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Land Snail Survey of Select Niagaran Escarpment
and Related Sites in Hiawatha National Forest, Mackinac County

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October 13, 2008

Introduction

Studies have shown, in Iowa, Wisconsin, Michigan and Ontario that the diversity of land snails on carbonate cliffs, with approximately 1/3 harboring 24 or more taxa, can be of global significance (Tattersfield, 1996). While many of these sites are pristine, others have been impacted by anthropogenic forces. Snail habitat is particularly susceptible to disturbance, especially changes in moisture, and has been shown to be some of the most fragile known to man (Frest and Johannes 1995). Logging can potentially cause drying by increasing the amount and intensity of wind and sun impacting a site. Since many snails rely on a cool, moist microclimate, any disturbance can be detrimental to them and their habitat. Therefore, any potential impacts need to be mitigated.

The St. Ignace District of the Hiawatha National Forest solicited surveys to provide guidance in their new management plan for this area. Sites surveyed were contained within management blocks proposed to be harvested for timber. Data gathered would be used to prioritize sites for protection, including limiting the type of harvesting and implementing buffers around the sites. Additionally, biologists were trying to develop methods to assess the quality of habitat and likelihood of high snail diversity or sensitive species when surveying potential sites in the future. This assessment would hopefully be done without the time-consuming process of a complete site survey for snails, and could be done by a Forest Service Wildlife Biologist or technician.

This report summarizes the results of surveys performed from May 8-11, 2008 in Mackinac County. These sites were mainly ledges, cliffs and fractured pavement associated with Devonian-age Niagaran Escarpment limestone. These results will not only inform managers, but also provide a better understanding of the distribution of rare land snail species in Michigan.

Methods

Sites were selected by following recommendations by Derek Heubner, Wildlife Biologist for the Hiawatha National Forest. This list was compiled by surveying other biologists and foresters with the St. Ignace office. Many sites were also added by referencing a list of sites that were surveyed for Heart's Tongue Fern, a federally listed species. These sites were then prioritized based on site quality and ease of access to maximize the number of highest priority (and/or quality) sites that would be included in this survey.

Surveys were completed May 8- May 10, 2008. A total of 27 sites were visited and described as part of the survey. 13 of the 27 sites were sampled to determine species diversity. Sites visited by previous researchers were excluded, as data already exists. The decision to sample a site for diversity was based on microclimatic, geologic and vegetative parameters that have been shown to indicate high species diversity. Sites of lesser apparent quality were also included in an attempt to more precisely establish parameters for biologists to use when identifying potential habitat.

Field Methods

At each site, photos were taken and the general geology of the site was described. General canopy, understory and groundcover species were noted along with a rating potential (from 1 to 5) to see if the apparent attributes of the site expressed themselves in species richness or diversity. Slope and aspect were noted to potentially show relationships with diversity. Groundcover noted was only the most common species and was intended to give a general sense of the soil richness of the site. At each site, one 4L sampling bag was filled with leaf litter from the most favorable microhabitats. Those include interstitial spaces, moss-covered ledges, pockets under and within talus, and fractures or fissures. Any of these that contain cool, moist organic soil or leaf litter are excellent candidates. Where applicable, as many of these different microhabitats were sampled at a site.

Lab Procedures

Each bag is then dried at 250 F for 24 hours. They are then sieved through a standard sieve series (ASTME 9.5 mm, 2.0 mm, .85 mm and .425 mm) and picked against a neutral background tray. All shells and shell fragments were removed, including immatures. Shells were then sorted and identified using a compound binocular microscope with 100x capability. Identifications follow Pilsbry's Land Mollusca of North America (1948). All shells were identified to the highest level possible. Specimens will be housed either at the Hiawatha National Forest office in St. Ignace or at the collections of All Things Wild Consulting (see address and contact information on cover page).

Site Descriptions

Ledge Crop

UTM 16 T 0670047 5107855

This site was a 1-2 m tall ledge associated with many other 1-3 m scattered boulders. On top of the ledge were some other fractures and fissures that were also sampled.

Overstory: Acer, Fagus

Ground Cover: Erythronium, Claytonia virginica

Aspect: 61 Slope: 0

Rating: 1/2

Species Noted:

Anguispira alternata

Columella simplex

Cochlicopa lubrica

Discus catskillensis

Euconulus alderi

Euconulus polygyratus

Gastrocopta contracta

Glyphylinia indentata

Hawaiia miniscula

Helicodiscus paralellus

Helicodiscus shimeki

Nesovitrea binneyana

Nesovitrea electrina

Paravitrea multidentata

Stenotrema cf. fraternum

Striatura exigua

Striatura milium

Strobilops labyrinthica

Zonitoides arboreus

Vertigo gouldi

Kenneth Rd. Cliff

UTM 16 T 0663703 5107414

A 2-3 m limestone ledge, with a subtending talus slope with 1-2 m class boulders characterize this site. There were many mossy ledges on the cliff face and many interstitial spaces in the talus.

Overstory: Thuja, Acer

Ground Cover: Maianthemum canadense, Claytonia virginica

Aspect: 222 Slope: 4

Rating: 3/4

Species Noted:

Anguispira alternata

Carychium exile canadense

Discus catskillensis

Euconulus fulvus

Helicodiscus paralellus

Nesovitrea binneyana

Punctum minutissimum

Striatura milium

Strobilops labyrinthica

Vitrina limpida

Zonitoides arboreus

Vertigo gouldi

Vertigo paradoxa

Kenneth Rd. Alvar

This site is directly adjacent to the Kenneth Rd. cliff site. Along the top of the cliff, on the way back toward the road, this sample was taken to determine the potential of fractured bedrock to hold unique snail faunas.

Species Noted:

Cochlicopa lubrica
Discus catskillensis
Euconulus fulvus
Helicodiscus paralellus
Nesovitrea binneyana
Striatura exigua

Striatura ferrea
Strobilops labyrinthica
Vertigo sp.
Vitrina limpida
Zonitoides arboreus

Heart's Tongue Alvar

UTM 16 T 0670963 5109156

This site was a rich upland maple stand with many deep fissures in the bedrock. Heart's Tongue Fern was located at the site as well.

Overstory: Acer, Fagus

Ground Cover: Trillium grandiflorum, Viola, Allium tricoccum

Aspect: 2 Slope: 1

Rating: 2

Species Noted:

Columella simplex

Discus catskillensis

Gastrocopta contracta

Glyphylinia indentata

Helicodiscus paralellus

Paravitrea multidentata

Striatura exigua

Striatura milium

Strobilops labyrinthica

Vitrina limpida

Zonitoides arboreus

Zoogenetes harpa

Vertigo gouldi

Maple Hill South

UTM 16 T 0670919 5113136

This site was a 1-2 m mossy limestone outcrop/ledge. There was also a 2 m deep fissure and other associated fissures nearby with good cover. Maple Hill is nearby and is known to be very malacologically diverse (Nekola, 1998) and is being protected by the Forest Service.

Overstory: Acer, Fagus

Groundcover: Viola sp., Allium tricoccum, Claytonia virginica, Dicentra cucullaria

Aspect: 226 Slope: 4

Rating: 3

Species Noted:

Anguispira alternata

Discus catskillensis

Euconulus fulvus

Helicodiscus paralellus

Nesovitrea electrina

Paravitrea multidentata

Columella simplex

Striatura exigua

Stritura milium

Strobilops labyrinthica

Vertigo gouldi

Vitrina limpida

Zonitoides arboreus

East Lake

UTM 16 T 0668623 5109271

This site consisted of .5-3 m class boulders in a rich upland woods. Trees at this site could possibly be old growth. There were no fissures or exposed bedrock, just the large boulders.

Overstory: Acer, Fraxinus

Groundcover: Viola sp., Allium tricoccum, Polypodium

Aspect: 44 Slope: 2

Rating: 2

Species Noted:

Anguispira alternata

Columella simplex

Discus catskillensis

Euconulus fulvus

Glyphylinia rhoadsii

Helicodiscus paralellus

Nesovitrea binneyana

Paravitrea multidentata

Striatura exigua

Striatura ferrea

Strobilops labyrinthica

Vertigo gouldi

Vertigo paradoxa

Deer Blind Pond

UTM 16 T 0688091 5106033

This site was a *Thuja occidentalis* gallery forest, with class sizes 15-35 cm dbh. There was a 1-1.25 m high very mossy limestone ledge, with some very good interstitial spaces on the cliff face. *Thuja* and *Abies* were on the cliff face.

Overstory: *Thuja occidentalis*, *Betula papyrifera*

Groundcover: *Sphagnum* sp.

Aspect: 238 Slope: 6

Rating: 3/4

Species Noted:

Anguispira alternata

Columella simplex

Discus catskillensis

Euconulus fulvus

Euconulus polygyratus

Glyphylinia indentata

Hawaiiia miniscula

Helicodiscus paralellus

Nesovitrea electrina

Striatura exigua

Striatura milium

Strobilops labyrinthica

Vertigo gouldi

Vertigo paradoxa

Zonitoides arboreus

No Leeks

UTM 16 T 0687301 5107431

This site consisted of a small, 100 m² Alvar with 2 m deep fissures and exposed moss-covered bedrock. Within the fissures, there was very good litter, hummus and organic soil, similar to soil that would be preferred by snails in interstitial spaces in talus.

Overstory: Acer, Fagus

Groundcover: Maianthemum, Viola

Aspect: 0 Slope: 0

Rating: 2

Species Noted:

Cochlicopa lubrica

Discus catskillensis

Euconulus fulvus

Gastrocopta contracta

Helicodiscus paralellus

Paravitrea multidentata

Stritura exigua

Striatura milium

Strobilops labyrinthica

Vertigo gouldi

Zoogenetes harpa

Fern Cliff

UTM 16 T 0689814 5101069

This site was a .5-1.5 m tall ledge, which was very mossy , with some fissures on front and on top of the cliff. However, the productivity was questionable due to the composition of the overstory.

Overstory: Picea, Betula

Understory: Picea

Groundcover: Vaccinium

Aspect: Semi-circle Slope: -1

Rating: 1

Species Noted:

Anguispira alternata

Columella simplex

Discus catskillensis

Euconulus fulvus

Helicodiscus paralellus

Paravitrea multidentata

Punctum minutissimum

Striatura exigua

Striatura ferrea

Striatura milium

Strobilops labyrinthica

Triodopsis albolabris

Vertigo gouldi

Little Dome

UTM 16 T 0686419 5101749

This site was a 20 m diameter, 2-2.5 m high domed limestone outcrop. It was highly fissured up to 2m deep, with moss and soil filling the interstitial spaces. Good litter, hummus and interstitial spaces made this a very unique and impressive site. Most of the sampling was done on the north-facing side of the dome, where it was more shaded and protected.

Overstory: Acer, Tsuga, Thuja

Understory: Fagus

Groundcover: Claytonia virginica, Dryopteris, Maianthemum

Aspect: circular Slope: 0

Rating: 3

Species Noted:

Cochlicopa lubrica

Discus catskillensis

Euconulus polygyratus

Gastrocopta contracta

Helicodiscus paralellus

Paravitrea multidentata

Punctum minutissimum

Striatura exigua

Striatura ferrea

Vertigo sp. (immature)

Vitrina limpida

Zonitoides arboreus

Little Ledge

UTM 16 T 0675723 5108668

This site was a 20 m long by 1 m high ledge that was very mossy and moist. There was some interstitial spaces on the ledge itself and also some fracturing on the top of the ledge.

Overstory: Acer, Fagus

Groundcover: Allium tricoccum, Erythronium, Claytonia virginica, Dentaria, Trillium grandiflorum

Aspect: 16 Slope: -1

Rating: 1

Species Noted:

Anguispira alternata

Cochlicopa lubrica

Discus catskillensis

Glyphylinia rhoadsii

Helicodiscus paralellus

Nesovitrea binneyana

Paravitrea multidentata

Punctum minutissimum

Striatura exigua

Striatura milium

Strobilops labyrinthica

Triodopsis albolabris

Rubble

UTM 16 T 0675663 5107918

This was a highly fractured area with many .5-1.25 m boulders covered with moss and a thin litter layer. There were many interstitial spaces, and the fractures were covered by litter. Most of the moss was quite dry, so the productivity of the site was not readily apparent.

Overstory: Acer with one Thuja

Understory: Fagus, Abies

Groundcover: Erythronium, Polypody

Aspect: None Slope: 0

Rating: 1

Species Noted:

Anguispira alternata

Cochlicopa lubrica

Columella simplex

Discus catskillensis

Euconulus fulvus

Euconulus polygyratus

Nesovitrea electrina

Paravitrea multidentata

Striatura exigua

Striatura ferrea

Striatura milum

Strobilops labyrinthica

Vertigo gouldi

Vertigo paradoxa

Vitrina limpida

Zonitoides arboreus

Stumble

UTM 16 T 0663972 5107143

This site was a rich, rocky woodland with a 1-2.5 m moss-covered (about half) ledge outcrop that did not have many fractures. There was a bit of fracturing on top of the ledge, as well as many .25- 1 m boulders associated with the outcrop. Nearby was another smaller .5 m ledge.

Overstory: Acer, Fagus

Understory: Abies

Groundcover: Erythronium

Aspect: 237 Slope: 0

Rating: 2

Species Noted:

Anguispira alternata

Cochlicopa lubrica

Discus catskillensis

Euconulus fulvus

Euconulus polygyratus

Glyphylinia indentata

Helicodiscus paralellus

Nesovitrea binneyana

Paravitrea multidentata

Punctum minutissimum

Pupilla muscorum

Striatura exigua

Striatura ferrea

Striatura milium

Strobilops labyrinthica

Vertigo gouldi

Vertigo paradoxa

Vitrina limpida

Sites not sampled

Nothing 1

UTM 16 T 0689688 5101100

This site was bedrock pavement at a snowmobile trail with only small (.25-.5 m) boulders laying singly under a Picea and Betula overstory. There was no understory or groundcover. There were small fissures in the pavement, but they were in the sun and therefore too xeric to support snails.

Not sampled

Rating: 0

Nothing 2

UTM 16 T 0690216 5100756

Small, 30 m² domed outcrop with some very deep fissures, but the whole site is quite exposed to sun and wind. This was the basis for not sampling. There was a very thick layer of lichens present.

Not Sampled

Rating: 0

Nothing 3

UTM 16 T 0679685 5108540

This site had sparse random boulders with one 5 m² pile. However, it seems to have been harvested in the last 15 years, leaving Picea and Betula. The site is very exposed, and so not a good prospect for snails.

Not Sampled

Rating: 0

Nothing 4

UTM 16 T 0678312 5106407

This was a very young Acer-Fagus forest with few scattered .25-.5 m boulders. There were no microhabitats present to support land snails.

Not Sampled

Rating: 0

Nothing 5

UTM 16 T 0676374 5108637

This was an upland Acer-Fagus forest with a very rich spring wildflower flora. There were, however, no boulders, rocks or fissures, and so would not support an unusual snail fauna.

Not Sampled

Rating: 0

Nothing 6

UTM 16 T 0676258 5108954

The north side of the road at this site has only one ~20m area with boulders .5-3 m tall, with no fissures or interstitial spaces. The woods themselves were a very rich Fagus-Acer upland. There was abundant Polypody on the boulders. The south side of the road here

had many more boulders and was much better habitat, but was not part of the management areas.

Not Sampled

Rating: 1

Nothing 7

UTM 16 T 0674866 5107206

This site was Thuja over a very small 60 m² area of fracturing and ~30 boulders. There were a number of other sites that had been sampled that were representative of the same habitat type and quality, so this site was not sampled to try to include other examples of potential habitat.

Not Sampled

Rating: 0/1

Nothing 8

UTM 16 T 0672093 5106806

At this site there was one Thula in a primarily Acer overstory. There was a small limestone outcrop and some fracturing, but the fractures were all buried under matted leaf litter and there were no microhabitats found on the ledge.

Overstory: Acer, Thuja

Understory: Abies

Groundcover: Erythronium, Claytonia virginica

Not Sampled

Rating: 1

Nothing 9

UTM 16 T 0663915 5106933

This site had very few scattered .25 m class boulders.

Overstory: Acer

Understory: Abies

Not Sampled

Rating: 0

Nothing 10

UTM 16 T 0664261 5110732

There were no rocks, boulders, or fractures associated with this site, and actually appears to be a good stand to harvest.

Overstory: Acer, Betula

Understory: Abies, Fagus

Groundcover: Erythronium

Not Sampled

Rating: 0

Nothing 11

UTM 16 T 0665047 5110333

This was a collection of 30 or so .25-1.75 m class boulders in an area with no exposed bedrock and really no particularly promising microhabitats for snails.

Overstory: Acer, Abies

Understory: Abies

Groundcover: Dryopteris, Erythronium

Not Sampled

Rating: 0

South side of Rd.

UTM 16 T

This site was very mossy pavement with numerous large fissures, and very promising habitat but was not in the harvest block.

Not Sampled

Rating: 2

Huron NE

UTM 16 T 0689274 5107653

This was a very wet mixed-deciduous forest, with very few boulders.

Overstory: Picea, Pinus, Betula

Not Sampled

Rating: 0

Tongue

UTM 16 T 0691154 5102460

This site was a 50-60 m long "tongue" of exposed bedrock .5-1.5 meters tall, with very mossy 1 m deep weathered fissures.

Overstory: Betula papyrifera, Picea sp.

Groundcover: Coptis, moss

Aspect: 57 Slope: 10

Rating: 1

Rocky Woods

UTM 16 T 0686189 5101344

This site contained scattered .25-1.5 m class boulders all sitting singly with no real interstitial spaces or fracturing bedrock.

Overstory: Acer, Tsuga

Understory: Fagus

Groundcover: Maianthemum

Not Sampled

Rating: 0

Fern Rock

UTM 16 T 0674207 5108581

This site was a small collection of very large boulders, some over 3 m diameter. The boulders were mossy but there were no interstitial spaces to provide microhabitats.

Additionally, there was a high degree of rodent traffic, which also negatively affects snails, both through competition for resources and through predation.

Not Sampled

Rating: 0

Results

Twenty-seven sites were visited for this survey. Thirteen of the 27 sites were sampled for snail diversity analyses. The most diverse site was Ledge Crop, with 20 taxa. The least diverse sites were No Leeks and Kenneth Rd. Alvar with 11 each. Four of the sites had 15 or more taxa, which is highly significant diversity. The mean diversity score was 13.85 species per site. Two Regional Forester Sensitive Species for the Hiawatha Ranger District were located, *Euconulus alderi* and *Vertigo paradoxa*. *Euconulus alderi* was located at one site, while *Vertigo paradoxa* was located at 5 stations. No additional taxa were added to the state or local fauna. However, since 21 stations were previously known for *Vertigo paradoxa*, these five additional sites represent an increase of nearly 20%.

Discussion

Perhaps most notable of this whole survey was how poorly the rating scores predicted the snail diversity at a site. One of the most difficult things of land snail research is how to sample effectively. When trying to maximize diversity in a survey, often times a number of sampling methods may be used. With experience though, a researcher can become familiar with the proper microhabitats to sample within whatever habitat type is being sampled. That being said, it is still difficult to predict how diverse a site is going to be. There are many factors that simply cannot be observed, although a general sense of potential diversity is still possible.

Determining, based on certain indicators, the likelihood of a site being malacologically diverse or harboring rare taxa has been attempted before. More accurately, many sites have been sampled for diversity and then corresponding data been gathered on geologic, vegetative, soil, light, temperature and aspect variables. While studies have shown certain variables to be important, none have been consistently shown to be predictive. That said, there are a number of factors that will often be indicative of a favorable site.

A site must be somewhat stable and not have been disturbed in recent times, in fact, the longer the site appears to have been without disturbance, the better. Snails need a cool, moist microclimate. Weather that microclimate is in a fracture in bedrock, a fracture in a small ledge, or a moss-covered ledge on a 4 m tall cliff. If sampling a cliff, sample from all available microclimates- top of the cliff, the cliff face (moss-covered ledges), the foot of the cliff, and the subtending talus (if available). Grab leaf litter that is at the very bottom of the mat, where it is cool and moist, and not necessarily bound together by roots or fungal hyphae. If sampling fractures, try to find cool moist leaf litter or even very dark organic soil. Moss-covered ledges can often be productive in these habitats as well.

While this survey did not expand the fauna of Mackinac County, the addition of 5 populations of *Vertigo paradoxa* and one of *Euconulus alderi* point out how important the work was. Northern Michigan has by far the most populations of *Vertigo paradoxa* globally. This fact should not be taken lightly. The habitats where this taxa are found should be afforded the highest protection for their natural features and their flora and fauna. The rarity of this species alone has prompted other researchers to call for its' listing as federally endangered (Frest and Johannes 1991).

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