National Park Service
U.S. Department of the Interior

Northeast Region
Philadelphia, Pennsylvania

Fishes of Bluestone National Scenic River

Natural Resources Technical Report NPS/NER/NRTR--2006/049

ON THE COVER

Top Left – John Switzer on the bank of the Bluestone National Scenic River; Top Right – Bluestone National Scenic River; Bottom Left – green sunfish (*Lepomis cyanellus*); Middle Right - bigmouth chub (*Nocomis platyrhynchus*); Bottom Right – greenside darter (*Etheostoma blennioides*)

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Natural Resources Technical Report NPS/NER/NRTR--2006/049

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August 2006

U.S. Department of the Interior
National Park Service
Northeast Region
Philadelphia, Pennsylvania

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This report was accomplished under Interagency Agreement F4560040053 with assistance from NPS. The statements, findings, conclusions, recommendations, and data in this report are solely those of the author(s), and do not necessarily reflect the views of the U.S. Department of the Interior, National Park Service.

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Please cite this publication as:

Welsh, S.A., D.A. Cincotta, and J.F. Switzer. August 2006. Fishes of Bluestone National Scenic River. Technical Report NPS/NER/NRTR – 2006/049. National Park Service. Philadelphia, PA.

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Abstract

Aquatic resource managers were previously without a reference document on historic and recent distribution data of native and nonnative fishes of the Bluestone River drainage, West Virginia, and Bluestone National Scenic River (BLUE). We compiled published and unpublished diversity and distribution data of native and nonnative fishes from 99 fish collections (1899 to 2003) within the Bluestone River drainage, West Virginia (including our own fish collection efforts in 2004 and 2005). We documented 57 fish species (26 native and 31 nonnative) within the Bluestone River drainage and 45 fish species (20 native and 25 nonnative) within BLUE boundaries (including upper Bluestone reservoir sites). Species richness fluctuated among three sampling time periods, but was similar between historic data and our collections (N = 44 for historic data 1899-1984; N = 35 for recent data 1985-2003; N = 43 for our collections 2004-2005). Species composition, however, differed among sampling periods owing largely to the addition of nonnatives and the attrition or nondetection of natives (including two endemic species). Based on species origins reported in the literature, at least 31 (54%) of 57 fish species are nonnative within the Bluestone River drainage. This synthesis is most useful as a reference document for researchers and managers with aquatic interests in the Bluestone River watershed, and provides baseline information for current management decisions and long-term species monitoring.

Executive Summary

We synthesized historic and recent distribution data of native and nonnative fishes within the Bluestone River drainage, West Virginia, including Bluestone National Scenic River (BLUE). This synthesis compiles published and unpublished fish distribution data, and appends an atlas of historic and recent data on native and nonnative fish distributions within the Bluestone River drainage and BLUE. The document is most useful as a reference for researchers and managers with aquatic interests in the Bluestone River watershed.

We compiled diversity and distribution data of native and nonnative fishes from 99 fish collections (1899 to 2005) within the Bluestone River drainage, West Virginia. These 99 collections documented a total of 57 fish species (26 native and 31 nonnative) within the Bluestone River drainage and 45 fish species (20 native and 25 nonnative) within BLUE boundaries (including upper Bluestone reservoir sites). Species richness fluctuated among three sampling time periods, but was similar between historic data and this study (N = 44 for historic data 1899-1984; N = 35 for recent data 1985-2003; N = 43 for this study 2004-2005). Species composition, however, differed among sampling periods owing largely to the addition of nonnatives and the attrition or nondetection of natives (including two endemic species).

The native fish fauna of the Bluestone River (New River drainage) is depauperate relative to numbers of fish species found in nine neighboring river systems. Nonnative fishes comprise approximately one-half of the New River fish fauna and ranges of several recently introduced fishes have rapidly expanded within the New River drainage. Based on species origins reported in the literature, at least 31 (54%) of 57 fish species are nonnative within the Bluestone River drainage. Based on recent surveys, nonnative species with recent range expansions within the Bluestone River system are whitetail shiner *(Cyprinella galactura*), telescope shiner (*Notropis telescopus*), rainbow darter (*Etheostoma caeruleum*), and Roanoke darter (*Percina roanoka*). The Bluestone River drainage previously contained four of the eight New River endemic fish species, bigmouth chub (*Nocomis platyrhynchus*), New River shiner (*Notropis scabriceps*), candy darter (*Etheostoma osburni*), and Bluestone sculpin (*Cottus* spp.), but only bigmouth chub and Bluestone sculpin are documented from recent studies.

Evaluating changes in the status of fish species abundances and community composition (including range expansions and impacts on natives) requires long term monitoring. Data synthesized during this study serves as historic and baseline information for such monitoring and other future studies. Resource managers also can use these historic and recent fish data as a basis for making well-informed management decisions.

Acknowledgements

Field assistance from Angie Burns, Colin Carpenter, and Mike Everhart was greatly appreciated. We especially thank our curator colleagues (Charles Dardia, Cornell University Museum of Vertebrates; Doug Nelson, University of Michigan Museum of Zoology; and Jerry Finan, United States National Museum) for providing workspace and access to museum specimens. Walt Kordek provided fish collection data of the West Virginia Division of Natural Resources. Doug Chambers provided fish information from the National Water Quality Assessment Program. Reference to trade names does not imply government endorsement of commercial products.

Introduction

The diversity and distribution of fishes of the Bluestone River (a large tributary of the New River system) derived from historic processes and recent events within the New River drainage. Historic processes influenced the fish fauna of the New River system, partly through drainage changes during Pleistocene and post-Pleistocene periods (see review in Jenkins and Burkhead 1993). Recently, the New River system supports a high number of introduced (nonnative) fishes owing, in part, to bait-bucket introductions and the New River's depauperate native fish fauna and proximity to speciose river systems (Jenkins and Burkhead 1993). Additionally, water quality influences the fish fauna of the New River system (specifically the Bluestone River drainage; Wilson and Purvis 2000, 2003).

The New River System

The New River watershed (approximately 17,918 km^2) includes sections of the Blue Ridge, Valley and Ridge, and Appalachian Plateau provinces of North Carolina, Virginia and West Virginia, respectively (Stauffer et al. 1995). The New River flows northward 402 km to its confluence with the Gauley River to form the Kanawha River. The New River follows the course of the ancestral Teays River (Ver Steeg 1945, Janssen 1953), and its lower section forms a deep gorge with a maximum rim height of approximately 488 meters (Swift 2000). The New River watershed, surrounded by nine large river basins, includes four large reservoirs (Bluestone, Claytor, Hawks Nest, and Summersville) and contains the following three relative large watersheds in West Virginia; Bluestone (969 km^2), Gauley (3,682 km^2), and Greenbrier (4,289 km^2; Stauffer et al. 1995).

Studies of the Lower New River Fish Fauna

Early studies of the New River's fish fauna were by Cope (1868), Goldsborough and Clark (1908), Addair (1944), and Ross and Perkins (1959). Addair (1944) conducted an extensive survey in West Virginia waters of the New River. Early collections provided a basis for later surveys and distributional histories of the New River's fish fauna (Jenkins et al. 1972, Hocutt et al. 1978, Hocutt et al. 1979, Hess 1983, Lobb 1986, Neves 1983, Easton et al. 1993, Easton and Orth 1994, Jenkins and Burkhead 1993, Stauffer et al. 1995, Cincotta et al. 1999, Messinger and Hughes 2000, Paybins et al. 2000, Messinger and Chambers 2001, Wellman 2004, Welsh et al. 2004, and the West Virginia Division of Natural Resources (WVDNR, unpublished data).

Jenkins and Burkhead (1993) and Welsh et al. (2004) summarized the New River's fish fauna as low numbers of native species, a high number of endemic species, and a high number of nonnative species. The depauperate New River fish fauna has lower native species richness than neighboring drainages and the lowest native species-area relationship of the 26 eastern major river drainages (Cincotta et al. 1999). Only five large piscivorous fishes are native to the New River system: American eel (*Anguilla rostrata),* channel catfish *(Ictalurus punctatus),* flathead

catfish *(Pylodictis olivaris)*, brook trout *(Salvelinus fontinalis)*, and green sunfish (*Lepomis cyanellus*;Cope 1868). In contrast, the ratio of endemic to native species is the second highest, surpassed only by the Mobile drainage (Jenkins and Burkhead 1993). The New River drainage is endowed endemically with eight taxa (Jenkins and Burkhead 1993); bigmouth chub (*Nocomis platyrhynchus)*, Kanawha minnow *(Phenacobius teretulus)*, New River shiner *(Notropis scabriceps)*, the undescribed Bluestone (*Cottus* spp.) and albino cave (*Cottus* spp.) sculpins, Appalachia darter (*Percina gymnocephala)*, Kanawha darter *(Etheostoma kanawhae)*, and candy darter *(Etheostoma osburni*). Jenkins and Burkhead (1993) listed 89 fish species from the New River in Virginia waters, and 48% as nonnative (46 native, 42 nonnative, and the catadromous American eel). Welsh et al. (2004) reported additional nonnatives in West Virginia waters of the New River; gizzard shad (*Dorosoma cepedianum*), southern redbelly dace (*Phoxinus erythrogaster*), emerald shiner (*Notropis atherinoides*), blackside darter (*Percina maculata*), and variegate darter (*Etheostoma variatum*).

Influences on the Lower New River Fish Fauna

Richness and distributions of species in the New River drainage are undoubtedly influenced by drainage history, such as Pleistocene and post-Pleistocene influences and stream piracy (Jenkins and Burkhead 1993). Within and downstream of the New River Gorge, barriers to fish migration (e.g. Kanawha Falls, Sandstone Falls, and high gradient rapids and cascades) have hindered upstream dispersal, and have isolated species in the New River system (Neves 1983, McKeown et al. 1984, Jenkins and Burkhead 1993, Messinger and Chambers 2001). Although the New River is part of the Kanawha River system, zoogeographers recognize separate fish faunas above and below Kanawha Falls; New River endemism is attributed to the 7.3 m high Kanawha Falls (Hocutt et al. 1986, Jenkins and Burkhead 1993).

Pleistocene glaciers and post-pleistocene climatic warming influenced fish distributions in the New River (historically called the Teays River; Hocutt et al. 1978, Neves 1983, Hocutt et al. 1986). During the Pleistocene, a proglacial lake (Teays Lake) inundated a lower section of New River Gorge (including Kanawha Falls) and permitted fish dispersal into the New River drainage (Hocutt et al. 1986). Post-Pleistocene climatic warming elevated mainstem water temperatures and isolated cool water species to relic tributary populations. New River endemic fishes (except bigmouth chub) are cold-tolerant (Jenkins and Burkhead 1993). Stream piracy influenced species richness in the New River system (Neves 1983, Jenkins et al. 1972, Hocutt et al. 1986), and possibly allowed ingress of mountain redbelly dace (*Phoxinus oreas)*, bluehead chub (*Nocomis leptocephalus*), white shiner (*Luxilus albeolus*), margined madtom (*Noturus insignis*), *Rhinichthys* species, creek chub (*Semotilus atromaculatus*), mottled sculpin (*Cottus bairdi*), and fantail darter (*Etheostoma flabellare*; Jenkins and Burkhead 1993).

High numbers of nonnative fishes emanated from intentional and accidental fish introductions in the New River system (Easton et al. 1993, Jenkins and Burkhead 1993, Cincotta et al. 1999, Fuller et al. 1999). Areas with low species richness and high resource availability often allow success of introduced fishes (Hocutt and Hambrick 1973); low species richness characterizes the native fish fauna of the New River drainage. Currently, 12 centrarchids occur in the New River drainage, including the native green sunfish; 11 nonnatives are rock bass (*Ambloplites rupestris*), black crappie (*Pomoxis nigromaculatus*), white crappie (*Pomoxis annularis*), smallmouth bass (*Micropterus dolomieu*), spotted bass (*Micropterus punctulatus*), largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), longear sunfish (*Lepomis megalotis*), pumpkinseed (*Lepomis gibbosus*), redbreast sunfish (*Lepomis auritus*), and warmouth (*Lepomis gulosus*; Jenkins and Burkhead 1993). Additional nonnative piscivores include yellow bullhead (*Ameiurus natalis*), brown bullhead (*Ameiurus nebulosus*), black bullhead (*Ameiurus melas*), muskellunge (*Esox masquinongy*), rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), white bass (*Morone chrysops*), striped bass *(Morone saxatilis*), and walleye (*Sander vitreus*). Threadfin shad (*Dorosoma petenense*), gizzard shad, and emerald shiner were introduced into reservoirs (Easton and Orth 1994). The nonnative telescope shiner (*Notropis telescopus*) and whitetail shiner (*Cyprinella galactura*) have expanded ranges within the New River system (Cincotta et al. 1999, Welsh et al. 2004). Additionally, Welsh et al. (2004) documented range expansions of several nonnative darters within the New River system; Roanoke darter (*Percina roanoka*), rainbow darter *(Etheostoma caeruleum*), snubnose darter (*Etheostoma simoterum*), and variegate darter.

Influence of Water Quality on Fish Distributions of the Lower New River Drainage

Water chemistry and productivity influence fish distributions and success of introduced fishes. Water chemistry and productivity varies among Blue Ridge, Valley and Ridge, and Appalachian Plateau provinces of the New River basin due to geological differences (Jenkins and Burkhead 1993) and land uses (Paybins et al. 2000). Coal mining, domestic waste, logging, agriculture, industrial activities, urbanization, and oil/gas extraction have influenced water quality throughout the New River basin (Addair 1944, Messinger and Hughes 2000, Wilson and Purvis 2000, 2003). High fecal coliform counts within many tributaries of the New River system (including parts of the Bluestone River drainage) result from inadequate sewage treatment plants and untreated sewage inputs (Wilson and Purvis 2000, 2003). Sewage increases productivity and fish numbers (deBruyn et al. 2003), but nutrient overdose stresses aquatic systems causing fish anomalies and altered macroinvertebrate and fish community structures (EPA 2000). Introduced species are often successful in impaired streams (Herbold and Moyle 1986, Wait and Carpenter 2000). Range expansions of many species coincide with water quality improvement within the New River basin (Messinger and Chambers 2001); however, current distributions of native populations may be reduced by previous water quality.

Fish Fauna of the Bluestone River

Bluestone National Scenic River (BLUE), a unit of the National Park Service (NPS), lies at the downstream end of the Bluestone River, a large tributary of the New River drainage (Figure 1). An understanding of both fish distributions (temporally and spatially) and species composition (native versus nonnative) within BLUE provides essential input to NPS for making management decisions and guiding future inventory and monitoring efforts. Specifically, a synthesis of historic and current fish distribution data provides valuable baseline for long term monitoring programs, and allows for assessment of temporal changes in fish composition.

This study synthesizes fish distribution data from the Bluestone River drainage, West Virginia. Fish distribution data from Virginia waters of the Bluestone River watershed were compiled elsewhere by Jenkins and Burkhead (1993). Previous faunal surveys within the New River drainage (see citations above) provide some distributional data of fishes of the Bluestone River and BLUE, but most spanned large sections of the Bluestone River watershed and were not comprehensive within current BLUE boundaries.

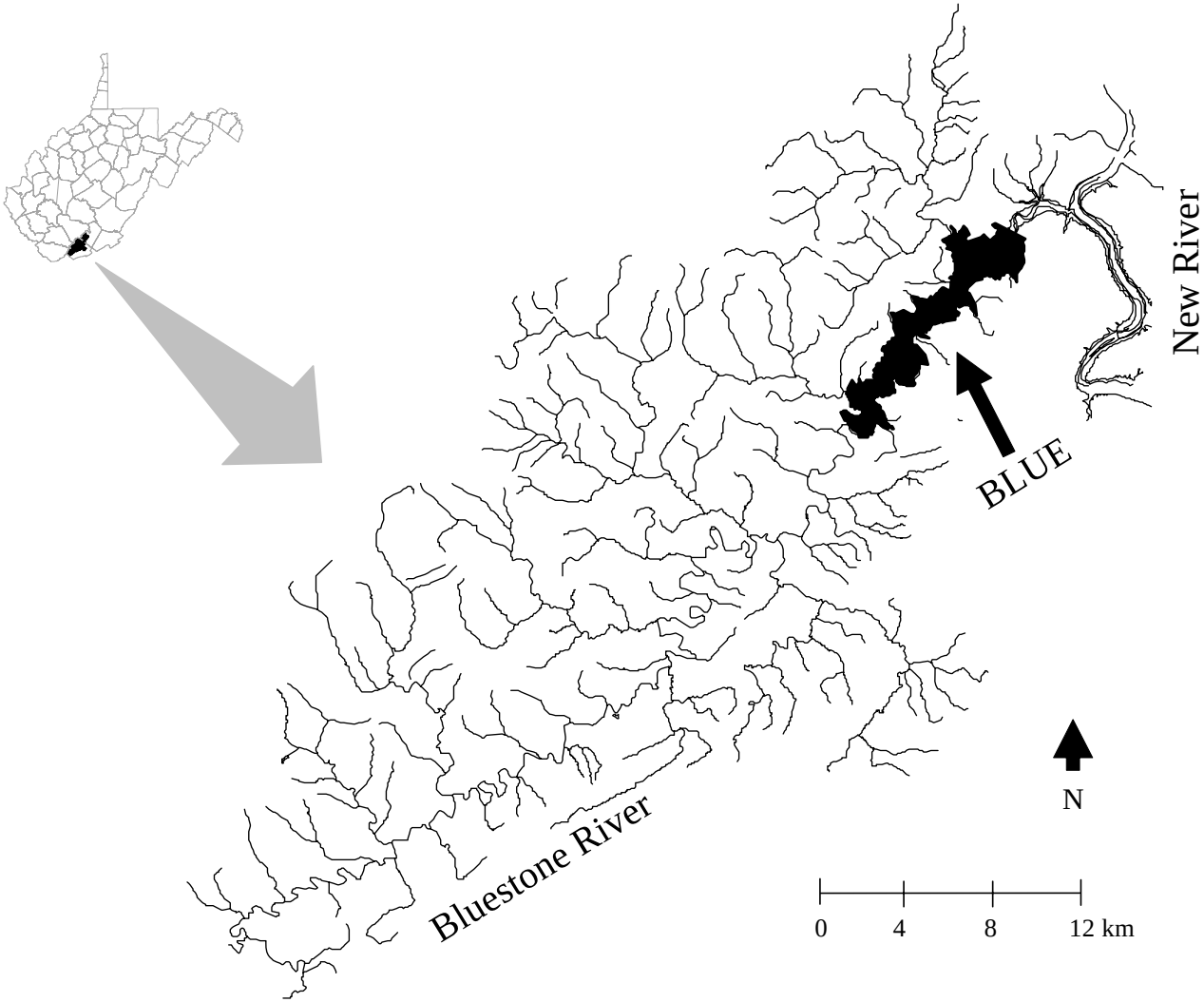

Figure 1. Bluestone River drainage and Bluestone National Scenic River (BLUE) in southern West Virginia.

Objectives

Study objectives were to (1) document the diversity of native and nonnative fish species within BLUE and the Bluestone River drainage via a synthesis of historic and recent fish distribution data, and (2) estimate fish species abundances and fish species richness within sections of BLUE. Evaluation of temporal and spatial changes in fish distributions and related issues with nonnative species (e.g. range expansions and impacts on natives) requires long term monitoring, and data collected during this study provides historic and baseline information for future long-term monitoring studies.

Methods

Description of Study Area

The Bluestone River (headwater tributaries Mud Fork, Wrights Valley, and the Bluestone mainstem) heads near Tiptop, VA, flows northeast, and confluences with the New River near Hinton, WV. Bluestone reservoir on the New River (built in 1952) inundates the lower reaches of the Bluestone River. Boundaries of BLUE encompass the lower reaches of the Bluestone River system, and include inundated sections of the upper Bluestone Reservoir during high flow conditions. Tributaries within BLUE mostly drain relatively small watersheds, except for the relatively large Little Bluestone River watershed. Water quality is degraded within sections of the Bluestone River watershed by inadequately treated human sewage (Wilson and Purvis 2000, 2003).

Synthesis of Historic and Recent Fish Distribution Data

Reviews of unpublished and published literature and museum searches and visits provided historic (1899-1984) and recent (1985-2003) data from surveys within BLUE and the Bluestone River watershed. We verified some Bluestone River fish records from museum data with visits to three museums (Cornell University Fish Museum, University of Michigan Museum of Zoology, and the Smithsonian – U.S. National Museum). We did not find Bluestone River records from fish holdings at the American Museum of Natural History or the North Carolina State Museum. Historic and recent fish distribution data of the Bluestone River watershed within West Virginia waters were entered into a Microsoft Access species inventory database. Jenkins and Burkhead (1993) synthesized fish distribution data from Bluestone River headwaters in Virginia, and these data were not duplicated in our report or the associated database. A data dictionary and the database were provided to the NPS electronically on CD-ROM.

Fish Distributions, Abundances, and Species Richness (2004-2005)

For collections in 2004 and 2005, fishes were vouchered by digital photograph and released at most study sites, but some were vouchered by formalin preservation. Data dictionaries, metadata, and photographs of species and sites are provided electronically on CD-ROM.

Recent distributional data and estimates of species abundances and species richness were obtained by sampling sites in the Bluestone River watershed within and outside of BLUE park boundaries during 2004 and 2005. Sites were selected from a stratified grid of BLUE, which allowed even coverage of the study area. However, sampling occurred primarily in the upper and lower reaches of BLUE owing to both limited access (including difficulty with long-distance transport of electrofishing gear) and drought (tributaries in the middle section of BLUE were dewatered during summer/fall sampling 2004). Based on site inspections, habitats within the middle section of BLUE were similar to upper and lower sections, so it is reasonable to assume a representative

sample of species composition from upper and lower sections. The sampling area within or adjacent to BLUE included all local habitat types (upper reaches of Bluestone Reservoir, Bluestone River mainstem, and medium to small tributaries); sampling areas within the upper reaches of Bluestone Reservoir were adjacent to the BLUE boundary.

Given differential difficulties in sampling streams of various sizes, our sampling methods differed among small, medium, and large stream sections (Thompson et al. 1998). Single or multi-passes with backpack electrofishers were used to sample smaller tributaries. Length of study sites on smaller tributaries equaled approximately 40 times the stream width with a minimum of 150 meters, and included all major habitat types (e.g., pool, riffle, run). Sites on larger tributaries were 150 meters and were sampled with single or double-pass methods. Sites on the Bluestone River mainstem were electrofished with a single pass using backpack, parallel wire, or boat electrofishers, depending on river flows and boat access. For each site and pass, fishes were identified and counted.

Analysis

Fish abundances and species richness were estimated from sampling sites within BLUE, and from the upper Bluestone Reservoir just downstream of the BLUE boundary. Fish abundances within stream sections of BLUE were indexed with raw count data from one or two passes with backpack or parallel wire electrofishing gear. Within upper Bluestone Reservoir, we boat-electrofished site transects (20 minute pedal time) with standard effort (i.e. power; Kolz et al. 1998) to obtain an index of fish abundance (Catch-per-unit effort, CPUE; Thompson et al. 1998). Site transects within the reservoir were selected systematically along shoreline and mid-channel habitats of four sampling areas.

Species richness of BLUE and the Bluestone River drainage were estimated for historic and recent periods from presence-absence data (Program SPECRICH2; Rexstad and Burnham 1991) following jackknife methods of Burnham and Overton (1979) as summarized by Williams et al. (2002). For this approach, a heterogeneity model (m_h) allowed different detection probabilities among species (i.e., no assumption that all species are detected). An objective for the Inventory and Monitoring Program of the National Park Service is to document at least 90% of the species found within park boundaries. This estimate is difficult given dependence on an unknown number (i.e., the total number of species present). If one uses species richness estimates to approximate the total number of species present (based on historic or recent information), then one can estimate the percentage of species captured to the approximated “true” number of fish species present. These ratios are biased, in part, by species extirpations or species introductions with historic data and by species non-detection with historic and recent data. Further, this approach with either historic or recent data does not account for changes in species composition, but is useful as a comparative measure of species richness.

Results

We compiled diversity and distribution data of native and nonnative fishes from 99 fish collections (1899 to 2005) within the Bluestone River drainage, West Virginia (Table 1, Figure 2). The 99 collections documented a total of 57 fish species (26 native and 31 nonnative) within the Bluestone River drainage and 45 fish species (20 native and 25 nonnative) within BLUE boundaries including upper reservoir sites adjacent to the BLUE boundary (Table 2, Appendix A). The diversity and distribution data were categorized into three time periods (Historic, pre-1985 and two recent periods, 1985-2003 and this study, 2004-2005; Table 2). Sixty-nine sample sites (outside of BLUE) within the Bluestone River drainage, West Virginia, included 46 historic sites (41 species), 19 sites during 1985-2003 (31 species), and 4 sites (23 species) during 2004-2005 (Table 1). Samples within BLUE (30 sites) included five historic sites (24 species), one site in 1996 (14 species), and 24 sites (40 species) during 2004-2005 (Table 1); hence, historic collection sites within BLUE were sparse. Jenkins and Burkhead (1993) reported 17 species from the upper Bluestone River drainage, Virginia; these 17 species were also documented in historic or recent records from West Virginia sections of the Bluestone River drainage.

Table 1. Synthesis of fish distribution studies (1899-2005) within the Bluestone River drainage, West Virginia (* indicates site was within current Bluestone National Scenic River, BLUE, boundaries, site numbers 89-99 were adjacent to the downstream BLUE boundary; ** indicates exact date unavailable; *** indicates coordinates unavailable).

Site	Date	Biologist	Stream	Study Location	UTM East	UTM North	Data Source[a]
1	1899**	W. Hay	Bluestone R.	Bluestone R. (above mouth) WV	507188	4162498	USNM
2	1899**	W. Hay	Bluestone R.	Bluestone R. at mouth of Delashmeet Creek, WV	485364	4139381	USNM
3	1899**	W. Hay	Bluestone R.	Bluestone R., Abbs Valley, WV	473107	4128315	USNM
4	1899**	W. Hay	Bluestone R.	Pools below dam at Lilley's Mill, Spanishburg, WV	490791	4143672	USNM
5	1899**	W. Hay	Brush Cr.	Brush Cr., Near Princeton, WV.	494320	4146220	USNM
6	1899**	W. Hay	Delashmeet Cr.	Delashmeet Cr., Kegley, WV.	485338	4139598	USNM
7	9/11/1928	CL & LC Hubbs	Bluestone R.	Bluestone R. along hwy N of Princeton	490250	4142725	UMMZ
8	9/11/1928	CL & LC Hubbs	Camp Cr.	Camp Cr. at Camp Cr. P.O.	490983	414927	UMMZ
9	7/22/1931	AH Wright	Bluestone R.	Bluestone R.	***	***	CU Museum
10	7/24/1931	AH Wright	Laurel Cr.	Laurel Cr. Near Athens, WV	497414	4141680	CU Museum
11	7/22/1931	AH Wright	Shawnee Cr.	Shawnee Lake, dev. By Virginia Hotel of Princeton	487421	4139655	CU Museum
12	7/22/1931	AH Wright	Wolf Cr.	Wolf Creek	490741	4146847	CU Museum
13	7/10/1933	J. Addair	Brushy Cr.	Gardner, WV	493554	4141916	Addair (1944)
14	7/10/1933	J. Addair	Camp Cr.	Camp Cr., tributary of Bluestone R., 3 mi above mouth	489809	4150566	Addair (1944)
15	7/9/1933	J. Addair	Widemouth Cr.	Widemouth Cr.	479585	4138407	Addair (1944)
16	7/17/1935	J. Addair	Pipestem Cr.	Pipestem Cr.	507526	4159925	Addair (1944)

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Site	Date	Biologist	Stream	Study Location	UTM East	UTM North	Data Source[a]
17	8/16/1959	E. Kinney	Camp Cr.	Rte 21 to junction of Bear Cr. – 6.0 mi upstream from mouth	488380	4152740	WVDCR data
18	10/10/1960	E. Kinney	Camp Cr.	4.3 mi upstream from mouth – Near mouth of Farley Branch	488120	4150740	WVDCR data
19	6/13/1962	WVDNR	Bear Cr.	1.0 mi upstream from mouth – Camp Cr. State Forest	487240	4153920	WVDCR data
20	10/23/1963	R. Preston	Bluestone R.	27.0 mi upstream from mouth – 2 mi above Spanishburg, WV	490920	4144640	WVDCR data
21	8/7/1963	R. Preston	Bluestone R.	18.0 mi upstream from mouth – near Turnpike Bridge	493500	4147880	WVDCR data
22	10/23/1963	R. Preston	Brush Cr.	1.0 mi upstream from mouth	494320	4146220	WVDCR data
23	5/28/1964	F. Schwartz	Bluestone R.	0.7 mi NW Bramwell on Rte 20	471197	4130736	Schwartz field notes
24	8/11/1966	R. Sumner	Brush Cr.	8.5 mi upsterm from mouth – 4.0 mi N of Princeton, WV	493440	4141640	WVDCR data
25	5/1/1968	J. Reed	Laurel Cr.	2.5 mi upsterm from mouth	499580	4143100	WVDCR data
26	8/26/1968	R. Sumner	Bluestone R.	68.0 mi upsterm from mouth, 1 mi above Bluefield VA	473030	4126890	WVDCR data
27	8/26/1968	R. Sumner	Bluestone R.	65.5 mi upstream from mouth, 0.5 mi above United Piece and Dye Works	473030	4126890	WVDCR data
28	8/26/1968	R. Sumner	Bluestone R.	62.0 mi upstream from mouth, 3 m. below United Piece and Dye Works	473030	4126890	WVDCR data

Table 1. Synthesis of fish distribution studies (1899-2005) within the Bluestone River drainage, West Virginia (* indicates site was within current Bluestone National Scenic River, BLUE, boundaries, site numbers 89-99 were adjacent to the downstream BLUE boundary; ** indicates exact date unavailable; *** indicates coordinates unavailable) (continued).

Site	Date	Biologist	Stream	Study Location	UTM East	UTM North	Data Source[a]
29	8/26/1968	WVDNR	Bluestone R.	51.5 mi upstream from mouth – Montcalm, WV	487240	4134100	WVDCR data
30	8/18/1969	H. Beall	L. Bluestone R.	3.0 mi upstream from mouth	501060	4162840	WVDCR data
31	10/11/1972	J. Reed	L. Bluestone R.	Upstream of confluence of Spice Cr., 6.5 mi upstream from mouth	500420	4163700	WVDCNR
32	9/28/1973	J. Reed	Camp Cr.	0.25 mi upstream from Bear Cr. – 5.75 mi. from mouth	488740	4152780	WVDCNR
33	10/7/1976	J. Reed	Brush Cr.	County Rte 3 bridge – 1.2 mi. above mouth	494320	4146220	WVDCNR
34*	9/5/1978	WVDNR	Mountain Cr.	0.25 mi above mouth (confluence with Bluestone R.)	497860	4154040	WVDCNR
35*	6/7/1979	Denoncourt, Hocutt, Stauffer	Bluestone R.	Below mouth of Mountain Cr. at end of County Rte 4	498287	4153921	Stauffer field notes
36	6/3/1979	Denoncourt, Hocutt, Stauffer	Bluestone R.	Along Rte 10/7, 3.2 road mi from Rte 71 downstream Rock, WV	483150	4137194	Stauffer field notes
37	8/24/1979	Denoncourt, Hocutt, Stauffer	Bluestone R.	Midway between both US 19 bridges, , Spanishburg WV at island	490362	4143264	Stauffer field notes
38*	8/24/1979	Denoncourt, Hocutt, Stauffer	Bluestone R.	At confluence with L. Bluestone R.	502610	4159360	Stauffer field notes
39	6/7/1979	Denoncourt, Hocutt, Stauffer	Camp Cr.	At US Rte 19 bridge	490951	4149259	Stauffer field notes
40*	8/24/1979	Denoncourt, Hocutt, Stauffer	L. Bluestone R.	At mouth, upstream 0.25 road mi	502494	4160500	Stauffer field notes

Table 1. Synthesis of fish distribution studies (1899-2005) within the Bluestone River drainage, West Virginia (* indicates site was within current Bluestone National Scenic River, BLUE, boundaries, site numbers 89-99 were adjacent to the downstream BLUE boundary; ** indicates exact date unavailable; *** indicates coordinates unavailable) (continued).

Site	Date	Biologist	Stream	Study Location	UTM East	UTM North	Data Source[a]
41	6/7/1979	Denoncourt, Hocutt, Stauffer	L. Bluestone R.	County Rte 25/3 bridge at Streeter WV	498350	4164261	Stauffer field notes
42	6/7/1979	Denoncourt, Hocutt, Stauffer	Mountain Cr.	County Rte 2 bridge, Dunns, WV	495251	4154969	Stauffer field notes
43	6/3/1979	Denoncourt, Hocutt, Stauffer	Pipestem Cr.	0.75 mi road mi. above mouth below falls	507514	4160283	Stauffer field notes
44	6/3/1979	Denoncourt, Hocutt, Stauffer	Pipestem Cr.	At mouth of unnamed tributary along Rte 20 site 3 pump station	506097	4164408	Stauffer field notes
45	7/17/1979	J. Reed	Camp Cr.	2.0 mi above mouth – at mouth of Bear Cr.	488380	4152740	CU Museum, WVDNR
46	7/17/1979	J. Reed	Marsh Cr.	1,0 mi above mouth – 0.5 mi below Mask Fork Falls	486840	4150480	CU Museum, WVDNR
47*	7/17/1979	J. Reed	Mountain Cr.	0.25 mi above mouth at confluence with Bluestone R.	497860	4154040	CU Museum, WVDNR
48	5/22/1982	J. Reed	Camp Cr.	Mill Branch upstream500 ft – 9.0 mi	486660	4156780	CU Museum, WVDNR
49	5/21/1982	J. Reed	L. Bluestone R.	Streeter bridge – 6.0 mi upstream from mouth	498840	4164220	CU Museum, WVDNR
50	8/17/1983	J. Reed	Bluestone R.	Spanishburg – 28 mi above mouth	490800	4143700	WVDCNR
51	8/16/1984	J. Reed	Laurel Cr.	Rte 20 bridge near Athens – 2.5 mi above mouth	499580	4143100	WVDCNR

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Site	Date	Biologist	Stream	Study Location	UTM East	UTM North	Data Source[a]
52	7/23/1985	Denoncourt, Hocutt, Stauffer	Bluestone R.	Rte 20/9 bridge just off Rte 20 Bramwell, WV	471235	4130632	J. Boltz field notes
53	8/14/1985	J. Reed	Camp Cr.	0.5 mi upstream from mouth of Bear Cr., 6 mi above mouth	488920	4153000	WVDCNR
54	10/1/1993	J. Reed	Bluestone R.	Spanishburg WV	490720	4143680	WVDCNR
55	11/5/1993	J. Reed	Mountain Cr.	1 mi upstream of Dunns	494500	4155000	WVDCNR
56	4/19/1996	Cincotta, Welsh, Oldham	Bluestone R.	Near WV/VA line access by train yard along RR grade	470824	4129028	Welsh field notes
57	8/23/1996	Cincotta, Welsh, Oldham	Bluestone R.	Near Flipping, WV	476512	4133024	Welsh field notes
58	4/19/1996	Cincotta, Welsh, Oldham	Brush Fork	Near Bluewell (Rte 23) 2 mi SE of Bluewell	477817	4127185	Welsh field notes
59	4/19/1996	Cincotta, Welsh, Oldham	Laurel Fork	At WV/VA line Rte 102 near Pocahontas, VA	470481	4129336	Welsh field notes
60*	4/19/1996	Cincotta, Welsh, Oldham	L. Bluestone R.	0.25 mi above the mouth	502500	4159800	WVDCNR
61	4/19/1996	Cincotta, Welsh, Oldham	Simmons Cr.	Rte 52 0.5 mi N Bramwell, WV	472092	4132629	Welsh Field Notes
62	7/17/1996	WVDNR	Cane Cr.	3.25 mi above mouth, 0.5 below McComas intersection	474700	4137300	WVDNR
63	8/7/1997	D. Chambers	Bluestone R.	1.4 mi upstream of Rich Cr., near Spanishburg, WV	490170	4142748	NAWQA

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Site	Date	Biologist	Stream	Study Location	UTM East	UTM North	Data Source[a]
64	9/24/1998	D. Chambers	L. Bluestone R.	Hwy 27 bridge near Jumping Branch, WV	501152	4162095	NAWQA
65	8/21/1998	T. Oldham, D. Phares	L. Bluestone R.	300 yds downstream of first crossing, 5.4 mi above mouth	499300	4164400	WVDNR
66	8/21/1998	T. Oldham, D. Phares	L. Bluestone R.	Station 2, 300yds upstream of swimming hole, 5.8 mi above mouth	498800	4164300	WVDNR
67	7/29/1999	WVDNR, D. Cincotta	Bluestone R.	0.25 mi downstream of WV/VA state line, in RR yard	472898	4126967	D. Cincotta
68	7/28/1999	WVDNR, D. Cincotta	Camp Cr.	US Rte 19 bridge	491052	4149275	D. Cincotta
69	7/29/1999	WVDNR, D. Cincotta	Tributary of Bluestone R.	WV/VA state line adjacent to Bowen baseball field	478174	4122159	D. Cincotta
70	7/29/1999	WVDNR, D. Cincotta	Tributary of Bluestone R.	Source from cave on Beaver Pond Mountain near dead end, South view	479174	4121449	D. Cincotta
71	6/25/2003	WVDNR, D. Cincotta	Bluestone R.	Near Camp Creek – I 77 bridge	493598	4147830	D. Cincotta
72*	8/28/2004	This Study	Bluestone R.	Upstream of mouth of Mountain Cr. confluence	498485	4153716	Welsh Field Notes
73*	8/28/2004	This Study	Bluestone R.	150 m upstream of Mountain Cr. mouth	498336	4153858	Welsh Field Notes
74*	8/29/2004	This Study	Bluestone R.	At mouth of Tony Hollow Run	502236	4158772	Welsh Field Notes
75*	8/29/2004	This Study	Bluestone R.	Downstream of mouth of L. Bluestone R.	504499	4160922	Welsh Field Notes
76*	9/1/2004	This Study	Bluestone R.	0.25 mi below Pipestem R. Lodge	499155	4155015	D. Cincotta
77	10/26/2004	This Study	Bluestone R.	Town of Rock near Montcalm	478835	4134971	D. Cincotta
78*	9/1/2004	This Study	Bluestone R.	At mouth of Mountain Cr.	498298	4153947	D. Cincotta

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Site	Date	Biologist	Stream	Study Location	UTM East	UTM North	Data Source[a]
79*	9/2/2004	This Study	Bluestone R.	At mouth of L. Bluestone R.	502585	4159620	D. Cincotta
80	8/31/2004	This Study	Bluestone R.	Nemours, WV	473218	4128237	D. Cincotta
81	10/26/2004	This Study	Brush Cr.	Just N of Bluefield and NE of Brush Fork off County Road 23	479875	4128516	D. Cincotta
82*	9/2/2004	This Study	L. Bluestone R.	At mouth	502606	4159406	Welsh Field Notes
83*	8/28/2004	This Study	L. Bluestone R.	Upstream of mouth	502524	4160096	Welsh Field Notes
84*	8/4/2004	This Study	Mountain Cr.	240 m above mouth	498191	4153937	Welsh Field Notes
85*	8/29/2004	This Study	Tony Hollow Run	250 m above mouth	502442	4158435	Welsh Field Notes
86*	8/28/2004	This Study	Tributary of Bluestone R.	At mouth of unnamed tributary, upstream of mouth of Mountain Cr.	498656	4153394	Welsh Field Notes
87*	8/29/2004	This Study	Tributary of Bluestone R.	Upstream of mouth of L. Bluestone R.	502228	4159196	Welsh Field Notes
88	9/1/2004	This Study	Widemouth Cr.	Right hand side of Browning School Rd	479513	4136608	D. Cincotta
89	4/21/2005	This Study	Bluestone R.	Lake headwaters, 200 m downstream of 1st riffle (left ascending bank)	505037	4162026	Welsh Field Notes
90	4/21/2005	This Study	Bluestone R.	Lake headwaters, 200 m downstream of 1st riffle (mid river transect)	505007	4162015	Welsh Field Notes
91	4/21/2005	This Study	Bluestone R.	Lake headwaters, 200 m downstream of 1st riffle (right ascending bank)	504957	4162011	Welsh Field Notes
92	4/21/2005	This Study	Bluestone R.	Lake headwaters, 300 m downstream of 1st riffle (left descending bank)	505007	4162198	Welsh Field Notes

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Site	Date	Biologist	Stream	Study Location	UTM East	UTM North	Data Source[a]
93	4/21/2005	This Study	Bluestone R.	Lake headwaters, 300 m downstream of 1st riffle (mid river transect)	504980	4162206	Welsh Field Notes
94	4/21/2005	This Study	Bluestone R.	Lake headwaters, 300 m downstream of 1st riffle (right ascending bank)	504961	4162206	Welsh Field Notes
95	4/22/2005	This Study	Bluestone R.	Lake headwaters, lower end of campground (left ascending bank)	505844	4162371	Welsh Field Notes
96	4/22/2005	This Study	Bluestone R.	Lake headwaters, lower end of campground (mid river transect)	505779	4162383	Welsh Field Notes
97	4/22/2005	This Study	Bluestone R.	Lake headwaters, lower end of campground (left descending bank)	505730	4162402	Welsh Field Notes
98	4/22/2005	This Study	Bluestone R.	Lake headwaters, upper end of campground (left descending bank)	505201	4162352	Welsh Field Notes
99	4/22/2005	This Study	Bluestone R.	Lake headwaters, upper end of campground (left ascending bank)	505197	4162317	Welsh Field Notes

[a] USNM = United States National Museum, UMMZ = University of Michigan Museum of Zoology, CU = Cornell University, WVDCR = West Virginia Division of Natural Resource, NAWQA = National Water Quality Assessment Program.

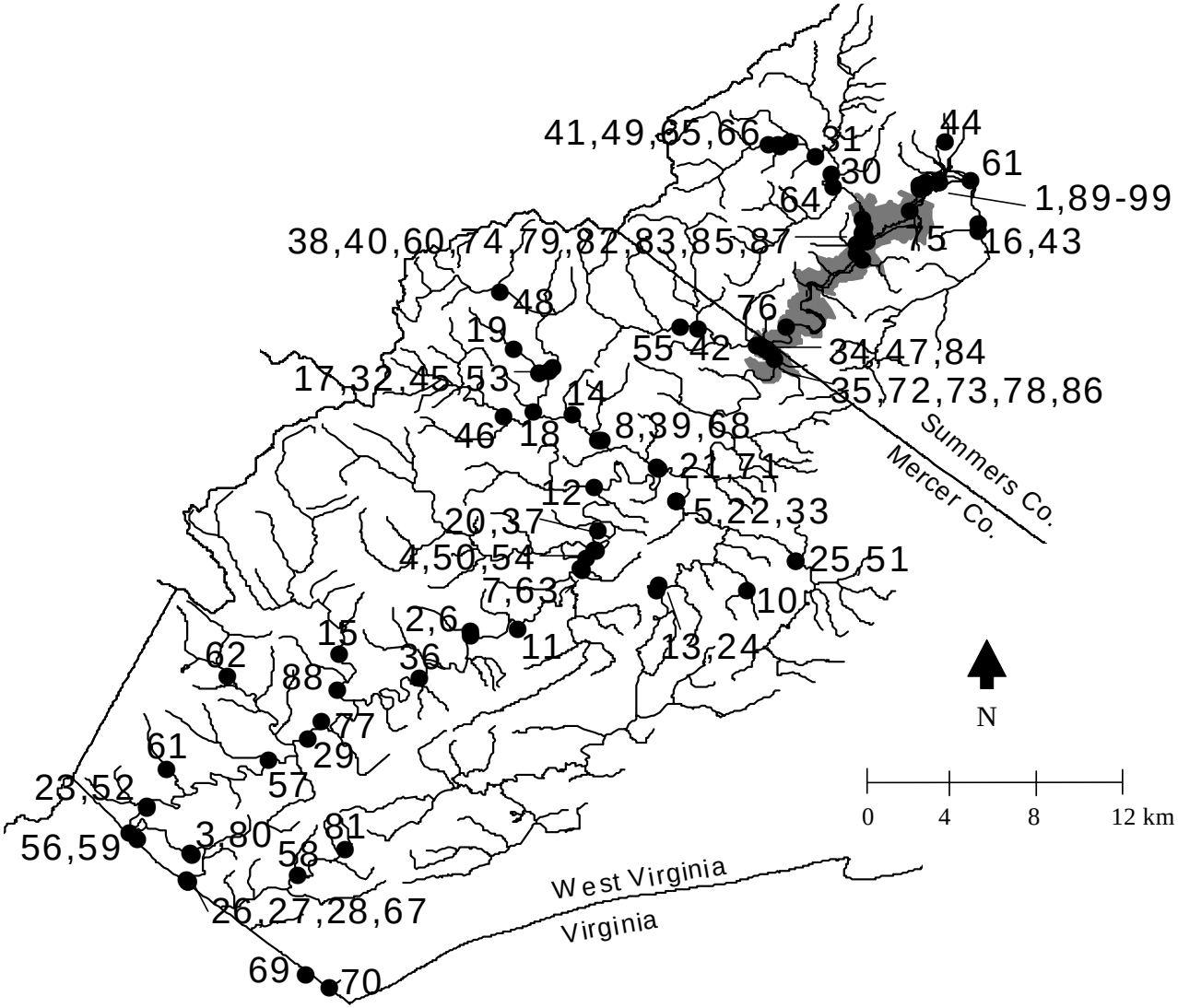

Figure 2. Synthesis of fish sampling locations (1899 – 2005) in the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.

Table 2. Historic (H, 1899-1984) and recent (R, 1985-2005) fish distribution data from the Bluestone River drainage, West Virginia. Recent data include species reported from other studies (R_1, 1984-2003) and this study (R_2, 2004-2005). Species origins are categorized as follows; N=native, I=introduced. Site number corresponds to Table 1.

Common Name	Scientific Name	Origin	H	R_1	R_2	Sites
Gizzard shad	*Dorosoma cepedianum*	I			X	89–99
Muskellunge	*Esox masquinongy*	I	X	X		50,63
Central stoneroller	*Campostoma anomalum*	N	X	X	X	2,8,14,16,20-22,25,26,29,33,35-43,45-47,49,52,56,57,59-61, 63,64.67-69,71,72,74-80,82-84,86-88
Rosyside dace	*Clinostomus funduloides*	N			X	80,81,84-87
Common Carp	*Cyprinus carpio*	I	X		X	24,50,89,90,92,94,95,98,99
Whitetail shiner	*Cyprinella galactura*	I		X	X	60,61,63,68,71,74-76,78,79,82-84
Spotfin shiner	*Cyprinella spiloptera*	N	X	X	X	1,3,7,9,20,60,72,75,76,78,79,82-84,86,92,94,95,97
Silverjaw minnow	*Ericymba buccata*	N	X			7
Tonguetied minnow	*Exoglossum laurae*	N	X	X		3,8
White shiner	*Luxilus albeolus*	N	X	X	X	35-37,39,60,68,71,76,78,79,83,84,88,95,96
Striped shiner	*Luxilus chrysocephalus*	I	X	X	X	20,21,33,47,52,59,61,67,80
Bigmouth chub	*Nocomis platyrhynchus*	N	X	X	X	3,7,8,21,35-38,47,59,63,68,71,72,74-79,82-84,86
Golden shiner	*Notemigonus crysoleucas*	I			X	95
Emerald shiner	*Notropis atherinoides*	I			X	91,95,97
Spottail shiner	*Notropis hudsonius*	I	X		X	42,74,75,76,78,79,82,91,92,94
Silver shiner	*Notropis photogenis*	N	X			20
Rosyface shiner	*Notropis rubellus*	I	X	X	X	3,7,8,35-37,46,52,79
New River shiner	*Notropis scabriceps*	N	X			8,39
Sand shiner	*Notropis stramineus*	N	X			14,20,25,36

Table 2. Historic (H, 1899-1984) and recent (R, 1985-2005) fish distribution data from the Bluestone River drainage, West Virginia. Recent data include species reported from other studies (R_1, 1984-2003) and this study (R_2, 2004-2005). Species origins are categorized as follows; N=native, I=introduced. Site number corresponds to Table 1 (continued).

Common Name	Scientific Name	Origin	H	R_1	R_2	Sites
Telescope shiner	*Notropis telescopus*	I	X	X	X	36,40,57,59-61,63,68,71,74-79,83,84,88
Mimic shiner	*Notropis volucellus*	N	X		X	7,36,37,39,75
Moutain redbelly dace	*Phoxinus oreas*	N		X	X	64,85,87
Bluntnose minnow	*Pimephales notatus*	I	X	X	X	2,3,6-8,20,22,26,29,36,38-40,46,51,52,57,58,60,63,67,68, 74,75,80,82,84,89,91,92,94,97
Fathead minnow	*Pimephales promelas*	I	X			44
Western blacknose dace	*Rhinichthys obtusus*	N	X	X	X	2,5,6,10,12,14,22,25,26,32,33,41-46,48,49,51-53,55,56,59, 61,62,64-67, 70,80,84-88
Longnose dace	*Rhinichthys cataractae*	N	X	X	X	36,38,40,52,68,72,75,76,78,79,83,84,88
Creek chub	*Semotilus atromaculatus*	N	X	X	X	6,8,12,14,16,20,22,25-29,32,33,38,39,41-47,49,51,53,55,58,59,61,63-67,69,78-81,84-88
White sucker	*Catostomus commersoni*	N	X	X	X	2,3,5,6,8,22,25,26,28,32,33,39,40,42,43,46,51,55,56,58, 62-65,67,69,80-82,87,88
Northern hogsucker	*Hypentelium nigricans*	N	X	X	X	3,7-9,14,20,21,29,35-40,46,47,52,60,63,67,68,71,75,77-80, 82,84,88
Yellow bullhead	*Ameiurus natalis*	I	X		X	40,75
Channel catfish	*Ictalurus punctatus*	N	X	X		1,40
Flathead catfish	*Pylodictis olivaris*	N			X	76
Margined madtom	*Noturus insignis*	I			X	74,75,79,82
Rainbow trout	*Oncorhynchus mykiss*	I	X	X	X	45,52,62,88
Brook trout	*Salvelinus fontinalis*	N	X			48

Table 2. Historic (H, 1899-1984) and recent (R, 1985-2005) fish distribution data from the Bluestone River drainage, West Virginia. Recent data include species reported from other studies (R_1, 1984-2003) and this study (R_2, 2004-2005). Species origins are categorized as follows; N=native, I=introduced. Site number corresponds to Table 1 (continued).

Common Name	Scientific Name	Origin	H	R_1	R_2	Sites
Brown trout	*Salmo trutta*	I	X	X		34,48,49,51,53,55,62,65,66
Brook silverside	*Labidesthes sicculus*	I			X	92,94
Bluestone sculpin	*Cottus* Bluestone form	N		X		56,67,69,70
Rock bass	*Ambloplites rupestris*	I	X	X	X	12,20,21,26,29,35-40,47,50,52,60,63,67,68,71,72,74,76-79, 82-84,88,89,92-95
White crappie	*Poxomis annularis*	I	X		X	50,95,97
Black crappie	*Poxomis nigromaculatus*	I			X	91,92,95,97
Redbreast sunfish	*Lepomis auritus*	I	X	X	X	36,37,52,56,57,63,74,79,80,82,88-92,94,98
Green sunfish	*Lepomis cyanellus*	N	X	X	X	2,10-12,22,25,36,52,63,68,81,82,85-89,95
Pumpkinseed	*Lepomis gibbosus*	I	X	X	X	40,52,56,94,95,97,98
Bluegill	*Lepomis macrochirus*	I	X	X	X	24,26,40,50-52,60,81,89,91,92,94,95,97-99
Longear sunfish	*Lepomis megalotis*	I	X	X		37,52
Smallmouth bass	*Micropterus dolomieu*	I	X	X	X	1,4,7,11,14,20,21,29,35-40,52,60,63,68,71,72,75-79,83,84, 88,89,91,94,98
Spotted bass	*Micropterus punctulatus*	I	X	X	X	11,20,29,37,50,52,60,63,79,91,92,94,95
Largemouth bass	*Micropterus salmoides*	I	X	X	X	25,26,51,56,63,79-81,89,92,94,95,98
Greenside darter	*Etheostoma blennioides*	N	X	X	X	14,20,21,35-40,52,57,60,63,68,71,72,74,76-79,82,83
Rainbow darter	*Etheostoma caeruleum*	I	X	X	X	40,43,60,72,74-79,82-84,88
Fantail darter	*Etheostoma flabellare*	N	X	X	X	8,10,14,25,32,35,38-46,48,49,51,60,64,65,68,78,81-84
Candy darter	*Etheostoma osburni*	N	X			14,38,40

Table 2. Historic (H, 1899-1984) and recent (R, 1985-2005) fish distribution data from the Bluestone River drainage, West Virginia. Recent data include species reported from other studies (R_1, 1984-2003) and this study (R_2, 2004-2005). Species origins are categorized as follows; N=native, I=introduced. Site number corresponds to Table 1 (continued).

Common Name	Scientific Name	Origin	H	R_1	R_2	Sites
Snubnose darter	*Etheostoma simoterum*	I		X	X	67,77,80
Logperch	*Percina caprodes*	N			X	73,75,76,79,82,91
Sharpnose darter	*Percina oxyrhynchus*	N	X			21,38
Roanoke darter	*Percina roanoka*	I	X	X	X	38,40,71,72,74-76,78,79,82

Synthesis of Distribution Data

Historic data of Bluestone River fish distributions were obtained from published and unpublished literature, and museum records. The earliest data for the Bluestone drainage was reported by Goldsborough and Clark (1908) and collected by W. Hay in 1899 (Table 1, Figure 3). Carl and Laura Hubbs collected fishes from two sites within the Bluestone drainage, West Virginia, in 1928 (Table 1, Figure 4). Addair (1944) extensively surveyed the New River drainage, West Virginia, from 1933 – 1935 including 8 sites within the Bluestone River drainage (Table 1, Figure 4). Additionally, four collections were conducted by A.H. Wright during the 1930s (Table 1, Figure 4). Additional surveys between 1959 and 1984 were conducted by F. Schwartz (unpublished data), WVDNR (unpublished data), and R. Denoncourt, C. Hocutt, and J.R. Stauffer (Stauffer et al. 1995; Table 1, Figure 5). A total of 76 records (all before 1985) was obtained from Cornell University (CU), the United States National Museum (Smithsonian, USNM), and the University of Michigan Museum of Zoology (UMMZ; Table 3). The WVDNR (unpublished data) and D. Chambers (Messinger and Chambers 2001) collected distribution data from 1985 to 2003 (Table 1, Figure 6). Our recent records (2004-2005) are primarily from within or adjacent to BLUE boundaries (Table 1, Figure 7).

Total numbers of fish species fluctuated among the three sampling time periods, but were similar between historic data and our collections (N = 44 for historic data 1899-1984; N= 35 for recent data 1985-2003; N = 43 for our data in 2004-2005; Table 2). Species composition, however, differed among sampling periods. We collected nine species during 2004-2005 that were absent or not detected from previous studies; gizzard shad, rosyside dace (*Clinostomus funduloides*), golden shiner (*Notemigonus crysoleucas*), emerald shiner, flathead catfish, margined madtom (*Noturus insignis*), brook silverside (*Labidesthes sicculus*), black crappie, and logperch (*Percina caprodes*). Fourteen species reported from previous studies (1899-1984) were not collected in our recent study (2004-2005); muskellunge, silverjaw minnow (*Ericymba buccata*), tonguetied minnow (*Exoglossum laurae*), silver shiner (*Notropis photogenis*), New River shiner, sand shiner (*Notropis stramineus*), fathead minnow (*Pimephales promelas*), channel catfish, brook trout, brown trout, Bluestone sculpin, longear sunfish, candy darter, and sharpnose darter (*Percina oxyrhynchus*).

Abundance data were recorded in 2004 and 2005 from one and two-pass samples at 28 sites, including catch-per-unit-effort (CPUE) estimates at 11 sites (Table 4 and 5). From data pooled across sites, natives with highest abundances were stoneroller (N=975), bigmouth chub (N=410), and creek chub (N=138); nonnatives with highest abundances were gizzard shad (N=110), spotfin shiner (*Cyprinella spiloptera*, N=245), telescope shiner (N=106), rainbow darter (N =355), and Roanoke darter (N=115). Catch-per-unit-effort (CPUE) was documented for species in the lower Bluestone River from inundated sections within the headwaters of Bluestone Reservoir (Table 5). Highest abundances for most reservoir species were documented from near-thalweg shoreline habitat. Low species diversity within the reservoir section occurred in the shallow, heavily-silted

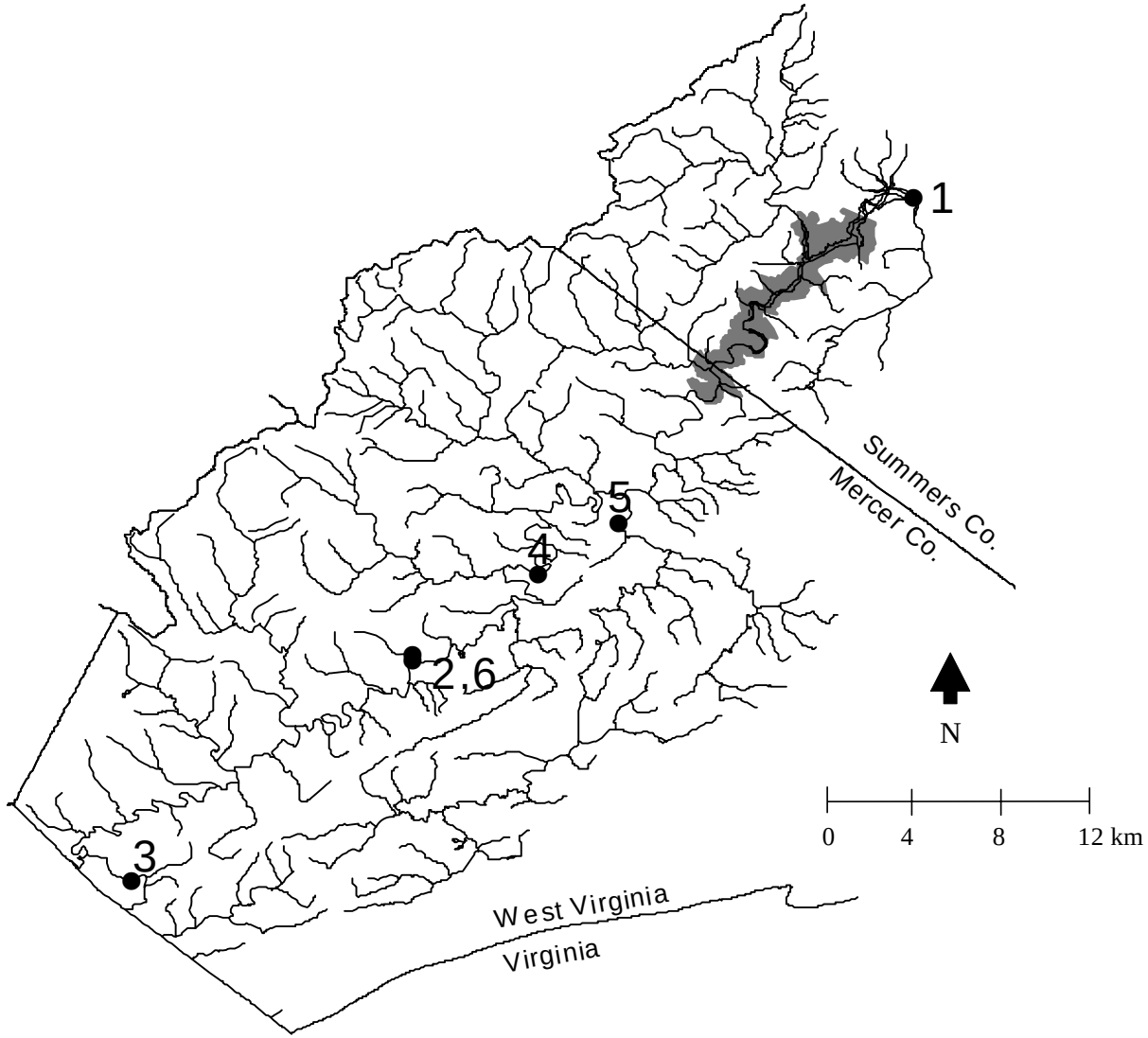

Figure 3. Fish sampling locations in the lower Bluestone River drainage, West Virginia, by W. Hay in 1899. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.

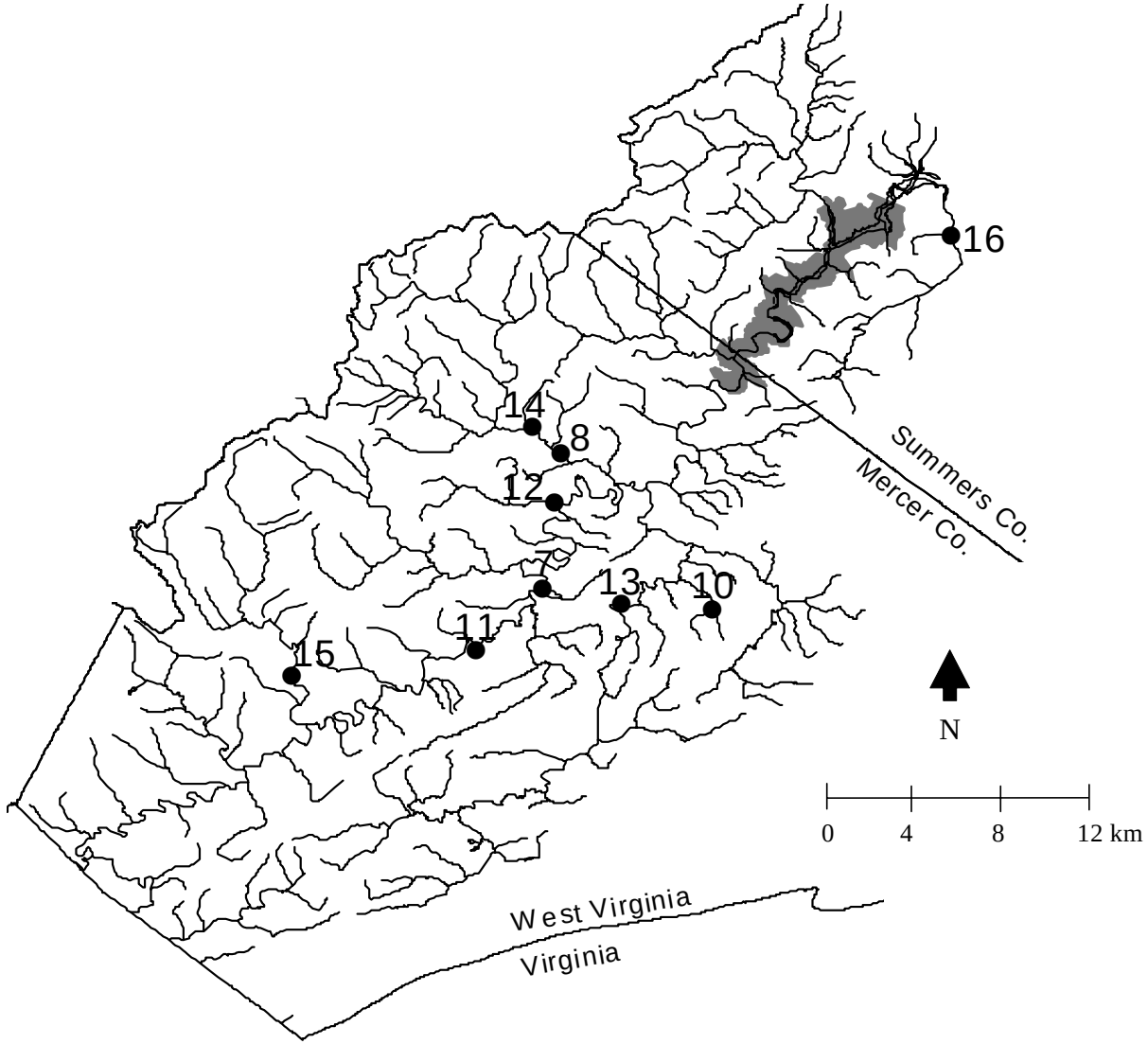

Figure 4. Fish sampling locations in the lower Bluestone River drainage, West Virginia, during the 1920s and 1930s. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.

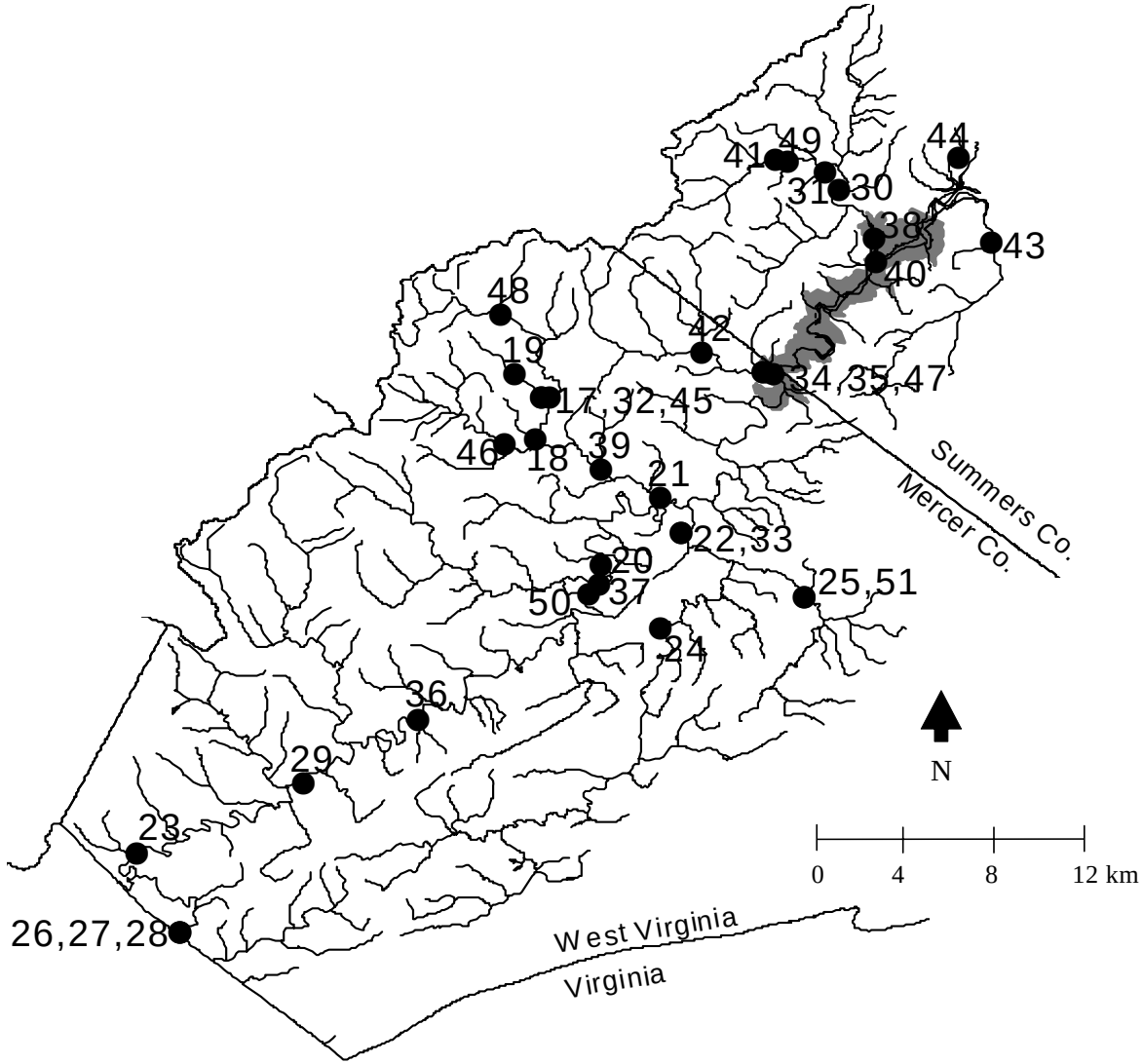

Figure 5. Fish sampling locations in the Bluestone River drainage, West Virginia, from 1959 through 1984. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.

Table 3. Fishes from the Bluestone River drainage catalogued at Cornell University (CU), the University of Michigan Museum of Zoology (UMMZ), and the U.S. National Museum (USNM). Site numbers correspond to Table 1. Scientific names are presented in Table 2.

Site	Common Name	Museum	Lot Number	Collector
1	Spotfin shiner	USNM	56515	W. Hay
1	Spotfin shiner	USNM	56490	W. Hay
1	Channel catfish	USNM	56556	W. Hay
1	Smallmouth bass	USNM	56933	W. Hay
2	Central stoneroller	USNM	56563	W. Hay
2	White sucker	USNM	56835	W. Hay
2	Green sunfish	USNM	56628	W. Hay
2	Bluntnose minnow	USNM	56562	W. Hay
2	Western blacknose dace	USNM	56880	W. Hay
3	White sucker	USNM	56751	W. Hay
3	White sucker	USNM	56868	W. Hay
3	Spotfin shiner	USNM	56867	W. Hay
3	Tonguetied minnow	USNM	56781	W. Hay
3	Northern hogsucker	USNM	56476	W. Hay
3	Bigmouth chub	USNM	56828	W. Hay
3	Rosyface shiner	USNM	56480	W. Hay
3	Tonguetied minnow	USNM	56466	W. Hay
3	Bluntnose minnow	USNM	56462	W. Hay
4	Smallmouth bass	USNM	56951	W. Hay
5	White sucker	USNM	56920	W. Hay
5	Western blacknose dace	USNM	56915	W. Hay
6	White sucker	USNM	56566	W. Hay
6	White sucker	USNM	56816	W. Hay
6	Bluntnose minnow	USNM	56564	W. Hay
6	Western blacknose dace	USNM	56894	W. Hay
6	Creek chub	USNM	56565	W. Hay
7	Spotfin shiner	UMMZ	95256	C.L. & L.C. Hubbs
7	Silverjaw minnow	UMMZ	95260	C.L. & L.C. Hubbs
7	Northern hogsucker	UMMZ	95262	C.L. & L.C. Hubbs

Table 3. Fishes from the Bluestone River drainage catalogued at Cornell University (CU), the University of Michigan Museum of Zoology (UMMZ), and the U.S. National Museum (USNM). Site numbers correspond to Table 1. Scientific names are presented in Table 2 (continued).

Site	Common Name	Museum	Lot Number	Collector
7	Smallmouth bass	UMMZ	95263	C.L. & L.C. Hubbs
7	Bigmouth chub	UMMZ	95261	C.L. & L.C. Hubbs
7	Rosyface shiner	UMMZ	95257	C.L. & L.C. Hubbs
7	Mimic shiner	UMMZ	95258	C.L. & L.C. Hubbs
7	Bluntnose minnow	UMMZ	95259	C.L. & L.C. Hubbs
8	Central stoneroller	UMMZ	95269	C.L. & L.C. Hubbs
8	White sucker	UMMZ	95266	C.L. & L.C. Hubbs
8	Fantail darter	UMMZ	95264	C.L. & L.C. Hubbs
8	Tonguetied minnow	UMMZ	92667	C.L. & L.C. Hubbs
8	Northern hogsucker	UMMZ	95265	C.L. & L.C. Hubbs
8	Bigmouth chub	UMMZ	95272	C.L. & L.C. Hubbs
8	Rosyface shiner	UMMZ	95270	C.L. & L.C. Hubbs
8	New River shiner	UMMZ	95271	C.L. & L.C. Hubbs
8	Bluntnose minnow	UMMZ	95267	C.L. & L.C. Hubbs
8	Creek chub	UMMZ	95268	C.L. & L.C. Hubbs
9	Spotfin shiner	CU	4695	A.H. Wright
9	Northern hogsucker	CU	4696	A.H. Wright
10	Fantail darter	CU	5016	A.H. Wright
10	Green sunfish	CU	4698	A.H. Wright
10	Western blacknose dace	CU	4697	A.H. Wright
11	Green sunfish	CU	4599	A.H. Wright
11	Smallmouth bass	CU	4598	A.H. Wright
11	Spotted bass	CU	4597	A.H. Wright
12	Rock bass	CU	4692	A.H. Wright
12	Green sunfish	CU	4691	A.H. Wright
12	Western blacknose dace	CU	4694	A.H. Wright
12	Creek chub	CU	4693	A.H. Wright
45	Central stoneroller	CU	76467	J. Reed
45	Fantail darter	CU	76368	J. Reed

Table 3. Fishes from the Bluestone River drainage catalogued at Cornell University (CU), the University of Michigan Museum of Zoology (UMMZ), and the U.S. National Museum (USNM). Site numbers correspond to Table 1. Scientific names are presented in Table 2 (continued).

Site	Common Name	Museum	Lot Number	Collector
45	Creek chub	CU	75994	J. Reed
46	Central stoneroller	CU	77289	J. Reed
46	Northern hogsucker	CU	76438	J. Reed
46	Rosyface shiner	CU	78366	J. Reed
46	Bluntnose minnow	CU	77651	J. Reed
46	Western blacknose dace	CU	77283	J. Reed
46	Creek chub	CU	78193	J. Reed
47	Rock bass	CU	76006	J. Reed
47	Northern hogsucker	CU	76434	J. Reed
47	Striped shiner	CU	76570	J. Reed
47	Bigmouth chub	CU	76466	J. Reed
47	Creek chub	CU	77642	J. Reed
48	Fantail darter	CU	78863	J. Reed
48	Western blacknose dace	CU	77684	J. Reed
49	Central stoneroller	CU	70308	J. Reed
49	Fantail darter	CU	70311	J. Reed
49	Western blacknose dace	CU	70309	J. Reed
49	Creek chub	CU	70310	J. Reed

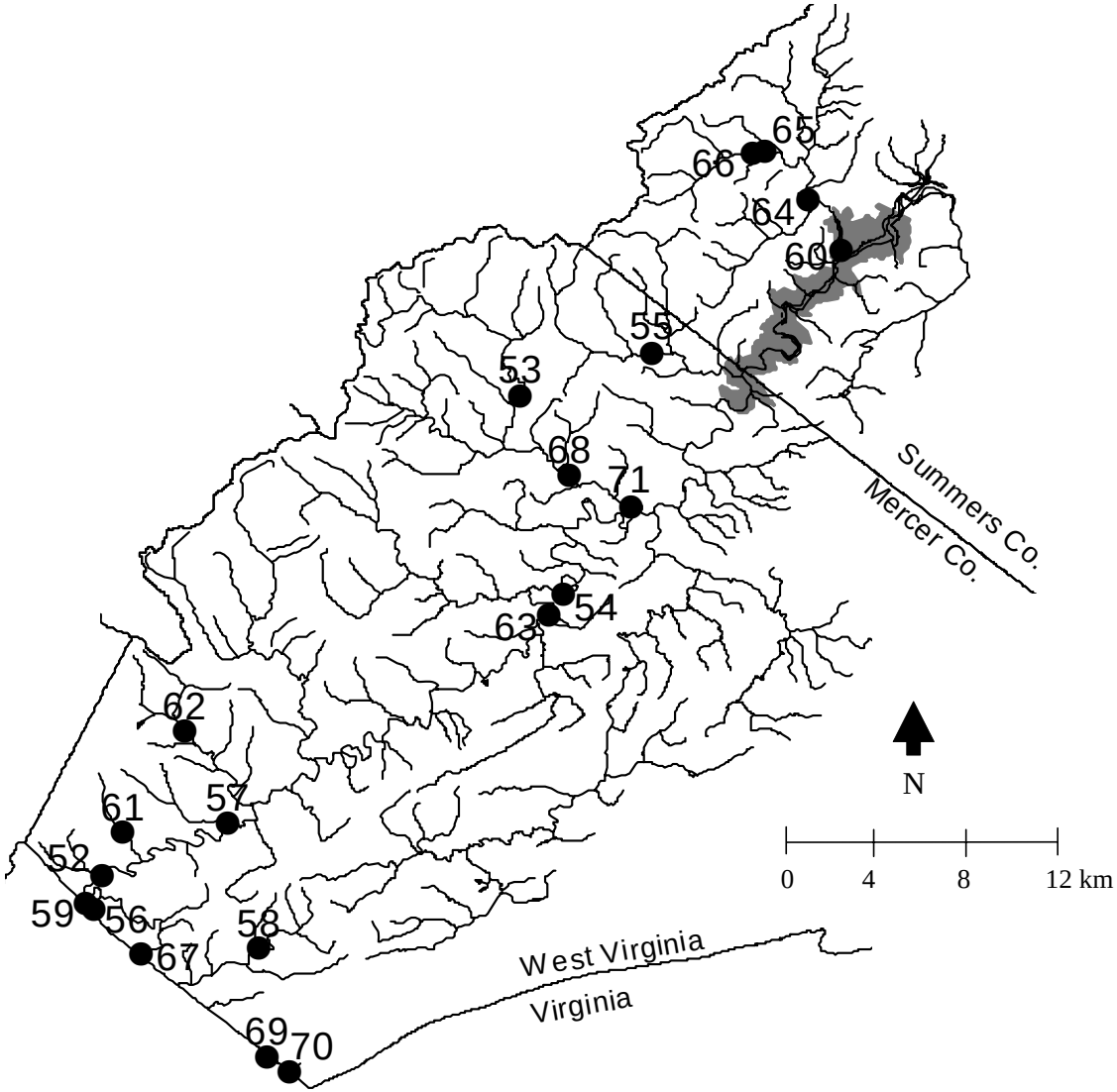

Figure 6. Fish sampling locations in the Bluestone River drainage, West Virginia, from 1985 through 2003. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.

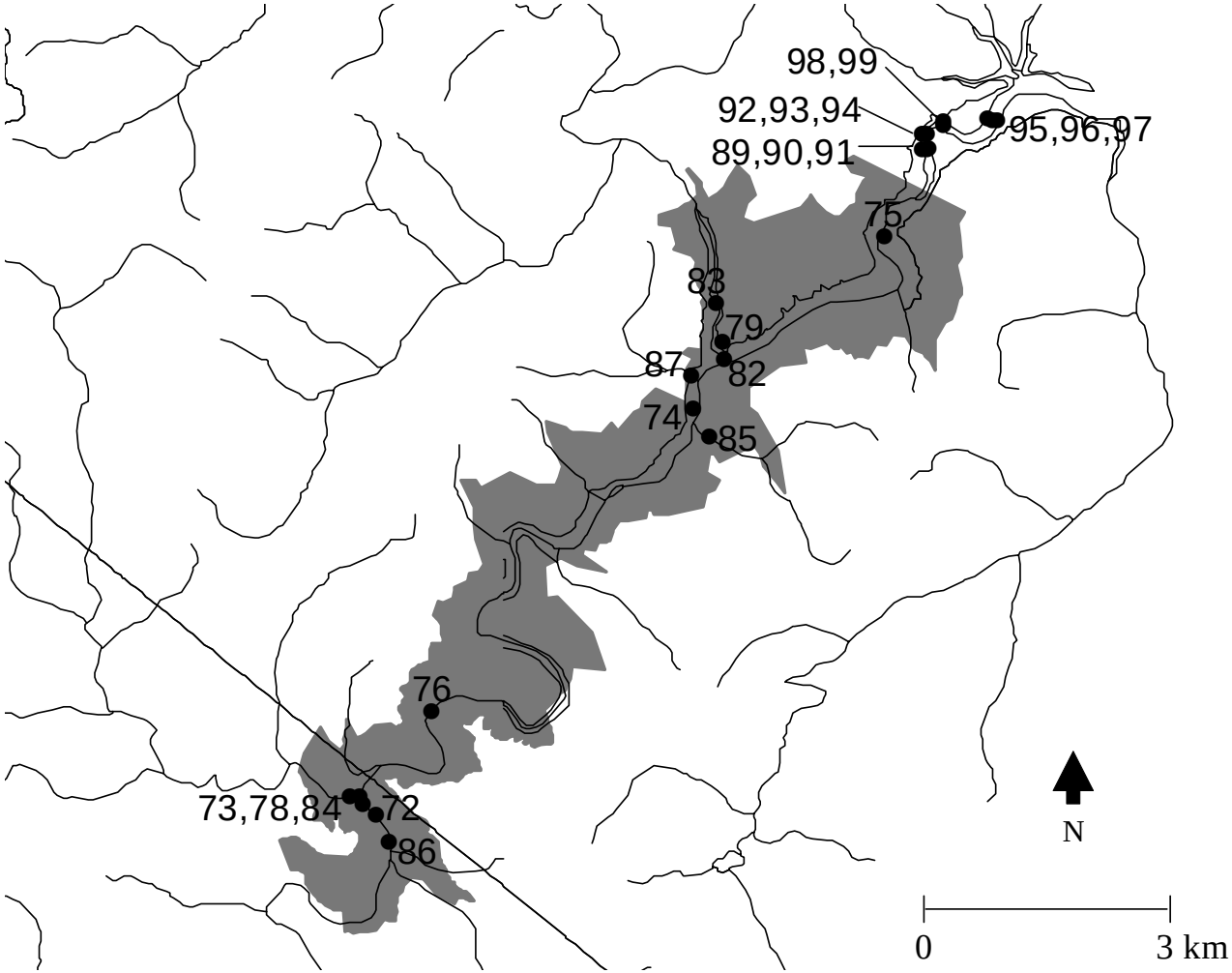

Figure 7. Fish sampling locations in the lower Bluestone River drainage, West Virginia, during this study (2004-2005). Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.

Table 4. Abundances of fishes documented within or near Bluestone National Scenic River during 2004 and 2005 sampling periods. Site numbers correspond with Table 1 and Figure 2. Scientific names are presented in Table 2.

Common Name	Site																								Total
	72	73	74	75	76	78	79	82	83	84	85	86	87	89	90	91	92	93	94	95	96	97	98	99	
Gizzard shad	---	---	---	---	---	---	---	---	---	---	---	---	---	21	16	11	16	3	7	2	2	4	26	2	110
Central stoneroller	24	---	8	7	41	205	517	41	11	114	---	6	1	---	---	---	---	---	---	---	---	---	---	---	975
Rosyside dace	---	---	---	---	---	---	---	---	---	21	7	2	11	---	---	---	---	---	---	---	---	---	---	---	41
Common Carp	---	---	---	---	---	---	---	---	---	---	---	---	---	2	1	---	1	---	2	3	---	---	2	1	12
Whitetail shiner	---	---	2	1	16	14	10	1	1	2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	47
Spotfin shiner	1	---	---	3	13	9	5	2	3	8	---	1	---	---	---	---	11	---	7	24	---	1	---	---	88
White shiner	---	---	---	---	8	33	20	---	5	8	---	---	---	---	---	---	---	---	---	18	2	---	---	---	94
Bigmouth chub	20	---	22	4	121	130	97	6	7	2	---	1	---	---	---	---	---	---	---	---	---	---	---	---	410
Golden shiner	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1	---	---	---	---	1
Emerald shiner	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1	---	---	---	1	---	1	---	---	3
Spottail shiner	---	---	4	6	1	1	43	48	---	---	---	---	---	---	---	70	1	---	71	---	---	---	---	---	245
Rosyface shiner	---	---	---	---	---	---	1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1
Telescope shiner	---	---	3	1	2	30	12	---	16	42	---	---	---	---	---	---	---	---	---	---	---	---	---	---	106
Mimic shiner	---	---	---	2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2
Moutain redbelly dace	---	---	---	---	---	---	---	---	---	---	2	---	2	---	---	---	---	---	---	---	---	---	---	---	4
Bluntnose minnow	---	---	1	2	---	---	---	1	---	1	---	---	---	2	---	1	2	---	6	---	---	1	---	---	17
Western blacknose dace	---	---	---	---	---	---	---	---	---	1	3	2	1	---	---	---	---	---	---	---	---	---	---	---	7
Longnose dace	1	---	---	1	19	7	8	---	2	9	---	---	---	---	---	---	---	---	---	---	---	---	---	---	47
Creek chub	---	---	---	---	---	1	1	---	---	16	37	43	40	---	---	---	---	---	---	---	---	---	---	---	138
White sucker	---	---	---	---	---	---	---	1	---	---	---	---	2	---	---	---	---	---	---	---	---	---	---	---	3

Table 4. Abundances of fishes documented within or near Bluestone National Scenic River during 2004 and 2005 sampling periods. Site numbers correspond with Table 1 and Figure 2. Scientific names are presented in Table 2 (continued).

Common Name	Site																								Total
	72	73	74	75	76	78	79	82	83	84	85	86	87	89	90	91	92	93	94	95	96	97	98	99	
Northern hogsucker	---	---	---	2	---	6	7	2	---	16	---	---	---	---	---	---	---	---	---	---	---	---	---	---	33
Yellow bullhead	---	---	---	1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1
Flathead catfish	---	---	---	---	1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1
Margined madtom	---	---	1	4	---	---	15	1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	21
Brook silverside	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1	---	3	---	---	---	---	---	4
Rock bass	7	---	7	---	9	36	12	8	1	5	---	---	---	8	---	---	3	1	1	5	---	---	---	---	103
White crappie	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2	---	3	---	---	5
Black crappie	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1	5	---	---	5	---	1	---	---	12
Redbreast sunfish	---	---	1	---	---	---	4	3	---	---	---	---	---	1	---	2	4	---	2	---	---	---	2	---	19
Green sunfish	---	---	---	---	---	---	---	1	---	---	3	6	1	2	---	---	---	---	---	1	---	---	---	---	14
Pumpkinseed	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2	2	---	3	1	---	8
Bluegill	---	---	---	---	---	---	---	---	---	---	---	---	---	11	---	9	5	---	8	8	---	3	7	5	56
Smallmouth bass	1	---	---	1	2	15	7	---	1	1	---	---	---	1	---	4	---	---	2	---	---	---	1	---	36
Spotted bass	---	---	---	---	---	---	1	---	---	---	---	---	---	---	---	4	2	---	2	1	---	---	---	---	10
Largemouth bass	---	---	---	---	---	---	1	---	---	---	---	---	---	1	---	---	1	---	5	5	---	---	2	---	15
Greenside darter	3	---	3	---	7	1	5	1	2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	22
Rainbow darter	13	---	27	19	14	9	139	79	49	6	---	---	---	---	---	---	---	---	---	---	---	---	---	---	355
Fantail darter	---	---	---	---	---	1	---	1	3	5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	10

Table 4. Abundances of fishes documented within or near Bluestone National Scenic River during 2004 and 2005 sampling periods. Site numbers correspond with Table 1 and Figure 2. Scientific names are presented in Table 2 (continued).

Common Name	Site																								Total
	72	73	74	75	76	78	79	82	83	84	85	86	87	89	90	91	92	93	94	95	96	97	98	99	
Logperch	---	1	---	14	3	---	14	3	---	---	---	---	---	---	---	1	---	---	---	---	---	---	---	---	36
Roanoke darter	12	---	1	10	34	10	46	2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	115
Total	82	1	80	78	291	508	965	201	101	257	52	61	58	49	17	104	52	4	118	78	4	17	41	8	

Table 5. Catch-per-unit-effort (CPUE) of fishes estimated from electrofishing boat collections within the inundated lower reaches of Bluestone River in 2005. Site numbers correspond with Table 1 and Figure 2. Scientific names are presented in Table 2.

Common Name	Site CPUE (fish/hour)											Mean CPUE	Standard Error CPUE
	89	90	91	92	93	94	95	96	97	98	99		
Gizzard shad	63	48	33	48	9	21	6	6	12	78	6	30	7.40
Common carp	6	3	0	3	0	6	9	0	0	6	3	3	0.90
Spotfin shiner	0	0	0	33	0	21	72	0	3	0	0	12	6.56
White shiner	0	0	0	0	0	0	54	6	0	0	0	5	4.66
Golden shiner	0	0	0	0	0	0	3	0	0	0	0	0	0.26
Emerald shiner	0	0	3	0	0	0	3	0	3	0	0	1	0.40
Spottail shiner	0	0	210	3	0	213	0	0	0	0	0	39	24.56
Bluntnose minnow	6	0	3	6	0	18	0	0	3	0	0	3	1.56
Brook silverside	0	0	0	3	0	9	0	0	0	0	0	1	0.80
Rock bass	24	0	0	9	3	3	15	0	0	0	0	5	2.29
White crappie	0	0	0	0	0	0	6	0	9	0	0	2	0.93
Black crappie	0	0	3	15	0	0	15	0	3	0	0	3	1.70
Redbreast sunfish	3	0	6	12	0	6	0	0	0	6	0	3	1.16
Green sunfish	6	0	0	0	0	0	3	0	0	0	0	1	0.56
Pumpkinseed	0	0	0	0	0	6	6	0	9	3	0	2	0.95
Bluegill	33	0	27	15	0	24	24	0	9	21	15	15	3.37
Smallmouth bass	3	0	12	0	0	6	0	0	0	3	0	2	1.10
Spotted bass	0	0	12	6	0	6	3	0	0	0	0	2	1.15
Largemouth bass	3	0	0	3	0	15	15	0	0	6	0	4	1.69
logperch	0	0	3	0	0	0	0	0	0	0	0	0	0.26

shoreline habitat and mid-channel habitat. Gizzard shad, spotfin shiner, spottail shiner (*Notropis hudsonius*), and bluegill had the highest mean CPUE values (30, 12, 39, 15, respectively, Table 5).

A total of 57 fish species within the Bluestone River drainage and 45 fish species within BLUE boundaries were documented from the 99 collections (1899-2005). Separate estimates examined spatial and temporal changes in species richness within the Bluestone River drainage. For example, species richness of BLUE was estimated as 41 (S.E. = 3) based on presence-absence data of 2004 and 2005. Species richness estimates based on all Bluestone River data (BLUE and outside of BLUE combined) were 55 (S.E. = 5) for the historic period (1899-1984), 44 (S.E. = 5) for the recent period (1985-2003), and 46 (S.E. = 4) for our study (2004-2005). An objective for IMP is to document at least 90% of the species found within park boundaries. The "true" number of species is unknown for BLUE, but was approximated from 2004-2005 data with program SPECRICH2 (N=41 species; 95% CI + or – 6). The percent of species found within BLUE in 2004-2005 was estimated with the ratio 40/41 (i.e. 98 %) with a range (based on 95% CIs) of 85% to 100% (i.e., 40/47 and 40/40, respectively). Alternatively, one could examine if the recent inventory of BLUE documents at least 90% of species historically reported from BLUE, but only six fish sampling events are documented within BLUE before our study.

Discussion

This synthesis of fish distribution data (99 collections from 1899-2005) documented 57 species within the Bluestone River drainage, West Virginia. Diversity information, however, is based on presence/absence information where species absence results from both "true" absence and non-detection of species. Fish diversity data were categorized spatially (within and outside of BLUE boundaries) and temporally (historic and recent). Fish diversity outside of BLUE boundaries exceeded that of BLUE, a difference explained likely by intensity and seasonality of sampling, species-area relationships, species non-detection, and nonnative species. Comparisons of historic and recent data revealed changes in species composition owing to addition of nonnatives and attrition or nondetection of endemics. Fish diversity of BLUE was of primary interest to NPS, and fishes found throughout the Bluestone River drainage have a high probability of occurrence within BLUE, except for species apparently restricted to headwaters, such as the Bluestone sculpin and snubnose darter. Historic and recent fish distribution data are critical as baseline information for inventory and monitoring programs. This report should prove useful as a reference document of baseline diversity information for management of fishes in the Bluestone River drainage and in BLUE.

Estimates of fish diversity outside of BLUE boundaries (largely influenced by sampling before the current study) exceeded that of BLUE, a difference likely explained by intensity and seasonality of sampling, species-area relationships, species non-detection, and species introductions. Our study used several types of electrofishers, whereas previous studies used seines (before 1950s) and electrofishing primarily in later years. The geographic range of previous sampling sites encompassed a larger sampling area within the Bluestone River drainage than that of our recent efforts in BLUE. One would expect a higher estimate of species richness from the larger area outside of BLUE, given that species richness generally increases with the size of sampling area (Angermeier and Schlosser 1989). Our collection of margined madtom within BLUE is a new distribution record, and likely resulted from bait-bucket introduction (see Welsh and Cincotta 2004). Presence of rosyside dace and mountain redbelly dace within BLUE may also represent bait-bucket transfers, but these species are considered native to the New River drainage. Recent collections of four non-natives (gizzard shad, golden shiner, emerald shiner, and brook silverside) are likely associated with forage fish introductions into Bluestone Reservoir. Channel catfish and Muskellunge (both reported previously) were likely present and not detected (instead of absent) from our 2005 sampling efforts in upper Bluestone Reservoir. Channel catfish are abundant within Bluestone reservoir, but are not easily detected with standard settings of electrofishing gear (Kolz et al. 1998). Muskellunge (typically not abundant within a site) are often not detected during reservoir electrofishing surveys.

Comparisons of historic and recent data revealed changes in species composition owing, in part, to addition of nonnatives. Fish introductions are common in aquatic systems throughout the United States (Fuller et al. 1999), but the New River (including BLUE, GARI, and NERI) contains a relatively high proportion of nonnative to native fishes. Nonnative fishes within the

New River were likely introduced as baitbucket releases (Cincotta et al. 1999) or as game and forage fishes dating back to the late 1800s (Jenkins and Burkhead 1993, Easton and Orth 1994, Cincotta et al. 1999). Fifty-seven species have been collected from within the Bluestone River drainage; 31 (54%) of the 57 species are nonnative. This high nonnative/native ratio is consistent with other estimates of the New River (Jenkins and Burkhead 1993, Easton and Orth 1994, Wellman 2004, and Welsh et al. 2004). Streams with high nonnative to native fish ratios often have high impairment and occur in close proximity to speciose drainages (Hocutt and Hambrick 1973, Herbold and Moyle 1986, Wait and Carpenter 2000). The New River, naturally depauperate of native fishes, is surrounded by nine large river basins (all potential sources of nonnatives). It is puzzling, however, that the Bluestone River drainage does not contain a higher number of nonnatives from the upper Tennessee River drainage, given the high diversity and proximity of the upper Tennessee River drainage relative to the upper Bluestone River drainage.

Two introduced nonnative minnows (telescope shiner and whitetail shiner) within the Bluestone drainage are likely downstream dispersants from "baitbucket" populations. The whitetail shiner, native to the Tennessee River drainage, was first reported in the New River basin in 1954 (Ross and Carico 1963, Jenkins and Burkhead 1993). Following the first collection, populations occurred in the mainstem and tributaries of the New River in Virginia and upper sections of West Virginia (Jenkins et al. 1972, Hess 1983). It was not collected below Bluestone Dam until 1988 – 1990 (Easton and Orth 1994). The whitetail shiner, currently distributed within BLUE, is more common in the mainstem than in tributaries (but were seasonally abundant in some tributaries within New River gorge; Wellman 2004). The telescope shiner, also native to the Tennessee River drainage, has occurred within the New River system since at least 1958 (Jenkins and Burkhead 1993). This species, first collected from West Virginia waters by Hambrick et al. (1973), continues to expand its range in the New River system (Cincotta et al. 1999). The telescope shiner, distributed within BLUE, occurs primarily within the mainstem of Bluestone River or in lower reaches of tributaries.

Two of the five darter species collected within BLUE during 2004 are introduced; rainbow darter and Roanoke darter (Jenkins and Burkhead 1993). The rainbow darter was considered rare and possibly native to portions of the New River, but was probably introduced into the lower Gauley River system in West Virginia and near the East River near the West Virginia – Virginia border (Jenkins and Burkhead 1993). Jenkins and Burkhead (1993), however, suggested populations have been The Roanoke darter was first collected in the New River drainage in 1963 (Ross 1969, Hocutt and Hambrick 1973) between Claytor Dam and Bluestone Reservoir, and later reported from West Virginia waters (mouth of Greenbrier River, 1970). Recent range expansions of rainbow and Roanoke darters within the lower New River drainage (Wellman 2004, Welsh et al. 2004) and within the Bluestone River drainage (as reported herein) supports introduced status. Our recent samples support higher densities of rainbow and Roanoke darters relative to native darters. Roanoke darters, typically absent from smaller tributaries, are not as widely distributed within BLUE as rainbow darters.

Several nonnative darter species documented from other areas of the New River drainage were not observed within the Bluestone River drainage. The variegate darter is recently-introduced and distributed widely within the lower New River drainage (including NERI and GARI; Cincotta et al. 1999, Wellman 2004, Welsh et al. 2004); Bluestone Dam detains its upstream dispersal into the Bluestone River drainage. The snubnose darter, an introduced darter in the upper Bluestone River drainage, was not collected historically or recently within or near boundaries of BLUE. The snubnose darter occurs in large river habitats elsewhere, and dispersal to the lower Bluestone drainage may be detained by water quality.

Researchers have reported four of the eight New River endemics from the Bluestone River drainage (bigmouth chub, New River shiner, candy darter, and Bluestone sculpin), but only two are recently reported (bigmouth chub and Bluestone sculpin). Bigmouth chubs are abundant within BLUE and the Bluestone River drainage. The Bluestone sculpin (a Bluestone River endemic) is restricted to upper reaches of the Bluestone River drainage. The absence of New River shiner and candy darter from recent collections may indicate declines or extirpation of populations in the Bluestone River drainage, but could also reflect non-detection during sampling; additional monitoring efforts may reveal localized populations of these species. Populations of New River shiner and candy darter, however, have declined elsewhere in the New River drainage (Welsh et al. 2004).

Conclusions

The fish fauna of the Bluestone River drainage is consistent with that of the greater New River system; depauperacy of natives, a high number of nonnatives, and a high number of endemics. Estimates of Bluestone River drainage fish species richness have remained relatively similar among time periods during 1899-2005, but large changes have occurred in species composition. Specifically, nonnatives have replaced native species (including two endemics) in recent lists of species diversity. Next to domestic waste issues, the influence of nonnatives on native fishes is an area of concern, but nonnative contributions to habitat alterations, disease/parasite introductions, hybridization, trophic alterations, and spatial alterations are undocumented. Prevention of additional introductions is unlikely, but educational programs aimed at bait bucket releases may reduce further introductions of nonnatives. This synthesis of fish distribution data provides managers of BLUE with abundance and distribution information concerning native and nonnative fish species, and will be useful for decisions on management of aquatic resources within BLUE.

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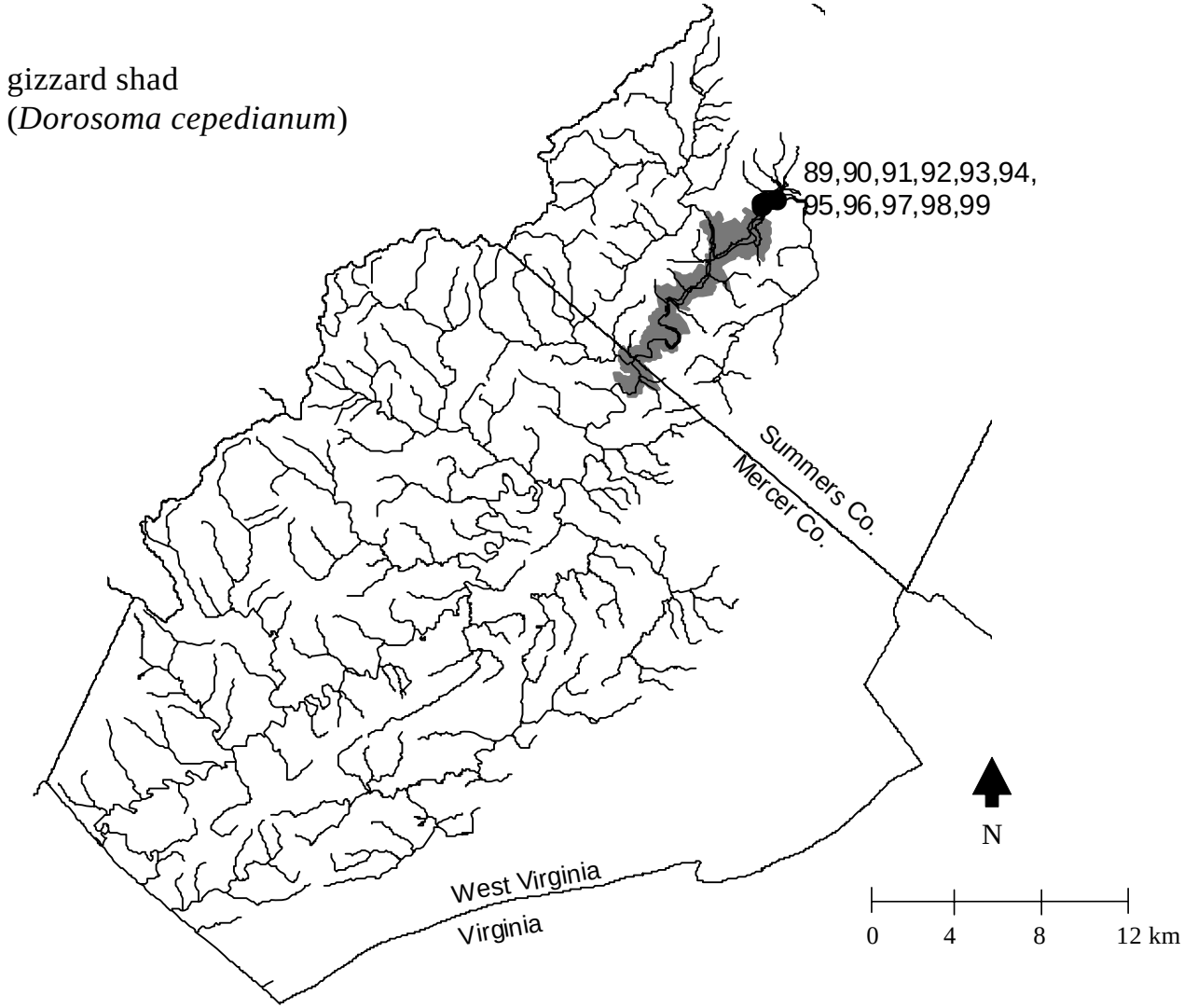
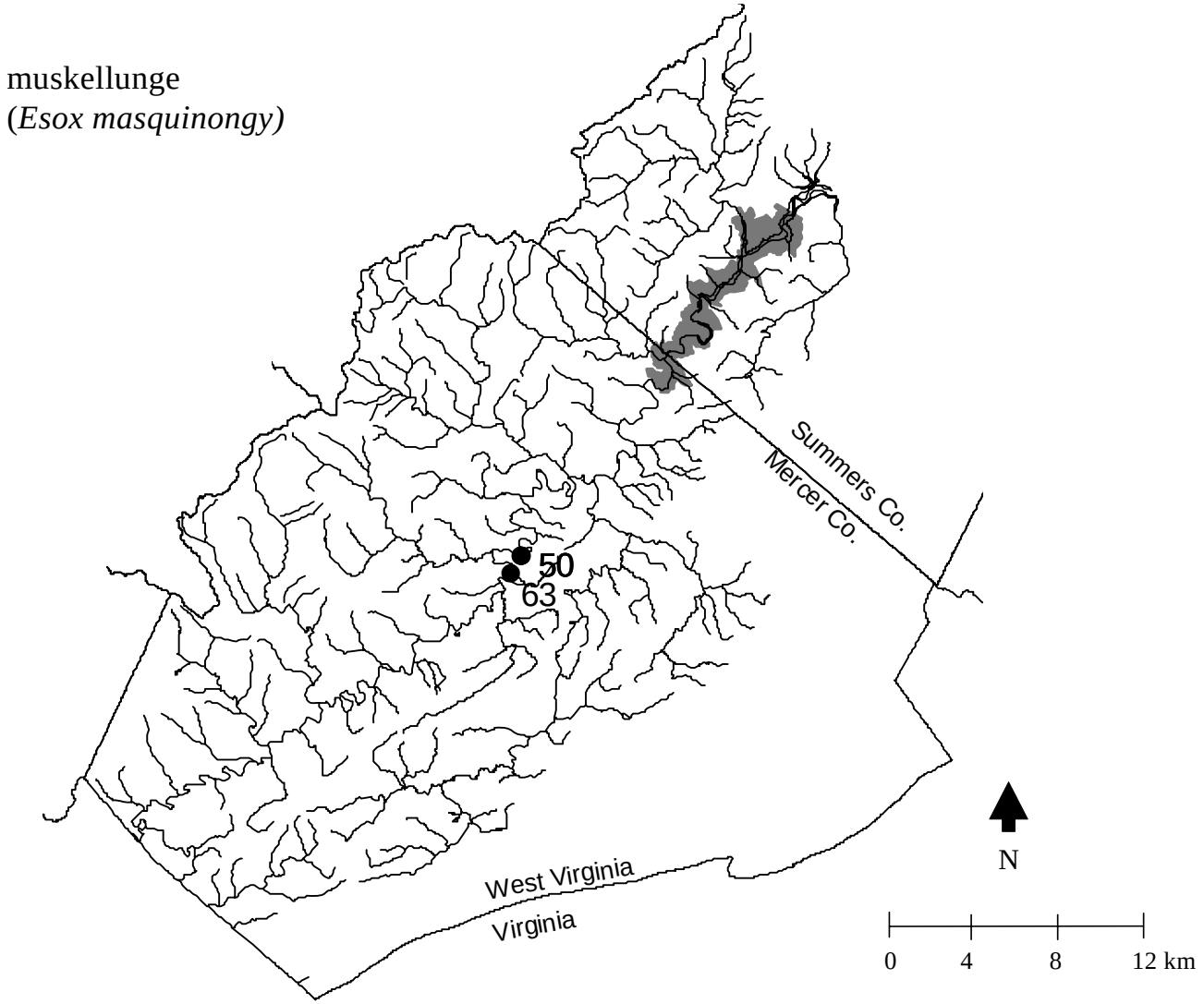
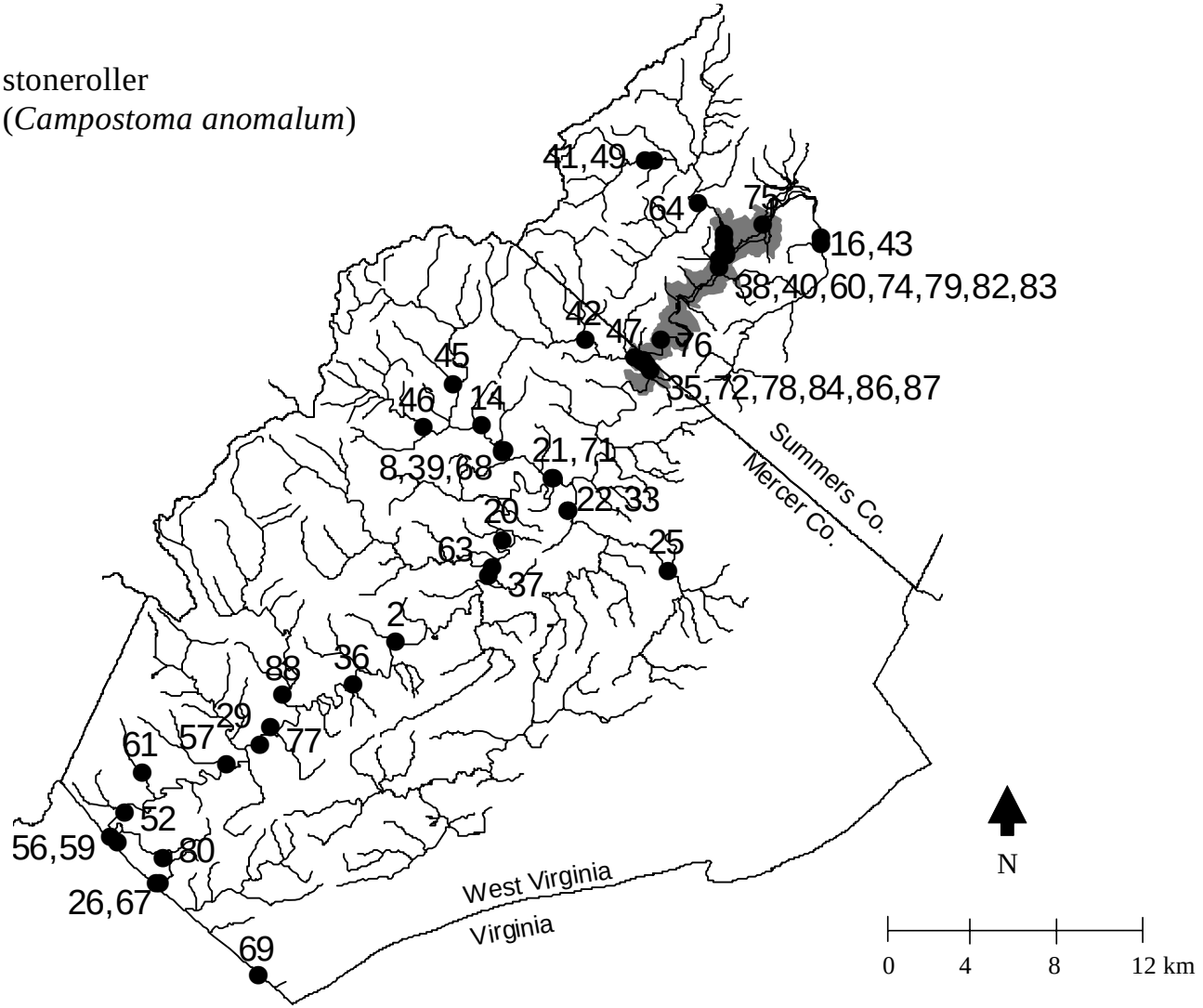
Appendix A. Distribution data for 57 fish species compiled from 99 collections taken between 1899 and 2005 within the Bluestone River drainage, West Virginia.



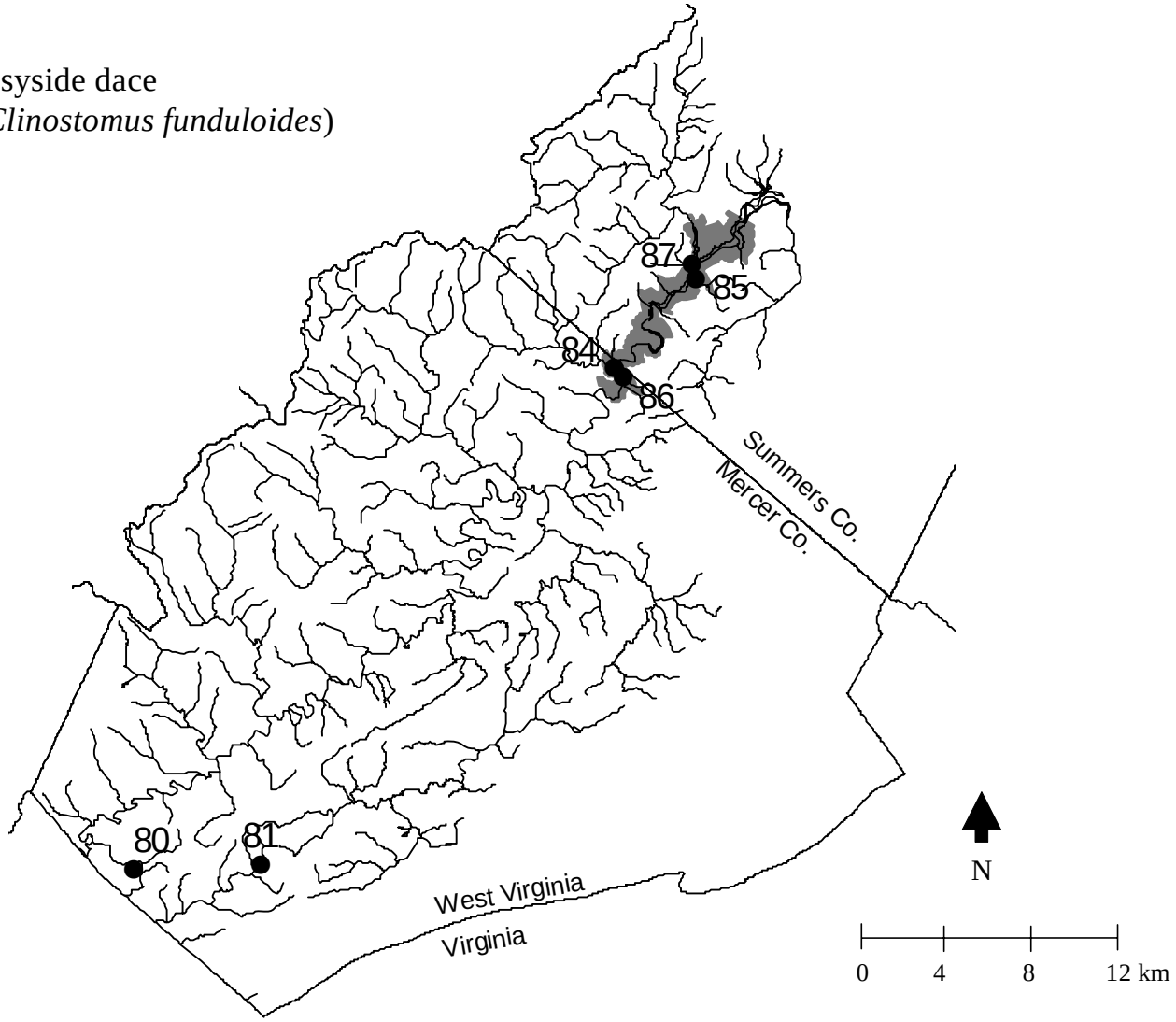
Appendix A-1. Collection sites of gizzard shad (*Dorosoma cepedianum*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



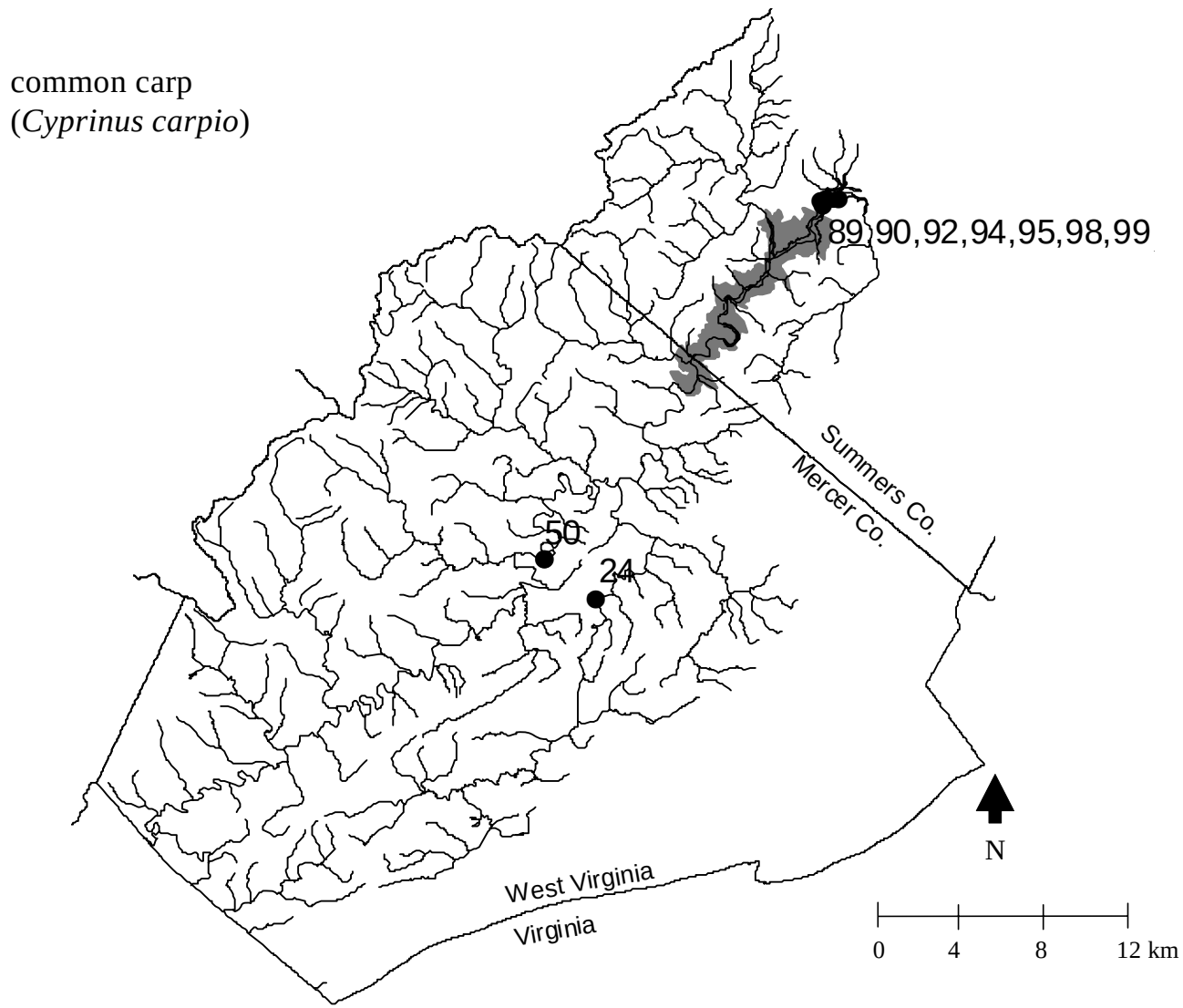
Appendix A-2. Collection sites of Muskellunge (*Esox masquinongy*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



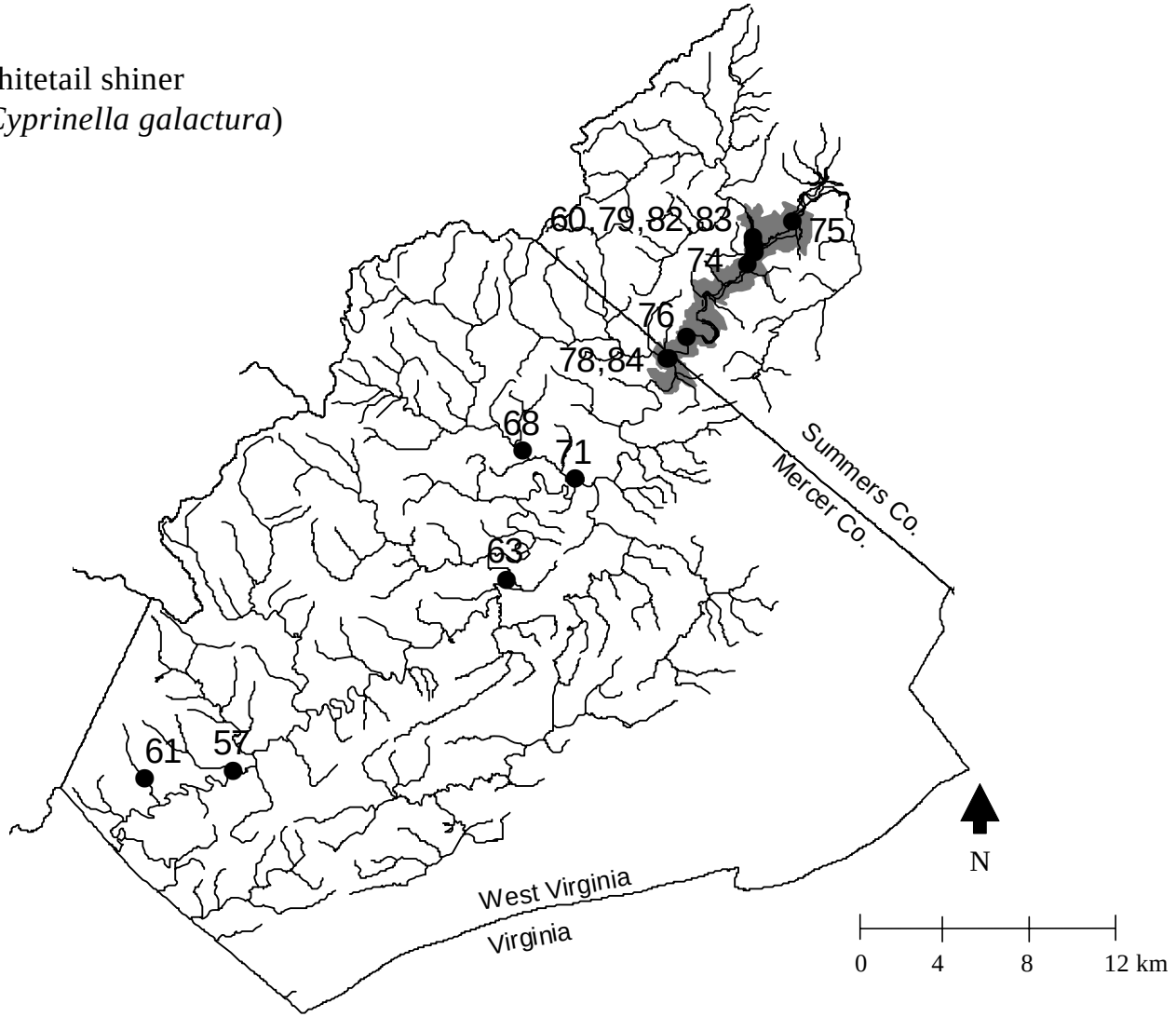
Appendix A-3. Collection sites of stoneroller (*Campostoma anomalum*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



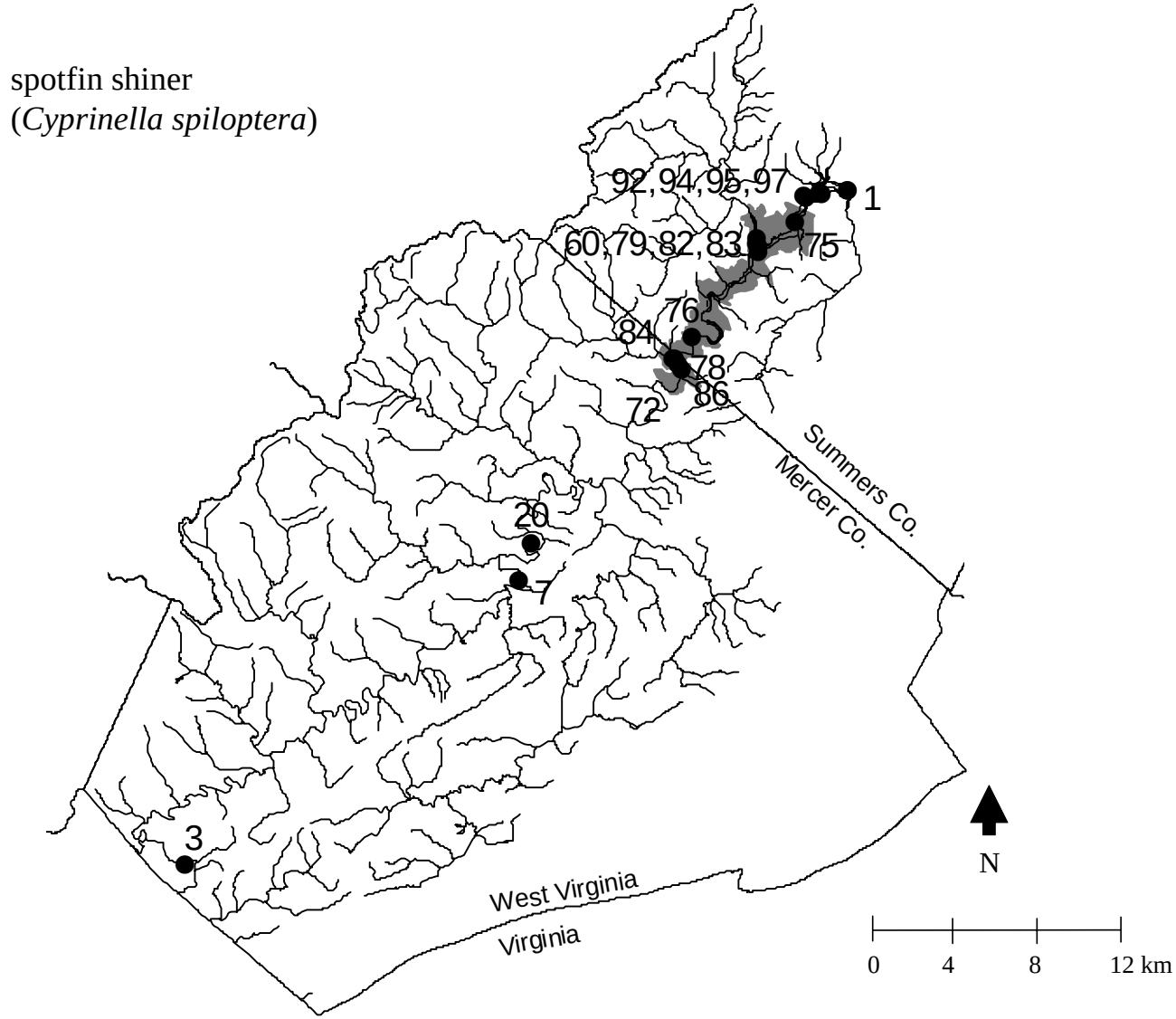
Appendix A-4. Collection sites of rosyside dace (*Clinostomus funduloides*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



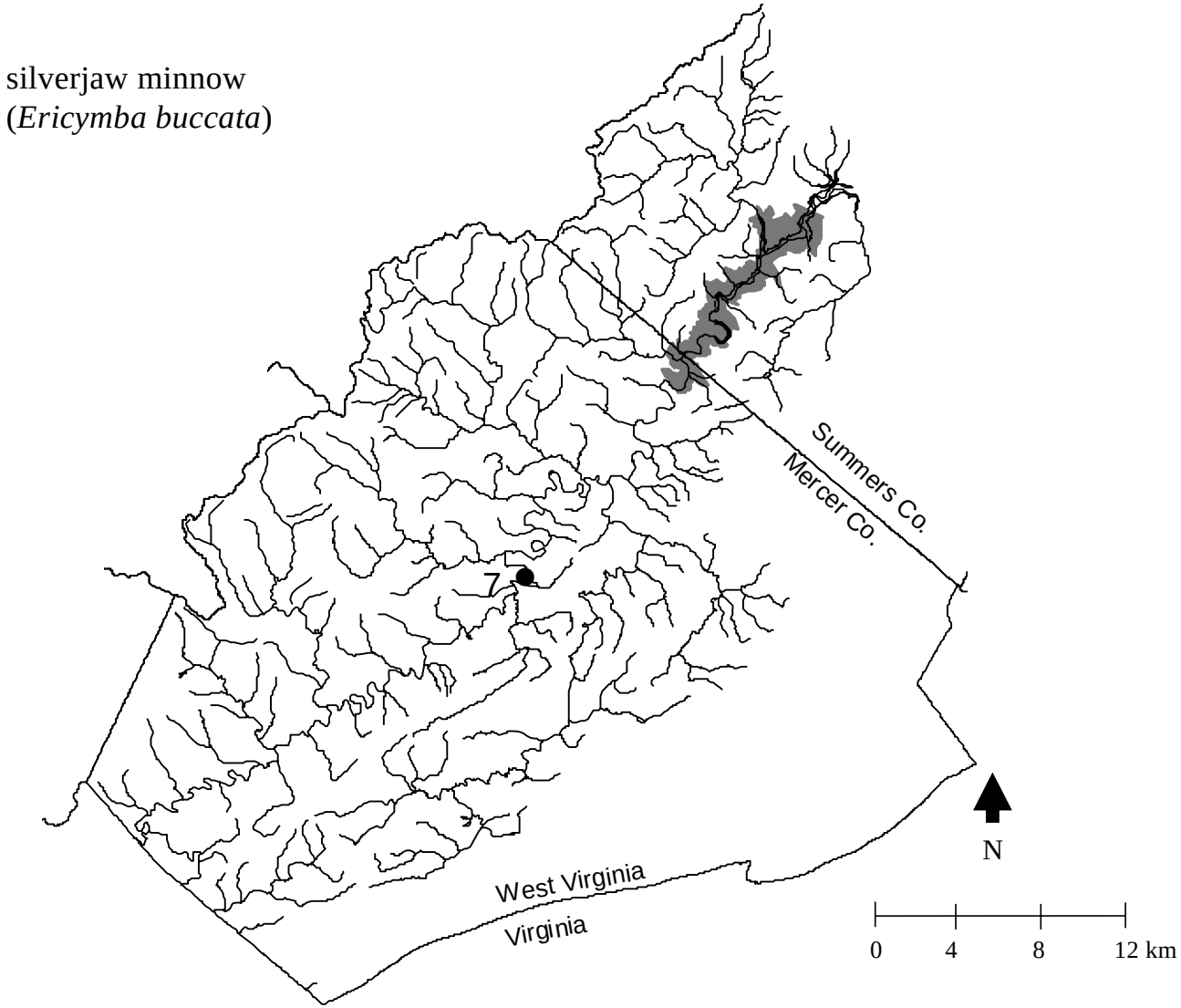
Appendix A-5. Collection sites of common carp (*Cyprinus carpio*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



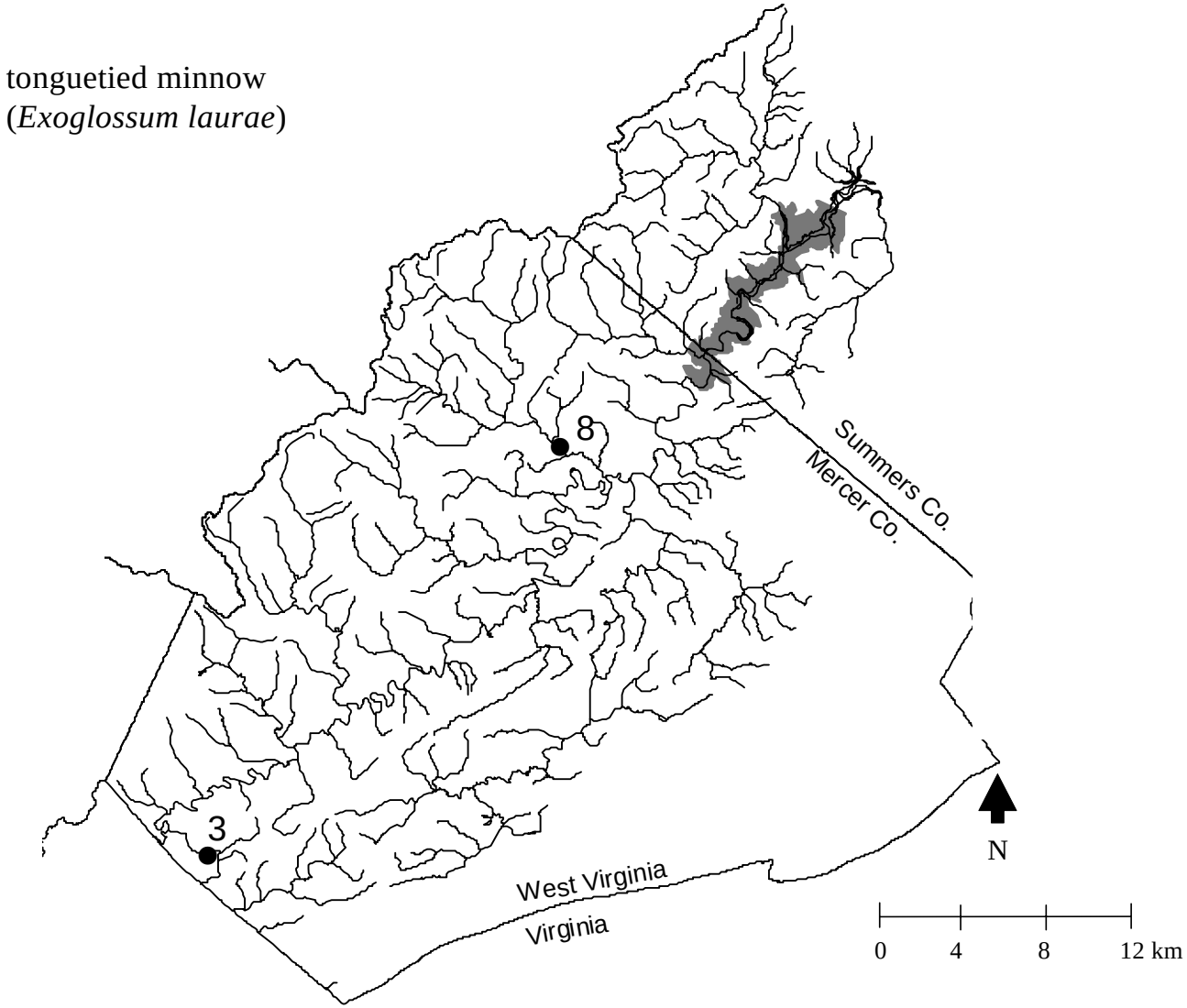
Appendix A-6. Collection sites of whitetail shiner (*Cyprinella galactura*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



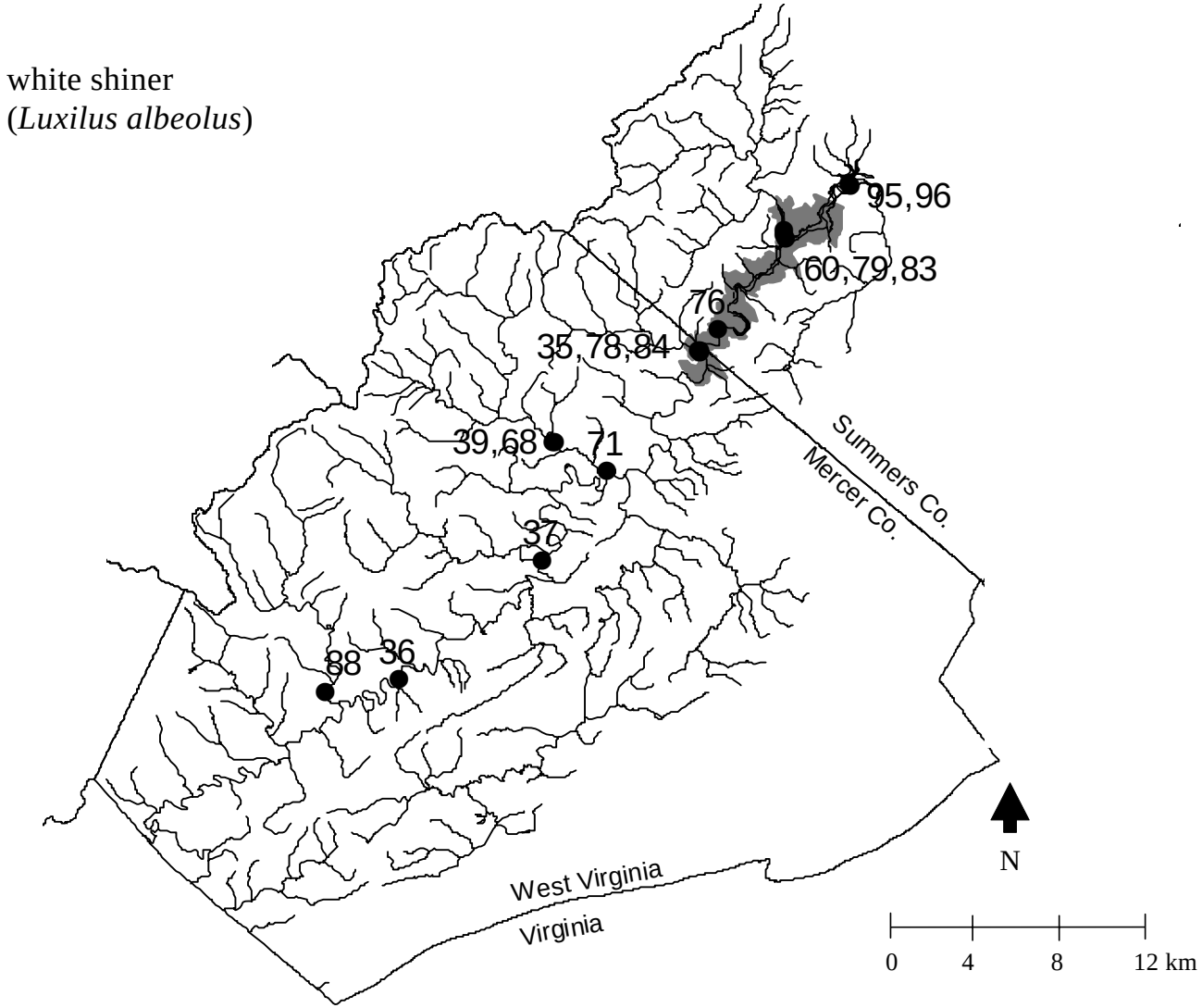
Appendix A-7. Collection sites of spotfin shiner (*Cyprinella spiloptera*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



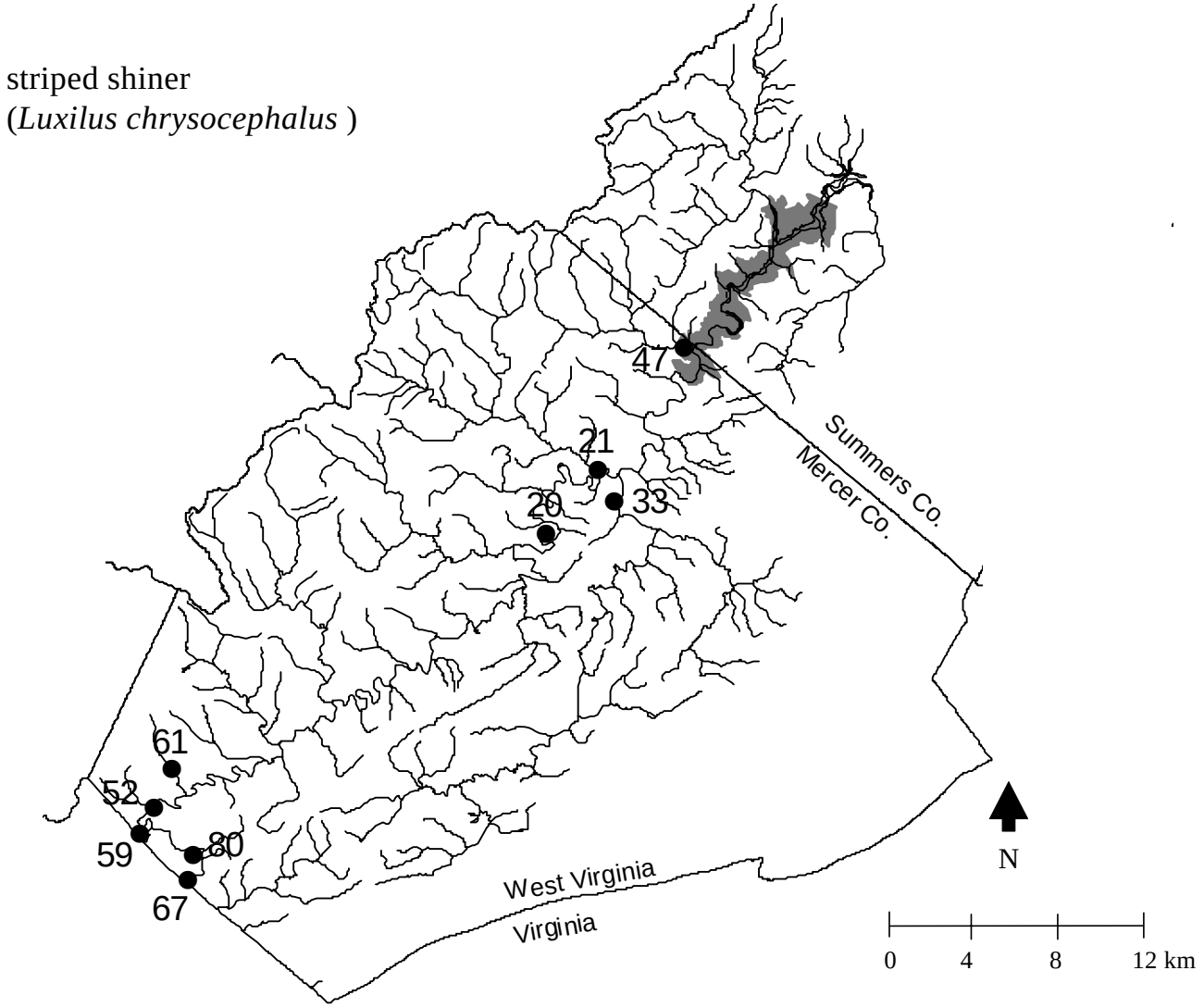
Appendix A-8. Collection sites of silverjaw minnow (*Ericymba buccata*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



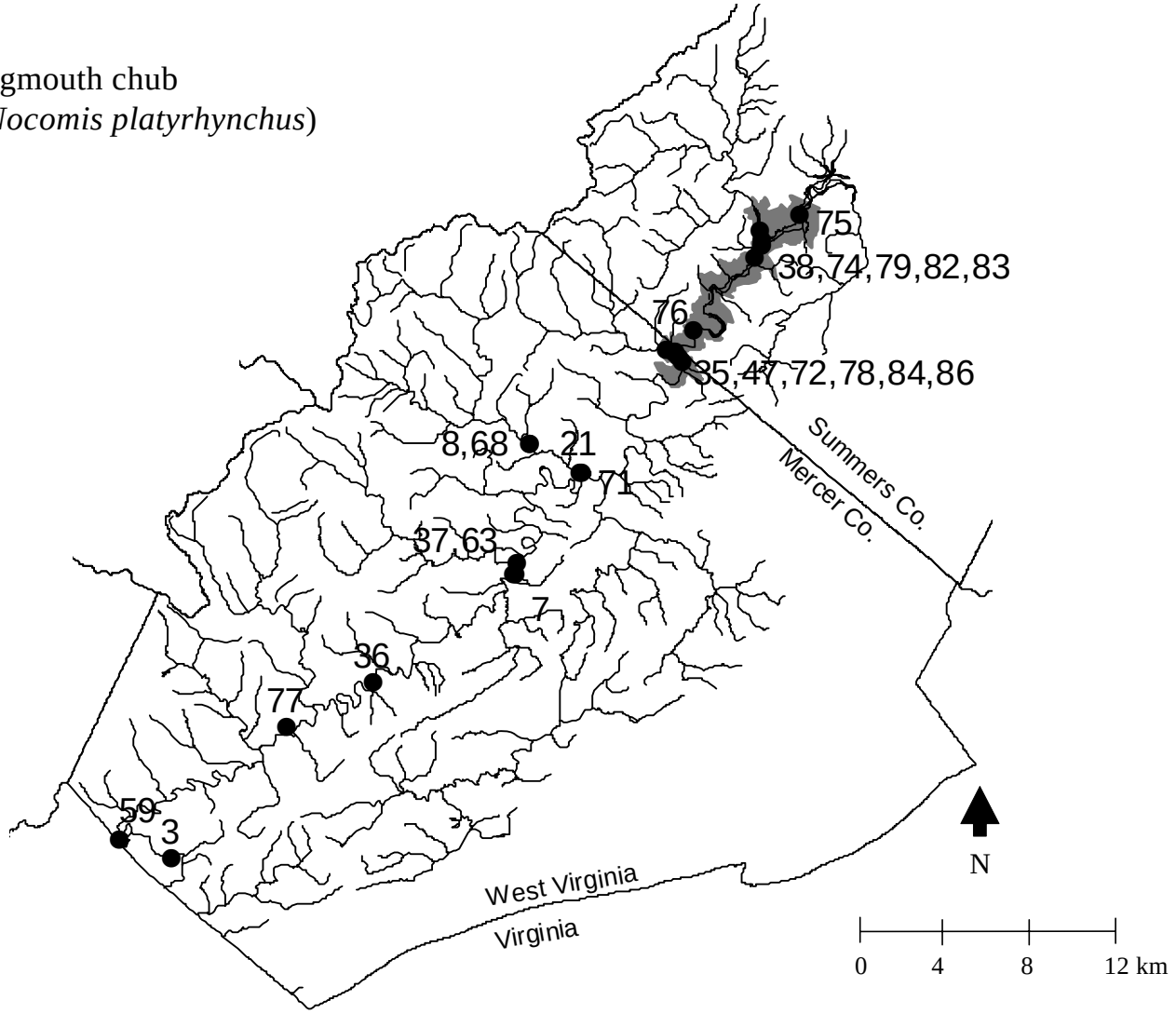
Appendix A-9. Collection sites of tonguetied minnow (*Exoglossum laurae*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



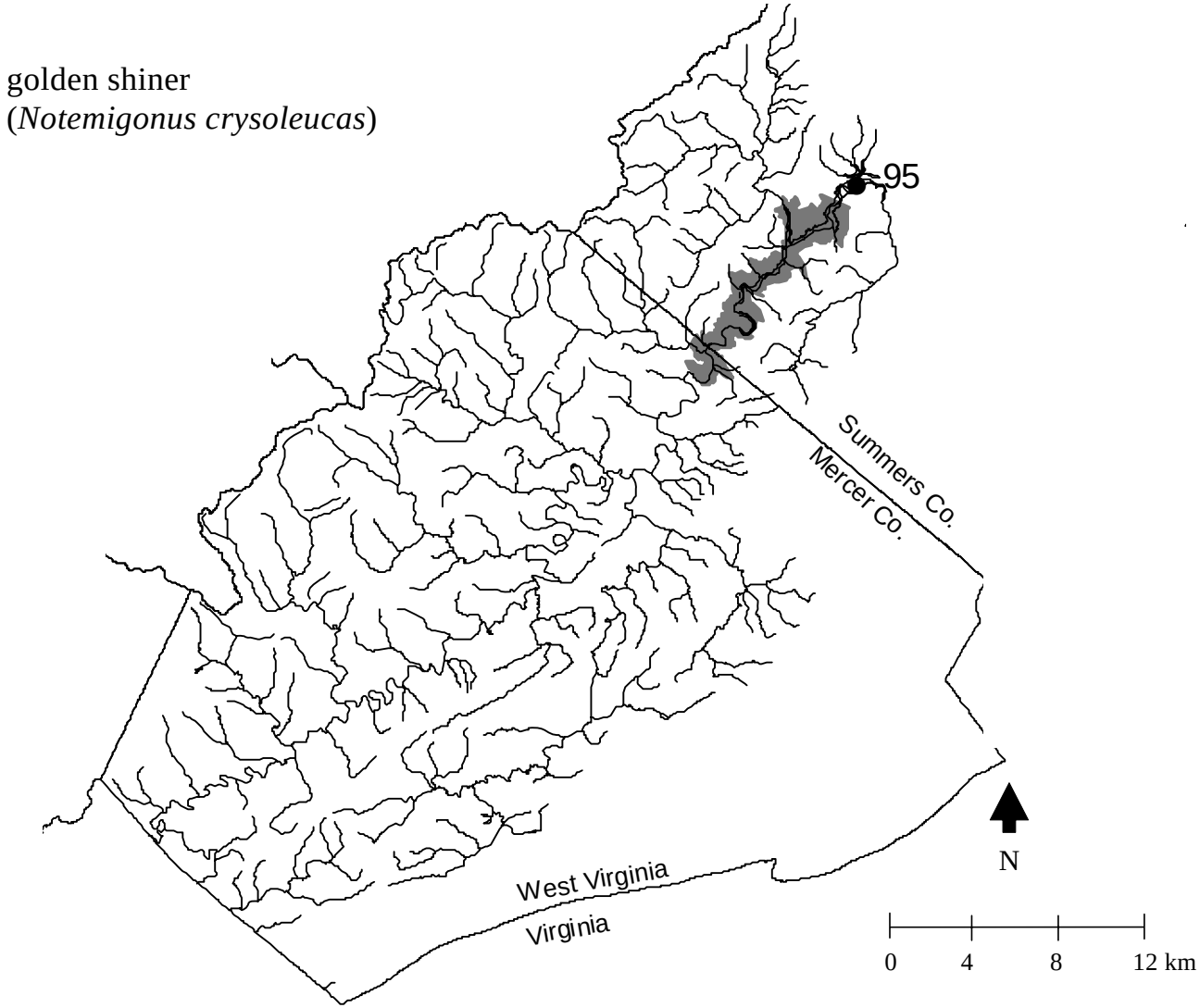
Appendix A-10. Collection sites of white shiner (*Luxilus albeolus*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



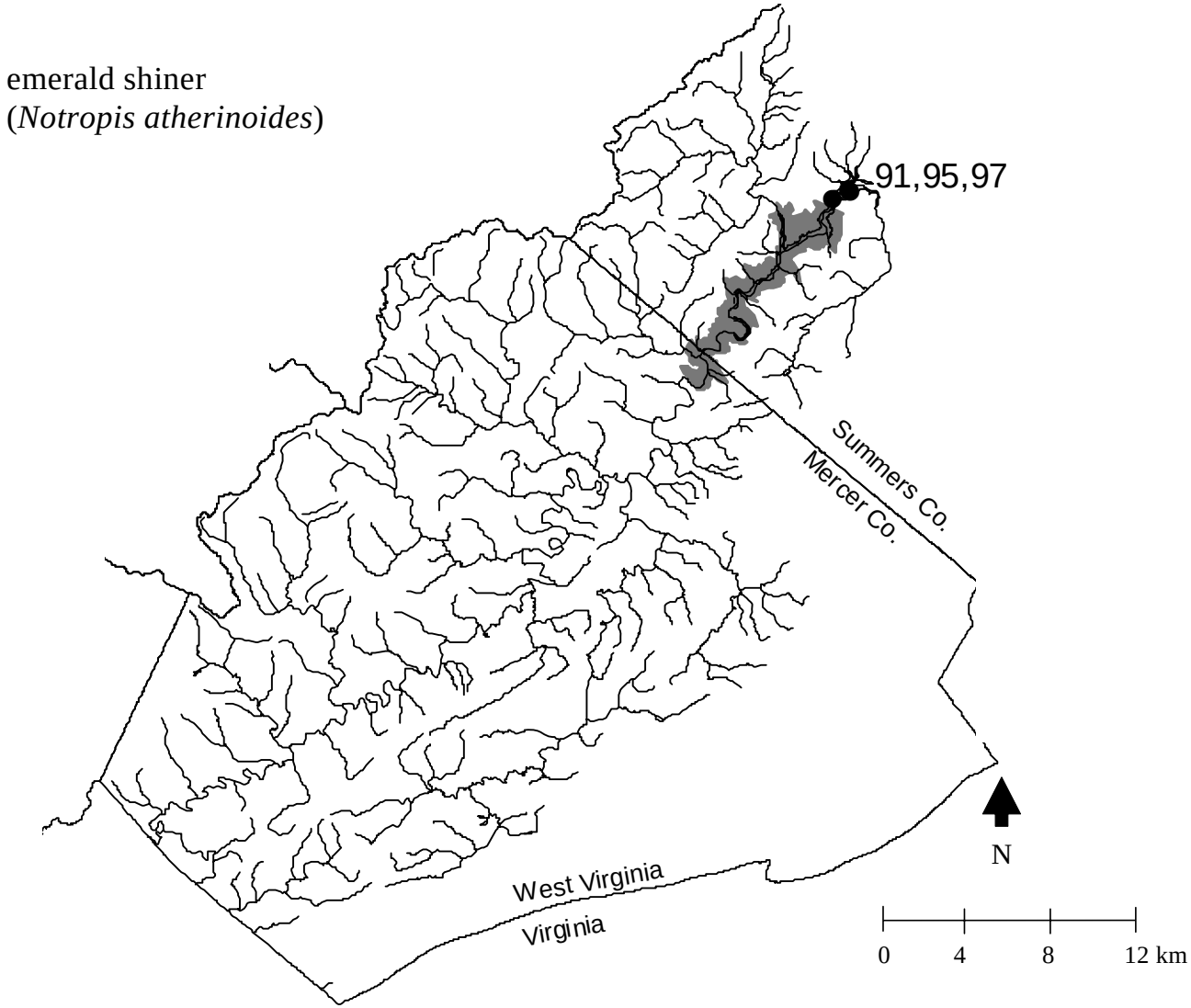
Appendix A-11. Collection sites of striped shiner (*Luxilus chrysocephalus*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



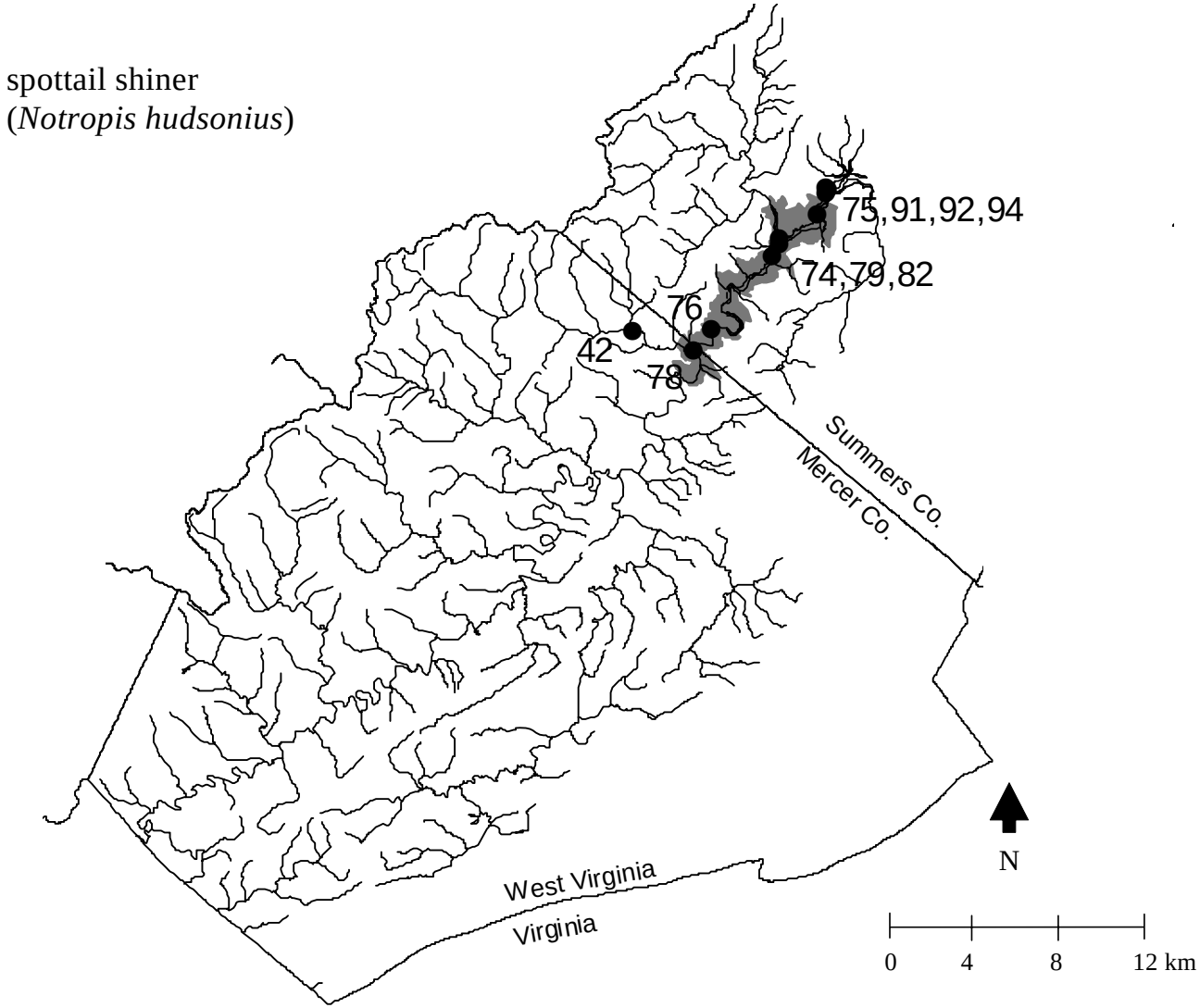
Appendix A-12. Collection sites of bigmouth chub (*Nocomis platyrhynchus*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



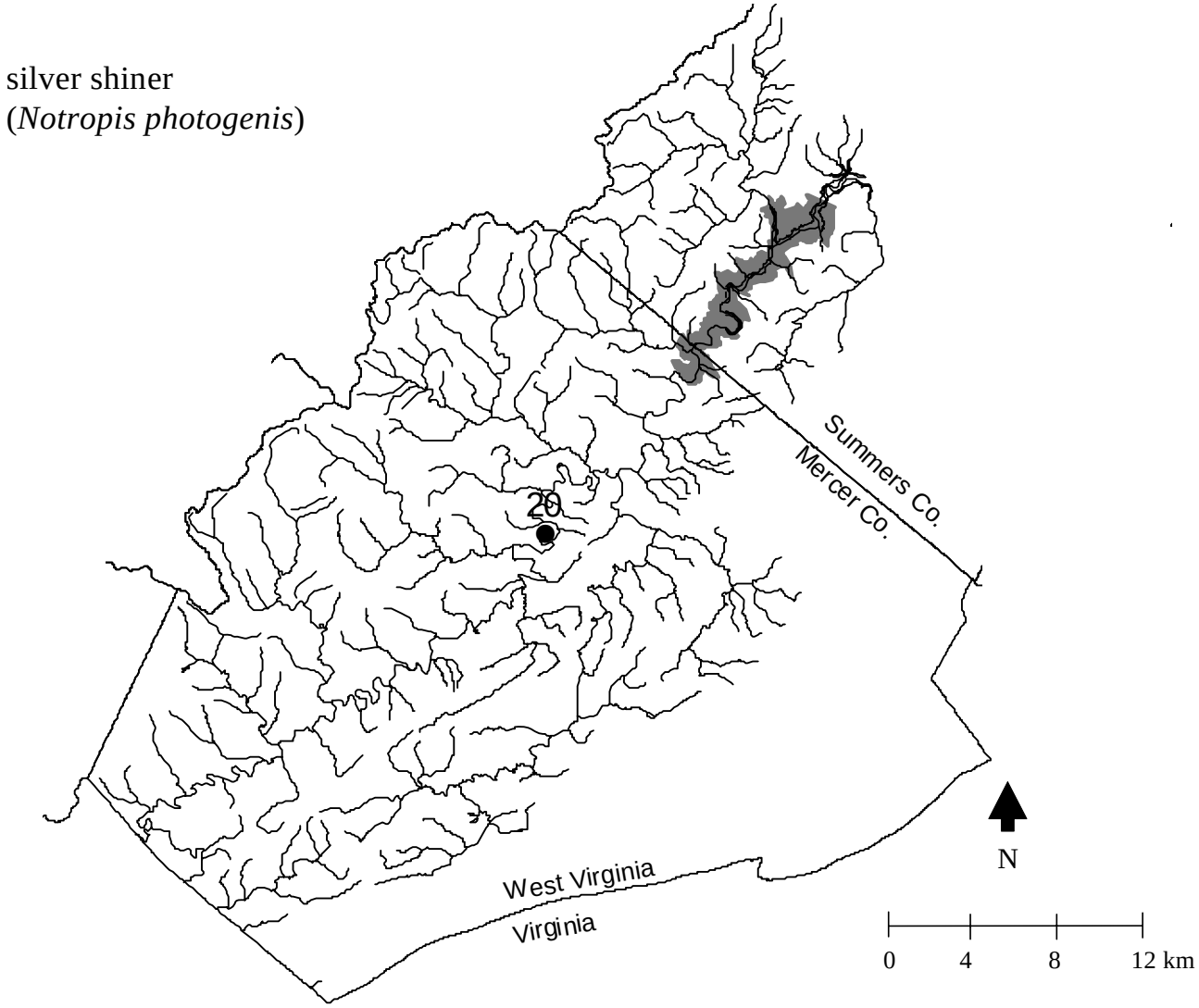
Appendix A-13. Collection sites of *Notemigonus crysoleucas* (golden shiner) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



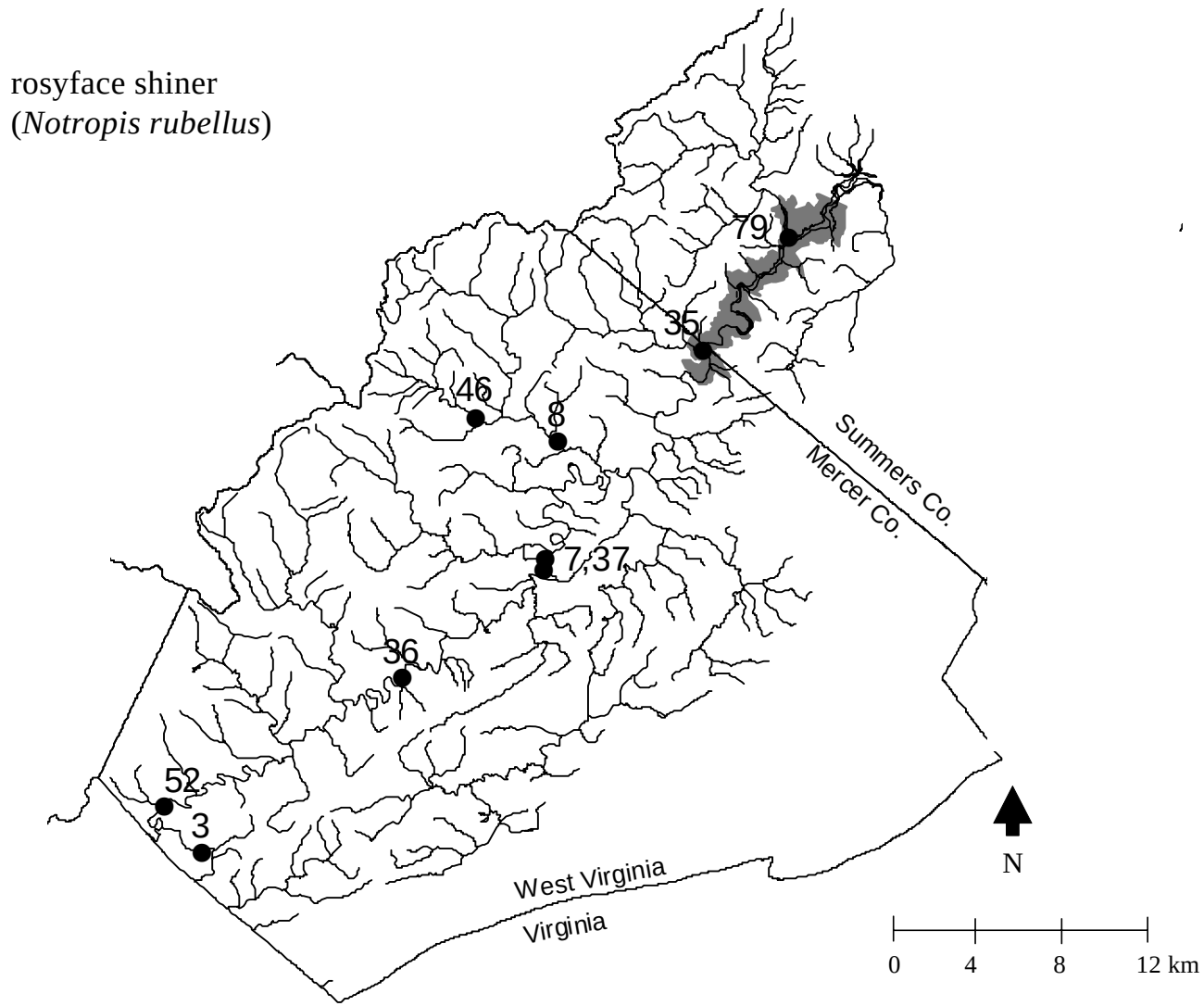
Appendix A-14. Collection sites of emerald shiner (*Notropis atherinoides*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



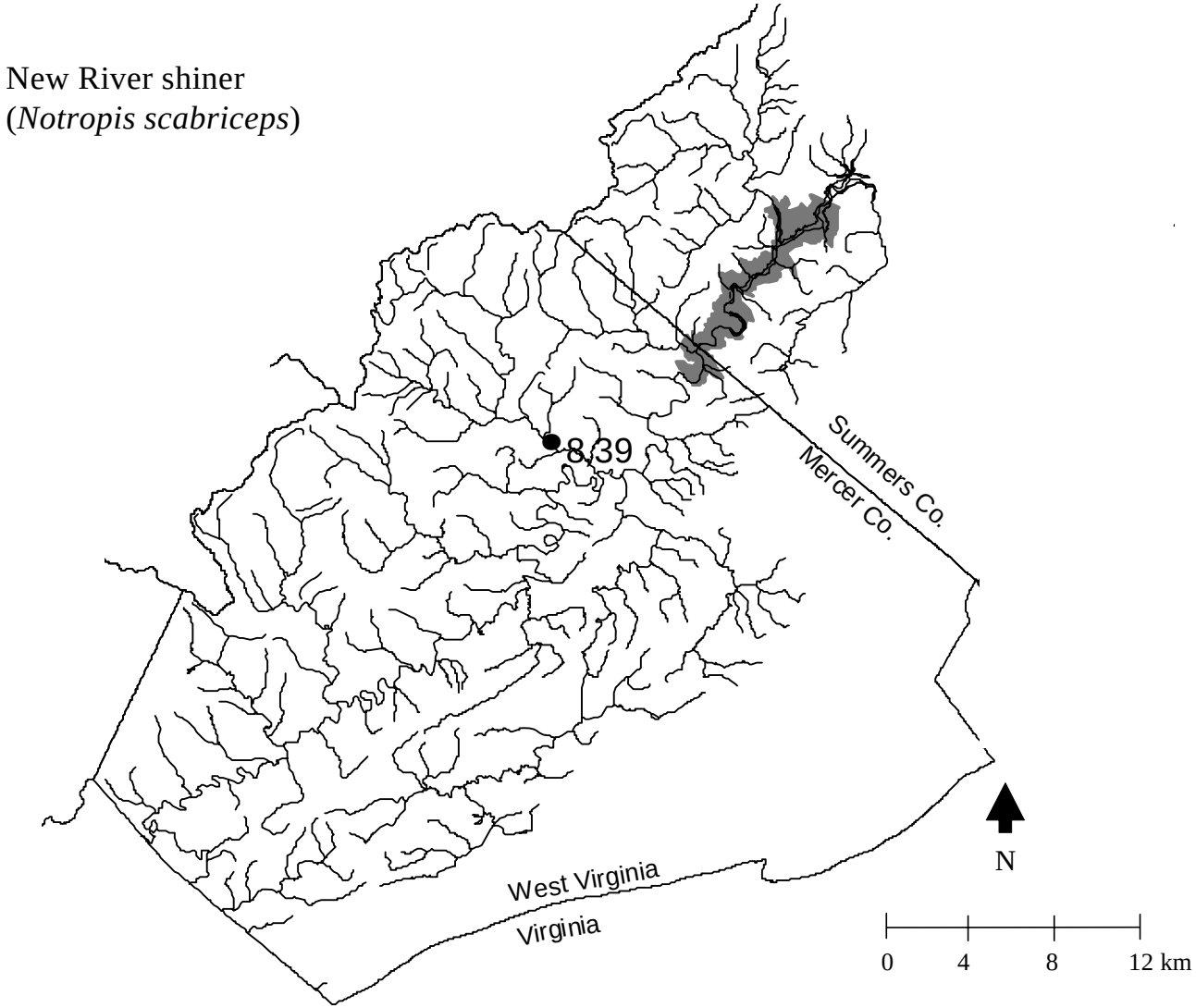
Appendix A-15. Collection sites of spottail shiner (*Notropis hudsonius*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



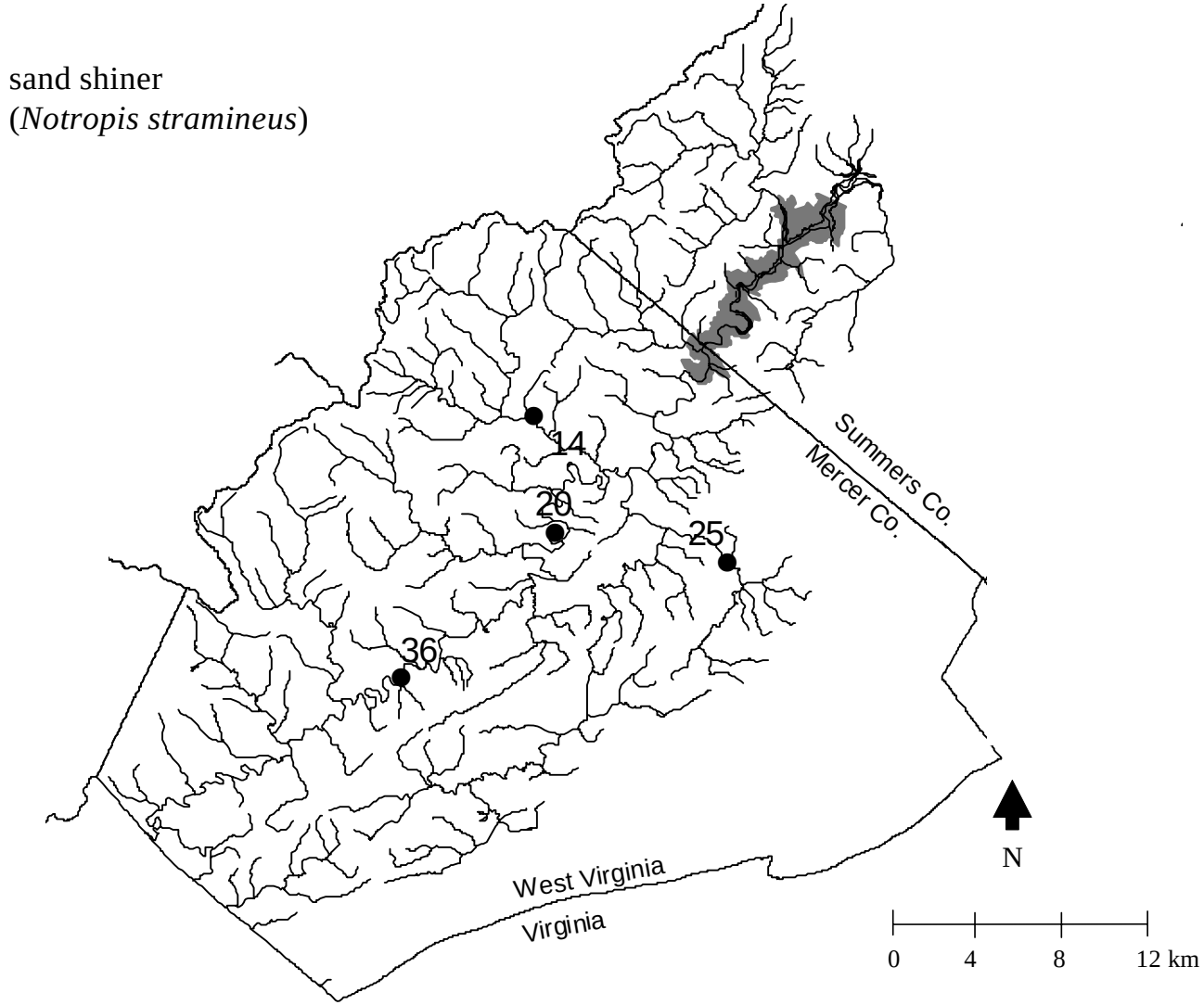
Appendix A-16. Collection sites of silver shiner (*Notropis photogenis*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



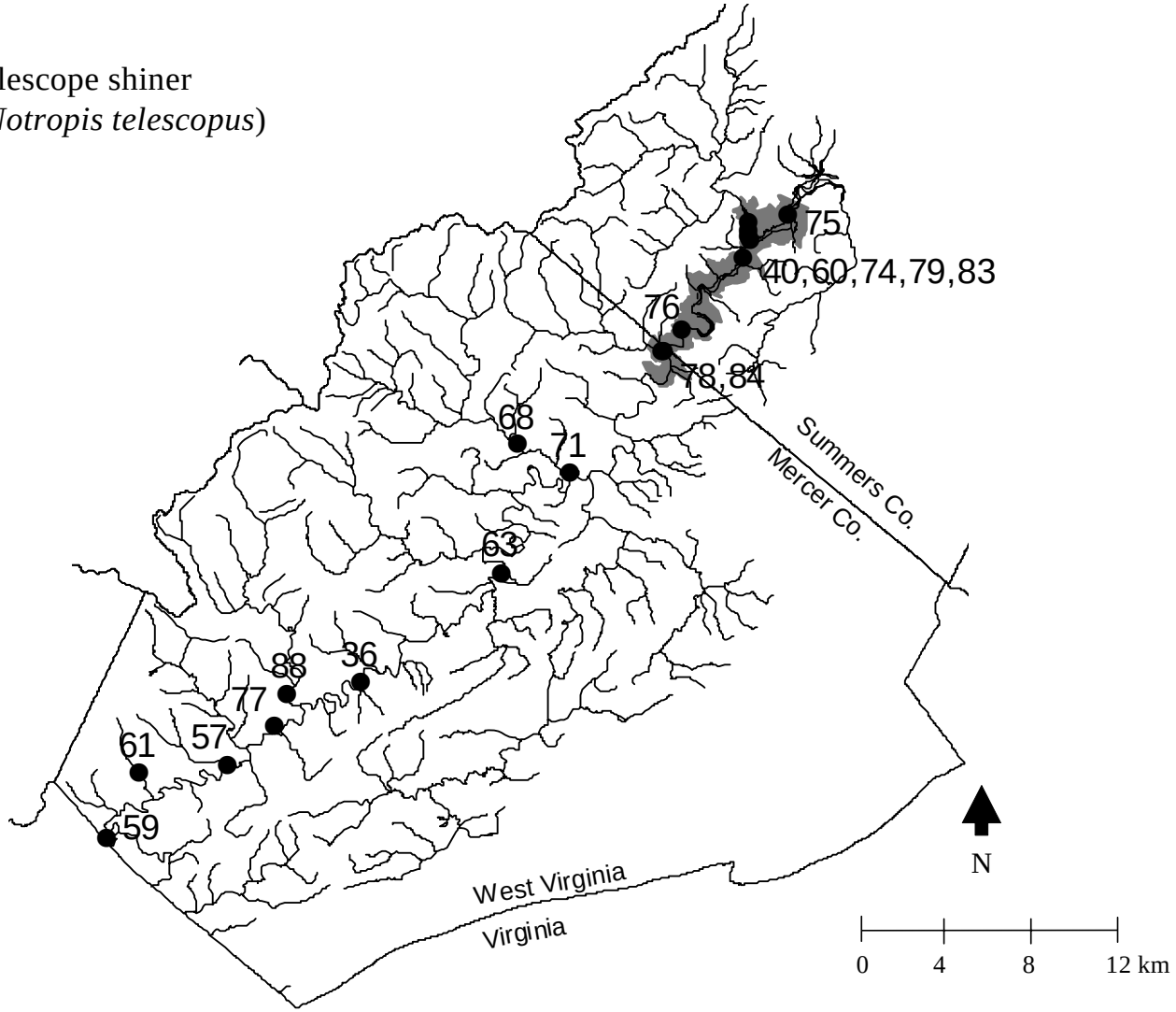
Appendix A-17. Collection sites of rosyface shiner (*Notropis rubellus*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



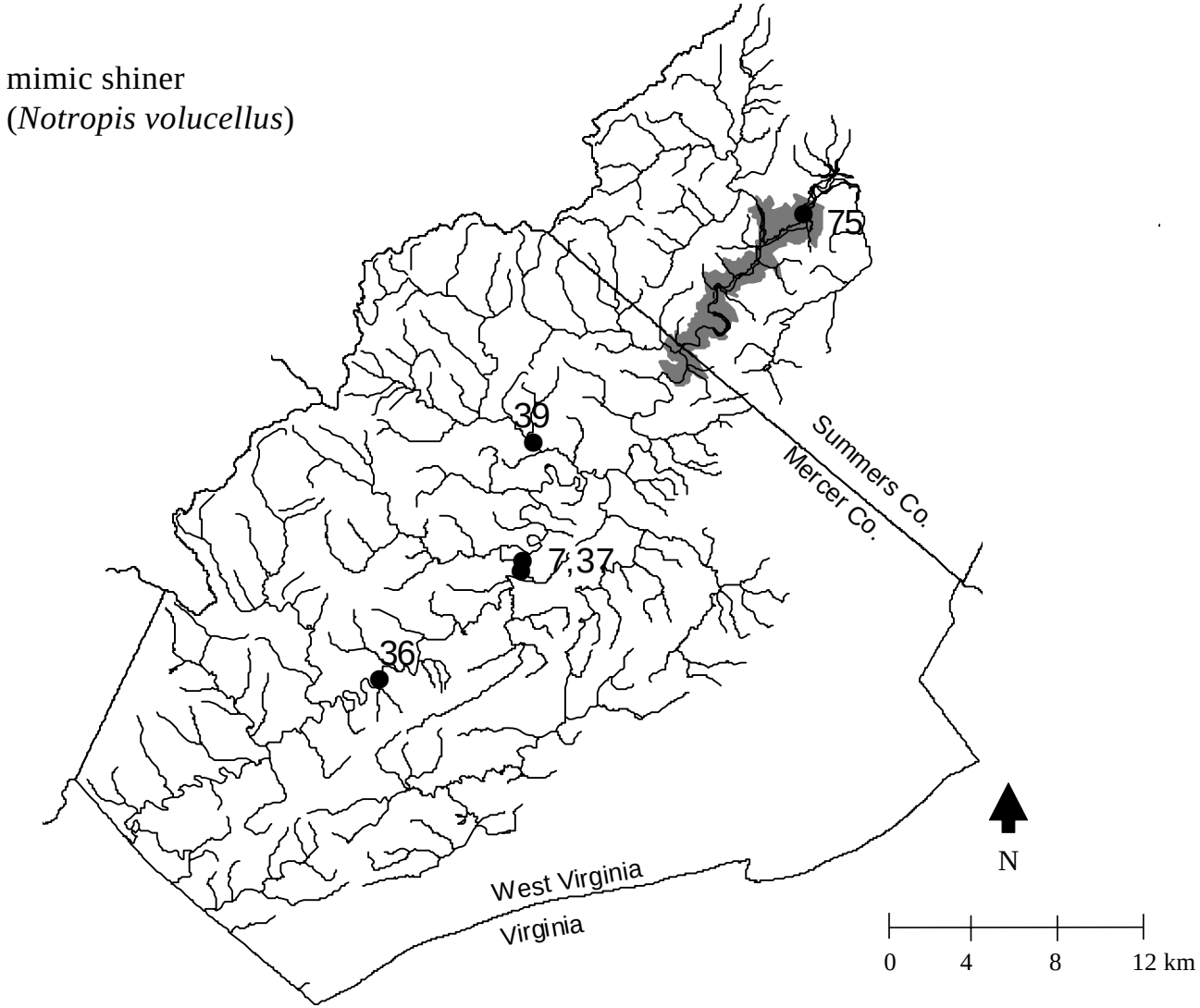
Appendix A-18. Collection sites of New River shiner (*Notropis scabriceps*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



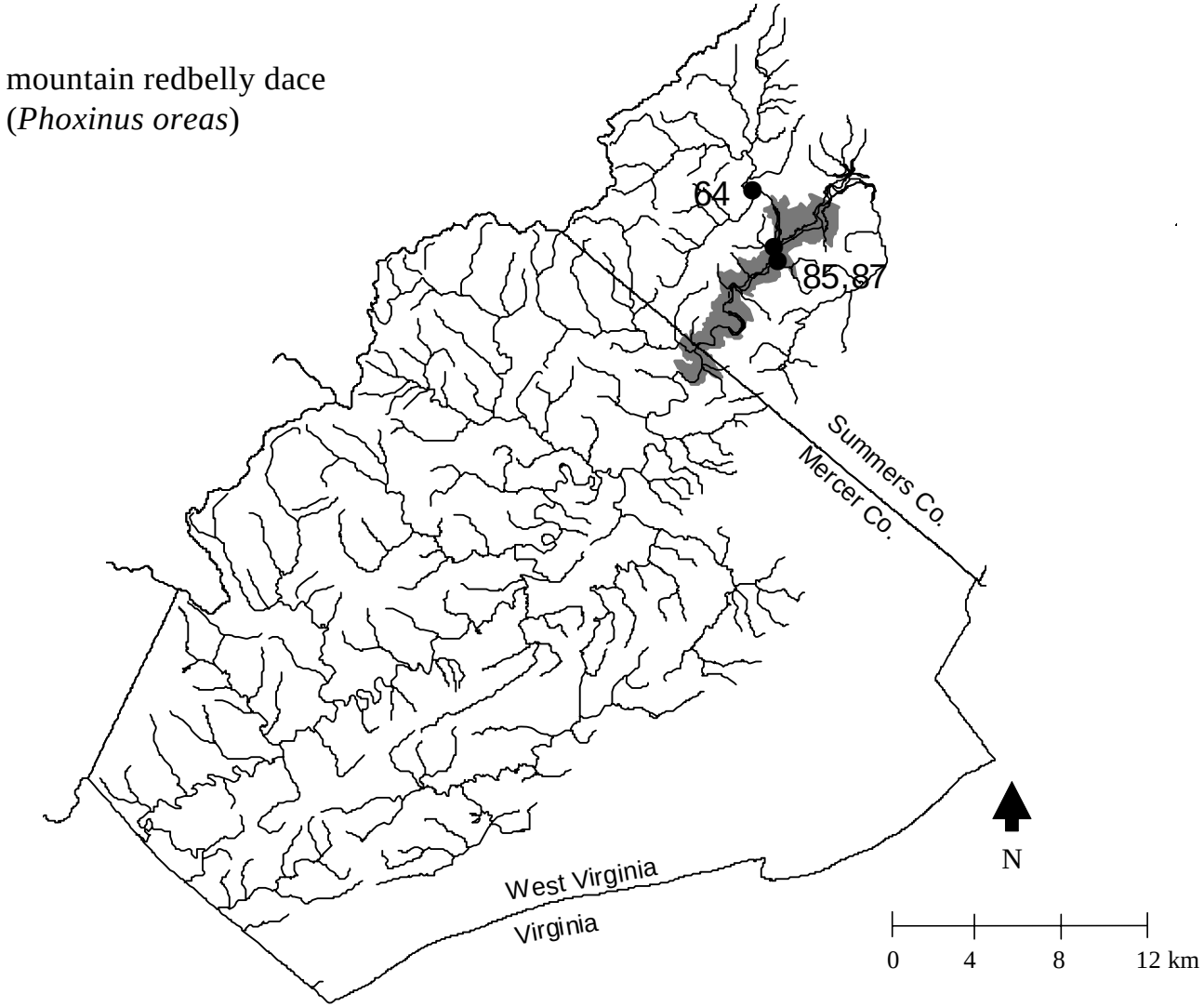
Appendix A-19. Collection sites of sand shiner (*Notropis stramineus*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



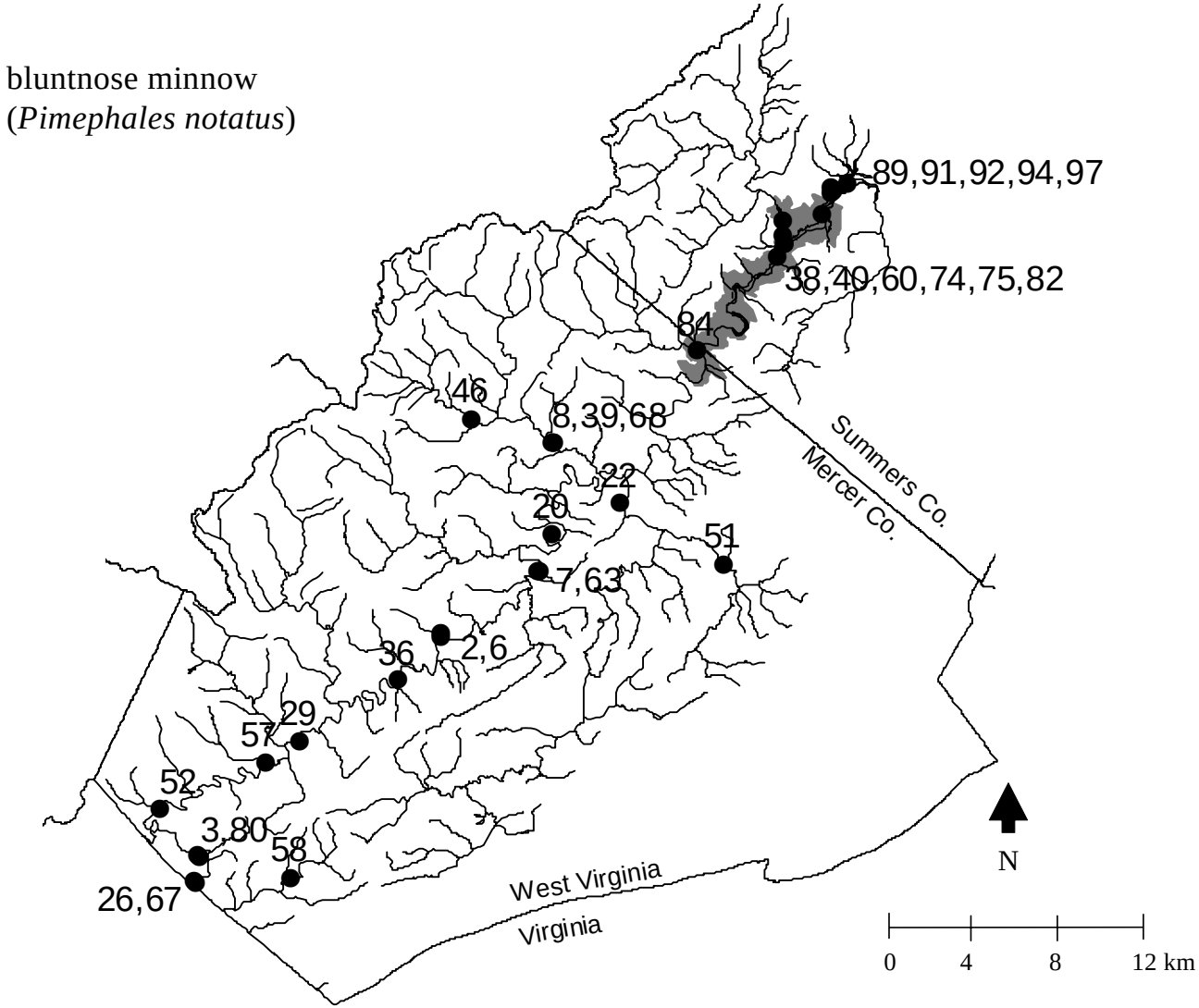
Appendix A-20. Collection sites of telescope shiner (*Notropis telescopus*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



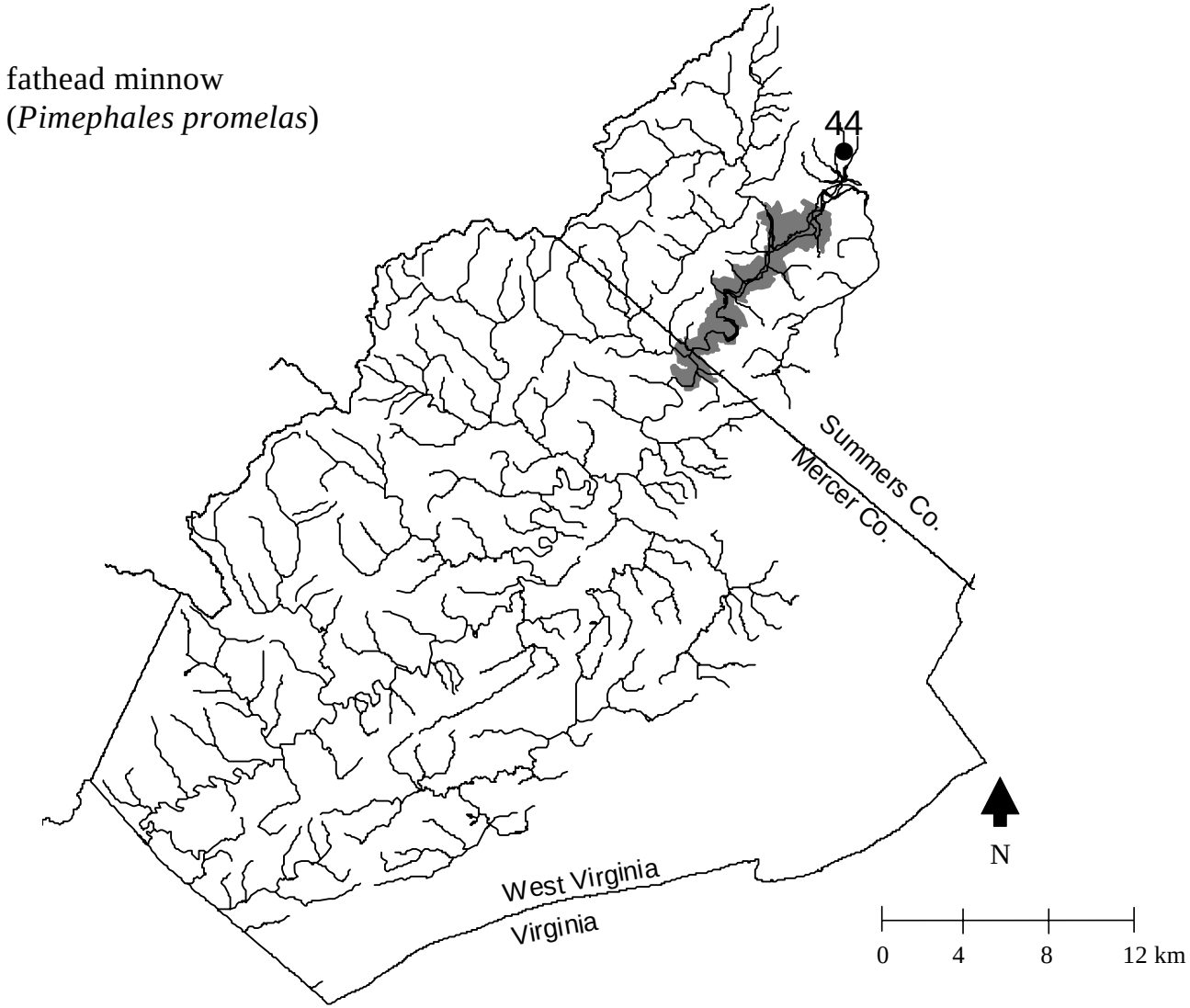
Appendix A-21. Collection sites of mimic shiner (*Notropis volucellus*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



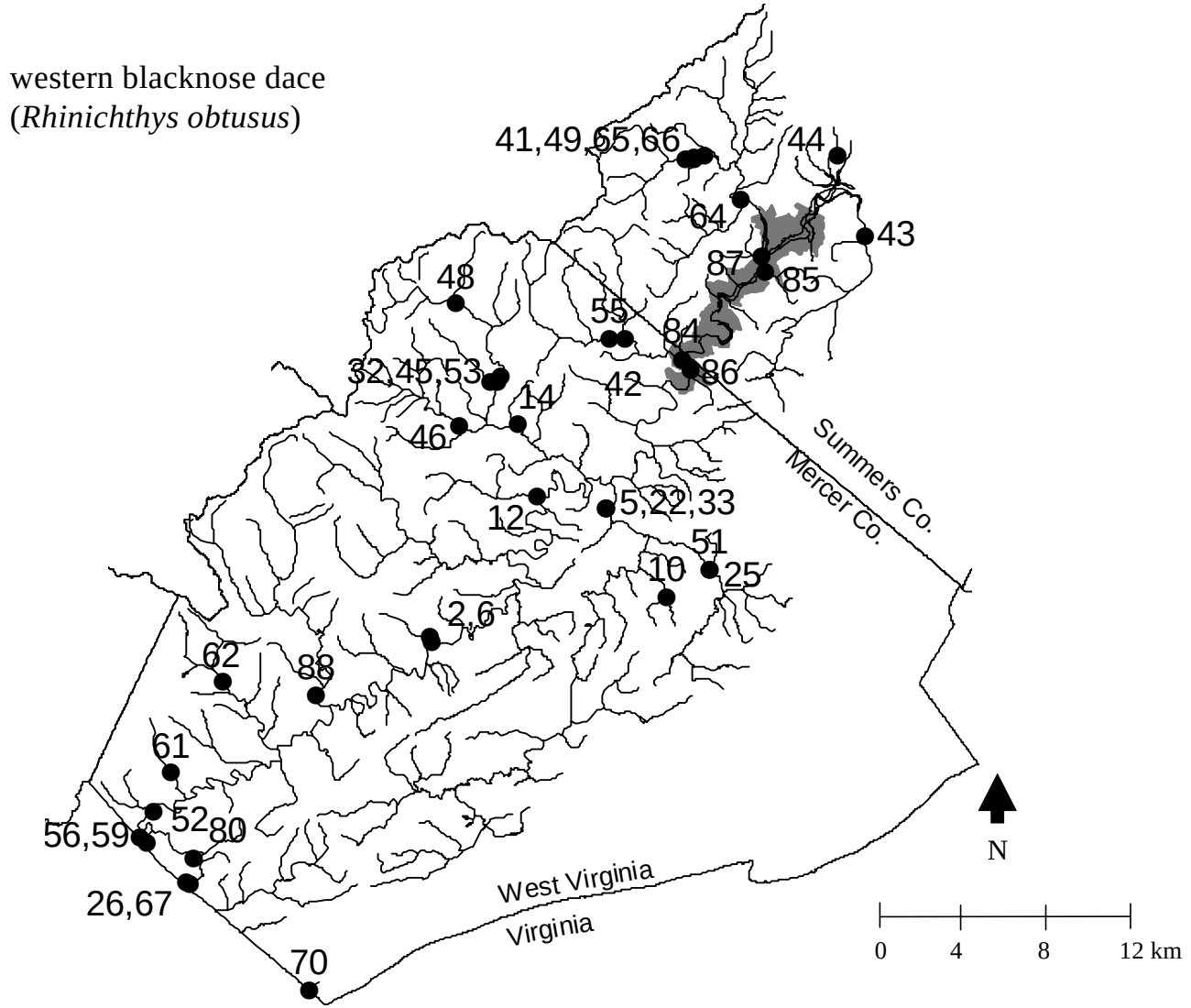
Appendix A-22. Collection sites of mountain redbelly dace (*Phoxinus oreas*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



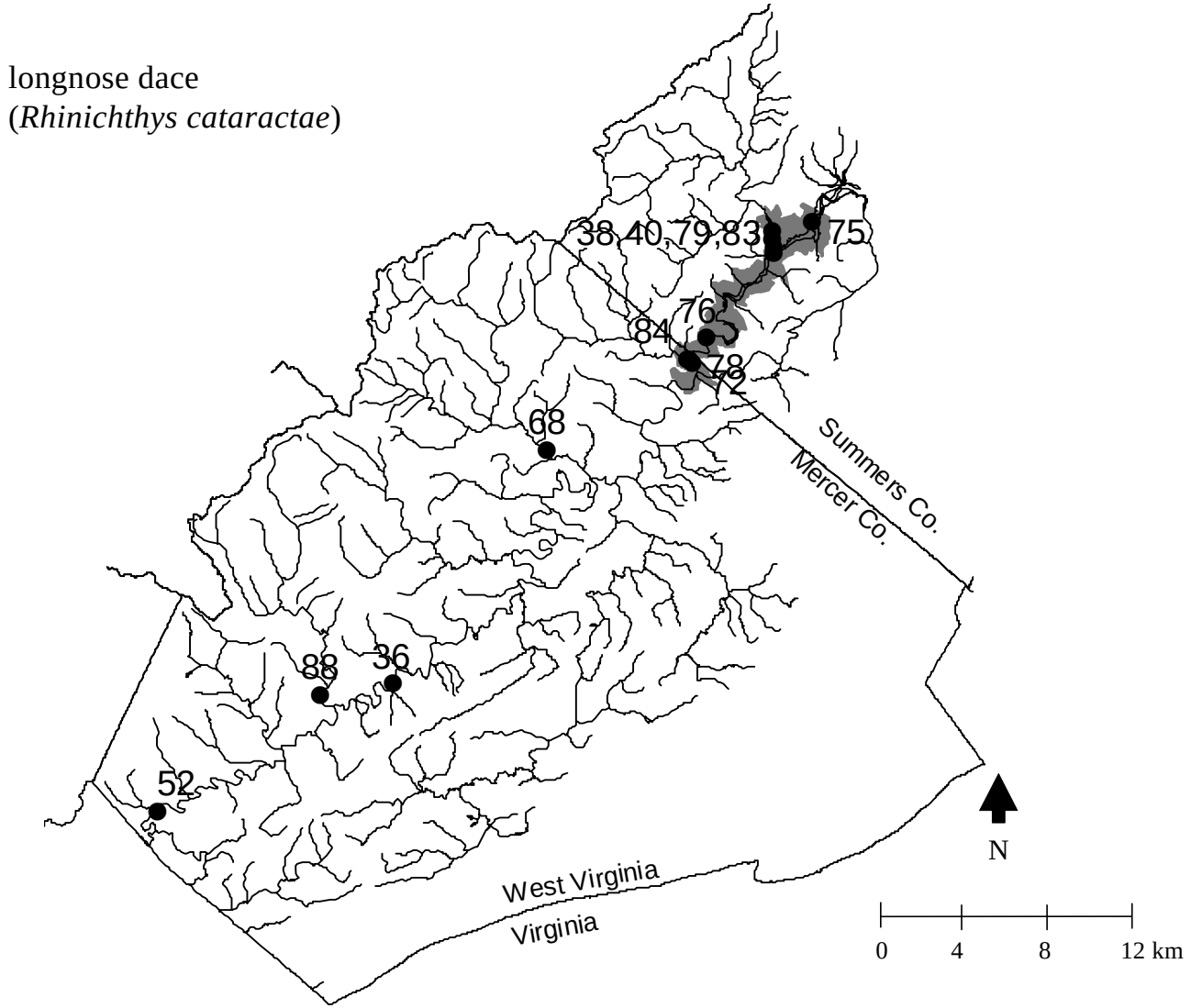
Appendix A-23. Collection sites of bluntnose minnow (*Pimephales notatus*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



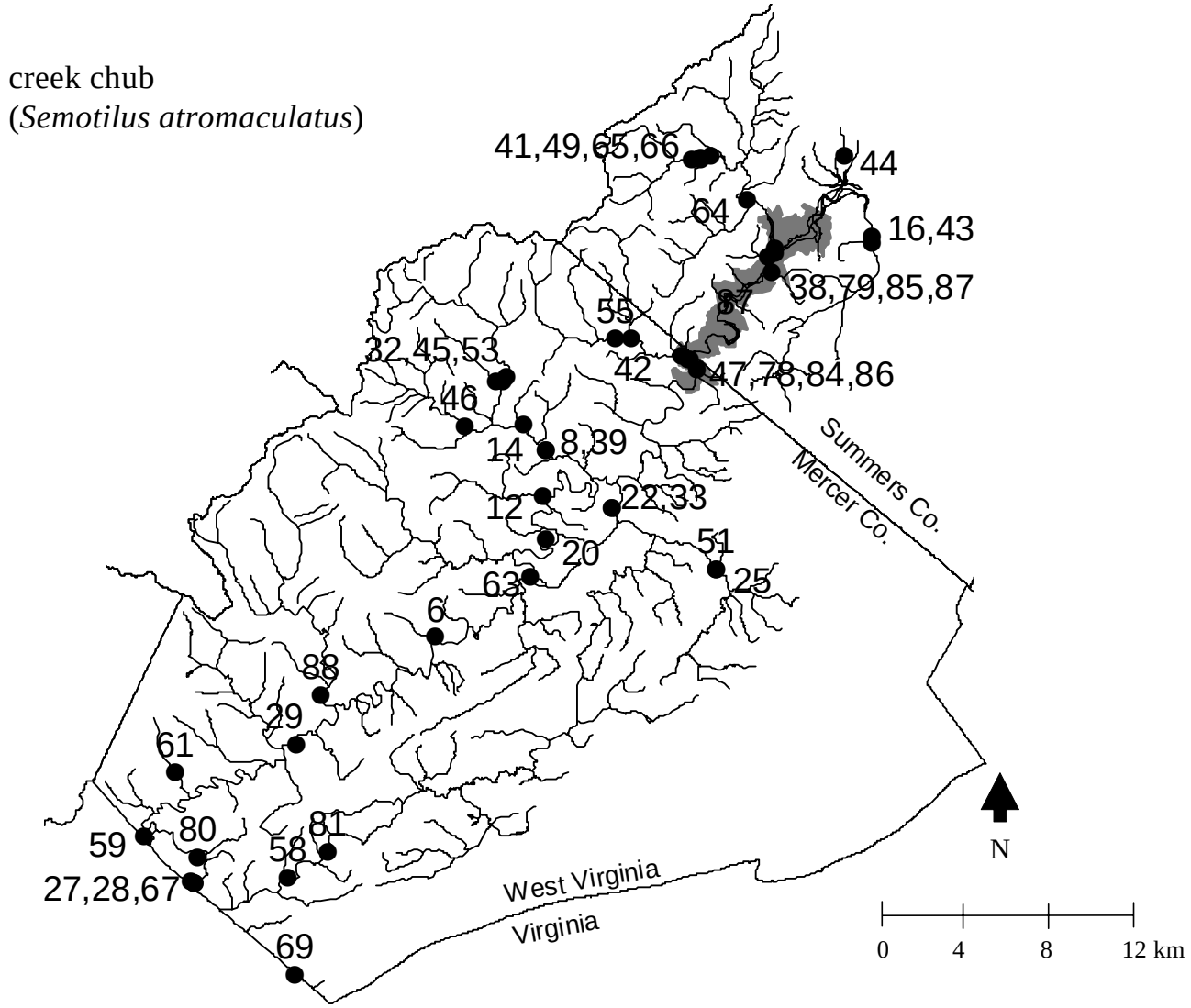
Appendix A-24. Collection sites of fathead minnow (*Pimephales promelas*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



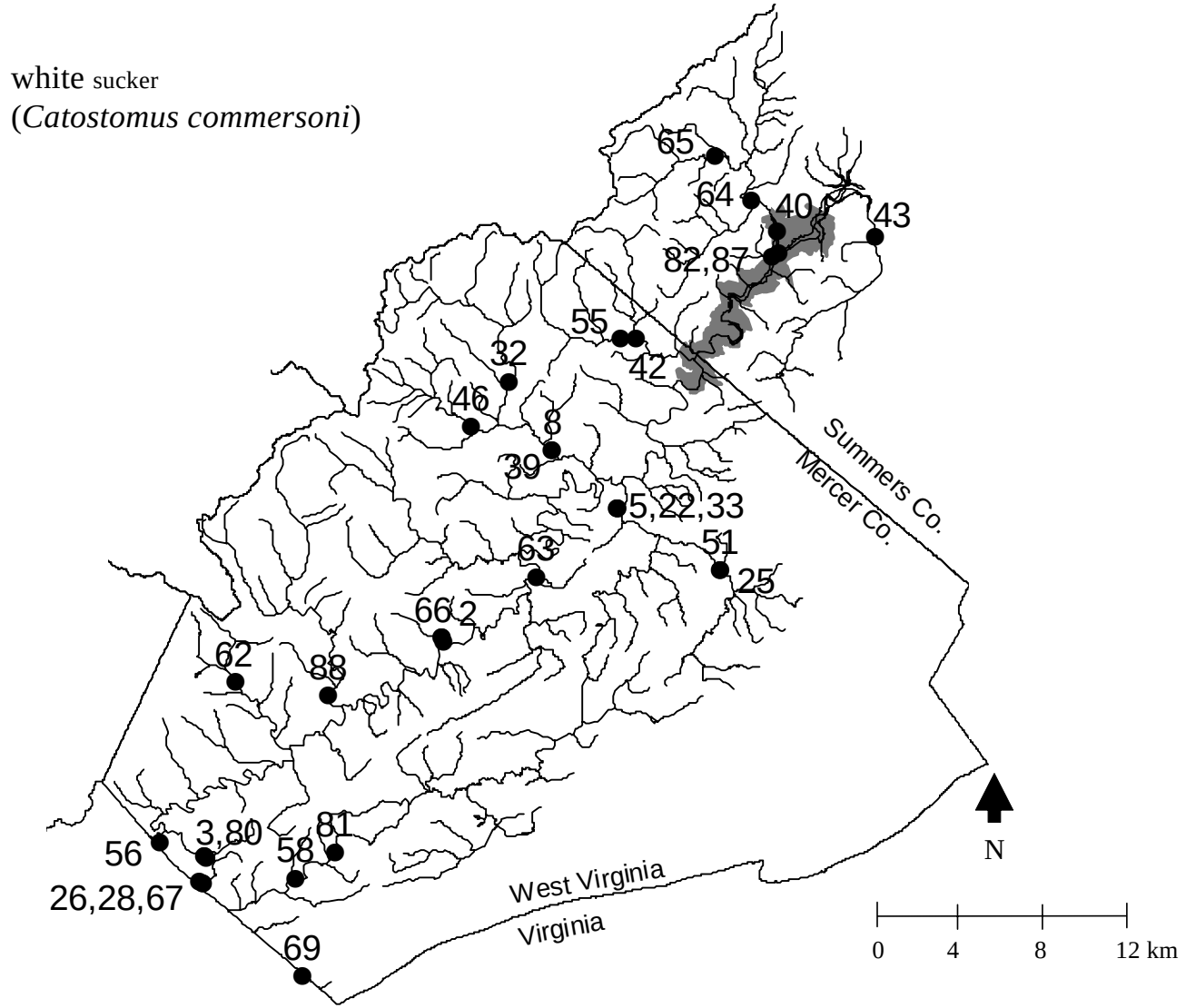
Appendix A-25. Collection sites of western blacknose dace (*Rhinichthys obtusus*) within the Bluestone River drainage, West Virgini
Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



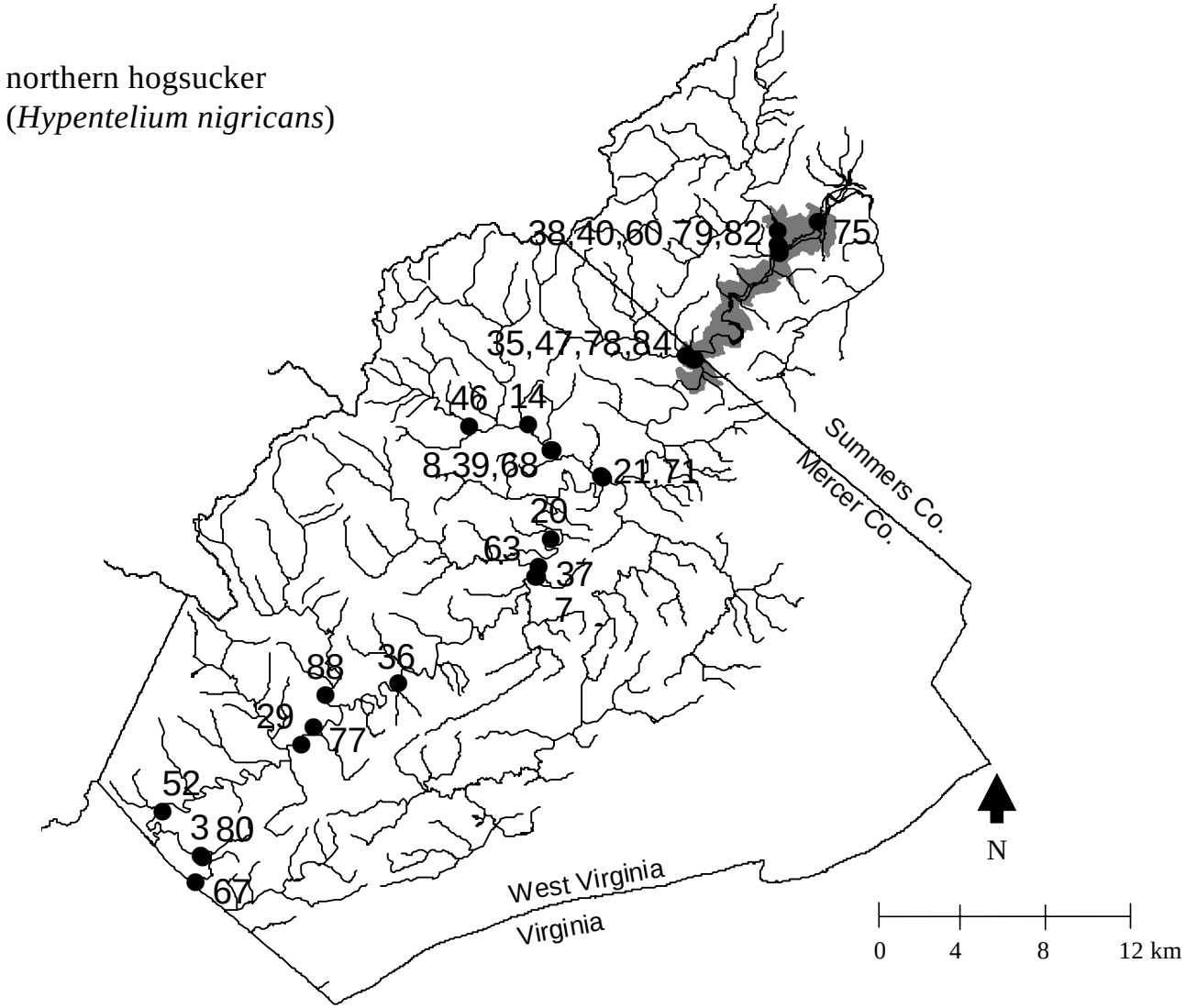
Appendix A-26. Collection sites of longnose dace (*Rhinichthys cataractae*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



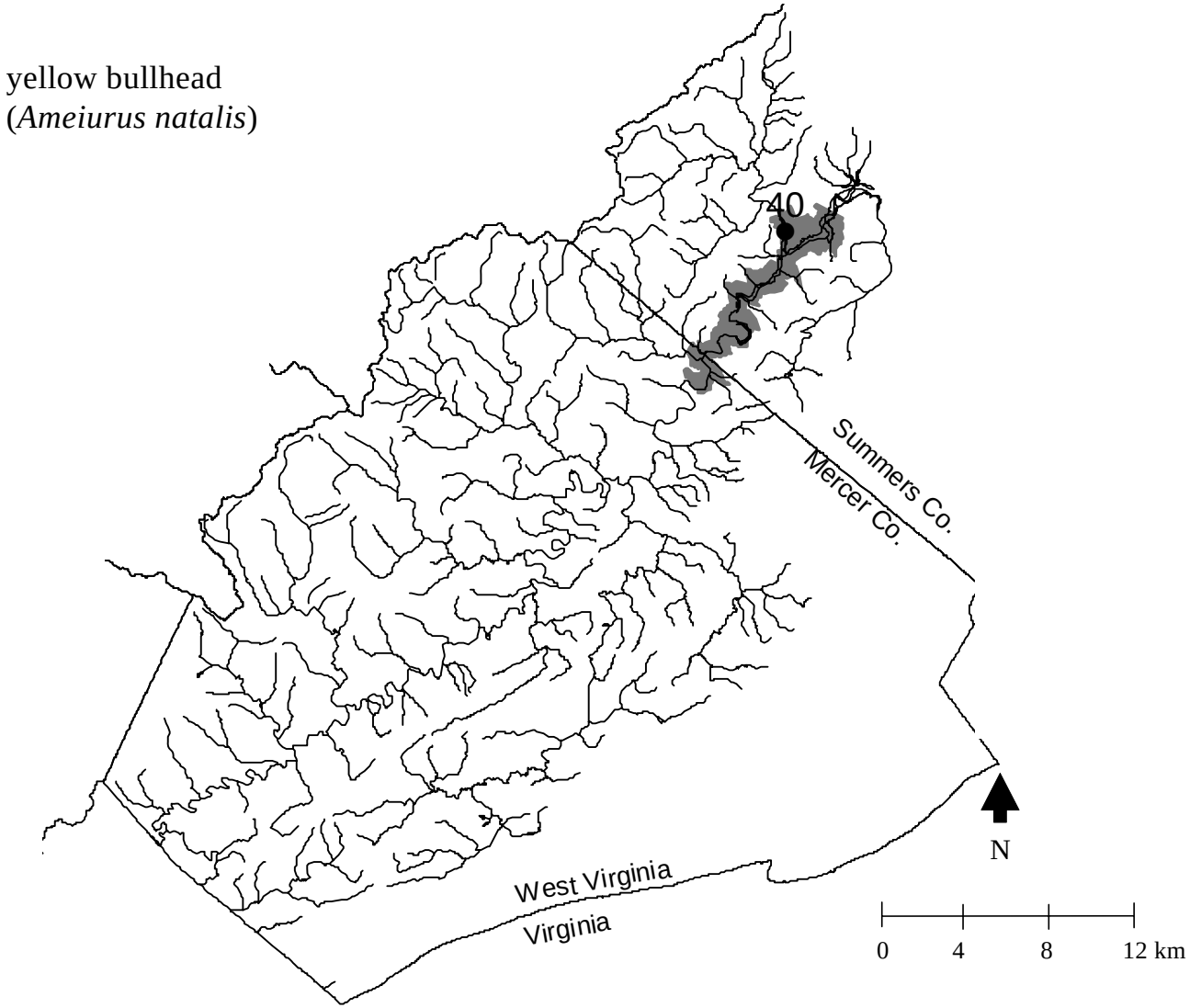
Appendix A-27. Collection sites of creek chub (*Semotilus atromaculatus*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



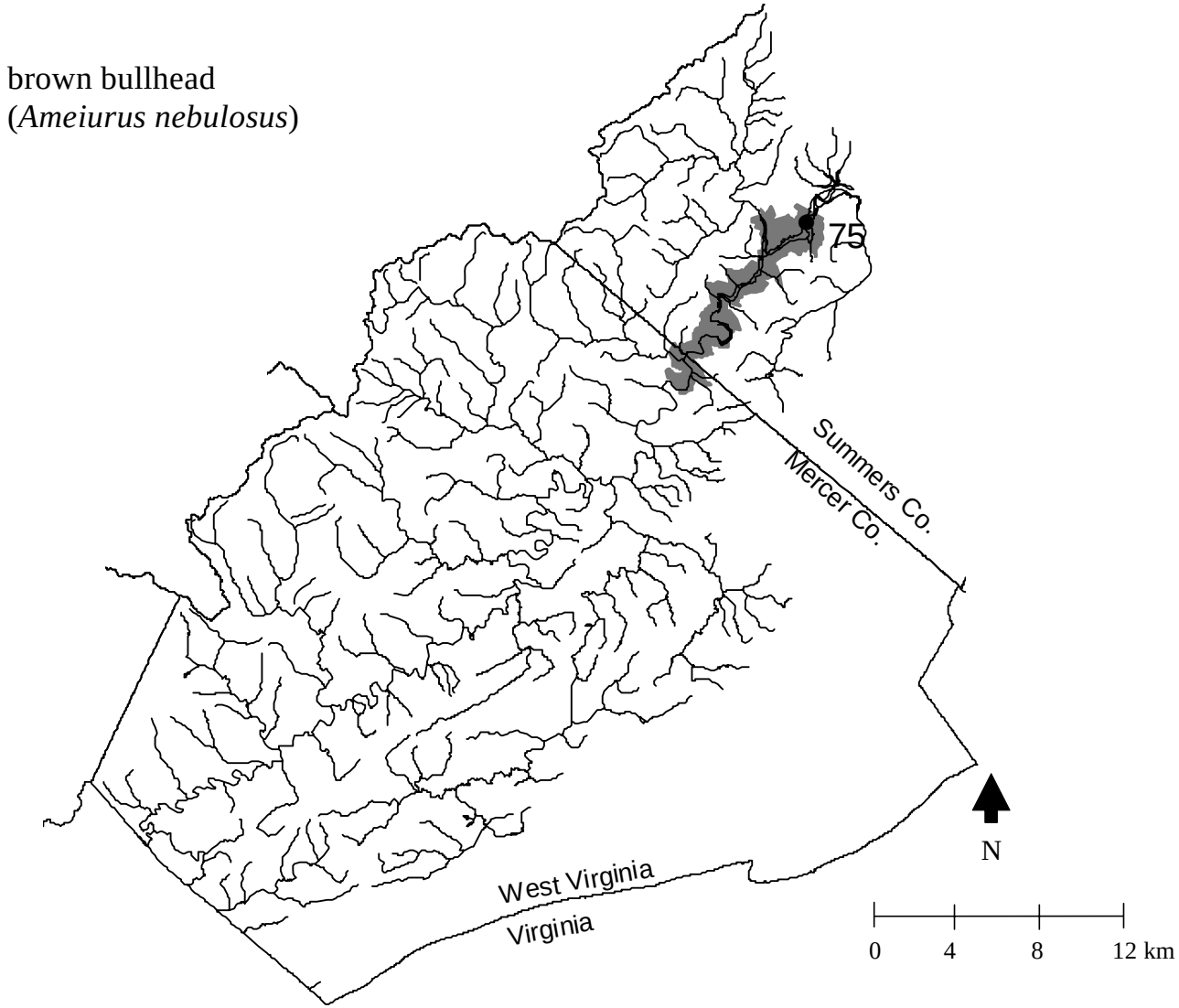
Appendix A-28. Collection sites of white sucker (*Catostomus commersoni*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



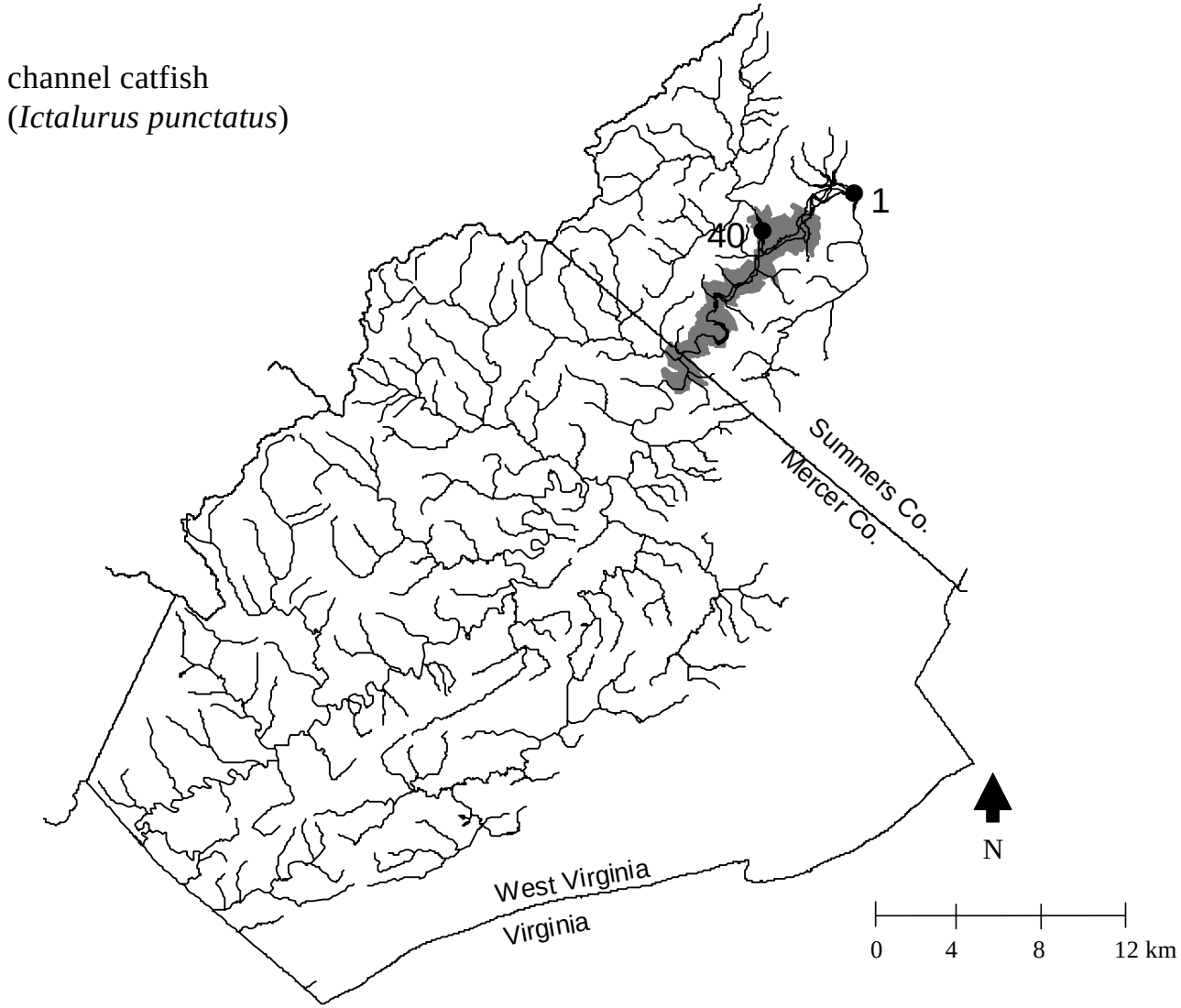
Appendix A-29. Collection sites of northern hogsucker (*Hypentelium nigricans*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



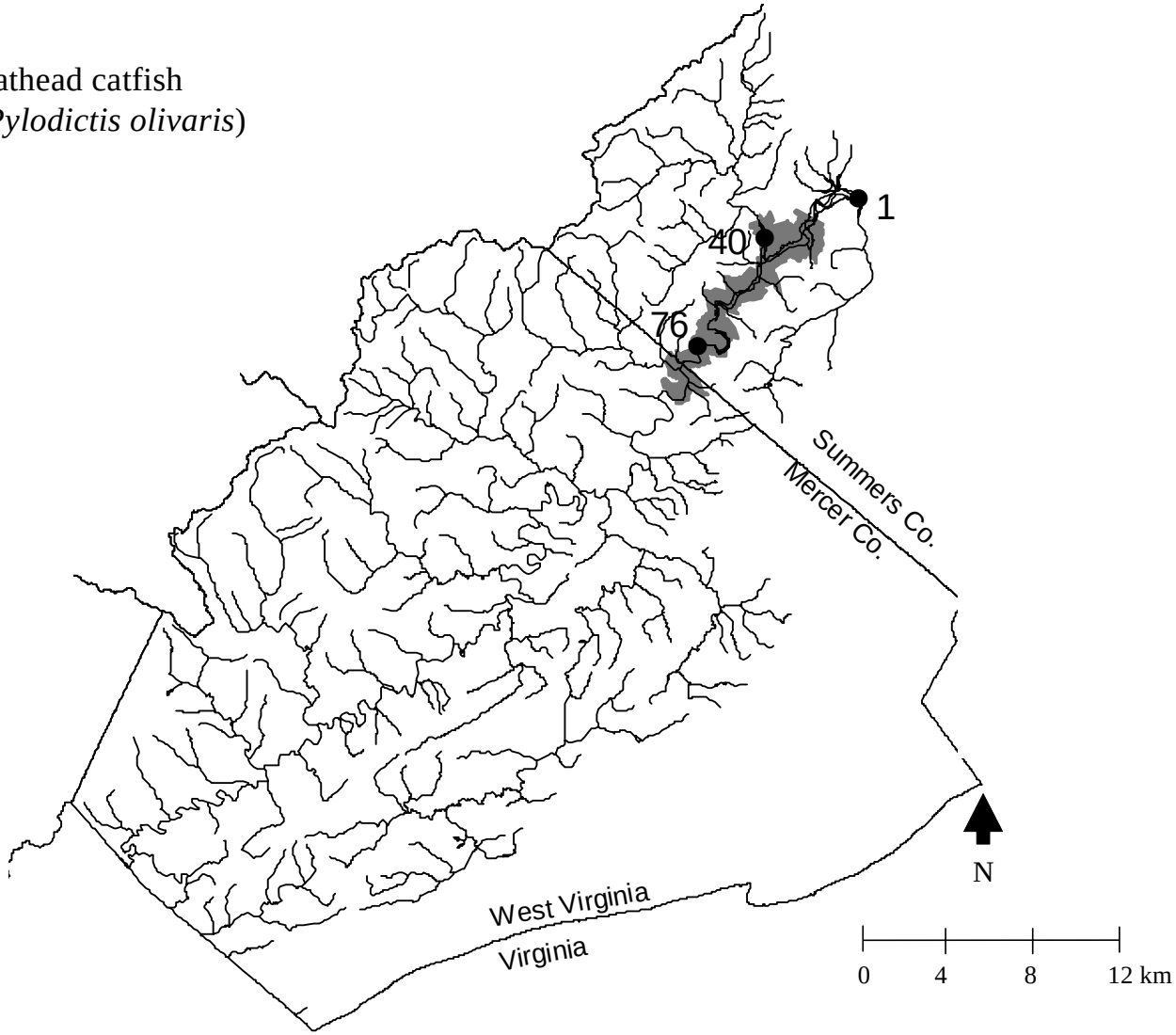
Appendix A-30. Collection sites of yellow bullhead (*Ameiurus natalis*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



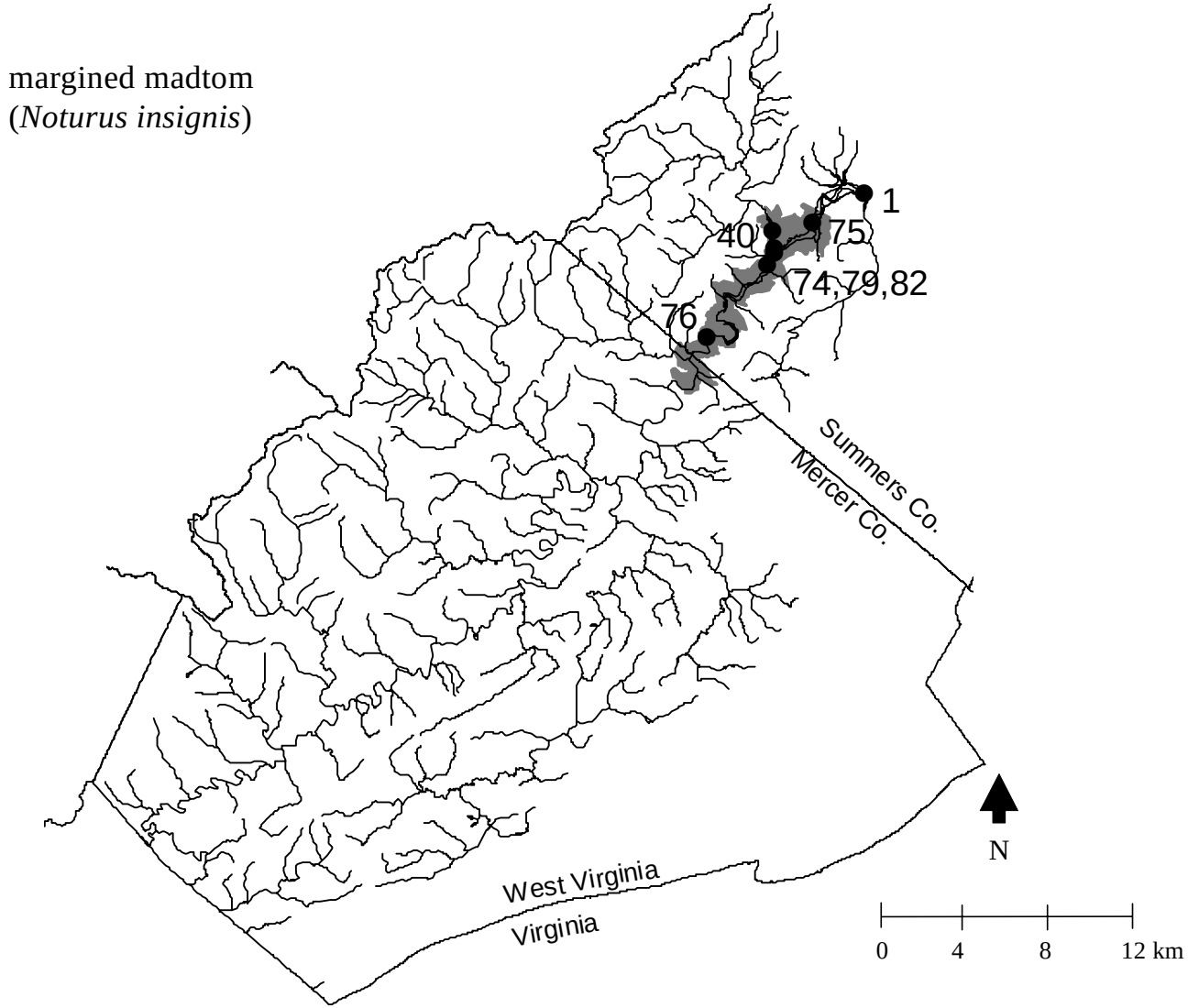
Appendix A-31. Collection sites of brown bullhead (*Ameiurus nebulosus*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



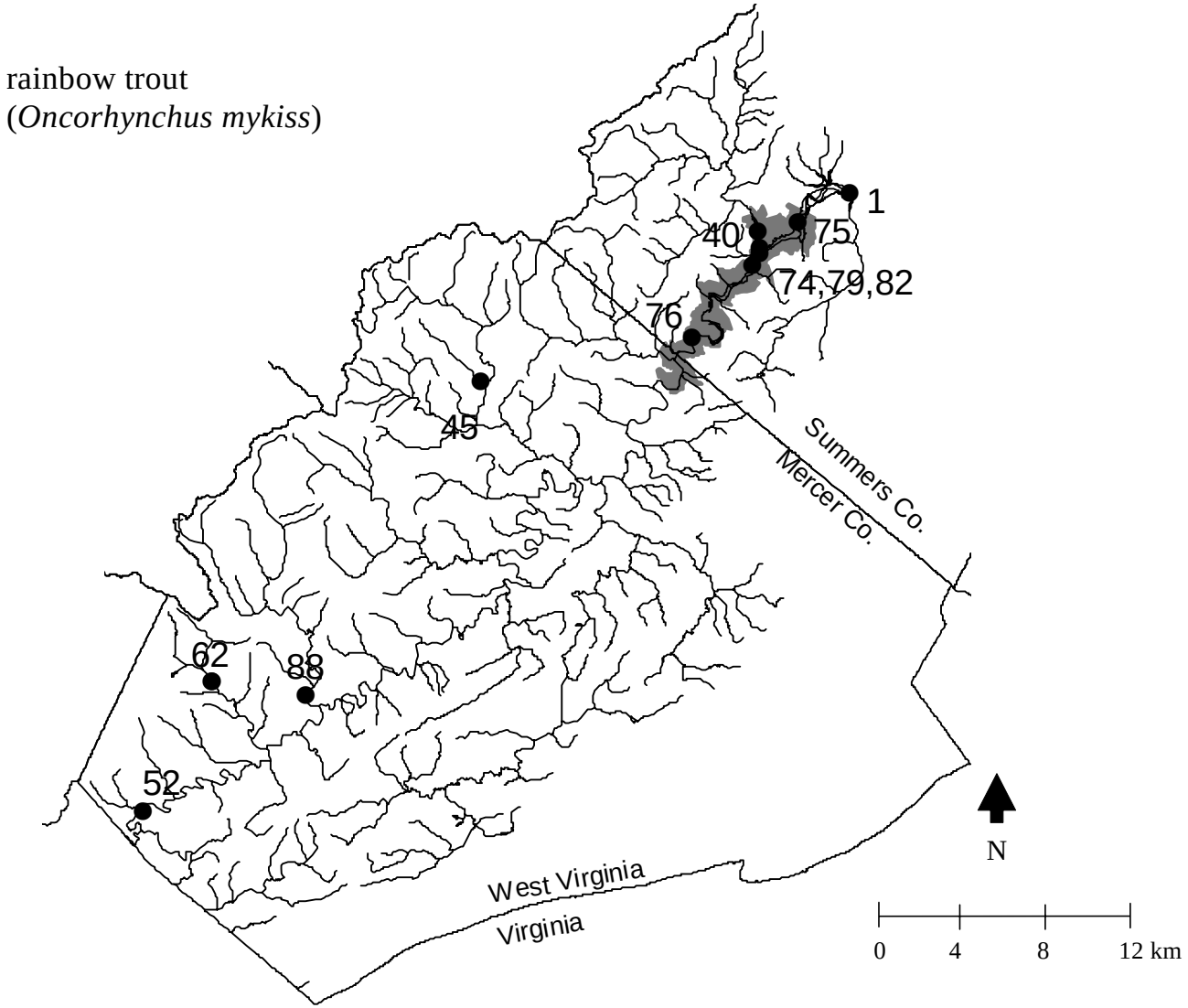
Appendix A-32. Collection sites of channel catfish (*Ictalurus punctatus*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



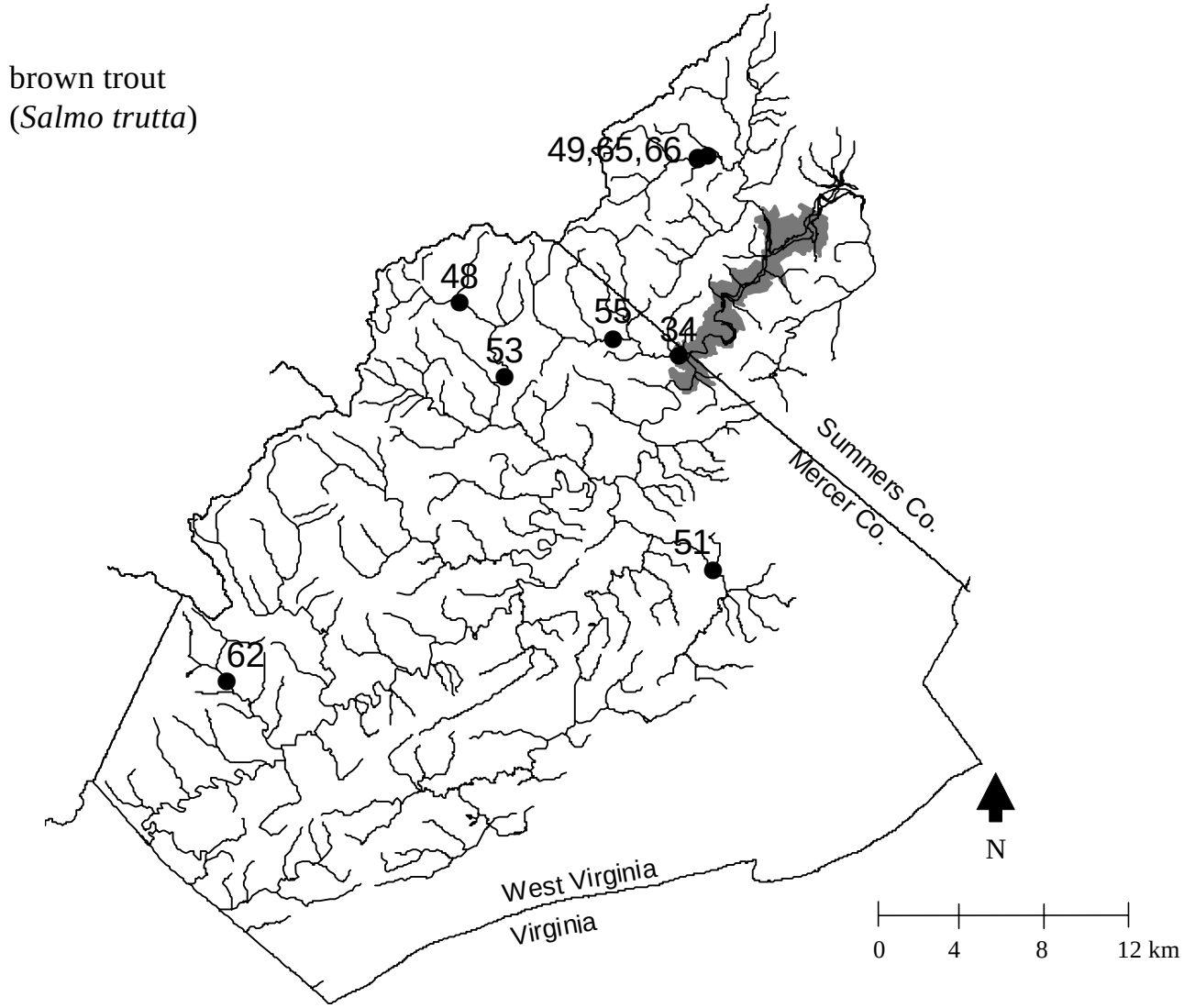
Appendix A-33. Collection sites of flathead catfish (*Pylodictis olivaris*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



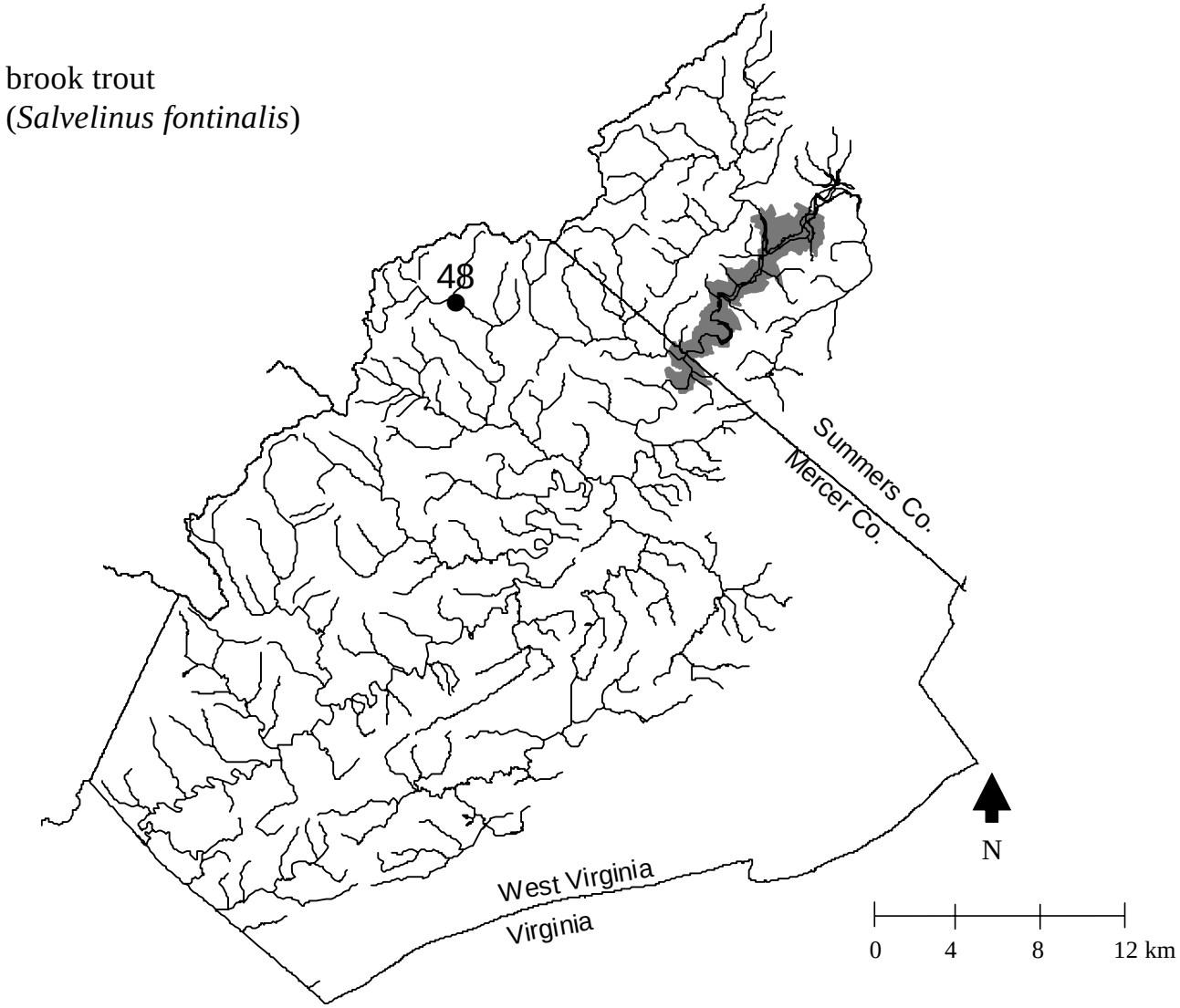
Appendix A-34. Collection sites of margined madtom (*Noturus insignis*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



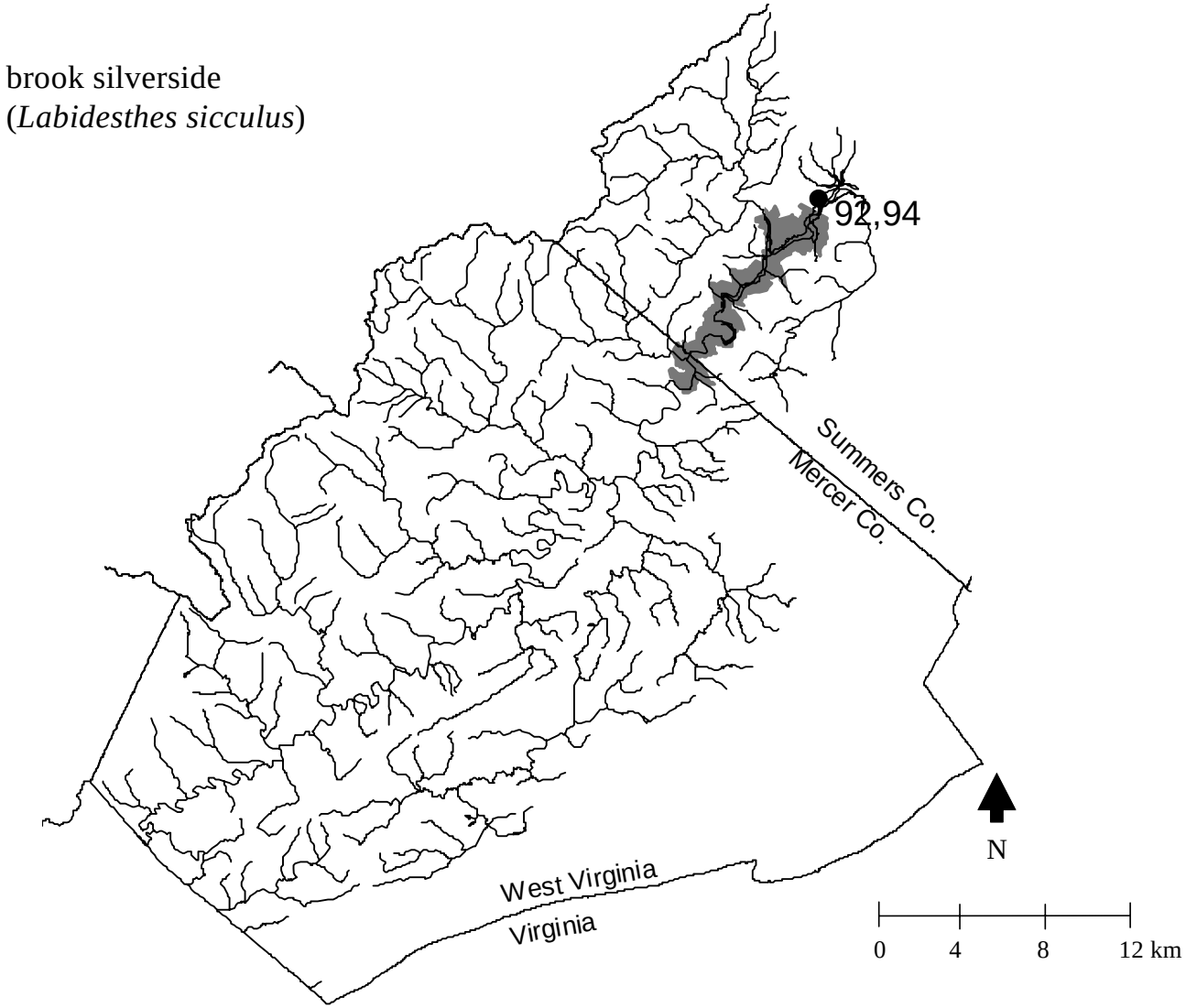
Appendix A-35. Collection sites of rainbow trout (*Oncorhynchus mykiss*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



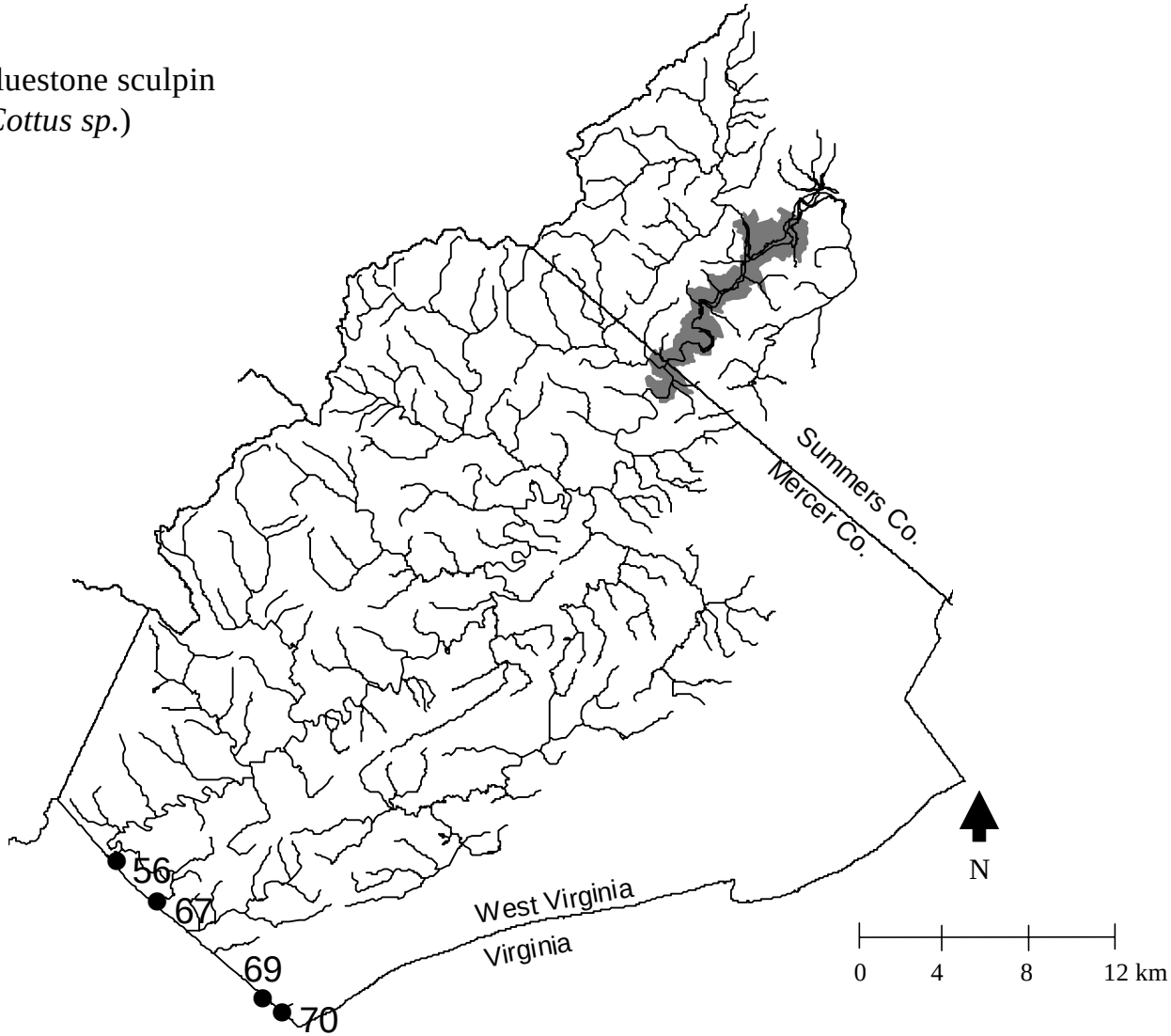
Appendix A-36. Collection sites of brown trout (*Salmo trutta*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



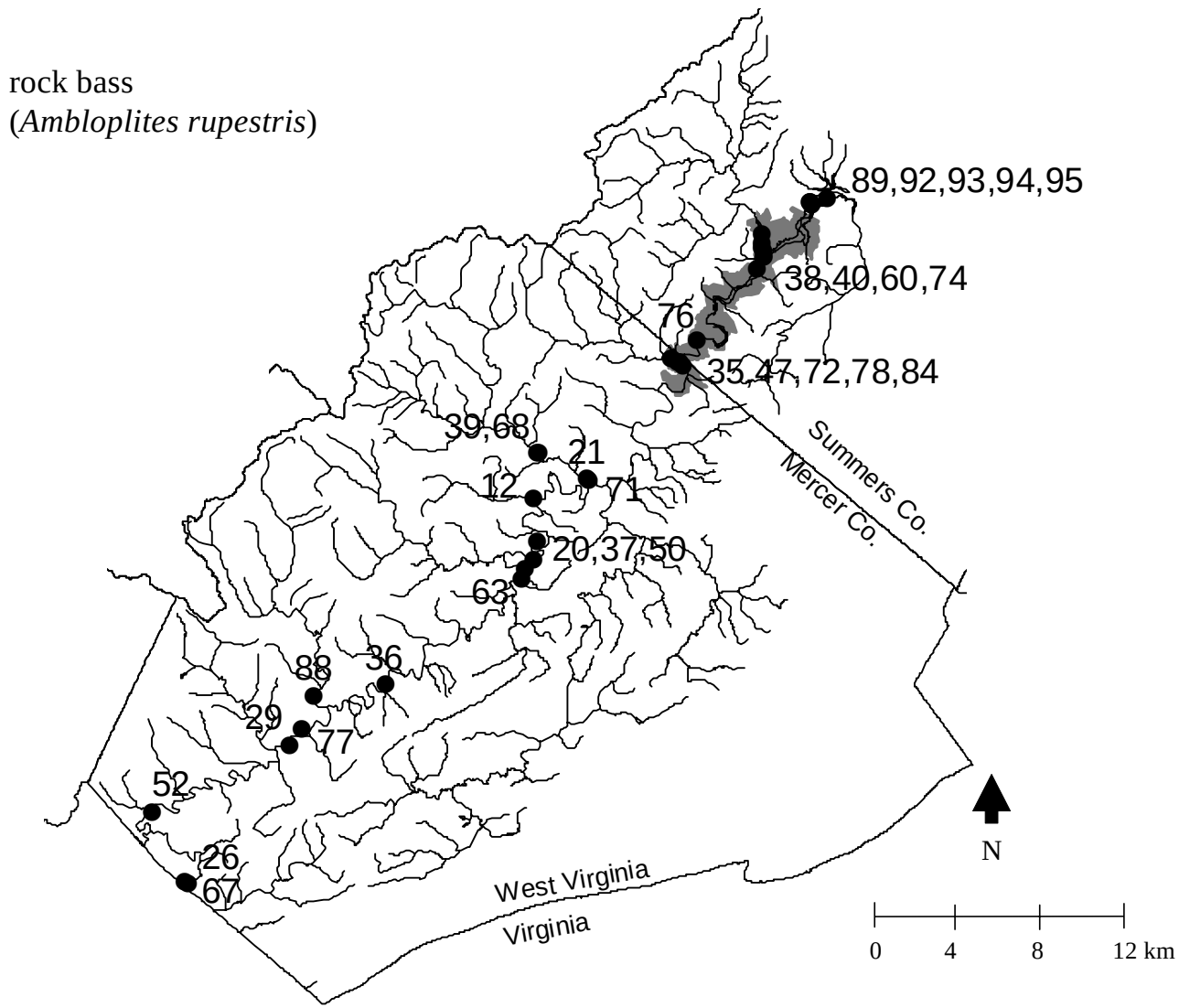
Appendix A-37. Collection sites of brook trout (*Salvelinus fontinalis*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



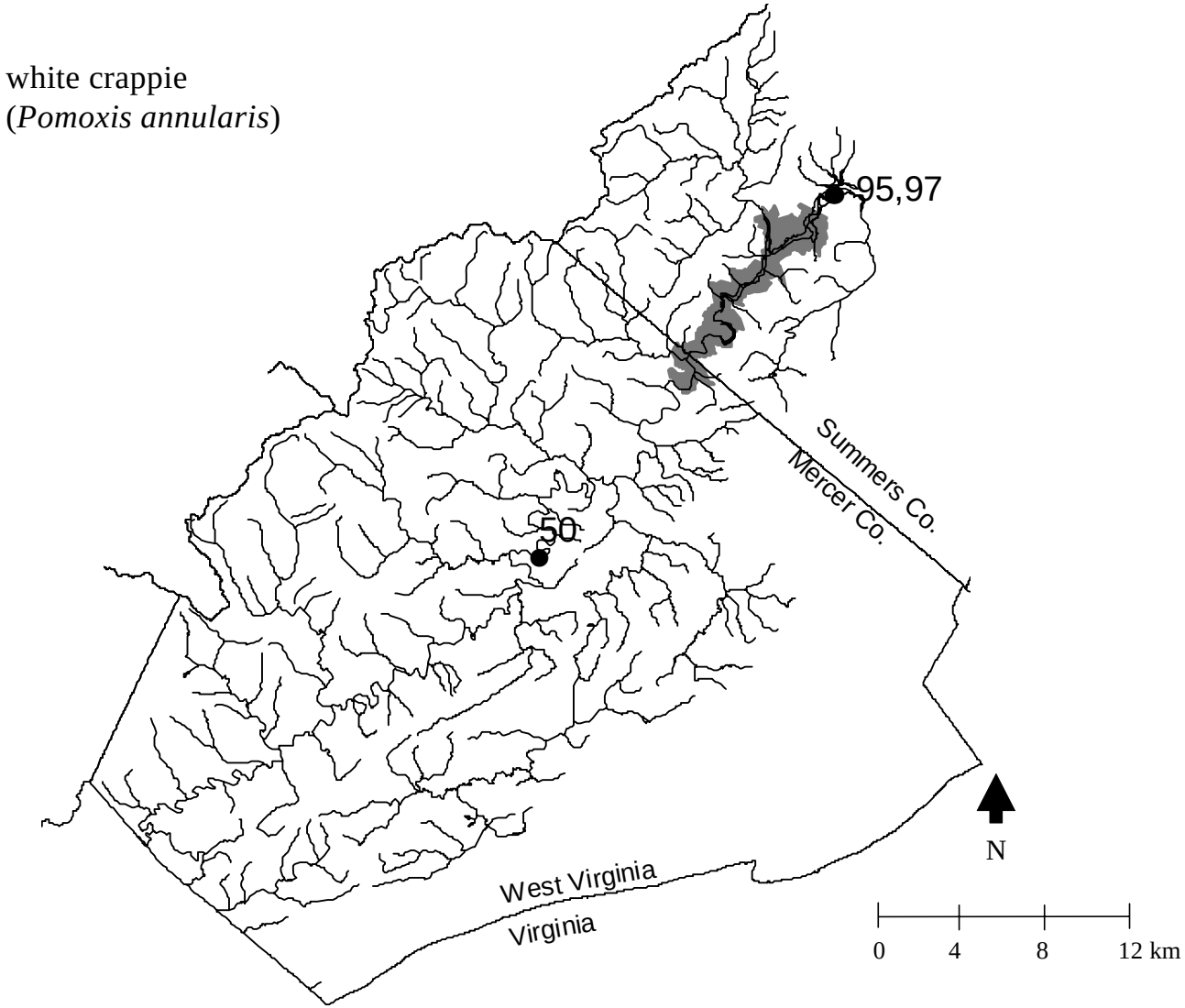
Appendix A-38. Collection sites of brook silverside (*Labidesthes sicculus*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



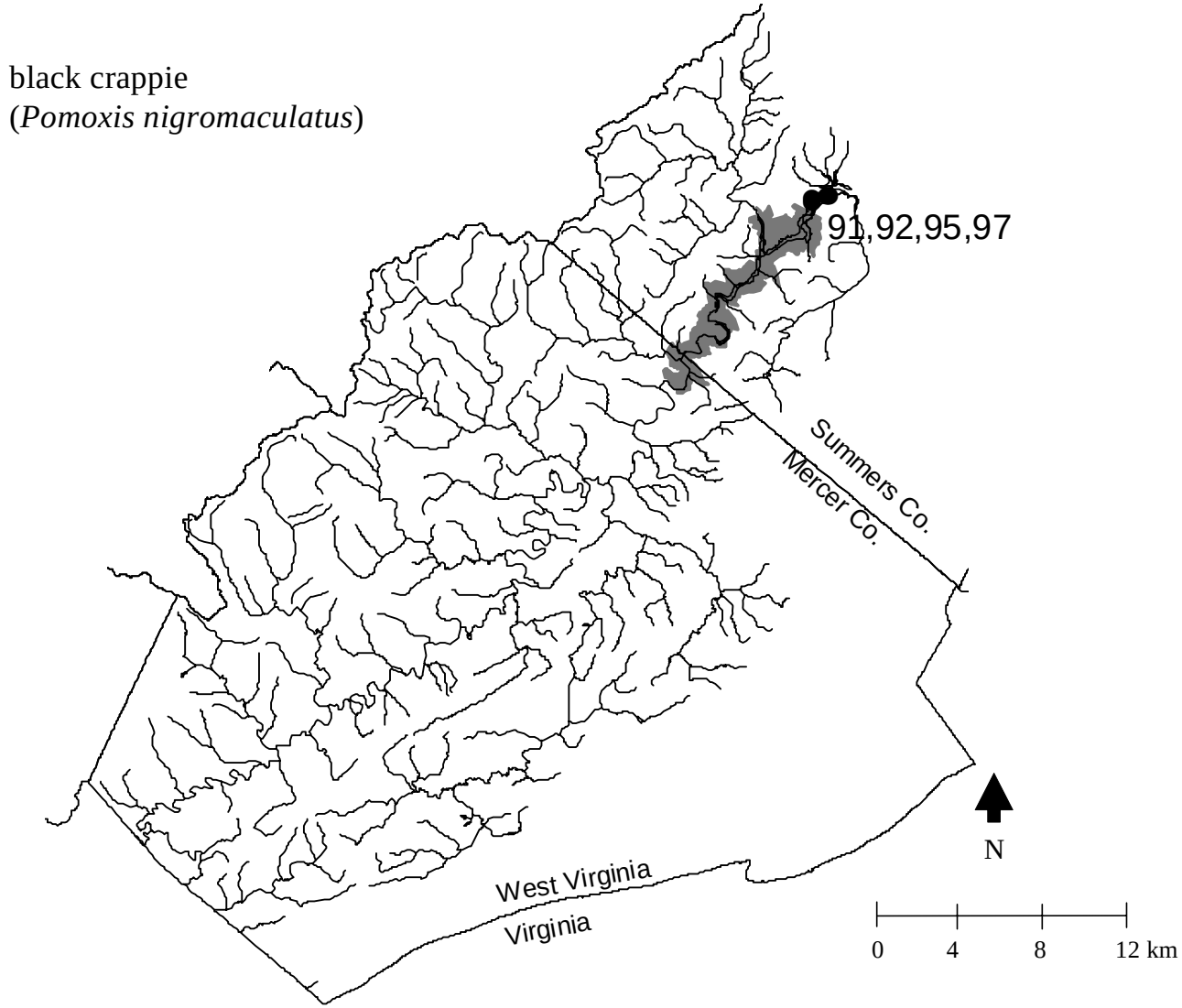
Appendix A-39. Collection sites of Bluestone sculpin (*Cottus sp.*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



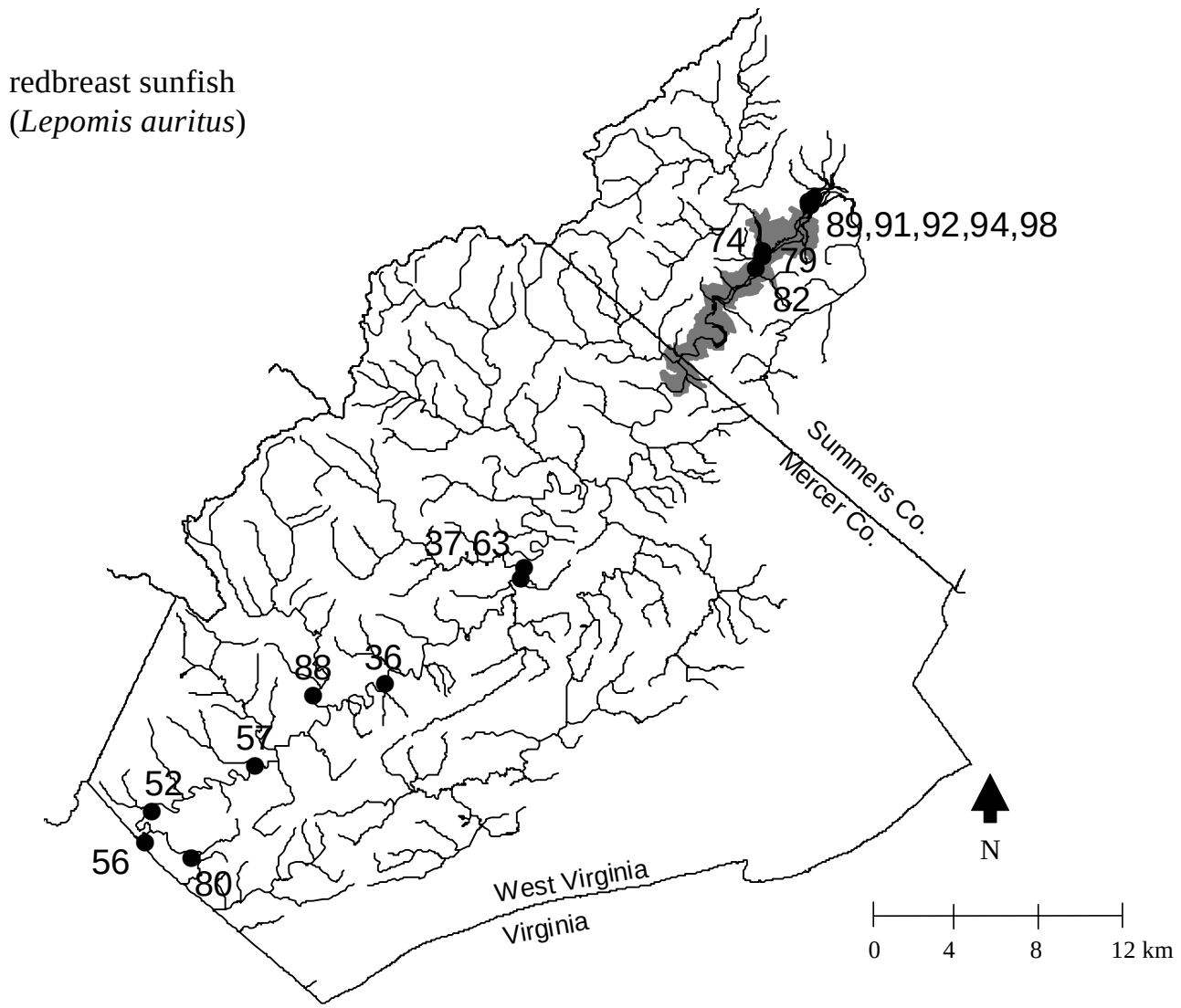
Appendix A-40. Collection sites of rock bass (*Ambloplites rupestris*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



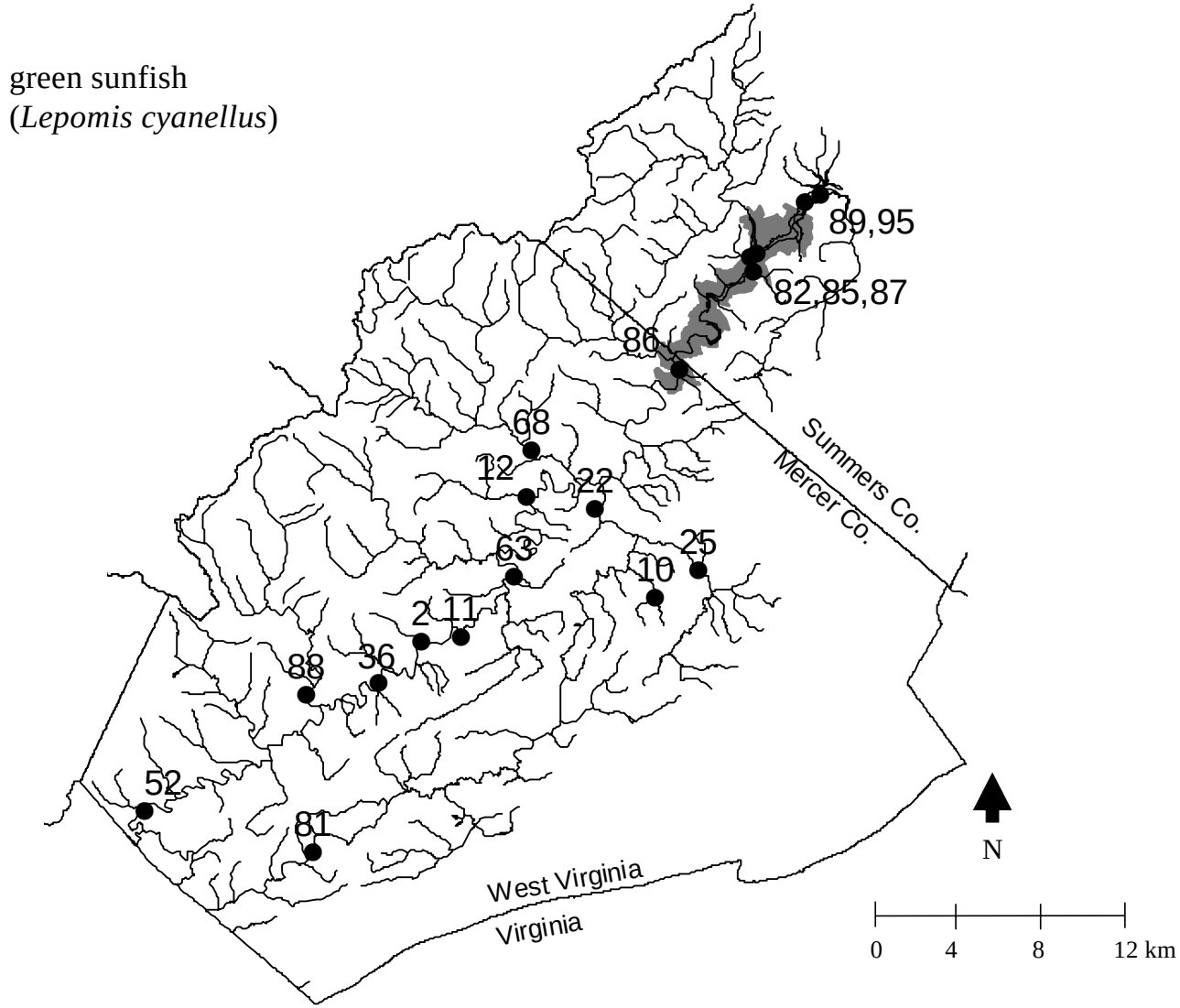
Appendix A-41. Collection sites of white crappie (*Pomoxis annularis*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



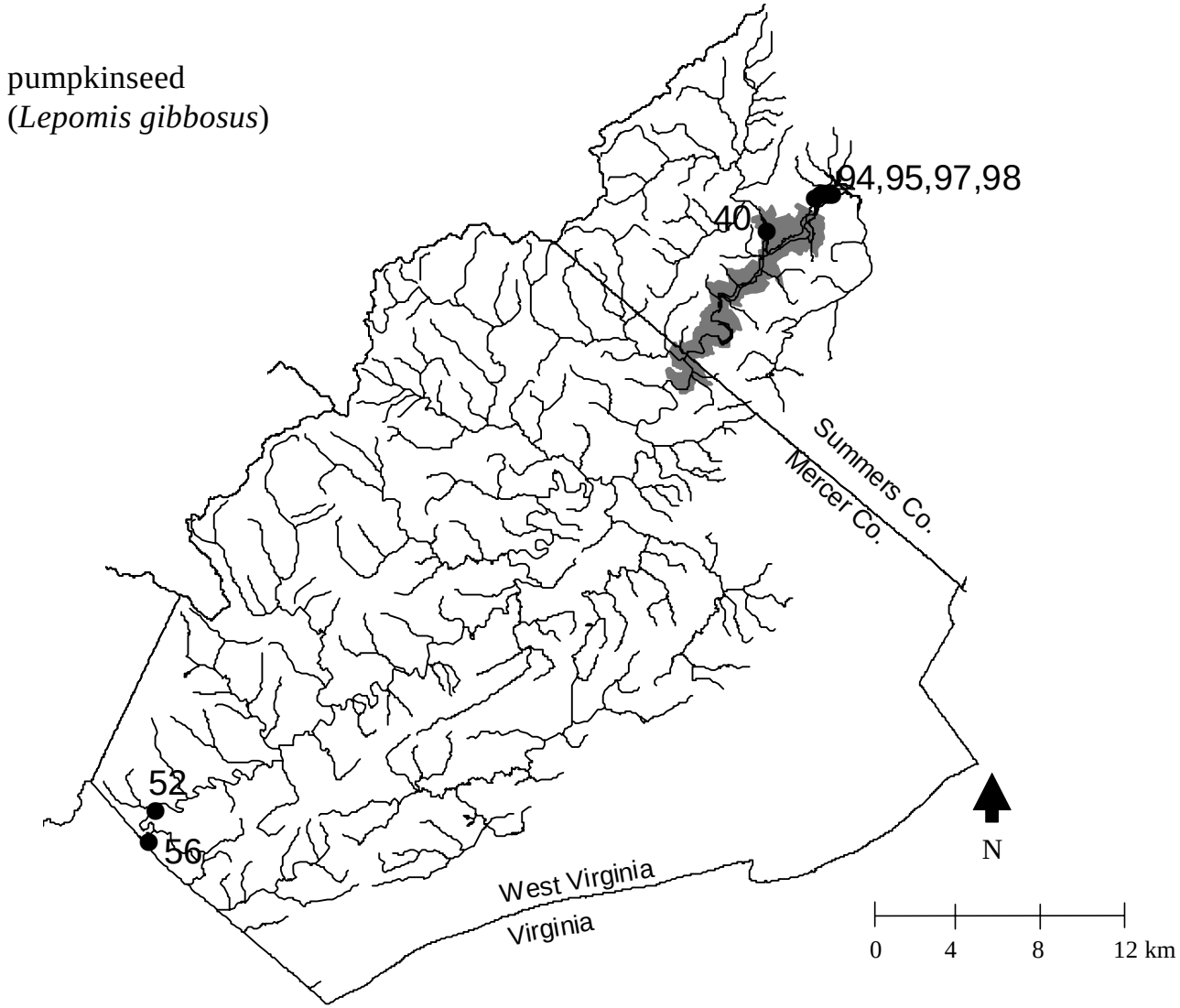
Appendix A-42. Collection sites of black crappie (*Pomoxis nigromaculatus*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



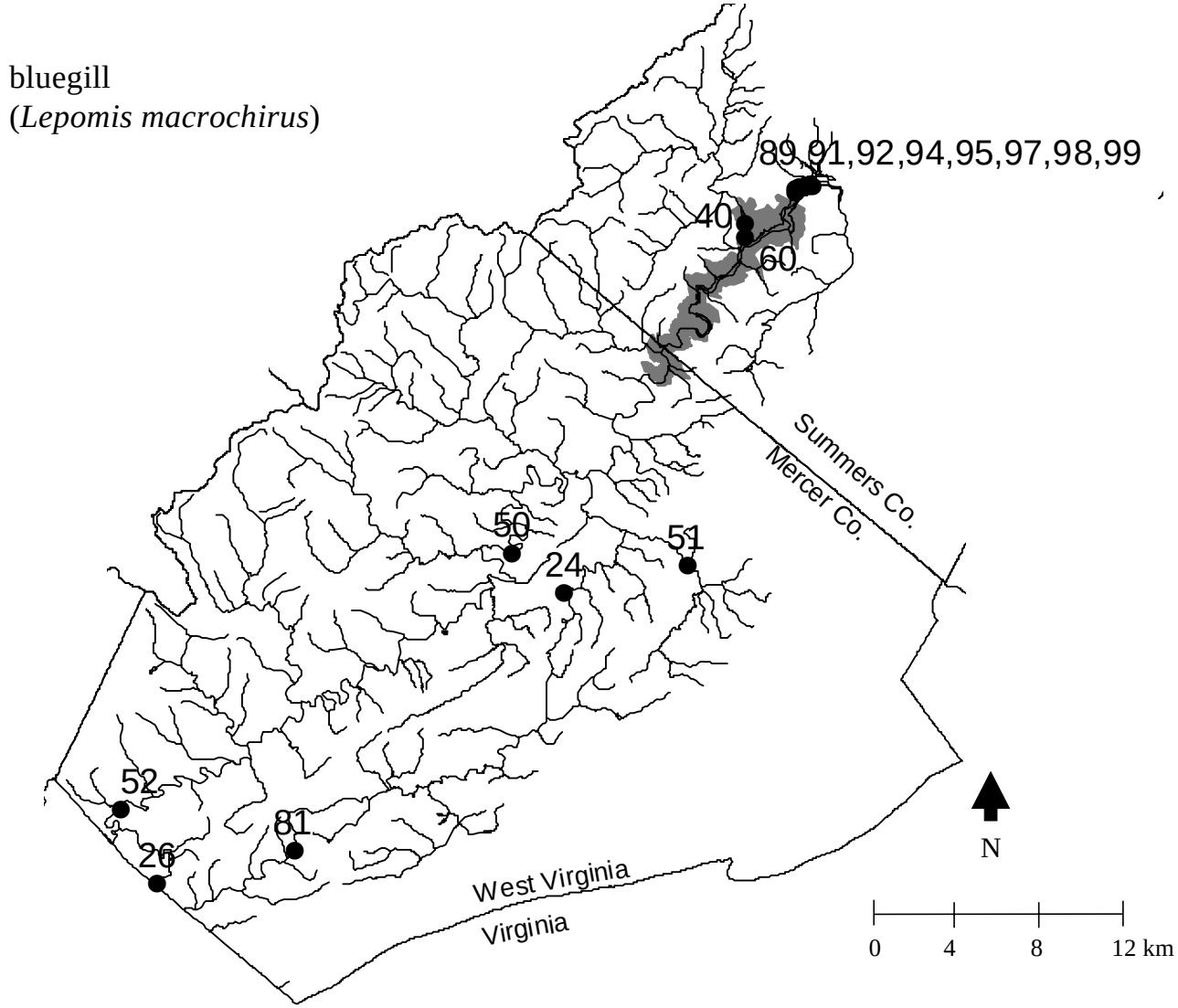
Appendix A-43. Collection sites of redbreast sunfish (*Lepomis auritus*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



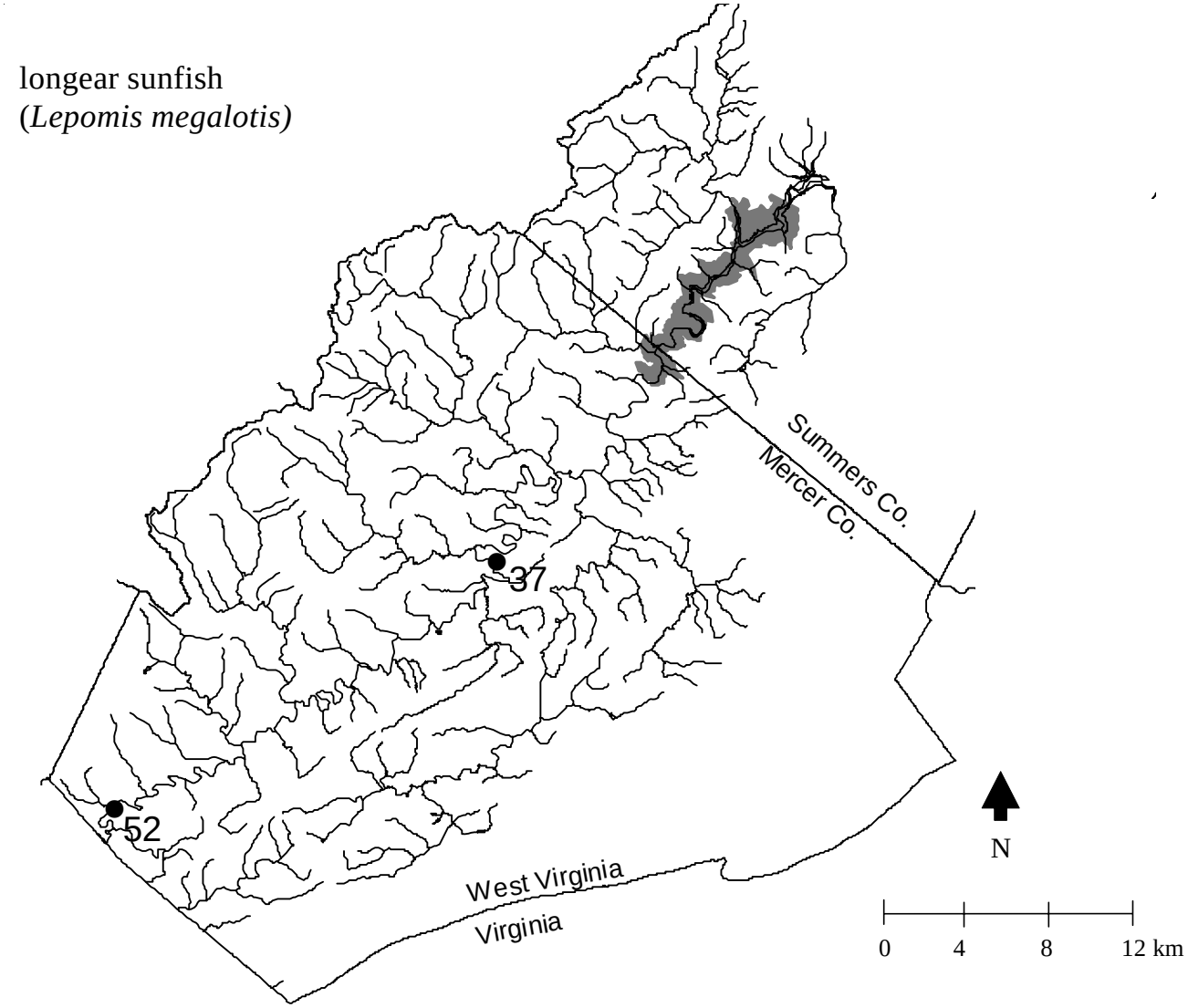
Appendix A-44. Collection sites of green sunfish (*Lepomis cyanellus*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



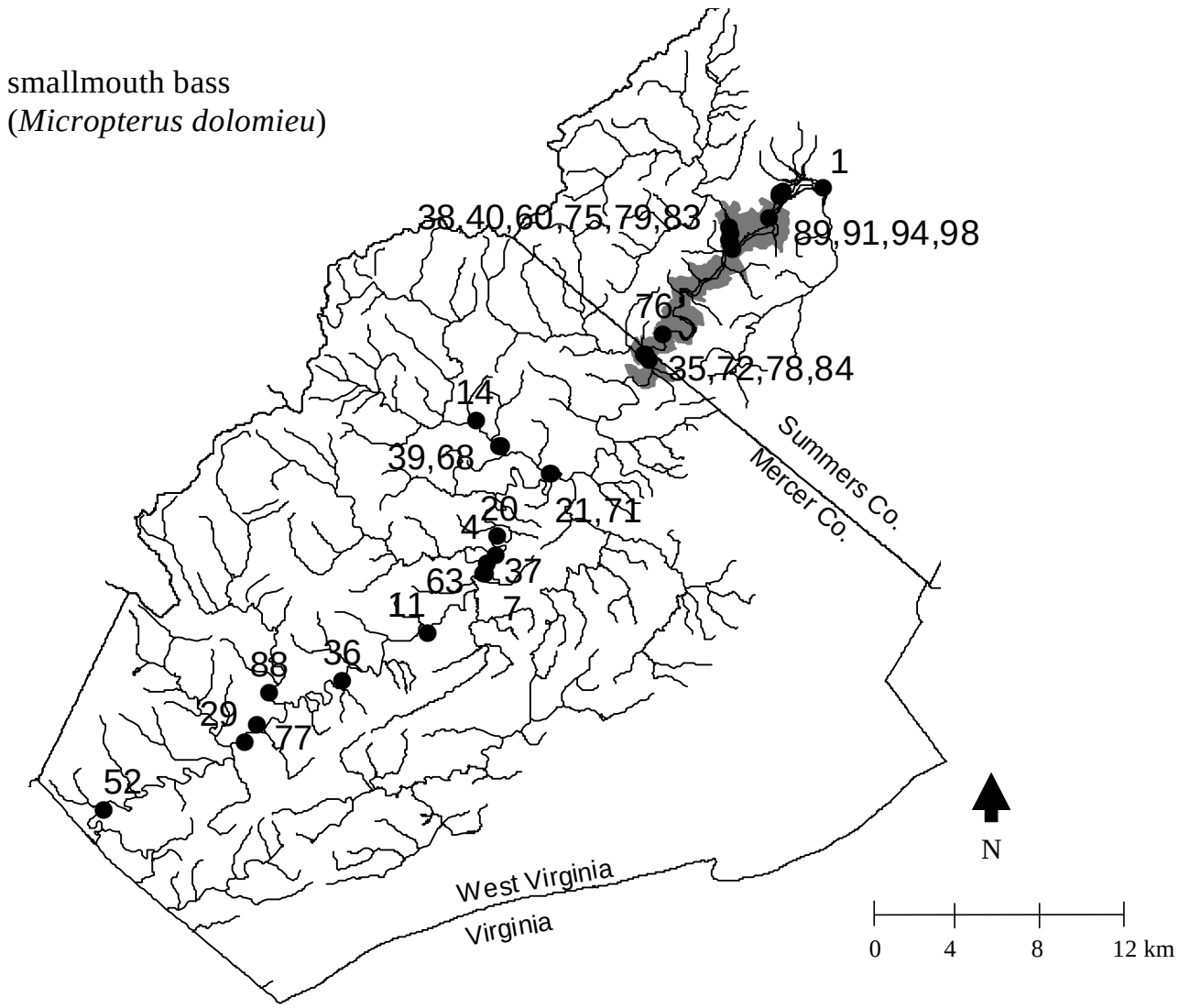
Appendix A-45. Collection sites of Pumpkinseed (*Lepomis gibbosus*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



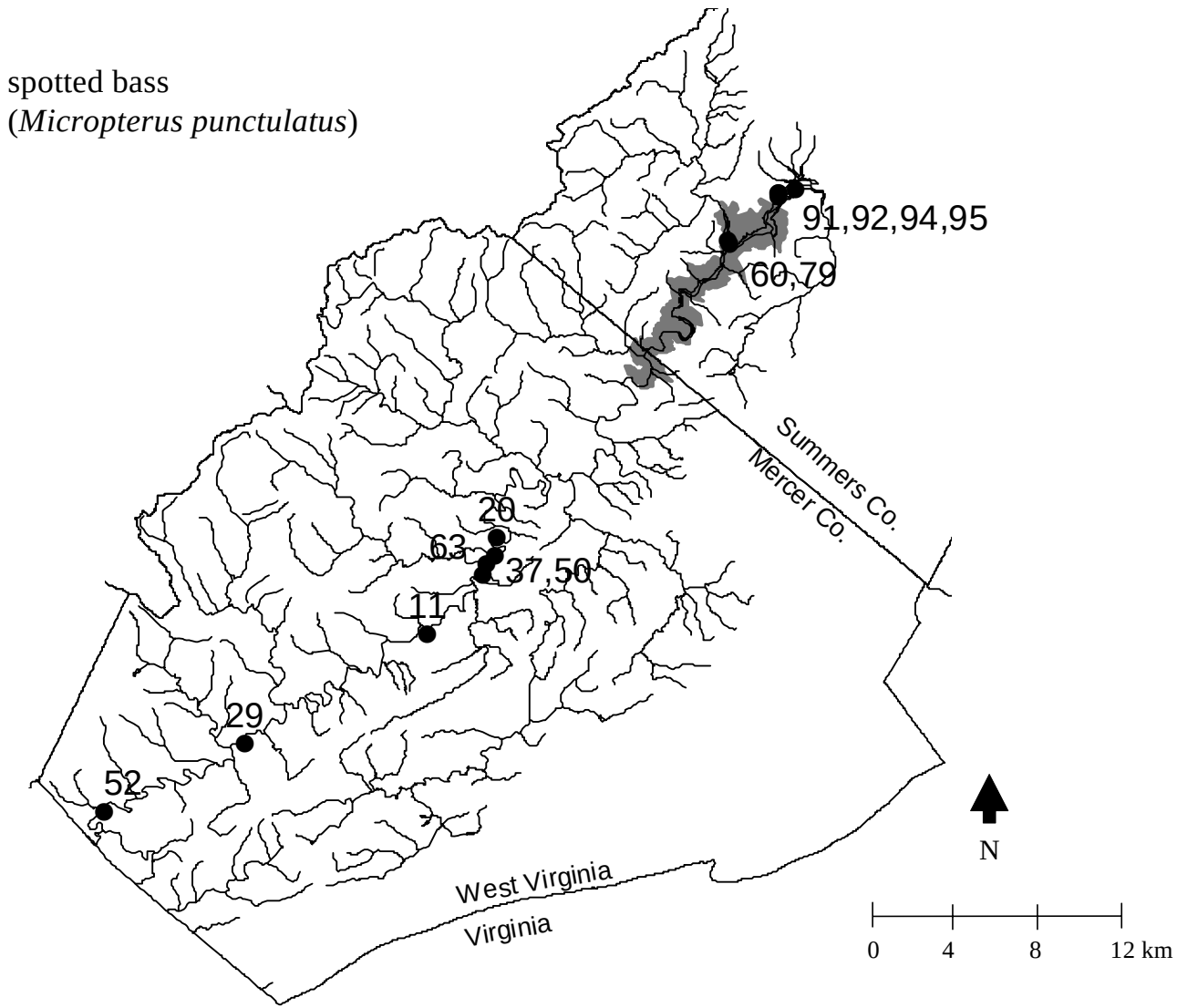
Appendix A-46. Collection sites of bluegill (*Lepomis macrochirus*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



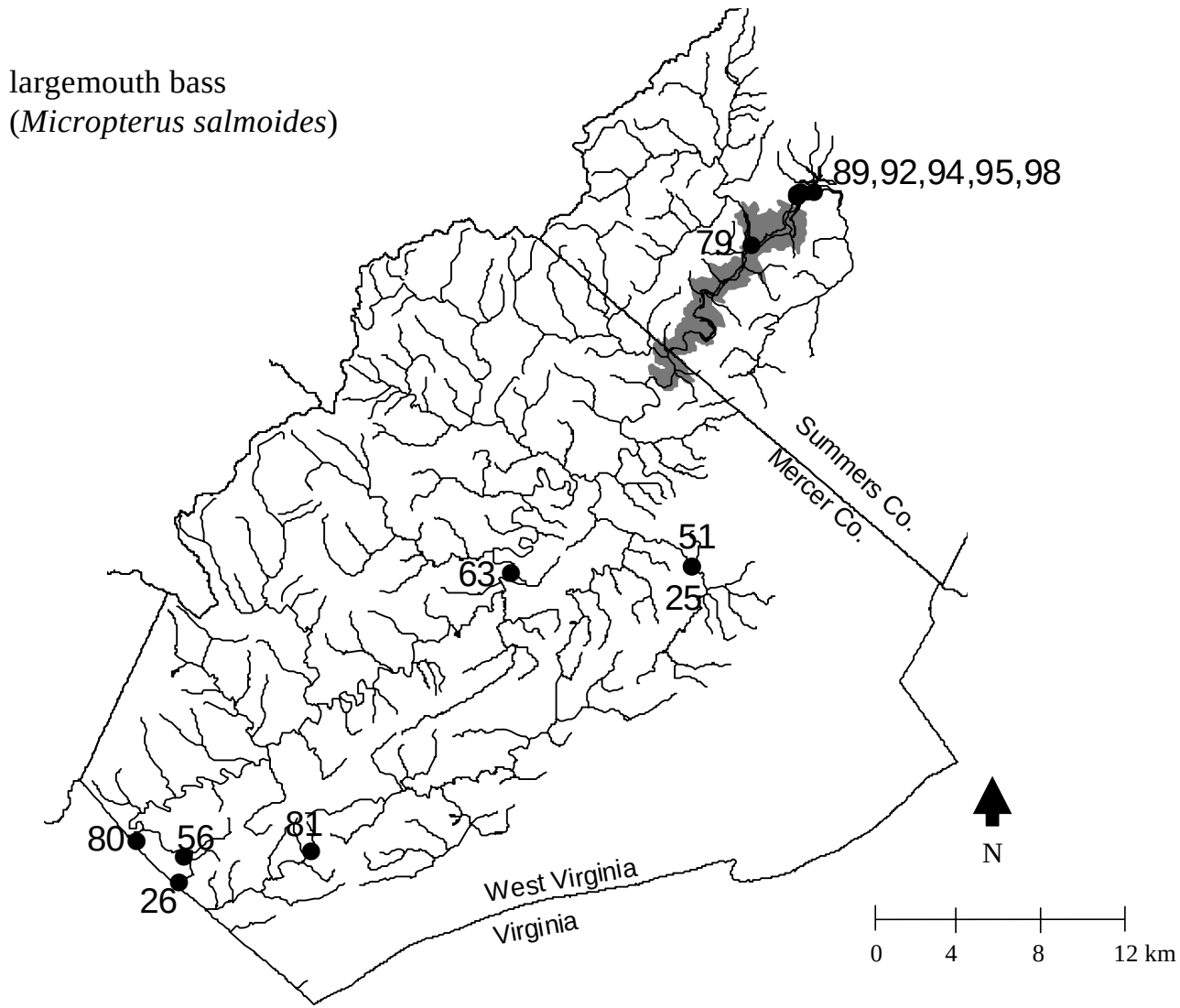
Appendix A-47. Collection sites of longear sunfish (*Lepomis megalotis*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



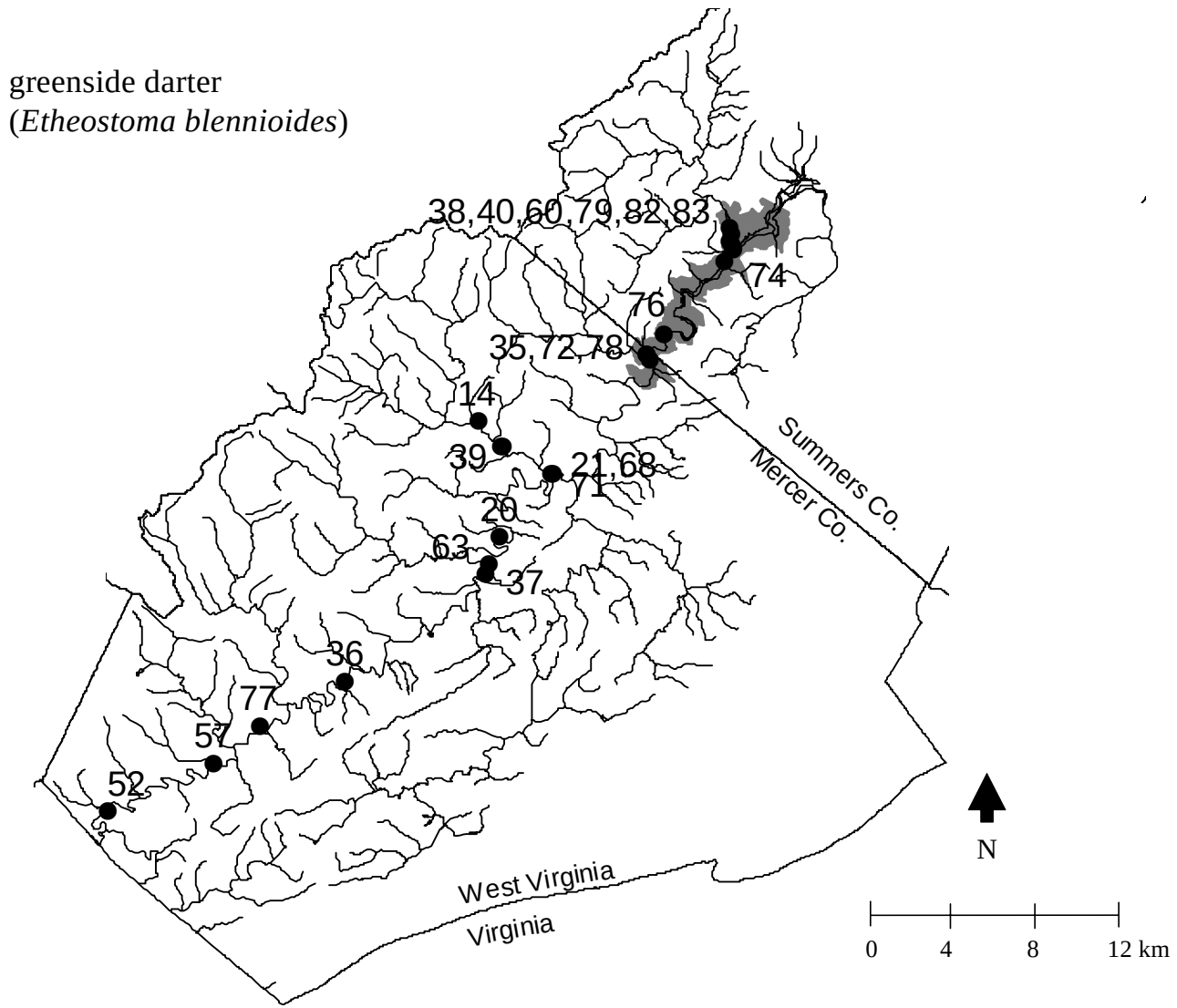
Appendix A-48. Collection sites of smallmouth bass (*Micropterus dolomieu*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



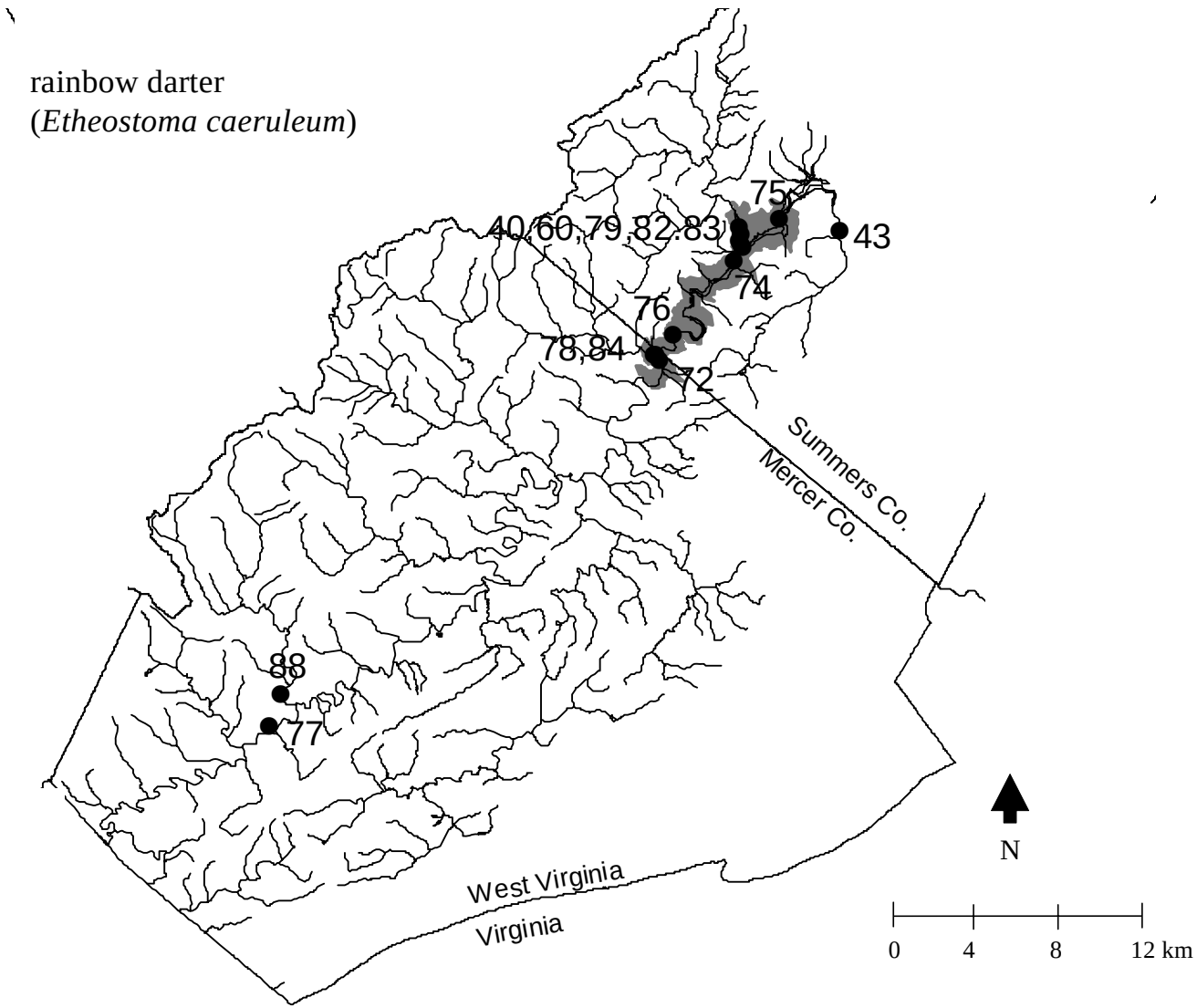
Appendix A-49. Collection sites of spotted bass (*Micropterus punctulatus*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



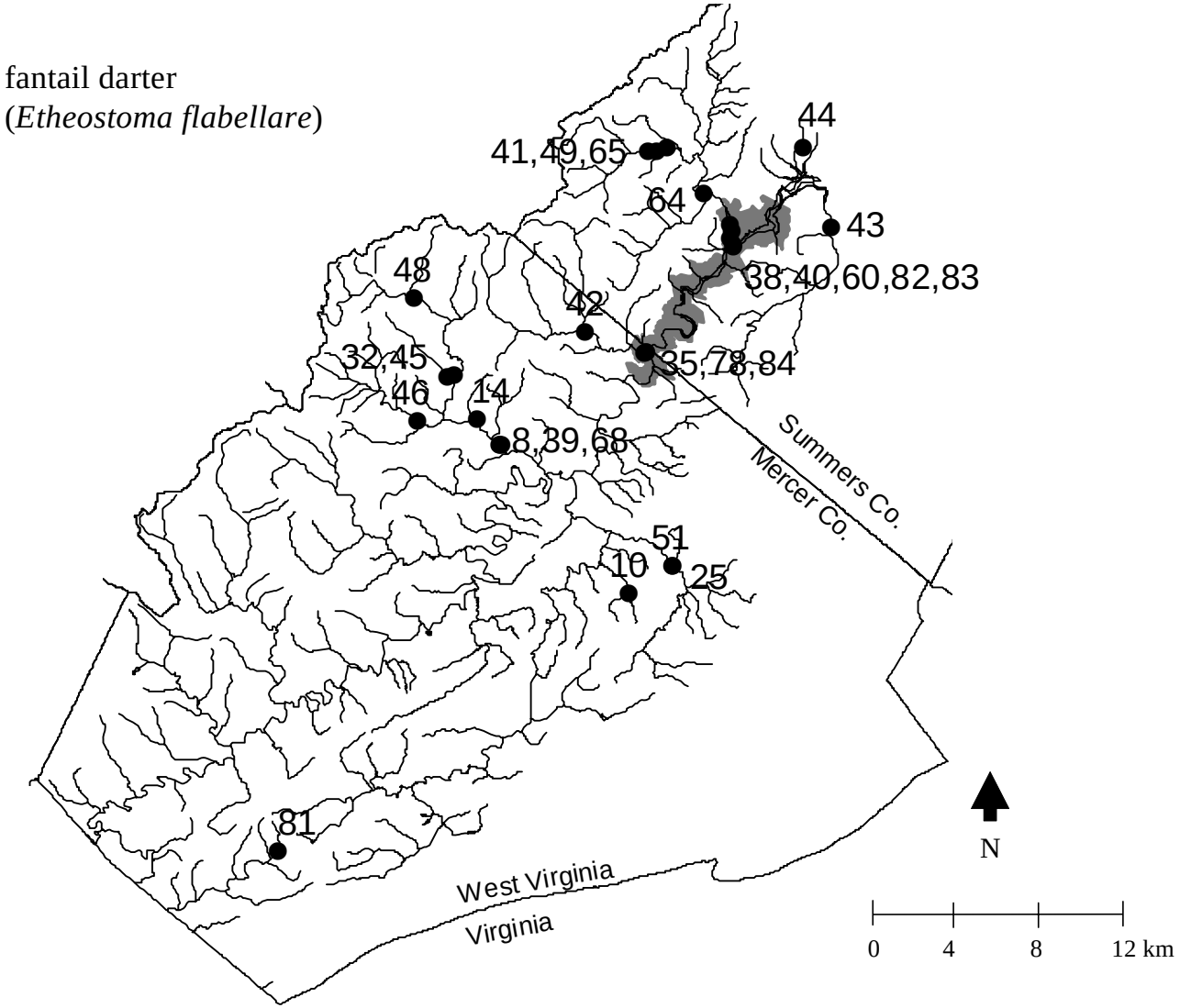
Appendix A-50. Collection sites of largemouth bass (*Micropterus salmoides*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



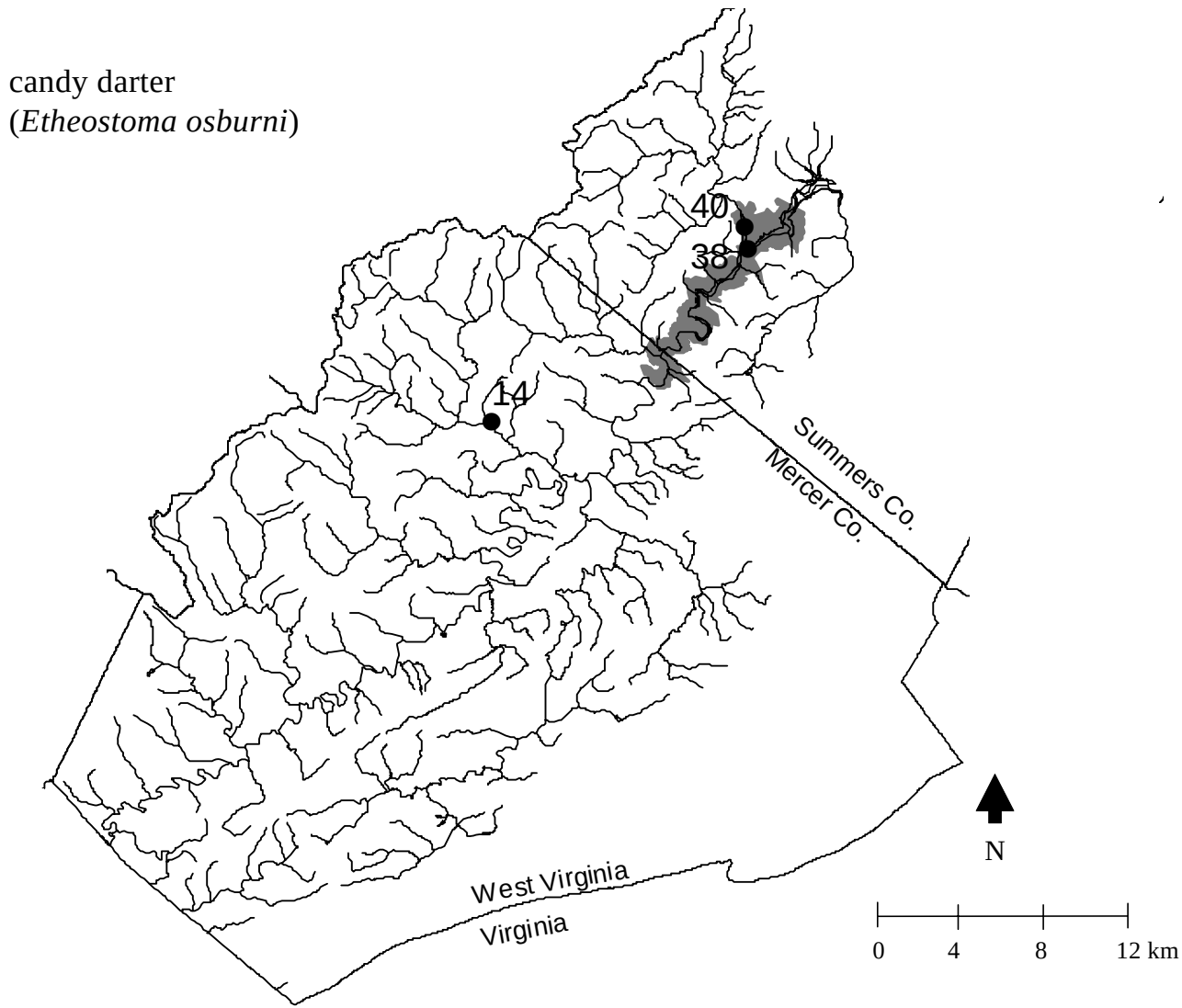
Appendix A-51. Collection sites of greenside darter (*Etheostoma blennioides*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



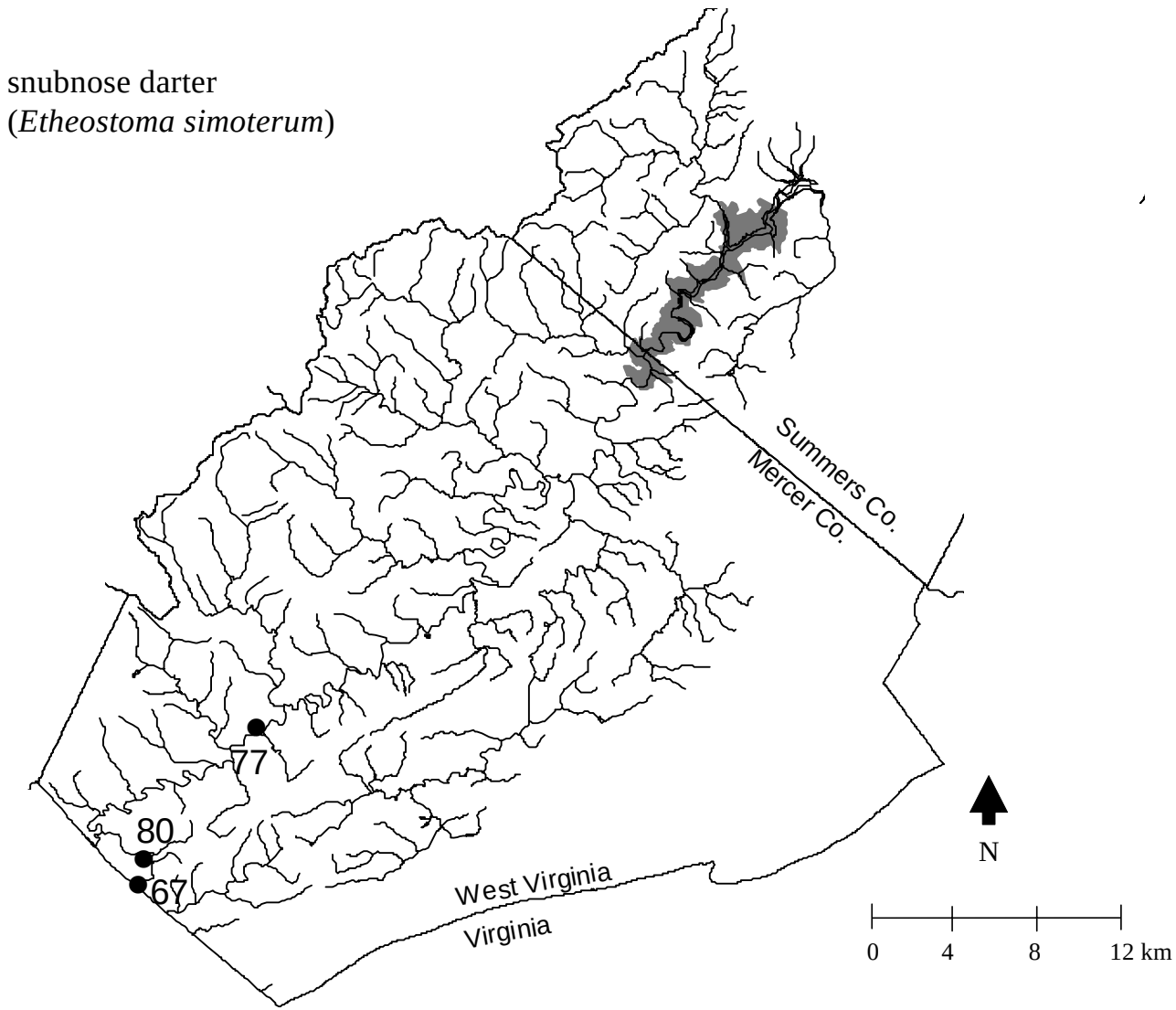
Appendix A-52. Collection sites of rainbow darter (*Etheostoma caeruleum*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



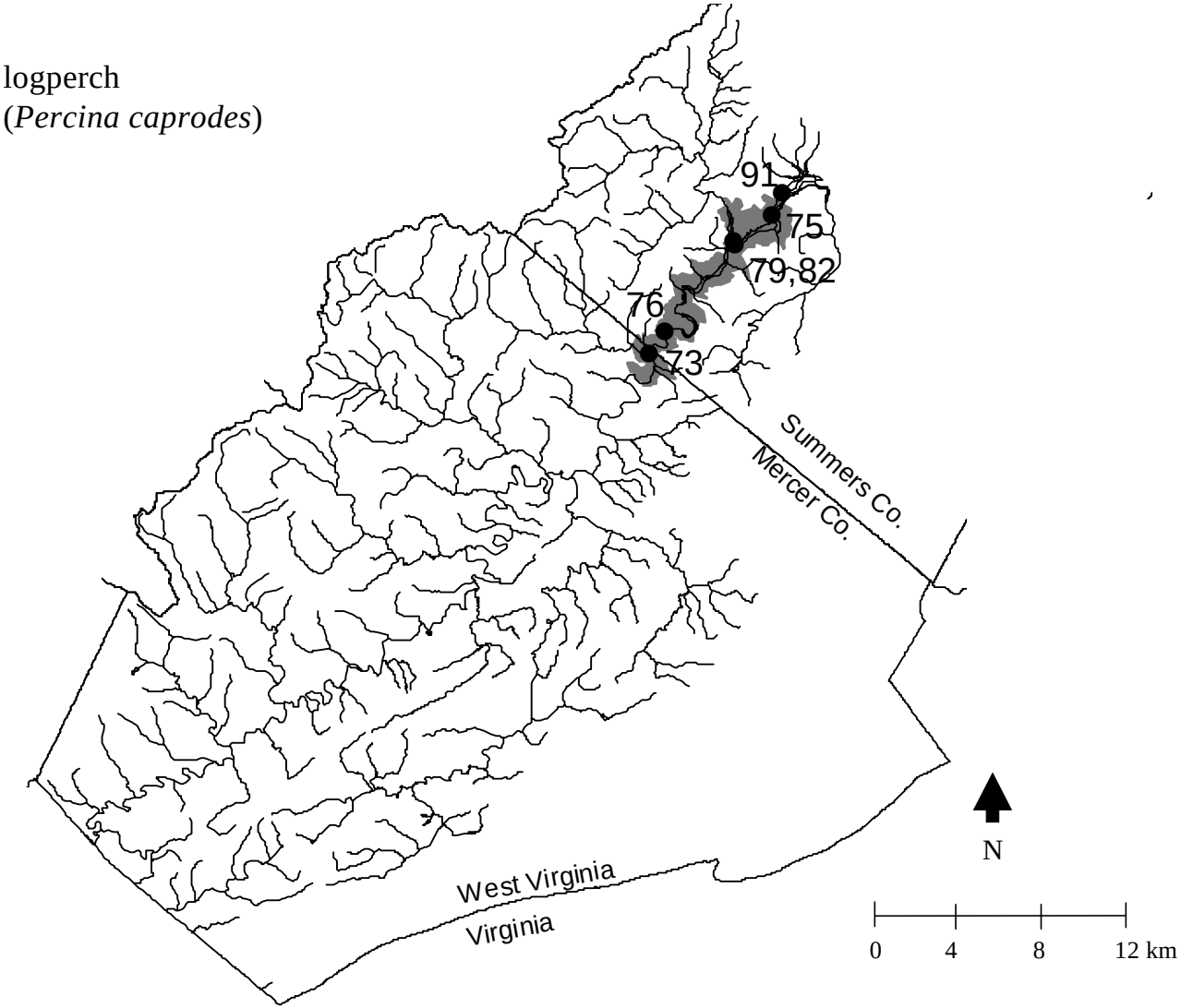
Appendix A-53. Collection sites of fantail darter (*Etheostoma flabellare*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



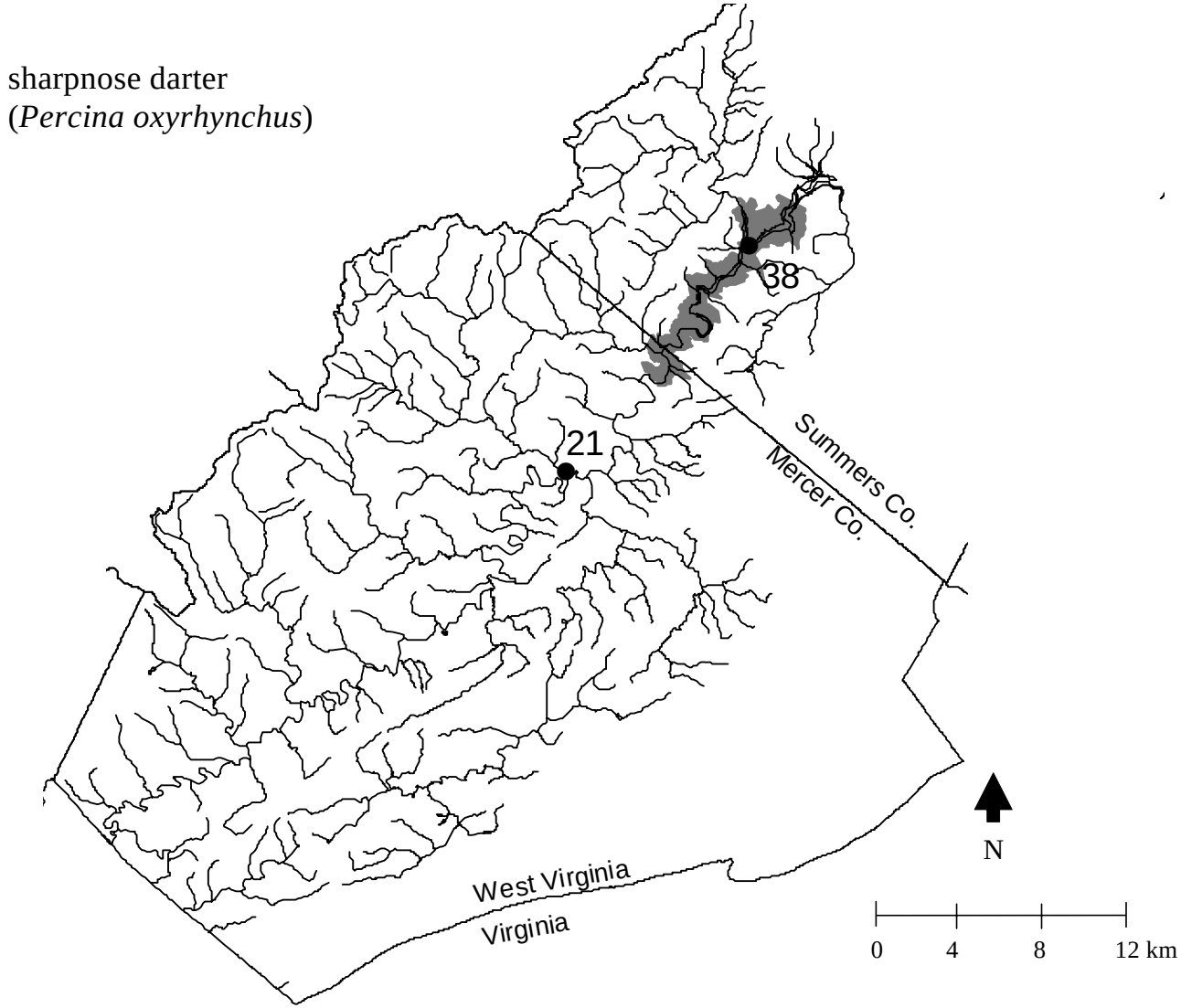
Appendix A-54. Collection sites of candy darter (*Etheostoma osburni*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



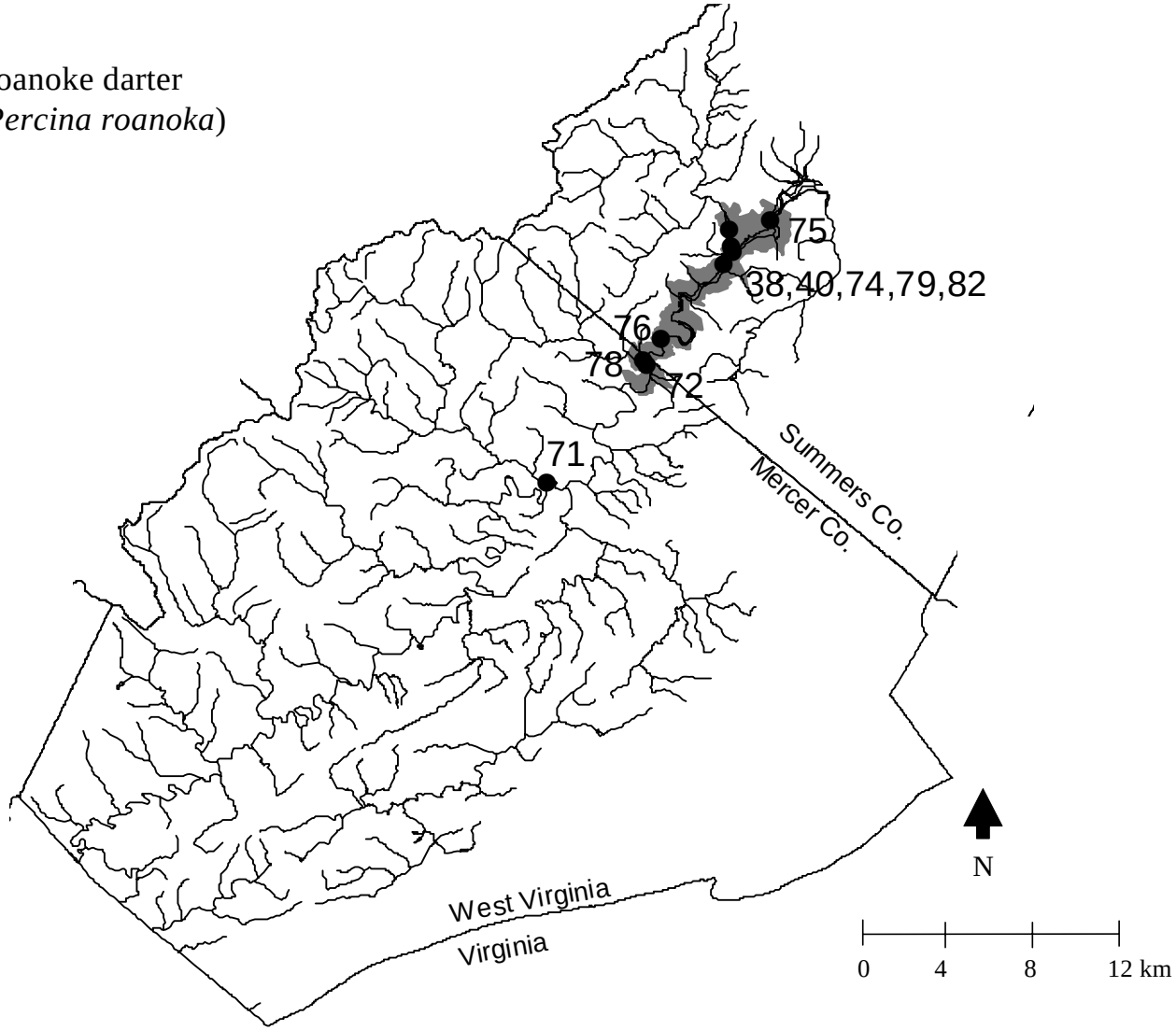
Appendix A-55. Collection sites of snubnose darter (*Etheostoma simoterum*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



Appendix A-56. Collection sites of logperch (*Percina caprodes*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



Appendix A-57. Collection sites of sharpnose darter (*Percina oxyrhynchus*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.



Appendix A-58. Collection sites of Roanoke darter (*Percina roanoka*) within the Bluestone River drainage, West Virginia. Site numbers correspond with Table 1. Shaded area is the Bluestone National Scenic River.

As the nation's primary conservation agency, the Department of the Interior has responsibility for most of our nationally owned public land and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

NPS D-8 August 2006

National Park Service
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