5. LINE DISTANCE PROTOCOLS

The goal of conducting line-distance transects is to acquire an unbiased estimate of the density and abundance of desert tortoises. Achieving this requires integration of various field activities, but most directly it requires the ability to define the transect, locate tortoises, and accurately measure the distance from the transect to the tortoise. Two types of practice arenas are used to assess your ability to successfully achieve these goals: 1) a model population of desert tortoises ("styrotorts") is utilized for training and testing on detection and measurement, and 2) practice transects are walked in the Large-Scale Translocation Site (LSTS) near Jean, Nevada.

Desert tortoise monitoring using distance sampling requires that distance from the transect line to live tortoises and carcasses be accurately measured. The current protocol requires tortoise monitors to walk transects at specified locations on predetermined bearings. When a tortoise or carcass is observed you must 1) use a compass to determine the local transect bearing (this may be different from the predetermined bearing), 2) use a compass to determine the bearing (azimuth) from the point of observation to the tortoise or carcass, and 3) measure the distance to the tortoise or carcass using a measuring tape. These data are used to calculate the distance from the observed tortoise or carcass to the local transect line. Accuracy and precision in these measurements are critical for adequate estimates of tortoise density.

Tortoises are not active and visible consistently throughout the day. For this reason, the timing of transect completion must be coordinated with optimum tortoise activity periods. These periods will change over the course of the many weeks of monitoring, and teams are responsible for matching their transect start times to these shifting windows. Each day of the field season, all transect teams are maintaining start times and distance sampling protocols that must be consistent with all other transect teams. They must also coordinate their activity with telemetry crews who collect information on the proportion of tortoises that might not have been visible even during the optimum time of day.

Refer to **Appendix I** and **II** for database dictionaries and paper data sheets, respectively.

Objective 1: On or near the transect line, each 2-person team will find all tortoises visible on the surface, in and under vegetation, and in burrows. Crews will apply the search technique as trained.

Metrics: Data collected by each team on tortoise models will be used to evaluate

1) Detection functions. These must reflect proper search technique by demonstrating consistent, high detection rates on the transect line out to about 2m, with declining detection rates beyond this.
2) Accurate tortoise abundance estimates. Each team's estimates of abundance must include the true value within the 95% confidence interval.
3) Dual-observer techniques. Teams will detect close to 100% of all models within 2m of the transect center line.

Detection curves for teams of crews and proportion of leader-follower detections for each crew will also be assessed on a weekly basis during the field season.

Objective 2: Each 2-person team will complete transects in the prescribed fashion within specified time limits, including minimum start, maximum end, and minimum total time.

> **Metrics:** On practice transects, crews will demonstrate ability to navigate to start points by the preplanned time, and will complete transects before a preplanned end time, moving at a sufficiently slow pace so that tortoise detection is not compromised. These metrics will also be assessed for each team on a weekly basis during the field season. On a daily basis, transect crews will communicate their transect completion times to telemetry crews so that scheduling of transects and radio-tracking can be coordinated.

Objective 3: Each crew member will accurately and precisely measure the local bearing of a transect, and the azimuth and distance from the point of initial observation to a tortoise/carcass.

> **Metric:** Perpendicular distances of tortoise models to the transect center line should be estimated to within 10% of the known value and without significant bias in 95% of the training trials.

Objective 4: Crews will walk standard (12km square) transects using standard protocols for range-wide monitoring of desert tortoises.

> **Metric:** On practice transects, crews will demonstrate ability to implement the set of guidelines for standard transects, appropriately collecting and entering data on paper and electronic forms. These metrics will also be assessed for each team on a weekly basis during the field season.

Objective 5: Crews will appropriately implement techniques to walk non-standard transects when obstacles prevent completion of standard techniques.

> **Metric:** On practice transects, crews will demonstrate ability to implement the set of guidelines for non-standard transects, appropriately modifying the transect and documenting changes on paper and electronic forms. These metrics will also be assessed for each team on a weekly basis during the field season.

METHODS

Objective 1: Apply the Search and Detection Technique

This objective will be the emphasis of training in the arenas with tortoise models. See *Distance Sampling Theory* for description of optimal detection functions that should result from correct implementation of search techniques.

Objective 2: Start and Complete Transects to Optimize Tortoise Detections

Optimizing monitoring to coincide with tortoise activity

One adaptation that tortoises have for living in the desert is to restrict surface activity to fairly narrow windows of time during the year. In general, tortoises predictably emerge from deep within shelters (burrows) from mid-March through mid-May and then again (less predictably) in the fall. These periods coincide with flowering of their preferred food plants (in spring) and with annual mating cycles (in fall). The annual range-wide monitoring effort is scheduled to match the spring activity period for tortoises.

During this season, not all tortoises are above ground or visible in burrows. In order to encounter as many tortoises as possible, monitoring is scheduled for early in the day and to be completed before the hottest time of day. Because we are finding tortoises by sight, monitoring is restricted to daylight hours. Based on past experience, we expect tortoises to become most active after 7am at the beginning of April (it is usually too cool before this time), but to emerge earlier and earlier until their daylight optimal activity period is around sunrise by the beginning of May. In May, we also expect daytime temperatures to limit tortoise above-ground activity as the morning progresses to afternoon.

Field crews should complete transects during this optimal period each day. Start times are decided in advance, and crews should arrive at transects at similar times on a given morning. Figure 5-1 was produced as part of weekly assessments in 2008, as a way to examine the efficiency of crews as they targeted different start times each week (these are agreed to between the field crew leaders and USFWS).

However, completion times will be more variable, and will be affected by terrain, air temperature, number of tortoises encountered, etc. Although we have general expectations about when tortoises are most active each day, and indeed have expectations of the proportion that will be active, density estimates require real-time estimation of daily activity during the actual periods tortoises are counted. The role of telemetry crews is to provide these activity descriptions (=estimates of G_0).

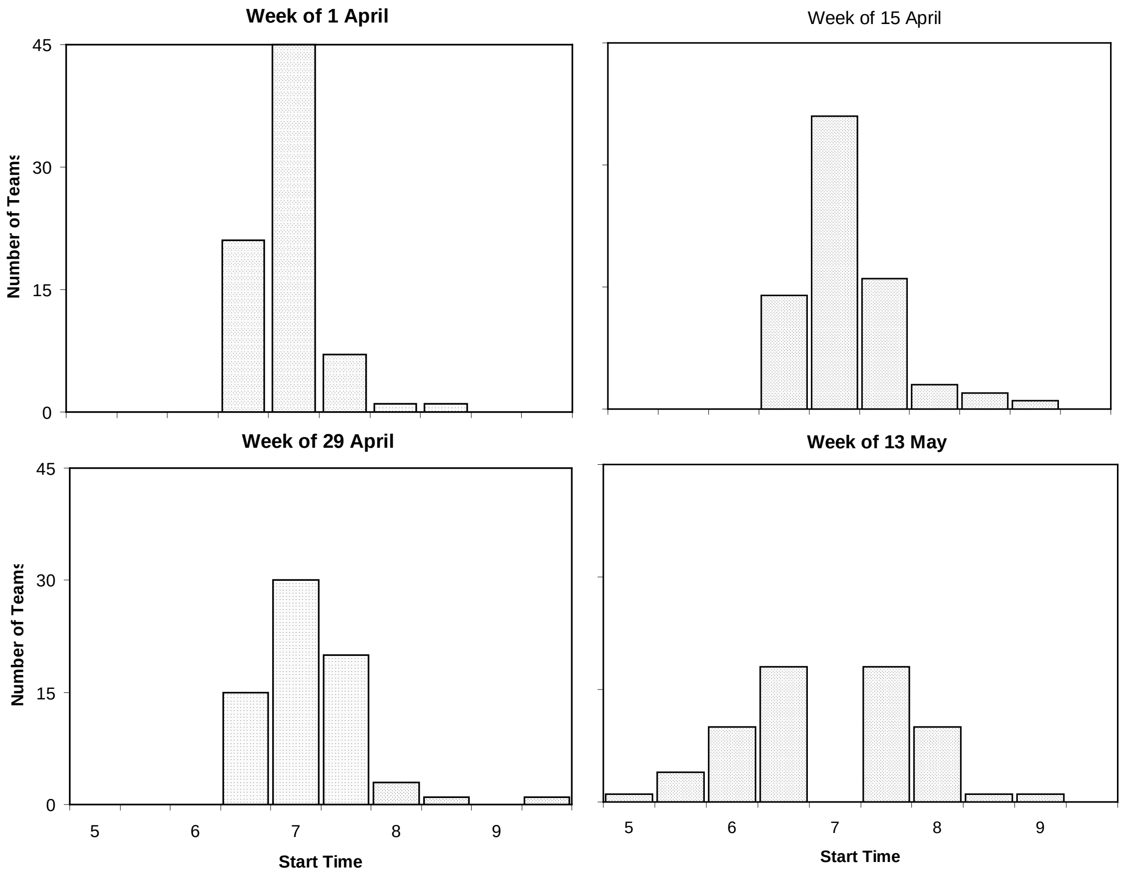


Figure 5-1. Weekly transect start times for 2008 in half-hour increments.

G_0 graphics from 2008 are presented in Figs. 5-2 and 5-3. Note that the proportion of radio-tracked tortoises is most consistent and highest in the second week of the field season at this site (Fig. 5-4). Activity was depressed early in the morning earlier in the field season and there is overall lower activity by the end of the field season, especially in the afternoon. Figure 5-3 indicates that early in the field season, tortoises were in burrows or well-hidden in vegetation in the middle of their activity period, whereas in the second half of the field season, they were more hidden in the early part of the day. This change in behavior does not necessarily coincide with classifying tortoises as visible or not (Fig. 5-2), but does indicate that visibility to crews on transects will be influenced by the search pattern that is used. Crews should remember that after emerging for daily activity, tortoise may withdraw to less visible above-ground locations.

Telemetry and transect crews are responsible for beginning the field day at the scheduled time. For transect crews, the field day begins at Waypoint 1. For telemetry crews it starts with the first behavior observation of a transmittered tortoise. Each field group will use their own method to communicate between transect and telemetry crews so that telemetry crews monitor until all transects have been completed for the day.

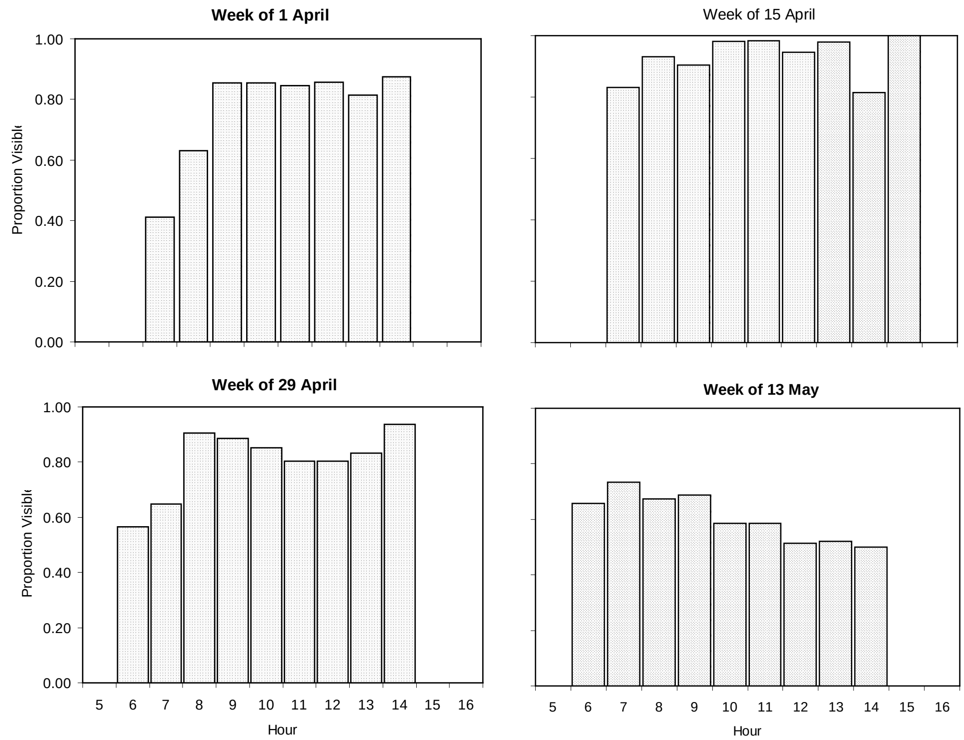


Figure 5-2. Proportion of tortoises at the Coyote Springs G_0 site that were scored "visible" after detection by radio receiver. Observations are graphed separately for each week and plotted for every other week of the monitoring season.

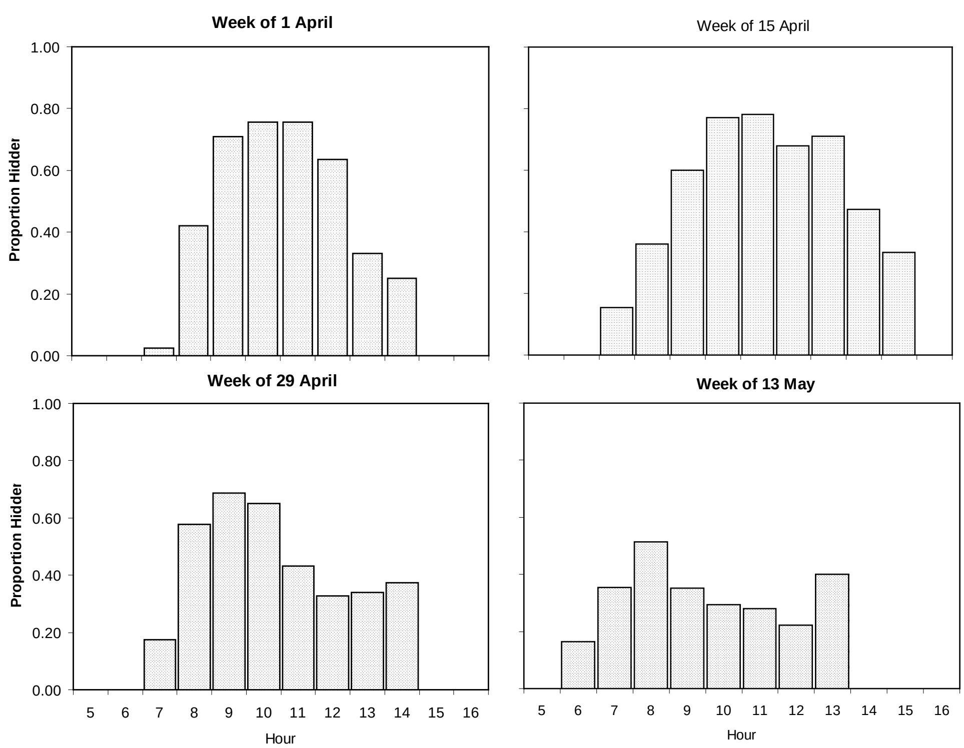


Figure 5-3. Hourly proportion tortoises that are in burrows or scored "low visibility" in vegetation. These tortoises are hidden, although some may be visible with effort.

Objective 3: Measure the Local Bearing of a Transect and the Azimuth and Radial Distance to each Tortoise

When a tortoise or carcass is found, the position of the leader identifies the moving end of the transect (which is why it is very important to walk a consistent bearing). If the leader locates a tortoise or carcass in the 180^o semicircle in front of him/her, the leader stops immediately and drops the 25m line, establishing the position of the transect line. After taking the bearing of the 25m line (the local bearing), the follower comes forward to assist the leader, and together they record the azimuth (compass bearing) and the distance from the end of the line to the tortoise (the radial distance, *r*). Radial distances are recorded to the nearest 0.1m. The database will calculate the perpendicular distance automatically as *r* times the sine of the difference between the azimuth and the bearing of the 25m line (Fig. 5-4). Ideally, the bearing of the 25m line should be close to the transect bearing, but the detection function must be developed using distance from the traversed line, not from the ideal line. In the example illustrated in Fig. 5-4, the intended transect path would have passed 6.4m from the tortoise, whereas the local bearing determined from the 25m line resulted in an actual perpendicular distance of 7.7m. In all cases when the transect has been paused, the team should recheck the bearing of the transect and the leader should resume walking on the original correct bearing.

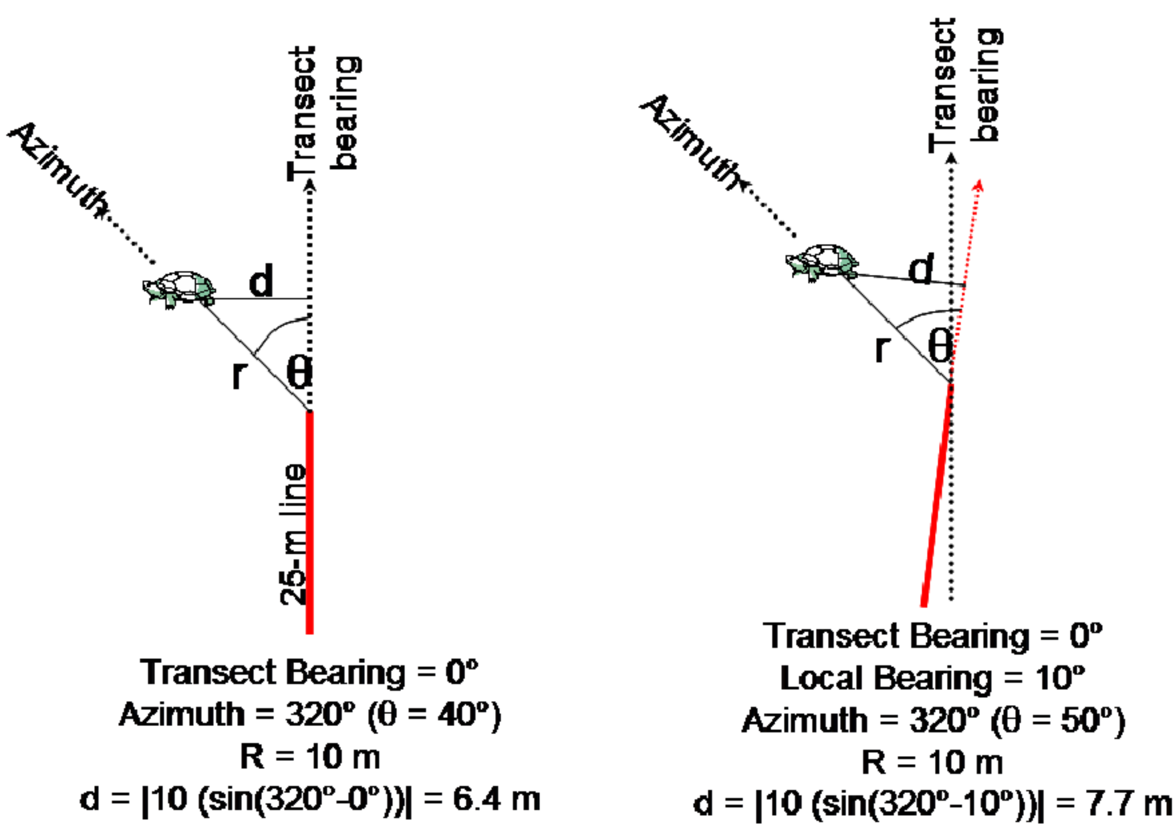


Figure 5-4. Schematic of position data collected to determine the perpendicular distance from a tortoise to the transect. The perpendicular distance, *d*, will be calculated automatically by the forms program on the RDA.

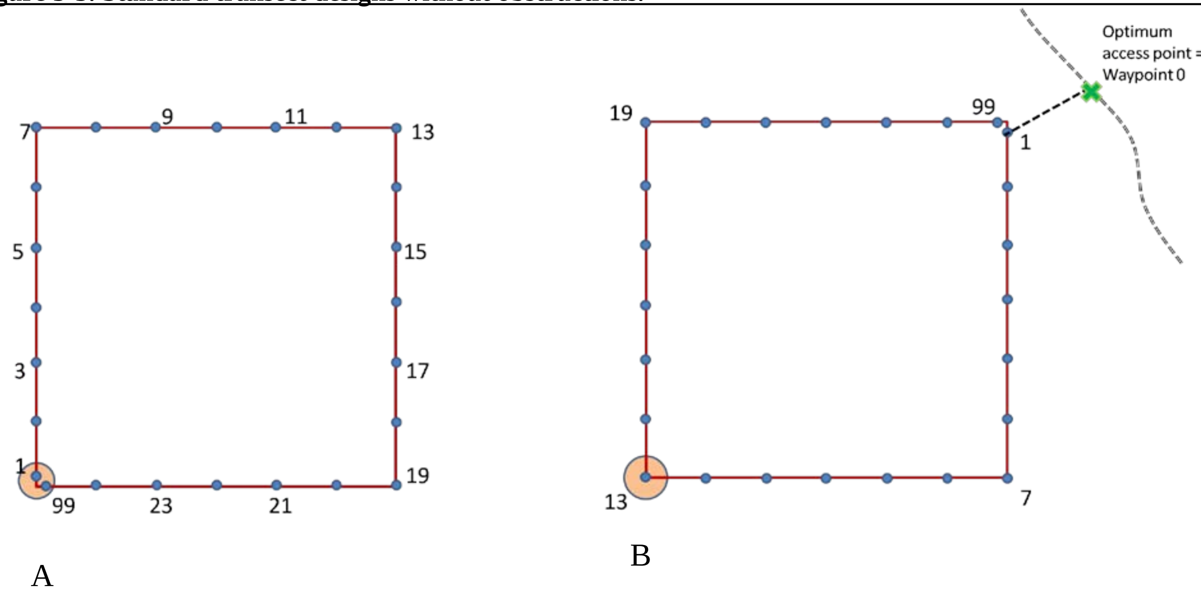
Occasionally, a tortoise or carcass will be located behind the follower. The same procedure applies, except the azimuth and distance are measured from the trailing end of the line.

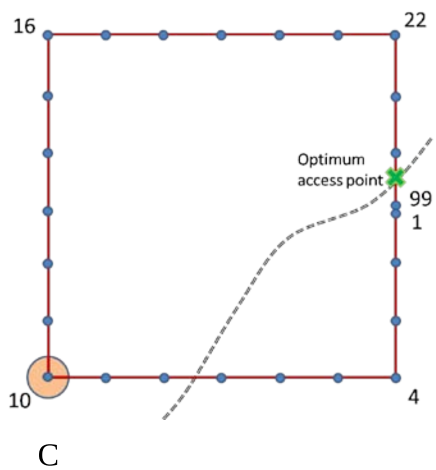
If a tortoise or carcass is detected between the leader and follower, there is a transect line on the ground, so perpendicular distance can be measured directly. There is no need to measure the local bearing and azimuth, which would add measurement errors. Instead, enter the [intended] transect bearing as the local bearing, enter 90˚ azimuth to the transect bearing without measuring it, and enter the perpendicular distance to the line as the radial distance. You should check that the calculated perpendicular distance given by the RDA is the same value as the radial distance you measured. This simplified procedure should only be used if the tortoise is detected between the leader and follower. Under no circumstances should a crew proceed forward to position a tortoise between them when a tortoise is detected in front of the leader. Movement by observers after an object (tortoise) is detected has been shown for other projects to add bias to density estimates.

Objective 4: Implement Appropriate Techniques for Standard 12km Transects

Monitoring strata are typically a combination of Desert Wildlife Management Areas and USFWS Critical Habitat. A systematic transect design is used to place transects within strata. If there are sufficient transects in a stratum, they will occasionally intersect. Standard transects are 12 kilometers long, comprising 24-500m segments defined by waypoints where coordinates are recorded. The standard transect forms a square with 3km sides (Fig 5-5A). A transect's starting point should be based on the location that is most efficient to access by vehicle (Fig. 5-5B). However, it is desirable to maintain segment lengths (the distance between waypoints) at 500m, so the start point should be a multiple of 500m from the first corner that will be encountered (Fig. 5-5C). Determining this point requires planning and map work before the transect is walked. Spatial files of the planned transects have been provided to GIS specialists for each field team, and have been used to plan access to transects and whether the transect is expected to be completed as a standard 12km square. Once the starting point is located and initial data (transect number, crew information, etc.) are collected, the transect is walked according to the following procedure. Note that all bearings are with reference to true north, so all **compasses must be adjusted for appropriate declination** (which can be determined from recent USGS topographic maps or directly from your navigational GPS receiver).

Figure 5-5. Standard transect designs without obstructions.





All 3 examples assume the same location of the southwest corner (orange dot). Waypoint numbers are indicated sequentially (A), from the starting waypoint (1) to the ending point (99). Waypoints are spaced approximately 500m apart and any planned waypoint can serve as a starting point, depending on the access point. In (B), the optimal access point (closest road access, usually waypoints 0 and 100) is the northeast corner. Transects can also be accessed at sides. Note that in (C) although the closest access point is on the transect, waypoint 1 (the starting point) is south of this to maintain 500m segments.

- Under normal conditions, you and a partner will walk one 12km square transect each day. You will be paired before training begins, and should remain partners throughout the field season. Partners alternate lead and follow positions at each corner of each transect, each person spending an equal amount of time in the leader and follower positions. The first leader each day should be the person who finished the previous day (transect) as follower.
- Using a compass adjusted for declination, the leader will start walking on the designated bearing, pulling a 25m length of durable line. The path that the leader walks becomes the centerline of the transect. While it is pulled, the line helps the follower report to the leader on whether the transect is on course; when the line is placed on the ground after a tortoise or carcass is detected, the line facilitates measurement of the local transect bearing. The walked length of each transect is calculated as the straight-line distance between GPS point coordinates that are recorded along the transect (waypoints). Therefore, it is important to walk as straight a line as possible between waypoints, using reference to the compass, a sighted point on the horizon, and the trailing line. The line should be passed over the top or

directly through shrubs or trees that lie in the transect path, attaching the line to a staff if necessary. Waypoints are recorded at 500m intervals and at corners where the transect turns. The leader maintains the correct bearing and has responsibility for determining the correct length of each leg of the transect.

- The follower will trail the leader at the end of the 25m line. Both leader and follower scan for tortoises independently without leaving the center line, and the role of the crew member finding each tortoise will be recorded in the data. Although the leader will see most of the tortoises, the role of the follower is to see all the remaining tortoises near the centerline, so the follower role is crucial to unbiased estimation of tortoise densities. The follower will also notify the leader if the transect is deviating from the designated bearing.
- The leader progresses along the transect, scanning the ground for tortoises or carcasses.
  - Concentrate on scanning the ground in a radius of about 5m and as far out as 10m. Little time should be spent scanning the horizon (except as necessary to maintain a consistent bearing) or scanning right around one's feet.
  - Special attention should be paid to searching vegetation intersected by the transect.
  - If it is necessary to leave the transect path to investigate a burrow or suspected tortoise or carcass more closely, the leader should drop the end of the line in place, so that the transect path remains unambiguous.
  - Attention should be given to ensuring the transect line does not "drift" toward a tortoise when one is observed. Tortoise density estimates would be biased if the transect consistently bends toward tortoises.
- The follower uses the same search technique as the leader. It is important that both crew members are searching for tortoises in the same manner.
  - If the leader stops to investigate a burrow, the follower should also stop to maintain position at the end of the 25m line.
  - Likewise, if the follower needs to investigate a burrow or suspected tortoise, the leader should stop while this is taking place.
- When a live tortoise or carcass is located, the leader drops the line, and the necessary data fields on both the electronic and paper data forms must be completed. Use of electronic data collection reduces data entry and transcription errors, but is not foolproof. Paper data sheets are completed for later cross-checking with the electronic data forms. Paper sheets are independent versions of data on the electronic data forms, *not* backup data. It is essential to take accurate data, and to complete each section of the data sheet in both paper and electronic forms before moving ahead. Refer to *Desert Tortoise Handling* for details on proper handling and measurement techniques.
- When a tortoise or carcass is found, the position of the leader identifies the moving end of the transect (which is why it is very important to walk a consistent bearing). Ideally, the bearing of the 25m line should be close to the transect bearing, but the detection function must be developed using distance from the traversed line, not from the intended line. In all cases when the transect has been paused, the team should recheck the bearing of the transect and the leader should resume walking on the original correct bearing.
- In addition to tortoise data, crew members will collect waypoints at regular 500m intervals, or more frequently if a corner is needed (*Implementing Protocols for Non-Standard Transects*, below).
- If an existing tag is present it should be recorded. Various identifying techniques have been used on tortoises for other projects, and the database is equipped to record identifying

information from these marks. Crews may need to clean the tags to make them legible, and should have any necessary reading gear with them; the numbers are small and will otherwise be difficult to read. If no tag is present, a tag should be applied.

- If a tortoise is in a burrow and cannot be removed, it is nonetheless important to record whether unhandled tortoises are adult or sub-adult (≥ 180 mm MCL or < 180mm MCL).
- When at least half of a tortoise carapace is located, the necessary data fields will be completed. Shell remains persist for a number of years in the Mojave Desert.
- Teams walking from their vehicle or from a drop-off location to the transect start point that encounter a live tortoise or a tortoise carcass should take all data on the "opportunistic" tortoise and carcass forms.
- GPS coordinates must be collected at all waypoints, tortoise, and carcass locations. If an automated (Bluetooth) GPS grab is not possible, UTM coordinates will be entered manually.
- Occasionally, transects will encounter obstacles that make it impossible to complete a standard transect. Paved roads with light traffic and rail lines should be crossed (after making sure it is safe) without interrupting the transect. Obstacles that should lead to changes in the transect path include major highways (e.g., all Interstate highways, US Highway 95 and 395, and California Highway 58), hazardous rock formations, or hills or washes too steep for safe navigation. When such obstacles are encountered, the transect path should be adjusted according to *Implementing Protocols for Non-Standard Transects*, below.

Objective 5: Implementing Protocols for Non-Standard Transects

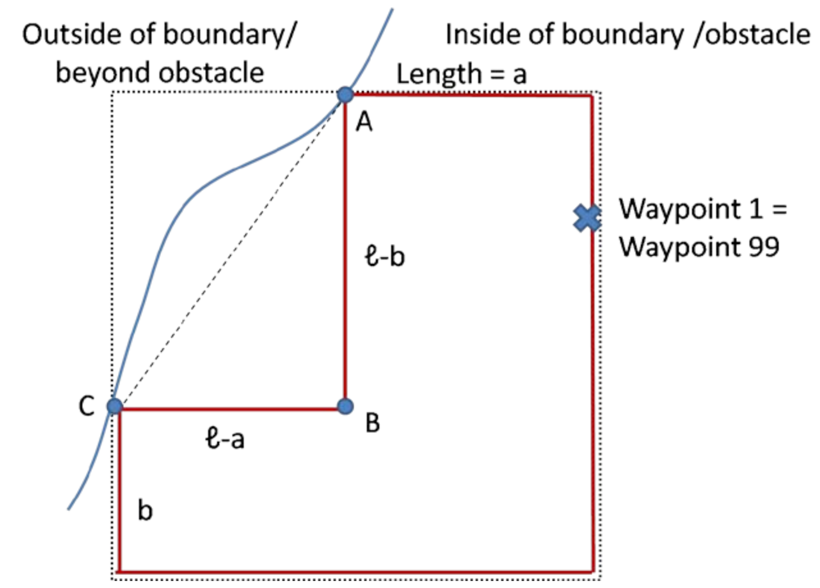
Each monitoring transect is associated with a "sampling stratum." For analysis, all data from all kilometers walked in a stratum are combined, and the analysis proceeds from there. If we only walked transects in mountains, we should only relate our analysis to mountainous areas of the stratum; if we only walked transects in flat areas, our estimates of tortoise density only apply to flat areas. Instead, each stratum has different terrains, topographies, vegetation types, and substrates. We are pretty sure that each of these attributes affects the density of tortoises, so to apply our tortoise density estimates to the entire stratum, we need proportional, representative sampling across the varieties of habitats that are available.

<u>Avoiding human infrastructure and administrative boundaries</u>
To sample stratum edges, we include some transects that would also cross out of strata and into adjacent lands. Before walking these transects, the "outside" portion is pulled into the stratum so that the path walked is the same distance from the stratum boundary, but is now inside.

There are other cases in which the landscape and the transect are intersected by human structures such as signed properties that prohibit access, or by major highways. (Roads with light traffic and railroads can be safely crossed as part of a standard transect.)

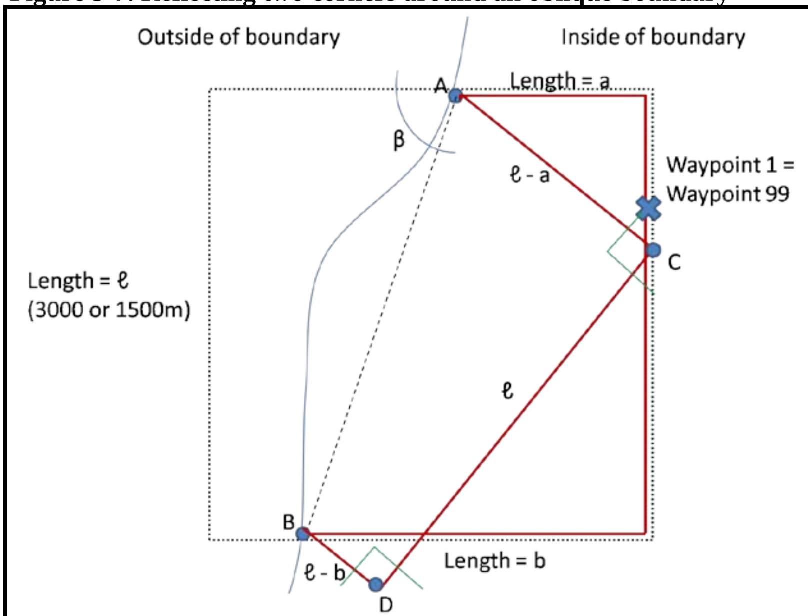
Transects should be rebuilt appropriately before the field season to move inside stratum boundaries and to one side of other identified obstacles listed above. Some structures are not indicated on our planning maps, so crews should understand the rules below and how to apply them when these situations arise unexpectedly. The figures below illustrate how to reflect a planned transect based on where a boundary (or fence that prohibits access, or interstate highway) intersects the transect. There are different approaches depending on whether a single corner is outside the boundary (Fig. 5-6), the boundary crosses at an oblique angle and excludes 2 corners (Fig 5-7), or it crosses parallel to one of the sides, excluding 2 corners (Fig. 5-8).

Figure 5-6. Reflecting one corner inside a boundary.



The planned transect (dotted square) is reflected inside the boundary (blue line) to create a new transect (red line). Crews must be given distances “a” and “b” before starting, or must measure these themselves based on the easting and northing at Point A and at the corner before it (here, the northeast corner). The length of a side, ℓ, is usually 3000m. Crews reorient at A, B, and C.

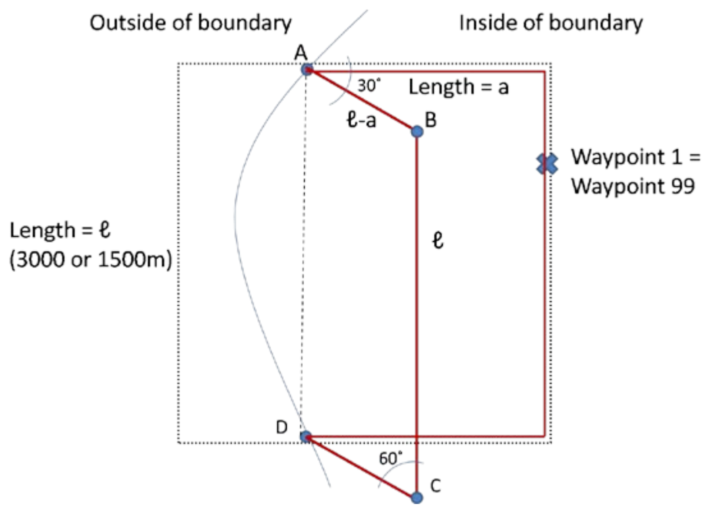
Figure 5-7. Reflecting two corners around an oblique boundary



The planned transect (dotted square) is reflected inside the boundary (blue line) to create a new transect (red line).

Crews must be given distances “a” and “b” before starting, as well as their new bearing at Point A. In the field, these measurements will be provided by the RDA after crews measure “a,” the length of a sideℓ, and the angle β. Crews reorient at A, B, C, and D.

Figure 5-8. Reflecting two corners around a boundary that is parallel to a transect side.



The planned transect (dotted square) is reflected inside the boundary (blue line) to create a new transect (red line). Crews must be given distance "a" before starting. At Point A, they will reorient 30° south or west if the transect is odd-numbered. For the obstacle crossing from north to south in this example, the crew would walk south. They would reorient west for a boundary crossing east-to-west. (Crews reorient north or east if the transect is even-numbered.) Corresponding shifts must be implemented at Points B, C, and D.

<u>Sampling through rugged terrain</u>

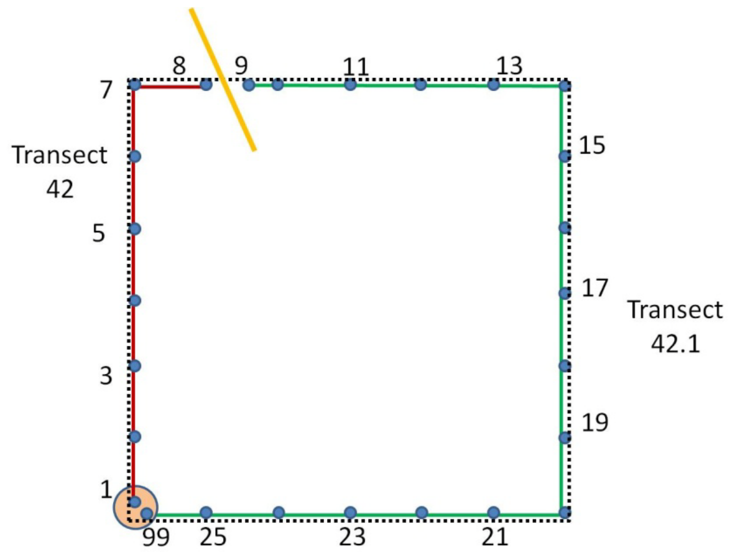
We would prefer for all transects to be walked exactly as they are selected so that we are confident of the applicability of our tortoise density estimates to the entire stratum. However, there are limits to what can reasonably be sampled. In particular, crews must return safely and be able to rest sufficiently to work safely the next day as well. As a rough guide, crews should evaluate their ability to return to their vehicles by 4pm each day. The following material describes the types of changes that will be implemented in rugged terrain to modify standard transects or those already restructured to avoid human-built boundaries (Figs. 5-6 to 5-8).

The transect is partially or entirely intersected by rugged terrain or unstable substrate
This can usually be determined before attempting the transect, although deeply incised washes or large stretches of instable substrate may not be obvious until the crew has started the transect.

- Is it interrupted by a very short but severe obstacle? Some transects cross a ravine or other relatively short, steep area. When small obstacles occur on a transect, crews can use a short scramble (~20-30m) to get up or over something, look really hard before scrambling, turn around and look really hard again. The lead scrambles up with the line, the follow stays at the bottom. After the line has been examined by both the lead and the follow, the follow scrambles up to meet the lead and the line is resumed as normal. The transect follows the regular assigned path.

- Is it interrupted by a relatively short (less than 500m wide) but severe obstacle like a cliff? In that case, enter a waypoint to interrupt the transect, find a safe route around the obstacle, and resume the transect at the point where it can once again be navigated (Fig. 5-9). The same terrain is sampled as for the standard transect, with the exception of the relatively short stretch that crosses the obstacle. This is nonetheless a non-standard transect.

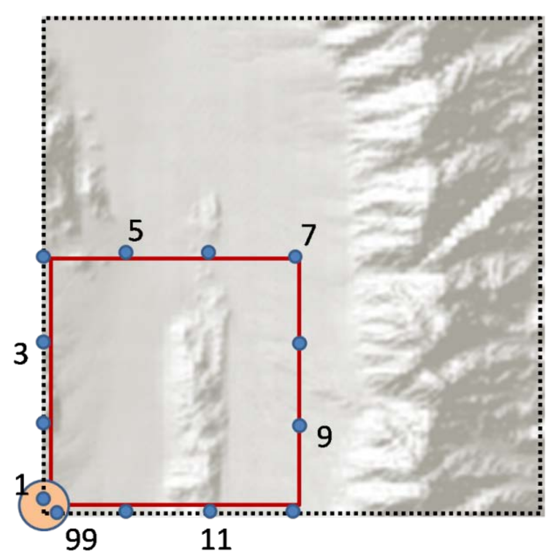
Figure 5-9. Interrupting a transect to move around a barrier less than 500m wide. This diagram uses transect and waypoint numbers to match the example at the end of this section on how to record information for interrupted transects.



The planned transect (dotted square) crosses an impassable obstacle such as a cliff (yellow line). The walked transect (red line) is ended with a waypoint at the obstacle, but Waypoint 99 is NOT used. A new transect (green line) is started after navigating around the obstacle. Note that Transect 42.1 initiates with Waypoint 9, continuing the series of waypoints from Transect 42. Waypoint 99 is only used in the last segment (in this case, the end of Transect 42.1).

- Is it covered by more than a few hundred meters of un-navigable terrain? A standard shape, completed more slowly, is preferable to a more freeform one where human judgment is required to guide deflection around terrain. These transects will be in the standard square shape or reflected around human-created obstacles (Fig. 5-5), and may be interrupted (Fig. 5-9).
    - In the Northeastern Mojave, consider it first as a 6km transect, built from the standard transect's southwest corner (Fig. 5-10). If the 6km transect can be completed, then do so.

Figure 5-10. Shortening a transect when planned 12km version is too rugged. This is the 6km, Northeastern Mojave version.



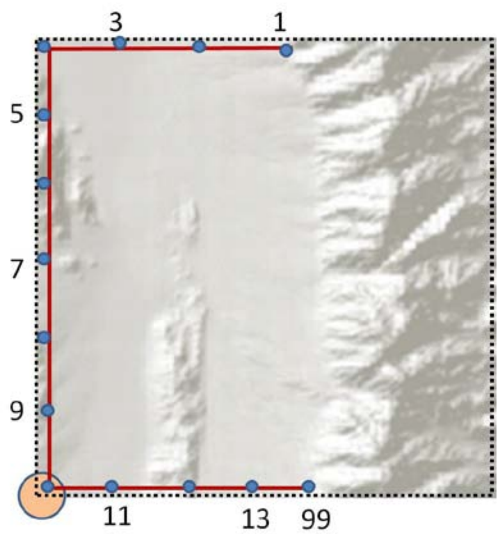
The planned transect (dotted square) traverses impassable terrain or is through passable terrain but at such a slow pace that it cannot be completed before 4pm. Consider a 6k version of the transect instead, building the sides off of the original southwest corner (red line).

The new transect may now be in flat topography, or still in somewhat rugged, but passable terrain.

- Elsewhere in the range (California and the Piute and Eldorado valleys in Nevada), shorten the transect along the original 12km path, interrupting as needed to avoid larger areas of non-traversable terrain (Fig. 5-11).

- If even a shortened transect is not possible, do not attempt the transect.

Figure 5-11. Shortening a transect when the planned 12km version is too rugged. This is the California and Piute-Eldorado valleys version.



The planned transect (dotted square) traverses impassable terrain or is through passable terrain but at such a slow pace that it cannot be completed before 4pm. Consider a shortened version of the transect instead, following the original path and using interruptions to avoid impassable terrain (red line).

This approach should be used when it is anticipated that at least 6km of the original 12km path will be sampled. Crews may also need to further shorten the transect in order to return to their vehicles by 4pm.

The transect must be accessed by hiking in for several kilometers
On-foot access increases either the time-to-transect in the morning, or the time-to-vehicle in the afternoon. Consider whether the transect can be completed as a 12km transect or shortened as appropriate, with or without interruptions. If an individual crew cannot access and complete the transect, then return to the vehicle by 4pm, do not attempt the transect. The exceptions to this guideline are when the field team uses base-camping to provision remote access of several transects at a stretch.

<u>Use appropriate documentation for non-standard transects.</u>

- At each point where a turn is made for a reflection, a waypoint should be recorded. At the points where a transect is interrupted and then restarted, waypoints should be recorded. Waypoints should be no more than 500m apart, but can be closer together in non-standard transects. Each waypoint subform includes a section for comments, and it is appropriate to note the start of a reflection or transect shape change in this field. The numbers of waypoints are tracked on your sketch of each transect; the sketch and associated waypoint numbering for non-standard transects is particularly important.

- When all waypoints on a transect are completed, the Juno will return you to the transect description section of the transect form. You will be asked whether the transect was walked as a standard transect, 12km long with 3km sides. All other shapes and lengths are not standard. Interrupted transects are not standard.

- For non-standard transects, you will identify the types of obstacles (terrain, substrate, “other”) that led you to modify the transect. Use the “other” field to record when a transect was modified to avoid an administrative boundary (e.g. stratum edge) or an uncrossable highway. If a transect has been pre-reflected, crews should clarify the reasoning for this before going into the field.

Additional documentation on paper data forms

The electronic and paper data forms are carefully matched to have the same fields and collect the same information. The exception is that paper data forms are also designed to collect information about how each transect was completed. Information on access routes, including GPS locations for important intersections, can be written long-hand on the paper data forms. These forms also have an area to sketch the transect as you completed it. Please indicate all waypoints, numbering 0, 1, 99, and 100. Also indicate roughly where any obstacles, tortoises or carcasses were encountered along the transect. These sketches can be used in the future to indicate access points, and in this season to clarify potentially misleading information such as inaccurate GPS grabs.

Using two or more transect forms to collect data on one interrupted transect

If a transect is interrupted as (Fig. 5-9), it is important to document the fact that data were not collected between those two waypoints. Normally, we assume that waypoints plot the continuous path walked on a transect. In order to indicate a transect interruption in the database, at each waypoint form you will be prompted to indicate whether you will continue using the search technique after this point or whether this is an interruption. If it is an interruption, you must also end the transect form at this waypoint. Once the obstacle is navigated, begin a new transect form, with the new transect number equal to the original number plus “0.1”. If the original transect was 42, for instance, the transect number for the section after the obstacle would be 42.1. If a subsequent interruption is required, a new transect would be created and designated as 42.2.

Treating the walkable parts as separate transects is an important bookkeeping device for data processing. A few things will be different though. Instead of beginning with Waypoint 1, added transect parts will number waypoints as a continuation of the sequence from the previous transect. For example, if the last waypoint recorded on transect 42 was 8, the start waypoint for transect 42.1 will be 9. In the case of using multiple transect forms to document a single interrupted transect, only the final transect form will end with Waypoints 99 and 100. In this example, if you have transects 42, 42.1, and 42.2, only the completed transect 42.2 will have a Waypoint 99 or 100. Waypoint 0 (drop off) will only be recorded for transect 42.

Record all transect or opportunistic observations of tortoises or carcasses under the transect part where they were found. As with waypoints, observations are numbered continuously through all parts of the transect; do not start counting again from “1” when you start a new transect part.

In summary, although the waypoint and observation numbers continue in sequence through all parts of the interrupted transect, all transect parts will have their own transect number, and their own transect form on the RDA. However, a single set of paper data sheets is used to document all parts of the transect. At the appropriate waypoints, write in the new transect number used in the electronic form, and on the transect drawing, indicate where the interruptions occurred and new transect numbers were instituted.

EXAMPLE – electronic form

Transect 42

Waypoints 0, 1, 2, 3, 4, 5, 6, 7, and 8
0 transect live observations
2 transect carcass observations, numbered 1 and 2
1 opportunistic live observation, numbered 1
1 opportunistic carcass observations, numbered 1
Waypoint 1 time 7:00am
All other regularly recorded transect information.

Transect 42.1

Waypoints 9, 10, 11, 12, and 13.
1 transect live observation, numbered 1
1 transect carcass observation, numbered 3 to follow those in transect 42
0 opportunistic live observations
0 opportunistic carcass observations
All other regularly recorded transect information.

Transect 42.2

Waypoints 14, 15, 99, and 100.
0 transect live observations
1 transect carcass observation, numbered 4 to follow the one in transect 42.1
0 opportunistic live observations
1 opportunistic carcass observation, numbered 2
Waypoint 99 time 3:22pm
All other regularly recorded transect information.

EXAMPLE – paper form

Transect 42

Waypoints 0 to 15, 99, and 100.
In the comment for Waypoints 8 and 13, indicate an interruption initiated.
In the comment for Waypoints 9 and 14, indicate Tran_num 41.1 or 42.2, respectively.
1 transect live observation
4 transect carcass observations, numbered consecutively.
1 opportunistic live observation
2 opportunistic carcass observations, numbered consecutively.
Transect Start time 7:00am
Transect End Time 3:22pm
A single transect sketch indicating all the above waypoints and observations, plus "42.1" and "42.2" written next to the waypoints where each new electronic form was started
All other regularly recorded transect information.