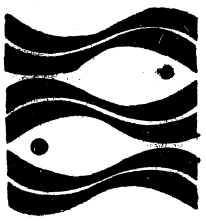

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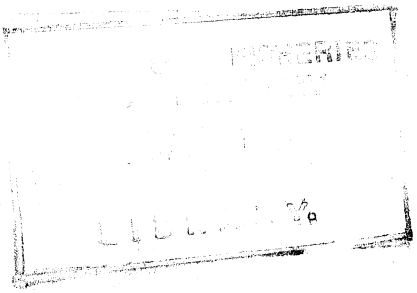

PROFILE OF THE CARAGH, COUNTY KERRY

A SALMONID PRODUCING CATCHMENT

by

Edward Fahy

Fishery Leaflet 136 1987

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From the mid 1960s competition for Atlantic salmon intensified with the expansion of high seas fisheries in the marine sub-Arctic and drift-netting closer to home. Inshore commercial fishermen and freshwater anglers saw progressively more of the salmon stock being landed outside its river of origin which prompted some to seek an alternative game species. Sea trout, which have traditionally been a by-catch of the commercial salmon fishery and which game fishermen valued, were considered and various clubs and individuals (fishery owners and managers) addressed queries to the Department responsible for fisheries on the possibility of developing a sea trout run to supplement a declining salmon population.

The majority of queries examined by this writer concerned the introduction of sea trout to parts of river systems outside their normal range. A review of sea trout distribution (Fahy, 1977) described their migratory limit inland and contained adequate information to assess the suitability of the majority of fresh water bodies for the fish. The Caragh (Glencar) catchment was more intriguing.

There are now in existence many investigations on the inter-relationships of salmonid species in fresh water and on their interactions with their environment but there are few specific references to the suitability of catchments for particular species. This investigation examines a case in point.

Introduction

A query from Mr Karl Daly, proprietor of the Glencar Hotel, who has much of the fishing in the catchment, on the possibilities of improving the sea trout run into the Caragh System, prompted the investigation described here.

The facts of a query of this kind must, first of all, be ascertained and this is usually accomplished by scrutiny of catch records. For the Caragh there was nothing relevant. Sea trout were known to occur in the catchment; indeed they probably occur in every coastal catchment in some numbers, but their actual strength could not be confirmed.

Information of secondary quality is the prevailing angling opinion and that regards the Caragh as a salmon producer. The Angler's Guide to the Irish Free State (1937) reported it

".... often very good in the spring, from January 17th to June ...."

and that is currently how it is perceived, hence the desire to enhance the sea trout run in order to extend the season.

Procedure

The investigation of the Caragh was approached in two ways:

A topographical inquiry was pursued on the ground, in the catchment, and from 1 : 63,360 (1 inch to 1 mile) O.S. maps.

A limited electrofishing survey was undertaken in October 1986.

Information collected in both of these was evaluated by comparison with similar data from the Connemara sea trout producing catchments in 1982-1983 (Fahy, Nixon, Murphy and Dempster, 1984).

The Caragh Catchment

The River Caragh is situated in the North-eastern half of the Iveragh Peninsula, Co. Kerry. The river rises at approximately 400m OD, 18.5 km south west of Killarney and flows in a north-westerly direction to the sea in Dingle Bay (Figure 1).

The area of the catchment is 154km. This is slightly smaller than the area given by Heuff and Horkan (1984) (who, however, included a small subcatchment to the North of Caragh Bridge) which is almost identical with the area of the Ballinahinch system (160 km)one of those examined in the course of the Connemara investigations referred to and a notable sea trout producer. Comparisons between these two will be made. Ballinahinch is regarded as typical of fisheries of Eastern Connemara, except that it

is larger than average. Where greater numbers of measurements describing elements of the water bodies are required, reference will be made to the general body of data collected in Connemara. Further comparisons between Caragh and Ballinahinch follow:

	Caragh	Ballinahinch
Area of catchment (km^2)	153.8	160.0
Lake area (km^2)	5.9	11.7
Land area in catchment (km^2)	147.9	148.3

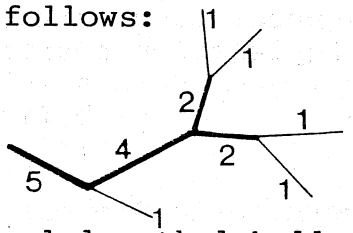
An important feature in the characterisation of river catchments is the drainage density which is defined as

$$\frac{\text{length of drainage channel (km)}}{\text{area of land surface } (km^2)}.$$

In Caragh there are 182.5 km of drainage channel, giving a drainage density of 1.23. This is very similar to the overall average for Connemara (1.20). Ballinahinch contains 209.7 km of drainage channel, giving a drainage density of 1.14. Caragh is well within the range of drainage density for Connemara, which varies from 0.11 to 2.00. A drainage density of 1.20 is said to be typical of "steep impervious areas in regions of high precipitation" (Gregory and Walling, 1973).

Stream ordering

Further analysis of the stream network in the region is undertaken using the terminology of R.L. Shreve (in Gregory and Walling 1973). According to Shreve's system stream order is described as follows:



In the present work each channel length labelled above is referred to as a "segment". The percentage frequency distribution of stream segment numbers and lengths is given in Table 1. A chi-square comparison suggests no significant difference from Ballinahinch.

Stream area

Correlations were carried out of stream width on stream order in Glencar and Connemara with the outcome:

	Glencar	Connemara
Number of observations	25	80
Correlation coefficient (r)	0.9159	0.6896
a (slope)	0.1798	0.1874
b (intercept)	2.5316	2.4057
P	<0.001	<0.001

Where width = a x stream order + b

Based on these calculations, a comparison of stream widths (m) at various orders would read:

Order	Caragh	Connemara
2	2.9	2.8
5	3.4	3.3
10	4.3	4.3
16	5.4	5.4
25	7.0	7.1
55	12.4	12.7
100	20.5	21.1

Stream areas were obtained by multiplying segment lengths by calculated widths. The lower order streams in both catchments are very small but they are also numerous and, in Connemara, they provide 50% of streambed area, a similar area in Glencar.

Riffle: pool sequence

A negative correlation between the percentage area of streambed occupied by riffle and the average depth (cm) was observed in Connemara:

Number of observations:	80
Correlation coefficient (r):	-0.3523
a (slope) :	-1.2751
b (intercept) :	82.7521
P	<0.01

A similar exercise in Glencar did not yield a significant correlation, being based on only nine observations. The slope and intercept of the correlation were however very close to those calculated in Connemara:

a (slope) :	-1.3131
b (intercept):	78.5568

The observations suggest a similar hydrology in Glencar and Connemara.

Elevation of the catchment

The percentage distribution of land at height above sea level in Glencar and Ballinahinch is compared in Fig. 2. In Caragh only 20% of the catchment surface lies below 61m 0.D. and almost 30% between this and 122m. In Ballinahinch (probably in Connemara generally - though this calculation was not attempted for any more than one of the Connemara catchments) 50% of the catchment surface lies below 200 feet 0.D. Thereafter as altitude increases, the proportion of catchment surface declines.

In the elevation of catchment surface, the two systems, Caragh and Ballinahinch, display their greatest differences. In Ballinahinch a substantial proportion of the drainage lies below 61m (0.D.), in Caragh an equivalent proportion occurs above this altitude and the greatest channel length of first order streams is situated above 122m.

Experimental fishings

In October 1986, during a period of low water following drought conditions, nine sites in the Caragh catchment were electrofished (Fig 1); their characteristics, described in terms of the Connemara investigation, are set out in Table 2. The sites were selected for their accessibility and their fishability but as wide a range of stream type and geography as feasible was examined. The depth of water in which fishings were carried out (average 28cm) tended to be greater than in Connemara where it averaged between 20 and 25 cm throughout that investigation. Other characteristics of the sites are tabulated in Table 2.
Each site was stop-netted at each end prior to electrofishing. At least three fishings were made at each location, an estimate of the standing crop being obtained by regressing the catch from each fishing on the sum of previous catches and extrapolating to the horizontal axis the line best fitting the points (Seber and le Cren, 1967). After the third fishing the significance of the correlation was tested and, if not significant, further fishings were undertaken.

Each salmonid was identified and a fork length measurement was taken. These, for all sites, are bulked in Fig. 3; lengths of salmon and trout at 1 and 2 years at each site are presented in Table 3. The biomass at each site was obtained by interpolating fork lengths with the weight: length regressions obtained for salmon and trout in Connemara.

The salmonid carrying capacities of each site are summarised in Table 4.

Discussion

The Caragh has been described as:
" ... an excellent example of a river system which is relatively unpolluted from headwaters to estuary ..." (Heuff and Horkan, 1984). Bedrock in the catchment is Old Red Sandstone which is highly resistant to weathering. Overlying soils, peaty podzols, lithosols and climatic peat, are strongly leached and they are poor. Nutrient input from human activities is on a very small scale. As might be expected, the water in the Caragh catchment is low in electrolytes, extremely soft, slightly acidic, low in nitrate and moderately poor in phosphate (Heuff and Horkan, 1984). Not ideal fish growing water.

Standing crops of salmonids, salmon and trout, are compared with data obtained in Connemara in 1982 (Table 4). The numbers of salmonids per unit area were greater in Caragh where they exceeded the Connemara figures by 60%. Standing crops of migratory salmonids fluctuate in accordance with adult escapement and there are other reasons which might explain differences between Caragh and Connemara. Salmonid biomass is also higher (by 86%) in the Caragh sites than in Connemara.

However, when components the of the salmonid figures are scrutinised, other differences appear. In Caragh trout numbered 58% of the Connemara figures although they weighed 8% more. This could be explained by the fact that the water fished in Caragh was deeper than in Connemara and deeper waters are favoured by larger trout. In the case of trout, numbers are a more suitable basis for comparing the two systems.

Salmon, on the other hand, were more numerous than trout in Caragh - five times more numerous, their average biomass four times the average in Connemara.

The nature of salmonid populations owes much to the nature of the waterbodies which contain them. A striking difference between the Caragh and Connemara surveys was the order of streams investigated, on average far lower in Connemara. Depth is related to stream order, higher order streams being, usually, deeper than lower order ones. Choice of fishing site inevitably influences which depths are investigated and, following the drought of September/October 1986, many of the smaller first order streams in Caragh had completely dried up. This frequently takes place in the catchment because of the location of these smaller streams high on the steep slopes of the enclosing mountains and it is interpreted as the key factor determining the salmonid species mix in Caragh.

Fig. 4 is a summary of juvenile trout and salmon preferences for streams of different order in Connemara; it is compiled from Tables 5 and 7 of the Connemara resource appraisal. From Fig.4 it is clear that salmon and trout share streams of any order. Co-existence means that one of them must be a proportion of total salmonid numbers and

biomass, the stream in question being a shared habitat. There are various explanations for the dominance of first order streams in Connemara by trout, prominent among those the likely fact that smaller streams do not permit access by salmon. But whatever the explanation, trout have a major stronghold in streams of lower order. When it is remembered that first order streams in both Caragh and Connemara constitute 50% of stream bed area (spawning and nursery ground), the importance of these running waters will be obvious. In Caragh, because such streams periodically dry out, they are effectively not available to salmonid production.

The distribution of smaller streams over the steeper parts of Caragh catchment is, then, regarded as a critical difference between it and the Connemara systems and the steep gradient in Caragh also influences its larger streams and rivers. The streambed strewn with large boulders typifies much of the catchment (See plates). Only large stones can resist the more powerful spates and the remaining spawning grades also tend to be large, more suitable for salmon than sea trout. Trout can find limited patches of spawning gravel in most parts of the catchment, hence their ubiquity.

Of those examined only one site (No. 3) contained only trout and this is believed to be upstream of a stretch through which the passage of migratory salmonids would have been difficult. The heavy biomass at site 3 suggests the trout there are partly a "resident" population, self generating from existing stock. The inflowing stream to Lough Acoose (site 6) contained trout in next strongest numbers although the nursery stretch in question is believed to be of limited extent. Appropriately, the Angler's Guide to the Irish Free State (1937) regarded L. Acoose as a very good brown trout lake" ... though the fish are small".

This may well be a phenomenon observed in maritime brown trout systems in Connemara: a limited spawning opportunity producing adequate numbers of trout to populate a freshwater lake but insufficient to constitute a population pressure forcing significant numbers down to the tide.

Opportunities for enhancing the sea trout run Caragh are limited. As a matter of course, vegetation should be removed from the stream bed and gravels periodically raked. There might, though it is doubtful, be some virtue in the creation of spawning stretches in the higher order streams by the judicious use of heavy boulders to retain smaller gravels; such improvements would not survive in the more torrenticolous streams. And it is likely that the increased spawning opportunities would be availed of by salmon rather than trout.

To summarise, the Caragh, in view of its nutrient poor status, currently supports high juvenile salmonid biomass. This consists of salmon rather than trout and the associated environmental conditions are consistent with this. The Caragh system is an Atlantic salmon producer and that is its likely best future.

Acknowledgements

Gratitude is expressed to Mr Karl Daly, proprietor of the Glencar Hotel, who introduced me to his fishery and assisted with the collection of topographical data. Electrofishings were carried out with the help of Messrs Paudie Foley and Denis Costelloe and the arrangements were facilitated by Mr. Michael Barry, Regional Manager, South Western Regional Fisheries Board.

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Table 1 A comparison by chi-square test of channel segment number and length in the Glencar and Ballinahinch catchments.

	Segment number		Segment length	
Segment	Glencar	Ballinahinch	Glencar	Ballinahinch
1	56.8	60.1	65.1	69.1
2	10.4	14.2	8.4	11.9
3	6.3	6.4	4.3	4.3
4	4.2	2.3	3.4	1.1
	12.5	10.1	8.8	5.4
5-10	8.3	7.8	5.4	5.2
11-20	5.2	4.6	3.5	4.1
21-40	4.2	2.8	3.4	1.2
	14.1	9.2	13.5	8.4
⩾ 41	4.7	1.8	6.6	3.1
	chi-square = 4.383		chi-square = 6.498	
	P < 0.005		P < 0.01	

Table 2 Physical characteristics of sites electrofished in the Caragh catchment, October 1986.

Site No	Stream order	Stream width(m)	Stream depth (cm)	Percentage area of depth greater than 20cm	Percentage riffle
1	57	10.1	13.0	22.2	60.9
2	4	5.4	24.8	62.5	12.5
3	7	5.0	34.5	82.3	23.5
4	22	7.8	30.1	84.6	34.6
5	11	6.4	27.7	76.9	34.6
6	9	5.8	23.0	64.3	67.9
7	16	7.5	32.8	90.9	54.5
8	6	5.9	36.3	75.0	16.7
9	3	7.8	30.5	100.0	70.0

Table 3 Summary of fork length measurements of salmon and trout at nine sites in the Caragh catchment

Site	Age 0+ N	0+ length (cm)	0+ S.D.	Age 1+ N	1+ length (cm)	1+ S.D.
Salmon						
1	48	5.32	0.4813	13	10.57	1.1235
2	23	5.12	0.4338	2	9.00	1.1874
4	59	5.37	0.4953	23	9.95	0.9876
5	81	6.82	0.6217	13	12.05	0.7412
6	44	5.40	0.4495	51	10.30	1.5382
7	19	5.79	0.4600	2	8.90	0.8485
8	12	5.84	0.3872	15	9.54	0.9876
9	13	6.13	0.5089	10	10.84	0.9536
Trout						
2	32	5.91	0.7094	9	11.23	1.6125
3	3	6.70	0.7141	50	11.73	2.7028
4	11	6.36	0.9791	6	14.15	1.8469
5	25	6.05	0.5409	7	11.60	1.6603
6	24	6.46	0.6050	35	11.34	1.8882

Table 4 Salmonid carrying capacities (Numbers m^{-2}; weights, g m^{-2}) at 9 sites in the Caragh catchment, October 1986

	Salmonids		Trout		Salmon	
Site No	No	Wt	No	Wt	No	Wt.
1	0.229	3.212	0.029	2.290	0.200	0.922
2	0.807	4.766	0.247	1.530	0.560	3.236
3	0.368	8.712	0.368	8.712	-	-
4	0.758	4.826	0.102	1.590	0.656	3.236
5	0.667	4.702	0.173	1.119	0.494	3.583
6	1.142	12.275	0.442	5.884	0.700	6.391
7	0.095	0.405	0.034	0.236	0.061	0.169
8	0.245	2.112	0.056	0.723	0.189	1.389
9	0.303	4.283	0.115	2.542	0.188	1.741
Where present						
Mean:	0.513	5.033	0.174	2.736	0.381	2.583
S.D. :	0.346	3.536	0.149	2.774	0.248	1.967
N.	9	9	9	9	8	8
In Connemara (October, 1982)						
Mean:	0.318	2.702	0.300	2.530	0.073	0.630
SD:	0.186	2.163	0.188	2.193	0.006	0.376
N:	12	11	12	11	3	3

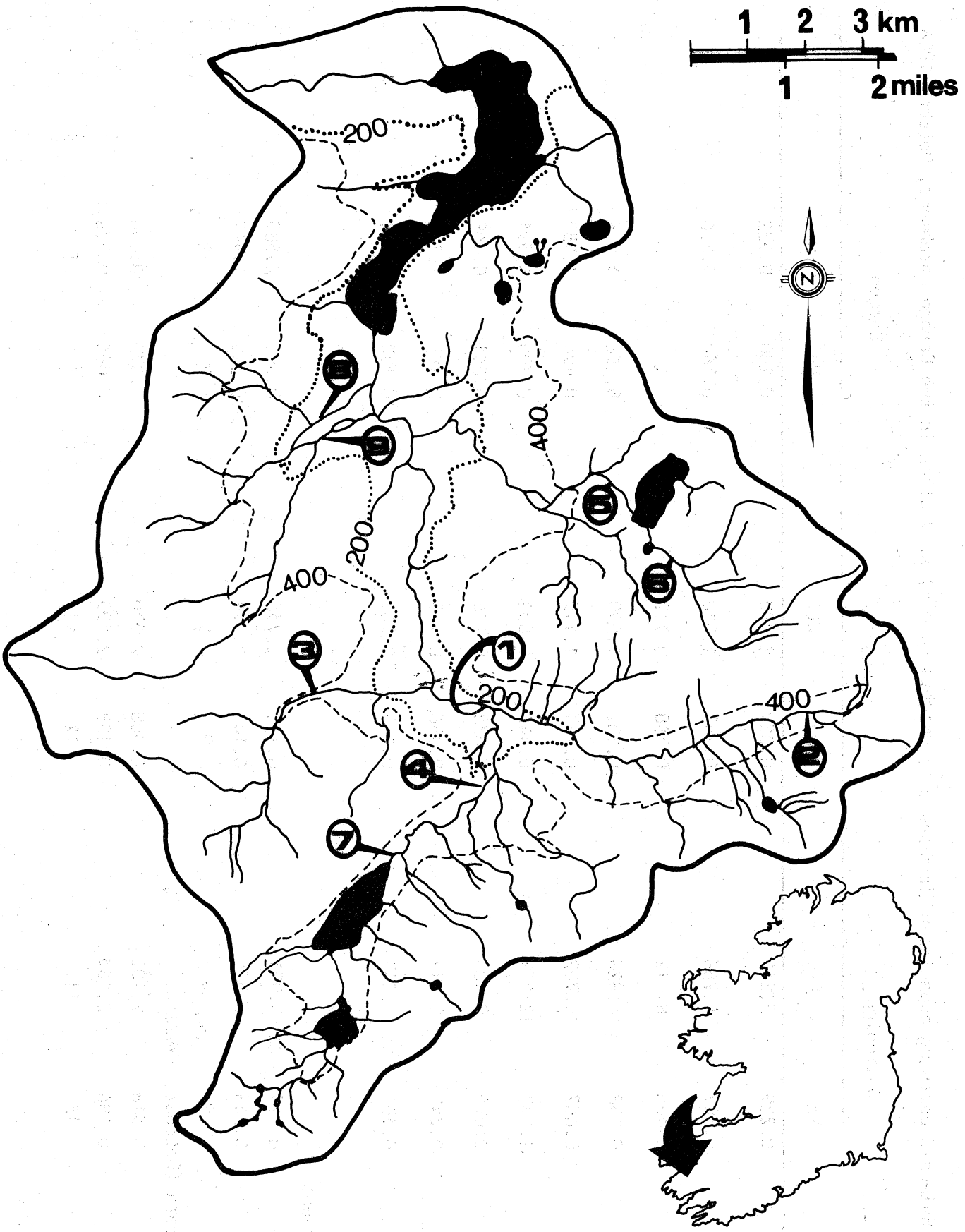


Fig 1. A map of the Caragh (Glencar) catchment indicating the positions of electrofishing sites (circled).

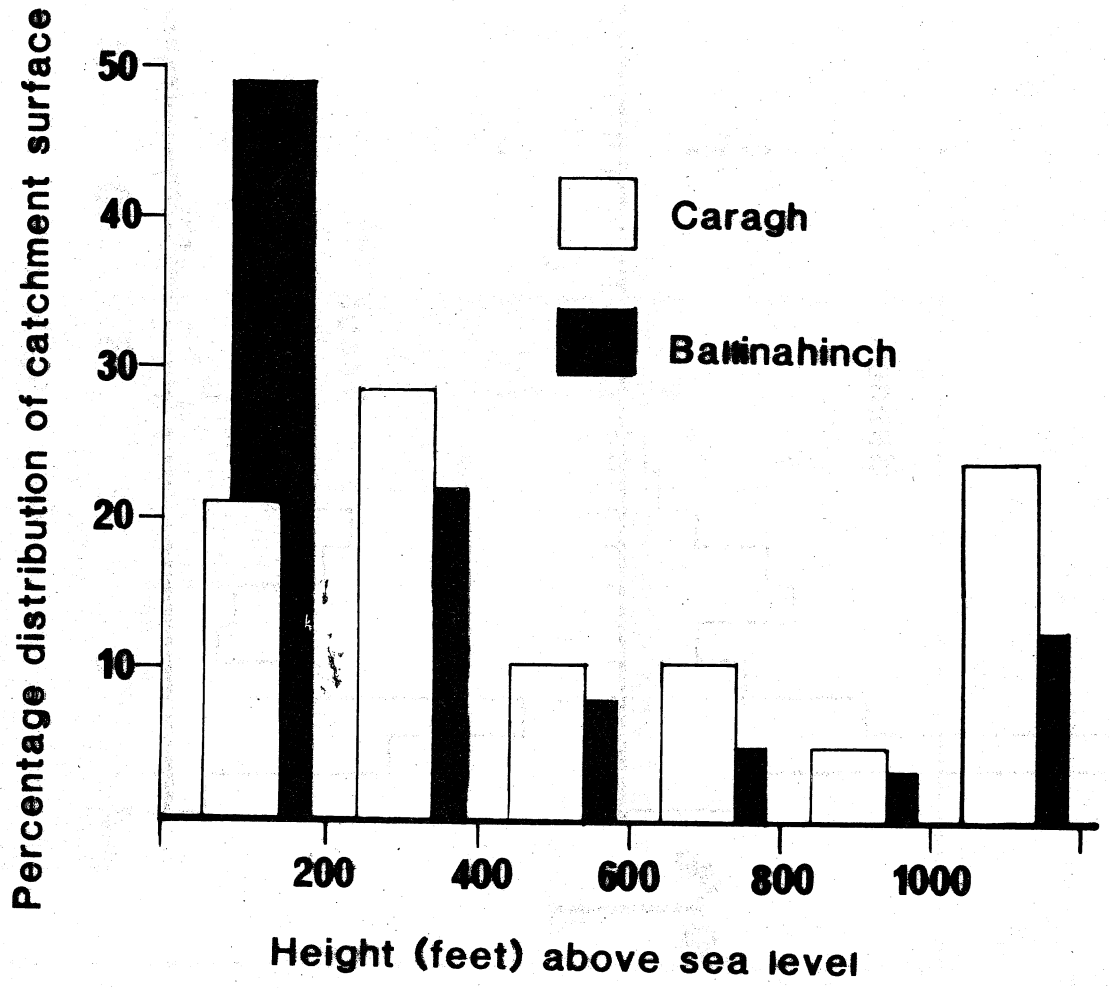


Fig 2. The percentage frequency distribution of catchment surface at various elevations, Caragh and Ballinahinch.

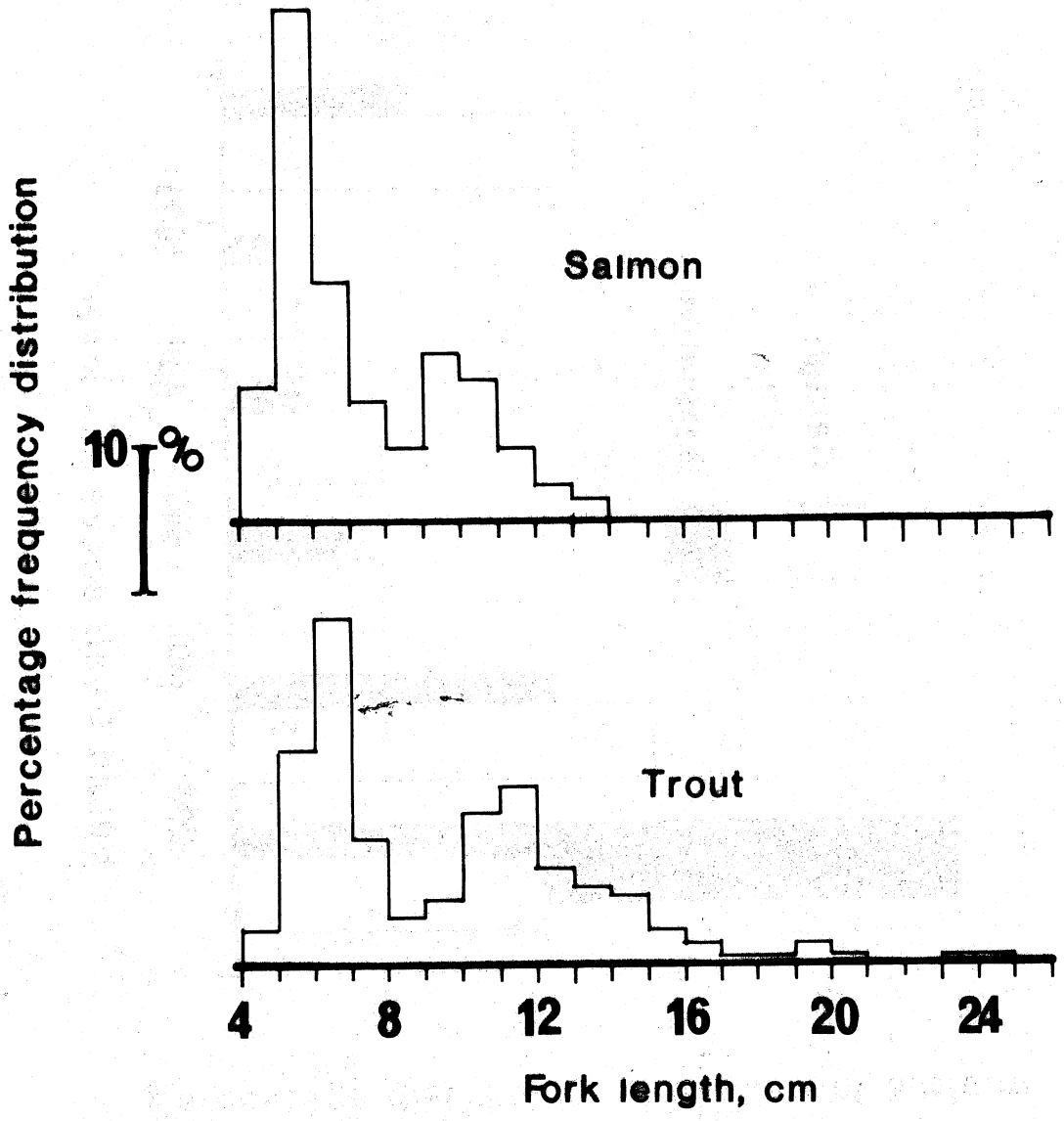


Fig 3. Frequency length distributions of all juvenile salmon and trout examined from the Caragh in October, 1986.

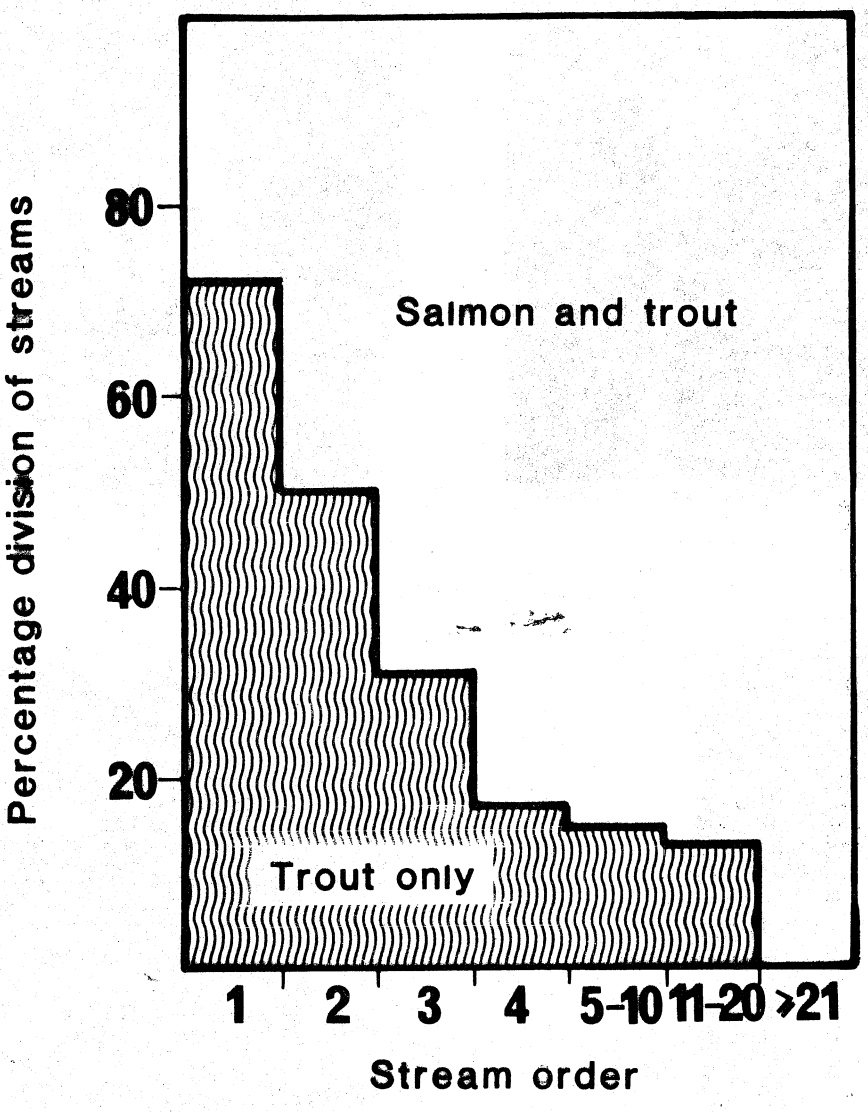
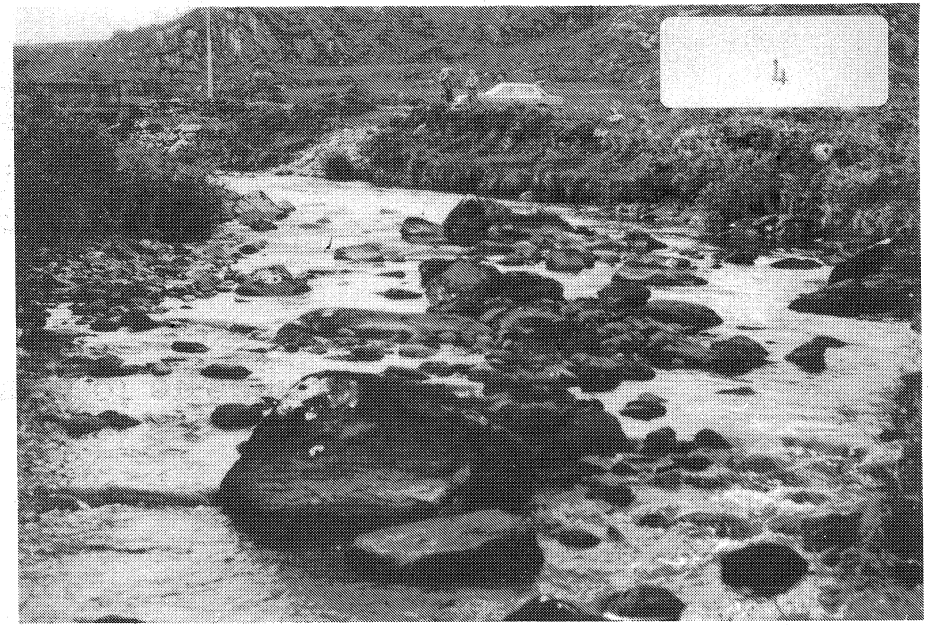


Fig 4. Diagramatic representation of salmonid preferences for stream order, based on the Connemara survey.

PLATES

Photographs of seven of the sites fished in the Caragh system. Site numbers are on the upper right hand corner of each.

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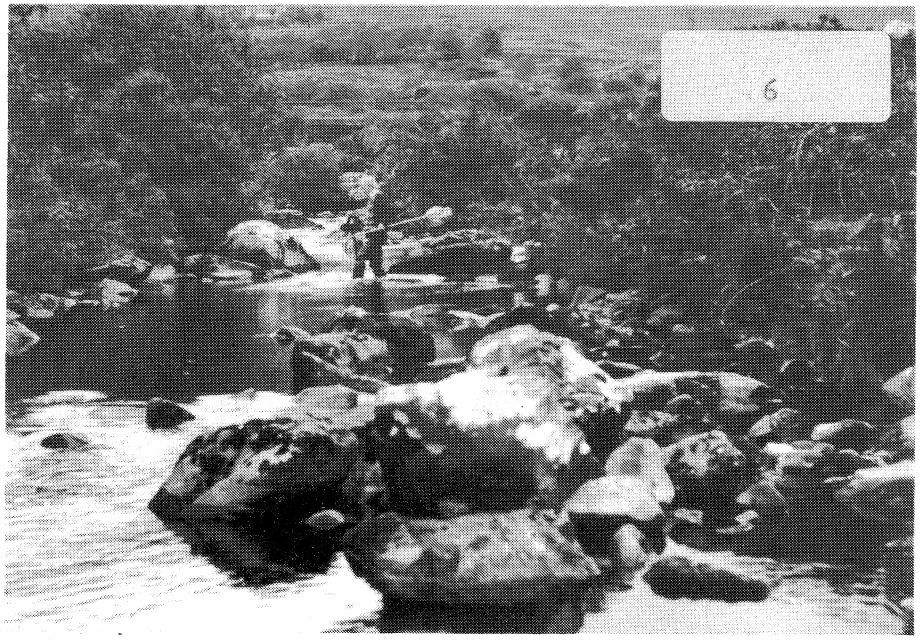
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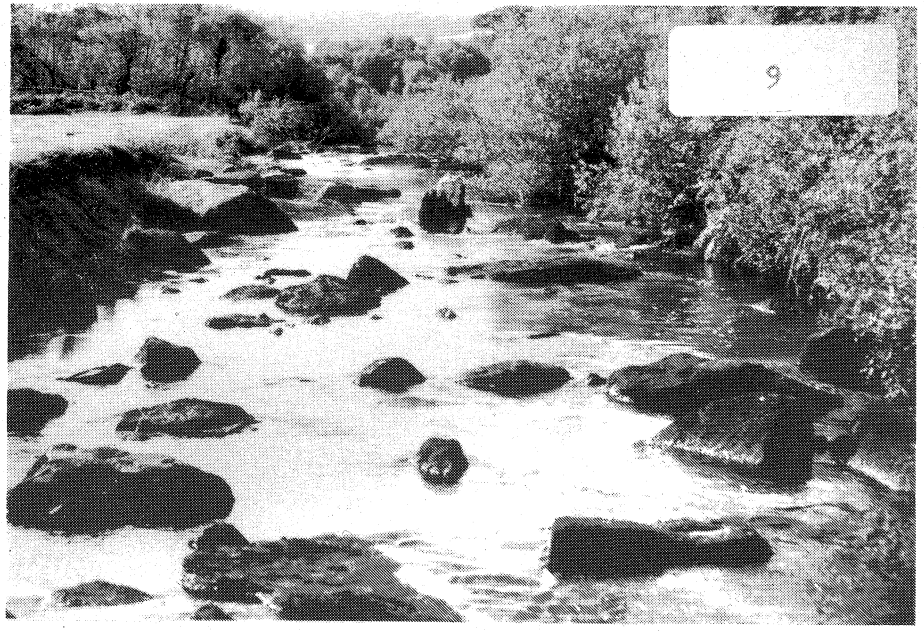
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