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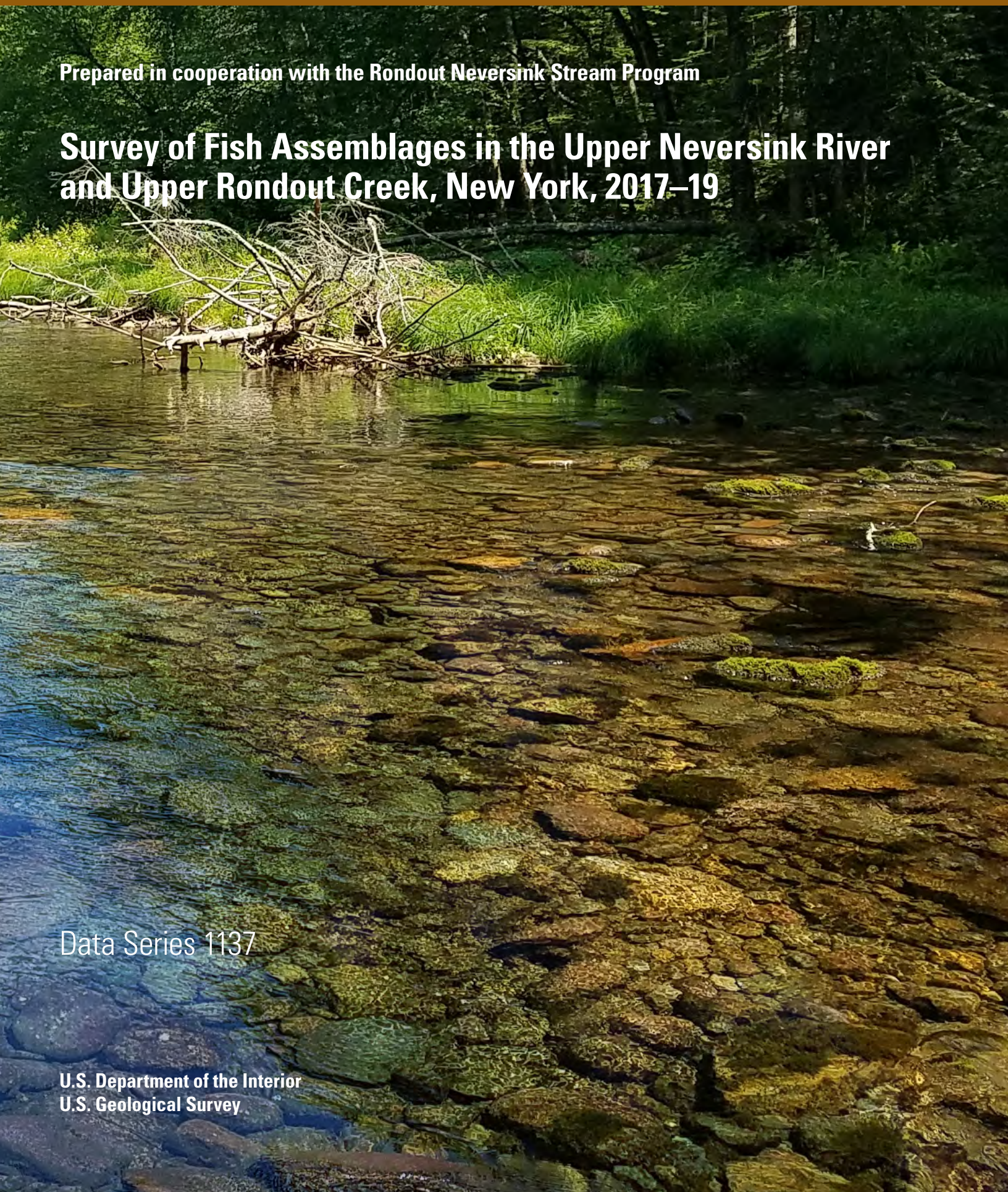
Survey of Fish Assemblages in the Upper Neversink River and Upper Rondout Creek, New York, 2017–19



Data Series 1137

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

Cover. A reach of the upper Rondout Creek in the Catskill Mountains region of New York in July 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)
square meter (m^2)	10.76	square foot (ft^2)
square kilometer (km^2)	0.3861	square mile (mi^2)

Datum

Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88).

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

Elevation, as used in this report, refers to distance above the vertical datum.

Supplemental Information

Concentrations of chemical constituents in water are given in microequivalents per liter (µeq/L) for acid-neutralizing capacity or micromoles per liter (µmol/L) for aluminum.

Abbreviations

USGS	U.S. Geological Survey
YOY	young-of-the-year

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Abstract

Streams in the Catskill Mountains region of New York provide many important ecological and economic services, including recreational angling and serving as a drinking water supply to New York City. Many streams in this region were adversely affected by acid deposition during the late 20th century, impairing water quality and aquatic ecosystems. More recently, the level of acid deposition has declined while changes in climate have become more pronounced. As a result, biological and chemical data are needed to determine the current condition of stream ecosystems in the Catskill Mountains region. The U.S. Geological Survey, in cooperation with the Rondout Neversink Stream Program, surveyed fish communities and water chemistry annually between 2017 and 2019 at 23 sites in the upper Neversink River and upper Rondout Creek watersheds to compile a contemporary baseline dataset and assess potential biological recovery from reduced acidification.

The resulting data indicated that brook trout (*Salvelinus fontinalis*) were present at every study site, although slimy sculpin (*Cottus cognatus*) was the most abundant species at most sites. Stream pH ranged from 4.8 to 7.0 across all sites and generally increased from upstream to downstream. Similarly, the number of species present and the ratio of brown trout (*Salmo trutta*) to brook trout increased at sites in each subwatershed from upstream to downstream.

Introduction

The Neversink River and Rondout Creek are historic trout fishing and recreational streams in the heart of the Catskill Mountains of southeastern New York. Both streams played an important role in the origins of fly fishing in the United States, and continue to be used heavily by anglers (Van Put, 2007). During the second half of the 20th century, however, the headwaters, tributaries, and some main stem reaches of both rivers were adversely affected by acid deposition. Surveys during the late 1980s and early 1990s found that some or all fish species were absent or their populations were depressed in many reaches of both river systems because of elevated acidity and concentrations of inorganic monomeric aluminum compounds (Baker and others, 1996; Baldigo and Lawrence, 2000, 2001). More recently, acid deposition and stream acidity have declined in the Catskill Mountains region (McHale and others, 2017), and climate change is an increasing threat that is affecting stream flow and temperature regimes across the northeastern United States (Dupigny-Giroux and others, 2018). Quantitative information on fish assemblages in the Catskill Mountains region is needed to assess the current health of stream ecosystems, evaluate potential biological recovery from decreasing acidification, and document the effects of climate change, invasive species, and other stressors on important natural resources.

In 2017, the U.S. Geological Survey (USGS) and the Rondout Neversink Stream Program initiated a study to determine the current status of fish assemblages and water chemistry across the watersheds of the upper Neversink River and upper Rondout Creek. The objectives of this study were to obtain a contemporary dataset that could be used to evaluate recovery from acid deposition and serve as a baseline for evaluating future changes in the watershed from climate change, invasive species, and other stressors. The information obtained in this study may be used to inform and assess future management actions in these watersheds related to stream restoration, trout stocking, and angling regulations.

Equipment and Methods

Fish communities were surveyed annually from 2017 to 2019 at study sites within the upper Neversink River and upper Rondout Creek watersheds (fig. 1). The study area was limited to the reaches upstream from the Neversink and Rondout reservoirs. A total of 23 study sites were surveyed annually for 3 years (table 1), with the exception of the DTHall site on the East Branch Neversink River, which was not sampled in 2017, and the WBGage site on the West Branch Neversink River, which was not sampled in 2018. The sites ranged in drainage area from 0.3 to 172.5 square kilometers.

Fish assemblages were surveyed between late June and early August using multipass depletion electrofishing surveys. During each survey, fish were collected from seine-blocked reaches in three or four consecutive passes with one person

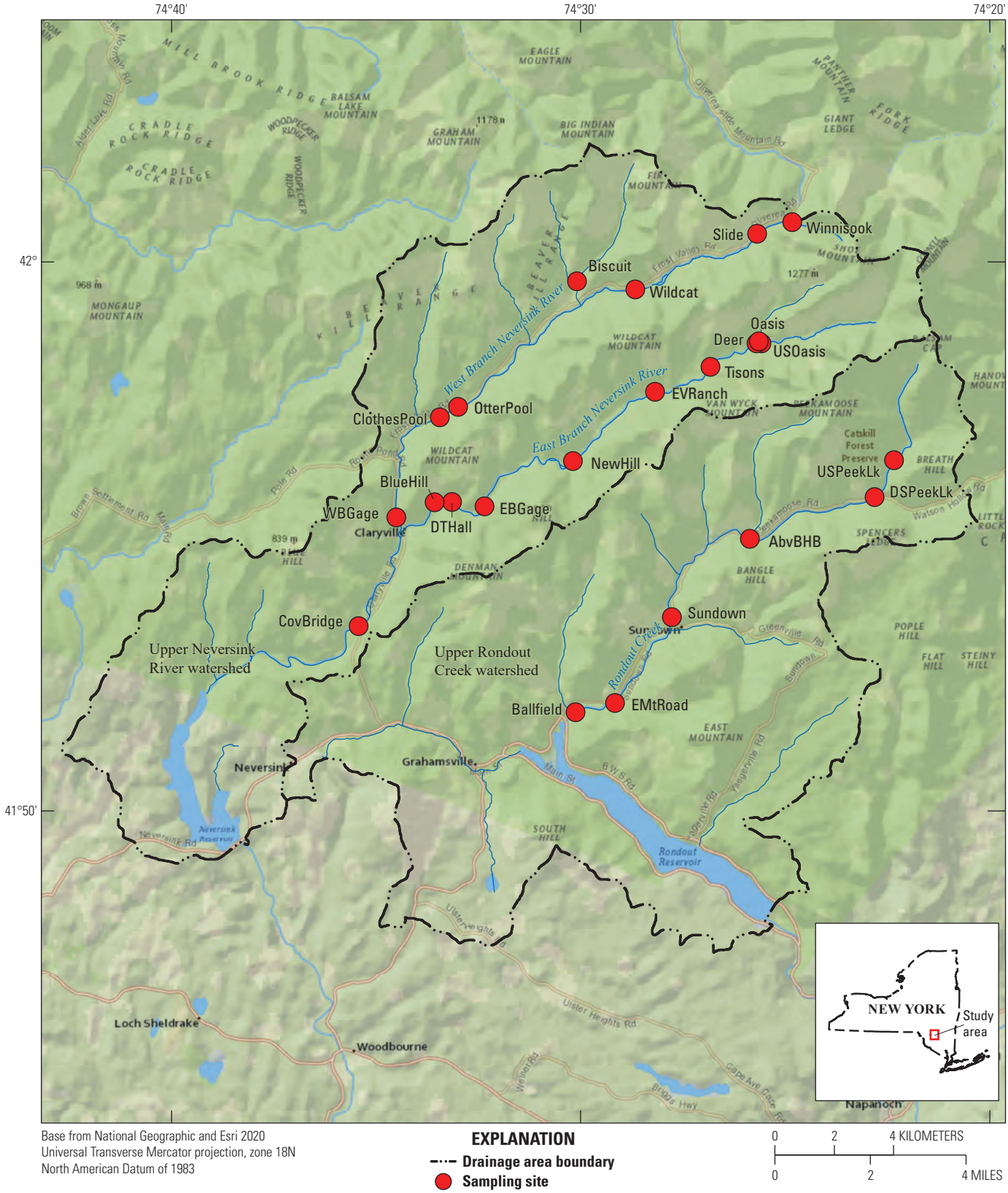

Figure 1. Location of 23 study sites in the upper Neversink River and upper Rondout Creek watersheds, New York, where fish communities were sampled from 2017 to 2019. Sites are described in table 1.

Table 1. Sites where fish assemblages were surveyed in the upper Neversink River and upper Rondout Creek watersheds, New York, from 2017 to 2019.

[U.S. Geological Survey (USGS) station names, identifiers (IDs), and drainage areas are from the National Water Information System (U.S. Geological Survey, 2020b). Sites are ordered by subwatershed and then by drainage area. Latitude and longitude are provided in decimal degrees and represent the downstream end of each sampled reach. km^2, square kilometer]

USGS station name	ID	Site name	Drainage area (km^2)	Years sampled	Latitude	Longitude
East Branch Neversink River watershed						
East Branch Neversink River tributary, East-Deer Shanty Brook, Denning, N.Y.	0143400360	Oasis	0.3	2017–19	41.97435	−74.42716
Deer Shanty Brook at mouth near Denning, N.Y.	0143400505	Deer	5.4	2017–19	41.97489	−74.42831
East Branch Neversink River near Table Mountain near Denning, N.Y.	0143400340	USOasis	15.0	2017–19	41.97433	−74.42917
East Branch Neversink River northeast of Denning, N.Y.	0143400680	Tisons	23.1	2017–19	41.96729	−74.44807
East Branch Neversink River near Woodhull Mountain at Denning, N.Y.	0143400980	EVRanch	34.2	2017–19	41.95985	−74.47063
East Branch Neversink River east of Ladleton, N.Y.	01434013	NewHill	48.2	2017–19	41.93888	−74.50417
East Branch Neversink River near Claryville, N.Y.	01434017	EBGage	59.3	2017–19	41.92532	−74.54025
East Branch Neversink River below Denning Road near Claryville, N.Y.	0143401850	DTHall	67.1	2018–19	41.92670	−74.55338
East Branch Neversink River near Denman Mountain near Claryville, N.Y.	01434019	BlueHill	67.6	2017–19	41.92669	−74.56052
West Branch Neversink River watershed						
West Branch Neversink River at Winnisook Lake near Frost Valley, N.Y.	01434021	Winnisook	2.0	2017–19	42.01104	−74.41441
West Branch Neversink River below Winnisook Lake near Frost Valley	0143402120	Slide	3.9	2017–19	42.00756	−74.42870
Biscuit Brook above Pigeon Brook at Frost Valley, N.Y.	01434025	Biscuit	9.6	2017–19	41.99354	−74.50204
West Branch Neversink River at branch near Frost Valley, N.Y.	0143402265	Wildcat	20.4	2017–19	41.99094	−74.47842
West Branch Neversink River near Claryville, N.Y.	01434176	OtterPool	65.5	2017–19	41.95554	−74.55080
West Branch Neversink River above Fall Brook near Claryville, N.Y.	01434185	ClothesPool	66.6	2017–19	41.95241	−74.55817
West Branch Neversink River at Claryville, N.Y.	01434498	WBGage	87.5	2017, 2019	41.92212	−74.57607
Neversink River						
Neversink River near Claryville, N.Y.	01435000	CovBridge	172.5	2017–19	41.88915	−74.59167
Rondout Creek watershed						
Rondout Creek above Red Brook at Peekamoose, N.Y.	01364959	USPeekLk	13.9	2017–19	41.93858	−74.37368
Rondout Creek at Peekamoose, N.Y.	01364962	DSPeekLk	23.6	2017–19	41.92738	−74.38162
Rondout Creek above Bear Hole Brook near Sundown, N.Y.	01364968	AbvBHB	36.8	2017–19	41.91385	−74.43253
Rondout Creek above Sundown Creek at Sundown, N.Y.	01364975	Sundown	67.6	2017–19	41.89135	−74.46433
Rondout Creek near Lowes Corners, N.Y.	01365000	EMtRoad	99.2	2017–19	41.86546	−74.48765
Rondout Creek at Lowes Corners, N.Y.	01365005	Ballfield	102.0	2017–19	41.86271	−74.50372

operating a Smith-Root LR–24 backpack electrofisher, and three to five people netting fish (fig. 2). The entire stream width was sampled during all surveys with the exception of the 2017 survey at the EMtRoad site on the Rondout Creek and all surveys at the CovBridge site on the Neversink River, where multiple nearshore subreaches (isolated using three blocking seines) were sampled because the entire width could not be blocked. Sampled reaches ranged from 42 to 99 meters (m) in length (table 2) and generally encompassed one or two complete geomorphic channel-unit sequences (Simonson and others, 1994; Fitzpatrick and others, 1998; Meador and others, 2003). 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. 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. All data from the fish community surveys and the dimensions of the surveyed reaches are available in George and others (2018).

The number of fish captured during each pass was used to generate population estimates for each species at each site using the Carle-Strub method (Carle and Strub, 1978) with the FSA package (Ogle and others, 2018) in R (R Core Team, 2019). Young-of-the-year (fish in the first year of life; referred to as YOY) slimy sculpin (*Cottus cognatus*), defined as those less than 30 millimeters (mm) in length, were excluded from the dataset used to calculate population estimates because they are not sampled efficiently with backpack electrofishing. Population estimates were standardized by the length of the sampled reach to produce estimates of fish density as fish per 100 m of stream (or fish per 100 m of nearshore habitat for sites where multiple subreaches were sampled). Estimates of total density for the entire community (all species combined) were calculated for each survey by summing the density estimates of all species present.

A single grab sample for water chemistry analysis was collected during each fish survey with the exception of five sites (Tisons, Winnisook, Biscuit, CovBridge, and USPeekLk) that were already part of a routine water-quality sampling program. At the routinely sampled sites, water chemistry data is presented from the date of the sample taken under baseflow conditions closest to the date of the fish survey, which was generally within 14 days. Water samples were analyzed for pH, acid-neutralizing capacity, total monomeric and organic monomeric aluminum, and other analytes at the USGS Soil and Low-Ionic-Strength Water Quality Laboratory in Troy, New York, following U.S. Environmental Protection Agency approved methods (U.S. Environmental Protection Agency, 1987). Standard operating procedures for these analyses are available from the U.S. Geological Survey (2020a). Inorganic monomeric aluminum, believed to cause toxicity to aquatic biota at values more than 2 micromoles per liter (µmol/L; Driscoll and others, 2001; Baldigo and others, 2007), was determined for each sample by subtracting organic monomeric aluminum from total monomeric aluminum. Inorganic monomeric aluminum, pH, and acid-neutralizing capacity data are presented in this report whereas the entire suite of stream chemistry data are available from the National Water Information System database (U.S. Geological Survey, 2020b).

Figure 2. A field crew during an electrofishing survey on the upper Rondout Creek in New York in 2018. Photograph by Barry Baldigo, U.S. Geological Survey.

Results

A consistent subset of information is presented for each site in this section. This information includes the number of species captured, most abundant species, density of brook trout (*Salvelinus fontinalis*) and brown trout (*Salmo trutta*) populations, percentages of brook trout and brown trout that were considered to be YOY, and the pH of stream water for each year at a given site. The percentages of brook trout and brown trout that were considered YOY were estimated for each survey using a length of 80 mm as a cutoff, below which fish were considered to be YOY. Brook trout and brown trout results are emphasized because these species are the primary targets of an extensive recreational angling industry in the Catskill Mountains region. When other species in the family *Salmonidae* (trout and salmon) were encountered at a site, the density of those populations is summarized as well. The percentages of brook trout and brown trout that were YOY (and associated length frequency distributions) are presented because this information may indicate how successfully these species are naturally reproducing and what proportion of fish attain sizes large enough to be captured by anglers.

Table 2. Fish metrics, stream reach information, and water chemistry data from fish surveys in the upper Neversink River and upper Rondout Creek watersheds, New York, from 2017 to 2019.

[Site names are identified in table 1. Sites are ordered by subwatershed and then by drainage area. m, meter; no, number; m^2, square meter; µmol/L, micromole per liter; ANC, acid-neutralizing capacity; µeq/L, microequivalent per liter]

Site name	Year	Total fish density (fish per 100 m)	Species richness (no. of species)	Reach length (m)	Reach area (m^2)	Inorganic monomeric aluminum (µmol/L)	ANC (µeq/L)	pH
East Branch Neversink River watershed								
Oasis	2017	455	2	56	123	0.000	72.5	6.50
Oasis	2018	448	2	58	160	0.610	35.8	6.07
Oasis	2019	466	2	57	132	0.352	86.5	6.37
Deer	2017	189	2	52	139	0.330	27.1	5.38
Deer	2018	90	2	60	260	1.830	−18.2	4.98
Deer	2019	109	2	62	194	0.936	−6.1	5.42
USOasis	2017	84	1	70	342	0.800	−39.4	5.05
USOasis	2018	40	1	70	468	1.810	−8.9	4.83
USOasis	2019	50	2	72	305	1.454	−14.6	5.06
Tisons	2017	215	3	82	671	0.659	−6.3	5.32
Tisons	2018	191	2	81	691	1.140	−6.2	5.39
Tisons	2019	147	2	84	690	0.980	19.2	5.41
EVRanch	2017	601	4	78	479	0.141	−5.3	5.89
EVRanch	2018	234	3	75	674	0.910	0.8	5.35
EVRanch	2019	283	3	75	562	0.700	−0.6	5.78
NewHill	2017	1,987	5	62	644	0.160	23.2	6.00
NewHill	2018	1,248	5	80	741	0.323	45.8	6.09
NewHill	2019	822	5	64	700	0.453	11.2	6.10
EBGage	2017	1,417	5	65	640	0.010	5.4	6.25
EBGage	2018	1,398	5	51	512	0.179	49.1	6.27
EBGage	2019	864	6	58	635	0.412	23.4	6.26
DTHall	2018	1,180	6	88	955	0.397	54.8	6.34
DTHall	2019	805	6	70	859	0.327	6.4	6.35
BlueHill	2017	1,228	6	67	508	0.101	53.6	6.53
BlueHill	2018	679	6	76	553	0.000	38.0	6.31
BlueHill	2019	688	5	80	942	0.361	53.7	6.43
West Branch Neversink River watershed								
Winnisook	2017	12	1	49	177	1.930	−22.3	4.90
Winnisook	2018	33	1	46	175	1.961	−22.1	4.94
Winnisook	2019	21	1	52	225	2.230	−11.9	4.88
Slide	2017	716	2	84	228	0.000	121.9	6.23
Slide	2018	661	2	82	177	0.445	105.2	6.04
Slide	2019	587	2	82	279	0.467	67.7	6.05
Biscuit	2017	451	3	89	485	0.000	−13.1	6.35
Biscuit	2018	705	3	88	471	0.180	45.6	6.19
Biscuit	2019	437	3	95	550	0.370	57.1	6.18
Wildcat	2017	1,846	4	85	706	0.000	40.2	6.34
Wildcat	2018	1,152	5	83	579	0.060	46.2	6.33
Wildcat	2019	923	5	75	638	0.306	30.0	6.40

Table 2. Fish metrics, stream reach information, and water chemistry data from fish surveys in the upper Neversink River and upper Rondout Creek watersheds, New York, from 2017 to 2019.—Continued

[Site names are identified in table 1. Sites are ordered by subwatershed and then by drainage area. m, meter; no, number; m^2, square meter; µmol/L, micromole per liter; ANC, acid-neutralizing capacity; µeq/L, microequivalent per liter]

Site name	Year	Total fish density (fish per 100 m)	Species richness (no. of species)	Reach length (m)	Reach area (m^2)	Inorganic monomeric aluminum (µmol/L)	ANC (µeq/L)	pH
West Branch Neversink River watershed—Continued								
OtterPool	2017	952	5	75	578	0.000	125.4	6.65
OtterPool	2018	601	4	67	550	0.601	86.2	6.43
OtterPool	2019	949	6	63	498	0.328	94.0	6.76
ClothesPool	2017	588	4	74	742	0.000	117.3	6.58
ClothesPool	2018	535	5	42	594	0.601	101.0	6.40
ClothesPool	2019	1,158	5	50	612	0.179	119.3	6.45
WBGage	2017	748	12	79	773	0.196	134.9	6.75
WBGage	2019	580	8	69	688	0.393	133.9	6.96
Neversink River								
CovBridge	2017	1,229	8	86	536	0.000	88.8	6.49
CovBridge	2018	556	10	77	462	0.536	37.9	6.30
CovBridge	2019	396	10	78	464	0.417	108.7	6.63
Rondout Creek watershed								
USPeekLk	2017	92	1	64	250	0.641	−53.0	5.72
USPeekLk	2018	45	1	64	241	0.516	13.3	6.05
USPeekLk	2019	77	1	60	280	0.642	−13.6	5.83
DSPeekLk	2017	1,291	4	88	706	0.000	64.9	6.34
DSPeekLk	2018	1,079	3	88	541	0.402	60.2	6.35
DSPeekLk	2019	824	3	84	791	0.333	37.6	6.38
AbvBHB	2017	2,155	4	75	635	0.000	37.5	6.36
AbvBHB	2018	2,654	4	78	678	0.039	55.9	6.38
AbvBHB	2019	2,211	5	80	899	0.309	55.1	6.51
Sundown	2017	3,553	5	68	559	0.000	70.7	6.41
Sundown	2018	1,921	5	52	436	0.000	75.6	6.31
Sundown	2019	1,987	5	62	622	0.257	39.2	6.48
EMtRoad	2017	2,094	6	51	622	0.016	137.6	6.48
EMtRoad	2018	1,779	7	60	538	0.040	114.9	6.42
EMtRoad	2019	2,400	6	61	760	0.308	81.3	6.68
Ballfield	2017	2,299	10	79	622	0.000	75.8	6.51
Ballfield	2018	3,754	10	85	713	0.007	97.0	6.37
Ballfield	2019	3,153	11	99	1,204	0.278	79.4	6.53

There are a number of other species that are not discussed in the standard subset of information provided for each site but are shown in the figures below at the sites where they occurred. These species include longnose dace (*Rhinichthys cataractae*), white sucker (*Catostomus commersonii*), brown bullhead (*Ameiurus nebulosus*), pumpkinseed (*Lepomis gibbosus*), bluegill (*Lepomis macrochirus*), creek chub (*Semotilus atromaculatus*), rock bass (*Ambloplites rupestris*), tessellated darter (*Etheostoma olmstedi*), longnose sucker (*Catostomus catostomus*), fallfish (*Semotilus corporalis*), and smallmouth bass (*Micropterus dolomieu*). Additional information on fish communities and water chemistry can be determined from the information in related tables and figures, whereas the full suite of fish data (such as the lengths and weights of all individual fish) are available in George and others (2018).

The total density of all fish species combined, averaged for 2017–19, ranged from 22 fish per 100 m at the Winnisook site on the West Branch Neversink River to 3,068 fish per 100 m at the Ballfield site on the Rondout Creek (fig. 3). In each of the three subwatersheds—East Branch Neversink River, West Branch Neversink River, and upper Rondout Creek—the density of fish was lowest at the upstream-most sites. In the East Branch Neversink River, total density ranged from 40 fish per 100 m at the USOasis site in 2018 to 1,987 fish per 100 m at the NewHill site in 2017 and averaged 612 fish per 100 m across all sites and years (table 2). In the West Branch Neversink River, total density ranged from 12 fish per 100 m at the Winnisook site in 2017 to 1,846 fish per 100 m at the Wildcat site in 2017 and averaged 681 fish per 100 m across all sites and years. At the CovBridge site on the Neversink River, the average total density of all fish captured from 2017 to 2019 was 728 fish per 100 m. In the upper Rondout Creek, total density ranged from 45 fish per 100 m at the USPeekLk site in 2018 to 3,754 fish per 100 m at the Ballfield site in 2018 and averaged 1,854 fish per 100 m across all sites and years.

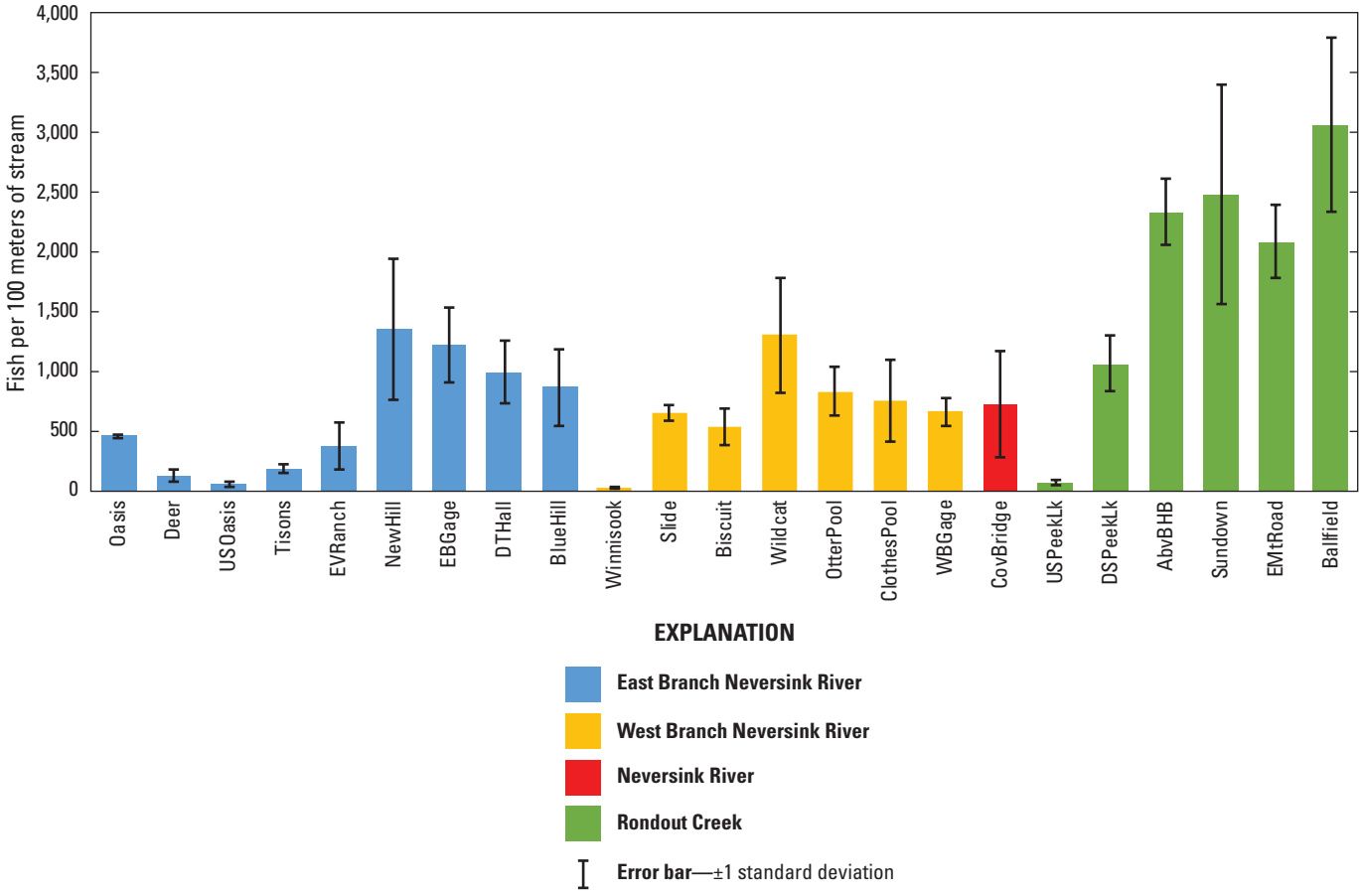

Figure 3. Total fish densities, in number of fish per 100 meters, for sites surveyed in the upper Neversink River and upper Rondout Creek watersheds, New York, from 2017 to 2019, averaged for the 3 years. Sites are listed in table 1.

East Branch Neversink River Watershed

Unnamed Stream, Oasis Site

There were two fish species present at the Oasis site during all 3 years, and the total density of all fish species was 455, 448, and 466 fish per 100 m in 2017, 2018, and 2019, respectively (table 2). Slimy sculpin was the most abundant species during each year, comprising 71, 69, and 62 percent of the entire fish community in 2017, 2018, and 2019, respectively (fig. 4). Brook trout were present at a density of 132, 138, and 175 fish per 100 m and comprised 29, 31, and 38 percent of the community in 2017, 2018, and 2019, respectively. The percentage of brook trout classified as YOY was 68, 82, and 82 percent in 2017, 2018, and 2019, respectively (fig. 5). The pH of stream water at this site was 6.50, 6.07, and 6.37 in 2017, 2018, and 2019, respectively (table 2).

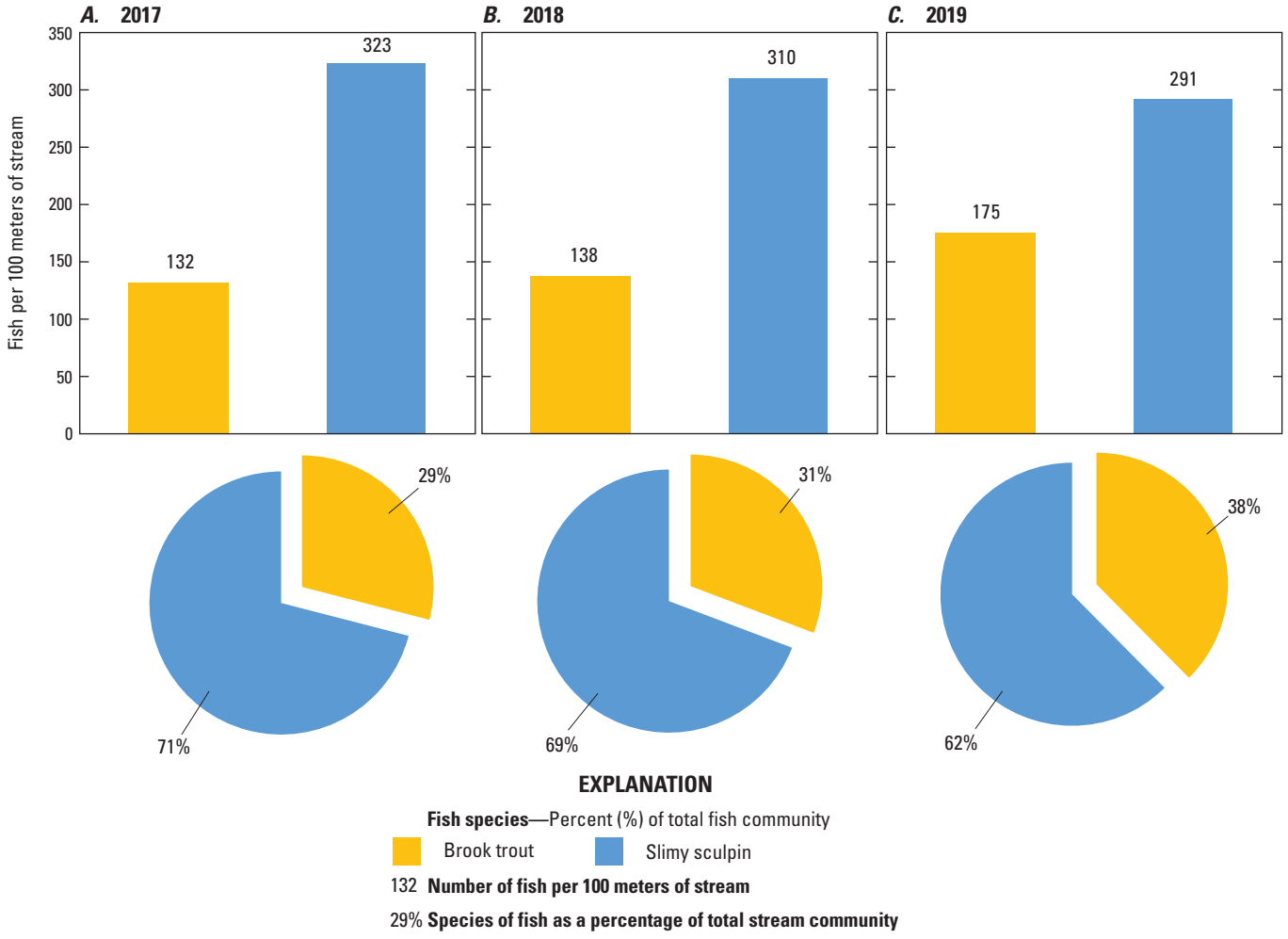

Figure 4. Population density of each fish species and proportion of each species as a percentage of the entire community at the Oasis site on unnamed stream for *A*, 2017; *B*, 2018; and *C*, 2019.

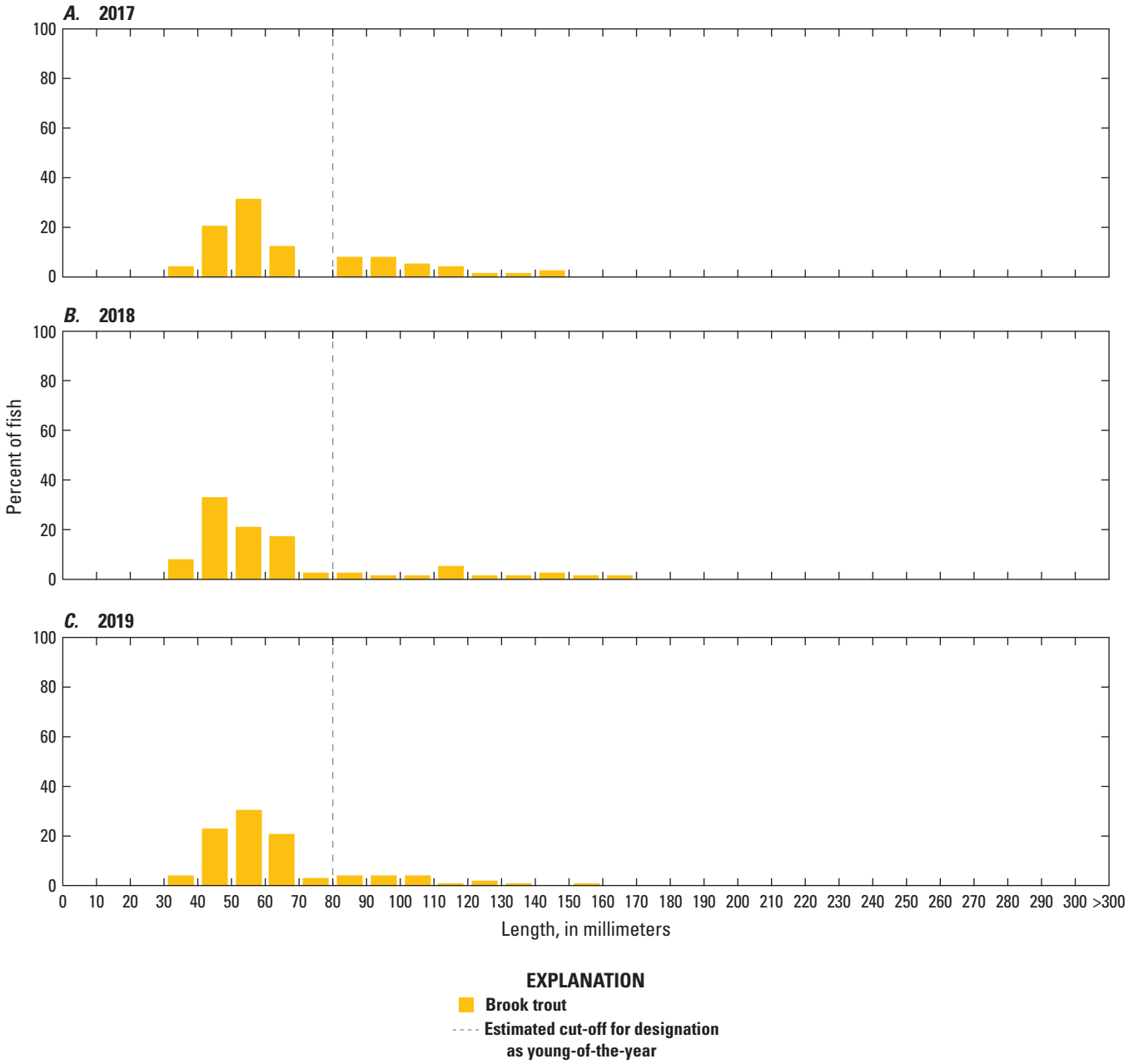

Figure 5. Length frequency distributions for brook trout at the Oasis site on unnamed stream for *A*, 2017; *B*, 2018; and *C*, 2019. Dashed vertical line indicates estimated cutoff for designation as young-of-the-year.

Deer Shanty Brook, Deer Site

There were two fish species present at the Deer site during all 3 years, and the total density of all fish species was 189, 90, and 109 fish per 100 m in 2017, 2018, and 2019, respectively (table 2). Brook trout were present at a density of 137, 60, and 83 fish per 100 m in 2017, 2018, and 2019, respectively, and was the most abundant species during each year, comprising 72, 67, and 76 percent of the entire fish community in 2017, 2018, and 2019, respectively (fig. 6). The percentage of brook trout classified as YOY was 63, 55, and 69 percent in 2017, 2018, and 2019, respectively (fig. 7). The pH of stream water was at this site 5.38, 4.98, and 5.42 in 2017, 2018, and 2019, respectively (table 2).

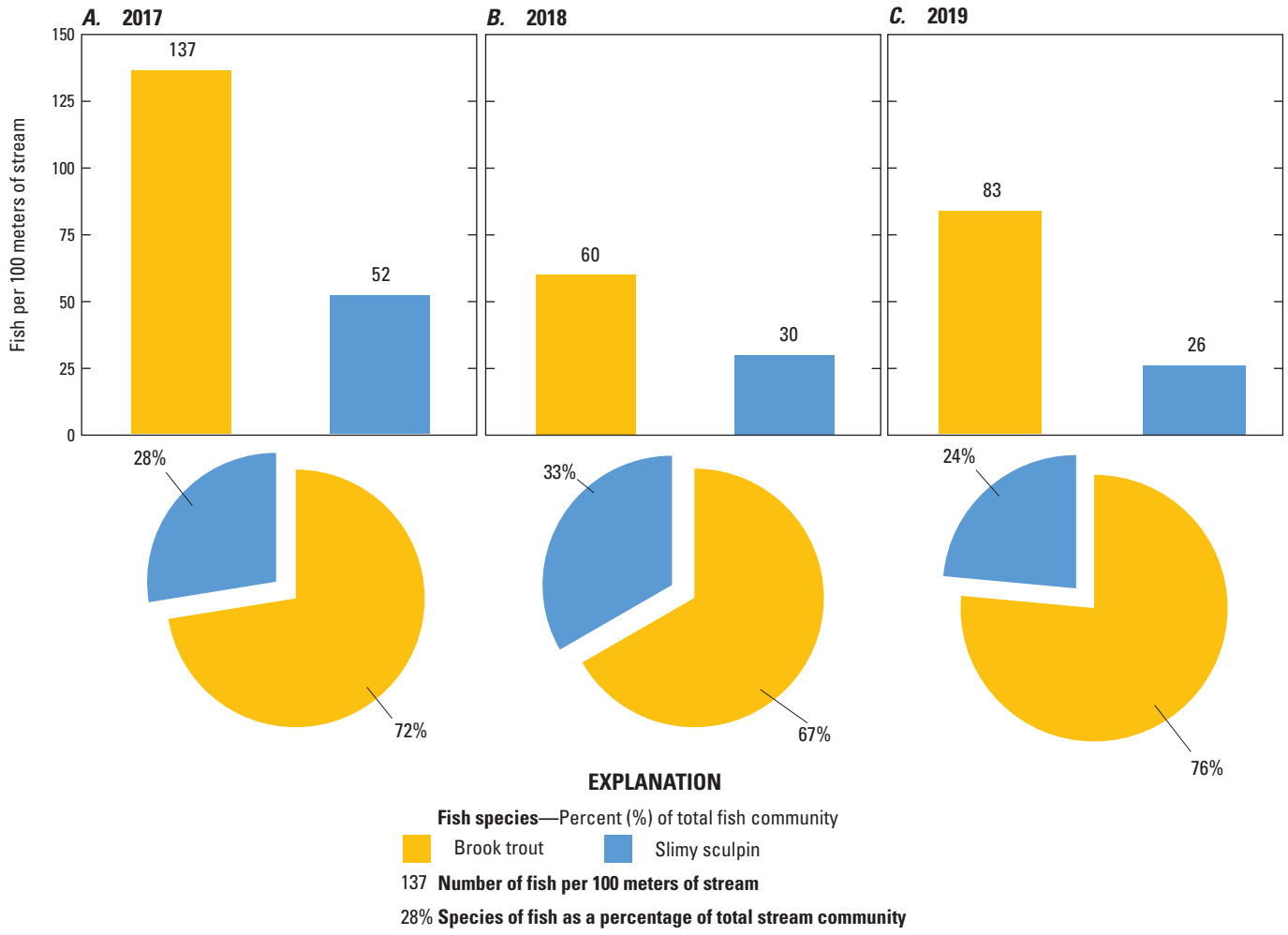

Figure 6. Population density of each fish species and proportion of each species as a percentage of the entire community at the Deer site on Deer Shanty Brook for *A*, 2017; *B*, 2018; and *C*, 2019.

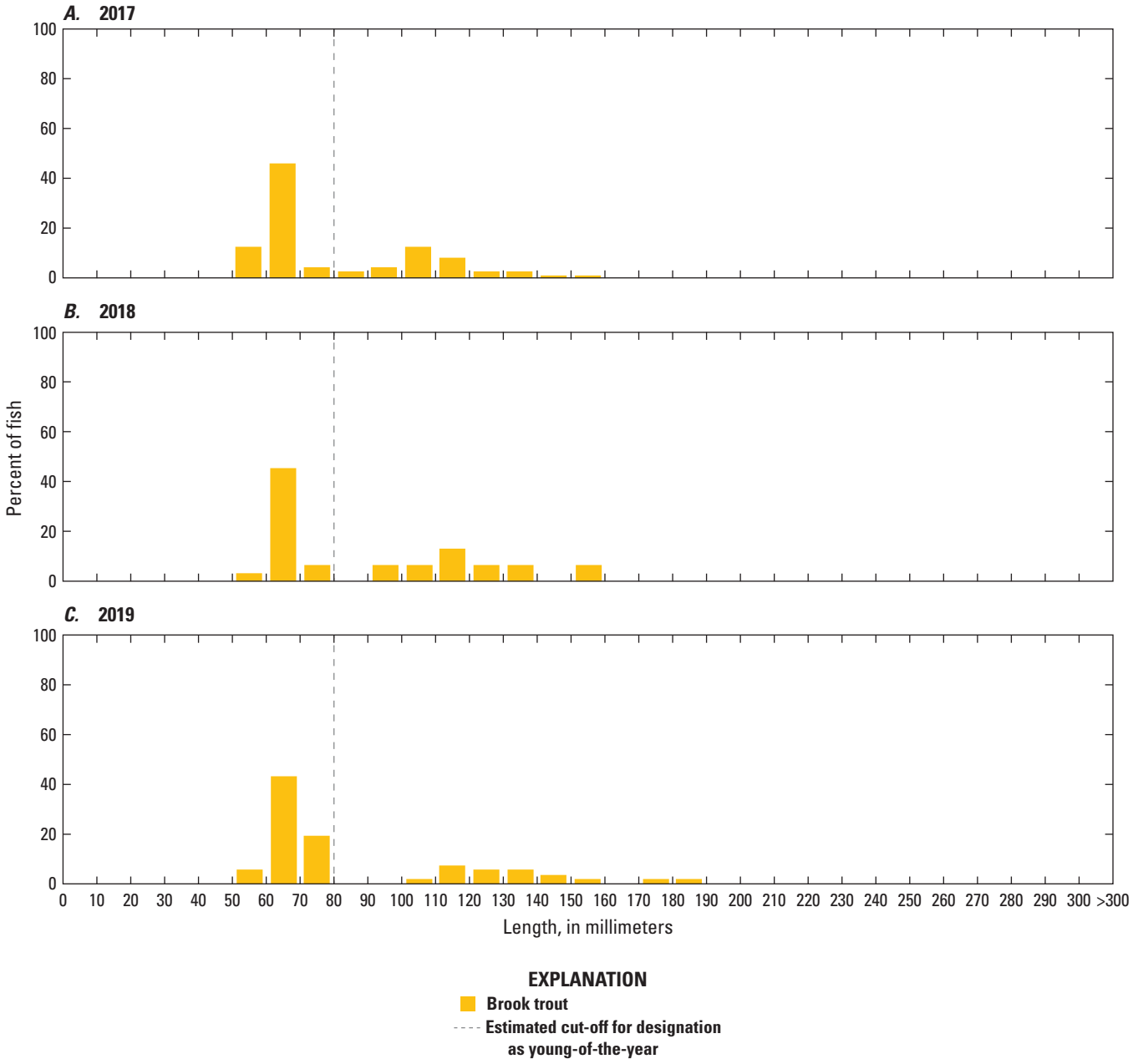

Figure 7. Length frequency distributions for brook trout at the Deer site on Deer Shanty Brook for *A*, 2017; *B*, 2018; and *C*, 2019. Dashed vertical line indicates estimated cutoff for designation as young-of-the-year.

East Branch Neversink River, USOasis Site

There was one fish species present at the USOasis site in 2017 and 2018 and two species in 2019, and the total density of all fish species was 84, 40, and 50 fish per 100 m in 2017, 2018, and 2019, respectively (table 2). Brook trout were present at a density of 84, 40, and 49 fish per 100 m and was the most abundant species during each year, comprising 100, 100, and 97 percent of the entire fish community in 2017, 2018, and 2019, respectively (fig. 8). Brown trout were present at a density of 0, 0, and 1 fish per 100 m and comprised 0, 0, and 3 percent of the community in 2017, 2018, and 2019, respectively. The percentages of fish classified as YOY were 10, 21, and 36 percent for brook trout in 2017, 2018, and 2019, respectively, and 0 percent for brown trout in 2019 (fig. 9). The pH of stream water at this site was 5.05, 4.83, and 5.06 in 2017, 2018, and 2019, respectively (table 2).

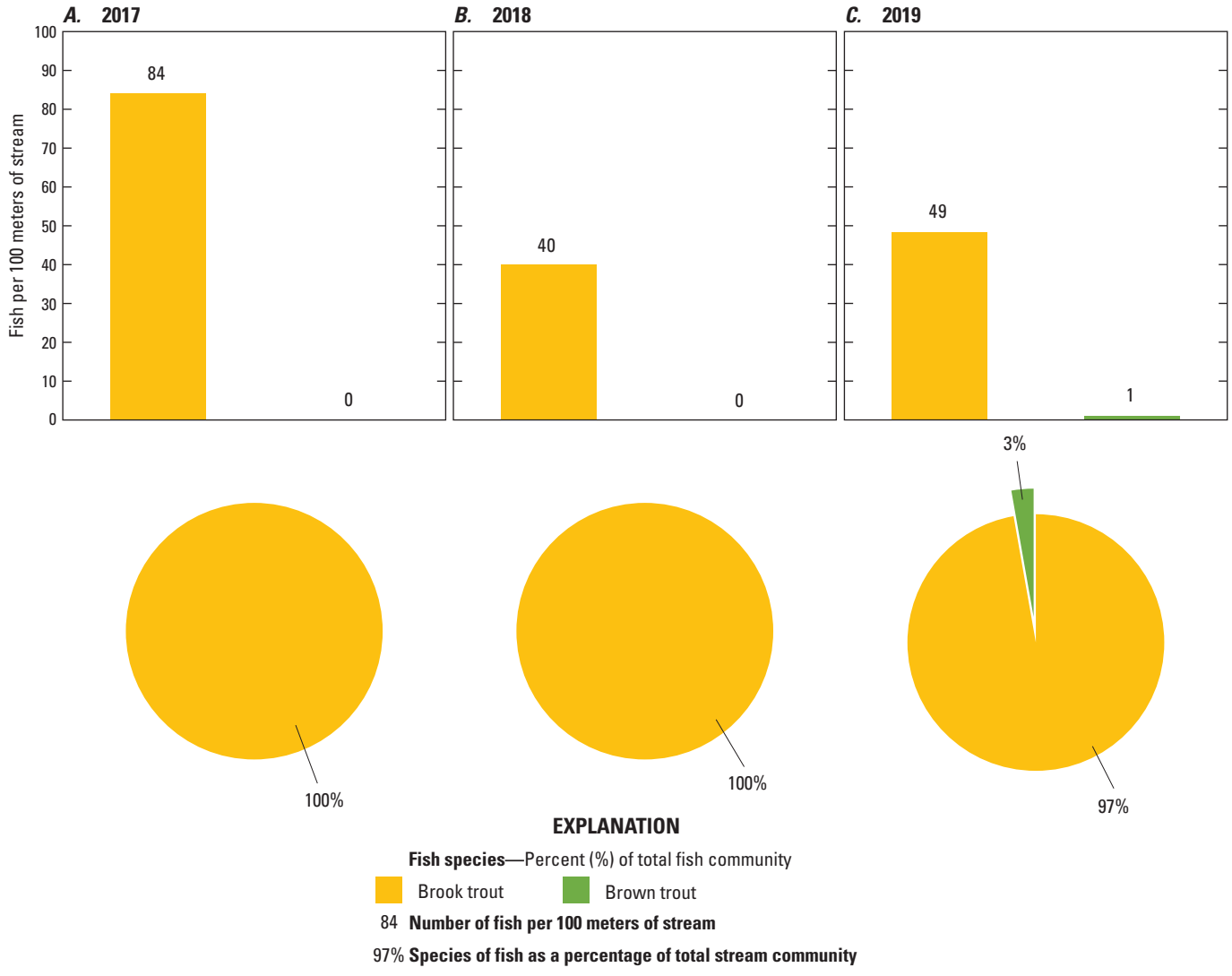

Figure 8. Population density of each fish species and proportion of each species as a percentage of the entire community at the USOasis site on the East Branch Neversink River for *A*, 2017; *B*, 2018; and *C*, 2019.

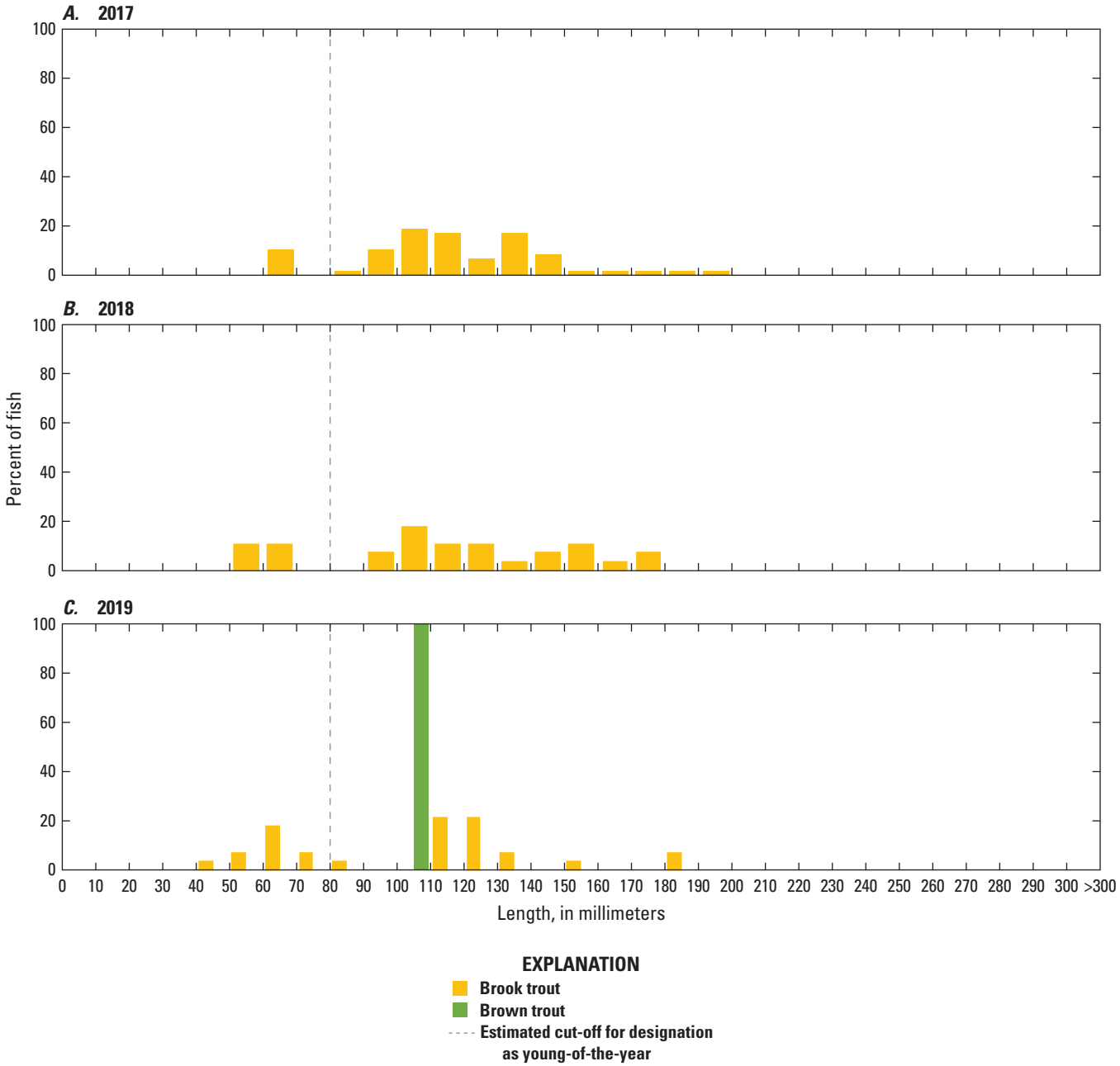

Figure 9. Length frequency distributions for brook trout and brown trout at the USOasis site on the East Branch Neversink River for *A*, 2017; *B*, 2018; and *C*, 2019. Dashed vertical line indicates estimated cutoff for designation as young-of-the-year.

East Branch Neversink River, Tisons Site

There were three fish species present at the Tisons site in 2017 and two in 2018 and 2019, and the total density of all fish species was 215, 191, and 147 fish per 100 m in 2017, 2018, and 2019, respectively (table 2). Brook trout were present at a density of 168, 114, and 111 fish per 100 m and was the most abundant species during each year, comprising 78, 60, and 76 percent of the entire fish community in 2017, 2018, and 2019, respectively (fig. 10). Brown trout were present at a density of 1, 0, and 0 fish per 100 m and comprised 1, 0, and 0 percent of the community in 2017, 2018, and 2019, respectively. The percentages of fish classified as YOY were 44, 54, and 74 percent for brook trout in 2017, 2018, and 2019, respectively, and 0 percent for brown trout in 2017 (fig. 11); brown trout were not present in 2018 and 2019. The pH of stream water at this site was 5.32, 5.39, and 5.41 in 2017, 2018, and 2019, respectively (table 2).

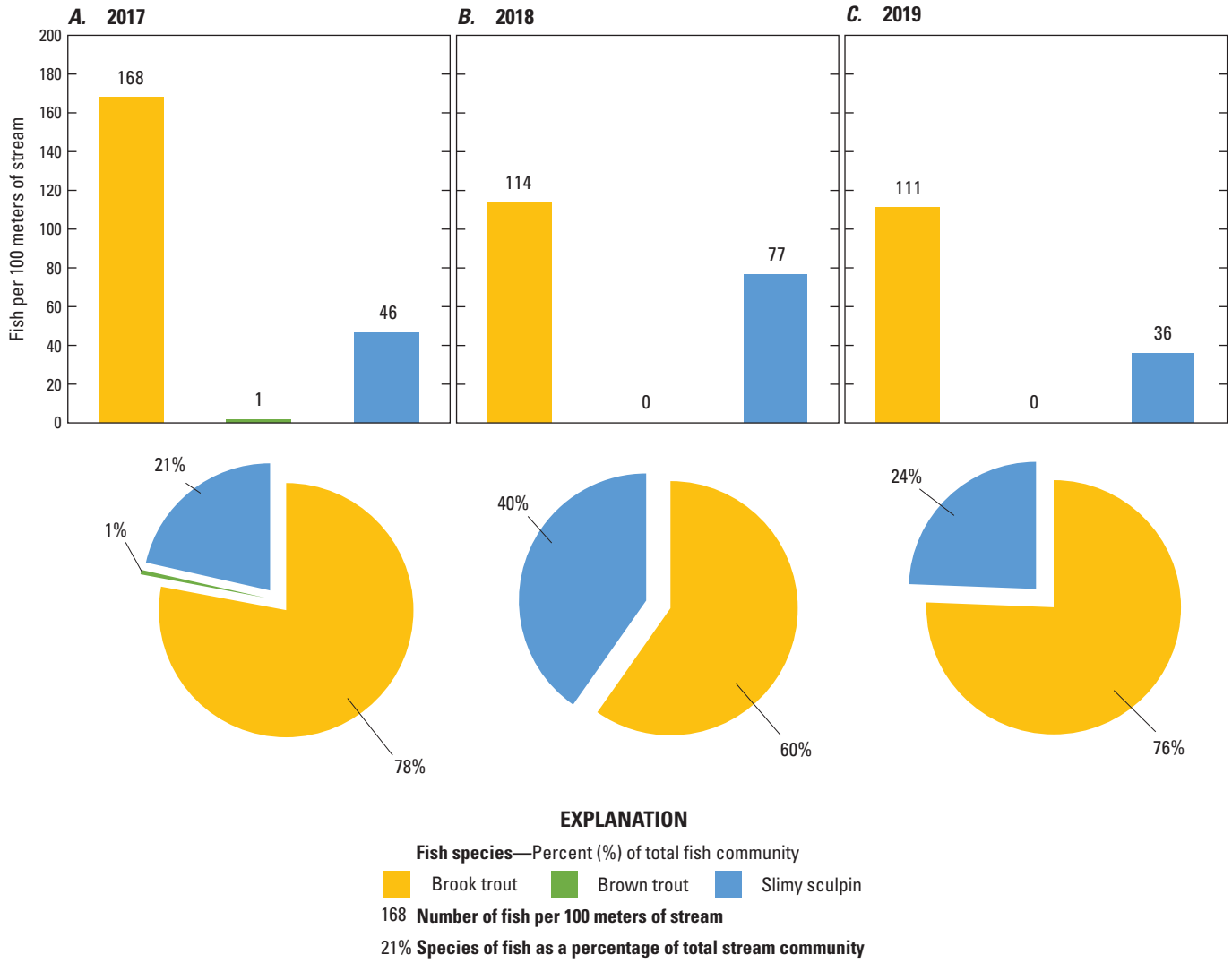

Figure 10. Population density of each fish species and proportion of each species as a percentage of the entire community at the Tisons site on the East Branch Neversink River for *A*, 2017; *B*, 2018; and *C*, 2019.

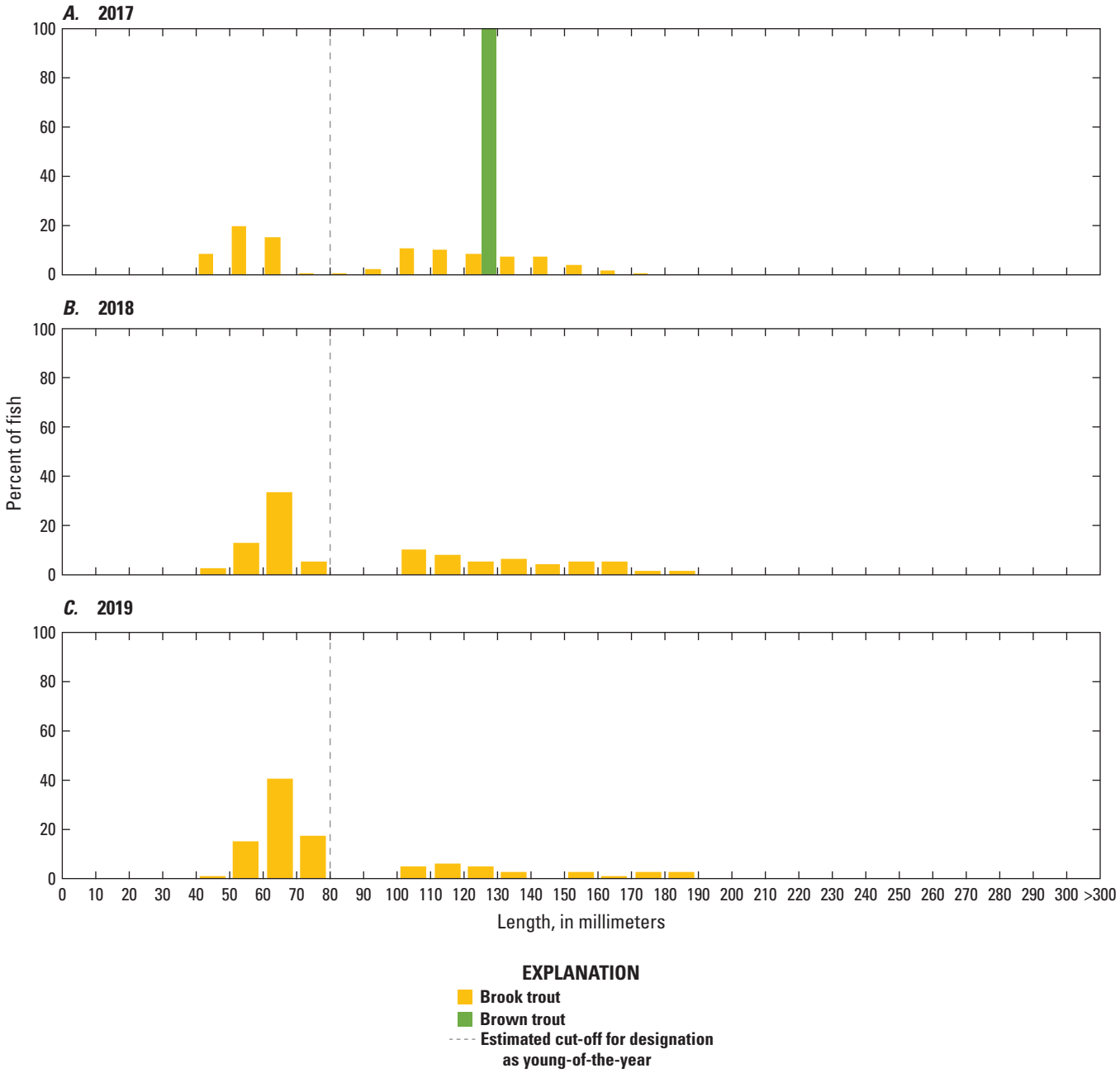

Figure 11. Length frequency distributions for brook trout and brown trout at the Tisons site on the East Branch Neversink River for *A*, 2017; *B*, 2018; and *C*, 2019. Dashed vertical line indicates estimated cutoff for designation as young-of-the-year.

East Branch Neversink River, EVRanch Site

There were four fish species present at the EVRanch site in 2017 and three species in 2018 and 2019, and the total density of all fish species was 601, 234 and 283 fish per 100 m in 2017, 2018, and 2019, respectively (table 2). Slimy sculpin was the most abundant species during each year, comprising 76, 69, and 66 percent of the entire fish community in 2017, 2018, and 2019, respectively (fig. 12). Brook trout were present at a density of 103, 37, and 47 fish per 100 m and comprised 17, 16, and 16 percent of the community in 2017, 2018, and 2019, respectively. Brown trout were present at a density of 42, 36, and 51 fish per 100 m and comprised 7, 15, and 18 percent of the community in 2017, 2018, and 2019, respectively. The percentages of fish classified as YOY were 53, 37, and 44 percent for brook trout and 37, 84, and 88 percent for brown trout in 2017, 2018, and 2019, respectively (fig. 13). The pH of stream water at this site was 5.89, 5.35, and 5.78 in 2017, 2018, and 2019, respectively (table 2).

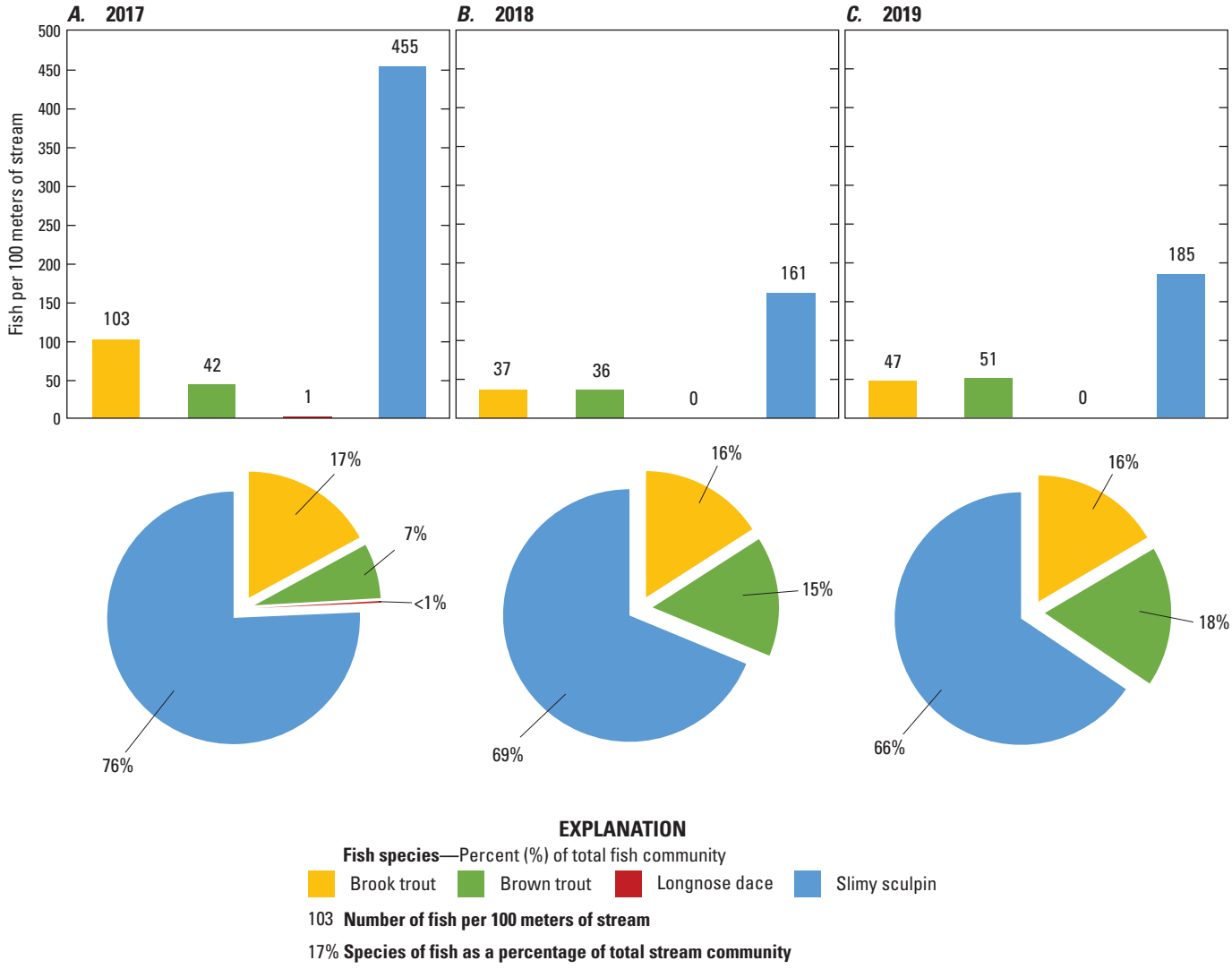

Figure 12. Population density of each fish species and proportion of each species as a percentage of the entire community at the EVRanch site on the East Branch Neversink River for *A*, 2017; *B*, 2018; and *C*, 2019. <, Less than.

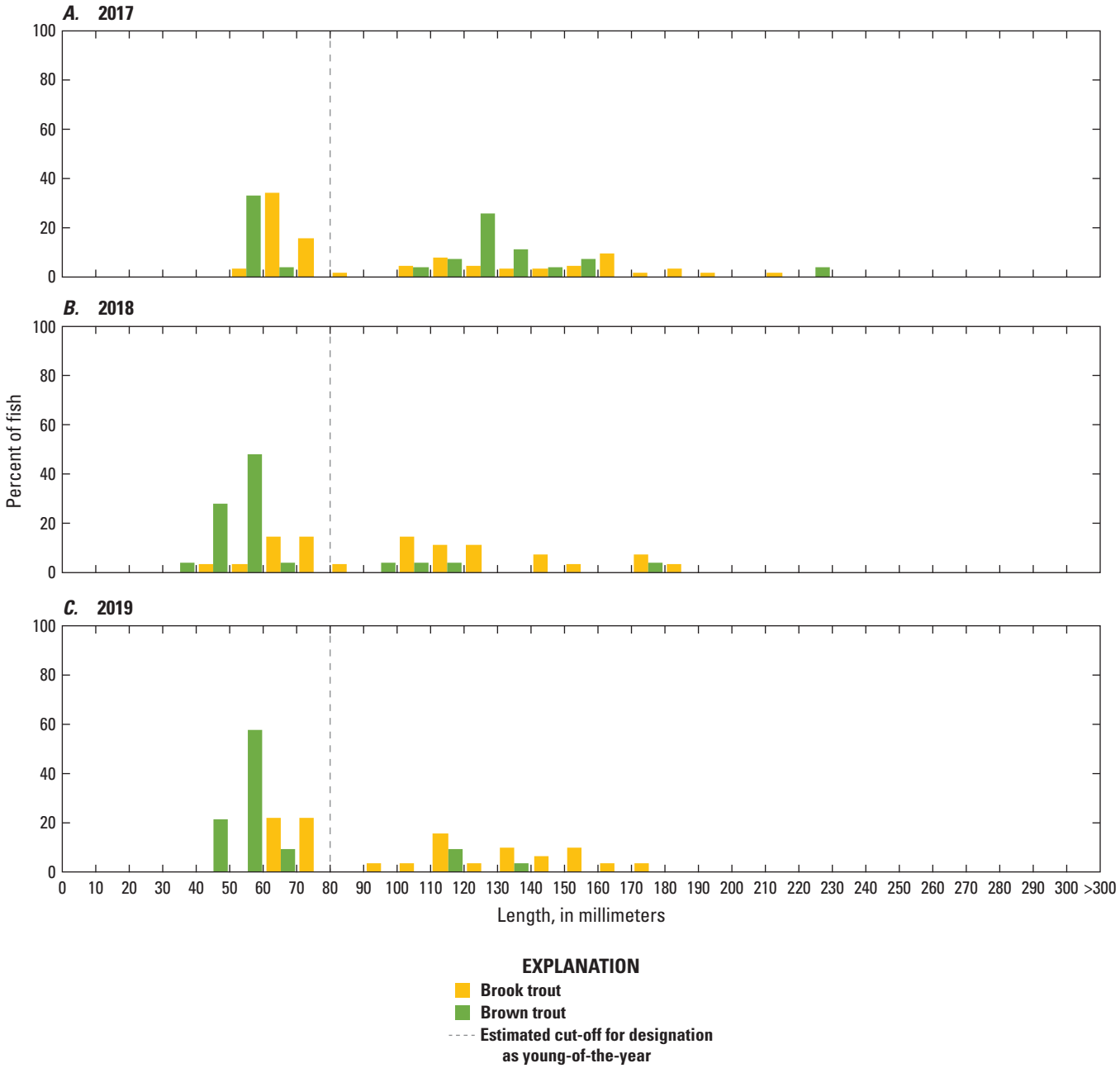

Figure 13. Length frequency distributions for brook trout and brown trout at the EVRanch site on the East Branch Neversink River for *A*, 2017; *B*, 2018; and *C*, 2019. Dashed vertical line indicates estimated cutoff for designation as young-of-the-year.

East Branch Neversink River, NewHill Site

There were five fish species present at the NewHill site during all 3 years, and the total density of all fish species was 1,987, 1,248, and 822 fish per 100 m in 2017, 2018, and 2019, respectively (table 2). Slimy sculpin was the most abundant species during each year, comprising 96, 89, and 93 percent of the entire fish community in 2017, 2018, and 2019, respectively (fig. 14). Brook trout were present at a density of 47, 78, and 23 fish per 100 m and comprised 2, 6, and 3 percent of the community in 2017, 2018, and 2019, respectively. Brown trout were present at a density of 18, 41, and 27 fish per 100 m and comprised 1, 4, and 3 percent of the community in 2017, 2018, and 2019, respectively. The percentages of fish classified as YOY were 48, 38, and 64 percent for brook trout and 64, 71, and 81 percent for brown trout in 2017, 2018, and 2019, respectively (fig. 15). The pH of stream water at this site was 6.00, 6.09, and 6.10 in 2017, 2018, and 2019, respectively (table 2).

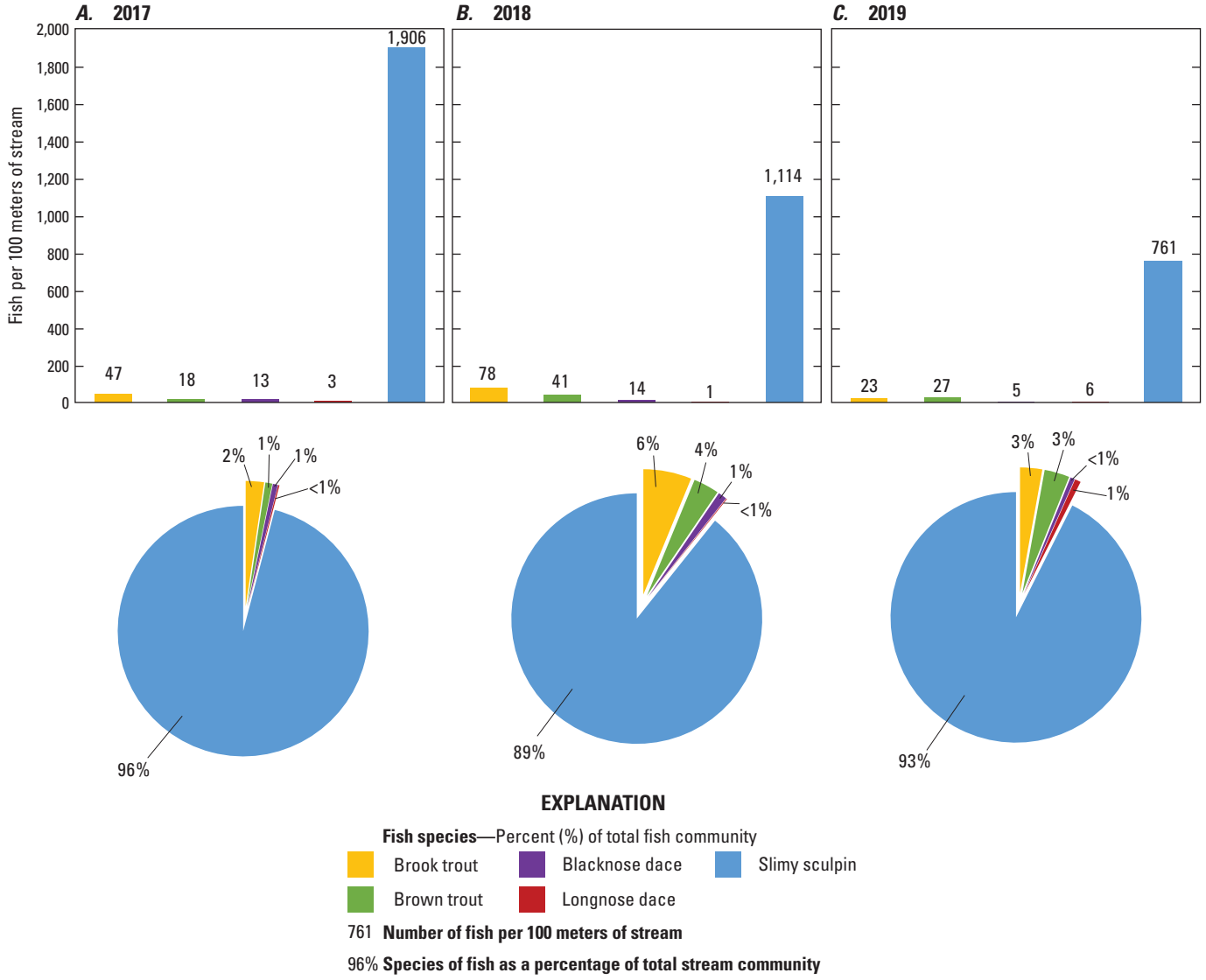

Figure 14. Population density of each fish species and proportion of each species as a percentage of the entire community at the NewHill site on the East Branch Neversink River for *A*, 2017; *B*, 2018; and *C*, 2019. <, Less than.

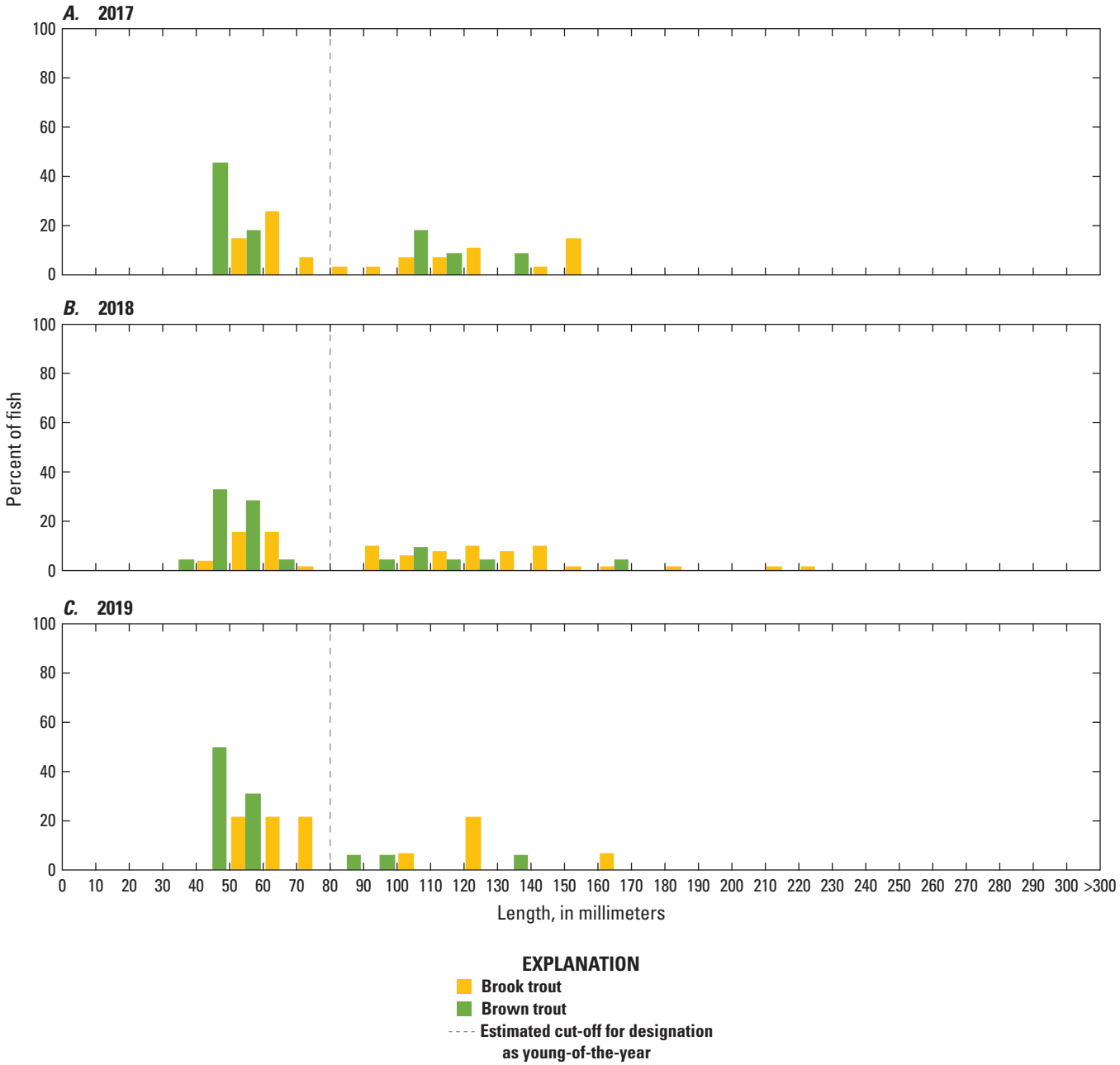

Figure 15. Length frequency distributions for brook trout and brown trout at the NewHill site on the East Branch Neversink River for *A*, 2017; *B*, 2018; and *C*, 2019. Dashed vertical line indicates estimated cutoff for designation as young-of-the-year.

East Branch Neversink River, EBGage Site

There were five fish species present at the EBGage site in 2017 and 2018 and six in 2019, and the total density of all fish species was 1,417, 1,398, and 864 fish per 100 m in 2017, 2018, and 2019, respectively (table 2). Slimy sculpin was the most abundant species during each year, comprising 83, 86, and 83 percent of the entire fish community in 2017, 2018, and 2019, respectively (fig. 16). Brook trout were present at a density of 52, 33, and 43 fish per 100 m and comprised 4, 2, and 5 percent of the community in 2017, 2018, and 2019, respectively. Brown trout were present at a density of 57, 65, and 40 fish per 100 m and comprised 4, 5, and 5 percent of the community in 2017, 2018, and 2019, respectively. The percentages of fish classified as YOY were 72, 53, and 60 percent for brook trout and 48, 73, and 74 percent for brown trout in 2017, 2018, and 2019, respectively (fig. 17). The pH of stream water at this site was 6.25, 6.27, and 6.26 in 2017, 2018, and 2019, respectively (table 2).

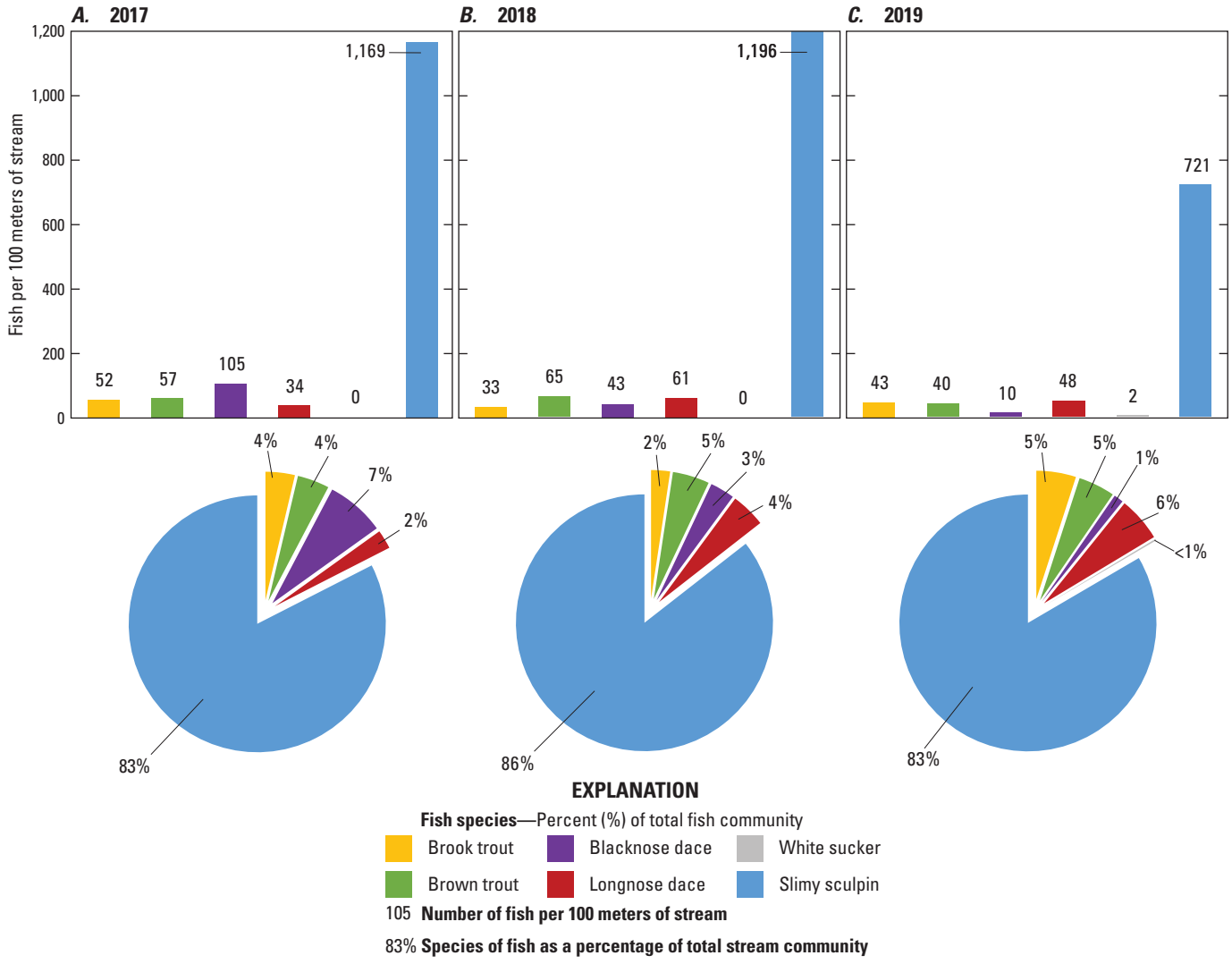

Figure 16. Population density of each fish species and proportion of each species as a percentage of the entire community at the EBGage site on the East Branch Neversink River for *A*, 2017; *B*, 2018; and *C*, 2019. <, Less than.

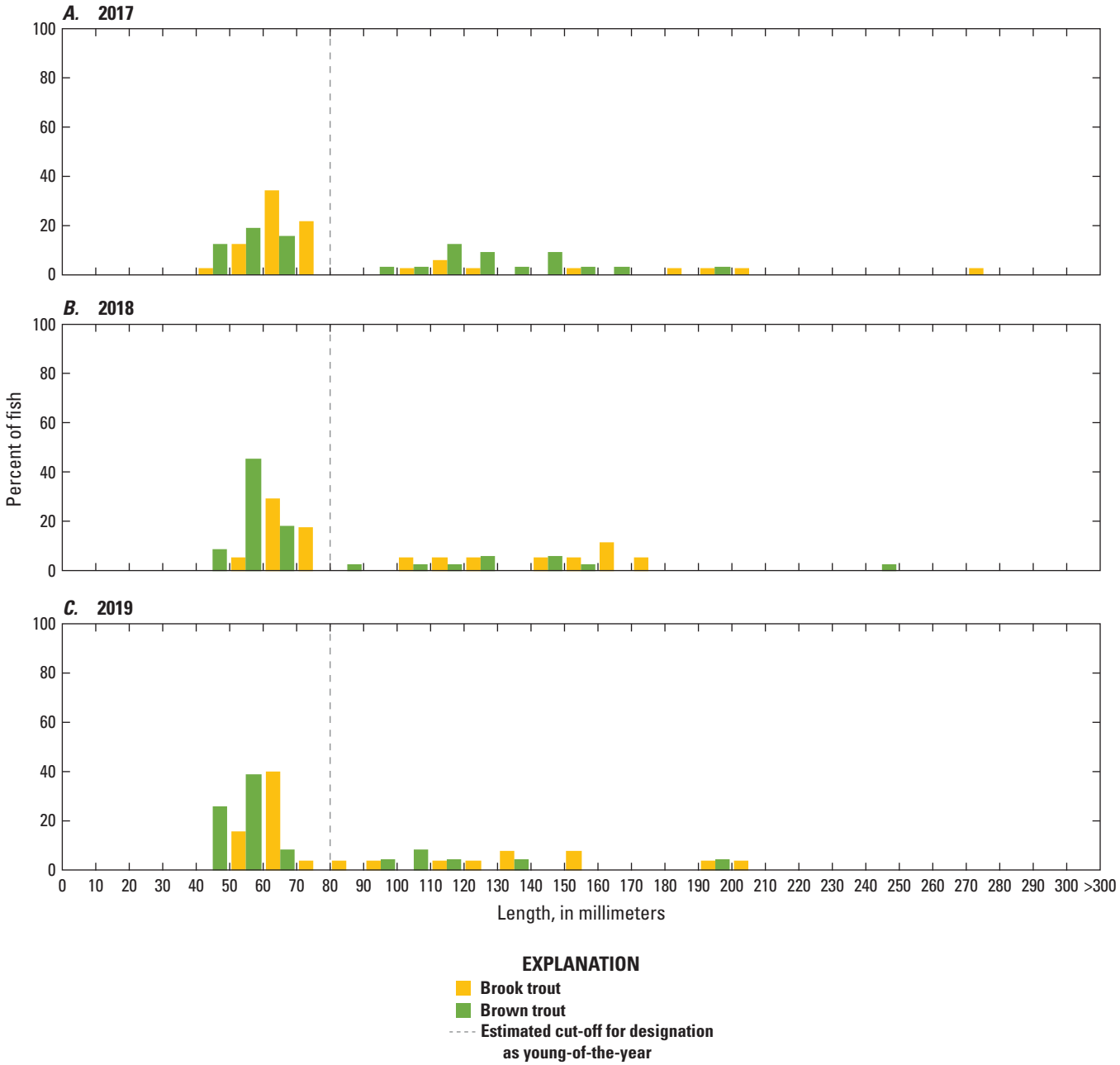

Figure 17. Length frequency distributions for brook trout and brown trout at the EBGage site on the East Branch Neversink River for *A*, 2017; *B*, 2018; and *C*, 2019. Dashed vertical line indicates estimated cutoff for designation as young-of-the-year.

East Branch Neversink River, DTHall Site

There were six fish species present at the DTHall site in 2018 and 2019, and the total density of all fish species was 1,180 and 805 fish per 100 m in 2018 and 2019, respectively (table 2). Slimy sculpin was the most abundant species during both years, comprising 61 and 59 percent of the entire fish community in 2018 and 2019, respectively (fig. 18). Brook trout were present at a density of 49 and 43 fish per 100 m and comprised 4 and 5 percent of the community in 2018 and 2019, respectively. Brown trout were present at a density of 267 and 116 fish per 100 m and comprised 23 and 15 percent of the community in 2018 and 2019, respectively. The percentages of fish classified as YOY were 53 and 58 percent for brook trout and 90 and 89 percent for brown trout in 2018 and 2019, respectively. (fig. 19). The pH of stream water at this site was 6.34 and 6.35 in 2018 and 2019 (table 2).

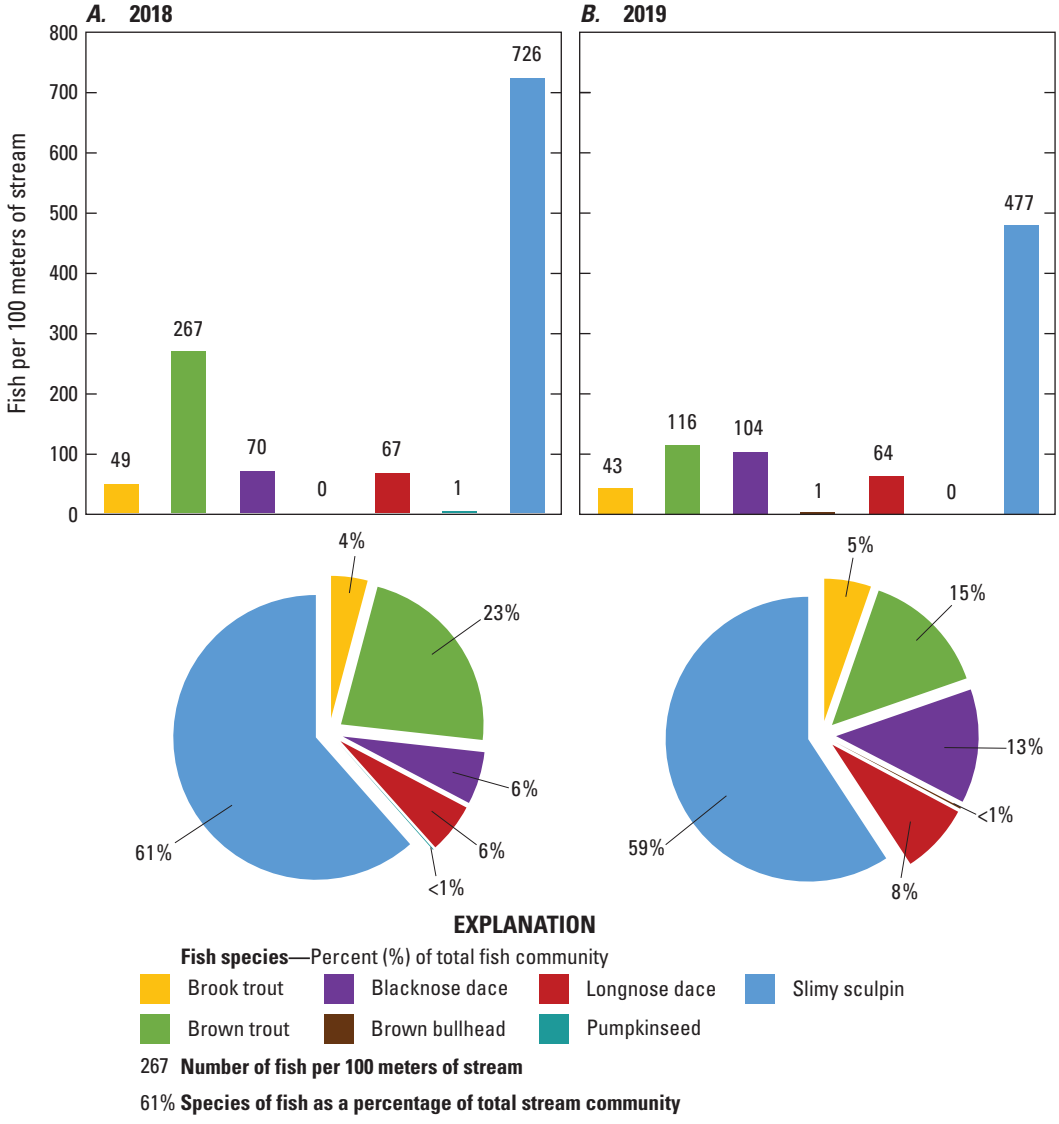

Figure 18. Population density of each fish species and proportion of each species as a percentage of the entire community at the DTHall site on the East Branch Neversink River for *A*, 2018; and *B*, 2019. <, Less than.

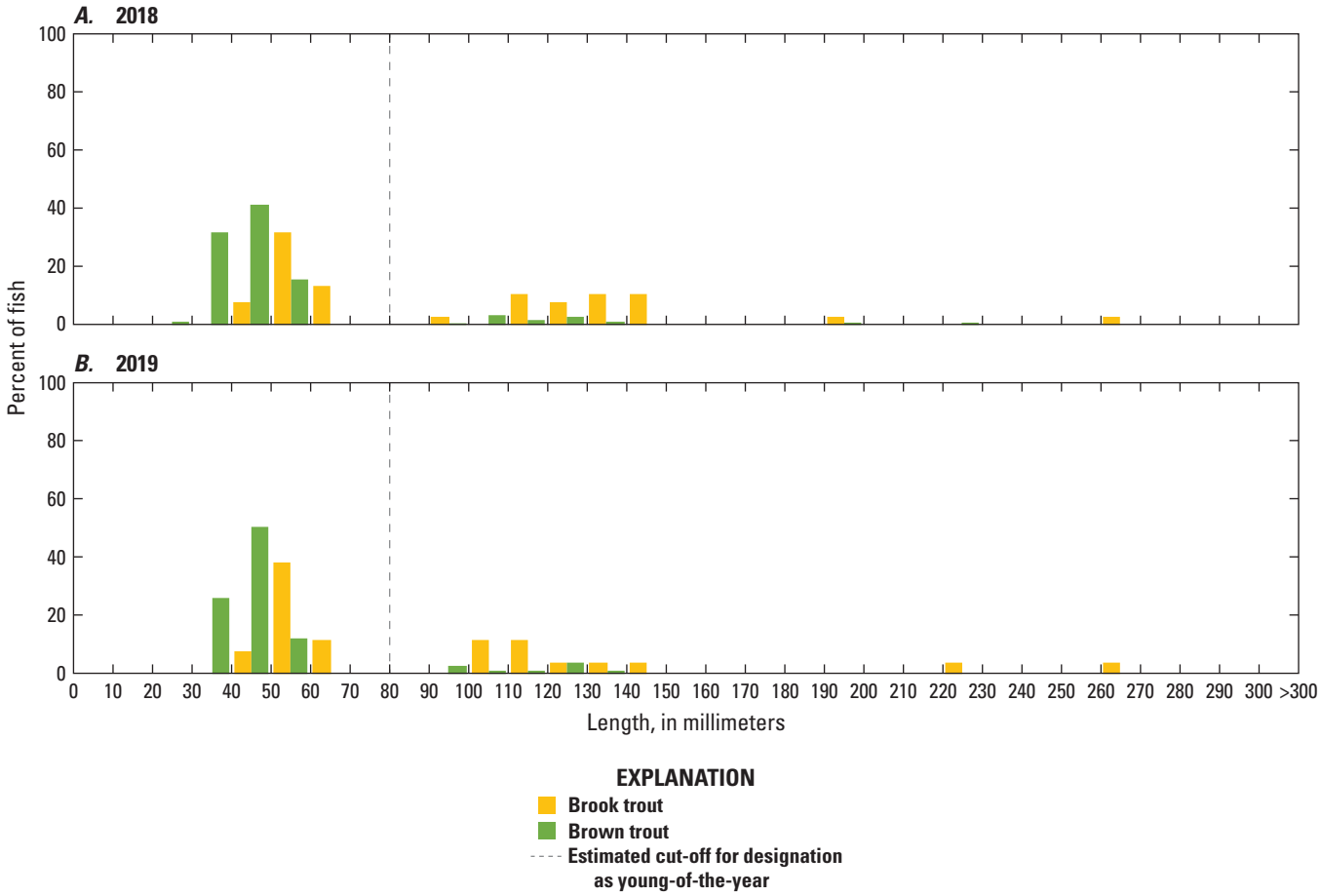

Figure 19. Length frequency distributions for brook trout and brown trout at the DTHall site on the East Branch Neversink River for *A*, 2018; and *B*, 2019. Dashed vertical line indicates estimated cutoff for designation as young-of-the-year.

East Branch Neversink River, BlueHill Site

There were six fish species present at the BlueHill site in 2017 and 2018 and five in 2019, and the total density of all fish species was 1,228, 679, and 688 fish per 100m in 2017, 2018, and 2019, respectively (table 2). Slimy sculpin was the most abundant species during each year, comprising 74, 58, and 51 percent of the entire fish community in 2017, 2018, and 2019, respectively (fig. 20). Brook trout were present at a density of 16, 24, and 30 fish per 100 m and comprised 1, 4, and 4 percent of the community in 2017, 2018, and 2019, respectively. Brown trout were present at a density of 64, 104, and 168 fish per 100 m and comprised 5, 15, and 24 percent of the community in 2017, 2018, and 2019, respectively. The percentages of fish classified as YOY were 45, 27, and 33 percent for brook trout and 58, 70, and 75 percent for brown trout in 2017, 2018, and 2019, respectively (fig. 21). The pH of stream water at this site was 6.53, 6.31, and 6.43 in 2017, 2018, and 2019, respectively (table 2).

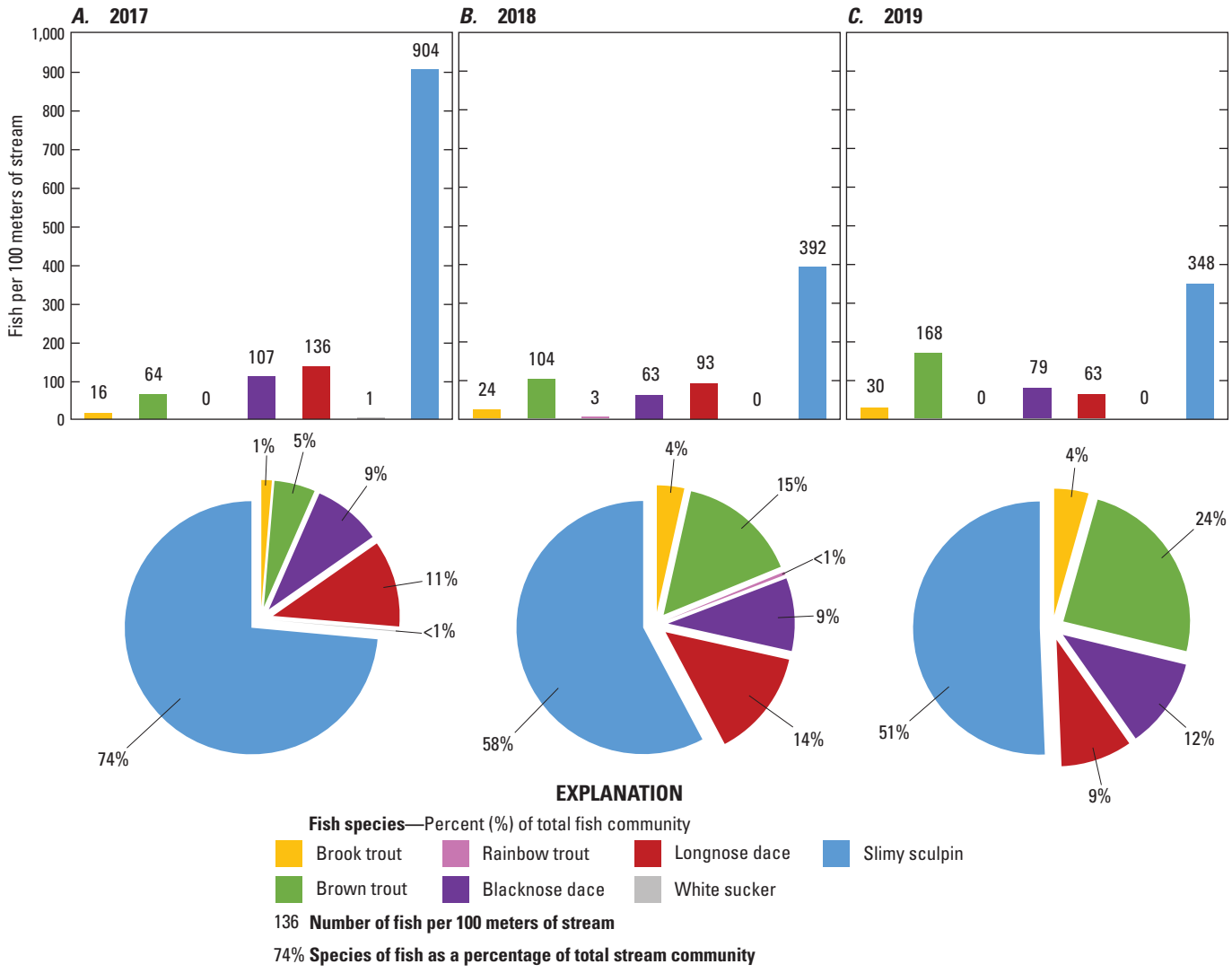

Figure 20. Population density of each fish species and proportion of each species as a percentage of the entire community at the BlueHill site on the East Branch Neversink River for *A*, 2017; *B*, 2018; and *C*, 2019. <, Less than.

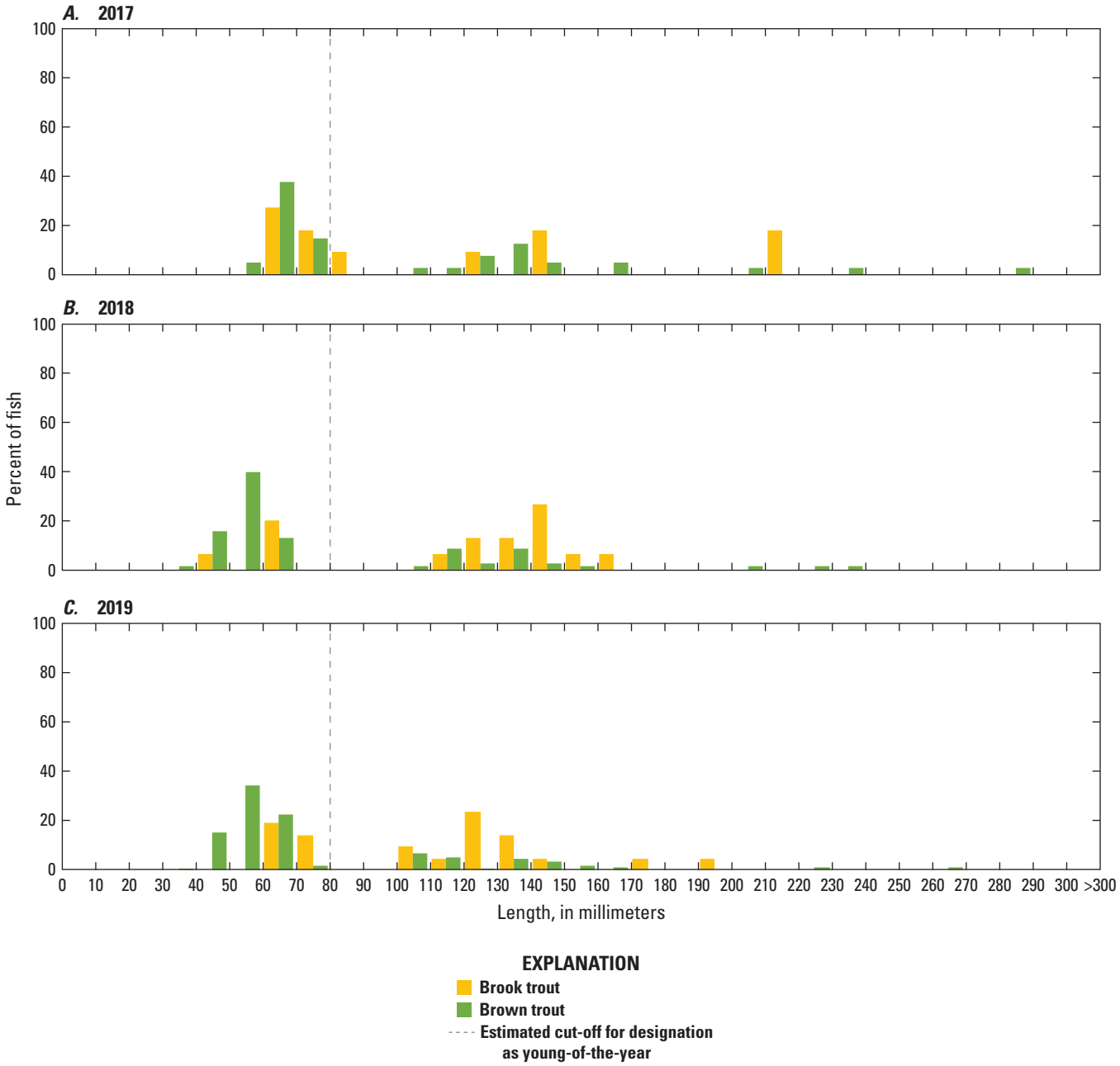

Figure 21. Length frequency distributions for brook trout and brown trout at the BlueHill site on the East Branch Neversink River for *A*, 2017; *B*, 2018; and *C*, 2019. Dashed vertical line indicates estimated cutoff for designation as young-of-the-year.

West Branch Neversink River Watershed

West Branch Neversink River, Winnisook Site

Brook trout was the only fish species present at the Winnisook site during all 3 years, and the density was 12, 33, and 21 fish per 100 m in 2017, 2018, and 2019, respectively (fig. 22; table 2). All brook trout at this site were greater than 80 mm in length, which was unique relative to most other sites where the majority of brook trout captured were less than 80 mm. The percentage of brook trout classified as YOY was 0 percent in all 3 years (fig. 23). The pH of stream water at this site was 4.90, 4.94, and 4.88 in 2017, 2018, and 2019, respectively (table 2).

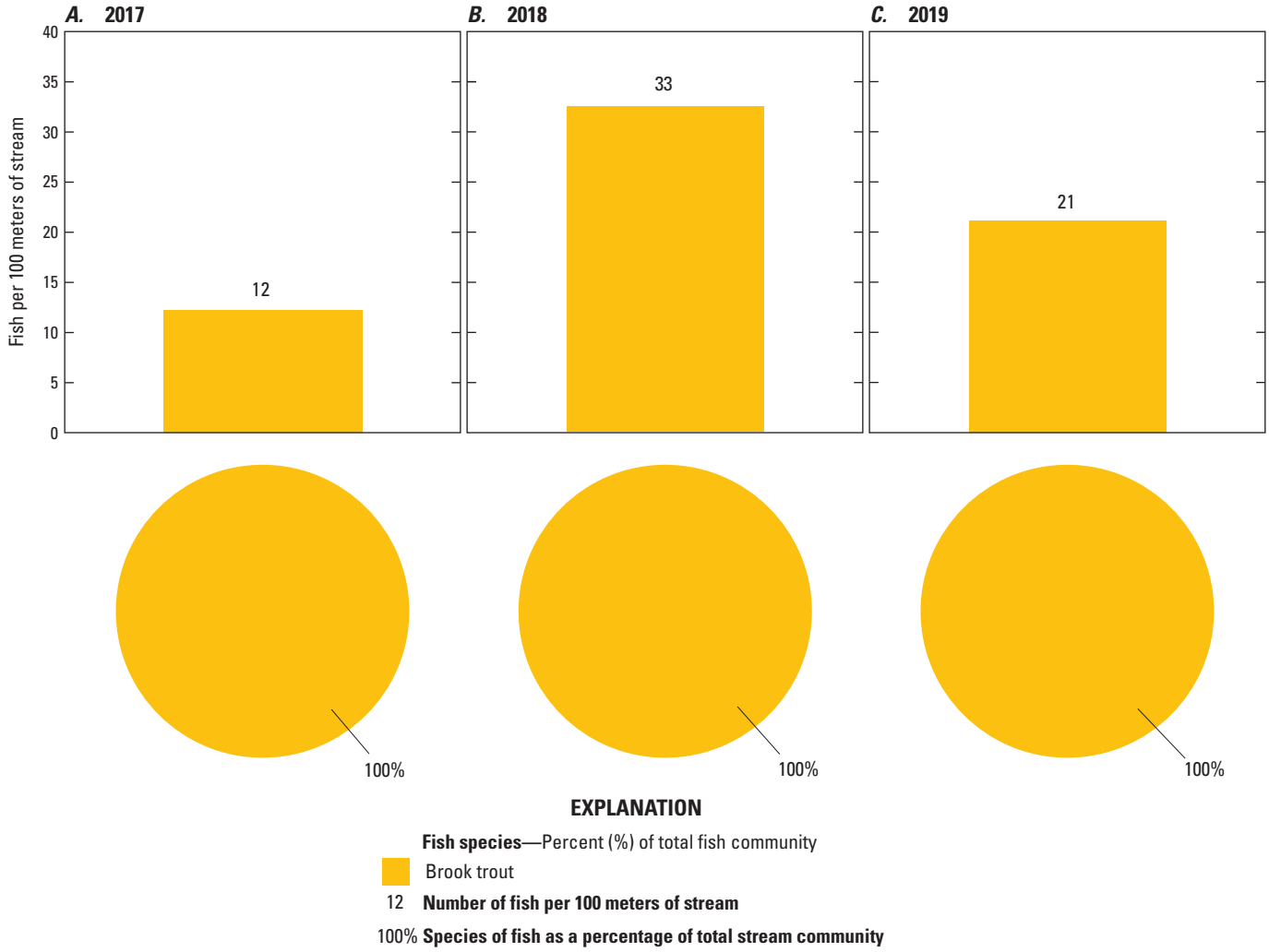

Figure 22. Population density of each fish species and proportion of each species as a percentage of the entire community at the Winnisook site on the West Branch Neversink River for *A*, 2017; *B*, 2018; and *C*, 2019.

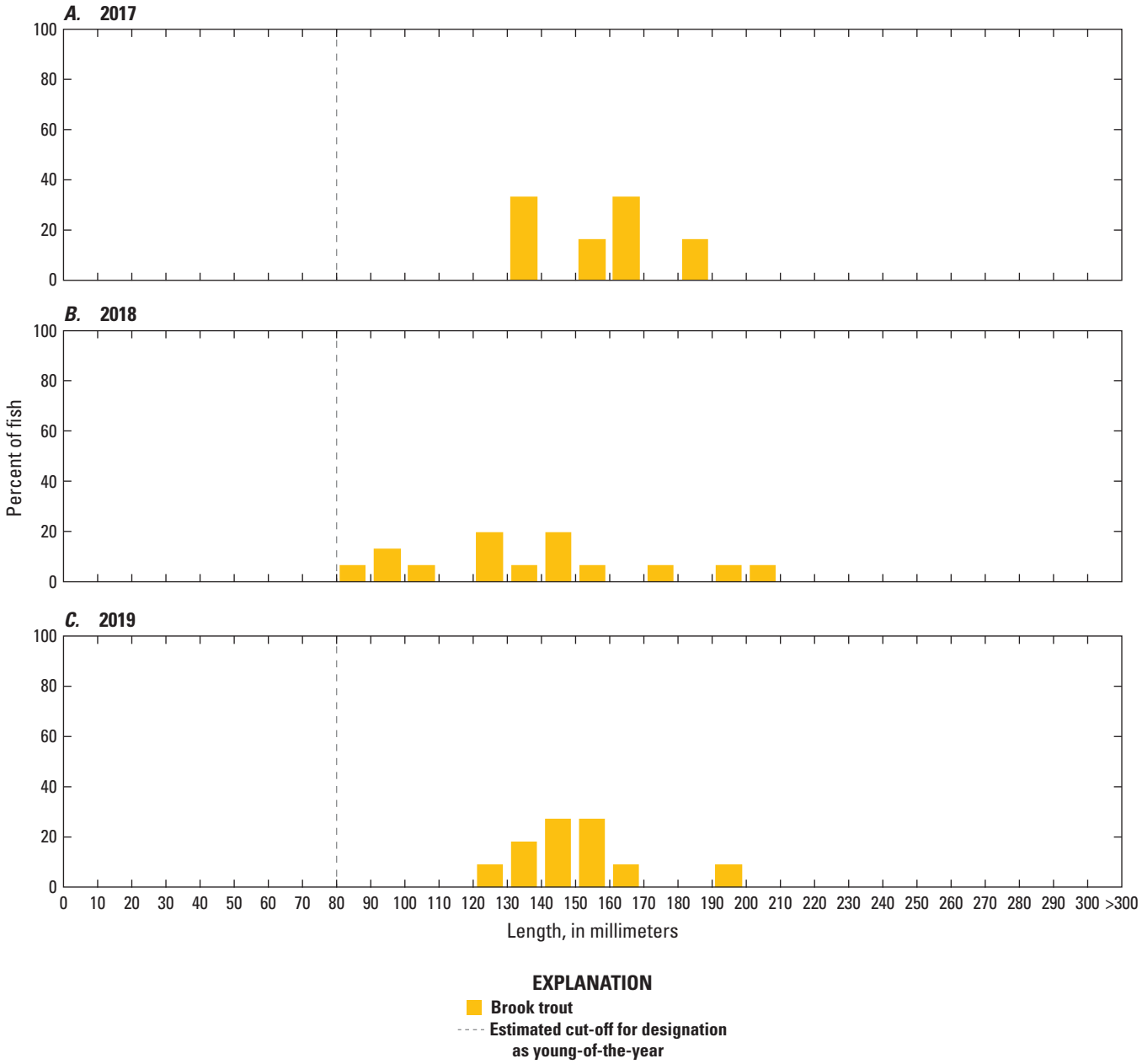

Figure 23. Length frequency distributions for brook trout at the Winnisook site on the West Branch Neversink River for *A*, 2017; *B*, 2018; and *C*, 2019. Dashed vertical line indicates estimated cutoff for designation as young-of-the-year.

West Branch Neversink River, Slide Site

There were two fish species present at the Slide site during all 3 years, and the total density of all fish species was 716, 661, and 587 fish per 100 m in 2017, 2018, and 2019, respectively (table 2). Slimy sculpin was the most abundant species during each year, comprising 73, 61, and 63 percent of the entire fish community in 2017, 2018, and 2019, respectively (fig. 24). Brook trout were present at a density of 193, 261, and 217 fish per 100 m and comprised 27, 39, and 37 percent of the community in 2017, 2018, and 2019, respectively. The percentage of brook trout classified as YOY was 81, 73, and 74 percent in 2017, 2018, and 2019, respectively (fig. 25). The pH of stream water at this site was 6.23, 6.04, and 6.05 in 2017, 2018, and 2019, respectively (table 2).

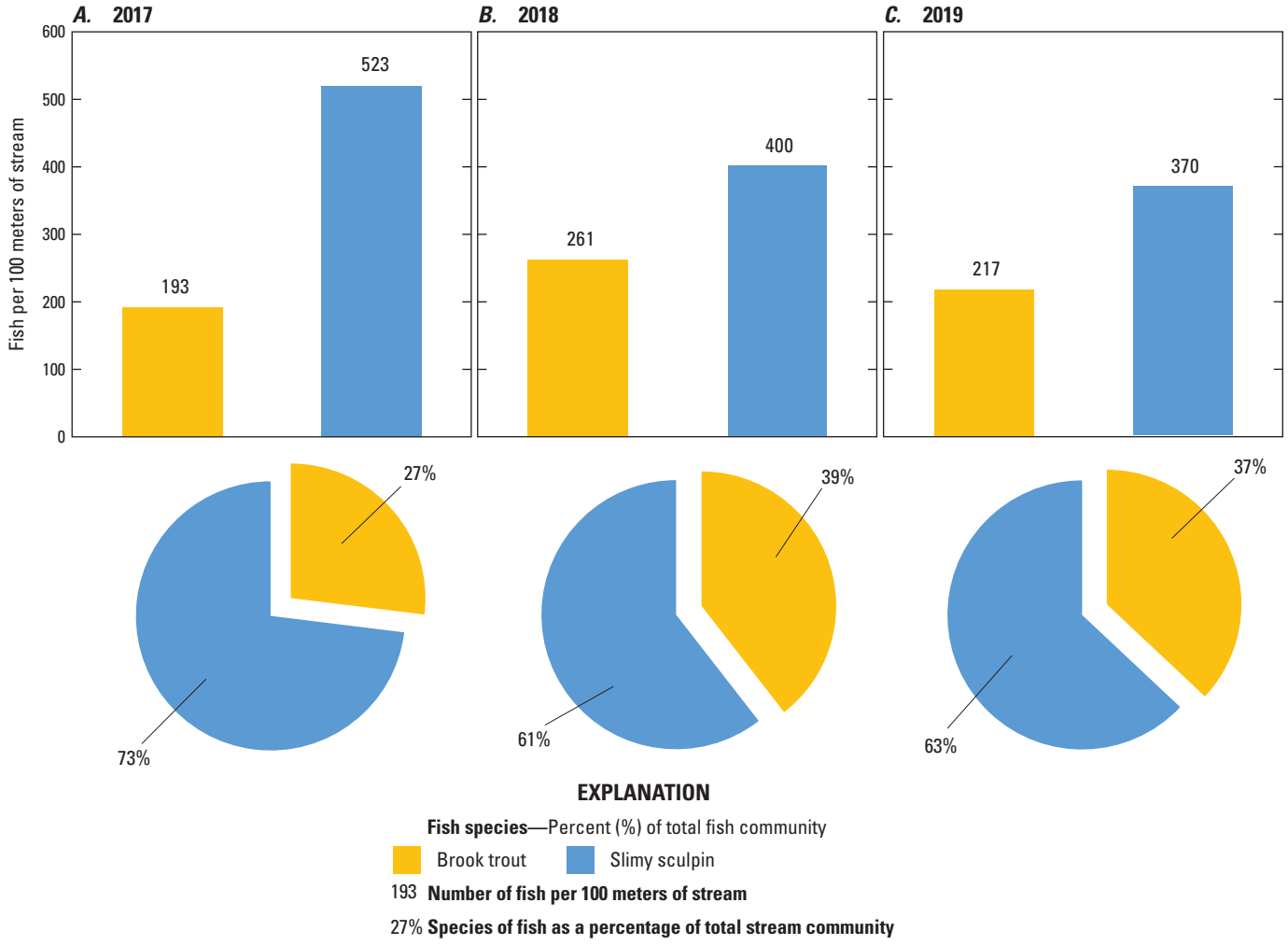

Figure 24. Population density of each fish species and proportion of each species as a percentage of the entire community at the Slide site on the West Branch Neversink River for *A*, 2017; *B*, 2018; and *C*, 2019.

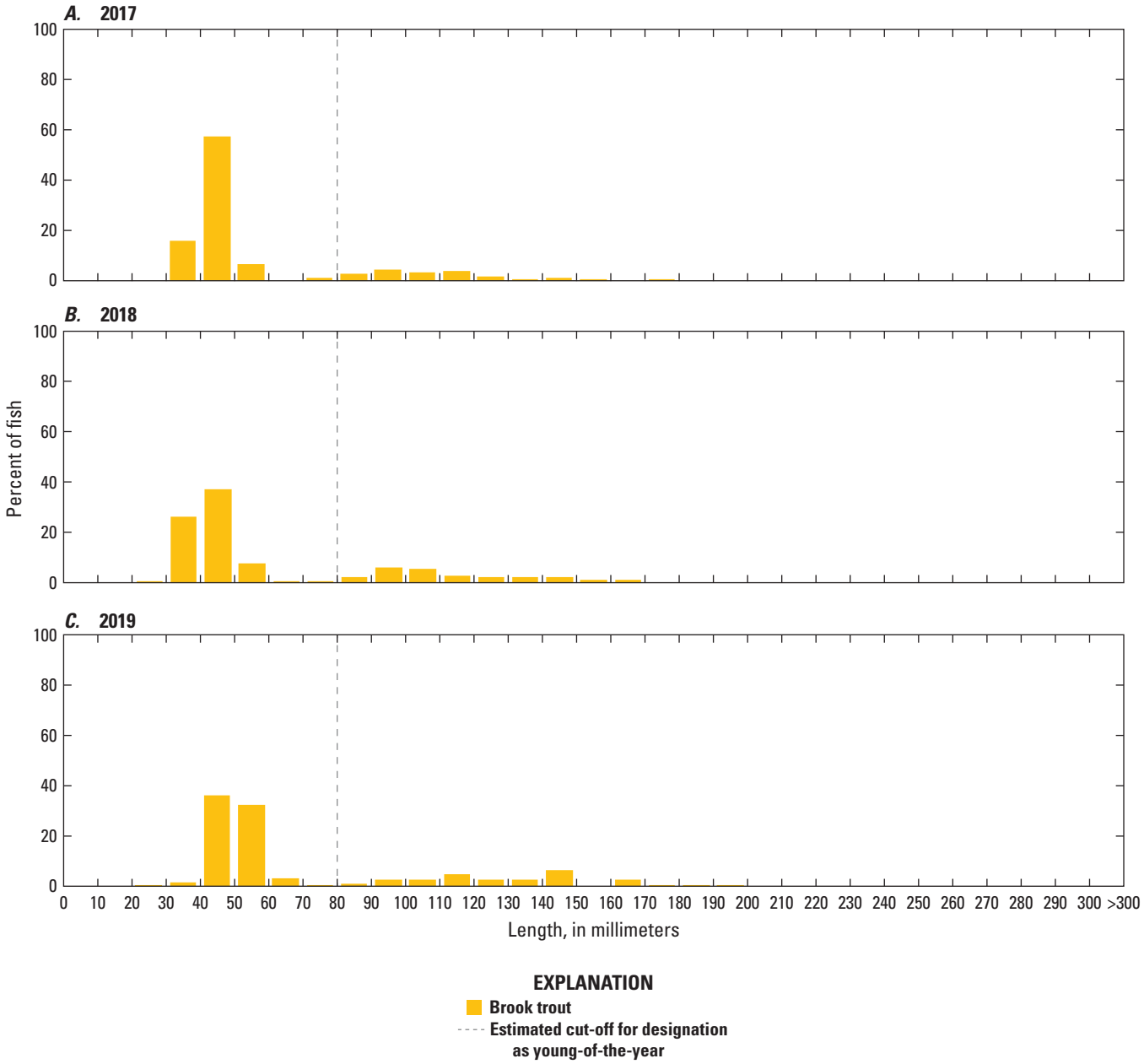

Figure 25. Length frequency distributions for brook trout at the Slide site on the West Branch Neversink River for *A*, 2017; *B*, 2018; and *C*, 2019. Dashed vertical line indicates estimated cutoff for designation as young-of-the-year.

Biscuit Brook, Biscuit Site

There were three fish species present at the Biscuit site during all 3 years, and the total density of all fish species was 451, 705, and 437 fish per 100 m in 2017, 2018, and 2019, respectively (table 2). Slimy sculpin was the most abundant species during each year, comprising 84, 83, and 83 percent of the entire fish community in 2017, 2018, and 2019, respectively (fig. 26). Brook trout were present at a density of 71, 117, and 44 fish per 100 m and comprised 16, 17, and 10 percent of the community in 2017, 2018, and 2019, respectively. Brown trout were present at a density of 2, 3, and 30 fish per 100 m and comprised less than 1 percent in 2017 and 2018 and 7 percent of the community in 2019, respectively. The percentages of fish classified as YOY were 60, 52, and 39 percent for brook trout and 0, 67, and 91 percent for brown trout in 2017, 2018, and 2019, respectively (fig. 27). The pH of stream water at this site was 6.35, 6.19, and 6.18 in 2017, 2018, and 2019, respectively (table 2).

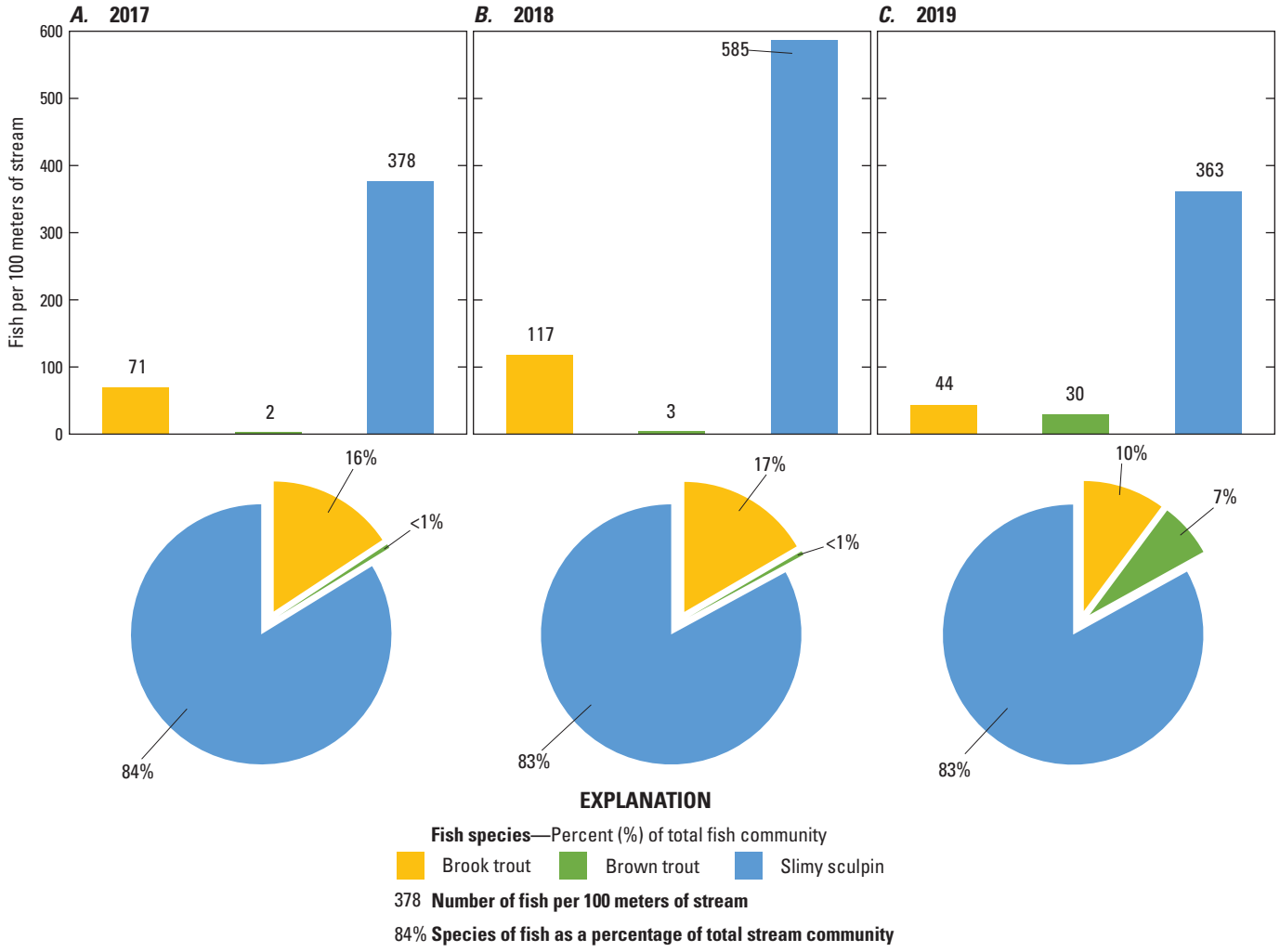

Figure 26. Population density of each fish species and proportion of each species as a percentage of the entire community at the Biscuit site on Biscuit Brook for *A*, 2017; *B*, 2018; and *C*, 2019. <, Less than.

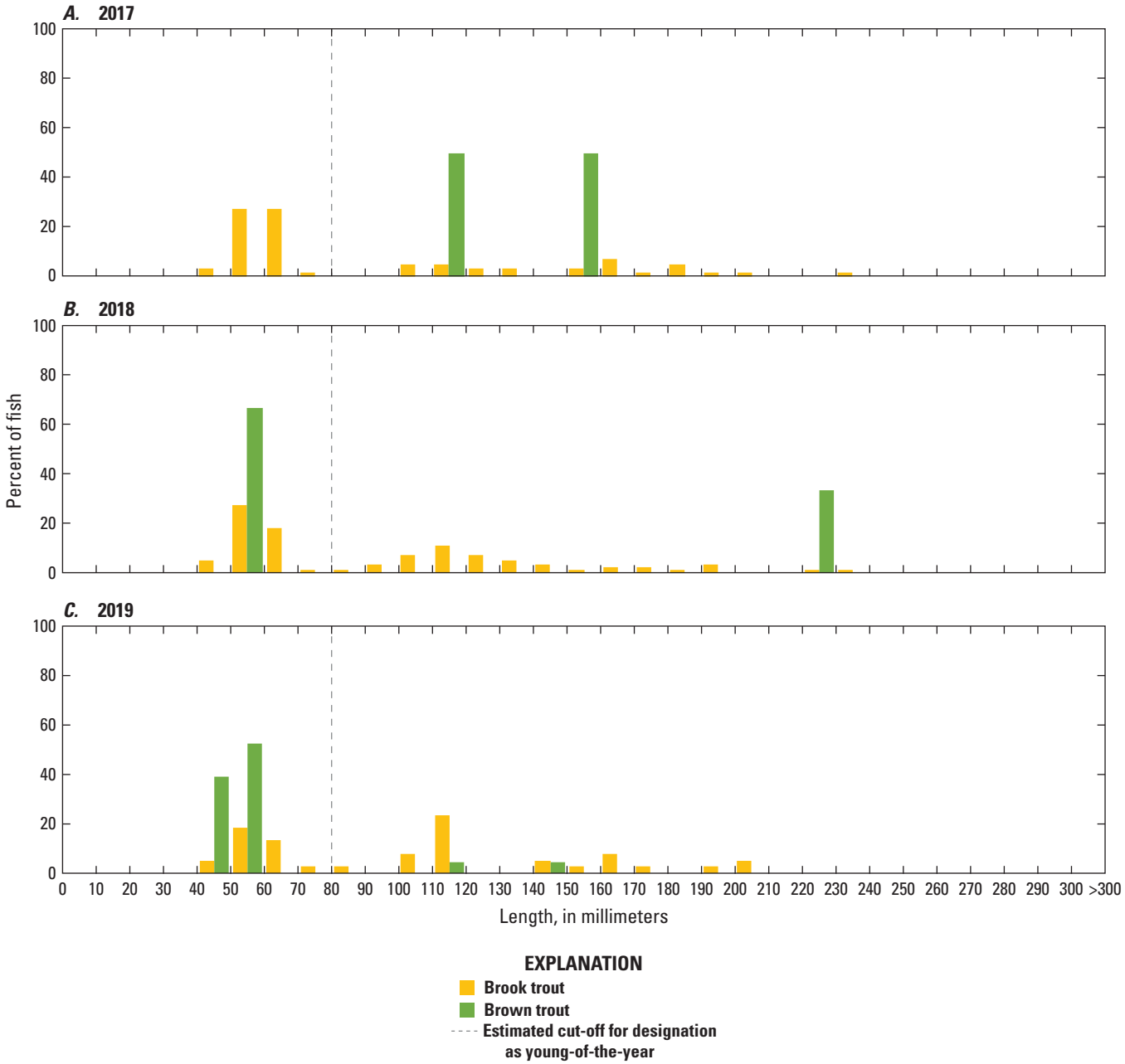

Figure 27. Length frequency distributions for brook trout and brown trout at the Biscuit site on Biscuit Brook for *A*, 2017; *B*, 2018; and *C*, 2019. Dashed vertical line indicates estimated cutoff for designation as young-of-the-year.

West Branch Neversink River, Wildcat Site

There were four fish species present at the Wildcat site in 2017 and five in 2018 and 2019, and the total density of all fish species was 1,846, 1,152, and 923 fish per 100 m in 2017, 2018, and 2019, respectively (table 2). Slimy sculpin was the most abundant species during each year, comprising 94, 75, and 81 percent of the entire fish community in 2017, 2018, and 2019, respectively (fig. 28). Brook trout were present at a density of 46, 47, and 51 fish per 100 m and comprised 3, 4, and 5 percent of the community in 2017, 2018, and 2019, respectively. Brown trout were present at a density of 21, 171, and 117 fish per 100 m and comprised 1, 15, and 13 percent of the community in 2017, 2018, and 2019, respectively. Rainbow trout (*Oncorhynchus mykiss*) were present at a density of 0, 1, and 0 fish per 100 m and comprised 0, less than 1, and 0 percent of the community in 2017, 2018, and 2019, respectively. The percentages of fish classified as YOY were 47, 19, and 73 percent for brook trout and 56, 95, and 79 percent for brown trout in 2017, 2018, and 2019, respectively (fig. 29). The pH of stream water at this site was 6.34, 6.33, and 6.40 in 2017, 2018, and 2019, respectively (table 2).

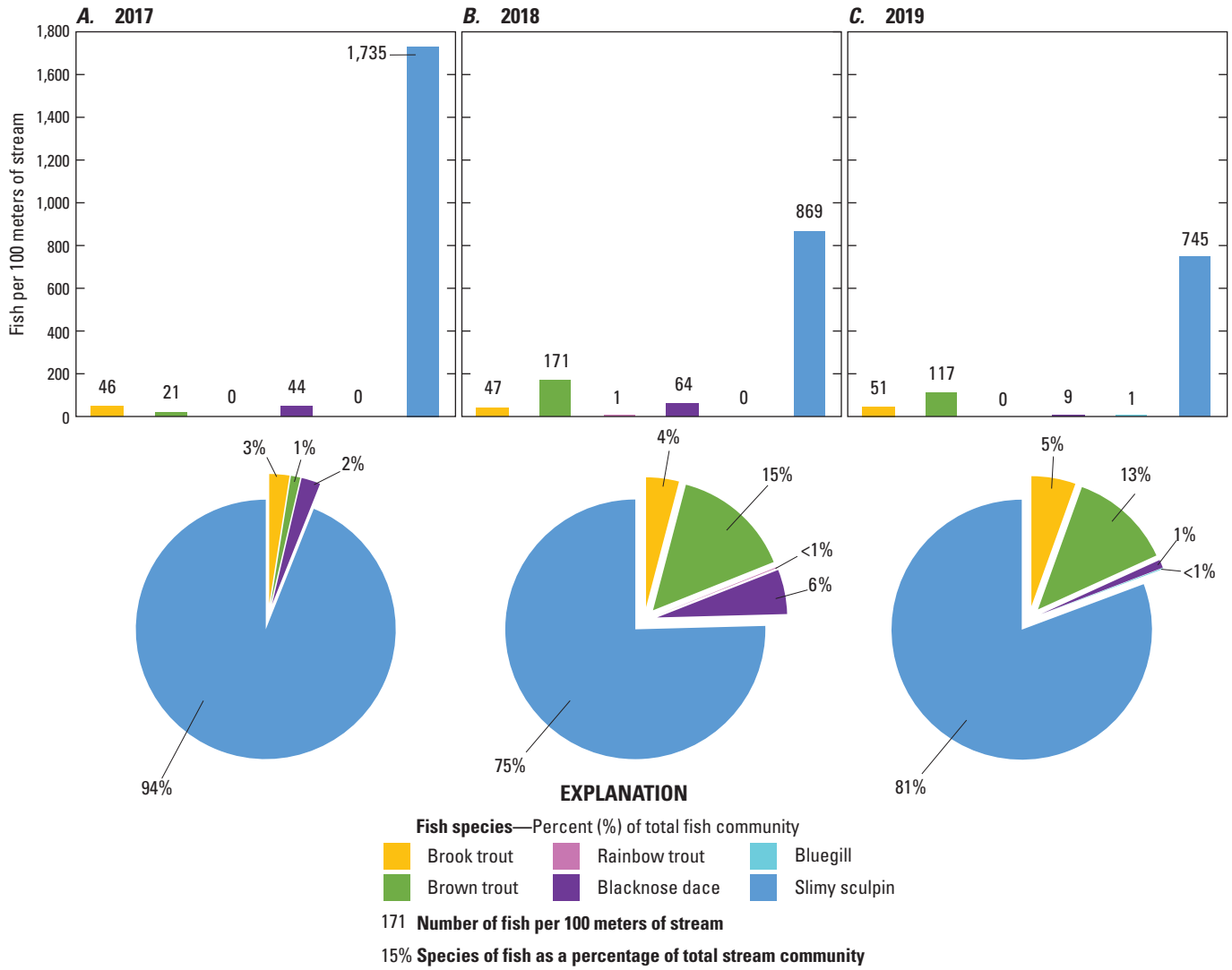

Figure 28. Population density of each fish species and proportion of each species as a percentage of the entire community at the Wildcat site on the West Branch Neversink River for *A*, 2017; *B*, 2018; and *C*, 2019. <, Less than.

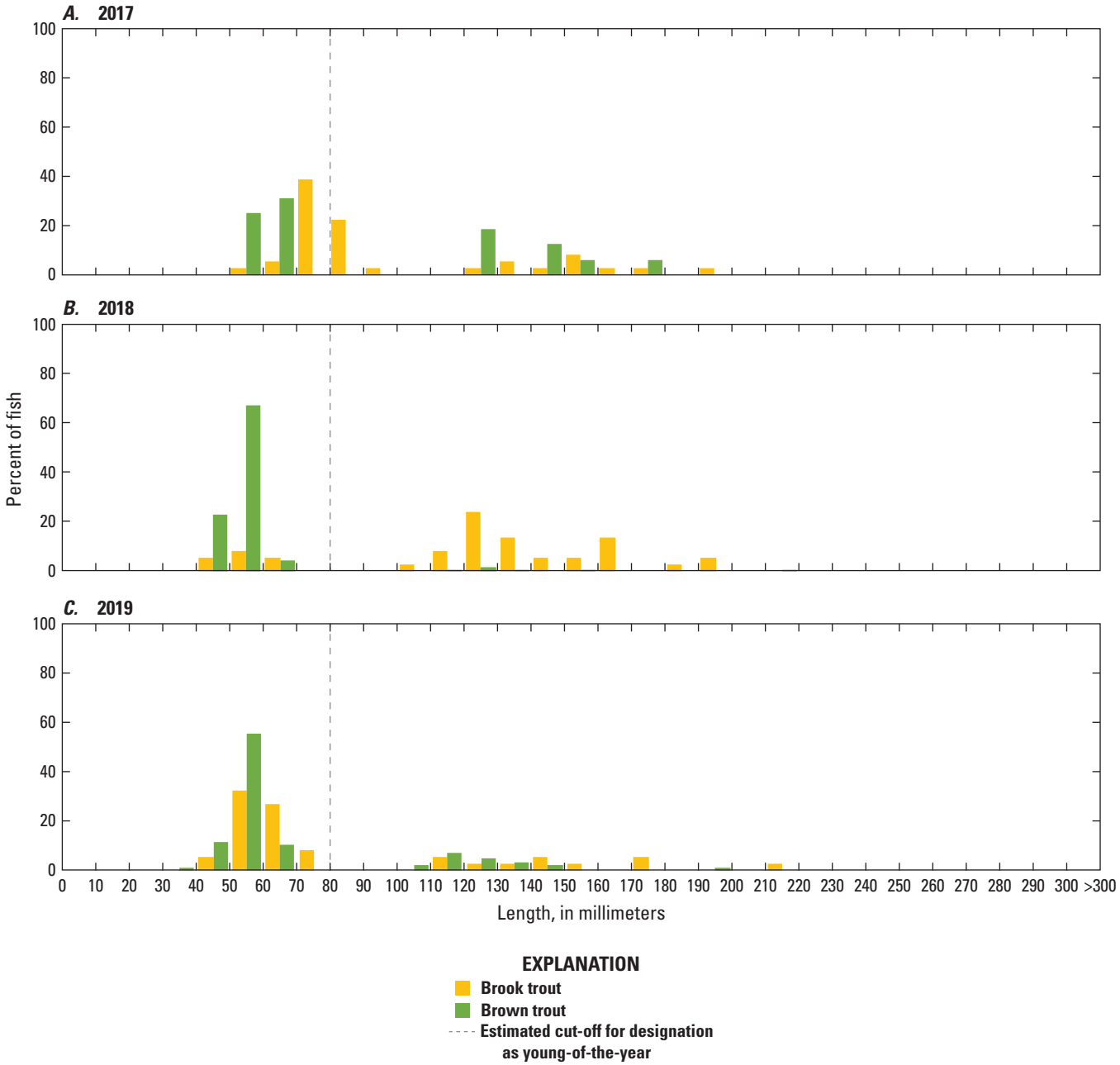

Figure 29. Length frequency distributions for brook trout and brown trout at the Wildcat site on the West Branch Neversink River for *A*, 2017; *B*, 2018; and *C*, 2019. Dashed vertical line indicates estimated cutoff for designation as young-of-the-year.

West Branch Neversink River, OtterPool Site

There were five fish species present at the OtterPool site in 2017, four in 2018, and six in 2019, and the total density of all fish species was 952, 601, and 949 fish per 100 m in 2017, 2018, and 2019, respectively (table 2). Slimy sculpin was the most abundant species during each year, comprising 74, 79, and 72 percent of the entire fish community in 2017, 2018, and 2019, respectively (fig. 30). Brook trout were present at a density of 49, 22, and 27 fish per 100 m and comprised 5, 4, and 3 percent of the community in 2017, 2018, and 2019, respectively. Brown trout were present at a density of 23, 43, and 90 fish per 100 m and comprised 3, 7, and 10 percent of the community in 2017, 2018, and 2019, respectively. Atlantic salmon (*Salmo salar*) were present at a density of 0, 0, and 70 fish per 100 m and comprised 0, 0, and 7 percent of the entire fish community in 2017, 2018, and 2019, respectively. The percentages of fish classified as YOY were 39, 64, and 47 percent for brook trout and 56, 64, and 65 percent for brown trout in 2017, 2018, and 2019, respectively (fig. 31). The pH of stream water at this site was 6.65, 6.43, and 6.76 in 2017, 2018, and 2019, respectively (table 2).

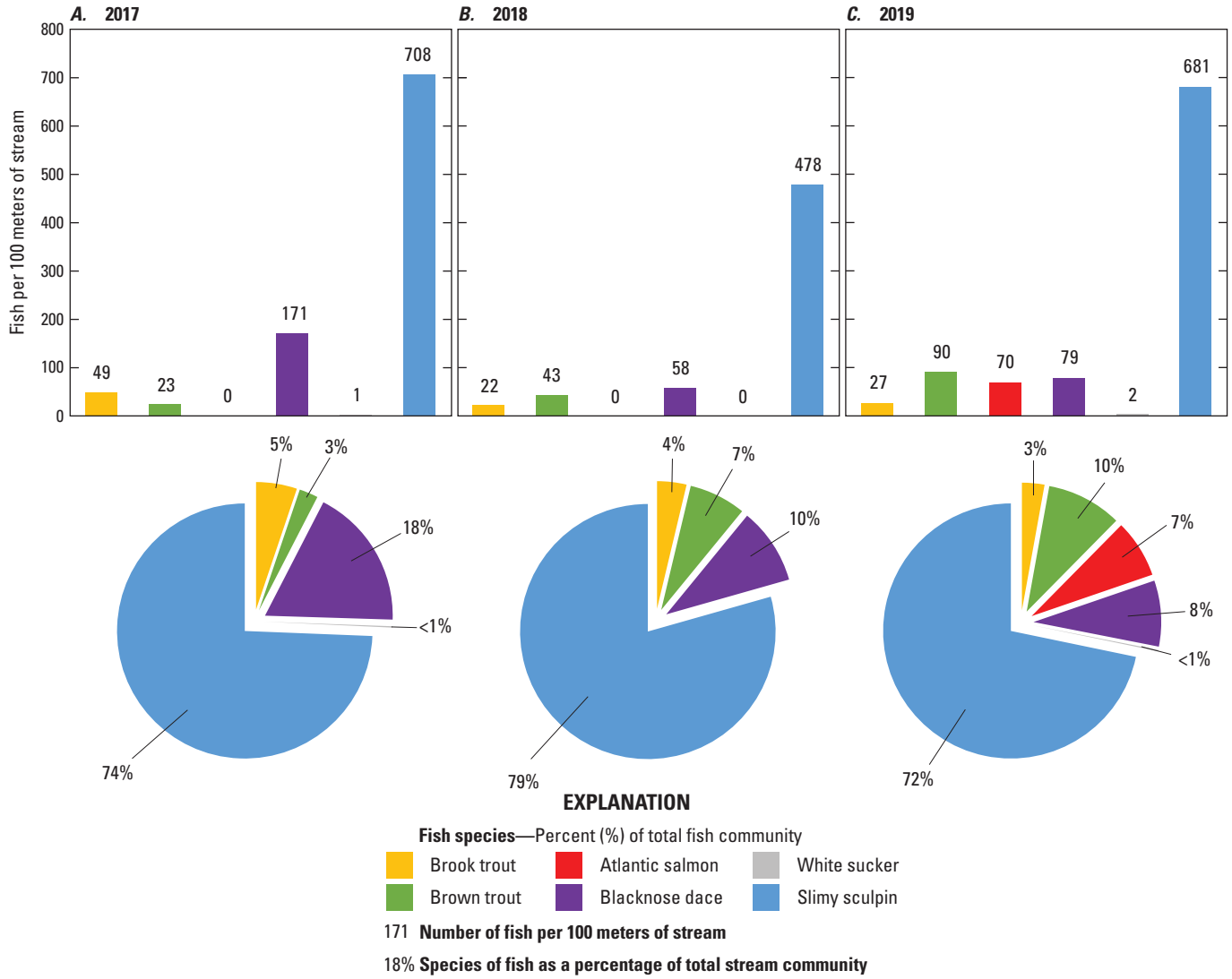

Figure 30. Population density of each fish species and proportion of each species as a percentage of the entire community at the OtterPool site on the West Branch Neversink River for *A*, 2017; *B*, 2018; and *C*, 2019. <, Less than.

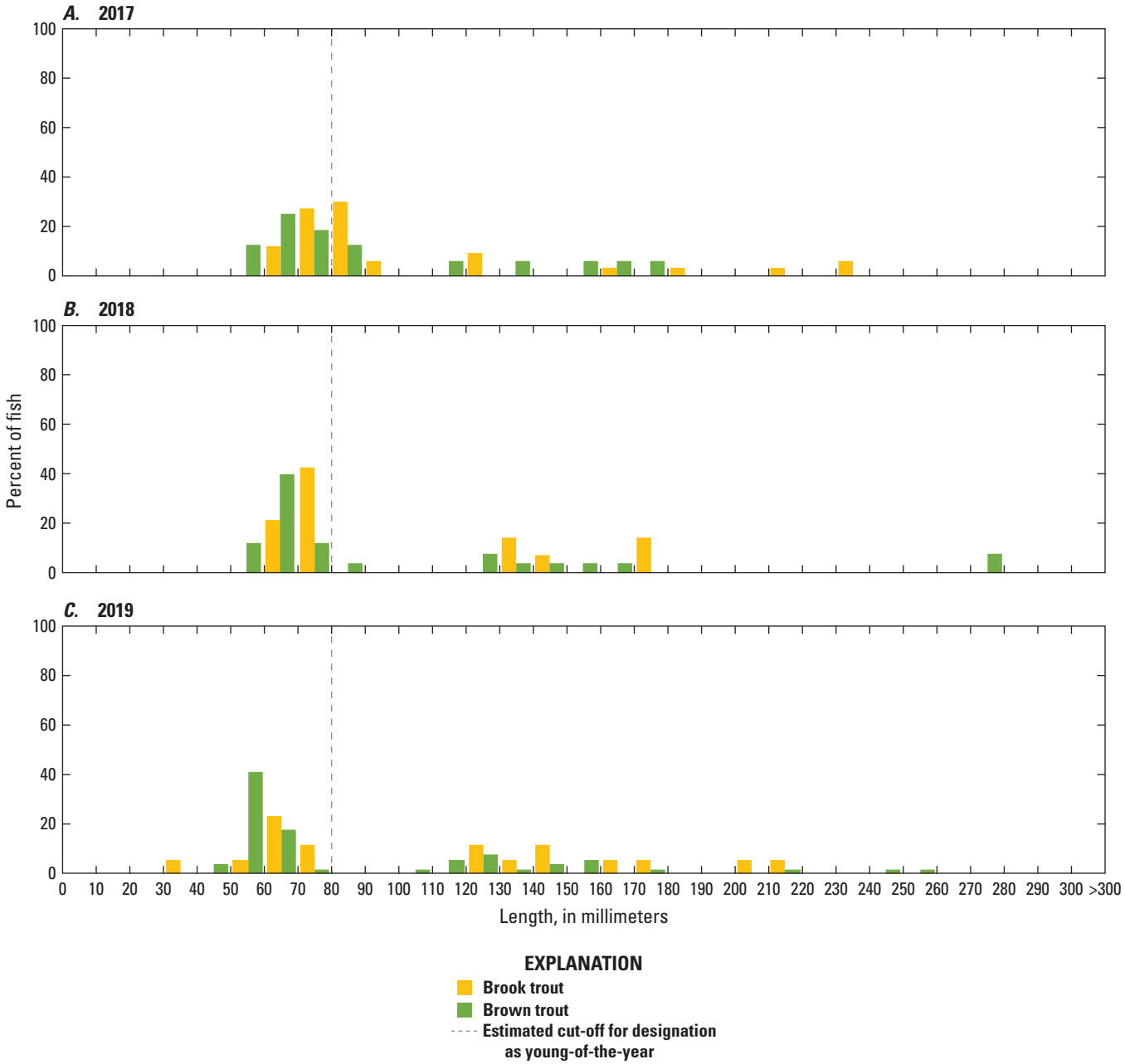

Figure 31. Length frequency distributions for brook trout and brown trout at the OtterPool site on the West Branch Neversink River for *A*, 2017; *B*, 2018; and *C*, 2019. Dashed vertical line indicates estimated cutoff for designation as young-of-the-year.

West Branch Neversink River, ClothesPool Site

There were four fish species present at the ClothesPool site in 2017 and five species in 2018 and 2019, and the total density of all fish species was 588, 535, and 1,158 fish per 100 m in 2017, 2018, and 2019, respectively (table 2). Slimy sculpin was the most abundant species in 2017 and 2018, comprising 71 and 56 percent of the entire fish community, and Atlantic salmon was the most abundant species in 2019, comprising 50 percent of the entire fish community (fig. 32). Brook trout were present at a density of 16, 19, and 20 fish per 100 m and comprised 3, 4, and 2 percent of the community in 2017, 2018, and 2019, respectively. Brown trout were present at a density of 41, 64, and 114 fish per 100 m and comprised 7, 12, and 10 percent of the community in 2017, 2018, and 2019, respectively. Atlantic salmon were present at a density of 0, 0, and 586 fish per 100 m and comprised 0, 0, and 50 percent of the entire fish community in 2017, 2018, and 2019, respectively. The percentages of fish classified as YOY were 83, 13, and 30 percent for brook trout and 55, 41, and 48 percent for brown trout in 2017, 2018, and 2019, respectively (fig. 33). The pH of stream water at this site was 6.58, 6.40, and 6.45 in 2017, 2018, and 2019, respectively (table 2).

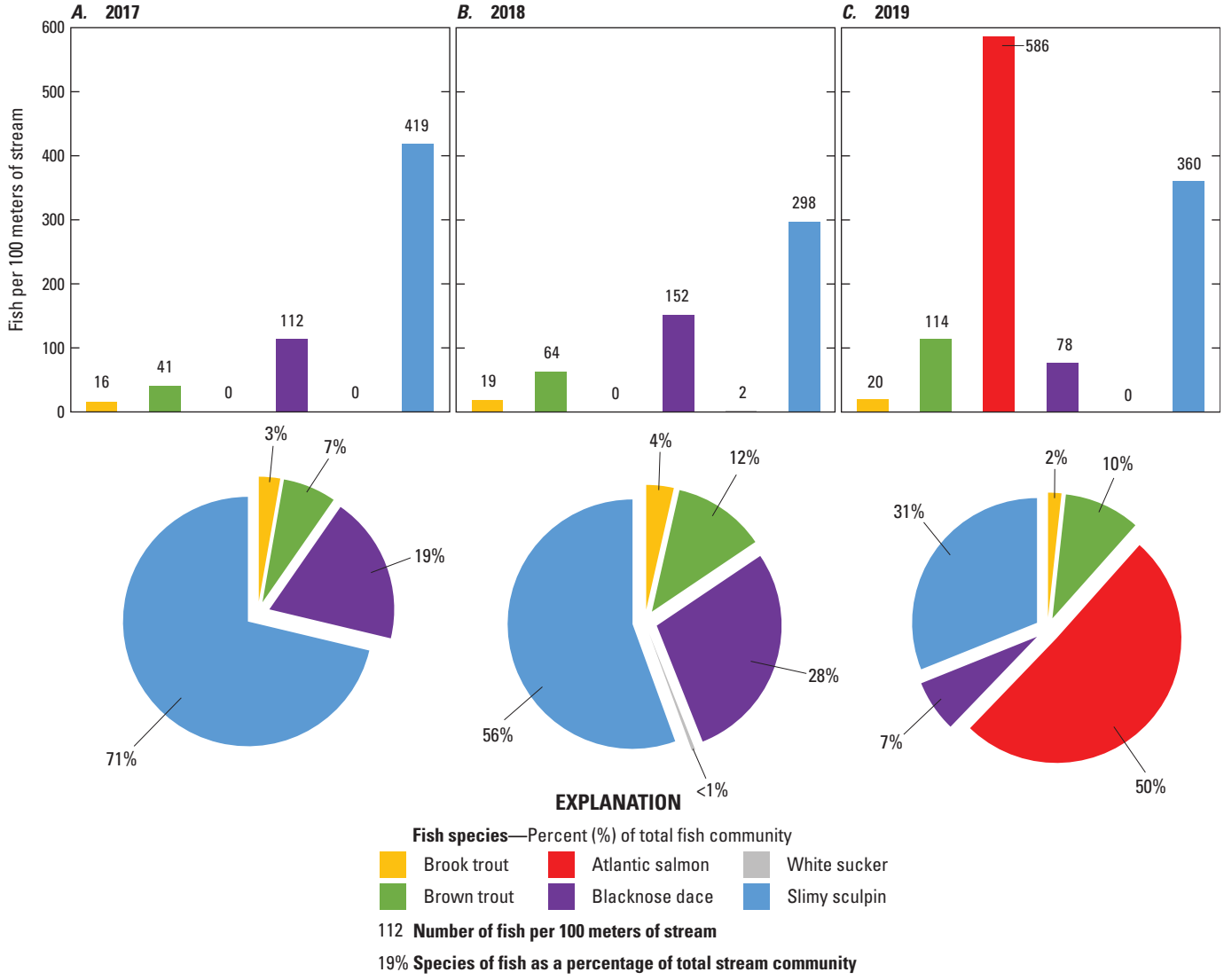

Figure 32. Population density of each fish species and proportion of each species as a percentage of the entire community at the ClothesPool site on the West Branch Neversink River for *A*, 2017; *B*, 2018; and *C*, 2019. <, Less than.

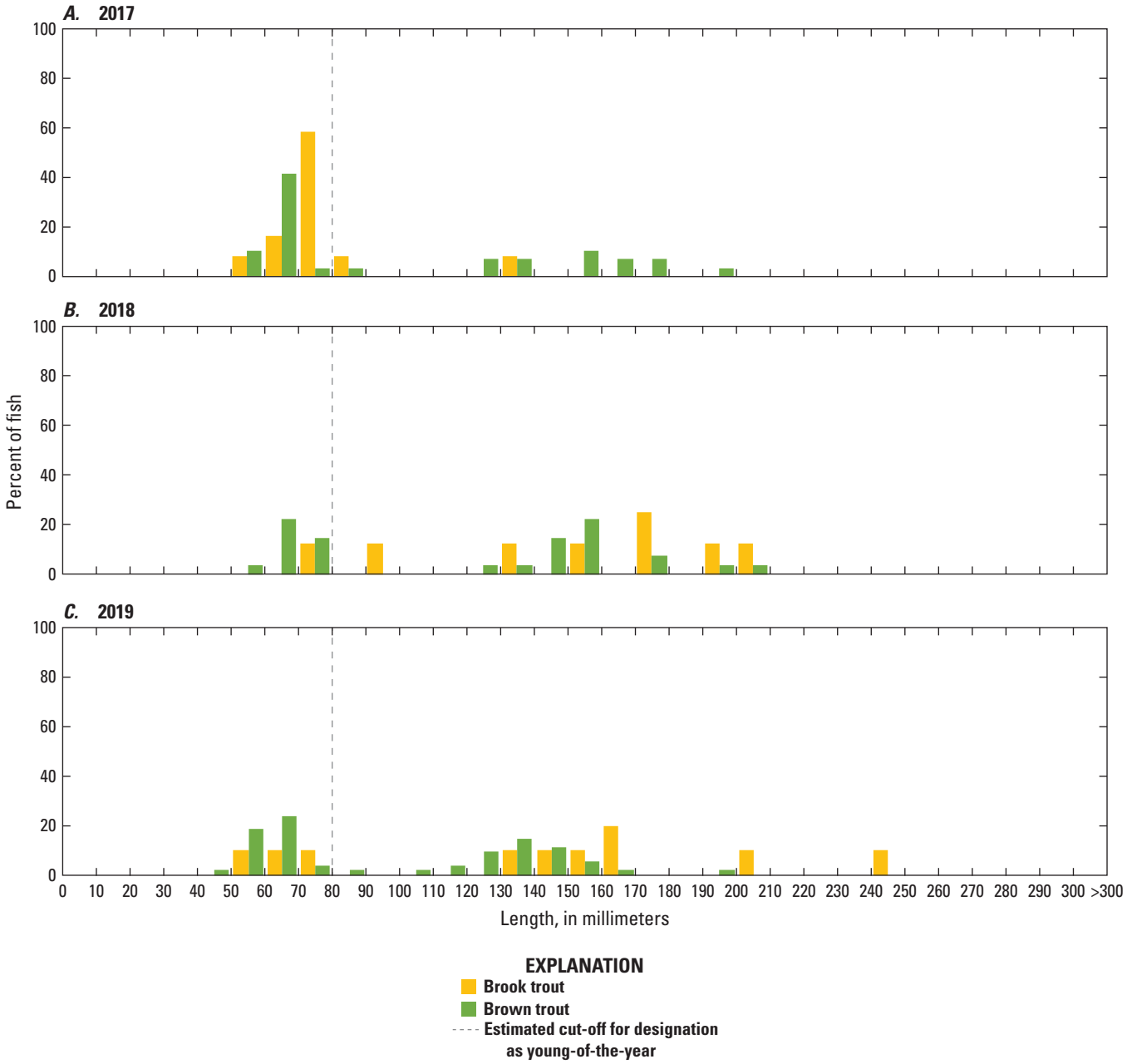

Figure 33. Length frequency distributions for brook trout and brown trout at the ClothesPool site on the West Branch Neversink River for *A*, 2017; *B*, 2018; and *C*, 2019. Dashed vertical line indicates estimated cutoff for designation as young-of-the-year.

West Branch Neversink River, WBGage Site

There were 12 fish species present at the WBGage site in 2017 and eight in 2019, and the total density of all fish species was 748 and 580 fish per 100 m in 2017 and 2019, respectively (table 2). Brown trout was the most abundant species in 2017, comprising 29 percent of the entire fish community, and slimy sculpin was the most abundant species in 2019, comprising 49 percent of the entire fish community (fig. 34). Brook trout were present at a density of 9 and 3 fish per 100 m and comprised 1 and less than 1 percent of the community in 2017 and 2019. Brown trout were present at a density of 220 and 114 fish per 100 m and comprised 29 and 20 percent of the community in 2017 and 2019. Rainbow trout were present at a density of 13 and 10 fish per 100 m and comprised 2 percent of the community in both 2017 and 2019. Atlantic salmon were present at a density of 0 and 54 fish per 100 m and comprised 0 and 9 percent of the community in 2017 and 2019, respectively. The percentages of fish classified as YOY were 43 and 50 percent for brook trout and 71 and 54 percent for brown trout in 2017 and 2019, respectively (fig. 35). The pH of stream water at this site was 6.75 and 6.96 in 2017 and 2019, respectively (table 2).

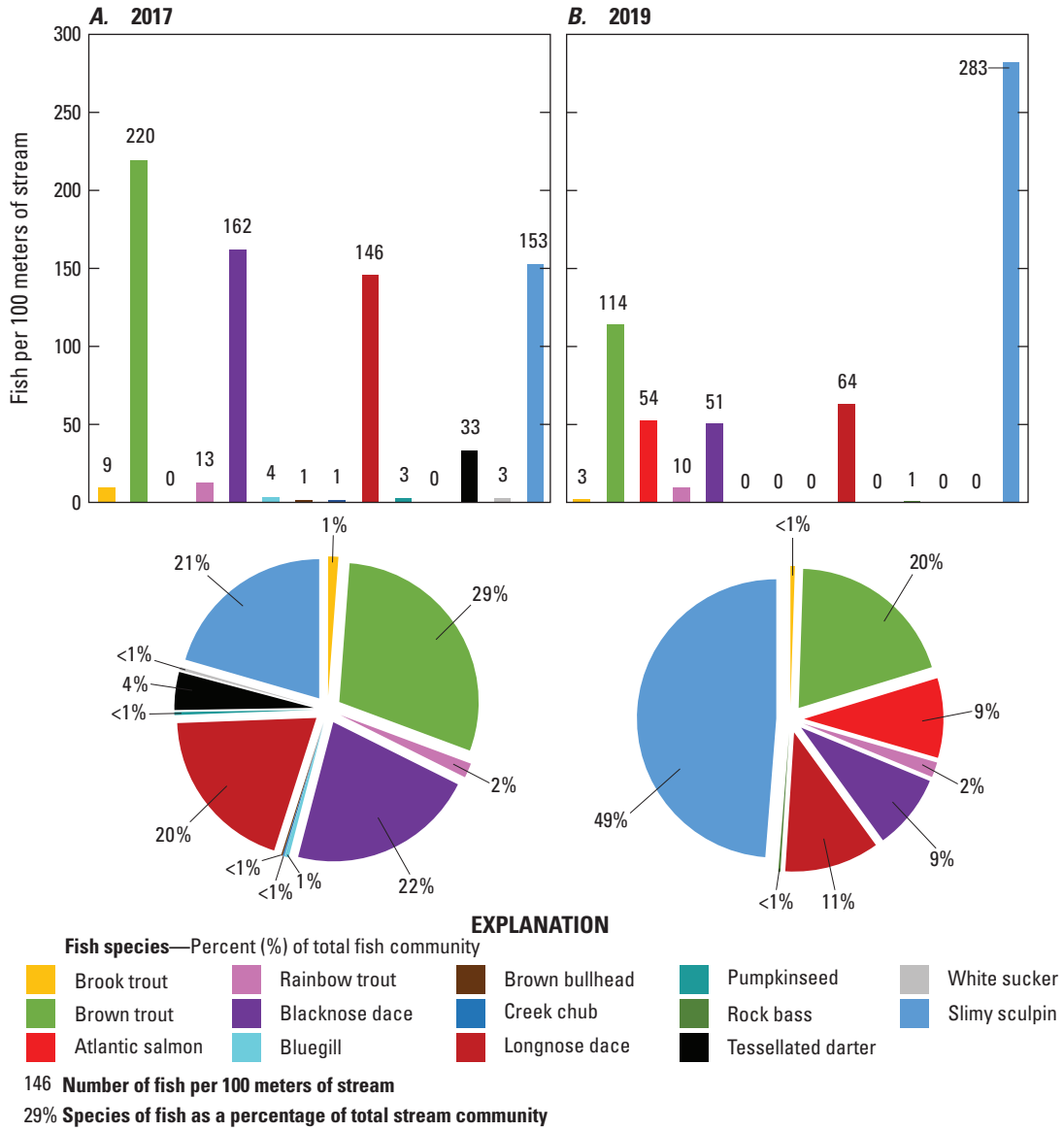

Figure 34. Population density of each fish species and proportion of each species as a percentage of the entire community at the WBGage site on the West Branch Neversink River for *A*, 2017; and *B*, 2019. <, Less than.

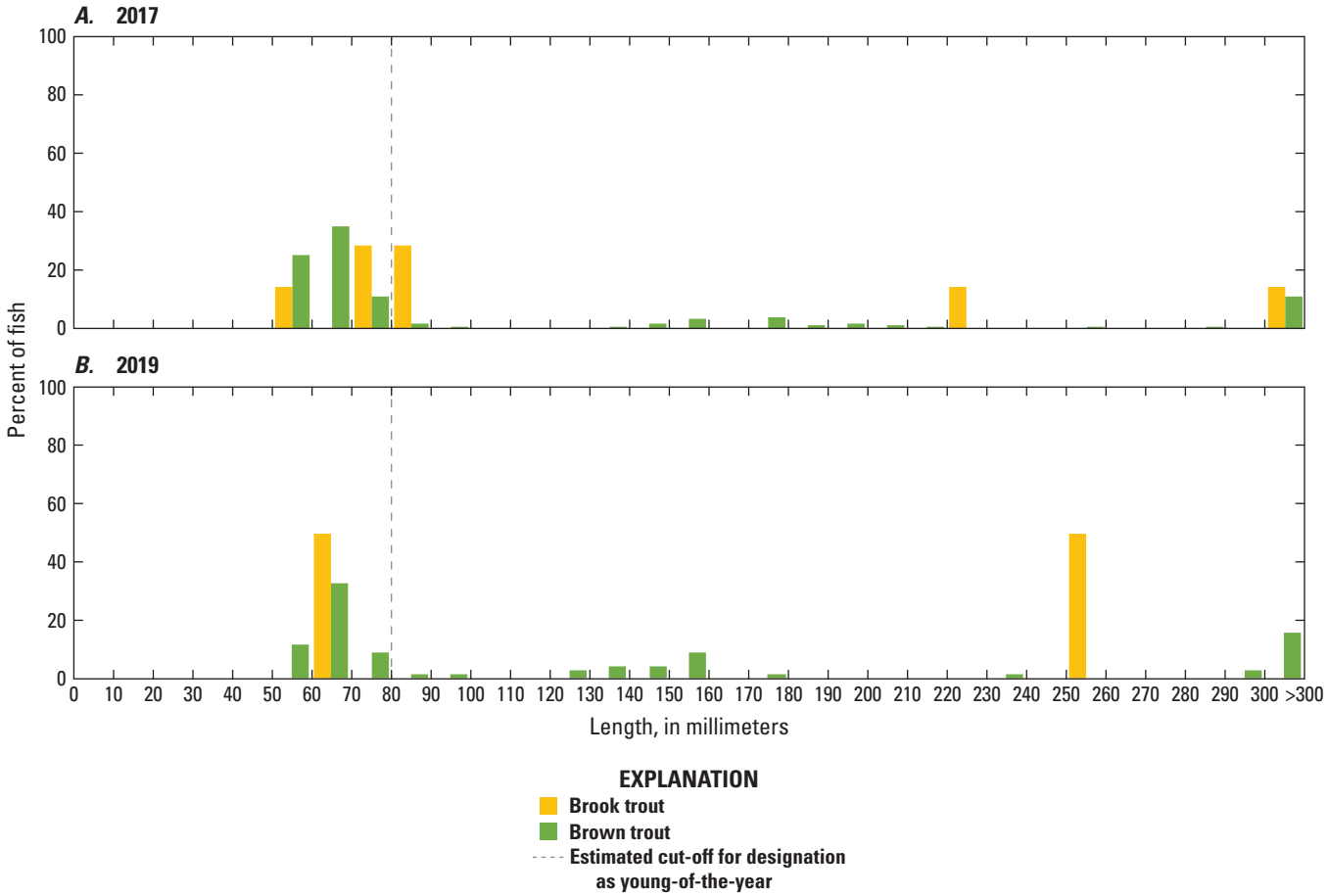

Figure 35. Length frequency distributions for brook trout and brown trout at the WBGage site on the West Branch Neversink River for *A*, 2017; and *B*, 2019. Dashed vertical line indicates estimated cutoff for designation as young-of-the-year.

Neversink River Watershed

Neversink River, CovBridge Site

There were eight fish species present at the CovBridge site in 2017 and 10 in 2018 and 2019, and the total density of all fish species was 1,229, 556, and 396 fish per 100 m in 2017, 2018, and 2019, respectively (table 2). Blacknose dace (*Rhinichthys atratulus*) was the most abundant species in 2017, comprising 45 percent of the entire fish community, and slimy sculpin was the most abundant species in 2018 and 2019, comprising 44 and 66 percent of the entire fish community, respectively (fig. 36). Brook trout were present at a density of 12, 14, and 5 fish per 100 m and comprised 1, 3, and 1 percent of the community in 2017, 2018, and 2019, respectively. Brown trout were present at a density of 64, 44, and 24 fish per 100 m and comprised 5, 8, and 6 percent of the community in 2017, 2018, and 2019, respectively. Rainbow trout were present at a density of 0, 8, and 1 fish per 100 m and comprised 0, 1, and less than 1 percent of the community in 2017, 2018, and 2019, respectively. The percentages of fish classified as YOY were 60, 100, and 75 percent for brook trout and 52, 64, and 63 percent for brown trout in 2017, 2018, and 2019, respectively (fig. 37). The pH of stream water at this site was 6.49, 6.30, and 6.63 in 2017, 2018, and 2019, respectively (table 2).

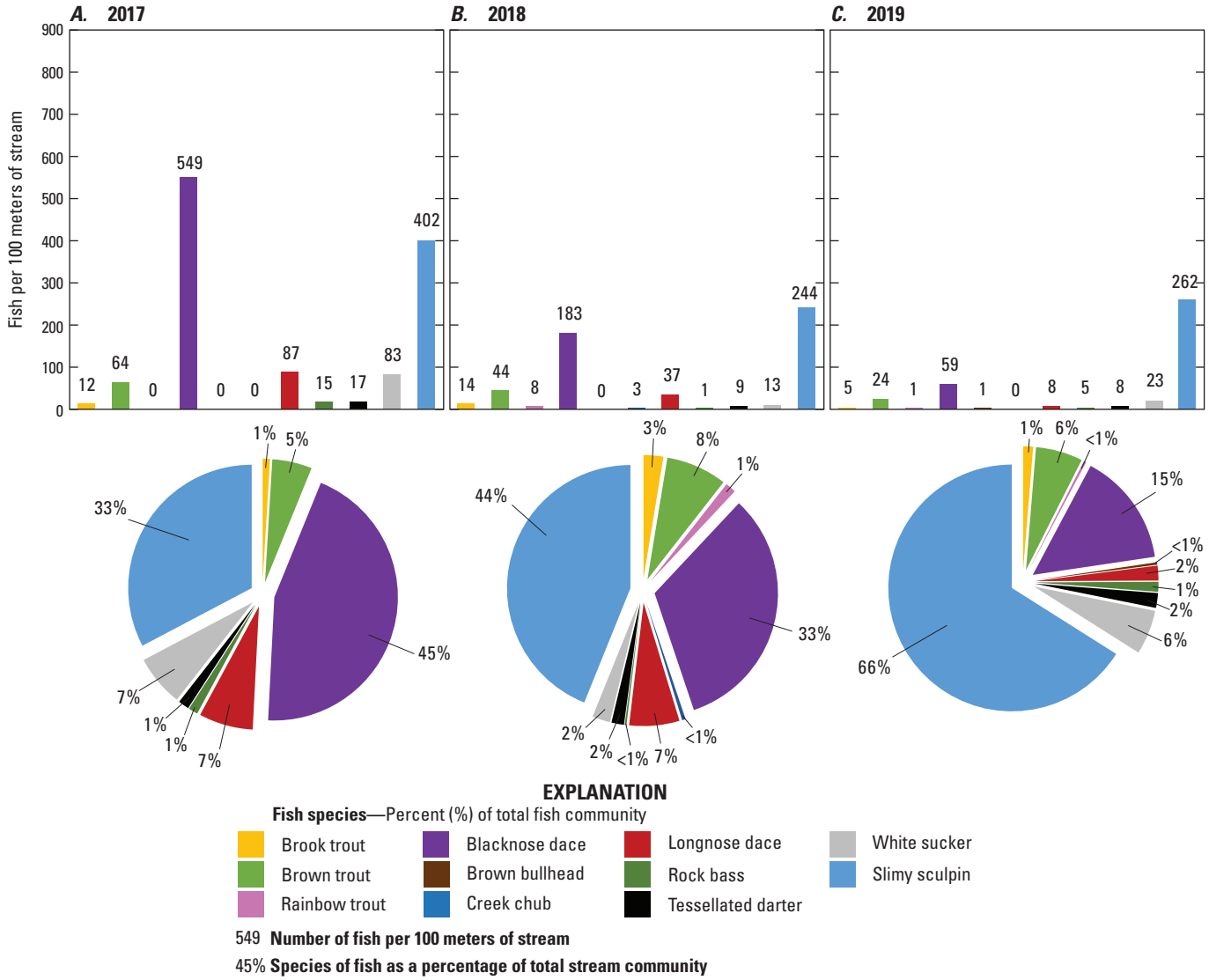

Figure 36. Population density of each fish species and proportion of each species as a percentage of the entire community at the CovBridge site on the Neversink River for *A*, 2017; *B*, 2018; and *C*, 2019. <, Less than.

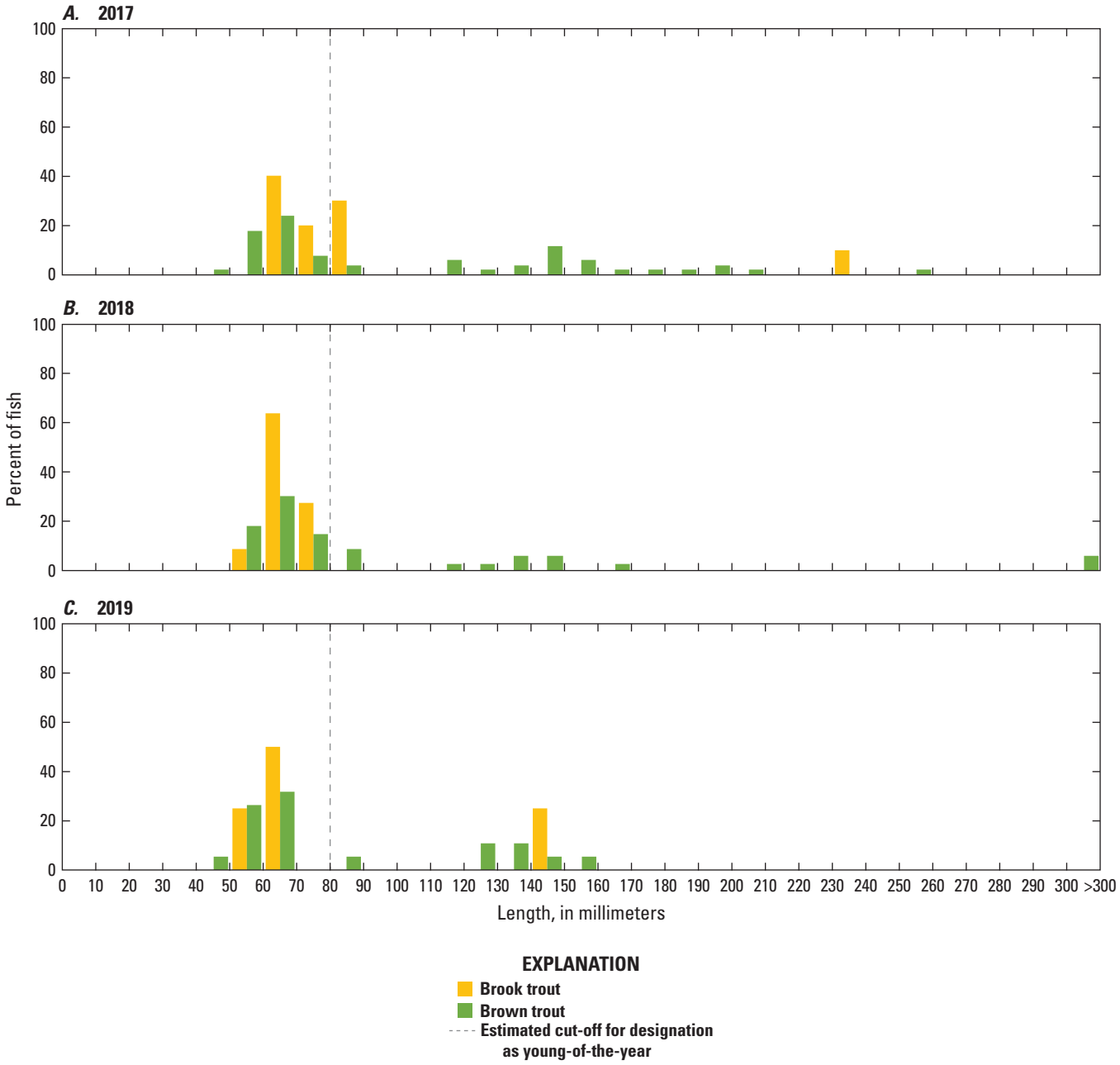

Figure 37. Length frequency distributions for brook trout and brown trout at the CovBridge site on the Neversink River for *A*, 2017; *B*, 2018; and *C*, 2019. Dashed vertical line indicates estimated cutoff for designation as young-of-the-year.

Rondout Creek Watershed

Rondout Creek, USPeekLk Site

Brook trout was the only fish species present at the USPeekLk site during all 3 years at a density of 92, 45, and 77 fish per 100 m in 2017, 2018, and 2019, respectively (fig. 38; table 2). The percentage of brook trout classified as YOY was 79, 48, and 92 percent in 2017, 2018, and 2019, respectively (fig. 39). The pH of stream water at this site was 5.72, 6.05, and 5.83 in 2017, 2018, and 2019, respectively (table 2).

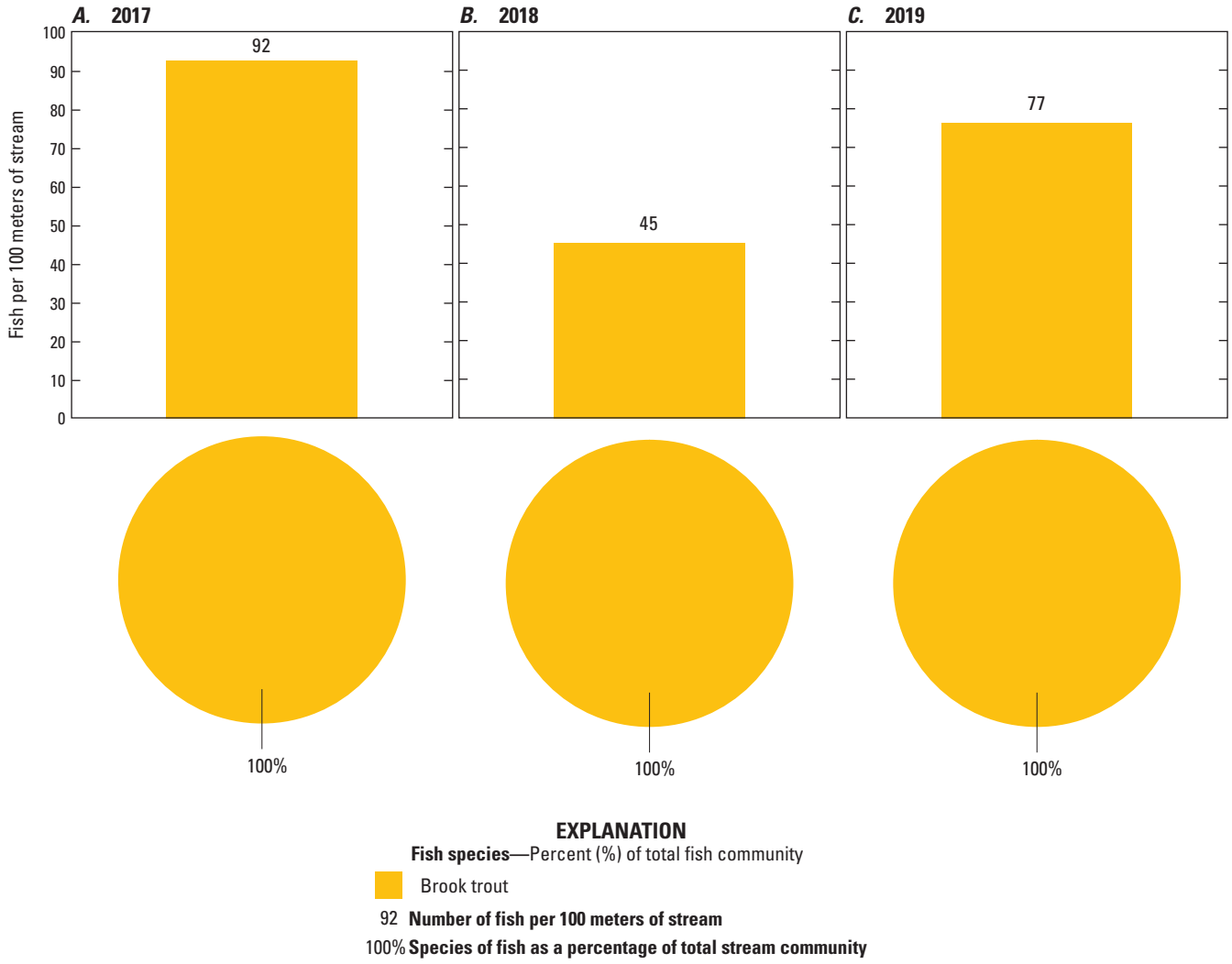

Figure 38. Population density of each fish species and proportion of each species as a percentage of the entire community at the USPeekLk site on the Rondout Creek for *A*, 2017; *B*, 2018; and *C*, 2019.

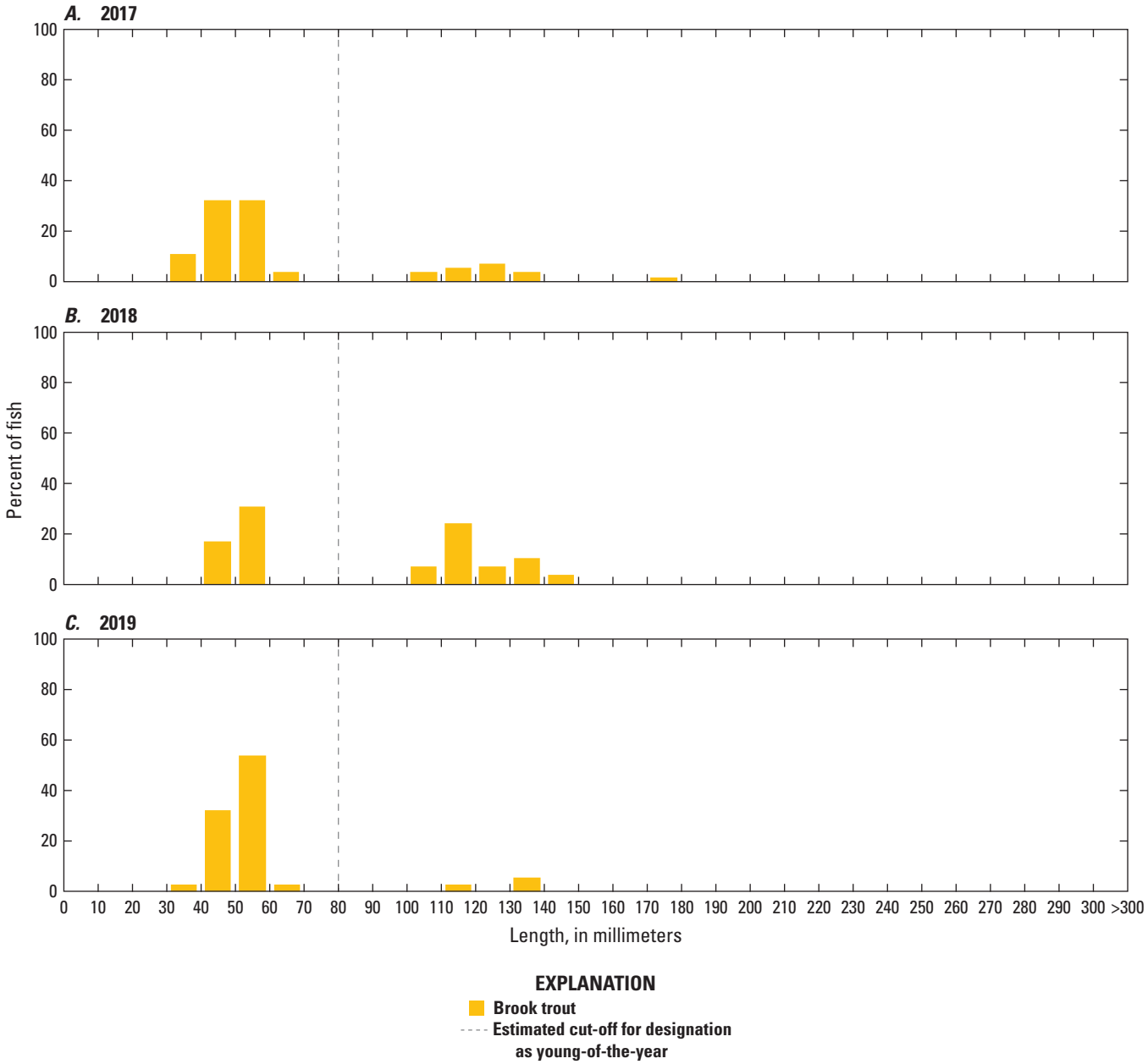

Figure 39. Length frequency distributions for brook trout at the USPeekLk site on the Rondout Creek for *A*, 2017; *B*, 2018; and *C*, 2019. Dashed vertical line indicates estimated cutoff for designation as young-of-the-year.

Rondout Creek, DSPeekLk Site

There were four fish species present at the DSPeekLk site in 2017 and three in 2018 and 2019, and the total density of all fish species was 1,291 1,079, and 824 fish per 100 m in 2017, 2018, and 2019, respectively (table 2). Slimy sculpin was the most abundant species during each year, comprising 93, 86, and 83 percent of the entire fish community in 2017, 2018, and 2019, respectively (fig. 40). Brook trout were present at a density of 81, 148, and 48 fish per 100 m and comprised 6, 14, and 6 percent of the community in 2017, 2018, and 2019, respectively. Brown trout were present at a density of 5, 6, and 0 fish per 100 m in 2017, 2018, and 2019, and comprised less than 1, less than 1, and 0 percent of the fish community in 2017, 2018, and 2019, respectively. The percentages of fish classified as YOY were 67, 71, and 44 percent for brook trout in 2017, 2018, and 2019, respectively, and 50 and 0 percent for brown trout in 2017 and 2018; brown trout were not present in 2019 (fig. 41). The pH of stream water at this site was 6.34, 6.35, and 6.38 in 2017, 2018, and 2019, respectively (table 2).

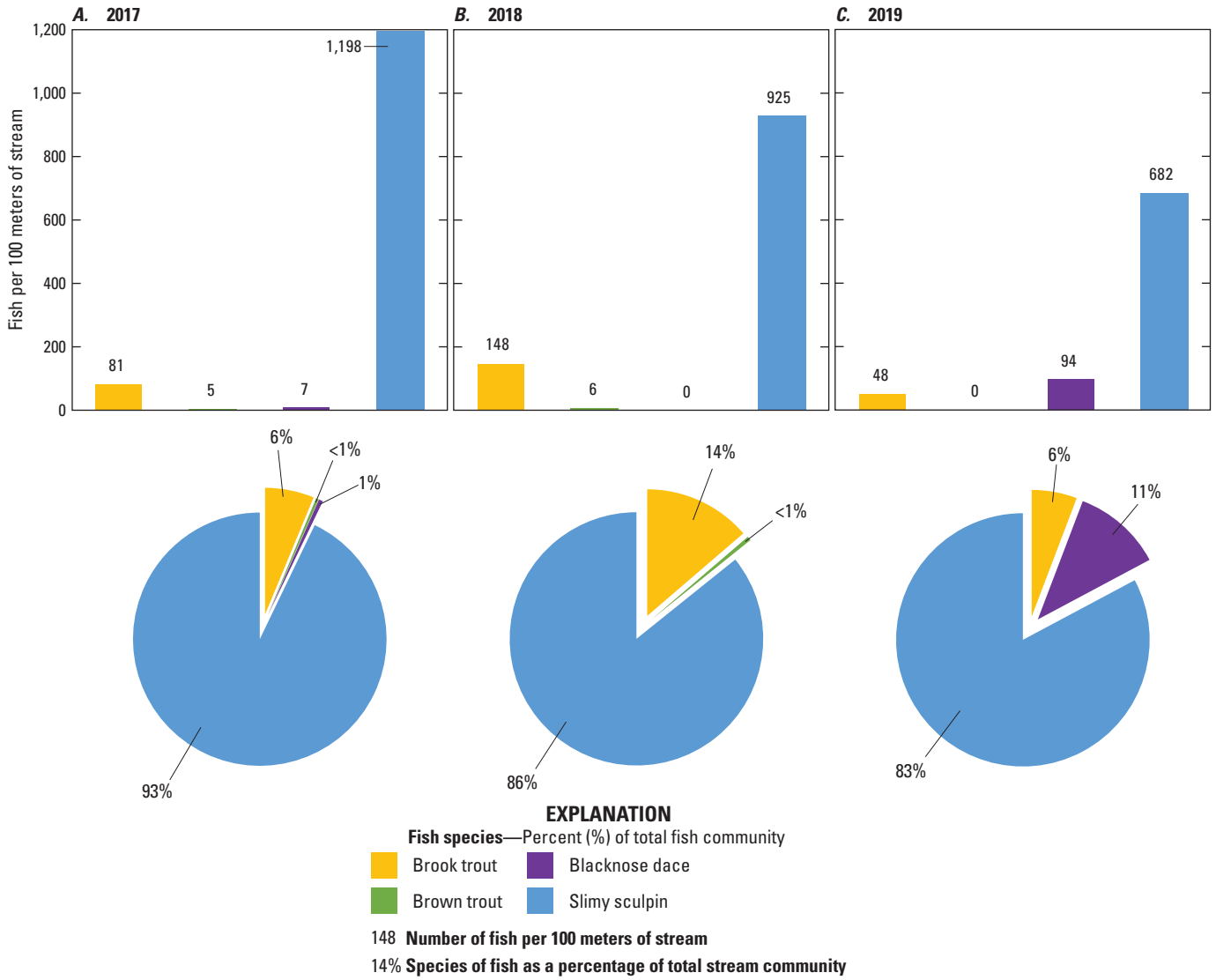

Figure 40. Population density of each fish species and proportion of each species as a percentage of the entire community at the DSPeekLk site on the Rondout Creek for *A*, 2017; *B*, 2018; and *C*, 2019. <, Less than.

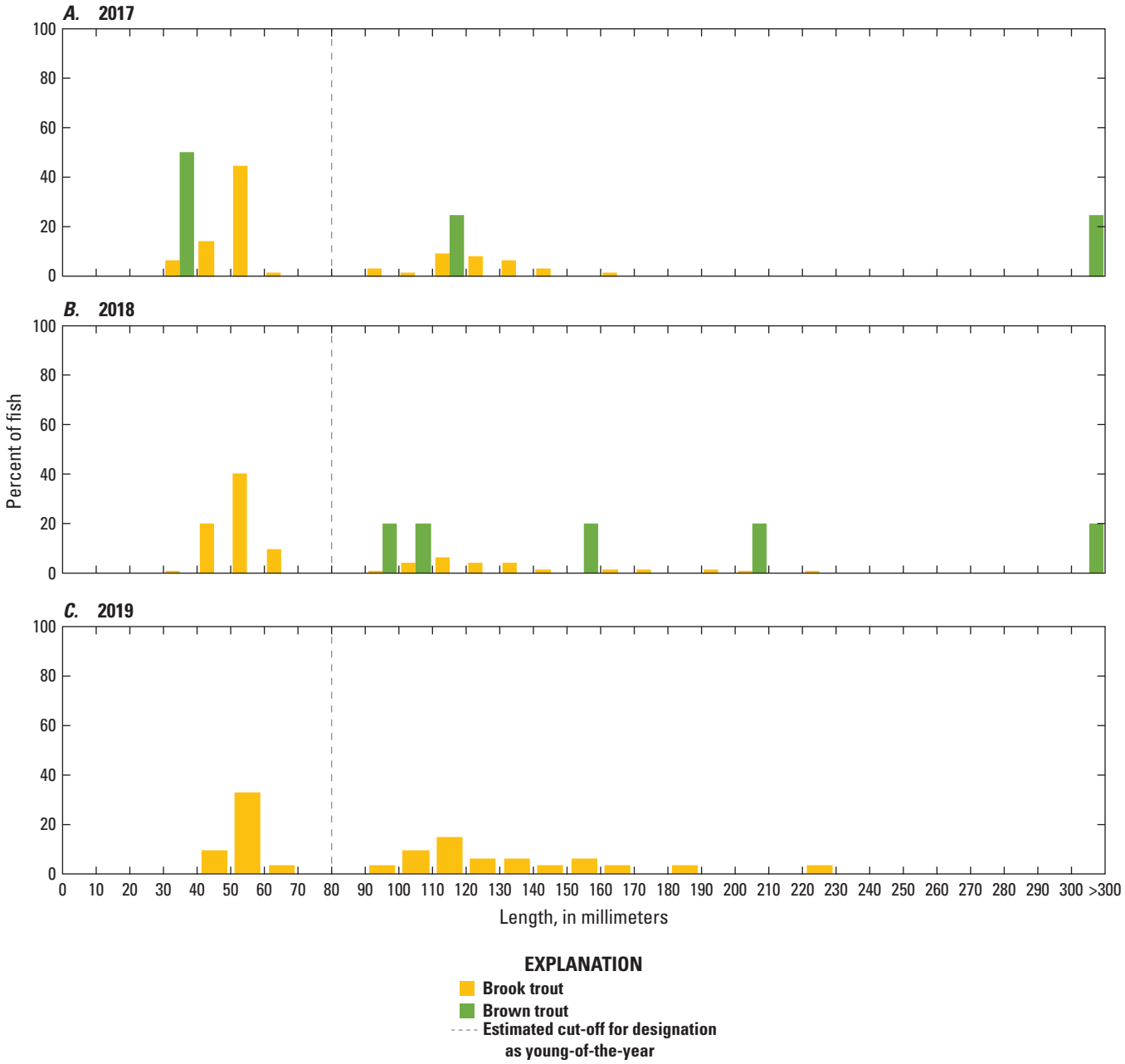

Figure 41. Length frequency distributions for brook trout and brown trout at the DSPeekLk site on the Rondout Creek for *A*, 2017; *B*, 2018; and *C*, 2019. Dashed vertical line indicates estimated cutoff for designation as young-of-the-year.

Rondout Creek, AbvBHB Site

There were four fish species present at the AbvBHB site in 2017 and 2018 and five in 2019, and the total density of all fish species was 2,155, 2,654, and 2,211 fish per 100 m in 2017, 2018, and 2019, respectively (table 2). Slimy sculpin was the most abundant species during each year, comprising 94, 95, and 96 percent of the entire fish community in 2017, 2018, and 2019, respectively (fig. 42). Brook trout were present at a density of 56, 47, and 36 fish per 100 m and comprised 3, 2, and 2 percent of the community in 2017, 2018, and 2019, respectively. Brown trout were present at a density of 63, 63, and 36 fish per 100 m and comprised 3, 2, and 2 percent of the community in 2017, 2018, and 2019, respectively. The percentages of fish classified as YOY were 54, 61, and 36 percent for brook trout and 71, 76, and 64 percent for brown trout in 2017, 2018, and 2019, respectively (fig. 43). The pH of stream water at this site was 6.36, 6.38, and 6.51 in 2017, 2018, and 2019, respectively (table 2).

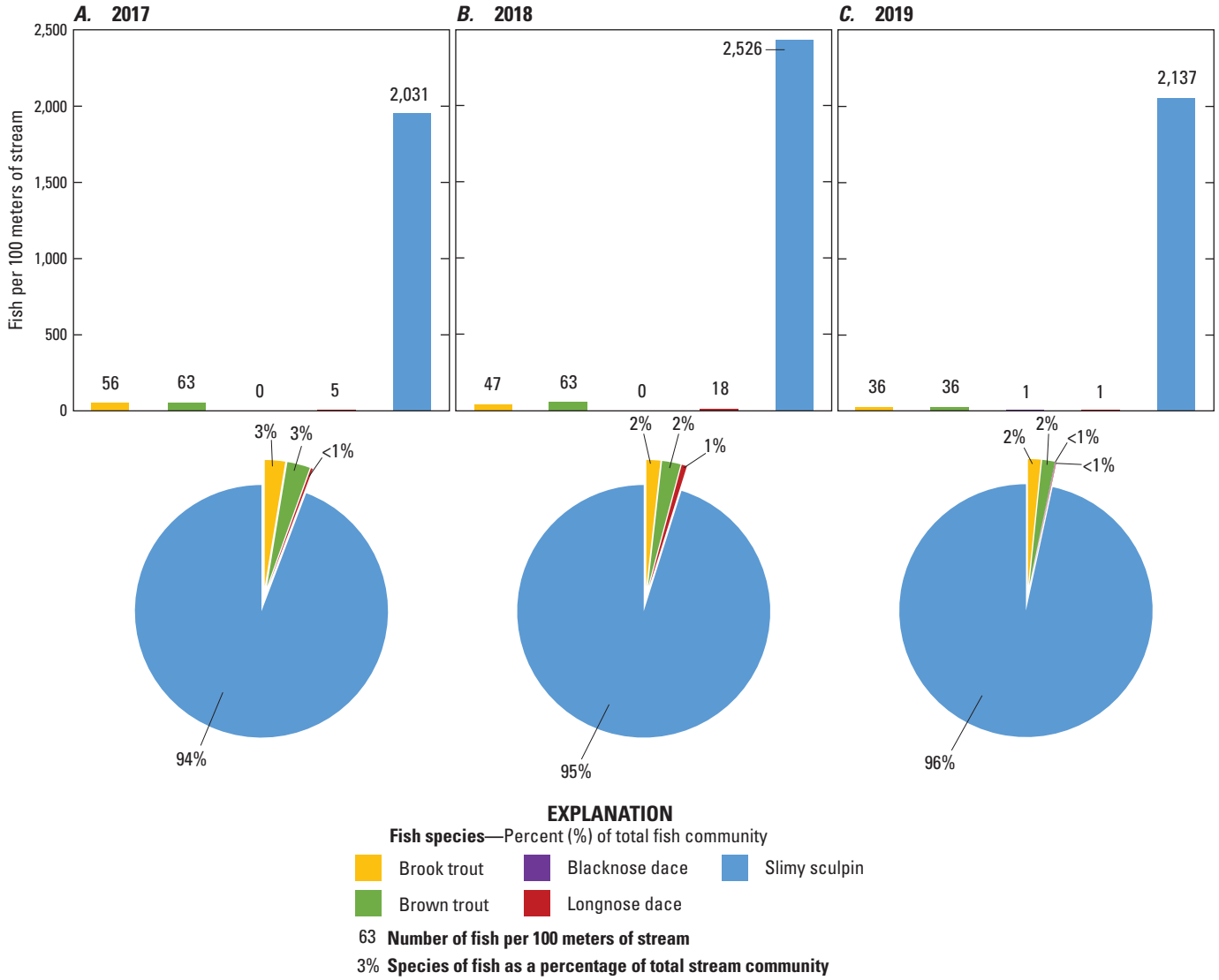

Figure 42. Population density of each fish species and proportion of each species as a percentage of the entire community at the AbvBHB site on the Rondout Creek for *A*, 2017; *B*, 2018; and *C*, 2019. <, Less than.

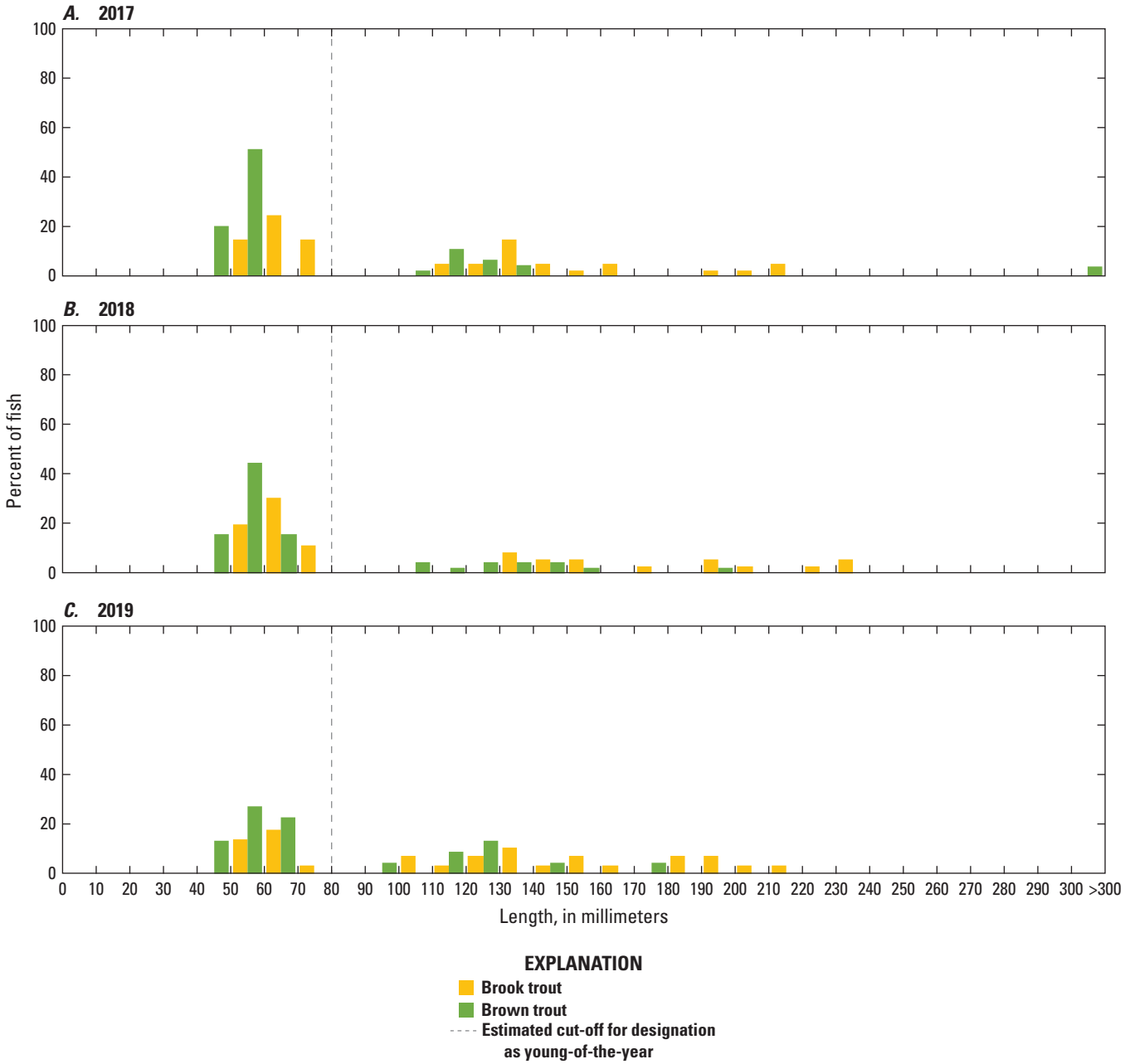

Figure 43. Length frequency distributions for brook trout and brown trout at the AbvBHB site on the Rondout Creek for *A*, 2017; *B*, 2018; and *C*, 2019. Dashed vertical line indicates estimated cutoff for designation as young-of-the-year.

Rondout Creek, Sundown Site

There were five fish species present at the Sundown site during all 3 years, and the total density of all fish species was 3,553, 1,921, and 1,987 fish per 100 m in 2017, 2018, and 2019, respectively (table 2). Slimy sculpin was the most abundant species during each year, comprising 93, 92, and 96 percent of the entire fish community in 2017, 2018, and 2019, respectively (fig. 44). Brook trout were present at a density of 34, 13, and 16 fish per 100 m and comprised 1 percent of the community in all 3 years. Brown trout were present at a density of 62, 42, and 29 fish per 100 m and comprised 2, 2, and 1 percent of the community in 2017, 2018, and 2019, respectively. The percentages of fish classified as YOY were 87, 29, and 50 percent for brook trout and 93, 50, and 41 percent for brown trout (fig. 45). The pH of stream water at this site was 6.41, 6.31, and 6.48 in 2017, 2018, and 2019, respectively (table 2).

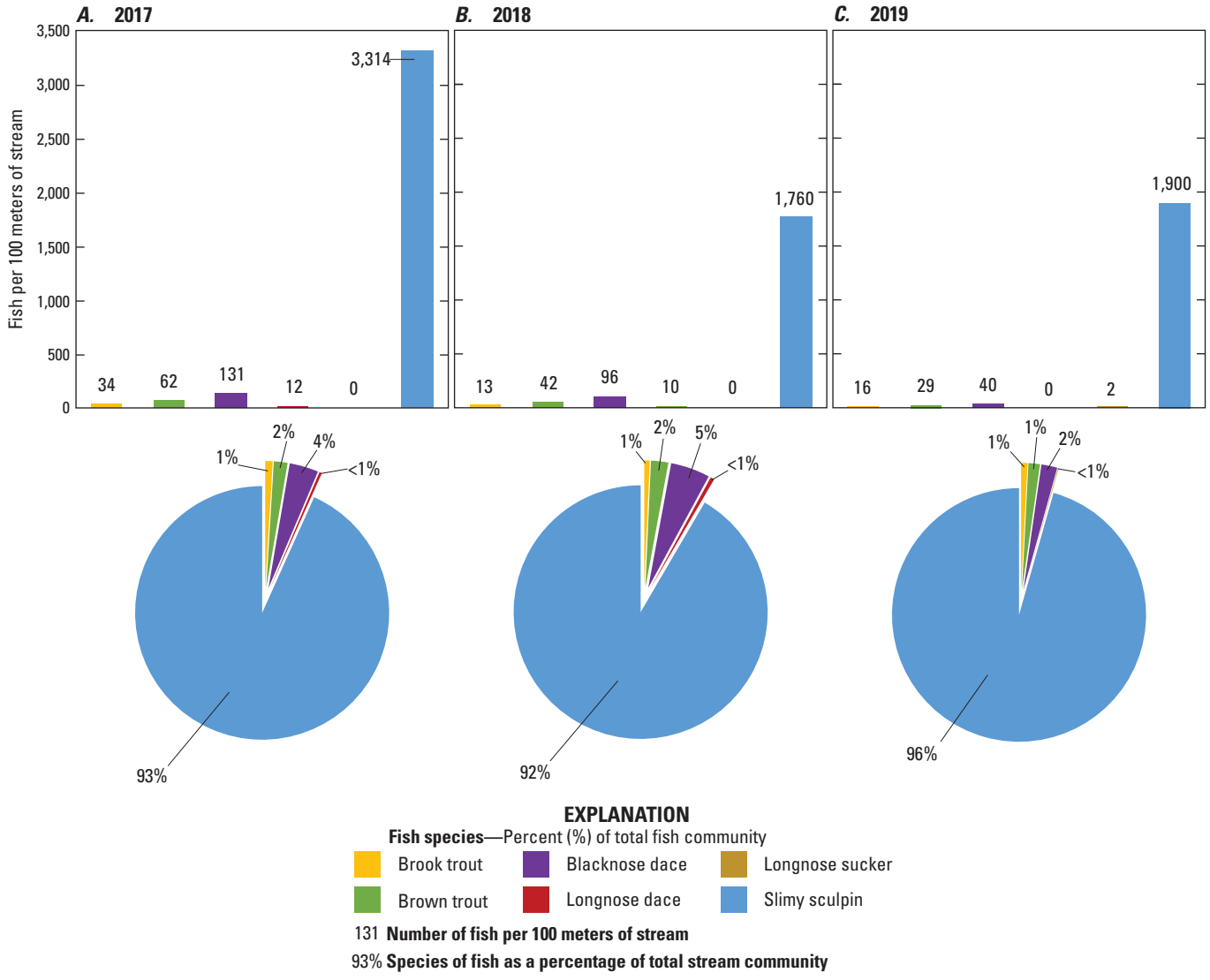

Figure 44. Population density of each fish species and proportion of each species as a percentage of the entire community at the Sundown site on the Rondout Creek for *A*, 2017; *B*, 2018; and *C*, 2019. <, Less than.

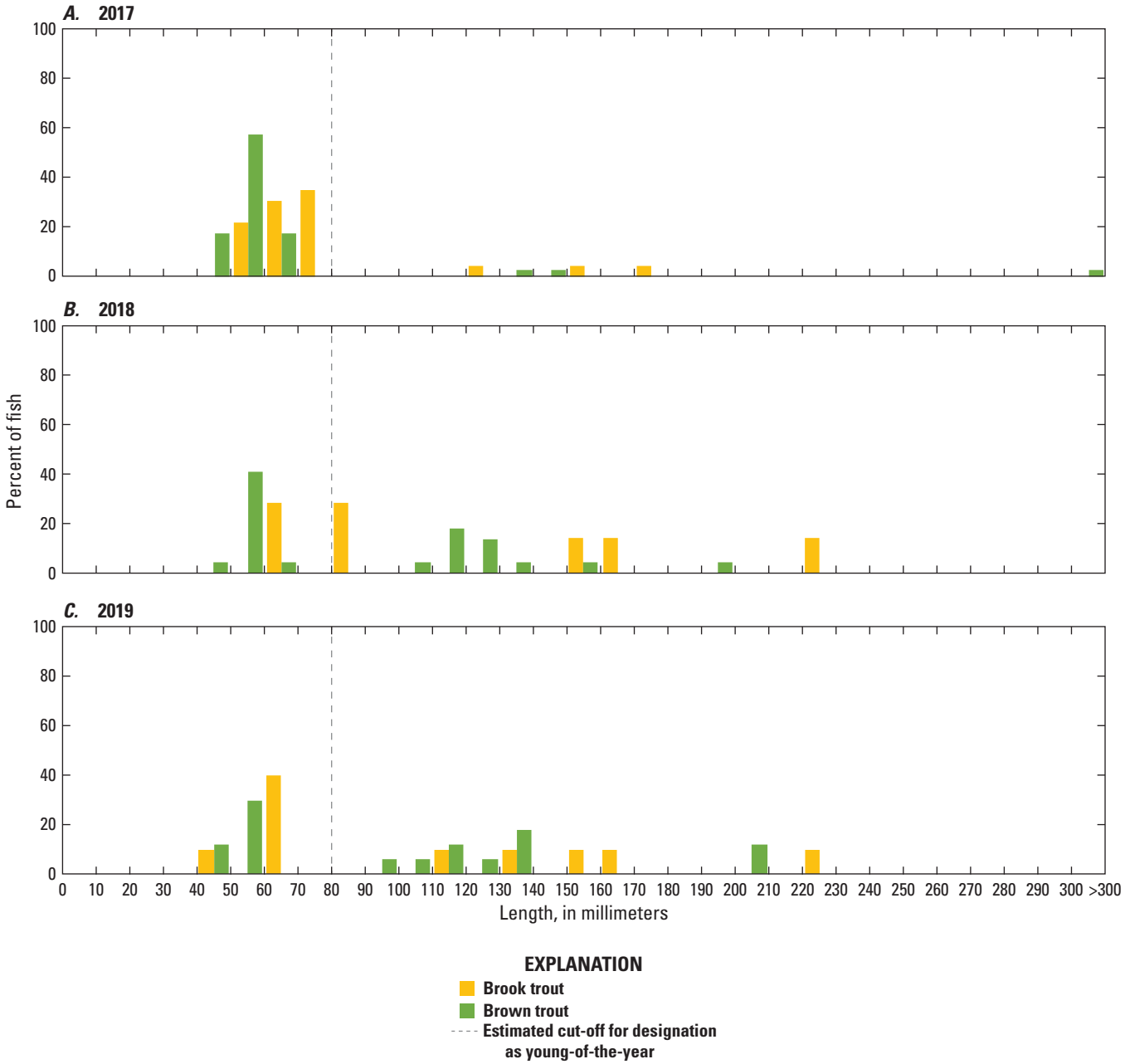

Figure 45. Length frequency distributions for brook trout and brown trout at the Sundown site on the Rondout Creek for *A*, 2017; *B*, 2018; and *C*, 2019. Dashed vertical line indicates estimated cutoff for designation as young-of-the-year.

Rondout Creek, EMtRoad Site

There were six fish species present at the EMtRoad site in 2017 and 2019 and seven species in 2018, and the total density of all fish species was 2,094, 1,779, and 2,400 fish per 100 m in 2017, 2018, and 2019, respectively (table 2). Slimy sculpin was the most abundant species during each year, comprising 69, 77, and 78 percent of the entire fish community in 2017, 2018, and 2019, respectively (fig. 46). Brook trout were present at a density of 42, 20, and 49 fish per 100 m and comprised 2, 1, and 2 percent of the community in 2017, 2018, and 2019, respectively. Brown trout were present at a density of 236, 62, and 72 fish per 100 m and comprised 11, 3, and 3 percent of the community in 2017, 2018, and 2019, respectively. The percentages of fish classified as YOY were 85, 83, and 68 percent for brook trout and 90, 68, and 74 percent for brown trout in 2017, 2018, and 2019, respectively (fig. 47). The pH of stream water at this site was 6.48, 6.42, and 6.68 in 2017, 2018, and 2019, respectively (table 2).

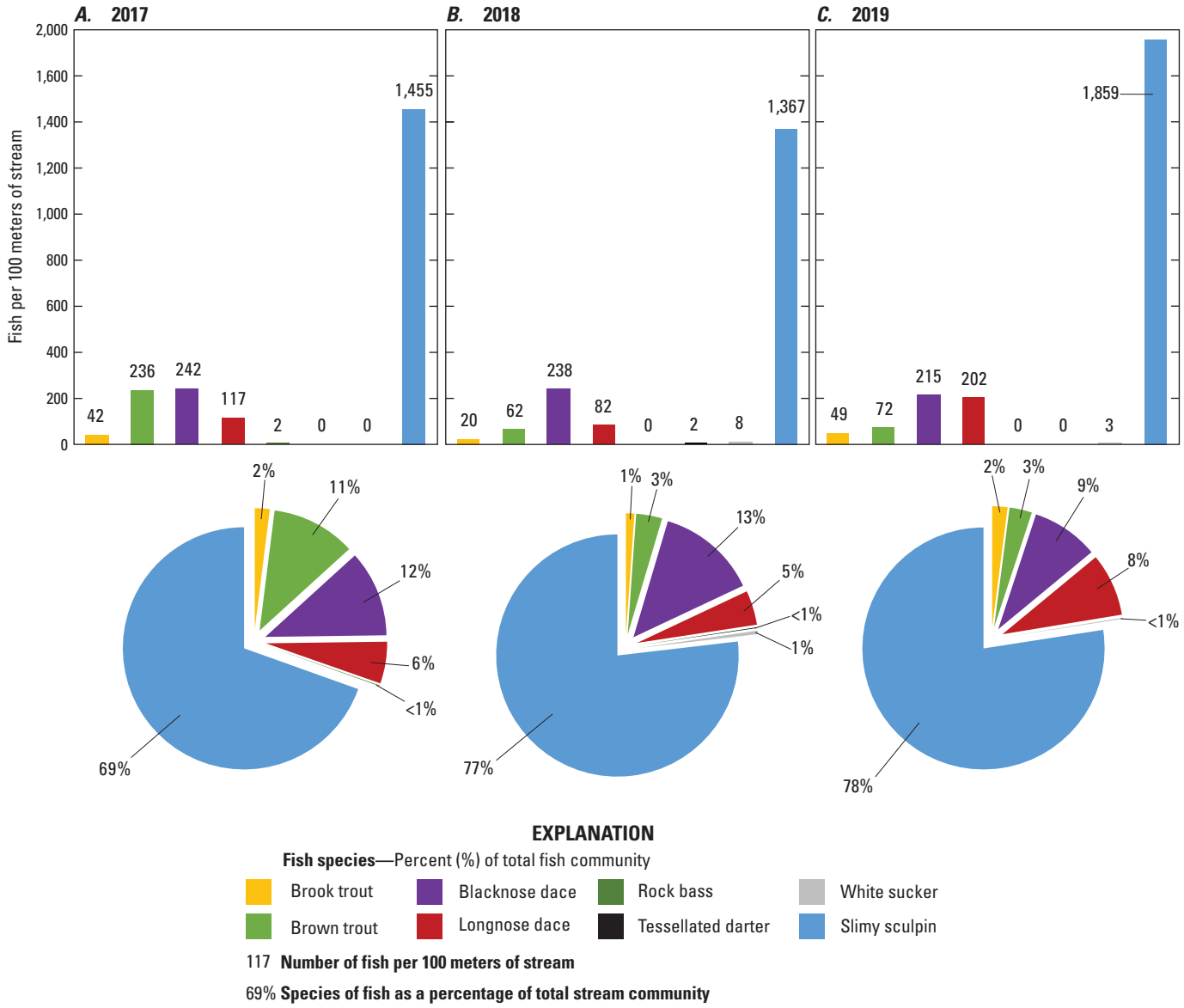

Figure 46. Population density of each fish species and proportion of each species as a percentage of the entire community at the EMtRoad site on the Rondout Creek for *A*, 2017; *B*, 2018; and *C*, 2019. <, Less than.

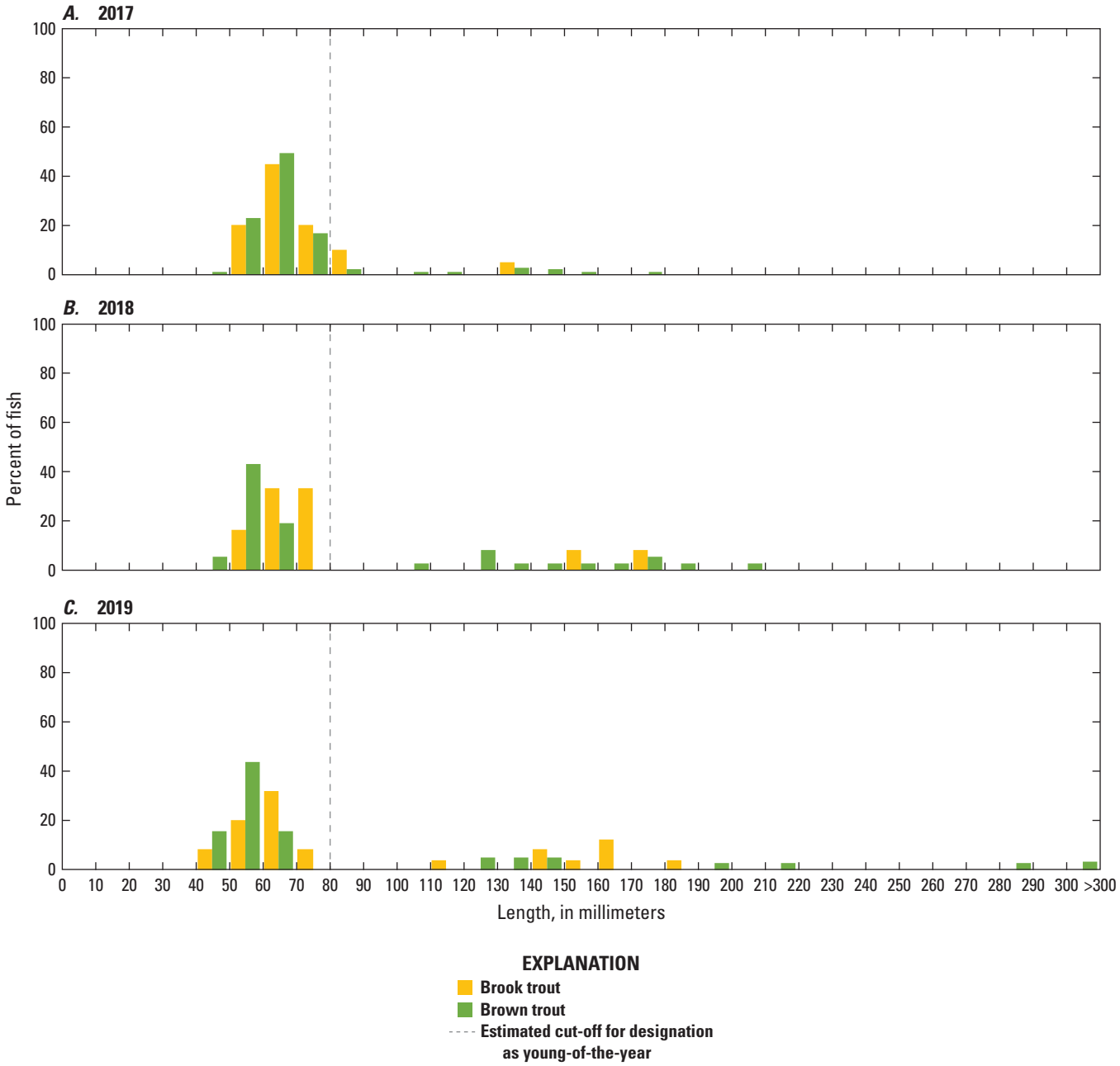

Figure 47. Length frequency distributions for brook trout and brown trout at the EMtRoad site on the Rondout Creek for *A*, 2017; *B*, 2018; and *C*, 2019. Dashed vertical line indicates estimated cutoff for designation as young-of-the-year.

Rondout Creek, Ballfield Site

There were 10 fish species present at the Ballfield site in 2017 and 2018 and 11 in 2019, and the total density of all fish species was 2,299, 3,754, and 3,153 fish per 100 m in 2017, 2018, and 2019, respectively (table 2). Slimy sculpin was the most abundant species during each year, comprising 62, 60, and 84 percent of the entire fish community in 2017, 2018, and 2019, respectively (fig. 48). Brook trout were present at a density of 5, 9, and 4 fish per 100 m and comprised less than 1 percent of the community in all 3 years. Brown trout were present at a density of 43, 31, and 23 fish per 100 m and comprised 2, 1, and 1 percent of the community in 2017, 2018, and 2019, respectively. The percentages of fish classified as YOY were 75, 63, and 50 percent for brook trout and 53, 42, and 19 percent for brown trout in 2017, 2018, and 2019, respectively (fig. 49). The pH of stream water at this site was 6.51, 6.37, and 6.53 in 2017, 2018, and 2019, respectively (table 2).

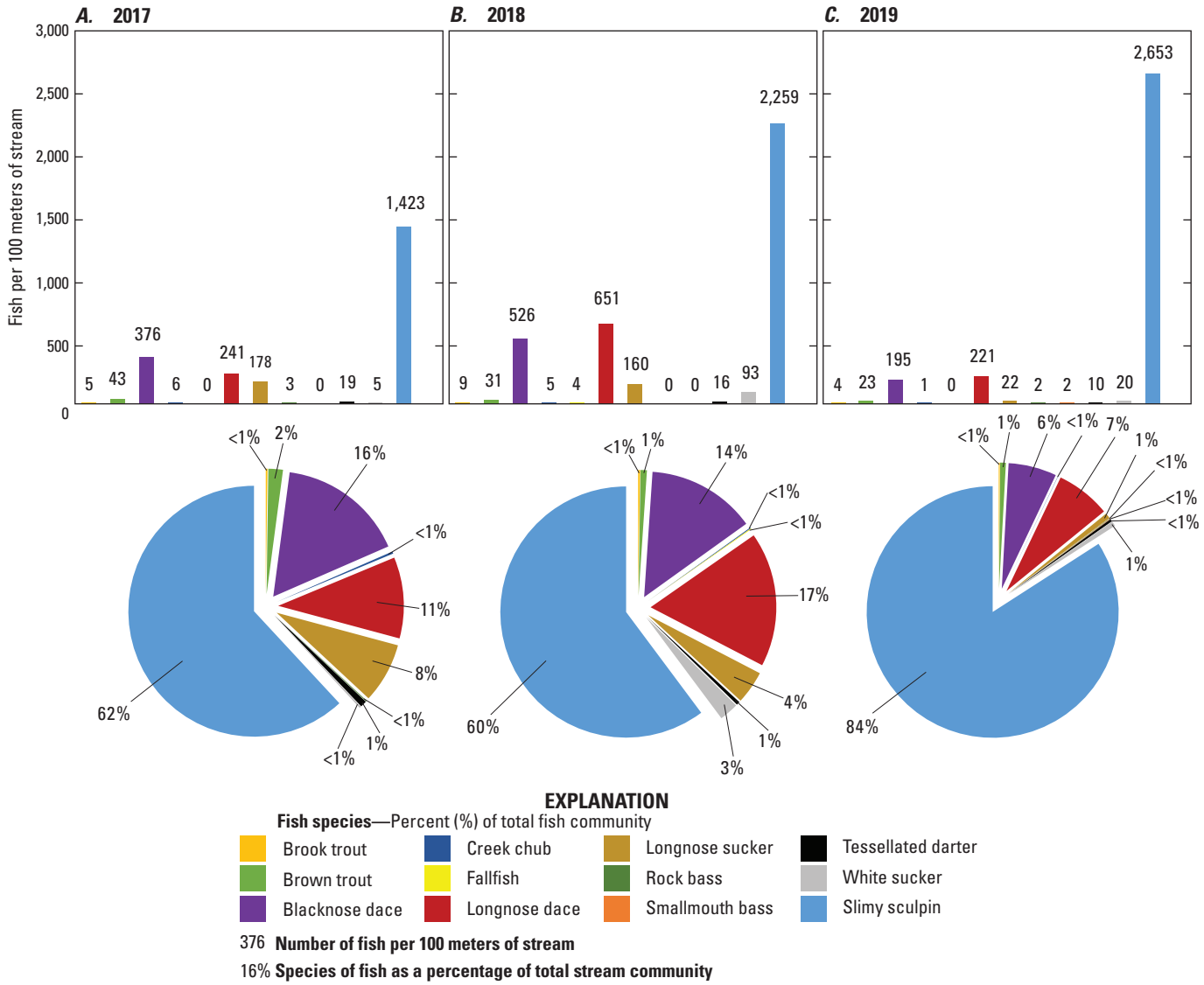

Figure 48. Population density of each fish species and proportion of each species as a percentage of the entire community at the Ballfield site on the Rondout Creek for *A*, 2017; *B*, 2018; and *C*, 2019. <, Less than.

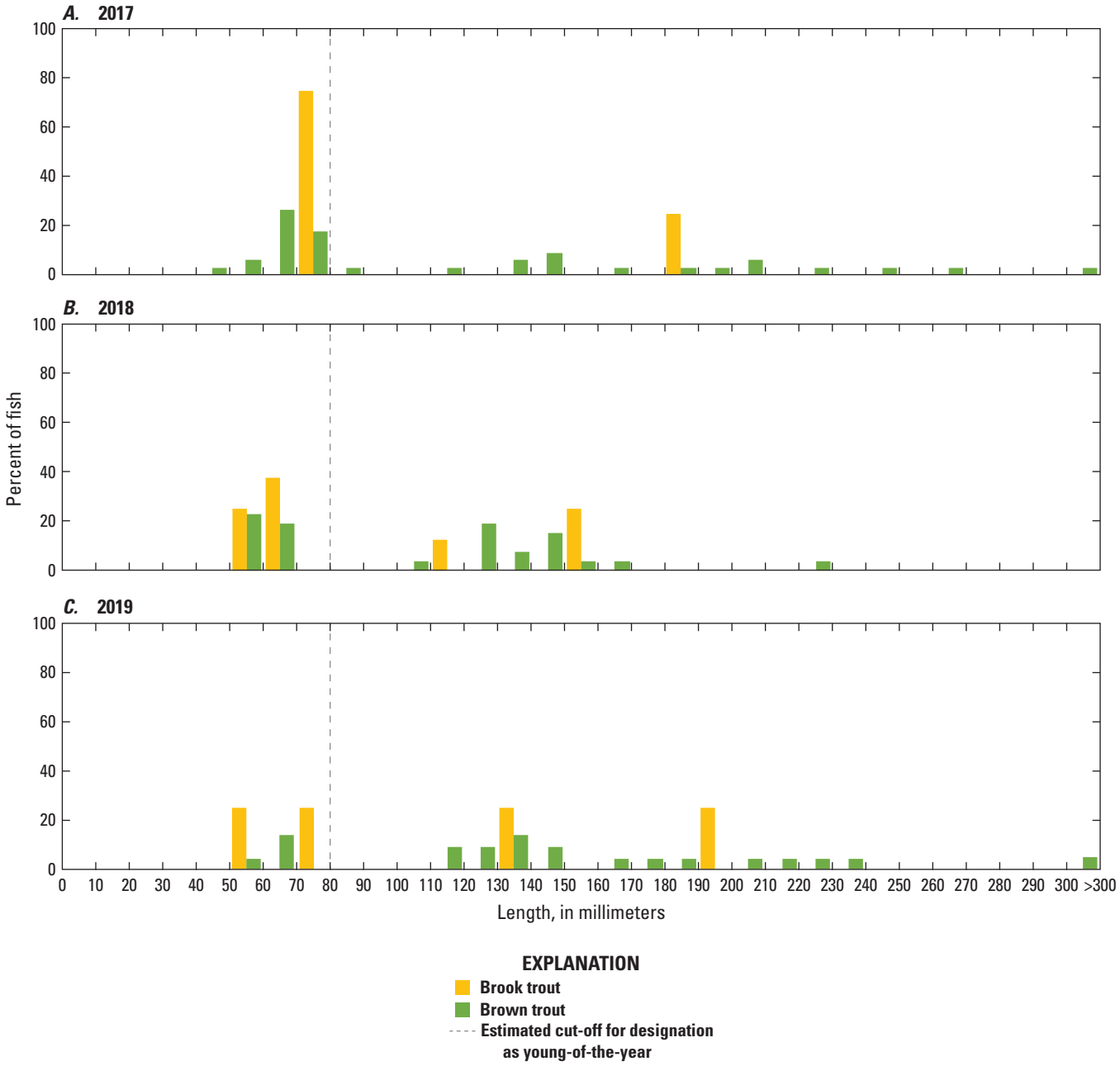

Figure 49. Length frequency distributions for brook trout and brown trout at the Ballfield site on the Rondout Creek for *A*, 2017; *B*, 2018; and *C*, 2019. Dashed vertical line indicates estimated cutoff for designation as young-of-the-year.

Findings

A number of patterns were consistently observed in the composition of fish assemblages in the East Branch Neversink River, West Branch Neversink River, and upper Rondout Creek subwatersheds. First, slimy sculpin was the dominant species at most sites, with the exception of a few high-elevation sites with low pH. Slimy sculpin is a species native to the Catskill Mountains and is an indicator of cold temperatures and good water quality (Carlson and others, 2016). Second, the upper Rondout Creek subwatershed supported a higher density of fish than the other two subwatersheds, although this difference was largely attributable to high densities of slimy sculpin. Third, the number of species present (richness) generally increased within each subwatershed moving in a downstream direction. Similarly, brown trout became more abundant moving downstream and outnumbered brook trout at the downstream-most sites in each subwatershed. Fourth, at most sites the majority of brook trout and brown trout were less than 80 mm in length. Fish of this size are likely YOY, indicating strong natural reproduction by both species in the study area. Stocking programs by the New York State Department of Environmental Conservation generally release trout in streams at a minimum length of 180 mm or greater (New York State Department of Environmental Conservation, 2020), which indicates that the majority of trout at most sites were wild fish that were spawned naturally. In contrast, the presence of Atlantic salmon at three sites on the West Branch Neversink River in 2019 is the result of a stocking program that the New York State Department of Environmental Conservation initiated in spring 2019. Finally, acidity in each subwatershed generally decreased from upstream to downstream, marked by increases in pH and acid-neutralizing capacity and decreases in inorganic monomeric aluminum. Across the study area, inorganic monomeric aluminum values as high as 2.2 micromoles per liter and pH values as low as 4.8 were observed, suggesting that water quality may still be adversely affecting fish assemblages and trout populations in some parts of these stream systems and the greater Catskill Mountains region (Driscoll and others, 2001; Baldigo and others, 2007). The effects of present-day water quality on fish assemblages in the Catskill Mountains is explored thoroughly in Baldigo and others (2021).

References Cited

Baker, J.P., Van Sickle, J., Gagen, C.J., DeWalle, D.R., Sharpe, W.E., Carline, R.F., Baldigo, B.P., Murdoch, P.S., Bath, D.W., Krester, W.A., Simonin, H.A., and Wigington, P.J., Jr., 1996, Episodic acidification of small streams in the northeastern United States—Effects on fish populations: Ecological Applications, v. 6, no. 2, p. 422–437. [Also available at https://doi.org/10.2307/2269380.]

Baldigo, B.P., and Lawrence, G.B., 2000, Composition of fish communities in relation to stream acidification and habitat in the Neversink River, New York: Transactions of the American Fisheries Society, v. 129, no. 1, p. 60–76. [Also available at https://doi.org/10.1577/1548-8659(2000)129<0060:COFCIR>2.0.CO;2.]

Baldigo, B.P., and Lawrence, G.B., 2001, Effects of stream acidification and habitat on fish populations of a North American river: Aquatic Sciences, v. 63, no. 2, p. 196–222. [Also available at https://doi.org/10.1007/PL00001352.]

Baldigo, B.P., George, S.D., Winterhalter, D.R., and McHale, M.R., 2021, Biological and chemical recovery of acidified Catskill Mountain streams in response to the 1990 Clean Air Act Amendments: Atmospheric Environment, v. 249, article 118235, 18 p. [Also available at https://doi.org/10.1016/j.atmosenv.2021.118235.]

Baldigo, B.P., Lawrence, G., and Simonin, H.A., 2007, Persistent mortality of brook trout in episodically acidified streams of the southwestern Adirondack Mountains, New York: Transactions of the American Fisheries Society, v. 136, no. 1, p. 121–134. [Also available at https://doi.org/10.1577/T06-043.1.]

Carle, F.L., and Strub, M.R., 1978, A new method for estimating population size from removal data: Biometrics, v. 34, no. 4, p. 621–630. [Also available at https://doi.org/10.2307/2530381.]

Carlson, D.M., Daniels, R.A., and Wright, J.J., 2016, Atlas of inland fishes of New York: New York State Education Department and New York State Department of Environmental Conservation New York State Museum Record 7, 362 p. [Also available at http://www.nysm.nysed.gov/common/nysm/files/atlasofinlandfishes.pdf.]

Driscoll, C.T., Lawrence, G.B., Bulger, A.J., Butler, T.J., Cronan, C.S., Eagar, C., Lambert, K.F., Likens, G.E., Stoddard, J.L., and Weathers, K.C., 2001, Acidic deposition in the northeastern United States—Sources and inputs, ecosystem effects, and management strategies: BioScience, v. 51, no. 3, p. 180–198. [Also available at https://doi.org/10.1641/0006-3568(2001)051[0180:ADITNU]2.0.CO;2.]

Dupigny-Giroux, L.A., Mecray, E.L., Lemcke-Stampone, M.D., Hodgkins, G.A., Lentz, E.E., Mills, K.E., Lane, E.D., Miller, R., Hollinger, D.Y., Solecki, W.D., Wellenius, G.A., Sheffield, P.E., MacDonald, A.B., and Caldwell, C., 2018, Northeast, chap. 18 of Reidmiller, D.R., Avery, C.W., Easterling, D.R., Kunkel, K.E., Lewis, K.L.M., Maycock, T.K., and Stewart, B.C., eds, Impacts, risks, and adaptation in the United States, Volume II of Fourth national climate assessment: Washington, U.S. Global Change Research Program, p. 669–742. [Also available at https://doi.org/10.7930/NCA4.2018.CH18.]

Fitzpatrick, F.A., Waite, I.R., D'Arconte, P.J., Meador, M.R., Maupin, M.A., and Gurtz, M.E., 1998, Revised methods for characterizing stream habitat in the National Water-Quality Assessment Program: U.S. Geological Survey Water Resources Investigations Report 98–4052, 67 p. [Also available at https://doi.org/10.3133/wri984052.]

George, S.D., Baldigo, B.P., and Winterhalter, D.R., 2018, Adirondack and Catskill stream-fish survey dataset (ver. 3.0, November 2020): U.S. Geological Survey data release, https://doi.org/10.5066/F70C4V25.

McHale, M.R., Burns, D.A., Siemion, J., and Antidormi, M.R., 2017, The response of soil and stream chemistry to decreases in acid deposition in the Catskill Mountains, New York, USA: Environmental Pollution, v. 229, p. 607–620. [Also available at https://doi.org/10.1016/j.envpol.2017.06.001.]

Meador, M.R., McIntyre, J.P., and Pollock, K.H., 2003, Assessing the efficacy of single-pass backpack electrofishing to characterize fish community structure: Transactions of the American Fisheries Society, v. 132, no. 1, p. 39–46. [Also available at https://doi.org/10.1577/1548-8659(2003)132<0039:ATEOSP>2.0.CO;2.]

New York State Department of Environmental Conservation, 2020, Fish stocking lists (actual)—Beginning 2011 data lens: New York State Department of Environmental Conservation, accessed December 7, 2020, at https://data.ny.gov/Recreation/Fish-Stocking-Lists-Actual-Beginning-2011-Data-Len/9hpx-asd8.

Ogle, D.H., Wheeler, P., and Dinno, A., 2018, FSA—Fisheries stock analysis (version 0.8.22): The Comprehensive R Archive Network web page, accessed August 23, 2020, at https://cran.r-project.org/package=FSA.

R Core Team, 2019, R—A language and environment for statistical computing: R Foundation for Statistical Computing website, accessed August 23, 2020, at https://www.r-project.org/.

Simonson, T.D., Lyons, J., and Kanehl, P.D., 1994, Quantifying fish habitat in streams—Transect spacing, sample size, and a proposed framework: North American Journal of Fisheries Management, v. 14, no. 3, p. 607–615. [Also available at https://doi.org/10.1577/1548-8675(1994)014<0607:QFHIST>2.3.CO;2.]

U.S. Environmental Protection Agency, 1987, Handbook of methods for acidic deposition studies—Laboratory analysis for surface water chemistry: U.S. Environmental Protection Agency report EPA 600/4-87/026, [variously paged], 7 apps. [Also available at https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=30000TA0.PDF.]

U.S. Geological Survey, 2020a, Soil and low-ionic-strength water quality laboratory: U.S. Geological Survey data release, accessed December 14, 2020, at https://www.sciencebase.gov/catalog/item/55ca2fd6e4b08400b1fdb88f.

U.S. Geological Survey, 2020b, USGS water data for the nation: U.S. Geological Survey National Water Information System database, accessed May 5, 2020, at https://doi.org/10.5066/F7P55KJN.

Van Put, E., 2007, Trout fishing in the Catskills: Skyhorse Publishing, 480 p.

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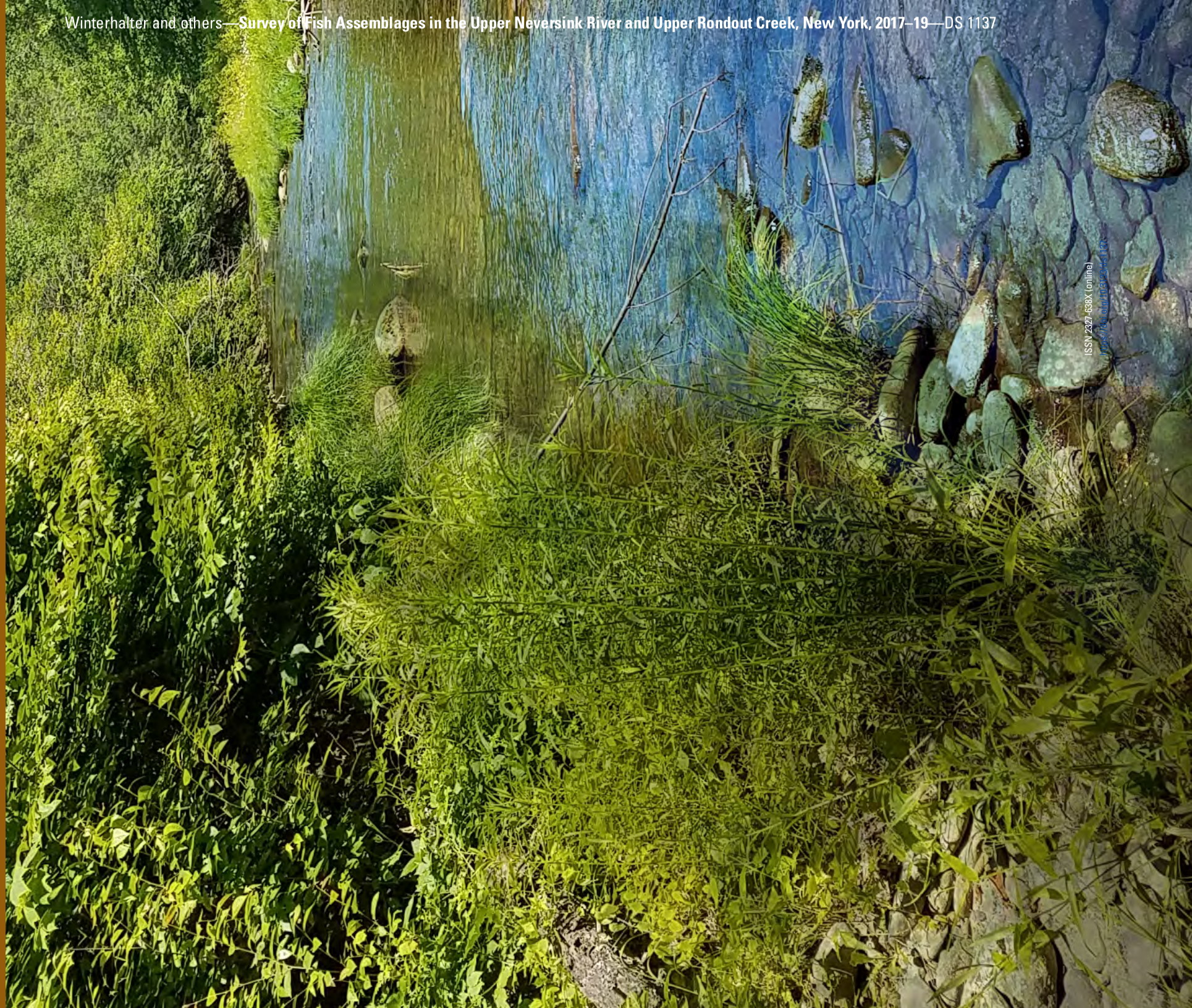

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