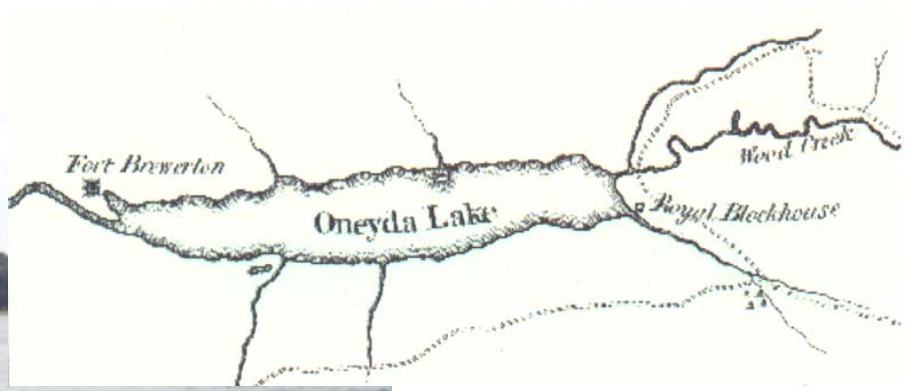
# Assessment of a Lake Sturgeon Restoration Stocking Program in Oneida Lake

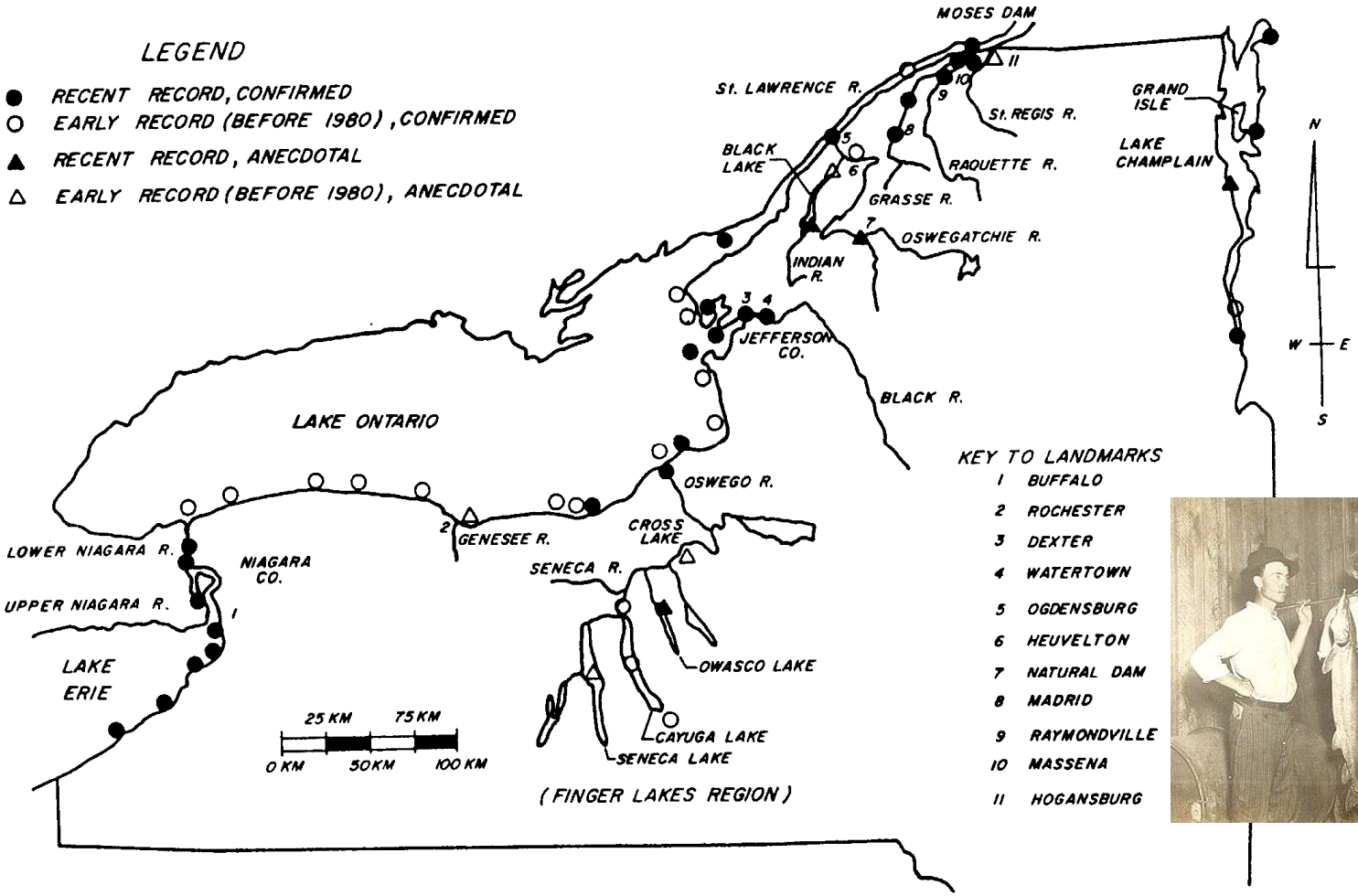
Randy Jackson, Tom Brooking and Tony Van De Valk,

Cornell Biological Field Station



# Lake Sturgeon in New York State

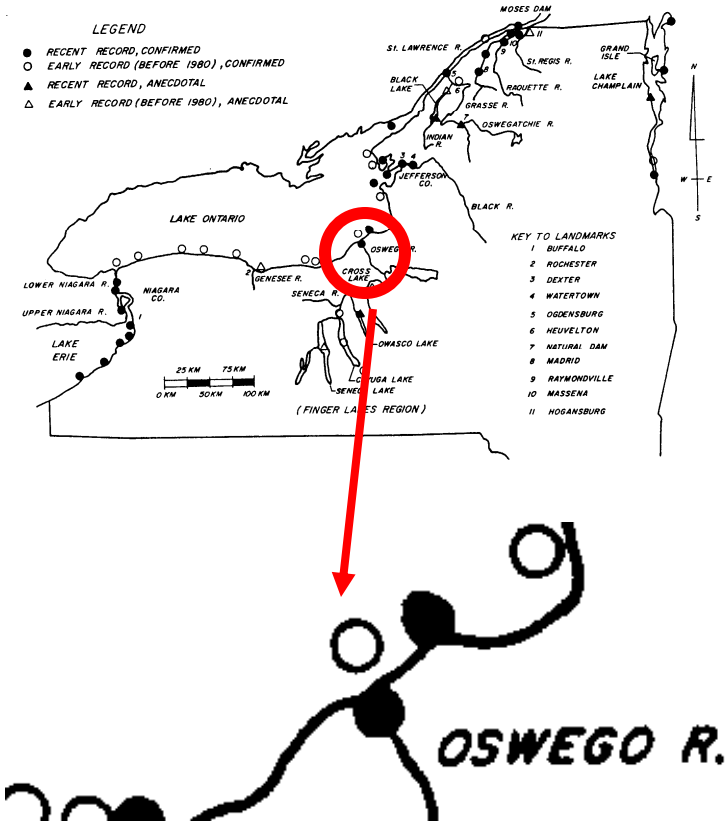
# (from Carlson 1995)



# Sturgeon at Oswego Falls

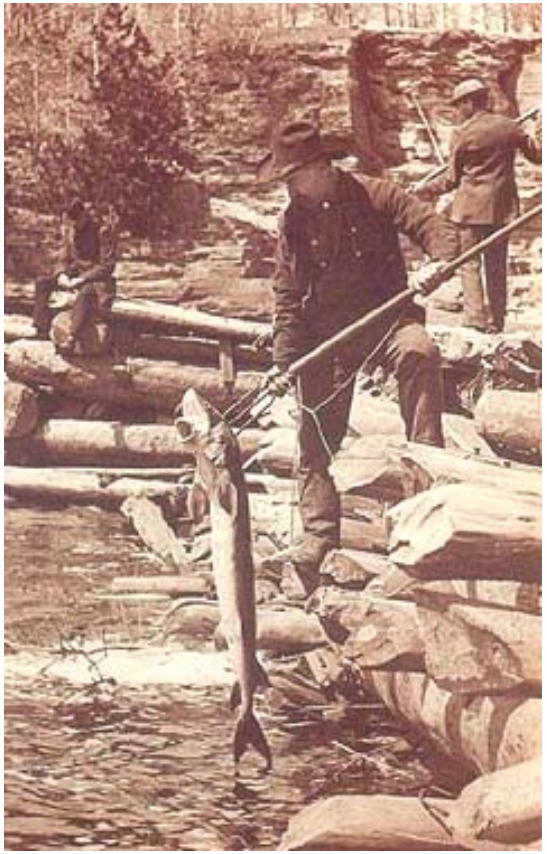
the falls abound with Sturgeon, Catfish, Oswego Bass and Salmon. The Indians spear them coming up the falls. This they do with great dexterity.

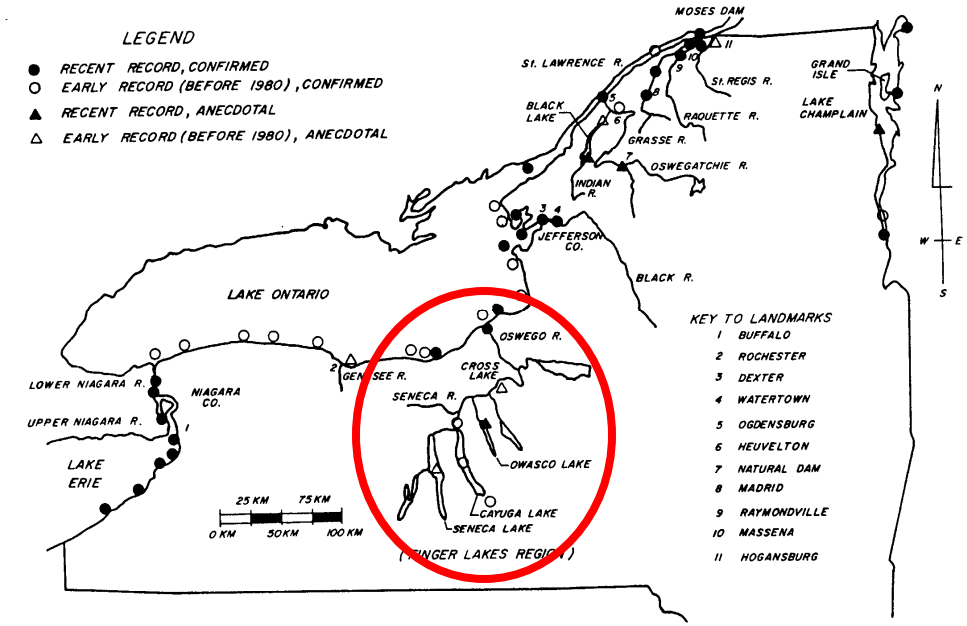
J. Cockburn, 1792

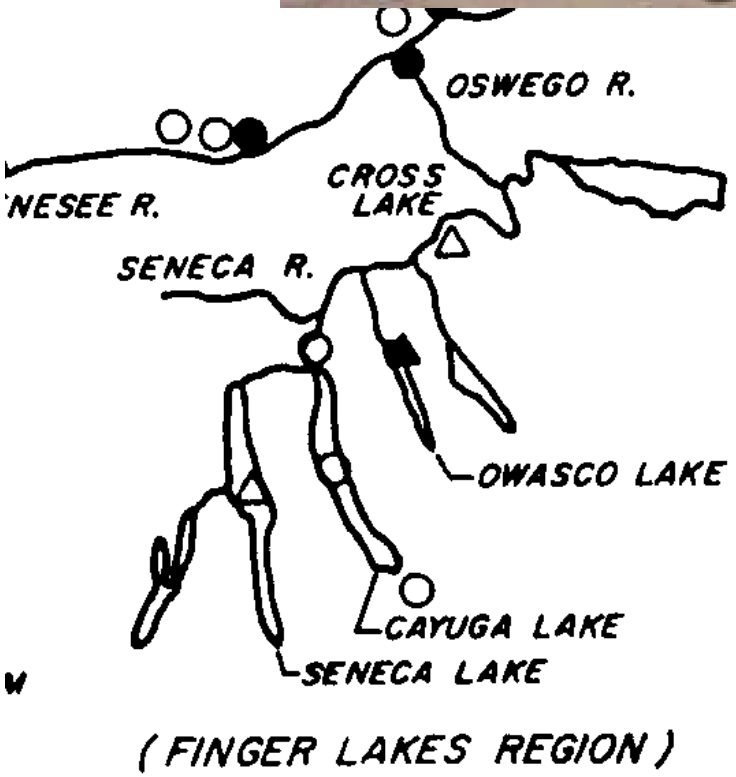



Sturgeon have been caught in the lake that weigh 100 pounds.

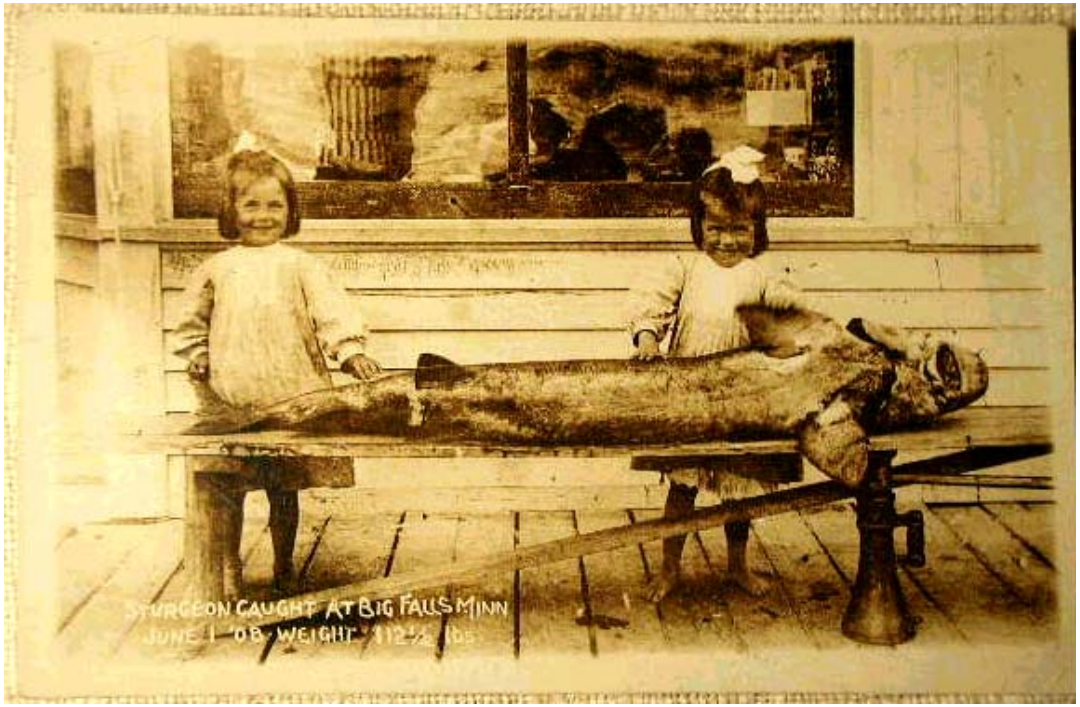
Dewitt Clinton, 1810

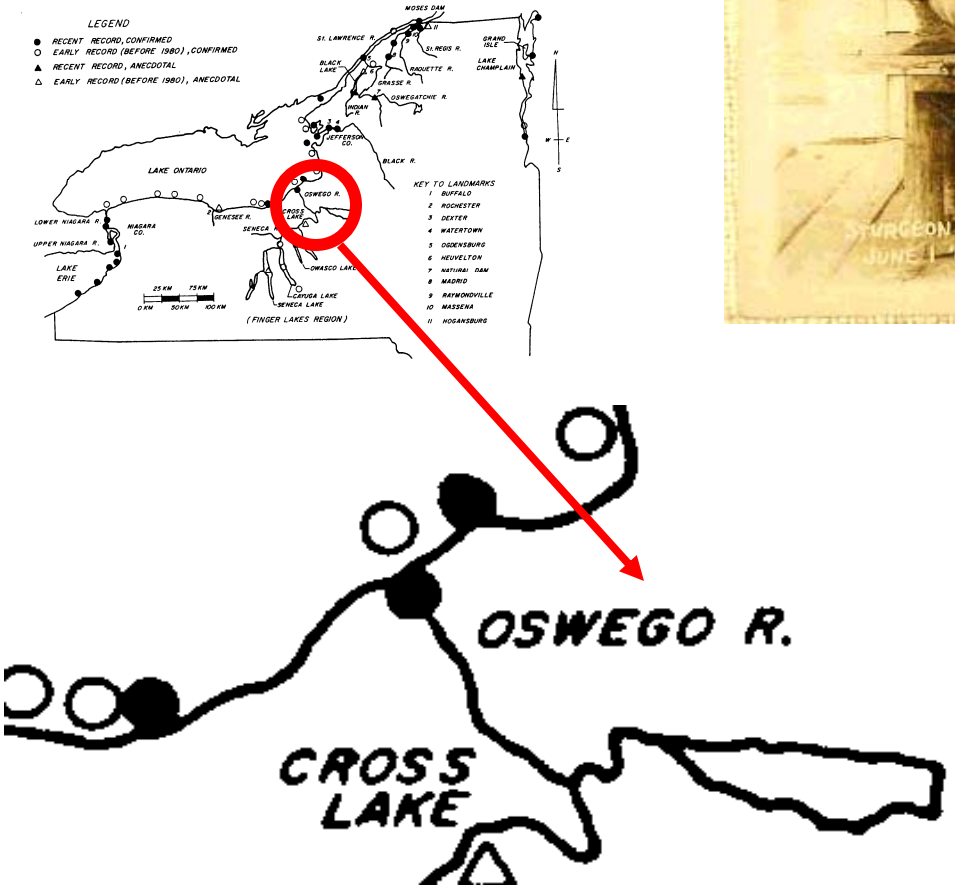







# Sturgeon were known in the Finger Lakes of New York, with anecdotal evidence of a fishery in Cayuga Lake




# Scattered Records of Sturgeon have also been found from Oneida Lake

# A 17 lb. Sturgeon Caught in Oneida Lake, Spring 1973

**(from the *Oneida Lake Bulletin*, Summer Edition 1973)**

# New York State Sturgeon Restoration Program

# Initiated 1995 on Oneida Lake

NYS Department of Environmental Conservation

# Lake Sturgeon Stocking History, Oneida Lake, New York

| Year | Number Stocked | Age/Size at Stocking |
|---|---|---|
| 1995 | 5,000 | Age-0 (254 mm) |
| 1996 | 500 | Age-0 (178 mm) |
| | 50 | Age-1 (560 mm) |
| 1998 | 287 | Age-1 (560 mm) |
| | 100 | Age-1 (369 mm) |
| 1999 | 300 | Age-0 (217 mm) |
| | 20 | Age-4 (900 mm) |
| 2000 | 300 | Age-0 (189 mm) |
| 2003 | 368 | Age-0 (233 mm) |
| 2004 | 1,200 | Age-0 (187 mm) |

# Sturgeon Captures in Oneida Lake

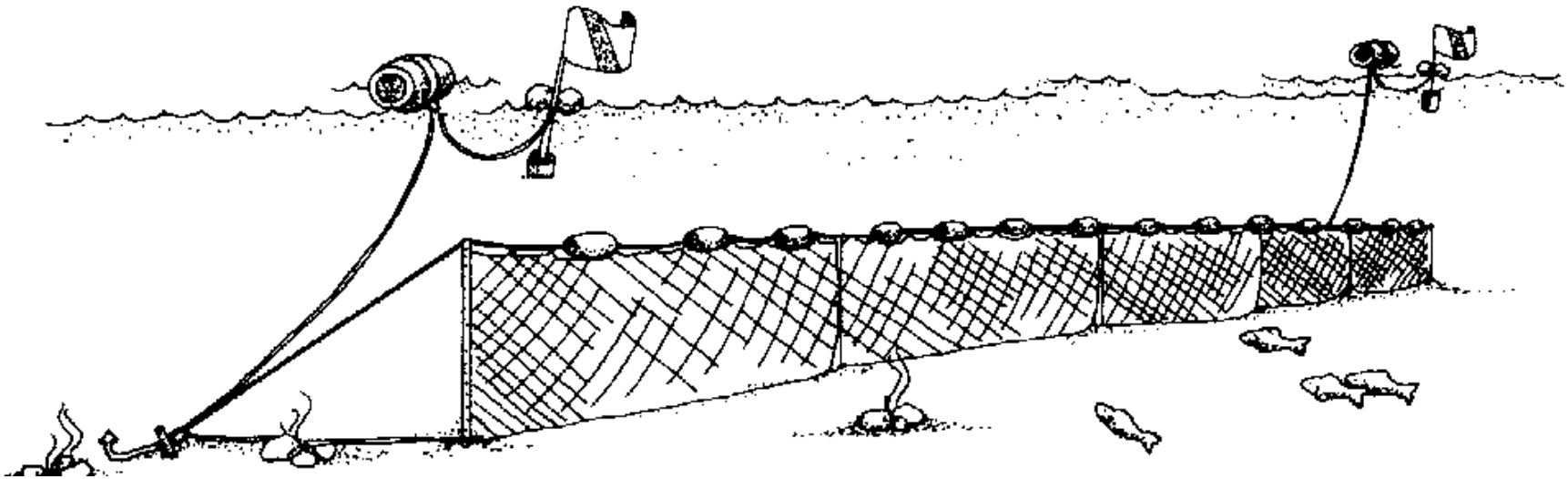
**All Ages captured**

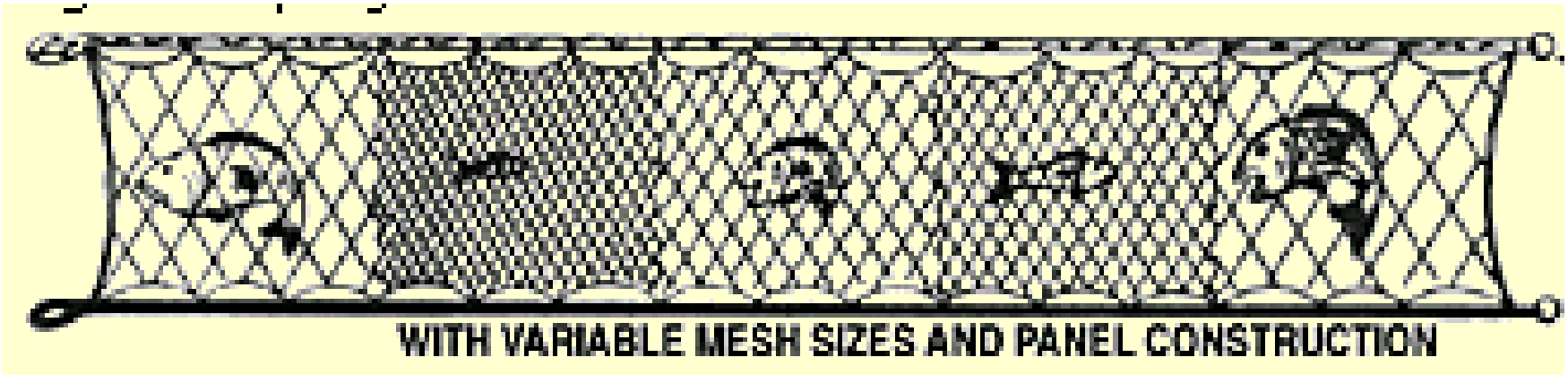
- **Over 700 handled as of the 2007 field season**

The CORNELL UNIVERSITY Biological Field Station At Shackelton Point

- **Distribution and habitat study conducted 2002-2004**
- **Three year total of 208 sturgeon**

# BEST GEAR IS GILL NET SET ON BOTTOM

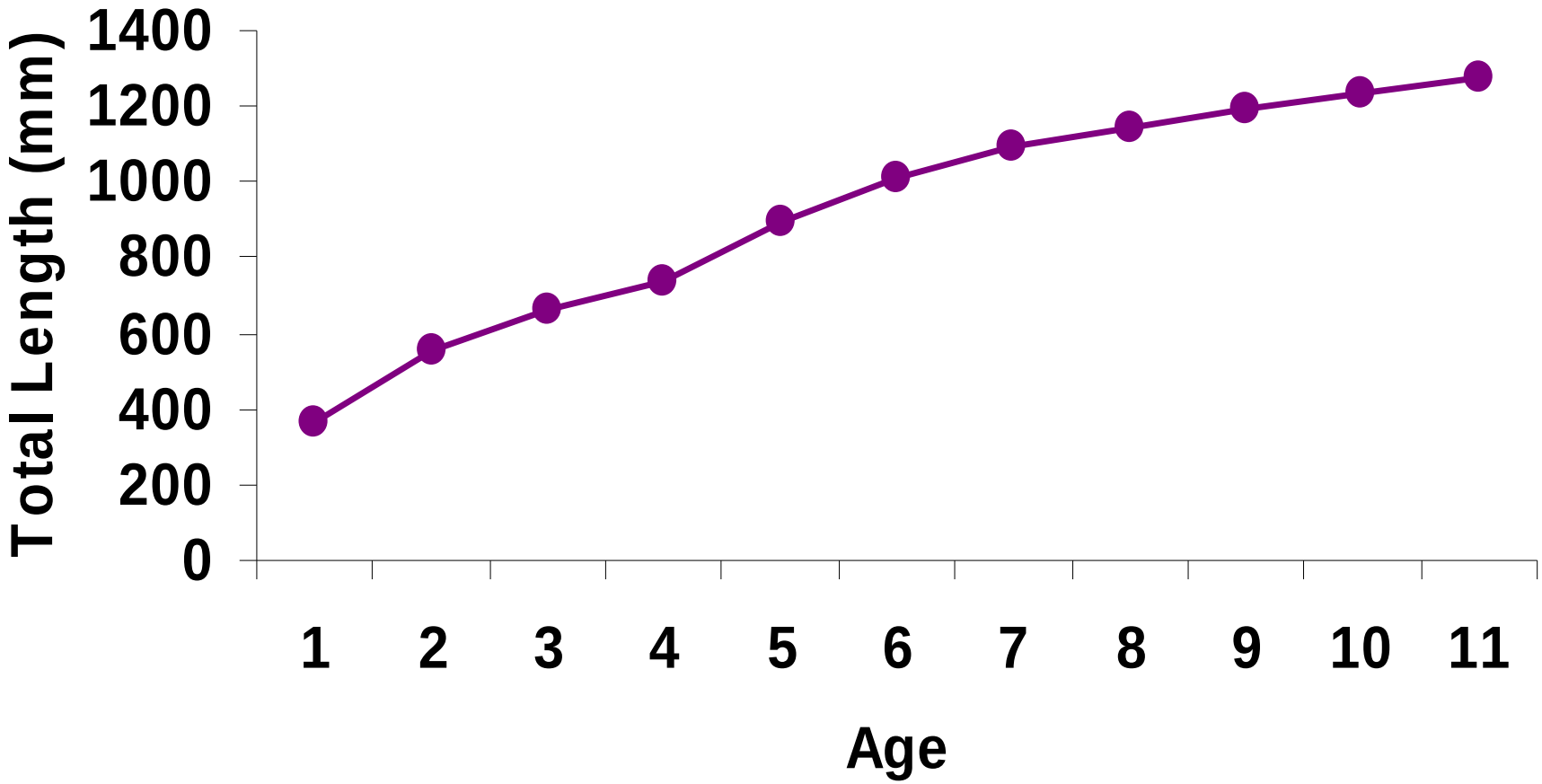




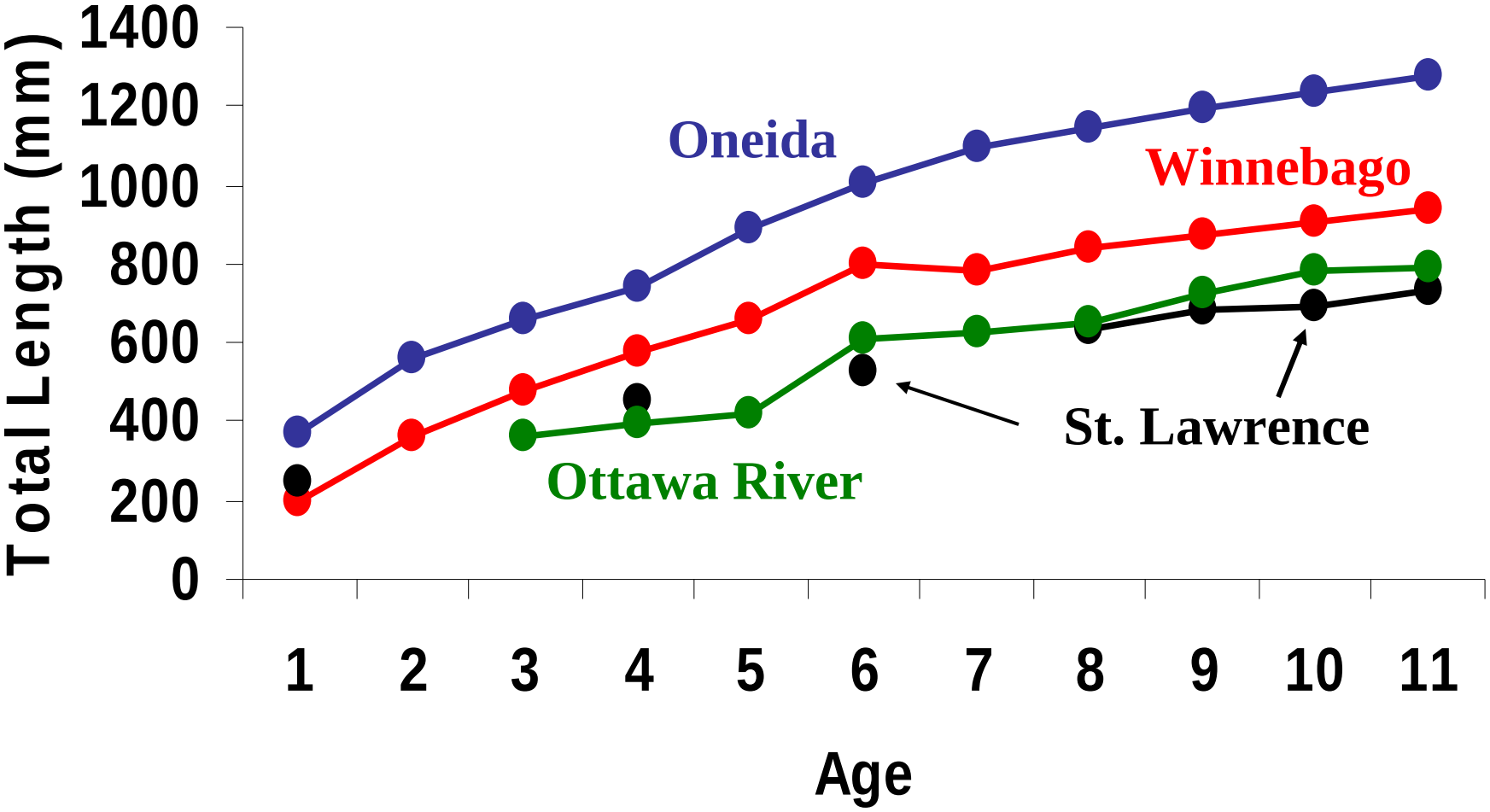

**VARIABLE MESH NETS – 6”, 8”, 10”, 12” STRETCH MONOFILAMENT**

# Observed Length-At-Age Relationship

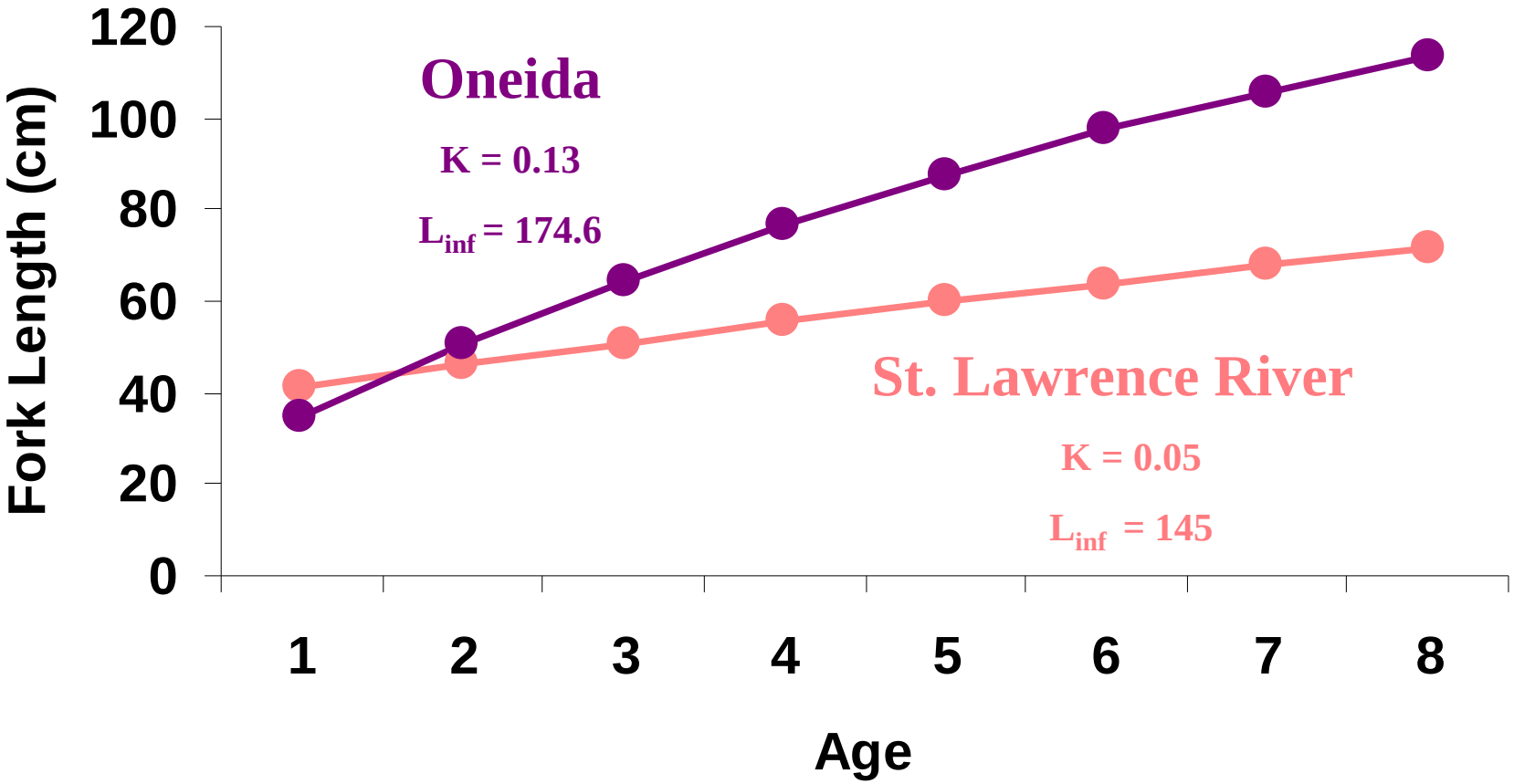
## Annual Growth Rate of 90 mm (~3.5 inches) per Year



# Comparison with Other Lakes:



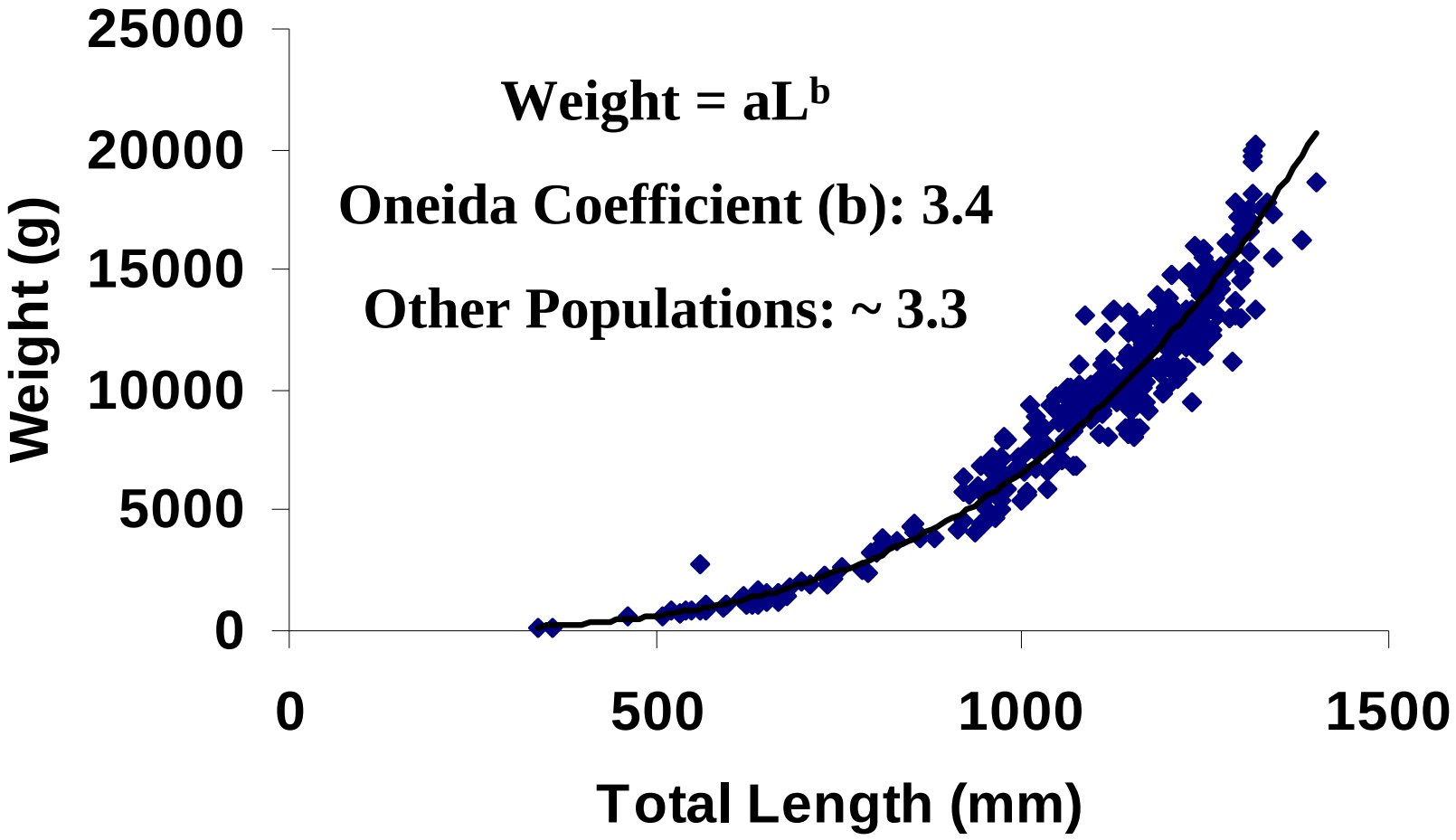
# Von Bertalanffy Growth Curves for Oneida Lake and the St. Lawrence River



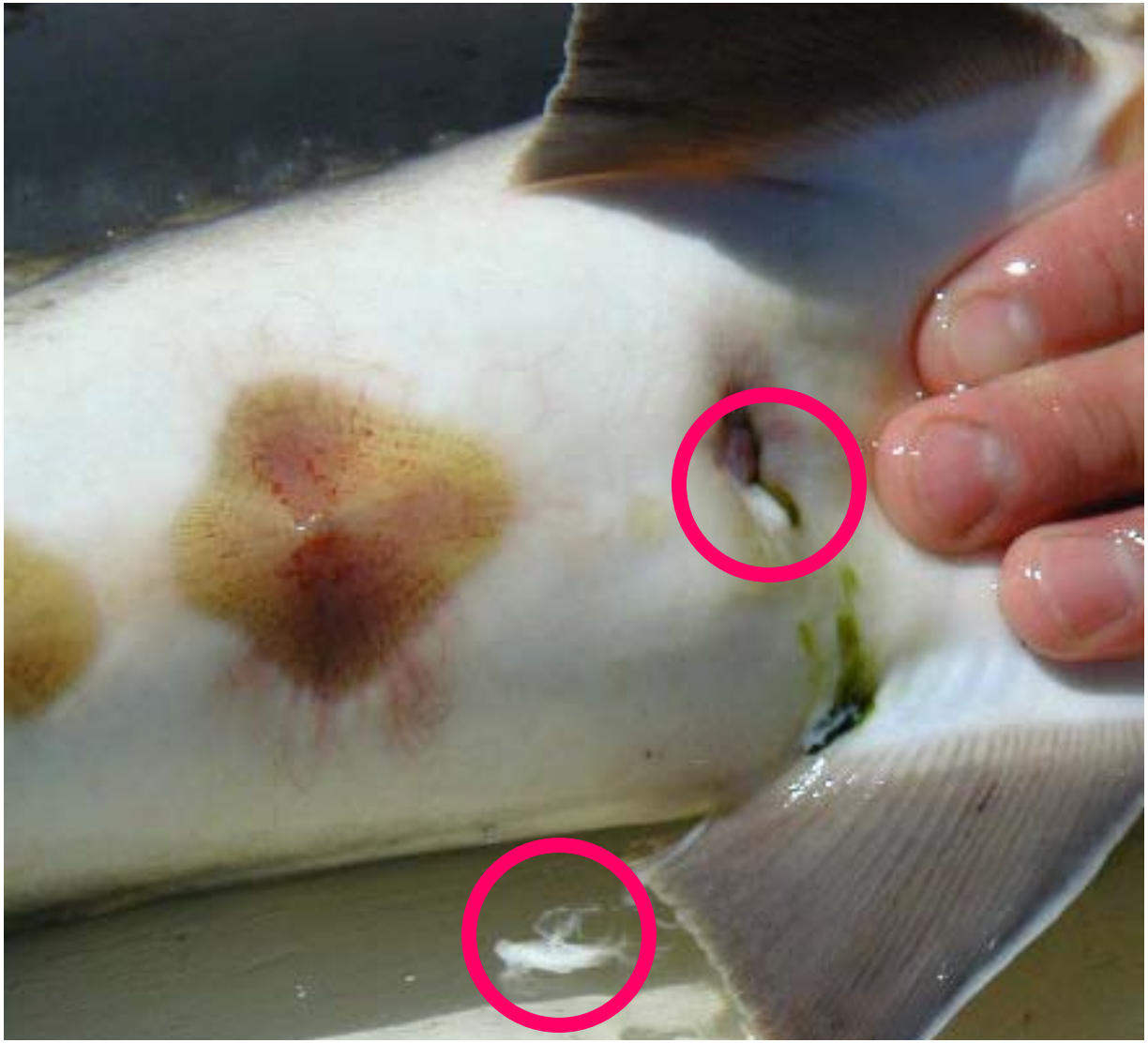

St. Lawrence parameter estimates from Johnson et al. (1998)

# Observed Length-Weight Relationship

## Heaviest fish so far, just over 72 pounds



# Ripe Male Sturgeon at Age 8 (so presumably 1995, 1996, 1997, 1999 YC's all mature)

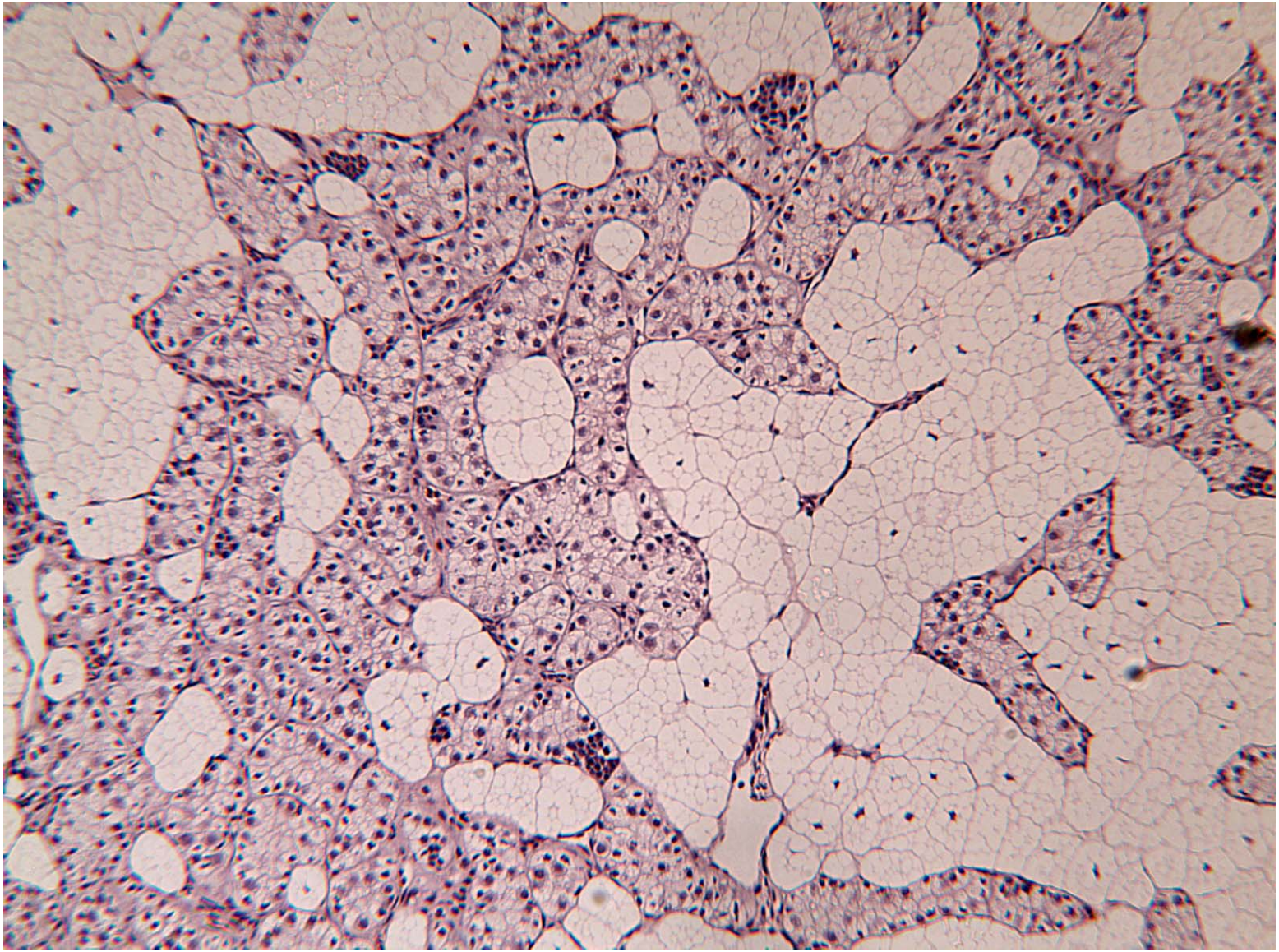


**Males**

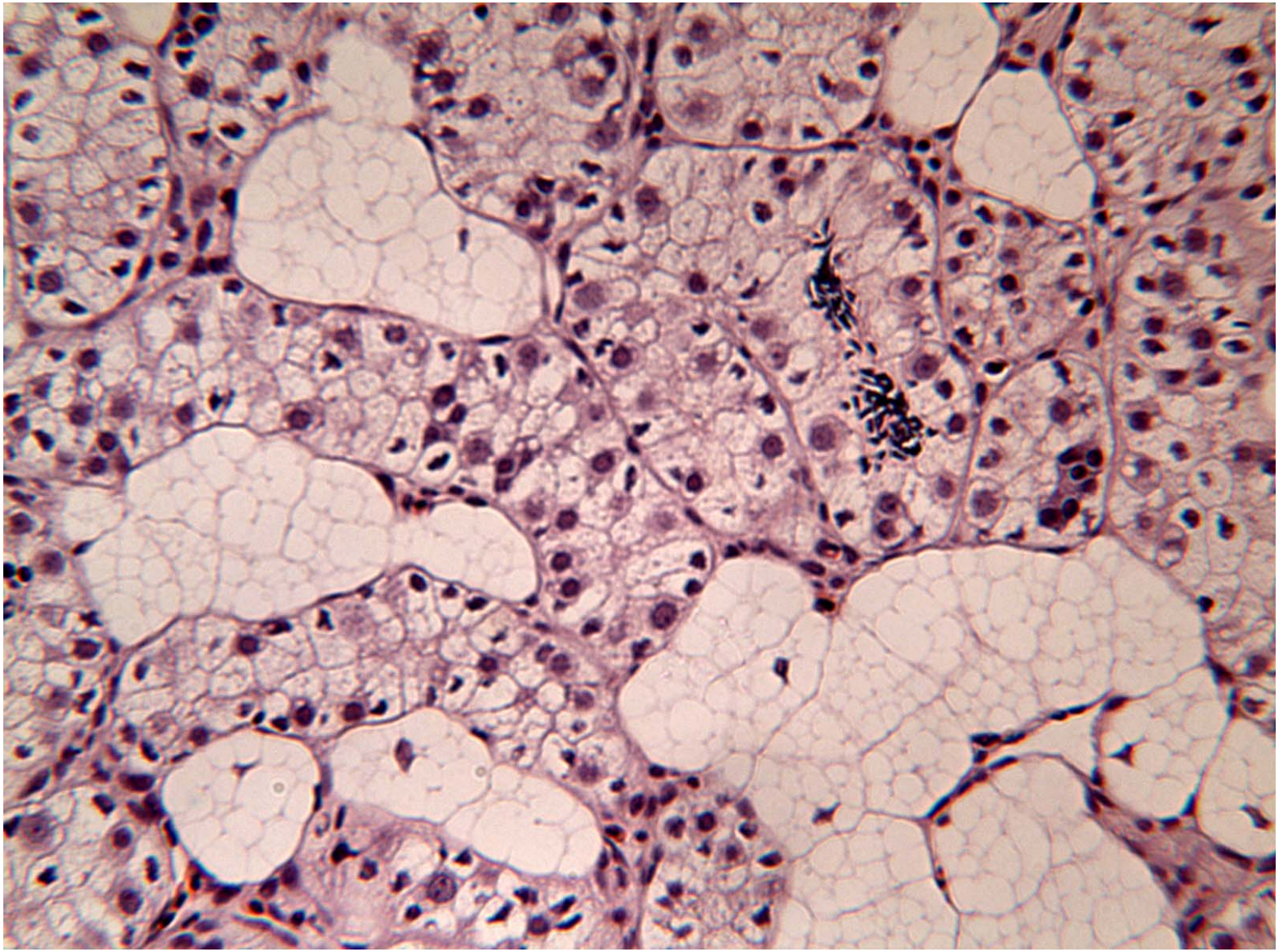
- **spawn first at age 12-15**
- **biennial and annual spawners**
- **life span 40+**

**Females**

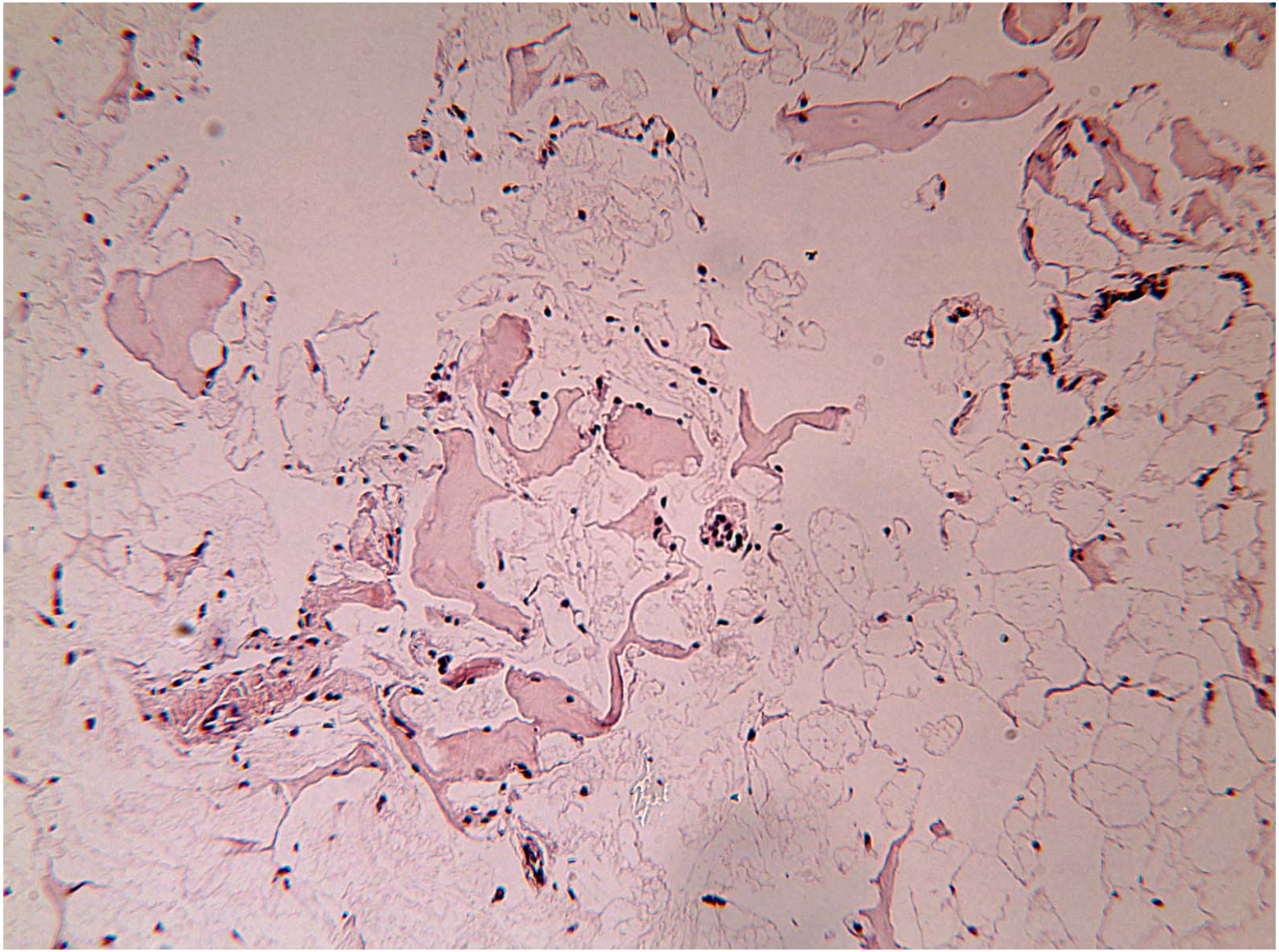
- **spawn first at age 20-25**
- **spawn every 3 to 5 years**
- **life span 100+**



**FP08-051C Sturgeon #3 biopsy: Gross ID: Female**
**Histology: Unknown/Immature Female (?) 10x H&E**

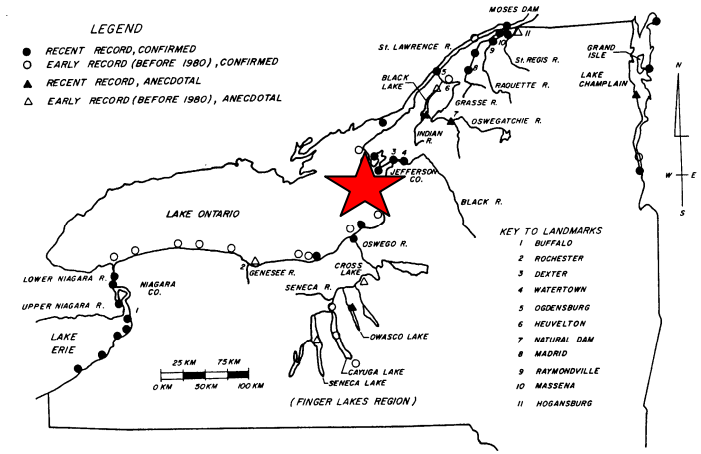


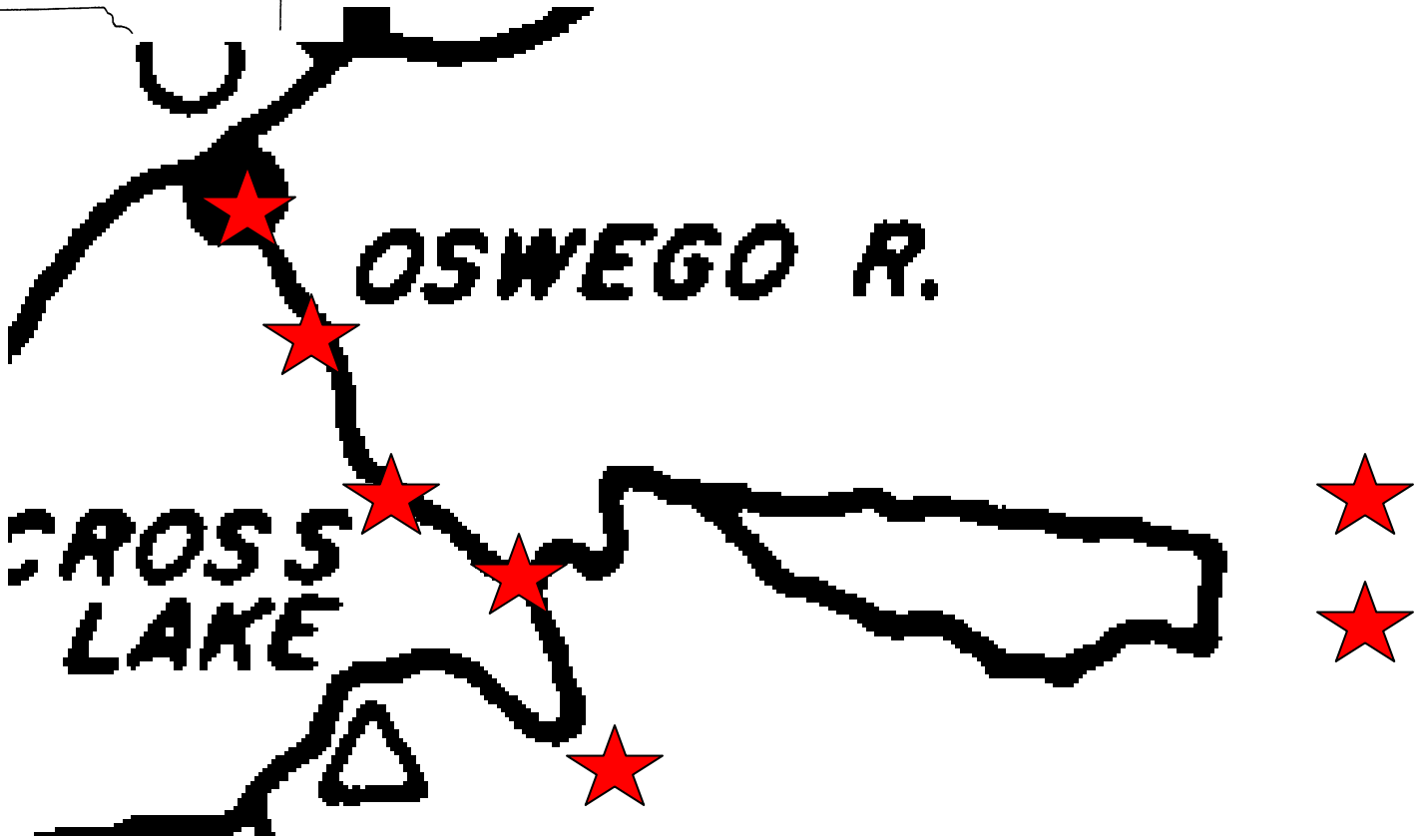
**FP08-051C Sturgeon #3 biopsy: Gross ID: Female**
**Histology: Unknown/Immature Female (?) 25x H&E**



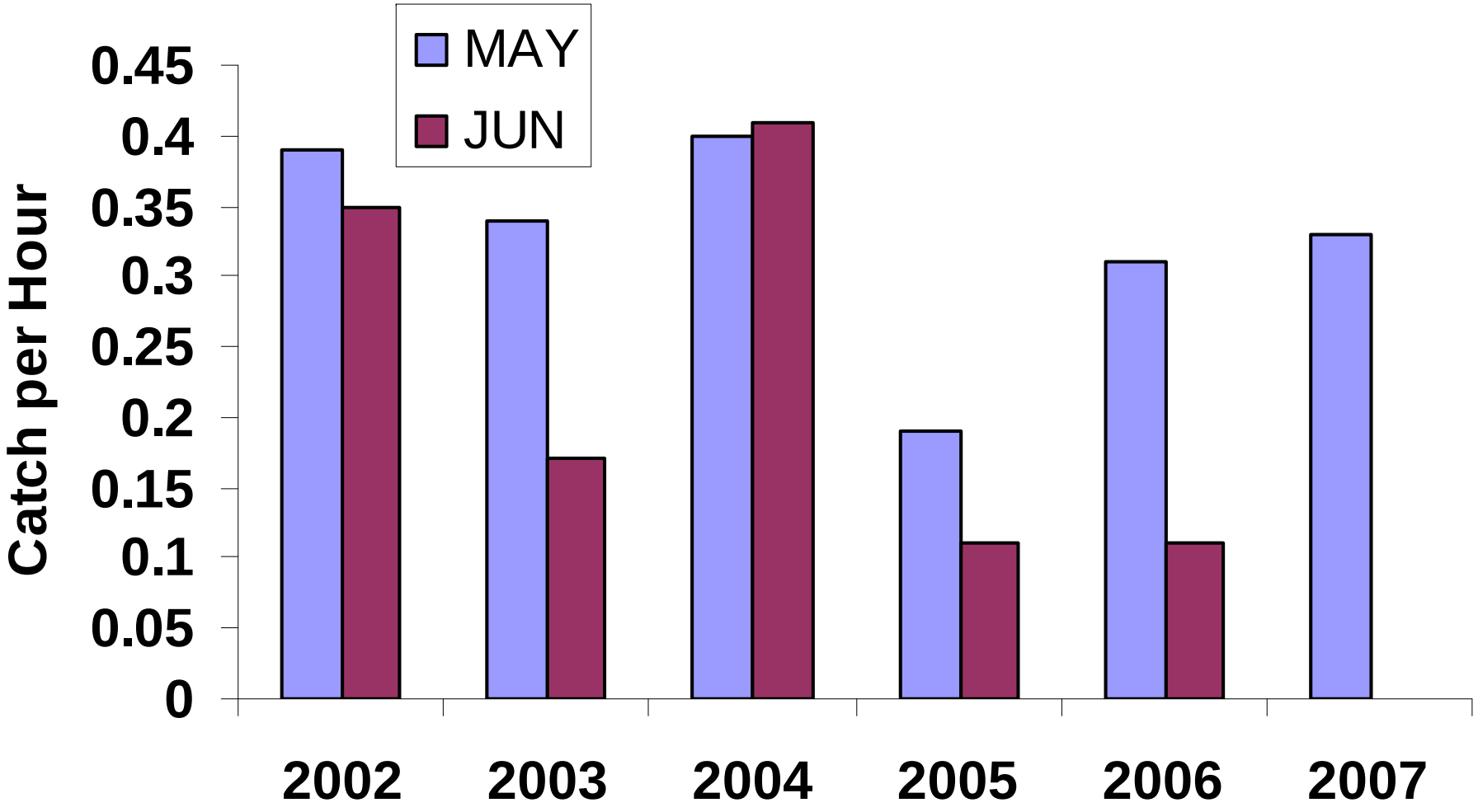
**FP08-051D Sturgeon #4 biopsy: Gross ID: Female**
**Histology: Unknown/Immature Female (?) 4x H&E**

# OUTMIGRATION IS OCCURRING – RATES AND TIMING UNKNOWN



# SPRING STURGEON CATCHES

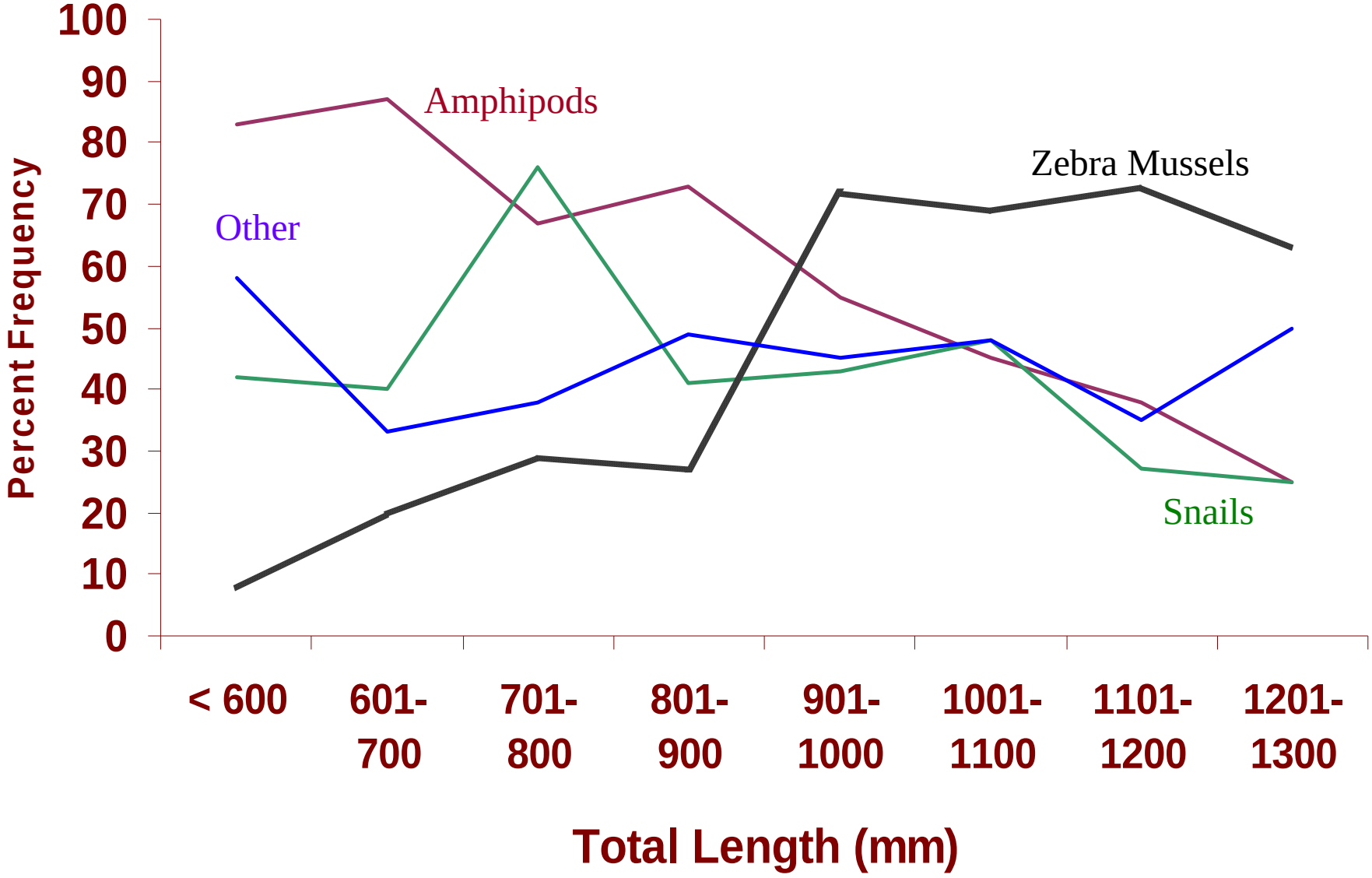


# Sturgeon Diets

# Frequency of Occurrence of Foods in Sturgeon Diets

| | # of Sturgeon | % |
|---|---|---|
| Amphipods | 128 | 58 |
| Zebra Mussels | 116 | 52 |
| Snails | 97 | 44 |
| Chironomids | 51 | 23 |
| Isopods | 37 | 17 |
| Caddis Flies | 12 | 5 |
| Oligochaetes | 4 | 2 |
| Water Mites | 3 | 1 |
| Leeches | 3 | 1 |
| Zooplankton | 3 | 1 |
| Fish Larvae | 2 | 1 |
| Clams | 2 | 1 |

# Size-Related Patterns in Sturgeon Diets



# Sturgeon Distribution and Habitat Use

## Major Substrate Types and Lake Sturgeon Sampling Locations in Oneida Lake, New York

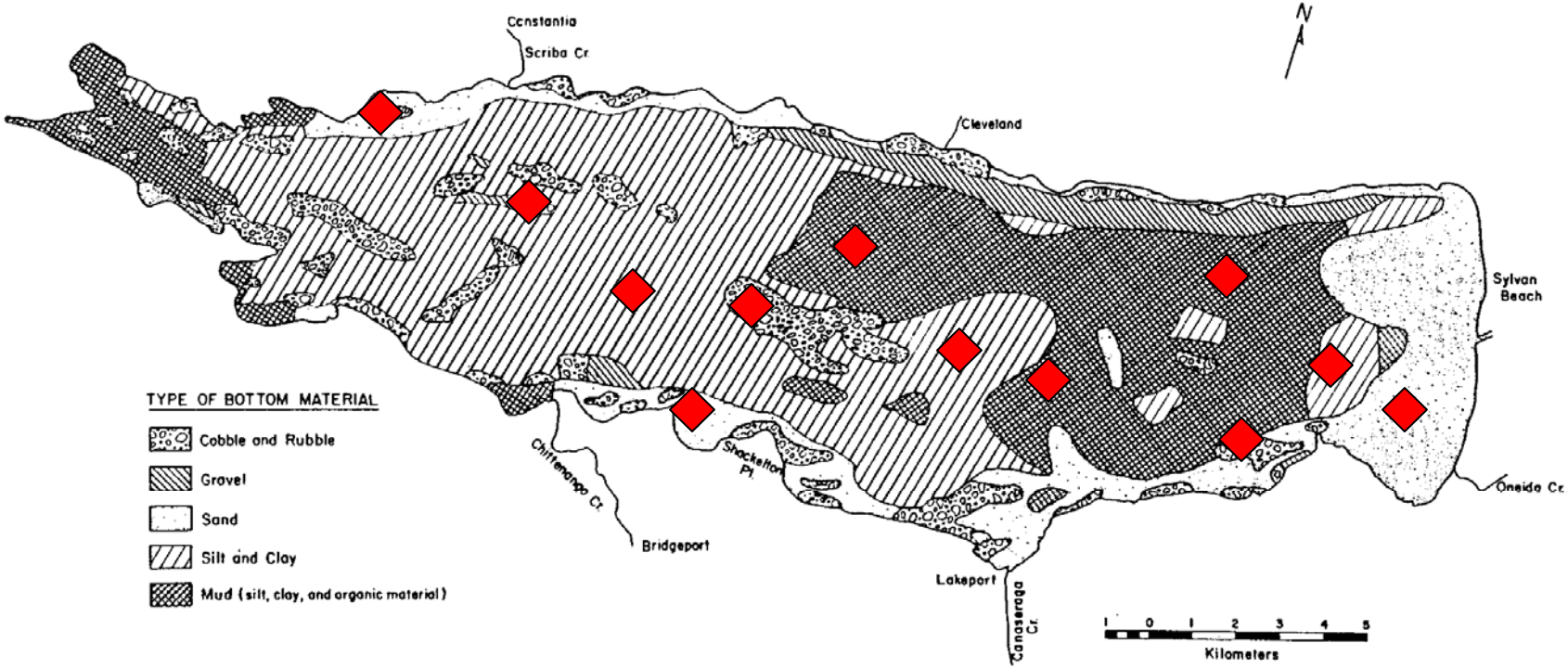
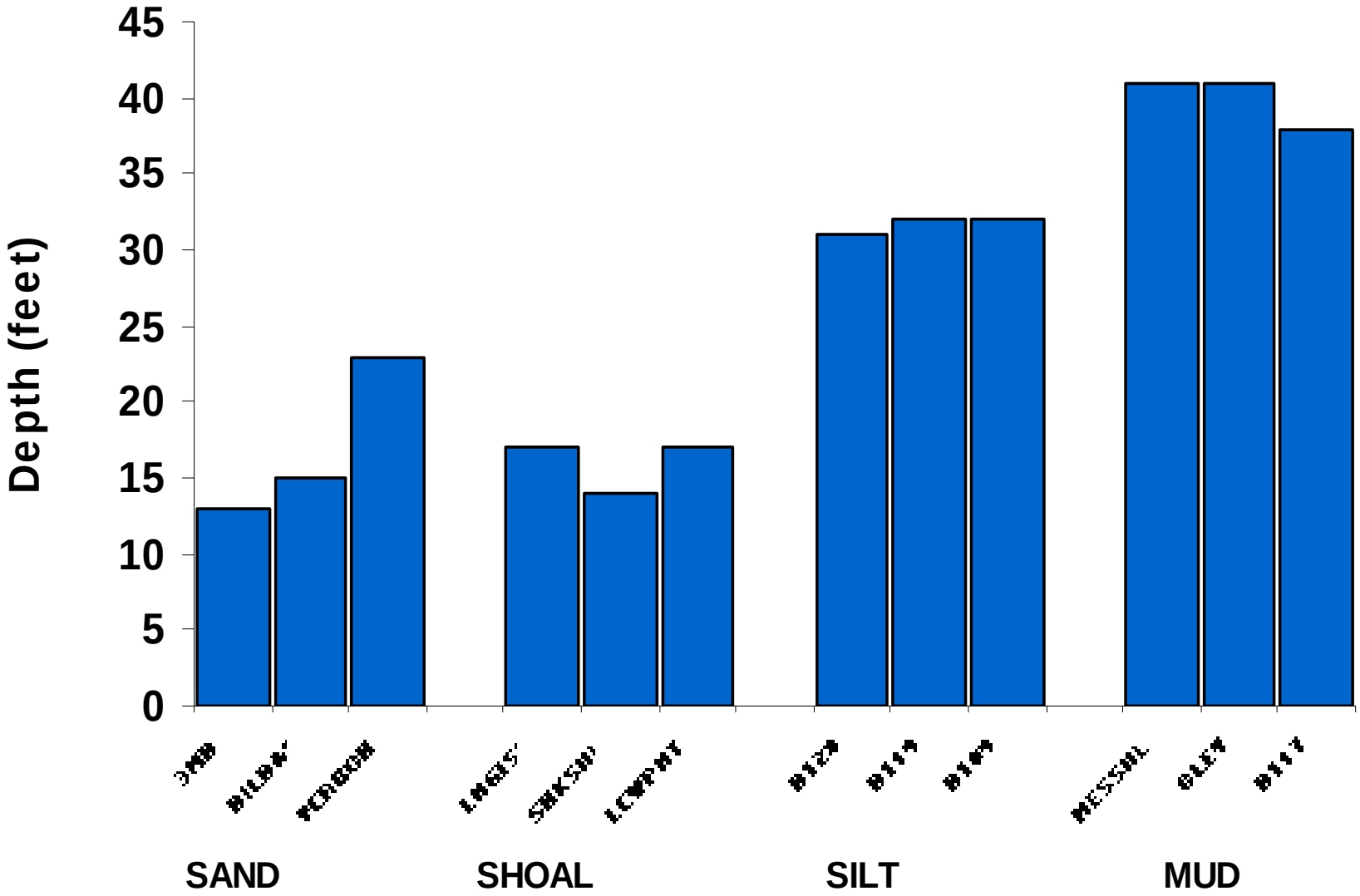



Fig. 16. Bottom sediments categorized on the basis of composition and size of materials in Oneida Lake. After Greeson (1971).

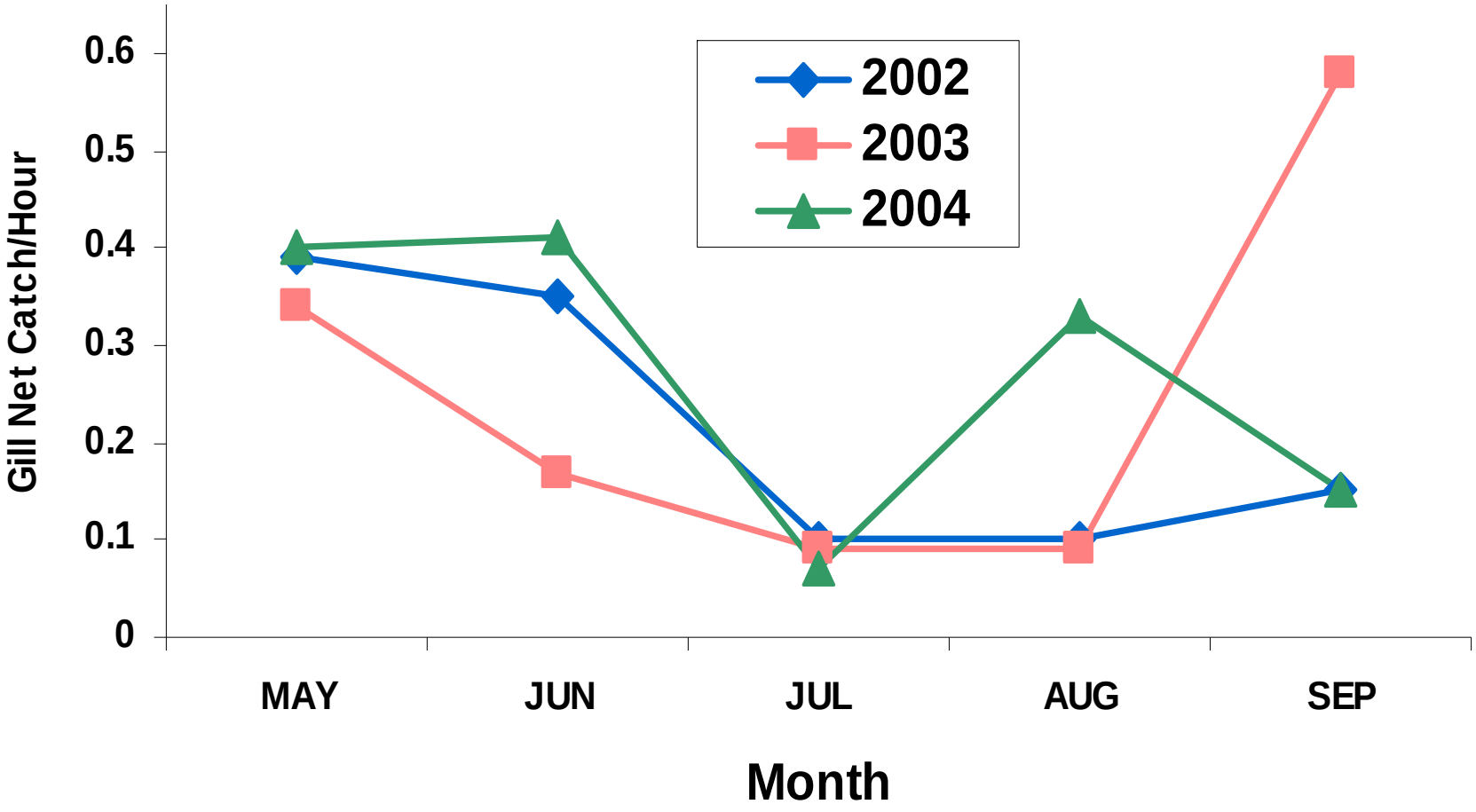
**12 sites, 3 in each of 4 substrate types**

**Sampled monthly May – September, Gill nets, 6-12” mesh**

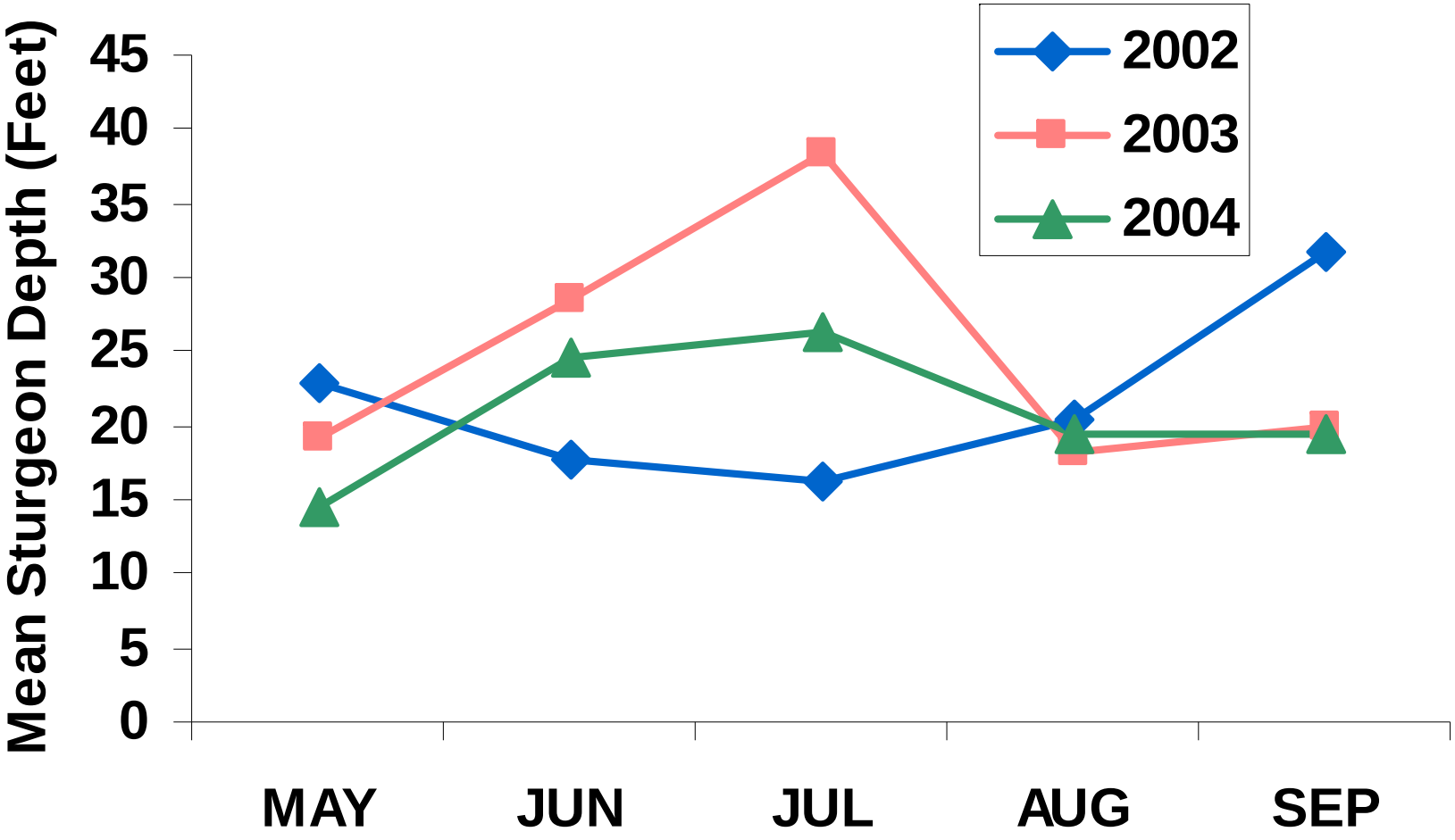
# Sites also Represented Range of Available Depths



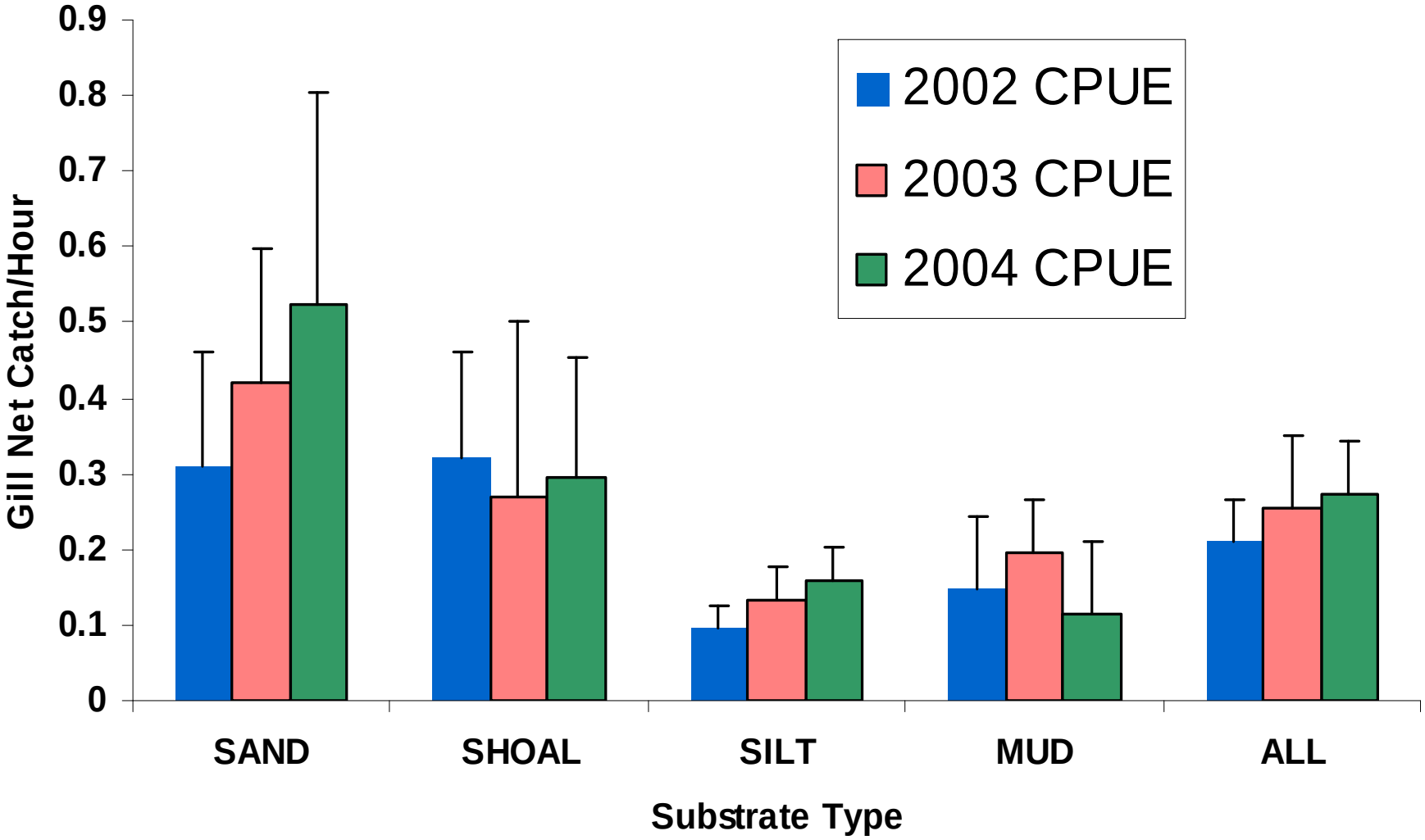
# Sturgeon Catches by Season



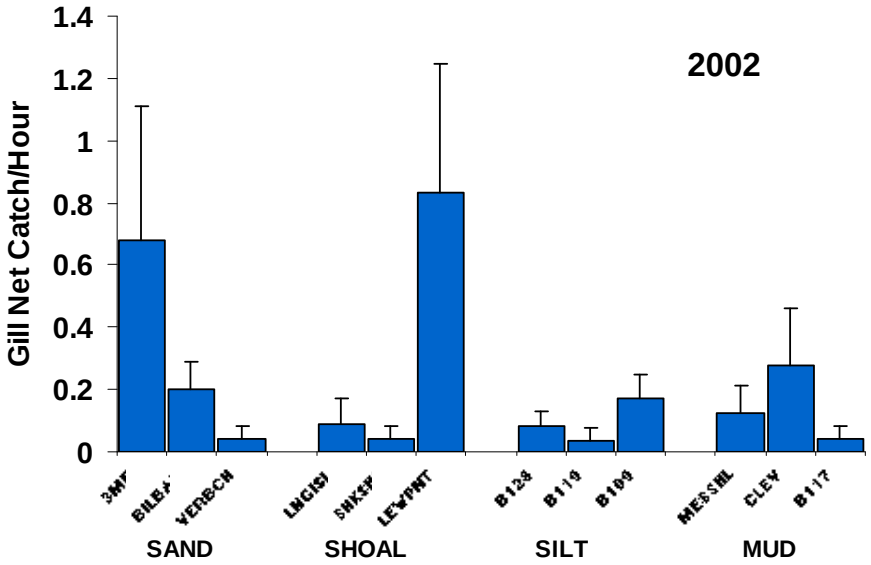
# Seasonal Catches by Depth

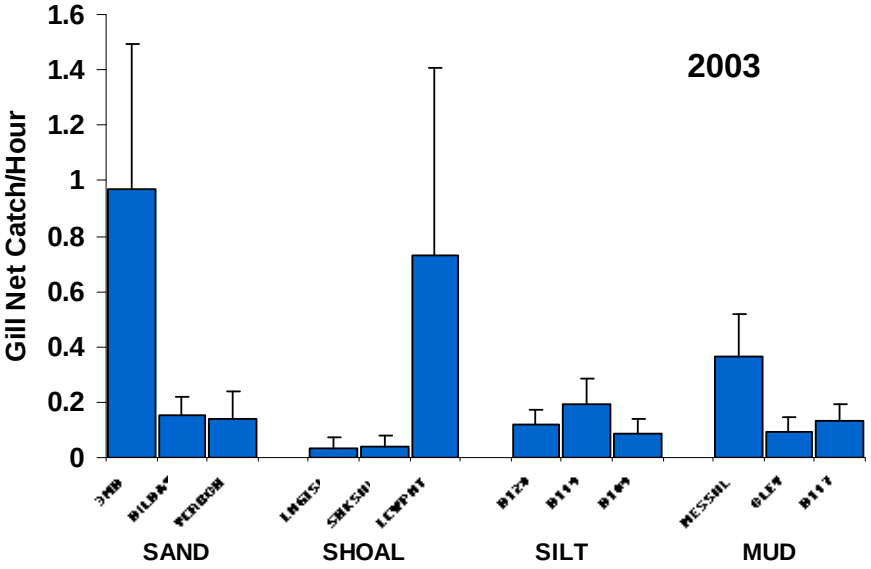


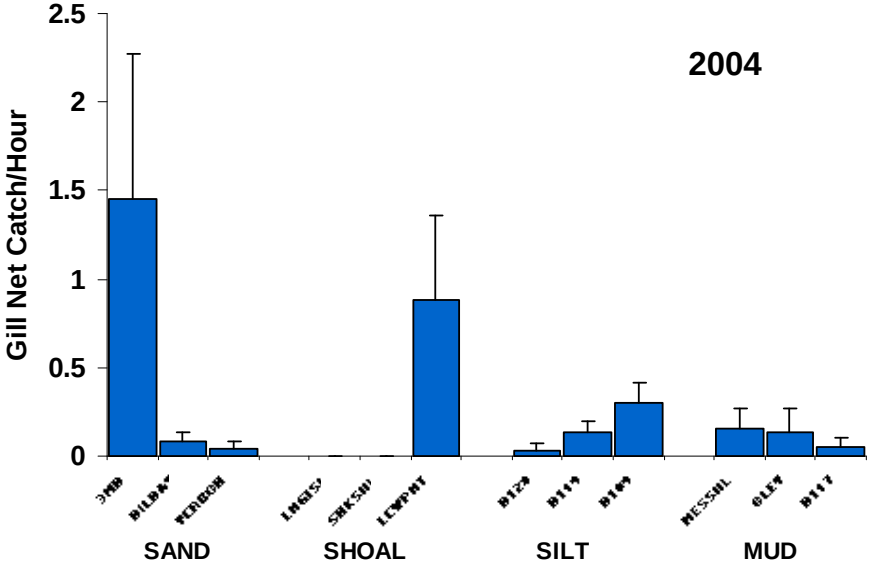
# Sturgeon Catches by Substrate



# Sturgeon Catches by Site

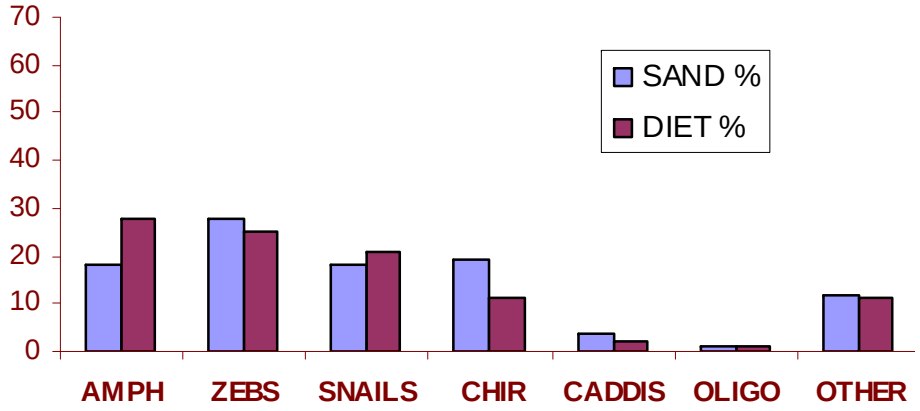


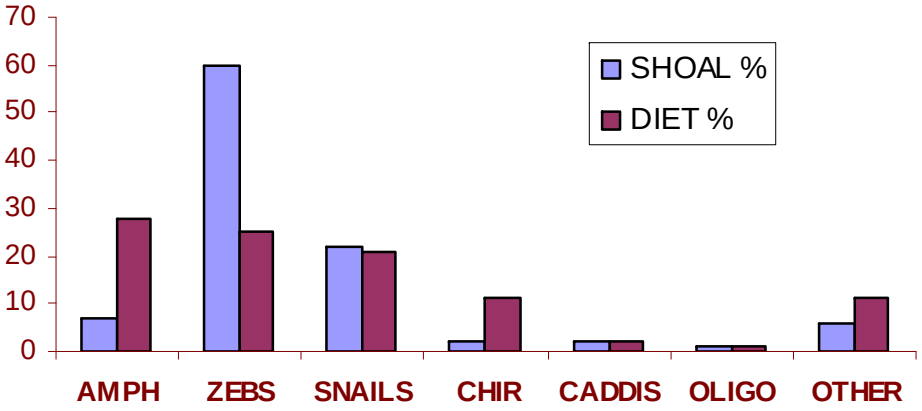



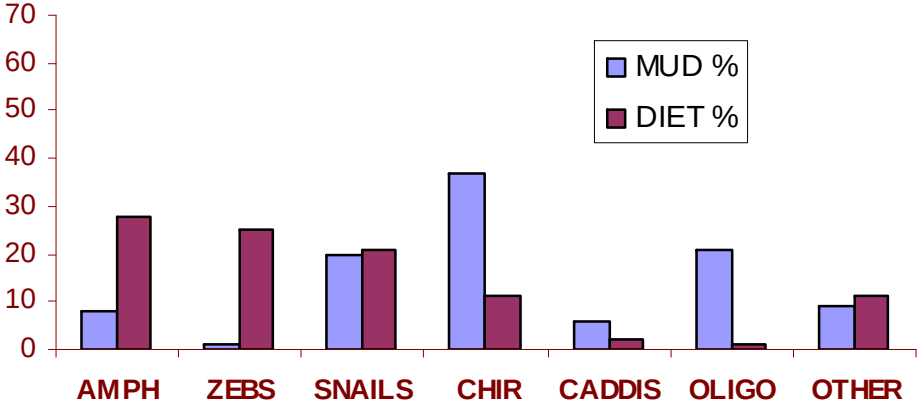



# Sampling Benthic Sturgeon Food

# Comparison of Sturgeon Diets and Substrate-Specific Benthic Communities (from Sled)





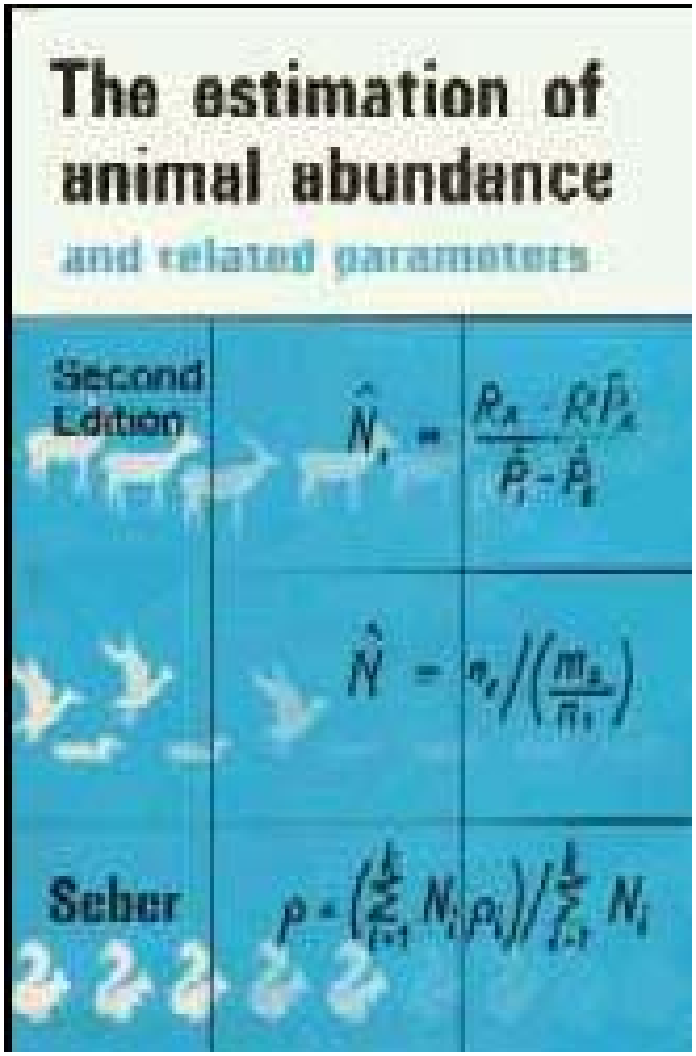
# Straining Credibility:

# Estimating Survival of Stocked Sturgeon

Program MARK

"A Gentle Introduction"

7th Edition



# Abundance Estimate for 1995 Stocking (5070 fish)

Chapman (1951) modification of the Lincoln-Petersen method:

$$N_c = \frac{(n_1+1)(n_2+1)}{(m_2+1)} - 1$$

$$\text{Var } N_c = \frac{(n_1+1)(n_2+1)(n_1-m_2)(n_2-m_2)}{(m_2+1)^2(m_2+2)}$$

$$95\% \text{ CI} = 1.96 \pm (\text{var } N_c)^{0.5}$$

# Abundance Estimate for 1995 Stocking (5070 fish)

- Used data from the lakewide habitat/distribution study (12 sites sampled monthly from May-September, over 3 years)

- Treated each YEAR as a sampling event (e.g., all fish collected in 2002 were treated as initial marking sample and all fish sampled in 2003 as recapture sample)

---

Chapman (1951) modification of the Lincoln-Petersen method:

$$N_c = \frac{(n_1+1)(n_2+1)}{(m_2+1)} - 1$$

## Abundance Estimate for 1995 Stocking (5070 fish)

**So for the 2002 "marking sample" and the 2003 "recapture sample", our estimate of the population of fish from the 1995 stocking present 7 years later in 2002 was:**

# 1220 (+/- 1165)

| Year | M | C | R | Est. | % |
|---|---|---|---|---|---|
| 2002 | 60 | 59 | 2 | 1220 (+/-1165) | 24 |

## Abundance Estimate for 1995 Stocking (5070 fish)

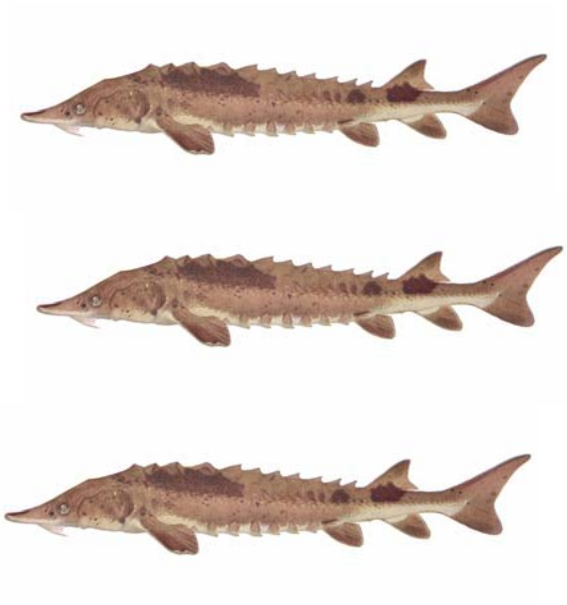
**Treating samples from 2002 and 2003 as a single "marking sample" and samples from 2004 as the "recapture sample", our estimate of the population of fish from the 1995 stocking present in the lake 8 years later in 2003 was:**

**2281 (+/-2178)**

| Year | M | C | R | Est. | % |
|---|---|---|---|---|---|
| 2003 | 115 | 58 | 2 | 2281 (+/-2178) | 46 |

# Abundance Estimate for 1995 Stocking (5070 fish)

| Year | M | C | R | Est. | % |
|---|---|---|---|---|---|
| 2002 | 60 | 59 | 2 | 1220 (+/-1165) | 24 |
| 2003 | 115 | 58 | 2 | 2281 (+/-2178) | 46 |



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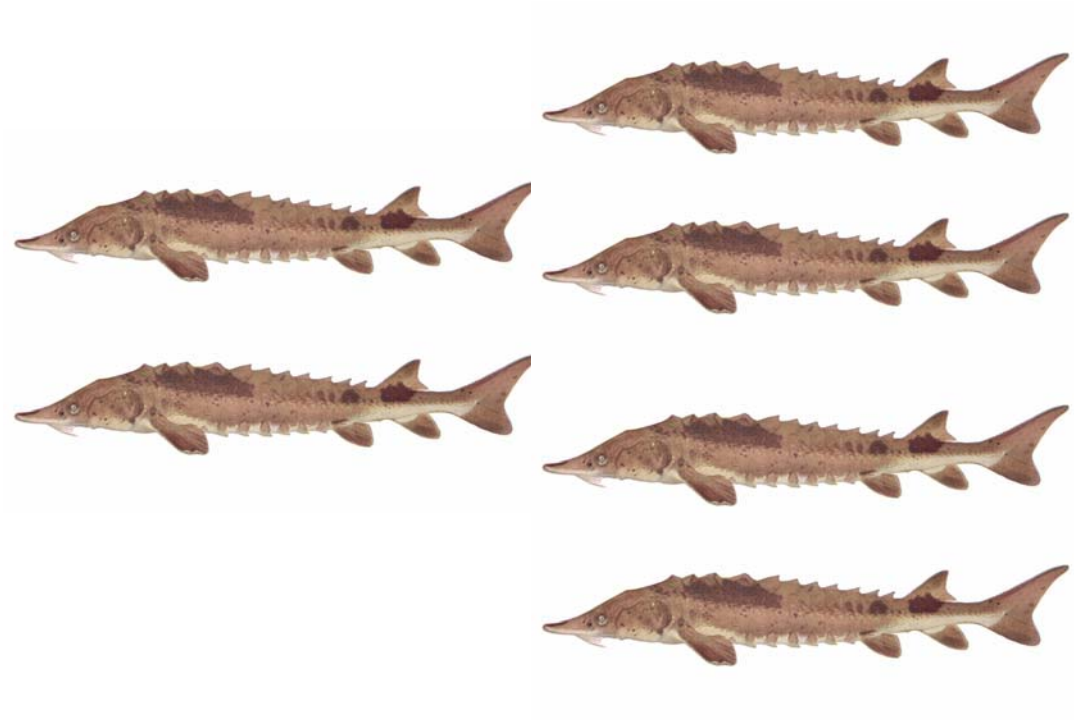


**Our situation, however, is really a k-sample capture recapture design, a maximum likelihood approach built on individual capture histories is more appropriate**

Program MARK

"A Gentle Introduction"

7th Edition

{1,1,1} capture all three times

{1,0,0} capture first time

{0,1,0} capture second time

{0,0,1} capture third time

{1,1,0} capture first two times

{0,1,1} capture last two times

{1,0,1} capture first and third times

{0,0,0} capture at no time

**Using the POPAN routine in Program MARK, and setting births and immigration at 0, our estimate of population size at start of the three year intensive sampling period was:**

"A Gentle Introduction"

7th Edition

# 1184

# 95% CI: 520-2941

(Note, confidence interval did shrink – and MARK approach is best estimate under our scenario)

# We continued with spring (and sometimes fall) sampling, so can extend capture histories for an additional three years

Program MARK

"A Gentle Introduction"

7th Edition

{1,0,0,0,0,0}

{1,0,1,0,0,0}

{1,1,0,0,0,0}

{0,1,0,0,0,0}

{0,1,0,0,0,1}

{0,1,0,0,1,0}

{0,1,0,0,1,1}

{0,0,1,0,0,0}

{0,0,1,0,1,0}

{0,0,1,1,0,0}

{0,0,0,1,0,0}

{0,0,0,1,1,0}

{0,0,0,0,1,0}

**Using the POPAN routine in Program MARK, and setting births and immigration at 0, our estimate of population size at start of the six year sampling period was:**

"A Gentle Introduction"

7th Edition

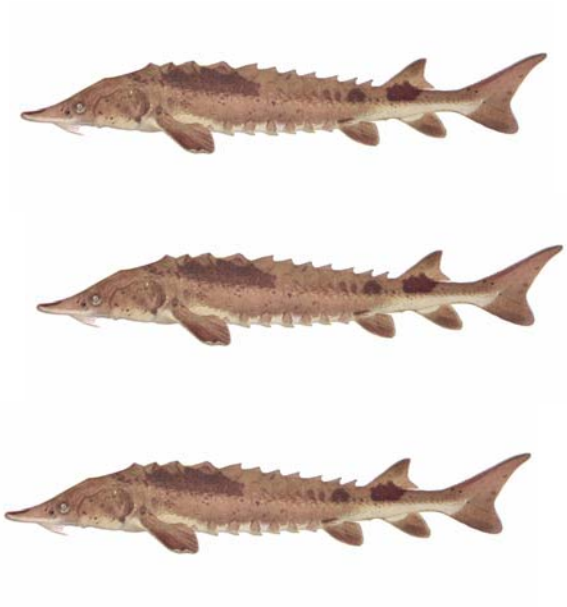
# 1790

# 95% CI: 1114-2970

(Note, confidence interval did shrink substantially from 3 year model)

# Abundance Estimate for 1995 Stocking (5070 fish)

| Year | M | C | R | Est. | % |
|---|---|---|---|---|---|
| 2003 | 60 | 59 | 2 | 1220 (+/-1165) | 24 |
| 2004 | 115 | 58 | 2 | 2281 (+/-2178) | 46 |
| MARK3 | | | | 1184 (+/-1105) | 24 |
| MARK6 | | | | 1790 (+/-900) | 36 |



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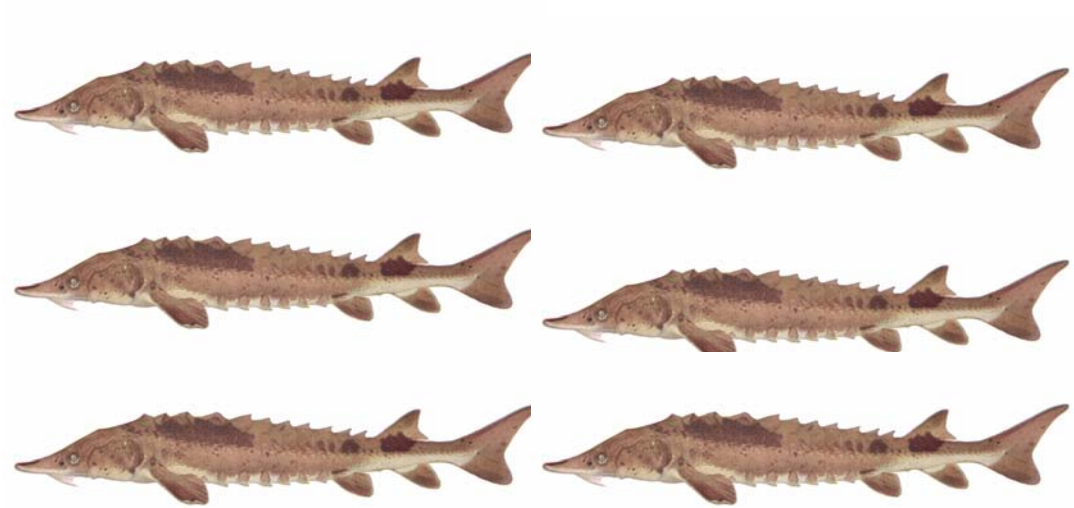
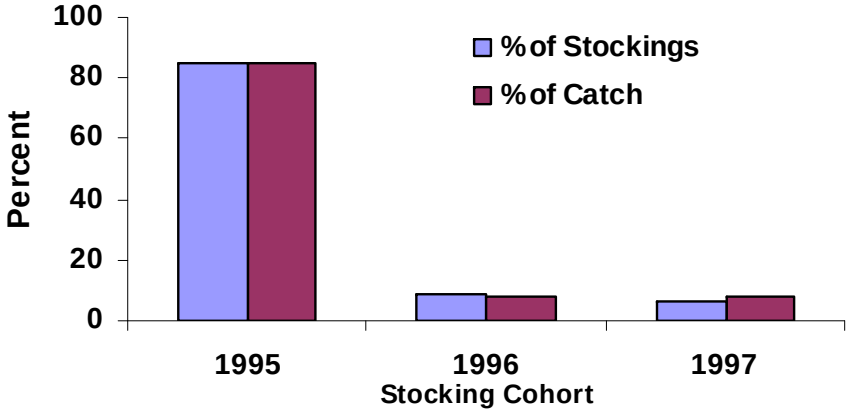
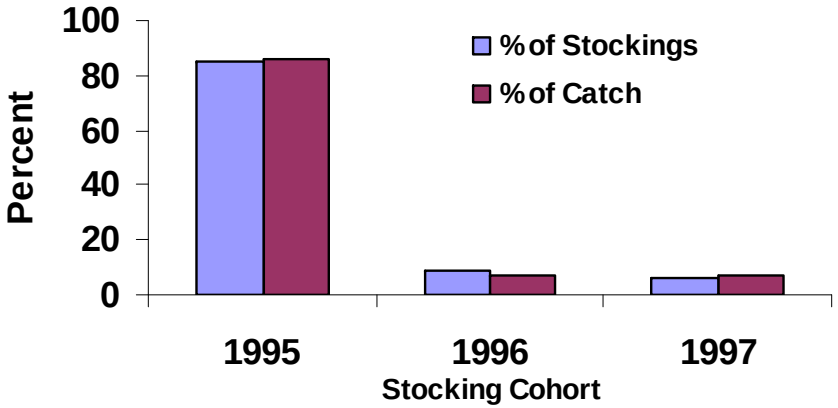
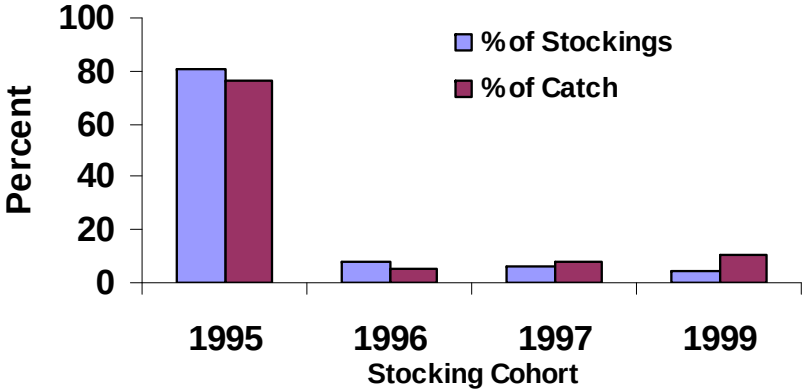


**Whatever actual survival is, catch ratios of different stocking cohorts suggests similar survival in all year classes**




**Note that the 1997 year class was stocked as yearlings at nearly double the average length as cohorts stocked as age-0 fish**



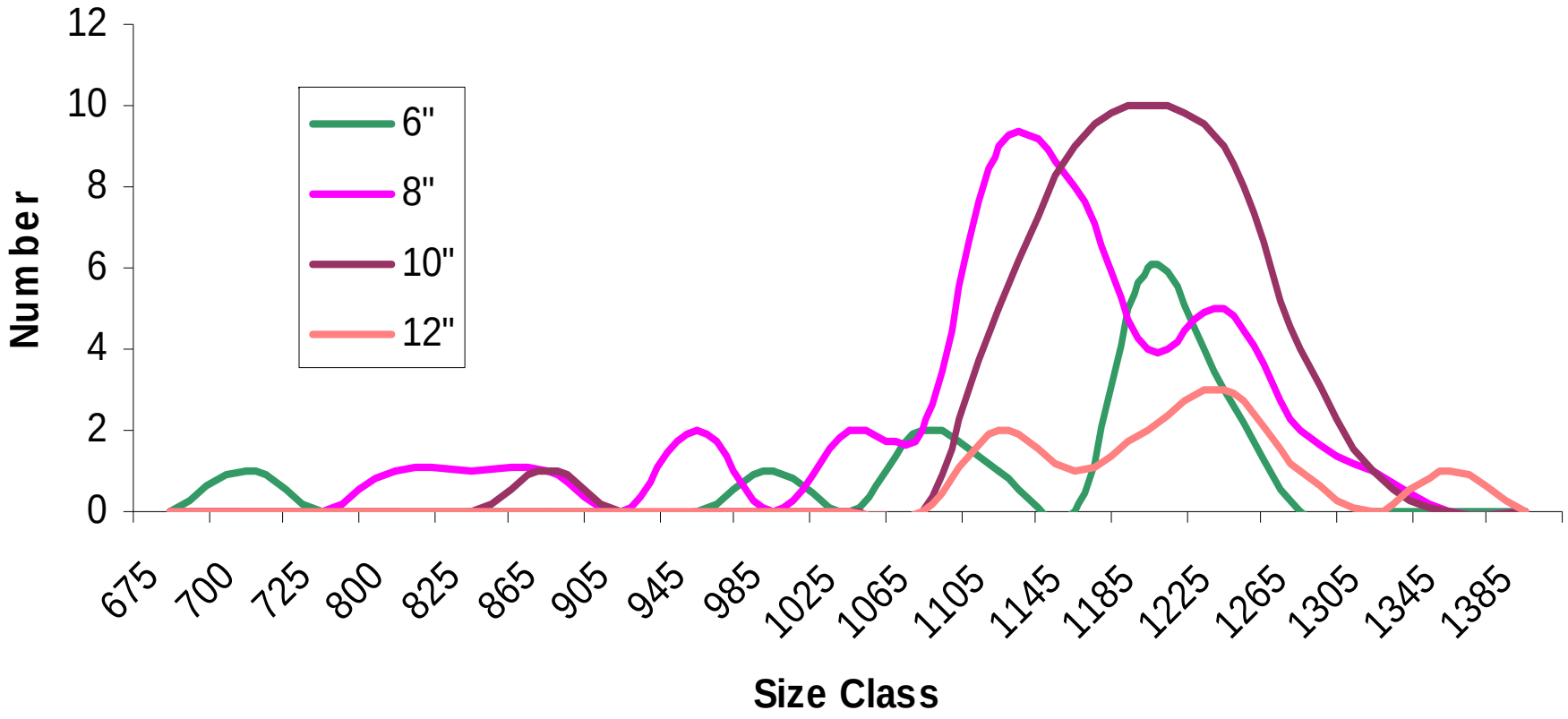
**Other Stuff:**

# Double Tagging Study

The tag then transmits a unique digital code back to the transceiver/reader where the code is displayed and/or stored. The tag only transmits its unique code when the tag is present in the transceiver's electromagnetic activation field. With no battery to fail, PIT tags are expected to last 100 years or more. The tag detection and display is almost instantaneous.

**Other Stuff:**

# Development of Gill Net Selectivity Curves?



Other Stuff:

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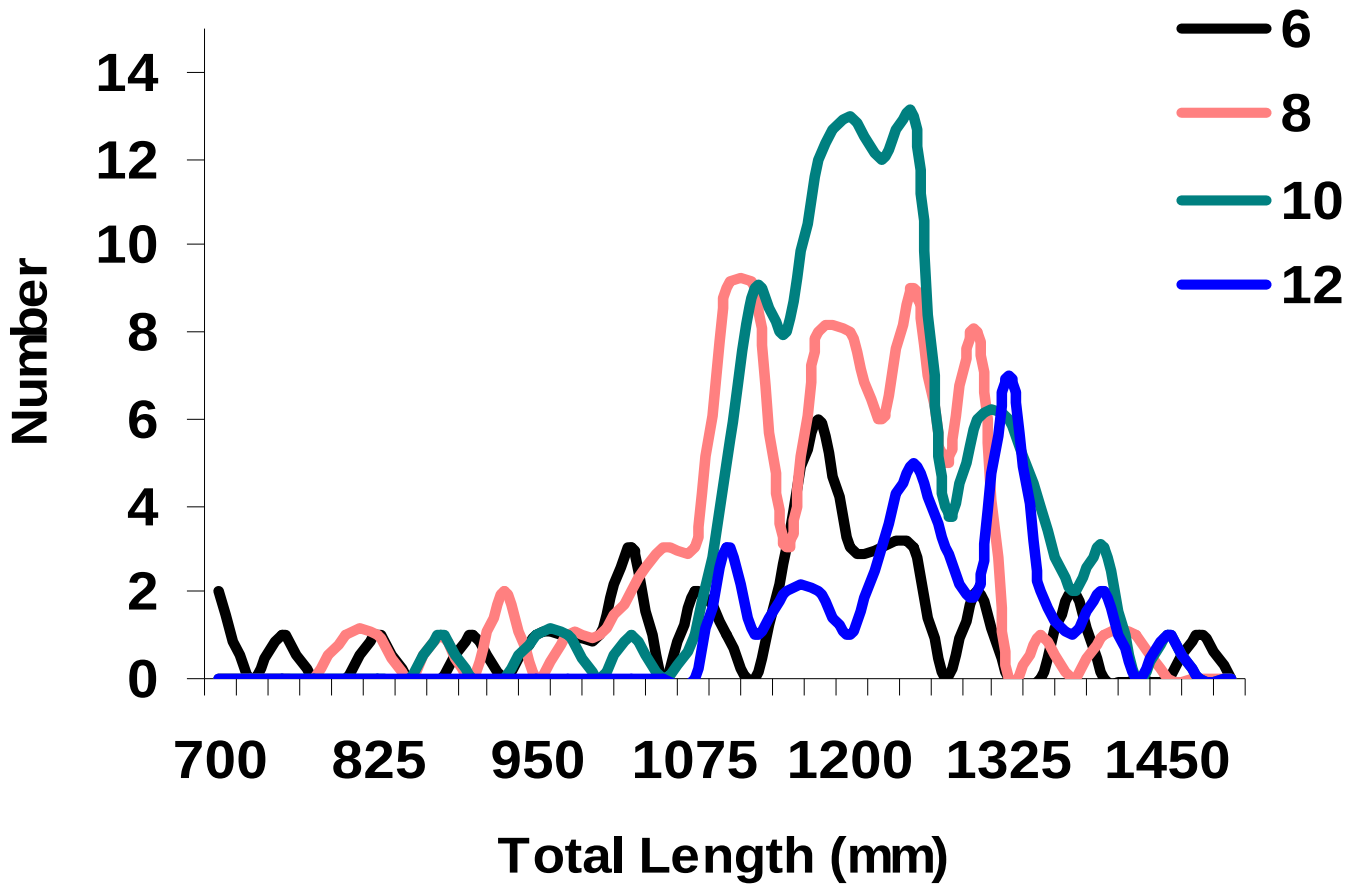
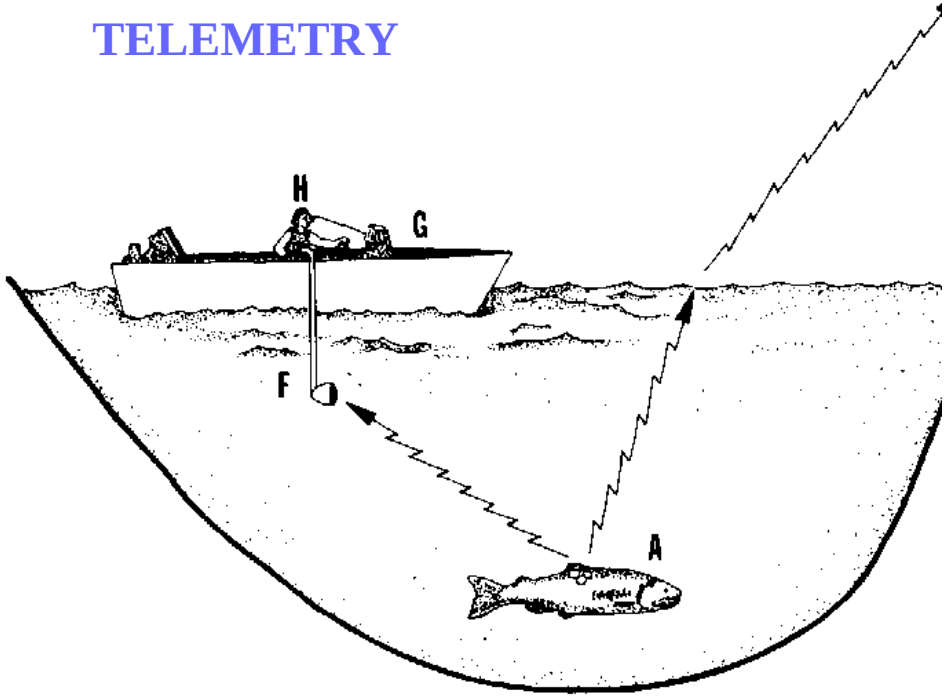


# Oneida Lake Component of SWG Project

**OUTPUT: REFINE HABITAT USE, MOVEMENT, OUTMIGRATION RATES, SPAWNING AREAS**

**SONIC TELEMETRY**



# Surgically Implant Tags in 100 Sturgeon (50/year)

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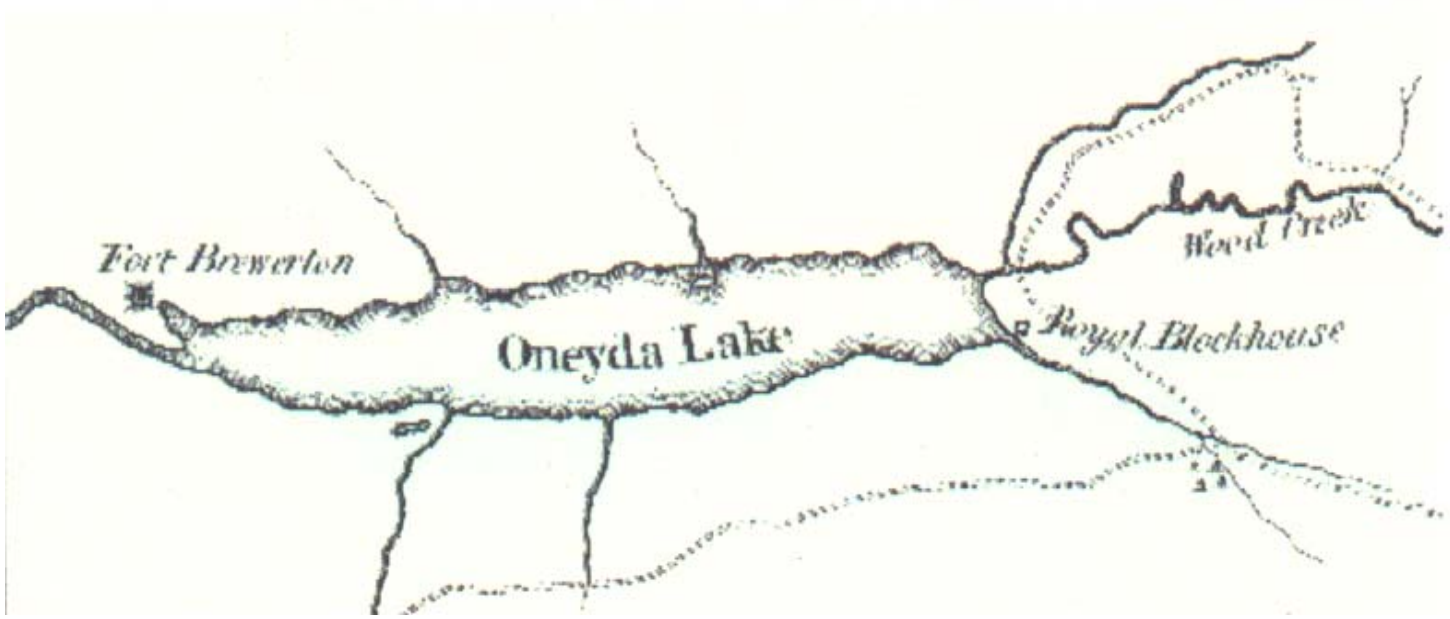
## Manually track fish in lake (habitat use and movements)



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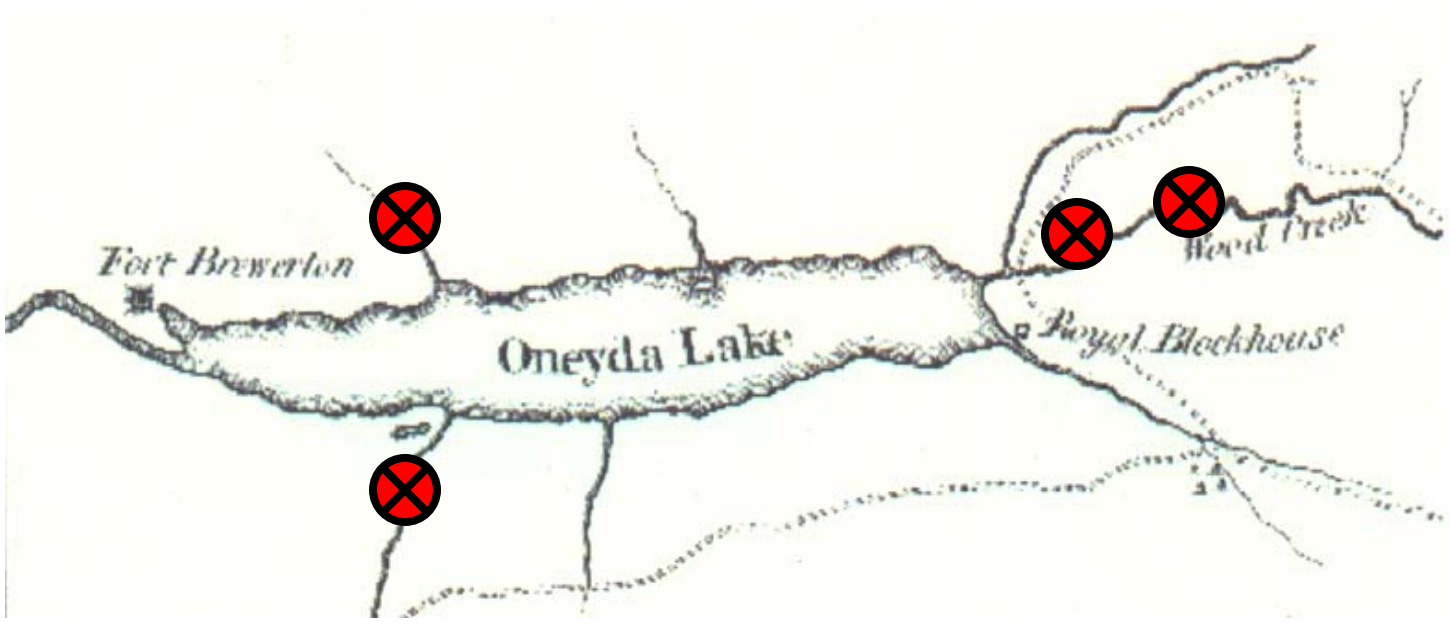
**Remote log passage upstream, particularly in spring (spawning)**



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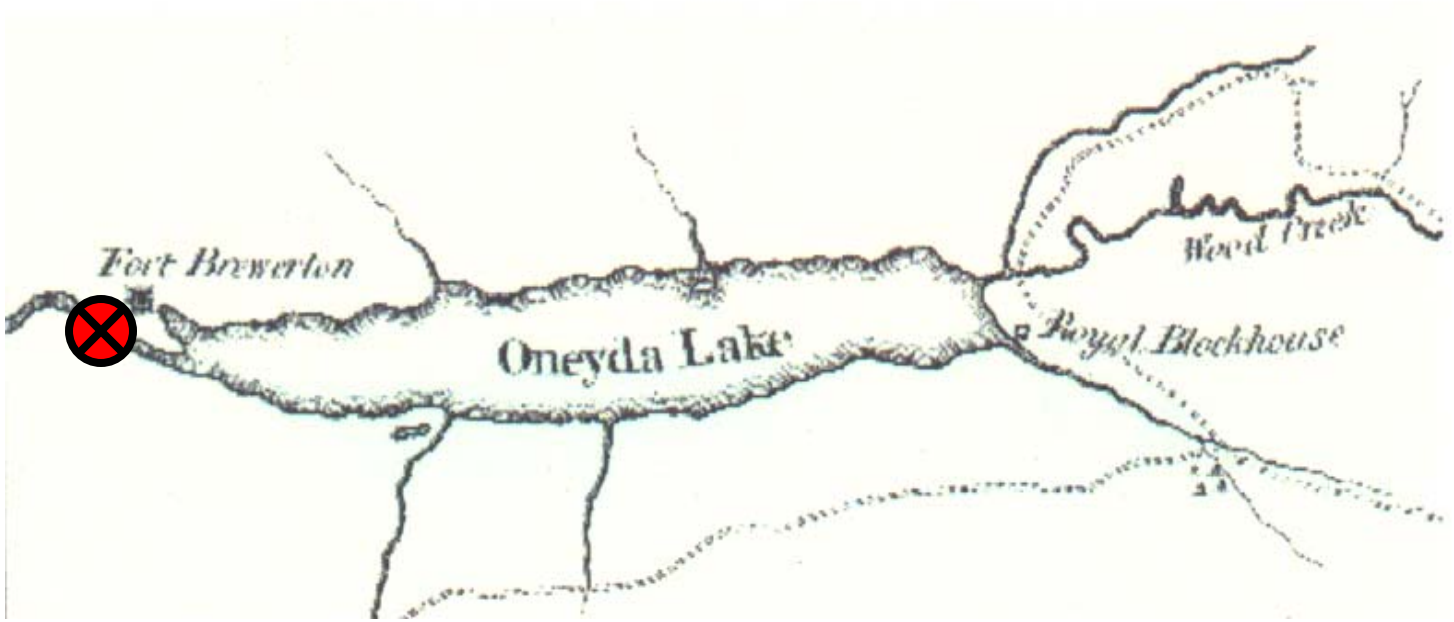
**Remote log passage downstream (outmigration)**