# *The Dramatic Decline of the American Eel*

## *Are they squirming back up that slippery slope?*

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# Background

- American eels in the St. Lawrence and Ottawa river watersheds were once extremely abundant, highly valued, and a heavily used resource but have declined to such a precarious state that in Ontario they are now officially classified as *endangered*.

- Declining abundance and loss of recruitment to the distant St. Lawrence stocks possibly forewarn a widespread decline of this ancient migratory species.

- The extent and causal factors of this decline need to be more thoroughly examined and quantified.

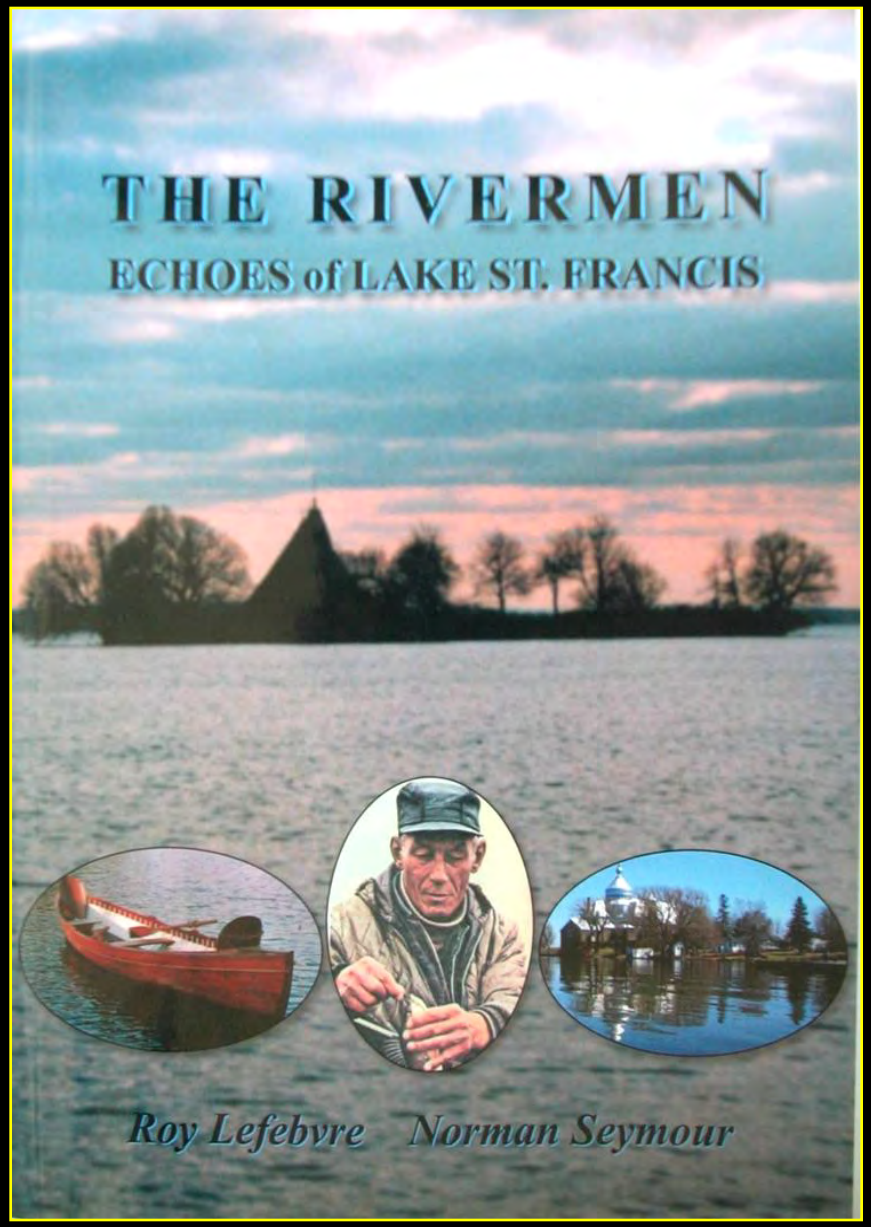
*Let's explore the problem of "Eels at the Edge"*

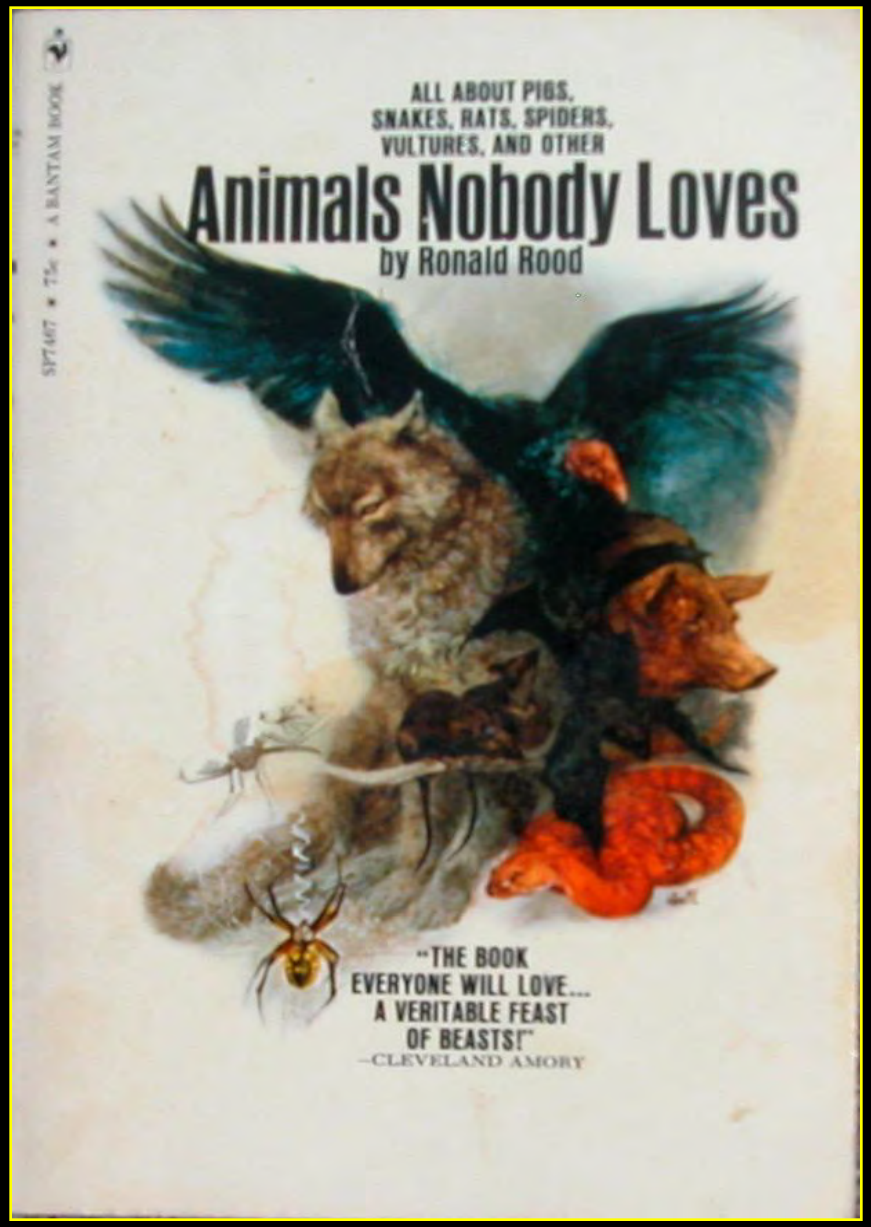
# Early historic myths, their origins shrouded in mystery

- In Aristotle's time, ancient Greeks considered eels as "the king of fish". But their source was unknown. Aristotle, in 350 BC, in his *Historia Animalium*, concluded they were a by-product of decomposition.
- Other speculations and weird fanciful notions attribute eels to horse hairs falling into water or reproduction involving rubbing their bodies against rocks and the bits of skin coming to life.
- Linnaeus and Leeuwenhoek, fathers of taxonomy and microbiology, incorrectly speculated that round worms (nematodes) were young eels awaiting birth.

# *Eels can be both loathed and loved with a passion!*

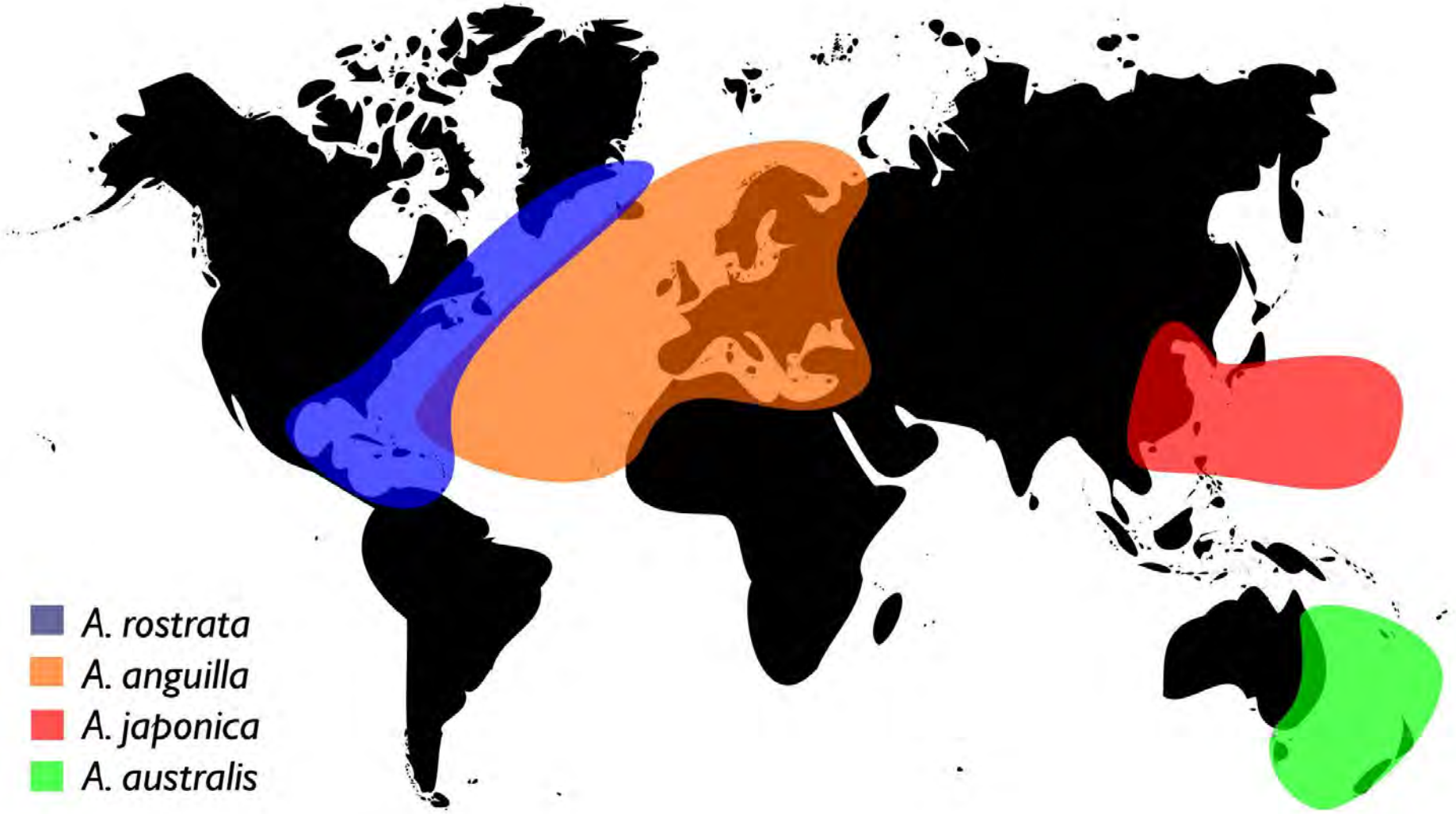
# *Love-hate relationship: a fish that some love to hate!*



# DISTRIBUTION OF FOUR ANGUILLID SPECIES

## A broad worldwide distribution (from Crook 2010)




*From Crook 2010 , adapted from Silfvergrip 2009*

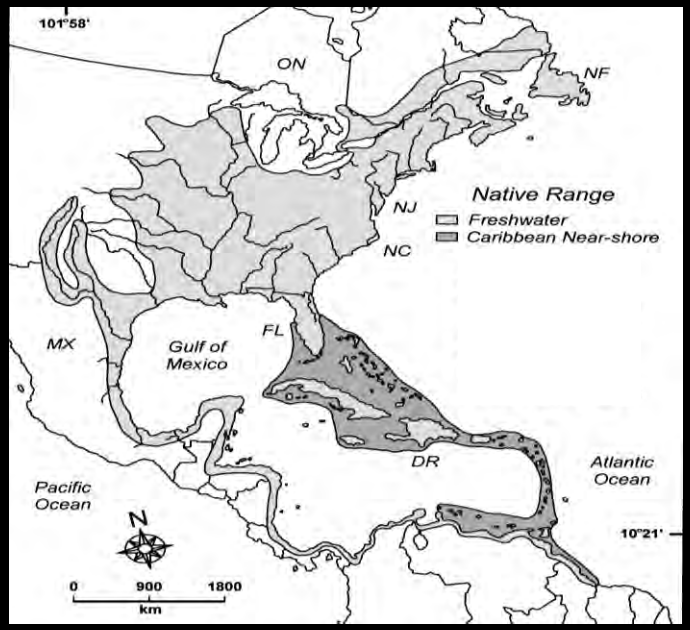
***There has been an unprecedented disappearance of this ancient fish from the St. Lawrence River system!***

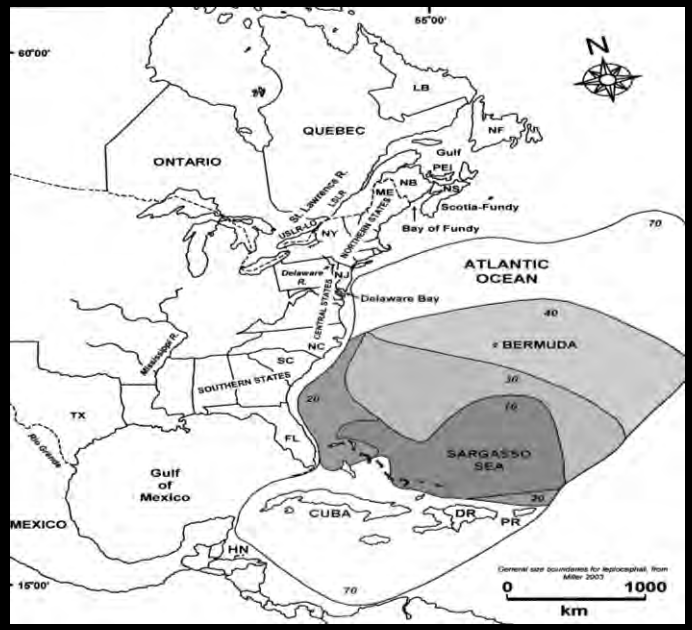
# *American eels*

***once very abundant and heavily utilized are leaving the largest basin of fresh water on the planet and not returning!***

# This Ancient Invader of Fresh Waters, Which Survived Continental Drift, Integrates the Marine and Freshwater Environments

***Has ancient life-history strategies, spawning in the sea; randomly dispersing and maturing in fresh or brackish water over one of the broadest species ranges and uniquely panmictic, forming one inter-breeding population***



Glass eel

Leptocephalus

Elver

Oceanic

Continental

Eggs

Yellow eel

St. Lawrence R. system

Spawning

Silver eel

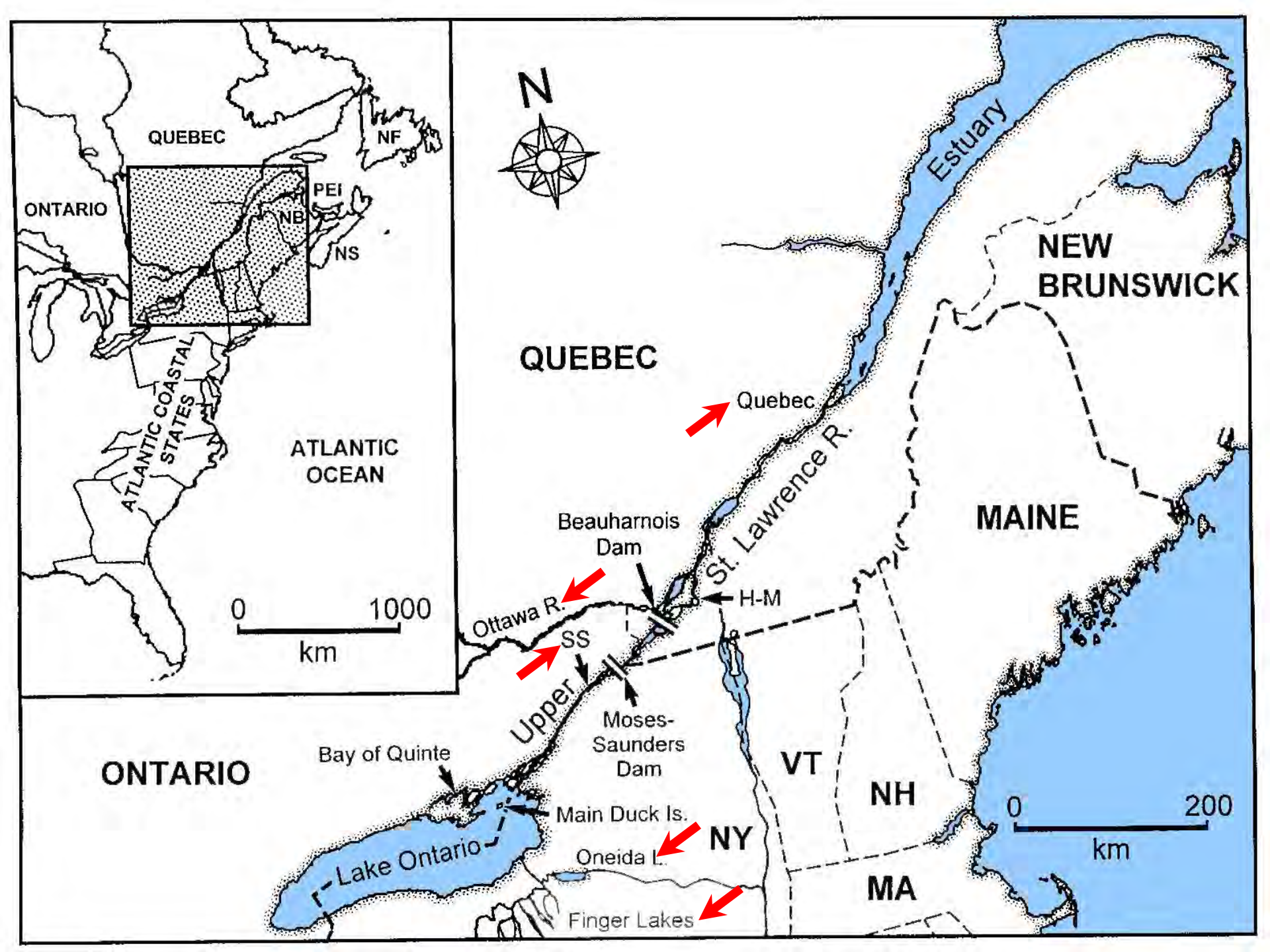
***A mysterious and ancient fish with a unique life history***

***Life cycle of the freshwater eel***

# American Eel Prehistoric and Early Historic Insights

## *Archaeology puts the species, resource value, and declining abundance in context*


*Ancient stone eel effigy or decoy*


QUEBEC
NF
PEI
NB
NS
ONTARIO
ATLANTIC COASTAL STATES
ATLANTIC OCEAN
0
1000
km
N
Estuary
NEW BRUNSWICK
QUEBEC
Quebec
St. Lawrence R.
MAINE
Beauharnois Dam
H-M
Ottawa R.
SS
Upper
Moses-Saunders Dam
Bay of Quinte
ONTARIO
VT
NH
Main Duck Is.
Lake Ontario
NY
Oneida L.
MA
Finger Lakes
0
200
km

# Chronology of prehistoric and early historic significance – selected events

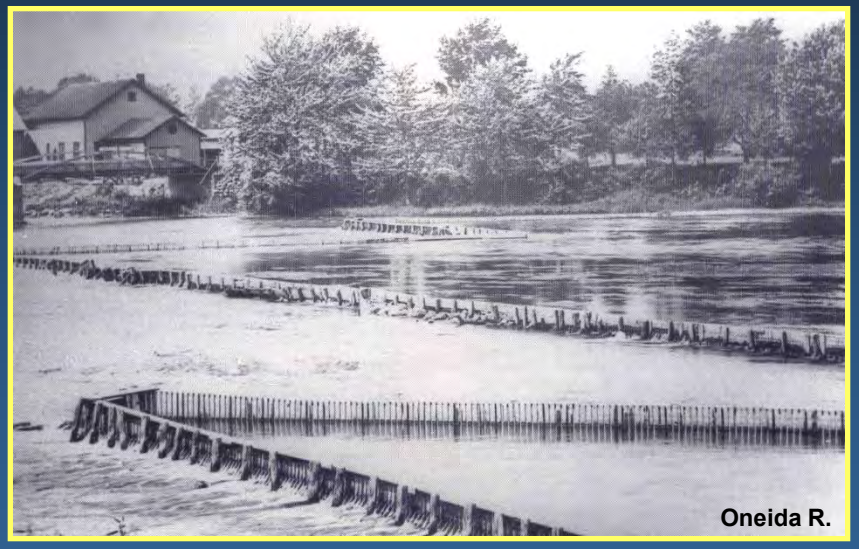
- 4200-5500 BP: Prehistoric Algonquin fishing sites at Morrison Island, Ottawa River (Pembroke), archaeology indicates largest known eel harvesting site in North America and on major pre-contact canoe route.

- 1100-1600: Prehistoric St. Lawrence Iroquoian eel fishing site on the upper St. Lawrence River (faunal remains analyzed by Junker-Andersen 1988). Smoked eels were nutritious and light-weight and very important to Aboriginals as food (Jesuit Relations)

- Harvested eels provided a highly efficient, storable surplus for later consumption. Eels are particularly nutritious, with six times the caloric value of any other freshwater fish and were important winter and “travelling” food.

- In prehistoric times, eel stocks of the watershed of the St. Lawrence and Ottawa rivers were very stable and predictable, composed of old individuals of many cohorts, which minimized population fluctuations, hence were a highly dependable fish resource.

- **1916: 100 t of silver eels trapped annually from Oneida Lake, a tributary to Lake Ontario (Adams and Hankinson). When dams were constructed, immigration was impeded; species became very rare and the resource was extirpated.**


Oneida R.


St. Lawrence R.

- **Over the past century, eel stocks have fluctuated widely but have generally declined as value and effort increased – *Is the decline universal ?***

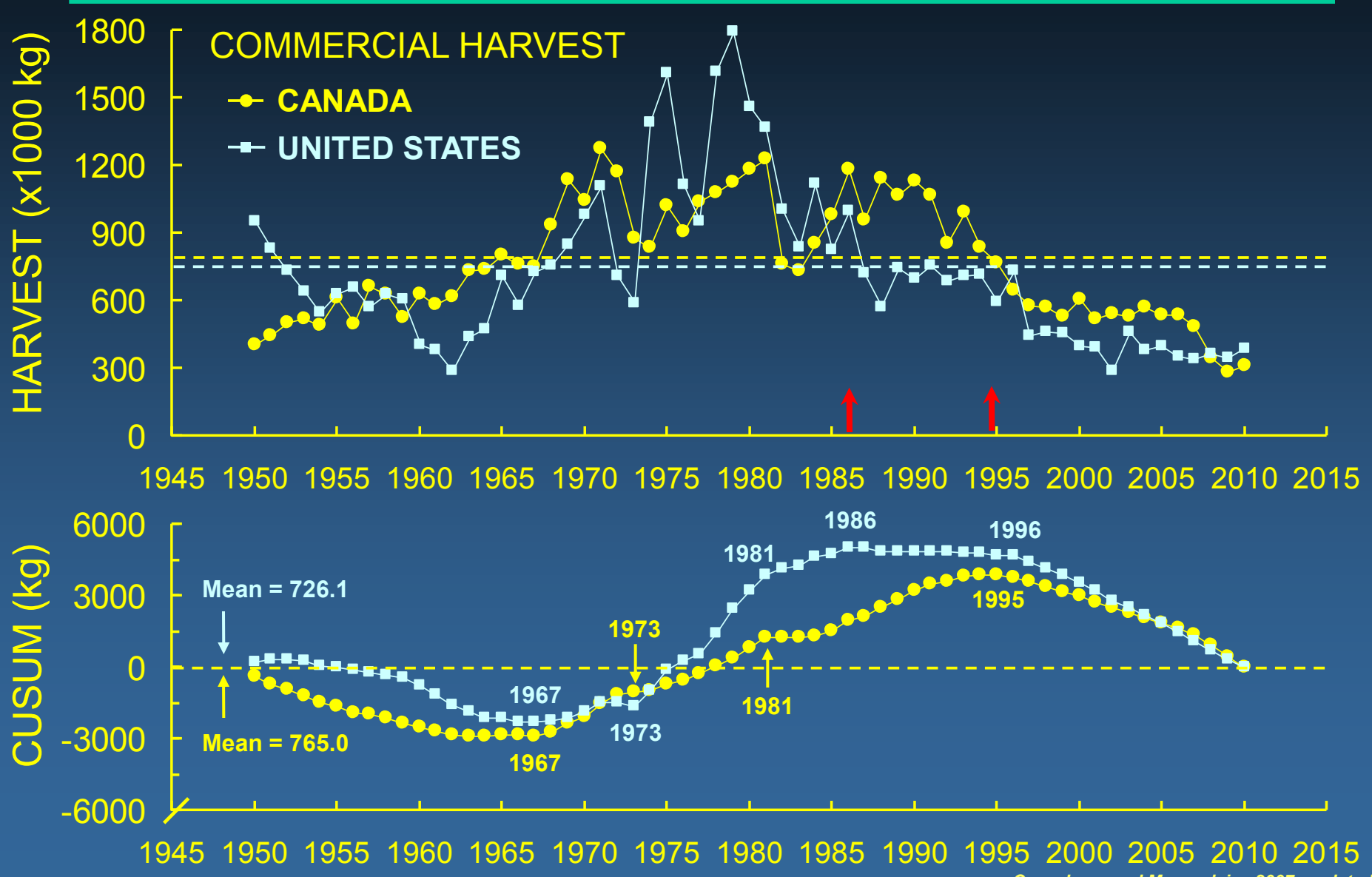
# Long-Term Trends in Commercial American Eel Harvest and Price

## *Combined across regions, Canada, United States, and overall*

## *1950-2010, update*

# COMMERCIAL HARVEST OF EELS, 1950-2010

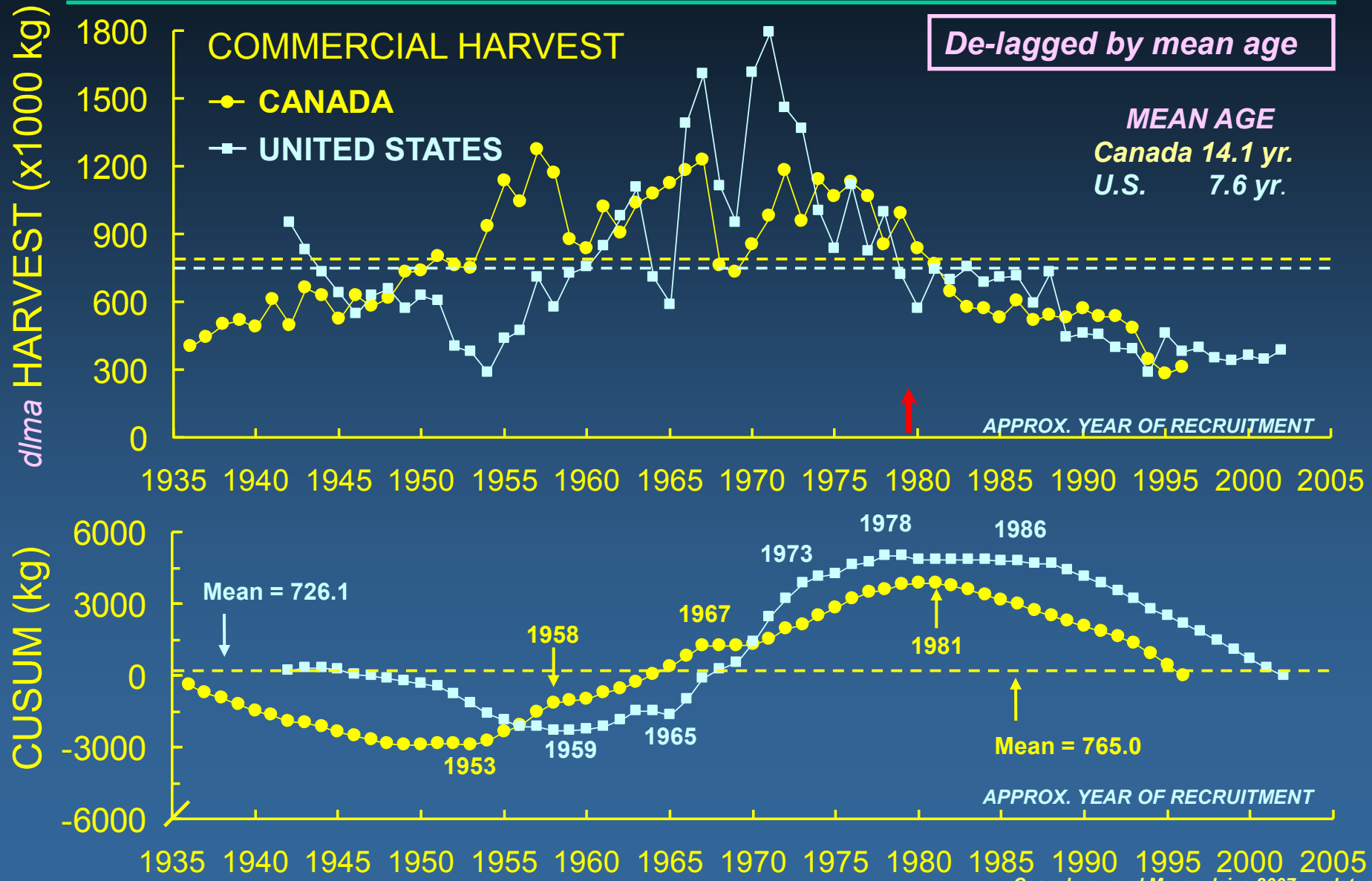
## Combined for all regions in Canada and United States




*Casselman and Marcogleise 2007, updated*

# ADJUSTED COMMERCIAL HARVEST OF EELS

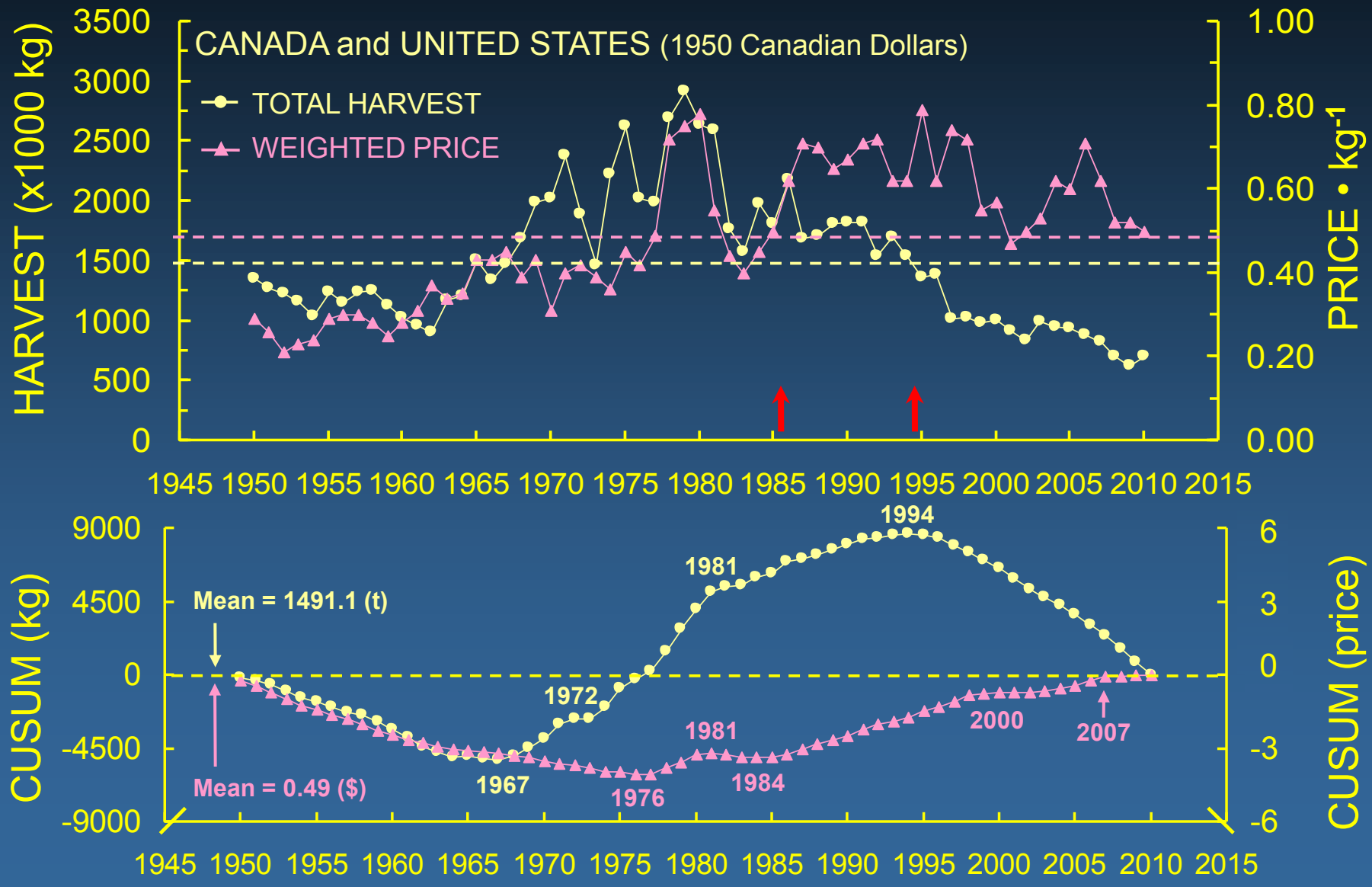
## Lagged for overall mean age of the catch



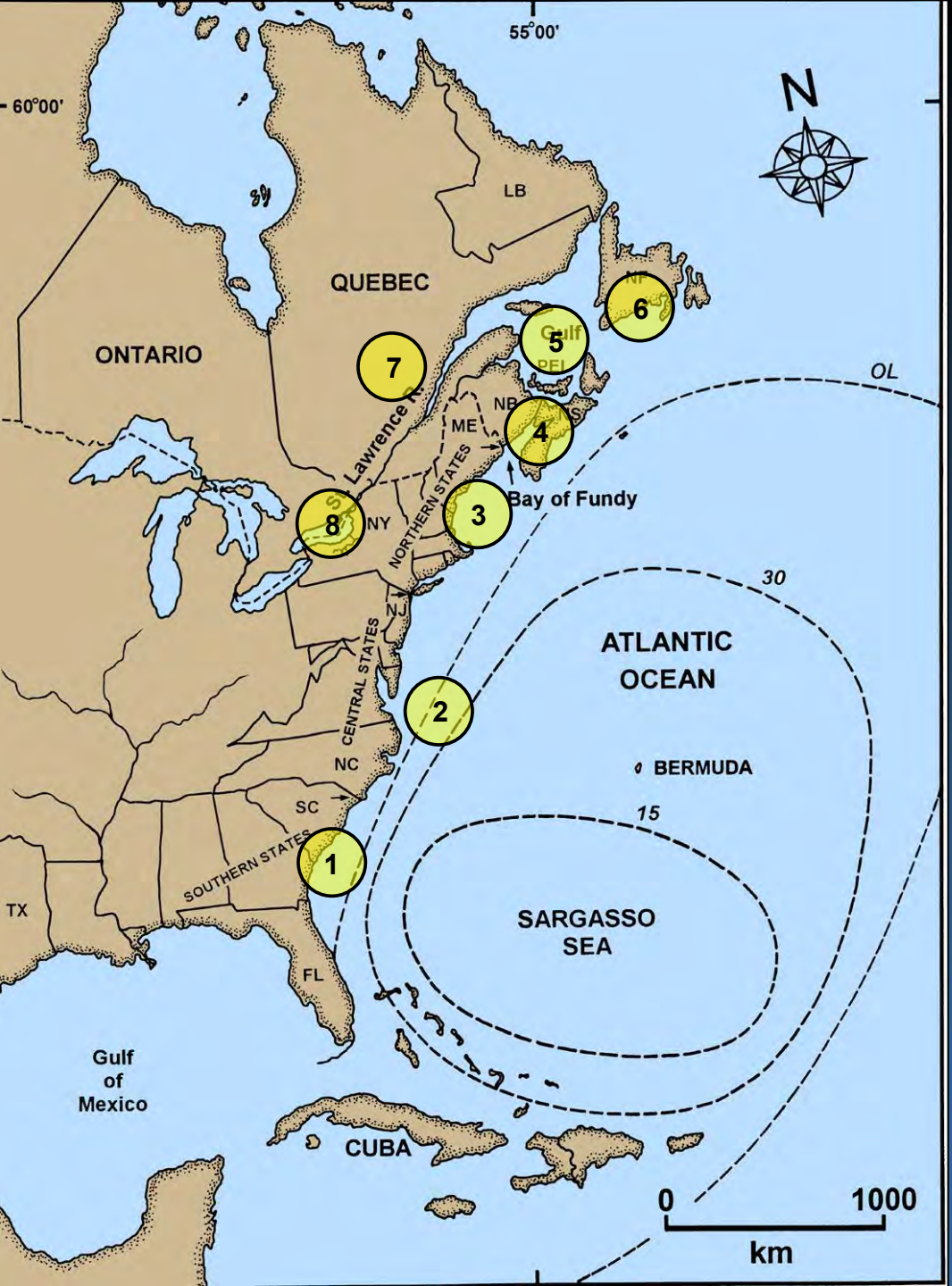

Casselman and Marcogleise 2007, updated

# OVERALL HARVEST – PRICE OF YELLOW EELS

## Price expressed in deflated 1950 Canadian dollars

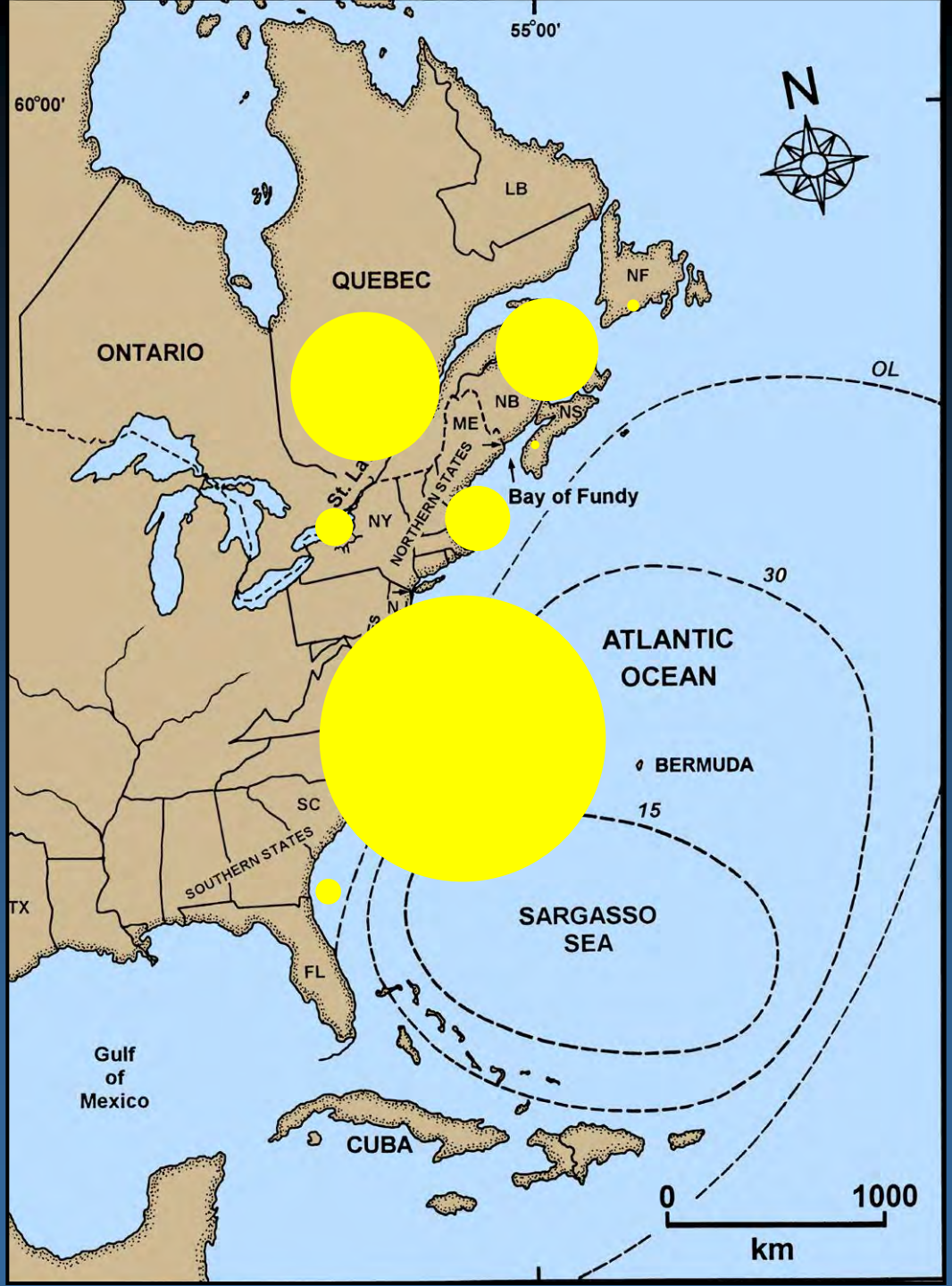



*Casselman and Marcogleise 2007, updated*



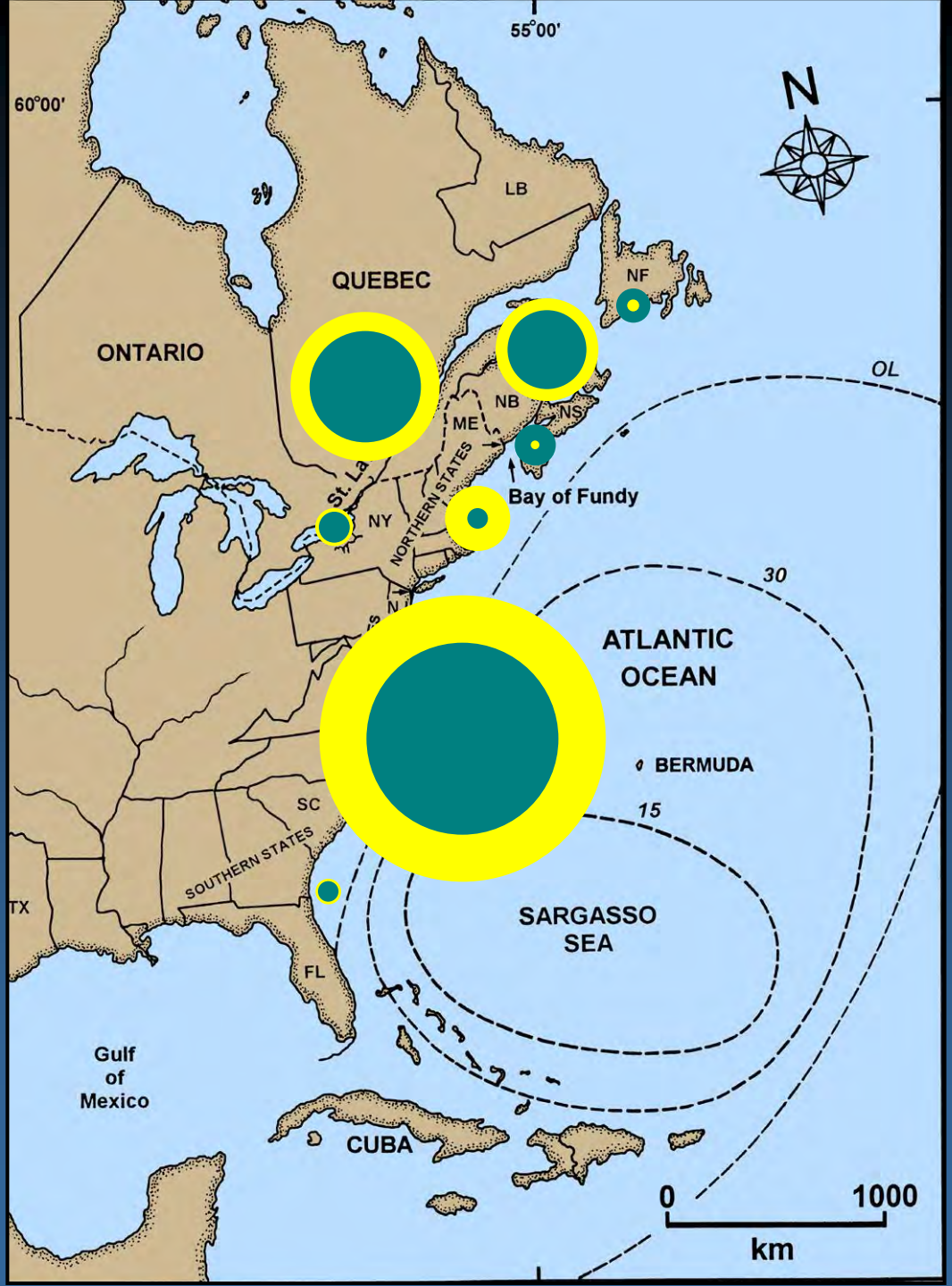

# American Eel Harvest Regions

1. Southern States
2. Central States
3. Northern States
4. Scotia–Fundy Region
5. Gulf Region
6. Newfoundland Region
7. Lower St. Lawrence River
8. Upper St. Lawrence River and Lake Ontario



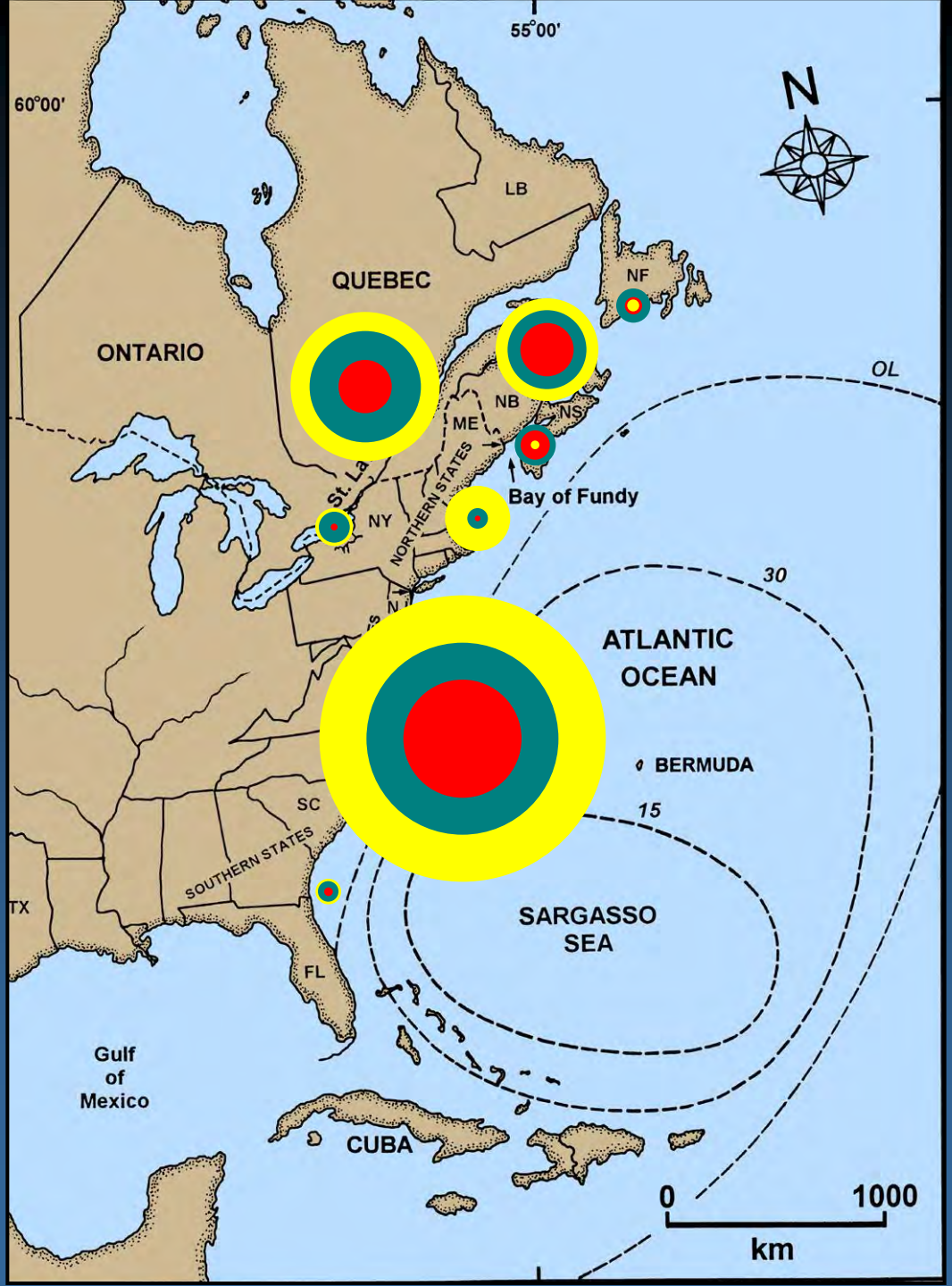

## Mean Harvest 1980 to 1984 (x1000 kg)

| | |
|---|---|
| Southern States | 79.0 |
| Central States | 876.7 |
| Northern States | 202.3 |
| Newfoundland Region | 40.8 |
| Gulf Region | 318.2 |
| Scotia–Fundy Region | 31.8 |
| Lower St. Lawrence River | 461.9 |
| Upper St. Lawrence River and Lake Ontario | 117.5 |
| Total | 2,128.2 |



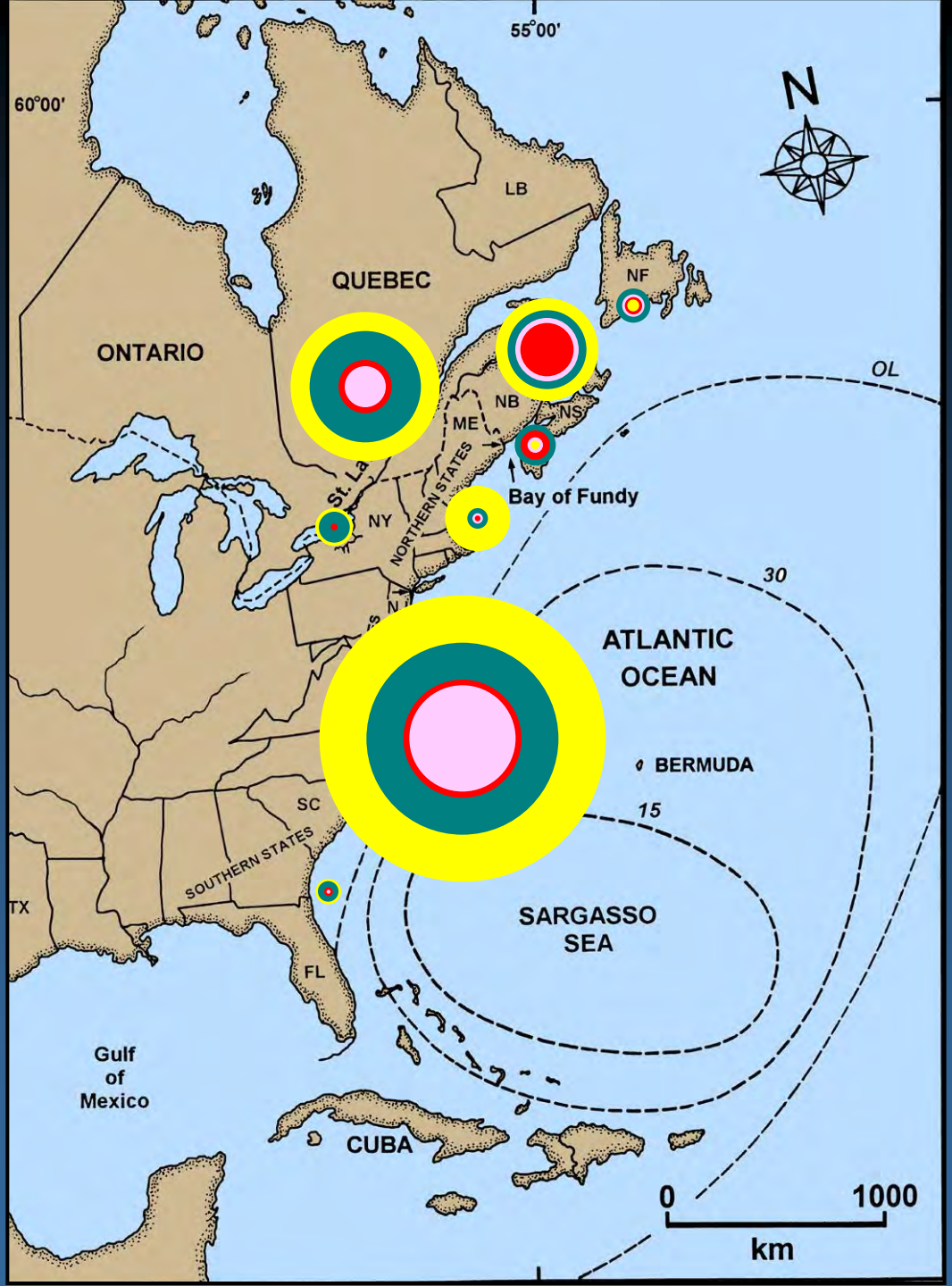

## Mean Harvest 1990 to 1994 (x1000 kg)

| | |
|---|---|
| Southern States | 70.4 |
| Central States | 589.9 |
| Northern States | 51.4 |
| Newfoundland Region | 119.6 |
| Gulf Region | 244.8 |
| Scotia–Fundy Region | 153.8 |
| Lower St. Lawrence River | 347.7 |
| Upper St. Lawrence River and Lake Ontario | 109.2 |
| Total | 1,686.8 |




## Mean Harvest 2000 to 2004 (x1000 kg)

| | |
|---|---|
| Southern States | 4.2 |
| Central States | 369.9 |
| Northern States | 11.0 |
| Newfoundland Region | 56.0 |
| Gulf Region | 180.0 |
| Scotia–Fundy Region | 111.8 |
| Lower St. Lawrence River | 168.4 |
| Upper St. Lawrence River and Lake Ontario | 20.8 |
| Total | 922.1 |



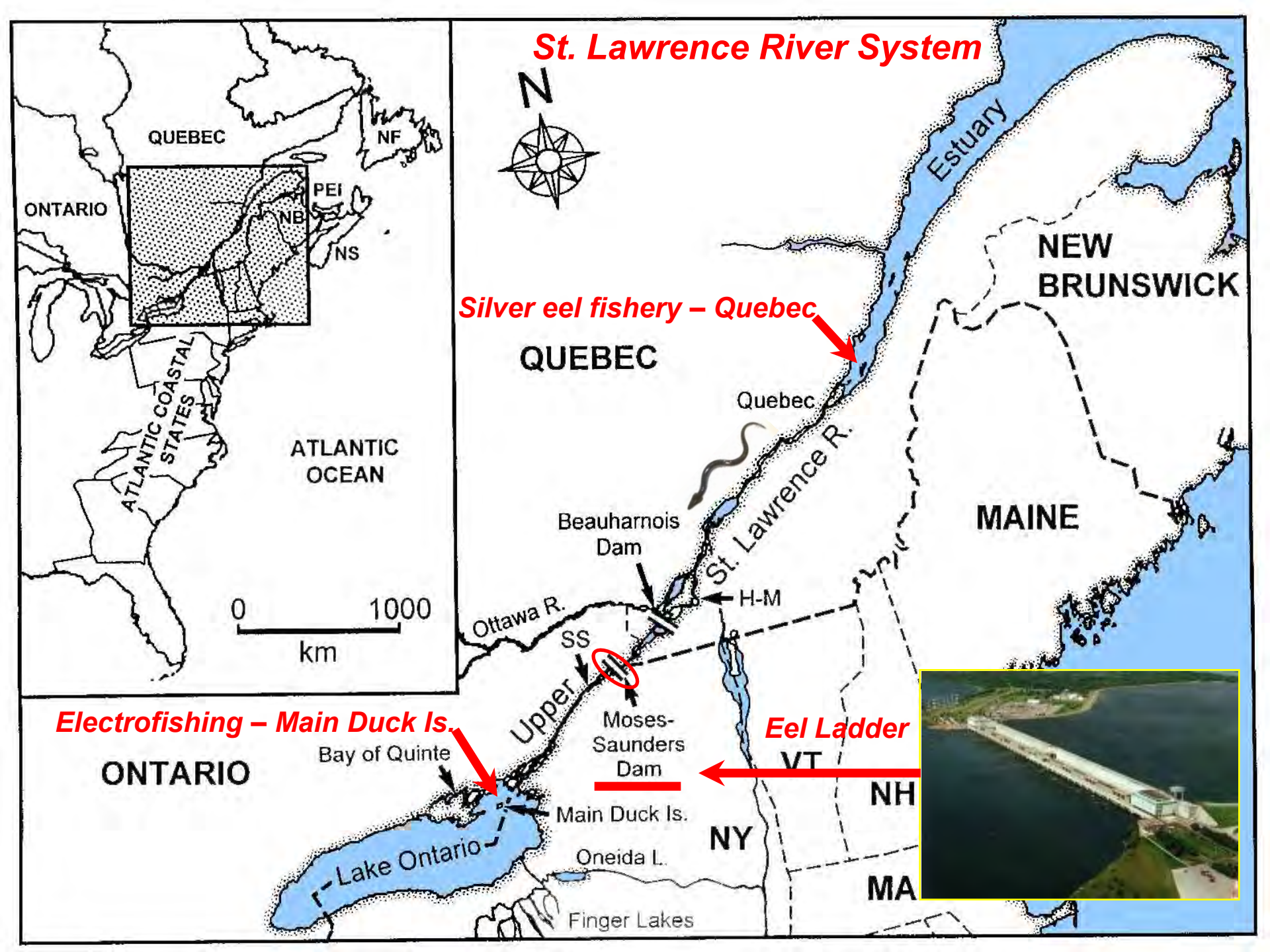

## Mean Harvest 2005 to 2010 (x1000 kg)

| | |
|---|---|
| Southern States | 1.2 |
| Central States | 351.0 |
| Northern States | 12.4 |
| Newfoundland Region | 57.7 |
| Gulf Region | 183.0 |
| Scotia–Fundy Region | 37.3 |
| Lower St. Lawrence River | 131.7 |
| Upper St. Lawrence River and Lake Ontario | 0.0 |
| Total | 773.0 |

# American Eel Recruitment and Abundance in the St. Lawrence River System

## *Long-term dynamics and trends at the extremity of the range*

## *Update*

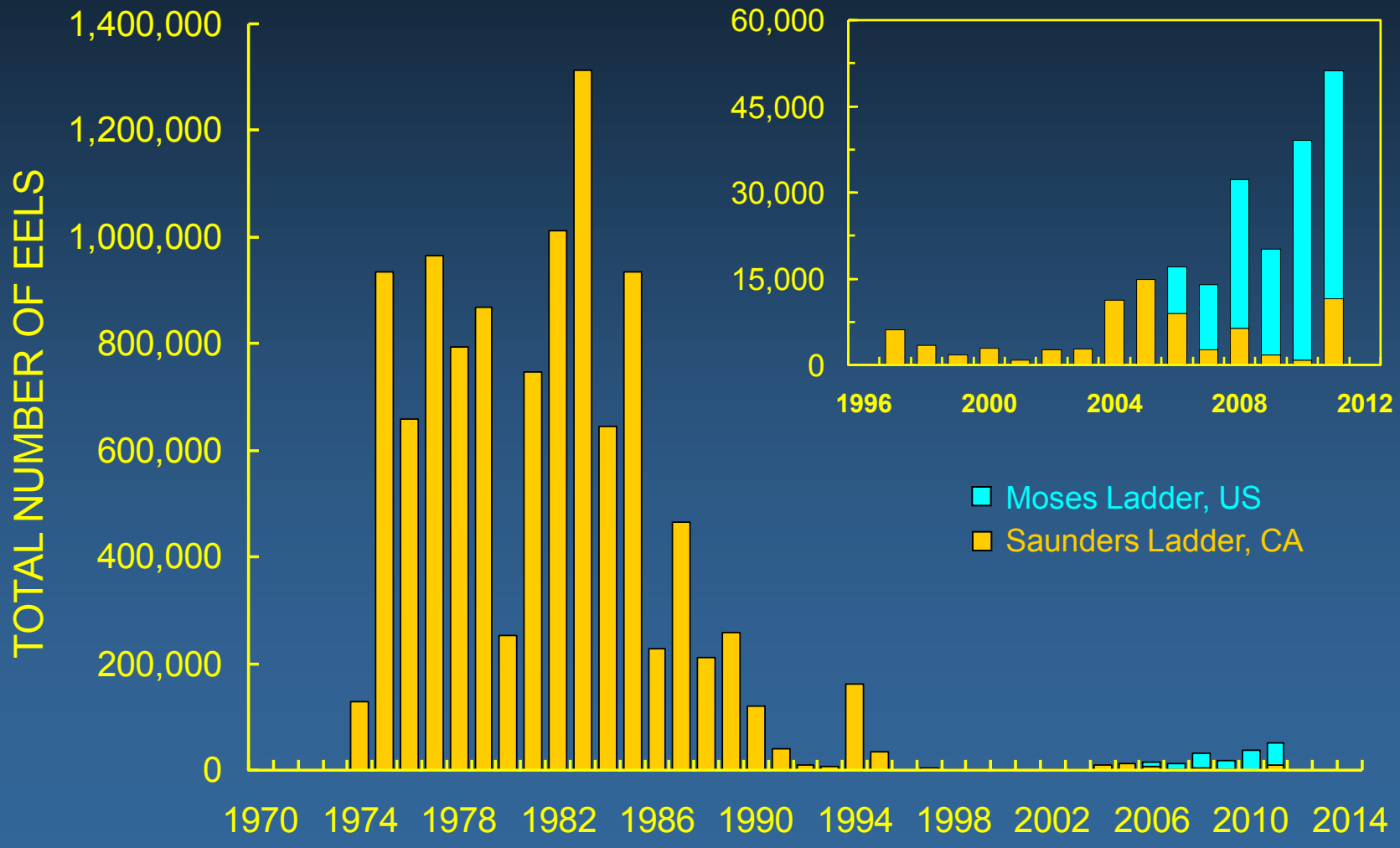

St. Lawrence River System
N
QUEBEC
NF
PEI
NB
NS
ONTARIO
ATLANTIC COASTAL STATES
ATLANTIC OCEAN
0
1000
km
Estuary
NEW BRUNSWICK
Silver eel fishery – Quebec
QUEBEC
Quebec
St. Lawrence R.
MAINE
Beauharnois Dam
H-M
Ottawa R.
SS
Upper
Moses-Saunders Dam
Electrofishing – Main Duck Is.
Eel Ladder
ONTARIO
Bay of Quinte
VT
NH
Main Duck Is.
NY
Lake Ontario
Oneida L.
MA
Finger Lakes

Moses-Saunders Dam and Eel Ladder, Upper St. Lawrence River

1975

# TOTAL ANNUAL UPSTREAM EEL PASSAGE

## Upper St. Lawrence R., Moses-Saunders dam, 1974-2011



# BAY OF QUINTE – TRAWLS

CATCH • TRAWL$^{-1}$ (numbers)

3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0

● – 0.00

1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

CUSUM ($N$ • trawl$^{-1}$)

10
8
6
4
2
0
-2

1977
1980
1982
1987
1994

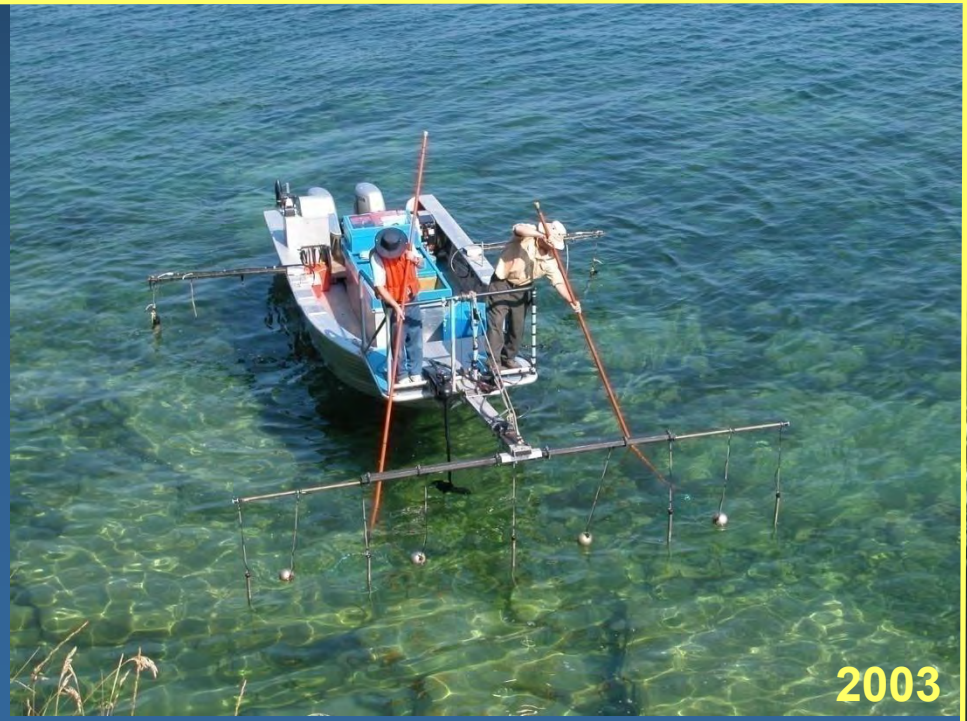
Mean = 0.559

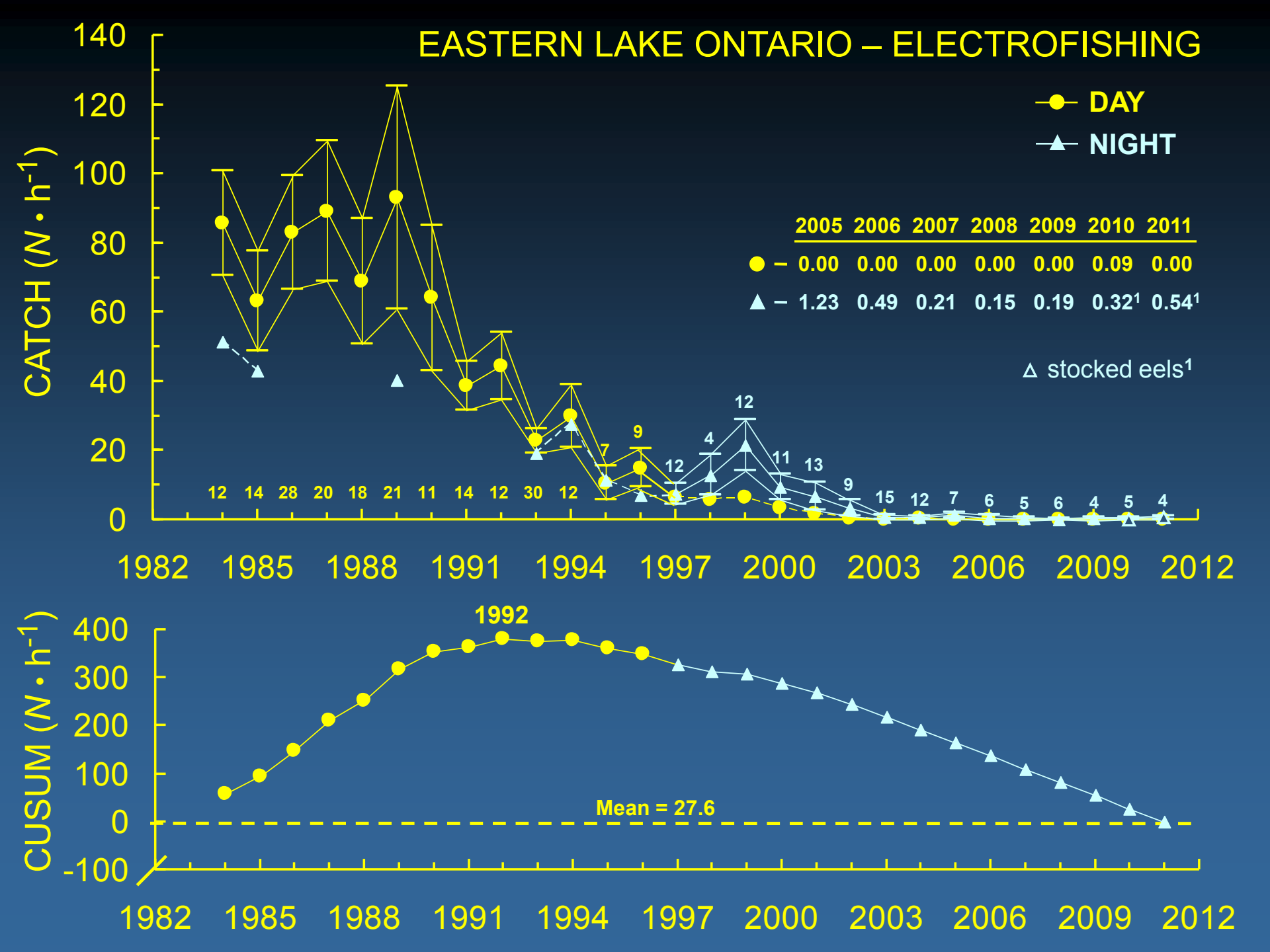
1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

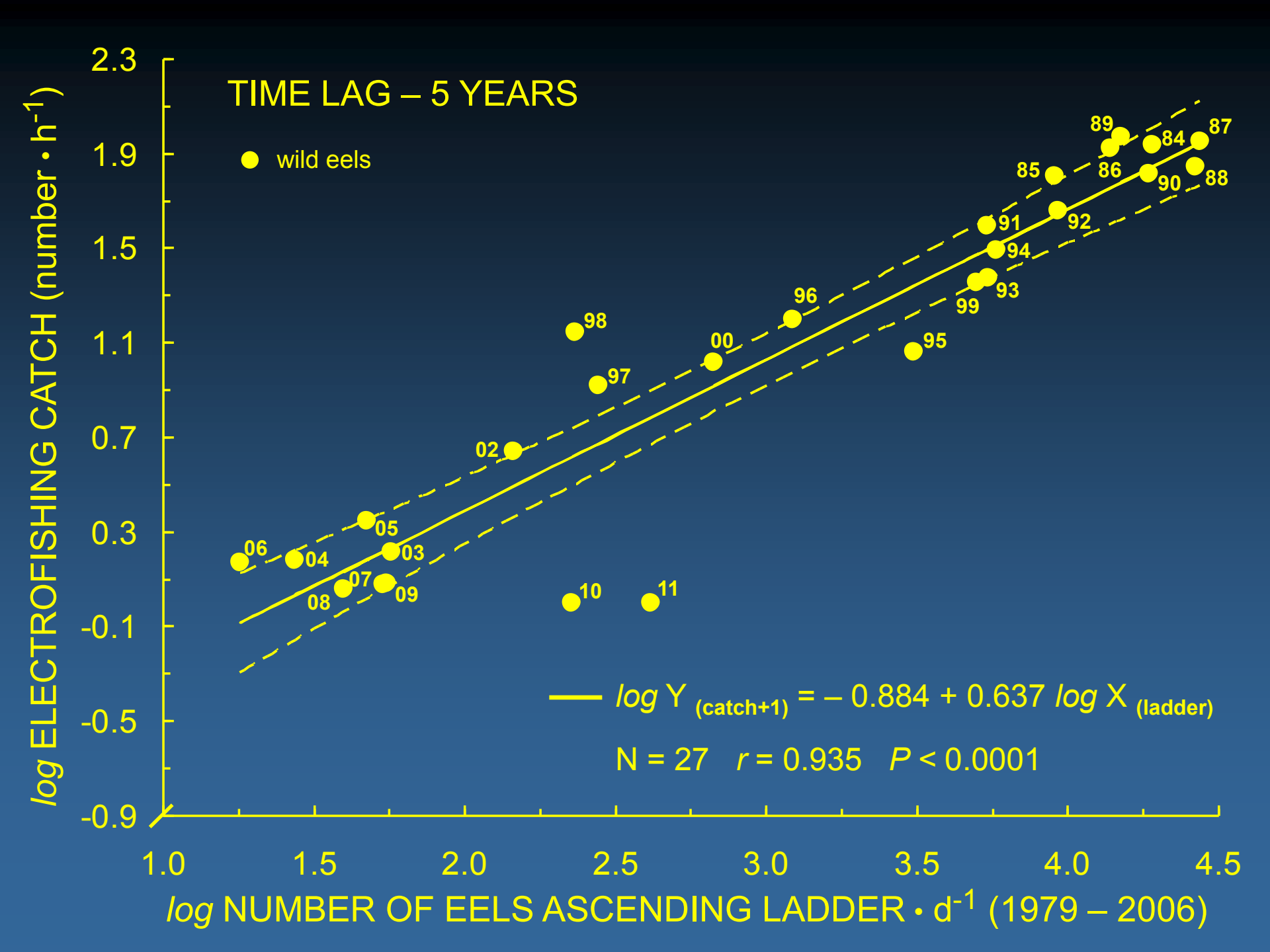
# Commercial Electrofishing

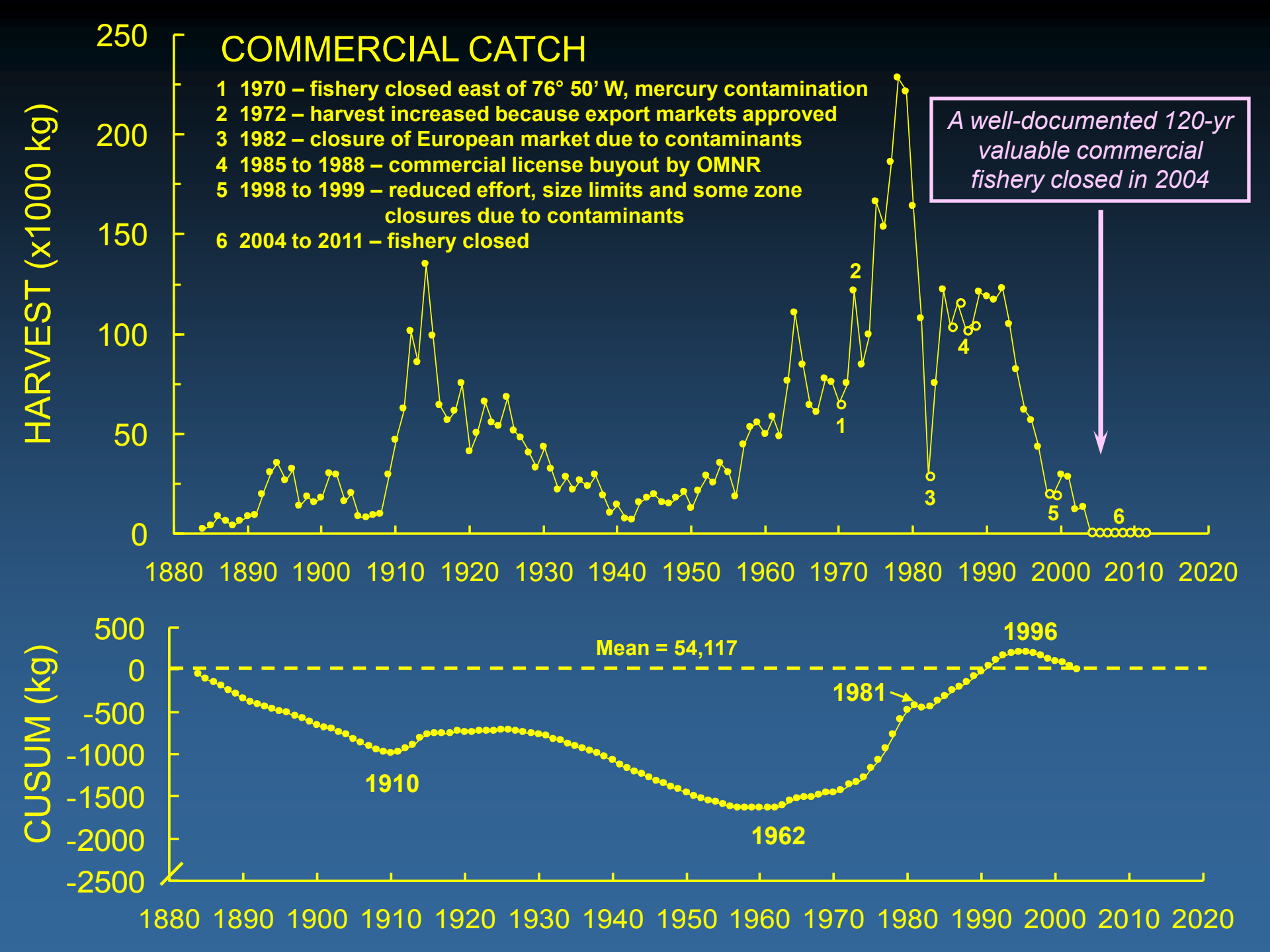
## Main Duck Island

## Eastern Lake Ontario

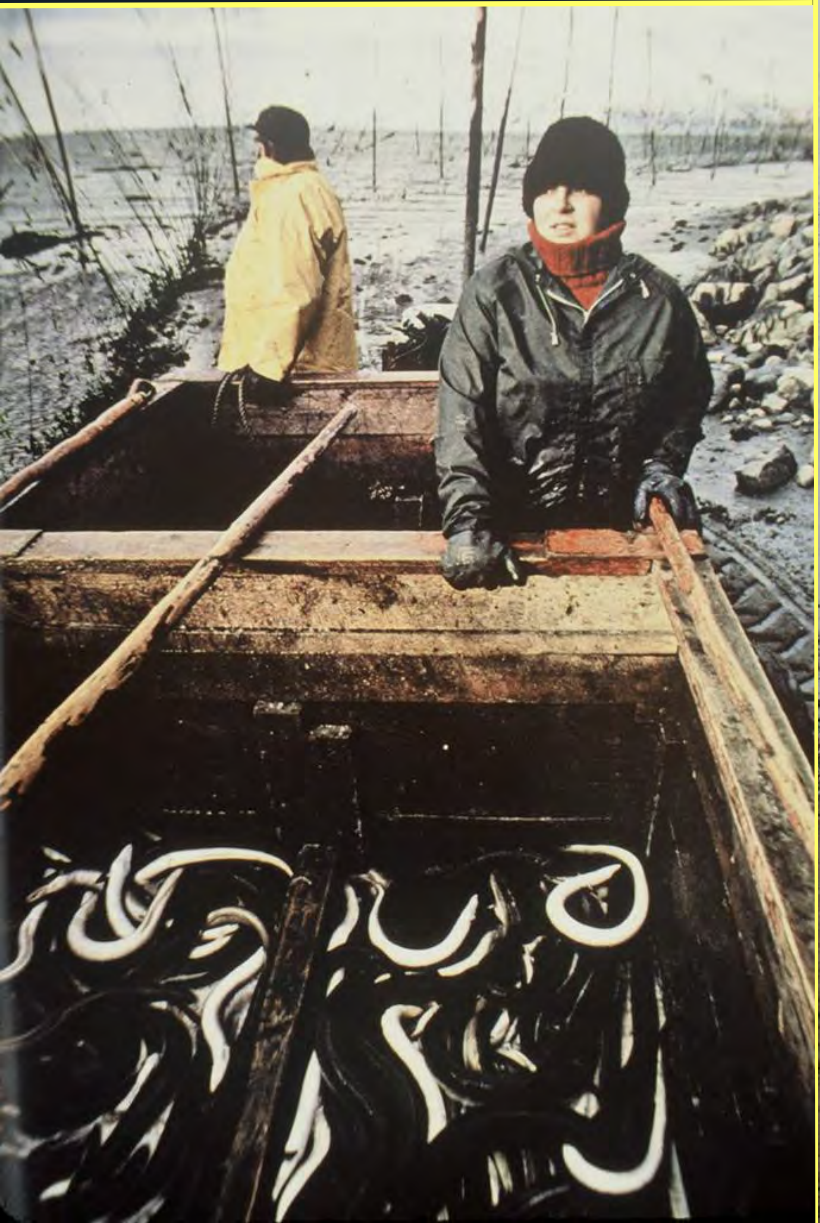




EASTERN LAKE ONTARIO – ELECTROFISHING
DAY
NIGHT
2005 2006 2007 2008 2009 2010 2011
– 0.00 0.00 0.00 0.00 0.00 0.09 0.00
– 1.23 0.49 0.21 0.15 0.19 0.32[1] 0.54[1]
stocked eels[1]
CATCH (N • h-1)
140
120
100
80
60
40
20
0
12 14 28 20 18 21 11 14 12 30 12 7 9 12 4 12 11 13 9 15 12 7 6 5 6 4 5 4
1982 1985 1988 1991 1994 1997 2000 2003 2006 2009 2012
CUSUM (N • h-1)
1992
400
300
200
100
0
-100
Mean = 27.6
1982 1985 1988 1991 1994 1997 2000 2003 2006 2009 2012


TIME LAG – 5 YEARS
wild eels
log ELECTROFISHING CATCH (number • h-1)
2.3
1.9
1.5
1.1
0.7
0.3
-0.1
-0.5
-0.9
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
log NUMBER OF EELS ASCENDING LADDER • d-1 (1979 – 2006)
89
84
87
85
86
90
88
91
92
94
93
99
96
98
00
95
97
02
05
06
04
03
07
08
09
10
11
log Y (catch+1) = – 0.884 + 0.637 log X (ladder)
N = 27 r = 0.935 P < 0.0001

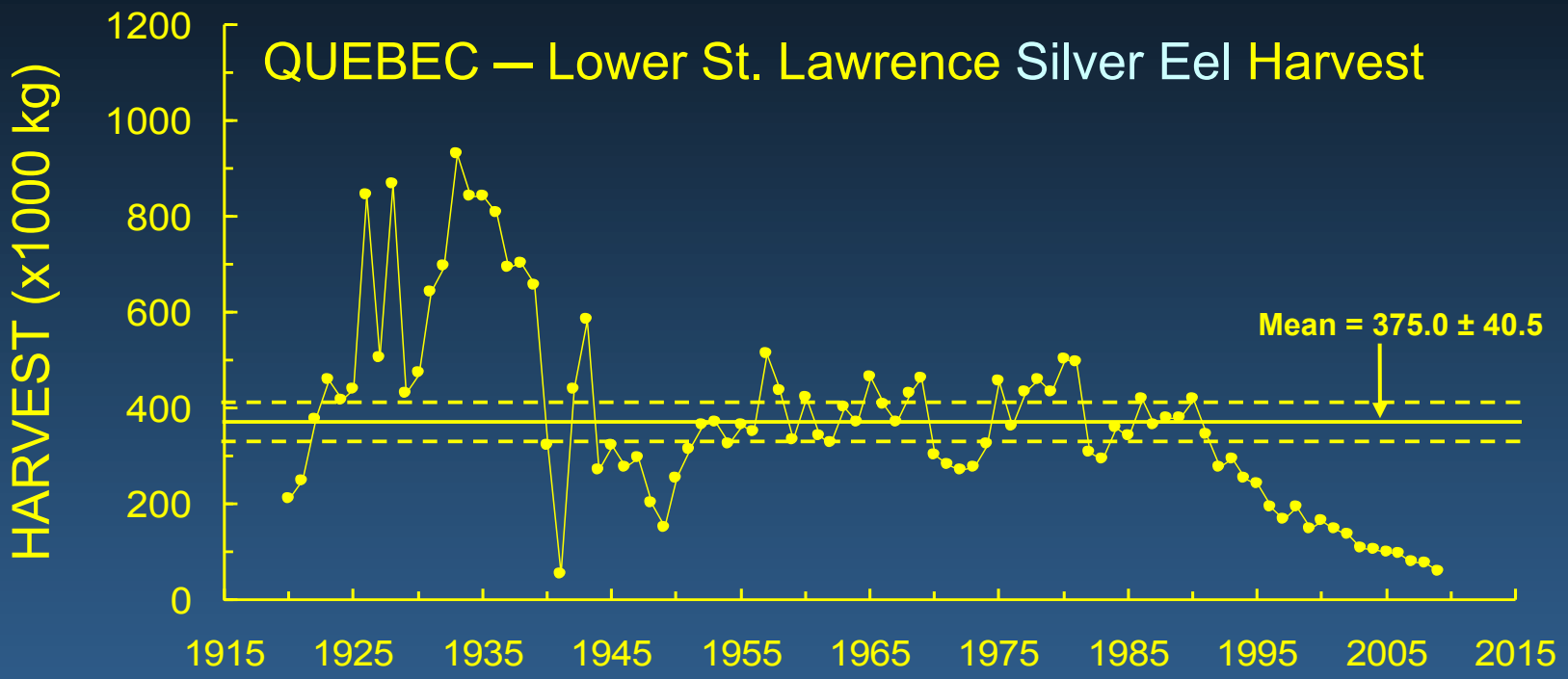

COMMERCIAL CATCH
1 1970 – fishery closed east of 76° 50' W, mercury contamination
2 1972 – harvest increased because export markets approved
3 1982 – closure of European market due to contaminants
4 1985 to 1988 – commercial license buyout by OMNR
5 1998 to 1999 – reduced effort, size limits and some zone closures due to contaminants
6 2004 to 2011 – fishery closed
A well-documented 120-yr valuable commercial fishery closed in 2004
HARVEST (x1000 kg)
250
200
150
100
50
0
1880 1890 1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010 2020
CUSUM (kg)
500
0
-500
-1000
-1500
-2000
-2500
Mean = 54,117
1996
1981
1910
1962

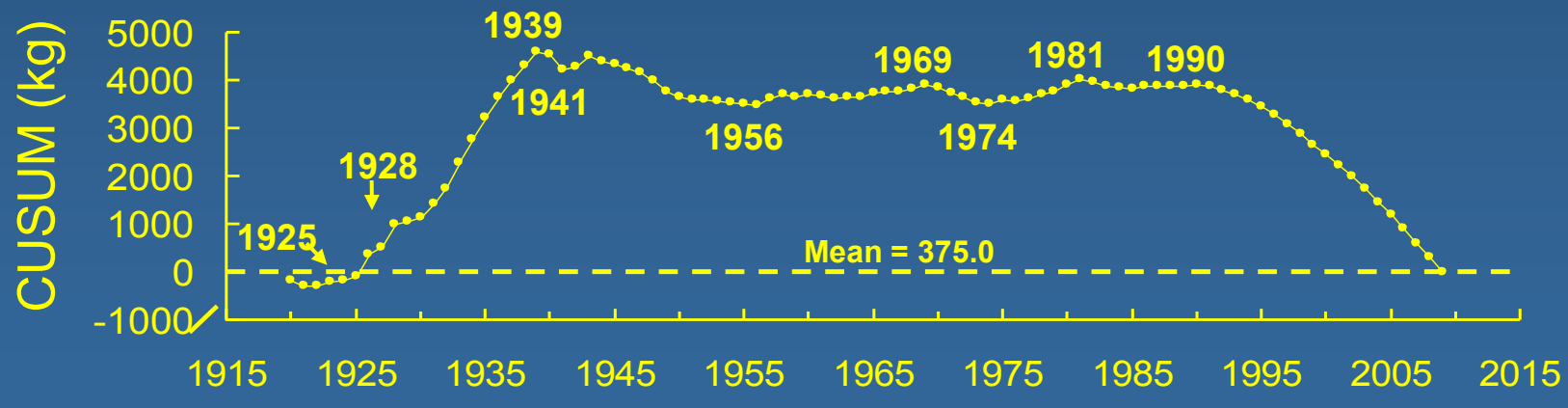
# Tidal Eel Weir
# Lower St. Lawrence River



# LOWER ST. LAWRENCE R. SILVER EEL HARVEST

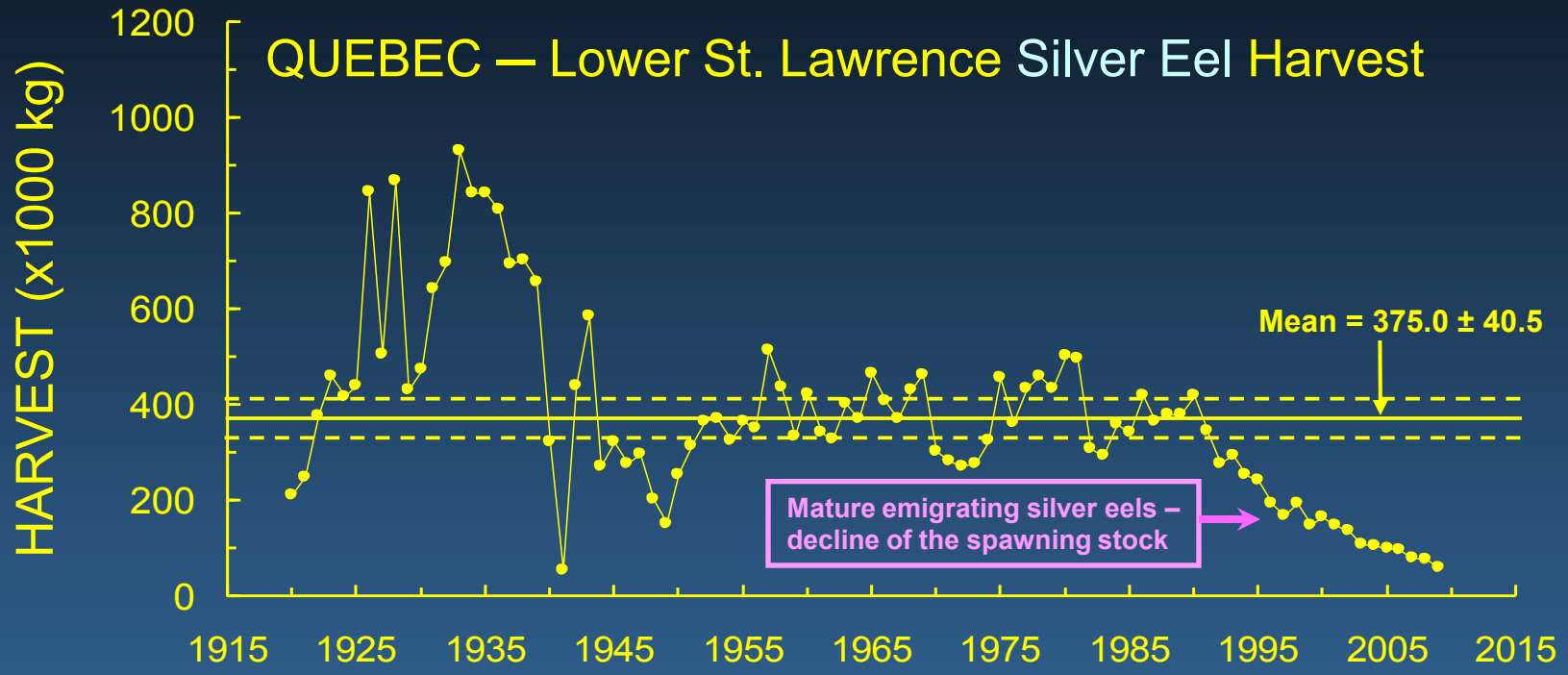
## Decline in the once single largest American eel fishery

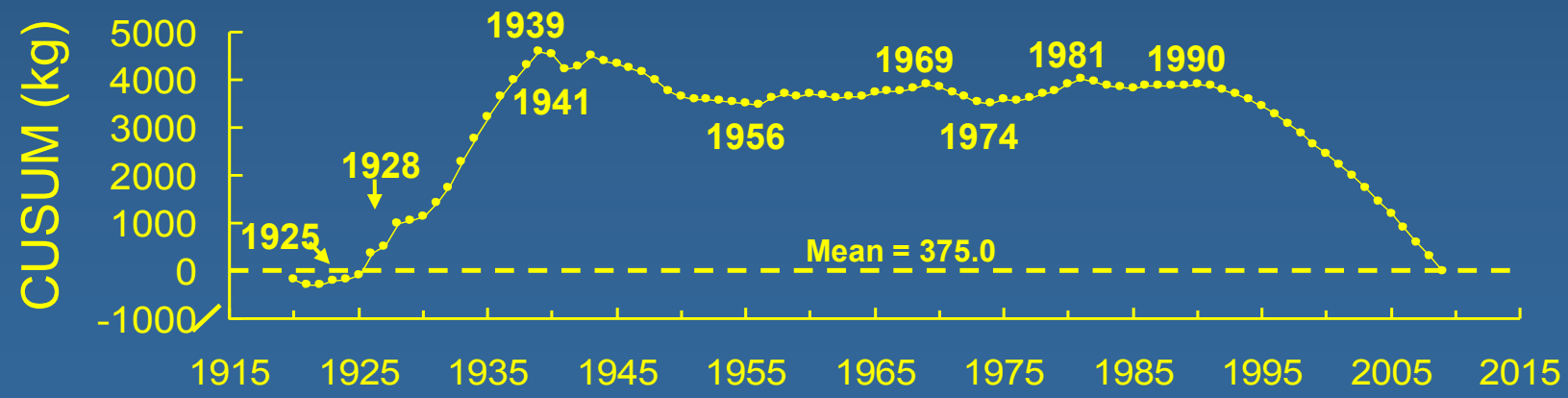


# LOWER ST. LAWRENCE R. SILVER EEL HARVEST

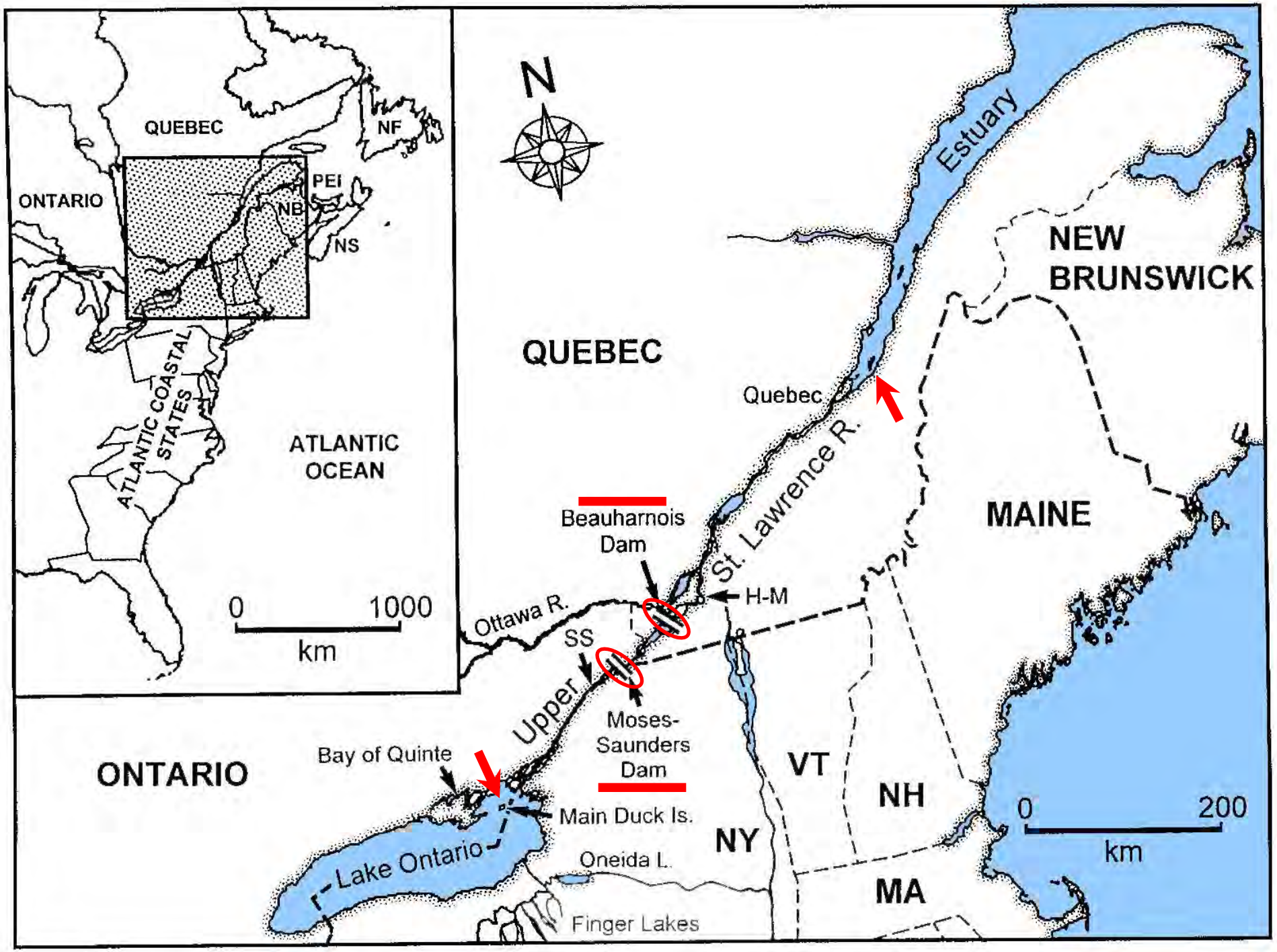
## Decline in the once single largest American eel fishery



# Modelling Eel Abundance and Emigrations in St. Lawrence River System

***Four recruitment and age-based models were developed, calibrated, and validated***


QUEBEC
NF
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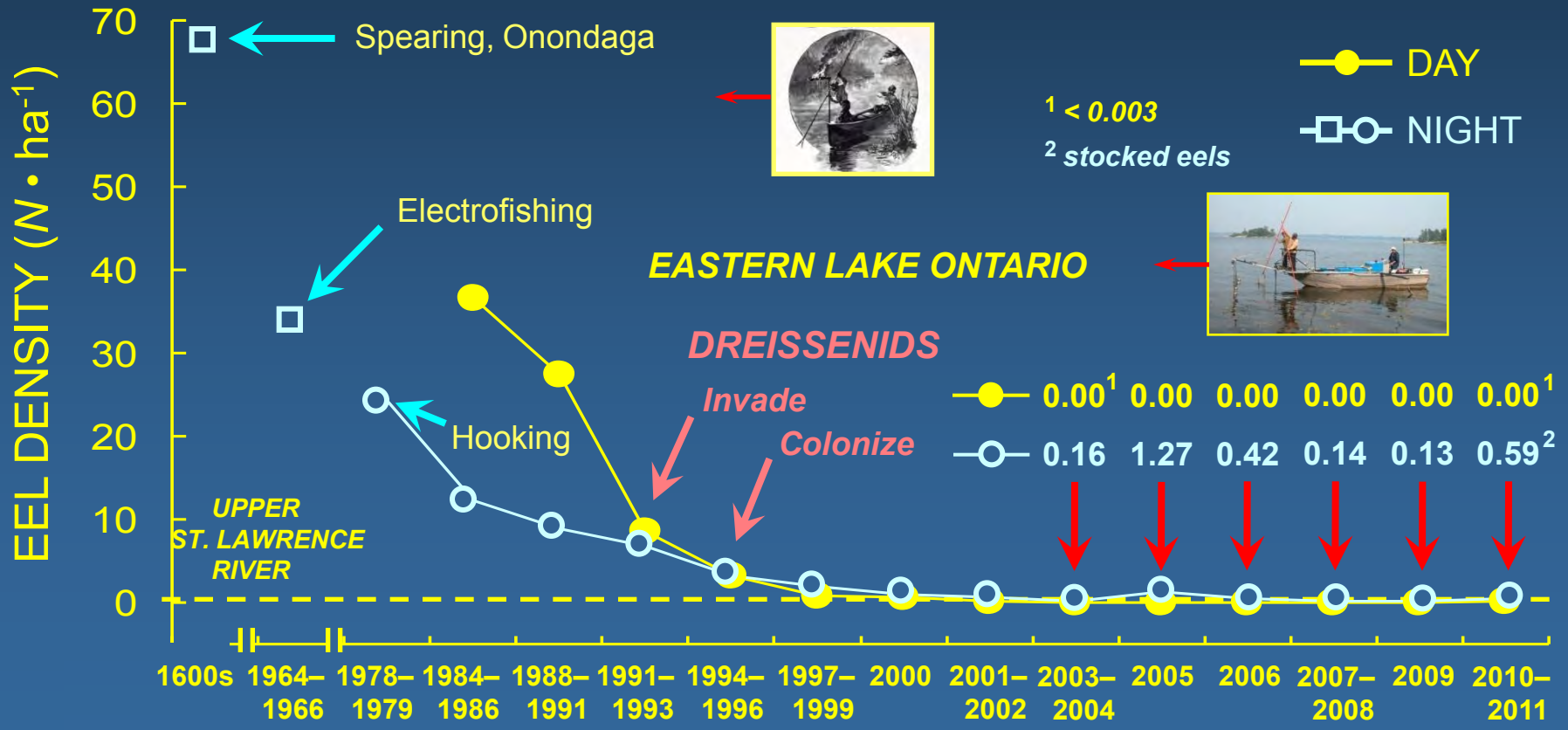
ONTARIO
ATLANTIC COASTAL STATES
ATLANTIC OCEAN
0
1000
km
N
Estuary
NEW BRUNSWICK
QUEBEC
Quebec
St. Lawrence R.
MAINE
Beauharnois Dam
H-M
Ottawa R.
SS
Upper
Moses-Saunders Dam
Bay of Quinte
ONTARIO
Main Duck Is.
Lake Ontario
Oneida L.
Finger Lakes
NY
VT
NH
MA
0
200
km

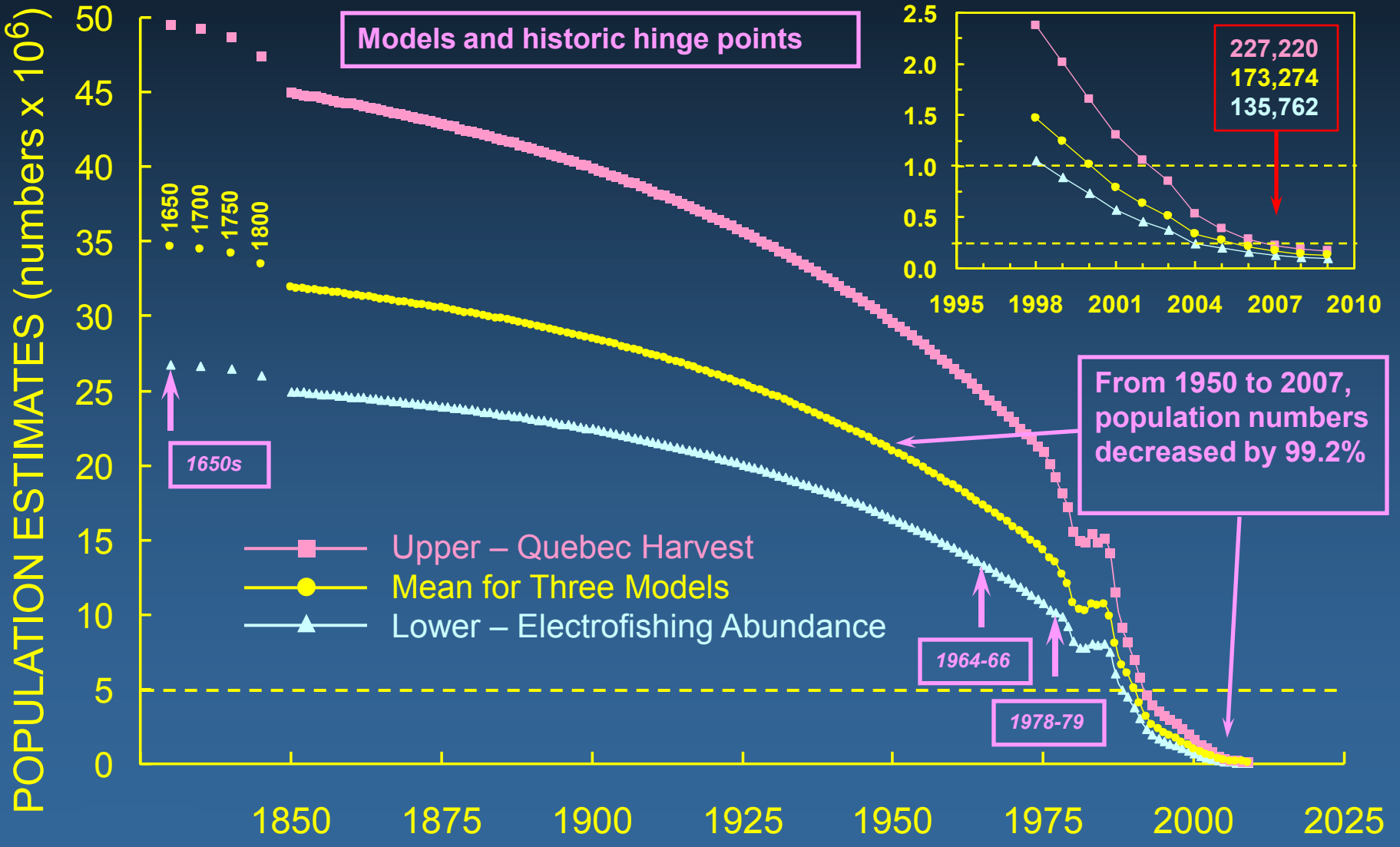
# *Abundance in Upper St. Lawrence River – Lake Ontario*

- **Absolute declines in eel abundance in inshore waters of upper St. Lawrence River – Lake Ontario are well documented with scientific evidence**
- **Eels have left inshore waters in daytime and are rarely seen at night (since 2003, one wild eel in every 2.4 ha)**
- **Current decreases in abundance are primarily related to emigration of mature eels and loss of recruitment (since 2005 no exploitation; in 1990s – 5-8%/yr)**



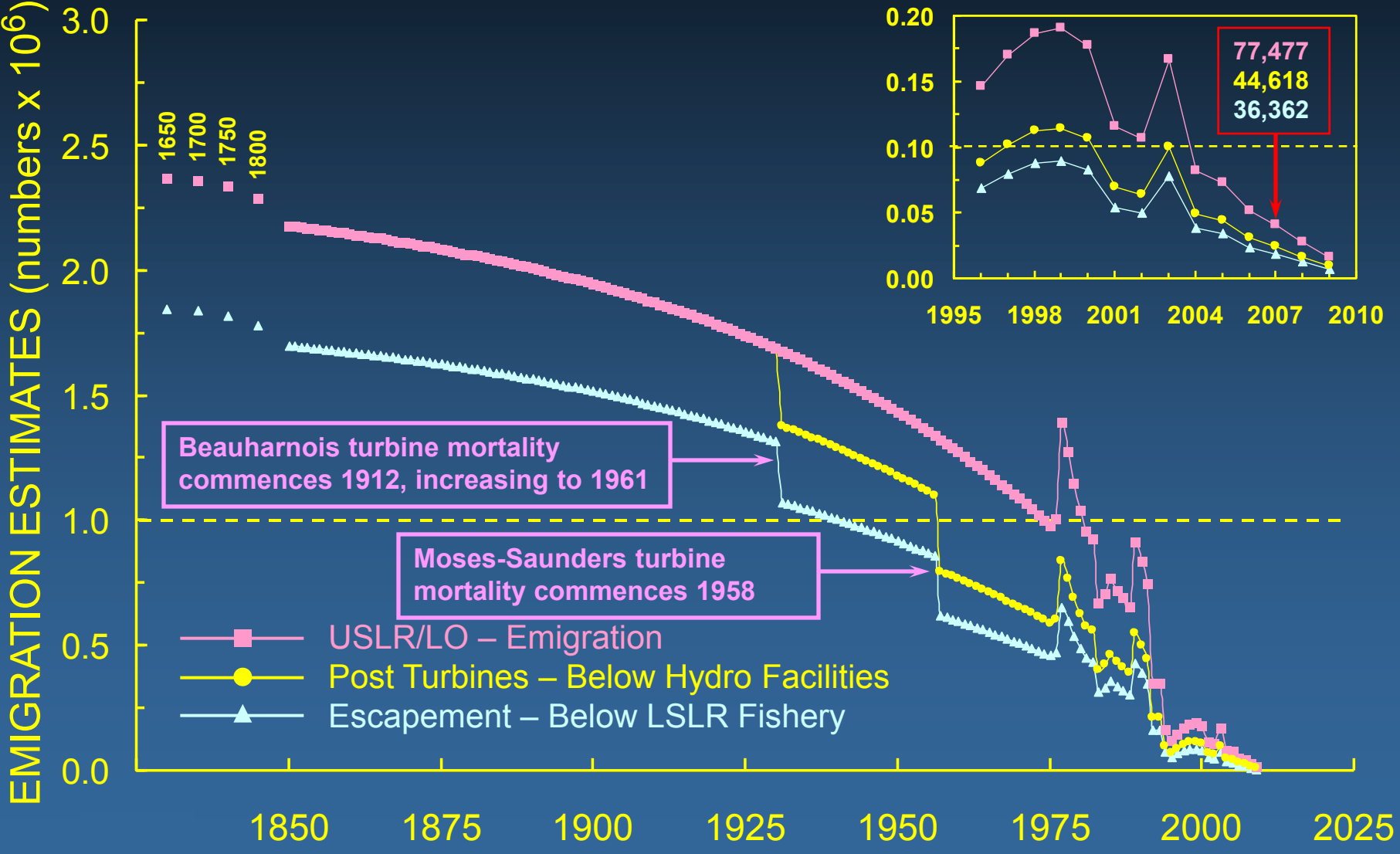
# MODEL ESTIMATES – POPULATION NUMBERS

## Lake Ontario – upper St. Lawrence River



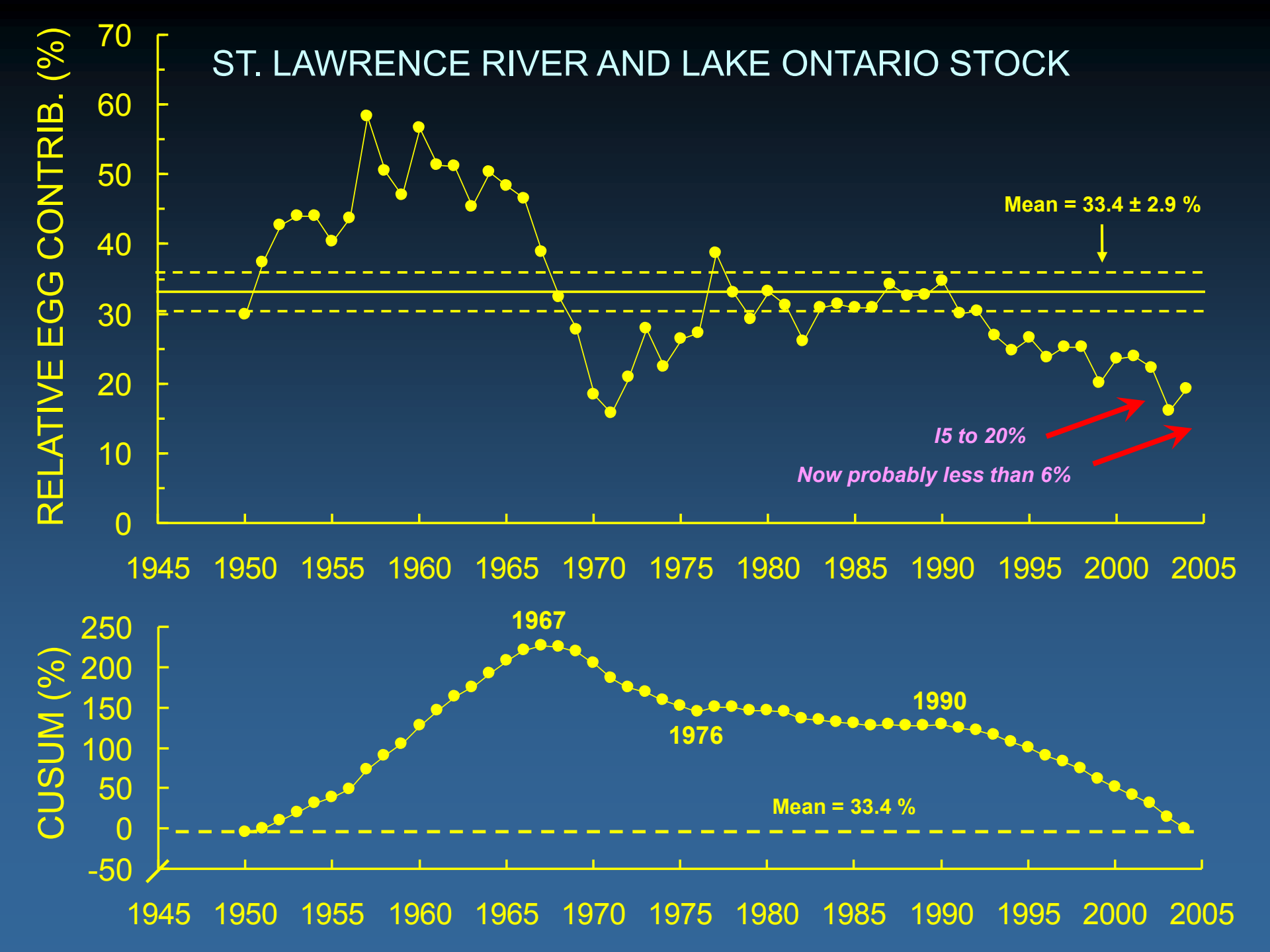
# MODEL ESTIMATES – EMIGRANT NUMBERS

## St. Lawrence River system



# Egg Production of the St. Lawrence River – Lake Ontario Eel Stock

***Calculations based on proportional freshwater discharge and relative abundance as indicated by commercial harvest***


ST. LAWRENCE RIVER AND LAKE ONTARIO STOCK
RELATIVE EGG CONTRIB. (%)
70
60
50
40
30
20
10
0
Mean = 33.4 ± 2.9 %
I5 to 20%
Now probably less than 6%
1945 1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005
CUSUM (%)
250
200
150
100
50
0
-50
1967
1976
1990
Mean = 33.4 %
1945 1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005

# Declining Eel Resources in a Changing World

***What factors are affecting the decline, and how do we conserve a global wild eel fishery?***

# A Chronology of the Factors Causing the Declines

*Historic order of impact:*

1. Alteration and loss of habitat
2. Barriers to migration
3. Toxicity of contaminants
4. Exploitation of all life stages
5. Hydroelectric turbine mortality
6. Changes in oceanic conditions
7. Productivity and food web changes
8. Parasitism
9. Sargasso weed harvest

*American Eels and Climate Change*

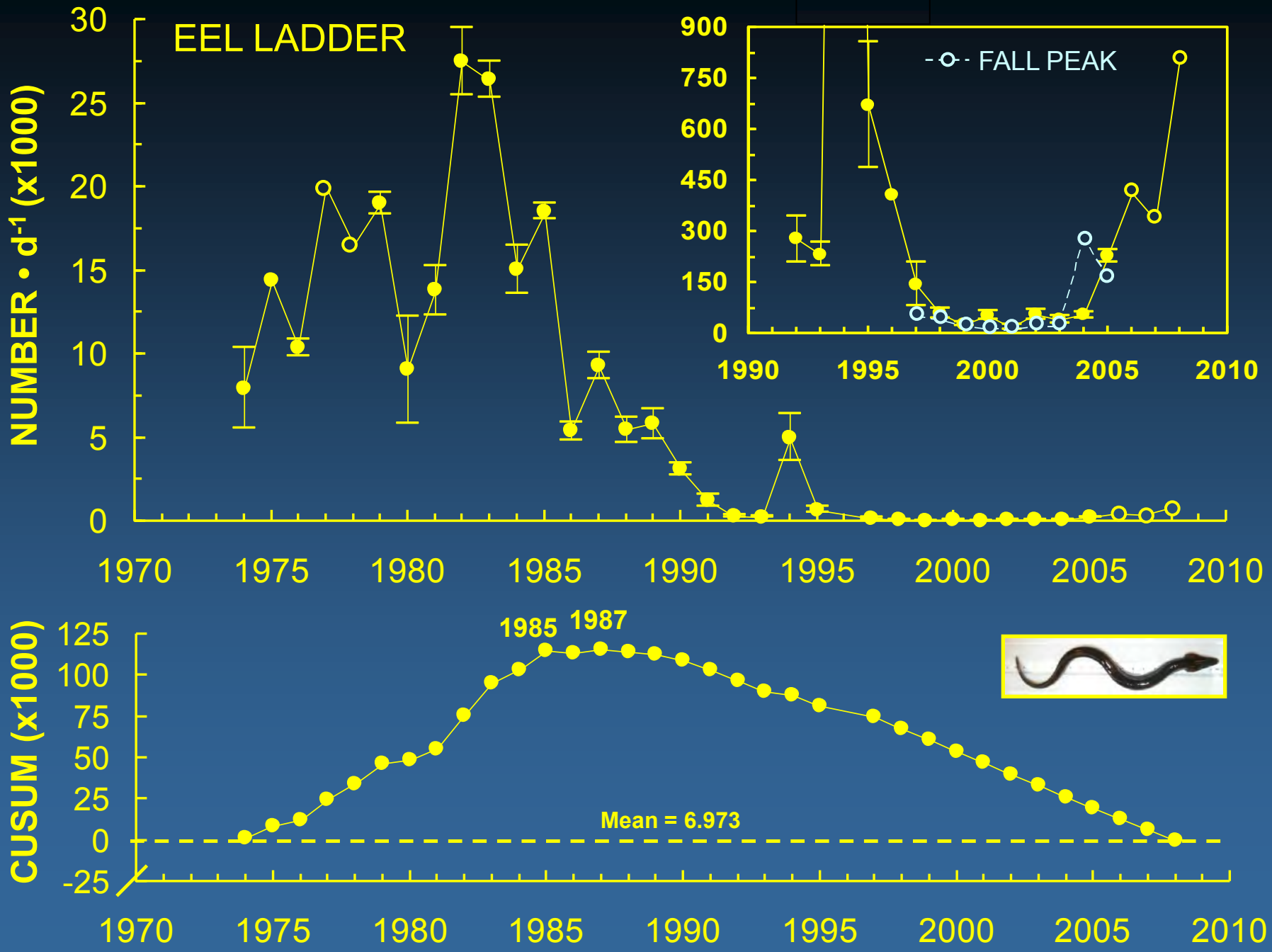
# Eel Immigration in the Upper St. Lawrence River and Oceanic Influences

## *Eel recruitment at the northern extremity of the range and the North Atlantic Oscillation Index*

# Oceanic Currents and Life Stages



# 34 YEARS OF PASSAGE DURING THE PEAK PERIOD



# *Long-Term Dynamics in Relative Year-Class Strength*

*Transverse thin section*

**TL − 440mm TW − 103g**
**Date − 20060830 − 4**
**CSA − 6o NCA – 5**
**Year class − 2001**

***Age assessment of 4,041 eel ladder eels subsampled from 9 years from 1976 to 2007***

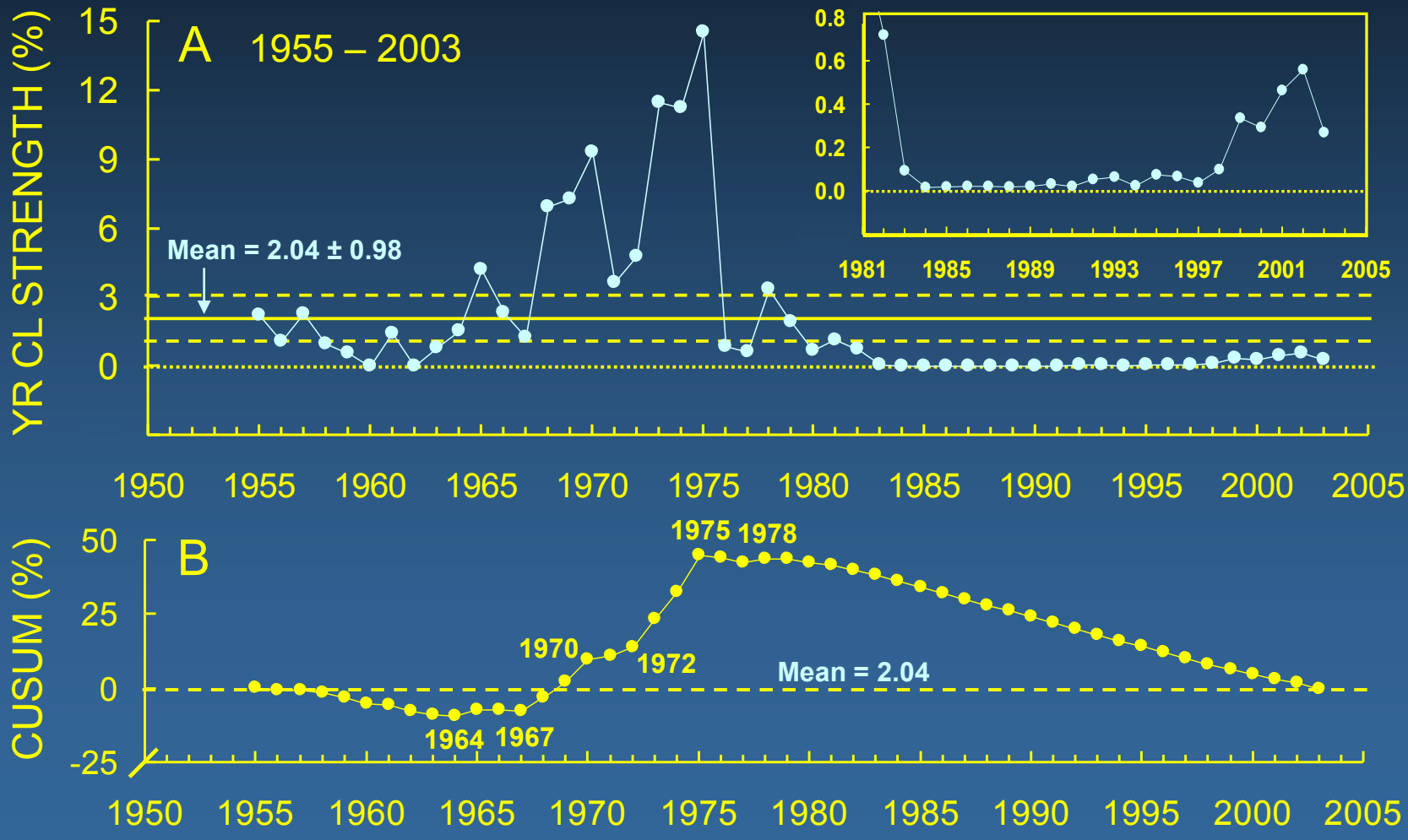
**AMERICAN EEL OTOLITH AGE ASSESSMENT**

*Acetate replica of section*

***Eel ladder otolith age − year-class strength assessment***

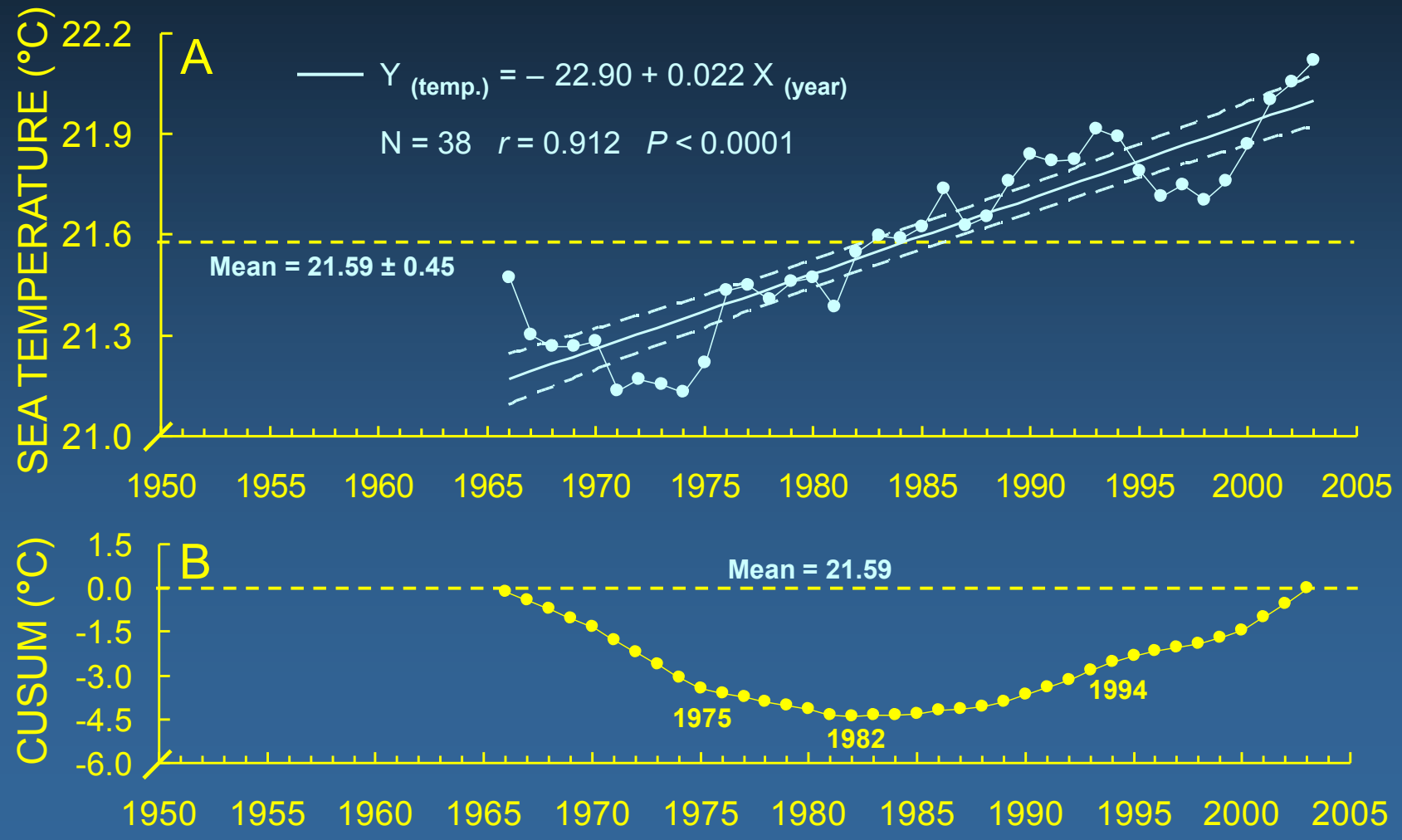
# RELATIVE YEAR-CLASS STRENGTH

## Upper St. Lawrence R. eel ladder, 1955 – 2003



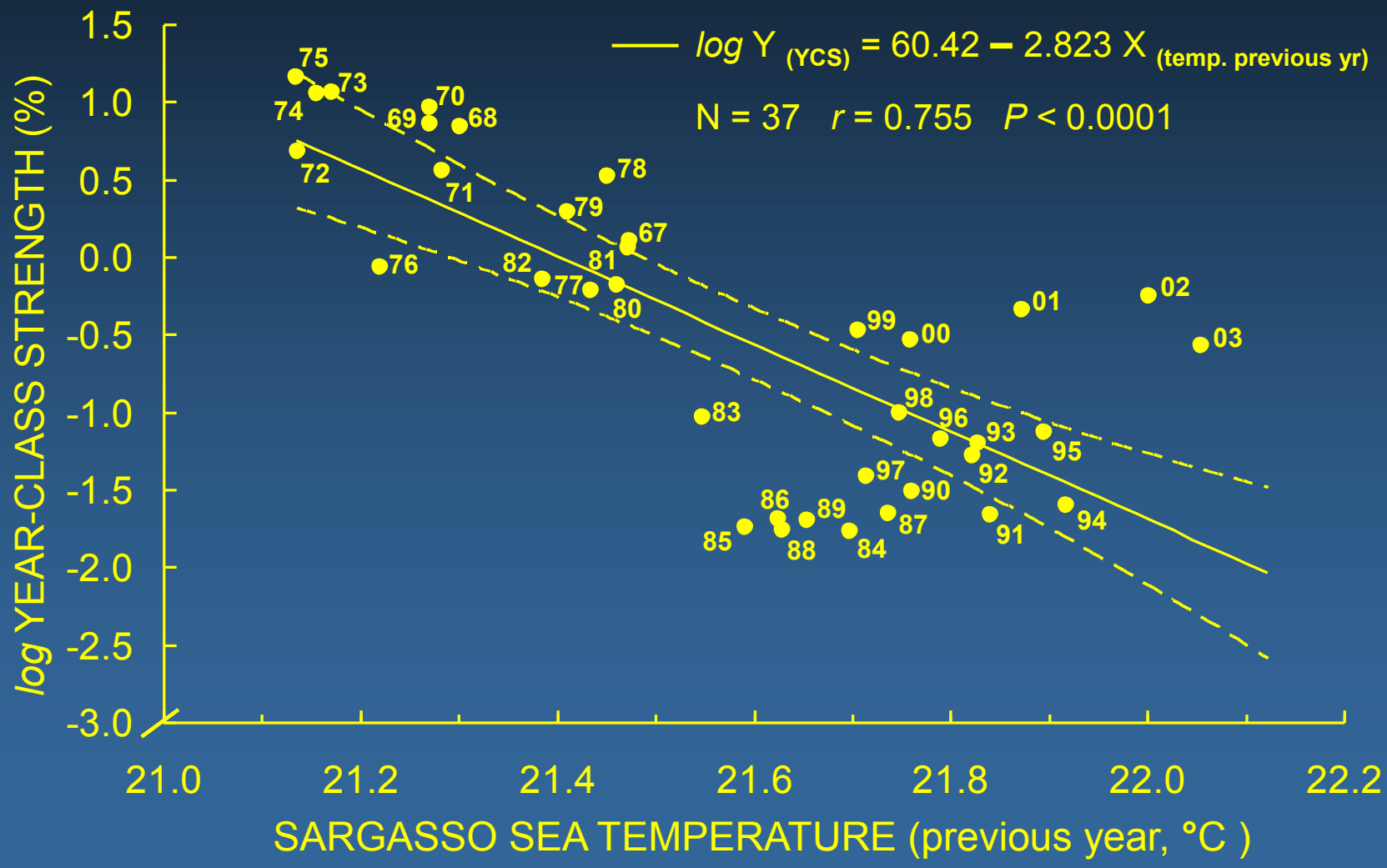
# SARGASSO SEA SURFACE TEMPERATURE

## Bermuda Biological Station, Hydrostation S, 38-yr period



# YEAR-CLASS STRENGTH AND SEA TEMPERATURE

## Temperature in previous year, for 37 years, 1967 – 2003

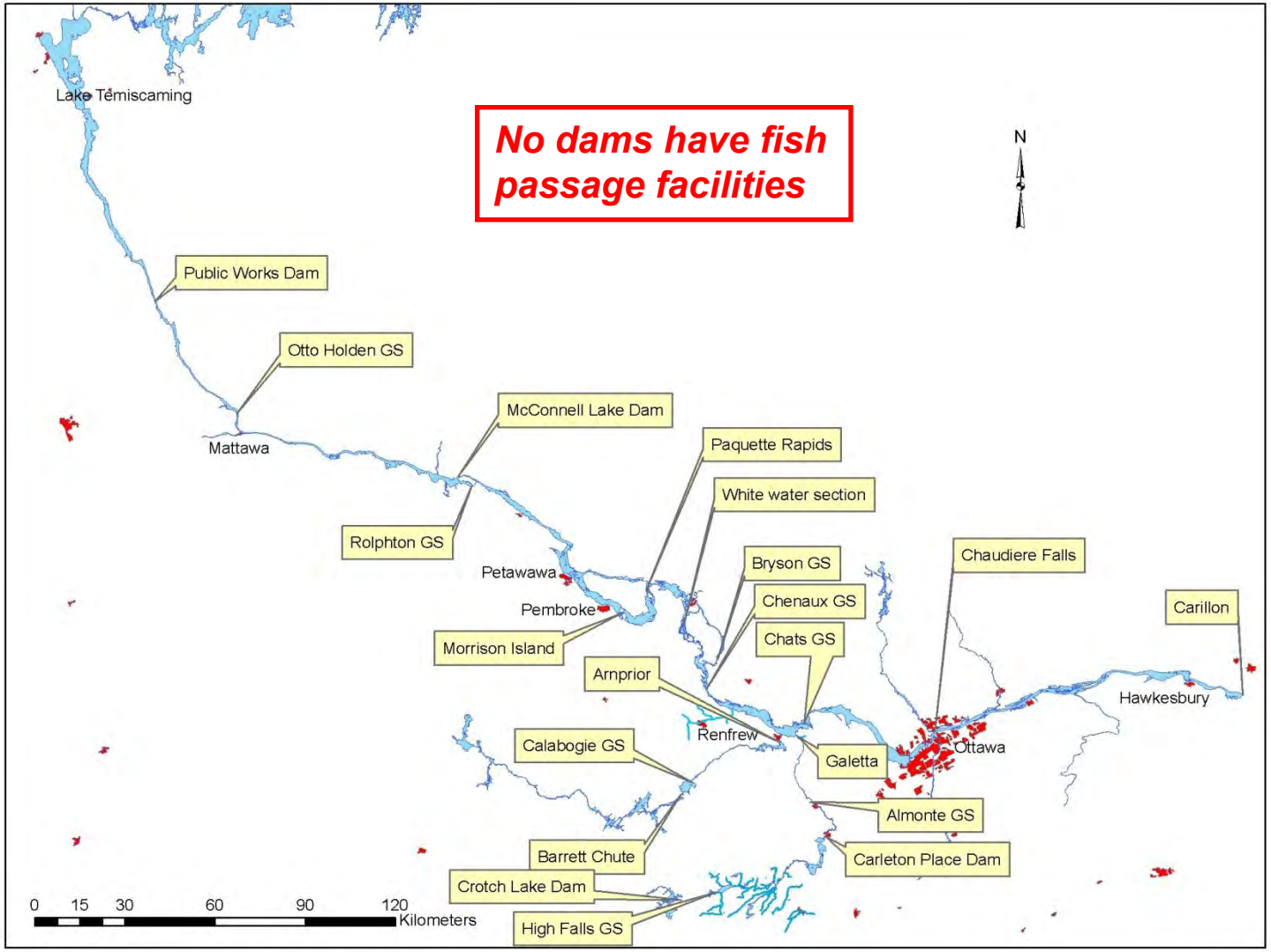


# Declining Abundance and Recruitment at the Extremities of the Ontario Range

## *With special reference to the Ottawa and Mississippi rivers and their watersheds*

# DAMS ON ONTARIO'S OTTAWA RIVER WATERSHED

## Hydro generating facilities and control dams



Carillon Dam, Ottawa River

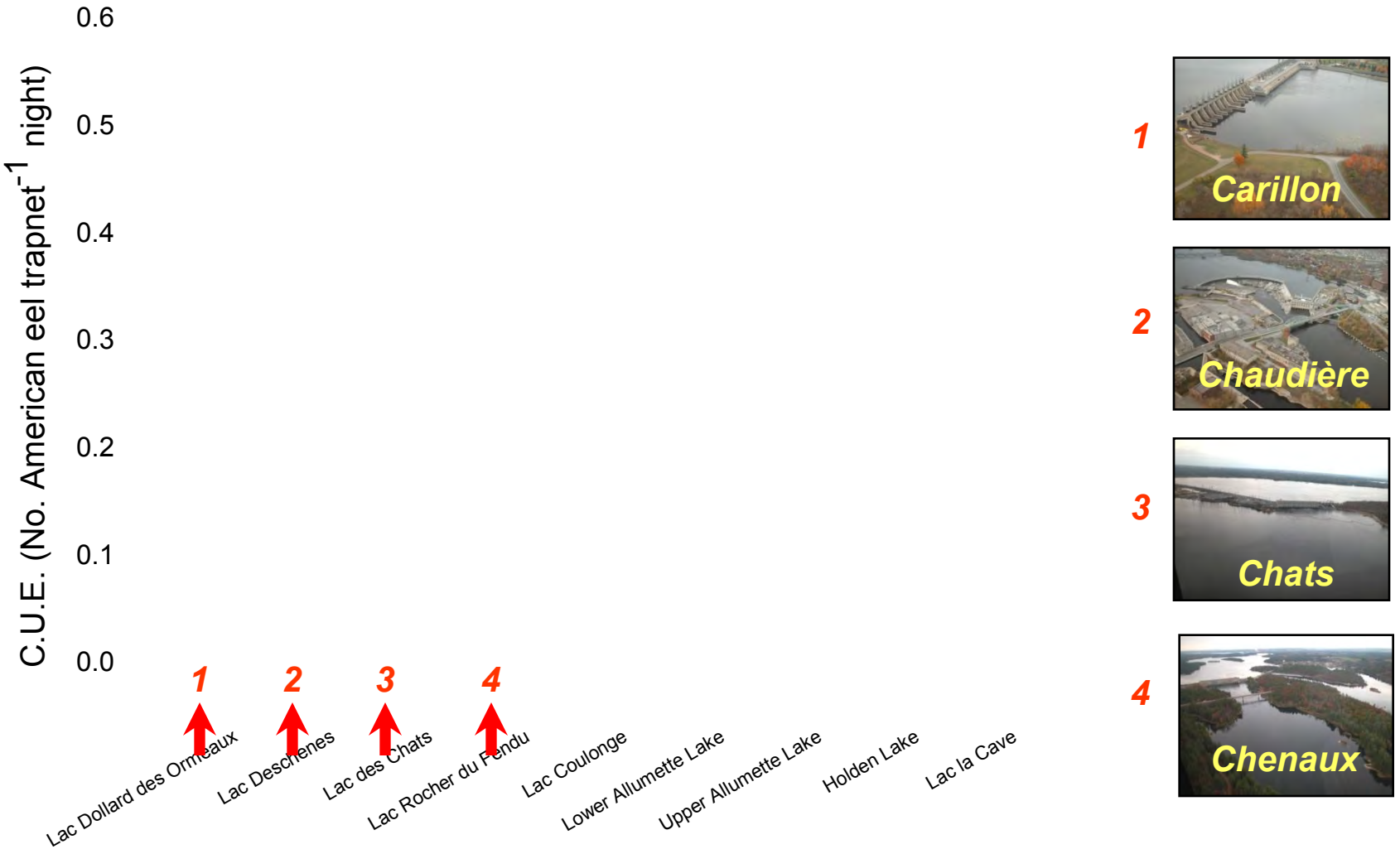
Chaudière Falls Dam, Ottawa River

Chats Falls Dam, Ottawa River

Galetta Dam, Mississippi River

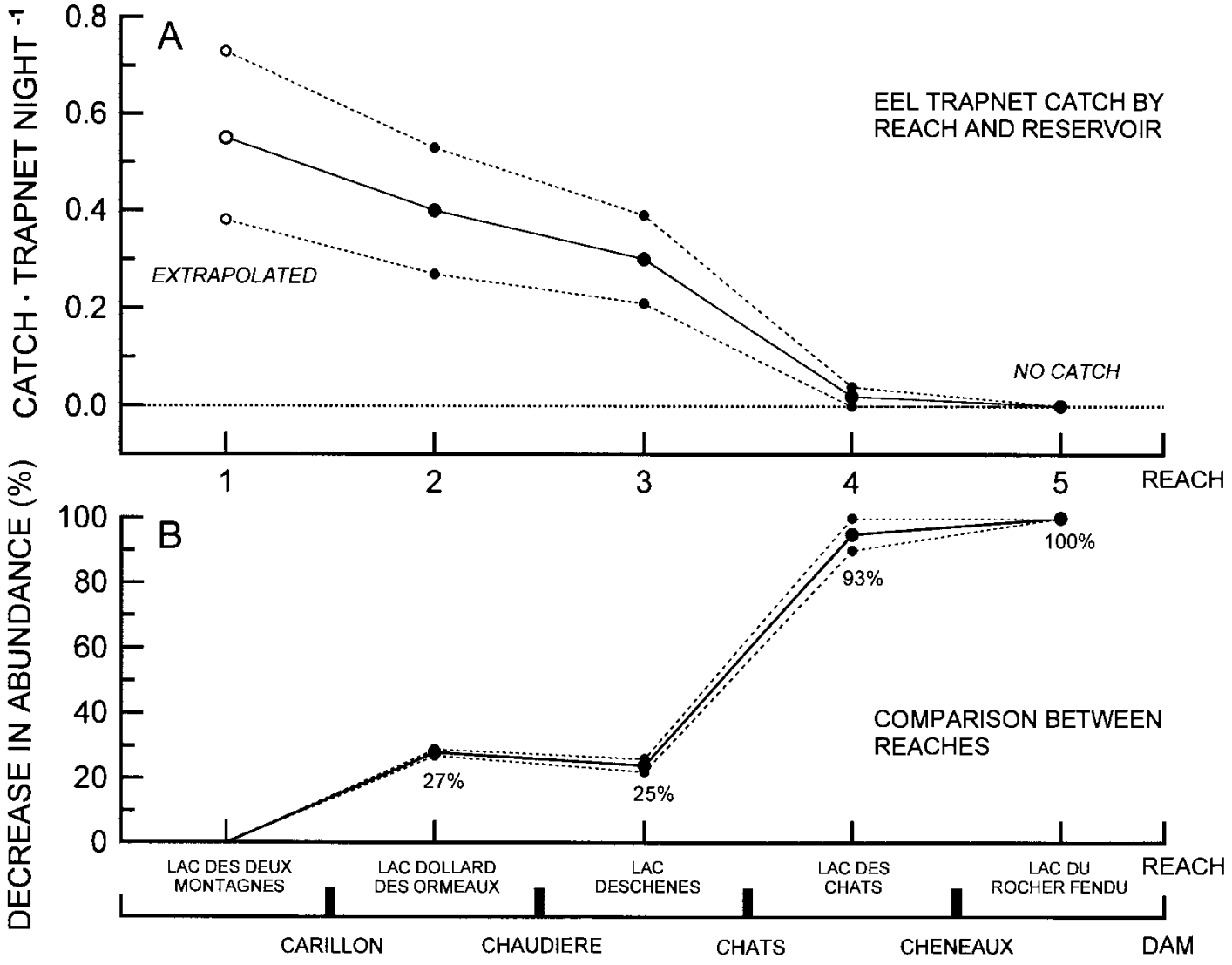
# TRAP-NET CATCH OF EELS IN OTTAWA R. REACHES

Ea



# DECLINING ABUNDANCE IN OTTAWA R. REACHES

## Progressively decreasing abundance above upstream dams

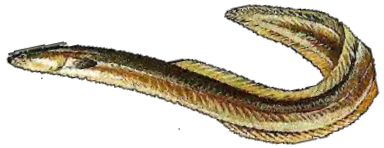


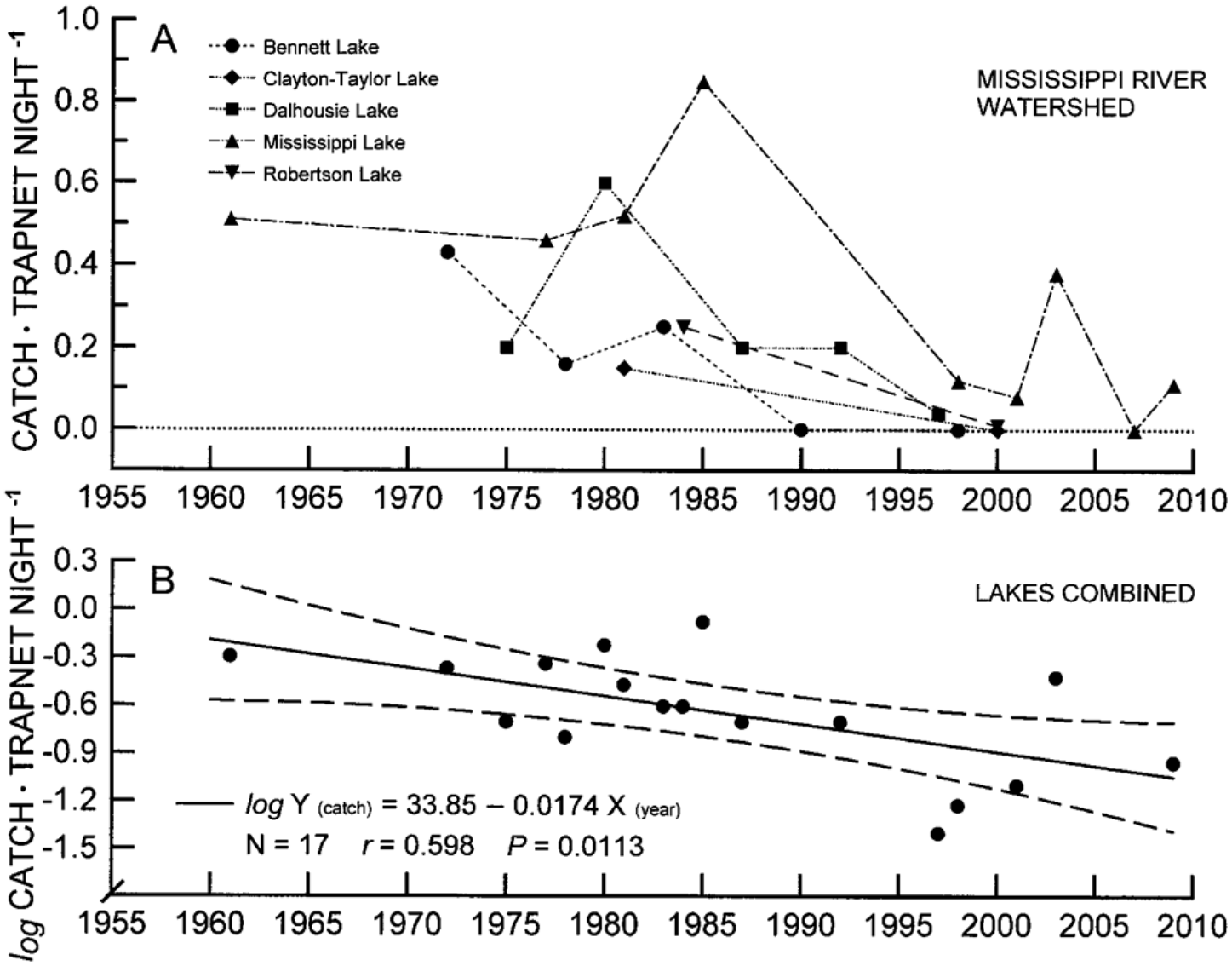
# Index Trap Netting of Mississippi River System and Ottawa River Reaches

***Eel catches for six lakes netted several times over a five-decade period and for five reaches***

# TRAP NET CATCH OF EELS IN LAKES

## Mississippi R. watershed, 1961-2009

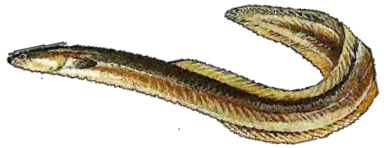


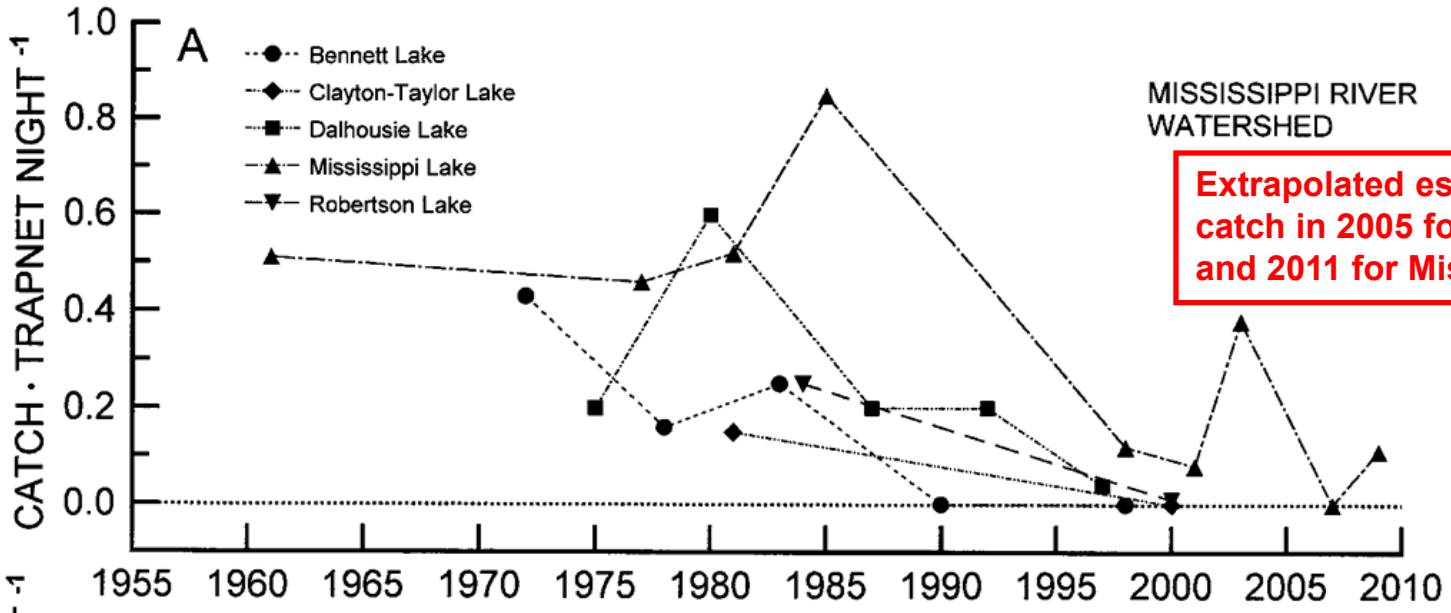



*Large Mississippi Lake eel 2009, held by Emily Verhoek*

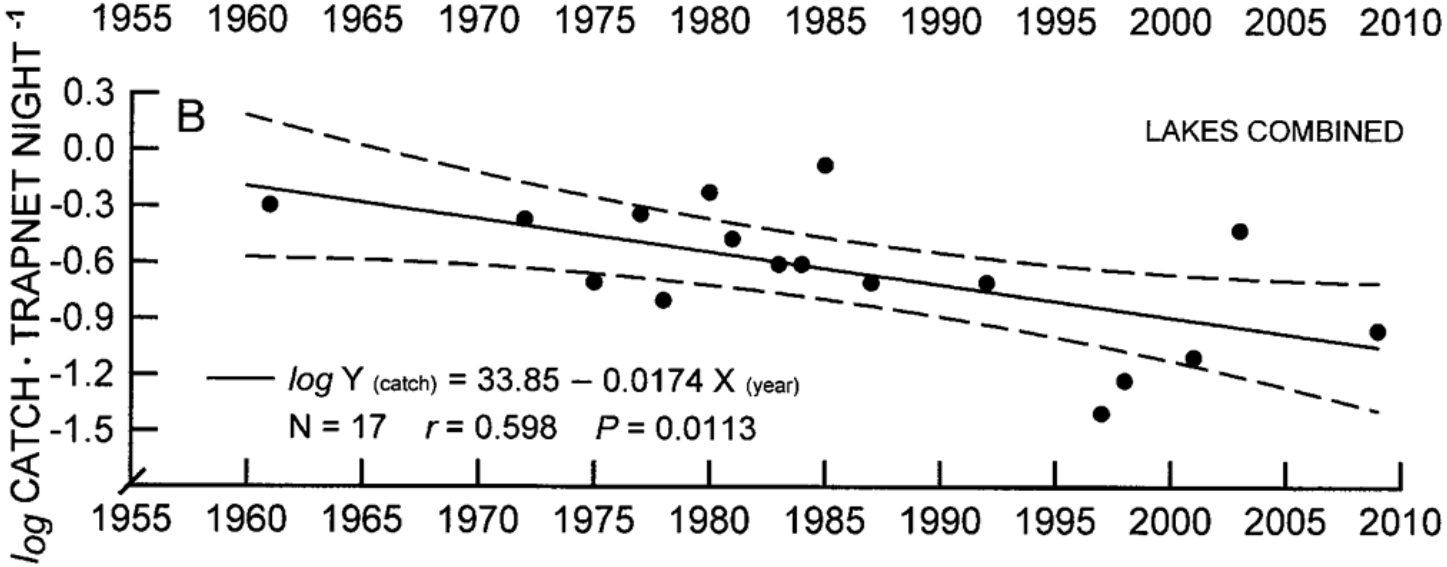
# TRAP-NET CATCH OF EELS IN LAKES

## Mississippi R. watershed, 1961-2009






**Extrapolated estimate of 0 catch in 2005 for combined and 2011 for Mississippi Lake**




*Large Mississippi Lake eel 2009, held by Emily Verhoek*

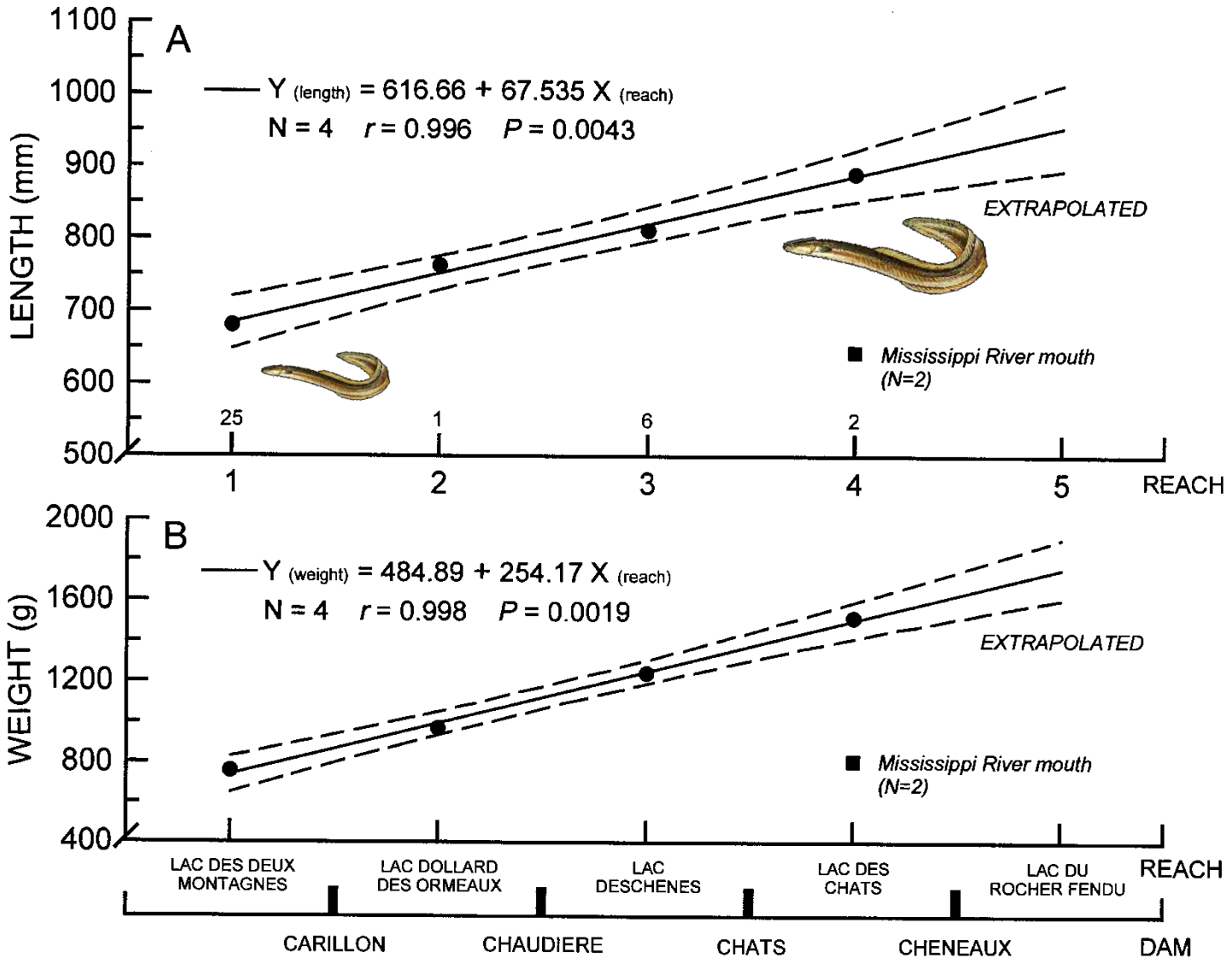
# Abundance and Distribution of Eels in the Ottawa and Mississippi Rivers

***As determined by quantitative electrofishing upstream of the Chenaux and High Falls dams***

# *Precise and Intensive Assessment Methods Are Needed*

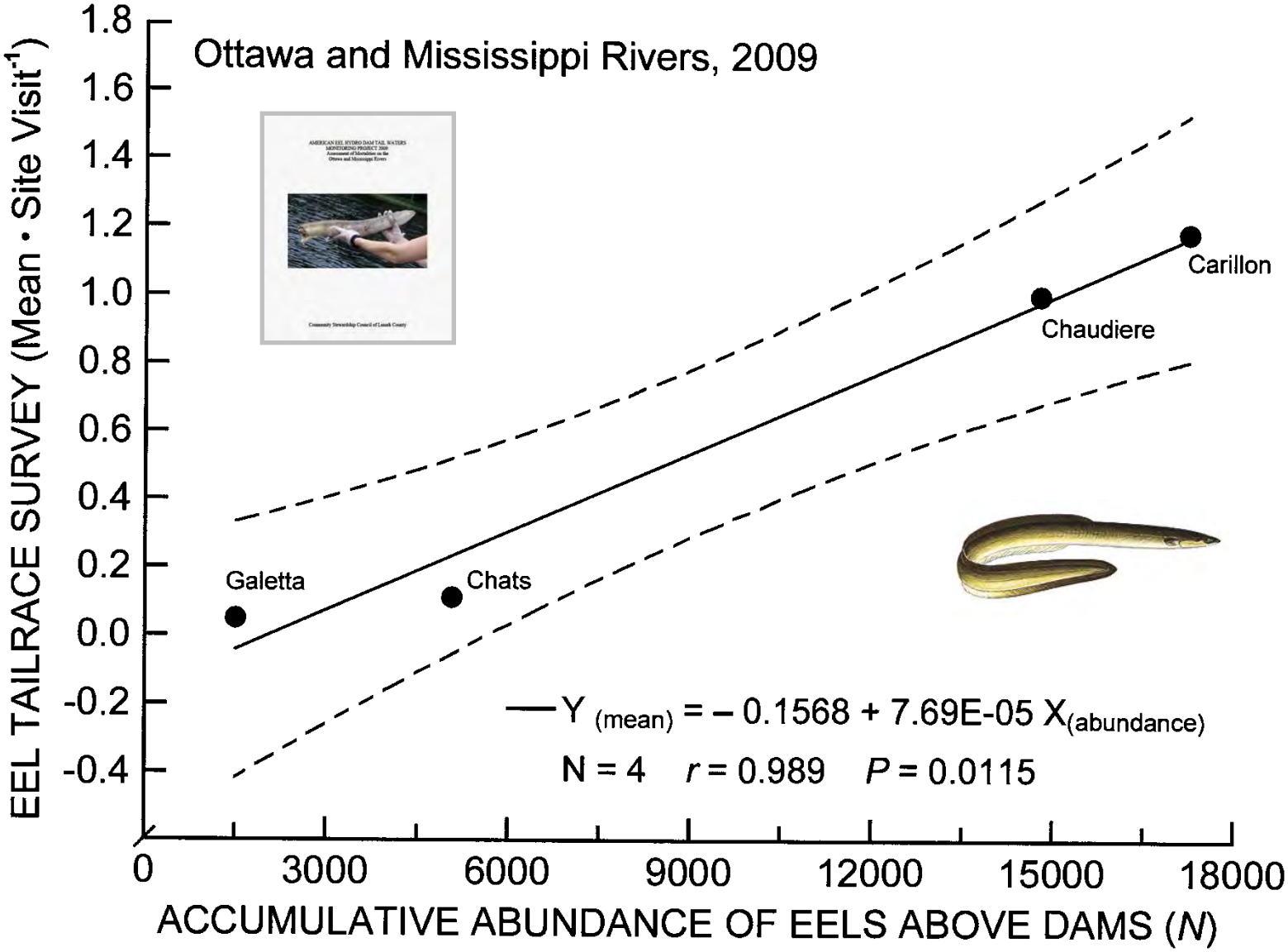
# OTTAWA RIVER EEL SIZE

## Mean length, weight and regression, by reach and reservoir



# EEL CARCASS SURVEY AND ABUNDANCE

## Dam tailrace survey and electrofishing, 2009



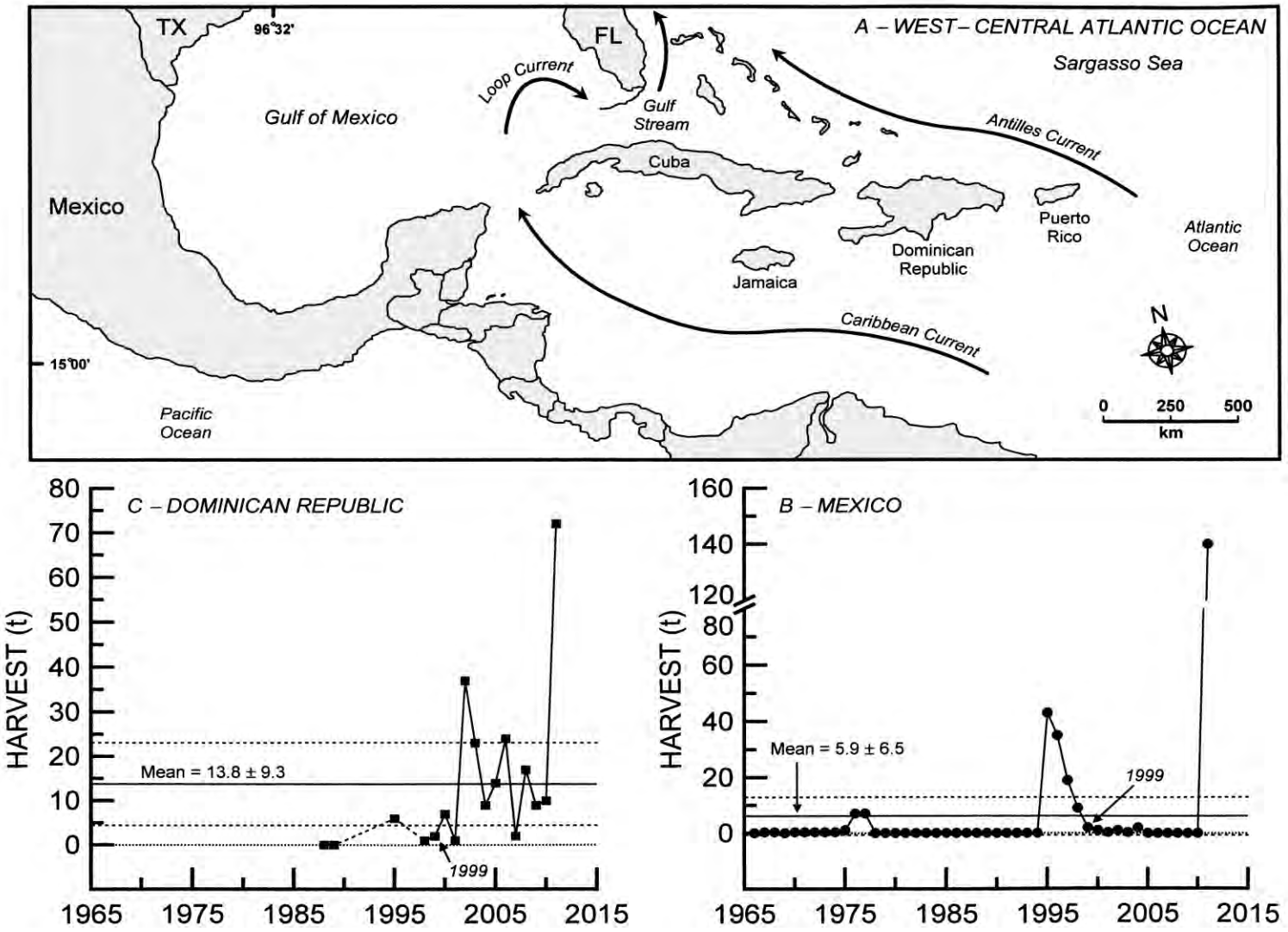
# Commercial Eel Harvest in the Caribbean Islands and Mexico

## *Temporal, sequential, and spatial changes at the southern extremity of the range*

### *1970-2010*

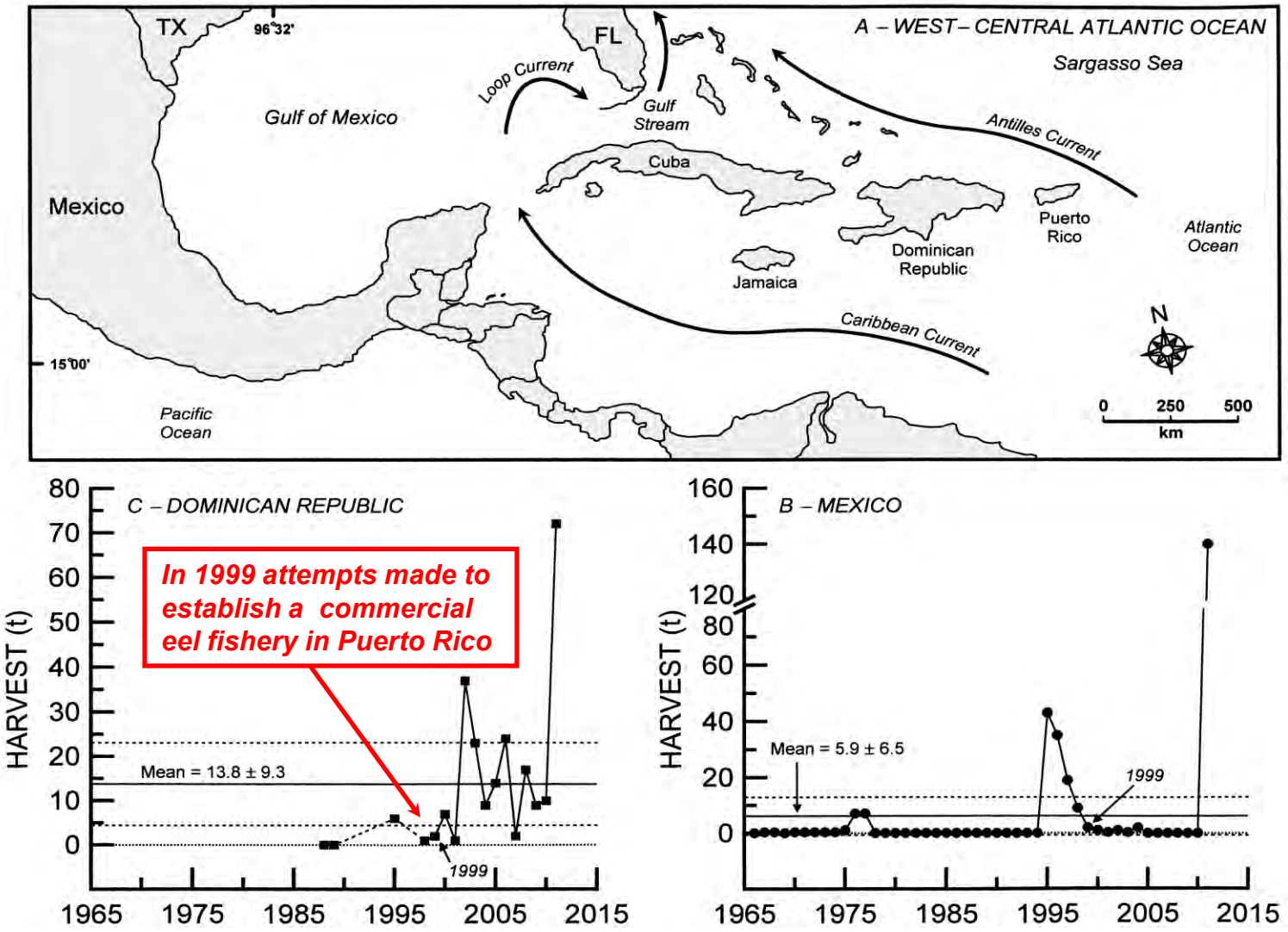
# FAO HARVEST – MEXICO AND CARIBBEAN

## Temporal, sequential, and extremity changes



# FAO HARVEST – MEXICO AND CARIBBEAN

## Temporal, sequential, and extremity changes

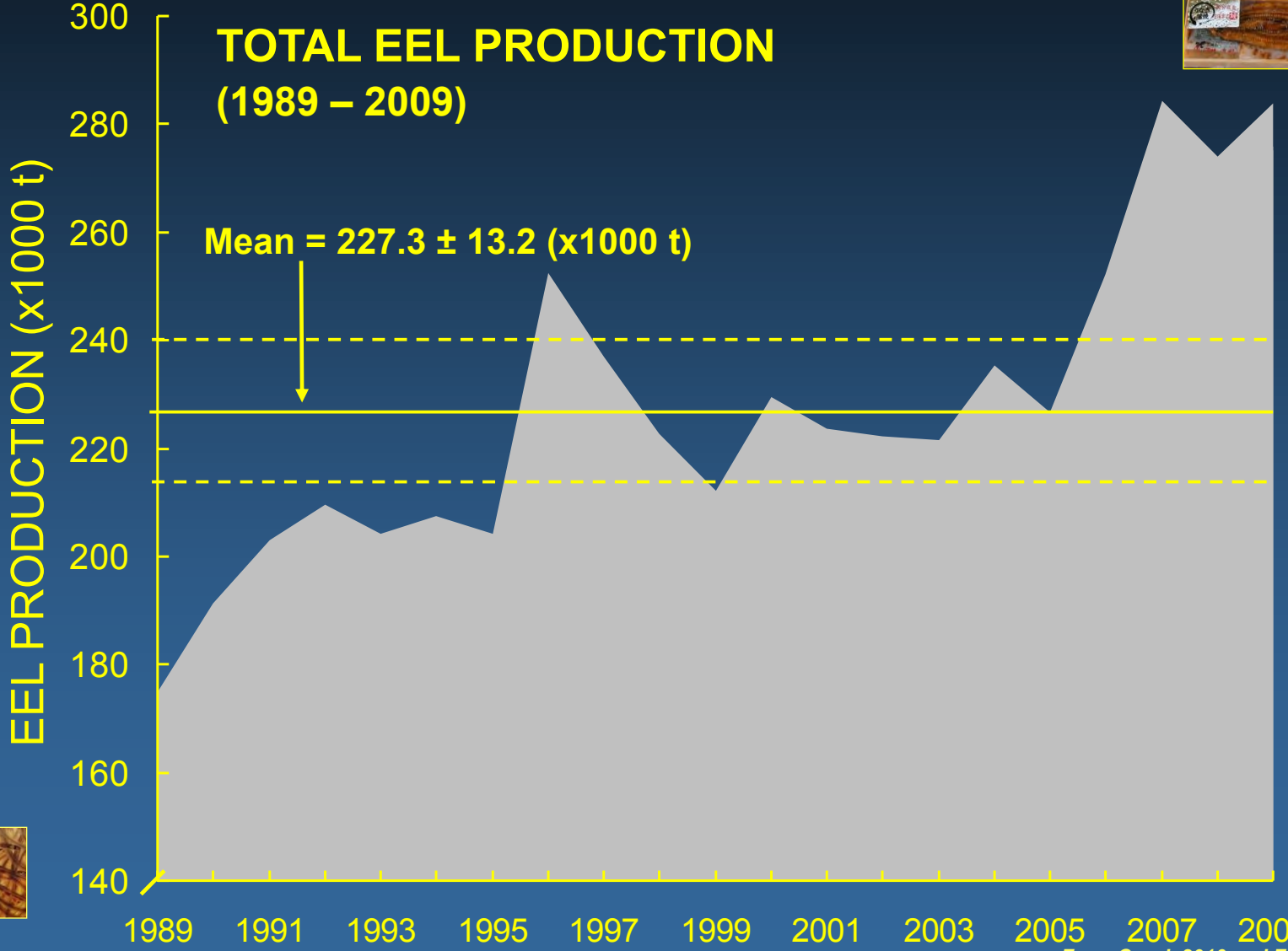


# Worldwide Demand for Eels Is Increasing

***Overall production is at record-high levels; this jeopardizes wild eel stocks; culture requires wild glass eels and elvers***

# WORLDWIDE EEL PRODUCTION – "*TRAFFIC*"

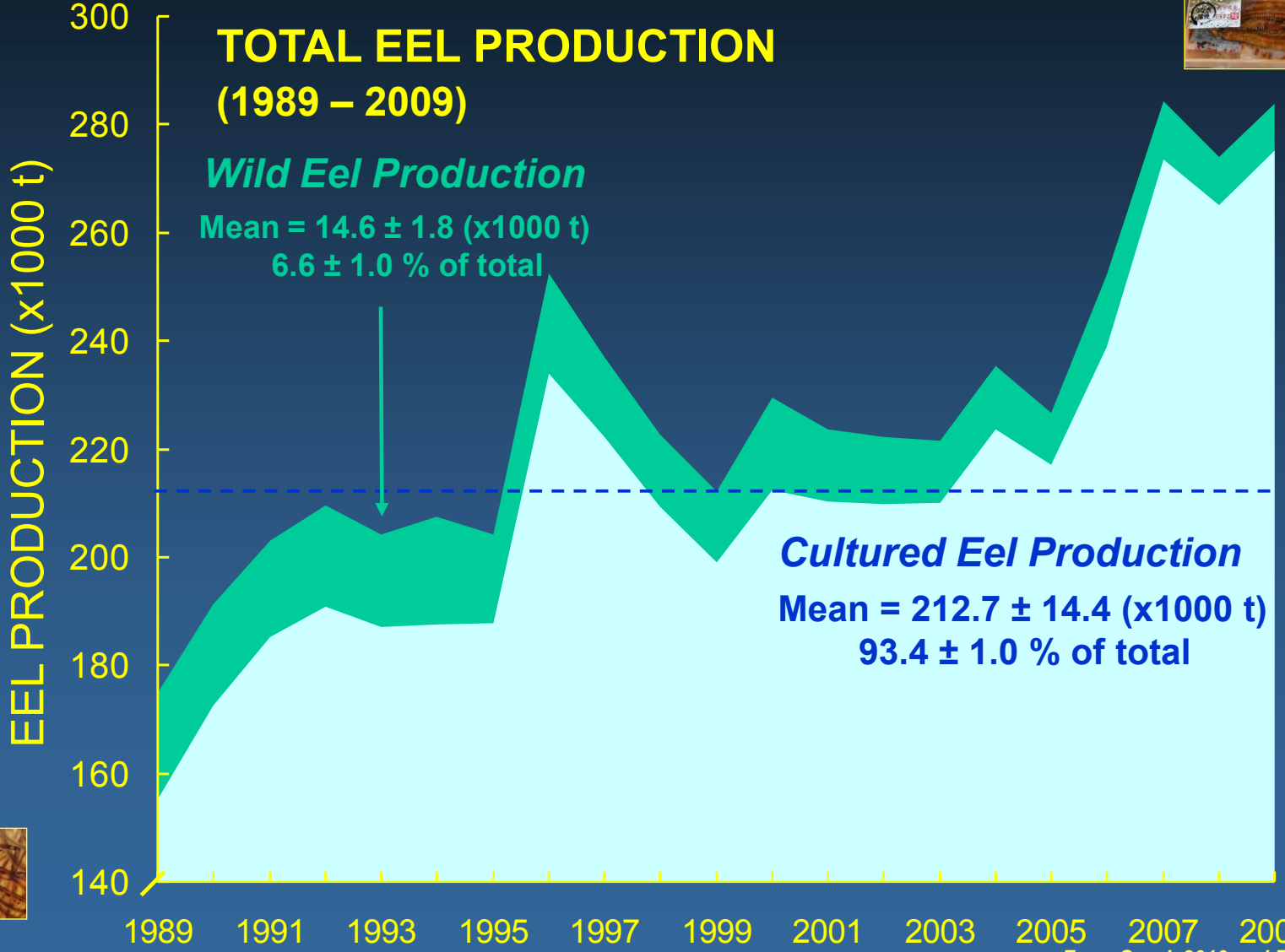
## Culture and wild production and wild American Eels




*From Crook 2010 and FISHSTAT – FAO*

# WORLDWIDE EEL PRODUCTION – "*TRAFFIC*"

## Culture and wild production and wild American Eels




*From Crook 2010 and FISHSTAT – FAO*

# WORLDWIDE EEL PRODUCTION – "*TRAFFIC*"

## Culture and wild production and wild American Eels

**TOTAL EEL PRODUCTION**
**(1989 – 2009)**

EEL PRODUCTION (x1000 t)

300
280
260
240
220
200
180
160
140

***Wild Eel Production***
**Mean = 14.6 ± 1.8 (x1000 t)**
**6.6 ± 1.0 % of total**

***Cultured Eel Production***
**Mean = 212.7 ± 14.4 (x1000 t)**
**93.4 ± 1.0 % of total**

***Wild American Eel Production***
**Mean = 1.2 ± 0.2 (x1000 t)**
**0.6 ± 0.1 % of total**

1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009

*From Crook 2010 and FISHSTAT – FAO*

# WORLDWIDE EEL PRODUCTION – "*TRAFFIC*"

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***Seafood Watch Red Lists Cultured Eels 2013***

***Cultured Eel Production***
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***Wild American Eel Production***
**Mean = 1.2 ± 0.2 (x1000 t)**
**0.6 ± 0.1 % of total**

*From Crook 2010 and FISHSTAT – FAO*

# EELS HAVE BEEN STOCKED WIDELY

## Recently for short-term mitigation in St. Lawrence R. system

- Stocked eels contained first documented occurrence of the swim-bladder worm in the St. Lawrence system
- Have dispersed widely and built the profile, keeping eels present, making many more people conscious of the catastrophic eel declines; could even provide a fishery


*Electrofishing Catch of Stocked Eels*
*Upper St. Lawrence , 2010*

# BLADDER WORM IN ST. LAWRENCE RIVER SYSTEM

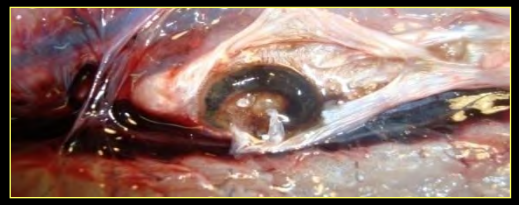
## First appeared in stocked eels in upper St. Lawrence in 2011

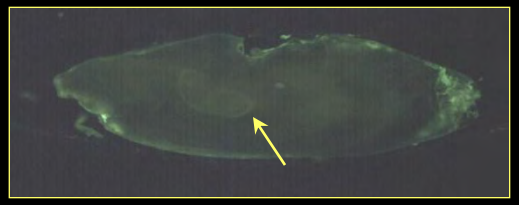
EEL

*Anguillicoloides crassus*

EEL OTOLITH SECTION

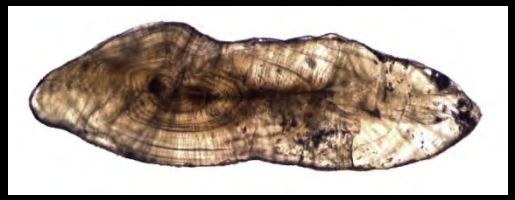
1

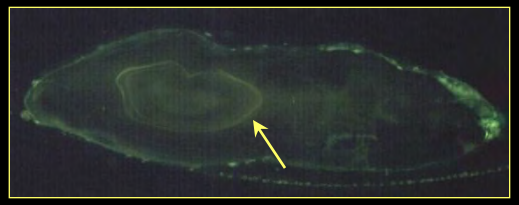




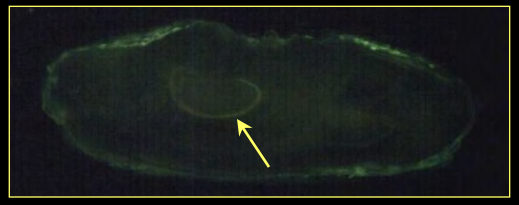
*Tetracycline label*

2





3

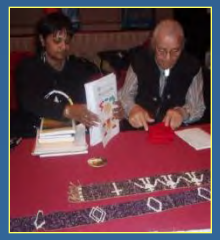


*Transmitted light*

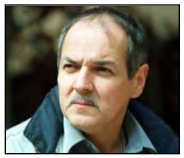
*UV light*

# Aboriginals and First Nations Are Reconfirming Their Interest in Eels

***Expressing a deep concern about the disappearance of this highly valued, sacred fish from their ancestral waters***



# Aboriginal and First Nation Declarations Indicate a Strong Desire to Rekindle Their Association With This Revered Fish



## ABORIGINAL PEOPLES' AMERICAL EEL RESOLUTION

We, the Aboriginal people who have attended the Eastern Ontario – Western Quebec workshop November 22-24, 2008 appreciate the guidance of our Elders who directed us on the way to address the decline of the American Eel, support the National Management plan guiding principles as amended during this workshop.

We wish to communicate the following, to ensure this ancient fish remains in the full historic range of its habitat and returns to waters from which it has been extirpated.

1. It was the unanimous decision that the status of the American eel must be listed nationally as ***THREATENED*** under the *SARA*.
2. Our collective Aboriginal responsibilities with the American Eel remain vitally important to us even though our relationship with the eel has been put into jeopardy.
3. We also reaffirm our responsibilities to our Aboriginal brothers and sisters whose strong relationship with the American Eel is impacted by decisions made in our respective territories.
4. All development and fisheries management decisions must be guided by the precautionary principle and cumulative impacts must be assessed both on a watershed basis and on the basis that the American Eel, *Anguilla rostrata*, comes from one genetic stock.
5. Recognizing that if the American eel is to recover, both habitat and recruitment issues must be addressed. Therefore, ambitious plans must be implemented immediately to enhance fish passage, reduce harvest and increase recruitment.
6. The Glass eel fishery for export must be closed, in order to achieve the objective for increased recruitment. Glass eels must be made available for conservation stocking, but only as a temporary measure until long term solutions are achieved to address declining abundance and recruitment.
7. Aboriginal peoples' ways of knowing and western science must be integrated equally in a full and respectful way in the decision making and implementation of the management plan.

Donald Marshall

## Algonquins of Ontario Returning Kichisippi Pimisi, the American Eel, to the Ottawa River Basin

January 11, 2011

### The American Eel Is Sacred

The American Eel (*Anguilla rostrata*) is considered sacred to the Algonquin people and has been an essential part of Algonquin culture for thousands of years. Recently the number of eels in the St. Lawrence Basin has been reduced significantly, falling approximately 99% from local populations in the 1980s, a span of only 30 years, until we are left with only a remnant population in Ontario. By the end of 2011, the American Eel may have been extirpated from huge areas of traditional Algonquin territory.

**It is vital to the Algonquins of Ontario that viable populations of the American Eel be restored to its historical range in Ontario and specifically to their traditional waters throughout the Ottawa River Basin, including the traditional waters of the Mississippi and Bonnechere Rivers and other tributaries.**

### The Significance of the Ottawa River's American Eel to the Algonquin Community

The American Eel of the Ottawa River is referred to as Kichisippi Pimisi, Kichisippi meaning 'big river' (Kirby Whiteduck, First Nation Algonquin Negotiation Representative and Chief of Algonquins of Pikwàkanagàn pers. comm. October 18, 2011) and being the original name given to the Ottawa River by the Algonquins and Pimisi being the Algonquin name for eel. Kichisippi Pimisi is a source of spirituality and is considered sacred by the Algonquin people. Historically the Algonquins were a people who were skilled at adapting to changing environments and conditions and they identify strongly with the eel's characteristics. The eel is a prayer-carrier of the waters because it travels farthest, through salt and fresh waters, and can travel in wetlands according to Aboriginal Traditional Knowledge (ATK). It connects all of Mother Earth (Katherine Cannon, Algonquin Negotiation Representative and Chief of Algonquin Nation Kijicho Manito Madaouskarini pers. comm. September 23, 2011).

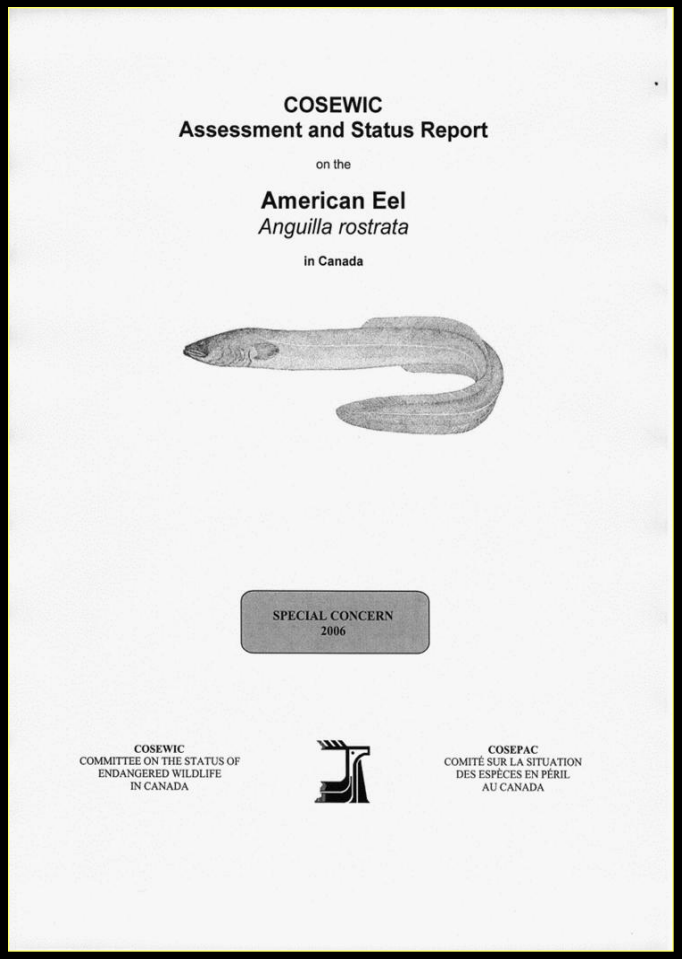
Elder Dr. William Commanda states in A Circle of All Nations Note titled *Manoshkadosh: The American Eel:*

> "I believe that Eel spirit is intrinsic to the Sacred Seven Fire Prophecy Wampum Belt. This unique and mysterious ancient creature was of tremendous significance to the original peoples of the eastern coast of North America, and in the stories of my ancestors, it was plentiful beyond imagination; the Eel was of great spiritual, nutritional and material importance to the people from time immemorial." (Elder Dr. W. Commanda undated)

Page 1

*Collective efforts among government, stakeholders, and Aboriginals to recover the species is unprecedented in our relationships*

# Committee on the Status of Endangered Wildlife in Canada reviewed eels in Canada in 2006 –"*Special Concern*"



COSEWIC
Assessment and Status Report

on the

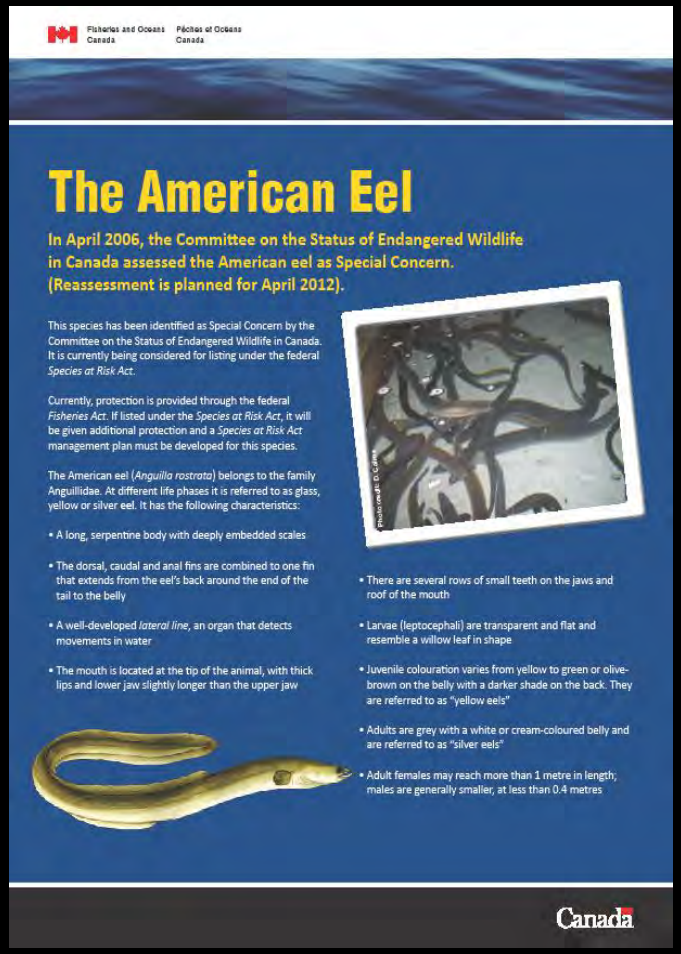
American Eel
*Anguilla rostrata*

in Canada

SPECIAL CONCERN
2006

COSEWIC
COMMITTEE ON THE STATUS OF ENDANGERED WILDLIFE IN CANADA

COSEPAC
COMITÉ SUR LA SITUATION DES ESPÈCES EN PÉRIL AU CANADA



Fisheries and Oceans Canada / Pêches et Océans Canada

## The American Eel

**In April 2006, the Committee on the Status of Endangered Wildlife in Canada assessed the American eel as Special Concern. (Reassessment is planned for April 2012).**

This species has been identified as Special Concern by the Committee on the Status of Endangered Wildlife in Canada. It is currently being considered for listing under the federal *Species at Risk Act*.

Currently, protection is provided through the federal *Fisheries Act*. If listed under the *Species at Risk Act*, it will be given additional protection and a *Species at Risk Act* management plan must be developed for this species.

The American eel (*Anguilla rostrata*) belongs to the family Anguillidae. At different life phases it is referred to as glass, yellow or silver eel. It has the following characteristics:

- A long, serpentine body with deeply embedded scales
- The dorsal, caudal and anal fins are combined to one fin that extends from the eel's back around the end of the tail to the belly
- A well-developed *lateral line*, an organ that detects movements in water
- The mouth is located at the tip of the animal, with thick lips and lower jaw slightly longer than the upper jaw
- There are several rows of small teeth on the jaws and roof of the mouth
- Larvae (leptocephali) are transparent and flat and resemble a willow leaf in shape
- Juvenile colouration varies from yellow to green or olive-brown on the belly with a darker shade on the back. They are referred to as "yellow eels"
- Adults are grey with a white or cream-coloured belly and are referred to as "silver eels"
- Adult females may reach more than 1 metre in length; males are generally smaller, at less than 0.4 metres

Canada

***In 2006 COSEWIC examined the status of eels in Canada and considered there was some concern for the species and asked for another review in five years***

# Committee on the Status of Endangered Wildlife in Canada reviewed eels in Canada in 2012 – "Threatened"

COSEWIC
Assessment and Status Report

on the

American Eel
*Anguilla rostrata*

in Canada

THREATENED
2012

COSEWIC
Committee on the Status of Endangered Wildlife in Canada

COSEPAC
Comité sur la situation des espèces en péril au Canada

COSEWIC
Committee on the Status of Endangered Wildlife in Canada

COSEPAC
Comité sur la situation des espèces en péril au Canada

responsibility for safeguarding remaining grizzly populations. In the southern part of their range, where they are in regular contact with humans, many populations are declining. In the north, the impacts of ongoing and escalating extraction of natural resources are a cause for concern. Considering these threats, the Grizzly Bear was assessed as Special Concern by COSEWIC. This assessment concludes a two-year process incorporating science and Aboriginal Traditional Knowledge.

**Enigmatic American Eel swims against the current**

American Eels are remarkable fish. They spend most of their lives in freshwater then return to the sea, migrating from streams and rivers that span Greenland to South America to spawn in the mid-Atlantic Sargasso Sea. Young eels journey over 7000 km to rivers and streams where they live for up to 20 years before starting their downstream migration to the sea. This complex lifestyle exposes the eels to a variety of threats over large areas and timespans, which resulted in a Threatened designation. American Eels that migrate to Lake Ontario and the upper St. Lawrence River have declined drastically over the past 40 years. Despite improvements to hydroelectric dams that reduce risks to young eels migrating upstream, older eels still suffer high mortality during the downstream migration. In Atlantic Canada, existing fisheries place additional pressure on the American Eel.

**Canada's other beaver can't handle the heat**

While nearly all Canadians can recognize the North American Beaver, its distant relative, the Mountain Beaver is probably unknown to most. Mountain Beavers occur in Canada only in the Coast Mountains and south of the Fraser River in British Columbia. Mountain Beaver, the last living representative of an ancient lineage of rodents, was assessed as Special Concern. These beavers live in underground dens built in deep, loose soil along the edges of cool, forested streams. These sites can be degraded by forestry practices that compact the soil. Mountain Beavers are highly intolerant of heat and drought, and are especially sensitive to climate change. The Magnum Mantleslug, another wildlife species assessed as Special Concern, is similarly restricted to edges of

***May 4, 2012, COSEWIC announced that in a 2011 update they saw a greater concern for eels in Canada than seen in the 2006 assessment and status report***

# Atlantic States Marine Fisheries Commission Announcement American Eel Benchmark Assessment – "Stock Is Depleted"

*FOR IMMEDIATE RELEASE, MAY 3, 2012*
*PRESS CONTACT, TINA BERGER, 703.842.0740*

**ASMFC American Eel Benchmark Assessment Indicates Stock is Depleted**

Alexandria, VA – In its report to the Commission's American Eel Management Board, an independent panel of scientists endorsed the findings of the 2012 benchmark stock assessment, which concluded the American eel population is depleted in U.S. waters. The stock is at or near historically low levels due to a combination of historical overfishing, habitat loss, food web alterations, predation, turbine mortality, environmental changes, toxins and contaminants, and disease. The panel urged the Board to examine alternative reference points to provide more protection to the spawning stock biomass.

Both trend and model analyses results indicate the American eel stock has declined in recent decades and the prevalence of significant downward trends in multiple surveys across the coast is cause for concern. Based on these findings, the stock is considered depleted. No overfishing determination can be made at this time. However, the Commission's American Eel Technical Committee and Stock Assessment Subcommittee caution that although commercial fishery landings and effort in recent times have declined in most regions (with the possible exception of the glass eel fishery), current levels of fishing effort may still be too high given the additional stressors affecting the stock such as habitat loss, passage mortality, and disease. Fishing on all life stages of eels, particularly young-of-the-year and in-river silver eels migrating to the spawning grounds, could be particularly detrimental to the stock, especially if other sources of mortality (e.g., turbine mortality, changing oceanographic conditions) cannot be readily controlled. Management efforts to reduce mortality on American eels in the U.S. are warranted.

In response to the findings, the Board tasked the American Eel Technical Committee with developing potential management actions for Board consideration at its next meeting. A more detailed overview of the American eel stock assessment is available on the Commission website at http://www.asmfc.org/speciesDocuments/eel/AmericanEelStockAssessmentOverview_May2012.pdf. It was developed with the intent of aiding media and interested stakeholders in better understanding the Commission's stock assessment results and process. The American Eel Stock Assessment Report and Assessment Peer Review Report will be posted to the Commission website under Breaking News on May 7. For more information, please contact Kate Taylor, Fishery Management Coordinator, at ktaylor@asmfc.org or 703.842.0740.

###

**ASMFC Stock Assessment Overview: American Eel**

## Introduction

This document presents a summary of the 2012 benchmark stock assessment for American eel. The assessment was peer-reviewed by an independent panel of scientific experts at an Atlantic States Marine Fisheries Commission (ASMFC) External Peer Review Workshop in March 2012. This assessment is the latest and best information available on the status of the coastwide American eel stock for use in fisheries management.

## Management Overview

American eels are managed by the ASMFC in territorial seas and inland waters along the Atlantic coast from Maine to Florida. The American Eel Fishery Management Plan (FMP) was approved in November 1999. The goal of the FMP is to conserve and protect the American eel resource to ensure ecological stability while providing for sustainable fisheries. Each state is responsible for implementing management measures within its jurisdiction to ensure the sustainability of the American eel population that resides within state boundaries.

The FMP requires that all states and jurisdictions implement an annual young-of-year abundance survey by 2001 in order to monitor annual recruitment. In addition, the FMP requires all states and jurisdictions to establish a minimum recreational size limit of six inches and a recreational possession limit of no more than 50 eels per person per day. Recreational fishermen are not allowed to sell eels without a state license. Commercial regulations vary by state but also include a six-inch minimum size limit with the exception of Maine and South Carolina which maintain glass eel fisheries. Commercial fisheries management measures stipulate that states and jurisdictions shall maintain existing (as of 2000) or more conservative regulations for all life stages. States with commercial minimum size limits must retain those minimum size limits, unless otherwise approved by the American Eel Management Board.

Addendum I, approved February 2006, established a mandatory catch and effort monitoring program for American eels. At this time, however, not all states are able to provide this level of detailed reporting. Addendum II, approved in October 2008, placed increased emphasis on improving the upstream and downstream passage of American eels.

## What Data Were Used?

The American eel assessment used both fishery-dependent data and fishery-independent data collected through state, federal, and academic research programs.

### *Life History*

American eels are catadromous, spending most of their life in freshwater or estuarine environments, then traveling to the ocean as adults to reproduce and die. Sexually maturing eels migrate to spawning grounds located in the Sargasso Sea, an area of the western Atlantic Ocean east of the Bahamas and south of Bermuda. The Gulf Stream then transports and disperses larval eels, called leptocephali, along the eastern coast of Central and North America. Because all mature adult fish from the entire range come together in one place and reproduce, the American eel population is considered a panmictic (single) stock. American eels found along the eastern coast of Mexico are from the same population as eels found in the St. Lawrence River in Canada.



***May 3, 2012, AMFSC stock assessment overview indicates that significant downward trends in multiple surveys across the coast are cause for concern***

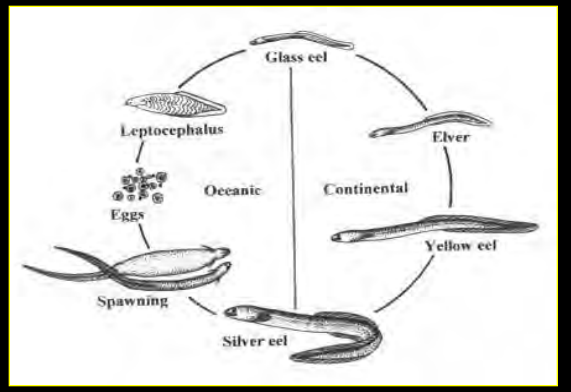
# Eels Are Shrouded in Mystery and Poorly Understood but Can Teach Us Much

***It isn't how little we know; it's how much we know and how little we do. Where should we begin? We should transfer our science and convey our concern and enthusiastic passion to the young: they will make the difference.***

*Stocked eel and friend*


*Citizen Science: American Eel Research*


Sydenham Public School
5 CLERGY STREET EAST, KINGSTON, ONTARIO


Glass eel
Leptocephalus
Elver
Eggs
Oceanic
Continental
Yellow eel
Spawning
Silver eel


The Amazing
Journey of the
American Eel
Powers
Grade 1/2
April 2010


The Amazing Journey of the American Eel
Silver eel
1 metre
Lake Ontario

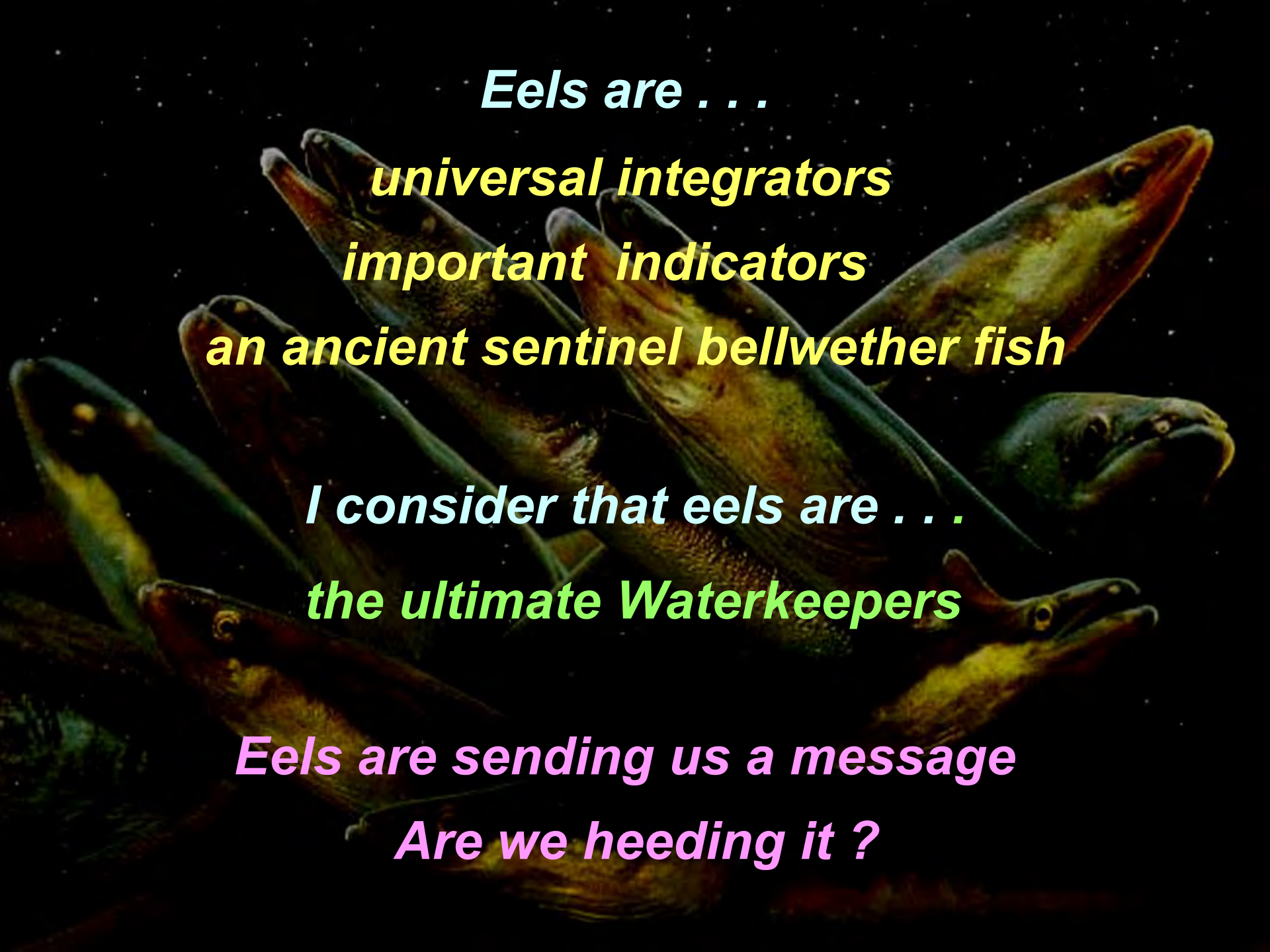

The Amazing Journey of the American Eel
Yellow eel


glass eel
larvae


Sargasso Sea
larvae
female


Seaweed
eel eggs
Sargasso Sea
female
Mating
Male


“The eel-fishery is highly productive and enables people to live when all else fails”
(Ancient saying from the Jesuit Relations)
But are we now losing our association with this ancient and long-valued fish and resource?
Indeed, will the species disappear from our consciousness?


Eels are . . .
universal integrators
important indicators
an ancient sentinel bellwether fish
I consider that eels are . . .
the ultimate Waterkeepers
Eels are sending us a message
Are we heeding it ?

# Summary

- All this supports the contention that there is a broad species decline in both abundance and recruitment, much greater at the various extremities of the range, well exemplified by the Ottawa River system

- Numerous factors combine and interact to put some stocks of this panmictic species in their present precarious state; nevertheless, human-induced fishing and emigration mortality must be reduced

- Loss of recruitment at the extremities of the range is strong evidence of a universal decline in this panmictic species and forewarns continued and accelerated species and resource declines

# Summary

- The species should be considered "*Threatened*" and the resource "*Endangered*", given the universal decrease in abundance and distribution

- The decline is to some extent influenced by changing oceanic conditions (Gulf Stream and Labrador Current); one way to try to compensate for this is to increase reproductive capacity of the spawning population through increasing spawner escapement

***This emphasizes that cooperative action is urgently needed !***

# *Will fishing and fishers persist?*

## *Eels are slip-sliding away!*

***Will they disappear from the St. Lawrence River watershed?***

# *Will our association persist?*

*Thank you !*