Appendix B. Coordinated Monitoring Strategy for Blanding's Turtle in the Northeastern United States:
Project Background, Implementation Protocols, and Site Selection Process

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Summary. This document provides an overview of the Northeast Blanding's Turtle coordinated monitoring strategy (CMS) for state coordinators and researchers in each of the five states (ME, NH, MA, NY, PA) participating in the Northeast Blanding's Turtle regional conservation planning process through the Competitive State Wildlife Grants program. The CMS was initially adopted by the Northeast Blanding's Turtle Working Group in 2012, the first of an extensive two-year effort lasting from 2012 to 2013. Results from the two-year sampling effort serve as a baseline for future efforts in order to evaluate the species' regional status and the effectiveness of conservation actions at both the site specific and regional level. This document is an updated and expanded version of the initial protocol developed in 2012.

The CMS outlines standardized monitoring protocols, site selection criteria, and a centralized, web-based data repository at the University of Massachusetts and supervised by the Eastern Blanding's Turtle Technical Committee (EBTTC). The monitoring protocol includes a two-tiered (long-term and rapid) assessment protocol. In the initial 2012-2013 phase, long-term assessments (LT) were conducted at 13 reference sites, and rapid assessments (RA) were undertaken at over 100 sites across the region. These populations should be reassessed using this same framework in the future, either on a rolling (annual) or five-year rotation. This document outlines the site selection process for both tiers and recommended field survey protocols and other implementation details. Additional information and access to the data entry portal are located at www.blandingsturtle.org. Results from 2012 and 2013 are summarized as a chapter within the *Conservation Plan for Blanding's Turtle and Associated Wetland Dependent SGCN*. If you are interested in becoming involved in future sampling efforts, please contact your state coordinator (Appendix B1), or visit www.blandingsturtle.org.

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OVERVIEW

Background and rationale.

Our purpose in designing this strategy was to develop a robust, flexible, and feasible monitoring framework to quantify the status and trends of Blanding's turtles (*Emydoidea blandingii*) (EMBL) in the Northeastern U.S. at multiple spatial and temporal scales. This effort was funded by a U.S. Fish and Wildlife Service Competitive State Wildlife Grant awarded to the state of New Hampshire in which the five states are cooperating to develop a regional conservation plan for the species. Our specific objectives for the monitoring strategy are to:

a.) quantify the current abundance of EMBL at the regional scale;
b.) quantify long-term trends in EMBL abundance at the regional scale;
c.) quantify current EMBL density at selected key sites;
d.) quantify long-term trends in EMBL density at key sites;
e.) gather additional information at poorly-known EMBL sites throughout the region.

This document is intended to serve as a brief overview of the strategy and to offer guidance for implementation beyond 2014. Toward this end, modifications have been made from the initial protocol developed in 2012. Additional background information, a power analysis and detailed justification for the sampling design, greater implementation detail, and analysis of results from 2012 and 2013 are available in NEBTWG (2014). In developing this monitoring strategy, we drew from previous monitoring protocols designed for Blanding's turtle (e.g., Grgurovic 2007; Chaloux 2010) and other turtle species (e.g., USFWS 2006; USGS 2006; Erb and Willey 2011; USFWS 2011; USFWS 2012), as well as general monitoring guidance documents (e.g., Oakley et al. 2003; Graeter et al. 2008).

Study Design.

The regional Blanding's Turtle monitoring strategy has two tiers: 1.) a network of at least 13 long-term (LT) monitoring sites that are intensively sampled to provide site-specific density estimates using spatially explicit capture-recapture methods (Borchers and Efford 2008); and 2.) a network of at least 100 rapid assessment (RA) sites which are analyzed in the 'abundance' framework using N-mixture models (as described in Royle 2004) (Table B1). Rapid assessment sites are sampled using one of two approaches: a

Table B1. Summary of sampling approach and statistical frameworks, with target sites for the reassessment effort.

	Long-term monitoring (LT)	*Rapid assessment (VRA and TRA)*
Model framework	Spatially-explicit capture-recapture (SECR) (Borchers and Efford 2008)	Abundance *N*-mixture models (Royle 2004)
Purpose	Contextualize abundance analyses, evaluate variation in detectability, and track change at key sites	Detect regional trends and allow landscape analyses at regional scale
Target number of sites per state for reassessment	1-4 sites /state	≥ 5-10 VRA; ≥10 TRA including LT sites; 10 Random TRA-lites
Target time requirement in field for reassessment	21 field days per site	Visual RA: 0.5 days per visit; 1.5 days per site (15 days for 10 sites) Trap RA: 3 days per site (30 days total (incl. 3 days at LT site)

series of three standardized visual surveys (VRA) at each site during the spring season or a single, four-night trapping event (TRA) at each site during any season. Random TRA-"lites" (TRA with a single reference plot) are also recommended to evaluate background EMBL density at non-priority sites. Sites are distributed throughout the Northeast Region within the range of Blanding's turtle, with at least one LT site per state and 10 RA sites per state.

Long-term (LT) monitoring summary.

Long-term sites are trapped for a period of 12 nights in each of three seasons: **Spring**: April 15 – May 27; **Nesting:** May 28 – July 8; and **Post-nesting:** July 9 to end of active season.[3] An optional 4th sampling event could occur in the fall, after September 1, in addition to, or instead of one of the three earlier seasons. During each sampling event, twenty traps are deployed throughout the site as described in the field implementation section below, for a total of 240 trap-nights per sampling event.[4] Traps are checked every 48 hours. Results from the LT trapping are analyzed in a spatially explicit capture-recapture framework (e.g., Borchers and Efford 2008) to estimate population density within the trapped area. Standardized, high intensity trapping at a few sites in this manner allows us to evaluate change in site-specific Blanding's turtle density over time as well as relative age structure and sex ratios at these targeted sites. The trap results allow us to assess variation in seasonal and annual trap success to inform the interpretation of results at the rapid assessment sites.

Rapid assessment (RA) summary.

RA sites are sampled using one of two sampling approaches: visual rapid assessment (VRA) and/or trap-based rapid assessment (TRA). TRA-lites are also conducted at random sites across the region.

[3] Seasons were delineated using movement distances of EMBL tracked in Massachusetts (Grgurovic 2006) and in Maine (Beaudry et al. 2009).

[4] The necessary number of trap nights required per event was initially calculated based on average trap rates over 47,547 trap nights in studies conducted throughout the Northeast by Johnson and Crockett (2009), Windmiller (2005 and 2006), Grgurovic (2005-2010) , Hartwig et al. (2007), and Yorks (2011). Results from 2012 and 2013 suggest that the number of trap nights / site was sufficient to reach our sampling goals.

Visual rapid assessments (VRAs) consist of a series of three visits to each site during the spring season (from April 1 – May 27; note that visual surveys can occur two weeks earlier than trap events), though surveys should cease once vegetation becomes too thick to observe basking turtles (this may vary annually and regionally). Each visit consists of eight, 10-minute surveys distributed throughout the site as described in the field implementation section below.

Trap-based rapid assessments (TRAs) consist of four consecutive nights of trapping at a site in any season (April 15 – October 1). TRA events utilize 20 traps / site deployed using the same design as the long-term sampling events, and traps are checked every 48 hours.

Random trap-based rapid assessment-lites (Random TRA-lites) also consist of four consecutive nights of trapping at a site in any season (April 15 – October 1). TRA-lite events utilize the same design as the long-term sampling events and TRA events, except that a single reference plot (rather than 4 reference plots) is placed with 5 traps. Traps will also be checked every 48 hours.

Long-term sites will be included in the rapid assessment analysis. Visual surveys should be conducted at each LT site in the spring. LT sites do not need an additional four nights of trapping beyond the LT design; rather the 12 night LT events can be sub-sampled to make results comparable to the TRA design.

VRA, TRA, and random TRA-lites are analyzed in an occupancy/abundance modeling framework where count data are used to assess regional rates of detection and abundance. This will allow us to evaluate changes over time at the regional scale.

BRIEF SUMMARY OF 2012/2013 FIELD EFFORT

During the 2012 and 2013 field seasons, field teams across the region sampled a total of 148 sites: of 13 long-term sites, 21 VRA sites, 71 TRA sites, 21 sites with both VRAs and TRAs, and 22 random sites (Fig. B1). This effort yielded 10,171 trap checks, during which Blanding's turtles were caught 1178 times, painted turtles 9162 times, snapping turtles 1585 times, and spotted turtles 110 times. Average trap success was 0.058 Blanding's / TN (or 17.25 TN/EMBL) (Table B2).

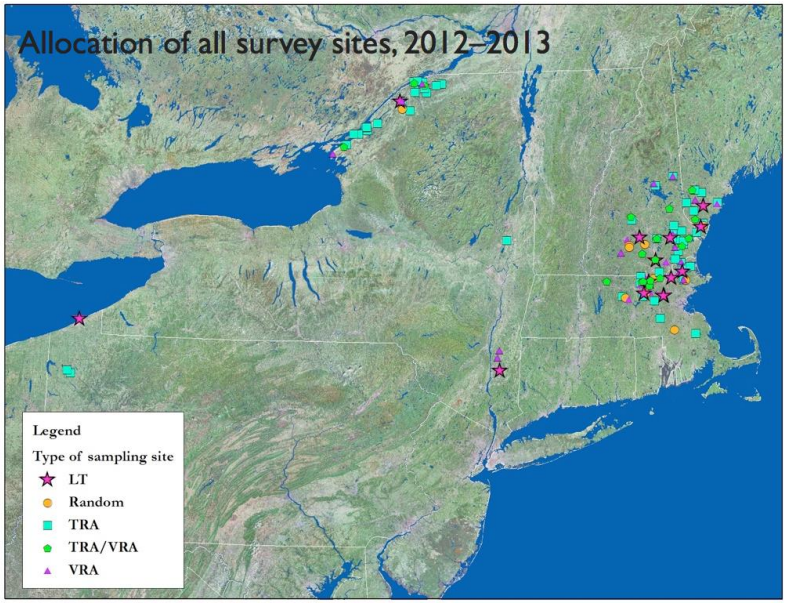

Figure B1. Distribution of sampling sites in 2012 & 2013.

Both probability of catching a Blanding's turtle (Figure B2B. $P<0.001$) and the relative number of Blanding's turtles caught (Figure B2C. $F_{1,333}=10.44$, $P=0.001$, $R^2=0.03$) declined significantly throughout the season, suggesting that trapping earlier in the season is likely to yield higher trap returns. Although significant, the slope

of the relationship was low and date accounted for only 3% of the variation in trap success. Trapping was still effective later in the season, and there was no evidence of a threshold after which trap results were minimal. Very few traps were set early and late in the season, however, so there may be a threshold effect prior to our trap effort commencing on April 15th, and after the majority of trapping concluded on September 1st. There were no significant effects of season (pre-nesting, nesting and post-nesting) on trap success at long-term sites ($F_{2,1701}$= 0.1178, P=0.89). The effect of date on trap success likely varies by year. For instance, in 2012 trap success was significantly lower in September than in 2013.

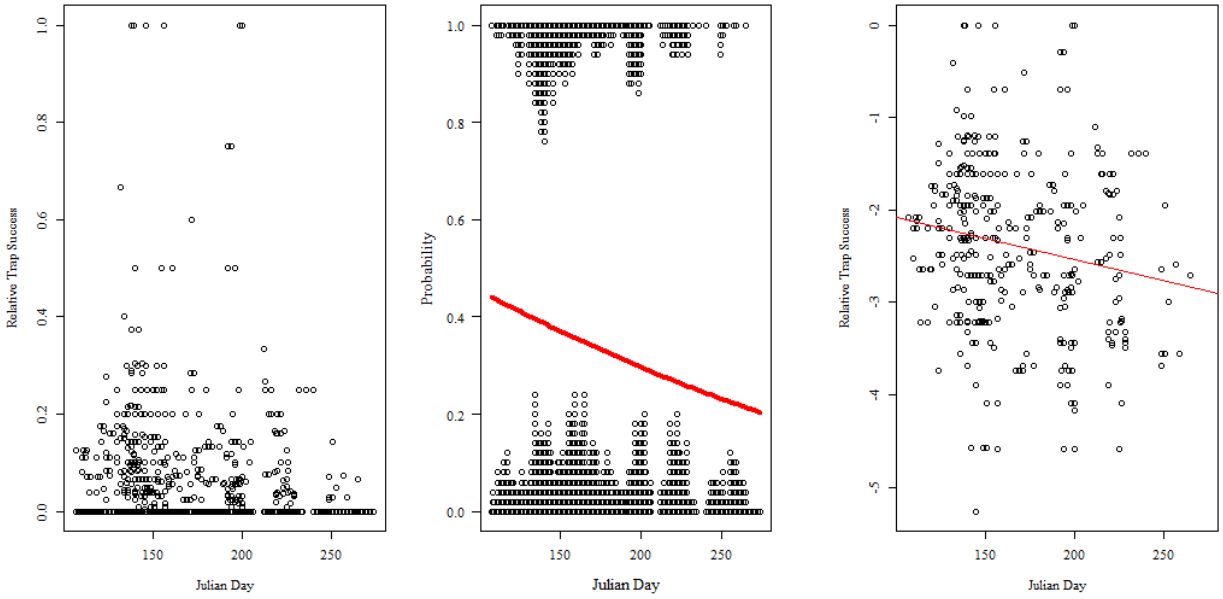

Figure B2. A.) Relative trap success at long-term reference plots throughout the season. B.) Binary trap success throughout the season at long-term reference plots, as a function of Julian day. C.) Relative number of Blanding's turtles caught, by long-term reference plot, on days in which turtles were caught, as a function of Julian Day. Both probability of catching a turtle (plot B) and number of turtles caught (plot C) decreased significantly throughout the season.

Table B2. Distribution and Results of Sampling in 2012 and 2013 across the Northeast Region.

	Maine	Massachusetts	New Hampshire	New York	Pennsylvania	Regional Total
Total sites trapped	17	31	42	30	3	123
Total traps deployed	370	858	907	597	149	2881
Number of 48 hour checks	1251	3287	2780	1931	922	10171
Standardized Blanding's turtles in traps	78	634	290	172	4	1178

Standardized painted turtles in traps	1129	3777	2943	972	341	9162
Standardized spotted turtles in traps	21	58	24	7	0	110
Standardized snapping turtles in traps	211	477	507	116	274	1585
Average Blanding's / trap night	0.031	0.096	0.052	0.045	0.002	0.058
Total sites visually surveyed	6	19	19	10	1	55
Total vantages	152	523	440	218	12	1345
Blanding's turtles observed during visual surveys	29	177	134	38	0	378
Spotted turtles observed during visual surveys	42	23	21	3	0	89
Painted turtles observed during visual surveys	223	3998	3405	437	4	8067
Average Blanding's / Vantage	0.191	0.338	0.305	0.174	0.000	0.281

Our results suggest that Blanding's Turtles are widely distributed throughout their known range in the northeast, with dense populations distributed patchily on the landscape.

TARGET SITE DISTRIBUTION FOR CONTINUED SAMPLING AND 5-YEAR REASSESSMENT

Regionally High Priority Sites

It is recommended that all high priority Blanding's turtle sites of regional significance be trapped in accordance with the LT protocol in order to develop a baseline, site-specific population estimate and evaluate age structure. These results can be used to help inform management decisions and to evaluate success of conservation actions underway at that site. For those high priority sites that were not trapped as an LT site in 2012 or 2013, we recommend they are trapped as soon as there are resources available to do so. In addition, those sites trapped in the LT framework with limited number of recaptures (so that a population estimate was not possible), we recommend an additional 12-night LT run as soon as possible in order to refine population estimates. All LT sites should be trapped again at during the regional 5-year reassessment. Because resources may not be available on 5-year rotations, states are encouraged to under LT sampling of high priority sites as resources allow, which may mean sampling a single site each year, instead of evaluating all high priority sites every 5 years.

Target distribution of sites at the regional and state scales for the 5-year reassessment

For a five-year reassessment, sites will once again be distributed throughout the Northeast region, within the range of Blanding's turtle (Fig. B3). As a target minimum, each state should revisit LT sites and designate **7-8 VRA sites**, **10 TRA sites**, and **5 random sites** (Table B3). Additional LT and RA sites are encouraged in each state, depending on resource availability. The site selection process is described briefly below and the 2013 site selection process is detailed in Appendix B3.

Table B3. Totals sites sampled across the region in 2012 and 2013, with sampling targets for reassessments in each state and the region.

Sampling method	Regional totals 2012/2013	State targets for reassessment	Sampling details	Regional targets reassessment
VRAs	21	5-8	(4 new high priority, 1-2 repeats, 2LTs)	40
TRAs	71	10		50
LT	13	1-4	High priority sites	20
Random TRA-lites	22	10	1 reference plot only. From random points layer	50

Site Selection

Site Selection Process.

LT, VRA, and TRA sites were selected in each state by the State Coordinator with help from the UMass team and/or Principal Field Investigators where appropriate. Known Blanding's turtle observations were delineated as 'sites' and ranked at the regional scale by the UMass team using a series of metrics to identify potential priority conservation sites in each state. The methodology for ranking sites is described in the site delineation and ranking section of the Northeast Blanding's Turtle Conservation Plan (NEBTWG 2014). Site boundaries were provided to State Coordinators in a shapefile (embl_sites.shp). Site boundaries and ranks were meant to serve only as guides for the 2012/2013 site selection process. The best Blanding's turtle habitat in the vicinity of the "site" should be the focus of the monitoring; sampling can occur well outside of the site boundaries delineated in the shapefile. Results from 2012 and 2013 were used to more accurately delineate and rank sites for conservation in the regional Conservation Plan (NEBTWG 2014). Sites were selected by State Coordinators following the considerations outlined here:

Step 1. Select at least one Long-Term (LT) Site. State coordinators selected at least **one LT site / state**. This site should be a high priority site, likely to be a regional priority, up to 5 LT sites should be designated in states with more Blanding's turtle sites.

Step 2. Select Trap Rapid Assessment (TRA) Sites. Select 6-10 sites for the 5 year reassessment. The selected sites should represent "high priority" sites, using the site rankings or empirical model shapefiles as guides. New TRA sites should be geographically distributed broadly across the range of Blanding's turtle in the state.

Step 3. Select new Visual Rapid Assessment (VRA) Sites. Select ~ 5 VRA sites, which should also represent high priority sites throughout the state.

Step 4. Select random TRA-lite sites. Select ~5 random sites from the random sites shapefile, to sample throughout the state as "TRA-lites" (TRAs with one 1 single reference plot). See Appendix B2 for guidelines on how to choose, reject, and record random sites.

See Appendix B3 for more detailed site selection considerations. Final site selections should be registered via the web-based data entry portal on www. blandingsturtle.org.

Allocating Resources

Allocation of field personnel and equipment.

The target time required to accomplish the minimum number of assessment sites in a state is 85 field days, assuming a single person is working independently, visiting only one trap site/day or 2 VRA sites/day. Realistically, teams of people could be used to install and breakdown traps and/or check traps. Recognizing that states have varied resources and amounts of Blanding's turtle habitat, the number of sites that each state is able to visit will vary from the target number suggested about.

VRA surveys are conducted only in the spring season, whereas TRA sampling events can occur any time from April 15 – October. However, because field personnel are likely to be conducting VRA surveys in the spring, TRA events are more likely to occur during nesting, post-nesting, and fall seasons.

In order prevent results of the VRA at a site from being confounded with observer effects, multiple observers should visit VRA sites if possible, and observers should visit multiple sites. One way this could be accomplished is to have observers work in pairs, each conducting four of the eight surveys at a site on a given day, then switching observation points on the next visit to the site. Alternatively if there are multiple observers working in a state, they could alternate who goes to which sites.

The trapping protocol requires that 20 traps are deployed at each site at a time, therefore traps should be purchased in multiples of 20 (plus extra traps in the event of damage). Because traps are checked every 48 hours, it is possible for a field team to operate traps at two sites at a time, which would require having 40 traps on hand.

IDENTIFYING REFERENCE POINTS WITHIN LT AND RA SITES

Reference points selection within sites.

Within each LT, VRA and TRA site, four references points will be selected for the purposes of sampling using the following protocol. For random sites, the reference plot has already been drawn.

1. Within a site, use aerial photographs or field reconnaissance to identify a **focus area** with diverse wetlands suitable for EMBL. As an approximate guide, the focus area should be ≥2km^2 and ≤6km^2 (smaller sites can be accommodated using the modifications suggested below). Wetlands suitable for EMBL should be diverse and broadly distributed throughout the focus area. The focus area does not need to be entirely within the area delineated in the shapefile; rather, it should include the most suitable Blanding's habitat nearby (see Fig. B4).

Figure B3. Sample distribution of **reference points** within a **focal area**. The stars represent reference points, which are placed 800 to 1600 m apart. Circular plots with a radius of 400 m are centered on each reference point.

2. Within the focus areas, identify four **reference points** separated by 800 to 1600 m[5] (depicted as stars in Fig. B4). Reference points should be centered on areas of high suitability Blanding's habitat (high potential use wetlands, HPUs, as described in the field implementation section). They may fall in a wetland area, or in an upland area centered on a constellation of wetlands. Around reference points, delimit **circular plots** with 400 m radius (shown as dashed circles on Fig. B5). Sampling will be conducted within the circular plots.

[5] Distance requirements between reference points are based on average movement distances of turtles radiotracked in two studies in Massachusetts (Grgurovic 2007; Windmiller 2005 and 2006).

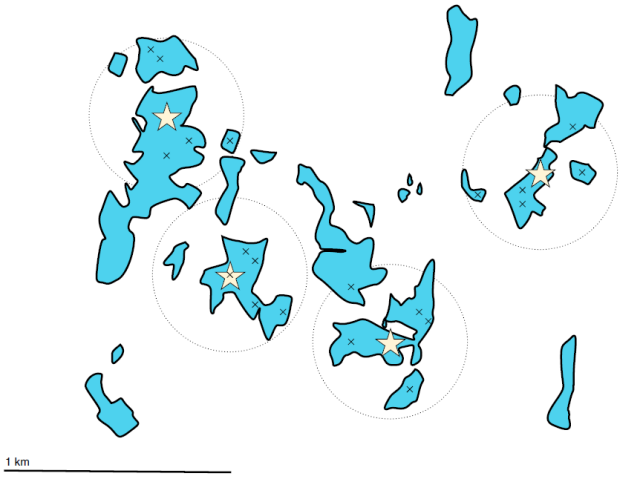

Figure B4. Recommended configuration of traps in relation to reference points, with "x" marking trap locations. The circular plots have a radius of 400 m

Modifications to Design and Field Protocols

Small sites.
If focus areas within a site are too small to place all four reference points, place only three reference points, but continue to use 5 traps/reference plot (for a total of 15 traps). Sites chosen for monitoring should typically be at least large enough to accommodate three reference points 800 m apart; if a site is not large enough to accommodate 3, 1 or 2 plots may be placed, with 5 traps / plot.

24 hr trap checks.
If required to check the traps every 24 hr, consider leaving the animals in the trap until the 48 hr period. In all cases, clearly note the actual frequency of checks when submitting results, which animals were observed on which day(s), which animals were left in traps, which animals were there the next day, and which escaped.

Capturing animals during VRA.
The 10-minute observation period is not intended to focus on hand captures. If possible, the 10 minute period should take place before moving to capture observed turtles. Animals hand-captured during and after VRA events, as well as during trap checks and while walking between sites, should be processed using the individual turtle form (discussed below).

Addition of nesting/upland surveys.
Nesting and upland surveys may be included in some SECR analyses if they are broadly conducted within the circular plots outlined in the previous section and the level of effort within each plot is recorded.

Field Implementation Protocol

Overview.
Field protocols for sampling sites follow one of four methodologies as outlined above: 1) Long-term (LT); 2) Visual Rapid (VRA) and 3) Trap Rapid (TRA) assessments, 4) Random TRA-lite. At each **priority** site, regardless of what type of monitoring occurs there, four reference points should be delineated as described above. The 400m radius buffer around each reference point serves as the circular sampling ***plots*** for the methods described below. For **random** sites, a TRA-lite assessment is conducted, in which only a single 400m circular reference plot is sampled. Random plots are drawn in the random plot shapefile, and should generally not be moved (but see the **Guidance for sampling random points** section, in Appendix B2).

Long-term (LT) assessment implementation.

Each long-term site will be sampled for three, 12-night, trap events: once in the spring (April 15 – May 27), once during nesting (May 28 – July 8), and once post-nesting (July 9 and on). An optional fourth sampling event can be conducted in the fall. For maximum efficiency, traps can be deployed for 12 consecutive nights. If this is not possible, traps can be pulled for intervals (e.g., weekends) within the sampling period, so long as 12 nights are trapped in total. During each sampling event, 20 traps will be deployed for the 12 nights, for a total of 240 trap nights / site / sampling event. Traps are deployed in the configuration shown in Fig. B5.

Within each of the four circular sampling plots, place five traps 0 to 400 m from the reference point at the plot center (= 20 traps total) in high potential use (HPU) wetlands, as determined by the researcher in accordance with criteria outlined below. Traps can be placed in one large wetland, or in a constellation of up to five smaller wetlands (constrained only by # of traps).

Ideally, traps should be placed at 80 m intervals, in different directions, from the reference point (e.g., 80 m to NW; 160 m to NE, etc.), but this is only the ideal. Emphasis should be placed on habitat suitability rather than strict adherence to the distance rules, but traps should be at least 20 m apart. If possible, field researchers should determine potential HPUs remotely prior to setting out into the field, recognizing that field conditions may alter the selection of wetlands once in the field.

Suitable wetland habitat should be selected according to the following criteria:

High potential use (HPU):

1. Deep (≥0.4 m) scrub-shrub and emergent wetlands;
2. Deep (≥0.4 m) vegetated vernal pools with abundant amphibian egg masses;
3. Vernal pools in close proximity to nesting habitat;
4. Deep (≥0.4 m) emergent and shrub vegetated sections within river and stream floodplains;
5. Deep (≥0.4 m) and vegetated sections of beaver impounded wetlands;
6. Wetlands with EMBL observed.

Low potential use (LPU) (these areas should be avoided when setting traps):

1. Deep open water habitats (i.e., ponds, lakes, reservoirs, etc.)
2. Dense canopy forested wetlands.
3. Shallow bogs

Trap placement criteria.

Visual reconnaissance prior to trapping is helpful and proper trap placement is essential to prevent turtle mortality and maximize trap night efficiency. Traps should be located within the HPUs as follows:

- In deep (≥0.3 m, ≤trap diameter) channels between vegetation, sedges, shrubs, logs, debris
- At the edge of thick vegetation
- Surrounded by good cover and relatively deep water
- Proximal to basking sites
- At sites with good solar exposure

Traps should be placed on tall (>1.2 m) stakes, posts, or rebar, and **firmly** affixed to prevent snapping turtles, beavers, and other non-target wildlife from moving them. The trap should be secured such that it cannot collapse during the 24 or 48 hour period. The trap must be firmly staked at 3 points to prevent

collapse. The traps must be set so that turtles have adequate headspace to breathe. GPS coordinates should be recorded at each trap once they are placed, and traps should be flagged or marked in accordance with each researcher's preference. On the day of trap deployment, complete the *trap set-up field form* including habitat suitability information. Traps should be baited with sardines in soybean oil (e.g., Beach Cliff), checked, and re-baited every 48 hours and left in place for 12 days in the same **season**. If heavy rain is expected during the trap event, traps should be checked more frequently to ensure that there is ample headspace in the event of rising water levels. On each trap-check day, the *trap-check field form* should be completed. This comprises a single **trap event.** Three trap events are obtained in different seasons. Turtles observed will be processed as described below.

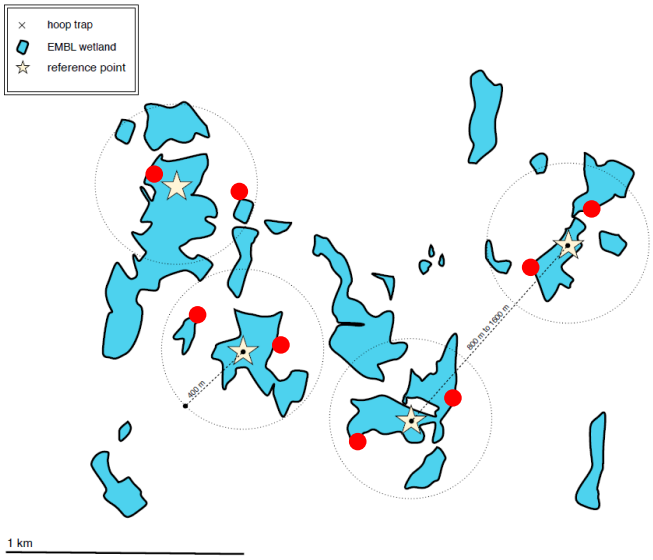

Figure B5. Sample distribution of visual vantage points, each pair located within 400 m of a reference point. Visual vantage points are shown as red dots.

Visual Survey Assessment (VRA) Protocols.

VRA surveys consist of three separate visits to each VRA site within a two week period in the spring season (April 1 – May 27). Each visit requires a total of 80 minutes of active visual survey time throughout the site allocated in the following way. Within each 400 m radius circular plot, select two **vantage points** (total of 8 per site)(Fig. B6). Vantage points should be located where an expanse of high suitability EMBL habitat is visible from shore, and should be focused on a particular wetland resource of less than 1 ha (e.g., a vernal pool, or cove of a larger wetland) . Prior aerial reconnaissance or field visits should be used to select potential vantage points where Blanding's turtle are likely to be observed basking (e.g., a wetland area with ample downed logs, hummocks, or other basking sites), but vantage points may be modified in the field. Record selected vantage points with a GPS in the field on the *VRA survey form.*

For each survey, stealthily approach the vantage point in the field, taking care to avoid disturbing basking turtles. Once the wetland is visible, begin the 10 minute timed survey. Using binoculars, scan basking sites, the water surface, and the shore for turtles and record all EMBL observed during the 10-minute period. If the wetland has been thoroughly scanned using binoculars and no turtles are visible basking, or turtles were scared into the water, the observer may use the remainder of the 10 minute period to approach the wetland and survey the upland surrounding the wetland, or wade into the wetland to look for submerged animals. At the end of the 10 minute period, the survey is over, and the observer should complete the field form, and move to the next vantage point. Once the two vantage points in the plot have been completed, move to the next circular plot and assume a new vantage point there, and repeat. During subsequent visits to the site, visual vantage points can be moved to different areas within the circular plots, or can remain the same, but all points should be recorded on the field form, along with habitat, vantage, and environmental characteristics. Ideally, visual surveys will be conducted by 30% overlap in observers to quantify observer effects.

Seasonal and weather requirements for visual surveys.
The start day of visual surveys is dependent on spring conditions; no visual surveys should be conducted prior to expected emergence (April 1 in most years, though this will vary with the year). Ideally, visual surveys should end once vegetation becomes too thick to readily observe basking turtles. This will likely vary annually and regionally and may occur prior to the end of the spring sampling period (May 27). Visual surveys should not be conducted on days cooler than 55^{0}F. Weather should ideally be sunny and >65^{0}F. Weather should be recorded on the field form.

Trap-based Rapid Assessment (TRA) implementation.
TRA sampling events can be conducted any time during the Blanding's turtle activity season (April 15th – October 1). TRA sampling events follow the same procedures as LT events, but traps are only left in place for 4 consecutive nights, rather than 12 (4 nights x 20 traps = 80 TN), and only 1 trap event is required rather than three. As with LT sites, complete the *trap set-up field form* upon trap placement, check traps every 48 hours, and report all trap-specific captures on the *trap-check field form.*

Random, TRA-lite implementation.
For points selected from the random sampling network, the TRA implementation is followed, except that only a single 400m reference plot with 5 traps is placed, rather than 4 reference plots. As with LT and TRA sites, complete the *trap set-up field form* upon trap placement, check traps every 48 hours, and report all trap-specific captures on the *trap-check field form.* Random plots generally should not be moved (but see the **Guidance for sampling random points** section, in Appendix B2).

Protocol for Processing Individual Turtles—Required Data.
When a turtle is captured (either during trapping or following visual surveys), the *turtle observation field form* should be completed, and the following protocols are recommended.

Morphometrics: Record shell dimensions in mm. At a minimum, record SCLmin (straight carapace length) and SPLmin (straight plastron length). Optionally, also record: PW @ H-P seam (plastron width at humeral/pectoral seam), and CW @ 8th marginal (carapace width at the 8th marginal). Use dial calipers 12"/300mm.

Weight. Record animal mass in g (Pesola scale ≥2500 g).

Age and Plastral Wear: Assess the animal's age if new growth is visible along the medial seams and the plastral scutes are only lightly worn. Otherwise, report the minimum number of annuli visible and whether the plastral scutes are "not worn" (≤10% wear), "partly worn" (<50%), "mostly worn" (50%-90%) or "worn" (>90%).

Individual marking. Turtles should be individually notched as directed by state coordinators. Secondary recognition is recommended using photographs, injuries, deformities, etc.

Photographs. Photograph carapace and plastron with animal ID visible in photo (or sorted/ tagged post-capture). If possible, photograph lateral head shot and limbs/tail, as well as obvious injuries or deformities.

Injuries and general health. Note missing or injured limbs, tail, eyes, etc., as well as the presence of skin or upper respiratory tract infection or lethargic condition.

Scute morphology and other deformities. Note any major scute or other deformities.

Required Equipment.

The following equipment is required to complete the protocol: field forms, writing implements, flagging for marking traps, binoculars (for visual surveys), dial calipers (> 12 in), Pesola scale ≥2500 g, file (for marking turtles), air and water thermometers, and 20 traps/site operated at a time with associated stakes, ties, and bait. Additional optional equipment may also be necessary including waders, polarized sun glasses, disinfecting equipment, blood sampling equipment, or a kayak/canoe. Because researchers currently have a range of available equipment, specifications are flexible. Any traps >0.5 m in diameter with < 5 cm mesh are acceptable. These variations will be incorporated as a covariate in the modeling process. To help standardize future equipment purchases, we recommend 0.8 m diameter, ≤3.8 cm (1.5") mesh traps, and offer the following additional suggestions:

Trap dimensions: ~0.8 m diameter; <3.8 cm (1.5") mesh; steel frame hoop trap (any 3 to 5-hoop trap ≥0.5 m diameter with mesh < 5.1 cm is appropriate if already in use).
Trap identification: Assign unique ID to each trap and label trap in the field.
Trap location/operation: Record trap ID, lat/long, and functional period (mm/dd-mm/dd), and complete appropriate field form upon trap placement.
Bait: Sardines in soybean oil (Beach Cliff or other brand).
Re-bait frequency: 48 hr (puncture can, do not open entirely).
Trap check frequency: 48 hr with more frequent checks as required by agencies/partners or flood conditions.
Retrofits: "Snapping turtle excluders" area optional.

General protocols to reduce likelihood of disease transfer.

A 10% bleach solution may be used to disinfect traps and clothing. Captured turtles should be held separately during processing, and equipment should be sterilized between turtles. Calipers should be swabbed with alcohol, files can be burned, and notches should be dabbed with Betadyne. Latex gloves for handling turtles are an additional precautionary suggestion.

Post-processing: data entry.

All survey details, habitat and traps details, turtle details, and photographs will be recorded on the appropriate field form as noted below, and entered electronically by the observer into a web-based form as soon as possible after returning from the field.

- **Form 1: Site designation** should be completed prior to the field season, recognizing that information may change due to realities in the field.
- **Form 2: Trap set-up field form** should be completed when traps are placed for an LT, TRA, or Random trap event.
- **Form 3: Trap-check field form** should be completed when checking traps at LT, TRA, and Random sites.
- **Form 4: VRA survey form** should be completed at each visit to VRA sites.
- **Form 5: Turtle observation field form** should be completed following all EMBL captures (including recaptures).

Entering these data electronically as soon as possible will allow the team at UMass to recalculate detection rates, critically evaluate our starting assumptions, analyze results in real time, and adapt the sampling plan if necessary. It will also allow the entire team to identify errors and missing data as soon as possible, and track our progress and know which sites have been sampled, and when.

Acknowledgments

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APPENDIX B 1.

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APPENDIX B2

RANDOM SAMPLING CONSIDERATIONS

Updated September 14, 2014

Rationale for adding a random component to our sampling strategy

Critics of the Desert Tortoise Planning process, including an audit by the General Accounting Office (GAO 2002) have suggested that without a random component, their sampling results are biased, and they are not able to identify actual trends in desert tortoise populations across the landscape. By including a random component in the Blanding's turtle sampling program we are able to:

- Extrapolate results across a wider zone of inference throughout the northeast.
- Develop a rough population estimate of Blanding's turtles in the northeast by using the random sampling results in conjunction with detection estimates from more heavily trapped sites.
- Develop a model of trap success across the landscape since the randomly chosen sites will include unbiased representatives across all landscape gradients.
- Estimate the percent of the landscape that is occupied by Blanding's turtles, and evaluate how many populations may still be unknown.
- Focus entirely on conservation priorities for the other sample sites, rather than trying to gather sites representative of the landscape.

Methodology for choosing random sites

Because Blanding's turtles do not occur across the entire landscape, a complete random sample of the landscape is not practical (i.e., sites would be randomly placed in developed cities, on mountain tops, and in other, inappropriate locations). In addition, because they are so rare on the landscape, sampling efforts must be focused within suitable habitat in order to achieve a sufficient number of positive sampling results to be able to estimate abundance and detect trends. To more effectively sample the landscape for Blanding's turtles, we constrained our random samples using the following criteria.

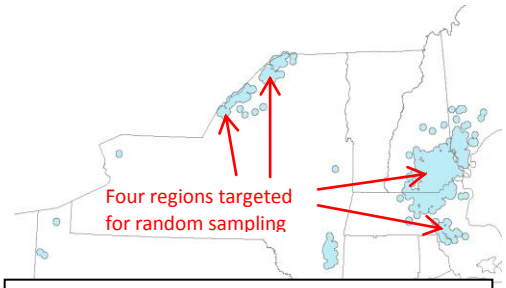

Fig. B2-1. The range of Blanding's turtle in the Northeast, defined as 5km from all known sites (or 6.3 km from all known records). The four largest contiguous areas are included in the random sampling plan.

We outlined the range of Blanding's turtles in the northeast region by buffering all site areas (i.e., records buffered by 1300m as outlined in the site delineation framework) by an additional 5km. Five km is four and five times the median straight line home range distance observed during telemetry studies in Maine (Beaudry 2007) and Massachusetts (Compton 2007), respectively, and twice as large as the distance of all known movement records by Blanding's turtles in the northeast, except for one outlier in Maine (Beaudry 2007). Using this method, the range of Blanding's turtles in the northeast is approximately 2.15 million ha.

To focus the random sampling effort, only the four largest contiguous areas known to be occupied by Blanding's turtle were included for sampling (one large area in New England, a smaller area in southeastern Massachusetts, and two areas in northern New York).

These four regions were tessellated into hexagons 800m in diameter. The hexagons are very similar in size and shape to the 400m radius sampling plots used throughout the northeast Blanding's turtle sampling design, and they allow all portions of the landscape to be accounted for without overlap. For each hexagon, the amount of habitat in each ecological system, as classified in the Terrestrial Habitat Map completed by the Eastern Conservation Science office of The Nature Conservancy's Eastern Region (TNC) (http://conserveonline.org/workspaces/ecs/documents/ne-terrestrial-habitat-mapping-project) was calculated, as well at the amount of high, medium, and low intensity development (as classified by 2006 NLCD). Whether or not a Blanding's turtle had ever been seen in the hexagon (i.e., whether an element occurrence [EO] fell within it) was also noted.

The ecological systems that occurred more frequently and in higher abundance within the hexagons with EOs than within hexagons without EOs were considered preferred wetlands habitats of Blanding's turtle. These are presented in Table B2-1.

Table B2-1. Preferred habitats of Blanding's turtles in the Northeast as defined by TNC's Terrestrial Habitat Map

Ecological system	frequency in hexagons without EOs	frequency in hexagons with EOs	frequency ratio	Average abundance in hexagons without Eos	Average abundance with hexagons with EO	average ratio
NACP Basin Peat Swamp: isolated	0.00	0.01	1.88	0.20	0.34	1.68
N. Appal-Acad Conif-Hwd Acidic Swamp: Larger river floodplain	0.00	0.00	1.31	0.06	0.06	1.14
Laur-Acad Alkaline Conif-Hwd Swamp: Lake/pond: any size	0.01	0.01	1.84	0.37	0.87	2.35
Laur-Acad Alkaline Conif-Hwd Swamp: Smaller river riparian	0.07	0.10	1.44	7.69	18.78	2.44
Laur-Acad Wet Meadow/Shrub Swamp: isolated	0.14	0.21	1.47	2.46	4.70	1.91
Laur-Acad Wet Meadow/Shrub Swamp: Lake/pond: any size	0.01	0.02	1.45	0.39	0.66	1.67
Laur-Acad Wet Meadow/Shrub Swamp: Smaller river riparian	0.24	0.33	1.40	7.32	13.20	1.80
Laur-Acad Wet Meadow/Shrub Swamp: Larger river floodplain	0.02	0.02	1.37	0.72	1.09	1.52
Laur-Acad Freshwater Marsh: isolated	0.14	0.19	1.36	2.36	3.60	1.52
Laur-Acad Freshwater Marsh: Lake/pond: any size	0.02	0.03	1.63	0.50	1.54	3.06
Laur-Acad Freshwater Marsh: Smaller river riparian	0.25	0.36	1.44	6.92	14.80	2.14
Laur-Acad Freshwater Marsh: Larger river floodplain	0.03	0.03	1.25	0.64	1.34	2.08
North-Central Appal Acidic Swamp: isolated	0.26	0.31	1.20	7.54	9.07	1.20
North-Central Appal Acidic Swamp: Smaller river riparian	0.28	0.30	1.07	17.06	17.75	1.04
North-Central Appal Acidic Swamp: Larger river floodplain	0.01	0.02	1.34	0.92	1.28	1.40
North-Central Interior & Appal Rich Swamp: isolated	0.10	0.19	1.92	3.01	6.51	2.17
North-Central Interior & Appal Rich Swamp: pond/lake	0.14	0.22	1.66	9.04	17.36	1.92
North-Central Interior & Appal Rich Swamp: stream/river riparian	0.01	0.02	2.36	0.44	1.21	2.72
North-Central Interior & Appal Acidic Peatland: Undifferentiated	0.02	0.04	1.77	1.03	1.54	1.50
North-Central Interior & Appal Acidic Peatland: Smaller river riparian	0.00	0.01	1.76	0.20	0.32	1.56

Five thousand hexagons within the four primary regions of Blanding's turtle occupation were then randomly selected. We then constrained this random sample by requiring that hexagons available for sampling had at least 50 cells of preferred Blanding's turtle habitat, and that there be at least 2 classes of preferred habitat available within the cell. Fifty wetland cells within a 800m hexagon is equivalent to about 4.5 ha or 8.1% of the hexagon. This number represents the 35th percentile of all Blanding's occurrences. That is, 65% of all Blanding's turtle occurrences are located in hexagons with at least 8% wetland area at the 400m scale. The 35th percentile was used to exclude records falling on roads, in nesting areas, and in other outlying areas that might not be suitable for trap sampling. Because landowner permissions are a consideration, the sample was further constrained to eliminate heavily developed hexagons. Any hexagons with more than 30 developed cells were also excluded from selection. The 30 developed cell threshold also represents the 35th percentile of hexagons with Blanding's turtle records. That is, 65% of Blanding's turtle EOs fall within hexagons less developed than this threshold.

Of the 5000 hexagons randomly selected on the landscape, 1072 met the constraining criteria and were converted to circular reference plots. 200 of these were evaluated from aerial photographs in Google Earth to determine whether they contained sufficient open water for trapping. 157 of the 200 random points evaluated were deemed trappable, and were passed to the states in the random shapefiles.

Guidance for sampling random points

The resulting shapefiles of random points are randomly ordered using the "nw_rand_id" column, and sites can be selected for sampling from the list. For a selected site, a 400m buffer can be drawn around the point. This circle will act as a reference plot, and five traps may be placed anywhere within the bounds of the reference plot. Traps should be left in place for 4 trap nights (and checked every 48 hours). Only 1 reference plot need be sampled / random point, rather than the standard four reference plots for TRA or LT sites. This is because logistics for placing random plots are likely much more difficult than for placing priority plots (which often occur in undeveloped areas or on public land). Whether or not random points are sampled can be tracked using the "Random_site_template.xlsx" file.

If a random site was sampled in 2012 (i.e., it overlaps with a 2012 reference plot and at least 1 trap was placed within the drawn random reference plot), that should be noted on the Excel spreadsheet and the site need not be resampled in 2013.

Generally, a random reference plot should be sampled in its current location within the given boundaries. If a site contains only a portion of a wetland at its boundary, and does not have additional trappable wetlands within the plot, the plot can be moved up to 200 meters to capture more of the peripheral wetland. The circle should not be moved so much as to incorporate new wetlands that were not partially in the plot initially, however. If a plot is moved, its new center point should be recorded in the Excel spreadsheet.

If it is impractical to sample the selected site (due to landowner permission or other logistical constraints, or because the site has already been sampled), that should be noted in the Excel spreadsheet, and the next site in the file can be selected until enough sites are sampled in each state.

APPENDIX B3

2013 SAMPLING CONSIDERATIONS

Updated September 14, 2014

Summary. This Appendix provides an overview of 2013 sampling priorities for the Northeast Blanding's Turtle Coordinated Monitoring Strategy (CMS) developed after the 2012 sampling year, outlines major objectives for continued sampling, proposes a strategy to meet those objectives, and outlines a step-by-step site selection process. Additionally, an estimate of effort required to implement the sampling plan in that year is provided. For detailed description of site sampling methodology, see the main text of the CMS. This Appendix incorporates suggested modifications to the 2012 sampling plan as well as priorities voiced by state coordinators in December 2012 and January 2013. Once the outlined sampling priorities were reviewed, modified, and approved by state coordinators in February 2013, this document was included as an appendix in the CMS. Priorities beyond 2013 will be included at a later date.

Sampling objectives for 2013

A) Conduct adequate sampling at candidate management plan sites to 1) inform the ranking of high quality sites, 2) develop a baseline relative population estimate at high priority sites, and 3) inform management plan development. At least one trap rapid assessment (TRA[6]), possibly 2 TRAs, and ideally a long-term sampling assessment (LT) should be conducted at potential management plan sites. Any site that might be a candidate for a management plan should be trapped in 2013 if it was not sampled in 2012.

B) Conduct enough LTs to inform variability in TRA/VRA sample results and develop a baseline population estimate at a few key sites across the region.

C) Sample other high priority areas where gaps in knowledge exist (within, adjacent to, or between confirmed sites).

D) Conduct sufficient sampling to develop a regional baseline for abundance.

E) Build in adequate overlap between years and methods to evaluate variation and error.

F) Include a random sampling component to allow extrapolation across the landscape and an unbiased analysis of the effects of landscape characteristics on sampling results.

Sampling Plan 2013

To meet the sampling objectives, we propose the following allocation of effort, across high priority sites, random sites, and repeat sites (Table C1). The targets for number of sites to sample at the regional level were determined using a power analysis.

[6] For a detailed explanation of sampling methodology, see the complete CMS.

1) High priority sites (i.e., sites that are candidates for conservation plans) that were not trapped in 2012 should be selected for sampling in 2013 in the following way (~50-60% of regional effort).
    a. 1 new LT in each state (Total regional target = 12 sites. 21 field days/site). Suggested distribution by state are as follows:
        Maine (2):
            1 in 2012
            1 New site in 2013
        Massachusetts (4):
            3 in 2012
            1 New site in 2013
        New Hampshire (3-4):
            2 in 2012
            1 or 2 New sites in 2013
        New York (2–3):
            1 in 2012
            1 or 2 New sites in 2013
        Pennsylvania (1):
            1 in 2012 (and again in 2013)
    b. 6-7 new TRAs at high priority sites in each state (regional target = 30). Priorities are:
        i. Sites that are candidates for management plans (i.e., rank high in expert poll and/or model results, see site ranks shapefile).
        ii. Areas adjacent to known (high quality) sites that have not been sampled (including unsampled areas inside large "sites" – as described in the site delineation document, Appendix B). See accompanying empirical model shapefile and *site selection process*, below.
    c. 4 new VRAs at high priority sites throughout the state
2) Randomly selected sites throughout the known range of Blanding's turtle in the northeast (~15-20% of regional effort).
    a. 10 'TRA-lites' (i.e., only 1-2 reference plots with 5 traps) at randomly selected sites in each state (regional target = 40). Random sites will be selected from the random sites shapefile. Only 1 reference plots (rather than the standard 4 at high priority sites) will be placed at each random site.
3) Sites repeated from 2012 /methodological overlap (~20-30% of regional effort).
    a. 1, 12 day LT run in each state + 1 full LT repeat in the region
    b. 1-2 repeat TRAs in each state
        i. Include repeats at highly successful sites, as well as those sampled during poor sampling conditions (e.g., September or low water)
    c. 1-2 repeat VRAs in each state
    d. 2 VRAs at 2012/2013 LT sites

Table B3-1. Totals sites sampled across the region in 2012, and 2013 sampling targets for each state and the region.

Sampling method	Regional totals 2012	State targets for 2013 (includes overlap sites)	Sampling details	Regional targets 2013	Combined 2012/2013 project targets
VRAs (includes LT sites)	40	7-8	(4 new high priority, 1-2 repeats, 2LTs)	40	65
TRAs (includes LT sites)	51	10	(2013 LT, 2012 LT, 1-2 repeats, 6-7 new high priorities)	50	80
New LT	8	1	At a high priority site	4	12
Random TRA-lites	NA	10	1 reference plot only. From random points layer	50	50
Repeat LT	NA	> 1 run		5	5

Site selection process

To aid in site selection, four shapefiles and 1 Excel file were prepared for each state.

- **Site rank shapefile.** This file contains sites that were delineated in accordance with the site delineation and ranking document (Appendix B). Sites were ranked using two methods. 1) An expert poll conducted in November 2012 that utilized weighted landscape metrics to assess site quality, and 2) an empirically derived model developed from 2012 sampling results. Results from these two ranking methods are listed in the "expert_sco" column (ranging from 0 to 0.86) and the model_scor" column (ranging from -12847.64 to 2776537). For both metrics, higher values indicate higher quality sites. Sites that scored well in either ranking metric, but were not trapped in 2012, are designated as 2013 priorities in the "Priority13" attribute (second to last column) of this shapefile. Sites were assigned priority 1 (highest priority), 2, 3, or 0 (lowest priority), based upon their rank on the two metrics, their location, and their previous sampling history. The comment field (last column in the file) addresses the reasons for their ranking. It should be noted that these ranks were designed at the regional scale and don't necessary take into account local habitat conditions, land ownership, or historical sampling record. They are meant only as guides, local interpretation should be used and logistical and other constraints may necessitate that different sites be chosen for sampling.

- **Empirical model shapefile.** This file contains preliminary results of the relative abundance model, built using 2012 sampling results, and applied across the landscape. It highlights polygons with relatively high wetland area and relatively low road density and impervious surface cover, which, according to the empirically derived model, could support relatively high densities of Blanding's turtle. These polygons have been designated as priorities in the "priority13" attribute (the second to last column in this shapefile) if they model well and are in areas that would benefit from additional sampling (e.g., they fall adjacent to or between known sites, and observations within these locations would increase the size of known Blanding's

habitat and could inform management plans). This file is meant to be used only as a rough guide in assisting the designation of priority sites for sampling in 2013.

- **Random points file.** This shapefile contains random points that were created using the process described below. These are randomized in the "nw_rand_id" column. Note that the FID column is not randomized. Also note that a new version: "EMBL_random_pts.shp" was provided on 2/21/13.

- **Random reference file.** This shapefile contains the 400m reference plots surrounding each of the random points in the random points file. These are randomized in the "nw_rand_id" column. Note that the FID column is not randomized. Also note that a new version: "EMBL_random_refs.shp" was provided on 2/21/13.

- **Random Excel file.** This Excel files is a template to be used to record which random points were selected for sampling, which were excluded, and why.

These shapefiles, in conjunction with the process outlined below (and in Fig. C1), can be used to assist in identifying sites for 2013 sampling.

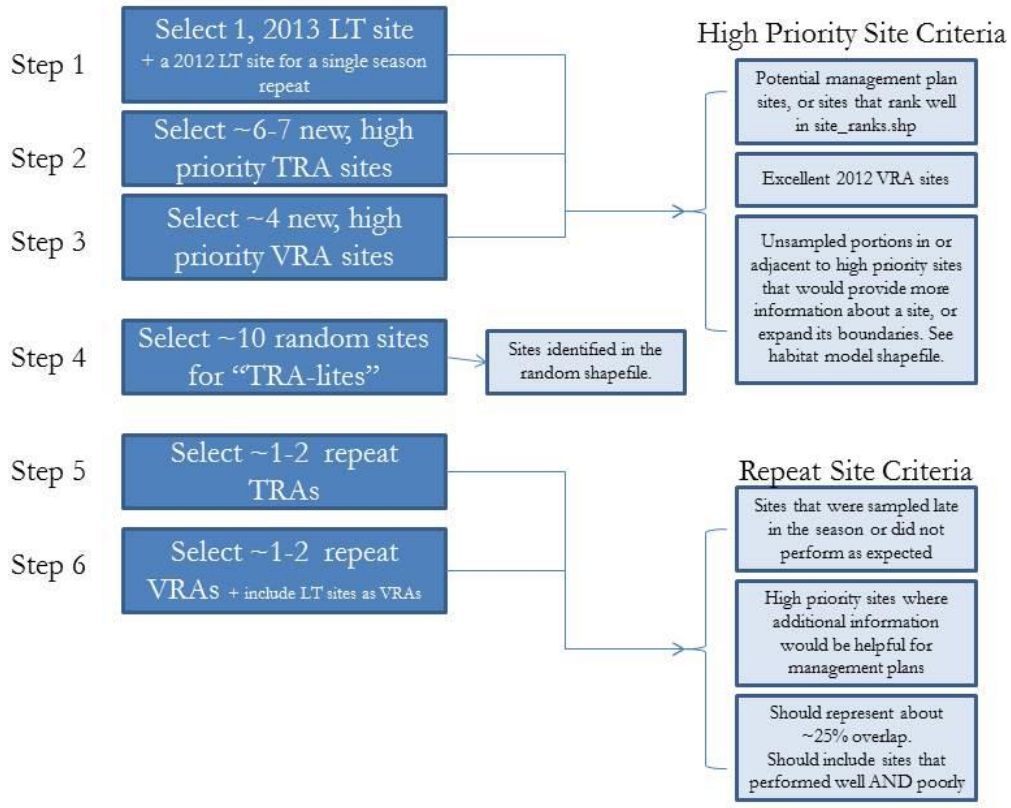

Fig B3-1. Schematic of site selection process for a single state in 2013.

Step 1) Select the state's new LT site (if applicable) and determine which 2012 LT site should be repeated during 1 seasom. New LT sites should be those that are very likely candidates for management plans (i.e., scored very high on either or both ranking metrics or had excellent TRA or VRA results in 2012). Several 2012 LT sites need additional information in order to develop a population estimate (due to too few animals successfully trapped or fewer than 3 samples collected).
Step 2) Select ~6-7 high priority TRAs. Sites should be selected for new 2012 TRAs using the following guidelines.

A) Sites with excellent VRA results in 2012 last year should have TRAs in 2013 if possible:
    - MA-ES-KS
    - MA-ES-BB
    - NH-RO-FR
    - ME-YO-WH
    - NY-SL-RF
B) Sites that might be considered for management plans (i.e., sites that rank well by experts and/or the model, but have no information or are strategically located near known sites. See high priorities in accompanying site ranks shapefile).
C) Unsampled portions of high priority sites (i.e., if only half of a high priority "site" was sampled in 2012, another portion could be sampled in 2013. This will allow us to have a better baseline for the population at that site and develop more informed management plans).
D) Areas adjacent to known sites that would expand the site boundaries (see accompanying empirical model shapefile).
E) Areas that model well and are near high priority sites, but are not within them (see priorities in accompanying empirical model shapefile).

Step 3) Select ~4 new sites for VRAs
    a. Use the same criteria for high priority TRA sites
    b. In addition, include all LT sites in the state

Step 4) Select ~10 random sites for TRA-lites (single reference plot TRAs):
    a. Start at the beginning (the lowest number in the "nw_rand_id" column) of the random point shapefile and place a 400m reference plot around that point (i.e, the matching reference polygon from the EMBL_random_refs.shp file).
    b. Plots should remain situated as-is unless the boundary of the plot clips the edge of the only wetland in the plot. In this case, the plot may be moved up to 200m to include more of that same wetland in the plot. The plot should not be moved to include additional wetlands not originally in the plot. If the plot is moved, the coordinates of the new center point should be noted in the excel file.
    c. If landowner permission cannot be obtained, if the site is logistically impossible to sample (i.e., contains no standing water), or if the site was sampled in 2012 (i.e., it overlapped with a 2012 reference plot and at least 1 trap was placed within the current random reference plot boundaries), note that in the Excel file and move to the next in the list.
    d. Continue choosing sites until 10 sites have been sampled in your state.

Step 5) Select ~1-2 sites for repeat TRAs. These could include:

a. Sites sampled in 2012, but late in the season (in September).
b. High priority sites that might have management plans where we want more information.
c. Sites selected in the random layer that were already sampled in 2012.
   NOTE: if more than 1 is repeated, these should not all be sites that had poor results in 2012.

Step 6) Select ~1-2 sites for repeat VRAs. These could include:

a. Sites sampled in 2012 with less than expect results.
b. Include a 25% overlap from 2012
c. Include high priority sites that have not been sampled
   NOTE: these should not be all sites that had poor results in 2012.

Effort

Using the results of 2012 sampling, we estimate that the proposed sampling plan will take approximately 85 field days, or 22 field weeks (primarily Monday/Wednesday/Friday, if using 48 hour trap checks) for each state. Resources, the feasibility of sampling sites, and the number of sites available for sampling vary across the region. The targets are meant to serve as generic guidelines across states, recognizing that this level of effort cannot be achieved uniformly across the region, and that some states will be able to sample more than the target number of sites and others may need to allocate effort differently.

Table B3-2. Approximate effort required to implement the proposed sampling plan

	Number / state	Field days/site	Field days	% of effort	Weeks (primarily MWF)
New LT site	1	21	21	0.25	6
New High Priority TRA sites	6-7	3	18	0.21	6
VRAs at high priority sites	4	3	12	0.14	2
Random TRA-lites	10	1.5	15	0.18	3
Repeat LT run from 2012	1	7	7	0.08	2
Repeat TRAs from 2012	1-2	3	3	0.04	2
1 Repeat VRAs from 2012 + 2 LT VRAs	3	3	9	0.11	1.5
Total Field Time Required / State			**85**		**22**
Total sampling time available (April 15 - August 31)			100		20