

LIFE CYCLE of a Fish Hatchery

Craig Lemon, Superintendent, Hackettstown Hatchery

Mother Nature dictates the start of the hatchery season each year as we await the melting ice pack covering Budd Lake, occurring anywhere from early March to late April.

Adult northern pike are the first target species each year. Northerns spawn as soon as the ice is out, providing about a seven-day window for us to collect brood stock.

Large trap nets are set in the lake's shallows. Fish encounter, then follow long mesh aprons leading them into a large mesh enclosure. Hatchery staff check the trap nets almost daily. Once brought to the hatchery, the fish are anesthetized to reduce stress while eggs and milt are collected. Eggs are incubated in McDonald jars in 52-degree water and hatch in 10 days. Five days after hatching the sac fry have absorbed their yolk and swim up into the water column looking for food.

Following the northern pike collection, hatchery crews reset the trap nets, this time in Swartswood Lake in search of walleye. In about four days, five million walleye eggs are collected. Efforts switch once again, this time the target species is *the fish of 10,000 casts*—muskellunge—at Greenwood Lake and Echo Lake Reservoir.

Both walleye and musky eggs hatch in 15 days. Once hatched and free-swimming, walleye fry are grown entirely in the outside ponds while muskie fry remain inside for a while longer on a diet of brine shrimp and dry feed.

April showers—plus millions of gallons of both brook and spring water—help our crews to fill many of the east and west hatcheries' 65 earthen ponds that were drained before winter. The ponds range in size from ¼ acre to 5 acres. When nearly full, each pond is fertilized with pulverized alfalfa meal. The fertilizer, when combined with sunlight, produces phytoplankton and zooplankton blooms on which the tiny

fry will feed for the first 50 days of their lives.

Northern pike, walleye and muskellunge fry are now transported from the intensive culture building and placed into the ponds.

As waters warm and the northern pike, walleye and muskie fry grow rapidly feeding on the abundant plankton, our staff's focus shifts to warm water species such as largemouth bass, smallmouth bass and hybrid striped bass. Smallmouth and largemouth bass adults are placed in ponds at a density of 40-50 per pond. Males clear out a spawning bed then herd over a ready female to lay her eggs. He follows, depositing his fertilizing milt over the eggs. They guard their nests and in one to two weeks, depending on water temperatures, the eggs hatch; the fry swim up out of the rock and gravel spawning bed.

Like clockwork, each Memorial Day weekend finds hatchery crews netting smallmouth bass fry in the East Hatchery. Wearing chest waders and using short, fine mesh seines (nets), the crew will capture schools of fry ranging in size from 200–2,000 fish, then transfer them by bucket to a separate fertilized pond where the fry will grow for the next few months. If left in the original ponds, adult bass would feed on the newly hatched young.

Just after moving all smallmouth fry, the crew begins to walk the largemouth bass brood ponds in search of the first schools of the year. Largemouth fry will school into tighter groups than other bass and can number up to 5,000 fish per group.

Pond water temperatures reaching into the 70s announces the hybrid striped bass spawning season. Also known as a *whiper*, this hybrid is a cross between striped bass and white bass. This exotic white bass is not available in New Jersey, so 300,000 five-day-old fry are purchased from

Delmarva Aquatics in Delaware. These fry are placed in a one-acre fertilized pond and grown for 40 days on zooplankton until the fish reach a size of 1.5 inches.

Next, the pond water level is lowered, the weeds and algae removed and the hybrid striped fingerlings are netted and brought into the intensive fish culture building. Fingerlings are divided among 350-gallon circular fiberglass tanks; their diet is converted to a dry, pelleted feed. Once converted the fingerlings grow quickly to the desired stocking size of four inches.

With all the bass now in production, focus turns to channel catfish. Pickup truck loads of 30-gallon catfish spawning barrels are hauled down to the hatchery's two brood stock ponds. It's the middle of June and pond water temperatures are reaching 80 degrees. The barrels have a one-foot hole cut into one end; placement is in shallow water along the shoreline. The cats pair-up and lay their eggs on a flat rock that was set into the barrel's bottom.

Every barrel is checked by hand for egg masses twice weekly. Unlike other species, channel cats lay their eggs in a gelatinous mass weighing between one to five pounds. Once brought into the hatchery, the matrix holding the mass together is chemically dissolved; the eggs are incubated in McDonald hatching jars. In 80-degree water the eggs hatch quickly—three to five days—and the fry are ready to feed just a few days later.

Summer is all about fish growth. In the warm, fertile water the fingerlings grow at an amazing rate. Hatchery staff continues fertilizing and feeding ponds and closely monitoring water quality parameters such as dissolved oxygen, temperature and Secchi disk readings which indicate water clarity. Fish sampling is an important tool for monitoring growth at this time. The number of fish per pound/weight is assessed both in the intensive building and the



▲ Removing channel catfish egg mass from a spawning barrel.

Tyler Tressler/NJ Department of Fish and Wildlife



▲ Grading hybrid striped bass fingerlings.



▲ Taking eggs from a ripe female walleye.



▲ Five million walleye eggs incubating in McDonald hatching jars.

seining ponds. Length measurements are taken on species such as bass and walleye.


It is critical to harvest the ponds as soon as fish reach their targeted size which varies from species to species. Although warm water means great fish growth, it also has a down side. Warm water holds less oxygen; rapid weed and algae growth, then decay, can deplete oxygen further. In addition, the physical interference of all that plant material must be addressed. Inevitably each year, several ponds require staff to spend hours harvesting weeds by pitch fork and good old elbow grease before the fish can be collected.

Once pond water levels are lowered and weeds are tackled, the pond can be netted. Seine nets from 25 to 80 feet long with varying mesh sizes of 1/8-inch, 1/4-inch and 1/2-inch are used to drag the “netting area,” created by the pitch forks. The first net usually tells the story of how the last few months of feeding and fertilizing have progressed. Over the past 25 years, some first-retrieved nets have contained zero fish; some have had 100,000 fish.

As autumn begins, most species are reaching their target sizes. Indoor intensive tanks and the outdoor ponds are emptied of fish systematically, several each week. Six-inch northern pike are float-stocked in places like Budd Lake and Spruce Run Reservoir and the popular Passaic River. Four-inch whippers are floated in places like Lake Hopatcong, Manasquan and Spruce Run Reservoirs. Two to 3-inch largemouth and smallmouth bass fingerlings are stocked in lakes like Union, Audrey and Splitrock.

The last of the stocking begins when the leaves start dropping from the trees in North Jersey. Ten-inch muskellunge are floated in lakes like Greenwood, Mountain and Mercer. Twelve-inch channel catfish are stocked in dozens of waters throughout the state from ponds as small as Ann Van Middlesworth to New Jersey’s largest water body, Lake Hopatcong, which holds the current

record channel catfish at 33 pounds. The final stocking comes in November when 9-inch lake trout, grown from Story, Wyoming eggs, are float-stocked in Merrill Creek and Monkville reservoirs.

With stocking complete for the season, the fiberglass tanks lie empty, ready to receive 200,000 *Gambusia*, known as mosquitofish, netted from the last few hatchery ponds. They will winter-over indoors and are slated for distribution to county mosquito control commissions the following spring. By now the first snow of the year has hit the ground and staff is working indoors repairing the many seines, nets, screens, plugs and other fish culture equipment that survived another season at the Hackettstown State Fish Hatchery. 

Photos this page: Craig Lemon/NJ Div. Fish and Wildlife



▲ Newly hatched walleye fry.

Good Fishing Depends on Clean Water

Supporting water quality protection supports great fishing!

Many of our rivers, lakes and coastal areas are experiencing algae blooms that cover our favorite fishing spots with green slime and cause fish kills and “dead zones” where no aquatic life can survive. The cause is usually nitrogen and phosphorous pollution that comes from farm and lawn fertilizers, septic systems, animal waste and sewage treatment plants. Everyone can do their part for clean water by reducing fertilizer use, preserving plants along shorelines and picking up pet waste. Supporting water quality protection supports great fishing! Learn more at:

epa.gov/nutrientpollution



MEET THE

Mosquito-eaters

By Bob Kent, Administrator,
Office of Mosquito Control Coordination

Outdoor enthusiasts vary in their appreciation for insects. A hiker stops to marvel at an emerging cicada. Campers watch moths at night, drawn to the light of a lantern. An angler “reads” a stream to see what insects have recently hatched in order to choose the right fishing lure. What do all of these outdoors people have in common? They all know the audible hum and the itchy bite of the *mosquito*.

To make that familiar bite less frequent, mosquito control practitioners network on the state, county and local levels to manage these insect populations by safer, yet still effective means. There is a multi-pronged approach, where either the pesky mosquito’s lifecycle must be interrupted or their habitat must be altered—or both.

— Mosquito Control in New Jersey

Organized mosquito control in New Jersey was established around the same time as was the Division of Fish and Wildlife—about 125 years ago. Now, the New Jersey Office of Mosquito Control Coordination is located within the Division of Fish and Wildlife. From the beginning a strong partnership was formed and found common agreement in the methods of managing wetlands, marshes and bodies of water in the state.

A healthy wetland ecosystem, one which may indirectly support a good sport fishery, is a wetland where developing mosquito populations are uncommon. The key reason: healthy wetlands often support native fish which forage on mosquito larvae—the best life cycle stage to target for biological control of these insect pests. Native fish populations such as sunfish, minnows or killifish sometimes can be encouraged to forage in areas where female mosquitoes lay eggs and larvae will soon emerge. In a salt marsh where mosquitoes flourish, canals and ponds are created to invite resident killifish to feast on developing larvae.

Every New Jersey county has a mosquito control program. These vary in size and resources but all address the annual mosquito pest and

disease problems brought to bear by blooming mosquito populations found in supportive breeding habitat.

While the more familiar method of mosquito control—such as the application of pesticides—is still a mainstay of some county programs, wetlands management, public relations, sanitation practices and biological pest control methods are all part of another approach known as Integrated Pest Management or IPM. With IPM, control strategies are based on surveillance and timing of control in consideration of the pest’s life cycle.

— Biological Control Program

Using fish as an effective biological control agent is not new in the arsenal of mosquito control techniques. Managing wetlands to encourage resident fish populations has long been practiced successfully. Aside from habitat management activities, utilizing indigenous fish has no associated breeding, rearing or stocking expenses. However, in areas where mosquitoes develop that are not associated with natural wetlands—such as storm water retention facilities, woodland pools, clogged roadside ditches, abandoned swimming pools, neglected ornamental ponds and more—mosquito control practitioners have relied on commercial fish hatcheries to produce and sell mosquito-eating fish. When considering the fish stocking rate necessary to control mosquitoes in these many breeding sites, such an expense can swiftly consume a mosquito control budget.

— The Program Evolves

Over time, the need to expand the practice of biological control of mosquitoes grew more pressing. In 1991, the Office of Mosquito Control Coordination enlisted the expertise of personnel with the Bureau of Freshwater Fisheries. The skilled staff at the Charles O. Hayford Hatchery at Hackettstown were invaluable in the development of the mosquitofish program. With minimal fiscal support, a working set of protocols was


developed to raise and use fish to control mosquito (www.nj.gov/dep/mosquito/biocontr.pdf). In 2011, hatchery personnel stocked the program’s three millionth fish!

The state Mosquito Control Commission endorsed a small \$2,000 budget as seed money to initiate the mosquitofish program. The Commission has since dedicated \$25,000 per year to compensate the Bureau of Freshwater Fisheries for program operating expenses. No dedicated Fish and Wildlife funds are used.

Five species of mosquito-eating fish have been enlisted into the arsenal of mosquito-fighting weapons available to all county control programs. These are bluegill sunfish (*Leopomis macrochirus*), pumpkinseed sunfish (*Leopomis gibbosus*), freshwater killifish (*Fundulus diaphanous*), fathead minnow (*Pimephales promelas*) and the eastern mosquitofish (*Gambusia affinis*).

Local mosquito control agencies perform ongoing surveillance of typical mosquito breeding sites. For those locations routinely requiring the application of pesticides, a state biologist will assess the appropriateness of using mosquito-eating fish for control, then select the species best suited to that specific habitat.

For efficiency, the Office of Mosquito Control Coordination accumulates a list of approved control sites. The county mosquito control agency plans their distribution route. Hatchery workers insert a fish transport tank into the bed of the county’s truck, loading the approved quantity of fish for several targeted sites. With a tank of compressed oxygen aerating the transport water, the county has a two-day window to stock these fish into the mosquito habitat well-matched for this bio-control approach—sites formerly requiring repeated applications of pesticides.

New Jersey’s integrated pest management methods of mosquito control have evolved to be more environmentally safe and economically feasible due to the efforts of Fish and Wildlife’s Bureau of Freshwater Fisheries staff, their modern facilities and the millions of mosquito-eating fish they have provided. 

Life Cycle of the Mosquito



Mosquitoes are in the Insecta order called Diptera, comprising the flies. They undergo a complete metamorphosis in their life cycle which includes four distinct stages. Mosquitoes begin as an almost-microscopic egg, laid by the thousands near or on still, shallow water. When flooded, the eggs hatch and the free-swimming larvae will spend a week to ten days in shallow, stagnant or sometimes putrid water while they grow through four phases called instars. The last aquatic stage is the pupa which rests for a day or two near the surface of the water before breaking open its exoskeletal skin to emerge as an adult, flying, blood-seeking (females only) mosquito.



Fish species such as sunfish, pumpkinseed, banded killfish and gambiausia feed on insect larvae and are a large component of county and state mosquito control efforts. All are raised at the Hackettstown State Fish Hatchery.



If you care about:

- Wise management of fish and wildlife populations
- Protection and enhancement of natural lands and waters
- Preservation of traditional outdoor sports

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Andy Shvane

New Jersey's STOCKING PROGRAMS

WARMWATER STOCKING

Raised with pride at New Jersey Division of Fish & Wildlife's Hackettstown State Fish Hatchery

MUSKELLUNGE—8-12"

- Echo Lake Reservoir (268)
- Furnace Lake (106)
- Greenwood Lake (1,000)
- Lake Hopatcong (1,000)
- Little Swartswood Lake (150)
- Manasquan Reservoir (500)
- Manasquan Reservoir (500)
- Mercer Lake (250)
- Monksville Reservoir (250)
- Mountain Lake (250)

NORTHERN PIKE—6"

- Budd Lake (2,863)
- Cranberry Lake (1,794)
- Deal Lake (1,580)
- Farrington Lake (2,715)
- Millstone River (1,000)
- Passaic River (3,150)
- Pompton Lake (2,162)
- Pompton River (2,783)
- Spruce Run Reservoir (5,580)

WALLEYE—2-4"

- Canistear Reservoir (12,515)
- Delaware River (146,496)
- Greenwood Lake (30,960)
- Lake Hopatcong (72,312)
- Monksville Reservoir (18,670)
- Swartswood Lake (19,344)

HYBRID STRIPED BASS—4"

- Lake Hopatcong (23,091)
- Manasquan Reservoir (7,275)
- Spruce Run Reservoir (10,400)

SMALLMOUTH BASS—2"

- Lake Audrey (5,500)
- Manasquan Reservoir (3,868)
- Split Rock Reservoir (2,200)
- Union Lake (5,500)

LARGEMOUTH BASS—2"

- East Creek Pond (1,505)
- Lake of the Lillies (1,200)
- Maskell's Mill Pond (2,114)
- Mirror Lake (5,000)
- Rising Sun Lake (2,000)
- Shaws Mill Pond (1,505)
- Spruce Run Reservoir (3,000)
- Stone Tavern Lake (2,500)
- Union Lake (5,210)
- 11 other smaller water bodies

LAKE TROUT—7"

- Merrill Creek Reservoir (3,250)
- Monksville Reservoir (2,430)

CHANNEL CATFISH—6"

- Twenty waters

CHANNEL CATFISH—12"

- Twenty-six waters

CHANNEL CATFISH—16"

- Twenty-three waters

- Plus thousands of black crappie, bluegill sunfish, and brown bullheads stocked in over 100 waterbodies throughout the state!

The Hackettstown Hatchery is located in the heart of Hackettstown. It encompasses over 230 acres, consisting of over 65 extensive culture ponds, and a large intensive culture building. The hatchery raises and distributes over 1,500,000 each year, representing 15 species of fish.

TROUT STOCKING

Raised with pride at New Jersey Division of Fish & Wildlife's Pequest Trout Hatchery

The fall of 1982 was a turning point both for the Division of Fish and Wildlife and the anglers who fish New Jersey waters. Trout fishing would never be the same. Over 1.5 million pathogen-free trout eggs arrived at the new Pequest Trout Hatchery. The spring of 1984 saw the first Pequest-raised trout released in the lakes and streams throughout the state. Since then the rearing facility has met and exceeded its production goals in raising brook, brown and rainbow trout. Due to modern technology and a high quality water supply, the hatchery remains one of the nation's leading pathogen-free trout producers.



Tom Pagliaroli

SPRING

- Over 570,000 brook, brown and rainbow trout
- Average size: 10.5 inches and ½ pound
- An additional 6,000 breeders 15–21 inches (3–6 pounds)
- Most waterbodies stocked at least three times
- 100 streams and 80 lakes stocked statewide
- All 21 counties stocked
- 180,000 trout released for Opening Day—April 7, 2012
- Stocking continues for seven weeks following Opening Day

- 20,000 trout stocked
- 30 streams, lakes & ponds
- 1,000 rainbow trout breeders, averaging 20 inches
- Best chance to catch big trout

WINTER

- All large two year olds, measuring 15–16 inches
- Over 5,000 trout
- 24 lakes and ponds
- Great fishing all winter long!

FALL

- Second and third weeks in October
- All large, two year old trout, measuring 14–16 inches

SEA RUN BROWN TROUT

- Lower Manasquan River
- 15,000 7–8-inch brown trout
- Try this elusive fishery!

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Protect New Jersey's Waters

Invasive Fish

Fish identification can be easy for species caught frequently, but tricky for species new to New Jersey waters. An untrained eye can mistake species that look similar.

Bowfin are native species, actually dating back 250 million years and should be released unharmed. However, **snakeheads** are invasive and should be destroyed and submitted to the Division of Fish and Wildlife for verification. Snakeheads have recently been found in the lower Delaware River and some of its tributaries.

BOWFIN—NATIVE



Short anal fin.

▶ SNAKEHEAD—INVASIVE



Long anal fin.

Painting: Susan Trammell
www.susantrammell.com

American eels are a diadromous native species, using both fresh and marine waters during their lifecycle. These eels are found in nearly every waterbody in New Jersey. **American brook lamprey** are a harmless native species that serves as an indicator of clean substrate. The **Asian swamp eel** is an invasive species with documented presence in Silver Lake, a 10-acre waterbody located in Gibbsboro.

AMERICAN EEL—NATIVE



Pectoral fins present; no gill slits.

AMERICAN BROOK LAMPREY—NATIVE



No pectoral fins; gill slits present.

▶ ASIAN SWAMP EEL—INVASIVE



No pectoral fins; no gill slits.

Although not a native species, **channel catfish** are stocked by Fish and Wildlife in select locations as a recreational and food species. The **flathead catfish** is considered an invasive species capable of causing ecological damage by out-competing other recreationally important species for food and habitat. Flatheads have been confirmed in the middle section of the Delaware River.

CHANNEL CATFISH—STOCKED



Upper jaw protrudes past lower jaw; tail deeply forked.

▶ FLATHEAD CATFISH—INVASIVE



Lower jaw protrudes past upper jaw; tail not deeply forked.

Water Chestnut



Fan-shaped, strongly toothed leaves. Nut-like fruit with four sharp spines.




Invasive Mussels—Zebra Mussels

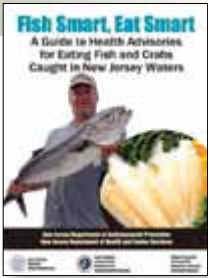
How to Identify Zebra Mussels

- Resembles a clam with a striped "D"-shaped shell, less than two inches long
- Usually grow in clusters
- ONLY freshwater mollusk that can firmly attach itself to solid objects
- If found, keep the mussel(s). Note date and specific location. Immediately, call Dr. Peter Rowe, New Jersey Sea Grant Headquarters, (732) 872-1300 extension 31, or write prowe@njmsc.org.



Keep on Reporting

The most effective way to succeed in containing aquatic invasive species is to report each encounter. Anglers are reminded that possession or release of flathead catfish, snakehead, Asian swamp eel, brook stickleback, oriental weatherfish, green sunfish and warmouth, bighead carp, silver carp and grass carp (diploid) is prohibited. Anglers must destroy these species if encountered and submit specimen(s) to the Bureau of Freshwater Fisheries at (908) 236-2118 for north Jersey and at (856) 629-4950 for south Jersey. 



Fish Smart, Eat Smart

Eating Fish And Crabs Caught In New Jersey Waters

Fishing provides enjoyable and relaxing recreation. Fish are

an excellent source of protein and other nutrients and play a role in maintaining a healthy, well-balanced diet. Many anglers enjoy cooking and eating their own catch. However, elevated levels of potentially harmful chemical contaminants such as dioxin, polychlorinated biphenyls (PCBs), pesticides and mercury have been found in certain fish and crabs in some New Jersey waters. Fish consumption advisories have been adopted to guide citizens on safe consumption practices.


The current list of fish consumption advisories consists of statewide, regional and water body-specific warnings for a variety of fish species and fish consumers. The New Jersey Department of Environmental Protection (DEP) and the Department of Health and Senior Services have prepared literature and a new Web site to help you make informed choices about which fish to eat and how to reduce your exposure to these harmful chemicals.

To reduce exposure to harmful chemical contaminants when preparing and eating the fish species taken from the identified waters, it is essential to follow the guidelines provided. The DEP encourages you to consult the Fish

Smart-Eat Smart Fish Advisory Guide or www.FishSmartEatSmartNJ.org when making decisions about eating recreationally caught fish and crabs.

The *Fish Smart-Eat Smart Advisory Guide* includes contaminant information, advisory charts, plus preparation and cooking methods to reduce contaminant levels, as well as specific guidelines, advice and prohibitions for people at high risk, such as children, pregnant women and women of child-bearing age. *The Guide* also includes Web site links to Pennsylvania, Delaware and New York for information about fish consumption advisories for shared waters.

For a complete list of state and federal marine fish consumption advisories visit: FishSmartEatSmartNJ.org.

The fish consumption advisories and Fish Smart-Eat Smart Web site are updated periodically and are available online or from the Office of Science at (609) 984-6070 and through the Division of Health and Senior Services at (609) 826-4935. 

Check online for fish consumption advisories on the local water body in which you fish!
Go to FishSmartEatSmartNJ.org

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▶▶ ANGLER ETHICS

1. Keep Only the Fish Needed
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3. Sharpen Angling and Boating Skills
4. Observe Angling and Boating Safety Regulations
5. Respect Other Anglers' Rights
6. Respect Property Owners' Rights
7. Pass on Knowledge and Angling Skills
8. Support Local Conservation Efforts
9. Never Stock Fish or Plants into Public Waters
10. Promote the Sport of Angling

▶▶ WARNING: WILDLIFE HAZARD

Please properly dispose of all fishing line. Plastic debris can endanger aquatic life and snare propellers. Do NOT litter.

Could this be *your* line?



Shyam Menon

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