Vertigo elatior Sterki — tapered vertigo

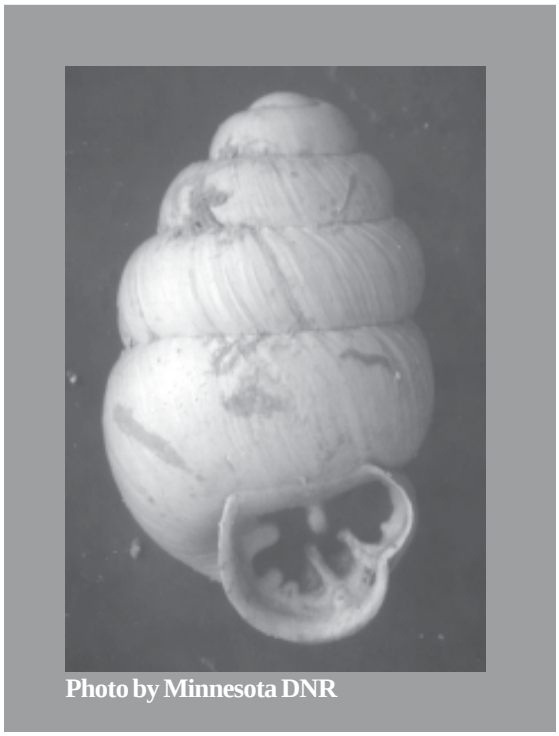
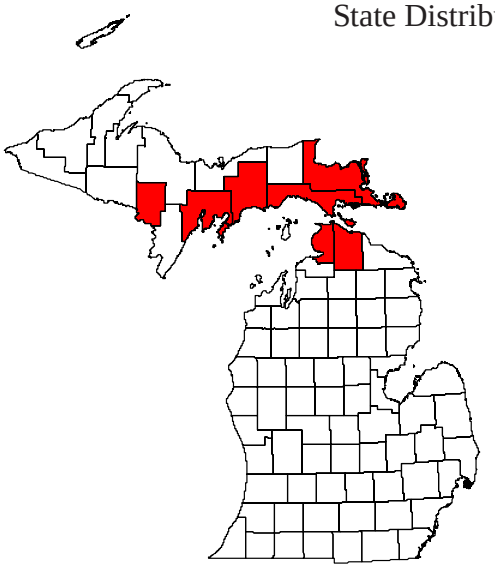


Photo by Minnesota DNR

State Distribution



Best Survey Period

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
					■	■	■	■			

Status: State special concern

Global and state rank: G5/S3

Family: Pupillidae

Range: The range of the tapered vertigo in the U. S. extends from Maine west to Montana and south to Arizona and New Mexico (Burch and Jung 1988, NatureServe 2007). The species also is known to occur from Newfoundland and Ontario west to Alberta and British Columbia in Canada (Burch and Jung 1988, NatureServe 2007). However, distribution data for the U. S. and Canada are known to be incomplete for this species (NatureServe 2007).

State distribution: In Michigan, the tapered vertigo has been reported recently (i.e., 1998-1999) from only four counties in the eastern Upper Peninsula (Nekola 1998, Michigan Natural Features Inventory (MNFI) 2007a). The species also was reported from Cheboygan and Emmet counties in the 1980's (Burch and Jung 1988) and from Dickinson County in the early 1900's (Baker 1922), but it is not known if the species still exists in these counties. Systematic surveys for this species have not been conducted throughout the state. Thus, potential exists for this species to occur at additional sites in which suitable habitat is available.

Recognition: This minute land snail has a **shiny, translucent, chestnut brown-colored**, **cylindrical or "beehive-shaped" shell** with 5 whorls (Baker 1939, Taft 1961, Nekola 1998, MNFI 2007b). The shell is **about 2.2 mm (0.09 in) in height** and about 1.2 mm (0.05 in) in width (Baker 1939, Taft 1961). The **outer lip of the aperture**, or main opening of the shell, **and the adjoining body whorl are strongly indented** (Burch and Jung 1988). The **aperture** usually **has five lamellae or "teeth."** The tapered vertigo also has a **strong apertural callus** (thickening of the outer lip), sinulus, and crest, as well as distinct striae or shell markings (Nekola 1998).

Best survey time: Surveys for the tapered vertigo can be conducted anytime during the growing season, but the best time to survey for this species is from June through September (MNFI 2007b). Because land snails require moisture, surveys are generally most successful in the spring (after snowmelt) and fall, particularly after rain events, when the soil is moist, and during higher relative humidity conditions and cooler temperatures (Taft 1961, Burch and Pearce 1990, MNFI 2007b). The best way to survey for this species is by soil litter sampling. This consists of collecting soil and leaf litter samples in the field and drying, sifting, and looking for snail shells in the samples in the laboratory (Nekola 1998, Nekola 1999).

Michigan Natural Features Inventory
P.O. Box 30444 - Lansing, MI 48909-7944
Phone: 517-373-1552

Habitat: In Michigan, the tapered vertigo has been found in a variety of open calcareous sites including fens, cobble beaches, alvars, and conifer swamps dominated by northern white-cedar (*Thuja occidentalis*) or tamarack (*Larix laricina*) (Nekola 1998). The alvars in which this species has been found include grasslands which developed on flat limestone or dolomite pavement with little or no soil development, and are wet or moist in early summer but xeric or dry by mid-summer (Nekola 1998). The white-cedar wetlands are comprised of forested peatlands dominated by a white-cedar canopy, with neutral soils, little or no *Sphagnum* moss, and other common species such as tamarack and speckled alder (*Alnus rugosa*) (Nekola 1998). The tamarack-sedge wetlands in which this species has been documented consist of open stands of tamarack with thick sedge (*Carex* spp.) ground cover, little or no *Sphagnum* moss, and speckled alder as a common shrub (Nekola 1998). These tamarack-sedge wetlands are not common in Michigan's Upper Peninsula, and appear to be restricted to areas underlain by Niagaran Escarpment carbonate bedrock (Nekola 1998). Natural community types in Michigan with which the tapered vertigo has been associated include northern fen, limestone cobble shore [cobble beach], limestone bedrock glade [alvar glade], limestone bedrock lakeshore [alvar pavement], and rich conifer swamp (MNFI 2007b). The tapered vertigo was found in highest densities in fens, and was absent from disturbed sites (Nekola 1998). This species appears to be restricted to high quality calcareous wetland sites and areas underlain by limestone (Nekola 1998). As a result, the tapered vertigo may have a very limited distribution in Michigan (Nekola 1998).

Biology: Little information is available about the specific biology and life history of the tapered vertigo. In general, land snails require adequate moisture, shelter, abundant food supply, and an available source of calcium (Burch 1962, Burch and Pearce 1990). Land snails require moisture or water for basic physiological processes as well as locomotion and reproduction (Burch and Pearce 1990). For example, land snails generate mucous trails as they crawl, and mucous is largely comprised of water (Burch and Pearce 1990). Also, most snail eggs are highly susceptible to dessication, and must be deposited in moist sites to survive (e.g., moist soil, under stones, logs, or leaf litter) (Burch and Pearce 1990, Martin 2000). Most land snails can minimize water loss and survive dry conditions by aestivating and closing their shell opening with an operculum (i.e., a calcareous "lid" that seals the opening) or a mucous film that hardens over the opening (Burch 1962, Burch and Pearce 1990).

Snails require calcium to maintain their shells. As a result, snails are often associated with habitats that are rich in calcium such as areas that are abundant in limestone (e.g., limestone outcrops), or have soils derived from limestone or are otherwise high in calcium carbonate (Burch and Pearce 1990). Snails also can occur in areas in which the soils are poor in calcium if the local vegetation can provide sufficient calcium (Burch and Pearce 1990). Snails ingest soil particles and scrape rocks or snail shells in order to obtain calcium (Fourníe and Chétail 1984). Snails also can obtain calcium that is dissolved in water by absorbing the water through their skin or drinking it (Heller and Magaritz 1983 in Martin 2000).

Availability of adequate shelter or refuges also is extremely important to land snails in general. Burch and Pearce (1990) have suggested that refuges may be the most important factor limiting the abundance of land snails. Refuges provide shelter from cold and hot weather conditions and desiccation as well as protection from predators (Burch and Pearce 1990). Refuges include soil humus, leaf litter, rotting logs and other woody debris, crevices and cavities in tree bark, rocks, soil crevices, and under the soil surface. Most land snails also overwinter underground or under rocks, logs, and boards (Burch 1962).

Some land snails, including the tapered vertigo, appear to respond strongly to soil surface architecture (Nekola 2003). The tapered vertigo appears to prefer soils with a thin (< 4 cm/1.6 in) organic horizon (soil layer) underlain by an upper soil horizon firmly bound by plant roots (i.e., "turf specialists") (Nekola 2003). Seventeen additional land snails across the Great Lakes basin appear to prefer similar thin soils, while twenty-eight other land snails in the region appear to prefer deeper (> 4 cm), loose soils comprised primarily of humus and mineral soil (i.e., "duff specialists") (Nekola 2003). Soil surface architecture may be important to land snails in general since almost 90% of land snails live within 5 cm (2 in) of the soil surface (Hawkins et al. 1998). The architecture of the organic litter layer and the underlying soil also may impact land snails (Cameron 1986, Nekola 2003).

Temperature, moisture, and light intensity are the primary factors regulating or influencing land snail activity (Burch 1962, Burch and Pearce 1990). Land snails are primarily nocturnal, but may be active during the day following a rain event (Burch 1962, Burch and Pearce 1990). High relative humidity and cooler temperatures also can cause increased land snail activity (Burch and Pearce 1990). Land snails generally do not move much except to find food or reproduce (NatureServe 2007). They actively migrate fairly slowly and over relatively short distances (i.e., usually only centimeters or meters) under favorable environmental conditions (Burch and Pearce 1990, NatureServe 2007). Long-distance dispersal is thought to occur passively through transport by animals (i.e, mammals, birds, or insects) or by humans such as on food, plants, or machinery (Burch and Pearce 1990, NatureServe 2007).

Land snails exhibit a number of different sexual systems and reproductive strategies, behaviors, and anatomy (Leonard 1991 in Martin 2000). The tapered vertigo is hermaphroditic (i.e., possesses both male and female sex organs) (Martin 2000). Although such land snails can self-fertilize, they commonly exhibit reciprocal mating or outcrossing in which each hermaphroditic partner acts as both male and female and exchange sperm during copulation (Martin 2000). Land snails can be oviparous (i.e., lay eggs), ovoviviparous (i.e., eggs develop inside the mother and the young are "born live"), or undergo egg retention in which the eggs are retained inside the mother for some period of time such that the embryo are more advanced when they are laid (Tompa 1979 in Martin 2000). The tapered vertigo is likely oviparous (Martin 2000).

Most land snails are generalist herbivores (Burch and Pearce 1990). Many also feed on fungus or detritus. A few snail species are carnivorous, consuming other snails, slugs, and invertebrates in the soil (Burch and Pearce 1990). Land snails are preyed upon by various organisms including birds, small mammals, amphibians, reptiles, other snails or slugs, beetle and fly larvae, and other insects (Burch and Pearce 1990).

Conservation/management: Given that the tapered vertigo has been documented from only a small number of sites in Michigan, all known populations of this species should be protected and monitored. The tapered vertigo may even warrant listing as a federally threatened species given its association with high quality calcareous wetland sites and limited distribution in the United States (Frest 1990 in Nekola 1998). Land-use activities that impact or alter critical habitat requirements including suitable microclimate and soil surface architecture as well as adequate moisture, calcium, food, and refuge should be avoided at known occupied sites (MNFI 2007b). The tapered vertigo is sensitive or vulnerable to excessive trampling (e.g., from recreational hiking or other uses), off-road vehicle use, and hydrological alterations (MNFI 2007b). Prescribed fire also has been found to significantly reduce land snail species richness and abundance in grassland habitats and negatively impact a number of snails that are considered "turf specialists" including the tapered vertigo (Nekola 2002). Use of prescribed fire in occupied sites should be avoided, if possible, or applied conservatively, leaving multiple refugia and using a burn interval of at least 15 years (Nekola 1998, Nekola 2002, MNFI 2007b). Additionally, fens, white cedar wetlands, and tamarack sedge wetlands have high conservation value for land snails because of the number of rare snail taxa associated with these habitats including the tapered vertigo (Nekola 1998). These habitats should be prioritized for surveys and potential management and/or protection for the tapered vertigo and other land snails. Tamarack-sedge wetlands, in particular, should receive some attention as these wetlands are uncommon in Michigan's Upper Peninsula.

Research needs: A systematic survey for the tapered vertigo is needed to identify additional occupied sites and determine this species' status and distribution in Michigan. Additional surveys and monitoring of known sites are warranted to determine their population status, extent, and viability. Research is needed to obtain information about the tapered vertigo's specific habitat requirements, life history, and ecology in Michigan. An assessment of threats to the species also should be conducted. Studies to monitor and investigate the effects of various land-use and recreational activities such as rock climbing, off-road vehicle use, prescribed fire, and others on the tapered vertigo are vital to ensure adequate management and protection of this species (Nekola 1998). It also is important to know how much buffer from management and recreational activities is needed to provide adequate protection for land snails (Nekola 1998).

Related abstracts: Vertigo cristata, Vertigo morsei, Vertigo nylanderi, Vertigo modesta parietalis, Vertigo paradoxa, alvar, limestone bedrock glade, limestone bedrock lakeshore, rich conifer swamp

Selected references

Baker, H. B. 1922. The mollusca of Dickinson County, Michigan. Occasional Papers of the Museum of Zoology No. 111, University of Michigan, Ann Arbor, Michigan. 45 pp.

Baker, F. C. 1939. Fieldbook of Illinois land snails. Illinois Natural History Survey Manual Series 2, Urbana, Illinois. 166 pp.

Burch, J. B. 1962. How to Know the Eastern Land Snails. Wm. C. Brown Company Publishers, Dubuque, Iowa. 214 pp.

Burch, J. B. and Y. Jung. 1988. Land snails of The University of Michigan Biological Station area. Walkerana 3(9):1–177.

Burch, J. B. and T. A. Pearce. 1990. Terrestrial gastropoda. Pages 201-299 in D. L. Dindal, ed. Soil Biology Guide. John Wiley & Sons, Inc., New York, New York. 1349 pp + i-xviii.

Cameron, R. A. D. 1986. Environment and diversities of forest snail faunas from coastal British Columbia. Malacologia 27:341-355.

Fourníe, J. and M. Chétail. 1984. Calcium dynamics in land gastropods. American Zoologist 24:857-870.

Frest, T. J. 1990. Final report, field survey of Iowa spring fens, contract #65-2454. Final report to the Iowa Department of Natural Resources, Des Moines, Iowa.

Hawkins, J. W., M. W. Lankester, and R. R. A. Nelson. 1998. Sampling terrestrial gastropods using cardboard sheets. Malacologia 39:1-9.

Heller, J. and M. Magaritz. 1983. From where do land snails obtain the chemicals to build their shells? Journal of Molluscan Studies 49:116-121.

Leonard. J. L. 1991. Sexual conflict and the mating systems of simultaneously hermaphroditic gastropods. American Malacological Bulletin 9:45-58.

Martin, S. M. 2000. Terrestrial snails and slugs (Mollusca: Gastropoda) of Maine. Northeastern Naturalist 7:33-88.

Michigan Natural Features Inventory (MNFI). 2007a. Biotics database. Lansing, Michigan.

Michigan Natural Features Inventory (MNFI). 2007b. Rare Species Explorer (Web Application). Available online at http://web4.msue.msu.edu/mnfi/explorer [Accessed Sep 28, 2007].

NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1 NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: February 25, 2007).

Nekola, J. C. 1998. Terrestrial gastropod inventory of the Niagaran Escarpment and Keewanaw volcanic belt in Michigan's Upper Peninsula. Final report to the Natural Heritage Program, Michigan Department of Natural Resources, Lansing, Michigan. 133 pp.

Nekola, J. C. 1999. Terrestrial gastropod richness of carbonate cliff and associated habitats in the Great Lakes region of North America. Malacologica 41:231-240.

Nekola, J. C. 2002. Effects of fire management on the richness and abundance of central North American grassland land snail faunas. Animal Biodiversity and Conservation 25:53-66.

Nekola, J. C. 2003. Large-scale terrestrial gastropod community composition patterns in the Great Lakes region of North America. Diversity and Distributions 9:55-71.

Taft, C. 1961. The shell-bearing land snails of Ohio. Bulletin of the Ohio Biological Survey 1(3):1-108.

Tompa, A. S. 1979. Oviparity, egg retention, and ovoviviparity in pulmonates. Journal of Molluscan Studies 45:155-160.

Abstract citation

Lee, Y. 2007. Special animal abstract for *Vertigo elatior* (tapered vertigo). Michigan Natural Features Inventory, Lansing, MI. 4 pp.

Funding for abstract provided by the Michigan Department of Transportation.