

Appendix C

Gastropod Species Descriptions

This appendix provides a general morphological and ecological description of the species found at the study localities and discussed within the text. The descriptions are generalized from Pilsbry (1948), Leonard (1952), Burch (1962), Frest and Dickson (1986), and Forsythe (2001) with updates and suggestions from Nekola (2003; personal communication, 2007). The taxonomy of terrestrial gastropods has been subject to frequent revision (e.g. Turgeon et al., 1998), and a systematic hierarchy is not discussed here. For detailed descriptions and identification, refer to the key from Barthel and Nekola (2000), which includes detailed photographs. Range maps represent compilations of Hubricht (1985) and Leonard (1952) with revisions by Nekola (2003) and Forsythe (1999). This is not intended as a detailed review of the literature, but instead represents the general understanding of the habitat preferences of the taxa discussed in this dissertation.

It is interesting to note the general pattern of modern versus fossil distributions. Late Pleistocene deposits from the Midwest contain abundant Cordilleran-Boreal taxa, while large Eastern Deciduous Forest taxa such as *Anguispira alternata* are restricted further south. The modern distributions likely reflect a complex interaction between the snails' dispersal capabilities and their habitat preference. Cordilleran-Boreal taxa dispersed to the North and West, while Eastern Deciduous Forest taxa expanded their range North and East. This compares with the changes in vegetation after the Pleistocene;

the Eastern Deciduous Forest expanded from a restricted range along the Gulf (e.g. Webb et al, 2004).

***Hendersonia occulta* (Say)**

Description:

Shell somewhat depressed, with solid, conical spire. Five, nearly flat whorls; surface dull, with fine, transverse growth striae. Periphery more or less keeled; aperture oblique, subtriangular to semicircular; peristome narrowly expanded, strongly thickened with a rounded edge. Umbilicus closed, covered by thick callus. Diameter variable from 5 – 8 mm, height 6 – 8 mm.

Remarks:

Common late Pleistocene fossil from Nebraska to Ohio and southward to Alabama and Louisiana (Figure C-1). Frest and Fay (1980) considered this species to be characteristic of the Midwest Biome, an extinct gastropod fauna typical of late Pleistocene fossil assemblages in Iowa. Currently restricted to the Driftless Area and UMV, the Niagaran Escarpment in eastern Wisconsin and the Upper Peninsula of Michigan, and the Appalachian Piedmont (van der Schalie, 1939; Pilsbry, 1948; Nekola, 2003; Pearce, 2007). A calciphile that prefers well-shaded sites with sufficient leaf litter.

Considered a state endangered species in Wisconsin and species of concern in Michigan and Pennsylvania. Its occurrence as a late Pleistocene fossil in Wisconsin may represent a relict population, or the fragmentary remains may be reworked from earlier, pre-glacial material. As of this writing, amino acid racemization analyses of the shell has

not been performed, but samples are prepared and awaiting study. Additional genetic analysis of the Driftless Area populations are also being considered (K. Perez, personal communication, 2009). Map C1.

***Vallonia gracilicosta* (Reinhardt)**

Description:

Shell minute, diameter 2.5 mm. Almost flat spiral, 2.5 whorls, convex, with deeply impressed suture. Surface sculpture consists of fine riblets obliquely transverse to whorls. Constantly increasing whorls with body whorl rapidly enlarging toward aperture. Aperture descending with strongly reflected peristome; thickened, with approaching terminations connected by callus.

Remarks:

Common in the Rocky Mountain region today, some relict populations in the Paleozoic Plateau in Minnesota and Iowa (Frest and Dickson, 1986). Abundant fossil in loess deposits of Iowa, Nebraska, and Kansas (Leonard, 1950; 1952). Map C2.

***Pupilla muscorum* (Linne)**

Description:

Shell large for pupillid, height 3.9 – 4 mm. Cylindrically ovate shell with six to seven whorls, convex but not inflated; rimate and finely striate. Prominent crest parallels the peristome, separated by a groove. Aperture truncated slightly oblique oval.

Occasionally, parietal tooth may be present (not observed in Wisconsin fossil specimens), peristome sharply everted, terminations approaching connected by thin callus.

Remarks:

Frest and Dickson (1986) describe *P. muscorum* as a northern species with a few disjunct populations in the Interior and Cumberland regions east of the Mississippi River. Common loess fossil in Iowa, Nebraska and Kansas. Nekola (personal comm., 2007) regards this species as consisting of both native and introduced (from Europe) populations. Map C3.

***Pupoides albilabris* (C. B. Adams)**

Description:

Height 3.7 – 5.6 mm. Shell elongate, tapering from last whorl to obtuse apex. Rimate with 4.5-6.5 whorls; finely striate. Peristome broadly reflected, heavily thickened within. Fresh shell often translucent reddish brown with opaque white peristome.

Remarks:

A common species throughout the eastern Interior of North America, found as a late Pleistocene fossil in Texas and other southern states (Pilsbry, 1948; Hubricht, 1985). Current Wisconsin distribution is unknown, but I have found it at several locations in Grant County at depths of up to 50 cm. Amino acid D/L Asp values indicate this species has only recently (Holocene?) been in Wisconsin. Generally found in areas of open ground (see also Frest and Dickson, 1986; Theler, 1997). Map C4.

***Vertigo modesta modesta* (Say)**

Description:

One of the largest *Vertigo* species, shell height between 2.0 – 2.3 mm. Shell ovately conical, summit convex. Four to five rimate, convex whorls. Nuclear whorls finely granular, remaining whorls with distinct, irregular and coarse striae; body whorl more than half the height of the shell. Aperture ovate, outer peristome barely indented with three to four denticles, including a low, slightly elongate parietal lamella, low tubercular upper palatal fold, a large, somewhat elongate lower palatal fold, and a low, short disposed coluellar fold. Palatal folds not on callus. Peristome not everted, margins slightly rounded.

Remarks:

Very common late Pleistocene fossil throughout Midwest (Leonard, 1950; 1952; Frest and Dickson, 1986; Woodman et al., 1996). Currently found in Northern and Rocky Mountain regions west of the Mississippi River. A holarctic species, it is typically found as different “races” that share distinct shell morphologies. Wells and Steward (1987) described the distribution of this and *V. m. parietalis* as Cordilleran-Boreal. Nekola (2003) reported isolated relict populations in northern Wisconsin, this species was not previously known as a late Pleistocene fossil in the state. Map C5.

***Vertigo modesta parietalis* (Ancy)**

Description:

Shell nearly identical to *V. m. modesta*, but with a fifth parietal lamella.

Remarks:

Rare late Pleistocene fossil, currently found in the Yukon and elsewhere in northern Canada (Woodman et al., 1996; Forsythe, 2001). Locally common in a few fossil localities in Iowa (Frest and Dickson, 1986). Nekola (1996) reported an isolated, relict colony in the Upper Peninsula of Michigan. Not previously reported as a late Pleistocene fossil in Wisconsin. Woodman et al. (1996) reported it as a fossil from an assemblage in northeastern Iowa at Elkader.

***Vertigo oughtoni* (Pilsbry)**

Description:

Shell smaller than *V. modesta*, rarely more than 2 mm in height. Shell volume 1/3 to 1/2 that of *V. modesta*. Subcylindric pupilliform shell with 4.5 whorls; strongly convex with well-incised sutures. Aperture ovate to subcircular containing up to three indistinct denticles. No depression on exterior of shell over palatal lamellae. Peristome rounded to slightly reflected, parietal callus absent or weak.

Remarks:

Previously described as *V. alpestris oughtoni* Pilsbry, Nekola (personal communication, 2007) and Forsythe (2001) consider it a separate species. Frest and Dickson (1986) describe this species as an uncommon loess fossil found near the glacial

margin. Currently restricted to the moist Tundra and Muskeg habitats of northern Canada.

Map C6.

***Columella columella alticola* (Ingersoll)**

Description:

Shell cylindrical 2.5 – 3 mm in height, six to seven whorls; striate. Shell distinctly columnar with high spire and blunt apex. Pentultimate whorl smaller than adjacent whorls, body whorl often rounded. Sutures deeply impressed, small subcircular aperture, peristome simple, slightly thickened. Peristome slightly reflected at termination near umbilicus.

Remarks:

Hubricht (1985) and Bequart and Miller (1973) regard this species as a North American subspecies of the holarctic, European *C. columella*. In North America, it is known only as a late Pleistocene fossil east of the Mississippi River. Common in the North and Rocky Mountain regions, Wells and Stewart (1987) consider it typical of the Cordilleran-Boreal gastropod fauna. Pilsbry (1948) reports this species only occurs at high elevations (>2,000 m) in the southern portion of its range. Barthel and Nekola (2000) describe this species as common in “willow scrub” and dwarf birch stands near the treeline. Not previously reported as a Wisconsin fossil. Map C7.

***Succinea bakeri* (Hubricht)**

Description:

Shell elongatedly oval, body whorl inflated and accounts for up to 90% of total shell height. Two to four whorls, 15 – 19 mm in height, sculpture consists of fine growth striae. Aperture ovate with height more than double the width. Simple peristome with no callus or thickening.

Remarks:

The most widespread fossil succineid throughout the Midwest. Considered extinct (Frest and Dickson, 1986), however morphologically similar to *S. ovalis*. Given the phenotypic variability of this family, additional work is necessary to assign species (even genera) designations to this group. Chamberlin and Salisbury (1885) reported *S. obliqua* from sites in Grant County, Wisconsin, which may be synonymous with “*S. cf. bakeri*” from this dissertation.

***Catinella gelida* (F. C. Baker)**

Description:

Slender shell, length 7 – 11 mm, nearly twice diameter. Three to four whorls, deeply impressed sutures with coarse, wrinkled growth striae. Aperture ovate to subcircular, apertural height less than twice the width. Body whorl accounts for half to three-quarters total shell length (less than *S. bakeri*). Simple peristome, somewhat thicker than *S. bakeri*.

Remarks:

Widespread late Pleistocene fossil throughout Midwest. Frest (1987) reported a few relict populations in the Driftless Area and UMV. Nekola (personal communication, 2007) reported that shells of *Oxyloma groenlandica* are identical to fossil *C. gelida*. As with *S. bakeri*, fossil succineids represent a taxonomic conundrum: the only currently reliable identification is by soft tissue dissection. However, amino acid composition of shell proteins may yield additional insight (see Chapter 3 and Appendix A of this dissertation).

***Discus whitneyi* (Newcomb, 1864)**

Description:

Shell small, 6.7 mm in width. Depressed heliciform, low spire with 4.5 whorls; convex or subangular (especially in juveniles). Deep suture, protochonc smooth, strong equally spaced axial riblets along outer whorls that extend onto base. Aperture rounded, peristome simple without callus. Umbilicus large, more than 33% the shell width.

Remarks:

Common fossil snail south of Minnesota and Wisconsin from Nebraska to Ohio and southward (Frest and Dickson, 1986). Common in floodplains and forested wet habitats. This species can still be found in the region today. Typical of cool climates, but more cosmopolitan than *D. shimeki* or *D. macclintocki* (Frest and Dickson, 1986; Nekola, 2003). Previously described as *D. chronkhitei* (e.g. Baker et al., 1986; Frest and Dickson, 1986), but *D. whitneyi* predates the former name. Similar to the European *D. ruderatus* in size and morphology (Forsythe, 200?). Chamberlin and Salisbury (1885)

reported this species (as *Patula striatella* Anthony) in Crawford County, Wisconsin from alluvial sediment near the Bridgeport Terrace along the Wisconsin River. Map C8.

***Discus shimeki* (Pilsbry)**

Description:

Shell small, generally 6.5 mm in width, slightly depressed heliciform with elevated spire. Periphery rounded to subangular (especially in juveniles), 4 – 4.5 whorls, robust. Sculpture consists of prominent, fine ribs above, which disappear along the base of the whorls. Aperture subcircular with simple peristome. Circular umbilicus is narrower than *D. whitneyi* (less than 33% of the shell width).

Remarks:

Sometimes referred to as *D. shimekii*, it is a common late Pleistocene fossil in Iowa and Wisconsin (Frest and Dickson, 1986; Kuchta et al., 2007a, b). Currently found in the Rocky Mountains, often at high elevations, especially at the southern end of its range. In Arizona, Bequaert and Miller (1973) reported it at altitudes above 2,000 m. Not previously reported for Wisconsin. Often found with *D. whitneyi*, but can be differentiated from the former by its narrower umbilicus and fine to absent axial striae along the base of the whorls (Barthel and Nekola, 2000). Map C9.

***Anguispira alternata* (Say)**

Description:

Shell helicoids, 5-5.5 whorls, widely umbilicate with simple peristome. Live specimens have a tan shell with bold red-brown markings. These markings are often discernable in fossil shells. Diameter of adult shells is about 20 mm.

Remarks:

A common, typical woodland species that lives under leaf litter or under decaying wood. Mostly occurs as a late Pleistocene fossil in the south, along the Gulf Coast in Louisiana and Mississippi. Occasional older fossils occur west in Kansas and north in Iowa. Map C10.

Helicodiscus parallelus (Say)

Description:

Shell small; diameter 3 – 4 mm. Planispiral to slightly convex, umbilicus broad and shallow. 4 to 4.5 parallel whorls, outer whorls conspicuously marked with numerous raised spiral lirae. Periphery flattened. Peristome simple, with thin callus. Two small denticles inside body whorl not visible on exterior.

Remarks:

Late Pleistocene fossil in some regions of the Midwest, common throughout the Eastern and Interior regions of North America east of the Mississippi River today (Hubricht, 1985). Typically found in decaying leaf litter or decaying wood, it has been reported burrowing deep into the soil (Pilsbry, 1948). Results from this dissertation show

that it was not likely a late Pleistocene fossil in Wisconsin, but rather burrowed into the soil at depths up to 1 m. Map C4.

***Glyphalinia indentata* (Say)**

Description:

Shell slightly depressed, deeply umbilicate 4.5 – 5.5 mm in diameter. Sculpture consists of numerous radial grooves which are missing on base of whorls. 3.5 to 4 whorls that rapidly increase in size. Aperture ovoid-lunate, simple, thin peristome.

Remarks:

Abundant in the Eastern Deciduous Forest. Burch (1962) considered it typical of the Interior province. Hubricht (1985) suggested this name was applied to several species with similar shells. Theler (1997) reported this species along bluffs in the Driftless Area. Amino acid D/L Asp values indicate this taxon was not a late Pleistocene fossil in Wisconsin. Map C4.

***Hawaiiia miniscula* (Binney)**

Description:

Shell minute 2.2 – 2.8 mm in diameter. Umbilicate, spire slightly depressed and convex. Four whorls strongly convex, slowly enlarging in size toward aperture. Shell surface smooth with irregular, fine striae above and smooth below. Aperture nearly round, simple thin peristome.

Remarks:

One of the most common terrestrial gastropods in the United States (Hubricht, 1985). Generally prefers deciduous forest habitats. Found in open areas in western Iowa (Frest and Dickson, 1986). Leonard (1952) regarded *H. miniscula* as very common and cosmopolitan in habitat preference. Based on amino acid racemization analysis, this species was not a late Pleistocene fossil in Wisconsin.

***Euconulus fulvus* (Müller)**

Description:

Shell thin, diameter 3.2 mm. Subconic-heliciform, width slightly greater than height. Spire moderately elevated with an obtuse apex. 5.5 whorls slightly convex, somewhat deep sutures; periphery rounded to subangular, especially along body whorl. Close axial striae become indistinct along the base of the whorls. Aperture narrow, crescent-shaped without denticles. Peristome simple with closed umbilicus.

Remarks:

Favors cool habitats, found in moist and shaded woodlands in northern regions, but also in drier grasslands to high elevations generally (Pilsbry, 1948; Frest and Dickson, 1986). Leonard (1952) regarded *E. fulvus* as inhabiting sites with abundant organic debris. Burch (1962) described it as inhabiting Northern and Interior provinces. Wells and Stewart (1987) considered this species typical of the Eastern Deciduous Forest habitats despite being widespread throughout North America. Some authors recognize *E. fulvus alaskensis* as a separate species (e.g. Lauriol et al., 2002).

***Deroceras laeve* (Müller)**

Description:

Shell about 4 mm, ovoid, flattened plate with concentric growth lines. Left margin more convex than right, nucleus not quite terminal on left posterior.

Remarks:

The small, flattened internal slug plates are found in moist habitats. Previous authors (Leonard, 1950; 1952; Baker et al., 1986; Frest and Dickson, 1986; Woodman et al., 1996) assigned these plates to *D. laeve*. The slug plates found in late Pleistocene sediments in Wisconsin may be identical to those described, but reliable taxonomic identification is difficult for slugs (Nekola, personal communication, 2007). All slug plates found from this study are unassigned at this time.



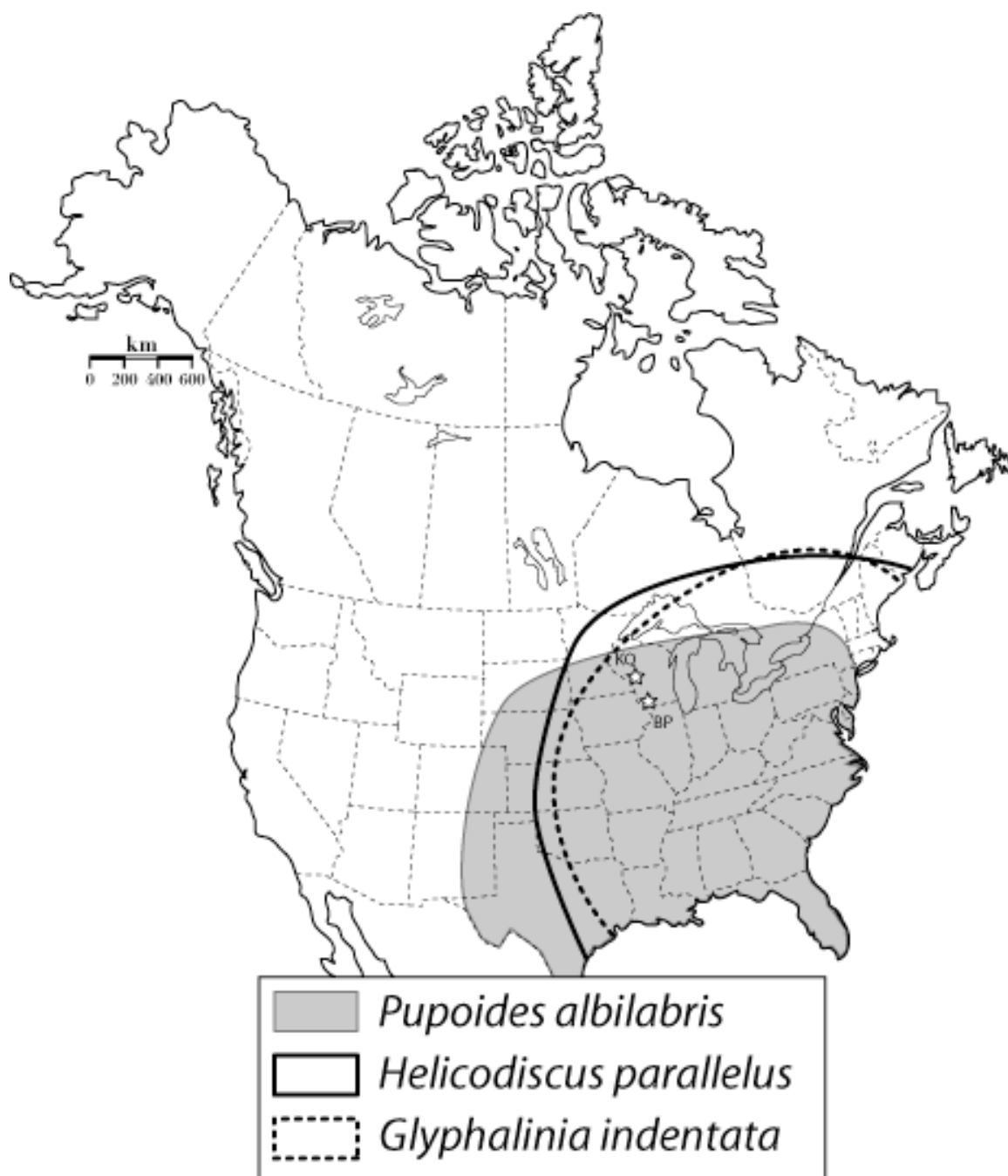
Map C1: *Hendersonia occulta*



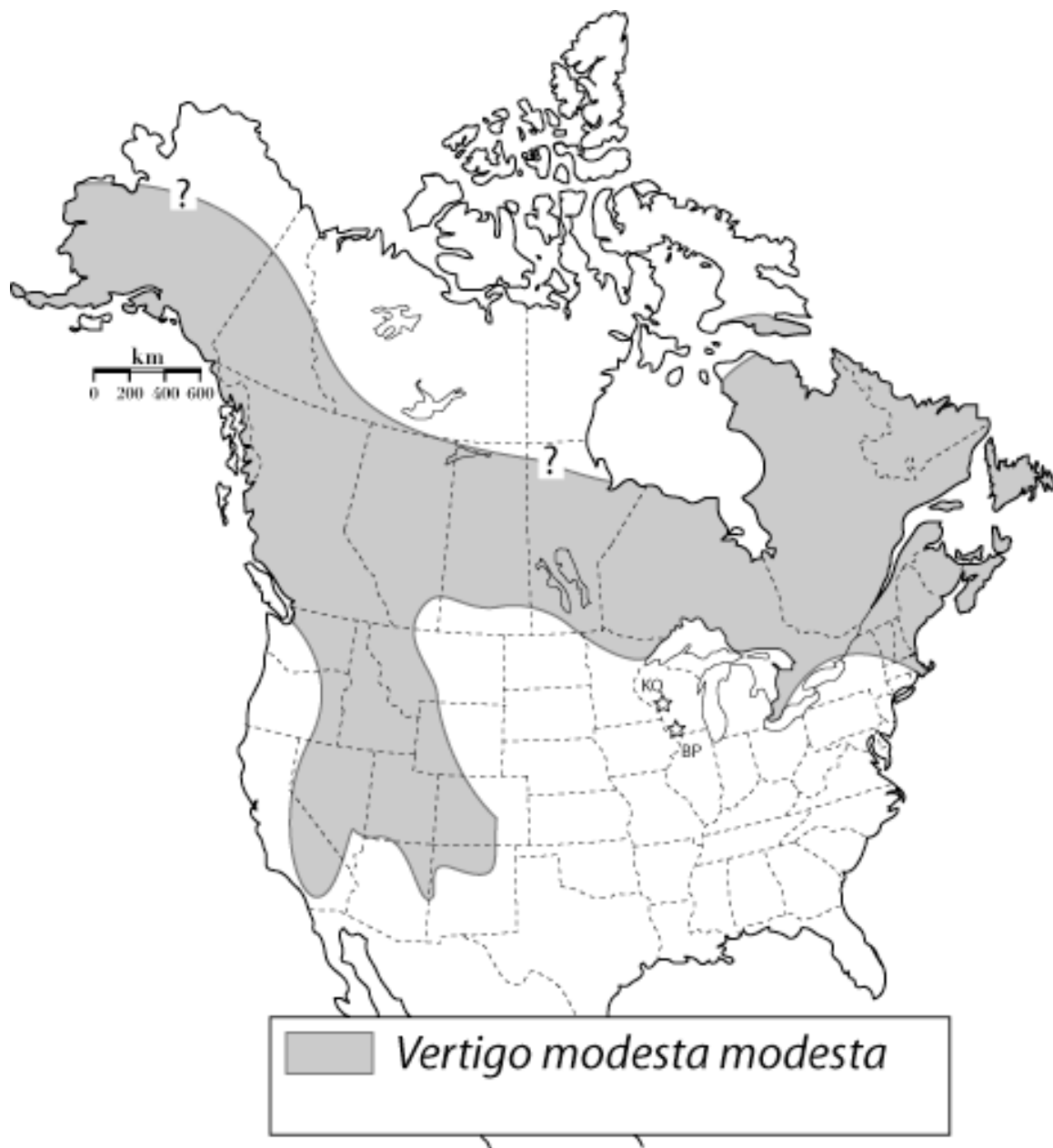
Map C2: *Vallonia gracilicosta*



Map C3: *Pupilla muscorum*



Map C4: *Pupoides albilabris*, *Helicodiscus parallelus*, *Glyphalinia indentata*



Map C5: *Vertigo modesta modesta*



Map C6: *Vertigo oughtoni*



Map C7: *Columella columella alticola*



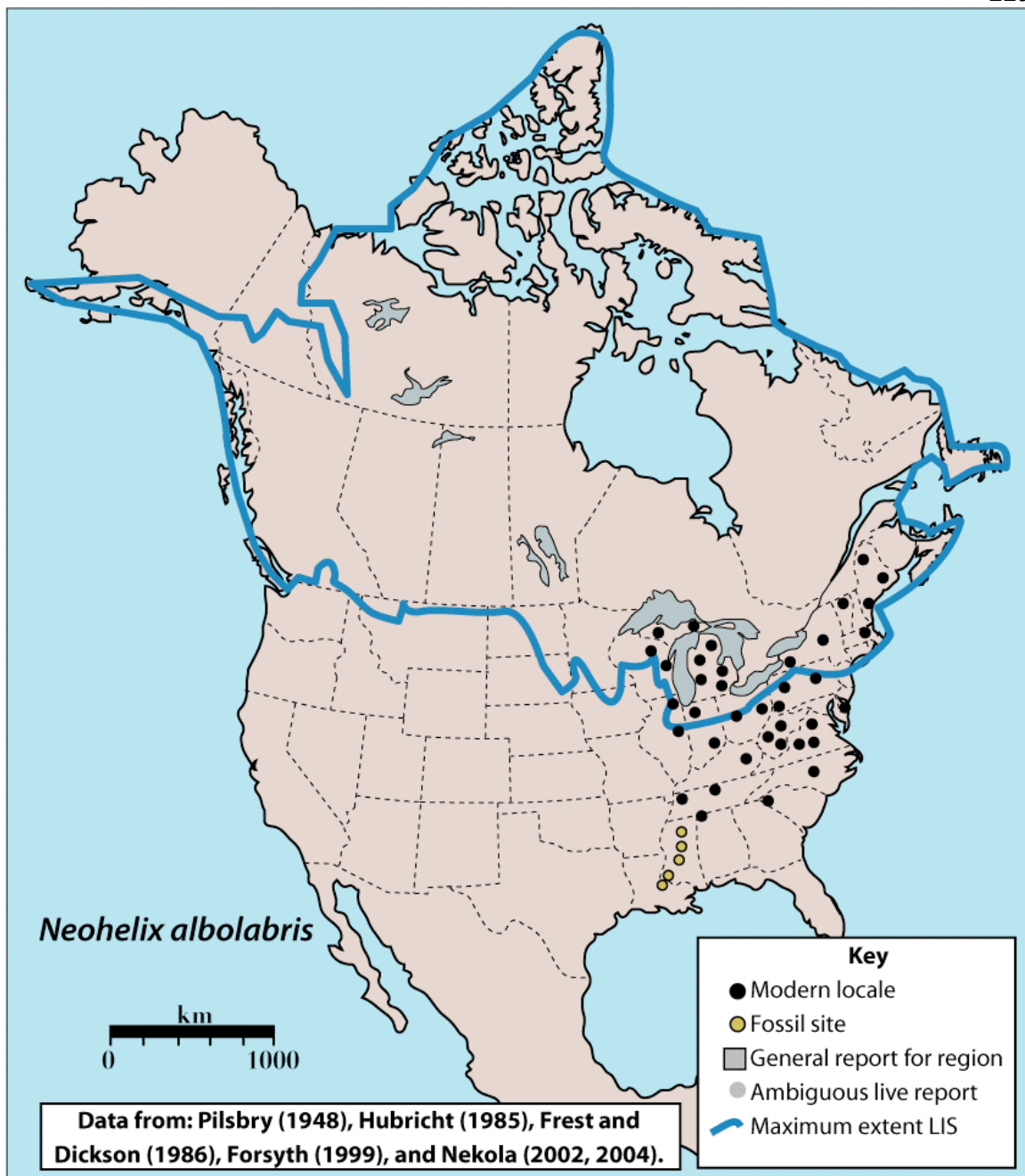
Map C8: *Discus whitneyi*



Map C9: *Discus shimeki*



Map C10: *Anguispira alternata*



Map C11: *Neohelix albolabris*