Coldwater Fisheries Management Plan

Executive Summary

New Jersey Department of Environmental Protection

Division of Fish and Wildlife

Bureau of Freshwater Fisheries

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Overview

Trout management in New Jersey dates back to the late 1800's when the New Jersey Fish Commission planned to re-stock natural trout streams believed to have been decimated by a severe drought. The state's first fish hatchery was constructed in 1912 to produce trout in response to a growing demand. Since that humble beginning, trout management within the state has evolved into efforts to protect water quality and in-stream habitat from widespread development and enhance seasonal and year round trout fishing opportunities for anglers through two modern fish culture facilities. Anglers help support agency research and management activities through the purchase of fishing licenses. While many of the Division's management efforts benefit the angler, the state's eight million residents also reap the benefits of resource protection and preservation efforts. In addition, the pursuit of freshwater fishing in New Jersey generates over 138 million dollars annually into the state's economy. Trout are widely recognized as indicators of high water quality and habitat and an important recreational game fish. Efforts to conserve, protect, and manage trout and their habitats are beneficial not only to other aquatic organisms that co-exist with trout, but to downstream biotic communities as well.

Despite the long history and evolution of trout management within the state there has never been a long term, strategic plan formulated to address the myriad of issues surrounding the state's fragile coldwater resources. The lack of long range goals and objectives leads to a "reactionary" approach to fisheries management. Considering that New Jersey is the fourth smallest state in the union, the most densely populated, and is currently undergoing rapid changes in land uses the development of such a plan is crucial to providing for the long term protection of coldwater resources and providing for its most optimal use. The plan also coincides with the Department's on-going initiative in protecting the state's waterways. This initiative most recently resulted in substantially increased buffers on trout production streams through changes in Stormwater Management rules. These rules, the most comprehensive and protective of any state's, protect the water quality and critical habitat of many indicator species inhabiting these waters.

For the first time an information base pertaining to New Jersey's trout resources has been compiled into one reference document. It addresses habitat, wild trout, fish culture, regulations, communication, funding and strategic planning. This information will be useful to a broad audience that includes resource managers and regulators, anglers, conservation organizations, and landowners. This plan not only documents the evolution of trout management practices over the last century, but it also identifies coldwater issues, goals and strategies in the areas of fish culture, habitat protection, fish health, regulations and stocking practices. Most importantly, it also provides a mechanism for implementing these strategies by establishing an operational plan. This plan is not static and should be considered a work in progress, subject to change as warranted by changes in environmental or social pressures on New Jersey's coldwater resources, or advances in fisheries management techniques.

Life History and Ecology

Trout (salmonids) are well known for their high water quality and habitat requirements throughut their various life stages which make them a useful indicator of stream health. It is important to note however that within these stream habitats reside a diversity of other aquatic organisms with similar affinities for good water quality and in-stream habitat. The salmonid family of fishes is represented in New Jersey by four species: brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*), rainbow trout (*Oncorhynchus mykiss*) and lake trout (*Salvelinus namaycush*). Of these four only the brook trout is native to New Jersey. However, historic stocking practices dating back to the late 1800's have resulted in the establishment of reproducing populations of brown and rainbow trout in a number of suitable New Jersey streams. Lake trout was more recently introduced (1977) and is currently confined to two reservoirs. Only the brown trout is considered to be an exotic species since its original descendents were of European ancestry. Rainbow trout and lake trout are considered non- natives.

The distribution of the three stream-dwelling trout species can generally be related to the physiography of the state. The majority of New Jersey's trout streams flow through two northern physiographic provinces, the Ridge and Valley Province and Highlands Province and a portion of the adjacent Piedmont Province (Figure 1). Headwater streams in these areas are typically cool, clear, and high gradient in nature with rock cobble substrate conducive to trout and trout associated species. However, trout production and trout maintenance stream segments are not always in stream headwaters. As in the case of the Lamington (Black) River, sluggish upstream reaches are classified as nontrout, while trout maintenance and trout production segments are found in steep downstream gorges. Scattered trout populations are found in central and southern New Jersey (Inner and Outer Coastal Plain Provinces), but the number of trout streams in central and southern New Jersey is severely limited due to lack of suitable habitat.

Where several salmonid species co-inhabit a stream, their populations tend to be longitudinally distributed through the stream system. Brook trout typically inhabit the colder, less productive headwater areas, and overlap downstream with rainbow and brown trout. Brown trout are often found in the lower gradient downstream areas.

In addition to naturally occurring trout populations, the Division of Fish and Wildlife distributes over 770,000 brook, brown and rainbow trout into over 200 waterbodies across the State, each year (Figure 2). Many of these waters are not conducive to the long-term survival of trout, however, some are able to support trout round year and have reproducing trout populations.

New Jersey's trout streams are generally characterized as cool, clear, waters with a coarse substrate. The majority of these streams flow through the two northern physiographic provinces, the Ridge and Valley Province and Highlands Province and a small portion of the adjacent Piedmont Province (Figure 1). Headwater streams in these areas are typically conducive to trout and trout associated species. Cover, which can be presented in many forms, is an important habitat component for trout. Diverse in-stream habitat

represented by a mix of pool, riffle and slow moving deeper areas known as runs are also important for various life stages.

Loss of habitat, reduced flows, sedimentation, and increased temperatures from resulting land use changes are just a few of the problems facing New Jersey's trout populations. Brook, brown and rainbow and slimy sculpin are intolerant of habitat and water quality impacts making them quite useful as indicators. The State's current stream classification system is based on the presence of trout and trout associated species. Although trout production streams receive additional protection through the State's Land Use Program and Surface Water Quality Standards impacts from land use changes are not prevented. The cumulative effect of these impacts is not always obvious, in that there is direct mortality, nonetheless, they have significant and long-term detrimental impacts to fish populations. Understanding the specific chemical, physical and biological needs of trout through their various life stages is essential as this information will provide the basis for the development of specific protective and/or corrective measures for damage to trout streams.

Classification of New Jersey Waters

The high water quality and habitat standards necessary for the survival and successful reproduction of trout have made them a useful indicator of stream health. In 1968, the process of identifying and classifying New Jersey waters according to their suitability to support trout was initiated by the Bureau of Freshwater Fisheries under Federal Aid Grant F-48-R. Over the course of the next five years a classification system for New Jersey waters was developed based upon sampling completed under this study.

Lakes are classified as trout maintenance or nontrout according to their ability to support trout year round. Trout survival in lakes is dependent upon summer water quality conditions, which can reach critical levels during the summer months. Lakes are surveyed mid-August when maximum annual temperature levels are reached and dissolved oxygen levels are typically at the lowest levels. To support trout lakes must have, throughout the year, a layer of water with favorable conditions of temperature (21° C or less) and dissolved oxygen (4 mg/l or greater). Surveyed lakes which meet these criteria are classified as trout maintenance.

Streams are classified based on the documented occurrence of natural reproduction, and the presence or absence of trout and/or trout associated species. Streams which lack naturally reproduced trout in their first year of life are classified as trout maintenance or non-trout based upon the streams total fish population.

> **Trout Production** – Young-of-the-year trout must be documented within the sampled stream segment. Young-of-the-year (y-o-y) trout can be visually distinguished from older trout in the field, based upon their size (typically less than 100 mm in length.
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> **Trout Maintenance** – Incidence of Occurrence of trout and/or trout associated species > 20 %.

Non–Trout - Incidence of Occurrence of trout and/or trout associated species < 20%.

The *Incidence of Occurrence* was initially developed based upon fisheries data collected during the trout classification study in 1968 – 1971. It was later modified in 1973 as sampling efforts continued and additional data became available. The number of incidences that the species was found to inhabit a stream with a naturally reproducing trout population was proportionally compared to the total number of stream segments the species was found to occur. The result was an Incidence of Occurrence, expressed as a percentage, for that particular species with reproducing trout populations. The higher the *Incidence of Occurrence* the greater the species' "association" with trout.

Table 4 within the Classification section of this plan has the assigned *Incidence of Occurrence* (I.O.) value for commonly encountered fish species. A figure of 20% is the minimum occurrence with trout that would classify a species as being "trout-associated". To determine the Incidence of Occurrence of a particular sampled stretch the I.O. value for each species found is added and then divided by the total number of species present. A value of 20 % or greater yields a trout maintenance classification and a value less than yields non-trout.

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*. As the name implies, the *Surface Water Quality Standards* includes statements of policy, designated use classifications and corresponding water quality criteria, and surface water classifications. The Clean Water Act of 1972 protects waters based upon their pre-existing use, so although waters may suffer severe impacts from surrounding land uses ultimately effecting the biotic community its classification is never downgraded. The suitability of a waterway to support trout affects the stringency of the standards set. Trout production waters are awarded Category I status, one of the Department's highest levels of protection which mandates an anti-degradation standard for a number of identified water quality parameters. 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, waters continue to be classified today as well was as upgrades in classifications when justified by additional field investigation data collected by the Bureau. The official classification of waters is changed by the NJDEP's Bureau of Water Quality Standards and Assessment through an established rule making process.

Management of Habitat

Habitat characteristics play a key role in determining fish assemblages (diversity of fish species, species present, abundance and size). Habitat also influences biotic interactions (competition, predation) that affect fish communities. The future of coldwater fishes in

New Jersey, particularly salmonids, will depend heavily upon managing their habitat and sustaining the health of ecosystems critical to their survival. In the face of human activities that continually disrupt the natural processes occurring within watersheds, this will be at times a daunting task for resource managers. Threats to New Jersey's coldwater resources and the continued survival of trout are warm summer water temperatures and degradation of the physical features of stream channels due to the following:

Dams – An on-stream dam impounds water that becomes susceptible to warming during the summer. Dams are also barriers to fish migration – a particular concern for streams that have spawning populations of trout. Manmade dams are responsible for damaging trout habitat in more streams than would first seem apparent.

In-stream flow Maintenance of in-stream flows, particular during periods of drought, is a concern. Water withdrawals for agricultural and other uses that coincide with dry weather can diminish flows on streams whose flows are already reduced. See also "Dams".

Loss of wetlands and buffers These areas are invaluable in maintaining flow and filtering runoff. The loss or diminished function of these areas, particularly those closely associated with trout production streams, would be detrimental.

Loss of nearstream vegetation The removal or loss of nearstream vegetation, particularly on the headwaters of trout stream, can result in undesirable thermal warming patterns. Construction activities in stream corridors such as road widening, bridge and culvert construction, etc. have resulted in short term or permanent losses of nearstream vegetation. Livestock grazing that destroys nearstream vegetation, causing unstable banks, has been observed along trout production streams and could be prevented or minimized through fencing.

Roadway culverts Improperly designed or installed culverts can prevent or impede fish passage and can be particularly problematic during low and high flow situations. In-stream fish habitat can also be lost if native substrate is not re-established in the culvert

Nonpoint source pollution Land disturbances within the watershed can increase pollutants. Runoff from roadways and a variety of sources may not pass through quality basins or other filtering devices prior to entering the stream. Pollutants such as road salts, oil and grease, and other contaminants can be problematic for trout. Silt is frequently a primary constituent of nonpoint pollution and is a major threat to the state's trout resources.

Point source pollution Discharges emanating from a point sources, such as wastewater from treatment plants, noncontact cooling water, etc can cause summer thermal alterations and increased pollutant loads that can stress or kill trout.

Channelization, channel relocation and stream cleaning The first of these two activities are occasionally performed as part of stream crossing and road widening projects. Municipalities, county Mosquito Commissions, and farmers are probably most active in stream cleaning activities intended to improve runoff patterns. These small scale projects can cause localized damage by leaving a uniform stream bottom devoid of cover and structure for fish. Beneficial woody debris, that should be left in the stream channel unless causing a significant blockage, may often be removed under the guise of stream cleaning.

Global warming Climatic changes associated with global warming may pose a problem for those trout streams in New Jersey where summer water temperatures approach critical levels for trout survival.

Threats to important lake habitat include:

Eutrophication Man's activities in the watersheds of many New Jersey lakes has accelerated the rate of eutrophication which influences the availability of summer trout habitat.

Water level fluctuations The demand for water, particularly drinking water, will likely increase in the future and cause greater variability in the water levels of reservoirs that sustain trout year round. While not currently considered a significant problem, this has the potential to disrupt the fisheries in Round Valley and Merrill Creek Reservoirs.

Zebra mussel This invasive, exotic mussel has not been documented in New Jersey. However, New Jersey anglers boat in waters of other states (NY and PA) that contain this species and could unwittingly transport this undesirable bivalve mollusc to New Jersey.

Environmental regulations aid in balancing the needs of a natural environment with those of society. A variety of regulatory programs administered by NJDEP give special consideration to designated trout waters. The Land Use Regulation program through its stream encroachment and freshwater wetlands permits recognize the surface water classifications for trout production and trout maintenance waters, as well as trout-stocked waters. Additional protection is afforded by minimizing project impacts through design modifications, timing restrictions and increased buffer requirements. The Environmental Review Program staff within the Division of Fish and Wildlife review stream encroachment and freshwater wetland applications to minimize environmental impacts to for all waters of the state.

Management of Wild Trout

Currently nearly 1,000 miles of streams, or five percent of streams statewide, in New Jersey contain populations of wild brook, brown, and rainbow trout (Table 5). A

reproducing population of lake trout has been established in a 2,365-acre reservoir. Three watersheds, the Upper Delaware, upper Raritan (North and South Branches), and Pequannock are particularly rich in wild trout resources (Figure 4). On average 30 percent of the streams in these watersheds are inhabited by wild trout populations and statewide, 80 percent of the wild trout streams occur in these three watersheds (Table 5).

Of the four salmonid species that currently reproduce in New Jersey freshwaters, only the brook trout, whose ancestors colonized this region following deglaciation 12,000 years ago, is considered native to the state. Over the last century reproducing populations of three non-native trout species (brown, rainbow, and lake trout) have become established through stocking efforts intended to replenish depleted populations and enhance recreational angling. Although historical information regarding the occurrence of trout in New Jersey dates back to the late 1800's, organized scientific efforts to collect empirical data on wild trout populations did not begin until the late 1960's. From 1968 to 1972 a research study conducted by NJDFW documented the occurrence and distribution of trout statewide, including the occurrence of wild trout populations in 75 streams (or stream segments). Since then, NJDFW has conducted stream surveys annually to identify additional wild trout streams and occasionally monitor the status of previously documented wild trout populations. To date, reproducing salmonid populations have been documented in 175 streams or stream segments and one lake (Appendix B, Part II).

Wild trout require cold water temperatures year round and a rocky substrate suitable for spawning in order to survive and reproduce. The occurrence of these habitat essentials in New Jersey is strongly influenced by the temperate climate and physiogeography. Habitat suitable for wild trout populations can be found primarily in small streams scattered throughout the Appalachian foothills and mountains within two northern physiographic provinces (Ridge and Valley, and Highlands) (Figure 5). The elevation and topography associated with these regions help provide and maintain cold summer water temperatures (through springs and groundwater inputs) and good physical habitat (pools and riffles, rocky substrate). Over 90 percent of New Jersey's trout production streams are located in these regions and most can be characterized as freestone streams, steep to moderate gradient, variety of high quality in-stream habitat, low temperature, well oxygenated waters that are relatively unfertile. Physical habitat (pool depth and woody debris) is believed to have the greatest influence in fish size and abundance.

Management strategies for wild trout include; inventorying trout waters, research and monitoring activities, fishing regulations, habitat preservation, protection and restoration and education and communication.

Culture of Salmonids

Presently, the NJ Division of Fish and Wildlife owns and operates two state-of-the-art-facilities, the Pequest Trout Hatchery and the Hackettstown Hatchery. Together, they meet the State's demand for coldwater and warmwater fish species. The Pequest Trout Hatchery raises over 770,000 catchable brook, brown and rainbow trout annually and distributes them using a fleet of tank trucks equipped with on board aeration systems. The fish are distributed to over 200 lakes and streams during which over 1,000 stocking

points are visited. The Hackettstown hatchery is responsible for raising lake trout which are currently stocked in Merrill Creek Reservoir.

Annual production goals at the Pequest Trout Hatchery are satisfied by harvesting approximately 650,000 eggs from both brook and rainbow trout broodstock and 400,000 eggs from brown trout broodstock. The production cycle begins in early fall when eggs from the broodstock trout are collected and fertilized. This process, known as "stripping," is performed by manually applying pressure to the trout's abdomen, forcing females to expel ripe eggs and males to expel milt (the fluid containing sperm). The eggs and milt are mixed together in plastic basins to achieve fertilization. Fertilized eggs are then placed in incubators in the nursery building where running water, held at a constant temperature of 11°C (52°F), supplies them with dissolved oxygen until hatching occurs. Trout eggs incubated at this temperature hatch in about 30 - 35 days.

The overall hatch rate for all three species averages 65 percent. Upon hatching, the young trout are called "sac-fry" because the yolk sac, which nourishes the fry, remains attached to the trout's abdomen. The sac-fry are removed from the incubators and placed in fiberglass holding tanks in the main portion of the nursery building. The yolk sac is gradually absorbed by the sac-fry over a two-week period.

After the winter and early spring growing cycle, which has an 85-95 percent survival rate, the trout average three to four inches and are called fingerlings. The fingerlings are sorted by size and their numbers are reduced to allow the remaining production fish more room to grow. The smaller, surplus fingerlings are either stocked or used in inter-state bartering programs. The production fingerlings are then moved to a series of outdoor raceways that have been divided into "pools." Each pool is set up with 13,500 fish, with 19 pools each of brook and rainbow trout and ten pools of brown trout.

After the summer growing period, the fish are again sorted for size, and the larger fish are retained and used to re-set the raceways with a density of 12,500 fish per pool. Approximately 600,000 trout are set to ensure that the spring baseline trout quota of 575,000 trout, averaging 10.5 inches in length, will be achieved. Surplus fish resulting from this sort (approximately 48,000 fish, averaging 5.8 inches) are held and stocked during the third week of the fall trout-stocking program. The production fish are then fed four times daily. Inventories are conducted and feed totals are calculated monthly and used to adjust trout growth rates.

By mid March the production trout are nearly 1½ years old and weigh ½ pound apiece. Over the next ten weeks these fish are loaded onto trucks and stocked statewide under the spring trout-stocking program. During the three weeks of pre-season stocking, the excess and spent broodstock are also liberated along with the production stock until their supply is exhausted. Once these catchable-size trout are shipped, fingerlings that hatched from eggs collected the previous fall are quickly moved from the nursery into the raceways.

Lake trout are raised at the Charles O. Hayford Hatchery in Hackettstown. Unlike brook, brown and rainbow trout lake trout eggs are obtained from an outside hatchery source.

Eyed eggs are obtained from the Story Hatchery in Wyoming in mid-December. At this stage in egg development they can be handled and are sent overnight express to the Hackettstown Hatchery. During shipping the eggs are packed in a cooler with a layer of ice over top of them to keep them cool and moist. They arrive at about 40 degrees Fahrenheit and are then gradually warmed to 52 degrees by dripping water over them for a couple of hours. Next they are placed in tray style incubators where they remain for an additional fourteen days until hatch occurs.

Hatching usually takes place over a two to three day period and then the eggs are placed on retrays in a long, narrow trough. Over the next two weeks the sac fry feed off the nutrients contained in the sac they were born with. Toward the end of the two week period they become very active and begin to swim freely in the water column. This period is referred to as swim-up and they are fed a commercially prepared, high protein, high fat, pelleted feed. They grow approximately 0.75 inches per month and are periodically moved to larger tanks They are trained to feed in a 100 gallon trough for the first thirty days. Once trained, they are moved to a 350 gallon circular tank where they grow to about two inches. Next they are transferred to a 1000 gallon rectangular tank where they will grow to four inches. Finally they finish their growth to seven and a half inches in a 2000 gallon tank. All of this time is spent indoors, however, prior to 2000 much of their growing time was spent outdoors in covered concrete raceways. Under these outside conditions the fingerlings endured predation (birds, mink, and otter) and faced other natural problems like (heavy snows, flow problems due to leaf-clogged screens).

Fish Health

Although diseases and parasites of wild trout in New Jersey have not been widely studied, there is currently no evidence suggesting that pathogens threaten the long-term viability of these fish populations. However, diseases and parasites have been encountered throughout the history of public fish culture in New Jersey and have been problematic at times within the confines of the hatchery facilities. The NJDFW's Hackettstown Hatchery, continuously operated since 1913, experienced a variety of pathogen-related problems including some which are considered to be major obligate pathogens of salmonids (furunculosis, whirling disease, bacterial kidney disease, and infectious pancreatic necrosis).

In the early 1980's all of the salmonid production except lake trout shifted to the newly constructed Pequest Trout Hatchery, and pathogen-related problems at Hackettstown Hatchery subsided. Salmonid eggs from certified disease-free sources were used to commence production at the Pequest Trout Hatchery. Since 1985, when the initial egg stocks matured as broodstook, no additional eggs or fish from outside sources have been introduced into the Pequest Trout Hatchery. Outbreaks of bacterial gill disease and coagulated yolk disease have occurred at this hatchery, however mortality have never exceed 1 % of hatchery production. With the exception of two years, losses with coagulated yolk disease for the most part have been insignificant.

Currently, the only disease problems which have been associated with significant mortalities of trout at the Pequest Hatchery are bacterial gill disease and coagulated yolk disease. Bacterial gill disease is caused by common waterborne *Flavobacteria*, which infect gill tissue and cause disease under conditions associated with intensive rearing. It is not known to occur in wild fish. Mortalities among Pequest Hatchery stocks have been controlled by chemotherapy and by alteration of environmental conditions (improved sanitation and increased water flow). Mortalities due to bacterial gill disease have never exceeded 1% of production in any given year, and its impact on the trout-rearing program at the Pequest Hatchery has been minimal.

Coagulated yolk disease is a poorly understood syndrome affecting eggs and fry. The cause of the disease has not been clearly defined and the disease may be caused by different factors or conditions in different hatcheries where it occurs. Although a chronic problem in brook trout at the Pequest Hatchery since 1984, losses have generally been insignificant in terms of their impact on hatchery production. An exception occurred in 1991 and 1992 when losses among swim-up fry exceeded 90%. Subsequent investigations have failed to identify the cause; however, alteration of egg incubation procedures has resulted in a greatly reduced incidence of coagulated yolk disease in the years since 1992.

Procedures and policies have been developed to prevent or minimize the introduction and transfer of pathogens within the NJDFW's fish culture operations and in wild fish populations. Measures taken at the Pequest Trout Hatchery include restriction of visitors to peripheral areas of the facility, exclusion of outside equipment and vehicles from the nursery and raceway area, and disinfection of any essential equipment which must be brought in from other areas.

Management of Cultured Trout

Angler demand for trout challenges fishery managers to develop programs and strategies aimed at providing this user-group with a satisfying angling experience. Trout propagated in a hatchery setting provide resource managers with an effective management tool for creating and enhancing recreational coldwater fisheries. The NJDFW propagates trout at two facilities, the Pequest Trout Hatchery (primary facility) and the Charles O. Hayford Fish Hatchery at Hackettstown. Cultured (hatchery-reared) brook, brown, rainbow, and lake trout are stocked in a variety of settings and seasons and provide the major opportunity to fish for coldwater species statewide, both seasonally and year round. Results from a survey of 800 anglers in 2003 indicated that 47 % of anglers purchased a trout stamp. As expected the vast majority of trout anglers, 84 %, fished for trout during the spring period. 74 % of trout anglers, during the same survey, indicated that they fished strictly for stocked trout.

In 2002 over 750,000 catchable and sub-catchable trout were reared and stocked during the spring, fall, and winter. This stocking program has an associated economic cost and must be managed to provide the most benefit to the angling community.

Cultured trout in New Jersey are presently managed according to two general management strategies:

Put-and-Take

Catchable-size brook, brown, and rainbow trout are stocked for immediate harvest to provide a short-term, seasonal fishery. Survival of these trout through the summer period is not expected (or poor) because suitable summer trout habitat (temperature < 21°C and dissolved oxygen > 4 mg/L) is absent, marginal, or sporadic. The trout-stocked waters managed under this stocking strategy include park ponds, shallow lakes, and warmwater streams. These waters are stocked in the spring and may be stocked again under the fall or winter program.

Put-Grow-Take

Brook, brown, rainbow, and lake trout are stocked for immediate and/or delayed harvest to provide a long-term, year-round fishery. Suitable habitat is consistently available to sustain trout throughout the year such that survival and growth of unharvested, stocked trout over more than one growing season is expected. Trout-stocked waters managed under this stocking strategy include coldwater streams and deep lakes that are capable of supporting trout year round, where wild trout populations are limited or absent. These waters are stocked in the spring and may be stocked again under the fall, winter, lake trout, and sea-run brown trout programs.

The NJDFW trout stocking program for catchable trout currently includes a spring, fall and winter component. The spring stocking program is by far the largest and most popular of the three, but fall and winter stockings programs are successful in providing additional opportunities for New Jersey anglers.

Spring Program - Approximately 575,000 catchable-size brook, brown, and rainbow trout (10.5-inch average size) are reared annually for the spring program. These trout are liberated over a ten-week period in 200 ponds, lakes, and stream segments statewide. A three-week "pre-season" period precedes the "opening day" of the trout season in April, during which most trout-stocked waters are closed to fishing and are heavily stocked. A seven-week "in-season" period follows opening day during which the frequency and quantity of trout stocked decreases incrementally for most waters. During the spring period, the harvest of trout is encouraged in most of these waters through a liberal harvest regulation (6 trout per day, 7-inch minimum size).

Trout species that have the least impact upon the resident fish population, and provide the highest survival and angler catch rates, are selected for stocking. For many waters, the species selection is not critical and brook, brown, and rainbow trout may be stocked in any combination. However, in these situations brook trout are typically stocked early on because their willingness to bite usually results in high angler catch rates and satisfaction on opening day. By the 1st or 2nd week following opening day, when the hatchery supply of available brook trout has been exhausted, rainbow trout are then stocked. Towards the end of the spring stocking season (4th or 5th week), brown trout are stocked. Most waters stocked

late in the season are generally capable of supporting trout year round and brown trout survival rates in these waters are generally better than the other two species.

Fall Program - In October, as surface waters begin to cool, rainbow trout are stocked to entice anglers to return to trout fishing. The 2003 angler survey found 47 % of trout fisherman fished during the fall. Approximately 45,000 yearling rainbow trout, averaging ten inches, are released in 16 northern and central-coastal streams and 16 southern ponds and lakes (Figure 11).

All streams with designated in-season stocking closures for the spring trout stocking program are stocked during the fall period. In addition, the Maurice River and 16 ponds/ lakes located in the southern portion of the state are also stocked to provide for a more equitable distribution of trout fishing opportunities across the state.

Winter Program - The Winter Trout Program was initiated in 2000 to add variety to the Division's trout program by offering anglers the opportunity and incentive to venture forth and brave the winter elements in pursuit of trout. 24 lakes and ponds scattered throughout the state are stocked with 12,000 catchable-size rainbow trout (11-inch average size).

Stocking programs for sub catchable trout include the sea run brown trout program, lake trout and stocking of surplus fingerlings.

Sea Run Brown Trout - 18,000 to 30,000 eight-inch brown trout are stocked late October in the tidal freshwater and brackish portions of the Manasquan River, an Atlantic coastal stream in Monmouth County. The trout are surplus browns from the May sorting period. To date, there have been more than 80 catches of sea-run trout ranging in size from 2 - 8 pounds.

Lake Trout Program – Currently only Merrill Creek Reservoir is stocked with lake trout. Round Valley Reservoir was stocked from 1979 to 1995 when sufficient natural reproduction within the reservoir could support the popular recreational fishery. The objective of the program was toprovide anglers with an opportunity to fish for this salmonid species outside of its natural range. Surplus fish have also been stocked in Lake Hopatcong, Swartswood Lake and Wawayanda Lake. These fail to meet all the criteria necessary to sustain a good population of lake trout and it is not surprising these stockings failed to produce even a marginal fishery

Surplus brook, brown, and rainbow fingerlings - Overproduction of cultured trout is a necessary safeguard against unforeseen problems that can and do occur under intensive culture conditions in order to consistently meet the targeted quota necessary to implement current Division stocking programs. At predictable times of the year the Pequest hatchery has excess trout which must be removed from the production cycle in order to ensure that the production capacity of the hatchery is

not exceeded. This overproduction of trout can be broken down into three categories:

1) Spring Fingerlings (3-4" average size)
   Midway through the spring stocking season the hatchery begins the process of sorting fingerlings and setting them up in raceways for the following spring. The excess fingerlings resulting from this sorting procedure are available for stocking by May. These fish may be used to initiate new stocking programs, barter with other state and federal agencies, stocking in large trout maintenance waters or usedas forage for other cultured fish species.

2) Spring Catchables (10.5" average size)
   Near the end of the spring stocking season, catchable trout in excess of the 575,000 baseline quota are available for stocking. These trout are kept in reserve until weeks 6 & 7, as a safeguard against unforeseen problems that may arise early on in the spring stocking program. These fish are stocked primarily in waters that support trout and provide a trout fishery year round. They are stocked during weeks 6 & 7 of the spring stocking season.

3) Fall Sub-catchables (5 – 7" average size)
   Early in the fall the sorting process is again conducted, resulting in excess trout (termed "surplus") which are typically stocked the third week of the fall stocking period. Stocked during week 3 of the fall stocking season.

Allocation Methodology for Cultured Trout

Prior to 1990 the statewide allocation of trout to nearly 200 waters was based upon an entrenched tradition that relied heavily upon political boundaries. The trout-stocked waters in each of the state's 21 counties had an assigned quantity of trout. Each year these "quotas" would be reviewed by members of the Fish and Game Council who, in consultation with county representatives from the NJ State Federation of Sportsmen, had the discretionary power to allocate and redirect spring-stocked trout. If waters or stocking points were added or dropped from a particular county, the trout would typically be redistributed among the remaining trout-stocked waters within that county. In the absence of defined allocation guidelines, haggling for trout inevitably occurred and over time resulted in noticeable inequities that were difficult to change. Variable production and quality of trout reared at the aging Hackettstown Hatchery further complicated this annual allocation process.

When the Pequest Trout Hatchery became operational in the mid-1980's, the production of brook, brown, and rainbow trout shifted from the Hackettstown Hatchery to Pequest. The modern facility at Pequest provides New Jersey anglers with a dependable supply of quality, catchable-sized trout. In response to a more stable supply of cultured trout, the Division sought a means to more equitably distribute trout statewide. Considerable trial

and error was involved in developing a methodology that was both resource and user-based, yet maintained existing, desirable allocation patterns. Public input was solicited on the new "Trout Stocking Improvement Plan", which included the allocation methodology and several regulatory modifications (creation of Wild Trout Stream and Trout Conservation Area regulations). The Fish and Game Council subsequently approved the methodology and regulatory changes and they were implemented in the spring of 1990.

The allocation methodology uses a combination of biological, physical, and social factors to determine the spring trout allocations over a 10-week period for each trout-stocked water. A computerized database containing data for each stream, lake, and pond is used in conjunction with formulas to calculate individual weekly allotments. The database is annually reviewed and updated by the regional fishery biologists, who receive input from conservation officers, stocking crews, the NJ Fish & Game Council, and the general public.

Fishing Regulations

The regulation of angling activity is an important tool used by resource managers to protect and enhance the fishery resource for the benefit users. Each year New Jersey's freshwater fishing regulations are adjusted based upon biological findings, changing conditions, and angler preferences. The state Fish and Game Council is responsible for proposing and adopting the Fish Code, a legal document that specifies the freshwater fishing regulations that anglers must follow while fishing. Regulations should not be overly complex and a recent survey indicated that 84% of New Jersey anglers found the freshwater fishing regulations to be clear and easy to understand. Conservation Officers enforce the fishing regulations by conducting patrols by vehicle, foot, or boat to detect or deter violations.

New Jersey trout regulations can be separated into three categories that are referred to as general, special, and boundary water regulations. The statewide general trout regulation governs the majority of trout fishing activity statewide and separates trout-stocked waters into those with and without closed in-season stocking dates. The special regulation trout areas (wild trout streams, trout conservation areas, fly fishing only waters, trophy and holdover trout lakes) provide anglers with alternative opportunities to fish for trout under more restrictive conditions. Special regulation waters characteristically support trout year round and are managed through regulation to enhance the fishery and/or angling experience. In addition to the general and special regulations, waterbodies whose boundaries are shared with adjacent states, and thus in need of regulatory uniformity, have separate fishing regulations.

Each regulation is comprised of four components (seasons, creel limits, length limits and gear restrictions) that vary by regulation type. Some regulations are predicated on traditions established long ago, while others reflect more recent changes in resources and angler attitudes. Although each trout regulation provides a different angling opportunity, the lack of measurable objectives hampers efforts to evaluate regulation success and need for change.

General Trout Regulation - Trout may be harvested year round from all waters statewide (excluding those designated under special trout regulations) except during the three-week pre-season period. The daily creel limit allows anglers to take six trout from opening day through May 30th, which encompasses the seven-week stocking period that follows opening day. From June 1st to the start of the preseason closure the following year (mid-March) the daily creel is reduced to four trout. The reduction in the daily creel later in the spring is intended to spread out the harvest of the trout resource whose numbers have gradually dwindled since opening day as stocking is scaled back. Waters may be replenished with trout through the fall and winter trout stocking programs.

Wild Trout Stream Regulation- Fishing was permitted year round in designated streams with harvest allowed from opening day in April through September 15th. The reduced creel limit (two trout per day), coupled with a minimum harvestable size (seven inches), harvest season, and gear restrictions (artificials only) were intended to allow for a reasonable use while protecting the population from overharvest.

Currently there are 35 streams (or portions thereof), flowing through both publicly and privately owned lands, that are regulated as *Wild Trout Streams* (Figure 14). This figure represents 20 percent of the streams that have been identified as having reproducing trout populations. Private ownership can and does limit the ability of an angler to legally access some of these streams. Angling activity on most of the *Wild Trout Streams* is believed to be low with the majority of anglers practicing catch-and-release fishing.

Year Round Conservation Areas – This regulation allows anglers to fish year round with artificial lures only, and retain one trout 15 inches or greater per day, except during the traditional 3 week pre-season period and in-season stocking closures all trout caught had to be immediately released. Stocking was curtailed in the spring, with catchable trout (averaging 10.5 inches) stocked once pre-season and twice in-season (Weeks 3 and 7). Four stream segments, encompassing almost nine miles of stream, are currently covered by the *Year Round Trout Conservation Area* regulation (Figure 15). These areas are considered primarily catch-and-release fisheries because of the low daily creel limit and high minimum harvestable size of 15 inches.

Seasonal Trout Conservation Areas - This seasonal regulation allows anglers to fish without gear restrictions on opening day and the following six weeks. Therefore, anglers who fish with bait, and those who enjoy creeling trout, are not displaced during this six-week period, when trout fishing is most popular. Thereafter only artificial flies and lures may be used (no artificial bait scent allowed). Trout are stocked weekly in the spring on two rivers (Musconetcong and Pequest) that are also designated with closed in-season stocking dates, and less frequently on the Pequannock River (six times in-season). Three stream

sections, encompassing 3.4 total stream miles are currently designated under the *Seasonal Trout Conservation* Area regulation.

Fly Fishing Only Area Regulation - Since 2002 only the Big Flatbrook section (four miles), which includes the ½ mile Blewett Tract stretch, has been retained under the *Fly Fishing Only Area* regulation (Figure 17). The statewide general regulations, with respect to minimum size and daily creel, apply (six per day from opening day through May 31st, and four daily thereafter, closed to fishing the three weeks prior to opening day). On opening day, and the next eight days thereafter, there are no gear restrictions, except on the Blewett Tract. The remainder of the year anglers may only use fly fishing equipment and artificial flies (no bait scent). The stream is stocked weekly during the seven weeks following opening day and is closed to fishing on the scheduled stocking dates (*see Trout Stocked Waters with Closed In-Season Stocking Dates*

Trophy Trout Regulations - Two lakes, Round Valley and Merrill Creek Reservoirs, are currently designated under the *Trophy Trout Lake* regulation. Trophy trout lakes carry a 15 minimum size limit on brown and rainbow trout with a creel of 1 fish per day. Round Valley has a 20" size limit on lake trout with 1 fish per day, Merrill Creek has a reduced size limit of 15" but an increased creel of two.

Holdover Trout Lake Regulation - Currently there are seven waterbodies covered by the *Holdover Trout Lake* regulation in the northern part of the state. *Holdover Trout Lakes* carry a reduced creel of 2 fish per day, from January 1 to May 31, and then 4 fish are allowed until December 31. The lakes are catch and release only during the pre-season stocking period. These lakes are stocked annually in the spring with catchable brown and rainbow trout (10 – 11 inches). Large brood stock trout are not stocked because the stocked catchable trout are able to survive year round and grow to a large size by foraging upon alewives.

Boundary Water Regulations – Specific trout regulations have been established for the Delaware River and Greenwood Lake. Neither are currently stocked with trout but regulations have been established for uniformity.

The Bureau of Freshwater Fisheries working in conjunction with the Fish and Game Council continually evaluates current regulations to be certain they provide pleasurable fishing experiences while providing a desirable level of protection to the resource.

Funding

The Division of Fish and Wildlife unlike other Department of Environmental Protection agencies is funded through dedicated funds generated from the sale of hunting and fishing licenses and permits. Revenues generated from license and permit sales comprise over 70 % of the Division's budget. In addition, the Division receives Federal Aid monies generated from excise taxes on hunting and fishing equipment (Dingell-Johnson Act (1950)). 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. In addition, wildlife associated recreation generates $ 2.2 billion dollars into the state's economy each year, with an estimated 300,000 freshwater anglers (resident , non-resident and unlicensed anglers) generating $ 138 million dollars alone.

Two Division programs, Marine Fisheries and the Endangered and Nongame Species Program, receive money from alternate funding sources. The Endangered and Nongame Species Program is funded only through a check-off on state income tax return forms, Federal grants, and the sale of Conserve Wildlife license plates. Although New Jersey's endangered and nongame wildlife generates millions in ecotourism, there is no stable, dedicated source of funding to ensure their protection.

The Marine Fisheries Program receives only a small fraction of its total funding from license and landing fees. The marine fish and shellfish programs, which help generate billions in economic benefits to the state, are supported with only a $ 1.3 million state appropriation. They are the only Division program area which receives general treasury funds on an annual basis. During 2001, the Marine Fisheries Administration budget totaled approximately $ 3.0 million. This includes $ 1.3 million in state apropriation, $ 1.6 million in Federal grants and $ 250,000 in finfish and shellfish license fees. Of the 14 Atlantic coastal states, New Jersey is third in recreational importance and sixth in commercial importance when ranked in value of its fisheries. However, it ranks 12th in the amount of State funding for marine programs.

Over 70 % of the Division's annual budget is generated from the sale of hunting and fishing licenses and permits. Revenues collected are deposited in a dedicated account known as the Hunter and Angler fund. The sale of freshwater fishing licenses and trout stamps currently generates over $ 4 million dollars annually, while hunting licenses and permits generate approximately $ 4.5 million.

Since 1991 there has been a 41 % decline in fishing license sales. Considering within this same time frame New Jersey anglers have benefited from successful management and stocking programs which have led to opportunities for walleyes, tiger muskies, northern pike, and muskellunge, in addition to an already successful trout stocking program, makes this decline even more disturbing. Fishing literally in New Jersey has never been better, yet participation continues to decline. A survey of anglers, completed in August of 2004, indicated that time constraints, either family or work related, were the primary reasons people did not purchase a license in 2003. Only 2 % of anglers indicated that cost was the reason they did not purchase a license in 2003. The survey also indicated that 40 % of anglers fished less than 20 times a year, with 22 % fishing 9 days or less. As anglers find less and less time to fish the cost of a license may influence their decision to purchase a license in the future.

The future of many of the Division's programs will depend on increasing recreational participation in fishing and hunting or identifying untapped funding sources.

Goals and Objectives

Despite the long history and evolution of trout management with the State of New Jersey there has never been a long term, strategic plan formulated to address the myriad of issues surrounding the state's fragile coldwater resources. The lack of long range goals and objections leads to a "reactionary" approach to fisheries management. The first phase of implementing a strategic approach to effective management, regardless of topic area, is the identification of specific goals. Identified below are goals as they relate to the Division's activities on coldwater management. Strategies for achieving the desired goals are then established with specific opportunities identified for implementation. These opportunities are identified throughout the plan and are a fitting example of the variety of issues facing the state's aquatic resources today. A timeline for the implementation of specific strategies and opportunities is found in the operational plan.

GOAL 1 ***Protect, restore, and enhance coldwater fish habitat and ecosystems.***

GOAL 2 ***Conserve and enhance wild trout populations at optimal levels.***

GOAL 3 ***Provide and promote a diversity of recreational angling opportunities for trout statewide.***

GOAL 4 ***Maximize the recreational use of trout through the appropriate use of fishing regulations.***

GOAL 5 ***Enhance and expand recreational angling opportunities for trout through the use of cultured trout***

GOAL 6 ***Educate and communicate with the public to increase awareness of the values and needs of coldwater fishes and promote recreational fishing opportunities***

Operational Plan

The success of any strategic plan is measured by the implementation of identified goals and strategies. A well developed operational component is an integral component to any successful strategic planning document regardless of topic area. The operational segment serves as a work plan for prioritizing goals and strategies, identifying steps for implementation and a time frame of completion. The failure of many strategic documents is that they often lack well developed work plans which identify the steps necessary to achieve desired goals as well as establish reasonable time frames for completion.

The work plan provides the framework of Bureau activities, as they relate to the State's coldwater resources, for the next five years. It also identifies long range activities which may be implemented at any time depending on available resources. It should be noted that the activities included within this work plan are in addition to the countless activities

which are carried out day to day in the overall management of the state's coldwater resources.

The first phase of implementation of a strategic plan relative to the state's coldwater resources is the adoption of the plan itself. The Coldwater Plan is being released to the public in a draft format to solicit input from the various angler groups, conservation and interested stakeholders prior to finalization. This allows the general public to play a major role in the direction of the management of the State's coldwater resources in the future. Comments and issues raised will be incorporated into the final document.

Depicted below is the workplan for calendar year 2004, workplansfor subsequent years, as well as long range goals can be found in the full version of the management plan.

CY 2004

Adoption of the Coldwater Fisheries Management Plan also includes the adoption of several policies outlined within the document. These include the Fish Health Policy, Pequest Hatchery Access Policy and Wild Trout Policy.

Schedule for the Adoption of the Coldwater Fisheries Management Plan:

❖	**Action**	**Schedule**
✓	Complete draft of the Coldwater Management Plan	January 2004
❖	Review by Division Administration	January 2004
❖	Review by Fish Committee	January 2004
❖	Review by Fish and Game Council	February 2004
❖	Release to general public	February 2004
❖	Public comment period	Feb – May 2004
❖	Incorporate comments and finalize plan	Sept – Dec 2004
❖	Adoption Coldwater Management Plan	January 2005

Opportunity - Determine if populations of wild (heritage) brook trout inhabit New Jersey waters and develop strategies to conserve and protect this native fish and its habitat.

Strategy 2.2 Develop management strategies to assure the protection of the State's valuable wild coldwater fish populations.

Waterbodies Involved: Mason's Run, Forked Brook, Kurtenbach's Brook, Independence Creek, Halfway House Brook, Cresskill Brook, Havemayer Brook, Crooked Brook, Preakness Brook, Oakdale Creek, Hacklebarney Brook, Kruegers Creek, Rocky Run, Turkey Brook, Trib to S/Br Raritan (S. of Hoffmans), Mud Pond Outlet Stream, Hibernia Brook, Burnt

Meadow Brook, Lake Stockholm Outlet Stream, Van Campens Brook, Cooley Brook, and Flanders Brook.

❖	**Action**	**Schedule**
✓	Collect blood samples	Completed
❖	Prepare & process samples for genetic analyzer	July 2004
❖	Analyze Data	
❖	Prepare draft report	December 2004
❖	Review by scientific community	

Opportunity – In order to improve angler satisfaction, investigate the feasibility of stocking broodstock into identified lakes each spring to generate increased interest in angling activity in these waters and trout fishing in general. Specific waters receiving broodstock would change each year. Consider the feasibility of stocking the larger fish during week 2 or 3 of the in-season period to generate renewed interest when typically angler interest in trout begins to decline.

Strategy 5.6 Investigate ways to further enhance current stocking programs to provide more attractive fisheries and increase angler effort without increasing hatchery production needs.

Waterbodies Involved: Statewide

❖	**Action**	**Schedule**
❖	Prepare Recommendations	January 2004
❖	Obtain Council Approval	February 2004
❖	Implementation	April 2004

Opportunity – Special regulated waters have grown in popularity, increasing angling pressure, investigate the feasibility of increasing the number of in-season stockings on these waters.

Strategy 5.6 Investigate ways to further enhance current stocking programs to provide more attractive fisheries and increase angler effort without increasing hatchery production needs.

Waterbodies Involved: Pequannock River, Musconetcong River, Raritan River S/Br, Claremont and Ken Lockwood Gorge sections, Pequest River, Paulinskill E/Br, and Toms River.

❖	**Action**	**Schedule**
❖	Prepare Recommendations	January 2004
❖	Obtain Council Approval	February 2004
❖	Implementation	April 2004

Opportunity – Investigate the feasibility of increasing the hathcery production of brown trout, at the expense of brook and rainbow, for stocking trout maintenance waters currently regulated as Year Round Conservation Areas.

Strategy 5.6 Investigate ways to further enhance current stocking programs to provide more attractive fisheries and increase angler effort without increasing hatchery production needs.

Waterbodies Involved: Paulinskill River E/Br, Raritan River S/Br, Claremont and Ken Lockwood Gorge sections, and Toms River

❖	**Action**	**Schedule**
❖	Prepare Recommendations	January 2004
❖	Obtain Council Approval	February 2004
❖	Alter hatchery species composition	February 2004
❖	Implementation	April 2005

Opportunity - Reconfigure the Bureau's fishing and Bureau page on the Division's web site to a more topic based approach. Also, reformat the information provided to improve the ease at which information can be acquired.

Strategy 6.4 Increase public awareness of the extensive variety of recreational fishing opportunities across the state.

❖	**Action**	**Schedule**
❖	Prepare new information for web site	January 2004
❖	Provide information to I & E staff	February 2004
❖	Implementation	March 2004

Opportunity - Better utilize "*trout stocked water*" signs to depict access for the purposes of fishing. Discontinue stocking in areas where access issues continue to be problematic.

Strategy 6.4 Increase public awareness of the extensive variety of recreational fishing opportunities across the state.

Waterbodies Involved: Statewide

❖	**Action**	**Schedule**
❖	Consult with Bureau of Law Enforcement	January 2004
❖	If feasible, devise new signs	February 2004
❖	Print and Distribute new signs	March 2004
❖	Address particular access issues which arise	Ongoing

Opportunity – Investigate the feasibility of using Natural Resources Damages funds to fund a staff position dedicated to the restoration and enhancement of coldwater fish habitat.

Strategy 1.4 Develop and implement a habitat improvement and restoration program.

❖	**Action**	**Schedule**
❖	Address feasibility with Administration	April 2004

Opportunity – The Open House has become a popular family event and is usually not attended by the more avid anglers. Scheduled for the first weekend in April the weather is usually uncooperative and greatly effects turnout. Investigate moving the event to coordinate with the Free Fishing Days and use the opportunity to solicit future potential anglers.

Strategy 6.3 Determine ways to use current Division programs and activities to increase angler participation.

❖	**Action**	**Schedule**
✓	Consult with Bureau of I & E staff	Complete

Opportunity - Prioritize and establish a monitoring schedule for wild trout populations.

Strategy 2.1 Routinely monitor fish populations, including wild trout, in order to keep management strategies current, aid in the identification of resource problems and issues, and demonstrate agency commitment to the management of aquatic resources.

❖	**Action**	**Schedule**
❖	Establish Schedule	November 2004

Opportunity – Investigate if additional opportunities for the stocking of lake trout within the state.

Strategy 3.2 Increase the diversity of angling opportunities for salmonid species within the state.

Waterbodies Involved: Monksville Reservoir

❖	**Action**	**Schedule**

✓	Lake Inventory Report for Monksville Reservoir	Completed
✓	Council Approval of Recommendations	October 2003
❖	Necessary Fish Code Changes	2004
❖	Initial Stocking of fingerlings	November 2004
❖	Monitor success	2005 - 2008