

Stock Characteristics of Lake Whitefish in Lake Michigan

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Lake Whitefish in Lake Michigan

- Native
- Benthivorous fish
- Important for energy transfer in Great Lakes
- Socioeconomically important to Great Lakes Basin
- Highly mobile
- Natal homing

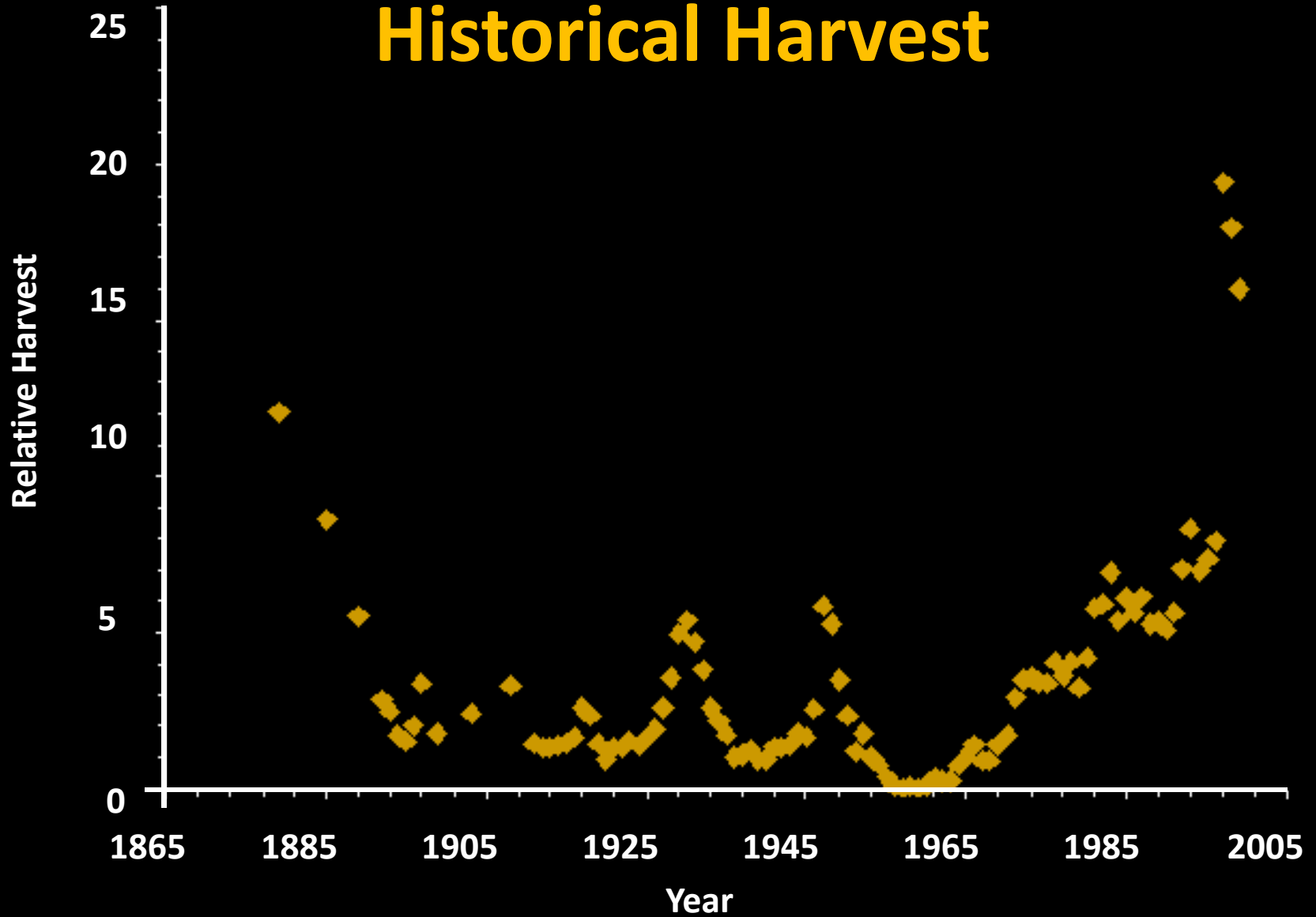


Commercial Fishery

- Most lucrative commercial fishery on Lake Michigan
- Dockside value of \$2.5-\$5.5 million
- Growing roe market (caviar)
- Current value \$160 per pound



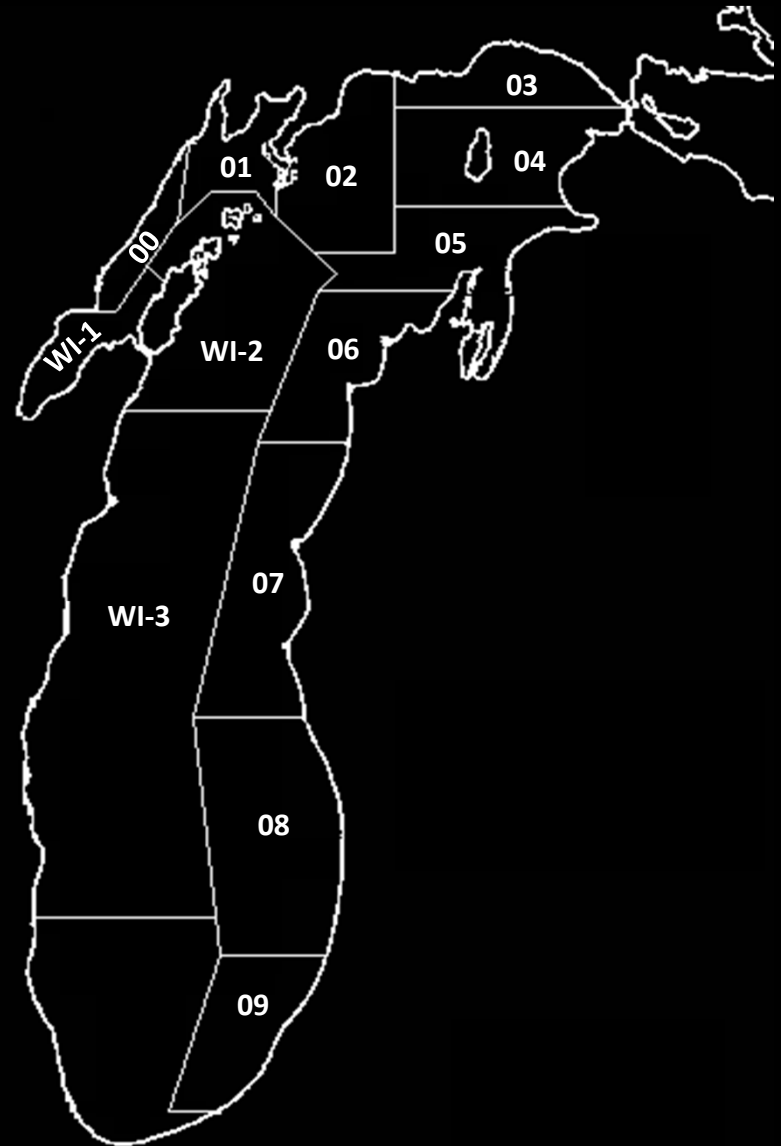
Historical Harvest



** Data compiled from Great Lakes Fishery Commission database

Management

- **Inter-jurisdictional fishery**
 - **WDNR**
 - **MDNR**
 - **CORA**
- **Quotas based on statistical catch-at-age models**
- **13 management zones**



Management

- **Issues**
 - Multiple agencies
 - Length of season
 - Recreational fishery
 - Superficial boundaries
- **Ebener (1985) tagging study**
 - Potential for a mixed-stock fishery



Stock Concept

- **Stock is the basic unit of a fishery or a “management unit”**
- **Component of a fishery susceptible to harvest**
- **Useful when:**
 - **Describing population dynamics**
 - **Setting quotas or harvest regulations**
 - **Maintaining sustainability of a fishery**

Genetic Stock Concept

Larkin (1972): “...a group of organisms, sharing a gene pool, that is sufficiently discrete and nominally identifiable that warrants management as such.”

Genetic Stock Concept

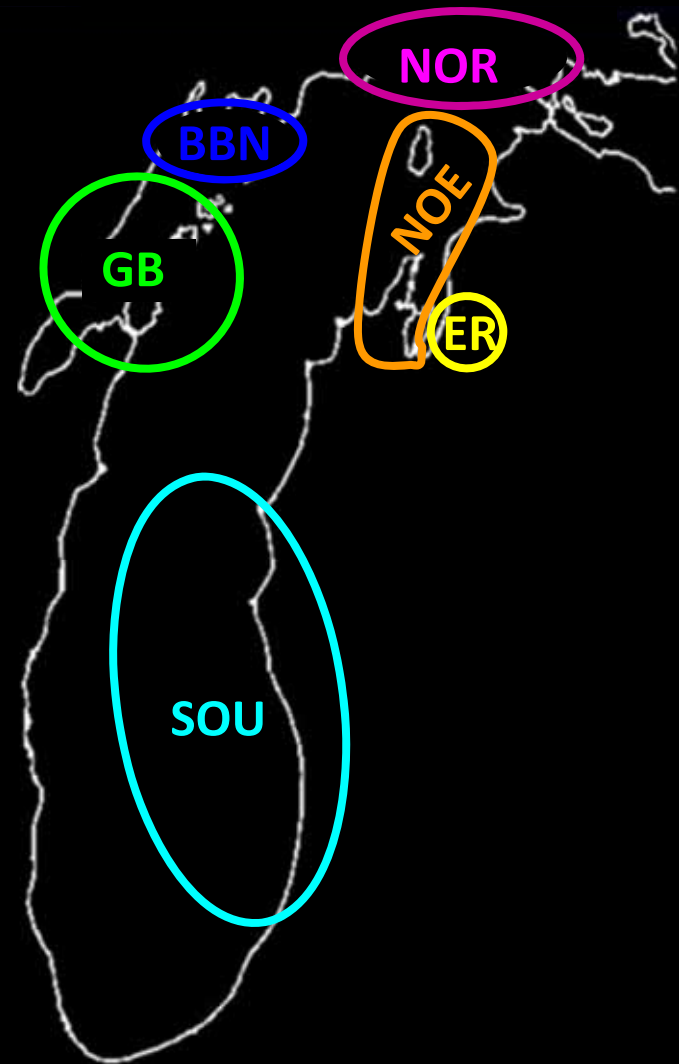
- **To conserve genetic diversity through time**
 - **Local adaptations**
 - **Adaptability**
 - **Resilience**
 - **Sustainability**

LWF Task Group

- **2001 LWF task recognized knowledge was insufficient to discriminate or manage LWF on a stock specific basis**
- **Recommended combining genetics and biological characteristics to rectify this issue**

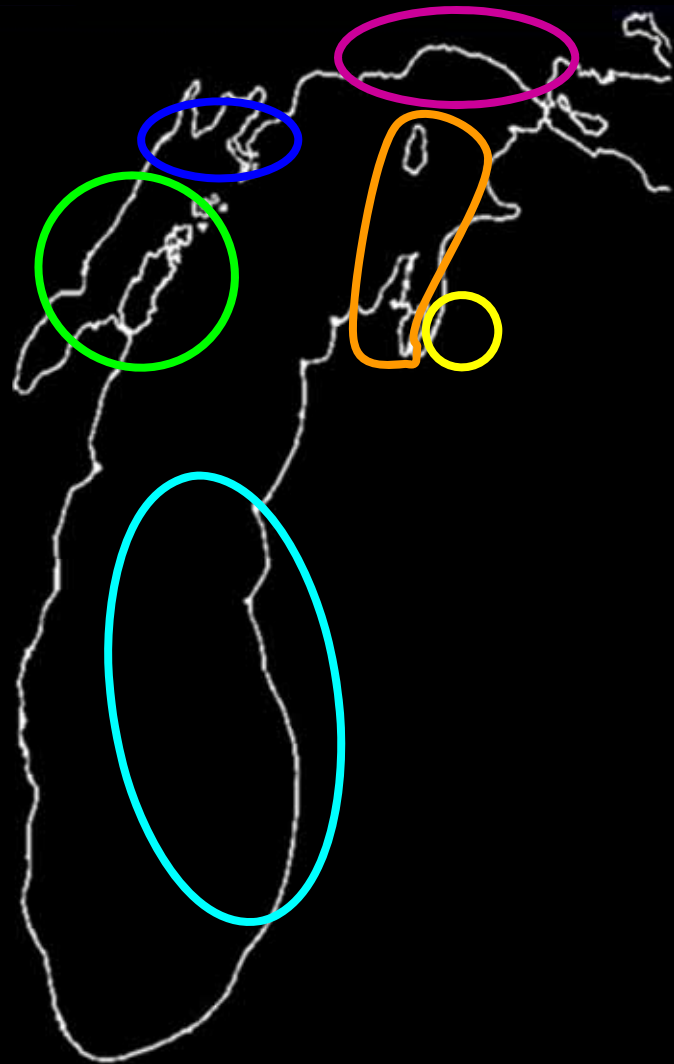
Recent Research

- 6 genetically distinct stocks
- Based on variation at 11 microsatellite loci
- Next step mixed-stock analysis



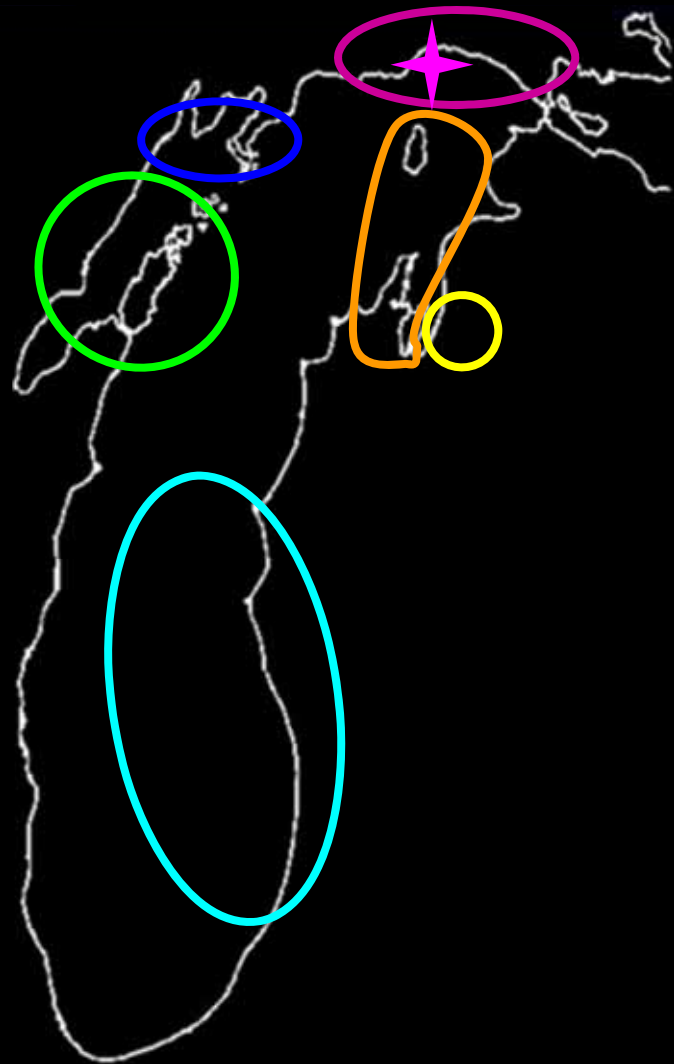
Recent Research

- **Mixed-stock analysis**
- **Closest stock consistently $< 60\%$ of harvest**
- **Composition of geographical stocks dynamic throughout commercial season and year to year**



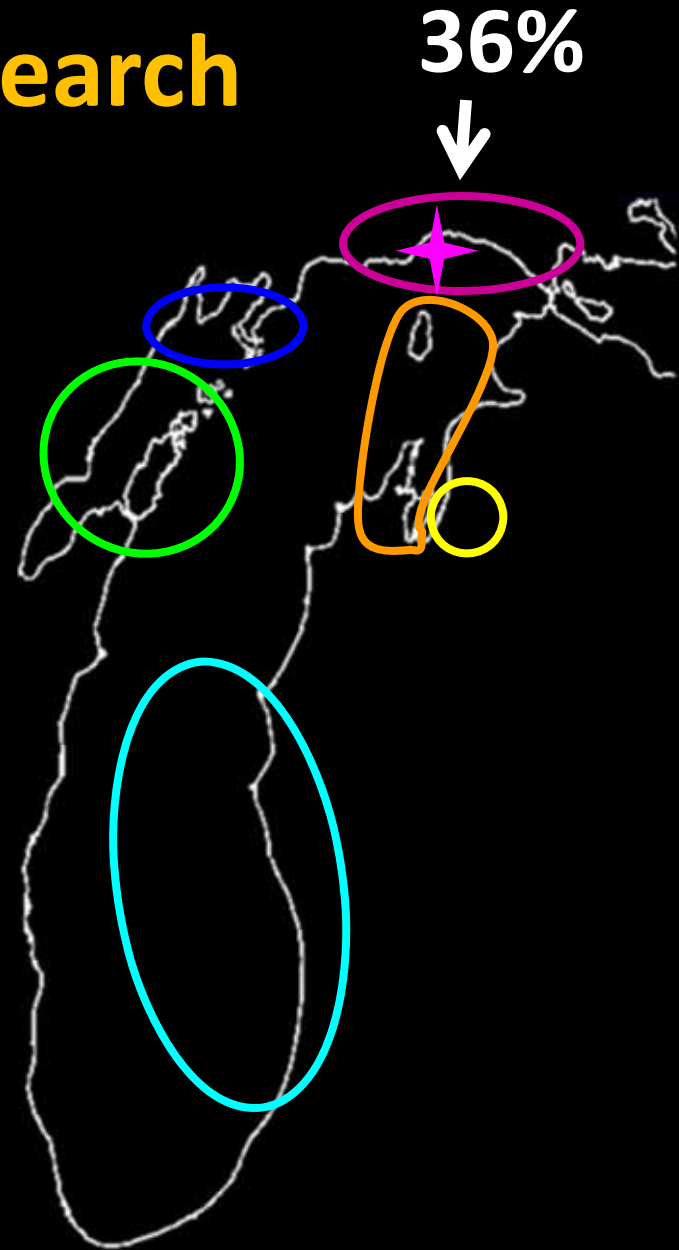
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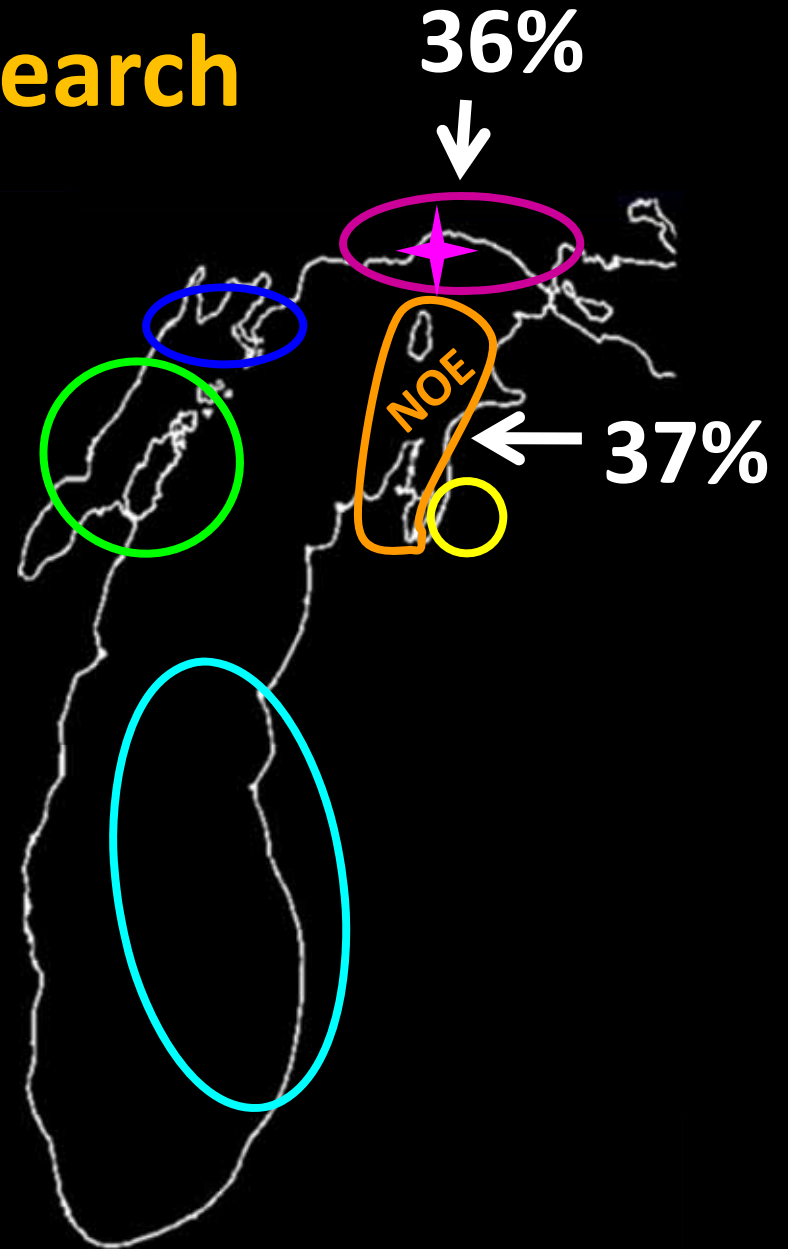
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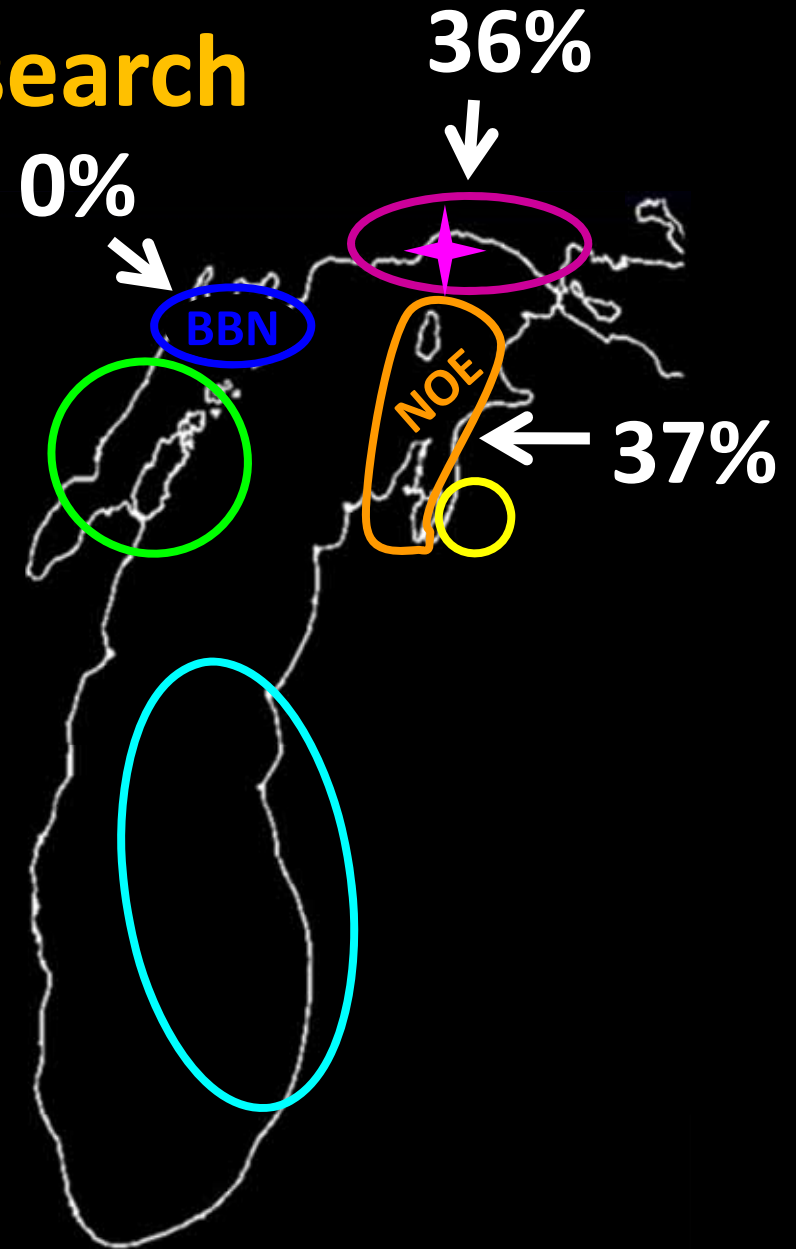
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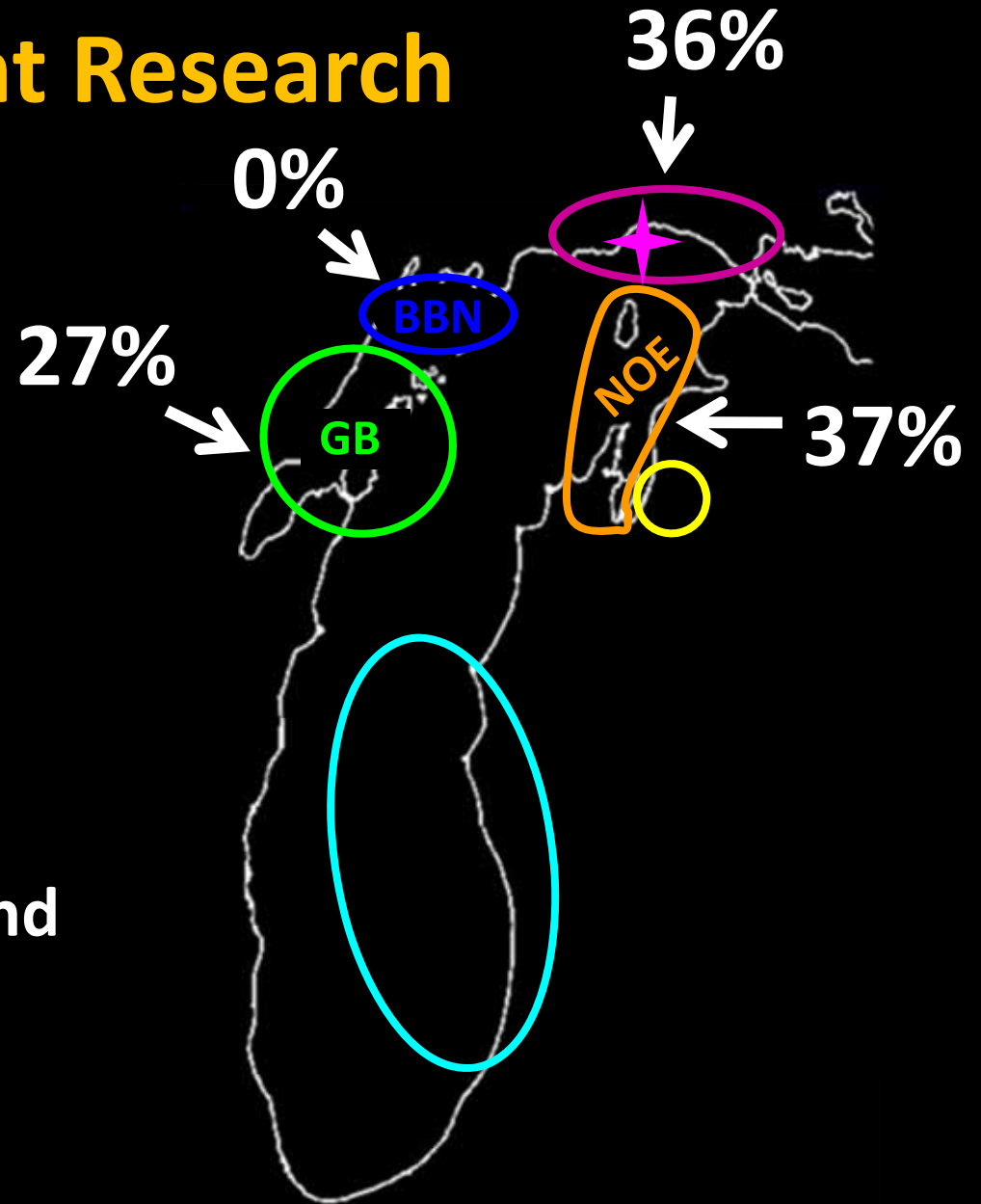
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Recent Research

- Mixed-stock analysis
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Objectives

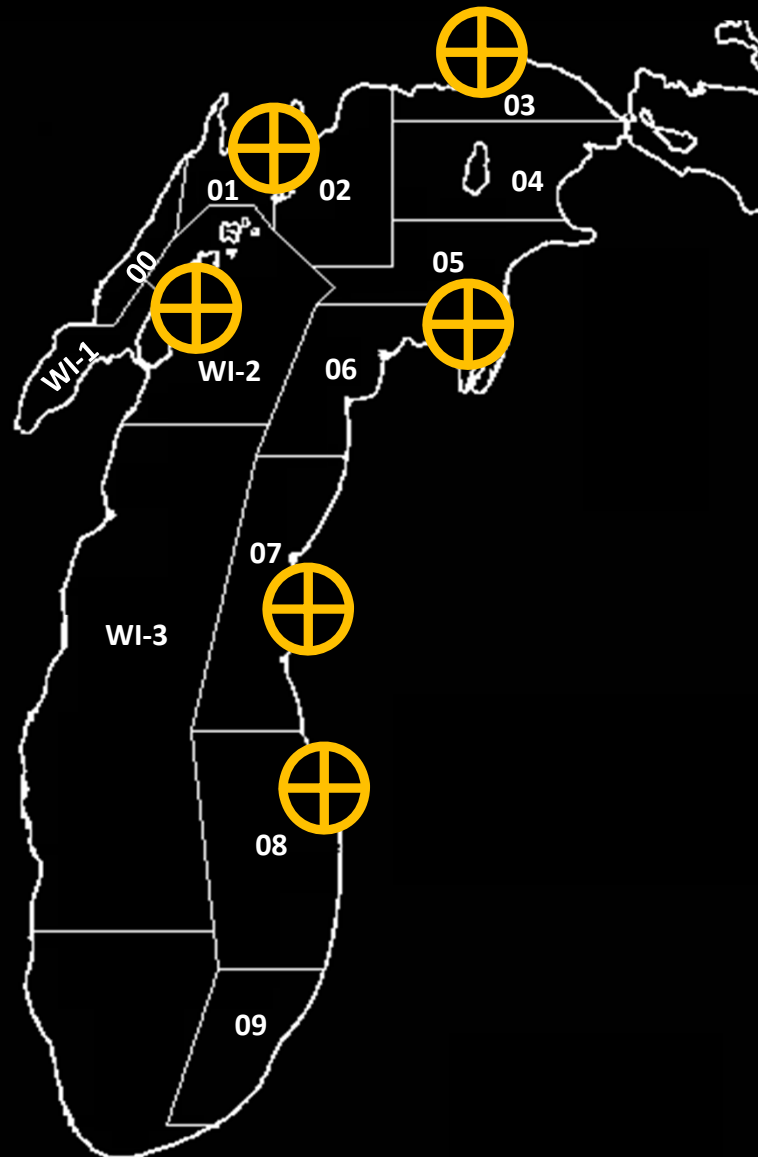
1. Determine if the accuracy of stock identification based on capture location varies by sampling period

2. Determine if biological differences exist among stocks

Sample sites

Wisconsin

- WI-2



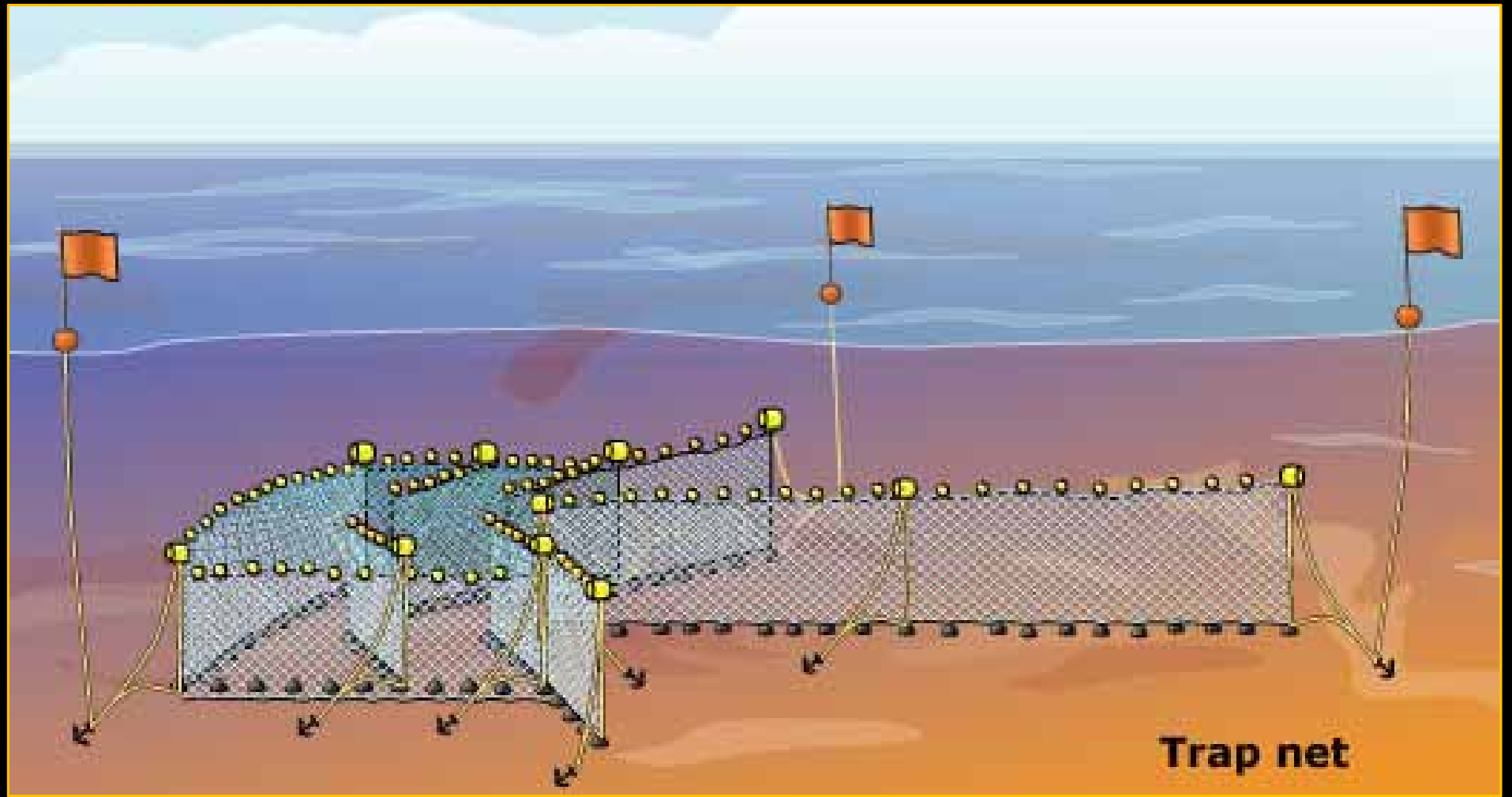
Michigan

- WFM-02
- WFM-03
- WFM-05
- WFM-07
- WFM-08

Methods

- **1,200 lake whitefish total**
- **October 1-15 (early)**
- **October 16-31 (late)**
- **Target of 100 fish per genetic stock per year**
- **1:1 sex ratio**





Trap net

Data collection

- **Weight**
- **Total length**
- **Sagittal otoliths**
- **Pelvic fin clip**
- **Gonad mass**
- **Gonad condition**



Methods

Stock Assignment

- 12 microsatellite loci
- ONCOR software
- Individual assignment to stock



Microsatellite?

- Non coding region of DNA
- Repeating patterns of base pairs
- No known biological function
- Surrogates for genetic diversity

```
NNNNNNNNCACACACACACANNNNNNNNNNNNNNNN  
NNNNNNNNGTGTGTGTGTNNNNNNNNNNNNNNNN
```


Methods

Biological Characteristics

- Age structure
- Back-calculated mean total lengths-at-age
- Length frequency
- Weight-length relationships
- Growth
- Fecundity



Methods

Age Structure

- Age estimation using otoliths
- Image Pro[®] for otolith imaging



Male LWF
TL= 486 mm
10/4/2012
Naubinway, MI

What is an Otolith?



Male LWF

TL = 486

Naubinway, MI

Methods

Fecundity

- Gravimetric method
 - Weigh and enumerate multiple subsamples of 50-100 eggs



Preliminary Results



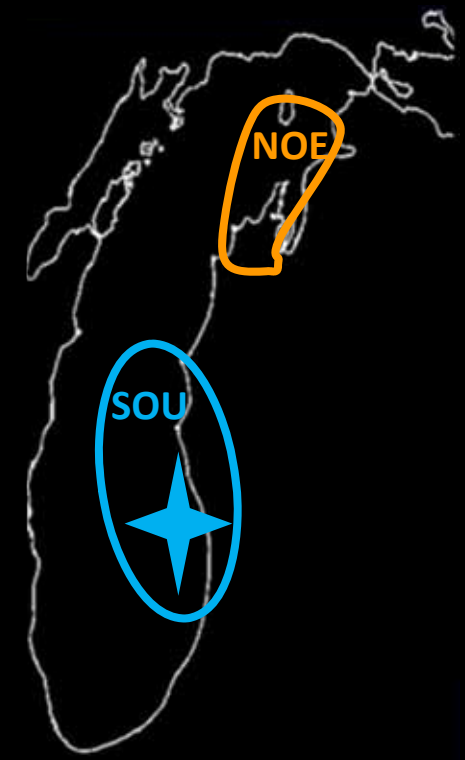
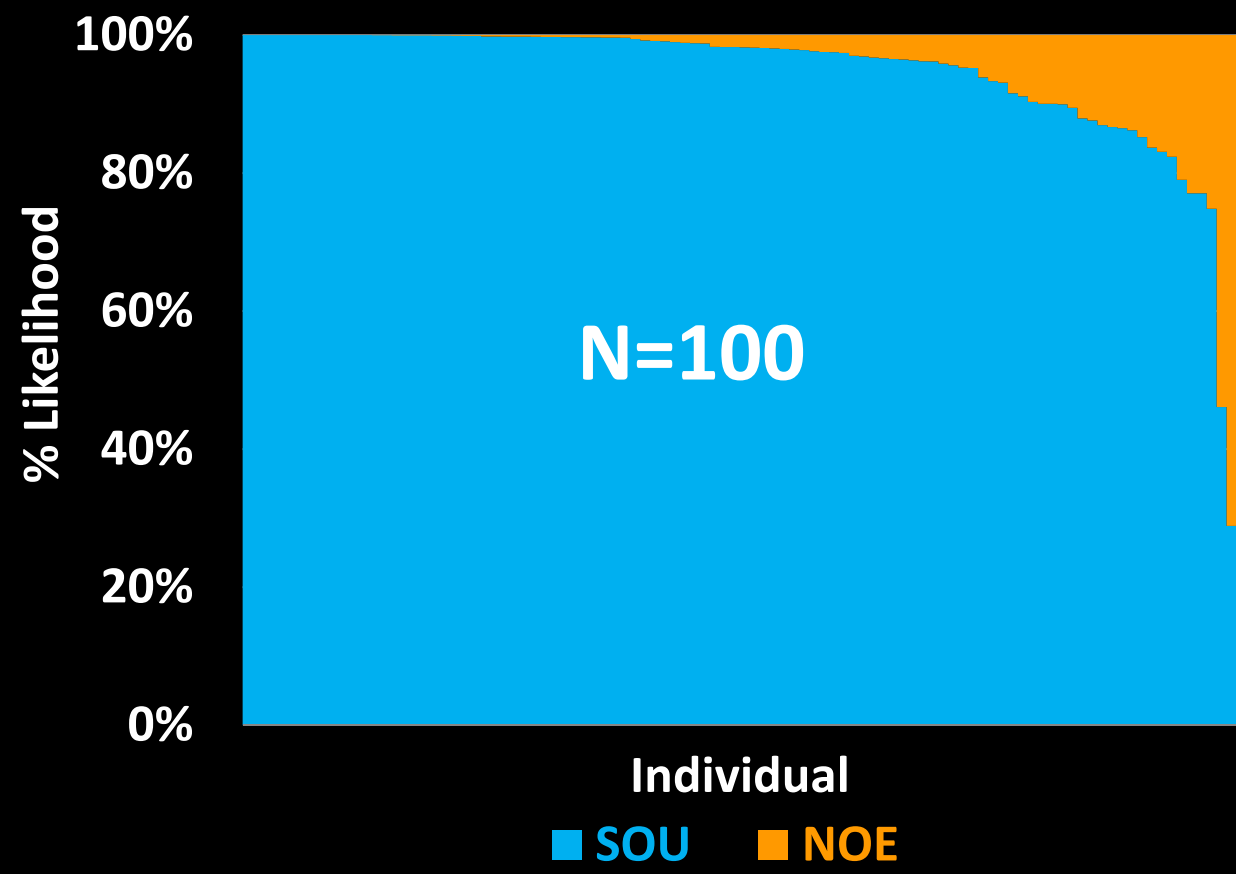
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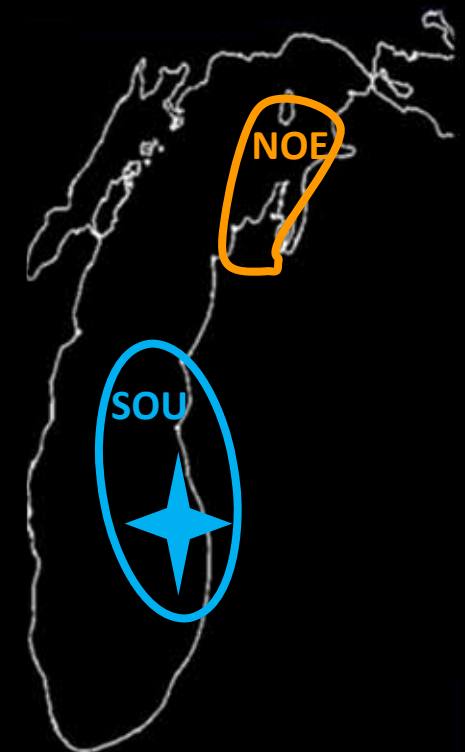
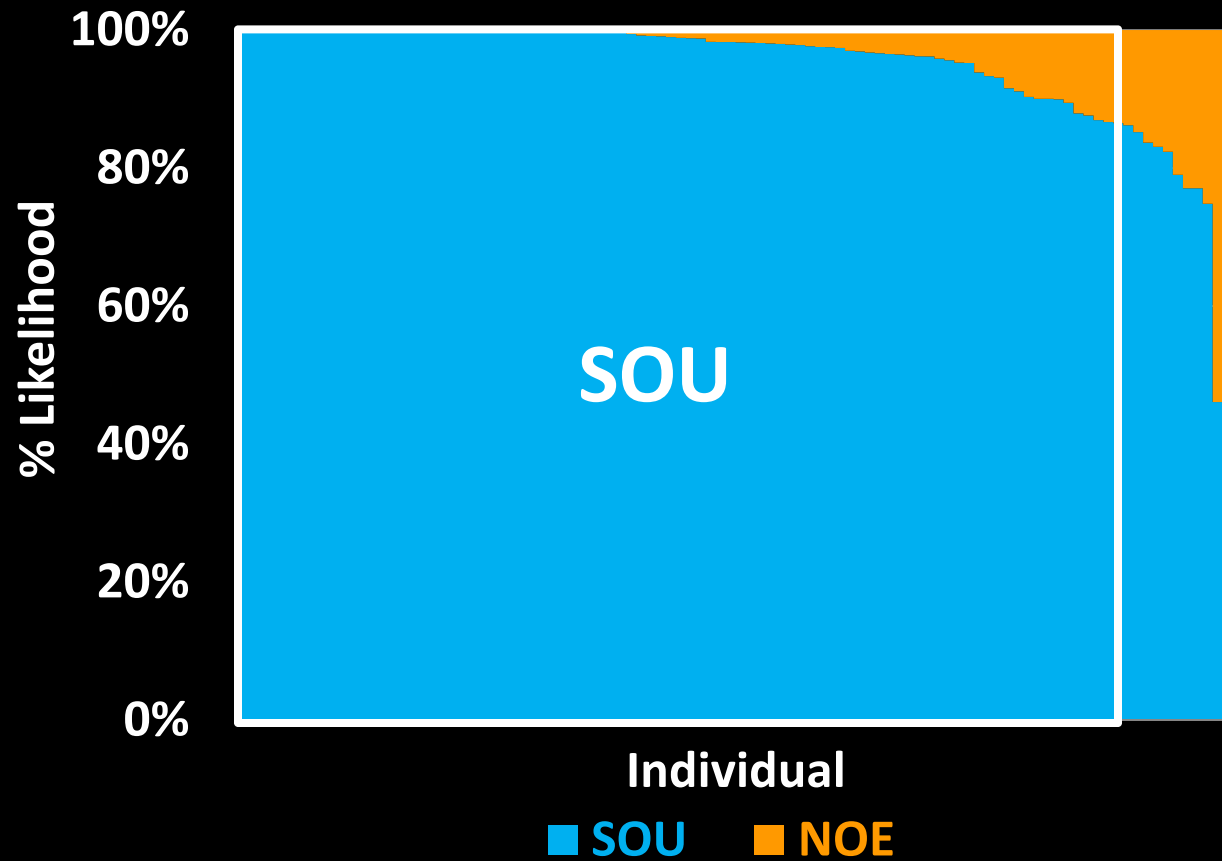
Results

Stock Assignment



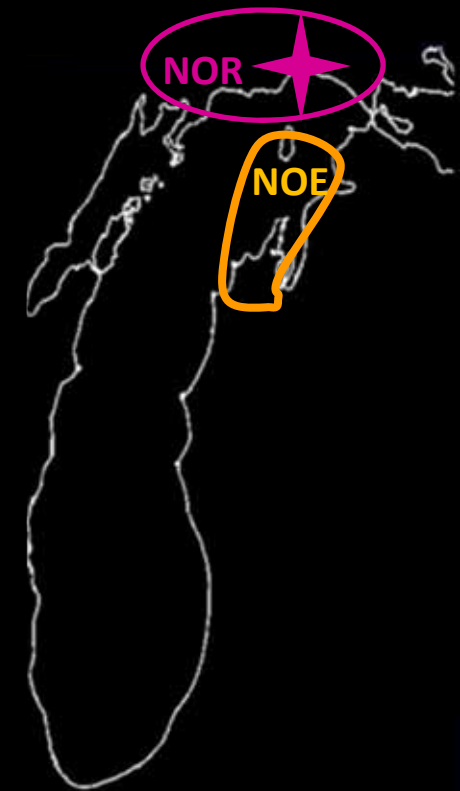
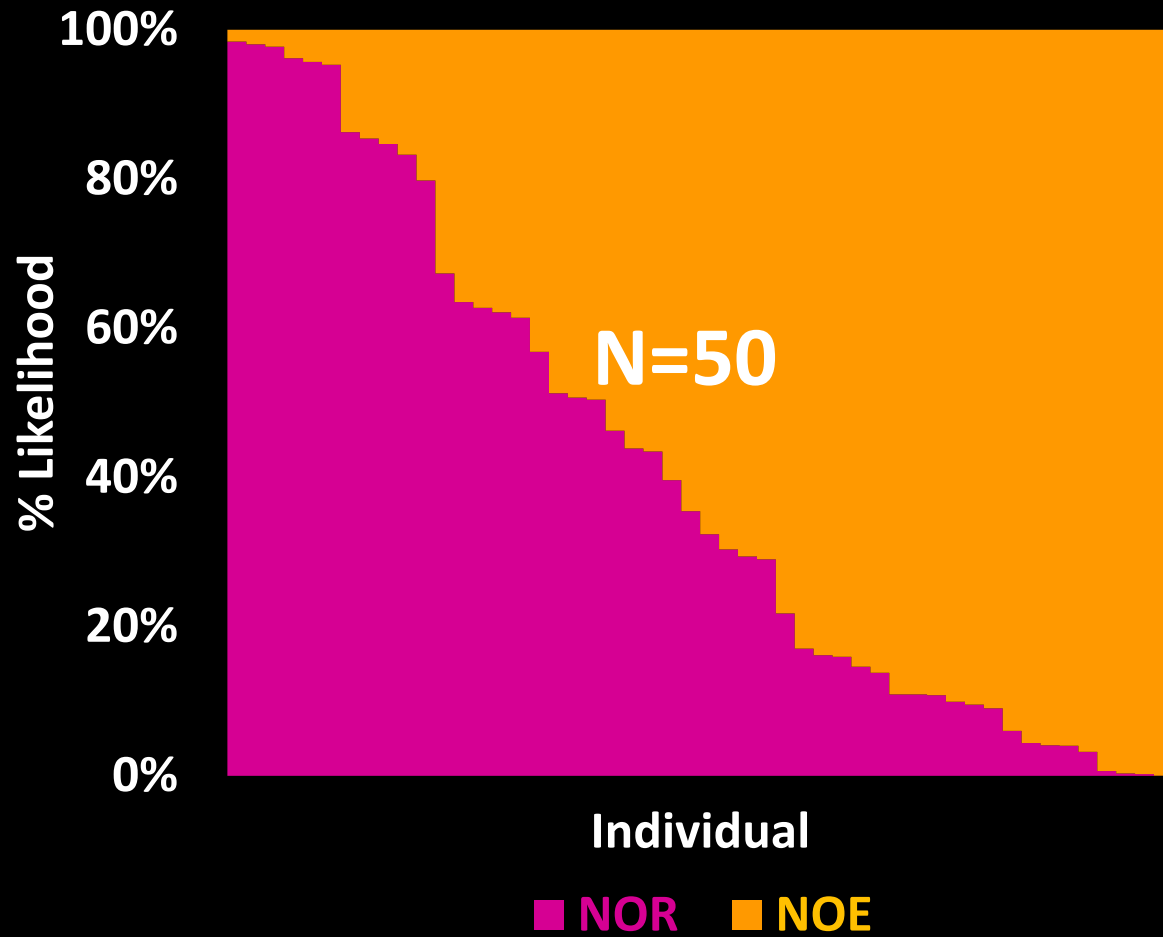
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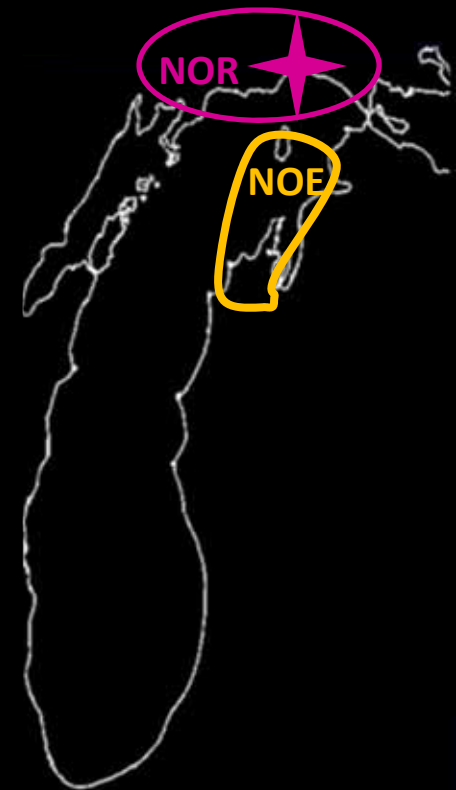
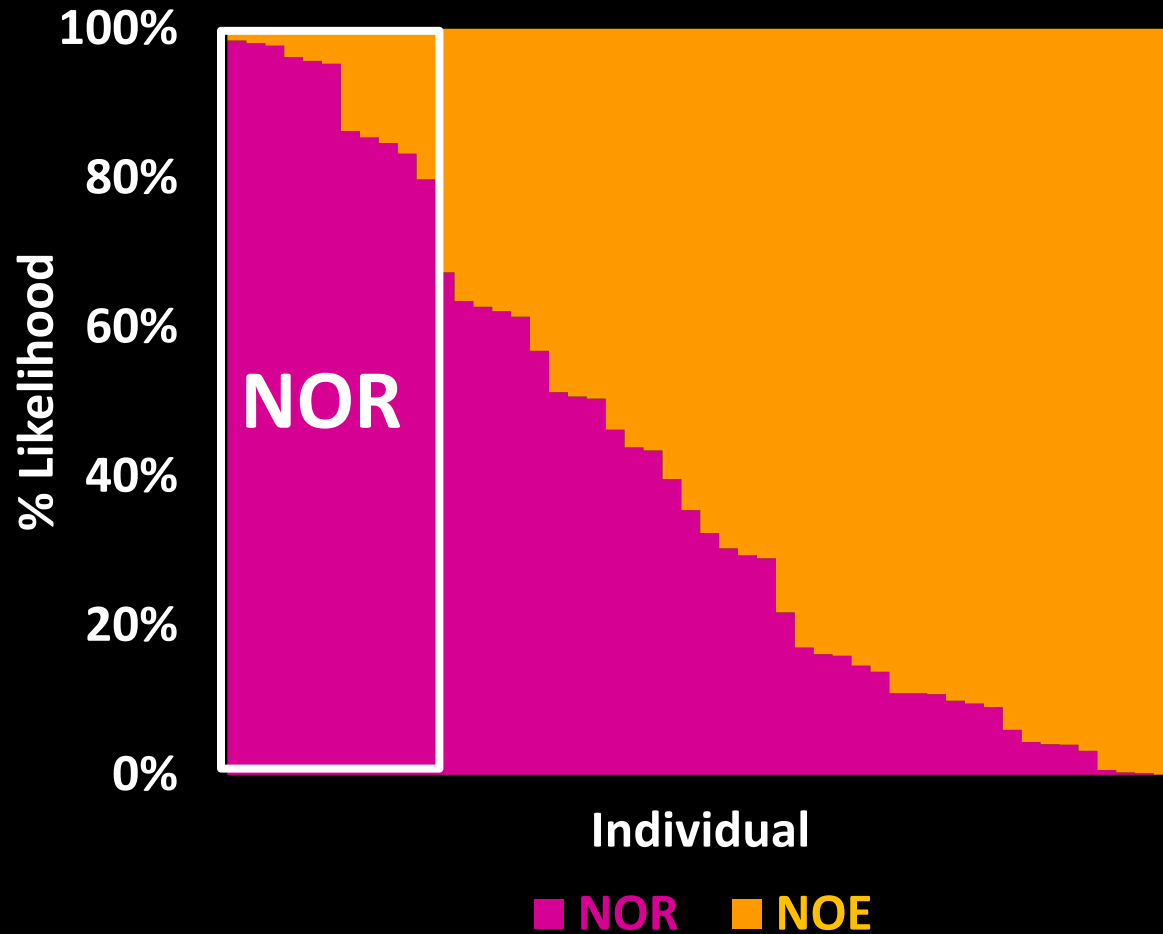
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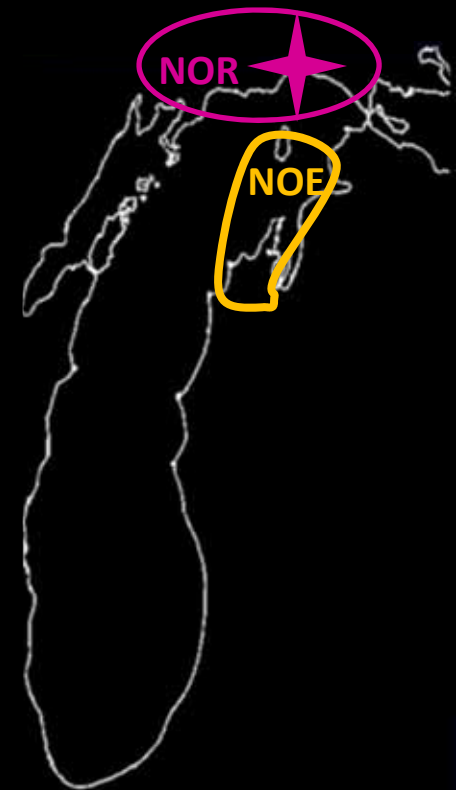
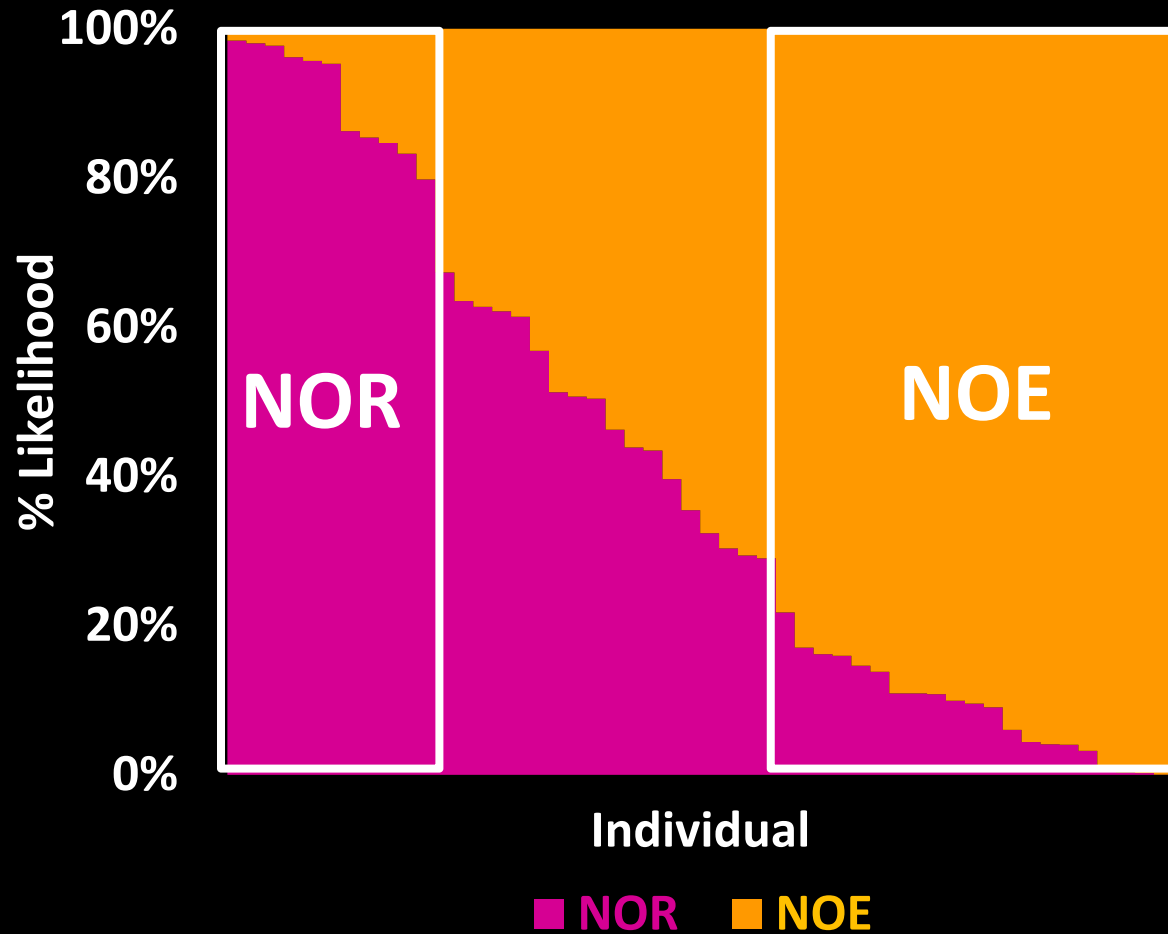
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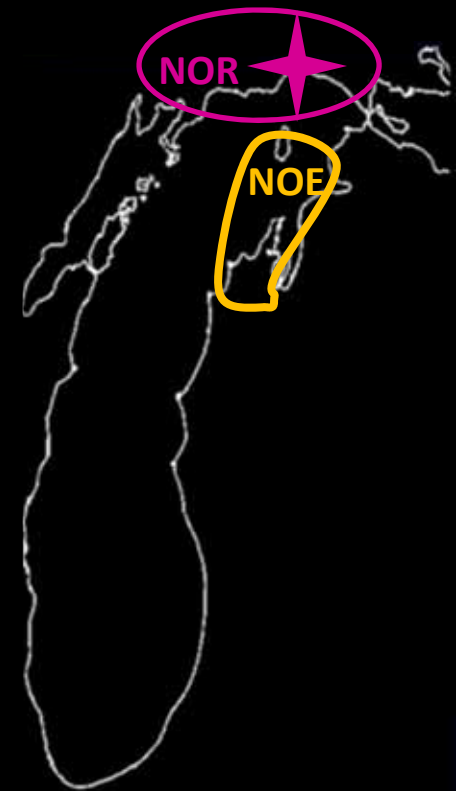
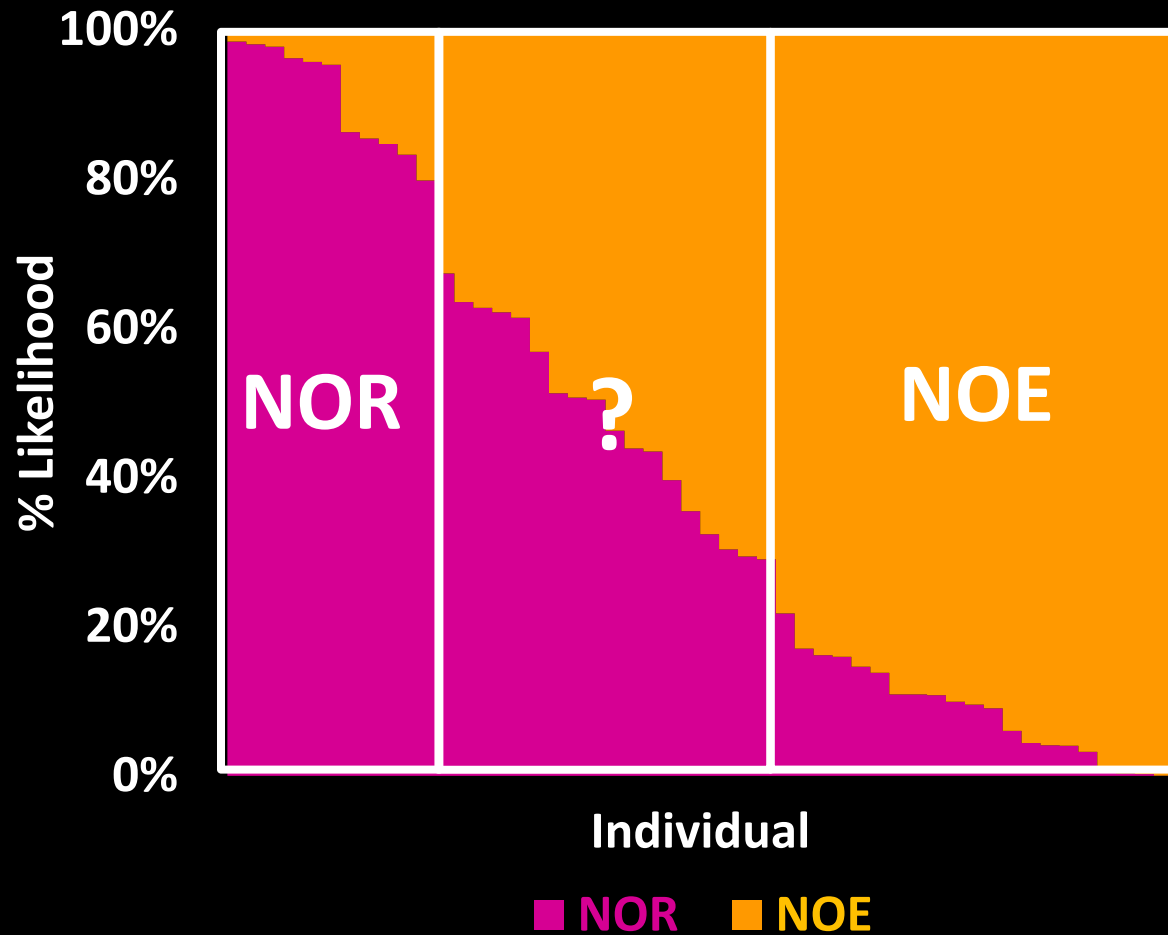
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Results

Stock Assignment



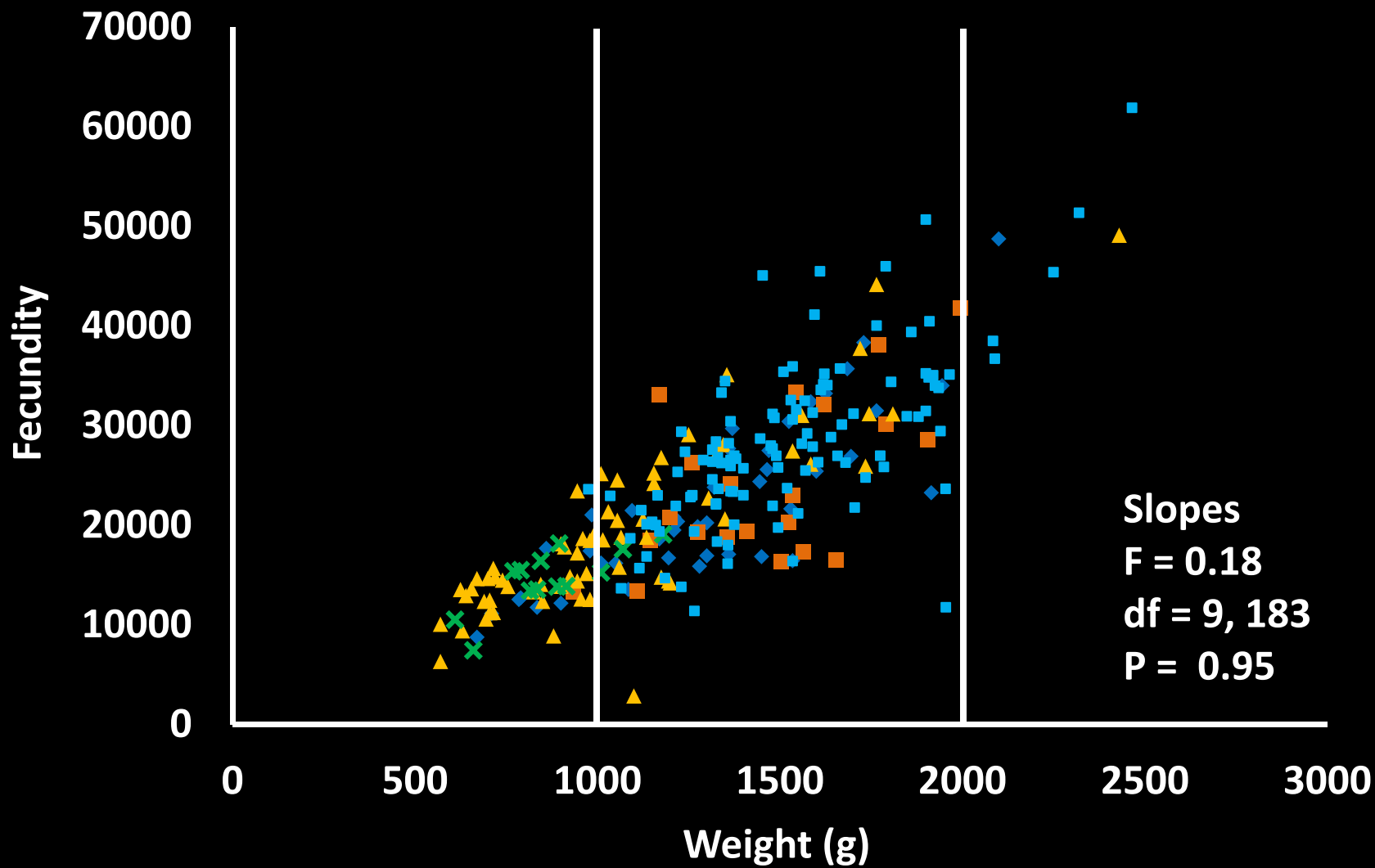
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Results

Fecundity All Stocks



Results

Expected Fecundity for a 1,325 g Female LWF

Stock	Expected Fecundity
Southern	24,241
Northeast	25,043
BigBaydeNoc	22,414
GreenBay	21,597
Northern	21,813

Results

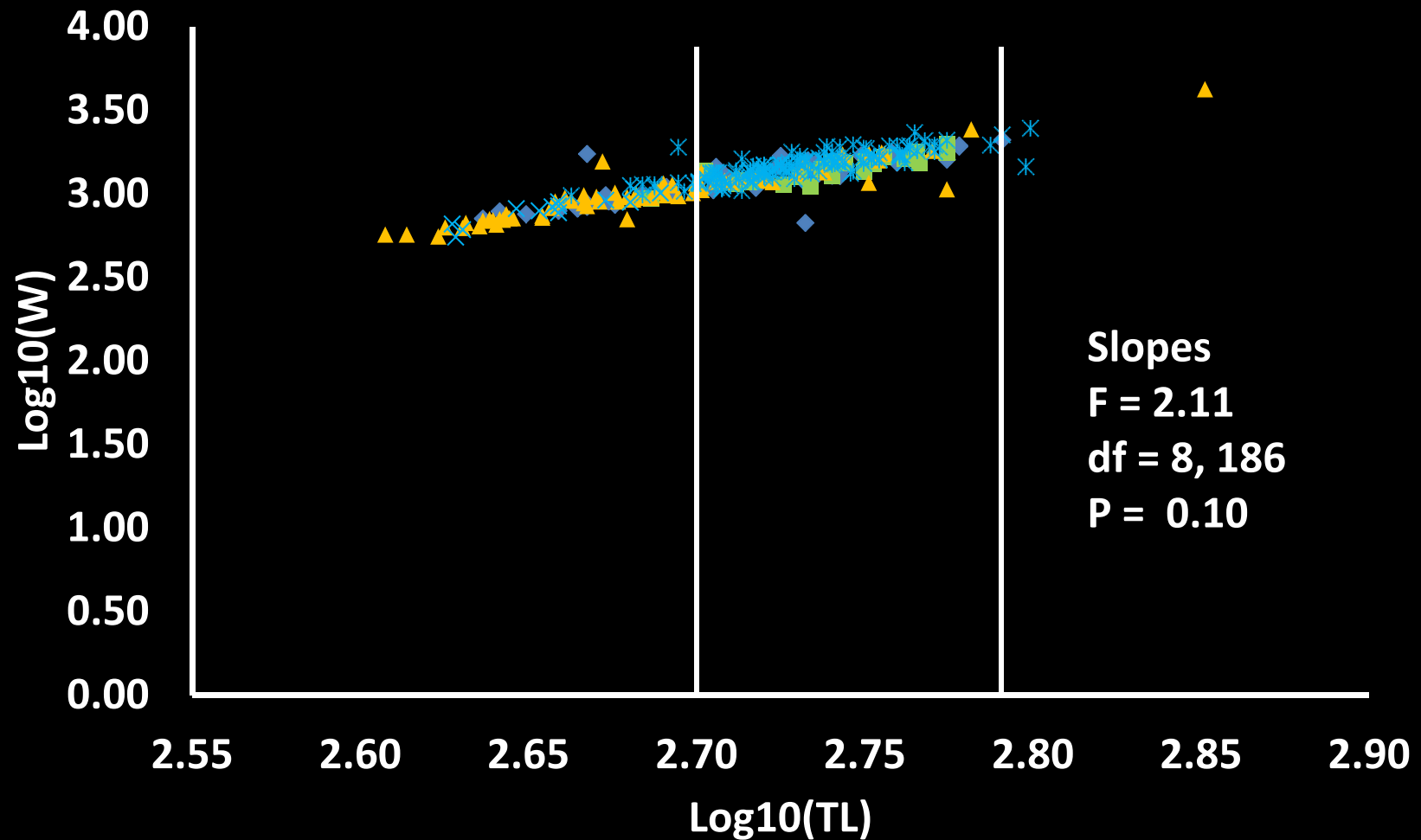
Expected Fecundity for a 1,325 g Female LWF

Stock	Expected Fecundity
Southern	24,241
Northeast	25,043
BigBaydeNoc	22,414
GreenBay	21,597
Northern	21,813

- The greatest difference among expected fecundities was 16%.

Results

Female Weight-Length Relationships



Results

Expected Weights for a 525 mm Female LWF

Stock	Expected Weight (g)
GreenBay	1,222
Northern	1,285
BigBaydeNoc	1,266
Southern	1,375

Results

Expected Weights for a 525 mm Female LWF

Stock	Expected Weight (g)
GreenBay	1,222
Northern	1,285
BigBaydeNoc	1,266
Southern	1,375

- The greatest difference among expected weights was 12.5%

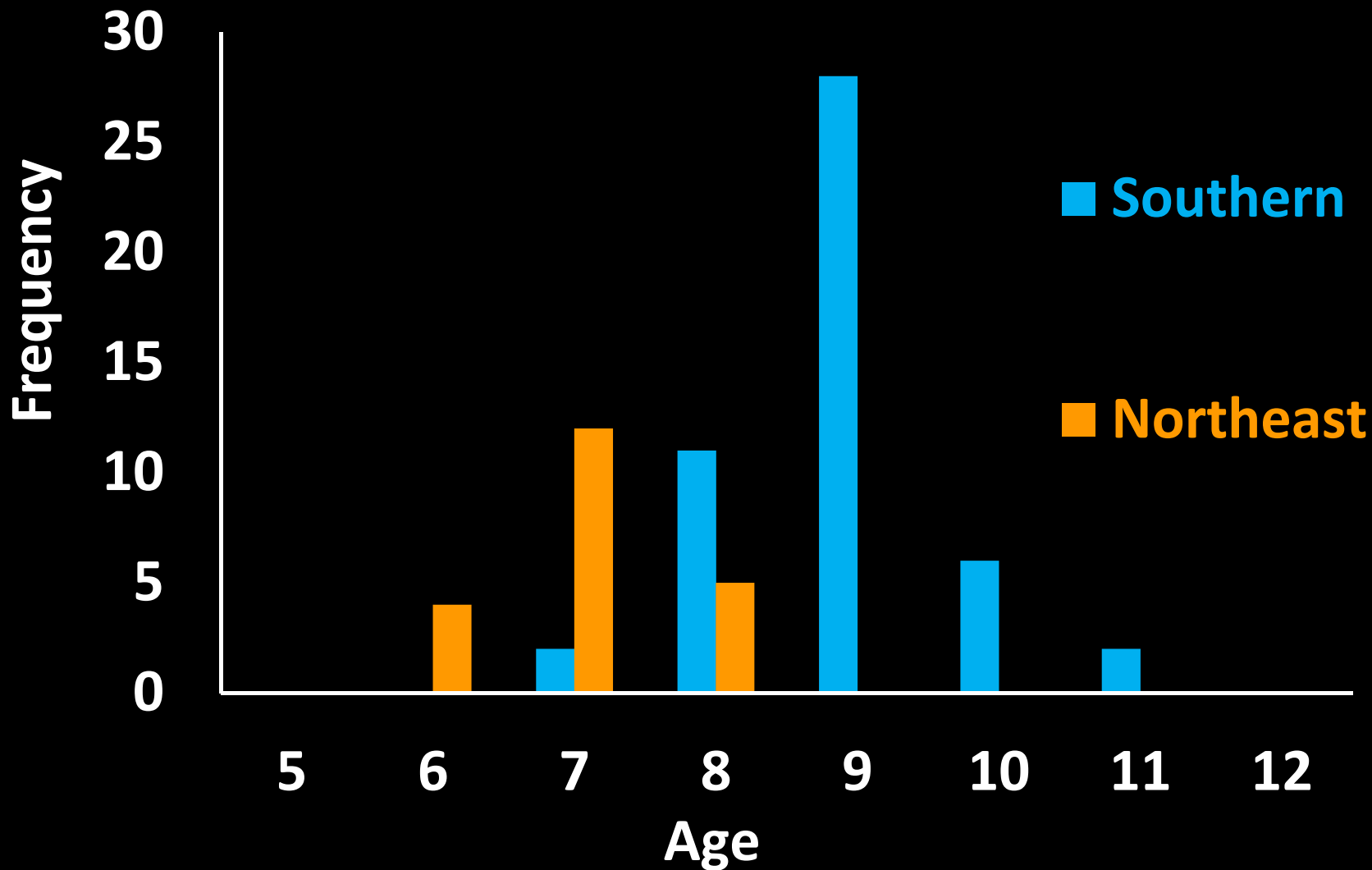
Results

Age Structure

Stock	Mean Age	SD
Southern	8.90	0.82
Northeast	7.05	0.67

Results

Age Structure



Summary

- **Stock assignment based on capture location is better at some sites than others**
- **No significant difference in stock-specific fecundity**
- **No significant difference in female W-L relationships**
- **Age structure shows potential differences**



Acknowledgments



- **WDNR**
Scott Hansen
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Dave Caroffino
Randy Claramunt
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- **Marty Holtgren (LRBOI)**
- **Erik Olsen (GTBNR)**

All Commercial Fishermen



