An efficiency estimate on the Millbank estuarial sampling trap, Miramichi River, New Brunswick, 1973

by

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ABSTRACT

In 1973, recapture traps similar in design to the Millbank sampling trap, were established on the Northwest and Southwest Miramichi rivers to estimate the population of salmon entering the Miramichi system using the Schaefer mark and recapture technique (Schaefer 1951a, b). Millbank was used as the marking site. The average population of 1-sea-winter salmon entering the Miramichi, based on 5-, 7- and 10-day estimation intervals was 102,030 while the average 2-sea-winter and older salmon population estimate was 32,778. Utilizing the average population estimates calculated by the Schaefer method and the population estimates calculated using the modified Peterson method (Bailey 1951) along with the Millbank trap catches of 1973, efficiency estimates of 3.5% and 3.4%, respectively, were calculated for 2-sea-winter salmon at Millbank and 2.4% and 4.4%, respectively, for 1-sea-winter salmon. The poor agreement between efficiency estimates for 1-sea-winter salmon relates to the difference in the estimated population which arose, at least partially, as a result of poor distribution of tag recaptures in recapture periods used in the Schaefer method.

RÉSUMÉ

En 1973, des trappes pour la recapture de saumons, identiques à la trappe d'échantillonnage de Millbank, ont été installées dans les branches nord-ouest et sud-ouest de la Miramichi dans le but d'estimer le nombre de saumons pénétrant dans le réseau de cette rivière. On a utilisé à cette fin la méthode de marquage-recapture de Schaefer (Schaefer 1951 a, b). Millbank a été choisi comme site de marquage. La population moyenne de saumons unibermarins pénétrant dans la Miramichi, sur la base d'estimations faites à intervalles de 5, 7 et 10 jours, était de 102 030 alors que la moyenne estimée de saumons dibermarins et redibermarins était de 32 778. A l'aide d'estimations moyennes de population obtenues par la méthode de Schaefer et les estimations de population dérivées de la méthode de Peterson modifiée (Bailey 1951), ainsi que des prises de la trappe de Millbank en 1973, on est arrivé à des estimations de 3,5 % et 3,4 %, respectivement, pour les saumons dibermarins à Millbank, et de 2,4 % et 4,4 %, respectivement, pour les saumons unibermarins. La faible concordance entre les estimations de rendement des saumons unibermarins est liée à la différence dans la population estimée résultant, au moins partiellement, de la mauvaise distribution des recaptures de marques durant les périodes de recapture choisies dans la méthode de Schaefer.

INTRODUCTION

The Miramichi River system, New Brunswick, with a drainage basin of 14,170 sq km (Bousfield 1955), has long been considered as one of the most important Atlantic salmon (Salmo salar) rivers in the world. Trapping operations at Millbank (Fig. 1) have been used since 1954 to provide valuable biological management data on Atlantic salmon related to run timing, run composition, relative run size from year to year, length, weight and sex ratios for 1- and 2-sea-winter or older salmon entering the Miramichi system.

A lack of accurate catch and effort statistics for the commercial and recreational salmon fisheries on the river as well as insufficient knowledge of the various factors affecting stock size from year to year have made it difficult to provide acceptable stock-recruitment models to predict runs of salmon back to the river system. In 1973, in an attempt to provide more accurate information on actual river escapement throughout the year as well as for the entire year, a mark and recapture program utilizing Millbank as the tagging site and traps on the Northwest and Southwest Miramichi rivers as recaptures sites was initiated. The study was originally planned for a 3-5 year period which would have allowed the Department of Fisheries and Oceans to assess the feasibility of using an efficiency estimate on the Millbank trap to determine stock size entering the river after the mark and recapture traps were discontinued. Unfortunately, the experimental work was discontinued after only one year.

The following material summarizes the results of the one year's findings related to utilizing Millbank as predictor of actual Atlantic salmon stock size.

METHODS AND MATERIALS

The Millbank estuarial trap (Fig. 2) has been operating each year since 1954, findings have been described by Turner (1974, 1975, 1976), Turner and Schofield (1984 in preparation) and by Ruggles and Turner (1973). The trap, a modified commercial salmon trap, was operated throughout the salmon run migration period in 1973 - from May 14 to November 1. Tagging with modified Carlin tags was carried out proportionate to run size over the entire migration period.

Recapture traps, similar in design to Millbank, were established upriver on opposite banks of each of the Northwest and Southwest Miramichi rivers (4 traps in total). The traps were approximately opposite each other, with the Northwest traps about 19 km upriver of Millbank near McKay Brook and the Southwest traps located approximately 17 km upriver of Millbank near Millerton

(Fig. 1). Although all the recapture traps did not fish the entire migration period, they did cover the major portion.

The Schaefer Method (1951 a, b) of mark and recapture was used to estimate total populations of 1- and 2-sea-winter or older salmon. Although 5, 7, 10, 15 and 30 day intervals were used in calculation of Schaefer population estimates, only the 5, 7, and 10 day estimates were included here. The 15 and 30 day interval calculations made little difference in population estimates. All computer printouts for all periods, including the numbers tagged and released in the various periods, have been supplied to those presently researching the practicality of future use of the Schaefer technique. The Northwest and Southwest Miramichi river trap catches and tag returns were pooled to provide populated estimates for the entire river system.

Petersen population estimates modified according to Bailey (1951) were calculated for the overall season run to compare with Schaefer estimates and to obtain standard deviation (S.D.) estimates.

RESULTS

Twice monthly catch per fishing day data for 1- and 2-sea-winter or older salmon at Millbank and the recapture traps for 1973 are plotted (Figs. 3 and 4). Run timing and relative run size are quite similar for both 1- and 2-sea-winter or older salmon at Millbank and at the recapture traps. Significant correlations (r) between catches at individual recapture traps and between Millbank and the recapture trap on a daily basis are evident, although r^2 values are low (Table 2).

Approximately 25% of the 1-sea-winter and 54% of the 2-sea-winter and older salmon which were trapped at Millbank in 1973 were tagged (Table 1). Using tag returns and numbers trapped on the Northwest and Southwest Miramichi and after several trials of the Schaefer Model, the 5-, 7- and 10-day periods were used to calculate total Miramichi River salmon runs into the river system. The 1-sea-winter run ranged between 89,493 and 116,464 (mean = 102,030) while the 2-sea-winter and older run ranged between 32,221 and 33,801 (mean = 32,778).

TABLE 1. Miramichi mark and recapture data and Schaefer population estimates for 1- and 2-sea-winter salmon entering the Miramichi River in 1973 (Northwest and Southwest Miramichi recapture trap data combined).

	Total no. salmon				Schaefer population estimates			
	Millbank trap		Recapture traps					
Stage	Trapped	Tagged	Trapped	Recapture	5-day	7-day	10-day	Mean
1-SW	2,450	604	7,333	79	89,493	100,133	116,464	102,030
2-SW	1,132	612	3,003	55	33,801	32,221	32,312	32,778

TABLE 2. Correlation coefficients (r), "P" values and coefficients of determination (r^2) from regression of early counts of salmon taken at the Northwest and Southwest Miramichi recapture traps and Millbank, 1973.

Age	Trap combinations	r	P	r^2
2-SW	Northwest Miramichi - north vs south side	0.7858	0.001	0.6175
	Northwest Miramichi total vs Millbank	0.7072	0.001	0.5001
	Southwest Miramichi - north vs south side	0.6776	0.001	0.4591
	Southwest Miramichi total vs Millbank	0.7260	0.001	0.5271
	Northwest vs Southwest Miramichi Total	0.8019	0.001	0.6430
1-SW	Northwest Miramichi - north vs south side	0.7337	0.001	0.5383
	Northwest Miramichi total vs Millbank	0.7492	0.001	0.5613
	Southwest Miramichi - north vs south side	0.6596	0.001	0.4351
	Southwest Miramichi total vs Millbank	0.5773	0.001	0.3333
	Northwest vs Southwest Miramichi Total	0.7020	0.001	0.4928

No confidence limits could be put on the Schaefer estimates but when the modified Petersen method was used on the same data, a 1-sea-winter population of 55,372 (SD = 6,119) was calculated. A Petersen determination on the 2-sea-winter and older salmon yielded an estimated population of 32,829 (SD = 4,308).

The estimated total populations of salmon entering the Miramichi system, according to Schaefer and the modified Petersen method, were compared with the total Millbank catches of 1- and 2-sea-winter salmon to calculate a trap efficiency at Millbank (Table 3).

It can be seen that the 2-sea-winter efficiencies by the two methods compare favorably, 3.5% according to Schaefer versus 3.4% according to the modified Petersen method. However, there is considerable difference between the two efficiency estimates or 1-sea-winter salmon, 2.4% according to Schaefer versus 4.4% according to the modified Petersen method.

TABLE 3. Comparison of efficiency estimates for capture of 1- and 2-sea-winter salmon at Millbank utilizing population estimates calculated according to Schaefer and the modified Petersen method.

Stage of salmon	Efficiency estimates calculated using mean Schaefer estimate from Table 1	Efficiency estimates calculated using the modified Petersen estimates
1-sea-winter	2.4	4.4
2-sea-winter	3.5	3.4

DISCUSSION

The 1973 mark and recapture effort on the Miramichi was to be the first year of a 3-5 year study looking, not only at yearly population estimate techniques, but also at within-year estimates. The study period never materialized and operations at the recapture traps ceased at the end of 1973.

This report looks only at the total years population estimates according to two recognized methods and it can be seen that there is considerable agreement for the 2-sea-winter population estimates using the two techniques but this was not the case for the 1-sea-winter estimates.

The Schaefer method works best when real, not assumed fish, are represented in each period for which in-season population estimates are calculated. In addition, the better the distribution of tag returns throughout all the periods, the better the estimate. The Schaefer estimate data for the 2-sea-winter salmon met these criteria more closely than did the 1-sea-winter estimate data. Thus, it is felt that only the modified Petersen method gives a reasonable estimate of the overall 1-sea-winter population for the year.

The Schaefer Method is essentially a series of Petersen estimates responsive to shorter periods for population estimation. Sufficient tags must be applied to ensure there are recaptures in each tagging period. When no recaptures occur in a period, it is necessary to carry out a mathematical manipulation to ensure each period's population estimate can be calculated.

To deal with no tag returns in a period, we used the following technique. If a period contained no tag returns although fish were tagged, we looked at the next period in line and ascertained if tags were recovered. If tags were recovered, we combined the two periods (all tags applied and tags returned),

carried out the Schaeffer calculations for estimating the "combined" period population estimate, and then averaged that period population over the two original smaller periods. This technique allowed us to deal with real tags applied as well as real tags returned rather than having to create "assumed" recaptures. The computer program used to carry out the Schaefer estimations is available in the Scotia-Fundy office of the Freshwater & Anadromous Division, Fisheries Research Branch.

Had the study lasted for more than one year, it might have been possible to alter the tagging regime for the 1-sea-winter salmon at Millbank to allow for more tagged fish per calculation period in the Schaefer technique. In this manner, we could have determined if the Schaefer and modified Petersen estimates would indeed correspond more closely and also if efficiencies for 1- and 2-sea-winter salmon would correspond better.

The author feels that the real potential of the Schaefer method is for in-season population estimates to allow for more timely response to changing production levels to a river system. If estimated production levels have varied from predicted levels due to some unforeseen circumstance, we are not able to detect this using Petersen-type estimates until after the fishing season is over. We may, by that time, have allowed too few fish through for spawning or not allowed enough to be harvested (resulting in an over- or under-escapement to the spawning beds).

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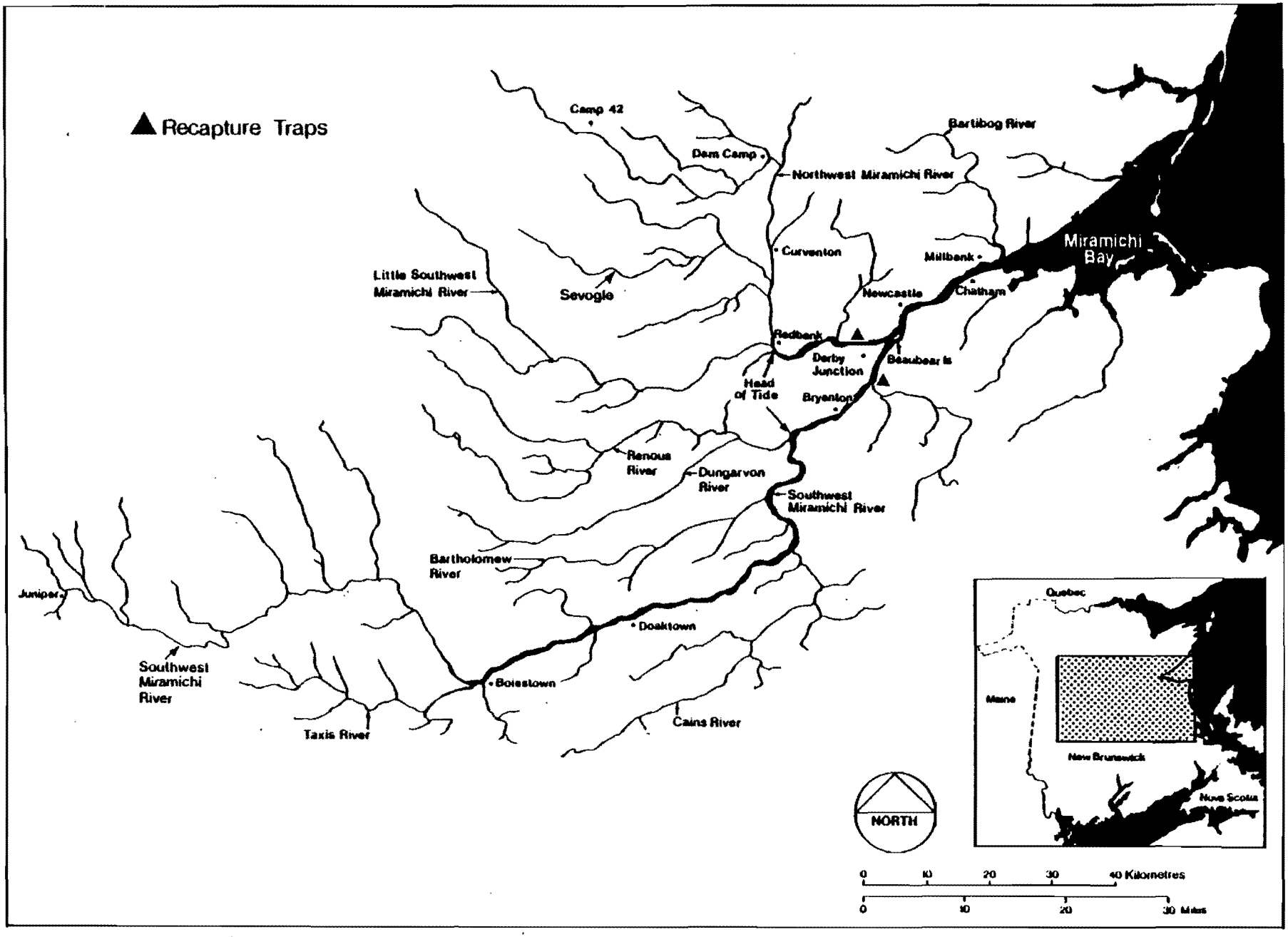
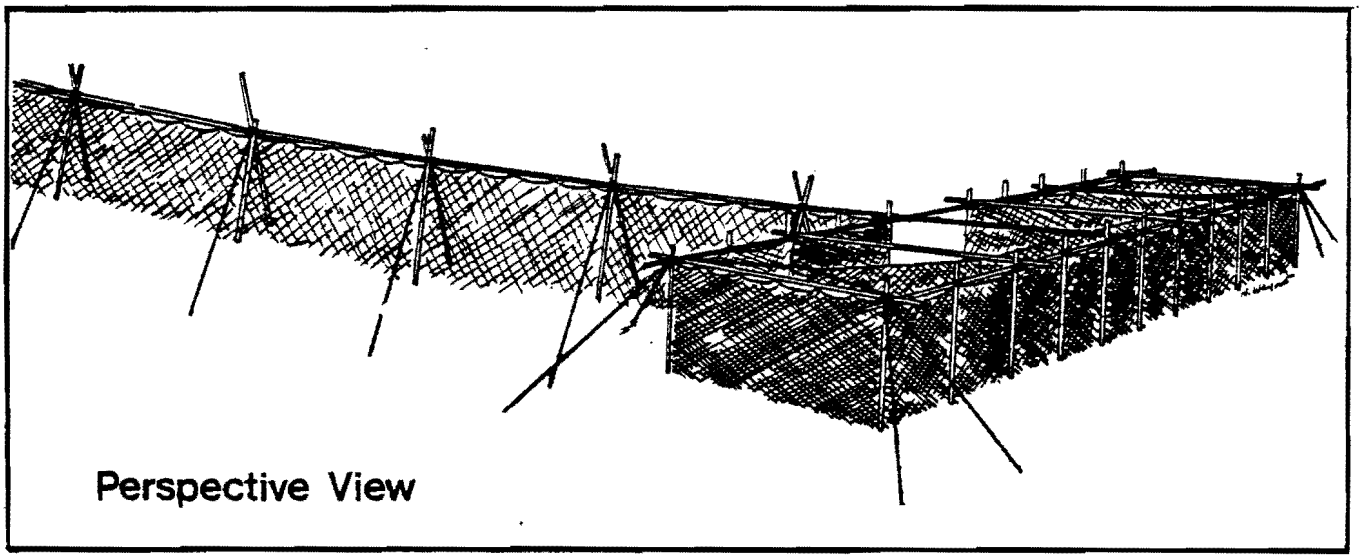


Fig. 1 Map of Miramichi River system showing experimental trap locations.



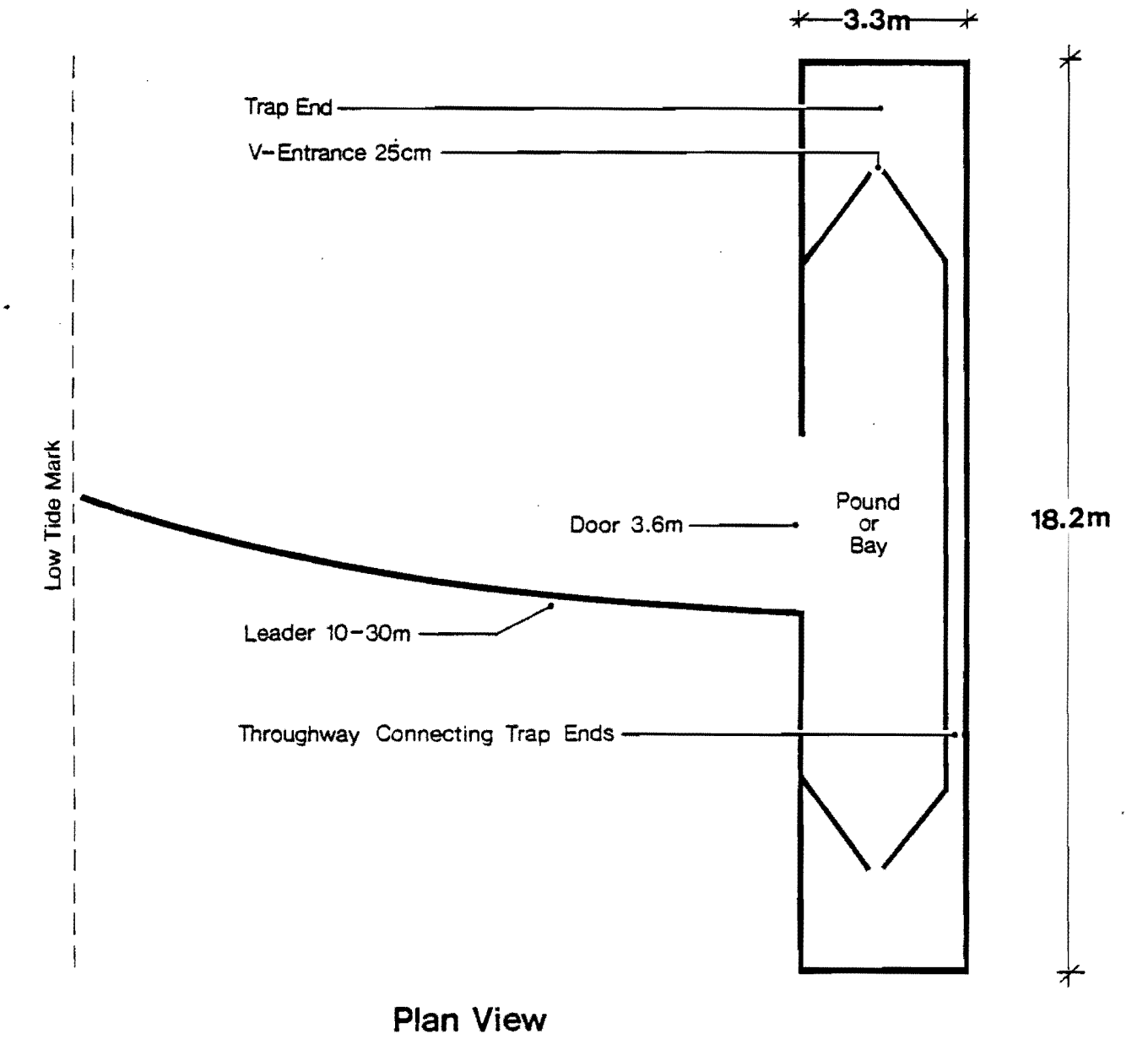


Fig. 2 The adult sampling trap used to monitor Atlantic salmon runs in the Miramichi River estuary, New Brunswick.

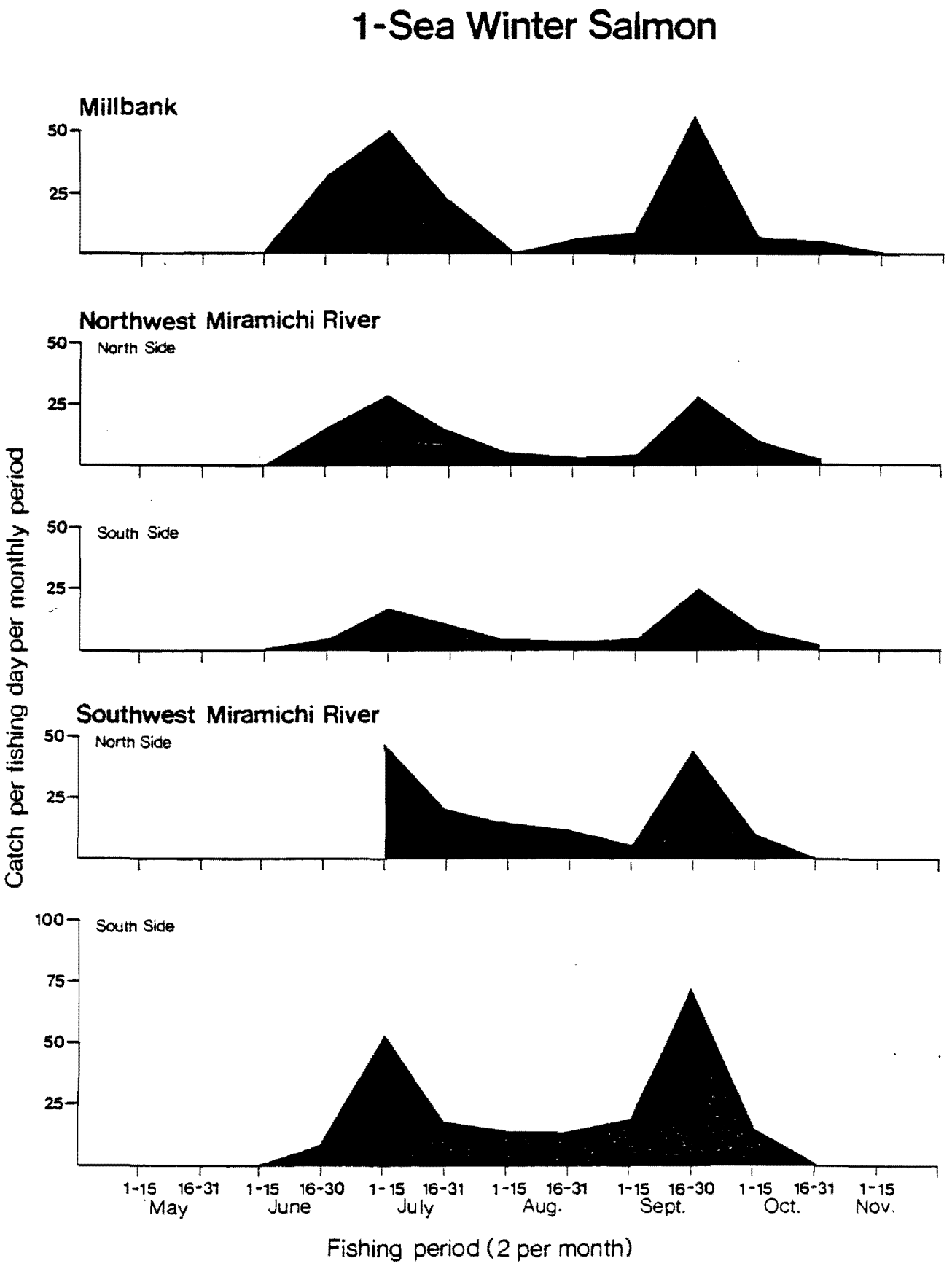


Fig. 3. Millbank, Northwest Miramichi and Southwest Miramichi experimental trap catches for 1973 on a twice monthly basis for 1-sea-winter

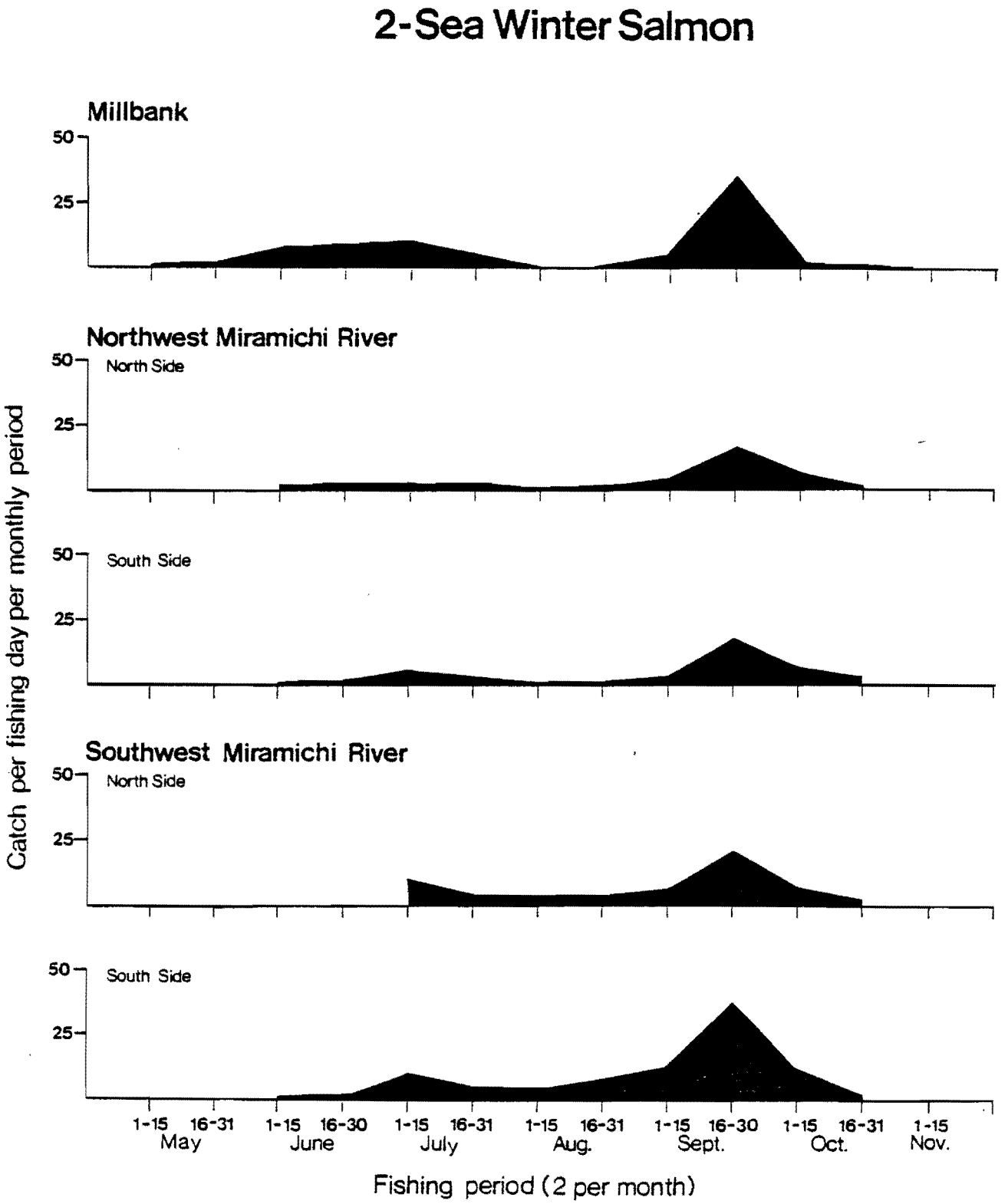


Fig. 4. Millbank, Northwest Miramichi and Southwest Miramichi experimental trap catches for 1973 on a twice monthly basis for 2-sea-winter and older salmon.