What is wrong with my fish? Fish Health in Michigan

Gary Whelan

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Fish Health is different and similar to Wildlife Health

Same General List of Potential Candidates with a few exceptions

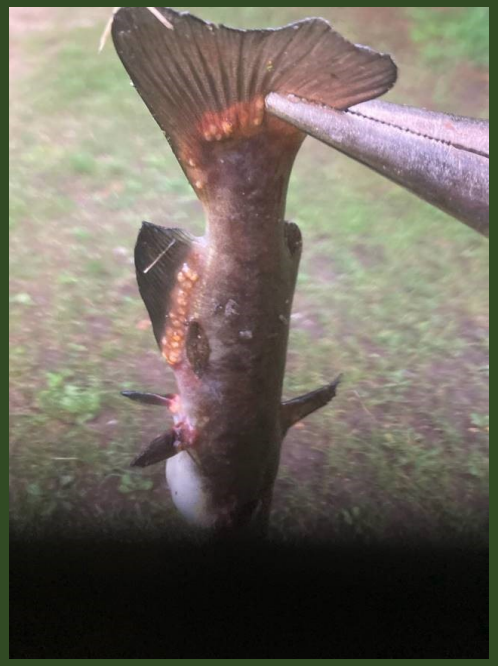
- Bacterial
- Viral
- Fungal
- Parasites
- Stress and physiological disorders
- Differences
  - No fisheries equivalent to prion based diseases
  - No wildlife equivalent to rapid environmental shock

Generalized Fish and Wildlife Health Contrasts – Wildlife Better Known

- Pathogen ID
- Detection and Sampling
- Distribution
- Native or Invasive
- Symptoms and Species affected
- Disease ecology and Virulence
- Origin
- Transmission Vectors
- Elimination or Containment

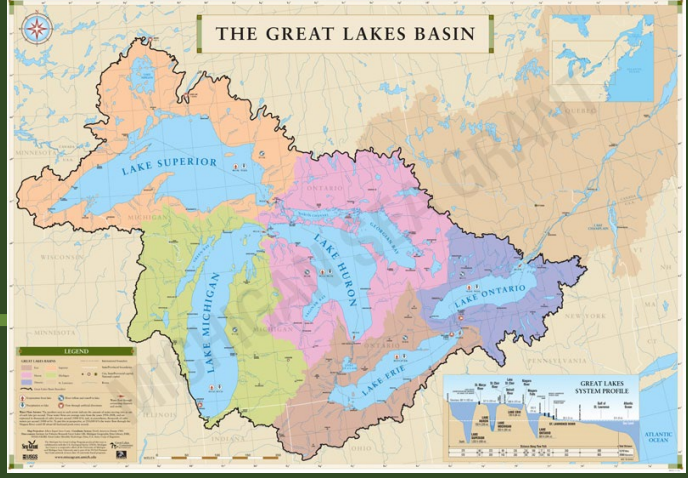
Generalized Fish and Wildlife Health Contrasts

- Treatments – Somewhat similar
  - Fish
    - Wild – Generally not possible
    - Hatcheries – Often possible as options are available
  - Wildlife
    - Wild – Possible occasionally
    - Captive – Possible as easier to handle animals and drugs available
- Resource Value Affected - Similar
- Human Implications of the Pathogen – Very Different



Givens

A Given - Michigan's Resource Scale



- Aquatic
  - Great Lakes (38,575 sq. miles)
  - Approx. 11,000 inland lakes (1,305 sq. miles)
  - 36,000-72,000 miles of streams/flowing water
- 154 species of fish
  - 27 non-native species
- Many species of invertebrates
  - 10 species of crayfish
  - 43 species of native mussels…….
- Thus, Most aquatic pathogens are poorly understood

A Given - Fisheries Infrastructure

- Six state fish hatcheries
- Five egg take and harvest stations
- 20-40 extensive rearing ponds
- About 325 tons of fish from 21 species and strains are produced annually

Last Givens

- Funding and staffing
- Many pathways for pathogen movement and introduction – Most marginally controlled
  - Commercial transportation
  - Fish in Commerce
    - Bait
    - Private Aquaculture – Most controlled
    - Pet Trade
    - Live fish in transit
  - Anglers
- Most aquatic pathogens are very difficult to manage

The Current Pathogen Actors Guild

- Flavobacterium
- Bacterial Kidney Disease
- Furunculosis
- Epizootic Epitheliotrophic Disease
- Viral Hemorrhagic Septicemia
- Infectious Pancreatic Necrosis
- Whirling Disease

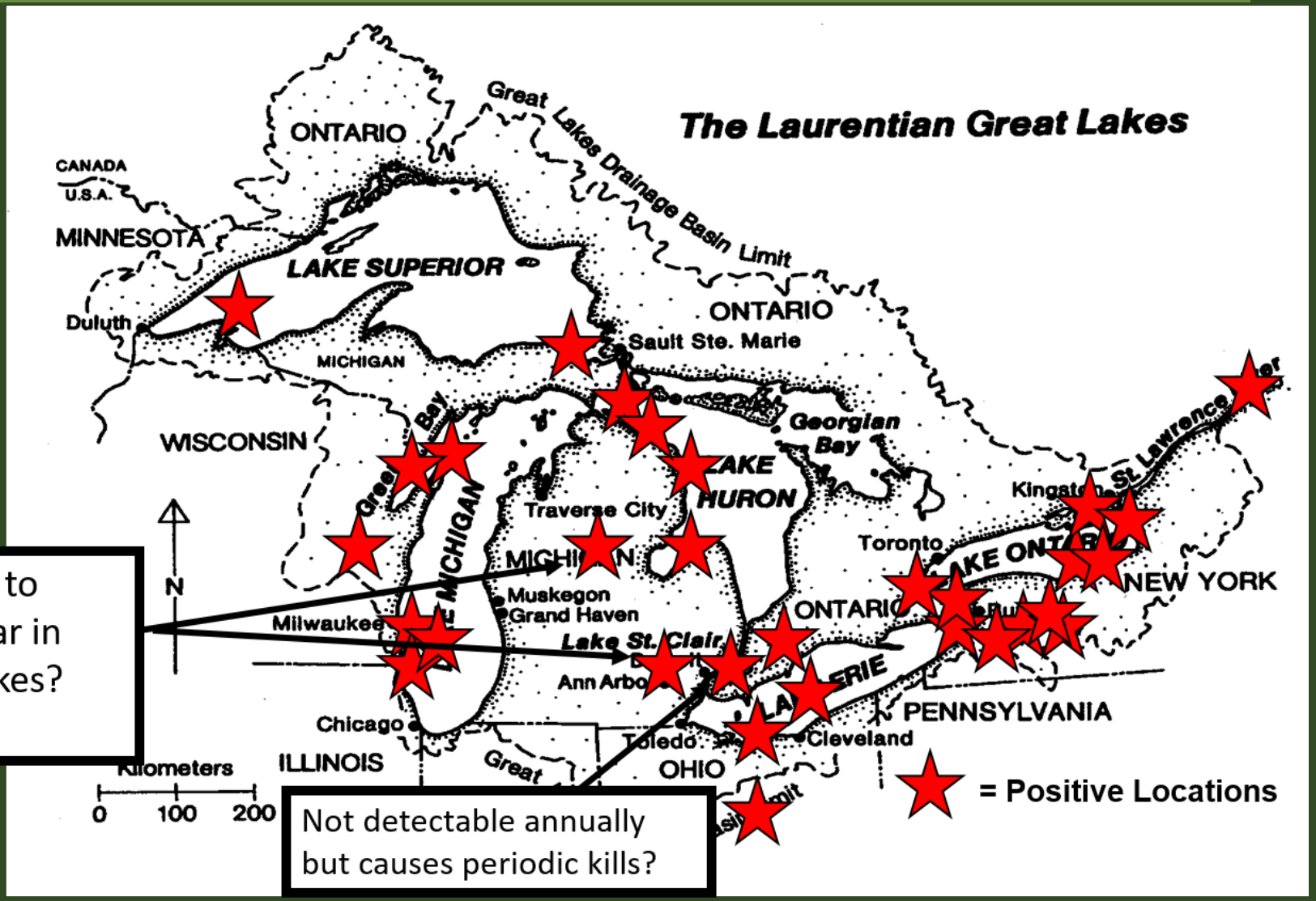
Likely Who - The All-Star Pathogen List

- Flavobacterium – Fish Enemy Number 1 – 100s of isolates
  - Bacterial coldwater disease (*Flavobacterium psychrophilum)*
  - Bacterial gill disease (*Flavobacterium columnare)*
  - Ubiquitous in distribution
- Bacterial Kidney Disease (*R. salmoncida)*
  - Caused population level mortalities of Great Lakes salmonids in the 1980s and early 1990s
  - Invasive?
  - Broadly distributed
- EEDv - Epitheliotropic Disease Virus – Salmonid Herpes Virus 3
  - Stress mediated Lake Trout skin disease in hatcheries
    - MSFH - high mortalities at times
  - Native herpes virus that never causes issues in the wild
  - Found in wild Lake Trout in lakes Superior, Huron and Michigan

Likely Who - The All-Star Pathogen List

- VHSv –Viral Hemorrhagic Septicemia virus (IVb) - Rhabdovirus
  - Invasive marine virus from Maritime Region of Canada that can infect over 25 fish species
  - Established about 2000 with the likely vector being commercial shipping.
  - Continues to cause large scale population level mortalities
    - 1000s (2018) to many millions of fish (2006 and 2017)

Current VHSv Distribution in the Great Lakes Basin

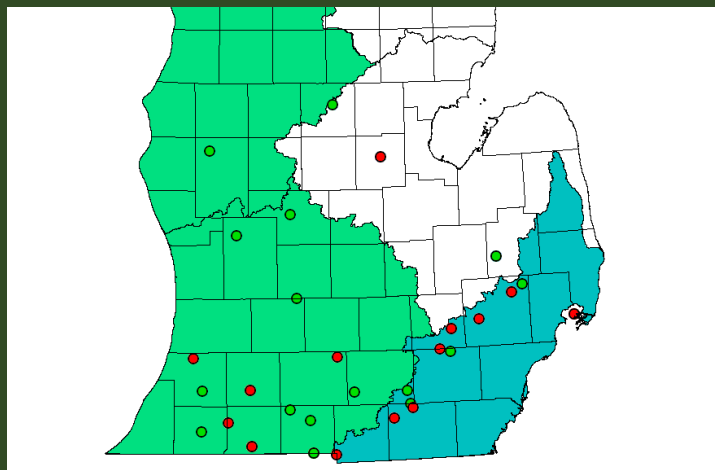


Likely Who – The All-Star Pathogen List

- Furunculosis (*A. salmonicida*) - Bacteria
  - Historically caused large hatchery mortalities but controlled by vaccines today
  - Found widely in wild trout populations and only occasionally see clinical signs
- IPNv - Infectious Pancreatic Necrosis virus – Birnaviridae
  - Stress mediated issue in hatcheries and does periodically cause mortalities in trout
  - While seen in a few waters in wild trout, it is very uncommon

Likely Who – The All-Star Pathogen List

- Largemouth Bass Virus (LMBv) – Iridoviridae (Ranavirus like)
  - Invasive pathogen from the Southern US
  - Arrived in MI about 2000, likely from by an angler translocation
  - Southern MI lakes through the early 2000s and caused mortalities of 10-20% of adult Largemouth Bass
  - Now making a resurgence in SMB and causing skin lesions along with potential recruitment issues

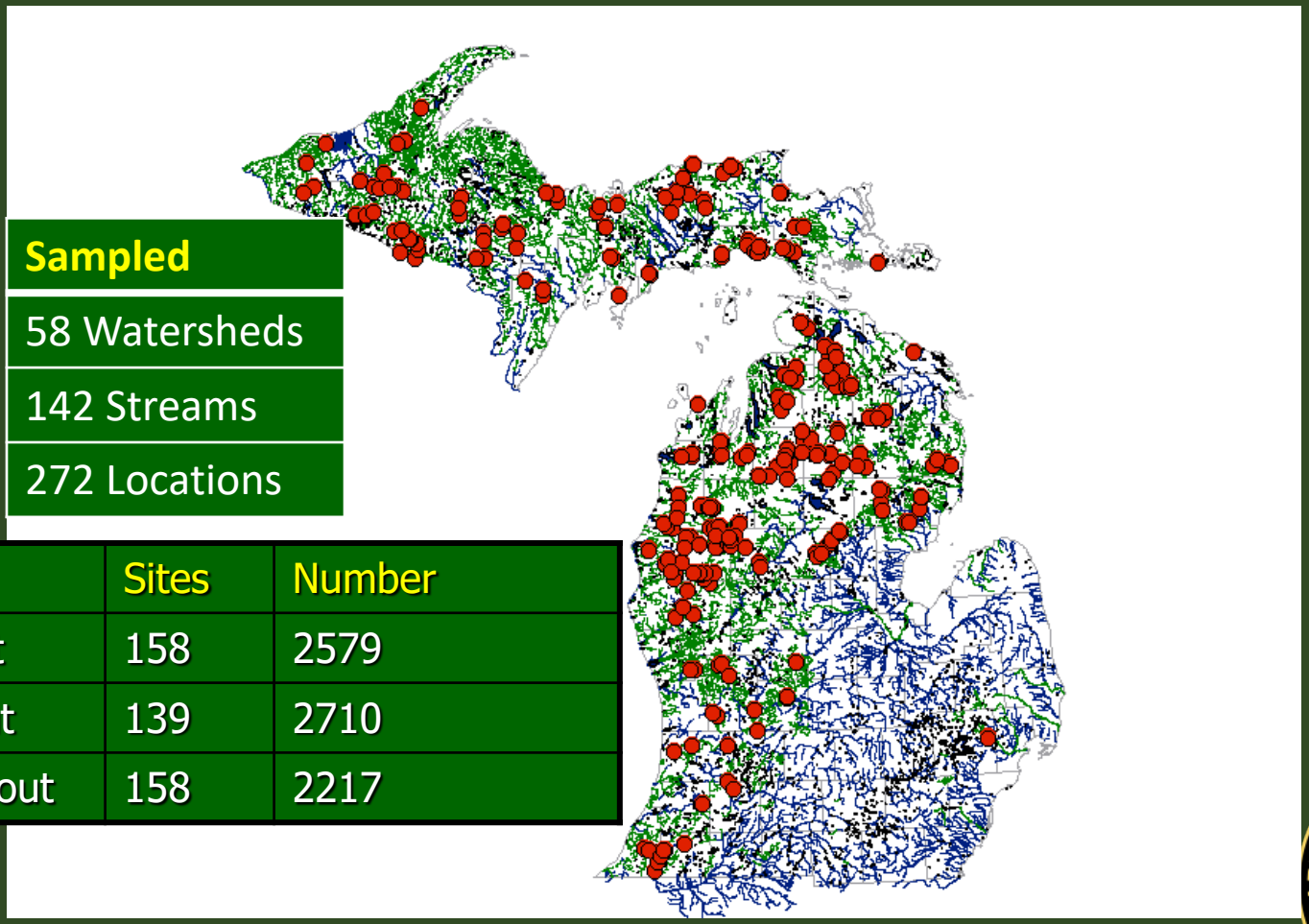


2000-2005 Locations

Likely Who – The All-Star Pathogen List

- Whirling Disease - *Myxobolus cerebralis* - Myxosporean
  - Invasive parasite from Europe
    - First found in MI in 1968
  - Population level effects in Western trout rivers but not in Midwest or East
  - We do not have the right intermediate tubificid (aquatic worms) hosts
    - Lineage III and IV are the key ones
    - Conditions favorable for these linkages could change with climate change as they need high organic material and temperatures than the other lineages

Wild Fish Disease Survey Sites 1998-2003



Sampled
58 Watersheds
142 Streams
272 Locations

Species	Sites	Number
Brook Trout	158	2579
Brown Trout	139	2710
Rainbow Trout	158	2217

1998-2003 Results

Species	Sample Sites	Positive Watersheds	Positive Streams	Prevalence
BKT	158	6	9	55%
BNT	139	3	6	38%
RBT	158	7	11	72%

About 10% of Michigan Trout Streams are Positive for *Mcer*

Likely Who – The All-Star Pathogen List

- Thiamine Deficiency Syndrome
  - Key forage species, particularly Alewives, have a high concentrations of long fatty acids and thiaminase
  - Cause thiamine loss in salmonids, particularly Lake Trout
  - Complete recruitment failure as the fry do not develop without adequate thiamine
  - Requires thiamine treatment of eggs in hatcheries
- Coolwater fish diseases are marginally understood
  - Carp viruses (Koi Herpesvirus) and STN Herpesvirus
  - Expect surprises from climate change

Likely Who's Next

- IHNv – Infectious hematopoietic necrosis virus – Rhabdovirus
  - West Coast salmonid disease
  - Not in Great Lakes Basin
  - Can cause large epizootic events
- ISAv - Infectious salmon anemia virus – RNA virus - Isavirus
  - East Coast and European virus with large losses seen in Atlantic Salmon farms
  - Not in Great Lakes Basin
  - Nonvirulent forms that can become virulent

Likely Who's Next

- PKD – Proliferative Kidney Disease – Myxozoan parasite
  - West and Intermountain
  - Causes large epizootic events in stressful conditions for salmonids and Mountain Whitefish
  - Not in Great Lakes Basin?
  - Currently, testing is difficult but new assays in development
- Spring Viremia of Carp - Rhabdovirus
  - Found in the US in a few locations but not MI
  - Can jump hosts to native minnow species

Key Fish Health Program Components

- Policy, Staffing and Funding
- Surveillance
- Biosecurity
- Inspection and Testing
- Treatment
- Research and Assessment
- Public Communication

Key Fish Health Decision Questions

- Pathogen ID?
- Ecology?
- Hosts?
- Virulence?
- Distribution and origin?
- Vectors?
- Elimination or containment?
- Treatment?
- Resource value affected?

Fish Health Policy

- Fish health is a food and economic security issue
  - Nearly all fish pathogens are not human pathogens
- Must have a firm science-based policy basis
  - GLFHC Model Fish Health Program and GLFC community of practice
  - Test using AFS-Bluebook or OIE procedures
  - Coordinated processes, procedures and communication
  - Require inspections for importations and transfers
  - Require all private stockings of public waters and bait industry to use inspected and certified fish with species specific testing
    - Salmonids - VHSv, IHNv, ISAv, IPNv, and *Myxobolus cerebralis*
    - Other species – LMBv, *Heterosporis sp.*, STN Herpesviruses, SVCv, KHV, FMNv, GOSv
    - Based on host sensitivity, virulence, and transmission to other species

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Fish Health Staffing and Budget

- Staffing
  - Policy and Analysis (0.3 FTE)
    - Gary Whelan
    - Edward Eisch
  - Field sampling from units
  - Coordination (0.5 FTE)
    - Jeremiah Blaauw
  - Laboratory (PERM – MSU AAHL)
    - Dr. Thomas Loch
    - Michelle Gunn Van Deuren
    - Many grad and undergraduate students
- Annual Budget
  - Approx. $450,000-$500,000 (1.5%)

Surveillance – Broodstocks

- All feral broodstocks tested annually
  - Steelhead
  - Chinook and Coho Salmon
  - Walleye
  - Muskellunge
  - Lake Sturgeon
- Captive broodstocks – Tested multiple times annually
  - Brook and Lake Trout
  - Brown and Rainbow Trout

Best Case Wild Fish Surveillance

- Use temporal and spatial sampling design
  - Fixed and random sites like our Status and Trends sampling
- Use citizen scientists as an initial screening tool
- Sentinel sites - key initial pathogen locations
  - Duluth, Sault Ste. Marie, Chicago, Detroit, Toledo, Cleveland, Welland Canal, Toronto, Hamilton, and Montreal
  - High use waters – Houghton Lake, Lake St. Clair

Wild Fish Surveillance – Current MI Approach

- Hatchery surface water supplies
  - MSFH and PRSFH
- Fish transfers from wild sources to other waters
  - Surrogate species
- *Myxobolus cerebralis* in selected waters
- Fish kill investigations
- Eyes in the Field – 380+ citizen observations since February 2018
- Lack of resources does not allow appropriate statistical design
  - Opportunistic and reactionary approach

Biosecurity

- Field
  - All gear and equipment is disinfected
- Fish Production
  - UV filters at MSFH and PRSFH
  - Individual equipment for each raceway and tank
  - Foot baths at building entrances
  - Facilities are intensively cleaned, and all dead fish removed as soon as observed
  - Mortalities closely monitored to examine for disease patterns

Biosecurity

- Fish Production
  - All fish stocking trucks are disinfected after use and limited truck transfer between facilities
  - Other than eggs and fry from broodstock facilities, fish are not transferred between facilities
  - Actively manage hatchery fish against pathogens
    - Keep different types of fish as separate as possible
    - Vaccines
    - Select against pathogen carriers
    - Cover raceways to reduce stress
    - Keep densities and stress as low as possible
    - Herd immunity used for select diseases
  - Extensive testing of production fish
- Baitfish

Testing and Inspections

- All GLFHC agencies report on their fish health findings
- Test all GLFHC Model Program pathogens for appropriate species
  - *R. salmoncida, Y. ruckeri, A. salmonicida*
  - VHSv, IHNv, ISAv, IPNv, EEDv (Salmonid herpesvirus 3), White sturgeon iridovirus, Sturgeon herpesviruses
  - *M. cerebralis, Heterosporis* sp.
- Test broodstocks, production, and transfer fish
- MSU- AADL Testing Totals – FY2021
  - Total cases – 169 (6573 fish)
  - Inspections – 124 (5703 fish)
  - Diagnostic – 31 (591 fish)
  - Wild Fish Diagnostics and kills – 15 (279 fish)

Disease Treatment

- Complete diagnostic testing done on affected hatchery fish
- Use available chemicals and drugs that are registered or under INAD
  - Vet scripts also used but infrequently
- For all bacterial pathogens, we test antibiotic susceptibility before treatment
  - Prevent antibiotic resistance

Research

- Developing pathogen histories
  - Analyses of published Great Lakes parasites completed
  - Analysis of published inland Michigan fish parasites in draft manuscript
  - Whirling disease history in Michigan in progress
  - Histories on BKD, EEDv and TDS planned
- Database refinement and population, and trend evaluation of current data in progress
- Statistical sample sizes in progress with PERM faculty
  - Standard sample sizes are based on wrong statistical model
    - Standardized random instead of clumped

Research

- MSU-AADL (PERM)
  - Flavobacteria control work
  - Pathogen challenge experiments
    - VHSv susceptibility for White Suckers
  - STN pathogen analysis
  - PKD test development

Public Communications

- The public notices dead fish
  - Respond to all public inquires and Eyes in the Field Reports
- If it bleeds, it leads with the press
  - Get confirmed information out into the press on fish kill events
  - Proactive with fish health press releases
    - Winter and summerkill
- Emphasize epizootic risk from fish pathogens
  - Viruses – None
  - Bacteria and fungi – Mostly none
  - Parasites – None if cooked
    - Freshwater fish – Do not eat raw fish products

Questions or Comments

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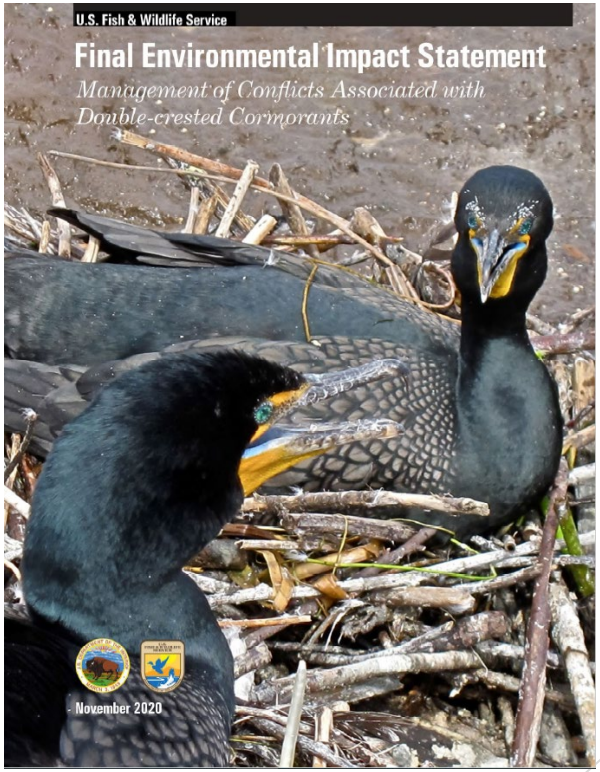
Managing the Cormorant-Fisheries Conflict in Michigan

Presentation to the Natural Resources Commission, Wildlife Committee, June 9, 2022

Randy Claramunt – Lake Huron Basin Coordinator, Fisheries Division
Sherry MacKinnon – Wildlife Ecologist, Upper Peninsula, Wildlife Division

Timeline for Cormorant Management

- Public Resource Depredation Order (PRDO) **2003-2016**
- The PRDO **vacated** in **2016**
- **Testified** in Committee on Natural Resources, U.S. House of Representatives, **2018**
- **Additional Hearing** Subcommittee on Oversight and Investigations, U.S. House of Representatives, Alpena, **2018**
- New **Environmental Impact Statement 2020**
- Special Double-crested Cormorant **permit system** established in **March 2021** for State or Tribal fish and wildlife agencies
- State permit approved on April 16 allowing take of 9,650 birds and 1,400 nests across 6 colonies, 6 stocking sites, and 2 lakes



Example of the Conflict – Saginaw Bay

Cormorant – Depredation Orders vs Permits

- Depredation Order:
  - Goal is to reduce economic loss
  - Implemented via the 2003 EA
  - Broad application (all lands and freshwaters in 24 states)

- Depredation Permits:
  - Authorized take to reduce damage caused by birds or to protect human health and safety or personal property
  - Specific number of individuals from a specific site by specified individuals
  - Intended to provide short-term relief until long-term solutions can be implemented

New State Permit System: Interior Region

Maximum allowable take for each subpopulation of cormorants in the lower 48 states

Cormorant Subpopulation	States included in Subpopulation	Maximum Allowable Take Per Year Across Subpopulation
Atlantic	GA, NC, SC, CT, MA, MD, ME, NH, NJ, NY, PA, RI, VT, VA	37,019
Florida	FL	1,314
Interior	NM, OK, TX, IL, IN, IA, MI, MN, MO, OH, WI, AL, AR, LA, KY, MS, TN, CO, MT, WY, KS, NE, ND, SD	78,632
Western	ID, OR, WA, AZ, UT, CA, NV	4,539
Total		**121,504**

- Permit information can be found at the USFWS website: https://www.fws.gov/regulations/cormorant/

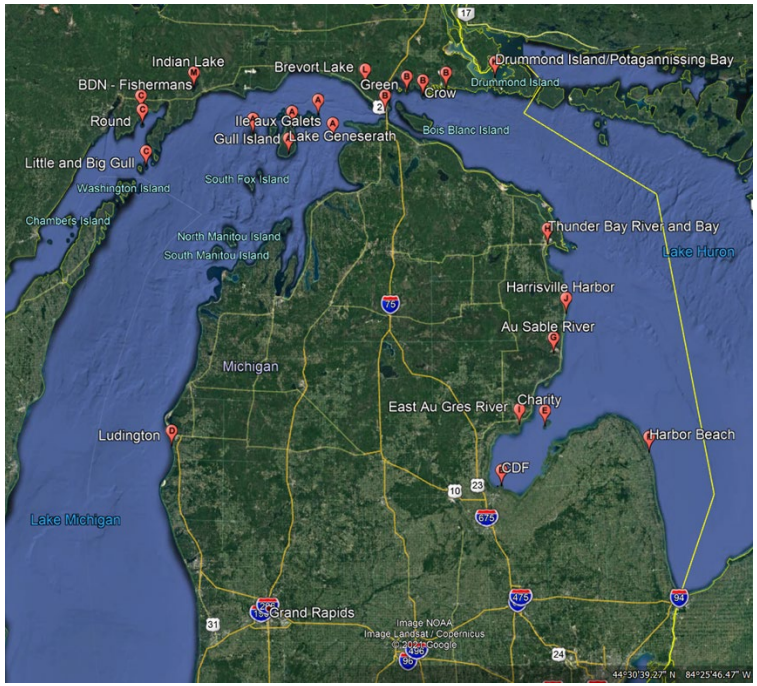
Requirements of the New Permit System

- Provide the **history** of double-crested cormorant conflicts in our state
- Provide the **size/description** of the area affected, timeline, seasons of conflict, and time of year control activities will occur.
- For each location(s), describe **non-lethal methods** used previously and/or plan on implementing
  - Hazing
  - Passive deterrents
  - Habitat management
  - Other changes

Requirements of the New Permit System

- Methods of take (i.e. shooting, nest-destroy, egg-oiling,etc.)
- Long-term plans to eliminate or significantly reduce the continued killing of double-crested cormorants or destruction of eggs/nests
- Proposed take of cormorants by life-stage (i.e. adults, active nests, etc.)

Cormorant Management Results - 2021



- Large spatial distribution of sites
- Three methods:
  - Fish stocking sites
  - Inland waterbodies
  - GLs Colonies
- Justification(s) provided in permit
- Approved permit issued on April 16, 2021
- Total of 11,050 approved including DCCO take of 9,650 and active nest take of 1,400

Cormorant Management Results - 2021

- Outreach and input from local biologists and stakeholders throughout the year
- Our reported adult take was 2,529 and 1,097 nests at colonies only
- Utilized only one sub-permittee, USDA-Wildlife Services
- Structured-Decision Making (SDM) study

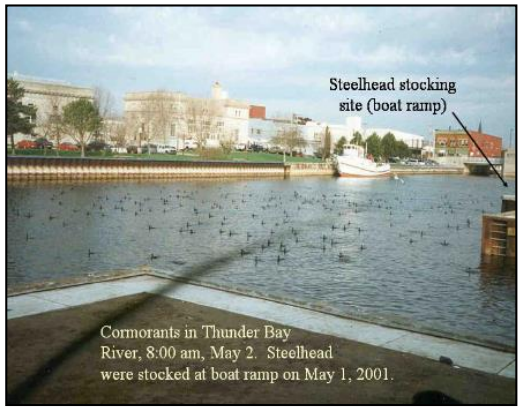
Cormorant Management Results - 2021

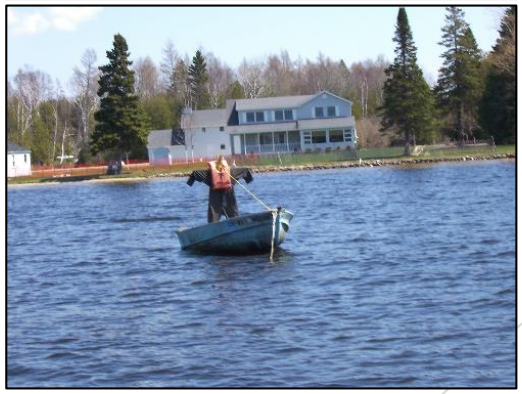
- Successfully completed report requirements and permit request for 2022 at similar take levels
- Fisheries and Wildlife Division administration and requirements are high
- Long-term funding and support needed
- Minimal use of non-lethal harassment techniques because of program limitations

Cormorant Management Techniques

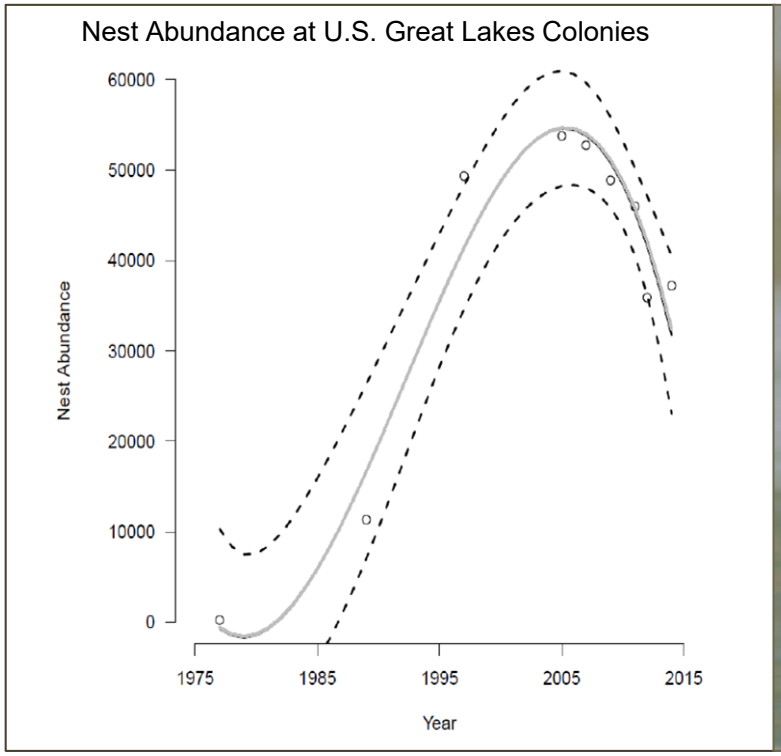
Non-lethal Approaches

- Harassment or animal behavior modification
- Avian Predator Notification (APN)
- Move locations of visual and auditory deterrents
- Begin when birds first arrive on location
- Consistent harassment and development of new techniques for our application





Cormorant Abundance



Wyman et al. Report, 2016

Questions?

Randy Claramunt – claramuntr@michigan.gov
Sherry MacKinnon - MackinnonS@michigan.gov

2021 DEER HARVEST SURVEY

Brian Frawley
June 9, 2022

MAJOR CHANGES IN 2021

- Universal antlerless deer licenses were available without application (maximum=10). These licenses could be used to take an antlerless deer on public or private land in any deer management unit open to antlerless deer hunting.
- In the Upper Peninsula, antlerless deer harvest was restricted in new DMUs 351 and 352. To hunt in these DMUs, hunters needed an antlerless deer hunting access permit AND a universal antlerless deer license. Access permits were distributed via a drawing.

2021 DEER HARVEST SURVEY

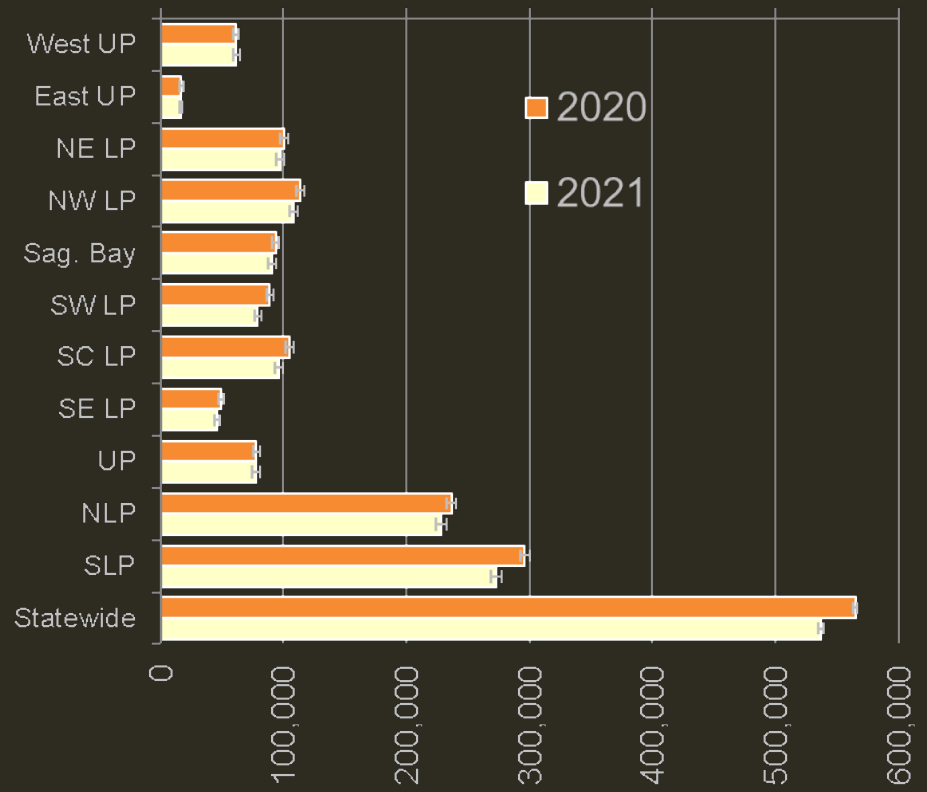
- 593,160 people purchased a license (3.7% decrease)
- 19,776 of 60,332 questionnaires returned (33% response)
- Estimates standardized to be comparable with estimates from previous years

HARVEST TAGS SOLD, 2019-2021.

Harvest Tags Issued	Number sold in 2019	Number sold in 2020	Number sold in 2021	Change Between 2020 and 2021 (%)
Deer	201,987	153,802	140,124	-8.9
Combination	709,116	872,806	861,580	-1.3
Antlerless	350,481	332,717	309,835	-6.9
Mentored Youth	10,142	12,020	11,014	-8.4
Total Harvest Tags	1,271,726	1,371,345	1,322,553	-3.6

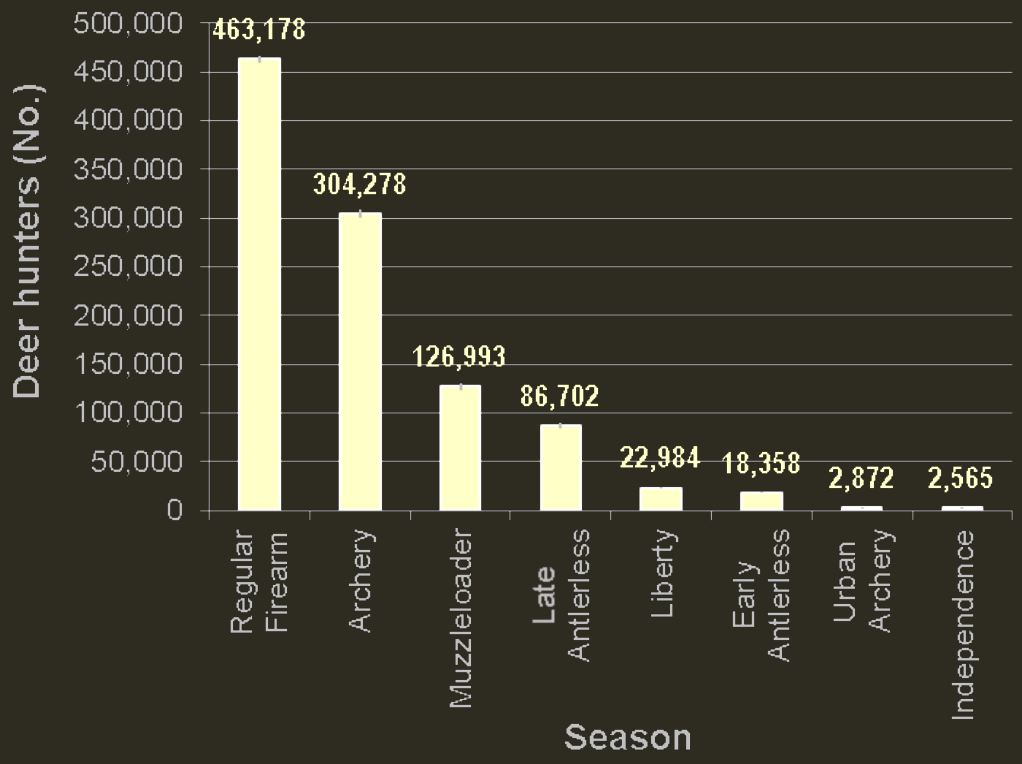
2021 DEER HUNTERS

- For all seasons combined, 537,014 people hunted deer, which was nearly 5% fewer than last year.
- Hunter numbers declined significantly in the NLP (-3.5%) and SLP (-7.6%).

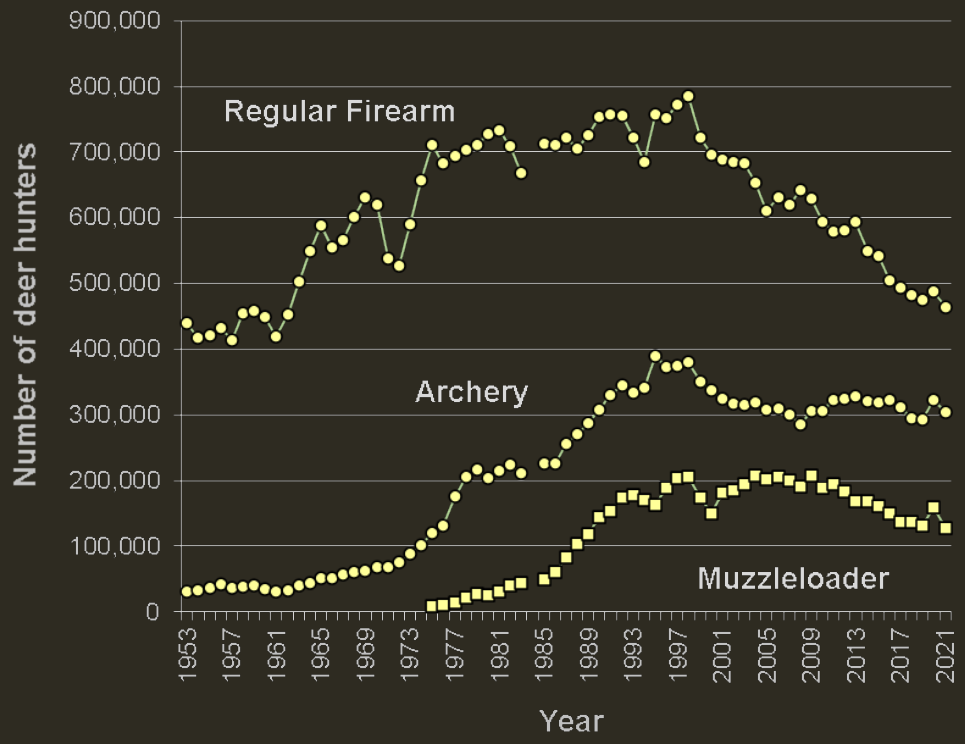


2021 DEER HUNTERS

Hunter numbers decreased significantly in all seasons except the late urban archery hunt.



LONG-TERM DEER HUNTER TRENDS

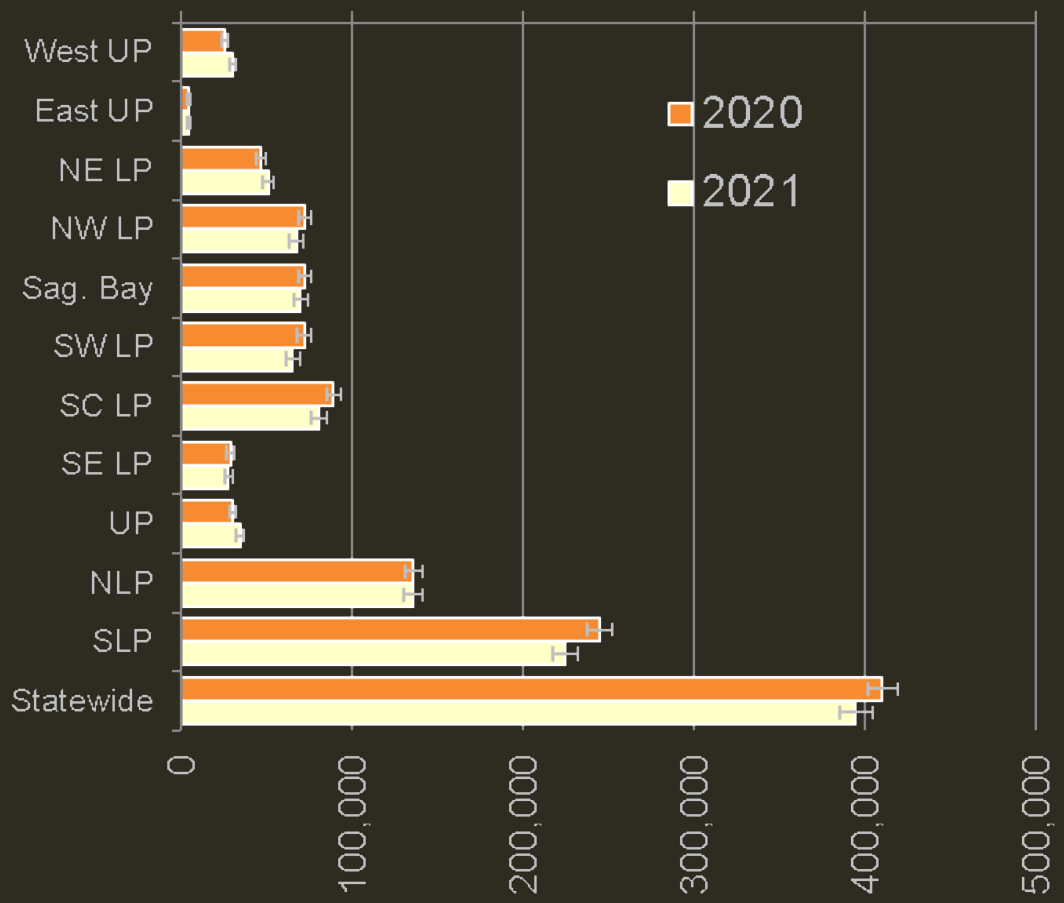


Fewer people hunting during the regular firearm and muzzleloader seasons.

The number of archers has been relatively stable.

2021 DEER HARVEST

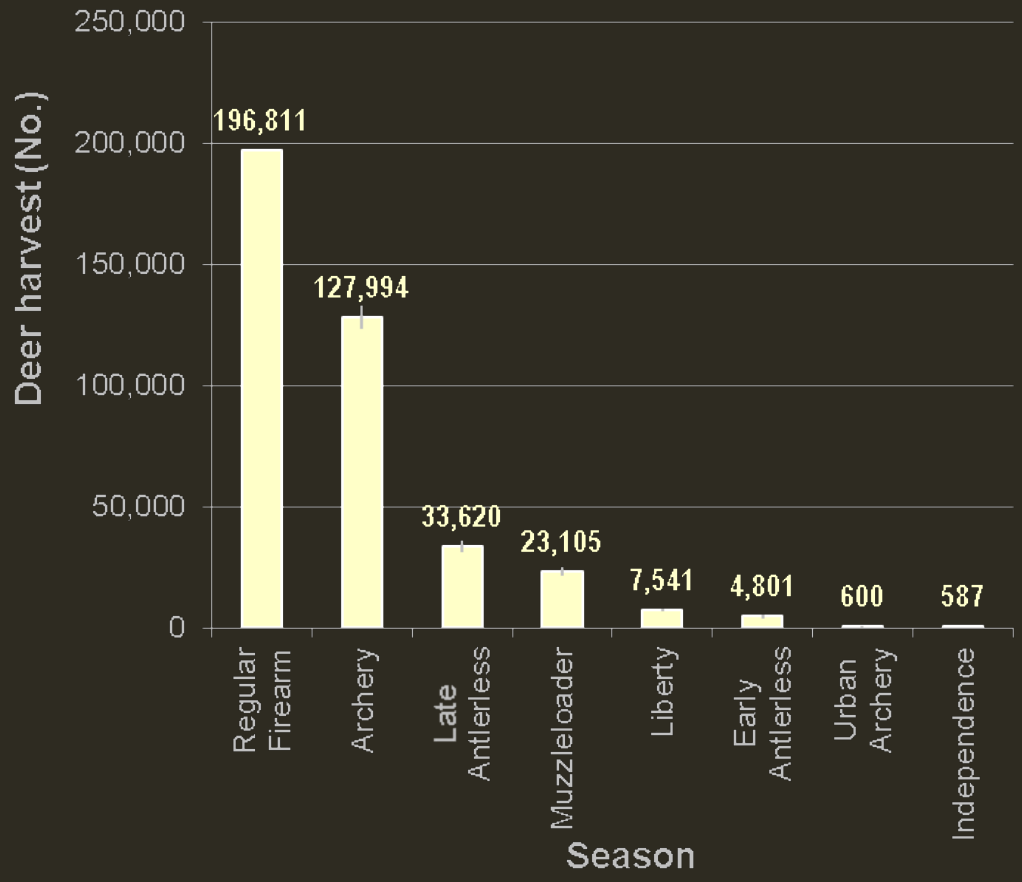
- In all seasons combined, 395,059 deer were harvested, which was not significantly different from last year (410,639).
- Buck harvest was not significantly different from 2020, but antlerless deer harvest decreased by 10%.
- Harvest decreased significantly in the SLP (8%).



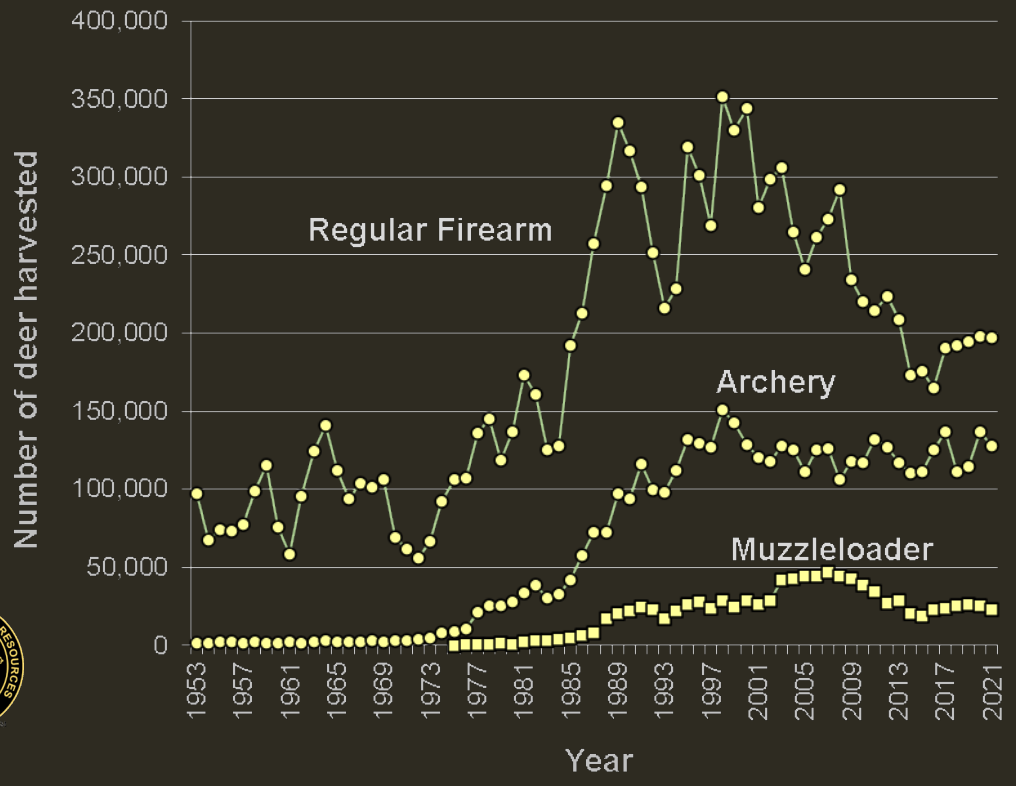
2021 DEER HARVEST

Harvest decreased significantly in the early antlerless (-43%) and Liberty (-24%) seasons

Harvest was unchanged in the remaining seasons.



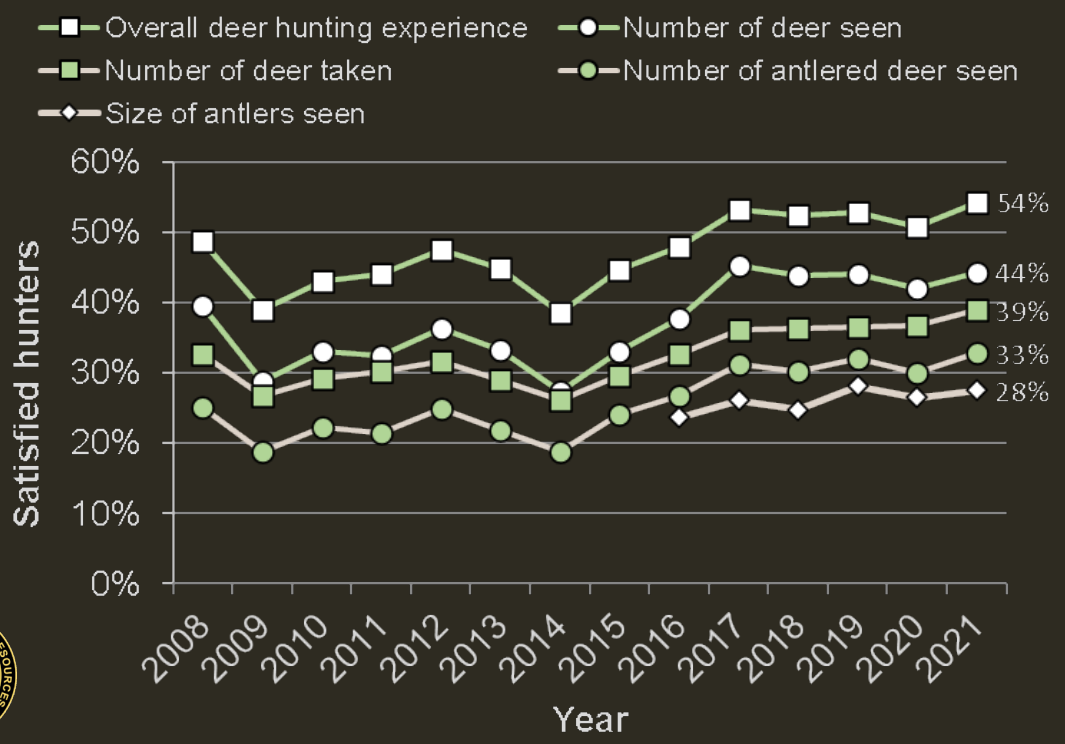
LONG-TERM DEER HARVEST TRENDS



Fewer deer taken during the regular firearm and muzzleloader seasons.

Harvest in archery season has been stable.

DEER HUNTER SATISFACTION



All levels of satisfaction increased, except for the size of the antlers

Experience (54%)*

Deer seen (44%)*

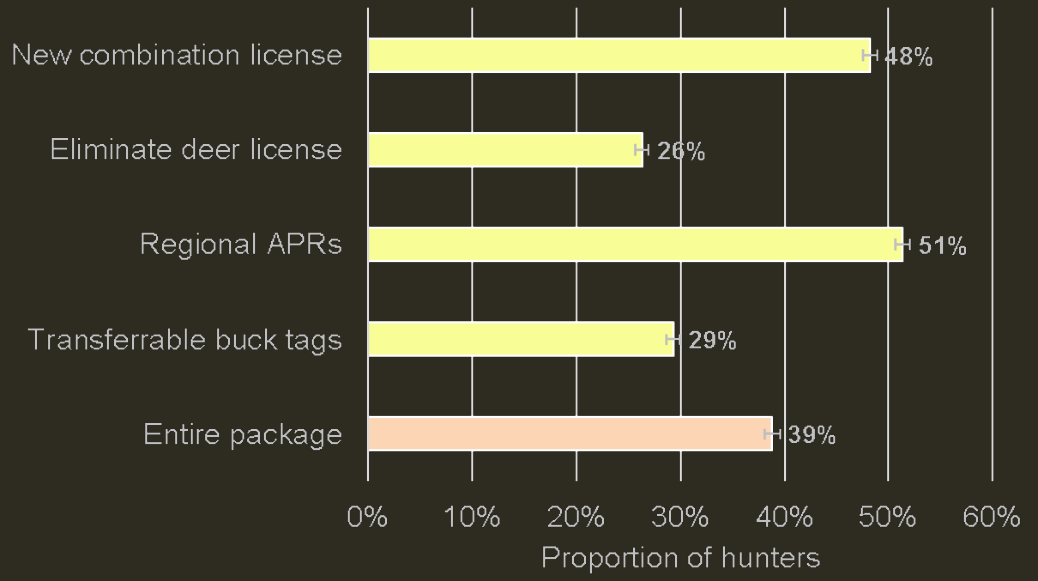
Deer taken (39%)*

Bucks seen (33%)*

Size of antlers (28%)

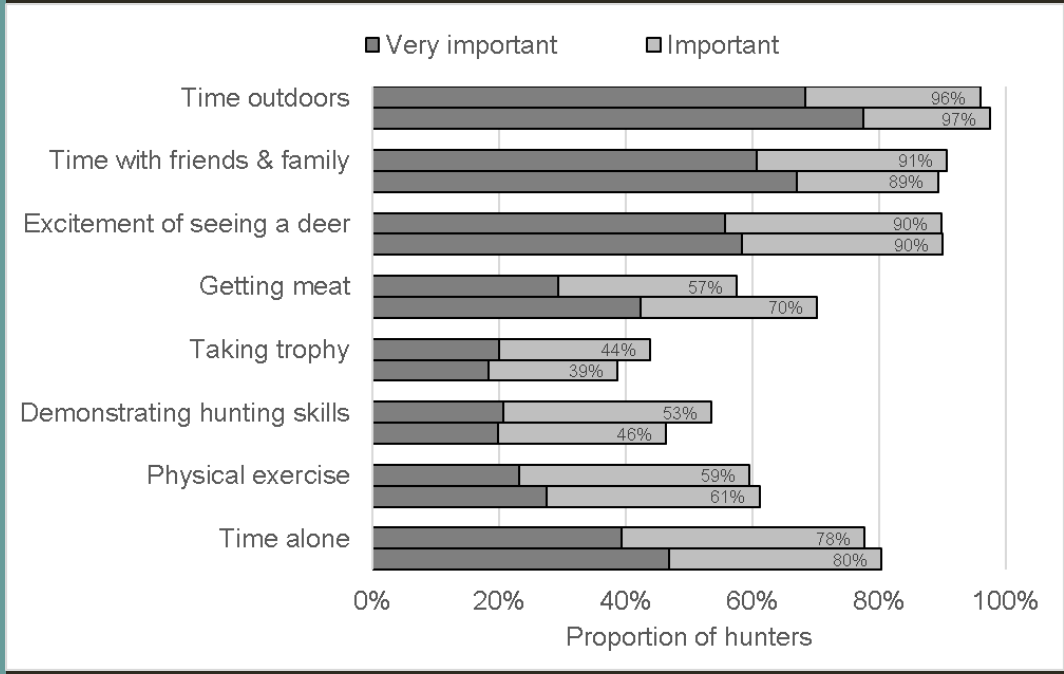
POTENTIAL DEER REGULATIONS

- 48% of hunters supported changing the combination license (1 buck and 1 doe statewide)
- 26% supported eliminating the single deer license
- 51% supported regional APRs on the buck tag
- 29% supported allowing hunters to transfer an unused buck tag
- 39% supported combined package (all 4 items)



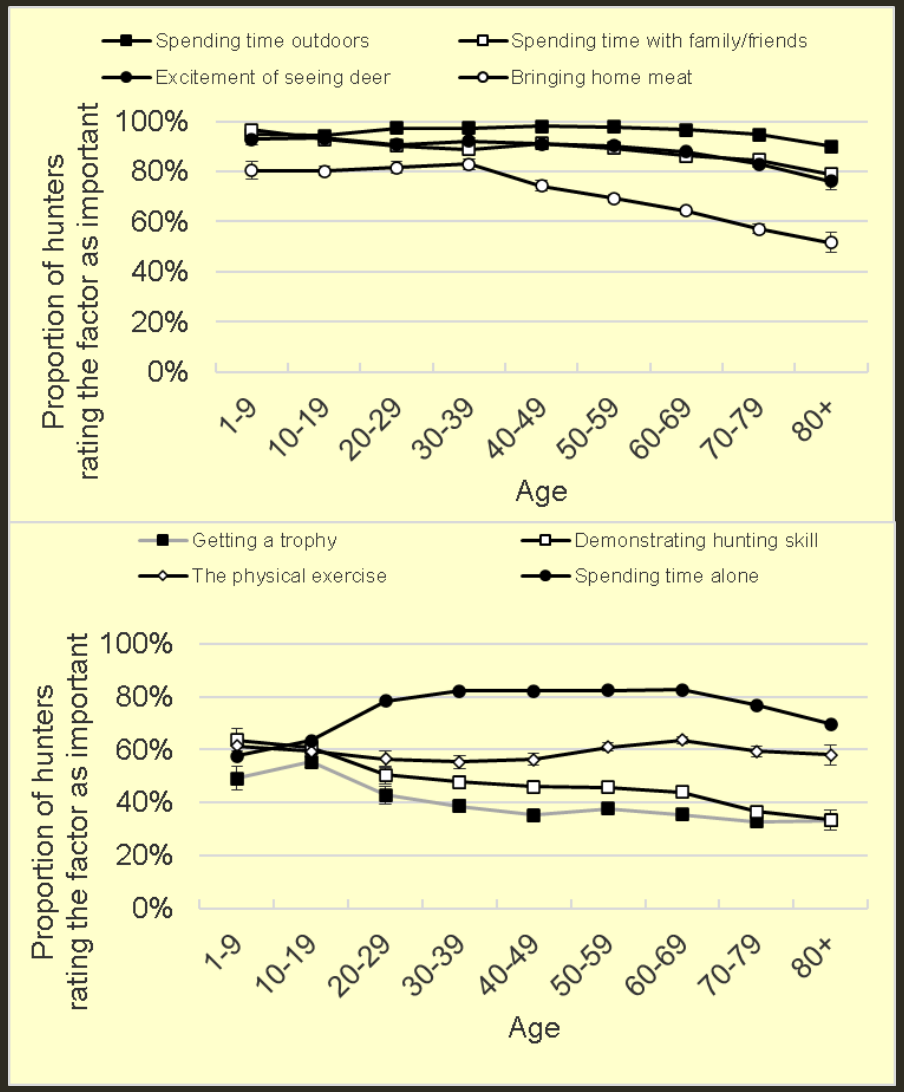
REASONS TO DEER HUNT

- The most important reasons why hunters enjoy hunting deer were (1) spending time outdoors, (2) spending time with friends and family, (3) experiencing excitement from seeing a deer, and (4) spending time alone in the field.
- Hunters placed more importance on bringing home meat for food in 2021 than hunters in 2006.



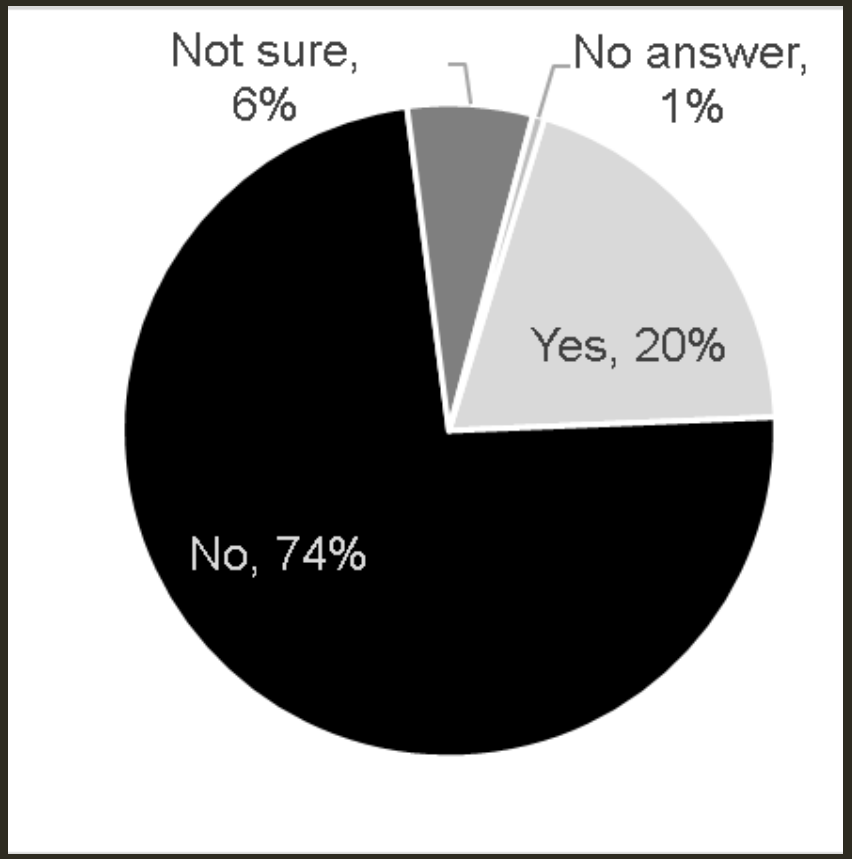
REASONS TO DEER HUNT

- Bringing home meat, getting a trophy, and demonstrating your hunting skills are generally less important as hunters get older.



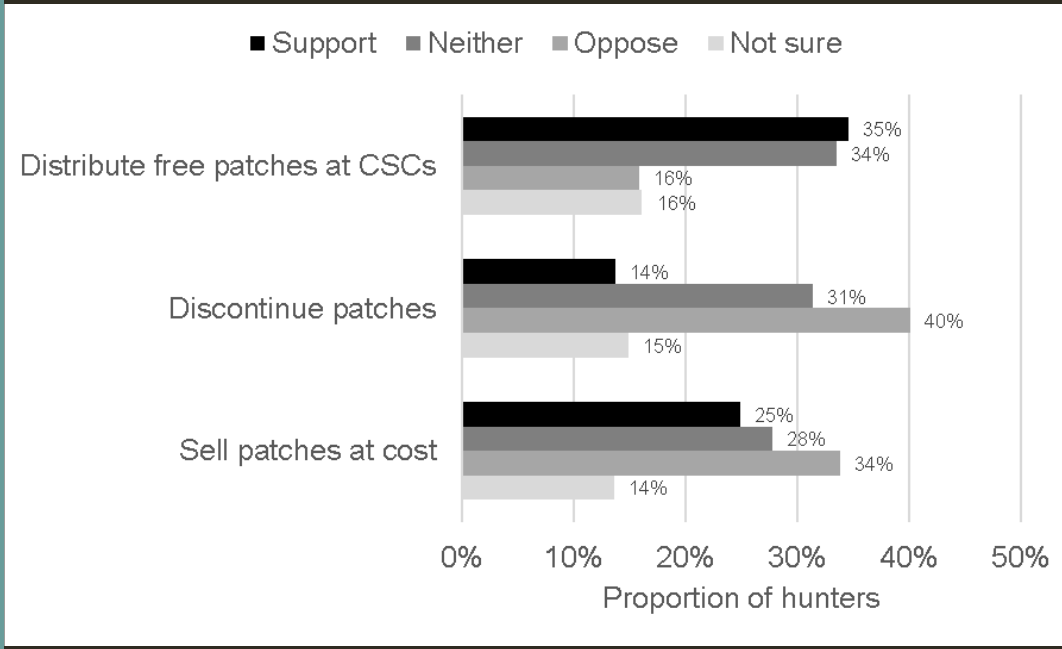
THE DEER PATCH PROGRAM

- About 20% of deer hunters tried to obtain a free patch if they harvested a deer.



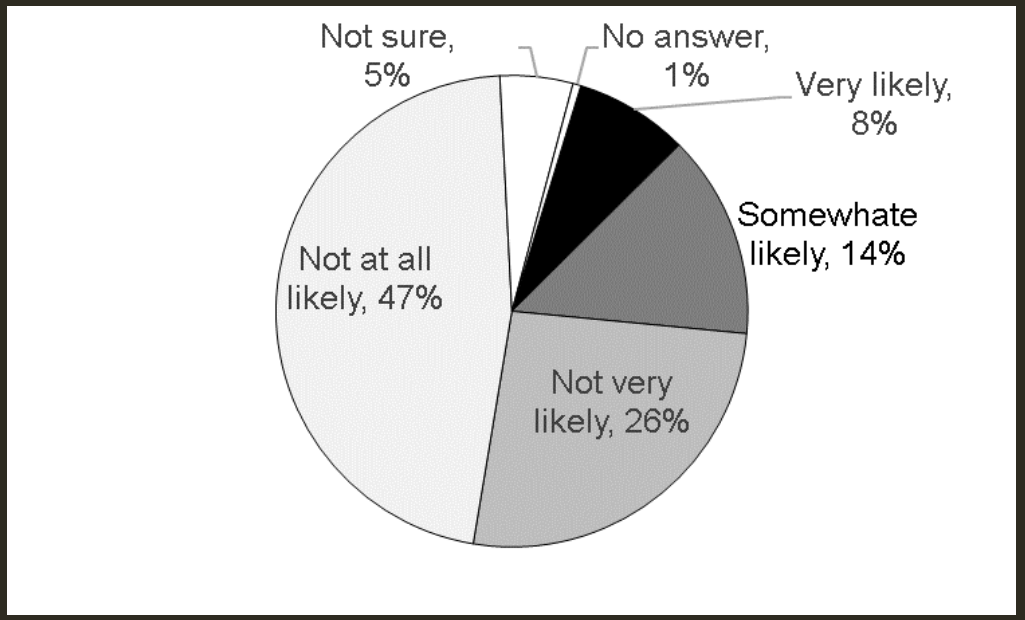
OPINIONS ABOUT THE FUTURE OF THE DEER PATCH PROGRAM

- None of the options were selected by most of the hunters.



HOW LIKELY IS IT THAT HUNTERS WOULD PURCHASE A PATCH IF IT COST $5?

- 8% very likely to buy a patch
- 14% somewhat likely to buy a patch
- 78% unlikely to purchase a patch or not sure



SUMMARY

- Nearly a 4% decrease in the number of license buyers.
- Nearly a 5% decrease in the number of people that went afield.
- Overall harvest was not significantly different from last year (buck harvest was unchanged but antlerless harvest decreased by 10%).
- Most levels of satisfaction (except antler size) improved.

SUMMARY

- 39% of hunters supported the regulation package that was evaluated.
- 20% of hunters currently tried to obtain a free patch if they harvested a deer.
- 22% of hunters were very likely or somewhat likely to purchase a $5 patch.

THANK YOU