GREAT LAKES FISH HEALTH COMMITTEE

2018 Winter Meeting
Cleveland, OH
February 6-7, 2018

Minutes
(with attachments)

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GREAT LAKES FISHERY COMMISSION
2100 Commonwealth Blvd, Suite 100
Ann Arbor, Michigan 48105
Great Lakes Fish Health Committee

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Great Lakes Fish Health Committee Meeting

Cleveland, OH
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Agenda

<u>Tuesday, February 6th, 2018</u>

8:00-8:15	Welcome, Introductions, Approve Minutes (Andy Noyes)
8:15-8:30	GLFC Update (Jeff Tyson)
8:30-9:30	Lessons on Fish Health from the Cuyahoga River and Lake Erie (Kevin Kayle)
9:30-10:00	White amur/grass carp ploidy case and inspection program (Ron Ollis, Ohio DNR, Division of Wildlife)
10:00-10:15	Break
10:15-10:45	Baitfish inspection program (Jeff Collingwood, Ohio DNR, Div of Wildlife)
10:45-11:00	GLFC Lacey Act/AIS Update (Jeff Tyson, group discussion)
11:00-11:30	Ohio Division of Wildlife - Injurious AIS Policy and Aquaculture Permitting (Kevin Kayle)
11:30-1:00	Lunch
1:00-1:30	Maumee Lake Sturgeon Update (Justin Chiotti, USFWS-Alpena)
1:30-2:00	Flavobacterial Diversity and Epidemiology in Hatchery Systems (Tom Loch, MSU)
2:30-4:30	Agency updates (all)

4:30 PM End of Day 1 presentations

<u>Wednesday, February 7th, 2018</u>

8:00-8:15	Reconvene and introductions (Andy Noyes)
8:15-8:45	Helminths of Birds Associated with an Ohio State Fish Hatchery (Doug Sweet) – *cancelled*
8:45-9:15	Double Crested Cormorant Control Update (Kevin Kayle)
9:15-9:45	Effects of Harmful Algal Blooms in Western Lake Erie fish populations (Stu Ludsin, OSU)
9:45-10:00	Break
10:00-10:45	Latest VHS Research & Techniques (Megan Niner, U Toledo)
10:45-11:15	Monitoring Project Icebreaker – Offshore Wind Power in Lake Erie
11:15-11:30	Interesting Cases
11:30-11:45	Other GLFHC Business, Baitfish Recommendation (group)
11:45-12:00	Upcoming Meeting Planning
12:00	AJOURN
1:30-4:00	Tour Options

1. Welcome, Introductions, Approve Minutes (Andy Noyes)

- Several sets of minutes were approved unanimously;
- recording secretary position abolished; host agency please bring someone along to take minutes
- Include presentations as an appendix of the Meeting Minutes

2. GLFC Update (Jeff Tyson)

- Webpage – Document search will take you to meeting minutes and documents
- Workshop on LWF management & research needs in Lansing MI March 27-28
- Steve Hurst (NYDEC) – Science Transfer Board Project
    - Streamline information transfer from GLFHC to lake managers
        - A lot of materials buried in agency, committee reports
        - Move into a database and a summary document
        - Annual reports need to be summarized for lake managers
        - Detections, risk of spread and recommendations on new methods
        - Can't find or navigate current formats
    - Database
        - Across all agencies – plug in information etc. directly into
        - Lake Committee Agencies – Report Card on state of lake being developed using existing databases
        - Pathogens – All-Agency wide
            - Website would generate reports for hatcheries; report-side needs to be populated
        - ACTION ITEM - Gary: Send out database structure to all on GLFHC
        - Andy will generate a quick and dirty summary;
        - Wild fish health survey – being restructured but moving along slowly – would be nice to link this into the GLFHC path forward.

3. Lessons on Fish Health from the Cuyahoga River and Lake Erie (Kevin Kayle)

- Cuyahoga River and Lake Erie has been ground zero for AIS, HABs and environmental movement
- Lake Erie fishery notoriety from
    - WAE and YEP capitals of the world
    - SMB history and "Steelhead Alley"
- Midwest Fish & Wildlife Conference will be held in Cleveland in January 2019
- Annual AFS Meeting in Columbus in Summer 2020
- Key Issues and Area Background
    - Great Lakes
        - **Cuyahoga River**
            - Crooked River – 122 miles – U shaped – 810 sq miles; mid-sized
            - National Park lies between Cleveland and Akron
            - Upper Cuyahoga watershed in good shape – Akron water supply
            - Lower reaches: USEPA Area of Concern identified in 1985
                - Remedial Action Plan in place in 1988

        - 14 different impairments including Fish Tumors
        - From Akron to mouth of river, with most impairments and issues in lower 5 miles (dredged ship channel and legacy pollutants)
            - Also legacy storm sewer issues
            - CSOs being sent to tunnels
                - Will be done in next 5-7 years
        - A lot of chemical inputs
        - A lot of prop damage to big fish from large shipping vessels- that allows bacterial infections
        - Fish DELTs down to 3.1% in recent surveys
        - Named a National Heritage River in 1998:
    - Big river fires in 1940-60s, common in summer – Big one in 1969
    - As cities developed industrially, people moved away from river
    - Big salt mine on Old Channel
    - Working river with deep navigation channel
        - Sediment plumes seen behind big vessels
        - Dredging is annual; 3 zones with large CDFs in CLE harbor
    - Big outfalls from industrial (steel) cooling systems
    - Recently improvements made to address impairments
    - Beginning to see more sensitive species showing up: including spotted suckers, and migratory fish showing up in large numbers – GLRI project evaluation
    - Industry trying to soften sheetpile walls: side energy too great from large ships turning in basin – High turbidity
    - Steel mills are placing riprap and gravel to change vertical walls
    - Dissolved oxygen levels are not crashing anymore, no fires!
    - Diverse plankton and fish populations including larval fish
    - Partners and NGOs working to remove some habitat impairments
    - Quality habitat is still an issue, particularly shallow water areas without high energy from shipping and relief near discharges
    - Grass carp seen in the upper area – all Triploids so far
    - Removing first barrier dam in National Park at Brecksville (RM20) sometime in 2018-2019, with next (last large remaining) dam upstream in Cuyahoga Falls near Akron (RM46)
    - Anglers seeing some stray steelhead showing up – not stocked by ODNR because of AOC impairment issues
        - Sagamore Creek is producing some natural recruitment
    - WAE re-establishment being considered – Some juveniles found above ship channel; no larvae sampled in GLRI project or OEPA or NEO Regional Sewer District sampling activities.
- **Lake Erie**
    - Aquatic Invasive Species issues
    - Dead zones – Particularly in the central basin with summer upwelling events
    - HABs
        - Primary issue is Maumee River with Agriculture

        - Central Basin is 80 feet and stratifies, most years has anoxic zone
        - VHSv – YEP, GIZ and WAE
        - SMT (Smelt) – Have observed die-off from post-spawning stress
        - Botulism E – Eastern and central basin areas – related to RGB and dead zones – Fairport to Erie to Buffalo
        - HABs – Bioaccumulations – Congeners are of interest now (see Stu Ludsin presentation)
            - Toledo water ban issue in 2015
        - Rehab
            - GLWQA, GLFC, GLRI – Binational effort
        - Big waves were sent by Superstorm Sandy – 15-20 feet into Cleveland Harbors - Huge debris inputs
        - Increasing numbers of warmwater species such as LMB and panfish seen in L Erie, harbors

    - **Fish Health concerns**
        - No pathology or vets on staff with ODNR; contract services
        - ID and address pathways and stressors
        - Bring in assistance and train ODW staff on how to deal with potential issues
        - Super-abundance issues with anoxia and fish movements
            - Crowding issues seen to get high pathway
            - Heterosporis occasionally seen in YEP and WAE, along with Asian Tapeworm in game and bait fish
        - Public concerns with fish kills – Not always a pollution issue in this system
        - Auglaize River had a kill in late summer last year, but no moribund fish were sampled (in L Erie drainage but south of current VHSv demarcation line)
        - Sex reversal not been documented in the Cuyahoga River below Akron
        - Burbot are being seen with reproductive issues in central and eastern basins of L Erie
    - Other concerns: Asian carps pathways in Ohio across Mississippi R and Great Lakes divide
        - Bighead Carp collected in Ohio R downstream of PA state line, Juvenile silver carp sampled in Ohio R around Cincinnati
        - Ohio, USACE multiple partners addressing barriers at potential pathways.

4. White amur/grass carp ploidy case and inspection program (Ron Ollis, Ohio DNR, Div of Wildlife)

- Grass Carp (triploids) Imported into Ohio for decades
- Increasingly, more fish in the wild have been seen, and diploid GC fish seen in 2012
- Origin of investigation – Issues with certification process, remnant fish before law changes – Joint operations between law and fisheries sections
    - Certification process issues
        - Ploidy inspection not conducted by receiving states.
        - Not examined at retail sites.

    - Inconsistent between-state regs
    - Financial incentive to launder diploids for more profit
  - Source
    - 40K USFWS-certified GC coming in annually
    - 130 shipments with 15-20 dealers
      - Dealers on interstate corridors
    - Certifications were not being examined closely – now logged and reviewed
  - Fisheries
    - Streamlined review
    - Sample size determination
    - Train staff to get samples
  - Law
    - Determine all sources
    - Staff to get samples – Some operations want ID to get fish
    - Cash flow needed - $14/fish
    - Follow up inspections
  - Objectives
    - Determine ploidy
    - Utilize undercover officers to get fish
    - Follow social media, internet sites
    - Violations found right away
  - Workflow
    - Triploid certification from USFWS
    - Random select shipment
    - Notify law enforcement to get 15 fish
    - Fish delivery to Fisheries
  - Sampling strata
    - 15-20 dealers – 3 strata
      - More than 1000 fish (GC) per year
      - Less than 1000 fish per year
      - Out-of-state dealers
    - Two Years (purchases, respectively)
      - Large (30, 28)
      - Small (5, 8)
      - Out of State (5, 4)
    - 40 purchases and 600 fish per year
  - Shipments
    - 2015: 129 – 40K Fish
    - 2016: 136 – 44K Fish
    - Covered 16 of the 17 dealers – all 4 Out-of-State from AR
  - 1200 fish – No diploids
    - Six indeterminate
    - 1 fish eyeball missing
    - Overwhelming majority triploids
  - Conclusions:
    - Effective certification system
    - Random inspections are necessary

        - Diploid origin of L Erie fish still needs to be determined
        - 16 “main” dealers contacted over 2-year project: 4 dealers did not keep any records = 25% arrest ratio

5. Baitfish inspection program (Jeff Collingwood, Ohio DNR, Div of Wildlife)

- In 2013, observed Ontario PPT at GLFC Law Enforcement Cmte: 42 million bait fish – 618K round gobies; 1 in 68 purchases had RGB. Thought: Ohio needs to do this!
- 558 bait dealers in OH; 1.3 million anglers in OH
- Are AIS being moved in bait buckets? Could be a significant pathway.
    - Where is bait coming from?
    - Any AIS in bait?
    - Teach bait dealers what to look for
    - Ensure compliance
    - Extensive LE training at districts (bait ID booklet distributed)
    - Purchased equipment
- Looking for non-bait fish
    - Records violations
    - Bait sources
    - 2014: 44 inspections, 1 AIS found, 16 violations
        - Often sellers did not know they needed a license
    - 2015:
        - Training provided on ID, purchased equipment (cameras and nets), outlined goals, distributed education materials to bait shops
        - 463 inspections, 3 AIS, 1 mosquitofish, 78 violations
    - All LEO contacts in uniform
    - Most bait dealers were very cooperative
    - Container labeling, and truck signage are issues
    - Sources – AR, IN, KY, MI, MN, NY, TX, WV, WI – larger ops, shipments are likely to have originated out-of-state
        - A&J Bait was noted as a potential issue
- Future Efforts:
    - 25% inspection rate
    - Violators automatically visited again
    - Plain clothes enforcement
- AIS not prevalent
- Education points will be forgotten, and we must be pro-active and re-engage
- All: discussion on Bait Certification programs

6. GLFC Lacey Act/AIS Update (Jeff Tyson)

- 2012 – Added injurious species and challenged by herps groups in DC
    - Shipment clause in Act was challenged
        - Interstate shipments can be made
        - Underlying state law violations
    - May 2015 – DC District ruled for herps groups (USARK)
- April 2017 – Appeals Court upheld lower court ruling

- No protections for shipping injurious species across state lines – No USFWS appeal will happen
- Lacey Act needs to be revised and resolution passed to move revision
    - AFWA is working on issue – Bill introduction that includes risk assessment being considered
    - Great Lakes states are examining issue

7. Ohio Div of Wildlife - Injurious AIS Policy and Aquaculture Permitting (Kevin Kayle)

- Aquaculture Permit – Future species of interest
    - Aquaculture permit A – Native, or some salt water in RAS
    - Aquaculture permit B – Non-native to watershed
    - Bait Dealer/Collector
    - Injurious AIS
- Division of Wildlife has Rapid Response Plan in place for AIS
- OH Rep. Hall proposed AIS legislation – Would have created new rules
- Wild animal importing, exporting, selling and possession regulations – Posted on ODW website for injurious species – PDF with species – Fish, mussels and crayfish
    - White perch excluded – Can have headless, preserved, eviscerated
    - Educational and research locations allowed by Chief authorization
- Lacey Act was one of ODWs anchors
    - Interstate commerce was external and is international in focus
- Center for Invasive Species Prevention proposal listing 30+ species of fish , including some native to Ohio, came out before National Aquaculture Association meeting and also some mis-information that Ohio was going to adopt all these species as Injurious AIS just because they were proposed – Created an issue
- ODW/Ohio AIS Committee - Need to focus on watershed and interstate issue:
    - Risk analysis and screening process
        - Literature review
        - Ecological risk screening
        - QA/QC from staff biologists and Aquatic Invasive Species Committee
        - ODW Chief approval
        - had to be in right format for an ODNR Policy
- Group effort
    - Stakeholders – Importers and exporters
    - Legislators
    - Law
- AIS Policy created – Distributed as PDF on their invasive species list
    - Prioritize species – Use and handling, considered along with potential for release
    - Classify risk
    - When done and who will do
    - Defined 'high risk' as likely to harm native ecosystems and their users
    - Defined risk process and risk
        - Three tiers:
            - 1 – Identified as Injurious AIS by USFWS

                - 2 – Determined to be a risk by ODNR-DOW staff; Methodology for RA includes FISK, FishBase, ERSS or by another state agency process
                - 3 - Determined to be a risk by designated, approved contractor and reviewed, approved process.
            - Risk levels – High (Not okay), Low (okay to bring in) or Uncertain (Not okay)
- Aquaculture Permitting - Considerations
    - International – Lacey Act, ODW, ODA
    - Interstate – Other agencies, ODA, ODNR
    - Across Ohio Watershed – ODA, ODNR
    - Across VHSv Demarcation Line – ODA, ODNR
        - Clear Fork Reservoir has been negative for last six years (only place for fish to test <+> south of demarcation line)
    - Permitting
        - Thru ODNR DOW, On-line application for 2019.
        - Risk assessment, classification, QA/QC
        - Inspections will occur
        - Will take time
        - Enforcement as option and resort – Checks and balances
- No consideration of GMOs in the policy (driven primarily by catfish and salmonids);
- Nothing on outfalls re: disease/pathogens (no authority).

8. Maumee Lake Sturgeon Update (Justin Chiotti, USFWS-Alpena)

- Five years into this project; Pilot gamete collection in 2017; Toledo Zoo and Genoa NFH partners (note: STN=Lake Sturgeon).
- Lake Erie
    - 19 populations historically – 300K-1.1 million fish
    - Currently – 3 Populations
        - Upper Niagara River
        - St. Clair River/Lake – 30-50K
    - Dispersal into Lake Erie
        - Tagged 282 adult STN in DR-LSC Corridor
            - L Huron – 35
            - Lower SCR – 86
            - L Erie – 22 with 20 tagged in Det R
            - Upper SCR – 85
            - Det R – 76
        - Huron River, River Raisin, Sandusky River, Maumee River – Acoustic arrays now – Historic populations
            - No detections in tributaries
            - Likely slow recolonization from other populations
        - Maumee River
            - Ran up river to Perrysburg historically
            - Currently extirpated
            - No spawning detected
            - Efforts started in 2013

- Lake Erie Waterkeeper, ODW, Toledo Zoo, USFWS
    - Rear STN as a way to raise awareness
- 2014 – Toledo Zoo
    - Defined habitat suitability - Collier
    - OH Restoration Plan
        - Goals
        - Status
        - Habitat conditions
        - Success
        - Education and Outreach
        - Long-term management
    - Developed suitability analysis – HSI Model
        - STN Adult – Good 7.7%, Moderate 49%, Poor 43.7% = (156 ha)
        - STN YOY – Good 25.9%, Moderate 65%, Poor 12.1% = (529 ha)
- Goals – 1500 adults after 25 years of stocking
    - Can support STN – Yes
    - Plan done – Yes
    - Toledo Zoo is constructing facility – 1500 streamside and 1500 from Genoa NFH – Evaluating imprinting
        - Single-Pass Drum filter – Use Maumee River water
        - 3.1 X 12.2 M cargo trailer
        - (10) 3.5' tanks and incubation jars
        - Staffed by ODW and Toledo Zoo
    - Biological monitoring – USFWS, Commercial fishers (each fish reported =$50)
    - Education and Outreach will be handled by Zoo
    - Stocking
        - 3K fingerlings/year
        - Donor population: St Clair R/Southern L Huron – GS1
        - 7 F and 28 M each – 175 females and 500 males; hold fish at Purdy Fisheries @ Sarnia ONT in raceways for a week; all PIT tagged.
- Research Questions
    - Homing analysis
    - Post-stocking survival between streamside and normal hatcheries
    - Contribution of the Maumee River to adjoining waters
- Outreach events
    - Annual Release Ceremony
        - Adopt a fish
        - Public release
        - Use other ceremonies
- Permits nearly all in hand
- 2017
    - Pilot gamete collection – 5 males and 25 females

- Permitting, CITES work, Fish collection, Fish handling/hormone injection, Gamete collection and Transportation
- Fish collected at Lake Huron exit
- Fish Collection – 3rd week in May
  - June 7 and 8 – 37 on setlines and 24 by Purdy's – 22 ripe males and 7 black egg females by ultrasound
  - Small number of eggs collected per female to examine maturity – Progesterone assay
    - Incubate for 16-18 hours
    - Boil eggs then section
    - Germinal vessel breakdown good to go
      - Control and treated eggs
    - Only keep those fish that are ready
- Did hormone injection
  - Got good sperm motility
  - 4 females injected with CCPH; eggs from three; one spawned in tank
  - 19 males injected with CCP hormone; 17 had sperm collected from them
- Results
  - Female 1 – 1.6% - GVBD 13%
  - Female 2 – 50% - GVBD 33%
  - Female 3 – 34.2% - GVBD 16%

- Likely will need 30 males and 10 females to get numbers wanted and equalize family sizes at 2500 fall fingerlings
  - Will not reuse adults

9. Flavobacterial Diversity and Epidemiology in Hatchery Systems (Tom Loch, MSU)

- *Flavobacterium psychrophilium* – Yellow-pigmented bacteria – Bacterial Cold Water Disease
- Huge impediment to fish culture
- Horizontal transmissions - move from external sources then to vertebrates
- Mats of bacteria with lesions, fin ulcerations
- Can be systemic: in brain and can cause scoliosis
- Fish to fish, vertically too, within eggs; surface dis-infection does not work
- Annual MI survival
  - Very prevalent, but variable
- Isolate Typing
  - Genetic diversity and how it relates to virulence – Chris Knupp
    - Multi-locus sequence typing – Used in food-borne outbreaks
      - Seven genes used
      - One central database in France thus comparable globally
      - Typed 400 isolates from 1981 and in 20 states: 87 MI, 122 ID

        - 83 variants in 12 complexes and 43 singletons in US
            - Some are widespread
            - Some are repeatedly associated with disease outbreaks
            - Some are found in multiple continents
            - Very diverse and changing rapidly
            - Virulent group is specific to RBT unless other species on site
                - Many are species-specific – BNT, COS, ATS….
        - Virulent group – Wolf Lake SFH and TSFH RBT – Never detected in feral broodstock or eggs until…
            - 2017 WLSFH RBT – Odd symptoms from new variant
                - 2016 broodstock – Seen at LMW – Novel strain in virulent complex in broodstock too
                - Also found in eggs
        - COS Clade – PRW, PRSFH, IN – Unclear on the source
        - Generalist Clade – LMRW, PRW, SRW – COS, CHS, RBT – Never in hatcheries
            - Disinfection is working
            - Outcompeted by other strains – Endemic GL strains
        - Site Specific Clades – Oden SFH – BNT-WR, BNT-GC, BNT-SR, RBT-EL
            - Only ever found there in the globe
        - WI-SPL – Bayfield? - Novel strain – Most similar to SMR-ATS, PRSFH – COS
        - MN
            - Lanesboro SFH 2016 – Novel strain in captive RBT
        - IN – COS clade
        - PA
            - PA Strain – RBT – Pleasant Gap - Production mortality
                - Vertical transmission
                - RAS system
                - Also found at Reynoldsville
            - Tylersville SFH RBT same to WLSFH along with WV, NC, VA – Both from feral and captive
                - OTC injected into females, but likely does not get to the eggs
                - Egg disinfection
            - LE RBT – Tionesta SFH RBT mortality – Egg transmission likely
    - Why do we care?
        - Clear relation to virulence – Varies greatly: 25-80% over 5 isolates studied
        - Resistance relationships
            - Range of OTC resistance seen in tests
            - Romet resistance seen in tests – 25 resistant of 240 strains
            - Florfenicol resistance seen 6-8 isolates – First time noted
            - Sequencing genomes to see why resistance is occurring
        - Maybe multiple subspecies (A and B) with A clade being more resistant
    - Prevention has been a focus in MI
        - Biosecurity
            - Egg disinfection – 4 Parts to 1 Parts – Adding more now

            - Footbaths
            - Separate rearing tools
            - Surface water treatment
        - Remove morts
        - Optimal water flow
        - Cull moribund fish
        - Early intervention
            - Prevent systematic issues with Chloramine T treatments which have reduced antibiotics

10. Agency Updates (all)

- OH (Kevin Kayle and Andy Jarrett)
    - VHSv - outbreaks in 2017 again
        - WAE <+> in Maumee River, but no fish kills associated with it.
        - GIZ and Orange-spotted Sunfish (first time recorded) mortalities in Huron River; small N's.
    - Golden Shiner virus detected in FHM in Senecaville and St Marys SFHs
    - St. Marys SFH seeing parasites in Goldfish forage for blue catfish
    - Fish kill in Auglaize River –didn't get a chance to grab fish for testing, if VHSv related it would have extended line of demarcation further south, but still in Lake Erie watershed.
- **ON (Kerry Hobden, OMNRF)**
    - No BKD found
    - BKT: *Yersinia ruckeri* seen in North Bay Provincial Fish Hatchery (PFH) – Routine monitoring
    - Wild Fish Collection – Lake Ontario lots tested
        - RBT – Ganaraska R – *Y. ruckeri* in 1 of 45 lots <+>
        - CHS and COS – *A. sal.* testing
            - CHS Credit River – 11 of 60 lots <+>
            - CHS Ganaraska River – 4 of 60 lots <+>
    - Normandeau PFH – *F. pys.* (BCWD) found, and bi-weekly peroxide treatments worked super
    - *Columnaris* found in walleye at White Lake
    - Fish kills:
        - Southern L Huron – VHSv was not found in GIZ from fish kill
        - Detroit River - YEP, PKS, GIZ and LMB were VHSv positive
    - CHS Novel Virus – Credit River – Offspring in quarantine right now and being tested
    - *Eptheliocystis* seen at Blue Jay Creek PFH – 3-week mortality event in LKT (30% mortality) – *Burconovirus*
        - Seen in yearling fish and at temps 6-8 C
        - Similar to that found at Allegheny NFH
        - Also seen in 3 private hatcheries; emerging issue?
        - Lethargy seen but no other gross symptoms
    - Working with CFIA on national fish health program – Absence of VHSv to allow stocking from Tarentorus PFH
    - In process to export bloater eggs to NY – Testing done

  - One inspector in whole of province of Ontario
- **USFWS – East/ Lamar (John Coll)**
  - ATS – ME @ Green Lake NFH *Y. ruckeri* seen in 6 of 30+ pools – VFD issues
    - Got feed late due to regulatory issues
  - NY: Wild Fish
    - No VHSv
    - EEDv seen – SHV strains 3 and 5 from LAT in Lakes Ontario and Erie
  - Allegheny NFH – Moved broodstock as a result of temperature issues (60 degrees) to Berkshire
    - *Epitheliocystis* – 2015 - 60% yearlings died
      - Sediment slug seen in hatchery at that time – High metal analysis
      - Did recover and metals cleared too
      - Severe anemia – Hematocrits in low single digits
    - 2016 saw it again, associated with high temperatures
      - At low flow, no sediment event, fish had issues, still lost 30-40%
    - 2017 - Late summer – Appears with PCR - Took fish off feed, seemed to recover
  - Coregonids
    - Bloaters from White Lake
    - LHR – Lake Ontario Chaumant Bay – Stocked in neighboring (Sodus) Bay
      - Isolation and quarantine at Lamar – Using UV for IPNv both inflow and outflow
      - Tested fish – IPNv is possible to move to LHR – Infected with PA BKT
      - Spent money to protect against IPN in cisco – exposed to normal water and no evidence of IPN in cisco; also exposed cisco to IPN infected Brook Trout – no infections
- **PA (Coja Yamashita - PFBC)**
  - *Furunc* and *F. pys* – Bad year last year
  - 200 VFDs done to control diseases at State Hatcheries and Co-ops
  - IPNv – at all facilities – Mortalities at 2 facilities
  - WD (*M. cer.*) – at Bellefonte SFH - Seen at one facility after 3 negative years – may have been associated with lack of hatchery maintenance /cleaning
  - BKD – RBT – Mortalities seen in juveniles
  - No ERM or VHSv
  - CTTv – Benner Spring SFH – fourth hatchery positive, no mortalities
  - Lake Erie Steelhead
    - Odd CPE in one egg-take lot of fish, nothing found with PCR
      - Next-gen sequencing: – ATS swim bladder sarcoma virus and IPNv
  - Wild Fish
    - CAR die off in Pymatuning Reservoir on border with Ohio – 1000s dead
      - KHV positive (U MN diagnosis)
      - Key broodstock source for WAE and MUS
      - Linesville SFH right on reservoir
      - Forage fish are taken from there for re-stocking elsewhere, but KHV has not been seen in other species

- **DFO (Sunita Khatkar)**
    - Domestic movement of fish across watersheds has greatly increased
        - More VHSv testing
        - WD (*M. cer.*) – BC too next year
    - Capacity is limited and increasing equipment for all of their labs
    - ISAv seen on east coast
    - VHSv – Ontario more frequently
    - qPCR and additional endpoint PCR done for confirmation
    - WD (*M. cer.*) – Pepsin digestion and PCR
        - Must have fully-validated assays; also same for SVC
    - KHV– Tissue analysis being done
        - Nucleic acid analysis being done
    - ACTION ITEM: CFIA needs to be brought to this table
        - Policy, Science and Regulation groups
- **MN (Ling Shen)**
    - Hatchery inspections
        - No major detections at MN HTFPs
        - Lanesboro SFH – BKD found, so changed classification from A to B
            - Trout in Classroom; hatchery facility for eggs – Caused issues – RBT and BNT
            - Will have to go to Troutlodge in future for eggs
    - L Superior eggs – BKD up @ 9.6% this year – about double recent rate
    - French River SFH – Closed, but have steelhead broodstock for just this spring
        - No more Kamloops will be spawned
    - New heritage BKT strain – Clean sourced from wild sources
        - Found one stream with 3 years of clean history then found 8 of 11 females positive for BKD – Could not move into an class A hatchery
        - Strain wanted, so will likely go to a B-classification hatchery
    - Diagnostic Cases
        - MUS issues at Waterville SFH – Found a bit of everything
        - Peterson SFH – BCWD seen and treated with florfenicol
        - No VHSv found
        - Crystal Springs SFH re-populated w/BKT from ME – Detected SMT aquareovirus from ME hatchery
            - Tested fish: 150 fish lots, 2x in 2017 – all Negative
            - IPNv seen in PA with a similar ME lot
        - KHV detections from several lakes with CAR kills; first detection in MN.
- **USFWS – LaCrosse (Ken Phillips and introducing Ellen Lark, USFWS Region 3)**
    - unknown *Flavo* outbreak
    - Reductions in LAT – Moving to Iron River and Pendills Creek
    - Jordan River NFH – Coregonid facility – Few 100K –
        - New building in progress
        - Second year-class of future LHR broodstock from northern L Huron
        - Some went to Jordan River NFH for production
        - LHR - ELISA done – 2016 (None) and 2017 (BKD 2 positive from one pairing)

        - Clearing quarantine for first broodstock lot this spring to Jordan River NFH
        - Bloater broodstock line from Lake Michigan being collected today using commercial fisherman – Now just one available and paid to go out
            - Sampling all pairs with one sample day per week from Jan to mid-Feb
            - Pools 2 M and 3 F – No positive BKD ELISAs – 86 pairings
            - Going directly to Jordan River NFH and extras to Lamar
            - Sampling for all pathogens – Kidneys
            - Catching fish from 300 feet with trawls – Most not useable directly, will go to surgical removal of gametes
        - Found *Y. ruckeri* (ERM) in one northern L Huron Cisco last fall
    - Renovating Fish Health Center – Adding a new lab for bacteriology
    - Ploidy Work
        - 75% of an FTE position now being allocated for this work – concentrating on Black Carp and Grass Carp
        - Future STN in domestication will go to 12N from 8N – Particularly in offspring
- **MI DNR (Gary Whelan)**
    - EEDv Outbreak – Marquette SFH LAT
        - Warm water temperatures; break down in UV system, high turbidity
        - September
        - October – Mortalities in future-brood 2016 YC: 15-100/day: Destroy
        - December – Gone
        - Chloramine T – no effect
    - VHSv monitoring
        - GIZ is the key; mortalities seen under the ice.
        - MUS rearing in future – Checked with USDA APHIS
        - APHIS will not require state hatcheries to be depopulated for VHSv cert – MIDNR has this in writing. Furthermore, APHIS has no jurisdiction over public hatcheries
        - May use Wolf Lake SFH for muskie production – feel like they can handle any zonation contamination issues;
        - VHS susceptible list – follow APHIS list, but anything that is detected is added;
        - Lake sturgeon are not susceptible.
    - WI Fish imported to MI - Isolated
        - BNT- Wild Rose strain
        - Feel BNT line is genetically bottlenecked – several generations out may have issues
        - CTTv in low titers
        - *Acinetobacter* sp. found; opportunistic, is virulent and resistant to antibodies; human pathogens; clinical signs of *Acinetobacter* for ataxia, cranial swelling, and external flavor (no systemic flavor);
        - decided to destroy the whole lot;
    - BKD – Prevalence/reporting up MDNR systemwide – Virulence change? no detections in returning feral fish;
    - Eyes in the Field – Reporting system for fish kills
    - Madagascar Long-finned Eels proposal

            - proposed for tertiary treatment, UV, and RAS; have their own air-bladder nematode
            - extensive fish health testing; governor is pushing this; also getting push to import Atlantic salmon from Maine into a RAS facility in Detroit;
    - AGR (grayling) import for re-introduction program
        - AK and MT being considered, with MT being leaned toward
        - Eggs only
        - just got over endangered species hurdle
        - Isolation at MSU or Oden SFH
        - Build a domestic broodstock at Oden SFH and feral stock at Hunt Creek Fisheries Research Station
        - probably stocked in inland lakes; also Big Manistee River is likely stocking location (partnership with tribes); eventual streamside rearing.

- **IN DNR (Dave Meuninck)**
    - CWD at Mixsabah SFH – Florfenicol worked, noted mortality to 50%
        - *A. sal.* – Typing to subspecies – seen in all production salmonids
        - TSA - Other bacteria showed up too.
        - Water quality decline is creating issues w/ biofilters
    - CAR kill – Roush Lake – KHV
    - Broodstock
        - Skamania RBT – All fish get handled every week
            - Hold fish for 21-day withdrawal period, then put fish back into the river when done
            - Males have poor survival – Get fungus from dropping
    - Aqualife from Syndel USA – Replaces electrolytes and seems to help; reduced mortality due to handling (spawning etc.); not approved for consumption fish but "it's a water treatment"; mixing it in the water with MS-222.
            - Females go back quickly
            - Maybe will help captive broodstock
    - Thiamine injections on broodstock
        - No treatments on young
        - Continues to work well

- **NYDEC (Andy Noyes)**
    - Wild fish health survey
        - LMBv in Erie Canal
        - VHSv – RGB kill – Cayuga Lake
            - Lake Erie and St. Lawrence River – RGB positive for VHSv
    - Treatment Terramycin 200 on Tiger MUS - Columnaris
        - Treated mort 4.1% and 59% for control
    - SLR MUS Cell Culture Mystery
        - Ovarian Fluid Tested
            - RL – Blue Book
            - KRB – Cell Culture and PCR for VHS
            - CPE on Day 4
                - KRB – Got nothing
            - Very odd CPE
                - Will not go in second pass
        - Cornell tried cell culture on fry then EM

        - Massive inclusion bodies in cells
    - Failed GLFHC Risk Assessment - don't know enough about what it is, what it affects etc.
    - No mortality on muskies, but unknown impacts on other species
    - Next Steps
        - Culture – Additional cell lines to test at USFWS
        - Test on Fish

11. Helminths of Birds Associated with an Ohio State Fish Hatchery (Doug Sweet)

cancelled, as Doug was stuck in a snowstorm in Columbus

12. Double Crested Cormorant Control Update (Kevin Kayle)

- DCCO: Migratory bird managed by USFWS
- Two permits – Aquaculture Depredation order (AQDO) and Public Resource Depredation Order (PRDO)
- May 2016 – Court orders control permissions vacated due to suit alleging USFWS did not fully develop EA or EIS.
- On West Sister Island (western Lake Erie), there were immediate canopy openings in response to no cormorant depredation
- 30% increase in OH breeding populations of cormorants in response to no cormorant depredation
- Ohio has used the PRDO to cull 5,700 birds prior to the federal ruling
- Inland cormorant population increases seen: 105% since 2015 and 318% in past ten years
- Increasing in all 5 Wildlife Districts inland (not L Erie islands)
- Four of the five state fish hatcheries with depredation orders had cormorant problems
    - Seasonal depredation permit in 2015 and through May 2016
    - No depredation actions in 2017
    - Resuming seasonal depredation in 2018 (assume the early permits were issued separate from the PRDO)
    - Direct hatchery losses from depredation (muskie, YP, blue cats, and channel cats); over 167K fingerling channel cats, 67K yearling channel cats, 3,600 catchables; Blue cats – 69K fingerlings; Muskies – 5K, YP – 749 sub-adults
    - Total Ohio SFH depredation losses = $200K
    - Indirect losses due to changes in fish behavior, hatchery operations; uneaten feed causing water quality issues; operational changes were necessitated; saw growth rate response also (both length and weight); small, weak fish.
- OSU Extension survey of Ohio Aquaculture industry
    - 67% had additional losses associated with cormorants
    - Around $6K lost per hatchery ($1500 direct losses, plus reduced growth, increased operational costs for harassment)
- FONSI issued by USFWS on Oct 25, 2017; reinstate strictly the AQDO; also combining PRDO and AQDO; will be able to take 5,200 birds around the state; each hatchery take would be around 500 per year max – the rest to non-aquaculture (non-SFH) impacts
- Harassment of cormorants futile
- The "depredation order" has been reinstated for OH at reduced levels after EA FONSI

- IN DNR (Dave M) also noted cormorant hatchery impacts lead to illness and sick fish due to behavioral changes;

13. Effects of Harmful Algal Blooms in Western Lake Erie fish populations (Stu Ludsin, OSU)

- Microcystins (Note: MCs)– known Liver toxin
    - Common in L Erie
    - Uptake via consumption and respiration
    - Disrupts liver cell processes
- Cyanobacteria blooms increasing in L Erie
    - Degrade water potability (Toledo water crisis in Aug 2014)
    - Beach issues
    - Tourism losses
- Fish Issues
    - Toxicity – Acute and Chronic
    - Food web issues and habitat (hypoxia and water clarity)
    - Fish Health
        - Can negatively affect early life stages
            - Altered hatching times
            - Developmental problems
            - Reduced growth and survival
            - Embryos may have a detox ability – Does not exist in older fish
        - Little known about LE fish effects
            - Evidence shows WAE and YEP are being exposed to MCs – Briland et al. (OSU) – MCs found in EMS, GIZ (very high), WPR, YEP
            - Lab studies few, weak to date – Injection, unrealistic exposure pathways, odd species (zebrafish), very high levels (mg vs. ug)
            - OSU – now looking at physiological, growth and survival efforts on YOY WAE and YEP from MCs
                - Immune response has not been examined yet
    - Prey availability issues
        - MCs are large and inedible, and impair filtering of zooplankton
        - Retard zooplankton growth and survival
        - Low water clarity reduces foraging ability
        - Zooplankton biomass is higher in HABs than outside according to Ruth Briland's work
            - Community structure changes from *Bosmina* to *Eubosmina* dominated
            - Less calanoid copepods inside
            - Copepods are loaded in bloom – maybe because there is good algae there also)
        - YOY YEP forage inefficiently in simulated phytoplankton turbidity (Wellington et al 2010)
        - Total consumption
            - Did not vary inside vs. outside of HAB
            - Diet changes inside and outside seen

        - YEP – In bloom benthos – outside zooplankton
        - Changes diet preferences with reduction in copepods (calanoid) to small items
    - Human health risks
      - MCs cause is a human health toxin
        - Very stable up to 300 C and will not freeze or boil away
      - Hard to measure in fish tissues (ELISA doesn't work) and data has not been available across season
      - Projects
        - Two methods
          - UP-LC-MS/MS – chromatography - looks at MC components: 140 congener variants known
          - MMPB – Extracts and purify – Breaks down cells to get MCs (total MC – not by variant)
          - Status - Have ways to measure 8 variants and total MCs
        - L Erie Fish Data – 3 most toxics
          - Looked at MC-YR, -RR, -LR in L Erie fish from 2015-2017
          - Found in YEP and WAE livers during bloom and after – accumulating and higher in post period
            - YEP up to 30ug/kg and WAE up to 24 ug/kg
          - Seen in YEP muscle tissue
            - Up to 14 ug/kg
            - 127 lb person can eat 23 ng daily
            - 40 ng/g body mass
            - 100 gr muscle per week – likely not at risk for top 3
            - Look at all MCs (MMBP summary method)
              - Measured at up to 30 ng/ml
              - Will likely be above WHO threshold level (valid, important?)
          - Not seen in WAE muscle tissue
- Conclusions/take homes
  - Fish
    - Unlikely to have a direct negative effect on big L Erie fisheries, larval development early for YEP and WAE (seasonal mismatch with HAB)
    - Forage fish and FWD might be affected and GIZ could be at risk – planktivores.
      - Indirect effects
        - Diet selectivity, composition maybe
        - Exploring effects on Age-0 percids
      - West and Central Basins are clearly impacted
  - Human Health
    - Methods to measure in hand
    - Most toxic forms: things may be okay for individual congeners
      - Breakdown of MCs is not known – maybe weeks?
    - But total MCs effects not known

14. Latest VHS Research & Techniques (Megan Niner, University of Toledo)

- Provided VHSv background, IVb history
- Sampled Great Lakes locations for VHSv
  - 2015-16 – March to July: 2561 fish, 55 species, 37 sites
  - Tested using SYBR Green qPCR – Spleen samples used
    - False negatives
    - Faster and economical
    - More accurate than cell culture?
  - Milwaukee and Lake Erie were positive
    - RGB from Fairport - Highest
  - Sequenced G gene – Compared to older haplotypes and isolates
- Saw positives: Many were below threshold – MUS, RGB, GIZ, EMS, LMB…- None were symptomatic
- G-Gene Sequence Haplotypes for different fish species examined
- Population genetics examined – G gene – 669 base pairs
  - RNA virus – high mutation
  - Quasi-species – you can have more coding errors then Haplotypes develop
  - Haplotypes have changed over time – Early, Mid and Late (sign difference)
    - Regions – Sign difference between Upper – Middle, Lower, Middle – Upper, Lower,
  - Showed pairwise differences – St Lawrence R very different, L Erie some differences, Lake St Clair is different from L Ontario
  - Species:
    - LMB – a b w
    - DRM – a b L
    - GIZ – all over
    - RBG – b
    - Found in trout perch, lake trout, white perch and white bass, too
  - Immune response
    - Viral yield assay – A V W – All go to 5th to 7th within 18 hours
    - Immune response – Anti-viral assay – B isolate is faster
      - Will look at what genes are being up-regulated
    - Clearly in LE, LM, LSC, Cayuga Lk
      - Old haplotypes not being seen
    - Continued diversification
      - Late vs. early/mid
      - Regions – More A in LE and B in LO
      - Species

15. Monitoring Project Icebreaker – Offshore Wind Power in Lake Erie (Kevin Kayle)

- Lack of obstructions key reason wind power to be proposed offshore
- LEEDco is principle proponent (developer group)
  - Pilot project with leased lands

    - Offshore of city of Cleveland
    - Many more potential wind power leases and plans lined up for future development, should this one be successful
- Foundation types – this project may likely use a Monopile design – 25-30 m into sediment
- First in freshwater in the U.S.
- Private funding – Fred Olsen Renewables – Swedish investor
- 6 Turbines – 20.7 MW – 6-8 miles offshore – if successful, it likely will lead to further developments with up to 200 units proposed
- 2020 construction date, if approved
- NEPA Assessment
    - Public Utilities Commission of Ohio – Power Siting Board analysis and approval
    - 12 analysis & review topics from Geology to Fisheries - re: impacts and minimization/mitigation
- Key Issues
    - Shipping, boat traffic
    - Fish behavior and distribution
        - Migration, congregation and feeding
        - Exploitation
        - Homeland Security Issues?
        - Habitat change
        - Forage change
        - Stressors, concentrators, flight response
            - Noise, EMFs, currents, WQ/habitat changes
            - Operating noise, Boat Noise, Pile Driving and Geophysical surveys all can cause issues
    - Fishing
    - Habitat
    - Viewshed
    - Ice cover and floes
    - Construction and Energy Generation Issues
- ODNR-Wildlife involvement
    - EA specifications
    - Comments for siting
    - Ohio Power Siting Board issues to install
    - Pilot Project- need to have all (pre-, during-, post-construction) data and analyses completed as this sets a precedent
    - Need to have pre-, during-, post- construction and mobilization plans verified and approved
    - Have aggregated “pre-construction” data lakewide for placement evaluation/decision
        - Geology and bottom type
        - Fish and water quality survey data
        - Sportfishing and Commercial data on 10’ grids
        - Aquatic sampling in 1’ grids
        - Seek placement that is favorable or neutral, not detrimental, to system
    - Develop a scoring system and metric for EA by topic areas with sampling requirements – Time period, amount, and location
        - Developers not keen to ODW requirements and needs, but are complying to get OPSB permit to proceed

- New Pre-construction monitoring
    - NOAA and Limno-Tech Buoy 45169
    - Limno-Tech field sampling
    - Needed for OPSB review process
- Moving forward slowly, summarizing new and existing data and future plans and agreements for approval process

16. Interesting Cases

- **MN (Ling Shen)**
        - Starting in July, wave of CAR kills to October (Cottonwood Lake – far west MN)
        - Seven lakes – Mostly just South of Minneapolis
        - Lots of gill erosion and pale livers
        - High titers seen in tested fish
        - Stays in carcasses for a long time – even in decomposed fish
        - Herpesviruses are stable for a long time
    - Starting to look in non-symptomatic fish (trying in Goose Lk, but non-detected)
    - Want to look to see how widespread the virus is

- **NY (Andy Noyes)**
    - Rome Fry Mortality
        - Eggs from other hatcheries
        - Eating normally
    - BNT Fry mortality – 11/8/2017
        - Sestonosis in gills – "Long Weekend" Disease
        - Treated with Perox-Aid and Chloramine T – no success
        - Fungus outbreak next
        - Histology normal
        - 395K died, and done by the end of the November
    - BKT Fry mortality – 12/13
        - 48K lost – 40%
        - N-supersaturation suspected
        - Thermal N-supersaturation
            - Very cold and ice – High saturation then released with warming
                - N-sat @105-107%
            - Recorded BKT mortality @ 103-104% supersaturation
            - Abatement installed with glitch-ring columns and pond aeration – reduced to 101%
            - Inflow avoidance is a good symptom;

- **USFWS – LaCrosse – (Ken Phillips)**
    - Mudpuppy Case – MS River, Guttenberg, IA
        - Distended gut area
        - Large cyst in viscera adjacent to kidney area
            - Fluid-filled

- Nothing bacterial, some viral CPE in Toad Cell line – Microplasma? – Aquoplasma?
- Crab mortalities noted
  - Sent Histology to MS State – Nepheroblastoma (1st record)
  - *Chtyra* found in Mudpuppies

17. Other GLFHC Business, Baitfish Recommendation (all)

- Baitfish Recommendations to CLC
  - Pass along comments on certification processes and regulations
  - Develop outline for Great Lakes policy
  - Testing for presence of Asian tapeworm? (not readily transmitted fish:fish)
- Conference call next week on RA pre-proposals ranking, recommendations

18. Upcoming Meeting Planning

- Summer 2018: Erie, PA (August 1-2, 2018)
- Winter 2019: Peoria, Illinois (February 5-6, 2019)
  - IL Jake Wolf Hatchery

Meeting Location:
Renaissance Cleveland Hotel
24 Public Square, Cleveland, OH 44113
(216) 696-5600

Contact info for Speakers from outside GLFHC:

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Virology
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Molecular
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Sharon Clouthier (Fisheries and Oceans Canada)

Nutrition
Wendy Sealey (U.S. Fish and Wildlife Service)
Ann Gannam (U.S. Fish and Wildlife Service)

Quantitative Fish Health Data Analysis
Dominic Travis (University of Minnesota)
Travis Brenden (Michigan State University)

Epidemiology
Lori Gustafson (U.S. Department of Agriculture)

Parasitology
David J. Marcogliese (Environment Canada)

Grass Carp Ploidy Case

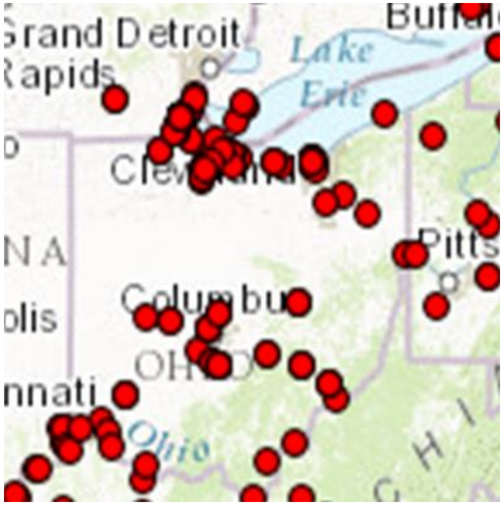
Ronald L. Ollis
Special Operations Supervisor
ODNR, Division of Wildlife

Grass Carp in Ohio

- **Imported into Ohio for decades**
- **Utilized by pond owners for vegetation control**
- **Caught and reported occasionally by fishermen and fisheries staff**

Cause for Alarm?

- **Increasingly reported in Lake Erie by commercial fishermen and Sandusky Bay by sport-fishermen**
- **Testing in 2012 confirmed diploid fish in the wild**



https://nas.er.usgs.gov

Cause for Alarm?

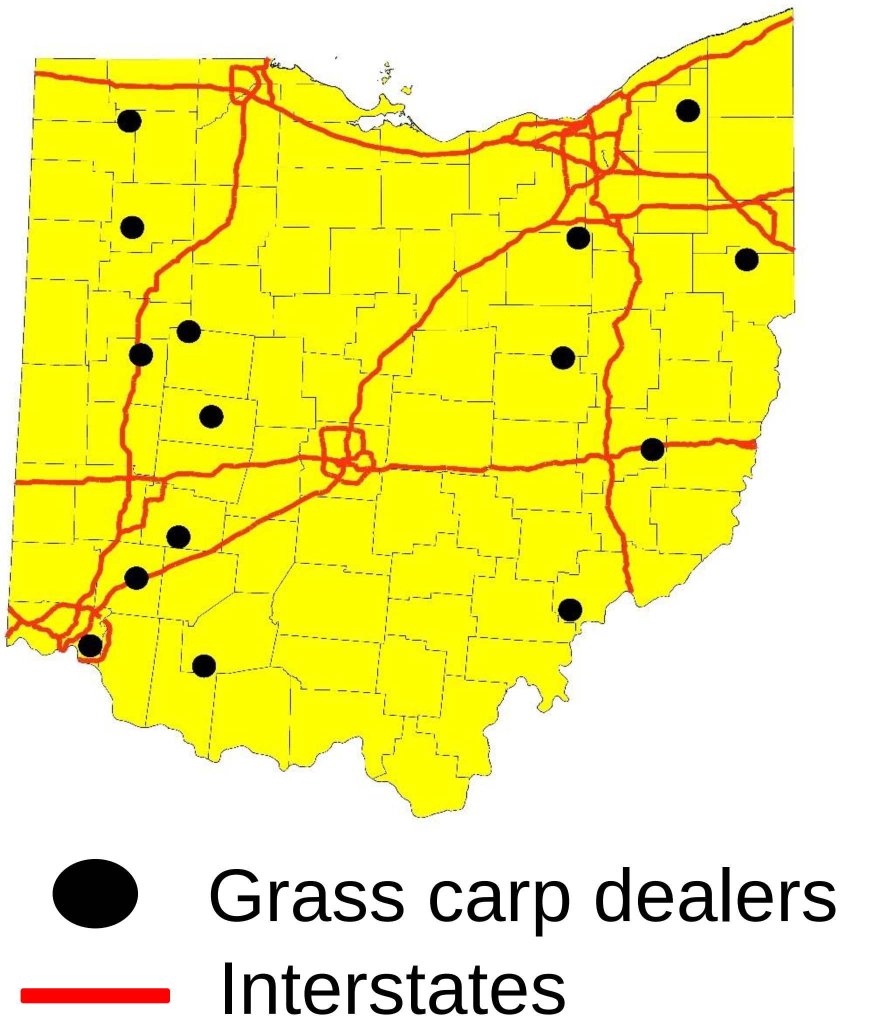
- **What is the origin of dipoid fish in Ohio?**
- **Multiple sources probable:**
  - Remnant population from pre-law stocks?
  - Sale of illegally propagated dipoid grass carp propagated in Ohio?
  - Laundering of diploids into triploid shipments?
  - Faulty certification process?
- **In consultation, a joint project between fish management and law enforcement was proposed to ensure the integrity of the supply chain**

Effectiveness of NTGCICP

- Ploidy inspections rarely conducted by any of the receiving states
- Effectiveness of the NTGCICP not been evaluated at point of retail sale
- Inconsistent state regulations…
- Significant financial incentive to launder diploids into shipments, root of all great law enforcement cases

Source?

- ~40,000 USFWS certified triploid grass carp enter Ohio per year
- ~130 shipments per year
- ~15-20 triploid grass carp dealers licensed annually



Project Proposal

- **Fisheries staff**
  - Review the process of how NTGCICP notifications are received and disseminated
  - Establish a sample size and testing protocol
  - Train appropriate staff to prepare samples
- **Law enforcement staff**
  - Determine all sources of grass carp sales
  - Assign appropriate staff to purchase fish
  - Provide the cash flow needed for the case
  - Follow-up inspections upon sampling completion

Objectives of the project

- Evaluate the effectiveness of the NTGCICP at preventing diploid grass carp at the point of retail sale.
  - Utilize undercover law enforcement to purchase grass carp from dealers
  - Test the “ploidy” of all fish purchased
  - Follow social media, internet sites and “other vendors” for possible sources of diploids
  - Follow-up upon successful completion of sampling for law enforcement violations

Workflow

Triploid certificate received from USFWS

↓

Randomly selected shipment

Yes | No

Notification for law enforcement to purchase 15 grass carp

↓

Grass carp delivered to fisheries biologist

Strata

- Identified 15-20 grass carp dealers
- 3 general strata
  - Large dealers: >1000 grass carp per year
  - Small dealers: <1000 grass carp per year
  - Out-of State dealers

Sample sizes

	2015	
	Purchases	Fish
Large	30	450
Small	5	75
Out	5	75

Sample sizes

	2015		2016	
	Purchases	Fish	Purchases	Fish
Large	30	450	28	420
Small	5	75	8	120
Out	5	75	4	60

40 purchases and 600 fish per year

15 grass carp purchased per sample site

Shipment summary

- 2015
  - 129 shipments
  - 40,990 grass carp
- 2016
  - 136 shipments
  - 43,888 grass carp
- 17 Ohio dealers
- 4 Arkansas producers

Percentage of grass carp sampled

- 2015
  - – Large dealers: 1.4 %
  - – Small dealers: 1.6%
  - – Out of state dealer: 1.8 %
- 2016
  - – Large dealers: 1.2 %
  - – Small dealers: 2.9%
  - – Out of state dealer: 1.6 %
- 16 of 17 dealers

Ploidy results

- 1,200 fish sampled
- No confirmed diploids
- One 2016 sample
  - Possible mosaics
- 6 fish indeterminate
- 1 fish missing
- Remainder triploids

Conclusions

- Fisheries perspective
  - NTGCICP is effective
  - Low risk of diploids from USFWS certified triploid supply chain
  - Random inspections by states are necessary
  - Determine other sources for Lake Erie diploids?

Conclusions

- **Law enforcement perspective**
  - Grass carp purchased from 16 dealers over 2 years
  - 4 dealers cited for failure to keep or maintain accurate records of sales as required by law
  - 1 dealer given a "Notice of Violation" for inaccurate records
  - 25% arrest ratio
  - Records are the key if diploids are discovered

Acknowledgements

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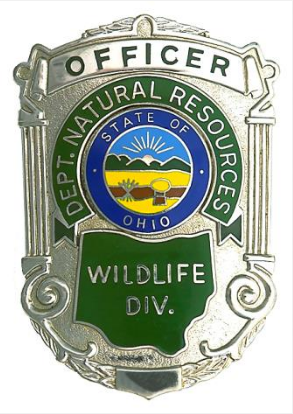
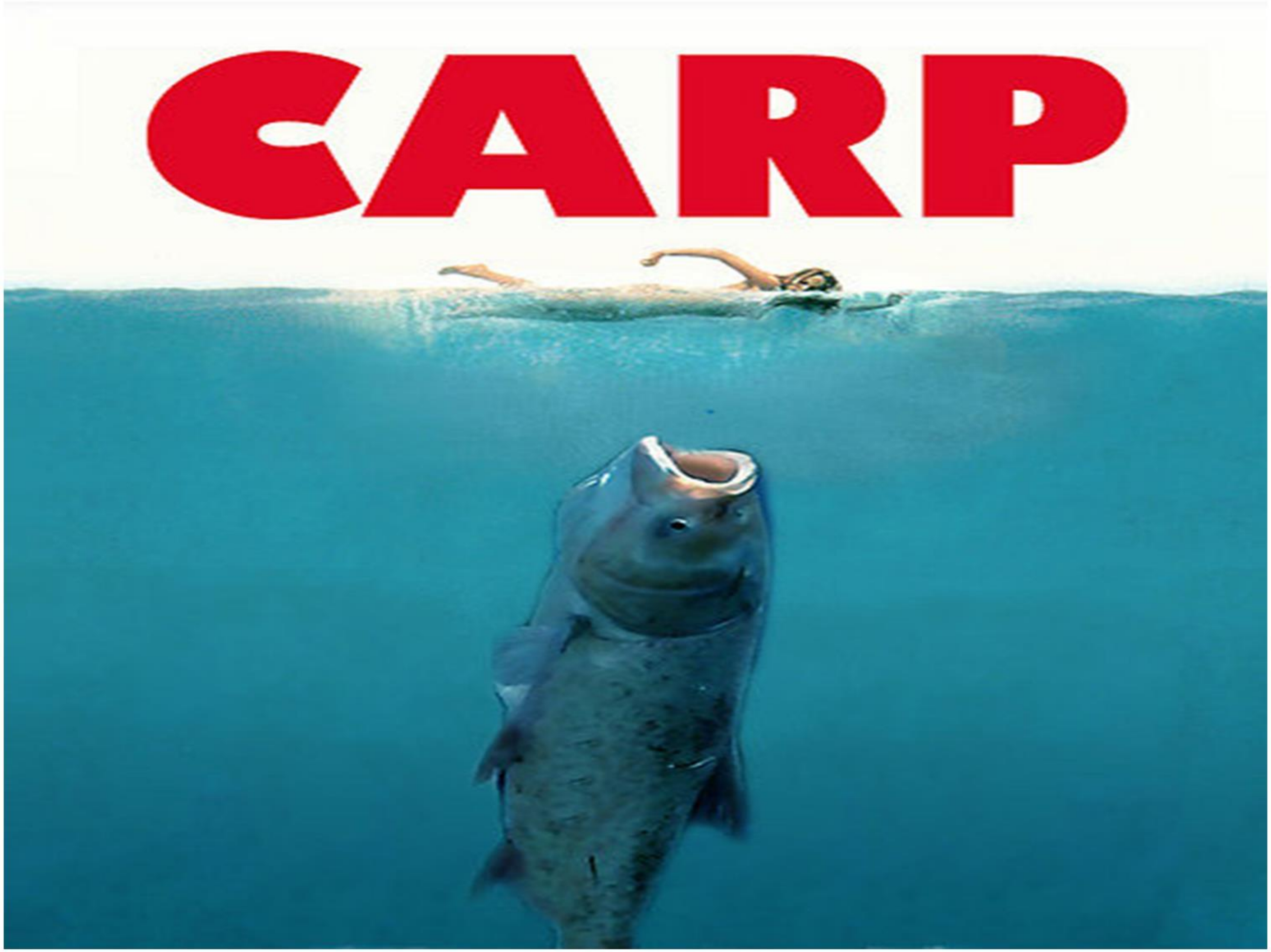
ODNR Division of Wildlife
BAIT DEALER INSPECTION PROJECT



Jeff Collingwood

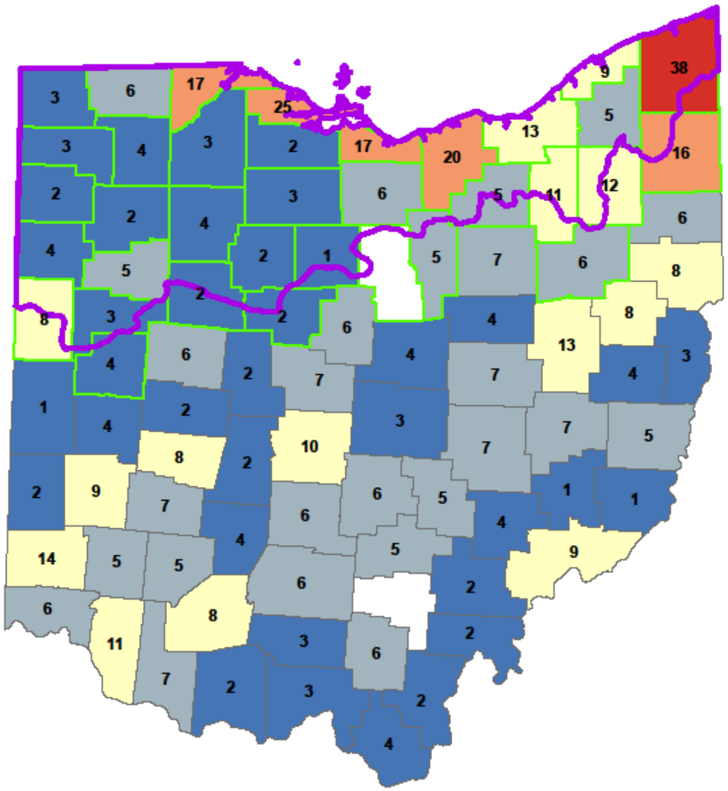
Lake Erie Law Enforcement Supervisor


CARP

What was the origin of the project?

- Great Lakes Fishery Commission Law Enforcement meeting 2013, presentation given by OMNRF
- Ontario – 42 million bait sales/year
- 1 in 68 purchases revealed a round goby
- =617, 000 gobies being moved in bait buckets

The Ohio Landscape



- 11.5 million people
- 3,875 square miles of water
- 1.3 million anglers
- 558 live bait dealers
- 2 distinct watersheds

A priority for Ohio

- Fishing is economically important.
- AIS are a major threat.
- Movement of bait is a significant pathway.
- Asian carp are in the Ohio River system.
- We must keep Asian carp out of Lake Erie.

What if aquatic invasive species are being moved in bait buckets?

What will impact fishing in Lake Erie more?

- Five perch over the daily limit of 30?
- Dumping a bucket containing silver carp in the lake?

What was the goal of the project?

- ➢ To determine where live bait was coming from.
- ➢ To determine if AIS was present in bait industry.
- ➢ To teach bait dealers what to watch for.
- ➢ To ensure compliance with the regulations.

What were we looking for?

- Fish that were not "baitfish"
- Records violations
- Sources of bait, especially from out of state or the Ohio River

- In 2014:
- 44 Inspections, 1AIS found, 16 violations

Approach for 2015

- Extensive Training at districts, including identification of bait fish and invasive species
- Purchased equipment
- Outlined our goals
- Provided educational materials to bait shops

RESULTS

2014

District	Inspections Conducted	AIS Found	Violations Found
1	11	0	5
2	11	0	4
3	7	0	2
4	6	1	2
5	9	0	3
Total	44 (8%)	1 (2%)	16 (37%)

2015

District	Inspections conducted	AIS Found	Violations Found
1	46	0	3
2	72	1	16
3	133	0	23
4	69	1	19
5	143	1	17
Total	463 (83%)	3 (.6%)	78 (17%)

Sources of Bait

- Arkansas
- Indiana
- Kentucky
- Michigan
- Minnesota
- New York
- Texas
- West Virginia
- Wisconsin

- The bigger that dealer the more likely that their bait would be coming from out-of-state

Future Law Enforcement Efforts

- **All violators will automatically be re-inspected the following year**
- **Maintain 25% inspection rates**
- **Plain clothes enforcement**

Bait Dealer Inspection Summary

- AIS are not prevalent in the industry.
- The industry is educated about AIS.
- We will continue to work towards protecting our fish and wildlife resources by being proactive.

Maumee River Lake Sturgeon Restoration Program

Spurring new Maumee sturgeon

THE BLADE
One of America's Great Newspapers

Giant sturgeon poised to spawn again

'Streamside' site would stock fish

BY TOM HENRY
BLADE STAFF WRITER

CURRENT WEATHER
25°
Cloudy
Complete Forecast→

THE BLADE
One of America's Great Newspapers

NEWS | SPORTS | A & E | BUSINESS | OPINION | OUR TOWN

HOME → HOME
Published: Thursday, 1/25/2001

Another sturgeon caught, fueling hopes of resurgence

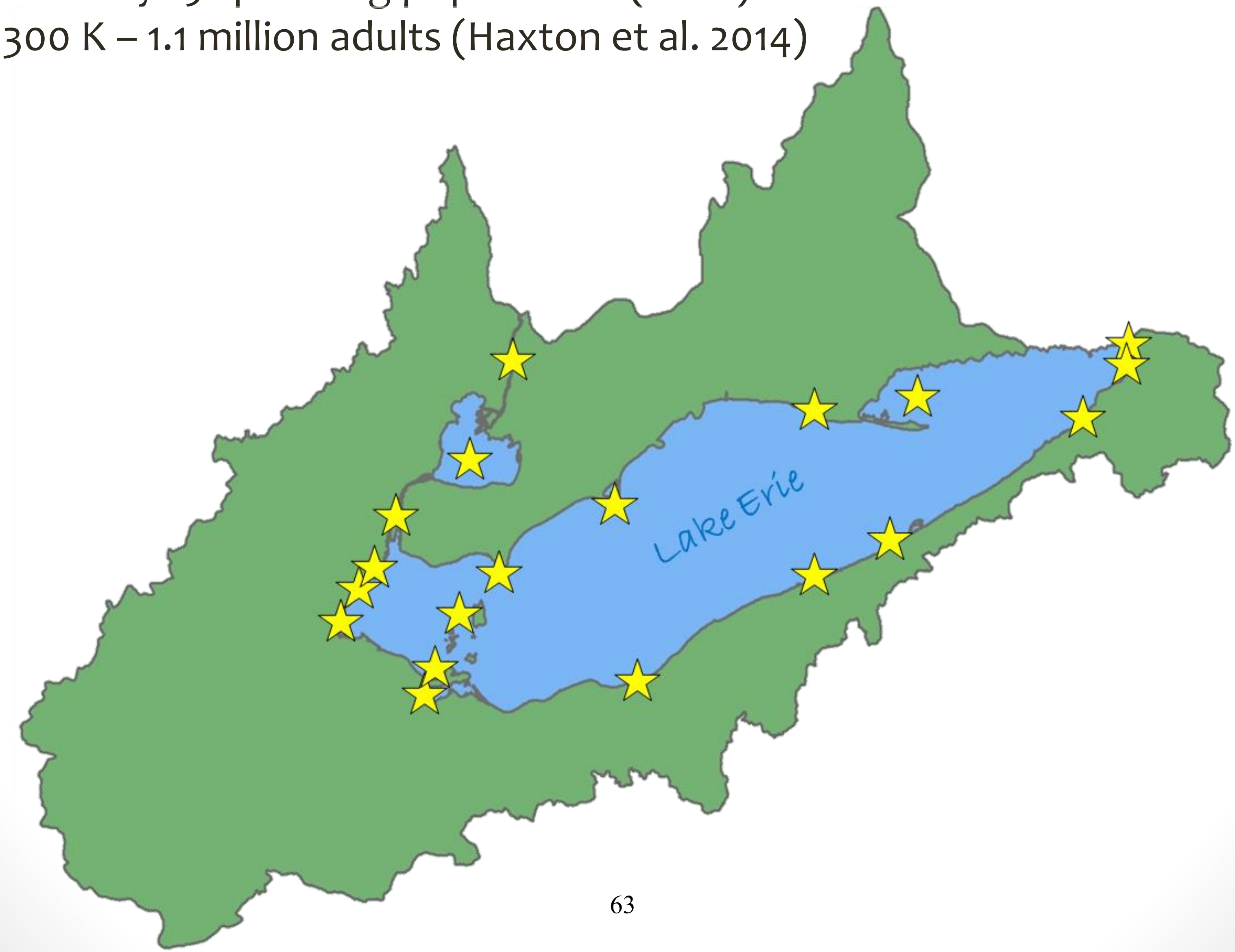
Maumee River Lake Sturgeon Restoration Program

Project Partners

Doug Aloisi – USFWS
Kent Bekker – Toledo Zoo
James Boase – USFWS
Jon Bossenbroek – University of Toledo
Justin Chiotti – USFWS
Jessica Collier – University of Toledo
Todd Crail – University of Toledo
Chris Davis – Ontario MNRF
Richard Drouin – Ontario MNRF
James Francis – Michigan DNR
Travis Hartman – Ohio DNR
Christine Mayer – University of Toledo
John Navarro – Ohio DNR
Trevor Pitcher – University of Windsor
Chris Vandergoot – U.S. Geological Survey
Eric Weimer – Ohio DNR
Amy Welsh – West Virginia University
Todd Wills – Michigan DNR

Lake Erie Population Status

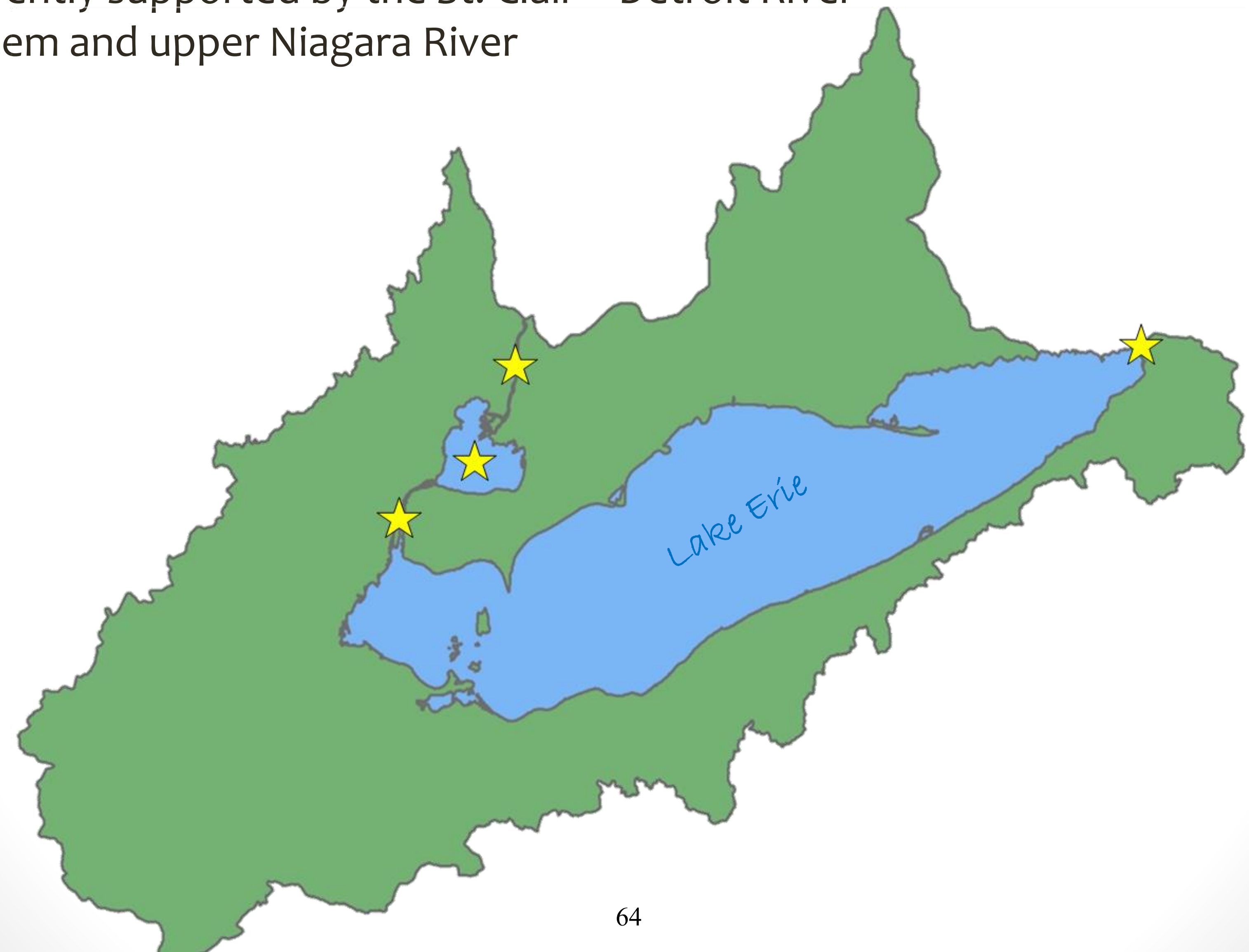
- Historically 19 spawning populations (2008)
  - 300 K – 1.1 million adults (Haxton et al. 2014)



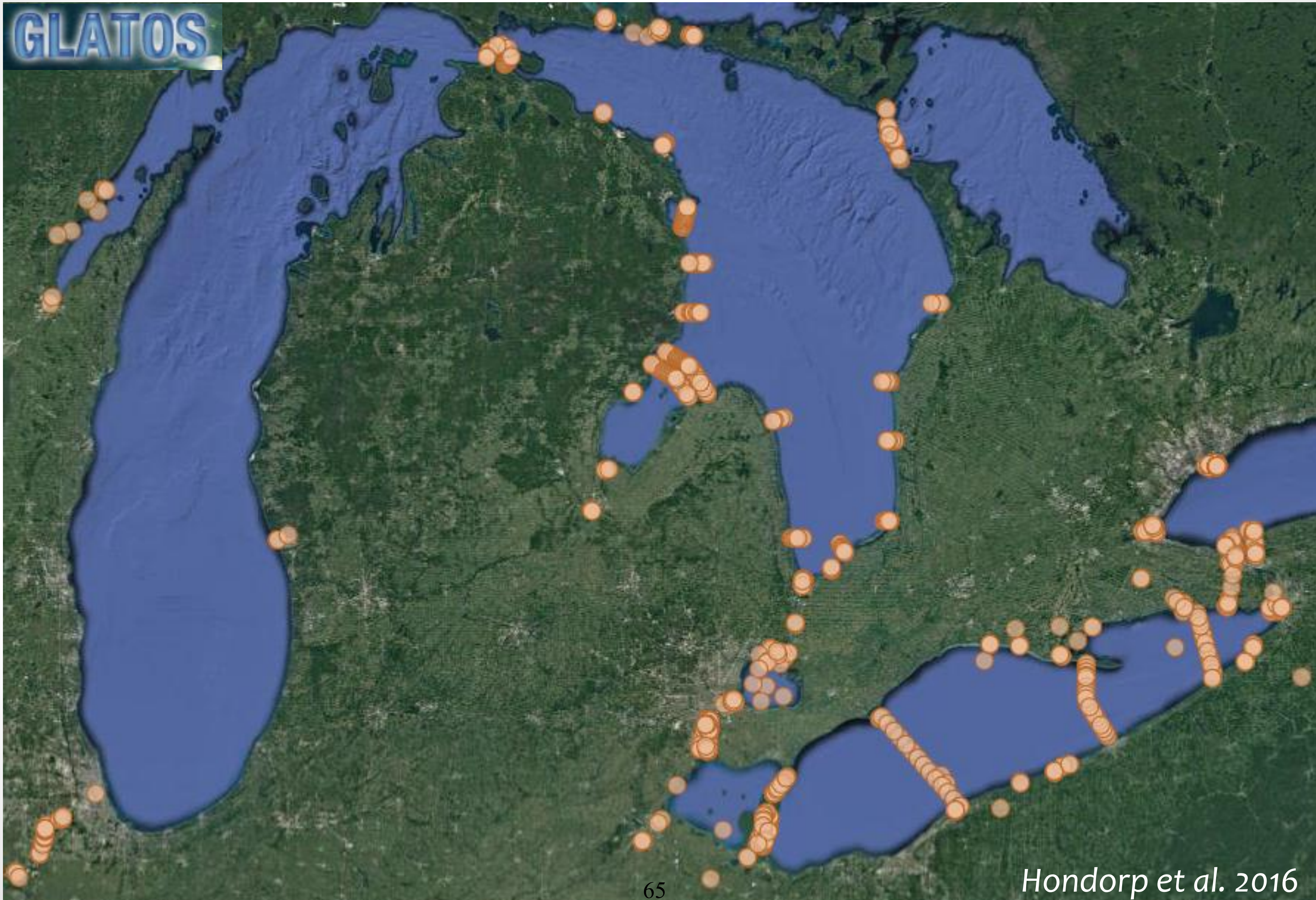
Maumee River Lake Sturgeon Restoration Program

Lake Erie Population Status

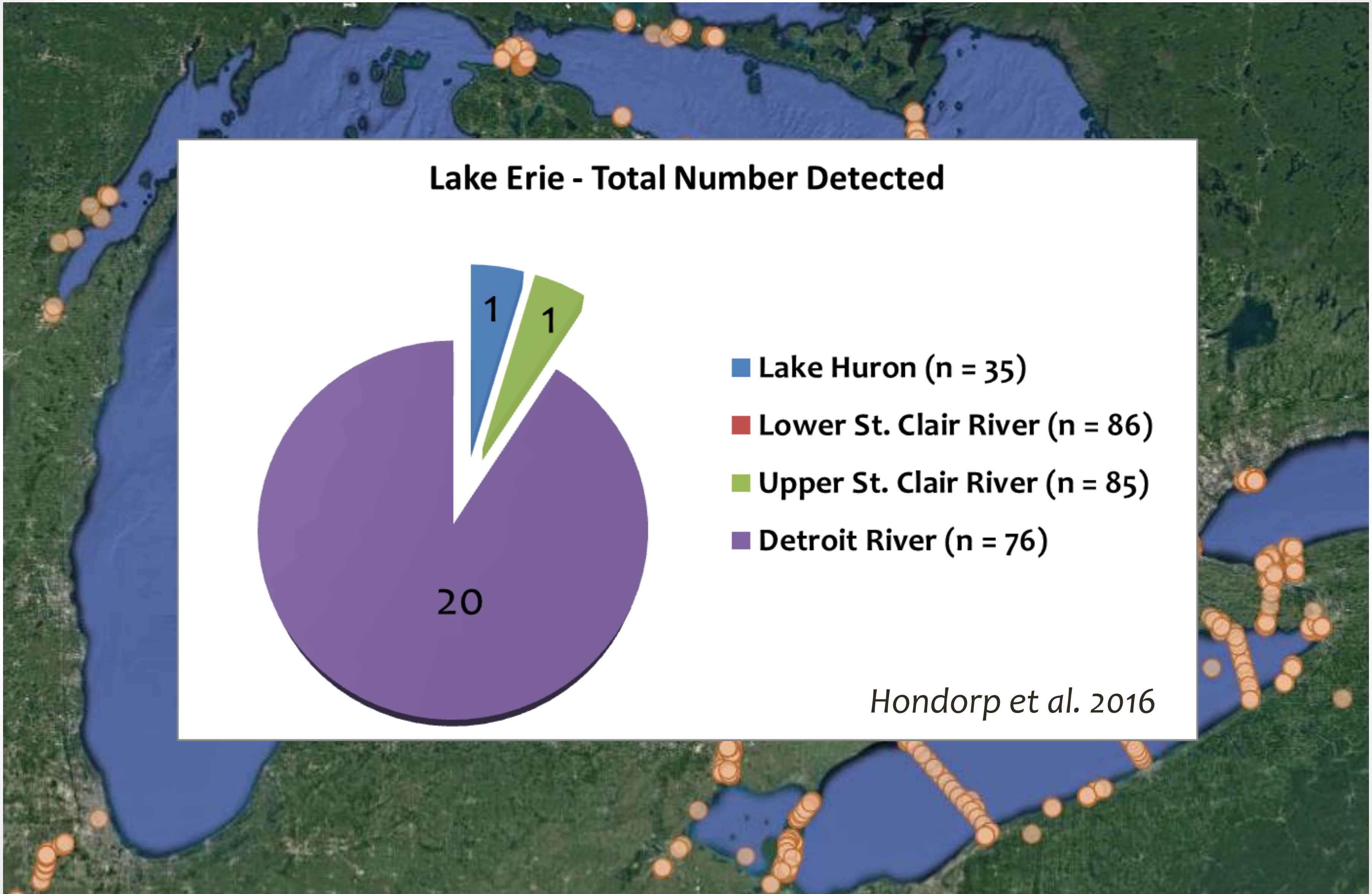
- Currently supported by the St. Clair – Detroit River System and upper Niagara River



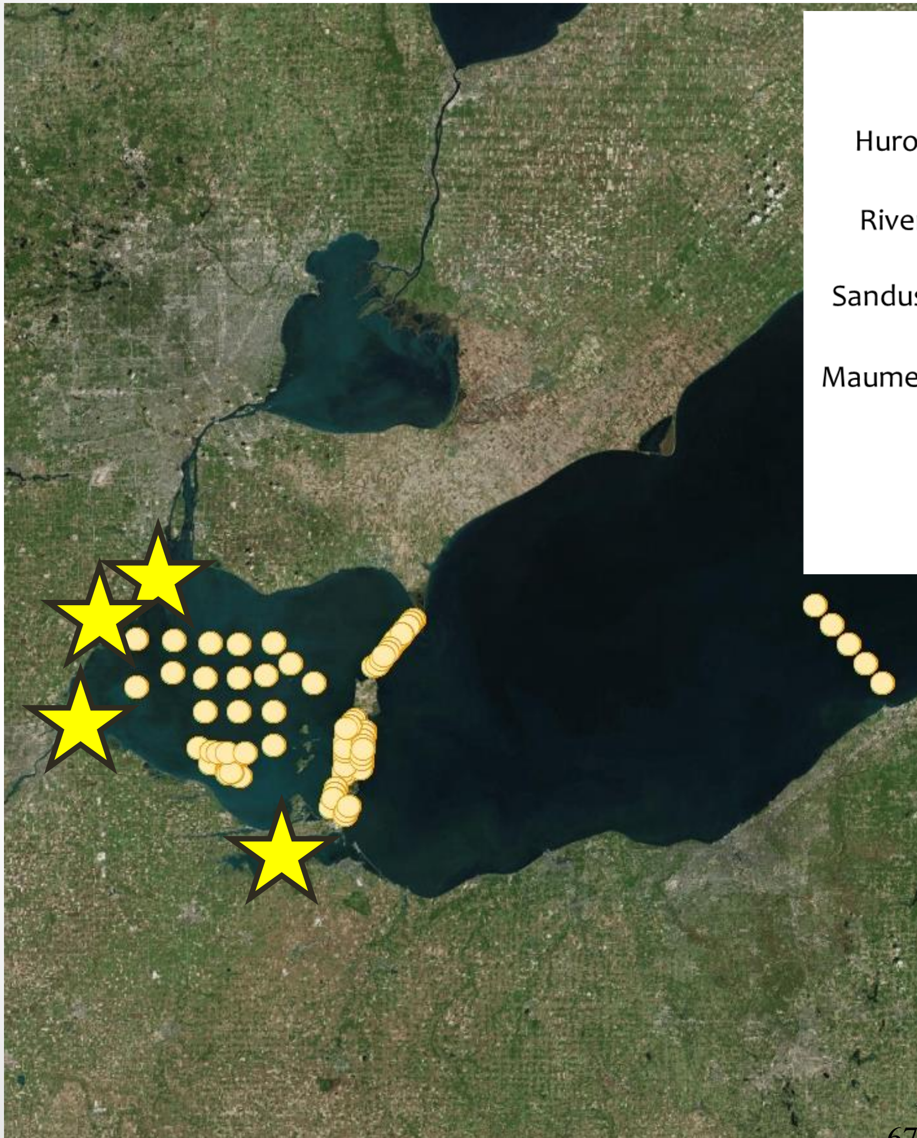
Dispersal into Lake Erie

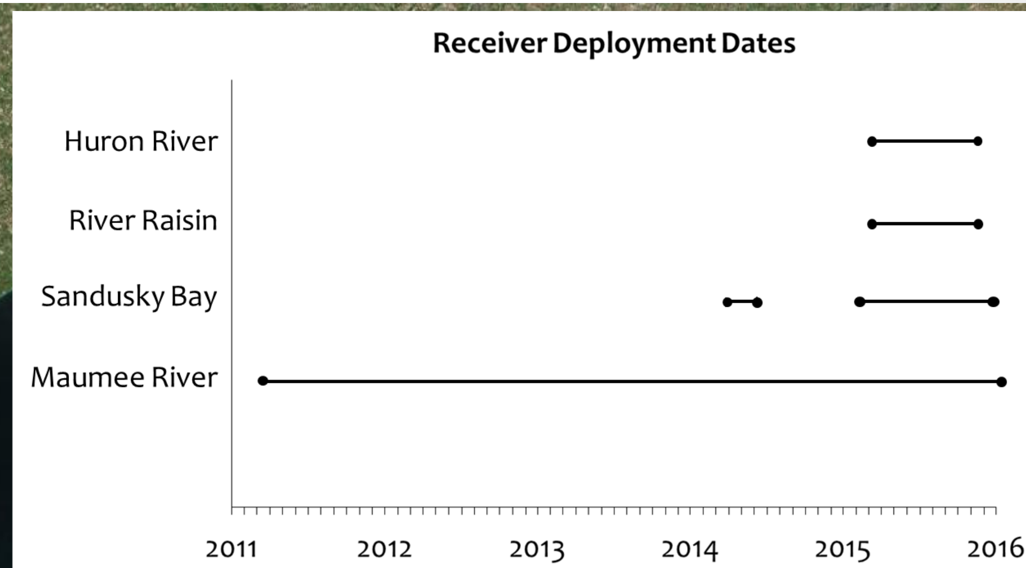


Dispersal into Lake Erie



Dispersal into Lake Erie

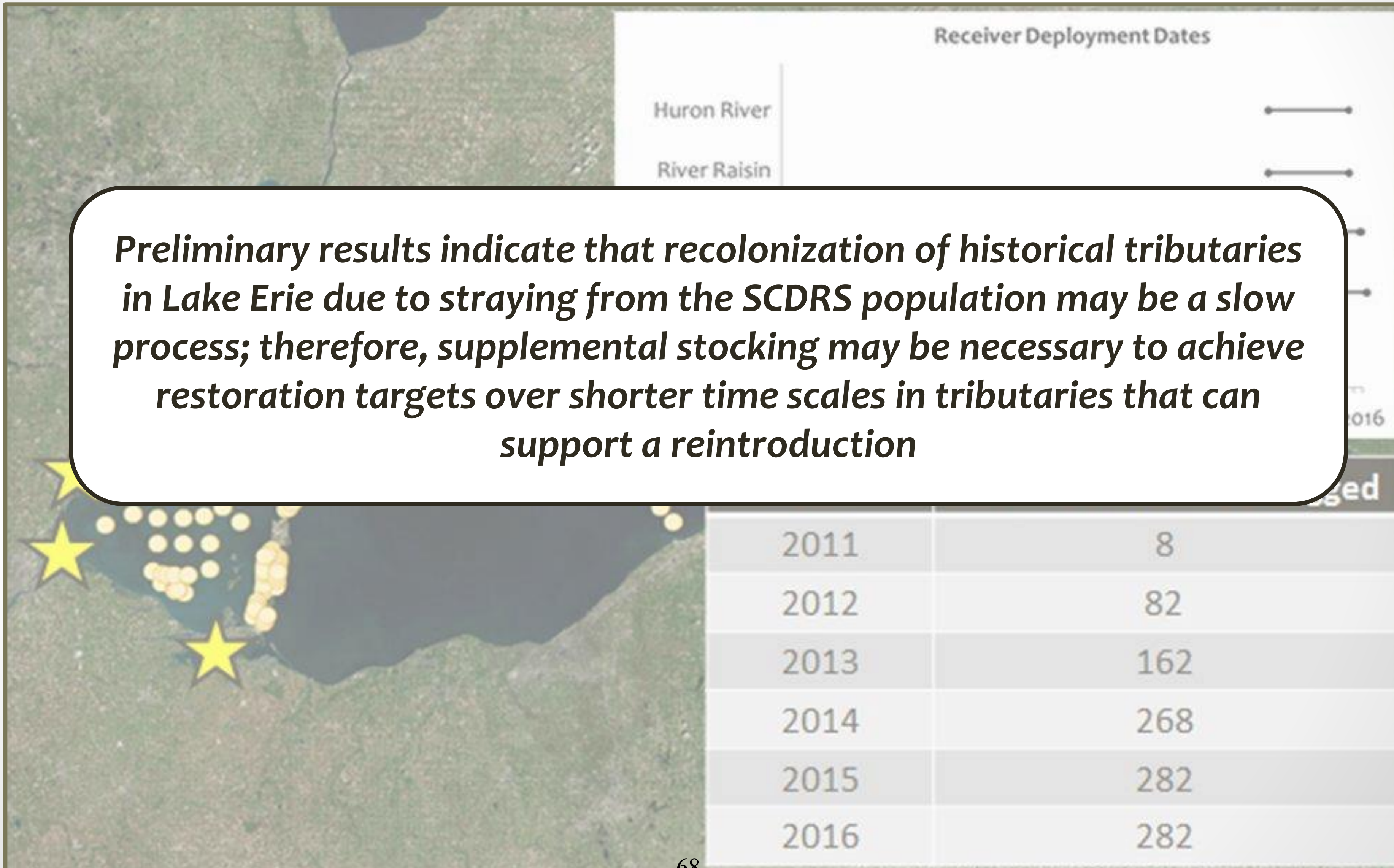




Year	Cumulative Number Tagged
2011	8
2012	82
2013	162
2014	268
2015	282
2016	282

Hondorp et al. 2016

Dispersal into Lake Erie



Preliminary results indicate that recolonization of historical tributaries in Lake Erie due to straying from the SCDRS population may be a slow process; therefore, supplemental stocking may be necessary to achieve restoration targets over shorter time scales in tributaries that can support a reintroduction

Maumee River Population Status

Historic Population Maumee River

- "Smith and Snell (1891:248) ...reported an early decrease of sturgeons in the Maumee River where "Sturgeon once ran up the river by the hundreds as far as the rapids above Perrysburg, but at present (1885) ...are absent" *in* Fishes of Ohio, by Milton B. Trautman (1981)
- Currently considered extirpated (Holey et al. 2000)

Current Population Status

- No spawning detected - eggs mats, gill nets, and setlines (Boase 2008)
- University of Toledo – larval drift and egg mat surveys (Mapes et al. 2015; Brian Schmidt)

The Catalyst for Maumee River Restoration

Fall of 2013

- Meeting @ Ottawa National Wildlife Refuge
  - Ohio DNR, Toledo Zoo, USFWS, Lake Erie Waterkeeper
- Lake Erie Waterkeeper (Sandy Bihn) - "Wanted to embark on a project that would raise awareness about the Lake Erie Watershed and current problems within this AOC"
- One potential project was to rear lake sturgeon in the Maumee River with annual outreach events that would promote aquatic stewardship within this watershed

Winter of 2014

- Meeting @ Toledo Zoo
  - Ohio DNR, Toledo Zoo, USFWS
- Discussed the potential of streamside rearing

Before Restoration Could Begin…..

Summer of 2014

- Define current habitat suitability
- Hired a graduate student (U. Toledo, Jessica Collier) to determine the amount of spawning and age-0 rearing habitat – USFWS ($90K)
- Ohio DNR – needed a restoration plan developed outlining the details of the project

Restoration Plan

- Restoration goals
- Biology and historical status
- Current habitat conditions (constraints)
- Stocking considerations
- Determining success
- Public education and outreach
- Regulation and enforcement
- Long-term management

Habitat Suitability Model

Habitat Suitability Model for the Maumee River

- Spawning adult & age-0 lake sturgeon (LAS)
- Evaluate suitability of Maumee River for LAS reintroduction

Assess habitat characteristics

Substrate

Water depth

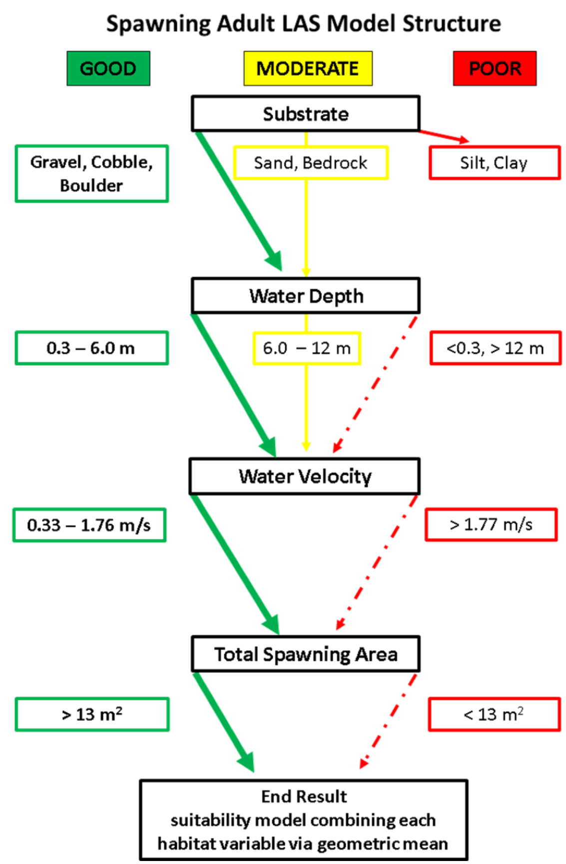
Water velocity

Water temperature

Total spawning area

↓

Spatially Explicit HSI Model for each life stage



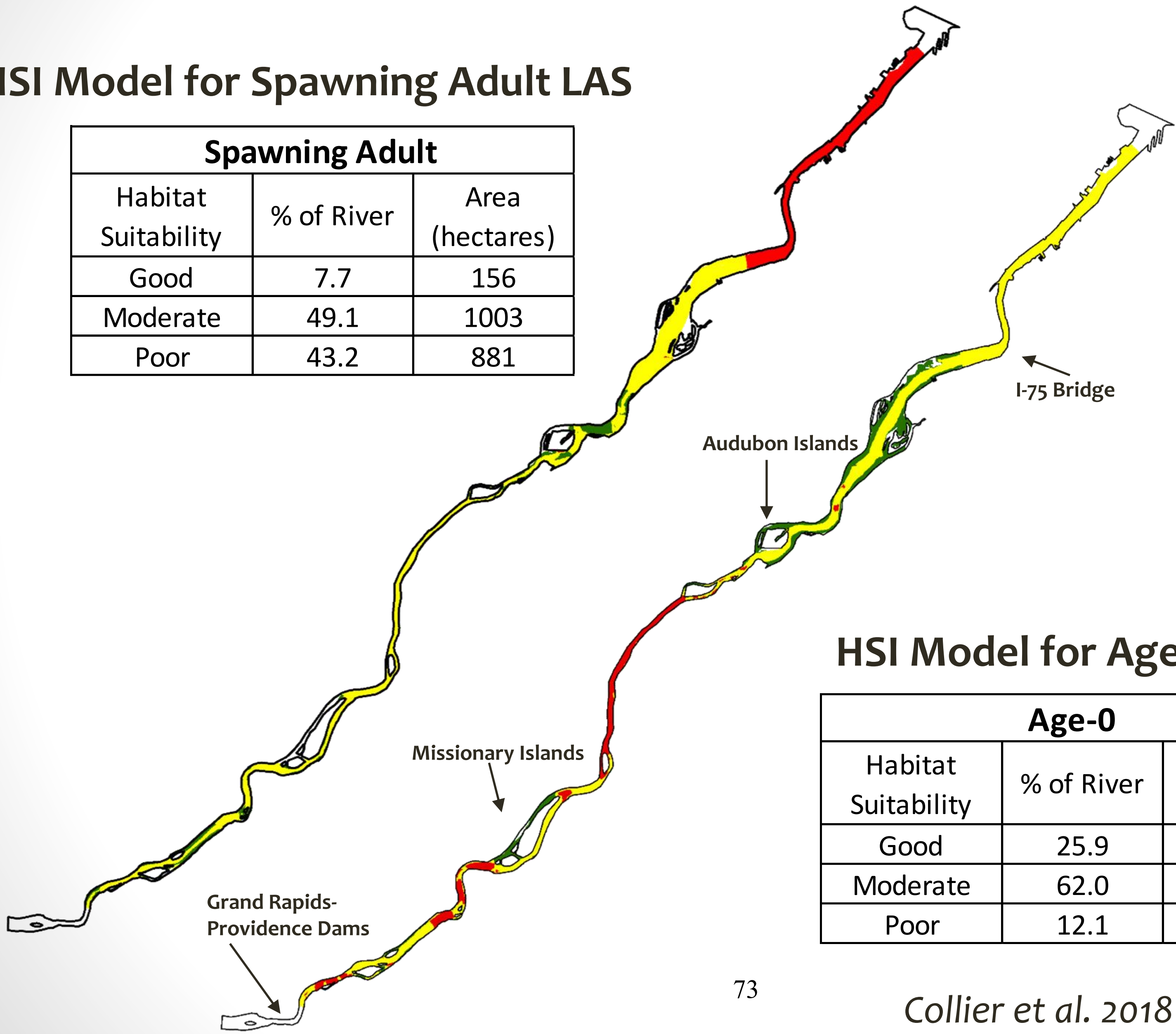
Collier et al. 2018

Maumee River Lake Sturgeon Restoration Program

Habitat Suitability Model - Results

HSI Model for Spawning Adult LAS

Spawning Adult		
Habitat Suitability	% of River	Area (hectares)
Good	7.7	156
Moderate	49.1	1003
Poor	43.2	881



HSI Model for Age-0 LAS

Age-0		
Habitat Suitability	% of River	Area (hectares)
Good	25.9	529
Moderate	62.0	1266
Poor	12.1	246

Collier et al. 2018

Maumee River Lake Sturgeon Restoration Prog

Maumee River Lake Sturgeon Restoration Plan

Goal – Create a self-sustaining adult lake sturgeon population of 1,500 adults (25 years of stocking)

Objectives (complete)

1) Can the Maumee River support a lake sturgeon population – **YES**
2) Develop a Restoration Plan (Lake Erie Committee) – **YES**
3) Secure funding **- YES**
   - GLFWRA (approx. $90K)
   - Region 3 GLRI USFWS Funds ($80K)

Objectives (ongoing)

4) Construct rearing facility – **TOLEDO ZOO with support from USFWS**
5) Annually stock 3,000 fingerlings into Maumee River (1,500 streamside; 1,500 Genoa National Fish Hatchery) – **EVALUATE IMPRINTING**
6) Biological monitoring
7) Education and outreach – **LOCATED ON ZOO PROPERTY EXCELLENT OPPORTUNITY FOR OUTREACH (BEST ZOO IN NATION USA TODAY, 2014**

Maumee River Lake Sturgeon Restoration Plan

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Maumee River Lake Sturgeon Restoration Program

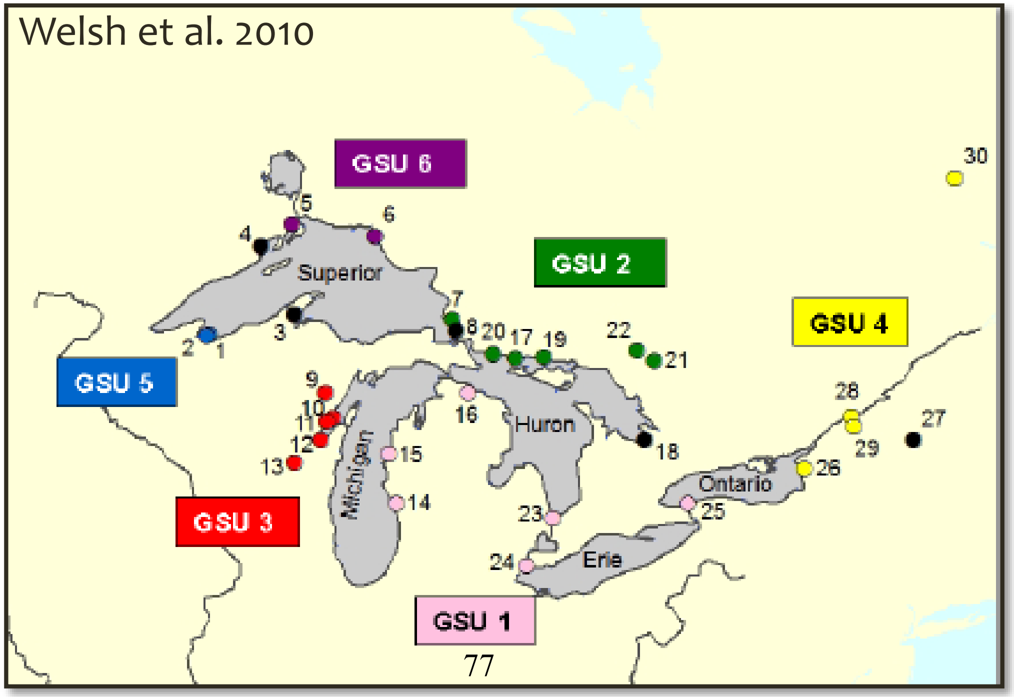
Maumee River Lake Sturgeon Rearing Facility

- Rearing facility will be constructed from a 3.1 m × 12.2 m cargo trailer
- Egg incubating jars and 10 rearing tanks (1.06 m width x 0.92m depth)
- Staffing – Toledo Zoo (5 full time aquarists); Ohio DNR; USFWS support
- Reared in Maumee River water

Stocking Strategy

Methods

- Annually stock 3,000 fingerlings into Maumee River (1,500 streamside; 1,500 Genoa National Fish Hatchery)
- Donor population (St. Clair River/Southern Lake Huron) – GSU 1
- 7 females and 28 males each year – 175 females and 700 males
- Housed at Purdy Fisheries (3.1 x 12.3 m raceways – St. Clair River water)



Maumee River Lake Sturgeon Restoration Program

Biological Monitoring

Research Questions

Do lake sturgeon cultured in a streamside rearing facility exhibit higher stocking site fidelity rates (i.e., a surrogate measure for natal imprinting) than lake sturgeon reared at another locale (i.e., Genoa National Fish Hatchery)?

- Adult returns

What are the differences in post-stocking survival rates between streamside reared lake sturgeon and those reared in a traditional hatchery setting?

- Acoustic telemetry?
- Recaptures from assessment and commercial fisherman

What is the contribution of lake sturgeon stocked from the Maumee River to adjoining waters (i.e., western basin of Lake Erie and Detroit River)?

- Acoustic telemetry?
- Recaptures from assessment and commercial fisherman

Outreach

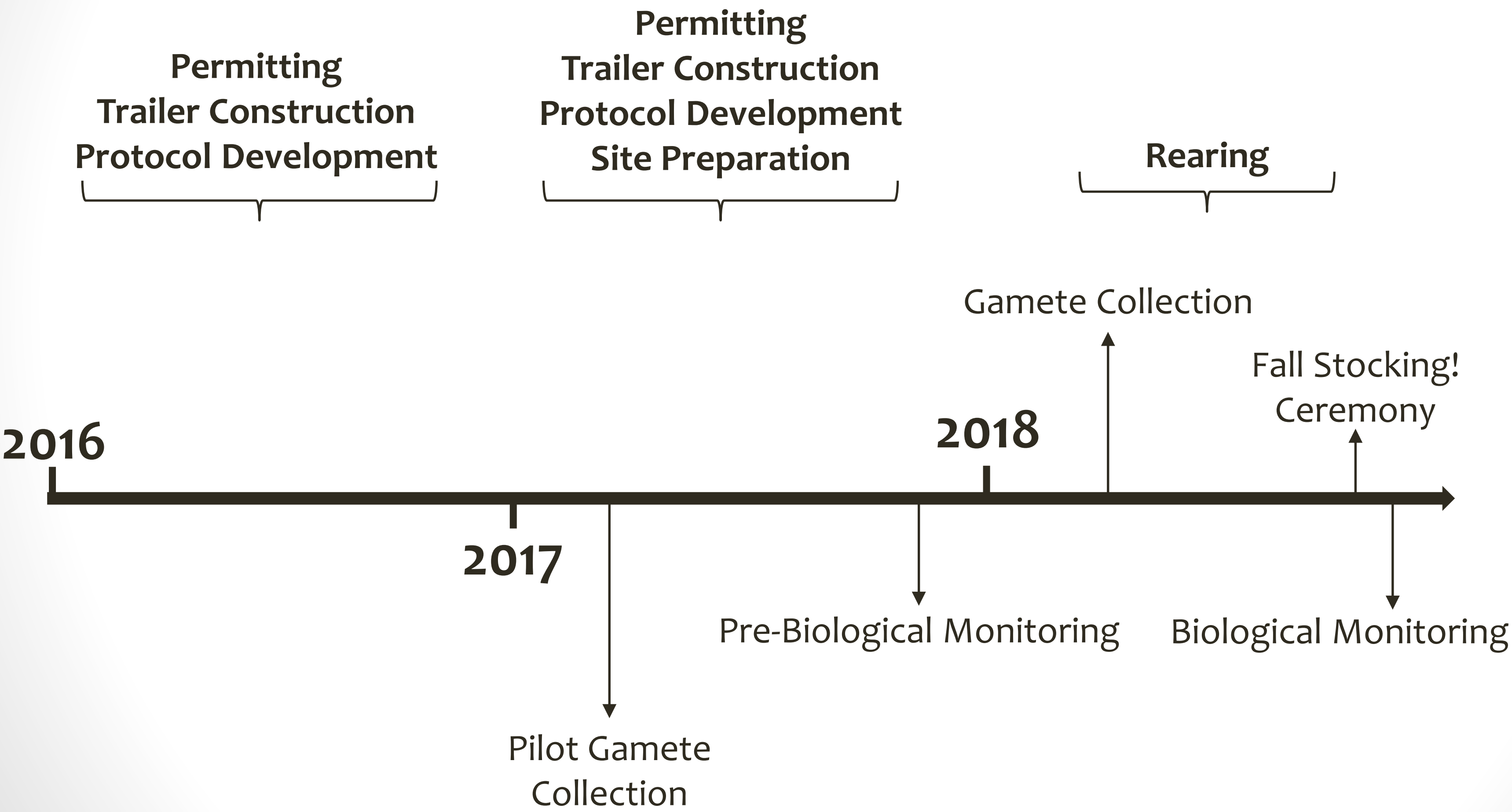
"It is the kind of giant step that our famous zoo can take in advancing its scientific accomplishments," **U.S. Rep. Marcy Kaptur (Toledo)**

Annual release ceremony

- Adopt a fish
- Public release
- Draw upon other ceremonies around the Great Lakes

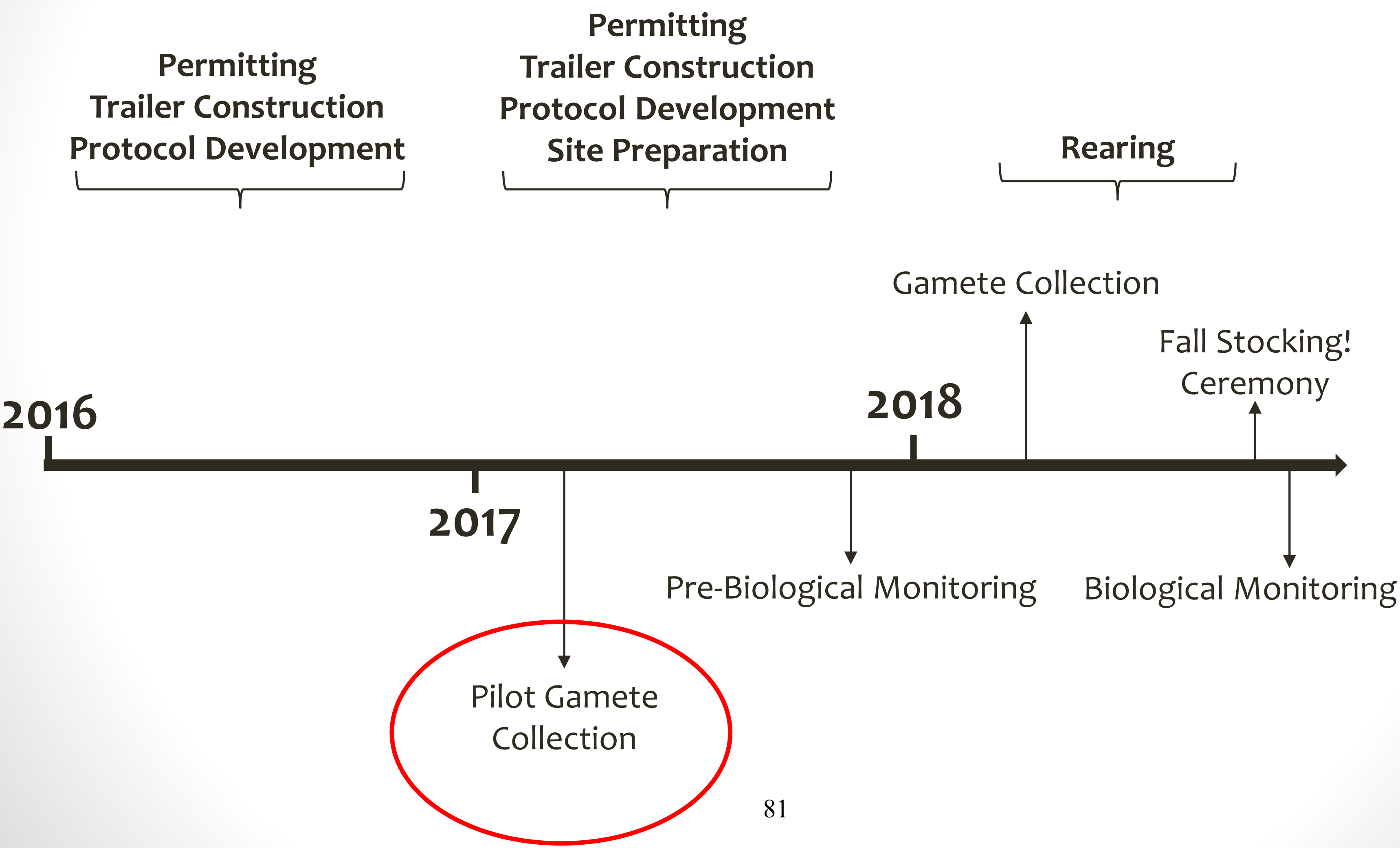
Possibilities with Toledo Zoo

Short-term Timeline



Maumee River Lake Sturgeon Restoration Program

Short-term Timeline



2017 Pilot Gamete Collection Year

Goal to go through the process for 2018 season collecting gametes from 5 females and 25 males

- Permitting (CITES; OMNRF Endangered Species Permit; MDNR T&E)
- Fish collection
- Fish handling/hormone injection
- Gamete collection
- Transport across the border and to Genoa NFH

Lake Sturgeon Gamete Collections in Southern Lake Huron/Upper St. Clair River

Maumee River Lake Sturgeon Restoration Program

2017 Pilot Gamete Collection Year

The process

- All permits in place set a precedent for 2018
- Fish collection
  - June 7th and 8th
  - 37 on setlines and 24 by Purdy's – **61** total fish in two days
  - 22 ripe males (milt observed); 7 black egg females based on ultrasound

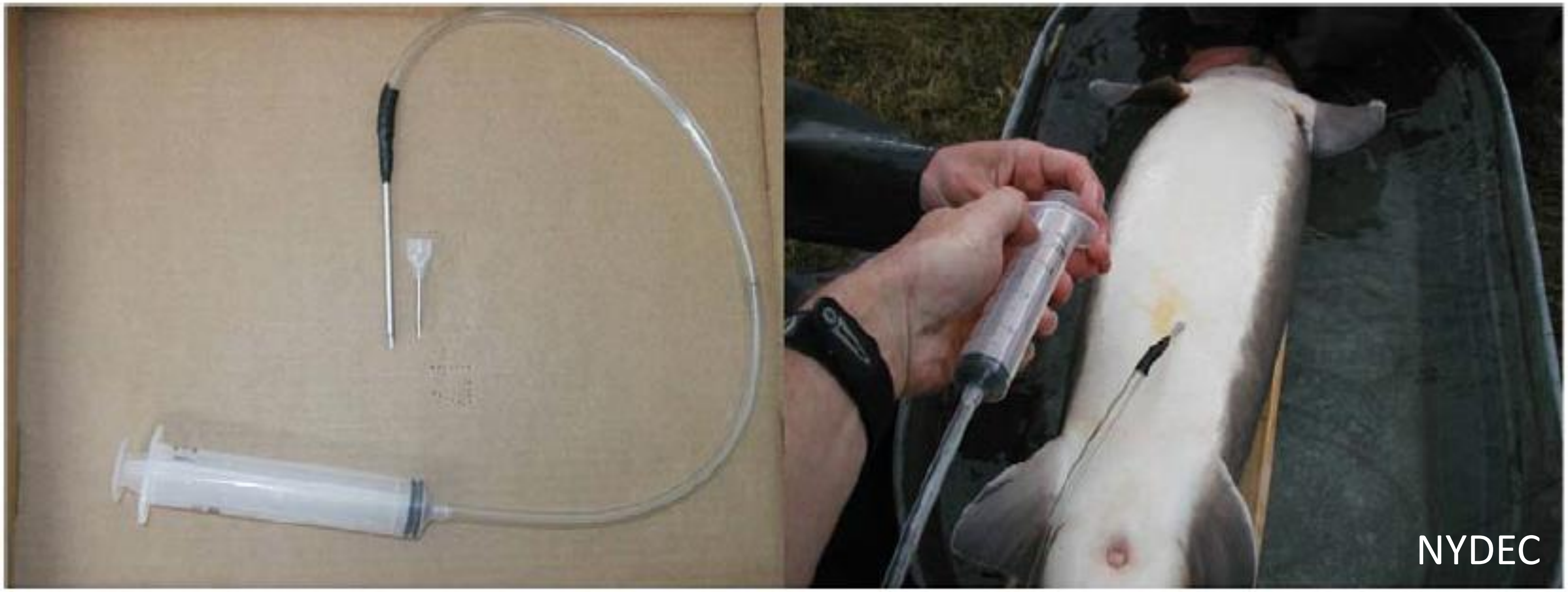
Maumee River Lake Sturgeon Restoration Program

Progesterone Assay

Progesterone assay

- Collect a small amount of eggs 25-30 eggs per female to examine egg maturation (Chapman & Van Eenennaam 2016)

Hypodermic Egg Extraction (HEE)



NYDEC Egg Tank Manual – Roger Klindt

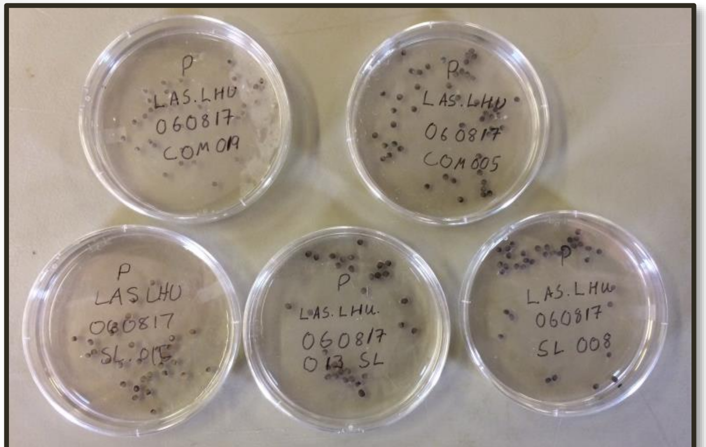
Progesterone Assay

Progesterone assay (cont.)

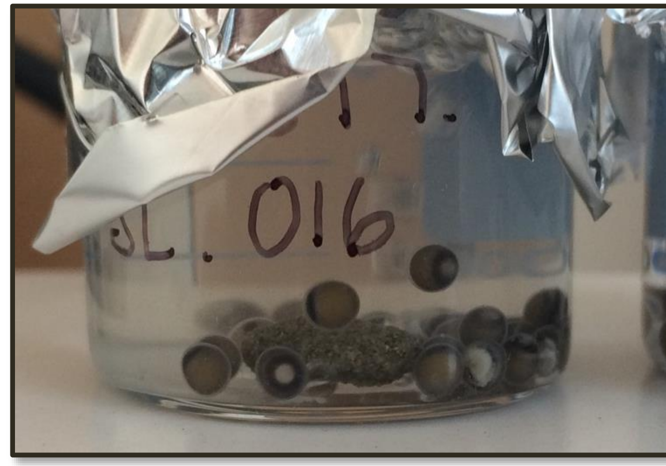
- Collect a small amount of eggs 25-30 eggs per female to examine egg maturation (Chapman & Van Eenennaam 2016)
- Control group (no P) and subset of eggs from each female collected treated with (P)
- Placed in egg incubator for 16-18 hrs @ 16˚C
- Boil eggs to harden and then section
- Should have germinal vesicle breakdown (GVBD) in 100% of eggs treated with P
- 100% breakdown in P; and some eggs breakdown in control – **GOOD!**
- Otherwise release…….reducing time of holding
- We released two females that were not ready to spawn w/in one week based on assay; would release eggs, but low survival

2017 Pilot Gamete Collection Year

Progesterone assay



25 – 30 eggs each female



Boiled to harden

No breakdown

breakdown

Maumee River Lake Sturgeon Restoration Program

2017 Pilot Gamete Collection Year

Hormone Injection

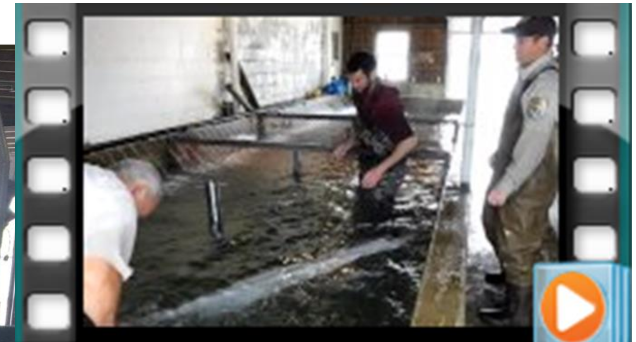
Induction Sequence
1. Midnight (hour 0), female 10%, male not handled
2. Noon (hour 12), female 90%, male 100%
3. morning (hour 32), female should show signs of maturation (eggs dropped), males ready for sperm harvest

Lake sturgeon induced with CCPH can be released back into their natal environment immediately (i.e. no withdrawal period). This is based on the new aquatic animal drug (INAD) exemption for CCPH under INAD #8391 (U.S. Fish and Wildlife Service).

	CCPH Suggested Dosage Rates
Female	5 mg/kg
Male	1 mg/kg

2017 Pilot Gamete Collection Year

Hormone Injection



Maumee River Lake Sturgeon Restoration Program

2017 Pilot Gamete Collection Year

Gamete Collection

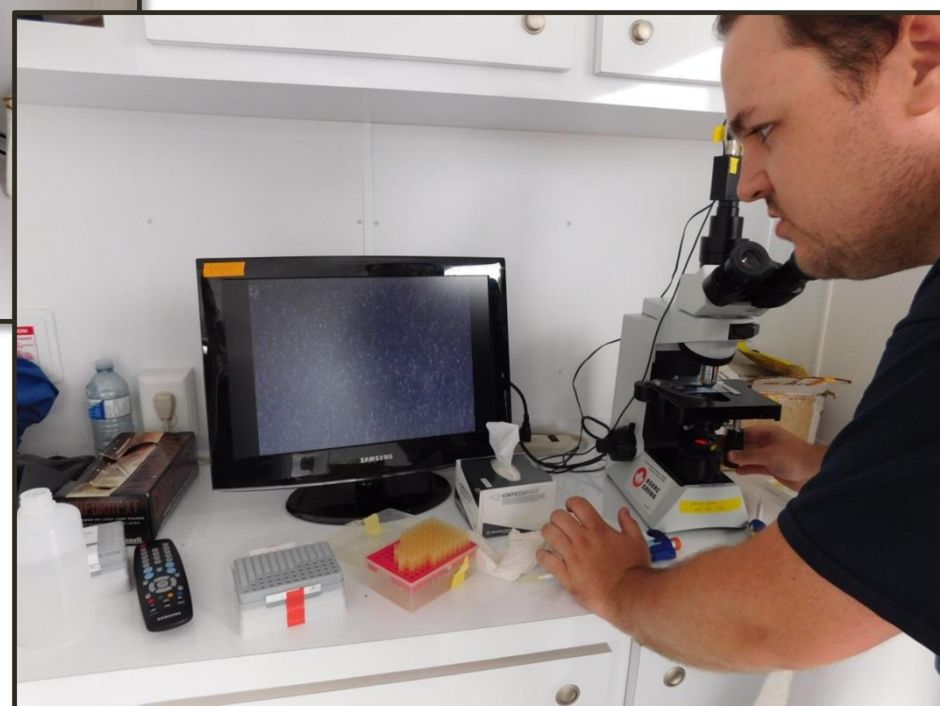
- 4 females injected with CCPH; eggs collected from three; one spawned in tank
- 19 males injected with CCP; sperm collected from 17

Maumee River Lake Sturgeon Restoration Program

University of Windsor – Pitcher Mobile Lab

University of Windsor

Sperm Motility



Maumee River Lake Sturgeon Restoration Program

2017 Pilot Gamete Collection Year

Hatchery Results (egg to fry)

- Female 1: 1.6% - 13% GVBD (several eggs nucleus right on edge)
- Female 2: 50% - 33% GVBD
- Female 3: 34.2% - 15% GVBD (several eggs nuclease right on edge)
- 5,500 fall fingerlings

Gamete Collection Targets - 2018 and Beyond…..

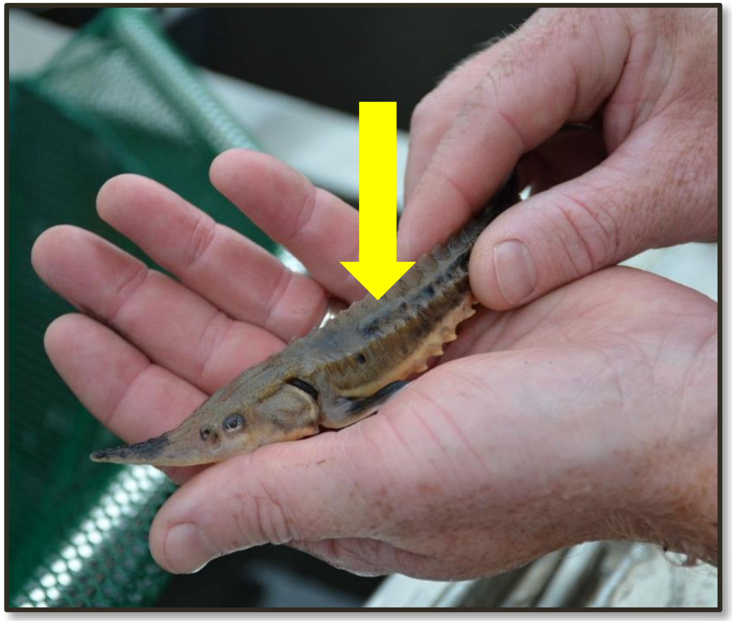
Targets

- Goal to collect eggs from 7 females and 28 males each year (1:4)
- Only sturgeon captured on setlines
- However 10 females and 40 males will be collected each year, just in case their is low hatch success for some females
- Goal for Maumee River 3000 fall fingerlings/7 females = 429 per female
- Families will be equalized prior to stocking; so 6 females = 2,574 released
- All fingerlings will be PIT tagged

Number of parents	Female 3	4	5	6	7	8	9	10	11	12
Male 4		8.0								
5		8.9	10.0							
6	8.0	9.6	10.9	12.0						
7	8.4	10.2	11.7	12.9	14.0					
8	8.7	10.7	12.3	13.7	14.9	16.0				
9	9.0	11.1	12.9	14.4	15.7	16.9	18.0			
10	9.2	11.4	13.3	15.0	16.5	17.8	19.0	20.0		
11	9.4	11.7	13.8	15.5	17.1	18.5	19.8	20.6	22.0	
12	9.5	12.0	14.1	16.0	17.7	19.1	20.6	21.8	23.0	24.0
13	9.8	12.2	14.4	16.4	18.2	19.8	21.3	22.6	23.8	25.0
14	9.9	12.4	14.7	16.8	18.7	20.4	21.9	23.3	24.6	25.8
15	10.0	12.6	15.0	17.1	19.1	20.9	22.5	24.0	25.4	26.7
16	10.1	12.8	15.2	17.5	19.5	21.3	23.0	24.6	26.1	27.4
17	10.2	13.0	15.5	17.7	19.8	21.8	23.5	25.2	26.7	28.1
18	10.3	13.1	15.7	18.0	20.2	22.2	24.0	25.7	27.3	28.8
19	10.4	13.2	15.8	18.2	20.5	22.5	24.4	26.2	27.9	29.4
20	10.4	13.3	16.0	18.5	20.7	22.9	24.8	26.7	28.4	30.0

$N_e \geq 20$

Welsh et al. 2010



Maumee River Lake Sturgeon Restoration Program

MAUMEE RIVER sturgeon restoration

Questions?

Justin Chiotti
U.S. Fish and Wildlife Service
Alpena FWCO – Detroit River Substation
justin_chiotti@fws.gov
(248-891-0087)

Flavobacterial Diversity & Epidemiology in Hatchery Systems

Thomas P. Loch

2/6/18

Aquatic Animal Health Laboratory, Dept. of Pathobiology & Diagnostic Investigation, Michigan State University, East Lansing MI, 48824; Dept. of Fisheries & Wildlife, Michigan State University, East Lansing MI, 48824

College of VETERINARY MEDICINE Michigan State University

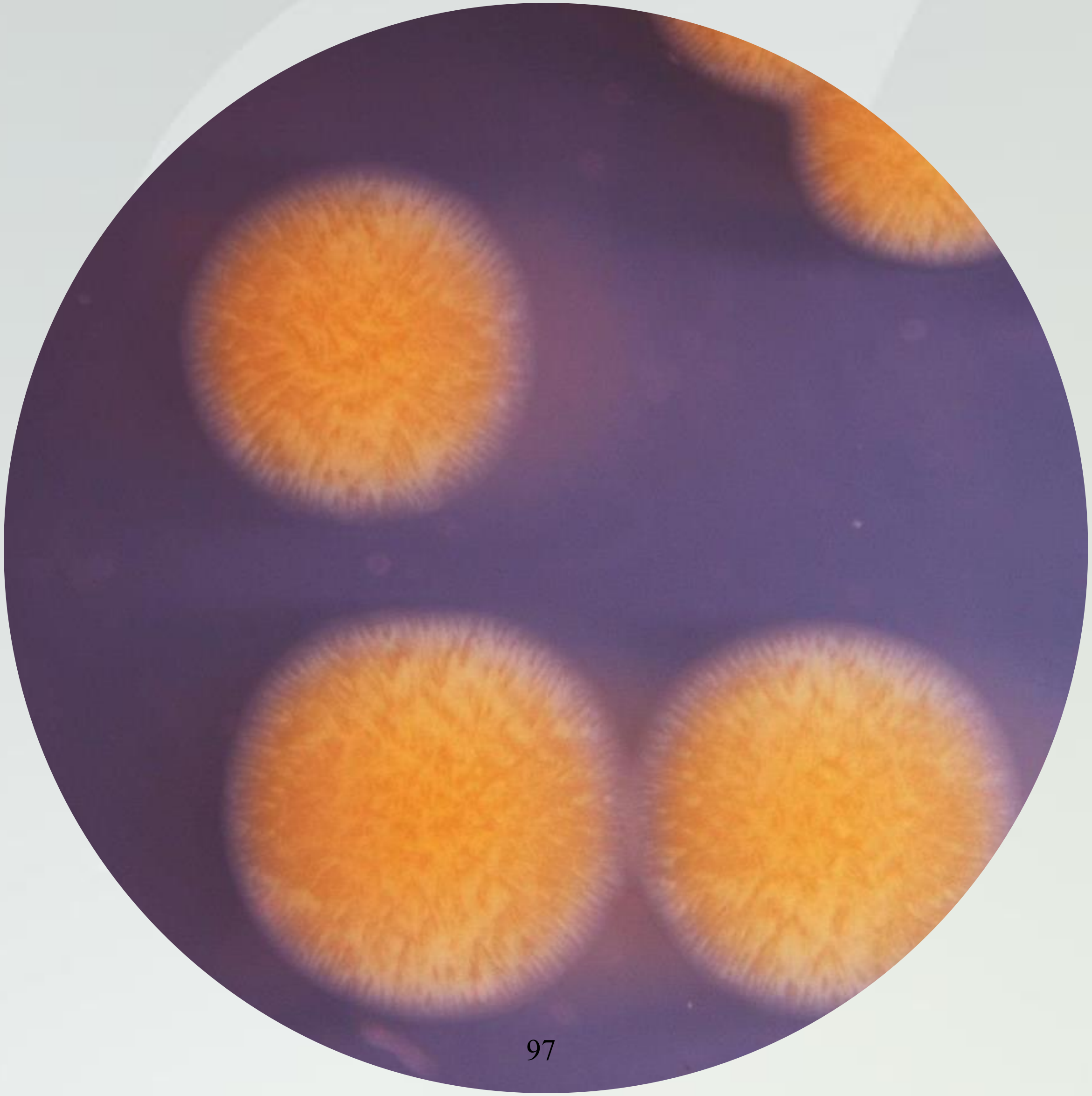
Department of Fisheries and Wildlife • Michigan State University •

Flavobacterial Diseases in Fish

A leading pathogen-associated impediment to fish culture

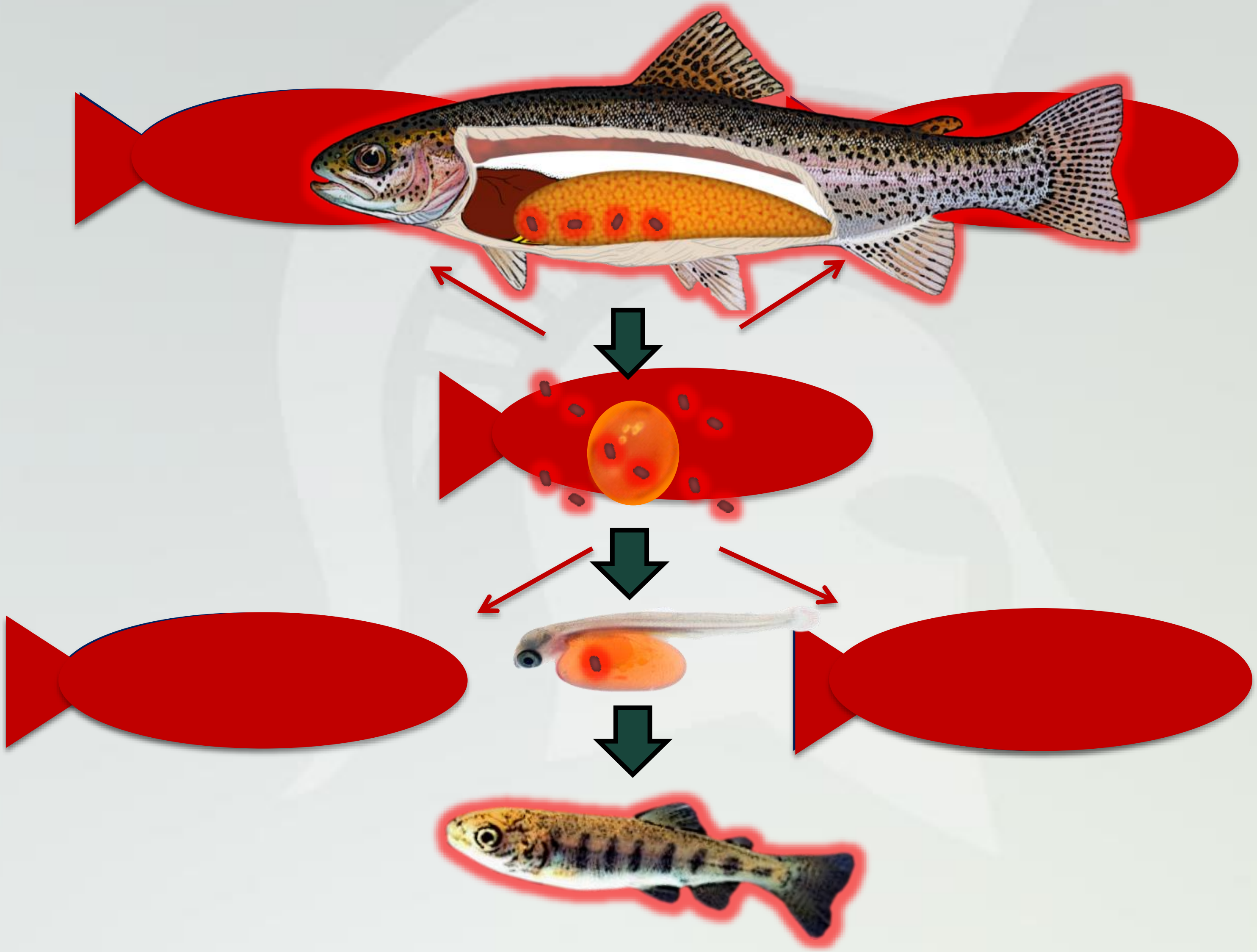
Loch TP, Faisal M. (2015) Emerging Flavobacterial Infections in Fish: A Review. *Journal of Advanced Research*. 6(3), 283-300.

Flavobacterium psychrophilum

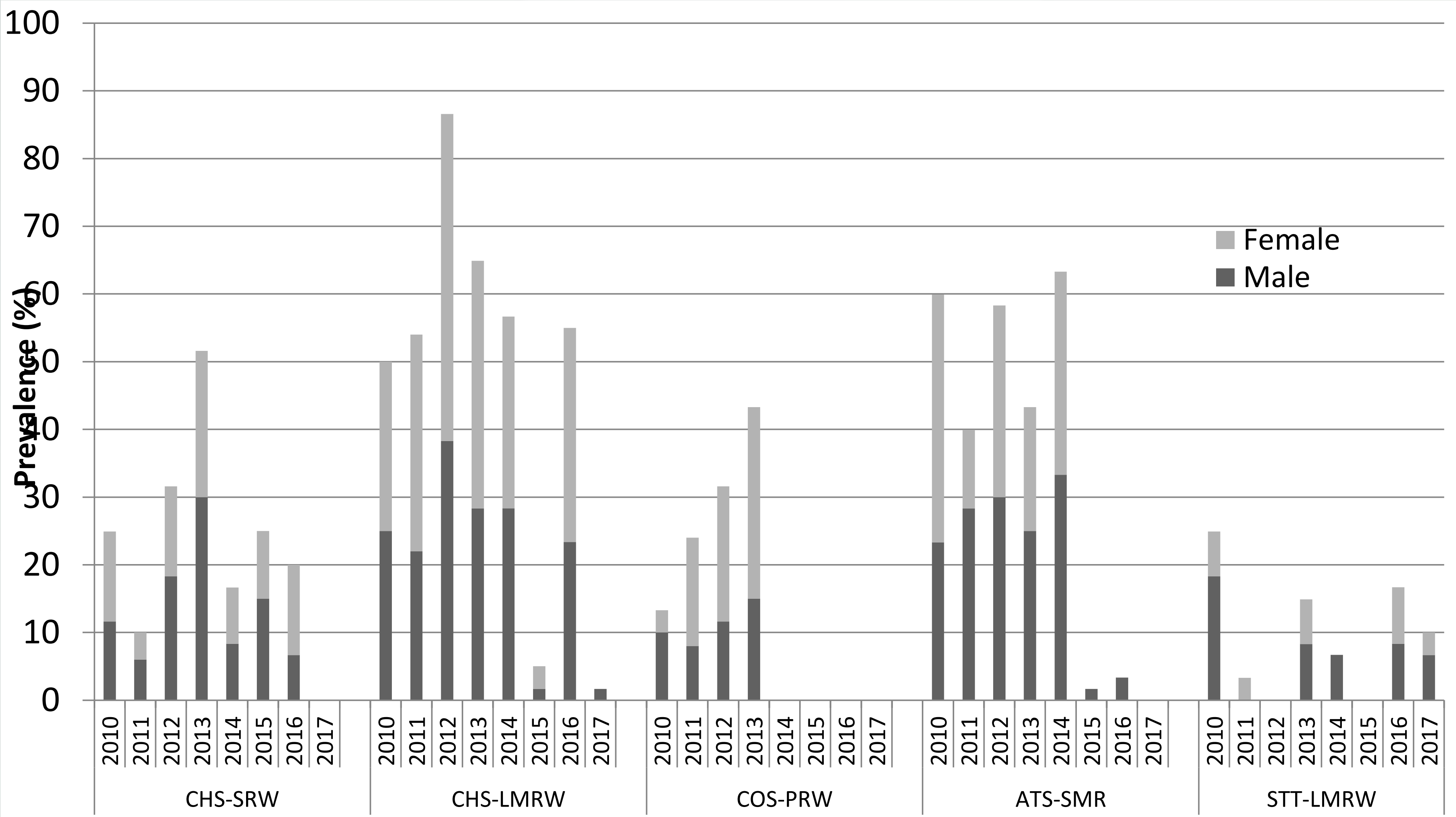


Bacterial Coldwater Disease

Transmission of *F. psychrophilum*



F. psychrophilum Infection Prevalence in MI Feral Salmonid Broodstock



Van Vliet D, Loch TP, Faisal M. (2015) *Flavobacterium psychrophilum* infections in salmonid broodstock and hatchery-propagated stocks of the Great Lakes basin. *Journal of Aquatic Animal Health.* 27(4), 192-202.

BCWD in Production Fish

***F. psychrophilum* sources? Reservoirs?**
=Guide Targeted Control Efforts

(Now Dr.) Danielle Van Vliet

AMERICAN SOCIETY FOR MICROBIOLOGY | Applied and Environmental Microbiology

CrossMark click for updates

Genetic Diversity of *Flavobacterium psychrophilum* Isolates from Three *Oncorhynchus* spp. in the United States, as Revealed by Multilocus Sequence Typing

Danielle Van Vliet,[a] Gregory D. Wiens,[b] Thomas P. Loch,[c] Pierre Nicolas,[d] Mohamed Faisal[a,c]

Department of Fisheries and Wildlife, College of Agriculture and Natural Resources, Michigan State University, East Lansing, Michigan, USA[a]; National Center for Cool and Cold Water Aquaculture, United States Department of Agriculture, Agricultural Research Service, Kearneysville, West Virginia, USA[b]; Department of Pathobiology and Diagnostic Investigation, College of Veterinary Medicine, Michigan State University, East Lansing, Michigan, USA[c]; MaIAGE, INRA, Université Paris-Saclay, Jouy-en-Josas, France[d]

Flavobacterial diversity and its effect on disease in aquaculture

United States Department of Agriculture
National Institute of Food and Agriculture

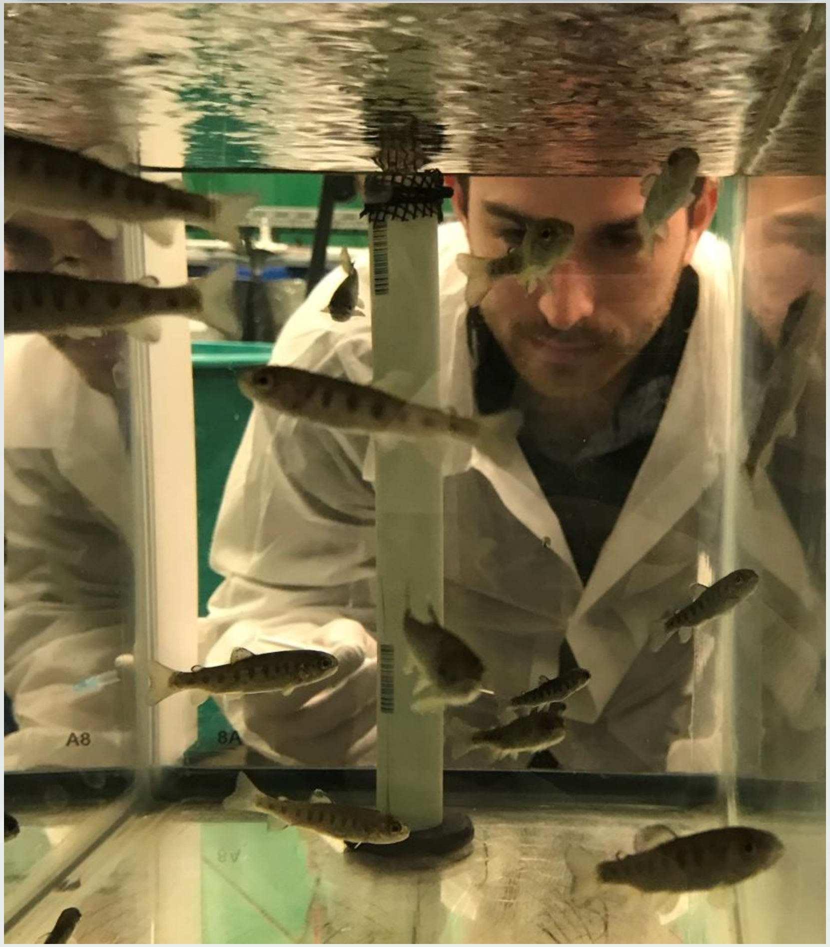
PI- Faisal/Loch; Co-PIs, K. Cain (UI) & D. Call (WSU)

Objective 1- Elucidate *F. psychrophilum* diversity of U.S. *F. psychrophilum* strains and how it relates to virulence & AMR.

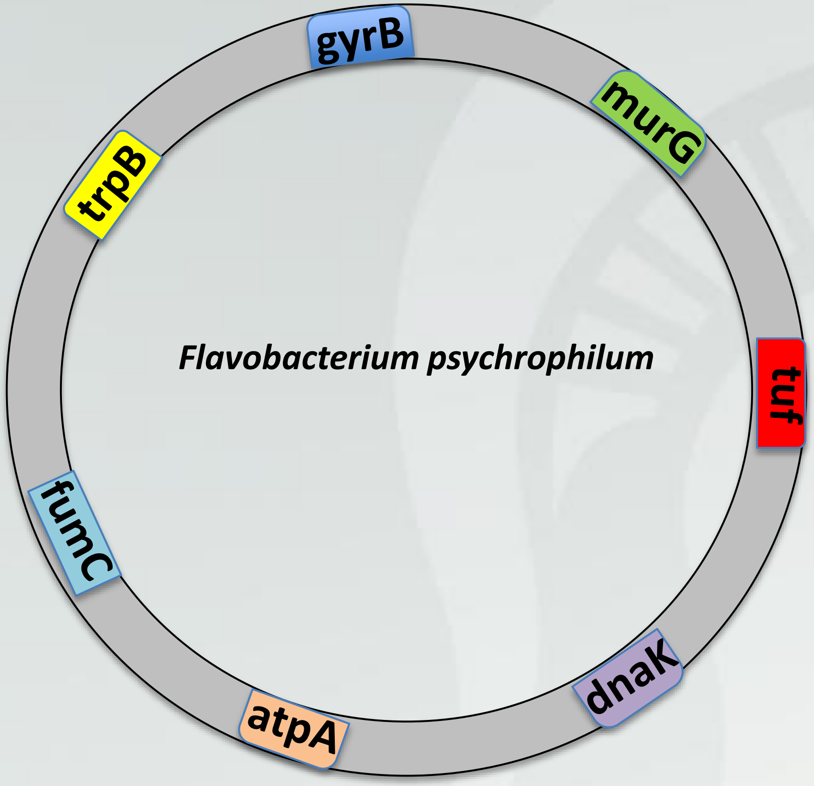
Objective 2- Identify non-*Fp* flavobacteria recovered from US BCWD outbreaks and elucidate their ability, alone and in combination with *F. psychrophilum,* to reproduce BCWD.

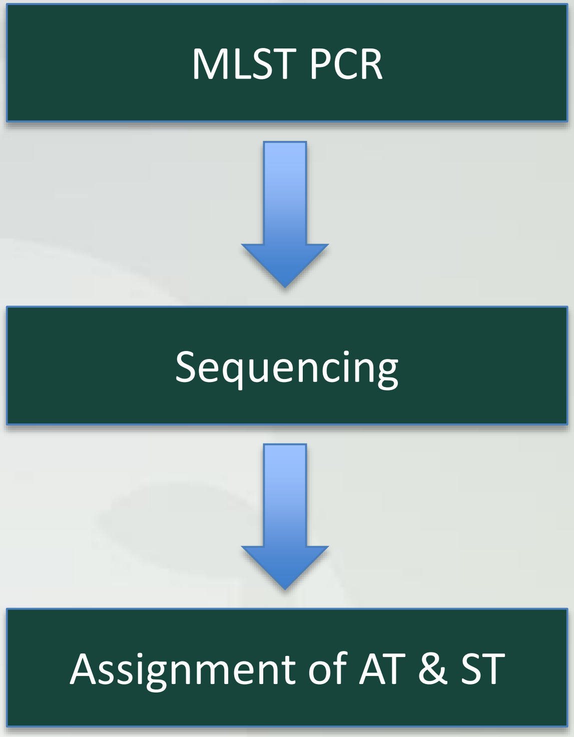
Objective 3- Determine if vaccination against *Fp* confers protection against representative *Fp* MLST variants and non-*Fp* flavobacteria.

Chris Knupp



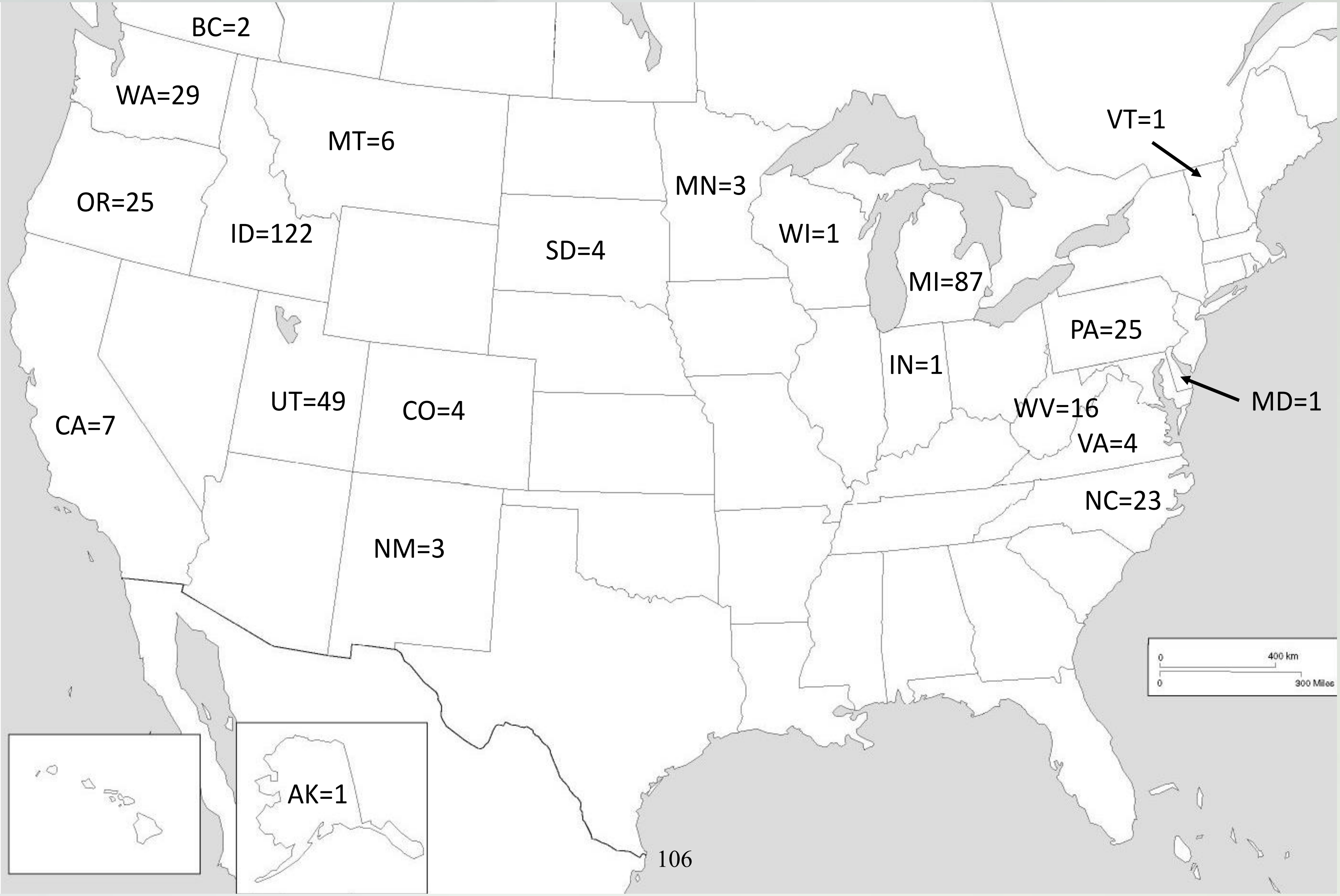
Multi-locus sequence typing (MLST)





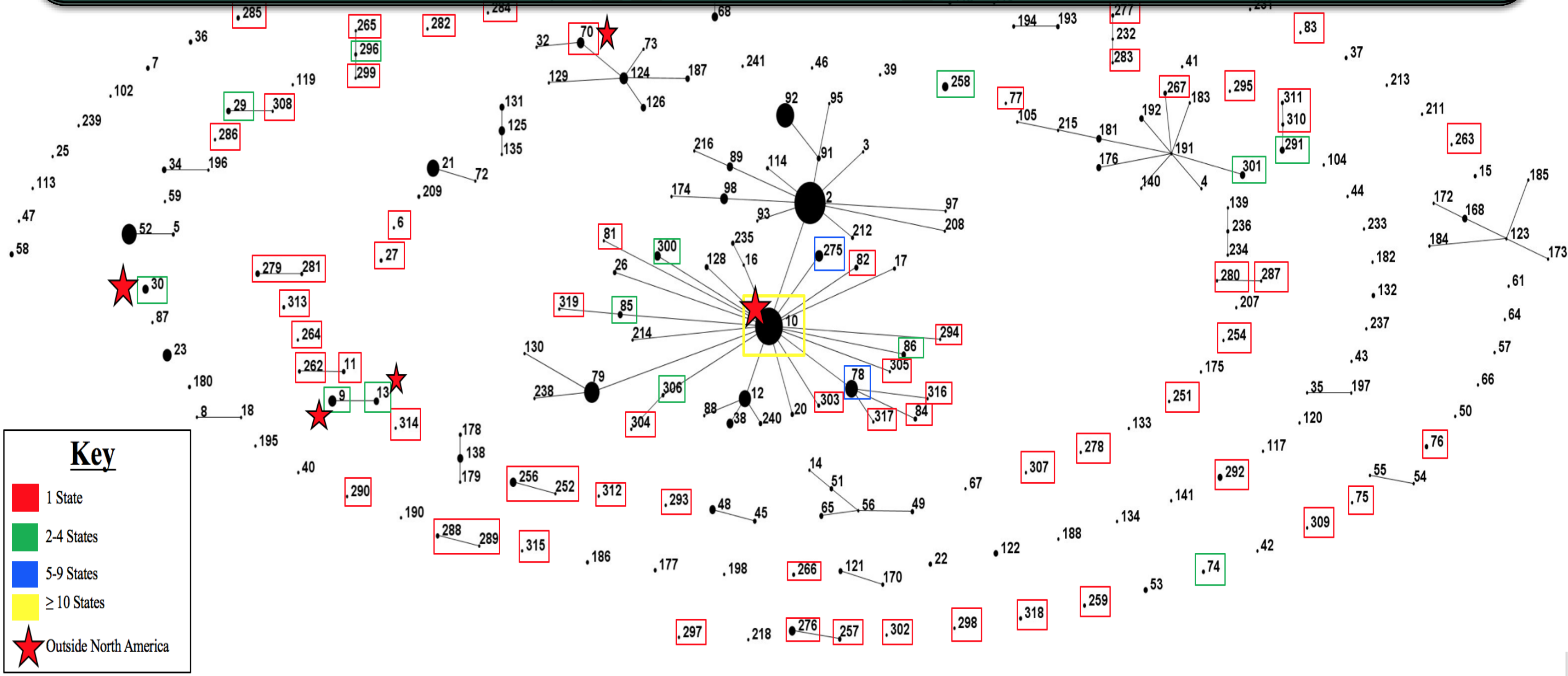
ST	trpB	gyrB	dnaK	fumC	murG	tuf	atpA
10							

>400 *F. psychrophilum* isolates recovered from 20 US states (1 CA Province) across four decades (1981-2017)

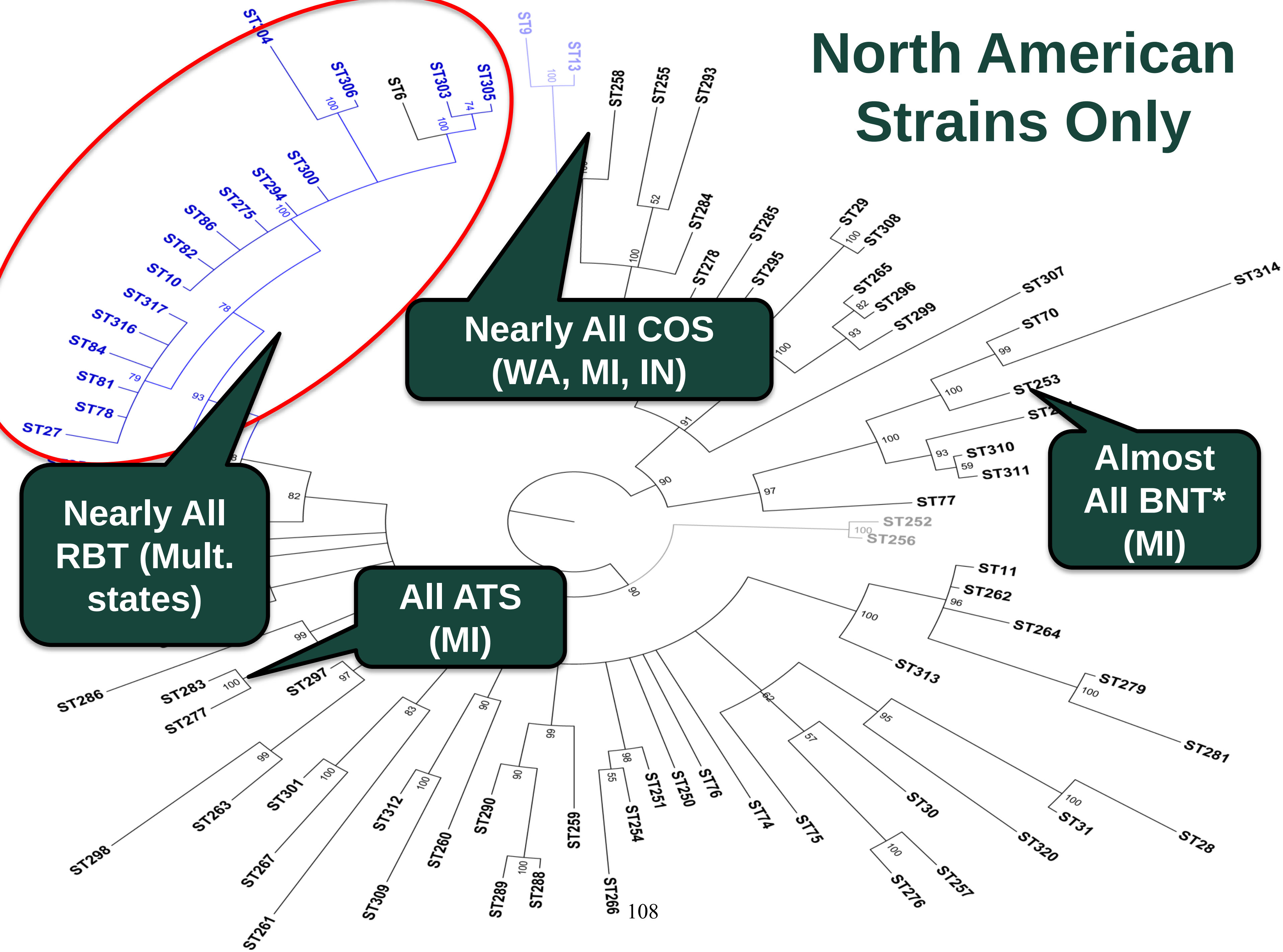


Significant Diversity (83 genetic variants in 12 complexes, 43 singletons)

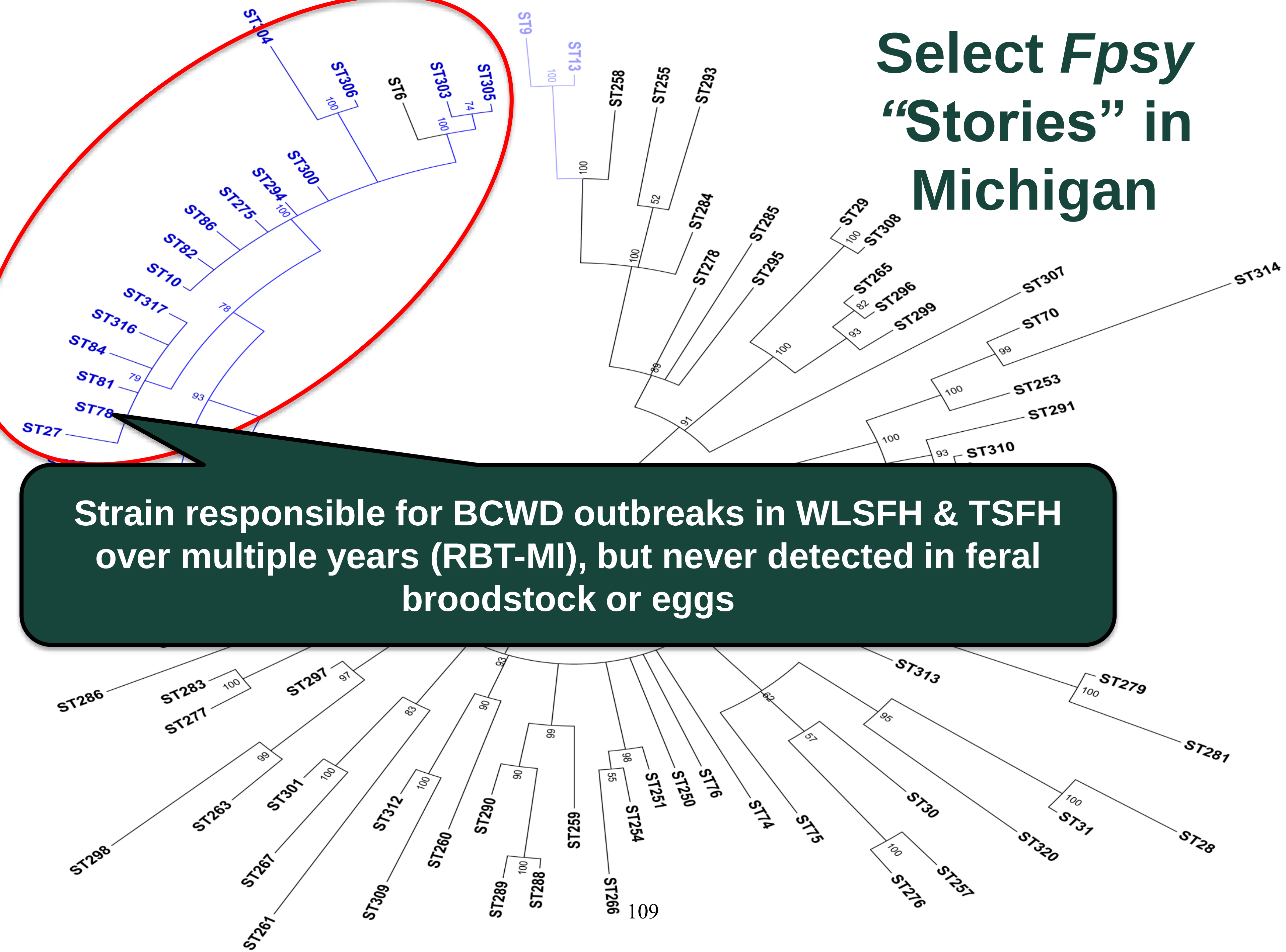
Some US variants have also been detected in Europe, South America, &/or Asia



North American Strains Only

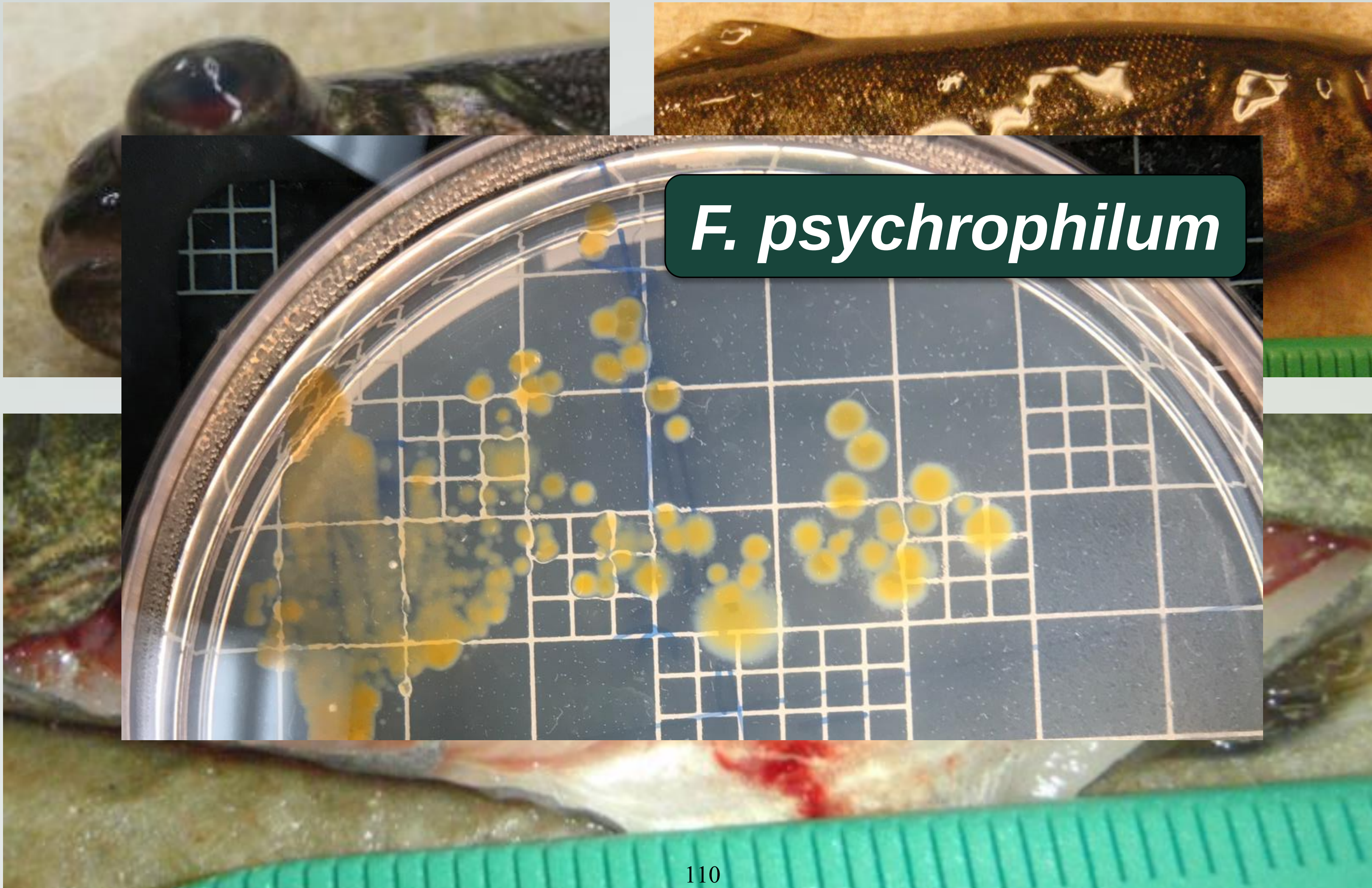


Select *Fpsy* "Stories" in Michigan

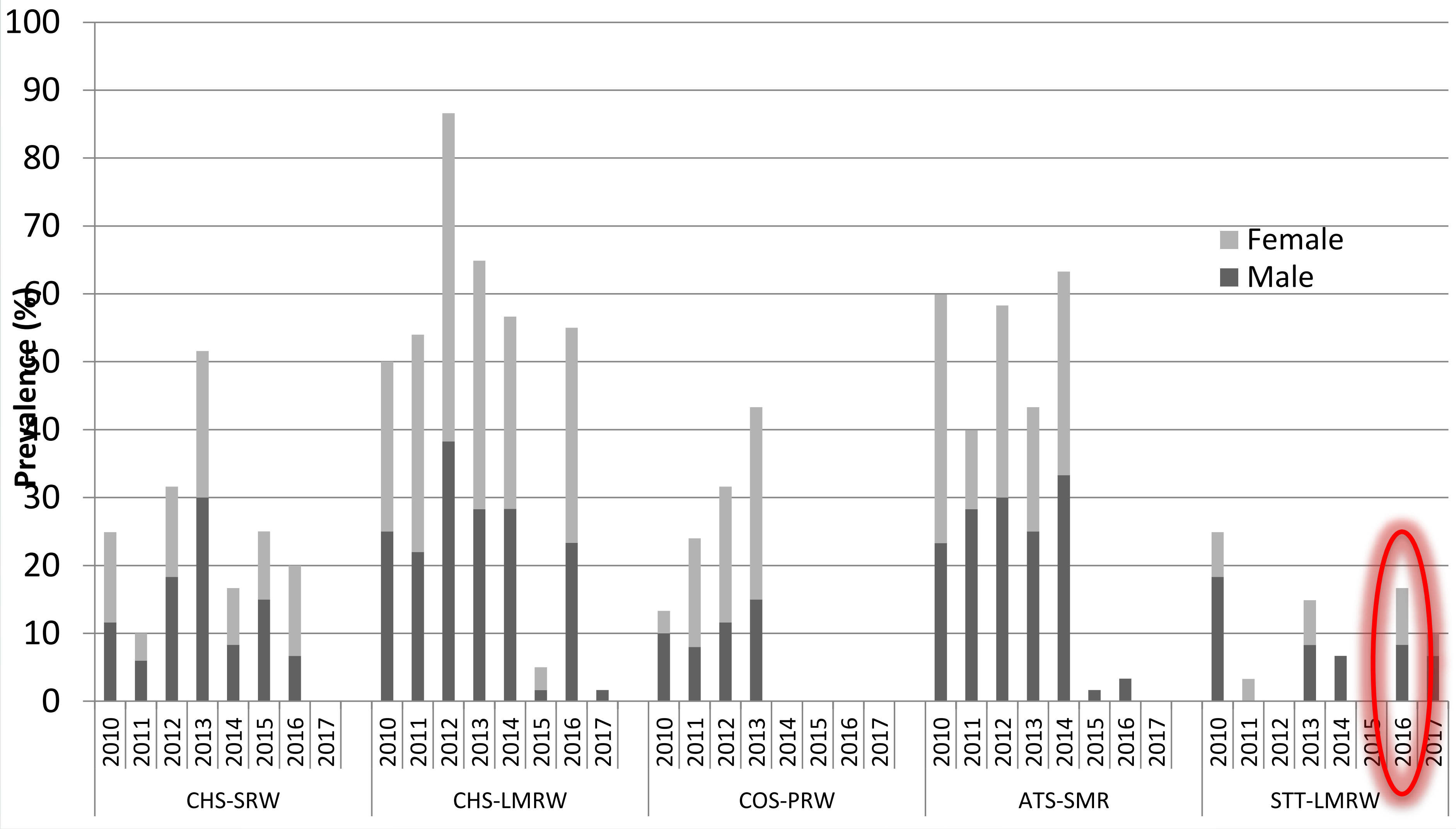


Strain responsible for BCWD outbreaks in WLSFH & TSFH over multiple years (RBT-MI), but never detected in feral broodstock or eggs

Disease Outbreak (P-RBT-MI-16-WL)

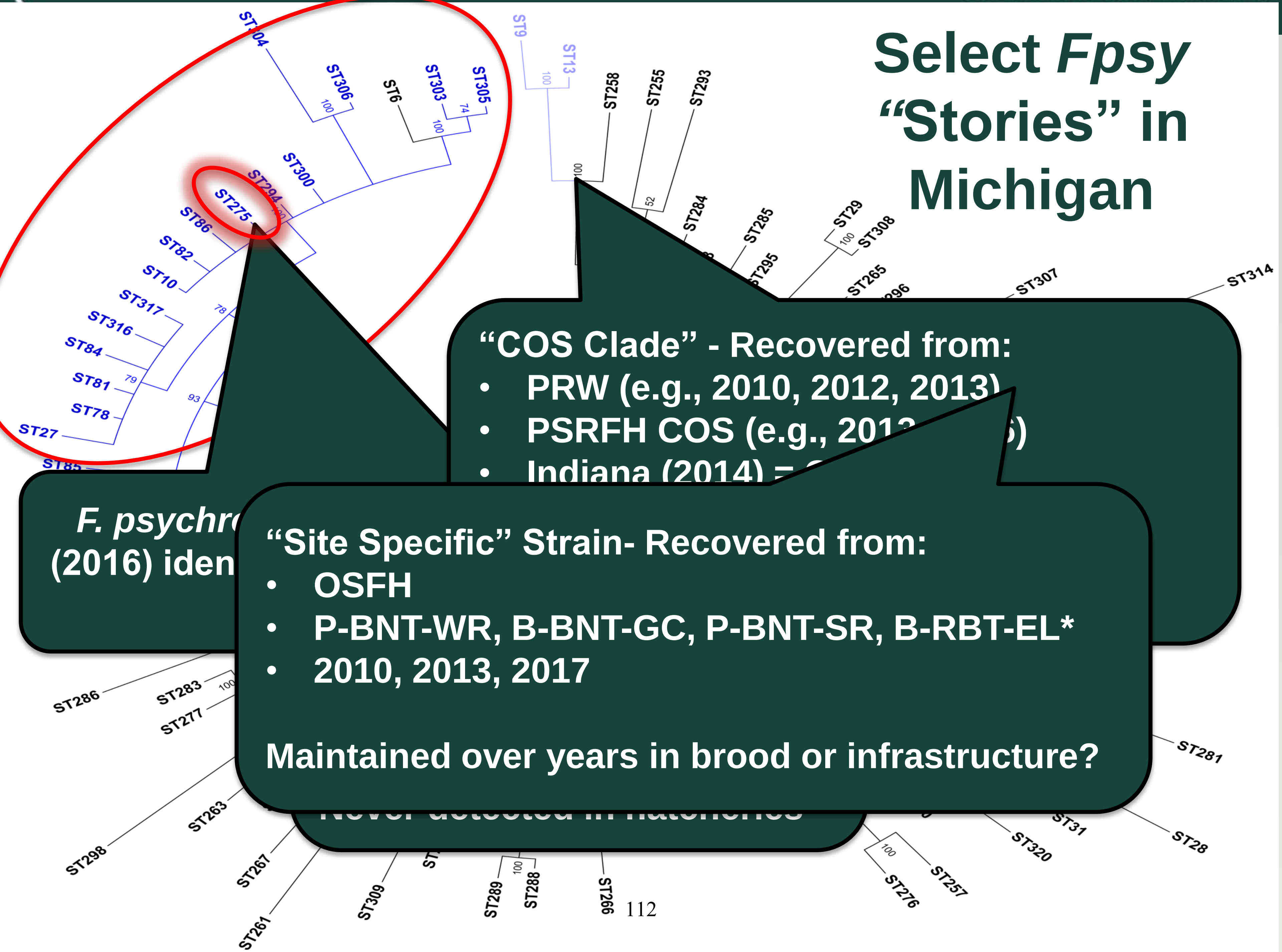


F. psychrophilum Infection Prevalence in MI Feral Salmonid Broodstock



Van Vliet D, Loch TP, Faisal M. (2015) *Flavobacterium psychrophilum* infections in salmonid broodstock and hatchery-propagated stocks of the Great Lakes basin. *Journal of Aquatic Animal Health.* 27(4), 192-202.

Select *Fpsy* "Stories" in Michigan



"COS Clade" - Recovered from:

- PRW (e.g., 2010, 2012, 2013)
- PSRFH COS (e.g., 201
- Indiana (2014) =

F. psychr

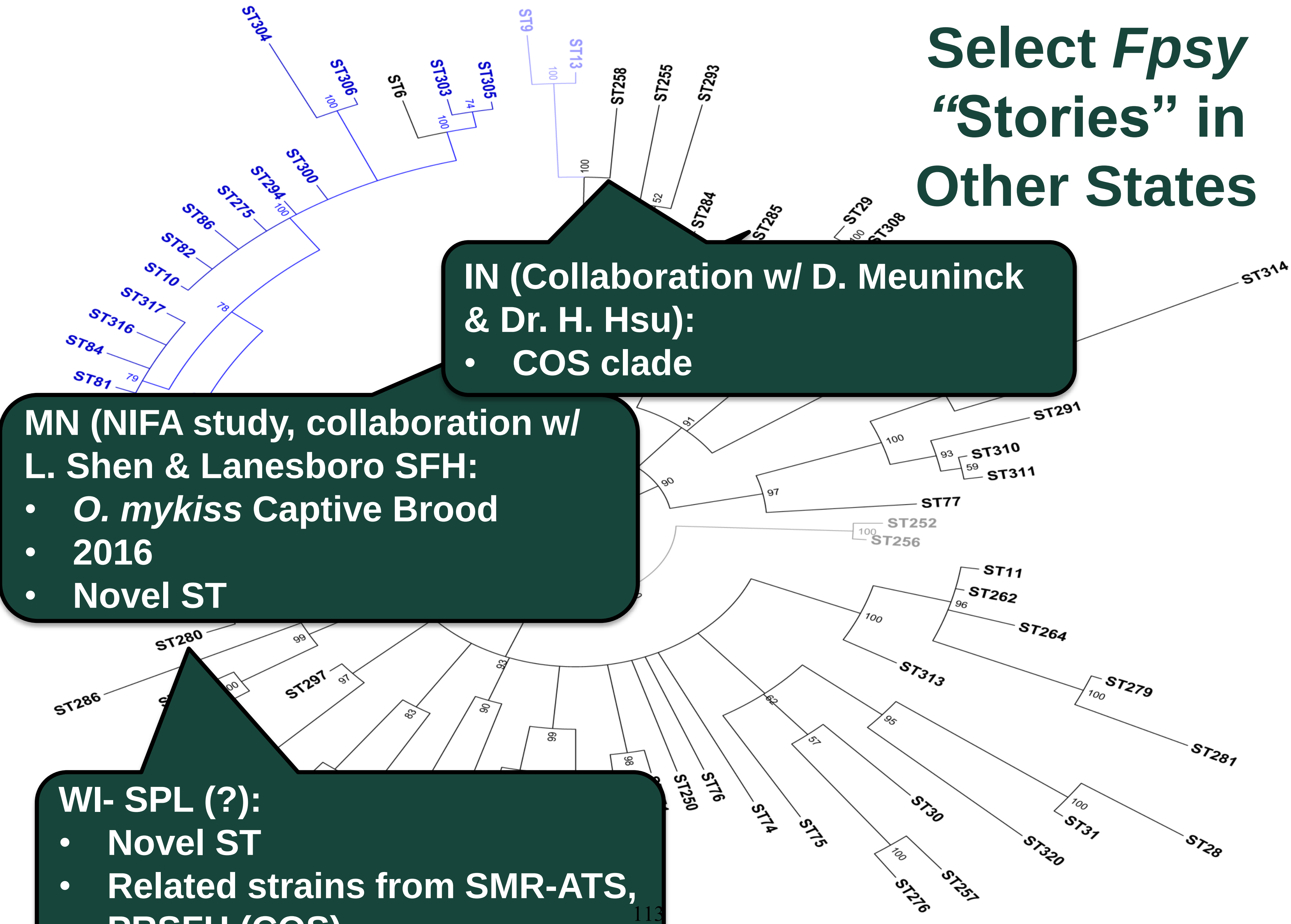
(2016) iden

"Site Specific" Strain- Recovered from:

- OSFH
- P-BNT-WR, B-BNT-GC, P-BNT-SR, B-RBT-EL*
- 2010, 2013, 2017

Maintained over years in brood or infrastructure?

Select *Fpsy* "Stories" in Other States

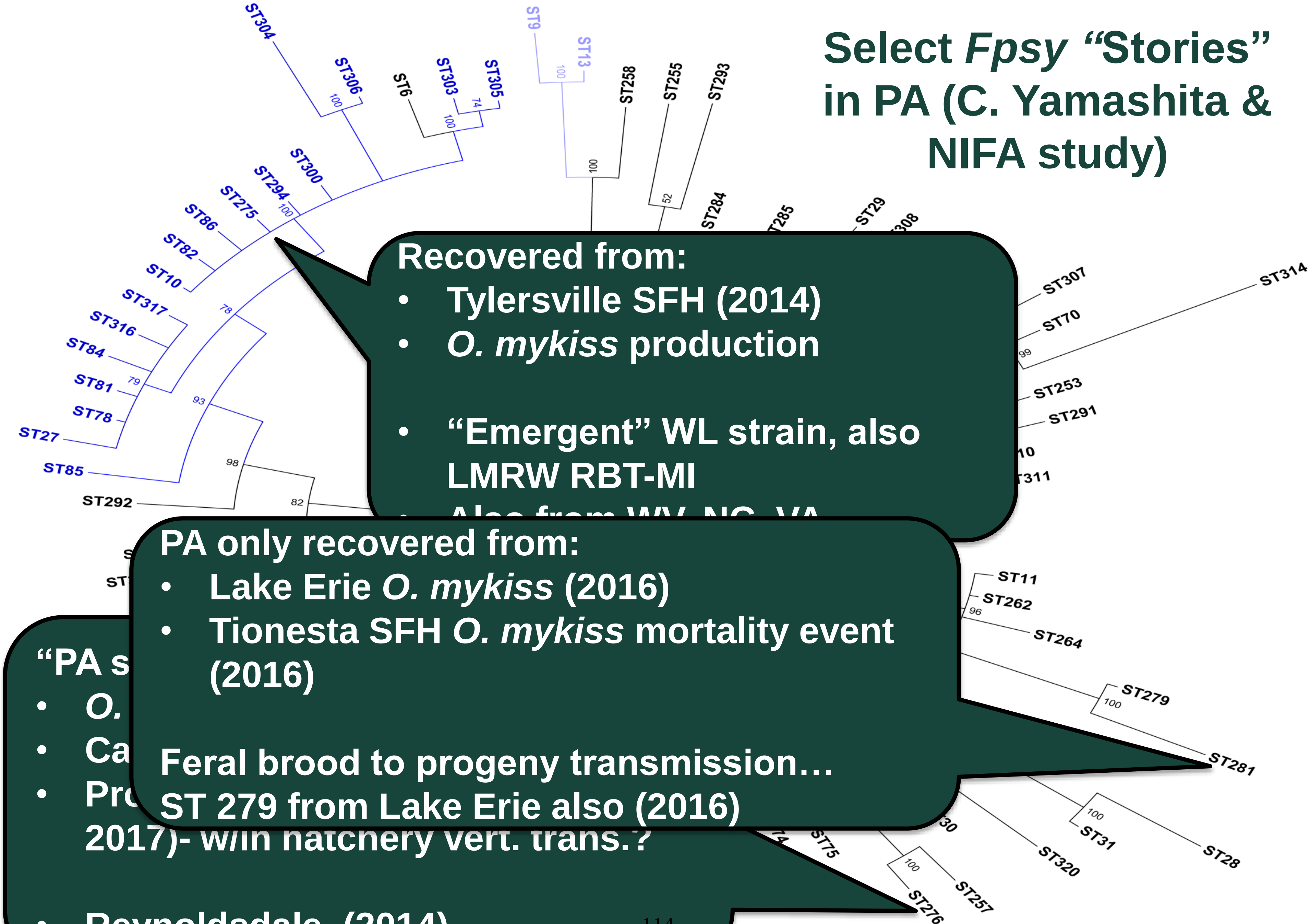


IN (Collaboration w/ D. Meuninck & Dr. H. Hsu):
- COS clade

MN (NIFA study, collaboration w/ L. Shen & Lanesboro SFH:
- *O. mykiss* Captive Brood
- 2016
- Novel ST

WI- SPL (?):
- Novel ST
- Related strains from SMR-ATS, PRSFH (COS)

Select *Fpsy* “Stories” in PA (C. Yamashita & NIFA study)



Recovered from:

- Tylersville SFH (2014)
- *O. mykiss* production

- “Emergent” WL strain, also LMRW RBT-MI
- Also from WV, NC, VA

PA only recovered from:

- Lake Erie *O. mykiss* (2016)
- Tionesta SFH *O. mykiss* mortality event (2016)

Feral brood to progeny transmission…
ST 279 from Lake Erie also (2016)

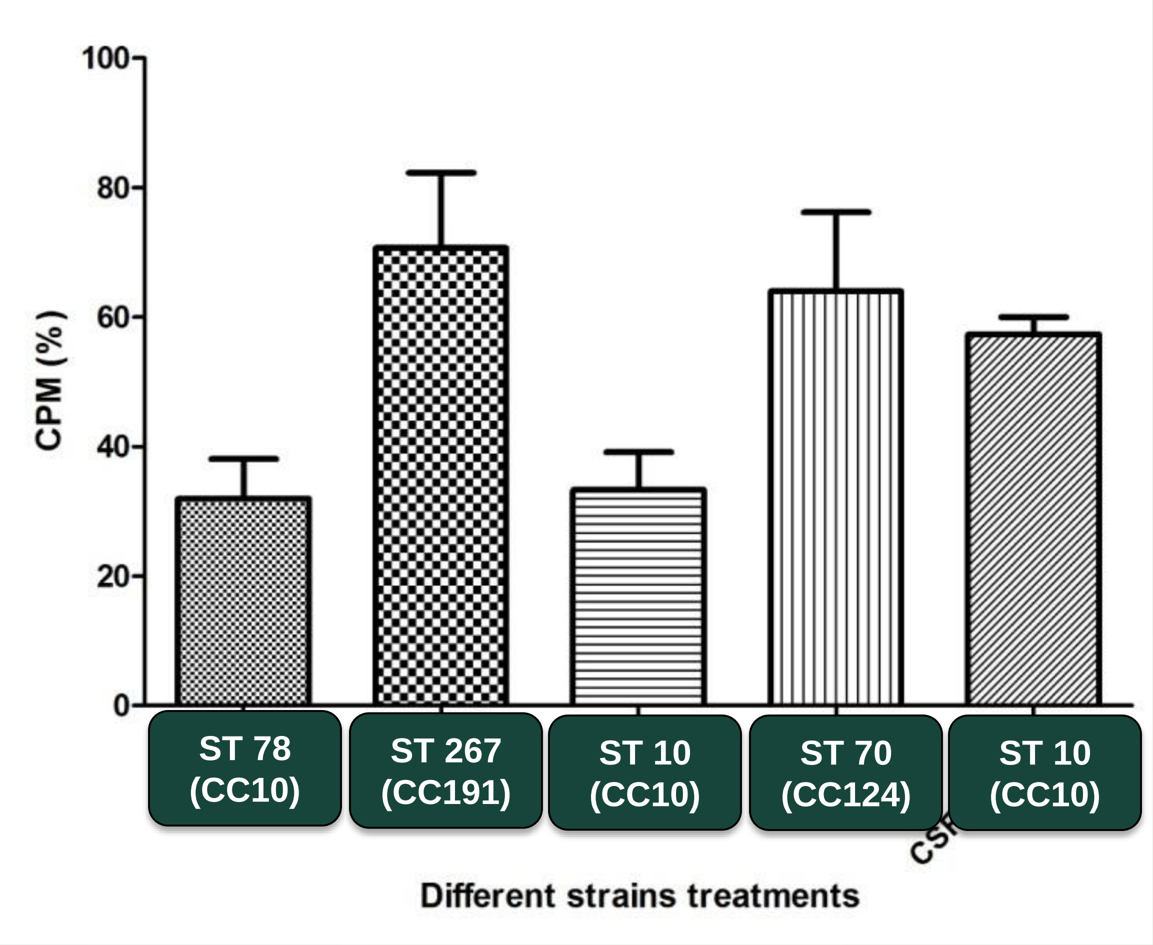
“PA s

- *O.*
- Ca
- Pro
2017)- w/in hatchery vert. trans.?

- Reynoldsdale (2014)

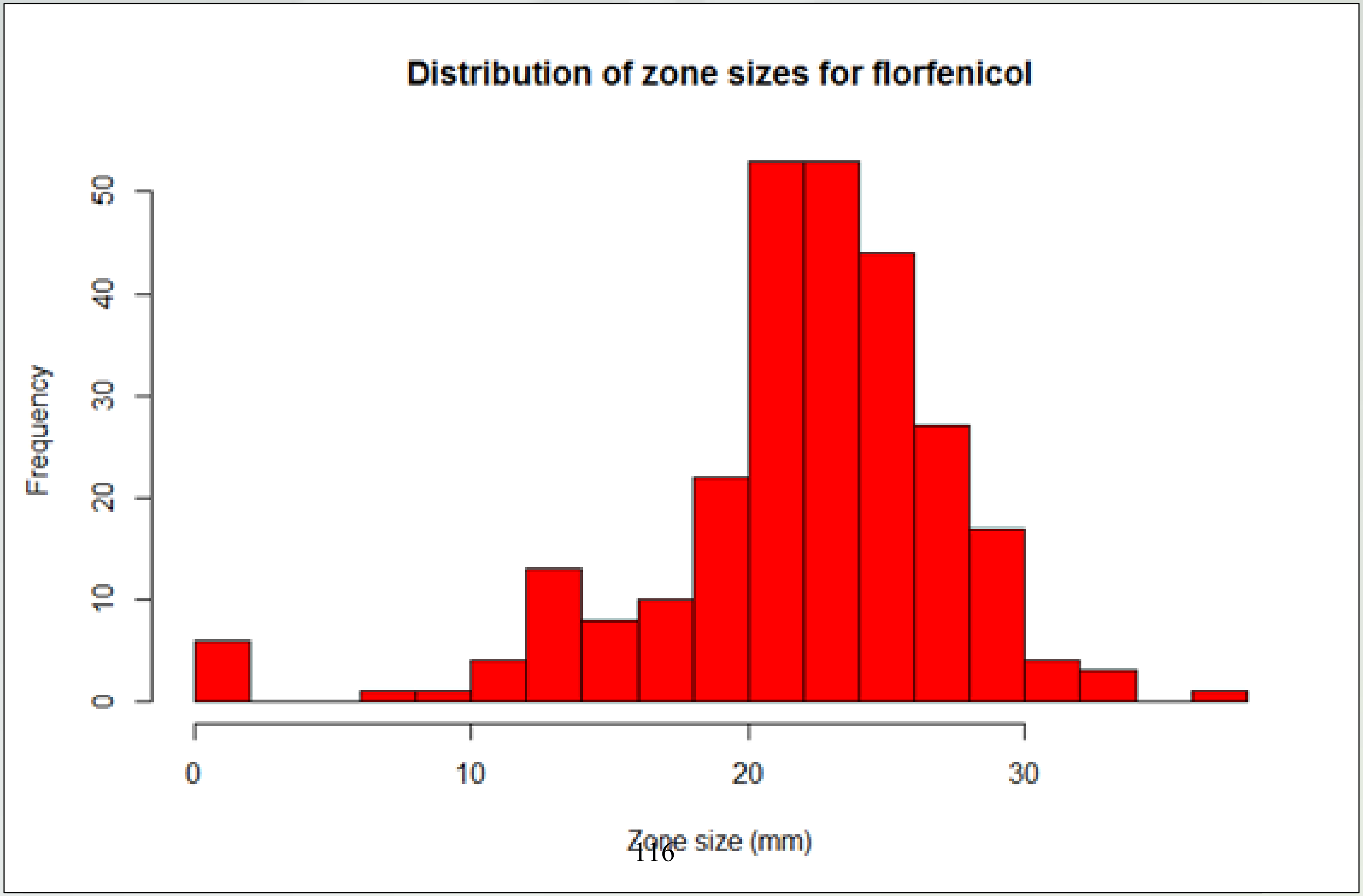
F. psychrophilum Diversity… So What?

- Relation to Virulence (Collaboration w/ Dr. K. Cain, U of I)

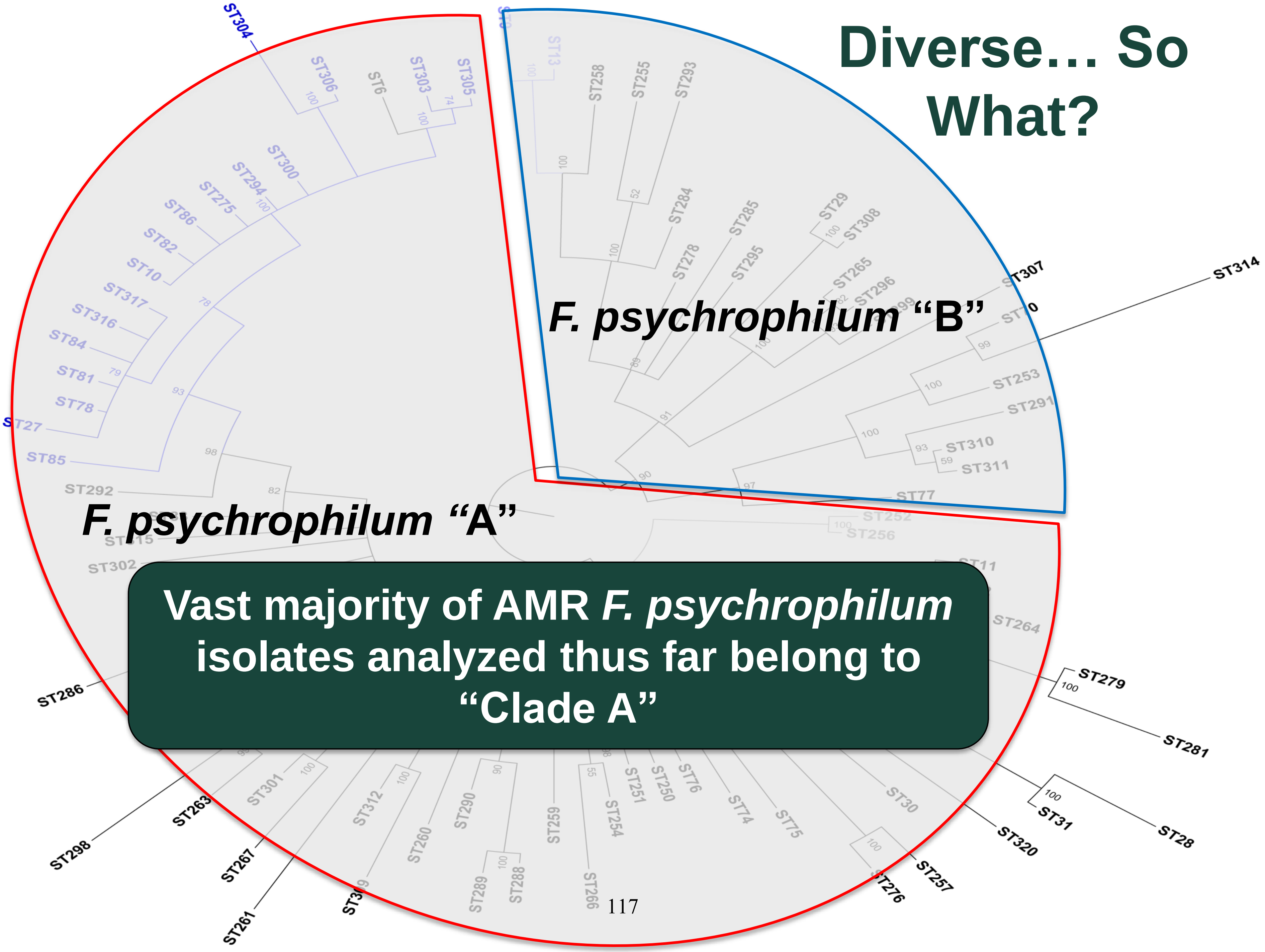


F. psychrophilum Diversity… So What?

- Relation to Antimicrobial Resistance (Collaboration w/ Dr. Doug Call, WSU)?



Diverse… So What?

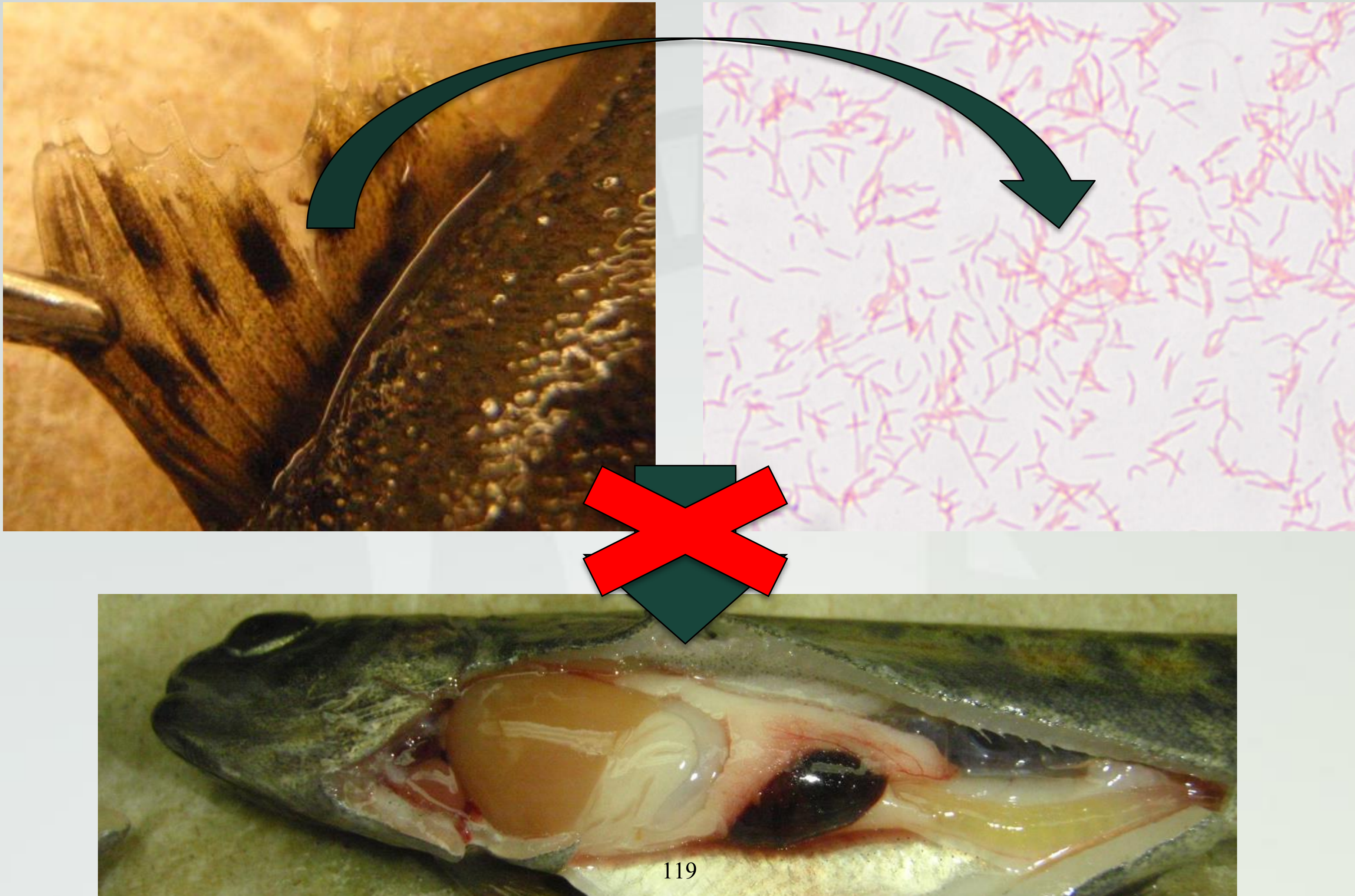


Vast majority of AMR *F. psychrophilum* isolates analyzed thus far belong to "Clade A"

Disease Prevention

- **Biosecurity**
  - Egg disinfection
  - Footbaths
  - Separate rearing unit tools
  - Surface water treatment (i.e., UV disinfection)
- **Rearing unit hygiene**
- **Optimal water flows**
- **Frequent removal of morts (and extra during outbreak)**
- **Culling of moribund fish when possible**

Then When Needed, Early Intervention



Acknowledgements

- **C. Yamashita & Pleasant Gap Crew, L. Shen & Lanesboro Crew, D. Meuninck & Dr. H. Hsu, many others**
- **MDNR/Gary Whelan et al.**
- **GLFT**
  - Grant # 2010-1147
- **USDA – NIFA**
  - Grant # 2016-67015-24891
  - Grant # # 2016-70007-25756

Double-crested Cormorant Control in Ohio

Kevin Kayle
ODNR- Division of Wildlife

Recent History of DCCO Control

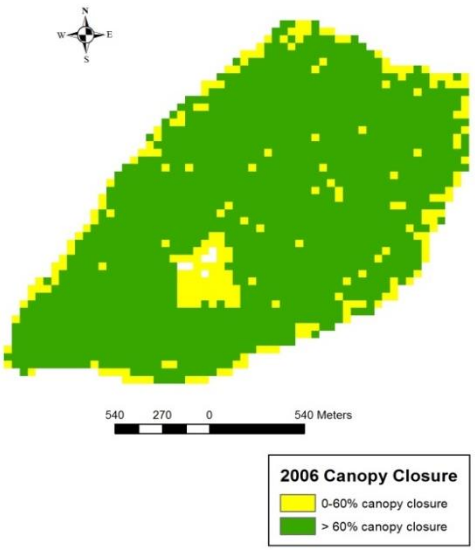
- As a migratory bird they are managed by the US Fish & Wildlife Service and USDA APHIS-Wildlife Services handles the Depredation permit process.
- Two types of permits [or orders]: AQDO (Aquaculture) and PRDO (Public Resource).
- May 2016 orders allowing depredation take were vacated by US District Court in Washington DC
- USFWS didn’t fully evaluate impact of DCCO depredation (EA or EIS)

Cormorant Damage – October 2015

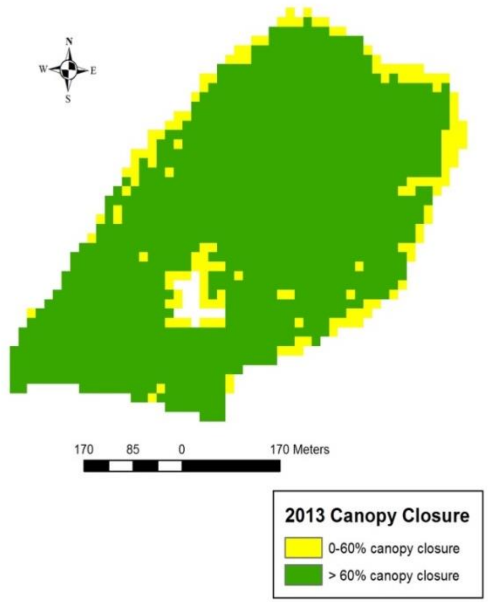
Turning Point

Sandusky River/
Sandusky Bay

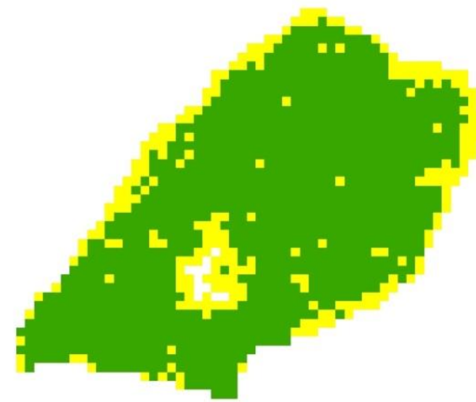
West Sister Vegetation Changes 2006-2013-2016



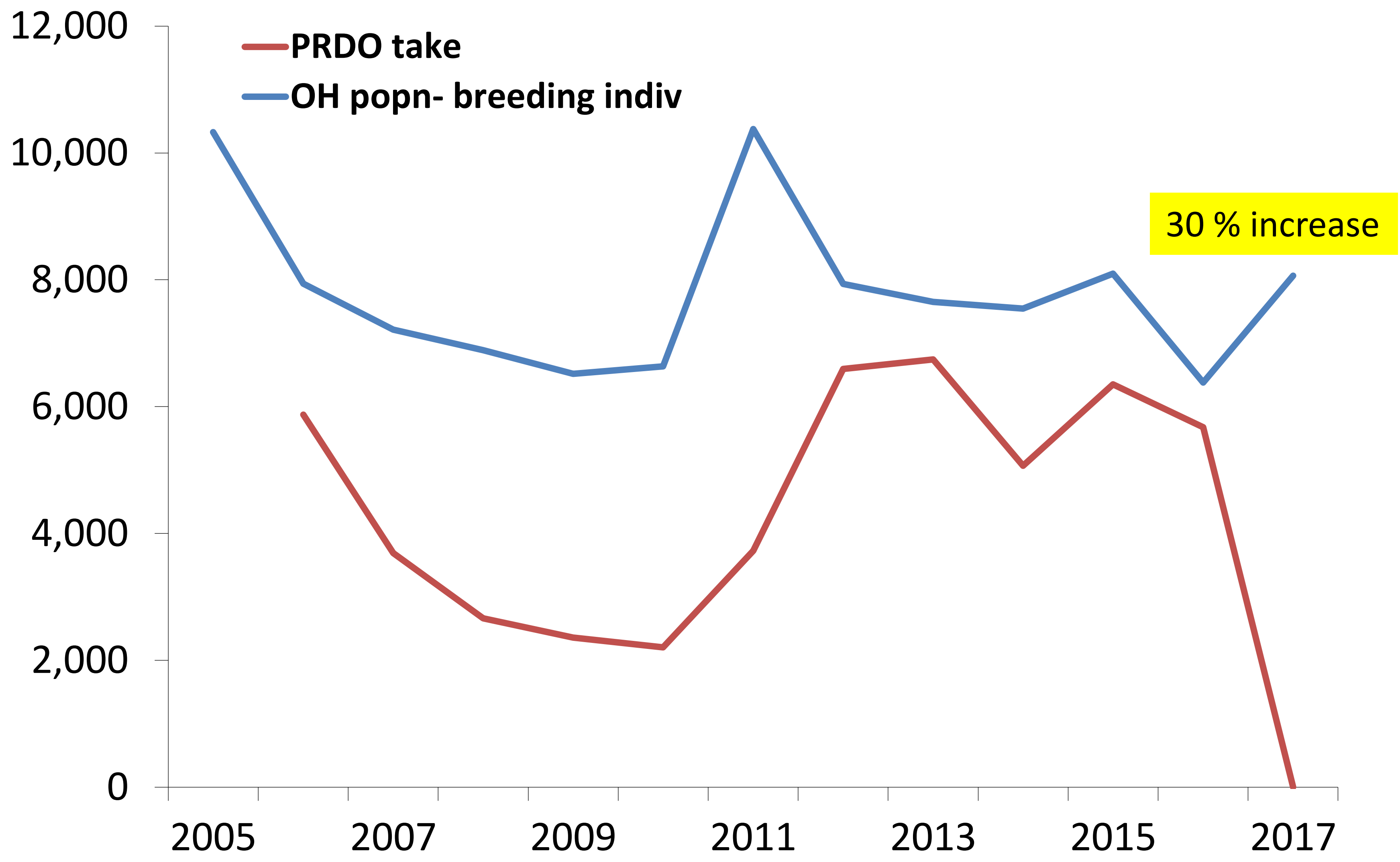
2006
245 canopy openings



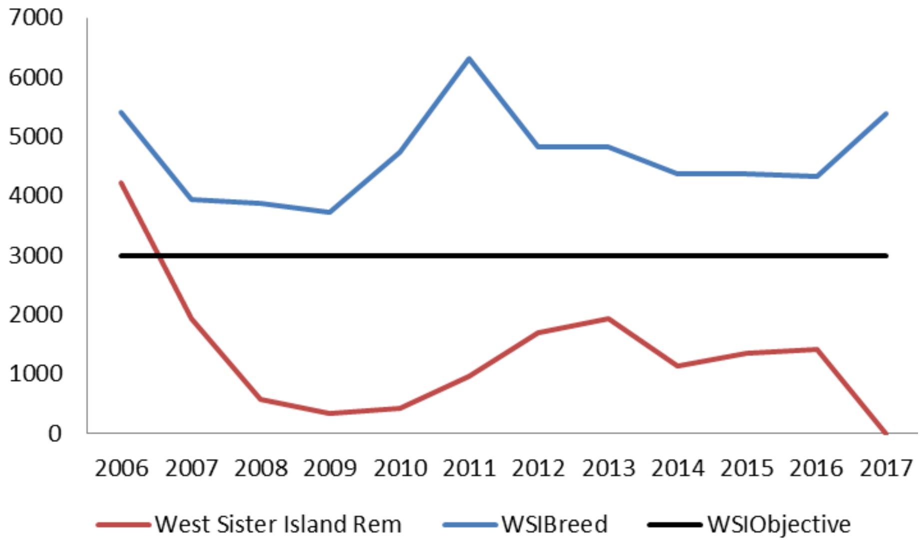
2013
150 canopy openings



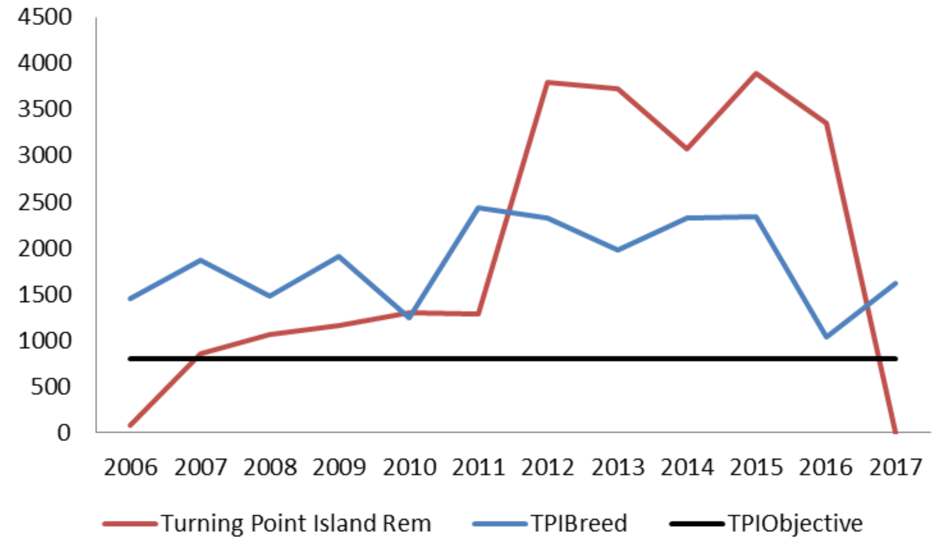
2016


12,000
10,000
8,000
6,000
4,000
2,000
0
PRDO take
OH popn- breeding indiv
30 % increase
2005
2007
2009
2011
2013
2015
2017

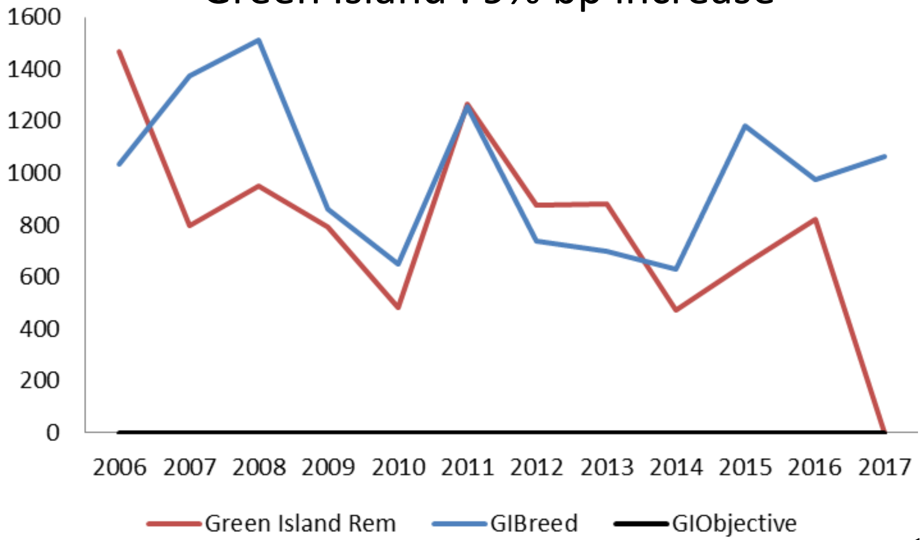
West Sister: 24% breeding population increase



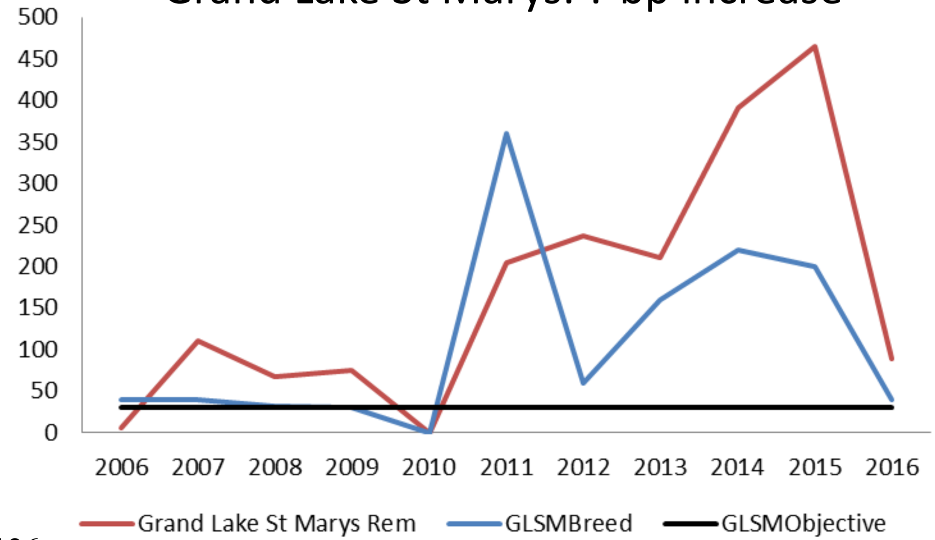
Turning Point: 56 % bp increase

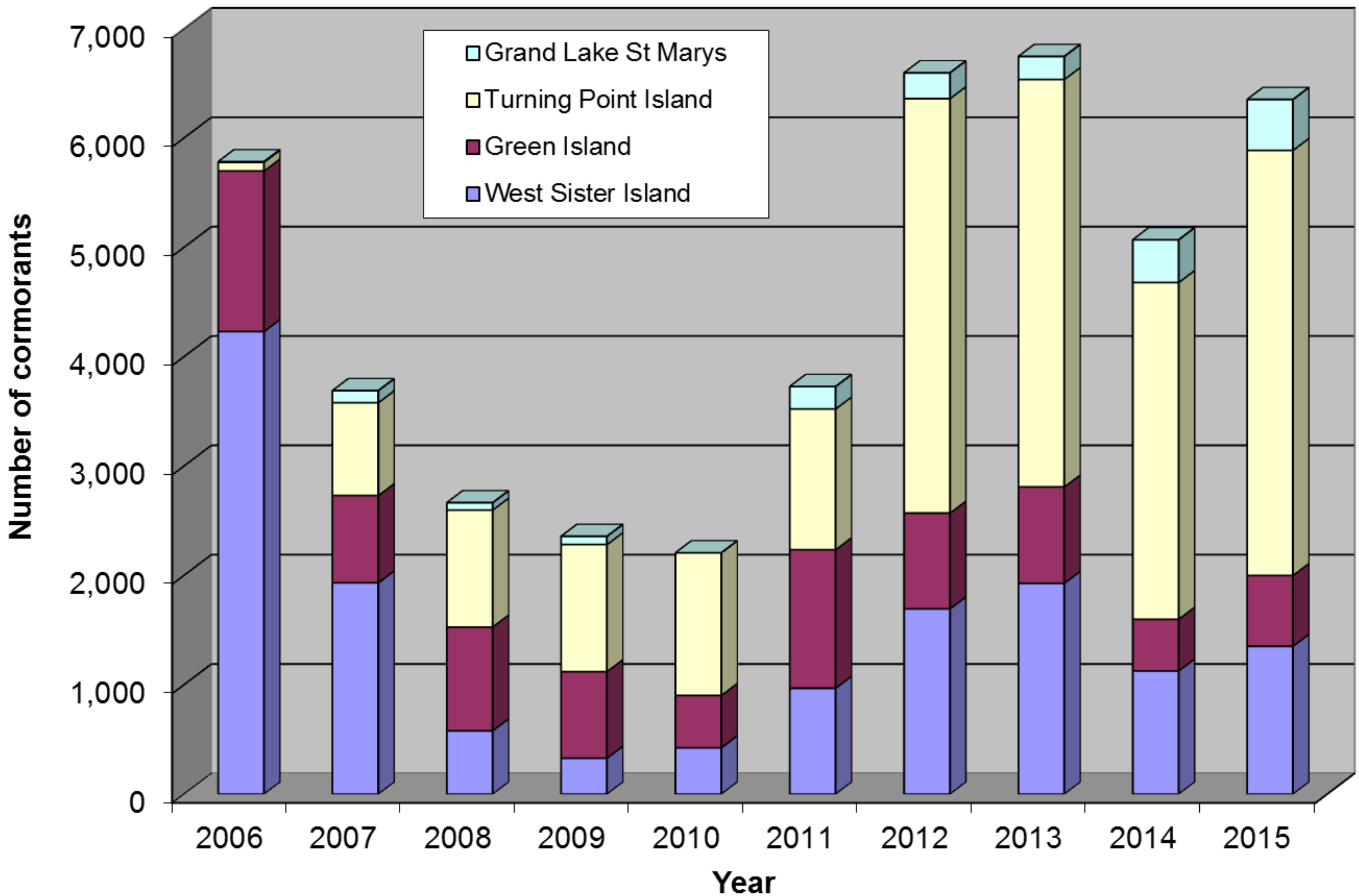


Green Island : 9% bp increase



Grand Lake St Marys: ? bp increase



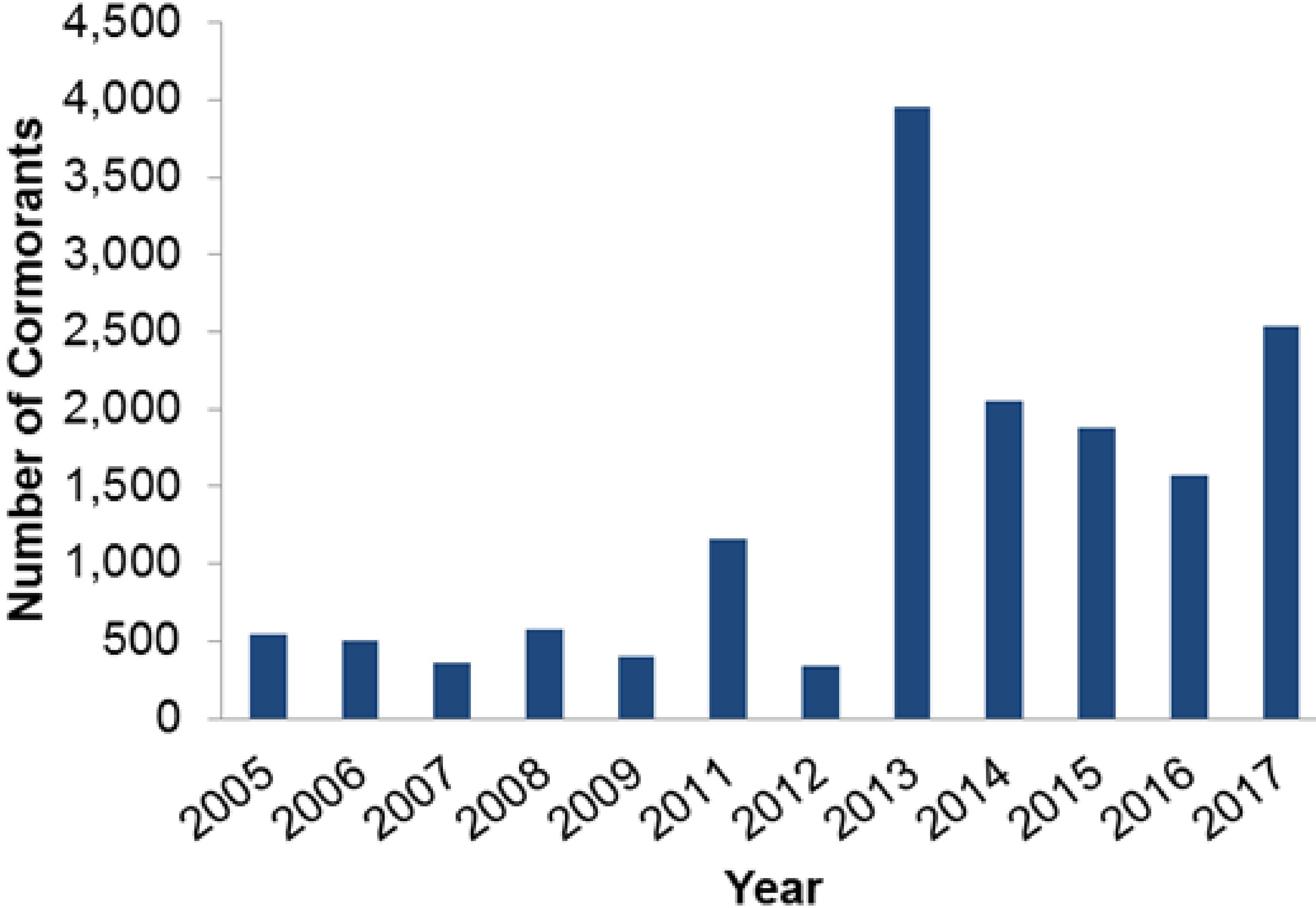


Grand Lake St Marys
Turning Point Island
Green Island
West Sister Island
Number of cormorants
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Year

DCCO Take @ Breeding Colonies

Year	West Sister Island	Green Island	Turning Point Island	Grand Lake St Marys	Year Total
2006	4,230	1,468	80	5	**5,783**
2007	1,932	798	849	110	**3,689**
2008	579	949	1,069	67	**2,664**
2009	328	792	1,162	75	**2,357**
2010	423	479	1,304	0	**2,206**
2011	968	1,267	1,287	205	**3,727**
2012	1,694	876	3,790	236	**6,596**
2013	1,928	881	3,726	211	**6,746**
2014	1,126	473	3,079	391	**5,069**
2015	1,352	647	3,888	465	**6,352**
2016	1,413	822	3,352	89	**5,676**
Total	**15,973**	**9,452**	**23,586**	**1,854**	**50,865**
3 Year Avg	**1,297**	**647**	**3,440**	**315**	**5,699**
Proposed	**2,000**	**1,000**	**1,550**	**50**	**4,600**

Inland Cormorant Population



Inland Cormorant Sites

- Increased by 105% between 2015 and 2016
- Increased by 318% in last 10 years
- Increasing in all of 5 Wildlife Districts
  - Colonies not yet developed in SE
  - 2017: locations, nests locations, birds:

Wildlife District	(N) Locations; Colonial Nests	(N) Locations; Number of Birds
1 (Central)	(2) 83	(11) 545
2 (Northwest)*	(3) 4,033	(2) 304
3 (Northeast)	(3) 180	(13) 657
4 (Southeast)	(0) --	(6) 165
5 (Southwest)	(1) 20**	(10) 865

Hatchery Production Issues…

- Cormorants!!!
  - Senecaville
  - St Marys

* Kincaid
* London

2015	2016	2017	2018
Seasonal Depredation	Seasonal Depredation	No Depredation	Seasonal Depredation?

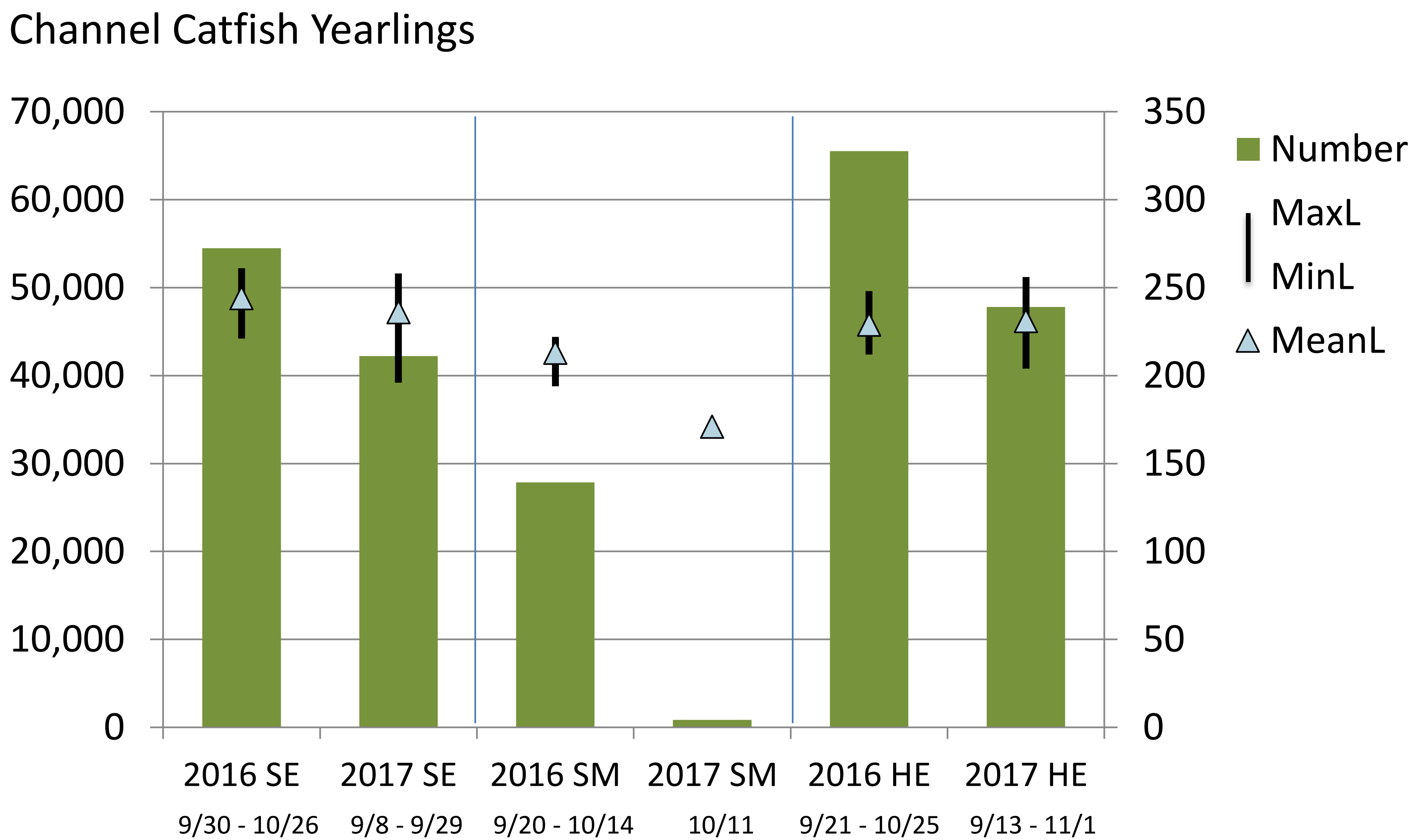
Losses Due to Cormorants

- **Direct Losses from Predation**
  - **Muskellunge**
  - **Yellow Perch**
  - **Blue Catfish**
  - **Channel Catfish**

Ohio State Fish Hatchery estimated value of fish lost from cormorant predation, summer and fall 2017.

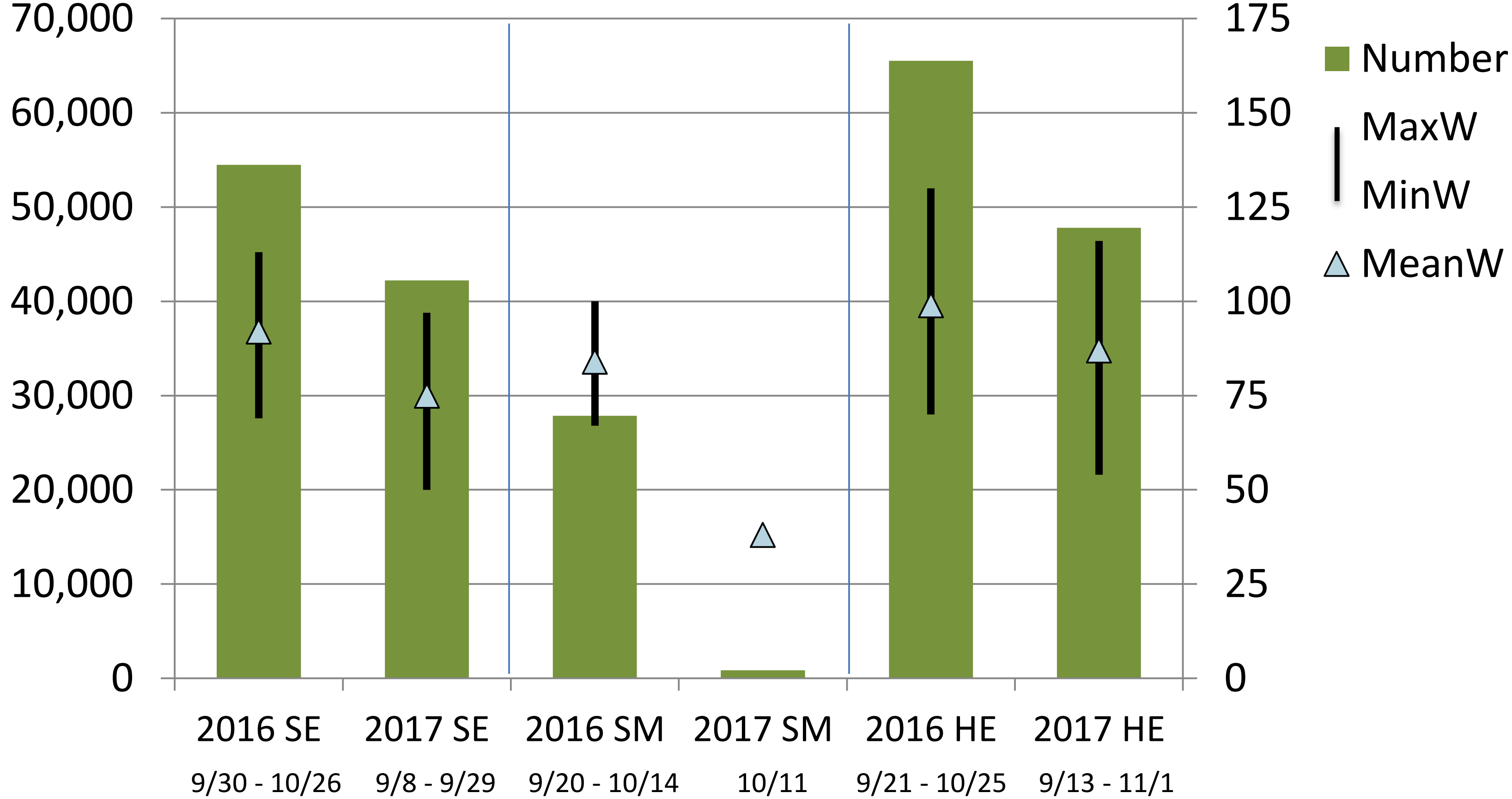
Species	Lifestage	Number fish lost	Approx value per fish	Total value lost
Channel Catfish	Fingerling	167,300	$0.35	$58,555
	Yearling	27,449	$1.00	$27,449
	Catchable	3,619	$1.81	$6,550
Blue Catfish	Fingerling	69,272	$0.45	$31,172
Muskellunge	Fingerling	4,997	$15.00	$74,955
Yellow Perch	Yearling	749	$1.00	$749
sum	all	273,386		$199,431

Losses Due to Cormorants

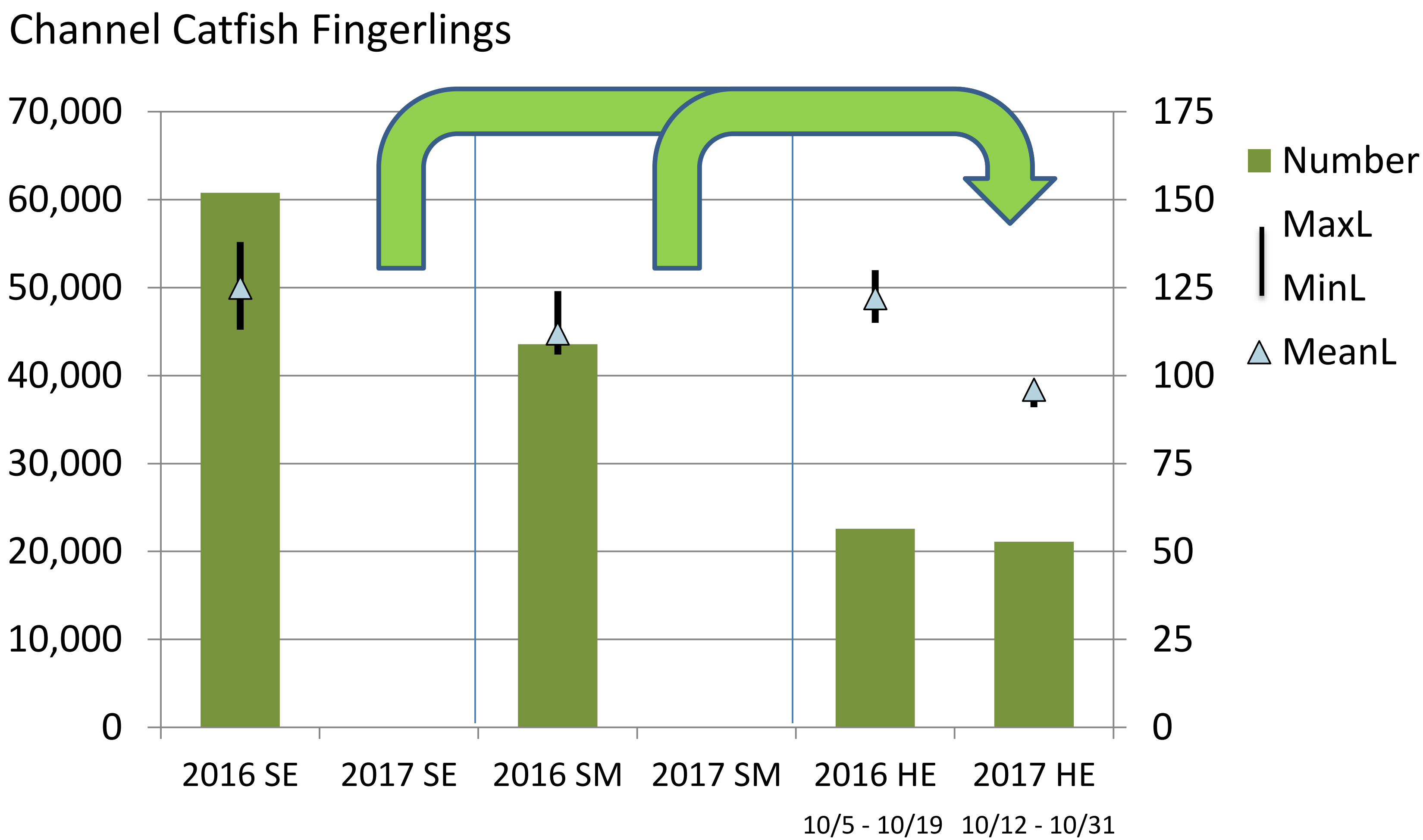


Losses Due to Cormorants

Channel Catfish Yearlings

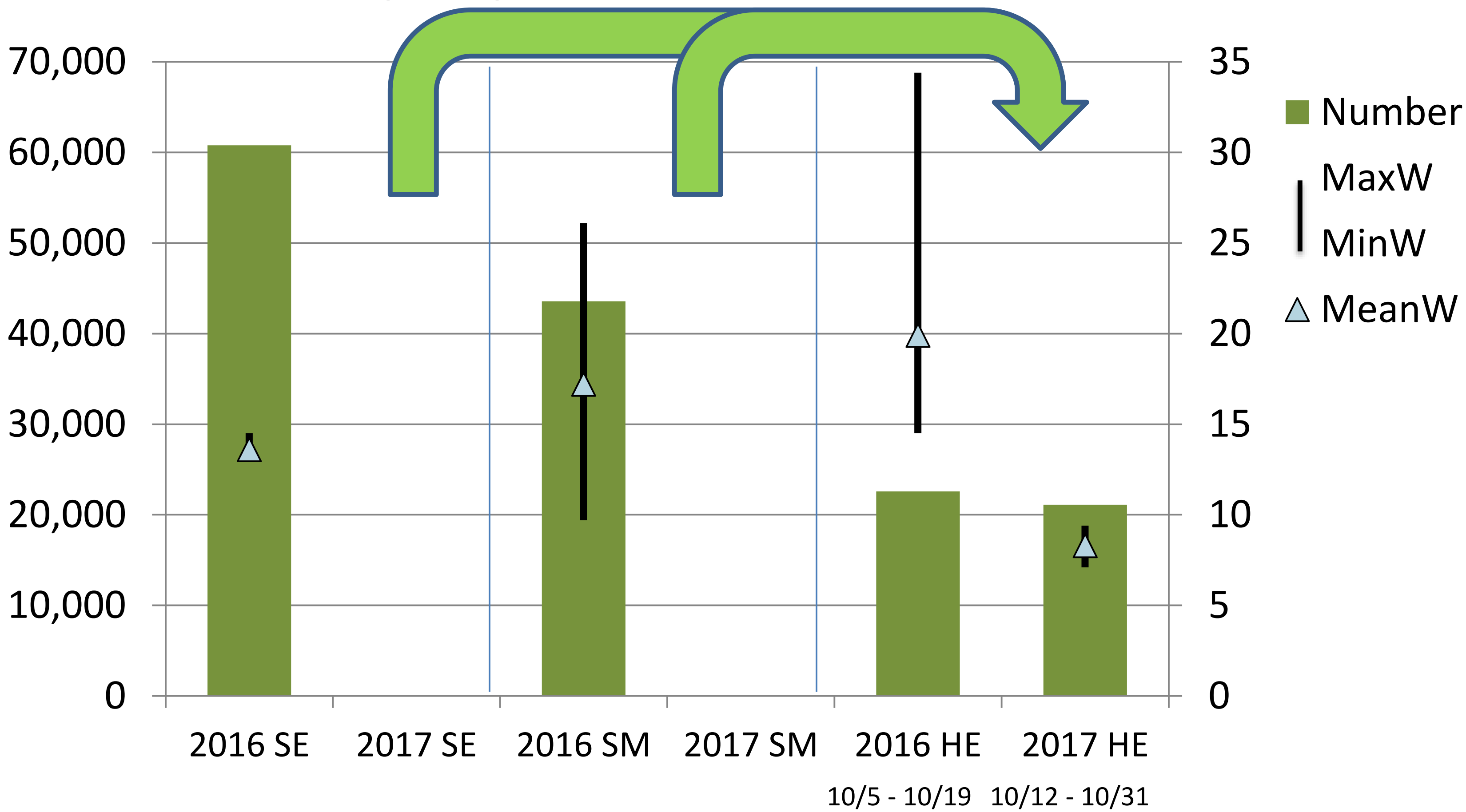


Losses Due to Cormorants



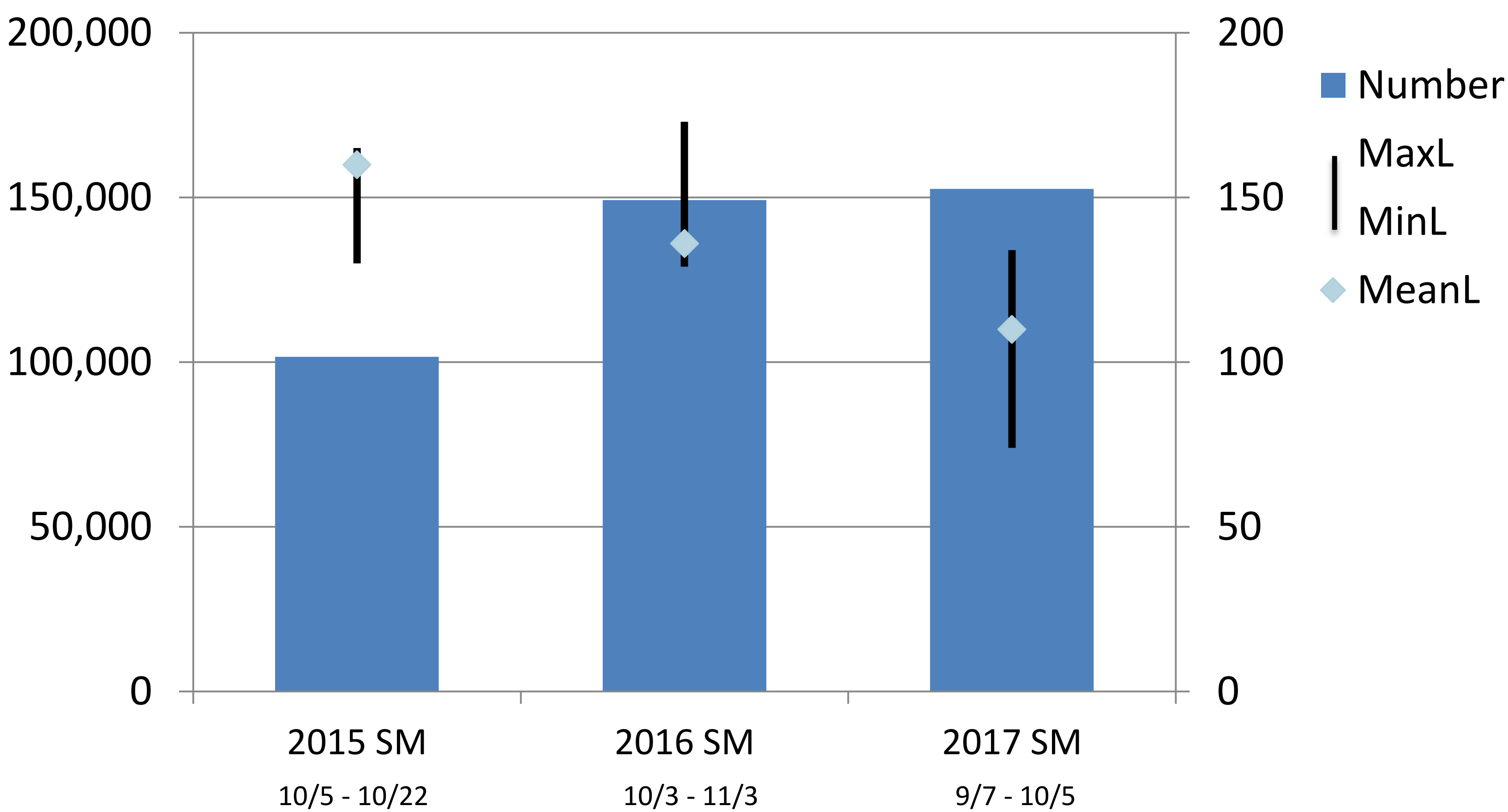
Losses Due to Cormorants

Channel Catfish Fingerlings



Losses Due to Cormorants

Blue Catfish Fingerlings



Ohio Aquaculture
Losses Due to Cormorants

- **Ohio Aquaculture Survey – OSU Piketon (Matthew Smith)**
  - 67% respondents had additional fish losses
  - 67% experiences increased DCCOs
  - Avg. fish loss @ ~6,000 fish per farm replying
  - $1500 avg loss by mortality
  - $9600 avg loss from reduced size
  - $6700 avg increase in costs - efforts to harass
- Small sample size

Cormorant Control Resumes

- FONSI issued Oct 25 2017; changes warranted going forward
- USFWS and USDA WL Services/APHIS are issuing bird depredation permits again
- Reduced DCCO take numbers expected; combining PRDO and AQDO in Ohio
- Closer monitoring and reporting
- 5,192 for Ohio; 18K for region

DCCO Take Allowances
State Fish Hatcheries

		DCCO Permit Allowance		
Hatchery	**County (Dist)**	**Previous**	**2018**	**Desired**
Castalia	Erie (2)	0	0	0
Hebron	Licking (1)	30	30	50
Kincaid	Pike (5)	6	6	10
London	Madison (1)	10	10	10
Senecaville	Guernsey (4)	40	40	80
St Marys	Auglaize (5)	200	200	350
Total		286	286	500

Conclusions

- Federal Court order restricted DCCO depredation control in Ohio during 2016 and 2017
- Increases in DCCO populations and nesting were recorded
- Harassing DCCO had little effect for lots of effort
- Losses were seen in Ohio State Fish Hatchery and Ohio private aquaculture operations
- Fish behavior and growth were affected
- Depredation orders have been reinstated at reduced numbers after EA FONSI, court release

DCCOs

- Open forum
- Other agency's issues?

THE OHIO STATE UNIVERSITY
COLLEGE OF PUBLIC HEALTH

DEPARTMENT OF EVOLUTION, ECOLOGY, AND ORGANISMAL BIOLOGY

THE OHIO STATE UNIVERSITY
EVOLUTION, ECOLOGY AND ORGANISMAL BIOLOGY
AQUATIC ECOLOGY LABORATORY

THE OHIO STATE UNIVERSITY
College of Food, Agricultural, and Environmental Sciences

Harmful Algal Blooms: Potential Impacts on Fish & Human Health in Lake Erie

Stuart A. Ludsin

Monetary Support

OhioHigherEd
Department of Higher Education

THE OHIO STATE UNIVERSITY
College of Arts and Sciences

OHIO DEPARTMENT OF NATURAL RESOURCES DIVISION OF WILDLIFE

SPORT FISH RESTORATION

Background: Harmful Algal Blooms (HABs)

- Lake Erie is becoming more eutrophic (Scavia et al. 2014)
  - Cyanobacteria blooms are larger & more frequent


HealthyLakes.org


Reuters

MI Sea Grant

Background: Harmful Algal Blooms (HABs)

- Cyanobacteria blooms threaten ecosystem services
  - Clean & potable water
  - Safe beaches for swimming
  - Tourism & property values
  - Fisheries

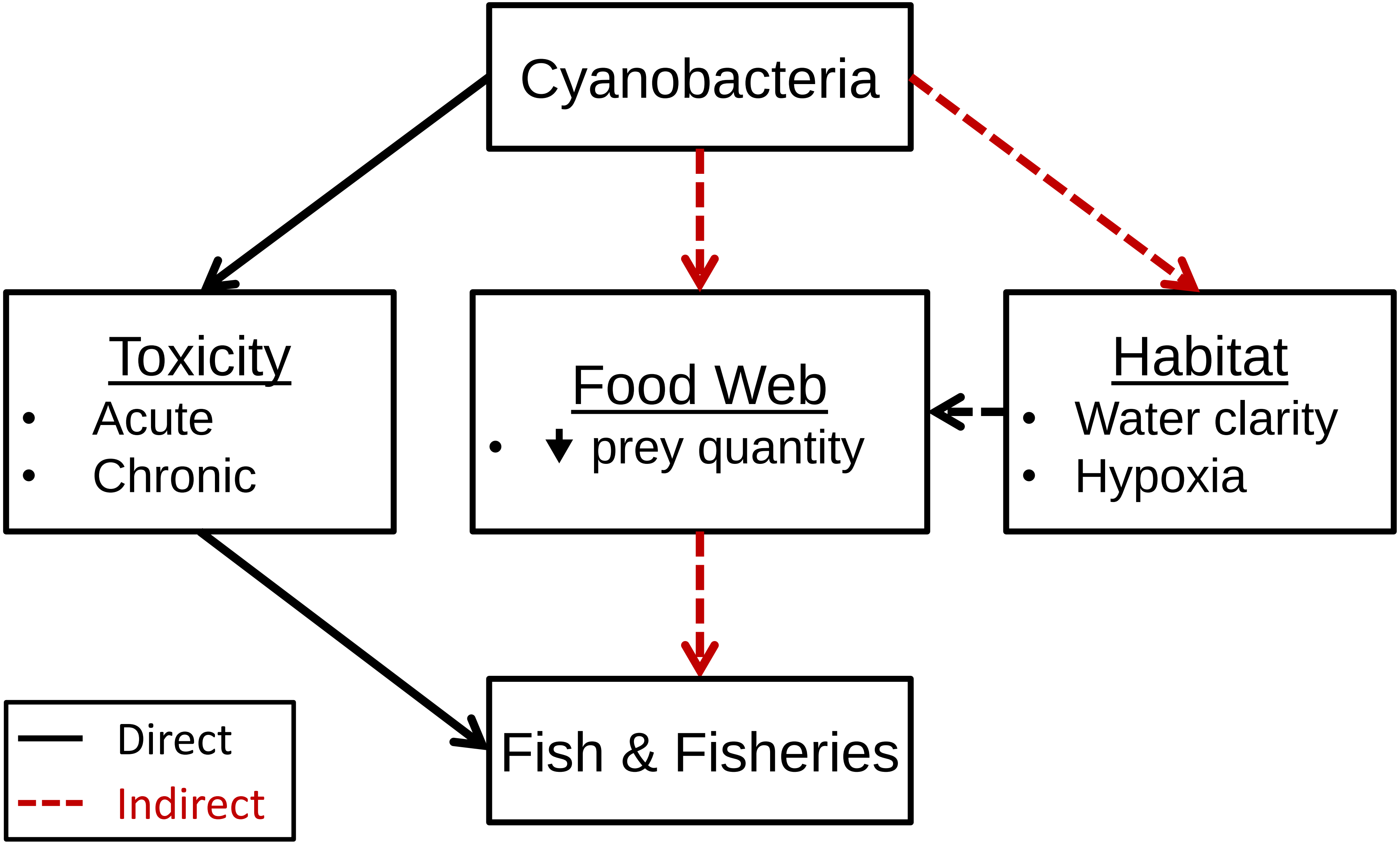
Courtesy of Peter Essick

greatlakesecho.org

Driven by Climate Change, Algae Blooms Behind Ohio Water Scare Are New Normal

Climate change and increased runoff are triggering more potentially toxic blooms.

Question 1: Indirect & Direct Effects of HABs

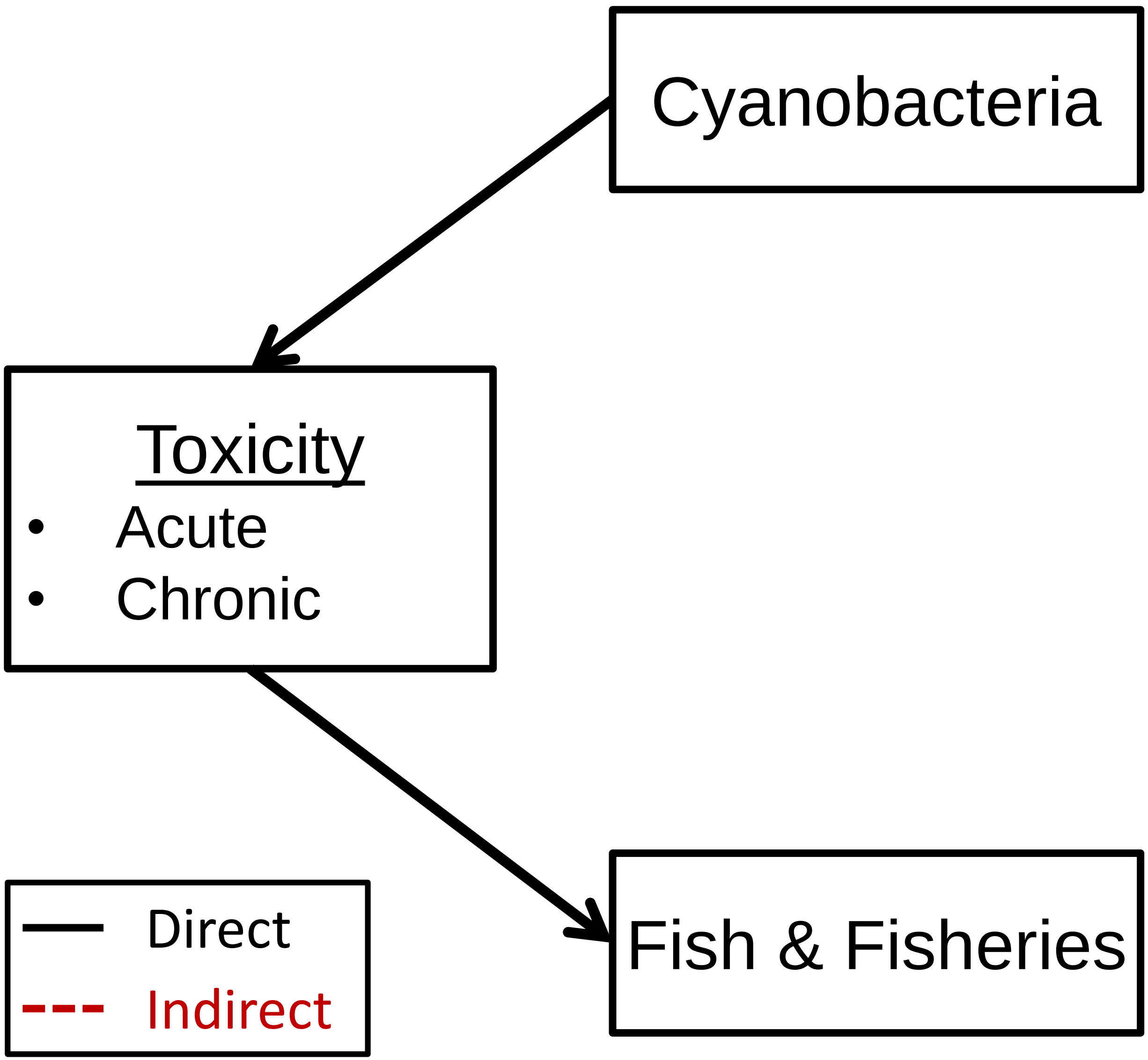


Central Questions

Question 1: Are HABs negatively affecting fish health in Lake Erie?

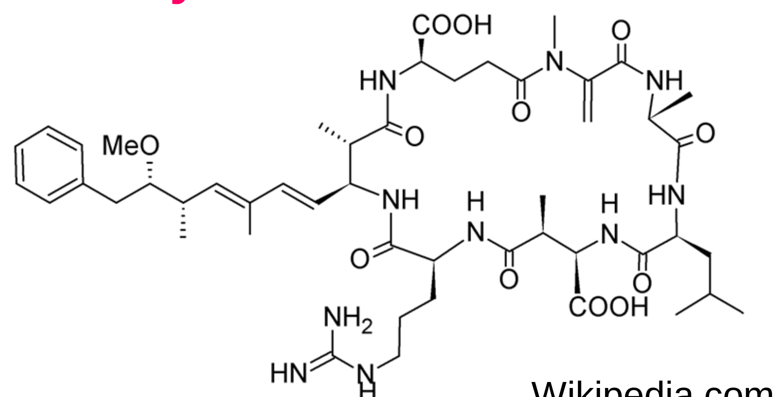
Question 2: Is consuming fish harvested during the HAB season a human health risk?

Question 1: Direct Effects of HABs on FIsh



- Cyanotoxins such as microcystin (MC)
  - Common in Lake Erie spp. (e.g., *Microcystis aeruginosa*)
  - Uptake via consumption & respiration (across gills)
  - Liver toxin that disrupts cellular control processes

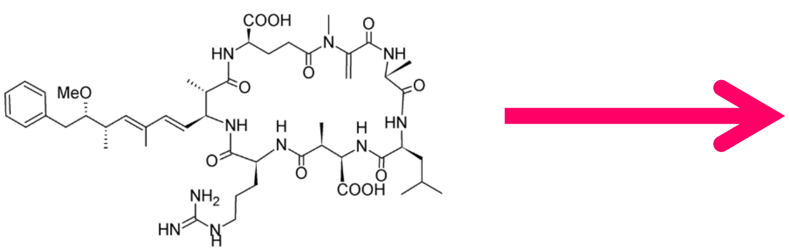
Microcystin L-R



Wikipedia.com

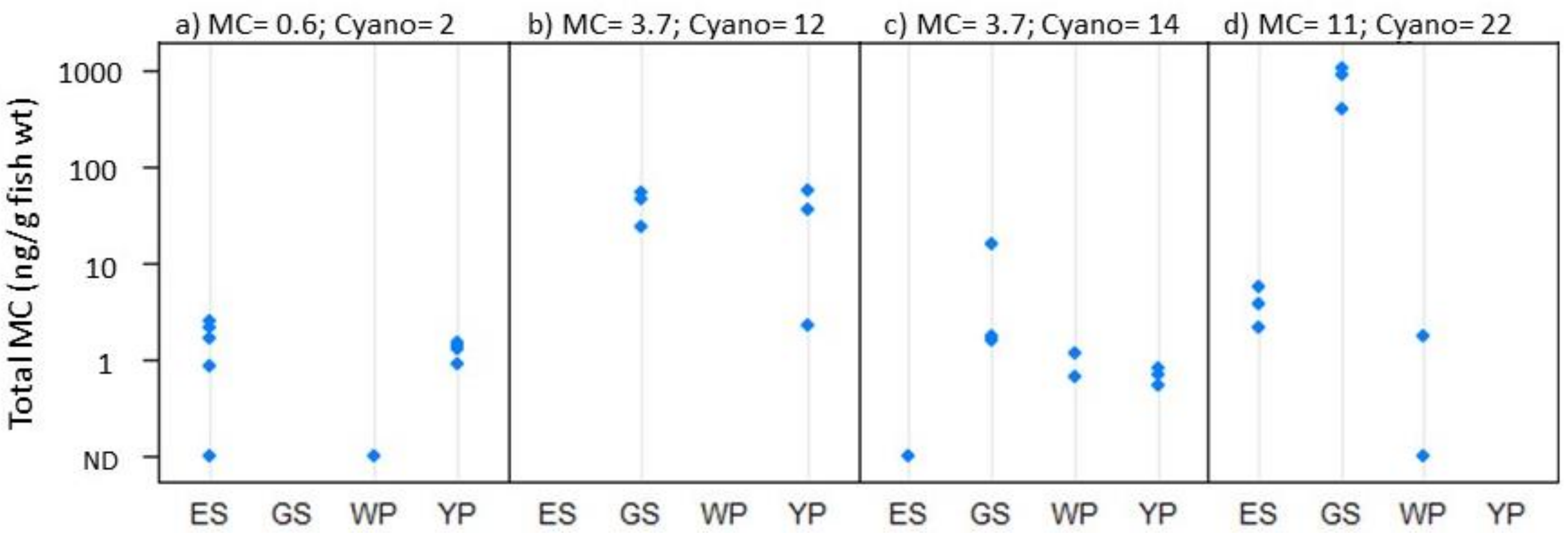
Question 1: Direct Effects of HABs on Fish

- Toxins produced by cyanobacteria can negatively affect fish, especially early life stages
  (Malbrouk & Kestemount 2006, Pavagadhi & Balasubramanian 2013)
  - Documented effects on fish early life stages include:
    - Altered embryonic hatching time (early & late)
    - Changes to yolk sac, head size, body & tail development, liver/heart functionality
    - Reduced growth & survival rates
    - But, embryos may have detoxification enzymes that offer some protection, which doesn't exist in later life stages



Question 1: Direct Effects of HABs on Fish

- Little is known about vulnerability of Lake Erie fishes to cyanotoxins (virtually no research conducted)
  - Some evidence to indicate that adult walleye & yellow perch, as well as their prey, are being exposed to MCs



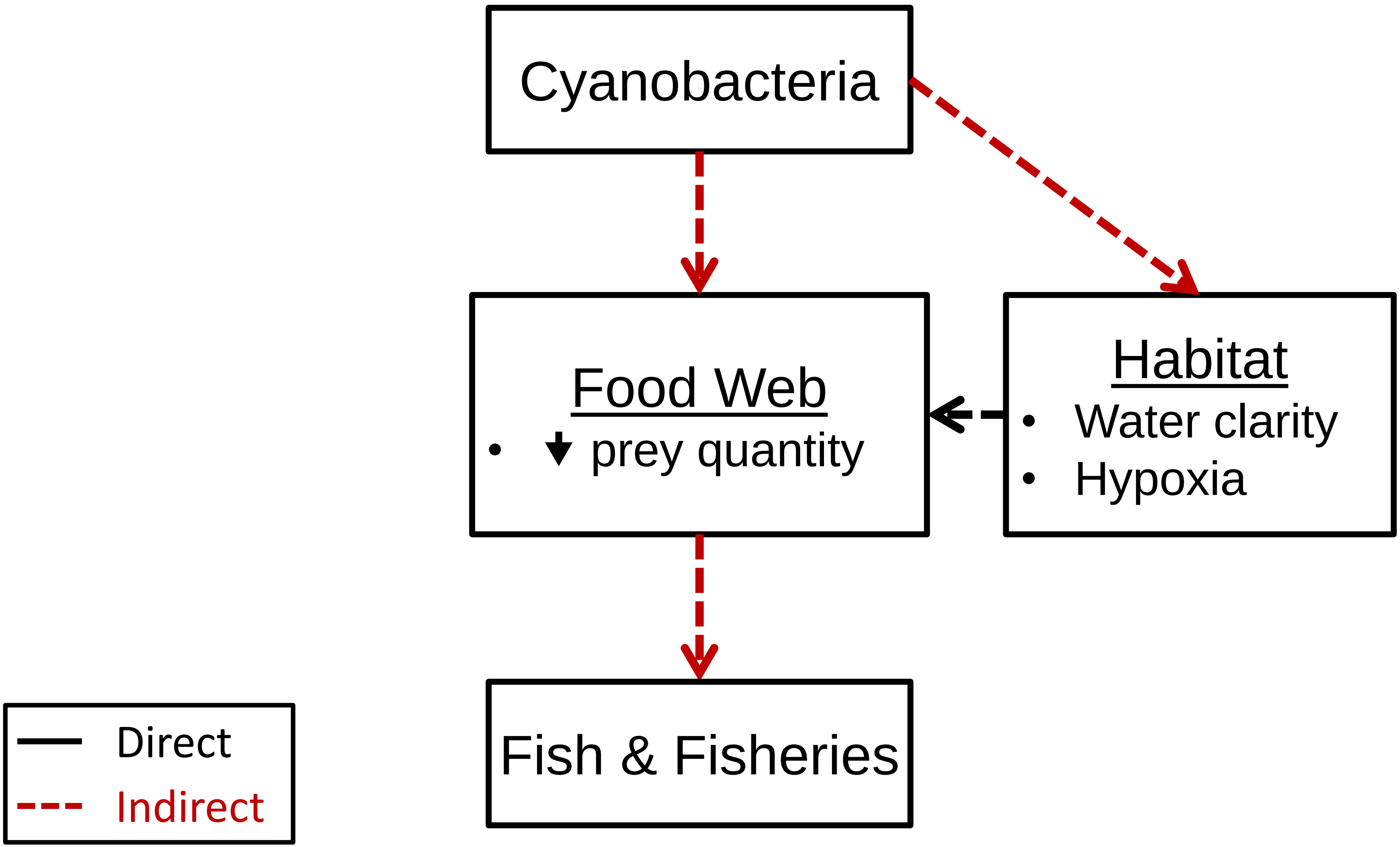
ES = 1+ Emerald Shiner; GS = YOY Gizzard Shad; WP = YOY White Perch; YP = YOY Yellow Perch

Briland, Manubolu & Ludsin, unpub. data

Question 1: Direct Effects of HABs on Fish

- Little is known about vulnerability of Lake Erie fishes to cyanotoxins (virtually no research conducted)
  - Some evidence to indicate that dult walleye & yellow perch, as well as their prey, are being exposed to MCs
  - Laboratory studies unrealistic at times
    - Unrealistic exposure pathways (injection, artificial food)
    - Unrealistically high exposure levels at times (0-15 mg/L)
      - Most blooms are 5-10 ug/L (highest level was 56 ug/L)
    - Different species used (mostly zebrafish & salmonines)
  - Ohio Department of Higher Education project (2018-2020)
    - Title: Physiological, growth and survival response of age-0 yellow perch and walleye to toxic cyanobacteria

Question 1: Indirect Effects of HABs of Fish



Question 1: Indirect Effects of HABs on Fish

- Cyanobacteria may reduce prey availability to fish
    1. Large size makes them “inedible” to ZP or impairs filtering efficiency ZP
    2. Cyanotoxins retard ZP growth & survival
    3. Low water clarity reduces planktivory by lowering foraging efficiency on ZP

Question 1: Indirect Effects of HABs on Fish

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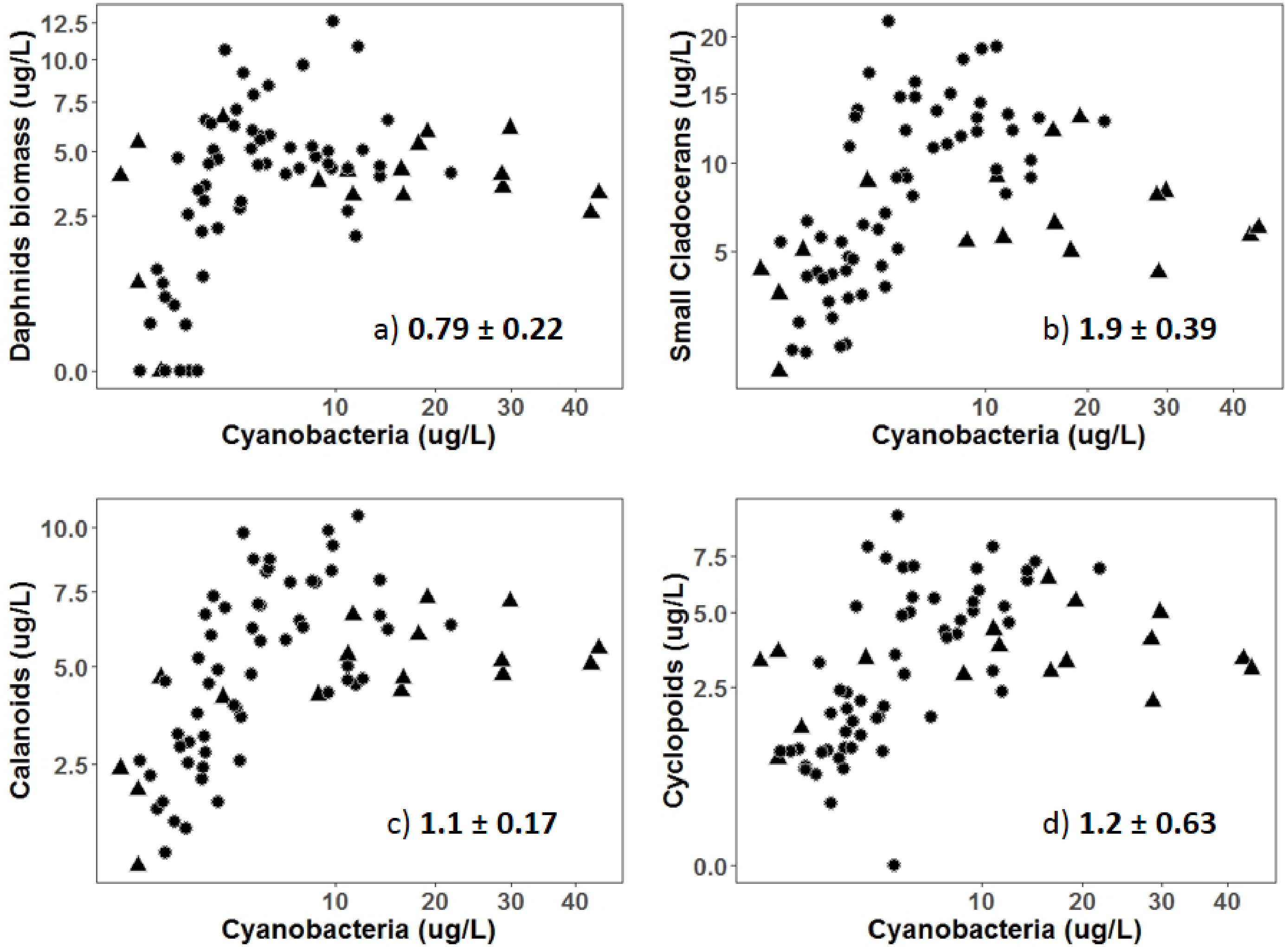
    2. Cyanotoxins retard ZP growth & survival
    3. Low water clarity reduces planktivory by lowering foraging efficiency on ZP
    - No consistent support exists for hypotheses 1-2
        - Species- and taxa-specific responses (Wilson et al. 2006, Tillmanns et al. 2008)

Question 1: Indirect Effects of HABs on Fish

- Zooplankton biomass is higher in HABs than outside



Briland & Ludsin, unpub. data

Question 1: Indirect Effects of HABs on Fish

- Cyanobacteria may reduce prey availability to fish
  1. Large size makes them "inedible" to ZP or impairs filtering efficiency ZP
  2. Cyanotoxins retard ZP growth & survival
  3. Low water clarity reduces prey intake by lowering foraging efficiency on ZP or spatial overlap
  - No consistent support exists for hypotheses 1-2
    - Species- and taxa-specific responses (Wilson et al. 2006, Tillmanns et al. 2008)
  - Little research into hypothesis 3
    - Juvenile yellow perch foraged inefficiently in simulated phytoplankton turbidity (not cyanobacteria) (Wellington et al. 2010)

Question 1: Indirect Effects of HABs on Fish

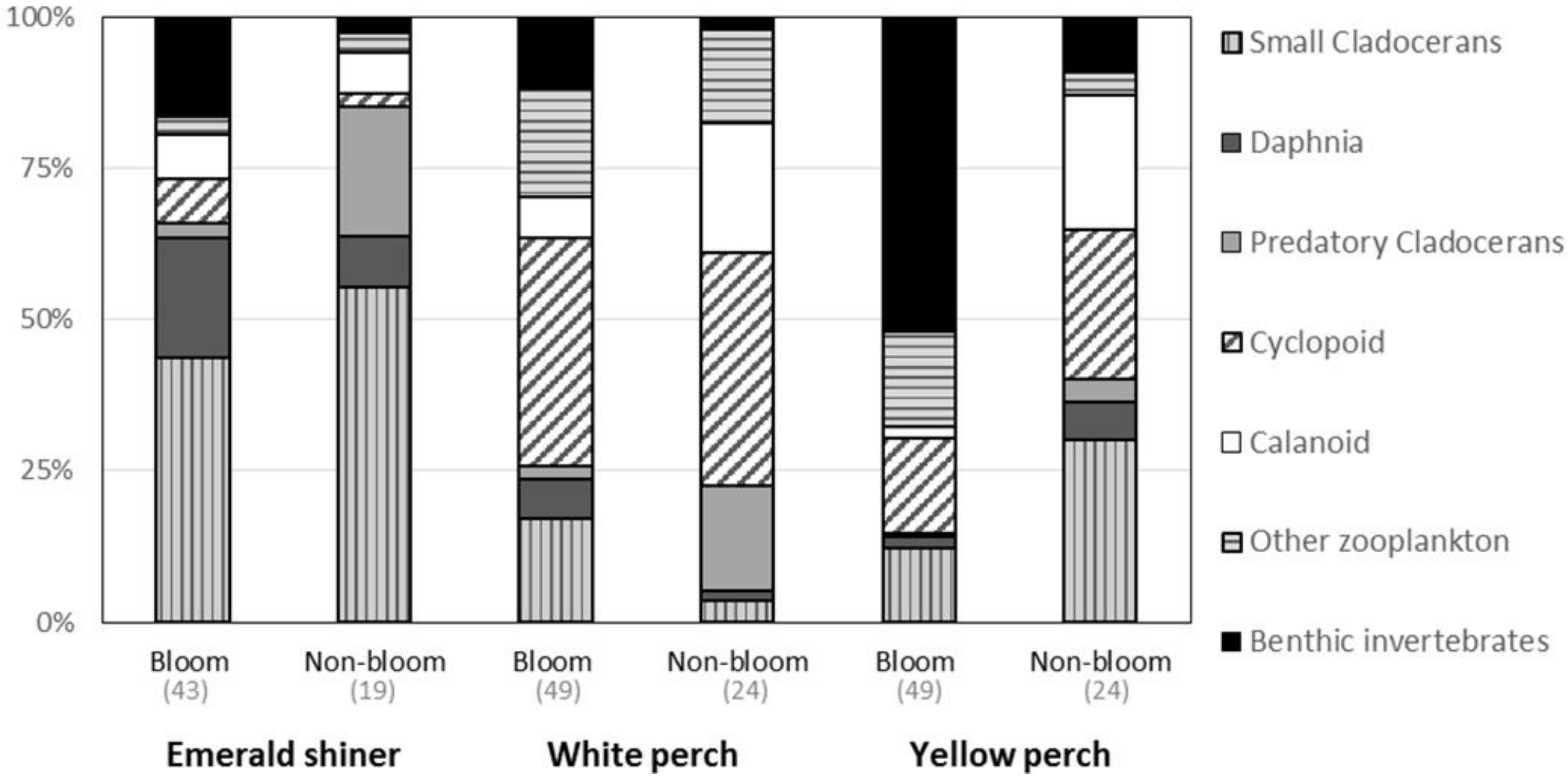
- Total consumption did not vary inside vs. outside of HABs (i.e., no relationship w/ cyanobacteria)

Taxa	Consumption (n_{fish})		
	Bloom	Non-bloom	β cyano ± SE
Adult emerald shiner	0.0154 (43)	0.0164 (19)	-0.08 ± 0.09
Age-0 white perch	0.0071 (49)	00067 (24)	0.05 ± 0.22
Age-0 yellow perch	0.0048 (49)	0.0045 (24)	0.05 ± 0.10

Briland & Ludsin, unpub. data

Question 1: Indirect Effects of HABs on Fish

- Diet selectivity did b/w bloom & non-bloom areas



- Health implications are unknown

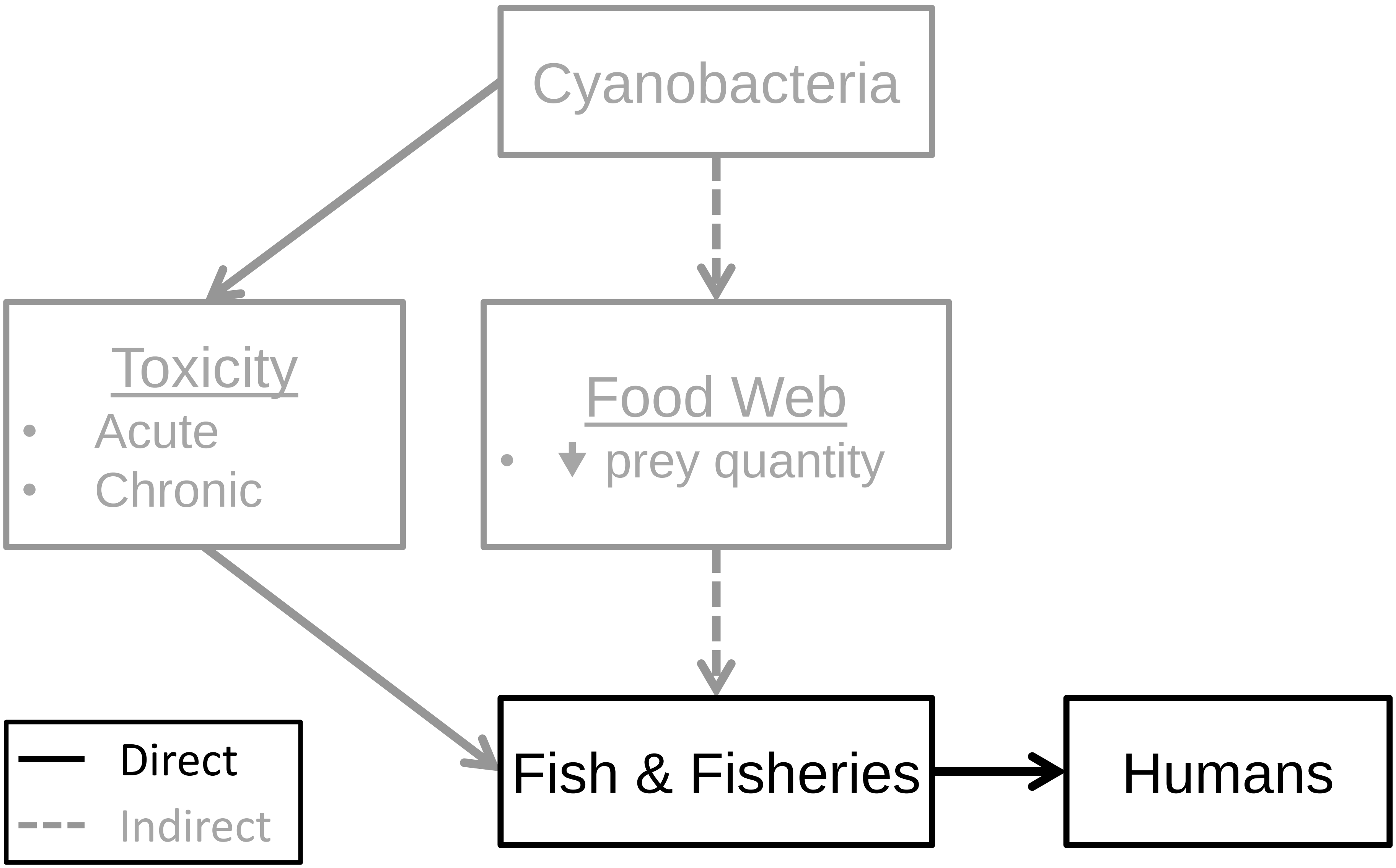
Briland & Ludsin, unpub. data

Central Questions

Question 1: Are HABs negatively affecting fish health in Lake Erie?

Question 2: Is consuming fish harvested during the HAB season a human health risk?

Question 2: Are Fish Safe to Eat during the HAB Season?



Question 2: Are Fish Safe to Eat during the HAB Season?

- Cyanobacteria produce many toxins that can harm humans
  - Liver, nervous system, skin, or body cells in general
- Microcystin (MC) is the most common (140 variants)
  - Can lead to liver cancer and liver necrosis at low doses
  - Death at high doses
- MCs are highly stable & toxicity is NOT reduced by boiling or cooking
  - Potentially can accumulate in edible fish tissues

Knowledge gaps:

1. Methods to measure reliable MCs in fish tissues
2. Measurements of fish tissue MCs across the HAB season

Question 2: Are Fish Safe to Eat during the HAB Season?

OhioHigherEd
Department of Higher Education

- Two projects designed to address these needs:
  - **Project 1:** "*Fish flesh and fresh produce as sources on microcystin exposure to humans*", 2015-2017.
  - **Project 2:** "*Development of the MMPB method for quantifying total microcystins in edible fish tissues*", 2016-2018.

General Project Goals

- Develop reliable methods to quantify MCs in fish tissue.
  - **Project 1:** Ultra-performance - liquid chromatography tandem mass spectrometry (UP-LC-MS/MS)
  - **Project 2:** 2-methyl-3-methoxy-4-phenylbutyric acid (MMPB)
- Quantify MCs in Lake Erie walleye & yellow perch before, during & after the cyanobloom season.

Question 2: Are Fish Safe to Eat during the HAB Season?

- Optimized UP-LC-MS/MS to quantify 8 MC variants
  - MC-RR, MC-LR, MC-YR, MC-LA, MC-LF, MC-LW, dsp-MC-RR & dsp-MC-LR
  - 94-98% MC-LR & MC-RR recover rates

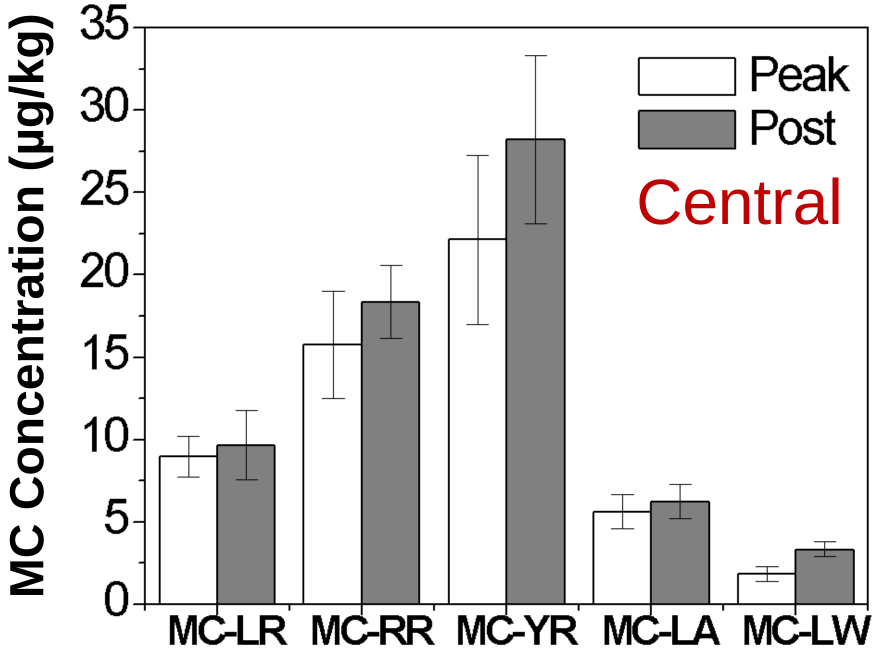
- Developed MMPB extraction & purification method to quantify total MCs prior to UP-LC-MS/MS
  - >95% recovery rate
  - Conducting inter-laboratory study to assess reliability

- Using these approaches to measure MCs in fish & estimate human health risk
  - Adult Lake Erie walleye & yellow perch, 2015-2017

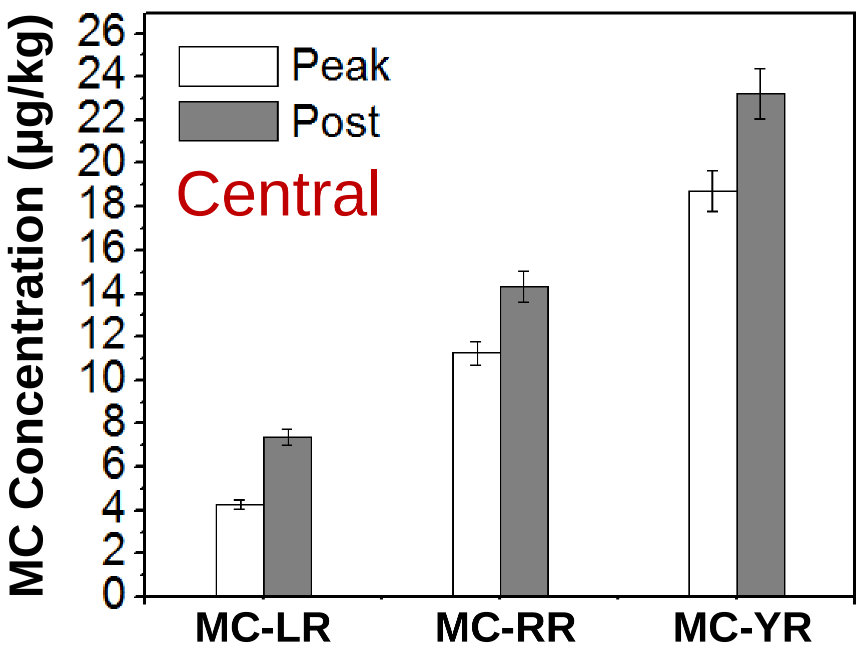
Question 2: Are Fish Safe to Eat during the HAB Season?

- MC-YR, MC-RR, and MC-LR were detected in yellow perch & walleye livers in central Lake Erie, peak and post-bloom.

Yellow Perch Livers



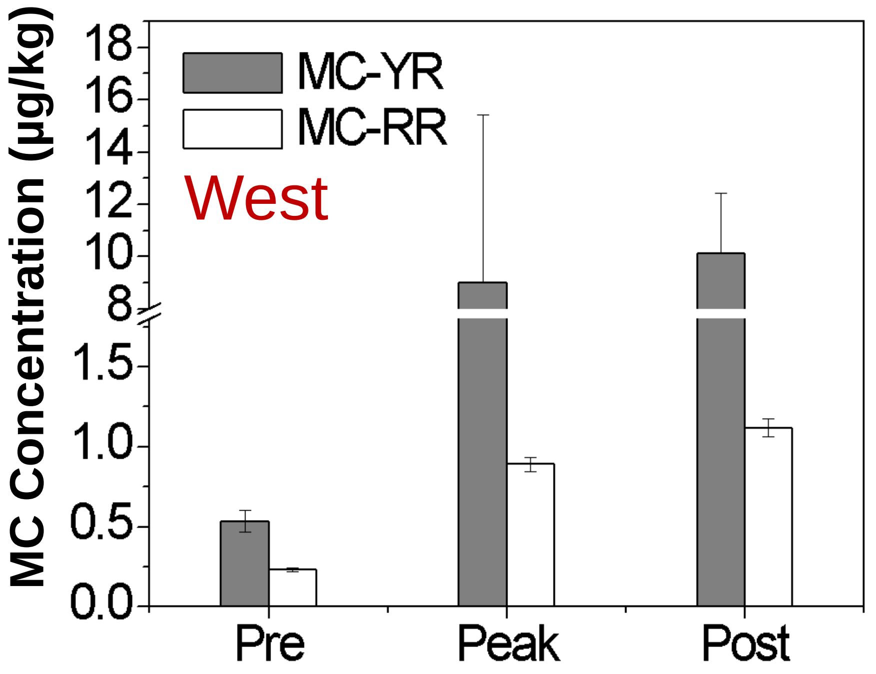
Walleye Livers

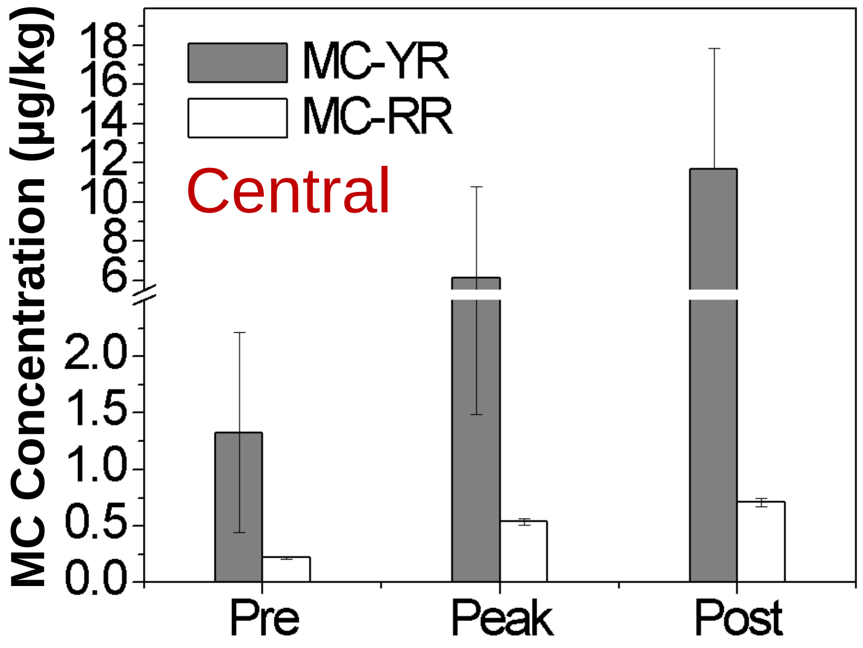


Question 2: Are Fish Safe to Eat during the HAB Season?

- MC-YR & MC-RR were detected in muscle tissues of yellow perch, but not walleye, in western & central Lake Erie

Yellow Perch Muscle Tissue





Question 2: Are Fish Safe to Eat during the HAB Season?

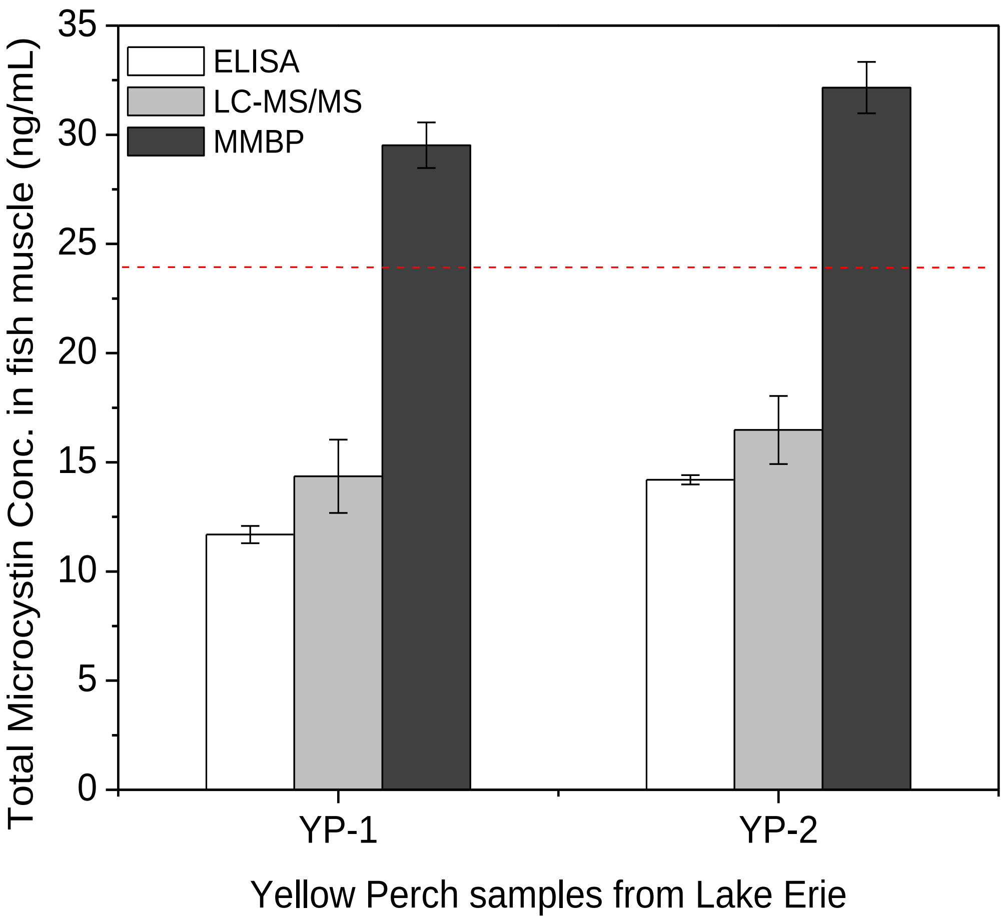
- World Health Organization set a tolerable daily intake (TDI) of 40 ηg MC-LR / g of body mass

- Thus, a typical 57.5 kg (127 lb.) person could consume up to 23 ηg MC-LR / day.

- Consuming a meal of $\leq$ 100 g (~0.22 lb.) of muscle / day would **not** exceed the established TDI
  - Based on the observed average MC level (11.68 ηg/g)
  - Based even on the maximum MC level (17.32 ηg/g, from a single yellow perch)
  - Sum of 8 congeners measured

Question 2: Are Fish Safe to Eat during the HAB Season?

- ELISA & LC-MS/MS underestimated total MCs by ≥ 50% in Lake Erie yellow perch



- Consuming a meal of ≤ 100 g (~0.22 lb.) of muscle / day would exceed the established TDI
  - If **total** MCs considered

Take-Home Messages

Question 1: Are HABs negatively affecting fish health in Lake Erie?

- Cyanotoxins are unlikely to directly negatively impact Lake Erie's "big" fisheries (percids, salmonines)
  - Vulnerable early life stages do not occur in summer

- But, prey species might be directly affected
  - Summer spawners such as shiners & freshwater drum
  - Phytoplanktivores such as gizzard shad

- One can only speculate on the indirect effects of HABs
  - Potential for cyanobacteria to limit percid production via food web effects seems plausible
  - Will explore potential impacts on age-0 juvenile percids (ODHE)

Take-Home Messages

Question 2: Are fish harvested during the HAB season safe to eat?

- ❖ State of Ohio now has the capacity to quantify MCs in fish
  - – Individual MC congeners & total MCs
- ❖ Eating Lake Erie fish during the HAB season appears safe based on UP-LC-MS/MS (8 congeners):
  - – If Ohio EPA fish consumption guidelines are followed:
    - - Walleye (1 meal per week)
    - - Yellow perch (2 meals per week)
- ❖ However, preliminary data suggest total MCs exceed TDIs
  - - Are these additional congeners a health risk?
- ❖ Given so little is known about HAB impacts on fish & human health risk in Lake Erie, we recommend continued research & monitoring

Thanks for your attention!

The Ohio State University
Evolution, Ecology, & Organismal Biology

Aquatic Ecology Laboratory

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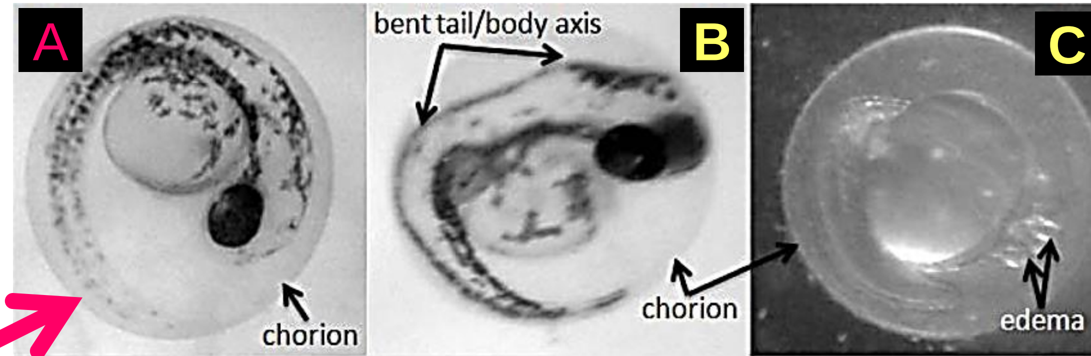
Cyanobacteria effects on fish: direct

Microcystis aeruginosa natural bloom extract on the embryonic & larval development of the zebrafish (*Danio rerio*)

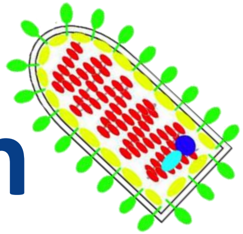


[redacted]

A: control (56 h)
B: treated embryo (56 h)
C: treated embryo (56 h)
D: control (84 h)
E: pre-exposed larvae (146 h)
F: pre-exposed larvae (98 h)
G: pre-exposed larvae (84 h)
H: pre-exposed larvae (98 h)

Ghazali et al. (2009)

G³ - Genetics & Genomics Group
NOAA Pacific Marine Environmental Lab



Latest VHS Research & Techniques: Evolutionary & Ecological Patterns Over Time & Space

NOAA Pacific Marine Environmental Laboratory

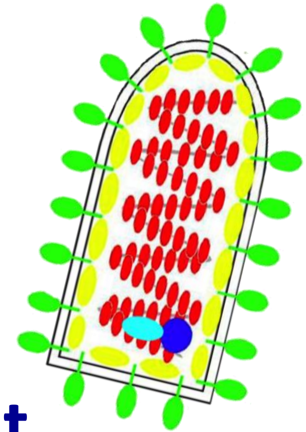
Department of Environmental Sciences

THE UNIVERSITY OF TOLEDO 1872

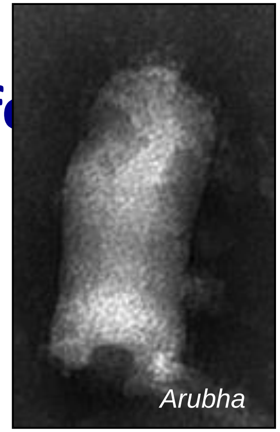
Megan Niner & Carol Stepien
February 7th, 2017

Viral Hemorrhagic Septicemia virus (VHSv)

- Novirhabdovirus
- 11,158 nt
  - 6 genes
  - 3'*N*-*P*-*M*-*G*-*Nv*-*L*5'
- World's most important finfish diseases
  - OIE (World Organization f
    Animal Health)
- Hemorrhages
- Globally infects >80 fish species



A. Pore 2008



Arubha

M. Faisal, MSU

Wisconsin Department of Natural Resources

VHSv Characteristics & Spread

Ecology:

- Stable 3-15ºC in water
- Survives up to 14 days in water out of host
- Infected fish shed virus ≤15 weeks

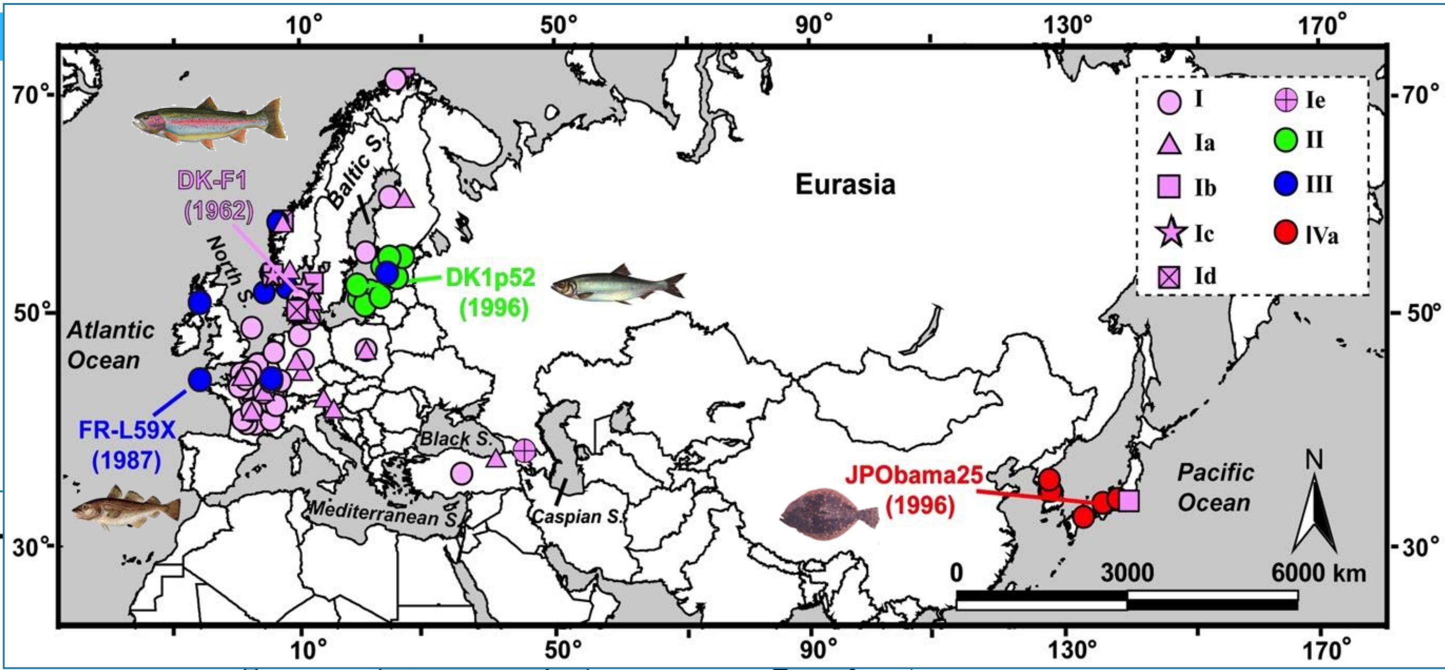
Transport:

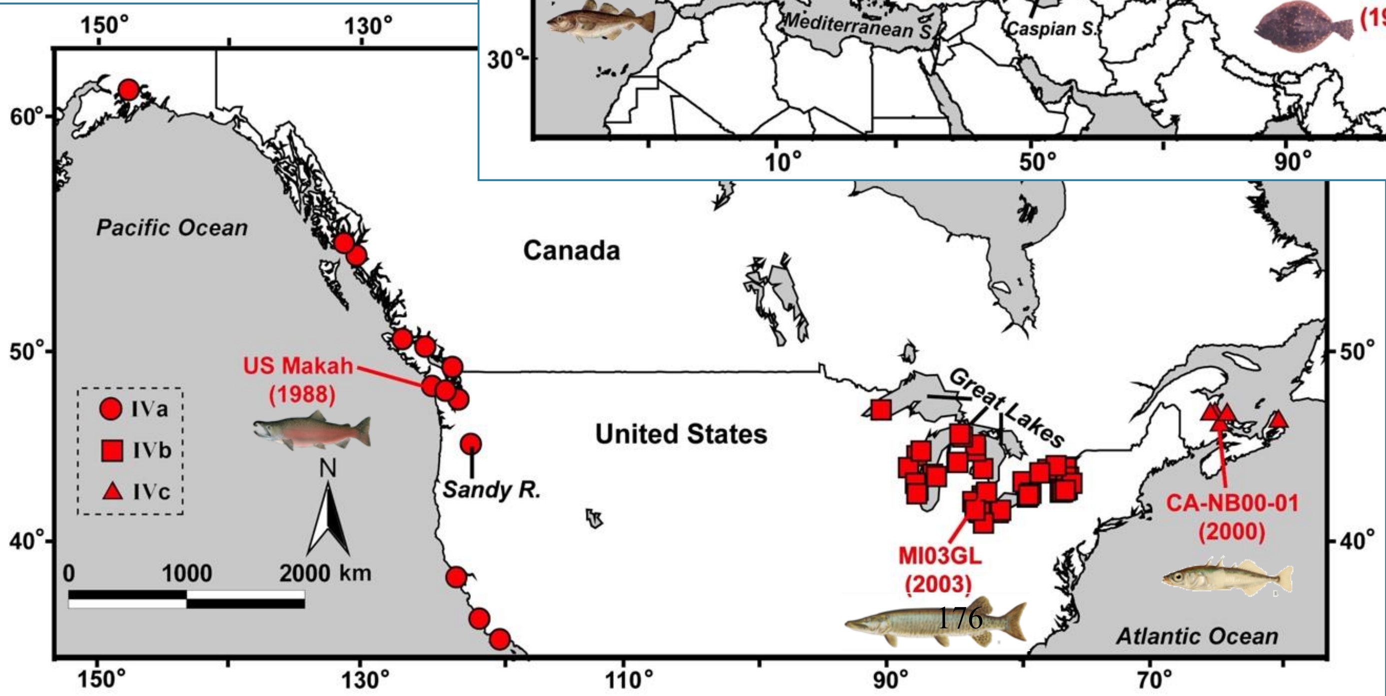
- Fish migration (spawning)
- Human activities
- Invertebrates, birds
- Aquaculture

VHSv: A Global Perspective

Four distinct genotypes (I, II, III, IV)

(Dates=first known occurrences)

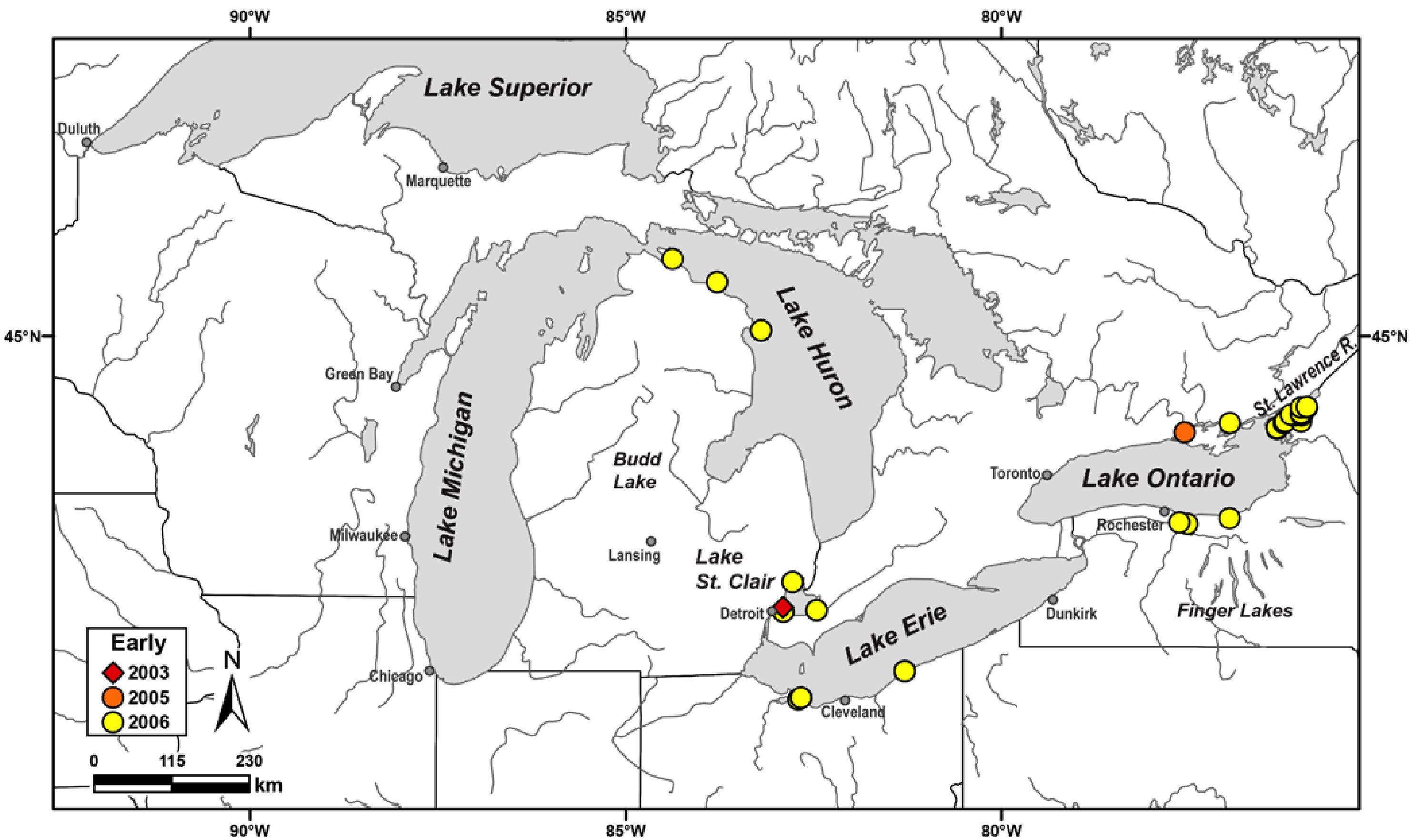




Three geographically separated substrains (IVa, b, c)

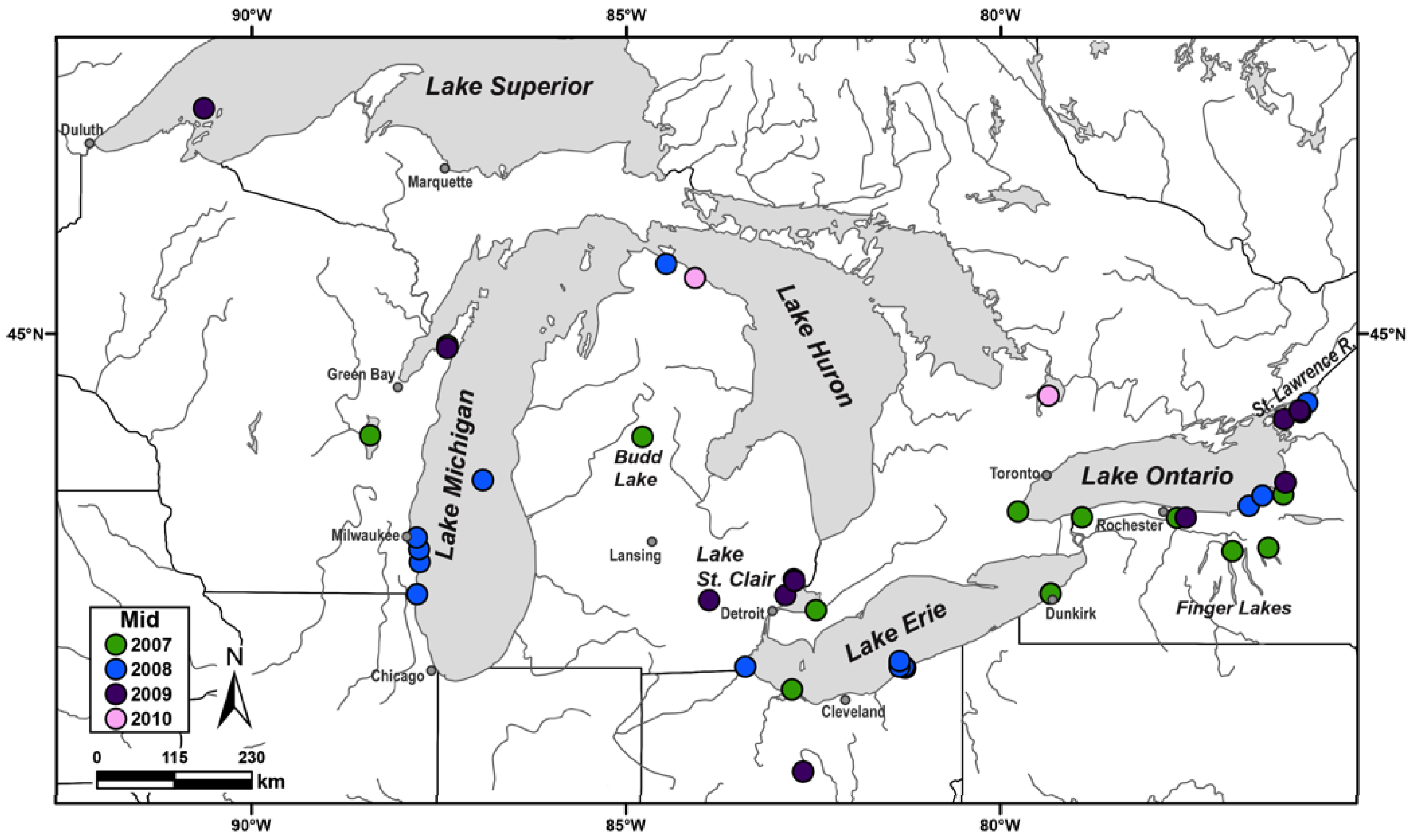
Pierce & Stepien 2012 Mol Phyl Evol, Stepien … Niner et al. 2015 PloS ONE

VHSv-IVb Spread in the Great Lakes



Pierce & Stepien 2012, J. Sieracki et al. 2014, Cornwell et al. 2015, Stepien et al. 2015 & Niner & Stepien (in progress)

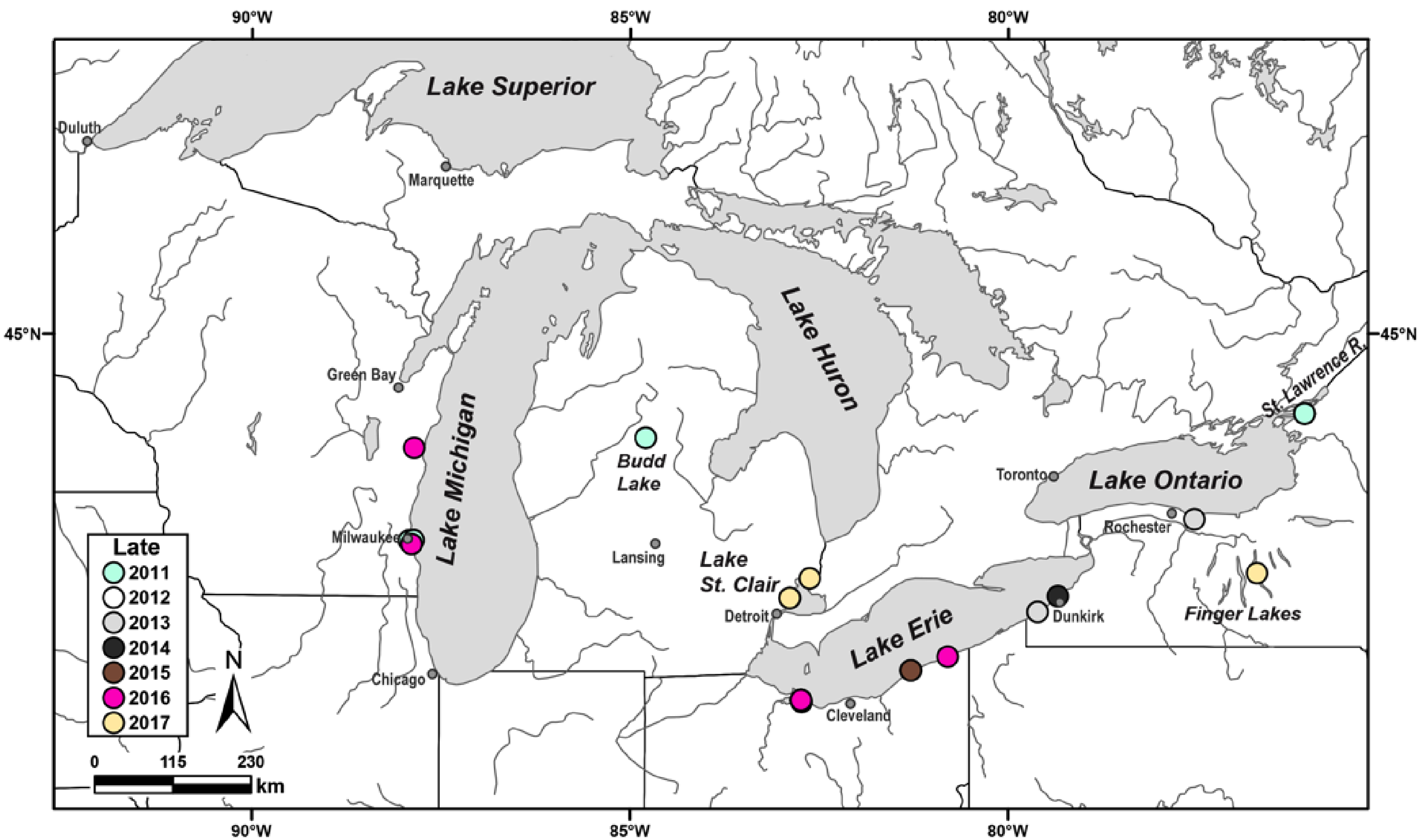
VHSv-IVb Spread in the Great Lakes



178

Pierce & Stepien 2012, J. Sieracki et al. 2014, Cornwell et al. 2015, Stepien et al. 2015 & Niner & Stepien (in progress)

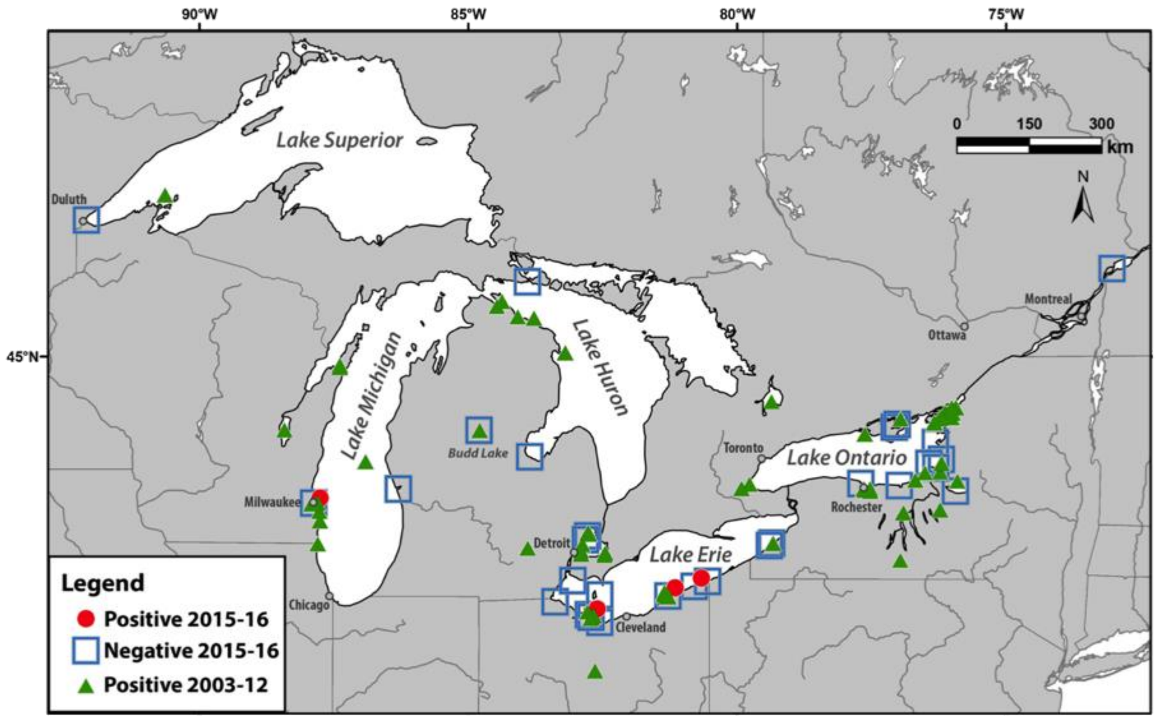
VHSv-IVb Spread in the Great Lakes



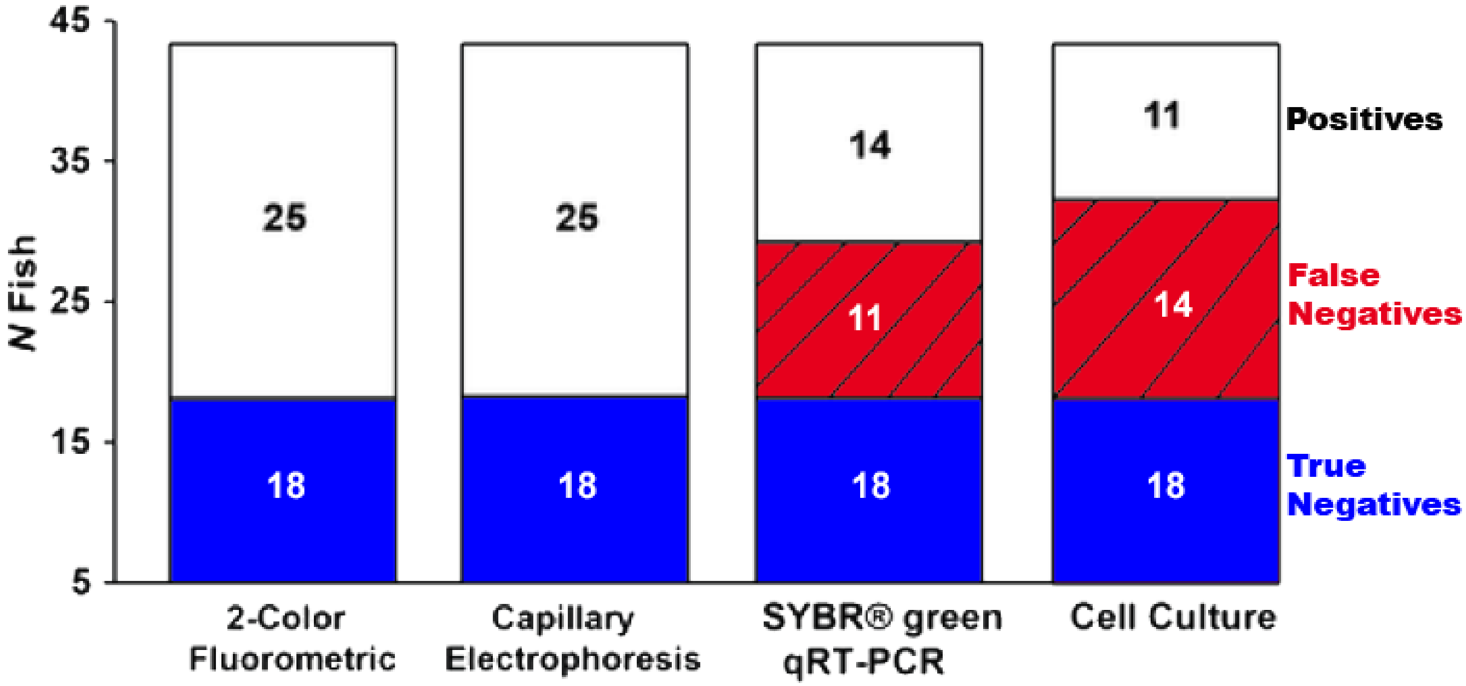
Pierce & Stepien 2012, J. Sieracki et al. 2014, Cornwell et al. 2015, Stepien et al. 2015 & Niner & Stepien (in progress)

2015 & 2016 Sampling Design

- First large-scale sampling since 2010
- Sample fish 2015-16
  - March-July
    - 2,561 fishes
    - 55 species
    - 37 sites
- Test tissues
  - SYBR green qPCR
  - 2-color fluorescence
    - Quantify VHSv
    - Internal standards
      - Pierce et al. 2013
- Sequence *G*-gene
  - Compare to older haplotypes



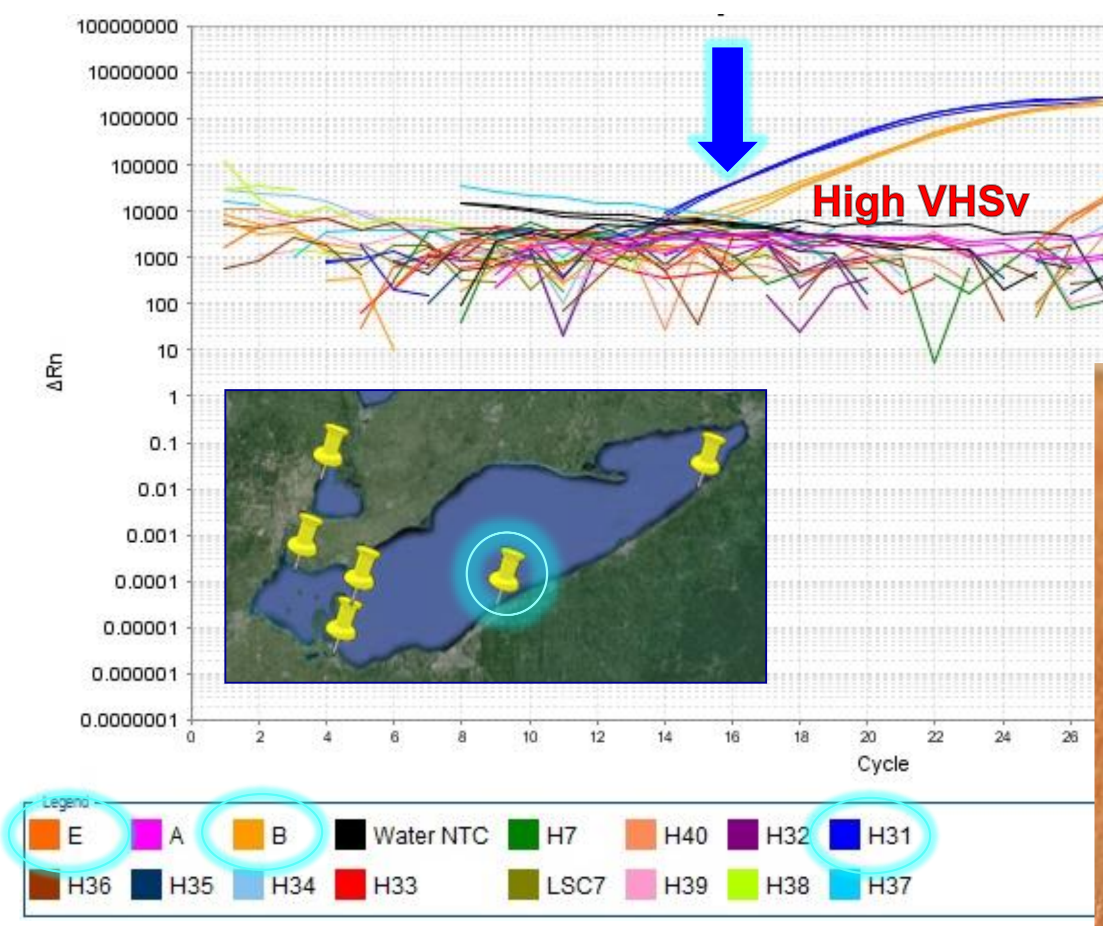
SYBR Green Pros & Cons



Adapted from: Pierce et al. 2013

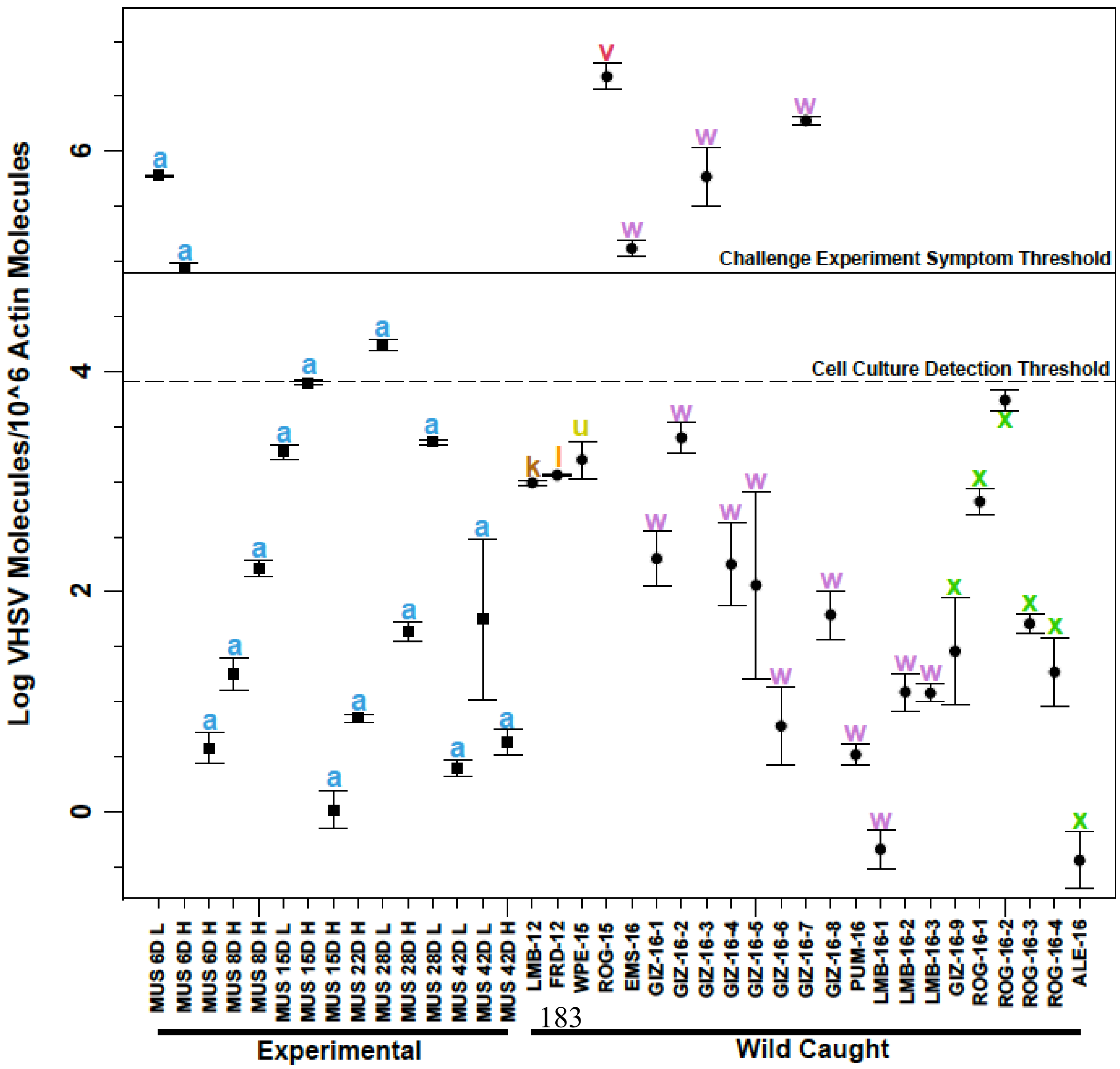
- **Drawbacks:**
  - **False negatives**
    - **Not as sensitive**
- **Benefits:**
  - **Faster**
  - **Economical**
  - **More accurate than cell culture**

SYBR Green Results



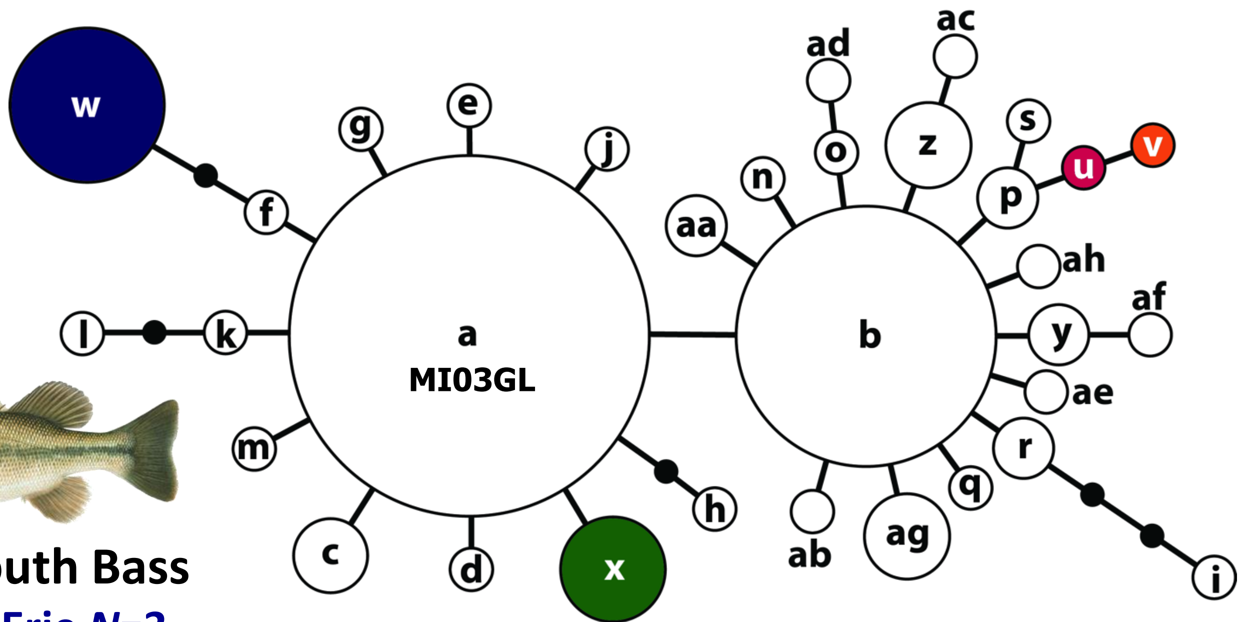
**E, A, & B are standards*

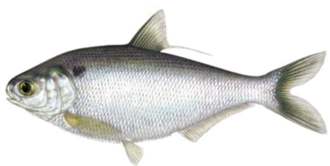
Sample Viral Loads



Positives 2015/2016

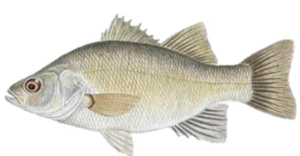
Round Goby
2015: L. Erie *N*=1
Haplotype v
2016: L. Michigan *N*=4
Haplotype x





Gizzard Shad
2016: L. Erie *N*=9
Haplotype w

Largemouth Bass
2016: L. Erie *N*=3
Haplotype w



White Perch
2015: L. Erie *N*=1
Haplotype u

Emerald Shiner
2016: L. Erie *N*=1
Haplotype x

Alewife
2016: L. Michigan *N*=1
Haplotype x

Pumpkinseed
2016: L. Erie *N*=1
Haplotype w

2017 Outbreaks

Fish-killing disease VHS confirmed in Cayuga Lake, first in Finger Lakes in decade

Leo Roth, @leoroth Published 2:15 p.m. ET May 31, 2017 | Updated 5:44 p.m. ET May 31, 2017

(Photo: M. SPENCER GREEN, ASSOCIATED PRESS)

CONNECT TWEET LINKEDIN 4

The New York State Departm… Conservation has confirmed… killing virus in Cayuga Lake.

Viral hemorrhagic septicemia… thousands of round gobies in… runs north-south between Se…

VHS, which poses no threat to humans, causes hemorrhaging… internal organs.

Michigan investigates possible fish virus in Lake St. Clair

Dead fish with bloody patches on their skin could be caused by VHSV virus

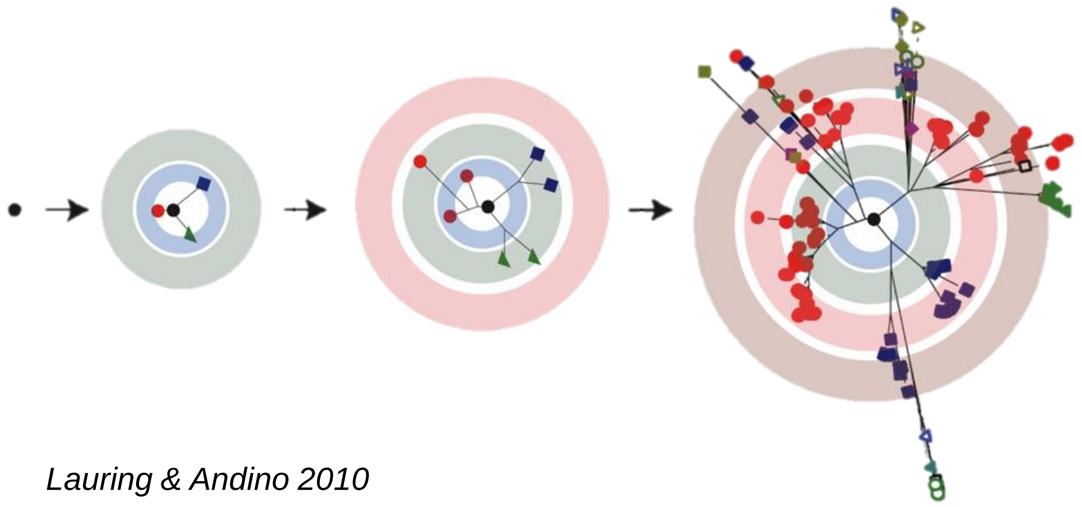
CBC News Posted: Apr 20, 2017 12:37 PM ET | Last Updated: Apr 20, 2017 3:55 PM ET

A fish from Lake St. Clair potentially infected with viral hemorrhagic septicemia, a highly contagious virus. (Michigan Department of Natural Resources)

Reports of dead fish floating in Lake St. Clair have Michigan's Department of Natural Resources investigating a possible outbreak of viral hemorrhagic septicemia, a virus researchers describe as "very contagious."

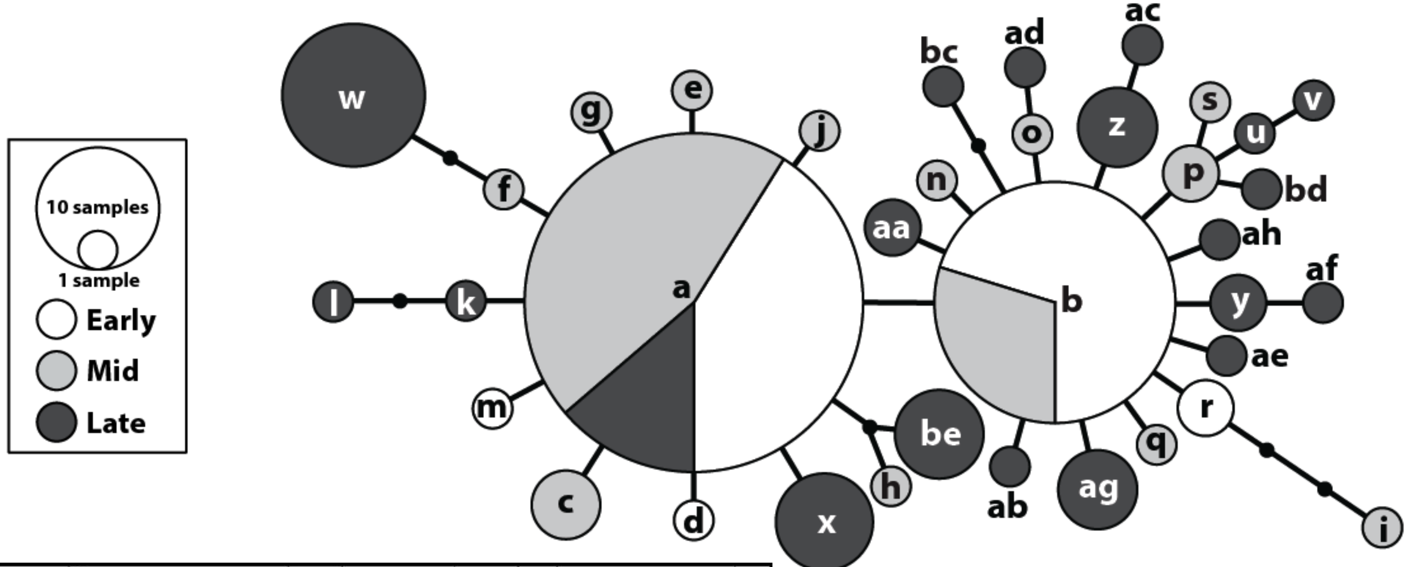
Why Population Genetics?

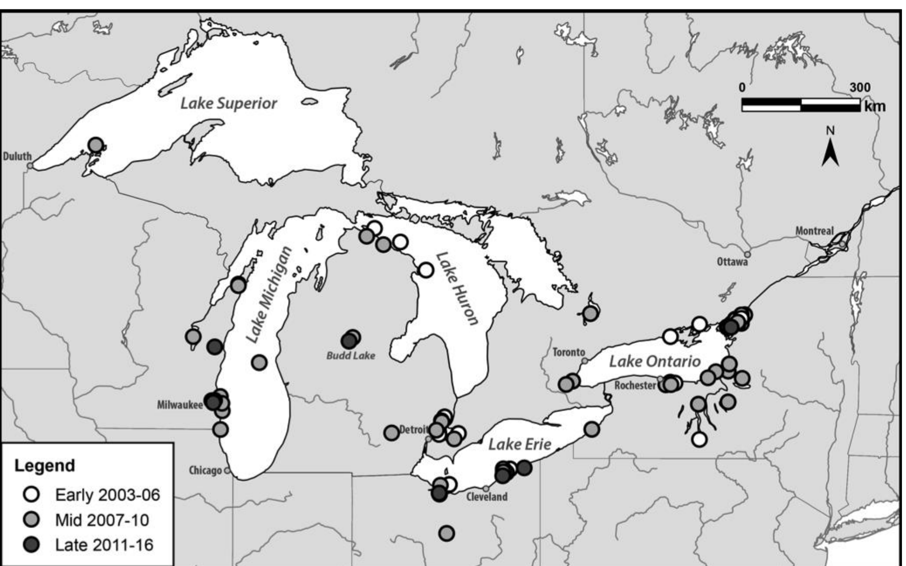
- Testing for changes across:
  - Time
  - Location
  - Species
- Quasispecies
  - RNA virus
  - Epidemiology
    - Immune escape



Lauring & Andino 2010

VHSv-IVb *G*-gene Haplotype Network & F_{ST} Table Over Time

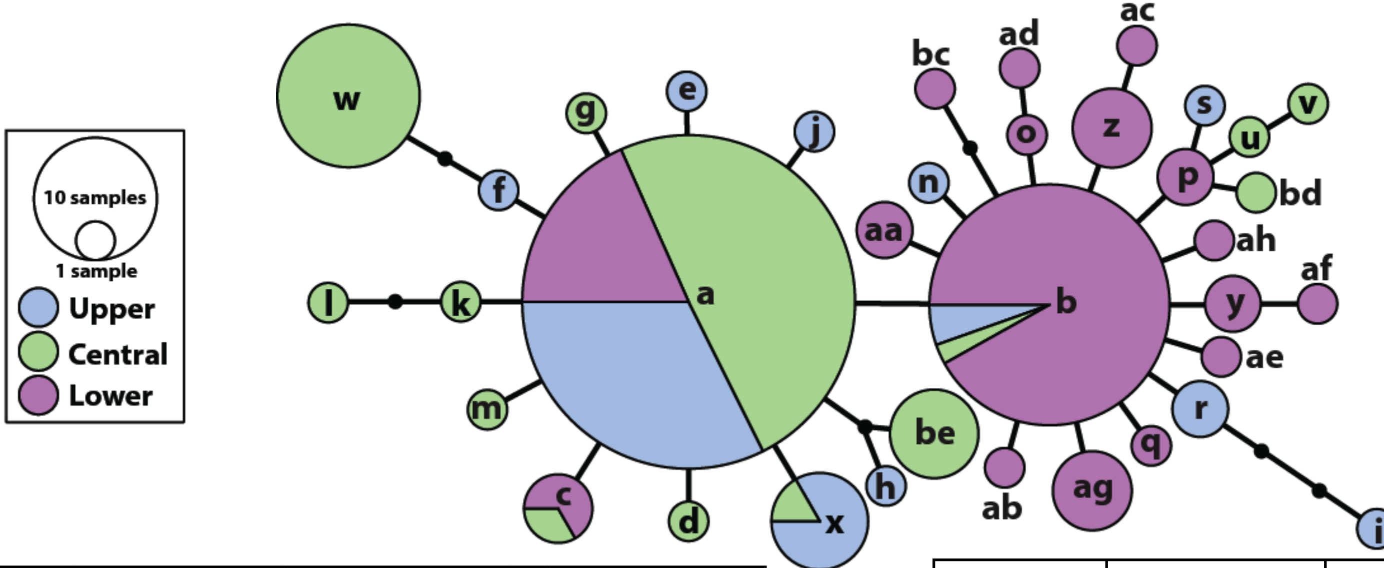


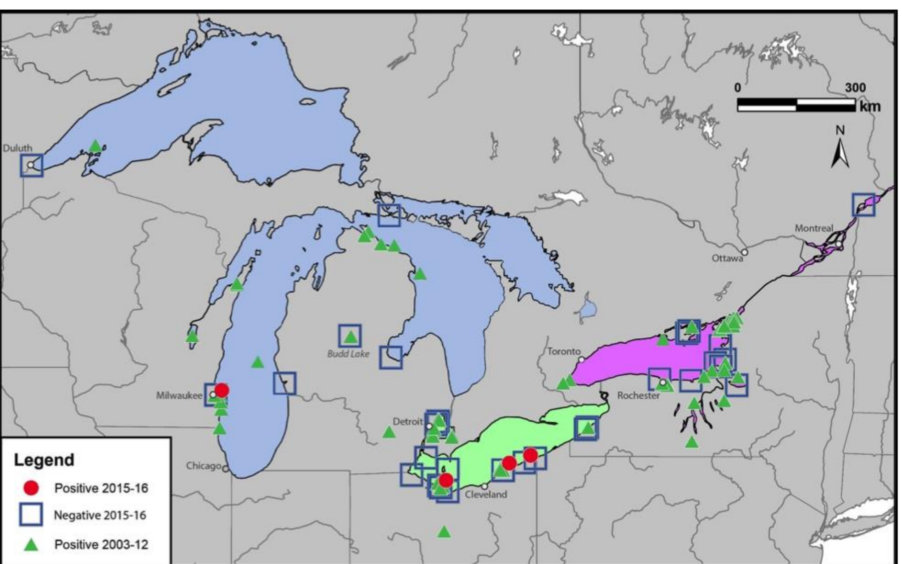


	Early (2003-06) *N*=58	Mid (2007-10) *N*=57	Late (2011-17) *N*=65
Early	-	NS	**
Mid	0.019	-	**
Late	0.153**	0.123**	-

(θ_{ST} = F_{ST} analog below diagonal, Exact tests above diagonal)

Pairwise Genetic Comparisons Between Regions





	Upper N=39	Middle N=57	Lower N=80
Upper	-	**	**
Middle	0.111**	-	**
Lower	0.264**	0.348**	-

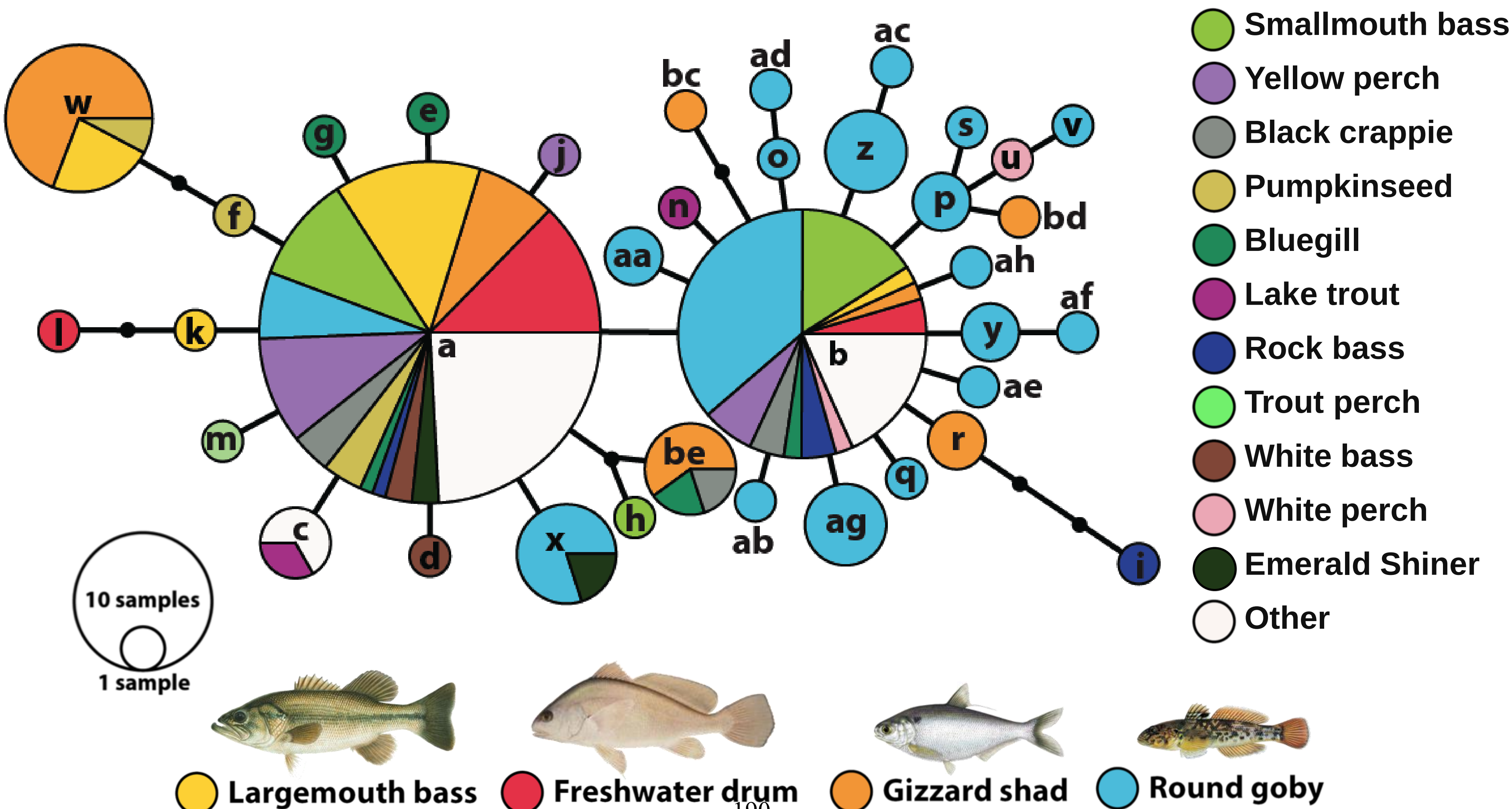
(θ_{ST} = F_{ST} analog below diagonal, Exact tests above diagonal)

Pairwise Genetic Comparisons Between Water Bodies

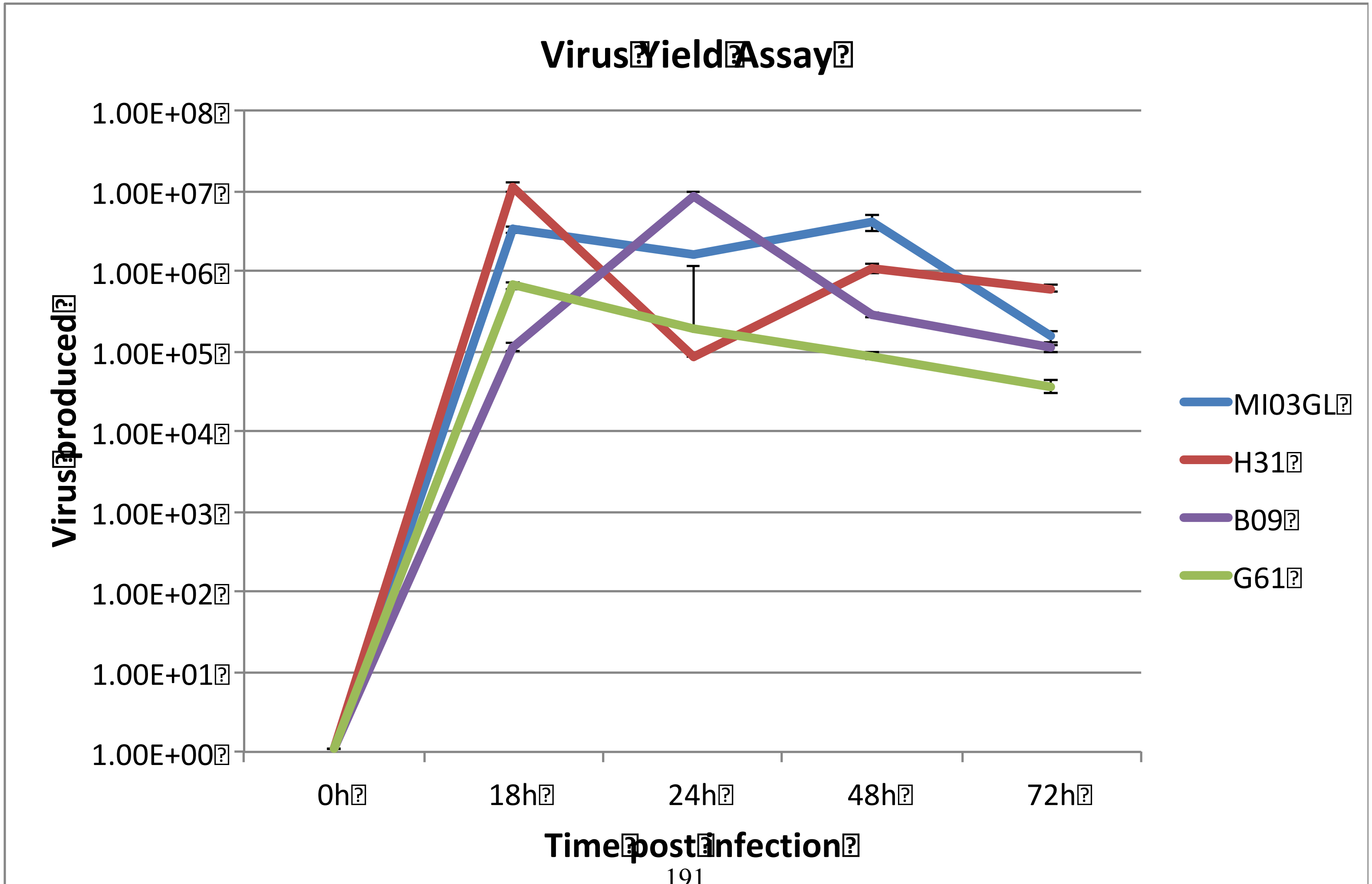
	L. Michigan *N=19*	*Budd L.* *N=12*	*L. Huron* *N=7*	*L. St Clair* *N=15*	*L. Erie* *N=43*	*L. Ontario* *N=21*	*St Lawrence R.* *N=52*	*Finger L.* *N=6*
L. Michigan	-	*	NS	**	**	*	**	NS
Budd L.	0.072*	-	*	NS	*	*	**	NS
L. Huron	0.037	0.198*	-	*	NS	NS	**	NS
L. St. Clair	0.136**	0.135	0.180*	-	*	**	**	*
L. Erie	0.165**	0.119*	0.115	0.114*	-	**	**	NS
L. Ontario	0.095*	0.220*	0.001	0.230**	0.189**	-	**	NS
St. Lawrence R.	0.393**	0.561**	0.257**	0.563**	0.447**	0.207**	-	**
Finger L.	0.001	0.153	0.001	0.180	0.113	0.001	0.318**	-

(θ_{ST} = F_{ST} analog below diagonal, Exact tests above diagonal)

Haplotype Network by Species

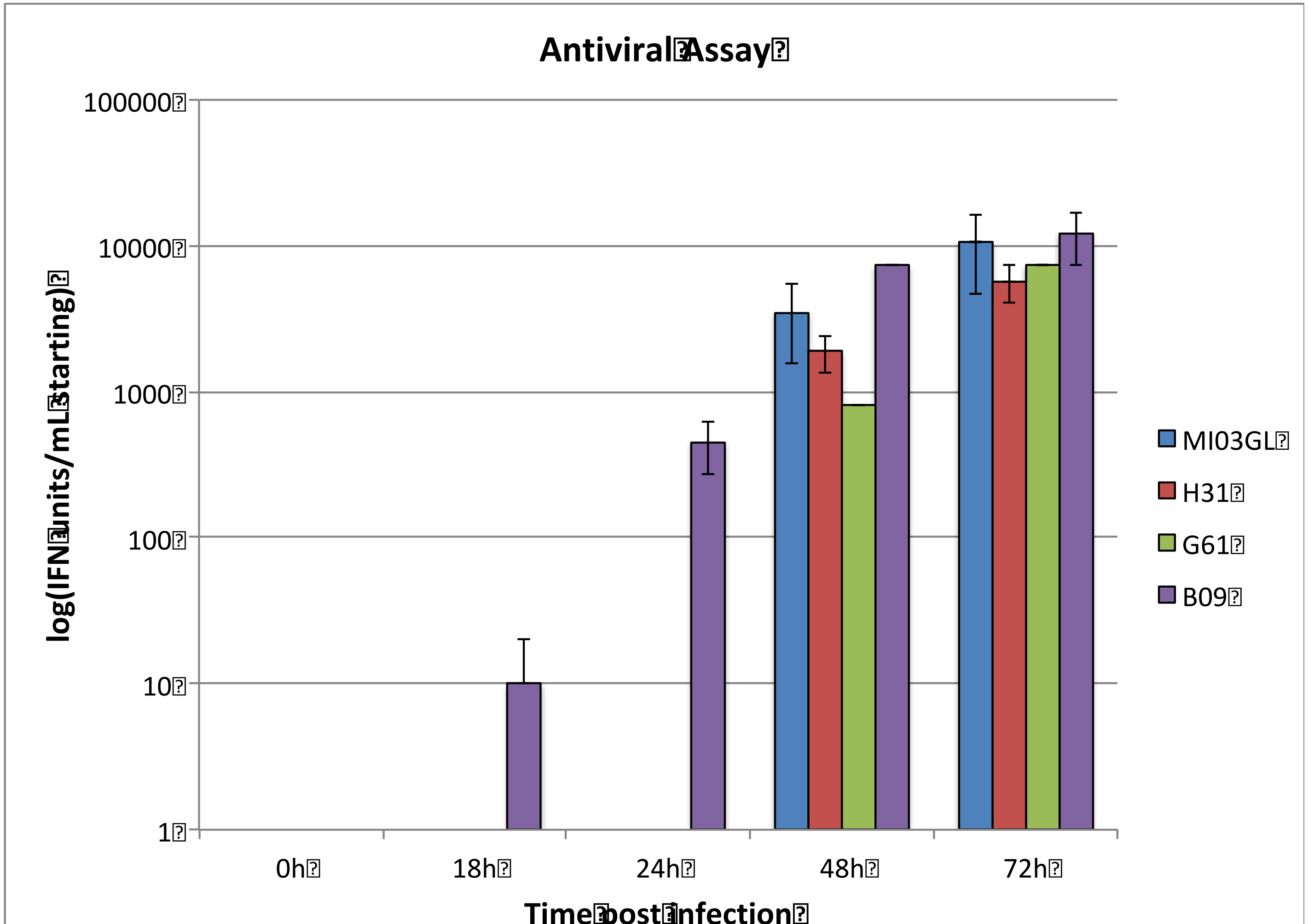


VYA Assay

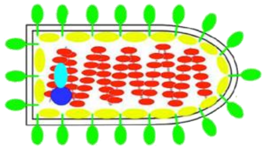


Virus Yield Assay
1.00E+08
1.00E+07
1.00E+06
1.00E+05
1.00E+04
1.00E+03
1.00E+02
1.00E+01
1.00E+00
Virus produced
0h
18h
24h
48h
72h
Time post infection
MI03GL
H31
B09
G61
a
v
w
w

Antiviral Assay



Summary & Future Direction



VHSv still in Great Lakes

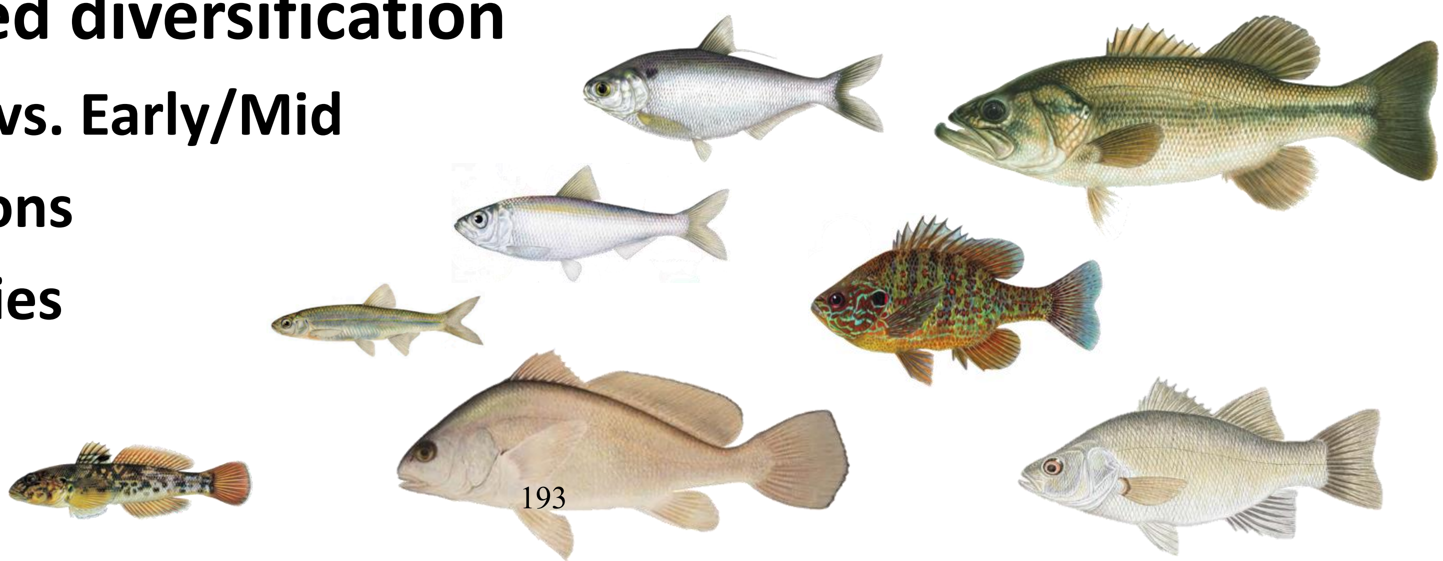
- 2015: L. Erie
- 2016: L. Erie & L. Michigan
- 2017: L. St. Clair & Cayuga L.
- Old haplotypes not seen

Continued diversification

- Late vs. Early/Mid
- Regions
- Species

UP NEXT

- Determine differences in cytopathogenicity, virulence, and others
- Full genome studies



Thanks to:

Virus & Samples:

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P. Bowser
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S. Edwards
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M. Faisal
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F. Goetz
J. He
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B. Lantry
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O. Miller
J. Maranowski
J. Markham
J. McDermid
S. Myers
V. Palsule
L. Pierce
J. Robinson
C. Ruetz III
C. Schelb
D. Schindelholz
C. Taborelli
M. Thomas
T. Van De Valk
V. Vakharia
M. Walsh
B. Weidel
G. Whelan
E. Wiemer
A. Whitten
T. Willis
J. Winton

Agencies & Universities::

1845 Treaty Authority
Cornell University
Grand Valley State University
Michigan DNR
New York State DEC
Ohio DNR
Ontario MNR
Quebec MFFP
US Fisheries & Wildlife
US Geological Survey
Wisconsin DNR

Funding:

NSF IOS –CAS & DWL
USDA NIFA (CSREES) CAS
DWL & J_B J_Willey
USDA-ARS CAS DWL
NOAA Ohio Sea Grant CAS
IAGLR- MDN
NSF REU CAS K_C

USDA ars

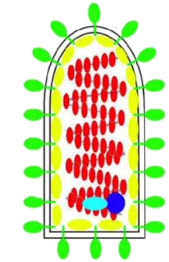
IAGLR

Sea Grant
Ohio Sea Grant College Program

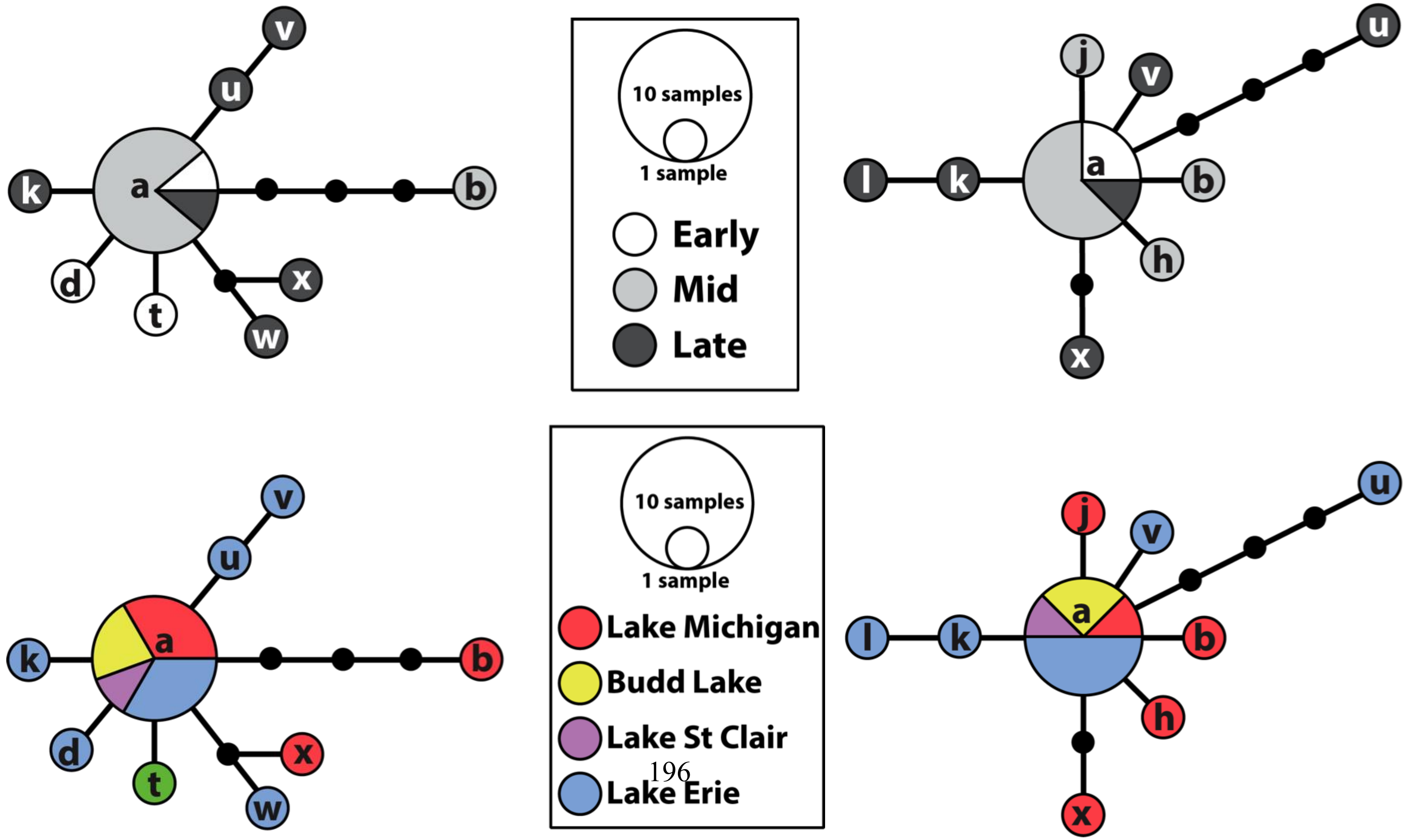
NSF

Questions?

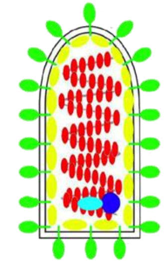
P & *M* Haplotype Networks



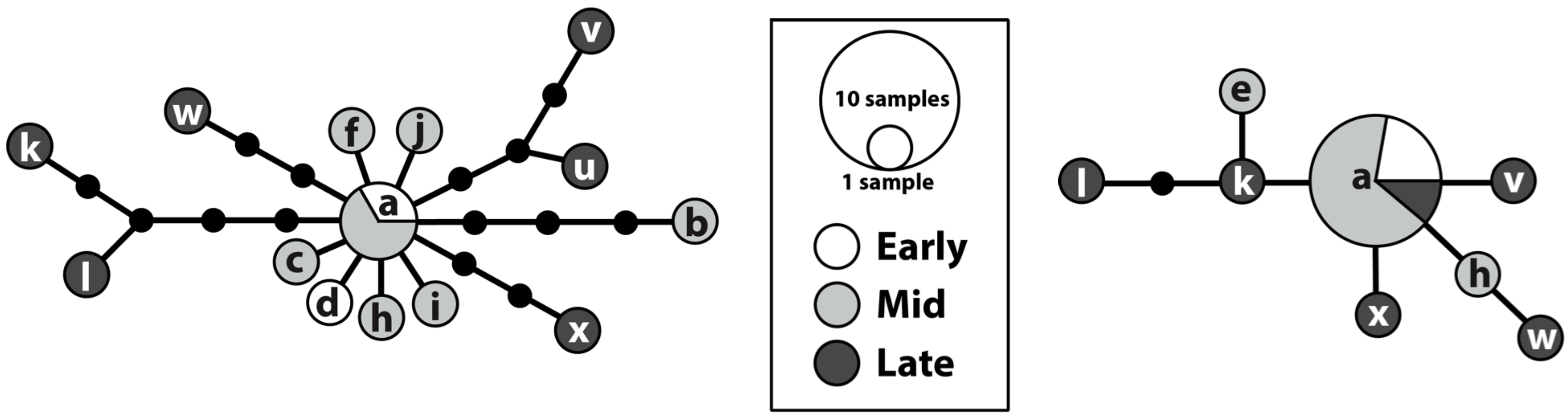
(*P*) Phosphoprotein	(*M*) Matrix

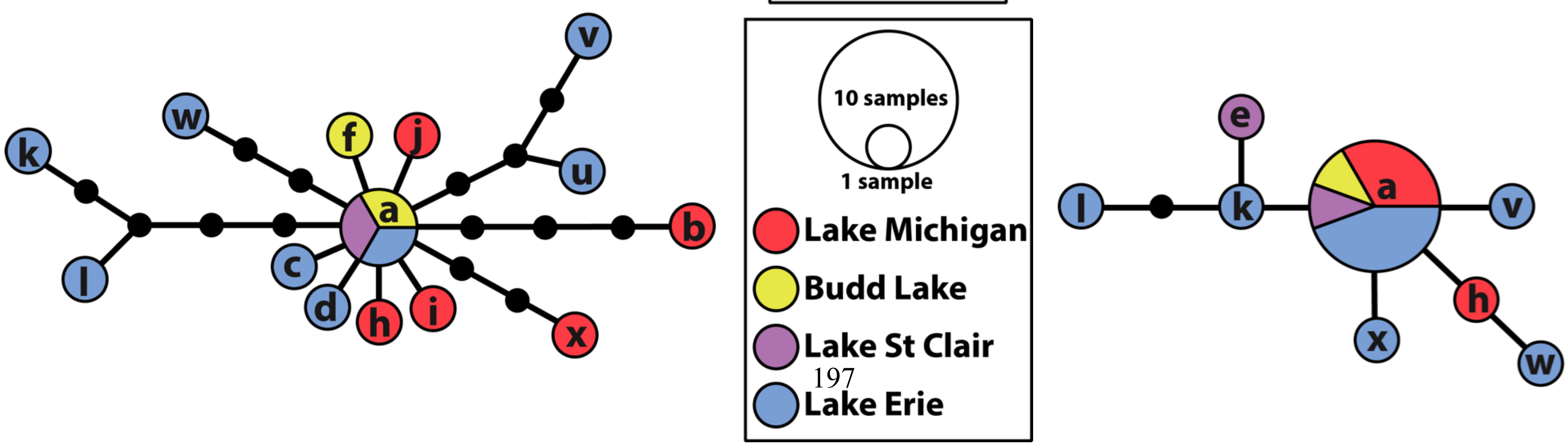


N & *Nv* Haplotype Networks



(*N*) Nucleoprotein	(*Nv*) Nonvirion





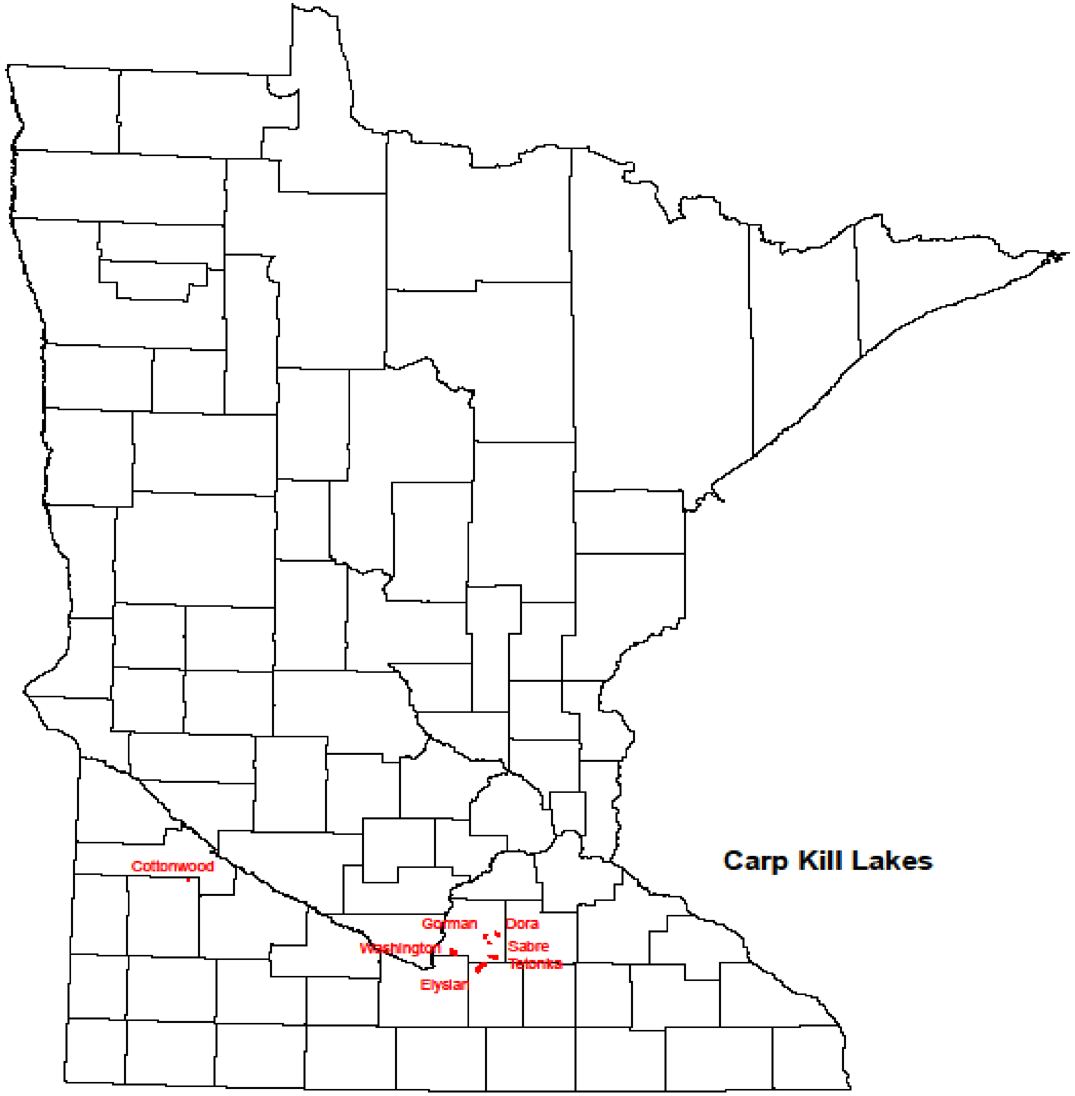
Common Carp Kill due to KHV 2017

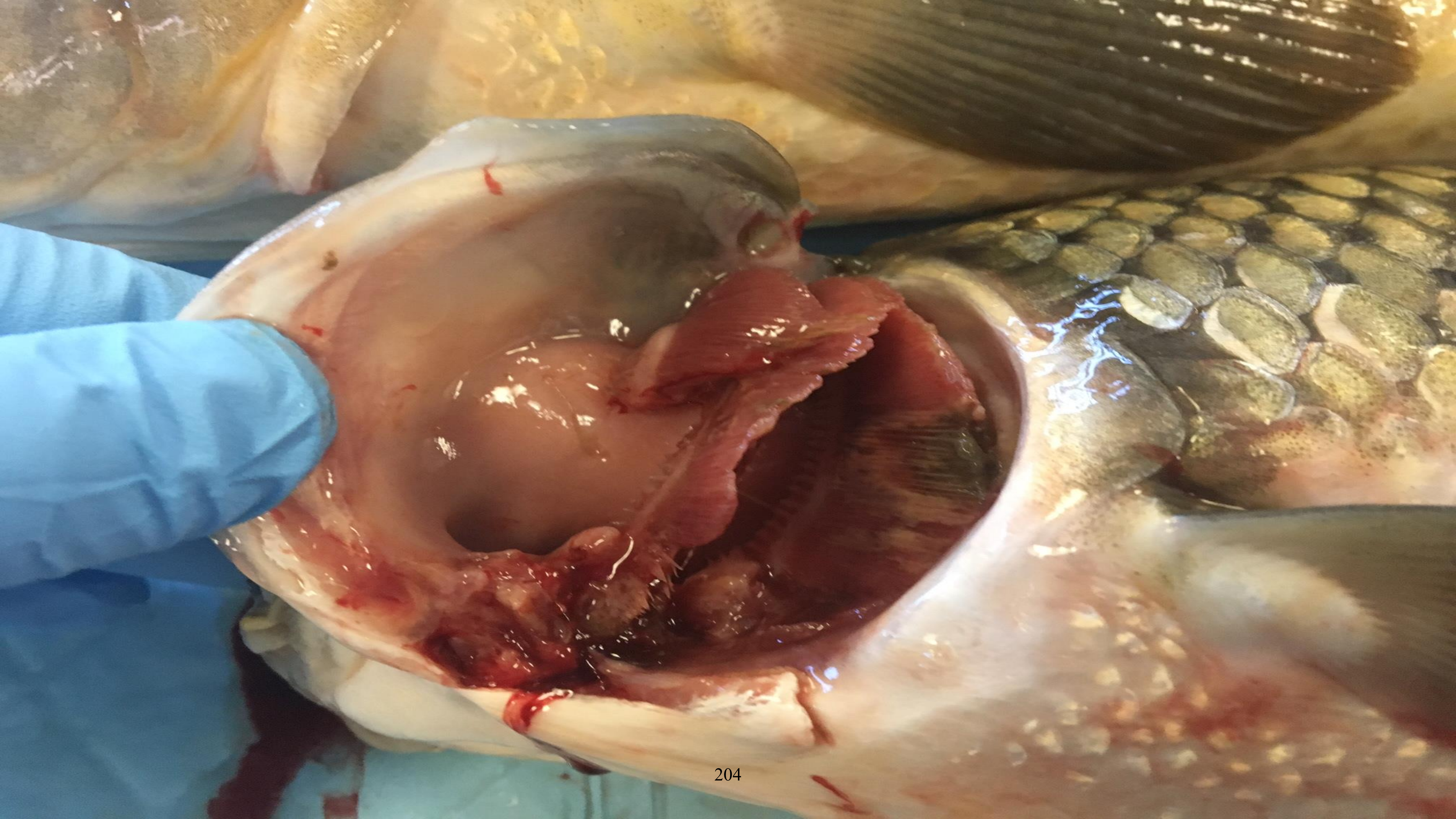
Ling Shen | Pathology Lab Supervisor

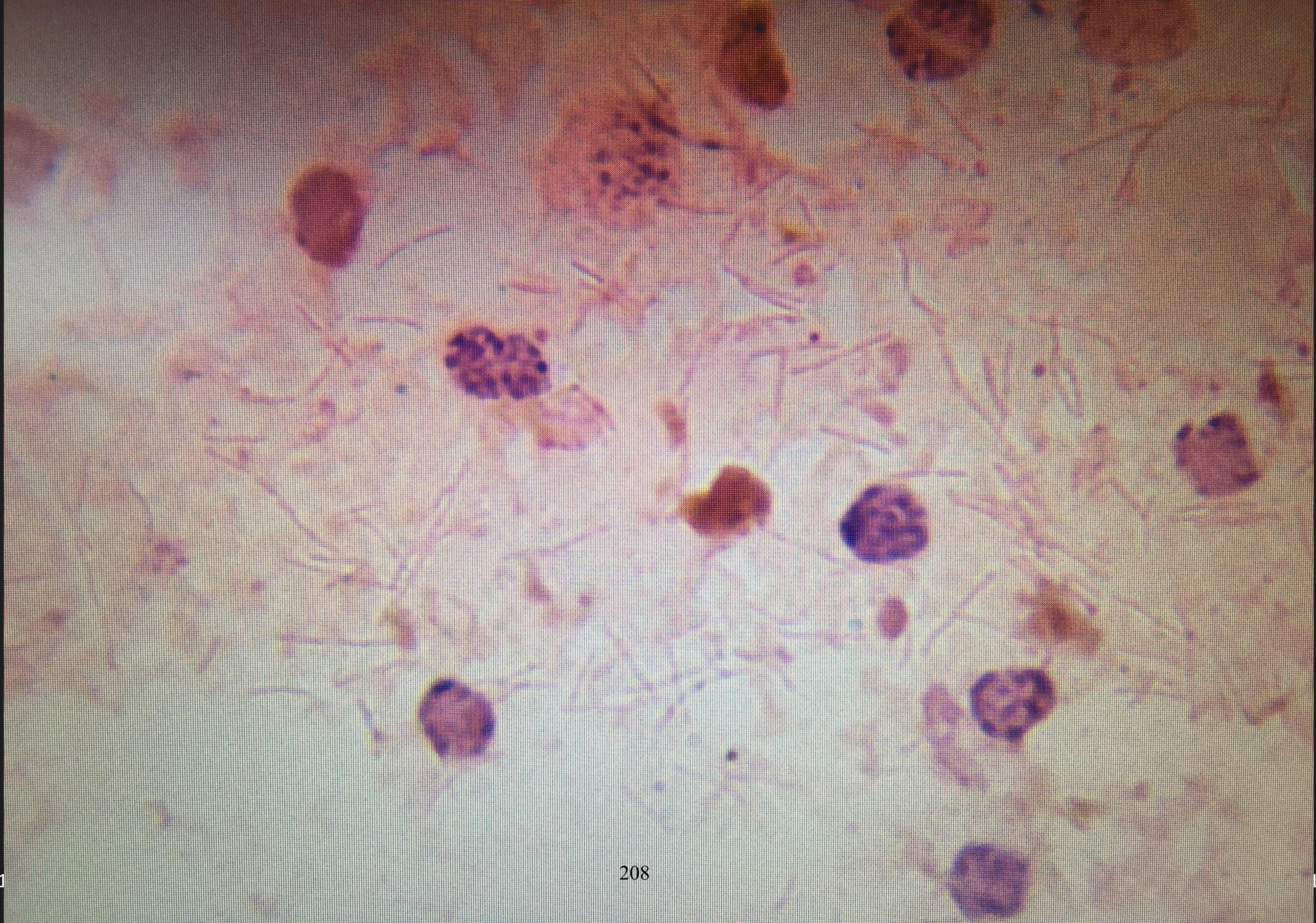
DEPARTMENT OF NATURAL RESOURCES

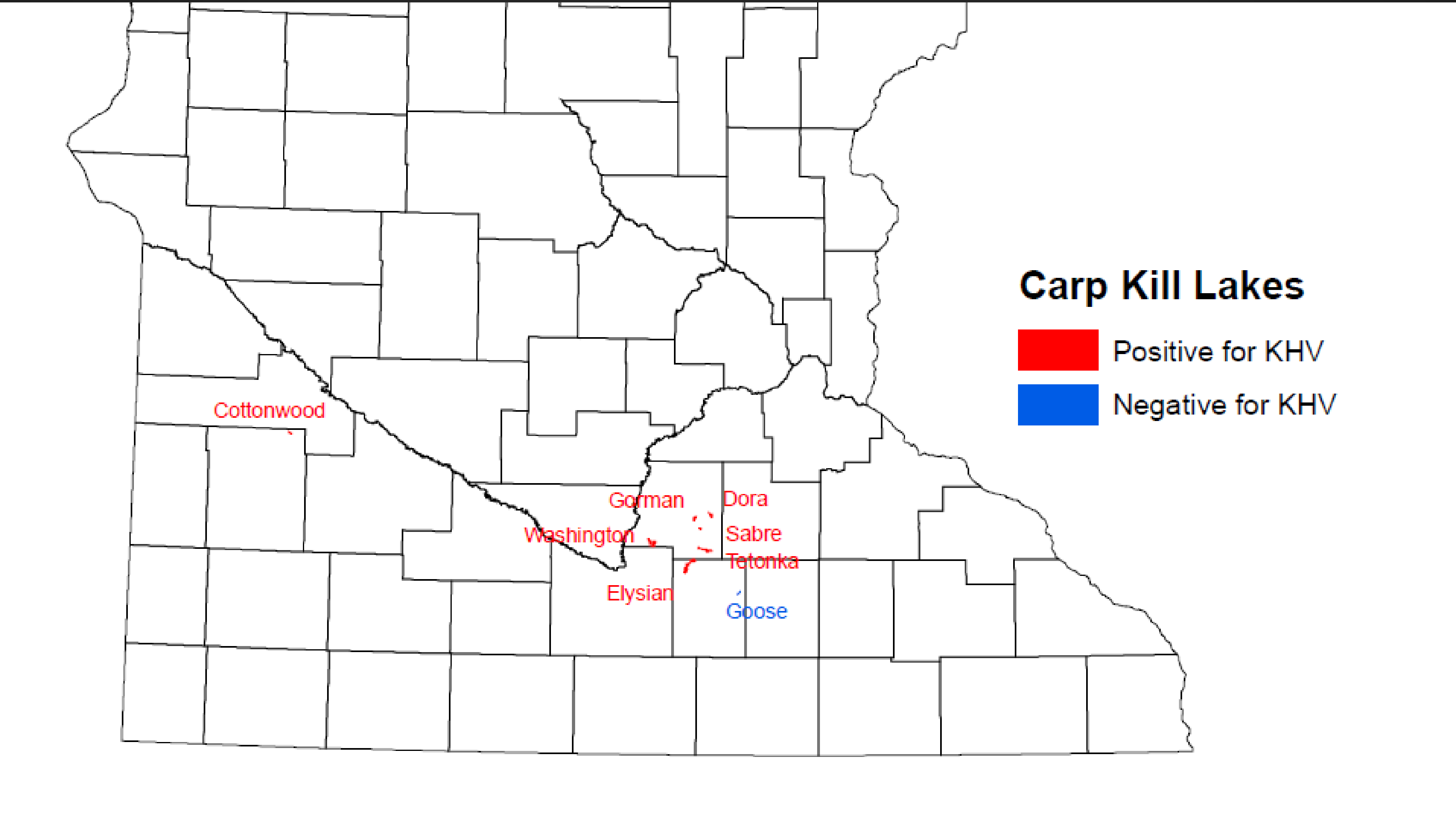
- Carp Kill Events in 2017
  - 7/6 Lake Elysian
  - 8/14 Lake Tetonka
  - 9/11 Lake Washington
  - 9/26 Lake Dora, Lake Sabre and Gorman
  - 10/10 Lake Cottonwood

Lakes with Carp Kill - 2017








Carp Kill Lakes
Positive for KHV
Negative for KHV
Cottonwood
Gorman
Dora
Washington
Sabre
Tetonka
Elysian
Goose

Next Step:

- Fisheries Managers would like to see if we can detect KHV in non-symptomatic population
    - BB indicates current method is not possible to detect the virus at this stage
- If we can detect the virus in this stage, will try to see how widespread this virus has become

Questions:

- How serious is the virus?
- What impact to the lake fish population?

DEPARTMENT OF NATURAL RESOURCES

Thank You!

Ling Shen

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651-259-5138

DEPARTMENT OF NATURAL RESOURCES

500 Lafayette Road
St. Paul, MN 55155-4040
888-646-6367 or 651-296-6157
mndnr.gov

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Fry Mortality at Rome State Fish Hatchery

GLS Meeting
Cortland
Feb 1-2, 2018

Dramatic Rise in BT Fry Mortality…….

- Started 11/8/17
- Sestonosis at first…..

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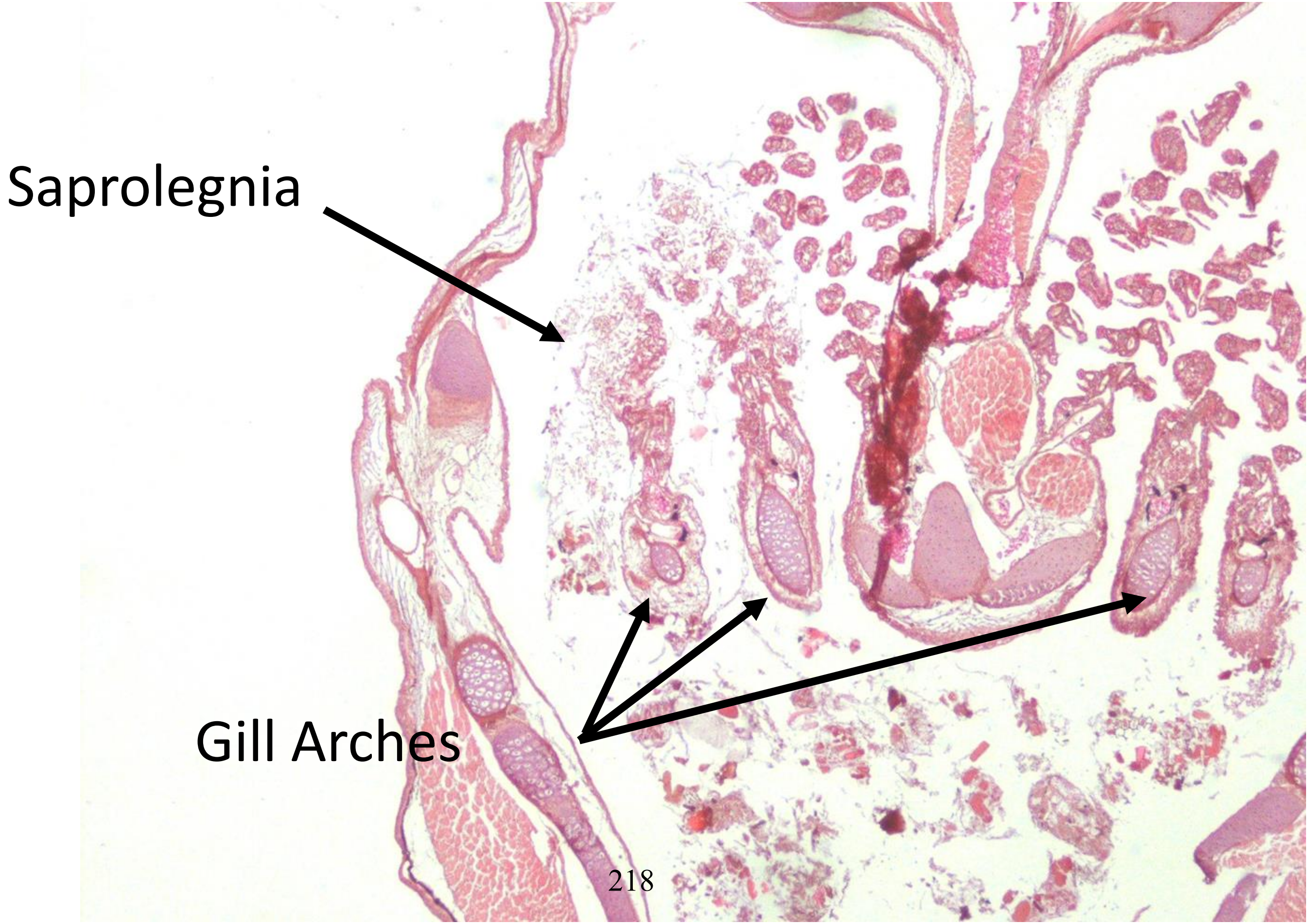
Dramatic Rise in BT Fry Mortality…….

- Started 11/8/17
- Sestonosis at first…..
- Treated every 2-3 days with Perox-Aid and Chloramine T-----No success
- ….then fungus
- No other pathogens
- Histo: tissues normal
- Lost 395K
- Worst losses due to sestonosis seen to date.


Saprolegnia
Gill Arches

….then the Brook Trout Fry Mortality

- Started 12/13
- 26K lost at peak (12/18-19)
- 48K lost total
- No causative agent (pathogens) identified

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  - ↑ temp ↓ solubility = supersaturation

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    - ↑ temp ↓ solubility = supersaturation
- No gas bubbles in tissue
- N-sat was 107% in pond, 105% in hatchery

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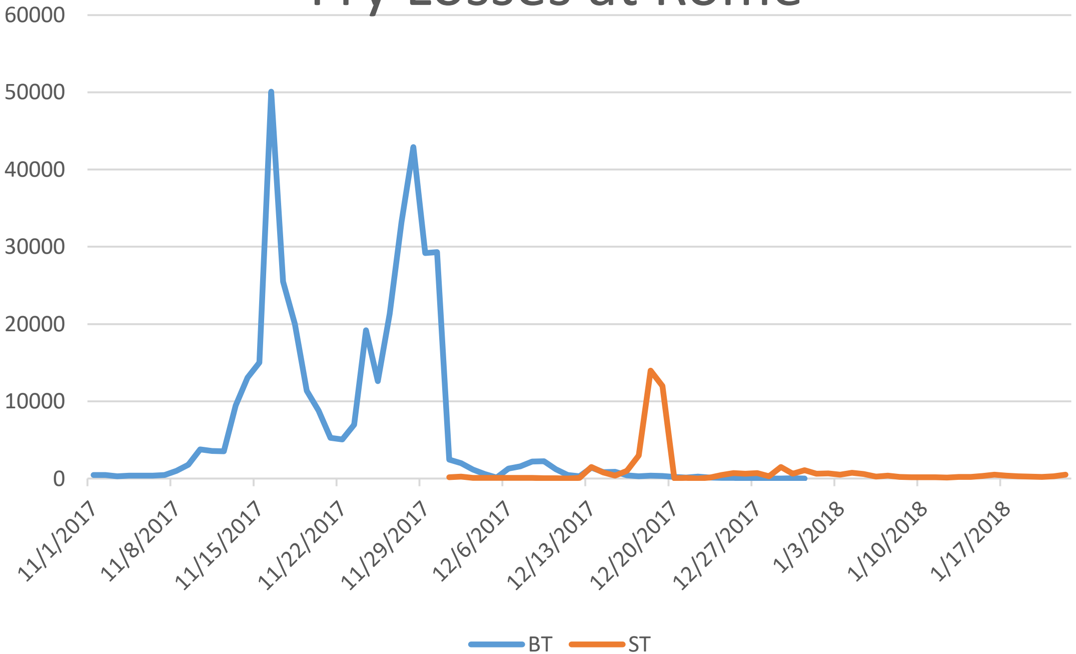
....Then the Brook Trout Fry Mortality

- **Wood (1968)** Impact of nitrogen supersaturation at various life stages of salmonids:
  - 103-104% for fry
  - 105-112% for young juveniles
  - 118% for adults
- Gas bubbles may not be evident at 105-107%
- Injuries may have long lasting effects.

Fry Losses at Rome



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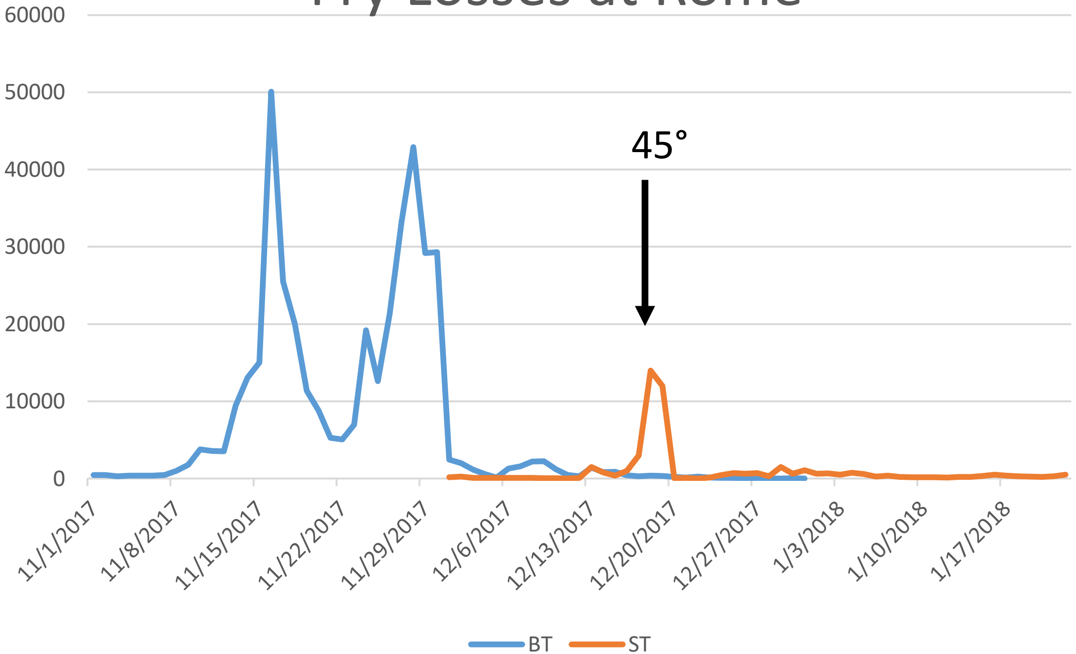
Fry Losses at Rome



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Abatement

N now = 101%

Thank You

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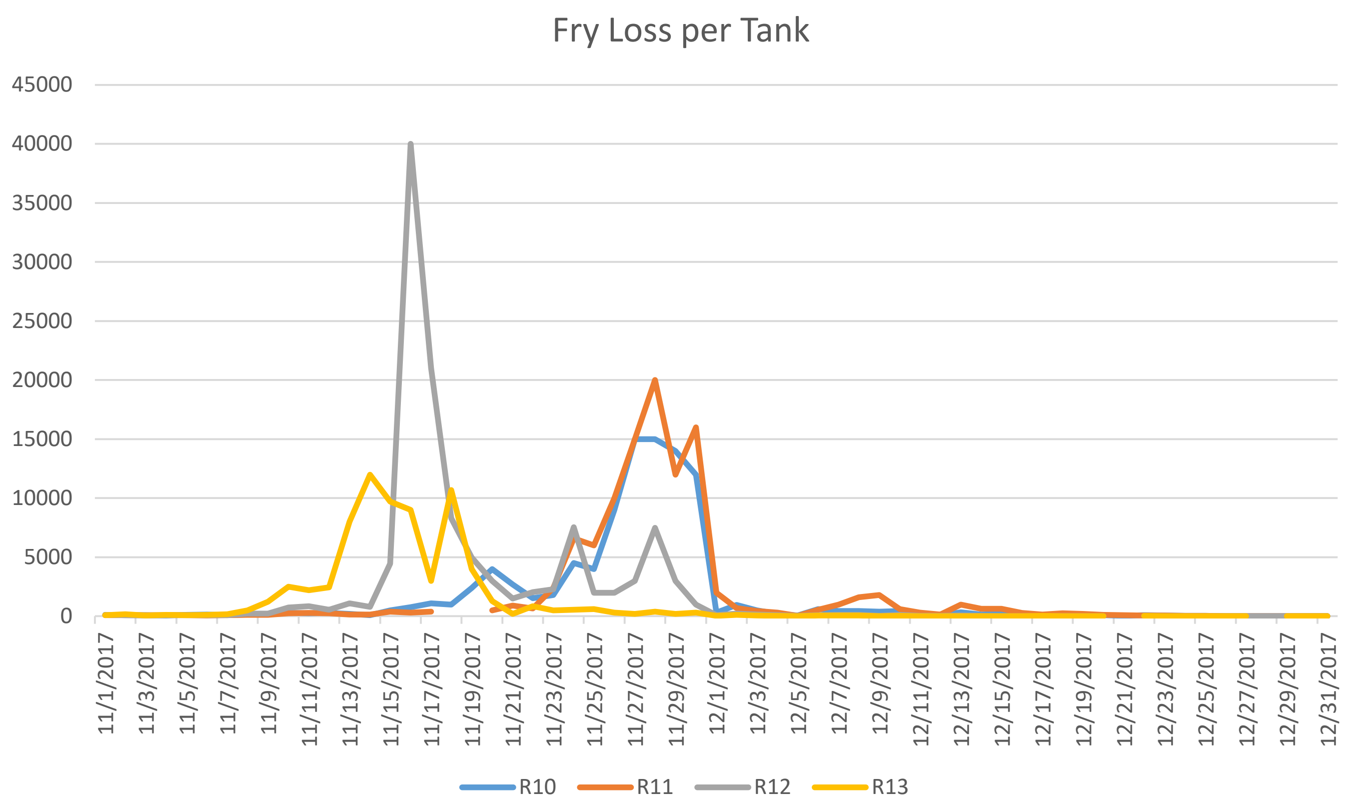

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SLR Musky Cell Culture Mystery

Clinical Details

- Ovarian Fluid and fry tested
  - RL-Blue Book Inspection
  - KRB-Cell Culture and PCR for VHS

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- Ovarian Fluid and fry tested
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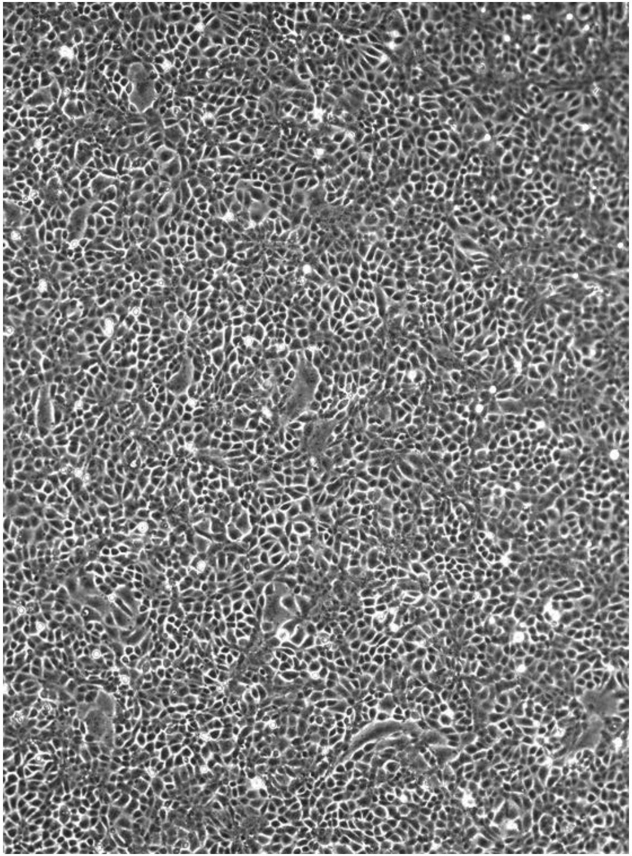
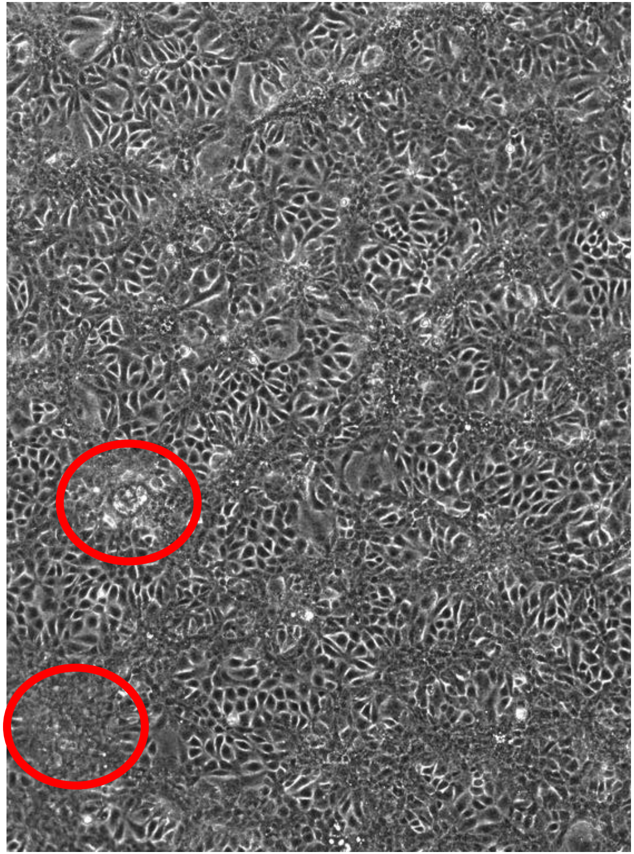
- KRB tried to isolate, purify, sequence
  - No joy.



Normal CHSE Cells



SLR

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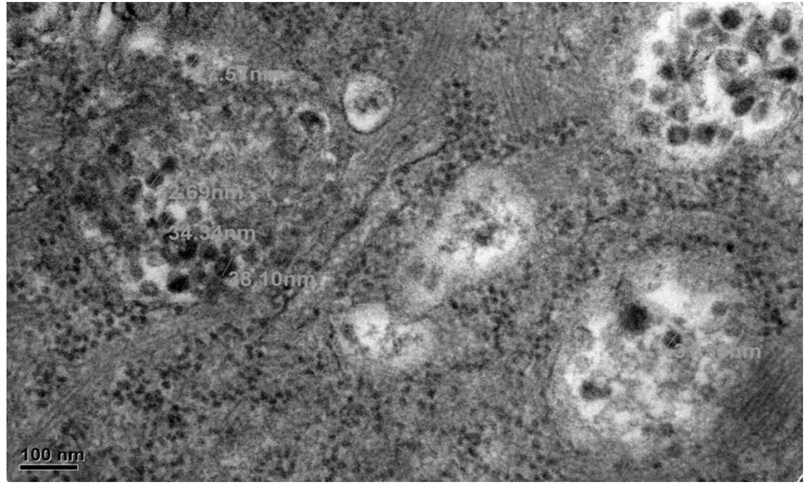
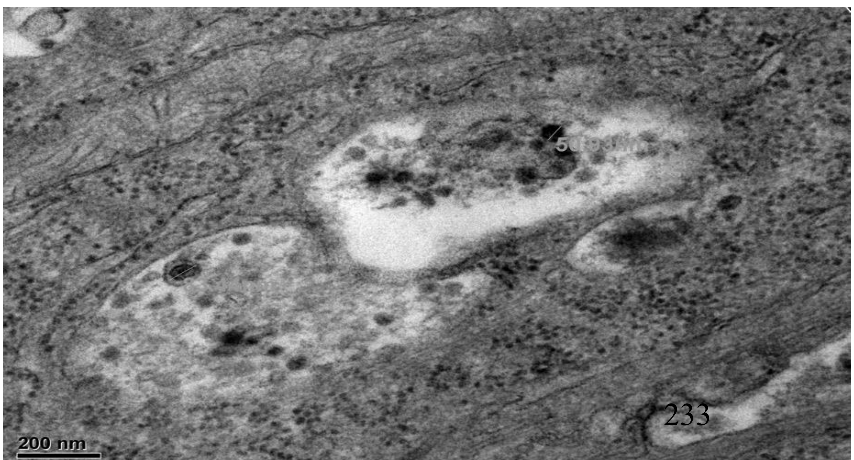
  - Same culture results
  - Nice EM, no clue what it is though.

EM





?

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- Failed GLFHC Risk Assessment

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Next Steps

- Will revisit this spring
  - Culture (if possible)
  - Identify
    - Purify
    - Determine nucleic acid type
    - PCR/Sequence
  - River's/Koch's Postulates
  - Etc….

Thank You

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