INVESTIGATIONS AND MANAGEMENT OF NEW JERSEY'S FRESHWATER FISHERIES RESOURCES 2018

State of New Jersey
Division of Fish and Wildlife
Bureau of Freshwater Fisheries

NEW JERSEY DIVISION OF
Fish and Wildlife

INVESTIGATIONS AND MANAGEMENT OF NEW JERSEY'S FRESHWATER FISHERIES RESOURCES 2018

March 2019

New Jersey Department of Environmental Protection
Division of Fish and Wildlife
Bureau of Freshwater Fisheries

Funded by fishing license sales and Dingell-Johnson funds available
through the Federal Sport Fish Restoration Act.
Sport Fish Restoration Grant F-48-R-29
(grant cycle January 1, 2018 – December 31, 2022)

State of New Jersey

Philip D. Murphy
Governor

Sheila Y. Oliver
Lt. Governor

New Jersey
Department of Environmental Protection

Catherine R. McCabe
Commissioner

Ray Bukowski
Assistant Commissioner
Natural and Historic Resources

Division of Fish and Wildlife

Larry Herrighty
Director

Dave Golden
Assistant Director, Operations

BUREAU OF FRESHWATER FISHERIES
Research and Management Unit

Lisa Barno
Chief

Shawn Crouse
Principal Fisheries Biologist

Pat Hamilton
Principal Fisheries Biologist

Christopher Smith
Principal Fisheries Biologist

Mark Boriek
Principal Fisheries Biologist

Ross Shramko
Senior Fisheries Biologist

Scott Collenburg
Senior Fisheries Biologist

Eric Boehm
Assistant Fisheries Biologist

Charles Sedor
Technician II

Elizabeth O'Neill
Administrative Analyst

With the assistance of:
Joe Citro, Kyle Civalier, Nick Cornine, Luke Diglio, Maria Berezin, Katelyn McStravog, Carmine Ricciardi, Justin Rozema, and Scott Ward

New Jersey's Freshwater Research and Management activities are funded entirely by New Jersey's licensed anglers. These activities benefit the state's 8 million residents by protecting and assessing New Jersey's vital freshwater resources.

Clean water for fish means clean water for us and generations to come

TABLE OF CONTENTS

INTRODUCTION

Highlights for 2018

The NJ Division of Fish and Wildlife's Bureau of Freshwater Fisheries (BFF) is responsible for the management of New Jersey's freshwater fisheries resources. BFF activities include many facets, including fish culture and managing wild and stocked fish populations, protecting and enhancing their habitats, and educating the public. Trout anglers enjoy up to 700,000 Rainbow Trout, stocked annually into public waters. 3.8 million (26,946 lb) warm and coolwater fishes were raised and distributed by the Division operated Charles O. Hayford Hatchery to supplement angling opportunities throughout the state. These programs are the result of an integrated management and culture program to the benefit of Garden State anglers. This report serves to account and convey the diversity and importance of the Bureau's Research and Management activities that occurred in 2018.

The BFF conducted a total of 242 fisheries surveys, at 176 waterbodies, to address a variety of recreational and resource management needs, including response to emerging fisheries issues. A total of 87 rivers and streams and 89 ponds and lakes were surveyed. Fisheries biologists captured, identified, and counted over 50,000 fish, representing 73 species. Surveys provide up-to-date data, so that the State's freshwater fisheries resources can be properly managed. These surveys were used to monitor populations, assess stocking programs, document both rare native fishes and emerging invasive species, among a variety of other functions. This work is made possible by funding from the Sport Fish Restoration Federal Grant F-48-R and New Jersey's Hunter and Angler Fund, which enables the Division of Fish and Wildlife to continue "*Managing Your Fish and Wildlife since 1892*."

In many ways, 2018 was "the year of restoration." New Jersey's Fish and Wildlife populations continue to benefit from the cooperative efforts of various conservation groups, state, and federal agencies. The removal of the Millstone River's Weston Mill Dam (Somerset) resulted in the first documentation of juvenile American Shad upstream of this impediment in 173 years! In fact, this noteworthy occurrence followed the first unimpeded adult spawning migration. This was made possible by a Natural Resource Damage Assessment settlement agreement reached between the Trustees for Natural Resources - the NJDEP, the U.S. Department of Interior's Fish and Wildlife Service, and the U.S. Department of Commerce's National Oceanic and Atmospheric Administration - and the party potentially responsible for contamination related to the American Cyanamid Superfund site in Bridgewater Township.

On a similar project, but of even greater magnitude, significant progress was made to restore connectivity to NJ's third largest tributary to the Delaware River, the Paulins Kill, when the Columbia Lake Dam (Warren) was breeched on August 3, 2018. Full dam removal and fish passage weir structures are on schedule to be completed in early spring 2019. There is little doubt that migratory fish species such as American Shad and possibly Blueback Herring will return to the Paulins Kill last seen in the late 1700's. This was made possible by a multi-faceted partnership led by the Nature Conservancy.

The second year of an exciting Brook Trout restoration project continued on Rinehart Brook, a tributary to the Black River within Hacklebarney State Park (Morris). In addition to increasing

Brook Trout numbers, multiple objectives of this study were achieved, including the determination that multiple depletion electrofishing seems to be an efficient technique to remove Brown Trout and a realization that a series of natural waterfalls would not be sufficient to prevent Brown Trout recolonization. During the initial removal, Brown Trout greatly outnumbered Brook Trout by a margin of 725 to 58. This was repeated during the fall of 2017, until the 7th pass, when only 9 Brown Trout (all YOY) and 60 Brook Trout were encountered (87.0% Brook Trout). Following the removal of non-native Brown Trout during year one, the Brook Trout population doubled in year two. Removals resumed in 2018 and continued until October 4, 2018, in which no Brown Trout were encountered. This project will continue in 2019, with intentions to enhance the existing natural waterfalls, thus preventing Brown Trout recolonization. Knowledge gained during this pilot project will help further Brook Trout restoration efforts in New Jersey.

New Jersey has over 400 impoundments open to the public for fishing and thousands more in private ownership, scattered throughout the state. These lentic environments offer excellent fishing opportunities for a variety of species such as bass, sunfish, crappie, and pickerel. These species naturally reproduce and often do not require active stocking to sustain their populations. The Bureau of Freshwater Fisheries conducts electrofishing surveys on lakes and ponds to assess the status of popular game species, primarily Largemouth Bass. A tremendous effort was invested in conducting a total of 57 surveys at 42 locations in 2018. Carnegie Lake had the highest density Largemouth Bass, as measured by a Catch Per Unit Effort of 115 bass/hr during electrofishing. The most impressive Largemouth Bass encountered this year was from Parvin Lake, weighing 6.75 lb. This lunker was followed closely by one from Union Lake that weighed 6.72 lb, and another from Parvin Lake that weighed 6.69 lb. Largemouth Bass exceeding six pounds were also captured at Alloway Lake, Salem Canal, and Sunset Lake.

In 2018 there was a concerted effort to evaluate the status of fisheries in small ponds throughout the state. These data are used to inform waterbody-specific management approaches. Seining is an effective sampling method used to assess the status of warmwater fish reproduction, which helps determine if stocking is necessary or if past stocking was successful. Seines provide a means to sample fish populations in waters that are not easily accessible or conducive to standard electrofishing methods, such as waters with extremely low conductivity, or those without trailer access. The data gathered from seining surveys are also beneficial in documenting the presence of rare native species, as well as invasive species, that can often be missed when sampling with other gear types. A total of 63 lakes and ponds were seined in 2018 during the months of June through early-October.

With support of New Jersey's wild trout anglers, the State's new *Wild Trout Stream* regulations went into effect on February 10, 2018. The goals were to determine if the recreational fishing opportunities afforded by this regulation were appropriate and if the conservation needs of wild trout were adequately addressed. This process was initiated in 2014 with 94 electrofishing surveys being conducted on 57 streams over a two-year period to obtain fish population data. The Division sought public feedback via numerous venues including public meetings and participation in ten Trout Unlimited Chapter meetings. The centerpiece of these new wild trout fishing regulations is the conservation of wild Brook Trout, a species that has significantly declined in our state, due to impacts from urbanization, and the building of dams and roadways,

and competition from non-native trout species. A *Brook Trout Conservation Zone* was established for northwestern New Jersey, in which they must be immediately released unharmed. Within the *Wild Trout Stream* regulation, three designations highlight a variety of wild trout fishing opportunities available and better align individual streams with management strategies specific to the wild trout species present. For more information on these regulations, please see annually published *Freshwater Fishing Digest*.

Conservation of wild Brook Trout continues to be a Bureau priority. The term "Brook Trout Assessment" is used to identify surveys conducted specifically to evaluate Brook Trout populations. 34 surveys were conducted under this umbrella in 2018. Data from these surveys are used to determine Brook Trout presence in catchments and small tributaries that lack survey data, identify the effect of impediments on the occurrence and distribution of Brook Trout and non-native trout species, and to assess the potential for Brook Trout restorations efforts, such as their re-introduction into suitable habitat or the removal of competitors such as Brown Trout. Data from 77 other statewide stream surveys in 2018 were also valuable in assessing Brook Trout status and distribution. A total of 58 surveys, in 44 streams documented wild Brook Trout, of which, eight previously undocumented populations were found. These data significantly contribute to the range-wide understanding of Brook Trout, an effort guided by the Eastern Brook Trout Joint Venture (EBTJV), a unique partnership initiated in 2004 under the National Fish Habitat Initiative (*www.fishhabitat.org*).

In a related project, BFF has expanded the use of continuous temperature data loggers to monitor and better understand the relationship between water temperature and trout. This program was significantly expanded in 2018 and sites were selected based on three distinct fisheries management objectives. The first relates to the holdover potential in popular trout stocked waters. The second aims to identify critical temperature thresholds in *Trout Production* streams. Finally, the project identifies waters that pose the greatest chance of withstanding impacts of climate change based on differing groundwater contributions. In total, temperature was continuously monitored at 72 stream sites. These data will enable the Bureau to evaluate long term trends, determine if ambient water quality is consistent with NJDEP's Surface Water Quality Standards, identify streams that may be good candidates for Brook Trout restoration, and address a multitude of other fisheries management goals.

The relationship between fish and their environment is no better addressed then by means of the classification of streams based upon their suitability for trout. Standardized stream electrofishing surveys contribute valuable data used for the classification of New Jersey's surface waters within the Department's Surface Water Quality Standards, N.J.A.C. 7:9B. This system is the regulatory cornerstone that helps protect critical watersheds. Data from 61 standardized electrofishing surveys completed in 2018 resulted in recommended upgrades from *Trout Maintenance* to *Trout Production* for two stream segments: Pequest River (trib.)(Buttzville) and Wanaque River (trib.)(N. of Post Brook) and five more surveys supported previously recommended upgrades. Data from 33 stream segments confirmed existing classifications.

The Flat Brook is considered one of New Jersey's most popular trout streams, and BFF biologists were surprised by the consistent low numbers of trout found in numerous electrofishing surveys conducted over the last decade. Temperature monitoring indicated

sufficient temperatures to support trout. Catch and Release regulations, instituted in 2016 ruled out angling harvest. To better understand where the high numbers of stocked trout were going, 40 Rainbow Trout from the Pequest Trout Hatchery were surgically implanted with radio telemetry transmitters in 2017 and again in 2018. The Bureau partnered with Montclair State University and their School of Conservation for the 2018 portion of this study. Results are consistent both years which indicate high predation rates (avian and terrestrial) are causing the low numbers of available habit.

In addition to these highlights, this report describes a host of other field work and educational activities conducted by the Bureau of Freshwater Fisheries. The efforts of full-time Bureau personnel are complemented by a dedicated and talented seasonal staff, who provide incredible insight, enthusiasm, and the labor vital to raise fish, conduct fisheries surveys statewide, and perform countless tasks that help maintain and enhance New Jersey's freshwater fisheries resources. The Bureau's work is made possible by both the dedicated monies of the Hunter and Anglers Fund and the Sport Fish Restoration Program.

Bureau of Freshwater Fisheries

The mission of the Bureau of Freshwater Fisheries (BFF) is to protect and manage the state's freshwater fish resources to maximize their long-term biological, recreational, and economic value for all New Jerseyans. Our goals are:

1) To maintain New Jersey's rich variety of freshwater fish species at stable, healthy levels and enhance the many habitats on which they depend;

2) To educate New Jersey residents on the values and needs of our freshwater fish resources and to foster a positive human/wildlife co-existence;

3) To maximize the recreational and commercial use of New Jersey's freshwater fishes for both present and future generations.

The Bureau of Freshwater Fisheries has Research and Management personnel in three regionally placed offices: Lebanon Field Office (Hunterdon), the Central Regional Office (Monmouth), and the Southern Regional Office (Camden). The Bureau oversees the management and protection of the state's over 27,000 miles of streams and over 400 public lakes. The biologists also carry out a number of freshwater projects each year.

The Bureau conducts fishery surveys, classifies the state's waterways, provides technical input on a variety of watershed and habitat-based issues, facilitates habitat restoration projects, serves as liaisons to a variety of sportsmen groups, and provides information to the general public in a variety of forums concerning the status of the state's fishery resources. The Bureau of Freshwater Fisheries also administers permits for fish stocking, water lowering, commercial baitfish, and scientific collecting to further provide for the effective management and protection of the state's aquatic resources.

The Bureau of Freshwater Fisheries works closely with NJDFW's fish pathologist, Dr. Jan Lovy, within the Office of Fish and Wildlife Health and Forensics. The fish pathology laboratory is

located at the Pequest Trout Hatchery outside Oxford, NJ, and close to the Hackettstown State Fish Hatchery. Dr. Lovy conducts disease monitoring and research in wild and hatchery-raised fish populations throughout the state. For disease diagnostics staff works with the NJ Animal Health Diagnostic Laboratory (NJ AHDL). The AHDL is a state-of-the-art facility equipped with molecular biology suites, a virology laboratory with cell culture facilities maintaining fish cell lines, and modern bacterial diagnostic equipment. The AHDL also provides diagnostic services in fish health for private fish hatcheries. In 2018 the Bureau had seven fisheries biologists on staff. The primary delineation of responsibilities is based on regional watershed management areas. The state currently is divided into seven regional watershed management areas (Figure 1). In addition to regional management responsibilities, each biologist has a specific area of expertise and oversees related research and management programs:

Eric Boehm – Assistant Fisheries Biologist
Fisheries Management in the Lower Atlantic Coastal Region (Sloop Creek to Dennis Creek watersheds) and Warmwater Fish Management

Mark Boriek – Principal Fisheries Biologist (retired September 2018)
Fisheries Management in the Lower Passaic & Upper Atlantic Region (Lower Passaic, Saddle, Hackensack, Pascack & Elizabeth to Toms River watersheds), Water Lowering Permit Coordinator, and Anadromous Fishes Management

Scott Collenburg – Senior Fisheries Biologist
Fisheries Management in the Upper Passaic Region (Pompton, Pequannock, Wanaque, Ramapo, Upper Passaic, Whippany, & Rockaway River watersheds), Coolwater Fisheries Assessment, and Stream Temperature Monitoring

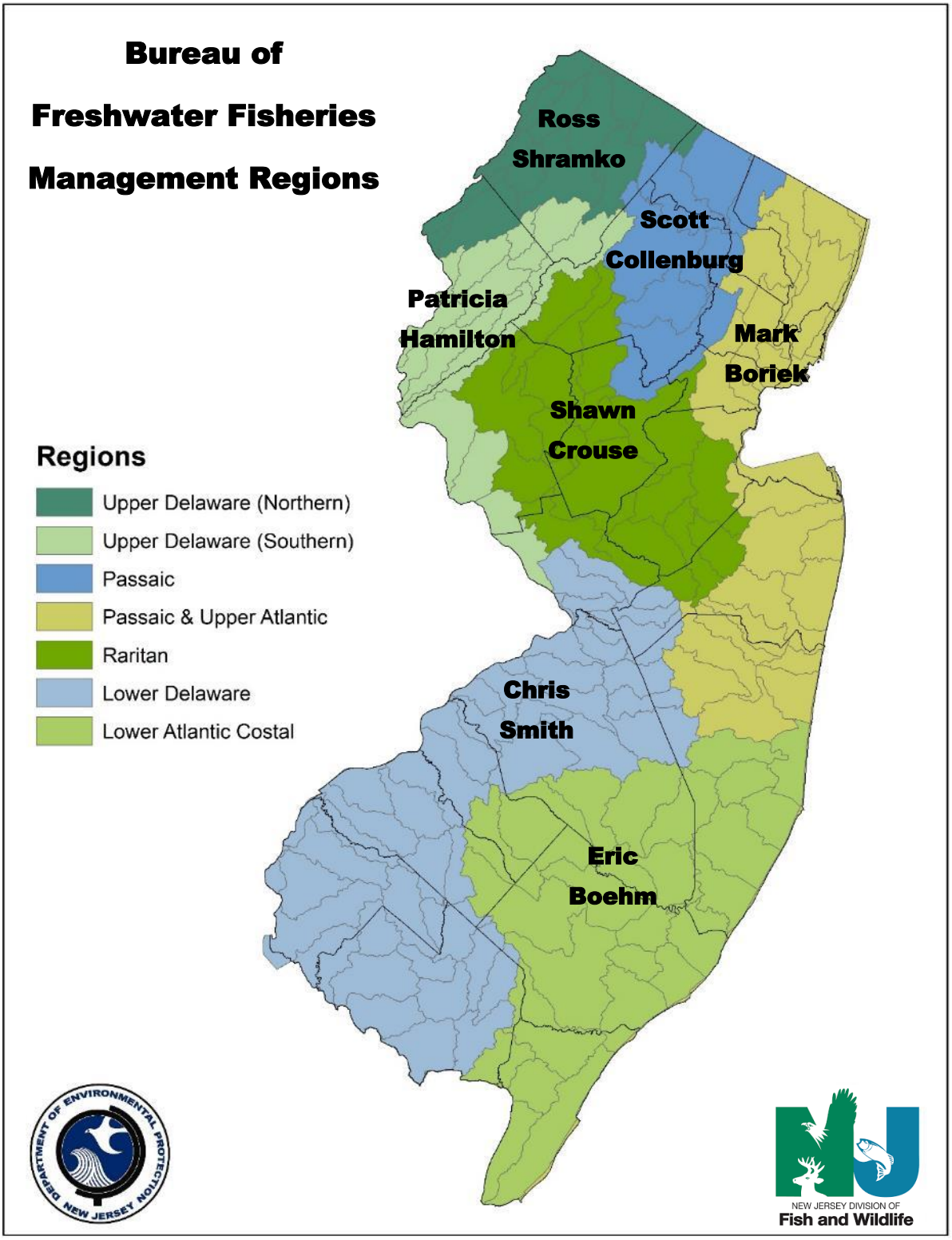
Shawn Crouse – Principal Fisheries Biologist
Fisheries Management in the Raritan Region (Raritan River Watershed), Native Fishes Management, State Wildlife Action Plan, and Annual Report Coordinator

Pat Hamilton – Principal Fisheries Biologist
Fisheries Management in the Upper Delaware (South) Region (Delawanna Creek to Lockatong Creek watersheds), Coldwater Fishes Management, and Federal Grant Coordinator

Ross Shramko – Senior Fisheries Biologist
Fisheries Management in the Upper Delaware (North) & Wallkill Region (Shimmers Brook to Paulins Kill and Wallkill River watersheds), Trout Stocking Coordinator, GIS, and Database Management

Chris Smith – Principal Fisheries Biologist
Fisheries Management in the Lower Delaware Region (Assunpink Creek to Maurice River watersheds), Warmwater Fisheries Management and Invasive Species Management

Figure 1. NJDFW, Bureau of Freshwater Fisheries – 2018 Fisheries Management Regions.



Funding

NJDFW's Bureau of Freshwater Fisheries is funded entirely by New Jersey sportsmen, through the sale of fishing licenses and through a Federal excise tax on the manufacturing of hunting and fishing related equipment. This "user-pays" system has made great strides in financing the management of New Jersey's fish and wildlife resources, not only to the benefit of licensed hunters and anglers but to every one of the state's over 8 million residents. Wildlife associated recreation also generates $2.2 billion dollars into the state's economy each year, with an estimated 300,000 freshwater anglers generating $138 million dollars alone. The two funding sources are described below and after each activity described later in this report the funding source is indicated as either Hunter and Angler Fund or Federal Grant F-48-R.

Hunter and Angler Fund - Licenses, Stamps, and Permits

The sale of freshwater fishing licenses and trout stamps generates over $3.2 million dollars to NJDFW each year. Of this, $1 million is allocated to the Bureau of Freshwater Fisheries to support the state's freshwater research and management efforts, and $2.2 million is allocated to hatchery operations.

Sport Fish Restoration Program

The Sport Fish Restoration Program (SFRP) provides grant funds to the states, the District of Columbia and insular areas fish and wildlife agencies for fishery projects, boating access, and aquatic education. The Program is authorized by the Sport Fish Restoration Act (Dingell-Johnson DJ) of 1950. Revenues collected by the manufacturers of fishing rods, reels, creels, and lures (who pay an excise tax on these items to the U.S. Treasury) fund the Program. These funds are made available to states through financial assistance grants administered by the United States Fish and Wildlife Service (USFWS). The amount of funding available is based on an apportionment formula. SFRP is a cost-reimbursement program, where the state covers the full amount of the approved project then applies for reimbursement for up to 75% of project expenses.

The Bureau of Freshwater Fisheries annually receives over $1 million in SFRP matching funds for research and management activities and fish culture. NJ F-48-R, *Investigations and Management of New Jersey's Freshwater Fisheries Resources*, funds surveys and investigations conducted by Bureau biologists on freshwater sportfish populations and anglers. Activities conducted under this grant document status and changes in fish populations and angling, and the data collected is used to adjust management actions to promote sustainable fisheries. This grant (and subsequent revisions) were approved as NJ F-48-R-29 by the USFWS, for a segment period of January 1, 2018 – December 31, 2020. Similar to annual apportionments received in previous years, NJDFW received an award of $256,668 for 2018. Of this amount, 75% ($192,501) was federally funded and matched with $64,167 (25%) from Hunter and Angler funds.

Prior to 2018 (2013 – 2017) the grant was organized into three projects: Project I "Assessment of the Biological Integrity of Inland Fisheries," Project II "Protection and Restoration of Inland Fisheries and Aquatic Habitats," and Project III "Management of Recreational Fisheries Users." Each project had an objective and multiple activities were listed under each one. Due to a change in USFWS grant administration, the Bureau reorganized the grant narrative for 2018 – 2020, replacing the three projects with the following five measurable objectives:

1) Conduct surveys on 50 streams and 20 lakes and ponds annually.
2) Continuously monitor water temperature in 20 streams annually.
3) Monitor the movement of fish in 1 waterbody.
4) Restore and/or enhance native Brook Trout in 3 streams over a five-year period.
5) Conduct 1 angler use survey annually.

A subset of this report, is prepared and submitted annually to the USFWS, provides pertinent information specific to work conducted under the grant.

Summary of Activities Conducted in 2018

The Bureau of Freshwater Fisheries conducted 242 surveys throughout the state in 2018, most of which include the determination of basic water quality parameters such as dissolved oxygen, temperature, pH, etc. These surveys were conducted under two funding sources, either Hunter and Angler Fund or Federal Grant F-48-R-29. The map below demonstrates the survey quantity, geographic distribution, and type (Figure 2). A total of 176 waterbodies were surveyed; 87 were rivers or streams and 89 were lakes or ponds. Approximately 50,000 individual fish composed of 73 species were handled. A complete list of field locations surveyed in 2018 is found following the map, in Table 1.

Figure 2. Field sites sampled in 2018 by NJDFW, Bureau of Freshwater Fisheries.

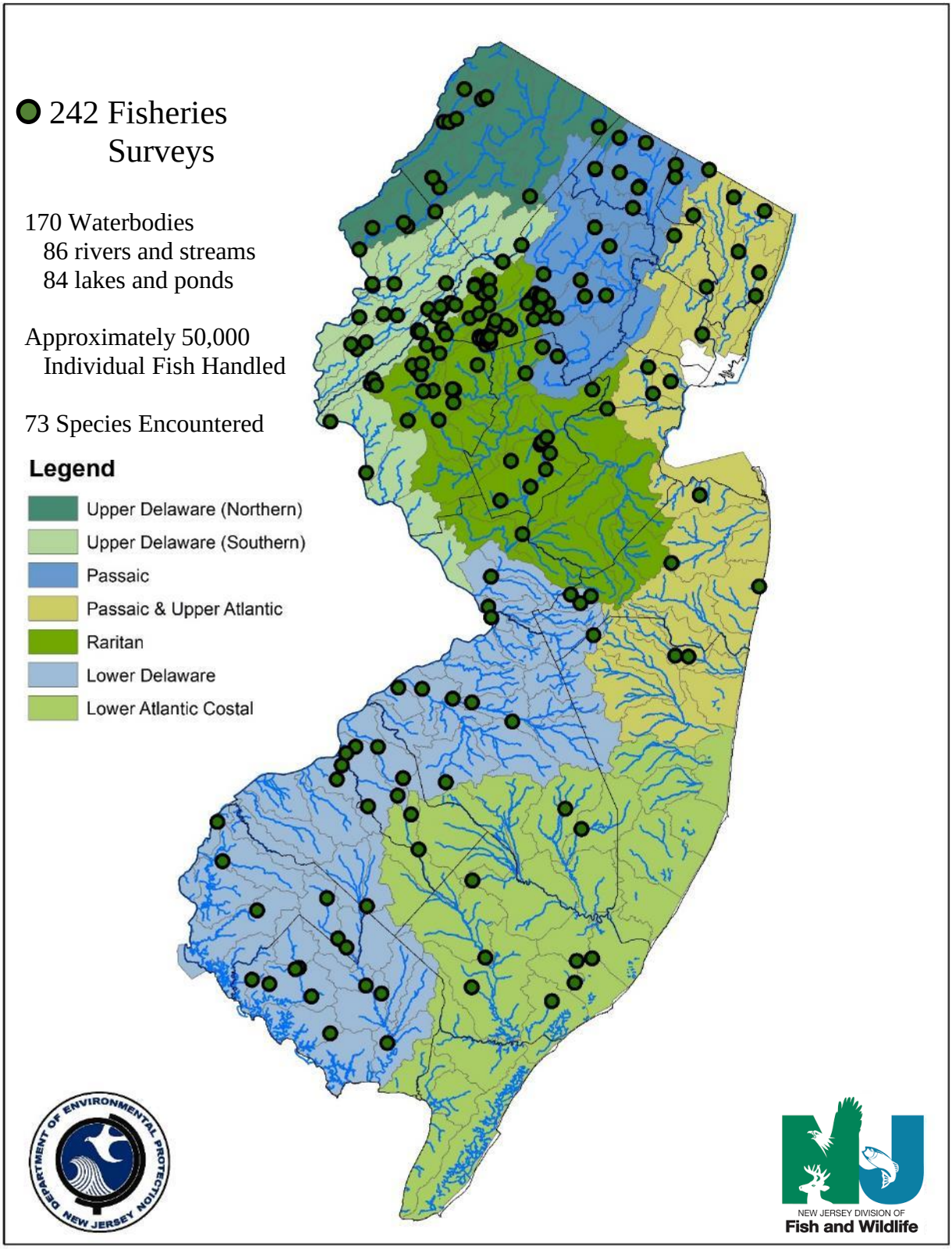


TABLE 1. List of Field Sampling Locations by Funding and Projects (2018).

Bureau of Freshwater Fisheries

2018 Field Sampling Activities

- ● Funding source or reason of data collection
- ▲ Data are applicable to additional projects

	Federal Grant F-48-R							Hunter & Angler Fund								
	Classification	**Brook Trout Restoration**	**Temperature Study**	**Inventory TP Streams**	**Lake Trout Assessment**	**Black Bass Assessment**	**Miscellaneous**	**Brook Trout Assessment**	**Anadromous**	**Warmwater Assessment**	**Invasive Species**	**Reproduction Checks**	**Native Fishes**	**Miscellaneous**	**RBA Stream Sampling Protocol Applied***	**Results Page #**
Upper Delaware (North) & Wallkill Region (Shramko) (Shimers Brook to Paulins Kill and Wallkill River watersheds)																
Beerskill Creek	▲		●					▲					▲		✓	33, 41, 151, A1
Big Flat Brook (trib.)(Lake Ashroe)	▲		●					▲					▲		✓	33, 41, 151, A2
Big Flat Brook (trib.)(W. of Lake Ashroe)	▲		●					▲					▲		✓	33, 41, 151, A3
Blair Lake (Sussex)												▲	●		NA	92, 130
Columbia Lake (Warren)														●	NA	38, 149
Forked Brook	▲		●					▲					▲		✓	33, 41, 151, A4
Little Flat Brook (trib.)(Bevans)	▲							●					▲		✓	41, 151, A5
Parker Brook	▲		●					▲					▲		✓	33, 41, 151, A6
Paulina Creek	▲							●					▲		✓	41, 151, A7
Paulins Kill (trib.)(Yellow Frame)	▲							●					▲		✓	41, 151, A8
Sparta Glen Brook – Sparta Glen Park restoration area	▲						●	▲					▲		✓	41, 55, 151, A9
Trout Brook (Middleville)	▲						●	▲					▲		✓	23, 41, 151, A10
Trout Brook (Middleville)(trib.)(Five Points)	▲							●					▲		✓	41, 151, A11
Trout Brook (Middleville)(trib.)(Trout Brook WMA)	▲							●					▲		✓	41, 151, A12
Yards Creek	▲			●				▲					▲		✓	24, 41, 151, A13

TABLE 1. List of Field Sampling Locations by Funding and Projects (2018) (continued).

Bureau of Freshwater Fisheries

2018 Field Sampling Activities

- ● Funding source or reason of data collection
- ▲ Data are applicable to additional projects

	Federal Grant F-48-R							Hunter & Angler Fund								
	Classification	Brook Trout Restoration	Temperature Study	Inventory TP Streams	Lake Trout Assessment	Black Bass Assessment	Miscellaneous	Brook Trout Assessment	Anadromous	Warmwater Assessment	Invasive Species	Reproduction Checks	Native Fishes	Miscellaneous	RBA Stream Sampling Protocol Applied*	Results Page #
Upper Delaware (South) Region (Hamilton) (Delawanna Creek to Lockatong Creek watersheds)																
Beaver Brook (trib.)(E. of Manuka Chunk) upstrm of waterfall								●					▲		no	41, A14
Beaver Brook (trib.)(E. of Manuka Chunk) dwnstrm of waterfall								●					▲		no	41, A15
Delaware River (trib.)(Holland)	▲			●				▲					▲		✓	24, 41, 151, A16
Furnace Lake (Warren)						●									NA	70
Hances Brook								●					▲		no	41, A17
Hances Brook (trib.)(Rockport)								●					▲		no	41, A18
Lake Hopatcong (Morris/Sussex)						●									NA	74,140
Lake Musconetcong (Morris/Sussex)						●									NA	75, 112, 145
Lommasons Glen Brook (aka. Buckhorn Creek tributary)	▲			●				▲					▲		✓	24, 41, 151, A19
Merrill Creek Reservoir (Warren)					●										NA	27, 29
Mill Brook (Broadway)	▲			●				▲					▲		✓	24, 41, 151, A20
Mountain Lake (Warren)						●									NA	79, 100, 112
Musconetcong River (trib.)(Anderson) – Lane to Audubon	▲						●	▲					▲		✓	41, 151, A21
Musconetcong River (trib. (Anderson) – confl w/ Musconetcong	▲						●	▲					▲		✓	41, 151, A22
Musconetcong River (trib.)(Lebanon)	▲			●				▲					▲		✓	24, 41, 151, A23
Musconetcong River (trib.)(Port Murry)	▲			●				▲					▲		✓	24, 41, 151, A24
Musconetcong River (trib.)(S. of Point Mtn.)	▲			●				▲					▲		✓	24, 41, 151, A25
Musconetcong River (trib.)(S. of Schooley's Mtn. Bk)	▲			●				▲					▲		✓	24, 41, 151, A26

TABLE 1. List of Field Sampling Locations by Funding and Projects (2018) (continued).

Bureau of Freshwater Fisheries

2018 Field Sampling Activities

- ● Funding source or reason of data collection
- ▲ Data are applicable to additional projects

	Federal Grant F-48-R							Hunter & Angler Fund								
	Classification	**Brook Trout Restoration**	**Temperature Study**	**Inventory TP Streams**	**Lake Trout Assessment**	**Black Bass Assessment**	**Miscellaneous**	**Brook Trout Assessment**	**Anadromous**	**Warmwater Assessment**	**Invasive Species**	**Reproduction Checks**	**Native Fishes**	**Miscellaneous**	**RBA Stream Sampling Protocol Applied***	**Results Page #**
Upper Delaware (South) Region (Hamilton) (Delawanna Creek to Lockatong Creek watersheds) (continued)																
Pequest River (trib.)(Buttzville)	●							▲					▲		✓	41, 151, A27
Pohatcong Creek (trib.)(New Village)	▲			●				▲					▲		✓	24, 41, 151, A28
Schooley's Mountain Brook	▲			●				▲					▲		✓	24, 41, 151, A29
Stephensburg Brook	▲		●					▲					▲		✓	33, 41, 151, A30
Trout Brook (Hackettstown)								●					▲		no	41, A31
Tunnel Brook (Oxford Mtn.)	▲			●				▲					▲		✓	24, 41, 151, A32
Turkey Hill Brook – Turkey Hill Road	▲			●				▲					▲		✓	24, 41, 151, A33
Turkey Hill Brook – Route 173	▲							●					▲		✓	41, 151, A34
Warford Creek	▲			●				▲					▲		✓	24, 41, 151, A35
West Portal Creek		●					●	▲					▲		✓	41, A36

TABLE 1. List of Field Sampling Locations by Funding and Projects (2018) (continued).

Bureau of Freshwater Fisheries

2018 Field Sampling Activities

- ● Funding source or reason of data collection
- ▲ Data are applicable to additional projects

	Federal Grant F-48-R							Hunter & Angler Fund								
	Classification	Brook Trout Restoration	Temperature Study	Inventory TP Streams	Lake Trout Assessment	Black Bass Assessment	Miscellaneous	Brook Trout Assessment	Anadromous	Warmwater Assessment	Invasive Species	Reproduction Checks	Native Fishes	Miscellaneous	RBA Stream Sampling Protocol Applied*	Results Page #
Upper Passaic Region (Collenburg) (Pompton, Pequannock, Wanaque, Ramapo, Upper Passaic, Whippany, & Rockaway River watersheds)																
Bear Swamp Brook	▲		●					▲					▲		✓	33, 41, 151, A37
Bear Swamp Brook (trib.)(Spruce Swamp)	▲							●					▲		✓	41, 151, A38
Bee Meadow Park Pond (Morris)												●	▲		NA	91
Beech Brook	▲			●				▲					▲		✓	24, 41, 151, A39
Bogues Pond (Passaic)												●	▲		NA	92
Clinton Brook (trib.)(Cedar Pond E/Br)	●							▲					▲		✓	41, 151, A40
Clinton Brook (trib.)(Cedar Pond W/Br)	●							▲					▲		✓	41, 151, A41
Green Brook (West Milford)	▲		●					▲					▲		✓	33, 41, 151, A42
Harmony Brook	▲							●					▲		✓	41, 151, A43
Harmony Brook (trib.) (SW of Clyde Potts Reservoir)	▲							●					▲		✓	41, 151, A44
Hedden Park Lake (Morris)												●	▲		NA	97, 139
Silver Creek Pond (Bergen)												●	▲		NA	106
Splitrock Reservoir (Morris)						●									NA	86
Sunrise Lake (Morris)												●	▲		NA	107
Walrus Pond (Morris)												●	▲		NA	109
Wanaque Reservoir (trib.)(N. of Posts Brook)	▲							●					▲		✓	41, 151, A45
Wanaque Reservoir (trib.)(S. of Blue Mine Brook)	▲							●					▲		✓	41, 151, A46
West Brook								●					▲		no	41, A47
Whippany River	▲							●					▲		✓	41, 151, A48
Whippany River (trib.)(Brookside)	▲							●					▲		✓	41, 151, A49

TABLE 1. List of Field Sampling Locations by Funding and Projects (2018) (continued).

Bureau of Freshwater Fisheries

2018 Field Sampling Activities

- ● Funding source or reason of data collection
- ▲ Data are applicable to additional projects

	Federal Grant F-48-R							Hunter & Angler Fund								
	Classification	**Brook Trout Restoration**	**Temperature Study**	**Inventory TP Streams**	**Lake Trout Assessment**	**Black Bass Assessment**	**Miscellaneous**	**Brook Trout Assessment**	**Anadromous**	**Warmwater Assessment**	**Invasive Species**	**Reproduction Checks**	**Native Fishes**	**Miscellaneous**	**RBA Stream Sampling Protocol Applied***	**Results Page #**
Lower Passaic & Upper Atlantic Region (Boriek, Collenburg, and Crouse) (Lower Passaic, Saddle, Hackensack, Pascack & Elizabeth to Toms River watersheds)																
Bear Brook (Park Ridge)	●							▲					▲		✓	41, 151, A50
Preakness (Singac) Brook	●							▲					▲		✓	41, 151, A51
Deal Lake (Monmouth)						●									NA	66
Durand Park Pond (Monmouth)												●	▲		NA	94
Haworth Pond (Bergen)												●	▲		NA	96
Pondside Park Pond (Bergen)												●	▲		NA	103
Rahway River Park Pond (Union)												●	▲		NA	104
Roosevelt Commons Park Pond (Bergen)												●	▲		NA	105
Shallcross Pond (aka Black Brook Park Pond (Union)												●	▲		NA	106
Van Saun Pond (Bergen)												●	▲		NA	108
Veterans Park Pond (Monmouth)												●	▲		NA	109
Warinanco Park Pond (Union)												●	▲		NA	110
West Hudson County Park Pond (Hudson)												●	▲		NA	110
Zabriskie's Pond (Bergen)												●	▲		NA	111

TABLE 1. List of Field Sampling Locations by Funding and Projects (2018) (continued).

Bureau of Freshwater Fisheries

2018 Field Sampling Activities

- ● Funding source or reason of data collection
- ▲ Data are applicable to additional projects

	Federal Grant F-48-R							Hunter & Angler Fund								
	Classification	**Brook Trout Restoration**	**Temperature Study**	**Inventory TP Streams**	**Lake Trout Assessment**	**Black Bass Assessment**	**Miscellaneous**	**Brook Trout Assessment**	**Anadromous**	**Warmwater Assessment**	**Invasive Species**	**Reproduction Checks**	**Native Fishes**	**Miscellaneous**	**RBA Stream Sampling Protocol Applied***	**Results Page #**
Raritan Region (Crouse) (Raritan River watershed)																
Ann Van Middlesworth Park Pond (Somerset)												●	▲		NA	90
Beaver Brook – Old Allerton Road							●	▲					▲		✓	23, 41, A52
Beaver Brook – Old Highway 22, upstream of Leigh Street							●	▲					▲		✓	23, 41 A53
Best Lake (Somerset)												●	▲		NA	91
Black Brook	▲		●					▲					▲		✓	33, 41, 151, A54
Boyd Pond (Middlesex)												●	▲		NA	93
Burnett Brook								●					▲		✓	41, A55
Carnegie Lake (Mercer)						●									NA	64
Cedar Brook Park Pond (Union)												●	▲		NA	93
Chub Park Pond (Morris)												●	▲		NA	94
Cold Brook (trib.)(Laurel Farms)								●					▲		✓	41, A56
Dawson's Brook								●					▲		✓	41, A57
Demott Pond (Lingerts Pond) (Hunterdon)												●	▲		NA	94
Echo Hill Park Pond (Hunterdon)												●	▲	●	NA	95, 142
Hacklebarney Brook	▲			●				▲					▲		✓	24, 41, 151, A58
Hickory Run	▲		●					▲					▲		✓	33, 41, 151, A59
India Brook								●					▲		✓	41, A60
India Brook (trib.)(E. of Lake Cherokee)								●					▲		✓	41, A61
India Brook (trib.)(Lake Cherokee)								●					▲		✓	41, A62

TABLE 1. List of Field Sampling Locations by Funding and Projects (2018) (continued).

Bureau of Freshwater Fisheries

2018 Field Sampling Activities

- ● Funding source or reason of data collection
- ▲ Data are applicable to additional projects

	Federal Grant F-48-R							Hunter & Angler Fund								
	Classification	Brook Trout Restoration	Temperature Study	Inventory TP Streams	Lake Trout Assessment	Black Bass Assessment	Miscellaneous	Brook Trout Assessment	Anadromous	Warmwater Assessment	Invasive Species	Reproduction Checks	Native Fishes	Miscellaneous	RBA Stream Sampling Protocol Applied*	Results Page #
Raritan Region (Crouse) (Raritan River watershed) (continued)																
Lamington (Black) River (trib.)(Fairmount)								●					▲		✓	41, A63
Lamington (Black) River (trib.)(N. of Hacklebarney Brook)								●					▲		✓	41, A64
Lamington (Black) River (trib.)(N. of Pottersville)								●					▲		✓	41, A65
Millstone River – Griggstown Causeway								▲	●				▲		NA	41, 114, A66, A67
Millstone River – Blackwells Mills Dam								▲	●				▲		NA	41, 114, A68, A69
Millstone River – above Weston Mill Dam									●		▲		▲		NA	114
Millstone River – below Weston Mill Dam									●		▲		▲		NA	114
Millstone River – near Raritan confluence									●		▲		▲		NA	114, 133, 136
Mine Brook (trib.)(S of Somersetin)								●					▲		✓	41, A70
Mount Olive PAL Pond (Morris)												●	▲		NA	100, 139
Mountain Valley Park Pond (Morris)												●	▲		NA	100, 139
Peapack Brook								●					▲		✓	41, A71
Peapack Brook (trib.)(W. of Mt. Paul)								●					▲		✓	41, A72
Powder Mill Pond (Somerset)												●	▲		NA	104
Raritan River, N/Br. (trib.)(N. of 2nd Watchung Mtn. N/Br)	●							▲					▲		✓	41, 151, A73
Raritan River, S/Br. – Stephens Mill Road							●	▲					▲		✓	23, 39, A74
Raritan River, S/Br. – Bartley WMA							●	▲					▲		✓	23, 39, A75
Raritan River, S/Br. (trib.)(Drakestown)	▲		●					▲					▲		✓	33, 41, 151, A76
Raritan River, S/Br. (trib.)(Long Valley)	▲			●				▲					▲		✓	24, 41, 151, A77

TABLE 1. List of Field Sampling Locations by Funding and Projects (2018) (continued).

Bureau of Freshwater Fisheries

2018 Field Sampling Activities

- ● Funding source or reason of data collection
- ▲ Data are applicable to additional projects

	Federal Grant F-48-R							Hunter & Angler Fund								
	Classification	**Brook Trout Restoration**	**Temperature Study**	**Inventory TP Streams**	**Lake Trout Assessment**	**Black Bass Assessment**	**Miscellaneous**	**Brook Trout Assessment**	**Anadromous**	**Warmwater Assessment**	**Invasive Species**	**Reproduction Checks**	**Native Fishes**	**Miscellaneous**	**RBA Stream Sampling Protocol Applied***	**Results Page #**
Raritan Region (Crouse) (Raritan River watershed) (continued)																
Raritan River, S/Br. (trib.)(SW of Budd Lake)	▲		●					▲					▲		✓	33, 41, 151, A78
Rinehart Brook – multiple surveys across entire length		●						▲							no	41, 50
Rinehart Brook (trib.)(Fairmount)		●						▲							no	41, 50
Rockaway Creek S/Br – Kullman Industries Campus Drive							●	▲					▲		✓	23, 41, A79
Rockaway Creek S/Br (trib.)(Lebanon Boro) – mainstream							●	▲					▲		✓	23, 41, A80
Rocky Run	▲		●					▲					▲		✓	33, 41, 151, A81
Round Valley Reservoir (Hunterdon)						●	●								NA	27, 84, 169
Spooky Brook Park Pond (Somerset)												●	▲		NA	107
Spruce Run Creek – Crystal Springs Preserve	▲							●					▲		✓	41, 151, A82
Spruce Run Creek – Miquin Woods	▲							●					▲		✓	41, 151, A83
Spruce Run Creek – Main Street	▲							▲					▲	●	✓	41, 56, 147, 151, A84
Spruce Run Creek – Route 31	▲							▲					▲	●	✓	41, 56, 147, 151, A85
Stony Brook (Morris-Washington)	▲		●					▲					▲		✓	33, 41, 151, A86
Teetertown Brook								●					▲		✓	41, A87
Trout Brook (Hacklebarney)	▲	●	●					▲					▲		✓	33, 41, 51, 151, A88
Turkey Brook	▲		●					▲					▲		✓	33, 41, 151, A89
Turkey Brook Park Pond (Morris)												●	▲		NA	108, 139
Willhoughby Brook	▲		●					▲					▲		✓	33, 41, 151, A90

TABLE 1. List of Field Sampling Locations by Funding and Projects (2018) (continued).

Bureau of Freshwater Fisheries

2018 Field Sampling Activities

- ● Funding source or reason of data collection
- ▲ Data are applicable to additional projects

	Federal Grant F-48-R							Hunter & Angler Fund								
	Classification	Brook Trout Restoration	Temperature Study	Inventory TP Streams	Lake Trout Assessment	Black Bass Assessment	Miscellaneous	Brook Trout Assessment	Anadromous	Warmwater Assessment	Invasive Species	Reproduction Checks	Native Fishes	Miscellaneous	RBA Stream Sampling Protocol Applied*	Results Page #
Lower Delaware Region (Smith) (Assunpink Creek to Maurice River watersheds)																
Alloway Lake (Salem)						●									NA	62
Assunpink Lake (Monmouth)						●									NA	63, 170
Centennial Lake (Mercer)						▲				▲				●	NA	64
Clarks Pond (Cumberland)						▲				●					NA	65
Colonial Lake (Mercer)										▲				●	NA	65
Davis Mill Pond (Cumberland)						●				▲					NA	66
Delaware River (Bordentown)						▲					●				NA	67, 133, 135
Delaware River (Burlington)						▲					●				NA	67, 133, 135, 136
Delaware River (Pennsauken)						▲					●				NA	67, 133, 136
Delaware River (West Deptford)						▲					●				NA	67, 133, 136
DOD Lake (Salem)						●					●				NA	69, 133, 136, 171
Elmer Lake (Salem)						●									NA	70
Game Creek (Salem)						●					●				NA	71, 133, 137
Gloucester City Pond (Camden)												●	▲		NA	96
Hankins Pond (Cumberland)												●	▲		NA	96
Hopkins Pond (Camden)												●	▲		NA	98
Lake Audrey (Cumberland)						●									NA	72
Laurel Acres Pond (Burlington)												●	▲		NA	98

TABLE 1. List of Field Sampling Locations by Funding and Projects (2018) (continued).

Bureau of Freshwater Fisheries

2018 Field Sampling Activities

- ● Funding source or reason of data collection
- ▲ Data are applicable to additional projects

	Federal Grant F-48-R							Hunter & Angler Fund								
	Classification	Brook Trout Restoration	Temperature Study	Inventory TP Streams	Lake Trout Assessment	Black Bass Assessment	Miscellaneous	Brook Trout Assessment	Anadromous	Warmwater Assessment	Invasive Species	Reproduction Checks	Native Fishes	Miscellaneous	RBA Stream Sampling Protocol Applied*	Results Page #
Lower Delaware Region (Smith) (Assunpink Creek to Maurice River watersheds) (continued)																
Little Mantua Creek (Gloucester)						▲					●				NA	77, 133
Log Basin Pond (Mercer)												●	▲		NA	99
Malaga Lake (Gloucester)												●	▲		NA	99
Mary Elmer Lake (Cumberland)						●								●	NA	78
Maurice River (Cumberland)						●									NA	79
Mill Creek Park Pond (Burlington)												●	▲		NA	99
Newton Lake (Camden)						●					●				NA	80, 133, 138
Northern Community Park Pond (Burlington)												●	▲		NA	102
Parvin Lake (Salem)						●									NA	81
Pemberton Lake (Burlington)						●									NA	81
Prospertown Lake (Ocean)						●									NA	82
Rancocas Creek, N/Br. (trib.)(W. of Timbuctoo)	▲							▲					●		✓	41,130, 151, A91
Rancocas Creek, S/Br. (Burlington)						●					▲				NA	82, 133, 136
Rainbow Lake (Salem)						●									NA	83, 171
Rising Sun Lake (Monmouth)						●									NA	83
Riverview Beach Pond (Salem)												●	▲		NA	105
Rowand Pond (Camden)												●	▲		NA	105

TABLE 1. List of Field Sampling Locations by Funding and Projects (2018) (continued).

Bureau of Freshwater Fisheries

2018 Field Sampling Activities

- ● Funding source or reason of data collection
- ▲ Data are applicable to additional projects

	Federal Grant F-48-R							Hunter & Angler Fund								
	Classification	**Brook Trout Restoration**	**Temperature Study**	**Inventory TP Streams**	**Lake Trout Assessment**	**Black Bass Assessment**	**Miscellaneous**	**Brook Trout Assessment**	**Anadromous**	**Warmwater Assessment**	**Invasive Species**	**Reproduction Checks**	**Native Fishes**	**Miscellaneous**	**RBA Stream Sampling Protocol Applied***	**Results Page #**
Lower Delaware Region (Smith) (Assunpink Creek to Maurice River watersheds) (continued)																
Salem Canal (Salem)						●					●					84, 133, 138, 171
Sheppards Mill Pond (Cumberland)						●										85
Shaws Mill Pond												●	▲			106
Silver Lake (Camden)											●				NA	86, 133, 135
Spring Lake (Mercer)						●									NA	87
Stone Tavern Lake (Monmouth)						●									NA	87, 171
Sunset Lake (Cumberland)						●									NA	87
Swedes Lake (Burlington)						●									NA	88
Union Lake (Cumberland)						●									NA	88, 171
Upper Sylvan Lake (Burlington)						●									NA	89
Westville Park Pond (aka. Thomas West Park Pond)(Gloucester)												●	▲		NA	111
Woolmans Lake (Burlington)												●	▲		NA	111

TABLE 1. List of Field Sampling Locations by Funding and Projects (2018) (continued).

Bureau of Freshwater Fisheries

2018 Field Sampling Activities

- ● Funding source or reason of data collection
- ▲ Data are applicable to additional projects

	Federal Grant F-48-R							Hunter & Angler Fund								
	Classification	**Brook Trout Restoration**	**Temperature Study**	**Inventory TP Streams**	**Lake Trout Assessment**	**Black Bass Assessment**	**Miscellaneous**	**Brook Trout Assessment**	**Anadromous**	**Warmwater Assessment**	**Invasive Species**	**Reproduction Checks**	**Native Fishes**	**Miscellaneous**	**RBA Stream Sampling Protocol Applied***	**Results Page #**
Lower Atlantic Coastal (Boehm) (Sloop Creek to Dennis Creek watersheds)																
Birch Grove Park Pond #1 (Atlantic)												●	▲		NA	91
Franklin Parker Preserve Reservoir (Burlington)												▲	●		NA	95, 130
Hammonton Lake (Atlantic)						●									NA	72
Heritage Park Pond (Atlantic)												●	▲		NA	97
Lake Carasaljo (Ocean)						●									NA	73
Lake Shenandoah (Ocean)						●									NA	77
Lily Lake (Atlantic)												●	▲		NA	98
Maple Lake (Atlantic)						●									NA	78
Oak Pond (Camden)												●	▲		NA	102
Oswego Lake (Burlington)												▲	●		NA	102, 130
Patriot Lake (Atlantic)												●	▲		NA	103
Penbryn Lake (Camden)						●									NA	81

** The Bureau of Freshwater Fisheries strives to use established sampling protocols for all field sampling efforts. However, certain sampling objective adherence to established sampling protocols would be prohibitive to accomplishing project goals. In these instances, non-standardized surveys are performed and are identified in appropriate areas within this document.*

COLDWATER FISHERIES

Cessation of Trout Stocking in Trout Production Streams Assessment

NJDFW discontinued stocking trout in eight small *Trout Production* streams during the period 2005 – 2010. This management action was taken to protect New Jersey's wild trout resources, particularly Brook Trout, the only salmonid native to New Jersey, and to better utilize hatchery trout in waters not having self-sustaining trout populations. In 2013 these eight streams were surveyed at sites where surveys had been conducted previously (prior to 2002) to provide comparative data. Two of the streams surveyed in 2013 no longer had wild Brook Trout (Barkers Mill Brook and Shimers Brook) and the wild Brook Trout populations in two other streams (Beerskill and Tuttles Corner Brook) were considered fragile due to low abundance. Restoration (translocation of wild fish/habitat enhancement) was recommended for these four streams. For the four remaining streams (Brass Castle Creek, Mill Brook, Paulins Kill tributary, and Spring Mills Brook) either no action, or in some cases, consideration of special trout fishing regulations was recommended.

In 2018 an extension of this project was initiated to more closely track fish assemblage changes in *Trout Production* waters in which trout stocking was recently discontinued in 2018. Metrics may include presence / absence of various species, changes in abundance or length frequency, etc. Analyses will include the relationship of multiple variables, including land use/land cover, water quality, habitat, connectivity, etc. A better understanding of the relationship between stocked and wild trout will allow fisheries biologist to make scientifically based fisheries management decisions when faced with choosing amongst various strategies. (Diglio, Federal Grant F-48-R)

In 2018 the following actions were taken:

- A total of 7 surveys were conducted along 4 streams. Wild Brown Trout were found at all 7 locations.
- 1 Brook Trout (older than young-of-the-year) was found in the Raritan River, S/Br. within the Bartley WMA.
- Fish assemblage data will be monitored over duration of study. Surveys will be repeated at the same locations intermittently over the next decade.

Streams sampled in 2018 include Beaver Brook (Hunterdon) (Appendices A52-53), Raritan River, S/Br. (Appendices A74-75), Rockaway Creek, S/Br. (Appendices A79-80), and Trout Brook (Middleville) (Appendix A10). Analysis of these data will occur subsequent to additional annual sampling for the next few years. Detailed survey results, summary, and recommendation for each stream, can be found on the previously referenced pages of Appendix A.

Inventory of Trout Production Streams

Waters used by trout for spawning and nursery areas are classified as *Trout Production* under the state's Surface Water Quality Standards. New Jersey has nearly 200 *Trout Production* streams and most of these are small tributaries and headwaters of larger rivers in the northern part of the state. Wild, naturally reproducing trout are important indicators of healthy ecosystems, requiring superior water quality, and pristine habitat. Despite the protection that state regulatory programs afford *Trout Production* waters, ongoing changes in land use have impacted these coldwater fisheries populations. In particular, wild Brook Trout, New Jersey's only native trout species, have declined dramatically over the last century due to land use changes which have affected the quality of their habitat. Documenting the status of wild Brook Trout in New Jersey is important, as this species may soon be designated state Special Concern.

Trout Production streams are monitored periodically to assess the status of their naturally reproducing trout populations (every 5 years if regulated as a *Wild Trout Stream*, every 10 years if wild Brook Trout were historically documented, or generally once every 20 years). Surveys are conducted using established protocols, which include electrofishing a 150-m reach, physicochemical measurements, and the EPA Rapid Bioassessment for habitat (with regional modifications) (Barbour et al. 1999) (Appendices C and D). The data collected through these surveys are evaluated to determine if changes have occurred and are used in the development management strategies and fishing regulations to protect this fragile resource. The data are also used by the Eastern Brook Trout Joint Venture (a National Fish Habitat Partnership) as part of a range-wide effort to conserve and manage Brook Trout in the eastern U.S. (Hamilton, Federal Grant F-48-R)

In 2018, 16 surveys were conducted on 16 *Trout Production* streams at (or near) locations that had been surveyed in the past (see table below). Results of these surveys are summarized as follows:

- Two stream survey locations failed to document any wild trout: Turkey Hill Brook and Warford Creek. The headwaters of Turkey Hill Brook may be a good candidate for Brook Trout restoration (another headwater location was surveyed in 2018 – no trout found; wild Brown Trout are known to occur further downstream) – see Wild Brook Trout Assessment section. Additional surveys are recommended for Warford Creek to determine if wild Brown Trout have been extirpated from this stream before considering it for Brook Trout restoration.
- Six streams have allopatric populations of wild Brook Trout: Beech Brook, Hacklebarney Brook, and four tributaries to the Musconetcong River (Port Murray, S. of Point Mountain., S. of Schooley's Mountain Brook, and Schooley's Mountain Brook). Previous data indicated Brook Trout at all of these streams, however wild Brown Trout were once found in two of these streams (Port Murray and S. of Point Mountain tributaries).
- Two streams continue to support only one wild trout species, Brown Trout: Yards Creek and Delaware River (trib.)(Holland).
- Six streams that had allopatric Brook Trout populations at some point in their past now have both wild Brook and Brown Trout: Lommasons Glen Brook, Mill Brook (Broadway), Musconetcong River (trib.)(Lebanon), Pohatcong Creek (trib.)(New

Village), Tunnel Brook, and Raritan River S/Br. (trib.)(Long Valley). The first documented occurrence of Brown Trout in three of these streams occurred in 2018; Lommasons Glen Brook, Mill Brook (Broadway), Tunnel Brook, and Raritan River S/Br. (trib.)(Long Valley). Brown Trout compete directly with, and can displace native Brook Trout. These streams may be candidates for Brown Trout removal.

Results of electrofishing surveys conducted in 2018 on 16 streams in, as part of a monitoring program for streams classified *Trout Production*. An "*" following the species name indicates that only older than young-of-the-year trout were found, and these were considered wild (not stocked) based upon a visual assessment of fin wear.

	2018			Prior to 2017	
Stream (County)	Survey date	Reproducing trout species	Results page #	Survey date	Reproducing trout species
Upper Delaware (North) & Wallkill Region (Shimers Brook to Paulins Kill and Wallkill River watersheds)					
Yards Creek (Warren)	7/20/18	Brown	A-12	8/13/08 7/18/02 7/8/70	Brown Brown Brown
Upper Delaware (South) Region (Delawanna Creek, Lockatong Creek to Assunpink Creek)					
Delaware River (trib.)(Holland) (Hunterdon)	7/12/18	Brown	A-16	7/10/02 9/8/70	Brown Brown
Lommasons Glen Brook) (Warren)	7/17/18	Brook Brown*	A-19	8/10/01 7/13/70	Brook Brook
Mill Brook (Broadway) (Warren)	8/17/18	Brook Brown	A-20	6/29/05 6/30/70	Brook Brook
Musconetcong River (trib.)(Lebanon) (Hunterdon)	7/13/18	Brook Brown	A-23	7/9/07 9/9/82	Brook Brown* Brook
Musconetcong River (trib.)(Port Murray) (Warren)	7/13/18	Brook	A-24	7/20/04 8/5/70	Brook Brown Brook
Musconetcong River (trib.)(S. of Point Mtn.) (Hunterdon)	8/16/18	Brook	A-25	8/3/09 9/9/93	Brook Brook Brown
Musconetcong River (trib.)(S. of Schooley's Mtn. Bk) (Morris)	7/18/18	Brook	A-26	7/10/07 10/22/80	Brook Brook
Pohatcong Creek (trib.)(New Village) (Warren)	8/7/18	Brook Brown	A-28	8/1/07 9/4/86 8/29/84	Brook Brown Brook Brook
Schooley's Mountain Brook (Morris)	8/27/18	Brook	A-29	8/11/05 8/5/70	Brook Brook
Tunnel Brook (Oxford Mtn.) (Warren)	7/5/18	Brook Brown*	A-32	8/17/00	Brook
Turkey Hill Brook (Hunterdon)	9/7/18	none	A-33	7/31/09 8/26/87	None Brook
Warford Creek (Hunterdon)	7/12/18	none	A-35	9/10/98	Brown
Upper Passaic Region (Pompton, Pequannock, Wanaque, Ramapo, U. Passaic, Whippany, & Rockaway rivers					
Beech Brook (Passaic)	8/10/18	Brook	A-39	7/29/03	Brook
Raritan Region (Mainstem Raritan River and all tributaries					

Hacklebarney Brook (Morris)	8/6/18	Brook	A-39	7/19/05 9/18/70	Brook Brook
Raritan River S/B (trib.)(Long Valley) (Morris)	7/11/18	Brook Brown	A-58	7/17/96	Brook

Lake Trout Population Assessment

Lake Trout (*Salvelinus namaycush*) fisheries exist in two waterbodies within New Jersey, Round Valley Reservoir and Merrill Creek Reservoir. Although stocked for years, the Lake Trout populations in these two reservoirs are now entirely supported by natural reproduction and are no longer stocked by NJDFW's Hackettstown State Fish Hatchery. Surplus Lake Trout were periodically stocked into Monksville Reservoir from 2004 - 2012, however it did not develop into a significant fishery. As a result, Lake Trout are no longer stocked in New Jersey.

Round Valley Reservoir (Hunterdon) - Trout reared at the Hackettstown State Fish Hatchery were stocked in this deep reservoir (maximum depth 160 feet) from 1977 until 1995. The Lake Trout population in Round Valley Reservoir has been closely monitored by NJDFW to evaluate the status of this trophy trout fishery. In 1985, evidence that natural reproduction was occurring within the reservoir was documented. By 1995 it was determined that the population could maintain itself by natural reproduction, as mature Lake Trout seek out suitable spawning habitat along the boulders lining the reservoir's dams, thus stocking was discontinued. In 1996 a drastic decline in Alewife, the primary forage base for salmonids in the reservoir was noted.

Since the Alewife crash in 1996 and subsequent decline in the trophy fishery, several management actions have taken place over the last two decades, including the liberalization of harvest regulations for Lake Trout (size and daily limit), the decrease in Brown and Rainbow Trout stocking rates, and the stocking of forage fishes (Alewife and Golden Shiner). The number of Lake Trout encountered during our monitoring program over 25 inches has steadily declined since 1996. During the mid-1990's more than 40 individual fish over 25 inches were documented. That number has decreased to single digits in recent years. Unfortunately, the trend of decreasing numbers of large Lake Trout is resulting in a less-desirable trophy fishery. 2014 was the first year no Lake Trout over 30 inches or over ten pounds were caught. Gill net surveys to monitor the reproducing Lake Trout populations have been conducted annually in the fall, however the monitoring schedule was modified from annual to biennial (every two years) monitoring in 2016. The following bullets are highlights from 2018 efforts:

- Four distinct locations are monitored with four gill nets per site in Round Valley Reservoir to monitor their reproducing population in the fall of 2018.
- The documented decrease in Lake Trout density in recent years, particularly of smaller fish, is in-line with management objectives to realign the population to reduce stockpiling of 15-20 inch size class, managing for fewer but larger Lake Trout
- Only 2 Lake Trout (2% of total), of the 101 Lake Trout captured, were of trophy size (> 26 in).
- 4 of the 101 Lake Trout exhibited Sea Lamprey scars, which reinforces angler observations of evidence of lamprey scars in 2018 and will be monitored.

In 2018, four large-mesh (6 x 6 in) gill nets (300 x 6 ft) were set overnight and retrieved on November 14 and 15. Eighty-two Lake Trout were captured, ranging from sub-adults to adults. Combined with 19 juveniles to sub-adults captured with experimental (5 panels from 1.5 - 3.5 in) gill nets (250 x 6 ft) on October 25 and 26, a total 101 Lake Trout were captured,

which is less than average and a decline in recent years (156 in 2015 and 157 in 2016). The reduction in the Lake Trout density and restructuring of the population is a desirable outcome, as it is an objective to manage increase growth, reduce stockpiling of small Lake Trout. The percentage of Lake Trout under 20 in has decreased in recent years (38% in 2015, 39% in 2016, and 27% in 2018) which is positive, but the percentage of trophy Lake Trout (>26 in) has insignificantly increased (1.3% in 2015, 1.9% in 2016, and 2.0% in 2018).

The largest Lake Trout in 2018 managed to dislodge itself from the net boat-side. That individual was likely in the 15 - 20 lb class. The heaviest Lake Trout handled was a male measuring 26.0 in and weighing 6.3 lb. Interestingly, the longest Lake Trout was a male that was 26.7 in long, however it weighed only 2.7 lb, resulting in a poor relative weight of 38. The fish also exhibited a Sea Lamprey wound. Relative weights on three other Lake Trout with lamprey wounds ranged from 87 to 93. There were growing discussions among anglers of an increased number of Lake Trout seen with lamprey scars. These observations were supported by lamprey scars on 4 of 101 Lake Trout taken with gill nets. Lamprey scars in recent years have been uncommon, an indication Sea Lamprey have been in low abundance over the years in the reservoir.

Lamprey wound on Lake Trout from Round Valley Reservoir.

All Lake Trout data will be analyzed and compared to those previously collected. The Division will continue to encourage the harvest of Lake Trout from 15 to 24 in, with the intention of achieving a more desirable fishery for trophy fish. (Crouse, Federal Grant F-48-R)

Merrill Creek Reservoir (Warren) – Merrill Creek Reservoir is a 650-acre privately-owned reservoir located in Harmony Twp., Warren County that is open to public fishing. Following construction and filling in 1988, a variety of fish species have been stocked in this deep-water reservoir (200 ft deep) by NJDFW to establish and maintain desirable sport fisheries for Smallmouth Bass and trout. The reservoir's fishery is managed by the Merrill Creek Owners Group in cooperation with Fish and Wildlife. This team meets annually to review and discuss fisheries data collected by the owner and their consultant and to make management decisions. From 1989 – 2012 NJDFW annually stocked Brown, Rainbow, and Lake Trout in the reservoir. When gill net survey data indicated that Lake Trout were naturally reproducing in the reservoir, the stocking of this species was discontinued in 2013. Brown Trout stocking was then discontinued in 2015 (in this reservoir and statewide), due to a fish disease (furunculosis) outbreak at the Pequest Trout Hatchery. From 2015 – 2017 the only salmonid species stocked in the reservoir was Rainbow Trout. In the fall of 2018 NJDFW began stocking catchable (14 – 15 in) Landlocked Salmon in the reservoir to help fill a void left by Brown Trout and expand fishing opportunities for salmon statewide to a fourth waterbody. In recent years, Lake Trout have been the primary fisheries management

focus at the reservoir and the owner's consultant annually monitors the Lake Trout population in the fall using gill nets.

Jane Bullis, Merrill Creek Reservoir staff, holding an 8 lb Lake Trout (28.5 in) captured in gill nets set by their consultant at the reservoir in 2017.

In 2018, the Bureau of Freshwater Fisheries deployed four experimental gill nets in Merrill Creek Reservoir overnight (11/7/2018 – 11/8/2018) to sample the juvenile Lake Trout population. This survey was done to supplement fisheries data collected the previous week by the owners' fisheries consultant. A total of 8 Lake Trout were captured in the Bureau's gill nets compared to 18 in 2017, 18 in 2016, 20 in 2015, and 27 in 2014. The Lake Trout captured by the Bureau in the 2018 survey ranged in size from 245 – 555 mm (9.6 – 21.9 in) and the heaviest fish weighed 1.5 kg (3.2 lb). None of the Lake Trout were fin clipped and these fish are the result of natural reproduction within the reservoir. No other fish species were captured in the gill nets. The data collected by the Bureau and the consultant will be analyzed by the consultant over the winter and reviewed at the annual fisheries management meeting held between the Bureau and Merrill Creek Reservoir staff. (Hamilton, Federal Grant F-48-R)

Landlocked Salmon

Only a handful of deep lakes in New Jersey have suitable year-round habitat for coldwater fish like trout and salmon. Landlocked Salmon (lake dwelling form of Atlantic Salmon *Salmo salar*) prefer water temperatures less than 21°C (70°F) and dissolved oxygen levels greater than 5 mg/L, but can withstand warmer, less oxygenated water conditions for short periods. Landlocked Salmon, not native to New Jersey, were stocked in several waters over a half-century ago, and the historical state record for Landlocked Salmon is an 8 lb fish caught from Lake Aeroflex in 1951. In 2006, the DFW began stocking Landlocked Salmon into two north Jersey lakes, Lake Aeroflex and Lake Wawayanda (Sussex), to provide anglers with an opportunity to fish for this unique coldwater sport fish close to home. The salmon stocked are surplus provided by Massachusetts Division of Fisheries and Wildlife in exchange for surplus Northern Pike from the Hackettstown State Fish Hatchery. From 2006-2013, spring yearling salmon at about 200 mm (8 in) were stocked each May in lakes Wawayanda and Aeroflex immediately upon their arrival from Massachusetts. In 2013 the Hackettstown State Fish Hatchery began retaining a portion of the salmon for 4-11 months and growing them to a much larger size (300-500 mm / 12-20 in) before stocking. In 2014 Tilcon Lake (Morris) was added to the salmon stocking program. Stocking salmon at a larger size made a big difference in both angler interest and success.

Highlights of Landlocked Salmon in NJ for 2018:

- Angler interest in the stocking of Landlocked Salmon continued to grow.

- 4-5 in fingerlings are held indoors at the Hackettstown Hatchery, where they are grown to 14-15 in and stocked in the Fall.
- The Landlocked Salmon stocking program increased from 3 waterbodies to four with the addition of Merrill Creek Reservoir in Fall 2018.
- On 06/02/2018 a new state record for Landlocked Salmon (8 lb, 5 oz) was set by an angler fishing at Lake Aeroflex.

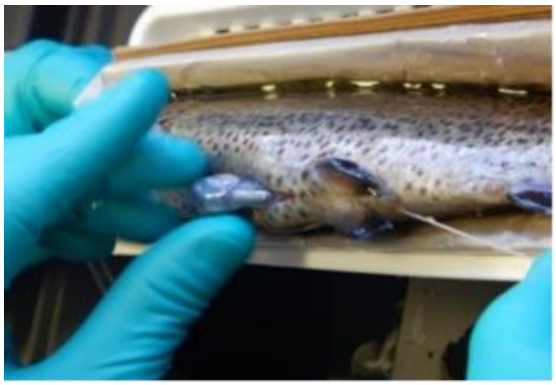
The overwhelmingly positive feedback received from anglers, combined with a change in the availability of salmon from Massachusetts in 2017, prompted further adjustments to the Landlocked Salmon stocking program. Massachusetts now provides fingerling salmon much earlier in their growth cycle (in the fall) at a size of 4-5 in. These fingerlings are immediately placed in several indoor tanks at Hackettstown where, in just one year, they can grow to 14-15 inches! These factors prompted Fish and Wildlife to establish a fall-based stocking program for Landlocked Salmon.

Although no assessment activity for Landlocked Salmon occurred during 2018, several notable events occurred. On 06/02/2018 a new state record for Landlocked Salmon was set by an angler fishing at Lake Aeroflex. The fish weighed 8 lb 5 oz (see photo). A fourth waterbody (Merrill Creek Reservoir) was added to the salmon stocking program and received its first stocking of salmon on 11/08/2018. Landlocked Salmon are closely related to Brown Trout and the stocking of salmon helps fill a void left when Fish and Wildlife discontinued stocking Brown Trout statewide in 2014 (due to a disease at the Pequest Trout Hatchery). At Merrill Creek Reservoir, a regulated *Trophy Trout Lake*, a 15-in minimum size and daily creel of 2 Landlocked Salmon (in combination with Brown and Rainbow Trout) is in effect. Information on Fish and Wildlife's website pertaining to the Landlocked Salmon stocking program was updated to reflect stocking program changes, including the addition of Merrill Creek Reservoir to the stocking program in the fall of 2018. (Hamilton, Hunter and Angler)

Stocked Trout Movement Study in the Big Flat / Flat Brook Catch and Release Area

The Big Flat Brook / Flat Brook is part of the NJDFW's Spring and Fall Trout Stocking Programs. It is considered one of the state's most popular stocked trout waters and is closed to fishing until 5:00 pm on the day that it is stocked. The Big Flat Brook / Flat Brook is allocated 34,000 trout in the spring, which is the third highest allocated waterbody in New Jersey, behind the Musconetcong River and the Raritan River, S/Br. The Big Flat Brook / Flat Brook and Raritan River, S/Br. have the only designated *Catch and Release Areas* (*C&R Area*) in the state. These areas were created in 2014 to increase availability of trout to anglers for recreation year-round.

Despite supporting wild trout, being heavily stocked, and no harvest regulations implemented in 2014, anglers continue to complain about the lack of trout within the 4.2-mile *C&R Area* on the Flat Brook. Numerous electrofishing surveys over the last decade confirmed angler's concerns with low numbers of trout documented despite acceptable summer stream temperatures and available habitat. Water temperatures, monitored daily since 2013, are suitable to hold fish year-round, but do approach and sometimes exceed optimal temperatures for trout. However, at no time did temperatures exceed the critical threshold for trout survival.



Radio transmitter surgically implanted into Rainbow Trout

In 2017 and 2018 the NJDFW implemented a Stocked Trout Movement Study using radio telemetry to determine if stocked trout were leaving the *C&R Area* and/or possibly leaving the Flat Brook system entirely. NJDFW partnered with Montclair State and their School of Conservation for the 2018 portion of this study. Radio transmitters were surgically implanted into 40 Rainbow Trout from the Pequest Trout Hatchery in April of 2017 and again in April of 2018 and stocked at three locations within the C&R Area, for a total of 80 tagged trout. The study provided key information concerning the lack of available trout in the Flat Brook *C&R Area*. Highlights of the two-year study include:

- 2017 and 2018 data were very similar, with little statistical variation between the years despite differing stream temperatures and flows between the two years. 70 of the 80 transmitters returned reliable data and were included in the analysis.
- 68 of 70 trout included in the analysis remained within the boundaries of the *C&R Area*. No trout left the Flat Brook system entirely.
- All 80 radio tagged trout were lost before the end of the summer with the loss of 70 of the 80 radio tagged trout attributed to predation. 32 lost due to avian predation and 38 to predation by mammals, but other predation types were possible.
- Trout survival ranged from 3 days to 122 days in 2017 and from 1 day to 121 days in 2018. The average number of days a trout survived was 48.5 days (52 in 2017 and 45 in 2018).
- The furthest distance a tagged trout moved ranged from 0 miles to 1.85 miles, with an average of 0.28 miles in 2017 and 0.31 miles in 2018.

- The total distance an individual trout moved ranged from 0 to 1.91 miles with average distances of 0.45 miles in 2017 and 0.34 miles in 2018.
- Six fish moved a mile or more from their original stocking location (3 in 2017 and 3 in 2018).

In 2017 the study lasted a total of 149 days. All 40 transmitters were either found without a fish, or completely lost by 9/11/17. Several days were spent looking for lost transmitters after the last known fish was found dead. In 2018, the study lasted a total of 129 days. All 70 transmitters included in analysis were found outside of a trout or were taken away from the stream before the predicted battery life of the transmitters expired (<230 days). Individual tagged trout survival following stocking ranged from 3 days to 122 days in 2017 and from 1 day to 121 days in 2018. The average number of days a trout survived after it was stocked was 48.5 days (52 in 2017 and 45 in 2018).

Initial movements from original stocking locations of forty-one of the tagged trout were downstream (19 in 2017 and 22 in 2018), 13 were upstream (10 in 2017 and 3 in 2018), and 16 trout did not move from their stocking location but were determined to still be alive at least a week after stocking (6 in 2017 and 10 in 2018). The number of days individual trout remained at the stocking location before moving ranged from 0 days to 121 days with an average of 15.5 days. The furthest distance a tagged trout moved from its stocking location ranged from 0 miles to 1.85 miles with averages of 0.28 miles in 2017 and 0.31 miles in 2018. The total distance an individual trout moved ranged from 0 to 1.91 miles with average distances moved of 0.45 miles in 2017 and 0.34 miles in 2018. Six total fish moved a mile or more from their original stocking location (3 in 2017 and 3 in 2018).

Forty-six transmitters were found and recovered (24 in 2017 and 22 in 2018). Some of these were found on land by the remains of trout, in scat piles, or in mammal runs or den like areas. Three transmitters were tracked to, but not recovered at a Great Blue Heron rookery. Nine transmitters were found after some time at the original stocking location (5 in 2017 and 4 in 2018). A total of 29 transmitters were lost over the course of the study and never located (2017 = 16, 2018 = 13). Fish implanted with these transmitters were most likely eaten by birds and flown away from the stream. Overall, it was determined that 32 transmitters were lost due to avian predation and 38 transmitters were lost due to most likely mammal predation, but other predation types were possible. Loss was attributed to predation from Great Blue Herons, Common Mergansers, Mink, Otters, and/or other forms of natural predation.

Direct predation on non-radio tagged trout was also documented by staff several times during the study and staff also anecdotally noted observing several predators such as Great Blue Herons and Mergansers. Signs of mammalian predators along the river banks in the forms of tracks, scat piles, runs, and dens were also evident. Remote cameras were deployed in 2018 by Montclair State to further document predation in the areas where the study fish were stocked. Review of the data from the cameras is ongoing and will be completed in 2019. Predation levels during the late spring/early summer are expected to be higher than at other times of the year as these predators are not just hunting to feed themselves but are feeding offspring as well. How predation levels on stocked trout within the Flat Brook compare to other trout stocked areas requires further investigation. (Shramko, Federal Grant F-48-R)

Stream Temperature Monitoring

In 2013 the Bureau established an ambient stream temperature monitoring network on 11 streams having trout fisheries that are recreationally important or of conservation interest. For this project (Trout Stocked Stream Temperature Assessment) water temperature data is continuously collected using data loggers and used to assess current temperature conditions, evaluate long term trends, determine if ambient water quality is consistent with NJDEP's Surface Water Quality Standards, and aid in the management of coldwater fisheries and associated stocking programs in these streams.

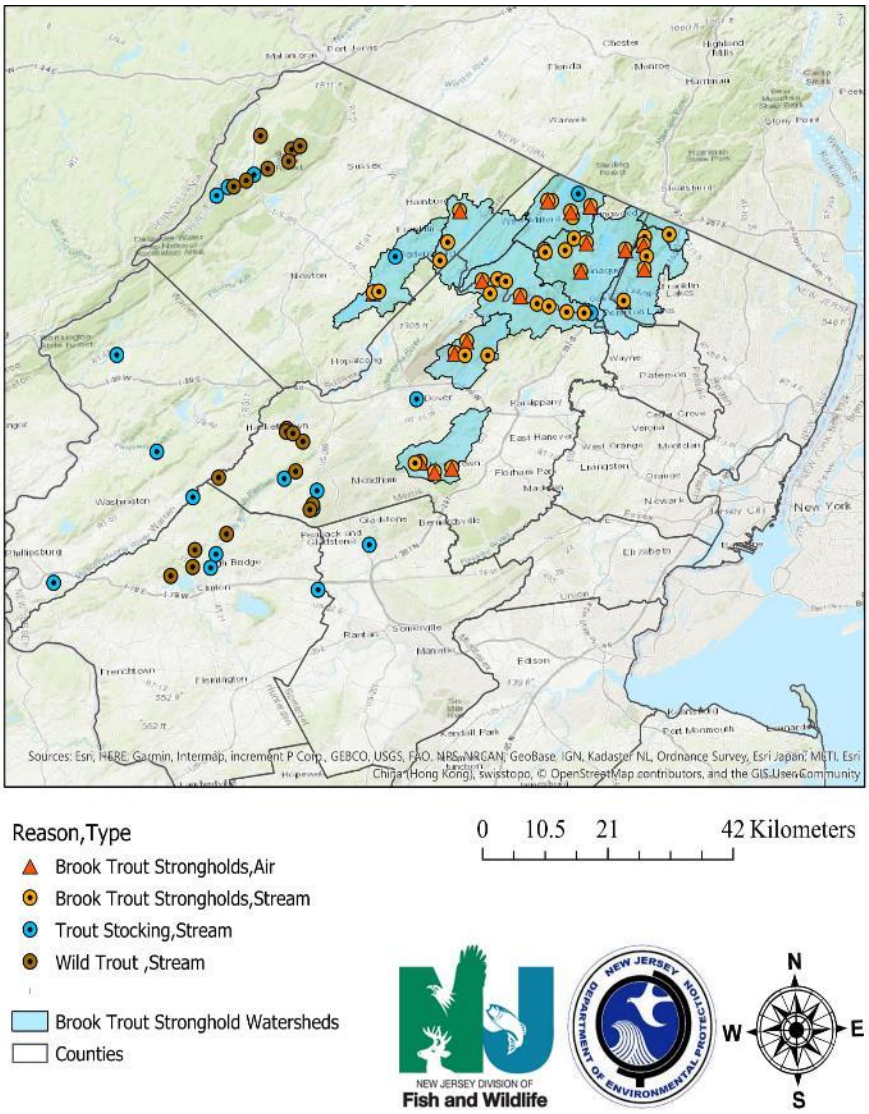
In 2015 the scope of work expanded to include a separate five-year study, *Trout Production* Stream Temperature Study, to gain insight on the link between seasonal stream and air temperatures, flows, and naturally reproducing Brook Trout populations. In 2018, another focus temperature monitoring was implemented to collect stream and air temperature data to identify strongholds for wild Brook Trout. The Brook Trout Strongholds Temperature study focuses on streams inhabited by wild Brook Trout, or streams that could be candidates for potential restoration projects for coldwater fish. Understanding the relationship between temperature and Brook Trout in stronghold areas helps fisheries managers to define and understand this species' resiliency to future climate change and identify streams that may be candidates for Brook Trout restoration. (Collenburg, Federal Grant F-48-R)

In 2018, temperature was continuously monitored at 73 stream sites (2 sites overlap between projects) and is summarized below:

- Trout Stocked Stream Temperature Assessment – 11 streams (17 sites, water only).
    - Not all data loggers were collected due to persistent high stream flow throughout the fall (data analysis delayed until all loggers collected).
- *Trout Production* Stream Temperature Study – 17 streams (water and electrofishing survey).
    - In 2018, the study was expanded to include 5 more streams in 2 drainages (Passaic River (2) and Flat Brook (3)). Standard electrofishing surveys were discontinued at Rinehart Brook due to the restoration project in progress.
    - Preliminary analysis of data collected from all survey sites over a three-year period found Brook Trout biomass was negatively correlated to increased stream temperatures (>21°C).
- Brook Trout Strongholds Temperature Study - 41 sites (20 were paired air/ water temperature) in the Passaic River drainage.
    - Preliminary analysis indicated variation in groundwater influence was greater within individual watersheds than between watersheds.

The sites monitored in 2018 are displayed in the map below, followed by additional details on each study.

Map of all NJDFW temperature monitoring sites in New Jersey.



Trout Stocked Waters Temperature Assessment

Seventeen of the stream temperature monitoring sites were located on 11 recreationally important, major trout-stocked streams. However, analysis and collection of a portion of the data was not performed due to high flows that persisted through the fall. Analysis will be conducted when the data is collected. Continuation of this project in 2019 will be contingent upon requests from biologists that are interested in thermal regimes of important trout stocked areas within their managed waterways. (Collenburg, Federal Grant F-48-R)

Trout Production Stream Temperature Study

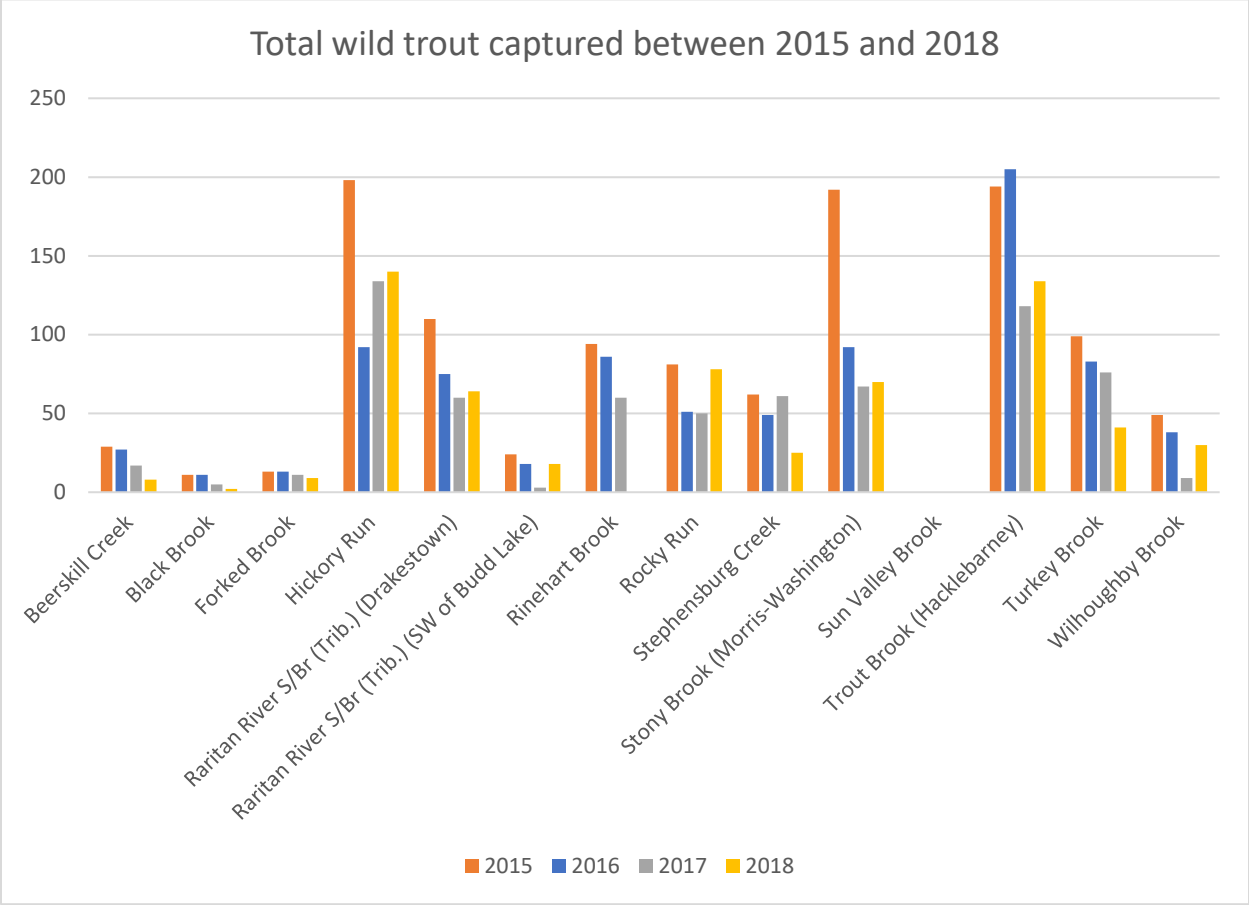
Natural variation that is seen in wild trout populations, by stream and by year, can confound analysis, hindering or decelerating management action and objectives. Understanding factors that drive these fluctuations in streams will help managers make decisions pertaining to monitoring, habitat improvements, regulations, and focus of conservation efforts. 2015 marked the beginning of the study to collect year-round continuous stream temperature data on *Trout Production* streams and assess their naturally reproducing trout populations using stream temperature and a host of other variables as potential predictors. Year-round stream temperature monitoring and electrofishing surveys were conducted over a three-year period and landscape-based variables were determined. In 2018, the study expanded to include streams in the Passaic and Flat Brook watersheds to expand sample size and avoid selection bias. These streams included Bear Swamp Brook, Big Flat Brook (trib.)(Lake Ashroe), Big Flat Brook (trib.)(W. of Lake Ashroe), Green Brook, and Parker Brook. No more standardized electrofishing is being collected at Rinehart Brook, as another project based on removal of Brown Trout is taking place. Under this project, a total of 17 streams were surveyed in 2018 (see figure below).

Highlights from 2018:

- In 7 out of 12 streams that were surveyed in 2017 and 2018, age 1+ wild trout increased from the previous year.
- In 6 out of 12 streams that were surveyed in 2017 and 2018, young-of-the-year (YOY) wild trout increased from the previous year. One stream remained unchanged with no YOY captured.
- A significant ($p = 0.016$), negative correlation ($r = -0.3807$), of Brook Trout Biomass to stream temperatures (percent of all summer time stream temperatures exceeding 21℃) was observed when looking at all survey sites for the three-year period.
- Analysis of stream temperature data (established in 2013) and related fisheries data indicated that streams experiencing the coldest temperatures during trout egg incubation have low wild trout recruitment.
- Trout Production streams with higher Growing Degree Days (GDD) had better recruitment (streams with slightly warmer winter and spring temperatures). These observations identify potential limiting factors of recruitment of trout in New Jersey and indicate metrics that could be developed for use in the monitoring of stream temperatures and in management of Trout Production streams.
- A significant ($p = 0.016$), negative correlation ($r = -0.3807$), of Brook Trout Biomass to stream temperatures (percent of all summer time stream temperatures exceeding 21℃) was observed when looking at all survey sites for the three-year period.

These observations identify potential limiting factors of recruitment of trout in New Jersey and indicate metrics that could be developed for use in the monitoring of stream temperatures and in management of *Trout Production* streams. (Collenburg, Federal Grant F-48-R)

Data collected from multiple wild trout streams between 2015 and 2018 to study natural variation and the factors that drive these changes.



Brook Trout Strongholds Temperature Study

Highlights from 2018:

- Data from this past year have been utilized to develop estimates of Ground Water (GW) influence at each site.
- Spatial variation in GW influence was greater within individual watersheds (mean SD within watershed = 0.118) than between them (SD among watershed means = 0.095). This supports previous findings that broad scale assumptions about the future of Brook Trout will be difficult/nearly impossible to make (Johnson et al. 2017). More fine scale analyses need to be made.
- Multiple linear regression models were developed to predict the daily mean water temperature (DMWT) using daily mean air temperature (DMAT) and a GW influence term (i.e. AirX) for each stream site from 2018 (n=53).
- It was observed that models that incorporated a GW influence term were better fit, higher adjusted R^2, than those that used just DMAT and will provide a great platform for making assumptions about future strongholds.

Brook trout resilience in the face of climate change is more strongly linked spatially than temporally. As air temperatures increase, not all streams have responded uniformly across

space (Trumbo et al. 2014). This variation in space and sensitivity of stream temperature to increasing air temperature is largely due to the influence of local groundwater. Snyder et al. (2015) documented this interaction in the Catoctin Mountain Park when studying potential predictor variables of Brook Trout responses to climate change. This is good news in the realm of coldwater fish in locations with sufficient groundwater. Suitable habitat may still be available despite large changes in air temperature and previous models predicting a high degree of habitat loss in New Jersey (these models were based on a large-scale watershed approach). The nature of currently highly fragmented and patchy catchments of Brook Trout populations in New Jersey lends itself to identifying which catchments will persist or fail to persist from direct measurements of local air and water temperatures on a fine spatial scale (i.e. catchments). This approach has grown in popularity because of the relatively low cost of temperature loggers and has been implemented in other states (i.e. Virginia, Pennsylvania). NJDFW installed temperature loggers at 41 sites in the Passaic River drainage, 20 of which were accompanied by air temperature loggers. The following project goals were established:

- The use of Snyder et al. (2015) and Johnson et al. (2017) groundwater and sensitivity models to determine resiliency of streams to future climate change scenarios.
- Continue shifting monitoring network to directly measure stream and air temperature in wild trout waters in 2019 and 2020.
- This project will include existing Brown Trout sympatric and allopatric streams. Various mechanisms have played a role in the displacement of Brook Trout when in the presence of introduced Brown Trout.
- Use patch/catchment resiliency measurements to prioritize and guide potential management actions.

Predicting future habitat in headwater streams will rely heavily on understanding the dynamics of groundwater inputs and stream temperature. Previously developed models using air-stream temperature regression can lend insight into the sensitivity of stream temperature to air temperature, but they may not be useful in predicting current or future water temperatures. The major goal of this study is to develop accurate predictions concerning future coldwater stream habitat to account for changes in one of the major buffers to air temperature change, groundwater. (Collenburg, Federal Grant F-48-R)

Trout Stocking Allocations

NJDFW's Bureau of Freshwater Fisheries annually determines which waterbodies and how many trout per waterbody to be stocked statewide. The allocation methodology uses a combination of biological, physical, and social factors to equitably allocate trout over a 10-week period in the spring, a 2-week period in the fall, and a 1-week period in the winter. A computerized database containing variables for each stream, lake, and pond is used in conjunction with a formula to calculate individual weekly allotments of trout. The database is annually reviewed and updated by biologists. (Shramko, Hunter and Angler)

Highlights from the 2018 Trout Stocking allocations:

- No major changes to the "Trout Formula" methodology.
- 3 waterbodies were dropped from the stocking program (Beaver Brook, Rockaway Creek, S/Br., and Trout Brook (Sussex)).
- 7 stream sections were adjusted, resulting in small changes to the number of trout.
- Black River and Wallkill River in-season stocking closures were lifted. Beginning in 2018, after opening day anglers can fish these waterbodies at any time, on the day they are stocked.
- Total trout stocked: Spring 606,961, Fall 21,330, and Winter 5,390. Stocking numbers exceeded the baseline established for each of the three stocking programs.

Beginning in the spring of 2015 all trout stocked from the Pequest Trout Hatchery are Rainbow Trout. In 2014, the Pequest Trout Hatchery had a serious Furunculosis outbreak that affected most of the hatchery's Brook and Brown Trout. Rainbow Trout showed a higher resistance to the disease. To reduce the likely hood of future outbreaks it was decided to rear and stock only Rainbow Trout until the potential source of this and other disease pathogens (raceway predation) could be addressed by covering the raceways.

There were no changes to the "Trout Formula" used to determine 2018 allocations. A spring baseline of 570,000 trout continues to be used to determine individual weekly allocations. Significant allocation changes for individual waterbodies are listed below.

Dropped / Suspended for 2018:

Trout stocking was discontinued on three waterbodies for 2018: Beaver Brook (Hunterdon), Rockaway Creek, S/Br. (Hunterdon), and Trout Brook (Sussex). These small streams for which there is little angling interest; all have reproducing Brown Trout populations and have other angling opportunities for stocked trout within a short distance.

Columbia Lake (Warren) – Beginning in 2018, trout stocking was discontinued in Columbia Lake due to a planned dam removal project. The dam forming the lake was breeched in the summer of 2018 to restore a historic migratory pathway for American Shad. The dam is scheduled to be removed in 2019.

Stream Mileage Updates:
Stocking locations for streams and rivers are ever changing. For example, when ownership of the land along a trout stocked stream changes, stocking locations may be gained or lost from the program. This can affect the total stream stocking mileage used to determine allocations and may result in more or less trout stocked in a particular stream. In addition, stream mile database corrections occur due to continued communication with the Lands Management staff and the use of GIS mapping to assess stream mileage of trout stocked sections. The following are waterbodies where the allocation changed due to the addition or subtraction of stream mileage.

Rahway River (Union)- The Rahway River trout stocking stream mileage was increased from 8.5 miles to 10.4 miles due to the gain of a five additional stocking locations and recalculation of the total mileage based upon the remaining stocking locations. This 1.9-mile increase resulted in an additional 5,650 trout in 2018.

Raritan River, S/Br. (upper section)- The upper section, from Flanders-Drakestown Rd. downstream to 200 feet above Schooley's Mountain Rd, will no longer be stocked with trout. This loss of five stocking points, coupled with more accurate GIS mapping, it was determined that the Raritan River, S/Br. stocking river mileage was reduced from 21.1 miles to 18.3 miles. This 2.8-mile reduction resulted in a decrease of 2,520 trout in 2018.

Raritan River, S/Br. (Ken Lockwood Gorge)- The mileage within the Ken Lockwood Gorge was reduced from 2.5 miles to 2.3 miles by means of GIS mapping. This small change resulted in a decrease of 550 fish in 2018.

Pequest River (upper section)- The upper section of the Pequest River, from Route 206 in Andover downstream to Route 611 in Tranquility, will no longer be stocked with trout. This equates to dropping three stocking points. The loss of these stocking points and through the use of more accurate GIS mapping, it was determined that the Pequest River stocking river mileage was reduced from 14.5 miles to 12.3 miles. This 2.2-mile reduction resulted in a decrease of 2,230 trout in 2018.

Paulins Kill (Warren/Sussex)- The Paulins Kill stocking run has been updated for 2018. Over the years, the Pequest Hatchery has been producing slightly larger fish than when the Paulins Kill run was designed, resulting in overcrowded loads. On the Paulins Kill, stocking crews were worried that they would lose fish due to the overcrowding if they were to have any sort of problem or delay and a re-design of the run was necessary. This re-design found that the Paulins Kill culminated in a reduction of stream mileage on the river. No stocking points were lost, but through the use of more accurate GIS mapping it was determined that the Paulins Kill stream mileage should be less than what the previous allocation program was using. This correction in stream mileage resulted in a 3,400-fish reduction for spring of 2018, for a total of 27,110 trout.

Lockatong Creek (Hunterdon)-The Lockatong Creek trout stocking stream mileage was reduced from 4 miles to 3.5 miles. This 0.5-mile reduction resulted in a decrease of 290 fish in 2018.

D&R Feeder Canal (upper section)- The upper section of the D&R Feeder Canal had a trout stocking location dropped due to poor access. This stocking point is near other trout stocking locations and the dropping of this location only drops the overall trout stocking stream mileage

from 5.5 miles to 5.4 miles. This 0.1-mile reduction does not lower trout allocated to the Feeder Canal. In fact, due to the correction constant and rounding the D&R Feeder Canal received 160 more fish in 2018 than in 2017.

Other Trout Allocation Changes:

In-season Closures Removed on Wallkill River and Black River – The Black and Wallkill Rivers were two of sixteen trout stocked waters closed to fishing from 5 a.m. to 5 p.m. on the day they were stocked (following opening day) and stocked all seven weeks during the spring program. The removal of these closures reduces the number of times these rivers will be stocked and the number of fish allocated. These rivers are now treated like the rest of the streams and rivers in the trout stocking program without in-season closures.

The Black River is now stocked once pre-season and six times following opening day, all but Week 1. The dropping of the in-season closure and subsequent change to the allocation schedule in the trout stocking allocation database resulted in a total decrease of 910 trout in 2018 compared to 2017.

The Wallkill River is a little bit more complicated than the Black River, as it has an upper and a lower section based on trout survivability. The upper section is classified as *Trout Maintenance*, because temperatures remain cold enough to support year-round trout survival. The lower section of the Wallkill River is classified as *Non-Trout*, because temperatures do not remain cold enough to support year-round trout survival. Due to the difference in trout survivability, the upper section will be allocated 1 more in-season stocking event than the lower section of the Wallkill River (a difference of 260 trout between the upper and lower sections). The dropping of the in-season closure and subsequent change to the allocation schedule in the trout stocking allocation database resulted in a total decrease of 2,250 trout in 2018 compared to what it was allocated in 2017.

A summary of trout stocked from NJDFW's Pequest Trout Hatchery during 2018, by season and species, is found in the table below.

Spring 2018 Trout Stocking Summary				
Species	Type	Avg. Length	Lb	# Fish
Rainbow Trout	Production	11.3"	309,559	599,471
	Broodstock	15.0" & 21.0"	16,712	7,490
		Totals	**326,271**	**606,961**
Fall 2018 Trout Stocking Summary				
Species	Type	Avg. Length	Lb	# Fish
Rainbow Trout	Production	14.2"	28,005	20,590
	Broodstock	19.3"	2,553	740
		Totals	**30,558**	**21,330**
Winter 2018 Trout Stocked Lakes Program Summary				
Species	Type	Avg. Length	Lb	# Fish
Rainbow Trout	Production	14.5"	7,860	5,390
		Totals	**7,860**	**5,390**

Wild Brook Trout Assessment

Anthropogenic landscape changes and past management practices have negatively impacted Brook Trout, New Jersey's only native trout species. Habitat alteration, stream fragmentation, diminished water quality, and competition with introduced non-native trout (Brown and Rainbow Trout) have contributed to the decline of wild Brook Trout in our state, such that wild populations of this species now persist in less than half their original range. In response to growing concern over the plight of Brook Trout, NJDFW has taken steps to conserve wild Brook Trout by adjusting fishing regulations and stocking practices. Most recently (2018) a *Brook Trout Conservation Zone* was established in northwestern New Jersey, where nearly all wild Brook Trout populations occur. All Brook Trout caught by anglers within this zone must be immediately released unharmed. In addition, permits for private stockings of Brook Trout in the Zone are no longer permitted (NJDFW discontinued rearing and stocking Brook and Brown Trout in 2014 due to fish disease at the Pequest Trout Hatchery). These changes highlight the importance of conserving this important native sportfish and helps to preserve the gene pools and genetic diversity of our wild Brook Trout populations, and their potential to evolve in response to environmental change. (Hamilton, Hunter and Angler)

NJDFW conducts surveys on stream to assess wild Brook Trout. The data from these (and other) stream surveys are used to:

1) Assess Brook Trout status (presence/absence), primarily in *Trout Production* stream catchments and small tributaries that lack survey data.
2) Determine if impediments affect the occurrence and distribution of wild Brook Trout and non-native trout species upstream.
3) Document stream fish assemblages that may have potential Brook Trout restoration.

In 2018, 106 stream surveys conducted statewide can be used to determine presence/absence of wild Brook Trout; 34 of these were conducted specifically for Brook Trout assessment purposes. The results from all surveys can be summarized:

- 58 surveys (in 44 streams) documented wild Brook Trout and of these:
  - 8 streams were new (previously undocumented) locations for Brook Trout
  - 17 streams also had Brown Trout
- 14 streams had only wild Brown Trout.
- 1 stream had wild Rainbow Trout (other trout species not present).
- 12 surveys were conducted to assess impediments and 1 dam appears to block non-native trout from migrating upstream to areas where wild Brook Trout occur.
- 10 surveys were conducted on streams to assess their potential for Brook Trout restoration (temperature data collected by Trout Unlimited on these streams will be used to help determine suitability)

The table below summarizes the results of the surveys (number of trout for each species indicated) and is followed by more detailed descriptions of the three projects.

Presence/absence of wild trout species in 99 stream surveys conducted in 2018 by NJDFW Jersey, listed by major watershed. BKT= Brook Trout; BNT=Brown Trout; RBT=Rainbow Trout. Surveys specifically conducted to assess wild Brook Trout are boldfaced; streams where the standard sampling protocol was not followed are noted by "+"; *WTS* indicates the stream (or stream section) was regulated as a *Wild Trout Stream* in 2018; A trout species was considered wild when young-of-the-year ("YOY") were present or when only trout older than young-of-the-year ("older") were present; "***n***" denotes a new finding for that wild trout species in the catchment.

Stream	County	Location	***n* (YOY/older)**			Results page #
			BKT	**BNT**	**RBT**	
Upper Delaware (North) & Wallkill Region *(Shimers Brook to Paulins Kill and Wallkill River)*						
Beerskill Creek	Sussex	Cemetery Road	2/6	0	0	A-1
Big Flat Brook (trib.)(Lake Ashroe)	Sussex	Brook Road	42/15	0	0	A-2
Big Flat Brook (trib.)(W. of Lake Ashroe)	Sussex	Brook Road	144/8	0	0	A-3
Forked Brook	Sussex	Grau Road	8/1	0	0	A-4
Little Flat Brook (trib.)(Bevans)	Sussex	Rt. 615	**37/23**	0/**1**	0	A-5
Parker Brook	Sussex	Crigger Road	0/5	0	0	A-6
Paulina Creek	Warren	Rt. 94	0	0	0	A-7
Paulins Kill (trib.)(Yellow Frame)	Warren	Lincoln Laurel Road	0	0	0	A-8
Sparta Glen Brook	Sussex	Rt. 620 Sparta Glen Park	0	0	0	A-9
Trout Brook (Middleville)	Sussex	Rt. 521	0	22/6	0	A-10
Trout Brook (Middleville)(trib.)(Five Points)	Sussex	Fairview Lake Road	0	0	0	A-11
Trout Brook (Middleville)(trib.) (Trout Bk WMA)	Sussex	Fairview Lake Road	0	0	0	A-12
Yards Creek	Warren	Wishing Well Road	0	16/8	0	A-13
Upper Delaware (South) Region *(Delawanna Creek, Lockatong Creek to Assunpink Creek)*						
Beaver Brook (trib.)(E. of Manunka Chunk) +	Warren	Upper Sarepta Road, upstream of waterfall	0	0	0	A-14
Beaver Brook (trib.)(E. of Manunka Chunk) +	Warren	Upper Sarepta Road, downstream of waterfall	0	0	0	A-15
Delaware River (trib.) (Holland)	Hunterdon	Rt. 627	0	59/19	0	A-16
Hances Brook +	Warren	Confluence with Musconetcong R. to Watters Road	1/2	0	0	A-17
Hances Brook (trib.) (Rockport) +	Warren	Hazen Road to Watters Road	3/4	0	0	A-18
Lommasons Glen Brook	Warren	Rt. 626	53/58	0/**1**	0	A-19
Mill Brook (Broadway)	Warren	Millbrook Road	17/21	28/13	0	A-20
Musconetcong River (trib.)(Anderson)	Warren	Asbury Anderson Road (lane to NJ Audubon)	3/3	0	0	A-21
Musconetcong River (trib.)(Anderson)	Warren	Asbury Anderson Road (lane to NJ Audubon)	0/1	0	0	A-22

Musconetcong River (trib.)(Lebanon)	Warren	Hollow Road	12/4	5/1	0	A-23
Musconetcong River (trib.)(Port Murray)	Warren	Washburn Road	36/8	0	0	A-24
Musconetcong River (trib.)(S. of Point Mtn.)	Warren	Musconetcong River Road	63/19	0	0	A-25
Musconetcong River (trib.)(S. of Schooley's Mtn. Bk)	Morris	Esna Drive	8/0	0	0	A-26
Pequest River (trib.) (Buttzville)	Warren	Creek Road	0	**2**/**1**	0	A-27
Pohatcong Creek (trib.) (New Village)	Warren	Montana Road	19/8	58/8	0	A-28
Schooley's Mountain Brook	Morris	Rt. 24	12/19	0	0	A-29
Stephensburg Brook (*WTS*)	Morris	Stephensburg Road	14/9	1/1	0	A-30
Trout Brook (Hackettstown) +	Warren	Petersburg Road	0	0	0	A-31
Tunnel Brook (Oxford Mtn.)	Warren	Rt. 31	0/5	0/**1**	0	A-32
Turkey Hill Brook	Hunterdon	Turkey Hill Road	0	0	0	A-33
Turkey Hill Brook	Hunterdon	Rt.173, upstream of RR culvert	0	0	0	A-34
Warford Creek	Hunterdon	Rt. 29	0	0	0	A-35
West Portal Creek +	Hunterdon	I-78, upstream	0	1/3	0	A-36
			(0/2 Tiger Trout)			
Upper Passaic Region						
(Pompton, Pequannock, Wanaque, Ramapo, Upper Passaic, Whippany, & Rockaway rivers)						
Bear Swamp Brook (WTS)	Bergen	Bear Swamp Road	7/33	0	0	A-37
Bear Swamp Brook (trib.) (Spruce Swamp)	Bergen	Bear Swamp Road	0	0	0	A-38
Beech Brook	Passaic	Beech Road	9/0	0	0	A-39
Clinton Brook (trib.) (Cedar Pond E. Branch)	Passaic	Clinton Road	0	0	0	A-40
Clinton Brook (trib.) (Cedar Pond W. Branch)	Passaic	Clinton Road	0	0	0	A-41
Green Brook	Passaic	Warwick Turnpike	31/14	0	0	A-42
Harmony Brook	Morris	Cold Hill Road	0	0	0	A-43
Harmony Brook (trib.) (SW of Clyde Potts Res.)	Morris	Cold Hill Road	0	0	0	A-44
Wanaque Reservoir (trib.)(S. of Blue Mine Bk)	Passaic	Red Mine Road	0	0	0	A-45
Wanaque Reservoir (trib.)(N. of Posts Brook)	Passaic	Red Mine Road	**11**/**15**	0	0	A-46
West Brook (*WTS*)	Passaic	West Brook Road	0	0	0	A-47
Whippany River (*WTS*)	Morris	Bockden Road	0	0	**9**/0	A-48
Whippany River (trib.) (Brookside)	Morris	Knight's Bridge Road	0	0	0	A-49
Lower Passaic & Upper Atlantic Region						
(Lower Passaic, Saddle, Hackensack, Pascack, & Elizabeth rivers to Tom's River)						
Bear Brook (Park Ridge)	Bergen	Pine Drive	0	0	0	A-50
Preakness Brook	Passaic	Hinchman Road	0	0	0	A-51

		Raritan Region *(Mainstem Raritan River and all tributaries)*				
Beaver Brook (Hunterdon) (*WTS*)	Hunterdon	Allerton Road	0	6/5	0	A-52
Beaver Brook (Hunterdon) (*WTS*)	Hunterdon	Old Highway 22	0	2/6	0	A-53
Black Brook	Hunterdon	Van Syckles Road	0	0/2	0	A-54
Burnett Brook (*WTS*)	Morris	Ironia Road	0	1/6	0	A-55
Cold Brook (trib.) (Laurel Farms)	Hunterdon	Rt. 517	0	0	0	A-56
Dawson's Brook	Morris	Calais Road	0	0	0	A-57
Hacklebarney Brook	Morris	Near confluence with Black River Road	3/2	0	0	A-58
Hickory Run (*WTS*)	Hunterdon	Hickory Run Road	67/73	0	0	A-59
India Brook (*WTS*)	Morris	Sussex Turnpike	0	0	0	A-60
India Brook (trib.) (E. of Lake Cherokee)	Morris	Sussex Turnpike	**0/1**	**3/3**	0	A-62
India Brook (trib.) (Lake Cherokee)	Morris	Sussex Turnpike	**26/11**	**0**	0	A-61
Lamington (Black) River (trib.)(Fairmount)	Morris	Pickle Road	**20/2**	0	0	A-63
Lamington (Black) River (trib.)(N. of Hacklebarney Brook)	Morris	State Park Road	**34/13**	0	0	A-64
Lamington (Black) River (trib.)(N. of Pottersville)	Morris	Pottersville Road	**28/15**	**2/4**	0	A-65
Millstone River (2 surveys)	Somerset	Griggstown Causeway	0	0	0	A-66, A-67
Millstone River (2 surveys)	Somerset	Blackwells Mills Road bridge	0	0	0	A-68, A-69
Mine Brook (trib.)(S. of Somersetin)	Somerset	Post Kunhardt Road	0	0	0	A-70
Peapack Brook	Morris	Cooper Lane	**32/16**	**32/19** (**0/1 Tiger Trout**)	0	A-71
Peapack Brook (trib.)(W. of Mt. Paul)	Morris	Fox Chase Road	0	0	0	A-72
Raritan River N/B (trib.) (N. 2nd Watchung Mtn. N/Br)	Somerset	Belcher Road	0	0	0	A-73
Raritan River S/B (*WTS*)	Morris	Stephens Mill Road	0	5/14	0	A-74
Raritan River S/B (*WTS*)	Morris	Bartley Road (Bartley WMA)	0/1	23/5	0	A-75
Raritan River S/B (trib.) (Drakestown)	Morris	Joy Drive	62/2	0	0	A-76
Raritan River S/B (trib.) (Long Valley)	Morris	Maple Avenue	29/0	**6/9**	0	A-77
Raritan River S/B (trib.) (SW of Budd Lake)	Morris	Rt. 46	18/0	0	0	A-78
Rinehart Brook (Hacklebarney) + (*WTS*)	Morris	Entire length surveyed multiple times	*/* (0/1 Tiger Trout)	*/*	0	51
Rinehart Brook (trib.) Fairmount) +	Morris	Hacklebarney State Park (entire length surveyed once)	63/32	0	0	51
Rockaway Creek, S/Br.	Hunterdon	Kullman Industries Campus Dr.	0	15/4	0	A-79
Rockaway Creek, S/Br. (trib.)(Lebanon Boro)	Hunterdon	Main Street	0	19/5	0	A-80
Rocky Run (*WTS*)	Hunterdon	Rocky Run Road	47/31	0	0	A-81

Spruce Run Creek	Morris	Crystal Springs Preserve, off Califon Road	0	0	0	A-82
Spruce Run Creek	Hunterdon	Miquin Woods, off Newport Road	0	17/14	0	A-83
Spruce Run Creek	Hunterdon	Main Street	0	3/35	0	A-84
Spruce Run Creek	Hunterdon	Rt. 31 across from Rocky Run Road	1/1	13/13	0	A-85
Stony Brook (*WTS*)	Morris	Columbia Trail Walking Bridge	5/10	36/19	0	A-86
Teetertown Brook (*WTS*)	Hunterdon	Hollow Brook Road	7/1	0	0	A-87
Trout Brook (WTS)	Morris	Hacklebarney State Park	86/48	0	0	A-88
Trout Brook (Hacklebarney) + (*WTS*)	Morris	Confluence with Black River to waterfall (2 surveys)	*/*	*/*	0	A-88
Turkey Brook (*WTS*)	Morris	Stephens Mill Road	21/1	11/5 (3/0 Tiger Trout)	0	A-89
Willhoughby Brook (*WTS*)	Hunterdon	Rt. 31	7/0	6/17	0	A-90
		Lower Delaware Region *(Assunpink Creek to Maurice River watersheds)*				
Rancocas Creek, W/Br. (trib.)(W. of Timbuktoo)	Burlington	Rancocas Road	0	0	0	A-91

* Denotes trout species found in survey – see referenced report page for more details.

Brook Trout Status

NJDFW participates in the range-wide Eastern Brook Trout Joint Venture (EBTJV), a unique partnership initiated in 2004 under the National Fish Habitat Initiative (*www.fishhabitat.org*). EBTJV is a geographically focused, locally driven, and scientifically based effort to protect, restore, and enhance aquatic habitat throughout the range of Brook Trout in the eastern United States. The Venture has produced a range-wide population assessment of wild Brook Trout, completed extensive work that identifies key threats to wild Brook Trout and their habitats, and developed conservation strategies to protect, enhance and restore wild Brook Trout. The EBTJV has refined their subwatershed status map to a fine-scale catchment level and NJDFW conducts surveys to assess the status of Brook Trout in catchments that lack survey data. *S*tream reaches (and their tributaries) are assessed to determine if Brook Trout are present in catchments upstream of where non-native trout (Brown and/or Rainbow Trout, and sometimes Brook Trout) have already been documented. These surveys provide data that will help complete range-wide mapping and enable fisheries biologists to better manage wild Brook Trout populations. The data from these and other surveys collected by NJDFW are entered into FishTrack (NJDFW's computerized freshwater fisheries database) and shared with the EBTJV.

The results from 12 surveys conducted in 2018 to determine Brook Trout presence/absence:

- Flat Brook drainage:
  - Little Flat Brook (trib.)(Bevans) Brook and Brown – Brook and Brown Trout
- Passaic River drainage:
  - Bear Swamp Brook (trib.)(Spruce Swamp) – no fish found
  - Harmony Brook – no trout
  - Harmony Brook (trib.)(SW of Clyde Potts Reservoir) – no trout
  - Wanaque Reservoir (trib.)(N. of Posts Brook) – Brook Trout
  - Wanaque Reservoir (trib.)(S. of Blue Mine Brook) – no fish found
  - West Brook – no (wild) trout found (one stocked Rainbow Trout)

- Raritan River drainage:
    - Lamington (Black) River (trib.)(Fairmount) – Brook Trout
    - Lamington (Black) River (trib.)(N. of Hacklebarney Brook) – Brook Trout
    - Lamington (Black) River (trib.)(N. of Pottersville) – Brook and Brown Trout
    - Spruce Run Creek (Crystal Springs Preserve) – no trout
    - Spruce Run Creek (Miquin Woods) – Brown Trout

Assessment of Impediments in Relation to the Distribution of Native Brook Trout

Impediments to fish passage (dams, culverts, waterfalls, etc.) on a coldwater stream can fragment and alter fish habitat and impact the occurrence and distribution of native Brook Trout. Wild populations of non-native Brown and Rainbow Trout also threaten the long-term survival of wild Brook Trout in New Jersey. Impediments may also prevent non-native trout from moving upstream and colonizing native Brook Trout streams. In 2018 a study was initiated to assess differences in trout species composition above and below barriers and determine if barriers may prevent: (1) non-native trout downstream from invading and displacing Brook Trout that may occupy areas upstream, and (2) Brook Trout from colonizing areas upstream of barriers where they may have historically occurred. *Trout Production* streams having dams were identified and electrofishing surveys were conducted to provide data to compare trout species present upstream and downstream of the barrier. Documenting fish communities in relation to specific barriers will allow the NJDFW to better manage wild Brook Trout populations. (Diglio, Hunter and Angler)

In 2018, 12 surveys were conducted upstream of potential impediments (see table below) and the data indicates:

- 1 dam (on India Brook (trib.)(Lake Cherokee) has prevented Brown Trout from migrating upstream and displacing Brook Trout.
- 5 dams had no trout upstream, which suggests they may prevent not only non-native trout from colonizing upstream areas, but also Brook Trout from re-colonizing areas where they may have once occurred.
- 5 dams that had non-native trout upstream may not be barriers to upstream trout movement.
- 1 natural barrier (waterfall on Teetertown Brook) neither proved or disproved that it is a barrier to trout movement upstream, as a dam further downstream is more likely the barrier preventing upstream movement of Brown Trout.

Results of 12 surveys conducted by NJDFW in 2018 to assess the impact of barriers on the distribution of Brook Trout and non-native trout in New Jersey.

	Downstream				Upstream			
		Trout species				Trout Species		
Barrier name	**Stream name**	**Bkt**	**Bnt**	**Rbt**	**Stream name**	**Bkt**	**Bnt**	**Rbt**
Mendham Township Pond Dam	Whippany River		X	X	Whippany River			X
Posner Pond Dam	Whippany River (trib.)(Brookside)		X	X	Whippany River (trib.)(Brookside)			
Four Bridges Dam	Burnett Brook		X		Burnett Brook		X	
J. Seward Johnson Dam	Cold Brook		X		Cold Brook (trib.)(Laurel Farms)			
Cifrese Dam	Dawson's Brook	X	X		Dawson's Brook			
Winarsky Dam	India Brook	X	X		India Brook		X	
Cherokee Lake Dam	India Brook	X	X		India Brook (trib.)(Lake Cherokee)	X		
Klodes Hotel Dam	India Brook	X	X		India Brook (trib.)(E. of Lake Cherokee)	X	X	
Memorial Park Pond Dam	Mine Brook	X	X	X	Mine Brook (trib.)(S. of Somersetin)			
Chester Pond Dam	Peapack Brook	X	X		Peapack Brook (trib.)(W. of Mt. Paul)			
Peapack-Gladstone Reservoir Dam	Peapack Brook	X	X		Peapack Brook	X	X	
Natural waterfall	Teetertown Brook	X			Teetertown Brook	X		

Potential Brook Trout Restoration Assessments

This project seeks to identify streams that may have potential for Brook Trout restoration. GIS tools (including EBTJV maps) are used to identify potential streams to be targeted for further assessment. NJDFW conducts electrofishing surveys to provide fish assemblage data and Trout Unlimited (TU) collects summer water temperature data on targeted streams. The data collected are jointly reviewed and used to identify streams that may be suitable for Brook Trout restoration.

In 2018, this project focused on streams in the Upper Delaware watershed. NJDFW completed 11 electrofishing surveys on 7 streams in 3 river drainages, and TU installed data loggers on these (and other) streams to continuously monitor summer water temperatures. Not all temperature data collected by TU in 2018 was available for analysis prior to the preparation of this report. The results from electrofishing surveys and available temperature data were used to identify possible candidate streams for Brook Trout restoration as follows:

- 3 streams may be suitable candidates for transference of wild Brook Trout (pending review of 2018 water temperature data and additional data collection in 2019):
    - Trout Brook (Middleville) – no trout found (2 tributaries electrofished), wild Brown Trout occur in mainstem further downstream.
    - Beaver Brook (trib.)(E. of Manunka Chunk) – no trout found (2 electrofishing surveys).
    - Turkey Hill Brook - no trout found (2 electrofishing surveys), wild Brown Trout occur further downstream (Brook Trout historically present).
- 1 stream, Hances Brook, that had low Brook Trout abundance (2 electrofishing surveys conducted) may be a good candidate for habitat (riparian buffer) restoration. TU will install additional water temperature loggers in 2019 to better document thermal impacts.
- 2 streams, Paulina Creek and Paulins Kill (trib.)(Yellow Frame), were electrofished (no trout found) and were considered unsuitable for restoration, due to warm summer water temperatures (data collected by TU analyzed).
- 1 stream, Trout Brook (Hackettstown), was electrofished (no trout found), however, the water temperature data collected by TU must be analyzed to determine if this stream should be considered for Brook Trout restoration.

In 2019, the remaining water temperature data collected in 2018 by TU will be analyzed by NJDFW to determine if other streams may warrant further consideration for Brook Trout restoration. The three streams identified above that may be suitable for Brook Trout restoration will be further assessed, primarily by TU (temperature monitoring, electrofishing spot-checks for wild trout species, and barrier assessment).

In addition to the streams surveyed under this project, Brook Trout restoration activities are currently underway at three streams – Rinehart Brook, Sparta Glen Brook, and West Portal Brook (see Protection and Restoration of Inland Fisheries and Aquatic Habitats: Coldwater section, page 49).

Protection and Restoration of Inland Fisheries and Aquatic Habitats: Coldwater

To protect New Jersey's critical aquatic resources, fisheries biologists both initiate projects and provide technical assistance to conservation, stream restoration, dam removal, and related Land Use projects each year. Land Use projects are coordinated through the Division's Environmental Review program. This input is directed towards minimizing land use change impacts to the state's fisheries resources. This is typically accomplished through the use of timing restrictions during critical fish spawning periods, protection of riparian buffers, and project modification, assuring best use practices are implemented at all times. However, at times a more in-depth review and comments are necessary on specific projects.

Boulder placement during habitat improvement project at Sparta Glen Brook.

In 2018 staff-initiated projects and/or provided technical assistance to the following projects related to our coldwater resources:

- An in-stream habitat restoration project was conducted in the Musconetcong River.
- Year 2 of a Brook Trout restoration project was continued on Rinehart Brook, in which Brown Trout were removed via backpack electrofishing. The number of Brook Trout in this section has doubled since project commencement.
- A small population of Brook Trout continues to be monitored at Sparta Glen Brook, in a restored section that was impacted by a landslide occurred in 2000.
- Electrofishing surveys were conducted 1 year after a large quantity of pulverized granite was discharged into Spruce Run (Creek). The fishery is making a recovery.
- A survey was conducted on West Portal Brook, a stream in which a catastrophic fish kill occurred in 2016, due to a detergent spilled originating from an accident on Route 78 into the creek. Data will be used to guide future research and management activities.

Musconetcong River Fish Habitat Enhancement Project (Hunterdon/Warren)

An in-stream fish habitat restoration project undertaken by Trout Unlimited on a section of the Musconetcong River (bounded on one side by property owned by Fish and Wildlife) was completed in June 2018. The purpose of the project was to enhance habitat for fish and macroinvertebrates and improve sediment transport. The project was funded by Trout Unlimited who hired a stream restoration consultant to build deep pools and narrow the stream channel by strategically placing boulders and creating gravel bars with an excavator. This major north Jersey river is classified as *Trout Maintenance* and is annually stocked with trout (in the spring and fall) and is open to public fishing. (Hamilton, Federal Grant F-48-R)

Rinehart Brook (Morris) - Brook Trout Restoration Project

A Brook Trout restoration project was initiated on Rinehart Brook, a tributary to the Black River within Hacklebarney State Park in 2017. Prior to the project, non-native Brown Trout had become the dominant trout species, with the native Brook Trout residing in small numbers. The objectives of this study were: to determine if multiple depletion electrofishing could be an efficient manner to remove Brown Trout, to monitor potential rebound effects of the Brook and Brown Trout populations, to determine if natural boulder waterfalls prevent Brown Trout from recolonization, and ultimately restore Brook Trout. The following bullets are highlights from this two-year study: (Crouse, Federal Grant F-48-R)

- 11 single pass removals of Brown Trout via backpack electrofishing were conducted along Rinehart Brook during 2017 and 2018.
- A total of 1,236 Brown Trout were removed from Rinehart Brook.
- 1,048 fin-clipped Brown Trout were relocated into several locations along the Black River and used to determine if a series of waterfalls prohibited recolonization from the Black River, of which 43 returned, indicating upstream passage.
- The maximum number of Brook Trout captured on any given complete pass increased from 65 in 2017 to 147 in 2018.
- The total number of Brook Trout older than young-of-the-year (YOY) increased from a maximum of 5 in 2017 to a maximum of 43 in 2018.

Capture and removal of Brown Trout were accomplished via multiple electrofishing passes from August 23, 2017 through October 4, 2018. Approximately two miles of Rinehart Brook and approximately 0.5 miles of an unnamed tributary were initially electrofished. Rinehart Brook was divided into multiple sections that could be electrofished either consecutively or at different times. Starting downstream and moving upstream; Section 1: mouth of the Black River and ended at the uppermost waterfall, which at one time was considered a potential barrier to fish movement (see photo). Section 2: from the waterfall upstream to the beginning of the standardized 150-m stretch (surveyed for several years as part of a study that aims to better understand the relationship of temperature with various measures of wild trout populations); Section 3: standardized 150-m stretch (so that it could be compared with trout numbers from previous surveys); Section 4: above standardized electrofishing section upstream to a small dam upstream of Hacklebarney Road. The core study area is designated as sections two through four. A fifth section continued upstream to Old Farmers Road. An unnamed tributary (Rinehart Brook)(trib.)(Fairmont) converges with Rinehart Brook just upstream of Hacklebarney Road. This tributary was also electrofished and only Brook Trout were found.

43 fin-clipped Brown Trout were found upstream of this waterfall in 2018, demonstrating it is not a barrier for upstream movement of Brown Trout.

During 2017, a total of seven passes were completed. This was broken down into 29 surveys for removal and 1 to remark fish below the potential barrier. In 2018, a total of four passes were completed, totaling 19 surveys. The tables below describe the numbers of both Brook and Brown Trout that were captured in each section for 2017 and 2018, followed by the percentage of all trout that were Brook Trout.

Beautiful male Brook Trout captured on November 2, 2017

The first pass through the core study area revealed a total of 725 Brown Trout and only 58 Brook Trout (7.4% Brook Trout). All Brown Trout were removed, and all other species were returned where they were captured. Subsequent passes resulted in fewer Brown Trout and relatively stable numbers of Brook Trout. By the seventh pass, only 9 Brown and 60 Brook Trout were encountered (87.0% Brook Trout). Seventy-seven Brook Trout (and no Brown Trout) were collected on the first pass in the tributary. Passes four through seven resulted in the capture of 79 additional Brown Trout that were euthanized.

Questions remained regarding the ability of trout to traverse a series of waterfalls/plunge pools near the stream's confluence with the Black River. To test this, adipose fins were removed from 1,048 Brown Trout collected in 2017 and were transplanted below the falls in both Rinehart Brook and the Black River. All Brown Trout were examined during subsequent removal efforts, to determine if any marked Brown Trout are found upstream of the falls. As of the final survey if 2017 on October 3, many marked Brown Trout were found below and between the series of falls, however none had been re-captured above the falls as of the final electrofishing survey.

Additional surveys resumed in 2018, continuing to remove Brown Trout not previously captured and to monitor the Brook Trout population. Unfortunately, 43 clipped Brown Trout were found upstream of the waterfalls, demonstrating recolonization. Those fish, in addition to 74 Browns that were not initially captured were euthanized. A total of four electrofishing passes took place in 2018, with the final pass on October 4, when no Brown Trout were found upstream of the upper falls for the first time in this study. In the best interest of the resident Brook Trout, all Brown Trout (152) captured in Rinehart Brook during 2018 were euthanized. A final removal was conducted from the confluence to the upper falls on October 18, with only six Brown Trout found.

In conjunction with the Brook Trout Restoration project, the Black River's most proximal tributary, Trout Brook, was surveyed. A section of Trout Brook is routinely monitored and is home to an abundance of Brook Trout. This section is free of wild Brown Trout, due to an impediment of fish passage in the form of a waterfall, that has precluded Brown Trout colonization. A section of Trout Brook was electrofished from its confluence with the Black

River, upstream approximately 300 meters to the waterfall. In this reach, 99 Brown Trout (29 young-of-the-year (YOY) and 70 older than YOY) were measured, inspected, and removed. None of the previously fin clipped Brown Trout were found in Trout Brook, as might have been expected. Seventy wild Brook Trout (31 YOY and 39 older than YOY) and 2 stocked Rainbow Trout were also encountered. Other species were encountered, but not documented. A second removal event took place on October 18 in which 52 Brown Trout (34 young-of-the-year (YOY) and 18 older than YOY) were removed. Brown Trout were removed from this section, as it is believed to be a rather large source population that could potentially recolonize Rinehart Brook, undermining the restoration efforts.

As an interesting aside, a wild Tiger Trout YOY measuring 82 mm / 3.2 in was captured in the lower end of Rinehart Brook and released on 11/2/17. During a subsequent survey through the same area, 8.5 months later on 7/16/18 (first time back) the same fish was captured, this time measuring 152 mm / 6.0 in. It is unmistakable that this is the same fish, as the unique markings in the photos can be seen in each photo below.

Brook Trout appear to have already benefited from the removal of Brown Trout, as the total number has more than doubled. The average number of Brook Trout captured on any given complete pass in 2017 was 55 (max. 65 / min. 38). This average increased to 120 (max.147 / min. 111) in 2018. More impressive was the total number of Brook Trout older than young-of-the-year (YOY) increased from a maximum of five (low of 2) to a maximum of 43 (low of 26). The lack of Brown Trout upstream of the upper falls and the increase in older than YOY Brook Trout give great reasons for optimism for 2019 and beyond.

This study will continue for several years. The next step is to install a barrier to upstream Brown Trout recolonization from the Black River. This is anticipated to happen prior to the 2019 spawning season. Subsequent electrofishing surveys will occur in 2019 to remove Brown Trout until the barrier is constructed and to monitor the existing Brook Trout population. Data tables are below.

Trout species composition at multiple locations within Rinehart Brook and its tributary during seven complete electrofishing passes to remove Brown Trout in 2017.

Pass # and Date	Species Composition	1) Black River confluence – Waterfall (140m / 0.1 miles)	2) Waterfall – Start of standard survey (275m / 0.2 miles)	3) Standard Survey (150 m / 0.1 miles)	4) Top of standard survey – Dam at Hacklebarney Rd (1,400m / 0.9 miles)	5) Dam at Hacklebarney Rd – Old Farmers Road (1,590m / 1.0 miles)	Fairmount Tributary (900m / 0.6 miles)	Rinehart Brook (sec. 2-5) (3,415m / 2.1 miles)	Watershed (Fairmount tributary Brook Trout # from pass 1 carried forward)
Pass 1 8/23 & 8/30/17	Brook	3	6	2	50	0	77	58	135
	Brown	82	160	58	504	3	0	725	725
	Total	85	166	60	554	3	77	783	783
	Brook%	3.5%	3.6%	3.3%	9.0%	0%	100%	**7.4%**	**15.7%**
Pass 1.1 8/23/17	Brook			1					
	Brown			12					
	Total			13					
	Brook%			7.7					
Pass 1.2 8/30/17	Brook			1					
	Brown			4					
	Total			5					
	Brook%			20					
Pass 2 9/1 & 9/7/17	Brook	6	14	1	29	0		44	121
	Brown	39	53	3	149	0		205	205
	Total	45	67	4	178	0		249	326
	Brook%	13.3%	20.9%	25.0%	16.3%	0%		**17.7%**	**37.1%**
Pass 3 9/12/17	Brook	5	8	3	39			50	127
	Brown	18	8	2	92			102	102
	Total	23	15	5	131			152	229
	Brook%	21.7%	50.0%	60.0%	29.8%			**32.9%**	**55.5%**
Pass 4 9/13/17	Brook		6	4	53			63	140
	Brown		5	0	38			43	43
	Total		11	4	91			106	183
	Brook%		54.5%	100%	58.2%			**59.4%**	**76.5%**
Pass 5 9/18/17	Brook		5	1	46			52	129
	Brown		2	0	10			12	12
	Total		7	1	56			64	141
	Brook%		71.4%	100%	82.1			**81.3%**	**91.5%**
Pass 6 9/20/17	Brook		7	2	56			65	142
	Brown		3	0	10			13	13
	Total		10	2	66			78	155
	Brook%		70.0%	100%	84.8%			**83.3%**	**91.6%**
Pass 7 10/3/17	Brook		6	1	53			60	137
	Brown		1	0	8			9	9
	Total		7	1	61			69	146
	Brook%		85.7%	100%	86.9%			**87.0%**	**93.8%**

Trout species composition at multiple locations within Rinehart Brook and its tributary during four complete electrofishing passes to remove Brown Trout in 2018.

Pass # and Date	Species Composition	1) Black River confluence – Waterfall (140m / 0.1 miles)	2) Waterfall – Start of standard survey (275m / 0.2 miles)	3) Standard Survey (150 m / 0.1 miles)	4) Top of standard survey – Dam at Hacklebarney Rd (1,400m / 0.9 miles)	5) Dam at Hacklebarney Rd – Old Farmers Road (1,590m / 1.0 miles)	Fairmount Tributary (900m / 0.6 miles)	Rinehart Brook (sec. 2-5) (3,415m / 2.1 miles)	Watershed (Fairmount tributary Brook Trout # from pass 1 carried forward)
Pass 1 6/20 – 7/16/18	Brook	32	1	4	111	0	95	116	211
	Brown	31	1	1	14	0	0	16	16
	Total	63	2	5	125	0	95	132	227
	Brook%	51%	50%	80%	89%	na	100%	**88%**	**93%**
Pass 2 7/16 & 7/30/18	Brook	25	8	2	137			147	242
	Brown	8	1	0	2			3	3
	Total	33	9	2	139			150	245
	Brook%	76%	89%	100%	99%			**98%**	**99%**
Pass 3 9/14/18	Brook	8	5	0	102			107	202
	Brown	5	1	0	0			1	1
	Total	13	6	0	102			108	203
	Brook%	62%	83%	na	100%			**99%**	**99%**
Pass 4 10/4/18	Brook	4	7	0	104			111	206
	Brown	1	0	0	0			0	0
	Total	5	7	0	104			111	206
	Brook%	80%	100%	na	100%			**100%**	**100%**

Total number of Brook and Brown Trout encountered per electrofishing pass in the core study area of Rinehart Brook (with percentage of Brook per pass). Passes 1 through 7 occurred in 2017 and passes 8 through 11 occurred in 2018.

Trout Species	Pass 1	Pass 2	Pass 3	Pass 4	Pass 5	Pass 6	Pass 7	Pass 8	Pass 9	Pass 10	Pass 11
Brook	58	44	50	63	52	65	60	116	147	107	111
Brown	725	205	102	43	12	13	9	16	3	1	0
Brook %	7%	18%	33%	59%	81%	83%	87%	88%	98%	99%	100%

Sparta Glen Brook Restoration

The Sparta Glen Brook Restoration project aims to restore a section devastated by a massive landslide from a microburst in August of 2000, dumping 16 inches of rain in a very short period of time. After a partial rebuild, the site again was severely damaged by Hurricane Irene in 2011. The Fred S. Burroughs North Jersey Chapter of Trout Unlimited partnered with the Township of Sparta to restore this section of stream back into its natural state. In the spring of 2016, in-stream habitat restoration was performed by a private consultant in an attempt to revert the stream back to what it was prior to the two flood / landslide events.

Division biologists have been monitoring Sparta Glen Brook pre and post restoration efforts annually since 2015. The following bullets are highlights from the work done in 2018 under the Federal Grant F-48-R.

- One electrofishing backpack survey was completed in 2018.
- 0 Brook Trout found – Surveys in 2015 - 2017 each found 2 Brook Trout.
- 360 individual fish were collected from 4 different species (Creek Chub, Blacknose Dace, Longnose Dace, and Pumpkinseed).
- A continuous temperature monitor was deployed this summer. Temperatures reached the sub-optimal category (22-25°C) on 40 different days and reached the critical threshold (>25°C) on 4 different days.

One of two Brook Trout captured in 2015 within the 150-m survey on Sparta Glen Brook

The 2018 survey did not find any native Brook Trout. This is especially significant, as surveys between 2015 – 2017 found only 2 (none of which were young-of-the-year. This compares with other surveys done in 2001 and 2009 where only six and two Brook Trout were found. The Brook Trout may have moved out of the survey area or may have been lost from the stream entirely. It is too early to determine the overall success of the restoration efforts, which will not be fully understood for several years, but the survey did not find any natural reproduction again this year. These results do not yet define the success or failure of the restoration project, as this is only the second full year post-restoration, as instream habitat changes will take several seasons to find equilibrium and riparian plantings will take several years to provide shading and associated thermal benefits. This survey found 360 individual fish representing four different species.

A continuous stream temperature monitor was deployed this season and will be used to monitor stream temperatures for several years. Temperature data will determine if the restoration efforts and the growth of the newly planted vegetation will re-create temperatures suitable for Brook Trout survival. Initial results from the summer of 2018 shows that temperatures are slightly warmer than optimal for Brook Trout. Temperatures reached the sub-optimal category (22-25°C) on 40 different days and reached the critical threshold (>25°C) on 4 different days. Stream temperatures are currently limiting recovery efforts, which may be negatively impacted by an upstream impoundment. Additional information is compiled in Appendix A9. (Shramko, Hunter and Angler)

Spruce Run Creek: Clean-up of Quarry Discharged Materials (Hunterdon)

Spruce Run (Creek) looking upstream from Van Syckles Bridge on Sunday July 30, 2017.

During the weekend of July 29 and 30, 2017, Eastern Concrete Materials Inc. illegally released a large amount of sediment from their stone quarry in Glen Gardner into Spruce Run Creek. This *Trout Production* stream, a major tributary to Spruce Run Reservoir, supports wild Brook and Brown Trout populations and is also trout stocked. The sediment, composed of pulverized granite, is produced as a waste product from the newly quarried stone. The sediment laden wastewater is then collected in settling basins. After solids settle, the clear top water is permitted by NJDEP to be discharged into the creek. Unfortunately, pumping continued until sediment was discharged, resulting in a tremendous amount released into the stream. A 1.7-mile section, from the quarry discharge to Spruce Run Reservoir, was impacted. Accumulations of sediment were estimated at approximately 2-4 inches throughout most of the stream, with most significant accumulations near the point of discharge, with a maximum depth of 20 inches. Sediment samples were collected by USGS the sediments were within human health and safety standards, however the impacts to habitat and aquatic life would be detrimental if not adequately removed. (Crouse, Hunter and Angler)

The following bullets are highlights of the work completed in 2017 and 2018 followed by a general overview of the project:

- Sediment consisting of pulverized granite (a biproduct from newly quarried stone) was released into Spruce Run (Creek) on July 29 and 30, 2017.
- Significant sediment accumulation of 2-4 inches (with a maximum of 20 inches at the discharge point) resulted in fish, amphibian, and crustacean mortality.
- A fish kill investigation and baseline electrofishing was conducted on August 1, 2017.
- A 4-month comprehensive cleanup was completed on November 29, 2017.
- Follow-up electrofishing surveys were conducted on August 9, 2018 (1 year later). There was no visible trace of quarry sludge. Species abundance and composition remained nearly identical to surveys initially conducted, however a significant decline in the number of young-of-the-year (YOY) Brown Trout was noted.
- It appears that Spruce Run will make a full recovery to pre-discharge conditions.

Various measures of water quality were taken on August 1, 2017 with no significant difference above and below the impacted area. Parameters included water temperature, oxygen, conductivity, specific conductance, total dissolved solids, salinity, pH, and alkalinity. Surprisingly, only a few dead fish including Brown Trout and amphibians such as Pickerel Frogs were reported.

The cleanup started immediately. A multitude of methods were utilized including the use of sediment curtains, installation of a series of seven check dams to slow velocities, concentrating accumulated sediment, and most successfully the use an innovative approach to clean up sediment-impacted habitats in rivers and streams by means of vacuuming the stream bed. The consultant hired had the expertise to vacuum sand and sediment from the impacted streambed, leaving the native gravel and cobble substrates. They trained local contractors to implement their techniques. Trash pumps were used to "power wash" the material, to consolidate it for removal.

Equipment used to vacuum sediment from the streambed.

The NJ Water Supply Authority was concerned with materials entering Spruce Run Reservoir, an important water supply reservoir. Therefore, additional sediment curtains were installed to prevent additional transport of material into the reservoir. A substantial amount of sediment was removed, using heavy equipment, in the inlet of Spruce Run Reservoir. The cleanup portion of the restoration of Spruce Run and Spruce Run Reservoir was completed on November 29, 2017.

Sediment was removed from the entire 1.7 miles that were impacted, in addition to the removal of material from the forebay of Spruce Run Reservoir. The cleanup progressed slowly at first, however techniques were refined and progressed more rapidly midway through the clean-up. All six check dams and all sediment curtains were removed, allowing mature trout to make upstream movements for spawning. All access roads have been removed and all soil disturbances were planted with native vegetation. A settlement between the quarry owner and DEP was reached.

Photographs days after discharge (left) and towards the end of clean-up (right) at Spruce Run Creek.

The fish assemblage in Spruce Run Creek was re-sampled at two locations on August 9, 2018. In-stream habitat looked wonderful, with no visible trace of quarry sludge. Species abundance and composition remained nearly identical to surveys conducted 2 days after the discharge, however a significant decline in the number of young-of-the-year (YOY) Brown Trout was noted, with 90 individuals last year at this time and only 16 individuals during

these surveys. The presence of YOY trout indicates that a spawn took place last fall (a major goal of the clean-up), however the limited number indicates the spawn was impacted. One very large wild Brown Trout was captured, measuring 23.3 inches. Bureau staff provided a one hour and 15-minute Bureau of Freshwater Fisheries presentation and electrofishing demonstration to representatives from Compliance and Enforcement, Water Allocation, and NJWSA, as part of a comprehensive field training exercise based on Spruce Run as a case study. Spruce Run Creek will continue to be monitored by DEP staff and hopefully will soon recover to its original stream quality.

23.3 in wild Brown Trout captured during survey to evaluate fish assemblage in Spruce Run Creek one year after quarry sludge was released into the creek.

West Portal Creek: Brook Trout Restoration Project (Hunterdon) – On May 5, 2016 a catastrophic fish kill occurred in this *Trout Production* tributary to the Musconetcong River, when a tractor trailer on I-78 caught fire and its cargo (detergent) spilled into the creek. Thousands of fish, many of them wild Brown Trout (and a few wild Brook Trout), died in a 2.8-mile stream reach that extended from the I-78 overpass downstream to the Musconetcong River. This calamity presented NJDFW with an unusual opportunity to restore/enhance wild Brook Trout in this stream by removing the remaining Brown Trout (a competitor species) so that wild Brook Trout could more easily repopulate the stream. Multiple electrofishing surveys were conducted in 2016, both upstream and downstream of I-78, and a total of 49 wild Brown Trout and 2 Rainbow Trout and 1 Tiger Trout presumably stocked in the Musconetcong River, were removed. All native fish species, which included 24 wild Brook Trout, were returned to the creek. (Hamilton, Federal Grant F-48-R)

Detergent in West Portal Creek (left), May 5, 2016, Same location, May 6, 2016 (center), Representative aquatic organisms killed (right).

During electrofishing surveys conducted in 2017, 1,239 Brown Trout (removed), 224 Brook Trout, and 64 Tiger Trout were captured. Nearly all trout (97%) were young-of-the-year fish, indicating that both Brook and Brown Trout had spawned the previous fall. The presence of Tiger Trout indicated wild Brook and Brown Trout interbreeding had also occurred, which impacts the ability of Brook Trout to repopulate the stream (i.e. gametes are "wasted" when Brook Trout spawn and produce Tiger Trout rather than Brook Trout).

With this information in hand, it was apparent that re-establishing a strong Brook Trout population in this stream would depend upon the complete removal of Brown Trout, and removal by electrofishing would be labor-intensive. Even if this removal effort was successful, wild Brown Trout from other nearby river tributaries (Turkey Hill Brook and the Franklin tributary) could easily invade, repopulate, and resume dominance over Brook Trout in West Portal Creek. Installation of an instream barrier on West Portal Creek near its confluence with the Musconetcong River was initially considered, but not pursued due to concerns regarding effectiveness and other project considerations (design, permits, timing, etc.). In consideration of these factors, it was decided to discontinue Brown Trout removal in the stream reach below the I-78, and instead focus on the creek's headwater area upstream of I-78 for possible Brook Trout restoration. Brook Trout were not found during electrofishing surveys conducted there in 2016 and 2017, and only few non-native trout were encountered and removed (2 Brown Trout in 2016; 1 Brown Trout and 1 Tiger Trout in 2017). The long culvert beneath I-78 (perched at its downstream end), a potential barrier to upstream fish movement, could prevent non-native trout residing downstream from recolonizing this upstream area.

In 2018 Trout Unlimited installed a data logger in West Portal Brook upstream of the I-78 bridge to obtain temperature data that will aid in determining the suitability of this stream for Brook Trout. NJDFW conducted one electrofishing survey on West Portal Brook, starting at the downstream end of the culvert and proceeding upstream until very little water and no fish were encountered (approximately 900 m). This survey (conducted on 9/27/2018) was timed to coincide with the beginning of the fall trout spawning period to assess upstream movement of trout residing downstream and remove non-native trout before they spawned. Though only five wild trout (four Brown Trout and two Tiger Trout) were captured and removed, this data was informative. The presence of Tiger Trout (194 and 195 mm long (7.6 in)) indicates that the culvert is not a complete barrier to upstream trout movement. One of the Brown Trout captured was a young-of-the-year fish (85 mm (3.3 in)). It is doubtful that a trout this small could swim upstream into, and through the culvert, and far more likely that Brown Trout reproduced in this upstream area in 2017. The temperature and fish data will be reviewed further to determine if this stream would be a good candidate for Brook Trout restoration. For more detailed survey information see Appendix A36.

COOLWATER / WARMWATER FISHERIES

Coolwater Fisheries Management

In 2016 a three-year initiative (2014-2016) was completed to assess the stocking of coolwater species such as Muskies, Northern Pike, Walleye, and Hybrid Striped Bass. These species do not readily reproduce in New Jersey waters and are maintained by annual stocking programs from Fish and Wildlife's Hackettstown State Fish Hatchery. The initiative included a review of management goals and objectives, plus an assessment of current fisheries. The assessment also included an online angler survey concerning angler opinions and experiences on their warmwater/coolwater fishing opportunities in New Jersey. Over 1,000 anglers participated.

A significant part of the coolwater assessment was data collection. To assess the status of these populations, trap nets were set, the most efficient means of capturing these species. Over the course of the study, the Bureau set 273 trap nets, 13 gill nets, and conducted 17 days of electrofishing - over 251 man-days of work. In 2017, significant changes to the State's Coolwater Program were made based on study results. Regulation changes were proposed and formally adopted following a 60-day public comment period. These regulations became effective on February 10, 2018. Sampling findings for each individual waterbody and management recommendations will be found in the when the draft report titled Assessment and Management of New Jersey's Stocked Coolwater Fishes is finalized. (Collenburg, Federal Grant F-48-R)

Echo Lake Musky (50.2 in. / 33.1 lb brought back to Hackettstown State Fish Hatchery for brookstock

New size limits and changes to the stocking program were implemented in 2018 and it will take several years for shifts in affected populations to take place. As a result, no significant fieldwork was conducted in 2018. Additional field work will continue in the future.

Lake Inventories

Successful management of New Jersey's warm and cool water fisheries resource is based upon specific knowledge of their physical, chemical, biological, and use characteristics. Such knowledge may serve to direct immediate management recommendations or be used as a baseline, upon which to recognize future changes, requiring remedial management efforts. Under this activity physical, chemical, and biological data is collected utilizing standard sampling techniques. Physical parameters include morphometry, bathymetry, access, watershed, and aquatic vegetation characteristics. Chemical parameters include general water chemistry and sediment nutrient characteristics. Biological parameters include fish species composition, abundance (catch-per-unit-effort), length frequency distribution, and calculated indices of population structure and dynamics such as proportional stock density (PSD), relative weight (W_r), age, and growth. The data are analyzed, and results are used to develop management recommendations and prepare an individualized fisheries management plan for the waterbody. These plans are summarized and published for dissemination to the angling public. No lake inventories were conducted in 2018.

Warmwater Fisheries Assessments via Electrofishing

New Jersey has over 400 impoundments open to the general public for fishing and thousands more in private ownership scattered throughout the state. These lentic environments offer excellent fishing opportunities for a variety of species such as bass, sunfish, crappie, and pickerel. These species naturally reproduce in the waterways and often do not require active stocking to sustain their populations. The NJDFW conducts abbreviated fisheries surveys on lakes and ponds throughout the state to assess the status of popular game species, compared to full inventories on others. Electrofishing surveys are conducted at various waterbodies throughout the state to assess the status of the bass populations. Lakes are assessed based on the catch per unit effort (CPUE) for stock size fish (Largemouth Bass ≥ 8 in) as determined from electrofishing surveys. CPUE is the number of fish caught per hour of electrofishing. Fish populations are further evaluated utilizing stock density indices that provide a numerical descriptor of length-frequency data. These indices include PSD, PSD-P, and PSD-M (formerly PSD, RSD_p, and RSD_m). Calculations for each parameter are made to determine a proportional size distribution of certain size fish that is within the stock size. The PSD-P is simply the percentage of fish sampled greater than the "preferred" size (Largemouth Bass ≥ 15 in). Standard lengths are used for each species. The PSD-M is the percentage of fish sampled greater than the "memorable" size (Largemouth Bass ≥ 20 in). Sampling results are used to determine if supplemental stockings or adjustments to current regulations are necessary.

Of the 57 surveys completed in 2018, 50 surveys were completed to assess black bass (Largemouth and Smallmouth Bass) populations and 7 assessed the warmwater fisheries as a whole. Carnegie Lake had the highest CPUE for Largemouth Bass at 115 bass/hr during daytime electrofishing. The largest bass encountered electrofishing this year was from Parvin Lake on 10/30/18 and weighed 6.75 lb, followed closely by a bass at Union Lake on 3/19/18 that weighed 6.72 lb, and another from Parvin Lake on 10/30/18 that weighed 6.69 lb Largemouth Bass weighing more than six pounds were also caught at Alloway Lake, Salem Canal, and Sunset Lake. (staff, Federal Grant F-48-R)

Summary of Black Bass Assessment efforts in 2018 include:

- 35 surveys were conducted on 31 lakes and 15 surveys were conducted on 6 rivers. Five surveys were along the tidal portion of the Delaware River, south of Trenton.
- 4 lakes (Elmer Lake, Hammonton Lake, Maple Lake and Sylvan Lake) were determined to require no further sampling. Stocking Bluegill to enhance the forage base was recommended for Elmer Lake. Maple Lake and Sylvan Lake were recommended for stocking of additional Largemouth Bass.
- 15 waterbodies were determined to have balanced stable bass populations and no additional stocking was required.
- 28 waters were recommended for additional electrofishing.
- 11 waterbodies were determined to benefit from stocking of supplemental Largemouth Bass; these waters will be stocked in 2019.
- 4 lakes (Pemberton Lake, Penbryn Lake, Rising Sun Lake, and Sheppard's Millpond) had unbalanced bass populations and require additional sampling, however no additional stocking is recommended for these waterbodies.

- 13 Lakes and Rancocas Creek, a tributary of the Delaware River, were determined to benefit from stocking of supplemental Largemouth Bass; these waters will be stocked in 2019.
- A total of 8 surveys were completed at 8 different river locations.
- 5 of 7 locations were along the tidal portion of the Delaware River, south of Trenton.
- 2 locations were tribs. of the Delaware River (Little Mantua Creek and Rancocas Ck).

Alloway Lake (Salem) - Alloway Lake is a 110-acre impoundment of Alloway Creek, located in Alloway Township, Salem County within Watershed Management Area 17. The Alloway Lake dam failed in March of 2000. A fish salvage was completed after the dam failed and the gamefish species were relocated to nearby public waterbodies. The lake was maintained approximately eight feet below normal pool, from 2000 to 2008, due to the NJDEP Bureau of Dam Safety mandated lowering. The dam was reconstructed in the spring 2008. The lake is bordered by private residences along one side of the lake and wooded farmland on the other side, which is also privately owned. Alloway Township owns a small parcel of land which includes the boat ramp, parking area, and spillway.

Prior to the dam failure, Alloway Lake was a private lake with no public access. Local anglers reported the Largemouth Bass fishing as one of the best lakes in New Jersey. A fish salvage was performed after the dam failed, however quite a few fish were left in the lake. Anglers with permission to fish the lake continued to catch trophy size bass while the lake was lowered.

After the dam was replaced in 2008, the lake was opened to the public with a gravel boat launch and a parking area for 25 vehicles. Shoreline fishing access is limited to a small area near the boat launch. Current lake rules and regulations are posted at the boat ramp and available through the Alloway Township website. Electrofishing sampling conducted in 2009 revealed a good Largemouth Bass population. A lake inventory was completed in 2011 and concluded that the Largemouth Bass and crappie populations were both excellent. It was subsequently added as a Lunker Bass Lake.

A daytime boat electrofishing survey was completed on 04/05/18 to evaluate the Largemouth Bass population. A total of 33 bass were collected during 2.33 hours of daytime electrofishing. The CPUE of 14 bass/hour for stock size (>200 mm) bass, is considered a rather low density. This catch rate is significantly lower than those observed in 2009 and 2011. The PSD of 84 and PSD-P of 39 were both higher than previous surveys. The PSD of 84 is higher than the recommended 40-70 by (Carlander, 2011) for a balanced population. However, considering the lake is managed as a "Lunker Bass Lake" the high PSD is good. Previous surveys in 2009, 2011 and 2013 were represented by high numbers of smaller stock

size bass ranging from 200 - 300 mm (8 to 12 in). These fish were absent from this survey. The largest bass collected in 2018 was 510 mm (20 in) and 2.72 kg (6.0 lb). Three bass greater than five pounds were collected.

A follow up survey is planned for spring 2019 to further evaluate the population. The forage base is good, consisting of Gizzard Shad, Bluegill, and Golden Shiner. No additional stocking of bass is recommended in 2019. (Smith)

Assunpink Lake (Monmouth) – Assunpink Lake is a 225-acre impoundment located within the Assunpink Wildlife Management Area, Upper Freehold Township. The lake is one of the five lakes managed under the Lunker Bass Program and one of the most utilized Wildlife Management Areas in the state. Organized fishing tournaments are regulated on WMA lakes and require applicants to supply a report form after each event. These tournament reports have proved valuable showing trends in angler success rate, average size of bass caught, and the number of trophy size bass (greater than 5 lb) caught. The reports provide supplemental data to annual electrofishing surveys. The bass population was stable, based on tournament catch reports, throughout the 1990's and early 2000's and few electrofishing surveys were completed. In the mid to late 2000's, anglers complained that overall catch rates and size of fish had declined. The Division began regular monitoring and stocking in 2013. Nine electrofishing surveys were completed from 2013 – 2018 and supplemental Largemouth Bass where stocked in 2014 and 2016.

Electrofishing surveys completed at Assunpink Lake have shown consistent improvement to the Largemouth Bass population since 2013. A total of 109 bass were collected during the 1.43-hour daytime electrofishing survey on 4/24/18. The CPUE of 76 bass/hour, for stock size bass greater than 200 mm (8 in), indicates an abundant bass population based on New Jersey standards. The PSD, PSD-P and PSD-M were 77, 25 and 2 respectively. These were all higher than in September 2017. The September survey resulted in a CPUE (stock size) of 60 bass/hour, a PSD of 51 and a PSD-P of 15. There were four bass more than five pounds collected during the April 2018 survey. Five pounds is the size socially accepted as a "Lunker" bass and a benchmark that has been tracked through the tournament reports. The largest bass measure 525 mm and weighed 2.86 kg (20.6 in and 6.31 lb).

An annual survey should be completed in spring 2019 just prior to spawning season. A seining survey should be completed in 2019 to evaluate reproduction success.

No supplemental stocking of Largemouth Bass is recommended for 2019, however should be re-evaluated on an annual basis. Stocking of surplus Channel Catfish should be discontinued to alleviate competition with the Largemouth Bass population. (Smith)

Carnegie Lake (Mercer) - A boat electrofishing survey was completed at Carnegie Lake on 10/29/18 to evaluate the Largemouth Bass population. This 237-acre impoundment of the Millstone River was last sampled in 2016 to evaluate the Musky fishery. Carnegie Lake receives a fair amount of fishing pressure considering the heavy presence of collegiate rowers that practice daily on the lake. Public fishing is allowed, but rowing activities impact angler utilization. A concrete boat ramp, floating dock, and large parking area provide ample access for boat anglers. Shoreline access in available on the eastern side of the lake, along the D&R Canal.

The Largemouth Bass population is doing extremely well based on the October 29 survey. The 2.20-hour daytime electrofishing survey resulted in 256 Largemouth Bass, of which 253 were greater than the 200 mm stock size. The CPUE of 115 bass/hour was the highest catch rate observed in 2018. The PSD of 77 and PSD-P of 35 indicate a balanced population. Only two bass greater than 510 mm (PSD-M) were collected, however five bass between 500 – 509 mm were collected and will certainly exceed 510 mm next year. No stocking is recommended at this time. The forage base is excellent, consisting of Bluegill, Gizzard Shad, and Yellow Perch. Juvenile White Perch were noted to be abundant during the Coolwater Assessment Project, however only a few were observed during this electrofishing survey.

The lake should continue to produce a quality bass population with little active management. The lake should be included in the list of bass waters regularly monitored by electrofishing to track changes to the population. (Smith)

Centennial Lake (Mercer) – A boat electrofishing survey was completed at Centennial Lake on 10/25/18, a 2.7-acre impoundment of Little Shabakunk Creek, located in Lawrenceville on the Rider University campus. The survey was completed as part of an ongoing monitoring project for Dr. Brown, a professor at the university. Her class provides students with an introduction to fisheries management and lake ecology. A similar survey was also completed in 2017. The population appears to have changed very little since last surveyed in the fall 2017. A total of 22 Largemouth Bass were collected, of which 21 were greater than the 200 mm stock size. A PSD of 80 and PSD-P of 4 indicate an unbalanced population. There were 28 total bass collected in 2017, at which time the PSD was 73 and PSD-P was 3. A CPUE was not calculated since the electrofishing time was less than an hour. This non-standardized survey resulted in three laps around the pond and traversing the middle of pond in a zig zag pattern. Bluegill and Pumpkinseed were abundant, with many large individuals collected. Bluegill were more abundant than Pumpkinseed with 126 collected. The PSD was 94 and PSD-P was 41, indicating the population is unbalanced consisting of mostly adults.

Centennial Lake is extremely shallow, with an average depth of about 2.5 feet and a maximum depth of about 5 feet. The lake has two fountains and is treated for filamentous algae annually. The pond was prone to fish kills in the past. Angling is not encouraged;

however students are permitted to fish the pond. Angling does not appear to have a large impact on the fish population. Marginal habitat and low forage diversity limits population growth. No stocking is recommended at this time. The introduction of a few evergreen trees may help with the survival of juvenile fish. (Smith)

Clarks Pond (Cumberland) - Clarks Pond WMA is a 43-acre impoundment located in Fairfield Township, within the Cohansey River watershed. A boat electrofishing survey was completed on 09/28/18 to evaluate the warmwater fish population. The electrofishing survey was cut short (0.22 hours) due to the low conductivity (48.4 us/cm) and poor transparency limiting the efficacy of electrofishing. A few adult Largemouth Bass, Yellow Perch, Bluegill, Golden Shiner, Creek Chubsucker, and Chain Pickerel were observed. The pH of 7.43 was somewhat elevated at the time of survey, compared to 2017 when the pH was 5.74. A pH level less than 6.0 results in poor Largemouth Bass recruitment.

A visual assessment of Clarks Pond suggests the fish community would consist of a native Pinelands fish community, based on the dark tannin stained water and bladderwort. A seining survey completed in August 2017 confirmed the assessment. The fish community present consists primarily of native species including; Banded Sunfish, Bluespotted Sunfish, Mud Sunfish (proposed species of Special Concern), Chain Pickerel, Golden Shiner, Yellow Perch, and Yellow Bullhead. There were no YOY Largemouth Bass collected during the survey.

Despite the poor sampling results, Clarks Pond is a rather popular location among bass anglers. In 2018 four WMA tournament reports were received, indicating 37 anglers caught 36 Largemouth Bass. The largest bass weighed 4.52 lb and the average weight for all bass was 1.33 lb. Based on the presence of the native species, the stocking of Largemouth Bass is not recommended. The low productivity and sporadic reproduction of centrarchids limits the expansion of the warmwater fish population. An additional electrofishing survey should be completed to further evaluate the Largemouth Bass population. (Smith)

Colonial Lake (Mercer) – A boat electrofishing survey was completed at Colonial Lake on 04/09/18 to evaluate the trout stocking program and collect information on other species in the lake. No recent electrofishing surveys have been completed. Colonial Lake has been part of the trout stocking program since the 1980's and a very popular location, due to the high population density of Lawrence Township and the Trenton vicinity. In recent years the catch rates have steadily declined. Twenty-one anglers were observed trout fishing at Colonial Lake on opening day 2018 and catch rates were again poor, with no tour caught amongst nine anglers.

The boat electrofishing survey resulted in the collection of 8 trout, 6 of which were brood stock greater than 14 inches. The high cormorant population, 32 observed on opening day, may contribute to the poor catch rate based on predation of the smaller trout. Only two smaller trout were collected. In general, the warmwater population is rather poor, with only a few legal sized Largemouth Bass collected. Large Common Carp and Brown Bullhead were the two most abundant species observed. White Sucker, Black Crappie, Bluegill, Pumpkinseed, Gizzard Shad, and American Eel were also present.

Colonial Lake would be a good candidate for stocking catchable size warmwater fish, including Largemouth Bass, Bluegill, and Channel Catfish. The lake would also benefit from dredging to remove accumulated sediment in the middle of the lake. (Smith)

Davis Mill Pond (Cumberland) – A boat electrofishing survey was completed at Davis Mill Pond on 09/28/18 to evaluate the Largemouth Bass population. Davis Millpond is a 40-acre impoundment located within the Stowe Creek Drainage, Greenwich Township. A total of 50 Largemouth Bass were collected during the survey, of which 46 were greater than the 200 mm stock size. The CPUE was 37 bass/hour based on 1.24-hour daytime survey, indicating a moderate density population by New Jersey standards. The PSD of 63, PSD-P of 29, and PSD-M of 2 indicate the population is balance, however indices were slightly lower than when last sampled in 2016. The two largest fish collected measured 530 mm (20.9 in) and 506 mm (19.9 in) and weighed 2.41 kg (5.31 lb) and 2.50 kg (5.52 lb).

The population appears to be stable but has not improved since last sampled. Additional stocking of Largemouth Bass is recommended for 2019. There is an abundant forage supply in the lake consisting of Bluegill, Gizzard Shad, Golden Shiner, and crappie which should support a more robust bass population. The population will continue to be monitored over the next few years. (Smith)

Deal Lake (Monmouth) – A boat electrofishing survey was completed at Deal Lake on 09/27/18 to evaluate the Largemouth Bass population. The last electrofishing survey completed at Deal Lake was on 09/23/15 during which the bass population appeared to be under-represented. The bass population is doing rather well in Deal Lake. A total of 45 Largemouth Bass were collected during the 1.90-hour survey. The CPUE (for stock size bass >200 mm) was 22 bass/hour, a relatively low catch rate. The PSD of 90 and PSD-P of 61 suggest the population is not balanced based on recommendations by (Carlander, 2011), but indicate the population would provide excellent recreational opportunities. The largest bass collected measured 495 mm (19.4 in) and weighed 2.24 kg (4.93 lb). The forage base is good consisting of Alewife, Gizzard Shad, Bluegill, and Golden Shiner. The Black Crappie population appears to be doing well

with numerous quality size crappies observed. One adult Striped Bass (approximately 32 in) was collected and quickly released. The fish was in excellent condition.

Deal Lake is characterized as an impacted waterbody, based on the urbanized landscape of the surrounding area. Sedimentation and turbidity are problematic within the watershed. Common Carp are overly abundant, and the lake commission hired a consultant to remove the undesirable species. Carp removals have been done in the past and may benefit the desirable warmwater species. Despite these challenges, a diverse fish population is present that offers excellent recreation fishing opportunities. There were no Northern Pike collected or observed during the survey. Deal Lake was recently removed from the annual stocking list for Northern Pike and rightfully so as habitat does not appear to be conducive to supporting a pike population. Northern Pike should continue to be stocked on a surplus only basis.

Deal Lake should be actively managed for Largemouth Bass. Stocking of supplemental Largemouth Bass is recommended to enhance the population. An additional electrofishing survey should be completed in the spring 2019 to further evaluate bass population. (Smith)

Delaware River (Burlington, Camden, Gloucester) – In 2018 five boat electrofishing surveys were completed on the Delaware River to evaluate the Northern Snakehead and Largemouth Bass populations. Invasive Flathead Catfish and Walleye, a species annually stocked by NJDFW, were also collected when encountered. Channel Catfish and Striped Bass were observed during all surveys, however were not collected. There were no sturgeon encountered during any of the Delaware River surveys. The discovery of snakeheads in the Delaware River in 2008 prompted the long-term monitoring of select sections of the river that will hopefully provide insight on impacts snakeheads may have on native and other recreational import game species. The Largemouth Bass electrofishing catch rates (CPUE) are rather variable and fluctuate with aquatic vegetation abundance. PSD and PSD-P vary from site to site, but generally indicate a balanced population.

Delaware River – Bordentown City (Burlington) – A boat electrofishing survey was conducted on the Delaware River on 07/16/18 to assess the Northern Snakehead and Largemouth Bass population around Bordentown. The survey included both sides of the river from Bordentown upstream to the Trenton power plant and the northern end of Newbold Island. There were no snakeheads collected during the survey. Two Walleye were collected, measuring 220 and 350 mm (8.7 and 13.8 in), noteworthy as they are not typically encountered in this far south in the Delaware River. A total of 106 Largemouth Bass were collected of which 103 greater than the 200 mm stock size. The CPUE of 43 bass/hour for stock size bass is a good density for the Delaware River. The PSD of 51 and PSD-P of 8 suggest the population is slightly unbalanced based on (Carlander, 2011). (Smith)

Delaware River – Bordentown City (Burlington) – A boat electrofishing survey was conducted on the Delaware River on 07/18/18 to assess the Northern Snakehead and Largemouth Bass population south of Bordentown. The survey included southern end of Newbold Island and the main river side of Newbold Island. There were two Northern Snakeheads collected during the survey that measured 487 and 695 mm (19.2 and 27.4 in).

Both snakeheads were captured behind Newbold Island from areas with thick aquatic vegetation. A total of 60 Largemouth Bass were collected during the 1.71-hour survey, of which 57 were greater than the 200 mm stock size. The CPUE of 33 bass/hour for stock size bass was good based on New Jersey standards for the Delaware River. The PSD of 35 and PSD-P of 8 suggest the population is slightly unbalanced. (Smith)

Delaware River – Burlington City (Burlington) – A boat electrofishing survey was conducted on the Delaware River on 08/30/18 to assess the Northern Snakehead and Largemouth Bass populations around the City of Burlington. The survey included areas upstream and downstream of the Burlington City boat ramp. There were no snakeheads collected during the survey, however one invasive Flathead Catfish that measured 890 mm (35 in) and weighed 8.28 kg (18.3 lb) was collected. One Walleye (YOY) was collected that 170 mm. A total of 58 Largemouth Bass were collected, of which 38 were greater than the 200 mm stock size. The CPUE of 19 bass/hour for stock size bass is a low density for the Delaware River and most likely attributed to the lack of submerged aquatic vegetation in this section of the river. Wild celery, coontail, and hydrilla typically flourish in this section of the river but were noticeably absent. Above average rainfall in July 2018 resulted in high flows and increased turbidity and accounted for the lack of vegetation. The PSD of 79 and PSD-P of 10 suggest the population is balanced. This location will continue to be monitored in the future. (Smith)

Delaware River – Pennsauken (Camden) – A boat electrofishing survey was conducted on the Delaware River on 08/02/18 to assess the Northern Snakehead and Largemouth Bass populations near the confluence with Pennsauken Creek. The survey included the flat at the southern end of Pennsauken Creek and approximately 200 meters into Pennsauken Creek. There were no snakeheads collected. The aquatic vegetation was very sparse compared to previous years. Only 10 Largemouth Bass were collected during the 30-minute survey. CPUE and indices of stock distribution were not calculated due to the small sample size. (Smith)

Delaware River – West Deptford (Gloucester) – A boat electrofishing survey was completed on the Delaware River, south of the West Deptford boat ramp, on 06/08/18 to assess the Northern Snakehead and Largemouth Bass populations. The area has been sampled numerous times since snakeheads were first confirmed in the Delaware River. Electrofishing was completed around the Red Bank Battlefield Park, a large flat cove with abundant submerged aquatic vegetation during the summer. Additional sampling was completed in the cove near the Riverwinds Golf and Tennis Club and near the confluence with Main Ditch. Surprisingly, there were no snakeheads collected during the one-hour electrofishing survey. A total of 29 Largemouth Bass were collected from these areas, of which 25 were greater than the 200-mm stock size. The CPUE of 25 bass/hour is a

moderate density for the Delaware River compared to other 2018 surveys. The PSD of 68 and PSD-P of 12 indicate a balanced population. The unseasonable cool temperatures and above average rainfall appears to have suppressed the growth of aquatic vegetation in these areas and affected catch rates. (Smith)

DOD Lake (Salem) – DOD Lake is a 120-acre borrow pit located in Oldmans Township and is located on a NJDFW Wildlife Management Area. The lake is regularly surveyed since acquired by the Division in 1998. A concrete boat ramp was installed in 1999, which increased angler use. A lake inventory and management plan were completed in 2002, which established good baseline data for future management decisions.

The Division stocked DOD Lake for nearly 20 years to diversify the fish population and provide increased recreational opportunities. Species stocked include; Largemouth Bass, Smallmouth Bass, Striped Bass, Black Crappie, White Crappie, Channel Catfish, Musky, and Tiger Musky. Largemouth Bass are the most abundant game species collected during electrofishing sampling. To date there have been no Smallmouth Bass, Musky, or Tiger Musky collected. Boat electrofishing surveys to monitor the Largemouth Bass population were completed in 2010, 2011, and annually from 2014 to 2018.

One of the more recent species to take up residence in DOD Lake is the Northern Snakehead. An invasive species that originates from Asia, the snakehead was first collected in DOD Lake during a 2015 electrofishing survey targeting Largemouth Bass. Supplemental surveys in 2016 and 2017 resulted in eight snakeheads collected in 2016 and three in 2017. The snakehead gained access through a pipe which connects directly to the Delaware River.

Three boat electrofishing surveys were completed at DOD in 2018; on 03/28/18, 05/23/18 and 07/12/18 to monitor the Largemouth Bass and Northern Snakehead populations. There were no Muskies or Tiger Muskies encountered during the surveys despite being regularly stocked. The table below is a summary of the three electrofishing surveys including runtime, total number of Largemouth Bass, CPUE for stock size bass, PSD, PSD-P and total number of Snakeheads.

Date	Electrofishing Time	No. LMB	LMB CPUE (stock)	PSD	PSD-P	No. Snakehead
3/28/18	2.09 hours	135	61	36	4	9
5/23/18	2.27 hours	169	64	38	8	20
7/12/18	1.48 hours	70	41	40	4	11

The CPUE for stocked size Largemouth Bass (greater than 200 mm / 8 in) ranged from 41 – 64 bass/hour indicating a good density based on New Jersey's standards. The PSD and PSD-P ranged from 36 - 40 and 4 – 8, indicating an unbalanced population consisting of mostly smaller individuals.

No additional stocking of Largemouth Bass is recommended. Natural recruitment and habitat appear to be adequate to support the bass population. The increased abundance of

invasive *Hydrilla*, although not a desirable species, provides good habitat for bass and panfish.

Bluegill, Golden Shiner, Yellow Perch, Gizzard Shad, and small Black Crappie serve as a good forage base. Musky and Tiger Musky were not collected or observed during the electrofishing survey but should continue to be stocked on a surplus basis.

A total of 30 Northern Snakeheads were collected from the three surveys. They ranged in size from 145-620 mm (5.7 - 24.4 in), the largest of which weighed 2.47 kg (5.44 lb). Scales were removed for age determination and stomachs were retained for an ongoing diet study. Early spring is the best time to target snakeheads prior to spawning activity. Monitoring will continue in 2019 with multiple surveys planned. (Smith)

Elmer Lake (Salem) – A dam reconstruction project was completed at Elmer Lake in 2011 – 2012. The construction plans originally required a complete lowering of the lake which necessitated a fish salvage. Construction engineers later determined that a complete lowering would not be required, however 68 adult Largemouth Bass had already been removed from the lake via electrofishing in 2011. A follow-up survey was completed in 2014 to evaluate the bass population following the dam reconstruction and re-stocking in 2014. The bass population appeared consistent with sampling prior to 2014.

A boat electrofishing survey was completed at Elmer Lake WMA on 04/11/18 to evaluate the Largemouth Bass population. A total of 63 Largemouth Bass were collected during the 1.34-hour survey, indicating a CPUE of 44 bass/hour for stock size (>200 mm) bass. The CPUE indicates a good population abundance and the PSD of 80 and PSD-P of 48 suggest a slightly unbalanced population. Most bass collected were in good condition, however the lake would benefit from stocking additional Bluegill and Golden Shiner to enhance the forage base. (Smith)

Furnace Lake (Warren) – This 53-acre municipally-owned lake has a public boat ramp (electric-only motors), docks with a handicap-fishing platform, swimming area, playground, and good shoreline fishing access. The lake is stocked annually with catchable-sized trout (in the spring and for the winter) and Muskellunge. A daytime electrofishing survey was conducted on 10/04/2018 to assess the black bass fishery. The entire perimeter of the lake was electrofished and a total of 48 Largemouth Bass were captured in 1.1 hours of electrofishing. Of these, 40 were stock size (203 mm (8 in) or greater), and the CPUE for stock-sized bass was 35 fish/hr. The largest bass captured was 47 cm (18.4 in) and weighed 1.8 kg (3.1 lb). The PSD (Proportional Size Distribution) for bass was 70, indicating a balanced population. PSD is a numerical index used to characterize the length-frequency data and provide insight about population dynamics (40–70 is the accepted range for a balanced Largemouth Bass population). The PSD-P for bass was 15 (Preferred >381 mm (15 in); 10–40 is the accepted range). Eight of twelve Muskellunge sighted were captured and ranged in size from 622 – 1,130 mm (37.2 – 44.5 in). The largest weighed 12.3

kg (27.1 lb). One Walleye, measuring 470 mm (18.5 in), was captured and was not returned to the water as the lake is not stocked or managed for this top-level predator. Other fish species observed but not captured during the survey were Channel Catfish, American Eel, Alewife, Bluegill, Golden Shiner, White Sucker, and Common Carp. It is recommended that the lake be sampled (electrofished and seined) at other times of the year to better assess and monitor the warmwater (bass and panfish) fishery. (Hamilton)

Game Creek (Salem) – Game Creek is a tributary of the Salem Canal, converging with the canal just downstream of the Route 40 bridges. Visually, Game Creek is rather different than the canal, with relatively clear tannin stained waters opposed to the turbid waters of the canal. Habitat is also different with fish relying on the abundant aquatic vegetation including water smartweed, bladderwort, coontail, and spadderdock. A few felled trees are also present in this tributary, but the Largemouth Bass and Northern Snakeheads appear to favor the vegetation, especially during the colder months. Game Creek is also unique in that a small borrow pit (approximately 3 acres) is connected to the creek and serves as a wintering area for many species. This "pond" area produced good results during the November 2017 survey. Snakeheads were first documented at this location in 2016 but reported by an angler in 2014.

Five electrofishing surveys were completed at Game Creek (upstream of the Route 40 bridge) in 2018; on 03/26/18, 04/20/18, 06/14/18, 06/19/18 and 08/28/18. The surveys were completed primarily to remove Northern Snakeheads; however Largemouth Bass were also collected in all but the 06/19/18 survey. The table below is a summary of the five electrofishing surveys including runtime, total number of Largemouth Bass, CPUE for stock size bass, PSD, PSD-P, and total number of Snakeheads.

Date	Electrofishing Time	No. LMB	LMB CPUE (stock)	PSD	PSD-P	No. Snakehead
3/26/18	2.24	157	68	36	7	4
4/20/18	2.11	66	31	69	31	8
6/14/18	2.46	49	19	62	18	35
6/19/18	2.18	-	-	-	-	23
8/28/18	1.91	62	31	45	11	10

The Largemouth Bass population appears to be doing well, despite the presence of Northern Snakeheads. Electrofishing results are highly variable based on the wide range of CPUE, PSD and PSD-P observed in 2018. The same sampling area from Route 40 to N. Game Creek Road was electrofished each time. The Largemouth Bass CPUE (68 bass/hour) was highest during the 03/26/18 survey prior to spawning. The lowest PSD (36) and PSD-P (7) were also observed during this survey. PSD and PSD-P indices ranged from 36 – 69 and 7 –

31 from all surveys. The bass population is balanced when considering an average of all sampling dates with a moderate population density. The two-surveys completed in June had the lowest bass CPUE and highest number of snakeheads. Largemouth Bass numbers were so low on 06/19/18 that bass were not collected. Snakeheads were actively spawning during this time and presumably forced the bass to relocate to another area.

The 03/26/18 survey was impacted by high salinity levels from road salt. The salinity in the "pond" was 1.24 ppt and conductivity was 1760 us/cm. This area is a known wintering and spawning area for Largemouth Bass. Due to the high conductivity electrofishing was not effective in the area and most likely contributed to the lower PSD and PSD-P. Seasonal fish movement, temperature, habitat, and food availability should all be considered as impacting catch rates.

A total of 80 Northern Snakeheads were collected and removed from Game Creek. Sizes ranged from YOY to mature adults. The largest individual measured 765 mm (30.1 in) and weighed 4.48 kg (9.9 lb). The population will continue to be monitored annually to determine any long-term effects on the bass population. Game Creek/Salem Canal is one of the most popular bass fishing locations in southern New Jersey. Largemouth Bass should be stocked in Salem Canal when surplus is available to offset tournament mortality and impacts of snakeheads. (Smith)

Hammonton Lake (Atlantic) – Hammonton Lake is a 75-acre impoundment of Hammonton Creek, a tributary of the Mullica River, located within the town of Hammonton. The lake is a NJDFW trout stocked waterbody that receives both spring and fall stockings. A public boat ramp located at the upper end of the lake provides angler access. A lake inventory was completed in 2007 and a boat electrofishing survey was last conducted on 07/29/2014. The lake received 3,500 fingerling Largemouth Bass in 2013 and 4,475 in 2014. A daytime boat electrofishing survey to assess the Largemouth Bass population was conducted on 11/07/2018. Total electrofishing time was 1 hour and 41 minutes. A total of 106 Largemouth Bass were collected, indicating a CPUE of 63 bass per hour. A PSD of 46 and PSDP of 0 were calculated, indicating an unbalanced Largemouth Bass population, comprised primarily of smaller individuals. Angler reports of abundant small fish (10-12"), with low numbers of large fish caught, lend support to the stock density calculations. Results from past electrofishing surveys indicate the Largemouth Bass fishery has remained relatively the same overtime. A PSD of 50 and PSDP of 4 were calculated for the 2014 survey and a PSD of 43 and PSDP of 7 were calculated from the 2007 inventory. Fingerling Largemouth Bass stocked in 2013 and 2014 should now be of legal size to harvest (12 in) and appear to have been successfully recruited into the fishery, currently making up the bulk of the bass population within the lake. The forage base within the lake does not appear to be a limiting factor, as Golden Shiner, Bluegill, and Yellow Perch were observed in abundance. Additional sampling is not recommended at this time. (Boehm)

Lake Audrey (Cumberland) – The State of New Jersey acquired the 120-acre borrow pit in 2004. At that time the lake was unable to support Largemouth Bass due to extremely low pH

levels. The Bureau of Land Management, in collaboration with the Bureau of Freshwater Fisheries initiated a project to enhance the water quality by adding lime to the lake. The projected was funded by a grant from the Cumberland County Utility Authority. In 2006, members of the South Jersey Bass Club Association, NJ Federation of Sportsmen members, Division staff, and other volunteers added 136 tons of lime to Lake Audrey to neutralize the pH. In addition, artificial habitat structures were deployed to provide fish habitat.

In 2007 the lake was stocked with Smallmouth Bass, Yellow Perch, Bluegill, Golden Shiner, Creek Chubsucker, and Brown Bullhead. The lake was stocked in 2008 with adult and juvenile Smallmouth Bass. Lake was subsequently stocked from 2009- 2012 with juvenile Smallmouth Bass.

Lake Audrey was closed to all fishing in 2008 to protect this developing fishery after a number of reports were received that anglers were harvesting and relocating Smallmouth Bass to other waterbodies. In 2010 the lake was still considered a developing fishery that would only achieve balance and reach its potential if adequately protected. Catch and Release regulations for Smallmouth and Largemouth Bass were instituted in an attempt to protect the developing population.

The pH in Lake Audrey has dropped to a level where centrarchids will no longer successfully spawn in the lake. Post lime application pH levels ranged from high 7's to low 8's and currently have dropped to around 4.4 – 4.6. These low pH levels are not conducive to supporting a reproducing bass population.

Angler introduction of Largemouth Bass and unstable pH levels resulted in discontinuing the Smallmouth Bass stocking and the removal of the Catch and Release regulations, effective as of 2018. Electrofishing surveys completed from 2007 – 2016 showed a decrease in the abundance of Smallmouth Bass population and increase in the Largemouth Bass population.

A boat electrofishing survey was completed at Lake Audrey on 05/02/18 to further evaluate the Largemouth Bass population. The pH was 4.85 and indicates that bass and sunfish will not consistently reproduce. A total of 14 Largemouth Bass were collected during 0.94 hours of daytime electrofishing. Two individuals collected measured less than the 200-mm stock size and indicate that natural reproduction is possible. The largest individual was 462 mm and 1.418 kg. Lake Audrey was last stocked with YOY Largemouth Bass in 2014. These fish were not represented in the survey. Considering the lack of forage within the lake, these fish may have been consumed by the adult bass. There were very few other species observed during the survey. Only a few Bluegill and one small Chain Pickerel were observed. An updated management strategy for Lake Audrey is currently being developed. (Smith)

Lake Carasaljo (Ocean) – Lake Carasaljo is a 67-acre impoundment of the Metedeconk River located in Lakewood Township. The lake was last sampled in 1982, when a lake inventory was completed. Lake Carasaljo receives annual Channel Catfish stockings. A fish ladder is present and young-of-the-year Alewife were observed with several individuals collected during sampling for identification. Aquatic vegetation was extremely abundant within the lake. Species observed include Lowly Water Milfoil, Fanwort, Hydrilla, and Parrot Feather. Hydrilla and Parrot Feather are considered invasive aquatic vegetation species. A daytime

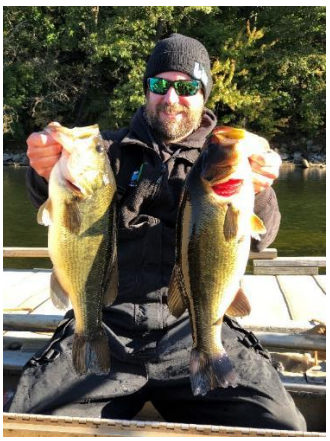
boat electrofishing survey was conducted on 10/17/2018 to evaluate the Largemouth Bass population. Total electrofishing time was 1 hour and 30 minutes. A total of 17 Largemouth Bass were collected, indicating a low CPUE of 11 bass per hour. A PSD of 70 and PSD-P of 41 were calculated, indicating a balanced population. The low number of bass collected is discouraging, however the individuals collected were observed to be quite robust and in good condition. An individual weighing 4.69 lb and measuring 19.9 in was the largest bass collected. Chain Pickerel, Yellow Perch, Bluegill, Pumpkinseed, Black Crappie, Golden Shiner, Creek Chubsucker, White Sucker, American Eel, Common Carp, Brown Bullhead, Gizzard Shad, and Alewife and were also observed during the survey. Presently, not enough is known about the existing Largemouth Bass fishery and follow up electrofishing surveys are recommended to gather additional data to further assess the population. (Boehm)

Lake Hopatcong (Morris) - Lake Hopatcong is New Jersey's largest freshwater impoundment and arguably the most utilized waterbody in the state. There are over 2000 residential homes situated around the lake, numerous public and private marinas and two public boat launches. Lake Hopatcong has an abundant user base consisting of recreational boaters and anglers. The NJDFW annually stocks warmwater and coolwater species: including Largemouth Bass, Channel Catfish, Walleye, Hybrid Striped Bass, Musky, and Tiger Musky. Boating activities are primarily limited to the warm weather during spring and summer, but anglers utilize the 2,686-acre lake daily throughout the year. This multiuse lake situated on the border of Sussex and Morris Counties is rich in history and productivity. The fish assemblage is one of the most diverse in the state, based on the 2014 Lake Hopatcong Fisheries Management Plan. Stocking remains a key component to maintaining the diversity and quality of the fish population.

Most warmwater fish will reproduce successfully on their own. Size and creel limits are established that maintain the balance of these populations with little additional input by fisheries managers. Occasionally, some populations need a little additional help through stocking or by changing regulations. The 2014 management plan showed that the Largemouth Bass population was rather poor, compared to other quality bass lakes in the state. Given the abundant habitat and forage in Lake Hopatcong, the lake should support a better bass population. It is not uncommon for one species to suffer, considering four top level predators are stocked annually in the lake. Additionally, the bass population was previously impacted by Largemouth Bass Virus.

Largemouth Bass have been actively stocked in Lake Hopatcong from 2015 – 2018. Over 100,000 young-of-the-year (YOY) bass were released to compliment the natural reproduction and bolster these year classes. Anglers report that overall catch rates and size of fish have improved over the last few years. A daytime boat electrofishing survey was completed on 10/18/18 to evaluate the bass population. A total of 95 Largemouth Bass were collected during the 3.41-hour survey. The CPUE for stock size bass (>200 mm) was 20 bass/hour (n=69). The catch rate is rather low in comparison to many of New Jersey's high-quality

bass populations, however the catch rate is higher than in 2014 (CPUE 11 bass/hour). A supplemental electrofishing survey is anticipated for spring 2019, prior to bass spawning to further evaluate the population abundance. Despite the low abundance, the population is well distributed based on the PSD of 71 and PSD-P of 43. These numbers were almost identical to that observed in 2014. There appeared to be a higher number of sub-stock size bass found during the survey. Twenty-six bass less than 200 mm were collected during the survey compared to eight during the 2014 spring surveys. Catch rates of smaller fish can vary significantly depending on sampling crew. Further evaluation is required to determine if this is a trend.



Six Walleye were collected during the survey, ranging in size from 440 – 665 mm (17.3 – 26.2 in). The largest individual weighed 3.29 kg (7.25 lb). Bluegill and Yellow Perch were not collected during the survey but were observed in good numbers. Two Smallmouth Bass, measuring 315 and 492 mm (12.4 and 9.4 in) were collected.

A boat electrofishing survey will be completed in March or April 2019, when water temperatures are appropriate, to further evaluate the bass population. (Smith)

Lake Musconetcong (Morris/Sussex) – This 329-acre lake has a free public boat launch (unlimited HP motors), but shoreline access is limited due to numerous lakefront private residences. The lake is stocked annually with catchable-sized trout (in the spring) and in 2018 NJDFW began stocking the lake with a low density of Tiger Muskies (2 fish/acre) to enhance recreational fishing opportunities. Lake Musconetcong is not typical of a large North Jersey lake, having been constructed in the mid-1800's as a water source for Morris Canal. It is quite shallow (maximum depth 8 feet) and though it has some rather large scattered boulders, it lacks the gravel substrate typical of the region. The soft mud substrate encourages excessive growth of aquatic vegetation (Eurasian Watermilfoil and Water Chestnut are very abundant) and control measures to curb weed growth have included mechanical (weed harvesting and hydro-raking), chemical (herbicide treatments), and physical (winter drawdowns). The lake is prone to winter fish-kills and early spring, stress-induced, fish die-offs that are exacerbated by winter drawdowns. In 2018 Parks and Forestry initiated periodic meetings with NJDFW and the Lake Musconetcong Regional Planning Board (and involved other agencies and non-governmental organizations when appropriate) to discuss lake management strategies and coordinate activities related to aquatic vegetation control, swirl chamber clean-outs, and associated water lowerings. Outcomes of these meetings were agreement to discontinue winter drawdowns for the purpose of aquatic vegetation control and allow a modest one-foot drawdown of short duration (one month) that starts in late October, to facilitate shoreline clean-up activities.

In 2009 NJDFW conducted a comprehensive lake inventory at Lake Musconetcong. At that time Chain Pickerel, Yellow Perch, Bluegill, and Golden Shiner were considered relatively abundant. However, growth rates for Largemouth Bass, Yellow Perch, and Bluegill, and reproduction of Largemouth Bass, were below average and was attributed to the extensive growth of aquatic vegetation. Despite below average growth rates and reproduction, the Largemouth Bass population was considered balanced and in good condition. In 2018 a daytime survey was conducted in the fall (11/1/2018) using an electrofishing boat to monitor and assess the black bass fishery. Most of the perimeter of the lake (estimated 85%) was electrofished and 39 Largemouth Bass were captured (all were stock size (200 mm (8-in) or greater)). The bass collected ranged in size from 219 – 504 mm (8.6 – 19.8 in) and the heaviest bass was 2.2 kg (4.9 lb). Other fish species observed but not collected during the survey were Chain Pickerel, Black Crappie, Rock Bass, Yellow Perch, White Perch, Bluegill, Pumpkinseed, Golden Shiner, Creek Chubsucker, Brown Bullhead, Hybrid Striped Bass, and Common Carp. Hybrid Striped Bass are not stocked in this lake, however the one large fish observed (estimated weight of 6 lb) probably escaped from Lake Hopatcong (located upstream), where this species is annually stocked by Fish and Wildlife. In the table below the results for bass from the 2009 and 2018 electrofishing surveys are summarized.

			Stock size (≥200 mm)		Quality size (≥300 mm)		Preferred size (≥380 mm)	
Date	Electrofishing runtime (hrs) and time of day	Total bass caught	Number (*n*)	CPUE (*n*/hr)	Number (*n*)	PSD	Number (*n*)	PSD-P
9/29/2009	1.02 nighttime	24	19	18	8	42	3	15
10/5/2009	2.50 nighttime	43	35	14	23	65	9	25
10/20/2009*	2.83 daytime	28	27	9	24	88	10	37
11/1/2018	2.30 daytime	39	39	17	36	92	28	72

* The lake was partially lowered when this survey was conducted.

The bass catch-per-unit-effort (CPUE) for these electrofishing surveys was relatively low (17 fish/hr in 2018, and 9, 14, and 18 fish/hr in 2009). Proportional Size Distribution (PSD), a numerical index used to characterize the length-frequency data, provides insight about fish population dynamics. For Largemouth Bass a PSD value within 40 – 70 is considered indicative of a balanced population. In 2009 the PSDs for bass from the two nighttime surveys were not drastically different (42 and 65), indicating a balanced bass population. The PSDs for the two daytime surveys were high – 92 in 2018 and 88 in 2009. PSD-P (P stands for Preferred >380 mm (15 in.)) was high in 2018 (72) compared to 2009 (15, 25, 37); for this metric a range of 10 – 40 is considered indicative of a balanced bass population. Because the bass catch rate was relatively low, and fish kills are known to occur after ice-out,

it is recommended that the lake be electrofished at other times of the year to better assess bass and panfish abundance. (Hamilton)

Lake Shenandoah (Ocean) – Lake Shenandoah is a 50-acre impoundment of the Metedeconk River located in Lakewood Township, and is part of the Ocean County Parks system. The lake is a NJDFW trout stocked water, that also receives Channel Catfish stockings. A boat ramp, numerous fishing docks, and plentiful shoreline openings provide abundant angler access. A fish ladder is present and numerous schools of young-of-the-year Blueback Herring were observed, with several individuals collected during sampling for identification. The lake was lasted sampled in March 1990. A daytime boat electrofishing survey was conducted on 10/03/2018 to evaluate the Largemouth Bass population. Total electrofishing time was 1 hour and 8 minutes. A total of 16 Largemouth Bass were collected. A PSD of 66 and PSD-P of 33 were calculated indicating a balanced population. However, the low number of bass collected is discouraging. A Largemouth Bass weighing 4 lb and measuring 18.9 inches was the largest collected. Chain Pickerel, Yellow Perch, Bluegill, Pumpkinseed, Black Crappie, Golden Shiner, Creek Chubsucker, White Sucker, American Eel, Common Carp, Brown Bullhead, Gizzard Shad, Blueback Herring, and Banded Sunfish were also observed during the survey. Worth noting was the lack of shallow shoreline habitat, most of the lake's littoral zone was barren. Habitat in the form of aquatic vegetation and course woody debris was very limited. The low number of Largemouth Bass encountered may be attributed to this or the bulk of the fish being deeper than could be effectively electrofished at the time of sampling. When water temperatures are high Largemouth Bass tend to move offshore and reside in the deeper portions of the lake where cooler temperatures provide refuge. Presently, not enough is known about the existing Largemouth Bass fishery and follow up electrofishing surveys are recommended to gather more data and further assess the population. Stocking of Largemouth Bass, if needed, may be considered in the future to improve the fishery. (Boehm)

Little Mantua Creek (Gloucester) – Little Mantua Creek is a tributary of the Delaware River and one of the most popular locations in New Jersey to fish for snakeheads. A boat electrofishing survey was completed on 06/08/18 to evaluate the Northern Snakehead and Largemouth Bass population. The creek is accessible by boat on high tide from the Delaware River, up to the railroad bridge. Three culvert pipes go under the railroad and allow Northern Snakeheads to migrate upstream. The location was previously sampled in 2010 and 2011 for Northern Snakeheads, however none were collected. The habitat is favorable for both Northern Snakeheads and Largemouth Bass with aquatic vegetation abundant. Three adult Northern Snakeheads ranging from 443 - 570 mm (17.4 – 22.4 in) were collected during this survey. A total of 18 Largemouth Bass were collected; all of which were greater than the 200-mm stock size. The PSD of 72 and PSD-P of 27 indicate the population is balanced. Surprisingly three adult Walleye were collected during the survey. They ranged in size from 500 – 525 mm (19.6 – 20.7 in) and weighed 1.26 – 1.41 kg (2.8 – 3.1 lb). (Smith)

Maple Lake (Atlantic) - Maple Lake is 35-acre impoundment of Stephen Creek located within Maple Lake WMA in the town of Estell Manor. A lake inventory was completed in 1996 and a boat electrofishing survey conducted in the summer of 2012. A sand boat ramp is present and provides angler access. A daytime boat electrofishing survey to assess the Largemouth Bass population was conducted on 09/14/2018. Total electrofishing time was 44

minutes. A total of 16 Largemouth Bass were collected, indicating a low CPUE of 21 bass per hour. A PSD of 87 was calculated indicating an unbalanced population. Largemouth Bass ranged in size from 11 to 15 inches. Chain Pickerel, American Eel, Creek Chubsucker, and Bluegill were observed in low numbers, but not collected. Worth noting was the low number of Bluegill and the absence of Golden Shiner, which serve as forage for Largemouth Bass in most lakes and ponds. The low catch rate and small size of Largemouth Bass can be attributed to the limited amount of suitable habitat and a lack of forage within the lake. Also, during the warm summer months Largemouth Bass tend to move offshore and reside the deep portions of a lake associated with creek channels and ledges and may have been too deep to effectivity collect with electrofishing gear at the time of sampling. However, it is doubtful that additional fish would have significantly changed the overall structure of the fishery. Currently, Maple Lake appears to have a very limited recreational fishery. Additional sampling is not recommended at this time. Taking into consideration Maple Lake is a Wildlife Management Area, with a public boat ramp, the stocking of surplus Largemouth Bass, adult Bluegill, and Golden Shiner maybe considered in the future to improve the fishery and bolster the forage base within the lake. (Boehm)

Mary Elmer Lake (Cumberland) – Mary Elmer Lake was one of the more popular bass ponds in southern New Jersey for many years. However, over time the effects of overfishing, poor water quality, sedimentation, and loss of habitat have become evident. Mary Elmer Lake is annually stocked with spring and fall trout and one of the more popular locations based on opening day angler counts. Catch rates are affected by high turbidity associated with heavy rainfall. Mary Elmer was most recently sampled in 2014 in conjunction with a fish health survey. The June 2014 survey resulted in a CPUE of 22 bass/hour which was significantly lower than when inventoried in 2003.

A daytime boat electrofishing survey was completed on 03/23/18 to assess the resident Largemouth Bass population and evaluate the spring trout stocking program. As previously mentioned, Mary Elmer Lake receives a good turnout for the opening day of spring trout season, however anglers have reported poor results in recent years. Opening day angler counts were completed seven times from 2005 – 2018 and ranged from 13 – 42 anglers. Catch rates ranged from 0 - 0.52 trout/angler, with an average catch rate of 0.23 trout/angler during the time sample period. The average catch rate for all water bodies surveyed from 1998 – 2018 is 0.54 trout/angler. The catch rate for Mary Elmer Lake is generally below average, however anglers report good catch rates during the spring in-season stocking period and during fall trout stocking. The recent electrofishing survey was completed three days following the spring stocking on March 20, to establish a baseline number of trout present; to quantify stocking effort, angler harvest, bird predation, and fish escaping. A total of 37 Rainbow Trout were observed during the 0.98-hour electrofishing survey. To determine a population estimate, or the number of trout present after stocking, a mark-recapture study would be required. However, for this evaluation, the presence of 37 Rainbow Trout was strong evidence that trout would be available for anglers on opening day.

A total of 28 Largemouth Bass were collected during the survey. The CPUE of 28 bass/hour indicates the population has not significantly improved since the 2014 survey. Young-of-the-year Largemouth Bass were stocked in 2015 and do not appear to have added to the population. The PSD of 79 and PSD-P of 21 indicate the population is balanced. An

additional survey is recommended in 2019 to evaluate the bass population. Additional stocking of Largemouth Bass is recommended. (Smith)

Maurice River (Cumberland) – A boat electrofishing survey was completed on the tidal section of the Maurice River, downstream of Union Lake on 08/06/18 to assess the Largemouth Bass population. The 1.24-hour daytime electrofishing survey produced 53 Largemouth Bass, of which all were greater than the 200 mm stock size. The PSD of 75 and PSD-P of 18 indicate the population is balance. The two largest individuals measured 550 and 526 mm (20.7 – 21.6 in) and weighed 2.26 and 2.15 kg (4.73- 4.96 lb). The survey was completed at the low outgoing tide when fish are concentrated. Other species observed included Chain Pickerel, Smallmouth Bass (1), Common Carp, White Perch, Yellow Perch, Channel Catfish, White Catfish, Eastern Silvery Minnow, Striped Bass, White Sucker, Bluegill, Pumpkinseed, Golden Shiner, Gizzard Shad, Blueback Herring YOY, and American Eel. A project was completed a few years ago which removed "navigable hazards" from the river following Hurricane Sandy, that also included the removal of a lot of good fish habitat. Additional surveys are recommended to make a comprehensive assessment of the population, in which stocking of additional Largemouth Bass may be considered. (Smith)

Mountain Lake (Warren) – This 122-acre lake has a public boat launch (electric-only motors) and shoreline public access is limited due to numerous lakefront homes. The lake is stocked annually with catchable-sized trout (in the spring, pre-season only) and Muskellunge. Although the Trophy Musky Waters regulation was discontinued at Mountain Lake in 2018, the minimum harvestable size for musky at this lake remains unchanged (40 inches), because the statewide minimum size for this species increased from 36 to 40 inches in 2018. In 2016 a nighttime electrofishing survey was conducted in the fall, prompted by the low number of centrarchids (bass and sunfish) captured earlier that year in trap nets (set in the spring to assess the musky fishery). The absence of Yellow Perch observed the 2016 survey prompted the stocking of this species in 2017 (due to limited availability only 37, 10-in fish were stocked). In 2018 a daytime electrofishing survey was conducted in the fall to monitor/assess the black bass fishery. The entire perimeter of the lake was electrofished. Only Largemouth Bass were present and the largest captured was 44 cm (17.4 in) and weighed 1.8 kg (2.8 lb). The results (for bass) from 2016 and 2018 electrofishing surveys are summarized in the table below. Seining was also conducted (page 100).

			Stock size (≥200 mm)		Quality size (≥300 mm)		Preferred size (≥380 mm)	
Date	Electrofishing runtime (hrs) and time of day	Total bass caught	Number (*n*)	CPUE (*n*/hr)	Number (*n*)	PSD	Number (*n*)	PSD-P
10/3/2016	1.29 daytime	94	62	48	31	50	10	16
10/4/2018	1.23 daytime	82	75	61	42	56	6	8

The results from these surveys are very similar. Stock-sized bass (individuals measuring at least 203 mm (8 in)) are used to calculate CPUE (Catch-Per-Unit-Effort). The CPUEs in the two surveys (48 and 61) are considered moderate. PSD (Proportional Size Distribution) is a numerical index that characterizes the length-frequency data, using stock and quality (≥305 mm or 12 in) sized bass to provide insight about population dynamics. The PSD values for both surveys indicate a balanced bass population was present (40–70 is the accepted range for a balanced Largemouth Bass population). PSD-P (Preferred) uses stock and preferred (≥381 mm or 15 in) size bass to characterize the prevalence of larger bass. The PSD-P values in the two surveys (16 and 8) suggests that the number of larger bass (desired by anglers) is low (10–40 is the accepted range). Also captured during the 2018 electrofishing survey were two Muskellunge (three others were sighted but not captured) measuring 930 and 944 mm (36.6 and 37.2 in). In addition, two large Black Crappie measuring 343 and 370 mm (13.5 and 14.6 in) were captured. Other fish species observed, but not captured during the survey were Chain Pickerel, Redfin Pickerel, Rock Bass, Brown Bullhead, American Eel, Alewife, Bluegill, Pumpkinseed, Bluespotted Sunfish, and Common Carp. It is recommended that the lake be electrofished at other times of the year to further assess the bass and panfish populations. Due to the continued absence of Yellow Perch it is recommended this species be stocked to establish a reproducing population that can provide forage and enhance sport fishing. A project to enhance habitat for panfish has been proposed by Muskies Inc. and is supported by NJDFW. Plans involve building and placing porcupine crib structures in the lake in 2019, pending necessary approvals and permits. (Hamilton)

Newton Lake (Camden) – Newton Lake is a 40-acre impoundment of Newton Creek bordered by Collingswood, Oaklyn, and Haddon Township. More than half of the lake's shoreline, including the boat ramp, is maintained by the Camden County Parks System. Private residences border the rest of the lake. Newton Lake has a small paved boat ramp, ample trailer parking, and good shoreline access for anglers. The lake is family friendly, with a playground and temporary restrooms nearby. A fish ladder to increase spawning habitat for Alewife and Blueback Herring was installed in the early 2000's and subsequently deemed a pathway for the invasive Northern Snakehead.

A boat electrofishing survey was completed on 05/29/18 to evaluate the Largemouth Bass and Northern Snakehead populations. A total of 103 Largemouth Bass were collected, of which 98 were greater than the 200 mm (8 in) stock size. The CPUE was 56 bass/hour based on 1.75 hours of daytime electrofishing, which indicates a good population density. The largest bass measured 505 mm (19.88 in) and weighed 2.10 kg (4.63 lb). A PSD of 85 and PSD-P of 55 indicate a slightly unbalanced population. A total of six Northern Snakeheads were collected ranging in size from 455 - 712 mm (17.9 – 28.03 in) and weighed 0.93 – 3.87 kg (2.05 – 8.53 lb). Submerged aquatic vegetation was determined to be extremely abundant in 2016, however was absent this year. The lake will continue to be monitored for the presence of Northern Snakeheads and any impact on the Largemouth Bass population. (Smith)

Parvin Lake (Salem) - Parvin Lake is a 95-acre impoundment of Muddy Run located within Upper Pittsgrove Township. Parvin Lake is a State Park facility and one of five lakes managed under Lunker Bass Regulations. The 2.07-hour daytime boat electrofishing survey was completed on 10/30/18 to evaluate the Largemouth Bass population. A total of 119 bass were collected, of which 117 were greater than the 200 mm stock size. The PSD of 78 and PSD-P of 33 indicate a balanced population. A PSD-M of 2, which represents fish greater than 510 mm (20 in), validates the "Lunker" status of this popular lake. The CPUE of 56 bass/hour was slightly higher than when sampled in 2016, at which time it was 43 bass/hour. In 2016 the PSD was 72 and PSD-P was 46 indicating an unbalanced fish population. The higher CPUE and lower PSD-P in 2018 suggests a slight population shift to smaller fish. The two largest bass were 575 mm, 3.03 kg (22.6 in / 6.69 lb) and 570 mm, 3.06 kg (22.4 in / 6.75 lb).

The Largemouth Bass population is stable, and no additional stocking is recommended. The forage base appears to be sufficient to support the existing bass population. Yellow Perch, Bluegill, and Golden Shiner are present in good numbers. The lack of Gizzard Shad observed during the survey is noteworthy, as they have historically comprised much of the bass' diet during the fall and winter months. Parvin Lake will be included in the list of regularly monitored bass lakes. (Smith)

Pemberton Lake (Burlington) – Pemberton Lake is a 20-acre borrow pit located in Pemberton Township. The WMA lake is annually stocked with trout and at one time was considered an excellent Largemouth Bass lake. In recent years, especially since 2009, algae blooms from excessive nutrient input have plagued the lake. An electrofishing survey was completed on 09/20/18 to assess the bass population. The CPUE of 41 bass/hour for stock size bass was much higher than when sampled on October 2017, at which time it was 21 bass/hour. The PSD of 33 and PSD-P of 6 were consistent with those observed in 2017 (PSD of 36 and PSD-P of 13), indicating an unbalanced population. Stocking of young-of-the-year Largemouth Bass earlier in the summer likely contributed to the abundant number observed during this recent survey. No additional stocking is recommended for 2019. The lake should also be discontinued from the Channel Catfish stocking program to alleviate competition. Additional electrofishing should be completed in 2020. (Smith)

Penbryn Lake (Camden) – Penbryn Lake is an old sand pond approximately 33-acres in size located in Winslow Township. The lake is part of the Penbryn Lake Wildlife Management Area. A lake inventory was completed in 2004. A sand boat ramp provides angler access but parking is limited. The lake is quite deep when compared to most South Jersey waters with several spots reaching 30 feet or more. Water clarity is typically clear, but algal blooms have been reported in the past. An algal bloom was on going at the time of sampling, greatly reducing visibility. A daytime boat electrofishing survey to assess the Largemouth Bass population was conducted on 09/14/2018. Total electrofishing time was 30 minutes. A total

of 20 Largemouth Bass were collected. A PSD of 11 was calculated indicating an unbalanced population comprised of small individuals. Young-of-the-year (YOY) Largemouth Bass were extremely abundant along the shoreline of the lake. Successful reproduction of Largemouth Bass is to be expected in a sand pond environment and is evident in the numerous YOY observed. An additional electrofishing survey under more favorable conditions is recommended to further assess the bass fishery before future management decisions are made. The deep water found in Penbryn provides a refuge for Largemouth Bass during the summer months and can make them difficult to sample with electrofishing gear. A springtime survey, possibly at night, should concentrate most of the bass in the shallows and make them much more exploitable to boat electrofishing. (Boehm)

Prospertown Lake (Ocean) - Prospertown Lake is an 80-acre impoundment of Lahaway Creek, a tributary of Crosswicks Creek in a WMA in Jackson Township. The lake is bordered by Six Flags Great Adventure on one side and private forested land on the other. A lake inventory and management plan were completed in 1997. The Prospertown Lake dam failed in 2011, was reconstructed and refilled by spring 2013. Following the dam re-construction, Prospertown Lake was restocked with Largemouth Bass, Bluegill, Black Crappie, and Brown Bullhead. Electrofishing surveys later determined that Brown Bullheads were over-abundant and should be removed from the lake to allow the Largemouth Bass and Bluegill populations a better opportunity to re-establish. The Brown Bullhead population appears to have stabilized from active removal completed in 2014 – 2017; no additional bullheads were removed in 2018.

A boat electrofishing survey was completed at Prospertown Lake on 05/15/18 to assess the Largemouth Bass population. A total of 41 bass were collected during the 1.77-hour daytime electrofishing survey. The CPUE for stock size bass greater than 200 mm was 23 bass/hour, indicating a low-density bass population by New Jersey standards. The PSD of 82 and PSD-P of 34 indicate the slightly unbalanced population, as the recommended PSD by (Carlander, 2011) is 40-70. A survey completed in 2017 resulted in a CPUE of 59 bass/hour, a PSD of 95 and PSD-P of 55. Both the catch rate and size distribution have declined over the last year. Prospertown Lake receives little pressure from fishing tournaments, due to the WMA regulations which prohibits the use of any electric or gas outboards. A potential impact to the population is the popularity of ice fishing in the central and northern parts of New Jersey. Ice anglers were frequently observed fishing at Prospertown Lake during the winter of 2017 and 2018. The population will continue to be monitored. Largemouth Bass should be stocked in 2019 to bolster the population. (Smith)

Rancocas Creek, S/Br. (Burlington) – A boat electrofishing survey was completed on the tidal South Branch Rancocas Creek on 10/10/18 to evaluate the Largemouth Bass population. Invasive species, including Northern Snakehead and Flathead Catfish were also collected. Snakeheads and Flathead Catfish are now widely distributed through the Delaware River and its tributaries. A new canoe access area was created in the upper reaches of the tidal section to increase recreational opportunities. The ramp is intended for canoes and kayaks, however the location is sufficient for launching trailered boats. This location has been sampled extensively in the past, as part of the Tiger Muskie stocking program evaluation and in more recent years by Marine Fisheries to evaluate river herring recruitment. The survey was

completed upstream starting at the "railroad bridge" and ending just upstream of the boat ramp. The tide was low and outgoing, which is the preferred time to sample tidal areas.

A total of 86 Largemouth Bass were collected during the 1.33-hour survey. The CPUE of 44 bass/hour based on the 59 stock size bass is a moderate density by New Jersey standards. The location should be resampled in 2019 or 2020 under similar conditions for comparison. Twenty-seven individuals were collected below the 200 mm stock size, many of which are suspected to be from the 2018 stocking by the hatchery. The location can support a more robust population and is limited by poor spawning success. The PSD of 71 and PSD-P of 6 indicate the population is slightly unbalanced.

Two Northern Snakeheads were collected during the survey. The fish measured 530 and 594 mm (20.8 and 23.4 in). Scales were taken from both individuals for age determination. A Flathead Catfish measuring 850 mm (33.5 in) and weighing 8.81 kg (19 lb) was also collected. Both species are invasive and are removed when encountered. (Smith)

Rainbow Lake (Salem) – Rainbow Lake is a 77-acre impoundment of Muddy Run, a tributary of the Maurice River and one of the most popular WMA Lakes in southern New Jersey. A concrete boat ramp and gravel parking area provide access for boaters, however shoreline fishing is limited. A boat electrofishing survey was completed on 10/16/18 to evaluate the bass population. A total of 100 Largemouth Bass were collected during the 1.86-hour survey. The CPUE of 52 bass/hour is significantly higher than when sampled during the summer of 2016, at which time it was 18 bass/hour. In October 2010 an electrofishing survey was completed at Rainbow Lake and resulted in a CPUE of 41 bass/hour. The Largemouth Bass population appears to be expanding based on the difference in catch rates from 2016 to 2018. However, fall electrofishing surveys generally produce higher catch rates than those conducted during the summer. Shallow waters bodies like Rainbow Lake, which has a maximum depth of six feet, have less variability in electrofishing rate rates than deeper waterbodies and generally less variability between the season. The most recent survey resulted in a PSD of 70 and PSD-P of 21 indicating a balanced population. The PSD-P was slightly lower than other high-quality bass populations in the area and should continue to be monitored. Further evaluation of these observations will be addressed in the Warmwater Management Plan, that will be completed in 2019.

The forage base is good consisting of Bluegill, Golden Shiner, Yellow Perch, and a low-density Gizzard Shad population. Despite the heavy fishing pressure, Rainbow Lake continues to produce rather consist electrofishing results and should provide excellent fishing opportunities to anglers. (Smith)

Rising Sun Lake (Monmouth) – A boat electrofishing survey was completed at Rising Sun Lake on 06/13/18 to evaluate the Largemouth Bass population. At 38 acres, Rising Sun Lake is the smallest of the three primary lakes that make up the Assunpink WMA. Rising Sun Lake is also the clearest of the three lakes and generally the least productive. Growth rates are rather slow, and most individuals are small. Electrofishing sampling suggests the population is unbalanced based on low PSD-P values.

A total of 150 Largemouth Bass were collected during 1.20-hour daytime electrofishing survey. The CPUE for stock size bass (>200mm) was 117 bass/hour, suggesting a high-density population. The low PSD and PSD-P values (27 and 1) indicate the population is not balanced. Largemouth Bass recruitment appears to high. Limited bass and pickerel and abundant aquatic vegetation probably contribute to excessive recruitment.

No additional stocking of Largemouth Bass is recommended at this time. Bluegill and Yellow Perch were both observed and should provide adequate forage for the bass population, when the bass population achieves balance. The Largemouth Bass population will continue to be monitored. A dam reconstruction project is planned for the fall 2019 and will require a major water lowering of 8-10 feet. At that time a new concrete boat ramp will be constructed. (Smith)

Round Valley Reservoir (Hunterdon) – Round Valley Reservoir is one of the largest waterbodies in the state and is unique to New Jersey supporting both warmwater and coldwater fish populations. The lake inventory in 2016 established a good baseline for the warmwater fish population, which will continue to be monitored on an annual basis. A daytime boat electrofishing survey was completed on 06/07/18 to evaluate the bass population. Smallmouth Bass and Largemouth Bass were both well represented during the survey. The CPUE for stock size Smallmouth Bass was 26/hour, which was higher than the CPUE observed in 2016, which was 17/hour and ranged from 14-20 bass/hour. The CPUE of 12 bass/hour for stock size Largemouth Bass was lower than those observed in 2016 which ranged from 24 – 44. The PSD and PSD-P values for Largemouth and Smallmouth Bass were considerably higher than those observed during the inventory. The 2018 sampling resulted in a PSD and PSD-P for Largemouth Bass of 60 and 21. The PSD and PSD-P for Smallmouth Bass were 84 and 22. In comparison Smallmouth Bass had a PSD of 31 and PSD-P of 3 in spring 2016; Largemouth Bass had a PSD of 41 and PSD-P of 5. The largest individual collected was a Largemouth Bass measuring 535 mm (21.06 in) and weighing 2.56 kg (5.65 lb). Fluctuating water levels in connection with the ongoing dam repair project could have positive impacts on the bass population. Additional sampling should be conducted at night as daytime electrofishing appears to under represent the bass population. (Smith)

Salem Canal (Salem) – The Salem Canal is a dammed section of the Salem River originating in Woodstown and flowing through the DuPont facility, before exiting at the confluence with the Delaware River. It is one of the most popular bass fishing locations in southern New Jersey and annually receives the most applications for WMA fishing tournament permits. The Salem Canal is not a WMA; however the Division owns a parcel of land and the concrete boat ramp located on Route 540. The shallow canal consisting of marshy banks,

spatterdock, submerged aquatic vegetation, and felled trees make the canal ideal habitat for Largemouth Bass and unfortunately for the Northern Snakehead in recent years.

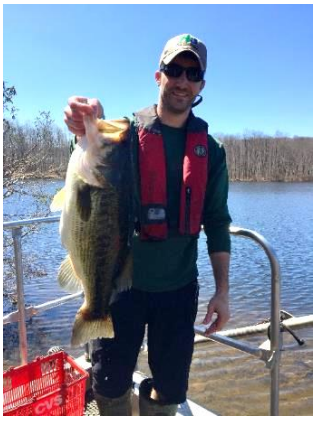
Three boat electrofishing surveys were completed in 2018; on 03/28/18, 04/10/18 and 06/18/18. The table below is a summary of the three electrofishing surveys. The CPUE for Largemouth Bass ranged from 29 – 53 for the three surveys. PSD and PSD-P ranged from 62 – 79 and 12 – 21. The average CPUE indicates a good density bass population. The average PSD and PSD-P indicate the population is balanced. As previously mentioned in the Game Creek survey summary, Salem Canal and Game Creek are directly connected. Though habitat is slightly different in the two areas, a bridge (which is too low for the electrofishing boat) is the only thing separating the two areas. CPUE, PSD and PSD-P were very consistent in Game Creek and Salem Canal. The largest bass collected measured 520 mm (20.5 in) and weighed 2.75 kg (6.07 lb).

Date	Electrofishing Time	No. LMB	LMB CPUE (stock)	PSD	PSD-P	No. Snakehead
3/28/18	1.76	79	42	79	21	13
4/10/18	2.25	121	53	71	16	12
6/18/18	1.94	60	29	62	12	0

A total of 25 Northern Snakeheads were collected from the three surveys (page 138). Snakeheads did not appear to be as abundant in the canal as Game Creek. The largest collected measured 635 mm (25 in) and weighed 2.55 kg (5.62 lb). The bass population appears to be in good condition and should be annually monitored to determine if supplemental stocking is required. Annual electrofishing should continue to remove snakeheads. (Smith)

Sheppards Mill Pond (Cumberland) – Sheppards Mill Pond is a 51-acre impoundment of Mill Creek, a tributary of the Cohansey River. The pond is the newest addition to the Cohansey River WMA. Prior to the acquisition by Green Acres, Sheppard's Mill was privately owned. The shoreline is primarily forested, excluding the three residences along the southeastern shoreline. In-water habitat is limited to a few felled trees and sparse submerged aquatic vegetation. A boat electrofishing survey was completed on 09/17/18 to evaluate the Largemouth Bass population. A total of 30 bass were collected during the 1.05-hour survey, of which 23 were greater than the 200 mm stock size. The CPUE of 21 bass/hour indicates a low-density bass population. The PSD of 30 and PSD-P of 17 indicate an unbalanced population, comprised mostly of smaller individuals. A population with a balanced size structure, as recommended by Carlander 2011, would have a PSD of 40-70 and a PSD-P of 10-40. Although unbalanced, three quality individuals measuring 496 – 521 mm (19.5 – 20.5 in) and weighing 1.88 – 2.38 kg (4.15 – 5.24 lb) were collected. No additional bass stocking is recommended for 2019. A nighttime electrofishing survey should be completed in spring 2019 to further evaluate the population. (Smith)

Silver Lake (Camden) – Two backpack electrofishing surveys were completed at Silver Lake, Camden County on 07/14/18 and 08/21/18 to monitor and remove invasive Asian Swamp Eels. The Asian Swamp Eel was first discovered in New Jersey in 2008 at this site. The NJDFW annual surveys Silver Lake to ascertain any population growth and collect and remove Swamp Eels. A total of 39 were collected on 07/14/18 from 0.66 hours of electrofishing and 47 on 08/21/18 from 1.2 hours of electrofishing. Monitoring and removal will continue in 2019. The Swamp Eel population appears to be stable. Silver Lake is privately owned and public fishing is not permitted. No additional fisheries surveys have been conducted at the lake since the lake is privately owned. (Smith)



Splitrock Reservoir (Morris) – During the late 1700's and early 1800's, an original dam was constructed, impounding 350 acres, within the Rockaway River Watershed. The dam was modified during the period of 1947-1949, through the construction of a 55-foot-high dam, raising the water level by approximately 20 feet. Today, Splitrock Reservoir is a 554-acre impoundment. The reservoir and surrounding 4,016 acres were acquired from Jersey City through a conservation easement in 1996 and established a hiking trail and a recently completed kayak launch provides anglers access. The Newark Bait and Fly Casting Club had use of Split Rock Pond for recreational fishing for many years prior to its purchase by Jersey City in 1923. It is likely that the club stocked a variety of fish species to enhance recreational fishing opportunities. The reservoir acts as a supplemental water supply source providing water to Boonton Reservoir, by way of Beaver Brook. Beaver Brook is classified as *Trout Production* waters from Splitrock Dam downstream to Meriden Road. Beaver Brook is a tributary of the Rockaway River that flows into Boonton Reservoir. Splitrock Reservoir is classified as a *Trout Maintenance* water.

A lake inventory and management plan was prepared in 2008 based on sampling surveys from 2007. At that time, Splitrock Reservoir was determined to have good Largemouth and Smallmouth Bass populations based on spring night electrofishing. Results from three electrofishing surveys resulted in PSDs ranging from 56-79 and PSD-Ps ranging from 21-38. Surveys were completed during the fall of 2016 and 2017, in which Largemouth and Smallmouth Bass populations were not well represented and had a lower PSD, PSD-P, and CPUE from those observed in 2007. Spring electrofishing appears to be a better option when sampling Splitrock Reservoir. Splitrock Reservoir has a diverse forage base consisting of Yellow Perch, Bluegill, and Golden Shiner. Alewife have been previously collected during other surveys, but none were observed.

A daytime boat electrofishing survey was completed on 04/23/18 to assess the Largemouth and Smallmouth Bass population. Previous surveys in the spring and fall have been completed at night. The survey focused on the northern portion of the lake, from the large island to the back of the lake. A total of 3.34 hours of electrofishing resulted in 79 Largemouth Bass and seven

Smallmouth Bass. The CPUE for stock size bass was 24 bass/hour and indicates a low-density population. The CPUE was lower than previous surveys, however the PSD and PSD-P were significantly higher. The PSD was 99 and PSD-P was 54 for 2018, both of which indicate a quality Largemouth Bass population. All Largemouth Bass appeared to be in good condition.

A supplemental spring electrofishing survey in May 2019 is recommended when the water temperature is between 58-65°F. The surface water temperature was 12°C (53°F) when the survey was completed. Splitrock Reservoir is a good candidate for stocking surplus Smallmouth Bass, as only five were collected during the survey. (Smith)

Spring Lake (Mercer) - Spring Lake is a 20-acre low-lying impoundment located with John Roebling Memorial Park, Hamilton Township. The lake and park are maintained by Mercer County Parks. A small gravel launch is perfect for small trailered boats, kayaks, and canoes. Shoreline access is good with a walking trail encircling the entire pond. A boat electrofishing survey was completed on 05/15/18 to evaluate the bass and possible Northern Snakehead population. Snakeheads have been reported from this location, however none were collected or observed. One Bowfin measuring 595 mm (23.4 in) and weighing 1.85 kg (4.07 lb) was collected, suggesting that it may also be possible for Snakeheads to enter the pond as the two are usually found together in recent years. Only seven Largemouth Bass were collected during the 0.48-hour survey. Bass ranged in size from 136 – 405 mm (5.4 – 15.9 in). A supplemental stocking of bass is recommended in 2019. (Smith)

Stone Tavern Lake (Monmouth) – Stone Tavern Lake is a 52-acre impoundment located within the Assunpink Wildlife Management Area. A daytime boat electrofishing survey was conducted on 05/30/18 to evaluate the Largemouth Bass population. A total of 56 bass were collected during the 1.07-hour survey, all of which were greater than the 200 mm stock size. The CPUE of 52 bass/hour is a good density bass population for New Jersey's waters. The PSD of 58 and PSD-P of 28 indicate a balanced population. Bass density is consistent with the last electrofishing survey completed in 2016, however the PSD is down from 83, while the PSD-P remained consistent. It appears that the population density and the number of bass greater than 15 inches has remained consistent. A slight shift in the population is evident with an increase number of fish between 8-12 in. The population will be re-evaluated in spring 2019. Noteworthy was the lack of aquatic vegetation in the lake which was previously abundant. (Smith)

Sunset Lake (Cumberland) - Sunset Lake is 88-acre impoundment of the Cohansey River located in Bridgeton. The dam failed in 2012 and remained lowered for nearly three years. Prior to the dam failure, Sunset Lake had an excellent Largemouth Bass population and was regarded as one of the best bass populations in Southern New Jersey.

The Largemouth Bass population has rebounded well since the dam reconstruction in 2014. The population should provide outstanding fishing opportunities in the next couple years. The lake was restocked with a total of 33,349 Largemouth Bass from

2015 to 2017. An electrofishing survey completed on 03/29/18 to monitor the recovering population. A total of 123 Largemouth Bass were collected during the 2.05-hour survey. The CPUE of 62 bass/hour indicates a good density population. The PSD was 39 and PSD-P was 4 indicating a population is unbalanced, comprised of mostly smaller fish. The largest bass collected measured 515 mm (20.2 in) and weighed 2.79 kg (6.15 lb). Approximately 750 Common Carp were removed from Sunset Lake to reduce biomass of undesirable species in 2017. An additional 250 carp were removed from Sunset Lake on 06/11/18. The bass population will be re-evaluated during spring 2019. No additional stocking is recommended. (Smith)

Swedes Lake (Burlington) – Swedes Lake, located in Delran Township is a 43-acre public municipally owned borrow pit. The pond is rather unique containing a pipe, with a flapper valve, that connects directly to Swedes Run and flows into Dredge Harbor, an embayment of the Delaware River. Swedes Lake has never previously been sampled by electrofishing. Seining surveys, the most recent in 2014, indicate good spawning success of Largemouth Bass and Bluegill. A boat electrofishing survey was completed on 10/19/18 to evaluate the bass population. A total 13 bass were collected during the 30-minute survey, which was the time it took to make one complete electrofishing pass around the perimeter of the lake. One side of the lake is characterized as an extremely shallow sand flat with little fish attracting cover. The other side consists of private houses with bulkheads and a few docks. All bass collected were along the shoreline with the houses. A few quality size bass ranging from 405 – 495 mm (15.9 – 19.5 in.) were collected. These fish appeared to be very robust and in good condition. Young-of-the-year Gizzard Shad were observed to be abundant and serve as a good forage base for the bass. The survey was rather inconclusive, due to depth of the pond. Swedes Lake has been regularly stocked with Channel Catfish for many years. Additional sampling is needed to further evaluate the fish population. (Smith)

Union Lake (Cumberland) – Union Lake is an 898-acre impoundment of the Maurice River located within the Millville WMA. The lake is one of the largest impoundments in southern New Jersey and one of the most utilized Wildlife Management Areas in the state.

Union Lake has been extensively sampled in recent years and for good reason as the lake is arguably one of the best, if not the best Largemouth Bass lake in southern New Jersey. A lake inventory was completed in 2015 and suggested the population had stabilized from issues associated with Largemouth Bass Virus (LMBV). Stocking of Largemouth Bass in 2009, 2010, 2011, 2015, 2017, and 2018 has contributed to the resurgence of the population. Despite the exceptional electrofishing results of the last three years, anglers still find catching bass rather difficult as indicated by the WMA Fishing Tournament reports.

Two boat electrofishing surveys were completed in 2018 to evaluate the Largemouth Bass population. One during the early spring on 03/19/18 and one during the fall on 11/08/18. Surveys were completed the same time of year in 2017 and should continue annually. During the March survey, a total 123 Largemouth Bass were collected during the 2.42-hour survey. The largest individual was 534 mm (21 in) and weighed 3.05 kg (6.72 lb). The CPUE for bass greater than 200 mm (8 in) stock size was 50 bass/hour indicating a good density for southern New Jersey and consistent with surveys completed in the spring and fall of 2017. A PSD of 95, PSD-P of 73, and PSD-M of 5 indicate a trophy population and

consistent with “Big Bass” lakes. Noteworthy were seven Largemouth Bass in excess of 5 pounds collected during the survey. In comparison, only five Largemouth Bass over five pounds were reported from 17 tournament reports in 2017. Only one smallmouth was collected during this survey measuring 498 mm (19.6 in) and weighing 1.71 kg (3.8 lb). Smallmouth Bass remain very difficult to collect via electrofishing at Union Lake, as they do not relate to any particular habitat and are dispersed amongst open water.

The second survey occurred in November to evaluate the Largemouth Bass population and seasonal variable of CPUE, PSD and PSD-P. A total of 48 Largemouth Bass were collected during the 2.0-hour survey. The CPUE of 23 bass/hour was significantly lower than that observed during the spring of 2018 when it was 50 bass/hour. The PSD of 87 and PSD-P of 55 were also slightly lower than during the spring when it was 95 and 73. Electrofishing surveys appear to produce a high variability in CPUE, PSD, and PSD-P depending on temperature.

The stocking of Largemouth and Smallmouth Bass should be continued on an annual basis to supplement the existing population. A habitat enhancement project should be completed for Union Lake, to support the growing bass population and is planned for the winter 2019/2020. Aquatic vegetation, felled trees, and sunken brush piles would further enhance the population. (Smith)

Upper Sylvan Lake (Burlington) – Sylvan Lake is a 12-acre municipally owned impoundment located in Burlington Township. The lake is part of the trout stocking program receiving both spring and fall fish. A concrete boat ramp is present, but parking is limited to just a few vehicles. Shoreline access is good despite the number of homes around the lake. The dam was replaced and the lake dredged in the early 2000’s. The lake was restocked with Largemouth Bass and Bluegill. Sylvan Lake receives an annual stocking of Channel Catfish.

A boat electrofishing survey was completed on 10/19/18 to evaluate the Largemouth Bass population. A total of 34 bass were collected, of which 33 were greater than the 200 mm stock size. A CPUE of 35 bass/hour based on 0.92 hours indicates a moderate density population. A PSD of 94 and PSD-P of 57 indicate an unbalanced population, comprised of mostly larger individuals, but one that should provide good fishing opportunities for anglers. A diverse forage base is present consisting of Bluegill, Golden Shiner, and Gizzard Shad. Noteworthy were the two bass greater than 510 mm (PSD-M), which measured 513 (20.2 in) and 520 mm (20.5 in). Stocking of YOY Largemouth Bass is recommended to enhance the population. (Smith)

Warmwater Fisheries Assessments / Reproduction Checks / Native Fishes via Seining

A seine is a small rectangular net used to collect fish in shallow water. The typical size used by NJDFW is 20 ft x 4 ft. A two-person team, one at each end, pulls the seine through the water when sampling. The net extends horizontally from the surface of the water to the bottom of the lake. Floats attached to the top keep the net on the surface, and weights attached to the bottom keep the net on the bottom. Seines are an effective sampling method used to assess the status of warmwater fish reproduction, which aids in the management of their fisheries and helps assess stocking success or need. Seines also provide a means to sample fish populations in waters that are not easily accessible or conducive to standard electrofishing methods, such as waters with extremely low conductivity. The data gathered from seining surveys is also beneficial in documenting the presence of unique native species as well as invasive species, that can often be missed when sampling with other gear types. A total of 63 lakes and ponds were seined in 2018 during the months of June through early-October. (staff, Hunter and Angler)

Bluegill (top) and Pumpkinseed (bottom) collected with a 20' x 4' seine.

Ann Van Middlesworth Park Pond (Somerset) – This 3.2-acre pond is located in Hillsborough Township. It is an onstream impoundment of Royce Brook. When last sampled in 1998, it was considered a well-balanced fishery, consisting of common species such as Largemouth Bass, Brown Bullhead, Bluegill, and Pumpkinseed. Channel Catfish were introduced for increased diversity and are regularly stocked. Shoreline access is limited to a few small clearings along the perimeter of the pond, however a fishing pier was constructed to improve access for anglers. Three fountains have been installed to oxygenate the water. Children's derbies are regularly held; and is routinely stocked by the Division in support of these events. A reproductive check was conducted for general fisheries management purposes by means of fifteen seine hauls on 08/14/18. All species found were common and appear to be well balanced. The most prevalent species were unidentified sunfish of the *Lepomis* Genus, averaging 48/haul. Bluegill (8/haul) were the most abundant sunfish species, followed by the invasive Green Sunfish (1/haul), and Pumpkinseed (<1/haul). A total of 5 Largemouth Bass were encountered (<1/haul), indicating that reproduction is taking place, however they are not very abundant. Other species encountered include Tessellated Darter and Banded Killifish. Stocking of fingerling warmwater species is not necessary at this time, as adequate reproduction is occurring. Supplemental stocking of catchable fish is acceptable in anticipation of fishing derbies for educational purposes and to supplement the recreational fishery. (Crouse)

Best Lake (Somerset) – This 4.2-acre pond is an onstream impoundment in the headwaters of Bound Brook in Watchung Borough, which flows into the Raritan River. It is situated in a residential area, with a walking path around 1/2 of the pond and it has adequate parking. The pond was dredged and the dam restored in 2008. Subsequently, the local scouts installed fish habitat structures, two fountains were installed, and the pond was restocked with warmwater fish in 2009, 2011, and 2012. The fishery was also impacted by Hurricane Irene in 2011. Seining data over the years indicate extensive sunfish (Bluegill, Pumpkinseed, and invasive Green Sunfish) reproduction is taking place, as hundreds of young-of-year (YOY) were collected with nearly every 20 ft. seine haul. Unfortunately, few Largemouth Bass were encountered in 2012 and 2013, and unfortunately Green Sunfish and Mosquitofish were abundant. It was seined again on 09/05/18 for potential inclusion in a future Community Lakes program. This survey had similar results, however sunfish numbers were lower than in the past, with 23/haul. Unfortunately, only one Largemouth Bass YOY was encountered. As a result, fingerling and catchable Largemouth Bass should be stocked to bolster the population, however no sunfish should be stocked. (Crouse)

Bee Meadow Park Pond (Morris) - This 10-acre pond located in Hanover Township was seined on 09/04/2018, primarily for evaluation of its inclusion into the Community Lakes Stocking Program. The pond is open to the public, has a large parking area, interconnected playgrounds, and a swimming pool. The pond is open to fishing along ~30% of its perimeter and has an annual fishing tournament. A total of 11 seine hauls were conducted and sunfish (10/haul) and Largemouth Bass (<1/haul) present. The habitat appeared complex and able to provide adequate cover for fish. Currently, there are no recommendations. (Collenburg)

Birch Grove Park Pond #1 (Atlantic) – Birch Grove Park Pond #1 is a 2-acre impoundment located in the town of Northfield. It is trout stocked and receives Channel Catfish stockings. Ample fishing access is provided by a bulkhead that runs along most of the pond's shoreline immediately adjacent to the parking area. A reproduction check was conducted on 06/29/2018. A total of eight locations were sampled around the perimeter of the pond using a 20' x 4' seine. A total of three species were collected which included Bluegill (10/haul), Pumpkinseed (4/haul), Brown Bullhead (<1/haul), and unknown *Lepomis* spp. (<1/haul). The unknown *Lepomis* species collected was a young-of-the-year (YOY). All the remaining Bluegill and Pumpkinseed collected were intermediate or adults. No Largemouth Bass were observed or collected. Water chemistry was recorded and pH measured 7.33. The lack of YOY Largemouth Bass and YOY *Lepomis* species encountered during sampling is discouraging. Their absence suggests harvest or angling mortality is high on this popular and easily exploitable fishery. The stocking additional Largemouth Bass and Bluegill may be considered to bolster the fishery and create additional freshwater angling opportunities in the area. Additional ponds are located within the park, however only pond #1 is being recommended. It provides the best access and is closest to the parking area. Stocking a

limited number of fish across multiple, less than favorable ponds within the park may result in decreased angler success and underutilization of the fish. (Boehm)

Blair Lake (Warren) – During the summer of 2017 Division staff performed a reproductive check on Blair Lake (5.3 acres) located in Blairstown, NJ to determine if the lake could benefit from additional fish being stocked. Blair Lake is stocked with trout in the Spring.

Staff collected Largemouth Bass (<1/haul) and sunfish (7/haul) in 8 seine pulls. The majority of sunfish collected were native Bluespotted Sunfish. This is unique, as most New Jersey ponds outside of the Pine Barrens are dominated by *Lepomis* Sunfish (such as Bluegill), not the native Bluespotted Sunfish. In addition to this unique sunfish population, an even more rare fish was found, seven Bridle Shiners (candidate state *Endangered*). Bridle Shiner populations are very rare and have been declining throughout the state and their native range.

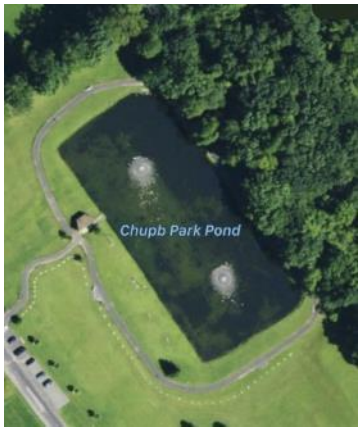
As a result of this finding and to better understand native species presence, abundance, and habitat preferences, additional sampling event took place on 08/15/18. Ten seine hauls were conducted to better assess the status of Bridle Shiners in the pond. The assemblage encountered this year was very similar to 2017. Once again, the most abundant species captured was the Bluespotted Sunfish (18/haul). Bridle Shiners were found once again, with a total of 7 individuals (<1/haul) found at 4 of 10 seining locations. The fishery has relatively high diversity for a small impoundment, consisting of 14 species. The assemblage was primarily native species, with a moderate abundance of such as Largemouth Bass (<1/haul), Bluegill (3/haul), and Mosquitofish sp. (<1/haul). The presence of the Bridle Shiner combined with the number of native sunfish collected shows that this waterbody is important for its unique fish assemblage and that care should be taken to protect these rare species. As a result, no new stockings of non-native warmwater species will occur. (Crouse/Shramko)

Bogues Pond (Passaic) – This 2-acre pond located in Bloomingdale Borough was seined on 08/15/2018, primarily for evaluation of its inclusion into the Community Lakes Stocking Program. The pond is open to the public and has street side parking for about 20 cars, a playground next to it, and fishing access around approximately 40% of its perimeter. The park is well maintained, and a trout fishing tournament is held annually. A total of 7 seine hauls were conducted on the waterbody and only sunfish (37/haul) were captured. Bluegill and Pumpkinseed Sunfish were abundant. Plenty of habitat was available in the form of vegetation and it is recommended to stock this waterbody with Largemouth Bass fingerlings since none were found. (Collenburg)

Boyd Pond (Middlesex) – This waterbody was surveyed in 2018 to assess warmwater fish reproduction and its suitability for inclusion in the Community Lakes Stocking Program. Boyd Pond is a series of three elongated, onstream ponds, each less than ½ acre (total acreage 1.1), located in a residential neighborhood in North Brunswick Township. Terrestrial vegetation limits fishing along some of the banks and the lowermost pond has a fountain. A few benches and picnic tables are present, and a modest playground is adjacent to the ponds. A local resident encountered during the survey stated that people (mostly children) fish the ponds and the town holds a fishing derby in the spring. A sign indicating NJDFW stocks the lake with warmwater fishes was posted on a nearby tree. The pond had been annually stocked with 30 Channel Catfish prior to 2018 and prior to 2007 it was stocked regularly with 70 – 200 5-inch Bluegills. Largemouth Bass were last stocked in 2003. Fish inhabiting these small ponds might easily be flushed downstream during periods of high flow (and would not be able to return to the ponds due to the dams). On 09/20/2018 a total of 14 locations around the perimeter of the two lowermost ponds were sampled using a 20 ft x 4 ft seine. A total of 828 fish were captured representing 4 species as follows (# individuals/haul indicated): Bluegill (20), Green Sunfish (19), Pumpkinseed (16), and Golden Shiner (<1), and unidentified young-of-the-year (YOY) sunfish (4). The Green Sunfish captured were removed as required by the regulations governing the possession or release of "potentially dangerous fish" (invasive species). The absence of bass and abundance of young-of-the-year sunfish (84% of the catch) indicates the fishery is unbalanced. The past stockings of Channel Catfish (a highly piscivorous species) at a high density may have contributed to this imbalance. To restore a balanced fishery, it is recommended that Largemouth Bass (YOY and/or older) be stocked. (Hamilton)

Cedar Brook Park Pond (Union) – Cedar Brook Park Pond is located on the boarder of Plainfield and South Plainfield and is part of the Union County Park System. During the early 2000's this pond experienced frequent fish kills due to anoxic conditions; however, none have been reported in recent years. It is 4.2 acres and has benefited from shoreline restoration via native vegetative plantings, 2 aerators, and aquatic herbicide (Copper Sulfate) treatments (unfortunately resulting in a very unnatural blue color). A 20' x 4' seine was used to survey this pond on 09/07/18 for potential inclusion in a future Community Lakes program. Ten seine hauls were conducted. A healthy population of sunfish consists primarily of Pumpkinseed (30/haul), Bluegill (5/haul), and invasive Green Sunfish (3/haul). An average of 2/haul sunfish young-of-the-year (YOY) were also encountered, however they were too small to reliably identify. Additional species found include Banded Killifish (6/haul), Golden Shiner (1/haul), and Brown Bullhead and Fathead Minnow at <1/haul each. Largemouth Bass were

noticeably absent from the survey; therefore, it is recommended to stock fingerlings (and possibly catchables) in the future. (Crouse)



Chub Park Pond (Morris) – This 1.7-acre pond is located in Chubb Park, Chester Township. It is perfectly rectangular in shape, 100% shoreline access with a walking path, and adequate parking. It is used for ice skating, fishing, and as a nature pond. The pond has two fountains and appears to be very shallow. No fisheries data was available for this pond; therefore, a reproductive check was conducted on 08/13/18 for general fisheries management purposes. Eighteen hauls were conducted using a 20' X 4' seine at various locations along the perimeter. Bluegill is the dominant species, with 538 collected (30/haul). Largemouth Bass are also reproducing well, with 68 encountered (3 young-of-the-year/haul). Other species captured include Banded Killifish (2) and Mosquitofish sp. (1). Due to adequate reproduction, it is not necessary to stock fish at this time. (Crouse)

Demott Park Pond / Lingert's Pond (Hunterdon) - This 3.5-acre pond is an onstream impoundment an unnamed tributary to the Raritan River, S/Br. in the Town of Clinton. It is situated in a residential area, with a walking path around ¾ of the pond and it has adequate parking. This pond is known to have a below average fishery, with low diversity and an abundance of carp. During the summer of 2007, 46 Common Carp were removed via electrofishing. Ten seine hauls were conducted, primarily along the southern and eastern shorelines on 09/03/18 for potential inclusion in a future Community Lakes program. Results indicate an unbalanced fishery, comprised of an average of 101 sunfish/haul and young-of-the-year (YOY) Largemouth Bass (<1 haul). Sunfish include Bluegill (59/haul), Pumpkinseed (2/haul), Green Sunfish (<1/haul), hybrid sunfish sp. (<1/haul), and small YOY *Lepomis* sp. (40/haul). The abundant sunfish population provides excellent forage for Largemouth Bass. Several Largemouth Bass measuring 10-12 inches and large Common Carp were observed, but not captured. Stocking of warmwater fish is not necessary at this time. This pond should be considered for the Spring trout stocking program. (Crouse)

Durand Park Pond (Monmouth) – On 07/24/18 warmwater fish reproduction seining was conducted at seven sites around the perimeter of the pond for potential inclusion in a future Community Lakes program. Seining was hindered by the heavy shoreline vegetation and dense mats of filamentous algae. Limited numbers of sunfish Bluegill (5/haul) were captured, while a decent number of Largemouth Bass (1/haul) were captured. Additional seining was

attempted on 09/09/18, however extensive aquatic weed growth (primarily coontail and water lily) prohibited seining from occurring. Stocking is not recommended. Further communication with the Township of Freehold (property owner) is warranted to identify potential management actions to improve the fishery. (Crouse)

Echo Hill Park Pond (Hunterdon) – A reproduction check was conducted at Echo Hill Park Pond within the Hunterdon County Park System as a follow up to a fish kill that occurred in mid-July 2018. This 1-acre pond is very shallow and eutrophic, with low visibility, and an abundance of watermeal coating the perimeter of the pond. Upon arrival on the morning of 07/20/18, approximately 75 adult Bluegill (from 5 to 9 in) and 4 young-of-the-year (YOY) Largemouth Bass were observed, floating in the water, apparently dead for approximately 24 hours. No live fish appeared to be stressed or gulping at the surface. Stocking of Triploid Grass Carp were permitted to control aquatic vegetation, three of which were observed and appeared to be exhibiting normal behavior. Fish mortality was due to low oxygen levels, evidence by the fish impacted consisted almost exclusively of large Bluegills and that all other fishes, including small Bluegills survived. Sixteen seine hauls were performed on 08/14/18. An abundance of sunfish was encountered including unknown *Lepomis* that were too small to be identified (5/haul), Bluegill (1/haul), Largemouth Bass (1/haul), invasive Green Sunfish (<1/haul), and Yellow Bullhead (<1/haul). The fishery in this pond appears to be very productive and relatively well-balanced. It is managed as Catch and Release by Hunterdon County Parks. This pond could be considered as an addition to the Spring trout stocking program. The stocking of warmwater fishes is not recommended at this time. This location would likely benefit from the installation of one of more fountains to oxygenate the water, thus reducing fish mortality. (Crouse)

Franklin Parker Preserve Reservoir (Burlington) – The Franklin Parker Preserve Water Supply Reservoir is a 35-acre impoundment of the West Branch of the Wading River located immediately south of Chatsworth. The reservoir is part of the 10,243-acre Franklin Parker Preserve, a former cranberry farm, now open to the public and owned by the New Jersey Conservation Foundation. Public fishing is allowed, but there is no boat ramp and walking trails provide the only access. Sampling for native pinelands fishes was conducted on 08/14/2018. A total of twelve locations around the perimeter of the reservoir were sampled using a 20'x4' seine. All three species of *Enneacanthus* sunfish were collected. Blackbanded Sunfish, a species soon to designated state Special Concern, and Bluespotted Sunfish were abundant. Only two adult Banded Sunfish were collected. A single Mud Sunfish, a species soon to be designated state Special Concern was also collected during the survey. A representative sample of all *Enneacanthus* species encountered was preserved. Additional species encountered include Chain Pickerel, Pirate Perch and Swamp Darter. Water chemistry was recorded, and pH measured 4.50. All fish collected during this survey are native pinelands species. The absence of non-native species can be attributed to the acidic water of the lake. Low pH can act as a barrier preventing the establishment of non-

native fishes within pinelands waters. The Chain Pickerel population does not appear robust enough to provide a recreational fishery, due to low productivity limiting the forage base (Creek Chubsuckers, a common forage species were not present), limited amount of aquatic vegetation, and extremely dark tannin stained water. Based on the present native fish community and location within pinelands this water should not be stocked. Additional sampling is not needed at this time. (Boehm)

Gloucester City Pond (Camden) – Gloucester City Pond is a 1-acre pond municipally owned park pond that has been part of the spring trout stocking program since the early 2000's. The pond has also been stocked by the town for children's fishing derbies. A seining survey was completed on 07/23/18 to access the warmwater fish population. Six locations were sampled using a 20'x4' seine. Four species including Largemouth Bass (< 1/haul), Bluegill (41/haul), Pumpkinseed (< 1 haul), and Black Crappie (3/haul) were collected. Four anglers were observed fishing the one-acre pond while the survey was conducted. The shoreline is nearly 100 percent accessible to angling. The pond is in a high population density, urbanized, residential development. The pond is a good candidate for stocking adult and YOY Largemouth Bass based on low density, angler access, and interest. (Smith)

Hankins Pond (Cumberland) – Hankins Pond is a 4.8-acre park, located in the town of Millville. The pond is also located within Corson Park Pond on Route 49. The pond has had a couple of fish kills in the past due to low dissolved oxygen. A fountain is present to improve oxygen levels. A seining survey was completed on 07/24/18 to assess the warmwater fish population. Ten seining locations resulted in the collection of five species including Largemouth Bass (1/haul), Common Carp (< 1/haul), Mosquitofish sp. (1/haul), Bluegill (19/haul), Pumpkinseed (1/haul), and unknown *Lepomis* (8/haul). Two anglers were observed fishing for Largemouth Bass while the survey was completed. One angler caught and released a bass measuring approximately 15 in. A few additional adult bass and sunfish were observed. The lake appears to have a sustainable fish population but stocking additional YOY Largemouth Bass is recommended for 2019. (Smith)

Haworth Pond (Bergen) – This waterbody was surveyed on two occasions in 2018 to assess warmwater fish reproduction and its suitability for inclusion in the Community Lakes Stocking Program. This 1.7-acre pond is owned and maintained by Haworth Borough. The attractive, park-like setting (mowed grass, benches, gazebo) near the town center is highly

visible and provides anglers with access to the entire shoreline. Although no water flows into or out of the pond, except perhaps during rain events (run-off from the adjacent road is not directed into the pond), three fountains keep the pond aerated and circulate the water. No rooted aquatic vegetation was observed, but the sandy/silty pond substrate was covered with filamentous algae. NJDFW's stocking records indicate that a one-time stocking of 400 young-of-the-year bass occurred in 2017 and that no other fish have been stocked. Two boys were observed fishing the pond (using hotdogs as bait) and one caught a 5-inch (estimated) Bluegill and a 24-inch Channel Catfish. One of them commented that he fishes the pond often and has caught bass but does not keep the fish because the water is treated with pesticides and warning signs are posted (no signs were posted that day). On 08/15/2018, 5 locations around the perimeter of the two lowermost ponds were sampled using a 20 ft x 4 ft seine. A total of 954 fish were captured representing 2 species as follows (# individuals/haul indicated): Bluegill (24), Pumpkinseed (19), and unidentified young-of-the-year sunfish species (148). In a follow-up site visit on 9/11/18 (to better quantify the unidentified sunfish species), there was only enough time to conduct four seine hauls due to the large number of small sunfish captured that had to be processed (separated from the algae and then counted). A total of 5,488 fish were captured representing 2 species as follows (# individual/haul indicated): Pumpkinseed (18), Bluegill (20), and unidentified young-of-the-year sunfish (1,334). Most of the sunfish captured were so small, <25 mm (1 in), they could not be readily identified to species in the field. Young-of-the-year sunfish were abundant, comprising 74% of the catch. No species other than sunfish were captured while seining. The absence of bass and extreme abundance of young-of-the-year sunfish (84% of the catch) indicates the fishery is unbalanced. To restore a balanced fishery, it is recommended that Largemouth Bass (YOY and/or older) be stocked. (Hamilton)

Hedden Park Lake (Morris) - This 6-acre lake located in the town of Dover was seined on 08/15/2018, primarily for evaluation of its inclusion into the Community Lakes Stocking Program. The pond is open to the public, has multiple parking lots that provide ample parking, baseball fields that lie adjacent to the pond, and fishing access around approximately 70% of its perimeter. The northern section of the lake is very shallow and has little habitat to hold fish. The southern end had good holding water and was where all Largemouth Bass were captured and spotted. A total of 8 seine hauls were conducted, but limited numbers of fish were captured in general. An invasive plant, Water Chestnut, was discovered as well. The temperature reading (20.2°C) was clearly a reflection of the coldwater influence of Wallace and/or Jackson Brook that fed it and may limit the growth of warmwater species (optimal temperature range for growth is between 24 - 30°C for Largemouth Bass, habitat suitability index). This warmwater fishery is hindered by temperature and it may be more suitable to stock this waterbody with trout and/or catchable size Largemouth Bass because of the assumed limitations on growth. (Collenburg)

Heritage Park Pond (Atlantic) – Heritage Park Pond is a 6-acre sand pond located within the town of Absecon. The pond is a NJDFW trout stocked waterbody and receives Channel Catfish stockings almost every year. A reproduction check was conducted on 07/13/2018. A total of 14 locations were sampled around the perimeter of the pond using a 20' x 4' seine. A total of 6 species were collected which included Largemouth Bass (6/haul), Pumpkinseed (2/haul), Bluegill (<1/haul) Brown Bullhead (<1/haul), Channel Catfish (<1/haul) and

Mummichog (<1/haul). All Largemouth Bass collected were young-of-the-year (YOY). Largemouth Bass reproduction appears to be excellent as YOY fish were abundant during the survey. The small number of Bluegill and Pumpkinseed encountered is discouraging and suggests forage is limited within the pond. A 2014 boat electrofishing survey indicated a low-density adult Largemouth Bass population and Channel Catfish were observed to be abundant. Typically, within sand pond environments, a high-density Largemouth Bass population, comprised of numerous smaller individuals and a low number of big fish is to be expected. The opposite of this suggests high mortality presumably through angler harvest or exploitation. The stocking of additional adult Bluegill is also recommended to achieve balance and increase the amount of forage within the pond. (Boehm)

Hopkins Pond (Camden) – Hopkins Pond is 5-acre park pond located in Haddonfield and part of the Camden County Park system. The location has ample parking, a walking trail and portable restrooms. The pond was once part of the trout stocking program, but due to poor water quality was dropped from the program. The site has had numerous fish kills in the past and the county park continues to try and improve water quality. Most recently a Clean Flo System (aerator) was installed to help improve dissolved oxygen. Four locations were sampled using a 20'x4'seine. Mosquitofish sp. (16/haul) and Bluegill (< 1/haul) were the only two species collected. Despite the low DO and poor species diversity the location is a good candidate for stocking. Adult Largemouth Bass, adult Bluegill, and low-density adult Channel Catfish should be stocked in the pond to increase recreational opportunities in the area. (Smith)

Laurel Acres Pond (Burlington) - Laurel Acres Pond is a 2.5-acre park pond owned by Mt. Laurel. The pond has excellent shoreline access, but boats are not permitted. Laurel Acres has been part of the Channel Catfish and trout stocking program for many years and opening day angler counts indicate it is one of the most popular spots in the area. Ten seining locations resulted in the collection of three species including Largemouth Bass (< 1/haul), Bluegill (5/haul), and Pumpkinseed (< 1/haul). In addition, 74 unknown *Lepomis* sp. were collected. Laurel Acres Pond would be a good candidate for stocking based on the low catch rate of both bass and sunfish. The location was considered to have a good bass population based on the previous assessments. Abundant parking, restrooms, walking trail, and playground make this a great location to enhance the fish population. The pond should be stocked with Largemouth Bass and Bluegill and stocking of Channel Catfish should continue. (Smith)

Lily Lake (Atlantic) – Lily Lake is a 21-acre federally controlled waterbody located within the Edwin B. Forsythe National Wildlife Refuge in Galloway Township. Fishing is allowed and shoreline access is provided along the south shore. The lake does not have a boat ramp. Canoes, kayaks, and other portable vessels can be launched if carried by hand from the parking area to the shoreline. Internal combustion engines are prohibited. A seining survey was conducted on 07/09/2018 to assess Largemouth Bass reproduction within the lake. A total of 16 locations around the perimeter of the lake were sampled using a 20'x4' seine. Six species were collected which included Largemouth Bass (2/haul), Bluegill (3/haul), Pumpkinseed (2/haul), Black Crappie (2/haul), Chain Pickerel (<1/haul), Yellow Bullhead (<1/haul), and unknown *Lepomis* species (3/haul). All Largemouth Bass, Black Crappie,

Chain Pickerel, Yellow Bullhead and unknown *Lepomis* species collected were YOY (young-of-the-year). Water chemistry was recorded; conductivity measured 183.6 us/cm, salinity 0.09 ppt, and pH 7.89. YOY Largemouth Bass collected during seining indicates successful reproduction of the species. Sunfish reproduction appears adequate as well. According to past angler reports Lily Lake once supported an excellent Largemouth Bass population, however little is known about its present fishery. A boat electrofishing survey would provide additional data and further assess the current fishery. No management actions are recommended at this time as data is limited and coordination with the wildlife refuge would be required. (Boehm)

Log Basin Pond (Mercer) – Log Basin Pond is 1.5-acre park pond, located in Trenton within Stacy Park, located along the Delaware River. The pond is within a residential neighborhood and provides good access for fishing. Parking is available along the residential street. The pond has been stocked a number of times by the NJDFW for an annual fishing derby. Three anglers were present fishing while the survey was conducted. One individual reported catching two Bluegill. Approximately 50% of the shoreline is accessible for fishing. On 07/11/18 a seining survey was completed to evaluate the warmwater fish population. Four locations were sampled resulting in four species collected, including Largemouth Bass (1/haul), Black Crappie (2/haul), Pumpkinseed (< 1/haul), and Bluegill (29/haul). Channel Catfish and Bullhead have also been stocked in the pond. Adult Largemouth Bass should be stocked in the pond to enhance the population. (Smith)

Malaga Lake (Gloucester) – Malaga Lake is an 83-acre impoundment of Scotland Run, a tributary of the Maurice River, located in the town of Malaga. A sand boat ramp with floating dock provides public access into the lake. Sampling to assess Largemouth Bass reproduction was conducted on 08/17/2018. A total of 20 locations were sampled around the perimeter of the lake using a 20' x 4' seine. A total of 14 species were collected which included Largemouth Bass (<1/haul), Bluegill (17/haul), Pumpkinseed (7/haul), unknown *Lepomis* sp. young-of-the-year (YOY) (16/haul), Blackbanded Sunfish, a species soon to be designated state Special Concern (4/haul), Banded Sunfish (1/haul), Golden Shiner (3/haul), Creek Chubsucker (<1/haul), Chain Pickerel (<1/haul), Swamp Darter (<1/haul), Black Crappie (<1/haul), Pirate Perch (<1/haul), Banded Killifish (<1/haul), Brown Bullhead (<1/haul), and Tadpole Madtom (<1/haul). Water chemistry was recorded and pH measured 5.96. All Largemouth Bass collected were YOY and reproduction appears sporadic with only five collected. Blackbanded Sunfish were abundant, which is encouraging. The *Enneacanthus* species appear to be holding their own within the lake amongst a variety of non-native Centrarchid species; provided adequate habitat (aquatic vegetation) is present and suitable water quality is maintained. The forage base appears excellent with numerous sunfish and Golden Shiner collected. Malaga Lake is a locally popular venue with both recreational and tournament fishermen alike. Stocking of additional Largemouth Bass in the future may be considered to maintain the fishery. (Smith/Boehm)

Mill Creek Park Pond (Burlington) – Mill Creek Park Pond (1.25 acres) is located in Willingboro, within Mill Creek Park. The pond has good shoreline access and nearby family friendly amenities (playground and restrooms) would make this location an excellent fit for stocking by NJDFW. Unfortunately, upon completing a seining survey on 07/11/18, a pipe

was found directly connecting the pond to nearby Mill Creek (a tributary of the Rancocas Creek) and fish would escape. Eight species of fish were collected from eight seining locations indicating a good diversity for such a small pond. Species collected include Largemouth Bass (3/haul), Bluegill (8/haul), Pumpkinseed (5/haul), Tessellated Darter (< 1/haul), Eastern Silvery Minnow (< 1/haul), White Perch (1/haul), Yellow Perch (< 1/haul), and American Shad. An adult Northern Snakehead and YOY were also observed. Mill Creek is not recommended for stocking. (Smith)

Mount Olive PAL Pond (Morris) – Previous to this survey, no fisheries data exist for this 3.2-acre pond in Mount Olive Township and little is known about angler success. The pond has been stocked by the NJDFW with a variety of warmwater fishes (primarily Channel Catfish) for fishing derbies. The pond is located in the headwaters of a tributary to Drakes Brook, known as Drakes Brook (trib.) (Mount Olive) classified as *Trout Production*. Approximately 90% of the pond was covered in the invasive Water Chestnut plant, making seining difficult. Township officials indicate an aquatic consultant will be implementing a strategy to remove the water chestnut this fall. A total of ten locations around the perimeter of the pond were sampled using a 20'x4' seine on 08/13/18 for general fisheries management purposes. Very little species diversity was documented, with only Black Crappie (4/haul) and Brown Bullhead (<1/haul) captured. To make this pond a more desirable fishery, recommendations include the chemical and/or physical removal of water chestnut and subsequent stocking of an appropriate ratio of Largemouth Bass, Pumpkinseed, and Bluegill. (Crouse)

Mountain Lake (Warren) – This 122-acre public lake has a public boat launch (fee charged, electric-only motors) and shoreline fishing is limited to a short stretch of public land along the easterly shoreline, due to numerous lakefront homes. NJDFW annually stocks trout in the spring (pre-season only) and Muskellunge. The lake has been occasionally stocked with other species, most recently with Largemouth Bass, Yellow Perch, Channel Catfish, and Black Crappie. During sampling conducted in the early spring 2016 (with trap nets to assess the Muskellunge fishery) the low number of centrarchid species (bass and sunfish) captured prompted additional sampling to more closely monitor their status. On 09/21/2018 a total of 17 locations around the perimeter of the pond were sampled using a 20' x 4' seine. A total of 177 fish were captured representing 9 species as follows (# individuals/haul indicated): Bluegill (6), Spotfin Shiner (2), and less than 1 fish/haul for Largemouth Bass, Pumpkinseed, Bluespotted Sunfish, Banded Killifish, Mosquitofish sp., and Common Carp. The total number of fish captured in 2018 was lower than in a previous seining survey (07/27/16 at 17 locations a total of 462 fish were captured - 8 species (carp were not found)). A temperature/dissolved oxygen profile conducted 09/26/2018 at the deepest part of the lake (40 ft) indicated the water was anoxic (<0.5 mg/L) from 19 ft below the surface to the bottom of the lake. The lake was also electrofished on 10/04/2018 to assess black bass (page 79). Additional electrofishing and seining is recommended next year to better assess warmwater fish reproduction. Muskies Inc., a Muskellunge based fishing organization, plans to build and install wood crib structures in the lake in 2019 to provide additional cover for warmwater fishes. (Hamilton)

Mountain Valley Park Pond (Morris) - This 1.5-acre pond is an onstream impoundment situated along the *Trout Production* section of the North Branch of the Raritan River. It is owned by the Borough of Mendham. This pond was not previously surveyed, however electrofishing surveys conducted in the river upstream of the pond in 2009 and downstream of the pond in 2015 revealed healthy Brown Trout populations. The pond was lowered and dredged in 2017. The pond has not been restocked with warmwater fishes, however the fish salvage was likely incomplete, in addition to stream fishes recolonizing the pond. Unfortunately, the surface is approximately 40% covered with the invasive Water Chestnut, a problem that the Borough of Mendham intends to address. This pond has excellent parking and shoreline fishing access. The Mendham Borough and Mendham Township Police Departments annually host a fishing derby in the spring which is very well attended. Mountain Valley Park Pond was evaluated for possible inclusion in a future Community Lakes program. The program is to identify waters which due to a variety of factors do not support a viable fishery for recreational fishing. Lakes were evaluated based on current fish population, amenities, access and general water quality.

Five seine hauls were conducted along the southern shoreline on 8/13/18. Additional surveys would have been conducted, but seining was suspended, due to the large number of small young-of-the-year (YOY) sunfish and shiners which ranged from 10-30mm in length. Nearly all the fish collected were too small to identify to the species level in the field. The small size of the sunfish (22/haul) was presumably due to an unseasonably cool spring season which delayed spawning and were thus identified to only the Genus level (*Lepomis* sp.). A representative sample of small sunfish were brought back to the laboratory and it was determined that the Pumpkinseeds outnumbered the Bluegills 5:1. Large Bluegill and Pumpkinseed were found in low numbers (1 intermediate and 2 adult Bluegill and 1 intermediate Pumpkinseed). Small shiners (20-25mm) were also identified in the laboratory resulting in an average of Creek Chub (2/haul) and Golden Shiners (4/haul). Tessellated Darters (2/haul) were also encountered. Mosquitofish (Gambusia sp.) were observed to be very plentiful in the very shallow shoreline habitat, with an average of 9/haul. This species is undesirable in many habitats and seems to be found in more waters across the state annually. The non-native Western Mosquitofish may be acting as an invasive species and their establishment throughout the state may warrant management actions to minimize their spread. Several large individuals were pregnant females, as Mosquitofish are live-bearers similar to the aquarium guppy. To improve the fishery, Water Chestnut removal/management should take place, with subsequent stocking of Largemouth Bass. (Crouse)

Northern Community Park Pond (Burlington) – Northern Community Park Pond is in Bordentown and a very popular fishing location for children within the community. The town annually hosts a fishing derby on July 4. The pond was renamed after former Division employee Jim Oross for his service and dedication to the stocking of the pond for derbies. The NJDFW still annually stocks the pond and stocking should continue. The park has adequate parking, restrooms, a playground, and walking trail. A seining survey was completed on 07/19/18 to assess the current fish population. Six seining locations resulted in the collection of three species including Brown Bullhead (< 1/haul), Bluegill (44/haul), and Pumpkinseed (2/haul). The pond should continue to be stocked annually with Largemouth Bass and Channel Catfish. (Smith)

Oak Pond (Camden) – Oak Pond is a 12-acre sand pond located in Winslow Township. The pond is a NJDFW trout stocked waterbody and receives both spring and fall stockings. A sand boat launch provides access for boat anglers and several openings around the pond provide access for shoreline anglers. A reproduction check was conducted on 07/17/ 2018. A total 14 locations around the perimeter of the lake were sampled using a 20'x4' seine. A total of eight species were collected which included Largemouth Bass (2/haul), Bluegill (14/haul), Pumpkinseed (1/haul), and Banded Killifish (5/haul), unknown *Gambusia* spp. (3/haul), Eastern Mudminnow (1/haul), unknown *Lepomis* sp. (<1/haul), unknown *Enneacanthus* spp. (<1/haul), and Black Crappie (<1/haul). All Largemouth Bass collected were YOY (young-of-the-year). The presence of YOY Largemouth Bass collected indicates successful reproduction of the species, as expected within a sand pond environment. Stocking surplus Largemouth Bass may be considered in the future. (Boehm)

Oswego Lake (Burlington) – Oswego Lake is a 102-acre impoundment of the Wading River located within Penn State Forest. The lake was last sampled on 09/01/1970, when a general fisheries survey was conducted using a 15-foot seine. Sampling for native pinelands fishes was conducted on 07/20/2018. A sand boat ramp provides public access, whereas limited shoreline access exists. Twelve locations around the perimeter of the lake were sampled using a 20'x4' seine. Eight species were collected which included Creek Chubsucker (19/haul), Bluespotted Sunfish (6/haul), Blackbanded Sunfish, a species soon to be designated state Special Concern (4/haul), Eastern Mudminnow (1/haul), Chain Pickerel (<1/haul), Yellow Bullhead (<1/haul), Swamp Darter (<1/haul), and Pirate Perch (<1/haul). Creek Chubsuckers were abundant with young-of-the-year (YOY), intermediate, and adult individuals all collected during the survey. Past and present survey results were nearly identical with regards to species composition. The few exceptions are as follows, Banded Sunfish, and Mud Sunfish, a species soon to be designated state special concern, were collected during the 1970 survey, but were not encountered during this recent survey. Eastern Mudminnow and Pirate Perch were absent in the previous survey, but collected this year, adding to species diversity within the lake. A representative sample of all

Enneacanthus species collected during the survey was preserved. Water chemistry was collected, and pH measured 3.87. Species composition indicates Oswego Lake is an intact and pristine pinelands waterbody. All fish collected during this survey are considered native pinelands species. The absence of non-native species can be attributed to the acidic water of the lake. Low pH can act as a barrier preventing the establishment of non-native fishes within pinelands waters. The primary recreational fishery present is the Chain Pickerel population, which is self-sustaining. Chain Pickerel are the native game fish of the region and do well in the acidic waters found there. Based on the present native fish community and location within pinelands this lake should not be stocked in the future. (Boehm)

Patriot Lake (Atlantic) – Patriot Lake is a 1-acre pond located in Galloway Township. The pond features excellent shoreline access, a fishing pier, nearby public restrooms, ample parking, and is handicap accessible. Largemouth Bass were last stocked in 2012 (875 measuring 2-3 in). A seining survey was conducted on 07/13/2018. Ten locations were sampled around the perimeter of the pond using a 20' x 4' seine. Five species were collected which included Bluegill (43/haul), unknown *Lepomis* sp. (27/haul), Pumpkinseed (4/haul), Largemouth Bass (5/haul), Green Sunfish (<1/haul), and *Gambusia* spp. (<1/haul). All Largemouth Bass collected were young-of-the-year (YOY) and indicates successful reproduction of the species within the pond. Adult, intermediate, and YOY size classes of Bluegill were all collected during the survey. All unknown *Lepomis* species were YOY. Green Sunfish are considered an invasive species within the state of New Jersey, and those collected were removed from the pond. The presence of YOY Largemouth Bass, along with abundant YOY and moderate numbers of intermediate Bluegill indicate the pond is currently balanced. Additional stocking of Largemouth Bass and Bluegill is not recommended at this time. (Boehm)

Pondside Park Pond (Bergen) - This 3.4-acre pond located in Harrington Park Borough was seined on 09/19/2018 primarily for evaluation for the Community Lakes Stocking Program. The pond is open to the public, has ample parking, a playground next to it, and fishing access around 100% of its perimeter. The park is well maintained and occasionally has fishing contests. Ten seine hauls were conducted, and a variety of fish species were captured including sunfish (5/haul) and Largemouth Bass (< 1/haul). The lake was in a lowered state during sampling. A lack of fish habitat and cover was noticeable, more than likely resulting in the poor status of the fishery. Stocked in 2017 with 250 Largemouth Bass (4-inch) the effect of the stocking is inconclusive as few bass were once again collected. The stocking was a result of Sampling in 2016 which resulted in no bass being captured in 11 seine hauls. This waterbody may be a good candidate for receiving catchable sized Largemouth Bass. Lack of habitat/cover may limit survival to larger sizes. (Collenburg)

Powder Mill Pond (Somerset) – A reproduction check was conducted for general fisheries management purposes using a 20'x4' seine on Powder Mill Pond (4.2 ac) within Colonial Park within the Somerset County Park system on 08/09/18. There are three onstream impoundments located downstream; Spooky Brook Park Pond (12.1 ac), Metlar's Pond (2 ac), and Duck Pond (1 ac). This park is heavily used by the public and parking is readily available. The ponds have no boat launch, but they are accessible by foot along the shoreline. Substantial improvements have been taking place and will continue to take place in the four ponds within the park. Metlar's Pond and Duck Pond were drained and dredged in 2013 and restocked in 2014. Stocking included Largemouth Bass (438 at 2 in), Black Crappie (2,000 at 2 in), and Bluegill (1,400 at 1 in). Duck Pond was partially lowered during 2018. Powder Mill Pond and Spooky Brook Park Pond (trout stocked) are anticipated to be dredged in the near future and will be lowered and the fish salvaged and relocated into Metlar's Pond and Duck Pond. Salvaged Largemouth Bass should be adequate to repopulate Metlar's Pond (in which none were found when surveyed last summer). Ten seine hauls were conducted, yielding an average of Bluegill (2/haul) and YOY *Lepomis* (2/haul) that were too small to identify to the species level. Other species collected at a rate of <1/haul included Largemouth Bass, and Pumpkinseed. Stocking is not recommended at this time. (Crouse)

Rahway River Park Pond (Union) - Sampling to assess Rahway River Park Pond (6.9 acres) for the inclusion in a future Community Lakes program was conducted on 09/13/18. The pond is located within the Union County Park System and is in a very developed residential area, therefore the park is heavily used. The perimeter of the pond is accessible for shoreline fishing via walking path. The pond was recently treated with an aquatic herbicide (Copper Sulfate), unfortunately resulting in a very unnatural blue color. Several young-of-the-year (YOY) Largemouth Bass appear to have absorbed the blue color into their skin (see photo). A total of 10 locations around the perimeter of the pond were sampled using a 20'x4' seine.

A well-balanced fishery was observed, with a good ratio of sunfish to Largemouth Bass. The most common fish were Bluegill (25/haul). Golden Shiner was the second most abundant (4/haul). Largemouth Bass were found at 1/haul, while Pumpkinseed, Black Crappie, Green Sunfish (invasive), and Mosquitofish were all found at less than 1/haul. Catchable Largemouth Bass or Channel Catfish could be stocked to provide additional recreation. No other stocking is warranted. (Crouse)

Riverview Beach Pond (Salem) - Riverview Beach Pond is a 5-acre pond located in Pennsville. The park has good parking, restrooms, a playground and a walking trail. The pond is less than 100 yards from the Delaware River and may be susceptible to occasional flooding. The pond was previously included in the trout stocking program and was removed due to poor angler participation and low water quality. The pond is inundated by Canada Geese for much of the year, contributing to low dissolved oxygen and frequent algae blooms. The state record White Crappie was once caught from this pond. A seining survey was completed on 07/23/18 to assess the warmwater fish population. Eleven species were collected from 12 seining locations. The pond had the greatest diversity of ponds assessed for the community lakes stocking program. Species collected included Largemouth Bass (< 1/haul), Common Carp (< 1/haul), White Crappie (< 1/haul), Banded Killifish (< 1/haul), Mosquitofish sp. (< 1/haul), White Perch (< 1/haul), Gizzard Shad (10/haul), Inland Silverside (2/haul), Bluegill (28/haul), Green Sunfish (2/haul)(invasive), and Pumpkinseed (< 1/haul). The pond has a good forage base consisting of Bluegill and Gizzard Shad. The pond would be a good candidate for stocking of adult Largemouth Bass and Channel Catfish. In addition, young-of-the-year Largemouth Bass should be stocked in 2019. (Smith)

Roosevelt Common Park Pond (Bergen) – This <0.5-acre pond located in Tenafly was scouted on 09/13/2018 primarily for evaluation of its inclusion into the Community Lakes Stocking Program. The pond seems to be an undesirable candidate for the program. A small walkway provides the only access for anglers, however there is an abundance of trees and shrubs that limit access. If the township could create access points for anglers, it may be a great candidate, as prior sampling indicated poor representation in variety and number of fish caught. Plenty of parking is available in multiple parking lots and it is in a highly developed and residential area (school located next to park). Tennis courts, baseball fields, and walkways make this park very attractive to people that live in or near Tenafly. Currently, there are no recommendations for this waterbody. (Collenburg)

Rowand Pond (Camden) – Rowand Pond is in Clementon and one of the NJDFW's Wildlife Management Areas. The location receives both spring and winter trout and annually has one of the highest catch rates and number of anglers in the spring despite heavy weed growth. The high population density, ample parking, and high success rate make it a popular location. Unfortunately, the long-term sustainability of the pond is currently impacted by aquatic vegetation and siltation. The size has been reduced by about 50% of the surface acreage. The "Places to Fish" publication lists the lake as 3-acres, however the pond is approximately 1.3 acres based on GIS mapping software.

A seining survey was completed on 07/24/18 to assess the current warmwater fish population. Five seining locations resulted in the collection of two species, Creek Chubsucker (4/haul) and Chain Pickerel (1/haul). Poor habitat from an overabundance of aquatic vegetation and siltation limit the potential to expand the population. The habitat

needs to be improved before the pond is a viable warmwater stocking location. Rowand Pond is not recommended for stocking of warmwater species at this time based on the poor conditions in the pond, however trout stocking should continue. The NJDFW plans to treat the extensive weed growth in spring of 2019 to improve conditions for angling. (Smith)

Shallcross Pond (Union) – This 2.3-acre park pond is located within Union County's Black Brook Park. This park has adequate parking, ball fields, and a walking path that goes around the pond. The pond has great shoreline fishing access and a fountain to aerate the water. The pond is routinely stocked by the NJDFW with warmwater species for well-attended fishing derbies. Sampling to assess the pond for a future Community Lakes program was conducted on 09/07/18. A 20'x4' seine was used for ten hauls. Bluegill were the most abundant species (18/haul), followed by *Lepomis* too small to identify (3/haul) and Pumpkinseeds (2/haul). Black Crappie, Brown Bullhead, Largemouth Bass, and hybrid sunfish were all found at 1/haul. Golden Shiner and the invasive Green Sunfish were both found at <1/haul. The numbers and ratio of fish present are adequate, however the observable condition of two of the Largemouth Bass (6.5 and 9 in) was poor and had a parasite known as blackspot. The abundance of sunfish should provide adequate forage to support better bass condition. Stocking of fingerling warmwater species is not necessary at this time, as adequate reproduction is occurring. Supplemental stocking of catchable fish is acceptable in anticipation of fishing derbies for educational purposes and to supplement the recreational fishery. (Crouse)

Shaws Mill Pond (Cumberland) – A seining survey was completed at Shaws Mill Pond to evaluate the warmwater fish population on 08/15/18. Six species, including Largemouth Bass (< 1/haul), Yellow Perch (1/haul), Golden Shiner (2/haul), Banded Sunfish (1/haul), Bluegill (2/haul), and Pumpkinseed (8/haul) were collected from 10 locations. Largemouth Bass reproduction appears to be inconsistent, due to low pH and the resulting low-density population. The low pH and habitat are consistent with waters supporting a native Pinelands fish community. The pond supports both a native and non-native fish population. The lake is part of the annual trout stocking program and has been part of Channel Catfish stocking program. Shaws Mill Pond should be removed from the Channel Catfish stocking program to alleviate competition with Largemouth Bass and predation on native species. (Smith)

Silver Creek Pond (Bergen) – This 0.79-acre pond located in Mahwah Township was seined on 09/13/2018 primarily for evaluation of its inclusion into the Community Lakes Stocking Program. The pond was seined in 2016 and subsequently, Largemouth Bass and Bluegills were stocked by NJDFW. Four seine hauls were conducted, and the fishery was dominated by Bluegill (12/haul), with Largemouth Bass (< 1/haul) also present. Sampling was limited

by the thickness of the aquatic vegetation. Filamentous algae, duckweed, and milfoil were so thick that the weight of the vegetation was causing extreme stress to the seining net and testing its resiliency. Fishing would be nearly impossible or extremely frustrating without treating this issue. Access is available around the entire lake, parking was ample, and annual fishing contests have been held here in the past. Local township workers indicated that an aerating fountain is typically operational and helps reduce the amount of vegetation observed at the time of sampling. Largemouth Bass (~12 inches) and good size sunfish were spotted near the outlet of the pond. Currently, there are no recommendations for this waterbody. (Collenburg)

Spooky Brook Park Pond (Somerset) – A reproduction check was conducted using a 20'x4' seine on Spooky Brook Park Pond (12.1 ac) within the Somerset County Colonial Park on 08/09/18. This pond has one onstream impoundment upstream of it, Powder Mill Pond (4.2 ac) and two onstream impoundments below; Metlar's Pond (2 ac) and Duck Pond (1 ac). This park is heavily used by the public and parking is readily available. The ponds have no boat launch, but are accessible by foot along the shoreline. Spooky Brook Park Pond is trout stocked by the Division. Substantial improvements have been taking place and will continue to take place in the four ponds within this park. Metlar's Pond and Duck Pond were drained and dredged in 2013 and restocked in 2014 with Largemouth Bass (438 at 2 in), Black Crappie (2,000 at 2 in), and Bluegill (1,400 at 1 in). Duck Pond was partially lowered during 2018 for a bridge repair project. Powder Mill Pond and Spooky Brook Park Pond are anticipated to be dredged in the near future and will be lowered and the fish salvaged and relocated into Metlar's Pond and Duck Pond. Salvaged Largemouth Bass should be adequate to repopulate Metlar's Pond (in which none were found when surveyed last summer). Twelve seine hauls were conducted, yielding Bluegill and Largemouth Bass, both at a rate of 1/haul. Other species collected at a rate of <1/haul included Pumpkinseed, Black Crappie, and Brown Bullhead. Stocking is not recommended at this time. (Crouse)

Sunrise Lake (Morris) – This 3-acre pond located in Brookside was seined on 09/11/2018 primarily for evaluation of its inclusion into the Community Lakes Stocking Program. The pond is open to the public, has a large parking area, a large interconnected park, and fishing access around approximately 65% of its perimeter. Ten seine hauls were conducted and a good number of sunfish (24/haul) were found. Although a Morris County employee mentioned seeing an angler who frequents the pond catching a good number of bass, no Largemouth Bass were captured or spotted at the time of this survey. The pond also has a swimming beach and is treated with aquatic herbicides. Since this sampling event found no Largemouth Bass, it is recommended that fingerling Largemouth Bass be stocked to supplement the fishery. (Collenburg)

Turkey Brook Park Pond (Morris) – Previous to this survey, no fisheries data existed for this 1.1-acre pond in Mount Olive Township and little is known about angler success. The pond is located directly east of Budd Lake, in the headwaters. The pond has been stocked by the NJDFW with a variety of warmwater fishes (primarily Channel Catfish) for fishing derbies. At the time of sampling, the pond was covered with invasive Water Chestnut making seining difficult. Township officials began working with an aquatic consultant in the fall of 2018 to implement a strategy to remove and treat Water Chestnut. Water Chestnut was also reported to occur in Budd Lake, therefore removal from this small pond, hydraulically located upstream, is very important. Not only would Water Chestnut in Budd Lake be ecologically harmful, but also a detriment to watersports and swimming, as it is one of only a few lakes in the State for which there is no horsepower limit on outboard engines making it a popular destination for waterskiing. Two locations around the perimeter of the pond were sampled using a 20'x4' seine on 08/13/18. Only 10 young-of-the-year Bluegill (2/haul) were encountered, however this survey was not thorough enough to provide an accurate inventory of reproductive success or species diversity. This pond should be seined in the future either early in the season before the Water Chestnut flourishes in the spring or upon conclusion of successful removal. Stocking of fingerling warmwater species is not recommended at this time. Supplemental stocking of catchable fish is acceptable in anticipation of fishing derbies for educational purposes and to supplement the recreational fishery. (Crouse)

Van Saun Pond (Bergen) – This waterbody was surveyed in 2018 to assess warmwater fish reproduction and its suitability for inclusion in the Community Lakes Stocking Program. This 4-acre elongated pond, an impounded section of Van Saun Mill Brook, is in a Bergen County park (bordered by Paramus and River Edge). Approximately 95% of the pond shoreline is lined with thick, nearly impenetrable, brushy plants, shrubs, and trees that effectively prevent/deter shoreline fishing. Access is limited to only two small observation decks along the banks. Although these decks were sturdy and well-maintained, they were not family-fishing friendly due to the rail height and wire fencing. "Do not feed" signs posted on the decks suggests waterfowl are a nuisance and may explain why the shoreline has not been developed (to help deter waterfowl). Parking adjacent to the lake is readily available and the park offers many attractive amenities (zoo, train and pony rides, picnicking, walking paths, etc.). A sign indicating NJDFW stocks the lake with warmwater fishes was visible on a nearby tree. A local resident who stopped to fish was interviewed and he stated that bass, sunfish, and carp are present, but fishing this year was not as good as last year (he felt all the rain this summer may have been a factor). In 2016 the pond was seined and 6 of 12 seine hauls yielded low numbers of Pumpkinseed, Bluegill, and Golden Shiner (average of <3 fish/haul). In 2017 it was stocked with 110 4-inch Bluegill and 210 fingerling

Largemouth Bass. On 08/15/2018 three locations around the perimeter of the pond were sampled using a 20' x 4' seine. The number of seining locations was limited by the heavily vegetated shoreline. Seining yielded only six Pumpkinseed (2 fish/haul). In a follow-up site visit on 09/11/2018 (to better assess the fishery) the pond could not be seined as the water level in the pond was too high due to recent rain. Additional sampling is needed to better assess the status of the fish population at this pond. The pond would be more attractive for fishing if shoreline access for angling were improved. (Hamilton)

Veterans Park Pond (Monmouth) – Veterans Park Pond is small manmade pond approximately one-half acre in size located in the town of Hazlet. The shoreline is heavily vegetated, primarily with bladderwart and floating mats were abundant. The pond has a fountain in the center of the pond, which was on at the time of sampling. Fishing derbies are held annually, and it is subsequently stocked with Channel Catfish annually, in addition to intermittent stocking of other warmwater species. Sampling to assess the pond for the Community Lakes program was conducted on 07/17/18. Efforts included a warmwater fish reproduction check using a 20'x4' seine at nine sites around the perimeter of the pond. Adequate numbers of young-of-the-year sunfish species (16/haul) were collected, all too small to accurately identify to the species level. Pumpkinseeds (1/haul) were more abundant than Bluegill and Brown Bullheads, each found at densities of <1/haul. No Largemouth Bass were encountered. Acidity of the water had a pH of 4.92. Due to the small size of the fish during this survey, a follow up seining effort was put forth on 09/05/18. A total of six locations around the perimeter of the pond were sampled using a 20'x4' seine. Unidentifiable *Lepomis* sp. YOY (21/haul) were found, along with Pumpkinseed (15/haul), and both Bluegill and Brown Bullhead were found at <1/haul. Once again, no Largemouth Bass were collected or observed. Upon arrival the pond had a distinct orange color. However, water chemistry was not out of the ordinary and readily supported aquatic life. In addition to fish, tadpoles were extremely abundant and were found in 4 of the 6 seine pulls. No decision of future management action has been determined at this point. (Boehm)

Walrus Pond (Morris) - This 4-acre pond located in Morris Plains was seined on 09/11/2018 for evaluation of its inclusion into the Community Lakes Stocking Program. The program is to identify waters, which due to a variety of factors, do not support a viable recreational fishery and subsequently stock them with catchable sized warmwater fish to boost recreational fishing activity. The pond is open to the public, has a large parking area, lies adjacent to a community center, baseball fields, a public swimming pool, and has fishing access around approximately 85% of its perimeter. After a total of 13 seine hauls, the majority of captured individuals documented were composed of sunfish (9/haul) and Largemouth Bass (<1/haul). Aquatic vegetation was not abundant, but woody debris/tree fall created a good amount of habitat in one section of the lake. This lake is well maintained and

located inside a large park facility. Currently, there are no recommendations for this waterbody. (Collenburg)

Warinanco Park Pond (Union) – This 7.5-acre park pond was sampled to assess the pond for the Community Lakes Program on 08/08/18. This park is located within the highly developed Roselle Borough and is actively used for outdoor recreation, with a walking path around the entire perimeter, ball fields, a paddleboat rental station, and fishing. The pond is routinely stocked annually, pre-season only with Rainbow Trout (>400) and Channel Catfish (30-55 annually). When electrofished in 2017 during Union County's Annual Bioblitz it was apparent that Brown Bullheads were in excess and the Largemouth Bass (zero captured in 45 minutes of electrofishing) fishery was nonexistent. As a result, it was recommended for the stocking of Largemouth Bass. The shoreline of this pond has been restored with plantings of native vegetation and selective fencing to limit disturbance, as a result the pond looks beautiful, however shoreline access for fishing is limited to approximately 50 percent. The pond was recently treated with an aquatic herbicide (Copper Sulfate), unfortunately resulting in a very unnatural blue water color. A warmwater fish reproduction survey was conducted with a 20' x 4' seine at six sites around the perimeter of the pond. Low numbers of young-of the-year and intermediate sunfish were collected. Three intermediate and two adult Channel Catfish were collected. No Largemouth Bass were collected. An additional seining effort was made later in the year on 09/13/18, to allow more time for the small sunfish to grow. Ten locations around the perimeter of the pond were seined. The pond is very productive with an abundance of sunfish including Bluegill (21/haul) and Pumpkinseed (10/haul), with fewer Green Sunfish (invasive), and miscellaneous sunfish hybrids. Black Crappie were present in large numbers, averaging 10/haul, with a large individual measuring approximately 14 in. Surprisingly, no Brown Bullheads were collected, however it is known via the 2017 electrofishing survey that they are very abundant and should be stocked. Continued stocking of Channel Catfish and both fingerling and catchable Largemouth Bass is recommended. (Crouse)

West Hudson County Park Pond (Hudson) – This waterbody was surveyed in 2018 to assess warmwater fish reproduction and its suitability for inclusion in the Community Lakes Stocking Program. This 2.2-acre, highly visible, urban pond is owned and well-maintained

by Hudson County. The park-like setting (a walkway around perimeter, benches, paved parking lot, and other amenities) provides anglers with fishable access along most of the shoreline. Although the pond appears to be fed by stormwater runoff, three fountains in the pond aerate and circulate the water. NJDFW annually stocks trout (350) in the spring (pre-season only) and the pond is a popular destination for trout anglers. Approximately 62 anglers were observed fishing the morning of the opening day of the trout season (04/05/2018) and 77 trout were caught (1.2 trout/hr) which is considered good. NJDFW also regularly stocks the pond with 100 Channel Catfish and last stocked Bluegills in 2006 and Largemouth Bass in 1995. On 09/21/2018 a total of 14 locations around the perimeter of the pond were sampled using a 20' x 4' seine. No rooted aquatic vegetation was observed, and the mud substrate was fairly firm/compacted at most seining locations. A total of 112 fish were captured representing 4 species as follows (# individuals/haul indicated): Bluegill (7), young-of-the-year Largemouth Bass (<1), Black Crappie (<1), and Common Carp (<1). Due to the relatively low abundance of warmwater fish, the pond's location in a densely populated area, and excellent fishing access, the stocking of catchable size warmwater fish would enhance the recreational fishery. Consideration should also be given to expanding trout stocking to include spring in-season stockings and/or a fall/winter stocking to enhance seasonal trout fishing opportunities. (Hamilton)

Westville Park Pond (Thomas West Park Pond) (Gloucester) – A seining survey was completed at Westville Pond on 08/1/18 to assess the fish population in the 1.6-acre pond. The location receives an annual stocking of pre-season spring trout and yields a good turnout.

Fish kills from low dissolved oxygen have been reported in the past. A total of six species were collected from the eight seining locations. Species collected include Largemouth Bass (< 1/haul), Banded Killifish (< 1/haul), Golden Shiner (5/haul), Bluegill (46/haul), Green Sunfish (invasive) (< 1/haul), and Pumpkinseed (2/haul). Westville Pond would be a good stocking candidate based on the proximity to local elementary school and high population density. The lake should be stocked with adult and YOY Largemouth Bass and Channel Catfish. (Smith)

Woolmans Lake (Burlington) - Woolmans Lake (2.5 ac) is in Mt. Holly within the Rancocas Creek drainage. The pond is plagued by frequent fish kills, poor water quality, and low dissolved oxygen. Four seining locations resulted in the collection of three species including Largemouth Bass (1/haul), Brown Bullhead (< 1/haul), and Bluegill (3/haul). There is no boat access and shoreline angler access is limited. The pond is not recommended for additional stocking at this time. Channel Catfish should continue to be stocked annually. (Smith)

Zabriskie's Pond (Bergen) – This 1.13-acre pond located in Wyckoff Township was seined on 09/06/2018 for evaluation of its inclusion into the Community Lakes Stocking Program.

The program is to identify waters, which due to a variety of factors do not support a viable recreational fishery and subsequently stock them with catchable sized warmwater fish to boost recreational fishing activity. The pond is open to the public, has a small parking lot (~12 cars), and fishing access around approximately 60% of its perimeter. Ten seine hauls were conducted and sunfish (55/haul), crappie, and Largemouth Bass (< 1/haul) were captured. One angler mentioned the over harvest of fish from other anglers, but also reported an otherwise quality fishery, even catching good sized Channel Catfish that the NJDFW stocks. Considering the surrounding area is heavily populated, the pond has great access, and catch of Largemouth Bass was relatively low compared to other species, over harvest may be occurring. Stocking catchable sized Largemouth Bass to supplement the current fishery may offset the amount of harvest that occurs. Monitoring of the Largemouth Bass population structure should include seining and potentially boat electrofishing every other year. (Collenburg)

Protection and Restoration of Inland Fisheries and Aquatic Habitats: Cool / Warmwater

To protect New Jersey's critical aquatic resources, fisheries biologists provide technical assistance to conservation, stream restoration, dam removal, and related Land Use projects each year. Land Use projects are coordinated through the Division's Environmental Review program. This input is directed towards minimizing land use change impacts to the state's fisheries resources. This is typically accomplished through the use of timing restrictions during critical fish spawning periods, protection of riparian buffers, and project modification, assuring best use practices are implemented at all times. However, at times a more in-depth review and comments are necessary on specific projects.

In 2018 staff provided technical assistance to the following projects related to our warmwater resources:

Lake Musconetcong (Morris/Sussex)

Meetings were held periodically with Parks and Forestry (Hopatcong State Park superintendent) and several members of the Musconetcong Regional Planning Board (LMRPB) and others to discuss issues and coordinate lake management activities including aquatic vegetation control, dredging and hydro-raking, water lowerings, swirl chamber retrofit, and grass carp stocking. The LMRPB indicated that they would no longer request winter drawdowns for aquatic vegetation control but requested a modest (1 foot) annual drawdown in the fall to allow for shoreline clean-up and dock repairs. Parks and Forestry will continue to investigate potential solutions to the swirl chamber design that would allow it to be cleaned without lowering the lake. (Hamilton, Hunter and Angler)

Mountain Lake Fish Habitat Enhancement Project (Warren)

NJDFW began assisting Muskies Inc. with their proposal to improve fish habitat for panfishes (sunfish, crappie, perch, etc.) by placing log crib structures in Mountain Lake. (Hamilton, Hunter and Angler)

ANADROMOUS FISHERIES

A number of New Jersey's river systems serve as important migratory pathways for fish. Each spring anadromous species such as American Shad, Alewife, Atlantic Sturgeon, Blueback Herring, Sea Lamprey, Shortnose Sturgeon, and Striped Bass navigate from marine waters to fresh waters of the state to spawn. In late summer and early fall, their young return home to marine waters to remain until maturity. In contrast, catadromous species such as American Eel reside in fresh waters throughout the state and migrate to open ocean waters to spawn.

With perhaps the exception of lampreys, these species are of great ecological, recreational, and commercial value to New Jersey and many other Atlantic coast states. The monitoring and restoration of these fisheries is a fundamental aspect in ensuring the population's wellbeing. As these species reside in both fresh and marine waters they are cooperatively management between the Bureau of Freshwater Fisheries and the Bureau of Marine Fisheries. As stocks migrate up and down the entire east coast, the management of species falls under the jurisdiction of the Atlantic States Marine Fisheries Commission (ASMFC). As a result, for New Jersey, primary management of these species falls to the Bureau of Marine Fisheries.

In March 2012 the recreational and commercial harvest of migratory river herring (Alewife and Blueback Herring) was prohibited. These regulations were put in place due to concerns about the significant coast-wide decline of river herring stocks and to comply with federal mandates outlined by the Atlantic States Marine Fisheries Commission. In 2013 a similar moratorium was placed on American Shad with the exception of the Delaware River, its bay and estuaries. The exact cause for these coast-wide declines remains uncertain, but numerous factors such as loss of spawning habitat, impediments to fish passage (i.e. dams), water quality degradation and fishing all likely played a role.

Freshwater efforts consist of monitoring fish passage through fish ladders, technical assistance for dam removal projects on migratory pathways, periodic confirmation of historic migratory pathways and identification of new runs. (staff, Hunter and Angler)

Protection and Restoration of Inland Fisheries and Aquatic Habitats: Anadromous

Millstone River Restoration Project – This project aims to restore connectivity of the Millstone River by removing dams. The Weston Mill Dam, located just downstream of the Wilhousky Street bridge in Manville, was the first impediment to fish passage on the Millstone River. This dam was 133 feet long and 5 feet high. Originally a mill dam at the Weston Mill, this site included a gristmill, sawmill, dam, and associated waterpower features. The dam was repaired with concrete in the early 20th century. The dam had no current purpose; the mill buildings were claimed by arson in July 1983. In recent years, the dam had partially failed. It was removed in August of 2017 through a Natural Resource Damage Assessment settlement agreement reached between the Trustees for Natural Resources - the NJDEP, the U.S. Department of Interior's Fish and Wildlife Service, and the U.S. Department of Commerce's National Oceanic and Atmospheric Administration - and the party potentially responsible for contamination related to the American Cyanamid Superfund site in Bridgewater Township. NJDFW (with partial funding from the settlement agreement and assistance from the US Fish and Wildlife Service and the Watershed Institute [formerly Stonybrook-Millstone Watershed Association]), committed to monitor changes to the fish assemblages above and below the dam, before and after dam removal. Efforts will continue for the next several years. (Crouse, NRDA settlement agreement and Hunter and Angler)

In 2018, a total of 10 surveys were conducted at 5 established monitoring stations along the Millstone River. Results of these surveys are summarized as follows:

- A total of 51 freshwater fish species have been documented in the Millstone River since monitoring began in the fall of 2016.
- Both adult and juvenile American Shad were documented downstream of the Weston Causeway dam prior to dam removal.
- The Weston Causeway Dam was removed in August 2017.
- 5 juvenile American Shad were captured below the Blackwells Mills Dam during the fall of 2018, following the first unimpeded migratory season after dam removal. This is the most upstream location they have been documented.
- 2 candidate species of Special Concern were documented, including Comely Shiner and Shield Darter.
- 4 invasive fish species were documented, including Flathead Catfish, Grass Carp, Oriental Weatherfish, and Green Sunfish.
- Monitoring will continue through the Spring of 2020.

Weston Mill Dam (photo by John Jengo) (left) and after removal of dam (right).

In anticipation of the removal of the Weston Mill Dam, five electrofishing surveys were conducted during the fall of 2016 and spring of 2017 to establish a baseline above and below the dam at the Wilhousky Street Bridge (Manville / Weston Causeway) as part of a study to determine potential fish assemblage changes as a result of the dam removal. The monitoring stations were established at two locations downstream of the dam and three locations upstream. Each of the two downstream stations are boat electrofished for approximately 700 m in length, each for one hour, netting every fish (with the exception of Carp and American Eels, both of which are enumerated by size class). The stations are referred to as "near the confluence with the Raritan River" and "immediately below Weston Mill Dam. The third monitoring station is referred to as "upstream of Weston Mill Dam" and was sampled by boat using the same methods. The two uppermost monitoring stations are wadeable and are sampled by means of a Smith-Root electrofishing barge with three anodes. Every fish encountered is netted and recorded. Each location is electrofished with a single pass for a 150-m distance. The first impediment upstream of the Weston Mill Dam is the Blackwells Mills Dam (5 miles), therefore the 150-m section below it is a station. The uppermost station is located below the Griggstown Causeway, approximately 9 miles upstream of the Weston Mill Dam.

Thus far, data have also been collected at the same locations during the same seasons from the fall of 2017 through the fall of 2018 (see table below). Surveys were led by NJDFW and assisted by partners from USFWS and The Watershed Institute. For more detailed survey information see Appendix A (pages A66-A69)

Migratory fish including American Shad, Gizzard Shad, river herring, Striped Bass, and American Eel, in addition to resident warmwater species, have been documented passing the Island Farm Weir fish ladder on the Raritan River near its confluence with the Millstone River, approximately 1.5 miles downstream of the Weston Causeway Dam. Fisheries data collected thus far has revealed a total of 51 species, ranging from a diverse recreational species, to a few rare species needing protection as they are recommended as Special Concern, to those considered invasive that have recently colonized the watershed. Thorough statistical analysis will be used to evaluate any post-dam removal changes in fish assemblage. At this point general observations of the Millstone River's fish assemblage will be conveyed.

Both adult and juvenile American Shad were documented downstream of the Weston Causeway dam prior to dam removal, and interestingly five juveniles were captured below the Blackwells Mills Dam during the fall of 2018. This is particularly noteworthy, as these juveniles were found following the first unimpeded migratory season

4-inch juvenile American Shad found below the Blackwells Mills Dam on 9/24/18.

after removal of the Weston Mill Dam, indicating this species has an inherent tendency to recolonize once obstacles are removed from its migratory path.

The Millstone River is host to a diverse warm and coolwater fishery. It generally has low bass densities, as indicated by average CPUE values of 4.3 and 3.1 fish/hr. for stock sized bass (<8 inches) for Largemouth and Smallmouth Bass respectively. These numbers are reputable, due to the combined survey time of 15 total hours. An abundance of sunfishes are typically encountered, including Redbreast, Bluegill, Pumpkinseed, and Green (invasive). A moderate number of large Common Carp and Channel Catfish, along with the occasional Walleye, Musky, and Northern Pike contribute to the recreational fishery. An assortment of ten minnow species have been found in this section of the Millstone River, along with a suite of native freshwater species ranging from common to rare. The Comely Shiner and Shield Darter have both been found during this study. Due to a combination of factors, these two species were recommended as species of Special Concern. Although not encountered in the mainstem of the Millstone, the Bridle Shiner (recommended state Endangered) is found in a few tributaries within the watershed. An assortment of other native species that are not commonly encountered, include Bluespotted Sunfish, Swallowtail Shiner, and both Margined and Tadpole Madtoms.

Four species found during these surveys (Flathead Catfish, Grass Carp, Oriental Weatherfish, and Green Sunfish) are considered invasive under the state's potentially dangerous species regulations. Two Flathead Catfish were found upstream of the confluence with the Raritan River in 2018, with the larger fish measuring 34.3 inches and 20.8 lb (see photo). Large Grass Carp have also been found up to 1,168 mm (46.0 in.) long and weighed 23.5 kg (51.8 lb).

Largest Flathead Catfish captured from the Millstone River weighing 20.8 lbs.

The table below lists the number of each species collected during the spring and fall at each location, starting in in the Fall of 2016 through the Fall of 2018.

An article titled, *Electrofishing Surveys Shed Light on Dynamic Millstone River Fishery* was written and posted on the Division's website to inform anglers of this fishery and the surveys the ongoing project https://www.njfishandwildlife.com/artmillstone.htm.

The monitoring program outlined for these surveys will continue through the spring of 2020.

Fifty-one fish species collected at two locations in the Millstone River downstream of the Weston Mill Dam.

Fish Species	near confluence with Raritan River by Electrofishing Boat (season / year)					below Weston Mill Dam by Electrofishing Boat (season / year)				
	F/16	Sp/17	F/17	Sp/18	F/18	F/16	Sp/17	F/17	Sp/18	F/18
Largemouth Bass	8	9	3	4	2	17	5	17	10	10
Smallmouth Bass	2	3	1	7	2	9	1	6	4	6
Rock Bass				1	1	1	5			
Striped Bass						1				
Bluegill			6	2	5	16	11	22	11	15
Pumpkinseed			1			8	3	2	3	
Redbreast Sunfish	9	29	17	23	16	43	57	46	21	41
Green Sunfish		2		1			1	3		
Lepomis hybrid					1					1
Bluespotted Sunfish				1		1	2			
Black Crappie				1			1		1	1
White Crappie								1		
White Perch		1	2			3	11			2
Shield Darter										
Tessellated Darter					1					
Channel Catfish	4	2	5	8	2	5	7	5	17	7
Flathead Catfish					2					
White Catfish	1		1	1	1		2			1
Yellow Bullhead		1	1		3	3		2		1
Brown Bullhead				1		1		4	3	4
Margined Madtom										
Tadpole Madtom										
Yellow Perch	4					22	2			2
Walleye		1	2	2		3		1		1
Muskellunge			1			1				
Northern Pike					1					
Chain Pickerel			1			9	2	4	1	1
Redfin Pickerel								1		
Rainbow Trout							4			
American Shad		13		14		15	1	50	1	9
Blueback Herring							4			
Gizzard Shad		3	3				3			3
Common Carp	12	52	25	9	89	48	9	15	7	8
Grass Carp			1	3						
Quillback										
Blacknose Dace										
Longnose Dace										
Creek Chub										
Fallfish										
Comely Shiner		2	4	6	8	2	1	2		2
Common Shiner		5	1							
Golden Shiner						6				
Satinfin Shiner						1	1			
Spottail Shiner		8	79	2	59	1	11	14		2
Swallowtail Shiner										
Banded Killifish										
White Sucker				1		10	8	6	5	7
Creek Chubsucker						20	2	4		
Sea Lamprey										
American Eel	9	5	88	76	44	25	48	36	149	88
Mosquitofish sp.		4								
Oriental Weatherfish										

Fifty-one fish species collected at two locations in the Millstone River downstream of the Weston Mill Dam.

Fish Species	above Weston Mill Dam by Electrofishing Boat (season / year)				
	F/16	Sp/17	F/17	Sp/18	F/18
Largemouth Bass	24	7	9	7	2
Smallmouth Bass	4	2		5	
Rock Bass			1	4	
Striped Bass	4				
Bluegill	25	5	17		5
Pumpkinseed	3	1			1
Redbreast Sunfish	37	18	38	27	58
Green Sunfish	1		2	1	
Lepomis hybrid					
Bluespotted Sunfish					
Black Crappie	2			1	1
White Crappie					
White Perch	2	5			
Shield Darter		1			
Tessellated Darter		1	1		
Channel Catfish		2	18	22	12
Flathead Catfish			1		
White Catfish			1		
Yellow Bullhead	3		6	1	3
Brown Bullhead		1	1		
Margined Madtom					
Tadpole Madtom					
Yellow Perch	11		5	1	4
Walleye					
Muskellunge					
Northern Pike					
Chain Pickerel	11		10		1
Redfin Pickerel					
Rainbow Trout				1	
American Shad					
Blueback Herring					
Gizzard Shad	2	1			
Common Carp	33	35	15	9	1
Grass Carp	1	1			
Quillback					
Blacknose Dace					
Longnose Dace					
Creek Chub	2		1		
Fallfish					1
Comely Shiner	2				2
Common Shiner		4			2
Golden Shiner	75	6	1		
Satinfin Shiner	1				2
Spottail Shiner	34	2	6		22
Swallowtail Shiner					
Banded Killifish					
White Sucker	5	4	3	16	3
Creek Chubsucker			2		
Sea Lamprey					
American Eel	54	11	150	124	120
Mosquitofish sp.					
Oriental Weatherfish					

Fifty-one fish species collected at locations in the Millstone River upstream of the Weston Mill Dam.

Fish Species	below Blackwells Mills Dam by Electrofishing Barge (season / year)					below Griggstown Causeway by Electrofishing Barge (season / year)				
Season / Year	F/16	Sp/17	F/17	Sp/18	F/18	F/16	Sp/17	F/17	Sp/18	F/18
Largemouth Bass	1	2	3	1		2		4		
Smallmouth Bass	4	2	3							
Rock Bass	1	1		3				1		
Striped Bass	2									
Bluegill	43	22	109	56	19	42	7	37	22	10
Pumpkinseed	9	9	7	20	13	1	1	8	5	1
Redbreast Sunfish	113	46	106	50	42	48	2	63	20	17
Green Sunfish	6	15	7	29	21	4		5	11	2
Lepomis hybrid			3		1					
Bluespotted Sunfish				5	1					
Black Crappie	1	1	8	1				3	1	
White Crappie										
White Perch										
Shield Darter	3		6	2	6	7	1	6	1	2
Tessellated Darter	130	25	77	96	97	46	35	142	153	115
Channel Catfish		1	1	4	1					
Flathead Catfish										
White Catfish	2				2			2		
Yellow Bullhead	13	2	3	2	2	8		2	1	1
Brown Bullhead			4	4						
Margined Madtom	2	1	4	3	4				3	2
Tadpole Madtom	2	2	2	1		2	1	1	4	4
Yellow Perch	3									
Walleye										
Muskellunge										
Northern Pike			1							
Chain Pickerel	5	2	1			2	1	1		
Redfin Pickerel	1	1		1					1	
Rainbow Trout										
American Shad		1			5					
Blueback Herring										
Gizzard Shad										
Common Carp										
Grass Carp										
Quillback										
Blacknose Dace						2	1	1	1	2
Longnose Dace	1	1			3	6	2	10	6	13
Creek Chub								5	2	
Fallfish	6		10		5	2	1	4		2
Comely Shiner	2		5		1	1		10		
Common Shiner	8		4		6	1	2	13	2	2
Golden Shiner					1					1
Satinfin Shiner	7		17	7	3	46	3	24	8	7
Spottail Shiner	76		105	6	33	21	38	328	9	17
Swallowtail Shiner					3	4		30	6	1
Banded Killifish	1	3		5		22	15	13	1	6
White Sucker	9	2	26	5		1	8	27	18	4
Creek Chubsucker	1									2
Sea Lamprey	1							1		
American Eel	274	56	72	109	103	257	44	145	146	100
Mosquitofish sp.	2	1				1	2			
Oriental Weatherfish	2									

Paulins Kill River Restoration Project - The Paulins Kill River Restoration Project is a multi-faceted partnership led by the Nature Conservancy, with goals of restoring connectivity to NJ's third largest tributary to the Delaware River and improving both riparian and in-stream habitat. One major aspect of the project is the removal of the Columbia Lake Dam. The project took significant steps forward in 2018 including breaching the Columbia Dam. (Shramko, Federal Grant F-48-R)

The following bullets are highlights of the work completed in 2018 followed by a general overview of the project:

- Approximately 2,000 fish were salvaged from the lake representing 19 different species during four separate salvage efforts (3 boat electrofishing and trap-nets).
- Low gamefish numbers were found (Bass, Catfish, Panfish) indicating a poor existing fishery.
- Numerous Common Carp were collected and euthanized in accordance with invasive species protocols.
- Division biologists assisted with salvage efforts of State Listed Threatened and Endangered mussels. Mussels were tagged and relocated.
- De-watering of Columbia Lake through the decommissioned hydro-electric facility began on June 4, 2018. This required Division staff to inspect and remove substantial amounts of debris from the rash racks almost daily for a month.
- Initial breach of dam structure occurred on August 3, 2018.
- Full dam removal and fish passage weir structures are scheduled to be completed in the spring of 2019.

Background -

The Columbia Lake Dam was built by the Jersey Central Power and Light Company (JCP&L) in 1909. This 18-foot high, 330-foot long dam is located on the Paulins Kill less than ¼ mile upstream from its confluence with the Delaware River. The dam impounded a 32-acre reservoir that stretched more than 1.5 miles upstream of the dam. The State of New Jersey owns both the dam (sold by JCP&L in 1955) and 1,098 of the surrounding acres and manages it as the Columbia Wildlife Management Area. Hydropower ceased being produced at the site in the spring of 2016, as the license to generate the hydropower was surrendered as part of the potential dam removal. The impacts this dam had on the Paulins Kill were significant; cutting off access to historic spawning grounds by American Shad, impeding passage of other migratory fish like American Eel and Sea Lamprey, disrupting the river's natural hydrology and sediment transport, and warming the water impounded behind the dam, among other effects. The ultimate desired ecologic outcome for the removal of the Columbia Lake Dam is to improve the overall health of this section of the Paulins Kill and maximize conservation and recreational benefits for nearby communities and businesses.

Paulins Kill Smallmouth Bass

Baseline data collection

Beginning in the spring of 2015, the Bureau of Freshwater Fisheries began a multiyear sampling plan of the Paulins Kill to document and measure fish assemblages prior to the proposed removal of the dam. The following is a summary of the NJDFW's 2015 and 2016 sampling efforts. No fish sampling was done in 2017 or 2018 as flows during the spring anadromous migration period were too high and not conducive to sampling techniques.

Ten sampling locations, in 17 field days, for a total of 499-man hours were spent during 2015 and 2016 to collect data for this study. Seven sampling techniques were utilized; stream electrofishing, boat electrofishing, gill nets, trap nets, seines, cast nets, and a dissolved oxygen / temperature probe with varying levels of success. The Paulins Kill being a large, wide, and deep river complicates sampling, which is why so many different sampling techniques have been utilized. Lower than average water levels during the spring of 2015 aided sampling efforts, however 2016 water levels were closer to average making sampling more difficult. 2017 and 2018 saw flows and water levels above average and too high for effective sampling efforts.

Overall, 2,313 individual fish representing 41 different species were collected, inspected and released. Anadromous fish species such as American Shad (33) and Blueback Herring (1) were documented below the Columbia Lake Dam, but not found above the dam indicating that it is a barrier to fish passage of these anadromous species. 461 American Eels (365 smaller than 200mm) were found in 2 locations below the Columbia Lake Dam. This compares to only 87 American Eels (8 smaller than 200mm) found in 8 locations above the dam. This data illustrates that the Columbia Lake Dam is restricting the passage of this catadromous species as well.

American Shad caught electrofishing below Columbia Lake Dam

No actual fish sampling surveys performed in 2017, but a substantial amount of progress was made towards the removal of the Columbia Lake Dam. Funding was secured, and all permits were issued. Fish passage design through the Route 80 overpass was approved by engineers, NJDFW, and USFWS fish passage professionals. This took many meetings, on-site and otherwise, as this area has unique fish passage issues due to flow, slope, and existing scour protection for the Route 80 overpasses. A multiple weir structure design was finally agreed upon by engineers and fish passage design professionals. Construction of the fish passage weir structures under Route 80 will begin in the winter of 2018 and continue into 2019 as water flows permit.

Yellow Lampmussel salvaged from below Columbia Lake Dam

Mussel Salvage

Mussel surveys done in 2016 and 2017 documented several State *Threatened* and *Endangered* freshwater mussel species. As part of the permitting process, these species must be relocated away from the impacted area in the Paulins Kill before any in-stream sediment generating work could be done. After several delays due to high flow

conditions, a contracted team of biologists began the mussel salvage process in early June. NJDFW staff assisted with these efforts. Seven mussel species were identified. Densities of Eastern Elliptio and Alewife Floater were high and it was impractical to relocate all individuals. In general, focus was on moving the four state-listed *Threatened* and *Endangered* species from below the lake and all mussels found within the footprint of instream disturbance. In total, 692 Eastern Elliptio, 271 Alewife Floater (some are likely eastern floater as contracted biologists did not always distinguish between young Alewife Floater and Eastern Floater), 6 Yellow Lampmussel, 5 Triangle Floater, 1 Eastern Lampmussel, and 1Creeper were relocated. State *Threatened* and *Endangered* species were tagged and relocated to either the Delaware River (Yellow Lampmussel) or a spot upstream of the impacted area (Creeper, Triangle Floater, and Eastern Lampmussel). Follow up surveys done in late summer found that the relocated mussels survived the translocation process.

Fish Salvage

De-watering of the lake began in the spring of 2018, but before de-watering could be completed several fish salvages were performed. The fish salvages on Columbia Lake began on May 1, 2018. NJ Division of Fish and Wildlife staff used multiple types of fisheries techniques to remove as many fish as possible from the lake. Trap nets were first used followed by boat electrofishing. May 1, three trap nets were deployed in Columbia Lake for three successive days. Trap nets were checked daily and the fish were removed from the nets and placed in a live well for transport. All fish salvaged were relocated to the Delaware River and stocked at the Belvidere boat ramp. 542 individual fish representing 15 different species were salvaged from the lake via trap nets. The predominant species collected were Pumpkinseed (139) and Bluegill (137), followed by Yellow Perch (53) and Black Crappie (50). Only five Largemouth Bass were captured by the trap nets.

On May 11, 2018, the NJDFW staff continued the salvage, this time by using an electrofishing boat. Total run time spent electrofishing was 160 minutes. An estimated 400 to 500 fish were removed from Columbia Lake. Most of the fish were White Suckers, Panfish, and Carp. Largemouth Bass (<10) and Channel Catfish (0) were collected at a lower than expected rate indicating a marginal fishery for these species. All the Carp were euthanized as per protocol on invasive species. The remaining salvaged fish were relocated to the Delaware River.

Common Carp collected during Columbia Lake fish salvage efforts.

The fish salvage continued on June 4, 2018, with a total of 681 fish removed from the lake. Again, most of the fish salvaged were White Suckers (339), Common Carp (49) and Panfish (141). Very few Channel Catfish (1), Smallmouth Bass (16), and Largemouth Bass (10) were collected. All Carp were euthanized as per protocol on invasive species. The remaining salvaged fish were relocated to the Delaware River. This salvage was performed with the lake at full pool. Dewatering of the lake through the decommissioned hydro-electric portion of the dam began after this salvage survey on this day.

The final day of the salvage was performed by Division staff on July 5, 2018 by means of boat electrofishing. The lake was in a partially lowered state at this time, making for launching and trailering of the electrofishing boat very difficult. This salvage found the most Common Carp (approximately 130) compared to the other electrofishing surveys. This was likely due to the lake being lowered and the electrofishing boat being more effective near the bottom of the lake where the Carp typically inhabit. Once again, very few Bass and Catfish were collected and the panfish numbers were also down from previous electrofishing surveys. All Carp were euthanized in accordance with invasive species protocols.

NJDFW staff using plywood to launch an electrofishing boat in partially lowered Columbia Lake

In total about 2,000 individual fish from 19 different species were removed from Columbia Lake between trap nets and boat electrofishing. The low abundance of Largemouth Bass, Channel Catfish, and other gamefish species is a reflection on the poor state of the lake and its fishery. The gamefish population found was far below average among similar impoundments of its size.

<u>Remnant Dam Removal and Breach of Columbia Dam</u>

In late June through early July of 2018, a large concrete structure known as the remnant dam located downstream of the Columbia Lake Dam was removed as part of the Paulins Kill Restoration Project. This remnant dam was constructed a few years before the Columbia Lake Dam was constructed in 1909. The dam failed almost immediately leading to the construction of the Columbia Lake Dam a few hundred yards upstream. The remnant dam did not block fish passage after it failed in the early 1900's.

On August 3, 2018 the initial breach of the Columbia Lake Dam occurred, lowering the lake even further. This marks the most significant step in the Paulins Kill Restoration Project and towards restoring fish passage to the Paulins Kill. This also marks an end to a two-month process of de-watering the lake through the decommissioned hydro facility. De-watering the lake through the decommissioned hydro facility required almost daily cleaning of the trash racks and was a huge investment of Division staff time and resources.

The moment when Columbia Lake Dam was initially breached.

With the lake in a lowered state, the focus on the upstream bridge scour protection work could occur. Work to protect the Brugler Road, Warrington Road, and the Interstate 80 bridges from any possible scour due to an increase in river flow resulting from the removal of Columbia Lake was performed from early August through the fall of 2018 by the private construction companies.

Clogged trash racks of decommissioned hydro-electric facility at Columbia Lake.

The region has seen much higher than average rainfall during fall of 2018 which delayed the project several weeks. Initial construction on the fish passage weir system under Interstate 80 was delayed until January 2019. Unfortunately, high flows continue to slow project progress. The final breach of the dam to natural stream level, along with the complete removal of the remaining portion of the dam and powerhouse, will also commence when river flows and conditions allow. This work is scheduled to be completed prior to the 2019 anadromous species run in the spring. Additional sampling is planned for 2019 and will continue into future years to document the fish assemblage once the old Columbia Lake Dam no longer restricts fish movement and the fish passage weir system under Interstate 80 is completed.

Technical Assistance: Anadromous

In order to protect New Jersey's critical aquatic resources, fisheries biologists participate in or provide input on a number of projects each year. Bureau staff provides technical assistance related to conservation, stream restoration, dam removal projects, and Land Use projects. Land Use projects are coordinated through the Division's Office of Environmental Review. This input is directed towards minimizing land use change impacts to the state's fisheries resources. This is typically accomplished through the use of timing restrictions during critical fish spawning periods, protection of riparian buffers, and project modification, assuring best use practices are implemented at all times. However, at times a more in-depth review and comments are necessary on specific projects.

In 2018 staff provided technical assistance to the following project related to our anadromous fisheries resources:

Monitoring the Passage of American Shad on the Raritan River - The Island Farm Weir Fish Ladder on Raritan River had been monitored by the NJ Bureau of Freshwater Fisheries from 1996 through 2003, and in 2005, 2011, and 2012. The final report for JOB I-5: American Shad Restoration in the Raritan River, was submitted in January 2013. Beginning in the spring of 2013, the Department of Marine and Coastal Sciences at Rutgers University conducted the monitoring under the direction of Dr. Olaf Jensen. The Raritan River American Shad and River Herring Project End of Season Report 2017 and multi-year summary was submitted. A report titled, Evaluating Passage performance of spawning shad and river herring at the Island Farm Weir on the Raritan River – Continuing Studies 2018-2019 was also submitted as part of Scientific Collecting permit reporting requirements. (Boriek)

Musconetcong River Restoration Partnership

The Musconetcong River Restoration Partnership is a multi-disciplinary team of agencies, organizations, and individuals working to improve and restore the Musconetcong River. Partners include the Musconetcong Watershed Association, USDA Natural Resources Conservation Service, National Oceanographic and Atmospheric Administration (NOAA), US Fish and Wildlife Service, National Park Service, Army Corps of Engineers, NJDEP (various agencies including NJDFW), American Rivers, North Jersey Resource Conservation and Development, Trout Unlimited, private landowners, and others. The Partnership works with willing dam owners to secure funding from conservation-minded organizations and government programs to remove antiquated dams and restore river health. The partners meet periodically during the year to discuss and plan dam removal projects. In 2018 the partnership met several times to discuss the status of dam removal projects (Warren Glen Mill Dam and Bloomsbury Dam) and other watershed restoration-related activities. The Warren Glen Mill Dam is the highest (37 ft) and lowermost dam on the Musconetcong River (37 ft). Located several miles upstream is the Bloomsbury Dam. American Shad were documented near the base of the Warren Glen Dam in 2017 and 2018 following removal of the Hughesville Dam in the fall of 2016.

On May 4, 2018 the river below the Warren Glen Dam was inspected to determine if American Shad were present. Although American Shad were seen in small schools (at most 12 fish were seen swimming together), obtaining video documentation was unsuccessful due to flow, poor underwater visibility, and skittish fish. This marks the second year that adult American Shad have been documented in the river upstream of the Hughesville Dam site since the dam was removed (Fall 2016). Information was prepared and posted on the Division website on April 26, 2018 to complement posters placed at popular fishing areas earlier, to encourage anglers who see or accidentally catch American Shad or river herring while fishing for other species to report their sightings to NJDFW. (Hamilton, Federal Grant F-48-R)

NATIVE SPECIES

New Jersey is home to nearly 60 Native Fishes, which form a significant component of the state's aquatic biological diversity and natural resource heritage. A list of fish species found in New Jersey can be found in Appendix D. While many native fish species are common, abundant, and widely distributed, such as Pumpkinseed, Blacknose Dace, and White Sucker, there also some that are of conservation concern and have limiting habitat and water quality requirements such as the Brook Trout, Bridle Shiner, Blackbanded Sunfish, and Slimy Sculpin. Many factors including land use changes, habitat loss, decline in water quality, and presence of invasive species threaten the survival of all aquatic biota, primarily those most sensitive.

Slimy Sculpin
(Candidate Threatened)

Brook Trout
(Candidate Special Concern)

The loss of any of these unique fish species through human impact is an undesirable outcome. In addition, natural factors such as climatic variations and watershed succession may dictate the future decline or expansion of fishes that are on the periphery of their established ranges. Further study is required to determine the current abundance and distribution of these nongame fishes throughout the state, including additional fisheries surveys, gathering additional fisheries data from other agencies, mapping, and legal listing, all of which will result in the formation specific management and regulatory objectives. (Crouse, Hunter and Angler)

The following bullets are highlights of recent work followed by a general overview of various aspects of the project:

- The State's first ever status review for freshwater fish led by NJDFW's Endangered and Nongame Species Program was conducted in 2014 and 2015.
- The Endangered and Nongame Species Advisory Committee (ENSAC) voted to accept the status review results on March 16, 2016 identifying 10 species of freshwater fish as potentially *Endangered* (2), *Threatened* (1) or as *Species of Concern* (7).
- The first phase of formally assigning species status, integrating BFF data into the Biotics database was initiated in 2018.
- Future steps include incorporating occurrence data into NJ's Landscape Mapping and then assigning official status via the state rulemaking process.
- 4 waterbodies were surveyed in 2018 to better understand the distribution of native species.
- 8 candidate species for state Endangered, Threatened, or Special Concern were encountered in 2018.

Status Evaluation of Native Freshwater Fishes

A formal review process led by the NJDFW's Endangered and Nongame Species Program was conducted in 2014 and 2015 to determine the status of our native freshwater fishes, known as the Delphi Technique. It is a systematic method for reaching consensus among experts in which absolute, quantitative answers are either unknown or unattainable. It is an iterative process characterized by anonymity among the participating experts, controlled feedback via the principal investigator, and a statistical estimator of group opinion. By structuring the group communication process, the Delphi Technique helps the group reach a consensus of opinion by incorporating all available data and disseminating those data among all participants. The Delphi has assisted the NJDFW's efforts to update New Jersey's State Wildlife Action Plan. To assist the Delphi efforts, the NJDFW created species distribution maps using GIS, based on data collected from 2000 through 2012. (Crouse, Hunter and Angler)

Shield Darter
(Candidate Special Concern)

Sixty-five species were evaluated by an expert panel, in which status selections, confidence levels, and comments were submitted by reviewers and compiled by ENSP staff. The findings were presented to the Endangered and Nongame Species Advisory Committee (ENSAC) during one of their regular meetings on March 16, 2016. During this time, committee members voted to accept the results, and supported future listing and designations. The next step will be assigning official status via the state rulemaking process. Results are listed below.

American Brook Lamprey
(Candidate Special Concern)

Endangered: Bridle Shiner, Ironcolor Shiner
Threatened: Slimy Sculpin
Special Concern: American Brook Lamprey, Blackbanded Sunfish, Brook Trout, Comely Shiner, Mud Sunfish, Northern Hogsucker, and Shield Darter

State Wildlife Action Plan

During 2015 through 2017 the Bureau of Freshwater Fisheries participated in the ten-year revision of the State Wildlife Action Plan (SWAP). The SWAP is a strategic and cost-effective mechanism to preserve the state's wildlife resources for the future. Recovery of species that have reached threatened or endangered status is typically more-costly than preventative actions that keep species populations from reaching such declines. Proactive management actions identified in the SWAP are intended to keep species from becoming federally (and state) threatened and endangered. NJDFW drafted the revised version of the plan in 2017, that was open for public comment. The final plan will be submitted to the U.S. Fish and Wildlife Service in 2018. An up to date Wildlife Action Plan is required by Congress to continue to receive federal State Wildlife

Ironcolor Shiner
(Candidate Endangered)

Grants. More importantly, New Jersey's update will serve as a blueprint for conserving our wildlife heritage. The plan will identify priority actions addressing known threats facing our targeted species and habitats that we, as a conservation community, can implement in the next ten years.

Blackbanded Sunfish
(Candidate Special Concern)

Fisheries related duties of the SWAP included a variety of tasks, including the prioritization of approximately 60 native fish species to determine those Species of Greatest Conservation Need. For these species, additional information was compiled to demonstrate species distribution, habitat information, state and range-wide status, etc. Species of Greatest Conservation Need were evaluated using several processes that resulted in the selection of eight Focal Species which were grouped into the following categories: Brook Trout, Pinelands Fishes (Banded Sunfish, Blackbanded Sunfish, Mud Sunfish, and Swamp Darter), and Vulnerable Minnows (Bridle Shiner, Comely Shiner, and Ironcolor Shiner). (Crouse, Hunter and Angler)

Native Species Data Collection Efforts

During 2018, four waterbodies were surveyed, specifically targeting native fishes. The highest priority sites were those in which the Bridle or Ironcolor Shiners (candidate state Endangered) were previously documented. Secondary priorities were sites that had candidate state Threatened or soon Special Concern species. This year the majority of those sites were located in the Lower Delaware River Drainage and Lower Atlantic Drainage to inventory for the presence of the four acid tolerant sunfish species (Blackbanded, Banded, Bluespotted, and Mud Sunfish). Additional sites were surveyed for a variety of other reasons. Sites and significant species accounts are in table below.

List of sites surveyed in 2018 searching for less common freshwater fish species.

Waterbody	Survey Date	Significance	Page #
Upper Delaware North & Wallkill Region (Shimmers Brook to Paulins Kill and Wallkill River watersheds)			
Blair Lake (Sussex)	8/15/18	Bridle Shiner and Bluespotted Sunfish in 2017 and 2018.	92
Lower Delaware Region (Assunpink Creek to Maurice River watersheds)			
Rancocas Creek, N/Br. (trib.)(W. of Timbuctoo) (Burlington)	7/30/18	Historical Record of Ironcolor Shiner "Rancocas affluents near Browns Mills - 1905" None found in 2018	A91
Lower Atlantic Coastal (Sloop Creek to Dennis Creek watersheds)			
Franklin Parker Preserve Reservoir (Burlington)	8/14/18	Located within the Pinelands with no previous data. Blackbanded, Banded, Bluespotted, and Mud Sunfish and Swamp Darter found in 2018	95
Oswego Lake (Burlington)	7/20/18	Blackbanded, Banded, Bluespotted, Mud Sunfish, and Swamp Darter 1970. Blackbanded, Bluespotted, and Swamp Darter 2018.	102

Mud Sunfish
(Candidate Special Concern)

In addition to the sites that were surveyed specifically for rare native species, many of the 242 fisheries surveys conducted by the Bureau contribute valuable information to the status and distribution of fishes, including some of New Jersey's less common native fishes. The table below lists candidate state Endangered, Threatened, or Special Concern species. The number of sites in which each species was found during 2018, along with the number of sites that mark the first time each species was documented at that location are also found in the table below.

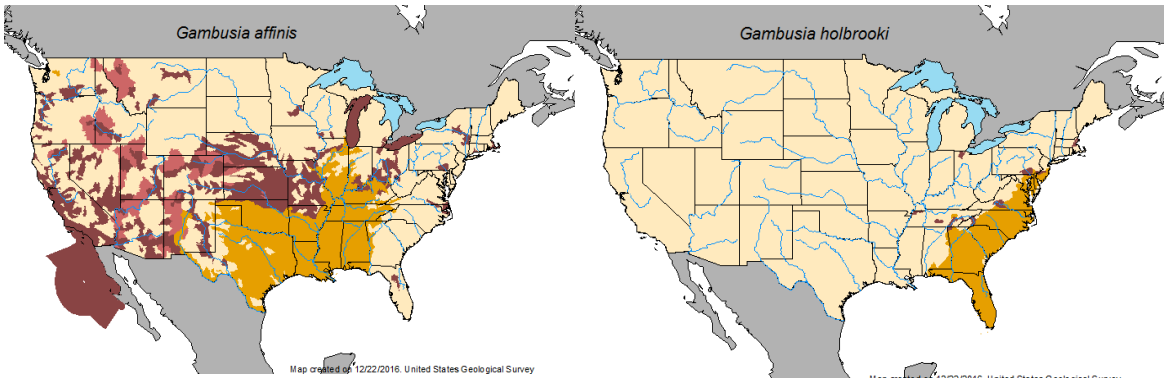
List of candidate state Endangered, Threatened, or Special Concern, including number of locations in which each species was encountered during 2018.

Species	Candidate Status	Number of sites	New sites in FishTrack Database
Bridle Shiner	Endangered	1	0
Ironcolor Shiner	Endangered	0	0
Slimy Sculpin	Threatened	9	2
American Brook Lamprey	Special Concern	2	1
Brook Trout (see Wild Brook Trout Assessment page 41)	Special Concern	48 (5 from 1 stream)	9
Blackbanded Sunfish	Special Concern	3	1
Comely Shiner	Special Concern	4 from 1 river	0
Northern Hog Sucker	Special Concern	0	0
Mud Sunfish	Special Concern	1	1
Shield Darter	Special Concern	2 from 1 river	0

Bridle Shiner (Candidate Endangered)

Mosquitofish

The Eastern Mosquitofish (*Gambusia holbrooki*) is native to the southeastern United States, with its northern range limit possibly extending into the southern portion of New Jersey. The Western Mosquitofish (*Gambusia affinis*) is native to the south-central United States (see figures below). The non-native Western Mosquitofish has been widely introduced as a mosquito-control agent and are currently raised at the Hackettstown State Fish Hatchery (up to 2.5 million/year) and supplied to the county Mosquito Control Commissions. Discerning Eastern and Western Mosquitofish is difficult, as their physical characteristics are very similar and in fact hybridization and hatchery rearing processes can further confound the differences. The recent status evaluation of native fishes did not result in a status assessment for Eastern Mosquitofish. Contributing factors for their "undetermined" status pertained primarily to difficulty in proper identification and uncertainty of native range in NJ.



Range maps of Western Mosquitofish (G. affinis) (left) and Eastern Mosquitofish (G holbrooki) (right) from USGS Non-Indigenous Aquatic Species website *https://nas.er.usgs.gov/*

The NJDFW has documented mosquitofish in an increasing number of locations in the wild in recent years, in fact 18 of 21 counties. They were captured from 25 sites in 2016, 6 sites in 2017, and 16 sites in 2018. Data exist for many of them were retained for future laboratory identification and are temporarily referenced generally as Mosquitofish sp./ *Gambusia* sp. Their increased distribution is believed to be a result of mosquito control related stockings. If the Eastern Mosquitofish are truly native and found very infrequently, they may warrant a protective measure to secure their future. Conversely, the non-native Western Mosquitofish may be acting as an invasive species and their establishment throughout the state may warrant management actions to minimize their spread.

Protection and Restoration of Inland Fisheries and Aquatic Habitats: Native Species

In order to protect New Jersey's critical aquatic resources, fisheries biologists participate in or provide input on a number of projects each year. Bureau staff provides technical assistance related to conservation, stream restoration, dam removal projects, and Land Use projects. Land Use projects are coordinated through the Division's Office of Environmental Review. This input is directed towards minimizing land use change impacts to the state's fisheries resources. This is typically accomplished through the use of timing restrictions during critical fish spawning periods, protection of riparian buffers, and project modification, assuring best use practices are implemented at all times. However, at times a more in-depth review and comments are necessary on specific projects.

INVASIVE SPECIES

Aquatic Invasive Fishes Management

New Jersey is host to over 85 freshwater fish species and of these nearly 60 are native. Native fishes contribute to the biological integrity of aquatic communities and may also be economically, recreationally, and culturally important. Introductions of invasive, non-native fish, aquatic plants, and pathogens are a growing concern of natural resource managers in New Jersey and elsewhere because of their potential to dominate and destroy aquatic ecosystems causing irreversible economic and cultural damage. (Smith, Hunter and Angler)

In New Jersey ten species of fish have been identified as having the potential to become a significant threat to indigenous animals, the environment, or public safety. Collectively, they are referred to and regulated as "potentially dangerous fish," which include: Asian Swamp Eel (*Monopterus albus*), Bighead Carp (*Hypophthalmichthys nobolis*), Brook Stickleback (*Culaea inconstans*), Flathead Catfish (*Pylodictis olivaris*), Grass Carp (diploid) (*Ctenopharyngodon Idella*), Green Sunfish (*Lepomis cyanellus*), Oriental Weatherfish (*Misgurnus anguillicaudatus*), snakeheads (*Channa sp*.), Silver Carp (*Hypophthalmichthys molitrix*), and Warmouth (*Lepomis gulosus*). To date, all but the Silver Carp have been documented in New Jersey waters. Possession and/or release of live potentially dangerous fish species is prohibited and when these species are encountered while angling they must be destroyed.

Surveys conducted under a variety of projects and/or funding sources provide data documenting the presence (and removal) of invasive fish species. The following invasive fish species were captured and removed during surveys conducted in 2018:

- 86 Asian Swamp Eel removed from Silver Lake (Camden), a known location.
- 156 Northern Snakeheads removed from 6 waterbodies where the species is known to occur: lower Delaware River, DOD Lake, Game Creek, Little Mantua Creek, Newton Lake, and Salem Canal.
- Flathead Catfish were removed from the Millstone River (2) and Rancocas Creek S/Br. (1), known location for this species.
- 3 Grass Carp removed from the Millstone River, a known location for these species.
- 26 locations surveyed statewide documented the presence of Green Sunfish, 18 of which are new locations (species now found in 17 of 21 counties).

Locations surveyed by NJDFW in 2018 where invasive fish species were found are listed and described in detail in table below. Green Sunfish were excluded as they are now fairly widespread, found at 26 locations in 2018, 18 of which are new documentations. Green Sunfish are now found in 17 of 21 counties.

Locations sampled by NJDFW where invasive fish species (excluding Green Sunfish) were found in 2018.

Location	Drainage		Species Targeted	Sampling Gear	Run Time (Hours)	Number of Fish
Delaware River (Bordentown) *	Delaware River	7/16/18	Northern Snakehead	Electrofishing	2.39	0
Delaware River (Bordentown) *	Delaware River	7/18/18	Northern Snakehead	Electrofishing	1.71	2
Delaware River (Burlington) *	Delaware River	8/30/18	Northern Snakehead & Flathead Catfish	Electrofishing	1.91	0 & 1
Delaware River (Pennsauken) *	Delaware River	8/2/18	Northern Snakehead	Electrofishing	0.50	0
Delaware River (West Deptford) *	Delaware River	6/8/18	Northern Snakehead	Electrofishing	1.0	0
DOD Lake	Delaware River	3/28/18	Northern Snakehead	Electrofishing	2.09	9
DOD Lake	Delaware River	5/23/18	Northern Snakehead	Electrofishing	2.27	20
DOD Lake*	Delaware River	7/12/18	Northern Snakehead	Electrofishing	1.48	11
Game Creek	Salem River	3/26/18	Northern Snakehead	Electrofishing	2.24	4
Game Creek	Salem River	4/20/18	Northern Snakehead	Electrofishing	2.11	8
Game Creek*	Salem River	6/14/18	Northern Snakehead	Electrofishing	2.46	35
Game Creek*	Salem River	6/19/18	Northern Snakehead	Electrofishing	2.18	23
Game Creek*	Salem River	8/28/18	Northern Snakehead	Electrofishing	1.91	10
Little Mantua Creek*	Delaware River	6/8/18	Northern Snakehead	Electrofishing	0.97	3
Millstone River	Raritan River	10/9/18	Flathead Catfish	Electrofishing	3.0	2
Millstone River	Raritan River	5/9/18	Grass Carp	Electrofishing	3.0	3
Newton Lake	Newton Creek	5/29/18	Northern Snakehead	Electrofishing	1.75	6
Rancocas Creek, S/Br.	Rancocas Creek	10/10/18	Snakehead & Flathead Catfish	Electrofishing	1.22	2 & 1
Salem Canal	Salem River	3/28/18	Northern Snakehead	Electrofishing	1.76	13
Salem Canal	Salem River	4/10/18	Northern Snakehead	Electrofishing	2.25	12
Salem Canal*	Salem River	6/18/18	Northern Snakehead	Electrofishing	1.94	0
Silver Lake*	Cooper River	7/14/18	Asian Swamp Eel	Electrofishing	0.66	39
Silver Lake*	Cooper River	8/21/18	Asian Swamp Eel	Electrofishing	1.20	47

* Sampled specifically to monitor and remove invasive fish species.

Asian Swamp Eel

Monitoring and control of the Asian Swamp Eel has been limited to backpack electrofishing removal methods. The complexity of the habitat and physiological adaptability of the Asian Swamp Eel significantly hinders chances of successful eradication.

Asian Swamp Eel

Silver Lake (Camden) – Backpack electrofishing surveys have been conducted annually at Silver Lake to monitor the Asian Swamp Eel population since 2008, when they were first discovered there. In 2018 two backpack electrofishing surveys were completed at Silver Lake (10 acres) on 07/14/18 and 08/21/18 to monitor the invasive Asian Swamp Eel population. A total of 39 Swamp Eels were removed during 0.66 hours of electrofishing on July 14. A total of 47 were removed from 1.20 hours of electrofishing on August 21. Increased monitoring and removal efforts will continue in 2019. The catch-per-unit-effort (CPUE) of 46 fish/hour was lower than 2017 (60 fish/hour) and higher than the mean CPUE (36/hour) since sampling began in 2008 (table below). (Smith, Hunter and Angler)

History of Asian Swamp Eel collection at Silver Lake (Camden).
CPUE (fish/hr) of Asian Swamp Eels collected from Silver Lake 2008 – 2018

Year	Number of Asian Swamp Eels Collected	Total Run Time (hrs)	Catch per unit effort (CPUE)
2008	355	7.73	46
2009	189	11.68	16
2010	224	7.68	29
2011	159	4.09	39
2012	119	2.85	42
2013	305	5.9	51
2014	123	4.36	29
2015	78	1.31	59
2016	85	2.06	42
2017	172	2.86	60
2018	86	1.86	46
Total	**1,895**	**52.38**	**36**

Flathead Catfish

Flathead Catfish, a species on the list of "potentially dangerous" fish, were collected during three surveys in 2018. Flatheads which all weighed between 18 - 20 lb were collected in the Delaware River, Rancocas Creek, S/Br. (a tributary of the Delaware River), and the Millstone River.

Delaware River – Burlington City (Burlington) – A boat electrofishing survey was conducted on the Delaware River on 08/30/18 to assess the Northern Snakehead and Largemouth Bass populations around the City of Burlington. One invasive Flathead Catfish that measured 890 mm (35 in) and weighed 8.28 kg (18.3 lb) was collected. This location will continue to be monitored in the future. (Smith)

Millstone River (Somerset) – Four invasive fish species have been found during recent surveys on the Millstone River, including Flathead Catfish, Grass Carp, Oriental Weatherfish, and Green Sunfish. The first Flathead Catfish documented in the Millstone River (below the Weston Mill Dam) occurred in 2013, although anglers previously reported catches in the Delaware & Raritan Canal during the last decade. Two Flathead Catfish were found upstream of the confluence with the Raritan River in 2018, with the larger fish measuring 34.3 inches and 20.8 lb (see photo). (Crouse)

Largest Flathead Catfish captured from the Millstone River weighing 20.8 lbs.

Rancocas Creek, S/Br. (Burlington) – A boat electrofishing survey was completed on the tidal South Branch Rancocas Creek on 10/10/18 to evaluate the Largemouth Bass population. Invasive species, including Northern Snakehead and Flathead Catfish were also collected. The Flathead Catfish measured 850 mm (33.5 in) and weighed 8.81 kg (19 lb) and was removed. Snakeheads and Flathead Catfish are now widely distributed through the Delaware River at the tributaries.

Northern Snakehead

17 electrofishing surveys were conducted on 4 waterbodies in 2018 to assess Northern Snakehead.

Delaware River (Burlington, Camden, Gloucester) – In 2018 five boat electrofishing surveys were completed on the Delaware River to evaluate the Northern Snakehead and Largemouth Bass populations. Invasive Flathead Catfish and Walleye, a species annually stocked by NJDFW, were also collected when encountered. Channel Catfish and Striped Bass were observed during all surveys, however were not collected. No sturgeon were encountered during any of the Delaware River surveys. The discovery of snakeheads in the Delaware River in 2008 prompted the long-term monitoring of select sections of the river that will hopefully provide insight into impacts snakeheads may have on native and other recreational import game species. The Largemouth Bass electrofishing catch rates (CPUE) are rather variable and fluctuate with aquatic vegetation abundance. PSD and PSD-P vary from site to site, but generally indicate a balanced population.

Two Snakeheads were collected during the survey that included the southern end of Newbold Island and the main river side of Newbold Island. They measured 487 and 695 mm (19.2 and 27.4 in). Both were captured behind Newbold Island from areas with thick aquatic vegetation.

No snakeheads were found at the other four sites: 1) both sides of the river from Bordentown upstream to the Trenton power plant, 2) the northern end of Newbold Island or at a site upstream and downstream of the Burlington City boat ramp, 3) the flat at the southern end of Pennsauken Creek and approximately 200 meters into Pennsauken Creek, and 4) south of the West Deptford boat ramp, around the Red Bank Battlefield Park, with additional sampling was completed in the cove between Riverwinds and the golf course and near the confluence with Main Ditch. (Smith)

DOD Lake (Salem) – DOD Lake is a 120-acre borrow pit located in Oldmans Township and is located on a NJDFW Wildlife Management Area. The lake is regularly surveyed since acquired by the Division in 1998. A concrete boat ramp was installed in 1999, which increased angler access and use. A lake inventory and management plan was completed in 2002, which established good baseline data for future management decisions.

One of the more recent species to take up residence in DOD Lake is the Northern Snakehead. An invasive species that originates from Asia, the snakehead was first collected in DOD Lake during a 2015 electrofishing survey targeting Largemouth Bass. Supplemental electrofishing surveys in 2016 and 2017 resulted in eight snakeheads collected in 2016 and three in 2017. The snakehead gained access through a pipe which connects directly to the Delaware River.

Three boat electrofishing surveys were completed at DOD in 2018; on 03/28/18, 05/23/18 and 07/12/18 to monitor the Largemouth Bass and Northern Snakehead populations. The table above is a summary of the three electrofishing surveys including runtime, total number of Largemouth Bass, CPUE for stock size bass, PSD, PSD-P and total number of Snakeheads.

A total of 30 Northern Snakeheads were collected from the three surveys. They ranged in size from 145-620 mm (5.7 - 24.4 in), the largest of which weighed 2.47 kg (5.44 lb). Scales were removed for age determination and stomachs were retained for an ongoing diet study. Early spring is the best time to target snakeheads prior to spawning activity. Monitoring will continue in 2019 with multiple surveys planned. (Smith)

Game Creek (Salem) – Game Creek is a tributary of the Salem Canal, converging with the canal just downstream of the Route 40 bridges. Visually, Game Creek is rather different than the canal, with relatively clear tannin stained waters opposed to the turbid waters of the canal. Habitat is also different with fish relying on the abundant aquatic vegetation including water smartweed, bladderwort, coontail, and spadderdock. A few felled trees are also present in this tributary, but the Largemouth Bass and Northern Snakeheads appear to favor the vegetation, especially during the colder months. Game Creek is also unique in that a small borrow pit (approximately 3 acres) is connected to the creek and serves as a wintering area for many species. This "pond" area produced good results during the November 2017 survey. Snakeheads were first documented at this location in 2016 but reported by an angler in 2014.

Five electrofishing surveys were completed at Game Creek (upstream of the Route 40 bridge) in 2018; on 03/26/18, 04/20/18, 06/14/18, 06/19/18 and 08/28/18. The surveys were completed primarily to remove Northern Snakeheads, however Largemouth Bass were also collected in all but the 06/19/18 survey. The table below is a summary of the five electrofishing surveys including runtime, total number of Largemouth Bass, CPUE for stock size bass, PSD, PSD-P, and total number of Snakeheads.

A total of 80 Northern Snakeheads were collected and removed from Game Creek. Snakeheads were actively spawning during this time and presumably forced the bass to relocate to another area. Sizes ranged from YOY to mature adults. The largest individual measured 765 mm (30.1 in) and weighed 4.48 kg (9.9 lb). The population will continue to be monitored annually to determine any long-term effects on the bass population. Game Creek/Salem Canal is one of the most popular bass fishing locations in the southern New Jersey. Largemouth Bass should be stocked in Salem Canal when surplus is available to offset tournament mortality and impacts of snakeheads. (Smith)

Newton Lake (Camden) – Newton Lake is a 40-acre impoundment of Newton Creek bordered by Collingswood, Oaklyn, and Haddon Township. Greater than half of the lake's shoreline, including the boat ramp, is maintained by the Camden County Parks System. Private residences border the rest of the lake. Newton Lake has a small paved boat ramp, ample trailer parking, and good shoreline access for anglers. The lake is family friendly, with a playground and temporary restrooms nearby. A fish ladder to increase spawning habitat for Alewife and Blueback Herring was installed in the early 2000's and subsequently deemed a pathway for the invasive Northern Snakehead.

A total of six Northern Snakeheads were collected ranging in size from 455 - 712 mm (17.9 – 28.03 in) and weighed 0.93 – 3.87 kg (2.05 – 8.53 lb). The lake will continue to be monitored for the presence of Snakeheads and any impact on the Largemouth Bass population. (Smith)

Salem Canal (Salem) – Salem Canal is one of the most popular bass fishing locations in southern New Jersey and annually receives the most applications for WMA fishing tournament permits. The Salem Canal is not a WMA; however, the Division owns a parcel of land and the concrete boat ramp located on Route 540. The Salem Canal is a dammed section of the Salem River originating in Woodstown and flowing through the DuPont facility, before exiting at the confluence with the Delaware River. The shallow canal consisting of marshy banks, spadderdock, submerged aquatic vegetation, and felled trees make the canal ideal habitat for Largemouth Bass and unfortunately the Northern Snakehead in recent years.

Three boat electrofishing surveys were completed in 2018; on 03/28/18, 04/10/18 and 06/18/18. The table below is a summary of the three electrofishing surveys including runtime, total number of Largemouth Bass, CPUE for stock size bass, PSD, PSD-P, and total number of Snakeheads. The CPUE for Largemouth Bass ranged from 29 – 53 from the three surveys.

Date	Electrofishing Time	No. LMB	LMB CPUE (stock)	PSD	PSD-P	No. Snakehead
3/28/18	1.76	79	42	79	21	13
4/10/18	2.25	121	53	71	16	12
6/18/18	1.94	60	29	62	12	0

A total of 25 Northern Snakeheads were collected from the three surveys. Snakeheads did not appear to be as abundant in the canal as Game Creek. The largest collected measured 635 mm (25 in) and weighed 2.55 kg (5.62 lb). Annual electrofishing should continue to remove snakeheads. (Smith)

Additional information regarding the previously mentioned surveys can be found in the Warmwater Fisheries Assessments via Electrofishing section of this report on page 84.

Aquatic Invasive Plant Management

Water chestnut, a non-native aquatic plant species that can rapidly colonize a waterbody once it is established, has become increasingly prevalent in New Jersey's waters. Early detection is the key to water chestnut control, since smaller populations are easier to eliminate than larger ones. It also costs less to control a small infestation because plants can be individually hand-pulled. A large population requires the use of mechanical harvesters or application of aquatic herbicides to achieve control. It can be difficult and costly to eradicate water chestnut given this plant's hardiness (seed pods remain viable for 10+ years) and abundance. Water chestnut is now found in at least 30 waterbodies in 11 counties. Most new sightings are brought to our attention by anglers, who typically mention that they were made aware of the problem via recent invasive species articles in NJDFW's Freshwater Fisheries Digest. (Smith, Hunter and Angler)

Water chestnut seed pods: immature (left) and mature (right).

Newly Identified Locations in 2018

Water chestnut was found in five new location in 2018, all of which are in Morris County. Locations include Hedden Park Lake, Mount Olive PAL Pond, Mountain Valley Park Pond, Turkey Brook Park Pond, and a small unnamed pond in Mount Olive located off Bennington Road.

FISH HEALTH

Cyanobacteria

Cyanobacteria, unlike more typical green algae, can produce toxins which can cause rashes on humans and pose a risk to animals drinking or swimming in affected areas of a waterway. A cyanobacterial Harmful Algal Bloom (HAB) is the name given to the excessive growth or "bloom" of cyanobacteria, some of which can produce one or more types of potentially harmful toxins. These "blooms" often result in a thick coating or "mat" on the surface of a waterbody, often in late-summer or early fall. It is important to note that some blooms are due to common green algae and not cyanobacteria and when present, cyanobacteria do not always produce cyanotoxins (https://www.state.nj.us/dep/wms/HABS.html).

While HABs have no impact on fish populations, adverse human health effects from recreational exposure to cyanotoxins range from a mild skin rash to serious illness or death. If the cyanobacterial cell count equals or exceeds 20,000 cells/ml in an area where primary recreational contact is likely to occur, health advisory signs are posted (NJDEP DSREH, 2017). NJDEP's Division of Science, Research, and Environmental Health also recommends the following guidance values for recreational exposure to individual cyanotoxins: Microcystins (3 µg/L), Cylindrospermopsin (8 µg/L), and Anatoxin-a (27 µg/L). NJDEP's "Cyanobacterial Harmful Algal Bloom (HABs) Freshwater Recreational Response Strategy" identifies the actions taken by respective facets of the Department. DEP's Bureau of Freshwater and Biological Monitoring is the lead for confirming the presence of cyanobacteria and coordinating response. The DFW's Bureau of Freshwater Fisheries (BFF) is responsible for posting advisories on waterbodies within the Division's 121 Wildlife Management Areas as well as visually monitoring the status of confirmed blooms within these areas. The DFW also maintains a list of active blooms on any recreationally fished waterbodies open to the public on the DFW website. BFF staff will also alert the BFWBM of any suspected blooms encountered when conducting fisheries surveys throughout the state.

In 2018, Cyanobacteria was confirmed at 18 waters throughout the state, with the majority occurring in counties in the north and central regions. 16 of the 18 waters had levels which resulted in the posting of a health advisory. The first outbreak was documented in Lincoln Community Park Lake on June 1, 2018, while the majority of blooms occurred in mid to late August and September. There were no documented HAB blooms on any DFW lakes in 2018. Four waterbodies, Branch Brook Park Lake, Deal Lake, Lincoln Park Community Lake, and Swartswood Lake had confirmed cyanobacteria blooms in both 2017 and 2018. (Barno, Hunter and Angler)

Waterbodies where Cyanobacteria was confirmed in 2018, in order of occurrence.

Waterbody	County	Township	Began	Ended
Lincoln Park Community Lake	Morris	Lincoln Park Borough	6/1/2018	8/8/2018
Echo Lake	Passaic	West Milford Twp.	6/29/2018	7/13/2018
Rahway River/Orange Res.	Essex	West Orange Twp.	7/12/2018	12/21/2018
Deal Lake	Monmouth	Asbury Park City	7/23/2018	10/26/2018
Duck Pond	Somerset	Franklin Twp.	7/8/2018	11/14/2018
Weequahic Lake	Essex	Newark City	8/9/2018	12/21/2018
Memorial Lake	Salem	Woodstown Borough	8/17/2018	10/23/2018
Saddle River Park Lake	Bergen	Glen Rock Borough	8/20/2018	12/21/2018
Cupsaw Lake	Passaic	Ringwood Borough	8/28/2018	10/12/2018
Swartswood Lake	Sussex	Stillwater Twp.	9/3/2018	10/26/2018
Budd Lake	Morris	Mount Olive Twp.	9/5/2018	12/21/2018
Little Swartswood Lake	Sussex	Stillwater Twp.	9/7/2018	11/1/2018
Spruce Run Reservoir	Hunterdon	Clinton Twp.	9/11/2018	10/22/2018
Southard Park Pond	Somerset	Bernards Twp.	9/12/2018	11/14/2018
Lake Hopatcong (cove at Kingsland Rd. only)	Morris	Roxbury Twp.	9/15/2018	12/21/2018
Crystal Springs Pond	Hunterdon	Lebanon Twp.	9/18/2018	12/21/2018
Boonton Reservoir	Morris	Boonton Twp.	9/27/2018	12/21/2018
Branch Brook Park Lake	Essex	Newark City	10/17/2018	12/21/2018

Fish Kill Investigations

Field investigations are conducted in response to reports of fish kills, distressed fish, unknown fish parasites, or to address potential pathogen issues in wild fish. These investigations are often a collaborative effort between the Bureau of Freshwater Fisheries staff (Hunter and Angler) and the fish pathologist in the NJDFW's Office of Fish and Wildlife Health and Forensics (under Grant FW-69-R administered by that Office). In 2018, the Bureau of Freshwater Fisheries responded to fish health concerns at 19 waterbodies. Two activities, the First Neshanic River sludge discharge and the Spruce Run Creek quarry discharge were a continuation of events that occurred in 2017, that required additional site visits and further assessment into 2018.

A summary of 2018 fish kill investigations are summarized as follows:

- The Bureau of Freshwater Fisheries responded to concerns on 19 waterbodies.
- The most common cause of stress and/or mortality was decreased oxygen levels in the water, due to warm conditions and was the cause in at least 6 locations.
- The second most common cause of stress/or mortality were pollution events, which occurred in at least 5 locations.
- Miscellaneous causes for stress include: saltwater intrusion, rapid pH drop, rapid increase in water temperature as opposed to dissolved oxygen drop, and water level manipulation.

Allentown Mill Pond (aka Conines Mill Pond) (Monmouth) - A mortality of approximately 50 Black Crappie was reported. An investigation occurred on 07/16/18 and multiple species of fish including Black Crappie, Bluegill, and White Perch were affected. Only a single moribund Bluegill was suitable for necropsy and lab testing. Necropsy done at the Pequest Fish Health Laboratory showed that the fish had external skin lesions and microscopic analysis of wet mounts taken from skin demonstrated abundant bacteria consistent with *Flavobacterium columnare*, the cause of columnaris disease, a common bacterial infection in a variety of fish species that causes

skin and gill necrosis. Infection is particularly common during warmer water temperatures. (Lovy)

Echo Hill Park Pond (Hunterdon) – A fish kill was investigated on 07/20/2018 within Hunterdon County's Division of Parks and Recreation's Echo Hill Park. This 1-acre pond is very shallow and eutrophic, with low visibility, and an abundance of watermeal coating the perimeter of the pond. Approximately 75 adult Bluegill, ranging in length from 5 to 9 inches, and 4 young-of-the-year Largemouth Bass were observed floating in the water apparently dead for approximately 24 hours. Many were significantly bloated, partially eaten, or desiccated, while small sunfish were observed swimming normally and swiftly swimming away when approached. No live fish appeared to be stressed or gulping at the surface. No other species seemed to be affected by the kill. Triploid Grass Carp were approved to be stocked in the pond to control aquatic vegetation. Three were observed and were exhibiting normal behavior. There was no visible oil sheen or unusual smells (other than dead fish) noted. Water temperature and dissolved oxygen were recorded at various depths (see below).

Echo Hill Pond water chemistry.

Depth (ft)	Temp. ℃ (℉)	Dissolved Oxygen (mg/l)
Surface	24.5 (76.1)	7.36
1	23.4 (74.1)	6.46
2	23.2 (73.8)	5.39

Although temperature and oxygen levels were suitable at the time of the investigation, the few days leading up to the fish kill were hot and sunny, presumably resulting in high water temperatures and low dissolved oxygen readings. Air temperatures significantly dipped down on the night of July 19, thus water temperatures and dissolved oxygen readings may have rebounded and resolved when recorded on July 20. NJDFW fish pathologist Dr. Lovy was consulted and based on observations concurred that the cause of fish mortality is most likely the result of low oxygen levels. This is consistent with other observations that the species impacted were almost exclusively large Bluegills and that all other fishes, including small Bluegills survived. Carp are known to be tolerant of extremely low oxygen levels. (Crouse/Lovy)

Sediment disturbance underneath the Route 202 / 31 bridge crossing of the First Neshanic River.

First Neshanic River (Hunterdon) – Clean-up activities following a discharge of food waste into the First Neshanic River (Raritan Township) in 2017 and continued into 2018. In October 2017, NJDEP Compliance and Enforcement identified Johanna Foods Inc. (JFI) as the source of sludge discharged into the First Neshanic River, Raritan Township (Hunterdon). The sludge, residual food waste, was observed from JFI's discharge point along a 100ft. drainage ditch leading to the First Neshanic River. Approximately 1,800 ft. of

the river, from the confluence of the ditch downstream to the southbound side of the Route 202/31 Bridge, was impacted.

On 10/23/17, JFI manually removed a significant amount of sludge from the drainage ditch. A private contractor conducted initial cleanup efforts December 4 through December 8. Approximately 270,000 gallons of water/material was removed from the stream and processed at Johanna Foods.

Following the clean-up of a significant portion of the stream channel, it became evident there was a second source of the sludge. Further cleanup was suspended until the new source was identified and addressed. Significantly less material was observed on the stream bed during a 5/2/18, site visit. Pockets of material were observed within the drainage ditch leaving the facility and for a short distance downstream in the First Neshanic River. Lower reaches of the stream appeared relatively free of material. Heavy accumulation of material that was observed last fall in the area under and around the Route 202/31 bridge was no longer present. Inspection of the next three bridge crossings downstream appeared to have little or no accumulated material. Removal of both sediment curtains was recommended. Compliance & Enforcement will identify next steps in regard to necessary corrective and enforcement actions. (Crouse)

Grenloch Lake (Gloucester) – Grenloch Lake is an 8-acre impoundment located in Washington Township. The lake is stocked annually with trout by NJDFW. A chemical spill and possible fish kill was reported to NJDFW law enforcement by Emergency Management on 08/30/18. Reportedly, Rustex-Sour, a laundry service cleaning agent, found its way into the creek adjacent to a nearby laundromat and into Grenloch Lake. Freshwater Fisheries, Law Enforcement, and County Emergency Management personnel responded. Fortunately, no dead or distressed fish were observed, nor any foreign odors or sheen detected. All water chemistry readings taken were suitable to support aquatic life and were typical of summertime conditions in southern New Jersey lakes. Numerous Bluegill and Largemouth Bass were observed swimming along the shoreline. Filamentous algae was also abundant within the lake. Additional investigation by Law Enforcement indicated that a local dry-cleaning establishment was power washing with the solvent. Rustex-Sour is a highly corrosive agent but water soluble. The water and solvent mixture made its way into the storm drain but would have been contained in the retention pond and would not have flowed into lake. DEP Water Compliance is following up with the issue to determine if a NOV is warranted. (Smith)

Grenloch Lake water chemistry.

Location	Temp. (°C)	DO (mg/l)	Specific Conductance	Conductivity	TDS	Salinity (ppt)	pH
Boat Ramp	30	3.79	274.3	300.7	178.1	0.13	7.52
Walking bridge	27.8	4.25	269.7	284.4	175.5	0.13	7.35
Dam	27	4.45	278.4	288	180.7	0.13	7.12

Hooks Creek Lake (Monmouth) – On November 7, a concerned angler reported that trout stocked on October 16th in Hook's Creek Lake within Cheesequake State Park were found dead. Upon investigation, it was determined that salinity levels were elevated, with several locations exceeding 3ppt and one location exceeded 9ppt. Species captured by dipnet at the time of investigation included Inland Silverside, Mummichog, Sheepshead Minnow, and Mosquitofish sp. This is reminiscent of when Superstorm Sandy greatly impacted this freshwater pond in 2012 by inundating it with saltwater, resulting in freshwater fish mortality. Salinity was monitored for several years until salinity returned to suitable levels and NJDFW restocked the pond in 2015. The extent of the fish kill and additional details are not known at this time. (Crouse)

Indian Lake (Bergen) – The NJDFW biologists responded to a fish kill at Indian Lake in Little Ferry on 10/15/18. Approximately 200 fish, a variety of species and sizes, were noted dead, and several panfish were reported gasping at the surface. Moribund fish, including Bluegill, Pumpkinseed, and Black Crappie, were collected and transported to the Pequest Fish Health Lab for necropsy. Parasitological examination revealed light infections with commonly found protozoan parasites. The cause of the fish kill is attributed to low dissolved oxygen (2.52 mg/L). This may have resulted from the mixing of bottom anoxic water with surface water, possibly as a result of lake turnover, which may occur in the spring and/or fall. Bacteriology and histology samples were obtained from six moribund fish and these results are pending. (Collenburg/Lovy)

Lake Lenape (Atlantic) – Lake Lenape is a 350-acre impoundment of the Great Egg Harbor River located in the town of Mays Landing. A boat ramp, maintained by Atlantic County Parks, provides angler access. The dam has a fish ladder to allow passage of anadromous river herring. Gizzard Shad kills have been reported at this location in the past, primarily during the winter months where extremely cold temperatures can cause winter kill. A fish kill was reported on 09/17/18 along Cove Beach on Park Avenue. Upon arrival no dead or actively dying fish were observed along Cove Beach or upstream at the Lighthouse Beach. No foreign odors or chemicals were observed. However, approximately 75-100, dead Gizzard Shad (4-6 in) were found on the bank from the park entrance along Old Harding Highway towards the dam (glass factory side). Fish were not fresh enough to be tested for pathogens. No visible signs of infection or disease was observed. Several of the dead Gizzard Shad were scavenged on. Only Gizzard Shad were affected during this kill, and no other species of fish were found.

Water chemistry was collected within the lake and readings would readily support aquatic life. However, pH readings were lower than typically expected. Recent heavy rains increase flows from low pH Pinelands headwaters which flushes a large amount of acidic water into the lake causing the pH to drop quickly. The drastic drop in pH is believed to have stressed the Gizzard Shad, a typically fragile species that cannot handle rapid changes in water chemistry or temperature. Atlantic County Parks personnel were notified of the fish kill. No further action is required at this time unless newly deceased fish are reported. (Boehm)

Lake Lenape water chemistry.

Location	Temp. (°C)	DO (mg/L)	Conductivity	TDS	Salinity (ppt)	pH
Cove Beach	21.9	4.53	78.0	53.95	0.04	5.64
Old Harding Hwy Bank	21.9	4.76	81.1	55.90	0.04	5.72

Lake Musconetcong (Sussex)- Reports of dead fish in Lake Musconetcong were investigated on 04/03/2018. A small number of dead sunfish were observed scattered in the shallow water areas inspected. No distressed or moribund fish were encountered, so none could be provided for pathological examination. Although the cause of death could not be determined, early spring fish kills in this shallow lake have been documented in the past, especially when it is drawn down over the winter. This past winter the lake was drawn down to facilitate dam repairs and this likely resulted in stressful conditions for fish (low dissolved oxygen, fish concentrated therefore more susceptible to disease). (Hamilton)

Lincoln Park Pond (Morris) - A fish kill affecting multiple species was reported on 09/12/2018. The kill comprised of Yellow Perch, Black Crappie, bullhead catfish, Common Carp, and Pickerel. It was estimated that over 1,000 fish were impacted, though an accurate estimate could not be obtained due to inadequate access to portions of the lake. All fish were decomposed, and it was estimated that the kill occurred about three days before investigation, thus fresh samples were not available for evaluation by necropsy. Considering all fish were in the same state of decomposition, it suggests that this was an acute fish kill. Water temperature was 21.2°C. Accurate dissolved oxygen (DO) and pH readings could not be obtained due to a faulty meter, though the DO was significantly lower relative to saturation. The case history suggests a DO crash and a period of anoxia that led to this mortality event. This may have been associated with previous warm weather, overcast skies, and possibly a dying algal bloom. (Lovy)

Morris Canal (Sussex) - Reports of dead fish and schools of live, but distressed fish, in the Morris Canal (adjacent to the Musconetcong River below Lake Musconetcong) were investigated on 04/03/2018. Numerous dead fish (primarily sunfish and perch, but also crappie, bass, and catfish) were observed in the canal and within the spillway. It was determined that numerous fish had been flushed from the lake into the canal during the winter when a gate was opened to divert water away from the dam and into the canal, so dam repairs could be competed "in the dry." Following repairs the gates were closed and little to no water flowed into this small section of canal (the normal situation for this canal section), where a large number fish had become trapped. Due to the high density of fish and lack of flow (fresh water) entering the canal the fish became stressed (low dissolved oxygen suspected) and began dying. The live fish in the canal were unable to re-enter the lake or exit to the river and it was apparent fish mortality would continue unless they could be captured and relocated. For more information on the fish salvage that took place on 04/04/18 and 04/13/18, see the following Fish Salvage section of this report on page 150. (Hamilton)

Musconetcong River (Sussex) - Dead fish (primarily Yellow Perch and sunfish) in the river immediately downstream of the Lake Musconetcong dam were reported by a local resident on 02/28/18. It was determined that the fish kill occurred when the flow out of the lake (which had been lowered to facilitate dam repairs) was significantly reduced to facilitate masonry repair work around the dam gates. This problem was quickly addressed by opening the dam gates wider to increase the flow to the pools immediately downstream where the dead fish were observed. More dead and distressed fish were reported the following day and it was determined that this was caused by construction workers cleaning raw cement (which is toxic to fish) off their equipment and tools by rinsing them directly in the river. The contractor was ordered to immediately discontinue this practice. Bureau staff conducted a fish salvage and no additional reports of dead fish were received. (Hamilton)

Overpeck Park Lake (Bergen) - Personnel responded to the report of dead fish at Overpeck Park Lake, in Teaneck. Only a few badly decomposed sunfish were observed. Warmwater fish were observed swimming in the shallows. Water Chemistry was taken and proved adequate. No further investigation is warranted. (Boriek)

Shabakunk Creek (Mercer) – Shabakunk Creek is a small tributary and part of the Assunpink Creek watershed located in Ewing Township. The creek flows into Colonial Lake, a NJDFW trout stocked water. A fish kill was reported in the creek, above the Spruce Street bridge on 02/13/18. A fish kill investigation was conducted the following day on 02/14/18. Upon arrival 20-30 dead fish, consisting of White Sucker, Creek Chub, Tessellated Darter, American Eel, Redbreast Sunfish, Green Sunfish, and a Rainbow Trout (~12 in) were found below the Spruce Street bridge. Water chemistry was taken at the bridge and all measurements readily supported aquatic life and does not appear to be a factor in the kill. A visual survey of the creek was conducted upstream to the next three bridge crossings at North Olden Avenue, Prospect Street, and Parkside Avenue, respectively. Dead fish were found scattered throughout the creek up until the Parkside Avenue bridge crossing. Water chemistry was recorded at North Olden Avenue and Parkside Avenue bridge crossings and is listed below, along with the Spruce Street bridge water chemistry data. Again, all measurements readily supported aquatic life. Approximately 100-125 fish, representing a variety of species, were found dead between the Spruce Street and Parkside Avenue bridges. No oil or chemical sheens were observed on the water and no foreign odors were detected. Except for two American Eels, the remaining fish were deceased for too long to be useful for necropsy (over 24 hours). The dead fish in the creek did not have any noticeable signs of infection or other clues to cause of death. The entire creek is heavily impacted and is in a highly urban environment. Various buildings, garages, car washes, restaurants, shopping centers, and parking lots directly border the creek on all sides. Several storm drains enter the creek and sediment piles were also present. The riparian zone is extremely limited and highly impacted. The cause of the fish kill appears to be the result of an unknown substance being washed into the creek after the recent heavy rains and high-water event. Toxic agents typically are not species selective and the numerous species effected in the fish kill lends support to this argument. (Boehm)

Shabakunk Creek water chemistry.

Location	Temp. (C)	DO (mg/L)	Conductivity	TDS	Salinity ppt	pH
Spruce St	5.6	11.52	475.3	490.10	0.37	8.15
N. Olden Ave.	6.3	11.73	460.4	465.40	0.36	8.11
Parkside Ave.	6.2	11.67	405.4	411.45	0.31	8.04

South Branch of the Raritan River (Ken Lockwood Gorge) - On 04/13/18, an angler reported catching a Rainbow Trout "covered in blisters" from the Ken Lockwood Gorge section of the South Branch of the Raritan River (see photo). The fish was obtained and delivered to the Division's Fish Pathologist, Dr. Lovy so that a necropsy could be performed. Boils were noted on the sides of the fish. The muscle of the fish was pale, though appeared to be in good condition. Internally, the spleen was slightly enlarged and there was little visceral fat around the pyloric ceca. Bacterial cultures were negative. Tissue samples were screened for viral diseases of concern; no viral agents were found. Screening of kidney for bacterial kidney disease was also negative. Histology was done on the internal organs and no signs of systemic disease were noted. The skin lesions were associated with dermatitis and did not extend into the musculature. It is possible that the skin lesions were related to a previous bacterial infection or a skin infection with a Flavobacterium spp. bacterium. No significant pathogens could be identified. (Crouse/Lovy)

Spruce Run Creek (Hunterdon) - Approximately 500 to 800 gallons of a product known as Endure Flush Portable Toilet and Holding Tank Deodorizer, the commonly used blue substance used in portable bathrooms, was accidentally discharged by Russel Reid Waste Management into Spruce Run Creek in Glen Gardner, Hunterdon County, on the evening of 04/25/18. At the time of inspection, around noon on 04/26/18, no noticeable color or odor was noted in Spruce Run Creek. No dead organisms were observed at this time. Measurable water quality parameters (specific conductance, total dissolved solids, pH, salinity, and dissolved oxygen) were not significantly different when comparing samples above and below the outfall pipe on Spruce Run Creek. Exposure to fish and other organisms likely occurred over a short duration of time. Chemical fact sheets indicate that "no ecological research has been carried out on this product," "components of this product are hazardous to aquatic life in high concentrations," and "product is considered biodegradable according to OECD standards." Above-average flows in Spruce Run Creek likely diluted the discharged liquid to a point in which there will be little or no impact to aquatic biota. There was no recommendation to suspend trout stocking or close the fishery. (Crouse)

Handful of discharged sediment scooped from Spruce Run Creek.

In a non-related pollution event during the summer of 2017, a section of Spruce Run Creek was severely impacted by a large quantity of rock fines and sediment released from a quarry in Glen Gardner. A layer of sediment choked a 1.7-mile section of this *Trout Production* Stream. For more detailed information, see the section titled, *Protection and Restoration of Inland Fisheries and Aquatic Habitats: Coldwater* in this report (page 56),

Sylvan Lake (Burlington) – A fish kill affecting hundreds of Gizzard Shad was reported on 04/23/18 in Sylvan Lake. The Bureau of Freshwater Fisheries staff responded to the kill, collected water chemistry, and obtained six moribund fish to submit to the Pequest Fish Health Laboratory. Water quality data included water temp 12.3°C, dissolved oxygen 13.3 mg/L, salinity 0.18ppt, and pH 7.87, were all within acceptable levels. Necropsy of the Gizzard Shad revealed hemorrhage on the skin and the base of the fins. Wet mount of the gills demonstrated severe lamellar fusion with large numbers of the ciliated parasite *Trichodina* and the flagellate *Ichthyobodo necator*, which would have resulted in severe gill impairment. Two bacterial species were cultured and identified from bacteriological cultures, including *Vibrio anguillarum* and a *Pseudomonas* spp. *Vibrio anguillarum* is a known fish pathogen most commonly associated with fish in the marine environment and *Pseudomonas* is a known opportunistic bacterium that can be related to stress in fish during the spring. The final results and cause for mortality were severe gill impairment associated with protozoan parasites (*Trichodina* and *Ichthyobodo*) combined with systemic bacterial infection with the above-mentioned bacteria. The spring is a stressful time of year for Gizzard Shad and mortality is frequently reported in this species in the early spring. It is most likely that the warming water temperatures and relatively poor condition of the fish made them vulnerable to bacterial and parasitic infection. (Sedor/Lovy)

Unnamed Impoundment on Lahaway Creek tributary (Monmouth) - Bureau of Freshwater Fisheries staff responded to a fish kill on 07/25/18 at pond on the Jenson's at Deep Run Retirement Community, located in Cream Ridge, Monmouth County. The property maintenance employees reported the kill the previous night on July 24. The small impoundment is located on a tributary of Lahaway Creek. Staff met Division Law Enforcement and property maintenance employees on site the next morning. An overwhelming smell of citrus was present at the site and the pond was uncharacteristically turbid. The turbidity was reported to have started two days prior following rainfall. Maintenance staff reported that the pond does not typically become turbid after rain. The dissolved oxygen, collected near the spillway, was extremely low at 0.31 mg/l. Approximately 200 fish of all species were observed, some of which had already been cleaned up and placed in a garbage can. Species affected include Largemouth Bass, Bluegill, Common Carp, Black Crappie, Golden Shiner, Bullhead, and Pirate Perch. An additional dissolved oxygen reading was also collected upstream of the lake at East Millstream Rd. This DO reading was significantly higher at 4.55 mg/l.

DEP Emergency Management was contacted. The water sample collected by the DEP Emergency Management tested positive for limonene, a derivative of citrus peels and is a component used in some herbicides. Three live Golden Shiners were collected by BFF staff and provide to DFW's Office of Fish and Wildlife Health and Forensics for analysis. The three golden shiners were necropsied at the Pequest Fish Health Laboratory. No external parasites were present. Histology showed marked degeneration of gill epithelial cells and degeneration of renal tubules in the kidney in all three fish. These changes may at least in part be related to postmortem changes since the organs were fixed about 24-28 hours post-death and these organs are prone to postmortem changes. Toxic exposure could also cause degeneration of gill epithelium and renal tubules, though this cannot be distinguished from postmortem changes in this case.

Based on the low dissolved oxygen levels detected in the lake, known to be at lethal levels, this kill was most likely a result of low DO. Low dissolved oxygen is acutely lethal to fish and this

ultimately was a large contributing factor to the fish kill. A possible contributor to the kill was the presence of limonene in the lake, which may be directly toxic to aquatic organisms or if used in conjunction with a pesticide would be lethal to aquatic plant-life, which may deplete the oxygen in the lake. Limonene is also directly toxic to aquatic organisms. The concentration of limonene in the lake affected by the fish kill was not measured, so direct toxicity to aquatic organisms is unknown in this case. Fortunately, Limonene is not expected to persist in the aquatic environment, since it is highly biodegradable and volatile. (Smith/Lovy)

Unnamed Private Pond in Cream Ridge (Monmouth) - Bureau of Freshwater Fisheries staff responded to a fish kill on 08/16/18 at a private residence in Cream Ridge, Upper Freehold Township. There were no dead fish observed however the home owners reported approximately 60 dead sunfish over a week timeframe. Water meal covered the entire surface of the pond. The dissolved oxygen was 0.5 mg/l in the pond and 6.91 mg/l at the inlet. It is possible that a substance may have entered the pond during a recent rainfall and caused the dissolved oxygen levels to drop. No further reports of dead fish were received. (Smith)

Verona Lake (Essex) - A fish kill was reported at Verona Lake on 07/23/2018 affecting only catfish. The Bureau of Law Enforcement responded and observed 20-25 dead catfish in the lake. Based on the level of decomposition, they had likely been dead for several days. Most fish were approximately 12-15 inches in length with 5 fish measuring up to 24 inches. One fish was transported to the Pequest Fish Health Lab for necropsy. Evaluation of the fish in the laboratory concluded that it was too decomposed for evaluation by necropsy/testing for infectious pathogens. (Lovy)

Fish Salvages

Permitted fish salvages are necessary under a variety of circumstances, such as substantial water lowering events related to projects such as the dredging of a lake or the repair of a dam. These salvages are typically conducted by trained private aquatic consultants and are conducted under controlled circumstances, during the more favorable conditions encountered in the fall and can be a relatively simple exercise. On the other hand, every year, as the result of a catastrophic dam failure or merely a minor leak, compounded with increased water temperatures and diminished oxygen levels during the summer, countless fish are threatened with demise. During emergency situations on state owned property such as Wildlife Management Areas or those managed by the Division of Parks and Forestry, the Bureau of Freshwater Fisheries may mobilize to conduct fish salvages to rescue fish and relocate them to suitable waters. (Hunter and Angler)

Columbia Lake (Warren) – In anticipation of the removal of the Columbia Lake Dam, an extensive fish salvage was conducted within Columbia Lake. For detailed information, see the section of this report that includes the Paulins Kill River Restoration Project (page 120). (Shramko)

Gifford's Mill Pond (Ocean) – Owners of Giffords Mill Pond have been mandated by the NJDEP Division of Dam Safety to lower the impoundment due to the deteriorated condition of the spillway structure. As the dam is partially owned by the Pinelands School District, the township and county, coordinating the lowering and fish salvage have proven problematic. The Bureau of Freshwater Fisheries was requested to assist with the fish salvage so that lowering the lake could

proceed as quickly as possible. A site inspection was performed by BFF staff on 10/26/18, to identify potential access location for the electrofishing boat. Boat access is imperative to perform an adequate fish salvage. Based on the inspection it was determined that it was not possible to get the boat into the pond. Wading the pond, after the water level has been dropped, to perform a salvage with nets and seines, was also ruled out due to site conditions. Based on water quality and habitat the pond, even during its lowered state, it was believed the remaining water was able to support the fish assemblage comprised mostly of native Pinelands fishes. No further action is warranted at this time. (Boehm/Smith)

Bureau staff using a seine to collect stranded fish within the Morris Canal.

Morris Canal (Sussex) – A fish kill was investigated on The Morris Canal on 04/03/2018, that ultimately led to a fish salvage. For more information of the fish kill investigation, see the previous Fish Kill Investigation section of this report (page 145). The salvage was conducted on a short section (315 ft. long, 40 ft. wide, 4-5 ft. deep) of the Morris Canal immediately below Lake Musconetcong on 04/04/18 and 04/13/18. On the first salvage day, four BFF staff, a WCC volunteer and two Parks and Forestry staff participated in the salvage. An estimated 5,000 fish were captured and returned to Lake Musconetcong. Most fish collected were sunfish (Bluegill and Pumpkinseed) and Yellow Perch, measuring 2 – 6 in. Black Crappie (6 – 10 in) were also abundant, and other species collected included White Perch, Largemouth Bass, Brown Bullhead, Chain Pickerel, and Golden Shiner. Due to poor visibility on the day of the salvage (rain, wind, and turbid water) the number of live fish that remained in the canal could not be determined. However, it was suspected that there were still too many fish in the canal and that another salvage was necessary to further reduce the density of fish to a level that the canal could support. Over the next week more dead fish were reported, and another salvage was conducted. The second salvage was utilized additional staff and a hatchery truck to transport the fish to be effective (rather than a live well on the back of a pick-up truck). Approximately 15,000 additional fish were captured from the canal and returned to the lake. Although the number of fish remaining in the canal could not be determined it is anticipated that the density of fish in the canal was sufficiently reduced to prevent further mortality.

Fish removed from the canal were loaded onto a hatchery truck and returned to the lake.

Collectively, almost 20,000 stranded fish were collected from the canal and returned to Lake Musconetcong. Later in the month residents and local officials complained about the stench from the decomposing fish that remained in/near the canal. On April 30, BFF staff with the assistance of Parks and Forestry staff used to nets to remove over 2,000 fish carcasses from the canal. (Hamilton)

SURFACE WATER CLASSIFICATION

Surface Water Classification Assessments

Trout are useful bioindicators of stream health, as excellent water quality and habitat are necessary for their survival and successful reproduction. In 1968, the Bureau of Freshwater Fisheries initiated the process of identifying and classifying New Jersey waters according to their suitability to support trout. Five years later, a classification system for New Jersey waters was developed. The Bureau's classification system, although already in use by various programs within the Department, was formally recognized in 1981 under the state's newly adopted *Surface Water Quality Standards* (SWQS).

Today, waters of the state are classified according to their suitability to support trout. Lakes are classified on their ability to support trout year-round, whereas streams are classified on the occurrence of natural reproduction and the presence or absence of trout and/or trout associated species (Hamilton and Barno 2006). Ultimately, the more suitable a waterway is to supporting trout the higher the classification and the more protection it will receive. The Department's Land Use Regulation Program, through Stream Encroachment, Freshwater Wetlands, and the more recently developed storm water rules acknowledge the fragile nature of these ecosystems and provide additional protective measures.

Although a vast amount of work has been accomplished in classifying New Jersey waters, more continue to be classified and reclassified according to their trout supporting capabilities, when justified by additional field investigation data collected by NJDFW. These data are interpreted and recommendations for surface water classification changes are provided to DEP's Bureau of Water Monitoring and Standards, Environmental Analysis Restoration and Standards, who ultimately integrate changes to the SWQS through an established rule making process. (Crouse, Federal Grant F-48-R)

Stream Assessments for Surface Water Classification

During the summer months, a 150-meter section of stream is electrofished (single-pass) using one or more backpack electrofishing unit or a generator positioned on land or in a barge, with 2-3 hand-held anodes (Appendix B). All fish are captured and enumerated by species (total length measurements taken on all game species). Physicochemical parameters measured include water temperature, dissolved oxygen, pH, alkalinity, conductivity, specific conductance, and stream width, depth, and substrate type. The EPA Rapid Bioassessment habitat assessment protocol is used to assess in-stream habitat and riparian conditions (Barbour et al. 1999) with regional modifications (Appendix C). (Crouse, Federal Grant F-48-R)

Double backpack electrofishing crew

A summary of 2018 data and interpretation as it applies to changes and/or confirmations of existing surface water classifications are summarized as follows:

- 6 stream segments were electrofished specifically for classification purposes: Bear Brook (Park Ridge), Clinton Brook (trib.)(Cedar Pond, E/Br.), Clinton Brook (trib.)(Cedar Pond, W/Br.), Pequest River (trib.)(Buttzville), Preakness Brook(Barbour Pond), and Raritan River, S/Br. (trib.)(N of 2nd Watchung Mtn., N/Br.).
- 55 additional electrofishing surveys provide data that can be used to identify potential upgrades, as well as confirm existing classification.
- 2 stream segments are being recommended for upgrades from *Trout Maintenance* to *Trout Production*: Pequest River (trib.)(Buttzville) and Wanaque River (trib.)(N. of Post Brook).
- Data from 3 stream segments were similar to previously recommended upgrades: Bear Brook (Park Ridge), Raritan River, S/Br. (trib.)(Drakestown), and Raritan River, S/Br. (trib.)(SW of Budd Lake).
- 5 stream segments with default classifications were confirmed, therefore could now be individually listed: Big Flat Brook (trib.)(Lake Ashroe), Flat Brook (trib.)(W of Lake Ashroe), Little Flat Brook (trib.)(Bevens), Raritan River, S/Br. (trib.)(N of 2nd Watchung Mtn., N/Br.), and Rancocas Creek, N/Br. (trib.)(W of Timbuctoo).
- Data from 33 stream segments confirmed existing classifications.
- Data from 10 surveys neither confirm an existing use (classification), nor warrant a change to the existing use (classification), as classifications are not downgraded unless proven the existing use cannot be re-established, therefore no action is required at this time (Tables 4)

Two streams are being recommended for upgrades for the first time (Table 2). An unnamed tributary to the Pequest River was not previously sampled and young-of-the-year (YOY) Brown Trout were found in 2018. It is currently classified as *Trout Maintenance* by default, however it is recommended to upgrade it to *Trout Production* with the name of Pequest River (trib.)(Buttzville). An unnamed tributary to the Wanaque River was not previously sampled and YOY Brook Trout were found in 2018. It is currently classified as *Trout Maintenance* by default, however it is recommended to upgrade it to *Trout Production* with the name of Wanaque River (trib.)(N. of Post Brook).

Surveys were conducted at three locations along stream segments that have been previously submitted for upgrades to existing Surface Water Quality Standards (Table 2). These sites include Bear Brook (Park Ridge) (currently [FW2-NT(C1)] by default because not previously surveyed), however data from 2017 and 2018 indicates it should be upgraded to FW2-TM(C1), with an Incidence of Occurrence values from 25.1 to 33.6. Finally, YOY Brook Trout were found in two unnamed tributaries to the Raritan River, S/Br. that currently have a default classification of [FW2-NT]. Both streams were previously recommended for upgrade to FW2-TP(C1) and were recommended to be named Raritan River, S/Br. (trib.)(Drakestown) and Raritan River, S/Br. (trib.)(SW of Budd Lake).

Five stream segments currently have default classifications that were confirmed, therefore they could now be individually listed in the Surface Water Quality Standards. These streams are Big Flat Brook (trib.)(Lake Ashroe), Flat Brook (trib.)(W of Lake Ashroe), Little Flat Brook (trib.)(Bevens), Raritan River S/Br (trib.)(N of 2nd Watchung Mtn. N/Br), and Rancocas Creek, N/Br. (trib.)(W of Timbuctoo). Data for these stream segments are in Table 2.

In addition to recommending changes to existing surface water classifications, since 2006 NJDFW has reported surveys in which data confirm existing surface water classifications. The 2018 data confirmed the classifications of 33 stream segments and no action is required (Table 3). At times, electrofishing surveys yield data that neither confirm an existing use (classification), nor warrant a change to the existing use (classification), as classifications are not downgraded unless proven the existing use cannot be re-established. This was true for 10 stream segments in 2018, therefore no action is required at this time (Tables 4). (Crouse, Federal Grant F-48-R)

Table 2. Summary of recommended surface water classification changes supported by 18 surveys conducted in 2018 by NJDFW. Reproducing trout species determined by the presence of young-of-the-year trout. A current surface water classification enclosed by brackets indicates a default surface water classification (i.e. the waterbody is not specifically listed in NJ's Surface Water Quality Standards, N.J.A.C. 7:9B). I.O. = Incidence of Occurrence; NA = Not Applicable (due to presence of trout reproduction).

Waterbody	Waterbody section	Midpoint of survey		Current surface water classification	Recommended surface water classification	I.O. value	Reproducing trout species	Survey date	Page
		Lat. (N)	Long. (W)						
Upper Delaware North & Wallkill Region (Shimmers Brook to Paulins Kill and Wallkill River watersheds)									
* Big Flat Brook (trib.) (Lake Ashroe) [c]	Entire length, including all tributaries	41º11'56.6"	74º48'54.8"	[FW2-TP(C1)]	FW2-TP(C1)	NA	Brook	7/19/18	A2
* Big Flat Brook (trib.) (W. of Lake Ashroe)	Entire length, including all tributaries	41º11'31.0"	74º50'6.5"	[FW2-TP(C1)]	FW2-TP(C1) [a]	NA	Brook	7/19/18	A3
* Little Flat Brook (trib.) (Bevans)	Entire length, including all tributaries	41º11'33.5"	74º50'59.9"	[FW2-TP(C1)]	FW2-TP(C1)	NA	Brook & Brown [b]	7/10/18	A5
*Trout Brook (Middleville) (trib.)(Five Points)	Entire length, including all tributaries	41º4'38.7"	74º52'46.9"	[FW2-TP(C1)]	FW1-NT(C1)	13.4	none	9/14/18	A11
*Trout Brook (Middleville)(trib.) (Trout Brook WMA)	Entire length, including all tributaries	41º4'37.8"	74º52'53.2"	[FW2-TP(C1)]	FW1-NT(C1)	14.9	none	9/14/18	A12
Upper Delaware (South) Region (Delawanna Creek to Lockatong Creek watersheds)									
*Pequest River (trib.) (Buttzville)	Entire length, including all tributaries	40º49'16.0"	74º00'53.2"	[FW2-TM]	FW2-TP(C1)	NA	Brown	7/5/18	A27
Upper Passaic Region (Pompton, Pequannock, Wanaque, Ramapo, Upper Passaic, Whippany, & Rockaway River watersheds)									
* Bear Swamp Brook (trib.)(Spruce Swamp)	Entire length including all tributaries	41º6'4.9"	74º13'5.3"	[FW2-TP(C1)]	FW2-NT(C1)	0	none	8/2/18	A38
* Clinton Brook (trib.) (Cedar Pond E. Branch)	Entire length, including all tributaries	41º5'36.1"	74º26'12.6"	[FW2-TP]	FW2-NT	16.9	none	8/28/18	A40
* Clinton Brook (trib.) (Cedar Pond W. Branch)	Entire length, including all tributaries	41º5'42.3"	74º26'14.4"	[FW2-TP]	FW2-NT	17.1	none	7/3/18	A41
* Harmony Brook (Brookside)	Entire length, including all tributaries	40º48'31.5"	74º35'16.4"	[FW2-TP(C1)]	FW2-NT(C1)	20.5	none	7/31/18	A43
* Harmony Brook (trib.) (SW of Clyde Potts Reservoir.)	Entire length, including all tributaries	40º48'19.6"	74º35'23.0"	[FW2-TP(C1)]	FW2-NT(C1)	20.5	none	7/31/18	A44

Table 2. (continued)

Upper Passaic Region (Pompton, Pequannock, Wanaque, Ramapo, Upper Passaic, Whippany, & Rockaway River watersheds) (continued)									
* Wanaque Reservoir (trib.) (N. of Post Brook)	Entire length, including all tributaries	41º3'16.0"	74º19'12.8"	[FW2-TM(C1)]	[FW2-TP(C1)]	NA	Brook	8/6/18	A45
* Wanaque Reservoir (trib.)(S. of Blue Mine Brook)	Entire length	41º3'25.1"	74º19'4.2"	[FW2-TM(C1)]	[FW2-NT(C1)]	0	none	8/6/18	A46
Lower Passaic & Upper Atlantic Region (Lower Passaic, Saddle, Hackensack, Pascack & Elizabeth to Toms River watersheds)									
*Bear Brook (Park Ridge)	Spring Valley Road to Woodcliff Lake, including all tributaries	41º01'59.5"	74º03'39.2"	[FW2-NT(C1)]	FW2-TM(C1) [a]	25.1	none	8/3/18	A50
Raritan Region (Raritan River watershed)									
*Raritan River, N/Br. (trib.)(N of 2nd Watchung Mtn., N/Br.)	Entire length, including all tributaries	40º40'26.6"	74º37'46.9"	[FW2-NT]	FW2-NT	19.2	none	7/11/18	A73
*Raritan River, S/Br. (trib.) (Drakestown)	Entire length, including all tributaries	40º51'9.5"	74º46'01.4"	[FW2-NT]	FW2-TP(C1) [a]	NA	Brook	7/27/18	A76
*Raritan River, S/Br. (Trib.) (SW of Budd Lake)	Entire length, including all tributaries	40º51'25.0"	74º46'0.1"	[FW2-NT]	FW2-TP(C1) [a]	NA	Brook	7/27/18	A78
Lower Delaware Region (Assunpink Creek to Maurice River watersheds)									
*Rancocas Creek, N/Br. (trib.)(W. of Timbuctoo) [c]	Entire length, including all tributaries	40º0'14.6"	74º49'42.1"	[FW2-NT]	FW2-NT	5.7	none	7/30/19	A91

[a] Potential change also supported by data collected previously
[b] Young-of-the-year trout not present, however trout from older year classes present.
* Indicates unnamed tributary as recognized by SWQS. Name given is recommended by NJDFW.

Table 3. Electrofishing surveys conducted in 2018 by NJ Division of Fish and Wildlife that *confirm existing surface water classifications* as indicted in New Jersey's Surface Water Quality Standards, N.J.A.C. 7:9B. No action is required. Reproducing trout species is determined by the presence of young-of-the-year trout. Data are found in report titled "2017 Investigation and Management of NJ's Freshwater Fisheries Resources."

Waterbody	Waterbody section	Midpoint of survey		Current surface water classification confirmed	I.O. value	Reproducing Trout Species	Date	Page
		Lat. (N)	Long. (W)					
Upper Delaware North & Wallkill Region (Shimmers Brook to Paulins Kill and Wallkill River watersheds)								
Beerskill Creek (Shaytown)	Boundary of High Point State Park to confluence with Little Flat Brook	41º15'34.9"	74º47'34.6"	FW2-TP(C1)	NA	Brook	8/29/18	A1
Forked Brook (Stokes State Forest)	Entire length	41º14'20.9"	74º44'42.3"	FW2-TP(C1)	NA	Brook	8/6/18	A4
Trout Brook (Middleville)	Source to confluence with Pond Brook	41º3'24.5"	74º51'41.4"	FW2-TP(C1)	NA	Brown	7/13/18	A10
Yards Creek (Blairstown)	Entire length	40º58'26.9"	75º2'38.4"	FW2-TP(C1)	NA	Brown	7/20/18	A13
Upper Delaware (South) Region (Delawanna Creek to Lockatong Creek watersheds)								
Delaware River (trib.) (Holland)	Entire length	40º34'29.7"	75º9'28.4"	FW2-TP(C1)	NA	Brown	7/12/18	A16
Lommasons Glen Brook (Lommasons Glen)	Entire length	40º47'23.5"	75º4'46.1"	FW2-TP(C1)	NA	Brook & Brown [a]	7/17/18	A19
Mill Brook (Broadway)	Entire length	40º44'19.7"	75º3'41.5"	FW2-TP(C1)	NA	Brook & Brown	8/7/18	A20
Musconetcong River (trib.)(Anderson)	Entire length	40º45'34.3"	74º55'14.7"	FW2-TP(C1)	NA	Brook	8/8/18	A21
Musconetcong River (trib.)(Anderson)	Entire length	40º45'34.3"	74º55'14.7"	FW2-TP(C1)	NA	Brook [a]	8/8/18	A21
Musconetcong River (trib.)(Lebanon)	Entire length	40º48'24.7"	74º53'37.2"	FW2-TP(C1)	NA	Brook	7/13/18	A23
Musconetcong River (trib.)(Port Murray)	Entire length	40º48'25.0"	74º53'37.0"	FW2-TP(C1)	NA	Brook	7/13/18	A24
Musconetcong River (trib.)(S. of Pt. Mtn.)	Entire length	40º45'37.1"	74º54'48.4"	FW2-TP(C1)	NA	Brook	8/16/18	A25
Musconetcong River (trib.)(S. of Schooleys Mtn. Brook)	Entire length	40º49'10.6"	74º49'56.4"	FW2-TP(C1)	NA	Brook	7/18/18	A26
Pohatcong Creek (trib.)(New Village)	Entire length	40º43'26.2"	75º5'8.3"	FW2-TP(C1)	NA	Brook & Brown	8/7/18	A28

Table 3. (continued)

Upper Delaware (South) Region (Delawanna Creek to Lockatong Creek watersheds) (continued)								
Schooleys Mtn. Brook (Schooleys Mtn.)	Entire length	40º48'55.4"	74º49'11.1"	FW2-TP(C1)	NA	Brook	8/27/18	A29
Stephensburg Brook (Stephensburg)	Entire length	40º47'34.7"	74º52'16.6"	FW2-TP(C1)	NA	Brook & Brown	7/31/18	A30
Tunnel Brook (Oxford Mtn.)	Entire length, including all tributaries	40º47'37.8"	74º58'37.3"	FW2-TP(C1)	NA	Brook [a] & Brown [a]	7/5/17	A32
Upper Passaic Region (Pompton, Pequannock, Wanaque, Ramapo, Upper Passaic, Whippany, & Rockaway River watersheds)								
Bear Swamp Brook (Mahwah)	Entire length	41º4'33.9"	74º13'9.5"	FW2-TP(C1)	NA	Brook	8/2/18	A37
Beech Brook (West Milford)	Entire length	41º8'50.3"	74º17'54.4"	FW2-TP(C1)	NA	Brook	8/10/18	A39
Green Brook (West Milford)	Entire length, except those segments described below	41º9'29.0"	74º22'12.6"	FW1-TP	NA	Brook	8/30/18	A42
Whippany River (Brookside)	Source to Whitehead Rd. bridge	40º47'31.3"	74º34'30.9"	FW2-TP(C1)	NA	Rainbow	7/27/18	A48
Lower Passaic & Upper Atlantic Region (Lower Passaic, Saddle, Hackensack, Pascack, & Elizabeth to Toms River watersheds)								
Preakness (Singac) Brook (Barbour Pond)	Pond to Passaic River	40º57'19.4"	74º13'24.3"	FW2-NT	17.0	none	8/2/18	A51
Raritan Region (Raritan River watershed)								
Hacklebarney Brook (Hacklebarney)	Entire length	40º46'2.9"	74º42'56.3"	FW2-TP(C1)	NA	Brook	8/6/18	A58
Hickory Run (Califon)	Entire length	40º42'55.8"	74º51'45.5"	FW2-TP(C1)	NA	Brook	7/12/18	A59
Raritan River, S/Br. (trib.)(Long Valley)	Entire length	40º47'18.3"	74º46'49.4"	FW2-TP(C1)	NA	Brook & Brown	7/11/18	A77
Rocky Run (Lebanon)	Entire length	40º41'41.0"	74º54'36.9"	FW2-TP(C1)	NA	Brook	7/13/18	A81
Spruce Run (Glen Gardner)	Source to, but not including, Spruce Run Reservoir	40º43'58.1"	74º53'47.7"	FW2-TP(C1)	NA	Brown	7/3/18	A83
Spruce Run (Glen Gardner)	Source to, but not including, Spruce Run Reservoir	40º41'26.1"	74º56'9.3"	FW2-TP(C1)	NA	Brown & Rainbow [b]	8/9/18	A84
Spruce Run (Glen Gardner)	Source to, but not including, Spruce Run Reservoir	40º40'53.0"	74º55'25.8"	FW2-TP(C1)	NA	Brook, Brown & Rainbow [b]	8/9/18	A85
Stony Brook (Washington)	Entire length	40º47'49.6"	74º45'17.3"	FW2-TP(C1)	NA	Brook & Brown	7/31/18	A86
Trout Brook (Hacklebarney)	Entire length	40º45'05.0"	74º43'52.5"	FW2-TP(C1)	NA	Brook	7/20/18	A88

Table 3. (continued)

Raritan Region (Raritan River watershed) (continued)								
Turkey Brook (Mt. Olive)	Entire length	40º50'18.7"	74º44'29.7"	FW2-TP(C1)	NA	Brook, Brown & Tiger	7/20/18	A89
Willhoughby Brook (Buffalo Hollow)	Entire length	40º40'18.5"	74º54'49.5"	FW2-TP(C1)	NA	Brook & Brown	7/13/18	A90

[a] Young-of-the-year trout not present, however trout from older year classes present.
[b] Stocked trout

Table 4. Electrofishing surveys conducted in 2018 by NJ Division of Fish and Wildlife that *neither confirm an existing use (classification), nor warrant a change to the existing use*, as classifications are not downgraded unless proven the existing use cannot be re-established. Reproducing trout species is determined by the presence of young-of-the-year trout. Data are found in report titled "2017 Investigation and Management of NJ's Freshwater Fisheries Resources."

Waterbody	Waterbody section	Midpoint of survey		Current surface water classification	I.O. value	Reproducing Trout Species	Date	Page
		Lat. (N)	Long. (W)					
Upper Delaware (North) & Wallkill Region (Shimmers Brook to Paulins Kill and Wallkill River watersheds)								
Parker Brook (Montague)	Entire length	41º14'37.2"	74º43'58.3"	FW2-TP(C1)	26.3	Brook [a]	7/10/18	A6
Paulina Creek (Paulina)	Entire length	40º58'38.4"	74º56'55.3"	FW2-TM	16.1	none	7/20/18	A7
*Paulins Kill (trib.) (Yellow Frame)	Entire length, including all tributaries	41º00'27.1"	74º52'24.4"	[FW2-TM]	15.8	none	8/10/18	A8
Sparta Glen Brook (Sparta)	Entire length	41º2'18.6"	74º36'56.3"	FW2-TP(C1)	29.1	none	8/28/18	A9
Upper Delaware (South) Region (Delawanna Creek to Lockatong Creek watersheds)								
Turkey Hill Brook (Bethlehem)	Entire length	40º39'10.4"	75º2'55.4"	FW2-TP(C1)	23.1	none	9/7/18	A33
Turkey Hill Brook (Bethlehem)	Entire length	40º39'41.7"	75º2'32.1"	FW2-TP(C1)	25.6	none	9/7/18	A34
Warford Creek (Barbertown)	Entire length	40º28'10.2"	75º3'39.6"	FW2-TP(C1)	21.3	none	7/12/18	A35
Upper Passaic Region (Pompton, Pequannock, Wanaque, Ramapo, Upper Passaic, Whippany, & Rockaway River watersheds)								
Whipany River (trib.) (Brookside)	Entire length	40º49'6.2"	74º34'0.2"	FW2-TP(C1)	31.4	none	7/27/18	A49
Raritan Region (Raritan River watershed)								
Black Brook (Polktown)	Entire length	40º39'39.0"	74º56'54.6"	FW2-TP(C1)	27.8	Brown [a]	7/12/18	A54
Spruce Run (Glen Gardner)	Source to, but not including, Spruce Run Reservoir	40º45'59.1"	74º51'16.4"	FW2-TP(C1)	16.5	none	7/3/18	A82

[a] Young-of-the-year trout not present, however trout from older year classes present.

* Indicates unnamed tributary as recognized by SWQS. Name given is recommended by NJDFW.

Lake Assessments for Surface Water Classification

As part of the continued assessment of New Jersey waters dissolved oxygen and temperature profiles are performed to determine a lake's ability to support trout throughout the harsh summer months. During the summer, most New Jersey lakes deeper than 3 m (10 ft) thermally stratify. The epilimnion (surface waters) become too warm to support coldwater fishes (trout), and the metalimnion and hypolimnion (middle and bottom waters), while often cold enough for trout, often have dissolved oxygen levels too low to support trout (and other fish species). Only deep lakes (generally at least 15 m (50 ft) deep), that are not overly eutrophic, maintain sufficient levels of dissolved oxygen in some portion of the strata below the epilimnion during the summer and early fall. A water temperature and dissolved oxygen profile is conducted in the deepest part of a lake using a YSI meter with cable marked in one-foot increments. Measurements are generally taken at 5 to 10-ft intervals, but more frequently (1-ft increments) when marked changes are observed (typically in the metalimnion). A secchi disk (also marked in one-foot increments) is used to measure water transparency. The criteria used to determine trout-supporting water is water temperature $\leq$ 21ºC (69.8ºF) and dissolved oxygen $\geq$ 4 mg/L (Appendix B). If criteria are met, Lakes and reservoirs are classified as *Trout Maintenance* and they are classified as *Non-Trout* if they are not met. The presence and amount of trout supporting water can vary from year to year, depending on air temperature and rainfall. Shallow lakes, particularly those less than 50 feet deep, often have little or no trout supporting water during the summer due to anoxic conditions in their colder bottom waters and warm surface waters. (Crouse, Federal Grant F-48-R)

No water temperature and dissolved oxygen profiles were conducted during the summer months for classification purposes in the Surface Water Quality Standards in 2018.

ANGLER USE ASSESSMENT

Opening Day Trout Angler Survey

NJDFW's trout stocking programs provide Garden State anglers with many opportunities to fish for trout throughout the year. Under the Division's spring stocking program, nearly 200 streams, ponds, and lakes throughout the state are stocked with 570,000 trout annually. The opening day of the trout season each April is greatly anticipated by anglers, who flock to these waters to fish for trout on this eventful day. To assess angler turnout and success on this important recreational day, angler counts, and interviews are conducted on various trout-stocked waters. Information on angler participation and satisfaction is used to assess trout stocking and to make program changes.

Richard Pharo with Rainbow Trout caught at Echo Lake Monmouth Co. on opening day 2018. Photo Credit: Pat Walker

Since 2004 the NJDFW's Wildlife Conservation Corps (WCC) volunteers have provided a valuable service by assisting with the collection of angler data on *Opening Day*. Each volunteer is assigned a trout-stocked water and provided with written instructions on how to conduct the survey, data forms, and information about their assigned waterbody. Volunteers are also asked to submit digital pictures of anglers fishing, and holding up their catch for display, as well as a panoramic view that would be indicative of the angler turnout. A Division presence is beneficial. For many anglers, this is often their first contact with a NJDFW representative. Anglers are generally willing to provide information about their fishing experience, and many are pleased to see Fish and Wildlife taking an active role in managing the waterbody they are fishing. The WCC volunteers that participate also have positive experiences, with several commenting that this was their first opportunity to assist and they had fun doing it. In 2013 NJDFW began funding this survey under the Sport Fish Restoration Program. (Shramko, Federal Grant F-48-R)

Results of the 2018 Opening Day Angler Survey

The Opening Day of the 2018 trout season was Saturday, April 7th. The weather was cold with mostly cloudy skies and somewhat windy conditions, with highs in the upper 30's to low 40's throughout the state. There was even a bit of snow showers in Warren, Hunterdon, and Morris Counties. Anglers faced difficult fishing conditions, as high flows and off colored water on the streams and rivers along with the usual colder water temperatures made fish lethargic. Anglers fishing lakes and ponds were also facing difficult conditions as temperatures leading up to opening day kept the water colder than average. Of the 38 surveys conducted, 32 were on lakes and ponds. 768 anglers were observed fishing (an average of ~24 anglers per waterbody) on the lakes and ponds. This number is down from last year's opening day, when 1,810 anglers were observed on 30 lakes and ponds surveyed (an average of ~60 anglers per waterbody). It is important to note the relatively low number of anglers was partially because Spring Lake (Monmouth) was not surveyed this year. Spring Lake has a very popular kids fishing derby on opening day annually. Last year about 666 anglers, many of them children, were fishing Spring Lake. Even removing Spring Lake, this year's total angler count was still down from last year,

likely due to the very poor weather conditions leading up to opening day, along with the cold forecast for opening day itself.

With that being said, many anglers who did very well for themselves. 2018 had the best fish per angler ratio ever recorded by the Division (11 years of data). 0.91 fish per angler were caught in 2018, much higher than 0.73 fish per angler in 2008. Those who braved the winter-like conditions were rewarded with excellent fishing.

Table 1: Yearly comparison of angler success rate

		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	AVERAGE
Total	Anglers	853	1095	1462	1675	1918	1830	2100	664	1810	828	**1424**
	# Trout	485	551	669	1107	1354	996	960	380	402	757	**766**
	Trout/Angler	0.57	0.50	0.46	0.66	0.71	0.54	0.46	0.57	0.22	0.91	**0.54**

Trout-stocked Lakes and Ponds Results

In some locations, trout fishing was fantastic. Several anglers expressed what a wonderful day of fishing they had and thanked the NJDFW for their efforts in making the 2018 opening day a huge success. Warinanco Park Pond (Union), Oak Pond (Camden), Roosevelt Park Pond (Middlesex), and Birch Grove Park Ponds (Atlantic), to name a few, were by far the places to be on opening day as anglers had the highest catch rates per angler at 3.15, 1.84, 1.83, and 1.82 fish per angler respectively.

Angler Craig Rothman proudly holds this 22 ¼ inch Rainbow Trout that he caught from Hook's Creek Lake. Photo Credit: John Miraglia

Oak Pond had the largest showing of anglers with 96 individuals fishing, but the place to be was the Pohatcong Creek in Warren County, as 81 trout were caught by 10 anglers (8.10 fish per angler). Not bad for the first 4 hours of the season.

Unfortunately, trout were not as cooperative in all stocked lakes and ponds across the state. The higher than usual, murky, and low water temperatures appeared to keep the fish from biting, frustrating anglers and sending them home early in multiple locations. Many clerks reported the number of anglers at a waterbody was highest at 8 a.m. or sometimes 9 a.m., but dropped heavily by 10 a.m. and throughout the rest of the day.

19 different lakes and ponds produced < 5 total fish during the 4-hour survey period. Of those 19 waterbodies, 12 of them had more than 10 anglers fishing, while 7 had less than 10 anglers.

Some waterbodies have consistently poor opening day catch rates. The following waterbodies in Table 2 will continue to be monitored, but if their success does not improve, dropping them from the trout stocking program may be considered.

A complete list of the 2018 Opening Day angler success on the lakes and ponds can be found in the appendix of this report along with information on angler success.

Table 2: Waterbodies with consistent poor angler success.

County	Waterbody	Acres		2010	2011	2012	2013	2014	2015	2016	2017	2018	AVERAGE
Mercer	Colonial Lake	10	**Anglers**	58			50	22	28	50	26	13	**35**
			# Trout	4			8	0	2	0	0	0	**2**
			Trout/Angler	0.07			0.16	0	0.07	0	0	0	**0.06**
Atlantic	Heritage Park Pond	6	**Anglers**					14	25	7	21	11	**16**
			# Trout					1	3	0	2	3	**2**
			Trout/Angler					0.07	0.12	0	0.1	0.27	**0.12**

Trout-stocked Streams and Rivers

Typically, the Opening Day Trout Angler Survey may only have a few streams or rivers as part of the survey because angler counts and success on streams and rivers is difficult to assess. The distance that must be covered and the movement in and out of fishing spots by anglers makes it difficult to get accurate quantitative data from the survey.

A father helping his son at Warinanco Park Pond on opening day of the 2018 trout season. Photo Credit: Bryan Delance

Angler surveys and counts were conducted on 6 streams or small sections of streams in 2018. A total of 60 anglers were surveyed. The rivers had high flows and the water was off-colored making it somewhat difficult for anglers to target and catch trout. Despite the difficult conditions, a few anglers found some success at the Lopatcong Creek, Pohatcong Creek, and the Musconetcong River (just below the Trout Conservation Area) with catch rates of 3.66 fish, 8.10, and 2.50 fish per angler respectively. In fact, the rivers and streams seemed to outperform the lakes and ponds as 66% of the waterbodies surveyed showed angler success above the 2018 record of 0.91 fish per angler compared to only 23% of the lakes and ponds surveyed.

In summary, opening day on the streams and rivers was quite successful and anglers who chose to fish them were rewarded with lots of action. Reports and detailed results noted by volunteer survey clerks for each waterbody surveyed can be found in Appendix F of this report. (Federal F-48-R, Shramko)

Acknowledgements

NJDFW's Bureau of Freshwater Fisheries staff would like to thank the volunteers, Conservation Officers and other DEP staff who make this project possible every year. Together with NJDFW staff, angler counts were conducted on 38 waterbodies across the state. A special note of thanks is also extended to Fisheries Technician Chuck Sedor for coordinating the volunteer efforts.

Trout Angler Logbook Program

NJDFW utilizes a logbook (diary) program to obtain current information regarding trout angler catch and effort on special regulation areas. Initially launched as a pilot program in 2012 on three special regulation trout fishing areas, the program was expanded in 2013 to include all seven areas. Logbooks are distributed annually to experienced anglers who indicate they regularly fish one or more of the areas in the study. Anglers record information about fish harvested or released during each trip, as well as time spent fishing and gear used. At the end of the calendar year, anglers return their logbooks to NJDFW and the data is then compiled and analyzed during the following calendar year. Compared to other survey methods, angler logbooks are one of the least expensive ways to collect information on a fishery. Data collected through angler logbooks supplement other data collected by NJDFW (such as Opening Day angler surveys, telephone and internet-based surveys, on-site angler creel surveys, fish population surveys using electrofishing gear, and water temperature monitoring). Collectively, this data aids in evaluating the fishery and guides managers and stakeholders in making informed decisions that benefit both the resource users and the resource. (Sedor, Federal Grant F-48-R)

In 2017 seven special regulation areas and one wild trout section were included in the logbook program and the logbooks results were compiled (see table below). A total of 88 anglers were issued logbooks for the program, receiving a total of 97 logbooks (some anglers needed more than one logbook to record all their trips). Despite efforts to encourage logbook returns, only 13 anglers (15%) returned their logbooks, down from a 16% return rate in 2016. Collectively the 13 logbook anglers logged 174 trips to 5 of the 7 special regulation trout fishing areas and spent a total of 671.8 hours fishing these areas. The Point Mountain *YTCA* on the Musconetcong River was the most commonly visited site with 60 trips (34%), followed by the Big Flat Brook / Flat Brook *Catch and Release Area* (48 trips, 26%), and the Pequest River *STCA* (38 trips, 22%). The remaining 28 trips (16% of total) were split evenly between the Ken Lockwood Gorge *Catch and Release Area* and the Pequannock River (combined STCA and Wild Trout Section) with 14 trips each. No fishing trips were recorded for the Toms River *YTCA* or the Claremont *YTCA*. Anglers fished an average of 3.6 hours per trip; the highest average trip lengths were at Point Mountain *YTCA* (5.3 hr/trip) and Ken Lockwood Gorge *Catch and Release Area* (4.0hrs/trip). The logbook data includes trips that were taken to the *STCA*'s at times when the special regulations were not in effect, as logbook data is collected year-round. Fly fishing gear was used by anglers for most trips; only 9 trips (5%) by two anglers reported using spinning gear

Logbook anglers recorded a total catch of 1,180 trout. Catch and release fishing was practiced by all participants in the study; no fish were recorded as kept (or unrecorded). Angler catch rate averaged 1.5 trout/hr, up from 1.2 in last year's survey. Catch per hour ranged (by special regulation area) from 0.3 – 1.9 trout/hour. The average number of trout caught per trip was 5.6, and by special regulation area ranged from 0.9 – 10.2 trout/trip. These catch rates are slightly up from last year and seem to reflect average catch rates across all six years of the program. The highest catch rates (per hour and per trip) occurred in the Musconetcong River *Point Mountain YTCA* (1.9/hr, 10.3/trip). The lowest catch rate was on the Pequannock River (0.3 trout/hr and 0.9 trout/trip). Most trip reports were close to the average, though fifteen trips were recorded with 20+ fish caught, with the highest being 68 fish in one trip to the Musconetcong River.

Of the total trout caught, anglers recorded the species for all but one fish. Overall Rainbow Trout were caught most frequently (99%), followed by Brook Trout and Brown Trout. In previous years, anglers have reported catching hybrid Tiger Trout in both the Ken Lockwood Gorge and Claremont sections, though none were reported in 2017.

Anglers were also asked to note if the trout they caught was wild, stocked, or unknown. This assessment can be very subjective and difficult since a decision is based primarily upon fin wear and fish coloration. Anglers reported catching 16 (1%) wild trout and 1,084 (92%) stocked trout. Only 80 (7%) trout were recorded as species origin unknown, indicating that most anglers were confident in their ability to distinguish wild from stocked fish. This may be in part due to the state's exclusive stocking of Rainbow trout; anglers can feel confident that any Brook or Brown trout they catch is likely to be wild in origin, and wild Rainbow trout are relatively uncommon in New Jersey.

The average size of trout caught (results not provided in the table) was 287 mm/11.3 in and they ranged in size from 127 mm/5 in (two Brown Trout, Pequannock Wild and Point Mountain) to 635 mm/25 in (Rainbow Trout, Pequest River *STCA*). 51% (606) of trout recorded fell within the 9 to 11-inch range, stocked by Pequest Trout Hatchery. 77% (911) were between 8 and 12 inches, a range which allows for some variation in length estimates (anglers are asked only to estimate trout length, not required to carry a measuring device) and slight differences in stocking length.

Summary of fishing trip and catch statistics for 19 logbooks returned by 13 anglers who participated in the 2017 Trout Angler Logbook Program which targeted 7 special regulation trout fishing areas, as well as the Wild Trout section of the Pequannock River

Total number of trips	Hours Per Trip	Number of trout caught by species[1]				Total trout caught	Number of trout caught by origin			% wild caught	Number of trout caught per	
		BKT	BNT	RBT	UNK*		Wild	Stocked	UNK*[1]		Hour	Trip
Big Flat Brook / Flat Brook (Catch & Release Area)												
48	2.9	2	0	227	1	230	2	191	37	0.9	1.6	4.8
Musconetcong River – Point Mtn. (Year-Round Trout Conservation Area)												
60	5.3	0	1	617	0	618	3	614	1	0.5	1.9	10.3
S/Br. Raritan River – Ken Lockwood Gorge (Catch & Release Area)												
14	4.0	0	5	77	0	82	2	80	0	2.5	1.5	5.8
Pequest River (Seasonal Trout Conservation Area)												
38	3.2	0	0	237	0	237	0	197	40	0	1.9	6.2
S/Br. Raritan River – Claremont Stretch (Year-Round Trout Conservation Area)												
-	-	-	-	-	-	-	-	-	-	-	-	-
Pequannock River (Seasonal Trout Conservation Area and Wild Trout Section)												
14	2.7	2	8	3	0	13	9	2	2	69.2	0.3	0.9
Toms River (Year-Round Trout Conservation Area)												
-	-	-	-	-	-	-	-	-	-	-	-	-

1 BKT = Brook Trout; BNT = Brown Trout; RBT = Rainbow Trout; UNK = unknown (trout species or origin).
* = Entries where species or origin were not marked have been included in unknown.

INFORMATION AND EDUCATION

In addition to a multitude of research and management activities, the Bureau of Freshwater Fisheries actively participates in a number of Information and Education activities each year. Several are directly tied to research and management activities and promulgation of regulations, such as two annual Fisheries Forums, a Public Trout Meeting, and biennial Public Hearing, governing the state's freshwater aquatic resources. In addition, Bureau staff actively participates in the preparation of the Freshwater Fishing Digest. For the 2018 edition, there are two feature articles, one highlights angling opportunities at five popular fisheries around the state. The other feature article provides an update on six ongoing management projects. The remaining article is the third in the "Fishing Tips from the Experts" series. The article provides angling tips for targeting bass from a kayak written by Layne Ell, President of the South Jersey Kayak Bass Fishing Club. The Freshwater issue of the Digest is perhaps the most widely distributed publication throughout the Department. The Bureau of Freshwater Fisheries also provides updated information and authors articles for the Division's Website regarding fishing regulations, angling opportunities, and fisheries projects and studies. (Hunter and Angler)

Division of Fish and Wildlife Mobile Trailer

Bureau staff participated on the planning team for the Mobile Conservation Outreach Trailer Project (MCOT). The 27-ft trailer contains interactive exhibits that inform the public about NJDFW's fish and wildlife management activities and conservation successes resulting from the partnership with the Wildlife and Sport Fish Restoration Program (WSFR). The purpose is to increase public knowledge of NJDFW and its mission, as well as to highlight how WSFR helps to meet agency goals. Assistance was provided in developing story lines related to freshwater fisheries research and management activities (fish sampling and fish culture) and to explain how scientific data collected by the Bureau was used to develop a statewide stream classification system to protect surface waters). Staff also provided photos and artifacts to be used in displays. The trailer made its debut at the Division's Wildlife Expo in September 2018. (Hamilton, Federal Grant F-48-R)

Professional Meetings/Conferences/Training

New Jersey participates in a number of regional initiatives geared towards the protection of the nation's freshwater fisheries resources. As such, state fisheries biologists participate in a number of regional panels and workshops to share information and experiences with biologists in other states on a variety of topics in the realm of fisheries management. These include, but are not limited to, the Eastern Brook Trout Joint Venture, Northeast Fisheries Administrators Association, and American Fisheries Society.

American Fisheries Society (AFS) – The Bureau's Fisheries Biologists attended the American Fisheries Society's annual national conference held in Atlantic City, NJ on August 19-24, 2018. The meeting was hosted by the Division's Bureau of Marine Fisheries, with an AFS membership appendance of over 1,800. In addition to attending relevant fisheries presentations, staff participated in various formal and informal discussions and presentation. Posters were prepared and presented during the poster session by Ross Shramko (Big Flatbrook Stocked Trout Movement Study) and Scott Collenburg (Temperature Monitoring and Implications on Brook Trout Management in NJ). Lisa Barno participated in a panel discussion regarding Eastern Brook Trout Management. Additional staff participated in a meeting to discuss the Rinehart Brook Brook Trout Restoration Project with biologists from other states and a geneticist that have been working to conserve Brook Trout throughout the east coast. (Staff)

Rivers and Streams Technical Committee – The Rivers and Streams Technical Committee is a sub-committee of the Northeast Fisheries Administrators Association (NEFAA). This sub-committee is tasked with sharing data, information and ideas on how to better protect and manage wild trout fisheries throughout the northeastern United States and Canada. A meeting was held on October 16 and 17 2018. (Shramko)

Safety Training - Safety training was completed by full-time and part-time staff who participate in electrofishing (required/renewed every two years). This training included successful completion of the USFWS online Electrofishing Safety course, watching the Wader Safety video, review of NJDFWs Electrofishing Safety Plan, and First Aid/CPR/AED certification. (staff, Federal Grant F-48-R)

Subcommittee on Ecological Flows (SEF) – The Subcommittee on Ecological Flows is a subcommittee of the Regulated Flow Advisory Committee (RFAC) for the Upper Delaware River System and its water supply reservoirs. Objectives of SEF are to provide scientifically-based information and recommendations to RFAC, as requested, regarding:

- Flows for the maintenance of healthy aquatic ecosystems, including consideration of water quality impacts over a range of regulated flows
- Sensitive species that could be impacted by regulated flows
- Flow regimes, thermal mitigation, and flow change mitigation
- The effects of existing and proposed regulated flows on habitat and ecological health
- Other, related matters as the RFAC may deem necessary or appropriate.

Fisheries biologists Ross Shramko and Scott Collenburg serve on SEF and participated in several meetings in 2018. (Shramko/Collenburg)

Public Events

The **New Jersey WILD Outdoor Expo** is an annual event celebrating the state's bountiful natural resources and rich outdoor heritage. The event was held on September 8 and 9, 2018, from 10 a.m. to 5 p.m. daily at the Colliers Mills Wildlife Management Area in Jackson Township, Ocean County. The Expo is an annual event which is free of charge and takes place rain or shine. The WILD Outdoor Expo is hosted by the NJDEP Division of Fish and Wildlife, Division of Parks and Forestry, the Green Acres Program, and the Conserve Wildlife Foundation of New Jersey. The event also has several sponsors, and exhibitors and vendors from the field of outdoor recreation were on site. The Expo helps people connect with the natural world by providing a unique blend of conservation information, education and hands-on opportunities to learn outdoor skills and activities. Numerous environmental and conservation exhibits, demonstrations and seminars are planned for the weekend. Visitors can learn about and try a wide array of activities including fishing, hiking, shooting sports, kayaking, camping skills, rock climbing, wildlife watching, and much more. (staff, Hunter and Angler)

Every year NJDFW holds an annual **Open House at the Pequest Trout Hatchery and Natural Resource Education Center**, prior to the opening of trout season. The event was held on June 2 and 3, 2018, from 10 a.m. to 5 p.m. The event was rescheduled from March due to inclement weather. Each year thousands of people of all ages come to the hatchery to see the trout that are raised, and participate in many activities including kids fishing, shooting sports, fisherman's flea market, and much more. Staff assist in a number of facets including assisting at the Fishing Education Pond, providing fish for the kiddie pool, and answering questions from the general public. (staff)

Bureau staff also assisted with two **Hook on Fishing Not on Drugs (HOFNOD)** Fishing Programs on July 12 at the Hackettstown Hatchery's Fishing Education Ponds. 42 kids from "Silk City Anglers" club from Paterson learned fishing basics and caught fish in the abovementioned ponds. On August 1, twenty 4th through 6th graders were given fishing instructions on the banks of the Paulins Kill, in Lafayette Township in Sussex County. (Boriek)

On July 6, attended a meeting at the Hackettstown Hatchery with representatives from the **Recreational Boating and Fishing Foundation's First Catch Center / Fishing's Future**. Hackettstown Hatchery was chosen as a First Catch Center. Children will come with their guardians to learn knot tying, casting, aquatic stewardship, etc. and fish in the hatchery's Fishing Education Ponds. Division personnel and volunteers from Centenary College will teach the 4 – 6 hour program. Several programs will be held annually, the first of which was held on 10/20/18, NJ's Free Fishing Day. (Boriek)

Bureau staff also assisted with the **15th Annual Pequest Teen Angler Event** on July 21, 2018. There were 53 anglers, 12 – 20 years old with 20 of them being current license holders. There were also 82 adults accompanying them with 23 being current license holders. (Boriek)

NJDEP's Youth Fishing Derby was held at Stacy Pond in Trenton on June 2, 2018. An estimated 70 youth participated in the fishing derby and an estimated crowd of 150 participants and volunteers experienced the event. Sunfish, Brown Bullheads and Largemouth Bass were caught and released. (Boriek)

Public Presentations

Each year state fisheries biologists attend meetings of a variety of organizations which may include angling clubs, watershed groups, local planning boards, and sportsmen shows. (Hunter and Angler, Staff)

In 2018, presentations on the fisheries resources within the state were presented to:

Black Bass Management Meeting - A black bass management meeting was held on January 10, 2018 at the Central Region Office. Officers and members from local bass fishing clubs and the NJ Bass Nation were in attendance. Angler concerns regarding popular WMA lakes were heard and discussed. Black bass sampling results, stocking histories, and habitat management topics were presented and discussed with the group. (Boehm/Smith)

North Jersey Fisheries Forum – Thirty-seven anglers attended the North Jersey Fisheries Forum held on January 20, 2018 at the Hackettstown State Fish Hatchery. All biologists with regions in the northern portion of the state were present to address angler's questions and comments concerning freshwater fisheries management activities. Presentations included an update on the clean-up of Spruce Run (Creek and Reservoir) in response to the discharge of quarry product by Eastern Concrete Materials during the summer of 2017, an overview of the upcoming dam rehabilitation project at Round Valley Reservoir, and results from the 2016 fisheries inventory and fisheries management plan at Round Valley Reservoir (2016) by Shawn Crouse. An open discussion was also held with anglers concerning the Division's Skillful Angler Program. Hatchery Superintendent Craig Lemon also provide an update of hatchery operations. (staff)

Outdoor Writer's Workshop – Fisheries Biologist Ross Shramko prepared and presented a PowerPoint presentation on the Big Flatbrook / Flatbrook Stocked Trout Radio Telemetry Movement Study. (Shramko)

Round Valley Trout Association – Biologist Shawn Crouse prepared and presented a PowerPoint presentation at Round Valley Trout Association's meeting held on March 15, 2018. Information provided included important dates, upcoming NJDFW events, new fishing regulations, the Spruce Run (Creek) sediment discharge cleanup, and research and management pertaining to Round Valley Reservoir. (Crouse)

South Jersey Freshwater Fisheries Forum – Forty-seven anglers attended the annual South Jersey Fisheries Forum held on February 24, 2018 at the Batsto Visitor's Center. Principal Biologist, Christopher Smith presented highlights of warmwater lake electrofishing surveys and Fisheries Biologist. A question and answer period and open discussion followed the presentations. (Boehm/Smith)

Trout Meeting – The annual Trout Meeting scheduled for March 3, 2018 was cancelled due to a nor'easter the day before which resulted in 10 to 12 inches of snow. There were numerous power outages and downed trees in the northern portion of the state. (staff)

OTHER FISHERIES RELATED ACTIVITIES

Permits

The Bureau of Freshwater Fisheries reviewed and issued 588 permits in 2018 to provide for the effective management and protection of the state's aquatic resources (see table below). These permits encompass nine specific permits, which include commercial harvest of aquatic species, water level management (for the protection of aquatic species), the introduction of aquatic species into waters of the state, as well as the collecting of aquatic species for scientific purposes, and special use permits. The review and approval of these permits not only include protection for freshwater fish, but also protection for other aquatic species such as frogs and turtles during critical spawning and hibernating periods. In addition to permits directly issued by the Bureau, the BFF also reviews Aquatic Use Permit Applications issued by the Department's Pesticide Control Program for the use of copper in waters known to be stocked or inhabited with trout. Trout are particularly sensitive to copper which is a basic agent for algal control treatments (copper sulfate) throughout the state. (Staff)

Permits issued by the Bureau of Freshwater Fisheries in 2018.

Permit Type	Number Issued
Baitfish – Commercial	4
Fish Stocking	141
Trout in the Classroom (TIC) (Fish Stocking)	41 New 156 Current All expire 2019
Gill Net – Staked – Commercial	0
Gill Net – Drifting – Commercial	0
Haul Seine – Commercial	1
Miniature Fyke/Pot	0
Scientific Collecting	60
Special Use Limited License	22
Water Lowering	155
Total	**580**

Wildlife Management Area Fishing Tournament Permits

Since 1996 the Division of Fish and Wildlife has required a permit to hold fishing tournaments on lakes within the Division's Wildlife Management Area. Permits are necessary to regulate the number of tournaments held on WMA Lakes, due to an increasing demand on our public waterbodies. NJDFW collects valuable information from tournament reports to supplement existing fisheries data. In 2018 there were 169 WMA Tournament Permits issued by the NJDFW. Permits were issued to 31 different organizations. The C.A.S.T. fishing club, which

annually holds Thursday night events at the Assunpink WMA lakes, obtained 22 permits in 2018. Big D Valley Bassmasters which regularly holds Friday night events at the Assunpink WMA Lake, obtained 13 permits in 2018. Cumberland County Bassmasters held the third highest number of tournaments at 12, in 2018. Anglers are required to submit a summary report within two weeks following the event. The return rate has fluctuated in recent years, until 2015 when the South Jersey Bass Club Association diligently pursued members of the organization reminding them of the reporting requirement. Their campaign was successful, resulting in a 64% return rate in 2015. In comparison, only 24% of reports were received in 2014. The return rate declined in 2018 to 54%. A letter will be sent out with 2019 WMA permits reminding anglers of the reporting requirement and the management implications for collecting the information. Angler catch data are utilized to track changes that would not necessary be known by just using standard fisheries sampling techniques.

Salem Canal was the most popular location in 2018, with 32 permits issued. The waterbody is not within a WMA, however the NJDFW has a concrete boat ramp and parking area which provides excellent access to this popular location. Assunpink Lake (30) and Union Lake (28) were second and third on the list in 2018. Other popular locations include DOD Lake (16), Rainbow Lake (13), and Stone Tavern Lake (16). All other locations had <10 permits issued.

Salem Canal far surpassed all other locations in total number of bass caught at 535, from 21 reports. It also had the highest angler participation at 348 total anglers spending 2,579 angling hours targeting Largemouth Bass. Union Lake was the next highest with 240 anglers catching 262 bass. Anglers reported catching 33 Smallmouth Bass at Union Lake, which represented 12% of the total catch.

The largest bass reported was a 6.26-pound Largemouth Bass from Assunpink Lake. 2018 was not a good year for "Trophy" size bass greater than five-pounds. Assunpink Lake had the highest number of bass over five-pounds, with four. However, only 11 total bass over five-pounds were reported in 2018 from all tournaments. Assunpink Lake had the highest average weight of bass at 2.16 lb, which is significantly lower than in the early 2000's when the average weight was greater than three pounds. (Smith)

WMA Fishing Tournament Report Return Rates.

Year	Tournament Permits Issued	Report Return Rate
2014	207	24%
2015	215	64%
2016	185	67%
2017	160	62%
2018	169	54%

Database Management - FishTrack

FishTrack is an Access database which houses New Jersey's Bureau of Freshwater Fisheries stocking information and field survey data collected by NJDFW throughout the state, historically through present day.

All 2018 field survey data was inputted and validated for accuracy. No major updates or changes to the *FishTrack* database occurred in 2018, beyond routine maintenance and quality

assurance/quality control measures. Maintaining an accurate and consistent database is critical as this gives staff biologists the ability to access accurate historical data to assist with appropriate management of the state's fisheries resources. (Shramko, Hunter and Angler)

LITERATURE CITED

Barbour, M. T., J. Gerritsen, B. D. Snyder and J. B. Stribling. 1999. Rapid bioassessment protocols for use in streams and wadeable rivers: periphyton, benthic macroinvertebrates, and fish, 2nd edition. EPA 841-B-99-002. U. S. Environmental Protection Agency, Office of Water, Washington, D.C.

Carlander, K. D. 2011. Standard Intercepts for Calculating Lengths from Scale Measurements for Some Centrarchid and Percid Fishes, Transactions of the American Fisheries Society, 111:3, 332-336.

Hamilton, P. L. and L. M. Barno. 2006. New Jersey Coldwater Fisheries Management Plan. New Jersey Division of Fish and Wildlife, Trenton, New Jersey.

Johnson, C.Z., C.D. Snyder, and N.P. Hitt. 2017. Landform features and seasonal precipitation predict shallow groundwater influence on temperature in headwater streams. Water Resour. Res., 53: 5788-5812.

Kurylyk, B. L., K. T. B. MacQuarrie, D. Caissie, and J. M. McKenzie. 2015. Shallow groundwater thermal sensitivity to climate change and land cover disturbances: Derivation of analytical expressions and implications for stream temperature modeling, Hydrol. Earth Syst. Sci. 19(5): 2469–2489.

New Jersey Department of Environmental Protection, Division of Science, Research and Environmental Health. Recommended NJ Action Level and Health Advisory Guidelines for Recreational Exposure to Microcystin-LR, Cylindrospermopsin, and Anatoxin –A. 2017.

New Jersey Department of Environmental Protection, Division of Water Monitoring and Standards. 2017. Cyanobacterial Harmful Algal Blooms (HABs). http://www.state.nj.us/dep/wms/bfbm/download/HABsFactSheet.pdf. (December 2017).

New Jersey Department of Environmental Protection, Division of Water Monitoring and Standards. Cyanobacterial Harmful Algal Bloom (HABs) Freshwater Recreational Response Strategy. 2018.

Snyder, C.D., N.P. Hitt, and J.A. Young. 2015. Accounting for groundwater in stream fish thermal habitat responses to climate change. Ecological Applications, 25(5): 1397-1419.

Trumbo, B.A., K.H. Nislow, J. Stallings, M. Hudy, E.P. Smith, K. Dong-Yun, B. Wiggins, and C.A. Dolloff. 2014. Ranking site vulnerability to increasing temperatures in southern Appalachian brook trout streams in Virginia: An exposure-sensitivity approach. Transactions of the American Fisheries Society 143:173-187.

Willis, D. W, B. R. Murphy and C. S. Guy. 1993. Stock Density Indices: Development, Use, and Limitations. Reviews in Fisheries Science. 1(3): 203-222.