

SOP #3. Occupancy Site Surveys, version 1.1

Revision History Log:

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.0	02/04/26	Alan Williams	Move location info. to SOP 3, Appendix 1.	To facilitate public sharing of SOP 3.	1.1

3.1 Purpose

Terrestrial habitats, in the context of surveys in Shenandoah National Park, consist of deciduous, coniferous and mixed forests. Forests are occupied primarily by species in the genus *Plethodon*, which occur underground or under rocks and logs during the day, and on the surface foraging in the spring and fall on rainy or humid nights (Petranka 1998). Anurans and stream-associated salamanders forage, hibernate, and traverse across terrestrial habitats and may also be found during terrestrial surveys. This SOP provides instructions for sampling occupancy sites associated with the Shenandoah salamander monitoring program in Shenandoah National Park. See descriptions of data fields (below) for sampling.

3.2 Scope and Applicability

Terrestrial sites will consist of a pair of 32 m x 2 m perpendicular natural cover object transects. Sampling consists of seasonal surveys (spring and fall) at randomly selected sites, distributed across the “historic” and “edge” areas of the species range in SHEN (see narrative; <https://irma.nps.gov/DataStore/Reference/Profile/2278763>). Due to concerns about sensitive information regarding the species range, the protocol and SOP narratives generically describe 3 “populations” of *P. Shenandoah*. Specific site location information and associated maps can be found in SOP 3, Appendix 1 and can be requested from the park and may be provided on a case-by-case basis.

3.3 Procedures and General Requirements

- Prior to the field day, prepare a list of sites to be sampled and the order in which they will be sampled based on proximity to other sites and minimizing travel time between sites, where possible. Once sites are established, personnel may prepare data sheets by filling in site numbers and transect bearings prior to going in the field. Be sure that points are properly uploaded into the GPS unit, and carry site directions and list of coordinates in the field to find origin tree tags (see below).
- Prior to hiking to a survey site, clean hands with 70% ethyl alcohol. Rinse with water. Prior to moving between sub-populations or prior to the first sampling event in SHEN, clean mud and debris from hiking boots. Spray boots with 10% bleach solution and allow to air dry.
- Establishing the transects

- Observers navigate to the survey site origin point. This point is located at the end of two linear transects arranged perpendicular to one another with a single origin (Figure 3.1). Each transect extends 32 m x 2 m from the origin. A tree tag will be utilized to mark the origin at each site. The tree tag description and relationship (distance and bearing) to the origin will be recorded in the site directions. The initial transect (transect A) will run at a randomly selected bearing determined at the first visit. It is possible the initial selected bearing will need to be adjusted slightly to account for impassable terrain (i.e. cliffs, massive boulders, etc.). The second transect (transect B) will be established perpendicular to the first. Following initial establishment, the transect bearing will not change from year to year.
- Prior to surveying, to construct the transect, observers use a compass and stretch a 50 m tape for 32 m from the origin at the appropriate bearing.

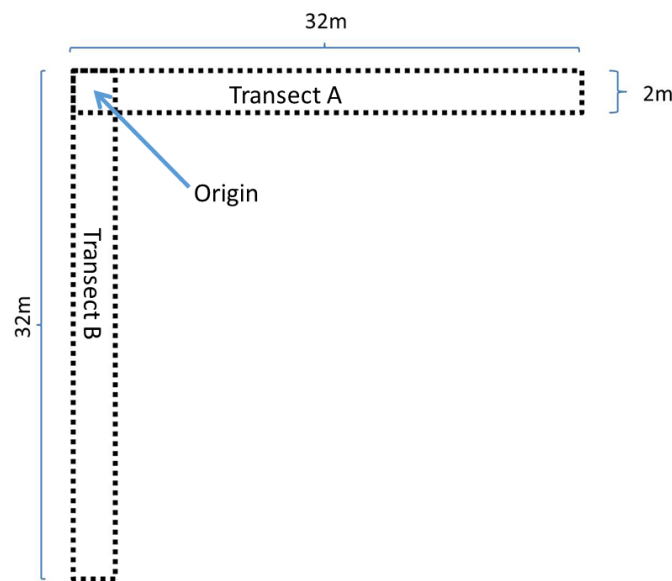


Figure 3.1. Transect diagram for *Plethodon shenandoah* monitoring at Shenandoah National Park, Virginia.

- Survey data sheet site covariates. These site covariates are only recorded during the first visit of the season using the “Occupancy site survey datasheet” and may be pre-filled prior to field work, if desired, at established sites. One third of a datasheet is used per visit during the survey season, and the reverse of the datasheet should be utilized for habitat data collection at each site once per season.
 - Site – Record the name of the established site as used in the site list or GPS unit. This should be consistent across years and unique to an origin point.
 - BearingA/BearingB – Record the bearing of the each transect from the origin using a compass with the declination set. This should be established on the first visit and not change from year to year.

- Surveying for amphibians – Each observer surveys a single transect alone during each visit. Observers begin separately at the distant end of one of the 32 m x 2 m transects and systematically search under all cover objects (rocks and logs that can be moved) greater than 6 cm in diameter (or maximum length if ellipsoid) until the entire area is searched. Observers should tie off the 0m end of the tape at the origin and walk the tape out to begin at the distant end of the transect each time and work back toward the origin to avoid trampling the transect more than necessary. All amphibians found on the surface or underneath cover objects will be captured by hand, identified, recorded and carefully returned to the cover object of capture immediately after measuring. Care should be taken such that the same salamander is not captured twice by placing the salamander back only after all salamanders from the same cover object are captured. The number of cover objects turned is also recorded (see below). Observers may record data in individual pocket-sized notebooks during survey and transfer data to datasheet at conclusion of survey.
 - Handling live amphibians - While conducting Shenandoah salamander surveys, observers will have to handle amphibians for identification. Adult salamanders can drop (autotomize) their tails, or could injure their backs trying to twist free of capture. To prevent this, salamanders should never be grasped by their tails but should be grasped mid-body between fore- and hindlimbs and immediately placed into a single-use plastic zip-top bag for measuring and individual data collection. It may be necessary at times to have multiple salamanders each in a bag if >1 is detected under a cover object, but care should be taken to return all salamanders to the cover object as soon as possible. Handling time should be minimized and extended observation or handling by multiple individuals should be conducted with the salamander housed in the plastic zip-top bag to minimize stress and injury to the salamander.
- Survey data sheet sampling covariates. Sampling covariates are recorded at each sampling visit, using the “Occupancy Site survey datasheet.”
 - Date – Record Month, Day and Year of survey as MM/DD/YYYY (e.g., 04/15/2005).
 - Obs A/Obs B - Record the first initial and last name of the observer for each transect.
 - Soil T – Record the soil temperature to the nearest 10th of a degree in centigrade (e.g., 20.2°C) by burying the full length of the temperature probe in the soil in shade at the origin (0 m) of the transects. Use a waterproof digital thermometer with a probe and an accuracy of $\pm 1^{\circ}\text{C}$ and a resolution of 0.1°C.
 - Air T – Record air temperature to the nearest 10th of a degree in centigrade (e.g., 20.2°C) at 2.5 cm height above ground in shade at the origin (0 m) of the transects. Use a waterproof digital thermometer with a probe and an accuracy of $\pm 1^{\circ}\text{C}$ and a resolution of 0.1°C.
 - Sky Code – Record the condition of the weather. Do not conduct surveys if sky codes are 6 or above (Table 3.1).
 - Wind Code – Record the estimate of wind speeds. Do not conduct surveys if wind codes are 6 or above (Table 3.2).
 - StartA/StartB – Record the start times separately for each observer in 24 hr HHMM format.

- EndA/EndB – Record the end times separately for each observer in 24 hr HHMM format.
- #coverA/#coverB – Record the total number of cover objects greater than 6 cm in diameter (or maximum length if ellipsoid) each observer turned in the natural cover transect during the survey.
- Site Notes – Record any pertinent information about the site condition (e.g. fresh downed tree, treetag missing, etc.)

Table 3.1. Sky codes used to record the sky condition during *Plethodon shenandoah* monitoring at Shenandoah National Park, Virginia.

Code	Sky Condition
0	Clear or few clouds (<20% of sky)
1	Partly cloudy or variable (20–50% of sky)
2	Cloudy or overcast (>50% of sky)
3	Fog
4	Mist
5	Showers or light rain
6*	Heavy rain
7*	Sleet/Hail
8*	Snow

* Do not conduct surveys if sky codes are 6 or above

Table 3.2. Beaufort wind codes used to record the estimate wind speeds during *Plethodon shenandoah* monitoring at Shenandoah National Park, Virginia.

Code	Wind Speed (mph)	Indicators of Wind Speed
0	0	<1 calm, smoke rises vertically
1	2–3	light air movement, smoke drifts
2	4–7	light breeze, wind felt on face, leaves rustle
3	8–12	gentle breeze, leaves/twigs in constant motion, raises dust
4	13–18	moderate breeze, small branches move
5	19–24	fresh breeze, small trees begin to sway
6*	25–31	strong breeze, large branches move
7+*	>31	strong winds

* Do not conduct surveys if wind codes are 6 or above

- Capture Data

- Tx (A/B) – Record transect on which the individual was found

- Species – The species code (or name if needed) of the individual, recorded as first letter of genus and first three letters of the specific epithet (e.g. PSHE = *P. shenandoah*, PCIN = *P. cinereus*, etc.)
- Loc (m) – The meter distance from the origin tree where the individual was found along the transect (to the nearest 0.1 m).
- Cover Type – Record the cover type where the individual was found (e.g. leaf litter (LL), rock (R), log (L), woody debris (WD))
- Str? – Record whether the individual has a dorsal stripe
- Str# – Record stripe color code that best describes the individual (see key in section 4.3)
- Vent# – Record the ventral pigmentation code that best describes the individual (see key in Figure 3.4)
- SVL – Record snout-vent length in mm as measured from the tip of the snout to the anterior edge of the vent.
- TL – Record total length in mm from the tip of the snout to the tail tip.
- VD/T? – Record whether vas deferens or testes were observed in the abdomen (Y/N)
- Eggs? – Record whether eggs are observed in the abdomen (Y/N)
- #eggs – Record # of eggs observed in the abdomen, if applicable.
- StW1 – Measure width of dorsal stripe (if applicable) at the head-body junction to the nearest 0.1mm with digital calipers.
- StW2 – Measure width of dorsal stripe (if applicable) at the body-tail junction to the nearest 0.1mm with digital calipers.
- Photo# – Record identification numbers for photos of individual, if applicable
- Species Notes – record any pertinent notes about the transect (e.g. individual had tail regenerating, was under rock with another individual, etc.), and any further information needed for identification confirmation.
- Habitat datasheet site covariates – Habitat covariates are recorded once per sampling season (spring/fall), and should be collected following salamander surveys to avoid disturbing surface active individuals prior to sampling.
 - Site – Record the name of the established site as used in the site list or GPS unit. This should be consistent across years and unique to an origin point.
 - Transect – Prefilled values for “A” or “B”.

- Date – Record Month, Day and Year of habitat data collection as MM/DD/YYYY (e.g., 04/15/2005).
- Canopy Cover – Measure and record the extent of canopy closure at the start, mid-point (16 m), and end (32 m) of the transect as a percentage, using a spherical densiometer.
- Soil Depth – Measure the depth of the soil (below any leaf litter or needle layer) at the start, mid-point (16 m), and end (32 m) of the transect in millimeters using a ruler.
- Leaf Litter Depth – Measure the depth of the leaf litter at the start, mid-point (16 m), and end (32 m) of the transect in millimeters using a ruler.
- % Cover (to the nearest 1%; sum to 100%)
 - Soil – Visually estimate and record the % of the transect surface area that is composed of soil within each of the four quarters of the transect (i.e. 0-8 m, 8-16 m, 16-24 m, and 24-32 m).
 - Cobble (64-256 mm) – Visually estimate and record the % of the transect surface area that is composed of cobble within each of the four quarters of the transect (i.e. 0-8 m, 8-16 m, 16-24 m, and 24-32 m).
 - Boulder (>256 mm) – Visually estimate and record the % of the transect surface area that is composed of boulder within each of the four quarters of the transect (i.e. 0-8 m, 8-16 m, 16-24 m, and 24-32 m).
 - Moss – Visually estimate and record the % of the transect surface area that is composed of moss within each of the four quarters of the transect (i.e. 0-8 m, 8-16 m, 16-24 m, and 24-32 m).
 - LWD (>5 cm diam) – Visually estimate and record the % of the transect surface area that is composed of LWD within each of the four quarters of the transect (i.e. 0-8 m, 8-16 m, 16-24 m, and 24-32 m).
 - Leaf Litter – Visually estimate and record the % of the transect surface area that is composed of leaf litter within each of the four quarters of the transect (i.e. 0-8 m, 8-16 m, 16-24 m, and 24-32 m).
 - Other – Visually estimate and record the % of the transect surface area that is composed of other substrates within each of the four quarters of the transect (i.e. 0-8 m, 8-16 m, 16-24 m, and 24-32 m).
- Notes – Record miscellaneous habitat information about the transect.
- Prior to hiking to next site – Clean hands with ethyl alcohol (wipes or spray). Rinse with water.
- Prior to moving between populations – Clean mud and debris from hiking boots. Spray boots with 10% bleach solution and allow to air dry.

- Data Sheets (Figures 3.2 and 3.3)

[illegible]

Figure 3.2. Occupancy site survey datasheet for *Plethodon shenandoah* monitoring at Shenandoah National Park, Virginia.

Site								
Transect	A				B			
Date								
	0m	16m	32m		0m	16m	32m	
Canopy Cover (%)								
Soil Depth (mm)								
Leaf Litter Depth (mm)								
% Cover / Section	0-8m	8-16m	16-24m	24-32m	0-8m	8-16m	16-24m	24-32m
Soil								
Cobble (64-256mm)								
Boulder (>256mm)								
Moss								
LWD (>5cm diam)								
Leaf Litter								
Other								
Other								
Notes								

Sky Key				Wind				
0	Clear/few clouds (<20% of sky)			0	Calm , smoke rises vertically			
1	Partly cloudy (20-50% of sky)			1	Light air movement , smoke drifts			
2	Cloudy/overcast (>50% of sky)			2	Light breeze , wind felt on face, leaves rustle			
3	Fog			3	Gentle breeze , leaves/twigs in constant motion			
4	Mist			4	Moderate breeze , small branches move			
5	Showers or light rain			5	Fresh breeze , small trees begin to sway			
6	Heavy rain			6	Strong breeze , large branches move			
7	Sleet/Hail			7+	Strong winds			
8	Snow							

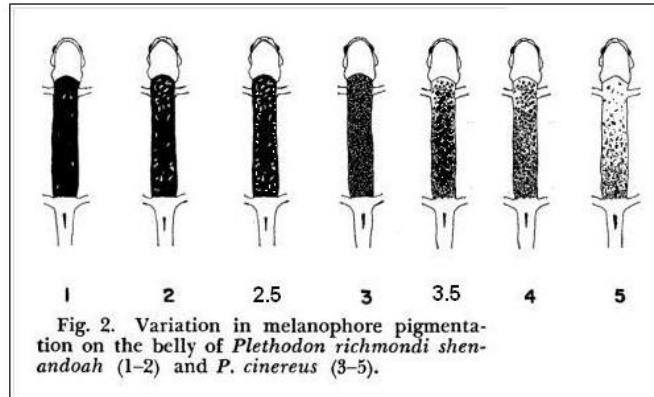
Figure 3.3. Habitat datasheet for *Plethodon shenandoah* monitoring at Shenandoah National Park, Virginia.

- Field Identification Guide (Figure 3.4)

P. shenandoah:

Thinner stripe

Generally dark belly, few large flecks to no flecks



P. cinereus:

Wider stripe

Moderately to heavily flecked belly, small flecks



Stripe color codes:	
1	red
2	red-orange
3	orange-tan
4	orange
5	yellow
6	yellow-orange
7	white
8	dark brown

For each individual, record:

- Species
- Meter of capture
- Cover Type
- Striped/unstriped
- Stripe color code (see left)
- Ventral color code (see above)
- Snout-vent length (SVL) in mm
- Total length (TL) in mm
- Vas deferens/Testes? Y/N
- Eggs? Y/N
- #Eggs
- StripeWidth1 at head/body junct. (mm)
- StripeWidth2 at body/tail junct. (mm)

Figure 3.4. Field guide to distinguish *Plethodon* species while monitoring *P. shenandoah* at Shenandoah National Park, Virginia.

3.4 Site locations and maps

See SOP 3, Appendix 1

3.5 Reference Documents

- Petranka, J. W. 1998. Salamanders of the United States and Canada. Smithsonian Institution, Washington, DC.