Lake Michigan Fisheries Meeting

March 16, 2016
Cleveland, Wisconsin

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Please join us in Milwaukee, Wisconsin

for the

Upper Lake Committees Meeting

and

The Great Lakes Law Enforcement Committee Meeting

March 21-23, 2016
The InterContinental Milwaukee

The Upper Lake Committees Meeting serves as a forum for fishery management agencies to assess the state of the fish communities, discuss pressing Great Lakes issues, and plan future management activities. Throughout the week, there will be sessions for:

- **Individual Lake Committees**
- **A presentation on the State of Lake Michigan report**
- **A common session about Environmental Principles**
- **A GLFC Advisors' lunch**

Draft Meeting Schedule

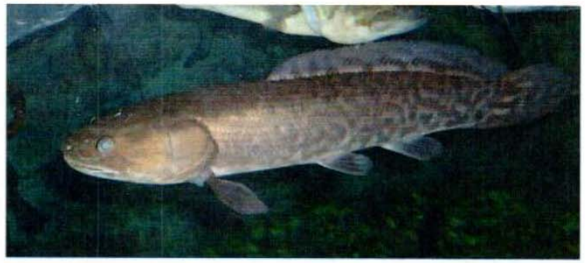
Monday, March 21, 2016

1:00 pm - 5:00 pm Lake Huron Committee

Tuesday, March 22, 2016

8:00 am - 9:00 am Lake Huron Committee (cont'd)
8:00 am - 5:00 pm Law Enforcement Committee (by invitation only; see location on reverse)
9:00 am - 12:00 pm Lake Michigan Committee
12:00 pm - 1:30 pm Upper Lakes Advisors Lunch
1:30 pm - 5:00 pm Lake Michigan Committee (cont'd)

Wednesday, March 23, 2016



Request of Presenters and Report Submitters

- Please email your PowerPoint presentation or a pdf version of your report by **Thursday, March 17, 2016** to Haley Tober (htober@glfc.org).

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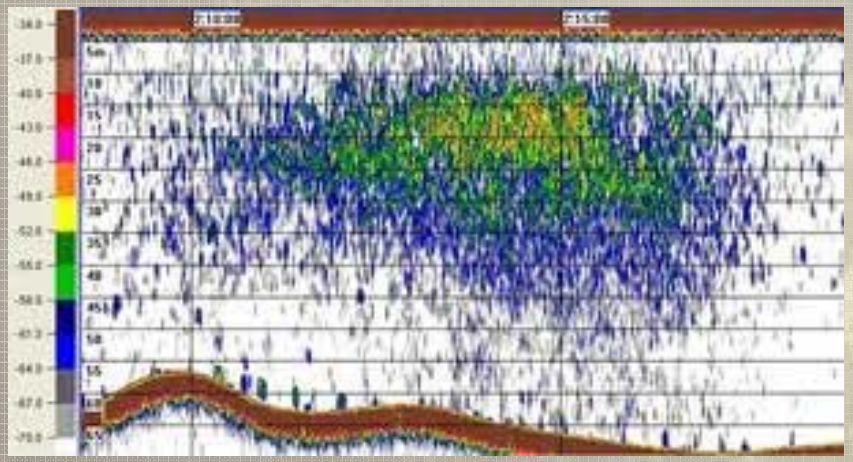
AGENDA

5:45 – 6:00	Sign-up, registration
6:00 – 6:05	Introduction
6:05 – 6:20	Forage survey information
6:20 – 6:30	Stocking and harvest updates
6:30 – 6:40	Predator Prey ratio information
6:40 – 7:00	Mass Marking
7:00 – 7:10	Break
7:10 – 7:30	Aquatic Invasive Species
7:30 – 7:45	Miscellaneous updates – Charter License and Reporting information, Kettle Moraine Springs Fish Hatchery, stakeholder involvement
7:45 – 8:00	Questions
8:00	Adjourn

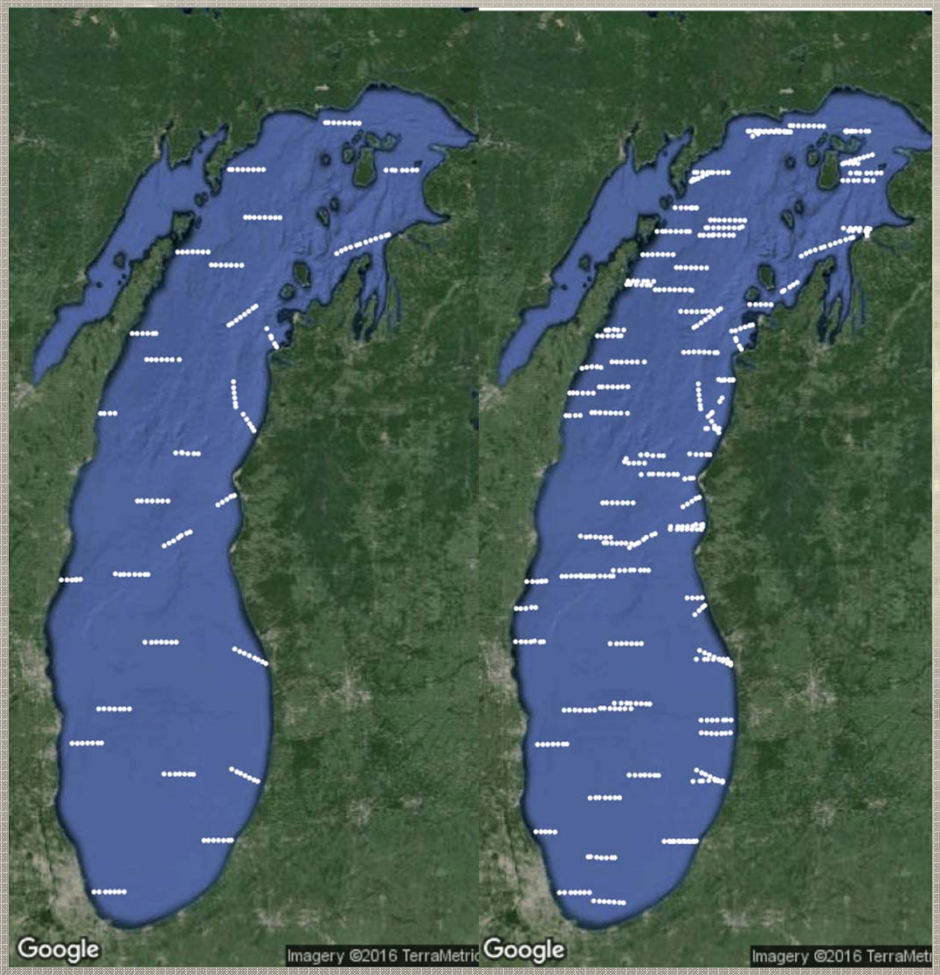
Forage Assessments



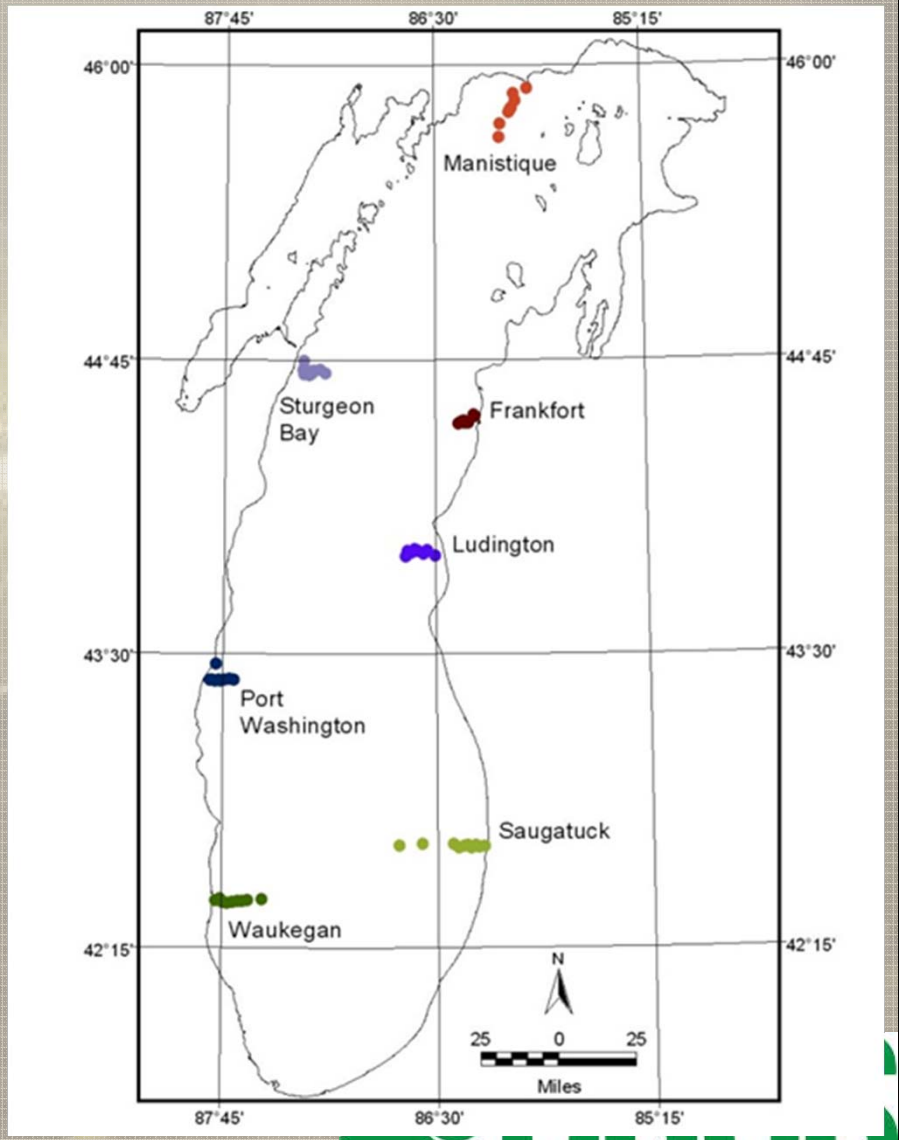
Hydro-acoustics

Bottom Trawl

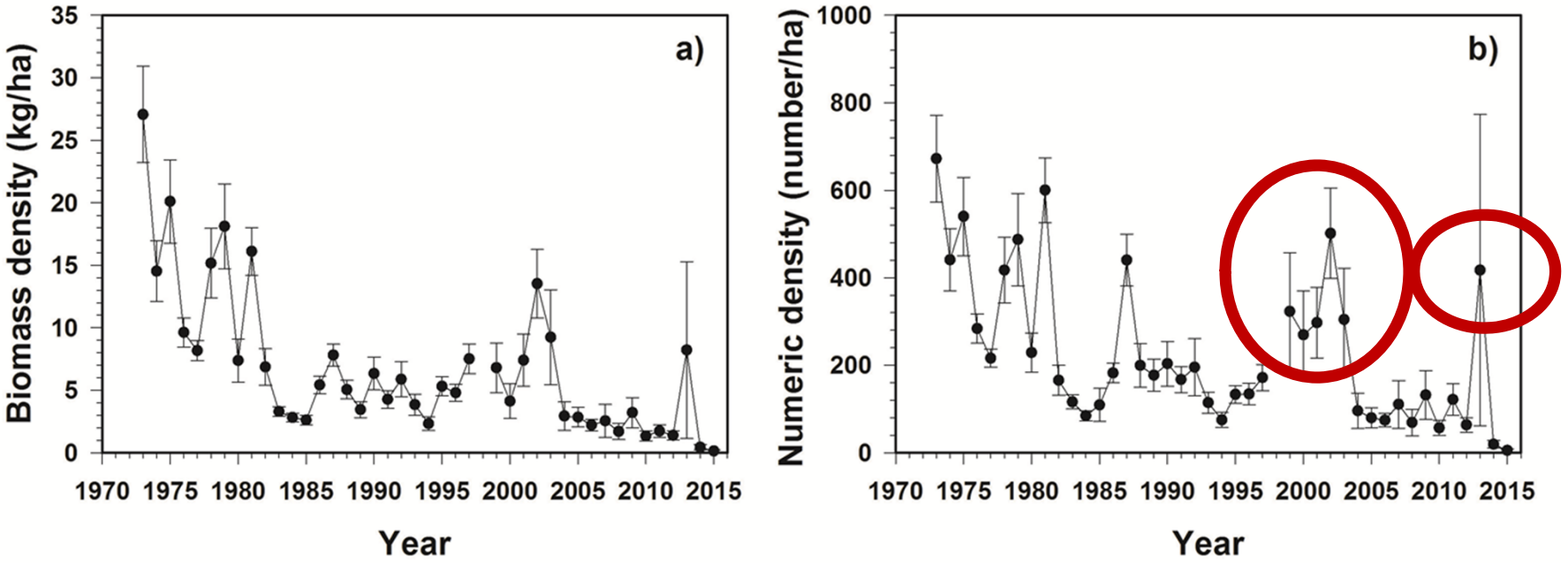
Forage Assessments



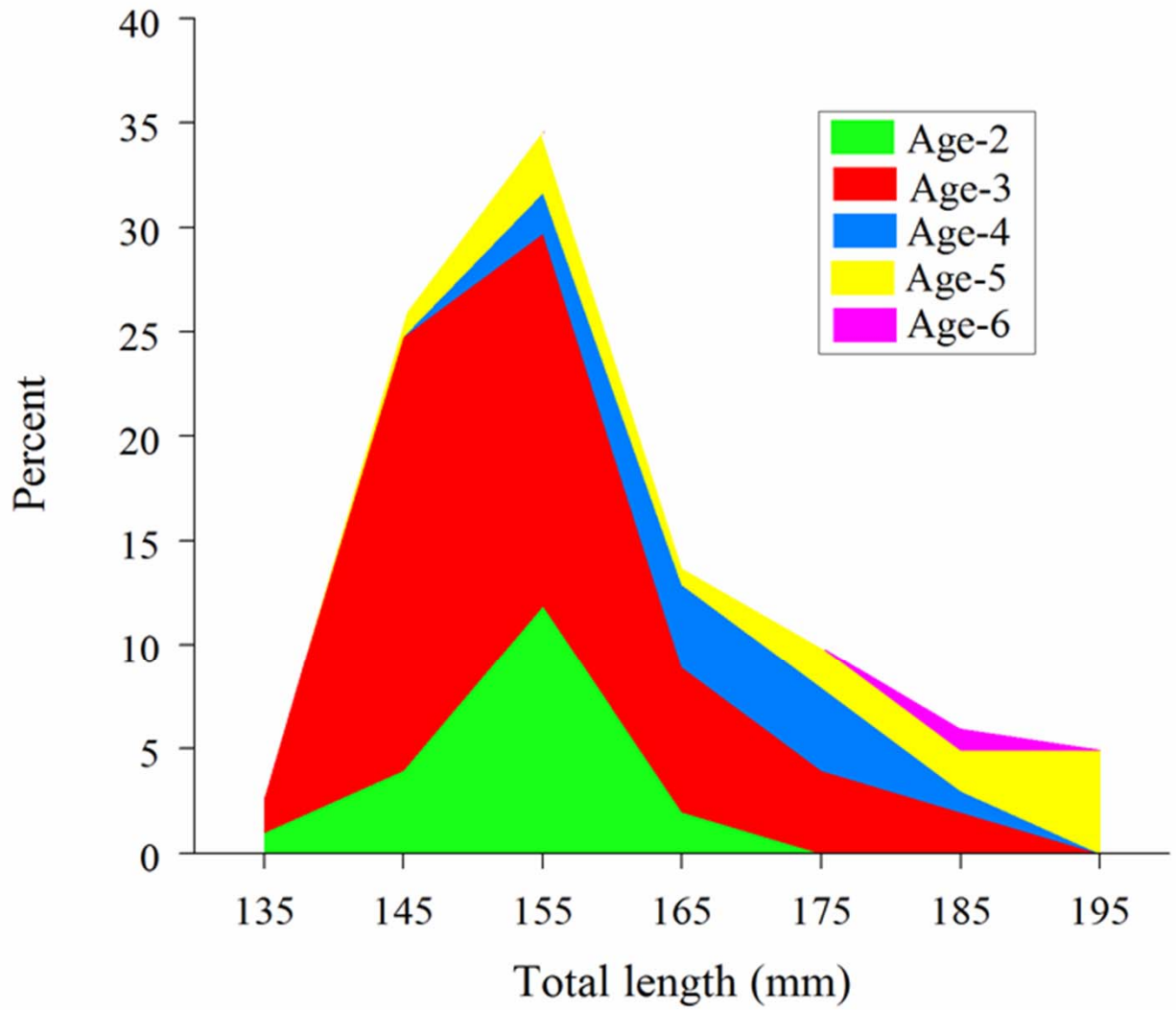
2015 2013 – 2015



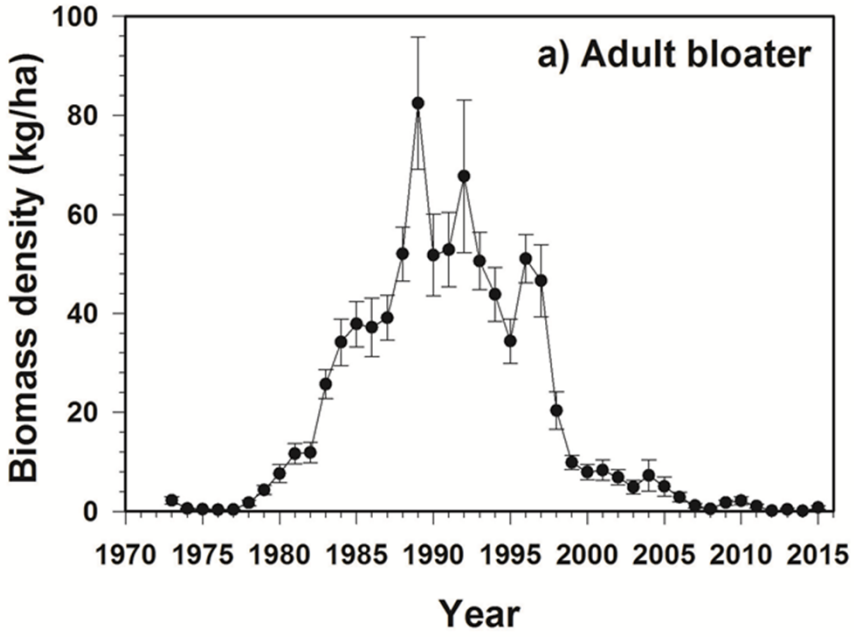
Density of adult alewives as biomass (a) and number (b) per ha (+/- standard error) in Lake Michigan, 1973-2015.

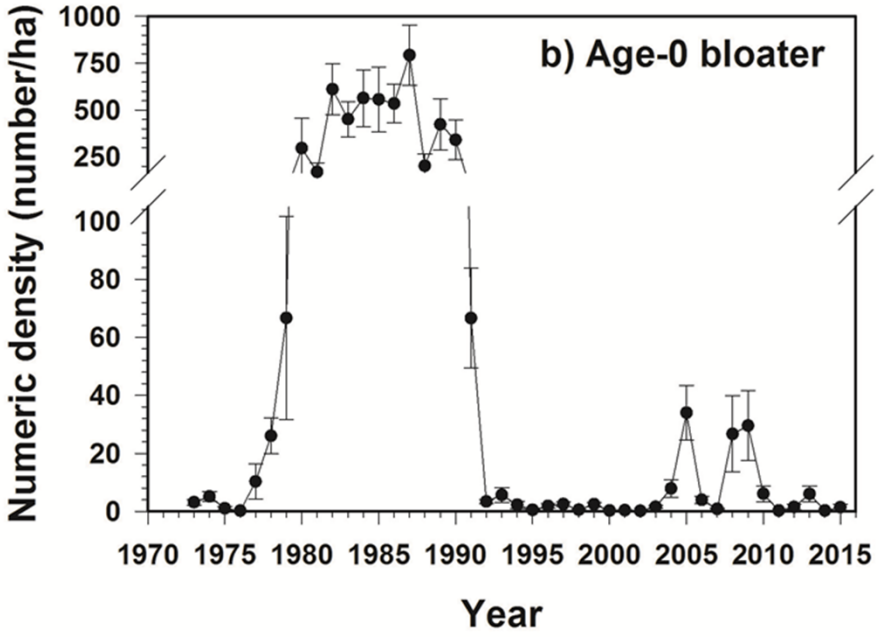


Age-length distribution of alewives ≥ 100 mm total length caught in bottom trawls in Lake Michigan, 2015.

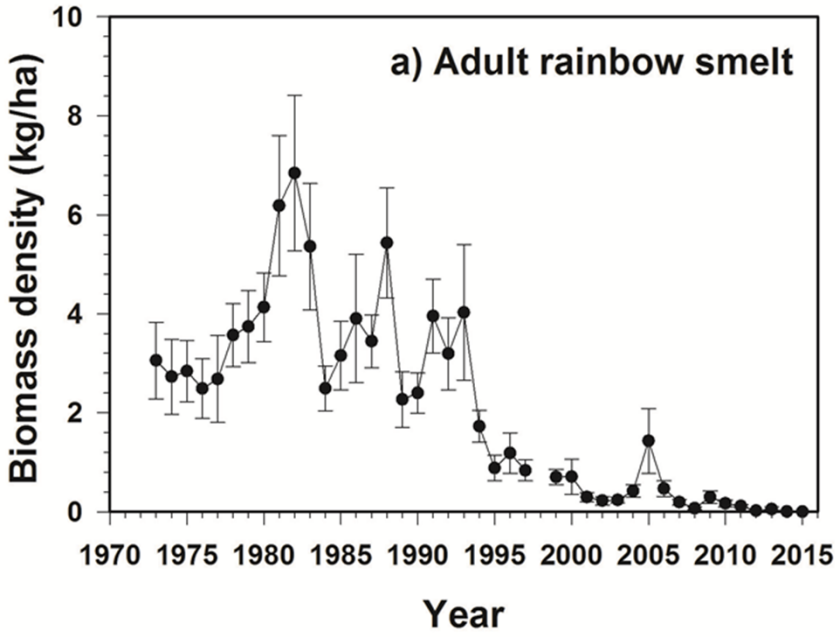


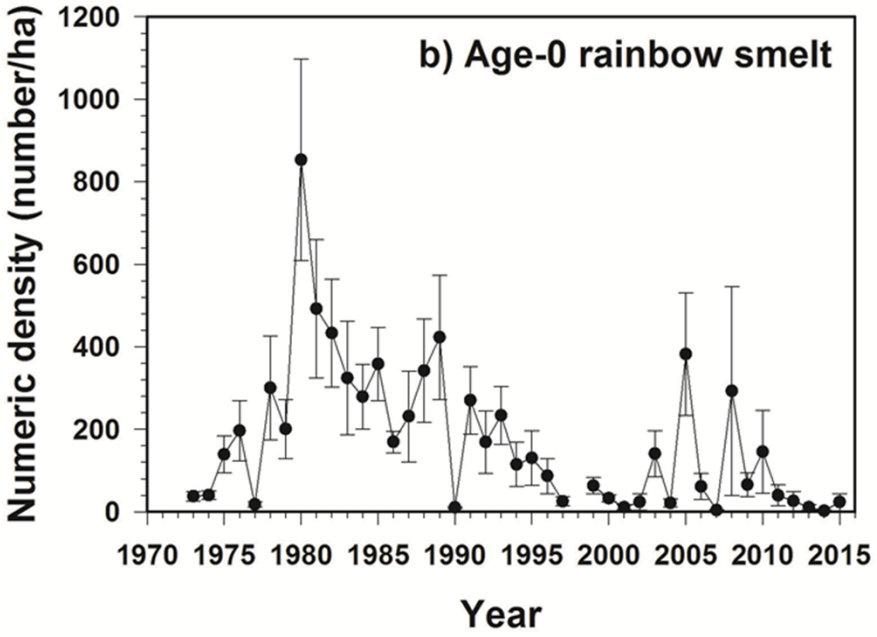
Biomass density (a) (+/- standard error) of adult bloater and numeric density (+/- standard error) (b) of age-0 bloater in Lake Michigan, 1973-2015.

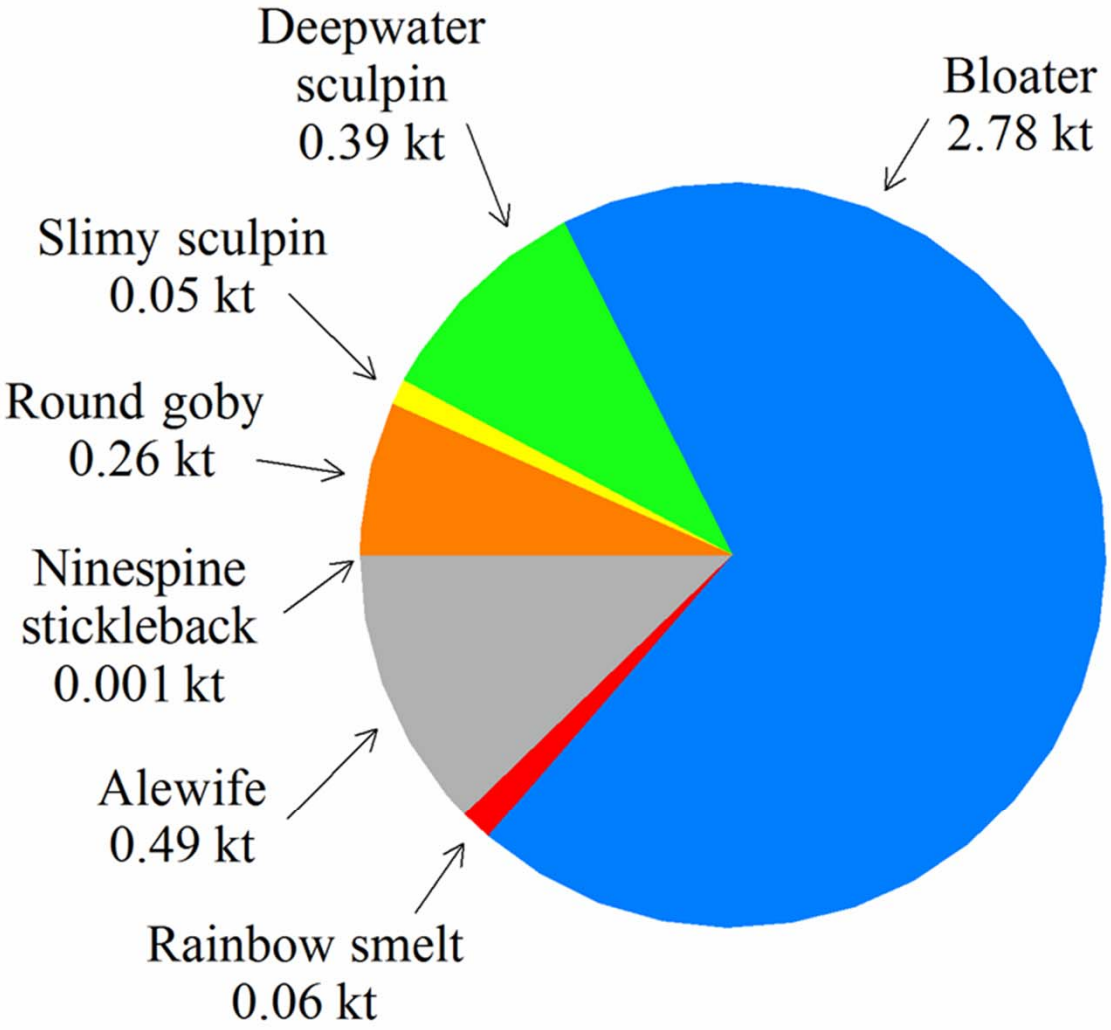




Biomass density (+/- standard error) of adult (a) and age-0 (b) rainbow smelt in Lake Michigan, 1973-2015.







Estimated lake-wide (i.e., 5-114 m depth region) biomass by species in Lake Michigan, 1973-2015.

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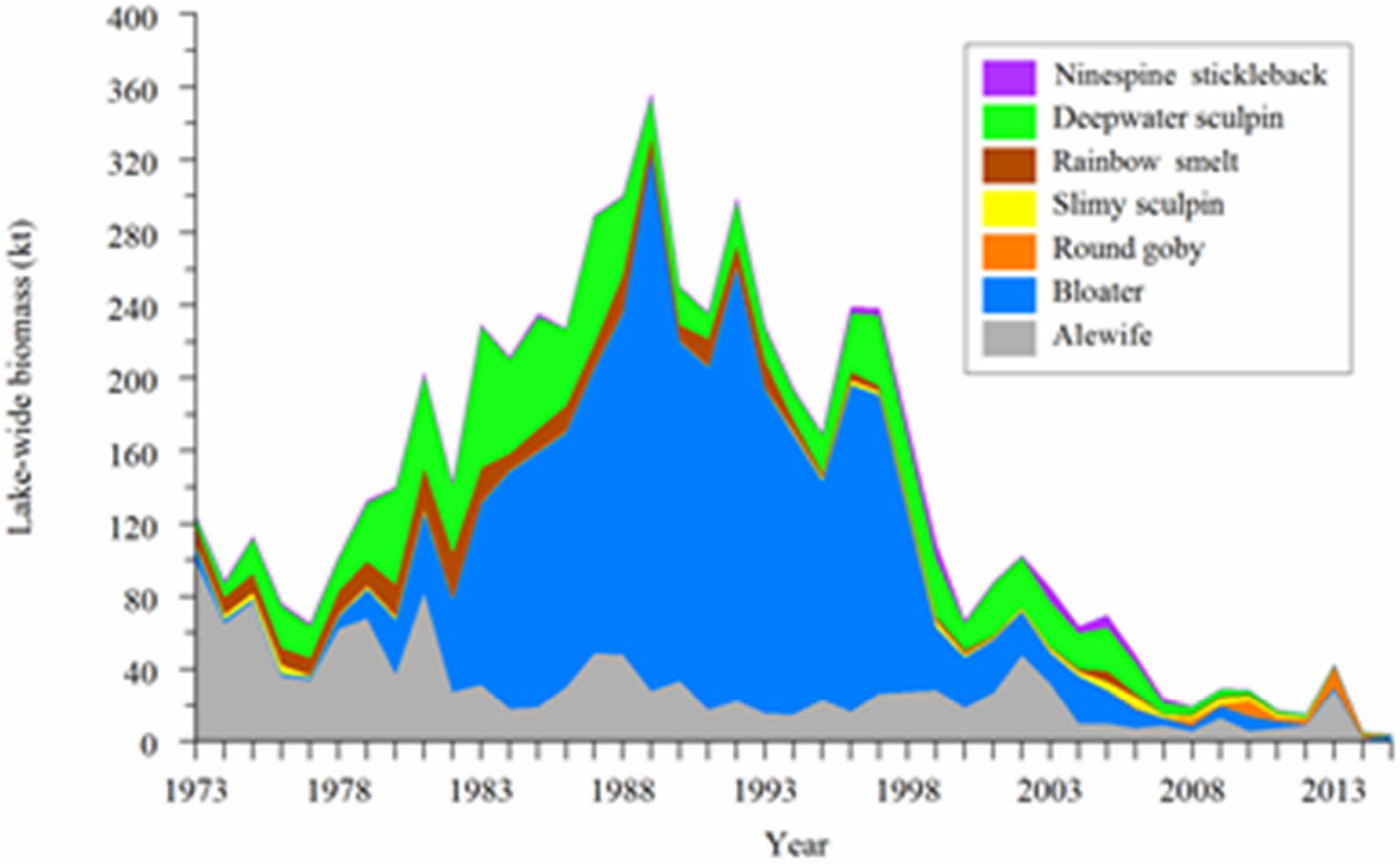
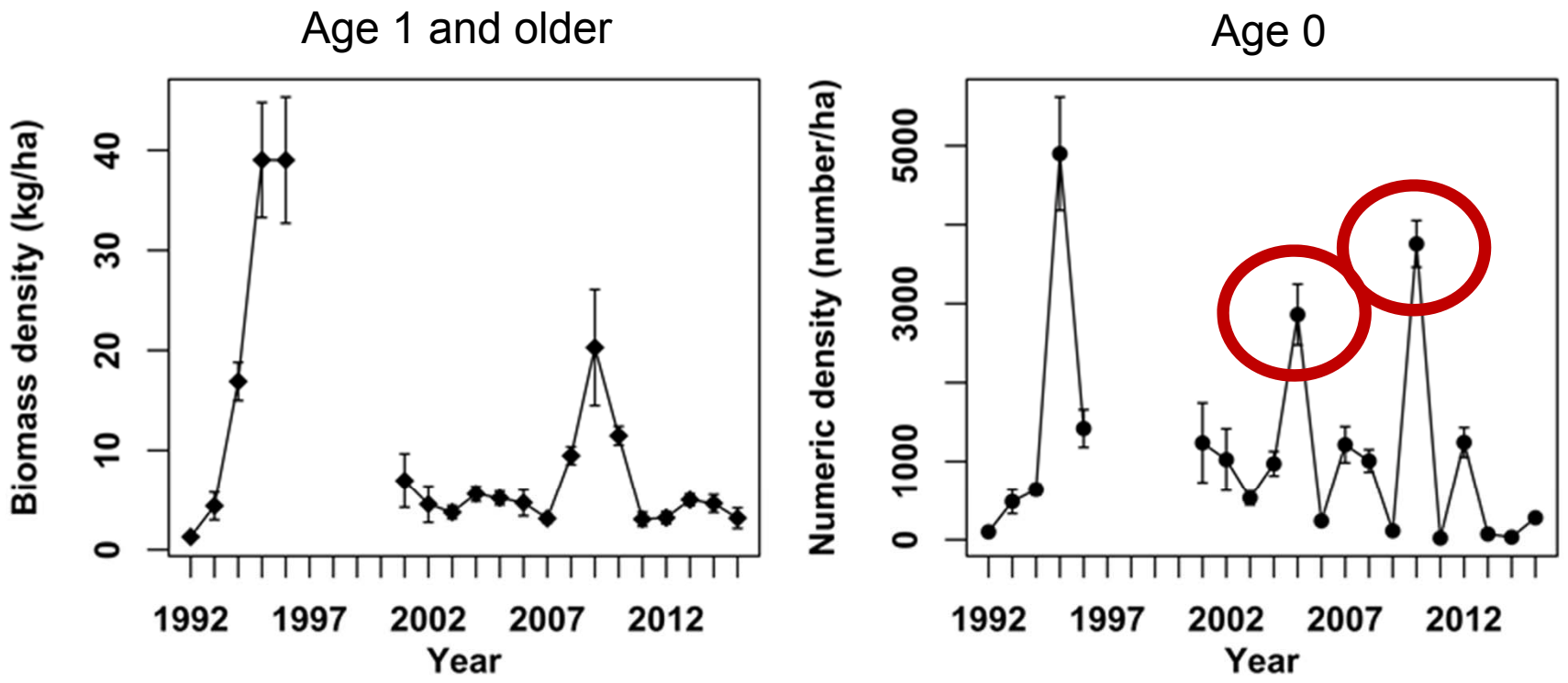
Estimated lake-wide (i.e., 5-114 m depth region) biomass of prey fishes in Lake Michigan, 1973-2015.



Biomass density of age-1 or older alewife (left panel) and Numeric density of age-0 alewife (right panel) in Lake Michigan during 1992-1996 and 2001-2016.



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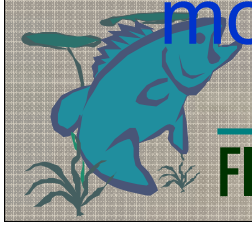
Preliminary Bottom Trawl Results for 2015
brief summary from Chuck Madenjian USGS

1. Based on the preliminary analysis, yearling and older (YAO) alewife biomass in Lake Michigan decreased by about 70% between 2014 and 2015, according to the bottom trawl survey
2. The 2015 value for alewife was the record low for the time series (0.5 kt) and overall biomass (4.0 kt) was also a record low.
3. Age distribution of alewives remained truncated with no alewife exceeding an age of 6.

Preliminary Acoustic Results for 2015, brief summary from David Warner USGS

- Mean prey fish biomass was 36% lower than in 2014.
- The numeric density of the 2015 alewife year class was 25% of the average and 8 times the 2014 density.
- Adult alewife were sparsely distributed and fewer were caught in 2015 than in 2014, which is consistent with forecasts of lower alewife biomass in 2015 based on catch at age modeling & consumption by predators.



Lake Michigan Sport Fishing Surveys

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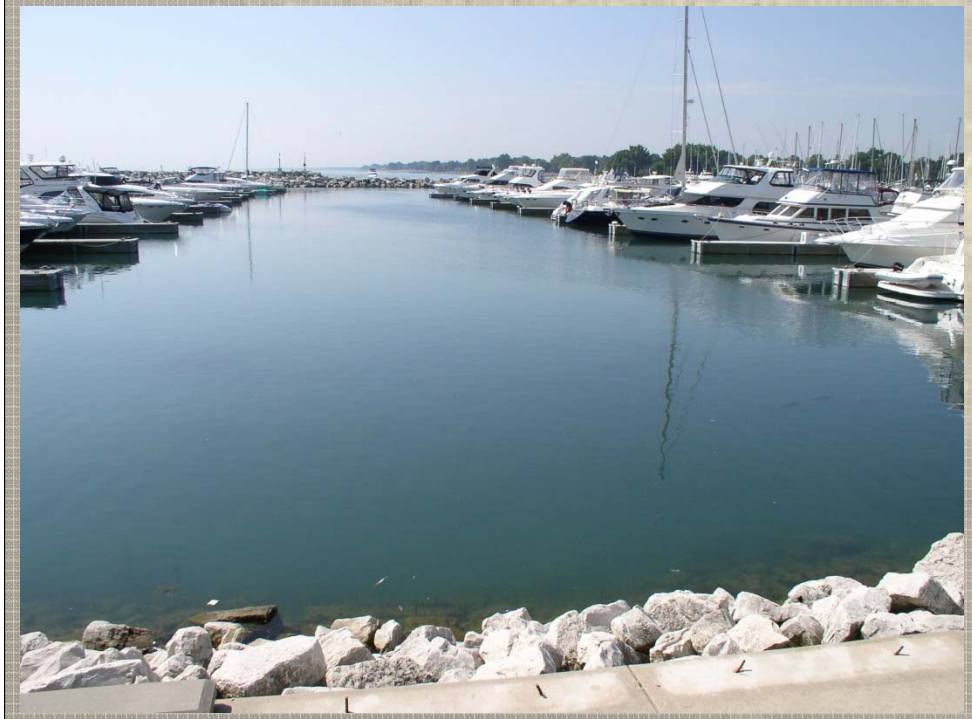
Creel Survey

- Collect information on sport fishing on Lake Michigan
- Modified access point design
- Randomized
- Counts, Interviews and Biological information
- Diet composition
- Fish consumption advisory
- Socio-economic


RAMP
PIER
SHORE
STREAM

Charter Boat Reporting

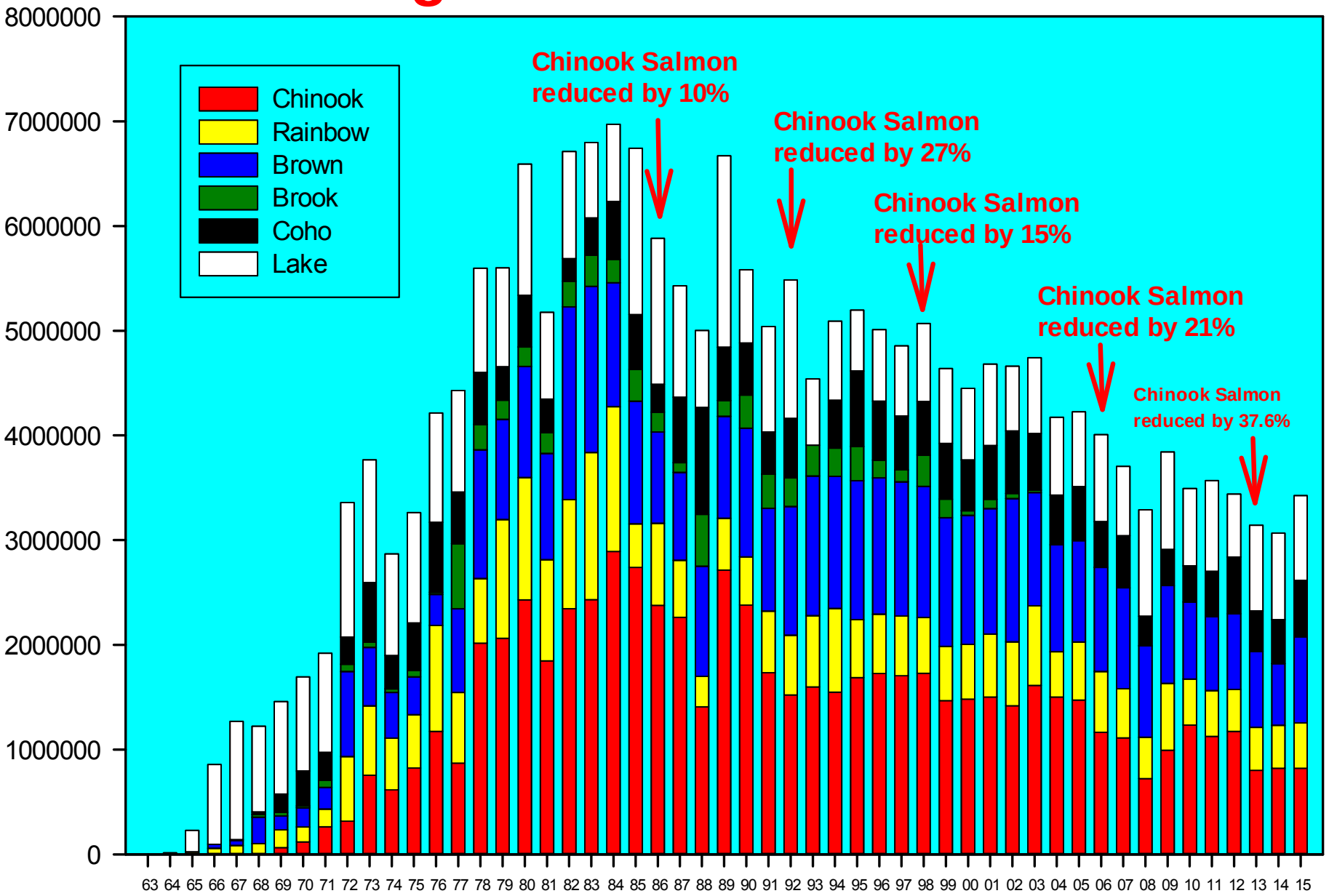


- Captains are licensed
- Mandatory monthly reports
- Information obtained included number of anglers, hours fished and number by species caught

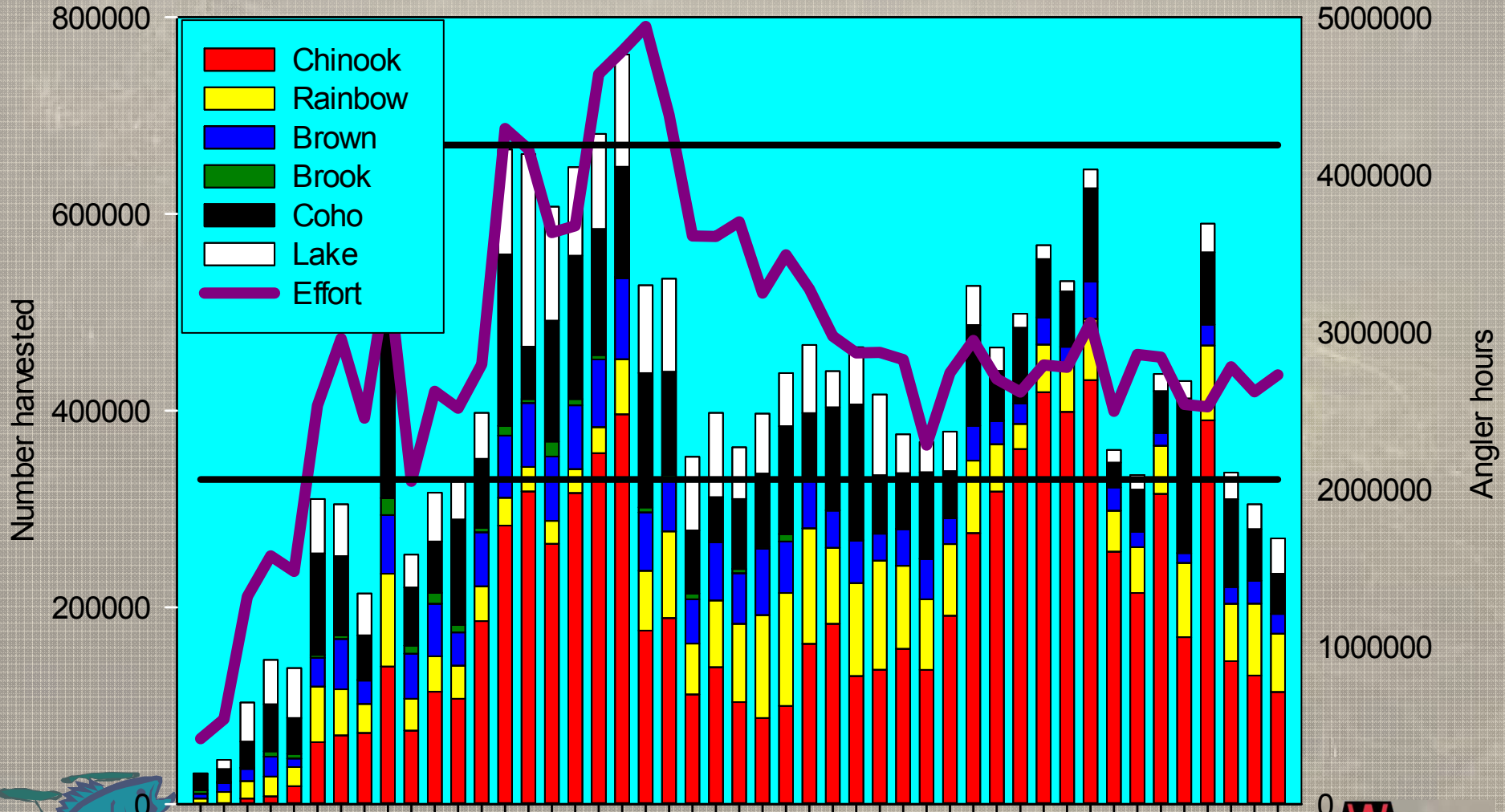
Moored Boat Survey

- Randomized mail survey
- Boat registration numbers are obtained to provide mailing list
- 2 – week survey period
- One survey per year

Lake Michigan Salmon and Trout stocking numbers 1969 to 2015



Lake Michigan Salmon and Trout harvest and effort from 1969 to 2015



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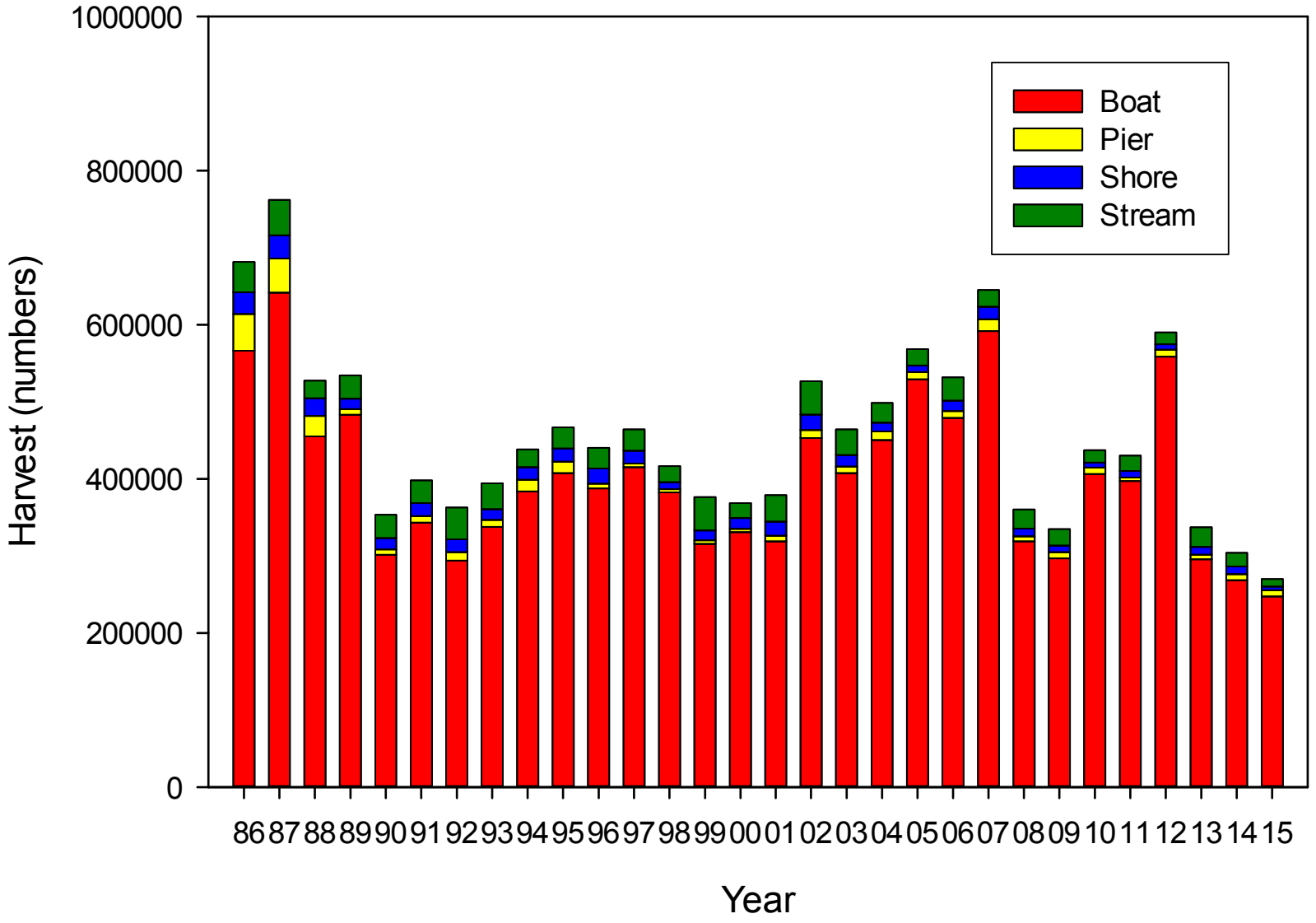
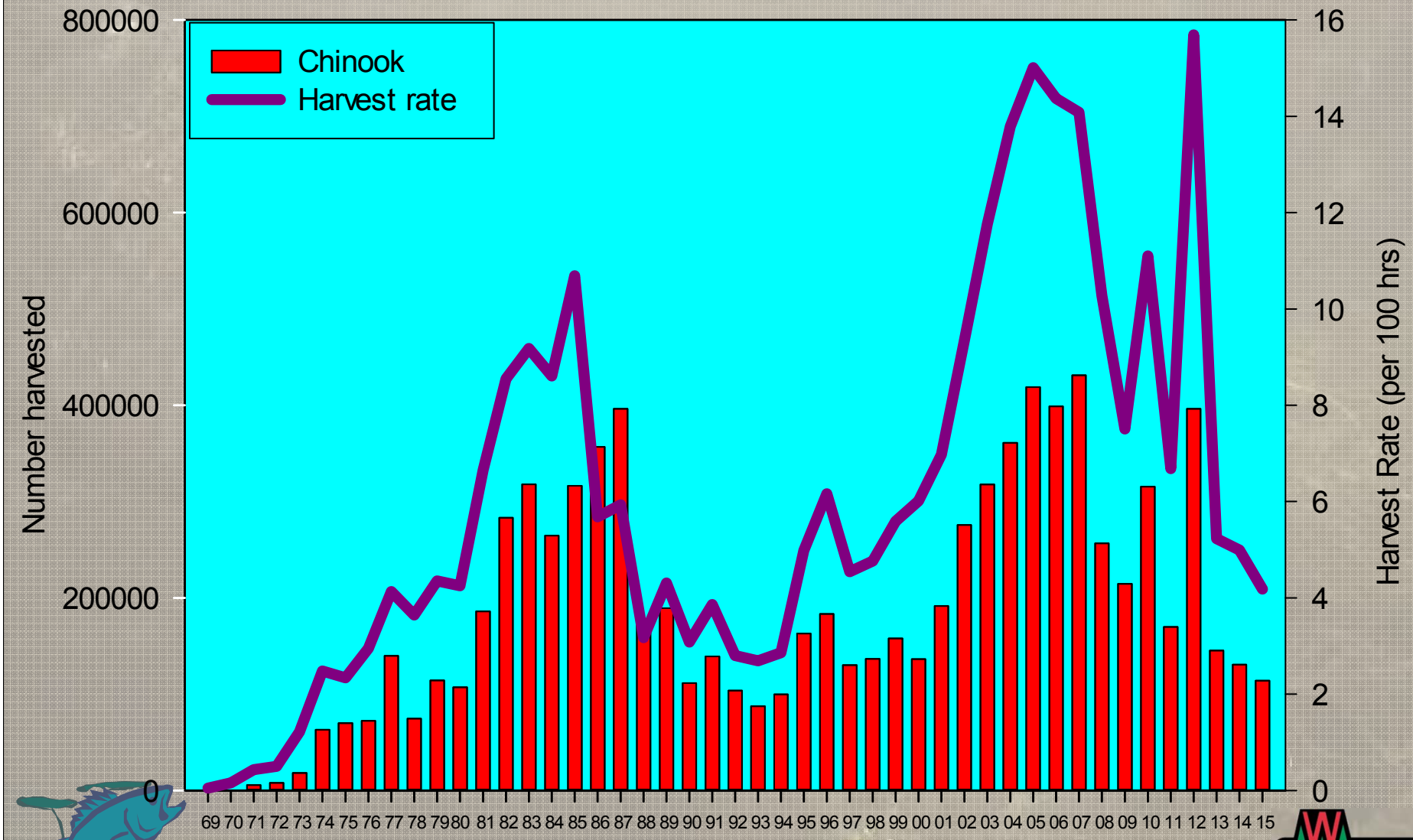
Lake Michigan salmon and trout harvest by year and fishery type, 1986 - 2015



Lake Michigan Chinook salmon harvest and harvest rate from 1969 to 2015



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Chinook Salmon Stocking Numbers and Distribution 2016

Wisconsin DNR Stocking Reduction Plans		
Chinook Salmon Actual Numbers to stock 2016		
	Number to Stock	
Wisconsin 2012 Quota	1,164,000	
Planned 37.8 % reduction	723,700	
Coho Salmon Equivalents	31,250	
Rainbow Trout Equivalents	29,167	
Lake Trout Equivalents	24,138	
FINAL NUMBER	808,255	808,255
FINAL PERCENT	30.6	
Total number to be stocked	808,255	
Total number for Strawberry Creek	120,000	
Total number for Northern Door	30,000	
Total number for rest of counties	658,255	
Number of counties	8	
Total number per county (75%)	61,711	

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	Step 3	STEP 4			
	Strategy accounts for 25% of stocking	Reduction based on equal number per county			
County	25%	Base stocking number is 75% of total allotment	Strategy comprises 25% of stocking number	Total stocking number per county	% change from 2015
Kenosha	14,676	61,711	14,676	76,387	-344.90
Racine	14,240	61,711	14,240	75,952	-155.28
Milwaukee	22,086	61,711	22,086	83,797	209.18
Ozaukee	27,826	61,711	27,826	89,538	364.76
Sheboygan	23,868	61,711	23,868	85,580	110.78
Manitowoc	23,182	61,711	23,182	84,894	-35.19
Kewaunee	32,593	61,711	32,593	94,304	-349.70
Southern Door - Strawberry Creek				120,000	0.00
Northern Door		30,000	0	30,000	0.00
Oconto/Marinette	6,092	61,711	6,092	67,803	198.95
TOTAL	164,564	523,691	164,564	808,255	-0.40

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Questions, comments, feedback?

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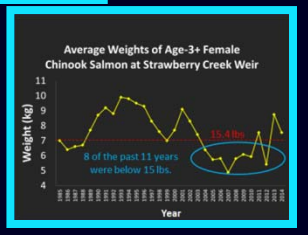
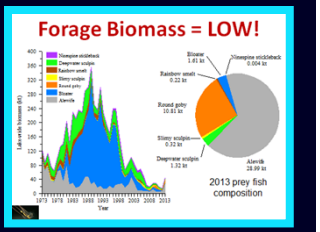
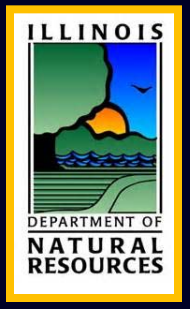
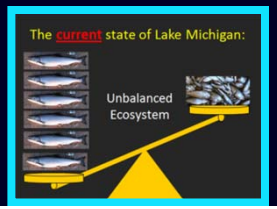
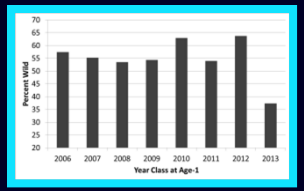



Lake Michigan
Wisconsin
Michigan
Illinois
Indiana
?

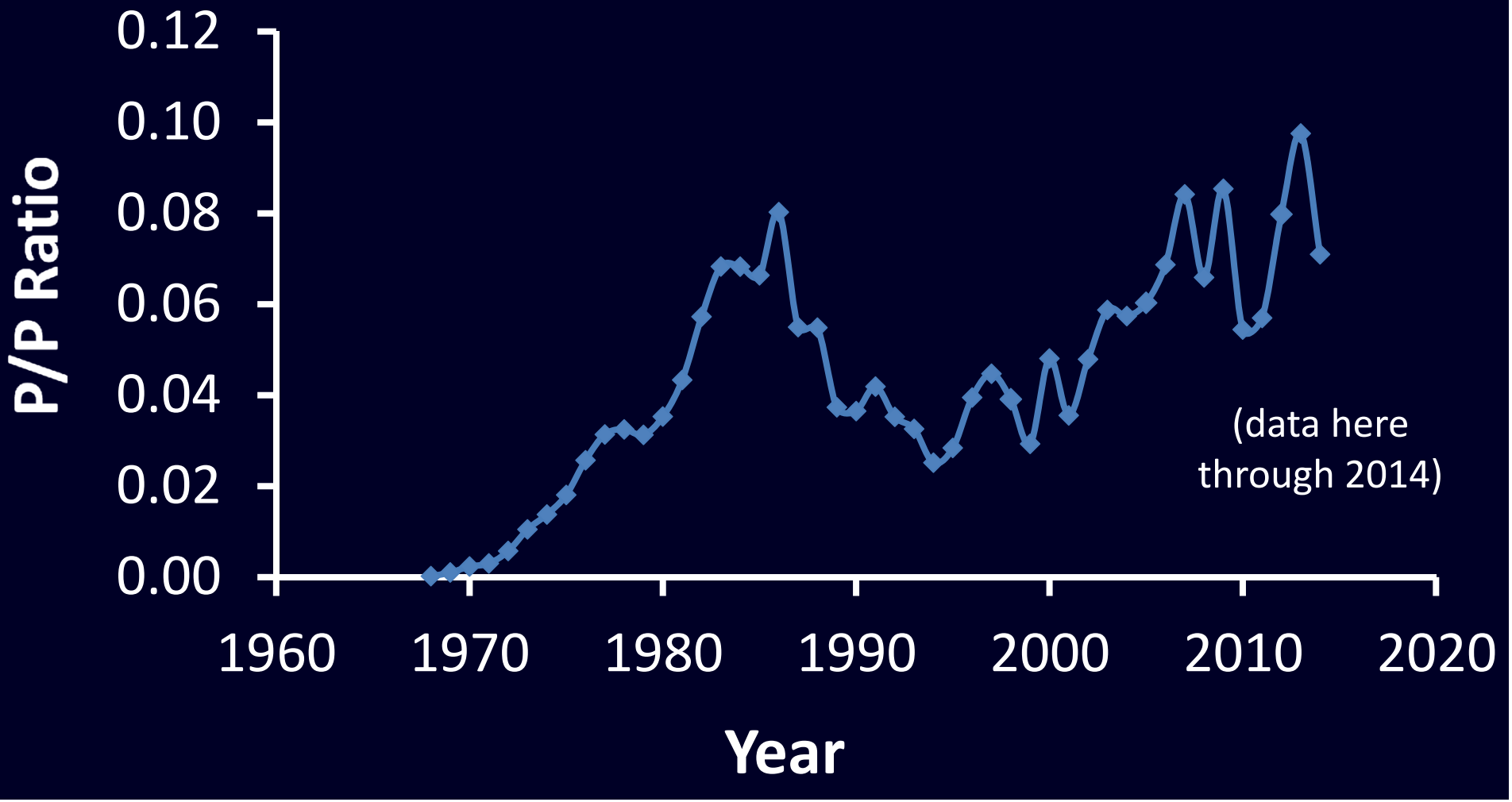


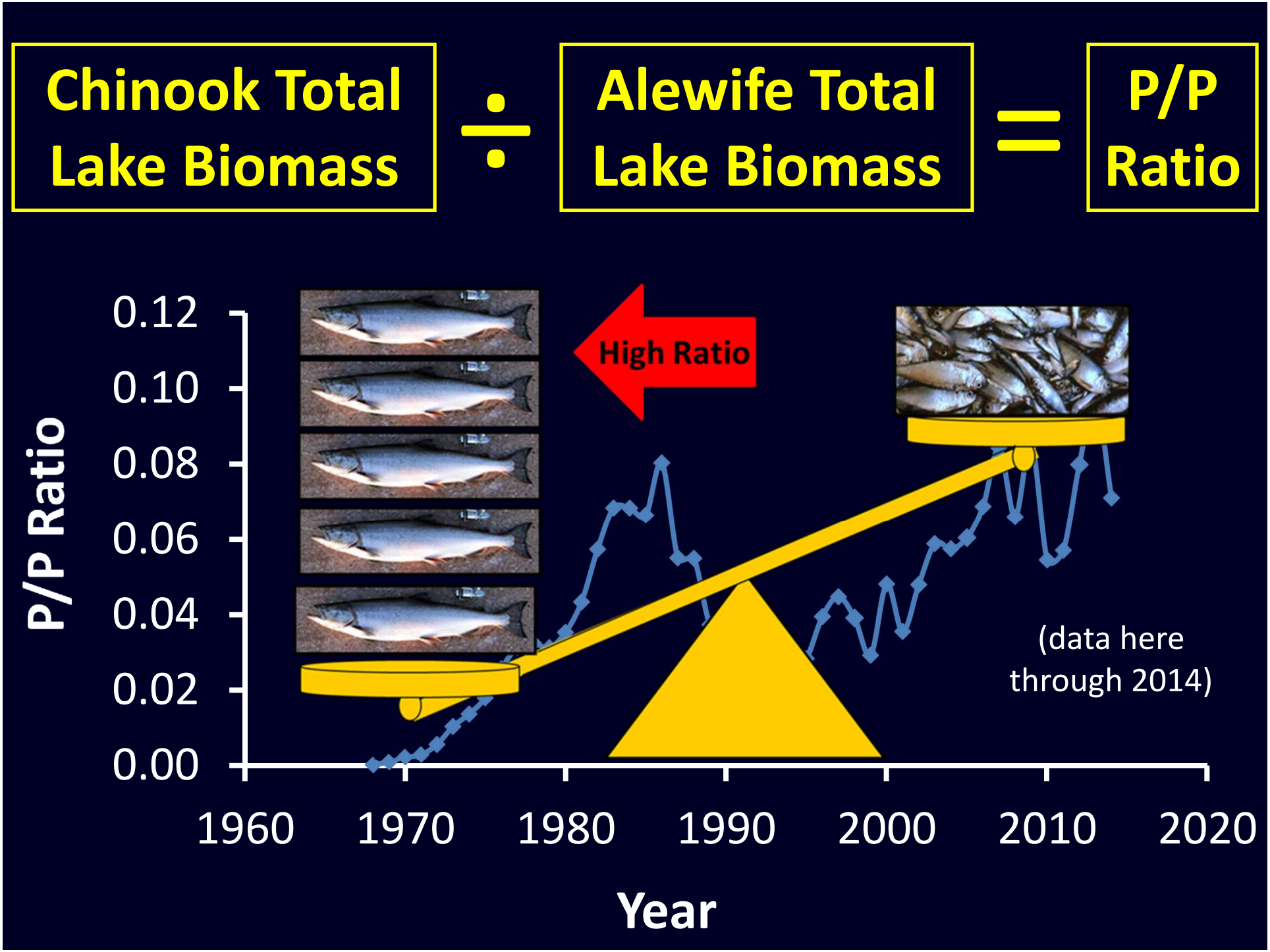



The current state of Lake Michigan:
Unbalanced Ecosystem

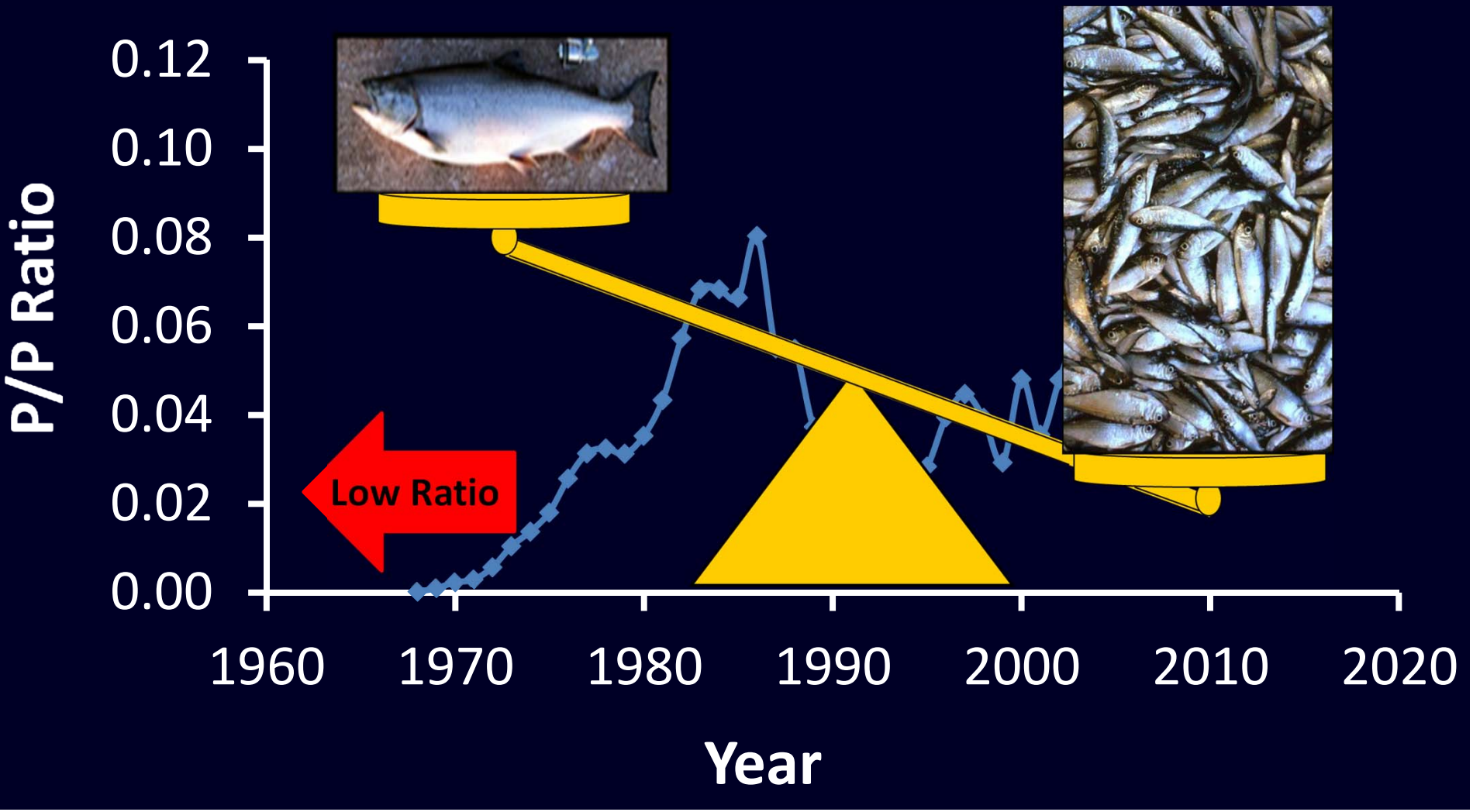

Percent Wild
Year Class at Age-1

Chinook Total Lake Biomass ÷ **Alewife Total Lake Biomass** = **P/P Ratio**

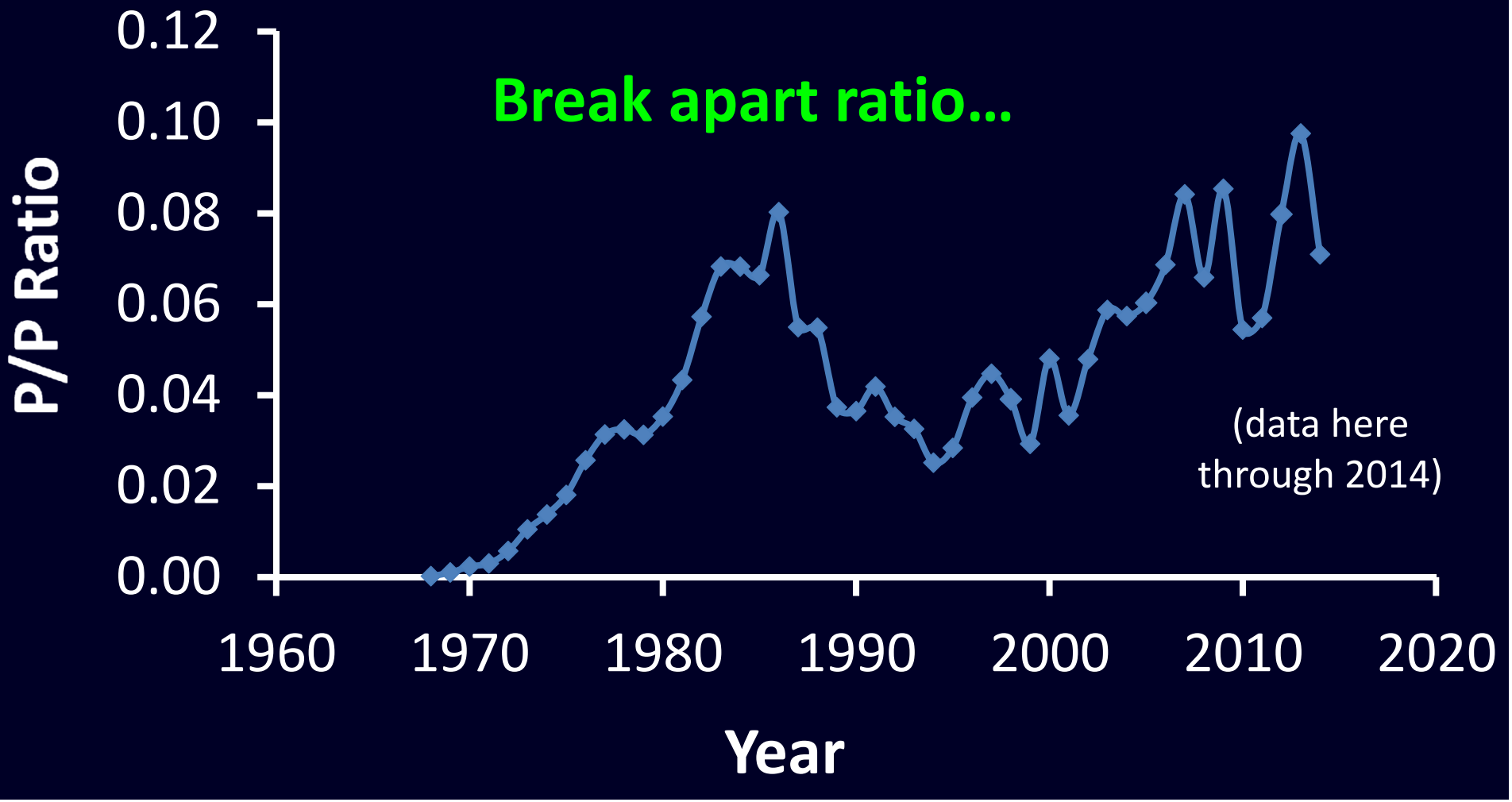


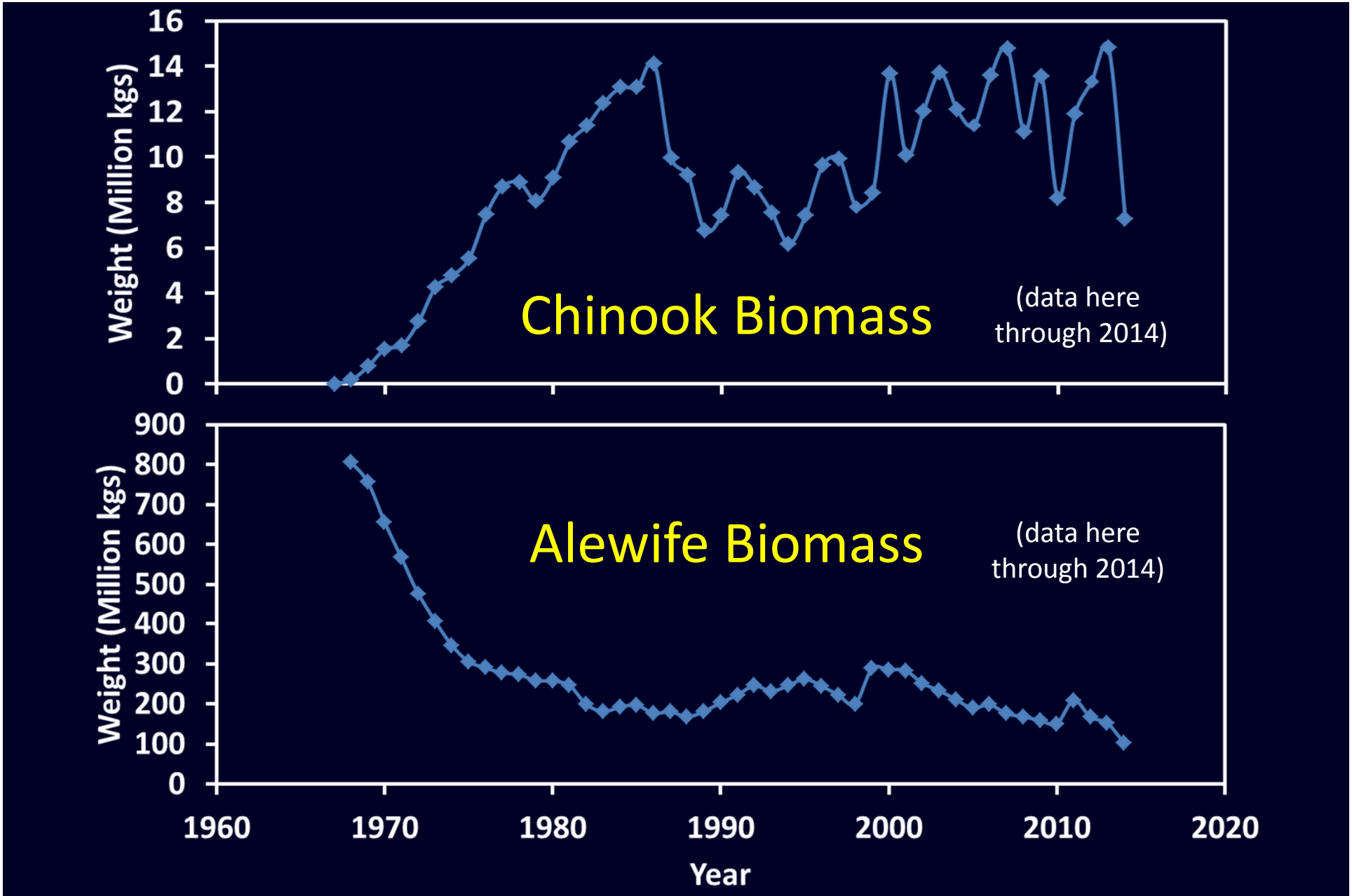

Chinook Total Lake Biomass
÷
Alewife Total Lake Biomass
=
P/P Ratio
High Ratio
(data here through 2014)
P/P Ratio
0.12
0.10
0.08
0.06
0.04
0.02
0.00
1960
1970
1980
1990
2000
2010
2020
Year

Chinook Total Lake Biomass ÷ **Alewife Total Lake Biomass** = **P/P Ratio**



Chinook Total Lake Biomass ÷ **Alewife Total Lake Biomass** = **P/P Ratio**





- Statistical catch at age models by **Tsehaye et al.**
- Abundance by age → biomass by age

Lake-wide datasets used for Chinook model:

- Number stocked
- Percent wild
- Number harvested
- Targeted effort
- Age & maturity of harvest
- Mean weights in harvest

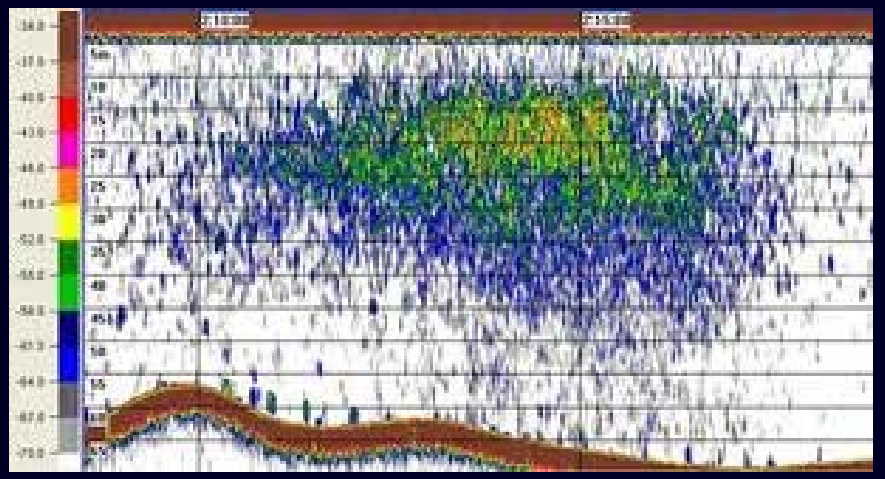
- Model uses observed data to generate a most likely answer to a question.
- How many Chinooks must have been present to produce observed survey results?

Catch at age models by **Tsehaye et al. 2014a,b**

Lake-wide datasets used for alewife model:

- Alewife abundance (trawl & hydro-acoustic)
- Alewife proportion by age (trawl)
- Number of salmon & trout stocked

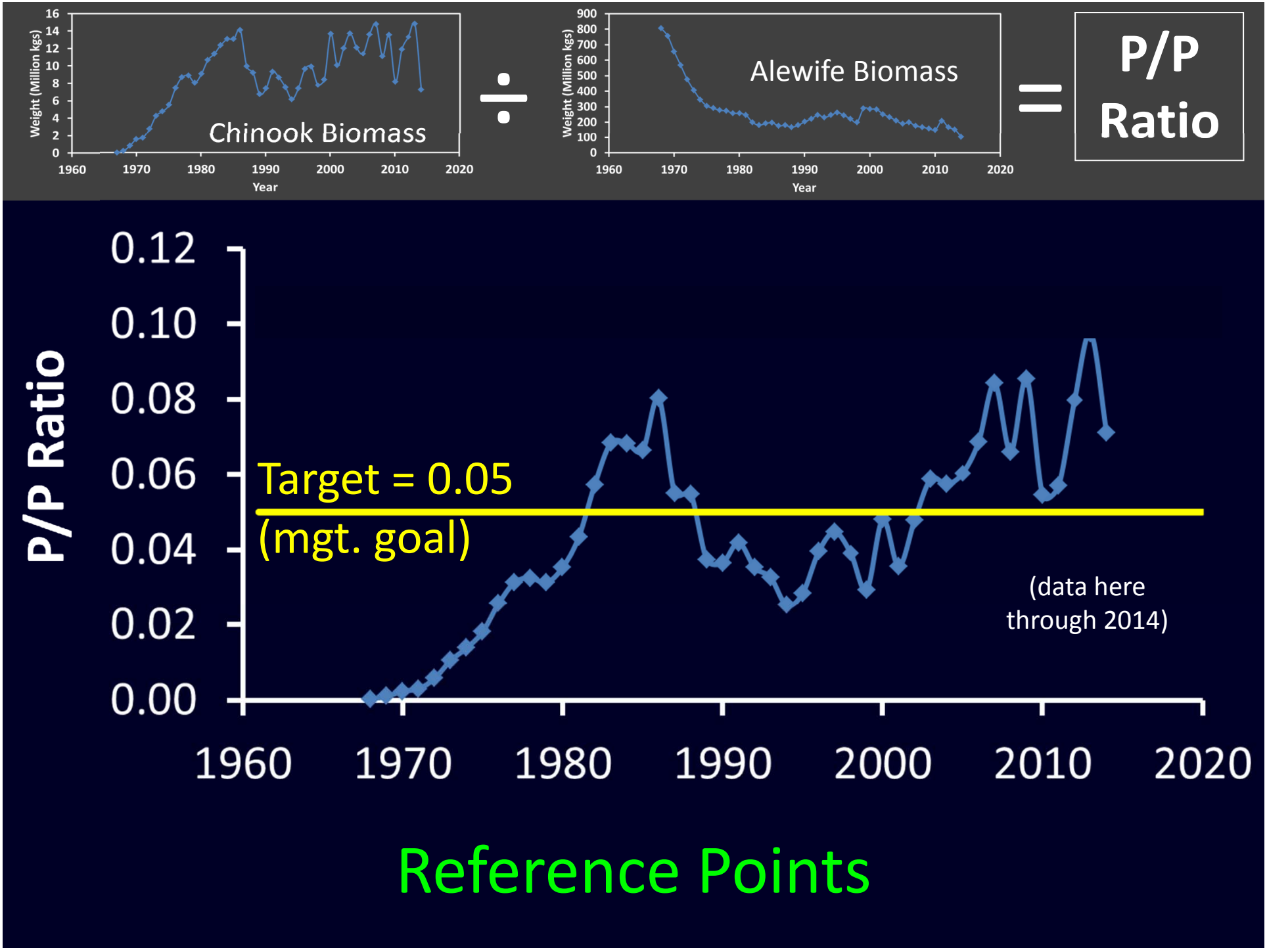
Bottom Trawl

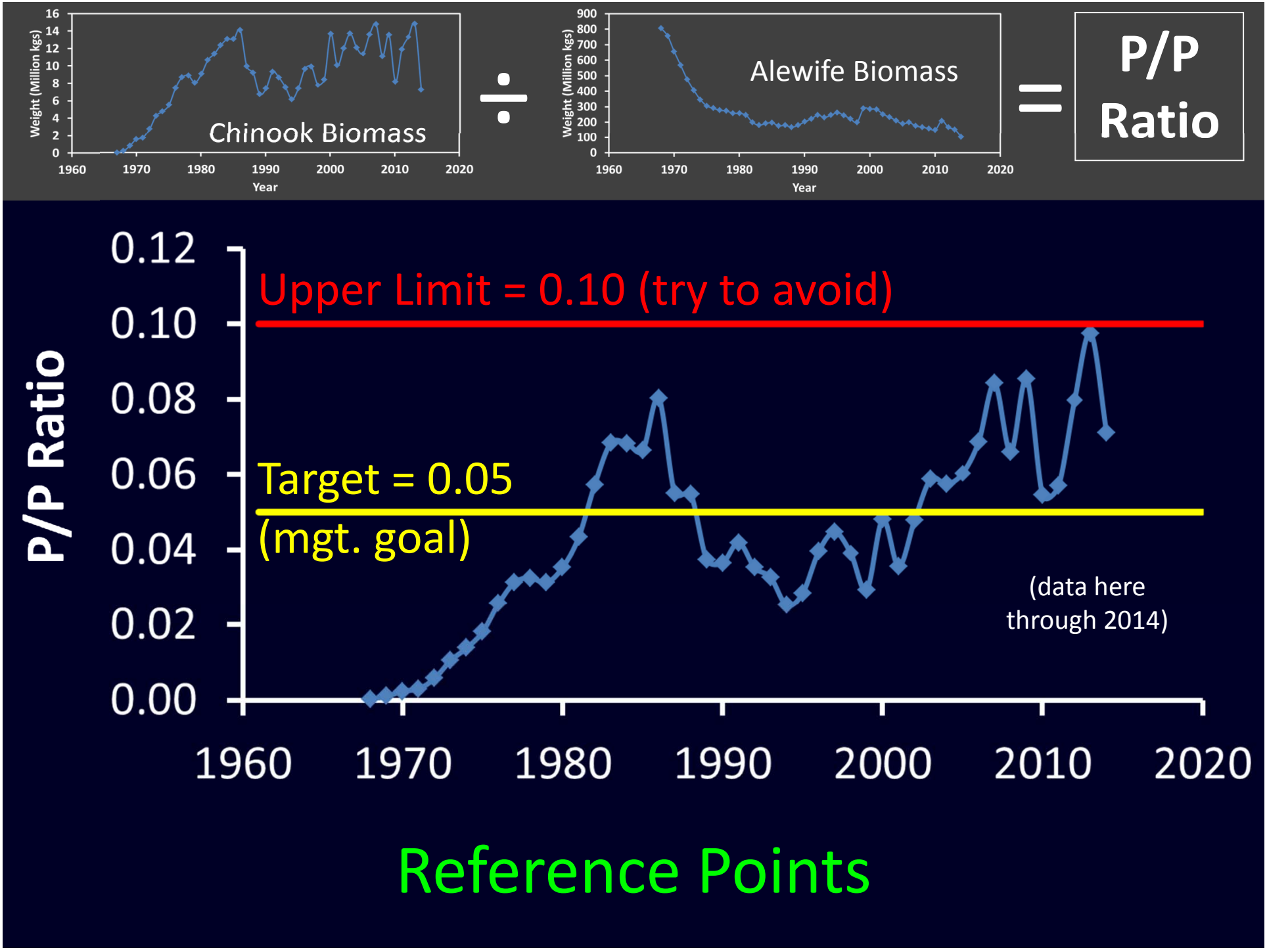


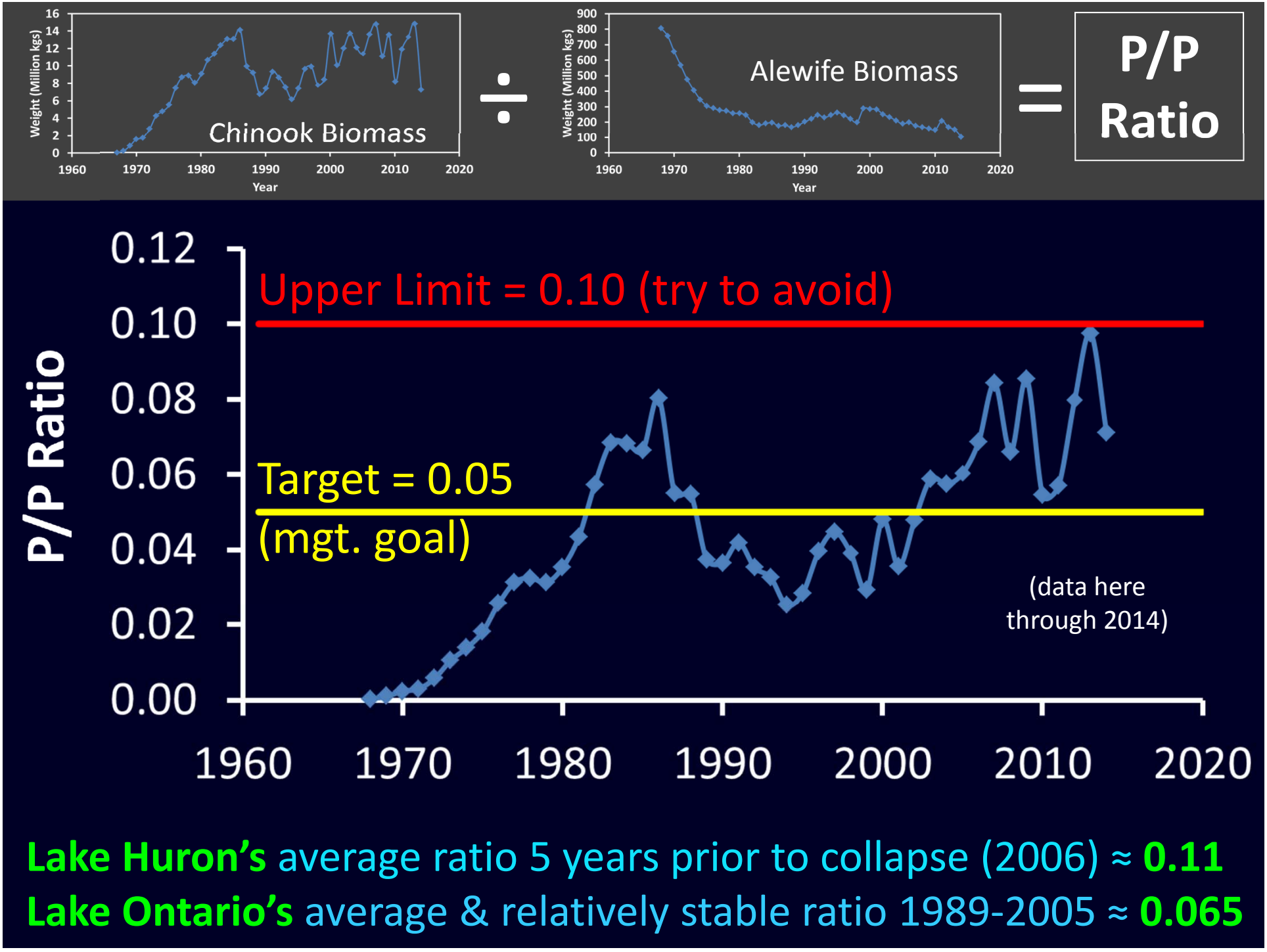
Hydro-acoustics

Catch at age models by **Tsehaye et al. 2014a,b**

USGS science for a changing world

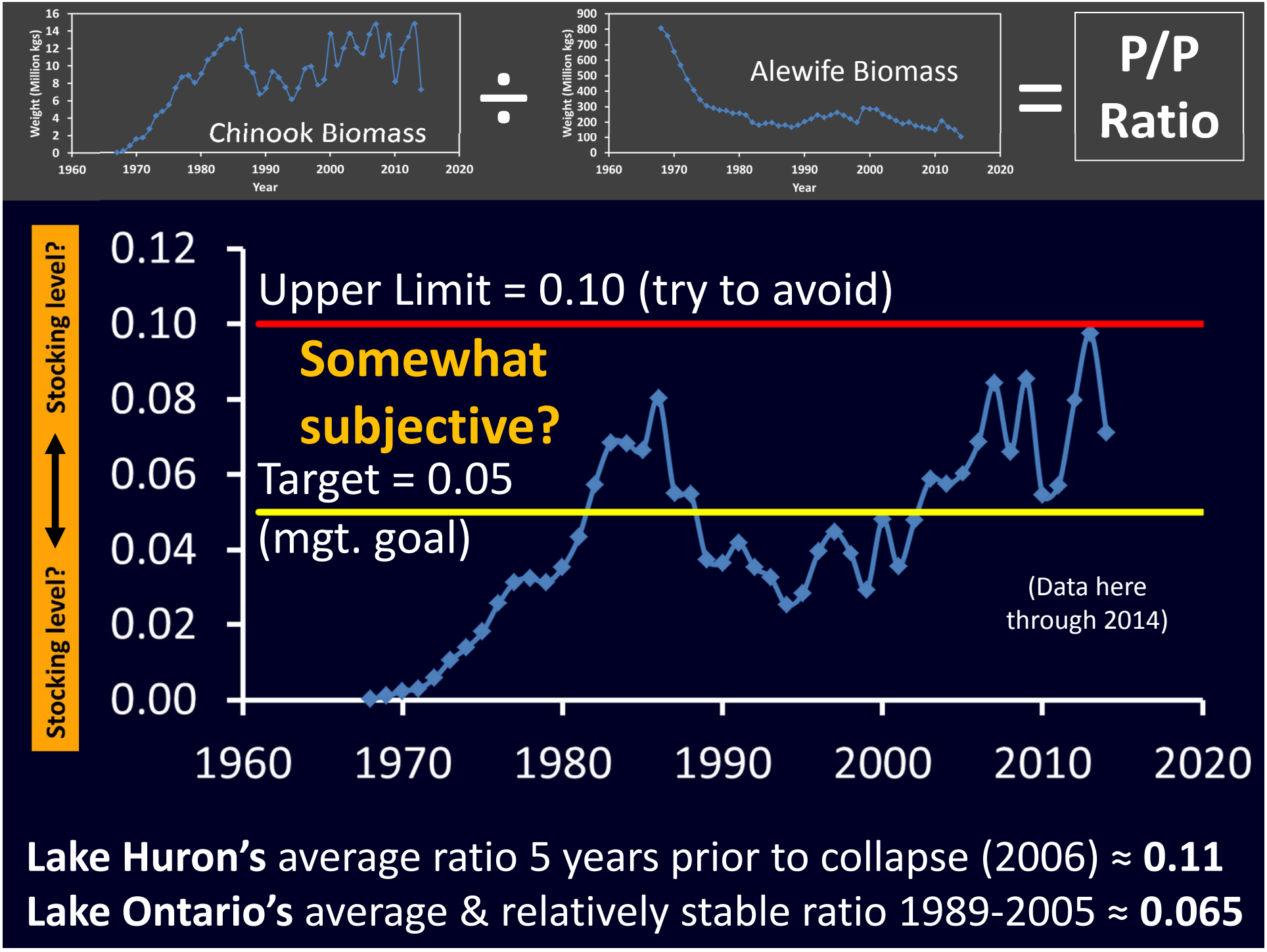

Weight (Million kgs)
Chinook Biomass
Year
÷
Weight (Million kgs)
Alewife Biomass
Year
=
P/P Ratio
P/P Ratio
Target = 0.05
(mgt. goal)
(data here through 2014)
Reference Points

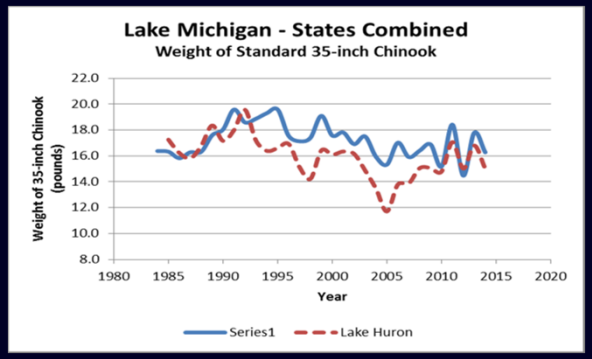

Chinook Biomass
Weight (Million kgs)
Year
÷
Alewife Biomass
Weight (Million kgs)
Year
=
P/P Ratio
P/P Ratio
Upper Limit = 0.10 (try to avoid)
Target = 0.05
(mgt. goal)
(data here through 2014)
Reference Points

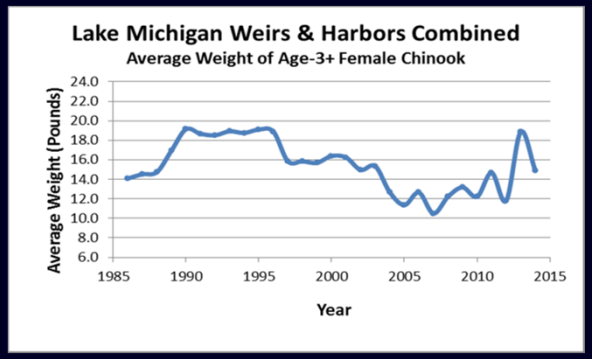


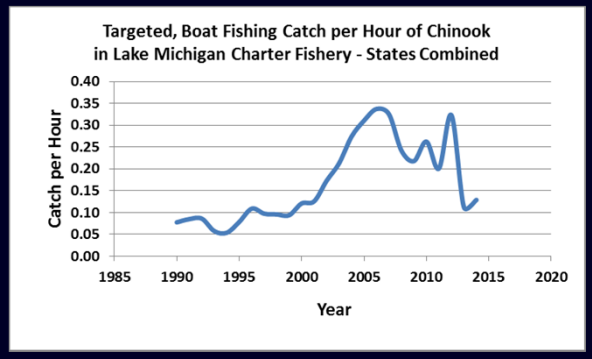
Lake Huron's average ratio 5 years prior to collapse (2006) ≈ **0.11**

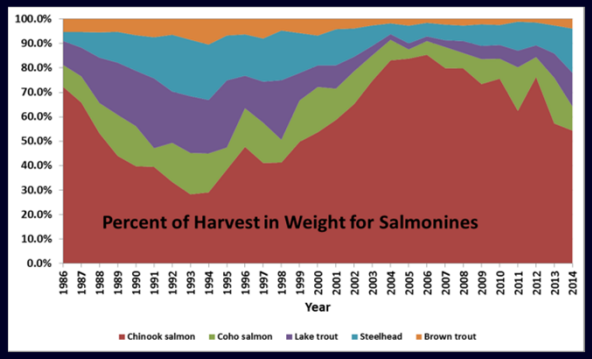
Lake Ontario's average & relatively stable ratio 1989-2005 ≈ **0.065**

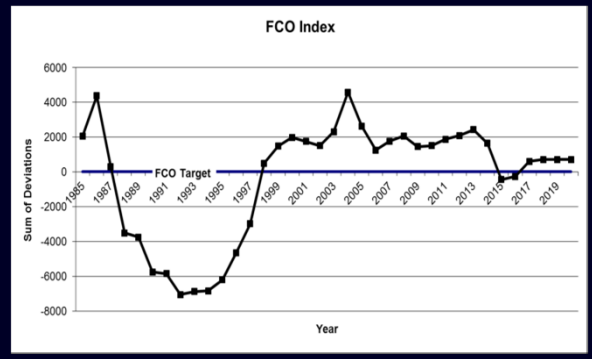

Weight (Million kgs)
Chinook Biomass
Year
÷
Weight (Million kgs)
Alewife Biomass
Year
=
P/P Ratio
Stocking level?
Stocking level?
Upper Limit = 0.10 (try to avoid)
Somewhat subjective?
Target = 0.05
(mgt. goal)
(Data here through 2014)
0.12
0.10
0.08
0.06
0.04
0.02
0.00
1960
1970
1980
1990
2000
2010
2020
Lake Huron's average ratio 5 years prior to collapse (2006) ≈ 0.11
Lake Ontario's average & relatively stable ratio 1989-2005 ≈ 0.065

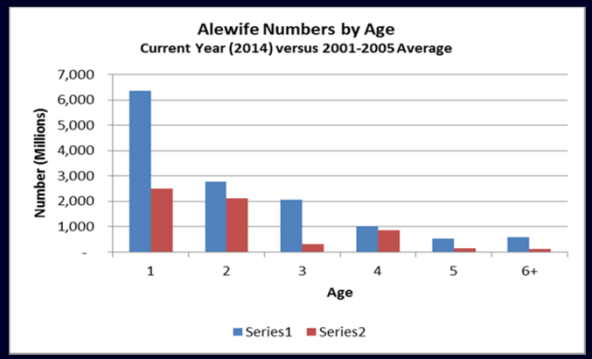












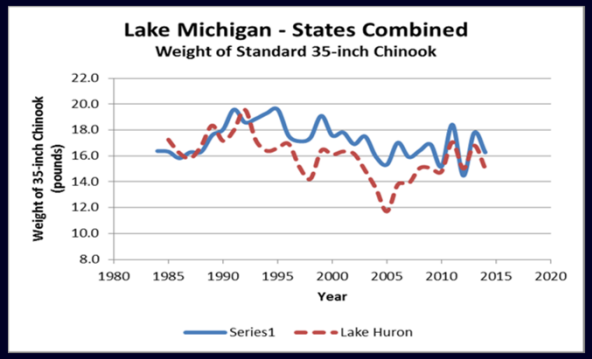
Six Auxiliary Indicators:

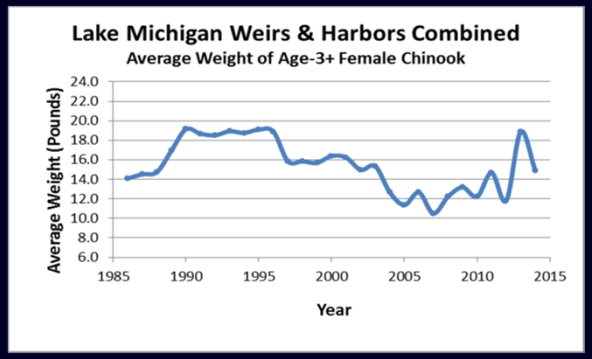
- Chinook condition (weight / length)
- Fall weight of age 3+ female Chinook
- Catch-per-effort (charter)
- % composition by weight in harvest
- Fish community objective index
- Alewife age structure

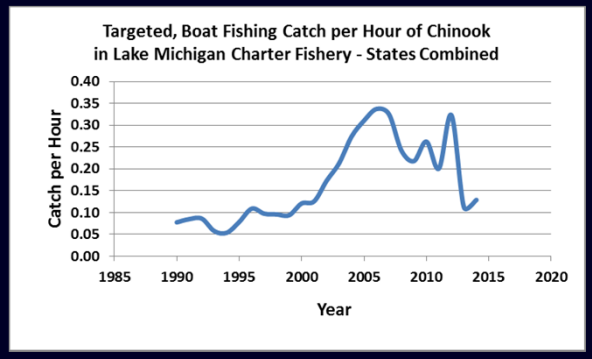
Chinook weight

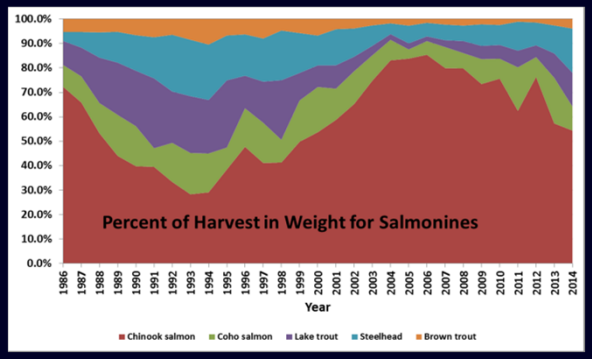
Chinook fishing effort & harvest

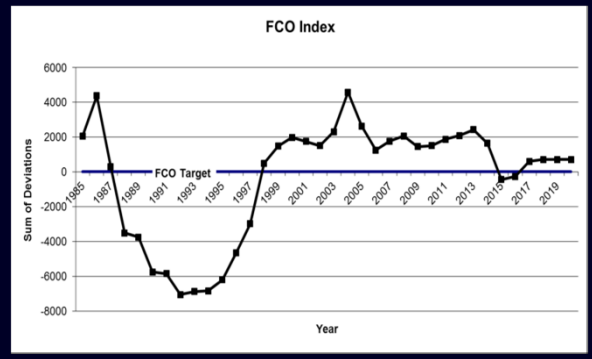
Alewife age

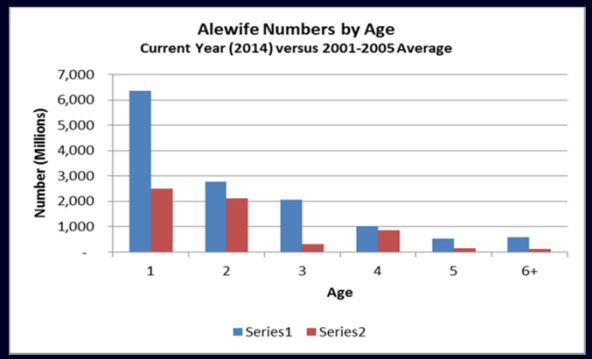












Six Auxiliary Indicators:

- Chinook condition (weight / length)
- Fall weight of age 3+ female Chinook

Chinook weight

- Catch-per-effort (charter)
- % composition by weight in harvest
- Fish community objective index

Chinook fishing effort & harvest

- Alewife age structure

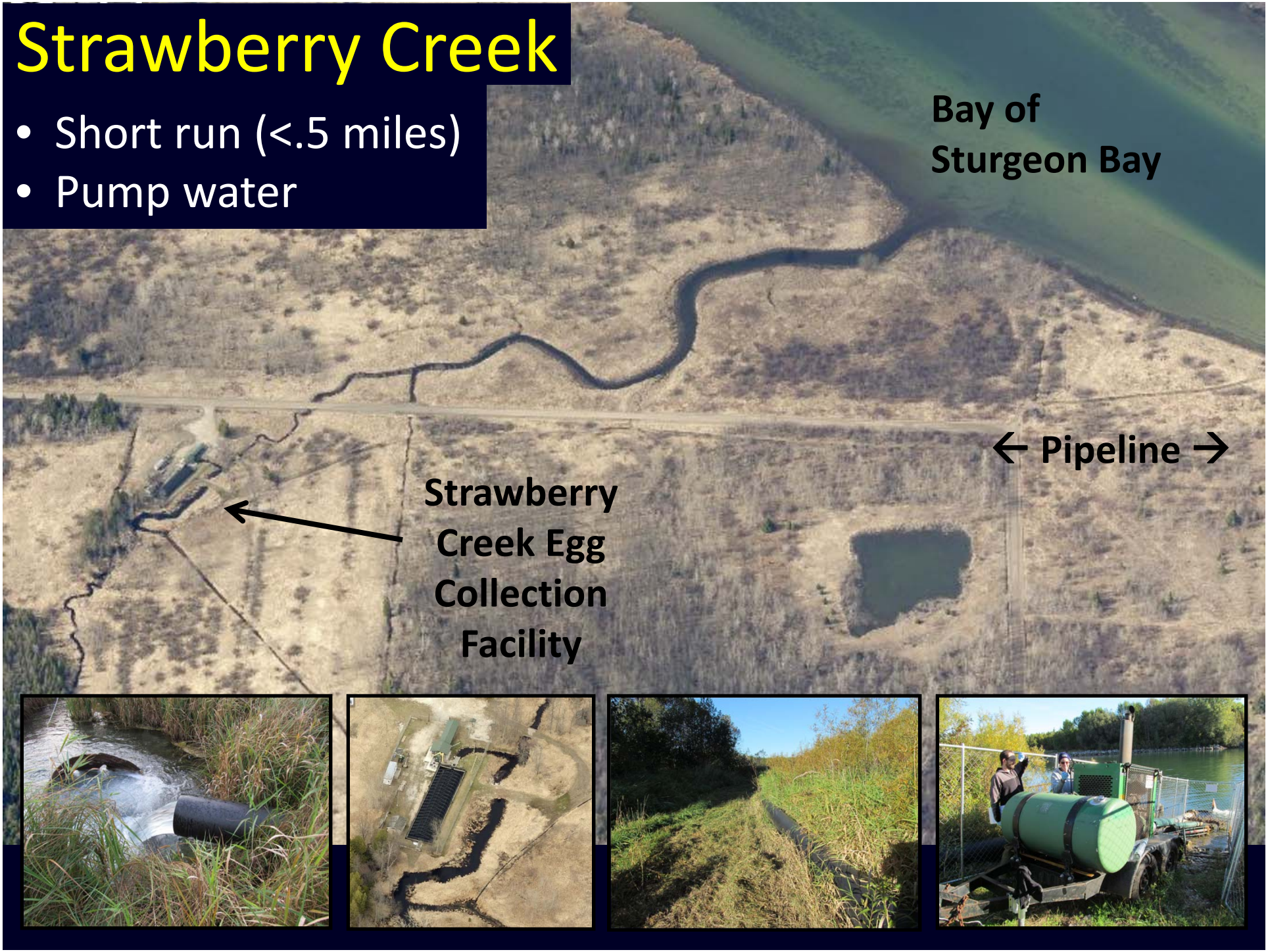
Alewife age

Strawberry Creek

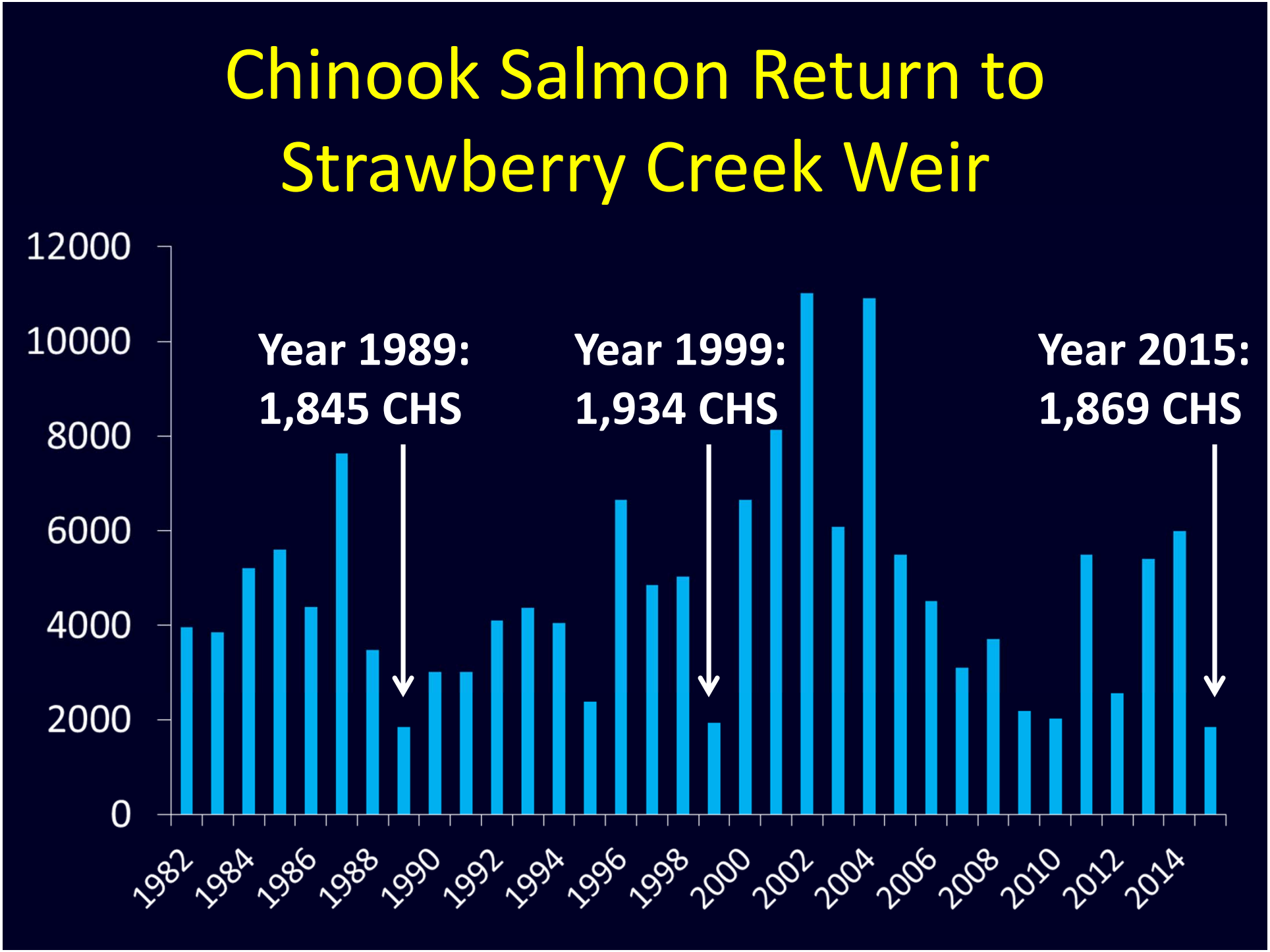
- WI's primary egg collection facility for Chinook salmon
- Initially stocked 1969
- Long term dataset to evaluate size-at-age

Strawberry Creek

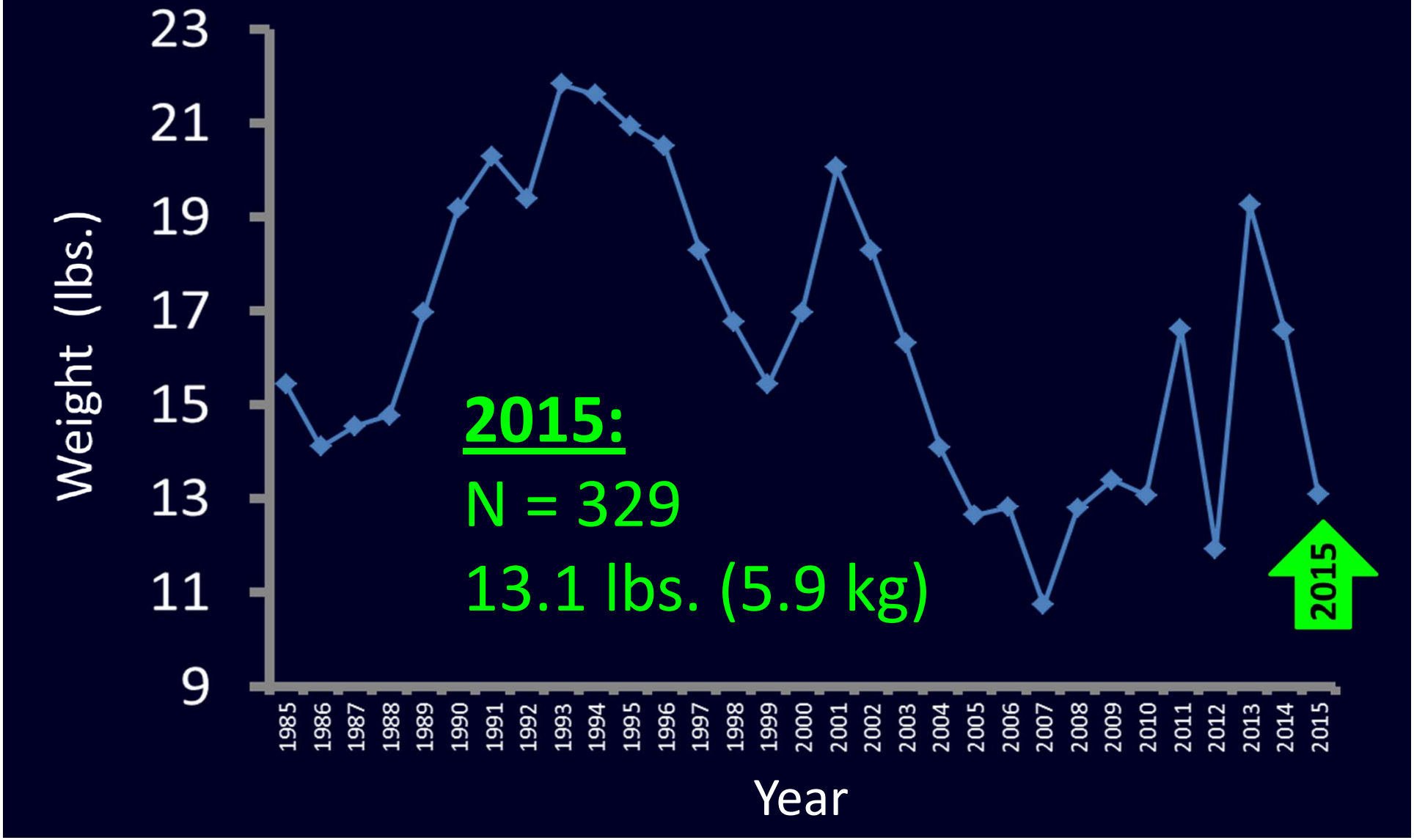
- Short run (<.5 miles)
- Pump water



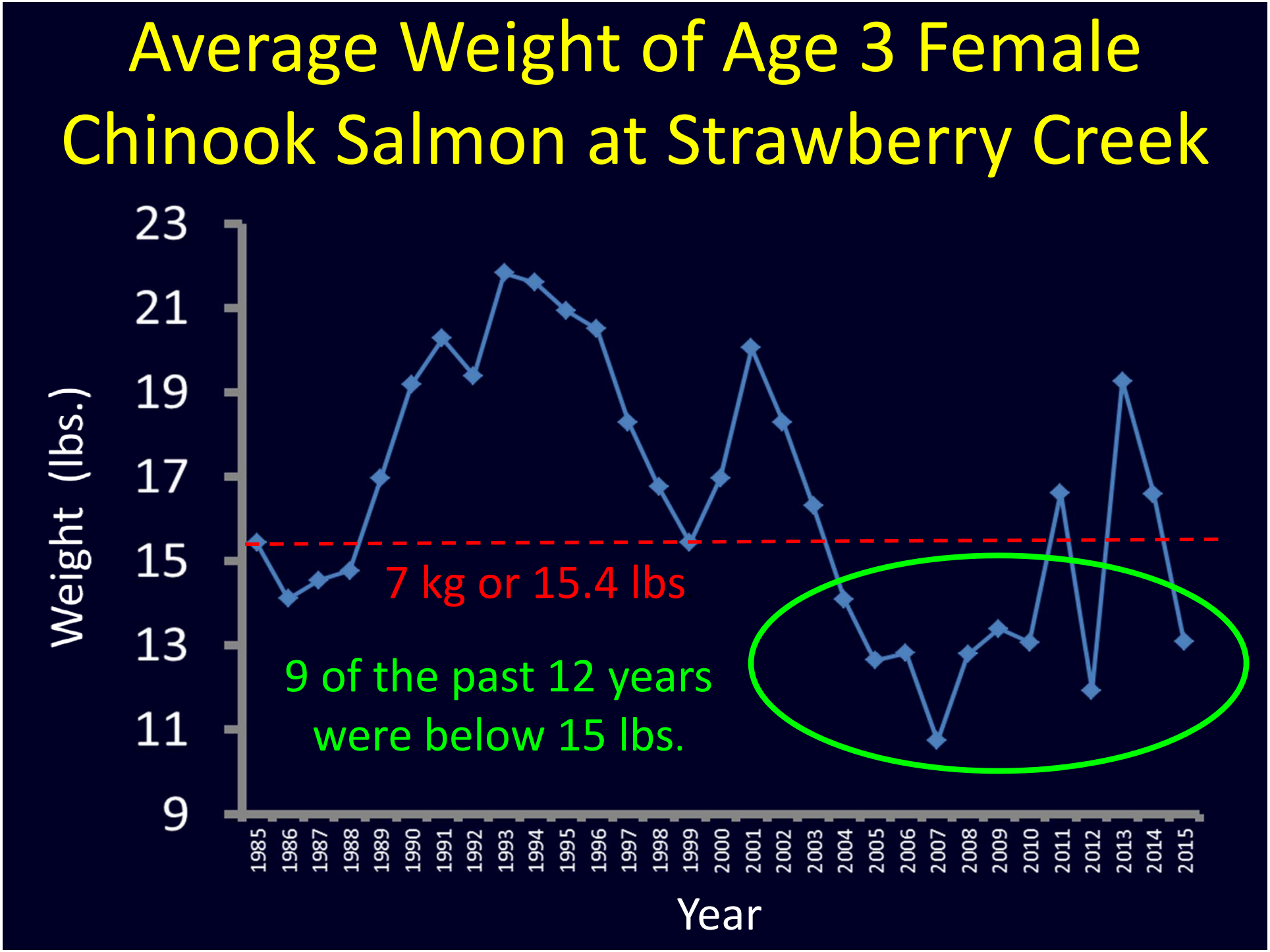
Chinook Salmon Return to Strawberry Creek Weir



Average Weight of Age 3 Female Chinook Salmon at Strawberry Creek

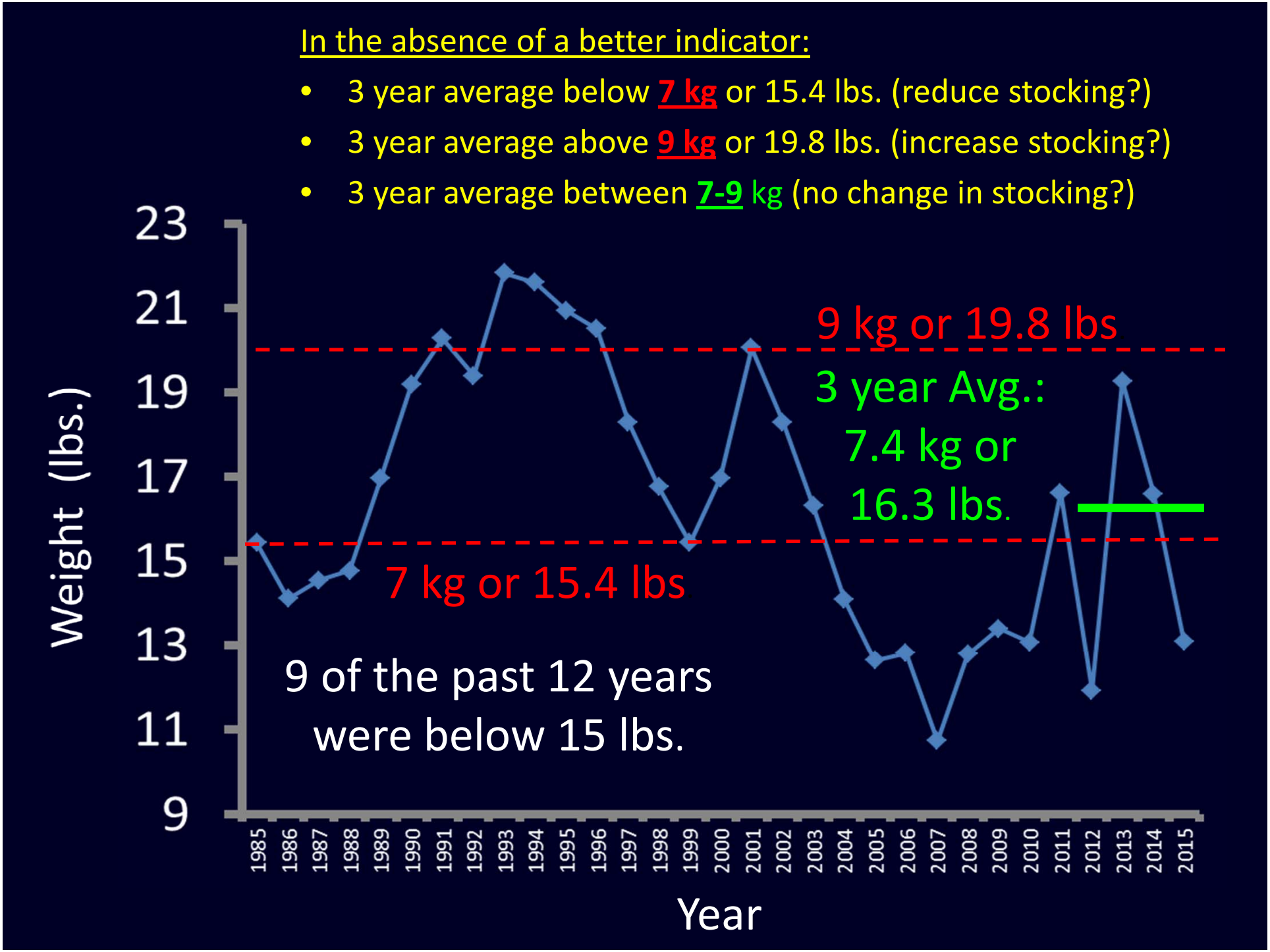


Average Weight of Age 3 Female Chinook Salmon at Strawberry Creek

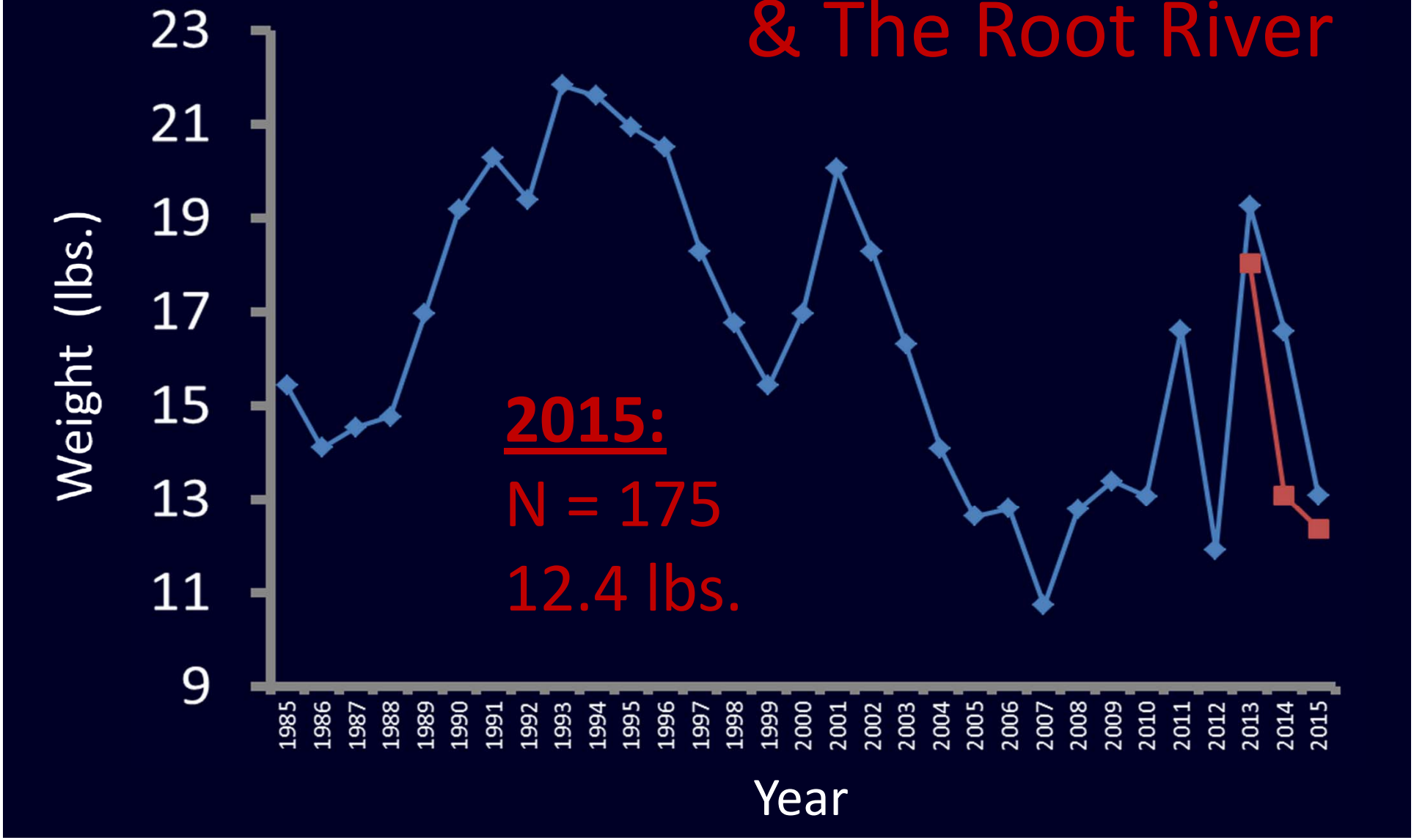


Strawberry Creek & LMC Stocking Strategy / Feedback Indicator

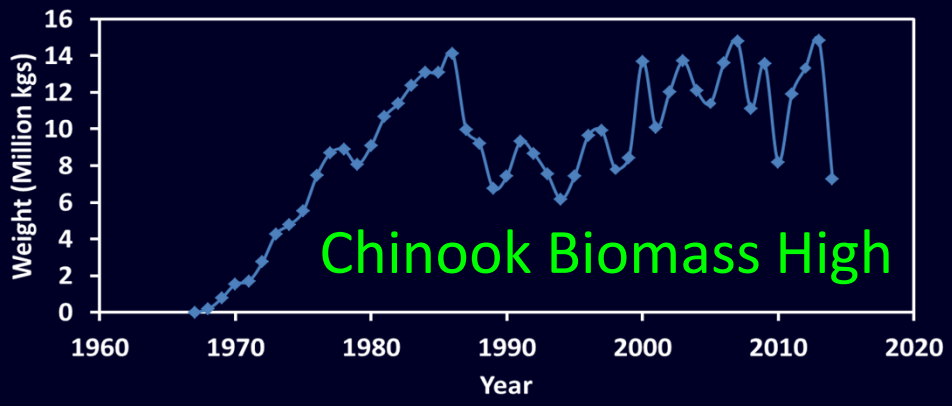
- **50% reduction** in Chinook salmon stocking (**2013**)
- "In the absence of a better indicator, LMC adopted **weight of age-3+ female Chinook salmon at the Strawberry Creek weir (WI)** as the feedback indicator to evaluate the predator-prey balance."
- 3 year average below **7 kg** or 15.4 lbs. (reduce stocking?)
- 3 year average above **9 kg** or 19.8 lbs. (increase stocking?)
- 3 year average between **7-9** kg (no change in stocking?)


In the absence of a better indicator:
• 3 year average below 7 kg or 15.4 lbs. (reduce stocking?)
• 3 year average above 9 kg or 19.8 lbs. (increase stocking?)
• 3 year average between 7-9 kg (no change in stocking?)
Weight (lbs.)
23
21
19
17
15
13
11
9
9 kg or 19.8 lbs.
3 year Avg.:
7.4 kg or
16.3 lbs.
7 kg or 15.4 lbs.
9 of the past 12 years
were below 15 lbs.
1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Year

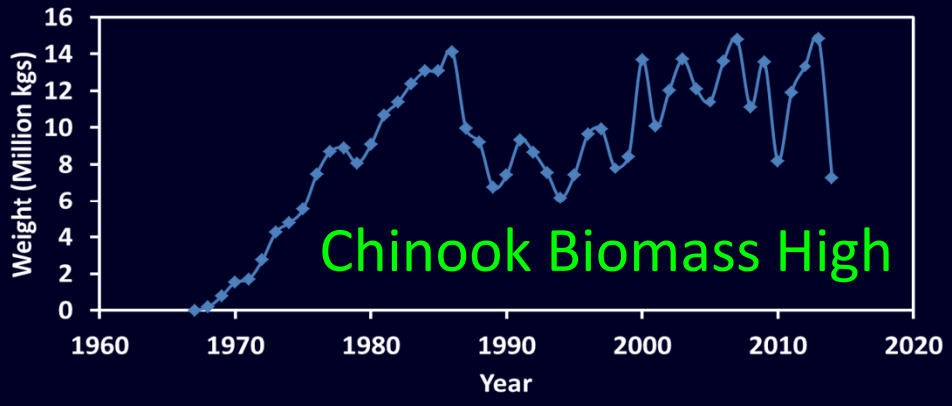
Average Weight of Age 3 Female Chinook Salmon at Strawberry Creek & The Root River

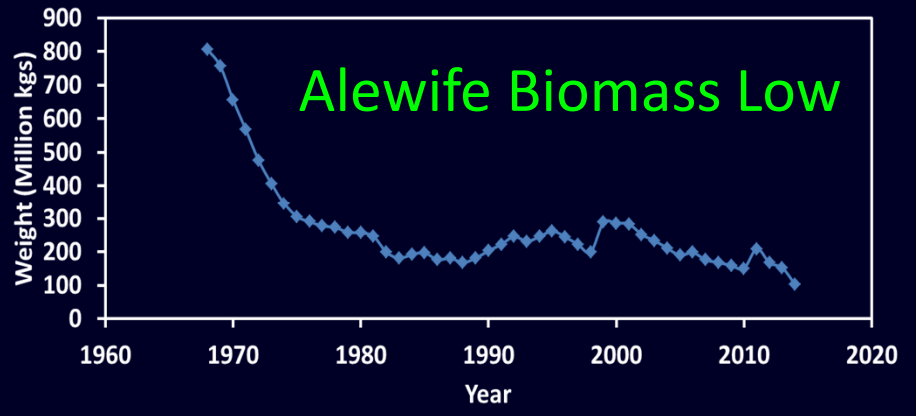


Overview & Conclusions

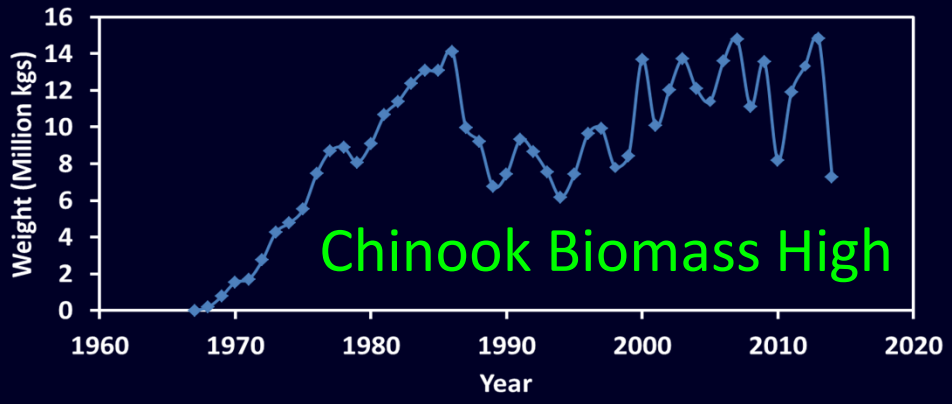


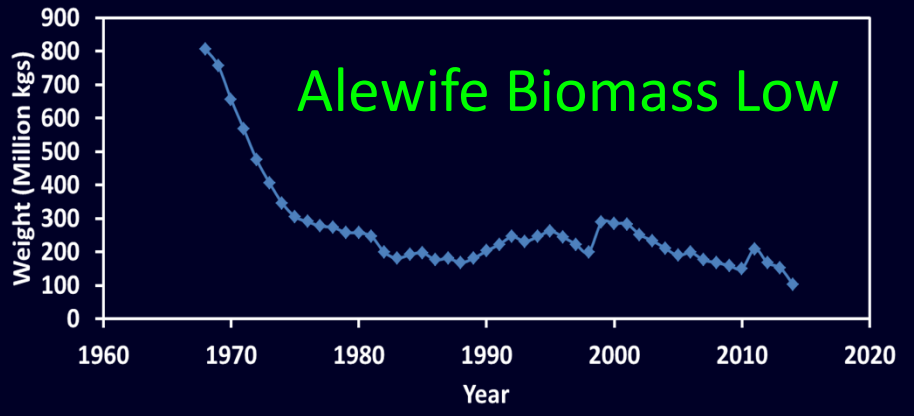
Overview & Conclusions

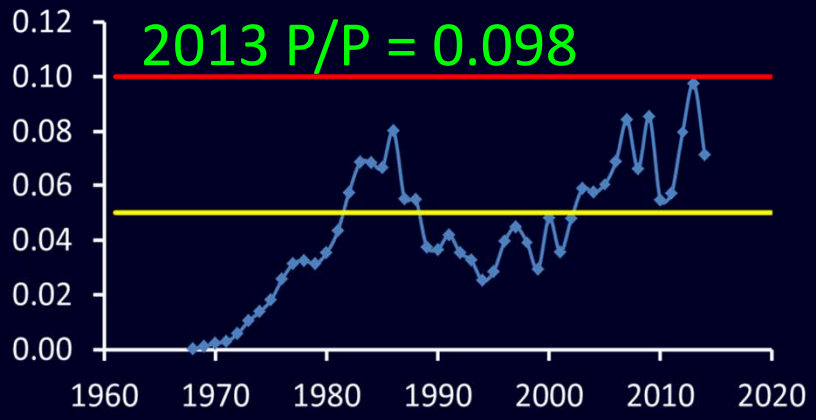




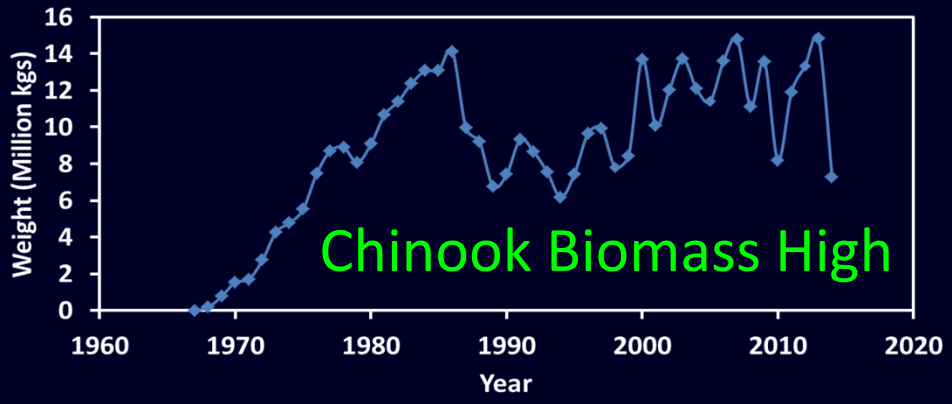
Overview & Conclusions

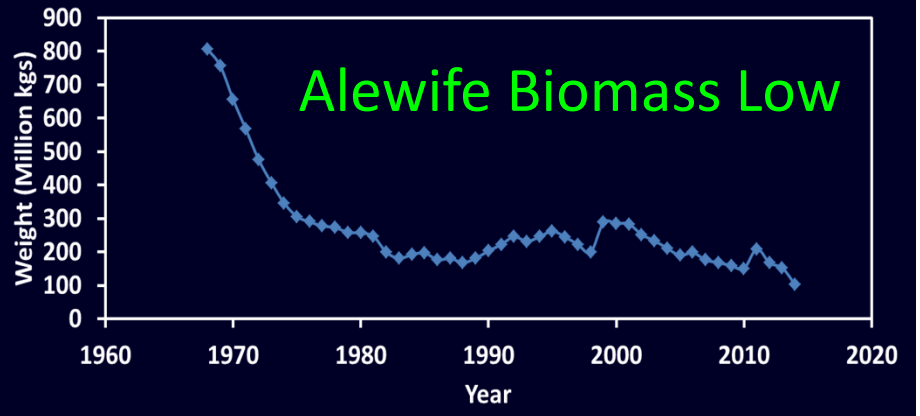


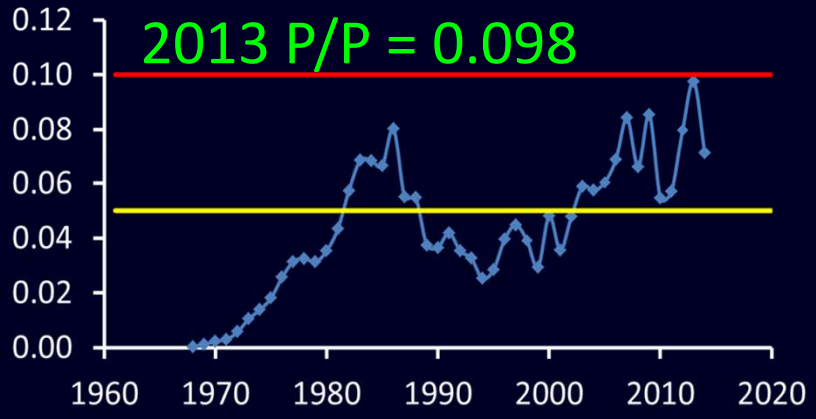


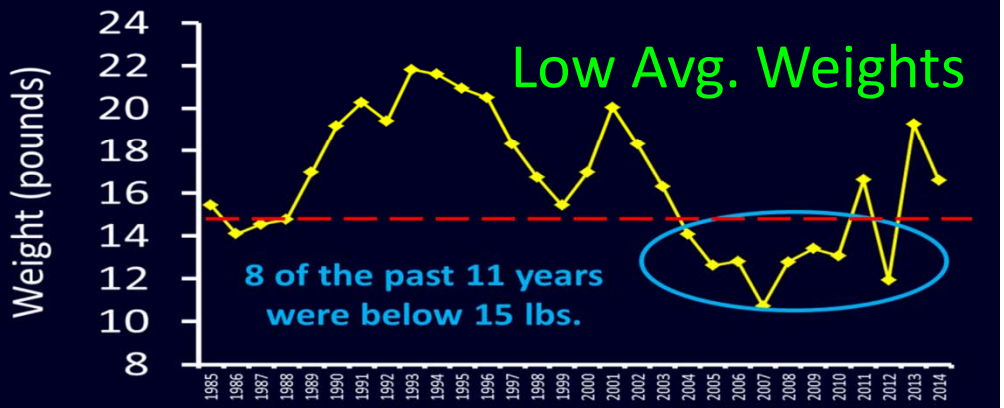


Overview & Conclusions

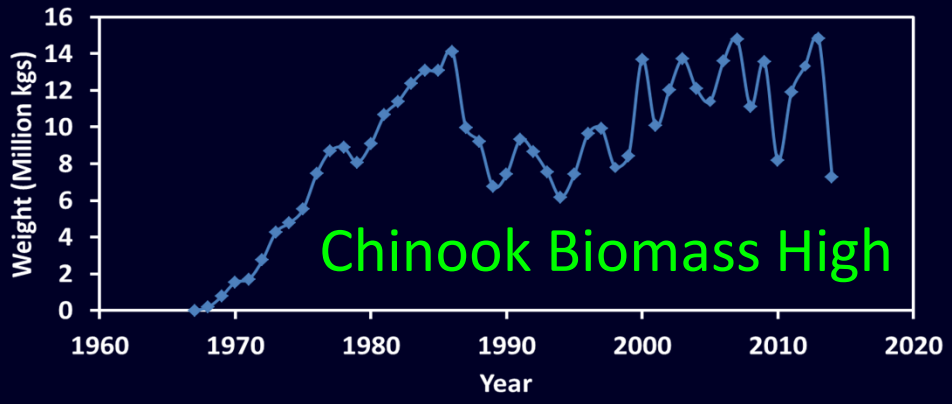


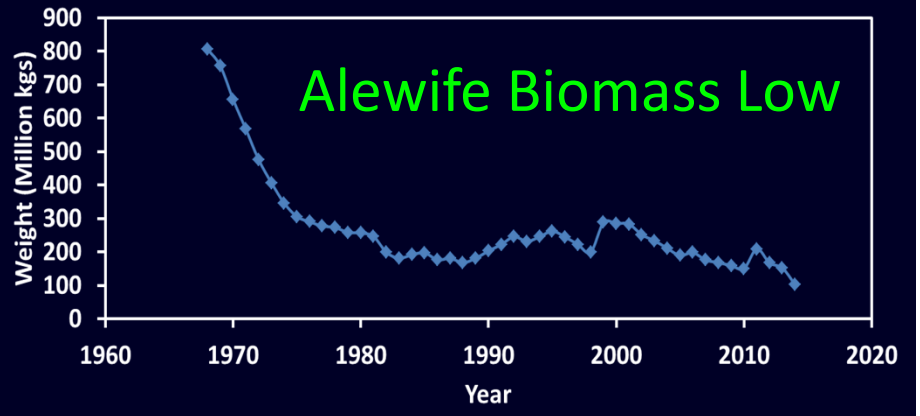


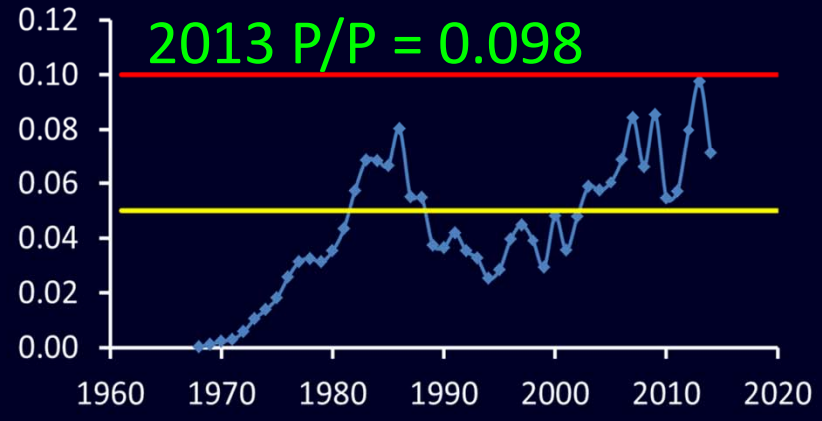


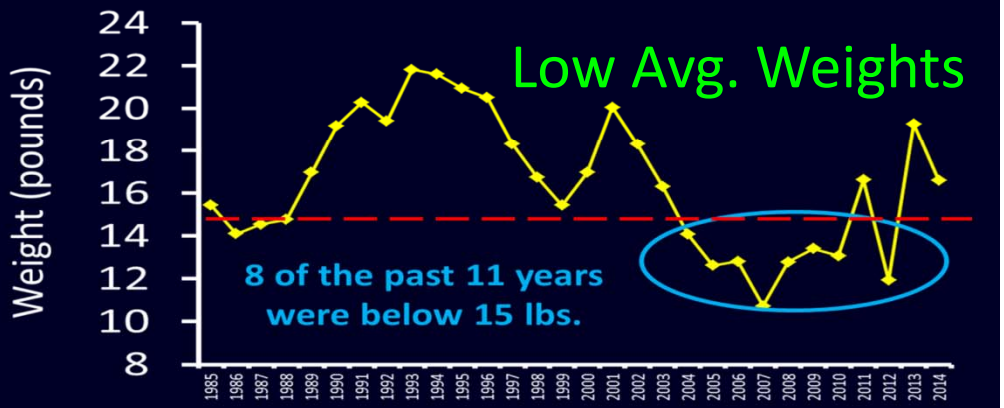


Overview & Conclusions









- What does 2015 data look like?
- Will continue to monitor predator/prey balance & discuss future management strategies.

Acknowledgements & Coauthors

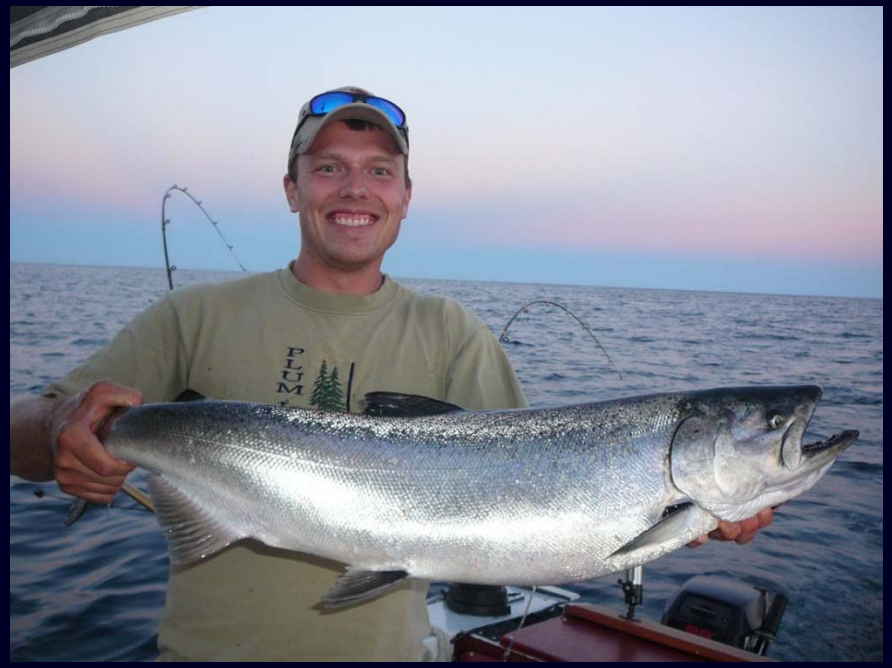
Salmonid Working Group:

- Nick Legler (WI DNR, chair)
- Randy Claramunt, Mark Tonello (MI DNR)
- Brian Breidert, Ben Dickinson (IN DNR)
- Steve Robillard (IL DNR)
- Greg Wright (CORA)
- Dave Warner, Chuck Madenjian (USGS)
- Mark Holey, Chuck Bronte, Matt Kornis, Rob Elliott (USFWS)
- **Richard Clark** (QFC, MSU)
- **Iyob Tsehaye** (WI DNR)

Key Collaborations:

- Great Lakes Fishery Commission
- Lake Michigan Committee
- Planktivore Working Group
- USFWS Mass Marking Program
- **Several agencies & personal provided input, data, etc.**

Questions?



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920-746-5112 (desk)
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Status of the Mass Marking Program in Lake Michigan

Charles R. Bronte
U.S. Fish and Wildlife Service
Great Lakes Fish Tag and Recovery Lab
New Franken, Wisconsin

Outline

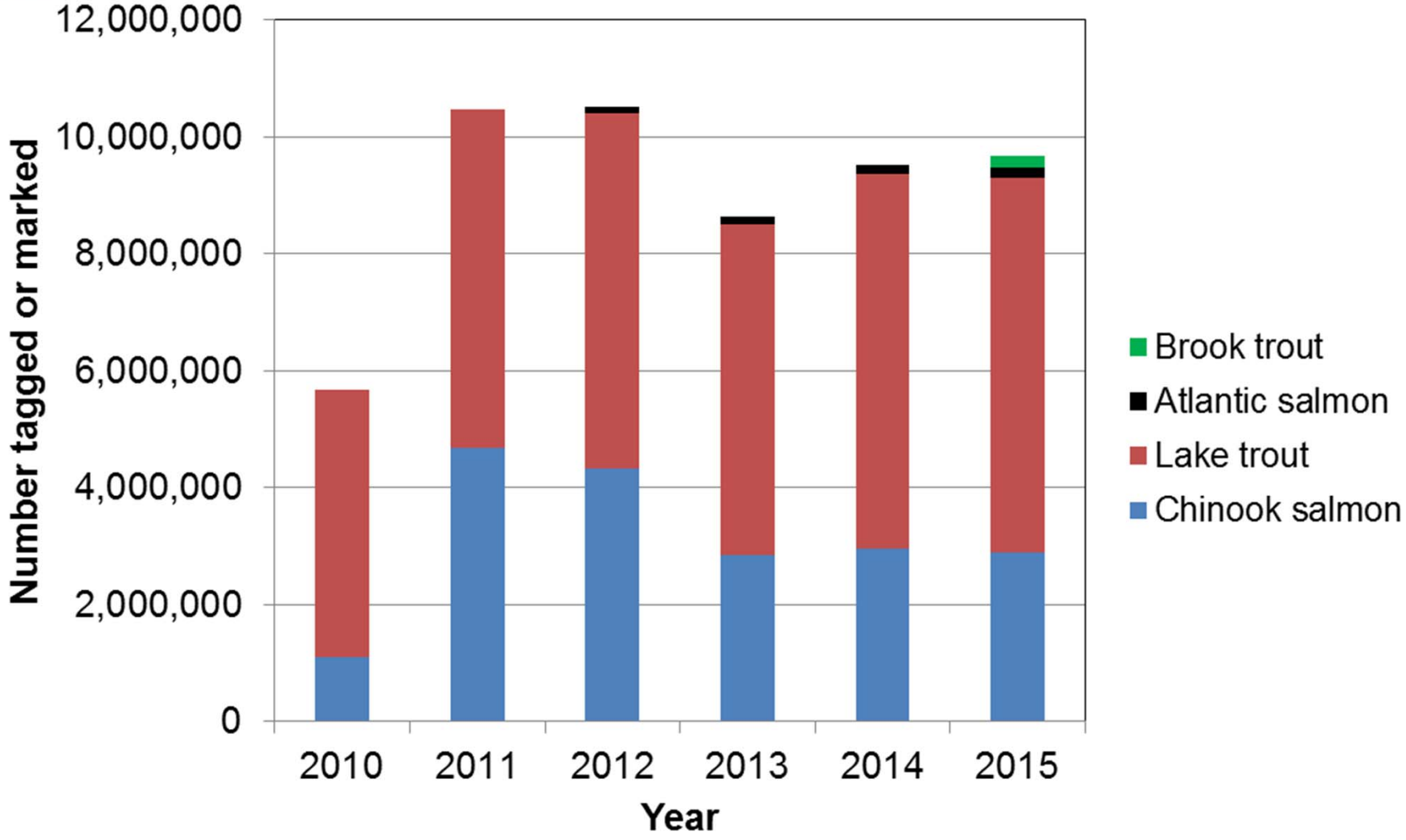
- Program Overview
- Chinook Salmon Results
  - Wild recruitment
  - Post-stocking survival
  - Movement
- Legacy Lake Trout Results
  - Post-stocking survival
  - Movement

Great Lakes Mass Marking Program
FY 2008-2016 Federal (non-base) Funding

Fiscal 2008: $1.7 million for equipment (Approp)
Fiscal 2009: $1.5 million for equipment (Approp)
Fiscal 2010: $1.0 million for operations (Approp); $2.6 million for equipment (GLFWRA/GLRI)
Fiscal 2011-14: $1.5 million/year for operations (GLRI)
Fiscal 2015: $1.0 + 0.5 million for operations (GLRI)
Fiscal 2016: $0.8? million + 0.6? for operations (GLRI)

This program is NOT funded by the U.S. Fish and Wildlife Service budget!

Number of fish by species tagged/marked by the Great Lakes Fish Tag and Recovery Lab, 2010-2015



Tagging schedule in 2015

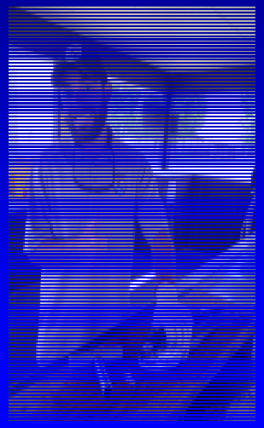
Agency	Hatchery	Dates	Species	Number of fish	Run hours	Mean length mm
ILDNR	Jake Wolf	Mar 11 - 15	Chinook	257,996	312	96
INDNR	Mixsawbah	Mar 18 - 21	Chinook	203,123	232	83
WIDNR	Kettle Moraine	Mar 30 - Apr 1	Chinook	176,113	183	71
MIDNR	Wolf Lake	Mar 23 - 27	Chinook	248,961	290	84
WIDNR	Wild Rose	Apr 7 - 14	Chinook	643,852	668	76
MIDNR	Thompson (ADCWT)	Apr 29	Chinook	53,233	63	81
MIDNR	Thompson (AD only)	Apr 30 - May 4	Chinook	411,761	423	81
MIDNR	Platte River	Apr 22 - 30	Chinook	973,758	1061	80
	Total Chinook salmon			**2,968,797**	**3232**	
MIDNR	Marquette	July 9 - 12	Lake trout	218,849	267	86
USFWS	Pendills Creek	Aug 4 - Sept 2	Lake trout	1,152,182	166	96
USFWS	Jordan River	Aug 5 - Sept 26	Lake trout	2,393,846	3391	88
USFWS	Iron River	Sep 23 - Oct 5	Lake trout	1,268,064	1390	92
USFWS	Allegheny	Aug 19 - Sept 13	Lake trout	1,111,754	1368	87
USFWS	Eisenhower	Sep 16-20	Lake trout	245,130	329	98
	Total Lake trout			**6,389,825**	**8405**	
MIDNR	Platte River (ADCWT)	Jul 14 - 18	ATS	190,170	312	84

Tag Recovery and Data Field Operations

Data collection, data archiving, tag recovery, tag extraction, and ageing wild fish

- Hired technicians to work with states
  - 2 Milwaukee, WI
  - 1 Zion, IL
  - 2 Charlevoix, MI
  - 2 Michigan City, IN
  - 2 Sturgeon Bay, WI
  - 2 Alpena, MI
  - 2 Lake Ontario

Tag Recovery and Bio Data Field Operation



Collected Data on each fish:

- Species
- Capture date and location (management unit and grid)
- Length, weight, sex and maturity
- Fin-clip status
- Presence/absence of CWT
- Lamprey wounding (A and B rating system)
- Year class/age by CWT or calcified structure
- Collection method (e.g., tech, angler return)
- Interview source (i.e., angler, charter, tournament)
- Sample bias

Collected in 2014 – 2016 for related studies

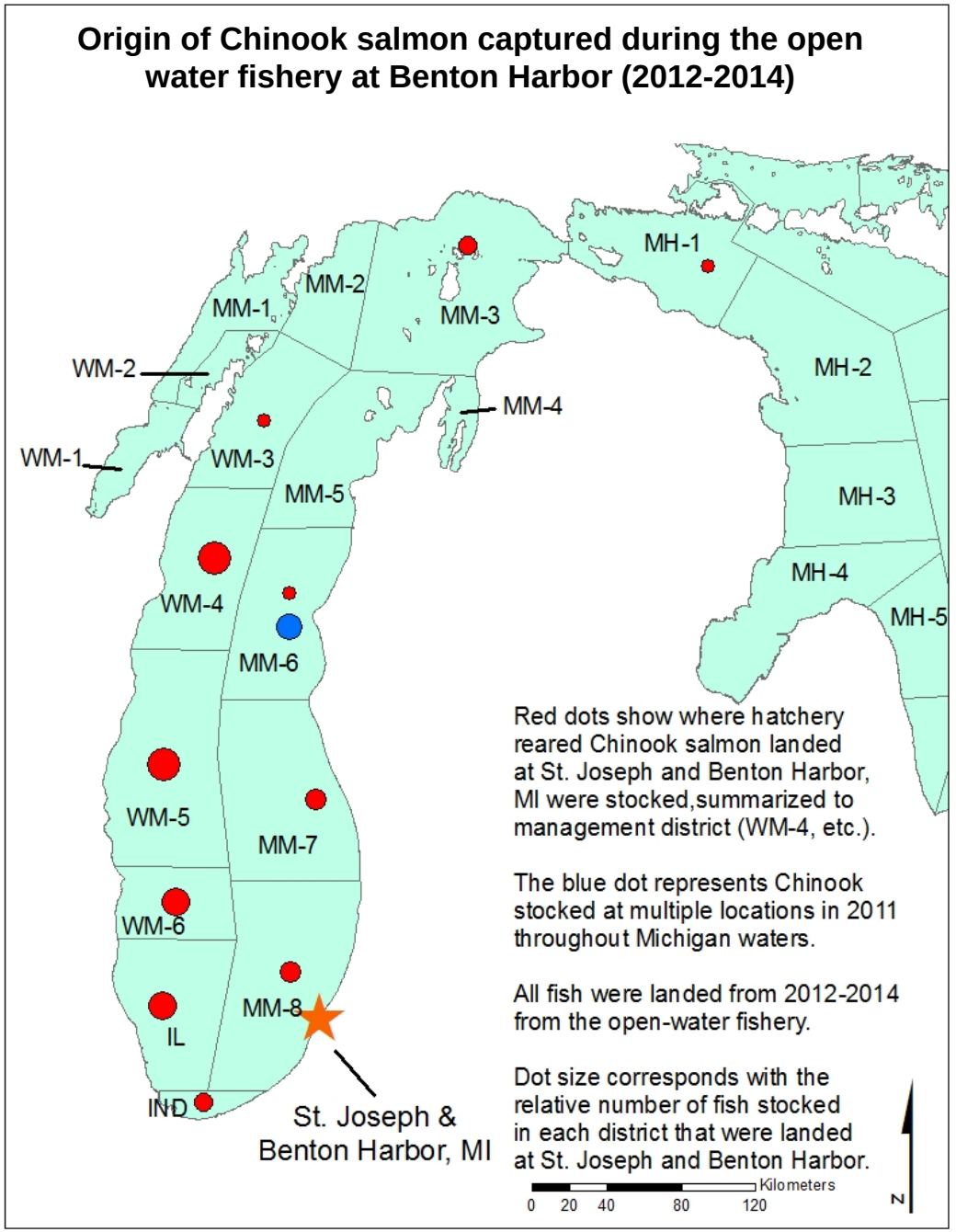
- Muscle tissue (stable isotopes)
- Belly tissue (fatty acid analysis)
- Stomachs (gut content analysis)

Tag Extraction and Reading

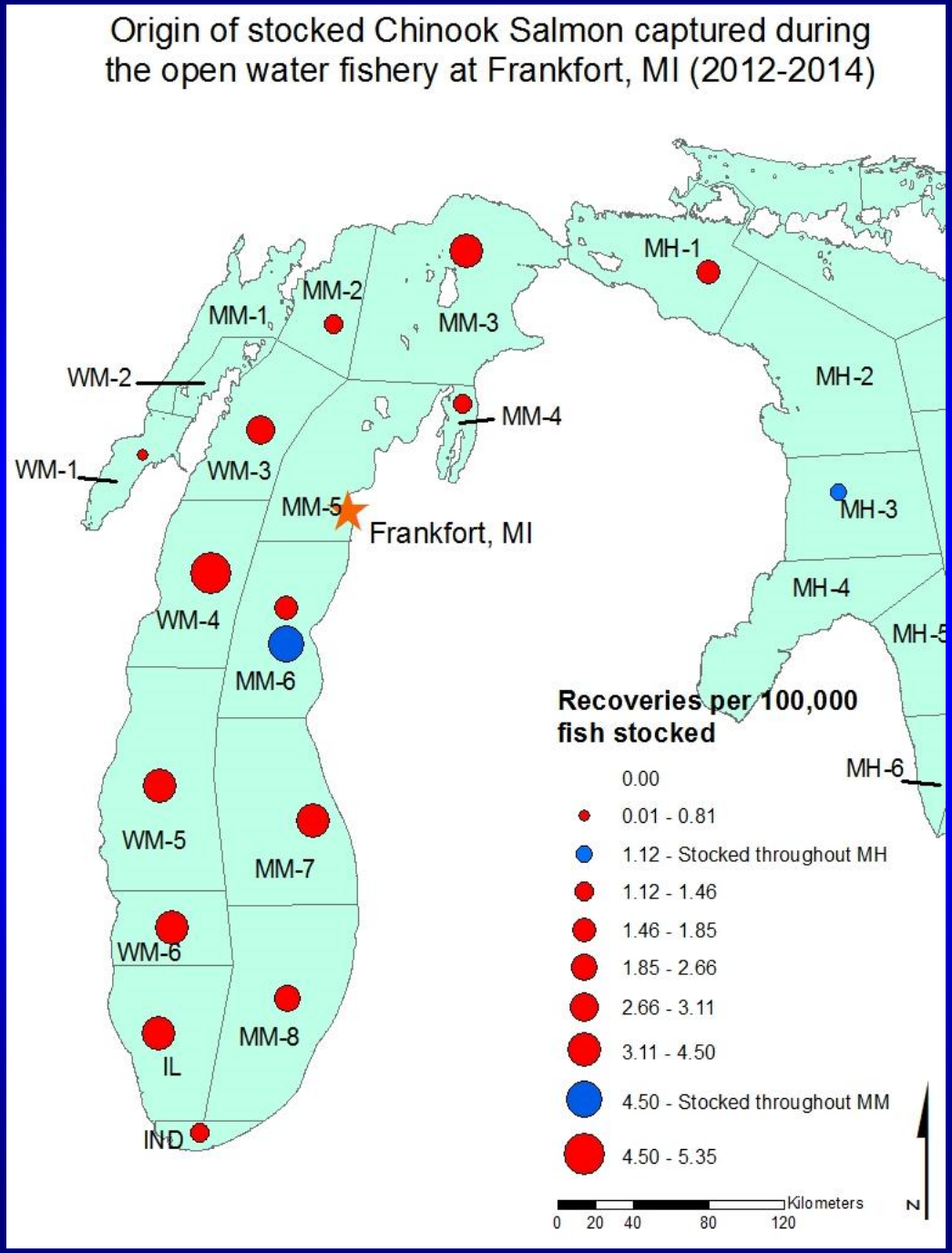
- Over 65,000 snouts (15,560 in 2015) have been processed, with more than 60,000 CWTs recovered through January 2016.

Tag recovery and read	92.1%
No tag detected	5.5%
Tag lost at extraction	1.3%
Tag damaged and not readable	<0.1%
Tag lost at reading	0.6%
Tag lost, found and read	0.5%

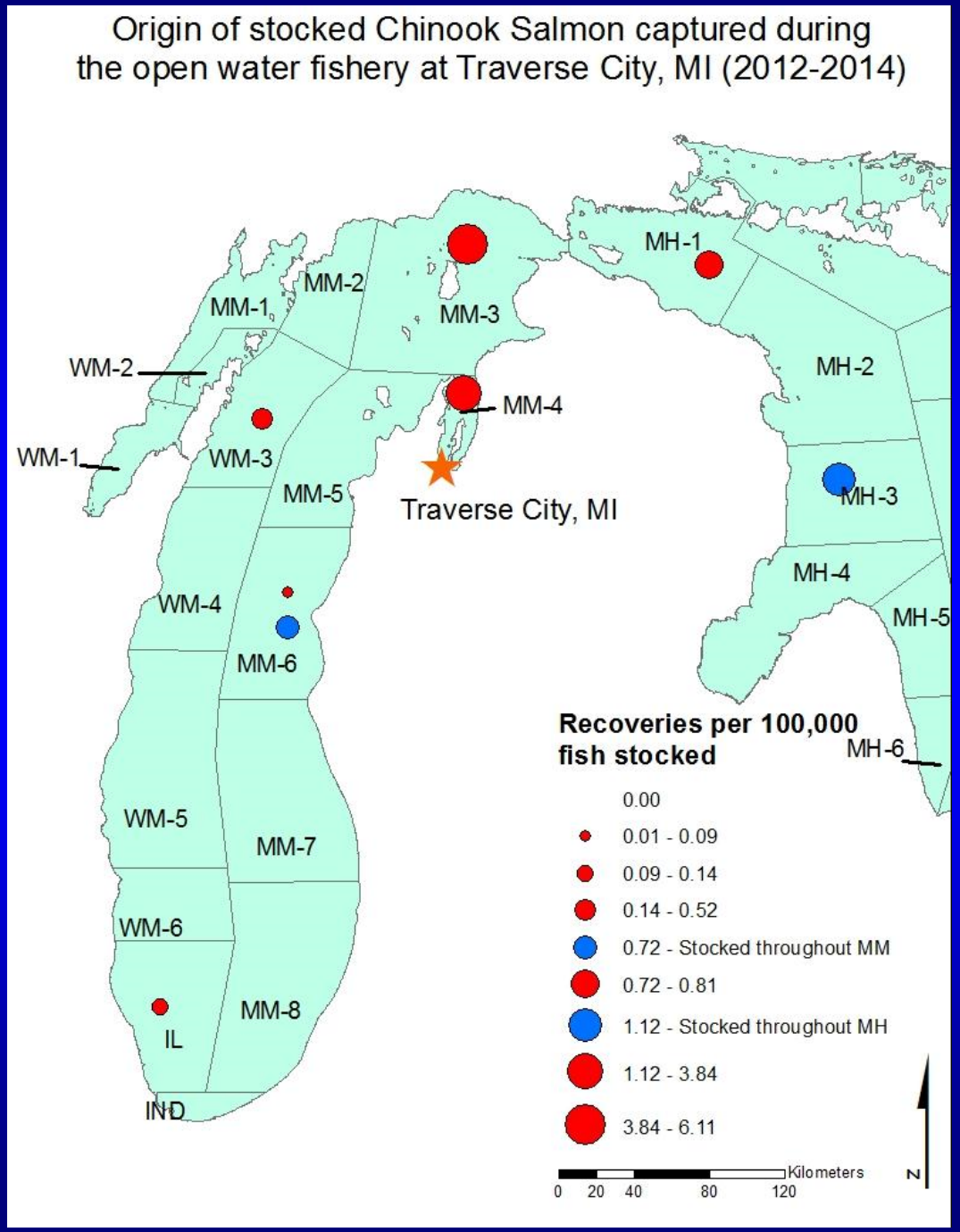
Chinook Salmon Captured at St Joseph/Benton Harbor, MI



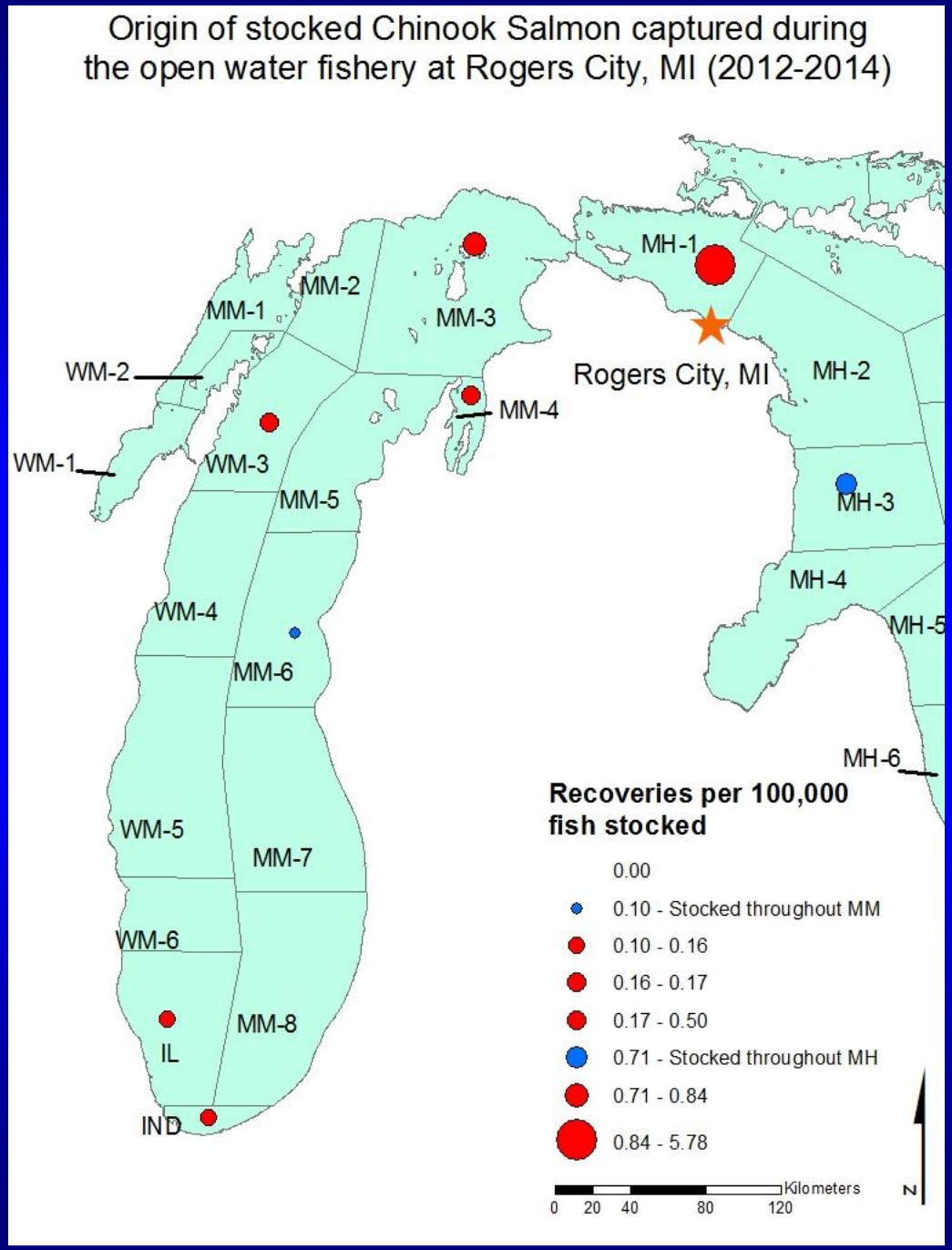
Chinook Salmon Captured at Frankfort, MI



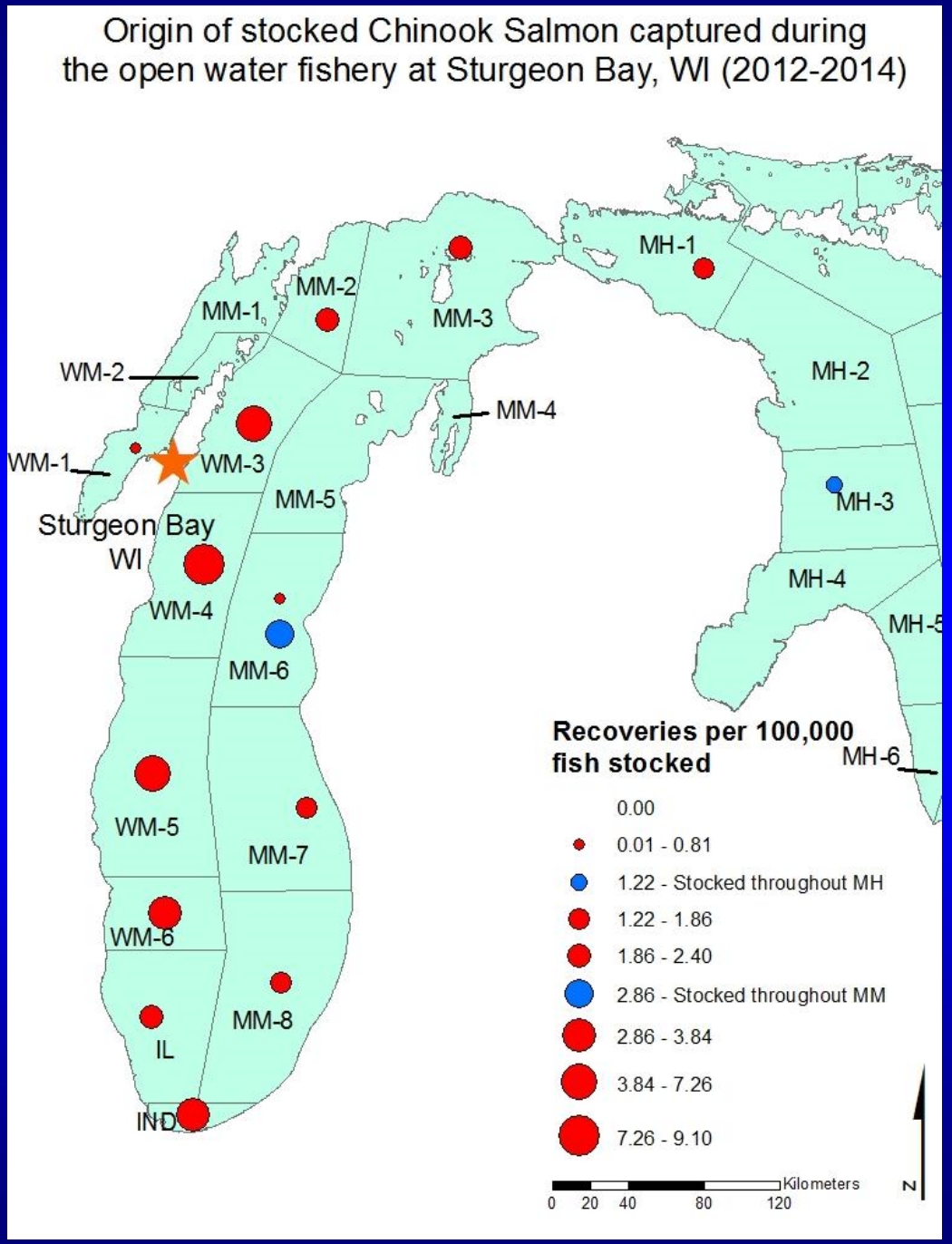
Chinook Salmon Captured at Traverse City, MI



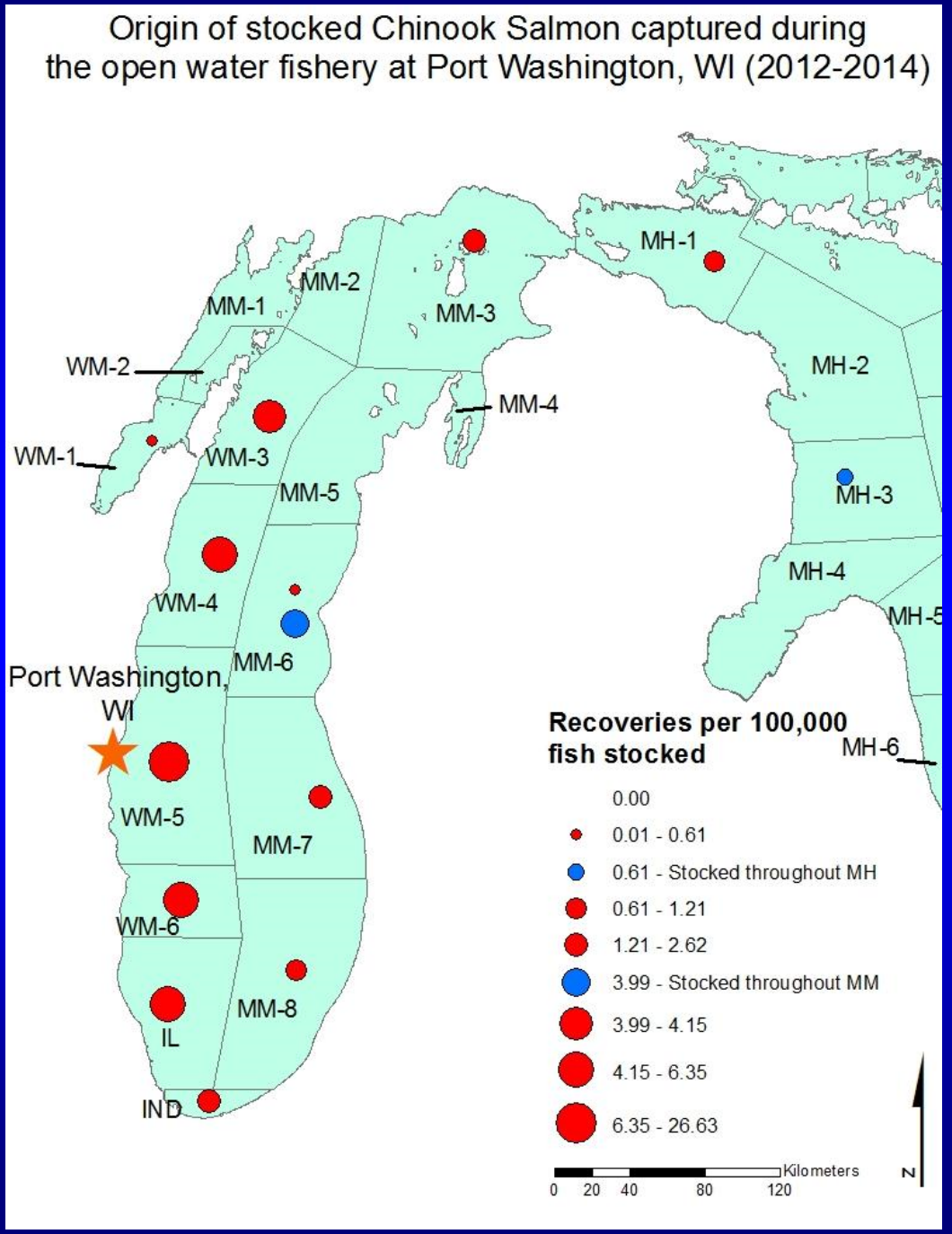
Chinook Salmon Captured at Rogers City, MI



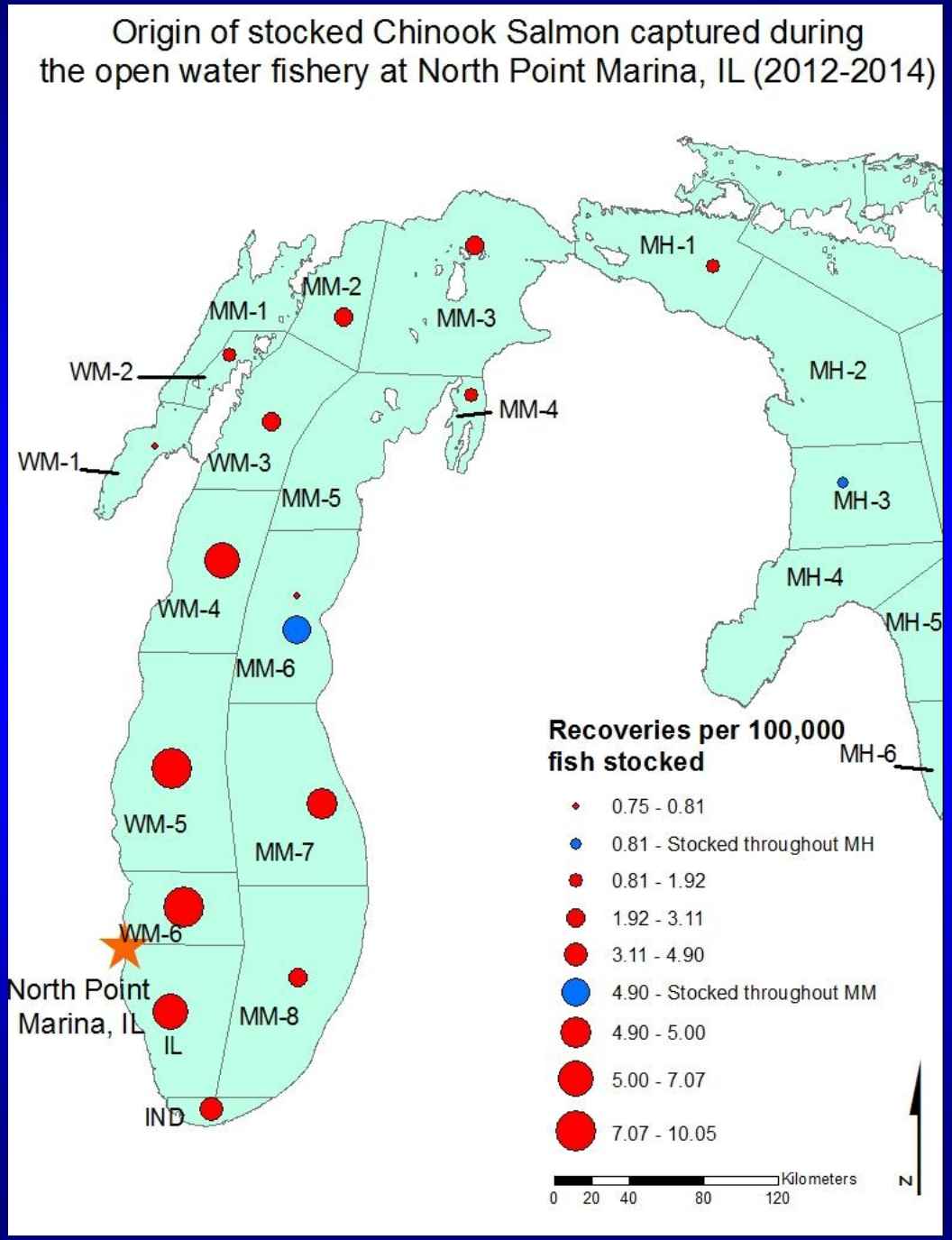
Chinook Salmon Captured at Sturgeon Bay, WI



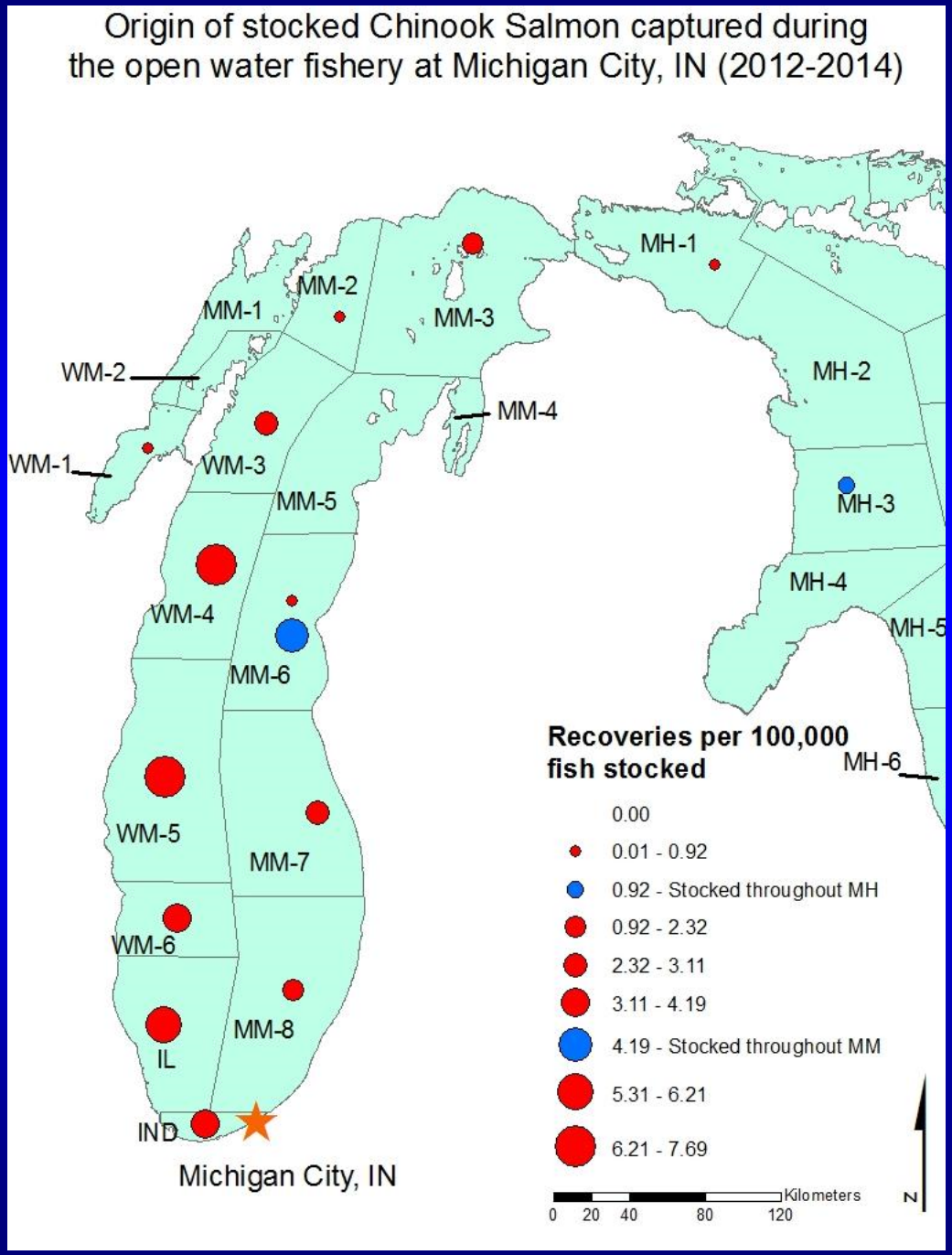
Chinook Salmon Captured at Port Washington, WI



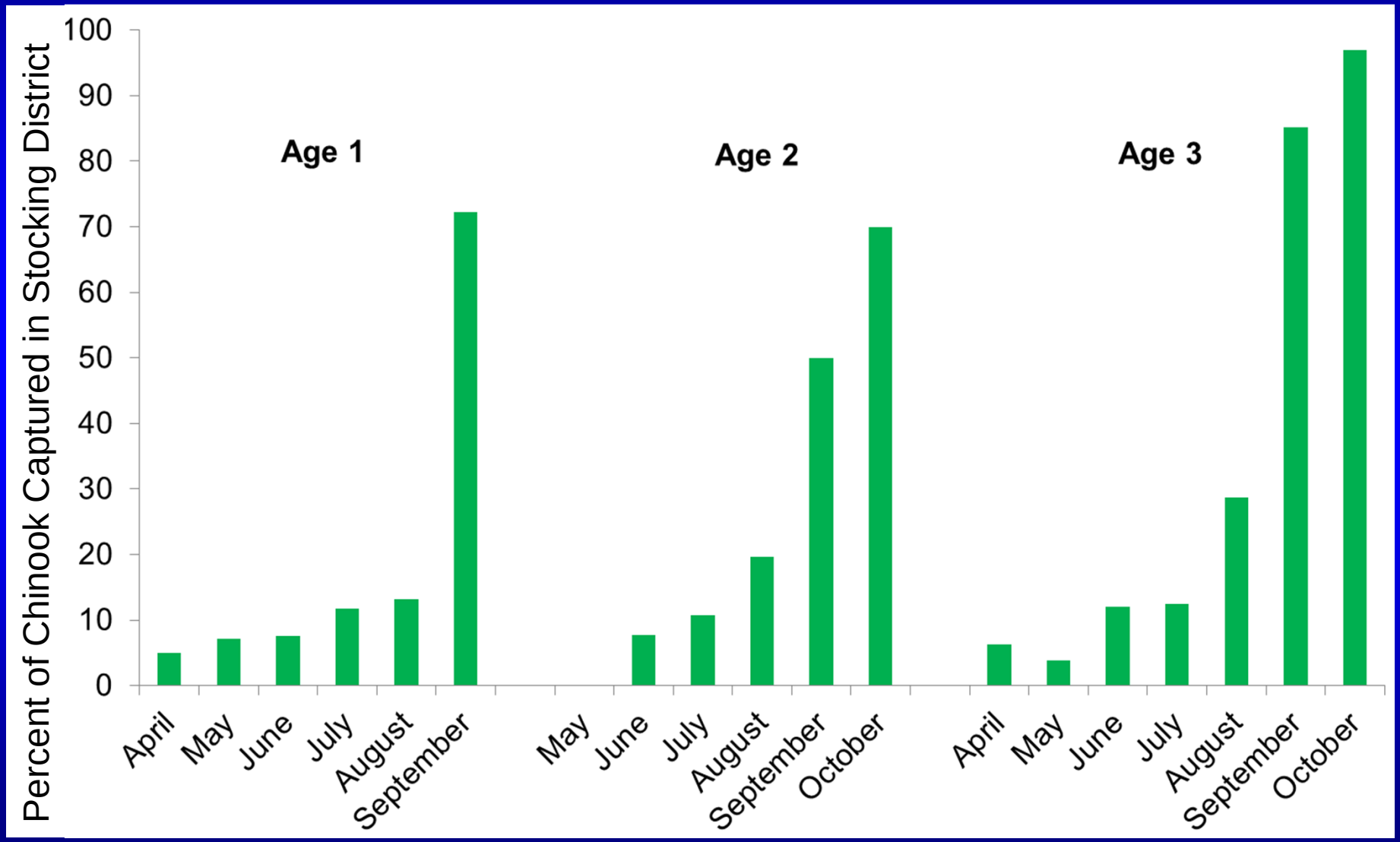
Chinook Salmon Captured at North Point Marina, IL



Chinook Salmon Captured at Michigan City, IN



Capture of Chinook salmon in stocking district by month
2011 Year Class Only



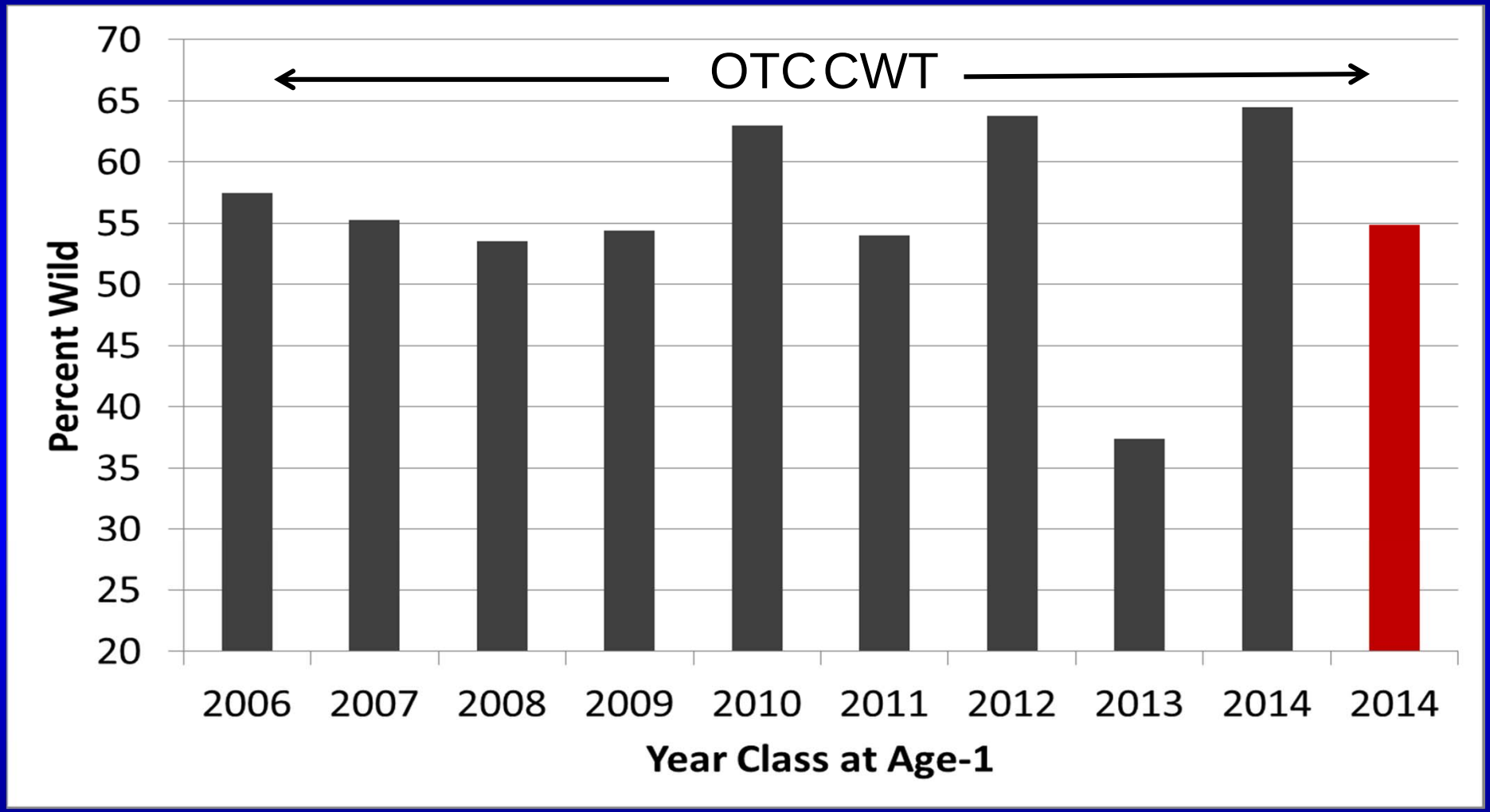
Movement of Stocked Chinook salmon between lakes Huron and Michigan

Fish sampled from April-August , 2012-2014

Lake stocked	Total recovered	Number recovered from lake where stocked	Percent movement
Michigan	5,877	5,701	3%
Huron	815	85	90%
	6,692		

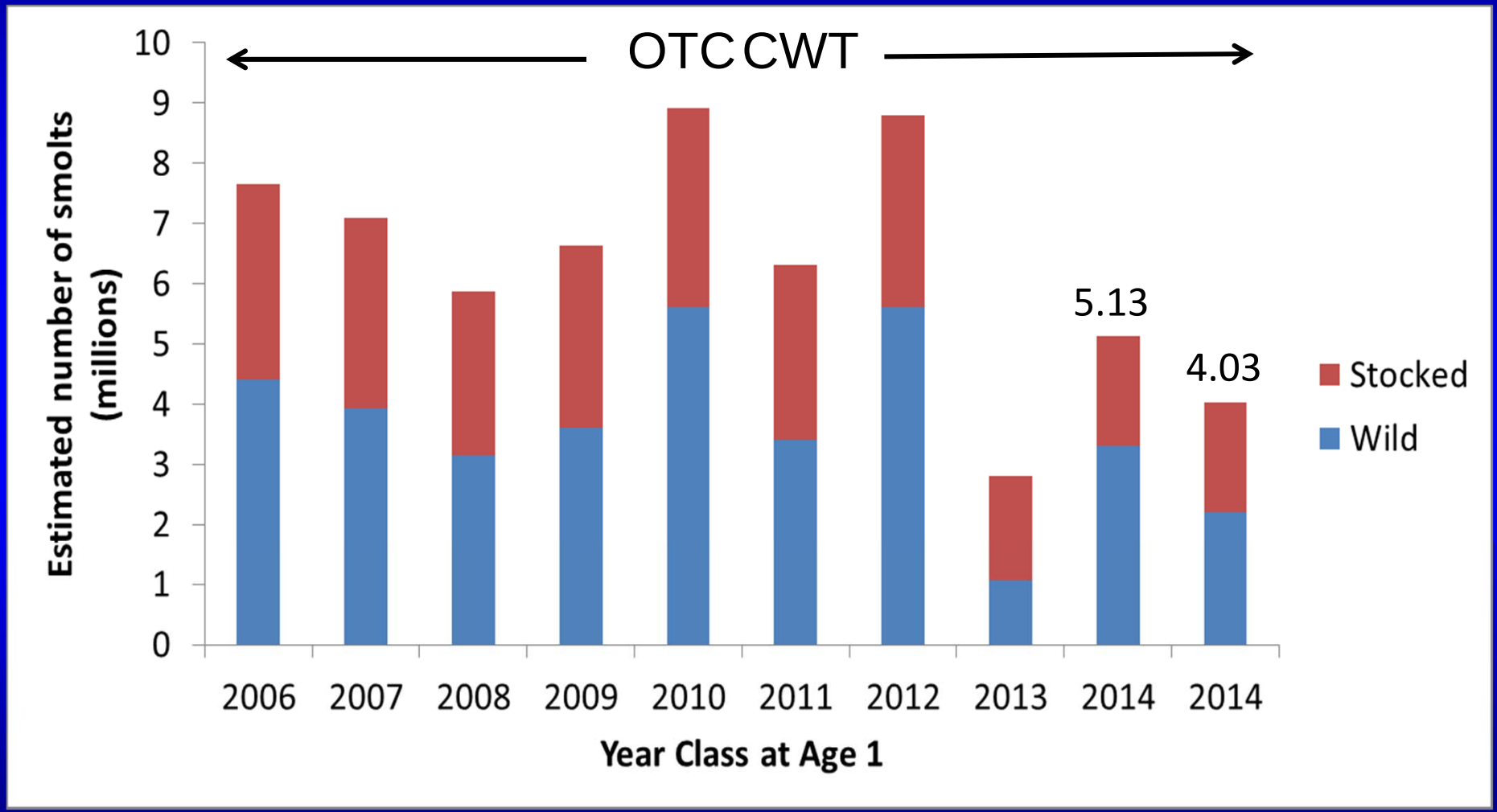
Percent wild recruitment of Chinook Salmon

2006–2014 year classes



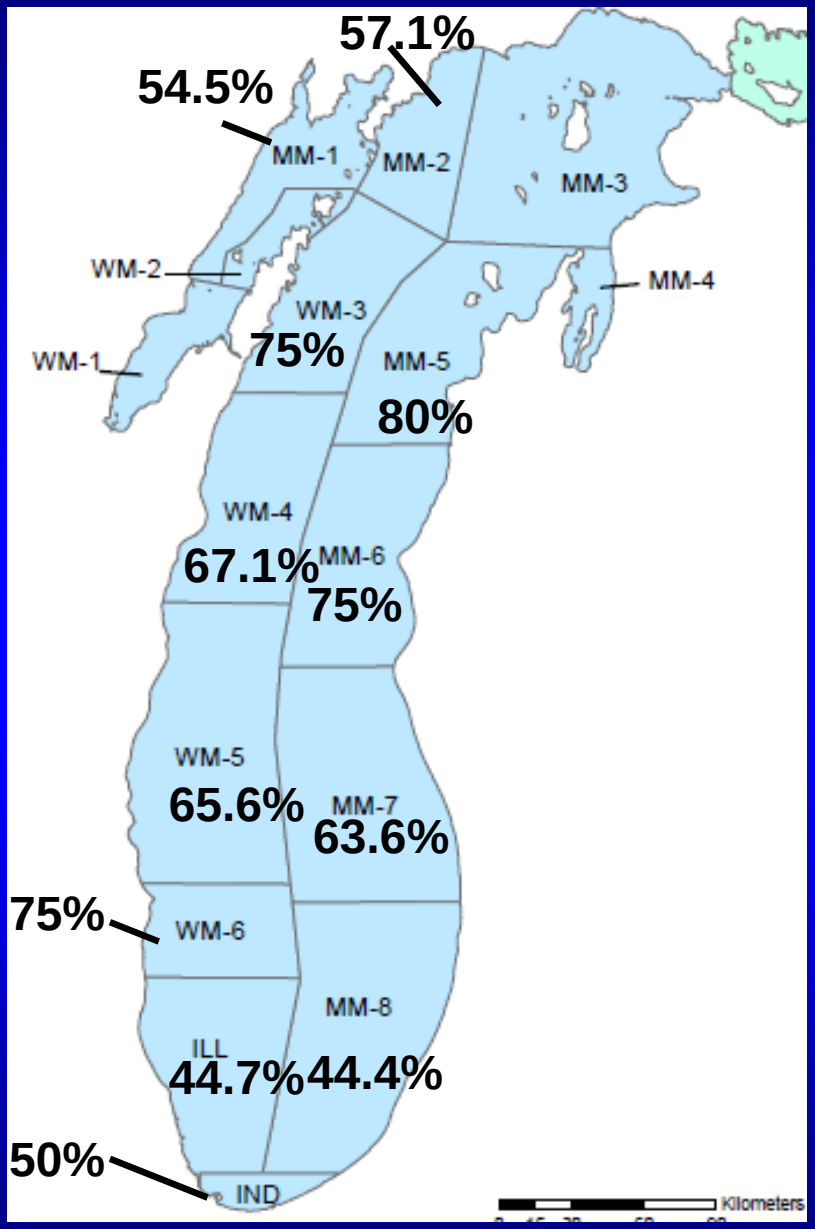
Recruitment estimates of Chinook Salmon at age 1

2006-2014 year classes



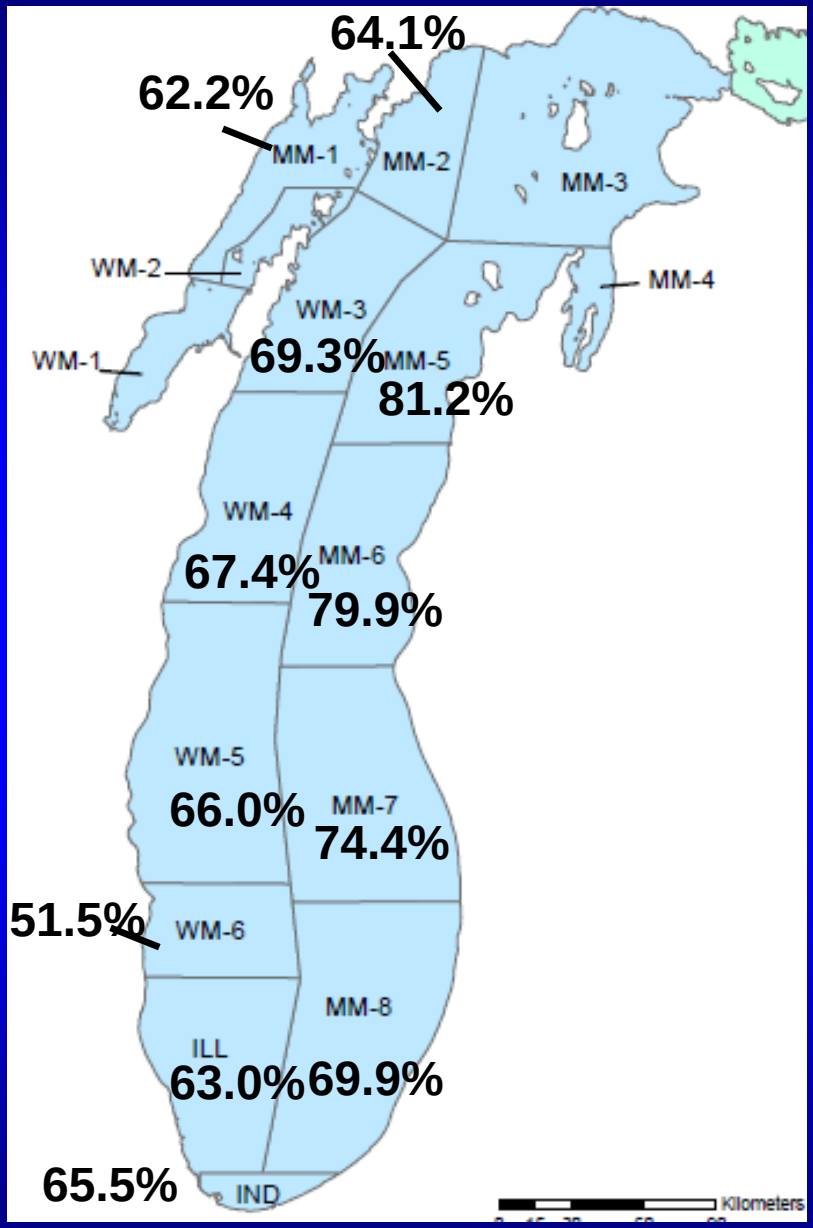
Percent Wild Chinook salmon 2014 yearclass at age 1 by Stat District

Overall 64.4% wild

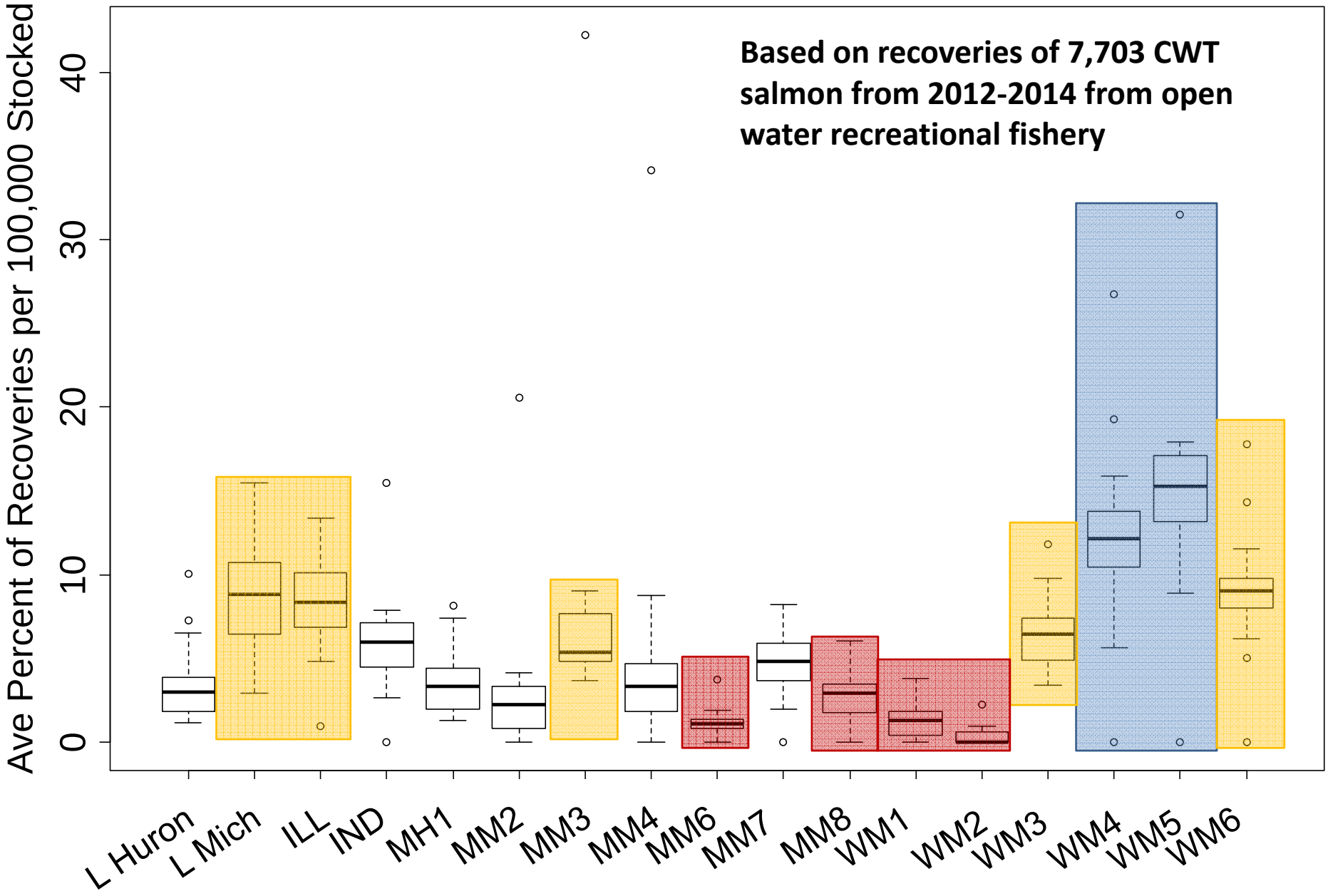


Percent Wild Chinook salmon all yearclasses in 2015 by Stat District

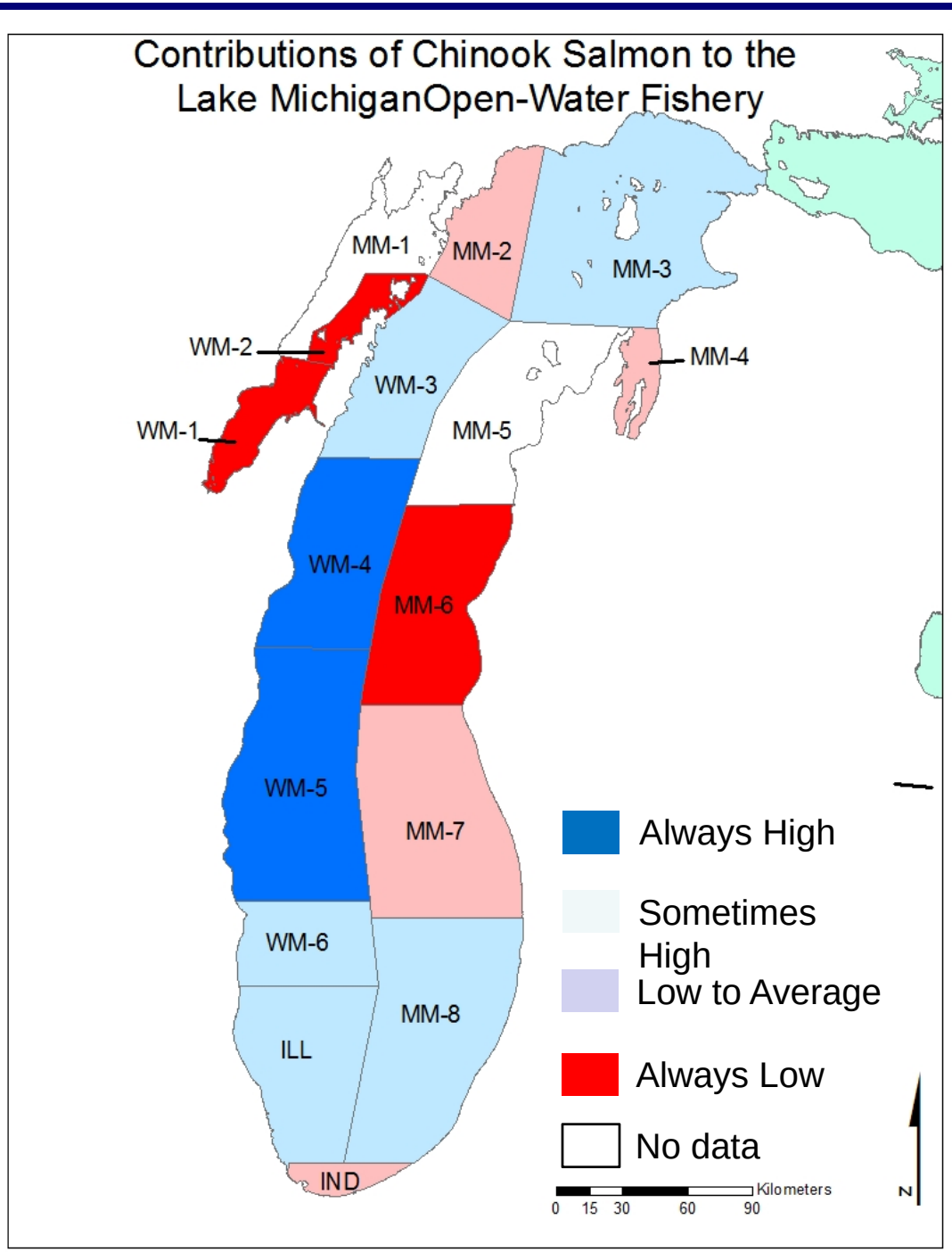
Overall 69.2% wild



Relative survival among statistical districts



Summary of post-stocking survival Chinook salmon by district



Summary for Chinook salmon results

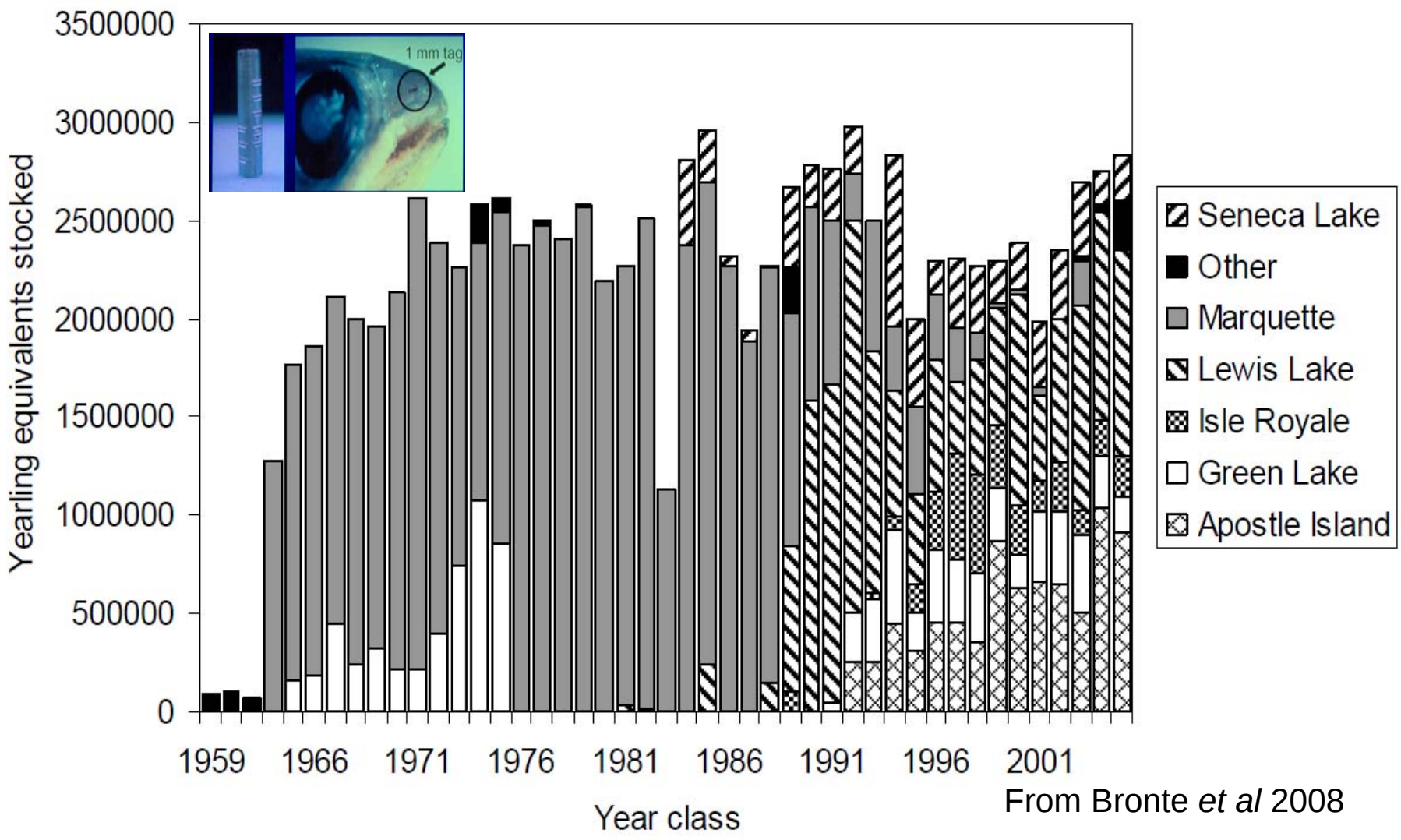
1) Lake-wide mixing of Chinook salmon during the feeding season
2) Chinook salmon stocked in Lake Huron feed in Lake Michigan and most are caught there.
3) Chinook salmon travel great distances, but have high fidelity to stocking district in autumn
4) Chinook salmon wild recruitment varies over space and time; weaker 2013-2014 year classes
5) Post-stocking survival of Chinook salmon appears greatest on the western shore of Lake Michigan

Factors affecting post-stocking survival of lake trout stocked in Lake Michigan, USA

Matthew S Kornis[1], Ted J Treska[1], Dale Hanson[1], Mark E Holey[1], Charles P Madenjian[2], David Boyarski[3], Erik Olsen[4], Kevin Donner[5], Barry Weldon[6], Brian Breidert[7], Steven Robillard[8], Jory Jonas[9], and Charles R Bronte[1]

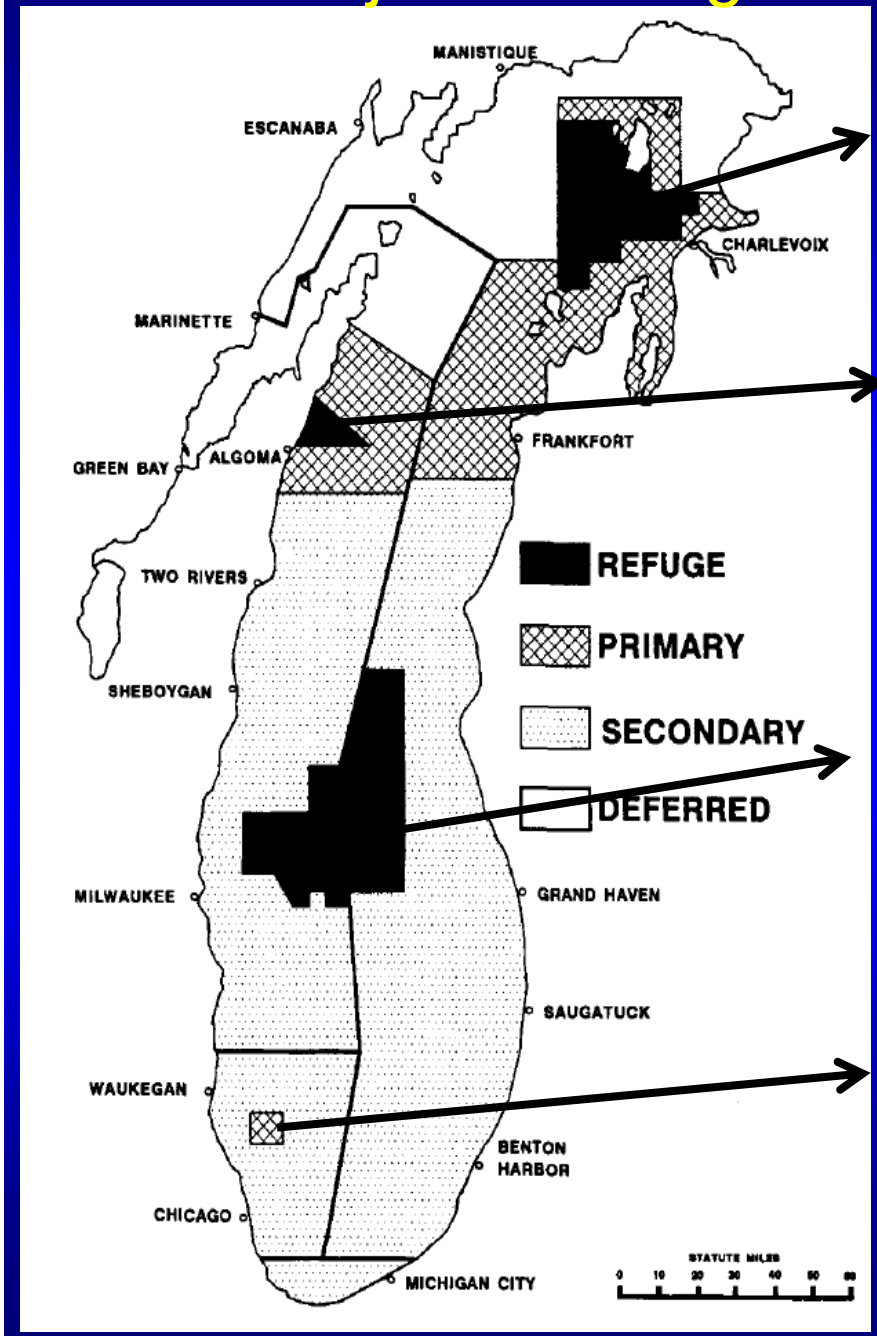
[1]US Fish and Wildlife Service, New Franken, WI
[2]US Geological Survey, Great Lakes Science Center, Ann Arbor, MI
[3]Wisconsin Department of Natural Resources, Sturgeon Bay, WI
[4]Grand Traverse Band of Ottawa and Chippewa Indians, Nat Res Dept, Suttons Bay, MI
[5]Little Traverse Bay Band of Odawa Indians, Natural Resources Dept, Harbor Springs, MI
[6]Little River Band of Ottawa Indians, Natural Resources Dept, Manistee, MI
[7]Indiana Department of Natural Resources, Michigan City, IN
[8]Illinois Department of Natural Resources, Des Plaines, IL
[9]Michigan Department of Natural Resources, Charlevoix, MI

Lake trout stocking in Lake Michigan



From Bronte *et al* 2008

Major stocking locations of CWT lake trout



Northern Refuge

Clay Banks

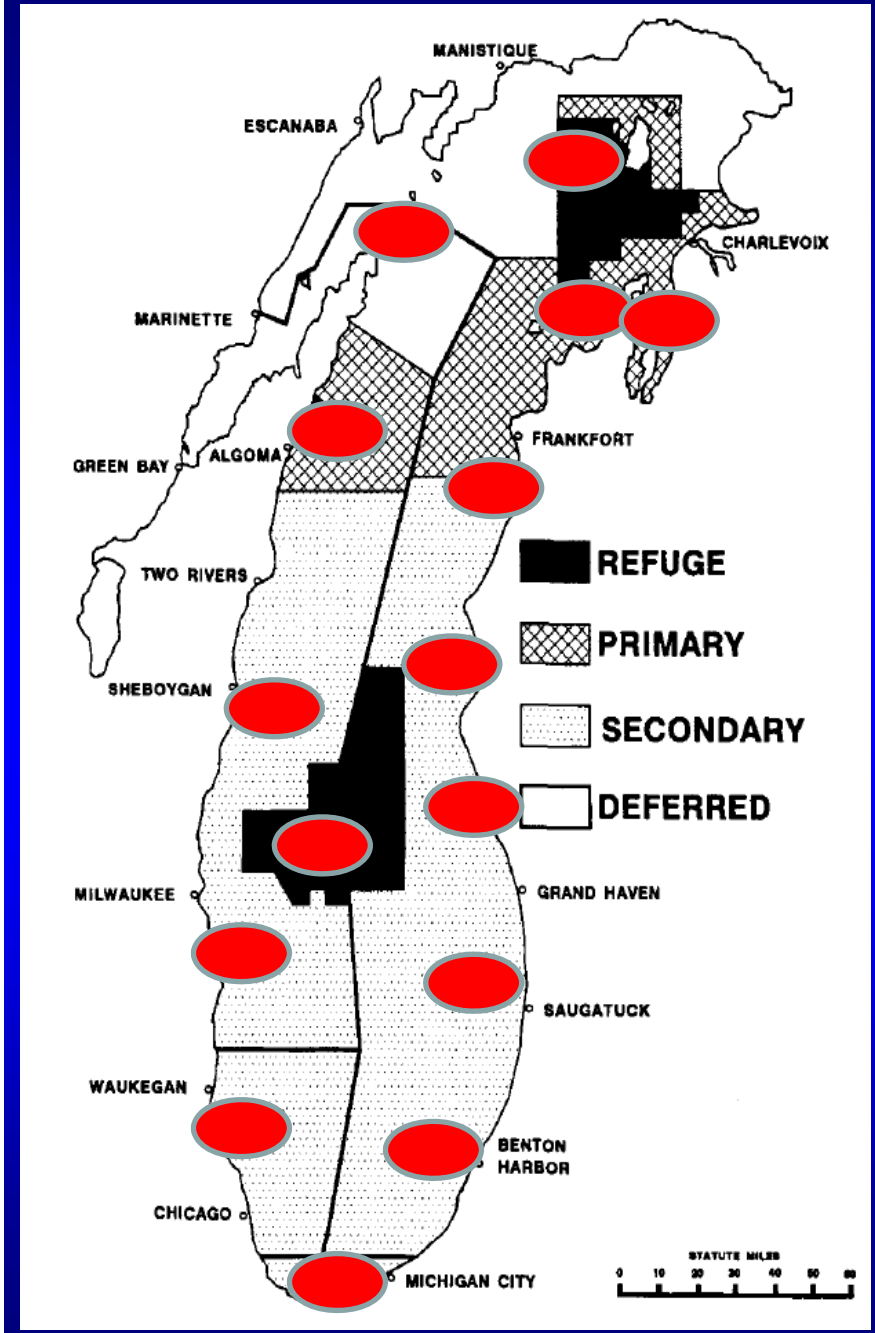
Southern Refuge

Julian's Reef

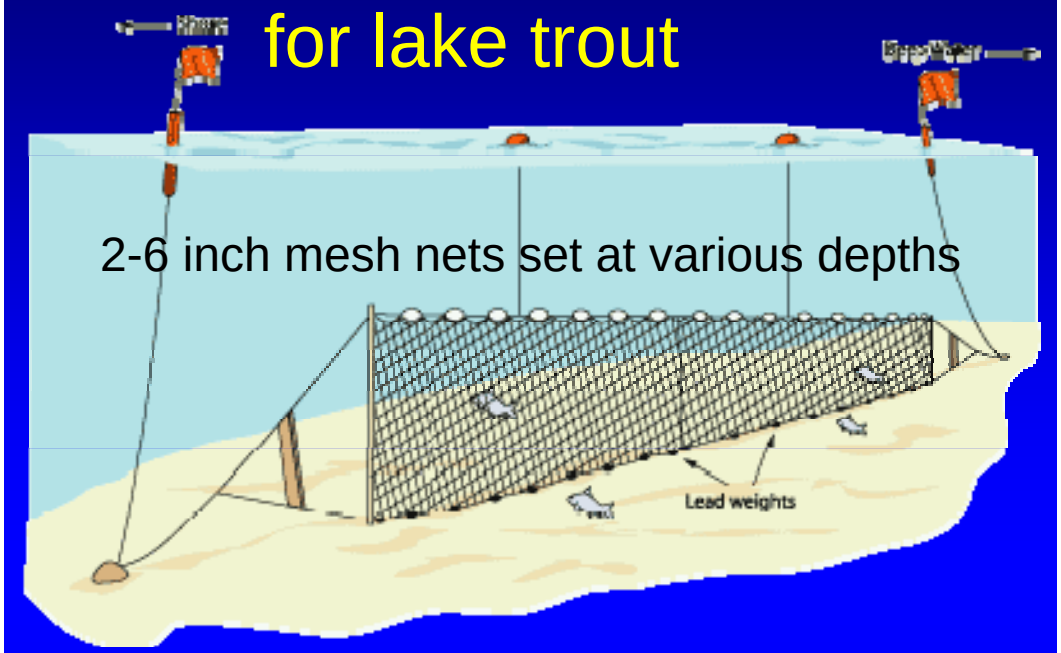
- Analysis focused on four stocking locations that were considered historically important
- Evaluating survival of 5 strains of lake trout

Lewis Lake, Green Lake; Isle Royale, Apostle Islands; Seneca Lake

- 1994-2003 year classes recovered during 1998-2014



Spring gill net assessment for lake trout

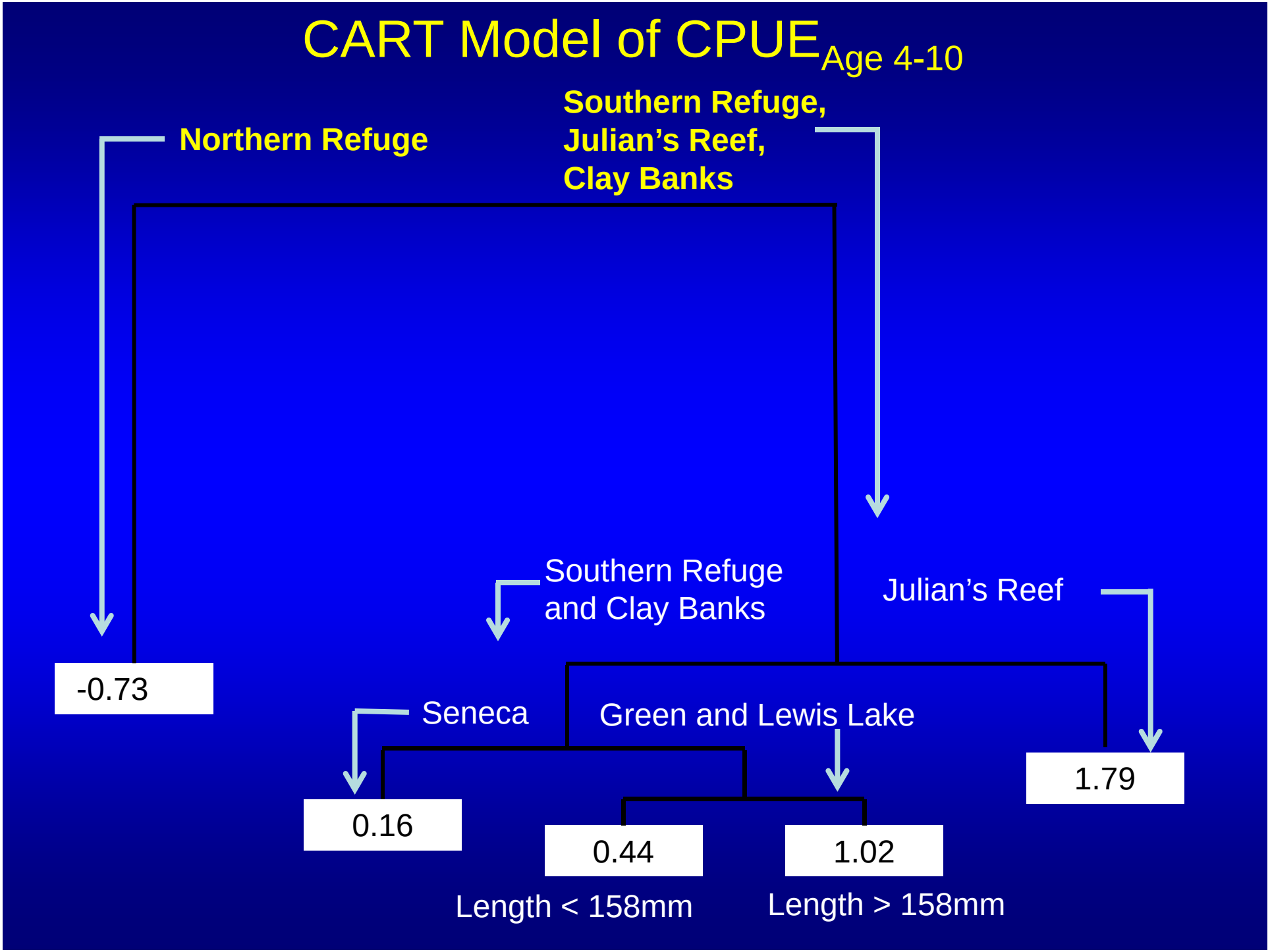


2-6 inch mesh nets set at various depths

Relative abundance
Age composition
Recover CWT fish
Sea lamprey wounding

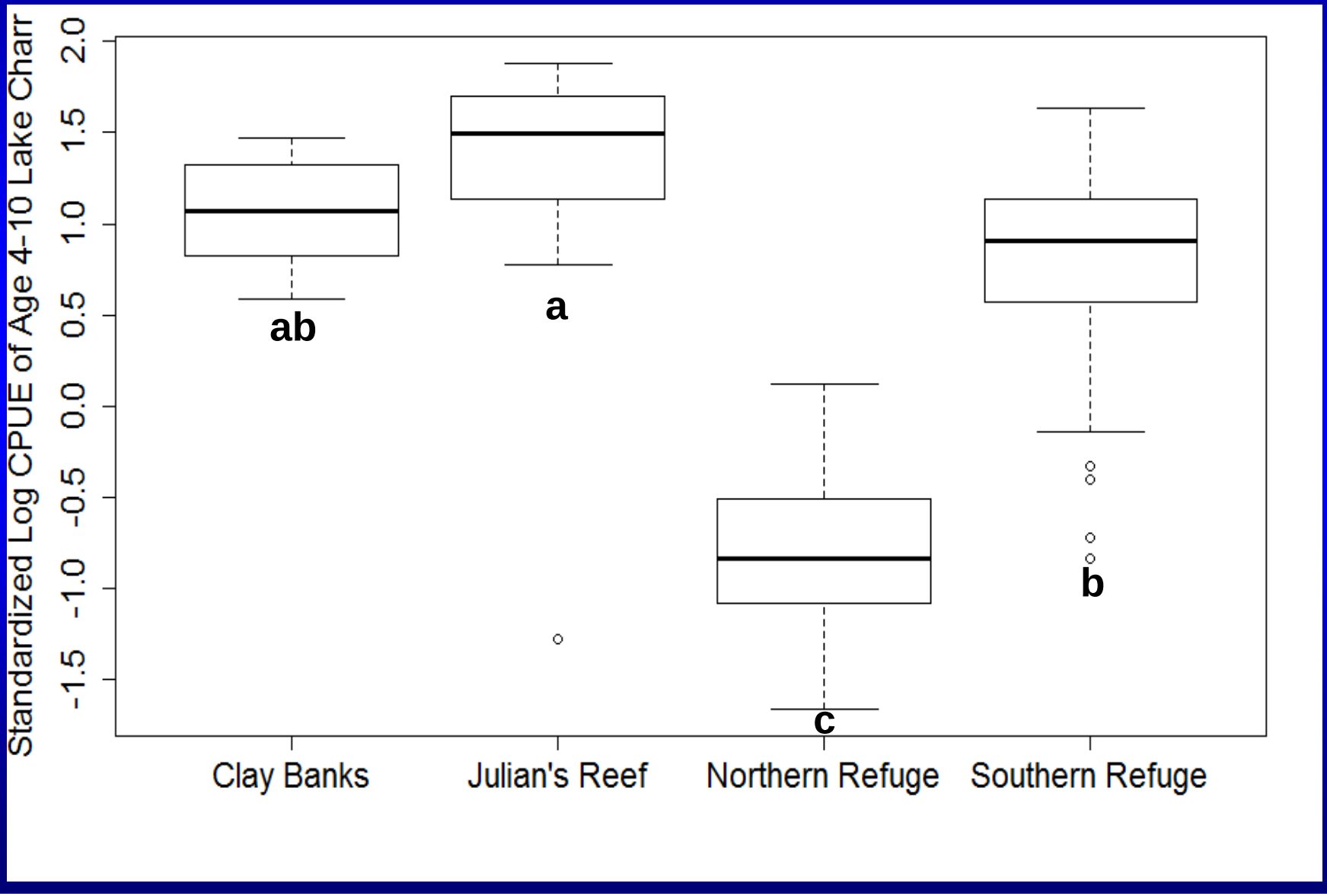
Evaluating Post-Stocking Survival – Response Variable

- CWT tag lots were the unit of replication
- Recoveries (CPUE) from spring assessment gill net catches corrected for year- and district-specific sampling effort, and for number of fish stocked
- For each tag lot, CPUEs at Ages 4 – 10 were pooled (modal ages)
- $CPUE_{Age\ 4\text{-}10}$ was standardized within each year class to remove inter-annual variability and served as our response variable
- Potential predictor variables: stocking location, strain, length at stocking, condition at stocking, and predator density at stocking
- Classification and Regression Tree (CART) analysis followed by node-specific ANOVAs and Tukey-Kramer procedures to determine those predictor variables that explained most of the variability in $CPUE_{Age\ 4\text{-}10}$


CART Model of CPUE Age 4-10
Northern Refuge
Southern Refuge, Julian's Reef, Clay Banks
Southern Refuge and Clay Banks
Julian's Reef
-0.73
Seneca
Green and Lewis Lake
1.79
0.16
0.44
1.02
Length < 158mm
Length > 158mm

First Node in Tree – Effect of stocking location

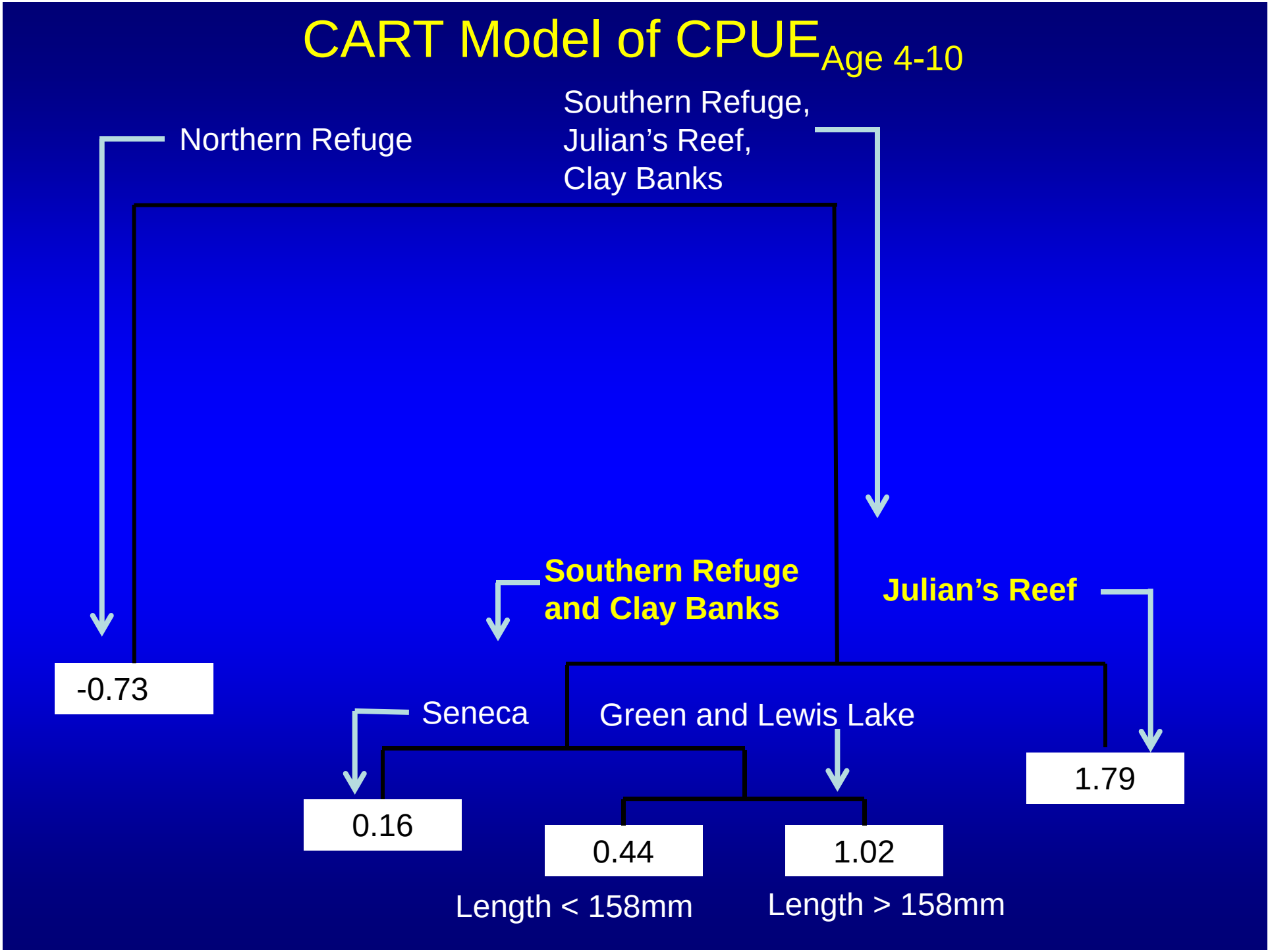
Northern Refuge CPUE lower than all other locations (*p* <0001); Southern Refuge < Julians Reef (*p* = 0003)



Total mortality estimates for lake trout by location

Stocking location	Ages	Annual mortality
Northern Refuge	6-9	79%
Clay Banks	6-9	41%
Southern Refuge	6-9	38%
Julian's Reef	6-9	30%

Higher morality in the north from fishing and sea lamprey.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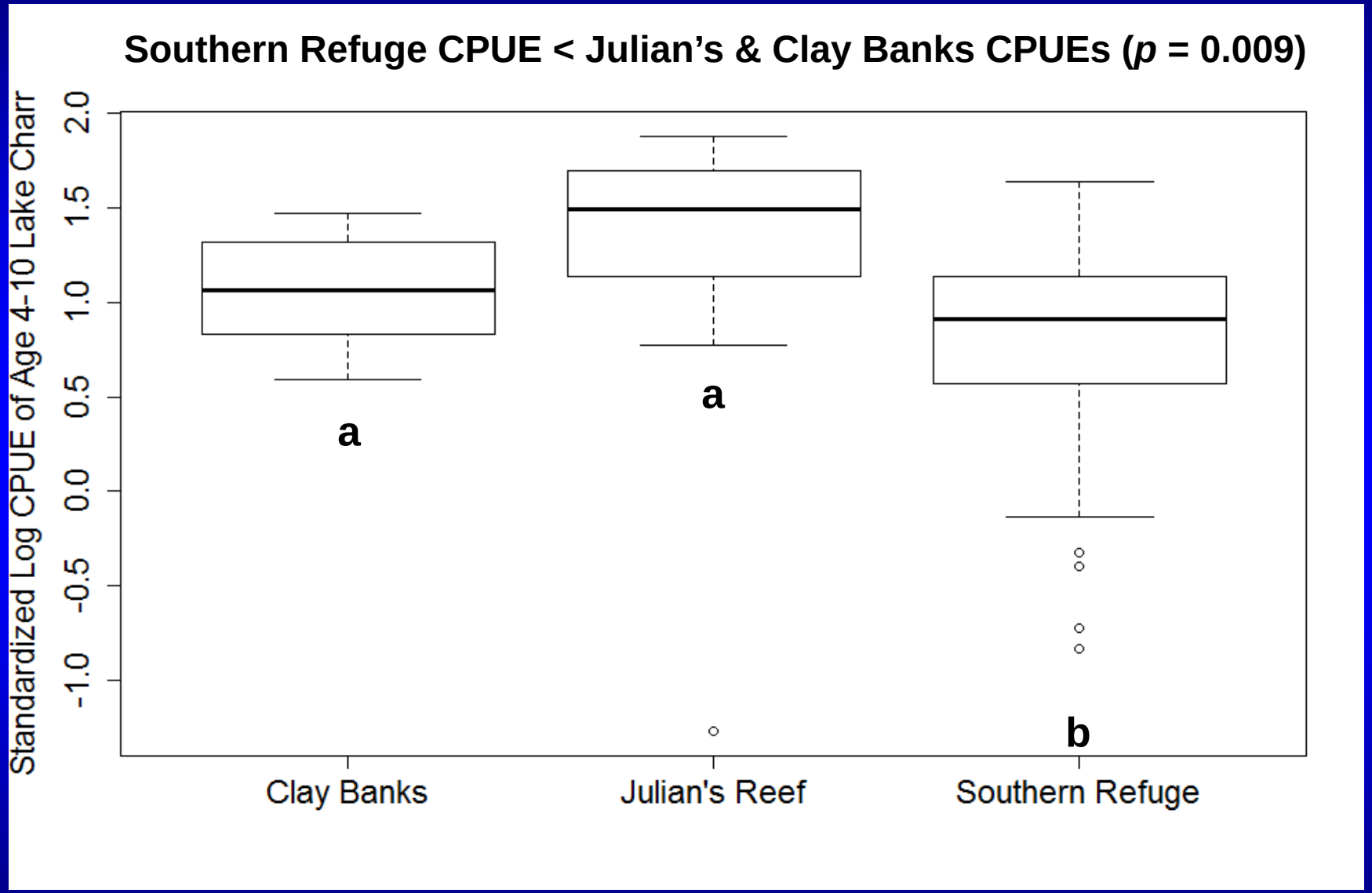
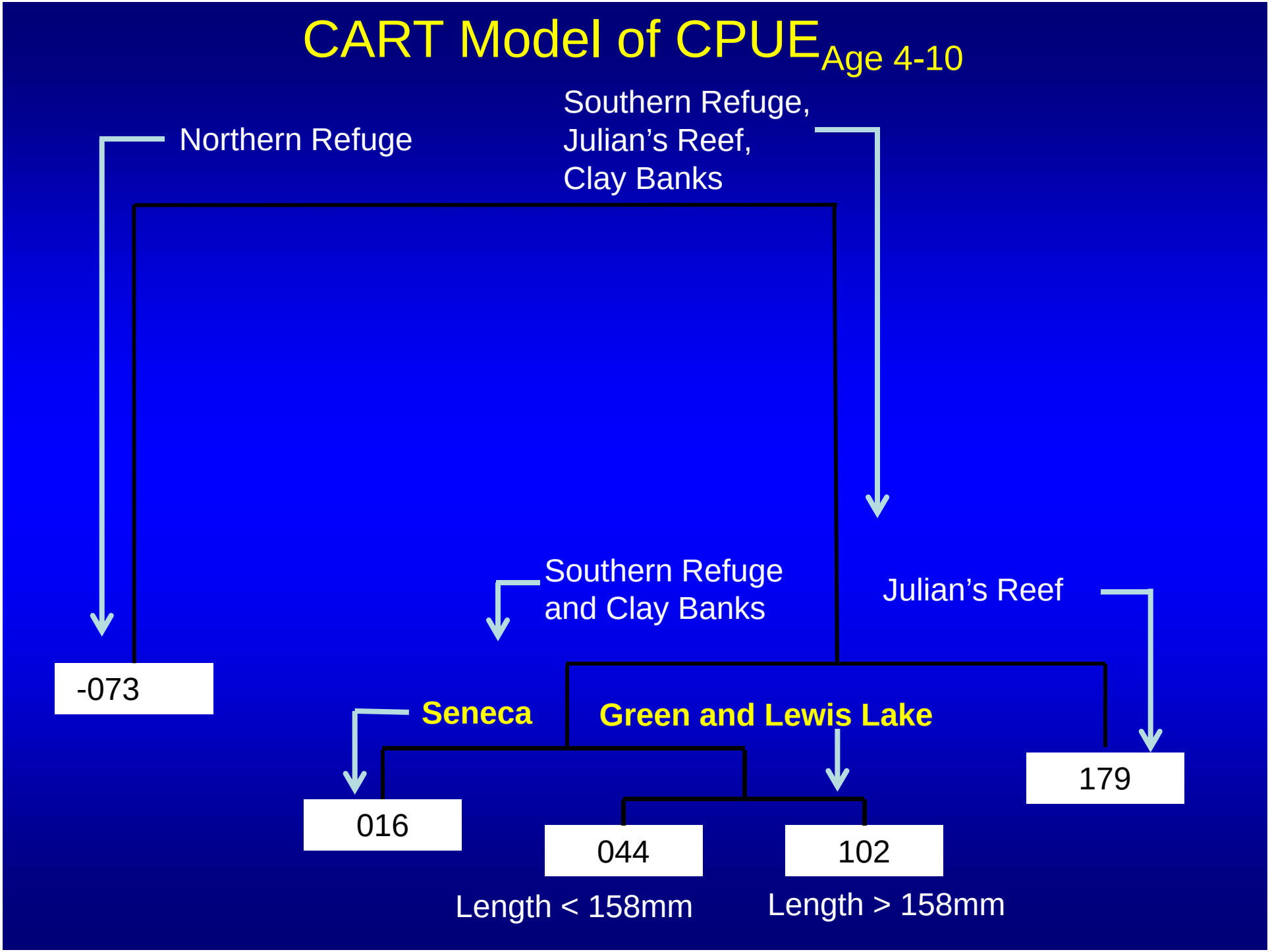
Southern Refuge, Julian's Reef, Clay Banks
Southern Refuge and Clay Banks
Julian's Reef
-0.73
Seneca
Green and Lewis Lake
0.16
0.44
1.02
1.79
Length < 158mm
Length > 158mm

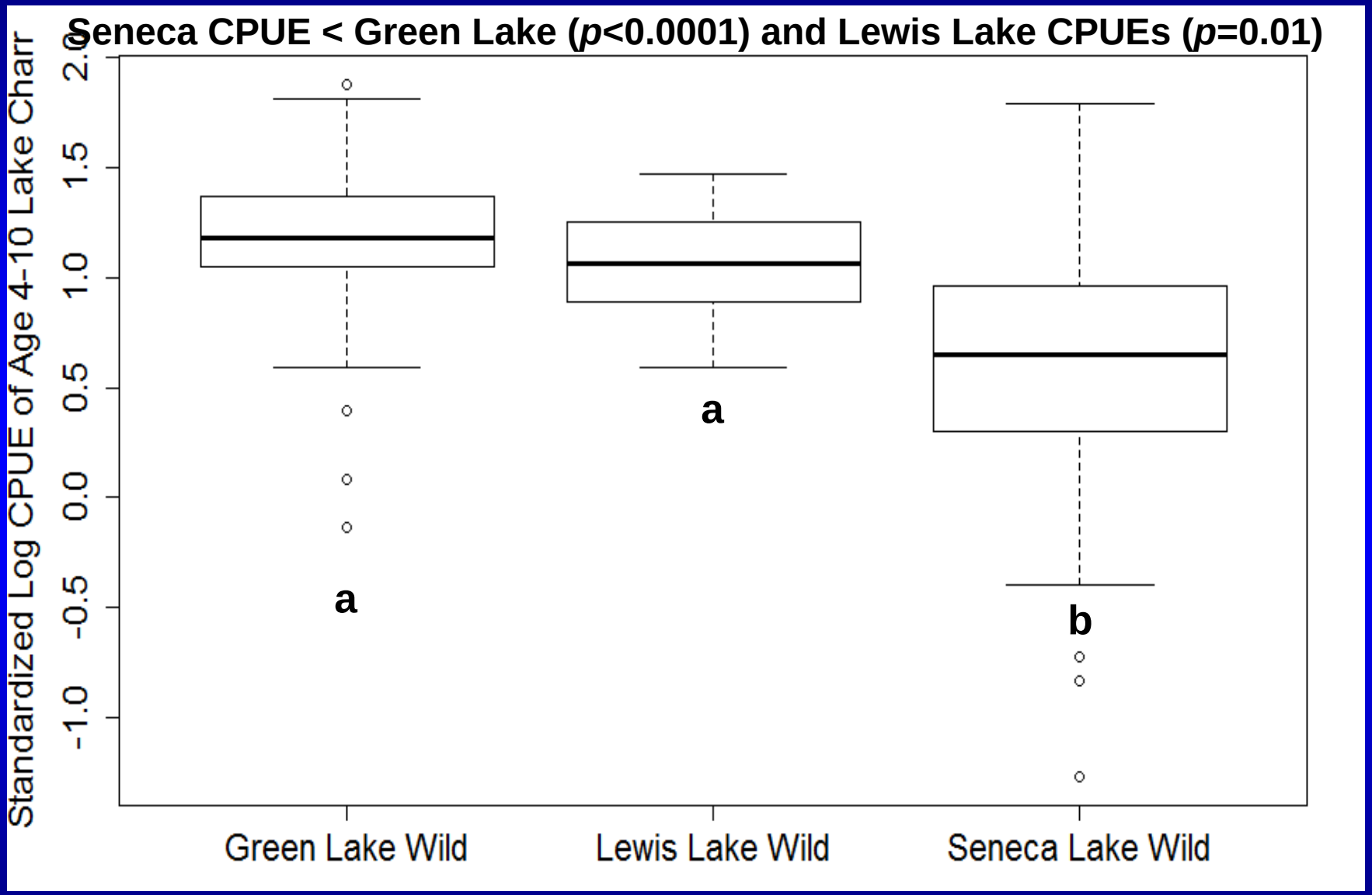
Second Node in Tree – Julian's Reef CPUE is highest

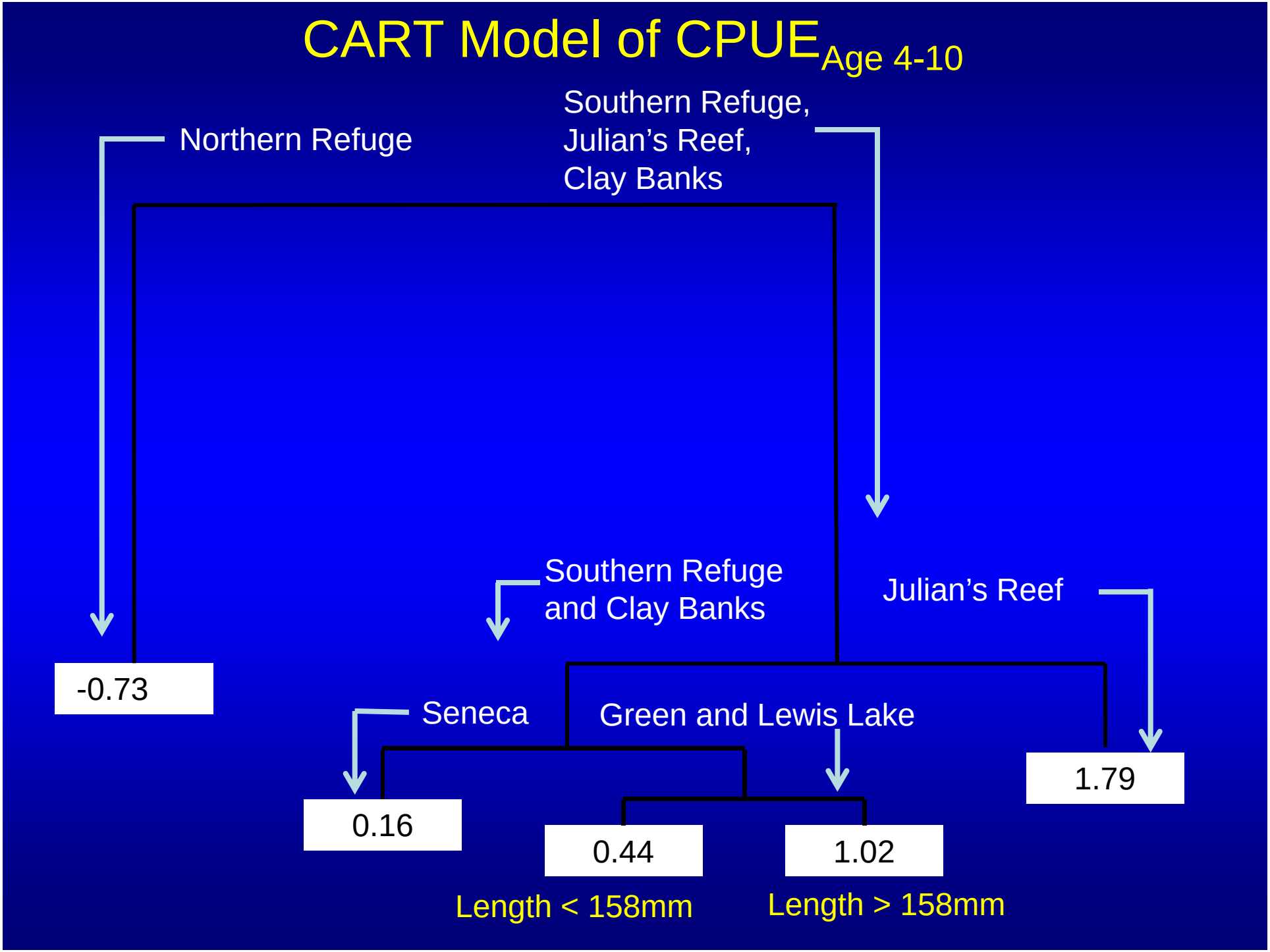


CART Model of CPUE$_{\text{Age 4-10}}$



Third Node – Strain effect in Southern Refuge and Clay Banks

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Northern Refuge
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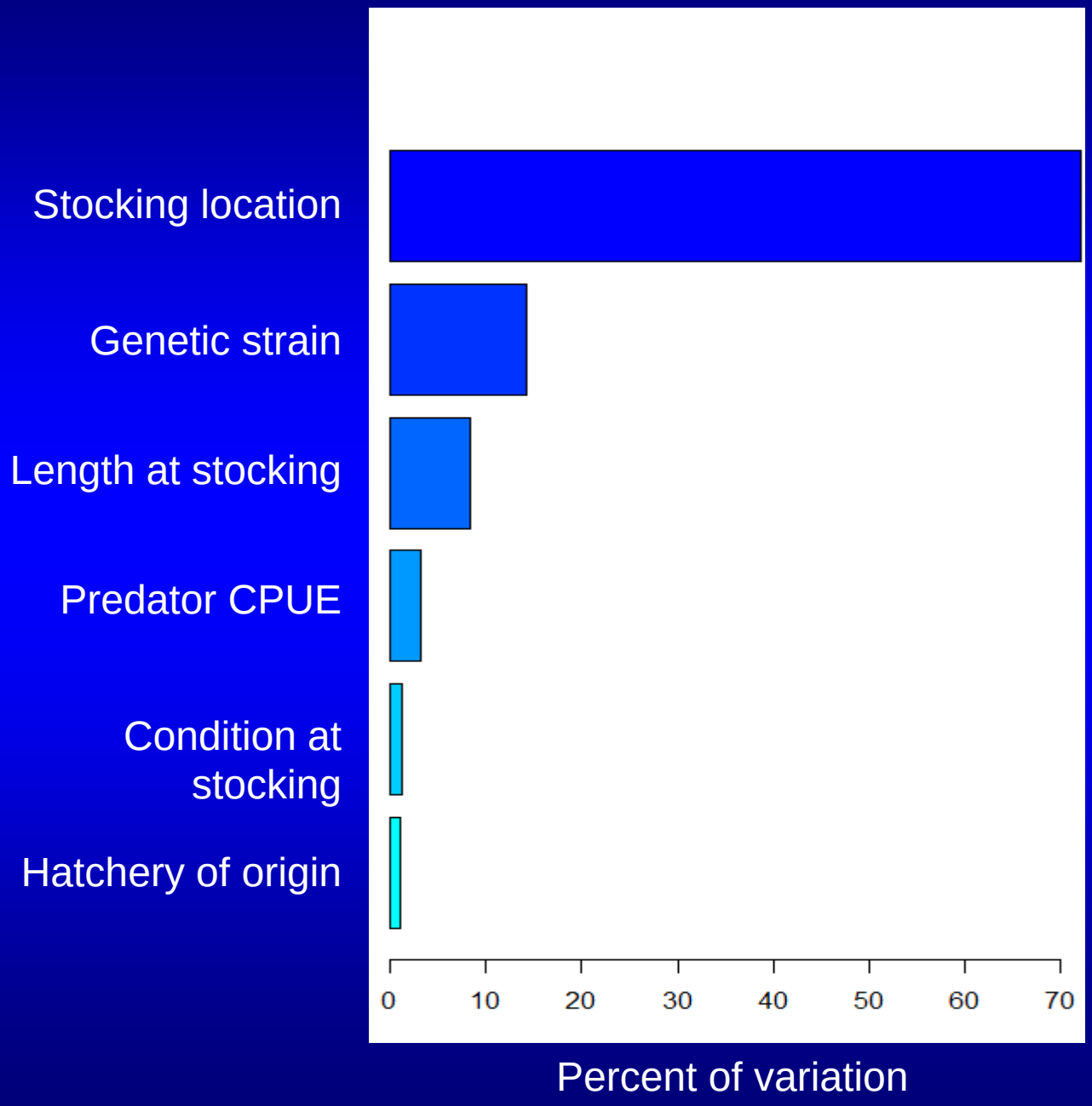
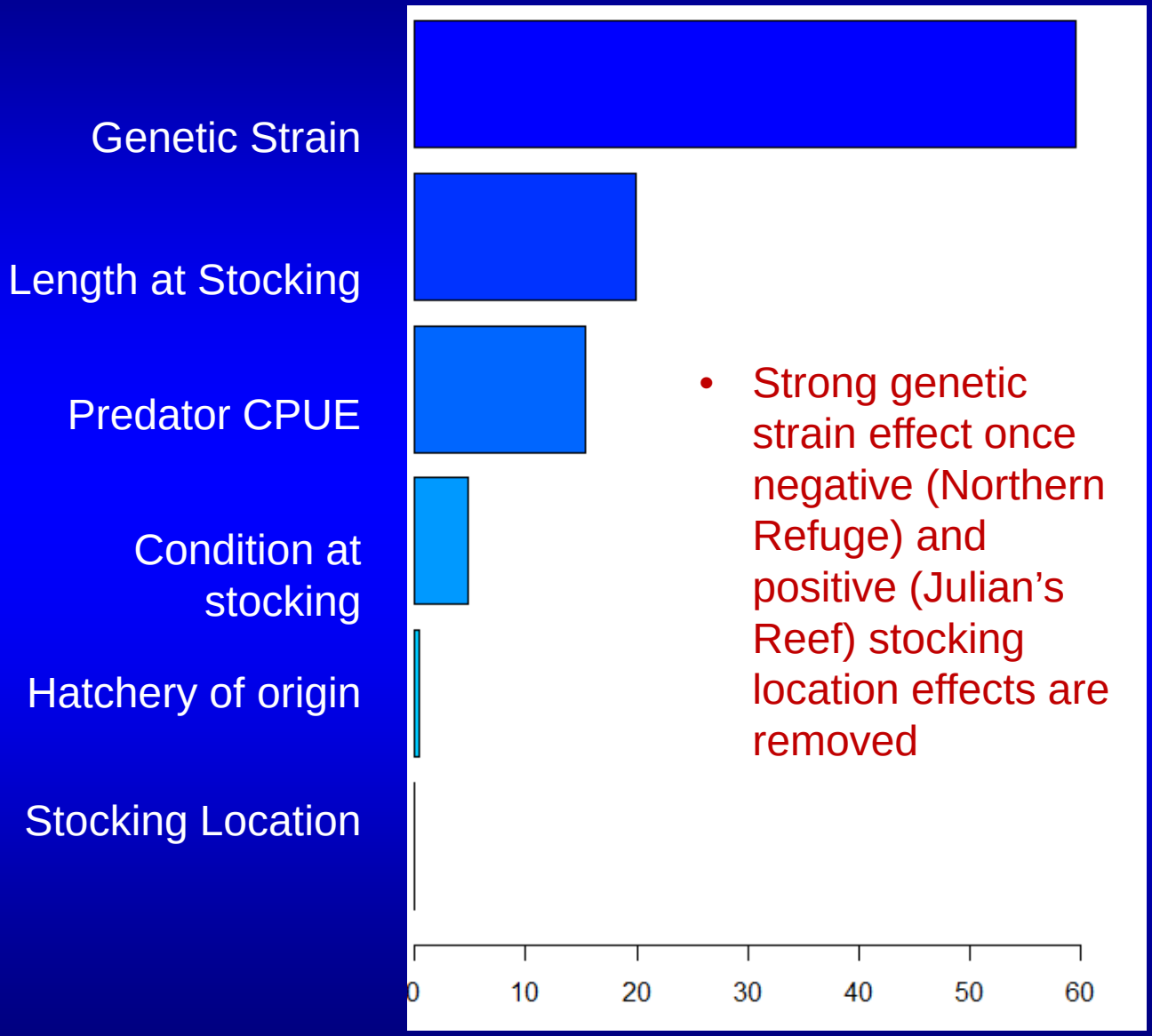
Southern Refuge and Clay Banks
Julian's Reef
Seneca
Green and Lewis Lake
-0.73
0.16
0.44
1.02
1.79
Length < 158mm
Length > 158mm

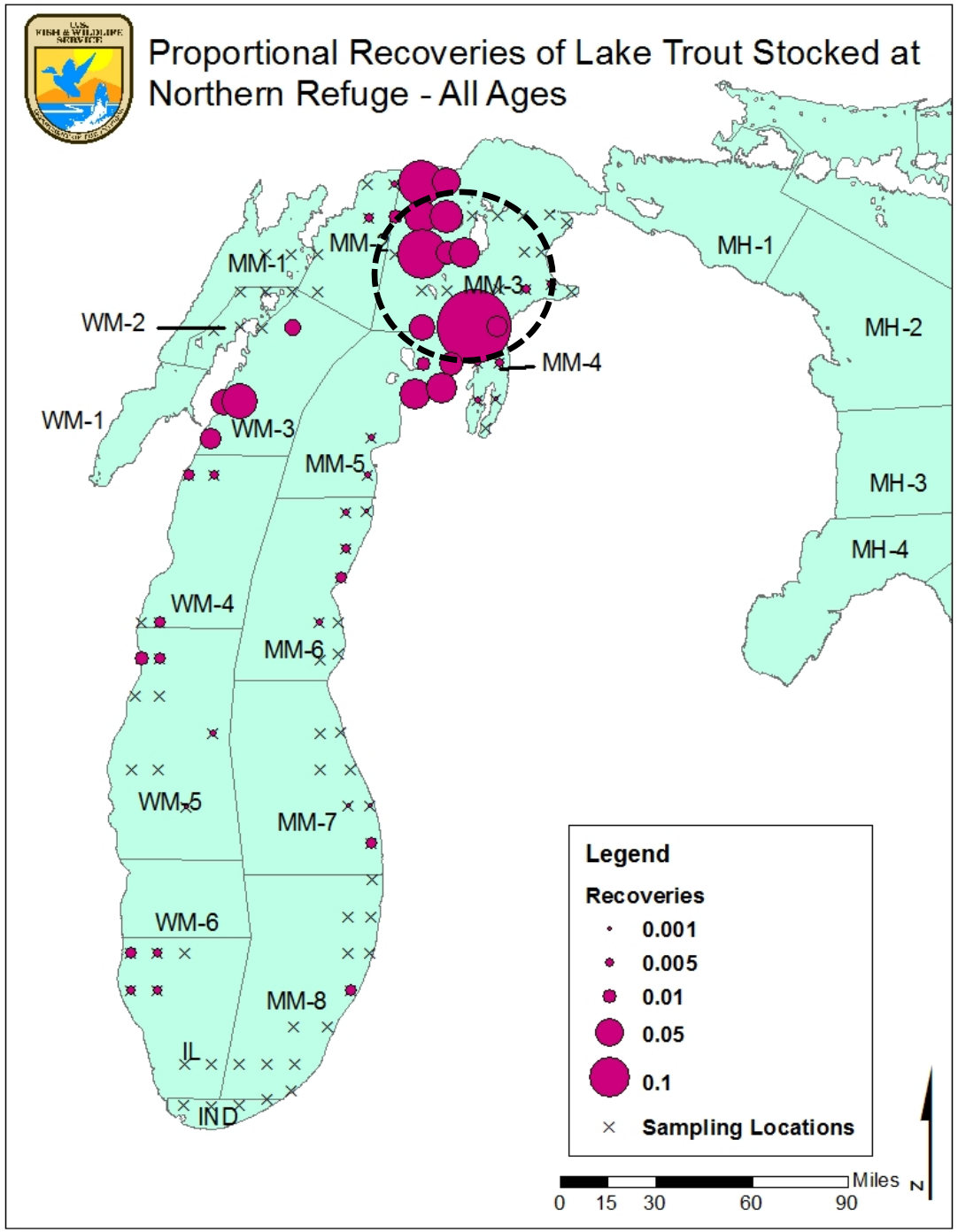
Variation of CPUE explained by each variable

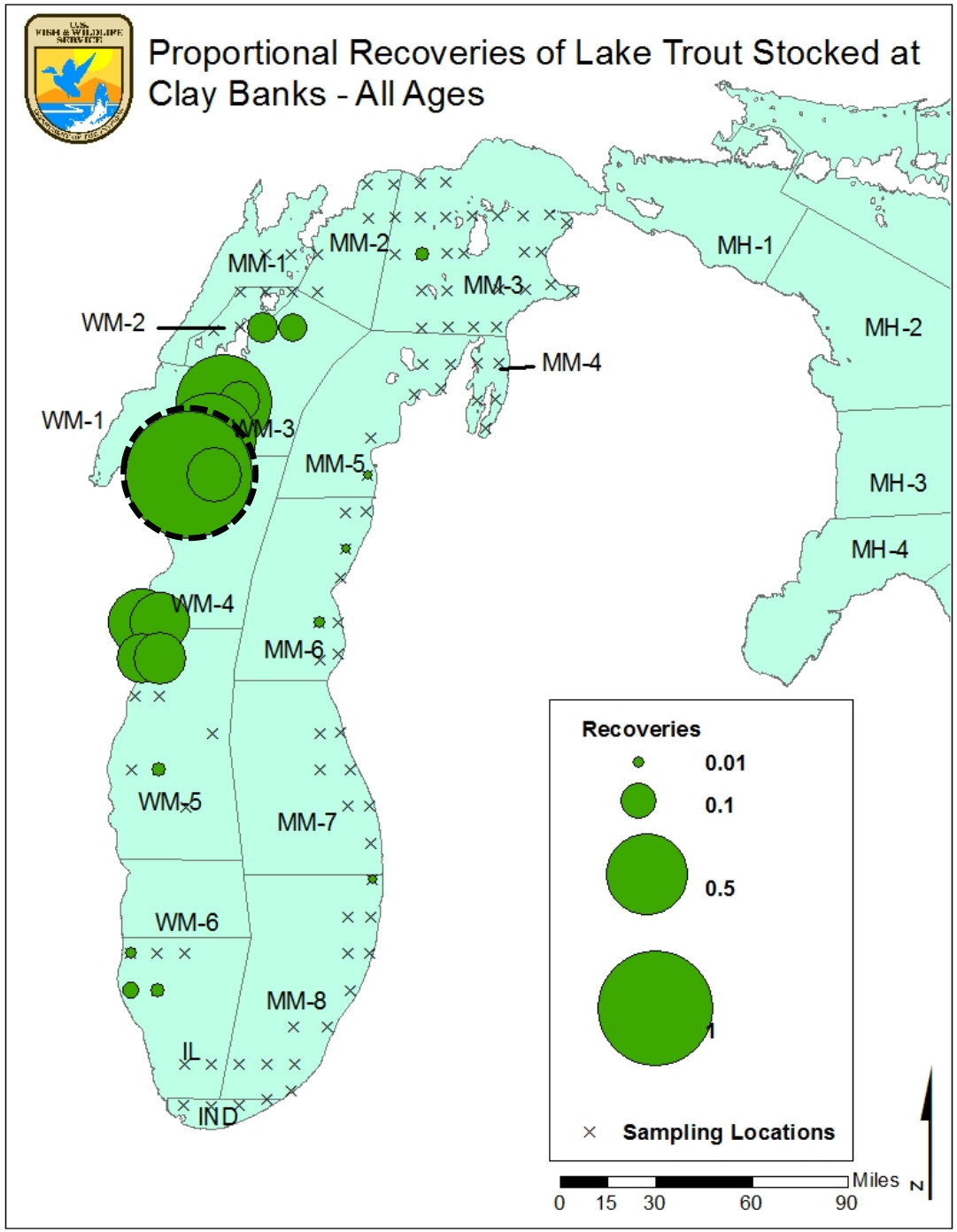


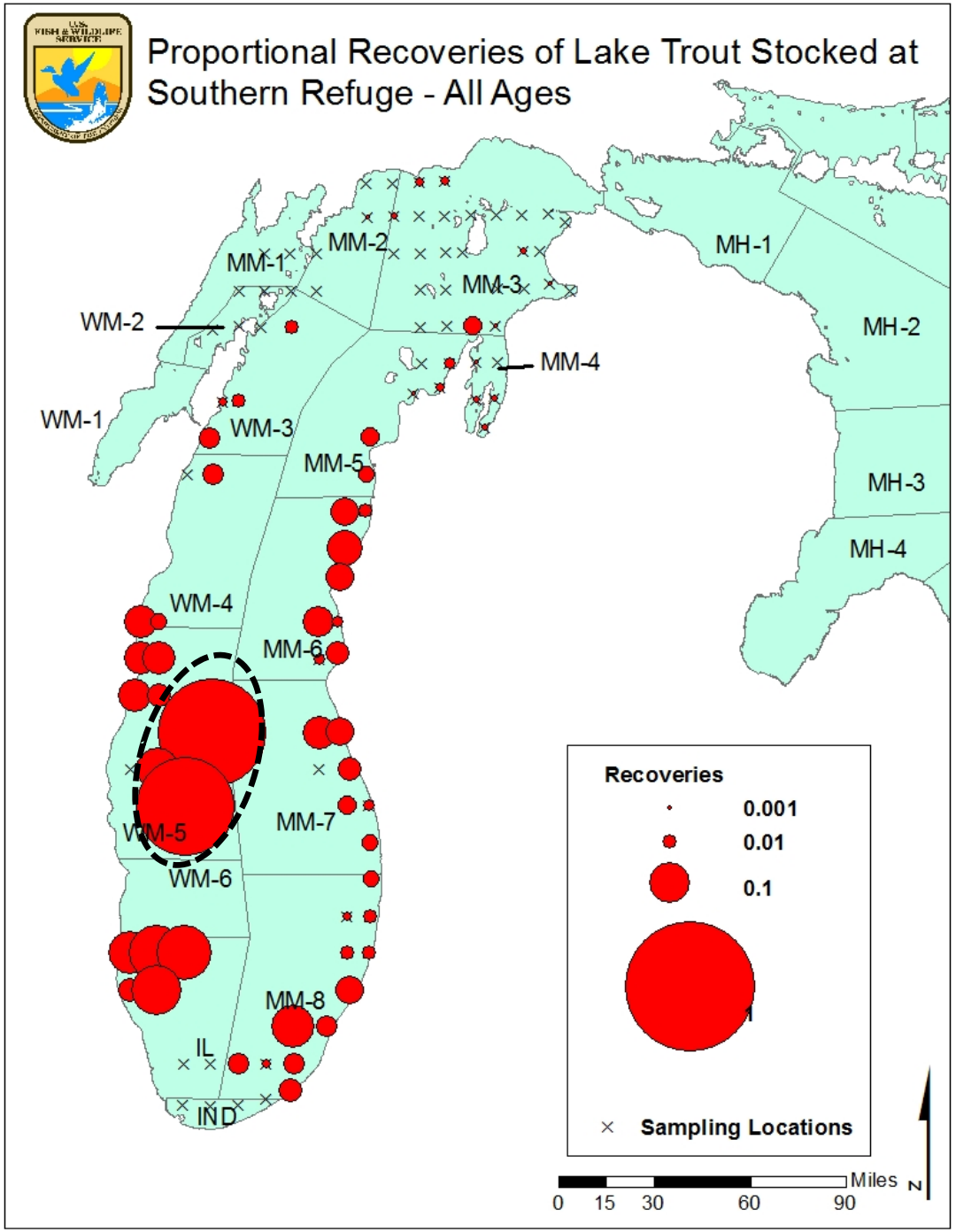
Variation of CPUE explained by each variable Northern Refuge and Julian's Reef Excluded

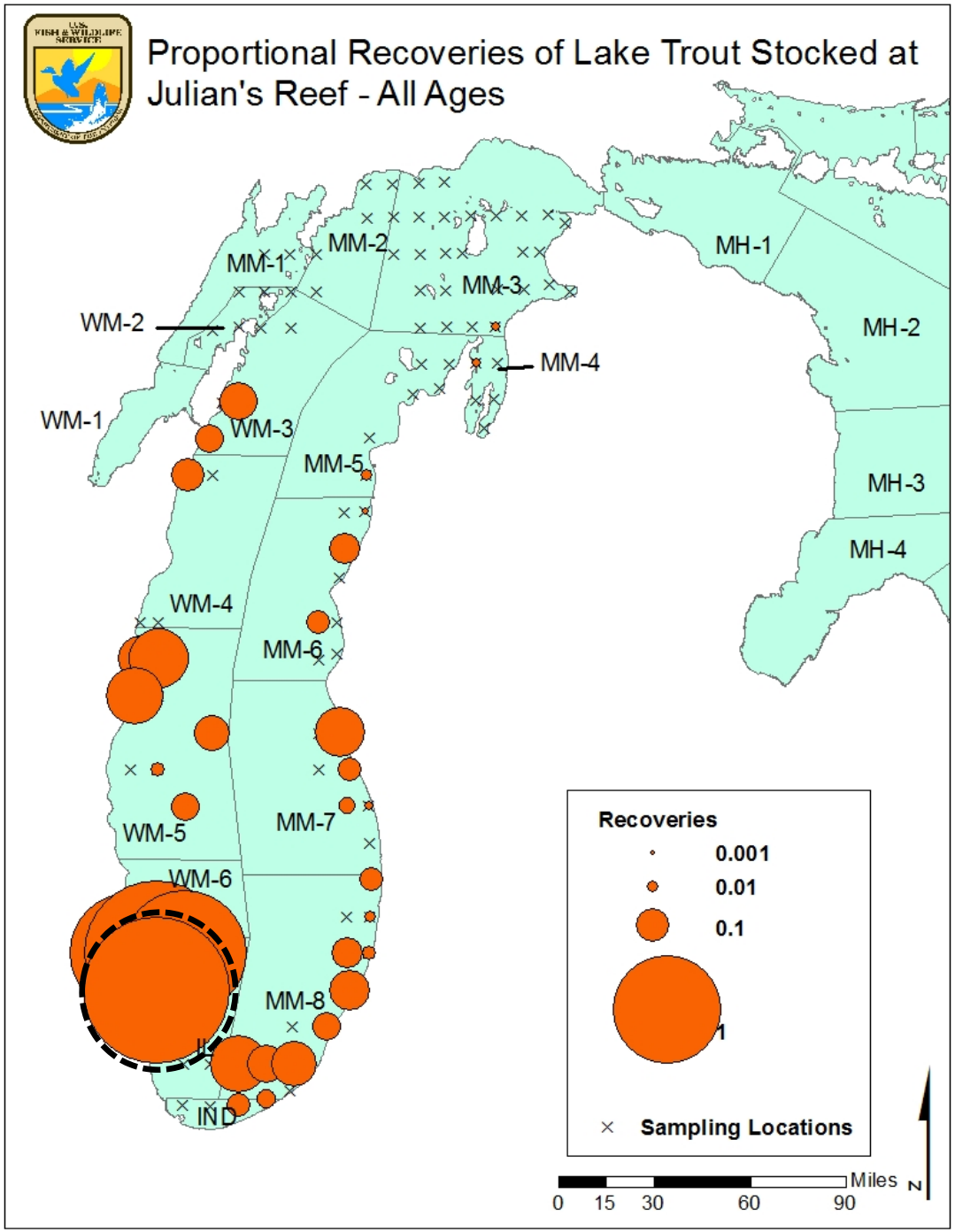


- Strong genetic strain effect once negative (Northern Refuge) and positive (Julian's Reef) stocking location effects are removed

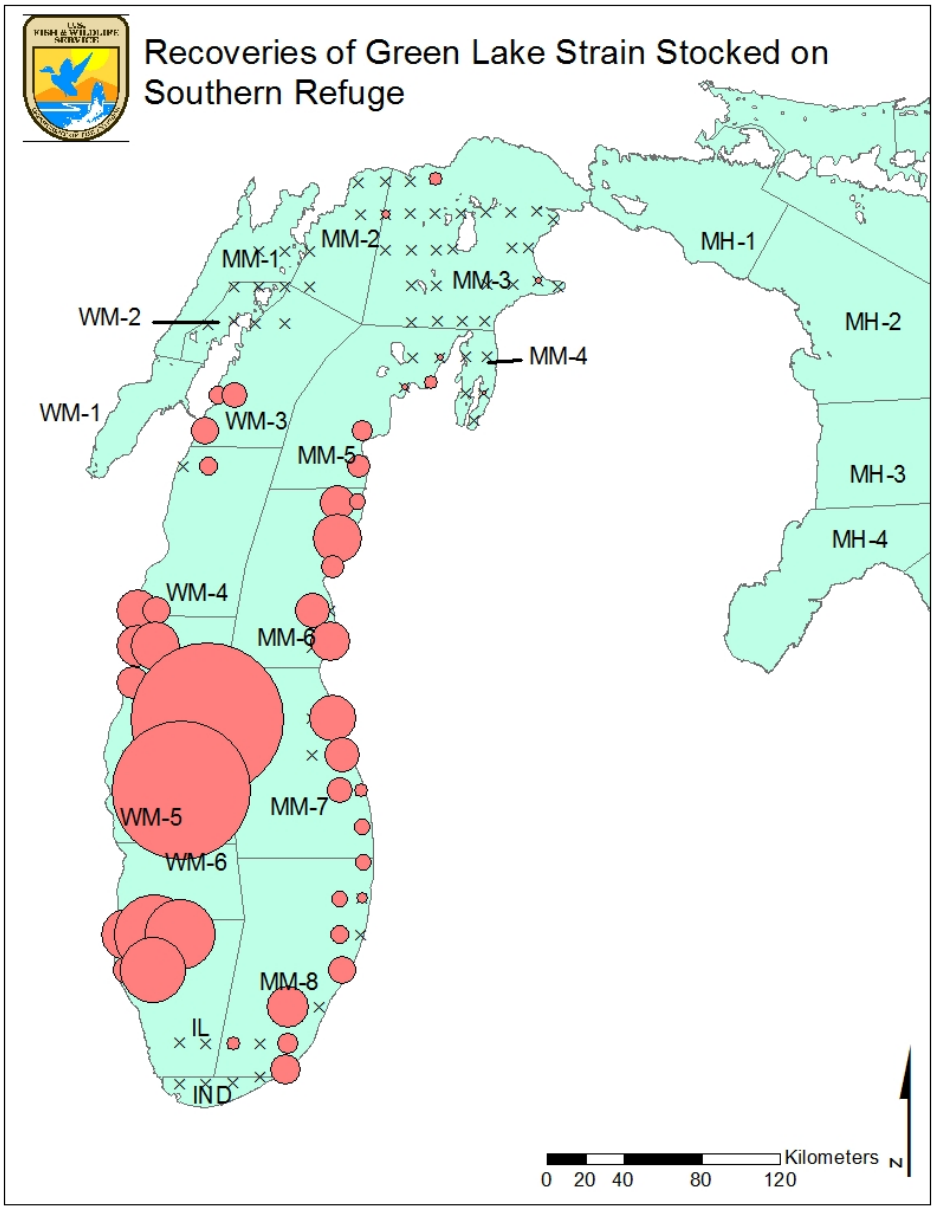

Proportional Recoveries of Lake Trout Stocked at Northern Refuge - All Ages
MM-1
MM-2
MM-3
MM-4
MM-5
MM-6
MM-7
MM-8
WM-1
WM-2
WM-3
WM-4
WM-5
WM-6
MH-1
MH-2
MH-3
MH-4
IL
IND
Legend
Recoveries
0.001
0.005
0.01
0.05
0.1
Sampling Locations
0 15 30 60 90
Miles
N

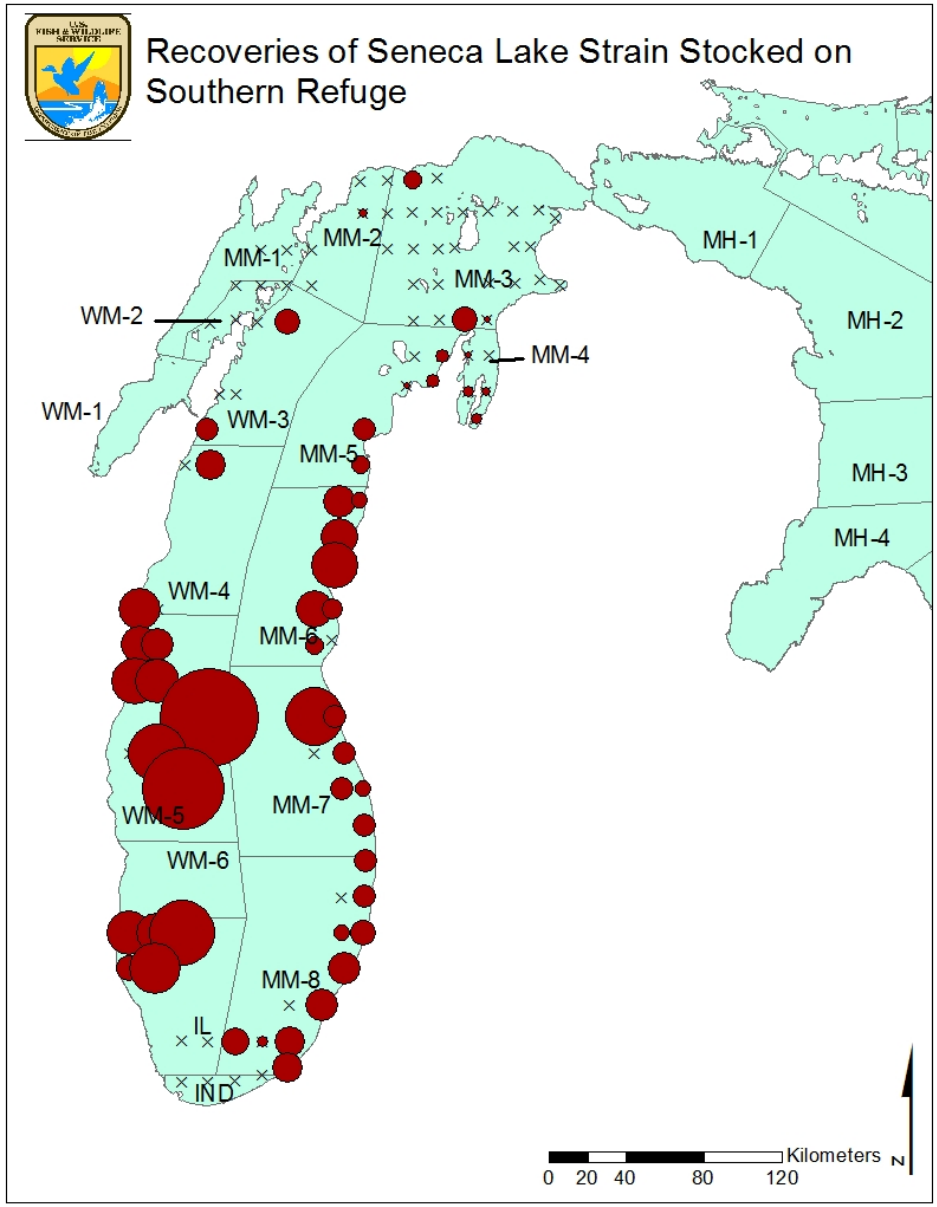

Proportional Recoveries of Lake Trout Stocked at Clay Banks - All Ages
MM-1
MM-2
MM-3
MM-4
MM-5
MM-6
MM-7
MM-8
MH-1
MH-2
MH-3
MH-4
WM-1
WM-2
WM-3
WM-4
WM-5
WM-6
IL
IND
Recoveries
0.01
0.1
0.5
1
Sampling Locations
Miles
0 15 30 60 90
N


Proportional Recoveries of Lake Trout Stocked at Southern Refuge - All Ages
MM-1
MM-2
MM-3
MM-4
MM-5
MM-6
MM-7
MM-8
MH-1
MH-2
MH-3
MH-4
WM-1
WM-2
WM-3
WM-4
WM-5
WM-6
IL
IND
Recoveries
0.001
0.01
0.1
1
Sampling Locations
Miles
0
15
30
60
90
N

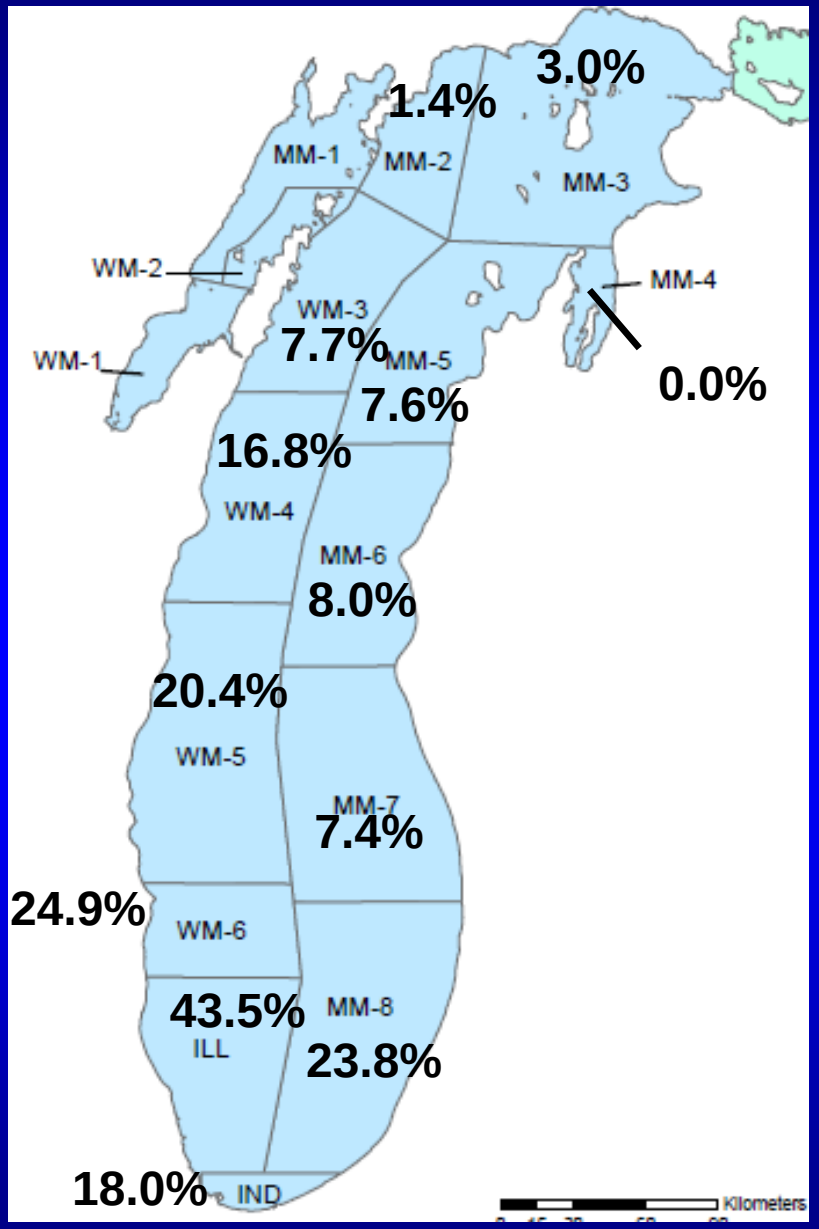

Proportional Recoveries of Lake Trout Stocked at Julian's Reef - All Ages
MM-1
MM-2
MM-3
MM-4
MM-5
MM-6
MM-7
MM-8
WM-1
WM-2
WM-3
WM-4
WM-5
WM-6
MH-1
MH-2
MH-3
MH-4
IND
Recoveries
0.001
0.01
0.1
1
Sampling Locations
Miles
0 15 30 60 90
N

Comparison of the recovery distributions of Green Lake and Seneca Strains stocked at the Southern Refuge





Percent wild Lake Trout in sport catches Apr-Sep 2015



Summary for lake trout results

1) Returns rates were low for all strains in the Northern due to high mortality.
2) Lake Michigan strains (Lewis and Green) did better than Seneca in the south where mortality was low.
3) Size at stocking, stocking condition, and predator density had little to no effect on return rates.
4) Distances moved are greater for populations that have higher densities.
5) Those areas with higher densities and older fish also have more wild fish.

Aquatic Invasive Species

Aisan carp

To

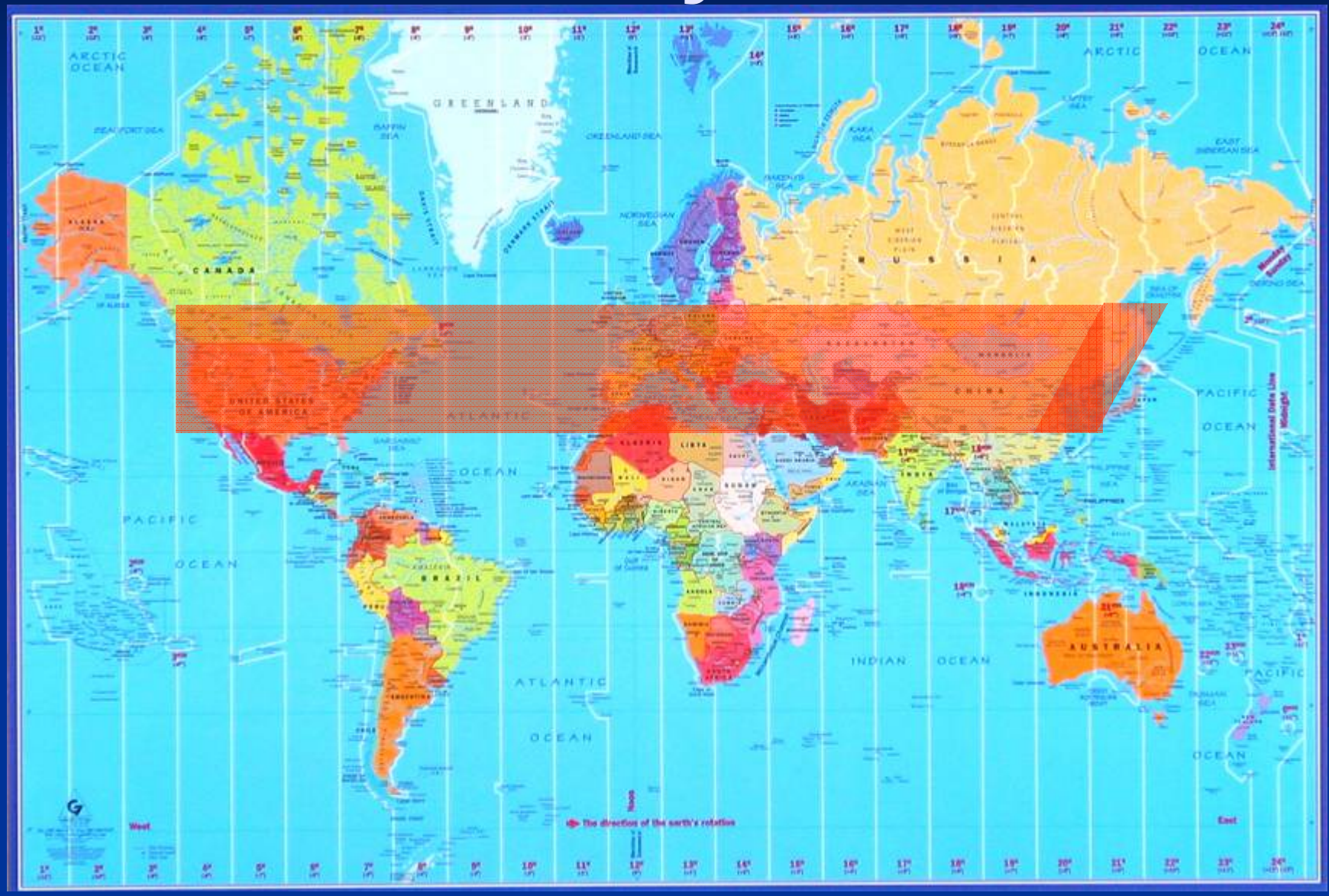
Zebra Mussels

Bob Wakeman, WDNR AIS Coordinator

Aquatic Invasive Species

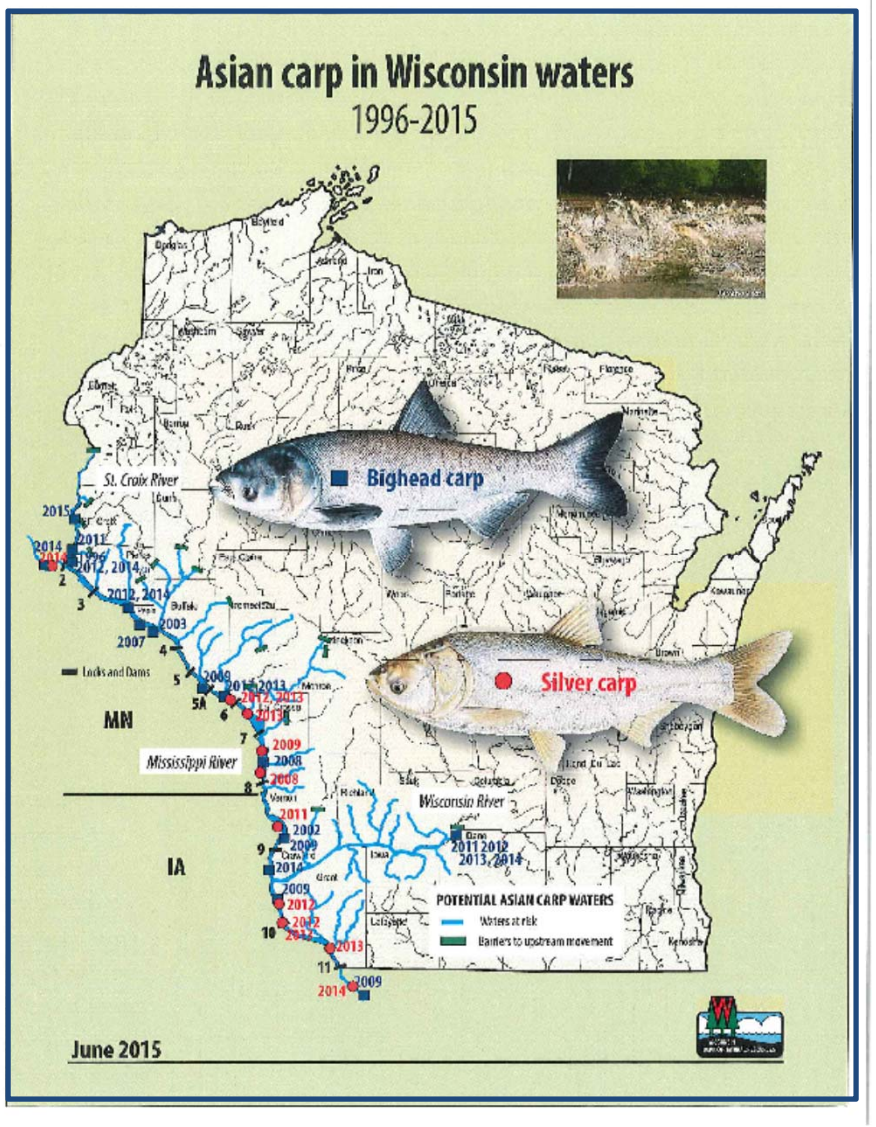
- Asian carp
  - The Basics
    - What are they?
      - 5 fish species that include;
        - » Silver
        - » Black
        - » Bighead
        - » Grass
        - » Common

Where did they come from?



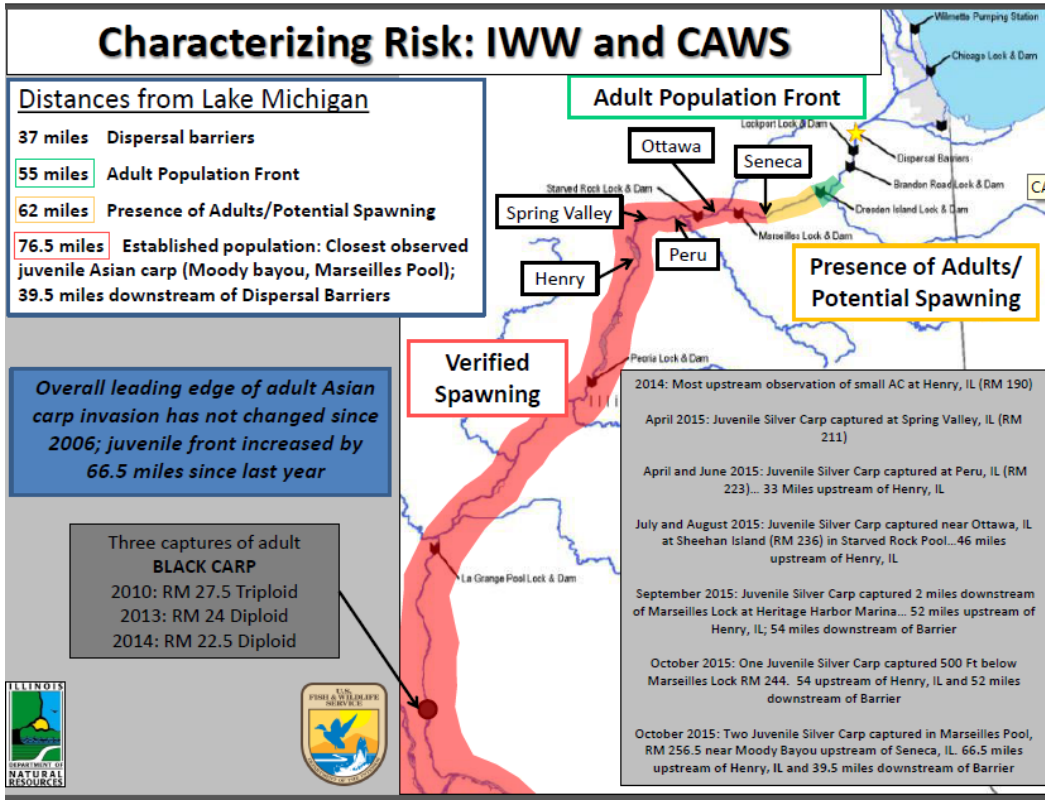
Aquatic Invasive Species

- Asian carp
  - The Basics
    - Where are they now?
      - Wisconsin



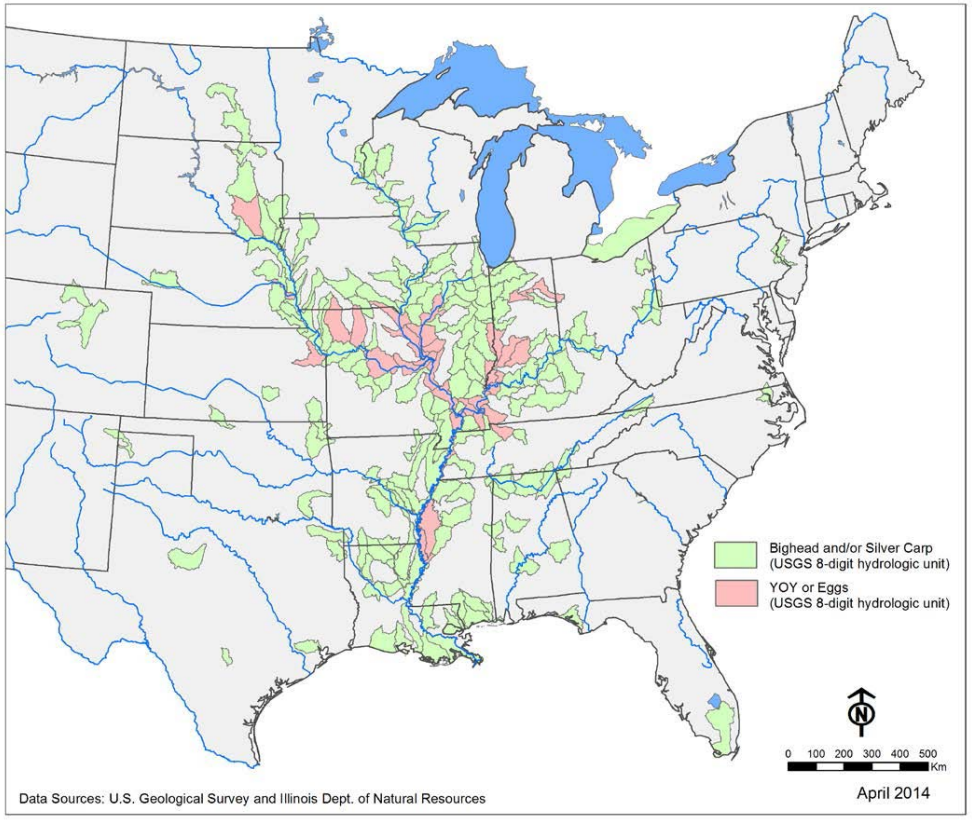
Aquatic Invasive Species

- Asian carp
  - The Basics
    - Where are they now?



Aquatic Invasive Species

- Asian carp
  - The Basics
    - Where are they now?
      - United States



Aquatic Invasive Species

- Asian carp
  - The Basics
    - Why are they a problem?
      - Consume enormous amounts of food (20% of body wt/day)
      - Spawns multiple times a year
      - Pose recreational hazard
      - Out compete our native fishes

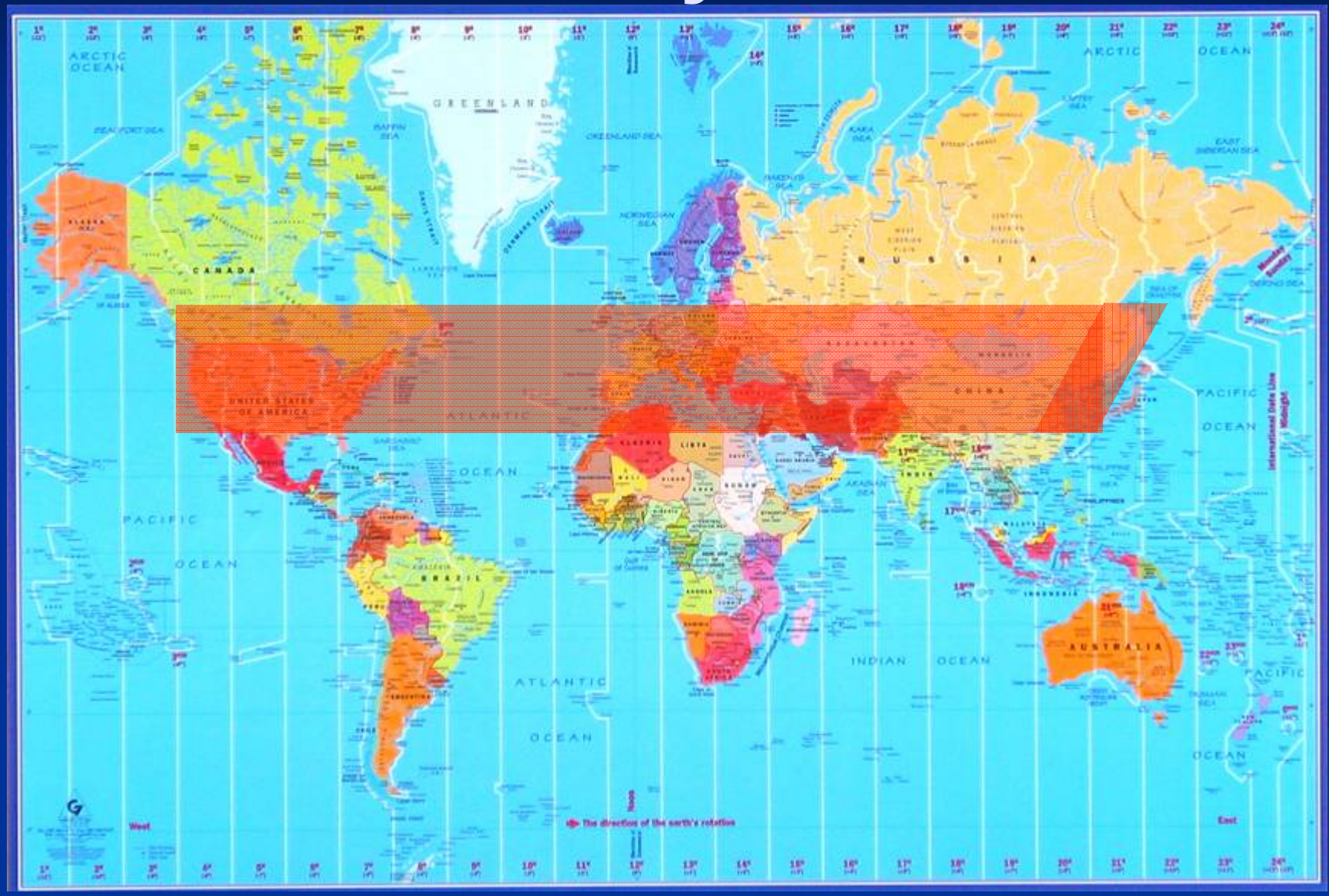
Aquatic Invasive Species

- Asian carp
  - The Basics
    - What is being done?
      - Keeping track of where they are and what the population is doing.
      - Harvesting, harvesting, harvesting
      - Research control technology
      - Closing pathways

Aquatic Invasive Species

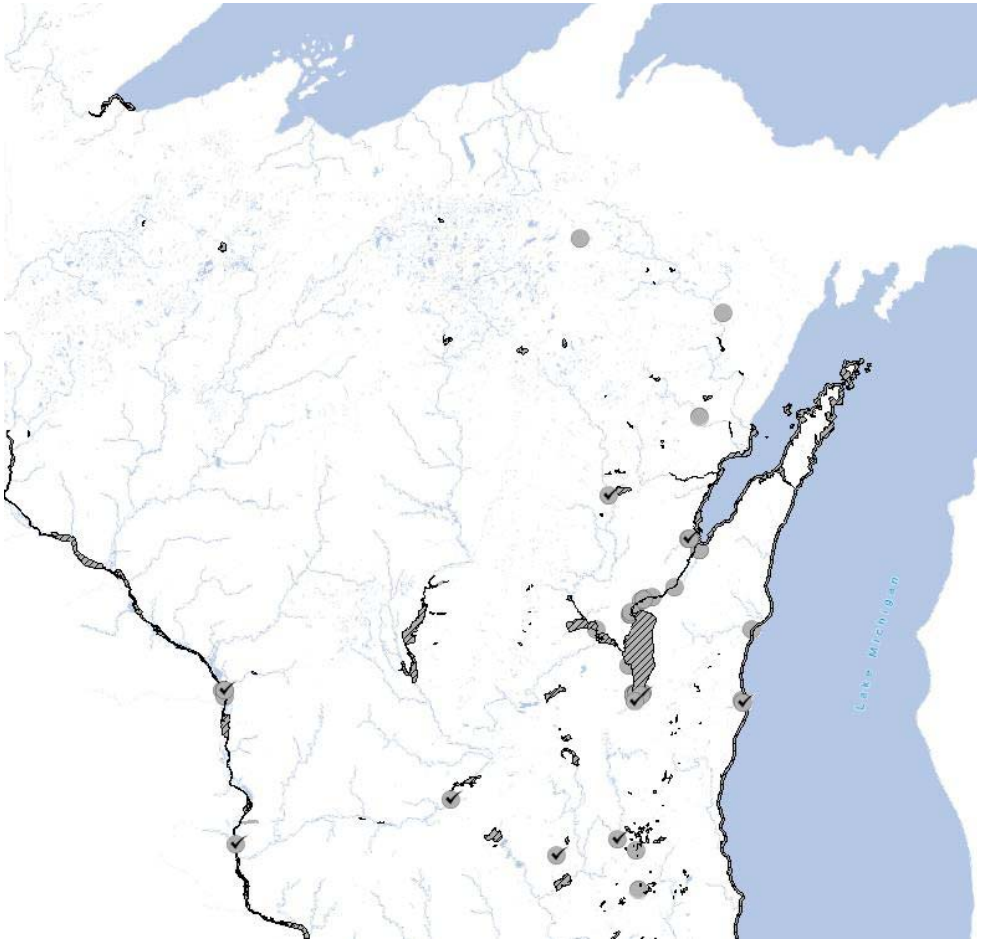
- Zebra Mussels
  - The Basics
    - What are they?
      - Invasive mussel (1/8th - 2”)
      - Native to Europe and Asia
      - Larval form called Veliger (microscopic, floats in water)

Where did they come from?



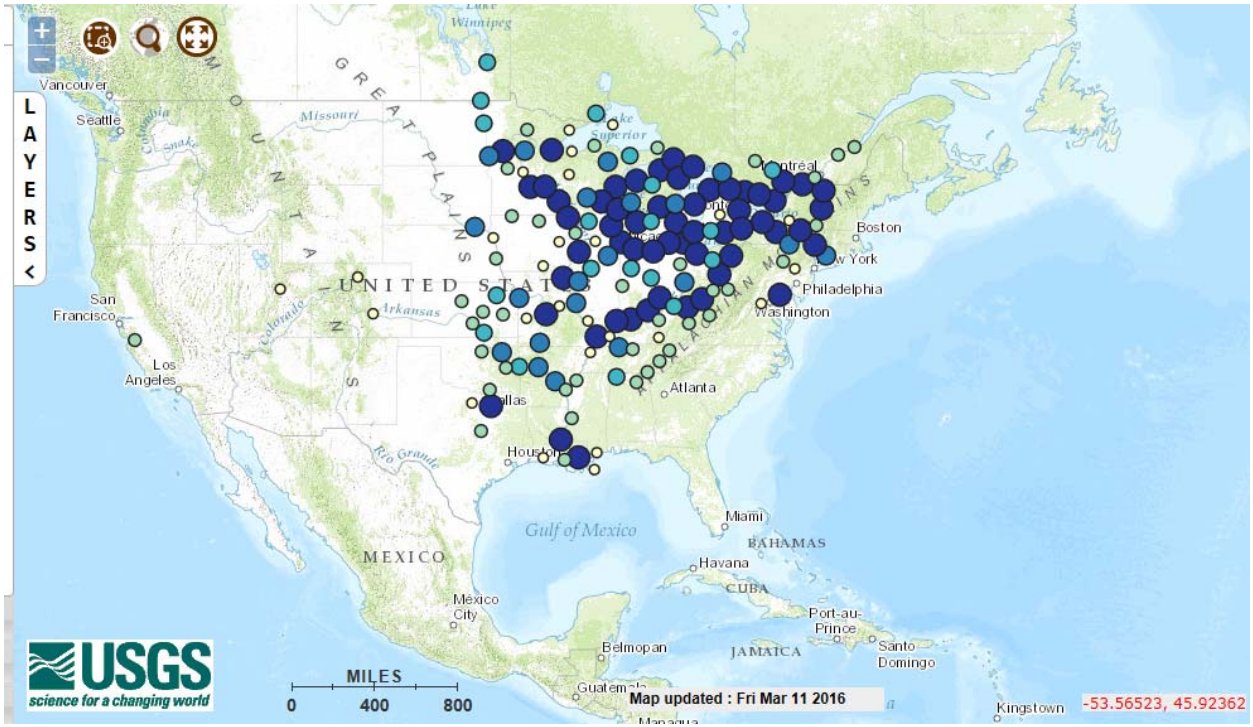
Aquatic Invasive Species

- Zebra Mussels
  - The Basics
    - Where are they now?
      - Wisconsin



Aquatic Invasive Species

- Zebra Mussels
  - The Basics
    - Where are they now?
      - United States

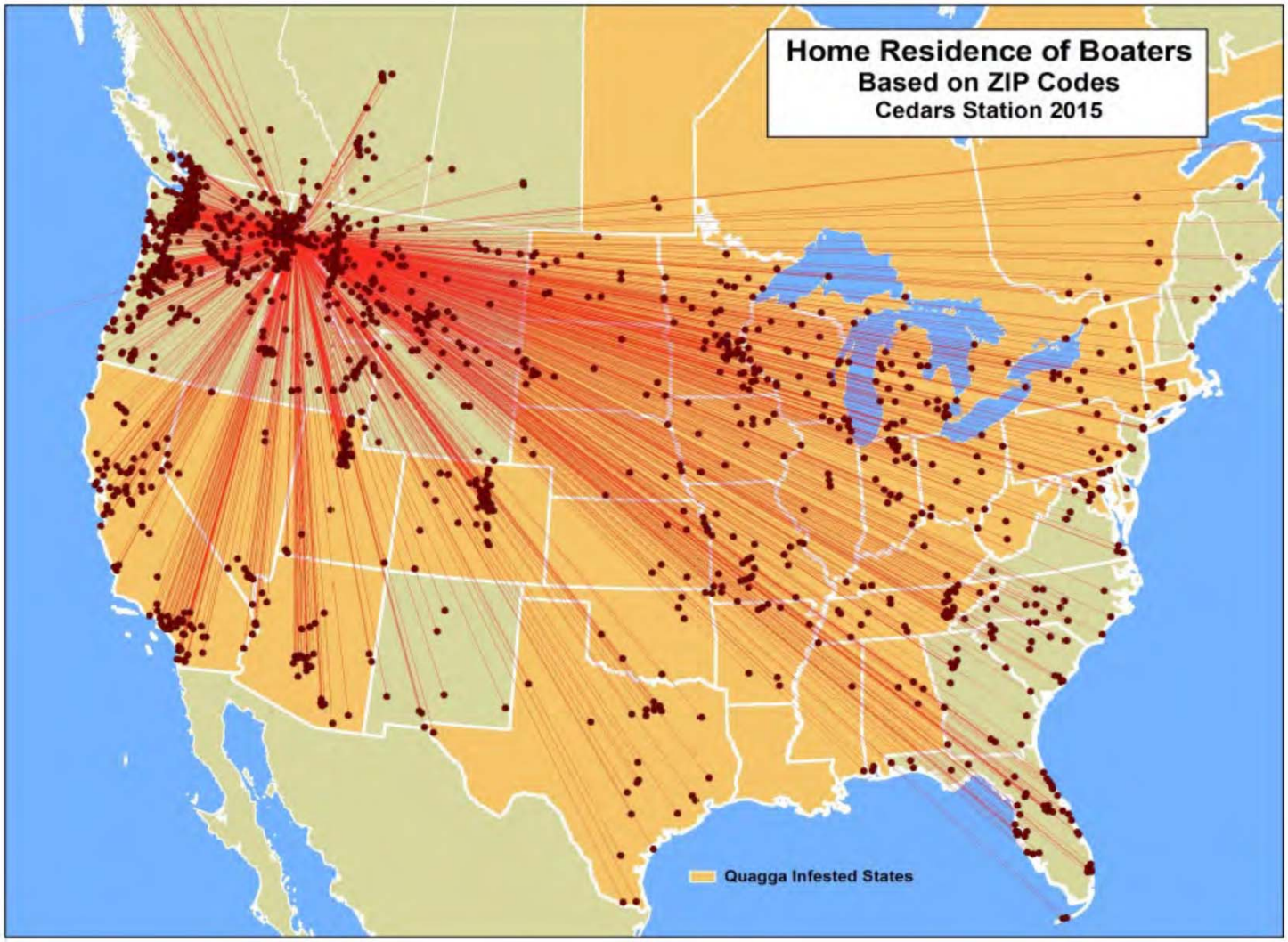


Aquatic Invasive Species

- Zebra Mussels
  - The Basics
    - Why are they a problem?
      - Consume enormous amounts of food (Each mussel filters 1 liter/day)
      - Clogs pipes
      - Pose recreational hazard
      - Stresses/kills native mussels

Aquatic Invasive Species

- Zebra Mussels
  - The Basics
    - What is being done?
      - Research control technology
      - Closing pathways


Home Residence of Boaters
Based on ZIP Codes
Cedars Station 2015
Quagga Infested States

Aquatic Invasive Species

- Zebra Mussels
  - The Basics
    - Zequanox
      - What is it?
        - » Dead soil bacteria (*Psudemonas floresence*)
      - How does it work?
        - » Ingested by mussel
        - » Destroys the lining of gut
      - Challenges
        - » Very expensive
        - » Designed for in-pipe systems
        - » Only viable 24 hrs after wetted (Delivery issue)

Aquatic Invasive Species

- Zebra Mussels
  - The Basics
    - Zequanox
      - Christmas Lake, Minnesota
        - » Isolated boat launch area
        - » Treated with;
          - Zequanox
          - Copper Sulfate
          - Potassium chloride
        - » Killed ZM's inside Rx area
        - » Later found ZM's outside of Rx area

Aquatic Invasive Species

- Zebra Mussels
  - The Basics
    - Zequanox
      - Wisconsin – Shawano Lake
        - » Field/Lab Trial
        - » Excellent control
        - » Impact on natives?

Aquatic Invasive Species

- Zebra Mussels
  - The Basics
    - Zequanox
      - Lake Erie
        - » “Additional development of barrier free treatment methods are also recommended. The current Zequanox formulation (a spray-dried powder) is developed to disperse readily for use in enclosed systems (for example, industrial cooling water systems). For open waters, development of an alternate formulation which is better able to target the benthos (where adult mussel populations are found), and limit dispersion over time into the upper layers, such as a sinking, slow dissolving granule, would be most beneficial.”

Aquatic Invasive Species

- Zebra Mussels
  - The Basics
    - Zequanox
      - What do we expect?
        - » Need more information on non-target mussels
        - » Continue to work on delivery techniques
        - » Cost will prevent broad applications
        - » Selective use

Questions?