



**New York Department of Environmental Conservation
Bureau of Fisheries
Chinook Salmon Egg Take in 2007**

In 2007, the collection of Chinook and coho salmon eggs at the New York State Department of Environmental Conservation's Salmon River Hatchery was adversely affected by extreme environmental conditions. The lower egg take will result in reduced stocking for Chinook salmon in 2008. This document characterizes conditions leading to the events of 2007 and the Department's response, and describes changes to stocking in 2008 and the expected effects on fishing quality on Lake Ontario.

Spawning of Chinook and Coho Salmon at the Salmon River Hatchery

Stocking of trout and salmon is an integral part of Lake Ontario fisheries management, supporting a world-class, multi-million dollar sportfishery with a diversity of trophy-sized salmon and trout. For over three decades, The New York State Department of Environmental Conservation (NYSDEC) has successfully maintained a fish culture system to collect eggs and propagate millions of salmon and trout for stocking into Lake Ontario each year.

Each year in the fall, Chinook (a.k.a. "King" salmon) and coho salmon ascend the lake's tributaries to spawn. One of Lake Ontario's most important tributaries is the Salmon River near Pulaski, New York, not only because it supports more than half of all New York tributary angler effort and harvest but also because it is where salmon and trout migrate upstream to the NYSDEC's Salmon River Fish Hatchery in Altmar, NY. Here, eggs are collected from fish, fertilized and then raised to



Each year, tens of thousands of anglers gather on the Salmon River near Pulaski, New York to catch Chinook and coho salmon, steelhead, brown trout and Atlantic salmon.

fingerling or yearling sizes before being stocked at various sites around the lake. Each year the hatchery targets certain numbers of eggs to collect from Chinook salmon (3.5 million eggs, 600 females) and coho salmon (1.6 million, 543 females) to meet stocking targets (1.76 million Chinook spring fingerlings, 245,000 coho fall fingerlings or spring yearlings). Not every egg survives, so hatchery staff collects extra eggs to account for anticipated mortality. Typically at the Salmon River hatchery, 85% of the green Chinook eggs “eye-up” (develop to the stage where the eyes of the larval fish can be seen). Coho have a lower fertilization rate so typically only 45% of the green eggs eye-up. These eyed eggs are kept in incubators until they eventually hatch into fry, which are fed until they grow to the desired size for stocking (about 3 inches for Chinook salmon).

From late August until November, adult salmon undergo significant physiological and behavioral transformations as they prepare to spawn. Water flow and temperature influence the timing of the salmon run, and the exact migration peak may vary, but typically water flow increases and temperatures drop to trigger salmon migration. Typical increases in river flow provide a stimulus for migration and increase the amount of available fish “holding” and nest building habitat, however, temperature and day length play the most significant role in egg development and maturation. Optimum water temperature for spawning is about 50°F and temperatures above 60°F have significant negative effects on egg development. Water temperatures above 60°F are also considered stressful for adult salmon, and temperatures above 70°F can induce pre-spawn mortality.

Environmental Conditions and Salmon River Hatchery Operations in 2007

Normally salmon begin migrating to the Salmon River Hatchery in late September, with the peak salmon spawning occurring during the second and third week of October each year. NYSDEC Salmon River Hatchery staff usually begin taking eggs from salmon around Columbus Day each year when water temperatures drop below 60°F and female salmon eggs are “ripe”, i.e. fully developed. Water temperature is a critical threshold to ensure egg maturity and to avoid any temperature related stress on adult salmon.

The 1996 Federal Energy and Regulatory Commission Hydroelectric licensing agreement prescribes year round base flows in the river. The prescribed base flow for the salmon

migration and spawning period is 335 cubic feet per second (cfs). Drought conditions in 2007 led to a base flow of only 100 cfs during this critical period.

The fall of 2007 was unusual ([Table 1](#)) due to higher than normal water temperatures and extreme drought. Daytime-high air temperatures throughout September averaged 6°F above normal (75 vs 69°F in Watertown), and average air temperatures in the first 2 weeks of October were almost 10 degrees above normal (65 vs 52°F). Normally air and water temperatures drop before the 1st week of October, and salmon are ripe and ready to enter the hatchery around Columbus Day. In 2007, water temperatures in the hatchery did not fall below 60°F until after October 15 ([Figure 1](#)). The Salmon River reservoir was 12 feet below normal in September and weather forecasts predicted extended drought conditions. In fact, significant rain did not fall until October 13th and base flow level (335 cfs) was not reached until October 20th ([Figure 2](#)). These conditions resulted in substantially fewer salmon entering the Salmon River Hatchery in 2007 (1891 Chinook vs. 10-year average 6,513), approximately two weeks later than usual.

Chinook egg take at the Salmon River Hatchery was substantially below target in 2007 ([Table 1](#)). Hatchery staff processed 224 Chinook females (1/3 of normal) and 499 Cohos (normal 543 females) producing an estimated 1 million green Chinook eggs (average 3.5 million) and 1.83 million green coho eggs (average 1.6 million). Likely due to temperature stress on female salmon during egg development, egg survival to the eyed stage was reduced to 64% for Chinook eggs (average 84%) and 15% for coho (average 43%). These efforts resulted in approximately 639,000 eyed Chinook eggs, and 275,000 eyed coho eggs.

In an urgent effort to supplement Salmon River egg collections, NYSDEC Region 6 staff collected and spawned Chinook from the Black River fish ladder, resulting in an additional 68,000 eyed eggs. NYSDEC also initiated egg collections from sections of Eighteenmile and Oak Orchard Creeks in western New York. With assistance from local anglers and sport fishing groups, the week-long emergency collection yielded a total of 387,000 additional eyed Chinook eggs (21,000 Oak Orchard, 366,000 Eighteenmile). Survival of green eggs collected from Eighteen Mile and Oak Orchard Creeks to the eyed stage was only 42%, likely due to added fish stress resulting from angler catch/harvest and the additional time required for transferring eggs to incubators at the Salmon River

Hatchery. Participants cooperating in the emergency egg-collection effort included Region 9 Fisheries staff and Environmental Conservation Officers, local anglers, the Town of Newfane, members of the Niagara County Fish Advisory Board, the Niagara River Anglers Association and the Lake Ontario Trout and Salmon Association. Anglers and staff in Region 8 also assisted.

The NYSDEC also issued emergency fishing regulations on the Salmon River which delayed the opening of the lower fly fishing section below the hatchery from September 15 until October 15 and subsequently extended to November 15, in an effort to reduce stress of salmon waiting to enter the hatchery. Low flow conditions and high temperatures continued, and Chinook salmon concentrated in the lower sections of the river. Anglers also concentrated their efforts in the lower river and it is suspected that this resulted in unusually high salmon harvest or additional stress on released fish.

Table 1- Conditions in 2007 were not typical. High temperature and extreme drought conditions affected the migration of salmon into the River and delayed egg take operations. Both the number of eggs collected and the survival was reduced in 2007 compared to normal years.

Conditions	Normal	2007
Begin Egg Take	Day after Columbus Day (Oct 9th in 07)	Oct. 17
Water Flow	Above base flow (335 cfs)	100 cfs
Water temperature	<60 °F	>60 °F
<u>Chinook Salmon</u>		
# Females stripped	665	224
# Green eggs	3.4 million	1.95
% Eye Up	84% (Based on 10-year average)	65%
<u>Coho Salmon</u>		
# of Females stripped	543	499
# Green eggs	1.6 million	1.83
% Eye Up Coho	43%	15%

Salmon egg collections in other Great Lakes

Lake Michigan's salmon run on the Little Manistee River was also delayed due to temperature and drought, reducing egg eye-up to roughly 69%. Chinook egg collections on the Credit River by the Ontario Federation of Anglers and Hunters/Ontario Ministry of Natural Resources (OMNR) also resulted in poor egg quality (60% eye-up) compared to normal years. Chinook eggs collected from the Swan River Weir on Lake Huron were in such poor condition due to warm temperatures the eggs were discarded.

NYSDEC also considered requesting eggs from other Great lakes agencies (e.g, Lake Michigan) to reach target levels. However, the risks associated with introducing bacterial kidney disease and viral hemorrhagic septicemia (diseases found in Lake Michigan Chinooks, but not detected in Lake Ontario Chinooks) to the Salmon River Hatchery far outweighed perceived benefits. NYSDEC has requested that the OMNR stock any available surplus Chinook into the lower Niagara River.

What about Stocking in 2008 on Lake Ontario?

Chinook stocking levels in 2008 will be reduced due to reduced egg take and survival in 2007. Decisions about allocating this year's Chinook salmon stocking (approximately 1 million fish) will give priority to maintaining the Salmon River broodstock, and to a number of alternative egg collection sites to help prevent future egg shortfalls. Fisheries managers also recognize the value of pen rearing programs and the potential for significant gains in survival versus direct stocking. Eggs are hatching late this year due to the delayed egg take, but Salmon River Hatchery staff is hopeful that Chinook growth can be accelerated enough to reach adequate size to be held in pens.

The NYSDEC Salmon River Fish Hatchery at Altmar has successfully collected, reared and stocked 90 million salmon and trout since 1981 including over 55 million Chinook salmon. 2007 was the first year the Salmon River Hatchery experienced any egg collection problems. Hopefully the 2007 environmental conditions will not be repeated, however, certain steps will be taken to improve the likelihood that future Chinook salmon egg targets are met. The extreme environmental conditions of 2007 provided valuable experience regarding when and how to react in case they reoccur. For example, NYSDEC staff is exploring options for improving methods to collect fish at alternate collection sites (e.g. upgrade the Black River fish ladder, build removable weirs).

NYSDEC could also implement emergency fishing regulations again on the Salmon River if future conditions warrant, however, these measures wouldn't necessarily result in additional fish collected at the Salmon River Hatchery, as water temperatures are beyond anyone's control.

How will fishing be affected?

Fishing quality in Lake Ontario should not be adversely affected by the reduced Chinook stocking in 2008. Lake Ontario continues to provide the largest Chinook salmon of all the Great Lakes ([Figure 3](#)) and catch rates in New York for Chinook and coho salmon have been at all time highs for the last several years ([Figure 4](#)). There is no reason to believe that one year's reduced stocking will change that. In fact, the data suggest no consistent relationship between numbers of Chinook salmon stocked and numbers harvested in subsequent years ([Figure 4](#)). For example, the 1995 stocking of 1.1 million Chinook salmon produced the largest return of adult Chinook harvested; substantially larger than previous stockings in excess of 3 million fish. In addition, studies have documented significant natural reproduction of Chinook salmon in the Salmon River system, producing as many as 5 million parr (pre-smolts) in a single year. The survival of these fish to the adult stage, however, is not yet known but may be substantial.

The Salmon River Hatchery expects to reach its stocking targets this year for other Lake Ontario species (steelhead, brown trout, and coho salmon), however, there is no capacity in our hatchery system to increase production of other trout and salmon species. Other New York State hatcheries will stock domestic strain rainbow trout, brown trout and Atlantic salmon and federal hatcheries will stock lake trout as usual. In addition, Ontario Ministry of Natural Resources will stock lake trout, steelhead, Chinook and Atlantic salmon into Lake Ontario. These fish (approximately 4.5 million) and existing year classes in the lake will continue to provide anglers excellent fishing opportunities this year and many years to come.

Summary

- High temperature and low flow in 2007 delayed salmon migration and significantly reduced the numbers of Chinook salmon entering the NYSDEC Salmon River Hatchery at Altmar, NY. Higher than normal temperatures resulted in reduced egg survival at hatcheries across the Great Lakes.

- Reduced egg take/poor survival will result in fewer Chinook salmon stocked in 2008 (approximately 1 million salmon vs 1.76 million normally). Fishing quality in Lake Ontario in 2008 and future years should not be affected by this one-time reduction.
- Lake Ontario continues to provide the largest Chinook salmon of all the Great Lakes and catch rates in New York for Chinook and coho salmon have been at all time highs for the last several years. In fact, the data suggest no consistent relationship between harvest and numbers of Chinook salmon stocked and numbers harvested in subsequent years.
- The Salmon River Hatchery fully expects to reach its stocking targets this year for other Lake Ontario species, and other NYSDEC, federal and Ontario hatcheries will meet their usual stocking targets. These fish (approximately 4.5 million) and existing year classes in the lake will continue to provide anglers excellent fishing opportunities this year and many years to come.

Additional Reading

- Barnes M.E., Lott J.P., Saylor W.A., Cordes R.J. (1999) Practical Observations on the Use of Eggs from Electroshocked Females during Spawning of Inland Fall Chinook Salmon. *North American Journal of Aquaculture*: Vol. 61, No. 2 pp. 162–166.
- Eckert, T.H. (2007) 2006 Lake Ontario Fishing Boat Census *In 2006 NYSDEC Annual Report Bureau of Fisheries Lake Ontario Unit and St. Lawrence River Unit to the Great Lakes Fishery Commission's Lake Ontario Committee.*
- Geist DR, Abernethy CS, Hand KD, Cullinan VI, Chandler JA, et al. (2006) Survival, Development, and Growth of Fall Chinook Salmon Embryos, Alevins, and Fry Exposed to Variable Thermal and Dissolved Oxygen Regimes. *Transactions of the American Fisheries Society*: Vol. 135, No. 6 pp. 1462–1477.
- Jensen, J.O.T., McLean, W.E., Sweeten, T., Damon, W., and Berg, C. (2006) Puntledge River high temperature study: Influence of high water temperature on adult summer chinook salmon (*Oncorhynchus tshawytscha*) in 2004 and 2005. *Can. Tech. Rep. Fish. Aquat. Sci.* 2662: vii + 47p.
- Prindle, S.E., and D.L. Bishop (2007) Fall 2006 Lake Ontario Tributary Angler Survey. *in 2006 NYSDEC Annual Report, Bureau of Fisheries Lake Ontario Unit*

and St. Lawrence River Unit to the Great Lake Fishery Commission's Lake Ontario Committee.

- Everitt, D. W. (2006) Natural Reproduction and Spawning Site Characteristics of Chinook Salmon (*Oncorhynchus tshawytscha*) in the Salmon River, New York. M.S. Thesis. State University of New York, College of Environmental Science and Forestry, Syracuse, NY.

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Figure 1- Flow on the Salmon River in typical years (2004, '05, '06) compared to 2007. Normally baseflow is regulated to stay above 335 cubic feet per second through this time period. In 2007, drought conditions for the majority of September and October prevented releases greater than 100 cfs.

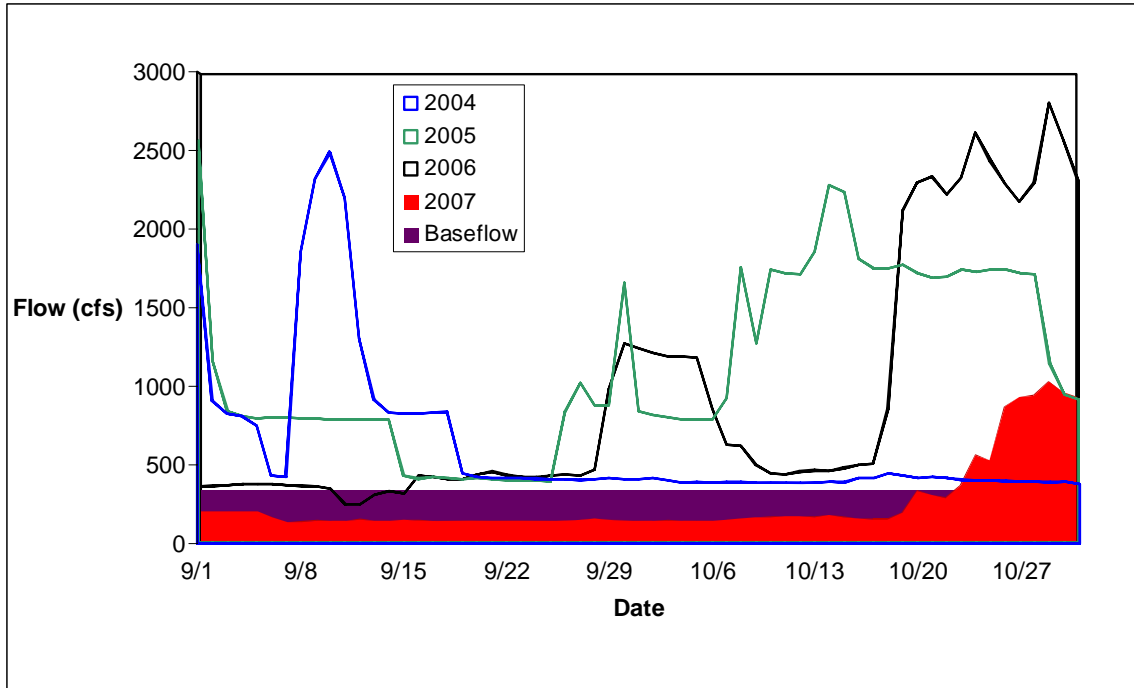


Figure 2- Water temperature measured in the Salmon River Hatchery in typical years (2004, '05, '06) compared to 2007 and the threshold for spawning (orange line). Normally temperature drops prior to egg take in the first week of October. In 2007 water temperature remained high until after Oct 15, which negatively affected egg number and egg quality.

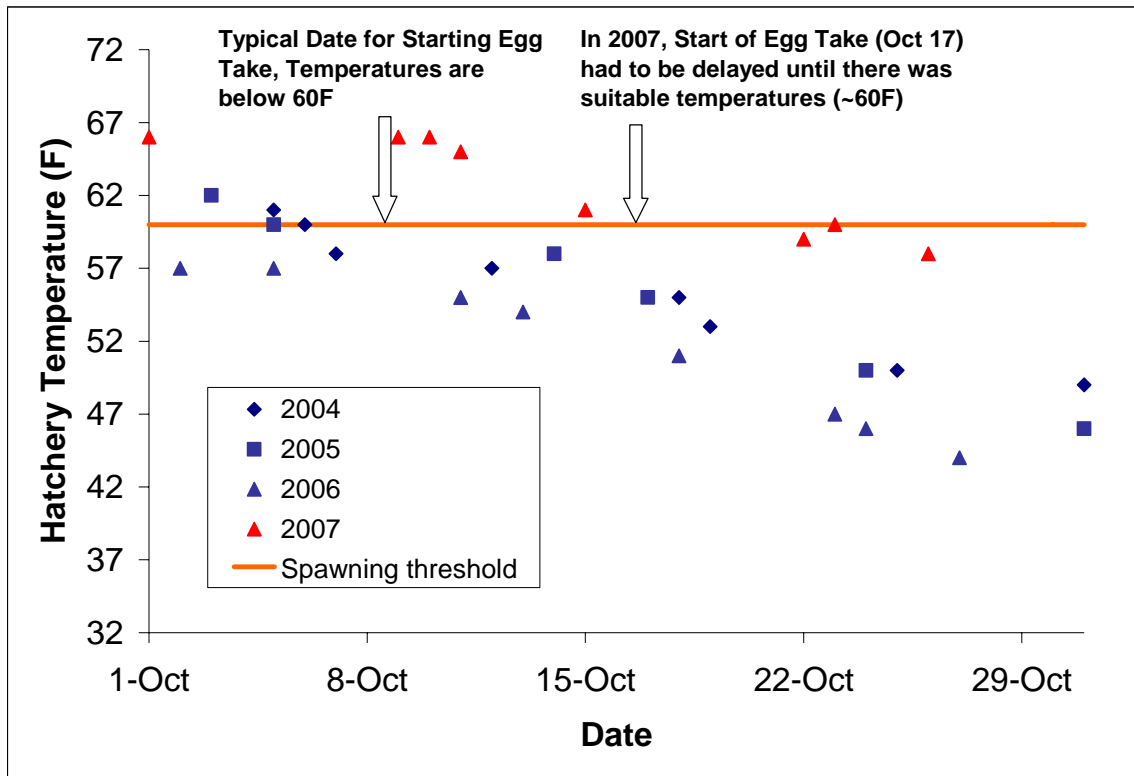


Figure 3- Average weight of Age 3 Chinook salmon in Lake Ontario compared to other Great Lakes from 1991-2006.

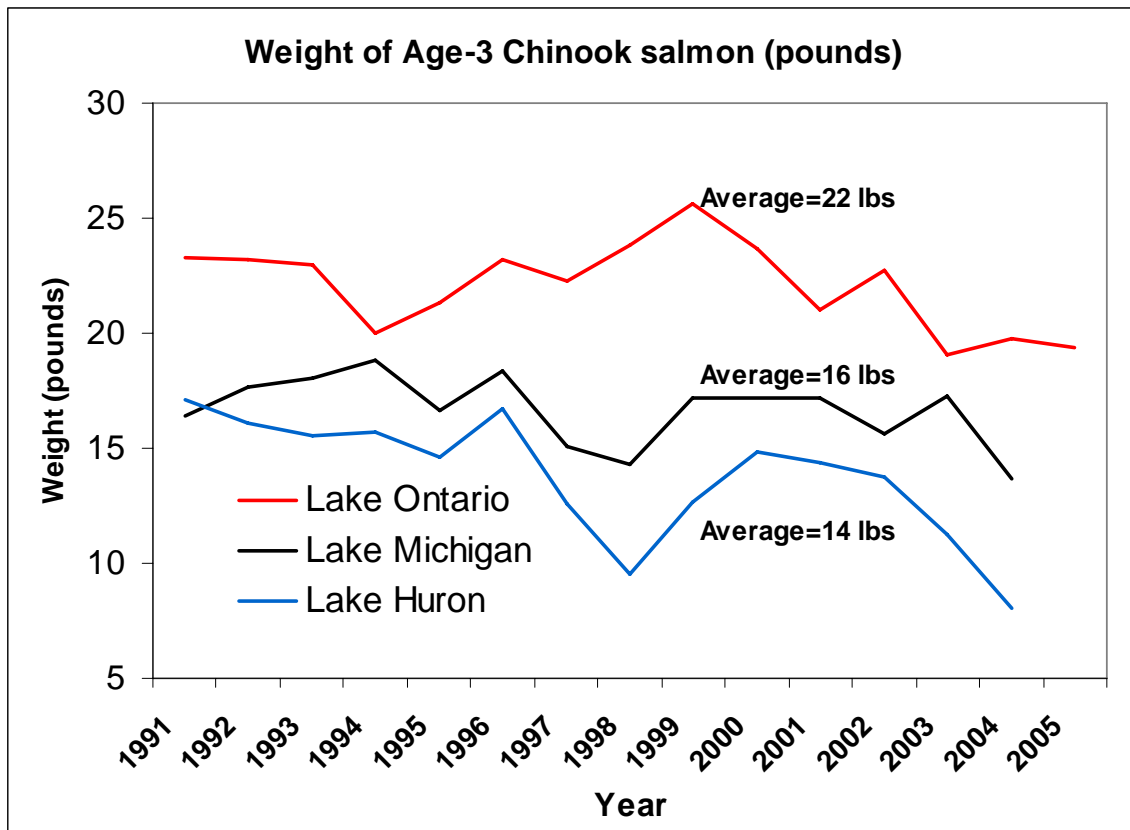


Figure 4- Lake Ontario Chinook salmon catch per angler hour for the months of April-September, 1991-2007.

