

PENNSYLVANIA GAME COMMISSION
BUREAU OF WILDLIFE MANAGEMENT
RESEARCH DIVISION
PROJECT ANNUAL JOB REPORT

PROJECT CODE NO.: 06718

TITLE: Allegheny Woodrat Research/Management

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TITLE: Allegheny Woodrat Surveys

PERIOD COVERED: 1 July 2005 to 30 June 2006

COOPERATING AGENCIES: Pennsylvania Biological Survey (PABS) Mammal Technical Committee; Department of Biology, Dickinson College; State Wildlife Grant Cooperator (J. Hassinger).

FIELD PERSONNEL: PGC Biologists - Calvin Butchkoski and Greg Turner; PGC Biologist Aides - Jessica Peterson-Smith, Curtis Small, Nathan Troyan

WORK LOCATION: Statewide

PREPARED BY: Calvin Butchkoski

DATE: 30 June 2006

Abstract: The Allegheny woodrat (*Neotoma magister*) is classified as a threatened species in Pennsylvania. This determination was based on the widespread decline of this species across the northern 1/3 of its range. Numerous islands and corridors of rock in eastern, central, and northwestern Pennsylvania that had supported woodrats no longer do so. In 2005 budget restraints resulted in little fieldwork being conducted. However, a review of historical data and PGC field data from 1982 through 2005 was completed in coordination with the completion of a Woodrat Management Plan funded by federal State Wildlife Grant. As a result of the management plan, definitions for woodrat sites were created and revised to: activity center, potential activity center, habitat site, metapopulation area, conservation management area, and core woodrat habitat. A new woodrat site survey code manual was created to incorporate these changes, which will be used in future surveys. A guideline for forest managers was also completed for management of active woodrat areas on a landscape scale. During May and June of 2006, 3 biologist aides monitored 5 woodrat conservation management areas (CMA) for woodrat activity. The Lehigh River CMA was a high priority because little woodrat sign was found in fall 2005. Eight habitat sites were searched with no sign found. One of these sites was trapped with 50 live traps resulting in 1 female captured. The remaining CMAs monitored were: Chestnut Ridge/Laurel Ridge, 2 sites surveyed of which 1 had visible active sign; Negro Mountain, 2 sites surveyed with no visible active sign; Savage Mountain, 4 sites surveyed of which 2 had visible active sign; and Wills Mountain, 5 sites surveyed of which 1 had visible active sign. Both the Lehigh River CMA and Negro Mountain CMA need to be monitored closely in 2006 because neither had any visible sign reported. Biologist aides also investigated a report of woodrats in Warren County, outside of any currently known area, with no evidence found.

OBJECTIVES

1. Monitor woodrat conservation management areas and metapopulation areas for status changes and identify new habitat sites within these areas.
2. Investigate any reports of woodrat habitat sites outside known conservation management areas.
3. Update the boundaries of woodrat metapopulation areas and conservation management areas as new data becomes available.
4. To protect known woodrat metapopulation areas and the surrounding, forested matrix from further habitat degradation.
5. Encourage the implementation of forest management guidelines for the Allegheny woodrat and work with managers to refine recommendations.
6. Monitor the results of implemented management guidelines.

INTRODUCTION

Woodrats (*Neotoma magister*) are classified as a threatened species in Pennsylvania. This determination was based on the widespread decline of this species across the northern 1/3 of its range. Numerous islands and corridors of rock in eastern, central, and northwestern Pennsylvania that had supported woodrats no longer do so. In 2005 budget restraints resulted in little fieldwork being conducted. However, a review of historical data and PGC field data from 1982 through 2005 was incorporated within a Woodrat Management Plan funded by a State Wildlife Grant (Hassinger 2005).

The following definitions, survey protocol and forest management guidelines have evolved as a result of extensive experience surveying woodrats in Pennsylvania and information gleaned from the Allegheny Woodrat Management Plan.

Suitable Habitat

In Pennsylvania the woodrat is, by force of circumstances, a forest interior species. Sufficient "overhead shelter" (rock overhangs, vegetative cover) is consistently mentioned as a habitat requirement for woodrats (Fitch and Rainey 1956). Allegheny woodrats inhabit rocky islands embedded in a forested matrix. Their habitat in Pennsylvania can be categorized as: (1) den sites consisting primarily of an island and/or corridor of rocks surrounded and typically overtopped by tree canopy; (2) foraging habitat that may extend >100 m beyond rocks (Wright and Hall 1996); and (3) forested dispersal habitat (between metapopulation areas) that is often absent of surface rocks.

Den Site

A den site is a core area within a rock island or patch characterized by tree cover and rocks and boulders with an abundance of large, deep crevices and galleries. Exceptions to this are a few river valley shale outcrops where crevices are scarce but deep. This basic physical habitat is influenced positively by the following features: (1) a southerly exposure (Hassinger 1992, Balcom and Yahner 1996), (2) many large, flat rock

overhangs, (3) subsurface rocks with some deep (below the frost-line) woodrat-accessible crevices, (4) the presence of caves, outcrops, talus, and complex cliffs (with ledges and crevices), and (5) a hectare or more of rocks and boulders. The quality of den sites is not equal and they are usually not distributed evenly on a rock island. A cave or deep galleries are the core of prime den sites. Superimposed on and adjacent to this physical structure is extensive (radii: >2 km desirable) forest and at least intermittent, herbaceous ground cover. A mix of trees, vines, shrubs, herbs, and fungi are desirable due to the woodrat's comprehensive diet and opportunistic foraging strategy (McMurray et al. 1993), and its need for a year-round, stable food source.

Activity Center

Activity centers are overtop or near subsurface woodrat nesting or denning sites. Activity centers are characterized by observable woodrat sign in the form of toilet area(s) and midden-cache(s) linked in most cases to a complex of surface rocks and fissures or to a cave/mine entrance zone. Multiple activity centers within the same habitat site should not overlap. Repeatedly or perennially used activity centers likely consist of an adult female and her young. Older daughters are tolerated nearby. In essence, activity centers (called den sites in past reports) contain a breeding assemblage. Males disperse from, visit, travel through, or occasionally occupy vacant activity centers. Generally, prime den sites or activity centers are defended and are rarely closer than 30 m to one another (Wright 1998).

Potential Activity Center

Some areas look like good woodrat habitat but have no sign of use by woodrats. In these survey instances, the most complex surface rock found, characterized by rock overhangs, ledges, small caves and numerous fissures, can be defined as a potential activity center. It is important that potential activity centers be documented to because they could become viable activity centers in the future. Potential activity centers are also a record of suitable habitat.

Habitat Site

A habitat site is a variable sized area of more or less contiguous surface rock without a break in the surface rock of 200 m or more. A Habitat Site is an island or patch of rock or a cluster of islands. The possibility of inter-island exchange of woodrats is greater within habitat sites than between habitat sites. The inhabitants of each habitat site can be called a subpopulation (Hunter 1996).

A habitat site and its adjacent fringing apron (ecotone) of rock and non-rock surface area has all the necessary resources for the persistence of a local subpopulation, and it is separated by unsuitable denning habitat from other habitat sites. At any given time, a habitat site may be occupied or empty. Adjacent habitat sites are separated by at least 200 m of non-surface rock habitat or by a substantial barrier in the form of a major, hardtop road or wide stream. Habitat sites contain one or more activity centers or potential activity centers. An active habitat site contains a woodrat subpopulation, which may be as small as a single breeding assemblage or contain multiple breeding assemblages. A habitat site will normally encompass at least 1 woodrat's home range (Goertz 1970, Wright and Hall 1996). The

most common types of movement by a woodrat are foraging forays within and on the fringe of the habitats site, den shifts within a Habitat Site, and short distance dispersal within larger habitat sites (Figure 1). Habitat site replaces the term survey site used in past reports.

Metapopulation Area

Metapopulation areas are separated from the nearest, adjacent metapopulation area by at least 10 km of non-woodrat habitat or a significant barrier to dispersal, e.g. a river or farmed valley bottom. A metapopulation area contains at least 1 but usually numerous topographically related woodrat habitat sites; some habitat sites may not be occupied. A metapopulation area contains a metapopulation defined as a set of subpopulations (1 per active habitat site) where typically migration from 1 subpopulation to at least some other subpopulations (habitat sites) is possible. Records of long-distance woodrat dispersal movements are rare. Movements of about 1-2 km and 1-4 km (McGowen 1993, Myers and Michael 1997) have been documented. The subpopulations are able to exchange individuals and recolonize habitat sites in which the species has recently become extinct. Metapopulation area replaces the term colony used in past reports.

Conservation Management Area

A conservation management area (CMA) contains physiographically related metapopulation areas. Administratively, a CMA represents an economy of scale; and different metapopulation areas within a CMA are likely to be impacted similarly regarding regional threats and public land management. CMA replaces the term metapopulation used in previous reports.

Core Woodrat Habitat

In his study of the distribution and ecology of the 6 species of woodrats in Colorado, Finley (1958) noted that if the species is dependent on rocks for shelter, the local distribution of dens is usually in a linear pattern, conforming to suitable rock exposures. With this in mind, a model of core woodrat habitat was developed (Butchkoski 2003) using forest habitat, surface geology and slope. This model is currently being used to identify survey priorities and, when combined with known conservation management areas, can be used to direct management options to preserve these core habitats and main corridors for dispersal.

METHODS

A habitat site search image has been developed as a result of past experience. Basically, surveyors find habitat sites and then look for woodrat toilet areas and food caches. When evidence of use is found, these signs are characterized as old (dried, faded, disintegrated) or recent (intact, dark-colored, shiny). The data is then incorporated into a Microsoft Access Database. In 2004 a federal State Wildlife Grant was awarded to prepare a Conservation Management Plan for the Allegheny Woodrat, completed in 2005. The plan includes: a literature review; collation and review of Pennsylvania data; organization of a volunteer science advisory committee; and development of management maps, species-level and habitat-related research, and management actions.

Some sites may be trapped for research purposes or to verify presence or absence. A minimum of 40 squirrel-sized live traps is used per site.

Trapping is conducted for 2 nights. A woodrat trapping protocol was developed by the Pennsylvania Biological Survey, Mammal Technical Committee in 2004 to standardize sampling (Butchkoski 2005).

A woodrat site survey form is completed for each site visited or trapped. All data from these site records are entered into a comprehensive woodrat database.

RESULTS

In 2005 budget restraints resulted in little fieldwork being conducted. Work emphasis was focused on working with a State Wildlife Grant cooperator to aide in the completion of the conservation management plan for the Allegheny woodrat (Hassinger 2005).

As a result the completion of the Woodrat Management Plan (Hassinger 2005), a new Allegheny Woodrat Site Survey Code Manual (Appendix A) was developed to address the revisions of definitions, standardize the collection of additional data, and increase the spatial resolution of the habitat site by recording more GPS information on activity centers within the site. Appendix A includes the new survey form with detailed instructions. Also, Forest Management Guidelines (Appendix B) were developed to manage for long term increases in the quantity and quality of *Neotoma* food within and adjacent to active and qualifying inactive habitat sites. Appendix B's guidelines place high priority on managing for increased woodrat foraging opportunities and reducing fragmentation of habitat.

A review to equate new terminology with that used in past reports is indicated. The new term *activity center* means den site. The new term *habitat site* replaces survey site as used in past reports. *Metapopulation area* replaces colony. *Conservation management area* (CMA) replaces metapopulation.

For reporting purposes, an activity center is the finest resolution of survey data (rock habitat suitable for a den site) and is a minimum of 30 m away from another. Activity centers can be active (fresh woodrat sign) or old (only old sign found.) Suitable habitat with no woodrat evidence constitutes a potential activity center.

One or more activity centers make up a habitat site. A habitat site is surface rock, or surface rock piles suitable for activity centers (including potential activity centers) within 200 m of each other.

A metapopulation area is now defined as a collection of habitat sites within 10 km of each other with suitable habitat connectivity for animal dispersal.

A conservation management area (CMA) is geographically related and offers a landscape view of management opportunities to increase connectivity of metapopulation areas. Currently there are 78 (29 active, 49 inactive) metapopulation areas identified within 23 conservation management areas (Figure 2).

During May and June of 2006, 3 biologist aides monitored 5 CMAs (Figure 2) for woodrat activity. The Lehigh River CMA was a high priority because little woodrat sign had been reported fall 2005. Eight habitat sites were searched with no sign found. One of these sites was trapped with 50 live

traps resulting in 1 female captured. The remaining CMAs monitored were: Chestnut Ridge/Laurel Ridge, 2 sites surveyed of which 1 had visible active sign; Negro Mountain, 2 sites surveyed with no visible active sign; Savage Mountain, 4 sites surveyed of which 2 had visible active sign; and Wills Mountain, 5 sites surveyed of which 1 had visible active sign. Both the Lehigh River CMA and Negro Mountain CMA should need to be monitored closely in 2006 because neither had any visible sign reported. Biologist Aides also investigated a report of woodrats in Warren County at a site outside any currently known CMA by Allegheny National Forest (ANF) biologists. The habitat site, located within the ANF, was trapped for 3 nights with 40 traps. No evidence of woodrats was found.

RECOMMENDATIONS

1. The Game Commission should continue to pursue the objectives of this project by cooperating with the PABS Mammal Technical Committee's Woodrat Subcommittee and the regional Northeast Woodrat Recovery Group.

2. Two wage employees should be used to continue field surveys in 1 or more metapopulation areas in 5 conservation management areas during 2006 to 2007. Attempts should be made to find more habitat sites as well as monitor existing metapopulation areas and conservation management areas for status changes.

3. Develop and test a procedure for monitoring winkout and recolonization rates of areas activity centers, habitat sites, and metapopulation areas.

4. Update the woodrat database to reflect data collection changes resulting from the newly prepared woodrat management plan and keep the database current.

5. Sample raccoon scats in terms of both scat prevalence and *Baylisascaris procyonis* egg prevalence therein. Collect samples from both active and inactive woodrat metapopulation areas and CMAs.

6. Continue to refine and test the preliminary model of core woodrat habitats.

7. Monitor the presumed collapse of the Delaware River CMA (Delaware Water Gap area).

8. Trap and monitor the Negro Mountain CMA to verify its status.

9. Closely monitor the Lehigh River CMA, which is declining in visual woodrat sign.

10. Continue to update the Woodrat Management Plan.

11. Begin planning a telemetry study of woodrats at Jacks Mountain where they exist in close proximity to a busy highway (U.S. Route 22) to investigate dispersal and the highway's effects on the colony.

12. Pursue funding to research for: woodrat dispersal/dispersal corridors, food resources as they relate to reproductive potential, juvenile survival rates, creation of habitat sites, and effects of landscape changes (access roads/right-of-ways, wind farms, highways, etc.) on habitat sites.

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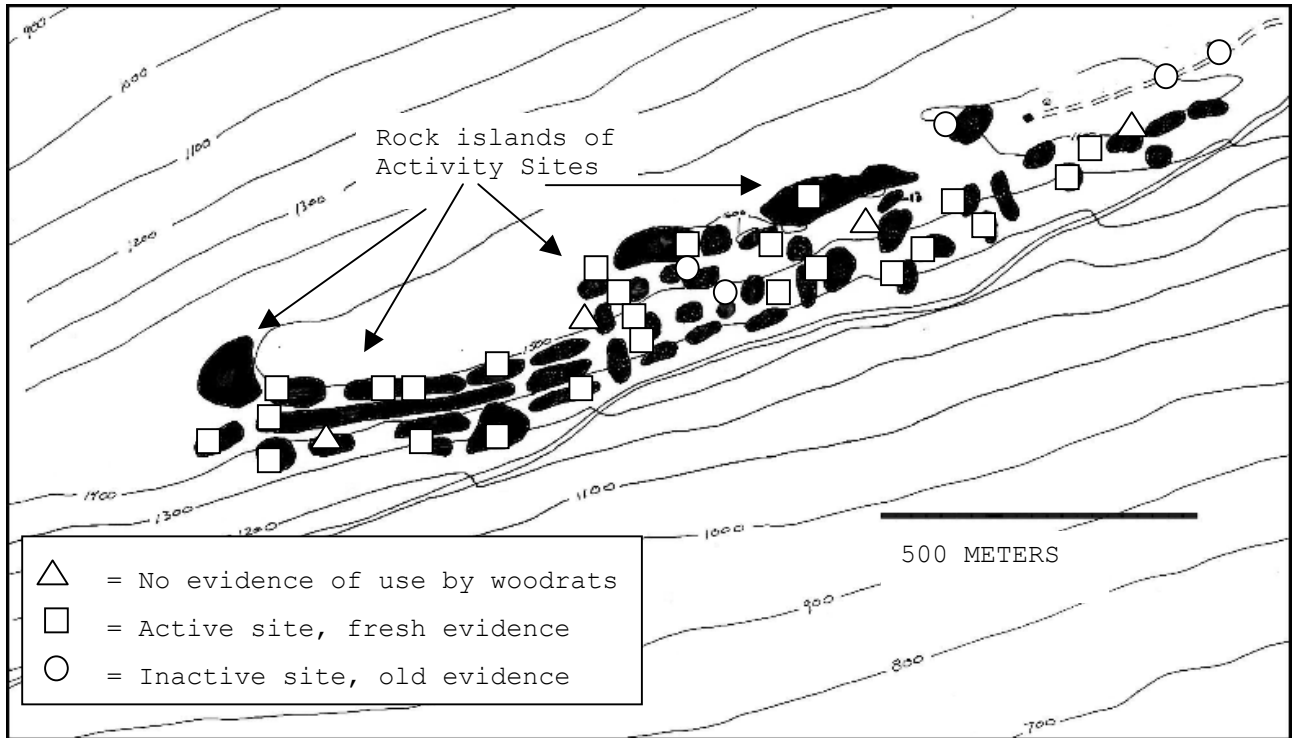


Figure 1. An example of a large Habitat Site made up of a series of small islands of surface rock (activity sites).

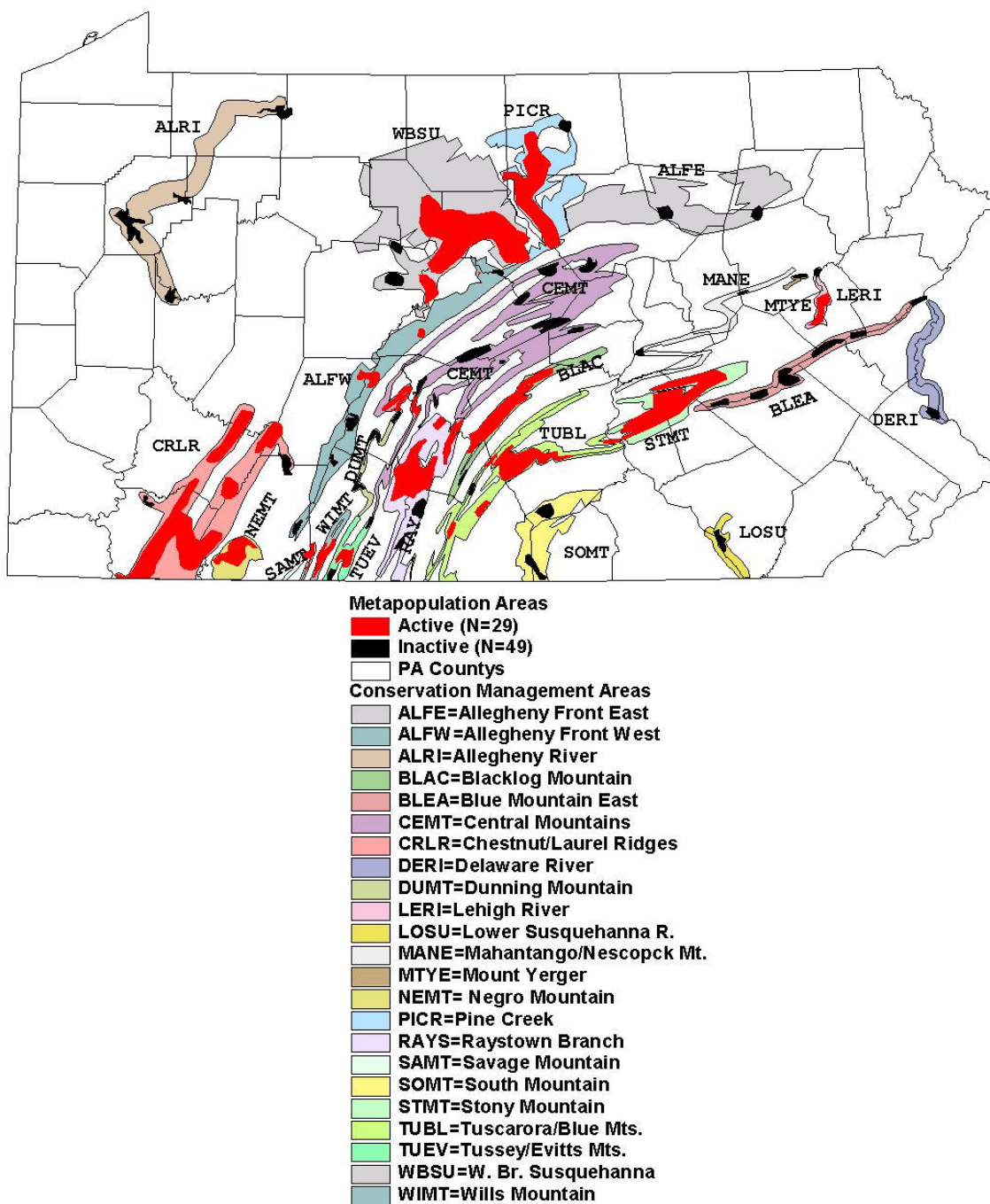


Figure 2. A map illustrating 23 Conservation Management Areas and 78 Metapopulation Areas.

APPENDIX A

Allegheny Woodrat
(*Neotoma magister*)

Site Survey form

and

Code Manual

PENNSYLVANIA GAME COMMISSION

WILDLIFE DIVERSITY SECTION

**ALLEGHENY WOODRAT
HABITAT SITE SURVEY**

CODE MANUAL

This manual provides instructions, definitions
and codes for completing the Allegheny Woodrat
Habitat Site Survey



The Allegheny
Saxicole or

← THE
ĀSAX

Saxicole: Dwelling in stony
places; something that lives
on or among rocks; a
saxicolous species.

Chittering and twittering,
Chompin and stompin,
The āsax is home.
In the shadow of stone

WOODRAT HABITAT SITE SURVEY

Use the accompanying Woodrat Survey Code Booklet to complete this form.

Habitat Site Name: _____ Trap-site Number: _____ Date: _____

Ownership (circle one): Public, Private, Both Access (Name, Address Telephone): _____

Location: _____ N or _____ S and _____ E or _____ W of: _____

Surveyors: _____

Effort: # of surveyors x survey minutes = _____ minutes. Was the site(s) previously surveyed? Yes No

Conservation Mgmt. Area (4 letters, see Appendix 1): _____ Habitat Site Code (if known): _____

County: _____ Quadrangle: _____ Map Photocopy attached? Yes No

Habitat Site Size (m): Longest Length: _____ Average Width: _____ Width range: _____

Activity Extent (m): Longest Length: _____ Average Width: _____ Width range: _____
(Estimate the length & width of rectangle that would include all Activity Centers within Habitat Site)

Latitude _____°-----'-----" & Longitude _____°-----'-----"
(Center of Habitat Site in Degrees, Minutes and Seconds, NAD27)

Elevation Range: _____ to _____ meters. Percent Slope: _____% to _____%

Aspects (degrees): southerly aspects: _____% _____° northerly aspects: _____% _____°
(135°-225°) (315°-45°)

easterly aspects: _____% _____° westerly aspects: _____% _____°
(45°-135°) (225°-315°)

Topography (ridge/valley-side, ridge top, river gorge, water gap, etc.): _____

Surface Rock Habitat Types: List the four most common surface rock habitat types (and estimate the percent coverage of each) starting with the most common (see Table 1):

- 1) Code # _____ % _____, 2) Code # _____ % _____,
- 3) Code # _____ % _____, 4) Code # _____ % _____

Geological formation: _____

Nearest mapped water: Name: _____ Distance to: _____ m

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Forest Fragmentation Code: _____ Two-digit Habitat Disturbance code: _____

Anderson Level III cover code on site: _____ and adjacent to site: _____

Tree canopy coverage overtop Habitat Site: _____%

Vegetation on and within 100 meters of the Habitat Site:

Trees Species (list most common first and least common last): _____

Shrub, Vine and Briar (Rubus) Species: _____

Herbaceous Species: _____

General Description of Surrounding Habitat (>100m & <500m): _____

If applicable: this Habitat Site replaces (merges) the following Sites (enter the Site names):

Comments, e.g. threats to site, unusual tree mortality, large population of porcupines (tally number of dens), snake species observed, droppings of predators noted etc.

ACTIVITY CENTERS or POTENTIAL ACTIVITY CENTERS (circles with a 15m radius)
Establish up to 10 ACs and/or PACs for every 1 km of Habitat Site length.

No.	GPS Latitude	GPS Longitude	# Toilet Areas		# Midden-caches		#Nests/Hutches		Rock Code	% Canopy Coverage
			Fresh	Old	Fresh	Old	Fresh	Old		
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										
TOTAL =										

FORM PGC 4150 wdrat

MIDDEN-CACHE CONTENTS COMBINED FOR ALL ACTIVITY CENTERS	
Green Vegetation & Buds	
Ferns	
Hard Mast	
Soft Mast	
Other Seeds	
Fungi & Lichens	
Misc. (Sticks etc.)	
Raccoon Feces	

WOODRAT HABITAT SITE SURVEY CODE BOOKLET

This booklet will help you to complete the accompanying woodrat site survey form. Some questions are self-explanatory and therefore not covered here. The site survey form should be completed for all initial surveys, resurveys, and trapping surveys of suitable rocky habitat even if no woodrats were found.

Important Definitions:

Activity Center: Activity centers are overtop or near subsurface woodrat nesting or denning sites. Activity centers are characterized by observable woodrat sign in the form of toilet area(s) and midden-cache(s) linked in most cases to a complex of surface rocks and fissures or to a cave/mine entrance zone. The estimated center of activity is GPSed. Then all toilet areas and midden-caches within a 15 m radius of this GPS point are tallied. Multiple Activity Centers within the same Habitat Site should not overlap. Repeatedly or perennially used Activity Centers likely consist of an adult female and her young. Older daughters are tolerated nearby. In essence, Activity Centers (previously referred to as den sites) contain a breeding assemblage. Males disperse from, visit, travel through, or occasionally occupy vacant activity centers. Generally, prime den sites or Activity Centers are defended and are rarely closer than 30 m to one another.

Potential Activity Center: Some areas look like good woodrat habitat but fail to have any sign of being used by woodrats. In these survey instances, the most complex surface rock found, characterized by rock overhangs, ledges, small caves and numerous fissures, can be defined as a Potential Activity Center.

Habitat Site: A Habitat Site is a variable sized area of more or less contiguous surface rock without a break in the surface rock of 200 m or more. A Habitat Site is an island or a “patch” of rock (sometimes referred to as a rock pile) or a cluster of islands. A Habitat Site and its adjacent fringing apron (ecotone) of rock and non-rock surface area has all the necessary resources for the persistence of a local subpopulation, and it is separated by unsuitable denning habitat from other Habitat Sites. At any given time, a Habitat Site may be occupied or empty. Adjacent Habitat Sites are separated by at least 200 m of non-surface rock habitat or by a substantial barrier in the form of a major, hardtop road or wide stream. Habitat Sites contain one or more Activity Centers or Potential Activity Centers. An active Habitat Site contains a woodrat subpopulation which may be as small as a single breeding assemblage or contain multiple breeding assemblages. The most common kinds of movements by woodrat are foraging forays within and on the fringe of the Habitats Site, den shifts within a Habitat Site, and short distance dispersal within larger Habitat Sites. See Figure 2.

Metapopulation Area: Metapopulation Areas are separated from the nearest, adjacent Metapopulation Area by at least 10 km of non-woodrat habitat or a significant barrier to dispersal, e.g. a river or farmed valley bottom. A Metapopulation Area contains at least one but usually numerous topographically related woodrat Habitat Sites; some Habitat Sites may not be occupied. A Metapopulation Area contains a metapopulation defined as a set of subpopulations (one per active Habitat Site) where typically migration from one subpopulation to at least some other subpopulations (Habitat Sites) is possible. The subpopulations are able to exchange individuals and recolonize Habitat Sites in which the species has recently become extinct.

Conservation Management Area: A Conservation Management Area contains physiographically related Metapopulation Areas. Administratively, a Conservation Management Area represents an economy of scale; and different Metapopulation Areas within a Conservation Management Area are likely to be impacted similarly regarding regional threats and public land management.

INSTRUCTIONS FOR COMPLETING FORM PGC 4150 wdrat

Habitat Site Name: Give each site a short individual name consisting of no more than two words. Group names (e.g. Big Mountain #4) may also be appropriate. Resurveys of previous Sites may require these Sites to be merged under a new name because previous adjacent Sites may not have the required ≥ 200 m of non-surface rock between them. The ≥ 200 m rule is new as of the year 2006. For example, Ellendale 1 through Ellendale 17 (absent ≥ 200 between adjacent Sites) would be merged into a single Habitat Site renamed Ellendale Merged or Ellendale A.

Trap-site Number: Enter if known otherwise leave blank, a number will be assigned later.

Location: Miles or kilometers due north or south and due east and west of nearest town on the topographic map.

Conservation Management Area: Use only the approved name or abbreviation from Appendix I and Figure 1.

Habitat Site Code: Enter if known, otherwise leave blank and a code will be assigned later.

Habitat Site size: See definition of Habitat Site. The longest length is measured along or close to the contour. Find the end of surface rock adjacent to an area spanning at least 200 m of mostly non-surface rock. The longest length of the surface rock island, without a break of 200 m or more, is estimated to the nearest 50 m, but not zero. Habitat Sites longer than 2 km (about a mile) should be GPSed at both ends and the longest length should be taken off of a topographic map rather than visually estimated. The width of a surface rock island is usually but not always at right angles to the contour, i.e. downhill or uphill. The average width in a few instances will be longer than the length. Estimate the average width of the Habitat Site to the nearest 25 m but not zero. The width range is the shortest and widest width of the surface rock island.

Area of Occupancy or Activity Extent: Estimate the length and width of a rectangle that includes all Activity Centers that have evidence (new and/or old) of being used by woodrats.

Latitude and Longitude: On the contour, estimate the middle of the Habitat Site and GPS this point.

Elevation Range, Example: 332' to 610' **Percent Slope, Example (%)**: 10% to 15%.

Aspects (degrees), Example: southerly aspects: 100 % 180°; in this example 100% of the Habitat Site was facing due south.

northerly aspects	clockwise 315° to 45°
southerly aspects	clockwise 135° to 225°
easterly aspects	clockwise 45° to 135°
westerly aspects	clockwise 225° to 315°

Note: numerous ridgetop sites will have contrasting aspects.

Classification of Rocky Habitat: This code can be determined with the use of Appendix II. Key down from column 1 to column 3; the number in the third column is the code number(s) to use. Spaces are available for only the four most common rocky habitat types.

Geological formation: This data comes from the Preliminary Atlas of Geologic Quadrangles for Pennsylvania, Map 61 from the Pennsylvania Geological Survey; refer to the DCNR website. If not available, briefly describe rock (limestone outcrop, sandstone talus, etc.).

Nearest mapped water: Provide the distance to and name of the nearest stream or other body of water taken from the 7.5' quadrangle map.

Forest Fragmentation: This is a basic distance code to measure massive encroachment of agricultural/urban areas into the forest cover type. For this reason consider only agricultural/urban areas >100 hectares. Usually this entry will be the closest measurement from the Habitat Site to the edge of the forest cover type where it meets the expansive, developed, cleared land of the valley.

<u>Code Number</u>	<u>Distance from >100 ha opening</u>	<u>Code Number</u>	<u>Distance from >100 ha opening</u>
1	On site	5	>1km to 2km
2	≤ 100m	6	>2km to 3km
3	>100m to 500m	7	>3km to 5 km
4	>500m to 1km	8	>5km

Normally the measurement can be taken off a 7.5 minute topographic map (closest distance to edge of white areas >100 hectares). However, this is not always the case. For example, large housing developments (>100ha.) in a forested site may still be colored green on a topographic map.

Linear agricultural/urban areas >100 hectares should be considered. Example: an agricultural/urban river bottom that measures 250m x 5,000m would qualify for this entry.

For this code, do not measure the distance to small housing developments, strip mines, clearcuts, forest clearings or other small disturbances <100 hectares. These smaller site disturbances should be recorded in the following "Two-digit Habitat Disturbance Codes."

Two-digit Habitat Disturbance Code: Disturbance code that may affect the Habitat Site. Space is available to list up to 3 disturbance codes. Get from Appendix IV.

Anderson Level III land cover code: Determine from Appendix III. Key down from column 1 to column 3; use the 3 digit number (code number) in the third column.

Tree canopy coverage overtop Habitat Site: Estimate to nearest 10%.

ACTIVITY CENTERS and POTENTIAL ACTIVITY CENTERS (PAC): (see definitions) this is a major change compared to previous (pre-2006) surveys.

Within Habitat Sites, Activity Centers are over-top or near subsurface woodrat nesting or denning sites. Activity Centers are characterized by observable woodrat sign in the form of toilet area(s) and midden-cache(s) linked in most cases to a complex of surface rocks and fissures or to a cave/mine entrance zone. Some areas look like good woodrat habitat but fail to have any sign of being used by woodrats. In these survey instances, the most complex surface rock found, characterized by rock overhangs, ledges, small caves and numerous fissures, can be defined as a Potential Activity Center (PAC). The estimated center of activity (actual or potential) is GPSed. Then, if present, all toilet areas and midden-caches within a 15 m radius of this GPS point are tallied. Multiple Activity Centers and/or PACs within the same Habitat Site

should not overlap. Establish up to 10 Activity Centers and/or PACs for every 1 km of Habitat Site length.

- Step 1: Starting at either end of the Habitat Site's "longest length," look for the closest Activity Center or Potential Activity Center. GPS the Activity Center or PAC.
- Step 2: Tally all toilet areas and midden-caches within 15m of the GPSed spot. Also note the rock type (Appendix 2) within and the tree canopy coverage over-top the Activity Center or PAC.
- Step 3: Look for the next closest, non-overlapping (≥ 30 m from nearest other Activity Center or PAC) Activity Center or PAC and continue in the fashion until no more qualifying Activity Center or PACs exist on the Habitat Site. Note, for every 1 km of Habitat Site length, the Centers (from 1 to 10) can be: 1) all Activity Centers with fresh and/or old signs of woodrat activity; **or** they can be: 2) all Potential Activity Centers with qualifying surface rock but no sign of ever being used by woodrats, **or** 3) very likely they will be a combination of 1 and 2. Ten is the maximum number of Centers to GPS within any 1 km stretch of Habitat Site.

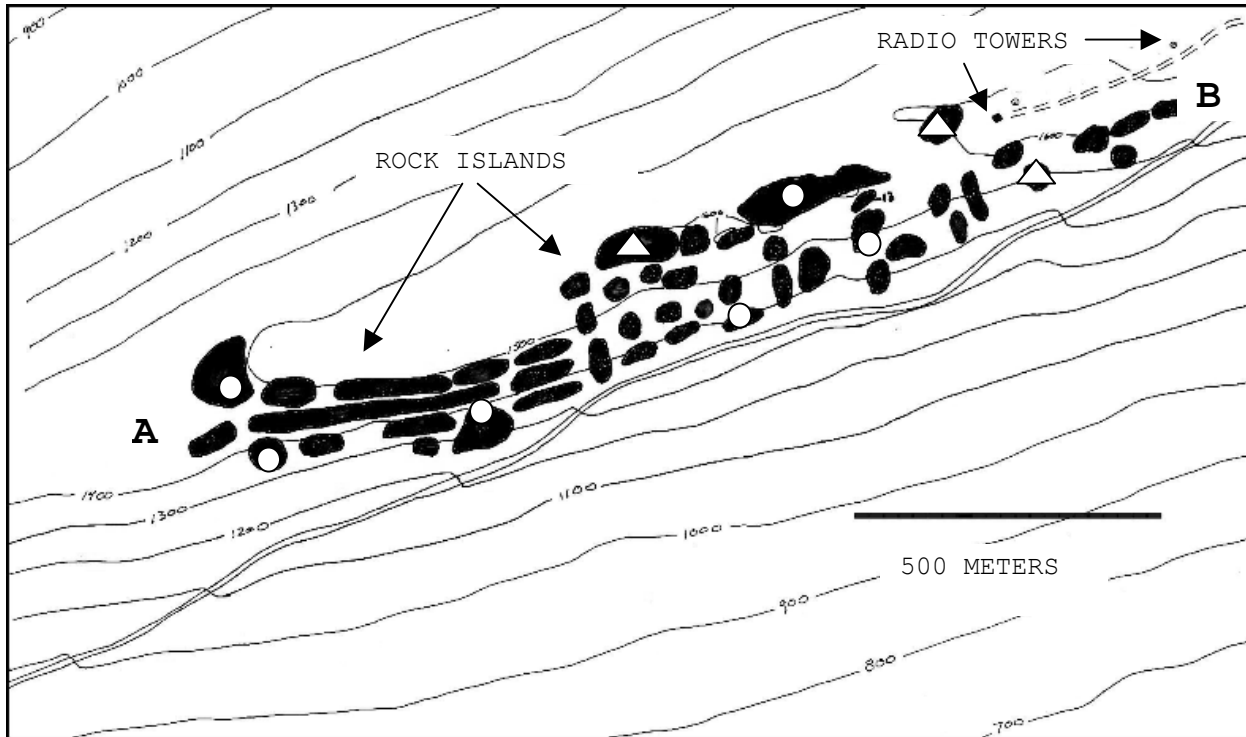
Midden-cache contents: List by indicated category. Be as specific as possible, i.e. sassafras leaves, blackberry twigs, tulip poplar fruits, hay-scented ferns. If you are not sure of the identity of an item, collect it and have it identified.

Vegetation: Be specific. Note anything that is exceptionally abundant such as large patches of fern or blueberries.

Mail Completed Form to:

The Pennsylvania Game Commission
Bureau of Wildlife Management
Wildlife Diversity Section
2001 Elmerton Avenue
Harrisburg, PA 17110-9797

Figure 1. Example: The Ellendale Towers Habitat Site.



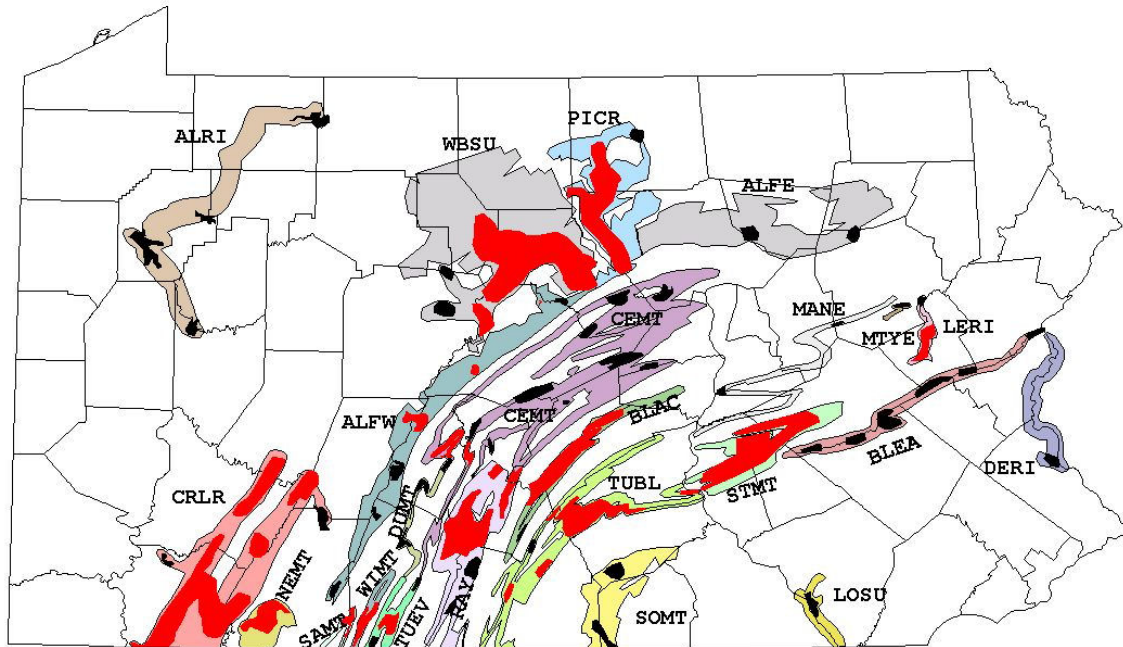
○ = Activity Center with fresh and/or old woodrat sign

△ = Potential Activity Center with “good” rock

Explanation:

- Ellendale Towers (the Habitat Site Name) is a cluster of rock islands treated as a single Habitat Site because each island is within 200 m of one or more adjacent islands.
- The Habitat Site Length is measured from A to B.
- Proceeding from A towards B, 7 Activity Centers and 1 Potential Activity Center were GPSed in the first kilometer. Two Activity Centers and 2 Potential Activity Centers were GPSed in the next 500 meters.

Figure 2. A 2006 map illustrating 23 Conservation Management Areas and 78 Metapopulation Areas.



- Metapopulation Areas**
- Active (N=29)
 - Inactive (N=49)
 - PA Countys
- Conservation Management Areas**
- ALFE=Allegheny Front East
 - ALFW=Allegheny Front West
 - ALRI=Allegheny River
 - BLAC=Blacklog Mountain
 - BLEA=Blue Mountain East
 - CEMT=Central Mountains
 - CRLR=Chestnut/Laurel Ridges
 - DERI=Delaware River
 - DUMT=Dunning Mountain
 - LERI=Lehigh River
 - LOSU=Lower Susquehanna R.
 - MANE=Mahantango/Nescopck Mt.
 - MTYE=Mount Yerger
 - NEMT= Negro Mountain
 - PICR=Pine Creek
 - RAYS=Raystown Branch
 - SAMT=Savage Mountain
 - SOMT=South Mountain
 - STMT=Stony Mountain
 - TUBL=Tuscarora/Blue Mts.
 - TUEV=Tussey/Evitts Mts.
 - WBSU=W. Br. Susquehanna
 - WIMT=Wills Mountain

Table 1. Classification of surface rock habitat.*Enter as a three digit code from the following table.*

<u>HABITAT TYPE</u>	<u>QUALITY OF HABITAT</u>	<u>SIZE OF ROCK</u>
1 talus	11 bare rock, deep interstices	111 blocks less than 1 meter 112 blocks 1-3 meters 113 blocks 3-5 meters
	12 bare rock, shallow interstices	121 blocks less than 1 meter 122 blocks 1-3 meters 123 blocks 3-5 meters
	13 rock covered by organic material including humus, leaves, moss, with deep interstices	131 blocks less than 1 meter 132 blocks 1-3 meters 133 blocks 3-5 meters
	14 rock covered by organic material including humus, leaves, moss, with shallow interstices	141 blocks less than 1 meter 142 blocks 1-3 meters 143 blocks 3-5 meters
2 rock city, large float blocks	21 numerous overhangs, crevices, and "caves"	211 blocks 5-10 meters 212 blocks 10 meters+
	22 few or no overhangs, crevices, and "caves"	221 blocks 5-10 meters 222 blocks 10 meters+
3 cliffs, rock outcrops	31 numerous overhangs, crevices, and "caves"	311 less than 3 meters high 312 3+ meters high
	32 few or no overhangs, crevices, and "caves"	321 less than 3 meters high 322 3+ meters high
4 Cave or mine entrance zone	41 rarely visited, may be gated	411 entrance 0-2 meters 412 entrance 2+ meters
	42 occasionally visited	421 entrance 0-2 meters 422 entrance 2+ meters
	43 active, heavily visited or commercialized	431 entrance 0-2 meters 432 entrance 2+ meters
Quarry or mine pit	51 highwall with numerous crevices, boulders, etc.	511 less than 3 meters high 512 3+ meters high
	52 highwall with few or no crevices, boulders, etc.	521 less than 3 meters high 522 3+ meters high
6 Other man made rocky habitat such as stone walls, railroad and road cuts, buildings, etc.	61 few or no suitable crevices, overhangs, or other interstices	611 less than 3 meters high 612 3+ meters high
	62 numerous suitable crevices, overhangs, or other interstices	621 less than 3 meters high 622 3+ meters high

Table 2. Anderson Level III Land-cover Codes Pertinent To Woodrat Habitat

4 Forest Land	41 deciduous forest	411 sapling stage: shrub land layer moderate to dense 412 sapling stage: grazed and/or shrub layer sparse 413 pole stage: shrub layer moderate to dense 414 pole stage: grazed and/or shrub layer sparse 415 mature stage shrub layer moderate to dense 416 mature stage: grazed and/or shrub layer sparse
	42 evergreen forest land	421 sapling stage: shrub land layer moderate to dense 422 sapling stage: grazed and/or shrub layer sparse 423 pole stage: shrub layer moderate to dense 424 pole stage: grazed and/or shrub layer sparse 425 mature stage shrub layer moderate to dense 426 mature stage: grazed and/or shrub layer sparse
	43 mixed forest land	431 sapling stage: shrub land layer moderate to dense 432 sapling stage: grazed and/or shrub layer sparse 433 pole stage: shrub layer moderate to dense 434 pole stage: grazed and/or shrub layer sparse 435 mature stage shrub layer moderate to dense 436 mature stage: grazed and/or shrub layer sparse
7 Barren land	74 bare exposed rock 75 strip mines, quarries and grade pits 76 transitional areas 77 mixed barren land	740 bare exposed rock 750 strip mines, quarries and grade pits 760 transitional areas 770 mixed barren land

Table 3. Classification of Habitat Disturbance.

Use the category(s) that best defines the site:

Code Number	PROXIMITY OF DISTURBANCE	Code Letter	TYPE OF DISTURBANCE
1	On-site	A	Dumping
2	<100m	B	Party spot
3	100m to 500m	C	Buildings
4	>500m to 1km	D	Agriculture
5	>1km to 2km	E	Utility rights-of-way
6	No significant disturbance	F	Railroad rights-of-way
		G	Improved roads
		H	Unimproved roads
		I	Recreation area
		J	Mining
		K	Fire
		L	Main logging haul road
		M	Concentrated tree mortality
		N	No significant disturbance

Example 1: Pastureland approximately 600 meters from suitable rocky habitat would be coded as **4D**.

Example 2: A rock outcrop/cliff used for beer parties would be coded **1B**.

Example 3: Excellent rocky habitat surrounded by uninterrupted forest for 2 or more kilometers in every direction would be coded **6N**.

Example 4: A main logging haul road and log loading site within 300 meters of the edge of the Habitat Site would be coded **3L**.

APPENDIX B

Forest

Management Guidelines

for the

**Allegheny Woodrat
(*Neotoma magister*)**

MANAGEMENT GUIDELINES FOR THE THREATENED ALLEGHENY WOODRAT

Major objectives for forest managers:

Based on information provided by the PGC Neotoma data-base manager, delineate and map all known Habitat Sites on your forest. GPS new sites (Nad27) and request a PGC survey.

Manage for long term increases in the quantity and quality of *Neotoma* food within and adjacent to active and qualifying inactive Habitat Sites. The highest priority is to increase and sustain hard mast production.

Prevent further and reduce if possible permanent forest perforation and fragmentation within 2 km of woodrat habitat sites.

Install gates to prevent access to caves and mines used by woodrats.

FIVE MANAGEMENT ZONES

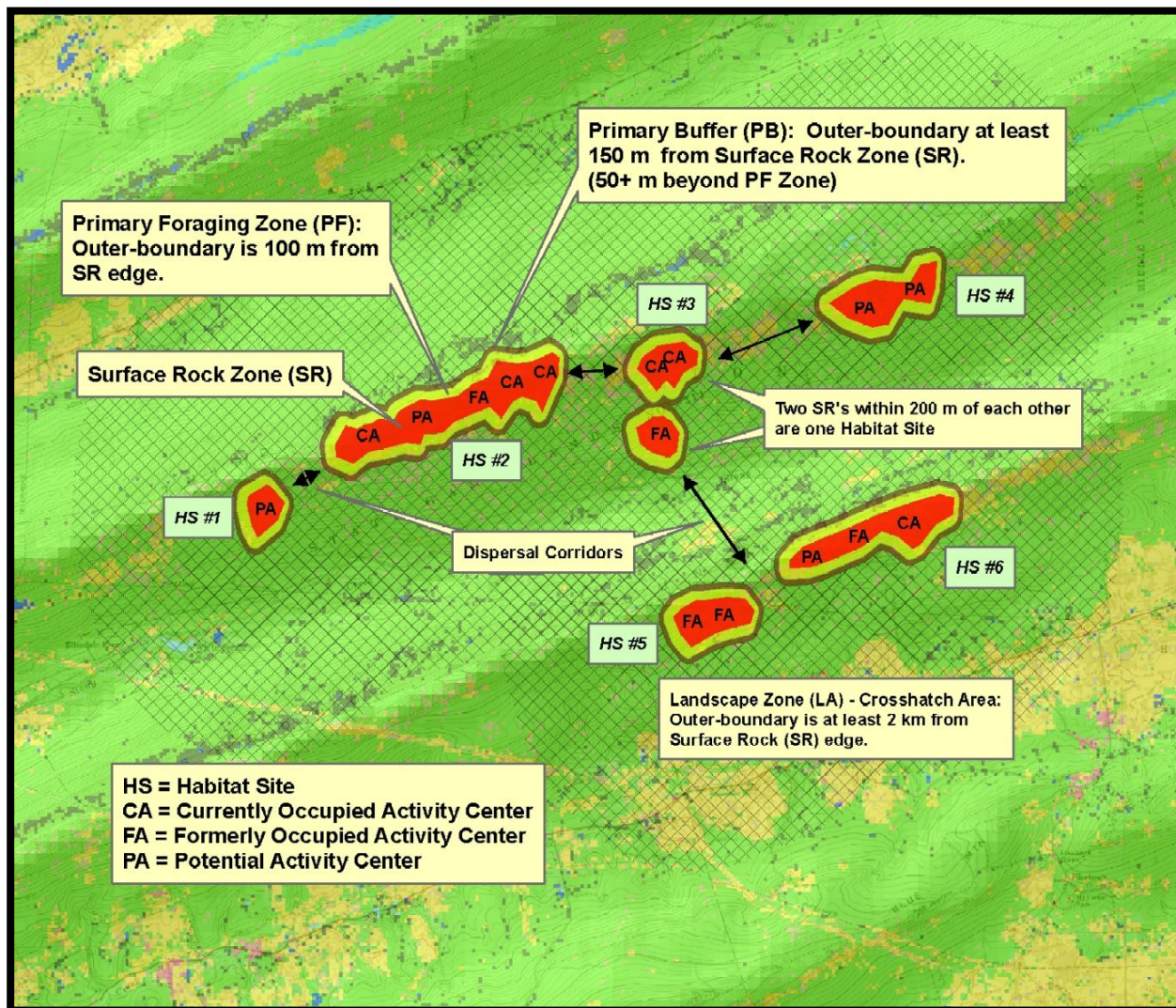


Figure 1. Illustration of surface rock zone, primary foraging zone, primary buffer zone, dispersal corridor zone, and landscape zone that should be considered when managing for the Allegheny woodrat.

1. SR or SURFACE ROCK ZONE (= HABITAT SITE): This zone is primarily (>50%) covered with surface rock. This is where activity centers and den sites are located. For some sites, this is a primary foraging zone. Insofar as practical and possible, positive management within 200 meters of activity centers is the highest priority.

- No harvesting or salvage of trees; cutting can be done to release hard mast producers.
- Red maple is a lower value seed producer; kill or hinge-cut red maples during release cutting.

Figure 2. Remove competing red maple saplings in foreground. The red oak in the background is at a valuable location; acorns may drop into rock crevices where they are primarily available to local *Neotoma*. There are rock and rock-free patches and corridors within larger Habitat Sites. Mast trees, vines, shrubs and herbaceous vegetation in these rock-free stretches have exceptional value for Allegheny Neotomas.



- In areas lacking a canopy or with a thin canopy, find, fertilize and if necessary fence hard mast producing tree seedlings and saplings.
 - Drape grape and Virginia creeper. A grape vine (summer grape *Vitis aestivalis*) draping over rocks is very valuable; fruiting period is September to October. Vines provide valuable cover.
 - Evergreens, particularly hemlock represent cover, food and water; if none are present introduce a few; however every Habitat Site's canopy should predominately consist of deciduous trees and preferably hard mast producers.
 - Cognizant of the Habitat Site's capabilities (xeric or mesic, growing site II or site III) and vegetative diversity, introduce (plant and protect) new soft and hard mast producing shrubs and trees. A few examples include grape, gooseberry, red elderberry, Hercules club, mountain sumac, serviceberry, sassafras, mountain ash, dwarf chestnut oak, and (hopefully) the American chestnut hybrid.
2. PF or PRIMARY/SUPPLEMENTARY FORAGING ZONE: The boundary of this predominately (>50%) rock free zone is 100 meters from the fringe of a Habitat Site. Smaller Habitat Sites (rock piles) may have few on-site management chances. The area around these sites is of particular importance from the standpoint of managing food and cover.
 - Surface Rock zone guidelines (above) also apply to this zone.
 - Use forest management techniques (thinning, release, fencing, planting) to increase the production of hard mast in this zone.
 - Dead wood in the form of brush piles and logs on the forest floor provide cover, travel lanes, and are a substrate for fungi, a major item in *Neotoma* food caches.
 - Not even temporary main haul roads should penetrate this zone.
 3. PB or PRIMARY BUFFER ZONE: The boundary of a primary buffer is 150 meters from the fringing-edge of a Habitat Site. By priority, it's important to first work in the SR and PF zones where most *Neotoma* activity is concentrated.
 - All of the foregoing guidelines apply to this zone; however the emphasis in this zone should be management (cutting and planting) to increase the variety and production of hard mast.
 - Reproduction cuts can penetrate this zone, but at any point in time no more than 25% of this zone should consist of seedlings and saplings. Pile slash, introduce new species of hard mast trees, and fence.

4. DC or DISPERSAL CORRIDOR: Habitat Sites within the same Metapopulation Area need to be connected by variable-width dispersal corridors.
- Longer dispersal corridors should be wider. Starting with a 100 m wide corridor connecting Habitat Sites that are 500 m apart, increase the width by 100 m for each additional 500 meters up to 2 km. A 2 km long corridor will be 400 m wide.
 - Normal forestry operations can occur in corridors with the following provisions: 1) no “new” permanent, main haul road should penetrate a dispersal corridor; and 2) at any point in time the entire length (but not width) of the dispersal corridor should consist of a variable-width strip of pole-sized or older trees.

5. LA or LANDSCAPE ZONE: This zone extends 2 km from the edge of the SR zone.

- Prevent further and reduce if possible permanent forest perforation and fragmentation within 2 km of Neotoma Habitat Sites; 100 percent forest cover (any age-class) is desirable in the landscape zone.

Figure 3. Woodrat subpopulations are likely to go extinct near large (> 100 ac) non-forest openings.

- To the extent possible, minimize further perforation of forest interiors by utility ROWs and permanent main haul roads.

