Aerial Photographic Measurement of Atlantic Salmon Habitat of the Miramichi River, New Brunswick

by

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Abstract

Salmon production area for the Miramichi River, New Brunswick was estimated by measuring and interpreting aerial photographs and maps. The methods selected, ordered and reviewed 369 separate streams and reported salmon production area with length, observed and discharge-corrected mean widths, separately for 206, and summarily for all major tributaries (15), branches and the total system. Proximate surveys on the Bartholomew River indicated that the remote survey accounted for more than 90 percent of the production area. Total salmon production area for the Miramichi drainage was estimated to be 54.6×10^6 m^2.

Résumé

Nous avons estimé la superficie de production de saumon du réseau de la rivière Miramichi, au Nouveau-Brunswick, par mensurantion et interprétation de photographies aériennes et de cartes. On a pu de cette manière classer et réviser 369 cours d'eau séparés, et faire rapport sur la superficie de production de saumon avec longueur, largeur moyenne et largeur corrigée pour tenir compte des débits séparément pour 206 cours d'eau, et de façon sommaire pour tous les principaux tributaires (15) et branches, et pour le réseau entier. D'après une étude approximative de la rivière Bartholomew, cette région éloignée renferme plus de 90 % de la superficie de production. On estime à $54,6 \times 10^6$ m^2 la superficie total de production de saumon du bassin hydrographique de la Miramichi.

INTRODUCTION

Proximate quantification of stream area accessible and utilizable for rearing of juvenile salmonids, particularly Atlantic salmon (Salmo salar L.) has been difficult and costly. Remote sensing of salmon production area using air photos to quantify habitat is both easier and less costly provided that premises governing the selection of habitat can be interpreted from physical attributes recorded on the photos and reasonable accuracy achieved. This paper provides results of an air photo survey conducted on the Miramichi River, New Brunswick to determine and describe the habitat for juvenile Atlantic salmon.

MATERIALS

National topographic series (N.T.S.) maps (1956) 1:50,000 scale and some Land Registration Information System (L.R.I.S.) ortho photo maps 1:20,000 were used to code the system and derive profile data.

Available aerial photography for the Miramichi drainage was 1:20,000 scale (approx.) panchromatic black and white, originally taken as part of a forest resources survey for the New Brunswick Department of Natural Resources 1974-1977. To view the drainage in stereo a total of 1414 photos, together with the associated flight line data (Table 1) necessary to calculate exact scale, were required.

A wing mirror stereoscope[1] with 3X oculars was used to examine the photographs in stereo pairs. A number 00 jewel tipped drawing pen and white opague ink was used to demark reaches on the photos. A 6X monocular comparator equipped with a 10^{-1} mm divisional line reticle was used to measure stream widths. A digitizing board and cursor[2] were used to measure reach lengths directly off the marked photos. All data were recorded on formatted data sheets, keypunched and processed by computers.

The Fishing Guide for the Miramichi River (N.B. Fish and Wildlife Branch; 1969-1973) was used to locate known angling pools.

Results of a proximate survey of the Bartholomew River for comparison with the remote sensing survey were provided by Messrs. T. Lutzac and P. Zamora[3]. These data are collected using a range surveying technique utilizing optical rangemeters[4] calibrated daily with measuring tapes.

Proximate surveys of selected reaches were conducted with rangemeters to locate transect locations at 50 m intervals. A fibre survey tape was used to measure stream top widths and a 1.3 m survey rod was used to measure depths.

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[1]Wild Heerbrugg model ST4
[2]Tallus Model 648
[3]T. Lutzac, DFO, P.O. Box 5030, Moncton, N.B. E1C 9B6
P. Zamora, DFO, P.O. Box 550, Halifax, N.S. B3J 2S7
[4]Ranging Inc. 90 Lincoln Rd., East Rochester, New York 14445

Spot-checks for presence/absence of juvenile salmon/trout were conducted with a Dirgo 600[5] portable electrofishing unit.

METHODS

The general methodology can be described as a series of activities involving: (1) coding and selecting of streams, (2) orderly arrangement of photography and associated photogrammetric data, (3) establishment of the extent of stream area occupied (penetration limit), (4) partitioning of streams into photo-interpreted "reaches" to account for as much area as possible while reducing "within reach" error and variance, (5) sampling of top width measurements for each reach, (6) measurement of reach lengths, (7) calculation of mean top width for each reach at the calculated photo scale, (8) correction of mean top width to standard summer low discharge and (9) summarily calculation of mean width, length and area for each reach, tributary, major tributary, branch and total drainage.

Selection and Coding of Streams

Using 1:50,000 maps, each tributary of the Miramichi drainage was uniquely identified by an alternating alpha/numeric heirarchial coding system adopted from the stream inventory system of DFO, Habitat Protection Section, Freshwater and Anadromous Division, e.g., Main Miramichi River (G26), the second tributary (Bartibog River, G26B), first tributary of the main Bartibog, (G26B1).

Tributaries showing less than 1 km of non-intermittent flow were included for further analysis. Tributaries in excess of 10 km and/or crossing at least 3 contour intervals (15.24 m/interval) were selected for profile analysis unless the tributary did not meet the inventory selection criteria. Profiles and reaches were initiated from Mill Cove Brook (Millbank trap, DFO).

Stream Gradient Tables and Profiles

Values for weighted moving average percent grade were calculated using a sampling frequency of 15 m over a 30 m rise in elevation. Weighted average percent grade was calculated using distance covered per sample interval as the weight for each moving average and for the overall gradient. Contour intervals of 15.24 m (N.T.S. maps) were rounded to 15.0 m for gradient calculations.

Profiles were computer plotted with branches and major tributaries as baseline or reference profiles with each tributary profile stemming from its own distance and elevation location on a reference profile. The vertical and horizontal ratio of the axes scales was 1:40.

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[5]Dirgo, Electronics Engineering, 1307 N.W. Buchanan, Corvallis, OR 97330

Air Photo Interpretation

Inventory selection

Initial photo inspection of a stream, meeting the selection criteria on N.T.S. maps, often indicated that the stream was not measurable because:

(1) Top width at the mouth of the stream was less than the resolving power (10^{-1} mm $\simeq$ 2.2 m) of the photos and comparator. These streams were deleted from the inventory.

(2) Shadow and/or overhanging vegetation obscured the stream. Decisions to include or exclude these waters were based on existing electrofishing data, reconnaissance and local knowledge of experienced observers.

Reach definition

Each tributary was examined stereoscopically upstream from its confluence and partitioned into defined reaches according to the following priorized criteria:

(1) A "pool" identified in the Fishing Guide series.

(2) A split channel resulting from an island in the stream. (Generally two reaches are defined for each island).

(3) An abrupt change in top width of the water.

(4) An abrupt change in photo identifiable habitat type.

(5) A reach approached the edge of the photo.

Reaches requiring more than 24 width measurements, were partitioned by decimal increments.

Reaches were defined on one of the stereo photos showing the better top width definition closest to the center of the photo. Reach limits were demarked with single straight white lines perpendicular to the stream banks and the reach referenced with a unique serial number. Stream codes were written on the photo to facilitate future identification.

Upper habitat limit

Reach assignment was terminated at a point above which the habitat was deemed unsuitable for salmon production. This upper habitat limit was established at a point where:

(1) There was a known obstruction without fish passage.

(2) The stream originated from a headwater lake. (Stream-lake-stream situations were seldom encountered).

(3) The last map gradient line on a stream above which the gradient is near-zero or stream originates from a bog.

(4) Complete stream surface was obscured from view by overhanging cover.

(5) Stream width was below the resolving power of the photography and comparator.

(6) The moving average % grade exceeded 3.5%. (This is greater than 3.0 percent indicated by Mills (1973) as the limit of favorable spawning for salmon because of the smoothing effect of moving averages).

Classification of Reach Habitat

Following stereoscopic examination reaches were classified for each of four photo identifiable habitat types as well as the angling pools as follows:

Type	Surface	Bottom	Location
A	not visible	light	shingles adjacent to shore and over bars
B	not visible	mottled	throughout
C	white broken	not visible	rapids
D	flat and dark	not visible	deep section not identified as a Fishing Guide pool
E	flat and dark	not visible	Fishing Guide pool

For each reach, the percentage of Type A through E was recorded.

Reach Identity Code

In order to omit estuarial or non-salmon producing reaches from those producing juvenile salmon and split channel reaches from mean width and summed length calculations, a system of control codes identifying each reach was instituted. The editing of control codes of selected portions of streams enables the updating of output for new information. Control codes and usage included:

Code	Usage	Salmon Producing
0	throughout	yes
1	throughout	no
2	tidal zone	no
3	above 3.5 percent gradient	no
4	low gradient	unknown
6	split channel in tidal zone	no
7	split channel	yes
8	indeterminate width	yes

Reach Measurements

Widths

Reach widths (to the nearest 10^{-1} mm) were measured perpendicular to the banks using a comparator and photogrammetric reticle. For each reach top width measurements of the water were made at the upper and lower limits and every 0.3 km of its course. When a reach was less than 0.3 km measurements were made at each of the bottom, top and mid-point. Points of measurement were located using dividers and for this reason may have resulted in some intervals on extensively meandering streams to exceed 0.3 km.

Length

The length of each reach was measured directly from the marked photos with a digital measuring device capable of achieving 7.6×10^{-2} mm accuracy. Lengths were measured following an imaginary line equidistant from each bank and converted to meters according to the scale factor (see "Calculations") for each photo.

Discharge correction factor

In order to decrease the variability in top width due to the variance in discharges for the photo dates, the means of all widths were corrected to a standard "summer low" discharge and resulting top width.

The complete Miramichi drainage was partitioned into nine sub-drainages or sections and assigned one of six sets of discharge data available (Fig. 1) from the Water Resources Branch, Inland Waters Directorate. The six guaging stations were on the Barnaby, Little Southwest Miramichi, Tomogonops, Northwest Miramichi, Renous River and Southwest Miramichi rivers.

The Average Daily Flow (ADF) in cubic feet per second (c.f.s.) for the years from 1961-1978 were calculated for each gauging station. The ADF's for these sets were scanned for outliers beyond $\pm$ 2 S.D. These were eliminated and if necessary a new ADF calculated for each station. For each year of data for a station a three month mean summer low (MSL) was calculated by eliminating the highest mean monthly flow of the four months July-Oct. An overall mean of these yearly MSL's was then calculated. The yearly MSL's were then scanned for outliers beyond $\pm$ 2 S.D. These were eliminated and if necessary a new three-month MSL for each station was calculated.

Utilizing regulated flow data given by Wesche (1973) for change in mean transect top width for two tributaries of the North Platte River in southwestern Wyoming, a regression was calculated for log % ADF on log % change Mean Top Width (based on 100% ADF). Minimum values, 12.5% of ADF, were eliminated from the regression because these values are below most minimum flows found on unregulated streams. The resultant equation ($\log y = 8.6897 \log x - 15.4158$ $r^2 = .9035$; $p = > .001$) allowed the calculation of the percentage change in top width for the estimated summer low discharge as well as the percentage change in top width for the date of the photo. The difference in percentage between these calculated values enabled the calculation of a Correction Factor (C_f) for each mean top width measurement of a reach to increase or decrease the value to a MSL width. The equation for the Correction Factor was:

$$C_f = \frac{\text{\% of ADF width for MSL}}{\text{\% of MSl width for photo day}}$$

Computer Processing

The mean of all measured top widths of each reach was converted to meters using a scale factor calculated for each photo. Scale factors being given by the formula,

$$Sf = \frac{\text{flying height (m) - ground elevation (m)}}{\text{focal length (m)}}$$

with values derived from Tables 1 and the NTS maps.

The mean top width for each reach was then corrected to a "standard summer low" top width using the previously calculated Cf value. The area of each reach was then calculated as the product of the corrected average width and reach lengths. Lengths and areas were summed and output according to the operation of the control codes.

MAPDAl Table 2

Produces output which can be considered as net values of accessible and utilizable salmon production area. All control codes are operational according to the following key:

Code	Description	Contributes to Production	Length	Width
0	normal reach	yes	yes	yes
1	inventoried but doubtful production	no	no	no
2	tidal zone	no	yes	no
3	above gradient 3.5%	no	no	no
4	low gradient	yes	yes	yes
6	split channel-tidal	no	no	yes[a]
7	split channel	yes	no	yes[a]
8	indeterminate width	yes	yes	no[b]

[a]for reach only, not for stream.

[b]not calculated from air photo data.

Ground Truthing

Photogrammetric scale for two particular photos was checked by measuring the widths of the Morrisey Bridge at Newcastle and the C.N.R. bridge at Doaktown and checking the photo converted lengths with the engineering specifications.

Accuracy of width measurements was examined in a selection of 15 locations covering stream orders 2-6 in a randomly selected sample, weighted by estimated percent area for each stream order Table 4, from 75 electrofishing locations established on the system. Stream orders were assigned in the manner described by Platts (1979) after Strahler (1952, 1957). Proximate surveys were conducted on 21 reaches at these locations. Data collected along transects 50 m apart were top width, bottom composition and depth at one quarter intervals across the stream. Bottom composition was assessed by partitioning the estimated percent of boulder, cobble, gravel and sand according to the following size classification: > 30 cm, 10-30 cm, 1-10 cm, < 1 cm respectively.

Reliability of habitat typing was based on proximate data describing four habitat types and known angling pools (Fishing Guide). For each transect the following classification was applied.

Depth (m)	Boulder & Cobble	Habitat
0-1	< 50%	A
0-1	≐ > 50%	B
0-1	> 50% + white surface water	C
>1	----	D

The percent of each habitat type was calculated for each reach, and compared to the reach totals for the air photo interpreted habitat data.

Results of a complete proximate survey of the Bartholomew river and tributaries measured with daily calibrated optical rangemeters (Zamora and Hambrook, pers. comm.[6]) were also compared to the remote sensing results.

The completeness of the inventory and accuracy of the salmon production status was checked for 32 streams reported by Schofield and Peppar (1983) for which no previous biological survey data was available.

RESULTS

A total of 369 streams were identified on NTS maps as having non-intermittent flow in excess of 1 km. Examination of air photos for these streams considered as possible salmon producing areas reduced this number to 206 on which 3,313 reaches were described. Profiles and gradient tables were constructed for 155 of these streams.

Output from MAPDA, not included here, indicated a gross discharge corrected water surface area above Mill Cove Brook of 1,022,369 x 10^2 m^2 which included esturial water. Output from MAPDA1, Table 2 indicated a net accessible production area for Atlantic salmon of 546,055 x 10^2 m^2. Area, mean width and variance as measured, mean width discharge corrected (mean top widths exclude split channel top widths) and length by stream, major tributary and branch is also reported (Table 2).

Absolute error due to photogrammetric sources was found to be relatively low. Estimated length of the Morrisey and CNR bridges differed from the engineering reports by - 2.3 percent and + 0.4 percent respectively. The larger error was attributed to the indefinite boundaries of the Morrisey Bridge.

Accuracy of average width determinations is depicted in Figure 2. Twenty-one selected and five identifiable and comparable reaches, and comparable reaches on the Bartholomew River (G26AF34) where proximate and

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[6]M. Hambrook, P.O. Box 5030, Moncton, N.B. E1C 9B6

remote surveyed reaches were equal, were statistically compared. Comparison of discharge corrected average top width from the air photo measured reaches and discharge corrected proximate measured average top widths indicated 80.8 percent of measurements were within -22.9 percent to +14.6 percent of the discharge corrected proximate width. While a paired data "t" test indicated no significant (p.05) overall difference between the two data sets, comparison of individual mean top widths by "Z" score indicated 5 cases of significantly (p.05) different (smaller) mean widths. One of these cases was drawn from a sample of only two widths ad the remaining 4 cases were attributed to overhanging cover and shadow. Under measurement error was also associated with smaller streams.

For the same 21 reaches no significant (p.05) correlations were determined between the percentages of five air photo determined habitats and five habitat classes derived from proximate surveys.

Proximate survey data for the main Bartholomew River exclusive of tributaries, estimated a total length of 50.5 km and an area of 7,799 x 10^2 m^2. The remote survey provided an estimate of 51.6 km and 7,054 x 10^2 m^2 respectively or a difference of +2.2 and -9.6%. However, differences for individual streams were highly variable and dependent on placement of upper penetration limits of salmon which had not been established by proximate survey. While the establishment of penetration limits in the field proved difficult, the remote placed limits for the North and South Branches of the Bartholomew were determined by spot checking for the presence of salmon with portable electrofishing equipment to be accurate to $\pm$ 1.0 km. No salmon were found in Otter Brook (G26 AF34H) which was believed to produce salmon and included in previous estimates. Spot checks of Leadbetter's Brook (G26 AF34U) indicated that salmon were present. Davis Landing Brook (G26 AF34AA) which was not previously included in estimates of production area of the Bartholomew system was not spot checked but included as accessible production area in this survey.

A comparison of a proximate survey of the entire Bartholomew river provided an estimate of salmon production area of 9,807 x 10^2 m^2. The estimate by remote survey was 9,288 x 10^2 m^2 or -9.4%.

As an indication of the remote survey methods to discriminate small streams as salmon producing or non-producing, an a posteriori comparison of electrofishing and streamside examinations reported by Schofield and Peppar (1983) was made (Table 3). For 15 of the streams examined which were assumed to not produce salmon 14 (93%) cases agreed with the remote survey. The remaining 17 streams which were fished 13 (77%) agreed with the remote survey. Two of the non-agreeing cases were based on one fish captured and all 4 non-agreeing cases were exclusions in the remote survey.

DISCUSSION

The inability to accurately interpret habitat was attributed to the type and quality of the photography. However omission of salmon producing streams would appear to be minimal in number and of little consequence in total production area.

Differences in width measurements of small streams in excess of -20% (Fig. 2) may have biased calculations of total area. However in only 4 of 13 cases or 30.8% with proximately measured widths < 20.0 m were proximate and remote mean widths significantly (p.05) different. Where proximate measured mean widths were > 20.0 m differences were not significant and evenly distributed.

Insight into the impact of significant width measurement error in smaller streams may be gained by considering that reaches where overall mean width is < 20.0 m comprise only 25% of the estimated total accessible salmon production area. However, the exclusion of streams or portions of streams (the effect of bias in stream width measurements) because of overhanging canopy may be advantageous if salmon production is primarily dependent on open streams (Gibson and Keenleyside, 1966).

The net production area estimated by aerial photographic measurement and interpretation would appear to be a conservative one considering the underestimate of widths and the exclusion of questionable producing streams. This estimate of accessible production area is intended as a base figure to be modified as information is obtained.

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Table 1. Flight line data for aerial photographs covering the Miramichi River.

Flight Line	Date D/M	Photo #'s From Incl.	To Incl.	Altitude (FT ASL)	Focal Length (mm)
74-501	23/9	1	115	10,600	151.98
74-502	25/9	1	251	10,600	151.98
74-503	25/9	1	236	10,600	151.98
74-509	8/10	1	254	10,600	151.98
74-510	8/10	1	272	10,600	151.98
75-501	15/9	1	174	11,500	151.73
75-502	25/9	1	267	11,500	151.73
75-503	25/9	1	213	11,500	151.73
75-504	5/10	1	283	11,500	152.74
75-505	5/10	1	81	11,500	152.74
75-505	23/10	82	129	11,500	152.74
75-506	9/10	1	250	11,500	152.74
75-507	9/10	1	179	11,500	152.74
75-510	10/10	1	169	11,500	152.46
75-511	23/10	1	277	11,500	152.74
76-501	10/9	1	242	11,500	152.46
76-502	10/9	1	261	11,500	152.46
76-503	10/9	1	97	11,500	152.46
76-506	10/9	1	280	11,500	153.14
76-507	10/9	1	262	11,500	153.14
76-508	10/9	1	152	11,500	153.14
76-508	13/9	153	330	11,500	153.14
76-514	4/10	1	276	11,500	153.14
76-515	3/10	1	174	11,500	153.14
76-515	4/10	175	208	11,500	153.14
76-519	3/10	1	252	11,000	153.34
76-521	3/10	1	16	11,500	152.46
76-521	3/10	17	159	11,000	152.46
77-501	8/7	1	26	10,300	153.37
77-501	8/7	27	53	10,500	153.37
77-501	8/7	54	114	11,500	153.37
77-503	8/10	1	140	11,742	153.22
77-505	24/10	1	187	11,700	153.22
77-508	25/10	1	58	10,956	152.46
77-511	29/10	1	17	11,800	153.22
77-511	29/10	18	38	11,300	153.22

Table 2. Summary of accessible and utiliziable streams with mean width as measured and discharge corrected, total length and area for the Miramichi drainage as determined by air photo survey.

STREAM NAME	STREAM REF.NO.	WIDTHS AS MEASURED (m) MEAN	WIDTHS AS MEASURED (m) SD	WIDTHS CORR (m) MEAN	LENGTH (km)	AREA (100m^2)	REPORT TYPE
MAIN MIRAMICHIR	G26	0.00	0.0	0.0	24.783	0	
BARTIBOG R	G26B	20.59	9.6	19.0	55.340	8,229	
LITTLEBARTIBOGR	G26B3	14.58	34.5	15.6	9.763	1,274	
GREEN BK	G26B20	5.73	3.2	5.7	23.452	1,346	
GOODFELLOW'S BK	G26B26	2.09	0.0	1.8	3.944	70	
NORTH BARTIBOGR	G26B28	2.06	0.0	2.0	5.735	114	
MIDDLEBARTIBOGR	G26B33	2.36	0.8	2.0	6.799	137	
S BARTIBOG R	G26B34	2.93	1.9	2.5	7.855	183	
TOTAL FOR	G26B				112.888	11,353	***
BLACK BK	G26D	12.87	12.5	13.8	3.185	235	
N W MIRAM RIVER	G26AE	33.09	19.3	34.8	134.231	42,548	
N W MILLSTREAM	G26AE8	25.17	41.6	29.0	28.491	4,785	
LIT SW MIRAM R	G26AE24	50.55	22.2	48.5	100.839	57,417	
CATAMARAN BK	G26AE24R	3.31	1.4	3.0	12.634	398	
LR N BR LT SW M	G26AE24AC	18.34	7.2	19.1	34.997	6,570	
GUAGUS BK	G26AE24AC2	7.13	2.8	7.5	6.151	457	
UNNAMED	G26AE24AC7	3.04	1.4	3.0	4.193	126	
UNNAMED BK	G26AE24AC12	2.82	1.4	2.8	3.896	112	
UNNAMED BK	G26AE24AC14	3.34	2.0	3.3	11.316	453	
UNNAMED BK	G26AE24AC15	2.90	1.2	2.8	8.371	232	
UNNAMED BK	G26AE24AC16	2.47	0.9	2.5	7.947	192	
UNNAMED BK	G26AE24AC18	1.85	0.0	1.8	0.000	0	
LIBBIES BK	G26AE24AF	4.69	3.7	4.2	9.341	281	
NORTH POLE BK	G26AE24AK	17.85	10.6	18.2	30.756	5,448	
UNNAMED BK	G26AE24AK6	2.11	0.0	2.1	1.601	33	
UNNAMED	G26AE24AK10	2.29	0.7	2.3	3.638	82	
UNNAMED	G26AE24AK12	2.07	0.0	2.0	2.564	52	
LIZZARD LK BK	G26AE24AK14	5.95	4.2	5.9	2.597	153	
UNNAMED BK	G26AE24AK21	2.58	1.5	2.4	7.152	174	
CAVE BK	G26AE24AK23	2.76	1.0	2.6	3.864	100	
UNNAMED	G26AE24AN	3.89	1.6	4.1	1.729	71	
INDIAN BK	G26AE24AO	10.49	28.3	10.3	3.999	412	
UNNAMED	G26AE24AR	2.10	0.0	2.2	3.185	71	
TUODOOK R	G26AE24AT	22.88	35.7	24.1	5.043	2,194	
NW BR LT SW MIR	G26AE24AW	23.64	31.8	24.0	11.226	2,838	
UNNAMED	G26AE24AY	2.43	0.8	2.6	1.919	49	

STREAM NAME	STREAM REF.NO.	WIDTHS AS MEASURED (m) MEAN	WIDTHS AS MEASURED (m) SD	WIDTHS CORR (m) MEAN	LENGTH (km)	AREA (100m^2)	REPORT TYPE
UNNAMED	G26AE24BA	6.21	3.7	6.1	1.863	113	
MITCHELL LK BK	G26AE24BB	24.26	21.9	23.9	5.246	1,260	
TOTAL FOR	G26AE024.0	38.42	24.4	37.2	286.067	79,289	**
CASTOR BK	G26AE29.5	2.31	0.0	2.4	2.243	55	
UNNAMED	G26AE29.5A	13.57	14.6	14.3	3.159	452	
TOTAL FOR	G26AE029.5	7.94	10.3	8.4	5.402	507	**
WILDCAT BK	G26AE33	2.89	2.0	3.0	4.857	148	
UNNAMED	G26AE33B	2.31	0.0	2.4	3.771	92	
TOTAL FOR	G26AE033.0	2.60	1.5	2.7	8.628	240	**
LITTLE SEVOGLE	G26AE36	9.04	6.3	9.0	42.377	3,860	
TOTAL FOR	G26AE036.0	9.04	0.0	9.0	42.377	3,860	**
SEVOGLE R	G26AE38	47.78	14.0	47.1	13.794	6,619	
WHITNEY BK	G26AE38C	3.35	6.7	3.3	13.179	458	
NORTH SEVOGLE R	G26AE38F	14.44	5.0	14.0	51.160	5,784	
LIT N SEVOGLE R	G26AE38F11	2.35	0.8	2.3	8.028	194	
SOUTH SEVOGLE R	G26AE38G	18.16	10.5	17.9	47.865	9,327	
MULLIN STR	G26AE38G2	10.89	8.4	11.1	35.404	3,554	
SHEEPHOUSE BK	G26AE38G6	3.44	1.5	3.4	20.506	722	
CLEARWATER STR	G26AE38G10	4.03	3.0	4.0	21.910	992	
TRAVIS BK	G26AE38G12	4.26	3.0	4.2	3.345	141	
N BR S SEVOGLER	G26AE38G14	5.82	6.1	5.6	12.600	693	
BARRACKS BK	G26AE38G15	2.06	0.0	1.9	5.579	110	
LIT S SEVOGLE R	G26AE38G19	2.06	0.0	1.9	8.654	169	
UNNAMED	G26AE38G23	2.02	0.0	2.0	4.395	88	
UNNAMED	G26AE38G24	2.27	1.6	2.1	3.684	84	
TOTAL FOR	G26AE038.0	16.86	11.1	16.5	250.103	28,936	**
TROUT BK	G26AE43	2.57	0.8	2.7	18.833	517	
LEE BK	G26AE45	3.09	1.7	2.9	4.311	124	
UNNAMED	G26AE46	2.68	0.9	2.5	3.957	99	
SMOKER BK	G26AE51	2.55	0.9	2.4	6.864	164	
PORTAGE R	G26AE53	10.97	8.6	10.4	23.836	1,772	
TOMOGONOPS R	G26AE54	12.93	6.4	11.8	21.889	2,667	
TOTAL FOR	G26AE054.0	12.93	6.3	11.8	21.889	2,667	**
LITTLE R	G26AE56	4.34	3.5	4.0	24.828	1,013	
STONEY BK	G26AE62	2.23	0.0	2.5	2.102	53	
MOUNTAIN BK	G26AE65	7.96	15.5	7.4	5.343	293	
UNNAMED	G26AE72	2.59	1.0	2.4	2.263	55	

STREAM NAME	STREAM REF.NO.	WIDTHS AS MEASURED (m) MEAN	WIDTHS AS MEASURED (m) SD	WIDTHS CORR (m) MEAN	LENGTH (km)	AREA (100m^2)	REPORT TYPE
S BR NW MIRAMIC	G26AE85	5.76	5.1	6.6	14.443	964	
TOTAL FOR	G26AE				883.968	167,887	***
S W MIRAMICHI R	G26AF	75.81	33.9	77.9	235.037	181,791	
BARNABY R	G26AF8	20.15	11.1	21.0	42.562	7,030	
SEMIWAGON R	G26AF8B	8.44	4.7	8.8	25.567	2,159	
MACDONALD BK	G26AF8S	7.59	4.1	8.0	33.049	2,774	
LT SEMIWAGON BK	G26AF8S7	2.28	0.0	2.5	5.560	138	
WISEMAN BK	G26AF8W	2.28	0.0	2.5	0.665	16	
MIDDLE BARNABY	G26AF8AF	5.05	2.3	5.4	17.152	927	
TOTAL FOR	G26AF008.0	13.39	9.6	14.0	124.555	13,044	**
LAKE BK	G26AF21	4.52	1.9	4.9	5.121	241	
TOTAL FOR	G26AF021.0	4.52	0.0	4.9	5.121	241	**
RENOUS R	G26AF22	45.92	15.7	46.1	40.300	18,996	
RESERVE BK	G26AF22N	2.29	0.0	2.3	4.014	91	
DUNGARVON R	G26AF22P	22.77	10.9	23.2	77.672	20,421	
UNNAMED	G26AF22P4	2.28	0.0	2.3	0.000	0	
UNDERWOOD BK	G26AF22P6	2.93	1.4	2.9	5.386	157	
UNNAMED	G26AF22P7	6.23	6.5	6.4	1.439	92	
UNNAMED	G26AF22P8	4.53	3.9	4.7	0.728	34	
UNNAMED	G26AF22P9	2.26	0.0	2.3	0.569	13	
UNNAMED(SPLIT C	G26AF22P10	2.26	0.0	2.3	0.230	5	
UNNAMED	G26AF22P12	2.25	0.0	2.3	4.158	96	
UNNAMED	G26AF22P13	3.01	1.2	3.1	2.352	73	
UNNAMED	G26AF22P14	2.25	0.0	2.3	1.219	28	
UNNAMED	G26AF22P15	2.24	0.0	2.3	1.860	43	
VALENTINE LAKE	G26AF22P32	2.20	0.0	2.3	0.000	0	
KING BK	G26AF22P34	0.00	0.0	0.0	6.900	0	
LT DUNGARVON R	G26AF22P41	8.82	12.7	9.1	13.836	882	
BAMFORD BK	G26AF22P42	2.18	0.0	2.2	1.896	42	
MCCONNELL BK	G26AF22P49	2.16	0.0	2.2	3.248	72	
N DUNGARVON R	G26AF22P61	5.54	3.8	5.2	7.323	362	
UNNAMED	G26AF22P61B	2.10	0.0	1.8	1.066	19	
UNNAMED	G26AF22P61E	4.89	4.8	4.3	1.078	46	
TOTAL FOR	G26AF022.0P	20.15	11.8	0.0	130.960	22,386	**
CROWN PT BK	G26AF22X	6.87	0.0	6.0	0.000	0	
NORTH RENOUS R	G26AF22AJ	21.63	9.7	20.8	40.123	8,779	
LAKE BK	G26AF22AJ11	17.31	14.5	15.8	9.230	1,374	
MCKENDRICK BK	G26AF22AJ12	4.20	3.2	3.8	2.300	59	
PEAR LAKE BK	G26AF22AJ25	6.62	4.8	6.8	1.767	121	
TOTAL FOR	G26AF022.0AJ	19.98	10.7	0.0	53.420	10,333	**
SOUTH RENOUS R	G26AF22AK	12.17	7.1	12.3	38.851	5,667	

STREAM NAME	STREAM REF.NO.	WIDTHS AS MEASURED (m) MEAN	WIDTHS AS MEASURED (m) SD	WIDTHS CORR (m) MEAN	LENGTH (km)	AREA (100m^2)	REPORT TYPE
MONAGHAN BK	G26AF22AK2	6.84	3.4	6.8	2.247	144	
LIT S RENOUS R	G26AF22AK7	5.65	3.2	5.8	9.667	591	
TOTAL FOR	G26AF022.0AK	11.20	6.8	0.0	50.765	6,401	**
TOTAL FOR	G26AF022.0	25.87	15.8	25.9	279.459	58,207	**
WHITE RAPIDS BK	G26AF24	6.53	5.7	6.5	2.312	115	
BARTHOLOMEW R	G26AF34	14.52	9.2	15.0	51.590	7,054	
LEDBETTER'S BK	G26AF34U	5.26	2.0	5.4	6.889	372	
DAVIS LANDING B	G26AF34AA	9.86	5.7	10.4	8.673	683	
N BARTHOLOMEW R	G26AF34AE	3.47	2.1	3.7	6.647	237	
S BARTHOLOMEW R	G26AF34AF	2.36	0.6	2.5	4.840	119	
OTTER BK	G26AF34H	5.60	2.6	5.8	13.754	822	
TOTAL FOR	G26AF034.0	12.96	8.9	13.4	92.393	9,288	**
BECKET BK	G26AF36	2.64	1.1	2.7	5.270	145	
UNNAMED	G26AF41	2.28	0.0	2.3	1.878	44	
MORSE BK	G26AF44	2.87	1.1	3.0	1.253	38	
MCKENZIE BK	G26AF46	2.62	0.8	2.7	5.673	155	
BLACK BK	G26AF51	6.22	3.2	6.5	9.133	507	
CAINS R	G26AF53	35.89	14.5	36.5	102.837	35,169	
OTTER BK	G26AF53C	2.82	0.9	3.0	7.919	233	
SALMON BK	G26AF53J	3.66	1.1	3.9	9.255	357	
PICARD BK	G26AF53K	2.57	0.8	2.8	0.000	0	
SABBIES R	G26AF53L	11.71	1.9	12.5	3.185	399	
EAST SABBIES R	G26AF53L3	5.81	4.8	6.2	24.089	1,752	
RYAN BK	G26AF53L3D	2.25	0.0	2.3	6.064	138	
CHAIN MEADOW BK	G26AF53L3F	2.24	0.0	2.4	4.407	106	
SUTTON BK	G26AF53L3G	2.24	0.0	2.4	3.109	75	
MEADOW BK	G26AF53L3I	3.79	2.0	4.1	3.437	146	
WEST SABBIES R	G26AF53L4	6.99	3.7	7.2	20.958	1,504	
MUZROLL BK	G26AF53AC	8.12	4.3	8.0	35.625	2,929	
N MUZROLL BK	G26AF53AC26	2.24	0.0	2.1	2.903	62	
S MUZROLL BK	G26AF53AC29	3.35	1.3	3.2	3.172	101	
SIX MILE BK	G26AF53AE	8.31	3.6	8.0	14.244	1,283	
E SIX MILE BK	G26AF53AE3	3.56	2.2	3.4	19.603	663	
COLD BK	G26AF53AE5	2.43	0.6	2.3	5.727	133	
UNNAMED	G26AF53AZ	6.79	6.4	6.5	0.683	44	
MACKENZIE BK	G26AF53BB	3.40	1.2	3.2	3.153	102	
TEN MILE BK	G26AF53BC	2.25	0.0	2.2	3.630	81	
BLUE ROCK BK	G26AF53BT	2.25	0.0	2.2	4.663	104	
GORDON BK	G26AF53CI	3.01	1.4	3.0	8.643	247	
LOWER OTTER BK	G26AF53CS	5.79	4.9	5.7	8.160	338	
NORTH CAINS R	G26AF53CV	5.76	1.8	5.7	5.452	311	
BANTALOP BK	G26AF53DE	2.66	0.9	2.6	4.104	106	
SUTHERLAND BK	G26AF53DM	2.43	0.7	2.4	5.197	121	
TOTAL FOR	G26AF053.0	27.23	16.6	27.7	310.219	46,505	**

Table 2 (Cont'd)

STREAM NAME	STREAM REF.NO.	WIDTHS AS MEASURED (m) MEAN	WIDTHS AS MEASURED (m) SD	WIDTHS CORR (m) MEAN	LENGTH (km)	AREA (100m^2)	REPORT TYPE
MOORE'S BK	G26AF68	3.05	1.3	3.2	6.726	215	
BIG HOLE BK	G26AF94	3.99	2.7	4.0	12.513	544	
N BIG HOLE BK	G26AF94J	2.99	1.7	3.2	15.143	526	
TOTAL FOR	G26AF094.0	3.49	2.2	3.6	27.656	1,070	**
BETTS MILL BK	G26AF96	5.00	2.3	5.0	10.512	501	
BURNTLAND BK	G26AF117	13.45	6.7	12.9	22.518	2,420	
TAXIS R	G26AF118	26.70	12.9	26.1	39.376	11,329	
CLEARWATER BK	G26AF118E	4.55	2.7	4.5	15.509	664	
STEWART BK	G26AF118N	5.39	3.4	5.1	5.662	284	
ENGLISH BK	G26AF118O	4.45	0.0	4.2	3.671	156	
MCMILLAN BK	G26AF118Q	2.21	0.0	2.2	0.000	0	
TAMARACK BK	G26AF118S	3.62	1.8	3.6	6.822	248	
HOVEY BK	G26AF118T	7.23	3.2	6.9	6.404	336	
BREWER BK	G26AF118T1	2.19	0.0	2.1	5.334	111	
LOWER HAYDEN BK	G26AF118U	2.74	1.1	2.6	10.790	323	
MID HAYDEN BK	G26AF118V	2.25	0.5	2.1	7.216	158	
UPP HAYDEN BK	G26AF118W	2.56	1.5	2.4	8.117	211	
UNNAMED BK	G26AF118Y	2.15	0.0	2.0	8.656	177	
TOTAL FOR	G26AF118.0	11.27	12.6	11.0	117.557	13,998	**
PORTER BK	G26AF123	3.75	3.0	3.7	6.035	268	
HAYES BK	G26AF129	2.42	0.7	2.4	10.570	264	
SALMON BK	G26AF139	5.73	1.8	6.1	6.448	404	
MCBEAN BK	G26AF141	4.17	1.6	4.5	1.989	80	
TROUT BK	G26AF146	4.92	1.0	5.3	3.101	163	
ROCKY BK	G26AF152	10.75	4.7	11.4	27.664	3,068	
SISTER'S BK	G26AF153	6.15	3.1	6.6	11.731	1,029	
UNNAMED	G26AF153C	2.62	1.2	2.7	4.673	119	
TOTAL FOR	G26AF153.0	4.74	3.3	5.0	16.404	1,149	**
CLEARWATER BK	G26AF157	17.19	9.3	17.6	54.080	10,025	
OTTER BK	G26AF157M	3.54	2.2	3.7	3.792	141	
TURNBULL BK	G26AF157Z	2.11	0.0	2.1	4.142	87	
LIT NE CLEARWAT	G26AF157AG	2.10	0.0	2.2	0.000	0	
UNNAMED	G26AF157AM	4.79	7.4	4.6	3.267	149	
UNNAMED	G26AF157A0	2.04	0.0	1.9	0.991	19	
TOTAL FOR	G26AF157.0	15.46	9.9	15.9	66.272	10,421	**

Table 2 (Cont'd)

STREAM NAME	REF.NO.	WIDTHS AS MEASURED (m) MEAN	SD	WIDTHS CORR (m) MEAN	LENGTH (km)	AREA (100m^2)	REPORT TYPE
BURNTHILL BK	G26AF164	21.40	7.9	22.7	13.832	3,757	
BEAVER BK	G26AF164M	4.41	3.0	4.6	8.189	390	
DEER BK	G26AF164M3	2.13	0.0	2.2	1.520	34	
N BURNTHILL BK	G26AF164O	7.78	3.1	8.1	9.959	826	
S BURNTHILL BK	G26AF164S	7.49	3.9	7.8	13.232	875	
LIT S BURNTHILL	G26AF164T	3.36	1.4	3.5	5.844	213	
GREEN BK	G26AF16403	3.20	3.0	3.3	6.969	239	
TOTAL FOR	G26AF164.0	10.62	9.0	11.2	59.545	6,333	**
MACLEAN BK	G26AF169	3.93	1.7	4.2	7.587	326	
SLATE ISLAND BK	G26AF172	2.16	0.0	2.1	0.000	0	
MCKIEL BK	G26AF177	9.53	5.2	9.7	18.719	2,014	
W MCKIEL BK	G26AF177D	4.80	3.2	5.1	1.441	66	
TOTAL FOR	G26AF177.0	8.44	5.2	8.6	20.160	2,080	**
UNNAMED	G26AF183	8.13	6.0	7.9	5.775	615	
UNNAMED	G26AF184	2.96	1.3	2.9	3.888	102	
FIVE MILE BK	G26AF187	4.28	0.0	4.3	0.000	0	
UNNAMED	G26AF188	3.74	3.2	3.7	0.551	20	
NBRSWMIRIMACHIR	G26AF197	16.36	7.8	16.7	49.426	8,321	
UNNAMED	G26AF197F	2.14	0.0	2.1	0.000	0	
UNNAMED	G26AF197M	3.19	1.5	3.4	2.722	86	
WEST BK	G26AF197O	6.20	3.5	6.6	3.162	253	
BEADLE BK	G26AF197S	3.99	3.2	4.3	21.225	1,015	
FIFTEEN MILE BK	G26AF197AA	2.54	0.9	2.7	2.468	66	
DEADWATER BK	G26AF197AG	4.19	0.0	4.4	2.500	110	
BEAVER BK	G26AF197AN	3.11	1.1	3.3	3.308	105	
TOTAL FOR	G26AF197.0	14.57	8.5	14.9	84.811	9,955	**
UNNAMED CHANNEL	G26AF199	2.85	1.2	2.8	0.583	35	
LIT CLEARWATER	G26AF203	7.27	7.5	7.0	11.240	759	
UNNAMED	G26AF203F	9.04	9.2	8.6	2.993	258	
TOTAL FOR	G26AF203.0	7.53	7.8	7.2	14.233	1,017	**
JUNIPER BK	G26AF209	2.46	0.8	2.5	11.277	293	
UNNAMED	G26AF210	3.57	2.5	3.5	0.649	23	
TEAGUE BK	G26AF219	5.80	3.5	5.9	11.115	499	
LITTLE TEAGUE B	G26AF219B	2.28	0.6	2.4	4.763	116	
TOTAL FOR	G26AF219.0	5.36	3.2	5.5	15.878	615	**
ELLIOT BK	G26AF225	2.66	1.7	2.8	17.105	622	

Table 2 (Cont'd)

STREAM NAME	STREAM REF.NO.	WIDTHS AS MEASURED (m) MEAN	WIDTHS AS MEASURED (m) SD	WIDTHS CORR (m) MEAN	LENGTH (km)	AREA (100m^2)	REPORT TYPE
LAKE BK	G26AF229	5.75	6.1	5.7	6.863	423	
TAMARAC BK	G26AF241	2.77	1.2	2.6	0.802	21	
TOTAL FOR	G26AF				1,645.462	366,581	***
RESULTS OF MIRAMICHI SURVEY 1981 FOR:					2,670.286	546,055[1]	

1. Differences in totals between these figures and Table 4 are due to rounding in Table 4.

** Totals for streams with reference code identical to the fourth level.

*** Totals for streams with reference code identical to third level.

Table 3. Streamside examination and electrofishing (Schofield and Peppar, 1983) as a posteriori index of the remote survey methods to discriminate small streams as salmon producing or non-producing.

		Prox. Survey Results		Inclusion in Remote Survey	
		Salmon Present	No Fishing Assumed No Salmon	Inventory	Salmon Producer
Wildcat Bk.	AE33	Yes		Yes	Yes
Trout Bk.	AE43	Yes		Yes	Yes
Lee Bk.	AE45	Yes		Yes	Yes
Pat's Bk.	AE48	Yes (1 parr)		No	No
Smoker Bk.	AE51	Yes		Yes	Yes
Harris Bk.	AE24J	No		No	No
Otter Bk.	AE200	Yes (1 fry)		No	No
Indiantown Bk.	AF21A	Yes		Yes	No
Reserve Bk.	AF22N		Yes	Yes	Yes
Mill Bk.	AF22T		Yes	No	No
Johnstone Bk.	AF22V		Yes	No	No
Devils Back Bk.	AF22Y1		Yes	No	No
Jardine Bk.	AF22P3		Yes	No	No
Becket Bk.	AF36	Yes		Yes	Yes
McKenzie Bk.	AF46	Yes		Yes	Yes
Black Bk.	AF51	Yes		Yes	Yes
Hurley Bk.	AF82		Yes	No	No
Fowler Bk.	AF92		Yes	Yes	No
Doak Bk.	AF93		Yes	Yes	No
Unnamed	AF104		Yes	No	No
Unnamed	AF107		Yes	No	No
Unnamed	AF113		Yes	No	No
Unnamed	AF114		Yes	No	No
Hickey Bk.	AF116		Yes	No	No
Standish Bk.	AF122		Yes	Yes	No
Porter Bk.	AF123	Yes		Yes	Yes
Palmer Bk.	AF125		Yes	No	No
Hayes Bk.	AF129	Yes		Yes	Yes
Salmon Bk.	AF139	Yes		Yes	Yes
Unnamed	AF118H	No		No	No
English Bk.	AF118O	Yes		Yes	Yes
MacMillan Bk.	AF118Q	Yes		Yes	No

Table 4. Classification by stream order of the accessible production area as defined by the 1981 air photo survey of the Miramichi River system, New Brunswick.

Stream Name	Ref. No.	Production Area (X 100 m^2) S.O. 7	S.O. 6	S.O. 5	S.O. 4	S.O. 3	S.O. 2	S.O. 1	TOTAL
Bartibog	G26B				8,229				8,229
L. Bartibog R.	G26B3				1,211	63			1,274
Green Brook	G26B20					1,346			1,346
Goodfellow's Brook	G26B26					70			70
N. Bartibog River	G26B28				114				114
M. Bartibog River	G26B33				137				137
S. Bartibog River	G26B34				183				183
Black Brook	G26D				235				235
TRIBUTARIES OF MAIN	TOTAL				10,109	1,479			11,588
MIRAMICHI RIVER	PERCENT				(87.24)	(12.76)			(100)
N.W. Miramichi River	G26AE		12,036	13,785	15,545	1,182			42,548
N.W. Millstream	G26AE8					4,785			4,785
L. S.W. Miramichi	G26AE24			42,861	4,079	10,477			57,417
Catamalan Brook	G26AE24R					273	125		398
Devil's Brook	G26AE24X								-
Lr.N.BR.LT.SW. Miramichi	G26AE24AC				6,381	189			6,570
Gaugus Brook	G26AE24AC2					457			457
Unnamed	G26AE24AC7							126	126
Unnamed	G26AE24AC12					112			112
Unnamed	G26AE24AC14					453			453
Unnamed	G26AE24AC15					232			232
Unnamed	G26AE24AC16						192		192
Unnamed	G26AE24AC18								-
Libbies Brook	G26AE24AF					281			281
Mains Brook	G26AE24AH								-
N. Pole Brook	G26AE24AK				5,448				5,448
Unnamed	G26AE24AK6							33	33
Unnamed	G26AE24AK10					82			82
Unnamed	G26AE24AK12					52			52
Sinclair Lake Brook	G26AE24AK13								-
Lizzard Lake Brook	G26AE24AK14						153		153
Unnamed	G26AE24AK21					174			174
Cave Brook	G26AE24AK23					100			100
Unnamed	G26AE24AN					71			71

Stream Name	Ref. No.	Production Area (X 100 m²) S.O. 7	S.O. 6	S.O. 5	S.O. 4	S.O. 3	S.O. 2	S.O. 1	TOTAL
Indian Brook	G26AE24AO						412		412
Unnamed	G26AE24AR							71	71
Toudook River	G26AE24AT				2,194				2,194
NW.BR.LT.SW. Miramichi	G26AE24AW						2,838		2,838
Unnamed	G26AE24AW22								-
Unnamed	G26AE24AY							49	49
Unnamed	G26AE24BA						113		113
Michell Lake Brook	G26AE24BB						1,260		1,260
Castor Brook	G26AE29.5					55			55
Unnamed	G26AE29.5A						452		452
Wildcat Brook	G26AE33					148			148
Unnamed	G26AE33B						92		92
L. Sevogle River	G26AE36					3,463	397		3,860
Unnamed	G26AE36A								-
Gillice Brook	G26AE36B								-
McNeal Brook	G26AE36C								-
Sevogle River	G26AE38			6,619					6,619
Whitney Brook	G26AE38C						96	362	458
Unnamed	G26AE38D								-
N. Sevogle River	G26AE38F				5,420	364			5,784
Peabody Lake Brook	G26AE38F5								-
L.N. Sevogle River	G26AE38F11						194		194
S. Sevogle River	G26AE38G				8,056	1,271			9,327
Mullin Stream	G26AE38G2					3,142	412		3,554
Sheephouse Brook	G26AE38G6						722		722
Clearwater Stream	G26AE38G10					820	172		992
Travis Brook	G26AE38G12					141			141
N.Br. S. Sevogle River	G26AE38G14					299	394		693
Barracks Brook	G26AE38G15						110		110
L.S. Sevogle River	G26AE38G19						169		169
Unnamed	G26AE38G23						88		88
Unnamed	G26AE38G24						84		84
Trout Brook	G26AE43						517		517
Lee Brook	G26AE45							124	124
Unnamed	G26AE46						99		99
Unnamed	G26AE49								-
Smoker Brook	G26AE51						164		164
Portage River	G26AE53				1,120	652			1,772
Tomogomops River	G26AE54				2,448	219			2,667

Stream Name	Ref. No.	Production Area (X 100 m^2) S.O. 7	S.O. 6	S.O. 5	S.O. 4	S.O. 3	S.O. 2	S.O. 1	TOTAL
S. Br. Tomogomops	G26AE54C								-
Little River	G26AE56					1,013			1,013
Stoney Brook	G26AE62						53		53
Mountain Brook	G26AE65					293			293
Unnamed	G26AE72							55	55
S. Br. N.W. Miramichi	G26AE85					554	410		964
Unnamed	G26AE95								-
NORTHWEST MIRAMICHI RIVER AND TRIBUTARIES	TOTAL		12,036	63,265	50,691	31,354	9,718	820	167,884
	PERCENT		(7.17)	(37.68)	(30.19)	(18.68)	(5.79)	(.49)	(100)
S.W. Miramichi	G26AF	33,557	121,018	23,586	3,336	294			181,791
Barnaby River	G26AF8				3,503	3,233	294		7,030
Semiwagon River	G26AF83					358	1,801		2,159
MacDonald Brook	G26AF85				1,562	770	442		2,774
L. Semiwagon Brook	G26AF857						138		138
Wiseman Brook	G26AF8W						16		16
M. Barnaby River	G26AF8AF						927		927
Lake Brook	G26AF21					241			241
Indiantown Brook	G26AF21A								-
Renous River	G26AF22			18,996					18,996
Reserve Brook	G26AF22N						91		91
Dunvargon River	G26AF22P				20,421				20,421
Unnamed	G26AF22P4								-
Underwood Brook	G26AF22P6						157		157
Unnamed	G26AF22P7						92		92
Unnamed	G26AF22P8							34	34
Unnamed	G26AF22P9							13	13
Unnamed	G26AF22P10							5	5
Unnamed	G26AF22P12					96			96
Unnamed	G26AF22P13						73		73
Unnamed	G26AF22P14						28		28
Unnamed	G26AF22P15						43		43
Valentine Lake	G26AF22P32								-
King Brook	G26AF22P34								-
Lt. Dunvargon River	G26AF22P41					667	80	135	882
Bamford Brook	G26AF22P42						42		42
McConnell Brook	G26AF22P49						72		72

Stream Name	Ref. No.	Production Area (X 100 m^2) S.O. 7	S.O. 6	S.O. 5	S.O. 4	S.O. 3	S.O. 2	S.O. 1	TOTAL
Twin Lakes Brook	G26AF22P56								-
N. Dunbarvan River	G26AF22P61					362			362
Unnamed	G26AF22P61B							19	19
Unnamed	G26AF22P61E						46		46
Crown Point Brook	G26AF22X								-
N. Renous River	G26AF22AJ				8,779				8,779
Orchard Brook	G26AF22AJ4								-
Rocky Brook	G26AF22AJ16								-
Quigley Brook	G26AF22AJ8								-
Upper McGraw Brook	G26AF22AJ9								-
Lake Brook	G26AF22AJ11				658	716			1,374
McKendrick Brook	G26AF22AJ12						59		59
Morrison Brook	G26AF22AJ14								-
Pear Lake Brook	G26AF22AJ25							121	121
S. Renous River	G26AF22AK				864	4,803			5,667
Monaghan Brook	G26AF22AK2					144			144
L.S. Renous River	G26AF22AK7					206	385		591
White Rapids Brook	G26AF24						115		115
Bartholomew River	G26AF34				2,308	4,746			7,054
Ledbetter's Brook	G26AF34U						372		372
Davis Landing Brook	G26AF34AA						577	106	683
N. Barthal River	G26AF34AE						237		237
S. Bartholomew River	G26AF34AF						119		119
Otter Brook	G26AF34H					822			822
Becket Brook	G26AF36						145		145
Unnamed	G26AF41					44			44
Morse Brook	G26AF44					38			38
McKenzie Brook	G26AF46					155			155
Black Brook	G26AF51					507			507
Cains River	G26AF53		14,777	15,011	5,381				35,169
Otter Brook	G26AF53C				5	193	35		233
Salmon Brook	G26AF53J					357			357
Picard Brook	G26AF53K								-
Sabbies River	G26AF53L			399					399
E. Sabies River	G26AF53L3				1,190	504	58		1,752
Ryan Brook	G26AF53L3D					35	103		138
Chain Meadow Brook	G26AF53L3F					106			106
Sutton Brook	G26AF53L3G						75		75
Meadow Brook	G26AF53L3I						146		146

Stream Name	Ref. No.	Production Area (X 100 m²) S.O. 7	S.O. 6	S.O. 5	S.O. 4	S.O. 3	S.O. 2	S.O. 1	TOTAL
W. Sabies River	G26AF53L4				1,504				1,504
Muzroll Brook	G26AF53AC				2,568	361			2,929
N. Muzroll Brook	G26AF53AC26							62	62
S. Muzroll Brook	G26AF53AC29					101			101
Six Mile Brook	G26AF53AE					1,283			1,283
E. Six Mile Brook	G26AF53AE3					663			663
Cold Brook	G26AF53AE5					133			133
Unnamed	G26AF53AZ						44		44
MacKenzie Brook	G26AF53BB				102				102
Ten Mile Brook	G26AF53BC						81		81
Blue Rock Brook	G26AF53BT					104			104
Leighton Brook	G26AF53BX								-
Gordon Brook	G26AF53Cl				186	61			247
Wildcat Brook	G26AF53CO								-
Low. Otter Brook	G26AF53CS					193	145		338
N. Caines River	G26AF53CV					311			311
McKinley Brook	G26AF53DC								-
Bantalor Brook	G26AF53DE					106			106
Sutherland Brook	G26AF53DM						121		121
Unnamed	G26AF64								-
Moore's Brook	G26AF68					132	83		215
Fowles Brook	G26AF92								-
Doak Brook	G26AF93								-
Bigltole Brook	G26AF94				274	193	77		544
Meadow Brook	G26AF94B								-
N. Bigltole Brook	G26AF94J					526			526
Bett's Mill Brook	G26AF96				398		103		501
Burntland Brook	G26AFl17				2,420				2,420
Taxis River	G26AFl18				11,043	286			11,329
Clearwater Brook	G26AFl18E					139	525		664
Stewart Brook	G26AFl18N					213	71		284
English Brook	G26AFl18O						156		156
McMillan Brook	G26AFl18Q								-
Tamarack Brook	G26AFl18S					163	85		248
Hovey Brook	G26AFl18T					336			336
Brewer Brook	G26AFl18Tl						111		111
L. Hayden Brook	G26AFl18U					296	27		323
M. Hayden Brook	G26AFl18V						158		158
V. Hayden Brook	G26AFl18W					139	72		211

Stream Name	Ref. No.	Production Area (X 100 m²) S.O. 7	S.O. 6	S.O. 5	S.O. 4	S.O. 3	S.O. 2	S.O. 1	TOTAL
Unnamed	G26AF118Y						94	83	177
Standish Brook	G26AF122								-
Porter Brook	G26AF123					268			268
Hayes Brook	G26AF129						264		264
Salmon Brook	G26AF139					404			404
McBean Brook	G26AF141					80			80
Trout Brook	G26AF146					163			163
Rocky Brook	G26AF152				3,068				3,068
Sister's Brook	G26AF153					945	84		1,029
Unnamed	G26AF153C						119		119
Clearwater Brook	G26AF157				9,552	208	265		10,025
Otter Brook	G26AF157M					141			141
Turnbull Brook	G26AF157Z						87		87
N.E. Clearwater Brook	G26AF157AF								-
Little N.E. Clearwater	G26AF157AG								-
Unnamed	G26AF157AM					149			149
Unnamed	G26AF157AO						19		19
Burnthill Brook	G26AF164			3,757					3,757
Beaver Brook	G26AF164M					268	122		390
Deer Brook	G26AF164M3						34		34
N. Burnthill Brook	G26AF164O				826				826
S. Burnthill Brook	G26AF164S				516	314	45		875
L.S. Burnthill Brook	G26AF164T					213			213
Green Brook	G26AF16403					82	157		239
MacLean Brook	G26AF169					326			326
Slate Island Brook	G26AF172								-
McKeil Brook	G26AF177				1,448	566			2,014
W. McKeil Brook	G26AF177D					3	63		66
Unnamed	G26AF183				615				615
Unnamed	G26AF184						102		102
Unnamed	G26AF185								-
Five Mile Brook	G26AF187								-
Unnamed	G26AF188						20		20
N.B. SW Miramichi River	G26AF197				5,980	1,429	912		8,321
Unnamed	G26AF197F								-
Unnamed	G26AF197M						86		86
West Brook	G26AF197O					253			253
Beadle Brook	G26AF197S					991	24		1,015
Fifteen Mile Brook	G26AF197AA					66			66

Stream Name	Ref. No.	Production Area (X 100 m^2) S.O. 7	S.O. 6	S.O. 5	S.O. 4	S.O. 3	S.O. 2	S.O. 1	TOTAL
Gray Brook	G26AF197AD								-
Deadwater Brook	G26AF197AG					110			110
Beaver Brook	G26AF197AN						105		105
Unnamed Channel	G26AF199							35	35
Little Clearwater Brook	G26AF203					759			759
Unnamed	G26AF203F						258		258
Juniper Brook	G26AF209						293		293
Unnamed	G26AF210							23	23
Teague Brook	G26AF219					329	170		499
L. Teague Brook	G26AF219B						116		116
Elliot Brook	G26AF225					548	74		622
Lake Brook	G26AF229					63	360		423
Tamarac Brook	G26AF241						21		21
SOUTHWEST MIRAMICHI RIVER AND TRIBUTARIES	TOTAL	33,557	135,795	61,749	88,507	33,814	12,521	636	366,579
	PERCENT	(9.15)	(37.04)	(16.84)	(24.14)	(9.22)	(3.42)	(.17)	(99.98)
MIRAMICHI SYSTEM	GRAND TOTAL	33,557	147,831	125,014	149,307.4	66,646.6	22,239	1,456	546,051
	PERCENT	(6.15)	(27.07)	(22.89)	(27.34)	(12.21)	(4.07)	(0.27)	(100)

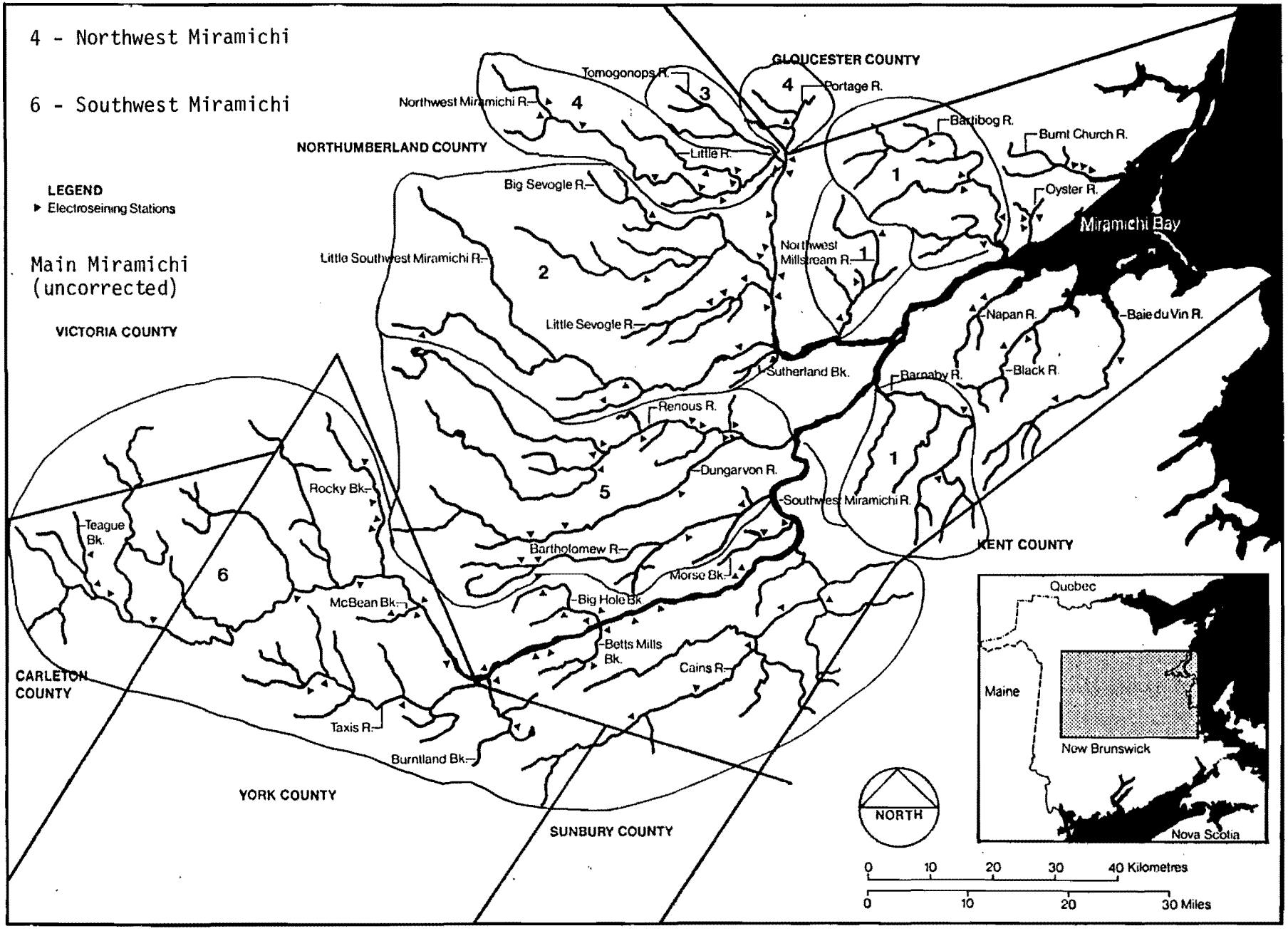

Fig. 1. Assignment of drainages to Gauging Stations for top width discharge corrections. (▼ indicates locations of electroseining stations). Figure taken from Peppar and Schofield, 1978.

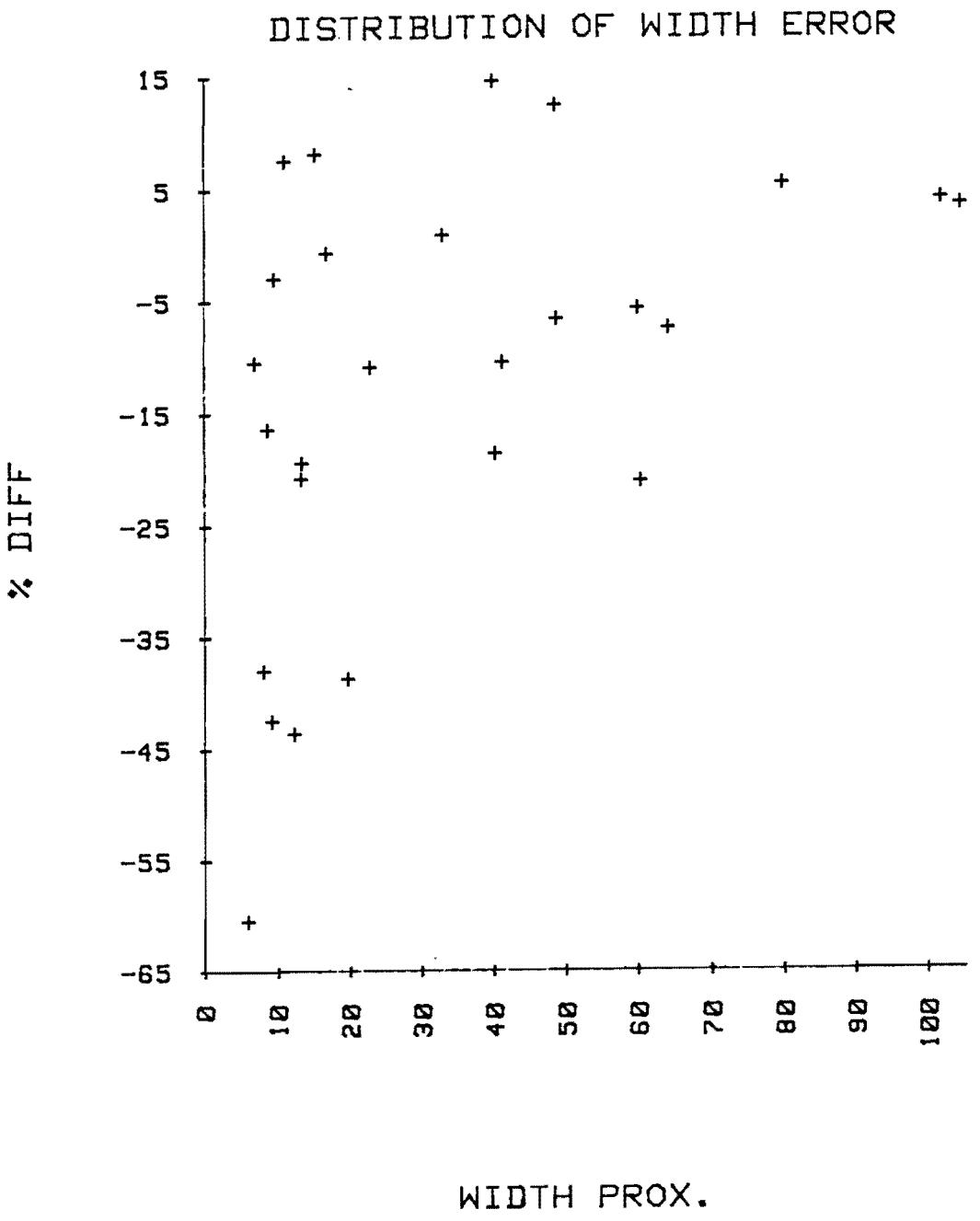

Fig. 2. Distribution of differences between mean top widths of selected reaches as measured by proximate and remote surveys and corrected to standard summer low discharge.