U.S. Fish and Wildlife Service
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Desert Tortoise Science Advisory Committee Meeting
January 20-21, 2006
Tucson, AZ

Meeting Goals and Objectives
- Review progress
- Identify recovery criteria

Attendees
Roy Averill-Murray, DTRO
Kristin Berry, SAC
Kim Field, DTRO
Sandy Marquez, DTRO
Earl McCoy, SAC
Katherine Ralls, SAC
Michael Reed, SAC
Amy Salveter, DTRO
Bob Steidl, SAC

Meeting Summary
1. Threats interaction survey
The DTRO has drafted a glossary of threats for use in the threats interaction survey of stakeholders. The glossary, annotated threats bibliography, and threats interaction survey are intended to be completed prior to convening regional recovery planning work groups.

Action Item: SAC members will provide review and comments on the glossary to Sandy Marquez by February 3.

2. Recovery planning with stakeholders
The agreement between the FWS and the U.S. Institute for Environmental Conflict Resolution should be completed soon (*update: this was completed during the week of January 30 and preparation for the stakeholder assessment is in progress; stakeholder interviews will occur largely during April*).

The SAC also discussed the importance of interacting with stakeholders directly. The committee's consensus was that conducting meetings open to observors would be counterproductive to open dialogue and debate. However, the committee reaffirmed its commitment to maintain transparency in its meeting summaries (which will continue to be posted on the DTRO website) by documenting uncertainty, using plain English, identifying any differences among SAC members, and documenting the decision-making process, including any paths identified but not taken. In addition, the committee agreed that regularly scheduled forums (e.g., once or twice per year) with the public would provide opportunities for the public to interact with the SAC. One such opportunity would be to discuss recovery objectives and criteria when the drafts are ready for outside review. It will be important to provide review materials to the public prior to such forums, and for attendees to actually review these materials. Questions to

the SAC should focus on the science behind the topic. Questions related to process, regulation, etc. will be handled by the FWS.

3. Occupancy estimation workshop
An Occupancy Estimation and Modeling Workshop will be held in San Marcos, TX, from May 31 through June 2. Michael, Earl, and Dick have expressed interest in attending, and Bob and Kristin plan to send a graduate student/technician. Given the relevance of this workshop to the draft recovery criteria, the DTRO can support those SAC members who wish to attend.

4. Post-fire restoration efforts
The SAC expressed concern about plans by some agencies to incorporate exotic species, including forage kochia, in post-fire restoration activities. The committee agreed that *extreme caution* must be applied when considering the use of exotics in these activities.

Action Item: Kristin will forward to the DTRO references on forage kochia that indicate that this species becomes woody and can itself be a fire hazard.

Action Item (completed): Earl will forward to the DTRO a reference on guidelines for biocontrol agents that would also apply to this situation: McEvoy, P.B., and E.M. Coombs. 2000. Why things bite back: unintended consequences of biological weed control. In: Follett, P.A., Duan, J.J. (Eds.), Nontarget Effects of Biological Control. Kluwer; Boston, MA, pp. 167-194.

Action Item: The DTRO will revisit this issue at its desert tortoise coordination meeting between the FWS field offices on February 1-2.

5. Clean-air rules and dust in rural areas
Kristin mentioned EPA's proposal to relax federal rules for wind-blown clouds of dust in rural areas, including mining and farming operations. This has the potential to spread elemental toxicants throughout the Mojave Desert, possibly impacting the desert tortoise.

Action Item: Amy will follow up with the Ventura Fish and Wildlife Office to determine if comments are being prepared in response to the proposed rule.

6. Recovery criteria
The SAC reviewed the revised draft list of recovery objectives and criteria (Attachment 1). Objectives in this draft address 1) tortoise distribution/occupancy across the landscape, 2) habitat, 3) demographics, 4) threat mitigation and uncertainty/information needs, and 5) genetic diversity. The following summary of the meeting discussion reorders the objectives and criteria to follow a more logical progression. A particular point of emphasis in the discussion was the need to incorporate measurable trends in the criteria, rather than specific target numbers (e.g., population size or density), due to the lack of historical (pre-decline) benchmarks or a scientific basis for specific target estimates.

<u>Draft Recovery Objective 1: Maintain well distributed, self-sustaining populations of desert tortoises into the future</u>.

This objective was moved from #3 to #1 to reflect the top priority of maintaining viable populations across the tortoise's range (similar to the first and third delisting criteria in the 1994

recovery plan). The concept of "demographic study areas" (similar to that used for Northern Spotted Owls) is introduced in the following criteria to focus sampling efforts at a scale at which statistically defensible trends can be measured (i.e., rather than measuring population growth rates, density, etc. across the entire range). These demographic study areas remain to be defined, but they may be based on outcomes of the habitat model required by Recovery Objective 3, below, and should occur within each recovery unit, which also remain to be defined.

As mentioned above, specific target numbers have been replaced with the requirement of stable to increasing trends at the 90% confidence level over 25 years (a tortoise generation). This avoids setting arbitrary goals without a biological basis. The confidence level was reduced from 95% to 90% to provide a more achievable confidence limit that is still meaningful (natural variation alone would likely preclude the ability to ever measure these trends at the 95% confidence level).

While headstarting or translocation may be necessary management tools to stabilize tortoise populations prior to recovery, these criteria may NOT be applied to augmented populations, as reflected by the objective of maintaining *self-sustaining* populations.

Draft Recovery Criterion 1a: Trends in desert tortoise population growth rates (lambda) over a single tortoise generation (25 years) are stable to increasing at the 90% confidence level within each demographic study area.

Draft Recovery Criterion 1b: Trends in desert tortoise density over a single tortoise generation (25 years) are stable to increasing at the 90% confidence level within each demographic study area.

Draft Recovery Criterion 1c: Trends in desert tortoise survival over a single tortoise generation (25 years) are stable to increasing at the 90% confidence level within each demographic study area.

Draft Recovery Criterion 1d: The most recent five-year sliding average of desert tortoises below reproductive size (<180 mm carapace length) is at least 40% of the population age structure at the 90% confidence level within each demographic study area.

Age structure is included as a criterion rather than fecundity (egg-laying rates or hatchling production) due to the difficulty of measuring fecundity and the low and highly variable survival of eggs and hatchlings. An age structure that includes 40% individuals below reproductive size falls within the range observed on study plots within both the Mojave and Sonoran deserts. The five-year sliding average provides assurances that the size/age distribution is stable without allowing a single bad year of recruitment (or detectability of juveniles) to cause this criterion to fail, even though criteria 1a-1c may be met.

Draft Recovery Objective 2: Maintain a broad and stable-to-increasing distribution of desert tortoises within each recovery unit *(note that recovery units remain to be evaluated)*.

Importantly, this objective and its associated criteria apply to the tortoise's entire distribution, not only to populations within designated critical habitat. This reflects the importance of populations outside critical habitat to recovery, recognizing the contribution of ongoing

management efforts outside critical habitat, as well as potentially important genetic lineages that are not included in critical habitat.

Draft Recovery Criterion 2a: The lower limit of the 90% confidence band around the slope of desert tortoise occupancy across all public lands and private conservation lands below 4200-feet elevation in each recovery unit, measured over a single tortoise generation (25 years), equals or exceeds 0.

As for Recovery Criteria 1a-1d, the confidence level was here reduced from 95% to 90% to provide a more achievable confidence limit that is still meaningful, and the time horizon was set at 25 years. The committee considered the 4200-foot elevation threshold adequate for the purposes of this criterion, as few tortoises populations occur above this elevation. Note that the criterion does not require tortoises to occupy ALL lands below 4200 feet, only that the level of occupancy across these lands remains stable or increases.

Draft Recovery Criterion 2b: The lower limit of the 90% confidence band around the slope of desert tortoise occupancy within each "geographic area" within each recovery unit, measured over a single tortoise generation (25 years), equals or exceeds 0.

Criterion 2a requires a stable tortoise distribution, as measured by occupancy, across the remaining range. Criterion 2b has been modified to eliminate specific areas of an arbitrary size. Instead, the criterion divides the tortoise's current range into smaller "geographic areas" to ensure that populations are well distributed across the range. These "geographic areas" remain to be defined, but they may be based on vegetation classifications, ecosystem units, current population distribution information, genetic data, or other information. Each "geographic area" would include a demographic study area, as mentioned above. Criterion 2b prevents tortoise range contraction in one area (e.g., tortoises disappearing from an entire valley) from being compensated by increasing levels of occupancy in another area (e.g., tortoises filling in temporarily unoccupied local areas within a valley already occupied by tortoises in other areas in the same valley), thus resulting in an overall measure of stable occupancy. The concepts contained in these criteria will be further developed as questions regarding sampling design and resolution are resolved.

Draft Recovery Objective 3: Ensure that enough habitat within each recovery unit is protected to allow long-term viability of desert tortoise populations.

Declining populations require intensive habitat management to stabilize and reverse trends. Much is known about what constitutes desert tortoise habitat, but we currently lack a method of monitoring changes in the quantity and quality of habitat, especially in the face of rapid urbanization, invasion by exotic plants, and increasing frequency and scales of fire. This objective parallels the second delisting criterion in the 1994 recovery plan and includes criteria that require a mechanism to track the status of different habitat categories.

Draft Recovery Criterion 3a: A GIS habitat model has been developed to identify minimum requirements for desert tortoise population persistence.

Draft Recovery Criterion 3b: A habitat-tracking system, based on the habitat model in Criterion 3a, is in place and implemented to monitor the status of desert tortoise habitat across the tortoise's range.

Criterion 3b requires a method to quantify the amount of habitat in different categories (e.g., critically important, moderate, degraded, non-habitat). Management agencies would be expected to report habitat status within their lands.

Draft Recovery Criterion 3c: The quantity of desert tortoise habitat is maintained with no net loss across the species' range, and trends in the condition of tortoise habitat within demographic study areas are demonstrably stable or increasing.

The demographic study areas (or other frame of reference for the second part of Criterion 3c) must include a buffer around what is considered the "biological core" to guard against the risk of "spot zoning" (i.e., allowing negative impacts) in non-core areas and creating edge effects into core habitat areas.

Draft Recovery Objective 4: Threats to desert tortoise population persistence are sufficiently mitigated to ensure the continued persistence of the species.

Draft Recovery Criterion 4: Management plans or cooperative agreements have been implemented within each recovery unit to ensure the maintenance of Recovery Criteria 1-3. Each plan or agreement must contain: a) explicit management actions that reflect the risks facing desert tortoise population persistence within that recovery unit, b) management strategies that ensure that the plan is evaluated and revised regularly, c) a system to track the implementation of management actions, and d) assurances that the plan will be implemented.

This criterion encapsulates the fourth delisting criterion in the 1994 recovery plan. It is important to understand as much as possible the direct links between threats and tortoise population response (i.e., cause and effect), however the number of potential threats affecting the tortoise and the nature of desert tortoise life history, especially the long generation time, may make it impractical to reach this level of understanding completely. Therefore, the requirement for "demonstrated effectiveness of management actions" was removed from the previous draft of this criterion. Experimental (or, in some cases, observational) studies should be applied to specific plots or areas to better understand the relationship of threats, management actions, and tortoise populations. Caution should be exercised, however, in applying treatments to demographic study areas, depending on the nature of the treatment, severity of threat, etc.

Genetic diversity: The committee determined that measures specifically designed to preserve the genetic diversity and integrity of the desert tortoise should be incorporated into specific recovery actions where appropriate, rather than as recovery goals and criteria. Specific trigger points may need to be identified to initiate captive breeding or headstarting. The requirement of well-distributed populations in objectives 1 and 2 incorporate genetic rationale, but genetics is not the only important component of the species' diversity.

Action Item: Roy will revise the draft recovery criteria based on this meeting and forward to Bob Williams, Paul Henson, and Diane Elam for FWS review to ensure that there are no major policy issues with the direction that the draft criteria are headed.

Action Item: The DTRO will provide for the next meeting maps that illustrate vegetation communities and other features.

Next Meetings

- March 16-17 (field trip on the 18th) in Tucson
- April 20-22 (2 days in this window) are tentatively planned for Las Vegas. Depending on progress and the ability to get work done remotely, this meeting may be postponed to coincide with the Occupancy workshop in San Marcos at the beginning of May.

Tasks include 1) finalizing draft recovery criteria, 2) outlining research needs as recovery actions (including guidance on captive propagation and headstarting), and 3) reviewing and delineating revised draft recovery units.

Attachment 1

DRAFT RECOVERY OBJECTIVES AND CRITERIA
January 20, 2006

Draft Recovery Objective 1: Maintain a broad and stable-to-increasing distribution of desert tortoises within each recovery unit *(note that recovery units remain to be evaluated).*

Draft Recovery Criterion 1a: The lower limit of the 95% confidence band around the slope of desert tortoise occupancy (across all public lands and private conservation lands below 4200-feet elevation in each recovery unit) measured over time equals or exceeds 0.

Draft Recovery Criterion 1b: Criterion 1a is specifically met within i) one "biological core area" of at least 100 square miles per critical habitat unit, AND ii) any additional "biological core areas" of at least 100 square miles necessary to establish a minimum of 3 such areas within each recovery unit. The only exception is that the Upper Virgin River Recovery Unit will have a single "biological core area" of 86 square miles coinciding with its sole critical habitat unit *(this assumes there is no other habitat within the UVR recovery unit suitable for an additional "biological core area").*

Rationale:
This recovery objective and associated criteria would essentially replace the 1994 Delisting Criterion 1: "As determined by a scientifically credible monitoring plan, the population within a recovery unit must exhibit a statistically significant upward trend or remain stationary for at least 25 years (one desert tortoise generation)." There are various difficulties in applying the original criterion.

- As currently worded, the criterion relies on statistical significance in recognizing a trend, but it does not explicitly acknowledge sampling or temporal variation within the data, which could result in a population shown to be statistically stable or increasing but actually decreasing on the landscape (i.e., incorrectly concluding that the trend is >0 when it is actually <0, a Type II error). Revision of the current criterion would clarify the statistical and biological confidence in measured trends.
- The current criterion ignores potential metapopulation processes acting across the vast spatial scale of each recovery unit by lumping all populations within each unit. The loss of complete populations could temporarily be balanced by increased density within other populations, potentially placing the entire stakes of recovery on fewer, more isolated populations.

The revised recovery objective would help provide for representative, resilient, and redundant populations within each recovery unit. Implicit in this objective is the maintenance of sufficient habitat to sustain tortoises on the landscape. That is, stable or increasing tortoise distributions can only be achieved by managing habitat appropriately. However, habitat should also be addressed in other objectives/criteria.

The new criteria lower the original bar of estimating range-wide density of tortoises to determining the presence (occupancy) of tortoises across the species' range. Estimating occupancy is quicker and easier than estimating density and will provide a much more efficient evaluation of where tortoises are on the landscape. However, these criteria do not sacrifice the need for viable populations. Criterion 1b and subsequent objectives/criteria help assure population viability.

These criteria require a stable-to-increasing trend of tortoise occupancy across each recovery unit, rather than a specified point estimate. A specific point estimate would essentially be arbitrary, because historical benchmarks for tortoise occupancy in the Mojave Desert do not exist. However, we may want to establish minimum "trigger points" below which more intensive management actions may be required.

These criteria would require the establishment of a precise baseline of the area over which tortoise occupancy is measured, so occupancy over time will be measured and compared against the same standard established at the time of the recovery plan revision. The baseline will prevent habitat loss resulting in a comparison of similar relative measures of tortoise occupancy across smaller absolute areas in the future.

Questions

- Should the baseline apply across the entire range (as indicated by 1a), only to designated critical habitat? What about occupied lands outside of critical habitat?
- Do we need a better/more specific habitat definition than everything below 4200 ft?
- Should a time horizon be incorporated into this criterion, or will additional criteria provide assurance that unwarranted delisting will not occur (or be advocated) even if minimum occupancy levels are achieved in a single year?
- The size of the "biological core areas" also needs to be evaluated further. Areas of 100 sq mi are based on 2005 fires.

Critical Habitat Unit	Area (sq mi)	2005 Burns (sq mi)	% Burned
BEAVER DAM SLOPE	320	73.1	22.8
CHEMEHUEVI	1,463	0	0
CHUCKWALLA	1,595	0	0
FREMONT-KRAMER	811	0	0
GOLD BUTTE-PAKOON	763	97.6	12.8
IVANPAH	988	1.7	0.0
MORMON MESA	668	24.3	3.6
ORD-RODMAN	398	0	0
PINTO MOUNTAINS	268	0	0
PIUTE-ELDORADO	1,517	0.2	0.0
SUPERIOR-CRONESE	1,197	0	0
UPPER VIRGIN RIVER	86	16.3	19.0
TOTAL	10,074	213.2	2.1

- We may need a better understanding of the spatial scale of tortoise population "clumps" or patches to design an effective sampling strategy to obtain precise estimates of occupancy. However, there was also discussion that random sampling within even crude stratification may minimize or eliminate sampling problems arising from patchy distribution of tortoises on the landscape.
- The resolution of the sampling frame needs to be determined, as well as the minimum number of sample points for precise estimates of occupancy. The large scale at issue may still present some problems.

- What are the monitoring implications of this criterion relative to the current distance-sampling program?

Draft Recovery Objective 2: Protect or intensively manage enough habitat within each recovery unit to ensure long-term viability of desert tortoise populations.

Draft Recovery Criterion 2a: A GIS habitat model has been developed to identify minimum requirements for desert tortoise population persistence.

Draft Recovery Criterion 2b: A habitat-tracking system, based on the habitat model in Criterion 4a, is in place to monitor the status of desert tortoise habitat within the areas identified in Criteria 1a and 1b.

Rationale:
This recovery objective directly parallels the second delisting criterion in the 1994 recovery plan ("enough habitat must be protected within a recovery unit, or the habitat and desert tortoise populations must be managed intensively enough to ensure long-term viability"), but specific criteria are added here to ensure that we have an accurate understanding of what constitutes desert tortoise habitat. Meeting Recovery Objective 1 necessitates meeting Objective 2, so criteria under this objective require the ability to relate habitat conditions to tortoise populations.

In order to manage desert tortoise habitat well enough to meet Objective 1, we must be able to link habitat data to tortoise demographic data. Information from this type of model will allow us to identify minimum conditions for potential tortoise occupancy and, therefore, to analyze occupancy as a function of habitat characteristics. Consequently, Criteria 1a and 1b are tied directly to Criterion 2a. The subsequent link to the habitat-tracking system in Criterion 2b provides a mechanism to measure an implicit requirement of "no net unmitigated loss" of desert tortoise habitat (i.e., stable-to-increasing distribution of desert tortoises).

Maintaining stable-to-increasing tortoise occupancy through no net unmitigated loss of habitat provides opportunities to balance habitat degradation or loss with restoration of currently degraded habitat. The habitat model must identify thresholds below which habitat degradation fails to provide the minimum conditions for potential occupancy. The tracking system will require a baseline delineation of habitat that includes the historic distribution of the tortoise (i.e., areas potentially containing tortoises at present, as well as in the future), less those areas already lost completely or degraded below suitability for tortoise occupancy. This system will provide an accountable "ledger" of habitat status so that restored areas are added to the positive side and degraded or lost areas are added to the negative side. We will then be able to quantitatively measure the amount of occupied habitat, the amount of newly available (restored) habitat for tortoises to expand into, and the rate that restored habitat is occupied/effectiveness of the restoration. An approach taken by the Sonoran Desert Conservation Plan modeled covered-species' habitat at 3 levels: i) critically important - biological core, ii) moderate, and iii) non-habitat/excluded. There may also be examples from the gopher tortoise arena.

This approach recognizes the need for large natural areas to accommodate large stochastic events, but focuses the most intensive management within "biological core areas" within these larger areas. The "biological core areas" should be as undisturbed as possible and include

intensive restoration or management (e.g., weed management). The size of "biological core areas" should be evaluated through the habitat model and adapted up or down as necessary. Modeling should help better quantify what proportion of the habitat needs to be occupied or available to be occupied. Of paramount importance is establishing specific recovery actions with clear timelines to develop the habitat model and tracking system.

Draft Recovery Objective 3: Maintain healthy desert tortoise population levels (lambda > 1) within each of the management areas specified in Recovery Criterion 1b.

Draft Recovery Criterion 3a: The lower bound of the 95% confidence limit for adult desert tortoise density equals or exceeds 65/square mile (25/square km) within each "biological core area."

Draft Recovery Criterion 3b: The lower bound of the 95% confidence limit for adult desert tortoise survival equals or exceeds 90% within each "biological core area."

Draft Recovery Criterion 3c: Desert tortoises <180 mm carapace length should comprise at least 40% of the total number of tortoises observed during surveys of each "biological core area."

Rationale
This recovery objective parallels the third delisting criterion in the 1994 recovery plan ("provisions must be made for population management within each recovery unit so that discrete population growth rates (lambdas) are maintained at or above 1.0") and also addresses representation and resiliency. Representation is achieved by applying the criterion to each recovery unit. Each of the sub-criteria establish minimum demographic parameters to ensure resiliency of the populations. The specified "biological core areas" identified in Recovery Criterion 1b should include elevated management above that in the surrounding areas, such as headstarting (at least until threat mitigation is better understood), provision of supplemental water during drought, plus those actions in the larger areas. Ideally, "biological core areas" would be managed at a level sufficient to produce excess tortoises to populate adjacent areas.

Density levels (3a) are based on estimates from range-wide distance sampling. Minimum survival (3b) is based on upper values estimated from study plots in California and Arizona. Minimum recruitment (3c) is based on pre-decline surveys of study plots throughout the Mojave Desert. (*We need to alter or specify these values more precisely. See the questions, below.*)

Questions
- 3a) Is 65 adult tortoises/sq mi appropriate? This value was taken from Upper Virgin River (most 95% CI lower limits between 1998 and 2003 are just below 65 tortoises/sq mi). Should the number differ between recovery units?
- 3b) Is 90% minimum survival appropriate? More/less? This level of precision was not met in any of 5 years of surveys at 3 sites with apparently healthy populations in Arizona.
- 3c) Is 40% representation of tortoises <180 mm adequate to ensure good recruitment? More/less/some different measure altogether? Numbers from 3 sites in Arizona (1 year each) that I was able to quickly pull up range from 22-45%.

- 3a-c) Should a time horizon be incorporated into these criteria, or will additional criteria provide assurance that unwarranted delisting will not occur (or be advocated) even if minimum density levels are achieved in a single year?
- 3a-c) What are the monitoring implications of these criteria?
- 3a-c) Should an updated PVA be incorporated more directly into these criteria?

Draft Recovery Objective 4: Threats (including potential interactions between threats) to desert tortoise population persistence are sufficiently understood and mitigated to ensure the recovery of the species.

Draft Recovery Criterion 4: Management plans or cooperative agreements have been implemented within each recovery unit to ensure the maintenance of Recovery Criteria 1-3. Each plan or agreement must contain: a) explicit management actions that reflect the risks facing desert tortoise population persistence within that recovery unit, b) demonstrated effectiveness of those management actions mitigating the relevant risks, c) adaptive management strategies that ensure that the plan is evaluated and revised regularly, and d) assurances that the plan will be implemented.

Rationale
This recovery objective parallels the fourth delisting criterion in the 1994 recovery plan ("regulatory mechanisms or land management commitments must be implemented that provide for long-term protection of desert tortoises and their habitat"). However, very little still is known about the demographic impacts on tortoise populations of any of the various identified threats or the relative contributions each threat makes to tortoise mortality (Tracy et al., 2004). Therefore, specific and meaningful threats-based recovery criteria cannot be identified at this time. Specific recovery actions, including research, must be implemented to identify sets of threats that contribute to a greater number of mortality mechanisms or that affect size structure or fecundity. The relative strengths of hypothesized connections between threats and mortality must also be assessed (some individual linkages may be more important than multiple linkages from other individual threats). This assessment should be based on data from research designed specifically to elucidate relationships between threats and mortality. As quantitative information on threats and tortoise mortality is obtained, effective management actions can be identified, prioritized, and implemented through the management plans or cooperative agreements required by this recovery criterion. In addition, new information may contribute to the development of more specific threats-based recovery criteria during future recovery plan review and revision.

Draft Recovery Objective 5: Maintain genetic diversity levels through all available and effective means including, where appropriate, ex situ propagation, translocation, and other ex situ methodologies.

Draft Recovery Criterion 5: Captive-breeding populations have been established and a contingency plan is in place to ensure the survival of each genetic lineage should catastrophic events destroy the wild populations or reduce them below viable levels.

Rationale

This objective addresses the current problem of tortoises disappearing from the landscape and the risk of losing entire genetic lineages of the species. The objective is based on the IUCN's vision statement within its Technical Guidelines on the Management of *Ex-situ* Populations for Conservation (http://www.iucn.org/themes/ssc/pubs/policy/exsituen.htm). Ex situ is defined by the IUCN as "the conservation of components of biological diversity outside their natural habitats." However, ex situ management relative to this recovery objective and criterion may also include intensively managed/protected enclosures within the tortoise's natural range and habitat.

Questions

- Should captive refugia be included as recovery objective/criteria (i.e., required to be in place before delisting can take place), or should this be packaged as a recovery action?