents should coordinate with the appropriate USFWS office to determine sample-size requirements based on **recipient-site** abundance estimates.



*Figure 4. Target sample size to detect 10% disease **prevalence** at the 95% confidence level and 5% precision. If the true **prevalence** is < 10%, fewer samples will be needed to reach the desired confidence level and precision.*

⁸ The targeted level of sampling is necessary to precisely document baseline conditions relative to monitoring potential changes in **prevalence** throughout the effectiveness-monitoring period. Sample-size analysis was conducted using the EpiTools epidemiological calculator (Sergeant 2015) and is based on the serological test for *Mycoplasma agassizii*, for which documented sensitivity (0.98) and specificity (0.99) estimates exist (Wendland *et al.* 2007; see also Gray *et al.* 2017).

Translocated tortoises—A minimum of two health assessments must be completed 14–30 days apart prior to translocation (under a biological opinion, incidental take permit, or recovery permit issued by the USFWS). Additional assessments (outside of 30 days) may be conducted, but a narrow window is necessary to discover animals with intermittent clinical signs. The last assessment should occur immediately (within 1–2 days) prior to the translocation date and does not require collection of **biological samples** from tortoises for which samples were previously collected. The final assessments will serve as the baseline condition with which to compare post-translocation assessments and as a final check against the current algorithm determining whether tortoises are suitable for translocation (Figure 5). Any tortoises that were previously approved for translocation, but now show clinical signs that disqualify them according to the algorithm, should not be translocated and their disposition discussed with the USFWS.

*A full **health assessment** must be conducted on each **translocated tortoise** within 14–30 days of the final assessment of release AND within 1–2 days of release; however, **biological sample** collection is not necessary if samples were collected within 1 year of the translocation season.*

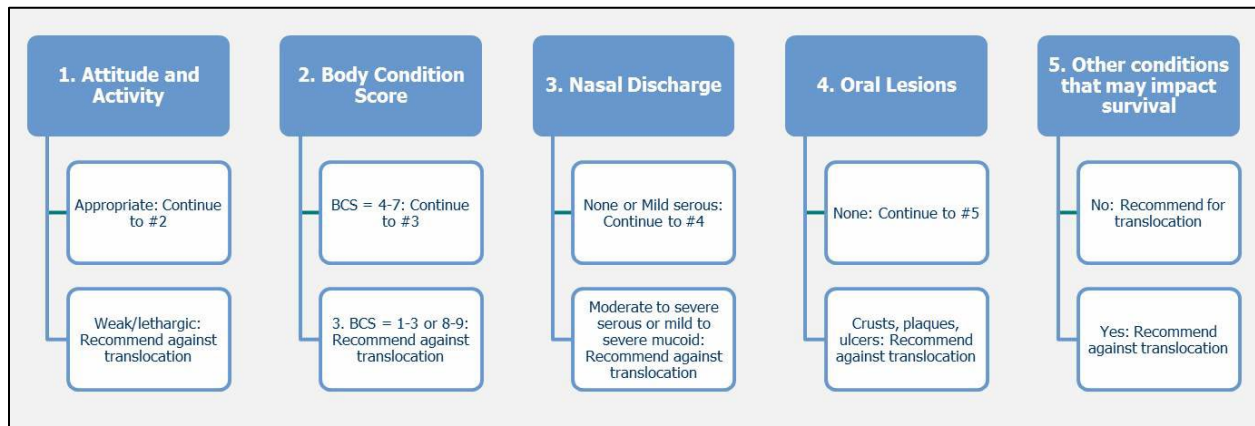


Figure 5. Health assessment algorithm used to determine whether an individual tortoise is suitable for translocation (Appendix G in USFWS 2019). Confirm with USFWS for most recent algorithm.

Health-assessment protocols—Health assessments include a physical inspection and, typically, collection of **biological samples**. Health assessments may only be conducted by individuals approved and permitted by the USFWS. Individuals should inquire with USFWS about opportunities to receive certification. Because of new health-assessment standards and the need for standardized data, certification will not be granted solely on past experience. Training for performing health assessments and collecting **biological samples** is conducted subject to availability of tortoises and instructors.

While health assessments may occur at any time after tortoises in the population generally have emerged from hibernation, it is important that the desert tortoise’s immune system is actively responsive when blood samples are drawn. Blood may be drawn beginning May 15 or, upon specific approval from USFWS, four weeks after the date that the individual of interest left its hibernaculum or was first found active and above ground. The last date for blood sampling is October 31. See (USFWS 2019) for complete details, but all tortoises will have blood collected

to check for antibody presence via **ELISAs** for *Mycoplasma agassizii* and *M. testudineum*. Pathogen detection via **qPCR** will be used to check for the presence of both mycoplasma species and Testudinid herpesvirus 2 on the oral swabs. The results of these tests will provide baseline information for comparison of pathogen **prevalence** over time, but will not determine eligibility for translocation of individual tortoises. *Therefore, results from **biological samples** are valid for 1 year from the date they were collected (for **translocated, resident, and control tortoises**).* A plasma sample and oral swabs should be sent to the labs specified in the health assessment handbook (see Appendix F.7 in USFWS 2019 or more recent) for immediate analysis, and the remainder of the plasma should be banked at the designated sample bank for future use in evaluating the effects of translocation on changes in disease status within individuals or within the **recipient population** at large.

Diagnostic laboratory results are used for monitoring potential changes in disease status or **prevalence** over time rather than disqualifying individual tortoises from translocation because

- a) the likelihood of presence of the target pathogens in source and destination populations is similar (*e.g.*, see Weitzman *et al.* 2017),
- b) the probability that planned translocations is the only avenue of exposure is low,
- c) translocations are targeted toward low-density tortoise populations, and
- d) the estimated cumulative risk of a negative population consequence is low (Rideout 2015).

Furthermore, without known **prevalence** in the population or if the population-level prevalence of a particular pathogen is low, positive test results for individuals may not be reliable (*e.g.*, Wendland *et al.* 2007). Repeated **health assessments** by qualified individuals will screen tortoises currently in poor health.

Given this rationale, projects translocating a **small number of tortoises** that will not be monitored long-term—when a **regional augmentation site** is unavailable—need not collect **biological samples** unless the tortoises are from a population of particular interest (*e.g.*, in the vicinity of a population with a history of a disease outbreak). A physical exam of each **translocated tortoise** will be conducted to screen against disqualifying conditions (Figure 5). When a **regional augmentation site** is available, projects will collect **biological samples** from all tortoises to contribute to the overall baseline at the augmentation site.

Samples should be delivered directly to the appropriate lab and/or the entity hosting the USFWS sample bank (currently the University of California, Los Angeles) for banking/analysis on a monthly basis (see Appendix F.8 in USFWS 2019 or more recent). *A fee to cover expenses associated with archiving **biological samples** and maintaining the sample bank should be included with the shipment: \$3000 in total to cover all fees for the duration of monitoring (2020 dollars). The full archival fee covers costs associated with samples expected to be collected during the pre-translocation and **post-translocation monitoring** periods, including proportional*

numbers of **resident and control tortoises**.⁹ Upon completion of the health assessments for a given season (*i.e.*, spring or fall), a copy of all health data sheets must be submitted to the USFWS, in accordance with the terms and conditions of the biological opinion, incidental take permit, or recovery permit. Additionally, data sheets must be available when **disposition plans** are being reviewed by USFWS.

Determine if desert tortoises on the project site will be held on- or off-site

The **translocation plan** should identify which of the following interim holding/monitoring arrangements will be used for the desert tortoises on the project site. All desert tortoises too small to be transmitted (*i.e.*, transmitter packages weighing no more than 10% of the tortoise's body mass are unavailable; project proponents should procure transmitters with a range of sizes to accommodate sub-adult and juvenile tortoises) should be placed into individual quarantine pens so they can be relocated at the time of translocation.

Option 1 (preferred): In situ monitoring – monitoring desert tortoises on the project site via telemetry—As protocol **clearance surveys** are conducted, health assessments, assignment of unique identifiers provided by USFWS, and affixing transmitters should be performed on each desert tortoise (including juveniles) as it is located. Telemetry monitoring would then be conducted a minimum of once per month with more frequent monitoring under certain circumstances. The USFWS will provide a standardized, minimum dataset to be collected for all projects. This option minimizes potential stress and associated health issues that may result from confinement in pens (Rideout 2015).

Option 2: Ex situ monitoring – construction of individual quarantine facilities—Desert tortoises located during protocol **clearance surveys** would be transferred to a quarantine facility, and these tortoises should be translocated within 6 months of collection. The quarantine facility may be located off-site or within an area on-site not scheduled for development activities until after the translocation. Attachment 2 provides an example for facility design, animal husbandry, and operating protocols, but the USFWS must approve the quarantine facility and operating plan for each project, under the authority of the project's biological opinion, incidental take permit, or recovery permit.

Facilities must be constructed and managed to prevent tortoises from coming into contact with one another, exclude predators, provide ability for appropriate thermoregulation, and allow for necessary husbandry activities by a caretaker qualified to care for captive tortoises and certified to conduct health assessments and collect samples. If this option is selected, quarantine facilities should be constructed to avoid inadvertently capturing any **resident tortoises** within the facility. If suitable USFWS-approved facilities exist in the area, the project proponent may inquire with facility managers about temporary use; however, these opportunities are extremely limited.

⁹ The fee assumes 5 archived tubes/assessment and 30 tubes archived/hour @ \$15/hour (\$15/hour ÷ 6 assessments/hour = \$2.50/assessment [tortoise]). Up-front fees to cover sample archival over the entire monitoring period assume approximately 100 **health assessments** per **recipient/control** site survey * 8 surveys: 800 assessments * \$2.50/assessment = \$2000. An additional \$1000 partially defrays the cost of purchasing a freezer to house the samples.

Construct project fencing and conduct clearance surveys of the project site

General clearance protocols—All desert tortoises, including juveniles, encountered during **clearance** of the project site and associated **perimeter fence** are considered part of the project and should be treated accordingly (e.g., tortoises moved < 300 m and \geq 300 m on the same project all receive the same health-assessment and monitoring considerations). During the initial health assessment, desert tortoises will be assigned a unique identifier (provided by USFWS), and a transmitter will be attached for monitoring purposes. If the desert tortoise is being moved to a quarantine facility, it need not be fitted with a transmitter until it leaves the quarantine facility (if telemetry-based monitoring is necessary).

Data collected during **clearance surveys** (see Attachment 1) will be standardized for all projects and must include detailed information about the exact point of collection. For those desert tortoises that will be monitored *in situ*, these data should be collected again on the day of translocation from the project site. The unique identifiers will allow us to link each individual desert tortoise with data obtained during **clearance surveys** and subsequent health assessments.

The placement of desert tortoises will depend on the health assessment results and the **translocation plan** (i.e., holding/monitoring option) approved under the incidental take permit or biological opinion. Individual tortoises eligible for translocation are those that exhibit appropriate attitude and activity; acceptable body condition (Body Condition Score of 4–7); no mucoid and not more than mild, serous nasal discharge; no oral lesions; and no other condition that may impact its survival (Figure 5; USFWS 2019).

There are three potential outcomes for tortoises located during **clearance surveys**.

- a. Preferred option: tortoises remain on-site for *in situ* monitoring until translocation, pending concurrence with results of health assessments and **disposition plan** (Appendix H in USFWS 2019 or more recent).
- b. Transfer of desert tortoises to quarantine facility for holding (*ex situ*). Final translocation decisions depend on concurrence with results of health assessments and **disposition plan** (see Appendix H in USFWS 2019 or more recent), but tortoises should not be held in the quarantine facilities for > 6 months.
- c. Transfer to agency-approved facility. Project proponents may identify and propose a separate facility to transfer tortoises. This option is only appropriate for individuals deemed ineligible for translocation. Project proponents should expect to pay costs associated with the provision of housing, care, treatment, and other expenses.

Component-specific protocols

Project proponents will require a biological opinion or incidental take permit from the USFWS to implement the following activities. In this section, we provide guidance regarding the implementation of these activities. The USFWS's biological opinion or incidental take permit will describe specific requirements for each project.

Perimeter Fence: Fence construction may be done during any season. Individuals located within the fence-**clearance** area should be moved into adjacent habitat outside the fence line (with the

landowner's approval) in accordance with **clearance** and handling procedures outlined in Attachment 1. These individuals still require a **health assessment**, as described above, should be given a unique identifier, and should be fitted with a transmitter or otherwise monitored to ensure the individual does not move back into the project site before the fence is completed. Shade structures should be installed along the fence line at a minimum 1,000 feet apart to provide cover for any tortoises that pace the fence (Figure 6; USFWS 2018b).



*Figure 6. Shade structure on outside of desert tortoise **exclusion fence**.*

If a desert tortoise that was moved out of the fence alignment moves back into the project site prior to the completion of the fence, the individual should be translocated as identified in the **translocation plan**. If the individual remains on the outside of the fence upon completion, it will be considered a **resident** of the area, and if **resident** individuals in this area do not need to be monitored as part of the **translocation plan**, the transmitter would be removed. However, if the tortoise is observed behaving abnormally (*e.g.*, pacing the fence, not seeking shelter during hot temperatures), the USFWS may direct that additional monitoring with telemetry be conducted long enough to ensure that the tortoise resumes normal behavior and activity. If there is no suitable habitat adjacent to the fence line and the **recipient site** is not yet available to receive desert tortoises from the project site, the individuals should be placed into quarantine pens or fitted with transmitters and placed inside the perimeter fence for *in-situ* monitoring. If **clearance** of the perimeter fence is conducted during the winter, then any desert tortoises located along the fence alignment should be moved as described above, fitted with a transmitter, barricaded into an artificial or empty natural burrow, and monitored as described below.

Non-linear Project Site (*e.g.*, power plant, substation, etc.): **Clearance surveys, health assessments**, and subsequent translocation should be conducted during the tortoise active season. The maximum transect width for **clearance surveys** is 5 m (see Attachment 1). All tortoise scat should be collected during each pass of the **clearance surveys** to facilitate locating tortoises that may have been missed on previous passes.

Linear Facilities (*e.g.*, transmission and buried lines): **Clearance surveys** may be conducted during any season. Any desert tortoises found during **clearance** of linear facilities should be moved out of harm's way as described under **Linear projects**, above.

Translocation of desert tortoises following acceptance of translocation-review package

As previously noted, translocation to regional population-augmentation sites is preferred. However, if a regional augmentation site is unavailable, projects may hire qualified scientists to develop and implement their own project-specific translocation and monitoring plan, which must be approved by the USFWS to ensure that it adequately addresses specific criteria of success (see ***Post-translocation monitoring***, below). In either scenario, a **translocation-review package**, incorporating the penultimate **health assessment** in the month before the scheduled translocation, must be submitted to the USFWS for approval of the proposed disposition of each tortoise from the project site. If **health assessments** are conducted in a season prior to the scheduled translocation date, a tentative **translocation-review package** may be submitted for review subject to consideration of new results from the assessments conducted in the month prior to translocation; this can help expedite final approval of the **disposition plan** (see below). The **translocation-review package** must include the following (information on **recipient-site** tortoises is not required for projects using a USFWS-identified regional augmentation site):

- **Disposition plan** (see Appendix H in USFWS 2019 or more recent available from USFWS), including complete health histories, for the project-site tortoises;
- Complete survey data from the project, **recipient**, and **control** sites (if updated from site selection surveys that were previously submitted);
- Photographs of individual tortoises as specified on the **health assessment** data sheet;
- **Health assessment** data sheets for **resident**, **control**, and project-site tortoises, if not submitted previously;
- Maps of the **recipient site**, showing proposed release points of project-site tortoises;
- Maps of the project site (including all project phases and all relevant digital GIS layers), illustrating distribution and health status of project-site tortoises and proposed **release sites** of tortoises to be moved < 300 m (if applicable); and
- Any other project-specific information that supports or clarifies translocation decisions.

Disposition plans summarize the key health findings from the translocation-suitability algorithm (Figure 5) and describe the proposed fate of each desert tortoise (*e.g.*, translocated to **recipient site** or removed from population due to suspected disease) from the project site and must be completed within the season in which translocation occurs. Project delays that result in translocation occurring in a subsequent desert tortoise activity season than that in which the **disposition plan** was developed also result in the need to complete updated **health assessments** (with the exception that results from **biological samples** are valid for 1 year). A minimum of two weeks should be provided for evaluation of the **translocation-review package**, assuming that the package is complete.¹⁰ Desert tortoises must not be moved prior to acceptance by the USFWS of the evaluated **translocation-review package**.

Once approved, translocation must proceed to the USFWS-approved, final **recipient site(s)** in a manner consistent with existing protocols, this guidance (*including a final **health assessment**, without **biological samples**, immediately prior to moving the tortoise*), and the specific translocation and monitoring plan. Some flexibility may exist for individual projects based on the

¹⁰ Note that anomalous results in past projects have required additional review, so we recommend sharing health data as early as possible (*e.g.*, prior to compilation of the full **translocation-review package**) to minimize unexpected delays.

time of year, local/regional weather patterns, actual weather conditions during the proposed release event, and condition of the project sites and final selected **recipient sites** (e.g., degraded or recently burned); the project-specific biological opinion or incidental take permit will provide such instructions. Translocations should occur in spring (April 1 through May 31) or fall (September 1–30), subject to temperature constraints described below. Note that the project proponent must make arrangements to hold any tortoises removed from project sites after the final date of translocation. In addition, the following conditions must be met for translocation to proceed:

- Releases will occur only when temperatures range from 18–30°C (65–85°F) and are not forecasted to exceed 32°C (90°F) within 3 hours of release or 35°C (95°F) within 1 week of release. Additionally, forecasted daily low temperatures should not be cooler than 10°C (50°F) for one week post-release.¹¹

Temperature thresholds for translocation differ from those for handling **resident** and **control tortoises** because **translocated desert tortoises** spend more time above ground subsequent to release as they habituate to unfamiliar surroundings, increasing their susceptibility to stress factors such as temperature extremes.

- Release points will be pre-selected during visits to the **release site** and specified in the **disposition plan** (configuration of release points is project-specific). Release points located in washes may contribute to increased site fidelity (reduced dispersal) within the **recipient site** (Germano *et al.* 2012; Nafus *et al.* 2017).
- Desert tortoises must be transported to their **release sites** in clean, ventilated protective containers. If re-used, these containers must be cleaned and disinfected before being used for another desert tortoise (see Appendix A in USFWS 2019 or more recent, for discussion on disinfection).
- When weather records indicate that desert tortoises likely have not had a chance to drink within the previous or current active season, or clinical signs indicate that a tortoise may be dehydrated, tortoises to be translocated should be hydrated within 12 hours before release. All tortoises that void will need to be hydrated according to existing protocols (Appendix F.5 in USFWS 2019 or more recent).
- Desert tortoises should be released at unoccupied shelter sites. Shelters include unoccupied soil burrows, spaces within rock outcrops, caliche caves, and the shade of shrubs.

Short-term data indicate that mortality does not differ between **translocated tortoises** and **residents** during drought (Esque *et al.* 2010; Nussear *et al.* 2012). However, drought can induce

¹¹ Forecasted maximum temperatures recorded at nearby weather stations are typically lower than those near the ground (*i.e.*, closer to tortoise level at 5 cm) at the **release area**. Even though Brand *et al.* (2016) found that **translocated tortoises** had higher average maximum daily temperature and spent more time above 35°C than **resident** and **control tortoises** in the first month after translocation and smaller effects through the fourth month, these differences in the initial months had no effect on survival. These results, combined with comparable survival between **translocated** and non-translocated tortoises observed elsewhere, therefore indicate that this release criterion successfully minimizes the relevant risks to **translocated tortoises**.

latent disease to manifest, and **translocated tortoises** may disperse widely during the first year after release, thereby potentially causing increased transmission of disease (*cf.* Aiello *et al.* 2014). The risk of spreading disease to **resident tortoises** will already be minimized by selecting a **depleted population** as the **recipient population**, so risks of spreading disease among drought-stressed **translocated tortoises** should be weighed against the risk of holding them in pens if project timelines are inflexible.

Desert tortoises determined to be infectious or unhealthy must be sent to an agency-approved facility where they will undergo further assessment, treatment, euthanasia, and/or necropsy. Such facilities may include a local veterinary clinic, research institution, or other facility with expertise in reptile medicine. Coordination with the USFWS and the proposed facility must be initiated when **clearance surveys** commence to facilitate prompt and humane transport of unhealthy desert tortoises, as necessary.

Compile and synthesize data

Data must be entered into the USFWS/BLM-provided master database, according to standardized format and conventions, to ensure consistency among projects across the desert tortoise's range. Minimum requirements will include data related to observations recorded during surveys, telemetry-based monitoring, and **health assessments**.

Post-translocation monitoring

Post-translocation monitoring must be designed to document the effectiveness of translocation as determined by specific criteria for success at four stages over an approximately 30-year period (Table 2).¹² The USFWS will oversee monitoring of regional augmentation sites, so projects moving tortoises to these sites need to coordinate funding for this monitoring with the USFWS. Projects hiring qualified scientists to develop and implement their own project-specific **translocation plan** must secure the approval of the USFWS for those plans and monitoring programs to ensure that they adequately address the criteria of success. Anticipated monitoring components include project management; field labor for surveys, **health assessments**, and environmental sampling (*e.g.*, annual and perennial vegetation, temperature, rainfall), including supervisory and technical personnel; travel; and supplies, including transmitters to relocate females for X-radiography.

When a regional augmentation site is not available and few tortoises need to be translocated, long-term monitoring of only a **small number of tortoises** lacks statistical power to inform questions about biological effectiveness or contribution to recovery. In addition, such projects conducted under the protocols described herein pose negligible risks of negative population-level effects. Therefore, we do not recommend long-term monitoring in these

¹² A review of reptile and amphibian translocations considered translocations to be successful when a) substantial new recruits were added to the adult population due to successful reproduction at the translocation site, and b) the site was monitored for at least as long as the time to reach maturity (13–20 years for desert tortoises). Success of prior translocations is often uncertain due to inadequate monitoring time (Germano and Bishop 2009). Given the time to reach maturity in desert tortoises and low and variable survival rates of juveniles, it may require 30 or more years to detect substantial recruitment to the adult population. Thirty years is commensurate to the duration of development permits for which this guidance was developed and is less than the duration of direct project impacts, which are essentially permanent.

instances. Instead, telemetry-based monitoring of 1 year may be appropriate to document short-term survival of **small numbers of translocated tortoises**.

The specific monitoring plan, including sample sizes and sampling intervals, should be developed by a qualified scientist working on the project and should be designed to address the success criteria in Table 2. However, for translocations to a regional augmentation site or other large translocations, a basic monitoring program generally is envisioned to consist of tracking each **translocated tortoise** (and a sample of **resident** and **control tortoises**) with radio telemetry for the first 5 years of the program. Telemetry monitoring during this period will allow evaluation of Stage 1 and Stage 2a in the success criteria (Table 2) and validate that there are no unforeseen complications with the **recipient site** that need to be corrected before continuing the translocation/augmentation program. **Health assessments** will also be conducted during this period to compile a solid baseline of health status in the **recipient** and **control** populations for longer-term monitoring comparison.

Subsequent to the telemetry-based monitoring, the remainder of the 30-year monitoring period could consist of periodic surveys (*e.g.*, biennial or triennial) of the **recipient** and **control** populations to evaluate the longer-term stages in the success criteria (Table 2). Environmental sampling and **health assessments** should be conducted in conjunction with alternate population surveys. Monitoring scheduling and approaches will be adapted based on initial results, scientific input, and the rate of translocation into a particular **recipient site**. Monitoring other site-specific measures that could influence the metrics listed in Table 2 will also be conducted depending on site-specific factors, which potentially could result in the need to re-evaluate prior stages of the success criteria. For example, the effectiveness of translocation relative to the contribution of **translocated** male tortoises to reproduction in the **recipient population** should also be evaluated in light of the results of Mulder *et al.* (2017).

Table 2. Success criteria for desert tortoise translocations (*cf.* Miller et al. 2014; Bell and Herbert 2017). Evaluation of each stage is contingent on success of the previous stage(s).

Stage	Indicators/metrics	Time frame (post-translocation)
1. Survival and growth of released and resident individuals	a. Survival within 20% of controls ¹³ b. Increase in CL since release (tortoises released at <180 mm CL) ¹⁴	a. 5 years b. 5–6 years
2. Evidence of reproduction in released and resident individuals	a. Female reproductive output is similar to controls ¹⁵ b. Juvenile segment of the size-class distribution is increasing ¹⁴	a. 5 years b. 9–18 years
3. Population growth	Increasing trend in adult population size ¹⁴	15–20 years
4. Viable population	Adult density >> 4/square km, excluding founders ¹⁴	20–30 years

¹³ Measured via radio telemetry. Survival within 20% of **control tortoises** is specified as a Stage 1 metric of success, even though much lower survival rates have been considered successful in translocations of other species, because high survival is necessary to achieve a self-sustaining population within 20–30 years (Stage 4).

¹⁴ Measured via periodic (*e.g.*, triennial) mark-recapture surveys

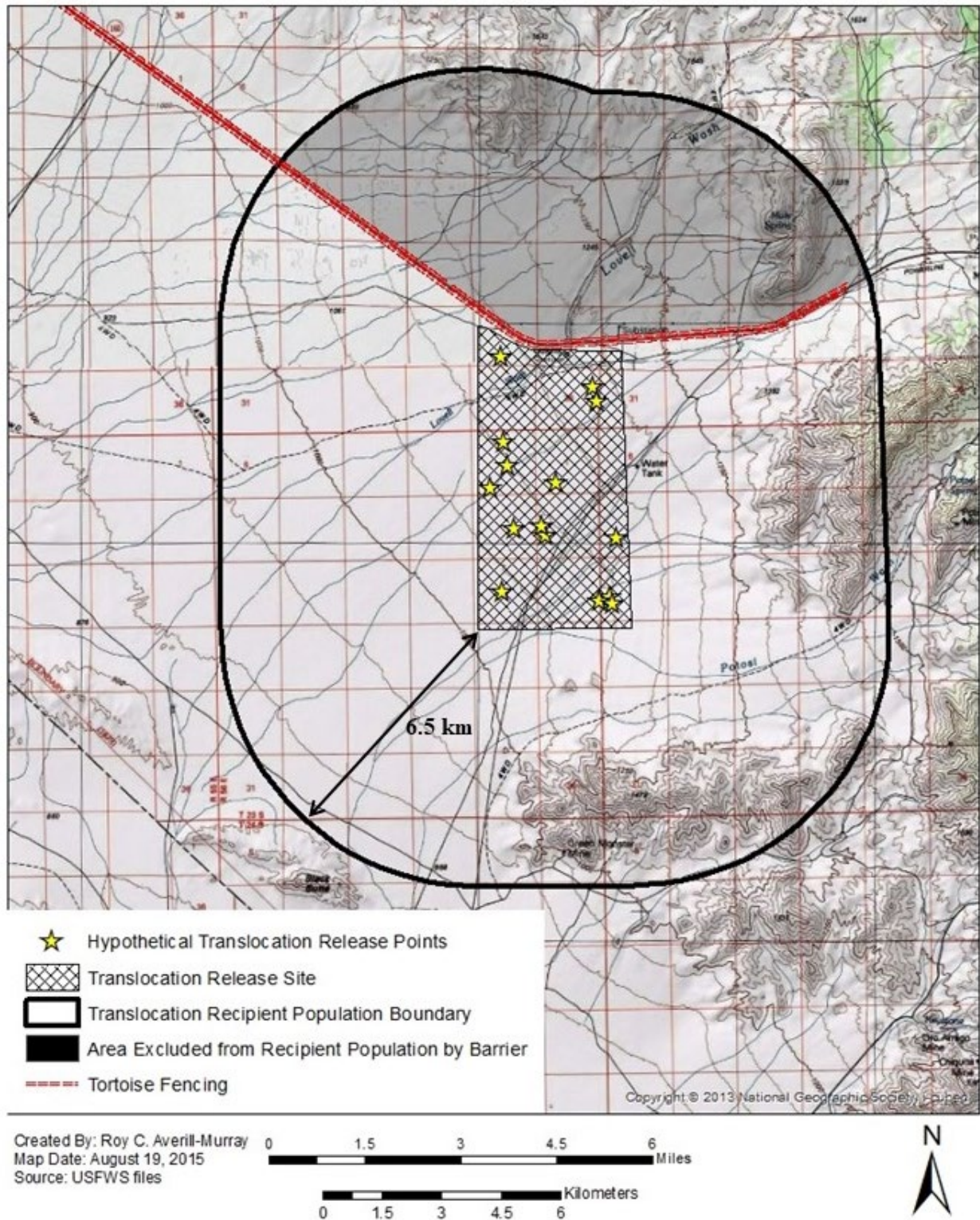
¹⁵ Measured via radiographic examination of females during the telemetry-based monitoring

Example 1. Illustration of key aspects of selecting a **recipient site** for translocation.

If on-site impacts to desert tortoises cannot be avoided, the emphasis for translocation projects is to contribute to tortoise recovery by augmenting **depleted populations** rather than merely moving them off-site to expedite development. Check with your local USFWS office to determine whether an augmentation site has already been identified that is relevant to your project.

- The **recipient population** should be low density (see *Determination of recipient-site size*) to minimize risk of disease transmission, whether inadvertently introduced by **translocated tortoises** or facilitated by increased tortoise interactions and contacts following the translocation (Rideout 2015).
- One or more potential sites should be identified within which tortoises would be released (hatched polygon).
- **Translocated tortoises** tend to move long distances and are likely to encounter tortoises with which they are unfamiliar (*cf.* Aiello *et al.* 2014). Therefore, habitat, **resident tortoise** densities, and **resident tortoise** health should be evaluated within a 6.5-km radius of the potential **release site(s)** (heavy black outline; distance based on data from the 2008 Ft. Irwin translocation: Berry *et al.* 2009; Drake *et al.* 2009).¹⁶
- Shading in the example illustrates how barriers to tortoise dispersal, such as tortoise exclusion fencing along a highway, may limit the total area requiring evaluation, although such eliminations should be confirmed with the local USFWS office (*e.g.*, to review the potential permeability, or lack thereof, of the putative barrier).

¹⁶ If the **recipient site** is adjacent to the project site, the **recipient site** has not already been surveyed for density and health, and all **translocated tortoises** will be moved <300 m, then an area within only 1.8 km need be evaluated. A 1.8-km radius surrounding the project footprint includes up to 300 m for potential releases and 1.5 km for dispersal.



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Attachment 1: Clearance Survey Protocol for the Mojave Desert Tortoise

***Attachment 2: Temporary Captive Care of Wild Mojave Desert Tortoises:
Examples of Protocols Used at the Desert Tortoise Conservation Center***