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WESTERN IRELAND MIGRATORY TROUT (SALMO TRUTTA) : SMOLT PRODUCTION, CHARACTERISTICS AND TIMING OF MIGRATION.

O'Farrell,M.M.[1], Whelan,K.F.[2] and Poole,R.[2], Gargan,P.[3], Peirce,R.P.[4], Moore,T.[5], and Lubberhuizen,J.[6].

Zoology Department, University College, Galway[1];
Salmon Research Agency of Ireland,Newport,Co. Mayo[2];
Central Fisheries Board, Mobhi Boreen, Glasnevin, Dublin 9.[3];
Gillie Angling, Cornamona, Co. Galway[4];
Costello and Fermoyle Fisheries, Costello, Connemara, Co. Galway[5];
Crumlin Fishery, Connemara, Co. Galway[6].

ABSTRACT

Migratory trout (Salmo trutta) smolt census work is ongoing in a number of catchments in western Ireland. The number of smolts counted downstream has been related to the amount of lentic water (ha) and catchment area upstream of trap sites. This information has been used to estimate the number of smolts migrating to sea in recent years for a geographic region in Western Ireland.
The timing of smolt migrations at each trap site is described. A description of the age and size characteristics of smolts based on individuals of known age is presented.

INTRODUCTION

This paper reports on migratory trout (Salmo trutta L.) smolt census work which is ongoing in the west of Ireland. The results of research presented here reflect the current interest in the status of migratory trout stocks that prevails throughout Ireland. Migratory trout smolt census work carried out in the years 1988 - 1993 is reported in this paper. The results from 1988 together with a more comprehensive treatment of the management of migratory trout populations were the subject of an earlier paper (O'Farrell and Whelan 1991).
The present paper does not present a comprehensive description of biological characteristics (age structure, sex ratio, length and weight statistics etc) from each study site. Instead, results obtained from smolt of known age (survivors of 0+ fish coded-wire tagged and stocked into lentic habit) are presented and compared with

other recent results.

STUDY AREA

The study area comprises the geographic area of Western Ireland bounded on the east by the Corrib catchment and on the north by the Moy catchment. This area covers 2189 km^2 (Anon., 1958)
A provisional calculation of the total amount of lentic water in this area has been made using GIS satellite images and found to be approximately 51km^2 (2.32% of the region) (A. Eachert, personal communication).
The locations of the catchments included in the study are shown in figure 1. The lentic area and catchment area upstream of each study site is given in table 1. Ordnance Survey maps with scales 1 : 10560 and 1 : 126720 were used to calculate lentic areas and catchment / subcatchment areas, respectively.
Study site National Grid references are as follows:
Burrishoole L 96 98 (Lough Feeagh afferent streams - the Mill Race and Salmon Leap - tidal lough immediately downstream of traps);
Erriff L 93 68 (Tawnyard Lough afferent stream, the Black River - trap located approximately 10 km from the sea);
-Culfin L 78 62 (Lough Fee afferent stream - trap located approximately 4 km from the sea);
-Gowla L 82 40 (trap located on the main channel immediately upstream of the tidal limit);
Cashla M 03 31 (School House Lakes afferent stream - trap located approximately 10 km from the sea);
Cashla L 99 33 (Lough Naskeha afferent stream - trap located approximately 6 km from the sea);
Crumlin M 05 25 (Lough Ugga Mor afferent stream - trap located approximately 4 km from the sea).

MATERIALS AND METHODS

Conventional downstream traps (Wolf 1950; Cresswell 1977) were used to intercept migrating smolt. Traps were serviced on a daily basis or more frequently if required. At some trap sites all fish recorded were measured for length to the nearest mm (forklength). At each trap site samples were weighed using a variety of electronic and spring balances. Scale samples were also collected from a representative sample of fish at each site. Specimens from each site were also retained for sex determination.

RESULTS

1. Smolt census

The numbers of smolt intercepted at each site, the catchment area and lentic habitat upstream of each site and the numbers of smolt intercepted per unit area of lentic habit (ha) and catchment (km^2) upstream of each site are presented in table 1. Census

conditions at each site varied between years. Spate conditions on the Erriff, Crumlin and Gowla may have resulted in an incomplete census. The Erriff data for 1993 may be an example of this.

2. Timing of migration

Figure 2 presents the cumulative percentage number of smolts recorded at five study sites during the years 1990 to 1993 (the Gowla trap was not operated in 1990). At four of the five sites there is considerable between year variation in the timing of migration. On the Gowla there is little between year variation.

Two traps were operated on the Cashla system during 1992 and 1993 (figure 3). Smolts migrated from Lough Naskeha earlier than those from School House Lakes but by the time approximately 80 % of smolts had migrated from their respective lakes the migration of the remaining smolts synchronised.

3. Characteristics of migratory trout smolts

Smolts migrating from the School House Lakes in 1992 and 1993 comprised wild fish and coded-wire tagged / adipose fin-clipped survivors of 2840 0+ trout planted in October 1990 with an average weight of 5g.

Survivors from this planting comprised 25.6% (33 of 129 fish) captured during a seining operation carried out in these lakes in October 1991 (top panel figure 4).

A total of 66 tagged smolt were recorded in 1992 which represents 20.2% of smolt output (66 of 327 fish - an additional 21 fish were sacrificed for sex determination) and 2.3% of trout stocked (centre panel figure 4).

In 1993 69 tagged smolt were recorded which represents 25.6% of smolt output (69 of 269 fish - an additional 17 fish were sacrificed for sex determination) and 2.4% of trout stocked (bottom panel figure 4).

The length characteristics of these fish as two- and three-year-old smolt are given in table 2. The weights of 59 two-year-old and 13 three-year-old smolt were recorded in 1992 and 1993, respectively, using an electronic balance reading to the nearest 5g. Two-year-old smolt averaged 55.9g (S.D. = 11.0) while three-year-olds averaged 83.4g (S.D. = 17.6).

A logarithmic equation best fitted the length : weight relationship (figure 5) as follows:
Log Y (weigth in grams) = Log 0.015 + 2.814 Log X (forklength in cm).

The sex ratio (female : male) of 74 smolt sampled in 1992 and 1993 on the Cashla system was 1: 1.24 while that of 48 smolt sampled on the Crumlin system in 1992 was 1: 0.84.

DISCUSSION

1. Smolt census

The numbers of smolt migrating from catchments studied since 1988 are declining. While there is considerable variation between sites in terms of numbers of smolt recorded per unit lentic area and catchment area upstream of these sites the overall trend is downwards. Lentic area upstream of trap sites would appear to be a better measure of smolt production for the region as large coastal tracts appear to be devoid of watercourses. Figure 6 presents estimates of regional smolt production based on

the area of the region (km^2) and on the amount of lentic habitat in the region (ha). Figure 6 presents the mean number of smolt recorded at all sites each year per hectare of lentic habitat and per km^2 of catchment upstream of each trap site as follows:

Year	Mean no. smolt ha^{-1}	S.D.	No. traps in operation	Regional estimate of smolt output
1988	22.5	21.4	4	114750
1989	7.9	1.2	2	40290
1990	18.5	17.5	4	94350
1991	24.4	23.9	5	124440
1992	19.1	14.9	5	97000
1993	8.7	8.2	6	44370

Year	Mean no. smolt km^{-2}	S.D.	No. traps in operation	Regional estimate of smolt output
1988	178.6	154.5	4	391000
1989	87.8	70.3	2	192000
1990	132.5	100.8	4	290000
1991	122.5	89.7	5	268000
1992	132.0	75.1	5	289000
1993	60.6	39.6	6	133000

While the estimates based on catchment area upstream of trap sites are judged to be unsatisfactory when raised to the regions total area they are similar to estimates of maximum salmon smolt production made for other Irish catchments. Kennedy and Crozier (1993) estimated maximum salmon smolt production for the Burrishoole catchment at over 175 km^{-2} and for the Bush catchment in Northern Ireland at 108 km^{-2}. A total of 5.77% of the Burrishoole catchment area is occupied by lentic water while the Bush does not have any lentic water and the wetted area of lotic habit amounts to 0.25% of the catchment area. Thus the Burrishoole has a maximum salmon smolt production km^{-2} of catchment which is 1.62 times that of the Bush while the area of lentic habit in the Burrishoole is twenty-three times the area of lotic habitat in the Bush. Migratory trout smolt production levels km^{-2} of catchment area upstream of trap sites have been found to be significantly higher than maximum levels recorded for salmon smolt production. Many of the small catchments of the west of Ireland have a significant percentage of their catchment area as lentic habitat e.g. Erriff - 1.14%; Cashla - 6.03%; Culfin - 9.3%; Gowla - 3.25%; Crumlin - 3.84%.

2. Timing of migration

The proximity of the Gowla trap to the sea probably makes the information from this trap, in terms of time of entry of migratory trout to the sea, more valuable than any other in operation. The other five traps operate at some distance from the sea and they may

be measuring the time of downstream movement - to lower freshwater / brackish reaches - rather than time of entry to the sea. The Gowla data set also shows that migratory trout smolt enter the sea with little variation in timing between years and that the migration is virtually completed by the end of April, unlike other catchments where migration occurs well into June e.g. Erriff and Burrishoole.

3. Smolt characteristics

The characteristics described earlier for smolt of known age suggest that cohorts may now be producing similar numbers of smolt at age two and three. If cohorts were of similar strength from year to year it would be expected that two- and three- year-old smolt would have a similar abundance among sampled migrating smolt. Similarly,a predominance of one age group over another may signal strong and weak cohorts.

Gargan and Roche (1992) recorded the following migratory trout age distribution on the Erriff:

Year	Age 2	Age 3	Age 4	Age 5	Number
1990	35.4%	52.3%	10.8%	1.5%	65
1991	26%	40%	1.5%	1.5%	68
1992	12.7%	63.5%	23.8%		63

It is planned to monitor the Cashla River School House Lakes trap in 1994 with a view to intercepting four-year-old coded-wire tagged smolt thus completing the assessment of smolt production from 2840 tagged 0+ trout stocked in 1990.

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Table 1 Sea trout smolt output from various catchments in Western Ireland during the years 1988 - 1993

Catchment	Lentic area (ha) upstream of trap	Catchment area (km^2) upstream of trap	Year	No. smolt	No. smolt ha^{-1} lentic area upstream of trap	No. smolt km^{-2} of catchment
Burrishoole	450.7	83.50	1988	4290	9.5	51.4
			1989	3179	7.0	38.1
			1990	2053	4.5	24.7
			1991	2520	5.6	30.3
			1992	1936	4.3	23.2
			1993	1686	3.7	20.2
Erriff (Tawnyard Lough)	55.0	11.81	1988	2877	52.3	243.4
			1989			
			1990	2426	44.1	205.3
			1991	3017	54.8	255.3
			1992	1857	33.8	157.1
			1993	491	8.9	41.5
Cashla (School House Lakes)	33.9	2.18	1988	800	23.6	366.9
			1989	300	8.8	137.6
			1990	503	14.8	230.7
			1991	279	8.2	127.9
			1992	348	10.3	159.6
			1993	286	8.4	131.2
Cashla (Lough Naskeha)	27.7	1.54	1992	357	12.9	231.8
			1993	162	5.8	105.2
Crumlin (Lough Ugga Mor)	79.6	12.26	1990	854	10.7	69.6
			1991	609	7.7	49.6
			1992	1928	24.2	157.2
			1993	203	2.5	16.5
Gowla	164.2	50.50	1991	7557	46.0	149.6
			1992	5999	36.5	118.7
			1993	4088	24.9	80.9
Culfin (Lough Fee)	187.6	16.44	1988	866	4.6	52.7

Table 2 Forklength characteristics of stocked trout from the School House Lakes, Cashla River system.

Year sampled	Age	Mean length (cm)	S.D	Number
1991 (October)	1+	14.66	0.84	33
1992 (March-May)	2	18.42	1.28	66
1993 (March-May)	3	20.43	1.55	69

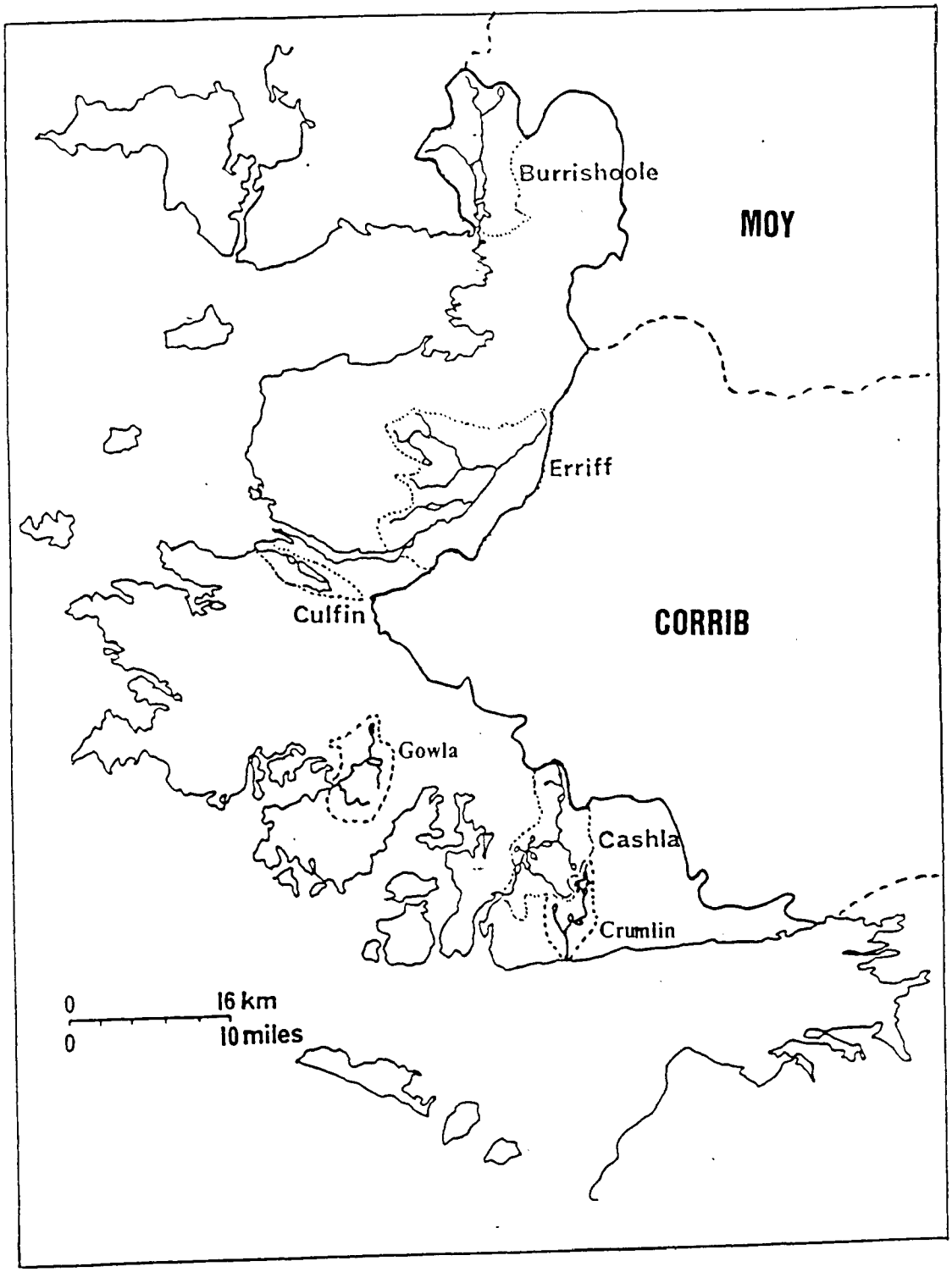

Figure 1 Study area in Western Ireland

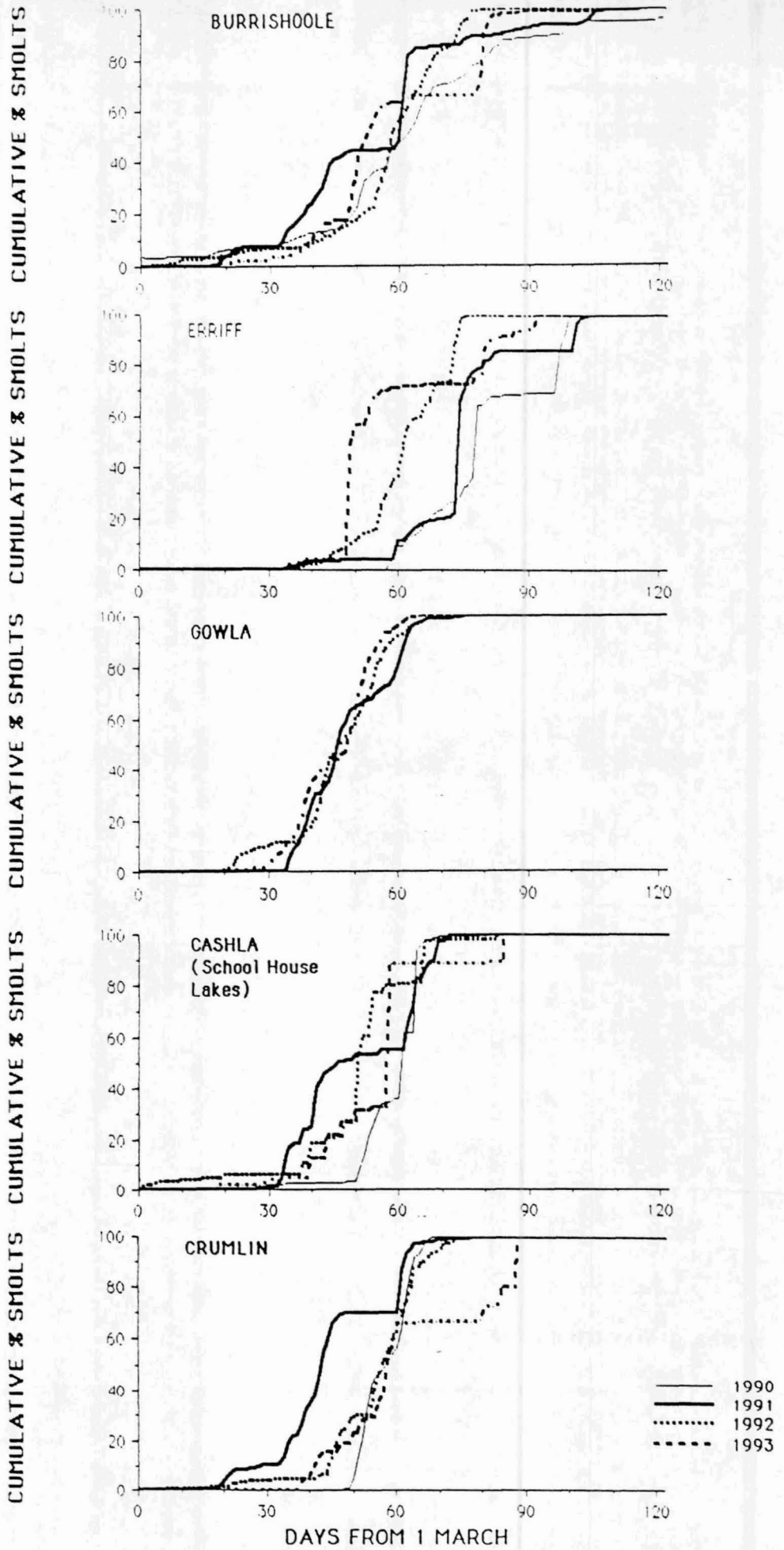

Figure 2 Timing of migratory trout smolt migration in five catchments in Western Ireland.

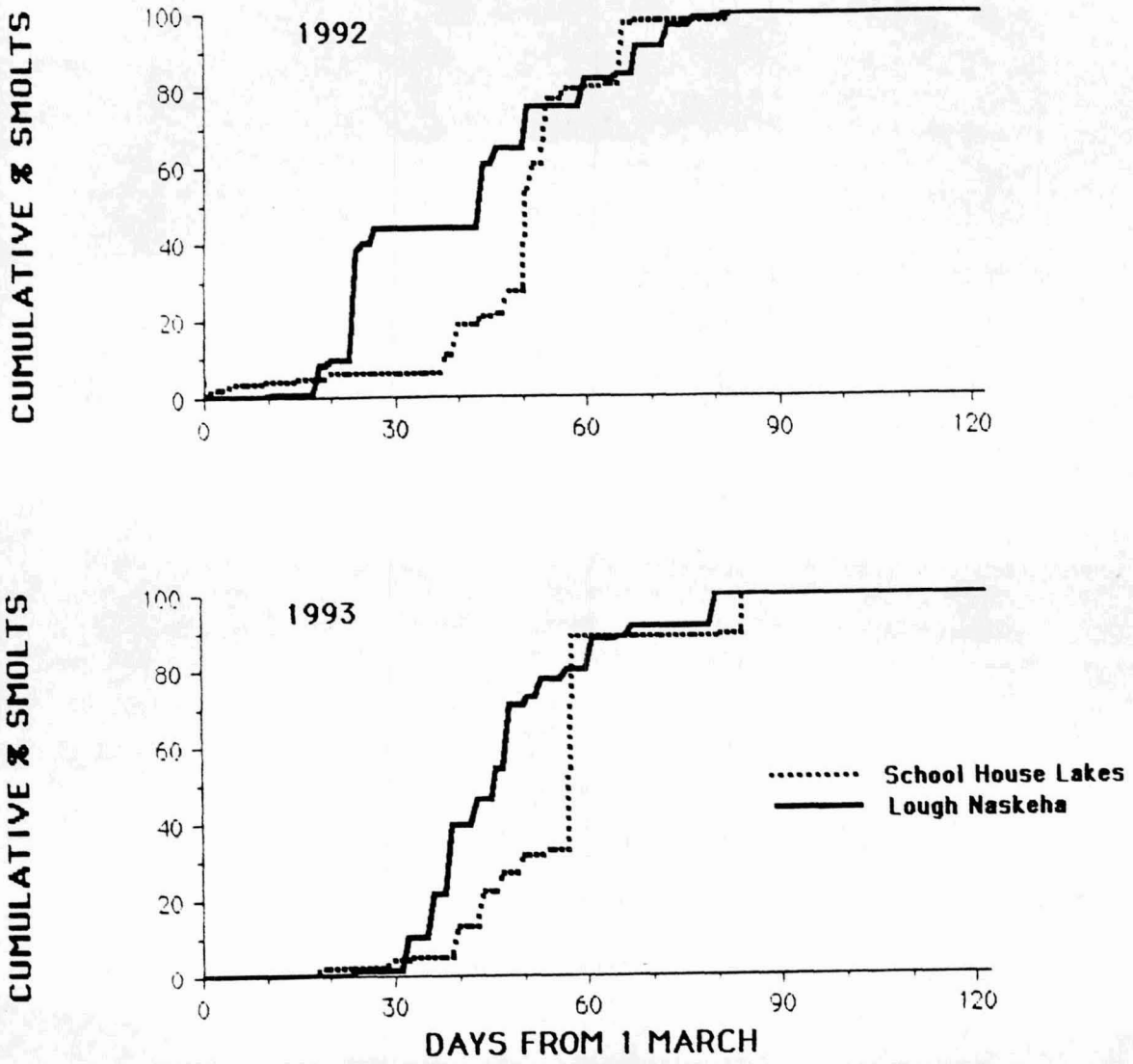

Figure 3 Timing of migratory trout smolt migration in two subcatchments of the Cashla River system.

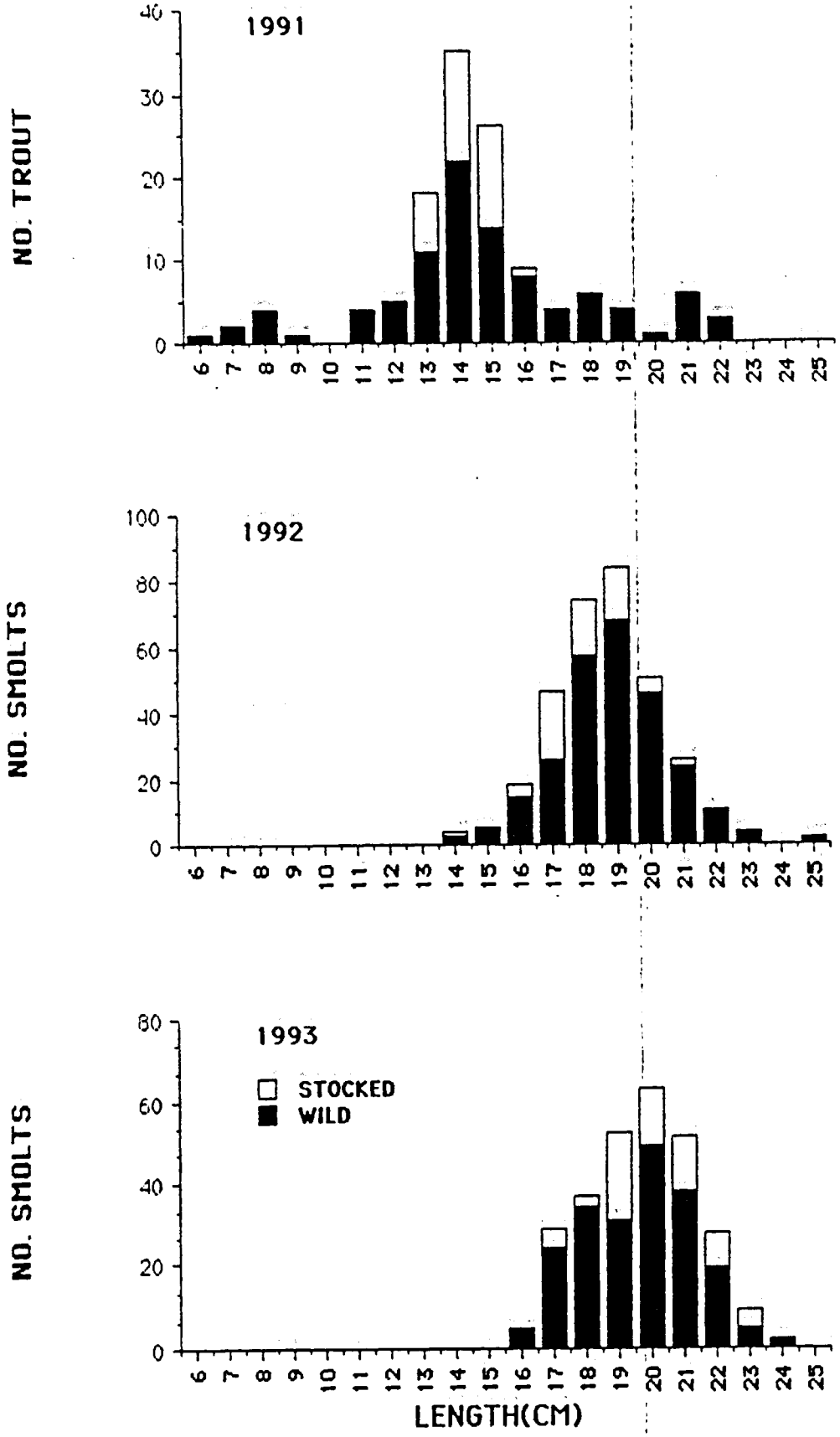

Figure 4 Length frequency distributions of stocked and wild trout from the School House Lakes, Cashla River system: top panel - from 1991 seine net survey; centre panel - from 1992 smolt migration; bottom panel - from 1993 smolt migration.

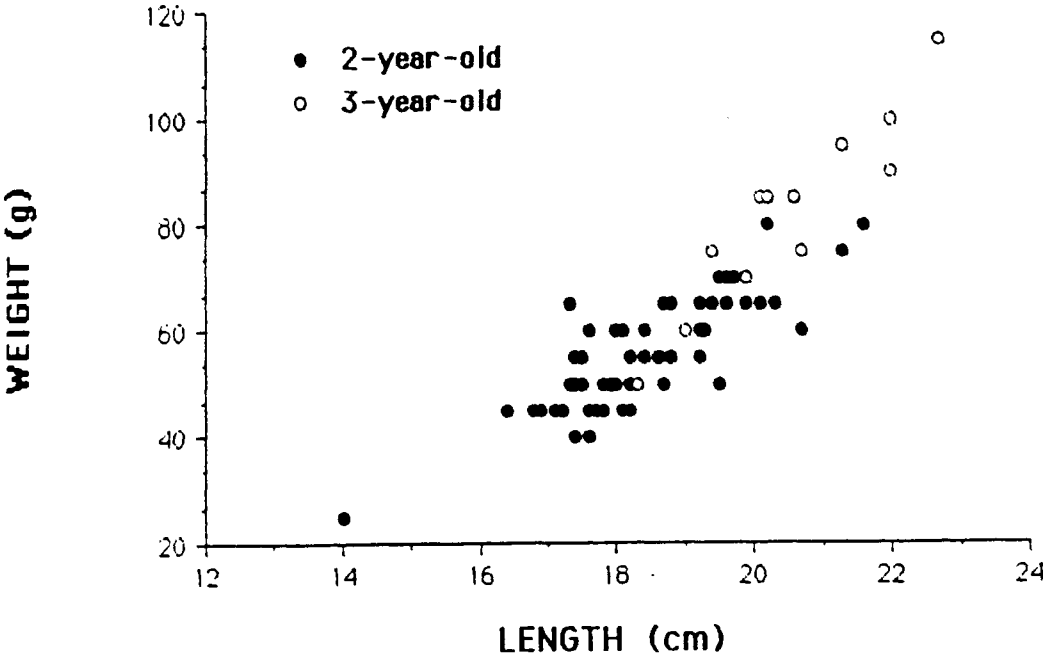

Figure 5 Length : weight relationship for two- and three-year-old migratory trout smolt from the School House Lakes, Cashla River system.

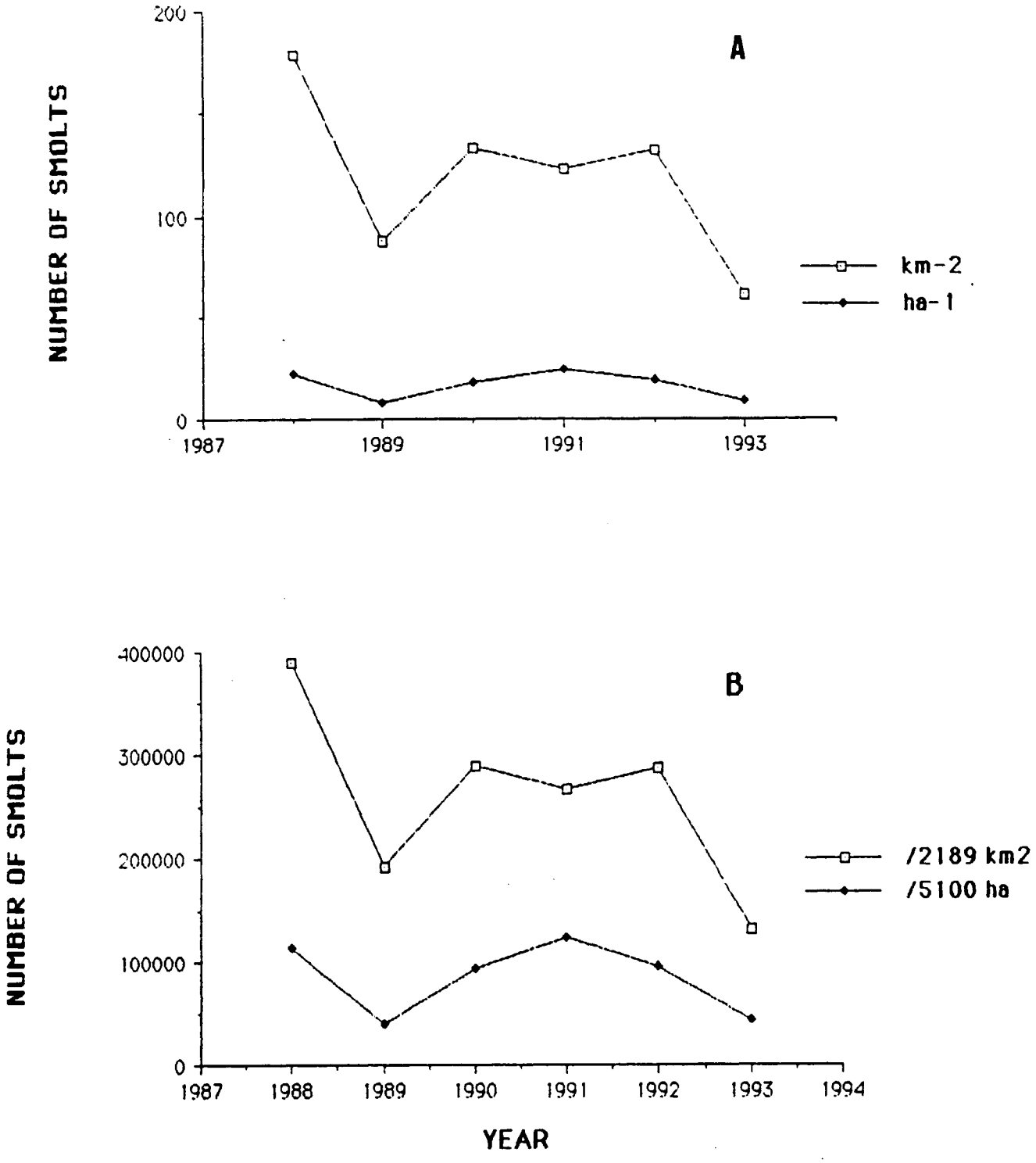

Figure 6 Estimates of regional migratory trout smolt output:
panel A - averages of output ha^{-1} of lentic habitat and km^{-2} of catchment area;
panel B - the above averages raised to regional level