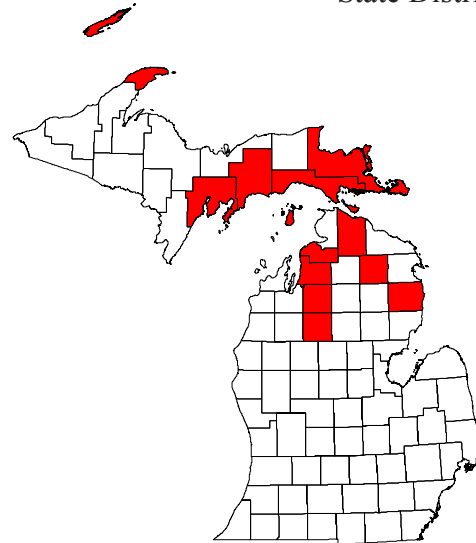
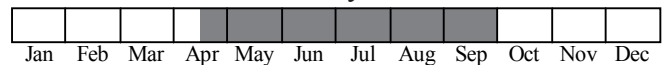


State Distribution



Best Survey Period



**Status:** State listed as Special Concern

**Global and state ranks:** G3G4/S3

**Family:** Valloniidae

**Synonyms:** none

**Total range:** The eastern flat-whorl’s global range covers ten U.S. states and Four Canadian provinces. Its status is “not ranked” or “under review” over most of its range, including eight States and three Provinces. It is ranked vulnerable in Michigan, imperiled/vulnerable in Ontario, and critically imperiled in Wisconsin (NatureServe 2007).

**State distribution:** In recent surveys, the eastern flat-whorl was found at nine sites in the Upper Peninsula of Michigan, in Chippewa, Delta, Keweenaw, Mackinac, and Schoolcraft Counties (Nekola 1998). Historic records (1948-1950) exist for it at eight sites, spread over seven counties in the Lower Peninsula (Alcona, Antrim, Charlevoix, Cheboygan, Kalkaska, Missaukee, and Montmorency).

**Recognition:** Eastern flat-whorl shells are very small, measuring less than 2mm in diameter. They have a low depressed spire and are widely umbilicate (i.e. have a

wide space on the underside of the shell spire). The shell is translucent with a pale brown color and is sculptured with thin ribs and fine spiral lines. The aperture is round with a thin lip. This species is similar to the costate vallonia (*Vallonia costata*), which has an aperture with a thicken lip and is lighter in color. Also, the ribs on the shell of the costate vallonia are more smooth and regular (Burch and Jung 1988). For more information on identifying land snails, see Burch and Jung (1988) pages 155-158 or Burch and Pearce (1990) pages 211-218.

**Best survey time:** Surveys for the eastern flat-whorl are best performed after rain, when the soil and vegetation are moist. During dry periods, a survey site can appear completely devoid of snails, while after a rain the same site can be found to contain numerous individuals. Temperatures should be warm enough that the ground is not frozen and there is no snow. Dry, hot periods during mid-summer should be avoided. The best time of day to survey is often in early morning when conditions are cool and moist. An indicator of suitable conditions for performing eastern flat-whorl surveys is the presence of other species of snails or slugs. Multiple site visits spaced days or weeks apart can help ensure that appropriate conditions are encountered during surveys. Empty shells might still be



found when conditions are not suitable for live individuals.

**Habitat:** Eastern flat-whorl populations documented in Michigan were most frequently found in white cedar wetland communities. They also occur in fen, lakeshore carbonate ledge, lakeshore alluvial bank, and rocky woodland habitats. All of these sites had rich, mesic to wet soils and supported northern white cedar (*Thuja occidentalis*). This species has an aversion to sphagnum dominated sites (Nekola 1998).

**Biology:** Terrestrial snails and slugs, along with aquatic snails (Gastropoda) belong to the Phylum Mollusca. They are related to clams and mussels (Bivalvia); squids, octopuses, and nautilus (Cephalopoda); and five Classes of lesser known mollusks found in marine environments: chitons (Polyplacophora), tusk shells (Scaphopoda), solenogasters (Aplacophora), Monoplacophorans, and Caudofoveatans. As the first molluscan group to expand out of aquatic environments (~150 million years ago, Clarkson 1979), land snails have adapted to a wide variety of terrestrial habitats. There are close to one thousand species in the U.S. and Canada alone.

Although there is very limited information on the specific biology of the eastern flat-whorl, the general biology of land snails applies to this species. One of the most important physiological characteristics of land snails is the need for moisture. Water is expended for locomotion and reproduction, and is lost by evaporation from external tissues (Riddle 1983). Land snail eggs have little resistance to desiccation, and so must be deposited in areas that remain moist. Snail shells are made of calcium carbonate, which is secreted from glands in the mantle along the edge of the shell. The oldest part of the shell is at the apex. The shells coil in one of two directions dextral or sinistral. With the aperture of the shell facing you and the pointed end of the spire pointed up, a dextral shell will have the aperture on the right side while a sinistral shell will have the aperture on the left. Most species of land snails, including the eastern flat-whorl, have dextral shells. Since land snails require a source of calcium for shell production, many species are most abundant on limestone and soils high in calcium carbonate (Burch 1955).

The diet of snails includes a wide range of organic materials including plants, fungi, animal tissue, and soil. Senescent plant material (e.g. aging leaves of deciduous trees, fruit, flowers, shoots) usually comprises the largest component of their diet, being preferred over green or dead plant tissue. Snails have been reported to eat algae, mosses, and lichens, but only rarely grasses. Senescent plant tissue is likely preferred because of its low toxin content. Many types of fungi are eaten by land snails, including some that are highly toxic to mammals. Soil particles are known to be a regular component of their diet, humic acid in particular is important for the nutrition of snails in laboratory culture. Animal remains probably comprise only a small portion of food items. Earthworms, chaetae, mites, remains of insects and other small animals, and mammalian feces have been reported in their diet. Land snail species can occur in a wide range of habitats, and utilize different food types based on what is available. Most snails begin foraging for food around sunset. The sense of smell, which is perceived by their tentacles, directs them toward some types of food items (Speiser 2001).

Reproduction in land snails is characterized by internal fertilization, and often includes elaborate courtship behavior. Land snail reproductive systems are complex and varied. The eastern flat-whorl, along with many other species of pulmonate land snails, are simultaneous hermaphrodites, meaning they have both male and female reproductive organs. The prosobranch land snails are dioecious, that is, individuals are either male or female. Cross-fertilization combined with oviparity (individuals lay eggs) is most common, but self-fertilization with ovoviviparity (eggs develop within the female's body until they hatch) has been documented in many taxa (Gomez 2001).

**Conservation/Management:** Land snails are particularly vulnerable to habitat degradation due to their localized nature and inability to migrate long distances. They are strongly tied to habitats such as carbonate cliffs, fens, wooded wetlands, and rocky upland woods. Irrevocable losses to land snail diversity may occur unless action is taken to protect these habitats in north-eastern Wisconsin and southern Upper Peninsula of Michigan (Nekola 2003). Roughly 97% of the regions land snail diversity could be conserved by protecting representative examples of these habitats within each of the geographic subregions (Nekola



2003). Landuse activities that could trample or otherwise alter cool, moist microhabitats should be avoided (e.g. ORV use and timber harvest). Prescribed fire has been shown to substantially reduce the abundance of land snails and cause the local extirpation of land snail species in upland and lowland grassland habitats (Nekola 2002). Nekola (2002) recommends that burn intervals be at least 15 years and that other methods of removing woody and invasive plants be used that preserve organic litter layers at sites with land snails. Hydrologic changes to ecosystems supporting land snail habitats should be avoided.

**Research needs:** Surveys for the eastern flat-whorl are needed to more accurately determine its true range and status in Michigan, and to gain better information on its habitat requirements. Additional populations are expected in both the Upper and Lower Peninsula of Michigan because its preferred habitat is relatively common (Nekola 1998). Studies on the life history of this species are also needed.

**Related abstracts:** *Euconulus alderi* (a land snail), Pleistocene *Catinella* (*Catinella exile*), Cherrystone Drop (*Hendersonia occulta*), Spike-lipped Crater (*Appalachina sayanus*), Alvar, Limestone Cobble Shore, Limestone Bedrock Glade, Limestone Bedrock Lakeshore, Rich Conifer Swamp, Boreal Forest, Northern Fen

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