Graphite Lake Fisheries Assessment

1987 and 1996

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GRAPHITE LAKE FISHERIES ASSESSMENT 1987 AND 1996

INTRODUCTION

The purpose of this study was to assess the fish populations in Graphite Lake following the same methods used in 1987, to allow for a direct comparison of fish abundance between then and now. The original July 1987 survey was conducted by Ministry of Natural Resources, (MNR) fisheries staff to establish baseline information in response to a proposed graphite mine, OMNR (1987). Both fisheries and water quality information was collected on three lakes Graphite, Minnow, and McGuire located adjacent to the proposed mill and open pit operations. The fisheries results from this study will be compared with 1987 data to determine if any changes have occurred in the fish populations since the original survey.

The water chemistry component, including metals and pH from the original 1987 survey, was done again in July of 1993 for all basins in all three lakes. Significant changes in metal concentrations, primarily zinc, and lower pH when compared to 1987 was the impetus for further water testing and studies, including but not limited to: Ministry of the Environment and Energy (MOE&E) October 18, 1993, November 29, 1993, and December 10 and 16, 1993; MNR, August 3, 1993, March 28,1994, May 9, 1995, May 31, 1995, November 27,1995; and Environment Canada (DOE) June 5, 1996.

Some supplementary water quality information including in situ pH and conductivity, and minnow trapping was also conducted in the vicinity of Minnow Creek to further document existing conditions, during this study.

Graphite lake is located within the municipal limits of the Town of Kearney, formerly part of Butt township, District of Nipissing. The lake is 14 kilometres east of Sand lake and less than 3 kilometres west of the Tim River Access point to Algonquin Park. The Applied Carbon Technology Inc. mill yard and open pit is located at the south end of Graphite Lake. Graphite Lake is a 68.4 hectare native lake trout and brook trout lake. In 1987 the lake was described as a fairly typical dilute, soft water lake for this area, Neary (1987).

METHODS

1. Fisheries Assessment

A fishery assessment of Graphite Lake was conducted from July 23rd to 24th, 1996. Large and small mesh gill nets (GL and GS) and minnow traps were fished using the same methods, including nets, timing and locations, as in 1987.

Graphite Lake consists of four distinct basins, each of which were sampled individually in 1987 to determine temperature and oxygen profiles and fish presence and abundance, Figure #1. The gill nets technique was designed specifically to reduce fish mortality by using short duration sets and smaller mesh sizes.

Large-mesh gill nets were fished at sites GL-1 through GL-21 (see Fig. 1,) for 30 min. each. The gangs consisted of five panels of green monofilament gill nets with stretch mesh sizes of 2.5 cm., 3.8 cm., 5.1 cm., 6.3 cm. and 7.6 cm. Nets were set to straddle the thermocline and spanned depths from 2.4m to 14.3m. The mesh size set closest to shore alternated with each set. There was no overnight set at site GL-17 as in 1987.

Small-mesh gill nets were fished at sites GS-1 through GS-8 (see Fig. 1,) for 90 min. each. The gangs consisted of four panels of green monofilament gill nets with stretch mesh sizes of 1.3 cm., 1.9 cm., 1.3 cm., and 1.9 cm. Nets were set parallel to shore in the thermocline and spanned depths from 6.1m to 7.9m. There was no overnight set at site GS-2 as in 1987.

Each gill nets panel was 15.25 m. long for a total length of 75.25 m. for GL sets and 61.00 m for GS sets.

All brook trout and lake trout were weighed, measured and a scale sample was taken before release. All other species were group weighed and the largest and smallest were measured to get a length range.

Standard wire mesh minnow traps were baited with dry dog food and set within the littoral zone, adjacent to cover, for approximately 24 hours. Eight minnow traps were set on July 24 at the same locations (Fig. 1) identified for the 1987 survey. Ten supplemental minnow traps were set July 23rd. These traps were located (Fig. 2) in and around the small inlet at the south end of the lake where Minnow Creek empties into Graphite Lake, see Figure #2.

2. Water Chemistry

A Leslie matrix Conductivity Bridge and a Horizon 5995-30 pH meter were used to collect conductivity's and pH values respectively, in the field. The pH meter was calibrated with standard solutions of a pH of 7 and 4 prior to and during field sampling.

RESULTS (July 23rd, 1996)

1. Fisheries Assessment

The netting assessment of Graphite Lake yielded seven fish species: 1 lake trout (*Salvelinus namaycush*), 2 brook trout (*Salvelinus fontinalus*), 45 common white suckers (*Catostomus commersoni*), 2 northern redbelly dace (*Chrosomus eos*), 22 creek chub (*Semotilus atromaculatus*), 11 lake chub (*Couesius plumbeus*) and 7 golden shiners (*Notemigonus crysoleucas*).

Nets were fished for a total effort of 22.58 100m-net hours of large and small mesh gill nets. The large mesh was fished for 10.5 100m-hours and the small mesh was fished for 12.08 100m-hours (Table 1).

Fish were grouped by species to obtain a catch per unit effort (CUE) for each species by the method of capture, i.e. large and small mesh gill nets and minnow traps (Table 2). Results from this also include two unidentified minnows which will be sent to the Royal Ontario Museum for positive identification. In 1987 one overnight set of gill nets large was made, in basin # 2, to try and capture lake trout which had not been sampled in the short sets, but were thought to be in the lake. In 1996 the overnight set was not necessary since lake trout were known to still be present, Jackson (1995) and the fish mortality generally associated with the overnight set could be avoided.

The supplementary minnow trapping conducted in the Minnow Creek area yielded only 2 minnows (Table 3) one of which was an unidentified minnow the same as the 2 found in the other minnow traps. This minnow was also sent for identification to the Royal Ontario Museum.

2. Water Chemistry

Water chemistry including pH, water temperature, conductivity, and cell temperature, was completed for basins #1 and 4 of Graphite lake and a series of samples from Minnow Creek. The results of this sampling, including a description of sample sites, are summarized in Table 4. Of particular interest is the pH reading of 3.9 from the discharge from underneath the road at the location of the former minnow creek crossing. The water temperature of the in situ sample was 14 degrees centigrade which is considerably colder than the other surface waters sampled. This temperature suggests a ground water influence.

DISCUSSION

The 1996 index netting was done following the same index methods as was used in 1987 to assess fish populations prior to the development of the mine site. Specifically both fish assessment surveys used the same sizes, colour, and brand of gill nets, set in the same manner and locations in the four basins. The fish survey on Graphite was done between July 20 to the 24 in 1987 and July 23 to the 26 in 1996. The only difference being that in 1987 two gill nets (a small mesh gill net and a large mesh) were left in overnight to see if lake trout were still present in the lake. Although the total effort is less in 1996, because no overnight sets were used, the results are comparable since the results are expressed in a standard catch per unit of effort, of 100 meters of net set for an hour.

Table 5 compares the results for 1987 and 1996 fisheries assessment for total effort, fish caught and catch per unit effort.

1. Abundance

The CUE for lake chub in the gill net small sets dropped from 33.86 fish per 100 meter net hours in 1987 to 1.49 in 1996, see Table 5. The lake chub CUE from this study is similar to the .111 CUE found by Jackson (1995) who used both large and small mesh gill nets, hoop nets, kushneriuk traps and baited minnow traps to index the fish population of Graphite Lake in the summer of 1995. Table 6 summarizes the CUE's by species reported by Jackson (1995) for his 1996 fish sampling Graphite Lake.

The 810 lake chub captured in 1987 were primarily from basins #1 and 2 , (personal observation) whereas the 11 lake chub caught in 1996 were captured in basin #4. No lake chub were captured from basins #1 and 2 in 1996. Basins # 1 and 2 of Graphite Lake are the closest to the mill yard and Minnow Creek.

In 1987 fifty-six creek chub were captured in the wire mesh minnow traps, resulting in a CUE of 7.3 individuals per minnow trap day. A total of twenty-two creek chub were caught in 1996, and a corresponding CUE of 2.63. Jackson (1995) ended up with a minnow trap CUE of 2.52 creek chub per trap day, (Table 6). Jackson (1995) noted that Kushneriuk traps around the lakes perimeter showed abundant catches of both creek chub, (CUE of 67.48) and brown bullhead (CUE of 16.63) with the exception of traps in one area. According to Jackson (1995), no fish were captured in either of two baited minnow traps or in a baited Kushneriuk trap, set in the inlet draining from Minnow Creek. Also, Jackson (1995) noted that no fish were sighted in this region either, although fish were typically observed in other shallow areas of the lake.

Eighteen of the twenty-two creek chub caught in 1996 came from basins #3 and 4, the furthest from the mine site. The three remaining creek chub, captured in Basin # 2, were located near the outflow from basin #2, furthest from the mill yard. No creek chub were captured in Basin # 1 despite the additional effort in 1996, with the ten supplementary sets in the vicinity of the minnow creek drainage, (Figure 2 and Table 3). Creek chub were last observed in basin #1, in May 1994 when three creek chub were seen spawning in the Minnow creek diversion,(personal observation).

The capture of other minnows, primarily northern redbelly dace and a small percentage of brassy minnows, dropped from 180, (CUE of 23.50) in 1987 to three (CUE of .01) in 1996. Similarly, Jackson (1995) found a CUE of .91 and 0 for northern redbelly from plastic traps and minnow traps respectively.

The reduction in common white sucker abundance, (Figure 4) is less than that of the other typically more abundant species.

Of the 19 brook trout captured in 1987 the vast majority were in basins # 3 and 4. In 1996 one brook trout was caught in basin #4 and one in Basin # 2, The brook trout C.U.E. for large mesh gill nets went from 1.04 in 1987 to .25 in 1996. Jackson (1995) failed to capture any brook trout, despite increased numbers of lake trout being caught, (Table 6).

Based on a comparison of index netting results from the whole lake in 1987, 1995 and 1996, the abundance of most fish species has declined . Figures 3 and 4 illustrate the decline in C.U.E. for lake chub, creek chub, other minnows (which are primarily northern redbelly dace), brook trout, and common white sucker. Although extremely abundant in 1987, lake chub appear to have completely disappeared from Basins #1 and 2. Fish are noticeably absent from the vicinity of the minnow creek drainage, (Table 3). Creek chub and northern redbelly dace are now absent or rare in basins #1 and 2. Brook trout are also substantially down in abundance across the whole lake compared to 1987 , (Figure #4).

There was an increase in the CUE for lake trout between OMNR (1987) and Jackson (1995) and for golden shiner between OMNR (1987) and this study. In both cases the number of individuals captured was small, indicating that the lake populations were sufficiently small that

individuals could be completely missed and that additional effort would be necessary to reduce sampling variation. The absence of burbot (*Lota lota*) from the 1995 and 1996 sampling may not be significant for the same reason.

2. Biological Assessment

According to Scott and Crossman (1973) the lake chub usually undergo a spawning migration from lakes to tributary streams in the early spring. Like lake chub, creek chub also ascend small feeder tributaries, like Minnow Creek, to spawn in the spring.

The disappearance of lake chub, and the dramatic reduction in creek chub abundance from basin # 1 and 2, and the fact that both species rely on small feeder streams, suggests a problem with their spawning area. Minnow Creek is the only known permanent feeder stream accessible to fish in basins #1 and 2 of Graphite Lake. Given the results of water quality testing in Minnow Creek over the last several years including this study (Table 4), and the results of acute toxicity testing for Minnow Creek, (OME&E 1995), it would seem logical and reasonable to assume that the disappearance of lake chub and near loss of creek chub from basins #1 and 2 of Graphite Lake is associated with the loss of fish recruitment from Minnow Creek because of toxicity. Since lake chub seldom live beyond five years (Scott and Crossman 1973) it is likely that recruitment failure has occurred for a period of at least five years for the population to disappear from these basins.

Predation is not a probable cause in the decline of these minnow species because of the noticeable absence of a strong predator population Graphite Lake.

White suckers spawn in the spring, when adults migrate from the lake into streams., however segments of the population may spawn in the lake, (Scott and Crossman 1973). The less restrictive requirements of white suckers for spawning habitat may have resulted in some spawning populations unaffected by the mill yard or Minnow Creek drainage, and therefore a less dramatic reduction in abundance. Mills *et. al.* (1978) found an unexpected increase in the abundance of lake trout, white sucker and pearl dace abundance in lake #223 during early years of experimental acidification. Abundance of lake trout and white sucker decreased in latter years when pH values went below thresholds for recruitment success for these species, and recruitment failure occurred, (Mills 1978).

Some other biological mechanisms may be causing the decline in brook trout abundance since their decline is on a whole lake basis rather than just basin #1 and 2. Lake populations of brook trout are known to use small ground water streams for spawning and nursery habitat, (Brady 1993). Minnow Creek is also known to have ground water discharges that have been impaired, (Table 4). Impacted groundwater was also known to be discharging to the lake from the mill yard, (HBT AGRA 1995). Since brook trout must spawn in areas of ground water discharge, (Curry and Noakes 1995) it is most likely that recruitment has been impacted by the impaired quality of these two ground water sources. Note that sampling of shallow ground water seeps in

the mill yard and more recently Minnow Creek results in pH values less than 4.0. It is also possible that brook trout residing in basin # 3 and 4 migrated to these ground water discharge areas in basin #1 to spawn, thereby causing a general lake wide decline in the population. Since brook trout are more tolerant of low pH than lake trout, (Beggs and Gunn 1986), and lake trout appear to still be present in Graphite lake, (Jackson 1995), it suggests that the impact on brook trout is related to the contamination of groundwater affecting recruitment versus a response to a lake wide change in water quality. Beggs and Gunn (1986) found brook trout populations were extirpated in lakes with a pH of less than 5.0. Although pH values of less than 5.0 have been recorded in Graphite Lake, (March 28, 1994, samples deeper than 9.75 meters), values are usually greater than 5.0 and have generally been in the 5.5 to 5.8 range since 1993.

How the abundance of other species, like northern redbelly dace, which prefer quiet waters and deposit nonadhesive eggs within masses of filamentous algae, (Scott and Crossman 1973), has been impacted is uncertain. It may be related to the general decline in pH and increase in metals within the lake reducing their overall fitness and ability to survive, or directly impacting on more sensitive life stages. However, Mills *et. al.* (1987), found that the primary mechanism for the population declines of fish in an experimentally acidified Lake 223 was recruitment failure.

Given the obvious decline in fish abundance in conjunction with the documented decline in lake water chemistry since the development of the mine it is logical to conclude that the loss of fish is related to past mining activities. The confirmation of the presence of acid generating rock or acid mine drainage (AMD) used as fill material in the mill yard and road, (AGRA 1994, AGRA 1995), is the obvious source of the contamination, although other mining activities and associated landscape modifications may also have contributed. Dust deposition, blasting, and fractures in bedrock as a result of mining activity may have and, in the case of bedrock fractures, may continue to contribute to water quality impairment. The results of acute toxicity tests (OME&E 1995) further confirm the toxicity of waters flowing into Graphite Lake disturbed by mining activities. Failure to recognize early water chemistry results as indicators of community impairment which required corrective measures has further contributed to the continued decline in fish abundance.

Further studies must be carried out to find out if similar reductions in fish abundance has occurred in Minnow and McGuire lakes, that flow into Graphite Lake. McGuire Lake, may not show a reduction in fish abundance, since the lake chemistry today is closer to predevelopment conditions than either Graphite or Minnow, and the inflowing stream feeding McGuire would appear to be unaffected by mining operations. If fish abundance has declined in Minnow Lake the cause will not be what has been documented so far, (i.e. mill yard drainage and Minnow Creek) since both these sources are downstream of Minnow Lake. Further work is also necessary to understand all of the factors contributing to the contamination of ground water on the site so that remedial measures can be effective in preventing further discharge of substances deleterious to fish. Studies must be objective and done quickly. Remedial measures must solve problems at their source and not just mask symptoms or redirect waters to less sensitive systems.

The impacts to fish abundance documented in this study clearly demonstrate the importance of ground water and small feeder streams to the maintenance of fish populations in shield lakes. Significant landscape modifications must be controlled to ensure the quality of ground and surface waters in order to maintain healthy aquatic ecosystems.

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TABLE 1 **FISHING EFFORT PER NET**
GRAPHITE LAKE
July 23rd - 26th 1996

DAY 1 (July 23rd)			DAY 2 (July 24th)		
	SET			SET	
NET	TIME (pm)	DURATION	NET	TIME (pm)	DURATION
GS-1	4:55	90 mins	GS-3	3:30	90 mins
GL-1	5:10	30 mins	GL-7	3:45	30 mins
GL-2	5:25	30 mins	GL-8	4:00	30 mins
GL-3	6:10	30 mins	GL-9	4:45	30 mins
GS-2	6:55	90 mins	GS-4	5:15	90 mins
GL-4	7:10	30 mins	GL-10	5:30	30 mins
GL-5	7:25	30 mins	GL-11	5:45	30 mins
GL-6	8:10	30 mins	GL-12	6:30	30 mins
			GL-13	7:00	30 mins
DAY 3 (July 25th)			**DAY 4 (July 26th)**		
	SET			SET	
NET	TIME (pm)	DURATION	NET	TIME (pm)	DURATION
GS-5	3:55	95 mins	GS-7	4:00	90 mins
GL-14	4:10	30 mins	GL-19	4:05	30 mins
GL-15	4:25	30 mins	GS-8	4:10	90 mins
GL-16	4:45	30 mins	GL-20	4:20	30 mins
GL-17	5:20	30 mins	GL-21	5:40	30 mins
GS-6	5:45	90 mins			
GL-18	6:10	30 mins			
TOTAL GL: 10.5					
TOTAL GS : 12.08					
TOTAL: 22.58					

GL - gillnet large (2.5 cm, 3.8 cm, 5.1 cm, 6.3 cm, 7.6 cm)
GS - gillnet small (1.3 cm, 1.9 cm, 1.3 cm, 1.9 cm)

TABLE 2 **1996 INDEX NETTING GRAPHITE LAKE**
SUMMARY OF CATCH PER UNIT EFFORT
BY NUMBER FOR EACH SPECIES

FISH SPECIES	GEAR	WHOLE LAKE		
		NUMBER CAUGHT	C.U.E.	TOTAL EFF. 100m NET HRS
Lake Trout	GL	1	0.12	8.01
	GS	0	0	7.37
Brook Trout	GL	2	0.25	8.01
	GS	0	0	7.37
Common White Sucker	GL	44	5.49	8.01
	GS	0	0	7.37
	MT	1	0.12	8.35
Lake Chub	GL	0	0	8.01
	GS	11	1.49	7.37
	MT	0	0	8.35
Creek Chub	GL	0	0	8.01
	GS	0	0	7.37
	MT	22	2.63	8.35
Burbot	GL	0	0	8.01
	GS	0	0	7.37
Golden Shiner	GL	0	0	8.01
	GS	0	0	7.37
	MT	7	0.96	8.35
Brown Bullhead	GL	0	0	8.01
	GS	0	0	7.37
	MT	0	0	8.35
Other Minnows: Northern Redbelly Brassy Minnow Unidentified (2)	GL	0	0	8.01
	GS	0	0	7.37
	MT	3	0.12	8.35

GL-GS CUE's expressed per 100m net hrs
MT CUE's expressed per 24hrs

TABLE 3 **SUPPLEMENTARY MINNOW TRAP RESULTS**
AREA OF MINNOW CREEK INLET
GRAPHITE LAKE
July 24-25, 1996

Minnow Creek Inlet TRAP LOCATIONS	TRAP #	TIME SET (pm) July 24	DEPTH OF SET (m)	TIME LIFTED (pm) July 25	FISH CAPTURED
10m FROM OLD CULVERT	MT-1	5:30	1.0	5.30	NIL
1/2 WAY OUT EAST SIDE	MT-2	5:45	1.0	5:35	1 dace
2/3 WAY OUT WEST SIDE	MT-3	5:48	1.0	5:38	NIL
ALL THE WAY OUT EAST SIDE	MT-4	5:51	1.0	5:41	NIL
10m EAST OF McGUIRE LAKE INLET	MT-5	5:56	1.25	5:46	1 crayfish
McGUIRE LAKE INLET (flow present)	MT-6	5:59	.35	5:49	NIL
75m NORTH OF McGUIRE CREEK	MT-7	6:03	1.0	5:53	1 unidentified 1 crayfish
100m WEST OF INLET	MT-8	6:08	1.25	5:58	NIL
200m WEST OF INLET	MT-9	6:11	.80	6:01	NIL
SOUTH OF PUMPHOUSE IN WATER SHIELD	MT-10	6:13	1.25	6:03	NIL

TABLE 4 **GRAPHITE LAKE WATER CHEMISTRY**
WATER CHEMISTRY RESULTS
JULY 23-24, 1996

Location	Site #	Sample Time	pH	Water Temp. °C	Conductivity	Cell Temp. °C
Graphite L. Basin 1 (surface grab mid basin)		4:07	5.8	22	70	25
Graphite L. Basin 4 (surface grab mid basin) ✓		4:50	5.5	22	50	24
Graphite L. Minnow Cr. inlet, 10 (m) out from Minnow Cr.		5:33	5.3	23	140	25
Minnow Cr. outlet at boulders	1b	7:06	5.3	23	140	22
Groundwater discharge into Minnow Cr. from under road		7:20	3.9	14		
Open Pit (surface grab from shore)		7:32	7.9	21	415	21
Mid Minnow Creek Diversion		7:43	6.4	21	120	21
Minnow L. outfall 3 m downstream from lake		7:52	6.2	21	110	21
Former Minnow Creek channel ✓		8:00	5.9	18	150	19

✓ indicates when calibration checks were completed

TABLE 5 **COMPARISON OF 1987 AND 1996 DATA FOR GRAPHITE LAKE INDEX NETTING**

Species	Gear	Total EFF		Fish Caught		C.U.E.(#)		WT. (kg)		C.U.E. (kg)	
		1987	1996	1987	1996	1987	1996	1987	1996	1987	1996
Lake Trout	GL	18.34	8.01	2	1	.11	.12	3.10	3.20	.17	.40
	GS	20.24	7.34	0	0	-		-		-	
Brook Trout	GL	18.34	8.01	19	2	1.04	.25	4.52	.09	.25	.09
	GS	20.24	7.34	0	0	-		-			
Common White Sucker	GL	18.34	8.01	124	44	7.76	5.49	27.87	37.19	1.52	4.64
	GS	20.24	7.34	4	0	.20	0	.03	0	.002	0
	MT	7.66	8.35	4	1	.52	.12	N/A		N/A	
Lake Chub	GL	18.34	8.01	124	0	2.62	0	N/A		N/A	
	GS	20.24	7.34	686	11	33.86	1.49	N/A		N/A	
	MT	7.66	8.35	0	0	-		N/A		N/A	
Creek Chub	GL	18.34	8.01	1	0	.055	0	N/A		N/A	
	GS	20.24	7.34	-		-		N/A		N/A	
	MT	7.66	8.35	56	22	7.31	2.63	N/A		N/A	
Burbot	GL	18.34	8.01	3	0	.16	0	N/A		N/A	
	GS	20.24	7.34	-		-		N/A		N/A	
Golden Shiner	GL	18.34	8.01	-		-		N/A		N/A	
	GS	20.24	7.34	1	0	.05	0	N/A		N/A	
	MT	7.66	8.35	0	7	.00	.96	N/A		N/A	
Brown Bullhead	GL	18.34	8.01	-		-		N/A		N/A	
	GS	20.24	7.34	1	0	.05	0	N/A		N/A	
	MT	7.66	8.35	1	0	.13	0	N/A		N/A	
*Other Minnows	GL	18.34	8.01	-		-		N/A		N/A	
	GS	20.24	7.34	-		-		N/A		N/A	
	MT	7.66	8.35	180	3	23.50	.01	N/A		N/A	

*Northern Redbelly Dave, Brassy Minnow and 2 Unidentified Minnows (1996)

TABLE 6 CATCH PER UNIT EFFORT BY SPECIES & SAMPLING METHOD FOR AUG. 21-29, 1995

FISH SAMPLING FOR GRAHITE LAKE BY UNIVERSITY OF TORONTO

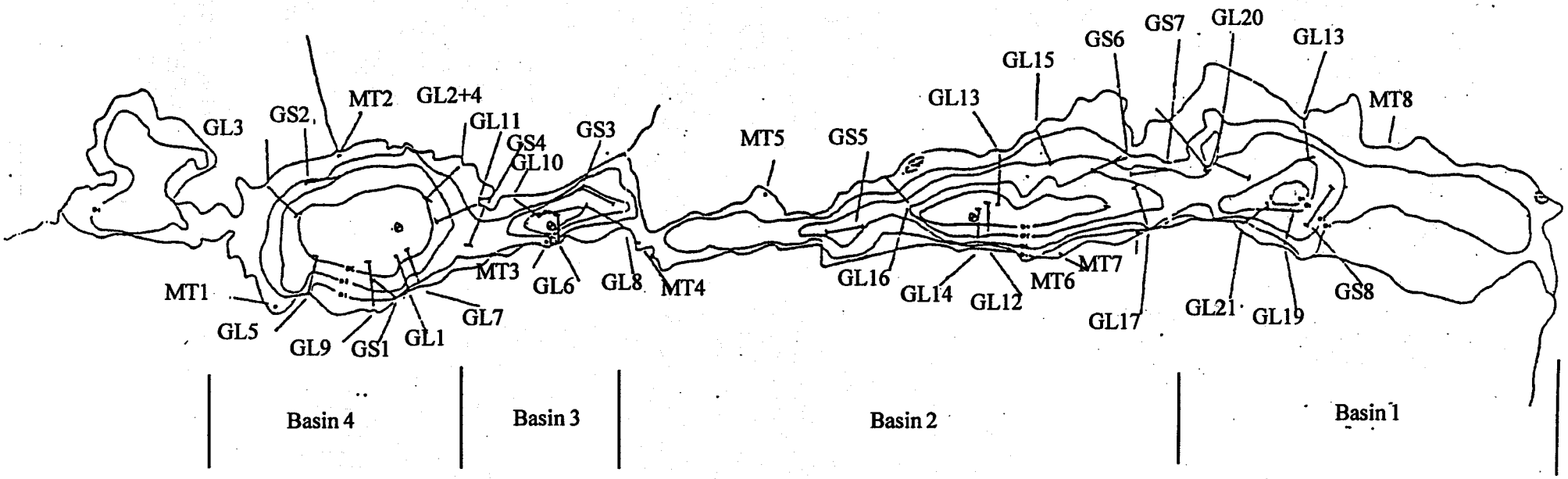
SPECIES		Catch per Unit Effort (Individuals)	Effort
		1995	1995
Lake Trout	(GL)	0.496	10.1
Brook Trout	(GL)	0	10.1
White Sucker	(GL)	3.967	10.1
	(GS)	0	9.0
	(PL)	0	79
	(MT)	0.07	343
	(HP)	1.538	125
	(KT)	0	150
Lake Chub	(GL)	0	10.1
	(GS)	0.111	9.0
Creek Chub	(GL)	0	10.1
	(GS)	0	9
	(PL)	0	79
	(MT)	2.518	343
	(KT)	67.483	150
Burbot	(GL)	0	10.1
	(PL)	0	79
Golden Shiner	(GS)	0	9
Brown Bullhead	(GS)	0	9
	(PL)	0	79
	(MT)	0	343
	(HP)	0.192	125
	(KT)	16.631	150
Northern Redbelly Dace	(PL)	.909	79
	(MT)	0	343

GL refers to large-mesh gill net (standardized to catch per hour per net in 1995)
GS refers to small-mesh gill net (standardized to catch per hour per net in 1995)
PT refers to plastic trap (unbaited in 1995)
MT refers to baited minnow trap
KT refers to baited Kushenerik trap
HP refers to 3 foot diameter hoop net

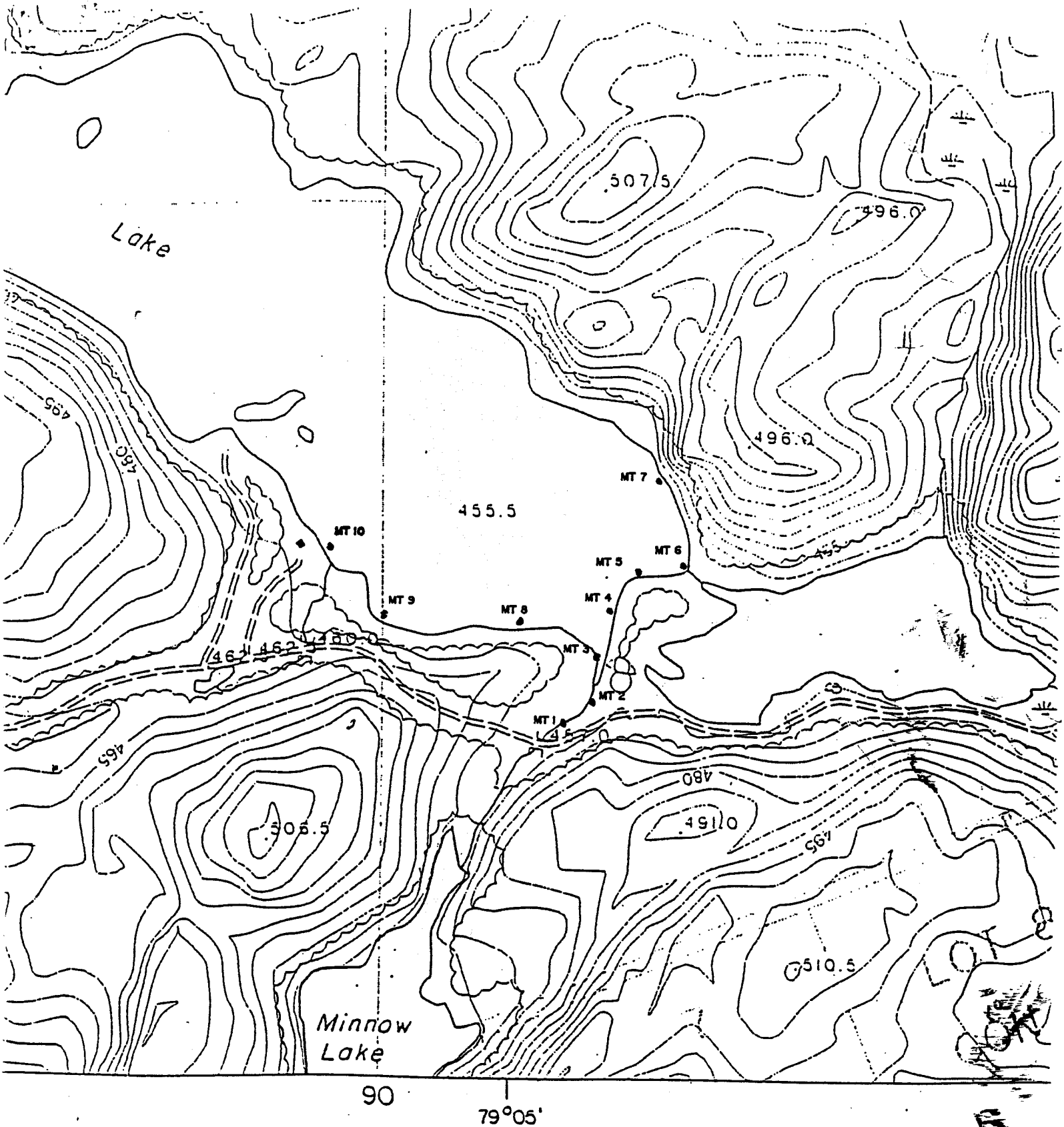
Figure 1

GRAPHITE LAKE
NETTING LOCATIONS

1987/1996



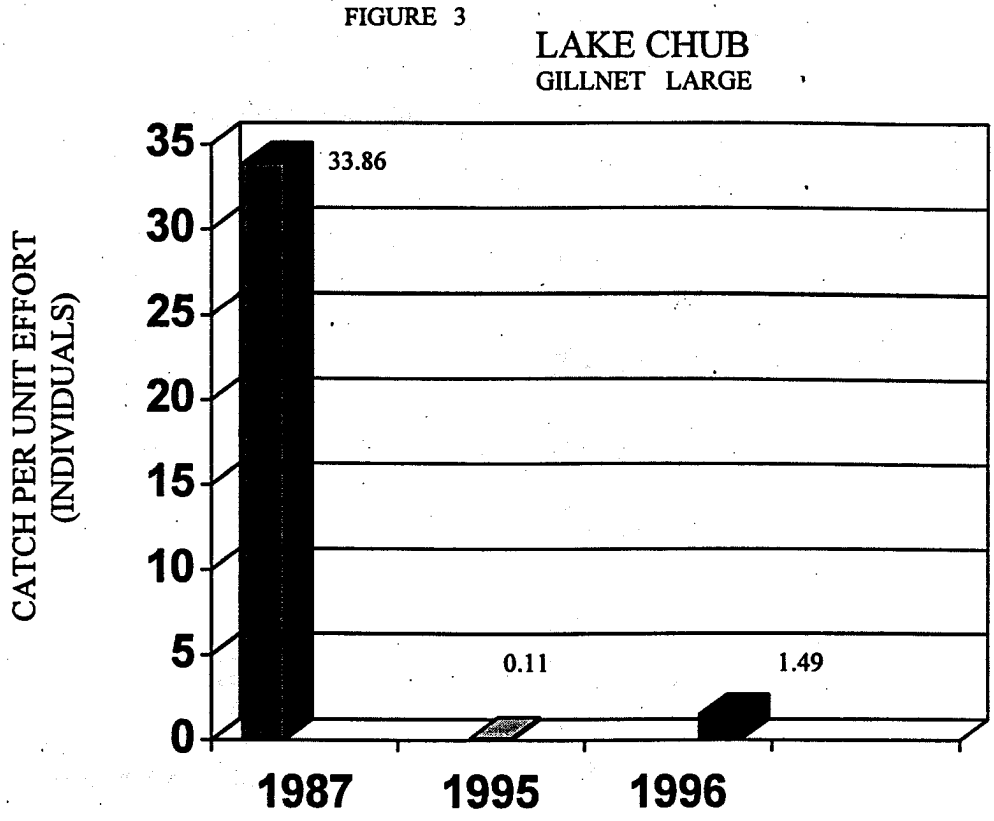
LEGEND
MT Minnow Trap
GL Large Gillnet
GS Small Gillnet



SUPPLEMENTARY MINNOW TRAPS
AREA OF MINNOW CREEK INLET
GRAPHITE LAKE
JULY 23

FIG.2

FIGURE 3


LAKE CHUB
GILLNET LARGE
CATCH PER UNIT EFFORT (INDIVIDUALS)
35
30
25
20
15
10
5
0
33.86
0.11
1.49
1987
1995
1996

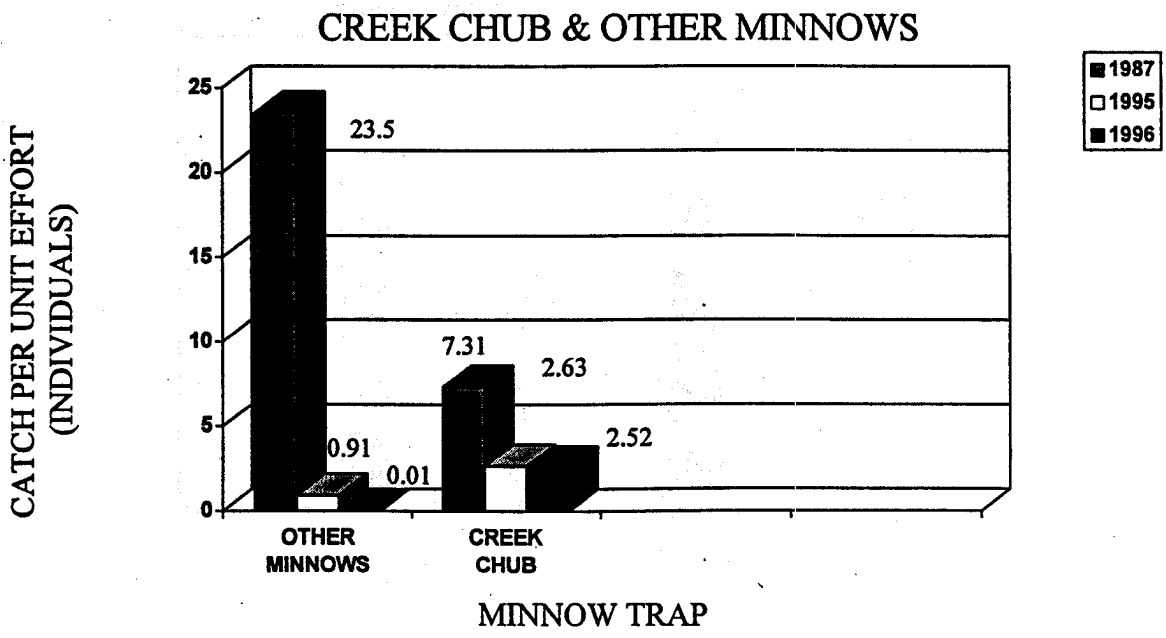
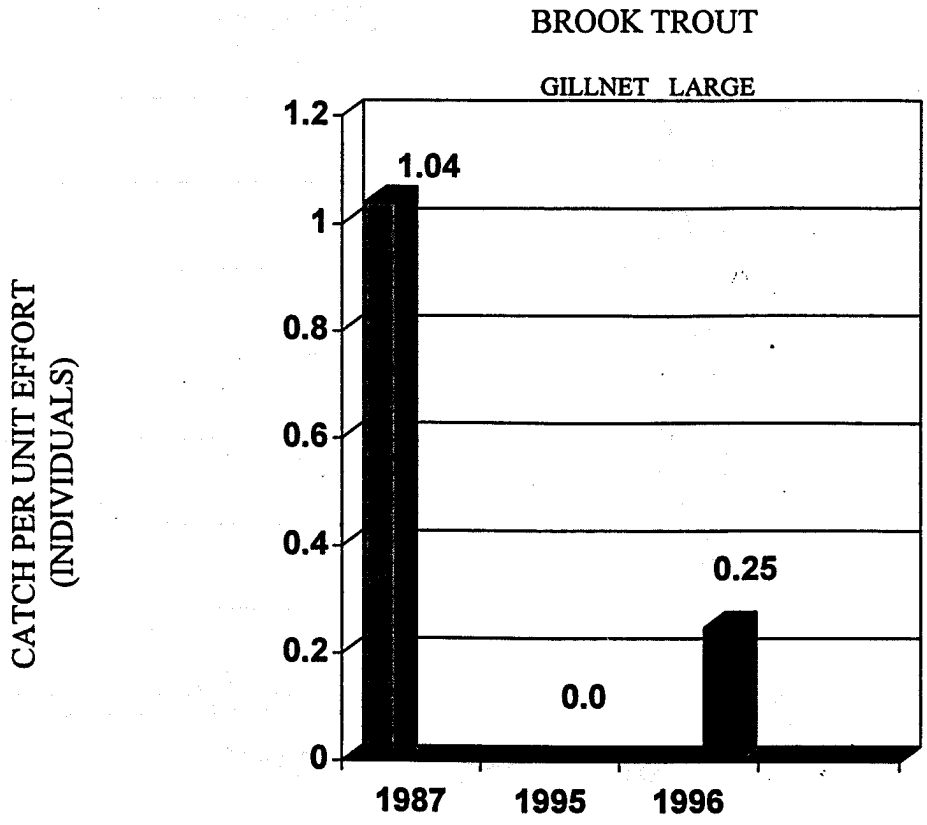
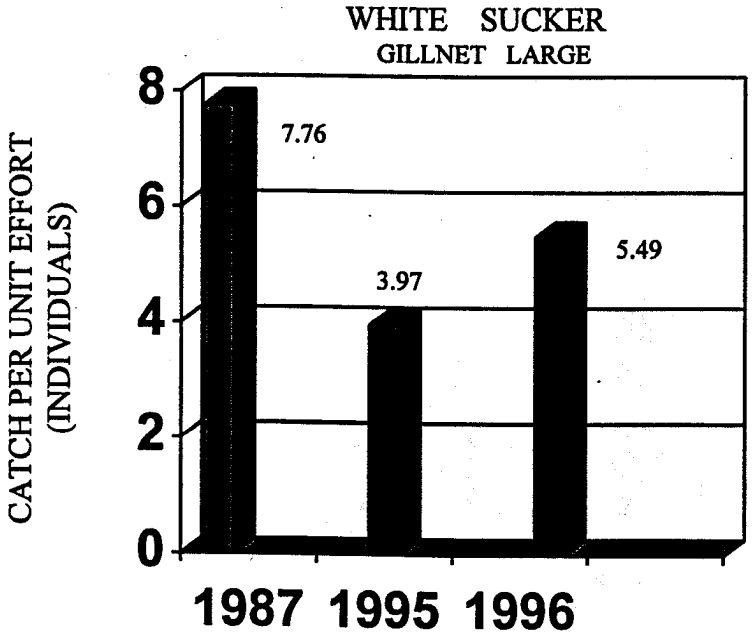

CREEK CHUB & OTHER MINNOWS
CATCH PER UNIT EFFORT (INDIVIDUALS)
25
20
15
10
5
0
23.5
0.91
0.01
7.31
2.63
2.52
OTHER MINNOWS
CREEK CHUB
MINNOW TRAP
1987
1995
1996

FIGURE 4


BROOK TROUT
GILLNET LARGE
CATCH PER UNIT EFFORT (INDIVIDUALS)
1.2
1
0.8
0.6
0.4
0.2
0
1.04
0.0
0.25
1987
1995
1996


WHITE SUCKER
GILLNET LARGE
CATCH PER UNIT EFFORT (INDIVIDUALS)
8
6
4
2
0
7.76
3.97
5.49
1987 1995 1996