

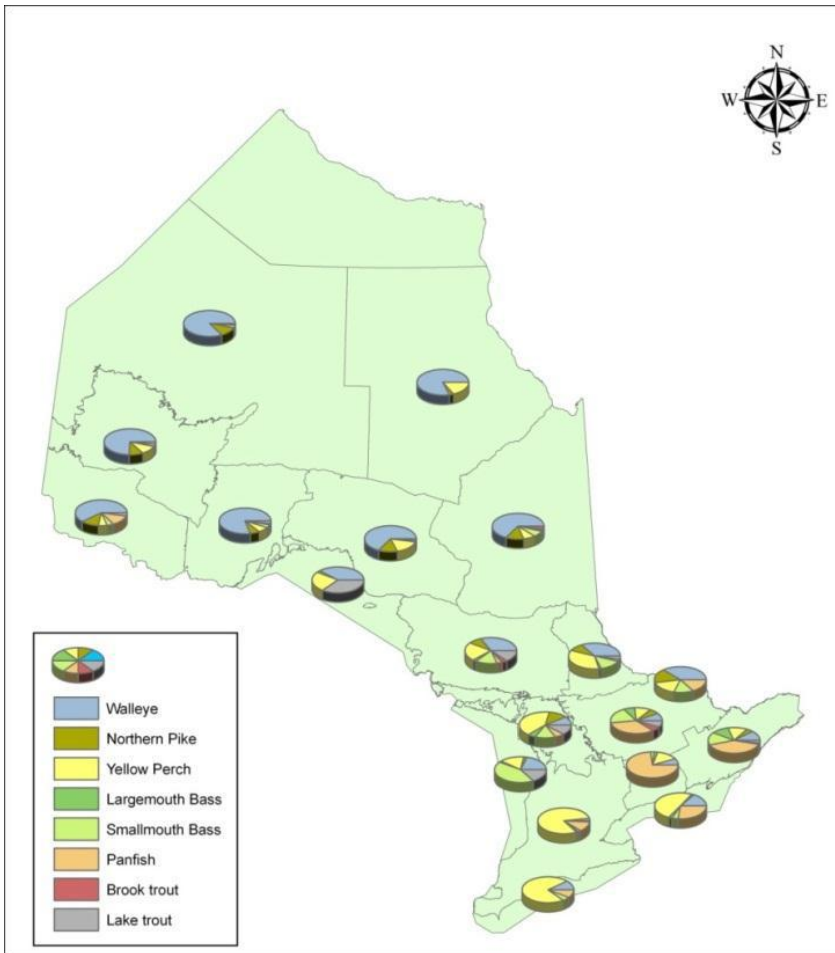
Walleye Stocking as a Management Tool in Ontario's Inland Lakes

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March 23, 2015

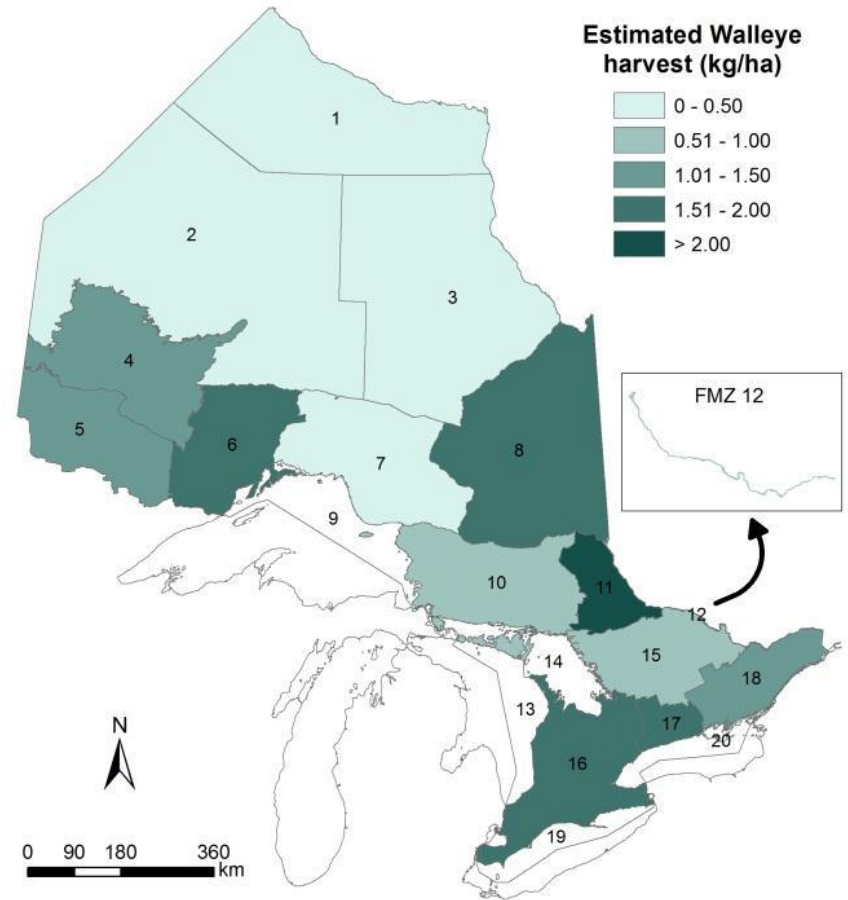
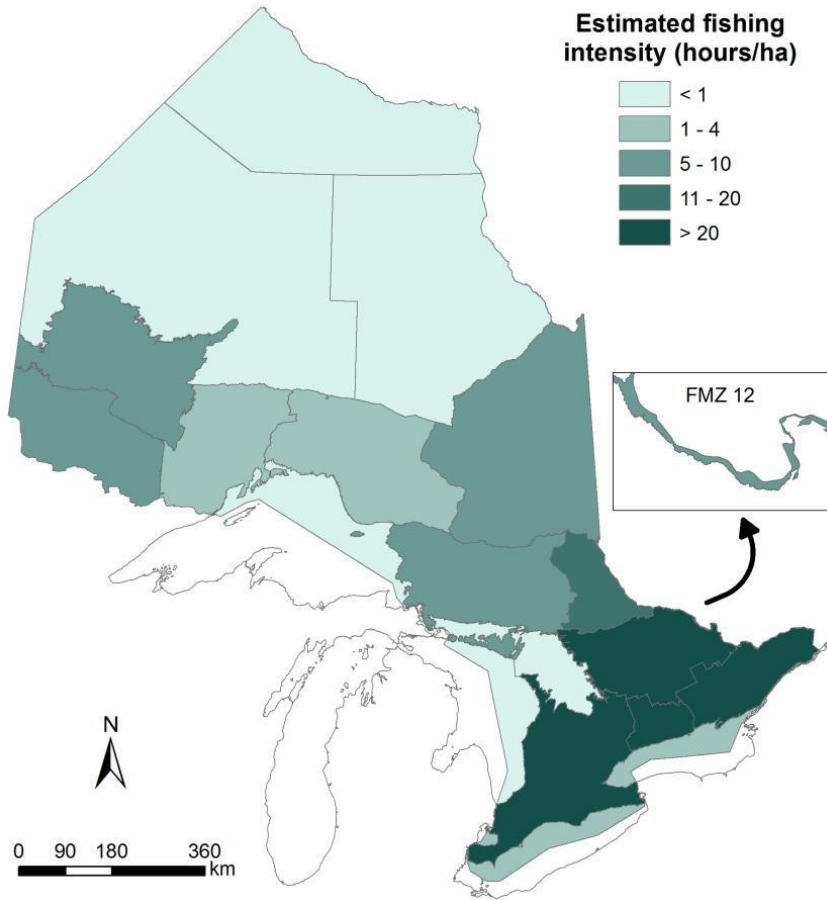
Walleye Aquaculture Workshop

We stock because people (who fish) want Walleye!

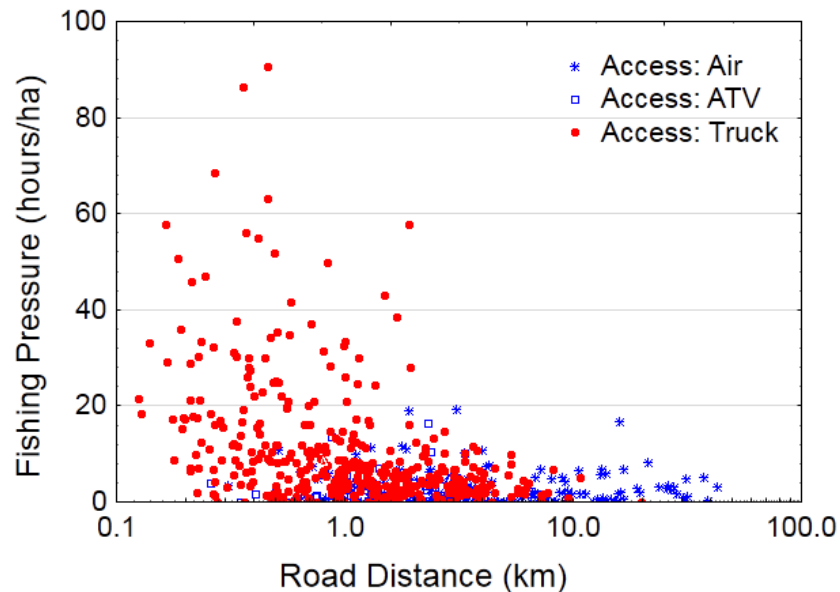


- Harvest dominated by Walleye and Northern Pike in northern zones; Walleye, Bass (Smallmouth and Largemouth) and Yellow Perch in central zones and Yellow Perch and panfish in southern zones

We stock because people (who fish) want Walleye!



We stock because people (who fish) want Walleye!

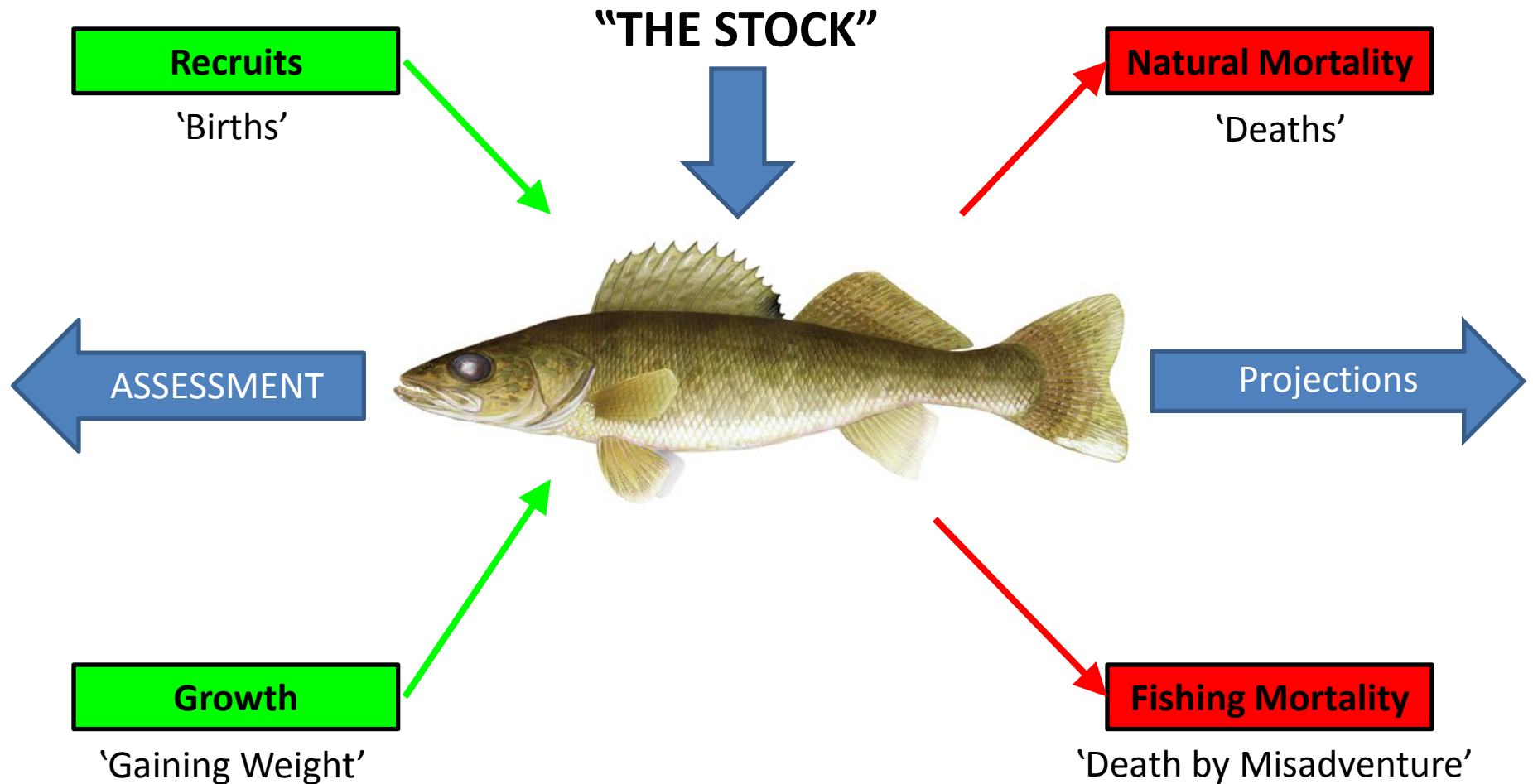


- Fishing pressure >10 hours \cdot ha $^{-1}$ generally lead to overfishing
- Increased access \approx Increased fishing pressure + Increased species introductions

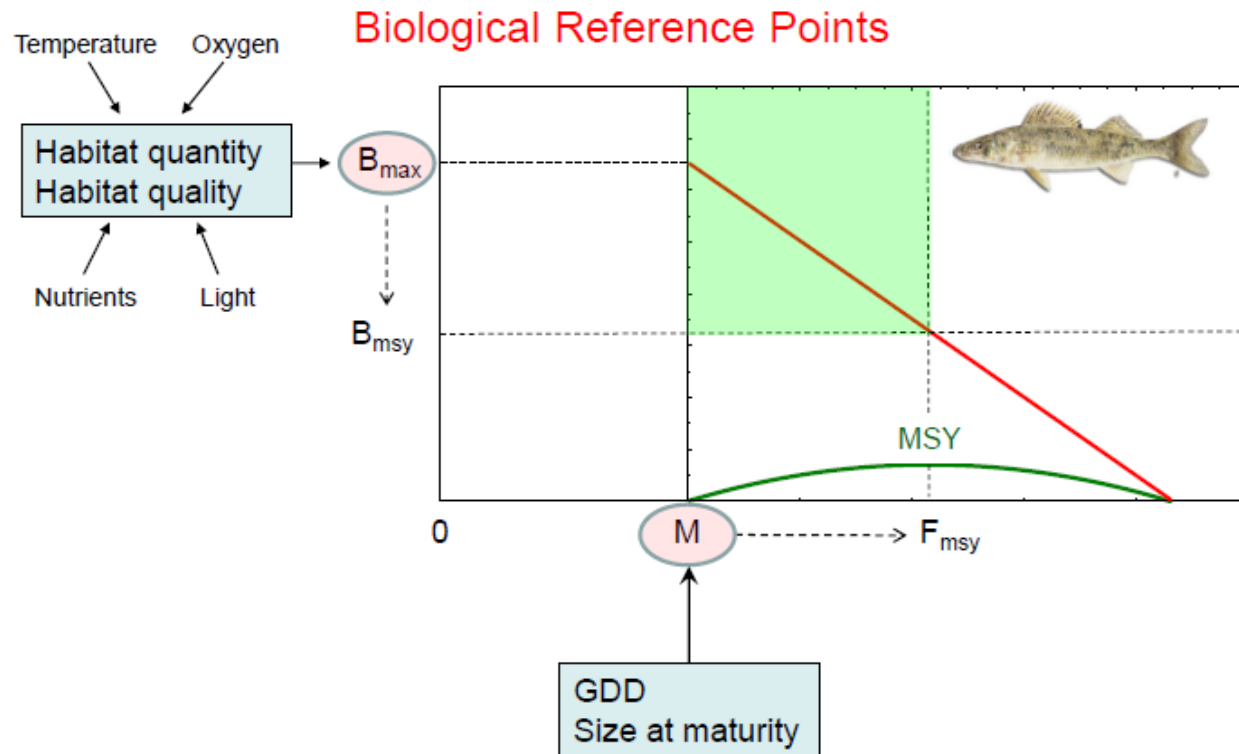


How do we manage Walleye?

Finds the values for the boxes and arrows, over time



We happen to know a lot about Walleye!

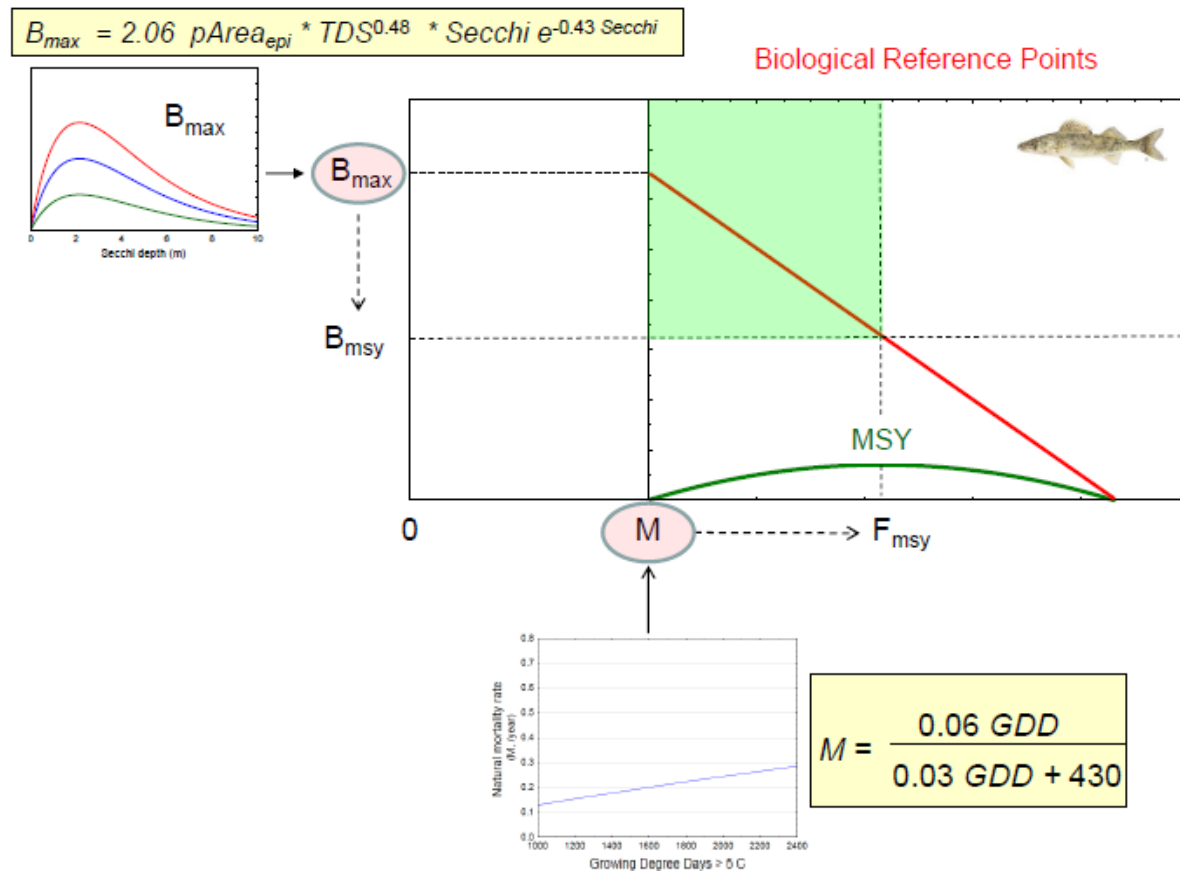


Lester et al. 2004a
(TOHA model)

Lester et al. 2004b
(Biphasic growth)

Lester et al. 2014
(Life history plasticity)

So we can determine how much Walleye a lake can produce and determine population status





Guiding Documents in Ontario

- Walleye Stocking as a Management Tool (OMNR 1996)



- Guidelines for Stocking Fish in Inland Waters of Ontario (OMNR 2002)



- Walleye Stocking Guidelines – New/Current Science (OMNR 2006)

Walleye Stocking as a Management Tool

When is Walleye stocking justified?

- Identify the problem
- Examine characteristics of the recipient waterbody
- Define stocking objectives and criteria for success
- Develop a stocking plan

Walleye Stocking as a Management Tool

Identify the problem

- A complete review of factors responsible for the absence or decline of the population should be undertaken
- Management techniques other than stocking may be appropriate
 - Habitat restoration, rehabilitation or creation
 - Harvest control

Walleye Stocking as a Management Tool

Characteristics of Recipient Waterbody

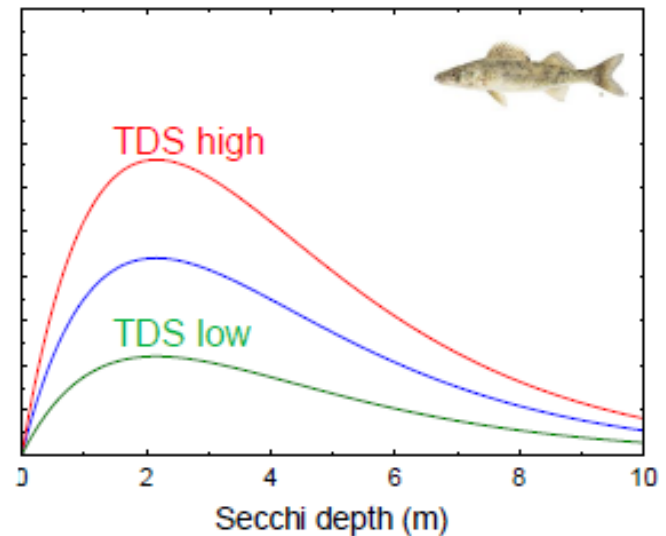
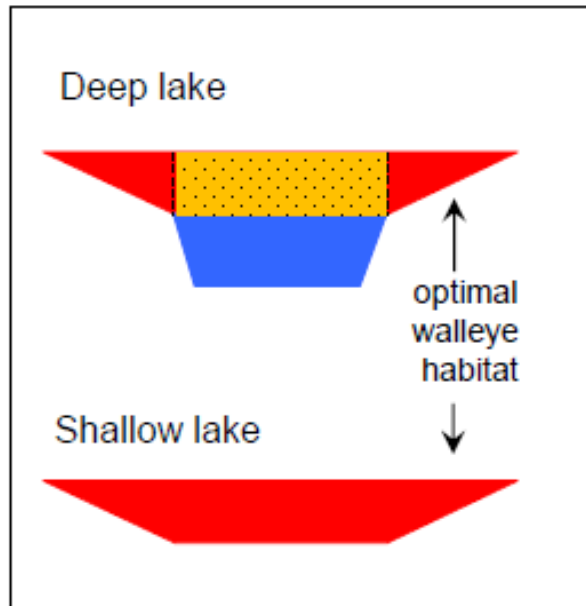
- Available habitat → TOHA
- Resident fish community → prey/competitors
- Location of waterbody → Public access
- Existing fishery

Thermal-Optical Habitat Area (TOHA)

Transactions of the American Fisheries Society 133:588–605, 2004
© Copyright by the American Fisheries Society 2004

Light and Temperature: Key Factors Affecting Walleye Abundance and Production

$$B_{max} = 2.06 \text{ } pArea_{epi} * TDS^{0.48} * Secchi e^{-0.43 \text{ } Secchi}$$



Walleye Stocking as a Management Tool

Stocking objectives and criteria for success

- Creation of a new self-sustaining fishery
- Rehabilitating a fishery
- Research and assessment
- Provision of angling opportunities

Walleye Stocking as a Management Tool

Develop a stocking plan

- Time frame a duration of stocking activities
- Strain of Walleye and source population
- Age and size of fish to stock
- Stocking rate and frequency of stocking
- Identification of stocked Walleye
- Stocking technique
- Stocking assessment
- Evaluation of stocking project

Guidelines for Stocking Fish in Ontario

Egg Collections

- The source of the donor stock for rehabilitation programs should be (in order of priority): (i) from the remnant stock; (ii) from a nearby sympatric stock; (iii) from a waterbody in the same watershed or with similar limnological and geological history
- Introductions (including adult transfers) should occur within the same tertiary watershed or from the closest water outside the tertiary watershed with similar limnology and geological history

Guidelines for Stocking Fish in Ontario

Egg Collections (continued)

- For rehabilitation and introductory stocking the spawning habitat (e.g., shoal vs. river) of the donor and recipient waterbody should be matched as closely as possible
- To maximize genetic diversity in small egg collection projects, separate eggs from individual female fish into several lots and fertilize each lot with a different male fish

Guidelines for Stocking Fish in Ontario

Egg Collections (continued)

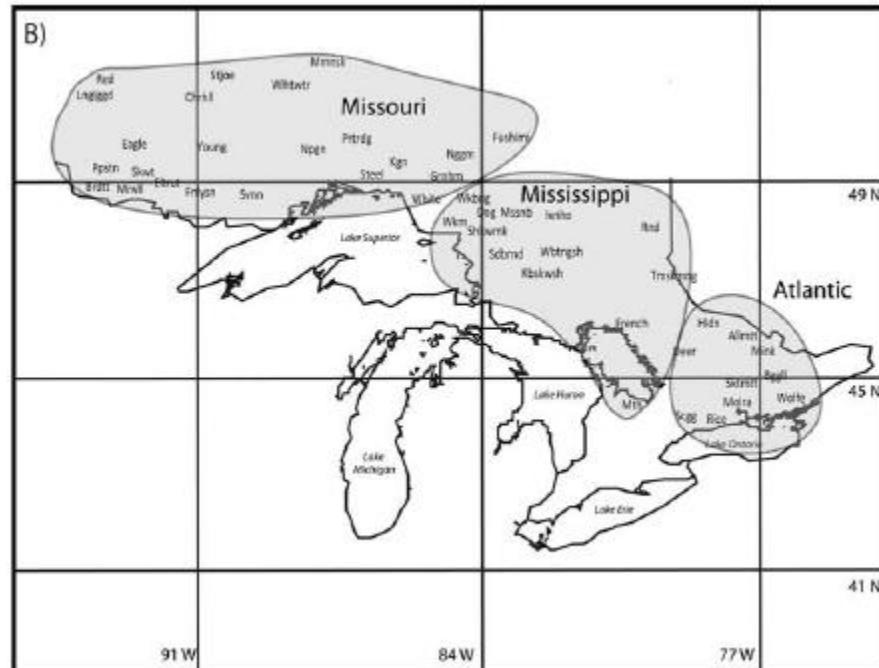
- For rehabilitation or introductions from hatchery-reared Walleye, the genetic base of the donor stock should be preserved in the cultured stock by using the formula:
Effective Population Size (N_e) = $4(N_m N_f) / (N_m + N_f)$; $N_m > 50$ and $N_f > 10$ (where N_m = number of male fish and N_f = number of female fish) and by sampling the donor parents over the entire spawning season

Walleye mtDNA Distributions

Journal of Heredity 2012;103(6):831–841
doi:10.1093/jhered/ess066
Advance Access publication November 1, 2012

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Historical and Anthropogenic Factors Affecting the Population Genetic Structure of Ontario's Inland Lake Populations of Walleye (*Sander vitreus*)



Guidelines for Stocking Fish in Ontario

Habitat Suitability

- Generally, lakes should be greater than 80ha in surface area, be relatively shallow in depth with a large littoral area, have some deepwater habitat, and an irregular shoreline. Mesotrophic-to-eutrophic waters with irregular substrates, preferred water chemical parameters and Secchi readings less than 3m are usually most productive

Guidelines for Stocking Fish in Ontario

Habitat Suitability (continued)

- Spawning habitat consists of clean cobble/rubble substrate on wind exposed shoals or in fast water tributaries. Lakes without spawning habitat should not be stocked unless the objective is to provide a put-grow-and-take fishery
- Walleye are extremely sensitive to light. Lakes having high water clarity (e.g., $> 3\text{-}4\text{m}$) are generally not suited for Walleye stocking

Guidelines for Stocking Fish in Ontario

Fish Community in Stocked Waterbody

- The presence of a varied and abundant forage base is important. Yellow Perch is one of the most preferred forage fish for Walleye
- Walleye stocking in waters containing large populations of predators (e.g., Northern Pike) or competitive fish species (e.g., Bass, panfish) should generally be discouraged

Guidelines for Stocking Fish in Ontario

Fish Community in Stocked Waterbody (continued)

- Walleye should not be stocked in oligotrophic lakes containing populations of Salmonids (e.g., Lake Trout)
- Walleye should not be stocked in waters already containing viable, naturally reproducing populations of Walleye

Guidelines for Stocking Fish in Ontario

Age/Size of Fish to Stock

- Generally, hatchery-reared Walleye should be released at the earliest life stage possible considering the trade-off between adult return rate and advantages of minimized rearing time
- Releases of eyed eggs should be limited to rehabilitation stocking on reefs or riverine spawning sites where there is a likelihood of imprinting

Guidelines for Stocking Fish in Ontario

Age/Size of Fish to Stock (continued)

- Fry should be used only for introductory and rehabilitation stocking in waters which have relatively simple fish communities and few predators
- Summer fingerlings, averaging at least 30mm in length and 0.5 grams in weight, should continue to be used as the most common life stage for most stocking programs particularly in waters which have relatively few predator

Guidelines for Stocking Fish in Ontario

Age/Size of Fish to Stock (continued)

- Advanced (fall) fingerlings should only be used in those waters having a complex fish community with an abundance of predators or where habitats for early life history stages is limiting
- Adult Walleye transfers may be preferable to the planting of younger life stages for introductory or rehabilitative purposes. An equal proportion of male and female fish, with not more than 10% exceeding 2kg in weight, should be selected

Guidelines for Stocking Fish in Ontario

Stocking Rate

- Eyed eggs should be stocked at the rate of approximately $5,000 \text{ eggs} \cdot \text{ha}^{-1}$
- Fry should be stocked at the rate of approximately $2,000 \text{ fish} \cdot \text{ha}^{-1}$
- Summer fingerlings should be stocked at the rate of $100\text{-}125 \text{ fish} \cdot \text{ha}^{-1}$
- Advanced fingerlings should be stocked at the rate of $25\text{-}50 \text{ fish} \cdot \text{ha}^{-1}$

Guidelines for Stocking Fish in Ontario

Stocking Rate (continued)

- For the transfer of adult/sub-adult Walleye the following rates should be used as a guideline:
 - i. Lakes 80-450ha: 150-200 fish
 - ii. Lakes 450-5,000ha: 1 fish for every 3ha
 - iii. Lakes > 5,000ha: consider introducing Walleye into a tertiary watershed that drains into it
- Introductions into very large lakes, even using high numbers of fish are often slow in developing natural populations

Guidelines for Stocking Fish in Ontario

Stocking Frequency

- Walleye stocking for rehabilitative or introductory purposes can be carried out annually for 2-3 years or in alternate years over a longer (e.g., 6-7 years) period of time. In bigger waters which require large numbers of juvenile Walleye, it is probably most appropriate to stock in consecutive years
- Stocking on an artificial or supplemental basis (i.e., put-and-delayed-take) basis should be conducted once every 2-3 year

Guidelines for Stocking Fish in Ontario

Stocking Frequency (continued)

- Transfers of adults/sub-adults should be considered a one-time event. If the initial stocking fails, the reason for the failure should be determined prior to restocking



Guidelines for Stocking Fish in Ontario

Timing of Stocking

- Walleye stocking activities should coincide with periods of peak food abundance, appropriate for the life stage being stocked, in the waterbody
- Capture and transfers of adult or sub-adult Walleye should be done in the spring at water temperatures not exceeding 15°C

Guidelines for Stocking Fish in Ontario

Stocking Temperature

- Walleye generally prefer water temperatures in the 18-23°C range. Rearing and holding water temperatures should be kept below 18°C and any dramatic temperature changes during handling and transport should be minimized. There should not be more than a 5°C variation in water temperatures (ideally < 3°C) between the holding and recipient water temperature. Generally, waters should not be stocked with Walleye if their temperature exceeds 26°C

Guidelines for Stocking Fish in Ontario

Walleye Transfers

- Fish taken from a river spawning population should be introduced into waters where there is an opportunity for fast-water spawning. Fish taken from shoal spawning populations should be transferred to waters having that type of spawning habitat. As a general rule, avoid mixing stream and shoal spawning populations

Guidelines for Stocking Fish in Ontario

Release Sites

- Make every effort to distribute Walleye over a number of different locations. This can be accomplished by running a boat slowly in a direction parallel to shore over sites having suitable water depths and substrates
- Release Walleye by gently submerging a smaller bucket into the water column and allowing the fish to swim out of the container
- Use a portable oxygen supply if stocking from a boat

Guidelines for Stocking Fish in Ontario

Stocking Techniques

- Fry should be stocked by boat in open water areas off the lee shore
- Fingerling Walleye should be released in nearshore sites having a moderate amount of vegetation and a relative abundance of invertebrates and small forage fish
- Adults and sub-adults should be released in an environment similar to that in the donor lake

Walleye Stocking Guidelines – New Science

Resident Fish Community

- Waters being considered for a Walleye stocking program should be surveyed to evaluate the quality of habitat and determine the fish community composition to evaluate available forage and potential predators (this condition is already identified in the fish stocking guidelines)
- The composition of the fish community should be used as a criteria to prioritize waters being considered for Walleye stocking.

Walleye Stocking Guidelines – New Science

Resident Fish Community

- Supplemental Walleye stocking should be discouraged (as stated in stocking guidelines)



Walleye Stocking Guidelines – New Science

Age/Size of Fish to Stock

- Summer fingerlings, averaging at least 30mm in length and 0.5 grams in weight, should continue to be used as the most common life stage for most stocking programs particularly in those waters which have relatively few predators
- Advanced (fall) fingerlings should only be used in those waters having a complex fish community with an abundance of predators or where habitats for early life history stages is limiting

Walleye Stocking Guidelines – New Science

Stocking Rate

- The current guidelines suggest a stocking rate in the order of 100-125 small fingerlings·ha⁻¹ but it may not always be prudent to stock at maximum densities. Lower stocking rates should be tried on an experimental basis with follow-up assessment to determine relative survival and returns to the fishery
- Stocking rates for large lakes should be based on the area of prime Walleye habitat (e.g., 3-15m in depth) instead of the entire surface area of the lake. This technique is similar to that used for Lake Trout

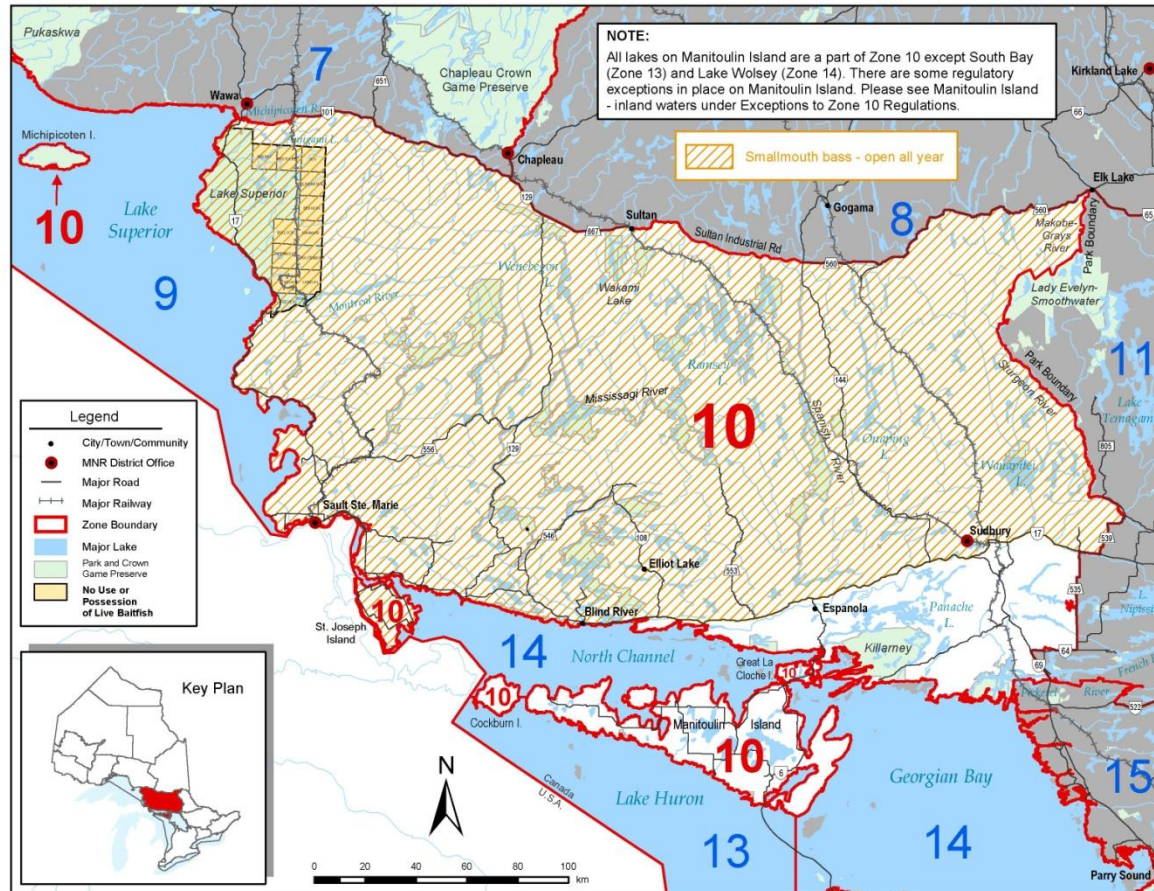
Walleye Stocking Guidelines – New Science

Stocking Frequency

- The current guidelines recommend stocking in more than one consecutive year only for introductions (where the recommendation is for a maximum of 2-3 years. Annual stocking programs should generally be discouraged
- Previous stocking history of a lake could be used as a criteria for determining the priority of a stocking proposal

Bringing it closer to home

Fisheries Management Zone 10



Fisheries Management Zone 10 Anglers

Where do Fisheries Management Zone 10 anglers reside?

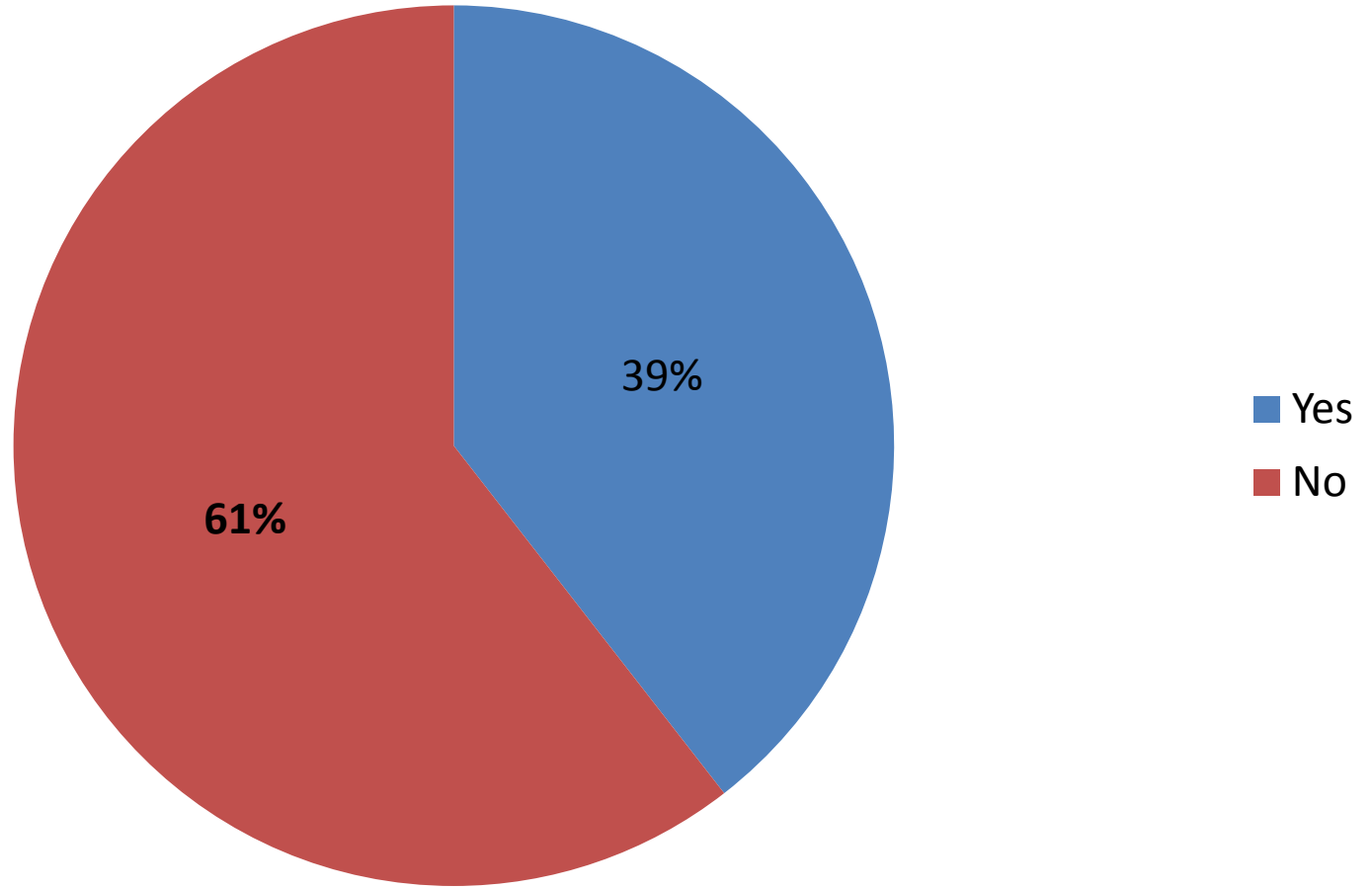
	Postal Code				
Proportion	K (eastern)	L (central)	M (Toronto)	N (western)	P (northern)
	3%	18%	4%	21%	54%

What species do Fisheries Management Zone 10 anglers prefer?

Anglers	Species Preference (#1 Choice)				
Proportion	Walleye	Bass	Lake Trout	Northern Pike	Brook Trout
	48%	17%	9%	8%	6%

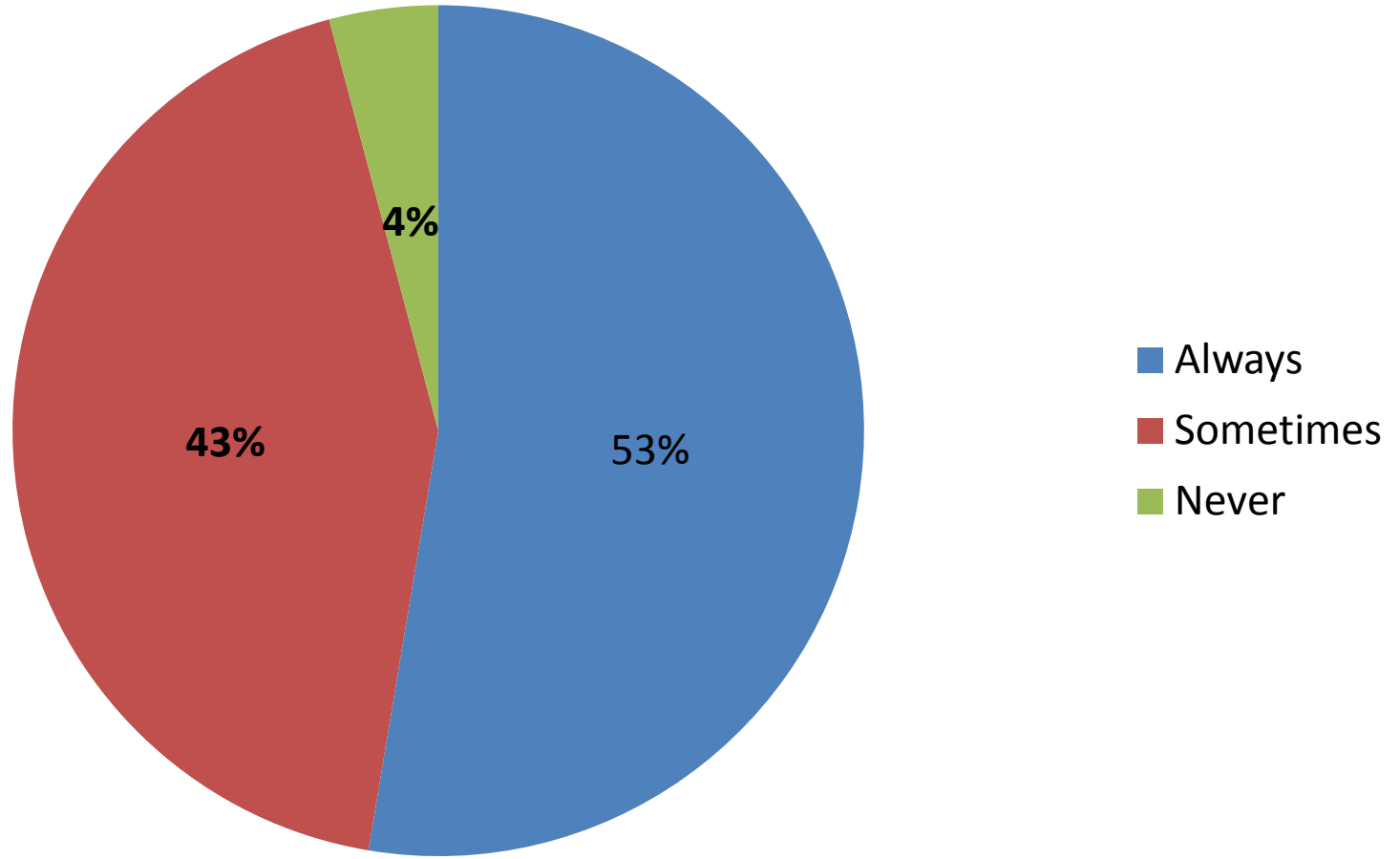
Fisheries Management Zone 10 Anglers

Do you fish stocked lakes?



Fisheries Management Zone 10 Anglers

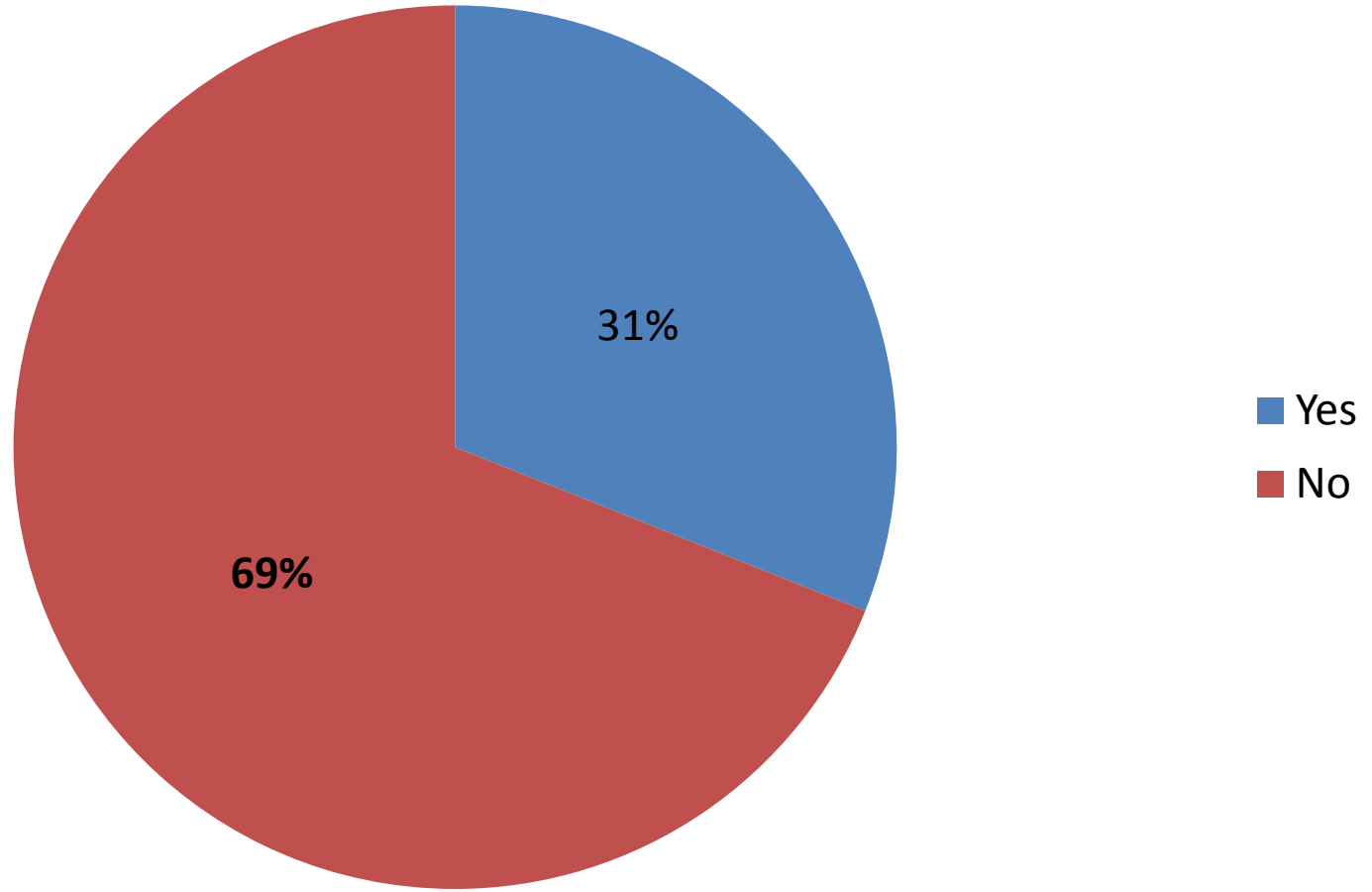
Do you fish for the stocked species?*



* In the stocked lakes

Fisheries Management Zone 10 Anglers

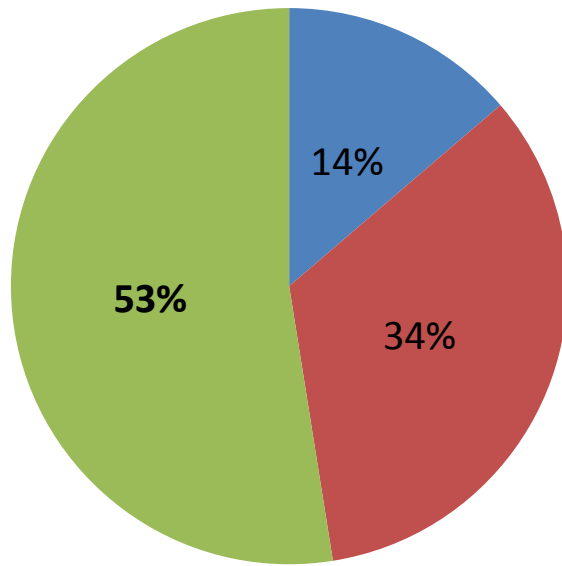
Do you know where to find a list of stocked lakes?



Fisheries Management Zone 10 Anglers

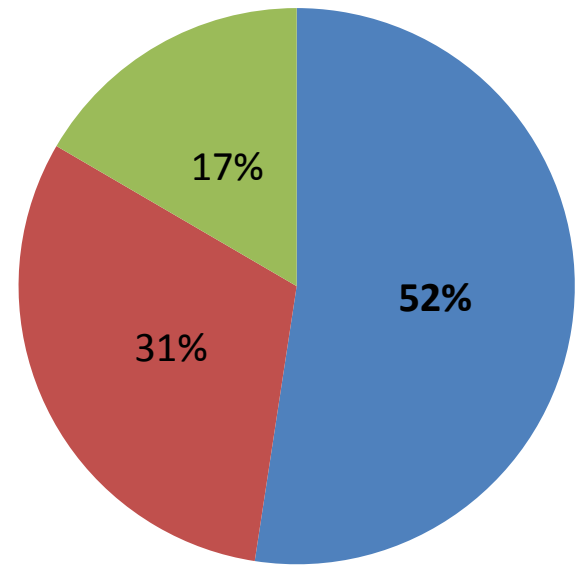
Importance of a stocked vs. wild fish

Stocked Waterbody



■ Important
■ Somewhat Important
■ Not Important

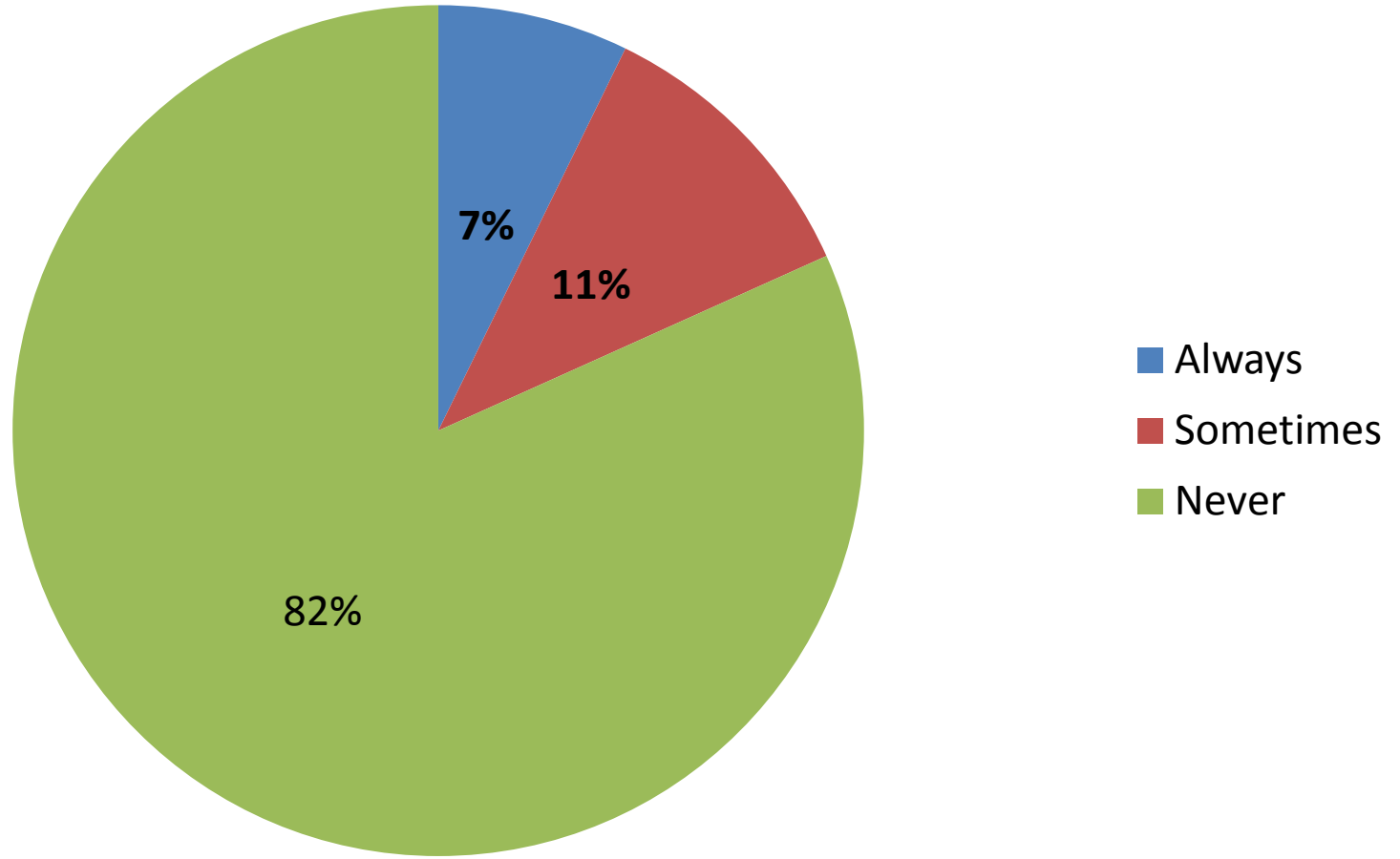
Waterbody with Wild Fish



■ Important
■ Somewhat Important
■ Not Important

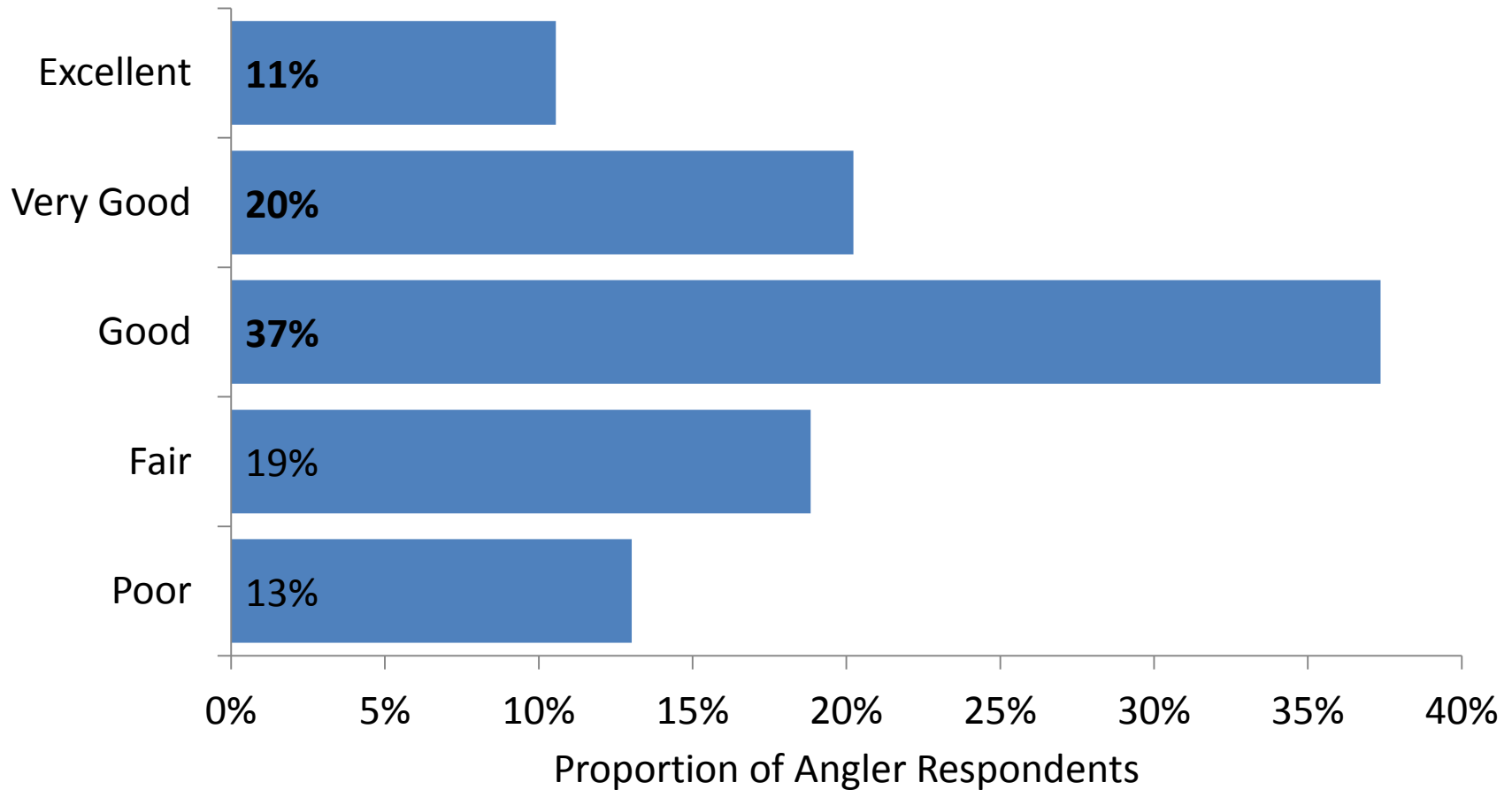
Fisheries Management Zone 10 Anglers

Live bait disposal method – Released in Waterbody



Fisheries Management Zone 10 Anglers

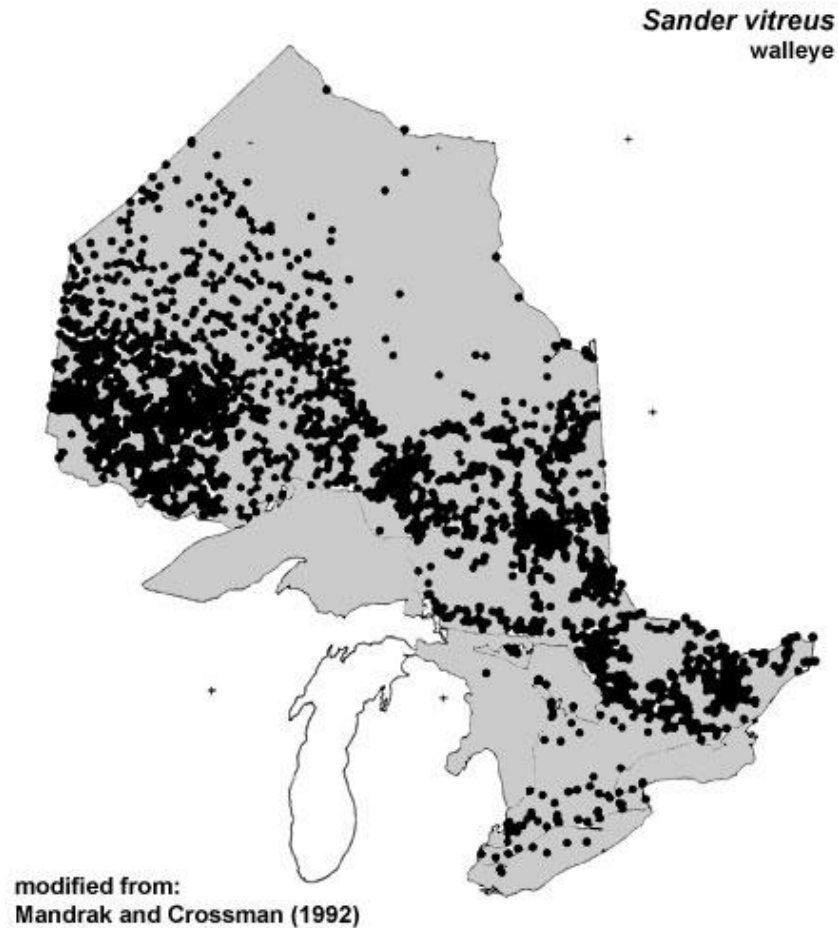
How do you rate your angling experience?



Fisheries Management Zone 10 Anglers

- Mostly from the north
- Prefer Walleye
- Don't fish stocked lakes and if they do don't target the stocked species
- Don't know where to find a list of stocked lakes
- Lakes with wild fish more important than lakes with stocked fish
- Some anglers still releasing bait into lakes
- Rate fishing good to excellent

The BIG Question – Where/when should we stock?



Why should I care if you stock?

- Stocking happens, driven mostly by resource users and managers rather than scientists
- Stocking creates complex fisheries systems that encompass and integrate everything fisheries stakeholders can practically manage
- Stocking emerges in fisheries where the scope for technical and governance control is high
- Successful stockings expands management options and achievable outcomes
- Many stocking fail or do ecological harm but persist regardless

Why should I care if you stock?

- Effective science engagement is crucial to developing beneficial stockings and preventing harmful ones
- Good scientific guidance is available to aid development or reform of stocking but is not widely applied
- Stocking research advances, integrates, and unifies the fisheries sciences
- Stocking provide unique opportunities for learning about wild fish populations and fisheries
- Needs, opportunities, and incentives for stocking are bound to increase