

For Tom Whillans

Paul
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Potential Restoration and Management Strategies for
Lake Trout (*Salvelinus namaycush*) in Kushog Lake, Haliburton

**Mike Francis & Dan Miller, 2011.
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Objective-

The numerous threats to Lake Trout populations stem from a wide variety of natural and anthropogenic origins, which have resulted in unfavorable living conditions for Trout in lakes like Kushog. The following report will be focusing mainly on those threats which are anthropogenic, as well as offering some potential management strategies for relieving these pressures. We feel it is important to mention that any strategies provided are simply suggestive and are in no means a final solution to the issue of Lake Trout population decline in Kushog. In reality, the problem most likely stems from many sources; all of which are having a cumulative degrading effect. "I only wish we had a single agent causing the declines. That would make our job much easier", was a statement made by Jeff Pettis of the USDA regarding the management of bee populations. We believe that the case of Lake Trout in Kushog Lake is a very similar situation and that integrated management strategies will be the most successful in restoring and preserving this population. The suggested management strategies will consist of projects that the community may wish to simply finance but will be aimed toward local participation. Because there are such a wide variety of anthropological threats to potentially explore, the report will need to be narrowed down to two central management aspects: sedimentation and local angling pressures within the lake.

Section 1: Sedimentation

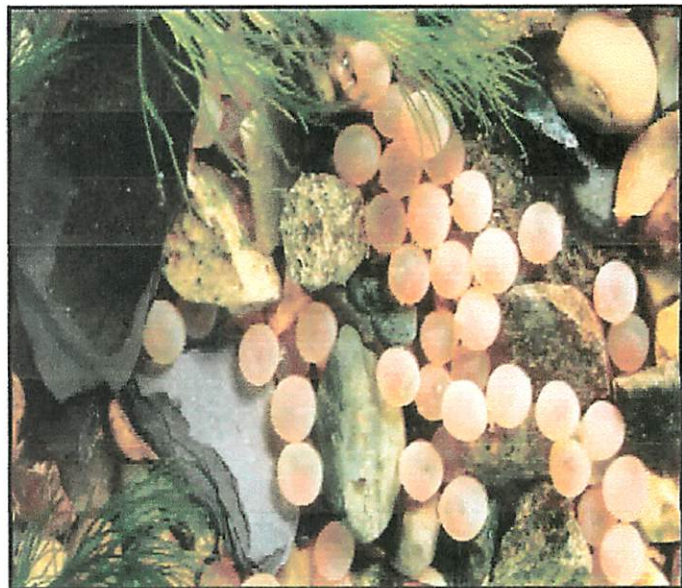
Sediment within a watershed is a result of erosion and surface runoff, which occurs naturally but is often accelerated by a variety of anthropogenic disturbances. These disturbance events can vary heavily in severity (that is the actual amount of sediment mobilized or deposited) and may be a result of some of the following activities: construction and development; excessive water turbidity; and invasive shoreline activities. In the case of Kushog Lake there are many activities carried out (mainly throughout the summer months), which are potentially degrading to the lake ecosystem through excessive sedimentation. There is not one apparent source of disturbance but more likely a collective issue involving all lake users.

Common activities like boating, swimming and fishing are capable of stirring up sediment from the lake bottom and mobilizing it to unnatural locations. Property maintenance activities like removing vegetation or altering the shoreline may also be responsible for inputting unnaturally high amounts of terrestrial sediment into the lake. None of these activities are the sole issue but the collective effect can prove to be detrimental to the species of interest – Lake Trout. Excessive sedimentation within Lake Trout spawning habitats is a major limiting factor for future reproductive success (Heywood & Walling, 2007). This being said, it is important to understand how exactly sedimentation degrades spawning beds, in order to establish some logical solutions to the problem.

Effect of Sedimentation on Lake Trout:

The following section of the report will aim to educate about the pressures on Lake Trout reproduction induced by sedimentation. We will be discussing the direct impact of sedimentation on the shoreline spawning beds, as we feel this has the most detrimental impact on the populations. An important aspect which makes Lake Trout so vulnerable is the highly adapted nature of the species. They are extremely vulnerable to both natural and anthropogenic

disturbances and are perhaps better adapted for past glacial landscapes, in the absence of human beings (Gunn et al, 2004). Lake Trout are particularly adapted to spawning close to shore on rocky reefs or shoals (McKay, 1963), which in present day is



the area in closest connection with lake users. These shoals provide space for the fish to deposit and incubate their eggs (above), as well as protect the emerging fry from predators.

The selection of spawning sites is heavily dependent on size and substrate within these shoals (Marsden et al, 1995), meaning that site selection is extremely specific. To put it into perspective; the rate of egg survival has been measured up to 60% among rock piles and natural cobble, in comparison to less than 10% survival rate among

alternative sandy spawning beds (Marsden et al, 1995). This is partially due to the direct deposition of sediment within these intergravel spaces, resulting in lethal and sub-lethal effects to the eggs and sac fry (Heywood & Walling, 2007). The mobilized sediment becomes trapped within the small spaces and essentially blocks eggs from entering or smothers them once laid.

Long term issues may also arise, for example: a large enough amount of built up sediment can have the ability to completely fill in the empty space within shoreline nests. Lake Trout are a part of the majority of fish species which do not care for their offspring after spawning (Rocha et al, 2008). This means that even if spawning Lake Trout continue to use filled in nests, there is absolutely no protection for the incubating eggs and emerging fry. Predation on young fish is very high (Rocha et al, 2008) and without suitable gravel space to hide, the young Lake Trout are extremely vulnerable. The cumulative result of excessive sedimentation leaves shorelines with limited suitable spawning habitat and will not allow the population to regenerate sustainable numbers. As previously mentioned, there is not one specific target for reducing sedimentation within Kushog Lake but there are some strategies available for reducing the variety of potential sources, which will be offered in the following section of report.

Management Strategies for Kushog Lake Sedimentation:

The following list of suggestions for the management of Kushog Lake Trout populations is a combined result of research; applicable case studies; and our personal opinions based on the information available. In comparable situations, these strategies have been reported as successful, which of course does not guarantee future success but is at least a step in a positive direction:

1) Spawning Reef Construction-

Management of excessive sedimentation within the Lake is most importantly a group effort, between all lake users. While Ox Narrows is the only currently known spawning bed, there is an opportunity for the lake community to re-establish spawning beds in other areas. The targeting of individual shoreline properties may be the most effective way of involving the local community and providing education on the issue. With proper permission, lake front property owners have the option of converting shoreline into suitable spawning habitat. Under the *Fisheries Act*, private land owners require a permit from the Department of Oceans and Fisheries to carry out any activities that alter fish habitat (DFO, 2010). That is why it is important to plan projects properly to ensure they are improving fish habitat and not causing further harm.

Rocky shoals can be constructed in small or large scale projects, independently financed by cottagers or by local fundraising. Evidence has shown that the ideal gravel

shoals for Trout spawning contain stones up to 3 inches in diameter, with a variety of smaller material where the mass is consolidated but still permeable to water (Frost & Brown, 1967). To put it simply, gravel piles with stones averaging 3 inches in diameter make ideal spawning sites and are seemingly easy to replicate. It is important to ensure that any gravel or rocks are cleaned prior to being placed in the water (DFO, 2010).

Another important aspect of creating spawning habitat is the planting of trees and shrubs at the water's edge. This provides shade and leaf litter, which in turn creates cooler shoreline environments with higher abundances of Lake Trout prey (Frost & Brown, 1967). With this knowledge, cottagers may choose to invest in laying gravel and planting vegetation to create possible shoreline spawning beds. Less populated shoreline would also be suitable for the creation of these gravel reefs. These by no means need to be large scale projects and can be something as simple as a constructing 'spawning boxes' (below), which provide a variety of opportunities for Lake Trout to spawn and are presumably easy to obtain permission for.



Another method of increasing the suitability of shoreline habitats is the enhancement of Lake Trout prey. It is generally agreed upon by fisherman and researchers alike that a higher abundance of prey species

along the shoreline is known to increase production in trout (Frost & Brown, 1967).

There is speculation as to whether it is best to stock these prey species or encourage higher production in the species already present. Stocking could be carried out by obtaining a supplier of appropriate prey species of invertebrates and fish, ensuring any organisms released are indigenous to the area. Naturally increasing the production of prey currently in Kushog may be accomplished as mentioned before by the planting of shoreline vegetation, to increase the amount of available litter and therefore food for prey species. In either case, this would be an excellent opportunity for the community to promote the start of new shoreline habitat projects and increase spawning at Ox Narrows as well. It should not be expected that the creation of suitable spawning habitat in Kushog Lake will result immediately -if at all- in the presence of spawning activity. The reality is that an increase in spawning habitat offers more options for the Lake trout to utilize and reduces the stress of finding suitable shoals. In the long term, including artificial spawning habitat into an integrated restoration plan may very well increase Lake Trout populations.

2) Spawning Reef Preservation-

Aside from the creation of new sites, preserving known spawning beds is perhaps the most important project. Within Kushog, there have been past efforts made to preserve remaining spawning habitat by actively de-silting and removing sediment. The spraying technique employed in 2009 could be deemed successful based on a higher

number of observed Lake Trout at the site during that spawning season (compared to the previous and following season). The actual success of the 2009 season's eggs and emerging fry is uncertain but a higher number of breeding pairs is clearly a positive sign. While the spraying requires funding and is somewhat labor intensive, the idea of conducting this process on regular yearly intervals could be considered. The downfall of de-silting in this manner is that the sediment is simply suspended and allowed to redeposit in the immediate area or at another location within the lake (Havas, 2011).

Perhaps a program similar to this could be designed, where volunteers or employees can actively remove silt from the area, as well as continue to spray where necessary. This gets at the root of the problem- excessive sediment within the lake- instead of simply brushing it off and allowing re-deposition. The removal of sediment on the rock reef will undoubtedly also have the effect of re-suspending sediment but the majority will be removed. Like the spraying technique, this strategy could be employed in regular intervals to combat the issue and can involve the community in the process.

3) Reducing Wave Turbidity & Shoreline Disturbance-

It seems possible that the highway along the North Western stretch of Lake Kushog may be largely responsible for depositing terrestrial sediment into the waters. Upon observation of highway conditions in the area, it is clear that a heavy amount of sand is being expelled to the road sides during snow clearance. This is in close proximity to Ox

Narrows, which poses a large threat to the main spawning location within the lake. The largest portion is likely being deposited as a result of spring runoff, carrying build up road salt, sand, and other debris into the lake. Silt fencing is a viable option in this situation but would include the regular removal of built up sediment. This option would be the easiest initially but may not be ideal in the long run because of the ongoing maintenance. Instead, more permanent erosion and runoff control is often recommended to reduce the actual amount of sedimentation occurring (M.T.H., 1997). This could be accomplished through ditch projects if there are none already in place, as well as the planting of denser vegetation on the shoreline bordered by highway.

Shoreline construction may occur periodically around the lake, including the raising of new cottages, small structures and landscaping projects. The exposure of top soil in these situations leaves the land open to precipitation and wind, leading the way for erosion and runoff of terrestrial sediments. There are many simple strategies that the individual and the community can employ to reduce this issue. The Department of Fisheries and Oceans lists a series of land development guidelines for reducing the impact on fish populations. Some of these include:

- 1) Where possible, plan construction activities during dry months of the year to avoid potential rain events and delays.
- 2) Halt construction during periods of heavy precipitation and runoff to minimize soil disturbance.
- 3) Retain existing vegetation where possible.

- 4) Cover temporary fills or stockpiles with polyethylene sheeting or tarps.
- 5) Use mulches and other organic stabilizers to minimize erosion until vegetation is established on sensitive soils.

Perhaps the most degrading shoreline activity that can take place is the installation of docks and boat launches. As this lake is highly populated by cottagers, the construction and renovation of these structures is an ongoing potential issue. It has already been established that shorelines are particularly important to the survival of Lake Trout populations. With that in mind, it is important to have these projects certified acceptable by the DFO, to minimize any harm to fish and their habitats. Some positive practices to promote in Kushog include:

- 1) Avoid the use of cement (prefabricated or poured). Use gravel as an alternative.
- 2) Choose floating and post-supported structures to avoid lake bed damage.
- 3) Research building materials prior to use to avoid chemical contamination of the water.
- 4) Avoid removing or covering important aquatic vegetation.

Another source of sediment mobilization in lakes is the use of powerboats, especially in the shallower areas. The wave motion created by boating and swimming activities is greatly responsible for the uprooting of plants and sediments (A.F.S., 2010). While this may not be an issue for areas of shoreline where spawning is not occurring,

Ox Narrows and any new reef projects may be affected by these types of small scale disturbances. Ox Narrows in particular should be considered to be a sensitive zone regarding wave disturbance because it is a confirmed spawning location. As mentioned in the de-silting project summary, many locals and visitors pass by this area during the summer. The community may wish to enforce specific restrictions regarding boat traffic and create what is known as a 'no wake zone'. This could include shutting down engines altogether in the area or more realistically; a restricted speed limit. Enforcement is clearly the most difficult aspect of this, as boaters may wish to disregard any guidelines for speed. To deal with this, the cottage association may wish to sponsor some employees to actively alert boaters around the Ox Narrows site; post permanent signage of the guidelines; or simply educate the community about the importance of the issue, as will be discussed in the following section of report.

Education-

The future success of Lake Trout populations in Kushog Lake and other similar lakes is highly dependent on education. This aspect should be heavily incorporated when considering management strategies. An important step in this particular situation is spreading awareness among the local community and visitors to the area. Newsletters, community meetings, and word of mouth can all help to educate on the importance of human impacts on this ecosystem.

A crucial aspect of education on the subject is the realization that change is inevitable and a natural part of ecosystems. The 'aging' of lakes towards eutrophic conditions occurs naturally over time due to gradual increases in suspended sediment and nutrients (Havas, 2011). Throughout this transition, fish biodiversity decreases and species like Lake Trout are less suited to the conditions. It is clear that human activity on this planet has accelerated these ecological changes to an unnatural rate; climate change being the prime example of this. As mentioned earlier, Lake Trout are a species adapted for post-glacial conditions, which are certainly different from the climatic conditions we experience today. The intention of this section is not to promote the idea that the issue is out of our hands but to educate that the ecosystem is a delicate balance and that Lake Trout are particularly sensitive to environmental change. This means that any anthropological activities in the area should be given consideration for the potential ecological impacts and everyone in the community should be aware of these impacts that they are having.

It is uncertain where Kushog Lake stands in terms of age but it is very likely that human activities in the vicinity are accelerating this natural aging process. The best thing that the Kushog community can do is understand their collective impacts and work together to reduce it. In doing so, they can maintain the current lake environment for longer and without drastic restoration projects. The reality is that Lake Trout populations may not be recoverable to the level they were once at but with community education and participation, the problem may be slowed or reversed.

Section 2: Angling Pressures

Seasonal restrictions-

Generally speaking, angling seasons are created based on a time of year where the selected fish species is more or less vulnerable than normal. Specifically the ice-out time period for lake trout, and protecting mature fish during spawning season (J.M. Gunn et al, 2004). In areas where anglers follow the seasonal access and closures, the fish are able to reproduce and live in relatively sustainable numbers. In Kushog Lake, the access both during the summer and during the winter allows anglers to impact the fish numbers twice a year. If there were to be any adverse impacts on trout population, it is likely a result of the amount of angling stress being put on the population in combination with other factors.

Access control-

Haliburton merits itself as a beautiful natural landscape. Many books, magazines and websites portray Haliburton as the ideal fishing destination. It is obvious that the area relies on fishing to attract a large amount of tourism. This addition to the population might add to the economic success of the Haliburton area, but is more than likely a hindrance for its natural fish population. The easy access to lake shores and boat launches in some lakes puts the fish population at serious risk for overfishing.

Every lake has a number of fish that can be caught and kept, while keeping a sustainable population to replenish numbers during the following season. Problems occur when the number of fish caught within a lake is greater than this amount, thus leaving the fish population at an unhealthy amount. Because Kushog Lake is part of the large number of Haliburton lakes portrayed as ideal fishing sites to the rest of Canada, and farther, the worry is that the number of fish caught could be unsustainable. It is difficult to pinpoint an exact number of fish that can be sustainably harvested for each individual lake, which is what makes this issue especially hard to deal with.

Ice fishing mortality-

Hooking mortality rates are larger during the winter months when ice fishing occurs. The method of still lining often allows the fish to swallow the hook, which results in higher instances of mortal injury (Persons and Hirsch 1994). Studies in Minnesota have revealed catch and release mortality rates of roughly 32% of the fish caught using still lining techniques. This is greatly contrasted by the hook set method used while jigging, resulting in only 9% mortality in the same year. This is due primarily to the fact that jigging requires the line and hook to be tended constantly. When the fish bites the bait, the hook is set only in the lip, and minimal harm is done. (J.M. Gunn et al, 2004) The studies also points to the fact that smaller fish tend to be caught during the winter. These younger fish are usually more easily harmed than older more resilient fish. It is recommended that deeply imbedded

hooks be left in place no matter what time of year they occur, because removal could cause significant injury leading to death.

All of these scenarios are based on a catch and release model, as mortality rate is of course 100% for catch and keep fishing. An early study of the differences between summer and winter fishing of lake trout in Algonquin lakes showed that fish that matured quickly and were a small to medium size, like the Halliburton gold, were vulnerable to losing a large number of their young populations during ice fishing seasons. This in turn would lead to an eventual lack of mature mating pairs, hindering sustainability of the species. Summer fisheries remove a relatively equal amount of mature and young fish allowing for sustainable breeding populations in the present and future.

Management Strategies for Kushog Lake Angling Pressures-

Regulatory Enforcement:

Ideally this problem could be solved by close monitoring of the number of fish being removed from the lake, and a cap being placed on the number allowed to be harvested in a season. There are obvious problems with this method. First of all, the issue of who would be responsible for this monitoring is a large issue. The local population could take it upon themselves to do this, but it would be a large, complicated, and likely unpaid position. The government would likely not have the human resources to allocate personnel to inspect every fish caught in every lake to ensure the cap is followed.

So the campaign most likely to be successful would be one based on community education and awareness. This would involve alerting cottagers and visitors of their individual impacts on fish populations, as a direct result of the fish they are harvesting. Stressing the sustainable fishing requirements of Lake Trout populations may be sufficient enough justification for fisherman to reduce their individual harvest, in hopes of having available fish for the future. This campaign could be carried through public meetings in the surrounding townships, signage posted around the lake with information about potential impacts of fishing, as well as radio and television broadcasts. By educating anglers about a balance of catch and release methods with catch and keep, they will gain an understanding of their influences. Topics such as catch limits, barbless hook use, and limited harvest would be ideal for these public displays. If education is issued properly, it may be able to make a positive difference in the Lake Trout population.

Fish sanctuaries-

Fish sanctuaries are areas that have been found to hold important features to a fish's success. In certain cases, areas like spawning sites and feeding sites have been deemed off limits to fishing, and other disruptive activities. It is possible that by implementing these sanctuary areas, the population of lake trout within Kushog Lake could be protected in its most vital areas. This should not be confused with the removal of fishing all together. It simply means that specific areas would be no-fishing zones to promote the health of the Lake Trout populous.

Studies done in lakes similar to Kushog have shown that sanctuaries can halt the decline of degraded Lake Trout populations (), making this a useful management tool to keep population levels at least stable. These should target sensitive breeding areas such as Ox Narrows, where fish gather in larger numbers and are more vulnerable. These sanctuaries can also exist as a seasonal restriction, where for example; sensitive areas would be off limits for winter breeding seasons and winter months, but unrestricted in late spring and early summer.

As mentioned previously, it is difficult to enforce restrictions such as fish sanctuaries. The government is very unlikely to take much concern in the matter, without scientific evidence of a population decline. Therefore the community would need to initiate a campaign to alert lake users of sanctuaries and educate them on the background issue. This could be conducted mainly through advertisements in local media and word of mouth between locals and lake visitors. Posted signage in the area is also necessary, which should include set boundaries for restricted areas and explain the reasoning. Anglers are more likely to accept these changes if they are educated on the necessity of sustainable fishing practices.

Catch and Release-

One method of keeping the population of Lake Trout sustainable, while still allowing for angling would be catch and release fishing. This method allows anglers to test their skills and continue taking part in the sport that they love, while taking nothing more from the

water than pictures of their prizes. There is still mortality rates coupled with this method of fishing that come as a result of poor hook set location, or stress based fish death. However, the overall lake trout population will benefit from this, and fishing will continue (Deroba, J.J. & Bence, J.R. 2008).

The catch and release method can be improved significantly by integrating the use of barbless hooks. The action of setting a barbed hook means there is possibility for a large amount of injury to the fish both at the time of hook set, and at the time of hook removal. Studies have proven that areas using the catch and release method with barbed hooks have 30% higher mortality rates over areas that use barbless hooks (Frederick, S.W. & Peterman, R.M. 1995). Once again, the action of setting a hook whether barbed or not, holds the possibility of injuring or killing the fish. However, the likelihood of survival is greatly improved with the use of barbless hooks.

Anglers may be concerned that the use of barbless hooks may impede their ability to catch fish because they may not get a good hook set. There are many arguments both for and against this point. An angler choosing to use a barbless hook may have to change their fishing technique slightly to improve their success rate. This change involves a different reel in technique that involves bringing in the fish as quickly as possible (Cornelius, F.C., Muth, K.M. et al 1995). The success rate of barbless hooks compared to barbed hooks is only slightly lower, but the benefit to the fish could be enormous.

The key would be to integrate a system that involved catch and release as well as harvesting. Ideally with the harvested numbering remaining low, so as to keep a healthy population of lake trout present in the lake. This would ensure that fishing would not need

to stop, as well as allow for harvesting to continue. As should be the case for fish sanctuaries, a background education on the issue should encourage anglers to support a catch and release program. This is something that may reduce their short term fishing success but allow for fishing to take place at all in the future.

Conclusions:

This report has compiled evidence for the potential reasons why Lake Trout populations often go into decline. Using this information, a variety of management solutions have been designed and offered to help protect the population in Kushog Lake specifically. The key topics focused on were selected based on relevance to Kushog lake. These solutions are heavily dependent on community involvement and participation by all visitors to the lake. This is especially important in an area like Haliburton, where tourism brings in many who will use the lake. Without interest from the lake community, the problem is likely to continue and worsen. In reality, there is no quick fix and no specific plan that is guaranteed to succeed. The best solution will come from an integrated strategy, targeting education and management strategies together. The goal of such a strategy is to relieve as much pressure as is possible from this population of Lake Trout. In doing so, we offer the fish a higher chance of survival, providing a more sustainable populations for the anglers who love to catch them.

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