Investigation into Loche (burbot, *Lota lota*) biology and liver quality in the Gwich'in Settlement Area, Northwest Territories

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Billy Tyrell (youth) jiggling in Aklavik, November 2007

Photo credit: Amy Thompson (GRRB)

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Summary

Loche (burbot, *Lota lota*) were collected from traditional fishing locations near four communities in the Gwich'in Settlement Area (GSA), Northwest Territories. Loche are a very important subsistence fish for the Gwich'in people especially their livers, which are considered a delicacy to most elders. Community concerns about the quality, in association with the appearance, of loche livers has been lingering in the communities of the GSA for more then a decade. This study compared the contamination content (organochlorines and metals) in good and bad livers that were categorized by local Gwich'in fish monitors. Stable isotopes, age, length, weight, and sex were also investigated. Other samples were taken that could add to the information in future studies when funds are available.

Louis Cardinal jiggling in Tsiigehtchic, May 2007

Introduction

Loche (loche, *Lota lota*) are found throughout the Gwich'in Settlement Area (GSA). They are a very important subsistence species especially for the Gwich'in people. The traditional Gwich'in name for loche is Chehluk (GRRB 1997). The Gwich'in fish for loche with a technique called jiggling which consists of a line and usually a hand-made hook attached to a strong willow stick (GRRB 1997). However, when supplies are scarce they improvise with whatever resources they have available (i.e. bend nails into hooks). When loche are running thick, bait is not needed but is often preferred.

Their livers are considered a delicacy and the preferred dish is to cook the liver with cranberries (Steven Bonneplume, personal communication, GRRB 1997). Local fishers have been complaining about discoloured and abnormal-looking loche livers for over two decades and want to know if these livers are still safe to consume and what causes the abnormalities (Steven Bonneplume and Anna May MacLeod, personal communication, GRRB 1997).

There was a study conducted in 1987 that investigated the occurrence of abnormal loche livers with an emphasis to examine it's relation to oil industry operations in Norman Wells (Lockhart *et al*. 1987). They found that the cause of the liver condition is unlikely due to exposure to petroleum hydrocarbons but it is associated with the energy stored in the liver (specifically fat and calories) and they suggest that there may be a linkage to growth. They did not find sufficient information on the timing of the appearance of the abnormal-looking livers. There was an unpublished study conducted by the Arctic Borderland Co-op in 1999 which sampled loche from Aklavik and Fort McPherson for contaminant levels and compared them to liver appearance. However, the sample size was small. No significant differences in contamination levels between the livers were found. These two studies provide valuable information about this unusual occurrence but they did not define the causes. There were a few other studies that investigated the occurrence of parasites (*Rahidascaris acus* (bloch) and *Trianophorus nodulosus* infecting loche livers (Bernier 1986a, Bernier 1986b, Dick and Bernier 1987). These studies confirmed that liver atrophy was worst in bad looking livers. They also described with great detail the pathology of loche livers. There have been other studies examining loche livers but none that compared the appearance of abnormal and normal-looking loche livers.

The study was designed to address this community concern by investigating the livers and comparing them to liver appearance. This was accomplished by 1) contamination analysis (organochlorines and metals), 2) stable isotope analysis, 3) biological analysis, and 4) traditional knowledge.

Methods

Study Area

The area of focus for this study is the Gwich'in Settlement Area (GSA), Northwest Territories. The GSA was established as a result of the *Gwich'in Comprehensive Land Claim Agreement* (GCLCA) which was negotiated between the Gwich'in and the Government of Canada in 1992 (Bill C-94). The GSA is 56,935 km^2. Tsiigehtchic and Fort McPherson are predominantly Gwich'in communities while Inuvik and Aklavik are composed of mixed backgrounds (Gwich'in, Inuvialuit and non-aboriginal). Inuvik translates to "town of man" and is the main administrative centre of the Western Arctic. Aklavik is known as the "place of the barren ground grizzly bear". Tsiigehtchic is known as the "place of the iron river". The traditional name for the community of Fort McPherson is

Teetl'it zheh, named after the Gwich'in name for the Peel River, Teetl'it njik (Ingrid and McCartney 2003).

Figure 1: Map of Gwich'in Settlement Area.

Field collection

Loche were collected between October and December 2007 from traditional fishing locations near the communities of Inuvik, Aklavik, Tsiigehtchic and Fort McPherson (Table 1). The locations were identified by Gwich'in Fish Monitors that were familiar with the area. In Inuvik, the Bombadeer location is downstream from a sewage lagoon and Sam Arey's Creek is upstream. In Aklavik, all fish were collected from a single creek (across from town). There was another good loche jiggling creek but due to a tragedy in the community it was recommended to not fish there at that time. In Tsiigehtchic, loche were mostly collected from Arctic Red River but some were capture from the Mackenzie River which is within 10 KM from Tsiigehchic. In Fort McPherson, there are not many good jiggling locations close to town and under the advisement of the fish monitor more locations were added all within 50 KM of Fort McPherson.

Table 1: Loche fishing locations, 2007

Location	Community	X coordinates	Y coordinates
Bombadeer Creek	Inuvik	133.82380	68.42845
Sam Arey's Creek	Inuvik	133.93619	68.35170
Arctic Red River	Tsiigehtchic	133.75036	67.44226
Mackenzie River (Fort McPherson Bay)	Tsiigehtchic	133.76023	67.44726
Woody Elias Creek	Fort McPherson	134.70819	67.79096
Basook Creek	Fort McPherson	134.64078	67.73399
Nelson Creek	Fort McPherson	134.59803	67.64416
Husky River Creek	Fort McPherson	134.86922	67.62216
Hudson Bay Creek	Fort McPherson	134.89604	67.44994
Rotten Eye Creek	Fort McPherson	134.83916	67.67864
Jackfish Creek	Aklavik	134.98901	68.22713

The target number of samples to be collected from each site was 25 loche which was the minimum amount for composite contamination samples. Based on the recommendations from the local Renewable Resource Council (RRC), a local fisher was hired in each community to capture loche in 2007 during ice melt-up (April to June) and freeze-up (October to December). Unfortunately, it was difficult to capture loche during the spring so after a few attempts the sampling was discontinued. After freeze-up, loche were collected from all communities. Biological information was collected from each fish (fork length, body weight, liver weight, liver appearance, liver classification, liver photograph, stomach weight, gonad weight, sex, otolith extraction, tissue samples and fin clippings). Where possible, sampling was completed with the fish monitor and youth to facilitate training of local assistants. Liver and tissue samples were sent to Environment Canada. The former were tested for contaminant levels and the latter were tested for stable isotopes. One set of ageing structures (otoliths) were also sent to Environment Canada. Each of these variables was compared with liver appearance. The other set of otoliths were used to age determination training in Winnipeg, Manitoba.

Analysis

Biological data was compiled and entered into an excel spreadsheet. Tables and graphs were produced to represent any trends found in these data. Livers were categorized by liver appearance by Gwich'in fish monitors. Type I livers were considered healthy and consumable. These type I livers were white in colour, large in size, and had no spots or marks visible. Type II livers were less healthy and were considered questionable for consumption. Livers were categorized into this section if they were not considered completely unhealthy but were also not considered very healthy. These livers were slightly discoloured, had a few spots or a few marks. Type III were very deformed livers and agreed that nobody would consume them. These livers were discoloured, small in size, and/or had lots of spots and marks.

Environment Canada provided analysis for ageing, stable isotopes and organochlorine content.

Results

A total of 136 fish were sampled (Table 2). Sampling was conducted between October and December but was most successful in November and December. Not many fish were captured in October.

Most fish (50 burbot) were collected from sites near Fort McPherson and had the least type III fish (Table 2). In Inuvik, there were more type III fish at Bombadeer Creek than Sam Arey's Creek. In Tsiigehtchic, there was no clear distinction between location and liver appearance. In Aklavik, all fish were collected from the same site.

Table 2: Numbers by site and liver type

Location	Community	Site ID	Liver I	Liver II	Liver III	Total
Bombadeer Creek	Inuvik	IN-BOMB	1	1	4	6
Sam Arey's Creek	Inuvik	IN-SAMA	12	6	1	19
Arctic Red River	Tsiigehtchic	TS-ARR	9	10	2	21
Mackenzie River (Fort McPherson Bay)	Tsiigehtchic	TS-FBAY	5	1	1	7
Woody Elias Creek	Fort McPherson	FM-001	1	2	1	4
Basook Creek	Fort McPherson	FM-002	21	10	0	31
Nelson Creek	Fort McPherson	FM-003	4	1	0	5
Husky River Creek	Fort McPherson	FM-004	5	0	0	5
Hudson Bay Creek	Fort McPherson	FM-005	0	3	0	3
Rotten Eye Creek	Fort McPherson	FM-006	1	0	1	2
Jackfish Creek	Aklavik	AK-JACK	12	17	4	33
Total			71	51	14	136

Livers appeared to be healthier in Fort McPherson and worst in Inuvik (Figure 1). However there were more samples collected from Fort McPherson then any other community. There appears to be a correlation between location and liver appearance. The liver somatic index (LSI) declined with increasing liver atrophy (Figure 2). The LSI was most evident in Inuvik (Figure 3). In Fort McPherson and Tsiigehtchic the LSI was similar in type I and type II livers (Figure 3). Aklavik had the least amount of distribution in the LSI (Figure 3). The liver appearance was correlated to diet. Loche diet appears to be effected as the liver becomes more deteriorated (Figure 4).

Figure 2: Liver Somatic Index for all locations

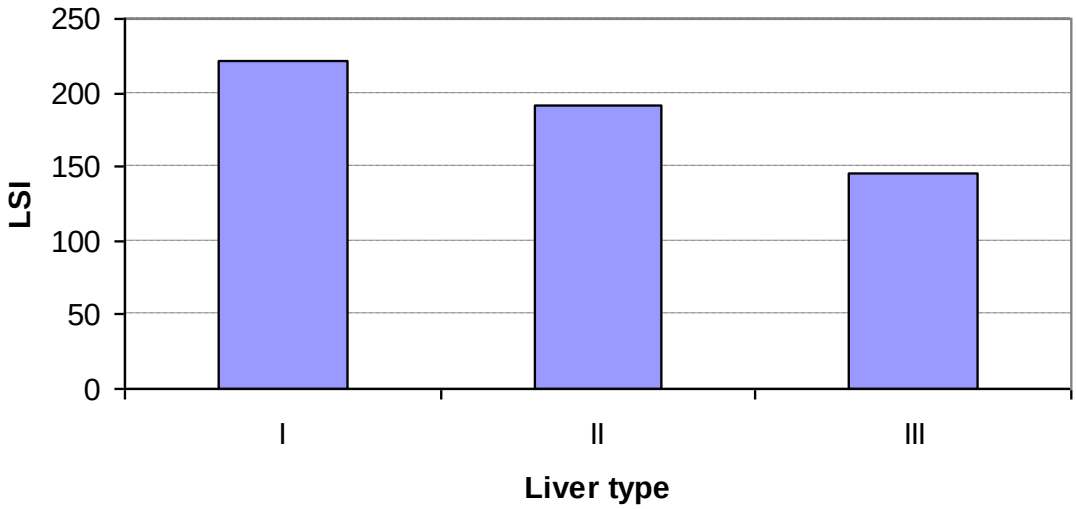
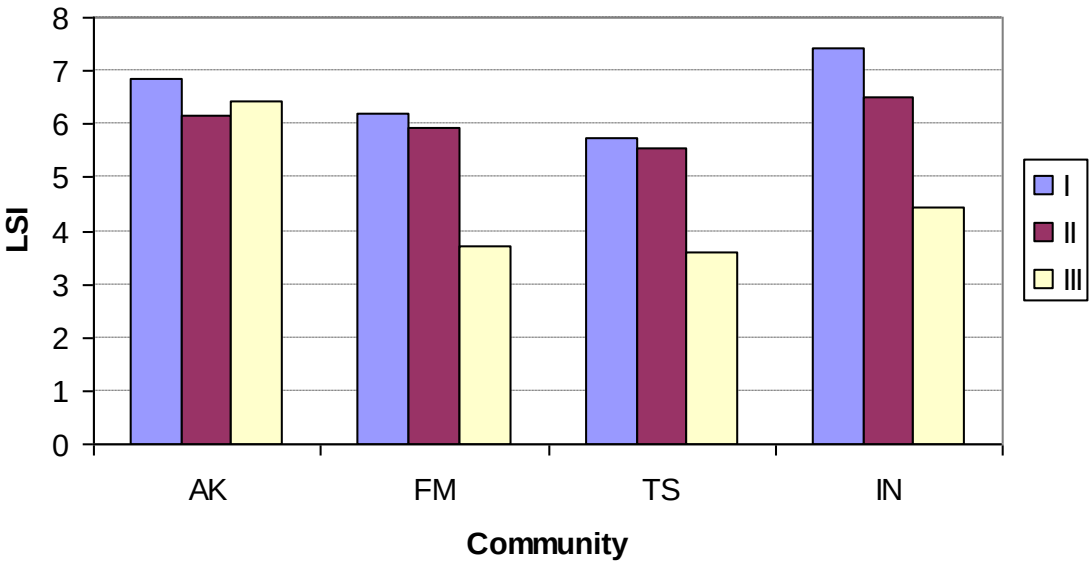
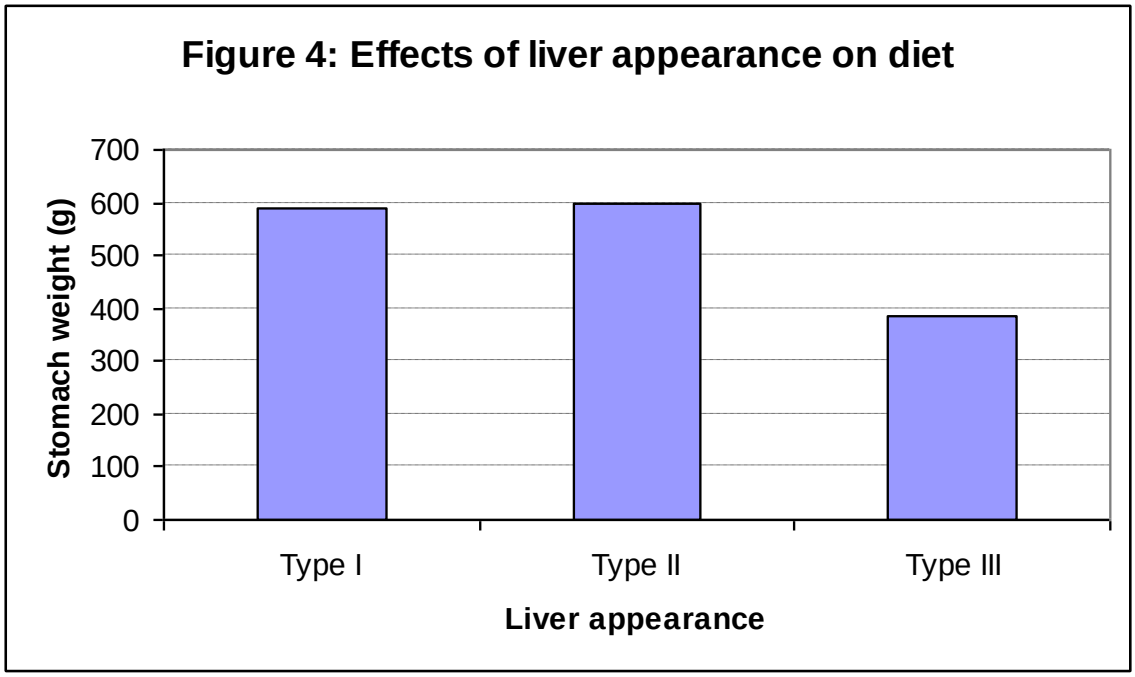
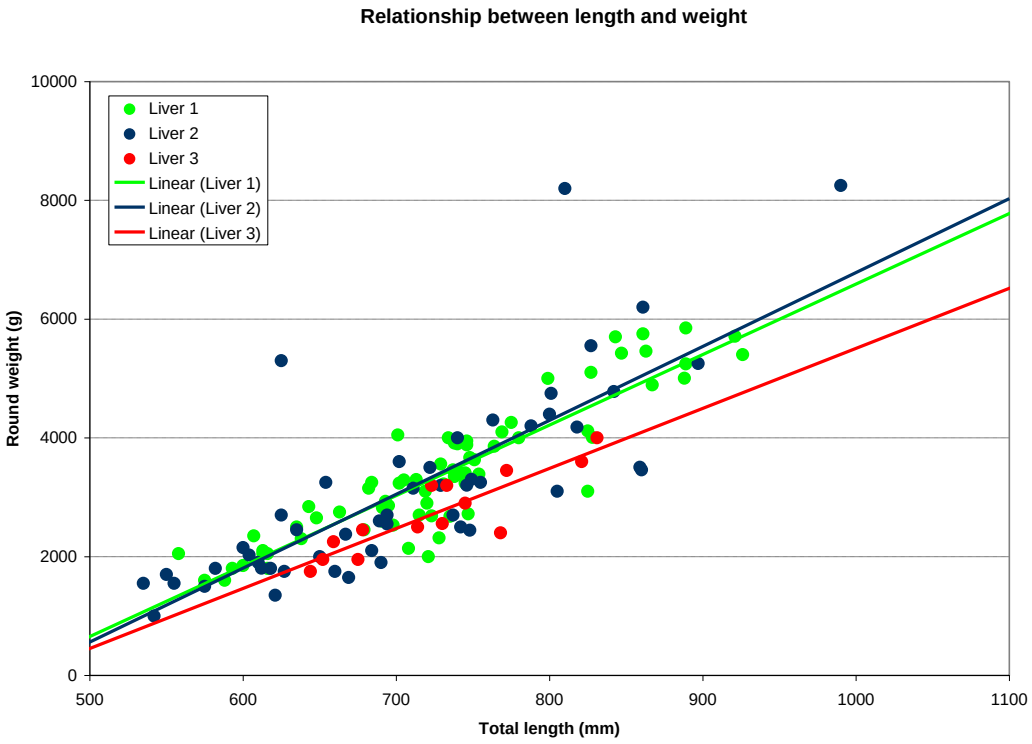


Figure 3: Spatial distribution of Liver Somatic Index

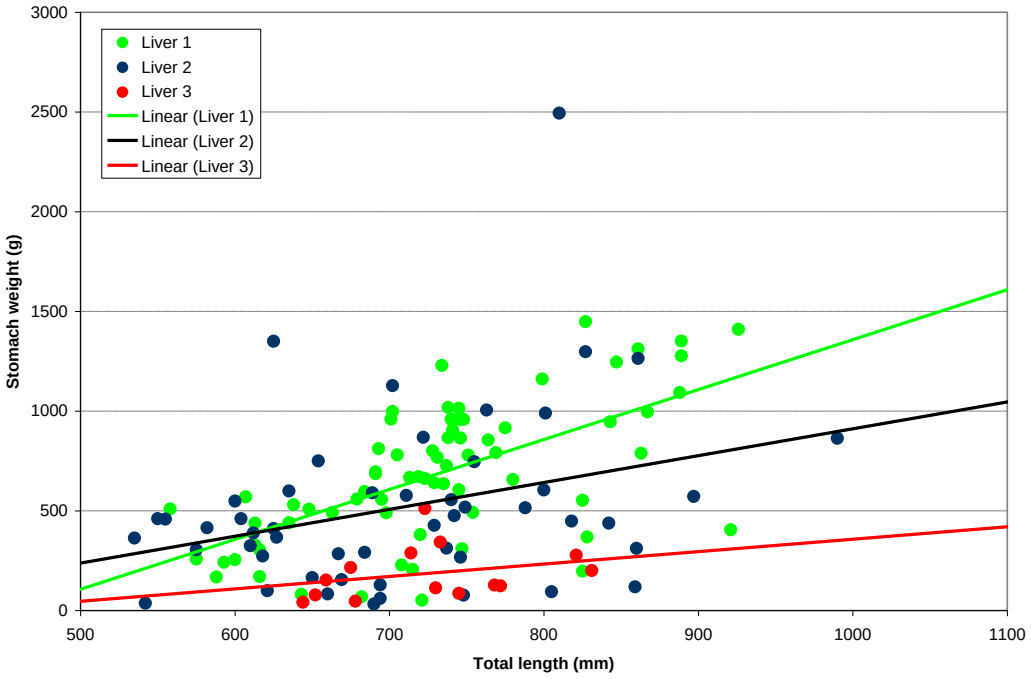




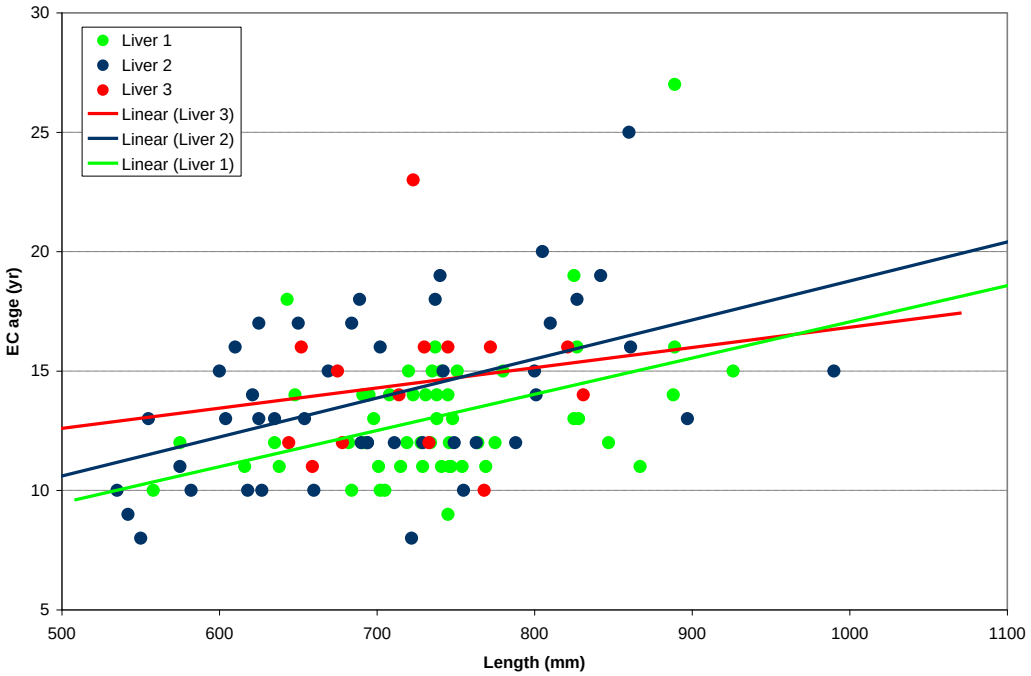
Livers were also correlated with other variables.

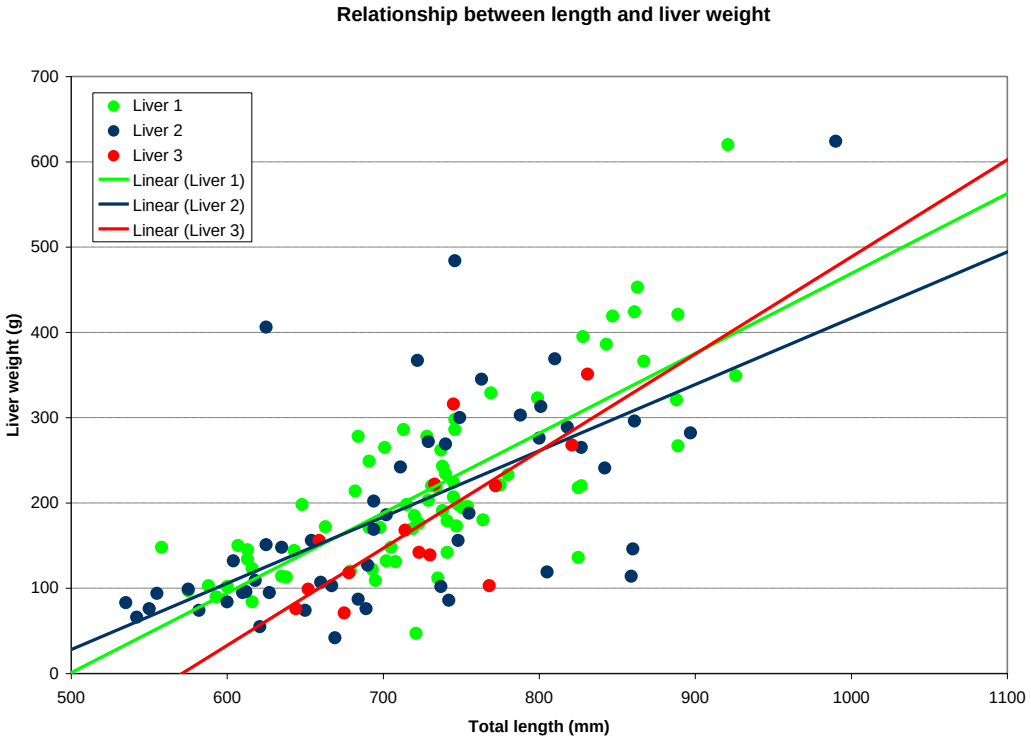


Relationship between length and stomach

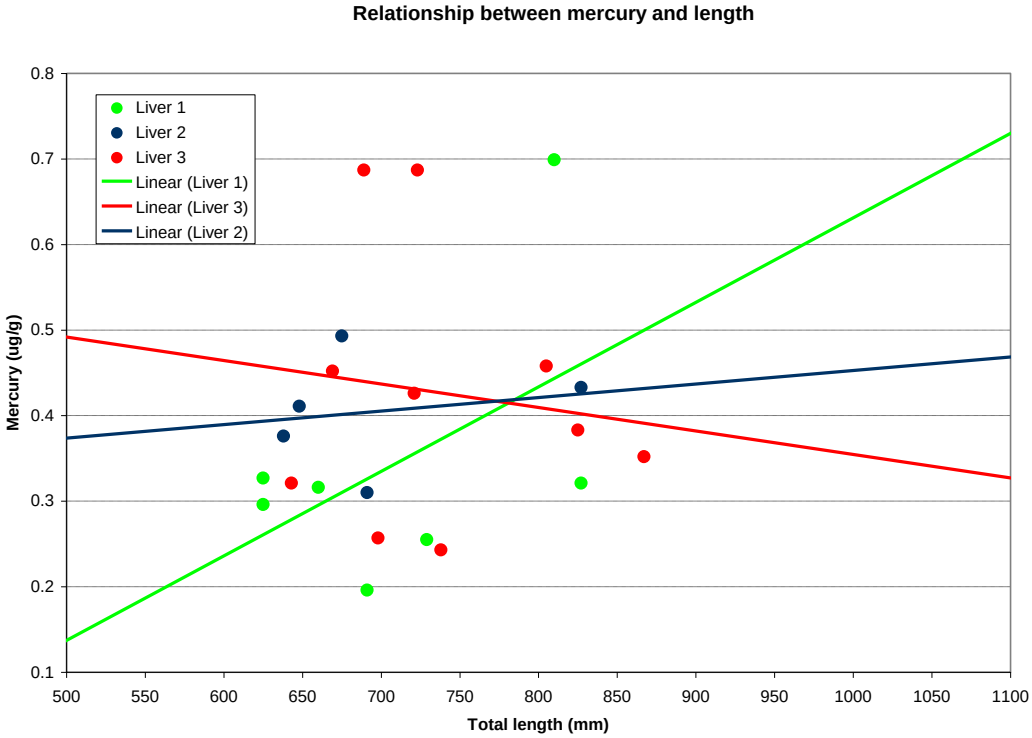


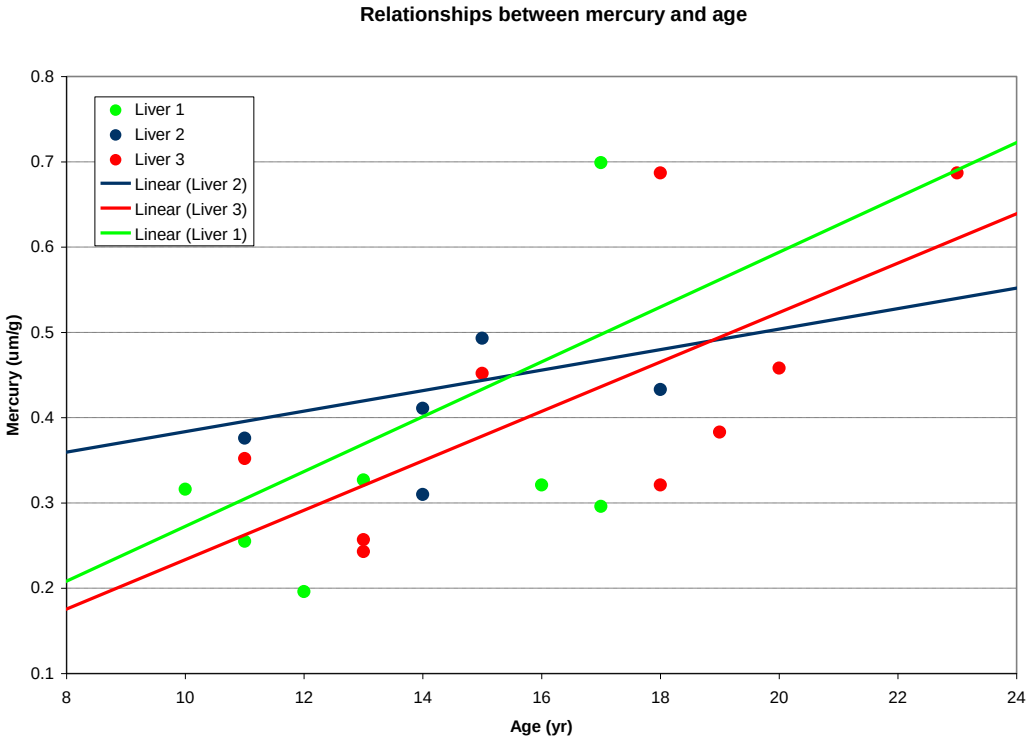
Relationship between length and age



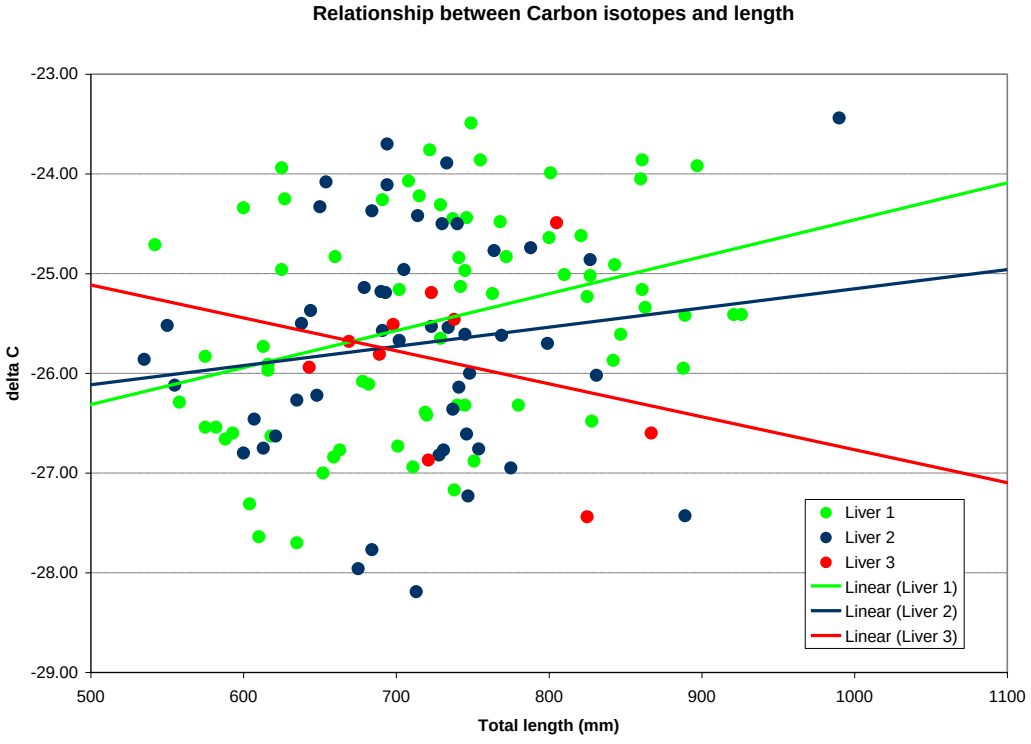


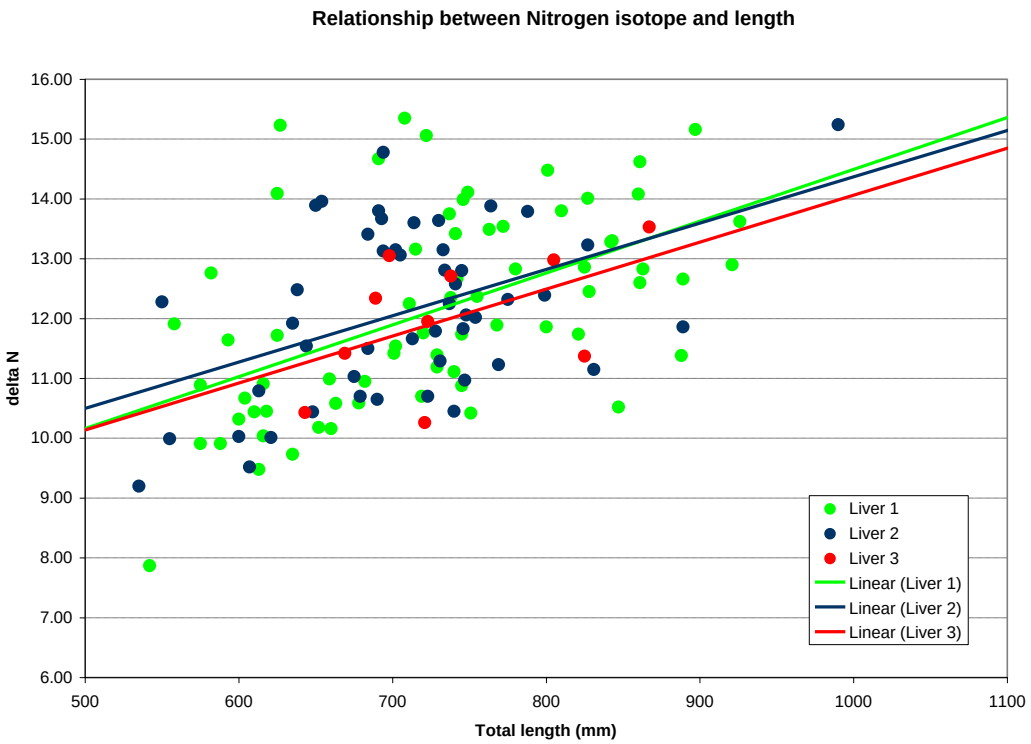
Metal Results





Stable isotope results





Discussion

Loche were most easily caught in Aklavik and Fort McPherson. This is probably because these areas have well known jiggling creeks and more fish were collected. Inuvik has many well known creeks but the fish monitor started fishing too soon. The water froze then melted and re-froze which left overflow and a unfrozen layer in between the ice (Tommy Wright, personal communication). This was in October. By early December, I hired another fish monitor to jiggle and he had no trouble getting the remaining loche. But he also fished at a different location. In Tsiigehtchic, there are no creeks and people wait for the loche to run after the broad whitefish (*Coregonus nasus*) stop. This took longer than usual (Willy Clark, personal communication). Both fish monitors in Tsiigehtchic were able to collectively catch the amount I was targeting, however, they were catching approximately 0-7 per day. For financial purposes, this technique was not the best because it took them more days to fish then other communities. However, Tsiigehtchic did not require skidoo rental. All other community fish monitors were paid salary plus skidoo rental. This racked up the costs associated with hiring local assistants.

Livers appeared healthiest in Fort McPherson (Figure 1). This could have been because more samples were taken or also because the loche were collected from 5 different locations. The livers in Inuvik were found to be more deteriorated

but all the Type III loche livers in Inuvik came from Bombadeer Creek (Figure 1). Location may have a correlation to liver deterioration. Community consultation in Aklavik revealed one location near the community that is believed to have leakage from the sewage lake (6 Mile Creek). People refuse to eat any of the fish caught there but people still jiggle because it's a good spot to catch loche. Sampling was not completed at this location due to recommendations after a community tragedy. The liver somatic index gives evidence that liver type is related to liver size (Figure 2). Outside factors, such as contaminants, may contribute to the problem of liver atrophy. It is difficult to see strong correlations between communities when looking at LSI (Figure 3). The sample sizes were too small to derive good information. However, all sites showed a decrease from type I to type III suggesting liver size is correlated with liver atrophy. Loche with bad livers (type III) had smaller stomachs (Figure 4) suggesting that liver condition is associated with diet. The main function of the liver is metabolism but it plays key roles in glycogen storage, decomposition of red blood cells, plasma protein synthesis and detoxificatioin (Mediawiki 2008). Liver atrophy could be associated with any of the above. When analysis is completed, this study will reveal the effects of oganochlorines on loche liver condition as well as stable isotope analysis and age.

Conclusion

Liver III fish, that appeared unhealthy, were found to be indeed less healthy than liver I and liver II fish. There were no strong correlations to liver appearance and age, stable isotopes or metal analysis. Future studies should increase the sample size to highlight any trends.

Traditional knowledge was important to understand when to fish and should be a big component of future research on this topic. Future studies will compare contamination levels with liver category and will include more traditional knowledge. Future contaminant studies should also compare Creeks up and downstream from sewage outlets. For example, in Aklavik Jackfish Creek (upstream) and 6 Mile Creek (downstream) should be investigated for contaminant level differences.

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References

Bernier L. 1986a. Liver atropy of loche, *Lota lota*, infected with larvae of the nematode *Rahidascaris acus* and with plerocerocoids of the cestode *Trianophorus nodulosus*. Prepared by Arctic Biological Consultants, Winnipeg, for the Department of Fisheries and Oceans, Central Arctic Region.

Bernier L. 1986b. Liver pathology of loche, *Lota lota*, (Linnaeus) and the parasites *Rahidascaris acus* (bloch) and *Trianophorus nodulosus* (pallas) with notes on transmission routes. Prepared by Arctic Biological Consultants, Winnipeg, for the Department of Fisheries and Oceans, Central Arctic Region.

Clark, Willy. November 2007. personal communication.

Dick, T. and Bernier, L. 1987. Liver pathology of loche, *Lota lota* (Linnaeus) infected with larvae of the nematode, *Raphidascaris acus* (Bloch, 1799) from the Northwest Territories. Prepared by Arctic Biological Consultants, Winnipeg, for the Department of Fisheries and Oceans, Central Arctic Region.

Gwich'in Elders and Raygorodetsky, G., 1997. Nành' Kak Geenjit Gwich'in Ginjik; Gwich'in Words About the Land. Gwich'in Renewable Resource Board, Inuvik, Northwest Territories.

Kritsch, Ingrid, and Leslie McCartney. "The Gwich'in." GSCI. Ed. Ronne Heming. 2003. GSCI. 20 Feb. 2008 <http://www.gwichin.ca/TheGwichin/ft.mcpherson.html>.

Lockhart W.L. et al. 1987. Studies to determine whether the condition of fish from the lower Mackenzie River is related to hydrocarbon exposure. Second cumulative data report submitted to the Department of Fisheries and Oceans, Central and Arctic Region, Freshwater Institute, Winnipeg, Manitoba.

Mediawiki. (2008, February 27). wikimedia foundation, Inc. Retreived on February 27, 2008 from http://en.wikipedia.org/wiki/Liver.

Wright, Tommy. December 2007. personal communication.