Chapter 9. Virginia's Southern Cumberland Mountains

9.1. Introduction

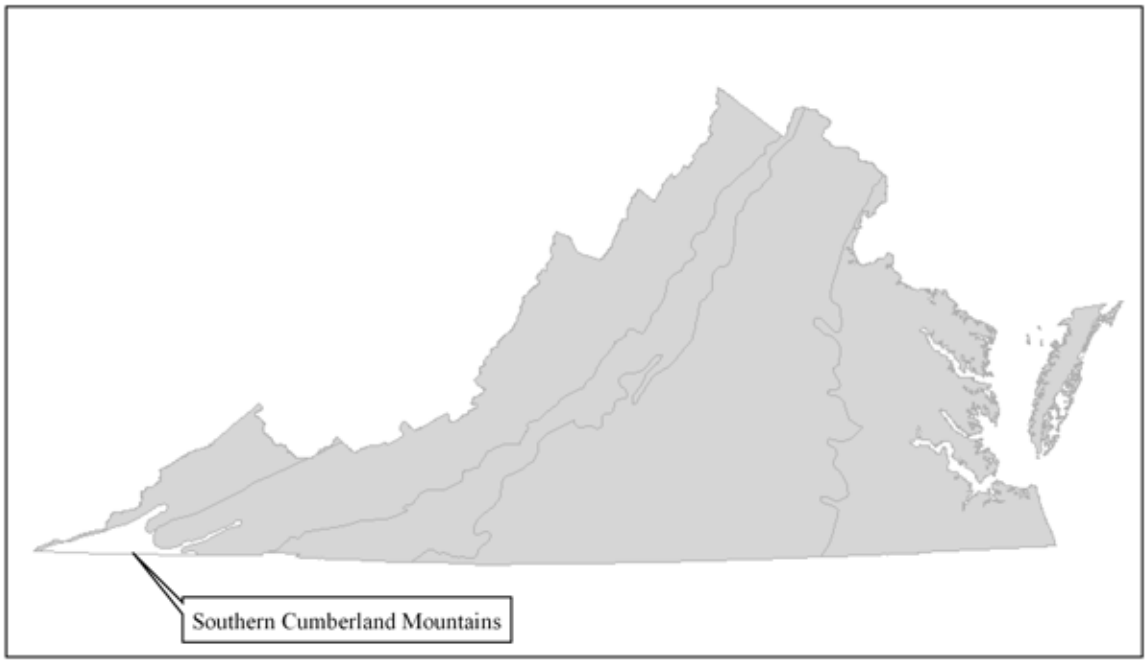

Figure 9.1. The Southern Cumberland Mountains ecoregion.

9.1.1. Description

The Southern Cumberland Mountains in Virginia (Southern Cumberlands, Figure 9.1) consists of parallel, northeast-to-southwest lines of mountains and valleys in southwestern Virginia. In many classification systems, this ecoregion is combined with the Northern Ridge and Valley (Table 9.1). The soils are mostly Udults (McNab and Avers 1995). Precipitation in the ecoregion averages between 92-140cm (McNab and Avers 1995). The average temperature ranges from 13 to 16°C (McNab and Avers 1995). The growing season generally lasts from 170 to 190 days, dependent on location (Woodward and Hoffman 1991). Forest cover is largely oak-pine and oak-hickory (historically oak-chestnut) (Woodward and Hoffman 1991). Surface waters are generally small or medium perennial streams, with moderate to high flow rates (McNab and Avers 1995). Much of this land has been cleared for pasture and agriculture (McNab and Avers 1995).

Table 9.1. Names for the Southern Cumberland Mountains as used in other ecoregional schemes and planning efforts. The following at least roughly correspond to the same area as Southern Cumberland Mountains as used in this document.

Planning Effort/Regional Scheme	Name of Ecoregion	Reference
NABCI	BCR 28, Appalachian Mountains [1]	NABCI 2000
PIF	Mid-Atlantic Ridge and Valley (Physiographic Area 12) [2]	Rosenberg 2003
United States Shorebird Conservation	BCR 28, Appalachian Mountains [3]	Brown et al. 2001
Waterbird Conservation for the	Southeast U.S. [4]	Kushlan et al. 2002

Planning Effort/Regional Scheme	Name of Ecoregion	Reference
Americas		
Freshwater Ecoregions	Ecoregion 35, Tennessee-Cumberland [5]	Abell et al. 2000
TNC's Ecoregional Planning Units	Ecoregion 50, Cumberlands and Southern Ridge and Valley [6]	Groves et al. 2000
Omernick's Ecoregions	Ecoregion 67, Ridge and Valley [7]	Omernik 1987
Bailey's Ecoregions	Section 221J, Central Ridge and Valley	Bailey 1995

[1] BCR 28 includes all of the Appalachian Mountains, and includes what are identified in the CWCS as the Blue Ridge Mountains, Northern Ridge and Valley, and the Northern and Southern Cumberland Mountains.
[2] Physiographic Area 12 also includes most of the Southern Cumberlands, as well as most of the Blue Ridge.
[3] No regional shorebird plan exists for this BCR.
[4] Southeast U.S. is a large region including all of Virginia. The regional scheme used by Kushlan et al. (2002) is based on composites of the BCRs used by NABCI.
[5] Ecoregion 35 also contains a portion of the Northern Cumberlands as used in the CWCS.
[6] Virginia's Southern and Northern Cumberlands are both within Ecoregion 50.
[7] Ecoregion 67 includes the Ridge and Valley and most of the Southern Cumberlands as used in the CWCS.

Despite breeding and wintering habitat frequently being the subject of focus in conservation of migratory birds, stopover habitat is just as essential (Moore et al. 1995). Some concern exists that migratory habitat may be a limiting factor in some populations, rather than breeding or wintering habitat (Sherry and Holmes 1993). Habitat usage during migration is complicated by the inability of birds to search for the best site, due to time or energy restraints (Moore and Simons 1989). As a result, migration stopover habitat is likely based more on food availability to replenish fat stores than on specific plant community composition (Moore and Simons 1989). For instance, one study found a much higher than expected proportion of migrant birds in scrub-shrub habitat on a barrier island in the Gulf of Mexico (Moore et al. 1990). The crucial conservation issue here is simply that migration stopover habitat is critical, and areas identified as migration pathways must conserve these habitats. All three major bird conservation plans recognize the importance of stopover habitat, and also recognize that in many cases habitat use during migration is poorly understood (Brown et al. 2001; Kushlan et al 2002; Rich et al. 2004).

Due to its position in the center of the Appalachians, Virginia's mountains are critical to hundreds of species of migrant birds, especially diurnal raptors (Hill 1984). The mountains provide updrafts that make migration energetically efficient for raptors (Johnsgard 1990). This makes the mountains of VIrginia an important flyway for raptor migration. For example, in 1997, 35% of the raptors observed during the fall migration hawk watch were in the mountains (with the remaining 65% occurring coastally, Holt 1998). Although many raptors migrate through the mountains and along the coast, it is rare for birds to switch routes: birds banded in the mountains are generally only recovered in the mountains, and vice versa (Hill 1984). Raptor migrants in the mountainous ecoregions include many species that breed in Virginia, such as the Tier I peregrine falcon *Falco peregrinus*, as well as many that do not, such as the northern goshawk *Accipiter gentilis* and golden eagle *Aquila chrysaetos.*

Several species of bats that occur in Virginia are also migratory. These include the Tier I Indiana myotis *Myotis sodalis* and the Tier II gray myotis *M. grisescens*, among many other more common species. Migratory bats are more difficult to study than migratory birds, both because they migrate nocturnally and because they are more cryptic than birds. As a result, very little is known about migration in bats. However, it appears that bats orient by following ridgelines and other land features during migration (Tuttle 2004). Since individuals of both of the aforementioned *Myotis* species migrate from other states to hibernate in only a few caves in the Appalachians (Pierson 1998), Virginia's mountain ecoregions may be important not only as a winter destination for bats, but also as a migration route. Therefore, even caves that do not serve as hibernacula are probably important as stopover habitat for many species (Whitaker and Hamilton 1998), especially in light of the fact that bats do not travel very far in one night. For instance, gray bats may

hibernate up to about 210km from their maternity caves, but only fly 18-52km per night (Whitaker and Hamilton 1998). These bats must be able to find suitable stopover caves for at least three nights during migration, and perhaps many more. Other bats may travel much further (little brown bats *M. lucifugus* may travel as far as 450km, Linzey 1998), and so may require even more stopover sites.

9.1.2. Land Cover Areas

Approximately 98% of the Southern Cumberland Mountains is montane, with the remaining 2% submontane. The vast majority of this ecoregion (78%) is forested (Figure 9.2). Agriculture/open areas are the second most abundant land cover type, covering 20% of the area. Approximately 1% of the area is developed. Water, wetlands, and barren areas (in order of abundance) make up less than 0.2% each. Less than 3% of the area within the Southern Cumberlands is protected in Conservation Lands (DCR 2003). This is the smallest percentage of any ecoregion in Virginia. Of the protected areas, approximately 98% are forested. Agriculture/open areas are vastly underrepresented in Conservation Lands, making up only 2% of their total area (DCR 2003). Water, developed, wetlands, and barren each make up less than 0.5% of land cover in the protected areas.

9.1.3. Human Population in the Southern Cumberlands

The Southern Cumberlands, with a population of slightly over 35,000 people (0.5% of Virginia's population) in 2000, has the fewest residents of any ecoregion (USCB 2003). Containing around 1% of Virginia's land area, the average population density is almost 26 people/km^2. Most of the area in the Southern Cumberlands is within the lower population density of less than 20 people/km^2 (Figure 9.3). Big Stone Gap is the only area containing more than 500 people/km^2. Between 2000 and 2009, the population in the Southern Cumberlands is expected to decrease nearly 2% (GeoLytics 2005).

There is only one high impact growth area, covering 2% of the area, within the Southern Cumberlands (Figure 9.4). This area containing Gate City and Weber City is expected to grow by over 15% between 2000 and 2009.

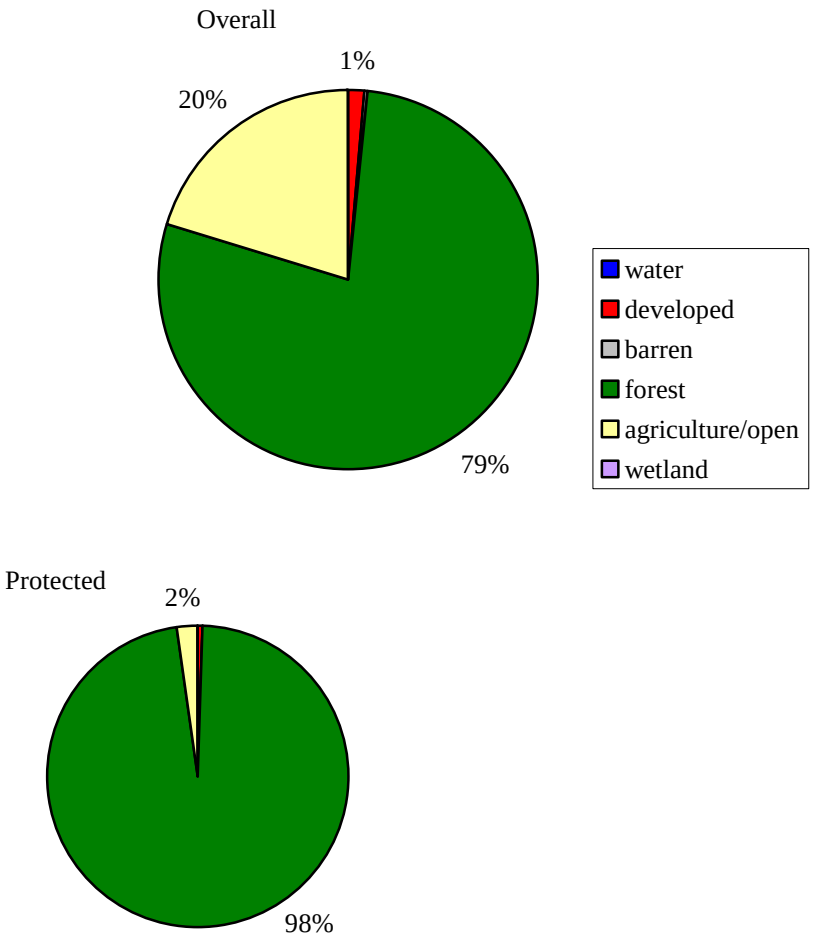

Figure 9.2. Proportional composition of land cover types within the Southern Cumberlands compared to proportion of land cover types within protected areas in the Southern Cumberlands.

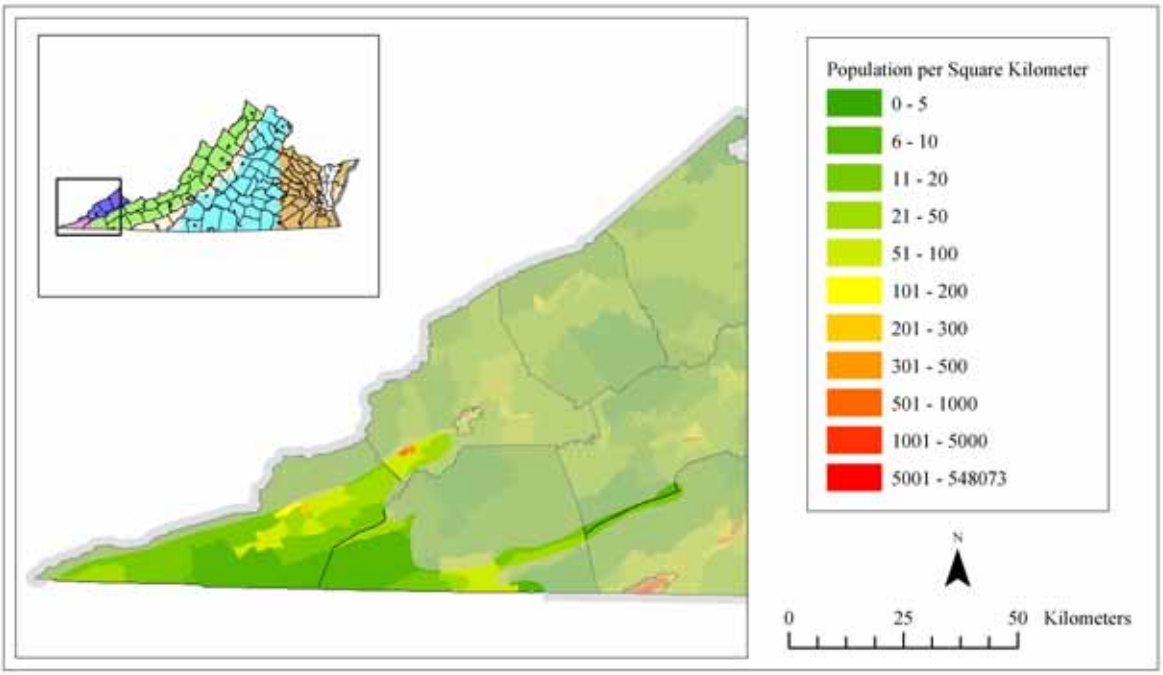

Figure 9.3. Population density for the Southern Cumberlands (USCB 2003). The inset map in the upper left shows Virginia's ecoregional boundaries, with the Southern Cumberlands in pink.

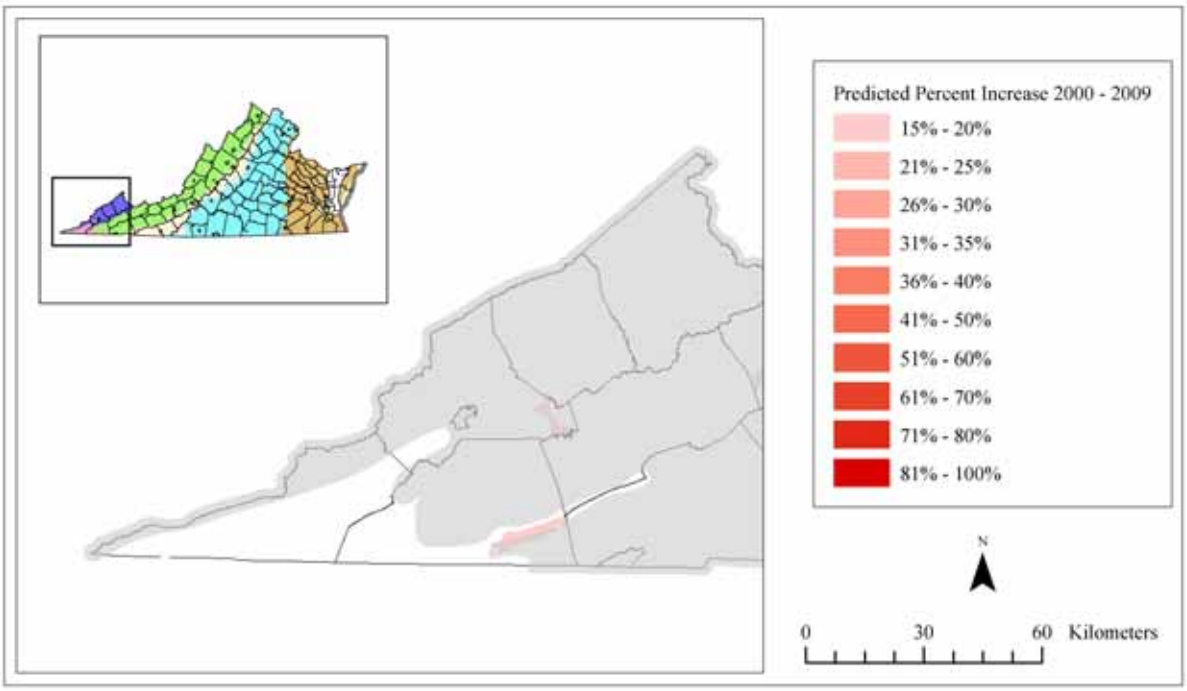

Figure 9.4. High impact growth areas in the Southern Cumberlands. This figure contains demographic data from GeoLytics, East Brunswick, New Jersey (GeoLytics 2005).

9.2. The Species of Greatest Conservation Need: Southern Cumberlands

Of the 174 species of greatest conservation need that occur in the Southern Cumberlands, 26 (15%) are in Tier I, 44 (25%) are in Tier II, 29 (17%) are in Tier III, and 75 (43%) are in Tier IV (Table 9.2).

Table 9.2. The species of greatest conservation need in the Southern Cumberlands.

Common Name	Scientific Name
Tier I	
Fishes	
Slender chub	*Erimystax cahni*
Ashy darter	*Etheostoma cinereum*
Turquoise shiner	*Cyprinella monacha*
Yellowfin madtom	*Noturus flavipinnis*
Duskytail darter	*Etheostoma percnurum*
Tennessee dace	*Phoxinus tennesseensis*
Amphibians	
None	
Reptiles	
None	
Birds	
Loggerhead shrike	*Lanius ludovicianus*
Appalachian yellow-bellied sapsucker [1]	*Sphyrapicus varius appalachiensis*
Mammals	
None	
Terrestrial Insects	
Holsinger's cave beetle	*Pseudanophthalmus holsingeri*
Other Terrestrial Invertebrates	
None	
Aquatic Mollusks	
Birdwing pearlymussel	*Lemiox rimosus*
Fanshell	*Cyprogenia stegaria*
Dromedary pearlymussel	*Dromus dromas*
Cumberlandian combshell	*Epioblasma brevidens*
Oyster mussel	*Epioblasma capsaeformis*
Green-blossom pearlymussel	*Epioblasma torulosa gubernaculum*
Fine-rayed pigtoe	*Fusconaia cuneolus*
Shiny pigtoe	*Fusconaia cor*
Cracking pearlymussel	*Hemistena lata*
Rough rabbitsfoot	*Quadrula cylindrica strigillata*
Cumberland monkeyface	*Quadrula intermedia*

Common Name	Scientific Name
Appalachian monkeyface	*Quadrula sparsa*
Purple bean	*Villosa perpurpurea*
Pink mucket	*Lampsilis abrupta*
Cumberland bean	*Villosa trabalis*
Unthanks Cave snail	*Holsingeria unthanksensis*
Crustaceans	
Lee County cave isopod	*Lirceus usdagalun*
Aquatic Insects	
None	
Other Aquatic Invertebrates	
Powell Valley planarian	*Sphalloplana consimilis*
Tier II	
Fishes	
Popeye shiner	*Notropis ariommus*
Paddlefish	*Polyodon spathula*
Blotchside logperch	*Percina burtoni*
Longhead darter	*Percina macrocephala*
Western sand darter	*Ammocrypta clara*
Amphibians	
Mountain chorus frog	*Pseudacris brachyphona*
Eastern hellbender	*Cryptobranchus alleganiensis*
Green salamander	*Aneides aeneus*
Southern zigzag salamander	*Plethodon dorsalis*
Reptiles	
None	
Birds	
None	
Mammals	
Gray myotis	*Myotis grisescens*
Terrestrial Insects	
Deceptive cave beetle	*Pseudanophthalmus deceptivus*
Cumberland Gap cave beetle	*Pseudanophthalmus hirsutus*
Long-headed cave beetle	*Pseudanophthalmus longiceps*
A cave springtail	*Pseudosinella hirsuta*
A cave springtail	*Oncopodura hubbardi*
A cave springtail	*Pseudosinella erewhon*
A cave springtail	*Pseudosinella extra*
A cave springtail	*Pseudosinella gisini*

Common Name	Scientific Name
A cave springtail	*Typhlogastrura valentini*
Rotund cave beetle	*Pseudanophthalmus rotundatus*
Other Terrestrial Invertebrates	
Shrew supercoil	*Paravitrea blarina*
Barred supercoil	*Paravitrea seradens*
Powell Valley terrestrial cave isopod	*Amerigoniscus henroti*
Gertsch's cave pseudoscorpion	*Kleptochthonius gertschi*
Lutz's cave pseudoscorpion	*Kleptochthonius lutzi*
A cave pseudoscorpion	*Kleptochthonius proximosetus*
A cave pseudoscorpion	*Kleptochthonius similis*
Valentine's cave pseudoscorpion	*Microcreagris valentinei*
A millipede	*Brachoria dentata*
Cedar millipede	*Brachoria cedra*
Aquatic Mollusks	
Slippershell	*Alasmidonta viridis*
Spectacle case	*Cumberlandia monodonta*
Snuffbox	*Epioblasma triquetra*
Tennessee pigtoe	*Fusconaia barnesiana*
Tennessee heelsplitter	*Lasmigona holstonia*
Slabside pearlymussel	*Lexingtonia dolabelloides*
Sheepnose	*Plethobasus cyphyus*
Fluted kidneyshell	*Ptychobranchus subtentum*
Rayed bean	*Villosa fabalis*
Pyramid pigtoe	*Pleurobema rubrum*
Coal elimia	*Elimia aterina*
Crustaceans	
Cumberland cave amphipod	*Stygobromus cumberlandus*
Lee County cave amphipod	*Stygobromus leensis*
Powell River crayfish	*Cambarus jezerinaci*
Cumberland Gap cave isopod	*Caecidotea cumberlandensis*
Aquatic Insects	
None	
Other Aquatic Invertebrates	
None	
Tier III	
Fishes	
Emerald shiner	*Notropis atherinoides*
Wounded darter	*Etheostoma vulneratum*
Channel darter	*Percina copelandi*
Tippecanoe darter	*Etheostoma tippecanoe*
Steelcolor shiner	*Cyprinella whipplei*

Common Name	Scientific Name
River redhorse	*Moxostoma carinatum*
Bluebreast darter	*Etheostoma camurum*
Ohio lamprey	*Ichthyomyzon bdellium*
Mountain brook lamprey	*Ichthyomyzon greeleyi*
Blackside dace	*Phoxinus cumberlandensis*
Amphibians	
Mudpuppy	*Necturus maculosus*
Reptiles	
Eastern black kingsnake	*Lampropeltis getula nigra*
Cumberland slider	*Trachemys scripta troostii*
Eastern box turtle	*Terrapene carolina*
Birds	
None	
Mammals	
Eastern small-footed myotis	*Myotis leibii*
Terrestrial Insects	
Riverbank tiger beetle	*Cicindela ancocisconensis*
Other Terrestrial Invertebrates	
Lee County terrestrial cave isopod	*Ligidium elrodii leensis*
Scott County terrestrial cave isopod	*Ligidium elrodii scottensis*
Aquatic Mollusks	
Elktoe	*Alasmidonta marginata*
Longsolid	*Fusconaia subrotunda*
Spiny riversnail	*Io fluvialis*
Black sandshell	*Ligumia recta*
Tennessee clubshell	*Pleurobema oviforme*
Brown walker	*Pomatiopsis cincinnatiensis*
Crustaceans	
Southwestern Virginia cave isopod	*Caecidotea recurvata*
Tennessee Valley cave isopod	*Caecidotea richardsonae*
Appalachian Valley cave amphipod	*Crangonyx antennatus*
Aquatic Insects	
Widecollar stonefly	*Paragnetina ichusa*
Newfound willowfly	*Strophopteryx limata*
Other Aquatic Invertebrates	
None	

Common Name	Scientific Name
Tier IV	
Fishes	
Mirror shiner	*Notropis spectrunculus*
Stargazing minnow	*Phenacobius uranops*
Stonecat	*Noturus flavus*
Northern studfish	*Fundulus catenatus*
Rainbow darter	*Etheostoma caeruleum*
Banded darter	*Etheostoma zonale*
Logperch	*Percina caprodes*
Sauger	*Stizostedion canadense*
Brook silverside	*Labidesthes sicculus*
Tangerine darter	*Percina aurantiaca*
American brook lamprey	*Lampetra appendix*
Streamline chub	*Erimystax dissimilis*
Blotched chub	*Erimystax insignis*
Mountain shiner	*Lythrurus lirus*
Bullhead minnow	*Pimephales vigilax*
Mountain madtom	*Noturus eleutherus*
Swannanoa darter	*Etheostoma swannanoa*
Gilt darter	*Percina evides*
Dusky darter	*Percina sciera*
Freshwater drum	*Aplodinotus grunniens*
Sawfin shiner	*Notropis sp.* A
Bluespar darter	*Etheostoma meadiae*
Amphibians	
Cumberland Plateau salamander	*Plethodon kentucki*
Reptiles	
Eastern hog-nosed snake	*Heterodon platirhinos*
Queen snake	*Regina septemvittata*
Stripe-necked musk turtle	*Sternotherus minor peltifer*
Northern map turtle	*Graptemys geographica*
Spiny softshell	*Apalone spinifera*
Birds	
Green heron	*Butorides striatus*
Northern bobwhite	*Colinus virginianus*
Yellow-billed cuckoo	*Coccyzus americanus*
Chimney swift	*Chaetura pelagica*
Eastern kingbird	*Tyrannus tyrannus*
Willow flycatcher	*Empidonax traillii*
Eastern wood-pewee	*Contopus virens*
Northern rough-winged swallow	*Stelgidopteryx serripennis*
Gray catbird	*Dumetella carolinensis*
Brown thrasher	*Toxostoma rufum*
Wood thrush	*Hylocichla mustelina*

Common Name	Scientific Name
Yellow-throated vireo	*Vireo flavifrons*
Black-and-white warbler	*Mniotilta varia*
Worm-eating warbler	*Helmitheros vermivorus*
Northern parula	*Parula americana*
Yellow warbler	*Dendroica petechia*
Kirtland's warbler (migrant)	*Dendroica kirtlandii*
Prairie warbler	*Dendroica discolor*
Ovenbird	*Seiurus aurocapillus*
Louisiana waterthrush	*Seiurus motacilla*
Kentucky warbler	*Oporornis formosus*
Yellow-breasted chat	*Icteria virens*
Eastern meadowlark	*Sturnella magna*
Rusty blackbird (winter)	*Euphagus carolinus*
Scarlet tanager	*Piranga olivacea*
Rose-breasted grosbeak	*Pheuctitus ludovicianus*
Eastern towhee	*Pipilo erythrophthalmus*
Grasshopper sparrow	*Ammodramus savannarum*
Field sparrow	*Spizella pusilla*
Mammals	
None	
Terrestrial Insects	
Diana fritillary	*Speyeria Diana*
A tiger beetle	*Cicindela formosa generosa*
Other Terrestrial Invertebrates	
None	
Aquatic Mollusks	
Onyx rocksnail	*Leptoxis praerosa*
Elephant ear	*Elliptio crassidens*
Pagoda hornsnail	*Pleurocera uncialis*
Pocketbook mussel	*Lampsilis ovata*
Cumberland moccasin	*Medionidus conradicus*
Pimple back	*Quadrula pustulosa*
Three-ridge valvata	*Valvata tricarinata*
Mountain creekshell mussel	*Villosa vanuxemensis*
Fragile papershell	*Leptodea fragilis*
Deertoe	*Truncilla truncata*
Crustaceans	
A crayfish	*Cambaras longirostris*
Sturgeon crayfish	*Orconectes forceps*
Clinch River crayfish	*Cambarus angularis*
A crayfish	*Orconectes erichsonianus*
Bunting's crayfish	*Cambarus buntingi*

Common Name	Scientific Name
Aquatic Insects	
None	
Other Aquatic Invertebrates	
None	

[1] The Appalachian yellow-bellied sapsucker may occur in the Southern Cumberlands but has not been confirmed (M. D. Wilson, pers. comm.). Please see Chapters 6 and 7 for accounts of this subspecies.

9.3. Terrestrial and Wetland Species in the Southern Cumberlands

9.3.1. Tier I Species in the Southern Cumberlands

9.3.1.1. Loggerhead shrike, *Lanius ludovicianus*

Life History Summary

The loggerhead shrike in Virginia occurs most frequently in the Blue Ridge Mountains and Ridge and Valley, but also occurs in the Southern Cumberlands (Fraser 1991). It occurs year-round in Virginia (Yosef 1996). It prefers open habitats with occasional shrubs, such as large grazed pastures (Fraser 1991). The loggerhead is a predator, taking mostly invertebrates but also some vertebrate prey, such as lizards, birds or rodents (Yosef 1996). It is well known for its habit of impaling its prey on spines of vegetation or barbed wire. Important threats include conversion from pasture to other uses and excessive use of pesticides (Fraser 1991; Yosef 1996). The loggerhead shrike is legally protected, both under MBTA and with the status of State threatened. According to VA-GAP (DGIF 2004a), 14% of its statewide predicted potential habitat is protected.

Location

Loggerhead shrike habitat in this part of the state is ephemeral and cannot be accurately mapped, so the map (Figure 9.5) includes confirmed locations from the breeding season (DGIF 2004b) and Conservation Sites (DCR-NH 2005).

Description of Habitat Requirements

Essential habitat for the loggerhead shrike includes open fields with scattered shrubs, small trees and/or hedges (DeGraff and Rappole 1995). In Virginia, the highest-quality breeding habitat consists of short grass, particularly active pastures with many perches (Luukkonen 1987).

Relative Condition of Habitat

There are six Collections locations of the loggerhead shrike in the Southern Cumberlands (145 statewide, DGIF 2004b). None of these locations is protected by a Conservation Land (DCR 2003). A single Conservation Site overlaps two Collections records (DCR-NH 2005). This Conservation Site contains three Element Occurrences of loggerhead shrike, each with a viability rating of "good" (DCR-NH 2005). The Conservation Site is partially protected by a state Natural Area Preserve.

Specific Threats and Trends

The loggerhead shrike has declined > 50% over the last 30 years range-wide (Rich et al. 2004). The same trend appears to hold for the PIF Mid-Atlantic Ridge and Valley (Rosenberg 2003), and Rosenberg (2004)

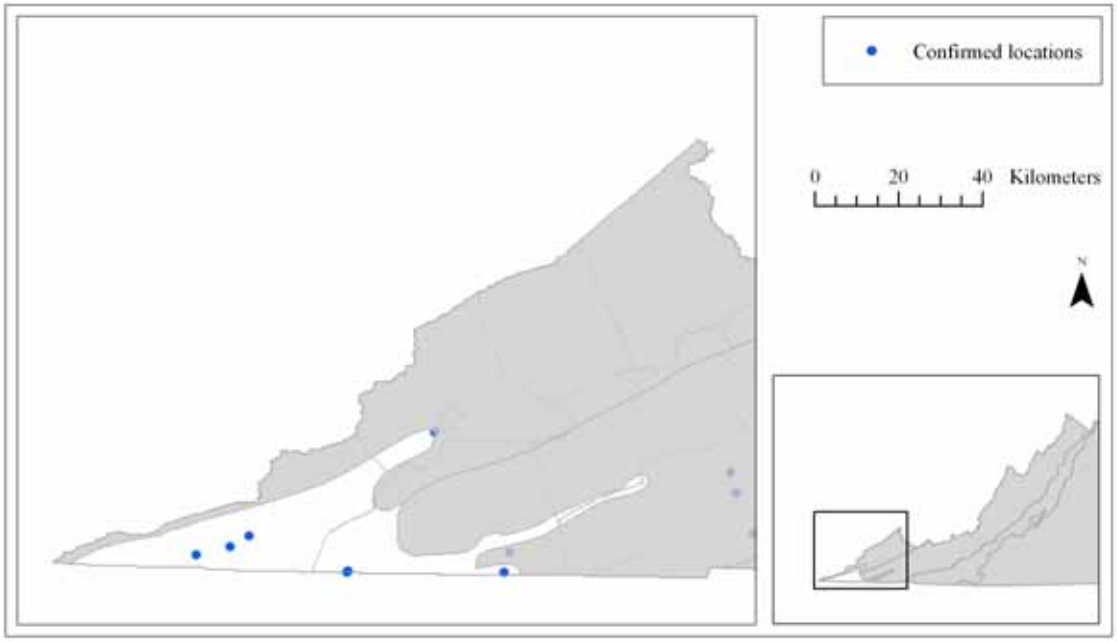

Figure 9.5. Distribution of the loggerhead shrike in the Southern Cumberlands.

and Bird TAC (2004) report a similar trend in Virginia. A decline of 87% in the northeast (which includes Virginia) is reported by NESWDTC (2004). Bird TAC (2004) reports that the population levels of this species are unknown in Virginia, but could be as low as < 100 individuals.

The reasons for the decline of the loggerhead shrike range-wide are unclear (Yosef 1996; Bird TAC 2004). However, threats to its preferred habitat are great and are enumerated in Appendix H. Yosef (1996) reports that the decline of this species corresponded with the increase in organochlorine pesticide use, and these substances are found in the birds in high concentrations. However, the decline also seems to correspond with the decline of pasturelands across its range, though birds do not seem to be habitat-limited in Virginia (that is, habitat exists that is not utilized by shrikes, Bird TAC 2004).

Conservation Actions and Strategies

The primary, species-specific action necessary for loggerhead shrike conservation in Virginia is a concerted, targeted survey effort to determine distribution of the species within the state (Bird TAC 2004) and throughout its breeding range in the northeast U.S. (NESWDTC 2004). This could include following the success of every individual nest (NESWDTC 2004). Other conservation actions are habitat-related. These can be found in Appendix I ("Birds: Early Successional") and generally involve grassland management. Yosef (1996) points out that mid-successional grasslands are often overlooked in habitat restoration in favor of grasslands without the shrubby vegetation that shrikes require for nesting and perching.

Research and Monitoring Needs

Little is known about historical distribution of the loggerhead shrike in Virginia, and such information would be useful if compiled (Bird TAC 2004). In addition, due to its spotty distribution across the state, targeted surveys should be considered to determine its true distribution and habitat usage across Virginia (Bird TAC 2004). The causes for the species' decline, both in Virginia and throughout its range, are unclear and need further research (Yosef 1996; Bird TAC 2004). Certainly, the role of pesticides in the decline of this species needs to be better understood.

9.3.2. Forest Species of Greatest Conservation Need in the Southern Cumberlands

9.3.2.1. Species of Greatest Conservation Need by Forest Type

Of the 29 tiered species that occur in forest in the Southern Cumberlands, 16 are generalists that occur in all forest types (Table 9.3). Of the remaining 13 species, all occur in deciduous forest (Table 9.4), two occur in coniferous forest (Table 9.5), and eight occur in mixed forest (Table 9.6).

Table 9.3. Forest generalist species of greatest conservation need in the Southern Cumberlands. "Open woods," throughout Tables 9.3-9.6, unless otherwise indicated, indicates mature, closed canopy, open understory forest, and not open canopy, shrubby understory forests, such as shelterwood cuts.

Common Name	Scientific Name	Tier	Special Habitat Needs
Eastern black kingsnake	*Lampropeltis getula nigra*	III	Ground litter and logs
Eastern small-footed myotis	*Myotis leibii*	III	Caves and crevices in forested areas
Eastern box turtle	*Terrapene carolina*	III	Forest generalist
Green heron	*Butorides striatus*	IV	Near streams or wetlands
Northern bobwhite	*Colinus virginianus*	IV	Open woods
Eastern wood-pewee	*Contopus virens*	IV	Open second-growth to mature woods
Prairie warbler	*Dendroica discolor*	IV	Open woods
Worm-eating warbler	*Helmitheros vermivorus*	IV	Thick understory near water
Eastern hog-nosed snake	*Heterodon platirhinos*	IV	Forest ecotones with sandy soils
Yellow-breasted chat	*Icteria virens*	IV	Open shrubby woods
Black-and-white warbler	*Mniotilta varia*	IV	Forest generalist
Kentucky warbler	*Oporornis formosus*	IV	Thick understory, closed canopy near water
Northern Parula	*Parula americana*	IV	Damp or wet woods near water
Eastern towhee	*Pipilo erythrophthalmus*	IV	Shrubby openings and edges
Ovenbird	*Seiurus aurocapillus*	IV	Open mature woods
Brown thrasher	*Toxostoma rufum*	IV	Shrubby clearcuts

Table 9.4. Deciduous forest species of greatest conservation need in the Southern Cumberlands.

Common Name	Scientific Name	Tier	Special Habitat Needs
Green salamander	*Aneides aeneus*	II	Damp crevasses in cove hardwoods
Southern zigzag salamander	*Plethodon dorsalis*	II	Mesic forests in rocky areas
Mountain chorus frog	*Pseudacris brachyphona*	II	Wooded hillsides near wet areas
Cumberland Plateau salamander	*Plethodon kentucki*	IV	Beneath logs and rocks, crevices
Chimney swift	*Chaetura pelagica*	IV	Large snags or houses with chimneys
Yellow-billed cuckoo	*Coccyzus americanus*	IV	Tall forest with partially open canopy
Gray catbird	*Dumetella carolinensis*	IV	Dense thickets in forest openings or edges
Willow flycatcher	*Empidonax traillii*	IV	Willow thickets near water
Wood thrush	*Hylocichla mustelina*	IV	Mature upland forest with undergrowth
Rose-breasted grosbeak	*Pheuctitus ludovicianus*	IV	Second-growth mesic forest
Scarlet tanager	*Piranga olivacea*	IV	Mature forest, min size 10-12ha
Louisiana waterthrush	*Seiurus motacilla*	IV	Near water
Yellow-throated vireo	*Vireo flavifrons*	IV	Tall forest with partially open canopy

Table 9.5. Coniferous forest species of greatest conservation need in the Southern Cumberlands.

Common Name	Scientific Name	Tier	Special Habitat Needs
Green salamander	*Aneides aeneus*	II	Damp crevasses in moist shaded areas
Yellow-throated vireo	*Vireo flavifrons*	IV	Tall forest with partially open canopy

Table 9.6. Mixed forest species of greatest conservation need in the Southern Cumberlands.

Common Name	Scientific Name	Tier	Special Habitat Needs
Mountain chorus frog	*Pseudacris brachyphona*	II	Wooded hills with wet areas or pools
Chimney swift	*Chaetura pelagica*	IV	Large snags or houses with chimneys
Yellow-billed cuckoo	*Coccyzus americanus*	IV	Open woods with dense understory
Gray catbird	*Dumetella carolinensis*	IV	Dense thickets in forest openings or edges
Wood thrush	*Hylocichla mustelina*	IV	Mature upland forest with undergrowth
Rose-breasted grosbeak	*Pheuctitus ludovicianus*	IV	Second-growth mesic forest
Scarlet tanager	*Piranga olivacea*	IV	Mature forest, min size 10-12ha
Louisiana waterthrush	*Seiurus motacilla*	IV	Near water

9.3.2.2. Status of Forested Habitats

The 2001 Forest Inventory Analysis (FIA) reported 18,000 acres (7,280ha) of coniferous forest, 187,000 acres (75,500ha) of deciduous forest, 15,000 acres (6,000ha) of mixed forest, and 97,500 acres (39,400ha) of non-forested land in the Southern Cumberlands (USFS 2001).

9.3.2.3. Trends in Forested Habitats

As mentioned in Section 2.5.5, NRCS combined the Northern and Southern Cumberlands for this analysis. According to USDA (2000), non-federal forestland in the Northern and Southern Cumberlands increased by > 40,000 acres (> 16,000ha) during the period between 1982 and 1997. These totals do not include a total of 126,000 acres (51,000ha) of federal land in these ecoregions. Forest trends by type are not available at the ecoregional level. Please see Section 3.2.3.1 for statewide status and trends in forested habitats.

9.3.3. Open Vegetated Habitat Species of Greatest Conservation Need in the Southern Cumberlands

9.3.3.1. Species of Greatest Conservation Need by Open Vegetated Habitat Type

Of the 24 tiered species that occur in open habitats in the Southern Cumberlands, 10 are generalists that occur in all open vegetated habitat types (Table 9.7). Of the remaining 14 species, eight occur in herbaceous open habitats (Table 9.8) and six occur in scrub-shrub (Table 9.9).

Table 9.7. Open vegetated habitat generalist species of greatest conservation need in the Southern Cumberlands.

Common Name	Scientific Name	Tier	Special Habitat Needs
Loggerhead shrike	*Lanius ludovicianus*	I	Scattered perches over short vegetation
Eastern box turtle	*Terrapene carolina*	III	Dense groundcover, some shrubs
Northern bobwhite	*Colinus virginianus*	IV	Grassy fields with shrubby cover, also agricultural fields (active and fallow)
Prairie warbler	*Dendroica discolor*	IV	Open habitat with some trees or shrubs
Eastern hog-nosed snake	*Heterodon platirhinos*	IV	Ecotonal areas with sandy soils

Common Name	Scientific Name	Tier	Special Habitat Needs
Yellow-breasted chat	*Icteria virens*	IV	Dense tall vegetation
Eastern towhee	*Pipilo erythrophthalmus*	IV	Dense tall vegetation
Field sparrow	*Spizella pusilla*	IV	Weedy fields with scattered shrubs
Brown thrasher	*Toxostoma rufum*	IV	Dense tall vegetation
Eastern kingbird	*Tyrannus tyrannus*	IV	Scattered perches (shrubs, trees, fences)

Table 9.8. Herbaceous habitat species of greatest conservation need in the Southern Cumberlands.

Common Name	Scientific Name	Tier	Special Habitat Needs
Mountain chorus frog	*Pseudacris brachyphona*	II	Breeds in wet fields adjacent to woodlands
Eastern black kingsnake	*Lampropeltis getula nigra*	III	Old buildings in fields
Grasshopper sparrow	*Ammodramus savannarum*	IV	Grassy fields with few to no shrubs
Rusty blackbird (winter)	*Euphagus carolinus*	IV	Croplands in winter
Queen snake	*Regina septemvittata*	IV	Open riparian areas
Northern rough-winged swallow	*Stelgidopteryx serripennis*	IV	Stream banks in open areas
Eastern meadowlark	*Sturnella magna*	IV	Grassy fields (pastures, etc.)

Table 9.9. Scrub-shrub species of greatest conservation need in the Southern Cumberlands.

Common Name	Scientific Name	Tier	Special Habitat Needs
Yellow-billed cuckoo	*Coccyzus americanus*	IV	Dense shrubby thickets
Kirtland's warbler (migrant)	*Dendroica kirtlandii*	IV	Pine scrub (migration only)
Gray catbird	*Dumetella carolinensis*	IV	Ecotonal thickets and shrubby clearings
Willow flycatcher	*Empidonax traillii*	IV	Willow thickets near water
Wood thrush	*Hylocichla mustelina*	IV	Shrubby clearings within deciduous forest
Black-and-white warbler	*Mniotilta varia*	IV	Sapling stage of forest clearings

9.3.3.2. Status of Open Vegetated Habitats

The 1997 NRI reports 6,300 acres (2,450ha) of cultivated cropland and 84,500 acres (34,200ha) of noncultivated cropland and pasture in the Southern Cumberlands (USDA 2000). These totals do not include a total of 8,100 acres (3,300ha) of federal land in this ecoregion (USDA 2000).

9.3.3.3. Trends in Open Vegetated Habitats

As mentioned in Section 2.5.5, NRCS combined the Northern and Southern Cumberlands for this analysis. According to USDA (2000), during the period from 1982 through 1997, cultivated cropland decreased by > 10,000 acres (> 4,000ha) and pastureland, CRP, and non-cultivated cropland increased by > 10,000 acres (> 4,000ha). These totals do not include a total of 126,000 acres (51,000ha) of federal land in these ecoregions. Please see Section 3.2.3.2 for statewide status and trends in open habitats for Virginia.

9.3.4. Barren Habitat Species of Greatest Conservation Need in the Southern Cumberlands

9.3.4.1. Species of Greatest Conservation Need by Barren Habitat Type

Of the nine tiered species that occur in barren or developed habitats in the Southern Cumberlands, eight occur primarily in developed residential areas (Table 9.10) and two occur in other barren areas (Table 9.11).

Table 9.10. Developed habitat generalist species of greatest conservation need in the Southern Cumberlands.

Common Name	Scientific Name	Tier	Special Habitat Needs
Eastern black kingsnake	*Lampropeltis getula nigra*	III	Residential neighborhoods
Eastern box turtle	*Terrapene carolina*	III	Residential neighborhoods
Chimney swift	*Chaetura pelagica*	IV	Residential neighborhoods
Yellow-billed cuckoo	*Coccyzus americanus*	IV	Residential neighborhoods
Eastern wood-pewee	*Contopus virens*	IV	Residential neighborhoods
Gray catbird	*Dumetella carolinensis*	IV	Residential neighborhoods
Northern rough-winged swallow	*Stelgidopteryx serripennis*	IV	Bridges
Brown thrasher	*Toxostoma rufum*	IV	Residential neighborhoods

Table 9.11. Other barren habitat species of greatest conservation need in the Southern Cumberlands.

Common Name	Scientific Name	Tier	Special Habitat Needs
Eastern small-footed myotis	*Myotis leibii*	III	Sometimes roosts under rocks on the ground or in quarries
Northern rough-winged swallow	*Stelgidopteryx serripennis*	IV	Sand pits

Beach species of greatest conservation need in the Southern Cumberlands

Appropriate beaches do not occur in the Southern Cumberlands of Virginia.

Balds species of greatest conservation need in the Southern Cumberlands

Appropriate balds do not occur in the Southern Cumberlands of Virginia.

9.3.4.2. Status of Barren Habitats

The 1997 NRI reports 18,000 acres (7,300ha) of urban and built-up land and 6,500 acres (2,600ha) of rural transportation infrastructure in the Southern Cumberlands (USDA 2000). This does not include a total of 8,100 acres (3,300ha) of federal lands in this ecoregion (USDA 2000).

9.3.4.3. Trends in Barren Habitats

Trends for most barren areas are not available at any scale. However, the NRI (USDA 2000) does track developed areas. As mentioned in Section 2.5.5, NRCS combined the Northern and Southern Cumberlands for this analysis. Developed areas in the Cumberlands increased by > 15,000 acres (> 6,000ha) during the period 1982-1997. Please see Section 3.2.3.3 for statewide status and trends of barren and developed areas in Virginia.

9.3.5. Wetland Species of Greatest Conservation Need in the Southern Cumberlands

9.3.5.1. Species of Greatest Conservation Need by Wetland Type

Of the 20 tiered species that occur in wetlands of the Southern Cumberlands, three are generalists that may occur in either wetland type (Table 9.12). Of the remaining 17 species, only one occurs in emergent wetlands (Table 9.13), and 16 occur in wooded wetlands (Table 9.14).

Table 9.12. Wetland generalist species of greatest conservation need in the Southern Cumberlands.

Common Name	Scientific Name	Tier	Special Habitat Needs
Mountain chorus frog	*Pseudacris brachyphona*	II	Wooded hills including or adjacent to wet areas
Green heron	*Butorides striatus*	IV	Nests in wooded wetlands, forages in any but avoids open water
Willow flycatcher	*Empidonax traillii*	IV	Willow thickets near water

Table 9.13. Emergent wetland species of greatest conservation need in the Southern Cumberlands.

Common Name	Scientific Name	Tier	Special Habitat Needs
Yellow warbler	*Dendroica petechia*	IV	Willow thickets near water

Table 9.14. Wooded wetland species of greatest conservation need in the Southern Cumberlands.

Common Name	Scientific Name	Tier	Special Habitat Needs
Eastern box turtle	*Terrapene carolina*	III	Forest generalist
Yellow-billed cuckoo	*Coccyzus americanus*	IV	Dense thickets in deciduous bottomland
Eastern wood-pewee	*Contopus virens*	IV	Seasonally-flooded bottomland forest
Gray catbird	*Dumetella carolinensis*	IV	Dense shrubs near water
Rusty blackbird (winter)	*Euphagus carolinus*	IV	Trees near marshes or wooded swamps
Worm-eating warbler	*Helmitheros vermivorus*	IV	Thick understory near water
Wood thrush	*Hylocichla mustelina*	IV	Mature forest
Black-and-white warbler	*Mniotilta varia*	IV	Hardwood swamps and bottomlands
Kentucky warbler	*Oporornis formosus*	IV	Dark, wooded swamps
Northern parula	*Parula americana*	IV	Wooded swamps with tree moss present
Rose-breasted grosbeak	*Pheuctitus ludovicianus*	IV	Deciduous wooded swamps
Scarlet tanager	*Piranga olivacea*	IV	Mature bottomland forest
Queen snake	*Regina septemvittata*	IV	Water with overhanging branches
Louisiana waterthrush	*Seiurus motacilla*	IV	Wooded streams or wooded swamps
Diana fritillary	*Speyeria diana*	IV	Streamside forests with *Viola* spp.
Yellow-throated vireo	*Vireo flavifrons*	IV	Wooded swamps

9.3.5.2. Status and Trends of Wetlands

Wetlands are rare in the Southern Cumberlands. According to the 1992 NLCD (USGS 1992), the Southern Cumberlands contains 85ha of wooded and shrubby wetlands and 37.5ha of emergent wetlands.

Trends of wetlands are not currently available at an ecoregional level for Virginia. Please see Section 3.2.3.4 for statewide status and trends of wetlands in Virginia.

9.4. Aquatic Species in the Southern Cumberlands

9.4.1. Southern Cumberlands-Clinch EDU

The Southern Cumberland-Clinch River EDU (Figure 9.6) is part of the Tennessee-Cumberland freshwater ecoregion, which is considered "globally outstanding" in terms of biological distinctiveness (Abell et al. 2000). Abell et al. (2000) also considered this freshwater ecoregion to be "Endangered." The Tennessee drainage contains the most diverse fish assemblage in North America (Jenkins and Burkhead 1994). There is a high level of endemism in this freshwater ecoregion, with 29% of the fish, 16% of the mussels, and 62% of the crayfish considered endemic (Abell et al. 2000).

The Clinch River flows 251km in Virginia before entering Tennessee (Jenkins and Burkhead 1994). Shortly after entering Tennessee, it joins the Powell and is impounded into the Norris Reservoir. In Virginia, the Clinch largely drains the Ridge and Valley, with some tributaries flowing off the Cumberland Mountains, and approximately the last half of the mainstem flowing through the Southern Cumberlands.

9.4.1.1. Tier I Species in the Southern Cumberland-Clinch EDU

9.4.1.1.1. Slender chub, *Erimystax cahni*

Life History Summary

A limited study found that the slender chub eats primarily insect larvae (particularly mayflies, caddisflies, and midges) (Jenkins 1975a). A few of the fish examined had eaten small snails or the Asian clam *Corbicula fluminea*. The slender chub is a relatively short-lived species. It is believed to live just over two years and reach a maximum length of 65-71mm (Jenkins and Burkhead 1994). This species spawns from late April to early May. It is legally protected with the status of State and Federal threatened.

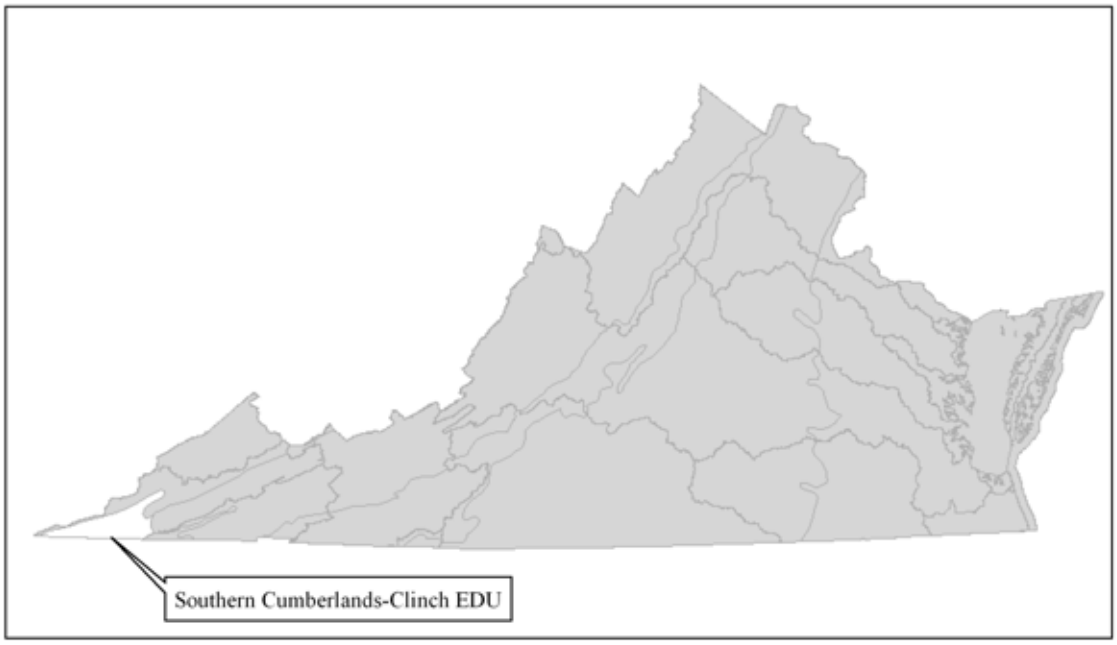

Figure 9.6. Location of the Southern Cumberland-Clinch EDU.

Location

The slender chub is one of the most geographically restricted minnows in North America (Etnier and Starnes 1993). The map of slender chub habitat (Figure 9.7) includes confirmed reaches based on collections (DGIF 2004b) and critical habitat (USFWS 2004). There were not enough confirmed reaches from which to determine potential habitat.

Description of Essential Habitat

This species is found in large streams and rivers with shallow, swift-flowing flats and shoals (Jenkins and Burkhead 1994). Jenkins and Burkhead (1994) indicated that it is not found in backwaters or pools; however, Starnes and Etnier (1980) indicated that it may use pools during the winter. There appears to be no difference in habitat use between young and adults (Jenkins and Burkhead 1994). This species apparently requires areas of at least 25m^2 with pea-sized gravel, sand-gravel mix, or large gravel. In the DGIF aquatic habitat classification, the slender chub has been documented in two reaches (Table 9.15).

Table 9.15. DGIF aquatic habitat types used by slender chub in the Clinch-Powell watershed.

Aquatic Habitat Type	Number of Reaches
Very low gradient large stream connected to another large stream	2

Relative Condition of Habitat

The known habitat of the slender chub is within a single impaired stretch of the Powell River (DEQ and DCR 2004). The impairment is general standard benthic from unknown sources. This means that the number, diversity, or composition of benthic macroinvertebrates in this stretch of stream indicate that water quality is impaired.

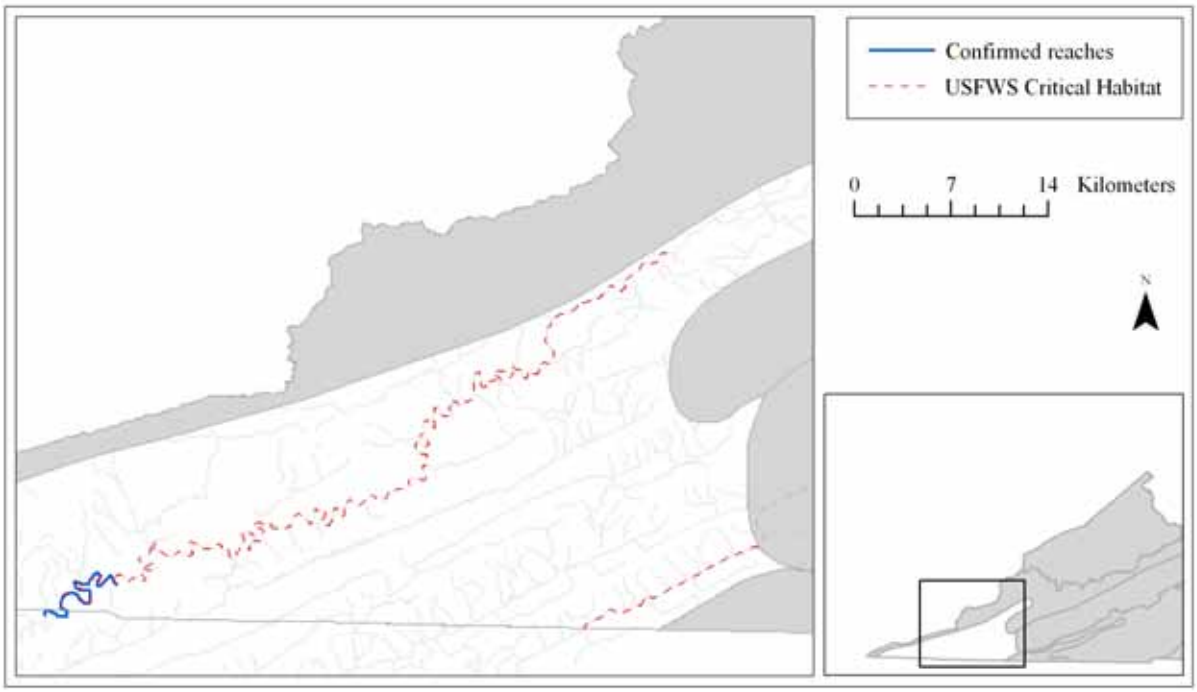

Figure 9.7. Location of confirmed slender chub habitat and USFWS critical habitat in the Southern Cumberlands-Clinch EDU (USFWS 2004; DCR-NH 2005).

Specific Threats and Trends

Much of the habitat for the slender chub has been destroyed by impoundment and its subsequent effects, such as cold water releases (USFWS 1983e). Deposition of coal fines has also affected slender chub habitat (USFWS 1983e; Burkhead and Jenkins 1991). In general, siltation, dredging, pollution, water withdrawal, and impoundment are all threats to the slender chub and its habitat (Burkhead and Jenkins 1991).

Fish TAC (2004) did not identify any specific threats to the slender chub. However, they identified several threats to the Clinch and Powell drainages (Appendix H).

Conservation Actions and Strategies

Burkhead and Jenkins (1991) recommend the execution of the USFWS recovery plan (1983e), reduction of sediment inputs, prevention of substrate disturbance, complete evaluation of any water withdrawal projects, and a possible ban on collection of specimens. One recommendation of the recovery plan is the continued enforcement and utilization of existing legislation and regulations (USFWS 1983e).

In addition, Fish TAC (2004) identified a suite of conservation actions for the Clinch and Powell drainages (Appendix I), but nothing specific to the slender chub.

Research and Monitoring Needs

The recovery plan indicates that it is necessary to characterize the habitat of the slender chub and its essential elements (USFWS 1983e). Burkhead and Jenkins (1991) recommend monitoring the population regularly.

Fish TAC (2004) identified several research or monitoring needs for the Clinch and Powell drainages (Appendix J). They did not identify anything specific to the slender chub.

9.4.1.1.2. Ashy darter, *Etheostoma cinereum*

Life History Summary

Much of what is known about the ashy darter was determined by one study (Shepard and Burr 1984). Food items include aquatic insect larvae and oligochaete worms. It is believed that the papillose lips of this species are modifications for food detection. The maximum life span is over four years. The ashy darter probably spawns from late February to mid-April (Shepard and Burr 1984; Jenkins and Burkhead 1994). This species has been designated a species of concern by the Virginia Field Office of USFWS.

Location

The ashy darter is widespread but localized in the Tennessee and Cumberland drainages (Shepard and Burr 1984). Burkhead and Jenkins (1991) considered it to be extirpated from Virginia. It was collected near the Tennessee border in 1992 (DGIF 2004b), so it is uncertain whether it occurs in this EDU. The map of locations for this species (Figure 9.8) includes DCR-NH Stream Conservation Units (DCR-NH 2005).

Description of Essential Habitat

The ashy darter is typically found in clear streams and rivers of moderate gradient (Jenkins and Burkhead 1994). It has been found in both cool and warm water.

This species is extremely rare in Virginia and determining essential habitat would be difficult. In its only Virginia location, it occurs in runs with slow to moderate current, < 1m deep (P. L. Angermeier, VCFWRU, pers. comm.). Etnier and Starnes (1993) stated that this species was found in small to medium upland rivers of 0.5 to 2m in depth, with boulders and a sluggish current. Jenkins and Burkhead (1994) added that it was found in streams and rivers of moderate gradient that are typically clear. The DGIF

aquatic habitat classification was used to examine patterns in habitat use and distribution. In the Clinch-Powell watershed, this species was found in one habitat type (Table 9.16).

Table 9.16. DGIF aquatic habitat types used by ashy darter in the Clinch-Powell watershed.

Aquatic Habitat Type	Number of Reaches
Very low gradient small river connected to another small river	1

Relative Condition of Habitat

The entire Virginia range of the ashy darter is found within or downstream of impaired waters (DEQ and DCR 2004). The impairments are primarily fecal coliform or general standard (benthics), and the sources of impairment are largely unknown, urban, or resource extraction.

Specific Threats and Trends

Historic declines in this species are believed to have been caused by impoundment and siltation (Etnier and Starnes 1993). These threats continue to affect the habitat of the ashy darter.

Fish TAC (2004) did not identify any specific threats to the ashy darter. However, they identified several threats to the Clinch and Powell drainages (Appendix H).

Conservation Actions and Strategies

Improvements in water quality and land use practices could positively affect the habitat required by the ashy darter. Fish TAC (2004) identified a suite of conservation actions for the Clinch and Powell drainages (Appendix I).

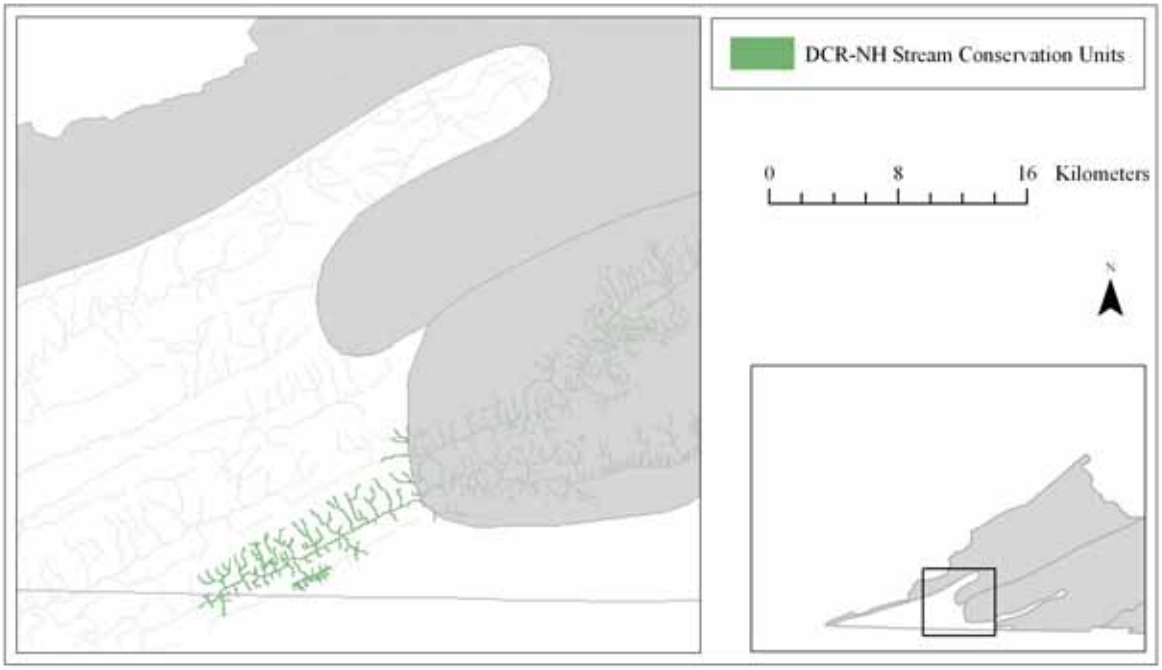

Figure 9.8. Location of the DCR-NH Stream Conservation Unit containing the ashy darter in the Southern Cumberlands-Clinch EDU (DCR-NH 2005).

Research and Monitoring Needs

Fish TAC (2004) identified several research or monitoring needs for the Clinch and Powell drainages (Appendix J). They did not identify anything specific to the ashy darter.

9.4.1.1.3. Duskytail darter, *Etheostoma percnurum*

Life History Summary

The duskytail darter feeds largely on benthic invertebrates. Layman (1991) found its lifespan to be two years. It appears that most spawning takes place in April and May (Jenkins and Burkhead 1994). The duskytail darter lays a single tier of clustered eggs while inverted under cobble slabs in depths of at least 55cm. This species is very vulnerable to extirpation from short-term and/or localized habitat alterations (e.g. chemical spills) due to its limited range, habitat specificity, and relatively short life span (USFWS 1993). This species is legally protected with the status of State and Federal endangered.

Location

The duskytail darter is endemic to the upper Tennessee and middle Cumberland drainages. According to Jenkins and Burkhead (1994), only six relict populations exist: one in Virginia (Copper Creek) and five in Tennessee. The map depicting locations for this species (Figure 9.9) includes confirmed reaches from Collections (DGIF 2004b) and potential habitat based on link magnitude, reach elevation and gradient attributes within DGIF's aquatic habitat classification. See Appendix D for more details.

Description of Essential Habitat

The duskytail darter is typically found in larger, warm, clear streams of moderate gradient (Jenkins and Burkhead 1994). Stream width ranges from 10-80m. It occurs in gently flowing pools with depths of 0.3-1.2m that are near riffles and have large rocks (Etnier and Starnes 1993). The DGIF aquatic habitat classification was used to examine patterns in habitat use and distribution. In the Clinch-Powell watershed,

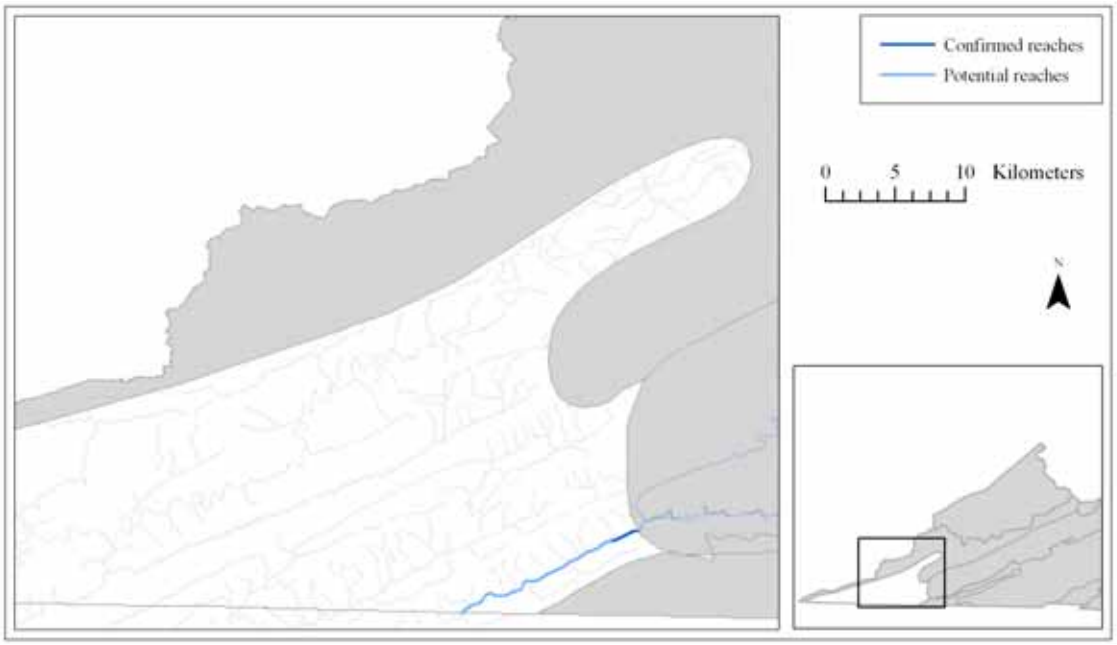

Figure 9.9. Location of confirmed and potential duskytail darter habitat in the Southern Cumberlands-Clinch EDU (DGIF 2004b).

this species was found in three habitat types (Table 9.17). Most of the occurrences were in very low gradient small streams.

Table 9.17. DGIF aquatic habitat types used by duskytail darter in the Clinch-Powell watershed.

Aquatic Habitat Type	Number of Reaches
Very low gradient small streams connected to another small stream	6
Very low gradient large streams connected to another large stream	2
Very low gradient small river connected to another small river	1

Relative Condition of Habitat

The stretch of known duskytail darter habitat in this EDU is downstream of Stock Creek, which is impaired (DEQ and DCR 2004). The impairment designation is due to fish tissue contamination with PCBs from unknown sources.

Specific Threats and Trends

Burkhead and Jenkins (1991) list siltation, agricultural runoff, and impoundment as threats to the duskytail darter. USFWS (1993) agreed that siltation from coal mining and adverse land use practices have contributed to the loss of this species. They also list other water pollutants and impoundments as threats to this species. Competition with the fantail darter *Etheostoma flabellare* may also be a threat (Burkhead and Jenkins 1991).

Fish TAC (2004) did not identify any specific threats for the duskytail darter. However, they identified several threats to the Clinch and Powell drainages (Appendix H).

Conservation Actions and Strategies

Burkhead and Jenkins (1991) recommended identifying and then correcting the sources of riparian erosion in the watershed. The USFWS recovery plan listed several actions and research and monitoring needs for the recovery of this species (USFWS 1993). These conservation actions included utilizing existing legislation and regulations to protect the species, developing and utilizing an education program, alleviating identified threats, and establishing five viable populations within its range through reintroduction and protection.

Fish TAC (2004) identified a suite of conservation actions for the Clinch and Powell drainages (Appendix I), but nothing specific to the duskytail darter.

Research and Monitoring Needs

USFWS (1993) identified four general categories of research and monitoring needed for the duskytail darter. These include searching for new populations, monitoring existing populations, determining its requirements at various life history stages, and determining threats to the species. More details can be found in the recovery plan (USFWS 1993).

Fish TAC (2004) identified several research or monitoring needs for the Clinch and Powell drainages (Appendix J). They did not identify anything specific to the duskytail darter.

9.4.1.1.4. Yellowfin madtom, *Noturus flavipinnis*

Life History Summary

This species is endemic to the Ridge and Valley region of the Tennessee drainage (as used in Jenkins and Burkhead 1994, which includes the Southern Cumberlands). Two life history studies have been completed

for the yellowfin madtom (Jenkins 1975b; Shute 1984). This madtom was found to eat mostly aquatic insect larvae during both day and night. Its life expectancy is about five years. Spawning occurs from about mid-May to mid-July. This species is legally protected with the status of State and Federal threatened.

Location

The habitat map for the yellowfin madtom (Figure 9.10) includes confirmed reaches from Collections (DGIF 2004b), potential reaches, and critical habitat (USFWS 2004). Potential reaches were selected in DGIF's aquatic habitat classification using magnitude of confirmed link, downstream link, reach elevation, and gradient variables. See Appendix D for more details.

Description of Essential Habitat

The yellowfin madtom is found in small streams to medium or large rivers (Jenkins and Burkhead 1994). They are found in warm water and the warm-cool water transition. This madtom prefers quiet water, usually pools and backwaters beside runs and riffles. Preferred cover is large, flat rocks, under which nests are spawned and defended (Dinkins and Shute 1996). The DGIF aquatic habitat classification was used to examine patterns in habitat use and distribution. In the Clinch-Powell watershed, this species was found in four habitat types (Table 9.18). The majority of the records were in very low gradient small streams.

Table 9.18. DGIF aquatic habitat types used by the yellowfin madtom in the Clinch-Powell watershed.

Aquatic Habitat Type	Number of Reaches
Very low gradient small stream connected to another small stream	11
Very low gradient large stream connected to another large stream	3
Very low gradient small stream connected to a large stream	1
Low gradient small stream connected to a large stream	1

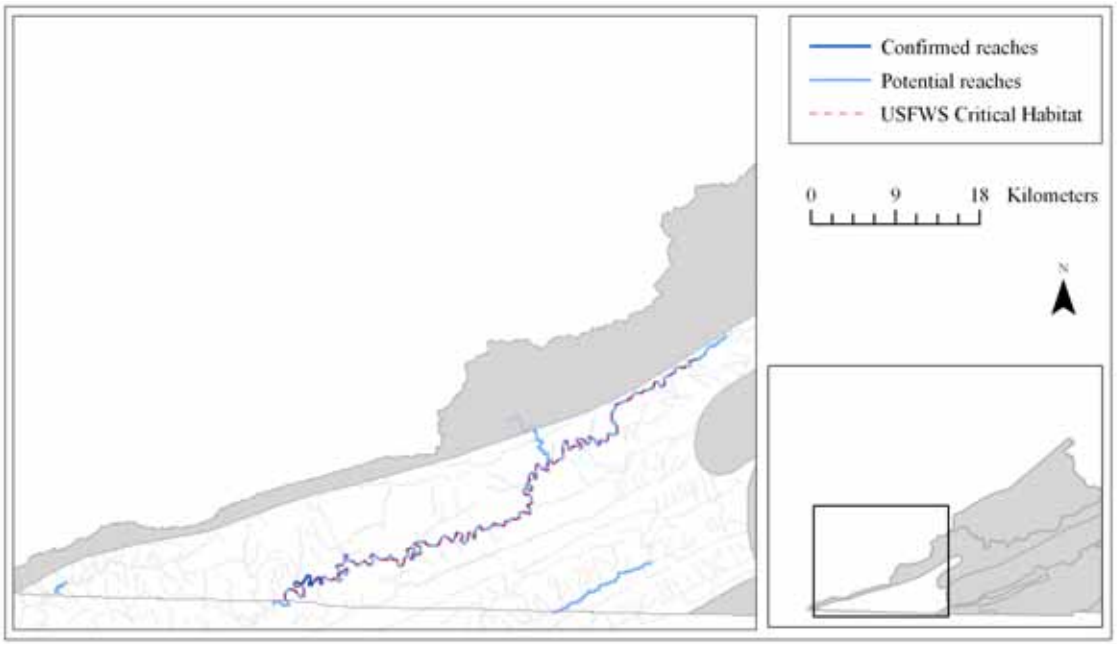

Figure 9.10. Location of confirmed and potential yellowfin madtom habitat and USFWS critical habitat in the Southern Cumberlands-Clinch EDU (DGIF 2004b; USFWS 2004).

Relative Condition of Habitat

The known habitat for the yellowfin madtom is within a stretch of the Powell River identified as impaired (DEQ and DCR 2004). The impairment is general standard benthic from unknown sources. This means that the number, diversity or composition of benthic macroinvertebrates in this stretch of stream indicated that water quality was impaired.

Specific Threats and Trends

This species seems to be most affected by habitat degradation from siltation, agricultural runoff, and impoundment (Burkhead and Jenkins 1991). Siltation and water quality degradation from mining activities are also threats to this species (USFWS 1983g).

Fish TAC (2004) did not identify any specific threats for the yellowfin madtom. However, they identified several threats to the Clinch and Powell drainages (Appendix H).

Conservation Actions and Strategies

The USFWS (1983g) recovery plan for the yellowfin madtom listed several actions necessary for the recovery of the species. These include research and monitoring needs, which are listed in the next section. The highest priority action in the plan is to utilize existing legislation and regulations to protect the species and its habitat. One conservation action from the recovery plan is to preserve populations and currently occupied habitat. Once feasibility is determined, this species should be introduced into its historic range. Lastly, sites should be located and techniques developed and implemented for habitat improvement.

Fish TAC (2004) identified a suite of conservation actions for the Clinch and Powell drainages (Appendix I), but nothing specific to this species.

Research and Monitoring Needs

The yellowfin madtom recovery plan lists several research or monitoring projects necessary for the recovery of the species (USFWS 1983g). One of the projects is to determine the feasibility of reestablishing the species in its native range. The next is to conduct life history studies as needed. The recovery plan also discusses the need to identify areas for habitat improvement. Monitoring tasks included monitoring population levels and habitat conditions, as well as the success of the recovery plan.

Fish TAC (2004) identified several research or monitoring needs for the Clinch and Powell drainages (Appendix J). They did not identify anything specific to the yellowfin madtom.

9.4.1.1.5. Birdwing pearlymussel, *Lemiox rimosus*

Life History Summary

Birdwing pearlymussel is rare throughout its range and is extremely rare in Virginia (Neves 1991b). It is relatively small, to 50mm in length, with a subtriangular to subovate shape (Parmalee and Bogan 1998). Its shell is very thick and very slightly inflated. Evidence suggests that it is bradytictic, or a long-term brooder, becoming gravid in the fall and holding the glochidia through the winter (Ortmann 1916). The glochidia are released in June or July. Research by TVA (1986) suggests that the banded darter *Etheostoma zonale* and greenside darter *E. blennioides* are possible fish hosts. This species is legally protected with the status of State and Federal endangered. While its correct accepted scientific name is *Lemiox rimosus*, this species is still listed as *Conradilla caelata* in the Code of Federal Regulations (50 CFR 17.11).

Location

The map of habitat for this species (Figure 9.11) includes confirmed reaches from Collections (DGIF 2004b) and potential reaches. Potential reaches were determined using reach size and connectivity attributes within DGIF's aquatic habitat classication. See Appendix D for more details.

Description of Essential Habitat

The birdwing pearlymussel is a riffle-dwelling species, preferring moderate to fast flowing water of shallow to moderate depth (USFWS 1983b). It is found in small to medium rivers with sand and gravel substrate (Parmalee and Bogan 1998). The DGIF aquatic habitat classification was used to examine patterns in habitat use and distribution. In the Clinch-Powell watershed, this species was found in three habitat types (Table 9.19). All of the records were in large streams and small rivers.

Table 9.19. DGIF aquatic habitat types used by birdwing pearlymussel in the Clinch-Powell watershed

Aquatic Habitat Type	Number of Reaches
Very low gradient small river connected to another small river	11
Very low gradient large stream connected to another large stream	5
Very low gradient large stream connected to another small river	1

Relative Condition of Habitat

The recovery plan for the birdwing pearlymussel describes some issues related to past and current conditions of its habitat (USFWS 1983b). The known habitat for the birdwing pearlymussel is within an impaired stretch of the Powell River (DEQ and DCR 2004). The impairment is general standard benthic from unknown sources. This means that the number, diversity or composition of benthic macroinvertebrates in this stretch of stream indicated that water quality was impaired.

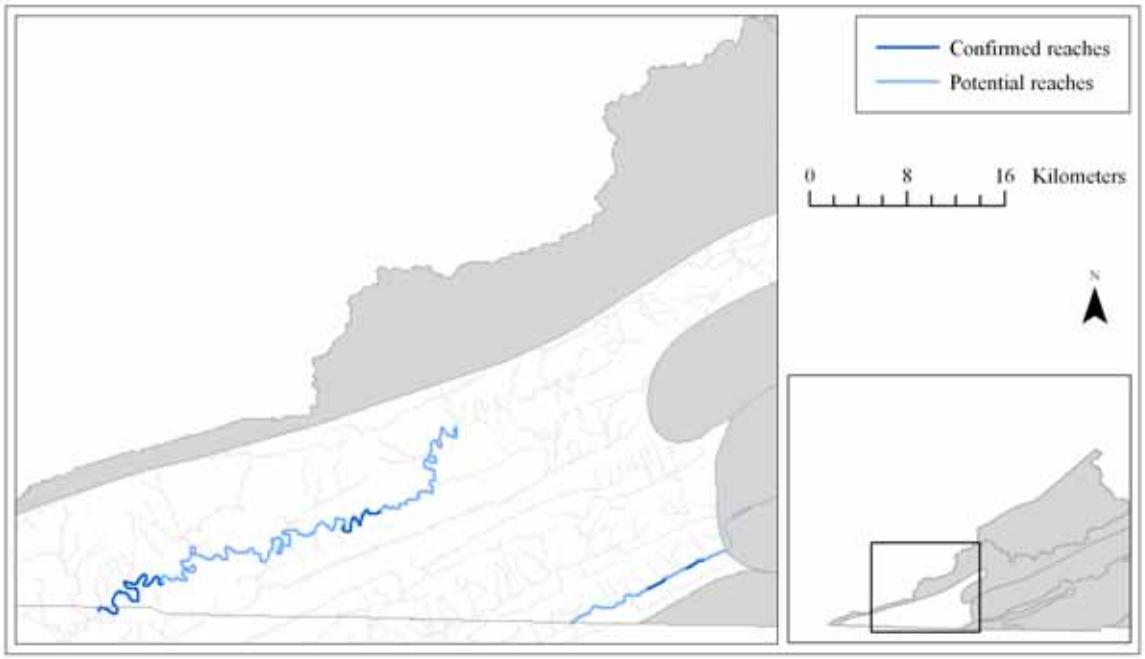

Figure 9.11. Location of confirmed and potential birdwing pearlymussel habitat in the Southern Cumberlands-Clinch EDU (DGIF 2004b).

Specific Threats and Trends

The recovery plan identifies impoundment as the greatest contributor to the loss of this species (USFWS 1983b). Impoundment affects this species through habitat alteration (i.e. reduction of flow and altered temperatures). Siltation is also listed as a strong contributing factor in the decline of this species. Sources of siltation include coal mining activities, farming, logging, and road construction. The third factor listed is water pollution from agricultural, municipal, and industrial discharges. Extremely small population sizes also threaten the viability of this species in the Clinch and Powell Rivers (Neves 1991b).

Mussel TAC (2004) did not identify any specific threats for the birdwing pearlymussel. However, they identified several threats to the Clinch and Powell drainages (Appendix H).

Conservation Actions and Strategies

The USFWS (1983b) recovery plan identifies several high priority tasks to support the recovery of the birdwing pearlymussel. These tasks represent both conservation actions and research and monitoring needs. The top conservation action on the list is to continue to utilize existing legislation and regulations to protect species and habitat. Other actions include reintroducing the species into native rivers where feasible and implementing habitat improvement techniques where appropriate.

Mussel TAC (2004) identified a suite of conservation actions for the Clinch and Powell drainages (Appendix I), but nothing specific to the birdwing pearlymussel.

Research and Monitoring Needs

The USFWS (1983b) recovery plan identifies several research or monitoring needs for the recovery of birdwing pearlymussel. The top two are identification of current and foreseeable threats and conducting life history studies. Other needs include determining the feasibility of reintroducing this species to its native waters, determining the need and appropriate techniques for habitat improvement, developing and implementing a program to monitor populations and habitats, and monitoring the success of the recovery program overall (USFWS 1983b).

Mussel TAC (2004) identified several research or monitoring needs for the Clinch and Powell drainages (Appendix J). They did not identify anything specific to the birdwing pearlymussel.

9.4.1.1.6. Fanshell, *Cyprogenia stegaria*

Life History Summary

The fanshell is rare throughout its range and is extremely rare in Virginia. It has an inflated, somewhat rounded shell with a maximum length of 55mm (Lipford 1991). The life history of this species is not well known. It is believed to be a long-term brooder. Its fish host is unknown (Parmalee and Bogan 1998). Most existing populations of the fanshell are geographically isolated and small, reducing the genetic viability of the species (USFWS 1991). This, coupled with the dramatic decline of the species across its range, could lead to its extinction in coming years (Lipford 1991). This species is legally protected, with the status of State and Federal endangered.

Location

The map of fanshell habitat (Figure 9.12) includes confirmed reaches from Collections (DGIF 2004b) and potential habitat using link magnitude from DGIF's aquatic habitat classification. See Appendix D for more details.

Description of Essential Habitat

The fanshell is found in medium to large rivers and is associated with coarse sand and gravel substrates (Ortmann 1919; Ahlstedt 1984; Dennis 1985). It occurs in both shoals and riffles with strong current. The DGIF aquatic habitat classification was used to examine patterns in habitat use and distribution. In the Clinch-Powell watershed, this species is found in two habitat types, very low gradient small rivers and large streams (Table 9.20).

Table 9.20. DGIF aquatic habitat types used by the fanshell in the Clinch-Powell watershed.

Aquatic Habitat Type	Number of Reaches
Very low gradient small river connected to another small river	12
Very low gradient large stream connected to another large stream	3

Relative Condition of Habitat

The recovery plan for the fanshell describes some issues related to past and current conditions of its habitat (USFWS 1991). The stretch of known fanshell habitat in this EDU is downstream of Stock Creek, which is considered impaired (DEQ and DCR 2004). The impairment designation is due to fish tissue contamination with PCBs from unknown sources.

Specific Threats and Trends

Historic declines of the fanshell have been caused by the impacts of impoundments, pollution, and habitat alteration (USFWS 1991). These stresses may have affected the fanshell both directly and indirectly (through the loss of its fish host). Lipford (1991) identified the degradation of water quality from a variety of sources as the greatest current threat to the species. The recovery plan also indicated that small population size is a serious threat to the viability of the species (USFWS 1991).

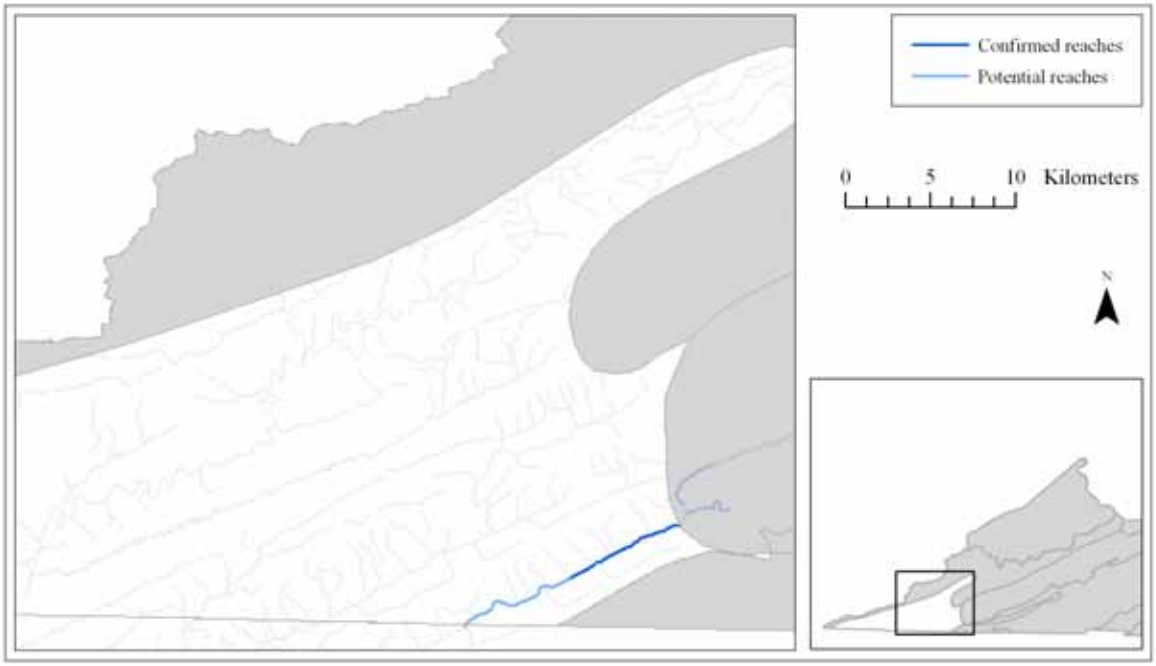

Figure 9.12. Location of confirmed and potential fanshell habitat in the Southern Cumberlands-Clinch EDU (DGIF 2004b).

Mussel TAC (2004) did not identify any specific threats to the fanshell. However, they identified several threats to the Clinch and Powell drainages (Appendix H).

Conservation Actions and Strategies

Lipford (1991) makes several recommendations for the recovery of the fanshell. Specific conservation actions include protecting and restoring the habitat of the species, improving water quality in the Clinch River, and implementing and enforcing BMPs for forestry and agriculture. The USFWS recovery plan also lists conservation actions as well as research and monitoring needs for the fanshell (USFWS 1991). The highest priority actions include utilizing existing legislation and regulations to protect species and its habitat and developing techniques and appropriate sites for reintroduction.

Mussel TAC (2004) identified a suite of conservation actions for the Clinch and Powell drainages (Appendix I), but nothing specific to the fanshell.

Research and Monitoring Needs

Because so little is known of the fanshell, some research projects are critically needed to protect this species. One is to conduct needed species management and recovery research, including determining habitat requirements, life history and biology, and threats analysis (Lipford 1991; USFWS 1991). The second is to search for additional populations and appropriate habitat. Lipford (1991) also recommends expanding water quality monitoring stations in the Clinch River. Identification of its fish hosts may also be important.

Mussel TAC (2004) identified several research or monitoring needs for the Clinch and Powell drainages (Appendix J). They did not identify anything specific to the fanshell.

9.4.1.1.7. Dromedary pearlymussel, *Dromus dromas*

Life History Summary

The dromedary pearlymussel is rare throughout its range and exceptionally rare in Virginia (Neves 1991g). It has two forms (or types), including an inflated large river type and a more compressed headwater form (USFWS 1983c). It can reach lengths of 90 to 100mm, with a subtriangular or subelliptical shape (Parmalee and Bogan 1998). This mussel is bradytictic. Fish hosts are unknown, though Neves (1991g) suggests from a personal communication with B. Yeager (TVA) that the gilt darter *Percina evides* is a possibility. The dromedary pearlymussel is believed to have been one of the more common species in the Tennessee River historically, based on samples found at aboriginal sites (Parmalee and Bogan 1998). This species is legally protected, with the status of State and Federal endangered.

Location

The map of habitat for this species (Figure 9.13) includes confirmed reaches from Collections (DGIF 2004b) and potential reaches selected using reach size, connectivity and gradient attributes in the DGIF aquatic habitat classification. See Appendix D for more details.

As with many other Cumberlandian mussels, the dromedary pearlymussel is a riffle-dwelling species. It typically inhabits shoals with moderate current, but has been found in deeper, slow moving waters in Tennessee (USFWS 1983c). It seems to prefer silt-free substrates of mixed sizes, including sand and cobble (Neves 1991g). The DGIF aquatic habitat classification was used to examine patterns in habitat use and distribution. In the Clinch-Powell watershed, this species was found in two habitat types representing small rivers and large streams (Table 9.21).

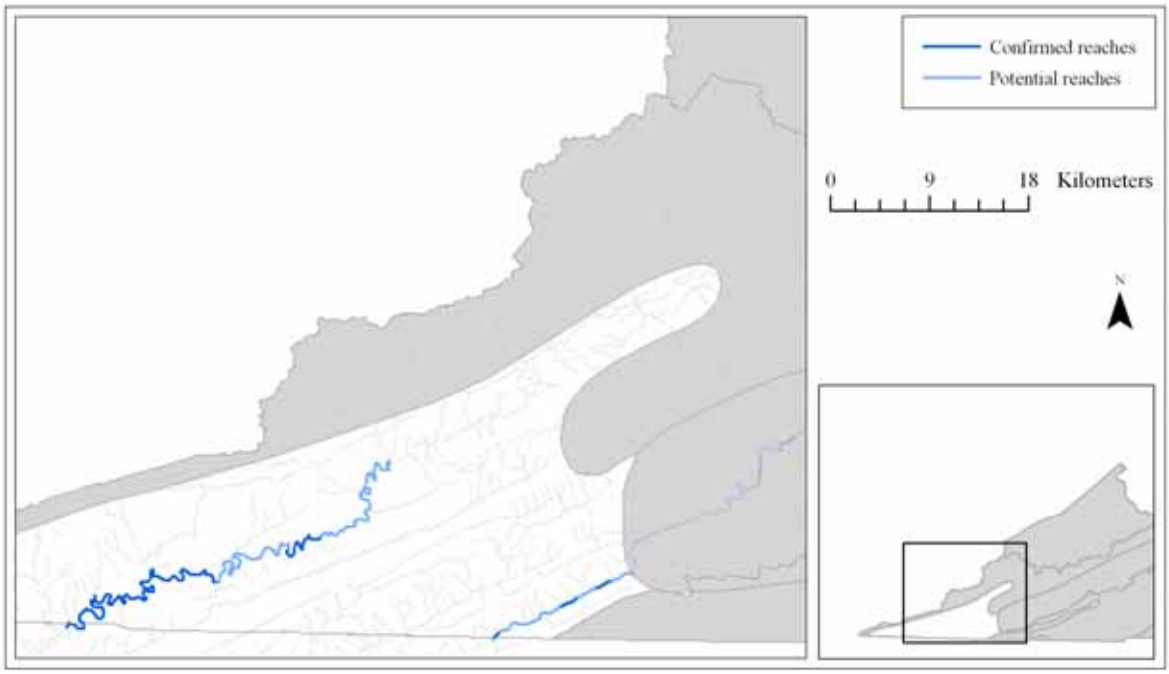

Figure 9.13. Location of confirmed and potential dromedary pearlymussel habitat in the Southern Cumberlands-Clinch EDU (DGIF 2004b).

Description of Essential Habitat

Table 9.21. DGIF aquatic habitat types used by the dromedary pearlymussel in the Clinch-Powell watershed.

Aquatic Habitat Type	Number of Reaches
Very low gradient small river connected to another small river	5
Very low gradient large stream connected to another large stream	5

Relative Condition of Habitat

The recovery plan for the dromedary pearlymussel describes some issues related to past and current conditions of its habitat (USFWS 1983c). Both sections of known dromedary pearlymussel habitat in this EDU are impaired (DEQ and DCR 2004). One is downstream of Stock Creek, which is considered impaired due to fish tissue contamination with PCBs from unknown sources. The impairment of the other stretch is general standard benthic from unknown sources. This means that the number, diversity or composition of benthic macroinvertebrates in this stretch of stream indicated that water quality was impaired.

Specific Threats and Trends

The recovery plan for the dromedary pearlymussel lists the impoundment of Tennessee drainage mainstem and tributaries as the factor that has contributed the most to this species' decline (USFWS 1983c). Siltation is a continuing threat and ranks second in the list of threats or factors in the species' decline. Pollutants from various sources, including industrial, municipal, and agricultural, are also considered a threat to this species. Natural resource extraction, including coal, oil and gas, are also believed to have a negative impact on this species. Neves (1991g) indicated that populations of this species in the Clinch and Powell Rivers have fallen below viable numbers.

Mussel TAC (2004) did not identify any specific threats to the dromedary pearlymussel. However, they identified several threats to the Clinch and Powell drainages (Appendix H).

Conservation Actions and Strategies

The recovery plan for the dromedary pearlymussel indicates that the top priority conservation action is to continue to utilize existing legislation and regulations to protect species and habitat (USFWS 1983c). Neves (1991g) recommends improving water quality in the Powell River, including updating water treatment plants, reducing the dumping of coal mine waste, and enforcing requirements of discharge permits. He also indicates that improving water quality in the Clinch River from "fair to good" to "good to excellent" would be beneficial for many mussel species.

Mussel TAC (2004) identified a suite of conservation actions for the Clinch and Powell drainages (Appendix I), but nothing specific to this species.

Research and Monitoring Needs

The USFWS (1983c) recovery plan recommends two high priority research or monitoring projects for the dromedary pearlymussel: determining present and future threats and conducting life history studies as needed.

Mussel TAC (2004) identified several research or monitoring needs for the Clinch and Powell drainages (Appendix J). They did not identify anything specific to the dromedary pearlymussel.

9.4.1.1.8. Cumberlandian combshell, *Epioblasma brevidens*

Life History Summary

The Cumberlandian combshell is extremely rare throughout its range. It is a medium-sized mussel, reaching an average length of 50mm (Parmalee and Bogan 1998). It is quadrangular or rhomboid in shape and very solid. It exhibits a bradytictic reproductive cycle (Ahlstedt 1991b). Some fish hosts have been identified, including the greenside darter *Etheostoma blennioides*, spotted darter *E. maculatum*, redline darter *E. rufilineatum*, Tennessee snubnose darter *E. simoterum*, logperch *Percina caprodes*, banded sculpin *Cottus carolinae*, and wounded darter *E. vulneratum* (Yeager 1987; Neves 1991f; Yeager and Saylor 1995). This species is legally protected, with the status of State and Federal endangered.

Location

The map of habitat for this species (Figure 9.14) includes confirmed reaches from Collections (DGIF 2004b) and potential reaches selected using link magnitude and the link magnitude of downstream reaches from the DGIF aquatic habitat classification. See Appendix D for more details.

Description of Essential Habitat

Neves (1991f) describes the habitat of Cumberlandian combshell as medium-sized streams with gravel shoals and riffles. This species appears to be absent from smaller tributaries. The DGIF aquatic habitat classification was used to examine patterns in habitat use and distribution. In the Clinch-Powell watershed, this species was found in two habitat types (Table 9.22). All occurrences were in small rivers and large streams.

Table 9.22. DGIF aquatic habitat types used by the Cumberlandian combshell in the Clinch-Powell watershed.

Aquatic Habitat Type	Number of Reaches
Very low gradient small river connected to another small river	18
Very low gradient large stream connected to another large stream	7

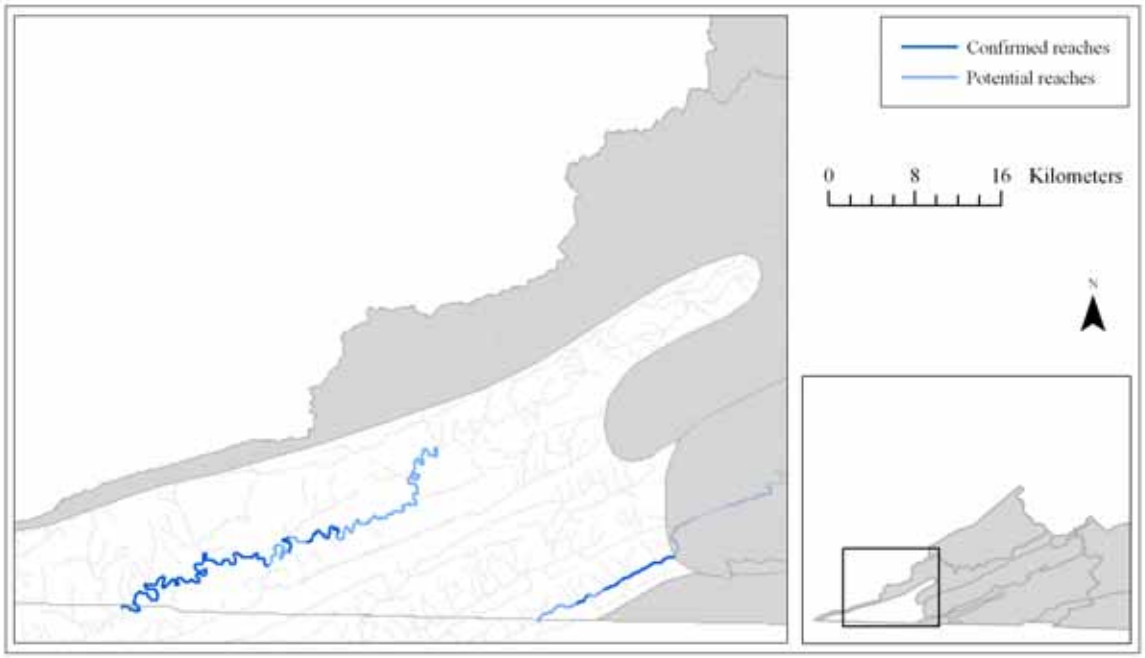

Figure 9.14. Location of confirmed and potential Cumberlandian combshell habitat in the Southern Cumberlands-Clinch EDU (DGIF 2004b).

Relative Condition of Habitat

Both sections of known Cumberlandian combshell habitat in this EDU are impaired (DEQ and DCR 2004). One is downstream of Stock Creek, which is considered impaired due to fish tissue contamination with PCBs from unknown sources. The impairment of the other stretch is general standard benthic from unknown sources. This means that the number, diversity or composition of benthic macroinvertebrates in this stretch of stream indicated that water quality was impaired.

Specific Threats and Trends

The reasons for the decline of this species are not well documented or understood (Neves 1991f). However, poor water quality and habitat alteration from siltation and pollution are believed to be its biggest problems. Members of this genus appear to be very sensitive to alteration in environmental quality and are the first to drop out of a faunal assemblage when environmental disturbance occurs (Dennis 1987).

Mussel TAC (2004) did not identify any specific threats to the Cumberlandian combshell. However, they identified several threats to the Clinch and Powell drainages (Appendix H).

Conservation Actions and Strategies

Neves (1991f) reports that measures must be taken to protect habitat from further degradation. The draft recovery plan that includes this species lists four high priority conservation actions, including: continuing to use existing legislation and regulations to protect the species and its habitats; soliciting help to protect the species and associated habitat through the development of cooperative partnerships; developing cooperative projects with private landowners to improve and restore riparian habitats using USFWS and USDA programs; and developing a public outreach and education program with an aquatic ecosystem and community-based watershed focus (USFWS 2003).

While Mussel TAC (2004) did not list any species-specific conservation actions for this species, they identified a suite of conservation actions for the Clinch and Powell drainages (Appendix I).

Research and Monitoring Needs

The draft recovery plan that includes this species indicated four high priority research and monitoring needs for the Cumberlandian combshell (USFWS 2003). These include investigating the need for management activities including habitat improvement, conducting detailed anatomical and genetic analyses throughout the range of the species, surveying for additional populations and appropriate habitat, and conducting a feasibility analysis of augmenting existing populations and reintroducing the species to suitable habitats.

Mussel TAC (2004) identified several research or monitoring needs for the Clinch and Powell drainages (Appendix J). They did not identify anything specific to the Cumberlandian combshell.

9.4.1.1.9. Oyster mussel, *Epioblasma capsaeformis*

Life History Summary

The oyster mussel is extremely rare throughout its range. Populations in the Clinch and Powell rivers are rapidly declining, probably due to degradation of water quality (Dennis 1991b). This is a small to medium-sized mussel (50-70mm) of elliptical or irregularly obovate shape (Dennis 1991b; Parmalee and Bogan 1998). This species is bradytictic. Fish hosts include the spotted darter *Etheostoma maculatum*, redline darter *E. rufilineatum*, wounded darter *E. vulneratum*, dusky darter *Percina sciera*, and banded sculpin *Cottus carolinae* (Yeager 1987; Yeager and Saylor 1995). This species is legally protected, with the status of State and Federal endangered.

Location

The map of habitat for the oyster mussel (Figure 9.15) includes confirmed reaches from Collections (DGIF 2004b) and potential habitat using variables (link magnitude, reach elevation and gradient) from DGIF's aquatic habitat classification. See Appendix D for more details.

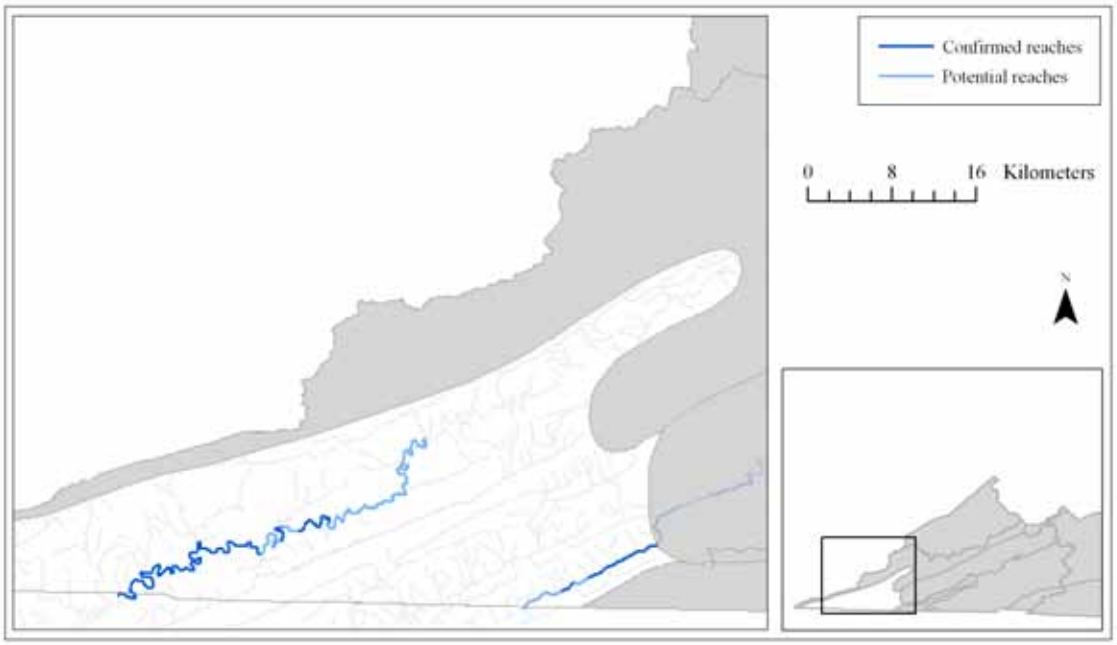

Figure 9.15. Location of confirmed and potential oyster mussel habitat in the Southern Cumberlands-Clinch EDU (DGIF 2004b).

Description of Essential Habitat

As with other members of this genus, the oyster mussel typically inhabits riffles or shoals in small to medium-sized streams with a silt-free gravel substrate (Dennis 1991b). The DGIF aquatic habitat classification was used to examine patterns in habitat use and distribution. In the Clinch-Powell watershed, this species was found in four habitat types (Table 9.23). The majority of the records were in small rivers and large streams.

Table 9.23. DGIF aquatic habitat types used by oyster mussel in the Clinch-Powell watershed.

Aquatic Habitat Type	Number of Reaches
Very low gradient small river connected to another small river	20
Very low gradient large stream connected to another large stream	8
Low gradient large stream connected to another large stream	1
Very low gradient small stream connected to a large stream	1

Relative Condition of Habitat

Both sections of known oyster mussel habitat in this EDU are impaired (DEQ and DCR 2004). One is downstream of Stock Creek, which is considered impaired due to fish tissue contamination with PCBs from unknown sources. The impairment of the other stretch is general standard benthic from unknown sources. This means that the number, diversity or composition of benthic macroinvertebrates in this stretch of stream indicated that water quality was impaired.

Specific Threats and Trends

This genus is more sensitive to water quality and habitat alterations than most other genera (Dennis 1987). Therefore, the relatively recent decline of this species is likely due to changes in water quality, though not enough is known about the specific habitat requirements of this species to identify threats with any certainty (Dennis 1991b). Likely causes for the decline of the oyster mussel are siltation, industrial and municipal effluent pollution, mine wastes, and agricultural and urban runoff.

Mussel TAC (2004) did not identify any specific threats to the oyster mussel. However, they identified several threats to the Clinch and Powell drainages (Appendix H).

Conservation Actions and Strategies

Dennis (1991b) postulated that, due to the low numbers of this species, it might be too late to save it from extinction. However, actions that were recommended (and that would likely benefit many aquatic species) include protecting and improving habitat for this species and its fish hosts.

Mussel TAC (2004) identified a suite of conservation actions for the Clinch and Powell drainages (Appendix I), but nothing specific to the oyster mussel.

Research and Monitoring Needs

Little is known of the habitat needs of the oyster mussel, so threats are also poorly known (Dennis 1991). Therefore, assessment of basic habitat requirements and the causes of its decline are needed.

Mussel TAC (2004) identified several research or monitoring needs for the Clinch and Powell drainages (Appendix J), but nothing specific to the oyster mussel.

9.4.1.1.10. Green blossom pearlymussel, *Epioblasma torulosa gubernaculum*

Life History Summary

The green blossom pearlymussel is extremely rare throughout its range (Dennis 1991a), and may be extinct. It is a medium-sized mussel (up to 65mm) with an irregularly ovate, elliptical or obovate shape (Parmalee and Bogan 1998). The life history of this mussel is not well known; however, it is probably bradytictic, like other members of this genus (Dennis 1991a). This species is legally protected, with the status of State and Federal endangered.

Location

The map of habitat for this species (Figure 9.16) includes confirmed reaches from Collections (DGIF 2004b) and potential habitat selecting using attributes (reach size and connectivity) from DGIF's aquatic habitat classification. See Appendix D for more details.

Description of Essential Habitat

Green blossom pearlymussel is a lotic species, found in fast flowing water with riffles and shoals (Dennis 1991a). It appears to prefer silt-free gravel substrates. The DGIF aquatic habitat classification was used to examine patterns in habitat use and distribution. In the Clinch-Powell watershed, this species was found in one habitat type (Table 9.24).

Table 9.24. DGIF aquatic habitat types used by the green blossom pearlymussel in the Clinch-Powell watershed.

Aquatic Habitat Type	Number of Reaches
Very low gradient small river connected to another small river	6

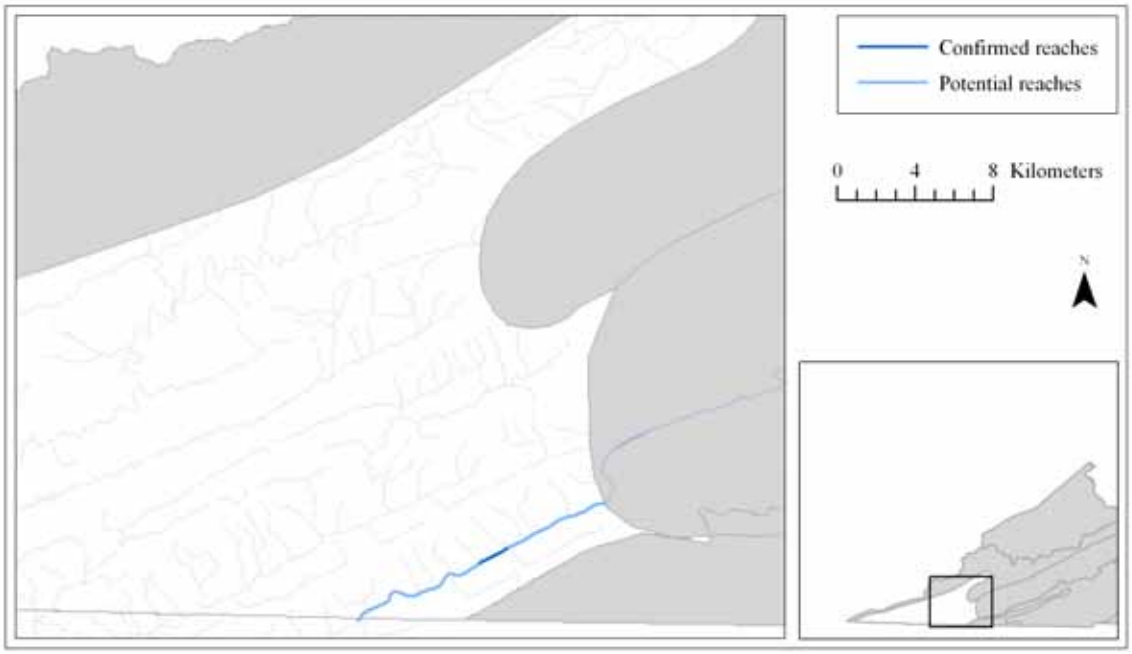

Figure 9.16. Location of confirmed and potential green blossom pearlymussel habitat in the Southern Cumberlands-Clinch EDU (DGIF 2004b).

Relative Condition of Habitat

The recovery plan for the green blossom pearlymussel describes some issues related to the past and current conditions of its habitat (USFWS 1984c). There are no impaired waters either within the known habitat or immediately upstream. However, Stock Creek, several kilometers upstream, has been listed as impaired for fish contamination with PCBs from unknown sources (DEQ and DCR 2004).

Specific Threats and Trends

If not extinct, this species is most threatened by habitat and water quality degradation (Dennis 1991a). Its historic decline is most likely due to the impoundment of the Tennessee and Cumberland drainages; siltation from mining activities, dredging, agriculture, logging, and road construction; and general water pollution from industrial, agricultural, and urban sources (USFWS 1984c).

Mussel TAC (2004) did not identify any specific threats to the green blossom pearlymussel. However, they identified several threats to the Clinch and Powell drainages (Appendix H).

Conservation Actions and Strategies

Dennis (1991a) indicated that the only strategy to possibly protect such a rare species is habitat protection and recovery. Mussel TAC (2004) identified a suite of conservation actions for the Clinch and Powell drainages (Appendix I), but nothing specific to the green blossom pearlymussel.

Research and Monitoring Needs

Several research or monitoring projects are recommended in the recovery plan for the green blossom pearlymussel, including determining the feasibility of reintroducing the species within its historic range; conducting life history studies; determining the necessity and techniques for habitat improvement; and developing and implementing a program to monitor populations and habitat conditions (USFWS 1984c).

Mussel TAC (2004) identified several research or monitoring needs for the Clinch and Powell drainages (Appendix J). They did not identify anything specific to the green blossom pearlymussel.

9.4.1.1.11. Shiny pigtoe, *Fusconaia cor*

Life History Summary

The shiny pigtoe is very rare in Virginia and rare throughout its range (Neves 1991i). Its decline is believed to be due to habitat degradation. Adult size ranges from 60-80mm, and the shell is typically subtriangular (Neves 1991i; Parmalee and Bogan 1998). This mussel is tachytictic (Kitchel 1985). Kitchel (1985) listed the following fish hosts: telescope shiner *Notropis telescopus*, warpaint shiner *Luxilus coccogenis*, and common shiner *L. cornutus*. This species is protected, with the status of State and Federal endangered.

Location

The map of shiny pigtoe habitat (Figure 9.17) includes confirmed reaches from Collections (DGIF 2004b) and potential reaches. Potential habitat was selected using attributes (link magnitude and link magnitude of downstream reaches, as well as gradient) within DGIF's aquatic habitat classification. See Appendix D for more details.

Description of Essential Habitat

The shiny pigtoe occurs in fords, shoals, and other shallow areas of riverine habitats with moderate to swift current (Bogan and Parmalee 1983). It can be found in any stable substrate, from sand to cobbles. The DGIF aquatic habitat classification was used to examine patterns in habitat use and distribution. In the Clinch-Powell watershed, this species was found in three habitat types (Table 9.25).

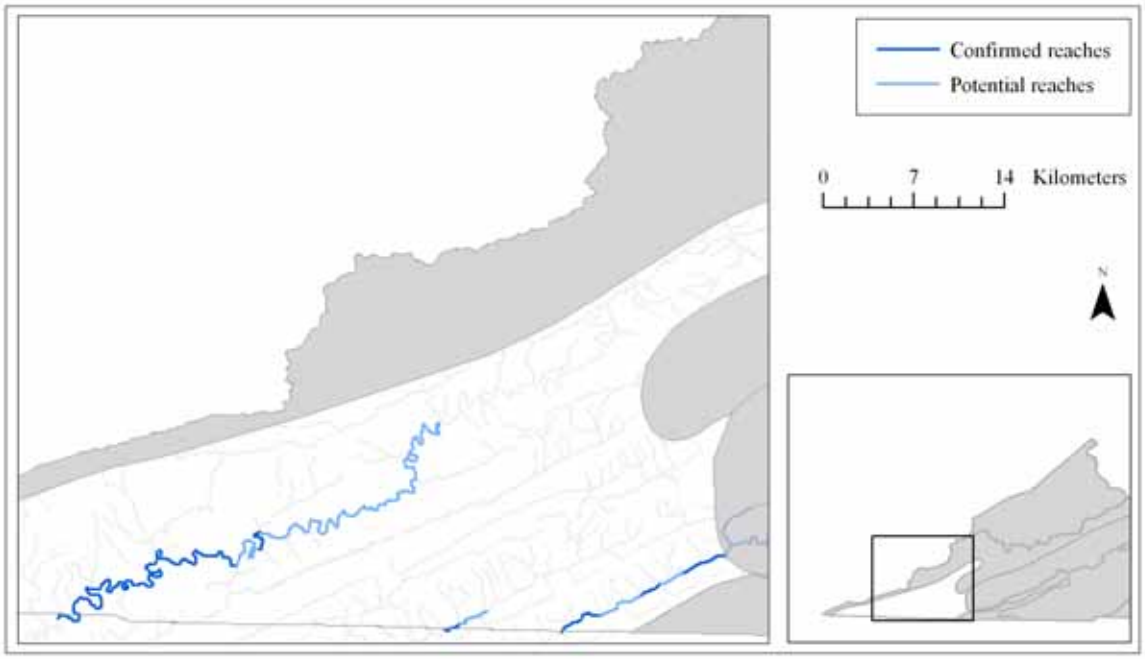

Figure 9.17. Confirmed and potential shiny pigtoe habitat in the Southern Cumberlands-Clinch EDU (DGIF 2004b).

Table 9.25. DGIF aquatic habitat types used by the shiny pigtoe in the Clinch-Powell watershed.

Aquatic Habitat Type	Number of Reaches
Very low gradient small river connected to another small river	31
Very low gradient large stream connected to another large stream	9
Very low gradient small stream connected to another small stream	2

Relative Condition of Habitat

The recovery plan for the shiny pigtoe describes issues related to past and current conditions of its habitat (USFWS 1983d). Both sections of known shiny pigtoe habitat in this EDU are impaired (DEQ and DCR 2004). One is downstream of Stock Creek, which is considered impaired due to fish tissue contamination with PCBs from unknown sources. The impairment of the other stretch is general standard benthic from unknown sources. This means that the number, diversity or composition of benthic macroinvertebrates in this stretch of stream indicated that water quality was impaired.

Specific Threats and Trends

The recovery plan for the shiny pigtoe identifies impoundments, siltation and general water pollution as contributing factors in the decline of this species (USFWS 1983d). Current threats include the water quality and sedimentation effects of mining activities, general water quality degradation (especially fecal coliform levels), and catastrophic toxic spills (Neves 1991i).

Mussel TAC (2004) did not identify any specific threats to the shiny pigtoe. However, it identified several threats to the Clinch and Powell drainages (Appendix H).

Conservation Actions and Strategies

Neves (1991i) recommends strict enforcement of water quality regulations to improve water and habitat quality. The recovery plan for this species recommends two high priority conservation actions (USFWS 1983d): protection of existing populations and habitats, and mitigation or elimination of current threats.

Mussel TAC (2004) identified a suite of conservation actions for the Clinch and Powell drainages (Appendix I), but nothing specific for the shiny pigtoe.

Research and Monitoring Needs

The recovery plan (USFWS 1983d) recommends that life history studies be completed. Mussel TAC (2004) identified several research or monitoring needs for the Clinch and Powell drainages (Appendix J). It did not identify anything specific to the shiny pigtoe.

9.4.1.1.12. Fine-rayed pigtoe, *Fusconaia cuneolus*

Life History Summary

The fine-rayed pigtoe is very rare in Virginia and throughout its range (Neves 1991h). It is subtriangular in shape and may reach 80mm (Parmalee and Bogan 1998). The fine-rayed pigtoe is tachytictic. Laboratory research has indicated that river chub *Nocomis micropogon*, white shiner *Luxilus albeolus*, telescope shiner *Notropis telescopus*, Tennessee shiner *N. leuciodus*, central stoneroller *Campostoma anomalum*, fathead minnow *Pimephales promelas*, and mottled sculpin *Cottus bairdi* can serve as hosts for glochidia of this species (Bruenderman 1989). This species is believed to live up to 35 years. This species is legally protected, with the status of State and Federal endangered.

Location

The map of fine-rayed pigtoe habitat (Figure 9.18) includes confirmed reaches based on Collections (DGIF 2004b) and potential reaches. Potential habitat was selected using attributes (link magnitude and link magnitude of downstream reaches, as well as gradient) within DGIF's aquatic habitat classification. See Appendix D for more details.

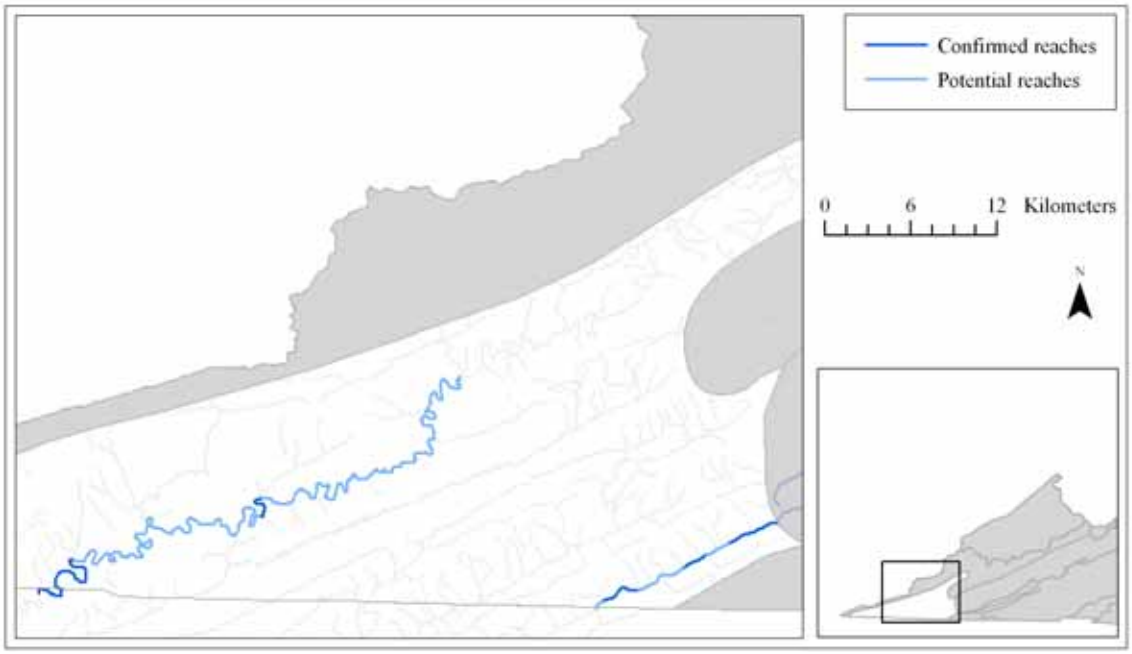

Figure 9.18. Location of confirmed and potential fine-rayed pigtoe habitat in the Southern Cumberlands-Clinch EDU (DGIF 2004b).

Description of Essential Habitat

Neves (1991h) indicated that the fine-rayed pigtoe is a lotic, riffle-dwelling species that is typically found in shallow ford and shoal areas with moderate gradient. The DGIF aquatic habitat classification was used to examine patterns in habitat use and distribution. In the Clinch-Powell watershed, this species was found in four habitat types representing mostly small rivers and large streams (Table 9.26).

Table 9.26. DGIF aquatic habitat types used by the fine-rayed pigtoe in the Clinch-Powell watershed.

Aquatic Habitat Type	Number of Reaches
Very low gradient small river connected to another small river	30
Very low gradient large stream connected to another large stream	8
Low gradient large stream connected to another large stream	1
Very low gradient small stream connected to a large stream	1

Relative Condition of Habitat

The recovery plan for the fine-rayed pigtoe describes some issues related to past and current conditions of its habitat (USFWS 1984b). Both sections of known fine-rayed pigtoe habitat in this EDU are impaired (DEQ and DCR 2004). One is downstream of Stock Creek, which is considered impaired due to fish tissue contamination with PCBs from unknown sources. The impairment of the other stretch is general standard benthic from unknown sources. This means that the number, diversity or composition of benthic macroinvertebrates in this stretch of stream indicated that water quality was impaired.

Specific Threats and Trends

Industrial development and agriculture has likely caused the historic declines in the fine-rayed pigtoe (USFWS 1984b). This development was the source of impoundments, mining wastes, herbicides, pesticides, siltation, and channelization. Existing populations are threatened by oil and gas drilling, impacts of coal mining, fecal coliform pollution, and siltation (Neves 1991h).

Mussel TAC (2004) did not identify any specific threats to the fine-rayed pigtoe. However, they identified several threats to the Clinch and Powell drainages (Appendix H).

Conservation Actions and Strategies

Neves (1991h) suggests that recolonizing the section of the Clinch River between Carbo and St. Paul would help to ensure the viability of the population in Virginia. In general, improvements in water quality would help populations in both the Clinch and Powell rivers. Specifically, the following actions would increase the viability of this species: upgrades to sewage treatment plants, expedition of reclamation of mined lands, elimination of coal waste dumping into the river, and the strict enforcement of permitted discharges.

The recovery plan for the fine-rayed pigtoe lists three high priority recovery actions: mitigating or eliminating current and future foreseeable threats, enforcing existing state and federal laws and regulations, and protecting known habitats and populations (USFWS 1984b). Details are available in USFWS (1984b).

Mussel TAC (2004) identified a suite of conservation actions for the Clinch and Powell drainages (Appendix I), but nothing specific to the fine-rayed pigtoe.

Research and Monitoring Needs

The recovery plan for the fine-rayed pigtoe recommends that threats (current and future) be identified (USFWS 1984b). Mussel TAC (2004) identified several research or monitoring needs for the Clinch and Powell drainages (Appendix J). They did not identify anything specific to the fine-rayed pigtoe.

9.4.1.1.13. Cracking pearlymussel, *Hemistena lata*

Life History Summary

Throughout its range, the cracking pearlymussel is very rare (Neves 1991c). Within Virginia, it is extremely rare, largely due to habitat degradation and reduced reproduction in the Clinch and Powell rivers. It is a medium-sized mussel, with a maximum length of approximately 90mm (Parmalee and Bogan 1998). Its shell shape is elongate, elliptical or subrhomboid. The shell is thin but strong. Glochidia have been found in mid-May, indicating that this species is tachytictic (Ortmann 1915). This species is legally protected, with the status of State and Federal endangered.

Location

The map of habitat for the cracking pearlymussel (Figure 9.19) includes confirmed habitat from Collections (DGIF 2004b) and potential habitat selected using link magnitude and link magnitude of downstream reaches within DGIF's aquatic habitat classification. See Appendix D for more details.

Description of Essential Habitat

The cracking pearlymussel appears to prefer unimpounded stretches of medium-sized rivers. It generally occurs in shallow areas (< 2ft or 0.6m) and moderate current (Parmalee and Bogan 1998). It is typically buried in mud, sand, or fine gravel. The DGIF aquatic habitat classification was used to examine patterns in habitat use and distribution. In the Clinch-Powell watershed, this species was found in two habitat types (Table 9.27).

Table 9.27. DGIF aquatic habitat types used by the cracking pearlymussel in the Clinch-Powell watershed.

Aquatic Habitat Type	**Number of Reaches**
Very low gradient small river connected to another small river	14
Very low gradient large stream connected to another large stream	3

Relative Condition of Habitat

The recovery plan for the cracking pearlymussel describes some issues related to past and current conditions of its habitat (USFWS 1990). Both sections of known cracking pearlymussel habitat in this EDU are impaired (DEQ and DCR 2004). One is downstream of Stock Creek, which is considered impaired due to fish tissue contamination with PCBs from unknown sources. The impairment of the other stretch is general standard benthic from unknown sources. This means that the number, diversity or composition of benthic macroinvertebrates in this stretch of stream indicated that water quality was impaired.

Specific Threats and Trends

Three factors—impoundments, siltation, and water pollution—have likely contributed to the decline of the cracking pearlymussel (USFWS 1990; Neves 1991c). Declines in water quality currently threaten this species (Neves 1991c). Oil and gas drilling and coal mining may also be affecting this species.

Mussel TAC (2004) did not identify any specific threats to the cracking pearlymussel. However, they identified several threats to the Clinch and Powell drainages (Appendix H).

Conservation Actions and Strategies

Any improvement in water quality is likely to positively affect this and many other mussel species (Neves 1991c). The recovery plan for the cracking pearlymussel identified four high priority conservation actions necessary for the species' recovery: continuing to utilize existing legislation and regulations to protect this species and its habitat; developing and presenting educational programs; developing techniques and

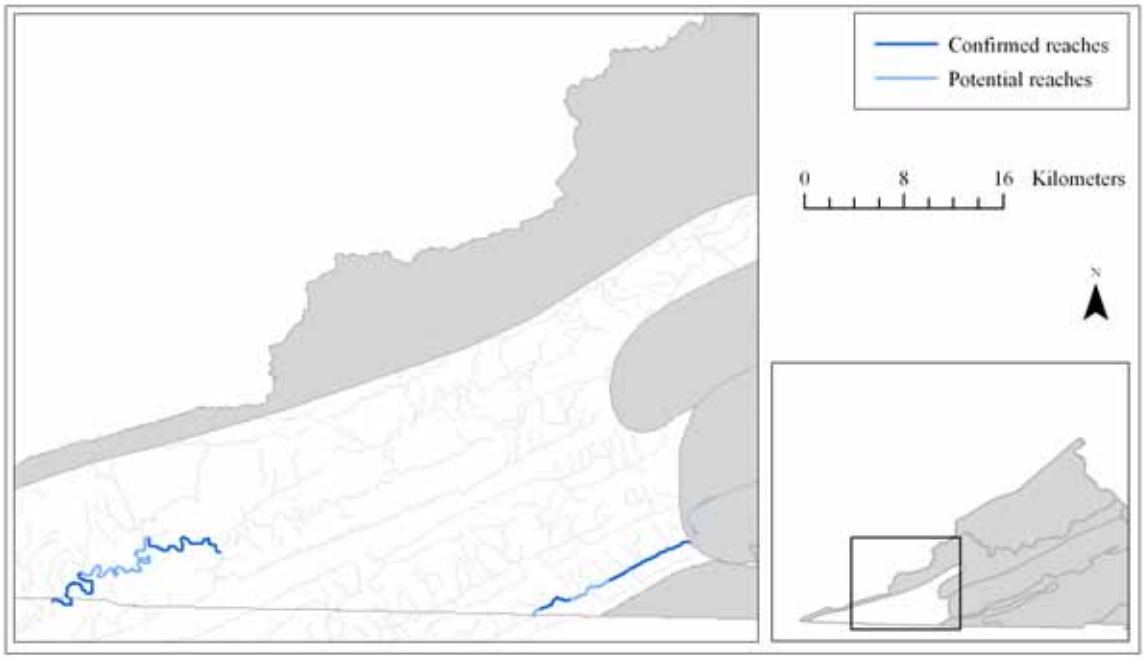

Figure 9.19. Location of confirmed and potential cracking pearlymussel habitat in the Southern Cumberlands-Clinch EDU (DGIF 2004b).

reintroducing the species to appropriate habitats within its native range; and developing and implementing cryopreservation (USFWS 1990).

Mussel TAC (2004) identified a suite of conservation actions for the Clinch and Powell drainages (Appendix I), but nothing specific for this species.

Research and Monitoring Needs

Studies are needed to ascertain important life history requirements and traits, to identify areas with reproducing individuals, and to search for additional existing populations and habitat (USFWS 1990; Neves 1991c). Mussel TAC (2004) identified several research or monitoring needs for the Clinch and Powell drainages (Appendix J). They did not identify anything specific to the cracking pearlymussel.

9.4.1.1.14. Rough rabbitsfoot, *Quadrula cylindrica strigillata*

Life History Summary

The rough rabbitsfoot is widespread but uncommon throughout its range (Kitchel 1991). Its occurrence in Virginia is localized. The shell of this species is elongate and rhomboid or rectangular in shape, and individuals may reach 120mm (Parmalee and Bogan 1998). This species is tachytictic (Parmalee and Bogan 1998). Yeager and Neves (1986) listed the following fish hosts for this species: whitetail shiner *Notropis galacturus*, spotfin shiner *Notropis spilopterus*, and bigeye chub *Hybopsis amblops*. This species is legally protected, with the status of State and Federal endangered.

Location

The map of locations for this species (Figure 9.20) includes confirmed reaches from Collections (DGIF 2004b) and potential reaches. Potential reaches were selected using link magnitude, downstream link magnitude and gradient in the DGIF aquatic habitat classification. See Appendix D for more details.

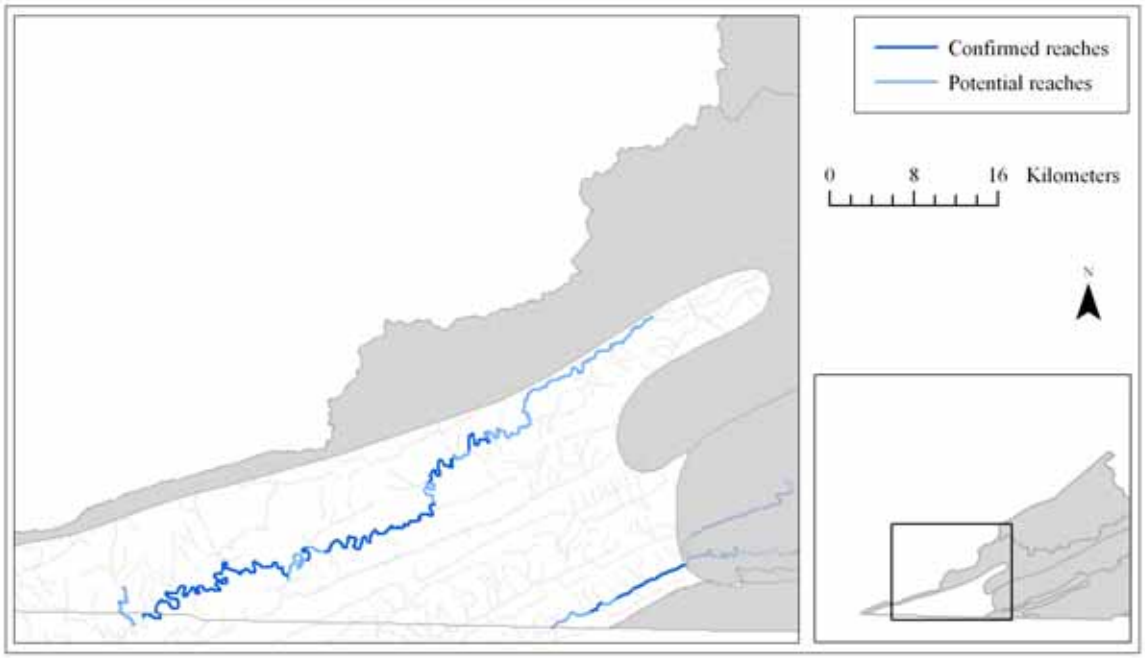

Figure 9.20. Location of confirmed and potential rough rabbitsfoot habitat in the Southern Cumberlands-Clinch EDU (DGIF 2004b).

Description of Essential Habitat

The rough rabbitsfoot is found in small to medium-sized rivers in clear, shallow water (Parmalee and Bogan 1998). It prefers shoals and riffles with sand and gravel substrate near banks. The DGIF aquatic habitat classification was used to examine patterns in habitat and distribution. In the Clinch-Powell watershed, this species was found in six habitat types (Table 9.28). Most occurrences were in small rivers and large streams.

Table 9.28. DGIF aquatic habitat types used by the rough rabbitsfoot in the Clinch-Powell watershed.

Aquatic Habitat Type	Number of Reaches
Very low gradient small river connected to another small river	29
Very low gradient large stream connected to another large stream	17
Very low gradient small stream connected to another small stream	2
Very low gradient small stream connected to a large stream	1
Low gradient large stream connected to another large stream	1
Low gradient small stream connected to a large stream	1

Relative Condition of Habitat

The recovery plan for the rough rabbitsfoot describes some issues related to past and current conditions of its habitat (USFWS 2003). All sections of known rough rabbitsfoot habitat in this EDU are considered impaired (DEQ and DCR 2004). The impairment of the other stretch is general standard benthic from unknown sources. This means that the number, diversity or composition of benthic macroinvertebrates in this stretch of stream indicated that water quality was impaired.

Specific Threats and Trends

The decline of the rough rabbitsfoot is partially attributable to pollution from mining, other industry, municipalities, and toxic spills (Cairns et al. 1971). Other factors that have universally affected freshwater mussels are impoundment, siltation, and channelization (Kitchel 1991). Current threats to this subspecies include degraded water, degraded substrate quality, and contaminants (USFWS 2003). The restricted range of this and other mussels makes them especially vulnerable to toxic spills and the negative effects of genetic isolation.

Mussel TAC (2004) did not identify any specific threats to the rough rabbitsfoot. However, they identified several threats to the Clinch and Powell drainages (Appendix H).

Conservation Actions and Strategies

Kitchel (1991) recommends improvements in land use practices, reduction or elimination of municipal, agricultural, and industrial contaminants, restricted instream construction activities, and the creation of mussel sanctuaries in appropriate sections of the Clinch, Powell, and Holston rivers to insure adequate protection for this species in Virginia. The recovery plan lists five priority conservation actions: utilizing existing legislation and regulations to protect this subspecies and its habitat; developing and presenting education programs; reducing or eliminating existing threats; augmenting or reintroducing where appropriate; and developing and implementing a cryogenic preservation program (USFWS 2003).

Mussel TAC (2004) identified a suite of conservation actions for the Clinch and Powell drainages (Appendix I), but nothing specific to the rough rabbitsfoot.

Research and Monitoring Needs

The recovery plan that includes this subspecies lists four research and monitoring needs (USFWS 2003). These include determining the species' life history requirements and threats, surveying for additional populations, conducting genetic analyses of the species, and developing and implementing a monitoring program. Mussel TAC (2004) identified several research or monitoring needs for the Clinch and Powell drainages (Appendix J), but did not identify anything specific to the rough rabbitsfoot.

9.4.1.1.15. Cumberland monkeyface, *Quadrula intermedia*

Life History Summary

The Cumberland monkeyface is extremely rare in Virginia and throughout its range (Neves 1991e). It is a relatively flat mussel, subquadrate to subcircular in shape. This species is a short-term brooder (Parmalee and Bogan 1998). Fuller (1974) concluded that the green sunfish *Lepomis cyanellus*, bluegill *L. macrochirus*, and sauger *Stizostedion canadense* were probable fish hosts. This species is legally protected, with the status of State and Federal endangered.

Location

The habitat map for the Cumberland monkeyface (Figure 9.21) includes confirmed reaches from Collections (DGIF 2004b) and potential reaches. Potential reaches were selected in DGIF's aquatic habitat classification using size, connectivity and gradient values. See Appendix D for more details.

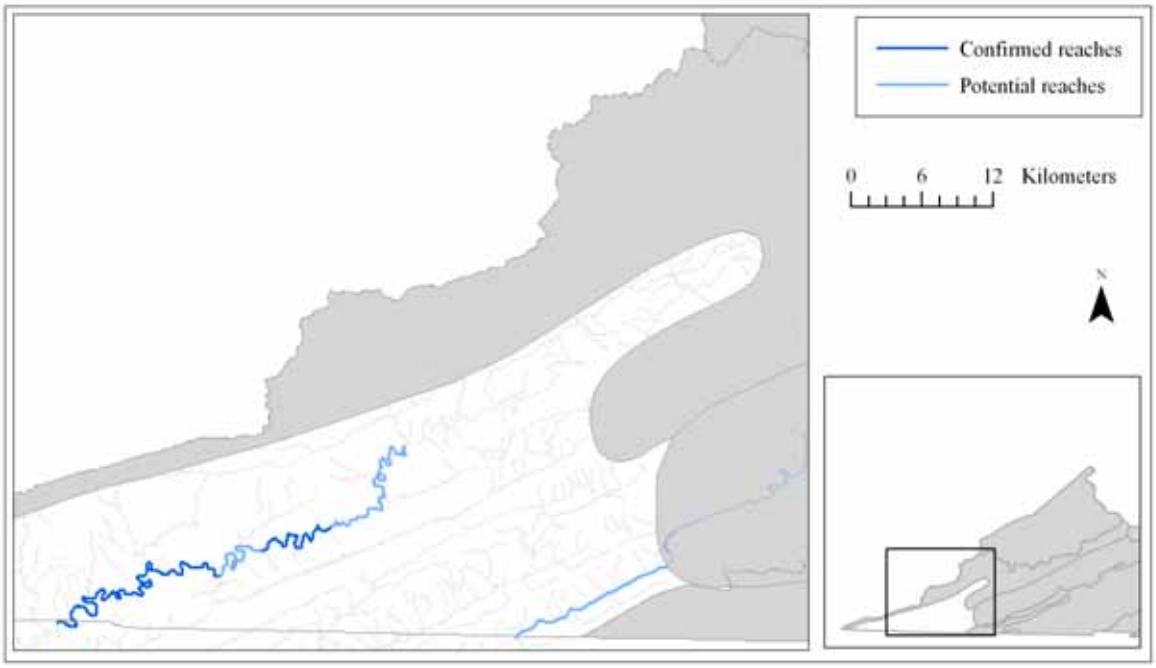

Figure 9.21. Location of confirmed and potential Cumberland monkeyface habitat in the Southern Cumberlands-Clinch EDU (DGIF 2004b).

Description of Essential Habitat

The Cumberland monkeyface is found in small to medium-sized streams with fast current and silt-free rubble, gravel, or sand substrate (USFWS 1982). The DGIF aquatic habitat classification was used to examine patterns in habitat use and distribution. In the Clinch-Powell watershed, this species has been found in two habitat types (Table 9.29).

Table 9.29. DGIF aquatic habitat types used by Cumberland monkeyface in the Clinch-Powell watershed.

Aquatic Habitat Type	Number of Reaches
Very low gradient large stream connected to another large stream	6
Very low gradient small river connected to another small river	2

Relative Condition of Habitat

The recovery plan for the Cumberland monkeyface describes some issues related to past and current conditions of its habitat (USFWS 1982). The known habitat for the Cumberland monkeyface is within an impaired stretch of the Powell River (DEQ and DCR 2004). The impairment is general standard benthic from unknown sources. This means that the number, diversity or composition of benthic macroinvertebrates in this stretch of stream indicated that water quality was impaired.

Specific Threats and Trends

The decline of this species in Virginia appears to be due to habitat degradation and non-viable population size (Neves 1991e). The Powell River population is likely threatened by wastes from oil and gas drilling, water quality and sedimentation effects of coal mining, and possibly fecal coliform contamination (Neves 1991e).

Mussel TAC (2004) did not identify any specific threats to the Cumberland monkeyface. However, it identified several threats to the Clinch and Powell drainages (Appendix H).

Conservation Actions and Strategies

The recovery plan for the Cumberland monkeyface recommended the continued utilization of existing legislation and regulations to protect this species and its habitat (USFWS 1982). Neves (1991e) more specifically recommended improving water quality in the Powell River through the upgrade of sewage treatment plants, the reclamation of mine lands, and the strict enforcement of discharge permits.

Mussel TAC (2004) identified a suite of conservation actions for Clinch and Powell drainages (Appendix I) but nothing specific to the Cumberland monkeyface.

Research and Monitoring Needs

The recovery plan for this species recommends determining current and future threats as an important task towards recovery of this species (USFWS 1983). Mussel TAC (2004) identified several research or monitoring needs for the Clinch and Powell drainages (Appendix J), but did not identify anything specific to the Cumberland monkeyface.

9.4.1.1.16. Appalachian monkeyface, *Quadrula sparsa*

Life History Summary

The Appalachian monkeyface is extremely rare in Virginia and rare throughout its range (Neves 1991a). It reaches a maximum length of 80mm and is triangular to irregularly rhomboid in shape (Parmalee and Bogan 1998). Based on life histories of closely related species, the Appalachian monkeyface is likely tachytictic. This species is legally protected, with the status of State and Federal endangered.

Location

The habitat map for the Appalachian monkeyface (Figure 9.22) includes confirmed reaches from Collections (DGIF 2004b) and potential reaches. Potential reaches were selected in DGIF's aquatic habitat classification using size and connectivity. See Appendix D for more details.

Description of Essential Habitat

The Appalachian monkeyface is a lotic species, found in fast-flowing shallow riffles and runs with stable, silt-free substrates of mixed composition (Neves 1991a). The DGIF aquatic habitat classification was used to examine patterns in habitat use and distribution. In the Clinch-Powell watershed, this species was found in two habitat types (Table 9.30).

Table 9.30. DGIF aquatic habitat types used by the Appalachian monkeyface in the Clinch-Powell watershed.

Aquatic Habitat Type	Number of Reaches
Very low gradient large stream connected to another large stream	6
Very low gradient small river connected to another small river	2

Relative Condition of Habitat

The recovery plan for the Appalachian monkeyface describes some issues related to past and current conditions of its habitat (USFWS 1983a). The known habitat of the Appalachian monkeyface in Virginia is within an impaired stretch of the Powell River (DEQ and DCR 2004). The impairment is general standard benthic from unknown sources. This means that the number, diversity or composition of benthic macroinvertebrates in this stretch of stream indicated that water quality was impaired.

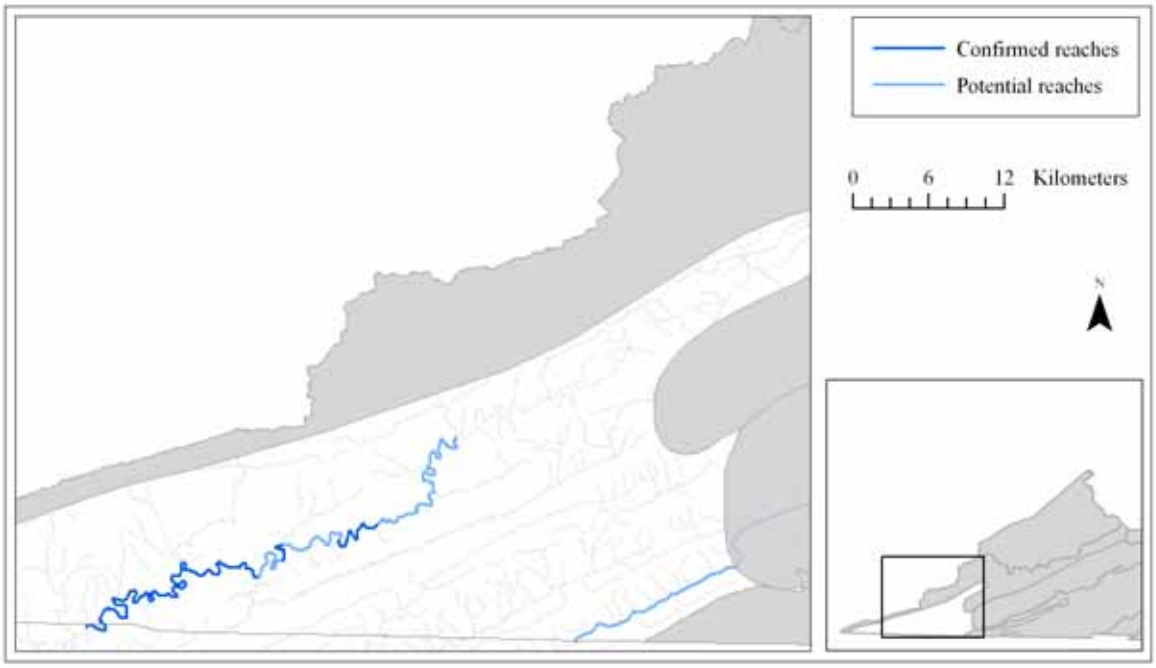

Figure 9.22. Location of confirmed and potential Appalachian monkeyface habitat in the Southern Cumberlands-Clinch EDU (DGIF 2004b).

Specific Threats and Trends

The decline of this species in Virginia appears to be due to habitat degradation and non-viable population size (Neves 1991a). The Powell River population is likely threatened by wastes from oil and gas drilling, water quality and sedimentation effects of coal mining, and possibly fecal coliform contamination. Mussel TAC (2004) did not identify any specific threats to the Appalachian monkeyface. However, it identified several threats to the Clinch and Powell drainages (Appendix H).

Conservation Actions and Strategies

The recovery plan for this species recommends the continued utilization of existing legislation and regulations to protect this species and its habitat (USFWS 1983a). Neves (1991a) more specifically recommended improving water quality in the Powell River through the upgrade of sewage treatment plants, the reclamation of mine lands, and the strict enforcement of discharge permits. General improvement of water quality in the Clinch River was also recommended.

Mussel TAC (2004) identified a suite of conservation actions for the Clinch and Powell drainages (Appendix I), but nothing specific to the Appalachian monkeyface.

Research and Monitoring Needs

The recovery plan for this species (USFWS 1983a) recommends determining current and foreseeable future threats as an important task towards recovery of this species. It also recommends the completion of needed life history studies. Mussel TAC (2004) identified several research or monitoring needs for the Clinch and Powell drainages (Appendix J), but did not identify anything specific to the Appalachian monkeyface.

9.4.1.1.17. Purple bean, *Villosa perpurpurea*

Life History Summary

The purple bean is considered uncommon to rare throughout its range and extremely rare in Virginia (Ahlstedt 1991a). It reaches a maximum length of 55mm (Parmalee and Bogan 1998). The shell is elongate and slightly inflated. This species is bradytictic. Fish hosts include sculpins *Cottus* sp., greenside darter *Etheostoma blenniodes*, and fantail darter *E. flabellare* (Watson and Neves 1996). This species is legally protected, with the status of State and Federal endangered.

Location

The habitat map for the purple bean (Figure 9.23) includes confirmed reaches from Collections (DGIF 2004b) and potential reaches. Potential reaches were selected in DGIF's aquatic habitat classification using link magnitude and downstream link magnitude values. See Appendix D for more details.

Description of Essential Habitat

The purple bean is usually found in moderate to fast current in depths < 3ft (1m, Parmalee and Bogan 1998). Typical substrate is coarse sand and gravel with some silt. The DGIF aquatic habitat classification was used to examine patterns in habitat use and distribution. In the Clinch-Powell watershed, this species was found in six habitat types (Table 9.31).

Table 9.31. DGIF aquatic habitat types used by the purple bean in the Clinch-Powell watershed.

Aquatic Habitat Type	Number of Reaches
Very low gradient large stream connected to another large stream	9
Very low gradient small river connected to another small river	9
Very low gradient small stream connected to another small stream	7
Low gradient large stream connected to another large stream	1
Low gradient small stream connected to a large stream	1
Very low gradient small stream connected to a large stream	1

Relative Condition of Habitat

The recovery plan for the purple bean describes some issues related to past and current conditions of its habitat (USFWS 2003). There are no impaired waters within its known habitat or immediately upstream. However, Stock Creek, several kilometers upstream, has been listed as impaired for fish contamination with PCBs from unknown sources (DEQ and DCR 2004).

Specific Threats and Trends

Factors that have generally affected all freshwater mussels are impoundment, siltation, and channelization. Current threats to this subspecies include degraded water and substrate quality and contaminants (USFWS 2003). Sources of these threats include logging, agriculture, and oil and gas exploration (Ahlstedt 1991a). The restricted range of this and other mussels makes them especially vulnerable to toxic spills and the negative effects of genetic isolation.

Mussel TAC (2004) did not identify any specific threats for the purple bean, but identified several threats to the Clinch and Powell drainages (Appendix H).

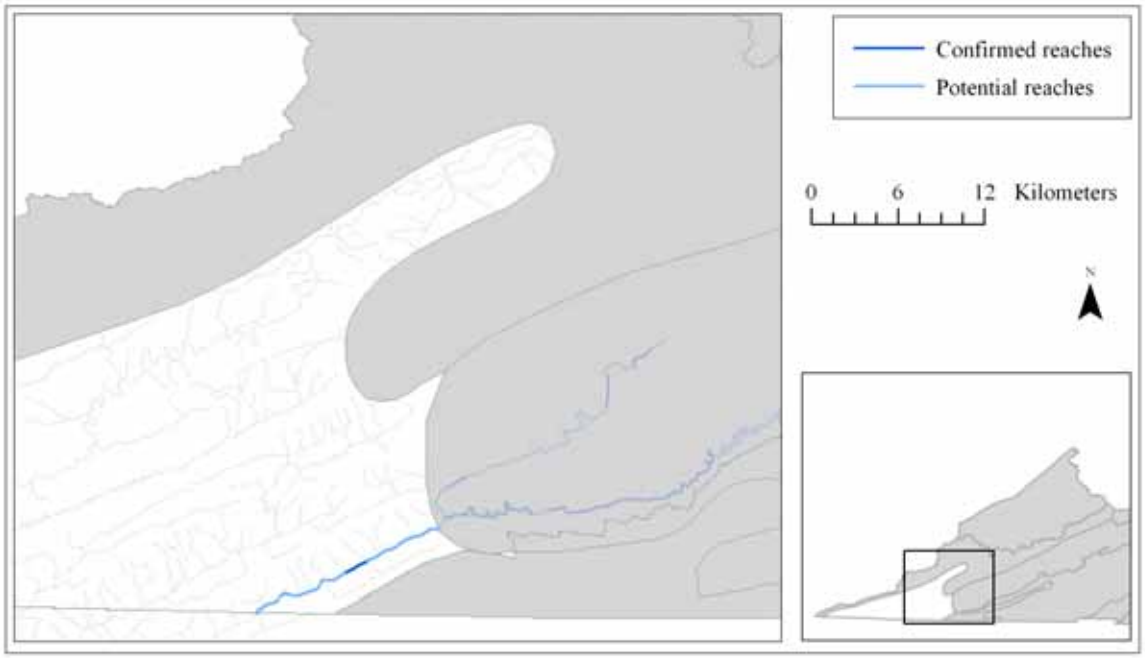

Figure 9.23. Location of confirmed and potential purple bean habitat in the Southern Cumberlands-Clinch EDU (DGIF 2004b).

Conservation Actions and Strategies

The recovery plan lists five priority conservation actions: utilizing existing legislation and regulations to protect this subspecies and its habitat; developing and presenting education programs; reducing or eliminating existing threats; augmenting or reintroducing where appropriate; and developing and implementing a cryogenic preservation program (USFWS 2003). Specifically, Ahlstedt (1991a) recommended improving water quality in the Clinch River and Copper Creek.

Mussel TAC (2004) identified a suite of conservation actions for the Clinch and Powell drainages (Appendix I), but nothing specific to this subspecies.

Research and Monitoring Needs

The recovery plan that includes this species lists four research and monitoring needs (USFWS 2003). These include determining the species' life history requirements and threats, surveying for additional populations, conducting genetic analyses of the species, and developing and implementing a monitoring program. Mussel TAC (2004) identified a suite of conservation actions for the Clinch and Powell drainages (Appendix J), but nothing specific to this subspecies.

9.4.1.1.18. Cumberland bean, *Villosa trabalis*

Life History Summary

The Cumberland bean may be extirpated from Virginia (Neves 1991d). It is elongate and inflated, with an irregular oval shape (Parmalee and Bogan 1998). It may reach a maximum length of 55mm. This species is bradytictic. Based on laboratory experiments, the following fish that occur in Virginia were identified as probable hosts: arrow darter *Etheostoma sagitta*, fantail darter *E. flabellare*, Johnny darter *E. nigrum*, rainbow darter *E. caeruleum*, snubnose darter *E. simoterum*, striped darter *E. virgatum*, and stripetail darter *E. kennicotti* (Layzer and Anderson 1991, 1992; J.B. Layzer, pers. comm. in Parmalee and Bogan 1998). This species is legally protected, with the status of State and Federal endangered.

Location

The map of habitat for the Cumberland bean (Figure 9.24) includes only potential habitat, since the confirmed reach (DGIF 2004b) just upstream falls within the Ridge and Valley-Clinch EDU. Potential habitat for this species was determined in DGIF's aquatic habitat classification using size, connectivity and gradient classes. For more detail, see Appendix D.

Description of Essential Habitat

The Cumberland bean is typically found in riffles of small rivers and streams with gravel or gravel and sand substrate (Parmalee and Bogan 1998). The DGIF aquatic habitat classification was used to examine patterns in habitat use and distribution. In the Clinch-Powell watershed, this species was found in three habitat types (Table 9.32).

Table 9.32. DGIF aquatic habitat types used by the Cumberland bean in the Clinch-Powell watershed.

Aquatic Habitat Type	Number of Reaches
Very low gradient small river connected to another small river	4
Very low gradient large stream connected to another large stream	3
Very low gradient small stream connected to a large stream	1

Relative Condition of Habitat

The recovery plan for the Cumberland bean describes some issues related to past and current conditions of its habitat (USFWS 1984a). There is only potential habitat (that is, no confirmed habitat) for the Cumberland bean in this EDU. Therefore, we did not examine its relative condition.

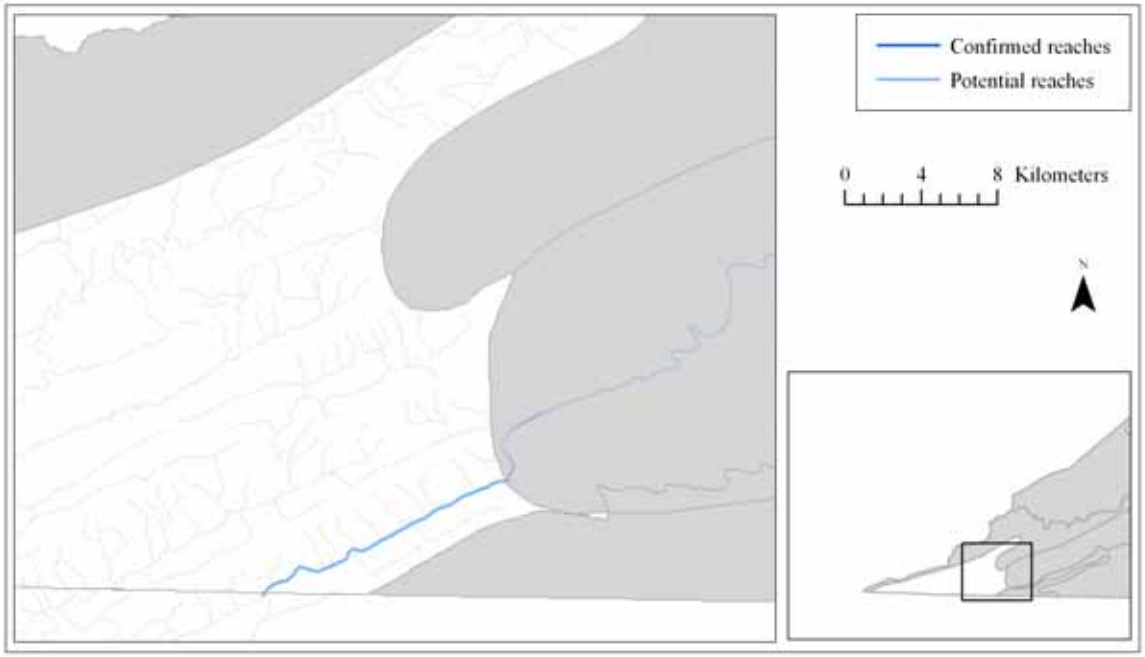

Figure 9.24. Location of potential Cumberland bean habitat in the Southern Cumberlands-Clinch EDU (DGIF 2004b).

Specific Threats and Trends

The decline of the Cumberland bean is not completely understood; however, it is believed to be due to impoundment, siltation and pollution (USFWS 1984a). Mussel TAC (2004) did not identify any specific threats to the Cumberland bean, but did identify several threats to the Clinch and Powell drainages (Appendix H).

Conservation Actions and Strategies

The recovery plan for the Cumberland bean identifies as a high priority the use of existing legislation and regulations to protect this species and its habitat (USFWS 1984a). Mussel TAC (2004) identified a suite of conservation actions for the Clinch and Powell drainages (Appendix I), but nothing specific to this species.

Research and Monitoring Needs

The recovery plan for the Cumberland bean identified the determination of current and foreseeable future threats as a high-priority research need (USFWS 1984a). Mussel TAC (2004) identified several research or monitoring needs for the Clinch and Powell drainages (Appendix J), but they did not identify anything specific to the Cumberland bean.

9.4.1.2. Aquatic SGCN by Habitat Group: Southern Cumberlands-Clinch EDU

The Southern Cumberlands-Clinch EDU has 87 tiered species. This includes 38 fish, 37 mussels, five snails, six crayfish, and one amphibian. These species are distributed among six habitat groups and one group of species with generalist or indeterminate habitat preferences (Tables 9.33-9.39).

Table 9.33. Aquatic species of greatest conservation need in very low gradient large streams connected to other large streams (DGIF Classification type 331).

Common Name	Scientific Name	Tier	Percent Occurrences in Habitat Group	Number of Types Used (DGIF Aquatic Classification)
Cumberland monkeyface	*Quadrula intermedia*	I	75	2 (drainage-wide)
Appalachian monkeyface	*Quadrula sparsa*	I	75	2 (drainage-wide)
Popeye shiner	*Notropis ariommus*	II	75	5
Wounded darter	*Etheostoma vulneratum*	III	75	3
Channel darter	*Percina copelandi*	III	83	3
Elephant-ear	*Elliptio crassidens*	IV	100	1 (3 occurrences)
Sauger	*Stizostedion canadense*	IV	83	2

Table 9.34. Aquatic species of greatest conservation need in very low gradient small rivers connected to other small rivers (DGIF Classification type 441).

Common Name	Scientific Name	Tier	Percent Occurrences in Habitat Group	Number of Types Used (DGIF Aquatic Classification)
Green-blossom pearlymussel	*Epioblasma torulosa gubernaculum*	I	100	1 (6 occurrences; drainage-wide)
Shiny pigtoe	*Fusconaia cor*	I	74	3 (drainage-wide)
Blotchside logperch	*Percina burtoni*	II	100	1 (3 occurrences)
Tippecanoe darter	*Etheostoma tippecanoe*	III	100	1 (4 occurrences)

Table 9.35. Aquatic species of greatest conservation need in very low gradient large streams and small rivers (DGIF Classification types 331, 332, and 441).

Common Name	**Scientific Name**	**Tier**	**Percent Occurrences in Habitat Group**	**Number of Types Used (DGIF Aquatic Classification)**
Birdwing pearlymussel	*Lemiox rimosus*	I	94	2 (drainage-wide)
Fanshell	*Cyprogenia stegaria*	I	100	2 (drainage-wide)
Dromedary pearlymussel	*Dromus dromas*	I	100	2 (drainage-wide)
Cumberlandian combshell	*Epioblasma brevidens*	I	100	2 (drainage-wide)
Oyster mussel	*Epioblasma capsaeformis*	I	97	4 (drainage-wide)
Fine-rayed pigtoe	*Fusconaia cuneolus*	I	97	4 (drainage-wide)
Cracking pearlymussel	*Hemistena lata*	I	100	2 (drainage-wide)
Rough rabbitsfoot	*Quadrula cylindrical strigillata*	I	90	6 (drainage-wide)
Western sand darter	*Ammocrypta clara*	II	100	2 (3 occurrences)
Snuffbox	*Epioblasma triquetra*	II	100	2 (7 occurrences)
Tennessee pigtoe	*Fusconaia barnesiana*	II	86	4
Slabside pearlymussel	*Lexingtonia dolabelloides*	II	100	2 (3 occurrences)
Sheepnose	*Plethobasus cyphyus*	II	100	2 (7 occurrences)
Fluted kidneyshell	*Ptychobranhus subtentum*	II	92	3
Elktoe	*Alasmidonta marginata*	III	100	2 (4 occurrences)
Bluebreast darter	*Etheostoma camurum*	III	92	3
Longsolid	*Fusconaia subrotunda*	III	85	5
Ohio lamprey	*Ichthyomyzon bdellium*	III	100	2
Spiny riversnail	*Io fluvialis*	III	92	3
Black sandshell	*Ligumia recta*	III	100	2 (9 occurrences)
River redhorse	*Moxostoma carinatus*	III	94	3
Streamline chub	*Erimystax dissimilis*	IV	79	6
Blotched chub	*Erimystax insignis*	IV	94	3
Banded darter	*Etheostoma zonale*	IV	71	8
Brook silverside	*Labidesthes sicculus*	IV	89	3 (9 occurrences)
Pocketbook mussel	*Lampsilis ovata*	IV	100	2
Fragile papershell	*Leptodea fragilis*	IV	90	3
Cumberland moccasinshell	*Medionidus conradicus*	IV	86	4
Mountain madtom	*Noturus eleutherus*	IV	100	2 (8 occurrences)
Tangerine darter	*Percina aurantiaca*	IV	94	3
Gilt darter	*Percina evides*	IV	86	5
Dusky darter	*Percina sciera*	IV	86	3 (7 occurrences)
Stargazing minnow	*Phenacobius uranops*	IV	78	6
Deertoe	*Truncilla truncata*	IV	100	2 (4 occurrences)

Table 9.36. Aquatic species of greatest conservation need in very low or low gradient small streams, large streams and small rivers (DGIF Classification types 221, 222, 231, 232, 331, 332, and 441).

Common Name	Scientific Name	Tier	Percent Occurrences in Habitat Group	Number of Types Used (DGIF Aquatic Classification)
Duskytail darter	*Etheostoma percnurum*	I	100	3 (drainage-wide)
Purple bean	*Villosa perpurpurea*	I	100	6 (drainage-wide)
Freshwater drum	*Aplodinotus grunniens*	IV	100	3
Mountain creekshell	*Villosa vanuxemensis*	IV	100	5

Table 9.37. Aquatic species of greatest conservation need in very low or low gradient small to large streams (DGIF Classification types 221, 222, 223, 231, 232, and 331).

Common Name	Scientific Name	Tier	Percent Occurrences in Habitat Group	Number of Types Used (DGIF Aquatic Classification)
Yellowfin madtom	*Noturus flavipinnis*	I	100	4 (drainage-wide)
Speckled darter	*Etheostoma stigmaeum*	IV	74	9
Mountain shiner	*Lythrurus lirus*	IV	76	8
Logperch	*Percina caprodes*	IV	89	5

Table 9.38. Aquatic species of greatest conservation need in headwaters and small streams. (DGIF Classification types 122, 123, 132, 221, 222, 223, 232, and 242).

Common Name	Scientific Name	Tier	Percent Occurrences in Habitat Group	Number of Types Used (DGIF Aquatic Classification)
Tennessee heelsplitter	*Lasmigona holstonia*	II	100	4 (5 occurrences)
A crayfish	*Cambarus angularis*	IV	88	6 (8 occurrences)
Swannanoa darter	*Etheostoma swannanoa*	IV	100	5 (7 occurrences)

Table 9.39. Aquatic species of greatest conservation need: generalists and those with unknown habitat requirements based on DGIF habitat classification.

Common Name	Scientific Name	Tier	Number of Types Used (DGIF Aquatic Classification)
Slender chub	*Erimystax cahni*	I	1 (2 occurrences; drainage-wide)
Ashy darter	*Etheostoma cinereum*	I	1 (1 occurrence; drainage-wide)
Cumberland bean	*Villosa trabalis*	I	NA (potential habitat only)
Powell River crayfish	*Cambarus jezerinaci*	II	NA
Eastern hellbender	*Cryptobranchus alleganiensis*	II	1 (1 occurrence)
Spectaclecase	*Cumberlandia monodonta*	II	2 (3 occurrences)
Coal elimia	*Elimia aterina*	II	NA
Longhead darter	*Percina macrocephala*	II	NA
Pyramid pigtoe	*Pleurobema rubrum*	II	NA
Paddlefish	*Polyodon spathula*	II	1 (1 occurrence)
Rayed bean	*Villosa fabalis*	II	1 (1 occurrence)
Steelcolor shiner	*Cyprinella whipplei*	III	1 (1 occurrence)
Mountain brook lamprey	*Ichthyomyzon greeleyi*	III	3 (5 occurrences)
Emerald shiner	*Notropis atherinoides*	III	1 (1 occurrence)

Common Name	Scientific Name	Tier	Number of Types Used (DGIF Aquatic Classification)
Tennessee clubshell	*Pleurobema oviforme*	III	3 (5 occurrences)
Brown walker	*Pomatiopsis cincinnatiensis*	III	NA
Bunting's crayfish	*Cambarus buntingi*	IV	NA
A crayfish	*Cambarus longirostris*	IV	2 (3 occurrences)
Rainbow darter	*Etheostoma caeruleum*	IV	2 (3 occurrences)
Onyx rocksnail	*Leptoxis praerosa*	IV	1 (1 occurrence)
Sawfin shiner	*Notropis* sp. 4	IV	4 (6 occurrences)
Mirror shiner	*Notropis spectrunculus*	IV	2 (2 occurrences)
Northern studfish	*Fundulus catenatus*	IV	2 (3 occurrences)
Stonecat	*Noturus flavus*	IV	1 (1 occurrence)
A crayfish	*Orconectes erichsonianus*	IV	NA
Sturgeon crayfish	*Orconectes forceps*	IV	1 (1 occurrence)
Bullhead minnow	*Pimephales vigilax*	IV	2 (2 occurrences)
Pagoda hornsnail	*Pleurocera uncialis uncialis*	IV	1 (1 occurrence)
Pimpleback	*Quadrula pustulosa pustulosa*	IV	1 (1 occurrence)
Three-ridge valvata	*Valvata tricarinata*	IV	1 (1 occurrence)

Relative Condition of Habitat

Approximately 8.5% of the riverine habitat in the Southern Cumberlands-Clinch EDU is impaired (DEQ and DCR 2004). The impairments include fecal coliform, general standard benthic, and dissolved oxygen. The sources of these impairments are unknown, non-point agricultural or urban sources, and solid waste.

Within the Southern Cumberlands-Clinch EDU, 22.4% of the land use is agriculture and 1.2% is developed (USGS 1992). Across the state, agricultural land cover ranges from 2 to 41%, and developed land use ranges from 0.2 to 15%.

Threats, conservation actions, and research and monitoring needs for the Tier II through Tier IV species are given in Appendices H, I, and J. Mussel TAC (2004) and Fish TAC (2004) provided this information within habitat groups selected at the workshops. The level of detail within these groups does not correspond to that used in the DGIF aquatic habitat classification.

9.4.2. Southern Cumberlands-Holston EDU

The Southern Cumberlands-Holston River EDU (Figure 9.25) is part of the Tennessee-Cumberland freshwater ecoregion, which is considered "globally outstanding" in terms of biological distinctiveness (Abell et al. 2000). Abell et al. (2000) also considered this freshwater ecoregion "Endangered." The Tennessee drainage contains the most diverse fish assemblage in North America (Jenkins and Burkhead 1994). There is a high level of endemism in this freshwater ecoregion, with 29% of the fish, 16% of the mussels, and 62% of the crayfish endemic (Abell et al. 2000).

The Holston River has three primary branches in Virginia: the South, Middle, and North Forks. The Holston River itself does not flow in Virginia. The South Fork and Middle Fork join and then merge with the North Fork just a few kilometers south of the border with Tennessee. Most of the Holston in Virginia drains the Northern Ridge and Valley ecoregion, with a few tributaries draining the Blue Ridge and Southern Cumberlands ecoregions.

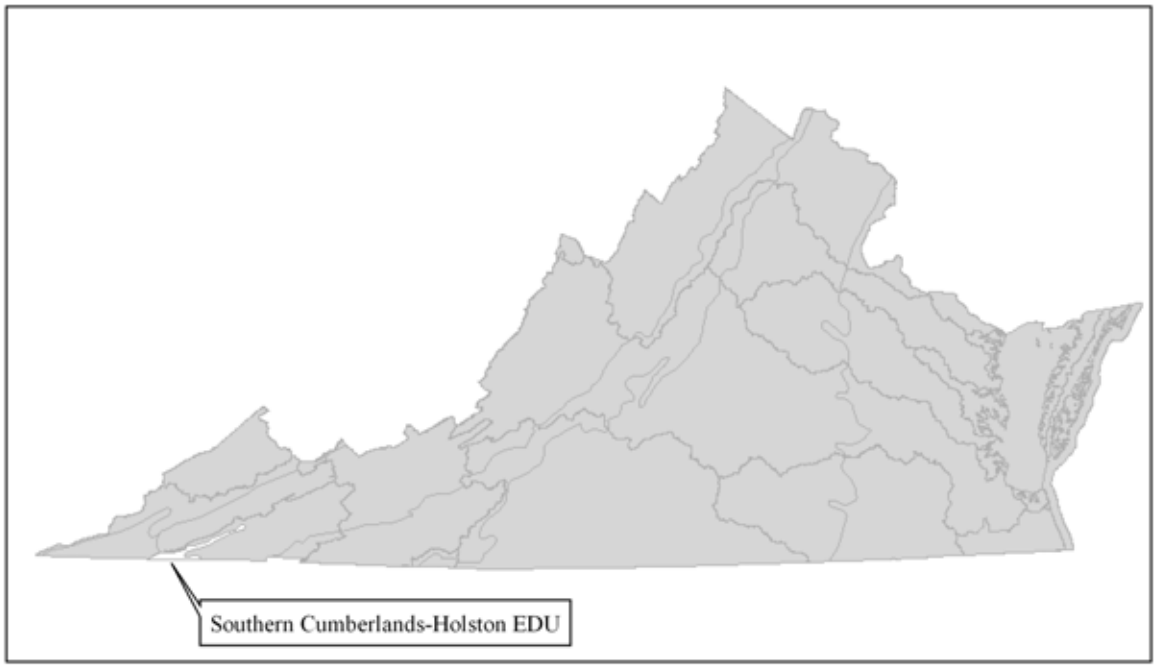

Figure 9.25. Location of the Southern Cumberlands-Holston EDU.

9.4.2.1. Tier I Species in the Southern Cumberlands-Holston EDU

9.4.2.1.1. Spotfin chub, *Erimonax monachus*

Life History Summary

In 1984, Jenkins and Burkhead published an extensive description of the life history and distribution of the spotfin chub (summarized in Jenkins and Burkhead 1994). The spotfin chub is a benthic insectivore at all life stages. The majority of its diet is composed of midge, blackfly, and mayfly larvae. Most individuals reach sexual maturity at two years. Males are generally larger than females. The breeding season may extend from mid-May to mid-August. It is a crevice spawner. This species is legally protected, with the status of State and Federal threatened.

Location

The spotfin chub has disjunct and localized populations in Virginia. The habitat map for the spotfin chub (Figure 9.26) includes confirmed reaches from Collections (DGIF 2004b), potential reaches and critical habitat (USFWS 2004). Potential reaches were selected in DGIF's aquatic habitat classification using reach size and connectivity. See Appendix D for more details.

Description of Essential Habitat

The spotfin chub is found in medium streams to medium rivers with cool to warm, clear water and moderate gradient (Burkhead and Jenkins 1991; Jenkins and Burkhead 1994). It tends to prefer larger-sized substrates with little silt. In the Holston watershed, this species was found in four habitat types (Table 9.40). Most occurrences were in small rivers and large streams.

Relative Condition of Habitat

The recovery plan for the spotfin chub discusses past and recent issues regarding habitat quality (USFWS 1983f). The known habitat for the spotfin chub in the North Fork Holston has a VDH fish advisory for

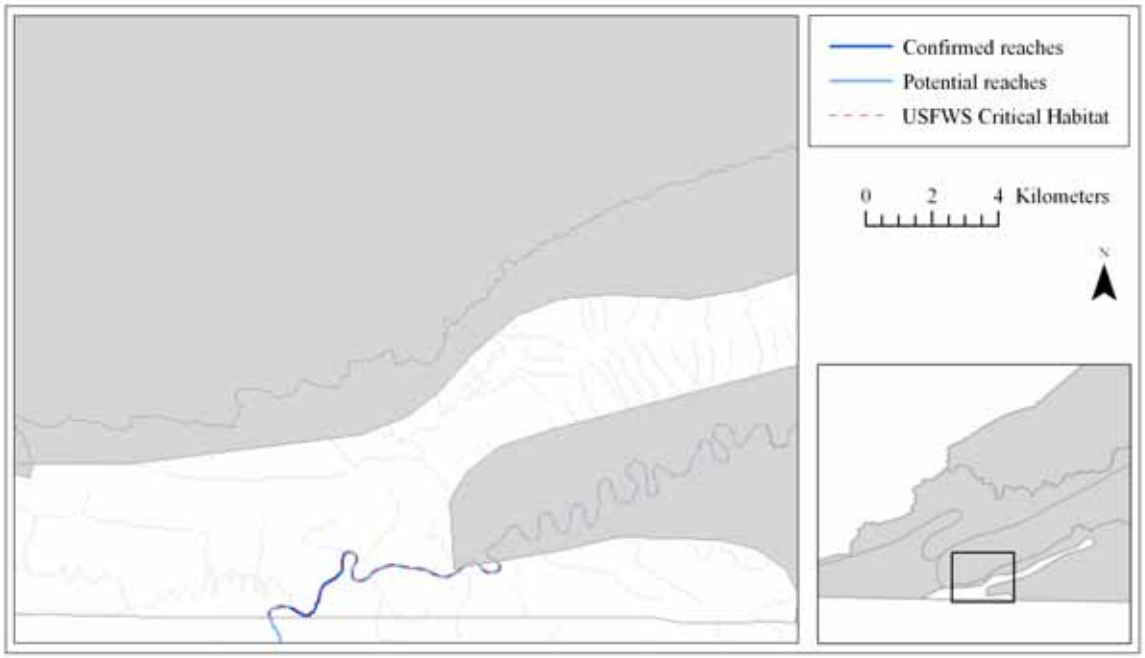

Figure 9.26. Location of confirmed, potential, and USFWS critical habitat for the spotfin chub in the Southern Cumberlands-Holston EDU (DGIF 2004b).

Table 9.40. DGIF aquatic habitat types used by the spotfin chub in the Holston River watershed.

Aquatic Habitat Type	Number of Reaches
Very low gradient small river connected to another small river	10
Very low gradient large stream connected to another large stream	5
Low gradient small river connected to another small river	1
Low gradient small stream connected to another small stream	1

mercury contamination (DEQ and DCR 2004). The source of the contamination is the Olin Matheson Plant site. This section is also impaired by fecal coliform and general standard (benthics) from unknown or urban sources.

Specific Threats and Trends

Siltation, pollution, and impoundment have reduced populations of the spotfin chub and continue to threaten its existence (USFWS 1983f; Burkhead and Jenkins 1991). Fish TAC (2004) did not identify any specific threats to the spotfin chub, but identified several threats to the Holston drainage (Appendix H).

Conservation Actions and Strategies

No high priority conservation actions were listed in the recovery plan for the spotfin chub (USFWS 1983f). However, Burkhead and Jenkins (1991) indicated that, because the populations in Virginia are disjunct and generally low in abundance, each population is important to the long-term survival of the species. Fish TAC (2004) identified a suite of conservation actions for the Holston River drainage (Appendix I), but nothing specific to the spotfin chub.

Research and Monitoring Needs

Burkhead and Jenkins (1991) recommended monitoring of the population in the North Fork of Holston River to assess the species' recolonization of this reach as it recovers from severe pollution. Fish TAC

(2004) identified several research or monitoring needs for the Holston River drainage (Appendix J) but none specific to the spotfin chub.

9.4.2.1.2. Yellowfin madtom, *Noturus flavipinnis*

Life History Summary

Two life history studies have been completed on the yellowfin madtom (Jenkins 1975b; Shute 1984). This madtom eats mostly aquatic insect larvae during both day and night. Its life expectancy is about five years. Spawning occurs from about mid-May to Mid-July. This species is legally protected, with the status of State and Federal threatened.

Location

This species is endemic to the Ridge and Valley region of the Tennessee drainage (as used in Jenkins and Burkhead 1994, which includes the Southern Cumberlands). The only known location for yellowfin madtom in the Holston drainage is from 1888, when it was collected above Saltville (USFWS 1983g). It is likely extirpated from this drainage.

There are no confirmed or potential reaches identified in the Southern Cumberland-Holston EDU. However, as it has occurred in the Holston above and below this point, the yellowfin madtom was included in the species list for this EDU.

Description of Essential Habitat

The yellowfin madtom is found in small streams to medium or large rivers (Jenkins and Burkhead 1994). They are found in warm water and the warm-cool water transition. This madtom prefers quiet water usually pools and backwaters beside runs and riffles. Preferred cover is large, flat rocks, under which nests are spawned and defended (Dinkins and Shute 1996).

Relative Condition of Habitat

This species may be extirpated from the Holston drainage. Therefore, we have no current data on the relative condition of habitat.

Specific Threats and Trends

This species seems to be most affected by habitat degradation from siltation, agricultural runoff, and impoundment (Burkhead and Jenkins 1991). Fish TAC (2004) did not identify any specific threats to the yellowfin madtom. However, they identified several threats to the Holston River drainage (Appendix H).

Conservation Actions and Strategies

The USFWS (1983g) recovery plan for the yellowfin madtom listed several actions necessary for the recovery of the species. These included research and monitoring needs, which are listed in the next section. The highest priority action listed in this plan was to utilize existing legislation and regulations to protect species and habitat. One conservation action from the recovery plan was to preserve populations and currently occupied habitat. Once feasibility was determined, this species should be introduced into its historic range. Lastly, sites should be located and techniques developed and implemented for habitat improvement.

Fish TAC (2004) identified a suite of conservation actions for the Holston River drainage (Appendix I), but nothing specific to the yellowfin madtom.

Research and Monitoring Needs

The yellowfin madtom recovery plan lists several research or monitoring projects necessary for the recovery of the species (USFWS 1983g). One of the projects is to determine the feasibility of reestablishing the species in its native range. The next is to conduct life history studies as needed. The recovery plan also discusses the need to identify areas for habitat improvement. Monitoring tasks included monitoring population levels and habitat conditions as well as the success of the recovery plan.

Fish TAC (2004) identified several research or monitoring needs for the Holston River drainage (Appendix J), but nothing specific to the yellowfin madtom.

9.4.2.1.3. Tennessee dace, *Phoxinus tennesseensis*

Life History Summary

The Tennessee dace has been shown to eat mostly living and decaying plant material (Starnes and Jenkins 1988). Maturity is not reached until after the first year, and its life span is likely three years (Burkhead and Jenkins 1991). The largest known specimen in Virginia was 58mm. This species breeds in May (Jenkins and Burkhead 1994). This species is legally protected, with the status of State endangered. It has also been designated a species of concern by the Virginia Field Office of USFWS.

Location

The habitat map for the Tennessee dace (Figure 9.27) includes confirmed reaches from Collections (DGIF 2004b) and potential reaches. Potential reaches were selected in DGIF's aquatic habitat classification using link magnitude values. See Appendix D for more details.

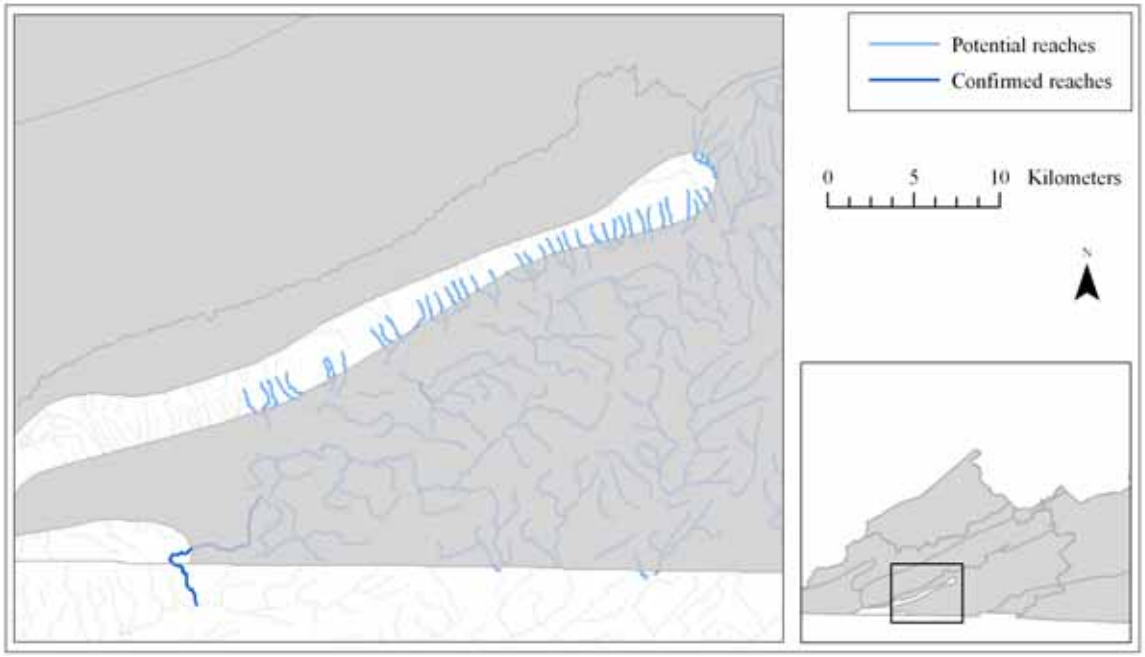

Figure 9.27. Location of confirmed and potential Tennessee dace habitat in the Southern Cumberlands-Holston EDU (DGIF 2004b).

Description of Essential Habitat

The Tennessee dace occurs in clear, small, cool to cold creeks with rock, gravel, or silt substrates (Jenkins and Burkhead 1994). It typically prefers wooded reaches, though a large population was found in a reach surrounded by pasture. Studies of habitat use in Lick Creek and Lynn Camp Creek only found the Tennessee dace in pools (Underwood and Dolloff 1999). The Tennessee dace has only been documented in one reach within this EDU; however, there are several potential reaches (Figure 9.27). Targeted sampling may reveal new locations for this species. In the entire Holston watershed, this species was found in six habitat types (Table 9.41).

Table 9.41. DGIF aquatic habitat types used by Tennessee dace in the Holston watershed.

Aquatic Habitat Type	Number of Reaches
Low gradient small stream connected to another small stream	7
Low gradient headwater connected to a small stream	3
Moderate gradient headwater connected to a small stream	3
Moderate gradient headwater connected to another headwater	2
High gradient headwater connected to a small stream	1

Relative Condition of Habitat

The draft recovery plan for the Tennessee dace indicated that there were several habitat-related threats, including channelization, stream modification, and siltation, which may have degraded or destroyed much of this species habitat (DGIF 2001). Most of the habitat in this EDU is potential and not confirmed. However, the one confirmed reach has not been identified as impaired by DEQ and DCR (2004).

Specific Threats and Trends

Populations of the Tennessee dace have been reduced due to habitat destruction and degradation (DGIF 2001). Current threats include channelization, impoundment, excessive siltation through removal of riparian vegetation or construction, flow impermanence, overcollection via bait seining, and introduction of the mountain redbelly dace *Phoxinus oreas* (Burkhead and Jenkins 1991; DGIF 2001).

Fish TAC (2004) did not identify any specific threats to the Tennessee dace. However, they identified several threats to the Holston River drainage (Appendix H).

Conservation Actions and Strategies

The DGIF recovery plan for the Tennessee dace recommends protection, maintenance, and enhancement of existing populations and habitats as its top priority conservation actions (DGIF 2001). It further lists eliminating or minimizing threats and soliciting widespread support for the recovery plan as important conservation actions. More detailed conservation actions include protecting current habitats from channelization and impoundment, prohibiting activities that jeopardize the stability of the riparian corridor, and prohibiting bait seining and bait fishing in streams containing Tennessee dace (Burkhead and Jenkins 1991; DGIF 2001).

Fish TAC (2004) identified a suite of conservation actions for the Holston River drainages (Appendix I), but nothing specific to this species.

Research and Monitoring Needs

Several research and monitoring needs have been identified for the Tennessee dace. These include monitoring existing populations and habitats, identifying current and foreseeable threats, investigating the effect of trout stocking, and examining the feasibility of reintroducing the Tennessee dace into watersheds within its historic range (Burkhead and Jenkins 1991; DGIF 2001). Fish TAC (2004) identified several

research or monitoring needs for the Holston River drainage (Appendix J), but nothing specific to the Tennessee dace.

9.4.2.1.4. Shiny pigtoe, *Fusconaia cor*

Life History Summary

The shiny pigtoe is very rare in Virginia and rare throughout its range (Neves 1991i). Its decline is believed to be due to habitat degradation. Adult size ranges from 60-80mm and the shell is typically subtriangular in shape (Neves 1991i; Parmalee and Bogan 1998). This mussel is tachytictic (Kitchel 1985). Kitchel (1985) listed the following fish as hosts: telescope shiner *Notropis telescopus*, warpaint shiner *Luxilus coccogenis*, and common shiner *L. cornutus*. This species is legally protected, with the status of State and Federal endangered.

Location

The map of habitat for the shiny pigtoe (Figure 9.28) includes only potential reaches since the nearest confirmed reach (DGIF 2004b) is just upstream and falls within the Ridge and Valley-Clinch EDU. Potential habitat was determined in DGIF's aquatic habitat classification based on link magnitude of confirmed and downstream reaches, and gradient. For more details, see Appendix D.

Description of Essential Habitat

The shiny pigtoe occurs in fords, shoals, and other shallow areas of riverine habitats with moderate to swift current (Bogan and Parmalee 1983). It can be found in stable substrates with anything from sand to cobbles. There are no confirmed occurrences of the shiny pigtoe in this EDU; however, there is a large section of potential habitat in the Southern Cumberlands-Holston (Figure 9.28). In the entire Holston watershed, this species was found in five habitat types (Table 9.42).

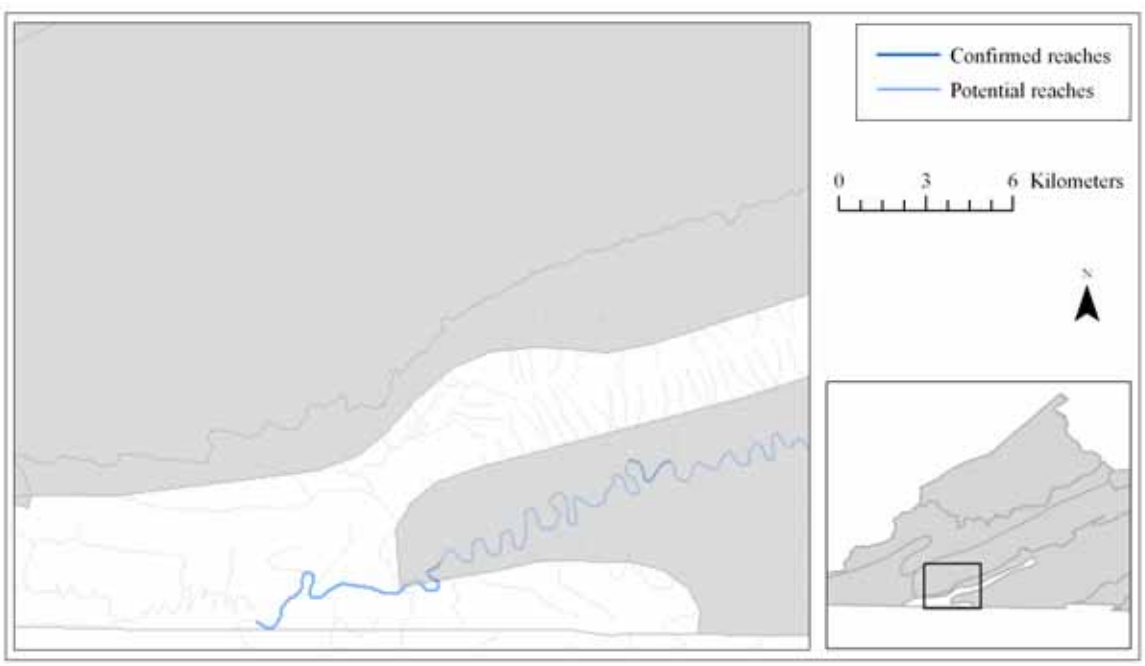

Figure 9.28. Location of potential shiny pigtoe habitat in the Southern Cumberlands-Holston EDU (DGIF 2004b).

Table 9.42. DGIF aquatic habitat types used by the shiny pigtoe in the Holston River watershed.

Aquatic Habitat Type	Number of Reaches
Very low gradient large stream connected to another large stream	7
Low gradient large stream connected to another large stream	1
Very low gradient small river connected to another small river	1
Low gradient small river connected to another small river	1
Low gradient small stream connected to another small stream	1

Relative Condition of Habitat

The recovery plan for the shiny pigtoe provides some information on past and recent habitat quality issues (USFWS 1983d). Only potential habitat for this species has been identified in the Southern Cumberlands-Holston EDU (that is, there are no confirmed occurrences). Therefore, we did not assess relative habitat condition.

Specific Threats and Trends

The recovery plan for the shiny pigtoe identifies impoundments, siltation, and general water pollution as contributing factors in the decline of this species (USFWS 1983d). Current threats include water quality and sedimentation effects of mining activities, general water quality degradation (especially fecal coliform levels), and catastrophic toxic spills (Neves 1991i). Mussel TAC (2004) did not identify any specific threats to the shiny pigtoe. However, they identified several threats to the Holston River drainage (Appendix H).

Conservation Actions and Strategies

Neves (1991i) recommended the strict enforcement of existing water quality regulations to improve water and habitat quality. The recovery plan for the shiny pigtoe recommended two high priority conservation actions (USFWS 1983d). These are to protect existing populations and habitats and mitigate or eliminate current threats. Mussel TAC (2004) identified a suite of conservation actions for the Holston River drainage (Appendix I), but nothing specific to this species.

Research and Monitoring Needs

The recovery plan (USFWS 1983d) recommends that life history studies be completed. Mussel TAC (2004) identified several research or monitoring needs for the Holston River drainage (Appendix J), but nothing specific to the shiny pigtoe.

9.4.2.1.5. Fine-rayed pigtoe, *Fusconaia cuneolus*

Life History Summary

The fine-rayed pigtoe is very rare in Virginia and throughout its range (Neves 1991h). It is subtriangular in shape and may reach 80mm (Parmalee and Bogan 1998). Fine-rayed pigtoe is tachytictic. Laboratory research has indicated that the river chub *Nocomis micropogon*, white shiner *Luxilus albeolus*, telescope shiner *Notropis telescopus*, Tennessee shiner *N. leuciodus*, central stoneroller *Campostoma anomalum*, fathead minnow *Pimephales promelas*, and mottled sculpin *Cottus bairdi* could serve as hosts for glochidia of this species (Bruenderman 1989). This species is believed to live up to 35 years. This species is legally protected, with the status of State and Federal endangered.

Location

The map of fine-rayed pigtoe habitat (Figure 9.29) includes confirmed reaches based on Collections (DGIF 2004b). There were not enough confirmed reaches from which to determine potential habitat within the Holston drainage.

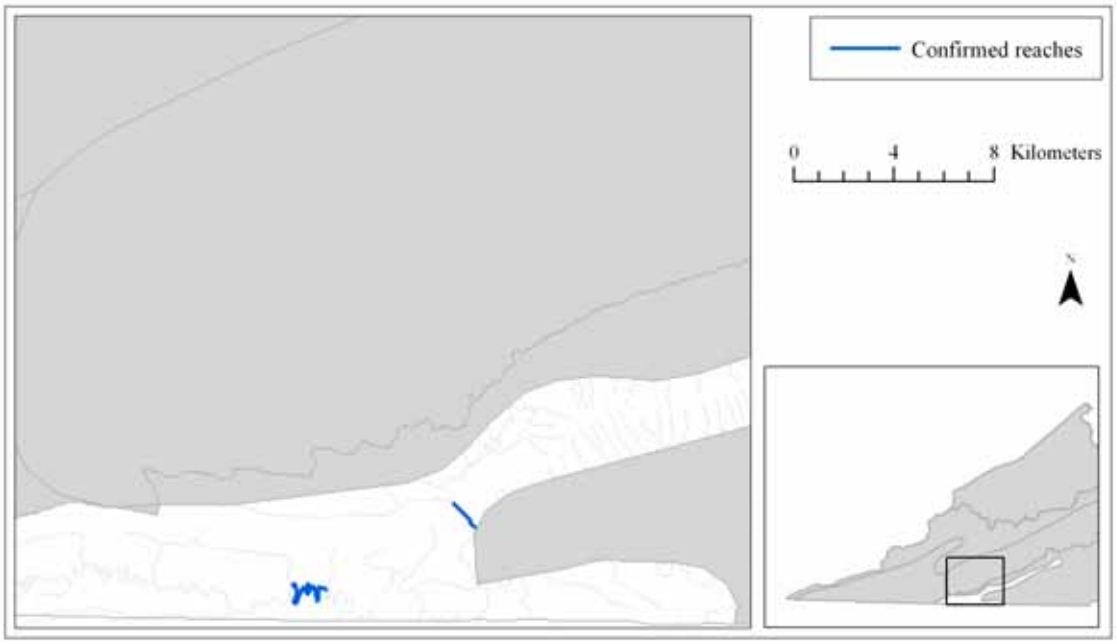

Figure 9.29. Location of confirmed fine-rayed pigtoe habitat in the Southern Cumberlands-Holston EDU (DGIF 2004b).

Description of Essential Habitat

Neves (1991h) indicated that the fine-rayed pigtoe is a lotic, riffle-dwelling species that is typically found in shallow fords and shoals with moderate gradient. The DGIF aquatic habitat classification was used to examine patterns in habitat use and distribution. In the Southern Cumberlands-Holston EDU, this species was found in two habitat types, representing small rivers and large streams (Table 9.43).

Table 9.43. DGIF aquatic habitat types used by fine-rayed pigtoe in the Holston River watershed.

Aquatic Habitat Type	Number of Reaches
Low gradient large stream connected to another large stream	1
Very low gradient small stream connected to another small stream	1

Relative Condition of Habitat

The recovery plan for the fine-rayed pigtoe describes some issues related to past and current conditions of its habitat (USFWS 1984b). Big Moccasin Creek is impaired by fecal coliform (DEQ and DCR 2004). The sources of the impairment are non-point agricultural and urban sources.

Specific Threats and Trends

Industrial development and agriculture has likely caused the declines in the fine-rayed pigtoe (USFWS 1984b). This development was the source of impoundments, mining wastes, herbicides, pesticides, siltation, and channelization. Existing populations are threatened by oil and gas drilling, impacts of coal mining, fecal coliform pollution, and siltation (Neves 1991h).

Mussel TAC (2004) did not identify any specific threats to the fine-rayed pigtoe. However, they identified several threats to the Holston River drainage (Appendix H).

Conservation Actions and Strategies

Neves (1991h) suggests that recolonizing the section of the Clinch River between Carbo and St. Paul would help to ensure the viability of the population in Virginia. In general, improvements in water quality would help populations in both the Clinch and Powell Rivers. Specifically, the following actions would increase the viability of this species: upgrades to sewage treatment plants, expedition of reclamation of mined lands, elimination of coal waste dumping into the river, and strict enforcement of permitted discharges.

The recovery plan for the fine-rayed pigtoe lists three high priority recovery actions: mitigating or eliminating current and future foreseeable threats, enforcing existing state and federal laws and regulations, and protecting known habitats and populations (USFWS 1984b). Details are available in USFWS (1984b).

Mussel TAC (2004) identified a suite of conservation actions for the Clinch and Powell drainages (Appendix I), but nothing specific to the fine-rayed pigtoe.

Research and Monitoring Needs

The recovery plan for the fine-rayed pigtoe recommends that threats (current and future) be identified (USFWS 1984b). Mussel TAC (2004) identified several research or monitoring needs for the Clinch and Powell drainages (Appendix J), but nothing specific to the fine-rayed pigtoe.

9.4.2.1.6. Rough rabbitsfoot, *Quadrula cylindrica strigillata*

Life History Summary

Rough rabbitsfoot is widespread but uncommon throughout its range (Kitchel 1991). Its occurrence in Virginia is localized. The shell of this species is elongate and rhomboid or rectangular, and individuals may reach 120mm (Parmalee and Bogan 1998). This species is tachytictic (Parmalee and Bogan 1998). Yeager and Neves (1986) identified the following fish hosts for this species: whitetail shiner *Notropis galacturus*, spotfin shiner *Notropis spilopterus*, and bigeye chub *Hybopsis amblops*. This species is legally protected, with the status of State and Federal endangered.

Location

The habitat map for the rough rabbitsfoot (Figure 9.30) includes confirmed reaches based on Collections (DGIF 2004b) and Stream Conservation Units (DCR-NH 2005). There were not enough confirmed reaches in this drainage from which to determine potential habitat.

Description of Essential Habitat

The rough rabbitsfoot is typically found in small to medium-sized rivers in clear, shallow water (Parmalee and Bogan 1998). It seems to prefer shoals and riffles with sand and gravel substrate near banks. In the Holston watershed, this species was found in two habitat types (Table 9.44).

Table 9.44. DGIF aquatic habitat types used by the rough rabbitsfoot in the Holston watershed.

Aquatic Habitat Type	**Number of Reaches**
Low gradient large stream connected to another large stream	1
Very low gradient small stream connected to another small stream	1

Relative Condition of Habitat

Big Moccasin Creek is impaired by fecal coliform (DEQ and DCR 2004). The sources of the impairment are non-point agricultural and urban sources. This section is also impaired by fecal coliform and general standard (benthics) from unknown or urban sources. A large portion of the Stream Conservation Unit

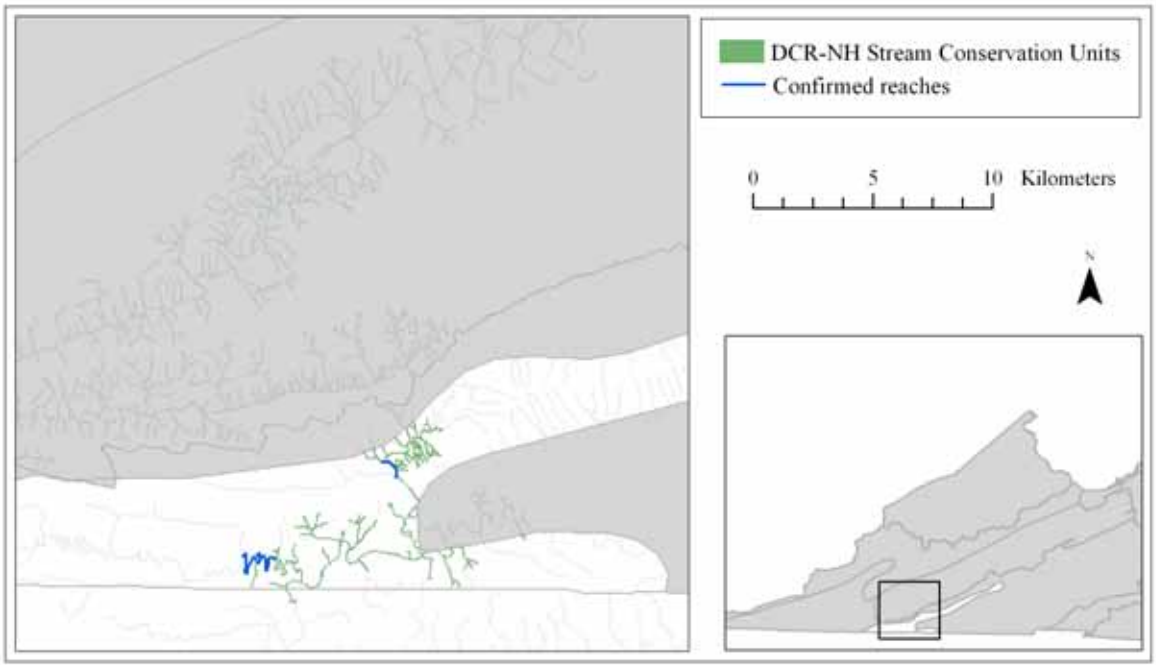

Figure 9.30. Location of confirmed rough rabbitsfoot habitat and DCR-NH Stream Conservation Units containing the rough rabbitsfoot in the Southern Cumberlands-Holston EDU (DGIF 2004b; DCR-NH 2005).

(DCR-DNH 2005) for rough rabbitsfoot in this EDU is listed as impaired due to a VDH fish advisory for mercury contamination (DEQ and DCR 2004). The contamination source is the Olin Matheson Plant site.

Specific Threats and Trends

The decline of the rough rabbitsfoot is partially attributable to pollution from mining and other industry, municipalities, and toxic spills (Cairns et al. 1971). Other factors that have universally affected freshwater mussels are impoundment, siltation, and channelization (Kitchel 1991). Current threats to this subspecies include degraded water and substrate quality and contaminants (USFWS 2003). The restricted range of this and other mussels makes them especially vulnerable to toxic spills and negative effects of genetic isolation.

Mussel TAC (2004) did not identify any specific threats to the rough rabbitsfoot. However, they identified several threats to the Holston River drainage (Appendix H).

Conservation Actions and Strategies

Kitchel (1991) recommended improvements in land use practices, reduction or elimination of municipal, agricultural, and industrial contaminants, restricted instream construction activities, and the creation of mussel sanctuaries in appropriate sections of the Clinch, Powell, and Holston rivers to insure adequate protection for this species in Virginia. The recovery plan lists five priority conservation actions: utilizing existing legislation and regulations to protect this subspecies and its habitat; developing and presenting education programs; reducing or eliminating existing threats; augmenting or reintroducing where appropriate; and developing and implementing a cryogenic preservation program (USFWS 2003).

Mussel TAC (2004) identified a suite of conservation actions for the Holston River drainage (Appendix I), but nothing specific to this subspecies.

Research and Monitoring Needs

The recovery plan that includes this subspecies lists four research and monitoring needs (USFWS 2003). These include determining the species' life history requirements and threats, surveying for additional populations, conducting genetic analyses of the species, and developing and implementing a monitoring program.

Mussel TAC (2004) identified several research or monitoring needs for the Holston River drainage (Appendix J), but nothing specific to the rough rabbitsfoot.

9.4.2.2. Aquatic SGCN by Habitat Group: Southern Cumberlands-Holston EDU

There are 38 tiered species in this EDU: 18 fish, 11 mussels, four snails, one amphibian, and four crayfish. There are four habitat groups and one group of species with generalist or indeterminate habitat preferences (Tables 9.45-9.49).

Table 9.45. Aquatic species of greatest conservation need in very low gradient small rivers (DGIF Classification type 441).

Common Name	Scientific Name	Tier	Percent Occurrences in Habitat Group	Number of Types Used (DGIF Aquatic Classification)
Popeye shiner	*Notropis ariommus*	II	83	2 (6 occurrences)
Bluebreast darter	*Etheostoma camurum*	III	100	1 (2 occurrences)
Spiny riversnail	*Io fluvialis*	III	100	1 (2 occurrences)
Streamline chub	*Erimystax dissimilis*	IV	88	2 (8 occurrences)
Northern studfish	*Fundulus catenatus*	IV	71	3 (7 occurrences)
Mountain madtom	*Noturus eleutherus*	IV	100	1 (2 occurrences)
Tangerine darter	*Percina aurantiaca*	IV	100	1 (3 occurrences)
Gilt darter	*Percina evides*	IV	83	2 (6 occurrences)

Table 9.46. Aquatic species of greatest conservation need in low gradient large streams (DGIF Classification type 332).

Common Name	Scientific Name	Tier	Percent Occurrences in Habitat Group	Number of Types Used (DGIF Aquatic Classification)
Eastern hellbender	*Cryptobranchus alleganiensis*	II	100	1 (2 occurrences)
Stonecat	*Noturus flavus*	IV	75	2 (4 occurrences)

Table 9.47. Aquatic species of greatest conservation need in very low small streams and low gradient large streams (DGIF Classification types 221 and 332).

Common Name	Scientific Name	Tier	Percent Occurrences in Habitat Group	Number of Types Used (DGIF Aquatic Classification)
Tennessee pigtoe	*Fusconaia barnesiana*	II	100	1 (3 occurrences; type 221 only)
Slabside pearlymussel	*Lexingtonia dolabelloides*	II	100	1 (2 occurrences, type 221 only)
Tennessee clubshell	*Pleurobema oviforme*	III	100	2 (3 occurrences)
Cumberland moccasinshell	*Medionidus conradicus*	IV	100	2 (5 occurrences)

Table 9.48. Aquatic species of greatest conservation need in very low and low gradient small streams to small rivers (DGIF Classification types 221, 241, 332, and 441).

Common Name	Scientific Name	Tier	Percent Occurrences in Habitat Group	Number of Types Used (DGIF Aquatic Classification)
Banded darter	*Etheostoma zonale*	IV	87	6
Stargazing minnow	*Phenacobius uranops*	IV	77	5

Table 9.49. Aquatic species of greatest conservation need: generalists and those with unknown habitat requirements based on DGIF habitat classification.

Common Name	Scientific Name	Tier	Number of Types Used (DGIF Aquatic classification)
Shiny pigtoe	*Fusconaia cor*	I	NA (potential habitat only)
Fine-rayed pigtoe	*Fusconaia cuneolus*	I	2 (2 occurrences)
Yellowfin madtom	*Noturus flavipinnis*	I	NA
Tennessee dace	*Phoxinus tennesseensis*	I	NA (potential habitat only)
Rough rabbitsfoot	*Quadrula cylindrica strigillata*	I	2 (2 occurrences)
Slippershell mussel	*Alasmidonta viridis*	II	1 (1 occurrence)
Coal Elimia	*Elimia aterina*	II	NA
Blotchside darter	*Percina burtoni*	II	1 (1 occurrence)
Longhead darter	*Percina macrocephala*	II	1 (1 occurrence)
Fluted kidneyshell	*Ptychobranchus subtentum*	II	NA
Wounded darter	*Etheostoma vulneratum*	III	NA
Clinch River crayfish	*Cambarus angularis*	IV	NA
A crayfish	*Cambarus longirostris*	IV	NA
Speckled darter	*Etheostoma stigmaeum*	IV	NA
Pocketbook mussel	*Lampsilis ovata*	IV	1 (1 occurrence)
Onyx rocksnail	*Leptoxis praerosa*	IV	NA
Sawfin shiner	*Notropis* sp. A	IV	NA
A crayfish	*Orconectes erichsonianus*	IV	NA
Sturgeon crayfish	*Orconectes forceps*	IV	NA
Bullhead minnow	*Pimephales vigilax*	IV	1 (1 occurrence)
Pagoda hornsnail	*Pleurocera uncialis*	IV	NA
Mountain creekshell	*Villosa vanuxemensis*	IV	3 (5 occurrences)

Relative Condition of Habitat

Within the Southern Cumberlands-Holston EDU, 5.2% of the riverine habitat is impaired (DEQ and DCR 2004). One of the impairments is a VDH advisory for mercury contamination from the Olin Matheson Plant. Other impairments include fecal coliform, general standard (benthics), and *Escherichia coli*. The sources for these impairments are non-point source pollution from urban and/or agricultural land use or unknown.

Within the Southern Cumberlands-Holston EDU, 10% of land use is agricultural and 2.1% of landcover is developed (USGS 1992). Across the state, agricultural land cover ranges from 2 to 41%, and developed land use ranges from 0.2 to 15%.

Threats, conservation actions, and research and monitoring needs for Tier II through Tier IV species are available in Appendices H, I, and J. Mussel TAC (2004) and Fish TAC (2004) provided this information within habitat groups selected at the workshops. The level of detail within these groups does not correspond to that used in the DGIF aquatic habitat classification.

9.5. Subterreanean Species in the Southern Cumberlands

9.5.1. Tier I Subterranean Species in the Southern Cumberlands

9.5.1.1. Holsinger's cave beetle, *Pseudanophthalmus holsingeri*

Life History Summary

This small carabid beetle is apparently endemic to its type locality, Young-Fugate Cave in Lee County, Virginia (Holsinger and Culver 1988). This cave is a long, narrow stream passage (Holsinger 1975). This species has no means of dispersal to new locations. It is likely a scavenger, feeding on organic materials washing into the cave. Threats may include pesticides (such as Dimilin, or diflubenzuron) used in gypsy moth control and other pollution (NatureServe 2005). This species is protected as State endangered, and is a candidate species for Federal listing.

Location

The map showing the location of this species (Figure 9.31) includes a cave Conservation Site (DCR-NH 2004). Not enough is known about the habitat requirements to map potential habitat, nor can the specific cave features necessary be identified.

Description of Habitat Requirements

Our limited knowledge of the habitat needs of this species includes what applies to most troglobites. They require stable environmental factors such as humidity, temperature, and import of organic material to serve as food (R. L. Hoffman, VMNH, pers. comm.).

Figure 9.31. Distribution of Holsinger's cave beetle in the Southern Cumberlands.

Relative Condition of Habitat

NatureServe (2005) reports that all of the property where this species occurs is privately owned. There is a single Conservation Site for the Holsinger's cave beetle in the Southern Cumberlands (DCR-NH 2005). This Conservation Site is unprotected by a Conservation Land (DCR 2003).

Specific Threats and Trends

Invertebrate TAC did not identify any specific threats to this species. NatureServe (2005) indicates that there is no indication of decline in this species, and C. S. Hobson (DCR-NH, pers. comm.) reported that similar numbers were seen in the 1990s as were seen in the 1960s. Alteration of surface features that would affect the water table, such as removal of the forest cover, would likely impact this beetle (R. L. Hoffman, VMNH, pers. comm.). NatureServe (2005) reports that road construction and pollution in various forms (pesticides, sewage, and leaking gasoline) are potential threats.

Conservation Actions and Strategies

Invertebrate TAC did not identify any conservation actions for this species. Restriction of pesticides for gypsy moth control in the vicinity of the cave is likely important, as is "appropriate protection" of the cave (NatureServe 2005).

Research and Monitoring Needs

Invertebrate TAC did not identify any research or monitoring needs for this species. Very little is known about this species. It occurs in a wet cave where studying the species would be difficult. However, life history studies and regular surveys should be conducted to determine the current status of this species.

9.5.1.2. Unthanks Cave snail, *Holsingeria unthanksensis*

Life History Summary

Very little is known about this species. It is an aquatic, cave-obligate snail that seems to be endemic to Lee County, Virginia. It is known to occur in five caves in Lee County (DCR-NH 2004), where it occurs beneath rocks in streams (Batie 1991). It is apparently one of the undescribed species of Unthanks Cave mentioned in Holsinger and Culver (1988). This species is listed as State endangered, and has been designated a species of concern by the Virginia Field Office of USFWS.

Location

The map showing the location of this species (Figure 9.32) includes a cave Conservation Site (DCR-NH 2004). Data are insufficient regarding the habitat requirements to map potential habitat of this species.

Description of Habitat Requirements

Nothing is known about the requirements of this species, other than that it inhabits stream bottoms in a few cave systems.

Relative Condition of Habitat

One of the caves reported to contain this species by DCR-NH (2004) is not mentioned in either Holsinger (1975) or Douglas (1964) (or is discussed in these sources using a different name). For the other four caves, neither of these authors provide any condition information. Douglas (1964) reports that Unthanks Cave is one of the largest in Lee County, and Holsinger (1975) reports that the hydrology of this cave is apparently complex and bears further investigation.

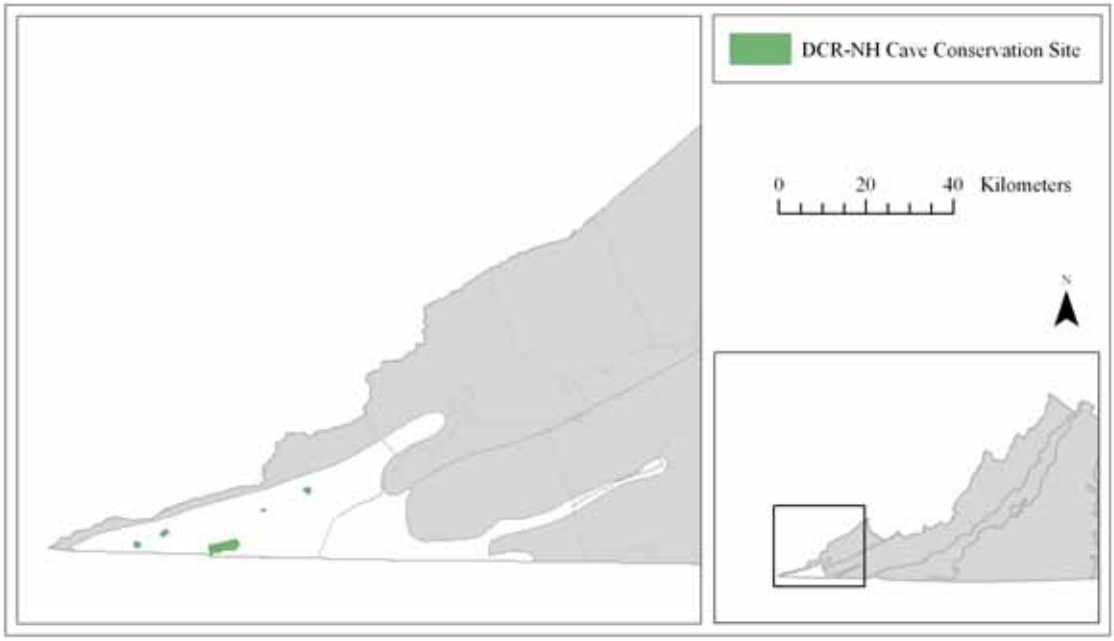

Figure 9.32. Distribution of Unthanks Cave snail in the Southern Cumberlands.

There are five Conservation Sites for the Unthanks cave snail in the Southern Cumberlands (DCR-NH 2005). Of these sites, only one contains an Element Occurrence with a current viability rating ("good") (DCR-NH 2005). This Conservation Site is also partially protected by a state Natural Area Preserve. None of the other sites is protected by a Conservation Land (DCR 2003).

Specific Threats and Trends

Invertebrate TAC did not indicate any specific threats to the Unthanks Cave snail. As an aquatic gastropod, this species is likely susceptible to water pollution from the surrounding areas. As with any cave species, human disturbance in the caves could be problematic. Batie (1991) indicated that decline in water quality and/or flow in cave streams would be detrimental to this species. Since Holsinger (1975) indicates that the stream in Unthanks Cave is likely part of the Powell River drainage, threats identified to the mussels of that drainage may apply to this species as well (Mussel TAC 2004; see Appendix zz for these threats).

Conservation Actions and Strategies

Invertebrate TAC did not provide any specific conservation actions for the Unthanks Cave snail.

Research and Monitoring Needs

Further surveys to determine the actual distribution of this species are important. In addition, nothing is known of its life history. Water quality in the caves in which it occurs, along with the caves themselves, should be monitored to ensure habitat quality for this species (Batie 1991). In addition, the taxonomy of this species is in question (Batie 1991).

9.5.1.3. Lee County cave isopod, *Lirceus usdagalun*

Life History Summary

This species occurs on flowstone, rocks, or in gravel or sand in cave streams, where it appears to prefer fast currents; indeed, it seems to be more dependent on high flows than on substrate (Estes 1978). Temperature of these streams is approximately 12.5°C year-round (Estes 1978). Gravid females occur in all seasons, but

seem to be most common from late winter to early summer (Estes 1978). This species is endemic to four caves within Lee County, Virginia, three of which make up one system (the Surgener-Gallohan cave system). The population of the fourth cave, which appears to have been the largest known population, was apparently extirpated by a single organic pollution event in 1987 (dumping of sawdust into a sinkhole, Holsinger 1991). This population appears to be recovering (Hobson and Orndorff 2005). In addition, new populations have been found in the last 10 years (Hobson and Orndorff 2005). This species is protected as both Federal and State endangered.

Location

The map showing the location of this species (Figure 9.33) includes a cave Conservation Site (DCR-NH 2004). Nothing is known about the specific habitat requirements of this species, so specific cave features necessary to map potential habitat cannot be identified.

Description of Habitat Requirements

Essential habitat is apparently relatively deep groundwater aquifers, where this species inhabits the gravel substrate of cave streams (J. R. Holsinger, ODU, pers. comm.).

Relative Condition of Habitat

One of the historic populations was extirpated when cedar sawdust was dumped into a sinkhole feeding the stream in Thompson Cedar Cave (Holsinger 1991). Unfortunately, this appears to have been the healthiest known population of this species (Estes 1978). This population is apparently now recovering (Hobson and Orndorff 2005). Neither Douglas (1964) nor Holsinger (1975) provide specific information relating to the condition of any of the caves in which this species occurs.

There are four Conservation Sites for the Lee County cave isopod in the Southern Cumberlands (DCR-NH 2005). Three of these sites are partially protected by a state Natural Area Preserve (DCR 2003).

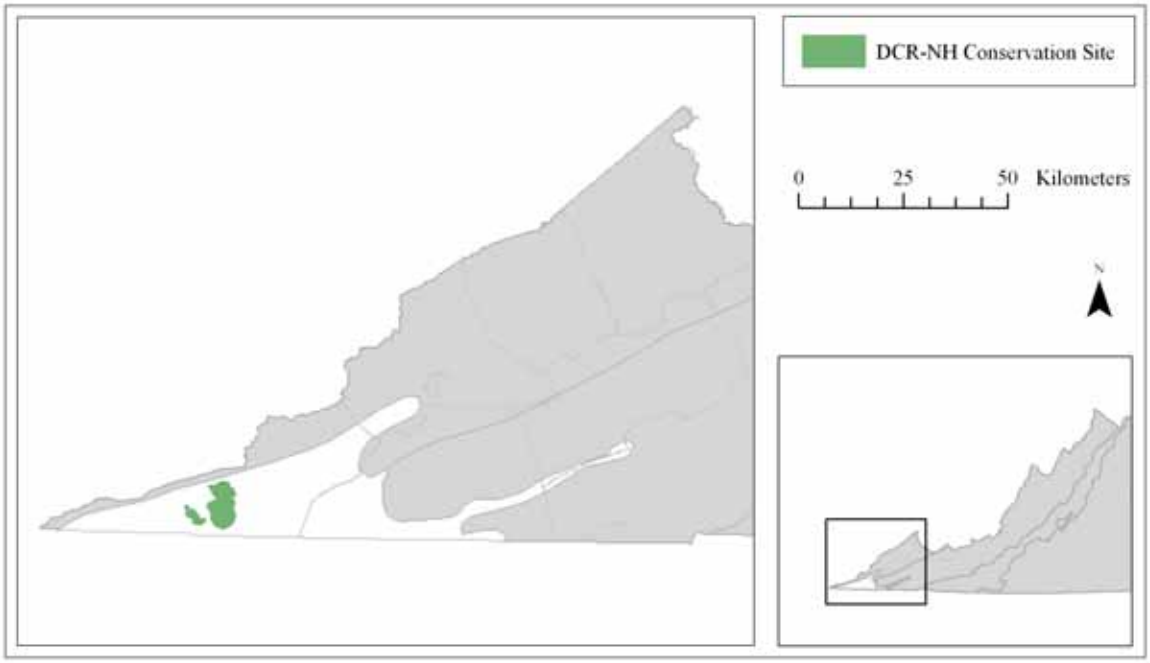

Figure 9.33. Distribution of the Lee County cave isopod in the Southern Cumberlands.

Specific Threats and Trends

Invertebrate TAC did not provide any specific threats to this species. Holsinger (1991) reports "ongoing degradation of habitat" but provides no specifics, apart from the 1987 sawdust incident. NatureServe (2005) reports that the Surgener-Gallohan system is threatened by "development interests." Estes (1978) reports that silt and detritus seemed to have an adverse effect on this species.

Conservation Actions and Strategies

Invertebrate TAC did not provide any specific conservation actions for this species. Holsinger (1979a) recommends that existing populations be provided permanent protection, ostensibly through purchase of the caves or conservation agreements with the current owners.

Research and Monitoring Needs

Invertebrate TAC did not provide any specific research or monitoring needs for this species. NatureServe (2005) recommends finding an entry to Sim's Spring, the possible connection between the Surgener-Callohan system and Thompson Cedar cave.

9.5.1.4. Powell Valley planarian, *Sphalloplana consimilis*

Life History Summary

Very little is known about this species. It is apparently endemic to a portion of the Powell Valley, in five Virginia caves and one in adjoining Tennessee (Holsinger 1979b). Gallohan Cave #1 is the type locality for the Powell Valley planarian as well as that of another Tier I species, the Lee County cave isopod (see Section 9.5.1.3). It inhabits the gravel and mud at the bottom of small cave streams and drip pools (Holsinger 1979b). It has been designated a species of concern by the Virginia Field Office of USFWS.

Location

The map showing the location of this species (Figure 9.34) includes a cave Conservation Site (DCR-NH 2004). Little is known about this species' specific habitat requirements, so cave features necessary to map potential habitat are not identifiable.

Description of Habitat Requirements

This species is known to inhabit drip pools or stream-fed pools in caves, or flat rocks in small cave streams. However, it is not clear if the species is limited to this type of habitat (S. M. Roble, DCR-NH, pers. comm.).

Relative Condition of Habitat

Holsinger (1975) reports that Gallohan #1 is used for scientific research, and that the owner restricts entry for this purpose; whether this is still true is unknown. Apart from this, neither Holsinger (1975) nor Douglas (1964) report specific conditions of these caves.

There are four Conservation Sites for the Powell Valley planarian in the Southern Cumberlands (DCR-NH 2005). A small portion of one of these sites is protected by a state Natural Area Preserve (DCR 2003).

Specific Threats and Trends

Invertebrate TAC did not report any specific threats or trends for this species. Holsinger (1979b) reports that this species, like most aquatic cave fauna, could be susceptible to groundwater pollution. Mussel TAC (2004) and Fish TAC (2004) also identified threats to the Powell River drainage, in which this species occurs (Appendix G). Some of these likely affect the Powell Valley planarian as well.

Figure 9.34. Distribution of the Powell Valley planarian in the Southern Cumberlands.

Conservation Actions and Strategies

Invertebrate TAC did not report any specific conservation actions for this species. Holsinger (1979b) proposes that caves with good populations of this species be permanently protected from both destruction and water pollution. Mussel TAC (2004) and Fish TAC (2004) also identified conservation actions for the Powell River drainage, in which this species occurs (Appendix zz). Some of these likely affect the Powell Valley planarian as well.

Research and Monitoring Needs

Invertebrate TAC did not report any specific research or monitoring needs for this species. Holsinger (1979b) suggests further research on the life history and ecology of this species, which is very poorly known. However, there is a paucity of researchers studying planarians, so these studies would likely require training new biologists.

9.5.2. Subterranean Species of Greatest Conservation Need in the Southern Cumberlands

9.5.2.1. Species of Greatest Conservation Need by Subterranean Habitat Type

All 28 subterranean species occurring in the Southern Cumberlands occur in caves (Table 9.50). None occur only in groundwater.

Table 9.50. Cave species of greatest conservation need in the Southern Cumberlands.

Common Name	Scientific Name	Tier	Special Habitat Needs
Unthanks Cave snail	*Holsingeria unthanksensis*	I	Stream bottoms in caves
Lee County cave isopod	*Lirceus usdagalun*	I	Gravel in cave streams
Holsinger's cave beetle	*Pseudanophthalmus holsingeri*	I	Organic deposits in cave riparian areas

Common Name	Scientific Name	Tier	Special Habitat Needs
Powell Valley planarian	*Sphalloplana consimilis*	I	Small cave streams and drip pools
Powell Valley terrestrial cave isopod	*Amerigoniscus henroti*	II	Rotting wood in wet parts of caves
Cumberland Gap cave isopod	*Caecidotea cumberlandensis*	II	Unknown
Gertsch's cave pseudoscorpion	*Kleptochthonius gertschi*	II	Unknown
Lutz's cave pseudoscorpion	*Kleptochthonius lutzi*	II	Unknown
A cave pseudoscorpion	*Kleptochthonius proximosetus*	II	Unknown
A cave pseudoscorpion	*Kleptochthonius similis*	II	Unknown
Valentine's cave pseudoscorpion	*Microcreagris valentinei*	II	Unknown
Gray myotis	*Myotis grisescens*	II	Warm caves in summer
A cave springtail	*Oncopodura hubbardi*	II	Unknown
Deceptive cave beetle	*Pseudanophthalmus deceptivus*	II	Under rocks or debris near streams
Cumberland Gap cave beetle	*Pseudanophthalmus hirsutus*	II	Under rocks or debris near streams
Long-headed cave beetle	*Pseudanophthalmus longiceps*	II	Under rocks or debris near streams
Rotund cave beetle	*Pseudanophthalmus rotundatus*	II	Under rocks or debris near streams
A cave springtail	*Pseudosinella erewhon*	II	Unknown
A cave springtail	*Pseudosinella extra*	II	Unknown
A cave springtail	*Pseudosinella gisini*	II	Unknown
A cave springtail	*Pseudosinella hirsuta*	II	Unknown
Cumberland cave amphipod	*Stygobromus cumberlandus*	II	Drip pools
Lee County cave amphipod	*Stygobromus leensis*	II	Shallow drip and seep pools
A cave springtail	*Typhlogastrura valentini*	II	Unknown
Southwestern Virginia cave isopod	*Caecidotea recurvata*	III	Drip pools or small gravel streams
Tennessee Valley cave isopod	*Caecidotea richardsonae*	III	Pools or small gravel streams
Appalachian Valley cave amphipod	*Crangonyx antennatus*	III	Mud-bottomed pools or small gravel streams
Lee County terrestrial cave isopod	*Ligidium elrodii leensis*	III	Unknown
Scott County terrestrial cave isopod	*Ligidium elrodii scottensis*	III	Unknown

9.5.2.2. Status of Subterranean Habitats

The status of these habitats is very difficult to ascertain, and so is not available at an ecoregional scale. For statewide status and trends of subterranean habitats, see Section 3.2.5.

9.6 Overview of Tier I Species Habitat in the Southern Cumberlands

In order to highlight geographic areas that are likely important for one or more Tier I species, the potential and confirmed habitats for Tier I terrestrial (Section 9.3.1), aquatic (Sections 9.4.1-9.4.2) and subterranean (Section 9.5.1) species, were overlaid in one map (see Figure 9.35). Please note that potential habitat for many Tier I species could not be mapped and that areas containing habitat for only one or a few Tier 1 species are important for conservation. However, areas with a higher density of Tier I species' habitat may represent extraordinary conservation opportunities.

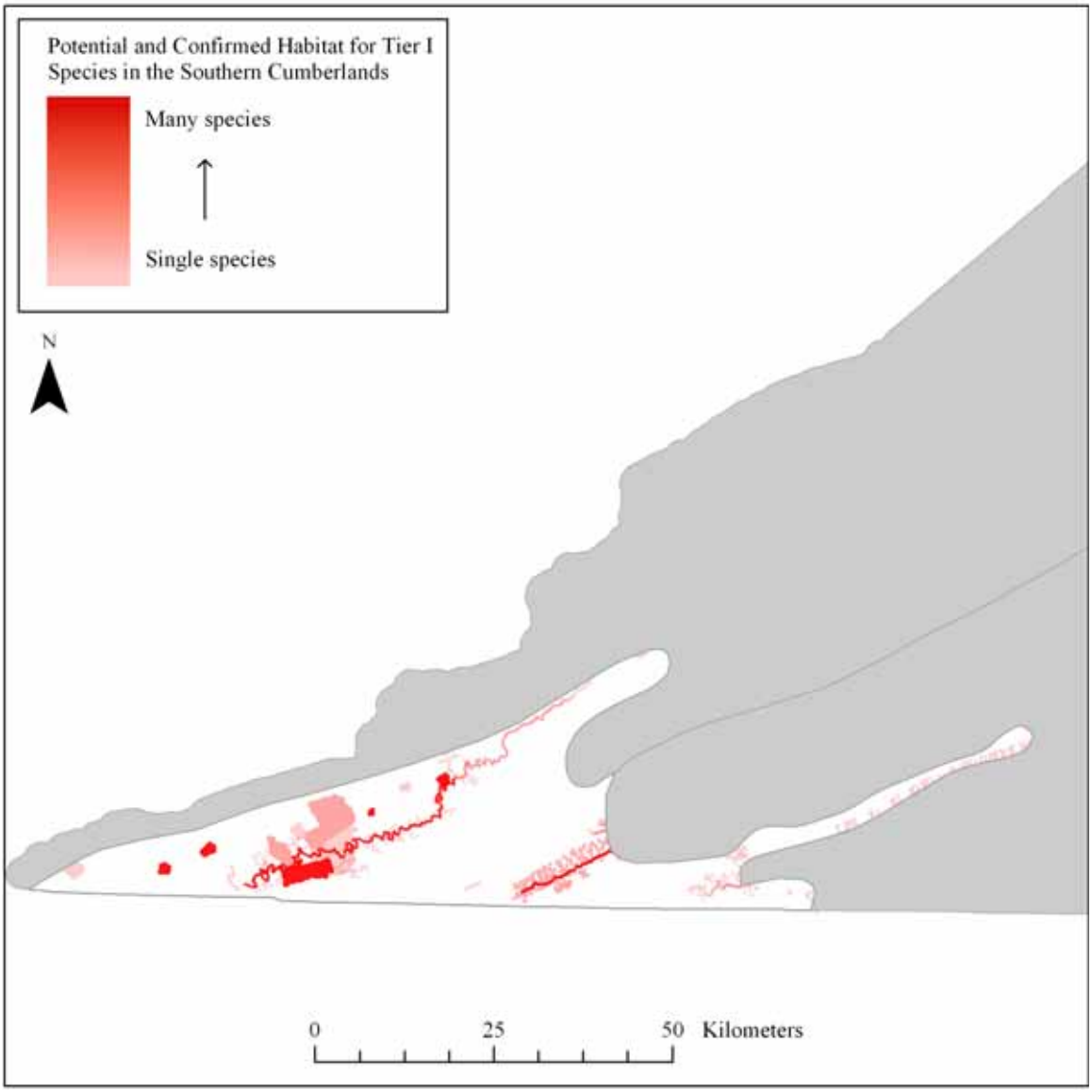

Figure 9.35. Potential and confirmed habitat for Tier I species in the Southern Cumberlands. Darker shades represent areas with a higher co-occurrence of these habitats.

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