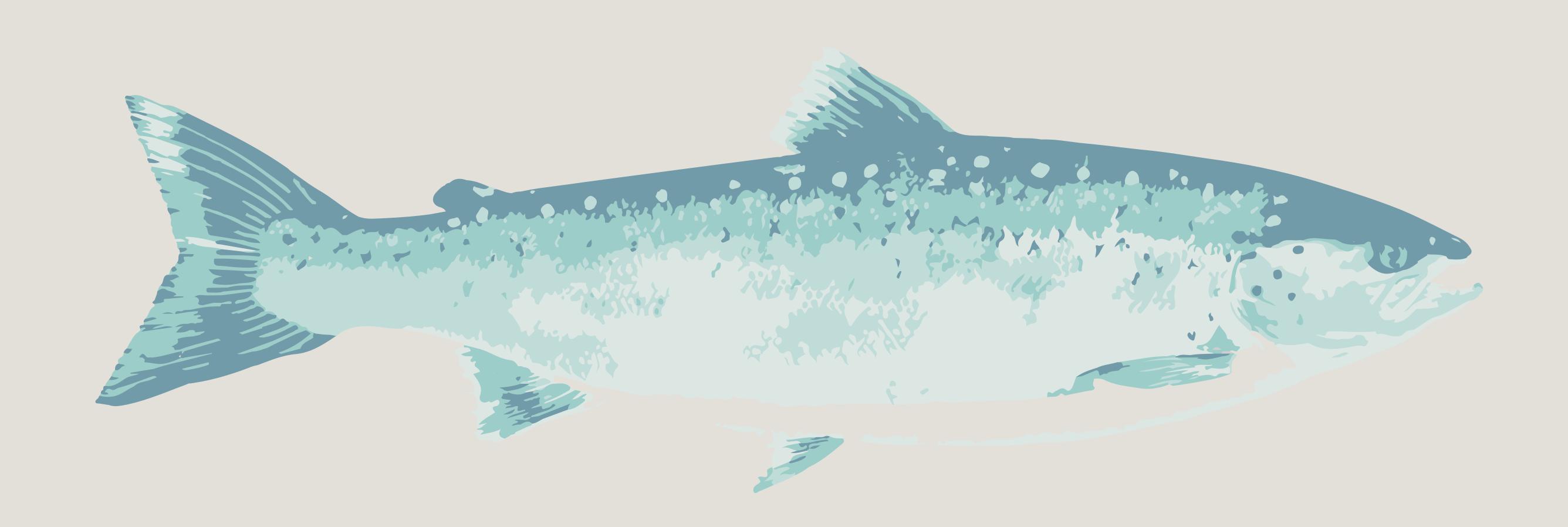


### SALMON MD M PEOPLE IN A CHANGING WORLD

The International Year of the Salmon is an initiative to inform and stimulate outreach and research that aspires to establish the conditions necessary to ensure the resilience of salmon and people throughout the Northern Hemisphere. We want to bring people together, share and develop knowledge, raise awareness and take action. are conserved and restored.

The extraordinary life histories of salmon in the Northern Hemisphere exposes them to many environmental and human-caused factors influencing their health and abundance. We want to raise awareness of what humans can do to ensure salmon and their habitats

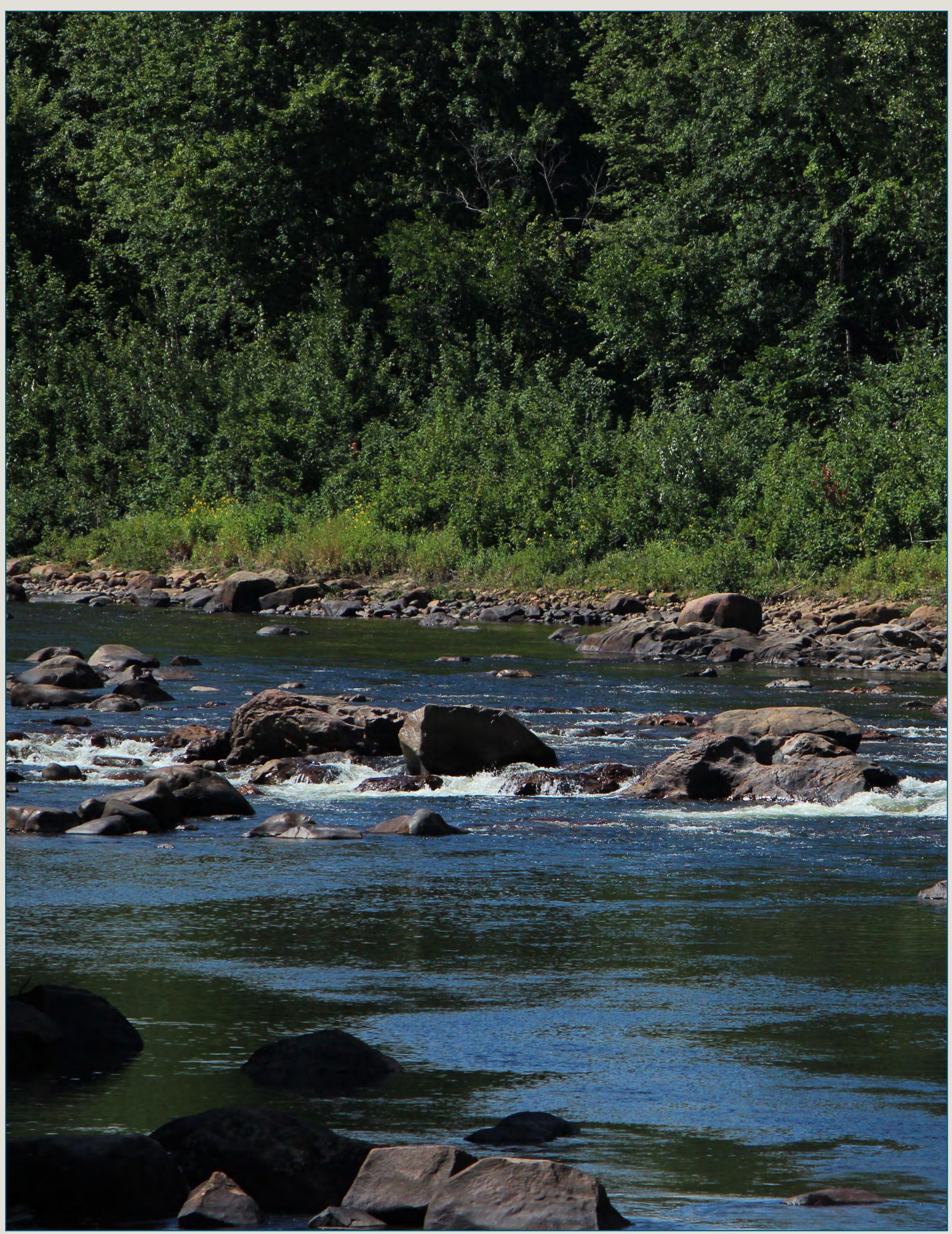


## YEAROFTHESALMON.ORG





# THE LIFE CYCLE AN THE SAL ATLANTIC SALMON



Clean, fast-moving and shaded streams with gravel bottoms are perfect spawning habitat for Atlantic salmon. Source: LCBP

#### RIVERS AS NURSERIES

Although most Atlantic salmon found in Lake Champlain are bred in hatcheries, in recent years, they have begun to breed in the rivers and streams that feed the lake. Atlantic salmon usually spawn in autumn. They seek riffle areas with gravel bottoms where the fast-moving water is rich with oxygen.

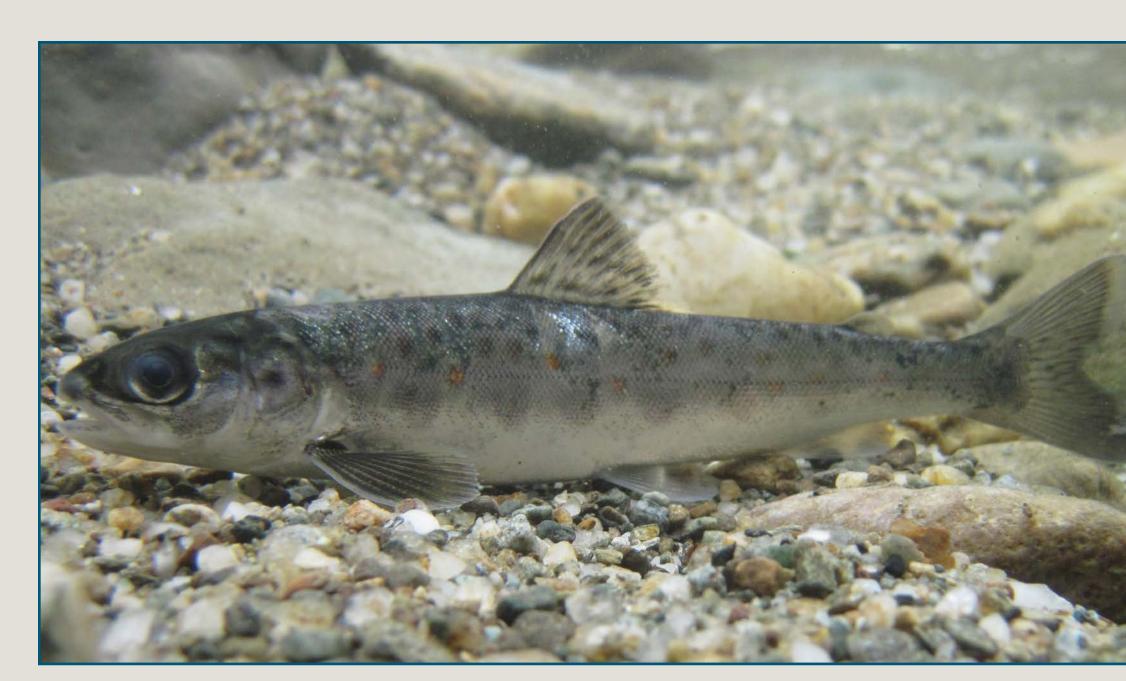
Females begin to reproduce at about four years of age; males at three. When they are ready to breed, males' jaws expand and turn upward into a hook, called a "kype." The male and female salmon swim together during the spawning event. The female digs several redds (nests) to deposit her thousands of eggs, which the male fertilizes. The eggs incubate for about 150 days after spawning. During that time, the fertilized eggs will develop into translucent "eyed eggs."



Salmon redd (nest) in the Winooski River, VT. Source: USFWS

#### FROM EGG TO SAC FRY TO PARR TO SMOLT

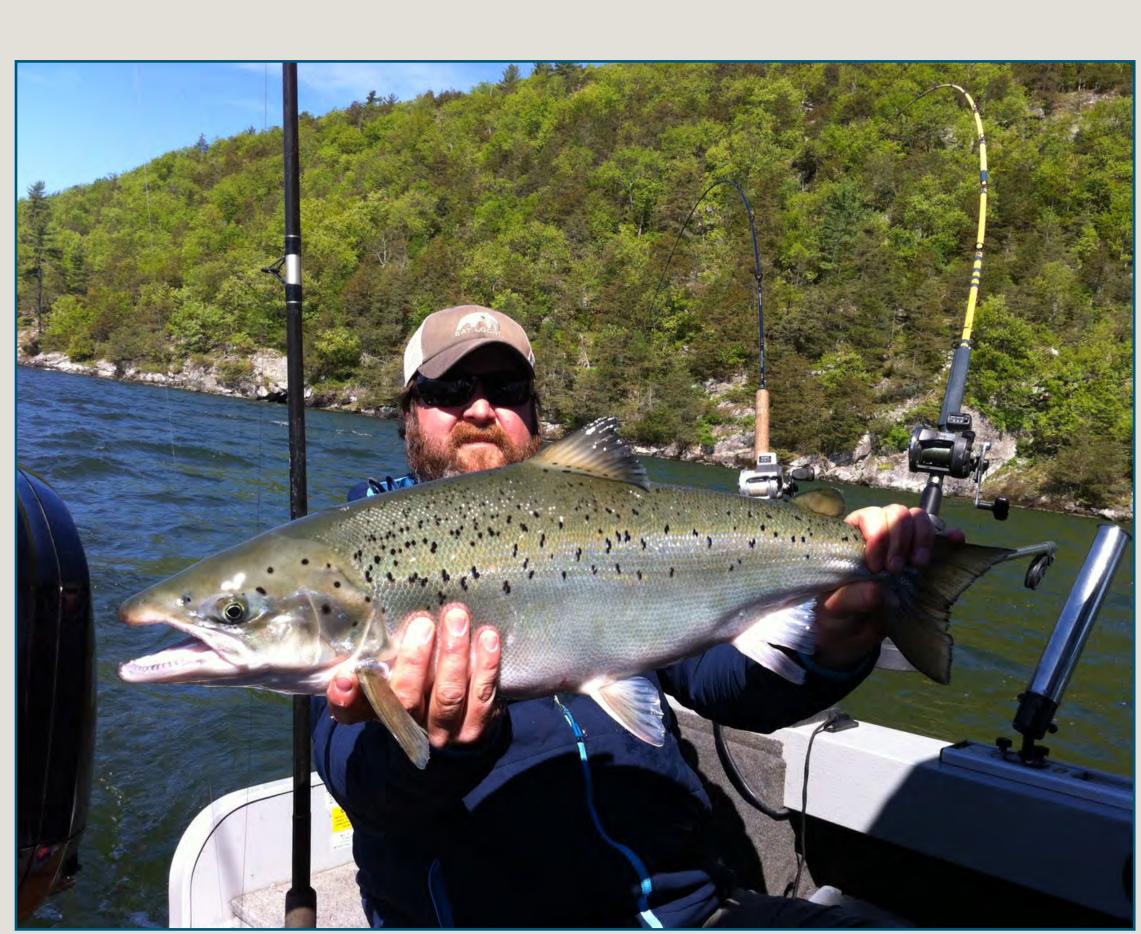
Once the eyed eggs hatch, the tiny alevins, or "sac fry," remain in the gravel until their egg sac is depleted of nutrients and completely absorbed. At this point, the alevins become young "fry" and work their way out of the gravel to feed on tiny insects. When fry reach two inches in length and develop dark vertical bars, or "parr" marks, they are referred to as parr. At this stage of their life, the parr remain in the stream, feeding on larger insects, including mayflies and caddisflies. After one to three years, the parr become "smolts" and swim downstream to Lake Champlain.



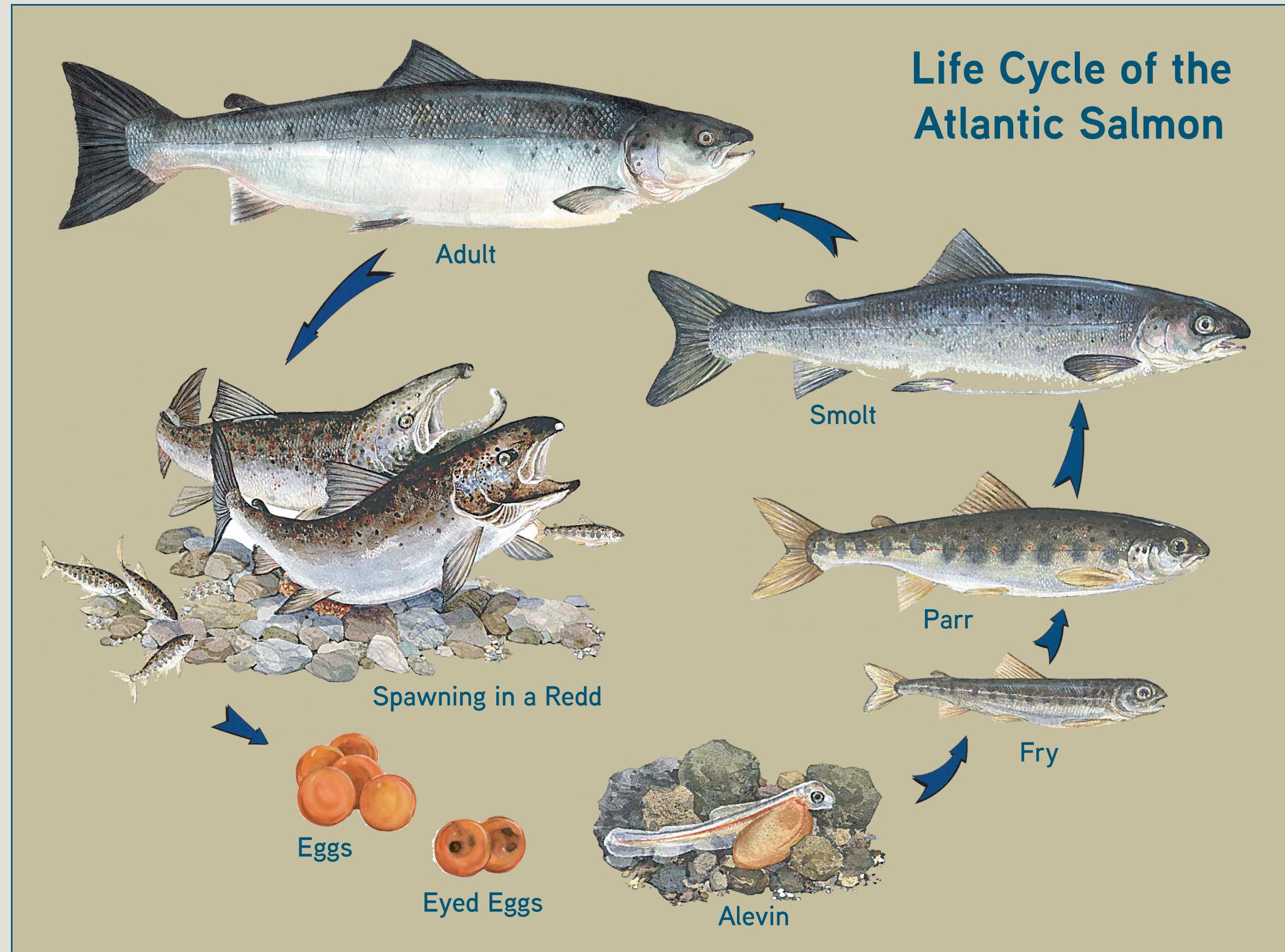
A parr in the Huntington River, VT. Source: USFWS

#### GROWING UP IN THE LAKE

After the smolts enter Lake Champlain, they grow rapidly primarily feeding on smaller fish. They become adult salmon in a year or two and head back to the same stream they were born in, or stocked, to spawn. Unlike Pacific salmon, Atlantic salmon can spawn more than once in a lifetime.



Adult salmon. Source: USFWS



Atlantic Salmon life cycle. Source: Atlantic Salmon Federation





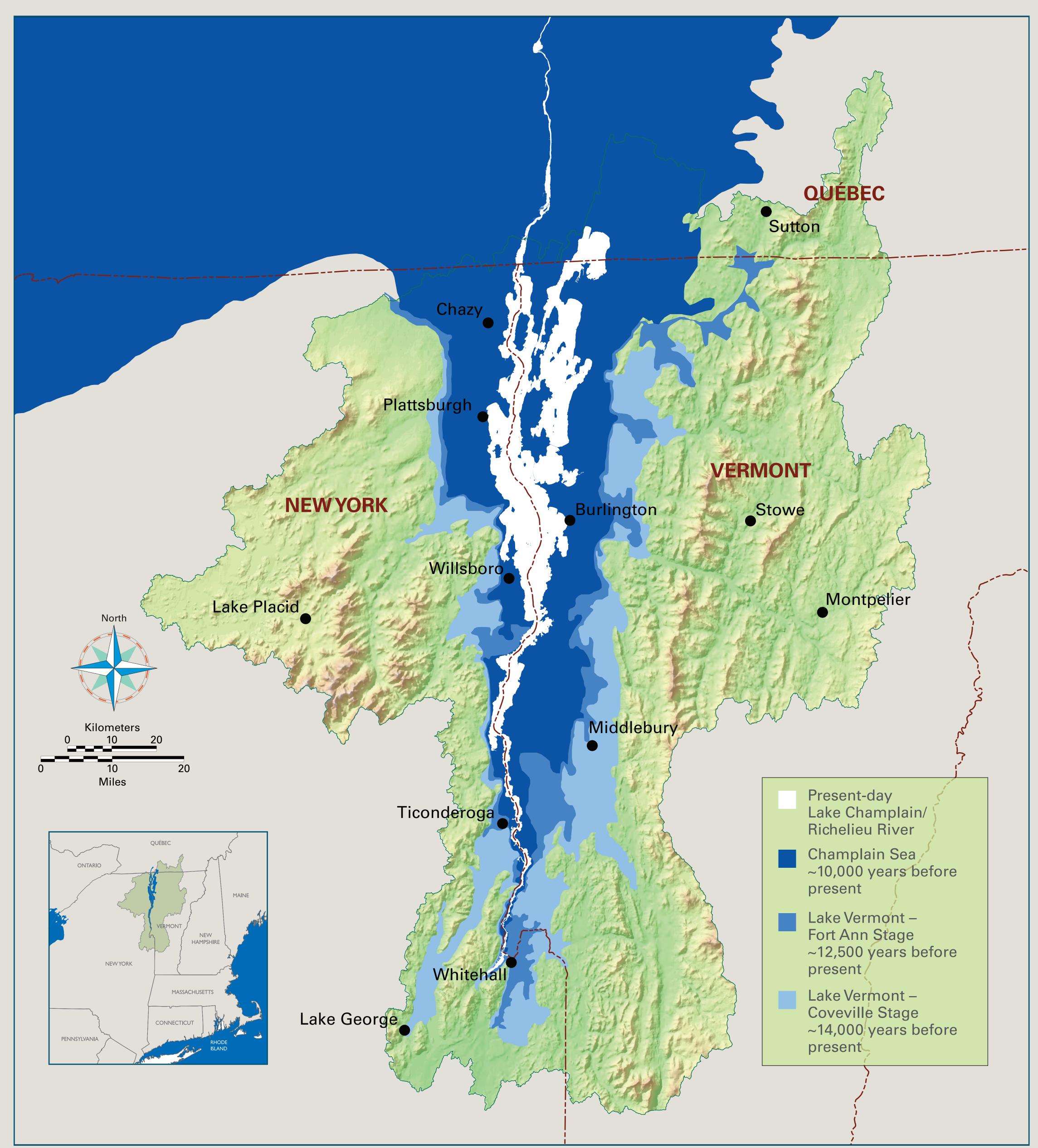








## CHANGING WATERSHEDS



The Champlain Sea was part of the Atlantic Ocean from approximately 13,000 to 10,000 years ago. Source: LCBP

Twenty thousand years ago, every bit of land in New England and New York was covered by a mile-high glacier. Even the highest Adirondack Mountains were encased by this gigantic slab of ice that stretched from the North Pole to Long Island Sound and as far west as Montana. Approximately 15,000 years ago, as the glacier melted and receded north, Lake Vermont was formed. This large, deep freshwater lake flowed south into what became the Hudson River.

Two thousand years later, seawater from the St. Lawrence Valley rushed in as the glaciers retreated further north. Lake Vermont became the Champlain Sea and teemed with marine life, including beluga whales, Atlantic cod, harbor seals, blue mussels and Atlantic salmon.

With the enormous weight of the glaciers removed, the earth's surface rebounded over thousands of years. The rising land cut off the supply of saltwater about 10,000 years ago. Melting snow and rainfall gradually transformed the briny Champlain Sea back into freshwater, forming present day Lake Champlain.



Early European settlers cleared the land in the late 18th and early 19th centuries. The loose soil washed into the Champlain Valley's rivers and streams, destroying salmon spawning habitat.

Source: Rokeby Museum

The Richelieu River drains Lake Champlain into the St. Lawrence River, creating a connection between Lake Champlain and the Atlantic Ocean. For millennia, salmon would return from the ocean and ascend these systems to spawn in the rivers and streams feeding Lake Champlain. Native Americans and early European settlers relied on the plentiful fish for sustenance.

Four hundred years ago, European settlers built dams on many of the rivers and streams the native Atlantic salmon used for spawning. The dams blocked their passage upstream, preventing access to spawning grounds. Early Europeans also cut down the vast forests that covered the Champlain Valley to make room for agriculture. Without trees to hold the soil in place, massive amounts of erosion occurred in the early 19th century, and sediment clogged the rivers and streams, destroying spawning habitat for the salmon. By 1840, the Atlantic salmon were gone from the Champlain Basin.



Source: Concordia University



Atlantic salmon spawn in shallow stretches of river, nesting in cobble. Silt and sand can fill in this habitat, preventing salmon from finding suitable places to lay eggs.

Source: Atlantic Salmon Federation











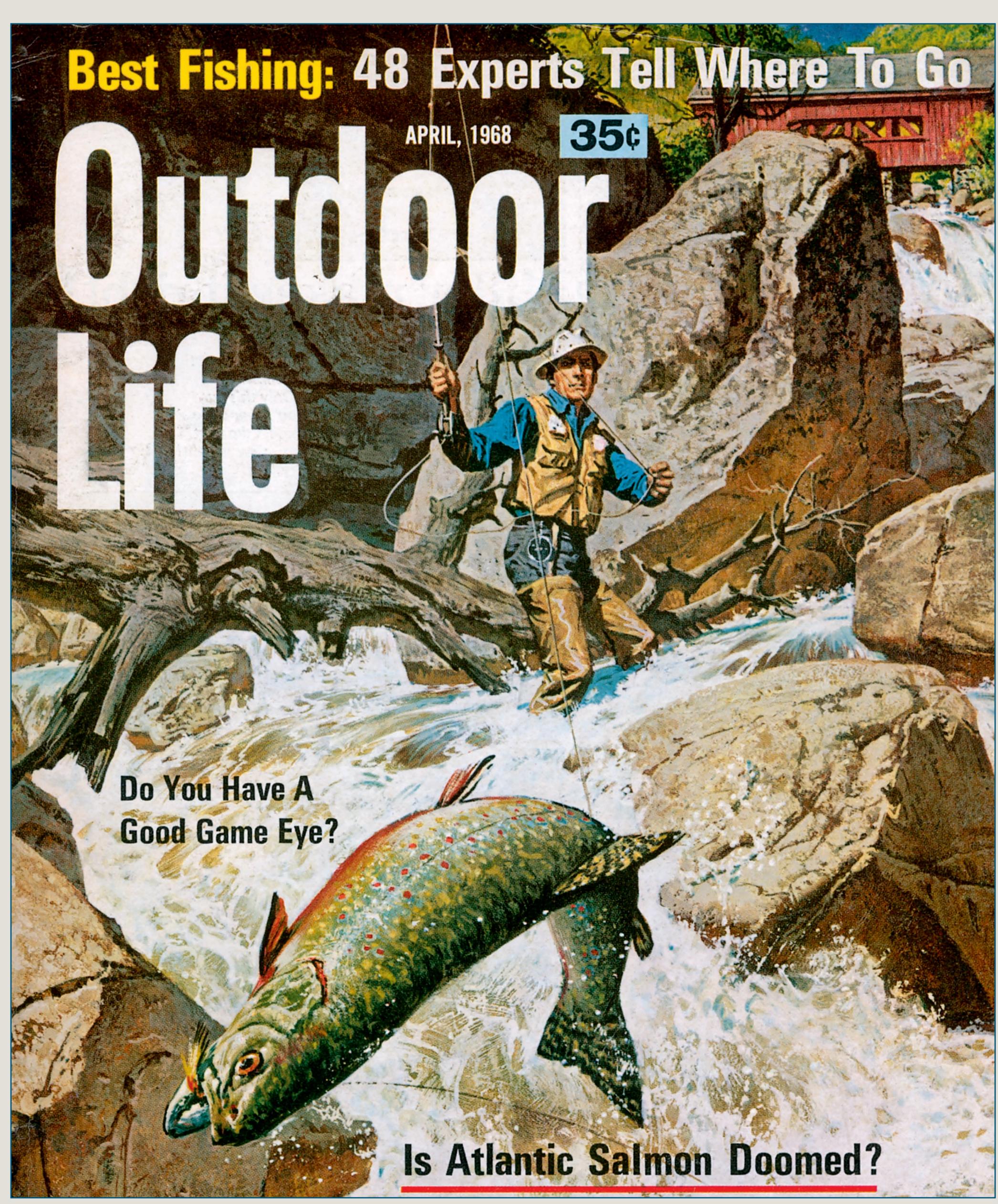








## A POPULATION CRASHES



The fate of the beloved "King of the Sportfish" has concerned anglers for decades. Source: Outdoor Life, April 1968.

#### TALES OF BOUNTY

The first known written account of Atlantic salmon comes from William Gilliland, an early settler in the Champlain Valley in 1776. He wrote of trading 75 salmon to a petty officer in Benedict Arnold's gunboat fleet in exchange for repairs to his salmon weir. Gilliland also wrote that he "had complemented the American Army with fifteen hundred salmon" in 1777.

The historic accounts of Atlantic salmon are striking. Early reports tell of horses being afraid to cross streams crowded with spawning salmon. In 1823, 1,500 salmon were caught in a single haul of a seine net off Port Kendall in Chesterfield, New York. Another source accounts for 500 salmon being taken in one afternoon on the Boquet River. The Saranac River had salmon in "such abundance as to completely fill the river, rendering their capture by the cart-load an easy matter."

The fish were so plentiful, they were harvested with baskets, pitchforks, or even by hand. Their abundance is illustrated by an account near New York's Salmon River, where a 20-pound salmon was traded for a plug of tobacco. Today, a plug of tobacco can be purchased for \$15 and 20 pounds of wild salmon can cost \$600!

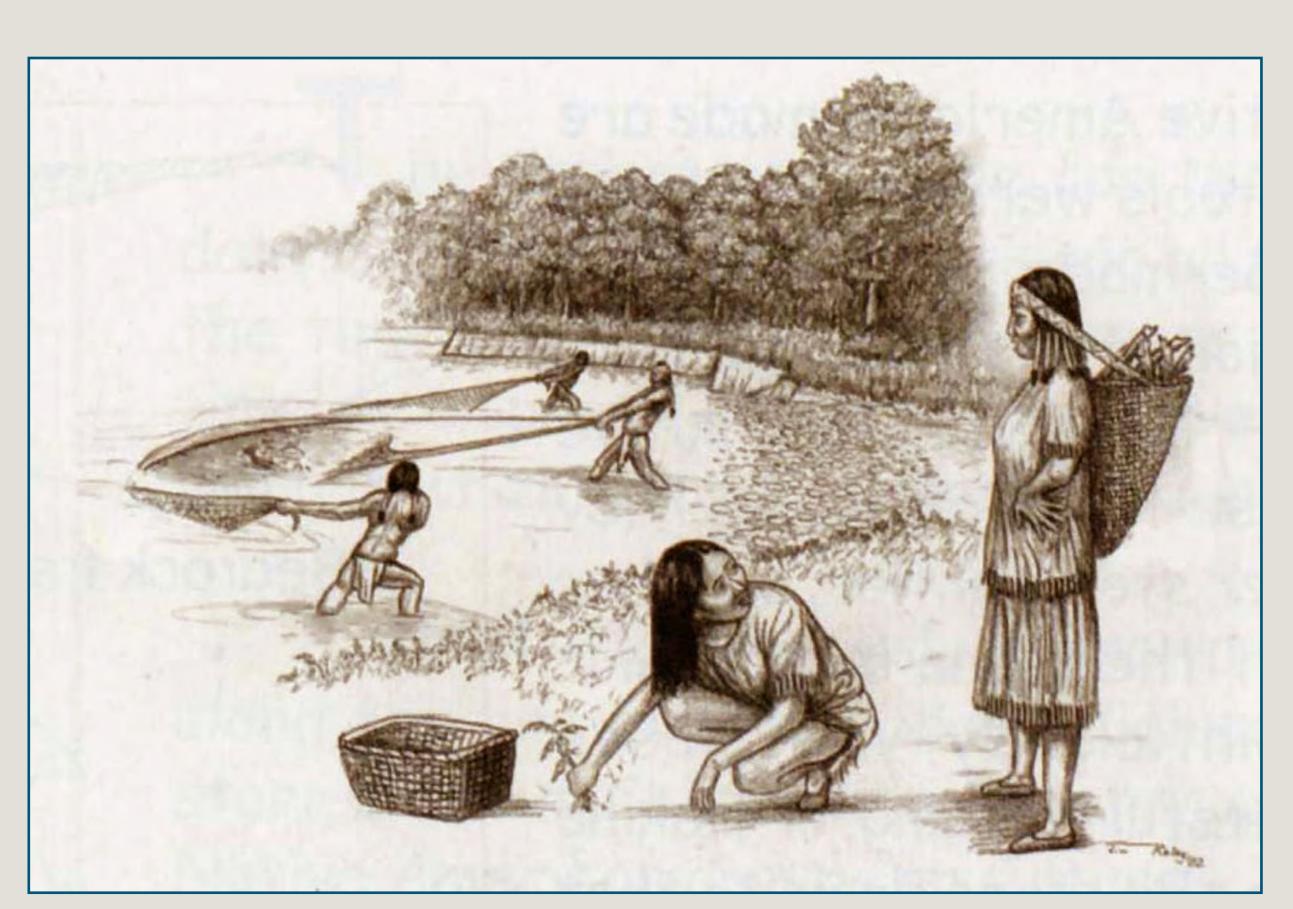
The last known account of salmon in the Champlain Valley is a report of 50-60 fish harvested from the Ausable River in 1838, following a 15-year gap in the last reported salmon sighted.



The American army must have eaten the bountiful, high-protein Atlantic salmon from the Saranac River while camped at Pike's Cantonment from 1812-1814. Artist: John J. Purdy.



Early European settlers found a heavily forested Champlain Valley with lakes and streams teeming with fish. "Camels Hump from the Western Shore of Lake Champlain" (1852) by John Fredrick Kensett. Source: High Museum of Art, Atlanta.



Archaeologists have found that Native Americans lived and fished on the banks of Lake Champlain. This illustration shows men harvesting fish with a seine net. Source: The UVM Consulting Archaeology Program.

#### WHY DID THE SALMON VANISH?

The Atlantic salmon rapidly disappeared from Lake Champlain in the early 1800s. During that time, dams built to power mills were constructed on just about every river and stream flowing into the lake. The dams blocked fish from returning from the Atlantic Ocean and swimming upstream to spawn. The overharvesting of timber in the Champlain Valley also created erosion, which added sediment to streambeds and destroyed spawning habitat.





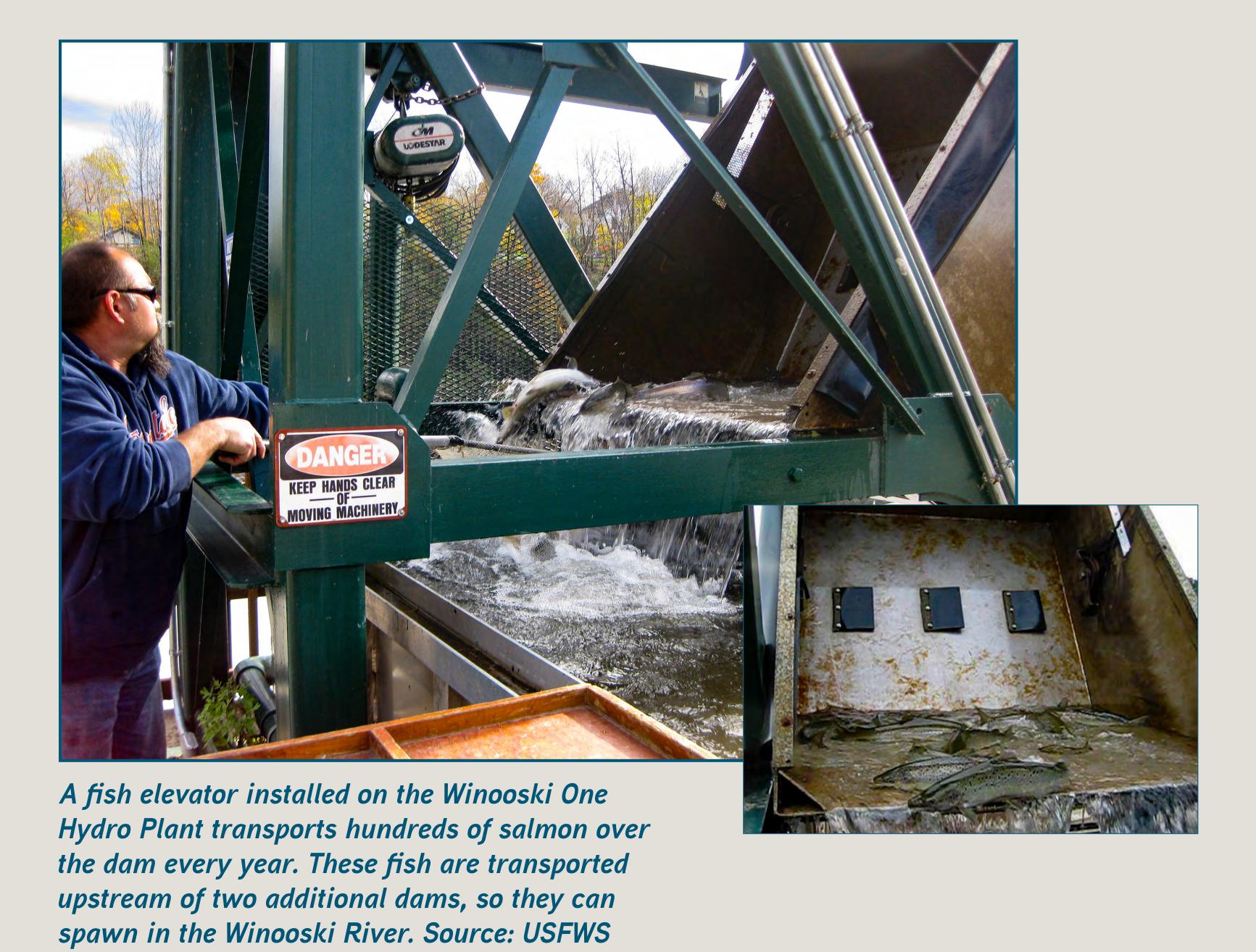
# OVERCOMING OBSTACLES UPSTREAM

Atlantic salmon face three obstacles in the Champlain Valley: dams, degraded habitat, and a changing climate.

#### DAMS

**The Problem:** Early European settlers built dams to power mills throughout the Champlain Valley. These barriers to spawning habitat and loss of quality habitat are the primary reasons why the native Atlantic salmon disappeared by the mid-1800s. Today, there are 463 dams in the Vermont portion of the Champlain Basin alone.

**The Solution:** Partners are working to overcome these obstacles by removing dams no longer used to generate power. If a dam is still in use, innovative measures have been implemented: fish elevators that carry spawning salmon to the top of a dam! This tool allows the fish to continue on their way upstream to find suitable spawning habitat.







The Willsboro Dam on the Boquet River in New York was removed in 2015. In 2017, Atlantic salmon were migrating up the cascade and spawning upriver of the former dam site. Source: Vic Putman

#### POOR HABITAT

**The Problem:** Atlantic salmon require shaded, fast-moving streams with clean, rocky bottoms for spawning. Streambank erosion, caused by heavy rains and snowmelt, can carry sediment that covers these rocky bottoms, making them an unsuitable place for the fish to lay eggs.

**The Solution:** Erosion can be reduced by planting trees along the edges of streams and rivers. Slowing the flow of stormwater with proper land-use practices also can help maintain stable stream-



Heavy rains and rapid snowmelt erode streambanks, causing sediment to cover spawning habitat for Atlantic salmon. Source: LCBP

#### A CHANGING CLIMATE

The Problem: Salmon like their water just right: not too cold and not too hot. Changing climate patterns can affect the rivers and streams salmon use to spawn, hatch and grow. Salmon don't do well in water warmer than 75 degrees Fahrenheit, so the increasing average temperature we are experiencing in the Champlain Valley is a real threat to Atlantic salmon and other species that prefer cold water. In addition to warmer temperatures, changing weather patterns can affect salmon habitat. More frequent droughts can make spawning beds inaccessible. Flooding from heavy rains can erode riverbanks and smother gravel spawning beds with sediment.

**The Solution:** Stable, cool streams will help the Atlantic salmon in the Champlain Valley. Planting more trees along streambanks will aid in maintaining suitable habitat while reducing erosion.



Planting trees on streambanks helps prevent erosion and creates shade for cooler water temperatures. Source: Friends of the Winooski River

#### WHAT YOU CAN DO TO HELP



Join your local watershed group or a local environmental organization like Trout Unlimited or Lake Champlain Committee.



Use rain barrels, rain gardens and other approaches to reduce runoff volume and create a "Rain Friendly" yard.



Work with a State or County forester to better manage your property for water quality.

Streambanks with minimal vegetation are prone to erosion. Source: LCBP













Champlain Valley
National Heritage Partnership





## OVERCOMING OBSTACLES THE LAKE

It has not been easy for the Atlantic salmon since the U.S. Fish and Wildlife Service and New York and Vermont state agencies began restocking this species in Lake Champlain in 1972. Atlantic salmon face two significant obstacles to recovery in the lake: the sea lamprey and alewife.

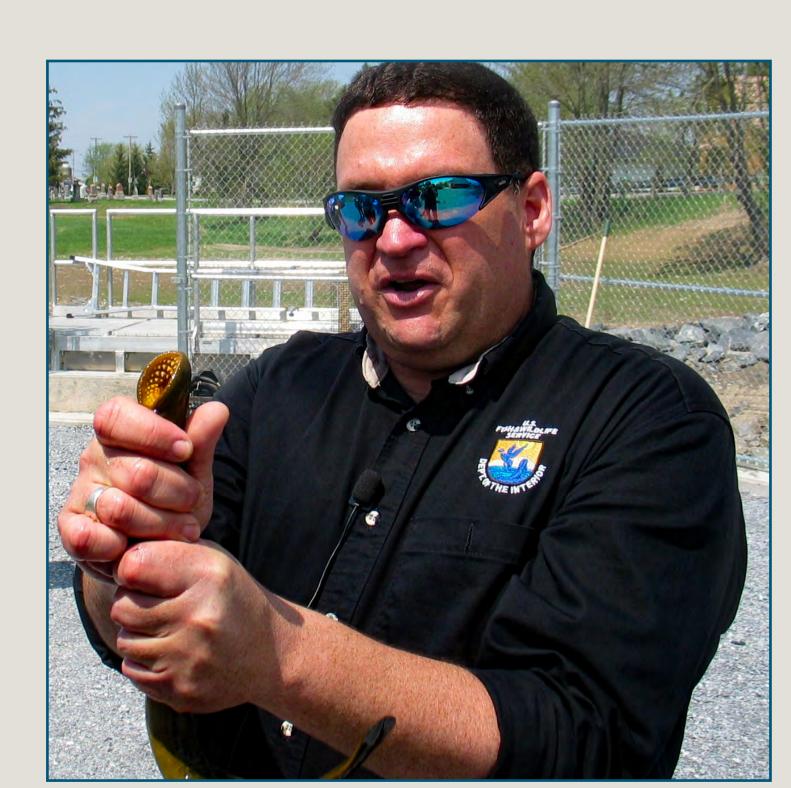
#### SEA LAMPREY

**The Problem:** The sea lamprey population explosion in the 1990s is linked to the 1972 reintroduction of salmon and lake trout to Lake Champlain. Sea lamprey feed on the blood and body fluids of host fish by latching on with their circular, suction mouth and small, sharp teeth. Biologists estimate that 40-60% of fish attacked by sea lamprey die from these wounds.

**The Solution:** The Lake Champlain Sea Lamprey Control Program was launched in 2001, following an experimental period. This program uses an integrated approach to control sea lamprey, including barriers, traps, and lampricides to manage sea lamprey populations in Lake Champlain.



Sea lamprey wounds. Source: LCBP



Dr. Bradley Young, USFWS
holds an adult sea lamprey
collected from the Morpion
Stream sea lamprey barrier
in Notre-Dame-de-Stanbridge,
Québec. Source: LCBP

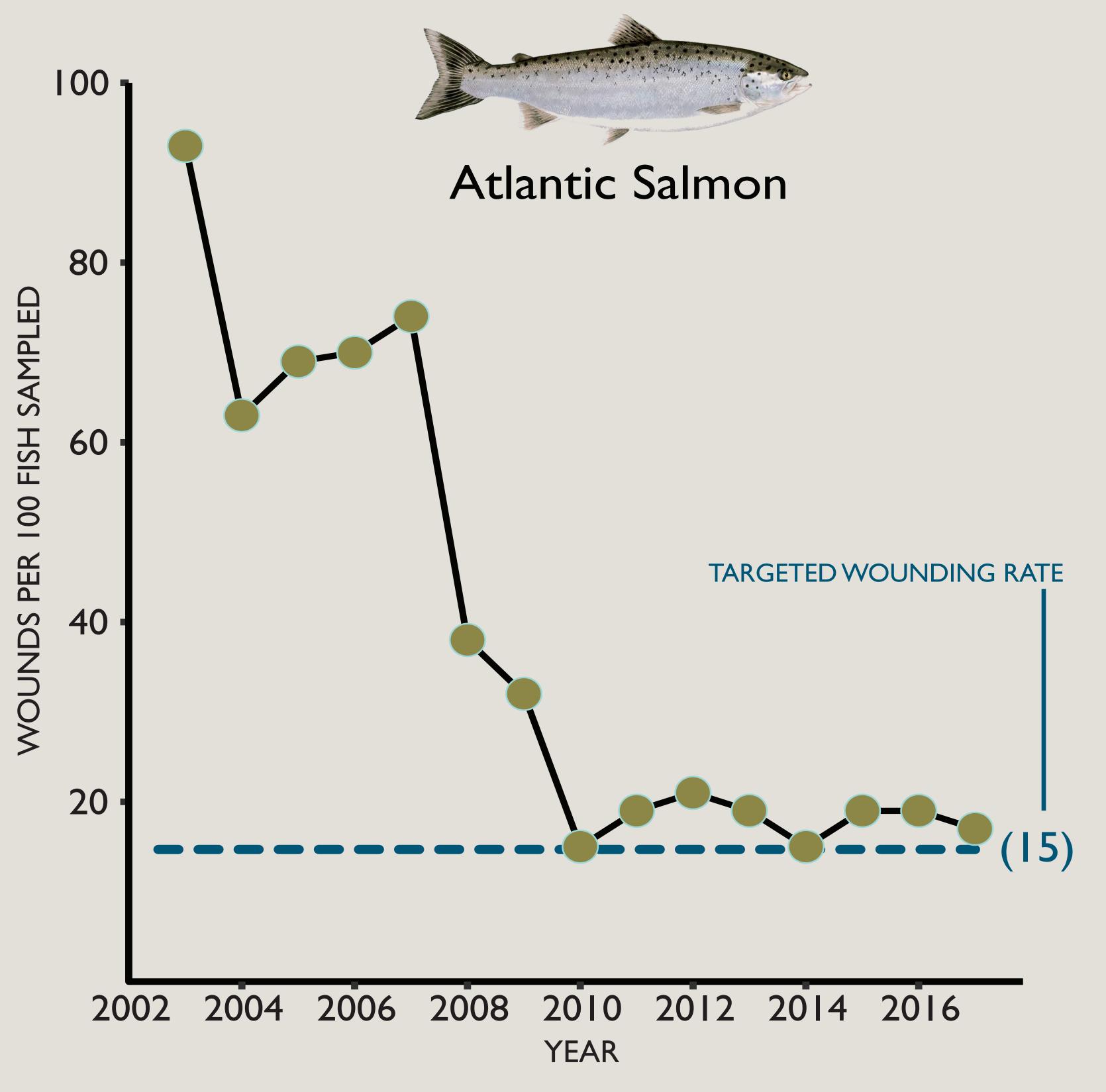
#### ALEWIFE

**The Problem:** Introduced into Lake Champlain in 2003, the alewife has crowded out rainbow smelt, the primary food source for salmon. Unfortunately, when salmon eat alewife, it causes a Vitamin B1 deficiency, which reduces energy levels in adults and the survival rate of young fish.

**The Solution:** Fisheries biologists are boosting Vitamin B1 into hatchery-raised Atlantic salmon by treating eggs with the vitamin. Biologists are also selectively breeding Atlantic salmon that are able to maintain higher levels of Vitamin B1, or survive with lower levels of the vitamin.



A USFWS salmon researcher returns an Atlantic salmon treated with Vitamin B1 back into the Boquet River in Willsboro, NY. Source: Bill Ardren, USFWS



Sea lamprey wounding rates on Atlantic salmon have plummeted from nearly 100% to below 20% in the past two decades. Data source: USFWS and VTFWD. Figure source: Adapted from the LCBP 2018 State of the Lake Report.



Top: Rainbow smelt; bottom: Alewife. Source: LCBP



In addition to harming the reproductive functions of Atlantic salmon, alewife populations have periodic, massive die-offs as seen here in this 2008 high-water image.

Source: Shawn Good, VTFWD.













Champlain Valley
National Heritage Partnership



The reintroduction of Atlantic salmon to the Lake Champlain Basin is a success because of strong partnerships. Generations of anglers, fisheries biologists, hydrology engineers, scientists, educators, activists, and policymakers have worked together for decades to bring this native species back to Lake Champlain. Although fishing is not for everyone, there are plenty of places to learn more about the Atlantic salmon.



#### ED WEED FISH CULTURE STATION

Grand Isle, VT

Tour the facility that raises salmon from eggs and releases them when they become smolts. A Visitor Center and tours teach visitors about how these fish are raised at the hatchery. If you visit in late-October or early November, be sure to see the spawning fish crowding into nearby Hatchery Brook as they make their way home.



#### ADIRONDACK FISH -----**HATCHERY**

Saranac Lake, NY

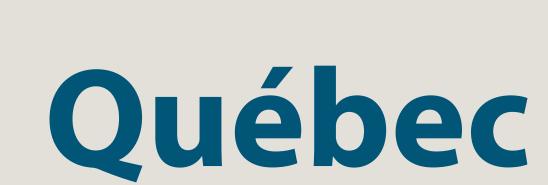
This New York State-operated hatchery produces 30,000 pounds of salmon annually for statewide distribution. Observe salmon in an indoor pool at the visitor center.



#### AMERICAN MUSEUM OF FLY FISHING

Manchester, VT

The Atlantic salmon is considered the "King of the Sportfish" by many anglers. Visit the museum to learn how flyrods are used to catch these prized fish, develop an appreciation for this artful sport, and learn more about conservation of our shared waterways.



Richelieu River

Chambly Canal



New York

Lake George

**Grand Isle** 

Winooski

Burlington

Lake Champlain

#### Vermont

North

Chittenden

Champlain Canal

Manchester

Hudson River



#### SALMON HOLE AND WINOOSKI ONE DAM

Burlington and Winooski, VT

The Salmon Hole at the base of the Winooski River Falls in Winooski, Vermont was a popular fishing spot before the Atlantic salmon were extirpated in the early 1800s. A fish elevator was added to the Winooski One hydroelectric dam in 1993. The public is welcome at any time especially in the fall when the salmon are being lifted and moved upstream. Tours are held during special events like "World Fish Migration Day" each April. The Riverwalk to the Salmon Hole is an easy, half-mile hike from Burlington's Intervale Center.



#### ECHO, LEAHY CENTER FOR LAKE CHAMPLAIN

Burlington, VT

From salmon to shipwrecks, ECHO is a dynamic lake aquarium and science center where families can learn just about everything about the Lake Champlain Basin and more.



DWIGHT D. EISENHOWER NATIONAL FISH HATCHERY

North Chittenden, Vermont

Feed adult Atlantic salmon at this hatchery operated by the U.S. Fish and Wildlife Service that produces 130,000 salmon for Lake Champlain every year.









