Government of Canada / Gouvernement du Canada

MEMORANDUM **NOTE DE SERVICE**

TO / À
R. J. Beamish
Director
Fisheries Research Board

FROM / DE
K. D. Hyatt
Read - Sockeye Ecology Unit
Lake Enrichment Program

SECURITY - CLASSIFICATION - DE SÉCURITÉ

OUR FILE – N / RÉFÉRENCE

YOUR FILE – V / RÉFÉRENCE

DATE December 7, 1983

SUBJECT / OBJET
Rationale and follow-up on terminating nutrient treatment of Morice Lake

Returns of sockeye salmon to the Morice-Nanika production system (tributary to the Skeena River) routinely exceeded 60,000 pieces prior to 1950. Between 1950 and 1955 escapements declined precipitously to only a few thousand adults and this condition has persisted to the present time (Figure 1). Shepherd as well as other DFO management personnel suggested a plausible mechanism through which a sudden decline in adult sockeye returns might trigger changes in within-lake growth and survival of juvenile sockeye such that further stock declines would occur (see appendix 1 for details of this explanation). Lake fertilization was suggested as a potential remedy to increase juvenile sockeye growth within-lake such that larger smolts would exhibit higher survival to maturity and thus aid in rebuilding the stock. Consequently, Morice Lake was treated during the summer of 1980 at a cost of approximately $90,000. During the fall of 1980 I reviewed the available data regarding limits on Morice Lake smolt growth in light of the sockeye ecology unit's experience from census work on the lake during the summer of 1978. This review (to be be discussed below with reference to recent returns) suggested that Morice Lake smolts were unlikely to exhibit severely food-limited growth during the 1980 treatment year due to extremely low population sizes. Consequently we concluded that the application of nutrients would likely fail to produce the desired increase in smolt size. Indeed, we concluded that treatment and its considerable expense should be eliminated at Morice until either (1) escapements (and associated fry recruitment) increased enough to result in clearly food-limited growth patterns by young sockeye, or (2) evidence could be obtained that, in spite of extremely low in-lake abundance, the juvenile sockeye in Morice Lake during the treated year (1980) had exhibited better growth and consequently achieved larger smolt sizes (during the 1981 and 1982 smolt migration years) than those reared in lake at roughly comparable fish densities (as indexed by brood year escapement levels) under untreated conditions in 1977, 1978 and 1979. Unfortunately, our attempts during the spring of 1981 and 1982 to obtain smolts derived from the treated year were unsuccessful and no firm conclusion was possible concerning whether or not lake treatment during 1980 had produced the desired size increase in the fish.

Recently rumours have circulated to the effect that the 1983 adult sockeye returns to the Nanika spawning grounds have increased "significantly" over the brood year and that analysis of freshwater growth patterns on the

scales of age groups of adults that had experienced treated conditions in Morice Lake supports the idea that lake treatment did produce larger smolts which have experienced higher survivals to adults. I have spent some time in following up these rumours in order to inject some rigour into the process of drawing conclusions about whether lake treatment has resulted in any unusual shift in production of sockeye returning to Morice Lake. Accordingly I address the following issues below. First, is the apparent increase observed for the Nanika River sockeye escapement a reliable indicator of a biologically significant event? Next, given that the increase appears to be biologically significant, does its magnitude or timing with respect to treatment represent an unusual event? Finally, do any other data link the increase clearly to an influence of lake treatment on juvenile sockeye?

Evidence for an Increase

Telephone contact with Terry Turnbull, the FSB employee in Smithers responsible for surveying the sockeye on the upper Nanika, indicated that approximately 4000 adult sockeye appeared on the spawning grounds this year. The majority of these adults were aged as 5_3 (Table 1), thus they were derived from the 1978 brood year and as juveniles experienced treated conditions in Morice Lake during their second year of freshwater residence. The 1978 brood year had been estimated at only 1000 adults, consequently the apparent return of 4000 adults in 1983 has been viewed in some quarters as evidence of a treatment induced increase in sockeye survival. It is difficult to give unqualified support to this interpretation in light of the quality of the escapement data (implicitly assumed to represent total stock) on which it is based. I have summarized a number of factors contributing to uncertainty regarding the biological significance of apparent between-year variations in Morice system sockeye escapements (Table 2), and have concluded that it will often be impossible to distinguish between whether changes in brood-year returns of up to 400% are biologically real or generated as an assessment procedure artifact. This condition is likely to persist as long as stock returns to Morice Lake number only a few thousand fish and annual assessments are subject to both changes in procedure as well as changes in climatic conditions which influence the relative accuracy of data generated by a given procedure. Both Howard Smith (Associate Director, FRB) and Terry Turnbull (FSB) who are familiar with assessment procedures and climatic conditions in the Morice system have indicated general agreement with this conclusion. However, Mr. Turnbull commented that the indication of a Nanika escapement increase along with qualitative information that the native food fishery caught "more" sockeye this year than in other recent years has left him with the feeling that the stock has likely increased somewhat over the brood year.

Uniqueness of an Increase

For arguments sake, one might assume that the apparent increase is real and biologically significant. Just how unique is the 1983 return? If the escapement data are taken at face value, the answer to this question is that the 1983 return year increase is not very unique, that is increases of 300% or more on returns associated with a given brood year have occurred 6 times in the 20 brood-year, return-year comparisons that can be made since 1959.

Increases of approximately the same magnitude as that observed in 1983 may occur for approximately 1 brood-year in three whether the lake is treated or not, thus the 1983 return event could not be considered unique even in the absence of uncertainties about the relative accuracy of stock or escapement estimates across recent years.

Other Evidence for Benefits

During the course of aging scales from 1983 brood-year adult sockeye, Yvonne Yole (FSB, Vancouver) also completed circulus counts associated with growth in years of freshwater residence in Morice Lake. Comparisons of circulus counts within and between age groups of 1983 brood year fish (affected by treatment) and 1974 brood-year fish (untreated) suggested to Yvonne that juvenile sockeye in Morice Lake during the treatment year (1980) had experienced better growth than observed in untreated years (see attached copy of memo dated Oct 18, 1983 from Yole to Graham). Yvonne attributed the better growth to fertilization. Reappraisal of Yvonne's circular data along with data on circulus counts and smolt sizes observed in a variety of years does not support this inference. Yvonne has pointed out correctly that the freshwater growth (untreated conditions) of 1974 brood-year fish was lower that that of the 1983 brood-year fish (treated conditions). However attributing the differences to treatment is questionable since in-lake populations of juvenile sockeye producing 1974 adult returns were apparently derived from escapements approximately 4 times higher than those giving rise to the 1983 adult returns. The freshwater circulus counts laid down in-lake in 1971 on the scales of adults returning in 1974 would be expected to exhibit lower circulus counts than those from 1983 adult scales regardless of treatment, since freshwater growth of sockeye is density-dependent and the juveniles giving rise to the 1974 adults could have been 4 times as abundant in-lake as those giving rise to the 1983 adult returns.

The comparison that would be most revealing is between the size of smolts leaving the Morice system and derived from untreated and treated conditions when in-lake population sizes were approximately equal. These conditions hold for smolts leaving in 1979 and 1980 (untreated) versus those leaving in 1981. Unfortunately we did not obtain smolt samples in 1981, however 1983 brood-year adults provide information, by way of their scale circulus counts, on juvenile sockeye growth performance as a result of the treated year. Consequently circulus counts on sub-2 and sub-3 sockeye can be compared, given some qualifiers (see Table 3), across smolt years 1979, 1980 and 1981 for growth performance under untreated and treated conditions, respectively. This comparison (Table 3) indicates that sub-2 sockeye laid down means of 15 and 14 circuli in two years of untreated conditions and at most 14-16 circuli in a treated year. Similarly sub-3 sockeye exhibited total mean circulus counts of 23 and 22 in untreated years versus 23 under the influence of treatment. These comparisons do not support the inference that treatment during 1980 resulted in an increase in smolt growth.

Our Position Reviewed

Given the information above, I believe we should stand by the position taken in 1981 that treatment of Morice Lake represents a long-shot for aiding sockeye stock recovery until such time as escapements increase to the point where recruiting fry are likely to exhibit pronounced food-limited growth patterns in-lake. Examination of smolt sizes produced between 1961 and 1980 (Table 3) allow some conclusions regarding escapements at which this will occur. The sizes on both age groups of smolts leaving Morice Lake between 1979 and 1981 are the maximum on record for this system and are on average twice as large as those produced between 1961 and 1966. Given the sizes of the smolts leaving Morice Lake between 1979 and 1981 (i.e. sub-2's greater than 6 grams, sub-3's greater than 18 grams) it is unlikely that they were very food limited with respect to growth in-lake. By contrast between 1961 and 1966 the mean size of smolts leaving Morice was only half that seen in the most recent years, that is within-lake growth of these smolts likely was food limited. Fry populations which produced the large smolts were derived from apparent escapements of 1000 adults or less while those which produced small smolts were derived from apparent escapements of 1000 to 9500 adults, consequently we suggest that treatment is unlikely to produce benefits to Morice sockeye as long as escapements are less than 1000 adults but that benefits are likely to be achieved when fry recruitments are based on escapments of 5000-10000 adults or more. Given the current cost estimate of treating Morice Lake (approximately \$140,000 .year^{-1} in 1983 dollars) our decision to suspend treatment in the fall of 1980 has saved a questionable expenditure that could have cost \$560,000. (1983 dollars) to date. However conditions at Morice Lake should be reviewed annually with respect to the advisability of treating the lake since its oligotrophic nature recommends that sockeye would benefit appreciably from effects of nutrient additions at times when fry recruitment is large enough to depress in-lake growth. To refine our assessment of whether or not this pre-condition is satisfied at the intermediate escapement levels observed for the 1982 and 1983 brood years (approximately 3000-4000 adult sockeye) smolt samples should be collected by regional FSB personnel over the next two to three years if possible for comparison with size data already on hand. Similarly, scale analysis on treated adults expected to return in the fall of 1984 (principally 5_3 and 6_3) would help shed additional light on questions dealt with above. Beyond this, I submit that if we are going to attach much significance to apparent moderate increases in brood year returns for stocks that at are as severely depressed as those at Morice, then substantial increases in effort may be required to clear away uncertainties that influence the quality of the data on which our inferences are based (Table 2).

MORICE SOCKEYE

Temporal Trend of Apparent Escapements Since 1945

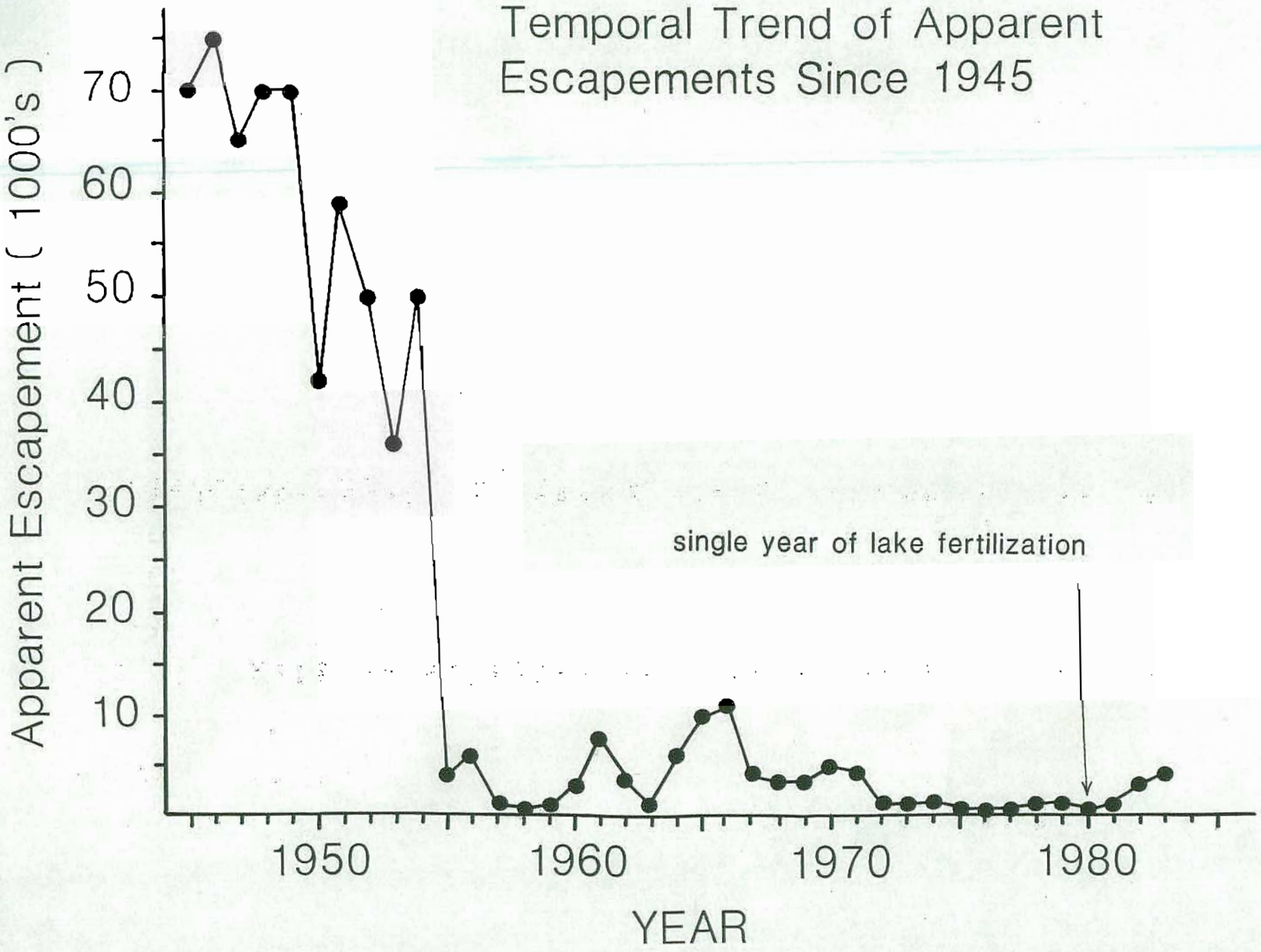

Table 1.

Brood year	Age groups affected by treatment	Year of freshwater growth affected	Year of return	No. expected[1] per 100 brood year returns	Treated age groups as % of observed 1983 returns[2]
1977	6_4 (3.2)	3rd	1983	1	0
	7_4 (3.3)	3rd	1984	0	
1978	4_3 (2.1)	2nd	1982	2	
	5_3 (2.2)	2nd	1983	49	68.5
	6_3 (2.3)	2nd	1984	34	
1979	3_2 (1.1)	1st	1982	1	
	4_2 (1.2)	1st	1983	7	9.8
	4_3 (2.1)	1st	1983	2	1.1
	5_2 (1.3)	1st	1984	5	
	5_3 (2.2)	1st	1984	49	
	6_3 (2.3)	1st	1985	1	
	6_4 (3.2)	1st	1985	1	
	7_4 (3.3)	1st	1986	0	
					79.4

[1]Based on average age composition of Morice-Nanika adults sampled between 1965-72 inclusive (N=6062). From Table 6B of Shepherd, 1979.

[2]Based on age determinations on a sample of 92 sockeye sampled from the Nanika spawning grounds in fall 1983. Aging by Yvonne Yole, DFO, 1090 West Pender, Vancouver.

NOTE: The majority of fish in age groups derived from treated brood years will return in 1983, 1984 or 1985. Maximum returns of treated age groups should return in 1984.

FROM: Shepherd, B.G. 1979. Vol. 5. Salmon studies on Nanika and Morice Rivers and Morice Lake relative to the proposed Kemano II development.

TABLE 6B: Characteristics of Nanika River sockeye spawners, 1965-1974

Year	Sample Size	Avg. Postorbital-hypural Length (in mm) M	F	Total	Range	Egg Retention as % 0-20	30-80	90-100	Age Composition as %[a] 3_1	3_2	4_2	4_3	5_2	5_3	6_3	6_4	7_4	% M
1965	301	463	441	453	350-612	100	0	0	0	0	4	1	13	38	43	1	0	56
1966	222	448	432	438	295-520	100	0	0	0	0	1	1	1	84	12	1	0	39
1967	400	-	-	477	365-535	-	-	-	0	0	1	0	1	18	78	2	0	-
1968	803	-	-	457	375-540	-	-	-	0	0	2	0	3	65	30	0	0	47
1969	1010	454	434	444	267-599	99	1	0	0	0	2	1	5	70	21	0	1	51
1970	1969	463	442	453	353-535	98	1	1	1	3	3	8	10	56	17	1	1	61
1971	1159	504	469	487	406-546	96	4	0	0	0	0	0	5	24	71	0	0	79
1972	198	501	482	494	416-565	100	0	0	0	6	45	2	5	40	2	0	0	63
65-72	$\bar{x}$	472	450	463	353-557	99	1	-	0	1	7	2	5	49	34	1	-	57
1974	77	476	452	464	402-534	97	3	0	0	0	4	2	4	65	25	0	0	49

Table 2. A summary of factors contributing to uncertainty regarding the biological significance of apparent between-year variations of Morice system sockeye escapements.

Factor	Significance
(1) Unmonitored Indian Food-Fishery	
The Indian food-fishery on sockeye at Moricetown Falls is not routinely monitored across years by DFO personnel. The "rule of thumb" used to estimate the impact of this fishery on the Morice stock is that 2 sockeye are intercepted for each adult that returns to the spawning grounds (Terry Turnbull, DFO-Smithers, personal communication).	The assumption of a constant exploitation rate of 66% by the Moricetown food-fishery is likely violated seriously in many years. Consequently variations in the exploitation rate by this fishery alone may largely mask variations due to other factors (e.g. increases or decreases in marine or within-lake survival of adults and juveniles respectively). Certainly at stock sizes as low as those that have apparently prevailed in recent years (8 year mean escapement, 1400 adult sockeye) it would not surprise me if 2-5 fold changes in brood year returns were produced by the food-fishery alone. This cannot be unequivocally supported or refuted in the absence of quantitative estimates of the annual food-fishery catch.
(2) No routine assessment of Atna Lake spawners or in-lake spawners in Morice Lake.	
Since approximately 1961 escapement estimates for Morice system sockeye have been based largely on "routine" visual counts of the maximum number of spawners appearing at the spawning grounds on the upper Nanika River. Shepherd (1979) summarized survey information on Morice system spawning grounds and concluded that beach spawning at the south end of Morice Lake could be important.	Counts of sockeye on the upper Nanika spawning ground are asserted to represent the majority of the Morice system sockeye escapement but the exact proportion represented by these fish in any given year remains uncertain in the absence of census information from other known spawning areas. For example consider the experience of DFO personnel on Sproat Lake this year. Lake Enrichment Program personnel informed the Alberni fisheries staff that 250,000 adult

Table 2. (cont'd)

Factor	Significance
See attached figures.	sockeye had entered Sproat Lake through the electronic counting facility on the fishway. In spite of being armed with this knowledge beforehand, fisheries officers counted only 30,000 sockeye on visible spawning grounds (tributary fans, beaches) around the lake margins. The point to be made here is that adult sockeye missed due to an incomplete census on Morice Lake in a given brood year could quite easily produce an apparent increase in subsequent returns ascribed to that brood year. This would be especially true if sockeye don't home faithfully to only the upper Nanika or the south-end-beach, spawning sites.
(3) Variation in effort expended on sockeye census activities between years.	
Visual counts during overflights of the upper Nanika spawning grounds are conducted on as few as one or as many as seven separate dates by DFO personnel in a given year. In addition ALCAN personnel "independently" do counts on an aerial basis to census sockeye spawners.	The current analytical procedure for estimating the escapements of sockeye reported for the upper Nanika is to multiply the maximum visual count of sockeye by a factor of 1.6 to account for fish mortality and replacement. The latter factor is apparently derived from International Pacific Salmon Fisheries Commission studies. Clearly in years when several visual census trips are completed under conditions of low turbidity, counts will likely reflect the true magnitude of the spawning population. The same cannot be said of years characterized by either few trips or poor viewing conditions. For example Shepherd notes that in 1975 the census was based on a single overflight while seven were completed in 1974. It is unlikely that these two escapements retain the same relative accuracy or that it is worth comparing either them or subsequent brood-year returns. In the absence of a year-by-year reconstruction of census
(4) Variations in viewing conditions occur on spawning grounds both within and between years due to variable turbidity of water created by glacial flour input.	

Table 2. (cont'd)

Factor	Significance
	procedures, viewing conditions and analytical procedures used to produce the recorded escapement estimates it is difficult to draw a firm conclusion regarding how large differences in brood-year returns must be before attaching some biological significance to them. My experience in detailed reconstructions of this sort on several coastal sockeye stocks currently dealt with by the Lake Enrichment sockeye ecology group is that two consecutive estimates may have relative accuracy levels that easily vary by 300-400%. Given the information at hand I wouldn't be surprised if a more detailed examination revealed this to be the case for Morice system sockeye estimates.

Government of Canada / Gouvernement du Canada

MEMORANDUM **NOTE DE SERVICE**

TO / A: K. Hyatt

FROM / DE:
R. J. Beamish
Director
Fisheries Research Branch

SECURITY - CLASSIFICATION - DE SÉCURITÉ	
OUR FILE – N / RÉFÉRENCE	
YOUR FILE – V / RÉFÉRENCE	
DATE	November 15, 1983

SUBJECT / OBJET: Rational for Terminating Production of Lakes

Some time ago, I recall that our staff argued that there were so few sockeye in Maurice Lake (I think it was this lake) that fertilizing didn't make any sense. Recently I heard that returns from the one fertilized year were exceptionally large.

Would you please provide me with a written summary of what happened so I can confirm what has been only a rumor.

R. J. Beamish

RJB/aa

cc: F. Bernard
J. Stockner

GC 177

7540-21-798-8998

From: Shepherd, B.G. 1979. Salmon Studies on Nanika and Morice Rivers and Morice Lake relative to the proposed Kemano II development. Volume 5. North Coast Branch, Department of Fisheries and Environment, Vancouver, B.C. February, 1979.

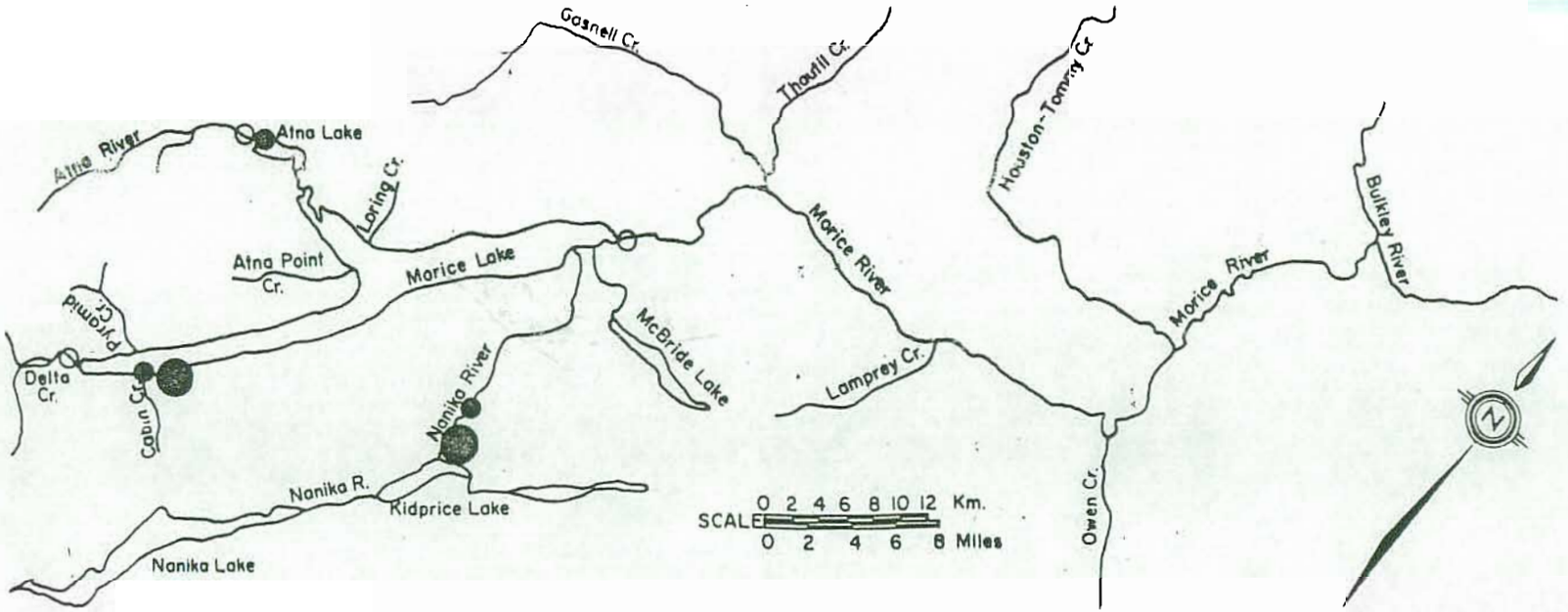

FIGURE 2B

FIGURE 2B Sockeye Spawning Distribution

From: Shepherd, B.G. 1979. DFO. Report on Kemano II

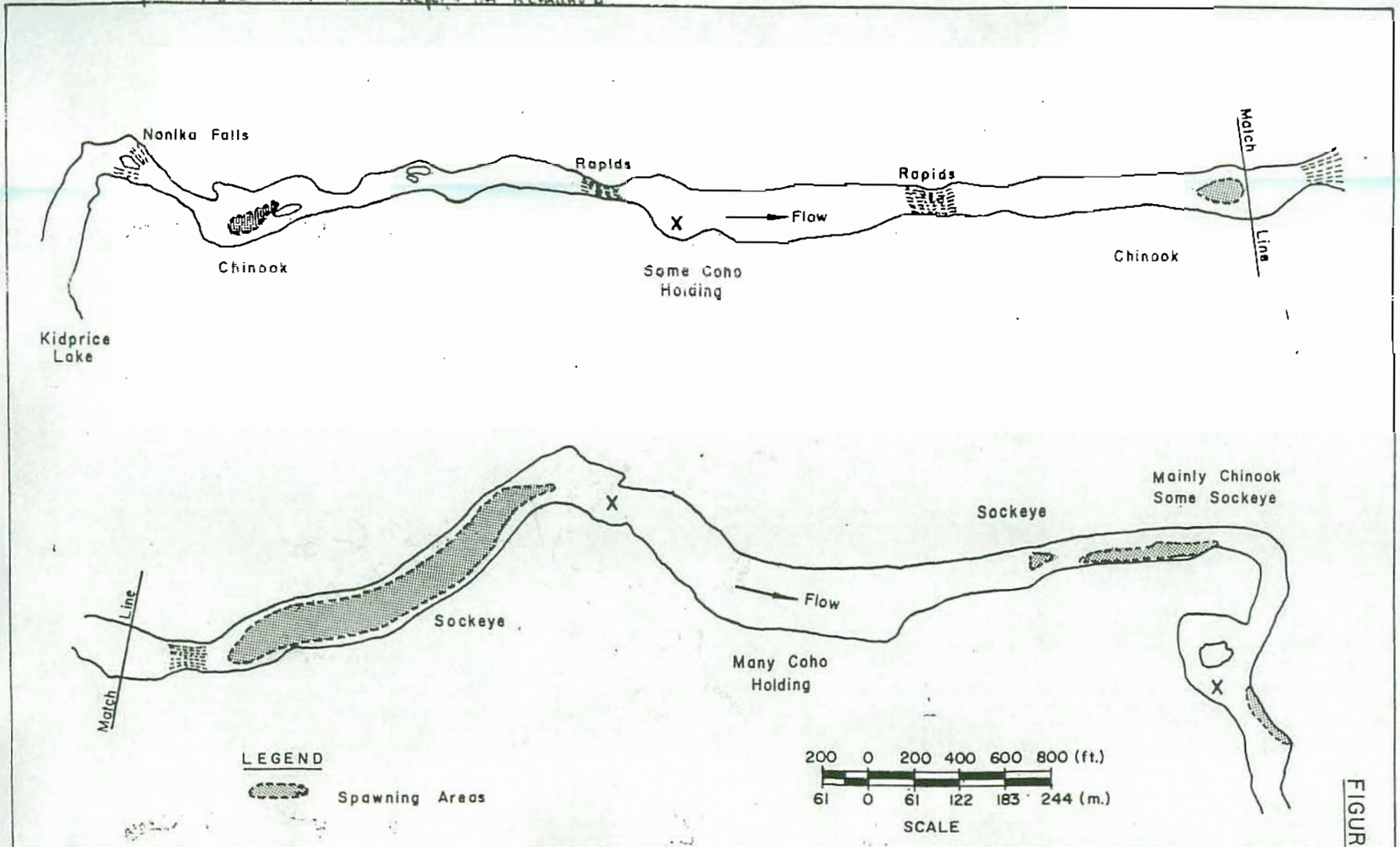

FIGURE 6 Spawning Areas in Upper Nanika River in 1974.

FIGURE 6

From: Shepherd, B.G. 1979. DFO Report - on Kemano II.

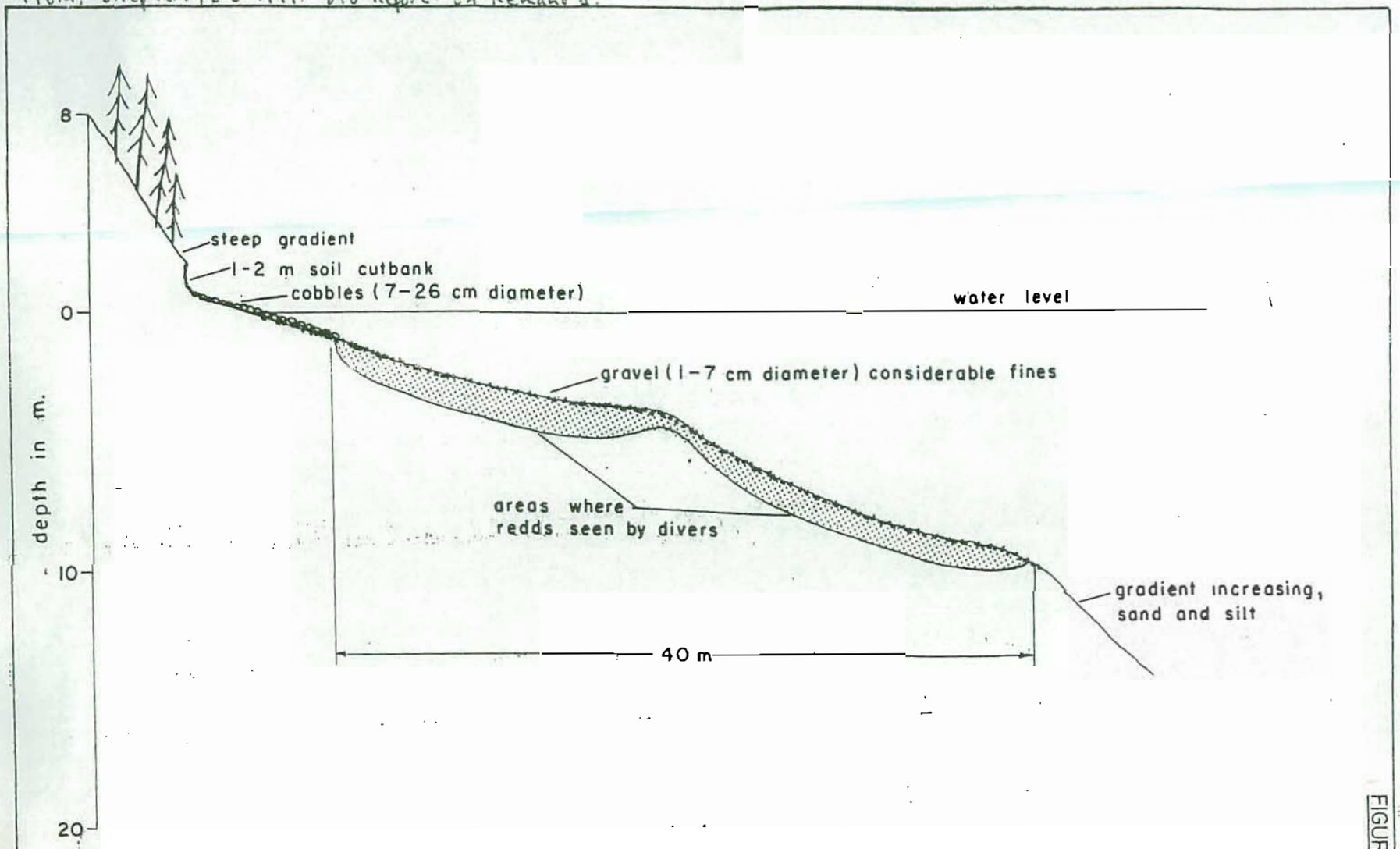

FIGURE 5 Divers' sketch of cross-section of Morice Lake Sockeye spawning.

FIGURE 5

Table 3. A summary of size and scale characteristics of Morice system sockeye smolts derived from a single treated year (1981 smolt data) and a series of untreated years.

Smolt year	1961	1962	1963	1964	1965	1966	1972	1979	1980	1981[4]
Sub-2 wt (g)	3.42	3.72	2.80	4.80	3.71	3.82	-	6.15	6.60	-
Circuli	$\bar{x}$ = 11, range = 10-13, 1961-66.						8[1]	15(10-19)[3]	14(9-17)[3]	14-16[2]
Sub-3 wt (g)	7.39	8.10	6.40	9.50	6.62	8.30	-	18.29		-
Circuli	$\bar{x}$ = 18, range = 17-20						15[1]	23(21-24)	22	23[2]

[1] Read from 4_2 and 5_3 adult scales recovered in 1974, no smolt samples available for direct measurement.

[2] Read from 4_2 and 5_3 adult scales recovered in 1983, no smolt samples available for direct measurement. Due to the possible occurrence of Lee's phenomenon (i.e. larger smolts will contribute disproportionately to returning adults because of higher marine survivals), circulus counts for freshwater growth as read from adult scales should be reduced by 1-3 circuli for comparison with circulus counts read directly from smolt samples.

[3] Only a portion of the smolt scales available from 1979 and 1980 samples has been read by Yvonne Yole at 1090 West Pender consequently mean circulus counts at age are currently based on small sample sizes. The rest of the scale samples available should be read to confirm preliminary conclusions drawn here.

[4] Sub-2 and Sub-3 smolts migrating in the spring of 1981 would have experienced treated conditions in Morice Lake during the summer of 1980. Smolts sampled in all years prior to 1981 were produced under untreated conditions.

Appendix 1. From Shepherd, B.G. 1979. Salmon studies on Nanika and Morice Rivers and Morice Lake relative to the proposed Kemano II development. Volume 5. North Coast Branch Department of Fisheries and the Environment, Vancouver, B.C. February, 1979.

(3) Abundance

Table 4 presents the best estimates of spawning adults in 1974, and compares them to previous annual estimates made by the Operations Branch of the Fisheries and Marine Service. 1974 was above average in comparison to the previous decade for chinook, average for coho, and below average for sockeye and pink. 1975 produced both the lowest firm estimates on record for chinook and sockeye, and the highest pink run ever recorded. The estimates in Table 4 do not include the sockeye that beach-spawn in Morice Lake. In the six years that beach spawning has been evaluated, counts have averaged 300 fish. This is to be regarded as a minimum estimate, as diving in 1974 indicated a population of 500 spawners in water of up to 10m in depth. Chum salmon have never been observed in the Morice system.

The recent decreases in the sockeye run to the Nanika River would appear to be part of a longer-term trend that the Fisheries Service has been investigating since the 1950's. Historically, the Nanika was a major natural producer of sockeye, with runs ranging from 24,000 to 70,000 fish in the period 1945-1953, comprising as high as 10 percent of the total Skeena escapement. Beginning in 1954, the population began to collapse over all year classes and reached escapements of 1000 fish or less for three consecutive years (1957-1959). As the commercial fishery had been managed so as to supply fairly consistent escapements, it was felt that the combined effects of obstructions and native food fisheries at Hagwilget and Moricetown Canyons on the Bulkley River were largely responsible for the decline in escapements to the Nanika. Accordingly, the obstruction was removed at Hagwilget prior to the 1959 migration.

This also eliminated the native food fishery at Hagwilget. As the escapement remained low in 1959, it was decided to attempt rebuilding the stock by artificial means, and a pilot hatchery operation was carried out from 1960 to 1965. Affiliated assessment programs indicated the following (R.N. Palmer, pers. comm.):

a) The natural spawning area in the Nanika produced unusually high egg-to-fry survival.
b) The hatchery transplant stock, from Pinkut Creek in the Babine system, was poorly adapted to Nanika conditions, particularly in timing, (emergence was three to four weeks early) life history (Pinkut adults were largely 4_2's and 5_2's) and quality (fry were small and thin compared to Nanika fish).
c) Smoltification appeared to be dependent on size at a particular point in the season.
d) Sub-2 smolt-to-adult survival was much lower than that of sub-3's in the Morice system.

The above results indicated that the hatchery was not producing viable fry, and that the natural egg-to-fry survival was not a limiting factor in the productivity of the Nanika River stock. For these reasons, and because of an upswing in escapements in the 1960-65 period, the hatchery was closed in 1966 pending evaluation of returns. As expected, returns to 1969 did not increase in relation to brood year hatchery production, and the project was terminated. It is hypothesized that the following sequence of events produced a continued decline in escapements, despite removal of the two major obstructions and some of the native fishing pressure (see also Figure 7):

FIGURE 7

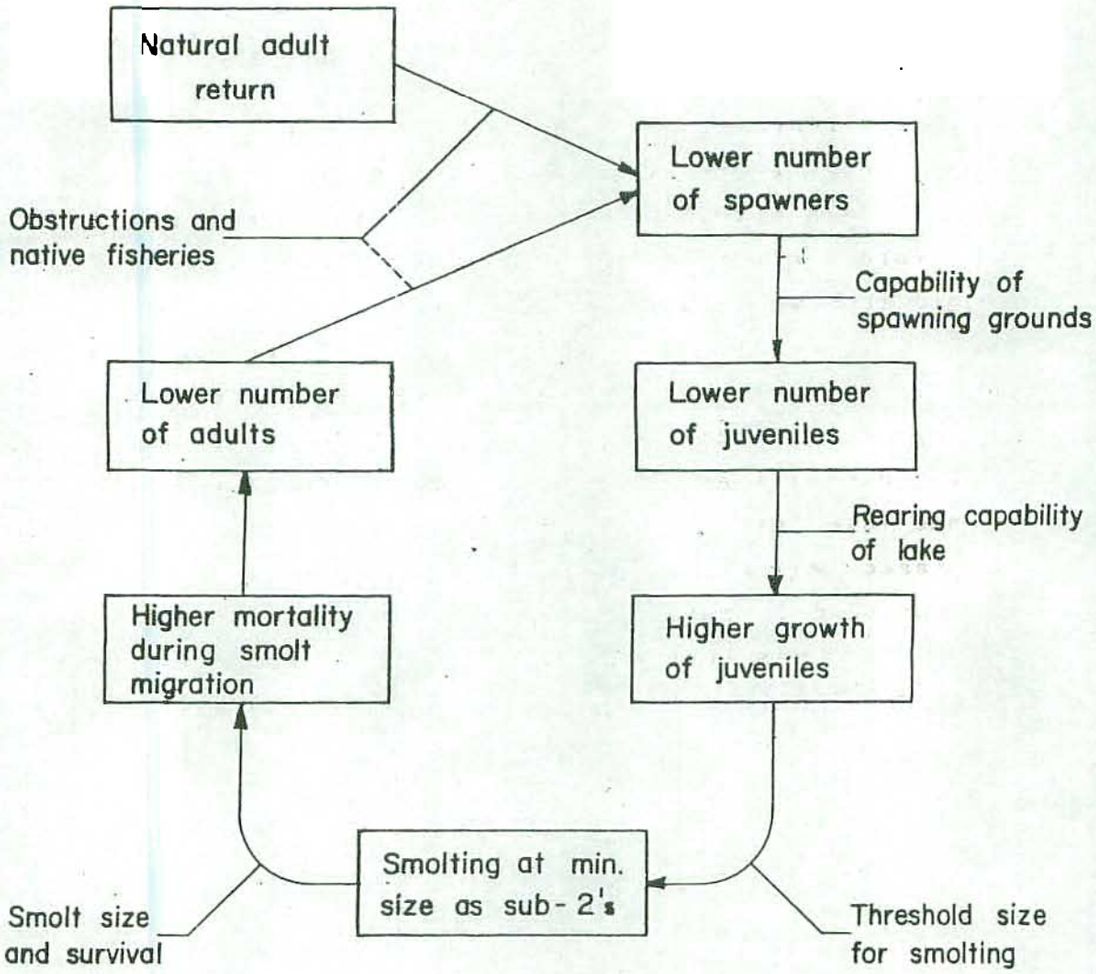

FIGURE 7. Schematic presentation of events thought to lead to Nanika sockeye stock decline.

Native fishing resulted in reduced numbers of adult spawners. Reduced adult escapements, in turn, reduced the numbers of fry produced. Fewer juveniles rearing in Morice Lake would result in more food per individual and consequently in increased growth. The increase in growth rate, however, would be small because of the very low productivity of Morice Lake. As a result, juveniles would just barely reach the threshold size for smoltification in their second year, whereas previous broods did not reach threshold size at smolting time in their second year, remained an extra year in the lake, and thus were larger than threshold size at smolting. It has been found that smaller smolts generally suffer higher mortalities during their migration to sea (D.R. Harding, pers. comm.). Lower adult returns would result and could continue to decline to a new and lower stable level, even when the migration hazards which initiated the sequence were removed. Continued operation of the Moricetown native fishery probably has ensured that the Nanika run will not recover to former levels unless enhancement techniques are used.

The rearing capability of Morice Lake presently appears to be the only factor amenable to manipulation. Two different approaches have been suggested:

a) Increase growth, so that sub-2 smolts are much larger upon downstream migration, and would thus show higher survival to maturity. Lake fertilization has been suggested as a technique to achieve this.
b) Decrease growth, so that sub-2 juveniles do not reach threshold size, and thus remain an extra year in Morice Lake. This could best be achieved by drastically increasing the number of juvenile sockeye in the lake, by transplants.

Both approaches require technology that is only now developing, and thus no action regarding restoration of the Nanika run is contemplated by the Fisheries Service in the near future. However, the Fisheries Service would oppose any actions which would lead to a further decline of this uniquely-adapted sockeye run, and wishes to retain the run as a future management option, rather than be forced into increasing dependence on the performance of a few major runs, such as Babine.

Pink runs to the Morice River have been minor, averaging 0.2 percent of the total Skeena escapements for 1965-1973 (Table 5). However, there has been a tremendous expansion in pink distribution in recent years (the Morice contribution to the total Skeena run increased to 2.7 percent in 1975) and it may continue to increase in the future. Although coho enumeration is very inaccurate and probably conservative,[1] it would appear that the Morice-Nanika accounts for at least 5 percent of the coho spawning in the Skeena system. The Morice River is a major area for chinook spawning, accounting for one-third of the average total Skeena escapement (Table 5). The Fisheries and Marine Service began more intensive management of Skeena chinook in 1973 to rehabilitate declining stocks, and thus would be opposed to any reduction in the Morice-Nanika stock.

(4) Population Characteristics

Results of adult sampling in the Morice and Nanika Rivers during 1974 (and previous years, when available) are summarized

[1] During period 1959-67, coho counts through just one of the two Moricetown fishways (and not counting fish that ascended the falls) exceeded the total upstream escapements from F381 surveys by an average of 15 percent, and rose as high as 150 percent.

Government of Canada / Gouvernement du Canada

MEMORANDUM **NOTE DE SERVICE**

Kim Hyatt

Sent by Miconet 3:15 26 October 1984

TO / A: R.J. Beamish,
Director, FRB

FROM / DE: J.G. Stockner, Section Head
Enrichment Research

SECURITY - CLASSIFICATION - DE SÉCURITÉ	
OUR FILE – N / RÉFÉRENCE	JGS/26oct84/dp JGS-me#1/beamish 4
YOUR FILE – V / RÉFÉRENCE	
DATE	26 October 1984

SUBJECT / OBJET: Rationale for fertilization of Morice Lake for sockeye enhancement in 1985.

The drastic decline of the sockeye stocks returning to Morice-Nanika system was discussed in some detail by Shepherd (1979), and recently Hyatt, in a December 7, 1983 memorandum to you, reviewed this earlier work in providing you with the rationale for termination of treatment after our first pilot-scale fertilization conducted during the summer of 1980. Two points raised by Hyatt are germane to our decision to once again commence treatment (summarized below):

1. If escapements of 5-10,000 could be achieved it is likely that sockeye would benefit appreciably from fertilization due to potential density-dependent food limitation in this ultra-oligotrophic lake.

2. There is an urgent requirement to document in-lake juvenile growth and abundance, smolt age and size at migration and adult escapement if DFO is serious in its intention to rehabilitate this important Skeena system sockeye stock.

Yesterday I spoke with T. Turnbull, FSB Fisheries Officer in Smithers. He said this years' escapement is again in the 3-5,000 range, with a good number of sockeye taken in the native food fisheries at Moricetown Falls. He went on to say, "If I could implement a conservation package, including a three-day per week closure at Moricetown, I'm convinced I could place 6-10,000 sockeye spawners on the grounds". In light of these comments and an apparent second year of moderate escapement to the Morice-Nanika, I think it is time to recommence fertilization of Morice Lake. Our intention is also to provide good solid assessment information on juveniles and smolts so we will not again be left in a position of uncertainty as to "effects" of treatment on stock dynamics.

Fertilization dose rates, frequency of application and coverage area have been calculated and we will be ready to proceed with treatment as soon as the SEP Board and DFO Senior Management grant approval. We will endeavour to sample smolts in May to obtain estimates of size and age from the untreated 1982-83 juveniles.

John Stockner

Dr. R.J. Beamish

Shepherd, B.G. 1979. Salmon studies on Nanika and Morice Rivers and Morice Lake relative to the proposed Kemano II development. Vol. 5. North Coast Branch, Dept. of Fisheries and Environment, Vancouver, B.C.

cc: Frank Bernard