1976

Land Snail Diversity at Rocky Branch Nature Preserve, Clark County, Illinois

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Land Snail Diversity at Rocky Branch Nature Preserve,

Clark County, Illinois

(TITLE)

BY

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THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

Master of Science

IN THE GRADUATE SCHOOL, EASTERN ILLINOIS UNIVERSITY

CHARLESTON, ILLINOIS

1976

YEAR

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TABLE OF CONTENTS

ABSTRACT: Terrestrial, shell-bearing gastropods were collected at Rocky Branch Nature Preserve, Clark County, Illinois. A total of three hundred nineteen specimens were collected representing five families and fifteen species. Two species of the family Endodontidae, eight species of the family Polygyridae, three species of the family Zonitidae, and one species in each of the families Pupillidae and Succineidae were collected.

In addition, an attempt was made to find the relationship between species diversity and dominant woody vegetation and soil quality. The land at Rocky Branch Nature Preserve ranges from lowland flood plain to high second growth forest. The dominant trees of the lowland were maple and elm, which produce an alkaline soil with high concentrations of calcium. The dominant trees of the second growth upland forest are oak and hickory, which produce an acid soil and lower calcium concentrations. More specimens of land snails were collected (one hundred and ninety-nine) from the upland forest than from the flood plain (one hundred twenty).

There seemed to be a direct relationship between calcium and pH, but relationship of these two physical properties to organic matter is more complex. Quantitative levels of organic matter appeared meaningless without qualitative data of the tree species involved.

LITERATURE REVIEW

One of the most interesting aspects of molluscan ecology is their relationship to the soil, in particular to the calcium content of the soil. Van Cleave (1952) considered snails to be a repository of calcium that will eventually return it to the soil.

In areas devoid of limestone, calcium is particularly important because the only sources are those available from the soil, the organic matter in the humus, and the shells of other snails (Burch, 1955). Calcium is not only necessary for normal physiological processes and the building of the shell, but certain forms of calcium affect the pH of the soil, and in at least one species (*Vitrina brevis*) a lack of calcium inhibits reproduction (Wareborn, 1970). Because snails have a very wide distribution and are found in every kind of habitat (Billups, 1903), calcium has been shown to have another important usage in land snails. Baker (1958) found that some species can aestivate for up to five years due to the high calcium carbonate content of the shell. The calcium carbonate can be utilized as a source of oxygen and as a buffer for the blood stream during these long periods of inactivity. This is given as the reason for the fact that most desert dwelling snail species are calcophiles.

When discussing the significance of calcium two other physical properties of soil are generally considered. Organic matter is brought to mind because this is the chief source of calcium where limestone is not present (Burch, 1955). The other factor is pH, because calcium compounds can have great effects on this physical property (Strandine, 1937; Valovirta, 1968; and Wareborn, 1970).

Calcium compounds such as calcium oxalate and calcium sulfate have little effect on the pH due to their relative insolubility (Wareborn, 1970 and Boycott, 1934). On the other hand, Wareborn (1969) has shown high alkalinity in soils because of the presence of calcium citrate. Strandine (1937) shows the same effect by calcium oxide, and others (Burch, 1955 and Valovirta, 1968) maintain that calcium carbonate has an alkaline effect on the soil. The latter three would have more action because of their higher relative solubility over the former two.

Valovirta (1968) has shown that leaf litter, therefore organic matter, under trees such as the European Hazel (Corylus avellana), the European ash (Fraxinus excelsor), and the European aspen (Populus tremula) has a much higher level of calcium while other Aspen trees (Populus spp.) absorb calcium so efficiently that snails cannot even grow shells. Wareborn (1969) found that the litter from oak and beech trees produces higher levels of calcium oxalate while litter from ash, maple, and elm trees tends to be high in calcium citrate.

Others have found the relationship between dominant plants and snails to be even more limited. Burch (1956) found that Mesodon thyroidus, Triodopsis albolabris and T. tridentata were restricted to areas where oak was the dominant tree. This may be a much more important reason for vegetation preference than those brought out by Boycott (1934). Calcium from litter tends to be absorbed into the humus layer and partially into the uppermost layer of the mineral soil (Valovirta, 1968). Wareborn (1969) does not agree, saying that the lowest level of humus is always much richer in calcium compounds, but probably includes the insoluble calcium compounds which may be utilized by mollusks, but will obviously not affect pH levels in the soil or humus.

Even those researchers (Strandine, 1937 and Agocsy, 1968) who do not believe calcium to be a limiting factor in snail distribution, agree that calcium in combination with pH and organic matter is a factor affecting distribution. Atkins and Lebour (1932) considered pH to be a limiting factor in itself. Most authors (Atkins and Lebour, 1923; Baker, 1968; Burch, 1953) agree that land snails prefer a pH near neutral, and that calcium has the effect of raising the pH. Wareborn (1969) believes that the relationship between calcium and pH is indefinite.

INTRODUCTION

Rocky Branch Nature Preserve is a 130 acre tract of land located in Section twenty-nine, T12N, R12W, Clark County, Illinois. It is located in the Illinoisan till, 5 miles south of the terminal moraine of the Wisconsin glacier (Ebinger and Parker, 1969). The relief of the preserve varies 73 feet; the highest ground, located in the southwest corner, is 645 feet above sea level.

There are three different habitat types at Rocky Branch Nature Preserve (Hughes and Ebinger, 1973). The first is a dry area on the extreme western end, classified as mature upland forest. The woody plants are predominantly oak (Quercus spp.), hickory (Carya spp.), and maple (Acer spp.), (Ebinger and Parker, 1969). The contour is slightly rolling, with shallow ravines. The rest of the preserve is comprised of second growth upland forest and lowland forest. The second growth upland forest is found mostly south of Big Creek. Oak (Quercus spp.) is by far the dominant species here. The contour is quite severe; there are sandstone cliffs and many steep ravines. The second growth upland forest is so classified because the timber here was harvested before the turn of the century (Ebinger and Parker, 1969). The third area is found predominantly south of Rocky Branch Creek although there are scattered lowland forest areas in spots south of Big Creek. The dominant woody vegetation in the lowland forest is maple (Acer saccharum), sycamore (Platanus occidentalis), and slippery elm (Ulmus rubra). Hellinga and Ebinger (1970) also studied the flora at Rocky Branch Nature Preserve and found some species here that are generally southern Illinois plants and some that were only known from the nothern and western parts of the state.

It is known that certain snail species are associated with certain species of woody vegetation (Burch, 1956 and Getz, 1974), or at least certain types are favored over others. It has also been established that in many areas the vegetation and therefore, leaf litter, plays an important part in the physical make up of the soil (Strandine, 1937; Valovirta, 1968; and Wareborn, 1969).

Even though Baker (1939) included some collections from Rocky Branch Nature Preserve, the fact that there has never been a definitive study of the snail fauna of the Preserve prompted this investigation of snail diversity and the relationship of land snails to vegetation and the soil.

MATERIALS AND METHODS

Terrestrial snails were collected during twenty-five trips to Rocky Branch Nature Preserve from September to November 1974 and from March to May 1975. Each collection trip lasted about four hours. The nature preserve was divided into two sections: the strip of land along Rocky Branch Creek and the strip along Big Creek, principally because of accessibility and the differences in dominant vegetation. Both sections were searched systematically for snails, with particular attention paid to those habitats known to be the diurnal resting places of snails, including fallen trees, old logs and heavy concentrations of leaf litter.

All snails observed were collected, including fragments of shells and obvious immature specimens; slugs were excluded. The specimens were returned to the laboratory for identification. Four keys were used for identification: Burch (1962), Taft (1961), Pilsbry (1939-1948), and Baker (1939). In addition, the method of Rawls and Baum (1971) was used to identify biofluorescent species.

All snails exhibiting the mature shell characteristics were measured using a caliper with a vernier scale to the nearest one-tenth of a millimeter. The diameters were taken at the widest part of the shell excluding the reflected lip, if any. The height of the shell was taken in front of the aperture. All specimens were placed under black light to check for mucus fluorescence.

Soil samples were collected on October 25, 1975. Starting from the west end of the nature preserve and walking along the south side of the creek, where possible, soil samples were collected at 200 pace intervals, either twenty-five paces from the creek or half way between the creek and the cliffs, depending upon the terrain. Only samples of mineral soil were taken, so the loose leaf litter was brushed aside and a one-hundred and fifty milliliter sample taken at each site. The soil samples were analyzed by the Soil Test Laboratory, Department of Agronomy, Purdue University, following the procedures found in Soil Survey Investigations Report No. 1 (1972).

RESULTS

Three hundred nineteen specimens of land snails were collected from Rocky Branch Nature Preserve. These specimens represent fifteen different species from five different families.

The following key is given to present an orderly account of those specimens taken. In addition to the key, a description of each species is given with some indication of its habitat preference. Because of the variety of names used in various keys, species synonyms are given after Pilsbry (1939-1948). The terminology used in the species descriptions is taken from Burch (1955) and Pilsbry (1939-1948). Where the two deviate in terminology, Pilsbry (1939-1948) is utilized.

Key to the Land Snails at Rocky Branch Nature Preserve

1. Shell heliciform 2
   Shell pupiform . . . . Pupillidae p 17
   Shell succiniform . . . . Succineidae p 17
2. Shell with reflected lip . . . . . . Polygyridae p 8
   Shell lip not reflected 3
3. Shell surface dull and coarsely ribbed . . . . Endodontidae p 7
   Shell surface polished, smooth and finely sculptured . . . . Zonitidae p 9

Key to Family Endodontidae

1. Shell over 10mm in diameter. . . . . *Anguispira alternata* (Say) p 9
   Shell less than 10mm in diameter . . . . *Discus patulus* (Deshayes) p 10

Key to the Family Polygyridae

1. Shell 10mm or less in diameter with no denticles

Stenotrema hirsutum (Say) p 14

Shell larger than 10mm in diameter or has a basal or palatal denticle or both 2

2. Umbilicus partially concealed by reflected lip . . 3

Umbilicus not at all concealed by reflected lip or shell imperforate 4

3. Shell large (13+mm), with parietal lamella . . . .

Mesodon thyroidus (Say) p 13

Shell large (12+mm), without parietal lamella, mucus fluoresces under ultraviolet light . . . . .

Mesodon clausus (Say) p 11

4. Shell 9-12mm in diameter, shell hirsute . . . . . .

Mesodon inflectus (Say) p 13

Shell not hirsute 5

5. Aperture with one or no lamellae 6

Aperture with three lamellae 7

6. Shell large (18+mm), spire elevated with strong parietal lamella. . . . . *Mesodon elevatus* (Say) p 12

Shell large (20+mm), spire more depressed without parietal lamella. . . *Triodopsis albolabris* (Say) p 15

7. Shell periphery distinctly carinate . . . .

Triodopsis obstricta (Say) p 16

Shell not carinate. . *Triodopsis tridentata* (Say) p 16

Key to the Family Zonitidae

1. Blue or violet callus within aperture . . . .
   Mesomphix spp. p 18

   Callus in aperture white 2

2. Shell surface finely striate, aperture obliquely lunate. . . . . . *Glyphyalinia wheatleyi* (Bland) p 18

   Shell surface smooth, aperture lunate . . . .
   Zonitoides arboreus (Say) p 19

Phylum Mollusca

Class Gastropoda

Sub-class Pulmonata

Order Stylomatophora

Family Endodontidae

Anguispira alternata (Say)

Helix radiata Muller, 1774

Helix alternata Say, 1816

Helix scabra Lamarck, 1822

Helix inflecta Pfeiffer, 1857

Carocolla dubia Sheppard, 1829

Patula alternata Say, W. G. Binney, 1878

Pyramidula alternata (Say), F. C. Baker, 1904

Anguispira alternata palustris Walker, 1928

Anguispira alternata var. *alba* Tryon, 1866

Anguispira alternata Say, Jones, 1935

Color is not generally a good diagnostic characteristic due to the ambiguity of terminology, but with this species there is a distinct color pattern that can be used for identification. The background color is tan and there are irregularly oblong, dark reddish, splotches that run transverse to the spirals. The shell is depressed, heliciform and has large ribs on all whorls. The aperture is ovate-lunate and the peristome unreflected and sharp. There are no peristomal lamellae. The umbilicus is perforate, but relatively narrow being less than one-third the diameter of the shell. The mucus of this species is fluorescent under ultraviolet light.

Found associated with leaf litter, *A. alternata* (Say) was collected from beneath decaying logs. Soil and sand were also seen to adhere to the periostracum due to the rough ribs.

Discus patulus (Deshayes)

Helix perspectiva Say, 1817

Patula perspectiva Say, W. G. Binney, 1878

Pyramidula (*Gonyodiscus*) *perspectiva* Say, Pilsbry, Man Conch., 9: 46.

Gonyodiscus perspectivas Walker, 1928

Helix patula Deshayes, 1830

Goniodiscus patula Deshayes, Kennard and Woodward, 1925

Discus patulus angulatus Kutchka, 1938

Discus patulus carinatus MacMillan, 1940

This strongly depressed, heliciform shell has evenly spaced ribs. There are approximately five gradually expanding whorls. The umbilicus is open so that all the whorls can be seen. The roundly lunate aperture is not reflected and is sharp. There are no peristomal denticles or lamellae. The mucus is fluorescent under ultraviolet light.

D. patulus (Deshayes) was collected only from the triangle of land between Rocky Branch and Big Creeks. It was found within the leaf litter in a small, rocky canyon.

Family Polygyridae

Mesodon clausus (Say)

Helix clausa Say, 1821

Mesodon clausa Say, W. G. Binney, 1878

Polygyra clausa Say, Sargent, Naut., 9: 89

Helix ingallsiana Shuttleworth, 1877

Helix jugallsiana Shuttleworth, Von Martens, 1860

Tridopsis thyroidus, b, *edentula* Beck, 1837

The shell of this species is heliciform with an elevated spire. There are approximately five and one-half gradually enlarging whorls. Each whorl has transverse striae and microscopic spiral lines. The shell is perforate, but the narrowly reflected peristome nearly covers the umbilicus, often making it slit-like. The aperture is ovate-lunate and typically does not have any peristomal denticles or a parietal lamella. The absence of the parietal lamella helps distinguish this species from *M. thyroidus* (Say). In addition, all of the mature specimens collected had a height that was more than twice the width (Table 1). *M. clausus* (Say) is a biofluorescent polygyrid.

All the specimens of _M_. _clausus_ (Say) were collected from the area south of Big Creek (Table 2) and were associated with leaf litter. The specimens were collected on the slopes of the hills and on the higher ground. None were found on the sandy floodplain.

Mesodon _elevatus_ (Say)

Helix _elevata_ Say, 1821

Mesodon _elevata_ Say, W. G. Binney, 1878

Polygyra _elevata_ (Say), Pilsbry, 1907

Helix _tennesseensis_ Lea, 1841

Helix _elevata_ Say, Shuttleworth, 1877

Helix _knoxvillina_ Ferussac, 1821

This species has an heliciform shell with an elevated spire. There are approximately six gradually expanding whorls. The shell is sculptured with rather heavy transverse striae and wrinkled microscopic spiral lines. The spiral lines are particularly evident on the ventral surface and near the sutures of each whorl. The apical whorl is devoid of sculpturing with the exception of the scattered, fine malleations which cover the entire surface. The widely reflected peristome does not have any denticles, however, the basal edge is not smooth. The aperture is ovate-lunate and has a strong parietal lamella which is curved toward the basal edge of the peristome. The umbilicus is imperforate.

_M_. _elevatus_ (Say) was the most frequently collected species south of Big Creek (Table 2). One specimen was found in the triangle of land between Rocky Branch and Big Creeks. All specimens were found in heavy leaf litter.

Mesodon inflectus (Say)

Helix inflecta Say, 1821

Helix (*Triodopsis*) *inflexa* Say, Von Martens, 1860

Triodopsis inflecta Say, W. G. Binney, 1868

Polygyra inflecta (Say), Pilsbry, 1900

Helix clausa Ferussac, 1821

Xolotreme clausa Rafinesque, 1831

Polygyra inflecta var. *media* Pilsbry, 1903

Polygyra herberti Bryant Walker, 1928

The depressed, heliciform shell of *M. inflectus* (Say) is hirsute with strong transverse striae. There are approximately four and one-half gradually expanding whorls. The peristome is reflected and has a basal and a palatal denticle. The long parietal lamella is curved toward the basal edge of the peristome. The aperture is ovate-lunate, but tends to be flattened along the palatal edge.

M. inflectus (Say) was found to be widely distributed at Rocky Branch Nature Preserve (Table 1 and Table 2). Specimens were found in both high and low areas, associated with leaf litter and decaying logs. In many instances specimens were taken with soil and sand adhering to the shell due to the periostracal hairs.

Mesodon thyroidus (Say)

Helix thyroidus Say, 1816

Helix albolabris J. Acad. Nat. Sci. Phil., 1: 123

Mesodon leucodon Rafinesque, Binney and Bland, 1870

Polygyra throidus Say, Pilsbry, 1900

Helix thyroides var. pulchella Cockerell, 1892

Polygyra thyroides Say, Chadwick, 1905

The shell of M. thyroidus (Say) is depressed, heliciform. There are approximately four and one-half whorls sculptured with transverse striae and fine spiral lines. The peristome is reflected, but contains no denticles. In most cases there is a small parietal lamella, but in some specimens this is lacking. The reflected peristome covers one-half of the perforate umbilicus. M. thyroidus (Say) is most often confused with M. clausus (Say). The height of M. thyroidus (Say) is more nearly one-half the width and mature specimens are 3 to 6 millimeters wider than M. clausus (Say) (Table 3). In addition, the mucus of M. thyroidus is not fluorescent under ultraviolet light while M. clausus is fluorescent.

Most specimens of M. thyroidus (Say) were found associated with the second growth upland forests south of Big Creek. All specimens were collected from leaf litter.

Stenotrema hirsutum (Say)

Helix hirsuta Say, 1817

Polygyra hirsuta Say, Walker, 1906

Stenotrema hirsutum Say, W. G. Binney, 1878

Polygyra hirsuta nana C. and A. Richards, 1934

Polygyra hirsuta yarmouthensis F. C. Baker, 1927

Helix porcina Say, 1824

The shell of *S. hirsutum* (Say) is globose, heliciform in shape. The transverse striae have radially lengthened granules making the shell hirsute. The peristome is narrowly reflected and does not contain denticles, but there is a "V"-shaped notch in the basal edge. The parietal lamella is long and makes the aperture slit-like.

The specimens of *S. hirsutum* (Say) were collected from leaf litter near the junction of Rocky Branch and Big Creeks.

Triodopsis albolabris (Say)

Helix albolabris Say, 1816

Mesodon albolabris Say, Morse, J. Portland Soc. Nat. Hist., 1: 8.

Polygyra albolabris Say, G. B. Simpson, 1901

Polygyra albolabris goodrichi G. H. Clapp, 1916

Triodopsis albolabris Say, Beck, 1837

Mesodon albolabris var. *dentata* Tryon, 1867

Polygyra albolabris var. *minor* Sterki, 1900

Helix albolabris var. *maritima* Pilsbry, 1890

Polygyra albolabris transversensis Leach, Pilsbry, Man. Conch., 9: 76.

Helix rufa Dekay, 1844

Polygyra redii J. B. Henderson, 1927

This large polygyrid is heliciform with a strongly depressed spire. The four and one-half to five whorls are sculptured with transverse striae and fine, microscopic spiral lines. The aperture is ovate-lunate with a widely reflected, white peristome. There are no denticles or lamellae, but the basal edge often has a raised spot near the imperforate umbilicus.

Specimens of *T. albolabris* (Say) were collected from leaf litter south of Rocky Branch and Big Creeks.

Triodopsis obstricta (Say)

Helix obstricta Say, 1821

Triodopsis obstricta Say, W. G. Binney, 1878

Helix palliata var., Binney 1851

Polygyra obstricta (Say) Pilsbry, 1894

Carocolla lelicoides Lea, 1834

Mesodon labiatum Rafinesque, Binney and Bland, 1870

The heliciform shell of *T. obstricta* (Say) is so depressed that in one specimen the dorsal surface was nearly flat. The shell is strongly carinate. The whorls expand gradually and have striae on the apical whorl that become rib-striae on the outer whorls. The aperture is ovate-lunate and tri-dentate. The parietal lamella is thin and long and curved toward the basal edge of the peristome.

Specimens of *T. obstricta* were collected only from the area immediately around the junction of Rocky Branch and Big Creeks. They were associated with leaf litter.

Triodopsis tridentata (Say)

Helix tridentata Say, 1816

Triodopsis tridentata Say, W. G. Binney, 1878

Polygyra tridentata Pilsbry 1900

Triodopsis lunula Rafinesque, 1831

The most obvious characteristics of T. tridentata (Say) are the peristomal lamellae. The aperture has a basal and a palatal denticle, but the parietal lamella is most characteristic. It extends along the parietal wall but a short distance, then curves up and outward towards a point dorsal to the palatal denticle. The aperture is ovate-lunate and the peristome is reflected. The umbilicus is perforate, but narrowly so, being less than one-fourth the diameter of the shell. The shell is depressed, heliciform in shape. The gradually expanding whorls have transverse striae.

Specimens of T. tridentata (Say) were found associated with leaf litter south of both creeks.

Family Pupillidae

Only one representative of this family was collected. The periostracum was missing excluding much information. The aperture was without denticles. Classification to family was done on the pupiform shape of the shell.

The specimen was collected at the extreme eastern end of Rocky Branch Nature Preserve associated with leaf litter.

Family Succineidae

Succinea spp.

The translucent shell of this specimen is comprised of three to four rapidly expanding whorls. The oval aperture is approximately one-half the height of the shell. The peristome is not reflected and is sharp. The surface of the shell is glossy and has fine transverse striae.

Specimens of *Succinea spp*. were found clinging to a sandstone cliff rising directly from the water at the eastern edge of Big Creek.

Family Zonitidae

Glyphyalinia wheatleyi (Bland)

Zonites wheatleyi Bland, 1883

Vitrea wheatleyi Bland, Walker, 1899

Retinella (*Glyphyalus*) *wheatleyi* (Bland, H. B. Baker, 1930

Only immature specimens of *G. wheatleyi* (Bland) were collected. The pale shells have darker brown lines at the suture of each whorl. The whorls are gradually expanding and sculptured with transverse striae. The peristome is sharp and unreflected.

The specimens were collected from leaf litter.

Mesomphix spp.

Only immature specimens of *Mesomphix spp*. were collected. These specimens did, however, exhibit some mature shell characteristics. The whorls expand rapidly. The umbilicus is perforate, but narrow. The surface is sculptured with minute transverse striae.

All specimens of *Mesophix spp*. were collected from leaf litter.

Zonitoides arboreus (Say)

Helix arboreus Say, 1816

Zonites arboreus Say, W. G. Binney, 1878

Hyalina arboreus var. *viridula* Cockerell, 1888

Hyalina arborea Say, Von Martens, 1892

Zonitoides arboreus J. Henderson, 1924

Helix ottonis Pfeiffer, 1840

Helix breweri Newcomb, 1864

Hyalina breweri Newcomb, W. G. Binney, 1869

Helix whitneyi Newcomb, 1864

Hyalina whitneyi Newcomb, W. G. Binney, 1869

Hyalina (*Polita*) *roseni* Lindholm, 1911

The small shell of *Z. arboreus* (Say) is depressed, heliciform. The gradually expanding whorls have fine transverse striae. The aperture is ovate-lunate. The peristome is thin and unreflected. The shell is narrowly umbilicate.

Specimens of *Z. arboreus* (Say) were found associated with decaying logs, frequently under the bark.

Table 1. Sizes of mature land snail specimens collected at Rocky Branch Nature Preserve.

	Height (mm)		Width (mm)		Height/ Width Ratio
	Mean	Range	Mean	Range	
Discus patulus	2.4	1.4- 3.2	6.7	4.7- 7.9	0.36
Mesodon elevatus	12.4	11.1-13.9	20.2	18.5-21.3	0.61
M. thyroidus	9.6	8.8-11.0	18.4	16.6-19.8	0.52
M. inflectus	4.8	4.2- 5.4	10.6	9.3-11.9	0.45
M. clausus	7.4	7.1- 7.9	13.6	13.2-13.8	0.54
Stenotrema hirsutum	4.7	4.6- 4.8	8.0	7.8- 8.2	0.59
Triodopsis albolabris	10.5	9.4-12.0	21.7	20.4-23.4	0.48
T. obstricta	7.7	---	19.3	---	0.40
T. tridentata	5.1	---	13.4	---	0.38
Succinea spp.	10.0	7.6-11.9	--	---	--

Table 2. Land snails collected south of Big Creek.

Species	Number of Specimens		
	Mature	Immature	Total
Anguispira alternata	1	3	4
Mesodon elevatus	31	17	48
M. thyroidus	14	6	20
M. inflectus	19	11	30
M. clausus	5	8	13
Stenotrema hirsutum	4	-	4
Triodopsis albolabris	4	4	8
T. tridentata	1	3	4
Pupillidae	1	-	1
Succinea spp.	44	-	44
Mesomphix spp.	-	2	2
Zonitoides arboreus	10	-	10
Unidentified	-	11	11
		Total specimens	199

Table 3. Land snails collected south of Rocky Branch Creek.

Species	Number of Specimens Mature	Immature	Total
Anguispira alternata	1	-	1
Discus patulus	5	5	10
Mesodon elevatus	1	-	1
M. thyroidus	1	-	1
M. inflectus	22	10	32
Triodopsis albolabris	1	6	7
T. obstricta	1	2	3
T. tridentata	1	1	2
Mesomphix spp.	-	1	1
Glyphyalinia wheatleyi	-	2	2
Zonitoides arboreus	59	-	59
Unidentified	-	1	1
		Total specimens	120

Table 4. Comparison of snails collected from highground and lowground south of Rocky Branch Creek (West) and Big Creek (East) to Mean Values of pH, calcium, and organic matter of the soil.

Area	No. of Species	No. of Specimens	No. of Soil Samples	Mean pH	Mean Calcium (ppm)	Mean Organic Matter (%)
East Highground	10	133	4	4.9	253	4.03
East Lowground	5	59	6	7.1	1620	3.70
West Highground	10	52	4	5.2	500	5.43
West Lowground	3	68	4	6.2	880	2.92

Of the 100 hours spent collecting snails at Rocky Branch Nature Preserve, only 24 hours were spent at the eastern end. Even so, this area yielded one hundred and ninety of the three hundred and nineteen specimens collected. The mean values of pH and calcium were lower (Table 4) on the high-ground south of Big Creek, even though this was the most productive area yielding one hundred and ninety-nine specimens representing ten species. The next lowest values for pH and calcium also yielded ten species, but only fifty-two specimens were collected from the highground south of Rocky Branch Creek.

The lowground south of both creeks had the highest values for pH and calcium, but were very unproductive. There was a total of sixty-eight specimens collected from the low-ground, representing only five species.

There seems to be a direct correlation between pH and calcium; as one rises, so does the other, but organic matter content does not appear to affect either.

DISCUSSION

One of the most interesting aspects of this project was the relatively few numbers of snails found in both the low-ground and the western areas of Rocky Branch Nature Preserve. This observation could be explained by determining the levels of calcium and organic matter and the pH of the soil. Several authors have considered these elements to be at least contributory to the distribution limitations of land snails (Strandine, 1937; Boycott, 1934; Burch, 1955; Valovirta, 1968; and Wareborn, 1969 and 1970). Although the results of this study (Table 4) do not rule out calcium, organic matter, and pH as limiting factors, they clearly show that some other parameters are also involved. This is well demonstrated by the fact that the largest number of specimens were collected where the pH and calcium concentrations were the lowest. This would indicate that the area had some other attribute more important to molluscan ecology.

Boycott (1934) stated that land snails require shelter, moisture, and calcium. Since calcium was not the primary factor here, shelter and moisture should be considered. Most of the specimens were collected from leaf litter. The floodplains at Rocky Branch Nature Preserve had very few areas with heavy concentrations of leaf litter. This was probably due to the fact that it is a floodplain and therefore subject to changing levels of water in Rocky Branch and Big Creeks. This was evidenced by small drifts found at the base of trees and the fact that the percentage of organic matter was lower (Table 4). The absence of leaf litter would remove the shelter preferred by several of the species collected. Leaf litter may also serve as a source of food for some species (Boycott, 1934).

Not only the quantity, but the quality of leaf litter is also important (Valovirta, 1968). Burch (1955) found that *Mesodon thyroidus*, *Triodopsis albolabris* and *T. tridentata* were restricted to areas where oak (*Quercus spp.*) was the dominant tree. This holds true for Rocky Branch Nature Preserve because the dominant tree species in the second growth upland forest (highground) are the white oak (*Q. alba*) and the black oak (*Q. velutina*) (Hughes and Ebinger, 1973). According to Wareborn (1969) the oak (*Quercus spp.*) produces calcium in the form of oxalate which has little effect on the pH due to its relative insolubility. Maple (*Acer saccharum*), which is the dominant species in the low land surrounding Rocky Branch produces calcium in the form of citrates which have an alkaline effect on the soil and humus. Other authors have a positive relationship between snail diversity and dominant tree species (Getz, 1974).

Burch (1955) found that few species of snails are found where the organic matter is less than two percent. All the areas at Rocky Branch exceeded this limit so organic matter is probably not a factor of limitations there.

The effect of pH on snail diversity and the effect of calcium levels on the pH are subjects on which there are many differing opinions. Atkins and Lebour (1923) considered the pH of the soil to be a limiting factor in snail distribution. Valovirta (1968) agrees that pH may have an adverse effect on not only species, but individuals as well. Others (Strandine, 1938; Burch, 1955; and Wareborn, 1970) say that pH is only important when it is extreme (high or low) or when considered with other factors such as calcium, moisture, temperature, and organic matter. Most of these authors agree, however, that snails prefer a slightly alkaline pH and more snails are found at a pH of seven to eight.

Rocky Branch seems to bear up this last argument. The greatest number of specimens were collected in areas where the mean pH was 4.9 (Table 4). The area with the highest pH (7.1) yielded only five species. It would seem obvious from this that pH alone is not a limiting factor at Rocky Branch Nature Preserve.

One factor that may be of importance in discussing the snail diversity at Rocky Branch Nature Preserve is the relative proximity of the various areas. There is no physical barrier between the areas, therefore, no hinderance to the movement between areas. Snails could easily move from one area to the other in the course of one night. Since no night collections were made, the differences between diurnal and nocturnal diversity is not known.

Two other points may be important in regard to the three physical properties considered in this paper. There is some question whether or not mineral soil will have the same high level of calcium as humus. Wareborn (1969) found that the lowest level of humus always contains more calcium than the upper layer of mineral soil. Valovirta (1968) reported that there was virtually no difference in calcium content of these two substrates. It was also found that in areas where there are hills, the movement of water down these hills better dissolves the minerals contained in the soil. If this is the case, then even if the soil of the highground contained more soluble calcium, it would be dissolved and washed onto the floodplain.

It seems obvious that pH, calcium, and organic matter are not the only important factors controlling snail diversity at Rocky Branch Nature Preserve. Other factors that are probably involved are the moisture content of the soil, the undergrowth, the general climate of the area and perhaps certain trace elements of the soil.

Although there was no record of snails at Rocky Branch specifically, all of the specimens found have been recorded from southern Illinois (Baker 1939). The identification of all snails collected at Rocky Branch was made by the use of shell characteristics. For this reason, members of the family Succineidae were identified only to genus, because identification to species requires anatomical data (Franzen 1959 and 1966).

SUMMARY

The collection of land snails at Rocky Branch Nature Preserve yielded some interesting dispersal patterns. The highground south of Big Creek yielded the highest number of specimens even though the pH and calcium values for the area were the lowest. The organic matter was, however, relatively high. This was expected considering the fact that oak and hickory were the dominant trees in this habitat.

Mesodon clausus, *M. thyroidus* and *M. elevatus* were collected almost exclusively from this area. The association is thought not to be one of poor soil quality, but rather an association with the dominant trees. Similarly, the association of the Succinea spp. collected from the lowground south of Big Creek, was more likely to be one in which water was the critical factor.

The floodplains south of the creeks had the highest levels of pH and calcium, but were relatively unproductive with the exception of three species (Zonitoides arboreus, M. inflectus and Succinea spp.). Although other species were collected from this lowground, they were so scarce that they could have been washed into the area. There were a variety of possible explanations for the preference of these species. Soil quality, vegetation preference, moisture levels and lack of interspecific competition may all have been factors.

A direct relationship was seen between pH and calcium content in all the habitats sampled. These two properties were not directly proportional to the amount of organic matter present. Only when qualitative data was available was a relationship seen. The oak-hickory vegetation of the high-ground produced more organic matter, but the calcium compounds were largely insoluble ones that did not raise the pH. In the lowground the dominant maples produced less organic matter, but it contained more soluble calcium compounds which exerted more influence on the pH.

ACKNOWLEDGEMENTS

I would like to thank Dr. Hugh C. Rawls for his guidance throughout the graduate program. Also, appreciation is given to Drs. Krehbiel, Ridgeway, Keppler and Chapman for their comments on the thesis. I would also like to thank Dr. Henry van der Schalie and Mr. Hans Wurzinger at the University of Michigan for their assistance in the identification of immature specimens. I would especially like to thank Dr. Roger Boneham and my wife, Linda for their encouragement in the writing of this thesis.

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