

**USFS Northern Region 2005 Land Mollusk Inventory: a Progress Report
(Agreement #05-CS-11015600-033)**

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Introduction

The FS is required under the National Forest Management Act (1976) and Code of Federal Regulations (CFR 1985) to maintain a diversity of plant and animal species. Inventory is a first step in the evaluation of landscapes and their likelihood of supporting populations of animal species of conservation concern. Pursuant with this legislation and associated regulations, the Northern Region initiated surveys in 2005 for a suite of land mollusks listed as Species of Concern in Montana and Idaho. Objectives of the 2005 inventory included testing survey methodology, filling species distribution gaps, and collecting geospatial and habitat data for the development of predictive habitat models that can aid future survey efforts. A presentation of the following material was made to the RIM Board at the Regional Office in Missoula on 7 December 2005.

Methods

We conducted field surveys for land mollusks during mid-September to early November 2005, when the weather was most suitable (cool and moist) for finding active snails and slugs. We attempted to visit all 12 National Forests in the Northern Region, so survey effort was stratified by Forest (sometimes by mountain range within a forest) and spread thinly across the inventory area. However, we tended to spend the most time on Forests with the least amount of prior survey effort or distribution information. Forests in Idaho were an exception because we were not aware at the time of our 2005 surveys how much survey history they already had.

We selected sites for surveys based primarily on the presence of perennial water, aspen, and/or limestone talus or outcrops. At each site, we conducted timed surveys while searching under leaf litter, dead wood and bark, rocks imbedded in the ground, or digging into talus. Usually within a survey site we searched several locations with habitat features (such as bryophyte mats, dead wood and imbedded rocks, or talus slopes) considered by experts to be favored by snails and slugs, often concentrating searches in riparian zones.

We recorded a variety of habitat and site information at each survey location on standardized data sheet (Appendix 1). Survey data have been entered into the Montana Natural Heritage Program Point Observation Database (POD); copies of the Idaho POD data have been sent to the Idaho Conservation Data Center (CDC) in Boise. We collected voucher specimens of all Species of Concern (SOC) that we discovered, as well as representatives of many other non-SOC taxa.; vouchers were preserved in 95% ETOH in order to permit future genetic analyses. We sent all slug specimens from Idaho and Montana west of the Continental Divide to taxonomic experts, and their identifications have been verified.

Henning Stabins (Plum Creek Timber Company) and the Amphibian Inventory Project provided us with additional records of SOC mollusk species. Susan Lenard and Matt Gates (both MTNHP) conducted some of the 2005 surveys. Bill Bosworth of the Idaho CDC provided us with location data on SOC species tracked in Idaho, and these records were critical for representing the current state of knowledge for Idaho mollusks in the distribution maps (Appendix 2).

Results and Discussion

Using Hendricks (2003) and the NatureServe web site as starting points, we compiled a list of 29 snail taxa within the Northern Region area ranked G1-G3 or T1-T3, thereby meeting USFS SOC criteria, and two additional G5 snail taxa ranked S1-S2, thereby meeting USFS Species of Interest (SOI) criteria (see Table 1). Two additional potential SOC taxa await verification and are not listed in Table 1. We also compiled a list of eight slug taxa ranked G1-G3, and three additional slug taxa ranked G4-G5 but S1-S2, again meeting the respective USFS criteria for SOC or SOI.

We conducted a total of 108 site surveys in 2005. These were distributed on the Montana Forests as follows: Beaverhead-Deerlodge (13), Bitterroot (0), Custer (8), Flathead (9), Gallatin (17), Helena (13), Kootenai (5), Lewis & Clark (19), Lolo (1). We distributed surveys on the Idaho Forests as follows: Clearwater (11), Idaho Panhandle (4), Nez Perce (8). We documented 83 new locations for ten SoC taxa and three SoI taxa during our 2005 surveys (Table 2); most of these are from west of the Continental Divide in mesic forest habitats (e.g., western redcedar, western hemlock, mesic Douglas-fir, grand fir). Of these, two SOC and one SOI slug species (all discovered on the Kootenai NF) are new to the known mollusk fauna of Montana. At least some SOI G4-G5 taxa found during our 2005 surveys may prove to be distinct from related coastal populations, as their disjunct distributions are similar to some vertebrate amphibian taxa (e.g., *Dicamptodon*, *Ascaphus*, *Plethodon*) now split into coastal and Rocky Mountain sister species. Thus, we think it desirable to conduct genetic analyses of several mollusk SOC and SOI taxa to determine if they represent forms that merit full species status.

We have also completed an initial summary of habitat associations of all SOC and SOI land mollusk taxa we have identified to date that have been documented on or near Northern Region lands (Table 3). We anticipate that this table will require refinement as additional information is compiled. Our goal is to make this habitat matrix as useful as possible for District Biologists to quickly assess potential habitat features that may require inventory or surveys prior to management activities in areas under their jurisdiction.

Finally, we compiled all location data available to us and generated distribution maps showing prior records and those collected during 2005 (Appendix 2). Additional records from other researchers remain to be incorporated in these maps, especially for Idaho, and we have begun contacting them for their data.

Future Directions

Besides producing a summary document for the 2005 inventory, we anticipate developing an illustrated field guide and/or poster that will aid District Biologists in future survey work they

conduct targeting SOC and SOI land mollusks; similar information and illustrations will be made available in the Montana Natural Heritage Program on-line Animal Field Guide.

We think an additional year of non-random surveys, similar to those of 2005, is needed to fill distribution gaps and gather additional habitat information. Two additional years of random site surveys (beyond the one of non-random surveys) are needed in order to validly document species distributions and habitat associations, as well as to determine site occupancy rates as a measure of status in various habitats. Using the habitat information, we can design a scheme for conducting random site-surveys and determining site occupancy probabilities. Developing predictive habitat models may also prove useful for some species groups, especially those associated with the mesic forest types mentioned earlier.

Survey and modeling efforts should be coordinated with the Idaho CDC, as well as MTNHP, as the Idaho CDC expertise with the Idaho land mollusk fauna exceeds ours. There is a need for genetic studies to inform current taxonomy of some species; we think some taxa currently considered conspecific with coastal populations may prove to be distinct sister species. Finally, we think it would be useful to conduct some workshops on land mollusk identification and management. This will heighten awareness of this overlooked and poorly understood group of animals, and provide biologists and managers some of the basic tools they need to make informed management decisions.

Reference Cited

CFR (Code of Federal Regulations). 1985. 36 Code of Federal Regulations. Chapter II
2119.19:64.

Hendricks, P. 2003. Status and conservation management of terrestrial mollusks of Special Concern in Montana. Report to Region I, U.S. Forest Service. Montana Natural Heritage Program, Helena. 67 pp. + appendices.

Table 1. Heritage Species-of-Concern land mollusks: distribution by Forest in Region 1.

SPECIES	G RANK	Montana ^a									Idaho ^b			
		B-D	BI	CU	FL	GA	HE	KO	L-C	LO	CL	I-P	N-P	
Snails														
<i>Allogona lombardii</i> (ID)	G1													X
<i>Allogona ptychophora solida</i> (ID)?	G5T2T3													?
<i>Anguispira nimapuna</i> (ID)	G1											X		X
<i>Cryptomastix harfordiana</i> (ID)?	G3G4													?
<i>Cryptomastix magnidentata</i> (ID)?	G1													?
<i>Cryptomastix mullani blandi</i> (ID)?	G4T1												?	
<i>Cryptomastix mullani clappi</i> (ID)	G4T1													X
<i>Cryptomastix sanburni</i> (ID)?	G1												?	
<i>Discus brunsoni</i> (MT)?	G1 S1				?									
<i>Discus marmorensis</i> (ID)	G1G3													X
<i>Discus shimekii</i> (MT, ID)?	G5 S1					X		X					?	
<i>Helicodiscus salmonaceus</i> (ID)	G1G2													X
<i>Oreohelix alpina</i> (MT)	G1 S1				X									
<i>Oreohelix amariradix</i> (MT)	G1G2 S1S2											X		
<i>Oreohelix carinifera</i> (MT)	G1 S1											X		
<i>Oreohelix elrodi</i> (MT)	G1 S1				X									
<i>Oreohelix hammeri</i> (ID)	G1													X
<i>Oreohelix idahoensis baileyi</i> (ID)	G1G2T1													X
<i>Oreohelix idahoensis idahoensis</i> (ID)?	G1G2T1T2													?
<i>Oreohelix intersum</i> (ID)?	G1													?
<i>Oreohelix jugalis</i> (ID)?	G1													?
<i>Oreohelix strigosa berryi</i> (MT)	G5T2 S1S2			X		X	X			X				
<i>Oreohelix strigosa goniogyra</i> (ID)	G5T1Q													X
<i>Oreohelix vortex</i> (ID)?	G1G3													?
<i>Oreohelix waltoni</i> (ID)?	G1G3													?
<i>Oreohelix yavapai mariae</i> (MT)	G4T1 R S1					X								
<i>Haplotrema vancouverense</i> * (MT, ID)	G5 (S1S2)							X				X	X	
<i>Planogyra clappi</i> (ID)	G3G4													X
<i>Polygyrella polygyrella</i> (MT, ID)	G3 S1S3										X	X		X
<i>Pristiloma idahoense</i> (ID)	G2G3													X
<i>Radiodiscus abietum</i> (MT, ID)	G4 S2S3		X		X			X			X	X	X	X
Slugs														
<i>Hemphillia danielsi</i> (MT)	G2G3 S1S3		X								?			
<i>Hemphillia camelus</i> * (MT, ID)	G4 (S1S2)							X			X	X	X	X
<i>Kootenaia burkei</i> * (MT, ID)	G2 (S1S2)							X					X	
<i>Magnipelta mycophaga</i> (MT, ID)	G3 S1S3		X		X			X			X	X	X	
<i>Prophysaon andersoni</i> * (MT, ID)	G5 (S1S3)							X					?	
<i>Prophysaon coeruleum</i> (ID)	G4													X
<i>Prophysaon dubium</i> (ID)	G4													X
<i>Prophysaon humile</i> * (MT, ID)	G3 (S2S3)				X			X			X	X	X	X
<i>Udosarx lyrata lyrata</i> (MT, ID)	G2T2 (S1S2)		X								?	X		
<i>Udosarx lyrata russelli</i> (MT)?	G2T1 (S1S2)										?			
<i>Zacoleus idahoensis</i> (MT, ID)	G3G4 S2S3	X						X			X	X	X	X

^a Montana Forests codes: Beaverhead-Deerlodge (B-D), Bitterroot (BI), Custer (CU), Flathead (FL), Gallatin (GA), Helena (HE), Kootenai (KO), Lewis & Clark (L-C), Lolo (LO).

^b Idaho Forest codes: Clearwater (CL), Idaho Panhandle (I-P), Nez Perce (N-P).

* new species for Montana SoC list

? taxon apparently not yet recorded on USFS Region 1 lands, but in area and should be looked for

Table 2. Number of survey sites where Heritage Species-of-Concern land mollusks were detected on Northern Region Forests during the 2005 survey (n = 108 sites). Species common names in bold are new to the Montana fauna.

SPECIES	G RANK	Montana ^a										Idaho ^b		
		B-D	BI	CU	FL	GA	HE	KO	L-C	LO	CL	I-P	N-P	
SNAILS														
Selway Forestsnail														
<i>Allogona lombardii</i> (ID)	G1													
Nimapuna Tigersnail	G1													3
<i>Anguispira nimapuna</i> (ID)													1	3
Striate Disc	G5				1									
<i>Discus shimelii</i> (MT, ID?)														
Berry's Mountainsnail	G5T2			1										
<i>Oreohelix strigosa berryi</i> (MT)									4					
Robust Lancetooth	G5												2	2
<i>Haplotrema vancouverense</i> (MT, ID)													3	3
Humped Coin	G2G3												6	3
<i>Polygyrella polygyrella</i> (MT, ID)													3	3
Fir Pinwheel	G3				1								6	3
<i>Radiodiscus abietum</i> (MT, ID)									4				2	2
SLUGS														
Pale Jumping-slug	G3G4												2	5
<i>Hemphillia camelus</i> (MT, ID)													1	2
Pygmy Slug	G1G2												4	2
<i>Kootenata burkei</i> (MT, ID)													1	
Reticulate Taildropper	G5												1	
<i>Proplysaon andersoni</i> (MT, ID)													1	
Smoky Taildropper	G2												1	2
<i>Proplysaon humile</i> (MT, ID)													5	1
Lyre-Mantleslug	G2T2												6	2
<i>Udosarx lyrata lyrata</i> (MT, ID)													2	2
Sheathed Slug	G3G4												5	2
<i>Zacoleus idahoensis</i> (MT, ID)													2	2

^a Montana Forests codes: Beaverhead-Deerlodge (B-D), Bitterroot (BI), Custer (CU), Flathead (FL), Gallatin (GA), Helena (HE), Kootenai (KO), Lewis & Clark (L-C), Lolo (LO).
^b Idaho Forest codes: Clearwater (CL), Idaho Panhandle (I-P), Nez Perce (N-P).

Table 3. Heritage Species-of-Concern land mollusks: habitat associations.

Species	G Ranks	Moist Mixed-conifer Forest Riparian			Aspen	Dry Mixed-conifer Forest			Limestone Talus*
		Cedar- hemlock ,grand fir, Douglas- fir	Spruc e-fir	Talus- rocky ground		Ponderos a pine, Douglas- fir	Juniper- sage	Talus- rocky ground	
SNAILS									
<i>Allogona lombardii</i> (ID)	G1	x							
<i>Allogona ptychophora solida</i> (ID)?	G5T2T3						x	x	
<i>Anguispira nimapuna</i> (ID)	G1	x		x		x		x	
<i>Cryptomastix harfordiana</i> (ID)?	G3G4							x	x
<i>Cryptomastix magnidentata</i> (ID)?	G1			x				x	x
<i>Cryptomastix mullani blandi</i> (ID)?	G4T1			x					
<i>Cryptomastix mullani clappi</i> (ID)	G4T1							x	
<i>Cryptomastix sanburni</i> (ID)?	G1			x					
<i>Discus brunsoni</i> (MT)?	G1			x					
<i>Discus marmorensis</i> (ID)	G1G3	x		x		x			x
<i>Discus shimekii</i> (MT, ID?)	G5				x	x			
<i>Helicodiscus salmonaceus</i> (ID)	G1G2			x				x	
<i>Oreohelix alpina</i> (MT)	G1			x					x
<i>Oreohelix amariradix</i> (MT)	G1G2					x		x	
<i>Oreohelix carinifera</i> (MT)	G1					x	x	x	x
<i>Oreohelix elrodi</i> (MT)	G1			x					
<i>Oreohelix hammeri</i> (ID)	G1							x	x
<i>Oreohelix idahoensis baileyi</i> (ID)	G1G2T1							x	x
<i>O. i. idahoensis</i> (ID)?	G1G2T1T2						x	x	x
<i>Oreohelix intersum</i> (ID)?	G1							x	
<i>Oreohelix jugalis</i> (ID)?	G1G2							x	
<i>Oreohelix strigosa berryi</i> (MT)	G5T2					x		x	x
<i>O. s. goniogyra</i> (ID)	G5T1Q					x		x	
<i>Oreohelix vortex</i> (ID)?	G1G3							x	
<i>Oreohelix waltoni</i> (ID)?	G1G3						x	x	
<i>Oreohelix yavapai mariae</i> (MT)	G4T1							x	x
<i>Haplotrema vancouverense</i> (MT, ID)#	G5	x							
<i>Planogyra clappi</i> (ID)	G3G4	x							
<i>Polygyrella polygyrella</i> (MT, ID)	G2G3	x	x	x				x	
<i>Pristiloma idahoense</i> (ID)	G2	x		x					
<i>Radiodiscus abietum</i> (MT, ID)	G3	x	x	x					
SLUGS									
<i>Hemphillia danielsi</i> (MT)	G2G3	x	x						
<i>Hemphillia camelus</i> (MT, ID)	G3G4	x	x						
<i>Kootenaia burkei</i> (MT, ID)	G1G2	x							
<i>Magnipelta magnipelta</i> (MT, ID)	G3	x	x	x		x			
<i>Prophysaon andersoni</i> (MT, ID)#	G5	x							
<i>Prophysaon coeruleum</i> (ID)#	G4	x							
<i>Prophysaon dubium</i> (ID)#	G4	x		x					
<i>Prophysaon humile</i> (MT, ID)	G2	x	x	x					
<i>Udosarx lyrata lyrata</i> (MT, ID)	G2T2	x	x						
<i>U. l. russelli</i> (MT)?	G2T1			x		x			
<i>Zacoleus idahoensis</i> (MT, ID)	G3G4	x	x						

These low G-rank taxa may prove to be distinct from coastal populations, as their disjunct distributions are similar to some vertebrate taxa (e.g. *Dicamptodon*, *Ascapus*, *Plethodon*) now split into coastal and Rocky Mountain sister species.

*Limestone talus associates may occur in either dry or moist sites, but are most often limestone or limestone-derived soil obligates.

Appendix 1

Data Sheets

Data Form for Terrestrial Mollusk Site Surveys

Locality Information

Ecoregion:	Sample Block:	Site No:	Locality:			
State:	County:	Map Name:	T	R	S	Section Description:
Owner:	Map Elevation:	FT	Datum:	UTM Zone:	UTM East:	UTM North:

Habitat Information

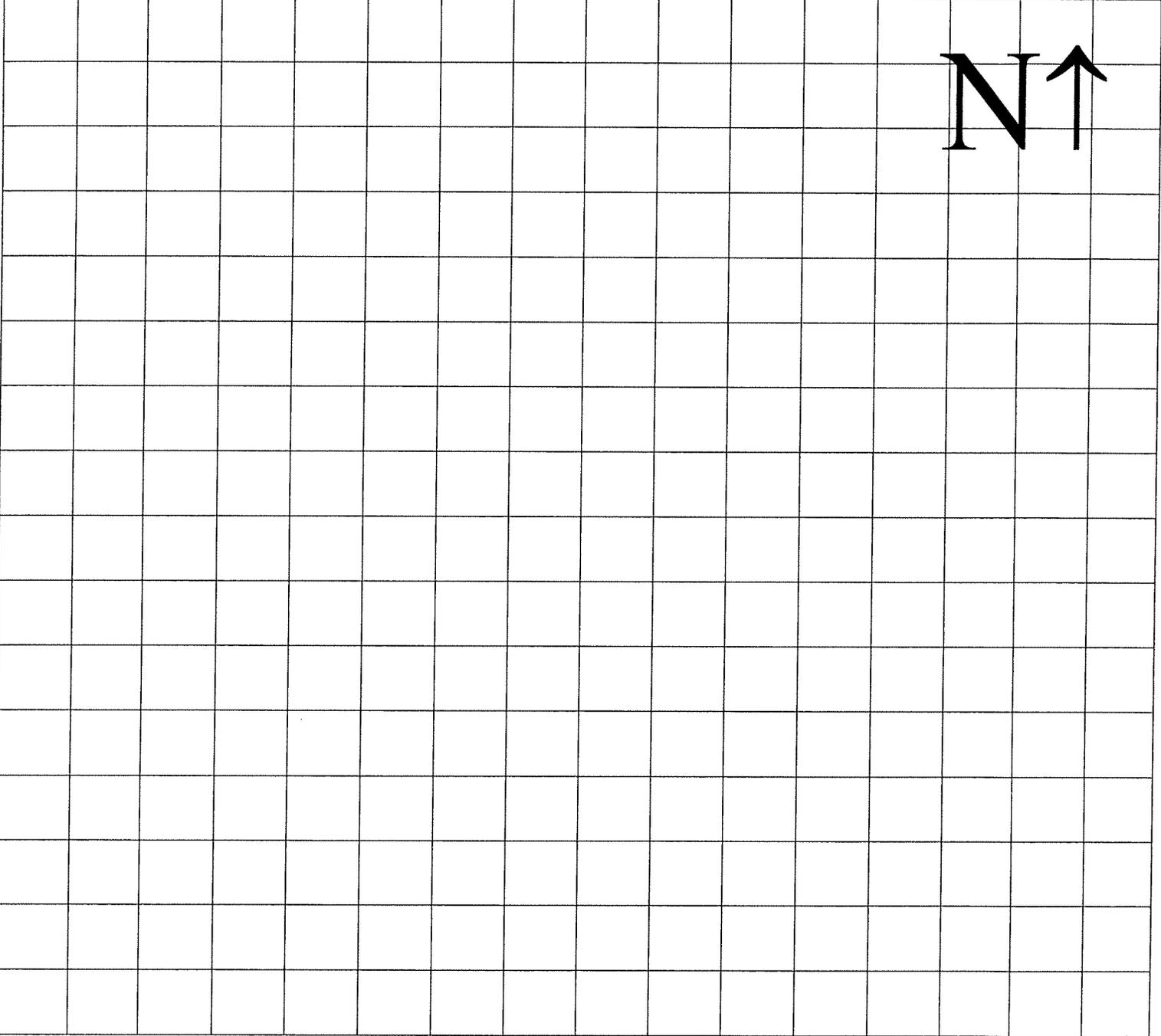
Date:	Observer(s)	Begin Time:	End Time:	Total Person Minutes of Search:	Area (M ²) Searched:
Percentage of Site Searched: 1-25 26-50 51-75 76-100		Percent Slope:	Aspect: N NE NW S SE SW E W		
Habitat Type: Spring/Seep Streamside Talus Deciduous Forest Conifer Forest Mixed Forest Shrub/Steppe Grassland Other					
Primary Canopy Species:				Overall Percent Canopy Cover:	
				0 1-25 26-50 51-75 76-100	
				Canopy Species Average DBH (cm):	
				0-5 5-15 15-30 30-60 >60	
Photo Frame Number(s) / Description(s):					
Weather: Clear Partly Cloudy Overcast Rain Snow				Air Temp: °C	
Soil Moisture: Dry Damp Wet Standing Water Snow				Soil Temp: °C	
Rock Type: Igneous Metamorphic Sedimentary			Note Specific Type (e.g. limestone, granite):		
Habitat Threats:					

Mollusk Species Information

Species:	Number Alive and/or Dead, Size, and Time at First Detection (e.g., 2 alive & 4 dead x 15mm Diameter or TL @ 10 minutes)				
Tissue Number (e.g., H001A)	Substrate Association (Circle):				
Voucher Number & Description:	under wood	under 4-20cm rock fragments	under >20cm rock fragments	under bryophyte mat on bryophyte mat in rock fracture Other _____	
Species:	Number Alive and/or Dead, Size, and Time at First Detection (e.g., 2 alive & 4 dead x 15mm Diameter or TL @ 10 minutes)				
Tissue Number (e.g., H001A)	Substrate Association (Circle):				
Voucher Number & Description:	under wood	under 4-20cm rock fragments	under >20cm rock fragments	under bryophyte mat on bryophyte mat in rock fracture Other _____	
Species:	Number Alive and/or Dead, Size, and Time at First Detection (e.g., 2 alive & 4 dead x 15mm Diameter or TL @ 10 minutes)				
Tissue Number (e.g., LC001A)	Substrate Association (Circle):				
Voucher Number & Description:	under wood	under 4-20cm rock fragments	under >20cm rock fragments	under bryophyte mat on bryophyte mat in rock fracture Other _____	
Species:	Number Alive and/or Dead, Size, and Time at First Detection (e.g., 2 alive & 4 dead x 15mm Diameter or TL @ 10 minutes)				
Tissue Number (e.g., G001A)	Substrate Association (Circle):				
Voucher Number & Description:	under wood	under 4-20cm rock fragments	under >20cm rock fragments	under bryophyte mat on bryophyte mat in rock fracture Other _____	

Site Map for Terrestrial Mollusk Site Surveys

Grid Scale:



* Draw a rough sketch of the site labeling major features such as streams, talus slopes, habitat cover types, etc. Be sure to indicate where animals were detected and label the following locations on the map: **G** = GPS reading, and **P→** = photo locations and directions of photos.

Other Notes:

Site ID (ecoregion, sample block, site number) _____ Date: _____

Mollusk Species Information Continued

Species:		Number Alive and/or Dead, Size, and Time at First Detection (e.g., 2 alive & 4 dead x 15mm Diameter or TL @ 10 minutes)		
Tissue Number (e.g., H001A)		Substrate Association (Circle):		
Voucher Number & Description:		under wood	under 4-20cm rock fragments	under >20cm rock fragments
		under bryophyte mat	on bryophyte mat	in rock fracture Other _____
Species:		Number Alive and/or Dead, Size, and Time at First Detection (e.g., 2 alive & 4 dead x 15mm Diameter or TL @ 10 minutes)		
Tissue Number (e.g., H001A)		Substrate Association (Circle):		
Voucher Number & Description:		under wood	under 4-20cm rock fragments	under >20cm rock fragments
		under bryophyte mat	on bryophyte mat	in rock fracture Other _____
Species:		Number Alive and/or Dead, Size, and Time at First Detection (e.g., 2 alive & 4 dead x 15mm Diameter or TL @ 10 minutes)		
Tissue Number (e.g., LC001A)		Substrate Association (Circle):		
Voucher Number & Description:		under wood	under 4-20cm rock fragments	under >20cm rock fragments
		under bryophyte mat	on bryophyte mat	in rock fracture Other _____
Species:		Number Alive and/or Dead, Size, and Time at First Detection (e.g., 2 alive & 4 dead x 15mm Diameter or TL @ 10 minutes)		
Tissue Number (e.g., G001A)		Substrate Association (Circle):		
Voucher Number & Description:		under wood	under 4-20cm rock fragments	under >20cm rock fragments
		under bryophyte mat	on bryophyte mat	in rock fracture Other _____

Other Species Information

Other Species: (millipedes etc.)	Time at First Detection:	Voucher Number:	Voucher Description / Comments:
Other Species: (millipedes etc.)	Time at First Detection:	Voucher Number:	Voucher Description / Comments:
Other Species: (millipedes etc.)	Time at First Detection:	Voucher Number:	Voucher Description / Comments:
Other Species: (millipedes etc.)	Time at First Detection:	Voucher Number:	Voucher Description / Comments:
Other Species: (millipedes etc.)	Time at First Detection:	Voucher Number:	Voucher Description / Comments:
Other Species: (millipedes etc.)	Time at First Detection:	Voucher Number:	Voucher Description / Comments:
Other Species: (millipedes etc.)	Time at First Detection:	Voucher Number:	Voucher Description / Comments:

Other Notes:

Site Information

Ecoregion: One of the 14 ecoregion sections in Montana or 6 in the Idaho Panhandle.

Sample Block: Identify three digit number of the sampling block (range 001-999).

Site No: Identify three digit number of the site being surveyed within each sampling block (range 001-999).

Locality: Describe the specific geographic location of the site so that the type of site is described and the straight-line air distance from one or more permanent features on a 7.5-minute (1:24,000 scale) topographic map records the position of the site (e.g., Large talus slope 1.5 miles north of Engle Peak, N side of FS Road 225).

State: Use the two-letter abbreviation.

County: Use the full county name.

Map Name: List the name of the USGS 7.5-minute (1:24,000 scale) topographic quadrangle map.

T: Record the Township number and whether it is north or south.

R: Record the Range number and whether it is east or west.

S: Record the Section number

Section Description: Describe location of the site at the $\frac{1}{4}$ of $\frac{1}{4}$ section level (e.g., SENE indicates SE corner of NE corner).

Owner: Use abbreviation of the government agency responsible for managing the land you surveyed. (e.g. USFS, BLM). If private land was surveyed list the owner's full name to indicate that you did not trespass.

Map Elevation: The elevation of the site as indicated by the topographic map in feet (avoid using elevations from a GPS)

Datum: The map datum used (typically NAD 27 if off topographic map or WGS84 if off GPS unit on standard setting).

UTM Zone: Universal Transverse Mercator zone recorded on the topographic map.

UTM East: Universal Transverse Mercator easting coordinate in meters as recorded on the topographic map or GPS receiver. Be sure to note any major differences between UTM coordinates on the map and those on the GPS receiver.

UTM North: Universal Transverse Mercator northing coordinate in meters as recorded on the topographic map or GPS receiver. Be sure to note any major differences between UTM coordinates on the map and those on the GPS receiver.

Survey Information

Date: Use MM-DD-YY format (e.g. 05/12/00 for May 12 of 2000).

Observers: List names or initials of individuals involved with survey of this site and circle the name of the recorder.

Begin Time: List the time the survey began in 24-hour format.

End Time: List the time the survey ended in 24-hour format.

Total Person Minutes of Search: Record the total person minutes the site was searched (e.g. if one person surveys for 15 minutes and another surveys for 30 minutes, but takes 5 minutes to measure a specimen the total person minutes is 40 minutes).

Area (M²) Searched: Area in square meters that was surveyed.

Percent of Site Searched: Circle the appropriate category.

Percent Slope: Percent slope of site. Enter range if variable.

Aspect: Circle primary aspect of the site.

Habitat Type: Circle the appropriate habitat type.

Primary Canopy Species: List the major plant species in the canopy (e.g., red cedar, western hemlock, grand fir, ninebark)

Overall Percent Canopy Cover: Circle the appropriate category for total canopy cover.

Canopy Species Average DBH: Circle the appropriate category.

Photo Frame Number(s) / Descriptions: The number of the photo as viewed on the camera's view screen and a description of the contents of the photograph (e.g., #13 = 1 x *Oreohelix strigosa* and #14-18 = 5 x habitat). Take photos of all portions of the site and anything else that may be of interest (e.g., millipedes, potential site threats).

Weather: Circle weather condition during survey.

Air Temp: Record air temperature in °C at chest height in the shade. °C = (°F - 32)/1.8

Soil Temp: Record soil temperature in °C at 10 cm depth. °C = (°F - 32)/1.8

Soil Moisture: Circle the appropriate category.

Rock Type: Circle the appropriate category; note specific type if known.

Habitat Threats: Note impacts from grazing, logging, mining, flooding, road building, weeds, fire, etc.

Species Information

For each species, record the genus name and species, if known. If species cannot be identified in the field, place a brief description of their morphology here. Record the number alive and dead, and size range for individuals encountered, and time at first detection for the first individual encountered (e.g., 2 x 15 mm diameter (shells) or TL = 80-90mm (slugs): @ 10 minutes). Record the tissue number or range of tissue numbers for tissue samples collected (see tissue collection protocols). Record the preliminary museum voucher specimen number and description for voucher specimens collected (see voucher specimen collection protocols). Circle the substrate the animal was associated with at time of detection. Record the presence of other species detected at the site (e.g., millipedes), the time at first detection, and the voucher number and description of animals collected (see voucher and tissue collection protocols).

Appendix 2
Distribution Maps