

Summary of Activities

Date: November, 2016

To: Ian Kitch
Sustainable Development - Fisheries
Branch
cc. Lloyd Rowe, Jonathon Stephens

From: Holly Urban, Brock Koutecky,
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Subject: *Two Mile Lake - Historical Literature Review, 2016 Assessments and Management Options.*

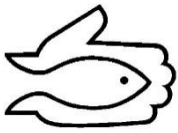
Two Mile Lake History:

(Practices, Findings and Studies prior to 2000)

Two Mile Lake was first stocked in 1963 with brook trout as an effort to create a unique trout destination in the Duck Mountain Provincial Park. Closely following this initial stocking, a stocked trout assessment was conducted to determine survival and growth rates of brook trout. This assessment was conducted by R. Andrews in November of 1964. Results determined that brook trout stocking was extremely successful and growth rates were significant. Also stomach contents were analyzed, and determined that the most important forage (November 1963) was backswimmers, boatmen, unidentified fish, predacious diving beetles, and unidentified odonada (respectively). Forage preference changed with size of brook trout, as expected. From total sample size (n=399) brook trout were captured and sampled, no evidence of any other large bodied fish was noted to inhabit the waterbody. A creel census was conducted by Conservation Officers in the summer of 1965. The survey summary concluded that "it would appear that Two Mile Lake is one of the better stocked trout lakes in Manitoba, and that angling pressure has certainly increased over the previous summers" (Andrews, 1966)

A more comprehensive study was conducted in 1967, entitled "Investigation in to the sport fishery of Two Mile Lake" by R. Andrews and J Dennehy. The study had three objectives (1) to describe the sport fishery of Two-Mile Lake, (2) to investigate the relationship between the sport fishery statistics, fish populations, and environmental peculiarities and (3) to assign "dollars spent" value to the sport fishery. This study included a creel census, water analysis, benthos sampling, creel fish sampling, gill net sampling, economic analysis, and enforcement analysis (Andrews, Dennehy, 1967). The summary of the report lists findings in each of these aspects, and overall suggests that it is economically viable to continue the trout stocking program. In summary, the lake attracts anglers and provides a high angling quality to levels that justify the stocking program.

Ten years later (1978), a test netting program was set out by J. Brunen and D. Bilenduke to determine approximate survival rates along with age and growth of stocked brook trout. In total seven standard gangs were set, after catching multiple yearlings, smaller meshes were excluded from the gangs. Results indicated that a large number of brook trout were caught (320), but only five were large (Brunen & Bilenduke, 1978). In total efforts, eight white suckers were caught. This was the first instance of white-sucker presence in Two Mile Lake. No brook trout age and growth information was referenced in the report.



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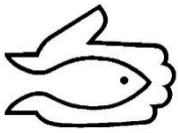
Following 1978, no fish community surveys occurred until the late 1990's in accordance to current known records. In this period of time, Two Mile Lake produced an exceptional put-and-take brook trout fishery (Whyte, 2016). "In the 1970/80's, the lake was covered in ice shacks, and the lake produced the a few trophy sized brook trout" (Whyte, 2016). In the mid-1980's evidence of walleye and northern pike began to show up in Two Mile Lake. It was hypothesised that the walleye entered the lake through connectivity to Black Beaver Lake (inflow), and the pike came through connectivity from the Spray, Ketchum Lake system (outflow). Following this invasion and high predation of stocked trout from top predators, Two Mile Lake was chemically reclaimed in 1987. Closely following chemical rehabilitation water control structures were erected on both inflowing and outflowing tributaries to limit further invasion. Shortly after, trout stocking resumed, and Two Mile Lake was once again established as a popular trout fishery (brook and rainbow trout two-tier stocking).

Closely following Lake reclamation (1993), the Manitoba Fly Fisher's Association was concerned with the current harvest levels at Two Mile Lake. They suggested a regulation change to protect trophy brook trout, and initiate a winter closure. Through further investigation and public consultations, the lake remained as a put-and-take managed lake and significant regulations changes (i.e. winter closures) were not initiated.

The next quantitative fish stock analysis was conducted in 1998. As an evaluation of status of brook trout stocking; Yakes set two overnight gangs in early May of 1998. Nets captured 20 smaller (~150-200mm) brook trout. Stomach contents were analyzed and found "mostly stickleback, some dragonfly larvae, three crayfish, and one leech". At that point in time no yellow perch were found. Yakes concluded that "some rainbow trout be stocked in Two Mile, and some winter dissolved oxygen should be completed" (Yake, 1998). At this point, over 10 years after chemical lake reclamation, no evidence of large bodied non-salmonid was determined (white sucker, walleye, northern pike) suggesting that chemical rehabilitation did in fact work as it was intended to.

(Practices, Findings and Studies post 2000)

At some point between 2002 and 2003 was the first confirmed instance of yellow perch documented in Two Mile Lake. At this point the exact date and sources is has not been determined. In July of 2003 a master angler yellow perch was submitted on the Master Angler Award Database. There are no significant theories suggesting how yellow perch became introduced to the waterbody. Potential sources could be (1) illegal (intentional or unintentional) introductions (2) invasion through inflowing/outflowing tributaries during high water periods, or (3) introduction through some other natural sources (i.e. birds).



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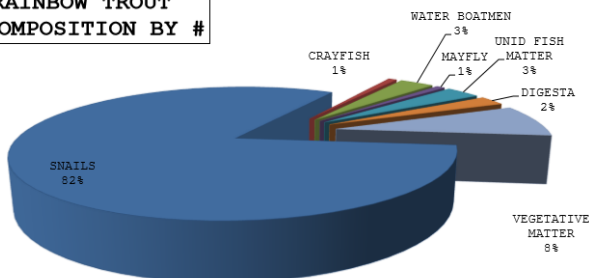
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In 2004, Keewatin Community College (KCC) Natural Resource Management Technology (NRMT) program from The Pas, MB contacted Regional Fisheries Biologist, Brian Yakes looking for a stomach contents project, as this type of research project was mandatory for their studies. Yakes, interested in the competition for forage overlapping between stocked trout, and recently introduced yellow perch suggested that the study be conducted on Two Mile Lake.

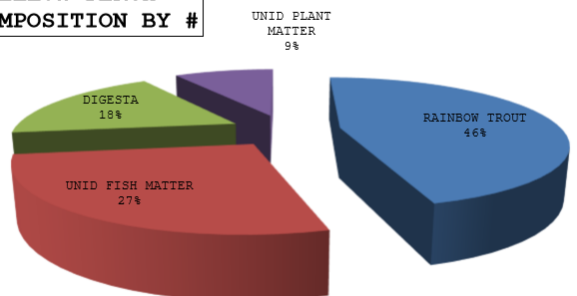
In the winter of 2004 using 3 and 3¾" gill nets, students acquired 29 fish specimens (15 rainbow trout, and 14 yellow perch). Rainbow trout ranged from 333-402mm, and due to large mesh sizes perch were quite large, 256-315mm. 15% of rainbow trout stomachs and 47% of yellow perch stomachs were empty. Rainbow trout stomach contents included primarily snails (42%), vegetative matter (30%), unidentified fish matter (9%) mayflies along with boatmen, back-striders, beetles, digesta, and shrimp (remaining 19%) - composition by weight. Yellow perch stomachs included primarily rainbow trout (54%), unidentified fish remains (25%), digesta (14%), and vegetative matter (7%) - composition by weight. Composition by number can be viewed below. 45% of perch consumed rainbow trout and 27% consumed some unidentified type of fish matter. The identified rainbow trout prey remains had an average length of 12cm (UCN, 2004). Results suggested that in winter, Two Mile rainbow trout were primarily bottom feeders, and larger perch were almost exclusively piscivorous.

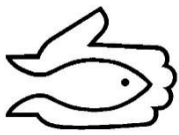
Amongst the sample size there was little evidence of overlapping feeding habits. Schrader, 2000 states when two or more ecologically similar species co-evolve in a system, the often partition-shared resources in a way to minimize the possibility of competition. In summary, the report suggests that the relationship between the two species was that perch were feeding on rainbow trout, and that the current stocking size of 12-15cm is like serving "dinner on a platter".

**TWO-MILE LAKE 2004
RAINBOW TROUT
% COMPOSITION BY #**



**TWO-MILE LAKE 2004
YELLOW PERCH
% COMPOSITION BY #**





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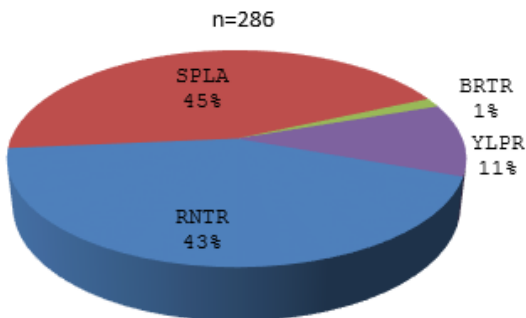
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In 2006, Kitch wrote a "history and status" report for Two Mile Lake. The report states that historically Two Mile Lake was a trophy trout fishery; only two master angler rainbow trout were registered in 2005, one in 2004, two in 2003, 25 in 2002 and 41 in 2001. The report then states that over the past three years, the yellow perch population had exploded meanwhile the trout fishery had collapsed (Kitch, 2006). As an effort to regain trophy trout status, splake would be stocked as an effort to reduce yellow perch populations. Initial splake stocking occurred in September of 2006.

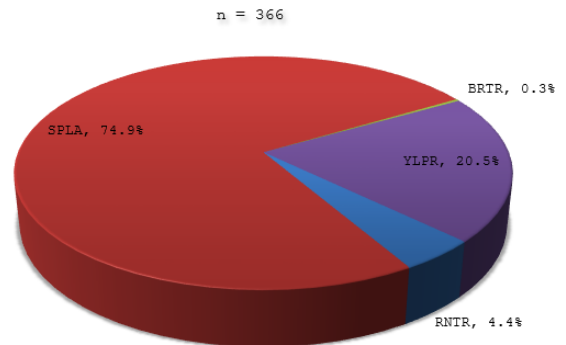
2010/2011 BTIN Assessments:

In the summers of 2010/2011 SVSFE technical staff assessed Two Mile Lake trout stocking success through BTIN (Brook Trout Index Netting). BTIN is a fish community protocol developed in Ontario, and is designed to provide an unbiased index of brook trout abundance, as well as provide biological information on the target species (Please refer to Prj 10-11, and Prj 10-30 Stocked trout assessments). In accordance to this protocol, 32 randomly located gill nets (three 15m panels of 2" and 2.5" mesh) were sampled in late June and early July 2010. This exact program was replicated in 2011 to further assess stocked trout success and compare efforts. Results are as follows:

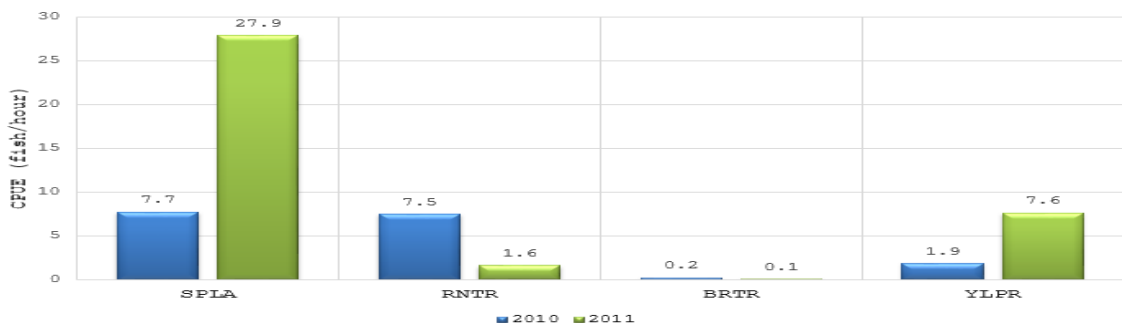
2010 Two Mile Lake
Species Composition

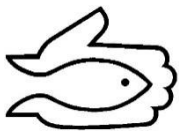


2011 Two Mile Lake
Species Composition



Two Mile Lake
CPUE Comparison of Stocked Trout
Assessments 2010 -2011





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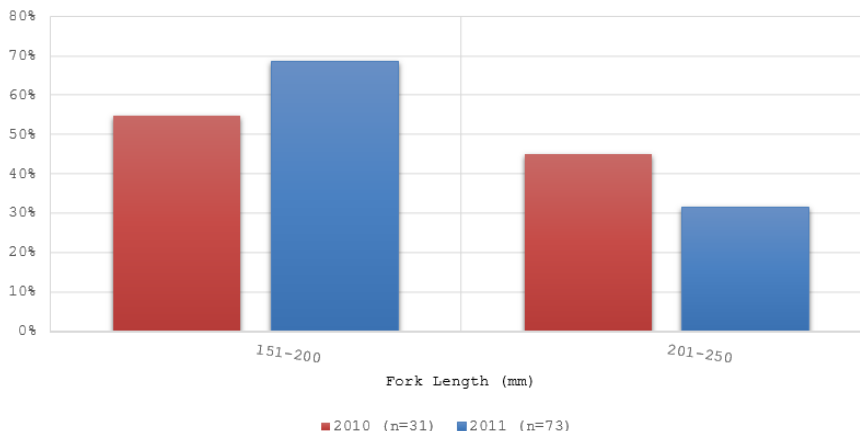
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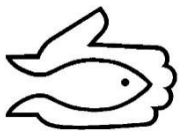
2010/11 Results determined some pretty interesting trends.

Brook Trout: First of all, there was very little evidence of brook trout within the system. Correlating with stocking records, this low catch was not surprising as brook trout stocking ceased in 2003. In 2010 (n=4) brook trout ranged from 300-312mm (3+ yrs). This does not correlate with documented stocking records.

Yellow Perch: With regards to yellow perch, no age structures were collected. Over both years of BTIN, a total of 104 yellow perch were captured and sampled. Interestingly, when comparing the size of perch captured in 2010 to the UCN program in 2004 some observations can be made. In 2004, UCN used 3 and 3¾" gill nets and in 2010 SVSFE used 2 and 2½" gill nets. UCN found very large perch (256-315"), whereas SVSFE found medium size perch (167-225mm). In the first few years after introductions to a waterbody perch sometimes produce attractive sized fish, and as the population expands rapidly they compete with each other (and trout) for food, affecting the growth of both species (FMB Alberta, 2008). When referencing the Master Angler Database, the first "master perch" was registered in 2003, seven were registered between 2005 and 2007, and one was registered in 2010. It becomes relevant to state this because in 2004 UCN found evidence that perch >250mm had been actively feeding on recently stocked rainbow trout (12-15cm). In the 2010/2011 sample size suggested no evidence of these very large perch. Of course, mesh size may be the reasoning behind this comparison; regardless, this is potential evidence suggesting that the perch population has become so prevalent in Two Mile Lake, that stunting has occurred as a result of overpopulation and competition for available forage.

**Two Mile Lake Yellow Perch
Length Frequencies**





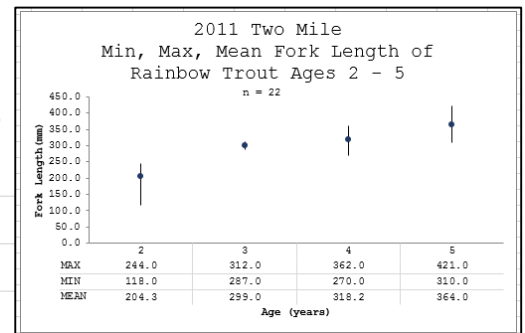
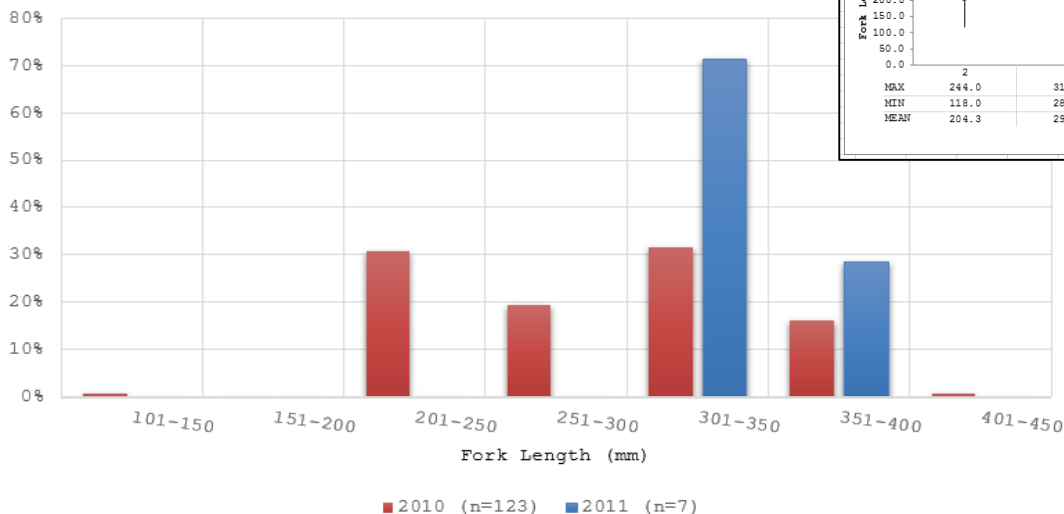
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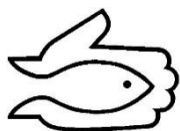
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Rainbow Trout: With regards to rainbow trout, BTIN provided some very interesting results as well. First of all, it appears that CPUE is 7.5 and 1.6 fish/hour netting of effort over 2010 and 2011, respectively. When correlating these catches with stocking records, one can assume that survival is relatively low. Trout do not prey heavily on perch, so when (perch) introduced into stocked trout waters increase greatly in numbers, thus negatively affecting growth and survival of trout species (FMB AB, 2008). At this point a greater degree of scientific evidence suggests that stocked rainbow success is limited due to both competition and predation from yellow perch in Two Mile Lake. There is evidence of survival from each annual stocking, however there is also evidence that initial loss of stock is significant.

In terms of age and growth analysis, the sample size equated to 22 rainbows. The first notable trend is a large variance of growth amongst each age class, a trend typical of trout, or fish in general (some individuals are more aggressive feeders and grow faster than others). For example, the age 5 class showed growth of certain individuals to be as low as 310mm, and as high as 421mm. Average total growth in this age class was 364mm. Furthermore, when comparing age and growth in Two Mile Lake, rainbow growth is relatively low in comparison to other stocked trout lakes (Koutecky, 2016).

**Two Mile Lake Rainbow Trout
Length Frequencies**





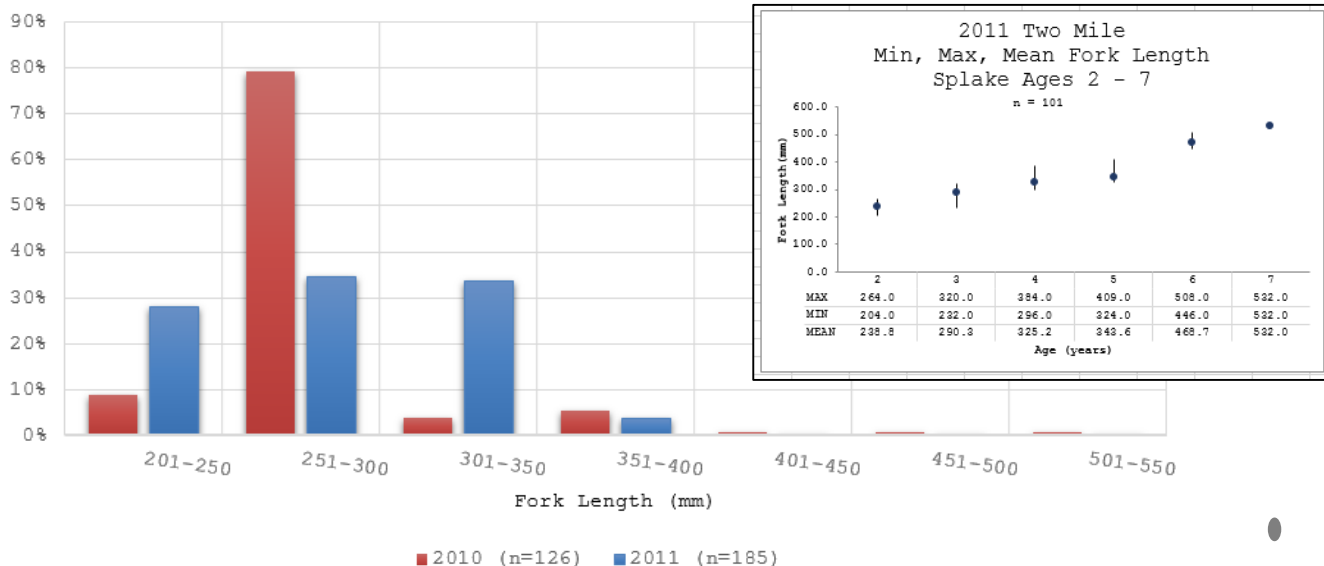
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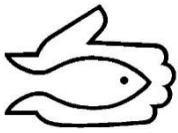
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Splake: When switching focus to splake some notable trends are noticed as well. CPUE is 7.7 and 27.9 fish/hour netting of effort over 2010 and 2011, respectively. The higher splake CPUE in 2011 was (~30% of splake catch) related to fall 2010 splake stocking. Also, when referring to species composition, it becomes important to express that both rainbow trout and splake, species compositions are quite similar in 2010 (43% and 45%, respectively), and dominated by splake in 2011. At this point it becomes important to refer to stocking records.

Sure there is a significant catch of both rainbows and splake, but when referencing the stocking database, from fall of 2004 spring of 2010, a total of 68,725 rainbows were stocked at various rates, sizes and time of years, whereas only 8,175 splake were stocked at 12-15cm fall stocking (2006 and 2008). As a result of this figure, it become safe to state that splake tend to do significantly better in Two Mile Lake than rainbow trout. In terms of fish size, it is noted that very strong compositions exist in multiple length frequencies which suggests success rates of each stocking. Regarding ages, it is noticed that splake in this particular waterbody growth is average, however are by no means rapid. Upon literature review multiple sources suggest that splake grow much faster than other stocked salmonids. At current the reason for the lower then average growth is unknown. Upon further research, it becomes obvious why lake managers decided to introduce splake as an effort to reduce perch populations in the first place. In East Lake, Ontario, splake were introduced as an attempt to control invasive perch populations. In summary, perch populations decreased by over 40% between 1990 and 1992, and it was determined to continue splake stocking to control perch populations (Rumsey, 1994).

Two Mile Lake Splake Length Frequencies

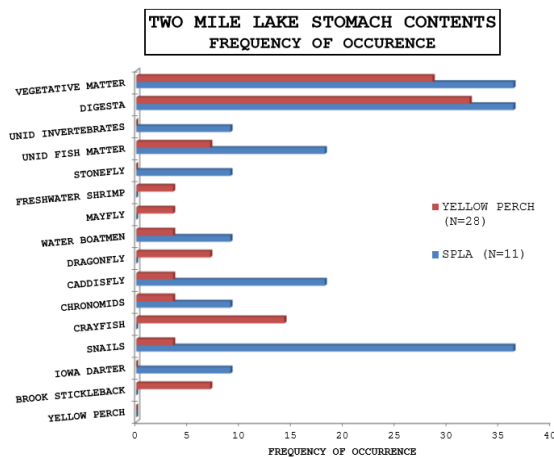
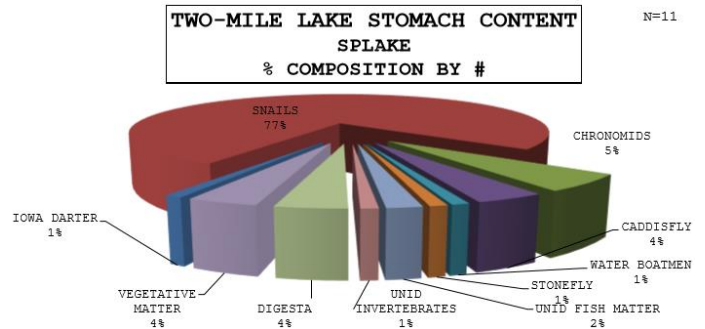
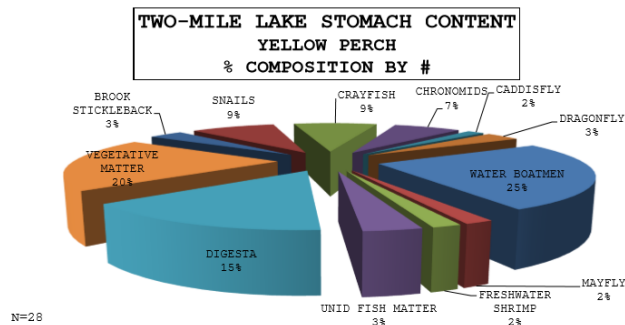




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Winter Stocked Trout Assessment: Winter 2011, seventeen BTIN gill nets were set beneath the ice for an average of (1.03hrs/net) to compare winter yellow perch and stocked trout CPUES, along with collect stomachs from unintentional mortalities to determine if there was an overlap between splake and yellow perch feeding habits. Managers were also very interested in determining if splake were consuming yellow perch as intended to. Results determined that both splake and rainbow trout CPUES dropped significantly in comparison to summer, and yellow perch CPUE remained very similar. Also additional length and age data was collected from trout species to correlate with stocking records, and therefore attempt to quantify stocking success (above). Results from stomach content analysis: Note that due to very low rainbow catches, none were sacrificed for lab analysis.



Results indicated that no significant overlap existed between yellow perch and splake aside from vegetative matter. Also, no evidence determined splake were feeding on yellow perch. However, significant evidence determined that splake were piscivorous. In winter, splake were primarily bottom feeders (snails) which correlated with the primary winter diet of rainbow trout found in 2004 (UCN, 2004). Results indicated that more significant results could be determined through stomach analysis in other seasons (i.e. summer).



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Angler Interviews: In 2015, SVSFE initiated the "Angler Interview Survey" creel program in the Duck and Porcupine Mountains. SVSFE's summer student, Megan Paterson spent 50% of her term during the summer in the Duck and Porcupine Mountains conducting creel surveys and general questionnaires (See Prj 15-004 SVSFE's IFIA). In total 178 general questionnaires were conducted, ten people considered Two Mile amongst their favorite fisheries. In terms of creel data acquired at the shoreline of Two Mile Lake, five people rated fishing quality at an average of 1.4/10 (1,1,1,1,3). Unfortunately, although very useful information, the sample size is far from optimal. The bulk of the serious trout fishing community fish in the early spring and late fall. Furthermore Two Mile lake is arguably most popular in the winter. For this reason, the creel duration and sample size (n=5) is not fully representative of current Two-Mile Lake angling quality.

Master Angler Awards: At this point it becomes important to analyze stocking records and evidence of success through the Manitoba Master Angler Database. Brook trout have been stocked since 1962 and continued until 2003, when it appears that stocking of rainbow trout became the new management plan. Interestingly, only twenty-six master brook trout have been registered between 1968 and 2011. As stated above, Whyte remembers the lake being an extremely popular put-and-take waterbody, especially during the ice fishing season; with evidence of the odd trophy being caught. Perhaps, low submission rates could be a result of high harvest in the 70's, 80's and 90's. In 1992, a total of twelve master brook trout were registered. This was by far the most registrations in one year, and immediately followed chemical reclamation (which occurred in 1987).

Swan Valley Sport Fishing Enhancement Inc.



SVSFE is a local non-profit organization dedicated to "Giving Fish a Helping Hand". The main focus of our organization is fisheries education, enhancement and research. Our team works closely with other user groups and Manitoba Fisheries Branch, by doing meaningful work with the common goal of ensuring sustainable fisheries and improving angling opportunities for now and the future.

**Want to be a part of managing our local fisheries?
Is there something you would like seen or done to improve angling in the area?
Participate in our 2015 Angler Survey!**

By filling out either the "General Questionnaire" or "Daily Catch Forms" you have the **chance to win prizes from the 2015 Angler Survey Draw** (limit of one general questionnaire/angler and one daily catch form/daily fishing trip within the Duck and Porcupine Mountains between May - September 2015). Deadline September 30, 2015. Information provides vital information on fishing quality in the area and helps improve fisheries management.

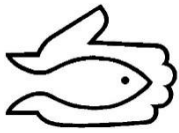
2015 Angler Survey Draw Prizes Include:

1st GPS/Sonar Unit
and Fly Rod & Reel
3rd Tackle Box & Tackle

Completed surveys can be:

- Left at pick up/drop off locations: Sticky's Bait & Tackle in Dauphin, Oak Stop in Swan River, Campground offices at Wellman, Blue, Child's, Whitefish & North Steeprock Lake, Wellman Lake Lodge <http://www.wellmanlake.com>, Blue Lakes Resort or at MB Conservation office in Swan River.
- Submitted online at www.swanvalleysportfishing.com
- Completed with our technicians working at various lakes when requested.
- Creel Box & Tagged Fish submissions will also be entered in draw as long as contact info is provided.





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Since 1993, a total of 221 rainbow trout master angler submissions have been registered. In this time there are two significant stockings. (1) 15,500 12-15cm rainbows were stocked in August of 1991. From 1993-1996, a total of 96 master submissions were registered as a result of this stocking. Currently, it is unknown why this particular stocking was so successful, especially when comparing to lack of brook trout submissions during these years. (2) following Yakes brook trout assessment in 1998 he suggested that rainbow be stocked. Later that year 15,840 fingerlings were stocked in Two Mile Lake. Between 2000 and 2002 a total of 80 "master rainbows" were registered as a result of this stocking. For the second time, two years following a "spontaneous" rainbow stocking (at 340 fish/ha), master angler submissions skyrocketed. Interestingly, 79% of the total master angler submissions in Two Mile Lake were a result of these two stockings. As we know, yellow perch invaded the lake at some point between 2002 and 2003. From 2003 until today (2016) only 40 master angler rainbow trout have been registered. Also, since 2003, over 110,000 rainbow trout have been stocked into Two Mile Lake at various rates, sizes, and times of year.

In terms of splake, only five masters have been registered since initial stocking in 2006. Four which were registered in 2015. This is quite surprising because the lake has had and continues to have a good population of large splake. Perhaps in coming years we will see more master angler splake registrations in Two Mile Lake. In regards to personal conversations over the past few years, there have been multiple instances of people catching trophy size splake in Two Mile Lake, especially immediately after ice-out (Koutecky, 2016)

Summarization the literature review 1964-2011:

(1) Brook Trout stocking was extremely successful from 1960's-2000, when salmonid stocking switched to rainbow trout. Although very few masters were submitted, there is significant evidence that the lake provided a very popular put-and-take brook trout fishery. Lack of master submissions could be a result of high angling pressure and therefore high harvest rates.

(2) Two very successful rainbow trout stocking occurred (1993 & 1998). From these two stockings there is significant evidence of stocking success (176 master submissions) which equates to 79% of total submissions today (2016). Since perch invasions, master submissions have decreased significantly and stocking rates have remained high. This, along with conclusions from 2010/2011 BTIN and 2004 UCN study suggests stocking success has decreased dramatically.

(3) Splake appear to be fairing quite well being stocked on top of prevalent perch populations. Although master angler submissions do not suggest this; 2010 and 2011 BTIN show significant evidence of success, even at low splake stocking rates.



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2016 Assessment: As stated above, Two Mile Lake has long history of being an extremely popular trout destination within the Duck Mountain Provincial Park. In recent years (since 2003), the lake has been invaded with a yellow perch population which has been hypothesised (with significant backing) to be the primary reasoning behind decreased trout angling quality. In late 2015 the idea of trout-maintenance discussions began. This idea referred to the manual removal of non-salmonid species (perch) in lakes where invasions have resulted in decreased trout stocking success and furthermore, angling quality. For this reason SVSFE set out in the 2016 open water season to (1) further quantify these invasions (2) remove as many perch as possible and experiment to see if manual removal programs are economically viable, and (3) come up with a constructive, yet economically viable management plan for Two Mile Lake.

Results: In early June, Two Mile Lake was assessed and perch were removed via electrofishing as the primary fishing method. Fishing took place in areas/habitats where yellow perch were considered to be. In total 2.32 hours of fishing effort was achieved and 2,250 yellow perch were captured and removed. Also, one brook trout was captured, sampled and released. In late August, trap-netting was utilized to further assess Two Mile Lake. In total 137.7 hours of fishing was achieved (six nets). In total, 1,055 yellow perch were captured and removed; thirty-two brook trout, two rainbow trout, and seventeen splake were captured sampled and released. Results are as follows;

Lake	Date	Method	Water Temp (°C)	Effort (hours)	Catch				
					YLPR	WHSC	BRTR	RNTR	SPLA
Two Mile	Early June	Electrofishing	NA	2.32 (one am & pm)	2550	0	1	0	0
	Late August	Trap Netting	17	137.5 (6 trap nets)	1055	0	32	2	17
biomass of yellow perch removed = 77,725 g (repurposed)									





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2016 Assessment cont'd:

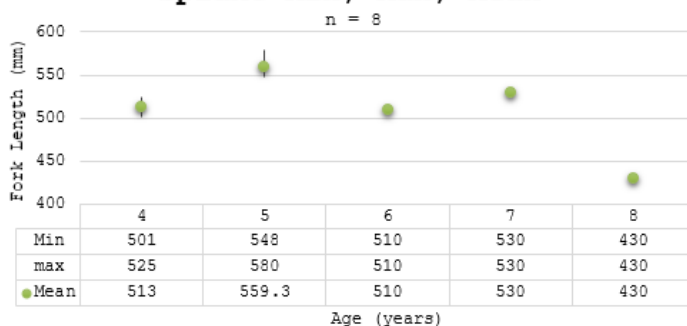
When analyzing growth from the 2016 trout catch, only a small sample was successfully aged, as a number of scales taken were found to be regenerated after the fact. Overall, sample sizes of $n = 1$, $n=3$, and $n=8$ were aged for rainbow trout, brook trout and splake respectively. It is difficult to draw too many conclusions as the sample size is extremely low, however some interesting findings are notable.

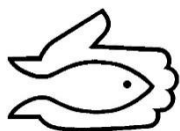
The single rainbow trout measured in at 310mm FL and was found to be 5+ years. Again, further samples are necessary to verify this trend but the interesting concept here is very limited growth within the rainbows considering a 5+ rainbow is barely half way to master angler size. Compared to productive stocked trout waterbodies void of perch invasions, (ie. Patterson Lake), rainbows at 300mm were aged around 3+ and would typically be master angler size around age 4+ (some as early as 3+). From a fair sample of rainbow trout taken from West Goose Lake in 2016, the average growth of a 5+ rainbow was 478mm. In a waterbody more similar in nature to Two Mile; East Blue Lake rainbow trout age sample in 2016 found that an 5+ year old fish exhibited and average length of 485mm ($n=16$). Overall, we know that growth rates can vary significantly from one trout to the next, and drawing conclusion from a sample size of one is impossible, however interesting.

In total three brook trout were aged; 410mm at 3+, 420mm at 4+, and 405mm at 4+. Again from the small sample not too much can be drawn here. When comparing ages of 4+ brookies to Black Beaver Lake (2010), the average growth ($n=11$) equates to 356mm. Interestingly, from this small sample, brook trout are showing greater growth in Two Mile Lake (perch-invasion), when compared to Black Beaver Lake (non-perch invasion). Also, the brook trout captured in Two Mile can only be a result of one stocking (October 2013), which has been the only documented brook trout stocking in Two Mile Lake from 2004-2015. This could be evidence suggesting that brook trout stocking is showing some level of success in Two Mile Lake, and a concept worth further investigation.

With regards to splake, a total of ($n=8$) were successfully aged; (figure). Again not too much can be concluded here aside from the fact that splake stocking on top of perch populations appears to show some level of success in Two Mile Lake. Also, notable is considerable growth and survival. Splake have been stocked 3 times since 2006 (2006, 2008, 2010).

**2016 Two Mile Lake
Splake Min, Max, Mean**

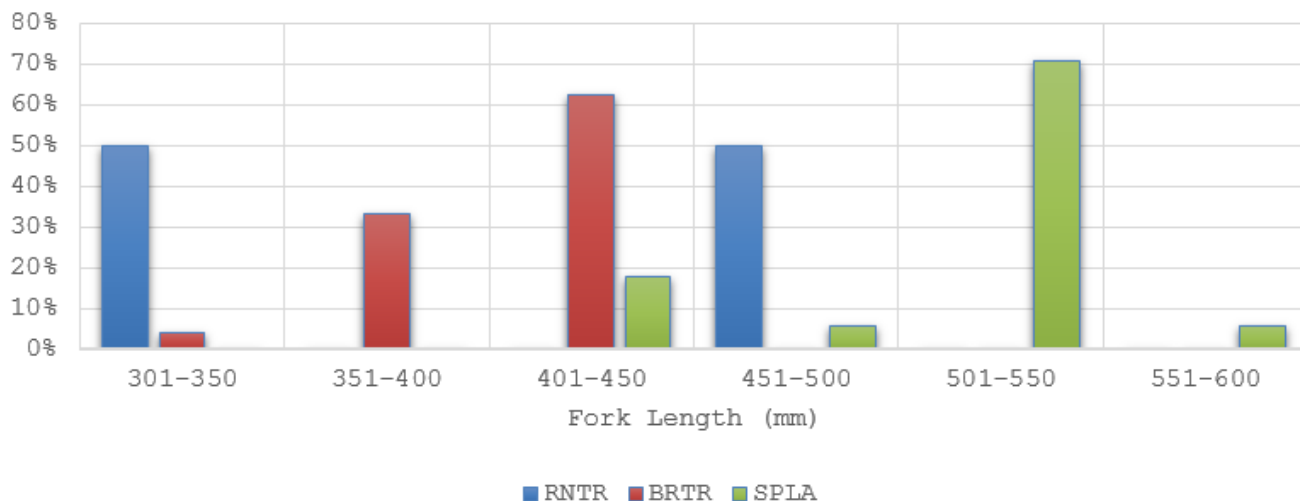




Summary of Activities

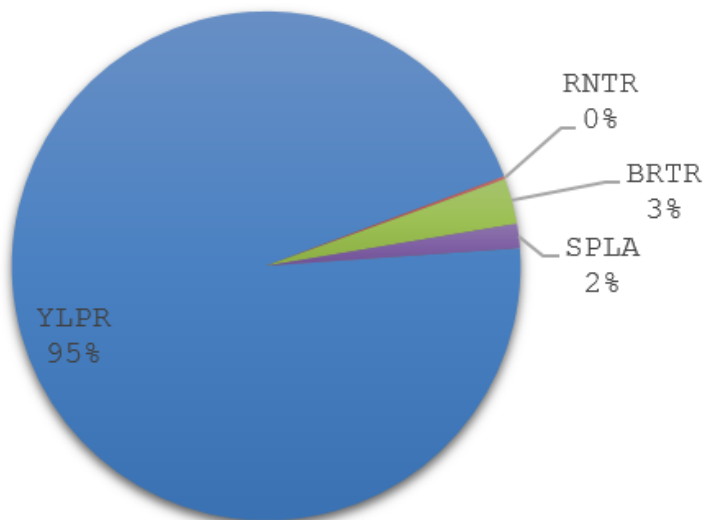
Subject: Two Mile Lake - Historical Literature Review, 2016 Assessments, and Management Options.

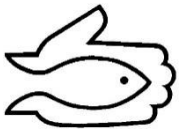
2016 TWO MILE LAKE Trout Length Frequencies (n=51)



2016 TWO MILE LAKE Species Composition

n=110





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Results cont'd: With regards to species composition; it consisted of 95% yellow perch, 3% brook trout, 2% splake, and 0% rainbow trout. The short electrofishing and trap-netting methods may not be the most effective methods for quantifying trout stocking success. At this point it becomes important to state that 2016 efforts are not lake representative (especially in terms of total species composition); primarily because efforts were targeting yellow perch in littoral and near-shore habitats.

In terms of preferred habitat, spring electrofishing displayed high perch catches to be associated with (1) beaver activity and high percentages of woody debris (2) shallow bays with chara and pondweed as the dominant vegetation, and (3) the windward shore(s). Aside from this no real highly productive areas were determined. Late summer/early fall trap netting seemed to be more effective in capturing larger, mature sized perch. In terms of most productive areas, again beaver houses and areas with prevalent woody debris were best. For example, two beaver houses, one slightly west of the boat launch and another located mid lake in narrows were productive. Also trap netting areas with excessive, dense, green pondweed were most productive.

In summary, these short experimental assessments were reasonably cost effective and determined specific locations and habitat types to effectively remove perch, though further methods/analysis should be considered. Perhaps different efforts in a greater variety of habitats and times of year would have determined more significant results in terms of quantifying; non-salmonid invasions, stocked trout survival and health, as well as efficient removal practices.





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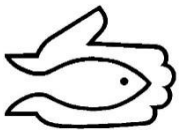
Discussion/Recommendations: In 2008, the Province of Alberta released a document entitled "Fisheries Management Branch Response to Unwanted Perch Populations in Stocked-Trout Lakes in Alberta" (FMB, 2008). This document essentially lays out different management options for different types of non-salmonid (i.e. yellow perch) invasions. It identifies three different perch invasion scenarios, and different options on how to deal with them. For further reading please refer to literature cited of this report for link to referred document. SVSFE has utilized this thought process to develop management options specific to our area. At this point please refer to a draft document entitled "SVSFE's Management for Unwanted Perch into Stocked Trout Lakes". This document is designed to provide a step by step approach to dealing non-salmonid (yellow perch) invasions in stocked trout waters. (Appendix)

Step 1: Quantify the problem - At current it appears the Two Mile Lake exhibits a very strong rate of non-trout invasion. However, it is important to state that the most current methodology used was targeting non-trout species, and therefore is likely not be representative of true lake species composition. SVSFE has noticed a demand for truly quantifying problems of this nature; and because of this we are in the works of creating a "standard protocol for assessing still-water stocked trout waters". This non-lethal program will be designed and agreed up by the scientific community. At this point in time (2016), regardless of true scientific backing, we can assume that the issue in Two Mile Lake is a serious one.

Step 2: Stakeholder Meetings: At this point, it becomes important for stakeholders to go over the data and discuss the options. Drawdown and ceasing aerations is not an option here. Chemical Rehabilitation is practised in some Canadian provinces, but is not an option for lakes in the Swan Valley area. This narrows the options down to changing management plans & mechanical removal. These approaches are far more beneficial to the current trout investment in the lake and the stakeholder meeting would review the possibilities available.

Step 3: Review Options- Based on current management plans for Two Mile Lake, one could assume changing the management plan to a perch fishery and walking away is not an option. Currently, there are four potential options which could be attempted, or combined for effectiveness.

(1) **Stocking Rate:** In terms of stocking rates and frequency, one should determine if current stocking practices are efficient; how do trout ages and length frequencies correlate with current status of trout in lake and what seems to be working and what does not; time of year and stocking size should be closely examined in this process. In terms of appropriate stocking densities, every managerial jurisdiction across the board has a different approach; where some densities work, some don't and in many cases the success rates from jurisdiction to jurisdiction contradict each other. For this reason, it is suggested that stocking rate be further discussed amongst stakeholders, as it is believed that efficient stocking rates are very lake specific, especially when competitive and predatory species inhabit the lake. Arguably a comprehensive age and growth study with a significant sample size will help with this process. Regardless, the current rainbow trout stocking practices in Two Mile Lake are hypothesised to be unsuccessful, and changes should be made. Also, there is significant evidence that past splake stocking (at low rates) was successful. Also, there is evidence that brook trout stocking may be more successful; however at this point further investigations are required.



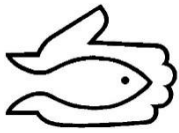
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(2) Stocking Size: In terms of stocking size, a strong argument is that larger fish are quicker and easily escape predation, as well as compete better. In 1959, Crossman, found that rainbows switched from a plankton to shiners at >250mm (Crossman et, el 1959). In Arizona, researchers found that rainbows <300mm fed predominantly on plankton before switching to a piscivorous diet (Otte, 1975). Beauchamp, 1990 found that rainbows switched from invertebrates to small bodied fish at a length of 250mm (Beauchamp, 1990). In Lake Washington, WA, researchers found that in spring and summer yellow perch were an important forage base for rainbow trout >250mm (10") (Beauchamp, 1990). This is noted because at this point stocking on top of perch populations is unavoidable and should be experimented with. Assuming these feeding habits are similar in Two Mile Lake, past growth rates would indicate the switching to a piscivorous diet wouldn't occur until approximately age four rainbows. In this case, stocking larger trout (specifically rainbows) will improve chances of reaching length frequencies where they will switch to a piscivorous diet, compete less with perch for invertebrates and plankton, and potentially even feed on young yellow perch. "In Saskatchewan, a couple lakes with perch we are planning on stocking larger trout (8-10 inches compared to 2-3 inches) at a reduced stocking rate (1/2 to 2/3 the regular rate) with the hope that the larger stocked trout will better compete with the perch. This was the first year this was tried and only in one lake so far, so we do not have any results yet" (Prestie, 2016). In general, the larger the trout is at the time of stocking, the greater chance it should have to reach sizes that will attract anglers in a system containing yellow perch.

(3) Stocking Species: To consider stocking another species. For example in Two Mile Lake, as an attempt to control perch numbers, SVSFE and Fisheries Branch stocked splake from 2006-2010. From known records, splake did exceptionally well in the lake and harvests were high. So high, in fact SVSFE invested in signage and protection regulations to protect the splake from harvest. Unfortunately, at this time, splake are not being produced within the hatchery. Future production is dependant on mandatory disease testing of lake trout and time associated with consecutive clear results and time to produce fish to stocking size. For this reason, splake stocking has not occurred since 2010. The Province of Saskatchewan found that rainbow and brook trout do not compete well with perch. "The only lakes that have maintained a decent trout fishery after the establishment of perch are lakes stocked with brown trout, tiger trout, or splake" (Prestie, 2016). In Goong Reservoir, Australia, triploid brown trout stocking was ceased do to substantial impacts and predation on Macquarie Perch (FRDR, 2016). Macquarie Perch (*macquaria australasica*) are not related to yellow perch, however, it has been suggested by Friends of the Red Deer River community organization of Alberta, that triploid browns may be able to control the perch problem in Cow Lake, Alberta.

Lastly, if altering stocking rates, stocking size, or species stocked becomes imperative that full communication be made between stakeholders, provincial fisheries staff, and Manitoba's fish stocking program. As we know, the Whiteshell Hatchery plans stocking years in advance, so if changing the stocking program becomes priority, it may take a few years to become implemented. Also, if a particular species (i.e. splake) become priority, SVSFE may have to invest in purchasing stock from elsewhere, because it may be a few years before the White-shell Hatchery hybridizes lake trout and brook trout due to mandatory disease testing necessary for rearing lake trout at this current time.



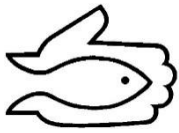
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(4) Manual Rehabilitation - Evaluate the cost and benefits of initiating a manual non-salmonid fish-out program. As we know, this is difficult to quantify, as manual removals can require significant effort, differ from lake to lake, are expensive, and only temporary. In terms of Two Mile Lake, when evaluating the cost-benefit of manual lake reclamation, degree of invasion, size of waterbody, available methods, gear and manpower are all factors that can effect whether it is economically viable to remove perch. The hard part here, is truly understanding the cost-and-benefits associated with reclaiming a lake.

According to a non-salmonid (northern pike) removal program in West Long Lake, Nebraska they state that mechanical fish removal is only recommended on small bodies of water where sufficient effort can be put forth to remove enough fish to achieve management goals (Jolley et al, 2008). Also, they state that efforts are extremely unlikely to remove all individuals, are only temporary because the juveniles that remain will display compensatory increases in recruitment, survival and growth. Therefore, mechanical removal programs should be comprehensive and long-term. Also note that cropping perch populations may lead to decreased interspecific competition and increased growth of perch. The Alberta response plan (FMB, 2008) states that if yellow perch density increases to 25% or more of species composition that the perch are considered to be adversely affecting the trout stocking program. The authors suggest that if feasible, work with clubs and volunteers to control perch numbers of recruitment by manual removal of eggs and fish, by keeping perch densities <25% of total species composition. If this objective is achievable, trout stocking should continue as necessary.

Another example is from Cow Lake, Alberta. Rainbow trout stocking began in 1982 and provided anglers with a trophy rainbow trout destination for over 10 years when in 1993, the illegal presence of yellow perch was confirmed. Since then the yellow perch population exploded and trout fishing quality declined to the point where it was not economically viable to stock trout anymore. The idea of conducting removal programs were considered, however the idea was tabled because it was determined that a substantial cost (over one million dollars) combined with lack of confidence in success due to physical characteristics of the lake (AB Gov, 2014). Upon further investigation Cow Lake is a total size of 856 ha, at \$1,000,000 to effectively remove perch equates to \$1,156 per hectare. For comparative reasons, Two Mile Lake is 43 ha, meaning at this rate it could cost \$50,000 to "effectively" manually remove perch. It is unknown how Alberta came up with this figure or methods/timelines for removals so for that reason, to move forward, SVSFE needs to quantify the potential cost of reclaiming Two Mile Lake through manual rehabilitation and the degree of success in this method.



Summary of Activities

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Options on How to Proceed:

1) Is there enough evidence to initiate changing the management plan?

Yes? Proceed to Step 2

No? Develop a standard assessment protocol to further evaluate stocking success in the summer of 2017 - review results in late 2017

2) What type of fishery should Two Mile Lake be?

Trophy Trout Fishery - Change the lake regulation - Limit of 1 or 0, and protect trophy fish, also initiate tackle restrictions. Arguably trophy fish will be piscivorous and will predate on yellow perch populations.

Put and Take Fishery - Leave regulations the same

Combination - Leave regulations the same

3) What is the desired species?

Brook Trout - 12-15cm stocking on top of perch populations success rates are unknown - experiment with stocking larger fish at lower stocking rates.

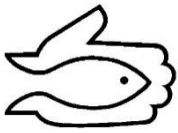
Rainbow Trout - 12-15cm stocking on top of perch population is inefficient - experiment with stocking larger fish at lower stocking rates.

Splake - Significant evidence that splake stocking on top of perch populations is successful in Two Mile Lake. Note, it could be up to 3-4 years before the hatchery will have splake stock - consider finding and paying for stock elsewhere. Note that (Fraser, 1988) found that splake actively prey on recently stocked rainbow trout and that (Burkard, 1962) found that rainbow trout and splake feeding habits overlap considerably in the spring, summer and fall. Interestingly, SVSFE found that splake feeding habits overlap rainbow trout in the winter of 2011.

Other Species - Experiment with tiger trout, or brown trout. These species have had success stocking on top of perch populations in the Province of Saskatchewan.

4) Consider Manual Rehabilitation:

Further investigate if manual removal programs specific to Two Mile Lake are cost-effective and whether objectives are achievable. Either 1) combining perch removal in conjunction with the agreed upon standard stocked trout assessment or 2) have volunteers carry out removals would be lower costs of conducting individual removal programs. Although these options provide lower costs, the feasibility of their success is likely low as these are only short term goals and manual removal requires long term commitments. Without long term commitments and the current status of the perch population and their ability to reproduce and out compete trout, manual rehabilitation is only "treading water" (Brock 2016).



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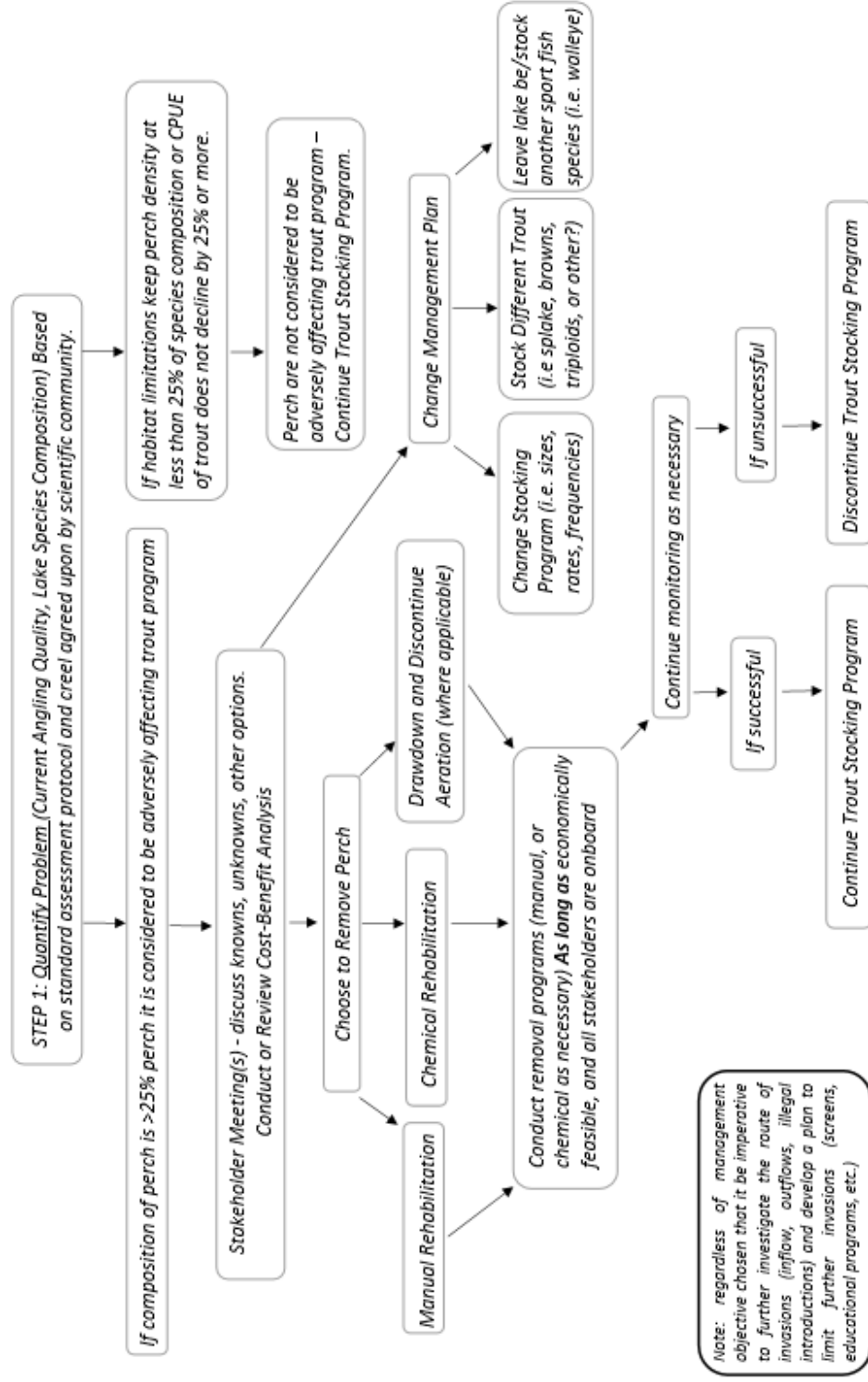
Notes for SVSFE technicians:

- (1) Develop a standard stocked-trout assessment protocol using non-lethal methods for future analysis of stocked trout waterbodies containing adverse non-salmonid presence. Work with the scientific community to ensure that this program will paint a true picture of stocked trout stocking success and species compositions
- (2) Discuss with local Fisheries Biologist, Ian Kitch and Hatchery Manager, Kevin Dyck to determine possibilities and timelines in changing species stocked or stock size to larger trout (specifically rainbow trout) to increase stocking success and angling quality in a perch invaded waterbodies.
- (3) If recommended by stakeholders, further investigate the concept of manual rehabilitation programs and determine if a program of this magnitude is economically viable



Appendix

SVSFE Management Options for Unwanted Perch into Stocked Trout Lakes





Summary of Activities

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