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PHYSIOGRAPHY AND INSECT FAUNA OF SCOBY DAM CAVE: WESTERN NEW YORK

S. J. Vermette*[1], W. K. Gall[2], and T. J. Fay[3]
[1]Department of Geography and Planning
[3]Great Lakes Center
Buffalo State College
1300 Elmwood Avenue
Buffalo, NY 14222
[2]New York State Department of Health
584 Delaware Avenue, Room 202
Buffalo, NY 14202

ABSTRACT: *This paper documents the first survey of Scoby Dam Cave which is located in the Zoar Valley of southern Erie County, New York. The cave was explored and surveyed in the fall of 2002. The cave is linear and extends 20 meters into a shale cliff of the northern gorge wall of Cattaraugus Creek. The cave formed along a pre-existing joint. The joint likely formed due to stresses attributed to ancient tectonic activity associated with orogenic events to the east. Evidence suggests that the cave formed due to joint widening by shale disaggregation, perhaps a consequence of varying flows of glacial melt waters. On November 20, 2002, a large number of mosquitoes were observed roosting in the cave, and 379 specimens of two species were collected (378* Culex pipiens-restuans, *1* Uranotaenia sapphirina). *This suggests that Scoby Dam Cave serves as an overwintering hibernaculum for adult female mosquitoes, particularly* Culex pipiens-restuans. *The mosquitoes tested negative for West Nile virus. The presence of a single male heleomyzid fly,* Schroederella iners, *is noteworthy, as this species appears to be rarely collected and reported in the literature.*

INTRODUCTION

A true cave is described as a natural opening in the ground that extends beyond the zone of light and is large enough to permit human entrance. A cave meeting the above definition was discovered in the rugged Zoar Valley gorge of western New York – Scoby Dam Cave. This discovery in itself is significant as caves are not common in the shale formations of this area. The exploration of this cave began as a student project, applying local geology and surveying and mapping techniques. While mapping Scoby Dam Cave, many mosquitoes were noticed roosting in the cave. Stephen Vermette contacted Wayne Gall since the latter is involved with mosquito surveillance for West Nile virus and other arthropod-borne diseases as part of his job responsibilities with the New York State Department of Health (NYSDOH). Gall and Glenn Robert, from the Erie County Health Department's Vector and Pest Control Laboratory (ECHD/VPCL), then became involved with the exploration of Scoby Dam Cave.

This paper provides the first survey of Scoby Dam Cave. It includes a description and map of the cave, an explanation as to its formation, as well as a preliminary survey of its insect fauna.

GEOGRAPHIC AND GEOLOGICAL SETTING

Scoby Dam cave is located approximately 2.2 kilometers (1.4 miles) south-southwest of the Village of Springville in southern Erie County, New York (Figure 1). The cave is located in the northern gorge wall of the cliffs rising about 55 meters above the water surface of Cattaraugus Creek in Zoar

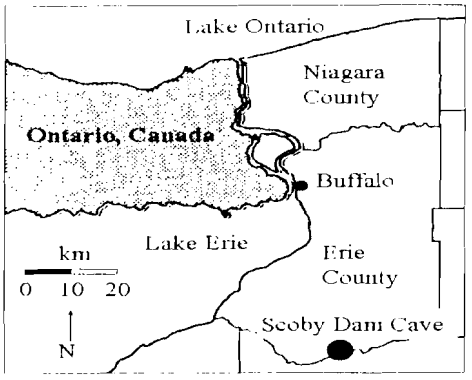

Figure 1. Location of Scoby Dan Cave in southern Erie County, NY, along the Cattaraugus River.

Valley. The cave entrance is located about 9 meters above the creek. The rock that makes up the cliff is shale of the Canadaway formation which is Late Devonian in age (Buehler and Tesmer, 1963). These shales formed from mud deposits in a shallow sea covering western New York. The mud was transported westward due to the erosion of highlands to the east, which themselves formed during the late Devonian, associated with the Acadian Orogeny (Buehler and Tesmer, 1963).

CAVE EXPLORATION AND MAPPING

The cave was first identified by a student living in the area. It apparently was a "hangout" for local teenagers. The cave was visited by Vermette and Tim Fay in October 2002. The initial visit revealed a cave entrance obstructed by layers of clay and fallen leaves. A number of days were spent digging out the cave's entrance. The small opening and layering of clay and leaves indicated that the cave had not been visited for several years.

Entrance into the cave proper required traversing a bend followed by a very tight squeeze taken in the head-first position. A 3 meter narrow passage was negotiated by belly sliding through the areas then, the cave opened up vertically reaching a maximum height of just over 3 meters. The cave was measured at 20 meters in length, extending to a water passage. The water passage has yet to be explored - the cave runs under water as far as the eye can see and deeper than one can stand. Much of the floor is made up of clay.

The walls and ceilings were wet (dripping at points). On November 20, 2002 the cave temperature was measured at 9.4°C with a hand-held Kestrel weather instrument. The same temperature was recorded off the walls, the ceiling and floor of the cave, with a MiniTemp® infrared surface thermometer (Raytek Model RAYMT 4U). A moist film on all cave surfaces suggested that the relative humidity was at or near 100%, and measurements recorded a relative humidity of 98.4% (Kestrel Weather Instrument).

Sections of the cave ceilings and walls were covered with fungi (not identified) that appeared bright white when photographed. An interesting feature in the cave was the hanging drops of water. These water drops were entangled in the fibers of the fungi, and took on a near-perfect spherical shape. A resistant rock layer produced a shelf running along each wall of the cave. The space between the shelves is about one meter, allowing room for

Figure 2. Photograph taken inside Scoby Dam Cave. The bright white fungus is shown in the upper left-hand corner wall and ceiling of the cave. Tim Fay is shown standing along between the cave shelves.

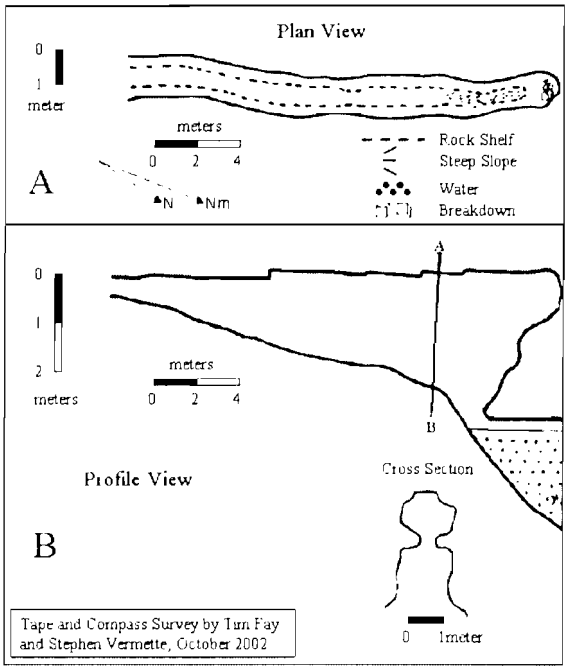

Figure 3. Hand drawn maps of Scoby Dam Cave, showing a plan view (A) and a profile view (B).

maneuverability (Figure 2). Debris associated with human occupancy was also found (e.g. candles, beer cans, etc.), and a make-shift foam raft was found near the back of the cave.

The cave was mapped using a tape and compass survey technique. A compass (Engineer Lensmatic Compass) orientation was first taken at the cave opening, and again along a series of marked stations. The distance between stations was measured using a 10 meter tape measure. The slope of the cave floor was measured using a clinometer (Osmiroid Measuring Set). Careful dimensional measurements were taken of the cave shelf (width and height above the floor). A cave map is presented in Figure 3.

CAVE FORMATION

The Cattaraugus Creek gorged formed as rivers flowing off the Appalachian Plateau deepened their channels in response to the lowering of Lake Erie (Lake Warren) to present levels (about 12,000 years ago). The cave is linear in pattern and likely formed along a joint in the rock. The cave's initial strike measured 335 degrees, turning slightly to 350 degrees deeper into the cave. The orientation runs somewhat parallel to the river, thus it is possible that the deepening of the gorge released pressure along the cliff rock, and caused local jointing (Figure 4). The cave's orientation is also similar to joint patterns mapped across western New York (Engelder and Geiser, 1980). A more likely possibility is that the joint forming the cave may have had its genesis with more ancient regional tectonic conditions associated with mountain building to the east (Figure 5).

The cave is formed in shale beds. Clay deposits form much of the cave's floor. While shale beds offer a resistance to the flow of water (low permeability), water flow would be enhanced along joints. The melt waters associated with the Laurentide ice sheet released huge volumes of water that could have flowed through the joint.

The widening of the joint, and thus creation of the cave, may have resulted from dissolution of the rock – typical of limestone caves. In our study of this cave, the shale was subjected to a dilute acid test. The

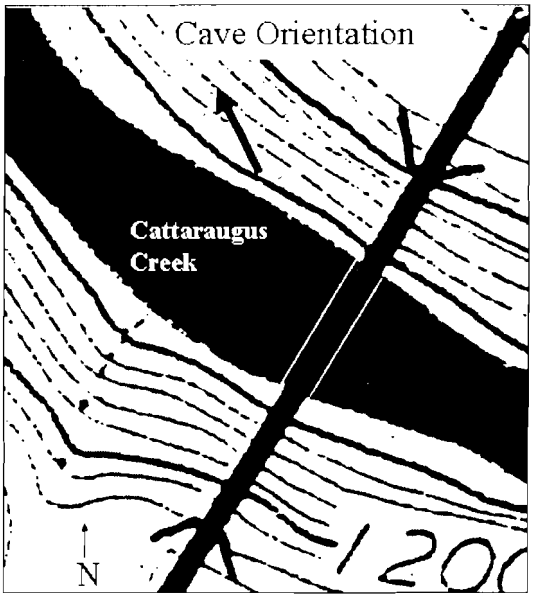

Figure 4. The orientation of Scoby Dam Cave (shown as arrow) in comparison to Cattaraugus Creek. The creek flows from lower right to upper left in the figure. The bridge of US Rt. 219 crosses the Zoar Valley gorge of Cattaraugus Creek immediately upstream of the cave.

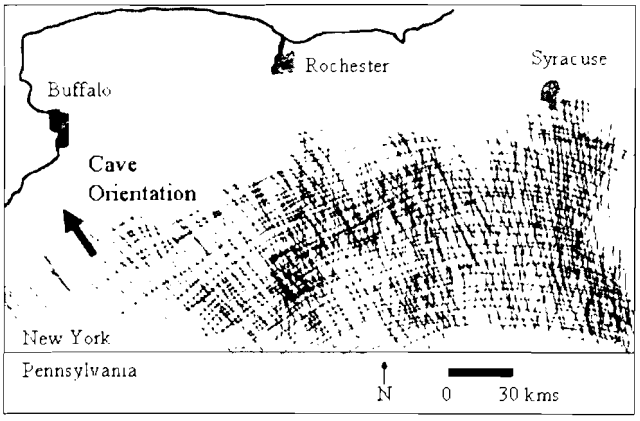

Figure 5. The orientation of Scoby Dam Cave in comparison to joint patterns mapped in Western New York (Engelder and Geiser, 1980).

absence of any carbonization (no significant calcium carbonate) suggested another mechanism of weathering and erosion. The disintegration of shale is usually associated with its wetting and drying, and subsequent swelling and shrinking. Even the changing pressure in pore spaces may cause disaggregation. The action of wetting and drying would be possible in the vadose zone (above the water table). This is a likely scenario for the Scoby Dam Cave, as the deepening of the channel of Cattaraugus Creek would have lowered the local water table. While glacial meltwater would have provided a large volume of water flowing through the joint, the flow through the cave would vary with changing climate (more or less melting water). The shelf indicates different rock resistance to changing water levels in the cave, thus supporting the theory of a vadose environment for cave formation. The presence of clay on the cave floor offers support for the disaggregation of shale attributed to prior flooding.

INSECT FAUNA

The insect fauna of Scoby Dam Cave was surveyed on November 20, 2002. The most conspicuous insects observed on the ceilings and walls of the cave, by virtue of their relatively large size (estimated body length 1-2 cm), were immature individuals of a species of cave or camel cricket, *Ceuthophilus* sp. (order Orthoptera or Grylloptera, family Rhaphidophoridae). These insects are reported to feed mainly on dead and dying invertebrates (Vickery and Kevan, 1985).

Hundreds of adult mosquitoes and smaller numbers of three other species of flies were observed on the ceiling and upper walls of the cave. Flies were collected for about one hour with a Bright Star® battery-powered aspirator (Hausherr's Machine Works, Toms River, NJ). The flies were transported to the Live Animal Laboratory of the Department of Biology at Buffalo State College where they were held at 21-22°C for 14 hours in a 30 cm x 30 cm screen cage. The cage was covered with Turkish towels saturated with water in an effort to maintain high relative humidity within the cage.

The collection was found to contain 408 individuals representing four families of Diptera as follows:

370 – *Culex pipiens* Linnaeus or *restuans* Theobald (family Culicidae)
8 - *Culex pipiens* Linnaeus
1 – *Uranotaenia sapphirina* (Osten Sacken) (family Culicidae)
27 – *Exechiopsis umbratica* (Aldrich) (family Mycetophilidae)
1 – *Corynoptera* sp. (family Sciaridae)
1 – *Schroederella iners* (Meigen) (family Heleomyzidae)

After the14-hour holding period, 40 flies that had died were removed from the bottom of the screen cage: 37 *C. pipiens-restuans*, 1 *U. sapphirina*, 1 *Corynoptera* sp., and 1 *S. iners*. The culicid and myceptophilid flies that survived were transported to the Erie County Vector and Pest Control Laboratory where they were frozen at -70°C in a REVCO® ultra-low temperature upright freezer (Kendro Laboratory Products, Asheville, NC). The mosquitoes were identified under a Leica zoom stereomicroscope as *Culex pipiens-restuans*, and segregated into pools on a chill table and cryolizer (BioQuip Products, Rancho Dominguez, California.). Adults of *C. pipiens* and *C. restuans*, are morphologically difficult to distinguish during routine surveillance because the setae that form diagnostic patterns are typically rubbed off in trapped specimens, thus explaining why 370 specimens were identified as *C. pipiens- restuans*. After removing eight voucher specimens (identified as *C. pipiens* Linnaeus), seven pools containing 333 *C. Pipiens-restuans* were submitted on dry ice to the Arbovirus Laboratory of the Wadsworth Center of the NYSDOH in Guilderland. The eight voucher specimens of *C. pipiens*, and vouchers of the other four species of dipterans, were deposited in the insect collection of the NYSDOH maintained at the Department of Biology, Buffalo State College.

The seven pools of *Culex pipiens-restuans* were negative for West Nile virus (WNV) when tested using the method previously described in Shi et al. (2001). Although these pools were negative for WNV, there is a precedent for testing overwintering *C. pipiens* from thermally-buffered natural sites such as Scoby Dam Cave that provide harborage for mosquitoes during the winter. West Nile viral

ribonucleic acid was detected in three pools, and live WNV was isolated from one pool of overwintering *C. pipiens*, that were collected from sewer manholes, catch basins, pipe chases, unheated/abandoned/historic buildings, etc., in New York City during January and February, 2000 (Nasci et al., 2001).

The cave crickets observed in Scoby Dam Cave are likely to be regular members of the invertebrate community there, perhaps functioning as scavengers. Like *Culex pipiens*, *Uranotaenia sapphirina* is known to overwinter in caves and other shelters (Wood, Dang and Ellis, 1979). Thus, although the immature stages of these two mosquitoes likely develop in aquatic habitats elsewhere, Scoby Dam Cave serves as a hibernaculum for adult females of these two species.

The larvae of mycetophilid fungus gnats mostly feed on fungi, i.e., are mycetophagous (Vockeroth, 1981). The larvae of sciarid fungus gnats generally feed on fungus as well as decaying plant material and animal excrement (Steffan, 1981). Since at least one species of fungus was observed in the cave (the reflective white fungus on the ceiling), it is possible that one or both species of fungus gnats breed there. Also, since one roosting bat was observed in Scoby Dam Cave on November 20, 2002, and more individuals likely roost in the cave during the warmer months, it is possible that sciarid larvae, in particular, feed on bat excrement. Some species in both families of fungus gnats are known to live mainly or entirely in caves (Steffan, 1981; Vockeroth, 1981). Resolution of the question of whether the two species of fungus gnats actually breed in the cave, or incidentally roost or overwinter there as adults (like the two species of mosquitoes), would depend on finding larvae or pupae of fungus gnats in the cave, and rearing them.

The presence of the single male heleomyzid fly, *Schroederella iners* (Meigen), is of particular interest because this species appears to be rarely collected. Gill (1962) reports that a specimen was collected alive off snow in November, 1933 (specific date not given), by D. Denning, at Plummer, Minnesota. Garnett and Foote (1966) report having taken one female in a funnel trap placed in the entrance of a woodchuck burrow near Kent, northeastern Ohio, on November 5, 1963. Thus these two published collection records are chronologically consistent with our record from Scoby Dam Cave on November 20, 2002. Larvae of heleomyzid flies, in general, are found in many types of decaying plant and animal matter, and are known to occur in bat caves, excrement, and fungi, as well as other habitats or substrate types (Gill and Peterson, 1987).

CONCLUSIONS

Scoby Dam Cave is a linear cave formed in shale beds of the Canadaway Formation. The cave is 20 meters in length (ending at an unexplored length of water passage), with a width of about 2 meters and a maximum height of 3 meters. It is likely that the cave formed along a joint that itself can be attributed either to the formation of the gorge of Cattaraugus River (unloading) or to tectonic activity (matching joint orientations mapped in Western New York). Shale expansion and contraction causing disaggregation is the most likely explanation for joint enlargement. This would have taken place in the vadose zone, associated with the down-cutting of Cattaraugus Creek and a varying flow of glacial melt waters through the joint.

Six insect species were identified in the cave. The presence of 378 specimens of *Culex pipiens-restuans* and one specimen of *Uranotaenia sapphirina* on November 20, 2002, suggests that Scoby Dam Cave serves as an overwintering hibernaculum for adult females of these two species of mosquitoes. Seven pooled samples of the *Culex* mosquitoes tested negative for West Nile virus. The presence of a single male heleomyzid fly, *Schroederella iners*, is noteworthy, as this species appears to be rarely collected and reported in the literature.

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