SKAGIT RIVER RAINBOW TROUT SAMPLING PROGRAM , 1992.

DATA REPORT

by

Ron Gellner

B.C. Environment, Lands, and Parks

Fish and Wildlife Management

Lower Mainland Region

Surrey, B.C.

Regional Fisheries Report No. LM 233

1992

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GELLNER, R.J.G., 1992. SKAGIT RIVER RAINBOW TROUT SAMPLING PROGRAM, 1992, data report. Regional Fisheries Report No. LM 233, B.C. Environment, Surrey, B.C.

This data report summarizes the 1992 Skagit River rainbow trout sampling program.

Skagit River rainbow trout were angled by Ron Gellner on July 22 to 24 , August 24 to 27 , and September 1 & 2, 1992. Trout 25Omm in length and over were sampled for length and fin clips. Catch location were also recorded. A total of 320 rainbow trout , twenty dolly varden, and two **westslope cutthroat** were captured. Mean length statistics were calculated for rainbow caught in the upper and lower reaches of the Skagit River. Statistics were also calculated for fish caught by Gil Sage and Poul Bech (volunteer log book anglers) on July the 14th, 25th and 26th ; and on the 15th, 16th, 21st, 22nd and from the 27th to the 30th of August.These volunteers captured an additional 55 rainbow and one dolly varden.

Length statisics by reach are presented in Table 1.

Table 1: Mean lengths for the Skagit River rainbow trout sampling program 1992

	mean length	95% c.i.	max. length	min. length	n
lower reach	319.9	± 4.72	407	250	173
lower reach,log books	318.0	±1O.6	372	254	36
lower reach, pooled	319.6	± 4.30	407	250	209
upper reach	326.8	± 6.11	422	250	147
upper reach,log books	303.8	± 16.15	380	259	19
upper reach, pooled	324.2	± 5.77	422	250	166

92-18

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Skagit Environmental Endowment Commission

ASSESSMENT OF THE 1992

SKAGIT RIVER SPORT FISHERY

Prepared for

British Columbia Environment, Lands and Parks
Fish and Wildlife Management
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Regional Fisheries Report No. LM232

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Summary

Scott, K.J. and M.J. Staley. 1993. MS. Assessment of the 1992 Skagit River Sport Fishery. B.C. Environment. Fish and Wildlife Management. Reg. Fish. Rep. No. LM232, by Scott Resource Services. 54p. + append.

An on-site survey of the Canadian Skagit and Sumallo Rivers sport fisheries was conducted during the summer and fall of 1992. The primary objective was to replicate a survey first conducted in 1986 and subsequently replicated in 1990 to monitor changes in angler effort and success. In all three surveys, information on angler characteristics and social carrying capacity was also collected.

From July 1 to October 31, 1992, total angler effort was estimated at 19,554 hours. Overall, angler use in the 1992 season increased 59% from 1990. At the lower Skagit River effort was up by more than 50% from 1986 or 1990. A 160% increase in July 1992 effort due to unusually favourable early season angling conditions accounted for 45% of the seasonal increase at the lower Skagit; August 1992 effort was more than double 1990. At the upper Skagit River, 1992 effort increased by 46% from 1990 but was only 6% higher than in 1986. The increase in effort between July 1990 and July 1992 (888 hours) accounted for 89% of the increase between the seasons (993 hours). Angler effort and the number of interviews obtained at the Sumallo River were low and parameter estimates from this area should be regarded with caution.

Angler success for rainbow trout (0.69 fish per hour) increased from both of the previous two surveys (1986: 0.43 fish per hour; 1990: 0.36 fish per hour). The significant increase in catch rates in all areas can probably be attributed to reduced harvest in the reservoir since 1990 and undepleted fish abundance in the river due to the newly implemented catch and release regulation.

The 1992 estimated catch of 14,786 rainbow trout increased significantly from 1990 (5,305 trout) and 1986 (5,605 trout). The rainbow catch at the lower Skagit (12,286) was about triple that estimated for both 1990 (3,925) and 1986 (4,301). At the upper Skagit, the estimated catch of 2,183 rainbow trout increased by more than 80% from 1990 or 1986. A similar increase in estimated catch was evident at the Sumallo River, although the magnitude of the catch was small (317 fish) compared to the Skagit River areas.

While the catch of rainbow trout increased substantially, the estimated catch of Dolly Varden char (140 fish) only increased moderately from 1990 (106) and 1986 (115 fish).

Anglers interviewed in 1992 collectively exhibited similar demographic characteristics to 1986 and 1990. However, more than 70% of the anglers had first fished the Skagit since 1986 and 48% fished the Skagit for the first time in 1992. Use levels in 1992 in all three areas were within social carrying capacity. While the quality of the fishing experience at the lower Skagit River was still high, the upper Skagit may be approaching a use level where the quality of the fishing experience will begin to decline due to crowding.

S2-19

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Flash Lake

Assessment of Fish Populations

1992

A project sponsored by the
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B.C. Ministry of Environment, Lands and Parks
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were rainbow trout in both years of sampling.

In the 1992 sampling, the total number of fish $\geq$ 20 cm (27; both nets combined) was only just over 10% of the total capture (263 fish). In comparison, of the total 18 fish captured in June 1980, 16 (nearly 90%) were $\geq$ 20 cm in length. Results between years also indicate a larger mean size for such fish in 1980, compared to 1992 (Table 3); but the significance of this is suspect, given the wide confidence limits associated with the small 1980 sample. However, it is highly noteworthy that 4 of the 18 fish captured in 1980 exceeded the maximum size of 266 mm in the 1992 capture of 263 fish. The maximum size in 1980 was 337 mm, and was recorded for 2 individuals (*op.cit.*). Furthermore, as shown in Figure 1, by far the majority of the 1992 catch was in the 100-150 mm size range. The smallest individual in the 1980 catch was 176 mm. To what extent this was influenced by the timing (afternoon/evening) and short duration of the set is unknown. It may also have been influenced, to some extent, by the orientation of the net, with the 2.5 in. mesh at the shore (*op.cit.*), in reverse to the 1992 sets.

Unfortunately, age data are not provided for the 1980 sampling, so that length at age comparisons cannot be made (Table 3). Nor can CPUE be compared, as the 1980 set was not extended overnight. However, it was previously noted that the mean length of fish $\geq$ 20 cm captured in Flash Lake (189.4 $\pm$ 7.4 mm) was almost precisely the mid-point of corresponding values from similar mid-August sampling of Lightning (200.5 $\pm$ 3.8 mm) and Strike (177.1 $\pm$ 7.7 mm) lakes, immediately upstream and downstream, respectively. Interestingly enough, the CPUE (fish $\geq$ 20 cm) for Flash Lake (13.5 fish/net night) is also near the mid-point between corresponding values for these lakes (33 and 3 fish/net night, respectively).

Inferior conditions, relative to Lightning Lake, are also suggested by condition factors (k; in $Wt_{(g)} = kL_{(mm)}^{3}$) for larger fish ($\geq$ 20 cm). For the Flash Lake sample (n = 27), the resultant mean was 1.01×10^{-5} (Table 1), compared to 1.05×10^{-5} for Lightning Lake (n = 33). Based on weight data provided by Philip and Wright (*op.cit.*), the corresponding mean for the June 1980 Flash Lake sample was also 1.05×10^{-5}. However, the accuracy of the latter results (ie. type of balance) is not known. In 1992, a highly accurate top-loading electronic balance was used, with precision (and recording) to $\pm$ 0.1 g. The 1980 data are provided to the nearest gram only (*op.cit.*).

CONCLUSIONS

1. Flash Lake appears to support a rainbow trout monoculture.

2. unfortunately, variation in netting procedures (timing/duration and orientation of net sets) limits the comparability of sampling in 1992 to that conducted in 1980.

3. however, the data appear sufficient to indicate diminishing length of larger fish (ie. > 20 cm) in Flash Lake, and associated reduction in the number of individuals exceeding 25 cm; the same phenomena are more clearly evident in corresponding sampling of Light-

ning Lake, located only 300 m upstream of Flash Lake.

4. Flash Lake is likely influenced by recruitment from Lightning Lake; if densities of small fish (ie. < 160 mm) are increasing (or have increased) in the latter lake, as they appear to, some proportion of the population may downstream to Flash Lake (density dependent?).

5. comparison of 1992 to 1980 netting data for Flash Lake (although limited) suggests an increase in the numbers of small fish in this lake as well.

6. certainly, recruitment does not appear to be limiting; sections of excellent spawning and rearing habitat exist within Lightning Creek (inlet and outlet to Flash Lake), and there is undoubtedly spawning/recruitment specific to Flash Lake itself.

7. however, unlike Lightning Lake, there was no evidence in the Flash Lake sample to suggest extended spawning; although the majority of inspected age 3+ fish were female (n = 12), only 1 was found to be mature; in contrast, the majority of age 3+ females were mature in the Lightning Lake sample.

8. the relatively low condition factor for Flash Lake fish $\geq$ 20 cm, compared to 1980 results, and corresponding (1992) data from Lightning Lake, may suggest some degree of over-recruitment, and intra-specific competition; however, on the basis of gut examinations, food appears to be exceptionally abundant in Flash Lake (notably, *Gammarus*), and results with respect to condition factors may be misleading (seasonal influence, sample sizes, accuracy of 1980 weight data, etc.).

9. as was concluded for Lightning Lake, it seems most probable that selective harvest of larger, dominant fish from Flash Lake (as evidenced by the apparently declining size and numbers of such fish since 1980) has resulted in the proliferation of smaller fish; as alluded to above, this may be compounded by the similar circumstances in Lightning Lake, perhaps resulting in additional recruitment of smaller fish to Flash Lake.

REFERENCES

B.C. Environment, 1992. *Manning Park Lake Surveys. Invitation to Tender.* Lower Mainland Region, Surrey, B.C. 3 p.

Neuman, H.R. 1992. *A method to assess fish populations in small lakes using standardized gill netting.* B.C. Environment, Lands and Parks. Fish and Wildl. Program Rept. No. LM 219. 7 p.

Philip, D.F. and G. Wright 1980. *Flash Lake survey.* B.C. Fisheries Branch, Victoria, B.C. 9 p.

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Nicomen Lake Survey

1992

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depth (tail hold), it is doubtful that this would be negotiable by fish at the observed flows (ca. 5 L/s), or lower discharges.

Other Surveys and Information

Prior to August 11-12, 1992, Nicomen Lake had not been formally surveyed. The only study that is known was a brief (1 page) reconnaissance report by Taylor (1979). This concentrated on the inlet and outlet streams, and the long term potential for their enhancement. The only other documentation is a letter by Dahl (1988) suggesting that the fish species in the lake is golden trout (*Salmo aquabonita*), imported from California, and stocked in the 1940's.

Restrictions on Use

Besides the necessity of substantial hiking to reach Nicomen Lake, the only significant restrictions to use are the mid-water deadheads and the log accumulations along the northwest shores (angling). The former are hazardous to inflatable boats, should hikers be ardent enough to endure packing one in. The latter complicate shore angling, although it was this site that was selected by the sole individual observed angling during the survey (presumably, due to the complexity of habitat). He was seen to have considerable difficulty, and apparently, no success in terms of catch. Much of the shoreline is ideal for angling, notably the southwest corner, which is also the deepest part of the lake.

DISCUSSION

Despite Dahl's (1988) suggestion that fish in Nicomen Lake are golden trout, no evidence was seen to suggest that they were anything other than rainbow trout (*Oncorhynchus mykis*). Taylor (1979) also refers to stocking in 1944, 1948, and 1949, but refers to the stock as "natural rainbow trout". If, in fact, golden trout was the species stocked on any of these occasions, there is no evidence of survival, nor any indication of hybridization. Upon reflection, Dahl (*pers. comm.*)[1] agrees that he was mistaken in his earlier identification, and that present fish are indeed rainbow. All fish captured during the 1992 survey were identified as such.

During his field inspection in late August, Taylor (1979) caught a sample of fish (n = ?), and noted that those >120mm typically showed highly developed gonads, or evidence of recent spawning. In August 1992, 13 females, out of a total 26 inspected, were found to be mature (Table 5); either kelts (typically with spent eggs loose within the body cavity), or in spawning or post-spawning condition, with fully developed eggs within skeins, and showing signs of resorption (Appendix 2). Another 11 females, including several of the smallest (174-188mm), were nearing maturity, typically with eggs of pinhead size. Clearly, late and prolonged spawning of the population is suggested, as might be expected, due to the lake's elevation.

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[1] Telephone conversation, January 5th, 1992.

gradient of the lower section of stream, which currently appears to be ideal for spawning. Consequently, removal of the plug could actually result in negative impacts on spawning and recruitment capabilities. Furthermore, even if such was not the case, and the result of the removal was increased recruitment, it is questionable whether fish production would benefit, from an overall perspective. Given the numbers of fish in the lake already, further recruitment might simply result in reduced size and/or condition, to the detriment of the existing fishery.

In 1979, Taylor (1979) suspected that the existing fishable population was "sufficient", at that time. Dahl (1988) reported that trout were "abundant" in the lake, and easy to catch in 1987. The results of the 1992 survey clearly indicate continued maintenance of the population at high numbers and good condition. Further assessment of productive capability (and the desirability of increased recruitment) may be made on the basis of Ryder's (1965) morphoedaphic index, once bathymetric mapping is completed (by B.C. Environment), and mean depth is accurately determined. However, at the present time, no action other than monitoring, appears to be warranted for this lake.

REFERENCES

Dahl, R.K. 1988. Letter addressed to J.D. McPhail, Department of Zoology, University of British Columbia. Dated March 14, 1988. Signed R.K. Dahl, Conservation Officer, B.C. Ministry of Environment and Parks, Chilliwack. 1p.

Griffith, R.P. *Flash Lake (Lightning #2): assessment of fish populations*. R.P. Griffith and Associates, Sidney. *For*: B.C. Environment, Surrey. 12 p.

_____ *Lightning Lake (Lightning #1): assessment of fish populations*. R.P. Griffith and Associates, Sidney. *For*: B.C. Environment, Surrey. 11 p.

Ryder, R.A. 1965. *A method for estimating the potential fish production of north-temperate lakes*. Trans. Am. Fish. Soc. 94: 214-218.

Taylor, G.D. 1979. *Nicomen Lake: to outline long term enhancement potential for natural rainbow trout in inlet and outlet*. Unpubl. Reconn. Rept., B.C. Fish and Wildlife Branch, Victoria. 1 p.

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Poland Lake Survey

1992

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Other Surveys and Information

An earlier inspection of Poland Lake was conducted in 1953 (Balkwill, 1991). However, this was limited to a single temperature/oxygen profile, and determination of TDS (filterable residues). No other data were recorded at that time. The only other source of information, that is known of, is the brief summary for Poland Lake in the B.C. Environment Lake Inventory Data Retreival System for the Lower Mainland Region. This summary is dated August 9, 1983, and in addition to the 1953 data (above), provides brief notes regarding location, access, drainage, development, etc. It also provides an estimate of lake area (4 ha, full) and maximum depth (14 m) and notes the presence of *Gammarus*, *Trichoptera*, and salamanders. It indicates that contour maps are on file, but investigation of Lake Inventory files of the Fisheries Branch (Victoria) suggests that such maps have yet to be prepared. Of particular interest is a note suggesting 150 yds. of spawning habitat in the outlet stream. This is addressed in the discussion below.

Restrictions on Use

Other than the necessity of substantial hiking to reach Poland Lake, there are no other real restrictions to use. Although trees and other vegetation complicate shore angling (lack of back-casting space) over much of the lake, there are, nonetheless, several excellent angling locations. This was well demonstrated by 3 anglers, who spent much of their time fishing, with apparent success, while the 1992 survey was being conducted.

DISCUSSION

Poland Lake appears to support a rainbow trout (*Oncorhynchus mykis*) monoculture. Not surprisingly, given the lake's elevation, fish tend to be small (Fig.4), and mature at early age (age 3+ for females, age 2+ for some males) and small size (Appendix 2). As was observed in Nicomen Lake, another alpine/sub-alpine lake in Manning Park investigated in 1992 (Griffith, 1993), delayed/prolonged spawning was also clearly evidenced in the fish sample from Poland Lake. In fact, of 7 mature females examined on August 13, 1992 (Table 5), 3 contained full compliments of fully developed eggs, ready for spawning (Appendix 2). Unlike Nicomen Lake, however, these all appeared to be totally viable, with no indication of resorption. It seems most likely that this may be explained by the nature of the inlet streams associated with the 2 lakes.

As at Nicomen Lake, the inlet stream to Poland Lake provides a short (ca. 100 m) low gradient section, prior to taking off steeply for the remainder of its length. This section averages 1 m in width, and is well endowed with small gravels suitable for the spawning of Poland Lake fish (Appendix 3; Photo 4). At the time of observation, flows were low (ca. 4 L/s), but some areas of the stream had depths to 15 cm over suitable substrates, and were likely still usable for spawning, given the small size of the fish in question. At Nicomen Lake, a log/boulder plug at the mouth of the inlet undoubtedly serves as a barrier to spawners at lower flows (as observed August 11-12, 1992), resulting in some degree of egg-bound females, resorption, and/or shore spawning, in that case.

With regard to the outlet of Poland Lake, the suggestion in the Lake Inventory Data Retrieval System file, that 150 yrds. is of spawning value to Poland Lake, seems highly doubtful. Firstly, the boulder/bedrock falls immediately below the lake would likely represent a barrier (or at least a serious obstruction) to small trout attempting to upstream, at most (if not all) flows. Secondly, the outlet stream (Poland Creek) below the falls is steep, and contains highly complex rearing habitat, but gravels are extremely sparse (Appendix 3). Even if passage was not an issue, it seems unlikely that outlet spawning would result in significant recuitment to the lake.

It would be safer to assume that recruitment to Poland Lake hinges on the inlet stream; and all evidence suggests that it functions adequately in this respect (including prolonged accessibility and usability, as noted above). With the capture of 44 fish in a total of 18.25 net hours (Table 2), the lake appears to be reasonably well populated. Numbers were somewhat lower than those obtained from Nicomen Lake (63.2 vs 68.8 fish/100 m/24 hr), but the average fish condition factor (k; in $Wt_{(g)} = kL_{(mm)}^{3}$) was correspondingly higher in Poland Lake (1.08×10^{-5}; Table 3) than in Nicomen (1.05×10^{-5}; Griffith, *op.cit.*).

Lower number of fish in Poland Lake are likely attributable to greater angling pressure. One of the anglers present at the lake, during the survey, reported that he frequently fishes it, and that other anglers are routinely encountered. Fish are small, but catch success is good, and only a moderate hike (10 km) is required to achieve the wilderness setting the lake provides. He also reported that the existence of the B.C. Parks service road may lead to some over-use by individuals, sometimes in numbers, who unlawfully use the road for access by motorcycle. Perhaps measures should be taken to control this, if possible. Otherwise, the only action advised at this time is to conduct routine monitoring to ensure that the current fishery does not decline. It should probably be assumed that ongoing maintenance of wild fish production in Poland Lake will hinge primarily on the adequacy of catch regulations into the future, and/or their timely modification, as required.

REFERENCES

Balkwill, J.A. 1991. *Limnological and fisheries surveys of lakes and ponds in British Columbia, 1915-1990.* Fish. Tech. Circ. No. 90, B.C. Recreational Fisheries Branch, Vancouver. 157 p.

Griffith, R.P. 1993. *Nicomen Lake survey report.* R.P. Griffith and Associates, Sidney. *For*: B.C. Environment, Surrey. __ p.

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Strike Lake

Assessment of Fish Populations

1992

A project sponsored by the

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ies Inventory (*pers.comm.*). However, a set of record sheets for rainbow trout captures from Strike Lake, dated August 17th 1950, were found in the files. Data were provided for 13 fish, which ranged in length from 180 to 260 mm. Again, this is consistent with the 247 mm maximum size obtained from the 1992 sampling. But unlike the 1992 results, 11 of 13 fish recorded for 1950 exceeded 20 cm in length. However, the record sheets give no indication of how the fish were captured. If they were angled, which they likely were, this would be expected to select for larger fish in the population. Also, the collectors may not have been interested in data from smaller fish. On the other hand, they would certainly be interested in the largest individuals, the maximum of which was only 260 mm, similar to that of the August 1992 sampling.

CONCLUSIONS

1. Strike Lake appears to support a rainbow trout monoculture.

2. all data seem to suggest that this lake has been greatly dominated by small fish (ie < 20 cm), for at least the last decade.

3. although there is clear evidence of declining fish size in both Lightning and Flash lakes, conditions in Strike Lake have probably stayed much the same since 1980, at least.

4. while the greater size and number of larger fish (coupled with easy access) have undoubtedly resulted in high angling pressure on Lightning and Flash lakes, it is doubtful that the same would apply to Strike Lake.

5. it does appear that fish numbers (as well as size) are lower in Strike Lake than in either Flash Lake or Lightning Lake; however, 63 fish were caught with a single overnight set in 1992, and with strong representation of age 1+ fish (Fig.1), it seems extremely unlikely that recruitment is a problem.

6. although spawning habitat is limited in the section of Lightning Creek immediately upstream of Strike Lake (including beaver dam barriers and swamps at approx. 300 m), the section downstream of the lake outlet contains ideal spawning and rearing habitat, particularly in the first 200-300 m.

7. it is unclear why trout in Strike Lake would be stunted, relative to neighbouring populations in Flash and Lightning lakes; quick cross-reference of basic lake characteristics, based on 1980 surveys (Philip and Wright, 1980) does not reveal any limitations to Strike Lake that do not apply to either (or both) of the other lakes as well (Table 4).

8. although it is possible (if not likely) that Flash Lake is influenced by recruitment from Lightning Lake, due to their close proximity, and extremely high numbers of fish in Lightning Lake (upstream), it is doubtful that Flash Lake has any similar influence on

Strike Lake; the distance between these lakes is considerably greater (1100 m), and a large swampy area, controlled by numerous beaver dams, occurs on the connecting portion of stream (Lightning Creek), about mid-way between the lakes.

9. without further, more complete data, it can only be concluded that 1) historically (ie. perhaps for the last 4 decades), Strike Lake fish have always been small, consistent with the 1992 sampling results, 2) there is no evidence to suggest major changes in either fish size or abundance, since 1980 at least, and 3) given the contrasting impacts (and associated effort) of angling on Flash and Lightning lakes, the absence of clear changes in Strike Lake seems to indicate low angling use, undoubtedly explained by small fish size (for whatever reason), the requisite hiking, and the superior angling opportunity provided by both Flash and Lightning lakes, at the trail head.

Table 4. Selected data from 1980 surveys of Strike, Flash, and Lightning Lakes (Philip and Wright, 1980).

	Units	Strike	Flash	Lightning
Surface area	ha.	7.8	13.4	52.3
Maximum depth	m.	7	3.5	7.5
Mean depth	m.	3.2	1.1	3.0
Filterable residues	mg/L	48	50	68
Secchi depth	m.	7.5	5+	8.5
Date		June 18/80	June 17/80	June 15/80

92-19

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Thunder Lake Survey

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Restrictions on Use

Although Thunder Lake is spectacular in an eerie sort of way, as observed at the time of survey it was neither hospitable nor pleasant for camping or any other use. There is little shelter from westerly winds, which were frequent during the survey, complicated field activities (notably boating), and were a general annoyance. Even at the flatter east end of the lake, it was necessary to traverse 50 m+ of relatively steep (est. 10°-15°) rocky bank between the campsite and the water's edge. Although this would not apply at full pool, there would then be a great abundance of floating logs and other debris to contend with. On top of all this, there is, of course, the requisite hike of approximately 4 km from Strike Lake, and the absence of any designated campsite.

DISCUSSION

The results of limnological and fish sampling in Thunder Lake were as strange as the hydraulic conditions, the lack of any aquatic plants and low abundance of aquatic insects, etc. The water body was a crystal blue in colour, and was remarkably transparent, as evidenced by the Secchi depth of 15.5 m at the deep water limnological sampling station. Presumably, phytoplankton and zooplankton abundance must also have been extremely low. This was quite unlike the conditions that were observed in the 3 other Lightning chain lakes (Lightning, Flash, and Strike) that were also investigated during August 1992 (Griffith, 1993). Based on 1980 surveys (Philip and Wright 1980) the filterable residue (TDS) concentrations in these lakes (48-68 mg/L) are either similar to (or somewhat less than) that determined for Thunder Lake in 1992 (66-68 mg/L; Table 1). Yet, consistent with observations in August 1992, the Secchi depths in the other Lightning lakes ranged between only 5 and 8.5 m in mid-June 1980 (Philip and Wright, *op.cit.*).

With no observable inflow or outflow, one might be more likely to expect the stagnation and proliferation of plankton blooms in a given water body (Russell-Hunter, 1970). The suggestion of the reverse, in Thunder Lake, is extraordinary, and presumably, must be attributable to the associated hydraulics, which are equally extraordinary. However, precisely why, and to what extent this is true, is unclear. Certainly, with the substantial inflow from Lightning Creek suddenly disappearing, short of the lake body, and the obvious porosity of the lake basin itself, much of the hydraulic dynamics must take place within the ground. Under the conditions observed at the time of survey, it is possible that vital nutrients were "filtered" out of the Lightning Creek inflow during its seepage (presumably) into the lake. Definitely, any recruitment of phytoplankton, zooplankton, aquatic insects, or any other organisms would be precluded, during the persistence of such conditions. Again, this is consistent with the extremely high incidence of empty guts in the Thunder Lake fish sample, and the dominance of ants and other terrestrial insects in the contents of those that were not empty (Appendix 2).

However, other results of the fish sampling seem totally contradictory. The 1992 investigations of the other 3 Lightning chain lakes (Griffith, *op.cit.*) were conducted simply to assess fish stock status, using standardized gill-netting methods (Neuman, 1992). The same methods (using 2 overnight sets) were employed for Thunder Lake. The results for all 4 lakes are compared in

Table 6. Firstly, despite all that is said above, the average condition factor (k; in $Wt_{(g)} = kL_{(mm)}^{3}$) for larger fish (ie. ≥ 20 cm) in Thunder Lake was as good, or better, than that in all 3 other lakes in the Lightning chain. Secondly, these fish represented much the highest proportion of the catch in Thunder Lake, compared to those of the other 3 lakes. Both the mean size and the maximum size of such fish was greatest (substantially) in Thunder Lake. Furthermore, the rate of capture for fish ≥ 20 cm (fish/net night) in Thunder Lake was only bettered by that of Lightning Lake, where numbers of fish (all sizes) were exceptionally high. None of these results would seem applicable to a lake that gives so little indication of any other biological production.

However, a comparison of total fish numbers (all sizes) may provide some explanation. The rate of capture, including fish of all sizes, was equal in Thunder and Strike lakes, but was by far lower than in Flash and Lightning lakes (Table 6). While conditions in Strike Lake are not entirely clear, it seems apparent that both the numbers and size of fish ≥ 20 cm in Flash and Lightning lakes are suppressed by angling (Griffith, *op.cit.*). It seems likely that the reverse again applies to Thunder Lake. It is probably safe to assume, given the extensive additional hiking involved, that Thunder Lake would be subject to less angling pressure than either Flash or Lightning lake, in any event. Add to this Thunder Lake's general lack of appeal, and the various restrictions to its use, and it seems unlikely that it would be a selected destination, even for those aware of the larger fish it contains (let alone the average visitor). Consequently, production may be concentrated in larger fish, perhaps at a cost to smaller individuals if food resources are limited.

Table 6. Comparison of fish data from gill netting samples from Thunder Lake, and other Lightning chain lakes (August, 1992).

Result	Thunder	Strike	Flash	Lightning
Number of fish ≥ 20cm	35	5	27	33
Proportion of total catch (%)	55.5	6.7	10.3	15.3
Condition factor for fish ≥ 20cm	1.07×10^{-5}	1.05×10^{-5}	1.01×10^{-5}	1.07×10^{-5}
Mean length of fish ≥ 20cm (mm)	237.9	219.8	220.4	217.5
Fish/net night for fish ≥ 20cm	317	247	266	264
Fish/net night for all fish	31.5	31.5	131.5	215
Number of overnight nets	2	1	2	1

This may be a seasonal phenomenon. In Lightning Creek, approximately 100 m upstream of its point of disappearance, the abundance of fish food items in August 1992 was excellent (most notably, caddis larvae and chironomids). During periods of direct surface flow to the lake, the associated drift of such organisms would provide greater food abundance for lake fish. Further to stream habitat, Lightning Creek not only provides substantial amounts of suitable spawning gravels upstream of Thunder Lake, it also contains excellent rearing habitat. The outlet section of Lightning Creek also contains reasonable amounts of gravel, and an abundance of larger substrates to serve as cover elements for rearing fish (Appendix 3). However, depending on how frequently and/or rapidly lake drawdown and dewatering (or interruption) of the streams occurs, there may be significant impacts in terms of successful recruitment to the lake, either routinely or periodically. This would also help explain the relatively low numbers of small fish in the sample (Fig. 4).

Lastly, due to the drawdown coinciding with the August 1992 sampling, the indicated fish capture results may be inflated. With a maximum depth in the order of 20 m at the time of survey (Appendix 1), and an estimated drawdown of 9.5 m below high water, the lake volume was reduced by at least 30% (perhaps 40-50% ?), relative to what might be expected with "normal" hydraulics. Accordingly, the fish population would be concentrated, and catch might be expected to be considerably higher than if the sampling was conducted at typical drawdown levels (ie. 0.5-1.0 m), as at Strike, Flash, and Lightning lakes.

In all respects, Thunder Lake is very intriguing from a fisheries perspective. With a data set that is somewhat contradictory, likely distorted, and from a single point in time, it is difficult to come to any firm conclusions. To provide any management capability, conditions closer to full pool should be investigated. Future netting evaluations, like those conducted in the other Lightning chain lakes in 1992, should also be undertaken in future years to monitor the lake's fish population, relative to the 1992 results (especially if angling pressure is known or suspected to increase). All things considered, it seems likely that fish production in Thunder Lake may be limited, far more than the 1992 capture results indicated. The dominance of larger fish may reflect competition for limited resources, perhaps coupled with limited recruitment, either routinely or periodically. If angling pressure (likely light at present) increases, impacts on the population could be fast and dramatic, particularly if the proportion of smaller fish (ie. recruitment) is as low as was indicated in 1992.