West Virginia Esocid Management and Stocking Plan

*** This document is intended to be used as an adaptive management tool to provide information and guide management and stocking effort of fishes within the family Esocidae in West Virginia. The document was completed as a collaborative effort by West Virginia Division of Natural Resources (WVDNR) fisheries biologists, and it includes a summary of information collected through decades of research. Also included is a prioritized stocking plan agreed upon by district fisheries biologists and hatchery personnel. This plan should be revisited periodically and revised as goals and objectives change and additional knowledge is gained relating to the management of West Virginia esocid fisheries. ***

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INTRODUCTION

Four fishes from the Family Esocidae (pikes) are identified as species native to the state of West Virginia: Muskellunge (*Esox masquinongy*), Chain Pickerel (*E. niger*), Grass Pickerel (*E. americanus vermiculatus*), and Redfin Pickerel (*E. americanus americanus*).

The Muskellunge is the only native esocid species the WVDNR has invested resources into stocking for both introductory and supplementary purposes. Since 1958, WVDNR has stocked Muskellunge into waters throughout the state. Each year, fisheries maintained through stocking efforts account for more than half of all Muskellunge caught by West Virginia anglers. Stocking Muskellunge gives the WVDNR the opportunity to protect a popular native game fish against habitat degradation, create trophy fisheries, establish new fisheries sustained by natural reproduction, diversify angling opportunities, and develop new sources for Muskellunge broodstock.

Native Muskellunge (*Esox masquinongy*) populations are known to occur in 43 West Virginia streams (Appendix 1), comprising more than 620 miles and 1,200 acres of Muskellunge habitat. Most of these streams are found within the Ohio River, Kanawha River, and Little Kanawha River drainages. Native self-sustaining Muskellunge waters have been, and will continue to be, a major asset to the state of West Virginia.

WVDNR is currently focused on utilizing Muskellunge of West Virginia and New York (in two isolated impoundments) origin for stocking purposes. However, the states of Kentucky and Ohio have supplied WVDNR with Muskellunge in the past. Though fish from multiple states have been used in the past, all were Ohio River drainage Muskellunge, once considered subspecies (*E. masquinongy ohiensis*) status.

The future of WVDNR Muskellunge stocking efforts are currently focused on the use of only three sources for brood stock purposes: Middle Island Creek/North Bend Lake (MIC); Kanawha River/New River (KR); and Chautauqua Lake (NY).

- The Upper Kanawha River (upstream of Kanawha Falls) has been stocked with NY and KR fish, and the lower Kanawha River (downstream of Kanawha Falls) has received MIC and NY fish. WVDNR considers the Kanawha River a mixture of MIC, KR, and NY fish, owing to historical stockings of all three currently used brood sources.
- Waters within the Monongahela River drainage have historically been stocked with both NY and KR fish.
- WVDNR considers only MIC fish to be of "pure" West Virginia stock to preserve the genetic integrity of native populations, and MIC has been used as the brood source for stocking efforts directed at all other waters within the state.

Northern Pike (*E. lucius*) were stocked heavily into many waters of the state between 1974 and 2004. Although Northern Pike are present in limited numbers in several state waters, stocking efforts to produce naturally reproducing populations were met with limited success. Because self-sustaining fisheries were never fully established, WVDNR suspended Northern Pike stockings in recent years.

Tiger Muskellunge (*E. masquinongy* X *E. lucius* hybrid) have also been utilized by the agency to establish unique fisheries since 1975. Although widely distributed among West Virginia waters from the 1970's to the early 2000's, recent Tiger Muskellunge stockings efforts are focused on small impoundments between 40 and 99 acres that provide limited opportunities for escapement and have the foraging capacity to support a population of apex predators. WVDNR currently stocks Tiger Muskellunge into two impoundments: Big Ditch Lake (Webster County) and Mountwood Lake (Wood County). The chance of escapement from these impoundments is extremely low, unless moved by anglers. Thus, the possibility of stocked Tiger Muskellunge impacting native fisheries is minimal. Additional lakes could be considered in the future if they meet the agreed upon criteria for establishing these unique fisheries.

BIOLOGY, ECOLOGY, AND LIFE HISTORY OF WEST VIRGINIA ESOCIDS

REDFIN PICKEREL AND GRASS PICKEREL

Redfin Pickerel (*Esox americanus americanus*) and Grass Pickerel (*Esox a. vermicaulatus*) and are the smallest esocids native to West Virginia, rarely exceeding 15 inches in total length. The two are considered subspecies and look very similar, having a vertical barring pattern. Both typically have 8 submandibular pores, 11–13 branchiostegal rays, fully scaled cheeks and opercles, and a defined black sub-orbital teardrop marking that is angled backward. Grass Pickerel are found in the greater Ohio River basin in West Virginia and have a concave appearance on the dorsal surface of the snout. Both anal and pelvic fins have a distinct yellow–green coloration. Redfin Pickerel occur in the Potomac River watershed and have a convex appearance on the dorsal surface of the snout. The anal and pelvic fins of Redfin Pickerel are red in coloration, typically more defined on the distal margin of the fins.
Both Redfin and Grass Pickerel prefer low gradient systems with low flow rates and an abundance of vegetation, and they cannot tolerate high turbidity for prolonged periods of time. Habitat has likely become limited in some systems that they naturally occur in due to stream channelization, dredging, and land-use practices. They are thought to be solitary in behavior with exception of spawning, which occurs in early spring. They are short-lived in comparison to other esocids, rarely exceeding 7 years in age. Redfin and Grass Pickerel are ambush predators, and adults feed primarily on fishes and crayfishes. Few fisheries exist in West Virginia.

CHAIN PICKEREL

Chain Pickerel (*Esox niger*) have distinct "chain-like" patterning on their sides and can reach sizes exceed 20 inches. They most commonly have 8 submandibular pores, 14–16 branchiostegal rays, fully scaled cheeks and opercles, and a sub-orbital "tear drop" that is typically vertical or slightly forward. They prefer shallow, densely vegetated lakes and low gradient streams. They spawn in late winter or early spring and are native only to the Atlantic Slope drainages in West Virginia. Life span is generally thought to be 8–9 years. Chain Pickerel are ambush predators, feeding primarily on fishes as adults. Few fisheries exist in West Virginia.

NORTHERN PIKE

Northern Pike (*Esox lucius*) are the second largest esocid species inhabiting West Virginia waters, commonly exceeding 30 inches in total length. They have a unique yellow spotting that occurs in horizon rows on their side. Cheeks are fully scale, but only the upper half of the opercle is scaled. They typically have 10 submandibular pores and 14-16 branchiostegal rays. Northern Pike spawn from March to April and can exceed 20 years in age. Although not considered native to West Virginia, Northern Pike have been widely introduced by WVDNR in the past, with a significant effort placed on the Ohio River basin. However, these stockings have been met with limited success. A few fish are caught annually and are likely remnants of past stocking efforts.

MUSKELLUNGE

Muskellunge (*Esox masquinongy*) are the largest member of the family Esocidae, and they are native to greater Ohio River drainage in West Virginia. They commonly exceed 40 inches in total length but are frequently caught even larger. They have 12-18 submandibular pores, 16-19 branchiostegal rays, and the cheeks and opercles are not commonly scaled on the lower half. They naturally occur in low gradient, medium to large streams and rivers in West Virginia. These waters are often characterized by short riffle areas and long slow flowing pools with abundant woody cover. In West Virginia, Muskellunge spawn in the spring, generally between the last week in March to the third week in April. Successful spawning and recruitment occur during most years in our native streams and may also occur in some of our stocked streams and rivers. Spawning sites are located at the lower or upper ends of pools in slack water near riffles. Spawning behavior has been observed in some of the state's stocked lakes and reservoirs; however, recruitment has not been documented.

The influential factor concerning Muskellunge reproductive success is likely stream conditions during the spawning period and throughout the first months of an individual's life. Swift flows and/or muddy water may have a negative influence on Muskellunge year class strength. Spawning success requires suitable flow and turbidity conditions, and fry must feed daily. Muskellunge are top predators that primarily ambush other fishes. Most native Muskellunge streams have abundant sucker (Catostomidae) populations. In West Virginia, Muskellunge grow quickly and mature during the third to fifth year of life. After their third year of life, females grow much faster than males, and males seldom reach a size greater than 40 inches. Muskellunge can be long-lived and are expected to exceed 20 years in age from West Virginia waters.

Muskellunge are the primary focus for the current WVDNR esocid program. For this reason, the remainder of this document is largely concentrated toward the management of this species.

SUMMARY OF WEST VIRGINIA MUSKELLUNGE MANAGEMENT

CURRENT STATUS

West Virginia Muskellunge populations are healthy and supply excellent angling opportunities. Fingerling Muskellunge stockings conducted by WVDNR has expanded the range of Muskellunge within the state. This stocking program has been successful, and each year stocked fish account for more than half of all Muskellunge caught by West Virginia anglers. Expanding the range of Muskellunge has allowed the WVDNR opportunities to protect a popular native game fish against habitat degradation, create trophy fisheries, establish new fisheries sustained by natural reproduction, diversify angling opportunities, and develop new sources for Muskellunge broodstock.

CHALLENGES TO MANAGEMENT

- Dynamic stream and river conditions during the spring spawning period.
- Habitat loss, pollution events, and water withdrawals from streams.
- Introduction of non-native or invasive aquatic species.
- Availability of broodstock and eggs/fry.
- Maintaining adequate rearing facilities at WVDNR hatcheries.
- Conflicting interests from differing angling groups.
- Fish escapement from lakes and reservoirs.
- Difficulty collecting information concerning angler pressure and harvest rates.
- Limited information exists relating to the effect of regulations.

PAST RESEARCH

Following are summaries of projects conducted by WVDNR that have focused on Muskellunge population dynamics and movement in West Virginia:

Middle Island Creek (1966–1974)

"A Life History Study of the Muskellunge in West Virginia" was published by Miles (American Fisheries Society Special Publication 11:140-145, 1978). This study was conducted on Middle Island Creek. Miles stated, "Middle Island Creek is fairly typical of most West Virginia's major Muskellunge streams". During Miles eight-year study, 216 fish were collected with trap nets and electrofishing gear (230-volt AC boat electrofisher). Electrofishing catch-rate CPUE was 0.9 fish/hour. Miles estimated Muskellunge populations abundance at 0.6 fish/acre and 1.8 fish/acre in two different pools, and he stated that adult Muskellunge were heavily exploited by anglers. Extensive upstream and downstream movement was documented. The largest movement recorded was a 21.0-mile downstream migration by 32.4-inch female, occurring over 71 days. Miles stated that males mature between ages 3–4 at total lengths ranging from 24.0–25.2 inches, and females matured at age 4 or 5 at 26.0 to 28.0 inches. Miles felt that spawning occurred during April when daily water temperatures average 50°F or higher for 4–8 days, and spawning sites were located at either the lower or upper ends of pools in slack water near riffles. He found that the time-period between egg fertilization and fry swim-up ranged from 17 to 30 days.

Middle Island Creek (2002–2007)

Another study was conducted on Middle Island Creek from 2002 to 2007. During this six-year Federal Aid Study, 244 different Muskellunge were sampled with pulsed DC boat-mounted electrofishing unit. Total CPUE was estimated to be 2.7 fish/hour and was not significantly different between regulation reaches. CPUE in a catch-and-release (C&R) reach was 2.50 ± 1.43, while CPUE between standard regulation (SR) reaches was 2.84 ± 1.41. CPUE for legal-sized Muskellunge was also not significantly different between reaches (C&R: 1.61 ± 1.01; SR: 1.90 ± 1.20). Males moved greater distances than females, and the longest move was made by a 37.0-inch male that traveled a minimum of 50.8 miles downstream in 538 days. The 2002 to 2007 study concluded the Muskellunge population in Middle Island Creek was healthy and supplied excellent fishing opportunities to West Virginia anglers. Angler harvest was not found to be of significant concern.

Age and Growth of Middle Island Creek Muskellunge (1971–2007)

Age and growth information was collected during both Middle Island Creek studies described above. Miles, using scales, found the average calculated lengths for 77 Muskellunge were 11.5, 19.0 23.9, 27.6 30.1 31.8 and 34.6 inches from ages 1–7, respectively. Miles found that average estimated lengths-at-age compared closely with averages of actual lengths taken from Middle Island Creek Muskellunge when measured in early spring.

During the 2002–2007 study, yearling Muskellunge collected in the spring averaged 13.0 inches, while age-2 fish averaged 19.6 inches. Age and growth data collected from 114 Muskellunge captured and recaptured in early spring (1971–2007) are presented in Table 1. Age at first capture was assigned using

data from Miles as a guide. Females grew faster than males every year of life and averaged at least 2 inches longer than males beginning at age five. At age nine, females averaged 37.1 inches in length and males averaged 33.1 inches. The oldest fish collected during this work was a female that was estimated to be 18 years old. This fish was first captured when she was 41.5 inches and was estimated to be 13 years old and was 47.0 inches in length five years late at time of recapture. The oldest males collected were estimated to be 15 years old. These two fish averaged 35.6 inches in total length.

Table 1. Age and growth data from recaptured Muskellunge collected from Middle Island Creek, 1971-2007. Lengths are presented in inches, and number of individuals is in parentheses.

SEX	ESTIMATED AGE															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	18
Female	13.3 (1)	– –	24.4 (7)	27.9 (23)	31.1 (17)	32.6 (29)	34.1 (19)	35.6 (17)	37.1 (13)	38.3 (6)	39.5 (6)	38.9 (4)	41.9 (3)	39.0 (1)	– –	47.0 (1)
Male	– –	19.8 (1)	23.5 (9)	26.6 (17)	28.9 (21)	30.6 (19)	31.3 (27)	32.7 (16)	33.7 (15)	33.9 (11)	35.0 (8)	35.6 (9)	35.1 (5)	36.1 (4)	35.6 (2)	– –
All Fish	13.3 (1)	19.8 (1)	23.9 (16)	27.4 (40)	29.9 (38)	31.8 (48)	32.4 (46)	34.2 (33)	35.3 (28)	35.5 (17)	36.9 (14)	36.6 (13)	37.6 (8)	36.7 (5)	35.6 (2)	47.0 (1)

Buckhannon River (2002-2009)

Muskellunge population characteristics and movement were investigated in the Buckhannon River, West Virginia. With increased angler interest, the project was initiated to collect more information on a population occurring within a special regulation area. Muskellunge were captured using pulse DC boat electrofishing gear during daytime surveys in the Buckhannon Pool, a 5-mile catch and release area above a low water dam. Individuals were marked with Passive Integrated Transponder (PIT) tags to evaluate movement and growth during recapture events. In total, 429 capture events were documented over the course of the study. Of which, 271 were recaptures of previously tagged individuals. Fish moved into the upper reaches of the Buckhannon Pool and into French Creek, a Buckhannon River tributary, during the spring. Capture of young of year Muskellunge suggests that successful natural reproduction occurs within the watershed. Over the course of the study, only one tagged fish was documented as leaving the catch and release area, escaping downstream over the low water dam. Although tag retention was an initial concern, results showed that PIT-tagged individuals retained tags for more than seven years. High catch rates were documented, averaging 5 Muskellunge fish per hour of electrofishing over the entirety of the study. Higher growth rates were documented for females at certain size classes. Buckhannon River catch and release area offers a unique opportunity for Muskellunge anglers to encounter several fish per day. Periodic monitoring of this population should occur to document changes in population characteristics and determine the necessity for supplementary stocking.

North Bend Lake (2010–2014)

"Seasonal Movements of Muskellunge in North Bend Lake, West Virginia" was published by Morrison and Warren (Journal of the Southeastern Association of Fish and Wildlife Agencies 2:42–49). Twenty-four fish were collected using pulsed DC boat-mounted electrofishing equipment and surgically implanted with acoustic transmitters. Six submersible data loggers were stationed throughout the lake. Between 2010 to 2014, this study discovered that most Muskellunge moved throughout the entire length of the lake, and that 29% of tagged individuals left the lake through the outlet structure of the dam. Fish occupied the upper half of North Bend Lake in spring and spent the summer and winter in the lower half of the lake. Fish occupied the lower lake in early and late fall but exhibited a collective upstream movement to the upper reaches of the lake in October. Based on their upstream movements in early spring, Muskellunge appeared to use the upper areas of the lake for spawning purposes.

Elk River (2008–2012)

Muskellunge distribution, growth, and movement was evaluated in the Elk River, West Virginia. More information on this population was desired due to increased angler interest and lack of survey data. Muskellunge were captured and tagged using pulse-DC electrofishing boats during both day and night surveys from a 161.2-km section of Elk River from Sutton Dam to the confluence with the Kanawha River in Charleston, West Virginia. In total, 194 individuals were collected, and 67 individuals were recaptured. A total of 261 capture events occurred over the course of the study. In addition to fish collected during boat electrofishing surveys, twenty-three anglers contributed 81 recaptures to the study. Spatial distribution of collection events suggests greater numbers of Muskellunge present year-round in the upper reaches of the study area. This is likely due to reduced habitat quality in the lower 30-km, resulting from shoreline development, dredging, and the pooling effect of Winfield Lock and Dam on the Kanawha

River. Despite evidence suggesting that spawning occurs throughout the watershed, many tagged Muskellunge were congregated in upstream reaches (near Sutton Dam) during the springtime. Sectioned fin rays proved to be a non-lethal alternative to utilizing cleithra for age determination purposes. However, further work is needed to validate age estimates for older individuals. Movement peaked during the spring, and a second, minor peak occurred in the fall. The longest movement documented was 120 km by a female. It is suspected that large-scale movements were associated with forage availability and seasonal habitat preferences. Results suggest a watershed-based management plan is recommended for managing self-sustaining, riverine Muskellunge populations. Preservation and enhancement of critical spawning habitat, flow mitigation, riparian corridor protection, and increasing angler awareness concerning post-release delayed mortality should be considered during the development of an adaptive management plan.

Kanawha River (2013–2017)

A Muskellunge movement study was conducted on the Kanawha River, 2013–2017. Nineteen fish were collected using pulsed DC boat-mounted electrofishing equipment and surgically implanted with acoustic transmitters. Fish were marked within the London Pool, and submersible data loggers were stationed within the London and Marmet pools of the river. The study concluded that implanted Muskellunge moved throughout the entire length of the London Pool and that the Kanawha Falls area is an important Muskellunge spawning area. Migration through the London Dam was documented. At least 11% of the marked fish were harvested by anglers.

ADAPTIVE MANAGEMENT PLAN

The goal of this plan is to improve the quality of Muskellunge fishing opportunities by protecting and increasing critical habitats and strengthening the fishery where possible. The plan contains strategies to increase, conserve, and enhance the Muskellunge fisheries in West Virginia. The strategies are intended to be adaptive and should be modified as conditions warrant.

Muskellunge have been, and will continue to be, managed on a statewide basis. Our statewide management objective has involved angler regulations, as well as species and habitat protection. New strategies are proposed for research studies, habitat improvements, and to increase public awareness of this valuable state resource. These strategies will protect and enhance the resource while providing a variety of angling opportunities.

OVERARCHING MANAGEMENT OBJECTIVES

1. Protect and enhance Muskellunge populations, their habitat, water quality, and river/stream flows.
2. Increase the statewide Muskellunge fishery and diversify angling opportunities.
3. Increase awareness and utilization of the West Virginia Muskellunge fisheries.
4. Ensure appropriate biological information is available to make informed management decisions.

The approach of the plan is to promote diverse angling opportunities in appropriate water bodies by utilizing all available fishery management tools. Through this approach, the most appropriate outcomes will be achieved in the most biologically sound and responsible manner.

Fishery managers have six tools that will be employed to meet these objectives:

1. **Environmental Reviews**. Comments will be supplied to appropriate parties during ecological review of projects occurring on or within watersheds in which Muskellunge occur.
2. **Hatchery-Reared Muskellunge**. Muskellunge stockings have been, and will continue to be, a fundamental part of the WVDNR management program.
3. **Biological data.** Biological information will be collected and utilized to make informed management decisions and to fill informational gaps concerning Muskellunge fisheries.
4. **Creel information.** Information from Muskellunge angling groups will be summarized annually. Projects will be initiated to collect information concerning catch and harvest information on Muskellunge fisheries.
5. **Implementation of Angling Regulations.** Current angling regulations are based on data relating to Muskellunge biological characteristics and angler recommendations.
6. **Habitat Improvements.** Projects that restore, enhance, or create new Muskellunge habitat will be initiated.

GOALS, ISSUES, and ACTIONS

1. Protect Muskellunge populations, their habitat, water quality, and stream flows.

Goals

- Development projects and other work occurring instream and within watersheds that may have a detrimental effect on Muskellunge waters will be reviewed. Concerns relating to aquatic resources will be incorporated into official comments.
- Improve habitat protection regulations and enforcement.
- Maintain the genetic integrity of West Virginia Muskellunge populations.
- Take steps to combat nuisance invasive species.

Issues

- Habitat loss is a major threat to all West Virginia aquatic resources.
- Sedimentation due to non-point source pollution impacts many rivers and streams.
- Water withdrawals from rivers and streams may have a significant negative impact on aquatic resources.
- Invasive aquatic species, which can drastically alter ecosystems, have been introduced through unregulated activities.
- WVDNR has limited regulatory authority and enforcement.
- Habitat protection regulations and enforcement are inadequate.

Actions

- WVDNR will review WV Department of Transportation projects, Federal Energy and Regulatory Commission applications, US Army Corps of Engineer permits, and right-of-entry applications through WVDNR Office of Land and Streams to supply comments that incorporate aquatic resource concerns.
- WVDNR will work with other State and Federal agencies to improve habitat protection regulations and environmental enforcement.
- Only Ohio River strain Muskellunge will be cultured or stocked by WVDNR.
- WVDNR will develop a plan to combat nuisance invasive species.

2. Increase the West Virginia Muskellunge fishery and diversify angling opportunities.

Goals

- Stock Muskellunge into selected waters.
- Manage Muskellunge fishing regulations for diverse angling opportunities.
- Develop Muskellunge stocking guidelines.
- Create a broodstock source within West Virginia for "Chautauqua Lake" strain Muskellunge (Chautauqua Lake is within the Ohio River drainage).
- Enhance angler access to Muskellunge waters.

Issues

- Potential new waters for Muskellunge introductions are limited.
- Limited sources for Ohio River strain Muskellunge.
- Variability in fingerling production.
- Stocking requests and angler expectations may exceed hatchery production.
- Maintaining adequate rearing facilities at WVDNR hatcheries.
- Muskellunge escapement from lake and reservoirs.
- Conflicting interests and desires from angler groups.
- Additional technical and scientific information is needed to diversify angling opportunities.
- Evaluating the regulations is challenging due to catchability of the species.
- Access to Muskellunge waters may limited.

Actions

- Muskellunge broodstock will be collected from select West Virginia waters.
- WVDNR hatcheries will produce fingerlings (4–6 inches) and advanced fingerlings (9–14 inches).
- WVDNR will only stock Muskellunge fingerlings into select waters.
- A draft Esocid Stocking Plan has been developed and is currently under review.
- WVDNR will recommend and implement fishing regulations that will create diverse angling opportunities.
- WVDNR will develop and improve public boat and access sites on Muskellunge waters.

3. Increase awareness and utilization of the West Virginia Muskellunge fisheries.

Goals

- Educate constituents on available Muskellunge resources.
- Develop material to help anglers choose tackle.
- Facilitate communications and develop working relationships between angler groups.
- Introduce Muskellunge into new areas of West Virginia.

Issues

- Constituents are unaware of the available Muskellunge resource.
- Potential anglers may not have suitable Muskellunge fishing tackle.
- Conflicts exist between angler groups (i.e. Bass anglers feel Muskellunge prey on other sport fish).
- Muskellunge are not widely distributed throughout West Virginia.

Actions

- Develop a West Virginia Muskellunge Fishing Brochure.
- WVDNR will utilize a variety of communication tools (website, social media, etc.) to inform anglers.
- WVDNR will facilitate meetings with concerned angling groups.
- WVDNR will stock fingerling Muskellunge in new areas of West Virginia.

4. Ensure suitable technical information are available to WVDNR for Muskellunge management decisions

Goals

- Conduct research that will assist WVDNR with making management decisions.
- Maintain membership within Esocid Technical Committees.

Issues

- There is limited Muskellunge biological and angler use information available.
- Collecting suitable information is challenging and can be expensive.
- Technical information may be dynamic.

Actions

- Develop research project that will assist WVDNR biologists.
- Assign a state representative American Fisheries Society Esocid Technical Committees.

STOCKING GUIDELINES

- No Esocid will be introduced into native Muskellunge streams and rivers.
- Ohio River drainage Muskellunge will be the only Muskellunge stocked into West Virginia waters.
- Northern Pike will not be introduced into any water within the Greater Ohio River Basin.
- Tiger Muskellunge will only be considered for waters where they have previously been introduced that are less than 100-acres in size that escapement is considered minimal.
- Esocids will only be considered for waters where a realistic fishery may be established that exceed 40-acres in size and support an adequate, self-sustaining forage base.
- Northern Pike and Tiger Muskellunge will not be cultured in any hatchery within the Greater Ohio River Basin.
- Efforts will be directed towards establishing a NY brood source at Stonewall Jackson Lake. The lake was initially stocked with NY fish, which were extremely successful in West Virginia waters. However, in recent years this source has not been available, and the lake received KR fish.

RIVERS AND STREAMS

1. Previously stocked streams will be evaluated and periodically monitored to assess natural recruitment. If recruitment is documented, the water will not be stocked.
2. Waters that do not have natural recruitment will be stocked on an every-other-year schedule. Rivers and streams will receive summer fingerlings (5-7" fish). If available, fry may be stocked into rivers and streams where fingerlings will not be stocked that year.
3. Stockings into new waterbodies will be conducted for five consecutive years. After this period, they will be evaluated for natural recruitment.
4. Waters within the Monongahela River drainage and upper Kanawha River drainage (above Kanawha Falls) will be stocked with KR fish; other rivers and streams that are within the Ohio River and Kanawha River drainages will be stocked with MIC fish.
5. Tiger Muskellunge will not be considered for these waters.

RESERVOIRS AND IMPOUNDMENTS

1. Reservoirs and impoundments will receive fall advanced fingerlings (10-16" fish).
2. Impoundments less than 100-acres will be stocked on an every-other-year basis.
3. Reservoirs and impoundments where migration through the dam has been documented will receive higher stocking rates.
4. Reservoirs and impoundments that are tributaries to the Ohio River, Little Kanawha River, and lower Kanawha River (downstream of Kanawha Falls) will be stocked with MIC fish. Waters within the Monongahela River drainage and the upper Kanawha River drainage (upstream of Kanawha Falls) will be stocked with KR fish. When available, NY fish will be stocked into Stonewall Jackson Lake, Stonecoal Lake and East Lynn Lake.
5. Tiger Muskellunge will only be considered for impoundments between 40-99 acres in size that escapement is considered minimal.

MUSKELLUNGE STOCKING STRATEGY

Prioritized Muskellunge Stocking List

First Priority Waters

- East Lynn Lake
- North Bend Lake
- Stonewall Jackson Lake

Second Priority Waters

- Burnsville Lake
- Stonecoal Lake
- Upper Mud Lake
- Woodrum Lake

Third Priority Waters

- Monongahela River (Opekiska/Point Marion)
- Tygart River Backwater
- Tug Fork

Rivers and Streams

Impounded Rivers					
Water Body	**County**	**District**	**Cohort**	**Number**	**Stocking Strategy**
Tygart River Backwater	Randolph	III	KR	150	Even Years
Tug Fork	Mingo	V	MIC	275	Annual (2017-2022)

Streams				
Water Body	**County**	**District**	**Cohort**	**Stocking Strategy**
Coal River	Kanawha	V	MIC	*
Fishing Creek	Wetzel	I	MIC	*
Guyandotte River	Cabell	V	MIC	*
Mill Creek	Jackson	VI	MIC	*
Mud River	Cabell	V	MIC	*
New River	Summers	IV	KR	*
Sandy Creek	Jackson	VI	MIC	*
West Fork River	Lewis, Harrison	I, III	KR	*

* Will only be stocked if natural reproduction fails to produce a fishable population

Navigable Rivers					
Water Body	**County**	**District**	**Cohort**	**Number**	**Stocking Strategy**
Monongahela River (Opekiska)	Monongalia	I	KR	150	Even Years
Monongahela River (Point Marion)	Monongalia	I	KR	150	Odd Years

Reservoirs and Small Impoundments

Reservoirs							
Water Body	**County**	**District**	**Cohort**	**Acres**	**Rate**	**Number**	**Stocking Strategy**
Burnsville Lake*	Braxton	III	MIC	960	0.15/Acre	145	Annual
East Lynn Lake	Wayne	V	MIC or NY	1,005	0.25/Acre	250	Annual
Stonecoal Lake	Lewis, Upshur	III	KR or NY	550	0.25/Acre	140	Annual
Stonewall Jackson Lake*	Lewis	III	KR or NY	2,650	0.2/Acre	530	Annual

* District fisheries biologist has recommended these rates

Small Impoundments							
Water Body	**County**	**District**	**Cohort**	**Acres**	**Rate**	**Number**	**Stocking Strategy**
North Bend Lake*	Ritchie	VI	MIC	305	0.4/Acre	125	Annual
Upper Mud Lake	Lincoln	V	MIC	310	0.25/Acre	75	Annual
Woodrum Lake	Jackson	VI	MIC	240	0.25/Acre	60	Annual

* Migration through the dam has been documented

TIGER MUSKY STOCKING STRATEGY

Water Body	County	District	Acres	Number	Strategy
Big Ditch Lake	Webster	III	55	100	When Available
Mountwood Lake	Wood	VI	50	100	When Available

APPENDIX

APPENDIX 1: WEST VIRGINIA STREAMS SUPPORTING NATIVE MUSKELLUNGE POPULATIONS

Kanawha River Drainage

- Kanawha River – Mason, Putnam, Kanawha, and Fayette Counties
  - Thirteenmile Creek – Mason County
  - Eighteenmile Creek – Putnam County
  - Pocatalico River - Putnam, Kanawha, and Roane Counties
    - Middle Fork – Kanawha and Jackson Counties
    - Flat Fork – Roane County
  - Elk River - Kanawha, Clay, and Braxton Counties
    - Little Sandy Creek – Kanawha County
    - Big Sandy Creek – Kanawha and Roane Counties
    - Birch River – Braxton County

Little Kanawha River Drainage

- Little Kanawha River – Wood, Wirt, Calhoun, Gilmer, and Braxton Counties
  - Walker Creek – Wood County
  - Standing Stone Creek – Wood County
  - Hughes River – Wirt County
    - North Fork Hughes River – Ritchie County
    - South Fork Hughes River – Ritchie County
      - Slab Creek – Ritchie County
      - Bone Creek – Ritchie County – Ritchie County
      - Middle Fork Hughes River – Ritchie County
  - Reedy Creek – Wirt and Roane Counties
  - Spring Creek – Wirt and Roane Counties
  - West Fork Little Kanawha River – Wirt, Calhoun, and Roane Counties
    - Henry Fork – Roane County
  - Straight Creek – Wirt County
  - Steer Creek – Calhoun and Gilmer Counties
    - Left Fork Steer Creek – Gilmer County
    - Right Fork Steer – Gilmer County
  - Cedar Creek – Gilmer County
  - Leading Creek – Gilmer County
    - Cove Creek – Gilmer County
    - Fink Creek - – Gilmer and Lewis Counties
  - Sand Fork – Gilmer County
    - Indian Creek – Gilmer County
  - Saltlick Creek – Braxton County

Monongahela River Drainage

West Fork River – Lewis and Harrison Counties

Ohio River Drainage

Middle Island Creek – Pleasants, Tyler, and Doddridge Counties

McKim Creek – Pleasant County

Indian Creek – Tyler County

McElroy Creek – Tyler and Doddridge Counties

Arnolds Creek – Doddridge County

Meathouse Fork – Doddridge County

Toms Fork – Doddridge County

Buckeye Creek – Doddridge County

APPENDIX 2: HISTORIC ESOCID STOCKINGS

Waters Stocked with Muskellunge Since 2000

Stream or River	County	District	Brood Source	Years Stocked
Bluestone River	Mercer	IV	KR, NY	2003-06, 08
Buckhannon River / French Creek	Upshur	III	KR, NY	2001, 03, 07, 11, 13, 14, 16
Coal River	Kanawha	V	MIC	2005-08, 10, 11, 13, 15
Dunkard Creek	Monongalia	I	KR	2006, 07, 09
Fishing Creek	Wetzel	I	MIC	2006-08, 11
Gauley River	Fayette	IV	KR, NY	2001, 03-09
Guyandotte River	Cabell	V	MIC	2013
Kanawha River	Entire River	IV, V	KR, MIC, NY	2003-07, 09, 11
Meadow River	Nicholas	IV	KR, NY	2003-08, 11, 13, 15
Mill Creek	Jackson	VI	MIC	2000-06, 08, 10, 12
Monongahela River	Marion, Monongalia	I	KR, NY	2000-01, 04-08, 11-12, 15
Mud River	Cabell	V	KR, MIC	2000-06, 08, 10, 13
New River	Summers	IV	KR	2001-04, 07-09
Ohio River	Mason, Wood	V, VI	MIC	2006
Sandy Creek	Jackson	VI	MIC	2001-07, 09, 11, 13, 16
Tug Fork River	Mingo	V	MIC	2013
Twelvepole Creek	Wayne, Cabell	V	MIC	2000-04
Tygart Backwaters	Randolph	III	KR, NY	2003, 06, 08, 11-12, 14
West Fork River	Lewis, Harrison	I, III	KR, NY	2000-01, 03, 06-08, 10-12, 15

Reservoir	County	District	Brood Source	Years Stocked
Burnsville Lake	Braxton	III	KR, NY	2000-11, 14-16
East Lynn Lake	Wayne	V	KR, MIC, NY	2000-16
Stonecoal Lake	Lewis, Upshur	III	KR, NY	2000-16
Stonewall Jackson Lake	Lewis	III	KR, NY	2000-16

Small Impoundment	County	District	Brood Source	Years Stocked
Bear Rock Lake	Ohio	I	MIC	2000-04, 06-07, 13
Big Run Lake	Marion	I	MIC	2002, 14
Castleman Run Lake	Brooke, Ohio	I	MIC	2008
Charles Fork Lake	Roane	VI	MIC	2008
Curtisville Lake	Marion	I	MIC	2002, 07, 14
Dog Run Lake	Harrison	I	MIC	2002
Dunkard Fork Lake	Marshall	I	MIC	2002, 05, 07, 09
Huey Run Lake	Marion	I	MIC	2002, 07, 14
Kimsey Run Lake	Hardy	II	MIC	2012
Lumberport Lake	Harrison	I	MIC	2002
Mason Lake	Monongalia	I	MIC	2007, 11, 13
Middle Wheeling Creek Lake	Ohio	I	MIC	2008
Mountwood Lake	Wood	VI	MIC	2007, 09, 11, 14
North Bend Lake	Ritchie	VI	MIC	2003-16
Teter Creek Lake	Barbour	I	MIC	2007, 11, 14
Tomlinson Run Lake	Hancock	I	MIC	2014
Upper Mud Lake	Lincoln	V	KR, MIC	2000-08, 13-14, 16
Woodrum Lake	Jackson	VI	KR, MIC	2000, 03-08, 10-16

Waters Stocked With Muskellunge - 1958-1999

Stream or River	County	District	Years Stocked
Bluestone River	Mercer	IV	1974-81, 83-95, 97-99
Buckhannon River/French Creek	Upshur	III	1966-68, 71, 73-97, 99
Buffalo Creek	Marion	I	1973, 93
Bull Creek	Wood	VI	1963
Coal River	Kanawha	V	1963, 66-68, 70, 73, 77
Crab Creek	Mason	V	1980
Dunkard Creek	Monongalia	I	1964, 66-67, 70-73, 75-76, 79-92, 94-97
Eighteenmile Creek	Putnam	V	1980
Elk Creek	Harrison	I	1973, 75, 82
Elk River	Braxton, Clay	III	1967, 80, 81, 84-85
Five and Twentymile Creek	Putnam	V	1980
Gauley River	Fayette	IV	1977-80, 82-95, 97, 99
Guyandotte River	Cabell	V	1979
Hackers Creek	Lewis	III	1974-81
Hughes River	Wirt	VI	1992, 94
Kanawha River	Entire River	IV, V, VI	1968-78, 80, 83, 85-88, 90-91, 93-99
Lee Creek	Wood	VI	1969, 71, 73
Little Kanawha River	Braxton, Gilmer, Wirt	III, VI	1964-68, 71, 80, 86, 92, 94, 97-99
McElroy Creek	Tyler	VI	1967
Meadow River	Nicholas	III	1963-67, 73-99
Middle Island Creek	Doddridge, Tyler	VI	1965, 67, 71, 73, 75-76, 78, 80, 83-84, 86-87, 89, 91-92, 94, 96-98
Mill Creek	Jackson	VI	1974-99
Monongalia River	Marion, Monongalia	I	1975-92, 94-99
Mud River	Cabell	V	1964, 66-68, 70-71, 73, 75-99
New Martinsville Marsh	Wetzel	I	1976

New River	Summers	IV	1963, 70, 73, 77-78, 80-81, 83-88, 90-99
North Fork Hughes River	Ritchie	VI	1964, 67-69, 75-76, 91
Patterson Creek	Mineral	II	1964
Pocatalico River	Roane, Kanawha	V, VI	1980
Pricketts Creek	Marion	I	1973
Sandy Creek	Jackson	VI	1974-83, 85-99
Shenandoah River	Jefferson	II	1964-65, 67-68, 71, 73, 75, 77, 79, 81
South Fork of Hughes River	Ritchie	VI	1991
Tomlinson Run Backwaters	Hancock	I	1967-69
Twelvepole Creek	Wayne, Cabell	V	1966-73, 75-80, 82-88, 90-91, 93-99
Tygart River	Randolph	III	1962, 64, 67-68, 70-73, 75-81, 83-98
Tygart River Backwaters	Randolph	III	1978, 92-94
West Fork River	Lewis, Harrison	I, III	1964, 66-68, 70-73, 75-77, 79-98
Whiteday Creek	Monongalia	I	1973

Reservoir	County	District	Years Stocked
Beech Fork Lake	Wayne	V	1982
Bluestone Lake	Summers	IV	1958-59, 63-68, 70-72
Burnsville Lake	Braxton	III	1979-90, 92-93, 95-99
East Lynn Lake	Wayne	V	1972-93, 95-99
Stonecoal Lake	Lewis, Upshur	III	1972-86, 89, 91-92, 94-99
Stonewall Jackson Lake	Lewis	III	1993-99
Sutton Lake	Braxton	III	1961, 63-64, 66-72
Tygart Lake	Taylor	I	1973

Small Impoundment	County	District	Years Stocked
Baker Lake	Ohio	I	1973
Bear Rock Lake	Ohio	I	1963, 66, 71, 73-75, 78-84, 86-92, 94-95, 97
Berwind Lake	McDowell	IV	1963, 73
Burches Run Lake	Marshall	I	1973-75
Castleman Run Lake	Brooke, Ohio	I	1971, 73, 75
Charles Fork Lake	Roane	VI	1980-83
Cacapon State Park Pond	Morgan	II	1966
Conaway Run Lake	Tyler	VI	1970, 73, 79
Dents Run Lake	Marion	I	1973, 75-76
Hawks Nest Lake	Fayette	IV	1967-69
Hurricane Lake	Putnam	V	1980
Krodel Lake	Mason	V	1970-71, 73, 76, 79
Laurel Lake	Mingo	V	1961, 71
McClintic Ponds	Mason	V	1965-66, 70-71, 73
New Lake on Middle Island Creek	Doddridge	VI	1970
Pennsboro Reservoir	Ritchie	VI	1973
Rock Lake	Ohio	I	1973
Saltlick Pond #9	Braxton	III	1973, 76-81
Sherwood Lake	Greenbrier	IV	1972
Smithburg Lake	Doddridge	VI	1970, 73
Stephens Lake	Raleigh	IV	1973
Tomlinson Run Lake	Hancock	I	1967-69
Turkey Run Lake	Jackson	VI	1970, 73, 93
West Union Pond	Doddridge	VI	1970
Wolf Run Lake	Marshall	I	1993
Wood Pond	Ohio	I	1973
Woodrum Lake	Jackson	VI	1990-99

Waters Historically Stocked with Tiger Muskellunge

Stream or River	County	District	Years Stocked
Buffalo Creek	Marion	I	1977, 82, 86, 91-96, 98-99, 01
Coal River	Kanawha	V	1978-83, 85-86, 89-96, 98-01
Fishing Creek	Wetzel	I	1991, 93-95, 98-01
Guyandotte River	Cabell	V	1978-82, 85, 93-96
Little Kanawha River	Braxton, Gilmer, Wirt	VI	1977-81
Middle Island Creek	Doddridge, Tyler	VI	1979-81
Shenandoah River	Jefferson	II	1982, 84, 93-94
South Fork of Fishing Creek	Wetzel	I	1975
Tomlinson Run Backwaters	Hancock	I	1977
Tug Fork River	McDowell, Mingo	IV, V	91-96, 98, 01
Tygart River	Randolph	III	1977-80, 82
Tygart River Backwaters	Randolph	III	1978

Reservoir	County	District	Years Stocked
Beech Fork Lake	Wayne	V	1983-86, 89, 91-96, 98
R.D. Bailey Reservoir	Mingo, Wyoming	IV, V	1980-84, 86, 90-96

Small Impoundment	County	District	Years Stocked
Athens Lake	Mercer	IV	1979-84, 86
Big Ditch Lake	Webster	III	1978, 91-99, 01
Burches Run Lake	Marshall	I	1992-97
Castleman Run Lake	Brooke	I	2006
Charles Fork Lake	Roane	VI	1974, 84, 86, 91-02, 06
Conaway Run Lake	Tyler	VI	1975, 77-79
Curtisville Lake	Marion	I	2005
Dog Run Lake	Harrison	I	2006
Dunkard Fork Lake	Marshall	I	2006
Huey Run Lake	Marion	I	2005
Hurricane Lake	Putnam	V	1974
Kimsey Run Lake	Hardy	II	1999-01, 03
Krodel Lake	Mason	V	1974
Middle Wheeling Creek Lake	Ohio	I	2006
Mountwood Lake	Wood	VI	1986, 91-06
O'Brien Lake	Jackson	VI	1991-98
Pennsboro Reservoir	Ritchie	VI	1977, 81-84, 86, 91-00
Ridenour Lake	Kanawha	V	1977-83
Sherwood Lake	Greenbrier	IV	1979-84, 86, 91-96, 98, 01, 03
Silcott Fork Lake	Roane	VI	1984, 86, 91-98
Stephens Lake	Raleigh	IV	1975, 77-84, 86, 91-03
Teter Creek Lake	Barbour	I	2004-05
Tomlinson Run Lake	Hancock	I	1968, 75, 77, 06
Turkey Run Lake	Jackson	I	1983, 93-94, 96, 99
Warden Lake	Hardy	II	2002
Wolf Run Lake	Marshall	I	1983, 86, 93-96, 99

Waters Historically Stocked With Northern Pike

Stream and Rivers	County	District	Years Stocked
Crab Creek	Mason	V	1974
Crooked Creek	Mason	V	1974
Cross Creek	Brooke	I	1977-78
Fishing Creek	Wetzel	I	1989, 91
Ohio River	Entire River	I, V, VI	1974-86, 91-01
Proctor Creek	Wetzel	I	1982-83, 89
Sutton Marsh	Braxton	III	1967
Tygart River	Randolph	III	1979
Tygart River Backwaters	Randolph	III	1978

Reservoirs	County	District	Years Stocked
Cheat Lake	Monongalia	I	1974, 79-84, 89-97

Small Impoundments	County	District	Years Stocked
Bear Rock Lake	Ohio	I	2000-01
Big Run Lake	Marion	I	1981-01
Burches Run Lake	Marshall	I	1976-97
Cameron Lake	Marshall	I	1997-01
Castelman Run Lake	Brooke, Ohio	I	1976-01
Curtisville Lake	Marion	I	1991-99
Dents Run Lake	Marion	I	1977-78, 80-85
Dog Run Lake	Harrison	I	1979-84, 88-00
French Creek Pond	Upshur	III	2000
Huey Run Lake	Marion	I	1976, 79-00
Krodel Lake	Mason	V	1979-86, 89-90, 92-96
Lumberport Lake	Harrison	I	1983-94, 00
McClintic Ponds	Mason	V	1983-84, 86, 89-99
Middle Wheeling Creek Lake	Ohio	I	1980-95, 97-01
Ridenour Lake	Kanawha	V	1983
Sleepy Creek Lake	Berkeley	II	1979, 91-92, 98, 04
Tomlinson Run Lake	Hancock	I	1977-97
Turkey Run Lake	Jackson	VI	1974, 76, 79, 81, 83-84, 86, 89, 92-99
Warden Lake	Hardy	II	1995-01, 04