

A Distributional Atlas of the Freshwater  
Mussels of Kentucky

Wendell R. Haag and Ronald R. Cicerello

Part Two (pages 152 - 299)





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Kentucky State Nature Preserves Commission  
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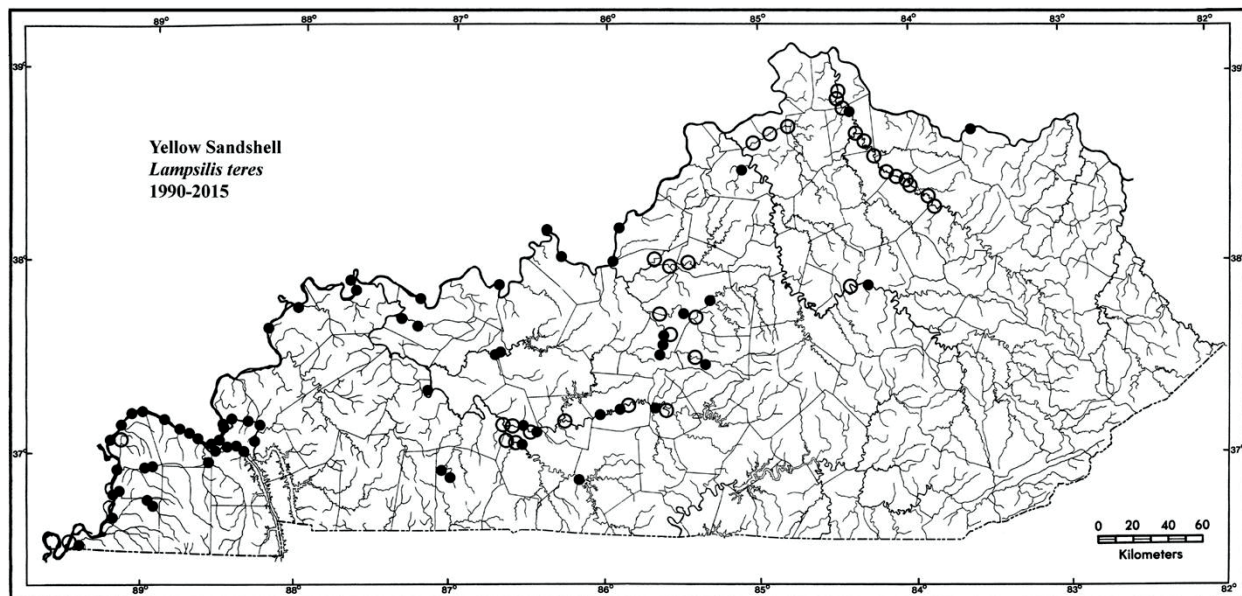
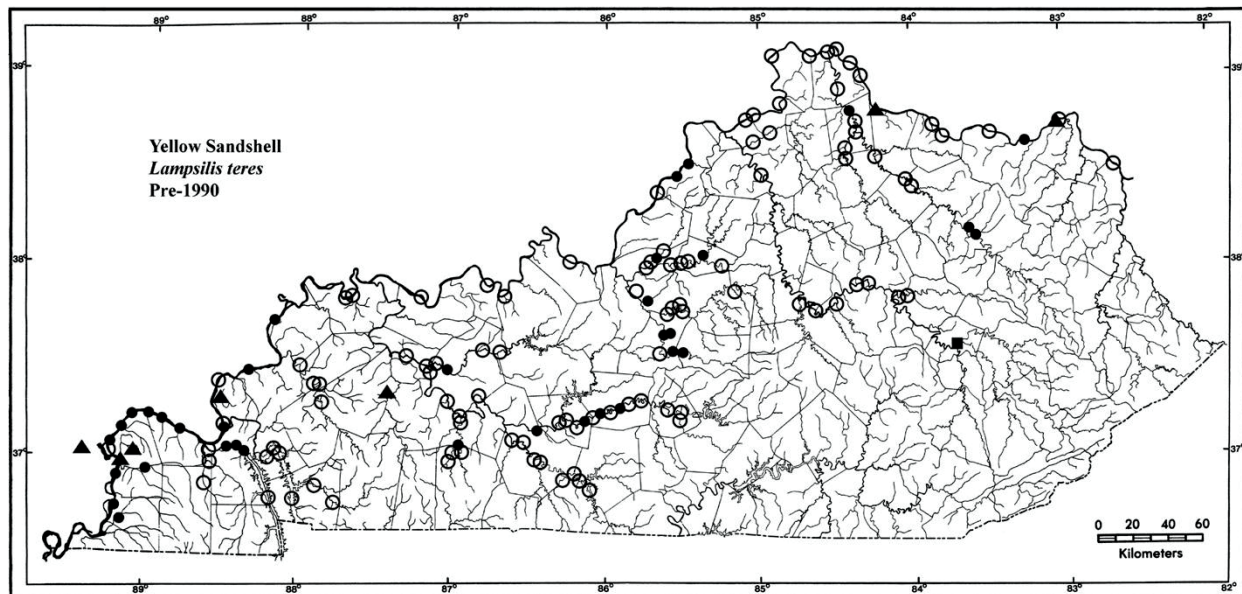
It is the mission of the Kentucky State Nature Preserves Commission to protect Kentucky's natural heritage by: (1) identifying, acquiring, and managing natural areas that represent the best known occurrences of rare native species, natural communities, and significant natural features in a statewide nature preserves system; (2) working with others to protect biological diversity; and (3) educating Kentuckians as to the value and purpose of nature preserves and biodiversity.

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*Lampsilis teres* (Rafinesque, 1820)

## Yellow Sandshell

**General Distribution**

Mississippi River basin from Louisiana north to Minnesota, and west to Kansas and South Dakota. Ohio River basin from the mouth upstream to at least the Muskingum River, Ohio, but absent in the upper half of the Tennessee and Cumberland River drainages. Widespread in Gulf Coast drainages from the Mobile River basin to the Rio Grande, Texas; populations in eastern Gulf drainages from the Escambia River to peninsular Florida are now referred to as a distinct species, *L. floridensis*. A few historical records exist for the Niagara River, New York (Strayer and Jirka 1997), but otherwise unknown from the Great Lakes basin.



**Kentucky Distribution**

Type locality: Mississippi, Alabama, and Ohio rivers. Generally distributed in the western half of the state including the Mississippi River and direct tributaries, the lower Ohio River, and major Ohio River tributaries upstream to the Salt River drainage, but absent from the middle and upper Cumberland River drainages. Generally distributed to occasional in the upper Ohio River and the lower Kentucky and Licking river drainages. Records for the South, Middle, and North forks of the Kentucky River (Williams 1975) are unsubstantiated but plausible; Danglade (1922) reported it as “rare to occasional” in the upper Kentucky River drainage (from unspecified locations but probably including the North Fork Kentucky River).

**Habitat & Larval Hosts**

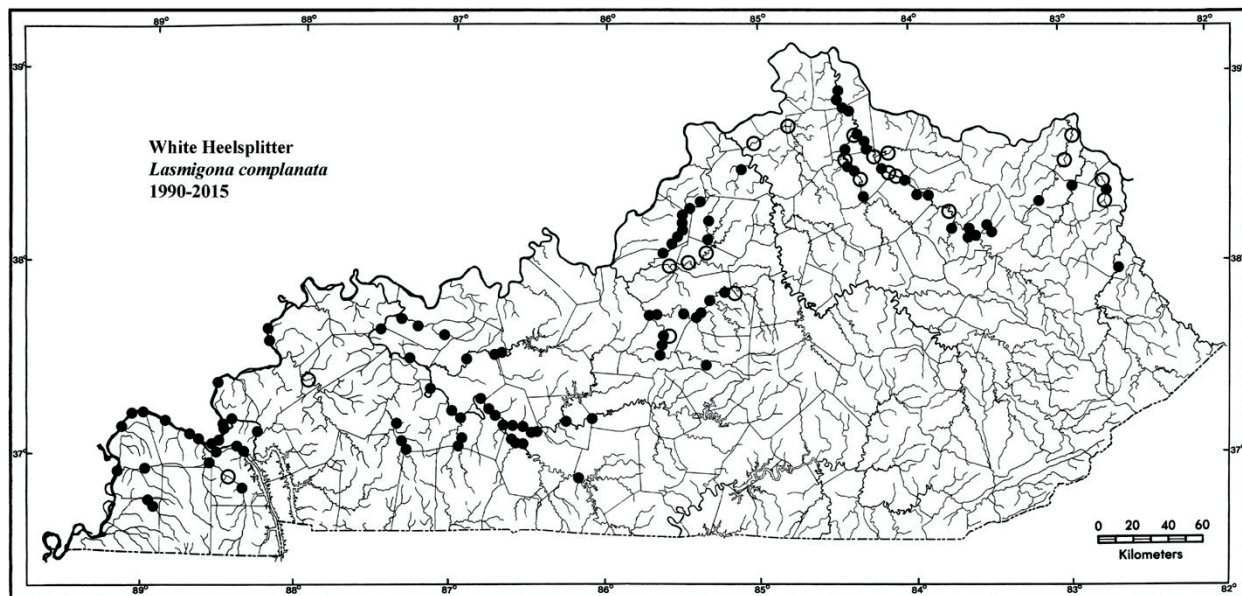
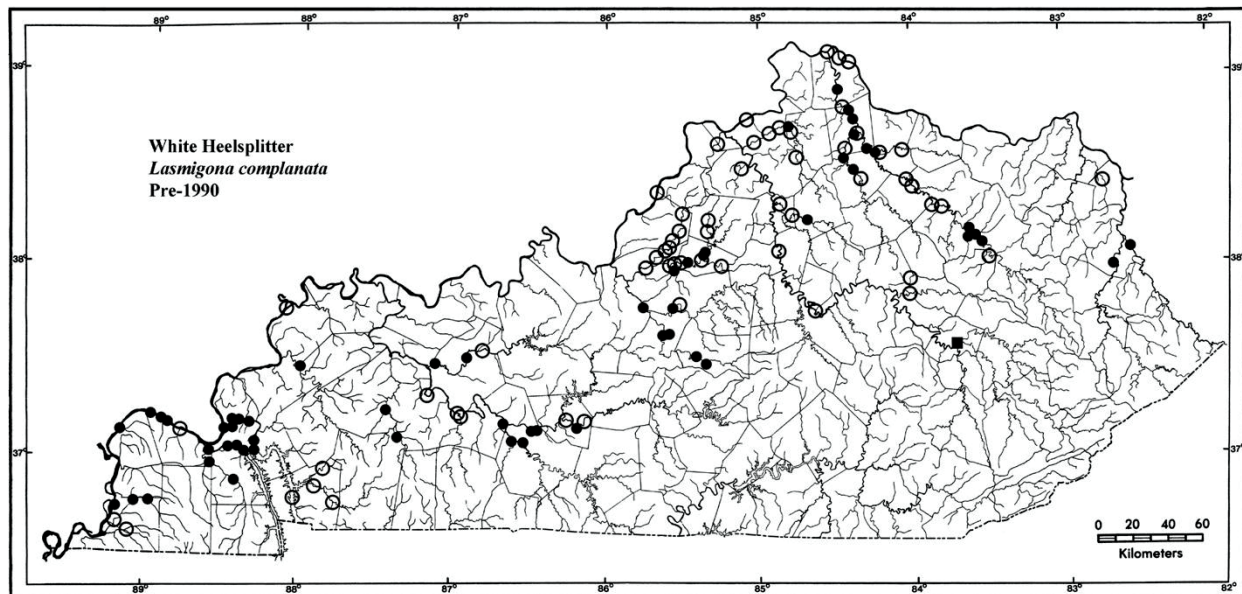
*Lampsilis teres* is primarily a species of large rivers and lowland streams. It is a characteristic member of lowland stream assemblages in the Mississippi Embayment, and elsewhere in the state it typically occurs in depositional areas along shore or in backwater pools. It is tolerant of impoundment to an extent and can adapt to some riverine reservoirs, but it is absent in truly lentic environments. *Lampsilis teres* appears to be a host specialist on several species of gar, but the distribution of *L. teres* is closely concordant with that of Shortnose Gar (*Lepisosteus platostomus*), suggesting that this species is of particular importance as a host (Haag 2012).

**Conservation Status**

*Lampsilis teres* is a highly adaptable species because of its fast growth, early maturity, and high fecundity; these traits allow it to tolerate considerable disturbance and to colonize habitats that are unsuitable to most other mussel species (Haag 2012). It is locally common in the lower Ohio, lower Tennessee, and lower Cumberland rivers, and in channelized streams in the Mississippi Embayment. Nevertheless, this species has declined dramatically in some parts of Kentucky. It seems to have been unable to adapt to impoundment of the Tennessee and lower Cumberland rivers, and it appears extirpated from the Little and Tradewater rivers due to coal mining in the latter drainage and unknown factors in the former. The decline of this species is most dramatic and curious in the upper Ohio River and in the Kentucky and Licking river drainages. These rivers continue to support diverse mussel faunas, but *L. teres* has nearly disappeared from these streams despite its resilience to disturbance elsewhere (see also Watters et al. 2009). For example, weathered shells of *L. teres* are numerous in the lower Licking River, attesting to its former abundance there, but the species has been found alive at only one site since 1990 (KNP). Shortnose Gar have largely disappeared from the upper Ohio River basin in the last 50 years for unknown reasons (Trautman 1981; Burr and Warren 1986; ORSANCO 2015), suggesting that loss of its host fish may explain the decline of *L. teres* in this region. AFS: currently stable.

*Lasmigona complanata* (Barnes, 1823)

## White Heelsplitter

**General Distribution**

Mississippi River basin from Louisiana and Mississippi north to Minnesota, and west to at least Kansas and North Dakota; populations in the Missouri River system in Montana may be introduced (Gangloff and Gustafson 2000). Ohio River basin from the mouth upstream to Ohio and West Virginia, but absent historically in the upper half of the Tennessee and Cumberland River drainages; appears to have naturally expanded its range or been introduced in the upper Tennessee River drainage in recent decades (Garner and McGregor 2001). Great Lakes basin from Lake Michigan to Lake Erie, the Hudson Bay basin west to Alberta, and in the Pascagoula and Pearl rivers, Louisiana and

Mississippi, on the Gulf Coast. Populations in the Mobile River basin are now referred to as a separate species, *L. alabamensis*.

**Kentucky Distribution**

Generally distributed to occasional in low gradient streams from the Mississippi River east to the Salt River drainage, but absent in the middle and upper Cumberland River drainages and most of the upper Green River drainage. Formerly occasional to sporadic in the lower Kentucky River drainage, but Dangler (1922) reported it as common in the upper Kentucky River drainage (from unspecified locations but probably including the North Fork Kentucky River). Generally distributed in the Licking River drainage, and sporadic in the upper Ohio River and tributaries from Tygarts Creek to the Big Sandy River drainage.

**Habitat & Larval Hosts**

This is a species of depositional areas along shore or in backwater pools, mainly in medium-sized to large streams, but it may be found in smaller streams, particularly in lowland areas. It can adapt to impoundment to some extent, but despite its affinity for depositional habitats, it is strongly associated with rivers and absent in most truly lentic environments. It has expanded its range in some areas subsequent to dam construction, which apparently increased available habitat for the species (e.g., Garner and McGregor 2001). This species appears to be a host generalist, able to use a wide range of fish species.

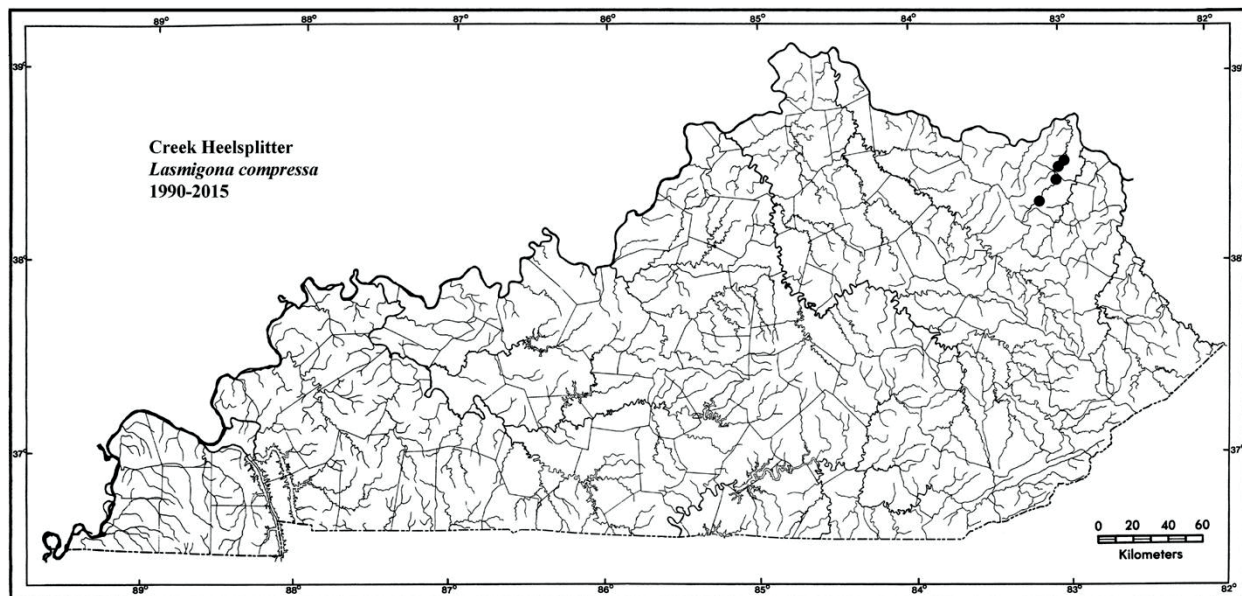
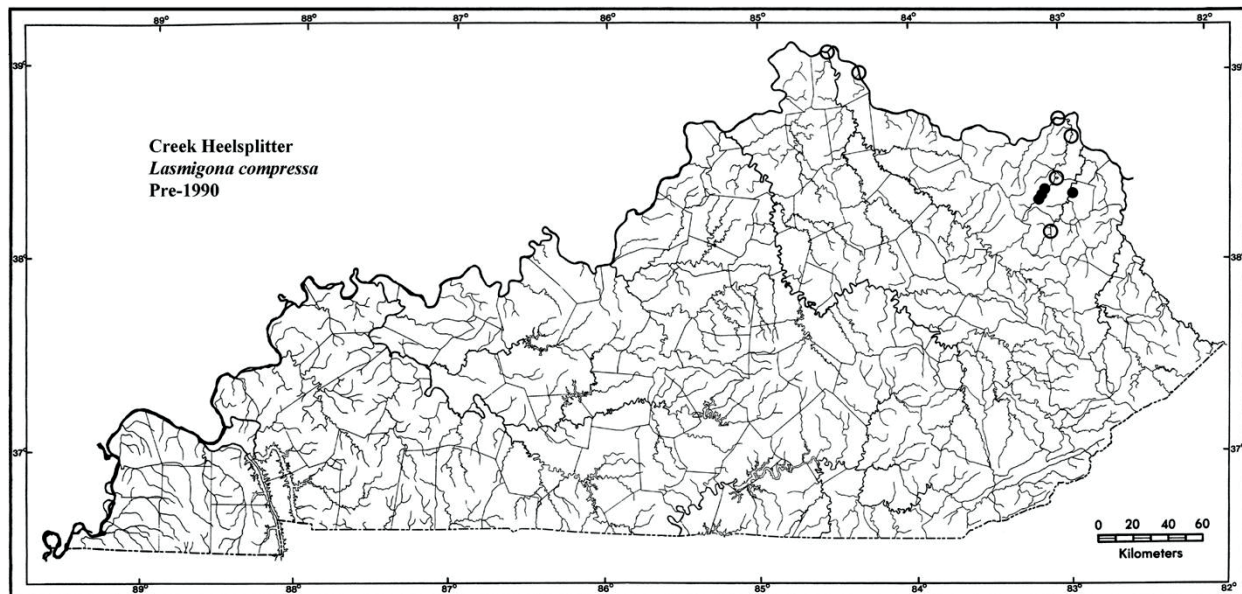
**Conservation Status**

The distribution of *Lasmigona complanata* in Kentucky has changed relatively little in the last 100 years, and it remains common throughout much of its range. The preference of this species for depositional environments, along with life history traits such as fast growth, early maturity, and the ability to use a wide range of fishes as hosts, apparently make it resilient to many recent changes to stream habitats. Nevertheless, populations in some areas seem to be extirpated or declining. The species appears extirpated from the Little and Tradewater rivers due to coal mining in the latter drainage and unknown factors in the former. The most notable exception to the otherwise stable distribution of this species is its apparent disappearance from the Kentucky River drainage, where only one record of live or recently dead individuals exists since 1990 (Drennon Creek, Henry County; KNP); the reasons for this disappearance are unknown. Its rarity or absence in Kentucky and Barkley lakes and the upper Ohio River also is unusual given that the species has expanded its range in other streams after impoundment. AFS: currently stable.



*Lasmigona compressa* (Lea, 1829)

## Creek Heelsplitter

**General Distribution**

Upper Mississippi River basin from Illinois and Iowa north to Minnesota, and west to Nebraska and North Dakota. Ohio River basin, mainly in northern tributaries from Illinois east to New York. Throughout the Great Lakes basin from Lake Superior to the St. Lawrence River system, the Hudson Bay basin west to at least Saskatchewan, and the Hudson and upper Susquehanna river basins on the Atlantic Coast.



**Kentucky Distribution**

This is a northern species that occurs in Kentucky only in the northeastern part of the state. It is reported only from Tygarts Creek, Carter and Greenup counties (Zeto 1979; OSUM), the Little Sandy River, Carter County (NCMNS; OSUM), and from a few historical records from the Ohio River, Kenton, Campbell, and Greenup counties (OSUM; CMNH; Watters et al. 2009).

**Habitat & Larval Hosts**

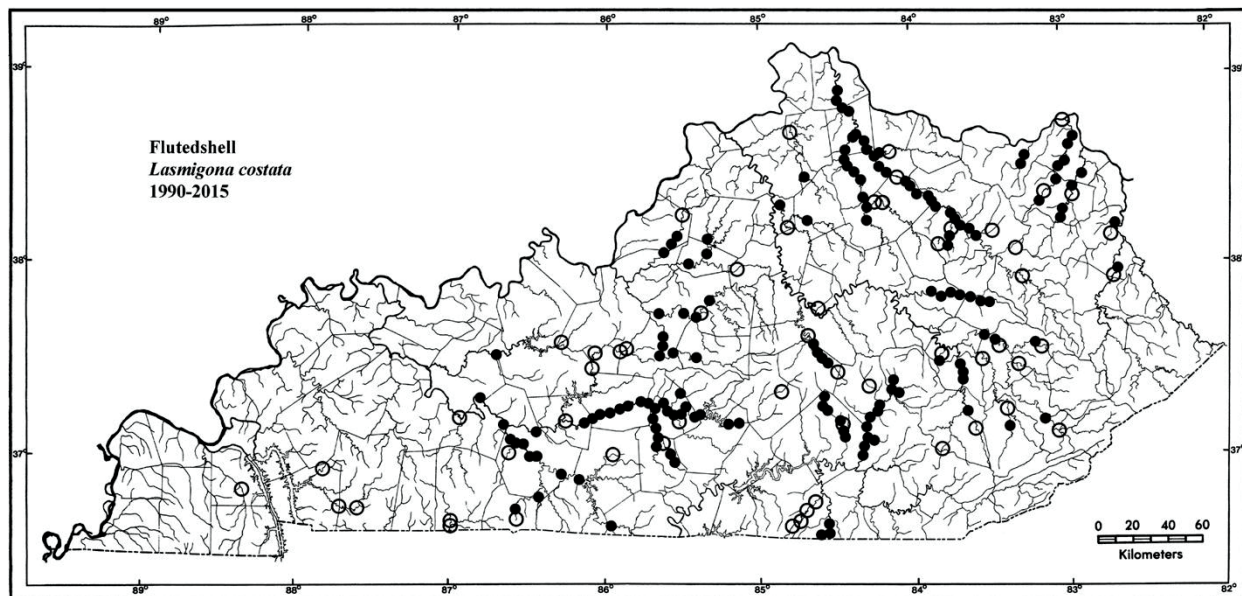
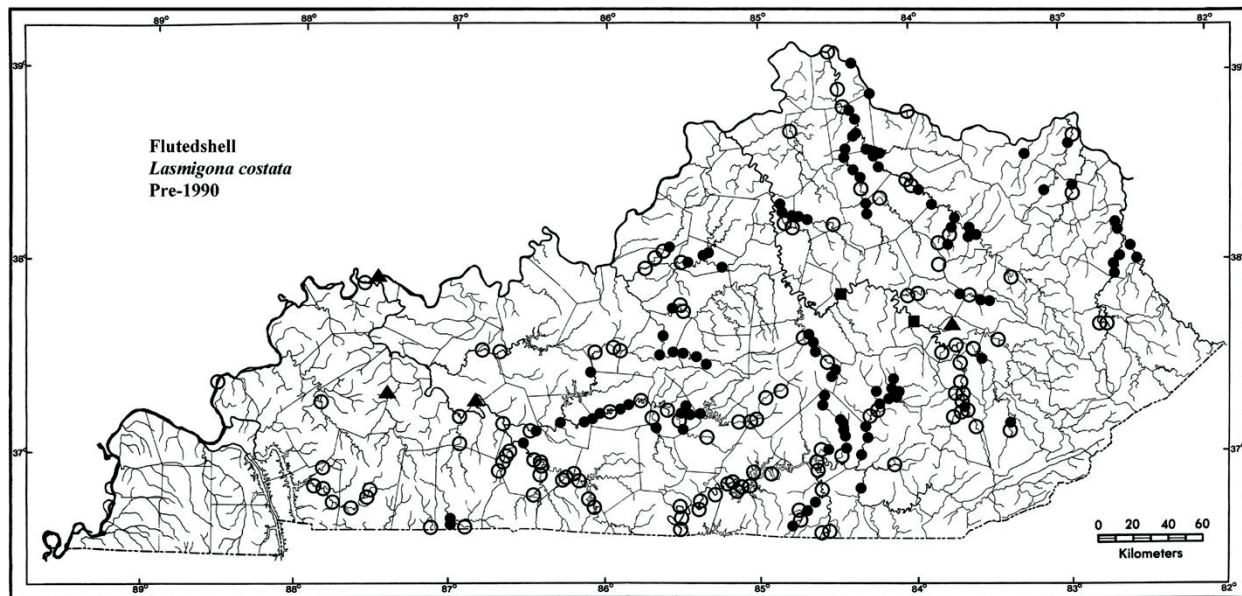
This species occurs mostly in small to medium-sized streams, and can penetrate far into headwaters where it may be the only species present (Strayer and Jirka 1997). Usually occurs in riffles and other flowing water habitats, but may occur in depositional areas. This species is a host generalist, able to use a wide range of fish species.

**Conservation Status**

*Lasmigona compressa* is in danger of disappearing from Kentucky. It has not been found recently in the Little Sandy River, where it was rare prior to 1990, and it appears extirpated from the Ohio River (Watters et al. 2009). It persists only in Tygarts Creek, where it is occasional and locally common, but mussel populations in this stream have declined markedly in recent years. Because it is a northern species, populations in Kentucky at the periphery of its range may be particularly susceptible to warming stream temperatures associated with global climate change. This species remains common elsewhere in its range (e.g., Strayer and Jirka 1997). It is one of the few North American species that is frequently hermaphroditic (Ortmann 1918), which allows eggs to be fertilized even when population density is low; this trait, along with fast growth, early maturity, and the ability to use a wide range of fishes as hosts, apparently make it resilient to many recent changes to stream habitats. KNP: endangered; AFS: currently stable.

*Lasmigona costata* (Rafinesque, 1820)

Flutedshell

**General Distribution**

Mississippi River basin from Arkansas north to Minnesota, and west to eastern Kansas. Ohio River basin upstream to New York, but generally absent in low-land regions of the lower basin. Great Lakes basin from Lake Michigan to the St. Lawrence River system, and the Hudson River basin on the Atlantic Coast.

**Kentucky Distribution**

Type locality: Kentucky River. Generally distributed nearly statewide, but absent from the Mississippi River and direct tributaries, and sporadic and rare in

other lowland habitats in western Kentucky; single records are available for the East Fork Clarks River and the Tradewater River (UMMZ; Lewis 2006). Sporadic and rare in the Ohio River and lower Green River drainage, and not reported from the lower Tennessee or Cumberland rivers. Absent in the upper Cumberland River drainage above Cumberland Falls.

**Habitat & Larval Hosts**

Occurs in a wide variety of upland stream habitats but typically rare or absent in the largest rivers and in the smallest headwater streams. Usually occurs in riffles and other flowing water habitats, but may occur in depositional areas. Although common in many streams, this species never dominates mussel assemblages in any habitat type. It appears to be only marginally tolerant of impoundment and has disappeared from even riverine habitats in many impounded rivers (e.g., Garner and McGregor 2001; Haag 2012). This species appears to be a host generalist, able to use a wide range of fish species.

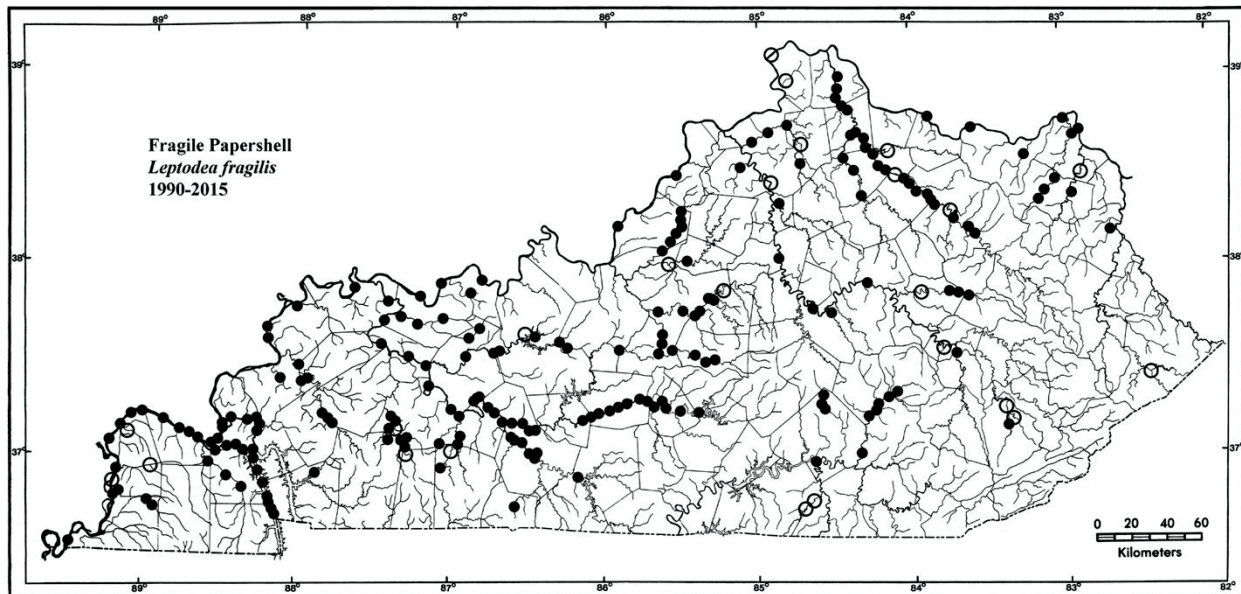
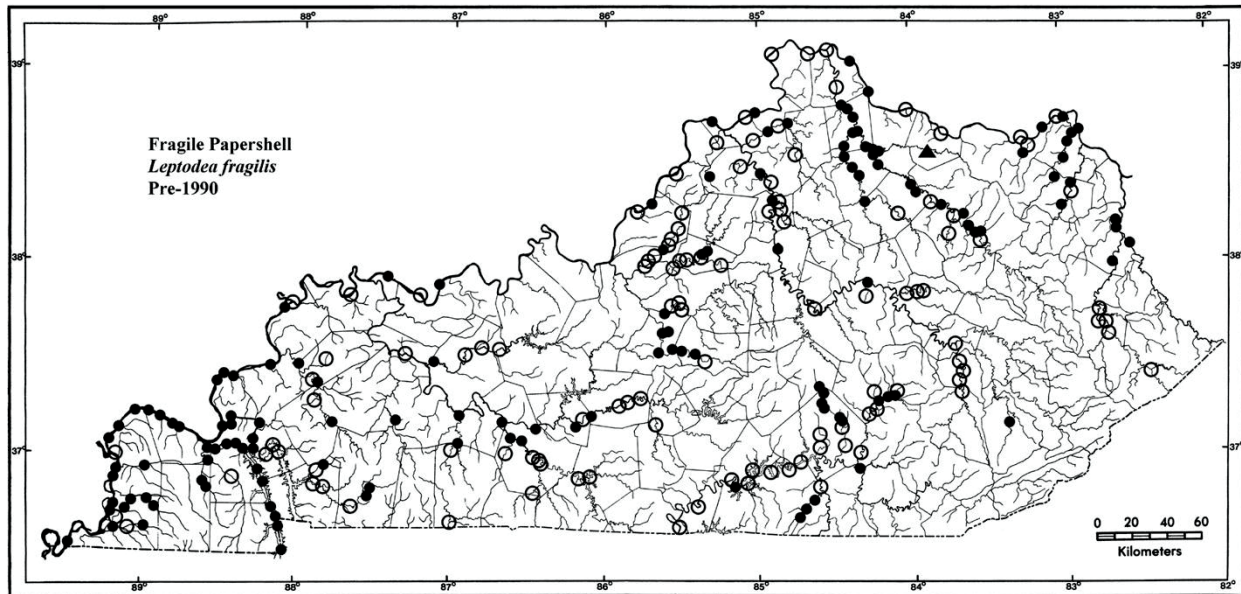
**Conservation Status**

*Lasmigona costata* remains one of the most widespread and common stream species in Kentucky. Several local populations appear to have been extirpated by severe water pollution or other factors. It appears extirpated throughout the lower Cumberland River drainage, the Nolin River (upper Green River drainage), and the Little South Fork Cumberland River. It was eliminated throughout the middle Cumberland River by Wolf Creek Dam. It is unclear to what extent this species has declined in large rivers after impoundment. It was rare even historically in the Ohio and middle Cumberland rivers (Ortmann 1919; Neel and Allen 1964), and largely absent in the lower Tennessee and Cumberland rivers (Wilson and Clark 1914; Ortmann 1925). It is now rare or absent in the lower Green, lower Salt, and Kentucky rivers, but its historical distribution in those streams is unknown. It persisted at very low levels in the Ohio River until at least the late 1980s and may survive there today (Williams and Schuster 1989; OSUM). Elsewhere in the state, many populations appear robust with evidence of recent recruitment. AFS: currently stable.



*Leptodea fragilis* (Rafinesque, 1820)

## Fragile Papershell

**General Distribution**

Mississippi River basin from Louisiana north to Minnesota, and west to Kansas and North Dakota. Throughout the Ohio River basin from the mouth upstream to Pennsylvania. Great Lakes basin from Lake Michigan to the St. Lawrence River system, and Gulf Coast drainages from the Mobile River basin to the Colorado River, Texas.

**Kentucky Distribution**

Type locality: Creeks in Kentucky. Generally distributed in larger streams statewide; absent from the upper Cumberland River drainage.



**Habitat & Larval Hosts**

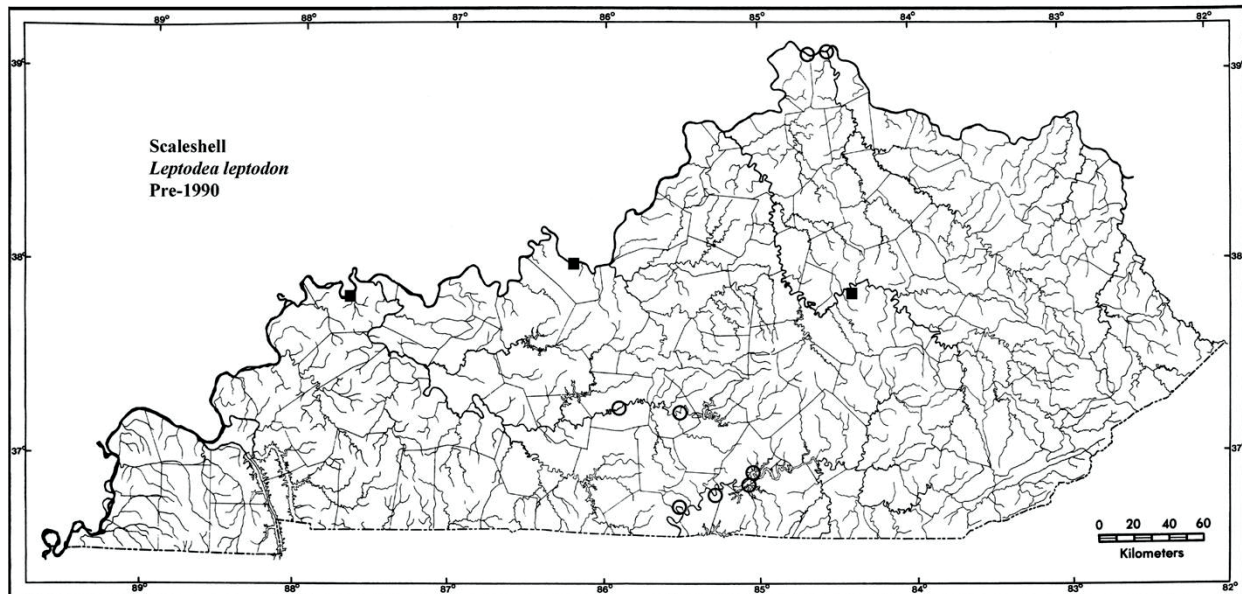
Occurs in a wide variety of habitats from lowland to upland streams to riverine reservoirs, but restricted to waters inhabited by its host fish, the Freshwater Drum (*Aplodinotus grunniens*). Consequently, *L. fragilis* is most common in medium-sized to large streams where drum are abundant and is usually rare or absent in small streams. Occurs in swift riffles and main-channel mussel beds but also frequently in depositional areas along shore or in backwater pools. This species is tolerant of impoundment to a large extent, but is usually absent in truly lentic habitats. Although common, this species does not occur at high densities and rarely dominates stream mussel assemblages.

**Conservation Status**

*Leptodea fragilis* is a highly adaptable species because of its fast growth, early maturity, and extraordinarily high fecundity; these traits allow it to tolerate considerable disturbance and to colonize habitats that are unsuitable to most other mussel species (Haag 2012). It has adapted to and is common in impounded streams throughout the state and in channelized or otherwise highly degraded streams in western Kentucky, and it is nearly ubiquitous in many other streams. Some local populations doubtless have been extirpated by severe water pollution (e.g., Little South Fork Cumberland River), and its apparent absence in Lake Barkley is puzzling. The species was largely eliminated from the middle Cumberland River by Wolf Creek Dam, but it is one of the few species that survived in the reservoir (Lake Cumberland), where it has colonized mudflats in the vicinity of Burnside, Pulaski County. AFS: currently stable.

*Leptodea leptodon* (Rafinesque, 1820)

## Scaleshell

**General Distribution**

Mississippi River basin from Arkansas north to Minnesota, and west to Oklahoma and South Dakota. Ohio River and larger tributaries from the mouth upstream to the Muskingum River, Ohio.

**Kentucky Distribution**

Type locality: Ohio River. Probably widely distributed historically in the Ohio River and in larger tributaries, but specific records are few. Documented specifically from only two sites in the Ohio River, Boone and Kenton counties (CM; OSUM), but reported

from an unspecified locality adjacent Indiana (Goodrich and van der Schalie 1944) and reported as common historically in the lower Ohio River (Rafinesque 1820a; Call 1900). Not reported from the lower Tennessee or lower Cumberland rivers in Kentucky, but present elsewhere in these systems (Ortmann 1925; see subsequent) and likely occurred at least sporadically throughout these rivers. Formerly occasional but rare in the middle Cumberland River upstream at least to Russell County (Wilson and Clark 1914; Neel and Allen 1964; UMMZ). Reported from two sites in the upper Green River, Hart and Green counties (Stansbery 1965; OSUM; NMNH), and from an unspecified locality in the Kentucky River (Vanatta 1915). Not reported from archaeological assemblages anywhere in the state.

**Habitat & Larval Hosts**

Restricted to main-channel habitats of medium-sized to large streams in gravel and sand substrates. Typically a minor component of main-channel mussel beds. This species is a host specialist on Freshwater Drum (*Aplodinotus grunniens*).

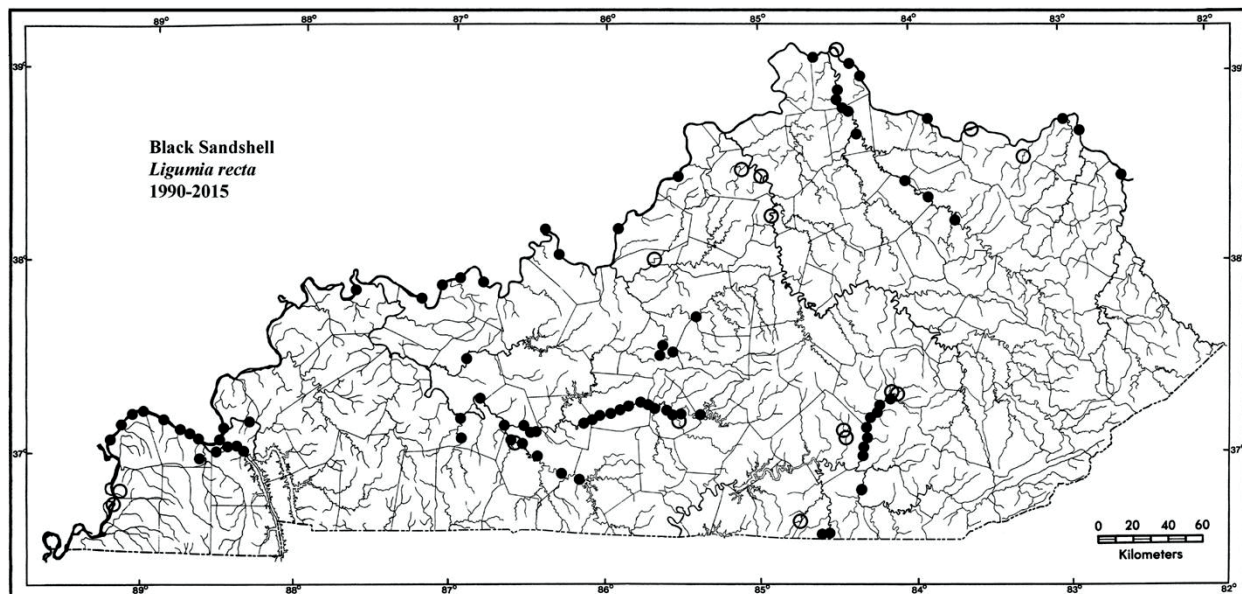
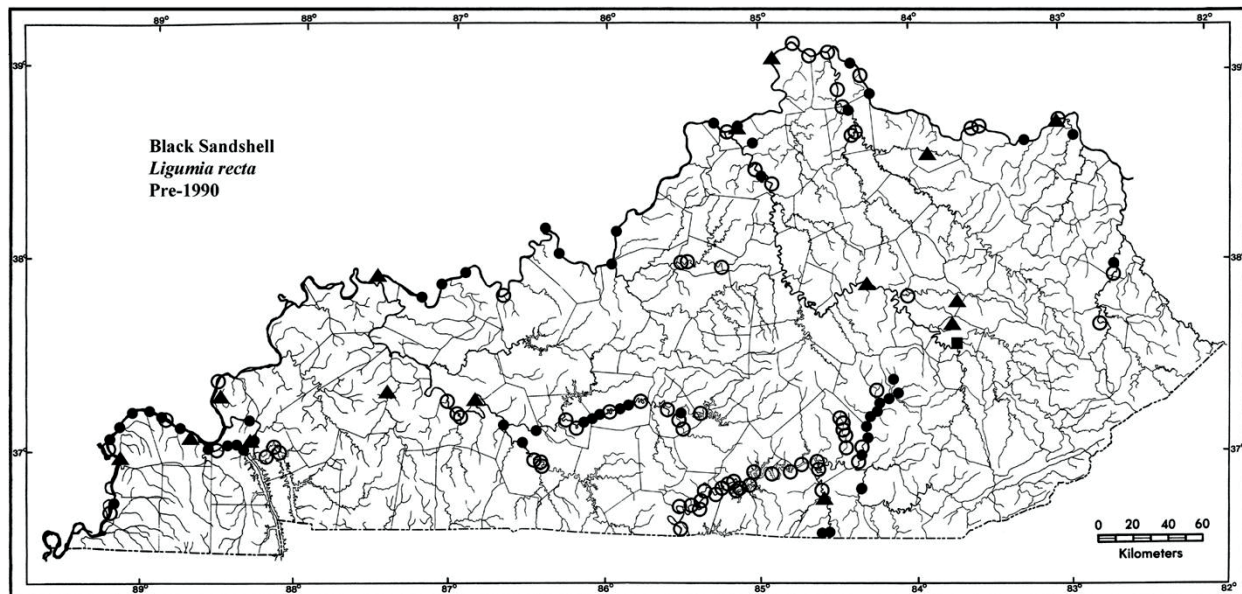
**Conservation Status**

*Leptodea leptodon* appears to be extirpated from Kentucky and it has disappeared from most of its historical range, including all states east of the Mississippi River. This species appears to have been rare even prior to major stream alterations, but this perception may be influenced by three factors: 1) the species' small size and tendency to be deeply buried, which makes it difficult to collect; 2) the paucity of historical collecting effort expended in many large rivers; and 3) the thin, fragile shell of this species, which results in poor preservation especially at archaeological sites. Regardless, this species appears intolerant of impoundment and highly sensitive to other human alterations of streams. The sensitivity of this species is puzzling because its life history traits are similar to the highly adaptable *L. fragilis*. However, *L. leptodon* does persist in at least two sections of the Missouri River, which is highly altered by impoundment and channel dredging, as well as in several other streams west of the Mississippi River (USFWS 2010b). This species was eliminated from the middle Cumberland River by Wolf Creek Dam in 1950, and it has not been seen in the Ohio River since its impoundment in 1929. It persisted in the Green River until at least 1964 (Stansbery 1965), but may have been extirpated by oil brine pollution and altered flows from Green River Dam (see Williams 1969; Konrad et al. 2012). Recent improvements in water release from Green River Dam (Konrad et al. 2012) may make this stream suitable for reintroduction of *L. leptodon* using source stock from western populations. KNP: presumed extirpated. AFS: endangered; USFWS: endangered.



*Ligumia recta* (Lamarck, 1819)

## Black Sandshell

**General Distribution**

Mississippi River basin from Louisiana upstream to Minnesota, and west to Kansas and South Dakota; populations in the Missouri River system in Montana are considered introduced (Gangloff and Gustafson 2000). Throughout the Ohio River basin from the mouth upstream to New York. Great Lakes basin from Lake Michigan to the St. Lawrence River system, the Hudson Bay basin west to Saskatchewan, and the Mobile River basin and Pearl River, Mississippi, on the Gulf Coast.



**Kentucky Distribution**

Generally distributed to occasional statewide in medium-sized to large streams including the Mississippi River, throughout the Ohio River, and in all major tributaries from the Tennessee to the Big Sandy River drainage; absent in the upper Cumberland River drainage above Cumberland Falls. Absent in most lowland streams in western Kentucky such as the Tradewater River, but one record is available for lower Clarks River, McCracken County (KNP). Relatively few records exist from the Kentucky River drainage, but reportedly common historically in the upper Kentucky River drainage (from unspecified locations but probably including the North Fork Kentucky River; Danglade 1922). Reported from the lower portions of Kinniconick Creek, Lewis County (KNP), and Tygarts Creek, Greenup County (C. Burchett, personal communication), but not reported from the Little Sandy River.

**Habitat & Larval Hosts**

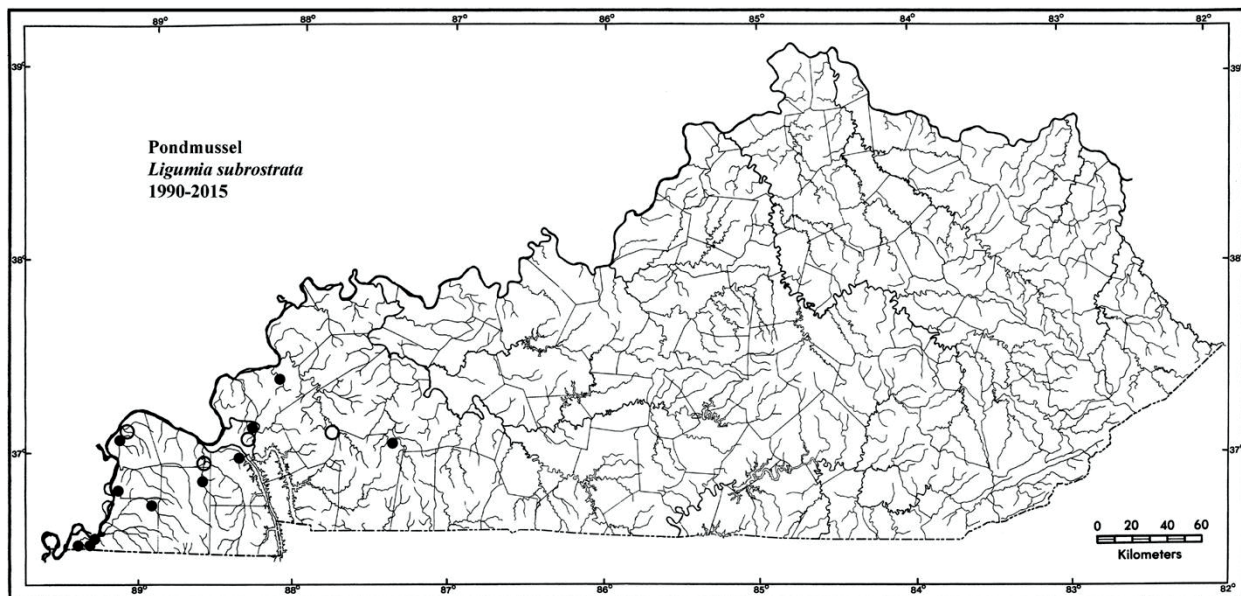
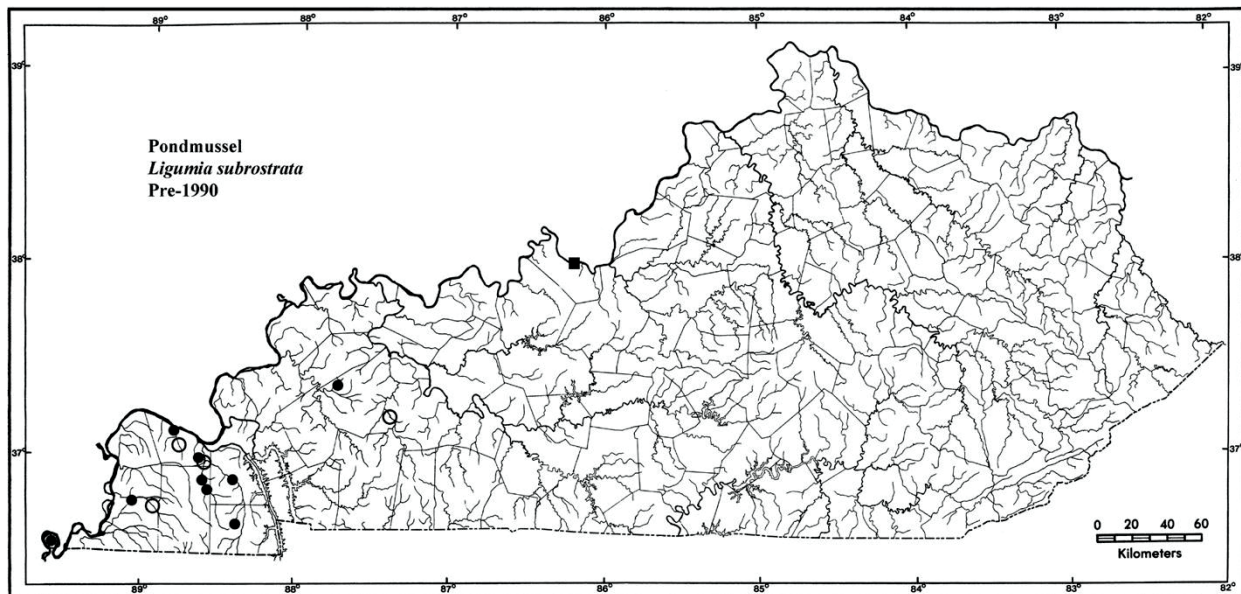
Restricted to main-channel habitats of medium-sized to large streams in gravel and sand substrates. This species is a host specialist primarily on Sauger and Walleye (*Sander*), and the distribution of the species in the state and elsewhere in its range is remarkably concordant with the combined distribution of those two fishes (see Burr and Warren 1986; Haag 2012). *Ligumia recta* is most common in streams that support large Sauger or Walleye populations (e.g., Tennessee, Ohio, and Rockcastle rivers), but it is never a dominant component of mussel assemblages.

**Conservation Status**

Because of its host relationship with Sauger and Walleye, *Ligumia recta* has declined or been extirpated in parts of its range where dams have disrupted spawning migrations of these fishes (Haag 2012). Navigation dams on the Ohio River appear to allow passage of these fishes, and the river continues to support large populations of Sauger and *L. recta*. The species remains common in the Tennessee River below Kentucky Dam and persists in the Cumberland River below Barkley Dam (Sickel 2000), but it appears absent from the reservoirs above those dams; however, it remains common in riverine sections of the Tennessee River upstream in Tennessee and Alabama (Garner and McGregor 2001). It was extirpated from the middle Cumberland River by Wolf Creek Dam, with the exception of a small population that persisted immediately below Cumberland Falls as late as 1993 (Cicerello and Laudermilk 1997). Elsewhere in the middle Cumberland River drainage, it remains only in the Rockcastle River and the Big South Fork, both of which retain Walleye populations; it appears extirpated from Buck Creek and the Little South Fork (Schuster et al. 1989; Warren and Haag 2005). It remains throughout much of the upper Green, Barren, and Licking rivers, but the species persists only at isolated localities in the Salt River drainage. It may be extirpated in the Kentucky and Big Sandy river drainages, both of which are fragmented by non-functional navigation dams that likely disrupt Sauger and Walleye migrations, but it may remain in the lower portions of those rivers. AFS: special concern.

*Ligumia subrostrata* (Say, 1831)

## Pondmussel

**General Distribution**

Mississippi River basin from Louisiana north to Minnesota, and west to Kansas and South Dakota. Lower Ohio River basin from the mouth upstream to the Wabash River system, but present only in the lower portions of the Tennessee, Cumberland, and Green river drainages. Gulf Coast drainages from the western Mobile River basin to the Nueces River, Texas.

**Kentucky Distribution**

Sporadic but locally common in direct tributaries of the Mississippi River and in tributaries of the Ohio River upstream to the lower Green River drainage.

No specific localities exist from the Mississippi or Ohio rivers, but reported from the Ohio River adjacent Indiana (Call 1900). Reported from the Tennessee River drainage only in the Clarks River system and Cypress Creek, Marshall County (KNP; MSU); a record from Kentucky Lake (Parmalee and Bogan 1998, no locality given) is unsubstantiated but plausible. Reported from the Cumberland River drainage in Kentucky only in Cypress and Richland creeks, Livingston County (KNP). Reported elsewhere in the Cumberland River drainage only from four specimens from the Harpeth and Stones rivers, Tennessee (Parmalee and Bogan 1998); a record from the Cumberland River (Parmalee and Bogan 1998, no locality given) is unsubstantiated but plausible. Reported from the Green River drainage only in the Pond River, Christian and Hopkins/Muhlenberg counties (Warren and Call 1983; KNP).

**Habitat & Larval Hosts**

This is a characteristic species of low gradient streams and sloughs throughout the Mississippi Embayment and eastern Great Plains, but it is rarely found in large streams. This species is a specialist on sunfishes (*Lepomis*) and black basses (*Micropterus*).

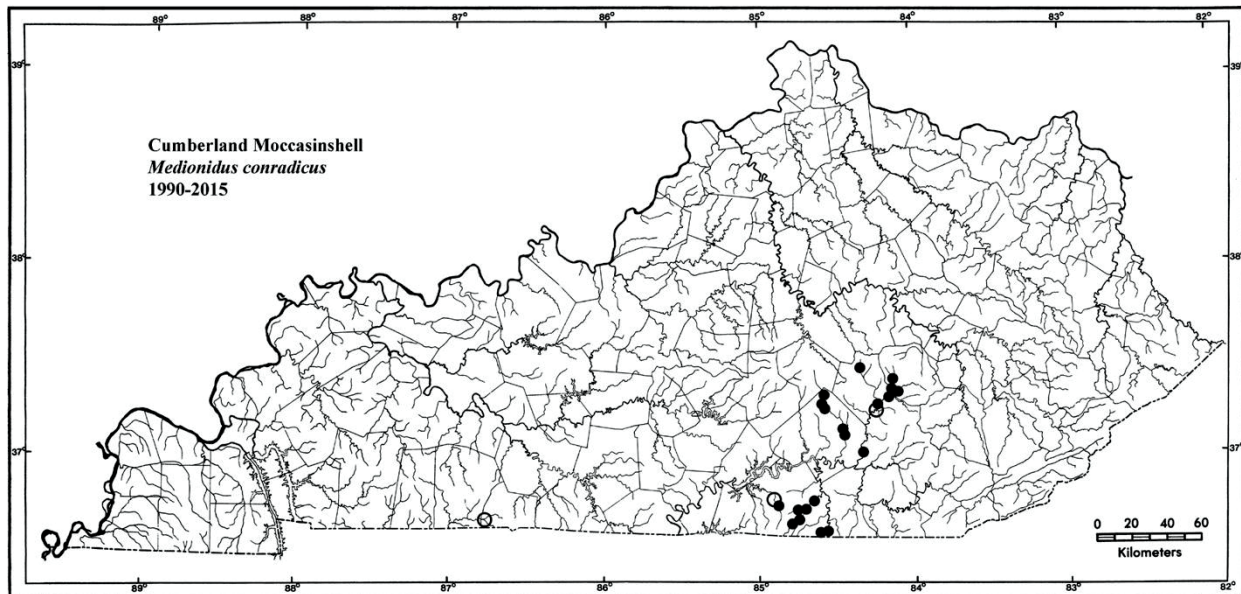
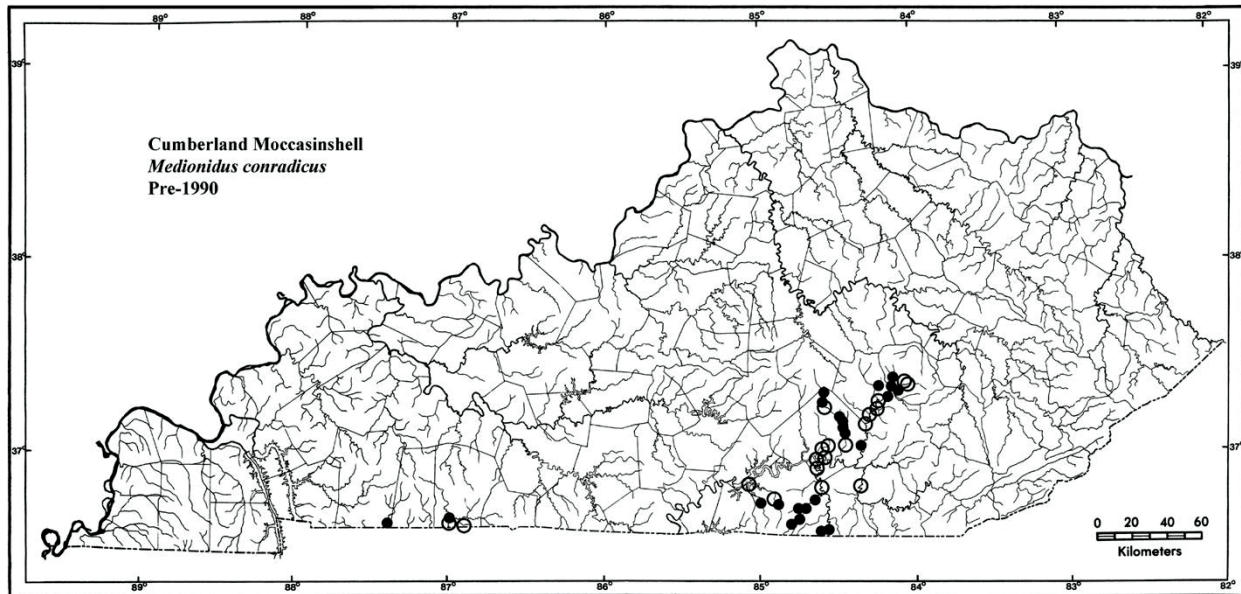
**Conservation Status**

*Ligumia subrostrata* doubtless has experienced localized declines or extirpations in response to widespread wetland drainage and stream channelization in western Kentucky. However, this is a highly adaptable species because life history traits such as fast growth and early maturity allow it to tolerate considerable disturbance and to colonize habitats that are unsuitable to most other mussel species (Haag 2012). It remains a locally common member of mussel assemblages in lowland habitats of western Kentucky where it can persist even in channelized streams or other highly degraded habitats. Because of this species' adaptability and its use of sunfishes and black basses as hosts, it is frequently introduced into ponds via stocked fishes (see Williams et al. 2008). Nevertheless, the restricted range of this species in the state makes it vulnerable to further degradation of lowland habitats. AFS: currently stable.



*Medionidus conradicus* (Lea, 1834)

## Cumberland Moccasinshell

**General Distribution**

Endemic to the Tennessee-Cumberland faunal province, occurring in northern Alabama, northwestern Georgia, southern Kentucky, western North Carolina, Tennessee, and southwestern Virginia.

**Kentucky Distribution**

Generally distributed in the lower and middle Cumberland River drainages from the Red River system, Christian, Logan, and Simpson counties, upstream to the base of Cumberland Falls; absent above the falls. Formerly nearly ubiquitous in tributaries of the



middle Cumberland River drainage from Beaver Creek, Wayne County, upstream to the Rockcastle River, but not reported from Fishing Creek or the Laurel River. Reported from the Cumberland River only immediately below Cumberland Falls and in the vicinity of Burnside, Pulaski County (Wilson and Clark 1914).

**Habitat & Larval Hosts**

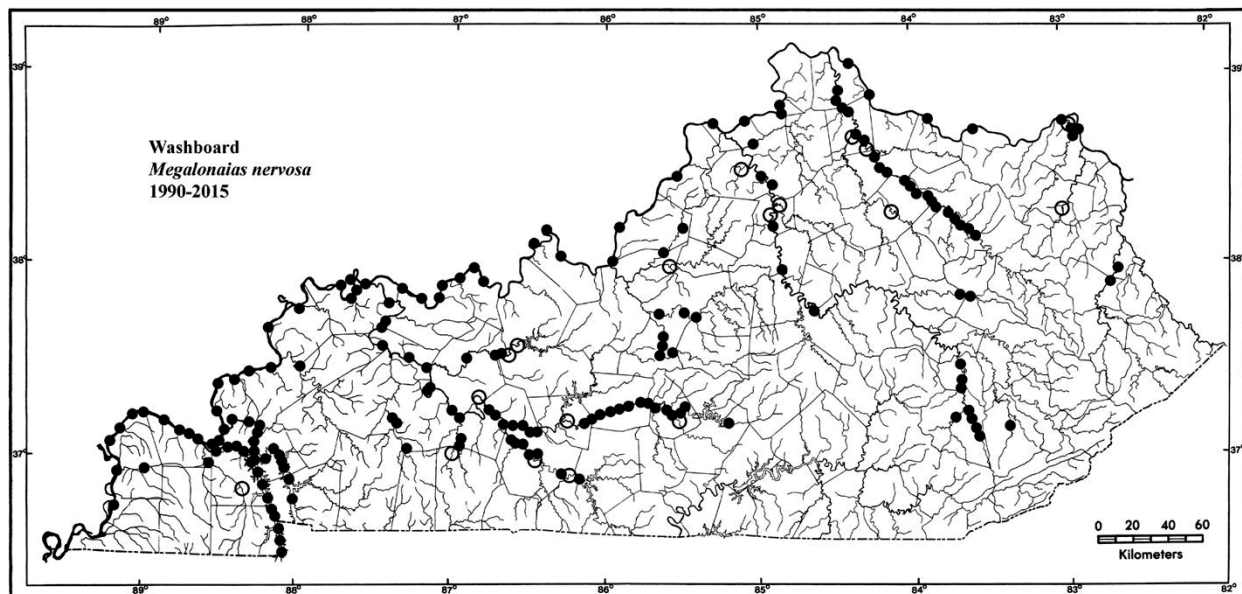
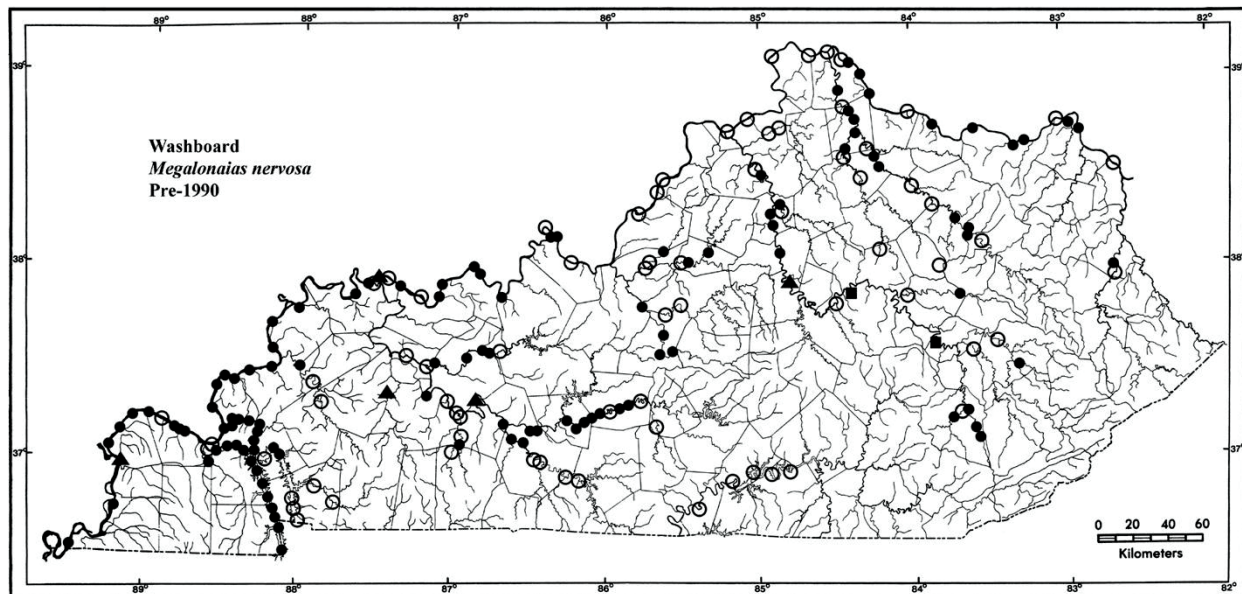
Small to medium-sized streams in gravel and sand substrates; formerly a locally dominant species in such habitats. Rare or absent even historically in the middle Cumberland River except for the area immediately below Cumberland Falls (Wilson and Clark 1914; Neel and Allen 1964; Stansbery 1969). This species is a host specialist on darters (Percidae).

**Conservation Status**

Because it is most common in smaller streams not directly influenced by impoundment, *Medionidus conradicus* remains more widespread than most other Tennessee-Cumberland endemic species. Nevertheless, it has declined dramatically and is in danger of disappearing from Kentucky and throughout much of its former range. Prior to the 1980s, at least five large populations and several smaller ones existed in the state. A small population persisted in the Red River system (lower Cumberland River drainage) until the late 1980s (KNP), and it was locally abundant in the Tennessee portion of the river into the late 1960s, but the species now appears extirpated from the entire system (OSUM; Ray 1999). It was abundant historically in the Cumberland River at the base of Cumberland Falls (Neel and Allen 1964) and remained so until at least 1961 (154 individuals found; OSUM; Stansbery 1969), but this population has disappeared (Cicerello and Laudermilk 1997). Its overall distribution remains relatively unchanged in tributaries of the middle Cumberland River drainage, but all remaining populations have declined dramatically and their long-term survival is tenuous. It appears extirpated from Pitman Creek, Pulaski County; and Otter Creek, Wayne County. It was “exceedingly abundant” and nearly covered the bottom of the Rockcastle River at Livingston, Rockcastle County, in the early 1900s (Wilson and Clark 1914) and remained abundant there until the 1960s (Neel and Allen 1964; OSUM), but it is now absent from this site and very rare throughout the Rockcastle River and the Middle Fork (Cicerello 1993, 1994). Two of the largest populations in the state in the 1980s and 1990s (Horse Lick Creek, Jackson County; Little South Fork, Wayne County) have declined dramatically apparently from coal mining and oil drilling and may now be extirpated. Over 400 individuals were found at 10 sites in Horse Lick Creek (Rockcastle River system) in 1993, but a survey of the entire creek in 2003 yielded only 7 individuals (Layzer and Madison 1994; Haag and Warren 2004). It declined from an average density in the Little South Fork of about 1/m<sup>2</sup> in 1981 to <0.1/m<sup>2</sup> in the late 1990s (Starnes and Bogan 1982; Warren and Haag 2005), and it was not found in the stream in 2013 (Ahlstedt et al. 2014). Two small populations may remain in Beaver Creek, Wayne County, and Clear Creek, Rockcastle County. The population in Buck Creek, Pulaski County, has declined markedly in the last 30 years (Schuster et al. 1989; Hagman 2000), and the species is sporadic and uncommon in the upper Big South Fork (Ahlstedt et al. 2003–2004). KNP: none, but this species warrants listing as endangered; AFS: special concern; USFWS: petitioned for listing.

*Megaloniais nervosa* (Rafinesque, 1820)

## Washboard

**General Distribution**

Mississippi River basin from Louisiana north to Minnesota, and west to Oklahoma and Kansas. Ohio River basin from the mouth upstream to at least the Muskingum River, Ohio. Gulf Coast drainages from the Ochlockonee River, Florida, to the Rio Grande basin, Nuevo Leon, Mexico.

**Kentucky Distribution**

Type locality: Falls of the Ohio (at Louisville, Jefferson County). Generally distributed statewide in medium-sized to large streams including the Missis-

sippi River, throughout the Ohio River, and in all major tributaries from the Tennessee to the Big Sandy River drainage; absent in the upper Cumberland River drainage above Cumberland Falls. Sporadic in smaller streams from the Mississippi Embayment to the Appalachian uplands, but absent in headwater streams.

**Habitat & Larval Hosts**

A characteristic species of medium-sized to large streams in uplands or lowlands. Often a dominant species in main-channel mussel beds in gravel and sand substrates, but also found frequently in depositional areas along shore or in backwater pools. It adapts readily to riverine impoundments, where it colonizes inundated river floodplains. This species appears to be a host generalist, able to use a wide range of fish species.

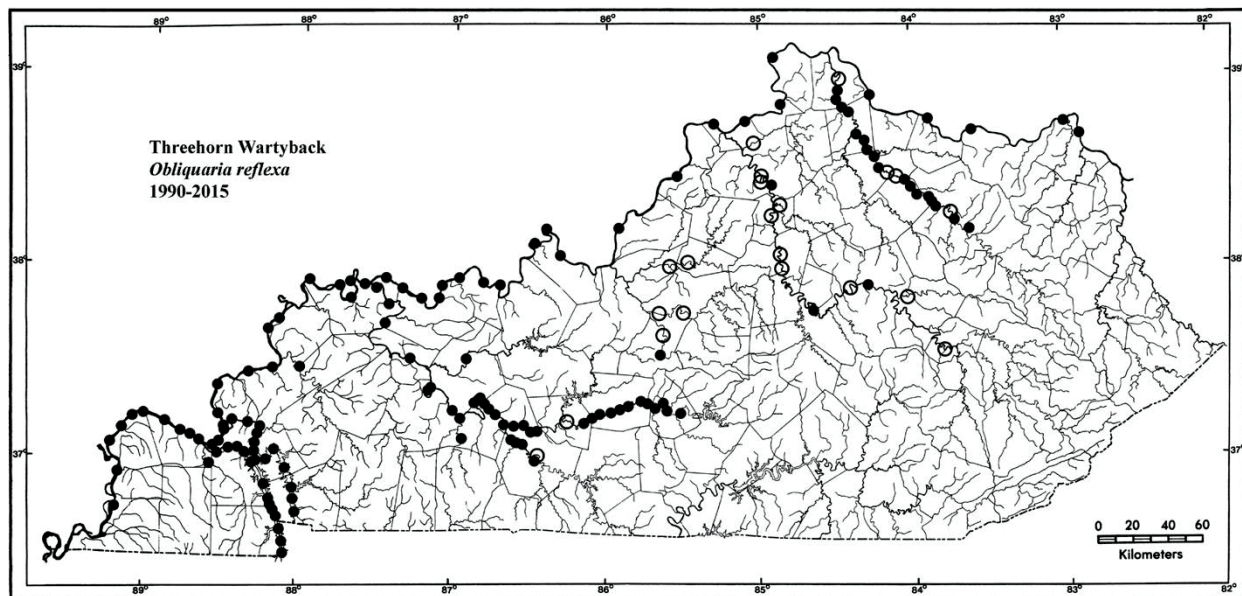
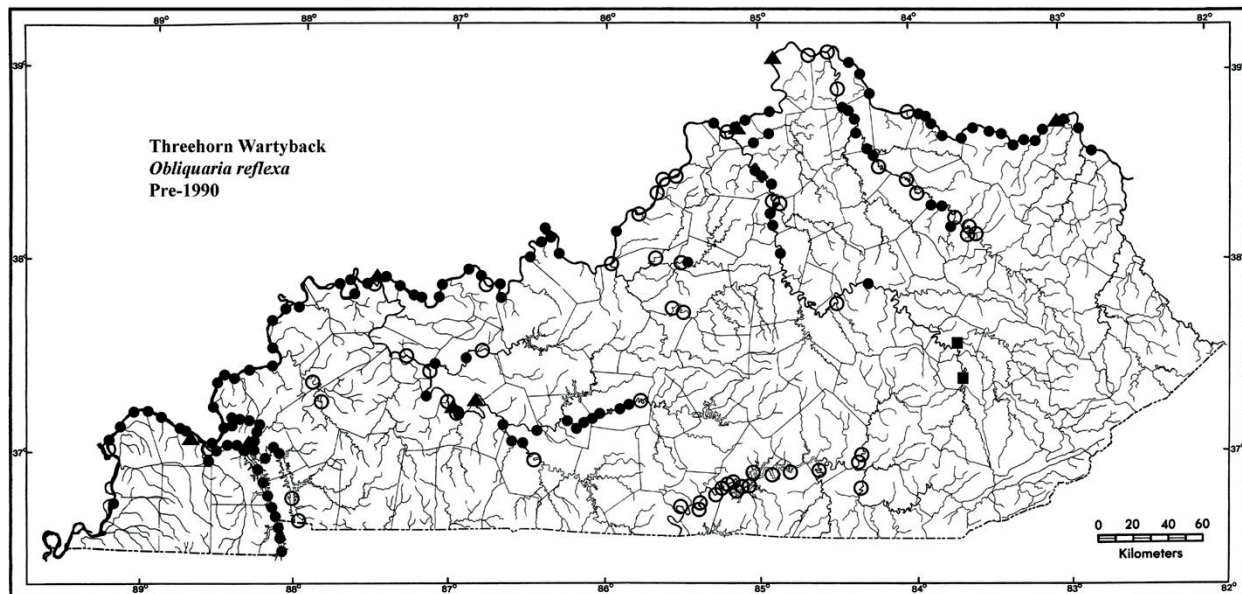
**Conservation Status**

*Megalonaias nervosa* remains common in larger streams throughout Kentucky, and its overall distribution appears to have changed little in the last 100 years. Nevertheless, several local populations may have declined or been extirpated. It has not been found recently in the Little River (lower Cumberland River drainage), North Fork Kentucky River, or South Fork Licking River. It was abundant formerly in the middle Cumberland River (Neel and Allen 1964), but this population was eliminated by Wolf Creek Dam. Elsewhere in the state, it remains common at least locally in all large rivers, even those extensively impounded for navigation. Populations in the impounded Tennessee and lower Cumberland rivers may have increased due to the inundation of former river floodplains, which this species has colonized extensively (Garner and McGregor 2001). Isolated populations in some smaller streams may be vulnerable to extinction from natural fluctuations in population size and environmental conditions. AFS: currently stable.



*Obliquaria reflexa* Rafinesque, 1820

## Threehorn Wartyback

**General Distribution**

Mississippi River basin from Louisiana north to Minnesota and west to eastern Kansas and South Dakota. Ohio River basin from the mouth upstream to Pennsylvania. Great Lakes basin in western Lake Erie and the Maumee River. Gulf Coast drainages from the Mobile River basin to the Trinity River, Texas.

**Kentucky Distribution**

Type locality: Kentucky River and Ohio River at Rapids of Letart, Ohio and West Virginia (type locality later restricted to Rapids of Letart by Johnson and

Baker 1973). Generally distributed throughout the Ohio River and in most larger streams from the Tennessee to the Licking river drainages; absent in the upper Cumberland River drainage above Cumberland Falls. Sporadic in the Mississippi River, Carlisle and Hickman counties (EKU; KNP), but not reported from direct tributaries. Generally distributed in the Tennessee River and sporadic in lower Clarks River. Generally distributed throughout the Cumberland River upstream to the base of Cumberland Falls, but reported from tributaries only in the lower Rockcastle River. Sporadic in the Tradewater River. Generally distributed throughout the Green River upstream to Green County, including the lower Rough, Mud, and Barren rivers; not reported from the Pond River. Occasional but widely distributed in the Salt River drainage. Generally distributed to occasional in the Kentucky River, and reported from the lower reaches of Eagle Creek, Elkhorn Creek, and the Red River. Reported from an unspecified location in the South Fork Kentucky River (Williams 1975), and Danglade (1922) reported it as rare in the upper Kentucky River drainage (from unspecified locations but probably including the North Fork Kentucky River). Generally distributed in the Licking River upstream to Rowan County, but reported from tributaries only in lower Slate Creek. Not reported from Ohio River tributaries upstream of the Licking River, but probably occurred historically in the lower reaches of the Big Sandy River.

**Habitat & Larval Hosts**

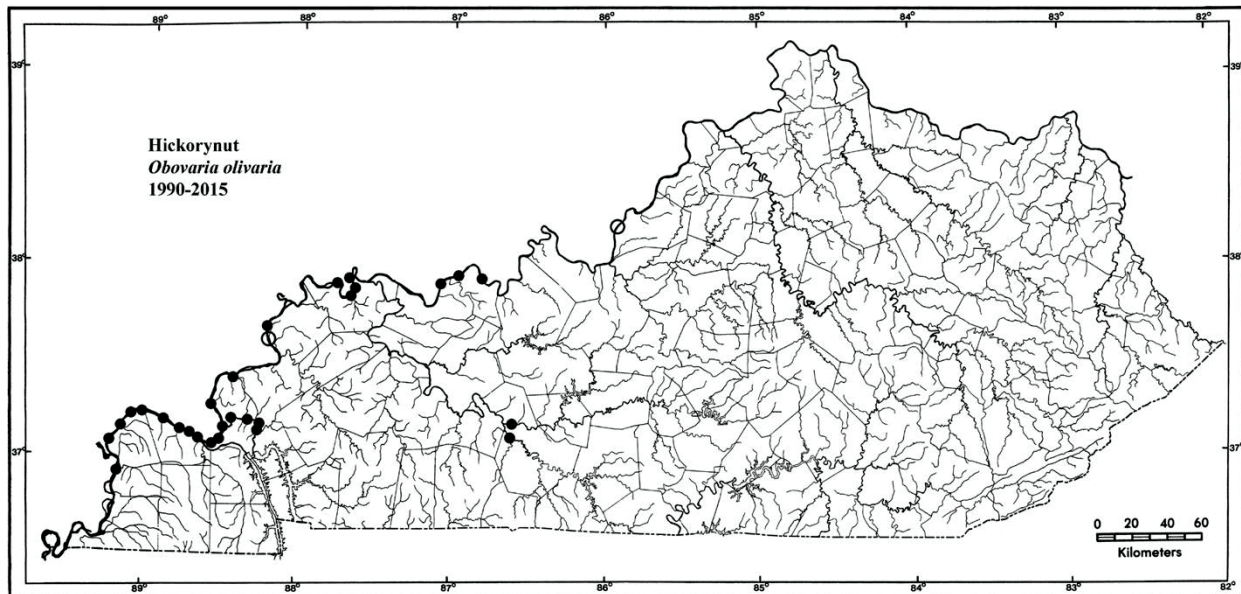
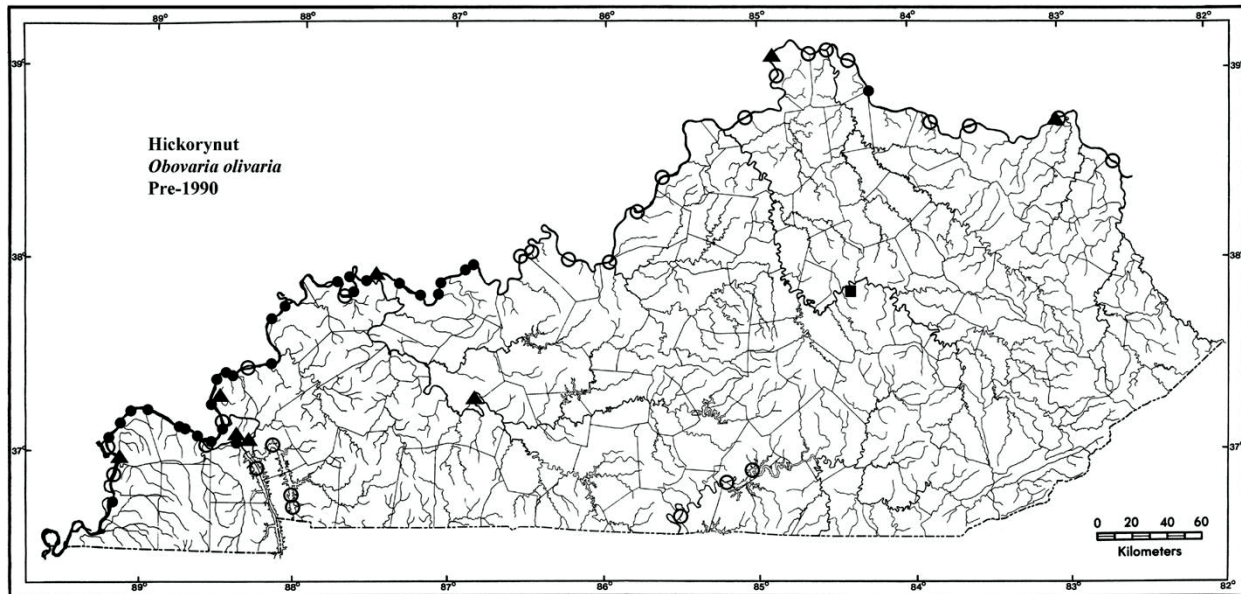
This species is a common and characteristic member of large stream mussel assemblages, but it only occasionally dominates those assemblages. It occurs in main-channel mussel beds, but also is found frequently in depositional areas along shore and in backwater pools. It adapts readily to riverine impoundments, where it colonizes inundated river floodplains, but is absent in truly lentic habitats. The host for this species is unknown.

**Conservation Status**

*Obliquaria reflexa* remains common in larger streams across most of Kentucky and its distribution has changed relatively little in the last 100 years. It was eliminated from the middle Cumberland River drainage by Wolf Creek Dam and now appears to be extremely localized in the Salt River drainage for unknown reasons. The species now appears to be sporadically distributed in the Kentucky River, but it is locally common there. Most other populations are large and show evidence of recent recruitment. Populations in the impounded Tennessee and lower Cumberland rivers may have increased due to the inundation of former river floodplains, which this species has colonized extensively. AFS: currently stable.

*Obovaria olivaria* (Rafinesque, 1820)

## Hickorynut

**General Distribution**

Mississippi River basin from Louisiana north to Minnesota, and west to Kansas and South Dakota. Ohio River basin from the mouth upstream to Pennsylvania. Great Lakes basin from Lake Michigan to the St. Lawrence River system.

**Kentucky Distribution**

Type locality: Kentucky River. Restricted to the largest rivers. Sporadic in the Mississippi River, but formerly generally distributed throughout the Ohio River and in the Tennessee and lower Cumberland rivers. Rare historically in the middle Cumberland River



upstream to Russell County (UMMZ; Wilson and Clark 1914). Only three records are available for the Green River system, an archaeological record from the lower Green River, Butler County (Patch 2005), and two contemporary records from the Green and Barren rivers, Warren County (Gordon 1993; Lewis Environmental Consulting 2011). A record from the Green River, Muhlenberg County (UF) is *Reginaia ebena* (J. Williams, personal communication). Not reported from the Kentucky River apart from the type locality; records for the Green and Kentucky river drainages (Williams 1969, 1975) are unsubstantiated. Not reported from the Salt, Licking, or Big Sandy river drainages. Despite the lack of records, this species may have occurred historically in the lower reaches of most large tributaries of the Ohio River in Kentucky.

#### Habitat & Larval Hosts

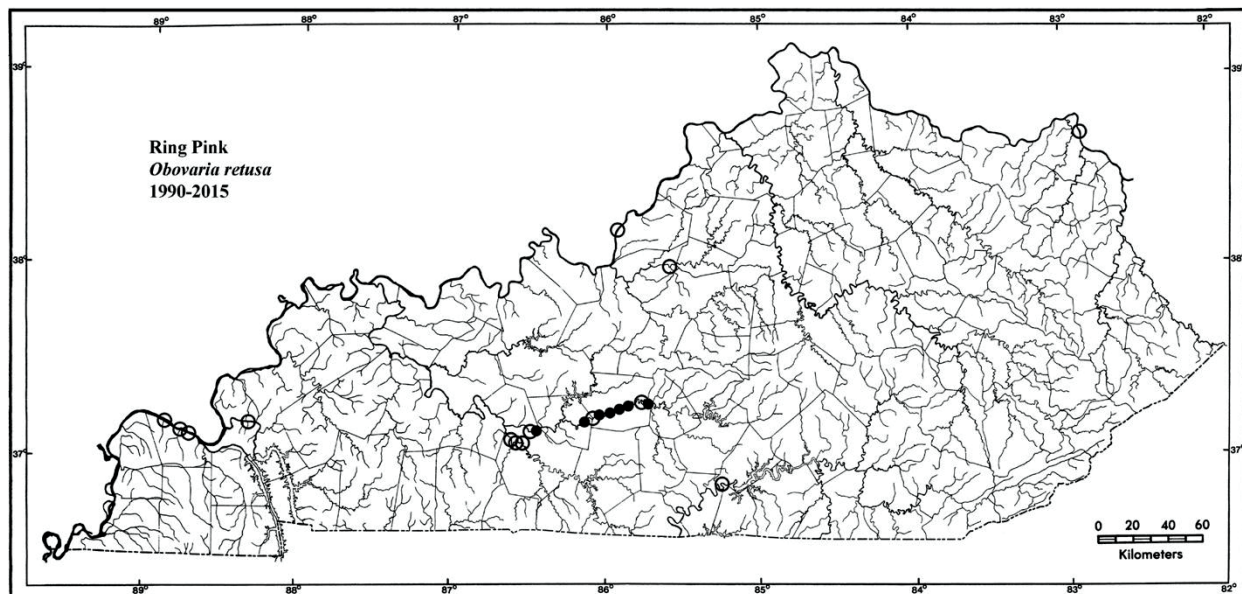
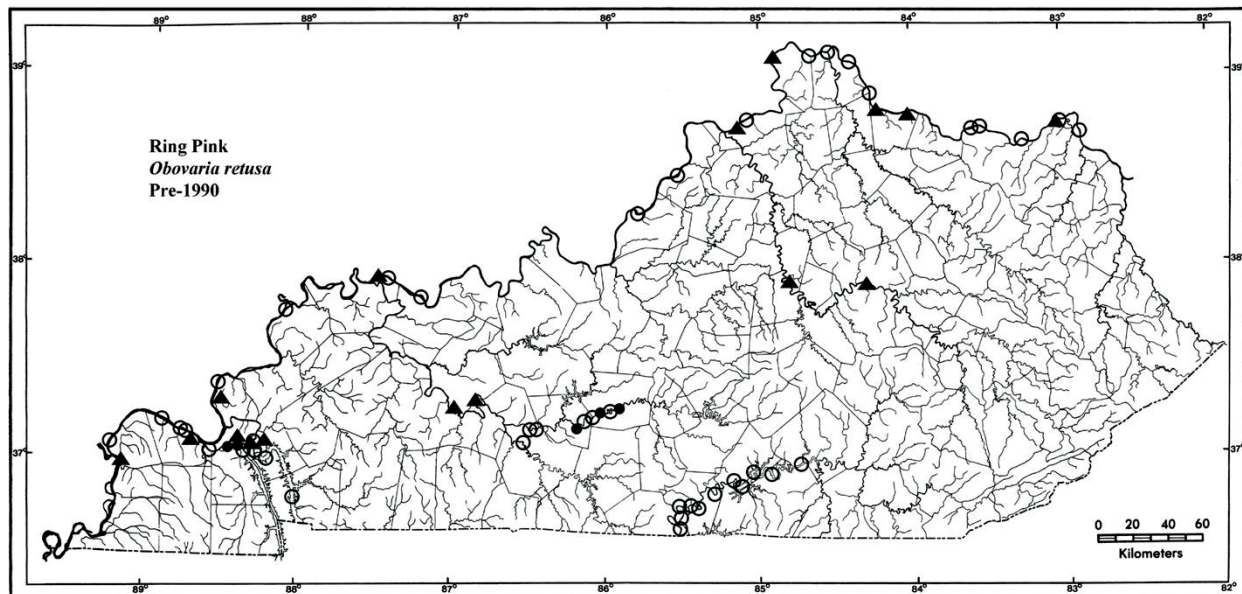
Restricted to main-channel habitats of large rivers in gravel and sand substrates. This species may be locally common but it is rarely a dominant component of mussel beds. This species is a host specialist on sturgeons, primarily Lake Sturgeon (*Acipenser fulvescens*) and Shovelnose Sturgeon (*Scaphirhynchus platyrhynchus*), which likely explains its restriction to large rivers.

#### Conservation Status

*Obovaria olivaria* has declined substantially in Kentucky and remains common only in the lower Ohio River from the mouth upstream to Smithland Lock and Dam, near the mouth of the Cumberland River. It is now sporadic and rare upstream to Cannelton Lock and Dam, Hancock County, and appears absent in the river upstream of this point. It has not been found recently in the Tennessee River, but it persists in the lower Cumberland River where it is occasional; the small population in the middle Cumberland River was eliminated by Wolf Creek Dam. Declines in sturgeon populations may largely explain the decline of *O. olivaria* in Kentucky. Sturgeon undertake lengthy spawning runs, and dams that block these migrations or otherwise destroy riverine habitat have eliminated or reduced sturgeon populations worldwide (Auer 1996). Lake Sturgeon are nearly extirpated from the Ohio River, and Shovelnose Sturgeon have declined dramatically in the upper river since the 1950s and remain common only in the lower river (Trautman 1981; Burr and Warren 1986), similar to *O. olivaria*. Older dams on the Ohio River (constructed prior to 1930) were lowered at high water, likely allowing sturgeon passage, but the newer, fixed high-lift dams that replaced them appear to have had negative effects on sturgeon populations. High-lift dams on the upper river were constructed earlier (1930–1964) than those on the lower river (Newburgh, John T. Myers, and Smithland locks and dams, 1975–1980), and the extreme lower section of the river remains influenced only by older, movable dams (locks and dams 52 and 53). This chronology of dam construction may explain the disappearance of sturgeon and *O. olivaria* in the upper river and their persistence only in the lower river, particularly the relatively high abundance of both species downstream of Smithland Dam. Sturgeon and *O. olivaria* have declined or disappeared in other impounded tributaries of the Ohio River, but both remain common in the unimpounded Wabash River (Cummings and Mayer 1992; Kennedy et al. 2007). The future of *O. olivaria* in Kentucky is uncertain. Populations in the Ohio River upstream of Smithland Lock and Dam may be relicts composed of individuals that recruited prior to construction of high-lift dams in the last 35 years. The population in the lower river appears large and healthy, but Olmsted Lock and Dam, currently under construction to replace dams 52 and 53, may reduce remaining habitat for the species in Kentucky. However, Lake and Shovelnose Sturgeon are being reintroduced in some parts of the Ohio River basin, which may make possible reintroduction or natural recovery of *O. olivaria*. KNP: none, but this species warrants listing as threatened; AFS: currently stable.

*Obovaria retusa* (Lamarck, 1819)

## Ring Pink

**General Distribution**

Endemic to the Ohio River basin, formerly occurring throughout the Ohio River upstream to Pennsylvania, and in larger tributaries from the Tennessee River upstream to the Muskingum River, Ohio.

**Kentucky Distribution**

Type locality: Ohio River at Cincinnati, Ohio (type locality designated by Johnson 1969). Formerly occurred throughout the Ohio River and in most larger tributaries; absent in smaller streams. An archaeological record from the Mississippi River, Ballard

County, suggests that conditions at that site were suitable for the species in prehistoric times (Wesler 2001; see Section IV.C.2). Widespread throughout the Tennessee and Cumberland rivers; formerly generally distributed in the middle Cumberland River upstream to at least Pulaski County; absent above Cumberland Falls (Neel and Allen 1964). An archaeological record from the West Fork Red River, Todd County (OSUM), is considered doubtful (see Section IV.C.2). Reported from the lower Green River only from archaeological assemblages (Morey and Crothers 1998; Morey et al. 2002; Claassen 2005; Patch 2005), but probably generally distributed there historically. Formerly generally distributed in the upper Green River upstream to Hart County, and reported from the lower Barren River, Warren County. Reported from a single site in the Salt River drainage (Salt River, Bullitt County; KNP). Reported from the Kentucky River at archaeological sites in Madison and Woodford counties (Call and Robinson 1983; N. O'Malley, personal communication), and unspecified historical localities (Rafinesque 1820a; Vanatta 1915; ANSDU). Not reported from the Licking or Big Sandy rivers but possibly occurred in the lower portion of those streams.

#### Habitat & Larval Hosts

Restricted to main-channel habitats of medium-sized to large streams in gravel and sand substrates. This species was locally common historically, but it probably was not a dominant member of mussel assemblages. The host for this species is unknown, but it probably specializes on darters, similar to *Obovaria subrotunda*.

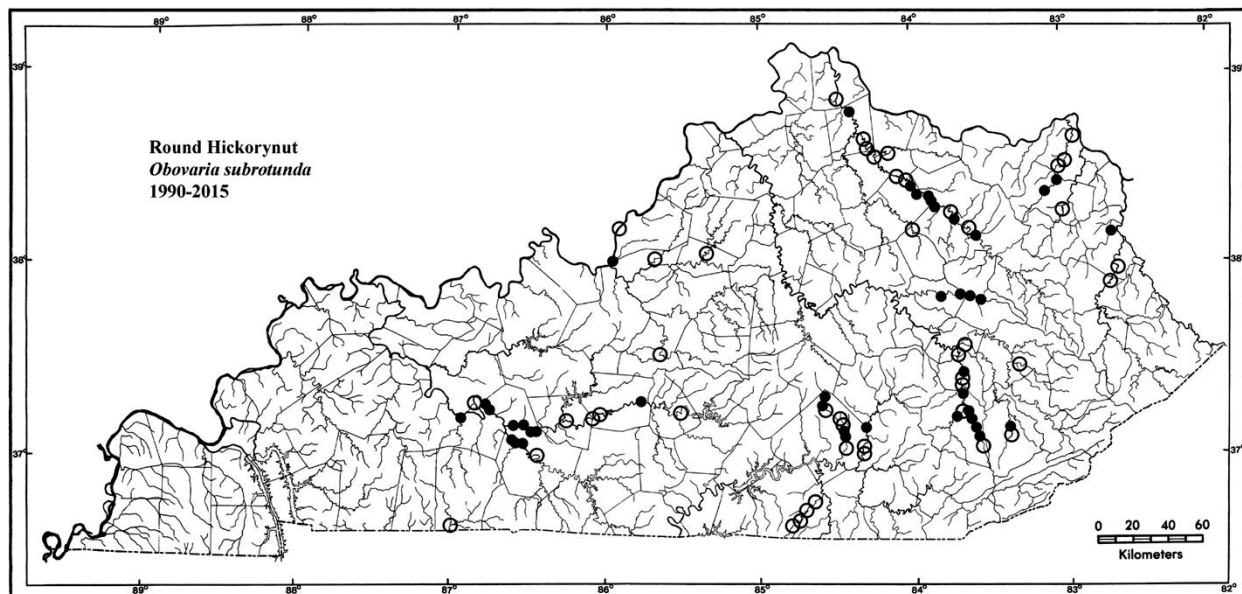
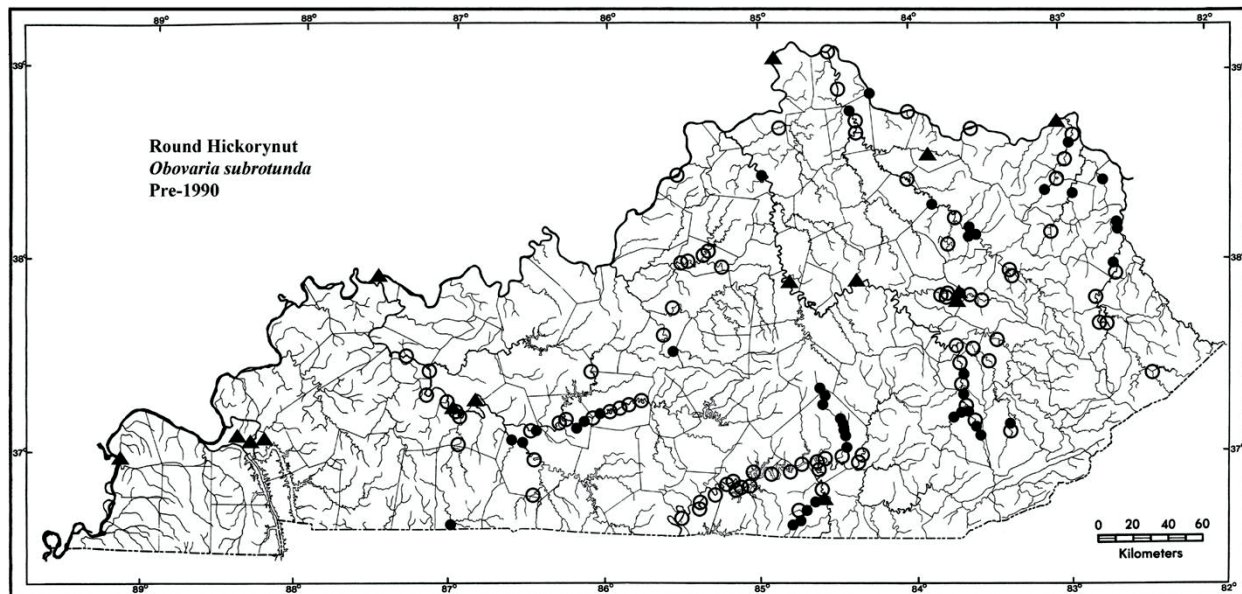
#### Conservation Status

*Obovaria retusa* probably was a characteristic member of large-stream mussel assemblages throughout much of Kentucky. Relic shells are found commonly throughout the Ohio and lower Tennessee rivers, attesting to its former regular occurrence there (Williams and Schuster 1989; OSUM). It was a common species historically in the middle Cumberland River (Neel and Allen 1964) and the upper Green River (Ortmann 1926a; OSUM; MCZ; NMNH). Today, this species has disappeared from nearly all of its historical range and is near extinction. It is clearly intolerant of impoundment, and dams have destroyed or radically altered most habitat for the species. There are few or no reports of living or recently dead *O. retusa* from the Ohio River since impoundment of that stream for navigation in 1929 (USFWS 1991), and navigation dams affecting the lower Green, Salt, and Kentucky rivers were probably responsible for its early disappearance in those rivers. The large population in the middle Cumberland River was eliminated by Wolf Creek Dam in 1950. The species persisted but was extremely rare in the lower Tennessee River, Livingston/Marshall counties, until at least the mid-1980s (Sickel 1985; USFWS 1991). Elsewhere in its range, the species persisted until at least the 1980s at two sites in the Tennessee River in Alabama and Tennessee, and at one site in the Cumberland River, Tennessee, but these populations were small and apparently non-reproducing (Parmalee and Klippel 1982; USFWS 1991). Perhaps the only remaining population on Earth is in the upper Green River, Warren, Edmonson, and Hart counties, but its viability is unknown. This population has declined since the 1960s probably due to oil brine pollution and altered flows from Green River Dam (Stansbery 1965; see Williams 1969; Konrad et al. 2012). In 1972, 8 recently dead shells were found at Munfordville (OSUM), but since that time only about 13 living or recently dead individuals have been found anywhere in the river, including single individuals in 2013, 2014, and 2015 (KNP; M. McGregor, personal communication). Improvements in water release from Green River Dam and other conservation measures in the watershed may have broad benefits for the mussel fauna, but the population of *O. retusa* may be too small to reproduce naturally. Attempts to bring live individuals from this population into captivity for propagation have been unsuccessful to date (USFWS 2011; M. McGregor, personal communication), but these efforts are ongoing and represent perhaps the only hope for survival of this species. KNP: endangered; AFS: endangered; USFWS: endangered.



*Obovaria subrotunda* (Rafinesque, 1820)

## Round Hickorynut

**General Distribution**

Largely confined to the Ohio River basin, where it occurs from the Tennessee River drainage upstream to New York, but generally absent in lowland regions of the lower basin. Also in the Great Lakes basin in Lake St. Clair and western Lake Erie. Reports of this species in the lower Mississippi River basin in Mississippi (Hartfield and Rummel 1985; Hartfield and Ebert 1986) may represent a disjunct population, *Obovaria jacksoniana*, or an undescribed taxon; previous reports from Arkansas were based on misidentifications (Harris et al. 2009).

**Kentucky Distribution**

Type locality: Ohio River and its tributaries (type locality designated as Kentucky River by Johnson and Baker 1973). Widely distributed in the eastern two-thirds of the state. Sporadic to occasional historically in the Ohio River; not reported from the lower section, but probably occurred throughout the river. An undated historical specimen labeled “Kentucky, Hickman, Ohio River” (MCZ), is not mappable; the town of Hickman (Fulton County) and the current boundaries of Hickman County are on the Mississippi River, but Hickman County formerly included portions of Ballard and McCracken counties on the lower Ohio River. An archaeological record from the Mississippi River, Ballard County, suggests that conditions at that site were suitable for the species in prehistoric times (Wesler 2001; see Section IV.C.2). Absent in lowland habitats in western Kentucky including the Tradewater River. Reported from the lower Tennessee and lower Cumberland rivers only from archaeological sites in Livingston and Lyon counties (Casey 1986, 1987), but widespread elsewhere in both drainages (Parmalee and Bogan 1998; Williams et al. 2008), and probably occurred at least sporadically throughout these rivers historically. Reported from the lower Cumberland River drainage from the Red River, Logan County (KNP; MSU). Formerly generally distributed throughout the middle Cumberland River drainage upstream to Laurel County, but absent above Cumberland Falls (Wilson and Clark 1914; Neel and Allen 1964). Generally distributed to occasional in the upper Green River drainage but sporadic in the lower Green River drainage and not reported from the Pond or Rough rivers. Sporadic in the Salt and Kentucky river drainages with the exception of the Red River and South Fork Kentucky River system, where it is generally distributed to occasional. Occasional and localized in all other Ohio River tributaries from the Licking to the Big Sandy river drainage.

**Habitat & Larval Hosts**

Occurs in a wide variety of upland riverine habitats from large rivers to small streams, but does not penetrate far into the headwaters. Restricted to main-channel habitats in gravel and sand substrates, and typically absent from depositional habitats or lentic environments. Although locally common, this species is rarely or never a dominant component of mussel assemblages. This species is a host specialist on darters (Percidae).

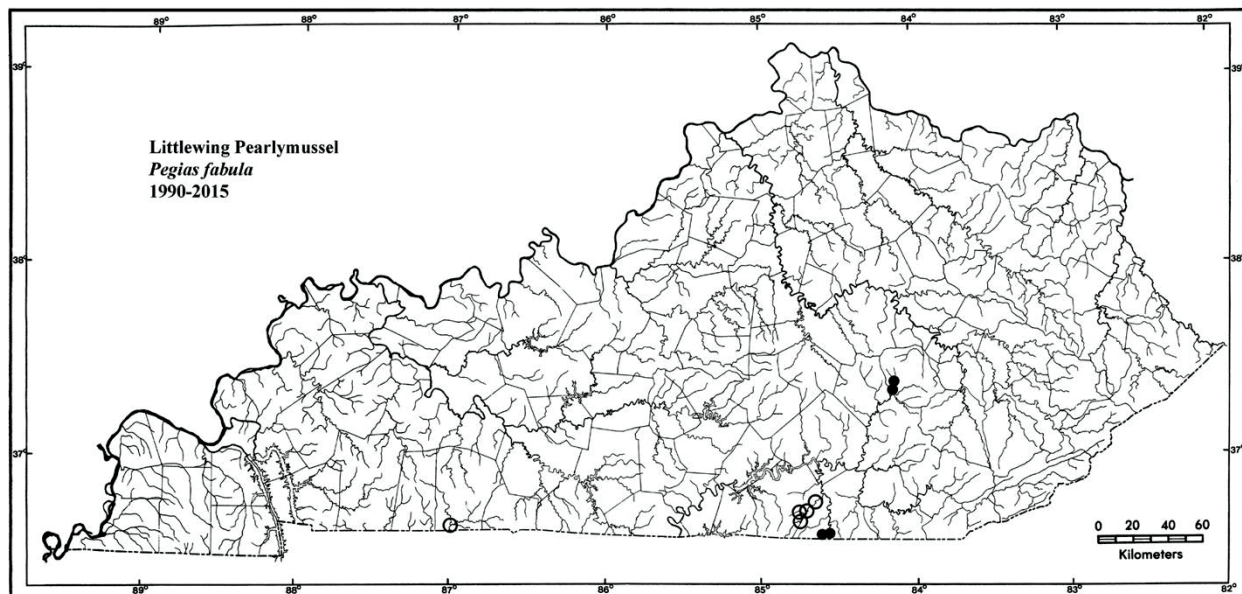
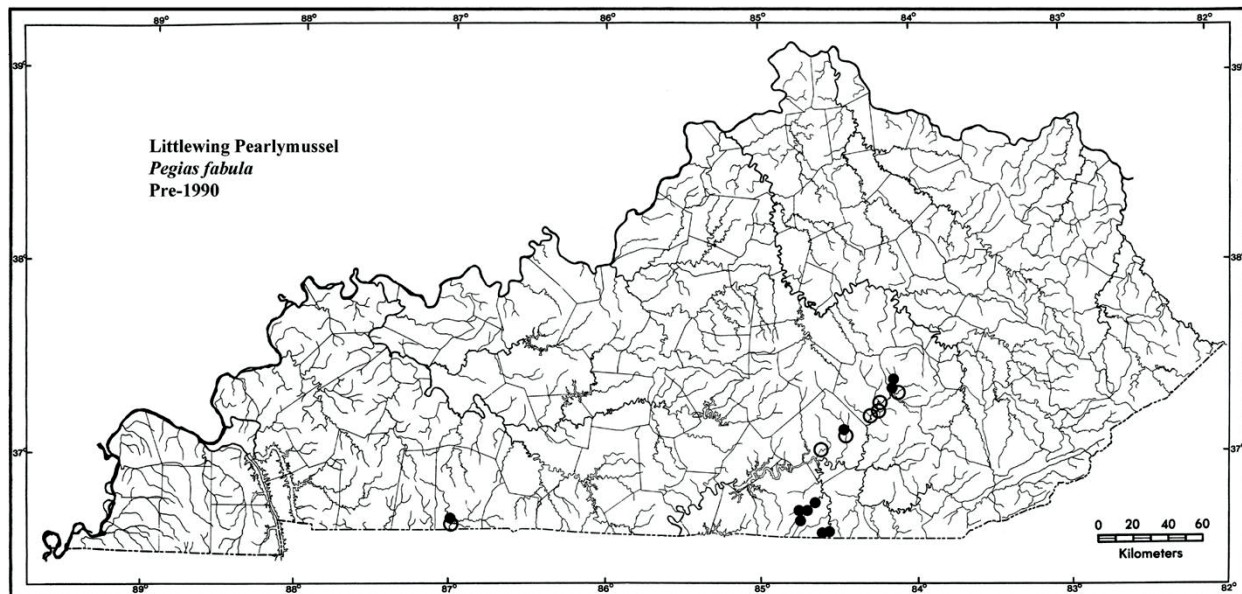
**Conservation Status**

*Obovaria subrotunda* remains widespread in Kentucky, but its distribution is much reduced and only a handful of small, widely scattered populations remain. Like other mussels species that are dependent on darters as hosts, *O. subrotunda* did not adapt well to the loss of shoal habitats after impoundment of large rivers. Historically, this species was “very common all along the Indiana shores” of the Ohio River (Call 1900), but there are only two reports of living or recently dead individuals since 1970 (G. Schuster and P. Morrison, personal communication). Impoundment probably eliminated the species from the Tennessee, lower Cumberland, Kentucky, and most of the lower Green River, and the large population in the middle Cumberland River was eliminated by Wolf Creek Dam. A large population existed in Blaine Creek, Lawrence County (Big Sandy River drainage; Bay and Winford 1984), but this population appears extirpated by construction of Yatesville Dam in 1992. Many other populations have disappeared for mostly unknown reasons. It is nearly extirpated throughout the Cumberland River drainage where small populations survive only in Buck Creek, Pulaski County; Rockcastle River, Laurel/Pulaski counties; and possibly the Red and Stones rivers, Tennessee (Schmidt 1982; Houpp and Smathers 1995; McGregor 2003). It also appears extirpated from the Salt River drainage, North Fork Kentucky River, Little Sandy River, and the Levisa Fork Big Sandy River. It remains relatively common locally in the Green and Barren rivers but has nearly disappeared from the upper sections of both streams. In addition to the Green River drainage, the largest remaining populations in Kentucky probably are in the upper Kentucky River drainage (South Fork and Red River) and the Licking River, but the species is uncommon in those streams. KNP: none, but this species warrants listing as threatened; AFS: special concern; USFWS: petitioned for listing.



*Pegias fabula* (Lea, 1838)

## Littlewing Pearlymussel

**General Distribution**

Endemic to the Tennessee-Cumberland faunal province, occurring historically in northern Alabama, southern Kentucky, western North Carolina, Tennessee, and southwestern Virginia.

**Kentucky Distribution**

Sporadic in the Red River system (lower Cumberland River drainage). Occasional to sporadic in the middle Cumberland River drainage, but reported from only four tributaries: Big South Fork (including the Little South Fork), McCreary and Wayne counties;



Pitman and Buck creeks, Pulaski County; and the Rockcastle River system, Laurel, Rockcastle, and Jackson counties. Not reported from the mainstem Cumberland River and absent above Cumberland Falls.

**Habitat & Larval Hosts**

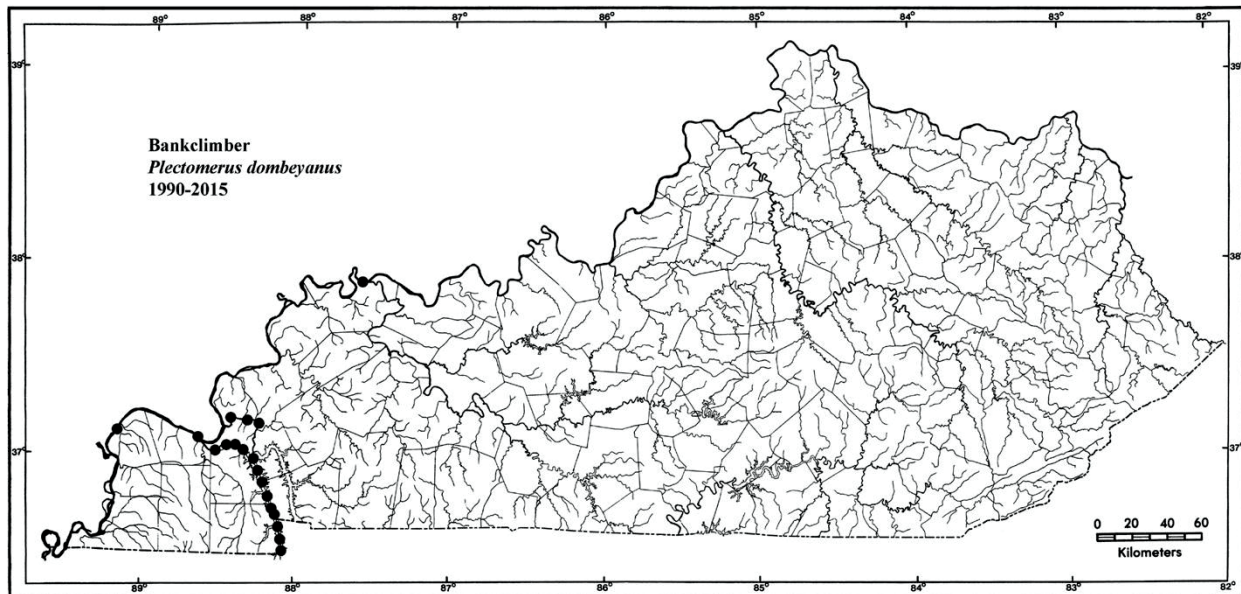
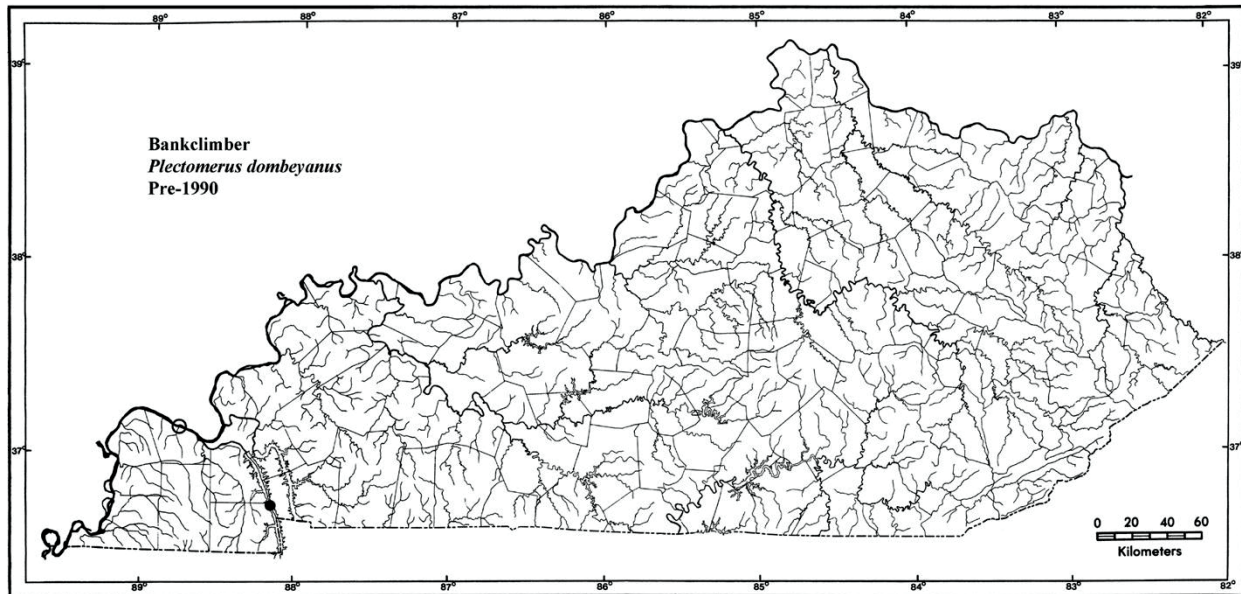
Restricted to small or medium-sized streams in gravel and sand substrates, but does not penetrate far into the headwaters. Frequently found under large, flat rocks, and such microhabitats may harbor multiple individuals. This species is a host specialist on darters (Percidae).

**Conservation Status**

The distribution of *Pegias fabula* in Kentucky and throughout its range has been reduced dramatically in the last 30 years, and this species is now in danger of extinction. This species was overlooked in a survey of the Cumberland River drainage in the late 1940s and was considered possibly extinct at that time (Neel and Allen 1964). In subsequent decades, several populations were discovered or rediscovered (e.g., Blankenship 1971; Starnes and Starnes 1980). Prior to 1990, there were at least three large populations in Kentucky, in the upper Big South Fork, the Little South Fork, and the Rockcastle River system. Density of the species in the Little South Fork in 1981 averaged 1.3/m<sup>2</sup> but was as high as 6/m<sup>2</sup> at one site (Starnes and Bogan 1982). Small or historical populations also existed in Buck Creek (only single individuals reported in 1974 and 1975, OSUM; NCMNS), Pitman Creek (KNP), and the Red River system (including a single live individual in Whippoorwill Creek, Logan County, in 1988; KNP). By the 1980s, the species had disappeared from the Rockcastle River, but it remained locally common in a tributary, Horse Lick Creek, Jackson County. From the 1980s to about 2000, coal mining and oil drilling appear to have extirpated the large populations in Horse Lick Creek and the Little South Fork (Layzer and Madison 2000; Haag and Warren 2004; Warren and Haag 2005), and the smaller populations in Buck Creek, Pitman Creek, and the Red River system also seem to have disappeared. Simultaneously, most other remaining populations elsewhere in its range disappeared or declined to very low levels. The largest and perhaps only viable population on Earth is now in the Big South Fork Cumberland River in Kentucky and adjacent Tennessee (Ahlstedt et al. 2003–2004). The species is sporadic but locally common in the Big South Fork and is probably reproducing, but it occupies only about 12 miles of stream and the population is highly vulnerable to extinction. It is imperative that specific factors leading to its extirpation in other streams, especially Horse Lick Creek, Little South Fork, and the Rockcastle River, be identified and remediated so that the species can be reestablished in those streams while source stock from the Big South Fork remains available. KNP: endangered; AFS: endangered; USFWS: endangered.

*Plectomerus dombeyanus* (Valenciennes, 1827)

## Bankclimber

**General Distribution**

Historical range included the lower Mississippi River basin from Louisiana north to the vicinity of the Missouri Bootheel and west to eastern Oklahoma. Widespread in Gulf Coast drainages from the Escambia River, Florida, west to the San Jacinto River, Texas. The species has expanded its range recently into the lower Ohio River basin (see subsequent).

**Kentucky Distribution**

Not reported from Kentucky prior to 1981, but now established throughout the Tennessee and lower Cumberland rivers, and four records are available for the

Ohio River in Ballard, McCracken, and Henderson counties (OSUM; Tiemann et al. 2013). Its apparent absence in the Mississippi River and direct tributaries is odd because the species occurs in similar habitats in southeastern Missouri and in the Reelfoot Lake and Obion River drainages just over the state line in northwestern Tennessee (Oesch 1995; Parmalee and Bogan 1998). A record from South Elkhorn Creek, Fayette County (UF), is *Quadrula verrucosa* (J. Williams, personal communication).

#### Habitat & Larval Hosts

In its historical range, this species is restricted to medium-sized to large low-land rivers where it occurs in main-channel habitats in sand and gravel and in depositional areas along shore or in backwater pools. May be a dominant component of mussel assemblages in these areas. It adapts to riverine impoundments but is usually absent in truly lentic habitats. The host for this species is unknown.

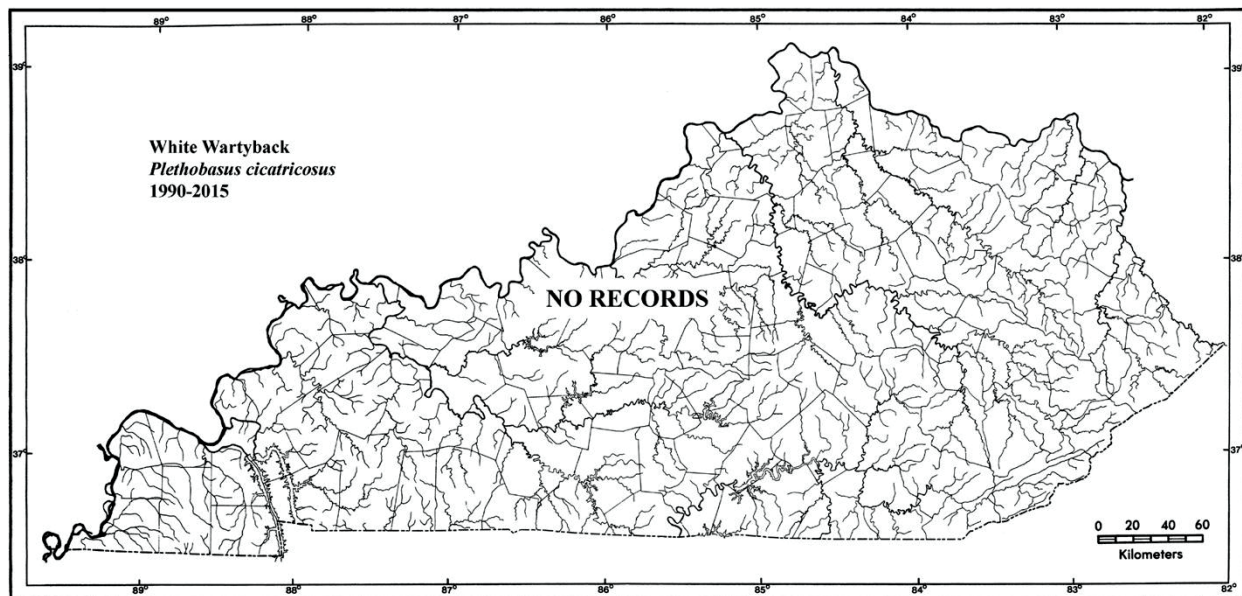
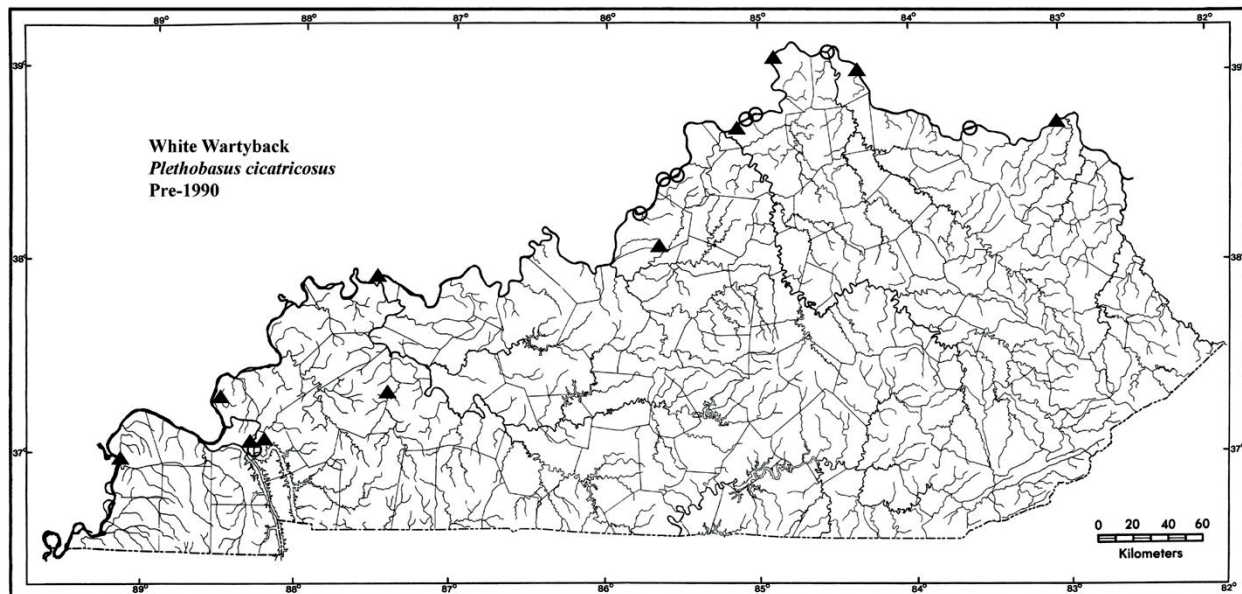
#### Conservation Status

*Plectomerus dombeyanus* appears to be a recent addition to the mussel fauna of Kentucky. It was not reported from the state prior to 1981 when it was discovered in Kentucky Lake (Tennessee River), Trigg County (Pharris et al. 1984). However, a relic shell was collected from the Ohio River, McCracken County, in 1982 (OSUM), suggesting that the species was present for some time previously. By 2001, the species had colonized all of Kentucky Lake, upstream to at least the mouth of the Duck River, Humphreys County, Tennessee (Parmalee and Bogan 1998; Sickel et al. 2007), and it became established in the Tennessee River below Kentucky Dam by 2003 (Sickel and Burnett 2001; Lewis et al. 2006). By 2009, it had colonized much of the lower Cumberland River below Barkley Dam (Fortenberry 2008, 2009). How *P. dombeyanus* arrived and spread in Kentucky is unclear. It may have simply expanded its range naturally from nearby populations in Tennessee, Missouri, or Arkansas, but the lack of established populations between these sources and the initial populations in Kentucky casts doubt on this idea. Another possibility is that the species moved north into the Tennessee River from the Mobile River basin via the Tennessee-Tombigbee Waterway, which connected these river systems. Several fish species have expanded their ranges via this route (Etnier and Starnes 1993), but the waterway was not completed until 1984, and the lack of established populations in the Tennessee River in the vicinity of the waterway in Alabama and Mississippi also makes this explanation implausible. Instead, the rapid, stepping-stone spread of the species in the Tennessee River both upstream and downstream of its initial location strongly suggests a single, probably human-mediated, introduction into Kentucky Lake sometime in the late 1970s. The species appears to have dispersed from the Tennessee River into the Ohio River and thence to the lower Cumberland River, but it is curious that it seems to have not yet entered Lake Barkley via the canal that connects it to Kentucky Lake. The 1982 record from the Ohio River and a 1996 record from Henderson County, 140 miles upstream of the Tennessee River, may represent separate introductions or isolated long-distance dispersal events. A highly mobile host fish that could transport larval mussels long distances could explain the rapid spread of this species. *Plectomerus dombeyanus* is now well established in the Tennessee and lower Cumberland rivers, and it can be expected to spread further throughout large streams in western Kentucky. AFS: currently stable.



*Plethobasus cicatricosus* (Say, 1829)

## White Wartyback

**General Distribution**

Endemic to the Ohio River basin, formerly occurring in the Ohio River from the mouth upstream to Ohio and West Virginia, and in larger tributaries from the Tennessee River upstream to the Muskingum River, Ohio.

**Kentucky Distribution**

Probably generally distributed historically throughout the Ohio River and in large tributaries, but specific records are few, especially for tributaries. An archaeological record from the Mississippi River, Ballard County, suggests that conditions at that site were

suitable for the species in prehistoric times (Wesler 2001; see Section IV.C.2). Documented historically from seven sites in the Ohio River from Jefferson to Lewis County, and reported throughout the river from archaeological assemblages. Not reported from the Tennessee River in Kentucky, but present historically throughout that stream upstream to at least Knoxville (Parmalee and Bogan 1998; Williams et al. 2008). Relic or archaeological specimens are reported from the lower Cumberland River, Livingston and Lyon counties (Casey 1986, 1987; Sickel and Chandler 1996). An archaeological record from the West Fork Red River, Todd County (OSUM), is considered doubtful (see Section IV.C.2). Parmalee and Bogan (1998) speculated that some specimens of *P. cyphus* reported by Wilson and Clark (1914) from the middle Cumberland River could be *P. cicatricosus*, but all museum specimens from this and other studies (Neel and Allen 1964; UMMZ) in the Kentucky portion of the middle Cumberland River are *P. cyphus*. Records of *P. cooperianus* from the lower and middle Cumberland River (Wilson and Clark 1914) were inadvertently mapped as *P. cicatricosus* by Schuster (1988). Reported from the Green River system from a single archaeological record from the Pond River, Hopkins County (Kreisa 1991), and from the Salt River drainage by a single relic shell from Floyds Fork, Jefferson County (Bader and McGrath 2015); these occurrences in medium-sized streams are unusual.

**Habitat & Larval Hosts**

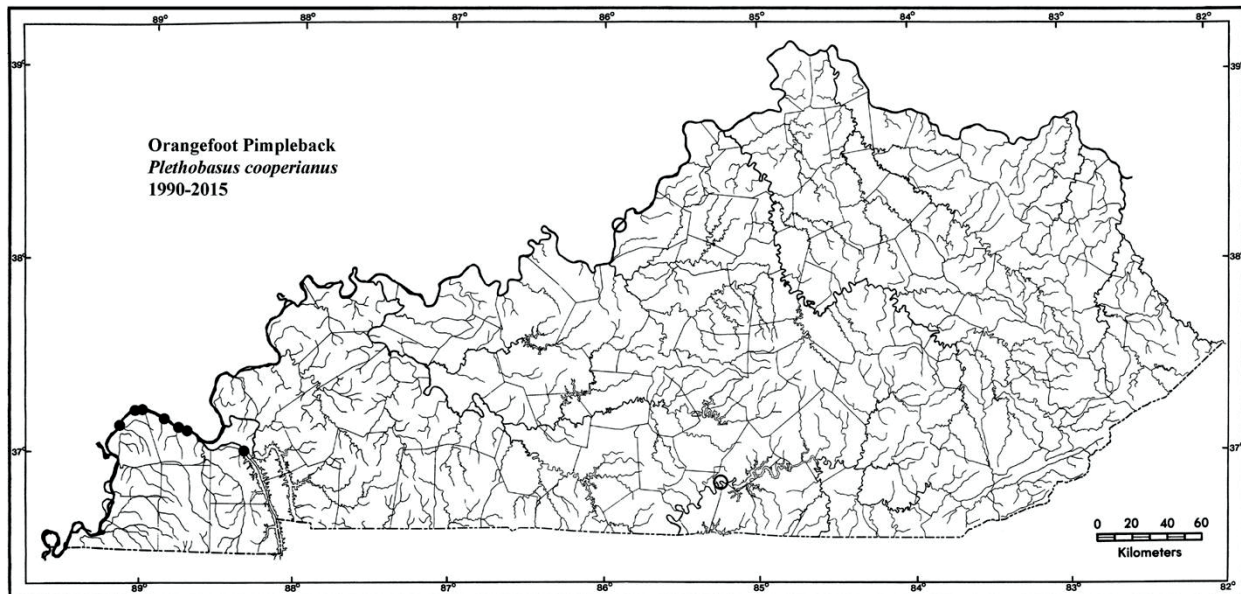
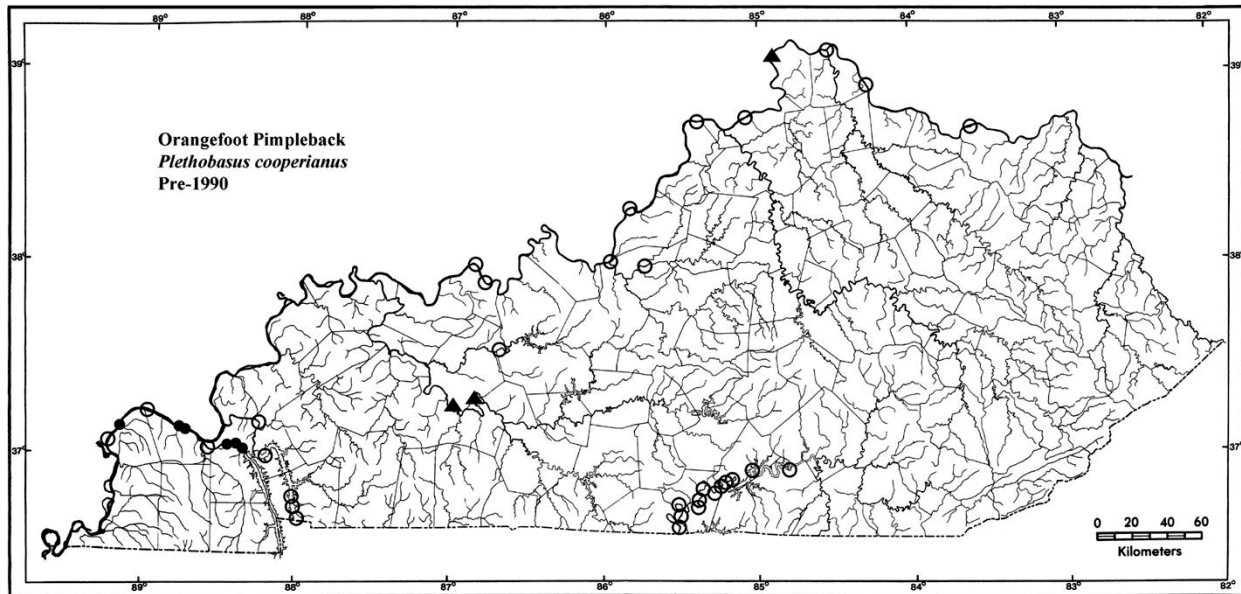
Apparently restricted to main-channel habitats of large rivers probably in gravel and sand substrates. On the basis of its abundance in archaeological assemblages and historical accounts (e.g., Call 1900), it appears to have been a locally dominant species in much of the Ohio River and a regular member of mussel assemblages in the lower Tennessee, Cumberland, and perhaps other large rivers in the state. The host for this species is unknown.

**Conservation Status**

*Plethobasus cicatricosus* appears to be intolerant of impoundment, and because almost none of its historical range remains free-flowing, it is now highly endangered and near extinction. Living individuals have not been reported from the Ohio River or any other stream in Kentucky in over 100 years. The only known population on Earth is in a short reach of the Tennessee River below Wilson Dam, Alabama. Less than 10 individuals have been seen here in the last 20 years, but the presence of 3–6 year old individuals indicates that some recruitment is occurring (Garner and McGregor 2001). Captive propagation of individuals from this population is vital to lessen extinction risk for the species, but the rarity of the species makes finding broodstock difficult and suitable sites for reintroduction elsewhere in its range are limited. KNP: presumed extirpated; AFS: endangered; USFWS: endangered.

*Plethobasus cooperianus* (Lea, 1834)

## Orangefoot Pimpleback

**General Distribution**

Endemic to the Ohio River basin, occurring throughout the Ohio River from the mouth upstream to Pennsylvania, and in larger tributaries from the Tennessee River upstream to the Muskingum River, Ohio.

**Kentucky Distribution**

Type locality: Ohio River. Formerly occurred throughout the Ohio River and in larger tributaries from the Tennessee to at least the Salt river; absent in small streams. Formerly generally distributed in the Tennessee and Cumberland rivers, in the latter upstream to at



least Wayne County, but absent above Cumberland Falls. Archaeological records exist for the lower Green River, Butler and Ohio counties (Morey and Crothers 1998; Morey et al. 2002; Patch 2005), and an unsubstantiated historical record (not plotted) from “southern Kentucky” likely refers to the Green or Barren rivers, Warren County (Price 1900). A historical record from the Rough River, Grayson/Ohio counties (Clench and van der Schalie 1944), is unusual due to the relatively small size of the stream but is considered valid. A single record is available for the Salt River drainage (Salt River, Bullitt County; NCMNS). Not reported from the Kentucky, Licking, or Big Sandy rivers, but possibly occurred in the lower reaches of those streams historically.

**Habitat & Larval Hosts**

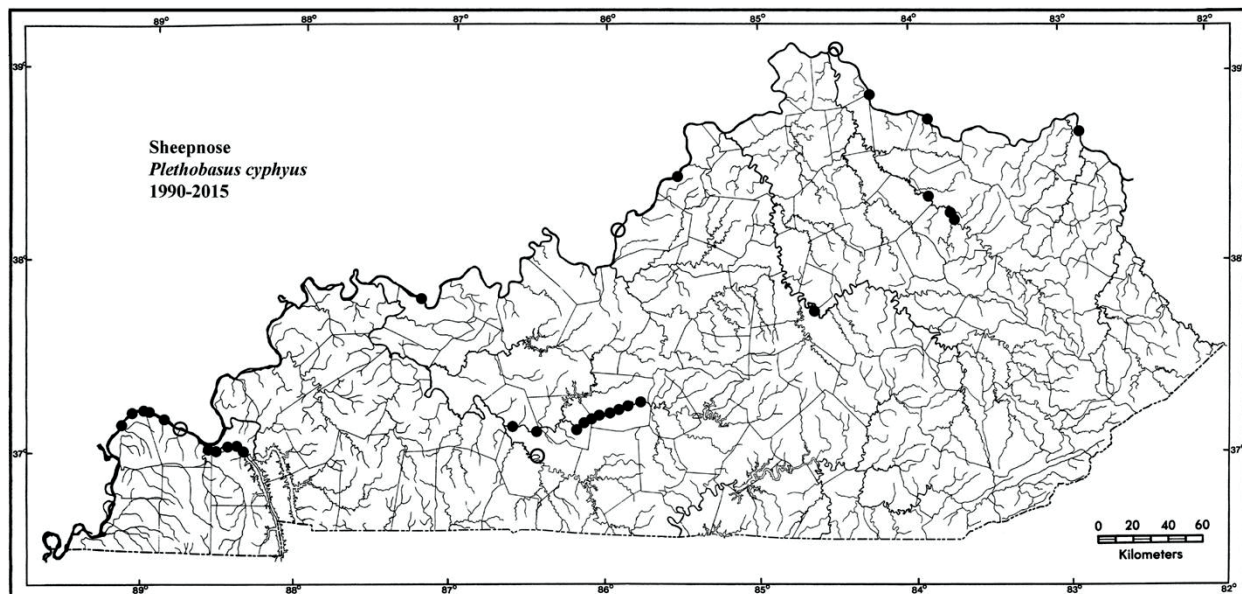
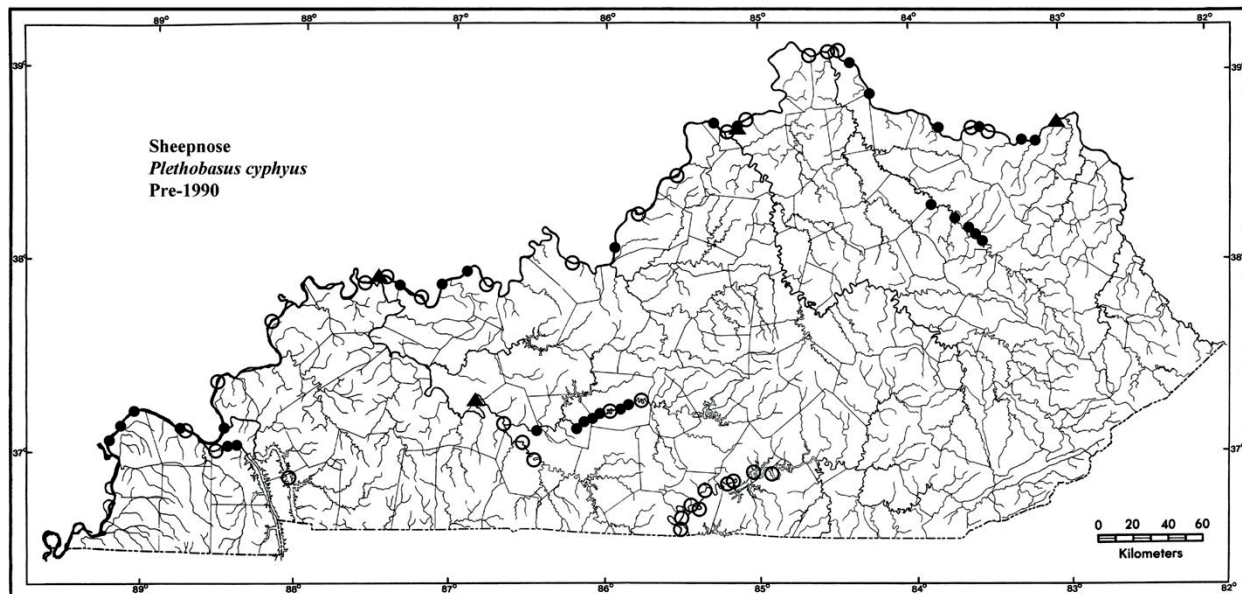
Restricted to main-channel habitats of large rivers in gravel and sand substrates. This species can be locally common, but it was never a dominant member of large stream mussel beds. The host for this species is unknown.

**Conservation Status**

*Plethobasus cooperianus* probably was a regular and characteristic member of large stream mussel assemblages throughout the Ohio River basin in Kentucky. It was common historically throughout much of the Ohio River (Call 1900; Ortmann 1919) and in the middle Cumberland River (Wilson and Clark 1914). This species appears to be minimally tolerant of impoundment, and because almost none of its historical range remains free-flowing, it is now highly endangered. The population in the middle Cumberland River was eliminated by Wolf Creek Dam in 1950. Populations in the lower Green River were probably extirpated by navigation dams. It persists in the Ohio River only in the short, free-flowing lower section and adjacent reaches that are influenced only by low-lift, movable dams (locks and dams 52 and 53). Similarly, it persists in the Tennessee River only in riverine sections below Kentucky Dam, and below Pickwick Dam in Tennessee (Garner and McGregor 2001). Elsewhere in its range, it persisted only in a short reach of the Cumberland River in Tennessee until at least 1979, but this population was small and apparently non-reproducing (Parmalee et al. 1980). It is generally rare in the Ohio and Tennessee rivers, but can be relatively common locally and some evidence of recruitment is evident in both streams. However, completion of Olmsted Lock and Dam on the lower Ohio River, which will replace locks and dams 52 and 53, may pose a threat to the survival of this critically imperiled species. KNP: endangered; AFS: endangered; USFWS: endangered.

*Plethobasus cyphus* (Rafinesque, 1820)

## Sheepnose

**General Distribution**

Mississippi River basin from Mississippi north to Minnesota and Wisconsin, and west to Missouri and Iowa. Ohio River basin from the mouth upstream to Pennsylvania.

**Kentucky Distribution**

Type locality: Falls of the Ohio. Generally distributed to occasional throughout the Ohio River and in most larger tributaries. Not reported from the Mississippi River, the Tradewater River, or other lowland streams in western Kentucky. Occasional in the lower Ten-

nessee River below Kentucky Dam, but only a single record is available for the lower Cumberland River, Trigg County (UMMZ). Formerly generally distributed in the middle Cumberland River upstream to Russell County; absent above Cumberland Falls (Wilson and Clark 1914; Neel and Allen 1964). Reported from the lower Green River only from archaeological sites in Butler County (Morey and Crothers 1998; Patch 2005), but probably present throughout the lower river historically. Generally distributed in the upper Green River upstream to Hart County and sporadic in the lower Barren River. A single record is available for the Kentucky River, Garrard County (KNP). Sporadic in the middle Licking River, Fleming, Nicholas, Bath, and Rowan counties. Not reported from the Salt or Big Sandy rivers but potentially present in the lower reaches of those streams historically.

#### Habitat & Larval Hosts

Restricted to main-channel habitats of medium-sized to large rivers in gravel and sand substrates. This species is characteristic of mussel beds in larger streams, but it is never a dominant member of those assemblages. This species is a host specialist on minnows (Cyprinidae) and perhaps Sauger (*Sander canadensis*).

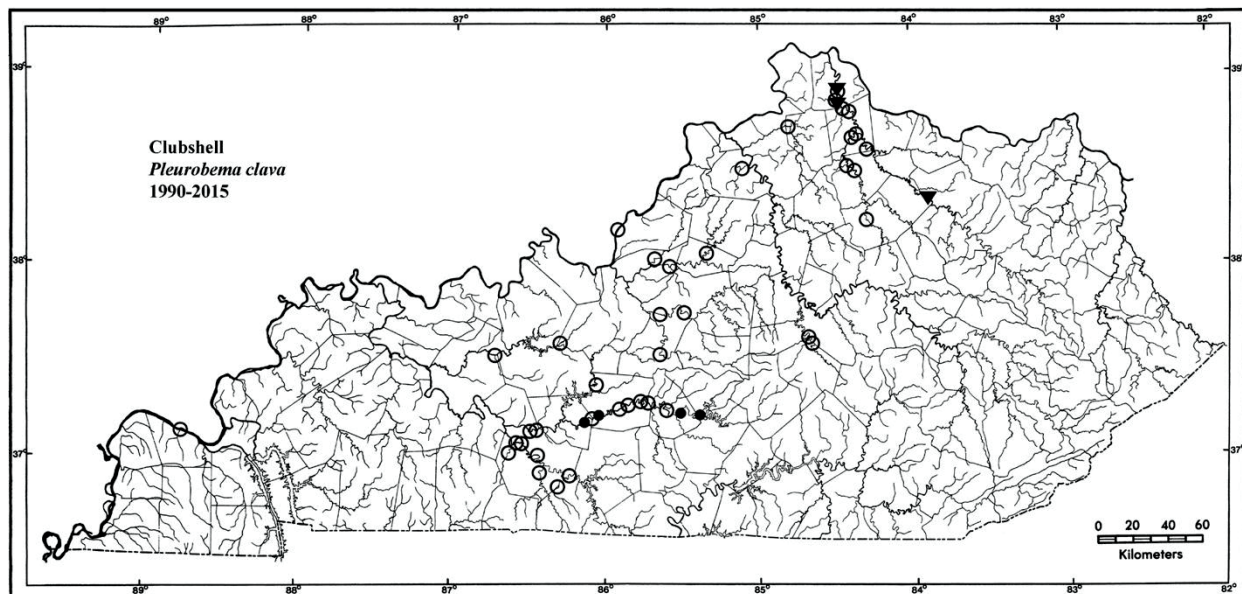
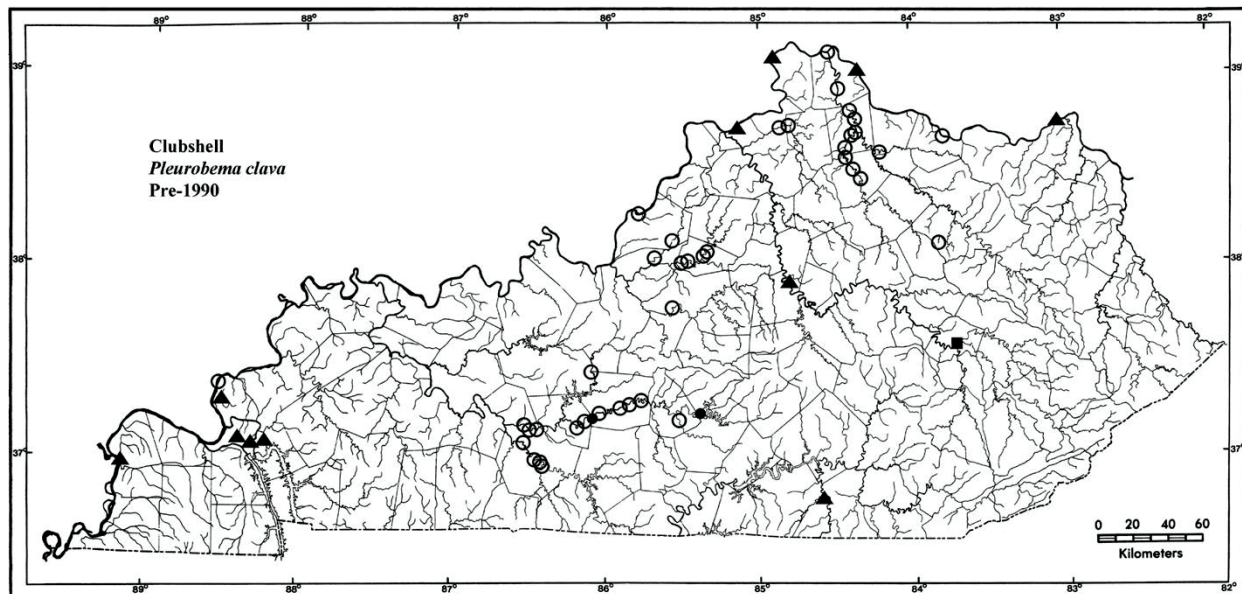
#### Conservation Status

*Plethobasus cyphus* has fared better than the other two species of *Plethobasus*, both of which are near extinction. Nevertheless, *P. cyphus* appears only marginally tolerant of impoundment and it has disappeared from much of its historical range in Kentucky and elsewhere. This species was probably generally distributed historically in most large rivers, but impoundment has eliminated most suitable habitat in the Tennessee, Cumberland, lower Green, Salt, Kentucky, and Big Sandy river drainages. The largest remaining populations in the state are probably in the Ohio River, but it is largely restricted to riverine sections downstream of dams, and its occurrence appears to have become more localized in recent decades. The population in the lower Tennessee River may be contiguous with populations in the lower Ohio River. The population in the upper Green River also is relatively large; the species is uncommon there but can be found in most mussel beds and occupies a long reach of river. The population in the Kentucky River appears to be very small; it is known from this river only from a single recently dead shell found in 1996. The population in the Licking River is small and localized and its absence in the lower river is unusual and unexplained. The overall decline of *P. cyphus* may be due in part to its host specialization on riverine minnows and Sauger, both of which also have been adversely affected by impoundment. However, with the exception of the Kentucky River population, at least some evidence of recent recruitment is seen in most streams where this species persists, which gives hope for its continued survival. KNP: endangered; AFS: threatened; USFWS: endangered.



*Pleurobema clava* (Lamarck, 1819)

## Clubshell

**General Distribution**

Largely confined to the Ohio River basin, where it occurs from at least the Wabash River drainage upstream to Pennsylvania, but generally absent in lowland regions of the lower basin. Reported historically throughout the Tennessee and Cumberland River drainages, but the relationship of these populations to *Pleurobema oviforme* is unknown (see subsequent). Also in the Great Lakes basin in the Maumee River system and possibly western Lake Erie.

**Kentucky Distribution**

Widespread historically throughout the Ohio River and in all major drainages from the Green River to the Licking River. Absent from lowland habitats in western Kentucky. An archaeological record from the Mississippi River, Ballard County, suggests that conditions at that site were suitable for the species in prehistoric times (Wesler 2001; see Section IV.C.2). Not reported historically from the lower Tennessee and Cumberland rivers, but reported from both rivers from archaeological assemblages (Casey 1986, 1987). Reports of this species farther upstream in the Tennessee and Cumberland River drainages (e.g., Parmalee and Bogan 1998) may represent *P. oviforme* (see account for this species). Voucher specimens of *P. clava* from these drainages are few and many have incomplete or questionable locality information (see Ortmann 1925). Records for the Rockcastle River, Laurel/Rockcastle counties, and Big South Fork Cumberland River, Pulaski and McCreary/Wayne counties (Williamson 1905; Wilson and Clark 1914; UMMZ; NMNH), are *P. oviforme* (D. Stansbery, personal communication). It is reported from an archeological assemblage from the Big South Fork, McCreary County, but this assemblage also contained specimens identified as *P. oviforme* (J. Kiser and P. Parmalee, personal communication), and positive identification of archaeological specimens is difficult. Ahlstedt et al. (2003–2004) observed and released a living individual tentatively identified as *P. clava* in the Big South Fork in Scott County, Tennessee. Given the scarcity of verifiable records of *P. clava* in the Tennessee and Cumberland River drainages, its historical distribution there is unresolved. Similar to other Ohioan or Mississippian species (e.g., *Epioblasma flexuosa*, *Fusconaia flava*, *Quadrula nodulata*, *Q. quadrula*), *P. clava* may have been restricted to the lower reaches of the Tennessee and Cumberland River drainages and was replaced by *P. oviforme* in their middle and upper sections. Reported from the lower Green river drainage only from two sites in the Rough River, Hardin and Ohio counties (KNP; Gordon 1993), but generally distributed in the upper Green River drainage. Generally distributed to occasional in the Salt and Licking river drainages. Sporadic in the Kentucky River drainage and not reported from the upper drainage except for Danglade (1922), who reported it as rare in this region (from unspecified locations but probably including the North Fork Kentucky River).

**Habitat & Larval Hosts**

Occurs in a wide variety of upland riverine habitats from large rivers to small streams, but does not penetrate far into the headwaters. Restricted to main-channel habitats in gravel and sand substrates, and typically absent from depositional habitats or lentic environments. This species is a host specialist on minnows (Cyprinidae).

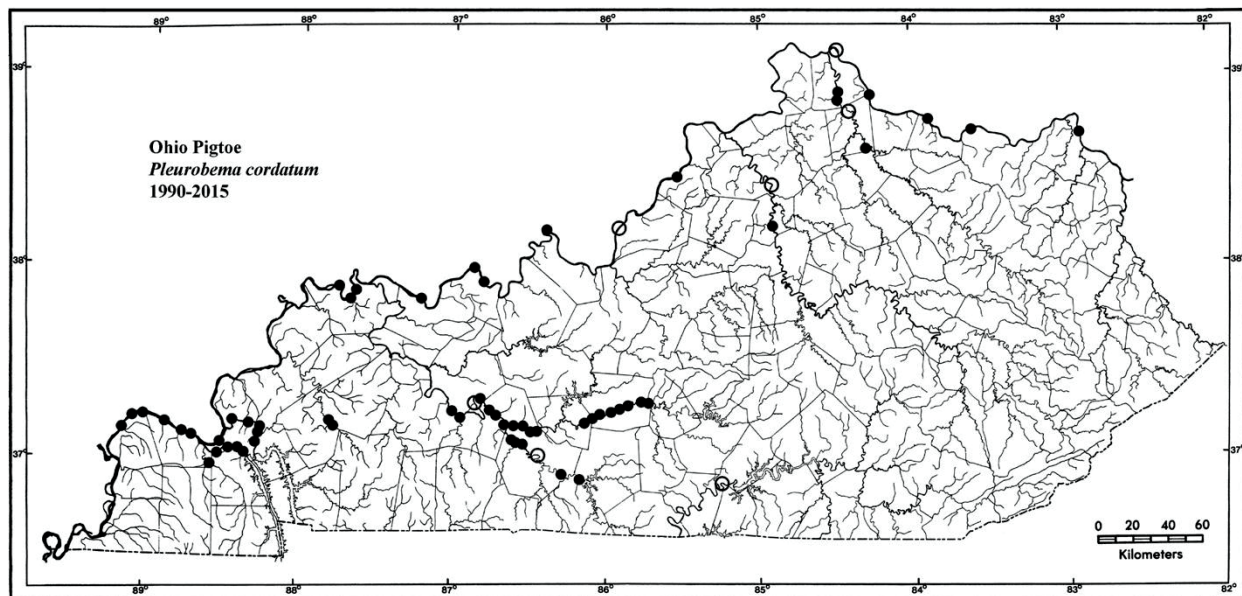
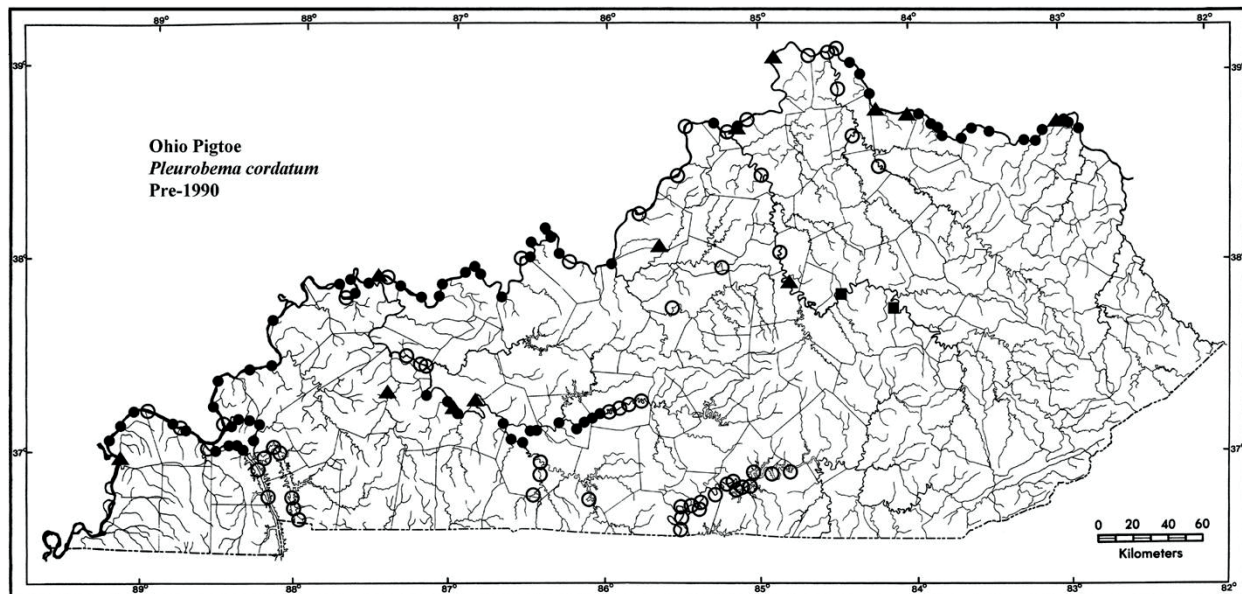
**Conservation Status**

*Pleurobema clava* appears to have been a common and perhaps locally abundant species throughout much of the Ohio River basin. It was “rather common” in the upper Ohio River (Rafinesque 1820a), and relic shells are found commonly in many Kentucky streams. However, it is now nearly extirpated from the state and has declined dramatically throughout its range. The species appears intolerant of impoundment and populations in large rivers likely were eliminated by dams. It has not been seen in the Ohio River in over 100 years, but an unsubstantiated recent record from the river in Meade County (Clarke 1995) gives hope that it may persist there. Its disappearance is especially puzzling in unimpounded streams that otherwise continue to support diverse mussel assemblages such as the Barren, Salt, and Licking rivers, and the reasons for the apparent inordinate sensitivity of this species are unknown. The only surviving natural population in Kentucky is in the upper Green River where it is generally rare; a short reach of the river in Green County supports a relatively large population that shows evidence of recent recruitment (TTU; McGregor et al. 2007). This population may expand along with improvements in water release from Green River Dam (Konrad et al. 2012). The species was reintroduced in 2013 and 2014 at four sites in the Licking River, Campbell, Pendleton, and Nicholas/Fleming counties, using source stock from the Allegheny River, Pennsylvania (KDFWR 2013; M. McGregor, personal communication); the success of these reintroductions is unknown. KNP: endangered; AFS: endangered; USFWS: endangered.



*Pleurobema cordatum* (Rafinesque, 1820)

## Ohio Pigtoe

**General Distribution**

Endemic to the Ohio River basin, occurring throughout the Ohio River and in larger tributaries from the Tennessee River upstream to Pennsylvania. Reports of this species from the upper Mississippi River basin and elsewhere are based on *P. sintoxia*, probable undescribed taxa (west of the Mississippi River), or misidentifications.

**Kentucky Distribution**

Type locality: Ohio River. Generally distributed throughout the Ohio River, and generally distributed to sporadic in larger tributaries from the Tennessee



River to the Licking River. An archaeological record from the Mississippi River, Ballard County, suggests that conditions at that site were suitable for the species in prehistoric times (Wesler 2001; see Section IV.C.2). Generally distributed in the lower Tennessee and Cumberland rivers, and formerly abundant throughout the middle Cumberland River upstream to Russell County; absent in tributaries and above Cumberland Falls (Wilson and Clark 1914; Neel and Allen 1964). Occasional to sporadic in the lower Green River, but probably generally distributed prior to impoundment; an archeological record is available for the Pond River, Hopkins County (Kreisa 1991). Generally distributed in the upper Green River upstream to Hart County and in the lower Barren River, Warren County. Reported from the Salt River drainage only from Beech Fork (Nelson County, KNP), the Salt River (Spencer County, KNP), and an archaeological assemblage from Floyds Fork, Jefferson County (Bader and McGrath 2015). Sporadic in the Kentucky and Licking rivers, and not reported from the Little Sandy or Big Sandy river drainages. Occurs rarely in smaller streams but reported from East Fork Clarks River, McCracken County (Lewis 2006); Tradewater River, Caldwell/Hopkins counties (KNP); scattered localities in the upper Barren River drainage; and the lower-most portion of Tygarts Creek, Greenup County (OSUM). An archaeological record from the West Fork Red River, Todd County (OSUM), is considered doubtful (see Section IV.C.2).

**Habitat & Larval Hosts**

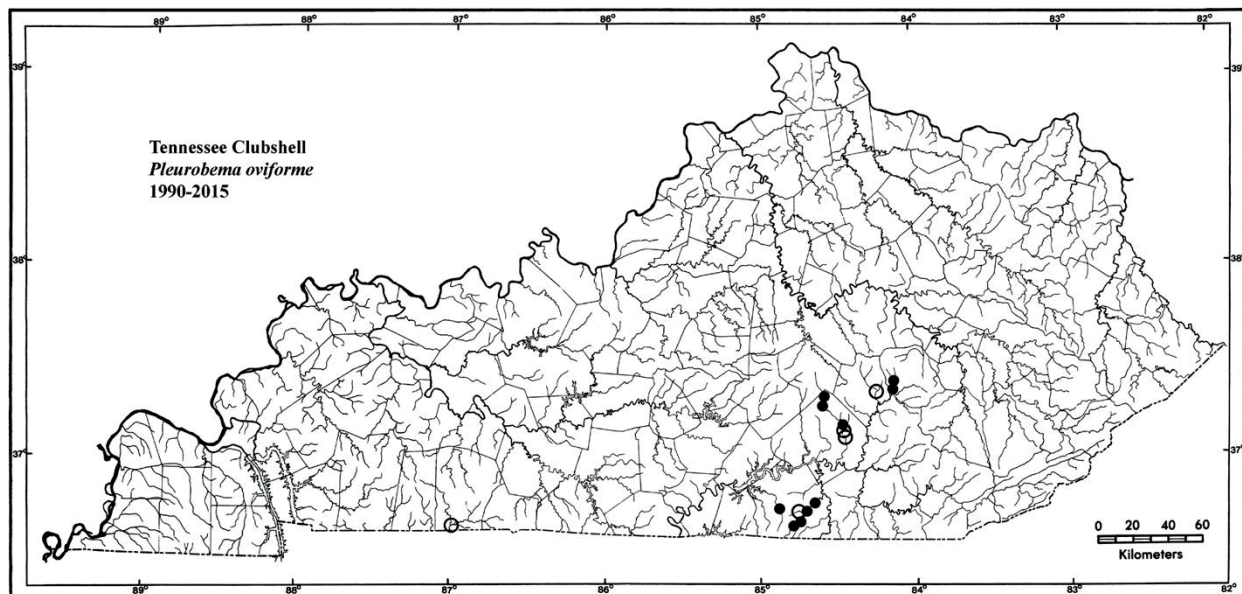
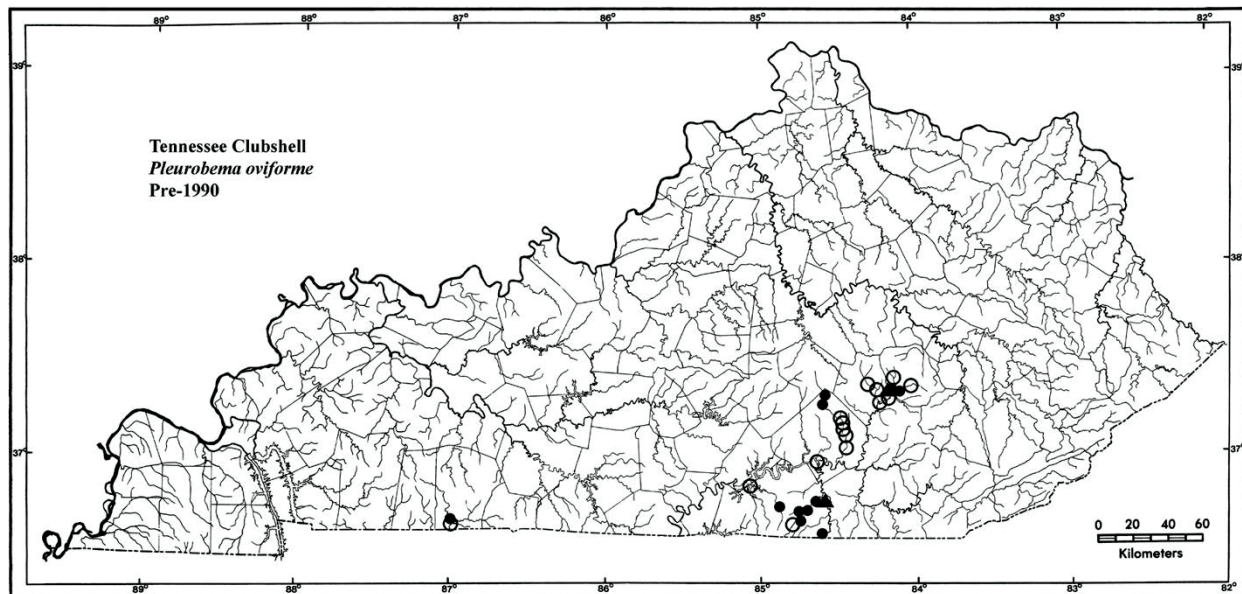
Restricted mostly to main-channel habitats of medium-sized to large rivers in gravel and sand substrates. This species is characteristic of larger streams, where it can be a dominant component of mussel beds. This species is a host specialist on minnows (Cyprinidae).

**Conservation Status**

*Pleurobema cordatum* has declined considerably in the last 100 years following widespread destruction of large river habitat. However, it is marginally tolerant of impoundment and can adapt to impounded sections of rivers that retain considerable riverine influence. It appears to have declined in the Ohio River since impoundment but remains locally common in riverine reaches downstream of navigation dams, and at least some populations show evidence of recent recruitment. It remains relatively common in the Tennessee and lower Cumberland rivers below Kentucky and Barkley dams, but was unable to adapt to the reservoirs above those dams. The large population in the middle Cumberland River was eliminated by Wolf Creek Dam. Its current rarity or absence in the lower Green and Kentucky rivers is likely due to impoundment of those streams for navigation in the 1800s, and it was probably a locally dominant member of mussel assemblages in those streams historically. Smaller populations such as those in the Clarks, Tradewater, and lower Licking rivers, may be sustained by immigration from the Ohio River. Apart from the Ohio River, the largest remaining populations in the state are in the upper Green River and the Barren River, where the species is generally distributed and absent only in impounded reaches. AFS: special concern.

*Pleurobema oviforme* (Conrad, 1834)

## Tennessee Clubshell

**General Distribution**

Endemic to the Tennessee-Cumberland faunal province, occurring in northern Alabama, southern Kentucky, northeastern Mississippi, western North Carolina, Tennessee, and southwestern Virginia. Populations in the Tennessee and Cumberland river drainages may represent two distinct species (see subsequent).

**Kentucky Distribution**

Sporadic in the Red River system, Logan County (lower Cumberland River drainage). Generally distributed to occasional in small to medium-sized

streams in the middle Cumberland River drainage upstream to the Rockcastle River, but absent above Cumberland Falls. Reported from the mainstem Cumberland River only at Burnside, Pulaski County (UMMZ).

**Habitat & Larval Hosts**

Small to medium-sized streams in gravel and sand substrates. Typically a minor component of mussel assemblages, but locally common formerly in some streams. This species is a host specialist on minnows (Cyprinidae).

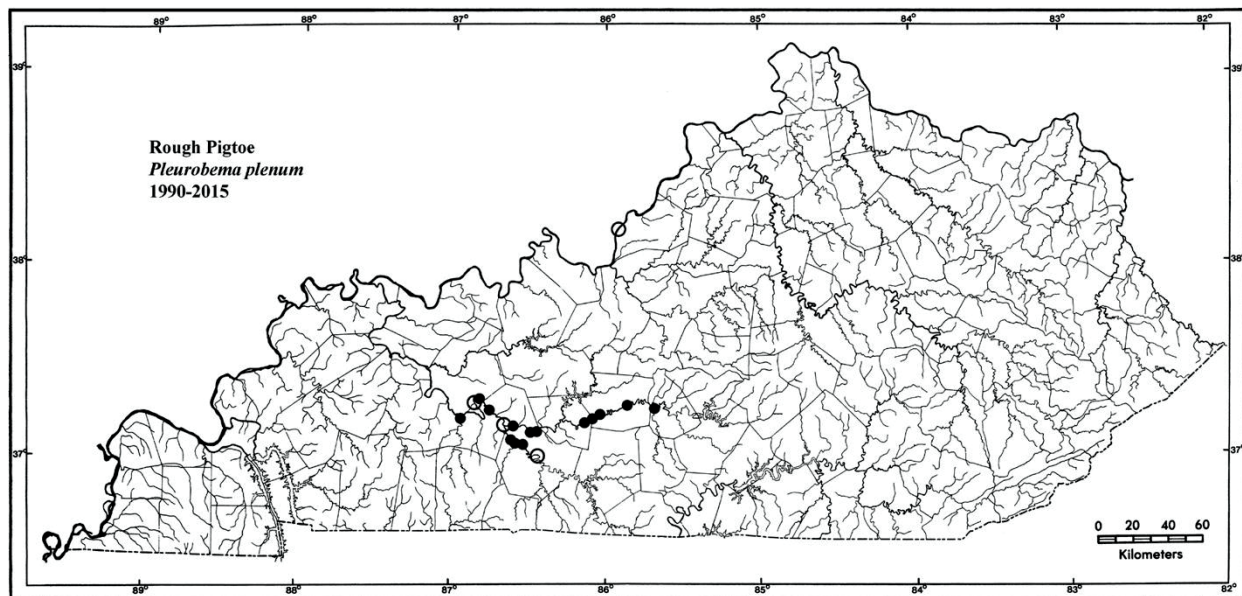
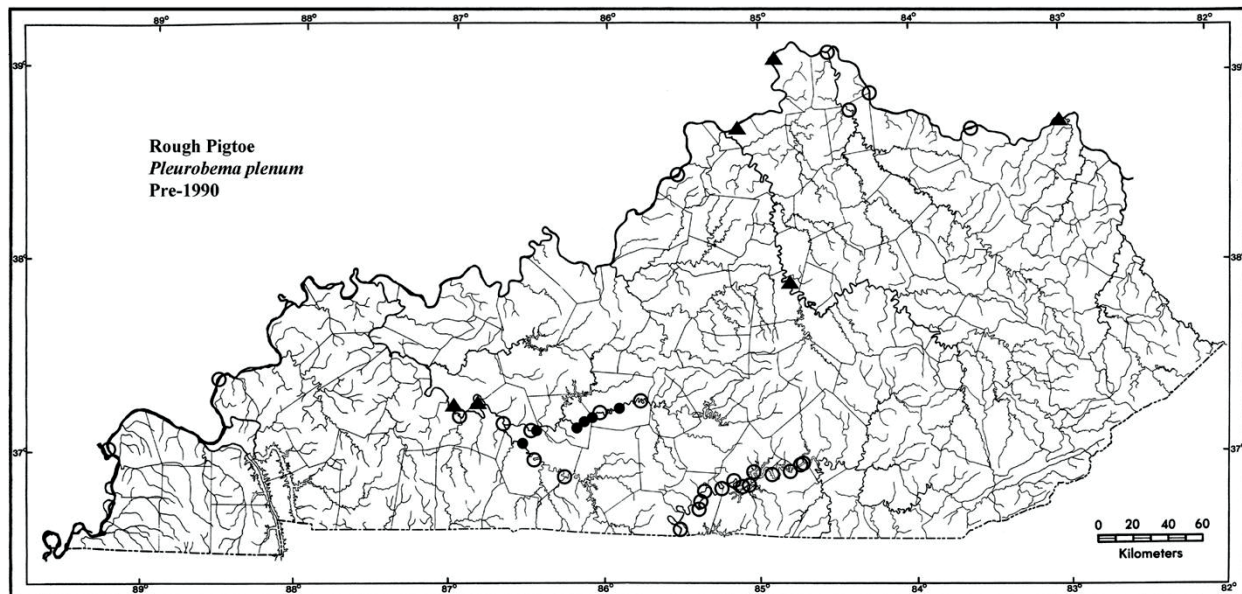
**Conservation Status**

Due to its occurrence mainly in smaller streams, *Pleurobema oviforme* was affected to a lesser extent than other Tennessee-Cumberland endemic species by impoundment of the Cumberland River. Nevertheless, it has declined dramatically in recent years and is in danger of disappearing from Kentucky. The last record of living or recently dead individuals in the Red River system was from Whippoorwill Creek, Logan County, in 1988 (KNP), and the species appears to be extirpated throughout that system from unknown causes. Prior to 1990, it was a characteristic member of small-stream mussel assemblages throughout much of the middle Cumberland River drainage, but all of these populations have declined and few survive. A large population existed throughout the Little South Fork, but coal mining and oil drilling appear to have eliminated the species there; only one live *P. oviforme* was found in the entire river in 1998 (Warren and Haag 2005), and only relic shells were found in 2013 (Ahlstedt et al. 2014). The species disappeared from the Rockcastle River system by the 1980s with the exception of a population in Horse Lick Creek, Jackson County, which survived into the 1990s. However, coal mining also seems to have eliminated the species from that stream; only a single live individual was found in the entire creek in 2003 (Haag and Warren 2004). The only recent record from the Big South Fork is a single live individual from Tennessee in 2000 (Ahlstedt et al. 2003–2004), but the species has not been found recently in the Kentucky portion of the river. A very small, isolated population may persist in the upper portion of Beaver Creek, Wayne County (TTU; KNP). A small population existed in Buck Creek, Pulaski County (Schuster et al. 1989; Hagman 2000), but this stream has experienced an unexplained mussel decline over the last 30 years, and it is unknown if this population survives. Elsewhere in the Cumberland River drainage, *P. oviforme* appears to survive only in the Obey River system in Tennessee (Schmidt et al. 1989; Moles et al. 2007). The species remains widespread in the middle and upper Tennessee River drainage, but these individuals differ morphologically from those in the Cumberland River drainage (see Moles et al. 2007). It is probable that *P. oviforme* in the Cumberland River drainage represents an undescribed, endemic species (see section IV.D.3). If so, this species is not only in danger of disappearing from Kentucky and the Cumberland River drainage, but is on the verge of global extinction. It is imperative that specific factors responsible for its disappearance in the Red River, Little South Fork, Horse Lick Creek, and other streams be identified and remediated so the species can be reestablished in those streams if source stock remains available. KNP: endangered; AFS: special concern; USFWS: petitioned for listing.



*Pleurobema plenum* (Lea, 1840)

## Rough Pigtoe

**General Distribution**

Endemic to the Ohio River basin, where it occurred historically throughout the Ohio River and in larger tributaries from the Tennessee River upstream to Pennsylvania. The historical range and abundance of this species are difficult to ascertain precisely because it was often synonymized under *Pleurobema cordatum* or *P. sintoxia* or misidentified.

**Kentucky Distribution**

Type locality: Ohio River, Cincinnati, Ohio. Formerly occurred throughout the Ohio River, but only two records exist for the lower river (Ballard and Living-

ston counties; INHS; OSUM). Not reported from the lower Tennessee or lower Cumberland rivers in Kentucky, but widespread in those rivers in Alabama and Tennessee and likely present historically throughout both streams. Apparently widespread formerly in the middle Cumberland River, but its historical distribution and abundance there is unclear. In archaeological assemblages from the middle Cumberland River in Tennessee, *P. plenum* outnumbered *P. cordatum* (Parmalee et al. 1980). Most historical records from the middle Cumberland in Kentucky are from Wilson and Clark (1914) and Neel and Allen (1964), and the latter reported *P. plenum* as common throughout the river. However, only five specimens from two sites from these studies labeled *P. plenum* and vouchered at UMMZ are this species; most others are *P. cordatum* or *P. sintoxia*, and the specimen of *P. plenum* illustrated by Neel and Allen (1964) is the large river form of *P. sintoxia*. Despite this uncertainty, all other records of *P. plenum* from these and other sources are plotted here because most reports are not accompanied by voucher specimens. Generally distributed to occasional in the Green River upstream to Green County and in the lower Barren River, Warren County (KNP; TTU). Not reported from the Salt River, and only single records exist from the Kentucky and Licking rivers (Call and Robinson 1983; OSUM).

#### Habitat & Larval Hosts

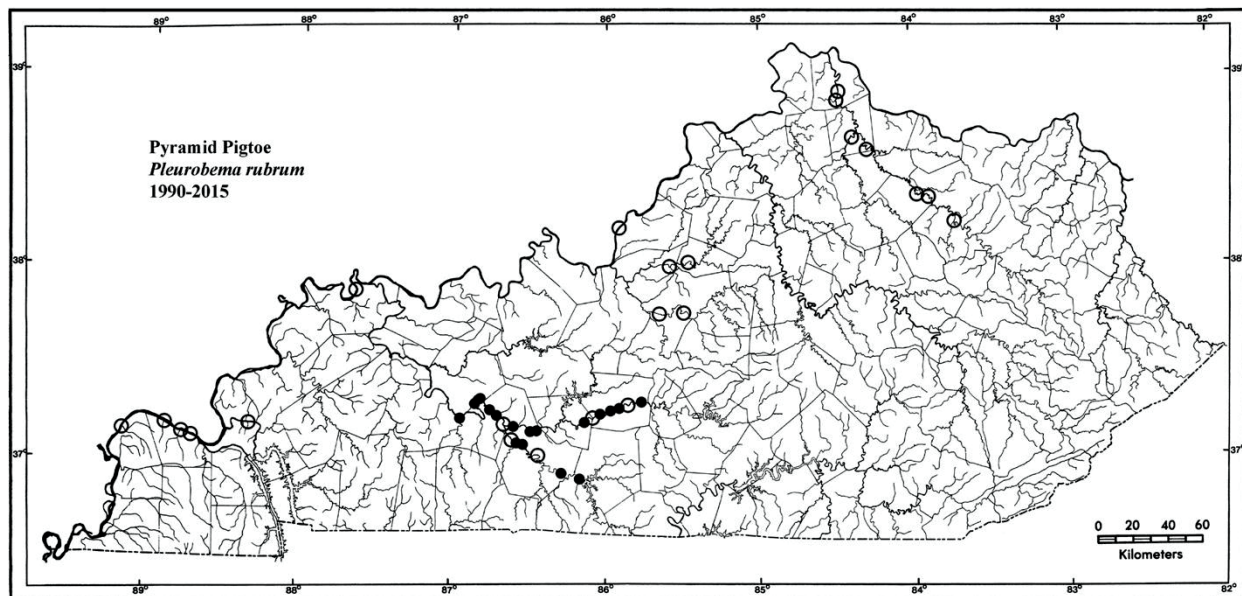
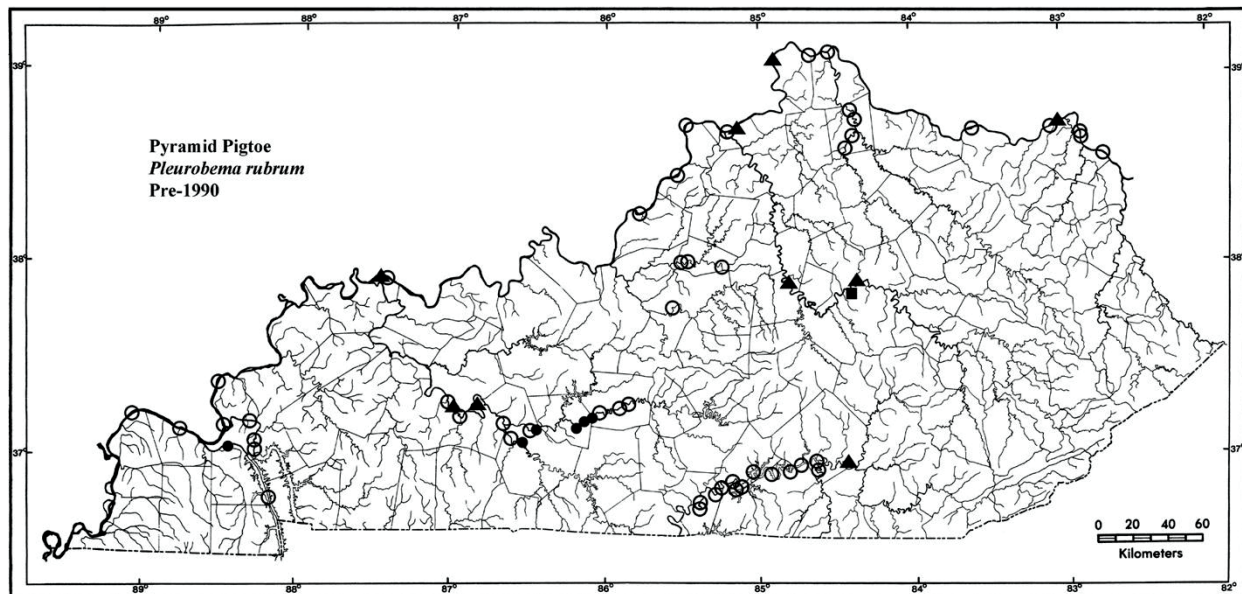
Restricted to main-channel habitats of medium-sized to large rivers in gravel and sand substrates. This species is characteristic of larger streams, but it is usually a minor component of mussel beds. This species is a host specialist on minnows (Cyprinidae).

#### Conservation Status

*Pleurobema plenum* has disappeared from nearly all of its historical range and is vulnerable to extinction. It appears minimally tolerant of impoundment, and dams have destroyed or radically altered most habitat for the species. It has not been seen in the Ohio River in at least 80 years and most tributary populations are extirpated. The population in the middle Cumberland River in Kentucky was eliminated by Wolf Creek Dam, but a relict population persisted until at least the early 1980s in a short reach of the river in Tennessee (USFWS 1984); it is now likely extirpated from the Cumberland River drainage. Very small and potentially relict populations persist below Wilson and Pickwick dams on the Tennessee River in Alabama and Tennessee, respectively, and a relatively large population survives in the Clinch River, Tennessee (R. Butler, personal communication). Along with the Clinch River population, the largest populations on Earth are in the Green and Barren rivers. A large, recruiting population existed downstream of Lock 5 on the Green River in Warren County in the 1960s (OSUM), but there is now little evidence of recruitment in this reach. The species remains widespread in other sections of the river and in the lower Barren River, but it is rare and there is no information about the viability or age structure of these populations. Because the Green and Barren rivers encompass much of the free-flowing habitat remaining within the range of *P. plenum*, survival of the species is dependent on protection and restoration of aquatic habitats in these streams. KNP: endangered; AFS: endangered; USFWS: endangered.

*Pleurobema rubrum* (Rafinesque, 1820)

## Pyramid Pigtoe

**General Distribution**

Ohio River basin throughout the Ohio River and in most large tributaries upstream to Pennsylvania. A few historical and archaeological records exist from the Illinois River and elsewhere in the upper Mississippi River basin, but the phylogenetic status of those populations is unknown. Lower Mississippi River basin in Arkansas, Louisiana, and Mississippi; these populations may in part represent an undescribed species (Campbell et al. 2005; Harris et al. 2009). The historical range and abundance of this species are difficult to ascertain precisely because it was often synonymized under *Pleurobema cordatum* or *P. sintoxia* or misidentified.



**Kentucky Distribution**

Type locality: Kentucky River. Formerly occurred throughout the Ohio River and in all larger tributaries from the Tennessee River to the Licking River. Sporadic in the lower Tennessee and Cumberland rivers, and generally distributed in the middle Cumberland River upstream to the lower Big South Fork, Pulaski County; an archaeological record is available from the middle Cumberland River, Pulaski County, near the mouth of the Rockcastle River (Dourson 1998; DBNF). Most historical records from the middle Cumberland River are from Wilson and Clark (1914) and Neel and Allen (1964), and the latter reported *P. rubrum* as common at some sites. However, only eight specimens from five sites from these studies labeled *P. rubrum* and vouchered at UMMZ are this species; most others are *P. cordatum* or *P. sintoxia*. Despite this uncertainty, all other Cumberland River records of *P. rubrum* from these and other sources are plotted here because most reports are not accompanied by voucher specimens. Generally distributed to occasional in the Green River upstream to Hart County and the lower Barren River; no records exist for much of the lower Green River, but probably present throughout the river historically. Sporadic to occasional in the Salt River drainage and the Licking River, including the lower South Fork Licking River. The only reports from the Kentucky River drainage are the type locality and from archaeological sites in Woodford and Clark counties (Call and Robinson 1983; KNP), but probably present at least sporadically throughout the mainstem historically. Not reported from the Big Sandy River drainage, but possibly present there historically; a specimen from the Levisa Fork, Floyd County (UMMZ), is *P. sintoxia*.

**Habitat & Larval Hosts**

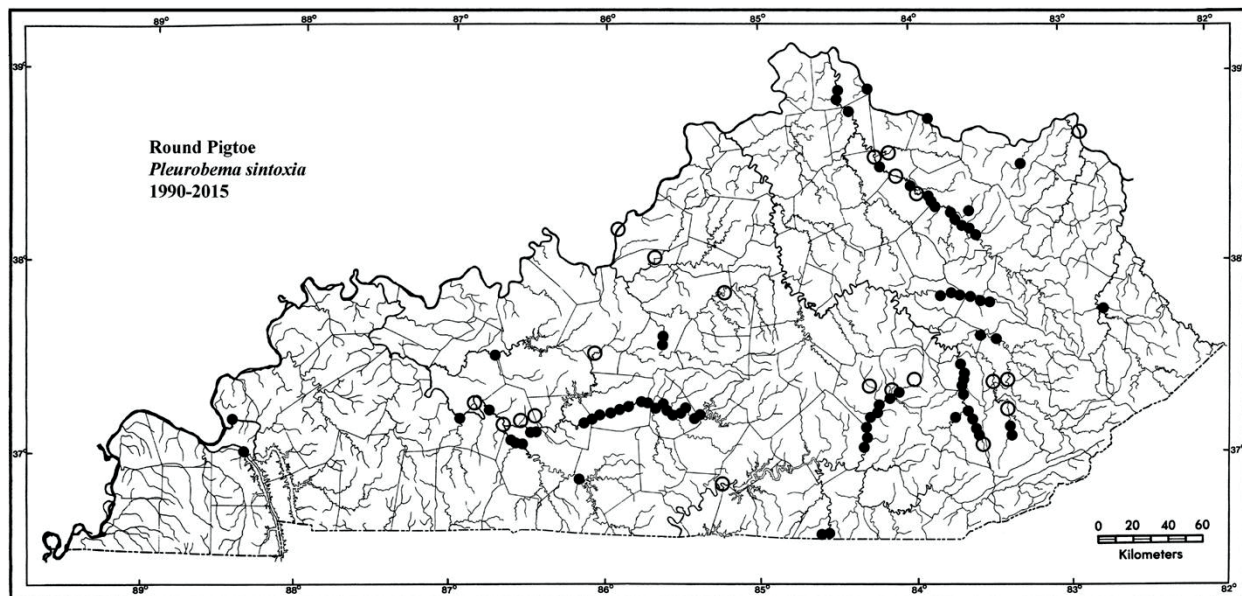
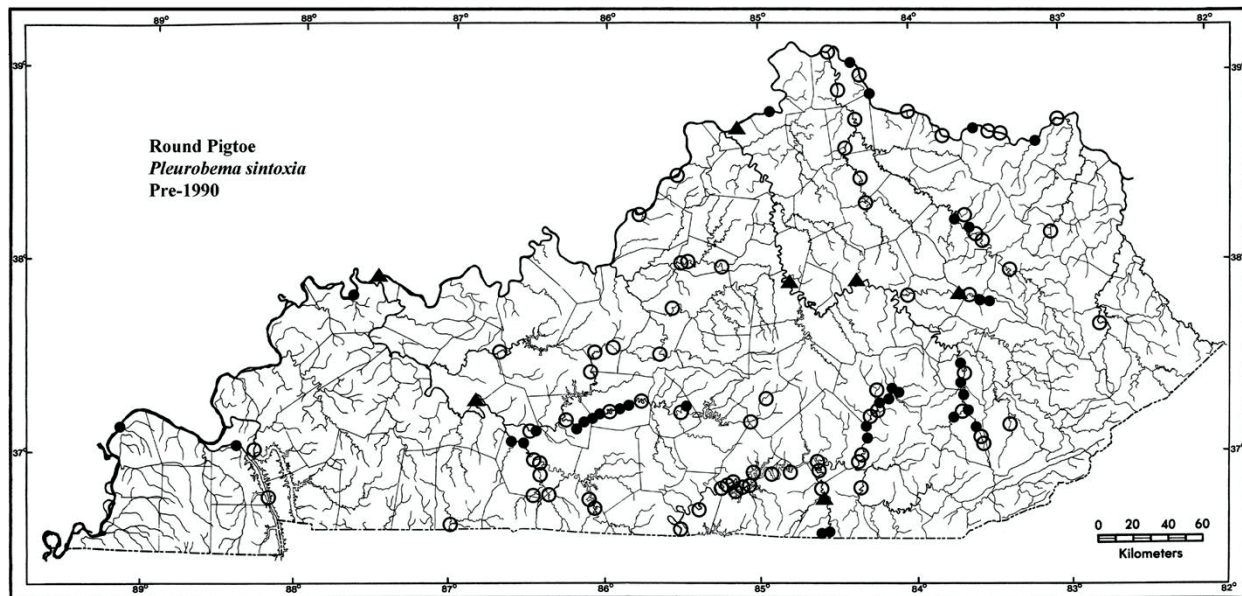
Restricted to main-channel habitats of medium-sized to large rivers in gravel and sand substrates. This species is characteristic of larger streams, but it is usually a minor component of mussel beds. This species is a host specialist on minnows (Cyprinidae).

**Conservation Status**

Despite uncertainty about identification of some historical records, *Pleurobema rubrum* clearly was a regular and characteristic member of large stream mussel assemblages throughout the Ohio River basin in Kentucky. Relic shells are still found frequently in many streams, indicating that it was relatively common species. It appears minimally tolerant of impoundment, and dams have destroyed or radically altered most habitat for the species in the Ohio River basin. There are no verified records of live or recently dead individuals in the Ohio River for at least 50 years, and the population in the middle Cumberland River was extirpated by Wolf Creek Dam. Similar to *P. clava*, the disappearance of *P. rubrum* in unimpounded streams such as Salt and Licking rivers is perplexing because these streams continue to support diverse mussel faunas. Small and potentially relict populations persist in a few short reaches of the Tennessee River in Alabama and Tennessee (Garner and McGregor 2001; Williams et al. 2008), and it may yet persist in the Tennessee River downstream of Kentucky Dam, where it was last seen in 1985 (MSU). The populations in the Green and Barren rivers are among the largest in existence, but despite their occurrence throughout long reaches of these rivers, the species is rare and there is little information about the viability or age structure of these populations. Elsewhere in the Ohio River basin, this species survives in only a few streams in Tennessee and Ohio (Parmalee and Bogan 1998; Watters et al. 2009). Large populations of *Pleurobema* cf. *rubrum* remain in several streams in Arkansas and Mississippi (Harris et al. 2009), but if these represent a distinct species, conservation of the few remaining populations of *P. rubrum* in the Ohio River basin becomes even more critical. KNP: endangered; AFS: threatened; USFWS: petitioned for listing.

*Pleurobema sintoxia* (Rafinesque, 1820)

## Round Pigtoe

**General Distribution**

Mississippi River basin from Arkansas north to Minnesota and Wisconsin, and west to eastern Kansas and South Dakota. Ohio River basin from the mouth upstream to New York, but generally absent in lowland regions of the lower basin. Great Lakes basin from Lake Michigan to the Niagara River.

**Kentucky Distribution**

Type locality: Ohio River. Sporadic to occasional throughout the Ohio River, but widespread in tributaries from the Tennessee to the Big Sandy river drain-

age. Not reported from the Mississippi River or other lowland habitats in western Kentucky including the Tradewater River. Sporadic in the lower Tennessee River and in the lower Cumberland River drainage (including the Red River, Logan County). Generally distributed in the middle Cumberland River drainage but absent above Cumberland Falls. Sporadic in the lower Green River drainage, but probably more widespread there historically. Generally distributed in the upper Green River drainage upstream to Taylor County. Sporadic in the Salt River drainage. Generally distributed in the upper Kentucky River drainage, but only archeological records exist for the mainstem, and not reported from tributaries in the lower drainage (e.g., Eagle and Elkhorn creeks); probably present throughout the mainstem historically. Generally distributed to occasional in the Licking River drainage, and sporadic in Kinniconick Creek and the Little Sandy and Big Sandy river drainages; not reported from Tygarts Creek.

**Habitat & Larval Hosts**

Occurs in a wide variety of upland riverine habitats from large rivers to small streams, but does not penetrate far into the headwaters. Restricted to main-channel habitats in gravel and sand substrates, and typically absent from depositional habitats or lentic environments. Most common in medium-sized streams where it may be among the dominant species in main-channel mussel beds. This species is a host specialist on minnows (Cyprinidae).

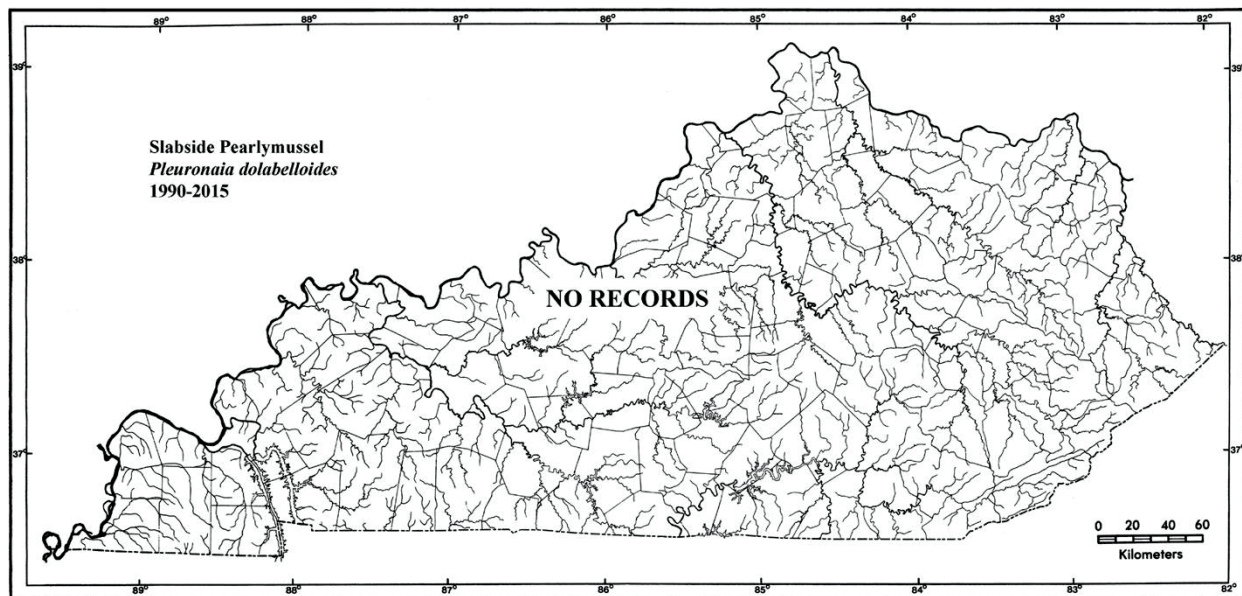
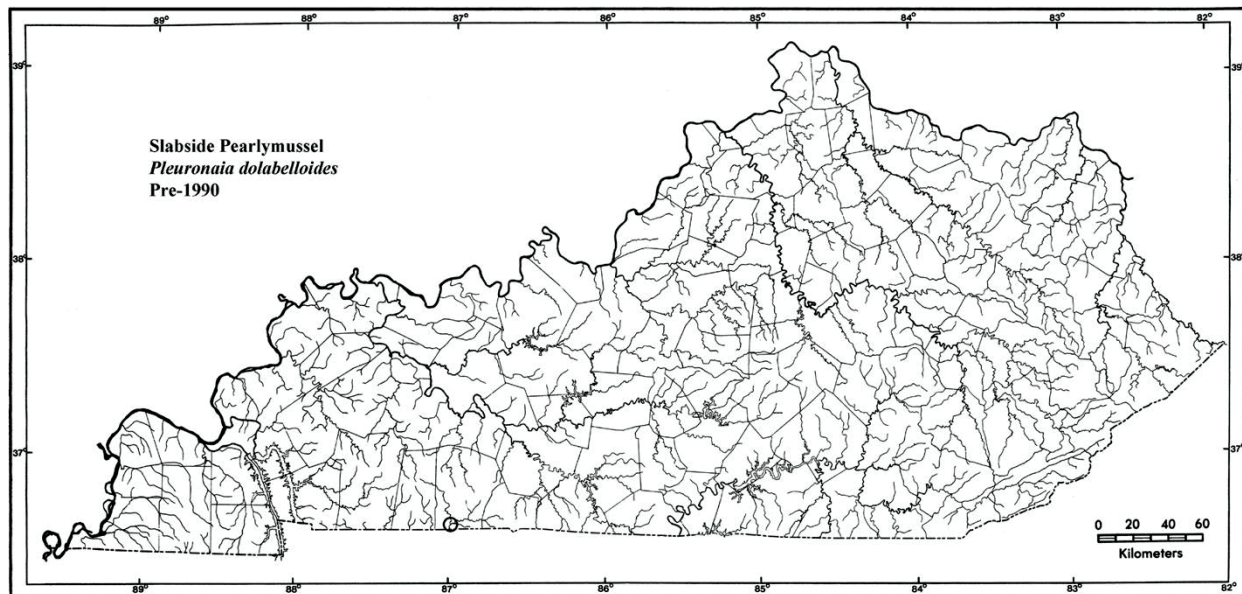
**Conservation Status**

*Pleurobema sintoxia* remains widespread and locally common in Kentucky, but its distribution in the state has been reduced considerably in the last 100 years. This species is only marginally tolerant of impoundment, and dams have reduced or extirpated many populations. It survives in riverine sections of the Ohio River and the lower Tennessee and Cumberland rivers but is now sporadic and rare, and it appears extirpated from Kentucky and Barkley lakes. It was eliminated from the middle Cumberland River by Wolf Creek Dam, and impoundment probably eliminated the species from the lower Green and Kentucky rivers at an early date. Populations also have disappeared from several unimpounded streams including the Red River (lower Cumberland River drainage), much of the Salt River drainage, and the South Fork Licking River. Only six large populations remain in the state, in the upper Green River, Big South Fork Cumberland River, Rockcastle River, South Fork Kentucky River (including the Redbird River), Red River (Kentucky River drainage), and the Licking River. These populations are robust and most show at least some evidence of recent recruitment, but because this species can live for >30 years, long-term population declines may not be evident for many years. Other populations are small and isolated, and their long-term status is unknown. AFS: currently stable.



*Pleuroaia dolabelloides* (Lea, 1840)

## Slabside Pearlymussel

**General Distribution**

Endemic to the Tennessee-Cumberland faunal province. Widespread in the Tennessee River drainage from the Duck River, Tennessee, upstream to Virginia. Sporadically distributed in the Cumberland River drainage from about the Red River upstream to the vicinity of the Caney Fork, Tennessee.

**Kentucky Distribution**

Reported in Kentucky only from the Red River, Logan County (MSU; KNP; OSUM). Archeological specimens are reported from the Cumberland River,

Stewart County, Tennessee (Parmalee and Bogan 1998), near the state line, suggesting that this species may have occurred in the lower Cumberland River in Kentucky at one time. A record for Rock Creek, McCreary County (USFWS 2013), is an error (R. Butler, personal communication).

**Habitat & Larval Hosts**

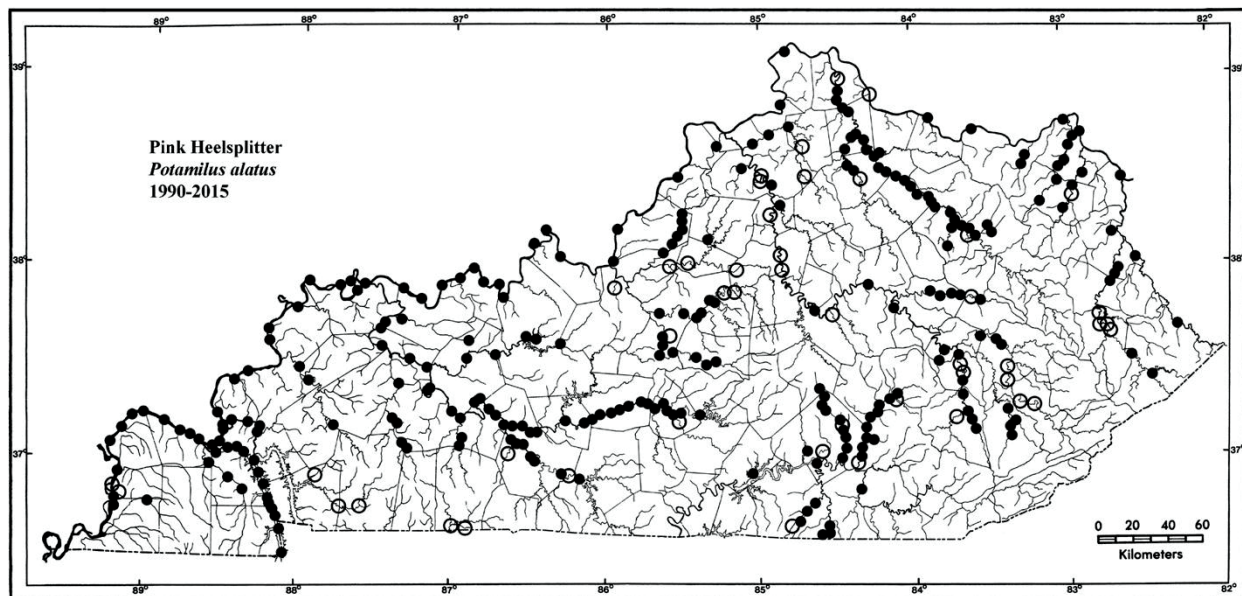
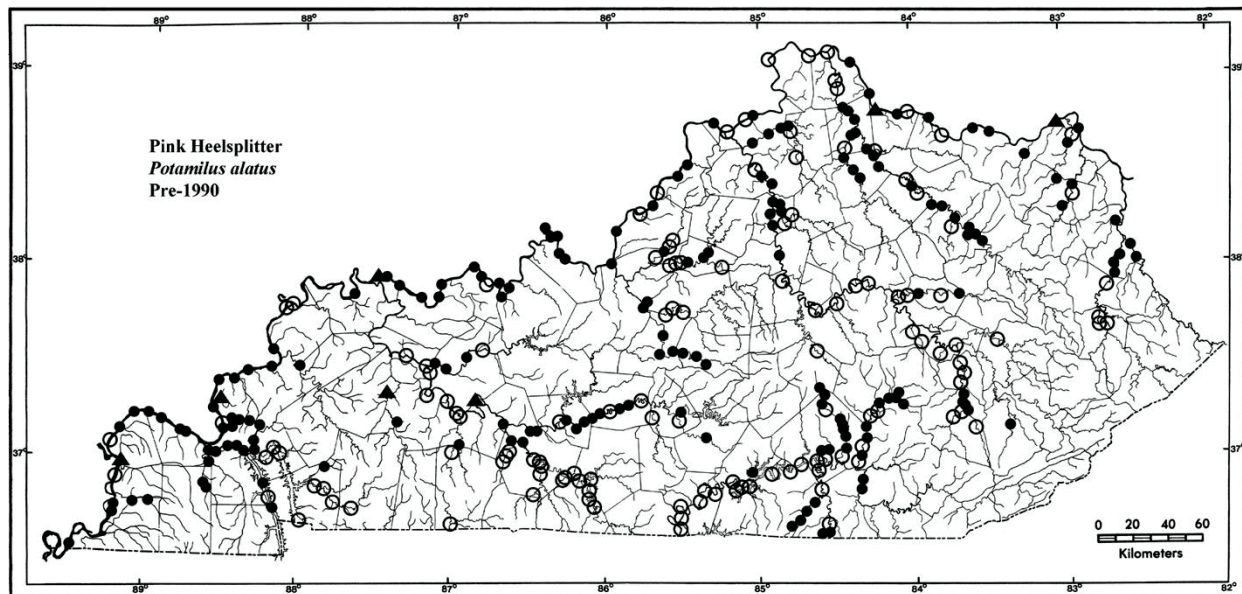
Occurs in a wide variety of upland riverine habitats from large rivers to small streams, but does not penetrate far into the headwaters. Restricted to main-channel habitats in gravel and sand substrates, and typically absent from depositional habitats or lentic environments. Most common in medium-sized streams where it may be among the dominant species in the Tennessee River drainage; apparently a rare species even historically in the Cumberland River drainage. This species is a host specialist on minnows (Cyprinidae).

**Conservation Status**

*Pleuroaia dolabelloides* was not reported from Kentucky until the discovery of relic shells in the Red River in 1981 and subsequently. By that time, the species seems to already have been extirpated in the state and living individuals have never been found in Kentucky. The mussel fauna throughout the Red River system has declined dramatically in the last 40 years for unknown reasons, and *P. dolabelloides* was last seen in the Tennessee section of the river in 1969 (OSUM). It appears extirpated from the entire Cumberland River drainage, but it remains in several streams in the Tennessee River drainage. No suitable habitat for reintroduction remains at this time in the Cumberland River drainage, and appropriate source stock is probably unavailable because phylogenetic relationships between Tennessee and Cumberland populations are unknown. KNP: presumed extirpated; AFS: threatened; USFWS: endangered.

*Potamilus alatus* (Say, 1817)

## Pink Heelsplitter

**General Distribution**

Mississippi River basin from Arkansas north to Minnesota and Wisconsin, and west to eastern Kansas and South Dakota. Ohio River basin from the mouth upstream to Pennsylvania. Great Lakes basin in tributaries to Lake Michigan and from Lake St. Clair to the St. Lawrence River system; southern Hudson Bay basin.

**Kentucky Distribution**

Generally distributed statewide, with the exception of the upper Cumberland River drainage above Cumberland Falls.



**Habitat & Larval Hosts**

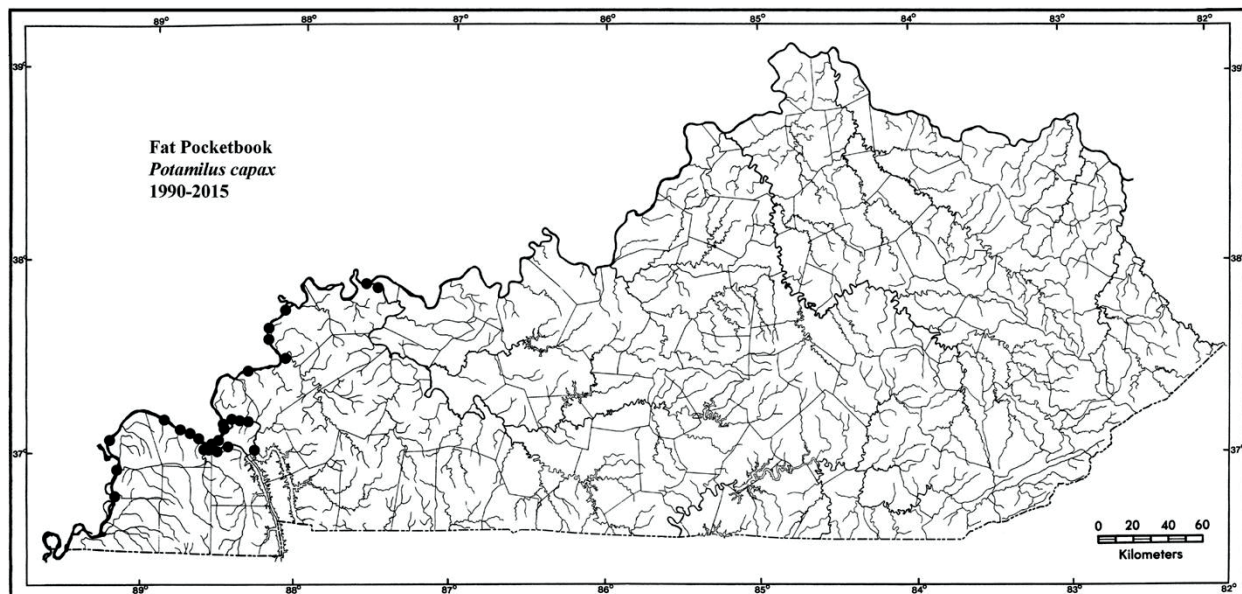
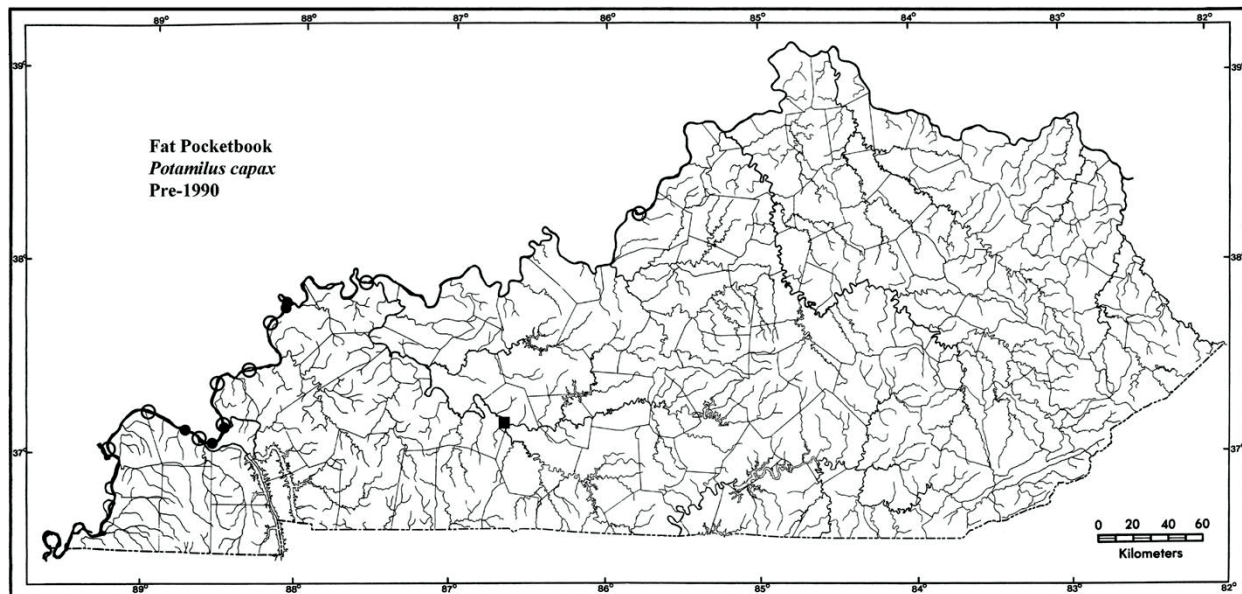
Occurs in a wide variety of habitats from lowland to upland streams to reservoirs, but restricted to waters inhabited by its host fish, the Freshwater Drum (*Aplodinotus grunniens*). Consequently, *P. alatus* is most common in medium-sized to large streams where drum are abundant, and it is usually rare or absent in small streams. Occurs in swift riffles and main-channel mussel beds but also frequently in depositional areas along shore or in backwater pools. This species is tolerant of impoundment to a large extent and may adapt to lentic habitats. Although common, this species does not occur at high densities and rarely or never dominates stream mussel assemblages.

**Conservation Status**

The distribution of *Potamilus alatus* in Kentucky has changed little in the last 100 years, and it is nearly ubiquitous in many streams statewide. Like other *Potamilus*, *P. alatus* appears to be a highly adaptable species because life history traits such as fast growth and early maturity allow it to tolerate considerable disturbance and to colonize habitats that are unsuitable to most other mussel species (Haag 2012). It has adapted to and is common in many impounded streams such as the Ohio, Tennessee, and lower Green rivers, but its apparent failure to adapt to Lake Barkley on the lower Cumberland River is puzzling. The species has declined or been extirpated only in streams such as the Little River, Red River (lower Cumberland River drainage), and Little South Fork Cumberland River that have lost nearly their entire mussel fauna to severe human impacts. It was eliminated from most of the middle Cumberland River by Wolf Creek Dam, but it is one of the few species that survived in the reservoir where it has colonized mudflats in the upper portion of Lake Cumberland. AFS: currently stable.

*Potamilus capax* (Green, 1832)

## Fat Pocketbook

**General Distribution**

Mississippi River basin from Arkansas and Mississippi north to Minnesota and Wisconsin, and west to eastern Missouri and Iowa. Ohio River basin primarily from the mouth upstream to about the Green River drainage. Records for this species exist for many areas beyond its range, but most are erroneous and based on misidentifications of *Lampsilis cardium* or *P. purpuratus* (e.g., Murray and Leonard 1962; Branson 1963). Two historical specimens of *P. capax* exist from New York (Niagara River and a tributary to Lake Ontario; Strayer and Jirka 1997), but their highly disjunct location makes these records questionable.

**Kentucky Distribution**

Known from two sites in the Mississippi River, Carlisle and Hickman counties (EKU; KNP), but probably distributed at least sporadically throughout the Kentucky portion of the river. Generally distributed to occasional in the lower Ohio River from the mouth upstream to Henderson County; one historical record exists from Jefferson County (NMNH). Occasional in the lower Tennessee and Cumberland rivers, and reported from the lowermost sections of the Clarks, Tradewater, and Green rivers (C. Lewis and D. Fortenbery, personal communication). A pre-1970 record from “Green River” identified by W. Clench (MCZ) is considered valid and is presumed to be from the lower river. Records for the Green River, Butler County, upstream to Taylor County (Williams 1969), are erroneous and based on *Lampsilis cardium* (OSUM).

**Habitat & Larval Hosts**

Occurs in medium-sized to large lowland rivers but is restricted to depositional backwater areas along shore, behind wing dams, or in side channels and sloughs. This can be a dominant species in such habitats, but it does not attain the high densities of some species in main-channel mussel beds (e.g., *Actinonaias ligamentina*, *Amblema plicata*, *Reginaia ebena*). This species is a host specialist on Freshwater Drum (*Aplodinotus grunniens*).

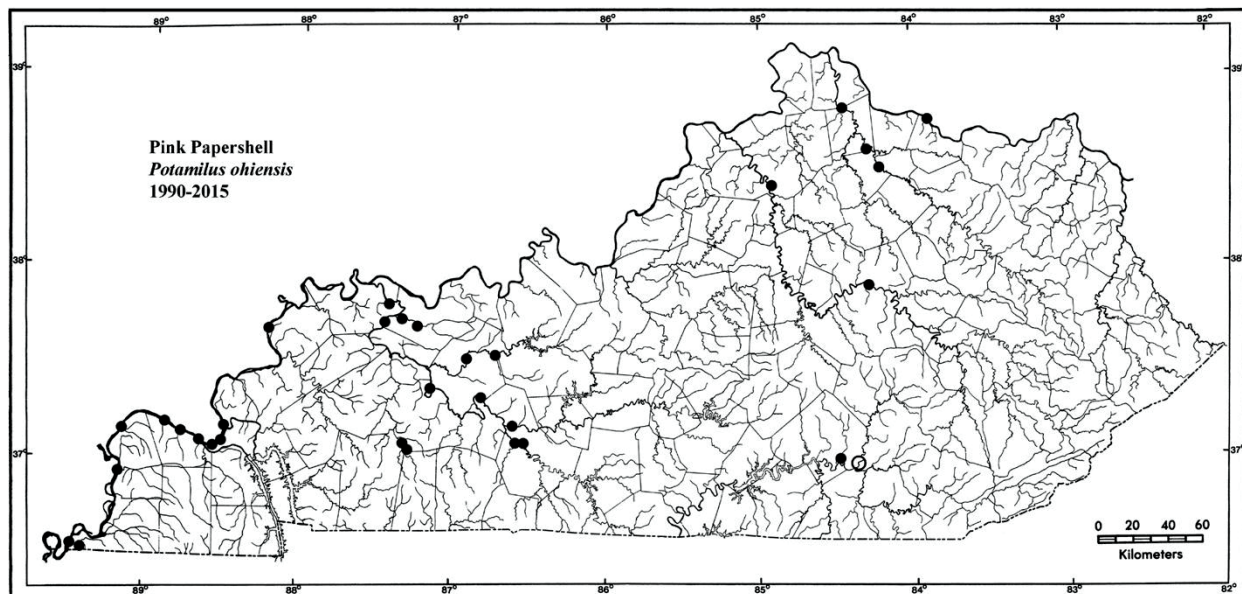
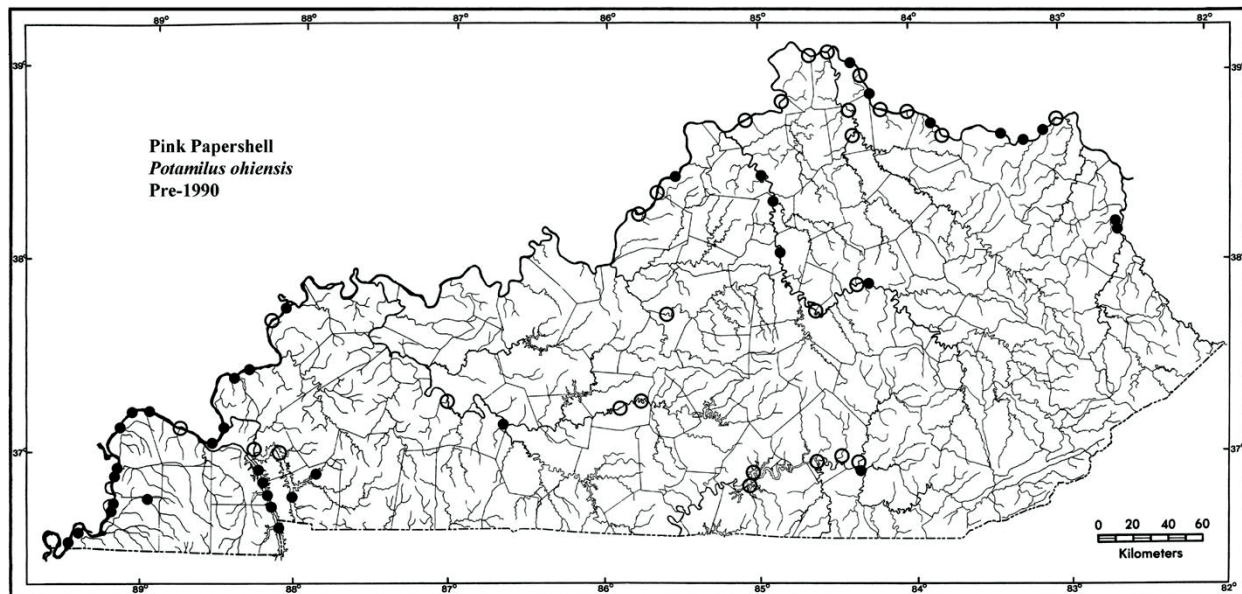
**Conservation Status**

Mussel surveys since the 1980s have found numerous individuals of *Potamilus capax* in large rivers of western Kentucky, and it is locally abundant in some areas. In contrast, there are few historical records of this species in the state, which suggests that its abundance has increased in recent times. This perception is difficult to evaluate because few historical mussel surveys were conducted in this region and most probably concentrated on main-channel mussel beds rather than the specialized backwater habitat of *P. capax*. This appears to be a highly adaptable species because life history traits such as fast growth and early maturity allow it to tolerate considerable disturbance and to colonize habitats that are unsuitable to most other mussel species (Haag 2012). In Arkansas, it is often abundant in channelized streams and large drainage ditches (Miller and Payne 2005). Despite its adaptability, this species has disappeared from parts of its original range, including the upper Mississippi River basin, for unknown reasons. This factor, along with the paucity of records in many other areas at the time, was largely responsible for its listing as a federally endangered species in 1976. Populations in Kentucky appear to be relatively large and healthy, and together with populations in the lower Wabash River, they may represent a single, large metapopulation. KNP: endangered, but downgrading to threatened may be warranted; AFS: endangered; USFWS: endangered.



*Potamilus ohiensis* (Rafinesque, 1820)

## Pink Papershell

**General Distribution**

Mississippi River basin from Louisiana north to Minnesota and Wisconsin, and west to Oklahoma and North Dakota. Ohio River basin from the mouth upstream to Ohio and West Virginia. Gulf Coast drainages from the Sabine to the Brazos river, Texas.

**Kentucky Distribution**

Type locality: Ohio River and adjacent rivers. Generally distributed to occasional in larger streams in the western third of the state, including the Mississippi River, the lower Ohio River, and the lower Tennessee, Cumberland, and Green rivers; not reported

from the Tradewater River but probably occurred there at least historically. Occasional in the upper Ohio River. Sporadic historically in the middle Cumberland River and the lower reaches of tributaries upstream to the Rockcastle River; absent above Cumberland Falls (Wilson and Clark 1914; Neel and Allen 1964). A record for the upper Rockcastle River, Rockcastle County (Blankenship and Crockett 1972), is unsubstantiated and may represent *Leptodea fragilis* (Thompson 1985). Sporadic in the upper Green, Kentucky, and Licking river drainages, and a single record is available from the Salt River drainage, Nelson County (KNP). Single records exist from the Big Sandy River and Blaine Creek, Lawrence County (Tolin and Schettig 1984).

#### Habitat & Larval Hosts

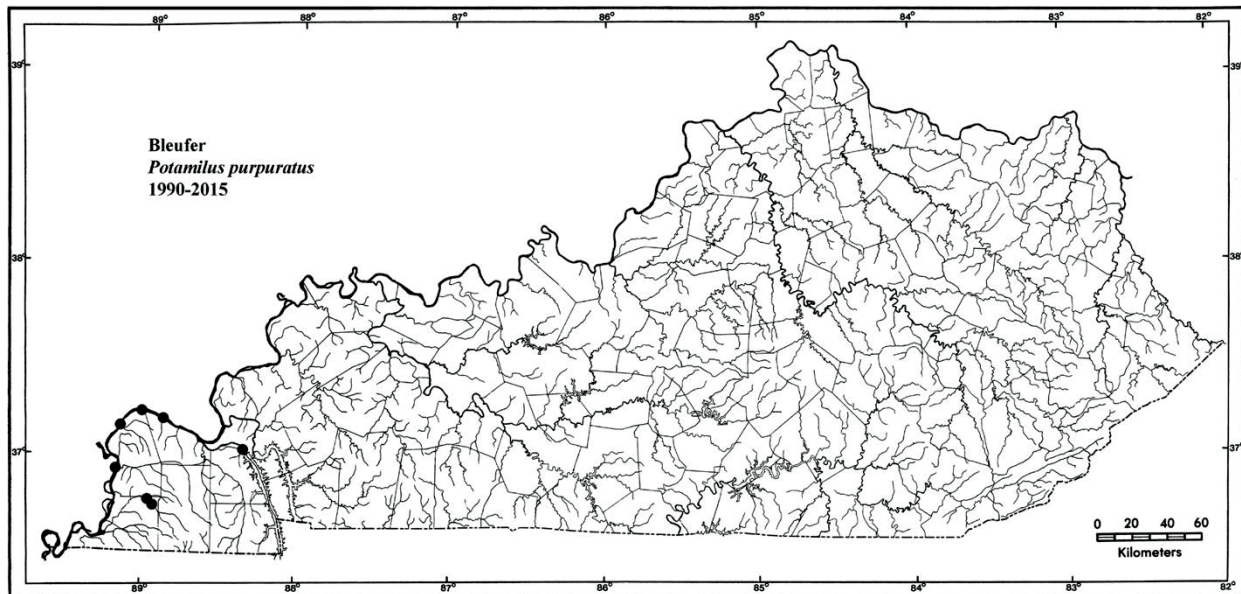
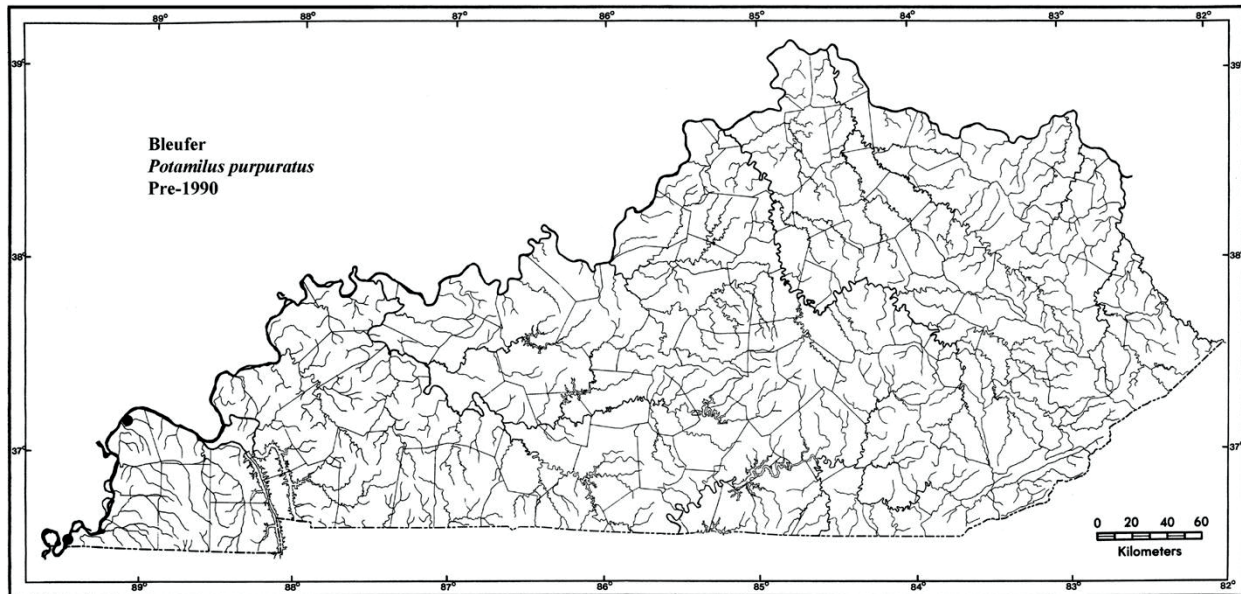
Occurs mainly in medium-sized to large streams where it is usually restricted to depositional areas along shore or in backwater pools. This species can be found sporadically in such habitats nearly statewide, but it is most common in lowland streams in western Kentucky where such habitats are more frequent. Although widespread, it is rarely abundant and is never a dominant member of mussel assemblages. This species is tolerant of impoundment to a large extent and may adapt to lentic habitats in some situations. This species is a host specialist on Freshwater Drum (*Aplodinotus grunniens*), which is probably a factor in its restriction to large streams (see *P. alatus*).

#### Conservation Status

*Potamilus ohiensis* appears to be a highly adaptable species because life history traits such as fast growth and early maturity allow it to tolerate considerable disturbance and to colonize habitats that are unsuitable to most other mussel species (Haag 2012). In addition, this species' preference for depositional environments may allow it to adapt to impounded streams or increased sedimentation in free-flowing streams. Although generally uncommon, it remains a frequently encountered species throughout much of its apparent historical range in Kentucky. It was eliminated from most of the middle Cumberland River by Wolf Creek Dam, but it is one of the few species that survived in the reservoir where it has colonized mudflats in the upper portion of Lake Cumberland (Schuster et al. 1989; Hagman 2000). Because of its adaptability, the absence of this species in several areas is puzzling. It appears to have disappeared from Kentucky and Barkley lakes and most of the upper Ohio River. Its apparent absence in these areas may be because mussel surveys often devote less effort to depositional habitats inhabited by *P. ohiensis*. The absence or rarity of this species in the Salt River drainage also is odd because of the abundance in that watershed of other species that thrive in similar environments (e.g., *Lasmigona complanata*, *Potamilus alatus*, *Toxolasma parvum*). AFS: currently stable.

*Potamilus purpuratus* (Lamarck, 1819)

Bleufer

**General Distribution**

Mississippi River basin from Louisiana north to southeastern Missouri and extreme southern Illinois, and west to eastern Oklahoma and Kansas. Ohio River basin upstream to the lower Tennessee River. Widespread in Gulf Coast drainages from the Mobile River basin to the Guadalupe River, Texas.

**Kentucky Distribution**

Restricted to lowland habitats in the Mississippi Embayment and elsewhere in far western Kentucky. Sporadic and rare in the Mississippi, lower Ohio, and



Tennessee rivers (Payne et al. 1994; Lewis et al. 2006; INHS; KNP; J. Schwegman, personal communication), but locally common in Obion Creek, Hickman County (KDOW; KNP). Kentucky is one of the few places where *P. purpuratus* co-occurs with *P. alatus*, which is extremely rare in Arkansas and apparently absent from the Mississippi Embayment in Tennessee (Parmalee and Bogan 1998; Harris et al. 2009).

#### Habitat & Larval Hosts

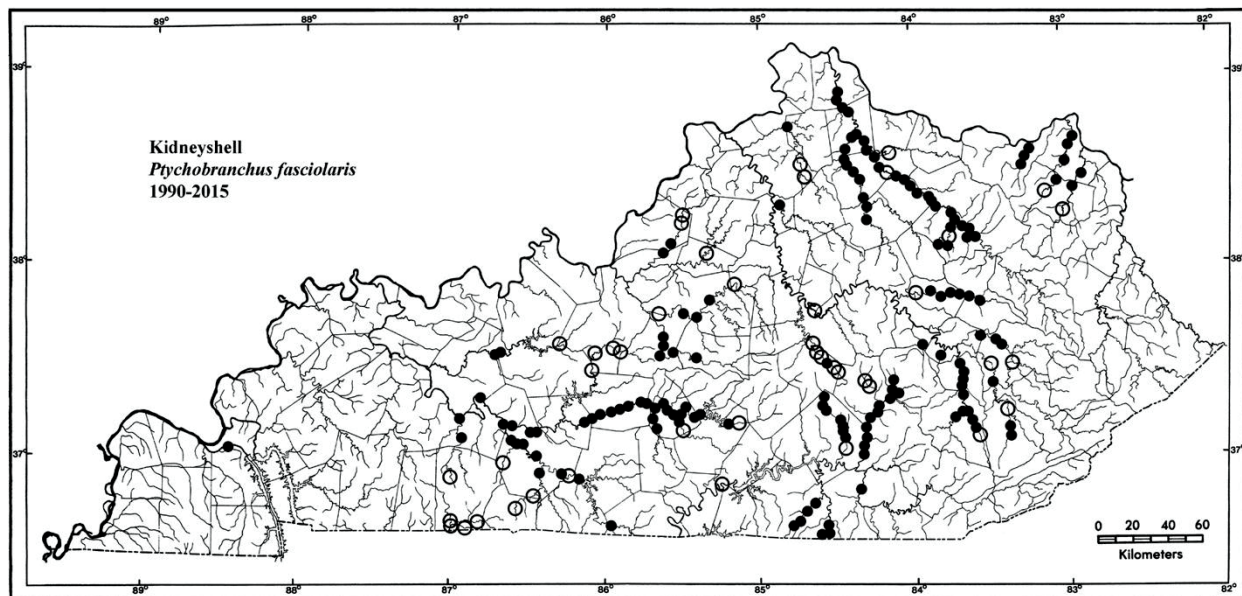
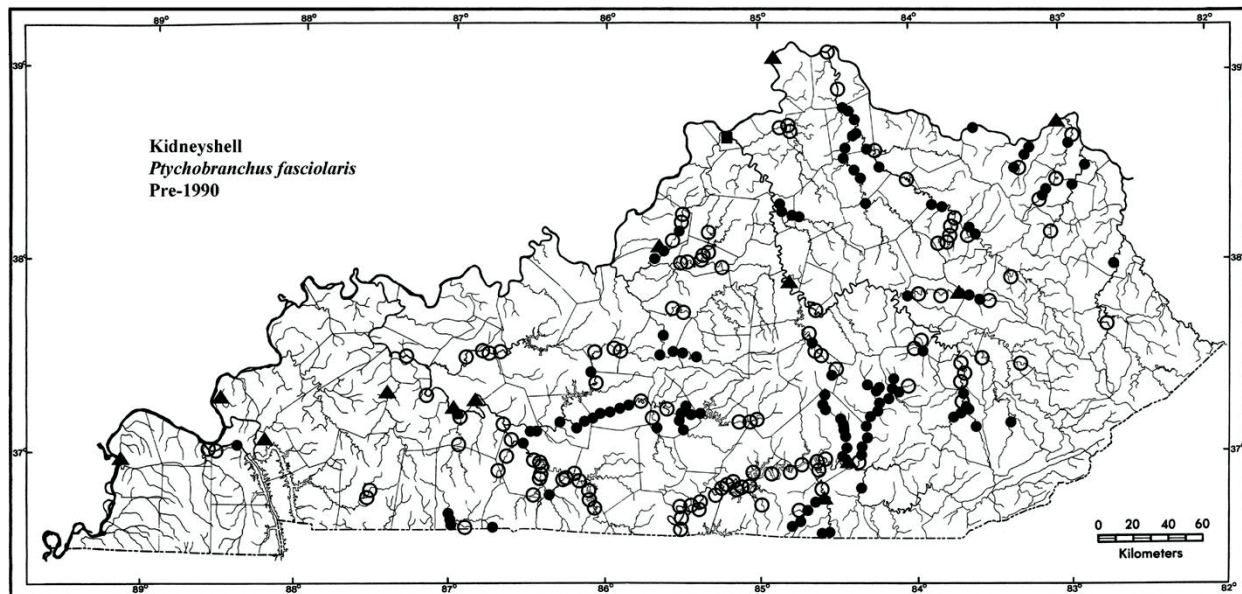
In the main portion of its range, this species is found in a wide variety of habitats from lowland to upland streams to reservoirs, in main-channel mussel beds to depositional areas, and it can be a locally dominant member of mussel assemblages. In Kentucky, it is restricted to large rivers or lowland habitats in silt or sand substrates and is usually rare. It is tolerant of impoundment to a large extent and may adapt to lentic habitats. This species is a host specialist on Freshwater Drum (*Aplodinotus grunniens*).

#### Conservation Status

*Potamilus purpuratus* is a characteristic species in most of the lower Mississippi River basin and in many Gulf Coast drainages, but it was not reported in Kentucky prior to the 1970s. The northern distributional limit of this species corresponds well to mean annual minimum air temperature isotherms (Haag 2012), suggesting that the increase in reported occurrences in Kentucky since 1990 could be related to global climate change. However, few mussel surveys were conducted in the Mississippi Embayment prior to the 1980s, and the historical distribution of this species in the state is unknown. *Potamilus purpuratus* is a highly adaptable species because life history traits such as fast growth and early maturity allow it to tolerate considerable disturbance and to colonize habitats that are unsuitable to most other mussel species (Haag 2012), and it is abundant throughout much of its core range. Nevertheless, the restricted range of this species in Kentucky makes it vulnerable to further degradation of lowland habitats. KNP: endangered; AFS: currently stable.

*Ptychobranchus fasciolaris* (Rafinesque, 1820)

## Kidneyshell

**General Distribution**

Ohio River basin upstream to New York, but absent in lowland regions of the lower basin. Great Lakes basin from Lake St. Clair to western Lake Ontario.

**Kentucky Distribution**

Type locality: Ohio, Wabash, and Kentucky rivers (see Johnson and Baker 1973). Generally distributed nearly statewide, but absent from the Mississippi River and direct tributaries, the Tradewater River, and other lowland habitats in western Kentucky; absent in the upper Cumberland River drainage above Cumberland Falls. An archaeological record from the Mis-

Mississippi River, Ballard County, suggests that conditions at that site were suitable for the species in prehistoric times (Wesler 2001; see Section IV.C.2). Sporadic in the Ohio River but widely distributed from Livingston to Greenup counties. Sporadic in the lower portions of the Tennessee, Cumberland, and Green rivers and the mainstem Kentucky River. Only two records exist for the Big Sandy River drainage (Tolin and Schettig 1984).

**Habitat & Larval Hosts**

Occurs in a wide variety of upland riverine habitats from large rivers to small streams, but does not penetrate far into the headwaters. Generally restricted to main-channel habitats in gravel and sand substrates, and typically absent from depositional habitats or lentic environments. Typically rare in the largest rivers (e.g., Ohio, Tennessee), and reaches maximum abundance in mid-sized streams where it is often common but is rarely a dominant species. This species is a host specialist on darters (Percidae).

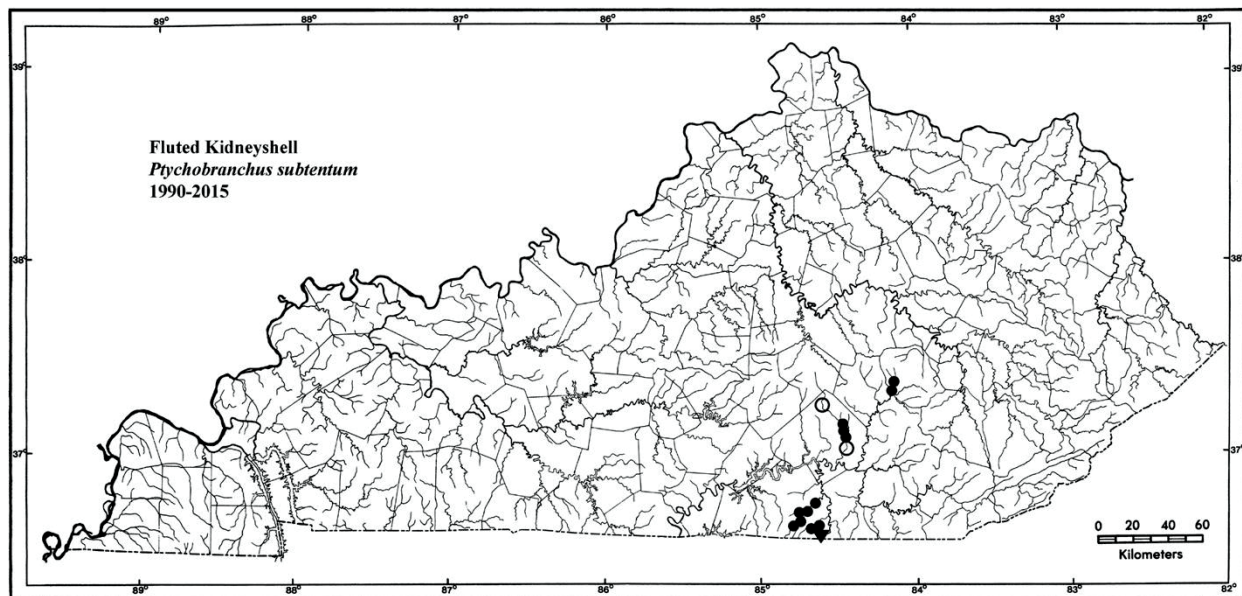
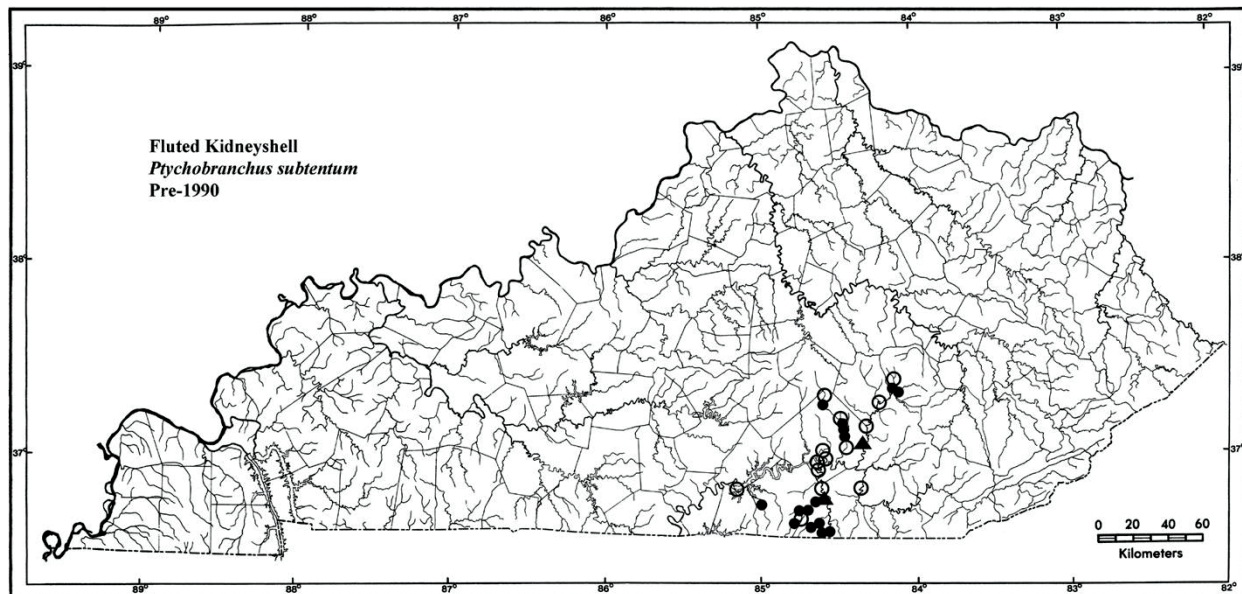
**Conservation Status**

*Ptychobranhus fasciolaris* remains a widespread and common riverine mussel species in Kentucky. Nevertheless, this species does not adapt well to impoundment and dams have eliminated many populations. It was abundant in the middle Cumberland River (Neel and Allen 1964), but Wolf Creek Dam eliminated the species from the mainstem with the exception of a small population immediately below Cumberland Falls (Cicerello and Laudermilk 1997). A single live individual was found in the entire length of the Ohio River in Kentucky in 1982 (Williams and Schuster 1989) and the species has not been found there subsequently. It is extremely rare or extirpated in the Tennessee, lower Cumberland, and Kentucky rivers. Its historical abundance in these rivers is poorly known, but it was reported as “an abundant shell in...the Ohio” in the late 1800s (Call 1900), and it was well represented (though not abundant) at archaeological sites along the Ohio, Green, and Kentucky rivers (Call and Robinson 1983; Call 1992; Morey and Crothers 1998). Because *P. fasciolaris* is a host specialist on darters, impoundment and loss of shoal habitats doubtless has greatly reduced darter populations and contributed to the rarity or extirpation of this and other darter specialists in large rivers (Haag 2012). Large, reproducing populations exist in most major upland drainages in the state, but populations in the Little, Red (lower Cumberland River drainage), Little South Fork Cumberland, Nolin, Dix, and Big Sandy rivers appear to have declined precipitously or are extirpated judging by the dearth of living individuals observed in recent years (e.g., Haag and Warren 2005). AFS: currently stable.



*Ptychobranchus subtentum* (Say, 1825)

Fluted Kidneyshell

**General Distribution**

Endemic to the Tennessee-Cumberland faunal province, occurring in northern Alabama, southern Kentucky, Tennessee, and southwestern Virginia.

**Kentucky Distribution**

Generally distributed in the middle Cumberland River drainage upstream to Cumberland Falls, but absent above the falls. Restricted mainly to small or medium-sized streams, and reported from the mainstem Cumberland River at only four sites including at the base of Cumberland Falls (Wilson and Clark 1914; UMMZ). Not reported historically from the Red

River system or elsewhere in the lower Cumberland River drainage, but reported from an archaeological site on the Cumberland River, Stewart Co., Tennessee, near the state line (Parmalee and Bogan 1998), suggesting that it may have occurred in the lower Cumberland River in Kentucky in prehistoric times. An archaeological record from the West Fork Red River, Todd County (OSUM), is considered doubtful (see Section IV.C.2).

#### Habitat & Larval Hosts

Small to medium-sized streams in gravel and sand substrates, where it may be a dominant species. This species is a host specialist on darters (Percidae).

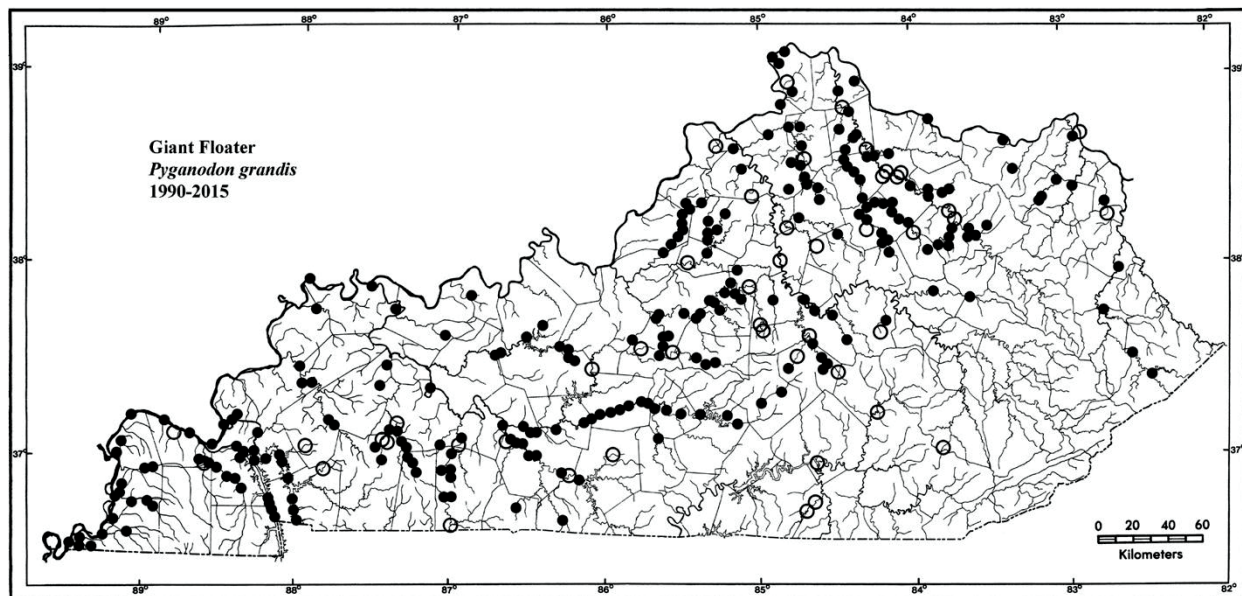
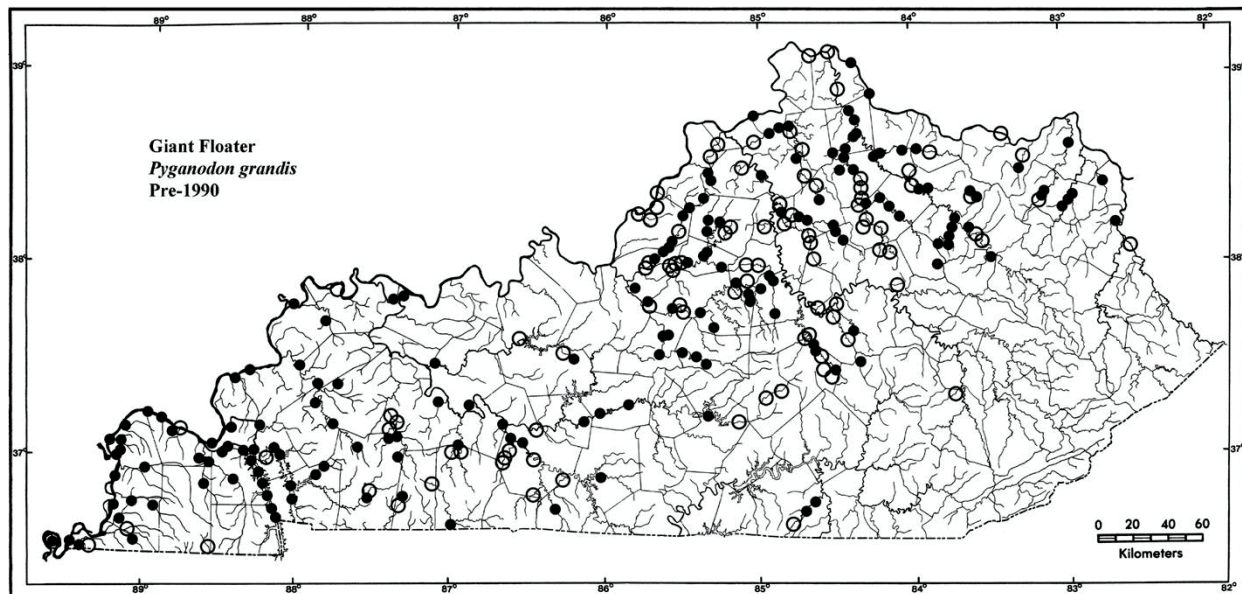
#### Conservation Status

Due to its occurrence in small streams, most of the range of *Ptychobranchus subtentum* was not directly affected by impoundment of the Cumberland River. Nevertheless, it has declined dramatically in recent years and is in danger of disappearing from Kentucky. Prior to 1990, it was a characteristic and locally abundant member of mussel assemblages in small streams throughout the middle Cumberland River drainage. All of these populations have declined in the last 20 years and few may be viable. A large population existed throughout the Little South Fork Cumberland River, where it was one of the most abundant species, but coal mining and oil drilling appear to have caused catastrophic declines of all mussel species in that stream. The abundance of *P. subtentum* declined about 90% by 1998, and only three live individuals were found in the stream in 2013 (Starnes and Bogan 1982; Warren and Haag 2005; Ahlstedt et al. 2014). The only post-1990 records from the Rockcastle River system are from Horse Lick Creek, Jackson County, but mussel populations also have been nearly eliminated in this stream apparently by coal mining, and only a single, recently dead *P. subtentum* was found in the entire creek in 2003 (Haag and Warren 2004). A small population persisted in Otter Creek, Wayne County, until at least the 1980s (KNP) but now may be extirpated, and the species has not been seen in the Cumberland River below Cumberland Falls since the early 1900s (Cicerello and Laudermilk 1997). It was rare in the Big South Fork and has not been found there since the late 1980s (Ahlstedt et al. 2003-2004). The only other remaining populations in Kentucky are in Buck Creek (Pulaski County) and Rock Creek (McCreary County), but both of these populations are small. Elsewhere in the Cumberland River drainage, *P. subtentum* potentially survives only in a short reach of the Wolf River, Tennessee (Obey River drainage; Moles et al. 2007). As for other Tennessee-Cumberland endemic species, there exists a high likelihood that Tennessee and Cumberland river drainage populations represent separate species (see section IV.D.3). If so, Cumberland River drainage populations represent a critically endangered species on the brink of extinction. The only large population of *P. subtentum* remaining on Earth is in the Clinch River, Tennessee and Virginia (Tennessee River drainage). In 2008, 142 adult individuals from the Clinch River were released in the Big South Fork in an attempt to augment this population (McGregor et al. 2008). However, genetic relationships between Cumberland and Tennessee River drainage populations were not assessed prior to this activity. If Cumberland River drainage populations represent a separate species, mixing with Tennessee River stock in the Big South Fork and elsewhere represents another threat to the survival of the species (see Haag and Williams 2014). KNP: endangered; AFS: special concern; USFWS: endangered.



*Pyganodon grandis* (Say, 1829)

## Giant Floater

**General Distribution**

The most widely distributed North American mussel species, occurring throughout much of North America east of the Rocky Mountains with the exception of most of the Atlantic Coast and peninsular Florida. Mississippi River basin from Louisiana north to Minnesota, and west to eastern Colorado and Montana. Throughout the Ohio River basin from the mouth upstream to New York. Throughout the Great Lakes and St. Lawrence basins, much of the Hudson Bay basin west to Alberta, and in the Mackenzie River basin in the Yukon and Northwest territories. Gulf Coast drainages from the Ochlockonee River, Florida, to southern Texas and perhaps into northern Mexico, and the Hudson River basin on the Atlantic Coast. Several subspecies or forms are described, but their phylo-



genetic relationships are poorly known. Introduced in Arizona; New Mexico; the Cape Fear River, North Carolina; and probably elsewhere (Bogan 2002; Hovingh 2004; B. Lang, personal communication).

**Kentucky Distribution**

Generally distributed over much of the state, but sporadic or absent in streams on the Appalachian Plateaus such as the upper Kentucky and Licking river drainages. Sporadic in the middle Cumberland River drainage and not reported there prior to the 1970s; absent in the upper Cumberland River drainage above Cumberland Falls. Found sporadically but statewide in farm ponds and reservoirs where it may be introduced via fish stocking.

**Habitat & Larval Hosts**

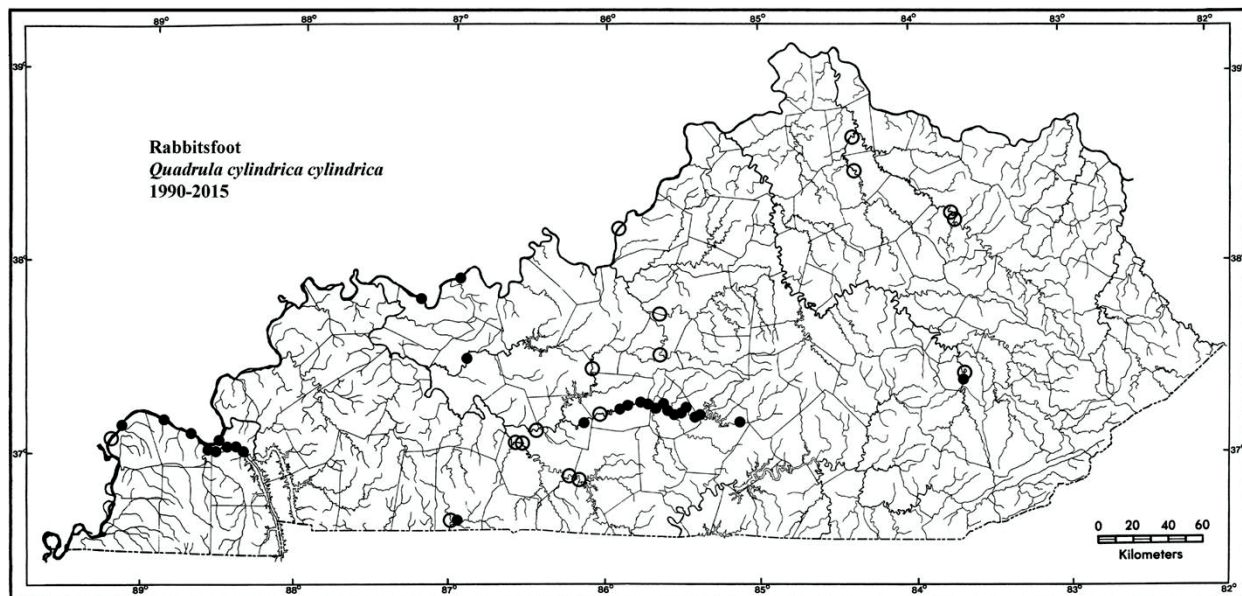
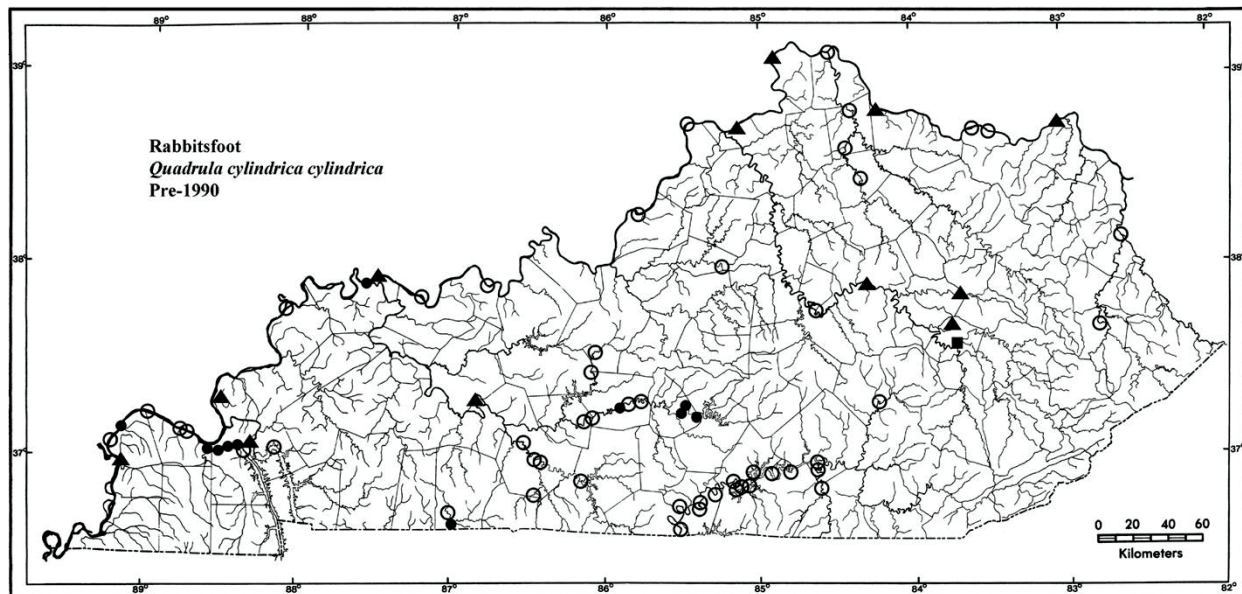
May occur in nearly any type of permanent aquatic habitat from lowland to upland streams, large or small, to reservoirs, ponds, and wetlands. In streams, it is typically restricted to depositional areas along shore or in backwater pools; the scarcity of these habitats in high gradient streams of the Appalachian Plateaus probably explains its rarity there. It adapts readily to impoundment and likely has expanded its range subsequent to dam and farm pond construction. Although common and widespread, this species does not occur at high densities and rarely dominates stream mussel assemblages, but it is often the only species in small ponds. This species is a host generalist, able to use a wide range of fish species.

**Conservation Status**

*Pyganodon grandis* doubtless has experienced localized declines or extirpations in response to severe water quality degradation, but the distribution and abundance of this species in Kentucky and elsewhere probably have increased in the last 100 years. This is a highly adaptable species because of its fast growth, early maturity, and ability to use a wide range of fishes as hosts; these traits allow it to tolerate considerable disturbance and to colonize habitats that are unsuitable to most other mussel species (Haag 2012). Stream impoundment and farm pond construction have greatly increased the extent of suitable habitat for this species, and increased sedimentation in free-flowing streams also may have increased habitat availability. This species often colonizes fish hatchery ponds, and stocking of fishes infected with glochidia of *P. grandis* has aided in its expansion and can be expected to result in establishment of additional populations anywhere in the state. AFS: currently stable.

*Quadrula cylindrica cylindrica* (Say, 1817)

## Rabbitsfoot

**General Distribution**

Mississippi River basin from Louisiana north to Missouri, and west to Oklahoma and Kansas. Ohio River basin from the mouth upstream to Pennsylvania. Great Lakes basin in the Maumee River system of western Lake Erie. The subspecies *Q. cylindrica strigilata* is considered endemic to the upper Tennessee River drainage in Tennessee and Virginia.

**Kentucky Distribution**

Sporadic to occasional throughout the Ohio River and in most major drainages from the Tennessee to the Big Sandy river. Not reported historically from the

Mississippi River, but an archaeological record from the Mississippi River, Ballard County, suggests that conditions at that site were suitable for the species in prehistoric times (Wesler 2001; see Section IV.C.2). Not reported from lowland habitats in western Kentucky including the Tradewater River. Occasional but locally common in the Tennessee River downstream of Kentucky Dam; not reported upstream of Kentucky Dam but probably distributed throughout the mainstem historically. Sporadic in the lower Cumberland River and occasional in the Red River, Logan County (KNP). Formerly generally distributed in the middle Cumberland River but reported from tributaries only in the lower Big South Fork and the Rockcastle River; absent in the upper Cumberland River drainage above Cumberland Falls (Wilson and Clark 1914; Neel and Allen 1964). Reported from the lower Green River only from archaeological sites in Butler County (Morey and Crothers 1998; Claassen 2005; Patch 2005), but probably present throughout the mainstem historically; the only recent record from the lower Green River drainage is from the Rough River, Ohio County (Gordon 1993). Generally distributed to occasional in the upper Green, Barren, and Nolin rivers. Sporadic from the Salt to the Big Sandy river drainage, but not reported from Kinniconick Creek, Tygarts Creek, or the Little Sandy River.

#### Habitat & Larval Hosts

Occurs mainly in medium-sized to large streams. May be found in main-channel mussel beds, but usually occurs in a rather specialized habitat in slack water adjacent to the current, often along shore. Unlike most mussel species, it often lies completely unburied on the stream bottom. This species is usually uncommon, even historically, but it may be locally common in some streams; however, unlike several other *Quadrula*, it is never a dominant member of mussel assemblages. This species is a host specialist on minnows (Cyprinidae).

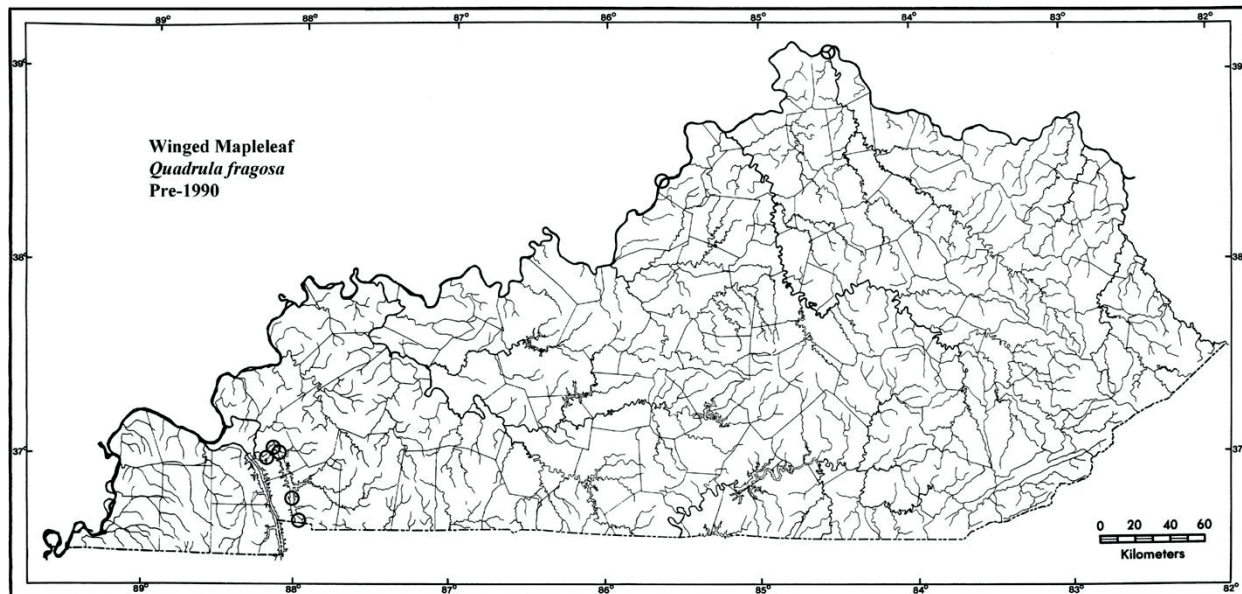
#### Conservation Status

*Quadrula cylindrica cylindrica* has disappeared from most of its former range in Kentucky. This species is only marginally tolerant of impoundment and it is extirpated in most large rivers. A large population exists in the Tennessee River downstream of Kentucky Dam (Sickel 1985; Lewis et al. 2006; Lewis and Sickel 2007; MSU; J. Schwegman and D. Henley, personal communication), and small, localized populations survive in the lower Ohio River (Williams and Schuster 1989; KNP); not reported from the upper Ohio River in decades. Apparently extirpated from the lower Cumberland, lower Green, and Kentucky rivers by impoundment, and the large population in the middle Cumberland River was eliminated by Wolf Creek Dam. The reasons for its disappearance in unimpounded streams across the state are unknown, but it now appears extirpated from the Salt, Licking, and Big Sandy river drainages, most of the Kentucky River drainage, and the Barren and Nolin river systems. Only four other populations are known in Kentucky at this time. Small populations persist in the Rough River, Ohio County (Gordon 1993), and the South Fork Kentucky River, Owsley County (KNP). Prior to the 1990s, it was common in the Red River, Logan County, but this population has declined dramatically along with all other mussel species in the river (OSUM; KNP). In addition to the lower Tennessee River, the largest population in Kentucky is in the upper Green River from Edmonson to Adair County, where the species is locally common (McGregor et al. 2007, 2009; TTU; ECU; KNP). KNP: threatened; AFS: threatened; USFWS: threatened.



*Quadrula fragosa* (Conrad, 1835)

## Winged Mapleleaf

**General Distribution**

Mississippi River basin from Arkansas north to Minnesota and Wisconsin, and west to Oklahoma. Ohio River basin upstream to about the Scioto River, Ohio. The distribution of this species is difficult to determine precisely because of confusion with the similar *Q. quadrula* (USFWS 1997).

**Kentucky Distribution**

The only reports of this species in Kentucky are from two sites in the Ohio River, Oldham (Call 1900) and Kenton (OSUM) counties, and from several

sites in the lower Cumberland River, Lyon and Trigg counties (Wilson and Clark 1914). The species may have occurred historically in other large streams but was not distinguished from *Q. quadrula*. Records from the Ohio River, Ballard County (Cicerello et al. 1991; OSUM), and the South Fork Licking River, Pendleton County (Schuster 1988; UMMZ), are *Q. quadrula*.

**Habitat & Larval Hosts**

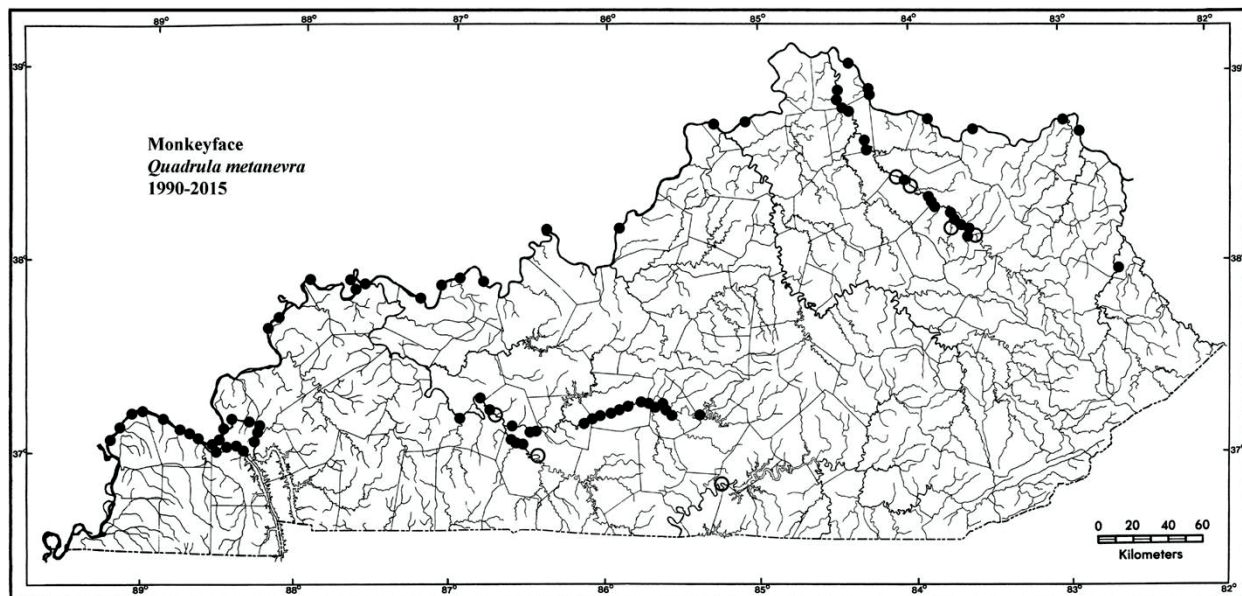
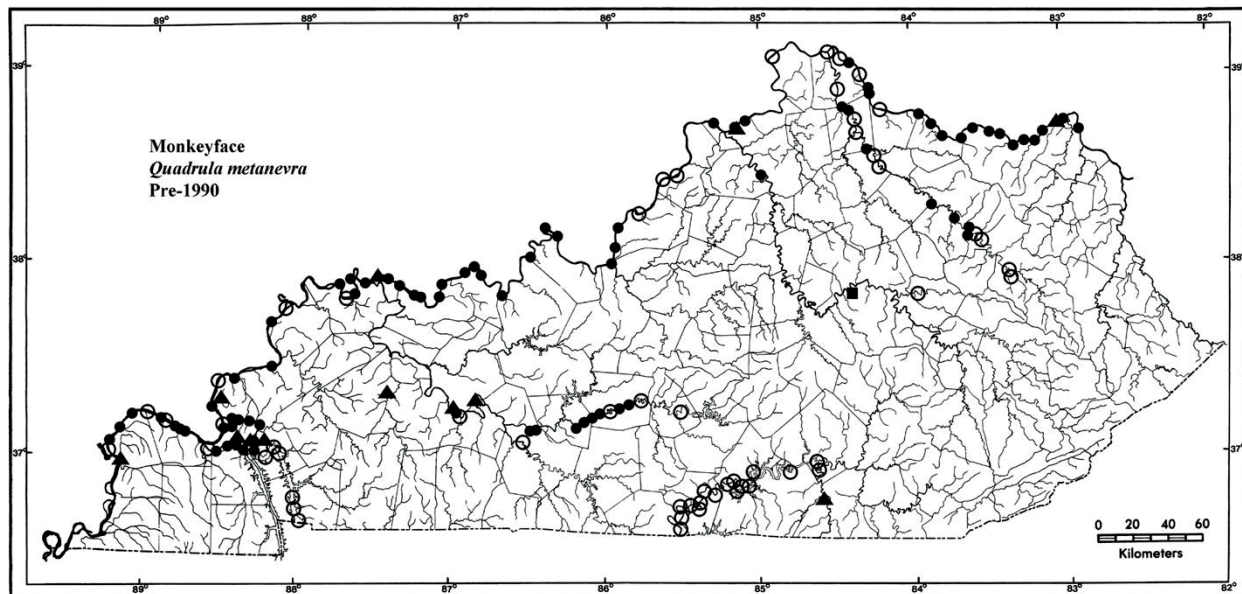
Restricted to medium-sized to large rivers. The population in the St. Croix River, Minnesota, occurs in main-channel mussel beds in gravel and sand substrates (Hornbach et al. 1996), but the species is reported from a variety of other habitats including depositional areas and even some impounded streams (USFWS 1997). This species is a host specialist on catfishes (Ictaluridae).

**Conservation Status**

*Quadrula fragosa* has not been reported from Kentucky in over 100 years and may be extirpated from the state. Most other species of *Quadrula* (especially *Q. quadrula*) are relatively tolerant of impoundment and other habitat alterations, but *Q. fragosa* appears intolerant of stream degradation and other aspects of its habitat requirements are poorly understood. It was locally abundant in the lower Cumberland River in the early 1900s (Wilson and Clark 1914), but this population, along with those in the Ohio River, appears extirpated. This species is known to survive in only five widely scattered streams: the St. Croix River, Minnesota and Wisconsin; the Saline and Ouachita rivers, Arkansas; the Little River, Oklahoma; and the Bourbeuse River, Missouri. Additional populations should be searched for in Kentucky by carefully examining specimens of *Q. quadrula* from the Ohio River and other large streams, and a better understanding of the phylogenetic relationships between these two species is needed. KNP: presumed extirpated; AFS: endangered; USFWS: endangered.

*Quadrula metanevra* (Rafinesque, 1820)

## Monkeyface

**General Distribution**

Mississippi River basin from Louisiana upstream to Minnesota, and west to Kansas. Ohio River basin from the mouth upstream to Pennsylvania. Occurs in Gulf Coast drainages only in the Mobile River basin.

**Kentucky Distribution**

Type locality: Kentucky River. Generally distributed throughout the Ohio River, and present in most major tributaries; absent in smaller streams. Not reported from the Mississippi River, but an archaeological record from the Mississippi River, Ballard County,



suggests that conditions at that site were suitable for the species in prehistoric times (Wesler 2001; see Section IV.C.2). Generally distributed in the Tennessee and lower Cumberland rivers but not reported from the Red River system; an archaeological record from the West Fork Red River, Todd County (OSUM), is considered doubtful (see Section IV.C.2). Formerly generally distributed and abundant in the middle Cumberland River upstream to Burnside, Pulaski County, but reported from tributaries only in the lower Big South Fork (Neel and Allen 1964); absent in the upper Cumberland River above Cumberland Falls. Records of *Quadrula tuberosa*, *Q. tuberosa sparsa*, and *Q. sparsa* from the middle Cumberland River drainage (Ortmann 1912; Wilson and Clark 1914; UMMZ; UIMNH; J. Kiser and P. Parmalee, personal communication), are considered to represent *Q. metanevra* (Parmalee and Bogan 1998; but see section IV.D.2). Only scattered records exist for the lower Green River, but probably present throughout the mainstem historically. Generally distributed in the upper Green River upstream to Green County, and occasional in the lower Barren River. Not reported from the Salt River drainage, but probably occurred historically in the lower Salt River. Apart from the type locality, reported from the Kentucky River drainage only from the Kentucky River, Henry/Owen counties (Tolin and King 1986), and the Red River, Powell County (NCMNS). Generally distributed in the Licking River upstream to Rowan County, but not reported from the South Fork Licking River. Known from the Big Sandy River drainage by only one record: Levisa Fork, Lawrence County (KNP).

#### Habitat & Larval Hosts

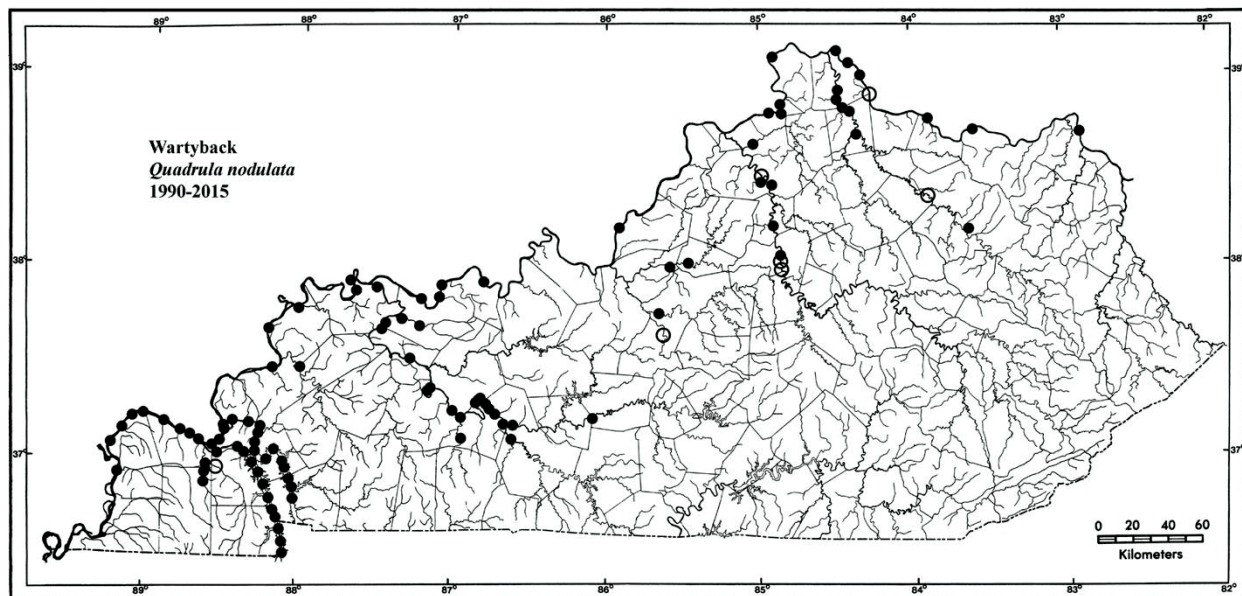
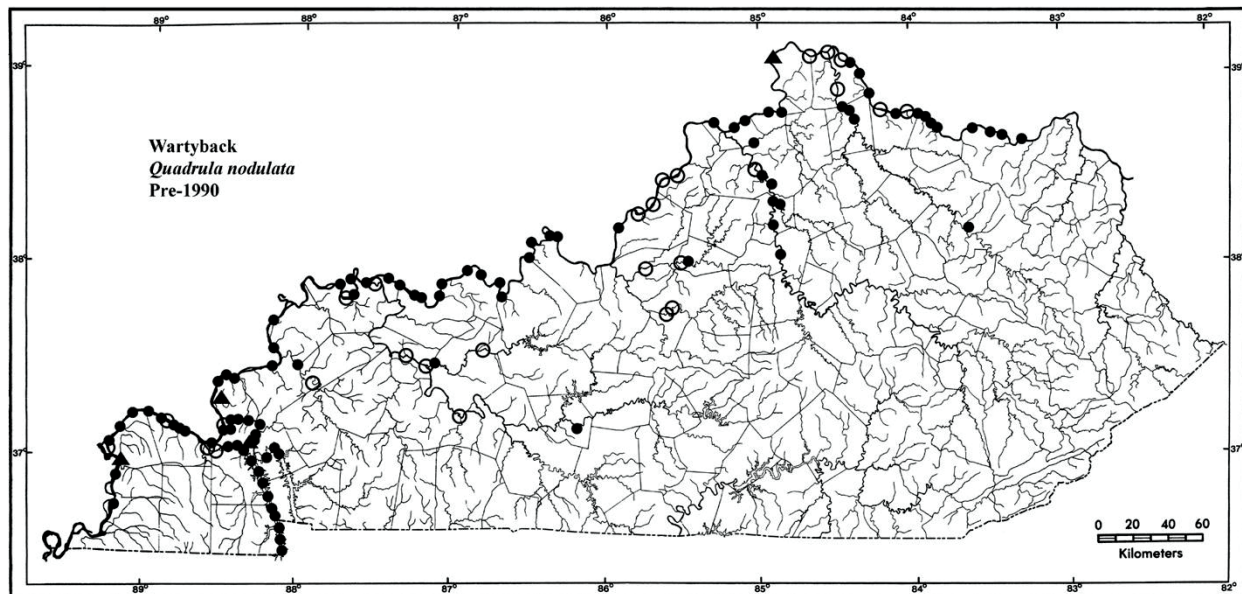
Restricted to main-channel habitats of medium-sized to large rivers in gravel and sand substrates. This species is characteristic of larger streams, where it can be common but is rarely a dominant component of mussel beds. This species is a host specialist on minnows (Cyprinidae).

#### Conservation Status

*Quadrula metanevra* appears less tolerant of impoundment than other *Quadrula* such as *Q. nodulata* and *Q. quadrula*, but it can adapt to impounded sections of rivers that retain considerable riverine influence. It remains common in sections of the Ohio River downstream of navigation dams, but has likely declined in sections more heavily influenced by impoundment. Similarly, its current rarity or absence in the lower Green, Salt, and Kentucky rivers is likely due to impoundment, and it was probably widespread in those streams historically. Unlike *Q. pustulosa* and *Q. quadrula*, it did not adapt to Kentucky and Barkley lakes, and the large population in the middle Cumberland River was eliminated by Wolf Creek Dam. In addition to the Ohio River, large and apparently healthy populations remain in the Tennessee, lower Cumberland, upper Green, and Licking rivers. AFS: currently stable.

*Quadrula nodulata* (Rafinesque, 1820)

## Wartyback

**General Distribution**

Mississippi River basin from Louisiana north to Minnesota, and west to eastern Kansas. Ohio River basin from the mouth upstream to about the Muskingum River, Ohio, but absent from the upper two-thirds of the Cumberland and Tennessee River drainages. Occurs in Gulf Coast drainages only in the Sabine and Neches rivers, Texas.

**Kentucky Distribution**

Type locality: Kentucky River. Mostly restricted to the largest rivers, but occasionally occurs in medium-sized streams. Sporadic in the Mississippi River,

and generally distributed and locally common throughout the Ohio River. Generally distributed to occasional and locally common in the lower reaches of all major Ohio River tributaries from the Tennessee to the Licking River. Absent from the middle and upper Cumberland River drainages and the Big Sandy River, and rare in the upper Green River drainage.

**Habitat & Larval Hosts**

A characteristic species of large, low gradient streams. Typically a minor component of main-channel mussel beds in gravel and sand substrates, but also found frequently in depositional areas along shore or in backwater pools. It adapts readily to riverine impoundments, where it colonizes inundated river floodplains. Host use for this species is unknown, but it is probably a specialist on catfishes (Ictaluridae), similar to *Q. fragosa* and *Q. pustulosa*.

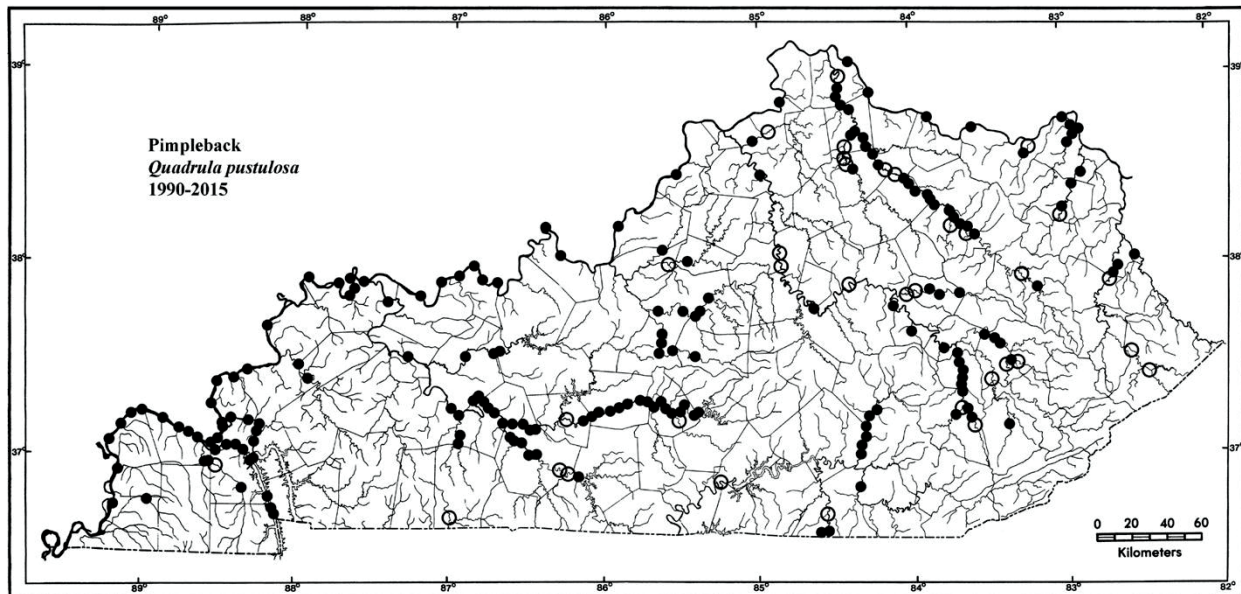
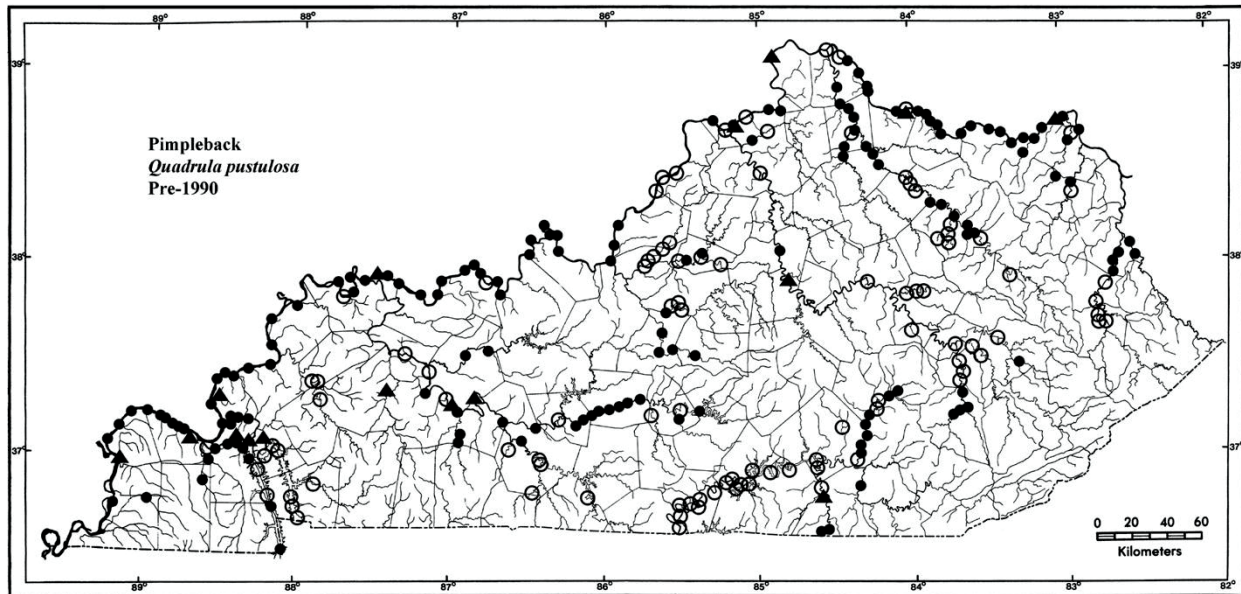
**Conservation Status**

*Quadrula nodulata* remains common in larger streams across most of Kentucky. Its distribution probably has changed little in the last 100 years, but it may have become more abundant or expanded its distribution in some areas. Its tolerance to impoundment has allowed it to adapt to streams such as the lower Green and Kentucky rivers, which have lost many other mussel species. Populations in the impounded Tennessee and lower Cumberland rivers may have increased in size due to the inundation of former river floodplains, which this species has colonized extensively. Most populations are large and show evidence of recent recruitment. AFS: currently stable.



*Quadrula pustulosa* (Lea, 1831)

## Pimpleback

**General Distribution**

Mississippi River basin from Louisiana north to Minnesota, and west to eastern Oklahoma and South Dakota. Ohio River basin from the mouth upstream to Pennsylvania. Great Lakes basin from Lake Michigan to the Niagara River. Reported from Gulf Coast drainages from the Mermentau River, Louisiana, west to the Neches River, Texas, but these populations may represent a separate species, *Q. mortoni* (Serb et al. 2003).

**Kentucky Distribution**

Generally distributed in medium-sized to large streams statewide, with the exception of the upper Cumberland River drainage above Cumberland Falls.

**Habitat & Larval Hosts**

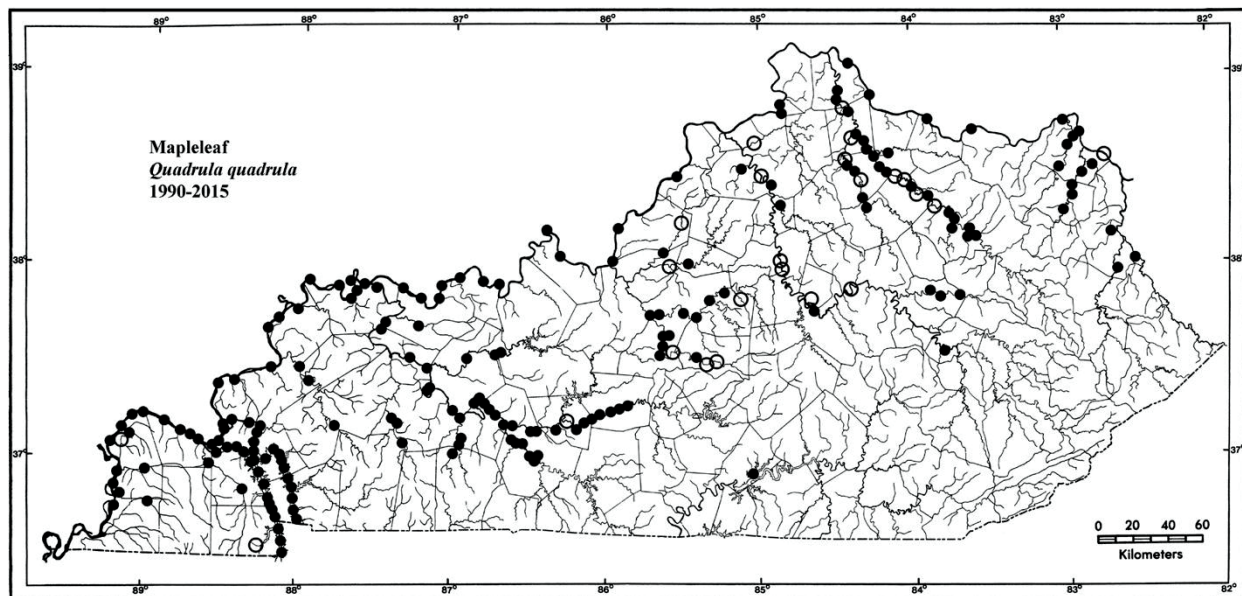
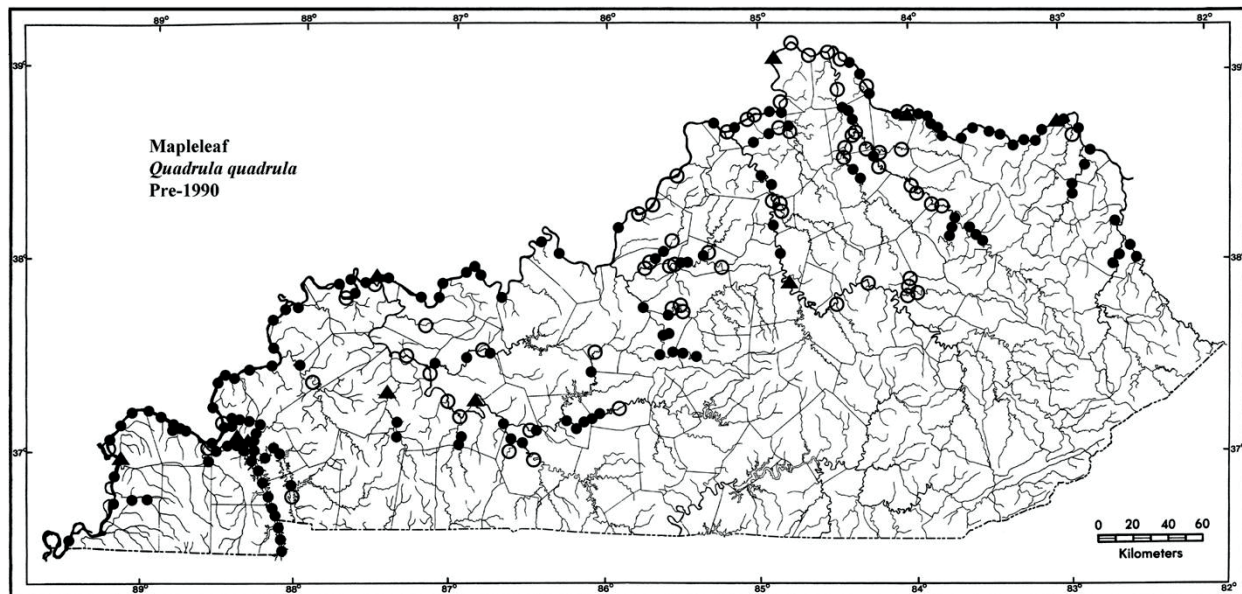
Occurs in a wide variety of habitats from lowland to upland streams to reservoirs, but becomes progressively rarer in smaller streams and does not penetrate far into the headwaters. It is a characteristic and often dominant species of main-channel mussel beds, but also is found frequently in depositional areas along shore or in backwater pools. It adapts to impoundment in some situations, where it colonizes inundated river floodplains, but is absent in truly lentic habitats. This species is a host specialist on catfishes (Ictaluridae).

**Conservation Status**

*Quadrula pustulosa* historically was a common and often dominant species in many Kentucky rivers and it remains so today. It doubtless has experienced localized declines or extirpations in response to severe water quality degradation, and populations in some streams seem to have disappeared (e.g., Little and Red rivers). It was abundant in the middle Cumberland River (Neel and Allen 1964) but was eliminated from that stream by Wolf Creek Dam, with the exception of a small population remaining immediately below Cumberland Falls (Cicerello and Laudermilk 1997). Small populations in isolated stream reaches may be vulnerable to extinction from random fluctuations in environmental conditions or population size (e.g., upper Barren River, Buck Creek), and the long term viability of many other populations is unknown. Nevertheless, several large populations remain in Kentucky, and many of these show evidence of vigorous recent recruitment. Its tolerance to impoundment has allowed it to remain an abundant species throughout the Ohio, lower Tennessee, and lower Cumberland rivers, and to persist in the lower Green and Kentucky rivers. However, it appears somewhat less tolerant of impoundment than *Q. nodulata* and *Q. quadrula*; it is less frequent than those species in Kentucky Lake, and it appears absent in Lake Barkley. In addition to the Ohio River, large, recruiting populations exist throughout long reaches of the upper Green and Licking rivers, and the species remains common in the upper Big South Fork Cumberland River, Rockcastle River, Barren River, and portions of the Salt and upper Kentucky river drainages. AFS: currently stable.

*Quadrula quadrula* (Rafinesque, 1820)

## Mapleleaf

**General Distribution**

Mississippi River basin from Louisiana north to Minnesota and west to Kansas and South Dakota. Ohio River basin from the mouth upstream to Pennsylvania. Great Lakes basin from Lake Michigan to the Niagara River, and southern Hudson Bay basin in North Dakota and Manitoba. Reported from Gulf Coast drainages from the Mermentau River, Louisiana, west to the San Jacinto River, Texas, but these populations, as well as others in the lower Mississippi River basin, may represent separate species or a species complex including *Q. apiculata* and *Q. nobilis* (Serb et al. 2003; see section IV.D.2). This species is expanding its range in the Tennessee River and perhaps other streams fol-



lowing impoundment (Williams et al. 2008), and it appears to have been introduced in the upper Missouri River, Montana (Stagliano 2010).

**Kentucky Distribution**

Type locality: Ohio River. Generally distributed in most medium-sized to large streams statewide, but typically absent in smaller streams and streams on the Appalachian Plateaus. Absent historically from the middle and upper Cumberland River drainages, but a 2007 record for the middle Cumberland River (Lake Cumberland), Russell County (KNP), suggests that this species has been introduced there either intentionally or via glochidia on stocked fishes. Some records from large rivers in western Kentucky may represent *Quadrula apiculata* or *Q. nobilis* (see section IV.D.2).

**Habitat & Larval Hosts**

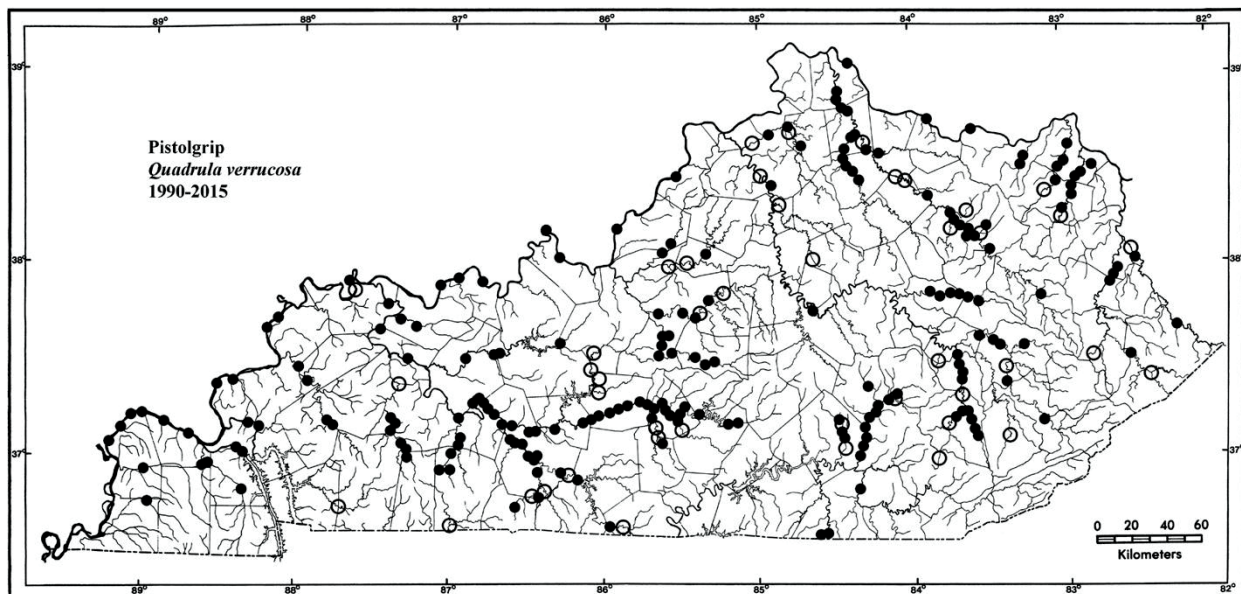
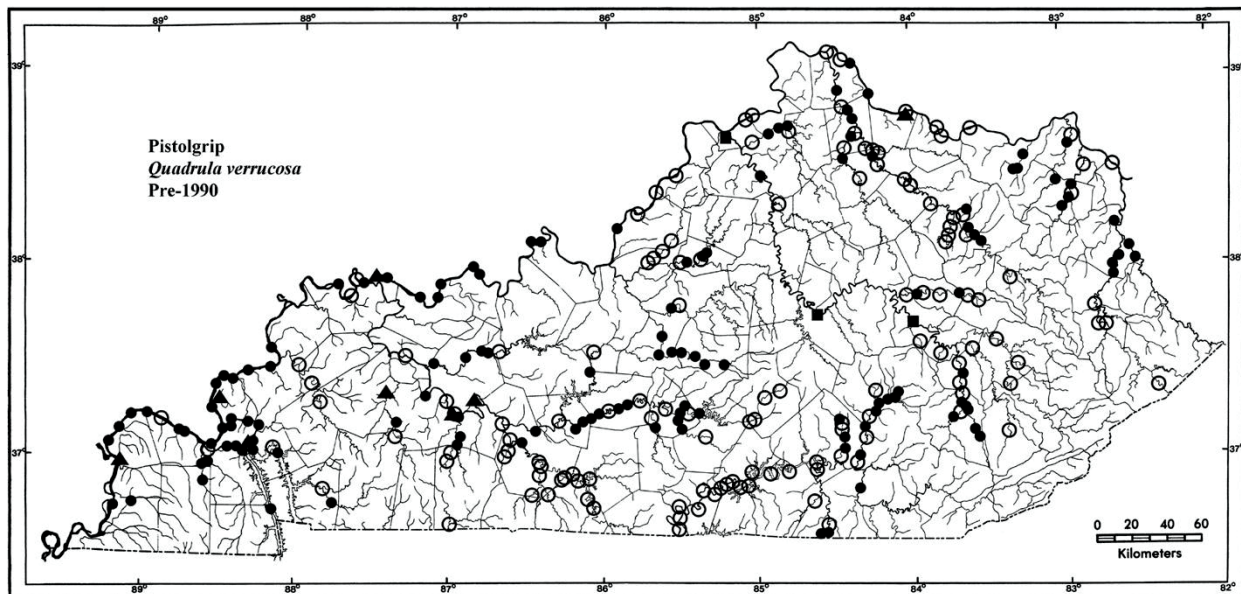
A characteristic species of medium-sized to large, low gradient streams where it may be a locally dominant member of mussel assemblages. Occurs in main-channel mussel beds in gravel and sand substrates, but also found frequently in depositional areas along shore or in backwater pools. It adapts readily to impoundment, where it colonizes inundated river floodplains. Host use for this species is unknown, but it is probably a specialist on catfishes (Ictaluridae), similar to *Q. fragosa* and *Q. pustulosa*.

**Conservation Status**

*Quadrula quadrula* appears to be a very adaptable species, and it remains common in many streams across Kentucky. Its distribution in the state has changed little in the last 100 years, but it is probably more abundant than in the past because impoundment of most large rivers has created extensive areas of favorable habitat for the species. It is a dominant species throughout Kentucky and Barkley lakes, where it has colonized much of the former river floodplains inundated by these reservoirs, and it may have increased in abundance in navigation pools on the Ohio and Green rivers. AFS: currently stable.

*Quadrula verrucosa* (Rafinesque, 1820)

## Pistolgrip

**General Distribution**

Mississippi River basin from Louisiana north to Minnesota, and west to Oklahoma and South Dakota. Ohio River basin from the mouth upstream to Pennsylvania. Gulf Coast drainages from the Mobile River basin west to the San Antonio River, Texas.

**Kentucky Distribution**

Type locality: Ohio River. Generally distributed to occasional statewide, with the exception of the upper Cumberland River drainage above Cumberland Falls.

**Habitat & Larval Hosts**

Occurs in a wide variety of habitats from lowland to upland streams, large and small, but does not penetrate far into the headwaters. Most common in medium-sized to large streams, but rarely a dominant component of mussel assemblages in any habitat. It occurs in main-channel mussel beds and in depositional areas along shore or in backwater pools. However, it is often found in a rather specialized habitat in slack water adjacent to the current, often along shore. Unlike most mussels, it often lies completely or partially unburied on the stream bottom. This species is a host specialist on catfishes (Ictaluridae).

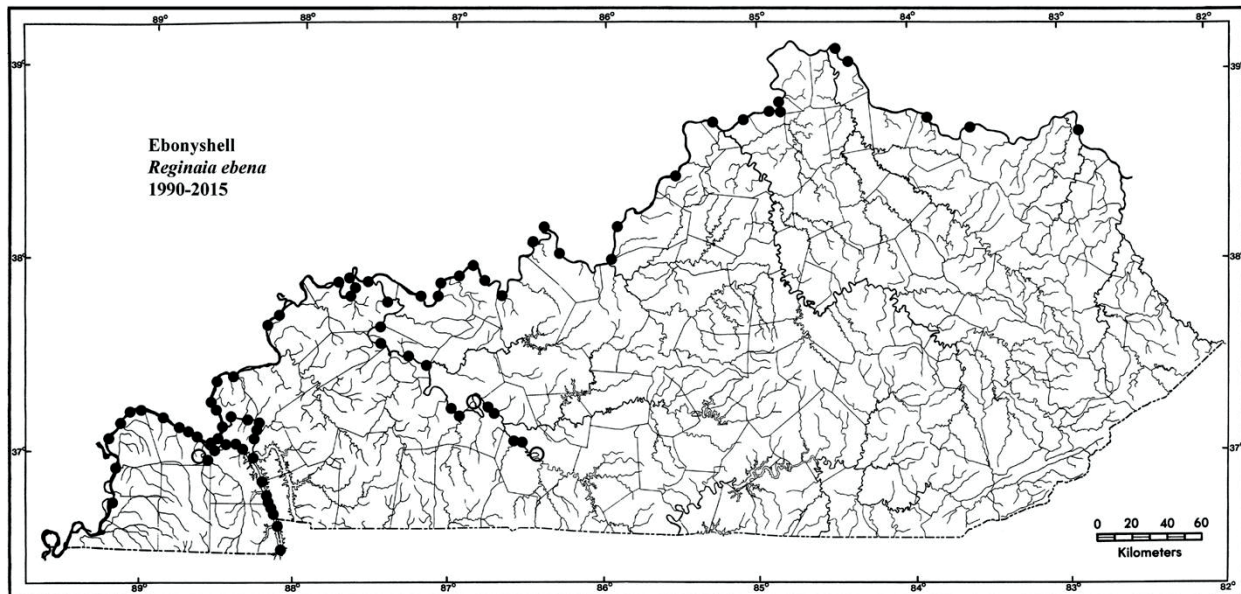
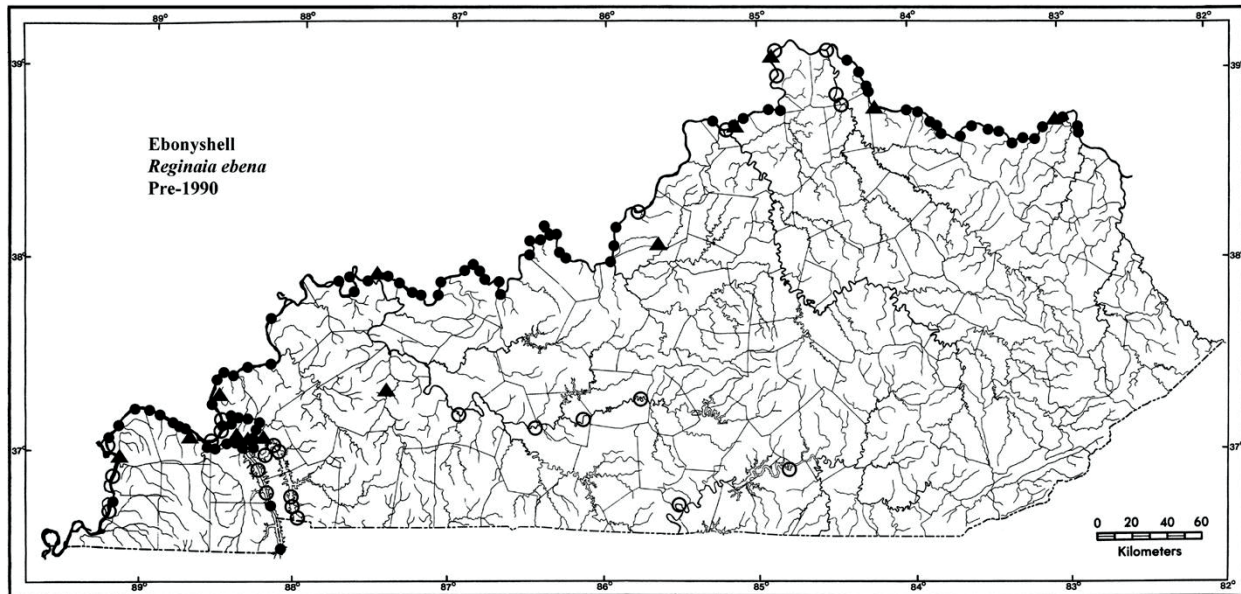
**Conservation Status**

*Quadrula verrucosa* remains a widespread and common riverine mussel species throughout Kentucky, but several populations have declined or been eliminated. It was common throughout the middle Cumberland River (Neel and Allen 1964), but Wolf Creek Dam eliminated the species from the mainstem with the exception of a small population remaining immediately below Cumberland Falls (Cicerello and Lauder milk 1997). Populations in the Little, Red (lower Cumberland River drainage), and Nolin rivers appear to be extirpated from unknown causes. This species appears less tolerant of impoundment than other *Quadrula*. It persists throughout the Ohio River, but appears extirpated from Kentucky and Barkley lakes, and it is rare in the Kentucky River. Elsewhere in the state, *Q. verrucosa* is seen frequently today in a wide variety of habitats. However, there is little information about age-structure or long term viability of most populations. Because it is long-lived and is rarely a dominant species, declines in abundance are difficult to detect and may not be evident for some time. AFS: currently stable.



*Reginaia ebena* (Lea, 1831)

## Ebonyshell

**General Distribution**

Mississippi River basin from Louisiana north to Minnesota, and west to central Arkansas and Missouri. Ohio River basin from the mouth upstream to Ohio and West Virginia. Gulf Coast drainages from the Mobile River basin west to the Pearl River, Louisiana and Mississippi.

**Kentucky Distribution**

Type locality: Ohio River. Typically found only in the largest rivers. Sporadic but locally common in the Mississippi River. Generally distributed throughout

the Ohio, Tennessee, and lower Cumberland rivers. Sporadic and rare historically in the middle Cumberland River upstream to Wayne County (UMMZ; Wilson and Clark 1914). Generally distributed and common in the lower Green River, but sporadic in the upper Green River upstream to Hart County and in the lower Barren River. Known from the Salt River drainage by a single archaeological record (Floyds Fork, Jefferson County; Bader and McGrath 2015) and not reported from the Kentucky River drainage, but likely present at least historically in the lower-most portions of both drainages. Sporadic in the lower Licking River, Campbell and Pendleton counties (OSUM).

**Habitat & Larval Hosts**

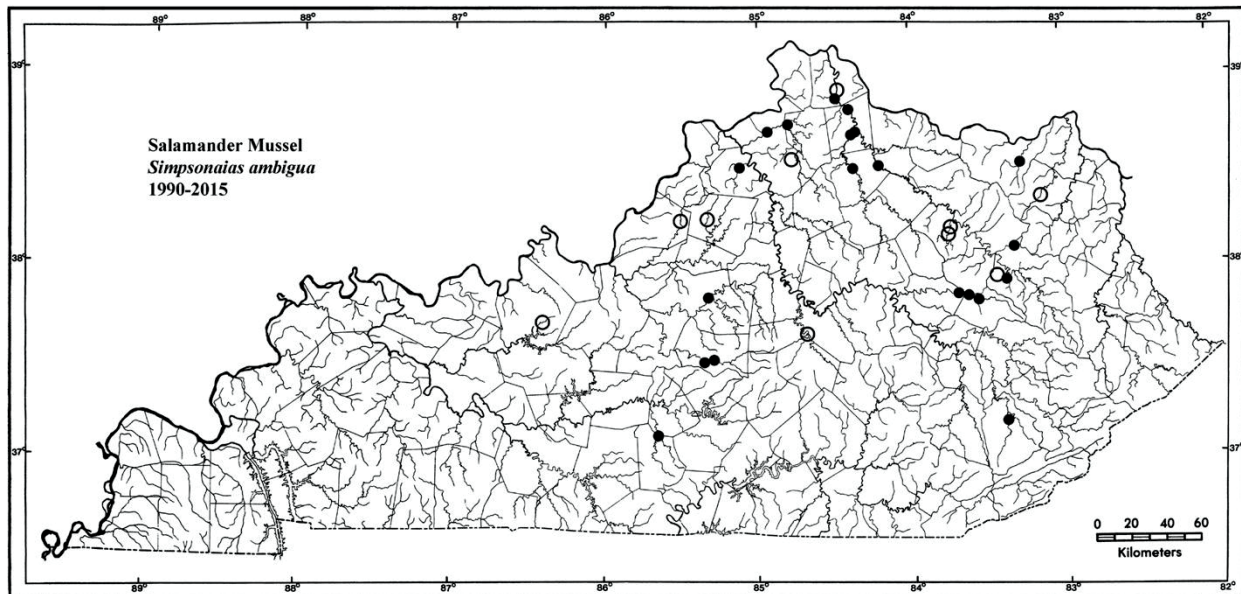
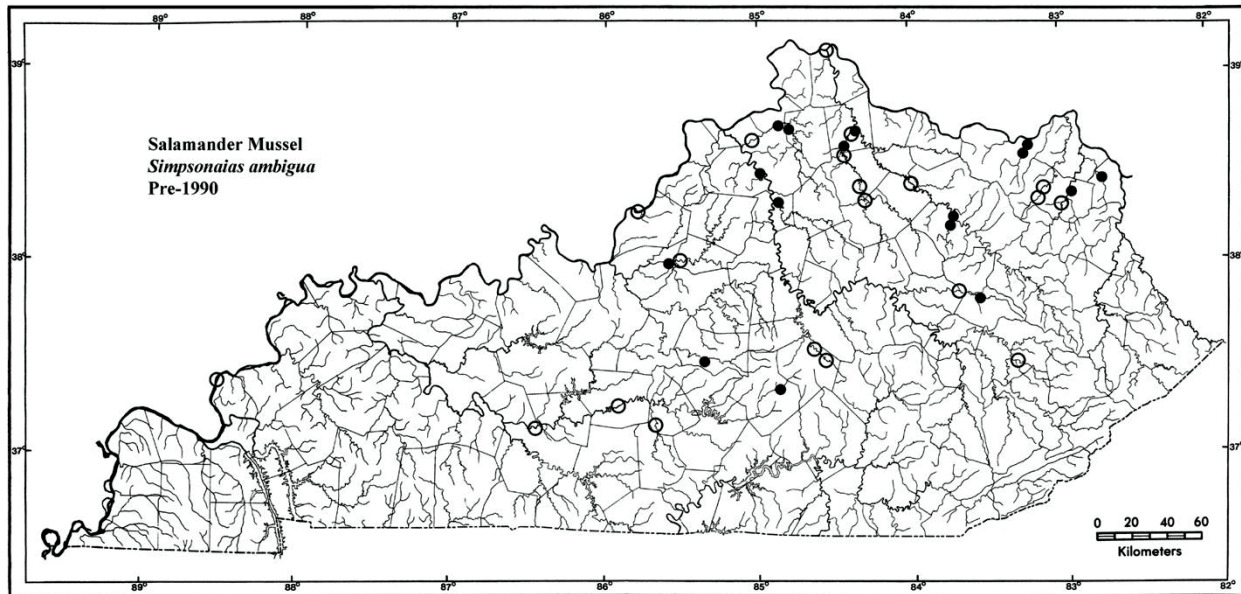
Restricted mostly to main-channel habitats of large rivers in gravel and sand substrates. It adapts to riverine impoundments in some situations, but typically does not colonize inundated river floodplains like other impoundment tolerant species (Williams et al. 2008). This is a dominant species in the lower Ohio, Tennessee, and lower Cumberland rivers where it can exceed densities of 50/m<sup>2</sup> and make up over 90% of individuals in main-channel mussel beds (Sickel 1985; Miller et al. 1986; Williams and Schuster 1989). This species is a host specialist on Skipjack Herring (*Alosa chrysochloris*) and possibly Alabama Shad (*A. alabamae*).

**Conservation Status**

*Reginaia ebena* remains a common to abundant species in much of its historical range in Kentucky, but it has declined or disappeared in other streams apparently in part because dams block migrations of its host fishes. Skipjack Herring has declined in many streams after impoundment (Boschung and Mayden 2004), and the disappearance of *R. ebena* in the upper Mississippi and Coosa rivers is attributed to dams that eliminated skipjack populations in those rivers (Kelner and Sietman 2000; Williams et al. 2008). Similarly, dams may be responsible for the disappearance of this species in the upper Green River and its absence in the Kentucky River. *Reginaia ebena* remains common in the Ohio, Tennessee, and lower Cumberland rivers evidently because navigation dams on these rivers allow skipjack passage, and in the Mississippi River, which is unimpounded. Curiously, it remains a common species in Kentucky Lake but appears to be extirpated in Lake Barkley even though skipjacks are present throughout both reservoirs (Burr and Warren 1986). There are no recent records of *R. ebena* from the Licking River, but no dams block the lower portion of that stream and the reasons for the disappearance of this population are unknown. Evidence of recent recruitment is apparent for several populations of *R. ebena* in Kentucky, suggesting that these populations are robust and healthy (e.g., Payne and Miller 2000). In contrast, evidence of recent recruitment is rare for another specialist on Skipjack Herring, *Elliptio crassidens* (see account for this species), and this species appears to have declined in areas where *R. ebena* remains common (e.g., Kentucky Lake, upper Ohio River). This suggests that factors other than host use may influence the long-term survival of these species. AFS: currently stable.

*Simpsonaias ambigua* (Say, 1825)

## Salamander Mussel

**General Distribution**

Mississippi River basin from Arkansas north to Minnesota, and west to Missouri and Iowa, but generally absent in lowland regions. Ohio River basin in upland regions from the Tennessee River drainage upstream to West Virginia. Great Lakes basin from Lake Michigan to Lake Erie.

**Kentucky Distribution**

Sporadic to occasional in the Ohio River and tributaries from the Green to the Little Sandy River drainage. Reported from the Ohio River from three sites in



Livingston, Jefferson, and Kenton counties (Clarke 1985). Apparently absent from lowland habitats in western Kentucky including most of the lower Green River drainage. Not reported from the Tennessee or Cumberland river drainages in Kentucky; reported from the Tennessee River drainage only from a single site in the Duck River, Tennessee, and from the Cumberland River drainage from one site each in the Stones and Caney Fork river systems (Gangloff and Folkerts 2006). A record for the Red River, Logan County (lower Cumberland River drainage; Clarke 1985) is based on a specimen from the Red River, Powell County (Kentucky River drainage; UMMZ). A single record exists for the lower Green River drainage (North Fork Rough River, Breckinridge County; KNP). Sporadic in the upper Green, Salt, and Kentucky river drainages. Occasional and locally common in the Licking River drainage. Sporadic in Kinniconick and Tygarts creeks and the Little Sandy River; not reported from the Big Sandy River drainage.

#### Habitat & Larval Hosts

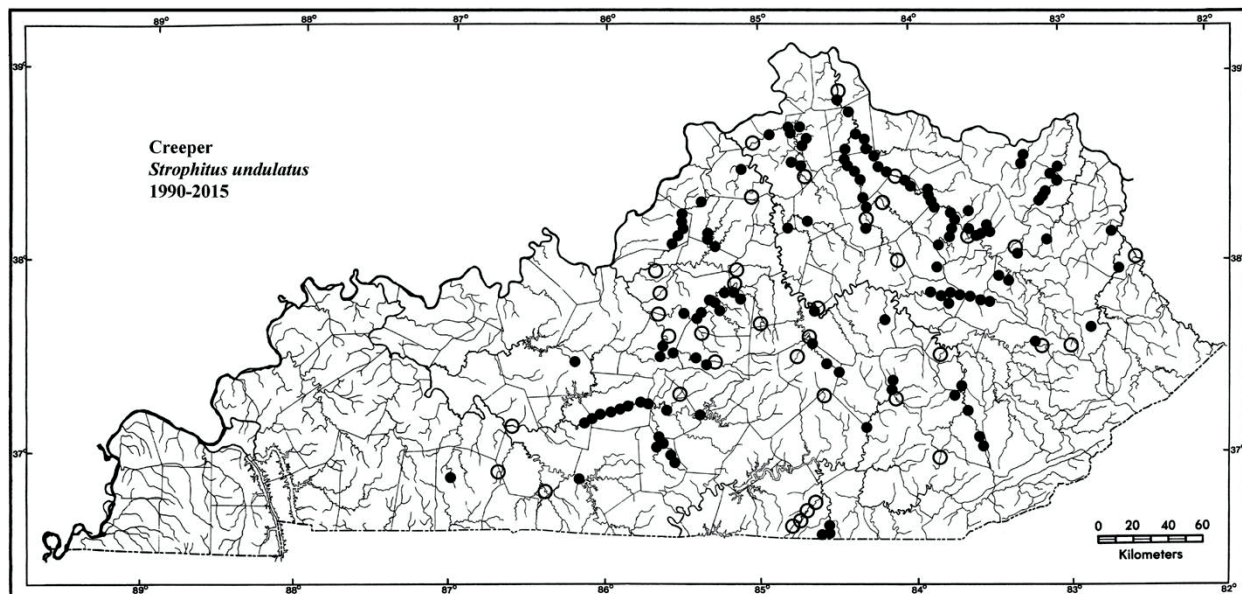
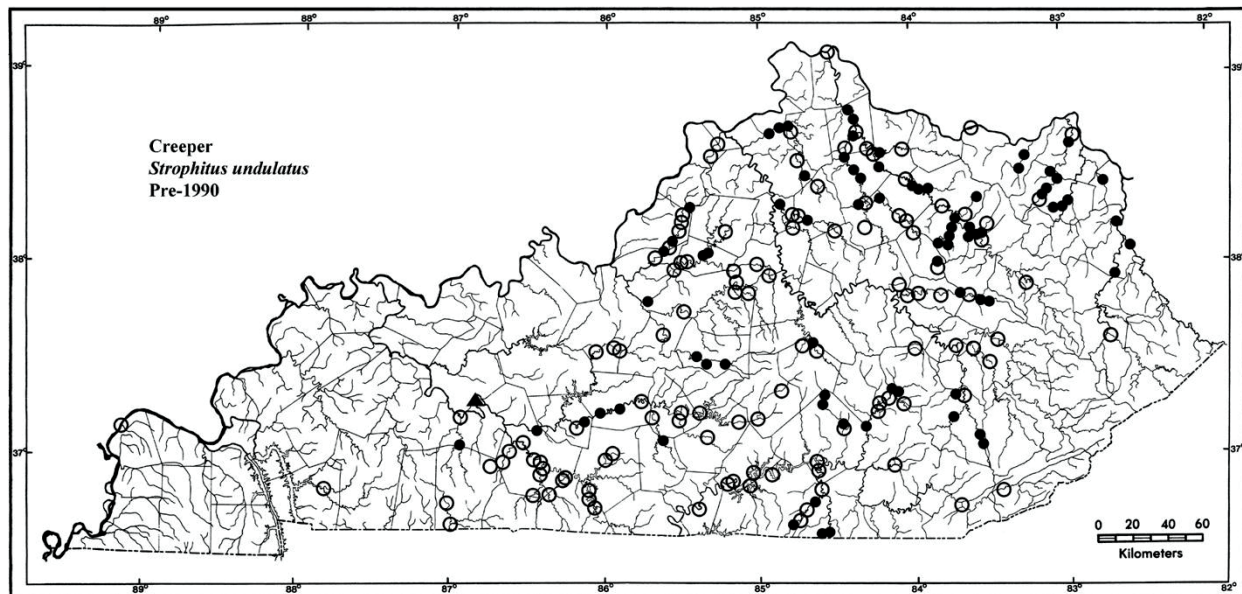
Found in upland streams ranging in size from the largest rivers to small creeks, but apparently restricted to streams that support populations of its only known host, the Mudpuppy (*Necturus maculosus*), a large aquatic salamander; *S. ambigua* is the only mussel species known to specialize on an amphibian host. Occurs primarily in fine sediments under large, non-embedded flat rocks, often in deeper water or slow current areas—a habitat also frequented by mudpuppies. In such habitats, this species can be abundant; more than 200 were reported under a single rock (Call 1900). Also found occasionally in gravel riffles particularly in beds of Water Willow (*Justicia americana*). These specialized habitat preferences, along with the absence of mudpuppies in the Mississippi Embayment (Petranka 1998), may explain its absence from lowland regions that lack rocks or water willow beds.

#### Conservation Status

*Simpsonaias ambigua* is encountered infrequently and traditionally has been considered a rare species throughout its range, particularly in the last few decades. Increased sedimentation in streams can fill in the spaces under slab rocks that are used as habitat by *S. ambigua*, and this increase in substrate embeddedness may have contributed to a decline of the species. However, its small size and occurrence under rocks, often in turbid conditions make this species difficult to find, and its perceived rarity may be a sampling artifact to some extent. It persists throughout much of its historical range in Kentucky and can be common locally. A large population exists in the lower Licking River; recently dead shells or live individuals have been found at multiple sites and it is abundant at a site in Campbell/Kenton counties (M. McGregor, personal communication). Relatively large populations also may exist in the Rolling Fork, Marion County, and the Red River, Menifee/Powell/Wolfe counties (D. Dourson, personal communication; KNP), but the status of these and other populations is poorly known. This species may be tolerant of impoundment to some extent. It was reported from the impounded Kentucky River, Owen County, in 1958, and rediscovered at that site in 1987 (Clarke 1985; OSUM), and it recently has been rediscovered in the Ohio River in West Virginia (P. Morrison, personal communication). Suitable habitat (i.e., an abundance of large, slab rocks) exists in much of the upper Ohio River in Kentucky and in many other streams that are not currently known to harbor the species. Finding this species, particularly in large rivers, requires concerted effort and methods not normally employed in routine mussel surveys. Widespread application of these methods is necessary to better assess the status of this species. KNP: threatened; AFS: special concern; USFWS: petitioned for listing.

*Strophitus undulatus* (Say, 1817)

## Creeper

**General Distribution**

One of the most widely distributed North American mussel species, and the only species that is widely distributed both along the Atlantic Coast and in the interior; however, phylogenetic relationships among populations are unknown. Mississippi River basin from northern Louisiana north to Minnesota, and west to Kansas and North Dakota. Throughout the Ohio River basin upstream to New York, but sporadic in lowland regions of the lower basin. Throughout the Great Lakes basin from Lake Superior to the St. Lawrence River system, and the southern Hudson Bay basin west to Saskatchewan. Gulf Coast drainages from the Sabine River to the Guadalupe River, Texas, and throughout Atlantic Coast drainages from Nova Scotia to South Carolina.

**Kentucky Distribution**

Generally distributed in most upland portions of the state. Reported historically from three sites in the Ohio River, Ballard, Kenton, and Lewis counties (NMNH, OSUM); other records from the Ohio River in Kentucky (Williams 1969) are unsubstantiated. Absent in lowland habitats in western Kentucky including the Tradewater River and most of the lower Green River drainage. Not reported from the Tennessee River drainage in Kentucky, but widespread in the middle and upper portions of that drainage (Parmalee and Bogan 1998). Sporadic in the lower Cumberland River drainage in the Little and Red rivers, and generally distributed in the middle Cumberland River drainage upstream to at least the Rockcastle River. Reported from the Laurel River and the upper Cumberland River drainage above Cumberland Falls, but no verifiable records exist and the former occurrence of the species in these areas is unresolved (see Cicerello and Laudermilk 2001). Specimens from Laurel River, Laurel County (Neel and Allen 1964; UMMZ), are *Alasmidonta atropurpurea* and *Anodontoides denigrata*, and specimens from Clear Fork (upper Cumberland River drainage, Whitley County; UMMZ) are *A. denigrata*. Wilson and Clark (1914) reported *S. undulatus* from the Laurel River at Corbin (as Laurel Creek), and Clear Fork at Jellico, Tennessee, and Neel and Allen (1964) reported it from two sites in the upper Cumberland River, Bell and Harlan counties. Specimens supporting these records could not be located; these records are plotted here but regarded as questionable. Reported from the lower Green River drainage only in the Green River, Butler/Ohio counties (UMMZ); Mud River, Butler/Muhlenberg and Logan counties (KNP; KDOW); Clifty Creek, Grayson County (KNP); and archaeological sites adjacent the Green River in Butler County (Morey and Crothers 1998; Claassen 2005). Generally distributed in the upper Green River drainage and in Ohio River drainages from the Salt River upstream to the Little Sandy River; occasional in the Big Sandy River drainage.

**Habitat & Larval Hosts**

Occurs in a wide variety of upland stream habitats and may penetrate far into the headwaters, but typically rare or uncommon in the largest rivers. Usually occurs in riffles and other flowing water habitats, but may occur in depositional areas. Although common in many streams, this species never or rarely dominates mussel assemblages in any habitat type except in small streams where it may be one of the only species present. This species is a host generalist, able to use a wide range of fish species. In addition, this is one of the few species in which glochidia are reportedly able to develop directly into juvenile mussels in the female gills without a fish host. Direct development may help it to persist in small streams with low fish abundance, but this ability has not been substantiated by recent research (see Haag 2012).

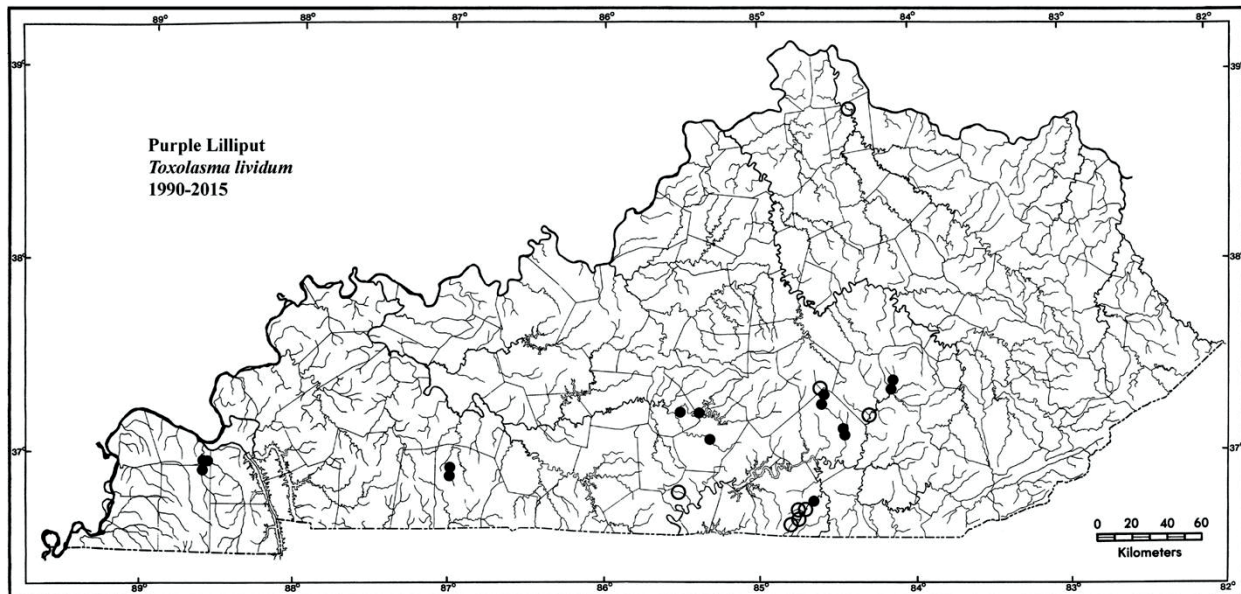
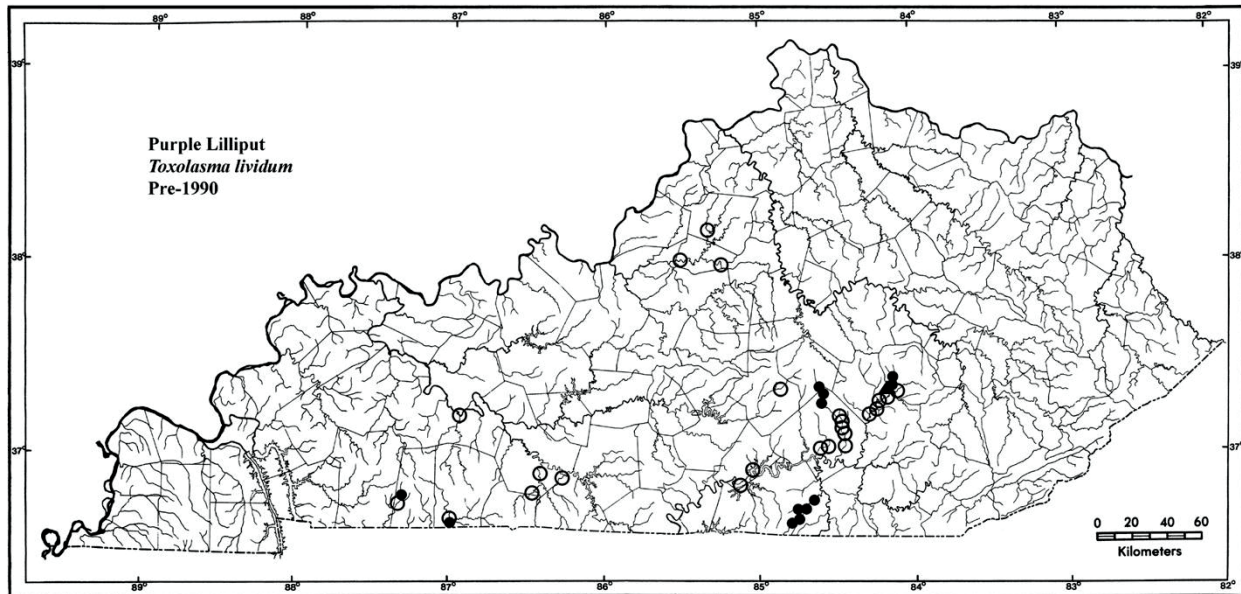
**Conservation Status**

*Strophitus undulatus* remains a widespread and common stream species in Kentucky, and it may be present in many unsurveyed headwater streams. This species appears intolerant of impoundment judging by its absence or rarity in the Ohio, lower Green, and Kentucky rivers, but its historical distribution in those rivers is poorly known. It remains a common species in the upper Green and Licking rivers, suggesting that it was more widespread in large rivers historically. It was common formerly in the middle Cumberland River (Neel and Allen 1964), but was extirpated from that stream by Wolf Creek Dam. Several local populations appear to have been extirpated by severe water pollution or other factors. It appears extirpated from the Little and Red river systems (lower Cumberland River drainage) and the Nolin River (upper Green River drainage), and it is now rare in the Barren River system. Populations in the Little South Fork Cumberland River and Horse Lick Creek appear extirpated by oil drilling and coal mining (Haag and Warren 2004; Warren and Haag 2005), and it appears to survive in the middle Cumberland River drainage mainly in the upper Big South Fork. AFS: currently stable.



*Toxolasma lividum* (Rafinesque, 1831)

## Purple Lilliput

**General Distribution**

Mississippi River basin only in the Ouachita and Ozark highlands in Arkansas, southern Missouri, eastern Oklahoma, and potentially eastern Kansas. Ohio River basin upstream to about the Little Miami River, Ohio. Great Lakes basin in a few tributaries of western Lake Erie, Lake St. Clair, and Saginaw Bay, Lake Huron.

**Kentucky Distribution**

Type locality: Rockcastle River. Generally distributed in the middle Cumberland River drainage, but sporadic or absent elsewhere in the state. Not reported

from the Ohio River, and absent from most lowland habitats in western Kentucky. Reported from the Tennessee River drainage in Kentucky only in the Clarks River system, McCracken County (Lewis 2006; Levine 2013), but widespread elsewhere in that drainage (Parmalee and Bogan 1998; Williams et al. 2008). Reported from the lower Cumberland River drainage in the Red River, Logan County, and the West Fork Red River, Todd County (OSUM). Generally distributed and locally common in tributaries of the middle Cumberland River including Marrowbone Creek, Cumberland County (KDOW); Pitman and Buck creeks, Pulaski and Lincoln counties (Schuster et al. 1989; Hagman 2000; KNP); the Little South Fork, McCreary/Wayne counties (Starnes and Bogan 1982; Ahlstedt 1986; Layzer and Anderson 1992); and the upper Rockcastle River system (DiStefano 1984; Ahlstedt 1986; Layzer and Anderson 1992; KNP). Reported from the mainstem middle Cumberland River at only two sites (Neel and Allen 1964) and not reported from the Big South Fork. Reported from the lower Green River drainage only in Mud River, Logan County, and the Green River at the mouth of Mud River, Butler/Ohio counties (KDOW; Clench and van der Schalie 1944). Sporadic in the upper Green River drainage including the Barren River system, but locally common in the Green River, Green and Taylor counties, and Russell Creek, Adair County (McGregor et al. 2007; TTU). Reported from three sites in the Salt River drainage, Shelby and Spencer counties (OSUM; G. Fallo, personal communication), and a single site in the Licking River, Pendleton County (INHS). Not reported from the Kentucky River drainage but possibly present there historically. Ohio River tributaries upstream of the Licking River may have been beyond the species' historical distribution.

#### Habitat & Larval Hosts

Mainly restricted to upland regions where it can occur in nearly any size stream from large rivers to headwaters, but most common in small to medium-sized streams. May occur in riffle habitats in gravel and sand substrates, but usually found in depositional areas along shore or in backwater pools. This species is a host specialist on sunfishes (*Lepomis*), and it may be found in sunfish nests (A. Shepard, personal communication).

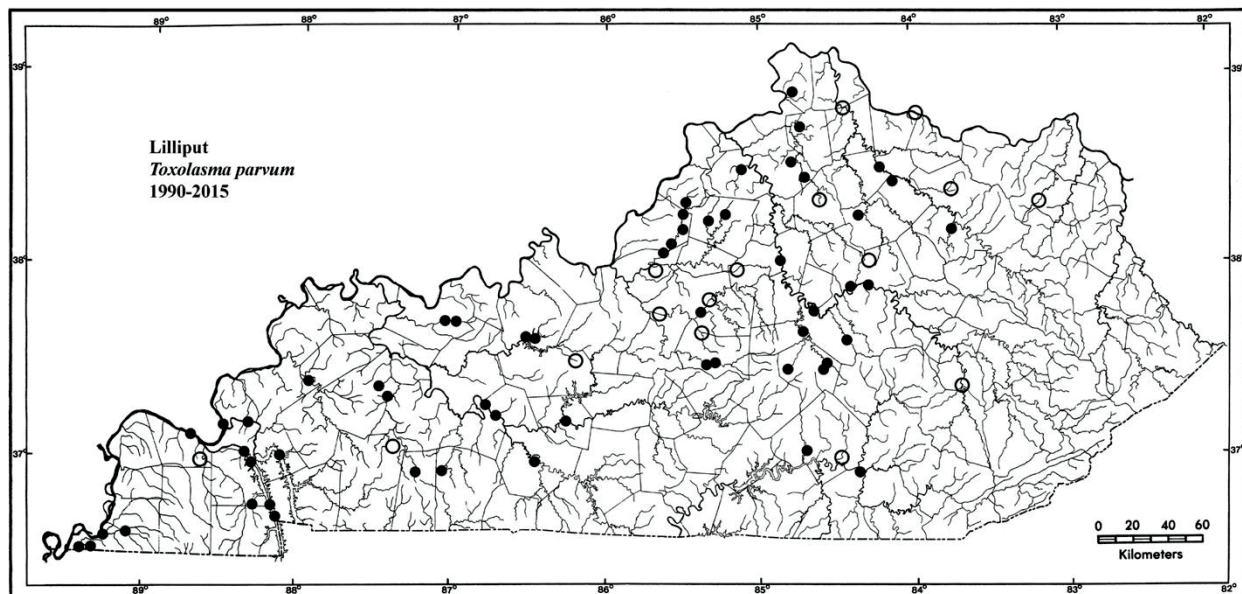
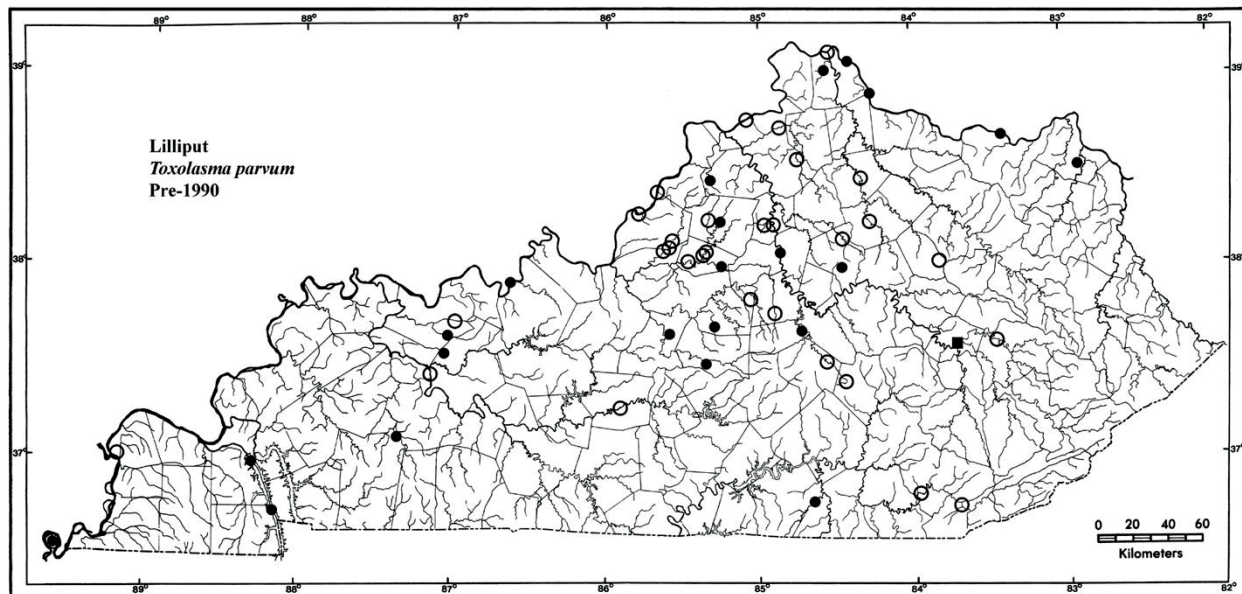
#### Conservation Status

With the exception of the Cumberland River drainage, *Toxolasma lividum* appears to have been sporadically distributed in Kentucky even historically, but it is now in danger of disappearing from the state. This was a common and characteristic species in tributaries in the middle Cumberland River drainage, but it is nearly extirpated from that region. Two of the largest populations in the state, in the Little South Fork and Horse Lick Creek (Rockcastle River system), have declined dramatically apparently from oil drilling and coal mining, and few live individuals have been found in those streams in recent surveys (Haag and Warren 2004; Warren and Haag 2005; Ahlstedt et al. 2014); populations elsewhere in the Rockcastle River system and in Marrowbone and Pitman creeks appear extirpated. Buck Creek appears to support the largest remaining population in the Cumberland River drainage, but this population is small and also appears to be declining (Hagman 2000; McGregor 2003; D. Dourson, personal communication). Populations in the Red and Barren river systems appear to be extirpated from unknown causes, and living or recently dead individuals have never been found in the Salt or Licking river drainages, suggesting that these populations have been extirpated for some time. Surviving populations in the Clarks and Mud rivers are small, isolated, and vulnerable to extinction. The only large population remaining in the state is in the upper Green River drainage. Apart from streams that experienced severe water quality degradation such as the Little South Fork, the disappearance of *T. lividum* is puzzling. Other species that thrive in depositional habitats appear tolerant of sedimentation and remain common today (e.g., *Lampsilis siliquoidea*, *Potamilus alatus*, *Quadrula quadrula*, *Toxolasma parvum*). Furthermore, *T. lividum* can occur in lakes in the northern part of its range and it adapts to impoundment in some situations (Garner and McGregor 2001); it is unknown why it has not adapted to impounded streams in Kentucky. KNP: endangered; AFS: special concern; USFWS: petitioned for listing.



*Toxolasma parvum* (Barnes, 1823)

## Lilliput

**General Distribution**

Mississippi River basin from Louisiana north to Minnesota, and west to Kansas and South Dakota. Ohio River basin from the mouth upstream to at least West Virginia. Great Lakes basin in lakes Michigan and Erie. Gulf Coast drainages from the Mobile River basin to the Rio Grande, Texas and Mexico. Populations in the Mobile River basin and elsewhere may be the result of introductions via stocked fishes (Williams et al. 2008).



**Kentucky Distribution**

Sporadic to occasional but locally common in low gradient streams from the Mississippi Embayment east to the Licking River drainage. Not reported from the Mississippi River mainstem. Reported from a few sites in the Ohio River upstream of the Licking River, and single records exist for Tygarts Creek, Carter County (KNP), and the Little Sandy River drainage, Greenup County (Greenbo Lake, KDOW). Generally absent from the Appalachian Plateaus, but single records exist from the South Fork Kentucky River, Clay County (Evans 2010), and the North Fork Kentucky River, Breathitt County (NCMNS); in addition, Danglade (1922) reported it as rare in the upper Kentucky River system (from unspecified locations but probably including the North Fork). Sporadic in the upper Green River drainage and not reported upstream of Hart County; additional records from the upper Green River (Williams 1969) are unsubstantiated but plausible. Not reported from the middle Cumberland River drainage historically, but reported from several, mostly impounded sites subsequent to construction of Wolf Creek Dam (KNP; OSUM). Two historical specimens, both single individuals, exist from the upper Cumberland River above Cumberland Falls: a 1966 specimen from Knox County (NCMNS), and a specimen from Bell County (UMMZ); the latter specimen is undated but was collected by Calvin Goodrich, who was active from the 1920s to the early 1940s. The upper Cumberland River has been the recipient of fish and mussel stockings since the early 1900s (Wilson and Clark 1914; Burr and Warren 1986). Because it is not commercially valuable, it is unlikely that *T. parvum* was stocked directly, but these records may represent individuals that were introduced on stocked fishes but failed to establish a population. Alternatively, these specimens could be mislabeled. The 1966 collection also includes a specimen of “*Villosa*” *lienosa*, which is also otherwise unknown from the upper Cumberland River drainage. We regard these records as questionable, and the status of this species in the upper Cumberland River drainage is uncertain.

**Habitat & Larval Hosts**

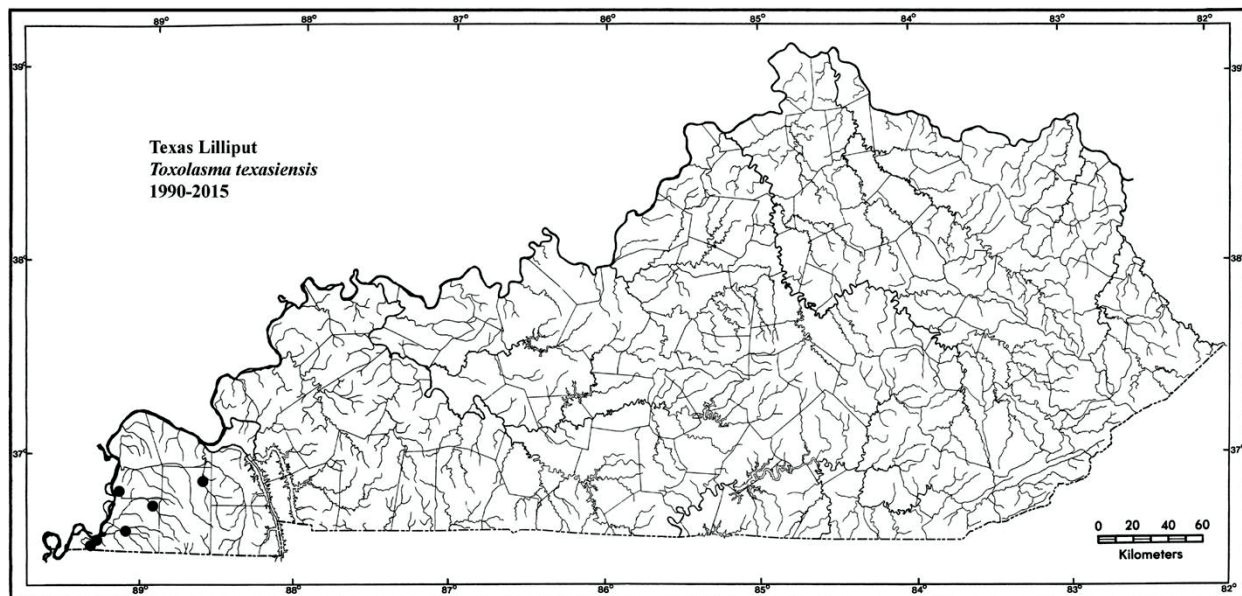
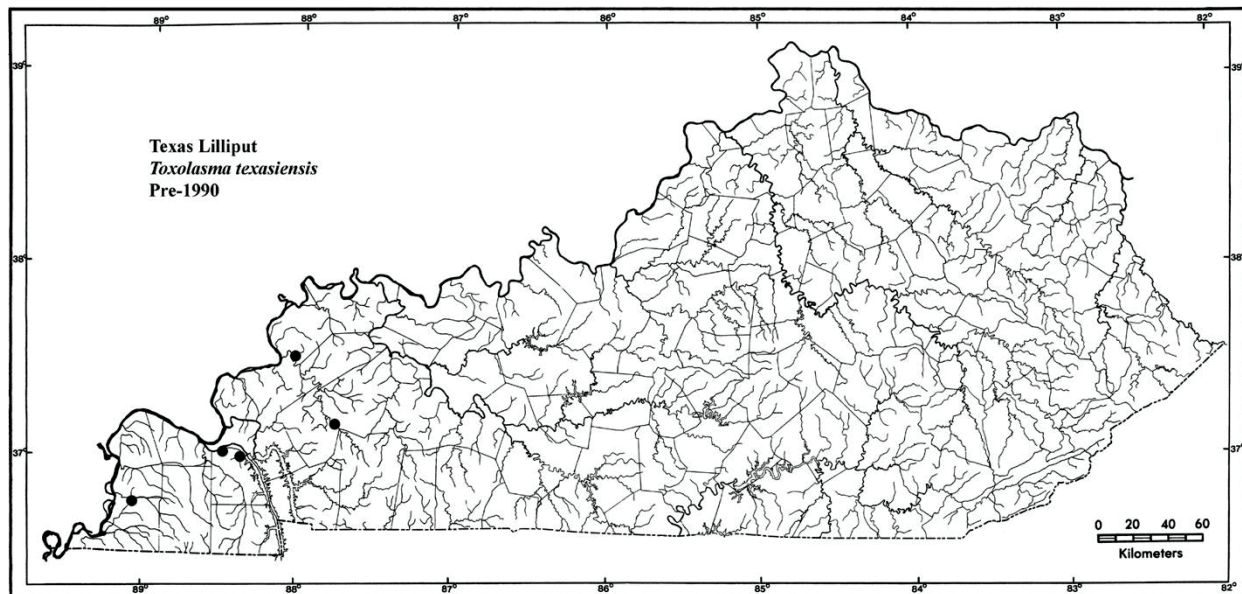
Occurs in a wide variety of stream habitats from the largest rivers to headwater streams, and in the latter it may be the only species present. Typically found in depositional areas along shore or in backwater pools; the scarcity of these habitats in high gradient streams of the Appalachian Plateaus probably explains its rarity there. It adapts readily to impoundment, occurring in lentic habitats from large reservoirs to farm ponds, and it also adapts to channelized streams and drainage ditches. This species is a host specialist primarily on sunfishes (*Lepomis*).

**Conservation Status**

*Toxolasma parvum* doubtless has experienced localized declines or extirpations in response to severe water quality degradation, but its distribution and overall abundance in Kentucky and elsewhere probably have increased in the last 100 years. This is a highly adaptable species because of its fast growth and early maturity, and it appears to be the only North American species that is completely hermaphroditic, which allows eggs to be fertilized even when population density is low; these traits allow it to tolerate considerable disturbance and to colonize habitats that are unsuitable to most other mussel species (Haag 2012). Because it thrives in depositional environments, stream impoundment and farm pond construction have greatly increased the extent of suitable habitat for this species, and increased sedimentation in free-flowing streams also may have increased habitat availability. This species often colonizes fish hatchery ponds, and stocking of Bluegill (*Lepomis macrochirus*) is probably responsible for establishment of *T. parvum* in the middle Cumberland River drainage, Greenbo Lake, and other areas where it was absent or rare historically. This mechanism of introduction can be expected to result in establishment of additional populations anywhere in the state. AFS: currently stable.

*Toxolasma texasiensis* (Lea, 1857)

## Texas Lilliput

**General Distribution**

Mississippi River basin from Louisiana north to southern Illinois and southeastern Missouri, and west to eastern Oklahoma. Lower Ohio River basin upstream to the lower Wabash River drainage. Gulf Coast drainages from the Pascagoula River, Mississippi, to the Rio Grande, Texas and Mexico.

**Kentucky Distribution**

Sporadic but locally common in direct tributaries of the Mississippi River and tributaries of the Ohio River upstream to the Tradewater River (Warren and

Call 1983; KNP; OSUM). Not reported from the Mississippi or Ohio rivers or the Cumberland River drainage. Reported from the Tennessee River drainage only in West Fork Clarks River, Graves County (KNP), and Cypress Creek, Marshall County (KDOW; KNP).

**Habitat & Larval Hosts**

A characteristic species of low gradient streams, lakes, and wetlands throughout the Mississippi Embayment, but uncommon in large rivers where it is usually restricted to depositional areas along shore or in backwater pools. This species is a host specialist primarily on sunfishes (*Lepomis*).

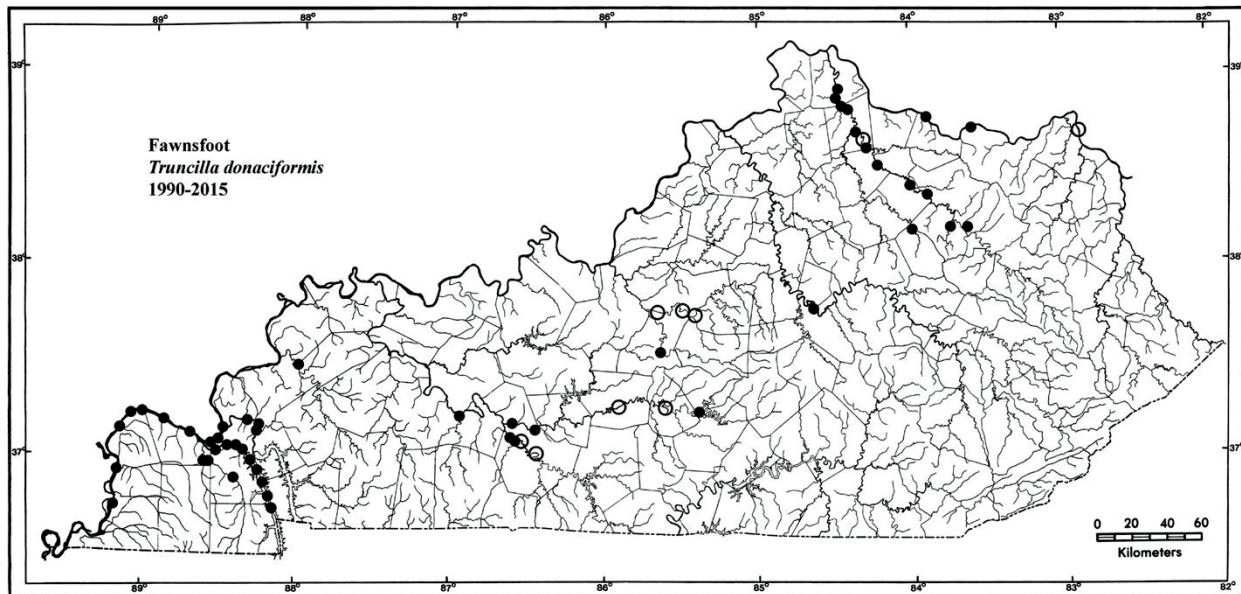
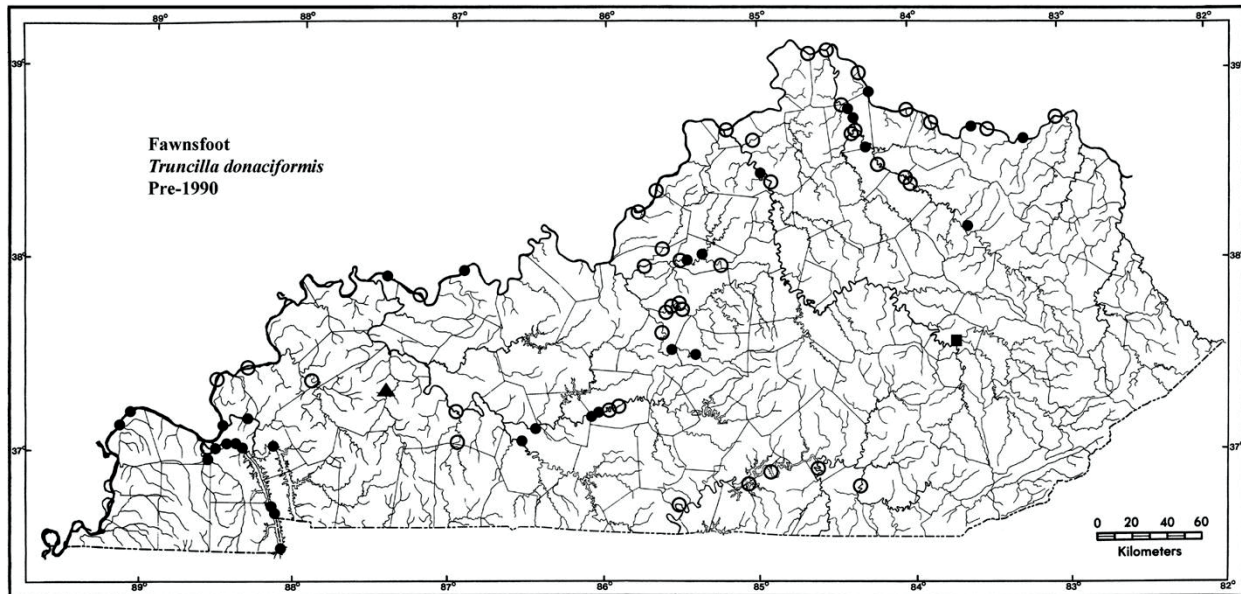
**Conservation Status**

*Toxolasma texasiensis* is a highly adaptable species because life history traits such as fast growth and early maturity allow it to tolerate considerable disturbance and to colonize habitats that are unsuitable to most other mussel species (Haag 2012). This species may have experienced localized declines or extirpations in response to severe habitat destruction or water pollution; for example, it has not been found recently in the Tradewater River drainage. It remains locally common in other lowland habitats of western Kentucky where it can persist even in channelized streams or other highly modified habitats, and it is ubiquitous in many parts of the Mississippi Embayment farther to the south. Despite its adaptability, there are few known populations of this species in Kentucky, and its restricted range in the state makes it vulnerable to further degradation of lowland habitats. KNP: endangered; AFS: currently stable.



*Truncilla donaciformis* (Lea, 1828)

## Fawnsfoot

**General Distribution**

Mississippi River basin from Louisiana north to Minnesota and west to eastern Kansas and South Dakota. Ohio River basin from the mouth upstream to Pennsylvania. Great Lakes basin from Lake Michigan to Lake Erie. Gulf Coast drainages from the Mobile River basin to the San Jacinto River, Texas.

**Kentucky Distribution**

Type locality: Ohio [River]. Mostly restricted to the largest rivers, but occasionally occurs in medium-sized streams, particularly in the Salt River drain-

age. Reported from two sites in the Mississippi River, Carlisle and Hickman counties (EKU; KNP). Generally distributed in the lower Ohio River, and sporadic to occasional throughout the remainder of the river. Generally distributed in the Tennessee River including Kentucky Lake, and reported from the Clarks River system, McCracken County (KNP; Levine 2013). Occasional in the lower Cumberland River, and formerly sporadic and rare in the middle Cumberland River upstream to the base of Cumberland Falls; reported from tributaries only in the lower Big South Fork, and absent above Cumberland Falls. Sporadic in the lower Green River drainage, and occasional in the upper Green River upstream to Taylor County and the lower Barren River. Generally distributed to occasional in the Salt River drainage. Sporadic in the Kentucky River drainage and reported only from three sites in the mainstem, Owen/Henry and Garrard counties (Tolin and King 1986; KNP), and Eagle Creek, Owen/Carroll counties (KNP); also reported as occasional in the upper Kentucky River system (from unspecified locations but probably including the North Fork Kentucky River; Danglade 1922). Generally distributed in the Licking River upstream to Bath County. Not reported from the Big Sandy River drainage.

#### Habitat & Larval Hosts

A characteristic member of mussel assemblages in large, low gradient streams, occurring in main-channel habitats in gravel and sand substrates. This species can survive in relatively unstable substrates, which are unsuitable for most other mussel species. It maintains its position in the bottom with a byssal thread, which is tethered to stones, instead of depending on the foot for anchoring. Byssal threads are present in juveniles of many species but are retained into adulthood only in *T. donaciformis* and a few other species (Haag 2012). This species is restricted to large streams to a greater extent than *T. truncata*, and it often outnumbers that species in large rivers where it may be a dominant member of main-channel mussel beds. Most records from smaller streams are from the lower reaches near the confluence with a large river (e.g., Clarks River, Eagle Creek, Slate Creek); the record for Hinkston Creek, Montgomery County (EKU), is extremely unusual due to the small size of that stream and the distance from a larger stream. It can adapt to riverine reservoirs in some cases, but is rare or absent in many impounded streams. This species is a host specialist on Freshwater Drum (*Aplodinotus grunniens*).

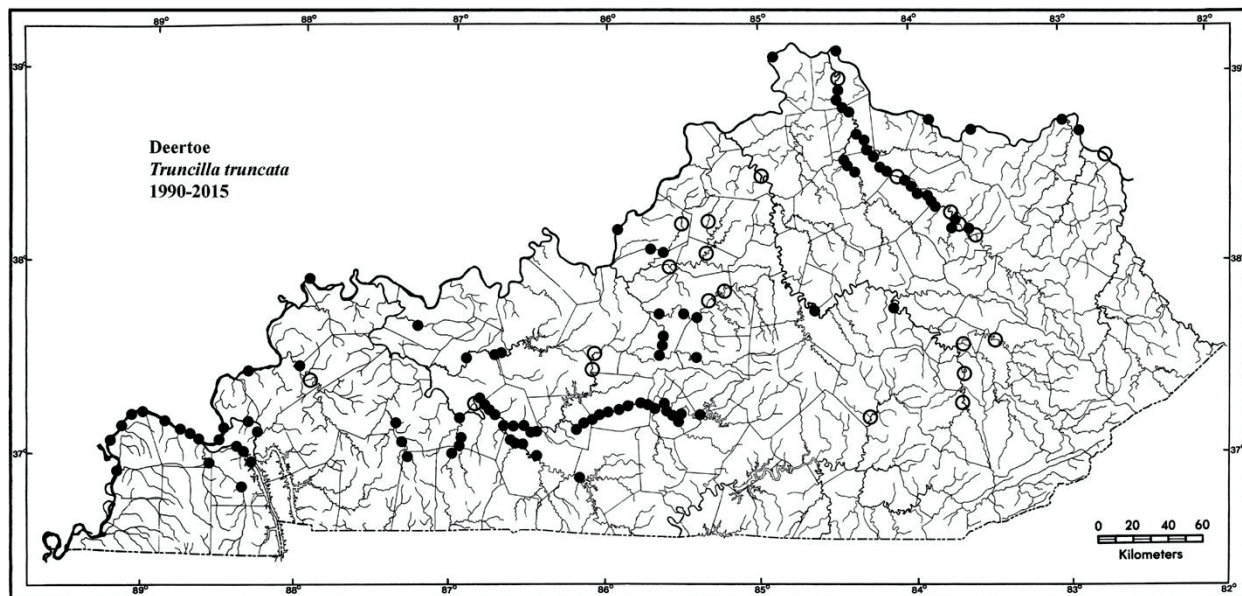
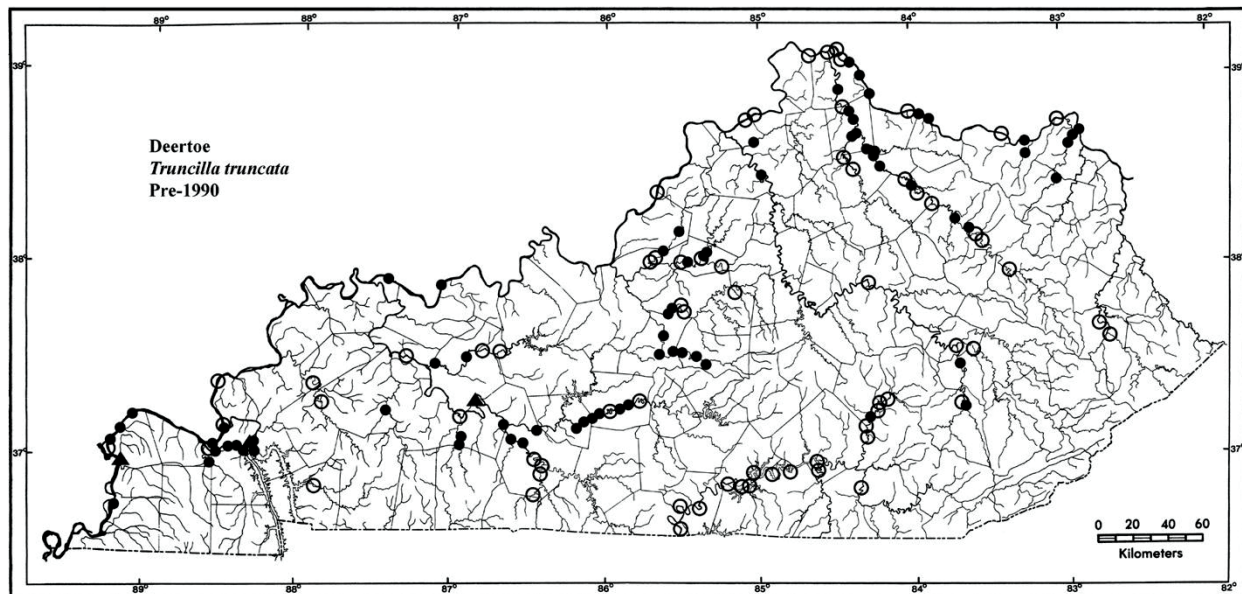
#### Conservation Status

*Truncilla donaciformis* is locally abundant in Kentucky, but large populations are known only in the lower Ohio, Tennessee, and Licking rivers. Elsewhere in the state, this species is only sporadic or occasional, and there are conspicuously few recent records from the Salt River drainage and the Ohio River upstream of the Cumberland River. The potential decline of this species in these streams and its rarity in other apparently suitable habitats (e.g., lower Green and Kentucky rivers) is puzzling. This appears to be an adaptable species due to life history traits such as fast growth, early maturity, and very high fecundity (Haag 2012), and large populations exist in many other parts of its range (e.g., Hornbach and Deneka 1996; Newton et al. 2011). It also shows variable responses to impoundment; it has adapted to Kentucky Lake but appears extirpated from Lake Barkley, and impoundment may be a factor in its rarity in the lower Green, Kentucky, and Ohio rivers. Part of the reason for its perceived rarity or decline in some places could be its small size, which makes this species hard to find, particularly in turbid conditions in large rivers. Furthermore, few comprehensive mussel surveys have been conducted recently in the Ohio River and other large rivers. This species appears secure in Kentucky for the foreseeable future, but more comprehensive surveys of large rivers are needed to better assess its status. AFS: currently stable.



*Truncilla truncata* Rafinesque, 1820

Deertoe

**General Distribution**

Mississippi River basin from Louisiana north to Minnesota and west to eastern Kansas and South Dakota. Ohio River basin from the mouth upstream to Pennsylvania. Great Lakes basin from Lake Michigan to the Niagara River. Gulf Coast drainages from the Sabine River, Texas and Louisiana, to the San Jacinto River, Texas.

**Kentucky Distribution**

Type locality: Ohio River. Generally distributed in most medium-sized to large streams statewide with the exception of the upper Cumberland River drainage



above Cumberland Falls; usually absent in small streams. Reported from two sites in the Mississippi River, Carlisle and Hickman counties (KNP; ECU), but not reported from tributaries. Generally distributed and locally common throughout the Ohio River and in most major tributaries upstream to the Licking River, but sporadic in the Tradewater River and Kentucky River drainage. Sporadic in Kinniconick and Tygarts creeks and the Big Sandy River drainage; not reported from the Little Sandy River.

**Habitat & Larval Hosts**

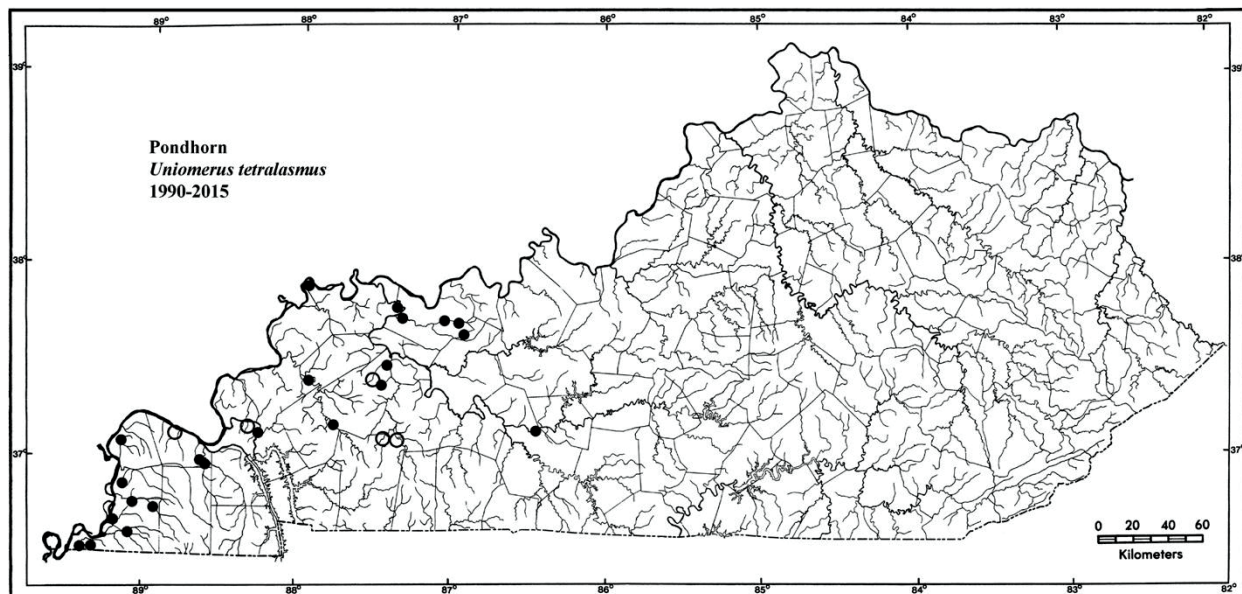
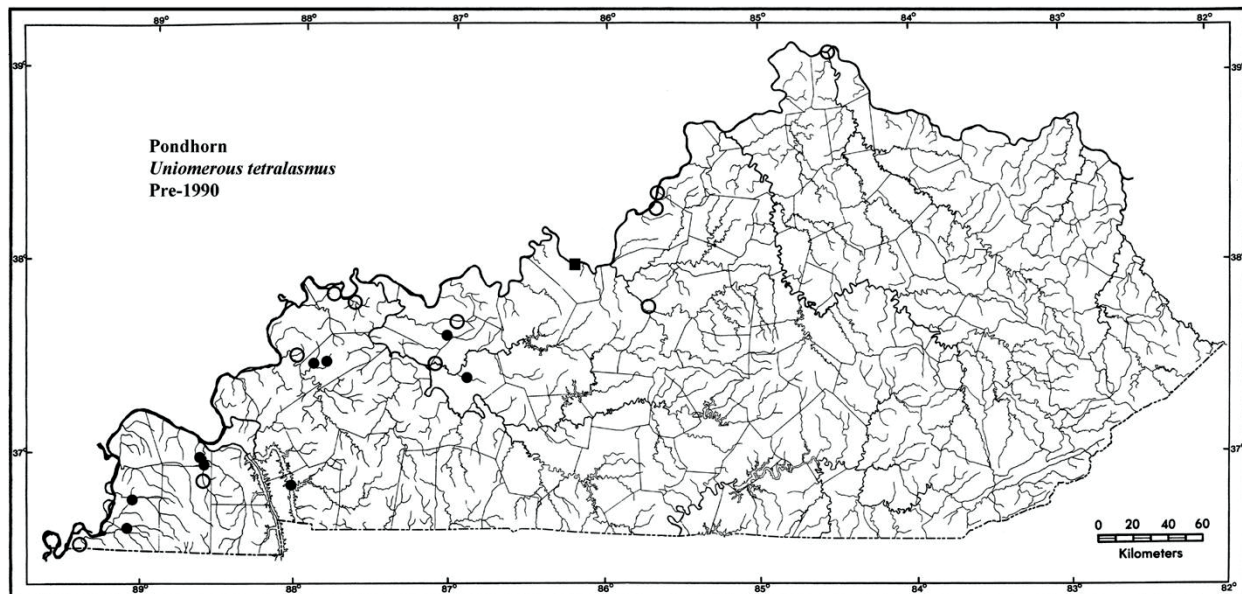
This is a common and characteristic species of medium-sized to large streams in both lowlands and uplands, where it occurs mostly in main-channel mussel beds in gravel and sand substrates. It reaches maximum abundance in medium-sized streams such as the upper Green and Licking rivers where it may be a dominant species. It can adapt to impounded streams to some extent, but mostly is limited to riverine reaches and colonizes inundated river floodplains less readily than *T. donaciformis*. This species is a host specialist on Freshwater Drum (*Aplodinotus grunniens*).

**Conservation Status**

*Truncilla truncata* remains a widespread species in Kentucky and large populations exist in several streams across the state. However, the species' distribution has been reduced substantially by impoundment of large rivers. It has not adapted to Kentucky and Barkley lakes on the Tennessee and lower Cumberland rivers, and it is rare in the impounded lower Green and Kentucky rivers. Populations in some free-flowing tributaries may have been indirectly affected by impoundment of larger streams. The large population in the middle Cumberland River was eliminated by Wolf Creek Dam, but the species persisted in the Rockcastle River until about the 1980s. This population appears to have disappeared subsequently perhaps in part because it was dependent on recolonization from larger downstream populations in the Cumberland River. Populations in other isolated streams (e.g., upper Kentucky River drainage) also may be vulnerable to loss of downstream source populations, and populations in Kinniconick Creek, Tygarts Creek, and the Big Sandy River may be extirpated from unknown causes. Nevertheless, *T. truncata* appears to be an adaptable species with life history traits similar to *T. donaciformis*, and most of the large populations remaining in the state appear stable and show abundant evidence of recent recruitment. AFS: currently stable.

*Unio merus tetraltas mus* (Say, 1831)

## Pondhorn

**General Distribution**

Mississippi River basin from Louisiana north to central Illinois and southern Iowa, and west to eastern Colorado and South Dakota. Ohio River basin upstream to about the Scioto River, Ohio, but generally restricted to lowland or former prairie regions. Disjunct populations are reported from the Muskingum River system, Ohio, and the Ohio River, West Virginia, and a population in a West Virginia pond may be the result of an introduction (Taylor 1984; Watters et al. 2009). Reported from the Great Lakes basin only from western Lake Erie, and apparently introduced unsuccessfully in the 1800s in the Mohawk River, New York (Erie Canal, Hudson River system; Strayer and Jirka 1997). Widespread in Gulf Coast drainages from the Yellow River, Florida, to the Guadalupe

River, Texas. A large river species or form, *U. declivis*, occurs in the Mississippi Embayment north to at least Arkansas and Tennessee (Parmalee and Bogan 1998; Harris et al. 2009); this taxon is not reported in Kentucky but may occur in larger streams in the western part of the state (see section IV.E).

#### Kentucky Distribution

Occasional to sporadic in lowland habitats of western Kentucky. Occasional but locally common in direct tributaries of the Mississippi River, but not reported from the mainstem. Sporadic and rare in the Ohio River upstream to at least Kenton County (MCZ), but Call (1900) reported that it “occurs in the Ohio, at many places along the Indiana shore.” Sporadic but locally common in Ohio River tributaries upstream to the lower Green River drainage, but single records exist for the upper Green River, Butler/Warren counties (KNP), and the Salt River drainage (Lick Creek, Nelson County, OSUM). Reported from the Tennessee River drainage in Kentucky only in the Clarks River system, but also reported from a small stream in the lower Tennessee River drainage, Hardin County, Tennessee (Parmalee and Bogan 1998). Sporadic in the lower Cumberland River drainage upstream to Trigg County (MSU). A record of three individuals from the middle Cumberland River immediately below Cumberland Falls (EKU) is considered erroneous and probably based on inaccurate locality information. A record for the Licking River (Taylor 1984 citing LaRocque 1967) is an error.

#### Habitat & Larval Hosts

In Kentucky, *Uniomerus tetralasmus* primarily is a species of lowland streams, sloughs, and wetlands where it occurs in depositional habitats. The genus *Uniomerus* is unique among North American mussels in that individuals can survive for up to two years out of the water by burrowing deeply in the sediment and essentially aestivating (Holland 1991), and live individuals have been brought to the surface by plows in drained ponds and wetlands (Frierson 1903; Isely 1914). Most other mussel species can survive for only a few days when exposed. Although *U. tetralasmus* is often found with other typical lowland species, its ability to withstand drying allows it to live in ephemeral streams or wetlands that support no other mussel species. The host for this species is unknown, but natural glochidial infestations have been observed on Golden Shiners (*Notemigonus crysoleucas*).

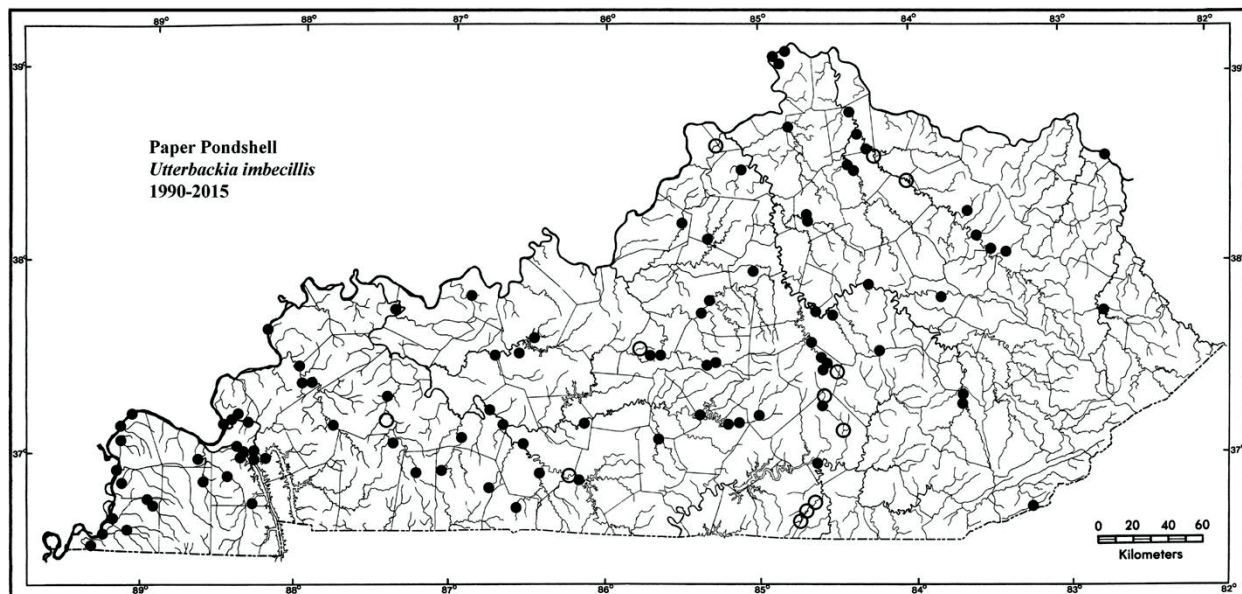
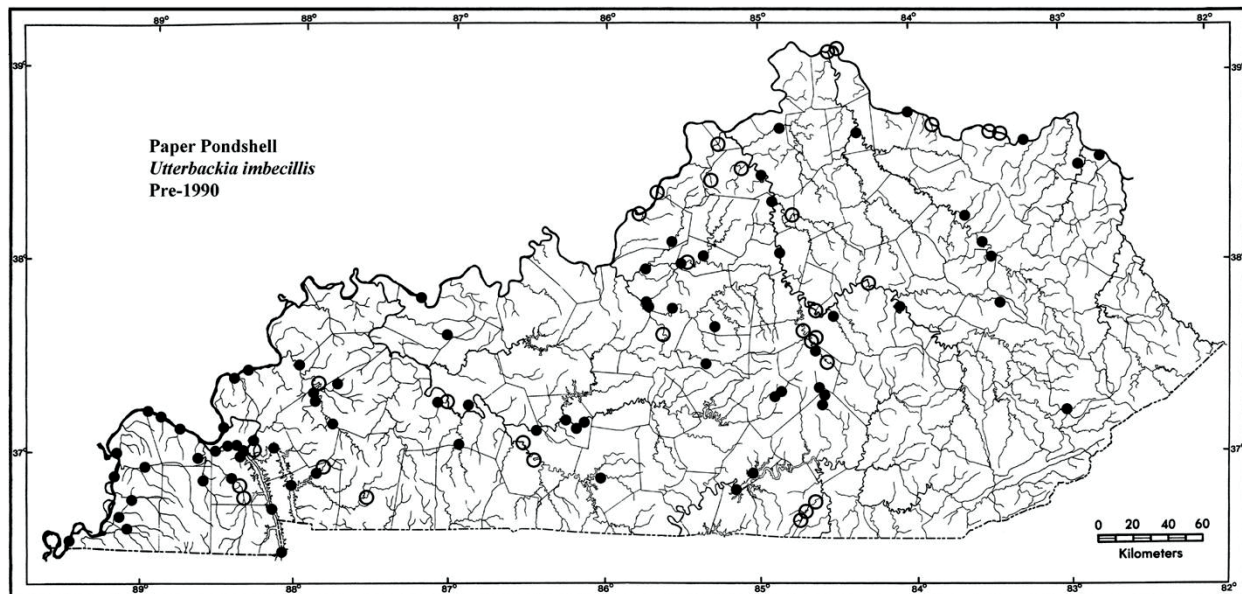
#### Conservation Status

*Uniomerus tetralasmus* doubtless has experienced localized declines or extirpations in response to widespread wetland drainage and stream channelization in western Kentucky. However, its ability to survive drying of its habitat and perhaps other life history traits appear to make this species tolerant of considerable habitat disturbance and alteration, and it remains a locally common species. It occurs in several highly degraded streams in Kentucky (e.g., Panther Creek, Daviess County) that support only similarly adaptable species (e.g., *Leptodea fragilis*, *Pyganodon grandis*), and it is a characteristic species of Great Plains streams, which represent stressful habitats for many aquatic organisms (Haag 2012). Nevertheless, the restricted range of this species in the state makes it vulnerable to further destruction of lowland habitats. AFS: currently stable.



*Utterbackia imbecillis* (Say, 1829)

## Paper Pondshell

**General Distribution**

One of the most widely distributed North American mussel species, occurring throughout much of the eastern half of the continent south of Canada. Mississippi River basin from Louisiana north to Minnesota, and west to South Dakota and New Mexico. Throughout the Ohio River basin from the mouth upstream to New York. Sporadic or absent in most of the Great Lakes basin but widespread in Lake St. Clair and Lake Erie. Gulf Coast drainages from the Apalachicola River, Florida, to the Rio Grande, Texas, and adjacent drainages in northern Mexico. Atlantic Coast basins from about the Delaware River, Pennsylvania, to the Altamaha River, Georgia. Some populations at the periphery of the species' range (e.g., northern Florida; New Mexico; Hudson River drainage, New York) may

have been introduced via fish stocking, but others may be the result of recent natural dispersal (Strayer and Jirka 1997; Williams et al. 2008).

**Kentucky Distribution**

Sporadic but locally common nearly statewide. Most common in the western half of the state and in the Bluegrass physiographic section. Generally rare in streams on the Appalachian Plateaus such as the upper reaches of the Kentucky River drainage, and not reported historically from the upper Cumberland River drainage above Cumberland Falls or the Big Sandy River drainage. Reported historically from the middle Cumberland River drainage only in Buck Creek, Pulaski County, and the Little South Fork, Wayne County. Occurs sporadically but statewide in farm ponds and reservoirs where it may be introduced via fish stocking; nearly all recent records from the Appalachian Plateaus and middle Cumberland River drainage are from this type of habitat.

**Habitat & Larval Hosts**

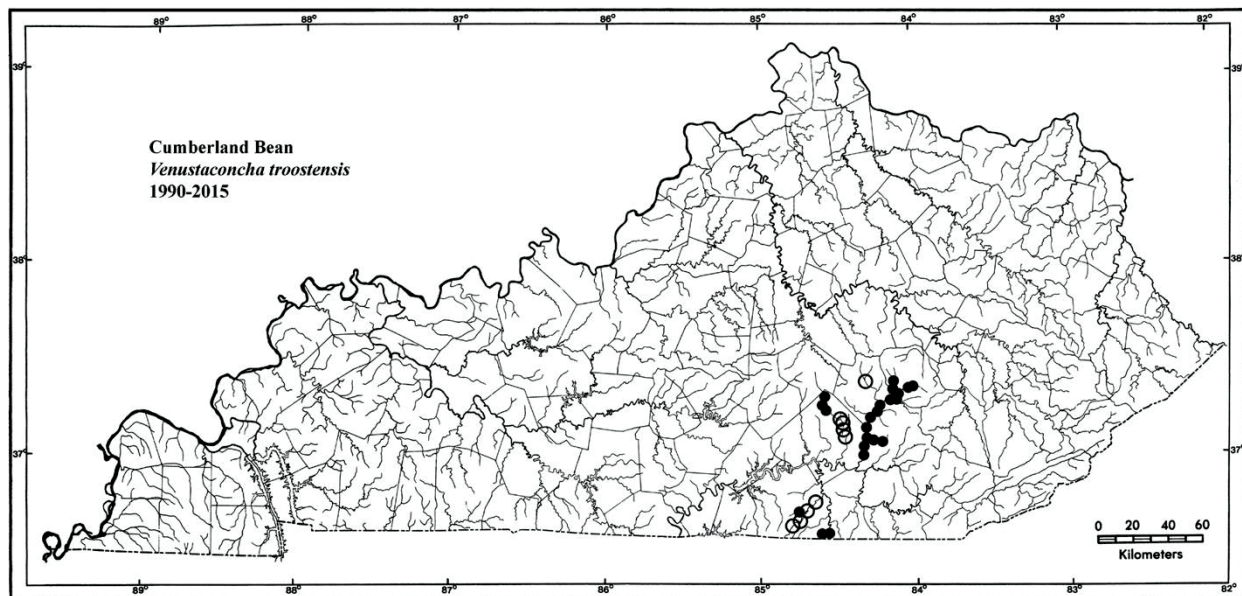
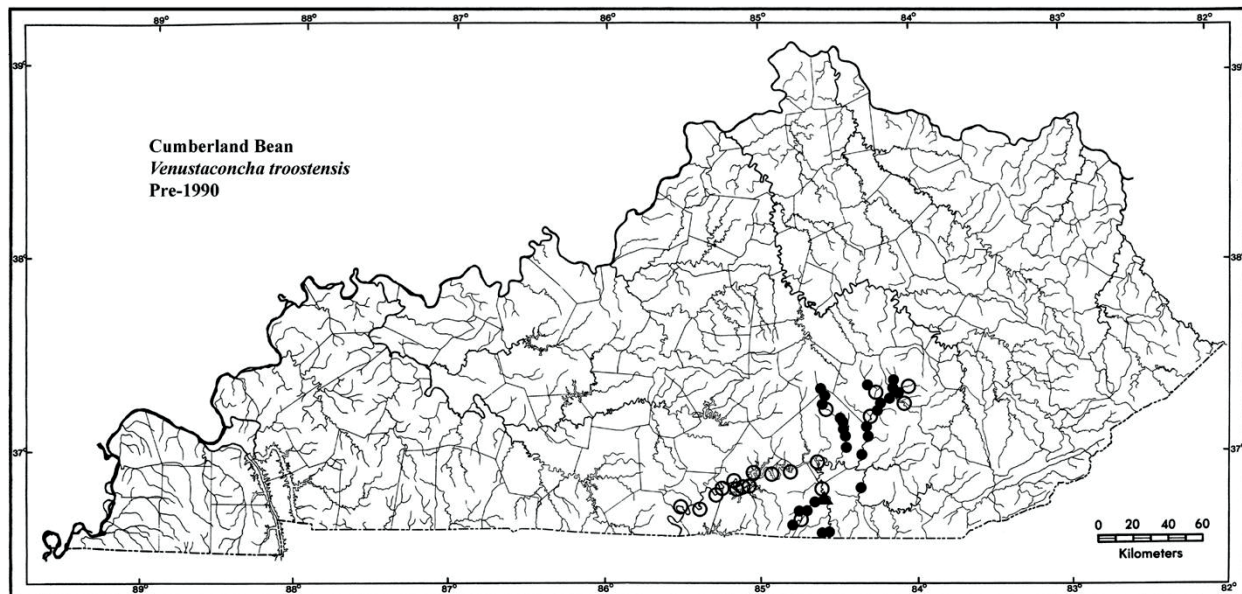
Can occur in nearly any type of permanent aquatic habitat from lowland to upland streams, large or small, to reservoirs, ponds, and wetlands, but most common in lentic habitats, where it may be the only mussel species present. This species is often rare in streams where it is typically restricted to depositional areas along shore or in backwater pools; the scarcity of these habitats in high gradient streams of the Appalachian Plateaus probably explains its rarity there. It adapts readily to impoundment and likely has expanded its range subsequent to dam and farm pond construction. Although widespread and locally common, this species does not occur at high densities and rarely dominates stream mussel assemblages.

**Conservation Status**

*Utterbackia imbecillis* is one of the most adaptable and resilient North American mussel species. It shares with other adaptable species (e.g., *Pyganodon grandis*) life history traits such as fast growth, early maturity, and generalist host use. In addition, this is one of the few species whose larvae can complete metamorphosis without a host fish, and it can be hermaphroditic, which allows eggs to be fertilized even when population density is low. Together, these traits allow it to tolerate considerable disturbance and to colonize habitats that are unsuitable to most other mussel species (Haag 2012). This species probably was absent or very rare historically in much of the eastern part of the state, and its distribution and abundance doubtless have increased dramatically because of stream impoundment, construction of farm ponds, and stream sedimentation. This species is often common in fish hatchery ponds, and stocking of fishes infected with glochidia of *U. imbecillis* has aided in its expansion. Reservoir populations in the upper Cumberland (Martins Fork Lake, Harlan County), upper Kentucky (Carr Fork Lake, Knott County), and Little Sandy (Greenbo Lake, Greenup County) river drainages were surely established via fish stocking, and this mode of dispersal can be expected to result in establishment of additional populations anywhere in the state. AFS: currently stable.

*Venustaconcha troostensis* (Lea, 1834)

## Cumberland Bean

**General Distribution**

Endemic to the Tennessee-Cumberland faunal province, but restricted to the middle Cumberland River drainage in Kentucky and Tennessee. Reported historically from the Stones River, Tennessee, upstream to Cumberland Falls; an archeological record is available for the lower Cumberland River, Stewart County, Tennessee (Parmalee and Bogan 1998), indicating that it occurred farther downstream in the system in prehistoric times. Until recently, this species was referred to as *Villosa trabalis*, which was thought to occur also in the Tennessee River drainage in northern Alabama, Tennessee, and southwestern Virginia, along with a similar species, *Villosa perpurpurea*. However, these species are members of the genus *Venustaconcha* (Kuehnl 2009; see section IV.D.4). Further-



more, populations in the Cumberland River drainage represent a separate species genetically and morphologically distinct from populations in the Tennessee River drainage, and *Venustaconcha perpurpurea* is indistinguishable genetically from Tennessee River *Ve. trabalis* (Lane et al. in press). *Venustaconcha perpurpurea* thus is a junior synonym of *Ve. trabalis*, but both were described from the Tennessee River drainage and the name *Ve. trabalis* is unavailable for the Cumberland River species. The earliest available name from the Cumberland River drainage is *Venustaconcha troostensis* (Lea, 1834; type locality = Stones River, Tennessee).

**Kentucky Distribution**

Formerly generally distributed and common throughout the middle Cumberland River to the base of Cumberland Falls and in most major tributaries, but not reported from the Laurel River; absent in the upper Cumberland River drainage above Cumberland Falls.

**Habitat & Larval Hosts**

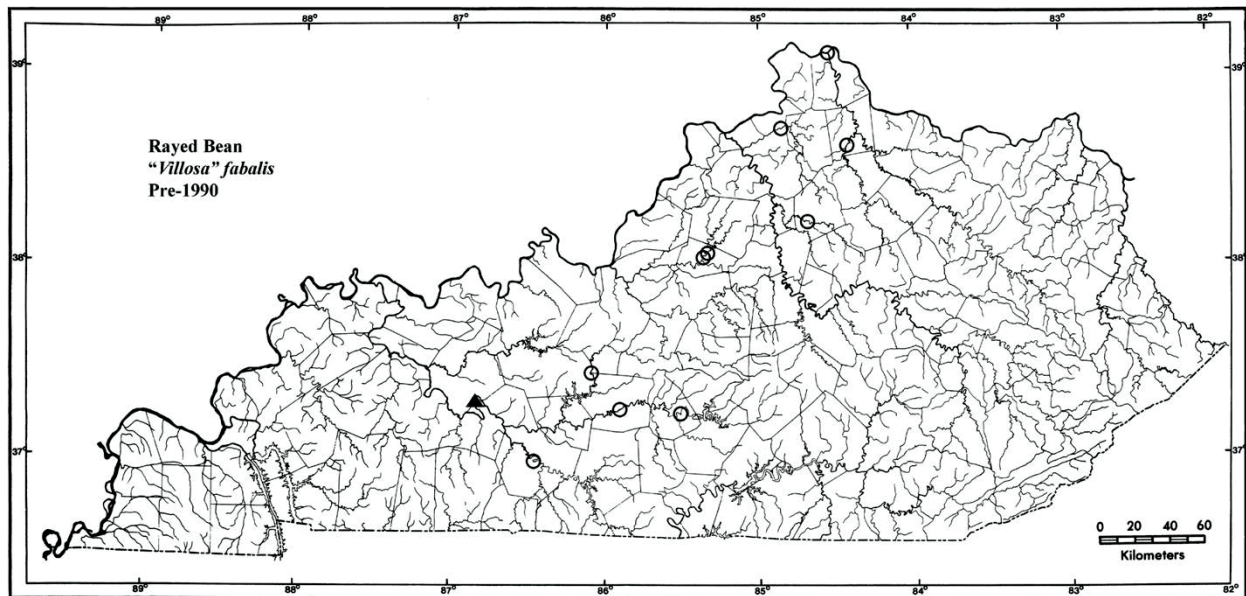
Occurs in large rivers to small streams, but does not penetrate far into the headwaters. Restricted to main-channel habitats in gravel and sand substrates, and typically absent from depositional habitats. This species is a host specialist on darters (Percidae).

**Conservation Status**

*Venustaconcha troostensis* is one of the most characteristic members of the unique mussel fauna of the middle Cumberland River drainage, and historically it was a prominent member of mussel assemblages in all but the smallest headwater streams in this region. It seems to have been equally common in the Cumberland River and in tributaries, but it was perhaps especially abundant in the Rockcastle River and at the base of Cumberland Falls (Neel and Allen 1964; Cicerello and Lauder milk 1997; OSUM). Since the 1950s, this species has declined dramatically and it is now critically imperiled and in danger of extinction. The large population in the Cumberland River was eliminated by Wolf Creek Dam with the exception of the population at the base of Cumberland Falls, which persisted until at least the early 1960s, but this population also appears extirpated (Stansbery 1969; Cicerello and Lauder milk 1997). It remained common in the Rockcastle River until the 1960s (OSUM), and although it survives in some sections of the river, it is now very rare. Until the 1990s, robust populations remained in Buck Creek; Horse Lick Creek and Sinking Creek (Rockcastle River system); the Little South Fork; and the Big South Fork (e.g., Schuster et al. 1989; Anderson et al. 1991; Bakaletz 1991; Layzer and Anderson 1992). The species was nearly or entirely eliminated from Horse Lick Creek and the Little South Fork apparently by oil drilling and coal mining (Haag and Warren 2004; Warren and Haag 2005), and the Big South Fork population appears to have declined recently for similar reasons (Ahlstedt et al. 2003-2004). The Buck Creek and Sinking Creek populations also have declined dramatically for unknown reasons (Hagman 2000; M. McGregor, personal communication). In Tennessee, this species remains only in the upper Big South Fork. Survival of this species depends on concerted efforts to improve water quality in the Cumberland River drainage. KNP: endangered; AFS: endangered; USFWS: endangered.

*“Villosa” fabalis* (Lea, 1831)

## Rayed Bean

**General Distribution**

Largely restricted to the Ohio River basin, but also occurs in the Great Lakes basin in Lake St. Clair and Lake Erie. Generally distributed and locally abundant historically in northern tributaries of the Ohio River from the Wabash River drainage upstream to New York. Sporadic and usually rare in most major southern tributaries from the Tennessee River upstream to the Monongahela River drainage, Pennsylvania, but not reported from the Cumberland River drainage. *“Villosa” fabalis* is not closely related to any other *“Villosa”* (*sensu lato*; see section IV.D.4); rather, it represents an as yet unnamed monotypic genus that is basal to the remainder of the tribe Lampsilini (Kuehn 2009).

**Kentucky Distribution**

Type locality: Ohio River [Cincinnati, Ohio] (see Watters et al. 2009). Apart from the type locality, a single historical record exists from the Ohio River, Kenton County (Lea 1870; NMNH). Sporadic from the Green to the Licking river drainage. Not reported from the Tennessee River drainage in Kentucky, but sporadic elsewhere in that system (Parmalee and Bogan 1998). A single archeological record exists for the lower Green River drainage (Green River, Butler County; Patch 2005). Reported from four sites in the upper Green River drainage: Green River, Hart and Green counties (Stansbery 1965; NCMNS), Barren River, Warren County (ANSDU; UMMZ), and Nolin River, Grayson/Hart counties (OSUM); an additional record from the Nolin River (Schuster 1988; ECU) is "*Villosa*" *ortmanni*. Reported from two sites in the Salt River drainage (Brashears Creek, Spencer County; OSUM), two sites in the Kentucky River drainage (Eagle Creek, Gallatin/Owen counties; North Fork Elkhorn Creek, Scott County; both OSUM), and a single site in the Licking River drainage (South Fork Licking River, Pendleton County; OSUM).

**Habitat & Larval Hosts**

Occurs in large rivers to small streams in main-channel habitats in gravel and sand substrates, but also in depositional areas along shore, particularly in association with Water Willow (*Justicia americana*; Ortmann 1918). It appears intolerant of impoundment, but occurs occasionally in natural glacial lakes in the upper Midwest. This species is a host specialist on darters (Percidae).

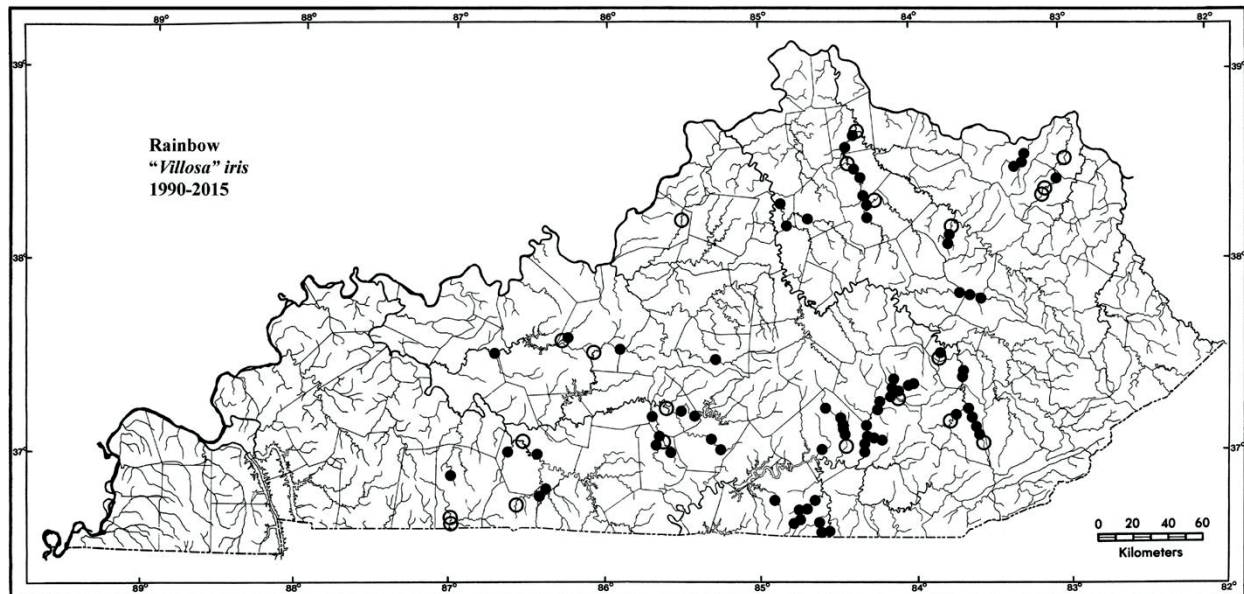
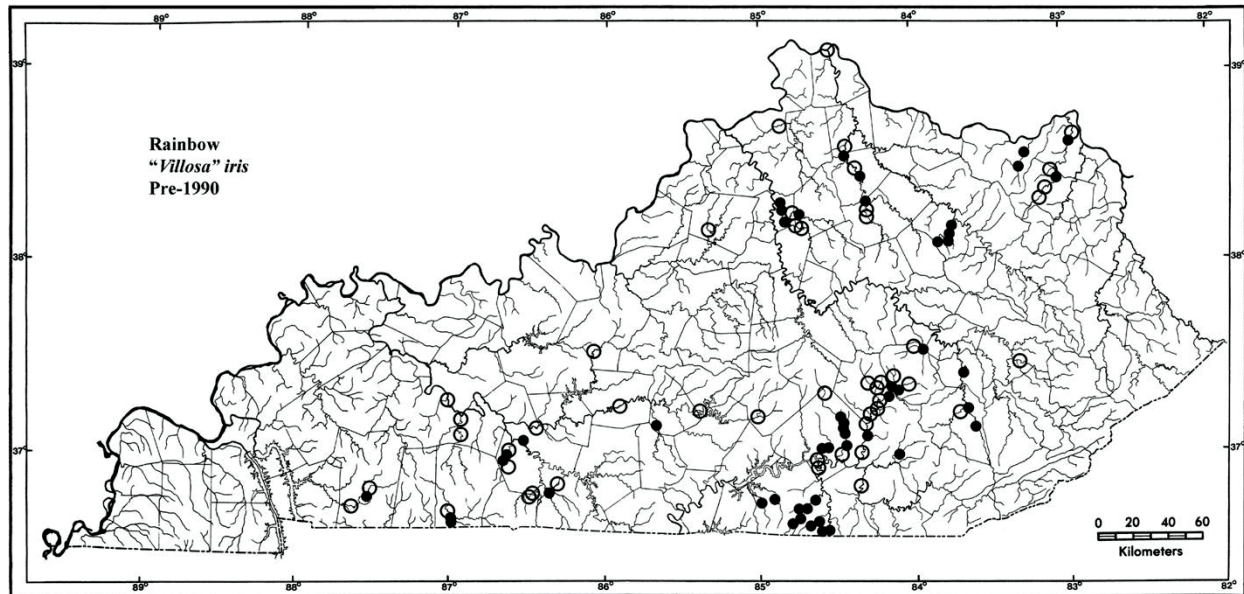
**Conservation Status**

Judging by the paucity of historical specimens, "*Villosa*" *fabalis* appears to have been rare in Kentucky even historically, but it now appears extirpated from the state. This is one of the smallest North American mussel species, which may have caused it to be overlooked to some extent, but nearly all records from the state are based on only one or two specimens. The last collections of living or recently dead individuals were from the Green River from 1961–1964 (Stansbery 1965; NCMNS). All subsequent collections were of relic shells, and no individuals in any condition have been found in the last 25 years. The reasons for the disappearance of this species from the state are unknown. All other populations of "*Villosa*" *fabalis* in southern tributaries of the Ohio River (in Tennessee, Virginia, and West Virginia) appear to be extirpated, but several large populations survive in northern tributaries and in tributaries of Lake St. Clair and Lake Erie (USFWS 2012). A large population in the Allegheny River, Pennsylvania, provided source stock for recent efforts to reintroduce the species in the Duck River, Tennessee, and the Elk River, West Virginia (USFWS 2012), and could provide individuals for future reintroductions in Kentucky. KNP: presumed extirpated; AFS: special concern; USFWS: endangered.



*“Villosa” iris* (Lea, 1829)

Rainbow

**General Distribution**

Mississippi River basin only in the Ozark and Ouachita highlands of Arkansas, Missouri, and Oklahoma, and in the Rock and Illinois river systems, Illinois and Wisconsin. Ohio River basin from the Tennessee River drainage upstream to New York, but absent in low-land regions of the lower basin. Great Lakes basin from Lake Michigan to Lake Ontario. Of the members of “*Villosa*” (*sensu lato*) in Kentucky (see section IV.D.4), “*Villosa*” *iris* is closely related only to “*V.*” *taeniata* and these species are members of an as yet unnamed genus (Kuehn 2009). “*Villosa*” *iris* contains at least three distinct lineages. Cumberland and Green river system populations are closely related to each

other and to populations in Arkansas and Missouri, but they are genetically distinct from Tennessee River drainage populations. The phylogenetic affinities of populations elsewhere in Kentucky are unknown.

#### Kentucky Distribution

Generally distributed to occasional but localized in most major Ohio River tributaries from the Cumberland River to Tygarts Creek; rare in large rivers and absent in lowland habitats in western Kentucky. A single historical record is available from the Ohio River, Kenton County (NMNH). Not reported from the Tennessee River drainage in Kentucky, but widespread elsewhere in that system (Parmalee and Bogan 1998). Sporadic in the Little and Red rivers (lower Cumberland River drainage). Generally distributed and nearly ubiquitous in tributaries of the middle Cumberland River drainage, but reported from the Cumberland River only immediately below Cumberland Falls and at Burnside, Pulaski County; absent above the falls (Neel and Allen 1964; KNP). Sporadic in the lower Green River drainage and primarily confined to upland areas (upper Rough and Mud river systems), but generally distributed to occasional in the upper Green River drainage. Reported from the Salt River drainage from only three sites: Rolling Fork, Marion County (KNP); Floyds Fork, Jefferson County (Hoggarth 2005); and Bullskin Creek, Shelby County (KNP). Occasional but localized in the Kentucky River drainage. Generally distributed in the South Fork Licking River system and Slate Creek, Bath County, but not reported elsewhere in the Licking River drainage. Generally distributed in Kinniconick and Tygarts creeks; not reported from the Little Sandy or Big Sandy river drainages.

#### Habitat & Larval Hosts

Restricted to upland regions primarily in small to medium-sized streams, and may penetrate far into the headwaters. It occurs in riffles in gravel and sand substrates or adjacent depositional areas near shore; may be found in high abundance under large, flat rocks. This species is a host specialist on black basses (*Micropterus*).

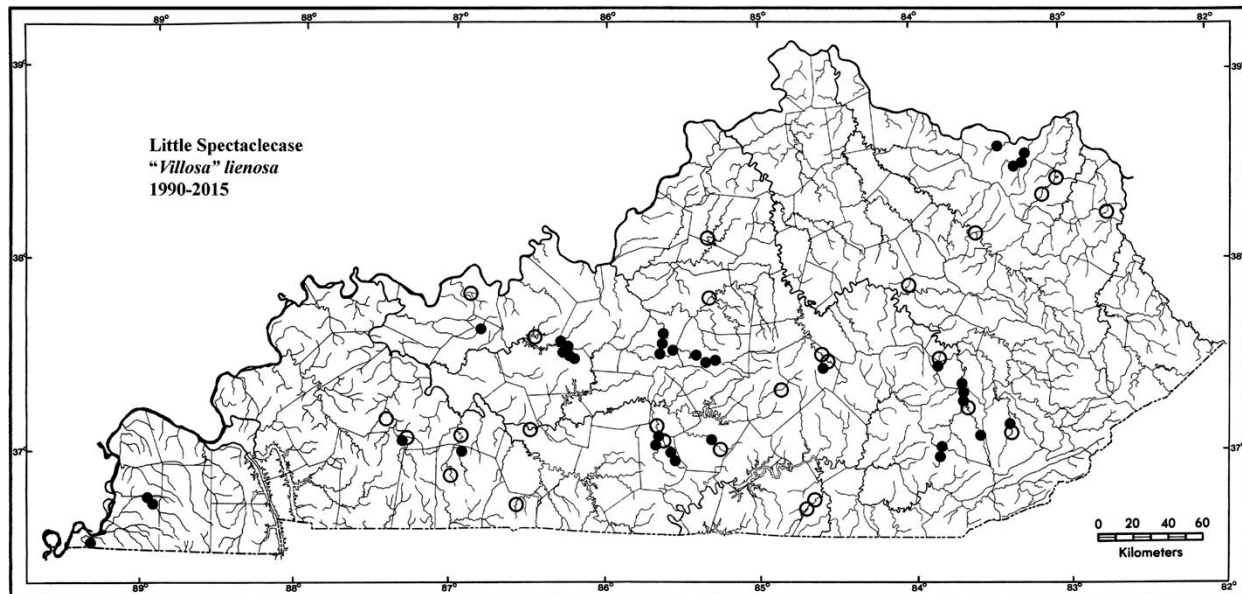
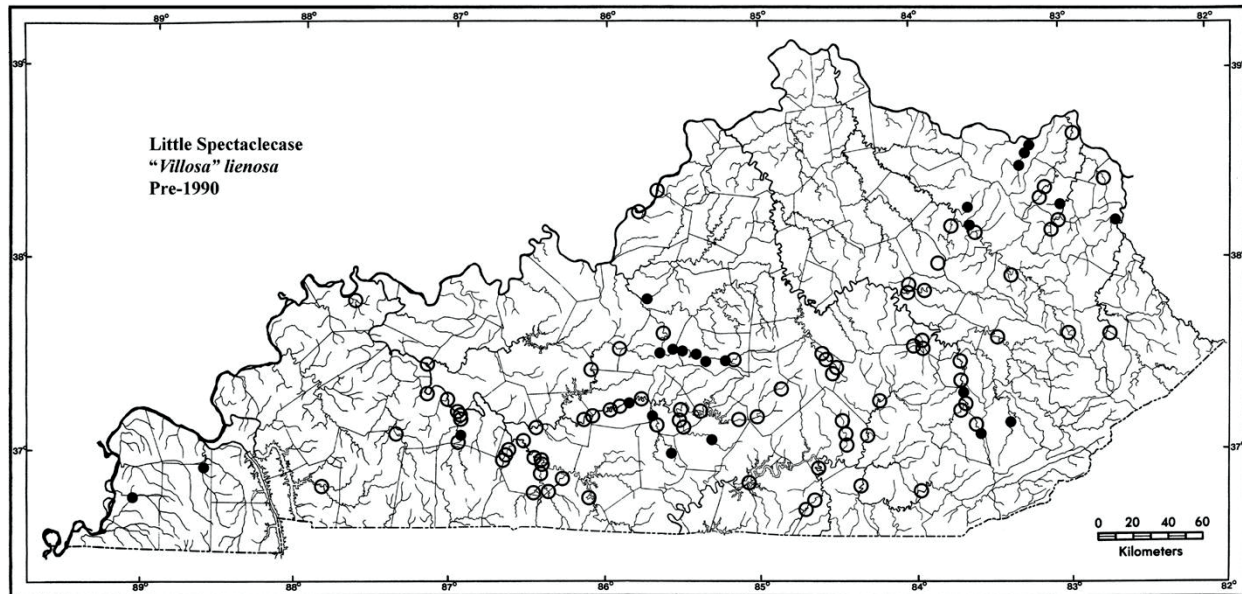
#### Conservation Status

The overall distribution of “*Villosa*” *iris* in Kentucky is mostly unchanged over the last few decades, but populations in several areas have declined sharply during this time. In addition, most small streams that potentially provided habitat for this species were not surveyed prior to the 1980s, and it is unknown the extent to which its current localized distribution is a natural phenomenon or a result of previous habitat degradation. For example, it is unknown if the species was more widely distributed historically in the Salt, Kentucky, and Licking river drainages, and the isolated nature of populations in these drainages places them at risk. It appears extirpated from the lower Cumberland River drainage from unknown causes. It remains one of the most common species in the middle Cumberland River drainage, but all mussel species have declined sharply in many of these streams due to coal mining, oil drilling, and other factors. For example, it is one of the few species that survives in the Little South Fork and Horse Lick Creek, but remaining populations are small (Haag and Warren 2004; Warren and Haag 2005; Ahlstedt et al. 2014); its former ubiquity throughout this drainage likely has masked similar declines in other streams. Another factor in the conservation status of this species is the potential for unrecognized cryptic diversity. Recent research supports the long-held idea that “*Villosa*” *iris* represents a complex of distinct species (Kuehn 2009; see previous), but the full extent of speciation across its range remains unknown (see section IV.D.3). This species is not currently of high conservation concern throughout most of its range, including Kentucky, and it remains common in many areas. However, identification of cryptic species with more restricted distributions will necessitate a reevaluation of their conservation status. AFS: currently stable.



*“Villosa” lienosa* (Conrad, 1834)

## Little Spectaclecase

**General Distribution**

Lower Mississippi River basin from Louisiana to southeastern Missouri, and west to eastern Oklahoma. Ohio River basin upstream to about the Kanawha River, West Virginia, but absent from most of the Tennessee River drainage. Gulf Coast drainages from the Suwannee River, Florida, to the San Jacinto River, Texas. This species is a member of an as yet unnamed genus that also contains “*V.*” *ortmanni*, “*V.*” *vanuxemensis*, and “*V.*” *umbrans* (endemic to the Coosa River system, Alabama, Georgia, and Tennessee) (Kuehn 2009; see section IV.D.4).



**Kentucky Distribution**

Generally distributed to occasional nearly statewide, but localized and conspicuously absent from most of the Bluegrass physiographic section. Sporadic in lowland habitats in western Kentucky but not reported from the Mississippi or Tradewater rivers. Only two records exist from the Ohio River, Jefferson and Oldham counties (NMNH; OSUM). Reported from the entire Tennessee River drainage only at a single site in West Fork Clarks River, Graves County (INHS). Reported from the lower Cumberland River drainage in Kentucky only from the Little River, Trigg County (UMMZ), but also reported from the Red River system in Tennessee (OSUM). Sporadic historically in the middle Cumberland River drainage. Not reported from the upper Cumberland River drainage with the exception of a single specimen from the Cumberland River, Knox County (NCMNS). We regard this record as questionable because the collection contained another species whose occurrence above the falls is uncertain (*Toxolasma parvum*). Generally distributed to occasional throughout the Green River drainage. Generally distributed in the Rolling Fork, but sporadic elsewhere in the Salt River drainage. Occasional in the Kentucky River drainage upstream of and including the Dix River, but not reported from the mainstem or the lower drainage. Sporadic in the Licking River drainage from Bath County upstream to the headwaters, but not reported from the lower drainage including the South Fork Licking River system. Generally distributed in Kinniconick Creek, and sporadic to occasional in Tygarts Creek, Little Sandy River, and the Big Sandy River drainage.

**Habitat & Larval Hosts**

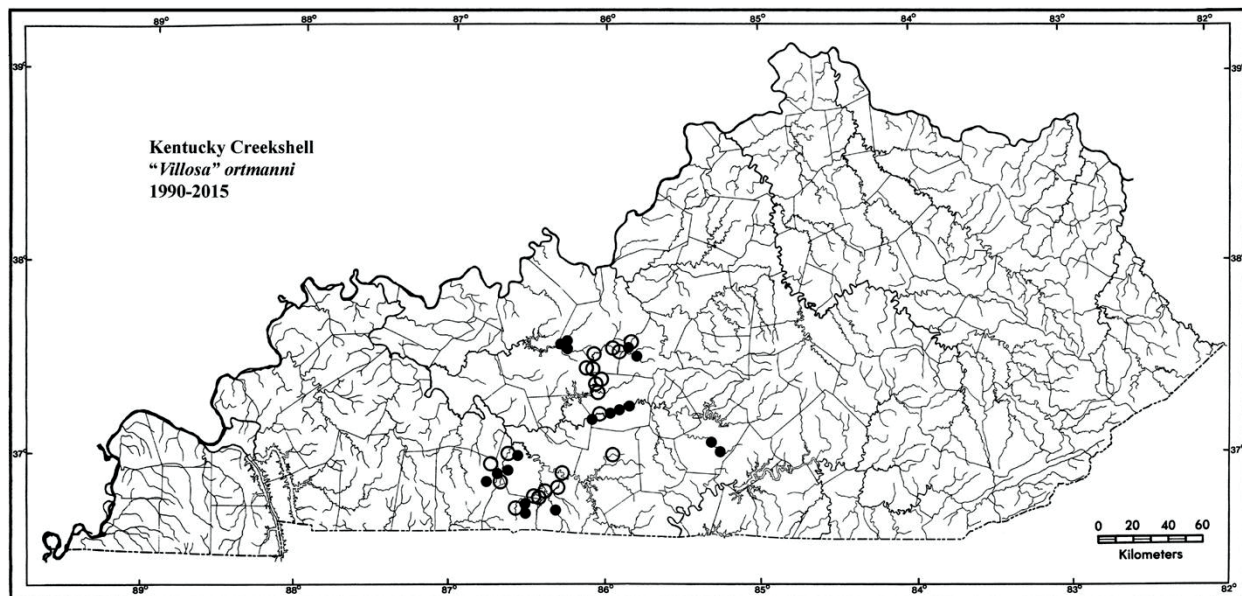
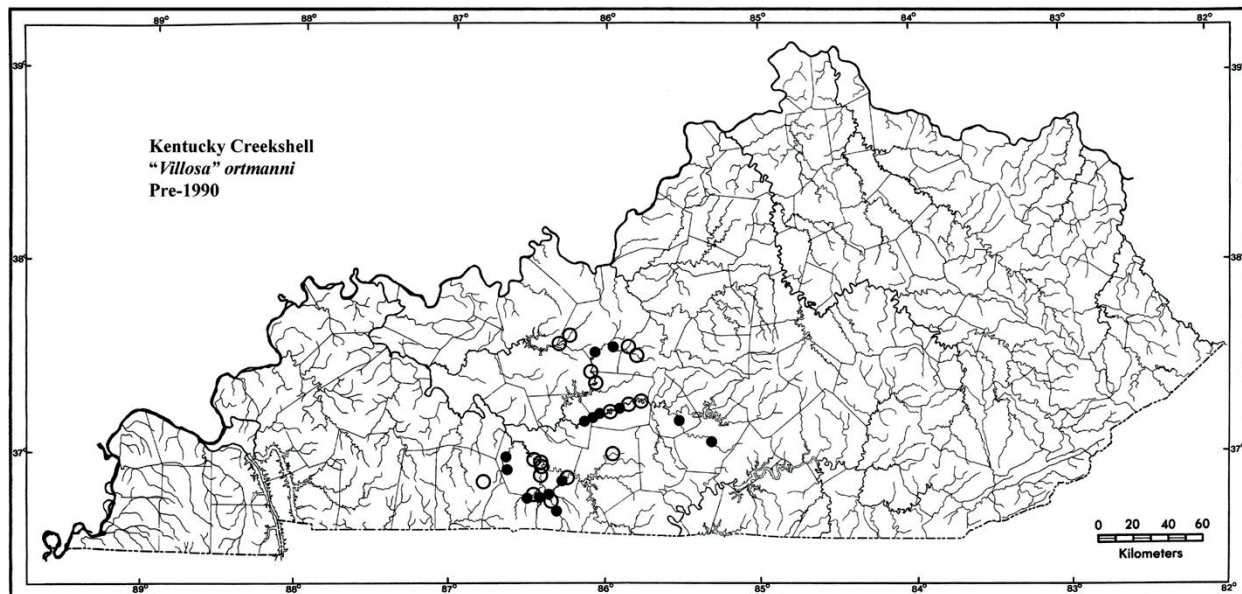
This species occurs in two distinctly different habitat types in Kentucky. In the Mississippi Embayment, it is found in sluggish lowland streams in depositional habitats. In the rest of the state it is restricted to cool, upland streams where it occurs primarily in riffles in sand and gravel substrates. In the Gulf Coastal Plain, this species often adapts to impoundment and can thrive in reservoirs (Williams et al. 2008), but populations in upland regions appear intolerant of impoundment. These stark differences in habitat use suggest that this taxon contains more than one species; however, research to date has provided little evidence of cryptic taxa within “*V.*” *lienosa* (Kuehn 2009). This species is a host specialist primarily on sunfishes (*Lepomis*).

**Conservation Status**

“*Villosa*” *lienosa* remains widespread across Kentucky, but it has declined dramatically in the last 50 years. In much of the Gulf Coastal Plain, this species is ubiquitous in lowland habitats and adapts to highly degraded streams (Williams et al. 2008; Haag 2012); its rarity in similar habitats in western Kentucky is perplexing. Many upland populations across the state seem to have disappeared. It now appears absent in the Barren River system, mainstem Green River, Licking River drainage, Tygarts Creek, Little Sandy River, and the Big Sandy River drainage. It also appears to be extirpated from the entire Cumberland River drainage. Most remaining populations in the state are small and widely scattered. The largest populations occur in the upper Rough River, Little Barren River, Rolling Fork, and the South Fork Kentucky River system. Large populations existed in Collins Fork, Clay/Knox counties (Kentucky River drainage), and Kinniconick Creek but these appear to have declined dramatically in the last 10 years (R. Evans, personal communication; R. Cicerello, personal observations). The reasons for the general decline of this species throughout the state are unknown, and several streams from which it has disappeared continue to support large and diverse mussel faunas. Its decline in upland habitats in Kentucky is especially puzzling because of its apparent resilience elsewhere in its range. KNP: special concern; this species warrants listing as threatened; AFS: currently stable.

*“Villosa” ortmanni* (Walker, 1925)

## Kentucky Creekshell

**General Distribution**

Possibly endemic to the Green River system. Restricted to upland portions of the watershed but not reported from headwaters of the Barren River system in Tennessee, making this perhaps the only species whose range lies entirely within the boundaries of Kentucky (but see *“Villosa” vanuxemensis*). However, there is uncertainty about the range and phylogenetic status of this species. A genetic study showed that a specimen of *“Villosa”* sp. cf. *vanuxemensis* from the Red River system, Logan County (lower Cumberland River drainage), was more closely related to *“V.” ortmanni* from the Green River drainage than to *“V.” vanuxemensis* from the Little River system (lower Cumberland River drainage) (Kuehn 2009). This suggests that populations in the Green and Red river systems and perhaps

other Cumberland River tributaries in Tennessee (e.g., Harpeth and Stones rivers) represent a single species. However, this study included only a single specimen from the Red River system, and additional sampling from this and other populations is needed to clarify this issue. Until such work is conducted, we follow traditional usage and consider “*V.*” *ortmanni* endemic to upland portions of the Green River system because such a distribution is concordant with that of several endemic fish species (e.g., *Etheostoma barbouri*, *E. bellum*, *E. rafinesquei*, *Noturus elegans*, *Thoburnia atripinnis*). Along with “*V.*” *vanuxemensis*, this species is a member of an as yet unnamed genus containing “*V.*” *lienosa* and “*V.*” *umbrans* (endemic to the Coosa River drainage, Alabama, Georgia, and Tennessee).

#### Kentucky Distribution

Type locality: Green River, Mammoth Cave, Ky, and Sulphur Fork of Russell Creek, Adair County, Ky. Widespread in upland portions of the Green River drainage, but patchily distributed apparently in association with areas of extensive karst (M. Compton, personal communication). Present in the lower Green River drainage only in the upper Rough River system, Hardin and Grayson counties; an unsubstantiated record exists from the lower Green River, Muhlenberg/Ohio counties (Isom 1971). Upper Green River drainage from the Barren River system upstream to Russell Creek, Adair County, but localized within this area. In the Barren River system, known only from the Gasper River upstream to Beaver Creek, Barren County, and not reported from the upper reaches of the system. In the Green River drainage upstream of the Barren River, known only from the Green River, Edmonson and Hart counties; the Nolin River; and Russell Creek.

#### Habitat & Larval Hosts

Occurs in a wide variety of upland stream habitats from the Green River to small streams and spring runs where it is found in riffles in gravel and sand substrates or adjacent depositional areas near shore. This species is a host specialist on sculpins (*Cottus*).

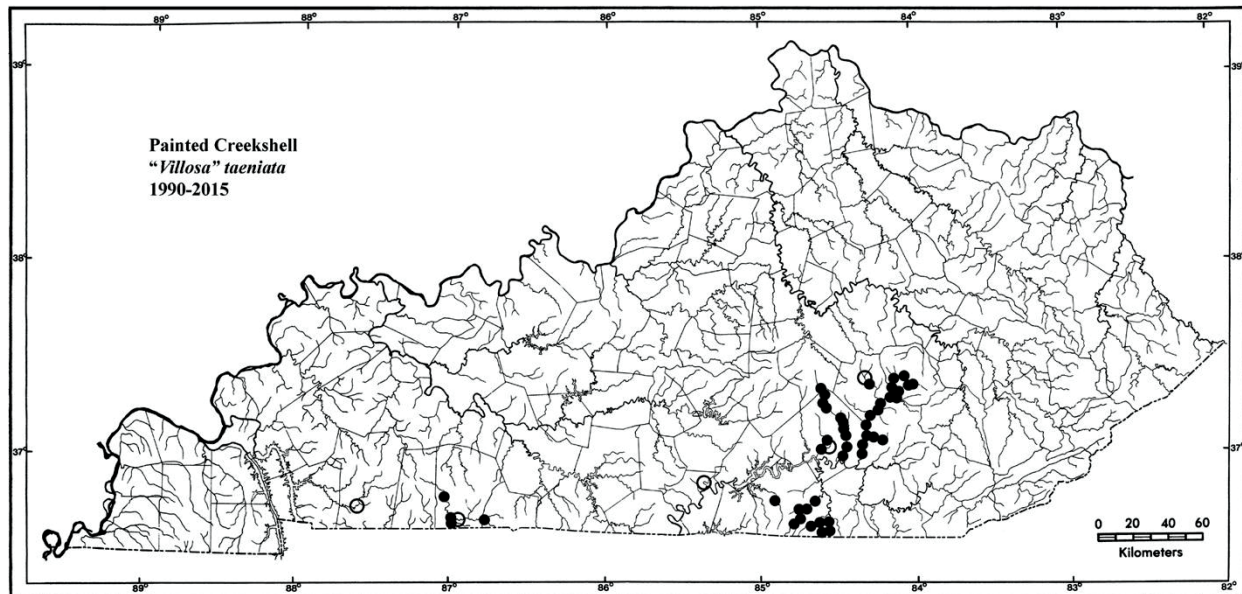
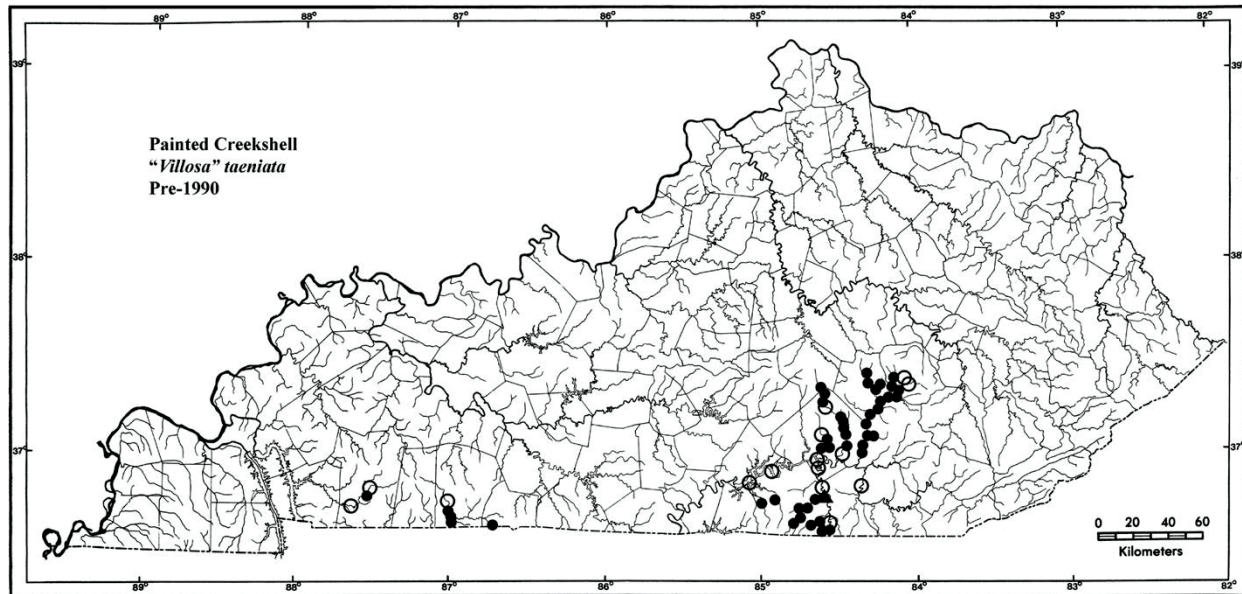
#### Conservation Status

“*Villosa*” *ortmanni* survives throughout most of its known historical range, but many local populations have declined dramatically or are extirpated. Construction of Barren River Dam in 1964 eliminated much potential habitat for this species, but its historical distribution in the area directly affected by the dam is unknown. This species was abundant in the Green River until at least the 1960s; collections from Munfordville, Hart County, during this period contain hundreds of individuals (OSUM). It persists in the Green River but is now sporadic and rare perhaps due to oil brine pollution and altered flows from Green River Dam (see Williams 1969; Konrad et al. 2012). It formerly was the dominant species in the Nolin River, Hardin County; live individuals were abundant there in 1964 (OSUM), and hundreds of relic shells were collected from three sites in the early 1980s (Taylor 1983). This population, along with most other mussel species, has been eliminated from the Nolin River by unknown causes, but a small population of “*V.*” *ortmanni* may survive in the headwaters in Larue County (KNP). Sizeable populations now survive only in the upper Rough River, Russell Creek, and a few small tributaries in the Barren River system (Cicerello 2005; KNP; KDOW). Regardless of the relationship of “*V.*” *ortmanni* to Cumberland River drainage “*V.*” *vanuxemensis*, this species is highly imperiled and in danger of extinction. Improvement of stream integrity in the upper Green River system is crucial to its survival. KNP: threatened; this species warrants listing as endangered; AFS: special concern; USFWS: petitioned for listing.



*“Villosa” taeniata* (Conrad, 1834)

## Painted Creekshell

**General Distribution**

Endemic to the Tennessee-Cumberland faunal province, occurring in northern Alabama, southern Kentucky, and Tennessee. Widespread in the Cumberland River drainage, and in the Tennessee River drainage only from the Duck River, Tennessee, upstream to the Paint Rock River, Alabama. It is likely that this taxon contains more than one species. Based on differences in shell morphology, populations in the lower Cumberland River drainage (e.g., Red and Stones rivers) have been referred to as *V. taeniata taeniata* and those in the middle Cumberland River drainage as *V. taeniata punctata* (e.g., Schmidt 1982; Schuster et al. 1989). A genetic study provided evidence for differences between Tennessee and Cumberland River drainage populations (Kuehn 2009), but relationships within

the Cumberland River drainage have not been examined. Of the members of “*Villosa*” (*sensu lato*) in Kentucky (see section IV.D.4), “*Villosa*” *taeniata* is closely related only to “*V.*” *iris* and these species are members of an as yet unnamed genus (Kuehn 2009).

#### Kentucky Distribution

Generally distributed throughout the lower and middle Cumberland River drainages from the Little River upstream to Cumberland Falls; absent above the falls. The distribution of this species extends farther downstream (Little River) than most other species endemic to the Tennessee-Cumberland faunal province (but see *Actinonaias pectorosa* and “*V.*” *vanuxemensis*). Nearly ubiquitous in tributaries of the middle Cumberland River drainage from Crocus Creek, Cumberland County, upstream to the Rockcastle River, but not reported from Fishing Creek or the Laurel River. Reported from the Cumberland River only immediately below Cumberland Falls and from a few sites in Pulaski and Wayne counties (Wilson and Clark 1914).

#### Habitat & Larval Hosts

Largely restricted to small or medium-sized streams, and can penetrate far into the headwaters where it may be the only species present. Occurs in riffles and flowing pools in gravel and sand substrates; often found under large, flat rocks. This species is a host specialist on black basses (*Micropterus*) and Rock Bass (*Ambloplites rupestris*).

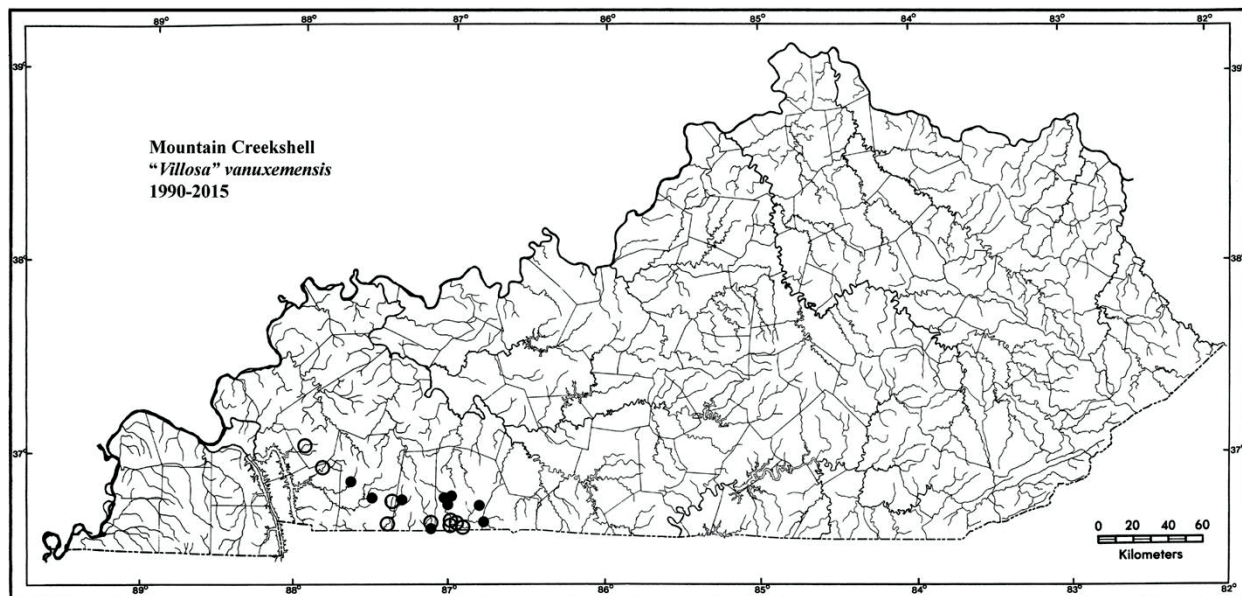
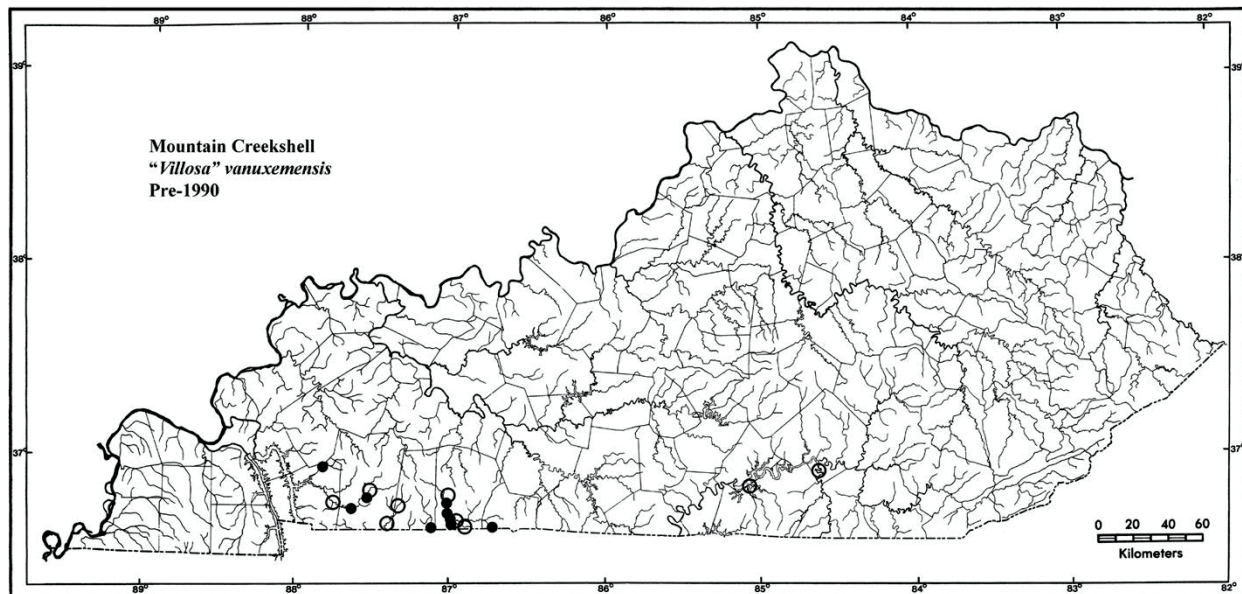
#### Conservation Status

“*Villosa*” *taeniata* is one of the most characteristic members of small stream mussel assemblages throughout the lower and middle Cumberland River drainages. It is especially prevalent in small streams in the middle Cumberland River drainage where it is often the most abundant species (e.g., DiStefano 1984; Schuster et al. 1989; Cicerello 1993, 1996). Because of its rarity in large streams, it was affected by the impoundment of the Cumberland River to a much lesser extent than other Tennessee-Cumberland endemic species, and it survives throughout much of its historical range. Its present wide distribution may give the inaccurate impression that it is tolerant of stream degradation, but the former abundance and ubiquity of this species masks its dramatic decline in many streams, and these declines are overshadowed by the disappearance of many, more critically imperiled species in this region. For example, “*Villosa*” *taeniata* has declined to a similar extent as other species in streams impacted by coal mining and oil drilling such as the Little South Fork and Horse Lick Creek, but it survives in these streams at least in part because it was initially one of the most abundant species (Haag and Warren 2004; Warren and Haag 2005). It remains relatively common in Buck Creek, portions of the Rockcastle River system, and the Big South Fork, and smaller populations may persist in other streams (e.g., Beaver and Pitman creeks), but all of these streams have experienced recent declines in overall mussel abundance. Populations in the middle Cumberland River drainage are not at immediate risk of extinction, but continued declines in water quality in this region will ultimately jeopardize the species. The status of populations in the lower Cumberland River drainage is more worrisome. It appears to be extirpated from the Little River system, and although it was abundant in the Red River until at least the 1960s (OSUM), it is now rare, and the reasons for its decline in these streams are unknown. Elsewhere in the lower Cumberland River drainage, “*Villosa*” *taeniata* survives only in the Stones River and possibly the Harpeth River, Tennessee (D. Hubbs, personal communication). If these populations are distinct from those in the middle Cumberland River drainage, the lower Cumberland species should be considered critically imperiled. KNP: none, but this species warrants listing as a species of special concern; AFS: currently stable.



*“Villosa” vanuxemensis* (Lea, 1838)

## Mountain Creekshell

**General Distribution**

*“Villosa” vanuxemensis* (*sensu lato*) represents a species complex endemic to the Tennessee-Cumberland faunal province; collectively, these species occur in northern Alabama, northwestern Georgia, southern Kentucky, Tennessee, and southwestern Virginia. A genetic study showed that Cumberland River drainage populations represent a distinct species more closely related to *“V.” ortmanni* than to Tennessee River drainage *V. vanuxemensis* (Kuehn 2009). Its distribution in the Cumberland River drainage is unclear. Specimens from the Little River system (lower Cumberland River drainage) represent a distinct species sister to *“V.” ortmanni*. Curiously, a specimen from the Red River system was more closely related to *“V.” ortmanni* than to Little River specimens. This suggests that



the population in the Little River system and possibly nearby tributaries (see subsequent) is endemic to that region and, if so, it has one of the smallest distributions of any North American mussel species. However, additional sampling from Red River populations is needed to clarify this issue. Until such work is conducted, we consider the Little and Red river populations to represent a single species endemic to the lower Cumberland River drainage because such a distribution is concordant with that of endemic fishes in this drainage (e.g., *Etheostoma microlepidotum*, *E. occidentale*). Elsewhere in the Cumberland River drainage, "*Villosa*" *vanuxemensis* is reported only from the Stones River, Tennessee (Parmalee and Bogan 1998), but two records exist from the middle Cumberland River drainage in Kentucky (see subsequent). Along with "*V.*" *ortmanni*, this species is a member of an as yet unnamed genus containing "*V.*" *lienosa*, Tennessee River drainage "*V.*" sp. cf. *vanuxemensis*, and "*V.*" *umbrans* (endemic to the Coosa River drainage, Alabama, Georgia, and Tennessee).

#### Kentucky Distribution

Generally distributed in the lower Cumberland River drainage in the Little and Red river systems, and a single record exists from Eddy Creek, Caldwell County (KNP). Not reported from the mainstem Cumberland River. The distribution of this species extends farther downstream (Eddy Creek) than all other species endemic to the Tennessee-Cumberland faunal province. Three records exist from the middle Cumberland River drainage: Beaver Creek, Wayne County; Big South Fork, Pulaski County (both Neel and Allen 1964); and Little South Fork, Wayne County (NCMNS). The Little South Fork specimens (2 individuals) are *Toxolasma lividum*. Starnes and Bogan (1982) also considered the Beaver Creek and Big South Fork records misidentifications of *Toxolasma lividum*. However, the specimen illustrated in Neel and Allen (1964) more closely resembles "*V.*" *vanuxemensis*, and they also reported *T. lividum*, suggesting that they were aware of the differences between these species; unfortunately, they did not illustrate *T. lividum*, and no voucher specimens exist. Another issue is confusion with "*V.*" *lienosa*, which was more widely reported in the middle Cumberland River drainage. Neel and Allen (1964) did not report "*V.*" *lienosa*, but Wilson and Clark (1914) reported atypical specimens from the Cumberland River below Cumberland Falls; it is possible that the specimens reported by Neel and Allen (1964) are "*V.*" *lienosa*. We have plotted these two localities here but regard these records as questionable and acknowledge that the identity of these specimens and their relationship to lower Cumberland River "*V.*" *vanuxemensis* may never be known. "*Villosa*" sp. cf. *vanuxemensis* is widespread in the middle and upper Tennessee River drainage, but it is not reported from that system in Kentucky.

#### Habitat & Larval Hosts

Occurs in small to medium-sized upland streams and spring runs where it is found in riffles in gravel and sand substrates or adjacent depositional areas near shore. This species is a host specialist on sculpins (*Cottus*).

#### Conservation Status

Despite uncertainty about the distribution of this species, it is now critically imperiled and in danger of extinction. Only two small populations are known in the Little River system. If these populations prove distinct from those in the Red River system, they may be the last remaining populations of the species on Earth. Even if the Little and Red river populations represent a single species, its status is only marginally better. It remains widespread in the Red River system, but mussel populations have crashed throughout that system, and all remaining populations of "*V.*" *vanuxemensis* there are small and scattered. Other populations potentially representing this species in the middle Cumberland River in Kentucky and Tennessee (Stones River) are now extirpated. KNP: threatened (but see subsequent); AFS: special concern. Previous assessments of this species' status were not aware of its genetic distinctiveness and restricted distribution. This species warrants listing as endangered at the state and national level.



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## X. Appendix: Sources of distributional information

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