Population Augmentation Strategy for the Mojave Desert Tortoise Recovery Program

U.S. FISH AND WILDLIFE SERVICE

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Introduction

The 2011 Recovery Plan for the Mojave Desert Tortoise identified "population augmentation" as a key strategic element in the recovery of the tortoise due to appreciable declines of tortoise populations across the range combined with multi-faceted interacting threats and slow natural population growth rates (USFWS 2011). This document applies the International Union for Conservation of Nature/Species Survival Commission's *Guidelines for Reintroductions and Other Conservation Translocations* (IUCN/SSC 2013) to outline a strategy for reinforcing tortoise numbers where low densities preclude the species rapidly increasing to recover from demographic vulnerability. The strategy primarily anticipates using "mitigation translocations"—removal of organisms from habitat due to be lost through anthropogenic land use change and release at an alternative site, but the primary focus will be on the conservation benefit of the receiving population rather than merely the expeditious removal of individuals from harm's way (IUCN/SSC 2013). We have identified the need for regional augmentation sites to serve this purpose (USFWS 2011, 2020). Several experimental head-starting projects are also under way, and these could be integrated into specific augmentation programs in accordance with the Fish and Wildlife Service's controlled propagation policy (USFWS 2000). Population augmentation is not intended to be a long-term strategy for conservation of the desert tortoise, but rather an intermediate strategy aimed at increasing populations more rapidly than possible through natural processes (USFWS 2011). This strategy provides the context for the development of individual augmentation plans, which should also include design, feasibility and risk assessment, implementation, monitoring, and evaluation and adjustment elements (IUCN/SSC 2013).

> **Translocation** is the human-mediated movement of living organisms from one area, with release in another. **Population augmentation** or **reinforcement** involves translocation of an organism into an existing population of conspecifics for the purpose of enhancing population viability, for instance by increasing population size, by increasing genetic diversity, or by increasing the representation of specific demographic groups or stages (IUCN/SSC 2013).

Goals and objectives

The goal of this strategy is to use population augmentation to demonstrably help achieve recovery criteria in each of the five recovery units identified in the Recovery Plan (USFWS 2011). Population augmentation is directly applicable to the first two recovery criteria:

- Recovery Criterion 1: Desert tortoise numbers are increasing over at least 25 years (a single tortoise generation), as measured a) by extensive, range-wide monitoring across tortoise conservation areas (TCAs) within each recovery unit, and b) by direct monitoring and estimation of vital rates (recruitment, survival) from demographic study areas within each recovery unit.
- Recovery Criterion 2: Distribution of desert tortoises throughout each TCA is increasing over at least 25 years.

While the recovery criteria focus on tortoise populations within TCAs specified in the 2011 recovery plan, population augmentation also may be used to reinforce populations in linkages between or adjacent to TCAs, thereby enhancing their overall resilience.

It is important to realize that if the causes of tortoise population declines are not addressed, simply adding individuals to populations in the wild through augmentation will not result in sustained recovery, so plans for individual desert tortoise augmentation programs (e.g., within different recovery units) should identify objectives that describe how augmentation at that site will contribute to the overarching goal of helping to achieve the recovery criteria. Objectives should be specific and describe how primary local threats will be addressed. Examples of additional objectives include the use of translocated tortoises to test the effectiveness of recovery actions, to facilitate measurement of demographic rates (Recovery Criterion 1b), or to better define parameters related to habitat quality in support of Recovery Criterion 3 (USFWS 2011). For instance, after augmentation, have recovery actions at the site been successful? Is the site providing linkage benefits as envisioned? Is recruitment occurring? These considerations also should be part of identifying augmentation sites and lead naturally to questions about the adequacy of the site size, condition of surrounding areas, ability to implement recovery actions, and whether associated funding sources are available to pursue the objectives.

> The **goal** of the strategy is to use population augmentation to help achieve recovery criteria within the recovery units. Individual augmentation plans should include **objectives** that describe how augmentation at that site will contribute to the overarching goal. Plans should also describe the specific **actions** that indicate how the goal and objectives will be achieved and measured, by whom, and over what time frame.

Individual augmentation plans[1] should describe specific actions and clearly indicate how the goal and objectives will be achieved and measured. Actions should also identify the responsible parties and establish time-tables for completing them. Success of augmentation projects will depend on coordinated working groups of the responsible and interested parties.

<u>Feasibility, design, and risk assessment</u>

Many of the feasibility, design, and potential risks that augmentation plans must consider are described in the Fish and Wildlife Service's translocation guidance (USFWS 2020). This section of the strategy describes important aspects of these elements that should be assessed in an augmentation plan.

Site selection and habitat

Augmentation sites will be identified to reinforce or re-establish locally depleted or extirpated populations, particularly within desert tortoise conservation areas (TCAs) or linkages between them. Populations to be augmented should be identified based upon knowledge of population abundance and trends, habitat, and threats or elevated management in the area, unique opportunities to learn about factors affecting the population through a research-based program, and feasibility. Data from previous population monitoring efforts, including a spatial analysis, and recent advances in genetics will facilitate initial identification of potential target areas. The following criteria should be addressed when identifying augmentation sites (see USFWS 2020,

[1] Under a regional augmentation plan for an established site, *project-specific translocation plans* (e.g., for a single solar-development project) would focus on details associated with identifying tortoise numbers, health, and clearance for that particular project.

although in this case the criteria also apply to sites that will receive translocatees from captive or head-starting programs).

1. Depleted recipient tortoise population (i.e., < 3.9 adult tortoises/km^2, the threshold below which populations are unlikely to be viable; USFWS 1994, Appendix C) within TCAs or population linkages.
2. Habitat suitable for all life stages.
3. No evidence of an active outbreak of disease, such as high prevalence of clinical signs of disease or seropositive responses to infectious pathogens.
4. A distance of at least 6.5 km from the release area to any 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.
5. No detrimental rights-of-way or other encumbrances that would pose ongoing risks to successful establishment of translocated tortoises.
6. Compatible management with continued desert tortoise occupancy.

The minimum area should be sufficient to achieve stated objectives, after which the initial number of tortoises for the augmentation can be determined based on USFWS (2020). The larger the augmentation area and/or the lower the current resident densities, the more tortoises will be necessary to meet the ultimate goal and objectives. The *initial* number of translocatees is based on the area of the recipient site and the expectation that translocated tortoises will disperse throughout an area up to 6.5 km from their release site (USFWS 2020). Within this area, the number of allowable translocatees is estimated based on the current resident density at the recipient site, typically in accordance with the guideline to keep initial adult densities within a standard error of the average recovery unit density after the translocation (USFWS 2020). The plan should stipulate the (conservative) number of translocatees of different size classes that will be released before results from direct monitoring at the site will be used to evaluate the potential for further releases (see "Adaptive management and exit strategy," below).

Potential sites should be characterized sufficiently during the planning phase so that there is reasonable confidence that threats that caused previous population declines have been correctly identified, removed, or reduced. Alternatively, the site should be described to illustrate how augmentation will proceed under specific objectives to evaluate potential remaining threats and associated management actions. Suitability of the site under projected climate change effects should also be considered (e.g., Barrows et al. 2016; Shryock et al. 2018). Plans should thoroughly describe potential negative impacts in addition to potential benefits in the context of a risk analysis. Planning should proceed only for cases where potential benefits are clear and there is high confidence that potential risks are small.

Sources of translocatees

Wild tortoises may be translocated from construction projects or other disturbed areas to augmentation sites to maximize their recovery value relative to simply moving them from harm's way to convenient locations that are less important to recovery. Tortoises also may be produced via head-starting with minimal impact to remote wild populations. Tortoises used in population augmentation will be of appropriate origin and genotype (genetic makeup) to the specific areas to be augmented. To be conservative in maintaining major genetic lineages, source populations

should be from the same side of the southern/western boundary of the Eastern Mojave Recovery Unit as a particular augmentation site.[2] However, tortoises may be moved on either side of this boundary within a 200-km straight-line distance without suffering negative effects on genetics or survival (Averill-Murray and Hagerty 2014; Scott et al. 2020).

Animal welfare and disease considerations

USFWS (2020) includes detailed protocols to ensure the welfare of tortoises throughout the translocation process. Relative to disease concerns, it is neither possible nor desirable for organisms to be parasite and disease free, and the level of attention to disease issues relative to translocated and resident tortoises should be proportional to the potential risks and benefits (IUCN/SSC 2013). Every tortoise used for population augmentation will be subjected to rigorous health screening according to USFWS (2020) and Rideout (2015) so that the estimated cumulative risk of a negative population consequence of population augmentation is low. Targeting low-density recipient populations minimizes risk of disease transmission, whether inadvertently introduced by translocated tortoises or facilitated by increased tortoise interactions and contacts following the translocation (Rideout 2015).

Monitoring goal- and objective-specific metrics

Augmentation projects consist of cycles of planning, implementation, monitoring, and adaptive management until goals are met or deemed unfeasible. For long-term projects, despite careful planning, uncertainty and risk are expected to affect project outcomes. Monitoring programs for each augmentation project are fundamental to identifying emerging challenges to the project and assessing the status of objectives compared to the baseline; monitoring results are especially interpretable if there are also pre-translocation baseline data. All augmentation projects are expected to include a monitoring program to measure population growth and expansion, with more intensive monitoring needed initially to also measure individual survival and health status. Reporting of monitoring results (i.e., format and frequency) should be guided by timelines for expected progress towards site-specific objectives and informative triggers (see below) for adaptive management. Results should also be reported to maximize applicability to augmentation efforts elsewhere.

Each augmentation plan should include metrics to evaluate effectiveness at achieving goals related to the recovery criteria plus metrics to measure progress with objectives specific to the particular augmentation site/program. For example, success criteria outlined in Table 1 provide interim milestones that ultimately lead to viable local populations (see also USFWS 2020). Evaluation of each stage is contingent on success of the previous stage(s), providing opportunities for monitoring results to inform adaptive management that can address factors affecting the population (see the next section). Toward that end, metrics tailored to site-specific threat management also should be identified. In general, monitoring plans should outline the goal of each phase of the project and relevant threshold population levels or other metrics and how they will inform ongoing management at the site. One or more control sites will be necessary to assess the metrics of success, which to the extent that demographic sampling is conducted will directly contribute to the evaluation of Recovery Criterion 1b. Addressing how the monitoring plan will be funded is of critical importance.

[2] 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).

Table 1. Success criteria for desert tortoise translocations (*cf.* Miller et al. 2014; Bell and Herbert 2017).

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

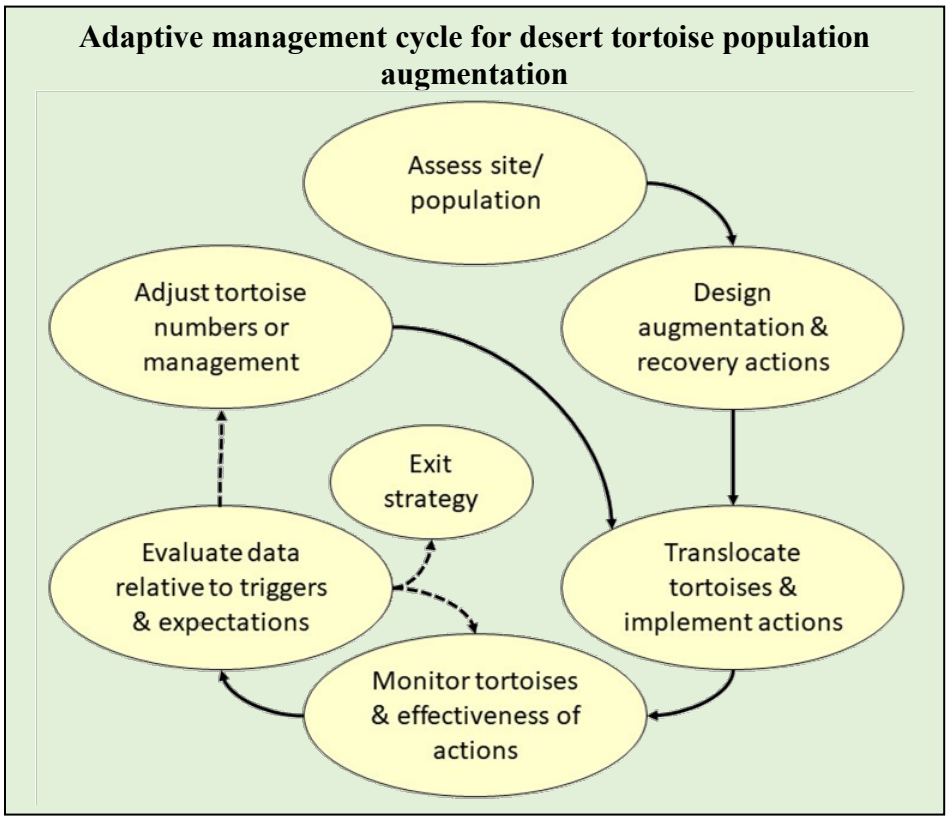
Adaptive management and exit strategy

Given the long-term nature of the population augmentation goal and site-specific objectives, augmentation plans should consider how and with what frequency the success of the augmentation will be evaluated and management adjusted based on this information. Clear objectives, actions, and expectations established in each augmentation plan will allow for a structured process of adaptive management that emphasizes accountability and explicitness in decision making (Williams et al. 2007). Pre-negotiated commitments within the adaptive management framework (i.e., triggers), will specify what actions to take should study reveal particular outcomes (Nie and Schultz 2012).

Field study should be used to evaluate efficacy of implemented recovery activities and whether population density can be supported at the levels initially planned, so the evaluation process may differ depending on the nature of the specific augmentation. In any case, monitoring will indicate whether survival rates, site fidelity, or changes in the number of tortoises meet expectations and will inform adaptive decisions about whether and how many additional tortoises would be useful. For instance, if a site cannot support an increased number of tortoises, whether through a single large or multiple smaller translocations, then monitoring should indicate when defined triggers have been reached, such as a decline in survival or no increase in tortoise density even with additional translocatees. If this happens, additional tortoises should not be translocated unless meaningful changes at the site can be implemented to improve conditions for additional tortoises. Each scenario requires contingency planning to identify management options that improve outcomes for remaining tortoises at the augmentation site, but also that specify conditions under which translocations to the site may resume.

For continuing management purposes, it is important that field study describes the effectiveness of recovery activities at the site. This information will inform future management changes at the site. It can also inform our general understanding of the value of different possible recovery activities. Adaptive management should also be responsive to changing habitat or disturbances at the site. Monitoring to document how well shorter-term objectives are achieved is fundamental to adaptive management. The augmentation plan should indicate how changes to management may be required to achieve goals if monitoring indicates that management can improve

outcomes. Because each project has defined goals and objectives, plans should also include an explicit **exit strategy** that describes criteria and specifies triggers for when the project should end, either due to success or because further investment is deemed not useful. A clearly defined exit strategy prepares the program for project exit due to realization of project goals, insurmountable challenges, or other events (Ruiz-Miranda et al. 2020).



Reporting

The design stage of each project should be captured in the augmentation plan and include information about the selected site with results from surveys that characterize the site, a feasibility and risk assessment, anticipated source of translocatees, site-specific objectives, and monitoring. The plan should clearly describe the reporting schedule so that each of these elements will be reported in a suitable format. Stages before the monitoring period likely will not follow a strict calendar reporting schedule, but rather a commitment to report each phase before starting the next. Each of the plans and reports should be available publicly as a reference for other projects and to create awareness and support for the augmentation.

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