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Survey of Fish Communities in Tributaries to the Mohawk River, New York, 2019

Scientific Investigations Report 2022–5121

U.S. Department of the Interior
U.S. Geological Survey

Cover. View of the Schoharie Creek, a large tributary to the Mohawk River, where fish communities were surveyed in 2019; photograph by Scott George, U.S. Geological Survey.

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Conversion Factors

International System of Units to U.S. customary units

Multiply	By	To obtain
millimeter (mm)	0.03937	inch (in.)
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
square meter (m^2)	10.76	square foot (ft^2)
square kilometer (km^2)	0.3861	square mile (mi^2)
gram (g)	0.03527	ounce, avoirdupois (oz)

Datum

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Abbreviations

USGS U.S. Geological Survey

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Abstract

Fish communities of the Mohawk River and associated sections of the New York State Canal System have been well documented but little information is available regarding the status of fish communities in the extensive network of tributaries that feed the Mohawk River. This lack of information is problematic because changes in species distributions or general ecosystem health may go unnoticed in the absence of baseline data. The need for baseline information has been made particularly urgent by the recent establishment of a high-profile invasive fish species in the mainstem of the Mohawk River, the round goby (*Neogobius melanostomus*). Round goby can adversely affect aquatic ecosystems in numerous ways and are able to colonize streams in addition to large rivers and lakes. This potential threat to the aquatic ecosystem, therefore, has created an urgent need to quantify the distribution and abundance of fish species inhabiting tributaries to the Mohawk River before round goby can begin colonizing these habitats. In response, the U.S. Geological Survey and the Mohawk River Basin Program of the New York State Department of Environmental Conservation initiated a study in 2019 to collect quantitative information on fish communities and stream habitats in tributaries to the Mohawk River that could be used in the future to determine the effects of round goby on local fish assemblages and identify substrate and other habitat characteristics that facilitate or inhibit colonization by round goby.

Fish communities were surveyed at 20 sites on tributaries to the Mohawk River during summer 2019, using three-pass depletion backpack electrofishing surveys. The resulting data were used to produce quantitative estimates of fish population density and biomass for all species at each site. A total of 11,794 individual fish and 37 species were captured during the 20 surveys. Longnose dace (*Rhinichthys cataractae*), white sucker (*Catostomus commersonii*), blacknose dace (*Rhinichthys atratulus*), fantail darter (*Etheostoma flabellare*), and creek chub (*Semotilus atromaculatus*) were the most frequently encountered species, occurring at 18, 18, 17, 17, and 16 of the 20 sites, respectively. Six darter species, small bottom-dwelling fish that are highly vulnerable to displacement by round goby, were captured during the surveys, and at least one darter species was captured at all but one of the sites. Round goby were only captured at one site, Ninemile Creek near Rome, New York, where they occurred at a low density. Overall, the results indicated that round goby had not extensively colonized tributaries to the Mohawk River as of 2019, and the suite of data collected in this project should serve as a valuable baseline for future assessments of the effects of round goby and other stressors on aquatic ecosystems.

Introduction

The Mohawk River is approximately 257 kilometers (km) long (McBride, 1994) and flows south from its headwaters near Boonville, New York, to Rome, where it turns and flows eastward, joining the Hudson River just north of Albany. The Mohawk River and New York State Canal System run together as a series of permanent and seasonal impoundments for most of the distance between Rome and Albany. Fish communities of the Mohawk River and associated sections of the New York State Canal System have been well documented (McBride, 1994, 2009; Carlson, 2015; George and others, 2016), but until 2019, comparatively less information was available regarding the status of fish communities in the extensive network of tributaries that feed the Mohawk River. This information gap was problematic because long-term shifts in species distributions or abundances from climate change or other anthropogenic stressors may go unnoticed in the absence of baseline data. In recognition of this, the 2012–16 Mohawk River Basin Action Agenda identified "expanding the river-wide fisheries survey to the tributaries" as a research priority for the watershed (New York State Department of Environmental Conservation, 2012).

The lack of information on the status of fish communities in tributaries to the Mohawk River has been made increasingly urgent by the approach of a high-profile invasive fish species, the round goby (*Neogobius melanostomus*). The species was first documented in North America in the 1990s in the Great Lakes region and was identified in the New York State Canal System near Utica in 2014 (U.S. Geological Survey, 2021a). Introductions of round goby have had profound effects on fish communities in the Great Lakes and other areas (Kornis and others, 2012). Round goby can outcompete native benthic fish species, reduce the recruitment of desirable gamefish through

egg predation, and increase biomagnification of contaminants to higher trophic levels (Corkum and others, 2004). They can also carry the viral hemorrhagic septicemia virus (VHSV), which has been linked to significant fish kills in parts of New York (Farrell and others, 2017; Getchell and others, 2019), and some evidence indicates round goby are an important vector in avian botulism outbreaks (Ruffing, 2004; Hannett and others, 2011). Round goby are also an abundant food source for predators, however, and their establishment has been linked to increased health and growth rate of smallmouth bass (*Micropterus dolomieu*; Steinhart and others, 2004; Crane and others, 2015; Crane and Einhouse, 2016).

The effects of round goby on ecosystems in small and medium sized streams have not been investigated as thoroughly, and the overall effect of the species in lotic habitats remains poorly understood (Šlapanský and others, 2017). A number of studies have identified the theoretical potential for adverse effects on native fish assemblages through studies of diet overlap or other criteria (Poos and others, 2010; Abbett and others, 2013; Firth and others, 2021), yet few studies have attempted to directly quantify the ecological effects of round goby in streams. There is some circumstantial evidence indicating that round goby have displaced native benthic fish or altered the composition of macroinvertebrate communities (Krakowiak and Pennuto, 2008; Abbett and others, 2013; Raab and others, 2018), but a larger subset of research has shown subtle or negligible effects of round goby in lotic habitats (Kornis and others, 2013; Janáč and others, 2016; Šlapanský and others, 2017; Krabbenhoft, 2019). The relative abundance of round goby in streams appears highly variable, with estimates ranging from less than 10 percent to as high as approximately 80 percent of the entire fish community (Phillips and others, 2003; Krakowiak and Pennuto, 2008; Kornis and others, 2013). There is also mounting evidence that in some systems round goby exhibit seasonal migrations in and out of stream habitats (Pennuto and others, 2010; Blair and others, 2019), potentially further complicating efforts to assess population abundance and ecological effects. Thus, the high degree of uncertainty surrounding the effects of round goby in stream habitats, recent establishment of round goby in the Mohawk River watershed, and the lack of information on fish communities in streams of this region have created an urgent need to quantify the distribution and abundance of fishes in tributaries to the Mohawk River so that the effects of round goby invasion can be assessed and understood.

In response, the U.S. Geological Survey (USGS) and the New York State Department of Environmental Conservation, through its Mohawk River Basin Program, initiated a study in 2019 to characterize fish communities in tributaries to the Mohawk River. The objective of this study was to collect quantitative baseline information on fish communities and stream habitats, which could be used in the future to determine the effects of round goby on local fish assemblages, identify substrate and other habitat characteristics that facilitate or inhibit colonization by round goby, and evaluate the effects of other stressors or changes in watershed management. Obtaining information on the current distribution and abundance of darter species (Percidae: Etheostomatinae) was of particular interest. Darters are small bottom-dwelling fish (fig. 1) that have been shown to be highly vulnerable to displacement by round goby (Lauer and others, 2004; Kornis and others, 2012).

Figure 1. Examples of three darter species commonly encountered on tributaries to the Mohawk River: *A*, rainbow darter (*Etheostoma caeruleum*), *B*, fantail darter (*Etheostoma flabellare*), and *C*, blackside darter (*Percina maculata*); photographs by Kyle Olivencia, U.S. Geological Survey.

Equipment and Methods

Fish communities were surveyed at 19 tributaries to the Mohawk River between June and August 2019 (fig. 2; table 1). A single study reach was sampled on each tributary, with the exception of the Schoharie Creek where, because of its large size, two separate study reaches were sampled, for a total of 20 study reaches. Reaches ranged from 33 to 79 meters (m) in length and typically contained one or two complete geomorphic channel-unit sequences (Simonson and others, 1994; Fitzpatrick and others, 1998; Meador and others, 2003). Reaches were usually downstream from any major barriers and within the downstream-most 5 km of each stream (table 1) in order to collect data from areas that were at high risk for round goby colonization. The entire stream width was sampled during all surveys, with the exception of Cayadutta Creek,

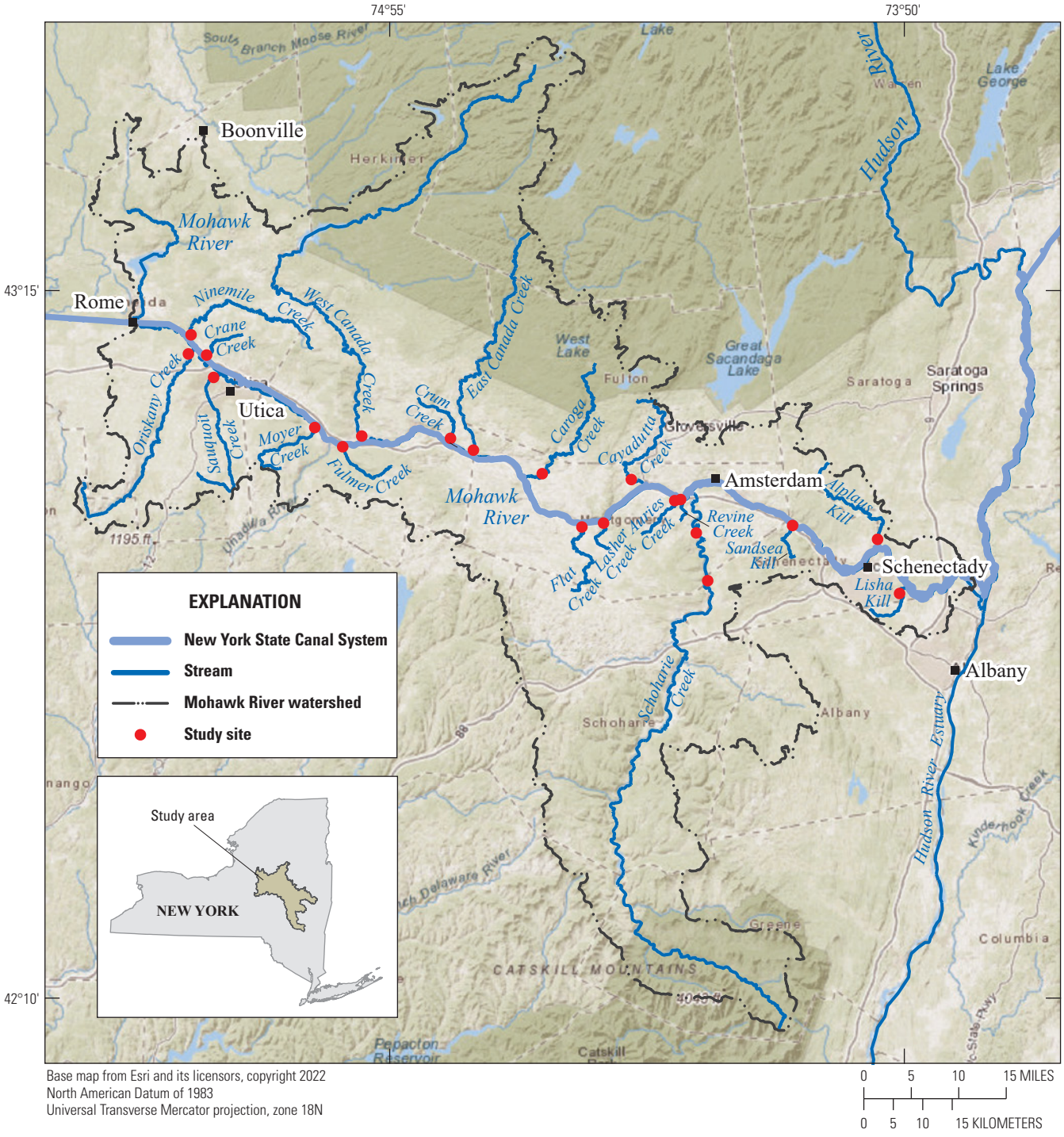

Figure 2. Location of 20 study sites on tributaries to the Mohawk River between Rome and Albany, New York, where fish communities were surveyed in 2019.

Table 1. Location and characteristics of 20 study sites on tributaries to the Mohawk River between Rome and Albany, New York, where fish communities were surveyed in 2019.

[U.S. Geological Survey (USGS) station names and station numbers are from the National Water Information System (U.S. Geological Survey, 2021c). Drainage areas were calculated using StreamStats (U.S. Geological Survey, 2021b). Latitude and longitude are provided in decimal degrees and represent the downstream end of each sampled reach. ID, identification number; km^2, square kilometer; m, meter; m^2, square meter; km, kilometer; Cr, Creek; Rd, Road; nr, near; NYS, New York State]

Reach ID	USGS station name	USGS station number	Date sampled	Drainage area (km^2)	Latitude	Longitude	Reach length (m)	Sampled area (m^2)	Distance upstream from mouth (km)
19	Alplaus Kill at Glenridge NY	01355470	7/25/2019	141.4	42.86621	−73.90179	63	1,023.1	2.2
14	Auries Creek at Auriesville NY	01349536	6/19/2019	66.8	42.92863	−74.32242	50	480.0	0.9
10	Caroga Creek near Fort Plain NY	01348500	7/26/2019	229.0	42.97109	−74.59778	53	459.0	4.4
13	Cayadutta Cr below Commons Rd at Berryville NY	425741074244501	8/1/2019	152.8	42.96138	−74.41247	38	394.1	4.1
3	Crane Cr below Old River Rd at Careys Corners NY	430910075174901	8/12/2019	15.3	43.15275	−75.29691	66	335.3	0.6
8	Crum Creek Near Indian Castle NY	01346990	6/18/2019	26.9	43.02563	−74.78844	75	481.5	1.4
9	East Canada Creek near St. Johnsville NY	01348002	8/1/2019	751.1	43.00750	−74.74076	44	788.9	0.9
11	Flat Creek at Sprakers NY	01349250	6/4/2019	134.9	42.88933	−74.51579	40	553.2	0.6
6	Fulmer Creek at Mohawk NY	01342750	6/18/2019	67.3	43.01298	−75.01296	52	376.0	0.3
12	Lasher Creek at mouth near Randall NY	0134931005	6/4/2019	13.2	42.89505	−74.47083	79	417.9	0.2
20	Lisha Kill northwest of Niskayuna NY	01356190	8/14/2019	42.0	42.78301	−73.85760	63	416.4	4.9
5	Moyer Creek at mouth at Frankfort NY	0134268305	6/5/2019	51.8	43.04230	−75.07114	53	668.3	0.3
2	Ninemile Creek near Oriskany NY	01337020	7/16/2019	183.9	43.18352	−75.32963	60	444.6	0.8
1	Oriskany Creek nr ballfield at Oriskany NY	430916075200601	8/12/2019	375.5	43.15433	−75.33509	33	586.1	2.2
15	Revine Creek at NYS Thruway at Auriesville NY	425549074183601	6/17/2019	78.5	42.93021	−74.31014	58	268.5	0.2
18	Sandsea Kill at Pattersonville NY	01354200	6/19/2019	24.6	42.88893	−74.07803	50	245.0	0.4
4	Sauquoit Creek at Yorkville NY	430707075165601	7/16/2019	158.0	43.11860	−75.28222	71	995.4	2.1
17	Schoharie Creek below bridge at Burtonsville NY	424821074152001	8/15/2019	2,302.5	42.80581	−74.25542	37	342.6	23.3
16	Schoharie Creek near Wellsville NY	425244074164101	7/18/2019	2,367.3	42.87893	−74.27818	53	769.0	11.7
7	West Canada Creek at Herkimer NY	430145074582401	7/17/2019	1,447.8	43.02929	−74.97330	48	527.5	1.3

Ninemile Creek, West Canada Creek, and the two reaches on Schoharie Creek where the channel width and stream discharge were prohibitively large. At the Cayadutta Creek, Ninemile Creek, Schoharie Creek near Wellsville, and West Canada Creek sites, a braided section of the channel was surveyed in which the entire width could be sampled, and at the Schoharie Creek at Burtonsville site, a single near-shore reach was isolated using three blocking seines.

Fish communities were sampled using multipass depletion electrofishing surveys. During each survey, fish were collected from seine-blocked reaches in three consecutive passes, with one person operating a Smith-Root LR–24 backpack electrofisher and three to five people netting fish. All fish were identified to species, measured for total length, weighed, and returned to the stream after all passes were completed. For some small and highly abundant species, lengths and weights were recorded from a subsample of 30 fish across their length distribution, after which mean length and pooled weights were recorded in batches of up to 30 fish.

Information on the dimensions and substrate composition of the sampled reaches was also collected during each survey. The total length of the reach and the widths of 10 evenly spaced transects were measured and used to calculate mean reach width and total area sampled. Substrate size was characterized using a reach-averaged, modified Wolman pebble count (Wolman, 1954) in which 10 particles were measured across each of the 10 perpendicular transects (100 total particles). The intermediate axis or "b-axis" of each particle was measured to the nearest millimeter using a meter stick. Fine particles less than 2 millimeters (mm) in size were not measured and instead were classified as sand if they were grainy to the touch or as silt if they were smooth to the touch. Bedrock or boulders with an intermediate axis greater than (>) 1 m were classified as >1,000 mm. The pebble count data were used to estimate commonly reported measures of substrate size, including the 16th percentile (D_{16}), 50th percentile or median (D_{50}), and 84th percentile (D_{84}), using linear interpolation with the PERCENTILE.INC function in Microsoft Excel. All data from the fish surveys and habitat characterization are available in George and others (2021b).

The number of fish captured during each pass was used to generate population estimates, with associated 95 percent confidence intervals for each species at each site, using the Carle-Strub method (Carle and Strub, 1978) with the FSA package (Ogle and others, 2021) in R (R Core Team, 2021). Population estimates and associated confidence intervals were standardized by the area of the sampled reach to produce estimates of fish density per 1,000 square meters (m^2) of stream. Estimates of population biomass and associated 95 percent confidence intervals were generated by multiplying the density estimates and associated confidence intervals by the mean weight for each species at each site. In rare instances where the lower bound of the confidence interval around an estimate was less than zero, the negative value was replaced with a zero. Estimates of total density and biomass for the entire community (all species combined) were also generated for each site using the same process described above. Additionally, the diversity of the community was assessed for each site using two indices: species richness and Shannon's index of diversity (Shannon, 1948). Species richness was calculated as the total number of species captured at a site and Shannon's index of diversity was calculated as:

$$H' = -\sum_{i=1}^{S} (p_i)(\log_e p_i) \quad (1)$$

where S is the number of species and p_i is the proportion of the total sample represented by the ith species (Kwak and Peterson, 2007).

Results

A total of 11,794 individual fish and 37 fish species were captured during the 20 surveys. Longnose dace (*Rhinichthys cataractae*), white sucker (*Catostomus commersonii*), blacknose dace (*Rhinichthys atratulus*), fantail darter (*Etheostoma flabellare*), and creek chub (*Semotilus atromaculatus*) were the most frequently encountered species, occurring at 18, 18, 17, 17, and 16 of the 20 sites, respectively (table 2). Eight species were present at more than half the sites, whereas the remaining 29 species were encountered infrequently, occurring at less than half the sites. Species richness ranged from 3 at Sandsea Kill to 19 at Oriskany Creek, and Shannon's index of diversity ranged from 0.33 at Sandsea Kill to 2.61 at Sauquoit Creek. The total density of all fish species (community density) ranged from 162 fish per 1,000 m^2 at Sauquoit Creek to 7,182 fish per 1,000 m^2 at Crane Creek (fig. 3), and the total biomass of all fish species (community biomass) ranged from 498 grams per 1,000 m^2 at Revine Creek to 10,588 grams per 1,000 m^2 at Crane Creek (fig. 4; table 3).

Six darter species were captured during the 20 surveys, and at least one darter species was captured at every site except for Sandsea Kill. Fantail darter was the most frequently encountered darter, found at 17 of the 20 sites, followed by tessellated darter (*Etheostoma olmstedi*) at 11 sites, rainbow darter (*Etheostoma caeruleum*) and logperch (*Percina caprodes*) each at 9 sites, blackside darter (*Percina maculata*) at 4 sites, and greenside darter (*Etheostoma blennioides*) at 3 sites (table 2). Fantail darter was widely distributed throughout the watershed, while tessellated darter and logperch were found less commonly but were also widely distributed (fig. 5). Rainbow darter was concentrated exclusively at the eastern end of the study area, occurring at 9 of the 10 easternmost sites. In contrast, blackside darter was found exclusively at the western end of the study area, occurring at four of the six westernmost sites. No discernable pattern was evident in the distribution of greenside darter, as the species was found at only three sites that were geographically distant from one another.

Table 2. Common name, scientific name, and the number of study sites present for all species captured during fish community surveys at 20 study sites on tributaries to the Mohawk River between Rome and Albany, New York, in 2019.

Common name	Scientific name	Number of sites
Longnose dace	*Rhinichthys cataractae*	18
White sucker	*Catostomus commersonii*	18
Blacknose dace	*Rhinichthys atratulus*	17
Fantail darter	*Etheostoma flabellare*	17
Creek chub	*Semotilus atromaculatus*	16
Central stoneroller	*Campostoma anomalum*	12
Smallmouth bass	*Micropterus dolomieu*	11
Tessellated darter	*Etheostoma olmstedi*	11
Green sunfish	*Lepomis cyanellus*	9
Logperch	*Percina caprodes*	9
Rainbow darter	*Etheostoma caeruleum*	9
Cutlip minnow	*Exoglossum maxillingua*	7
Fathead minnow	*Pimephales promelas*	7
Common shiner	*Luxilus cornutus*	5
Fallfish	*Semotilus corporalis*	5
Northern hog sucker	*Hypentelium nigricans*	5
Stonecat	*Noturus flavus*	5
Blackside darter	*Percina maculata*	4
Bluntnose minnow	*Pimephales notatus*	4
Brown bullhead	*Ameiurus nebulosus*	4
Largemouth bass	*Micropterus salmoides*	4
Bluegill	*Lepomis macrochirus*	3
Brook stickleback	*Culaea inconstans*	3
Brown trout	*Salmo trutta*	3
Greenside darter	*Etheostoma blennioides*	3
Pumpkinseed	*Lepomis gibbosus*	3
Spotfin shiner	*Cyprinella spiloptera*	3
Walleye	*Sander vitreus*	3
Banded killifish	*Fundulus diaphanus*	2
Golden shiner	*Notemigonus crysoleucas*	2
Rock bass	*Ambloplites rupestris*	2
Chain pickerel	*Esox niger*	1
Common carp	*Cyprinus carpio*	1
Margined madtom	*Noturus insignis*	1
Hybrid sunfish	*Lepomis gibbosus* × *Lepomis cyanellus*	1
Round goby	*Neogobius melanostomus*	1
Spottail shiner	*Notropis hudsonius*	1

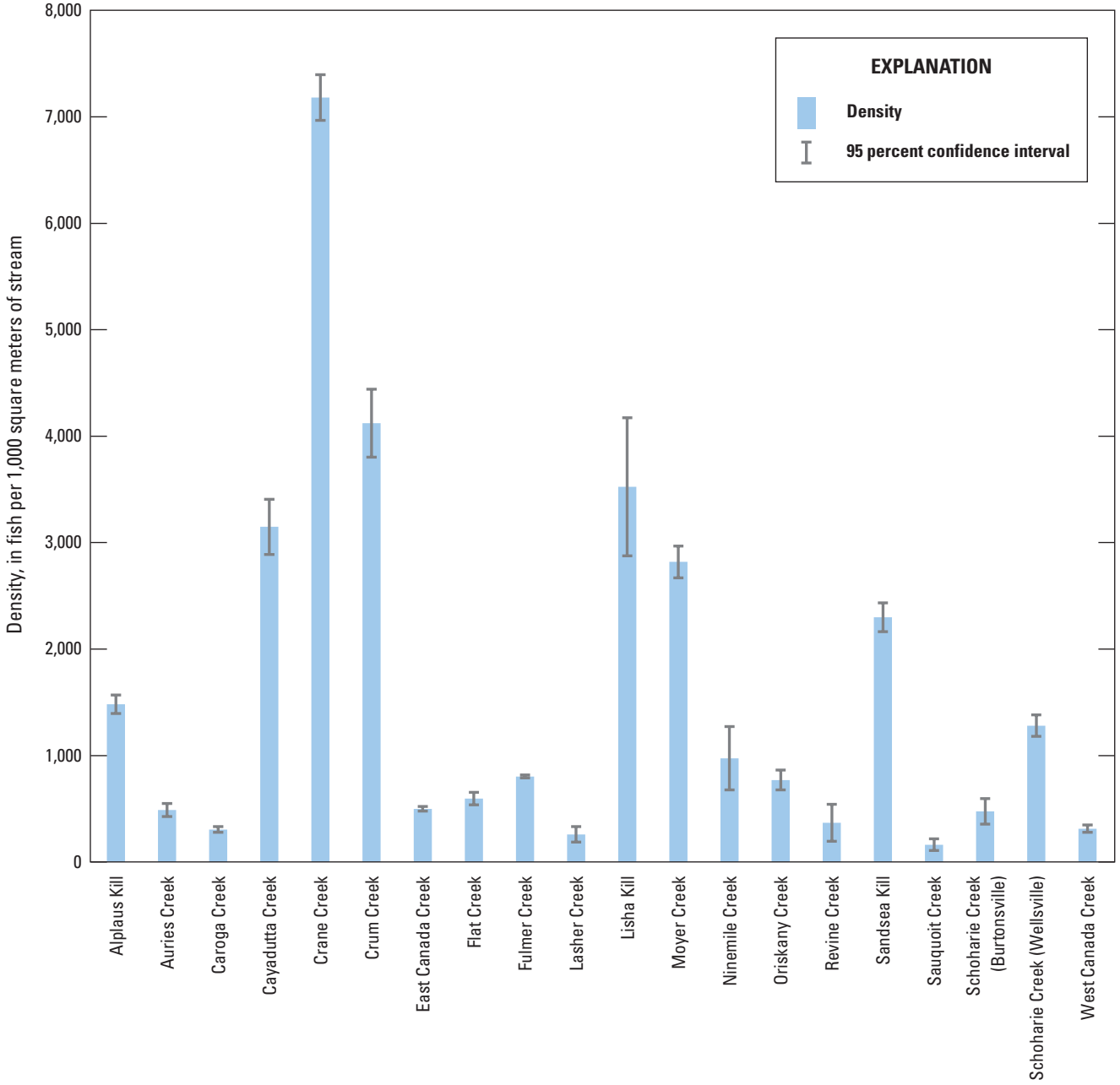

Figure 3. Total fish community density for 20 sites on tributaries to the Mohawk River between Rome and Albany, New York, where fish communities were surveyed in 2019.

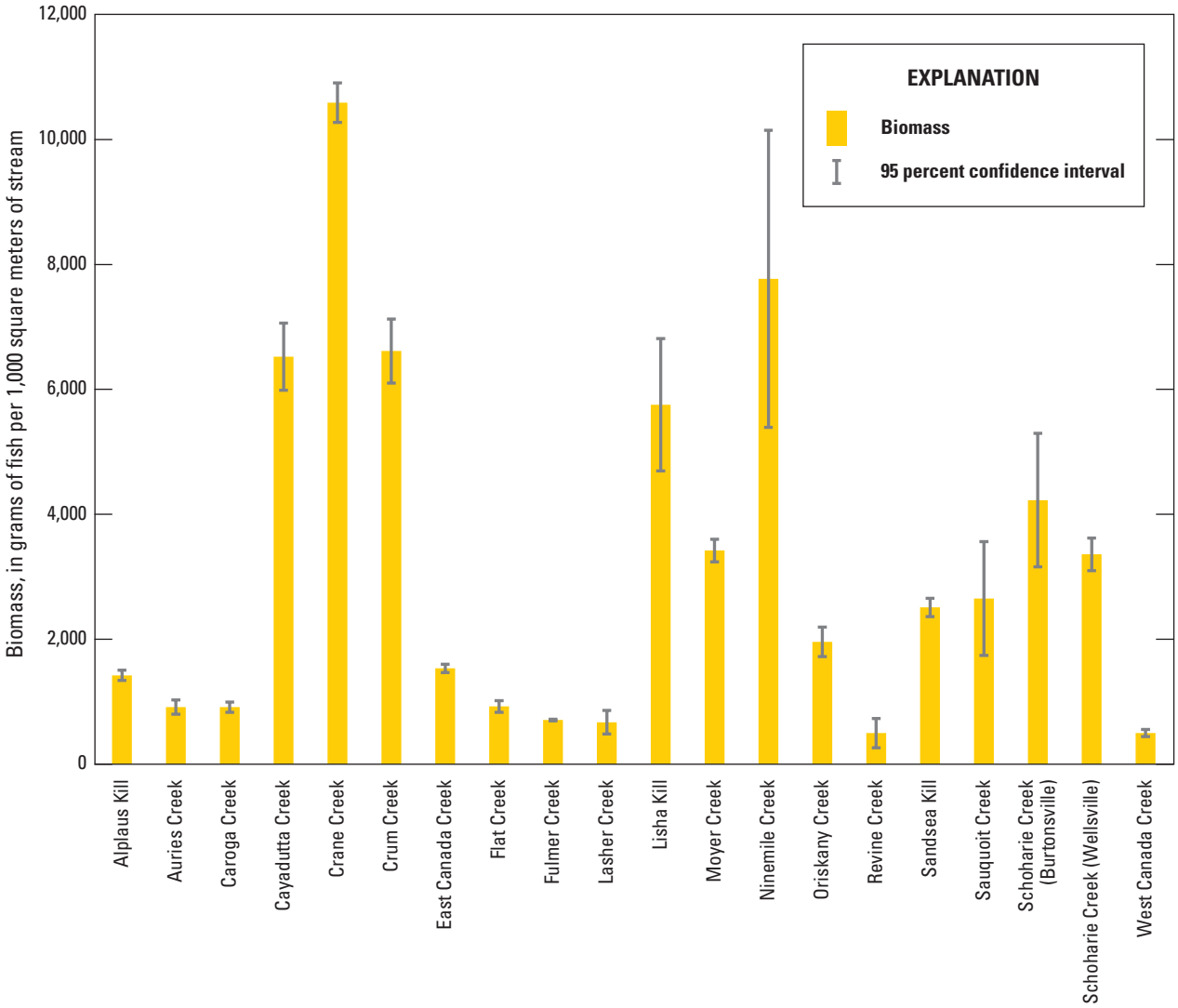

Figure 4. Total fish community biomass for 20 sites on tributaries to the Mohawk River between Rome and Albany, New York, where fish communities were surveyed in 2019.

Table 3. Fish metrics from 20 study sites on tributaries to the Mohawk River between Rome and Albany, New York, where fish communities were surveyed in 2019.

[USGS, U.S. Geological Survey; no, number; m^2, square meter; mm, millimeter; D_{16}, 16th percentile; D_{50}, 50th percentile or median; D_{84}, 84th percentile; Cr, Creek; Rd, Road; nr, near; NYS, New York State]

USGS station name	Species richness (no. of species)	Shannon's index of diversity	Total fish density (fish per 1,000 m^2)	Total fish biomass (grams per 1,000 m^2)	Substrate size (mm)		
					D_{16}	D_{50}	D_{84}
Alplaus Kill at Glenridge NY	12	1.72	1,482	1,423	31	64	122
Auries Creek at Auriesville NY	9	1.68	488	915	20	79	210
Caroga Creek near Fort Plain NY	12	2.00	305	913	51	118	314
Cayadutta Cr below Commons Rd at Berryville NY	14	0.81	3,149	6,525	38	97	215
Crane Cr below Old River Rd at Careys Corners NY	10	0.90	7,182	10,588	27	50	113
Crum Creek near Indian Castle NY	15	1.26	4,123	6,614	41	85	173
East Canada Creek near St. Johnsville NY	8	1.28	499	1,534	67	126	220
Flat Creek at Sprakers NY	9	1.18	595	925	17	85	>1,000
Fulmer Creek at Mohawk NY	8	1.13	803	708	16	43	94
Lasher Creek at mouth near Randall NY	12	2.17	258	673	11	33	141
Lisha Kill northwest of Niskayuna NY	11	1.47	3,525	5,755	6	25	46
Moyer Creek at mouth at Frankfort NY	14	0.88	2,819	3,422	23	63	125
Ninemile Creek near Oriskany NY	15	1.91	974	7,769	28	51	81
Oriskany Creek nr ballfield at Oriskany NY	19	2.19	769	1,959	24	51	84
Revine Creek at NYS Thruway at Auriesville NY	8	1.96	369	498	12	40	99
Sandsea Kill at Pattersonville NY	3	0.33	2,298	2,510	30	70	170
Sauquoit Creek at Yorkville NY	18	2.61	162	2,652	4	21	71
Schoharie Creek below bridge at Burtonsville NY	5	0.59	476	4,227	47	178	575
Schoharie Creek near Wellsville NY	14	1.26	1,281	3,360	56	111	300
West Canada Creek at Herkimer NY	14	2.17	313	500	21	56	154

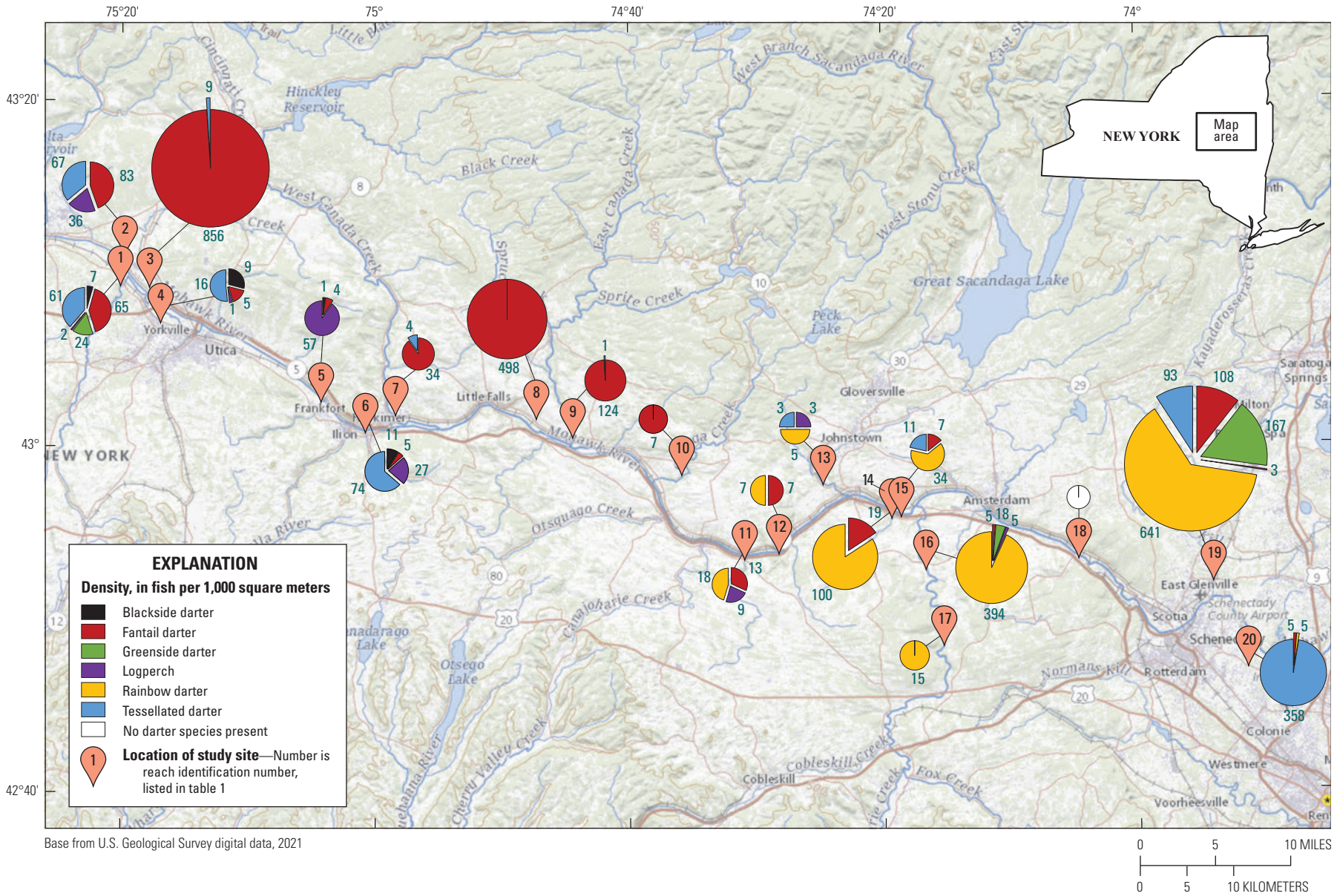

Figure 5. Map showing the distribution and density of all darter species for 20 sites on tributaries to the Mohawk River between Rome and Albany, New York, where fish communities were surveyed in 2019. Distribution and density are shown as pie charts proportionally sized to the total density of all darter species.

Alplaus Kill at Glenridge, N.Y

There were 12 fish species present at the Alplaus Kill site (fig. 6). The total community density was 1,482 fish per 1,000 m^2, and rainbow darter was the most abundant species, composing 43 percent of the community. The total community biomass was 1,423 grams per 1,000 m^2, and smallmouth bass had the greatest biomass, composing 43 percent of the community. There were five darter species present—fantail darter, greenside darter, logperch, rainbow darter, and tessellated darter—which together composed 68 and 47 percent of the community density and biomass, respectively. The pebble count yielded a particle size distribution with a D_{16} of 31 mm, D_{50} of 64 mm, and D_{84} of 122 mm (table 3).

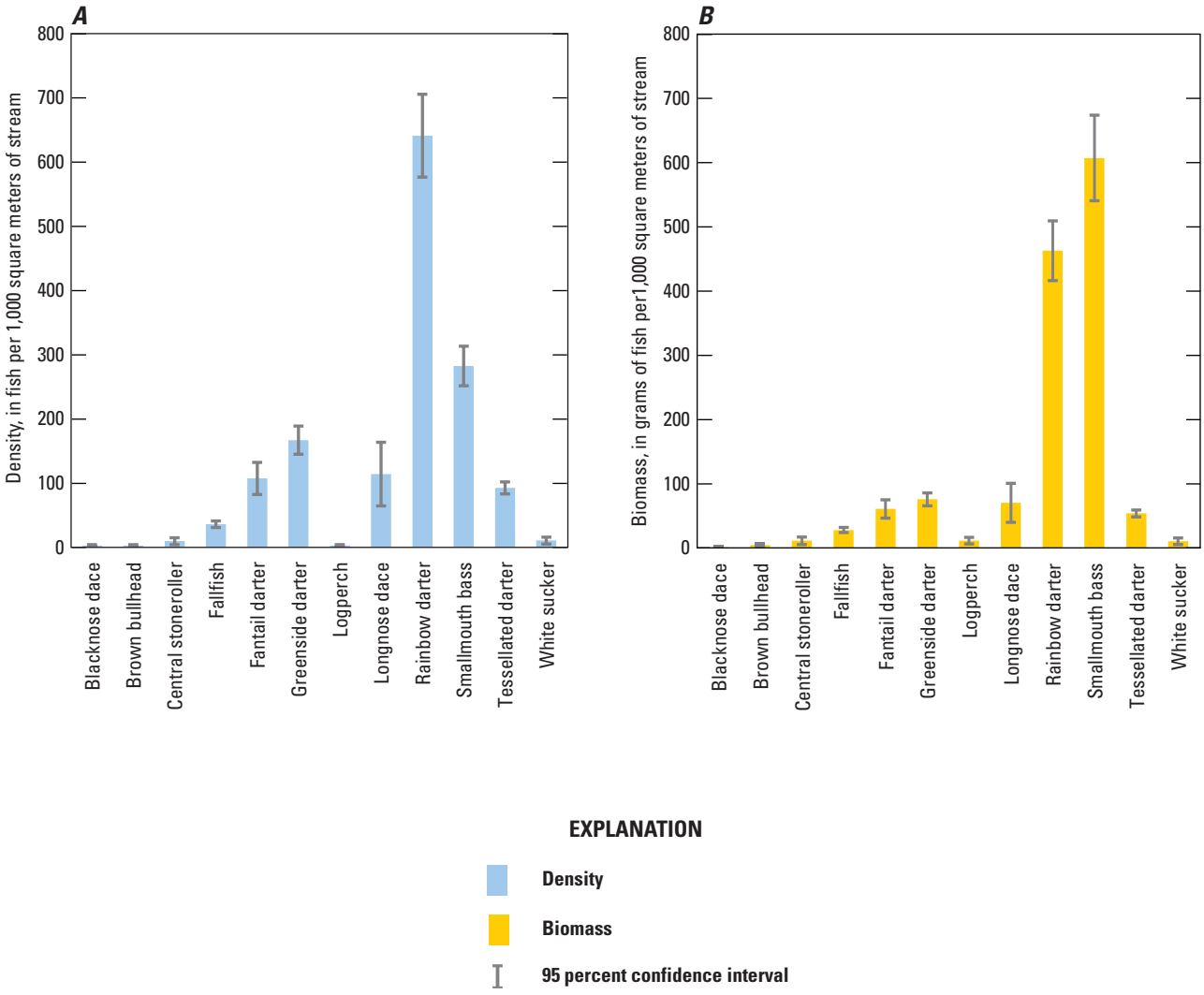

Figure 6. Population density and biomass of each fish species captured at the Alplaus Kill at Glenridge, New York, site.

Auries Creek at Auriesville, N.Y

There were nine fish species present at the Auries Creek site (fig. 7). The total community density was 488 fish per 1,000 m^2, and blacknose dace was the most abundant species, composing 40 percent of the community. The total community biomass was 915 grams per 1,000 m^2, and blacknose dace had the greatest biomass, composing 34 percent of the community.

There were two darter species present—fantail darter and rainbow darter—which together composed 24 and 20 percent of the community density and biomass, respectively. The pebble count yielded a particle size distribution with a D_{16} of 20 mm, D_{50} of 79 mm, and D_{84} of 210 mm (table 3).

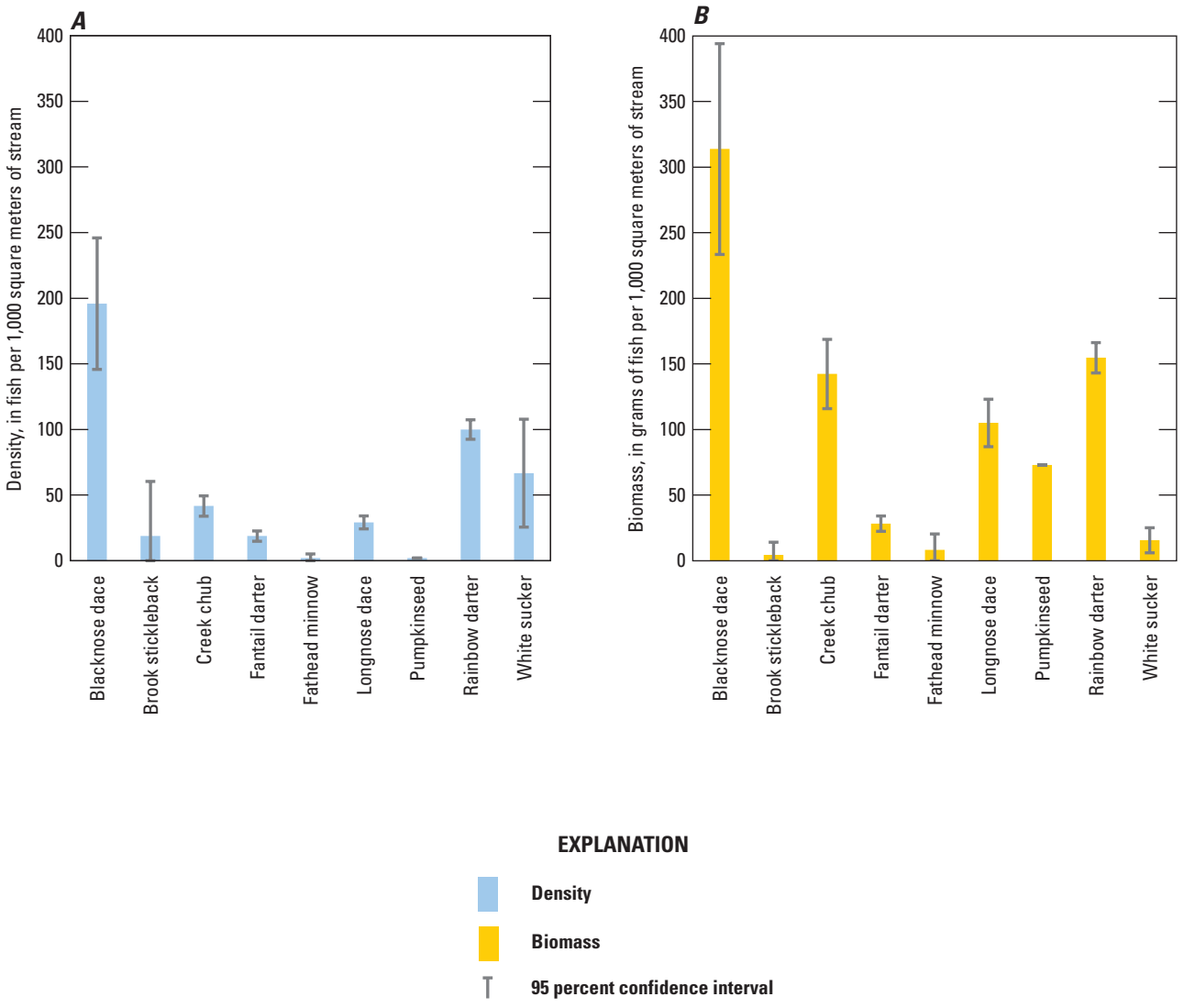

Figure 7. Population density and biomass of each fish species captured at the Auries Creek at Auriesville, New York, site.

Caroga Creek Near Fort Plain, N.Y

There were 12 fish species present at the Caroga Creek site (fig. 8). The total community density was 305 fish per 1,000 m^2, and longnose dace was the most abundant species, composing 28 percent of the community. The total community biomass was 913 grams per 1,000 m^2, and brown bullhead (*Ameiurus nebulosus*) had the greatest biomass, composing 16 percent of the community. Fantail darter was the only darter species present, which composed 2 and less than 1 percent of the community density and biomass, respectively. The pebble count yielded a particle size distribution with a D_{16} of 51 mm, D_{50} of 118 mm, and D_{84} of 314 mm (table 3).

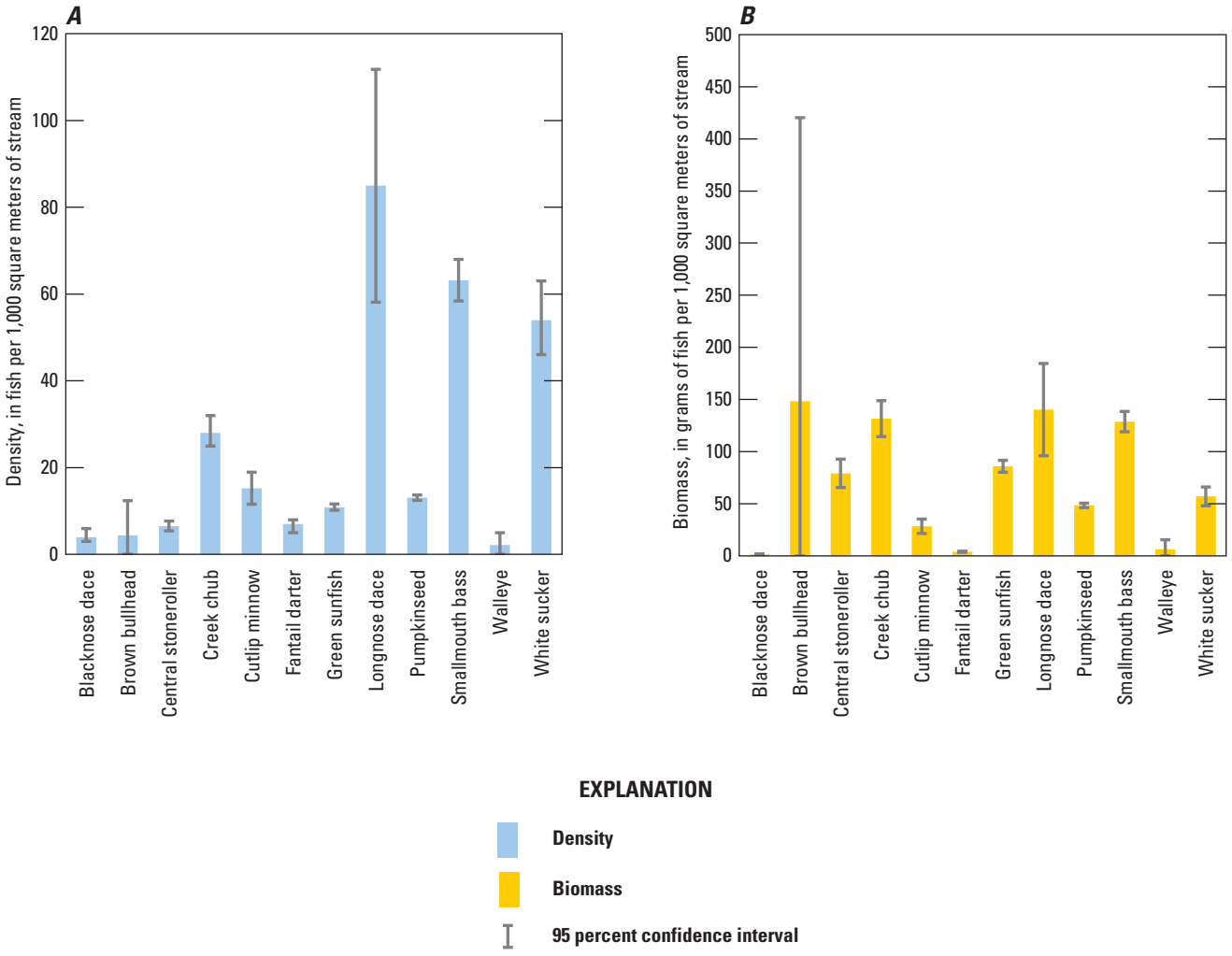

Figure 8. Population density and biomass of each fish species captured at the Caroga Creek near Fort Plain, New York, site.

Cayadutta Creek Below Commons Road at Berryville, N.Y

There were 14 fish species present at the Cayadutta Creek site (fig. 9). The total community density was 3,149 fish per 1,000 m^2, and longnose dace was the most abundant species, composing 78 percent of the community. The total community biomass was 6,525 grams per 1,000 m^2, and longnose dace had the greatest biomass, composing 57 percent of the community. There were three darter species present—logperch, rainbow darter, and tessellated darter—which together composed less than 1 percent of both the community density and biomass. The pebble count yielded a particle size distribution with a D_{16} of 38 mm, D_{50} of 97 mm, and D_{84} of 215 mm (table 3).

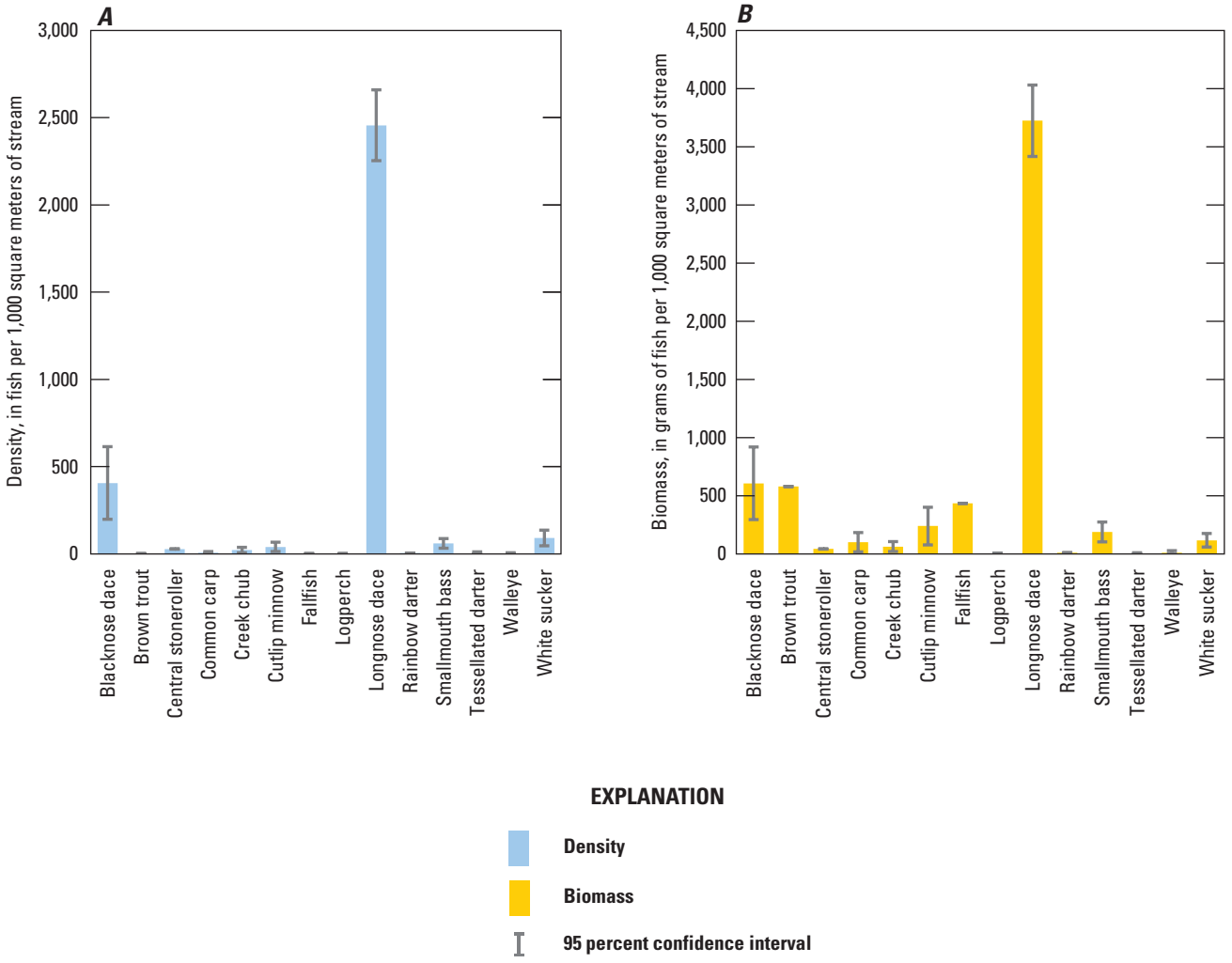

Figure 9. Population density and biomass of each fish species captured at the Cayadutta Creek below Commons Road at Berryville, New York, site.

Crane Creek Below Old River Road at Careys Corners, N.Y

There were 10 fish species present at the Crane Creek site (fig. 10). This site was noteworthy because it produced the greatest estimates of community density and community biomass in the entire study. The total community density was 7,182 fish per 1,000 m^2, and blacknose dace was the most abundant species, composing 72 percent of the community. The total community biomass was 10,588 grams per 1,000 m^2, and blacknose dace had the greatest biomass, composing 59 percent of the community. There were two darter species present—fantail darter and tessellated darter—which together composed 12 and 10 percent of the community density and biomass, respectively. The pebble count yielded a particle size distribution with a D_{16} of 27 mm, D_{50} of 50 mm, and D_{84} of 113 mm (table 3).

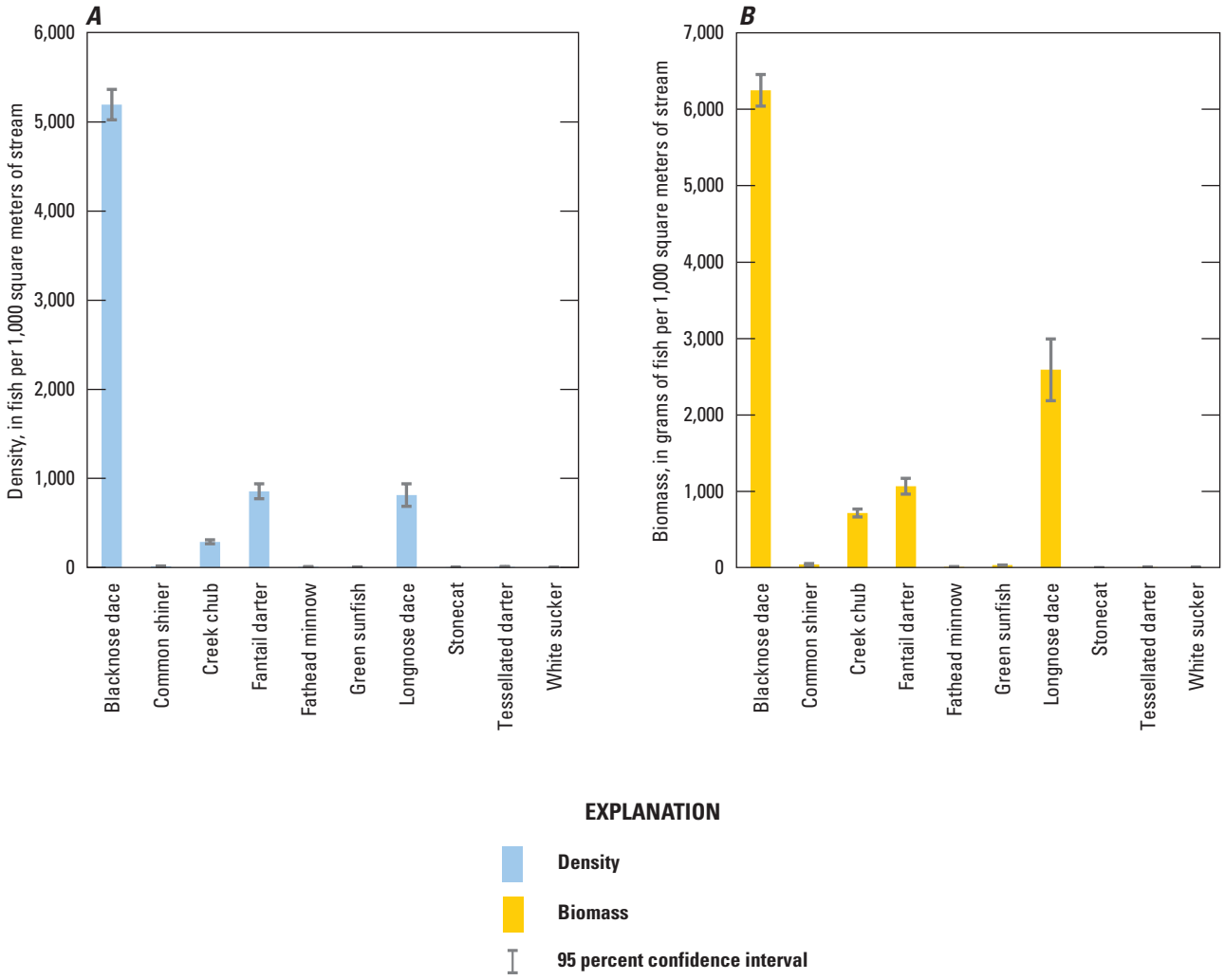

Figure 10. Population density and biomass of each fish species captured at the Crane Creek below Old River Road at Careys Corners, New York, site.

Crum Creek Near Indian Castle, N.Y

There were 15 fish species present at the Crum Creek site (fig. 11). The total community density was 4,123 fish per 1,000 m^2, and blacknose dace was the most abundant species, composing 60 percent of the community. The total community biomass was 6,614 grams per 1,000 m^2, and blacknose dace had the greatest biomass, composing 32 percent of the community. Fantail darter was the only darter species present, which composed 12 and 7 percent of the community density and biomass, respectively. The pebble count yielded a particle size distribution with a D_{16} of 41 mm, D_{50} of 85 mm, and D_{84} of 173 mm (table 3).

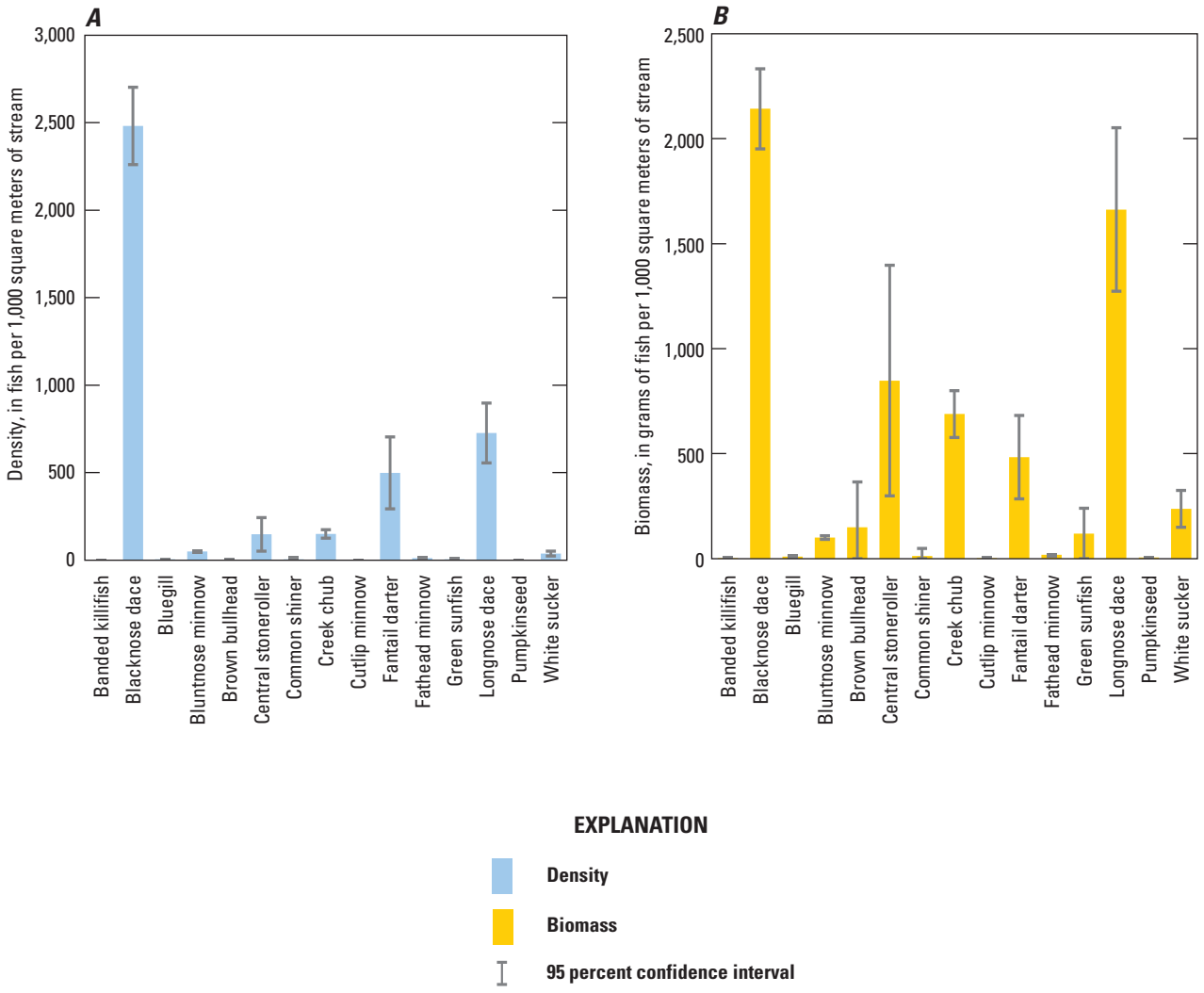

Figure 11. Population density and biomass of each fish species captured at the Crum Creek near Indian Castle, New York, site.

East Canada Creek Near St. Johnsville, N.Y

There were eight fish species present at the East Canada Creek site (fig. 12). The total community density was 499 fish per 1,000 m^2, and longnose dace was the most abundant species, composing 44 percent of the community. The total community biomass was 1,534 grams per 1,000 m^2, and stonecat (*Noturus flavus*) had the greatest biomass, composing 39 percent of the community. There were two darter species present—fantail darter and tessellated darter—which together composed 25 and 19 percent of the community density and biomass, respectively. The pebble count yielded a particle size distribution with a D_{16} of 67 mm, D_{50} of 126 mm, and D_{84} of 220 mm (table 3).

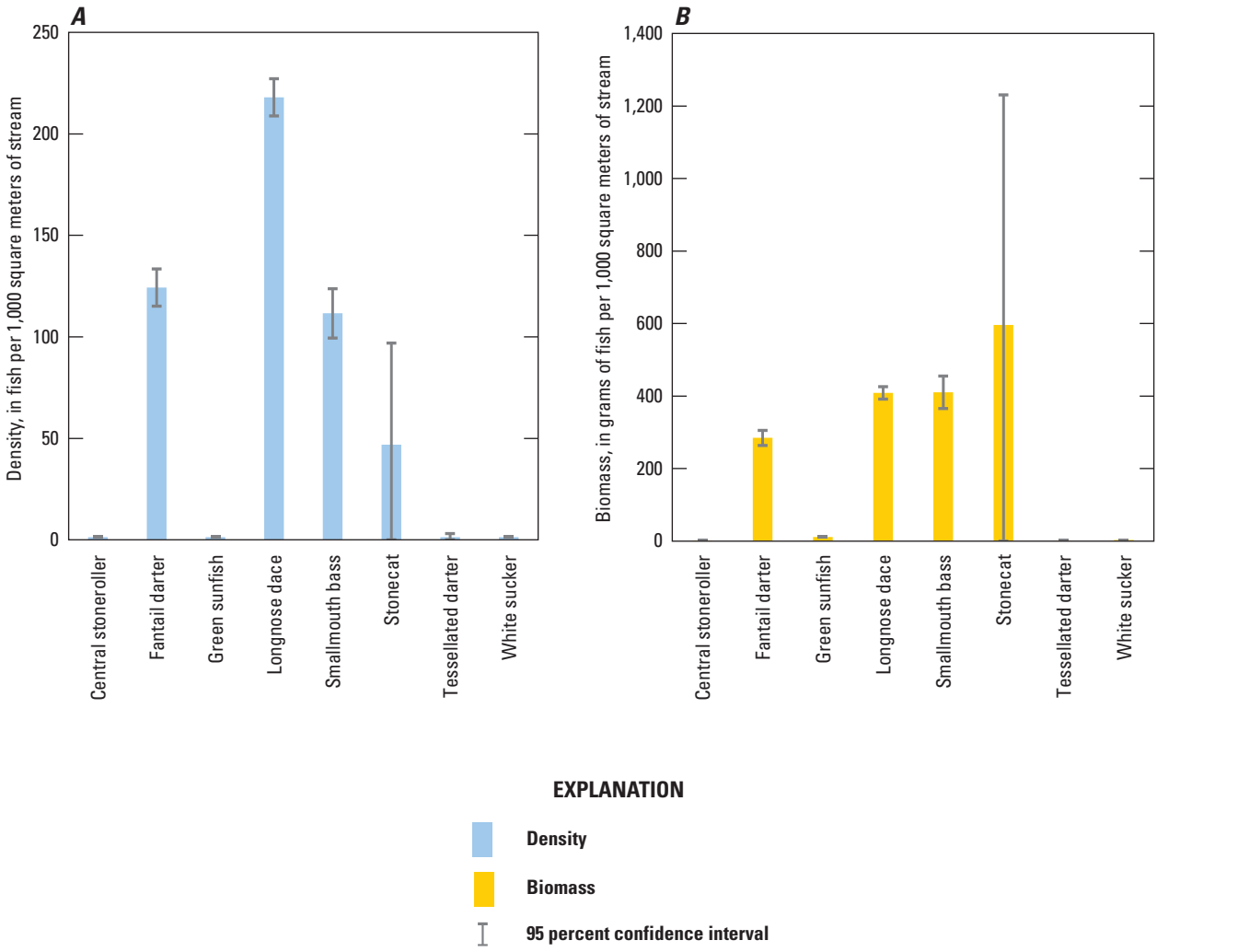

Figure 12. Population density and biomass of each fish species captured at the East Canada Creek near St. Johnsville, New York, site.

Flat Creek at Sprakers, N.Y

There were nine fish species present at the Flat Creek site (fig. 13). The total community density was 595 fish per 1,000 m^2, and blacknose dace was the most abundant species, composing 64 percent of the community. The total community biomass was 925 grams per 1,000 m^2, and blacknose dace had the greatest biomass, composing 46 percent of the community. There were three darter species present—fantail darter, logperch, and rainbow darter—which together composed 7 and 14 percent of the community density and biomass, respectively. The pebble count yielded a particle size distribution with a D_{16} of 17 mm, D_{50} of 85 mm, and D_{84} of >1,000 mm (table 3).

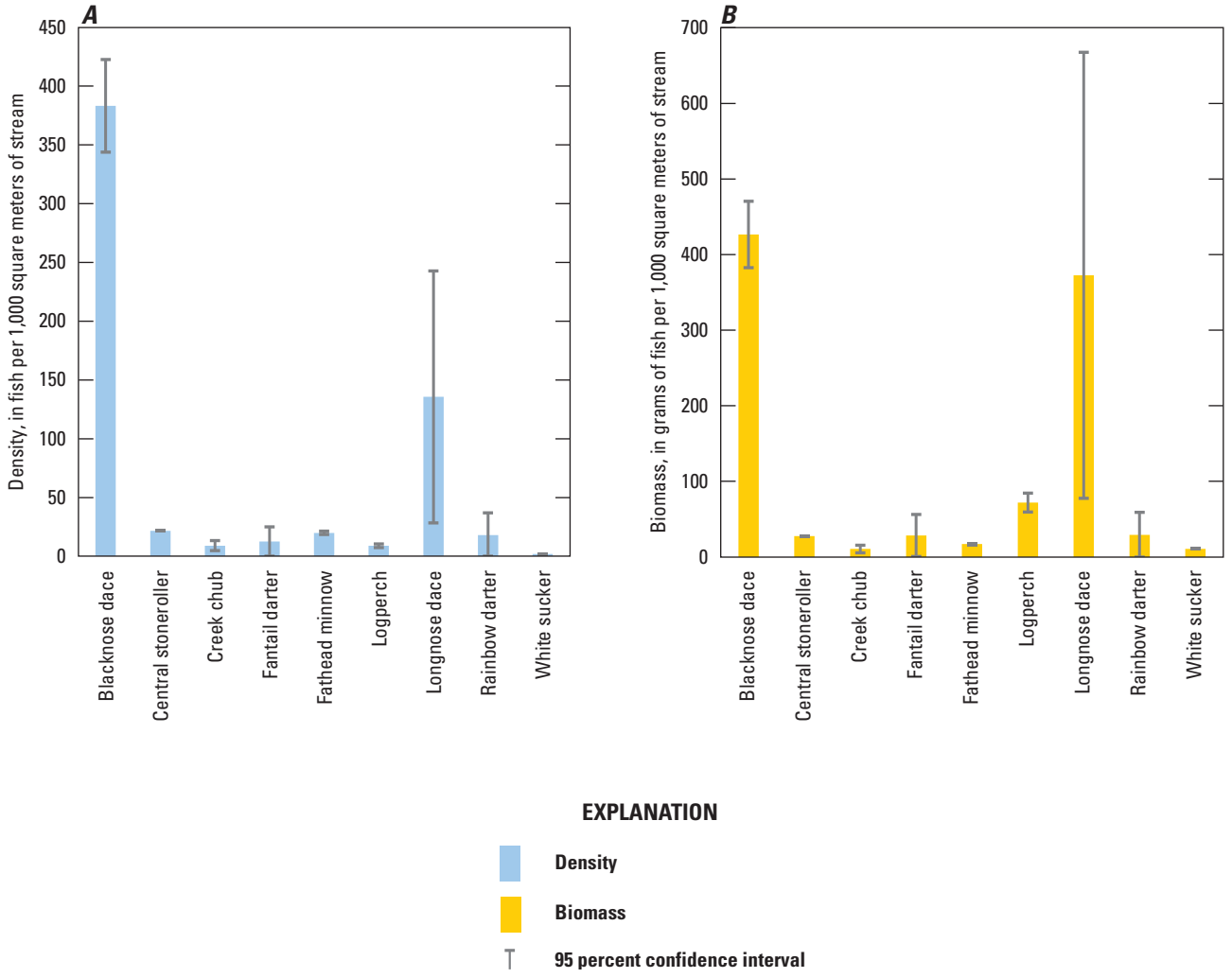

Figure 13. Population density and biomass of each fish species captured at the Flat Creek at Sprakers, New York, site.

Fulmer Creek at Mohawk, N.Y

There were eight fish species present at the Fulmer Creek site (fig. 14). The total community density was 803 fish per 1,000 m^2, and white sucker was the most abundant species, composing 62 percent of the community. The total community biomass was 708 grams per 1,000 m^2, and longnose dace had the greatest biomass, composing 30 percent of the community. There were four darter species present—blackside darter, fantail darter, logperch, and tessellated darter—which together composed 15 and 43 percent of the community density and biomass, respectively. The pebble count yielded a particle size distribution with a D_{16} of 16 mm, D_{50} of 43 mm, and D_{84} of 94 mm (table 3).

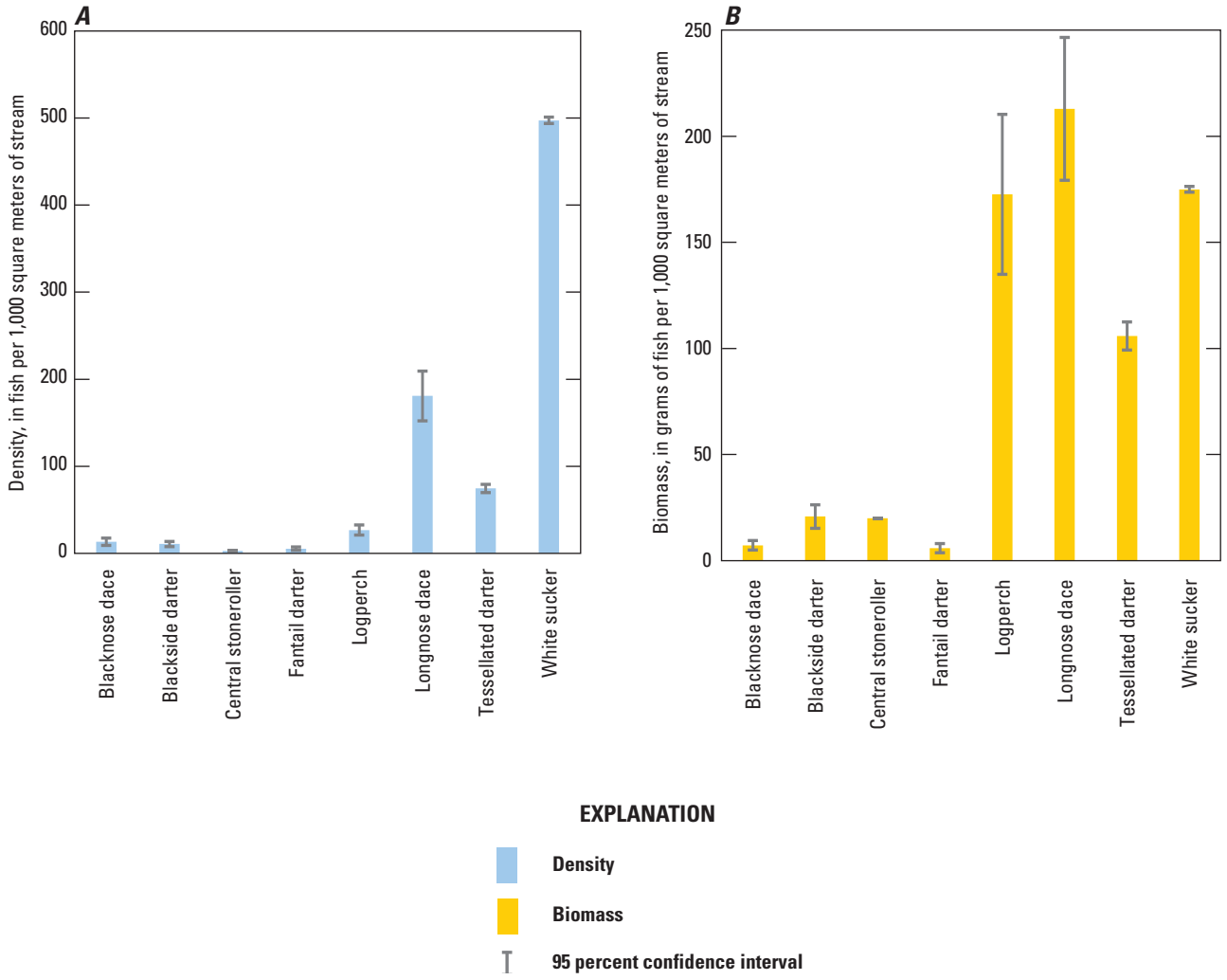

Figure 14. Population density and biomass of each fish species captured at the Fulmer Creek at Mohawk, New York, site.

Lasher Creek at Mouth Near Randall, N.Y

There were 12 fish species present at the Lasher Creek site (fig. 15). The total community density was 258 fish per 1,000 m^2, and longnose dace was the most abundant species, composing 19 percent of the community. The total community biomass was 673 grams per 1,000 m^2, and white sucker had the greatest biomass, composing 46 percent of the community. There were two darter species present—fantail darter and rainbow darter—which together composed 5 and 3 percent of the community density and biomass, respectively. The pebble count yielded a particle size distribution with a D_{16} of 11 mm, D_{50} of 33 mm, and D_{84} of 141 mm (table 3).

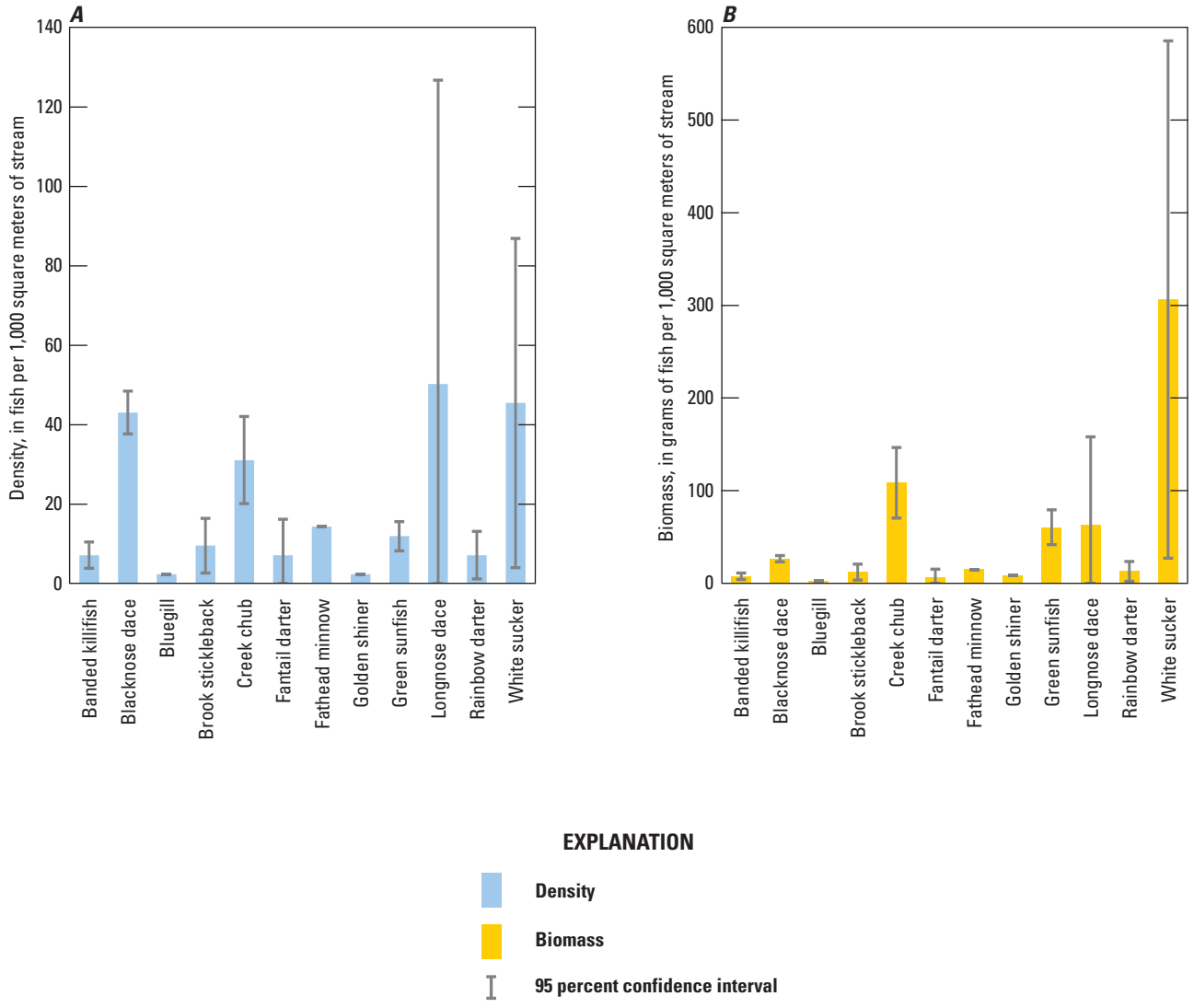

Figure 15. Population density and biomass of each fish species captured at the Lasher Creek at Mouth near Randall, New York, site.

Lisha Kill Northwest of Niskayuna, N.Y

There were 11 fish species present at the Lisha Kill site (fig. 16). The total community density was 3,525 fish per 1,000 m^2, and central stoneroller (*Campostoma anomalum*) was the most abundant species, composing 30 percent of the community. The total community biomass was 5,755 grams per 1,000 m^2, and creek chub had the greatest biomass, composing 46 percent of the community. There were three darter species present—fantail darter, rainbow darter, and tessellated darter—which together composed 10 and 4 percent of the community density and biomass, respectively. The pebble count yielded a particle size distribution with a D_{16} of 6 mm, D_{50} of 25 mm, and D_{84} of 46 mm (table 3).

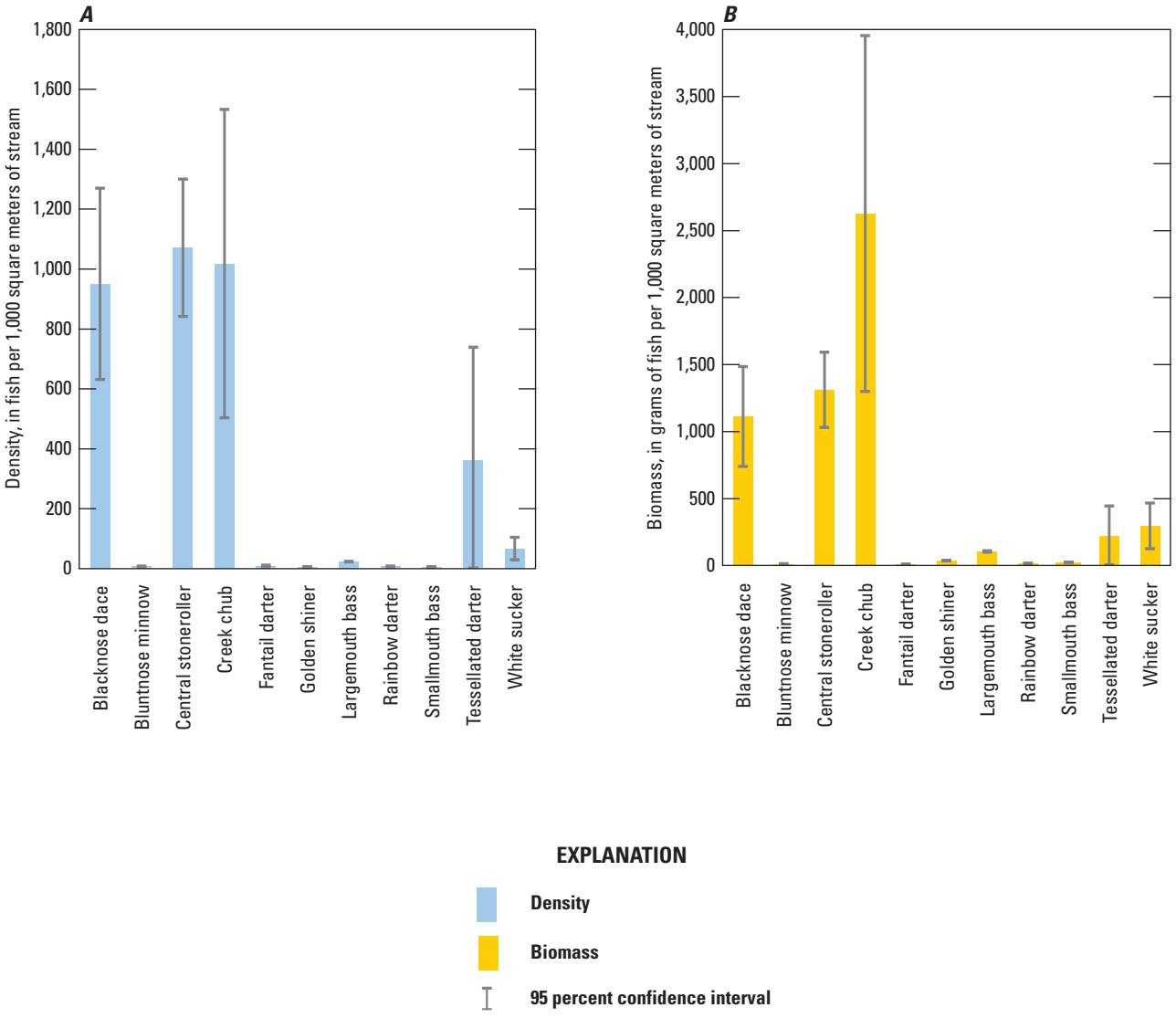

Figure 16. Population density and biomass of each fish species captured at the Lisha Kill northwest of Niskayuna, New York, site.

Moyer Creek at Mouth at Frankfort, N.Y

There were 14 fish species present at the Moyer Creek site (fig. 17). The total community density was 2,819 fish per 1,000 m^2, and longnose dace was the most abundant species, composing 70 percent of the community. The total community biomass was 3,422 grams per 1,000 m^2, and longnose dace had the greatest biomass, composing 65 percent of the community. There were three darter species present—blackside darter, fantail darter, and logperch—which together composed 2 and 7 percent of the community density and biomass, respectively. The pebble count yielded a particle size distribution with a D_{16} of 23 mm, D_{50} of 63 mm, and D_{84} of 125 mm (table 3).

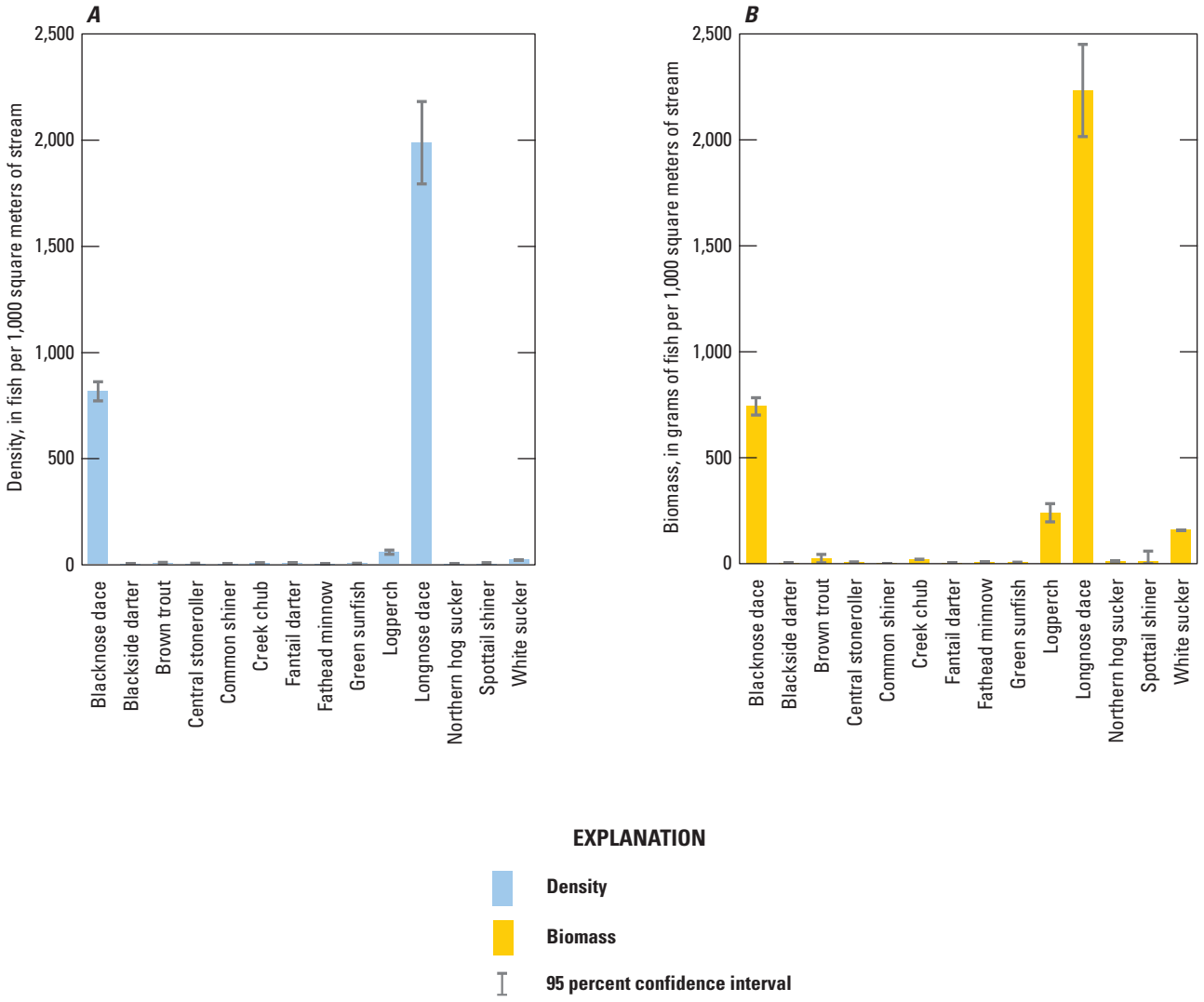

Figure 17. Population density and biomass of each fish species captured at the Moyer Creek at mouth at Frankfort, New York, site.

Ninemile Creek Near Oriskany, N.Y

There were 15 fish species present at the Ninemile Creek site (fig. 18). The total community density was 974 fish per 1,000 m^2, and longnose dace was the most abundant species, composing 49 percent of the community. The total community biomass was 7,769 grams per 1,000 m^2, and smallmouth bass had the greatest biomass, composing 46 percent of the community. There were three darter species present—fantail darter, logperch, and tessellated darter—which together composed 19 and 3 percent of the community density and biomass, respectively. Additionally, round goby were present in the study reach with an estimated density of 20 fish per 1,000 m^2 and biomass of 68 grams per 1,000 m^2 (fig. 19). The pebble count yielded a particle size distribution with a D_{16} of 28 mm, D_{50} of 51 mm, and D_{84} of 81 mm (table 3).

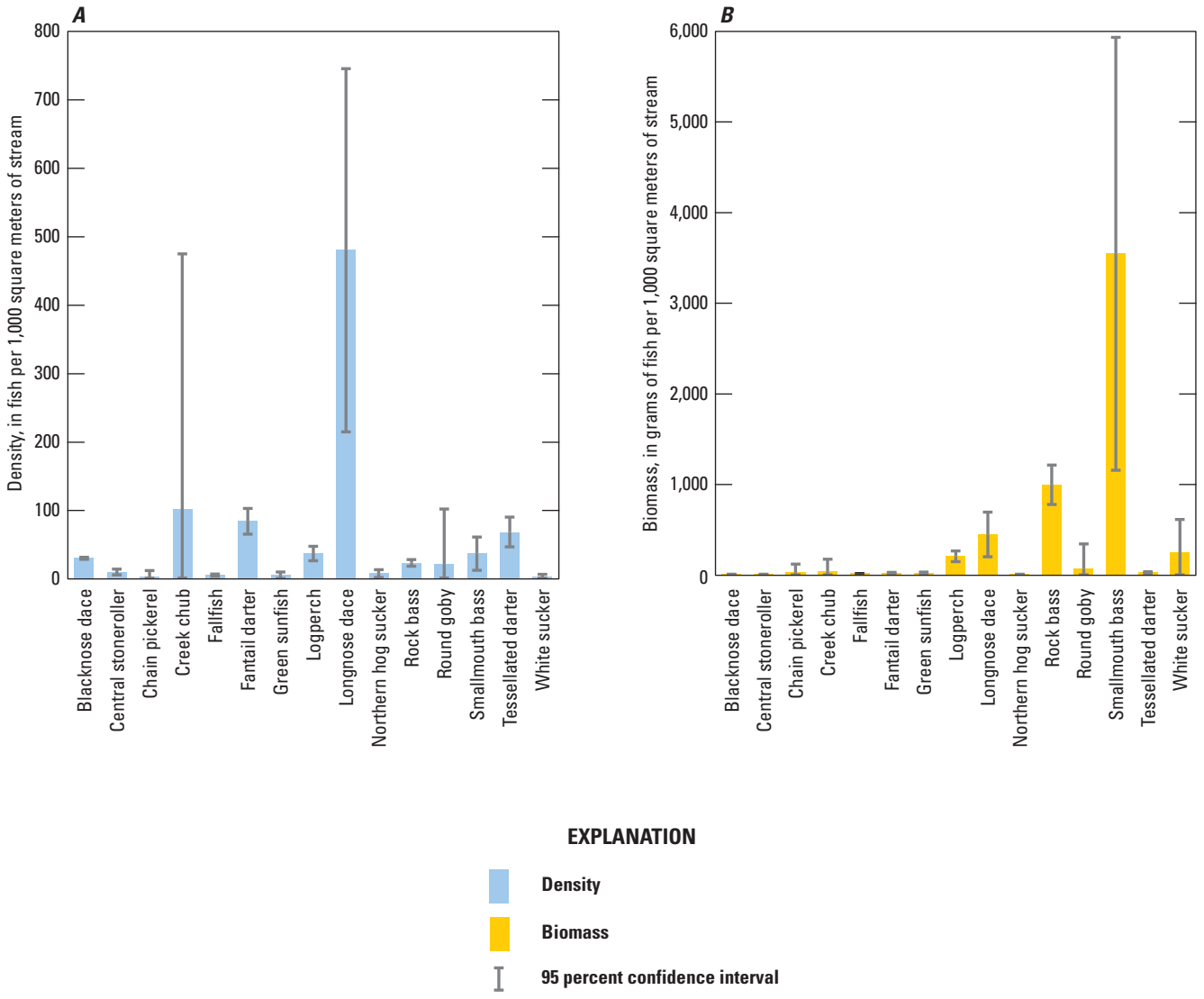

Figure 18. Population density and biomass of each fish species captured at the Ninemile Creek near Oriskany, New York, site.

Figure 19. A round goby captured during the fish community survey at the Ninemile Creek near Oriskany, New York, site. Photograph by Kyle Olivencia, U.S. Geological Survey.

Oriskany Creek Near Ballfield at Oriskany, N.Y

There were 19 fish species present at the Oriskany Creek site (fig. 20). The total community density was 769 fish per 1,000 m^2, and longnose dace was the most abundant species, composing 34 percent of the community. The total community biomass was 1,959 grams per 1,000 m^2, and green sunfish (*Lepomis cyanellus*) had the greatest biomass, composing 27 percent of the community. There were five darter species present—blackside darter, fantail darter, greenside darter, logperch, and tessellated darter—which together composed 21 and 9 percent of the community density and biomass, respectively. The pebble count yielded a particle size distribution with a D_{16} of 24 mm, D_{50} of 51 mm, and D_{84} of 84 mm (table 3).

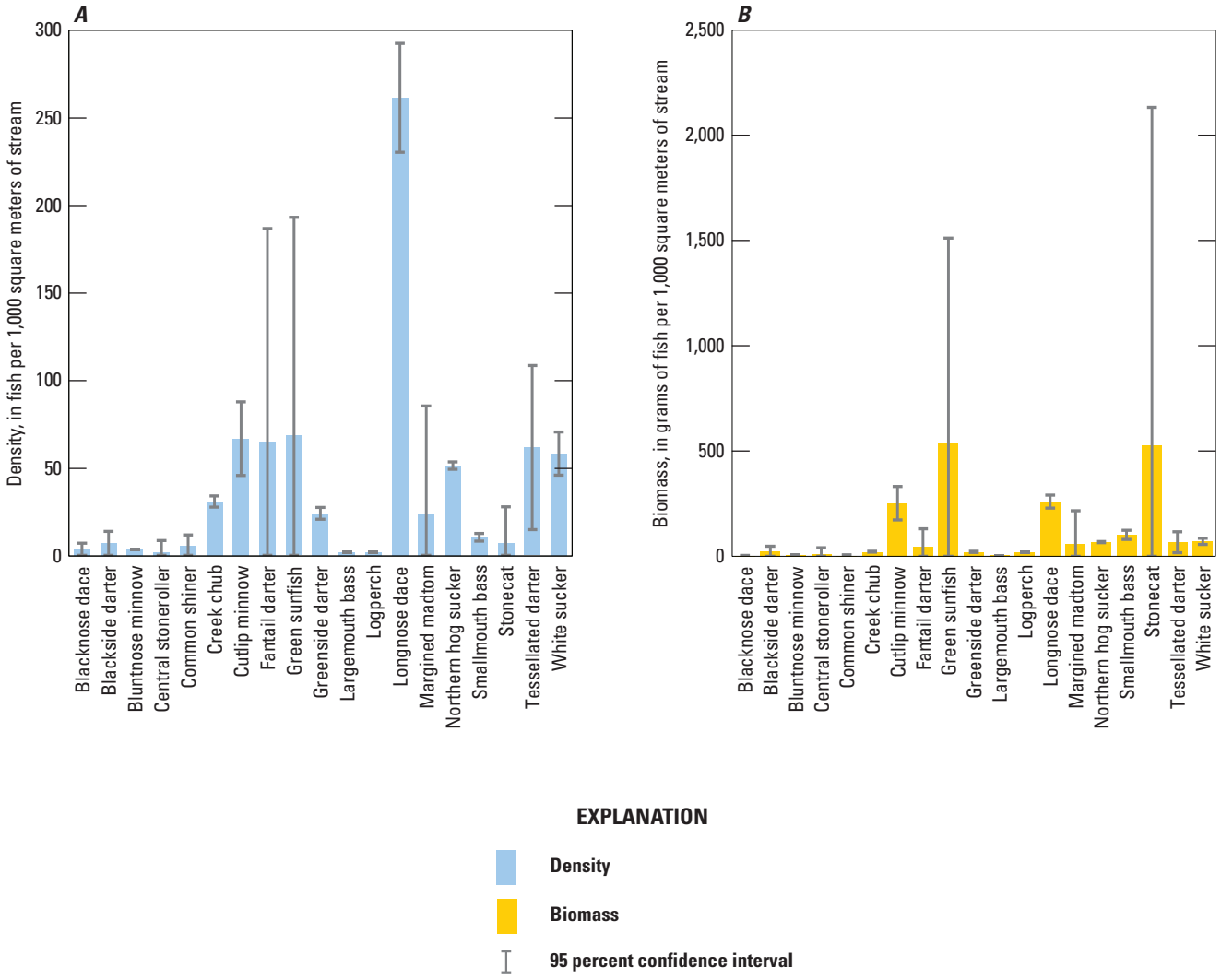

Figure 20. Population density and biomass of each fish species captured at the Oriskany Creek near Ballfield at Oriskany, New York, site.

Revine Creek at New York State Thruway at Auriesville, N.Y

There were eight fish species present at the Revine Creek site (fig. 21). The total community density was 369 fish per 1,000 m^2, and white sucker was the most abundant species, composing 21 percent of the community. The total community biomass was 498 grams per 1,000 m^2, and creek chub had the greatest biomass, composing 23 percent of the community. There were three darter species present—fantail darter, rainbow darter, and tessellated darter—which together composed 14 and 15 percent of the community density and biomass, respectively. The pebble count yielded a particle size distribution with a D_{16} of 12 mm, D_{50} of 40 mm, and D_{84} of 99 mm (table 3).

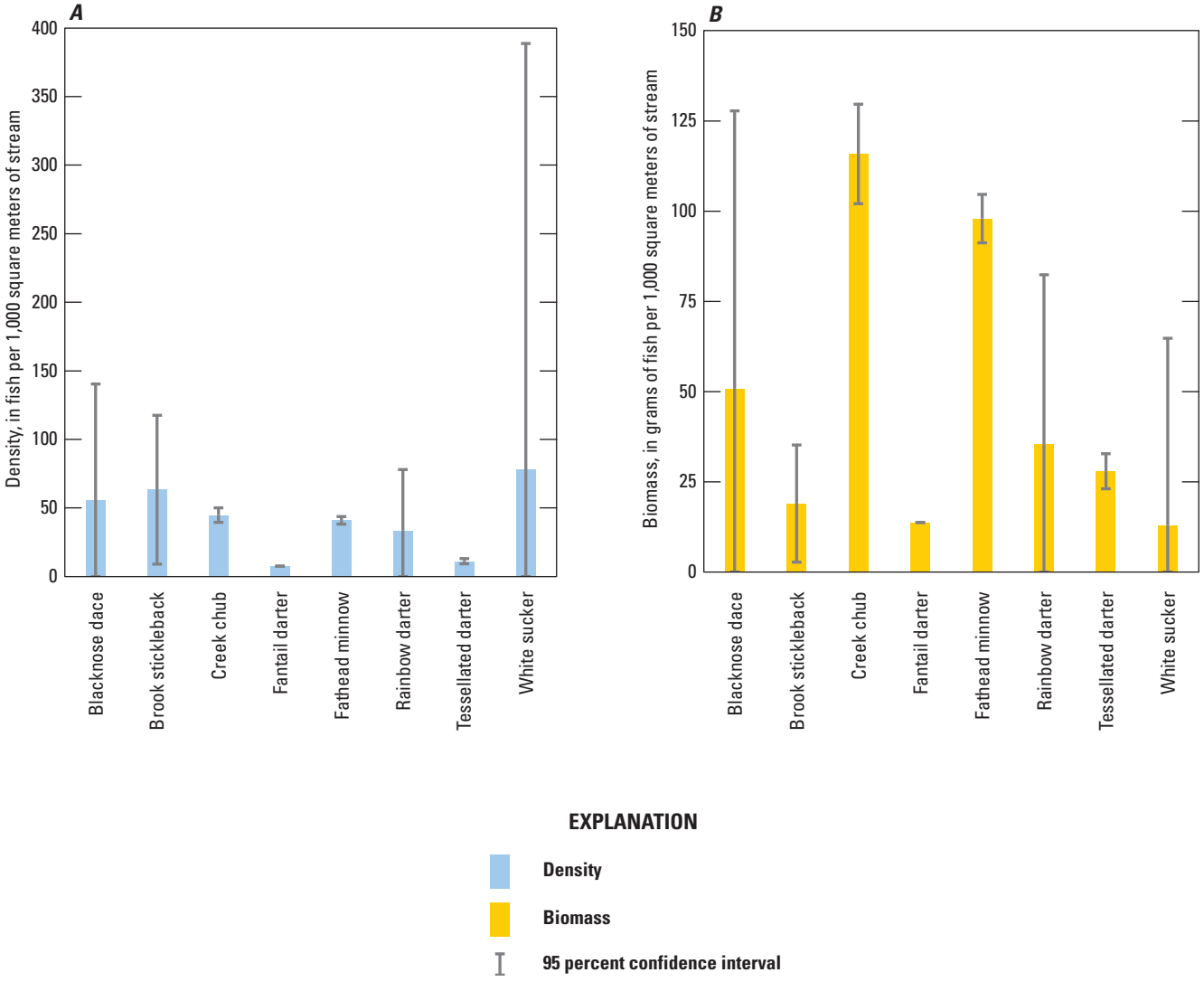

Figure 21. Population density and biomass of each fish species captured at the Revine Creek at the New York State Thruway at Auriesville, New York, site.

Sandsea Kill at Pattersonville, N.Y

There were three fish species present at the Sandsea Kill site (fig. 22). The total community density was 2,298 fish per 1,000 m^2, and blacknose dace was the most abundant species, composing 92 percent of the community. The total community biomass was 2,510 grams per 1,000 m^2, and blacknose dace had the greatest biomass, composing 83 percent of the community. There were no darter species present. The pebble count yielded a particle size distribution with a D_{16} of 30 mm, D_{50} of 70 mm, and D_{84} of 170 mm (table 3).

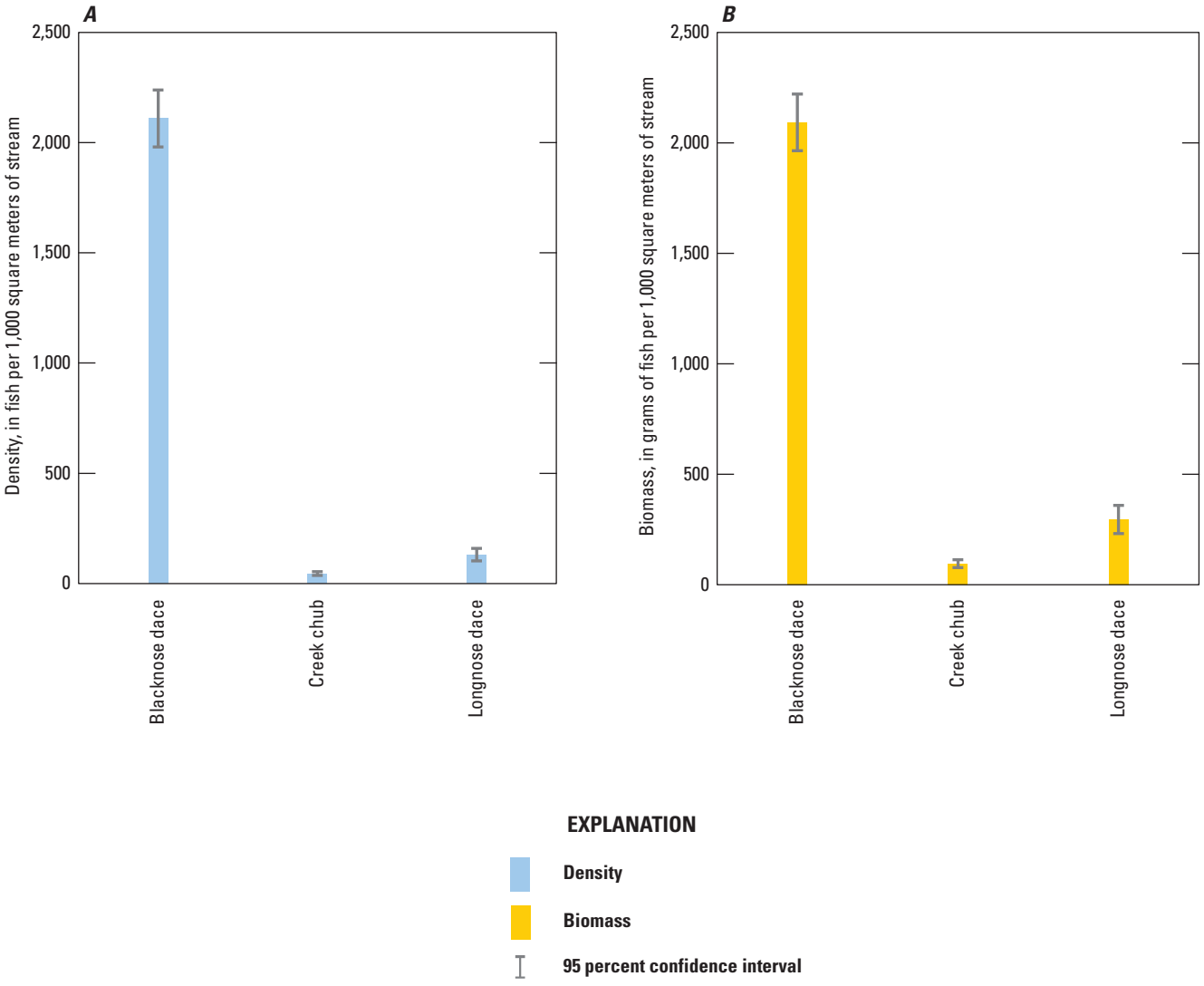

Figure 22. Population density and biomass of each fish species captured at the Sandsea Kill at Pattersonville, New York, site.

Sauquoit Creek at Yorkville, N.Y

There were 18 fish species present at the Sauquoit Creek site (fig. 23). The total community density was 162 fish per 1,000 m^2, and longnose dace was the most abundant species, composing 12 percent of the community. A single brown trout (*Salmo trutta*) with a length of 448 mm and mass of 1,214 grams, the largest fish captured in the entire study, was responsible for nearly half of the biomass in the study reach (fig. 24).

The total community biomass was 2,652 grams per 1,000 m^2, and brown trout had the greatest biomass, composing 46 percent of the community. There were four darter species present—blackside darter, fantail darter, logperch, and tessellated darter—which together composed 19 and 3 percent of the community density and biomass, respectively. The pebble count yielded a particle size distribution with a D_{16} of 4 mm, D_{50} of 21 mm, and D_{84} of 71 mm (table 3).

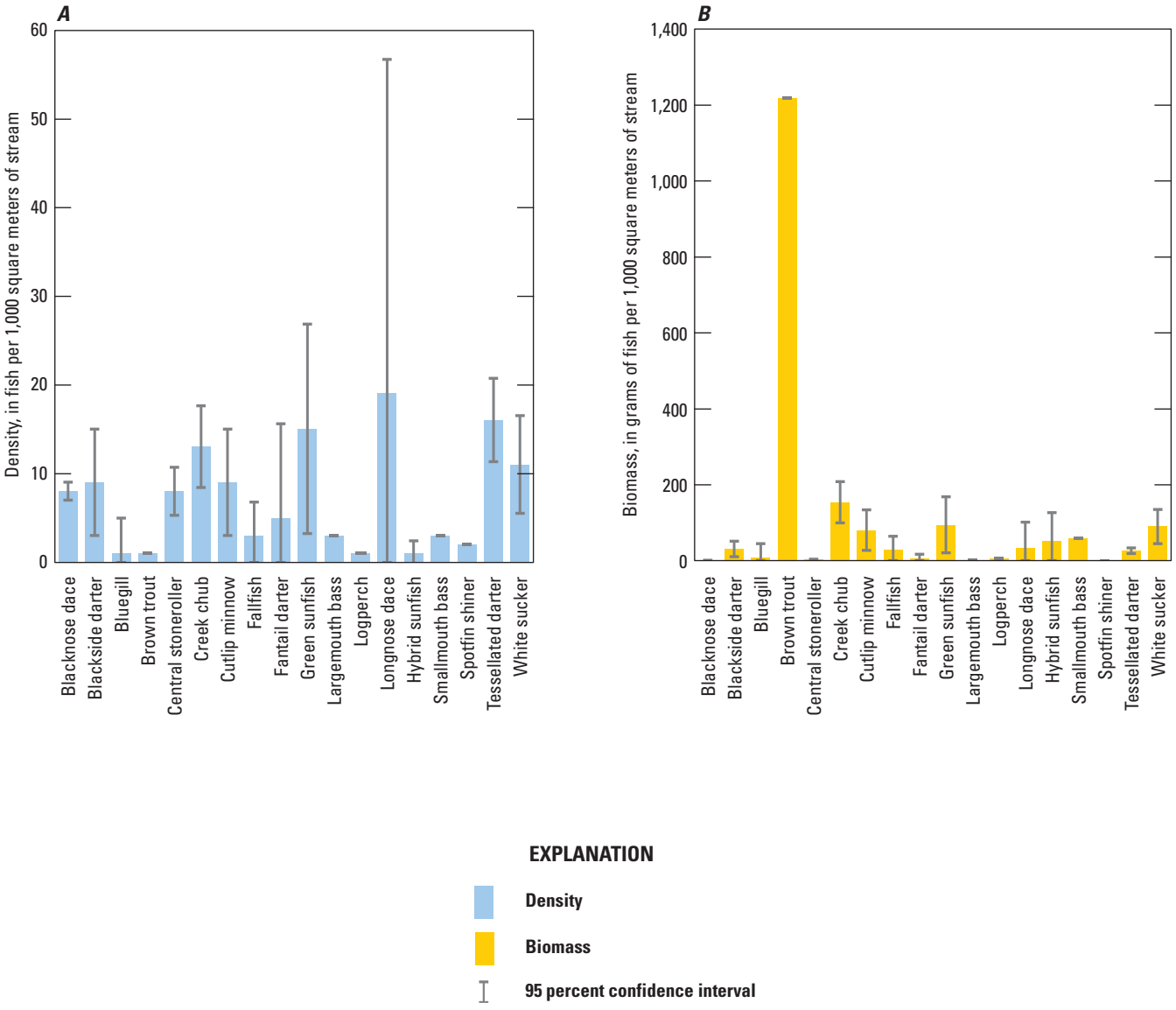

Figure 23. Population density and biomass of each fish species captured at the Sauquoit Creek at Yorkville, New York, site.

Figure 24. A large brown trout captured during the fish community survey at the Sauquoit Creek at Yorkville, New York, site. Photograph by Dylan Winterhalter, U.S. Geological Survey.

Schoharie Creek Below Bridge at Burtonsville, N.Y

There were five fish species present at the Schoharie Creek at Burtonsville site (fig. 25). The total community density was 476 fish per 1,000 m^2, and smallmouth bass was the most abundant species, composing 83 percent of the community. The total community biomass was 4,227 grams per 1,000 m^2, and smallmouth bass had the greatest biomass, composing 88 percent of the community. Rainbow darter was the only darter species present, which composed 3 and less than 1 percent of the community density and biomass, respectively. The pebble count yielded a particle size distribution with a D_{16} of 47 mm, D_{50} of 178 mm, and D_{84} of 575 mm (table 3).

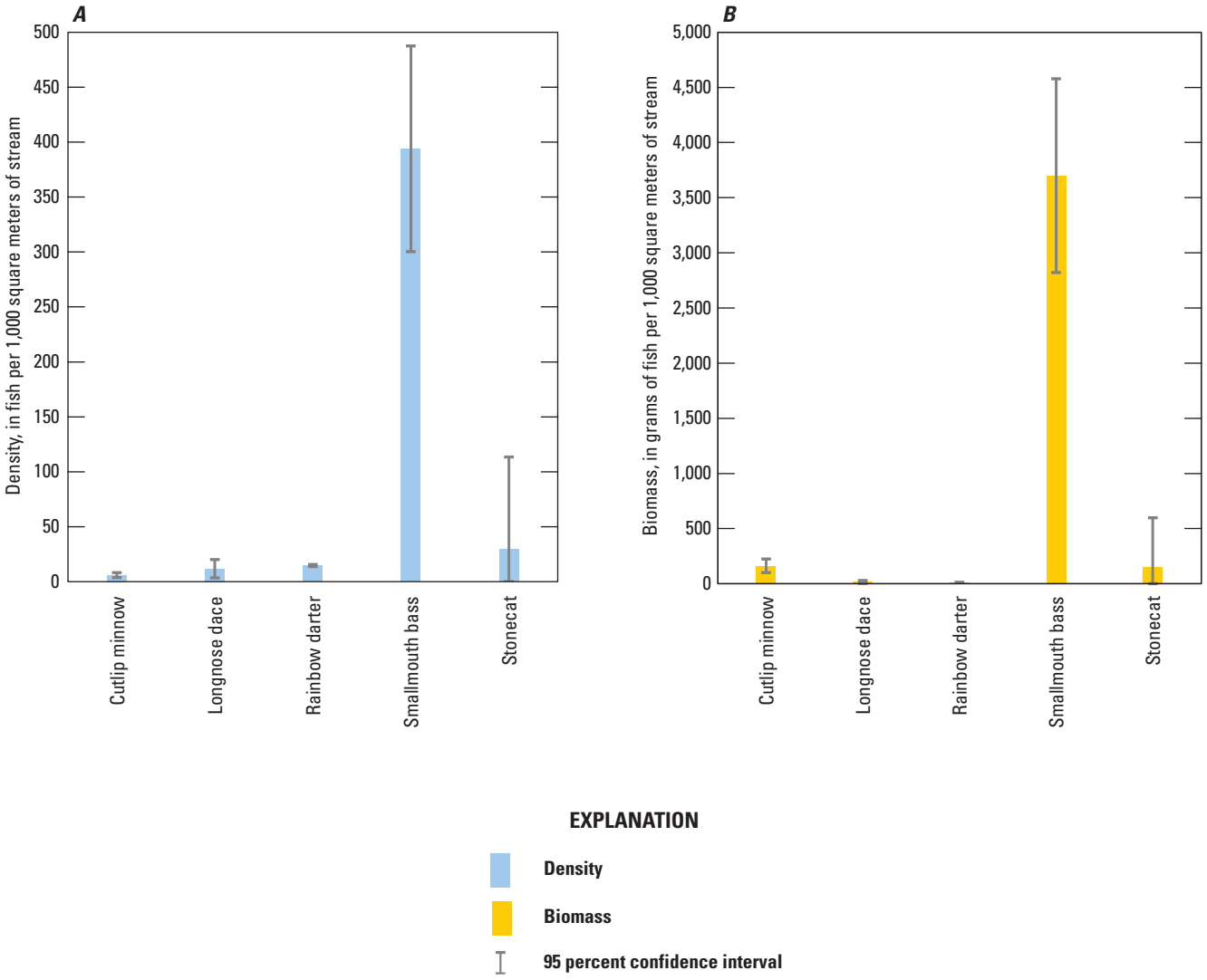

Figure 25. Population density and biomass of each fish species captured at the Schoharie Creek below bridge at Burtonsville, New York, site.

Schoharie Creek Near Wellsville, N.Y

There were 14 fish species present at the Schoharie Creek near Wellsville site (fig. 26). The total community density was 1,281 fish per 1,000 m^2, and smallmouth bass was the most abundant species, composing 51 percent of the community. The total community biomass was 3,360 grams per 1,000 m^2, and smallmouth bass had the greatest biomass, composing 61 percent of the community. There were four darter species present—fantail darter, greenside darter, logperch, and rainbow darter—which together composed 33 and 18 percent of the community density and biomass, respectively. The pebble count yielded a particle size distribution with a D_{16} of 56 mm, D_{50} of 111 mm, and D_{84} of 300 mm (table 3).

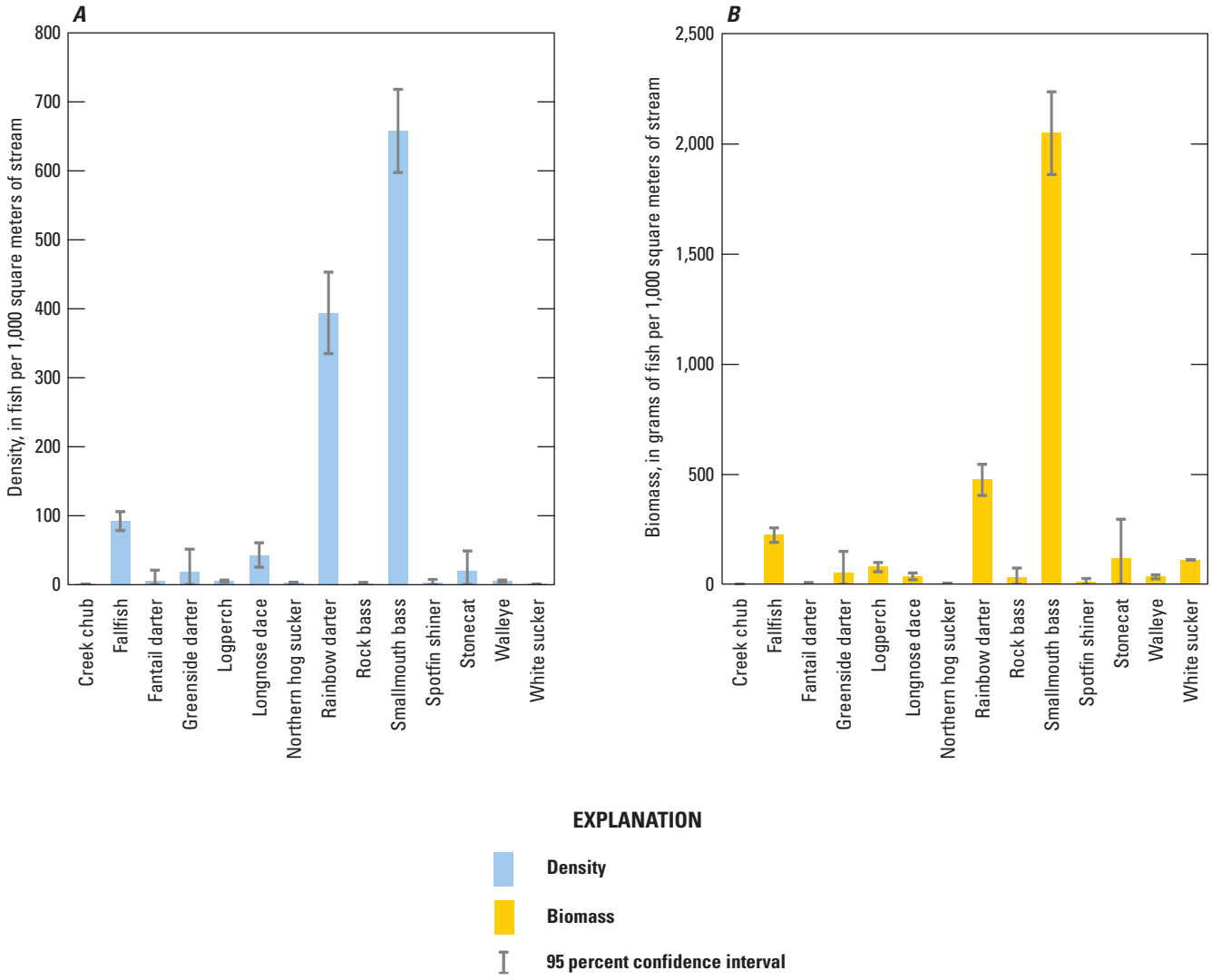

Figure 26. Population density and biomass of each fish species captured at the Schoharie Creek near Wellsville, New York, site.

West Canada Creek at Herkimer, N.Y

There were 14 fish species present at the West Canada Creek site (fig. 27). The total community density was 313 fish per 1,000 m^2, and longnose dace was the most abundant species, composing 24 percent of the community. The total community biomass was 500 grams per 1,000 m^2, and longnose dace had the greatest biomass, composing 25 percent of the community. There were two darter species present—fantail darter and tessellated darter—which together composed 12 and 10 percent of the community density and biomass, respectively. The pebble count yielded a particle size distribution with a D_{16} of 21 mm, D_{50} of 56 mm, and D_{84} of 154 mm (table 3).

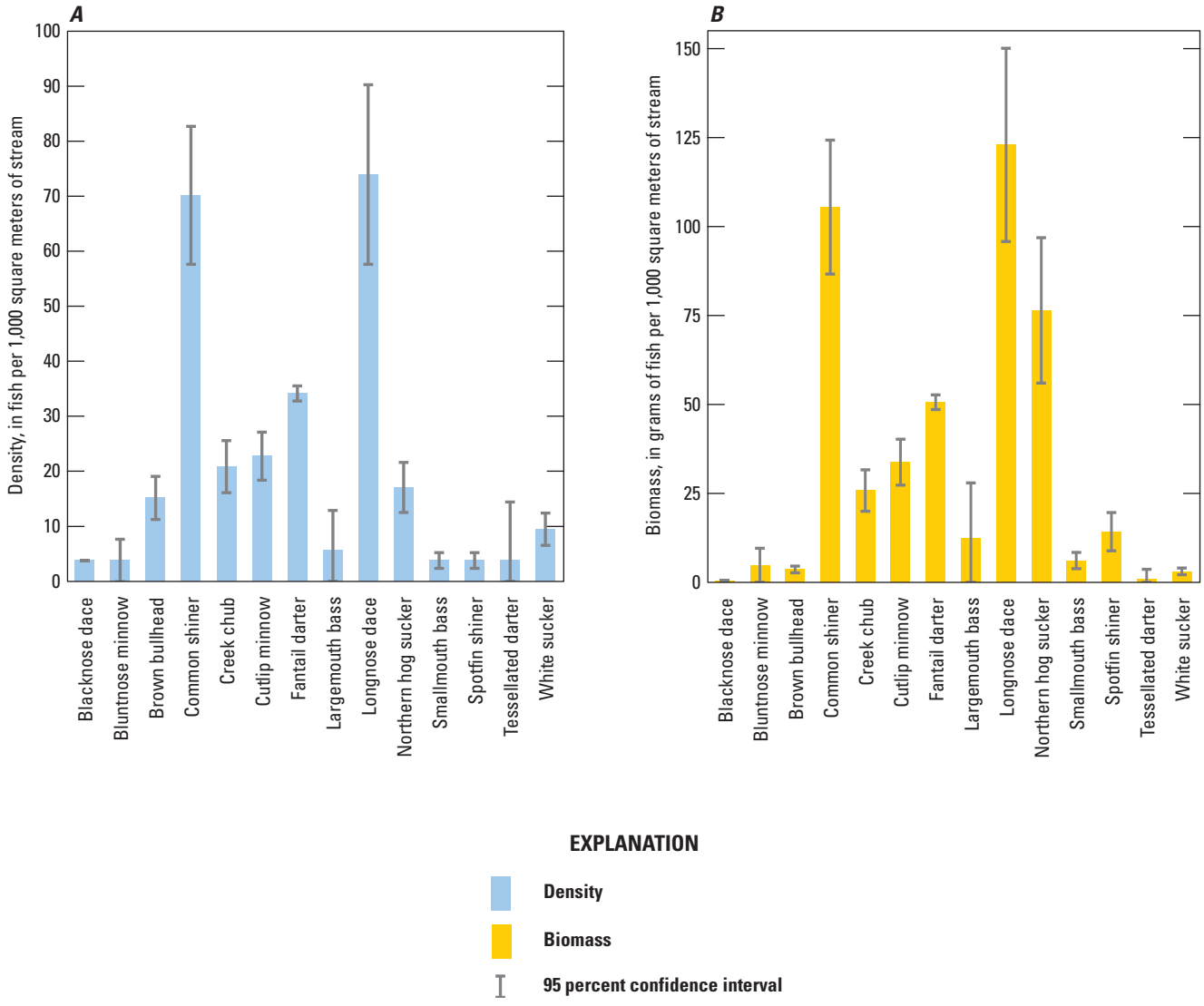

Figure 27. Population density and biomass of each fish species captured at the West Canada Creek at Herkimer, New York, site.

Findings and Conclusions

The findings from this study have several important implications. First, it appears that round goby had not extensively colonized tributaries to the Mohawk River at the time the reaches were surveyed in summer 2019. Round goby were only captured in one tributary, and the density of that population was low. The near absence of round goby from tributaries to the Mohawk River in 2019 was expected given the existing information on the sparse distribution of round goby in the mainstem of the Mohawk River at that time. At the end of 2019, the easternmost capture of round goby was near Utica, although environmental DNA data suggested the species may have been present further east than fish capture records indicate (George and others, 2021a). Overall, this information indicates that fish communities in tributaries to the Mohawk River remained largely unaffected by round goby in 2019, and the data described in this report represent the preinvasion baseline condition, thus fulfilling a primary objective of this project.

Second, although fish communities were generally dominated by minnow species such as blacknose dace and longnose dace, darters were an important component of communities, averaging 15 and 12 percent of the density and biomass, respectively. The distribution and abundance of darter species were of particular interest in this study because darters and round goby occupy similar niches, and darter populations are often negatively affected by the presence of round goby. The darter community in tributaries to the Mohawk River comprised six species: blackside darter, fantail darter, greenside darter, logperch, rainbow darter, and tessellated darter, and some evidence indicates the distribution and abundance of these species may be changing. Of this group, fantail darter, greenside darter, and tessellated darter are believed to be native to the Mohawk River watershed, blackside darter and rainbow darter are believed to be nonnative to the Mohawk River watershed, and there is not a consensus regarding the status of logperch (Carlson and others, 2016a; U.S. Geological Survey, 2022). Rainbow darter, for example, is only native to the western portion of New York State and was first identified in the Mohawk River watershed in 2009 in Fox Creek, a tributary to Schoharie Creek (Carlson and others, 2016a). The surveys described in this report, which were conducted only 10 years later (2019), indicated that rainbow darter were present in nine tributaries in the eastern half of the study area and was the dominant darter species at most of these locations. This suggests that the species has expanded rapidly since its recent introduction to the Mohawk River watershed and may be outcompeting other resident darter species.

Lastly, data from future fish community surveys in tributaries to the Mohawk River could be compared with the 2019 data provided in this report to address a number of important research and management questions. First, it would be instructive to determine if round goby indiscriminately colonizes all the tributaries included in this study or if the species shows affinity for certain habitat characteristics, such as substrate size or water velocity. In turn, this information could be used to predict the invasion susceptibility of streams in other adjacent watersheds, such as those in the lower Hudson River and Lake Champlain. It would also be valuable to obtain estimates of how quickly round goby populations are expanding upstream in tributaries to the Mohawk River. A few studies have estimated rates of upstream expansion in tributaries to the Great Lakes and other areas with values ranging from 0.5 to 4 kilometers per year (Bronnenhuber and others, 2011; Kornis and others, 2012; Šlapanský and others, 2017), but it is not known if these estimates are applicable to streams in central and eastern New York. Most importantly, future fish community data could be used to evaluate the effects of established round goby populations on the composition of resident fish assemblages. In particular, future analyses could compare quantitative estimates of darter population density and biomass to determine if round goby have extirpated some of these species, reduced their density, restricted their distribution, or caused no discernable effect. Similarly, future studies might assess changes in populations of stonecat, a small native catfish species that was present at five of the study sites and may also be adversely affected by round goby (Poos and others, 2010; Kornis and others, 2012). Finally, temporal changes in streams of this watershed during the past century could be analyzed more in depth using historical data from the New York State Fish Atlas Database (Carlson and others, 2016b). Thus, it may be prudent to repeat fish community surveys at the same locations and using the same methods 5 to 10 years after the surveys described in this report. Together, this new information and the information from the 2019 surveys could be used to identify the ecological effects of round goby in tributaries to the Mohawk River and to project future effects on aquatic ecosystems in adjacent watersheds.

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