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A COMPARISON OF STEELHEAD FRY DENSITIES IN SPIUS AND MAKA CREEKS BEFORE AND AFTER HEADWATER STOCKING

by

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Abstract

In 1984 117,000 steelhead fry were stocked into Spius and Maka Creeks. Prior to stocking, several sites were electroshocked ~~in both streams~~ to determine relative numbers & size of wild fry, ~~present and their average size~~. Similiar sites were sampled ~~again~~ two months after stocking to ~~try and~~ evaluate the contribution of hatchery fry. Growth of fry was examined in each stream.

Although sample data was limited some results were common to both streams and may help evaluate future stocking plans. Fry densities were directly proportional to adult spawner observations in the pre-stock fry assessment. Where no adults were observed no fry or low densities were encountered. Stocking densities were 0.25-0.35 fry/m^2 in Maka and 0.35 fry/m^2 in Spius.

Post-stocking fry densities were highly variable in both streams.The lowest densities were found in the furthest upstream areas and suggest emmigration or mortality in stocked fry. Further downstream fry densities exceeded the combined wild/hatchery densities and support the downstream migrant theory. The remaining outmigrants may accumulate in middle reaches of Spius Creek or in the Nicola and Thompson Rivers.

Wild and hatchery fry were very close in length at the time of stocking which precludes an earlier assumption that hatchery fry would have a competitive advantage. It was impossible to distinguish wild vs. hatchery fry based on size, marking hatchery fry would be the only solution. Growth of fry in the 2 months following stocking averaged 16 mm.

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Appendix 1 Summary of rainbow capture data and population estimates for sample sites in Spius and Maka Creeks, July - August, 1984

Appendix 2 Summary of rainbow capture data and population estimates for sample sites in Spius and Maka Creeks, October, 1984

1.0 Introduction

Since 1979 the SEP component of the Fisheries Branch in conjunction with the Fish Culture section has carried out headwater steelhead fry stocking of several tributaries of the Thompson River. A major Nicola River tributary, Spius Creek, and its tributaries, Maka and Prospect Creeks, were considered as potential locations for headwater stocking (McGregor pers. comm.). A major study of the Nicola River System by the Fish Habitat Improvement Section (F.H.I.S.) confirmed that habitat was underutilized and recommended scatter stocking steelhead fry in Spius and Maka Creeks at densities of 0.5 fry/m^2 or less (Sebastian, 1982).

Fry have been stocked in the headwaters and middle reaches of Spius and Maka Creeks since 1982 at varying densities. In 1984, a total of 70,000 fry were stocked in Spius Creek and 47,000 fry in Maka Creek at recommended densities.

Prior to fry stocking a brief assessment of wild fry densities was completed on both streams. A follow-up assessment took place 59 days after the fry were stocked. The comparison of results from these two assessments was intended to a better understanding of stocked fry survival and movements to improve stocking strategies in the future.

2.0 Methods

Methods used were similar to the standards of the Fish Habitat Improvement Section (DeLeeuw, 1981). Electroshockers and stop nets were used to isolate sites and capture fish within. A probability of capture was assigned to calculate total Rb populations at each

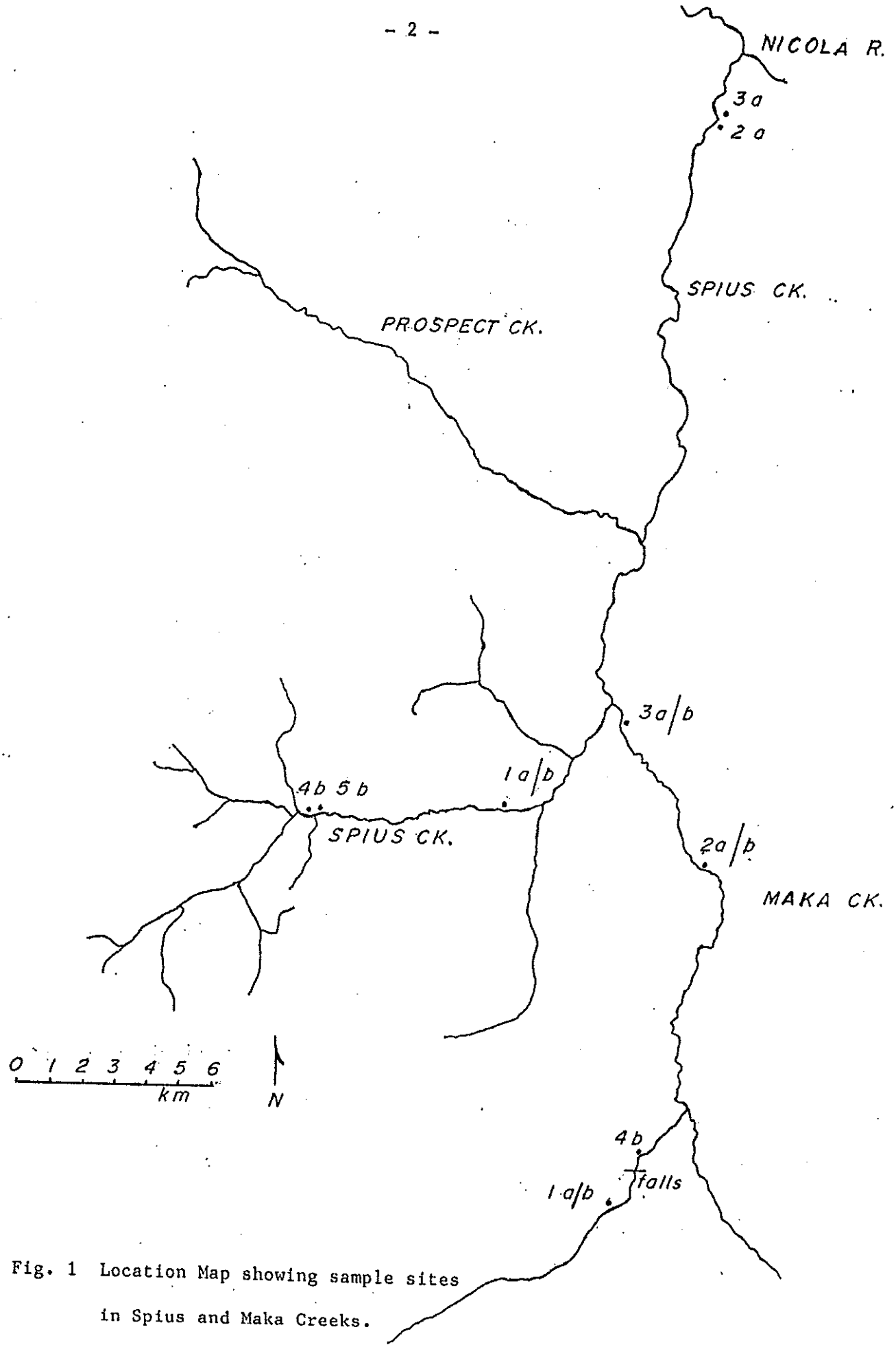

Fig. 1 Location Map showing sample sites in Spius and Maka Creeks.

site. July sample sites were resampled in October.

Habitat descriptions and total population estimates were not part of the 1984 study due to manpower limitations. Results are based on sample site comparisons before and after stocking.

How low & clear give WSC daily discharge for Spius as reference for each day sampled.

The pre-stocking assessment of Spius and Maka Creeks took place on July 31 and August 1 of 1984. Three sites were sampled on Maka and Spius creeks when stream flow was low and clear. Steelhead fry were scatter-stocked into Spius (70,000) and Maka (47,000) Creeks on August 13, 1984 upstream of the Spius-Prospect confluence. A small subsample of the stocked fry were measured to determine mean length. The subsequent fry assessment took place October 11, 1984. On Maka Creek, three of the July sites were duplicated and one additional site was shocked just below the falls. In Spius Creek only one site was duplicated and two headwater sites were sampled upstream. July sites are identified as 1a, 2a etc. and October sites by 1b, 2b etc.

Graphs were prepared on a DEC PRO 350 using Synergy.

3.0 Results

3.1 Maka Rb Densities & Growth

Above the falls at Maka Creek at Site 1a on July 31, no fry were captured. Fry stocking above the falls was two weeks later on August 13 at a density of 0.35 fry/m^2. On October 11 resampling at Site 1a/1b resulted in densities of 0.14 fry/m^2 with a mean fork length of 53 mm (Table 1, 2, 3, 4, Figure 2). The mean fork length of stocked fry 59 days earlier was 38 mm (Table 5). Post - stocking densities were less than the original stocking density but growth averaged 15 mm.

- temp. ?
fish behaviour?

Parr densities at Site 1a and Site 1b were .03 fish/m^2 in July and 0.06 fish/m^2 in October, respectively. Mean fork length was 85 mm in July and 89 mm in October. These fish ~~are most likely~~ may have been survivors of 2000-3000 fry stocked above the falls in 1983. Detailed sample site data and calculations are outlined in Appendix 1 and 2.

Just below Maka falls, a new site (4b) had densities of 0.19 fry/m^2 in October, scatter plant stocking density was 0.25 fry/m^2 suggesting good survival for this area. At Site 2a in July a density of 0.26 fry/m^2 was found reflecting nearby spawning activity. A stocking density of 0.25/m^2 fry was applied throughout this area and October sampling at 2b found densities of 0.88 fry/m^2, a 0.64/m^2 increase (200 %).

Further downstream at Site 3a in July a density of 0.70 fry/m^2 was found compared to 0.46 fry/m^2 in October at 3b, a drop of 0.24 fry/m^2.

Overall mean fork lengths for wild fry in Maka on July 31 - August 1 was 32 mm. Mean fork length of stocked fry was 38 two weeks later. In October sampled fry averaged 51 mm indicating growth of 14 mm since stocking 59 days earlier. Parr in Maka Creek averaged 92 mm in July and 97 mm in October, average growth only 5 mm.

Table 1 Summary of fish density (no/m^2) estimates for sample sites in Spius and Maka Creek, July - August, 1984 prior to stocking.

Site No.		Location	Rainbow Trout/m2 0+	1+	2+	3+	Total/m^2
Maka	1a	Above falls	*	0.03			0.03
	2a	Powerline	0.26	0.04			0.30
	3a	Airstrip	0.70	0.03			0.73
Spius	1a	Cat Crossing	*				0.00
	2a	Lower River	1.2				1.2
	3a	Lower River	1.4				1.4

* no fry captured at site

Table 2 Summary of fish density (no/m^2) estimates for sample sites in Spius and Maka Creek, October, 1984 after stocking.

Site No.		Location	Rainbow Trout/m2 0+	1+	2+	3+	Total/m^2	Reach Stocking
Maka	1b	Above falls	0.14	0.06			0.20	.35/m^2
	2b	Powerline	0.88				0.88	.25/m^2
	3b	Airstrip	0.46	0.32		0.05	0.83	.25/m^2
	4b	Below falls	0.19				0.19	.25/m^2
Spius	1b	Cat Crossing	0.54	0.02	0.02		0.58	.35/m^2
	4b	Twin Trib Area	0.17				0.17	.35/m^2
	5b	Twin Trib Area	0.04	0.03			0.07	.35/m^2

Table 3 Mean fork lengths of Rb age groups in Spius and Maka Creeks, July - August, 1984.

	Age Group	N	Mean fl(mm)	Range (mm)
Spius Creek	0+	29	35	28 - 46
	1+	NONE CAPTURED		
Maka Creek	0+	38	32	28 - 44
	1+	4	92	85 - 120

Table 4 Mean fork lengths of Rb age groups in Spius and Maka Creeks, October, 1984

	Age Group	N	Mean FL(mm)	Range (mm)
Spius Creek	0+	35	54	44 - 81
	1+	7	91	81 - 175
	2+	1	130	130
Maka Creek	0+	58	51	36 - 78
	1+	9	97	89 - 107
	3+	1	166	166

Suggests late emergence & or overstocking & poor growth
Was the 36 mm fish from upper reaches?

FIG.2 Fry density comparison, July - October in Maka Ck.

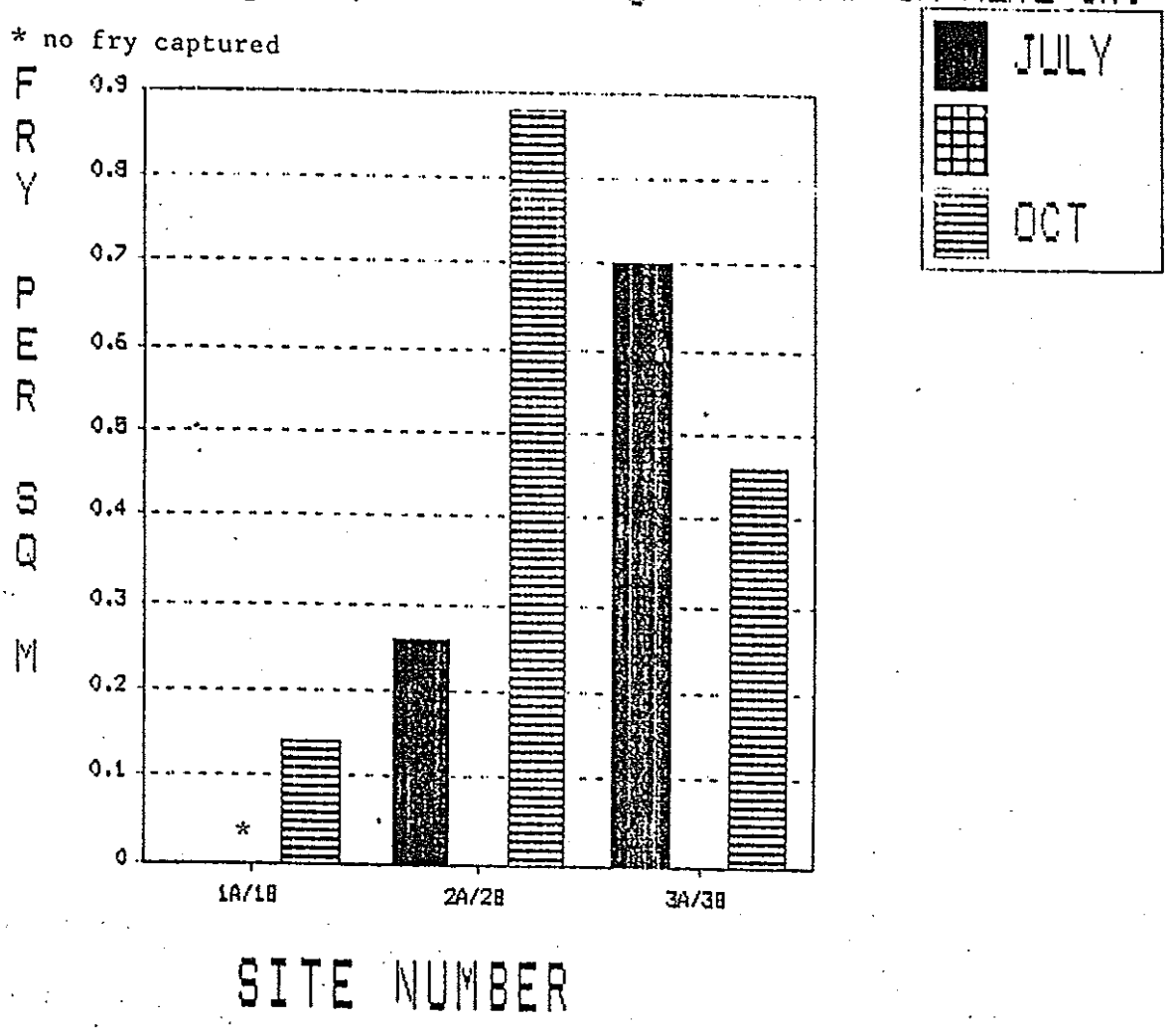

Table 5 Mean fork lengths of 70,000 stocked Rb Fr in Spius and 47,000 stocked Rb Fry in Maka Creek, August, 1984

	Age Group	N	Mean FL(mm)	Range (mm)
Spius/Maka	0+	132	38	28 - 50

3.2 Spius Rb Fry Densities & Growth

In Spius Creek in July at Site 1a no fry were captured. Sites 2a and 3a in the lower river where major spawning activity took place (pers. obs.) had densities of 1.20 and 1.40 fry/m^2, respectively.

In October sampling at the site (1b) produced a density of 0.54 fry/m^2, 0.19 higher than stocking densities. Parr were found in October at 0.02 fish/m^2 but not in July.

In October two additional sites (4b and 5b) were shocked several km upstream of Site 1a, 1b. This area was stocked at 0.35 fry/m^2 but October sampling found densities at 4b of 0.17 fry/m^2 and 5b at 0.04 fry/m^2.

Mean fork lengths of stocked fry in Spius Creek were once again 38 mm on August 13 compared to 35 for wild fry on August 1. As with Maka wild fry size compares favourably with hatchery fish. In October average fork lengths were 54 mm, an increase of 16 mm since stocking, 59 days earlier. No parr were captured in August sampling but in October averaged 91 mm.

4.0 Discussion

The 1984 fry stocking evaluation in Spius and Maka Creeks was fairly limited in range as only a few sample sites were examined. Any conclusions of this report are based on minimal data and should be used with discretion. Comparisons of sample site Rb densities and hatchery vs. wild fry growth before and after stocking should provide guidelines for future stocking plans.

Spius and Maka sampling took place following emergence of wild steelhead fry. The spawning escapement to Maka in the spring of 1984 was fairly small (less than 50 fish) as low water conditions throughout April and May forced the majority of spawners into Reaches 1, 2 and 3 of Spius Creek (pers. obs.). No spawners were observed in the upper reaches of Spius Creek. On May 15 at the Maka Powerline crossing (Site 2a, 2b), about 2 km upstream of the Spius confluence, 9 male adults and 1 spawning pair were observed. A log jam appeared to be an obstruction to most upstream migrating adults, particularily females. July and August sampling densities reflect the spawning distribution and October sampling the additional contribution of hatchery fish.

An overall comparison of combined sample sites in Maka for July and October within stocking areas indicates an average of 0.32 fry/m^2 in July and 0.42 fry/m^2 in October, an average increase of 0.10 fry/m^2. Stocking density averaged 0.28 fry/m^2 so the fate of the additional stocked fry may be emigration or mortalities. Downstream fry movement is suggested in areas such as middle to lower Maka Creeks. In middle Maka, Site 2a, 2b, densities increased by 0.62 fry/m^2 in October, most likely from stocked fry moving downstream. In upsrteam sample sites this is supported by low densties in October. Upper sites were 0.14 fry/m^2.

In lower Maka, Site 31, 3b, fry densities of 0.70 fry/m^2 dropped to 0.46/m^2 from July to October, despite a stocking density of 0.25 fry/m^2. Excess fry may have been displaced downstream to Spius.

Similar differences in sample site densities from summer to fall were previously noted by Sebastian (1982) and were attributed to outmigration. The contribution of outmigrants to adult returns is not well understood.

Similar results were found in Spius Creek. No fry were captured at the uppermost site in July. After stocking fry at 0.35 fish/m^2 a density of 0.54 fry/m^2 was found at the same site. In the section further upstream, stocked at 0.35 fry/m^2, October densities were only 0.17 and 0.04 fry/m^2 respectively. The high density must at the lower site probably reflects reflect downstream movement of fry.

Sampling efficiency may have been lower in October for both Spius and Maka Creeks due to higher flows from recent rainfall. This can lower sample densities due to greater wetted useable habitat area (Sebastian pers. comm.)

Growth of fry in the wild was comparable to growth of hatchery fry. Wild fry in late July averaged 32 mm and hatchery fry two weeks later, 38 mm. In October, in Maka Ck. wild/hatchery combined averaged 51 mm, an increase of 14 mm over 59 days. This made separation of wild and hatchery fry by size criteria impossible. Later stocking of hatchery fry may have resulted in a larger average size compared to wild fry. This would presumably give the hatchery fry a competitive advantage and provide a method of comparison during sampling. Marking all stocked fry would ensure the most accurate results in a post-stocking evaluation.

In conclusion fry planting of Spius-Maka Creeks appears to be a successful way of utilizing vacant stream habitat or areas of low low recruitment. Fry appear to redistribute themselves to utilize the best habitats. Actual saturation densities seem highly variable in different sections of stream and are difficult to determine accurately considering downstream movements that are not yet fully understood. For the Spius-Maka system fry densities of 0.5 - 1.0 fry/m^2 were felt to be quite high and reflect good habitat quality (Sebastian and Yaworski, 1984). Initial suggestions of 50% summer mortalities of fry may be high. The downstream movement of fry throughout the watershed accounts for a unknown portion of this Sampling results in 1984 confirm this although provide no exact numbers or conclusions for the fate of downstream migrants.

The total Rb wild and stocked fry population Spius, Maka and Prospect Creeks could support, based on preliminary 1980 observations by Sebastian was suggested to be about 340,000 fry. In 1981 further investigations prompted a revision of this estimate to 400,000 fry to saturate the entire watershed with late summer fed fry.

Stockings in 1982 and 1983 reflected these limitations and were 28,000 and 76,000 respectively. Stocking densities ranged from 0.18 to 1.33 fry/m^2 in 1982 and 0.60 to 1.52 fry/m^2 in 1983. Followup assessment by the Fish Habitat Improvement Section in 1983 found mean densities increased to 1.44 fry/m^2 from 0.20 fry/m^2 in upper Spius, these were presumed to be a result of fry stocking. This reflects much higher stocking density than in 1984 (0.35 fry/m^2 in barren habitat) and suggests that higher densities would have been acceptable if more fry were available for Spius Creek in 1984.

In Maka Creek in 1983, prior to stocking, fry density averged 0.37 fry/m^2. Stocking density averaged 0.40 fry/m^2 and took place in the summer with follow-up assessment in the fall. Fry densities remained unchanged (0.32-0.37 fry/m^2), and it was assumed habitat was saturated. In 1984, however, densities ranged from 0.14 to 0.88 fry/m^2 with an average of 0.42 fry/m^2, slightly higher than in 1983. The conclusion in 1983 was that 0.37 fry/m^2 was saturation density for Maka Creek. Year to year and site to site variability, and downstream migration makes any single density extrapolation to total stream carrying capacity questionable. One area that has been stocked for three years and has remained unsampled due to inaccessability is the area upstream of the canyon in Reach 2 of Spius Creek. This area has good fry habitat (pers.obs.) and may be absorbing some of the excess fry with densities as high as those found in lower Spius (up to 1.6 fry/m^2). The remaining outmigrant fry probably end up in the Nicola or Thompson mainstems.

5.0 Conclusions

1. Adult spawning distributions and density based on visual observations in Spius and Maka Creeks were reflected by sites with high or low fry densities prior to stocking.

2. Several sample sites in both Spius and Maka Creeks had significantly greater fry densities than the sum of wild and hatchery densities combined. This seemed to indicate downstream migration of stocked fry.

3. Wild and hatchery fry were similar in length in early August so could not be separated by this criteria during the assessment. Later stocking may have given hatchery fry a size advantage

4. Stocked fry survived in adequate numbers until the fall assessment and successfully occupied underutilized or vacant habitat in Spius and Maka Creeks.

5. Accurate evaluation of fry stocking strategies by pre/post assessments is complicated by year to year and site to site variability and by downstream migrations.

6. Downstream emigrating fry may accumulate in the middle reaches of Spius Creek with the remainder moving into the Nicola or Thompson mainstem.

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Appendix 1 Summary of rainbow capture data and population estimates for sample sites in Spius and Maka Creeks, July - August, 1984

Site No.	Age	FL Range	$\overline{FL}$	$\overline{WT}$	C_1	P	N	Total Biomass	No/m^2 Density	Biomass/m^2	No/lineal m	Comment
Spius 1a	0+	NONE CAPTURED				0.7						
2a	0+	28-46	33.7		14	0.6	23.3					OPEN SITE
3a	0+	30-43	36.0		15	0.6	25					OPEN SITE
Maka 1a	0+	NONE CAPTURED										
2a	0+	28-35	31.1		12	0.75	16		0.26		1.74	
3a	0+	28-44	33.7		26	0.7	37.14		0.7		5.71	
Spius 1a	1+	NONE CAPTURED										
2a	1+	NONE CAPTURED										OPEN SITE
3a	1+	NONE CAPTURED										OPEN SITE
Maka 1a	1+	85	85		1	0.8	1.25		0.03		0.12	
2a	1+	85-120	102.5		2	0.75	2.67		0.04		0.29	
3a	1+	88			1	0.7	1.43		0.03		0.22	

Appendix 2 Summary of rainbow capture data and population estimates for sample sites in Spius and Maka Creeks, October, 1984

Site	No.	Age	FL Range	$\overline{FL}$	$\overline{WT}$	C_1	P	N	Total Biomass	No/m^2 Density	Biomass/m^2	No/lineal m	Comment
Spius	1b	0+	44-68	53.0	2.34	26	0.7	37.14	86.91	0.54	1.27	3.38	July Site 1a
	4b	0+	50-81	59.13	2.16	8	0.7	11.43	24.72	0.17	0.37	1.61	new site
	5b	0+	50	50	2.34	1	0.1	10	23.40	0.04	0.10	0.40	open site
													new site
Maka	1b	0+	41-78	58.2	2.62	5	0.7	7.14	18.71	0.14	0.38	0.79	July site 1a
	2b	0+	42-77	50.96	1.24	23	0.6	38.33	47.66	0.88	1.09	4.12	July Site 2a
	3b	0+	43-60	51.65	2.09	20	0.6	33.3	69.45	0.46	.96	4.16	July Site 3a
	4b	0+	36-54	44.7	1.29	10	0.55	18.18	23.45	0.19	0.24	1.23	new site
Spius	1b	1+	89	89	7.80	1	0.7	1.43	11.15	0.02	0.16	0.13	July Site 1a
		2+	130	130	25.0	1	0.7	1.43	35.75	0.02	0.52	0.13	
	4b	1+	NO SITE										
	5b	1+	81-175	93.4	7.80	6	0.1	60.0	468.0	0.03	2.08	2.40	new site
													open site
													new site
Maka	1b	1+	99-101	100	11.45	2	0.07	2.86	32.75	0.06	0.66	0.32	July Site 1a
	2b	1+	NONE CAPTURED										
	3b	1+	89-107	93.7	9.5	7	0.3	23.3	221.35	0.32	3.07	2.91	July Site 2a
		3+	166	166		1	0.3	3.3	155.1	0.05	2.15	0.41	July Site 3a
	4b	1+	NONE CAPTURED										new site