Sustainable Fisheries

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1-One Ecosystem

1A- Sustainable Fisheries

• The concept of *ecological sustainability* refers to the fact that ecosystems have a finite ability to provide for the wants and needs of humans.

• It is the balance between people who use the earth's processes and resources to survive, and the ecosystem of which they are a part. Humans are an integral part of all ecosystems on earth.

• The earth and humans are partners in life. This is the most important partnership we will ever know.

• *Sustainable living* is balance. It is based on the idea that humans can protect and maintain ecosystems while simultaneously deriving a quality existence from them.

• Therefore, to live sustainably means that people live within the limits of the ecosystem's capacity.

1B- Ecosystem Approach

The ecosystem approach tries to manage the system as a whole and thereby has a number of advantages over traditional approaches:

• Accounts for a broader range of values than what has traditionally been the case

• Allows people to think about and manage social, cultural, economic, and ecological forces and factors at the same time.

• Emphasizes the need to maintain, and where appropriate, enhance whole natural systems.

• Involves everyone

• Draws expertise and know-how from every sector of society.

• Recognizes that the protection and maintenance of natural systems are essential to a high quality of life.

1C- Why is Shoreline Rehabilitation Important?

• Ninety percent of all lake life is born, raised and fed in the first 10 to 15 metres from the shoreline

• Natural vegetation in the riparian zone is crucial in the effort to protect water quality, preventing soil erosion and preserving the ecological balance of aquatic environments which sustains lake life

• Fish spawning beds can be destroyed by siltation due to soil erosion.

• Dissolved oxygen in the water is depleted, carbon dioxide is increased, algae and aquatic plant growth is increased.

1D- Benefits of Natural Shoreline Vegetation

• provides shelter and food for wildlife
• supports spawning beds for fish
• enhances water quality
• traps runoff and excess nutrients
• shades and cools water
• discourages growth of algae and aquatic plants

2- Fish Science

2A- Fish Mortality

• Most fish species have a relatively short life and a high rate of Mortality

• Even large fish too big to be eaten by predators such as bass and pike have an approximate death rate of 50% per year.

• Dissolved oxygen levels are determined by
    1) water mixing with air above the lake
    2) rate at which plants produce oxygen and
    3) rate that oxygen is consumed by living organisms (even bacteria that decompose organic mater require oxygen).

• Oxygen is vital to life.

• During extra long and harsh winters shallow lakes with muddy bottoms are vulnerable to oxygen depletion to the extent that large numbers of fish may die. They have a lower storage capacity for oxygen and a higher rate of organic matter.

• In winter the ice prevents mixing with air, snow and ice reduce the sunlight reaching plants so they don't produce as much oxygen and meanwhile oxygen continues to be consumed. Larger fish requiring more oxygen are the first to die.

• Species of fish vary in their tolerance of low oxygen. Trout are most sensitive; walleye, bass, and bluegill have intermediate sensitivity; and northern pike, yellow perch, and pumpkinseed are relatively tolerant. Bullheads and certain minnows are very tolerant. The type of fish in your lake may be a factor of winter oxygen levels

• Spring kills can also occur due to weakened fish from harsh winter, high stress levels associated with spawning activities, and water turnover which may bring water from the bottom of the lake which is low in oxygen and high in noxious gases

• Low oxygen levels can occur in the summer when water temperature is high, there are excessive weeds, excessive decomposing weeds, and if there are several cloudy days.

2B- Habitat Diversity

• DFO policy for protection of fish habitat: Any development causing a harmful alteration, disruption , or destruction of the productive capacity of fish habitat needs DFO authorization.

• In some cases of approval conditions of ‘creating like for like habitat are imposed.

• Habitat diversity (heterogenity) increases foraging and refuge opportunities creating more fish species richness.

• Littoral zone habitats are important for some or all of the life stages of numerous fishes

• In a sample lake habitat was classed as SR shallow rock; SMu shallow mud; SC shallow Chara (algae); SMi shallow mean cover; SV shallow vegetation; MC medium depth Chara; MMi medium depth, medium cover; MV medium depth vegetation and DC deep Chara. Fish diversity was studied against these various habitats. Shallow was classed as 0-2m, medium 2-5m and deep as 5-7m.

• Majority of species and ‘stages’ of development were associated with vegetated habitats.

• Dominate factor in habitat selection of fish appeared to be the presence or absence of aquatic macrophytes (macroscopic forms of aquatic vegetation)

• Shallow mud sites and shallow rock habitats had lower observed fish species than vegetated sites.

• The carpet like Chara (algae) vegetation have low heterogenity.

2C- The First Year

• Juvenile fishes (YOY – Young of Year) should attempt to maximize growth rates as mortality decreases with increasing body size.

• Do YOY have a habitat preference, do they go where their food is, do they avoid places where predators exists?

• Young walleye grow rapidly reaching lengths of 7 inches

• In their early stage of development (until mid July) YOY walleye were found in heavily vegetated medium depth habitats. By the end of this stage they are about 3 inches long.

• In the later period of their first year YOY walleye were found in shallow Chara and shallow habitats with medium cover.

• Stomach contents of YOY walleye consists entirely of fish with most being YOY sunfish, minnows and YOY perch. They can eat prey up to half of their own size.

• There is a high relationship between YOY and prey availability prior to mid July but less so after this period.
• Selection of highly vegetated habitat helps reduce the risk of predation.

• By early August they can reach the length of 5 inches significantly reducing the number of potential predators.

• Use of shallow habitats after mid July may be to avoid predation from older walleye.

2D- BioMass

• A lake or ecosystem is capable of supporting a maximum level of ‘biomass’

• The makeup of this biomass can be a certain percentage of each fish species

• If one fish species grows significantly in numbers it stresses the ecosystem and can result in a decrease of the numbers of other fish.

• This is why ‘sunfish tournaments’ are a good thing – if the numbers of sunfish are disproportionately large reducing their numbers may help increase the numbers of ‘sport fish’.

• Zebra mussels can negatively effect the ecosystem by eliminating the ‘food’ at the bottom of the food chain thereby reducing the total biomass that the lake can support. Increased water clarity allows deeper plants to get more sunlight and grow faster.

3- Sport Fisherman Choices

3A- Fish are Good Food

You can improve the taste and freshness of your catch by following a few simple steps:

• Quickly land and kill those fish you will keep as extended fighting adversely affects the flavor of the meat as lactic acid builds up in the muscle tissue.

• Don't let your catch flop about on rocks or in the bottom of your boat.

• Bleed your catch immediately. This protects the flavor and increases storage life as it eliminates waste products, removes oxygen that leads to spoilage, and decreases the number of bacteria in the flesh.

• Remove the gills and all blood and viscera from the body cavity. The internal organs contain millions of bacteria and numerous enzymes. Cleaning should be done immediately after killing and bleeding.

• Ice your catch to preserve the quality of the meat by delaying deterioration. Pack ice inside the body cavity to lower the core temperature quickly. Pack your catch in ice until you can get it into long-term storage. Freezing inhibits the growth of bacteria. By glazing your fish with ice and using vacuum packing when freezing, your catch can still be very palatable after several months in the freezer.

3B- Selective Harvest, Catch and Release

• Harvest only the fish you intend to use for food and releasing the rest of your catch unharmed

• Selective harvest depends upon using catch and release techniques to land your fish

• Catch and release fishing is gaining in popularity as more and more anglers are becoming concerned about state of some of our fisheries

• Sportfishing is so popular that demand often exceeds the capabilities of local waters to produce sufficient numbers of fish.

• This catch and release philosophy suggests that angling is valued as a high-quality recreational experience, rather than just a way to secure food

• If the fish is released in such poor condition that is likely to die anyway, the whole point is defeated.

• How a fish is handled when the hook is removed can greatly affect its survival. If the fish is handled carefully and gently, it will have an excellent chance of survival. Barbless hooks make it easier to release fish. Taking a few precautions when releasing your fish will allow it to live, spawn and be caught again.

3C- Catch and Release Techniques

• Bait caught fish typically suffer a much higher hooking mortality than fish caught on lures. At least 1 out of 3 fish caught with bait will die after release.

• Over 60% of deep hooked fish die. Cutting the line on deep hooked fish and not trying to remove the hook increases survival significantly.

• Most fish that are bleeding from being hooked will not survive.

• Keeping fish on stringers damages their gills and holding fish in live wells for long periods reduces survival.

• Generally 9 out of 10 fish caught on lures will survive after release.

• Use strong line to bring your catch in as quickly as possible.

• Use hooks appropriate to the size of the fish.

• Use barbless hooks or use pliers to pinch barbs down.

• Replacing treble hooks with single hooks also makes the release easier.

• Land your fish as carefully and quickly as possible.

• Avoid removing the fish from the water any longer than necessary.

• Use a pair of forceps or long needle nosed pliers to remove the hook.

• Cradle large fish gently with both hands: one under its belly, one at the tail.

• Keep your fingers out of and away from the gills and eyes.

• Use wet hands or wet cloth gloves to handle the fish.

• Never squeeze the fish.

• Fish can not remain healthy out of water for longer than you can hold your breath

• Use steel hooks that will rust out, avoid stainless steel hooks.

• If you want to take a photograph, support your fish in the water while the photographer prepares to take your picture. Get ready, then lift the fish out of the water, take the picture and quickly return it to the water.

• If a released fish does not swim away, hold it in a normal swimming position and gently move it back and forth in the water to move water over the gills and allow more oxygen to enter its blood. Most fish recover in a minute or so and readily swim away. Larger fish may take more time

3D- How NOT to Catch a Bass

• Many people remain uninformed about the damage of catch and release bass fishing before the official opening of bass season
• In early June male Smallmouth and Largemouth bass are the 'fathers of the year'

• In spring male bass move into the shallows and dig nests, shallow bowl like depressions in the lake bottom which are easily seen

• Once the eggs are laid and fertilized the male will guard the nest until the eggs hatch and are free swimming. And they guard the nest ferociously making them easy target for lures – 15 casts over a nest resulted in 70% of the bass being hooked with half of that number being landed.

• Angling a fish off the nests opens the eggs and fry to predation. In 1990 a study was conducted when it was thought that up to 63% of anglers were intentionally going after bass during the closed season. A known spawning territory was divided into no-fishing and fishing permitted zones.

• In the fishing zone 23% of the bass had hook wounds while there was just 4% in the no fish zone

• In the fishing zone 44% of the nests in the unprotected area produced free swimming fry while the success rate hit 63% in the no-fishing zone.

• On average, if males took just two minutes to return to the nest from the moment they were caught, 49% of the nests were visited by predators and 24% of the sites were abandoned.

• Further, if they took ten minutes to return - very possible when you consider fighting time, unhooking time, recovery time, and boat drift - 72% of nests were raided, and 83 % were abandoned.

• To protect spawning fish, regulations state that it is illegal to harvest fish during the closed season.

• Further, it is also illegal to attempt to capture fish during the closed season, making pre-season catch-and-release illegal.

• And, there aren't too many conservation officers around that will believe you are really going for walleye with a weighted spinner in three feet of water over a sandy, gravel bottom, adjacent to a swamp.

• The only ethical thing for anglers to do is to leave the shallow water alone until bass season is officially open.

3E- Weigh Your Fish with a Ruler

• You can quickly measure and release the fish as opposed to weighing it with portable scales which can cause injury.

• To estimate the weight with a length measurement (in inches), use the following formulas:

• Walleye: Length x Length x Length divided by 2,700

• Pike: Length x Length x Length divided by 3,500

• Sunfish: Length x Length x Length divided by1,200

• Bass: Length x Length x *Girth* (distance around the body) divided by1,200

• Trout: Length x *Girth* x *Girth* divided by 800

For example:
An 18-inch Walleye weighs approximately 2.16lbs.
[18" x 18" x 18"=5,832" divided by 2,700=2.16lbs].

Average age and size of Walleye in Ontario

Age (years)	Avg. Length (in)	Avg. Weight (lbs)
13	25.1	10lb. 12oz.
12	24.1	8lb. 14oz.
8	20.3	4 lb. 14oz.
6	15.3	2 lb. 3oz.
4	12.3	1 lb
3	10.6	10 oz
2	7.4	3 oz

4- MNR, DOF, CA Initiatives

4A- Fall Walleye Index Netting (FWIN) survey

• designed to measure relative abundance of fish

• differs from the traditional assessment method previously used on lakes because a gill net is used to collect fish rather than a trap net

• capable of sampling in deeper parts of lake therefore providing information from the entire lake which will result in a more representative measure of relative abundance

• net can catch small and large fish and certain indicator species such as perch

• very accurate age determination from otoliths rather than scale aging which is not accurate for older fish

• reproductive fitness can be obtained

• stomach contents and therefore forage can be determined

• general condition of fish can be established by looking at body fat, organ and round weight

• of course the negative side is that the sample fish are removed from the lake

4B- Spring Littoral Index Netting (SLIN) Survey

• conducted to assess the relative abundance and provide biological measures or indicators of the population's status

• used to make decisions for the management of cold water fisheries dominated by Lake trout.

• using this approach, comparable estimates for analysis of trends through time in a single water body, as well as comparisons between different water bodies and water body types can be obtained

• uses 90 minute gillnet sets to sample the littoral zone during spring time

• technique easy to apply and the short duration sets of small mesh gillnets reduce mortality compared to overnight sets

• sampling occurs in spring prior to thermal stratification

4C- Fish Tagging

• Tagging can be as simple as attaching a coloured tag to a fish, clipping certain fins or implanting a microchip device that responds to a portable reader

• Tagged fish provide abundance and age / growth information

• Fish can be caught via netting surveys or by anglers

• One thing to be careful of regarding angler catches is that fish can continue to be caught in abundant numbers even though the overall population is crashing – i.e. fisherman can catch fish even when the numbers are on a steep decline

• If tags indentify a particular fish or a particular fish year then tracking of individual fish or fish years provides a much clearer picture of survival rates as the fish are caught … i.e. if 100 YOY fish are tagged and 4 years later 20 of those YOY are caught you know that at least 20 of them survived for 4 years. The other 80 might not have survived or might still be alive in the lake … if another 20 of that year class are caught next year then we gain more insight into survival rates

• Catch and Release programs coupled with tagging gives even more information as a tagged fish might be caught and released many times during its life.

High Tech Equipment

• Is used to study the calcified tissue, or 'ear stones', in the inner ear of the fish. That can tell us the age of a fish not only in years, but in days - we can actually determine what day the fish hatched.

• stable isotopes are used to determine the temperature of the water in which the fish have spent most of their time. This is used to determine if walleye in the Bay of Quinte are adapting to waters

that, according to records, have warmed in the past 20 years. If the walleye are still spending most of their time in the cooler waters, it means they are seeking out lower levels and not adapting because they have temperature limits. Further warming of those cooler areas in the bay could eventually wipe out the species.

• Electro Fishing accuracy has improved to the point where sampling is done on one-metre-wide cross-section strips. We're collecting all the fish in that area so now we can actually estimate the grams of fish per square metre of bottom.

• Underwater cameras attached to a remote controlled underwater craft is used to count fish populations

4E- Slot Size Limits

• Slot size is intended to protect the fish that have reached and are in the best years for spawning

• Smaller fish have a lower probability of reaching that premium age so although you throw it back to grow bigger so you can catch it when it is a ‘good size’ it probably won’t make it … hence you are better to leave a fish that has beaten the odds and made it and keep and eat two or three smaller fish

• The larger fish that have made it should be left to ‘lead’ the smaller fish increasing their odds that they will make it

5- Stocking

Through the MNR Program they can only be released into lakes without a current Walleye population

• New lakes are being stocked to increase our fishing opportunities

• It takes 28 days for the eggs to hatch with fry released mid May

• In a 10 year stocking program of walleye in a lake that already had a walleye population it was concluded that there was no benefit to the stocking

• The new fingerlings had a much higher rate of mortality than the native fish

• News of the ‘stocking’ travelled quickly and dramatically increased the number of fishermen who fished the lake causing great numbers of native and stocked fish to be taken.

• The best way to improve walleye numbers in a lake with an existing population is to improve or create spawning beds.

6- Habitat Rehabilitation

6A- Walleye Spawning

• Walleye males can reproduce at the age of 3 to 4 years (10 to 12 inches)

• Walleye females reach reproductive age at 4 to 5 years.

• Walleye are prolific spawners, but there is considerable variation in the number of eggs produced by individual fish. For example, the number produced by a three- to three-and-a-half-pound female may vary from 72,000 to I 10,000. Average counts of eggs in the ovaries have shown that there are about 26,000 eggs per pound of fish. The eggs are small and measure approximately 120,000 to the quart. Spawning takes place soon after the ice goes out in spring when the temperature of the water ranges from 38F. to 44F. This may occur early in April, if the season is advanced, or early in May if the season is delayed because of cold, inclement weather.

• Large numbers of walleye ascend tributary streams and spawn in bouldery riffles at night. Spawning also takes place in the shallow waters of lakes, on sandy, gravelly or ston shoals.

• The males usually precede the females. When the spawn is ripe, eggs and milt (sperms) are extruded into the water and fertilization of the eggs is effected. The eggs are very sticky and adhere to the gravelly bottom, downstream from the spawning area.

• The incubation period is of two to three weeks' duration.

6B- Walleye Spawning Survey

• Done in mid April by boat with a light when the walleye are spawning within 15 feet from shore

• Observed large groups of Walleye in certain areas and none whatsoever in others

• Almost without exception, shallow (less than a foot deep) stony-rubble (3 to 5 inch diameter) areas, usually adjacent to undeveloped shoreline had high counts of walleye

• Developed shoreline, particularly areas finished with concrete, stone or wood walls dropping into two or more feet of water attracted no spawning Walleye whatsoever.

6C- Creating New Walleye Spawning Habitat

• Older spawning beds can become silted over (remember all that sand that was dumped in for a nice beach or all your shoreline that eroded a few years ago with the high spring water and huge waves) or overgrown with algae such that the eggs cannot slip down into cracks between the rocks

• Any exposed eggs become dinner for many fish

• Existing spawning beds can be scrubbed to get rid of algae – or if the water level decreases in the fall to the point that the rock becomes exposed the sun can kill the algae

• Existing beds or new beds can be created by adding new round, oval stone between 3 and 10 inches in diameter

• New shoals can be created along the shore in 2 to 3 feet of water by dumping the rock in a long string on the ice.

• In one case walleye were observed spawning over the new shoals – over 250 in one week. After 1 week a number of eggs were collected from the new shoals with about 45% of these eggs being viable into their late developmental stage – this percentage being comparable to natural shoal results

6D- CFIP

• Community Fisheries Involvement Program sponsored by MNR

• To encourage the public to actively undertake hands on fisheries management projects which will benefit fisheries

• Help restore and improve the aquatic habitat essential to fish

• Requirements
– Project must improve Ontario's fisheries resource
– Project must fit into the Ministry's fisheries management plans
– All labor should be voluntary
– Project must be of a public, rather than private, benefit

6E- CFIP Sample Projects

• Planting vegetation, installing deflectors and riprap to restore stream banks

• Building fences to protect stream banks from grazing cattle

• Constructing, operating and maintaining incubation boxes

• Adding gravel, rocks to lake, river or streams to create spawning beds

• Operating small, officially approved hatcheries

• Providing cover and improving nursery habitat

• Removing obstructions to fish movements

7- Fish Management Plan

7A- Management Plans

• Lake Management Plans have two targetted audiences – Lake residents: encourage them to adopt lake steward practices – Municipal bodies: influence planning, policy and development

• Influence of Municipal policy requires Science, i.e. a lake capacity study which involves professionals and costs $$

• If you do not have the resources to make a significant impact on municipal policy then most of the benefit of a lake plan is in the area of having local residents adopt steward practices

• A significant number of people involved in a lake plan and who will buy into it are already the ‘converted’

• Perhaps a lake management plan called a Fish Management Plan would have a wider appeal … both require a healthy Ecosystem

• Evaluate the importance of different fish habitat areas

• Protect all fish habitat, especially areas critically important to fish

• Restore high priority areas
  – Littoral zone
  – Wetlands
  – Spawning beds

7B- Identify Threats

• Loss of habitat
• Loss of spawning beds
• Water pollution
• Dramatic increase of aquatic vegetation
• Reduction of dissolved oxygen
• Over fishing
• Invasive Species

7C- Identify Cures

• Shoreline vegetation
• Reduce pollutants
• Improve habitat
• Conservation practices when fishing

7D- Action

• Education
• Buy-In by all residents
• Seek assistance from other groups
• Implement projects