THE SEA TROUT STOCK COLLAPSE, 1989 -1992

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ABSTRACT

The sea trout collapse, which affected many fisheries in the mid-west of Ireland during the period 1989 - 1992 is described. Particular emphasis is placed on sea trout data from the Burrishoole catchment where quantitative estimates of survival are available. A general review of all research data relating to the collapse is discussed as a case history of a species requiring conservation in a limited portion of its range. The overall response to the collapse is assessed in terms of response time, the effectiveness of the actions taken, financing the response and future actions required to protect and enhance the remaining stocks.

INTRODUCTION

The sea trout has been described as displaying an archetypal life history. It is considered the true original of the trout species; its ancestors having colonised freshwater some 10,000 years ago.

Adult sea trout return from the sea during the late spring and summer to spawn in the late autumn, in tiny streams and rivulets located high in the mountains. Irish west coast sea trout are relatively slow growing and long lived, in comparison with salmon and their life cycle is far more complex (Fahy, 1985; Whelan, 1989). Sea trout remain in freshwater for two to four years before migrating to sea as smolts and they will often return three or more times to spawn in freshwater.

Sea trout are essentially fish of acid waters (pH 5.5 - 6.5). In general, sea trout populations flourish where growth rates are poor, where survival in freshwater is difficult and where there is easy access to the sea. Survival fluctuates widely, both in freshwater and at sea, and alternating periods of dearth and abundance can appear in consecutive years.

DECLINING STOCKS

Because of the marginal existence of the species, there has been increasing evidence during the past two decades of a slow decline in stocks from some catchments and this was largely attributed to poaching and a range of environmental problems such as: field drainage, stream drainage and maintenance fertilization of the hillsides, afforestation and more recently hillside erosion, due to overgrazing by sheep (Whelan, 1992).

Whelan (1991, 1992 and 1993) has described the appearance of a more serious decline which appeared in many fisheries along the western seaboard in 1986 and had, by 1989, resulted in a population collapse in many mid-western sea trout fisheries (Table 1).

The major collapse occurred in 1989 when, tragically, there was little sea trout research taking place and there is only some anecdotal information available on the sequence of events which took place during the May/June period of 1989. However, the following details are known:

* In May large numbers of post-smolts and some mending kelts appeared in the estuaries of the Delphi and Erriff systems.

* Many of these fish were heavily infested with lice and photographic evidence is available showing the level of lice damage to the skin and fins of the more seriously affected fish.

* In some fisheries, such as Delphi and Kylemore, appreciable numbers of very thin adult fish appeared during the angling season and the majority of these displayed poor gonadal development. Not all of these fish showed evidenc of lice damage. Thin fish which did not display lice damage also appeared in the Crumlin and Costello/Fermoyle fisheries.

In 1990 the Salmon Research Agency co-ordinated a broadly based research programme which, it was hoped, would identify the extent of the problem and define possible cause or causes. The results of this programme are summarised in Whelan (1992).

* In the Burrishoole catchment there was evidence of a long-term decline in sea trout stocks, overlaid by a severe population collapse during the period 1987 to 1990, particularly during 1989 and 1990.

* The most severe collapse in sea trout stock levels occurred in the area from Galway Bay in the north to Clew Bay in the south.

* In the so-called 'affected area' there was evidence of a significant drop in growth at sea, finnock were particularly small and maiden sea trout were no larger than normal finnock. There were also changes in growth in freshwater with larger than normal smolts migrating to sea.

* Many smolts returned to freshwater after spending only a matter of weeks at sea. These were heavily infested with juvenile sea lice (*Lepeophtheirus salmonis).* Levels as high as 200 were recorded on an individual 20cm fish.

* Lice had caused severe skin and flesh damage to the trout. Observational evidence indicated that some of these fish later became infected with secondary infections and died.

* No evidence of a disease was found which was consistent with the stock collapse.

* Many of the more fanciful theories which were rampant during the initial stages of the research were discounted. There was no evidence of sea trout feeding in the vicinity of cages, where it was claimed pollack and coalfish were eating the fish.

* From the stomachs of the sea fish, caught while sampling for sea trout, there was no evidence of reduced food availability at sea or a lack of specific food items (e.g. sandeels).

* A detailed study of historical records of water temperature and water height showed that subtle interactions between both factors resulted in the successful exodus of smolts. Two critical temperatures were suggested: a temperature of 7°C-8°C must be reached before exodus commences, while recruitment was adversely affected by the occurrence of temperatures of 13°C or higher before migration had taken place.

The obvious manifestation of the problem affecting the sea trout was severe sea lice infestation but the preliminary research did not answer the vital questions as to the source of the lice and whether or not there was some other physiological or disease factor predisposing the fish to the unprecedented sea lice infestation. It was, however, hypothesised by STAG (The Sea Trout Action Group) that a major factor in the collapse of sea trout stocks during 1989 and 1990, was a sea lice population explosion deriving from coastal salmon farms. The group also accepted that physiological stress, disease and environmental factors may have played a role both in the long-term decline and the collapse of 1989 and 1990. (Anon 1991a).

FURTHER RESEARCH

During the following two years the research programme concentrated on five principal areas:

* Monitoring of sea trout survival in a range of fisheries
* Further investigations into the role of sea lice
* A physiological profile of sea trout smolts to study their state of fitness when entering saltwater
* Disease monitoring
* The development of practical sea trout enhancement strategies

In 1991 the Department of the Marine established a Sea Trout Working Group and the results of the sea trout research programme were examined by this group in December 1991 and 1992 (Anon, 1991b and 1993).

Whelan (1993) discusses the possible role played by such factors as: increased acidity, physiological stress, disease and increased parasite loadings (both external and internal) on sea trout survival. In addition the Sea Trout Working Group also considered these factors in the context of the sea trout stock collapse (Anon, 1993) and concluded:

* No evidence of disease was observed in sea trout examined during 1992. A variety of internal parasites was observed and identified but did not provide an explanation for the collapse of sea trout stocks

* While acid flushes or chronic acidification may be contributory factors to the sea trout problem in some catchments, there is no direct evidence to identify a causal link.

* A number of man made environmental changes have taken place and these undoubtedly affect stocks in specific catchments. The sea trout stock collapse, however, cannot be attributed either individually or collectively to these changes.

* No global failure of osmoregulatory ability of sea trout, which could explain the premature return of sea trout smolts to rivers, was identified.

* Sea lice infestations on sea trout continued to be a major problem in 1992. Data examined by the Working Group in 1992 again failed to show a causal link between sea lice on farmed salmon and infestations on sea trout. A relationship was postulated, however, between production of juvenile sea lice larvae from fish farms and the mean intensity of sea lice found on prematurely returning sea trout during May. Failure to find the free living larval stages is severely hampering attempts to investigate the presence or absence of a causal link between the production of sea lice larvae and infestations of sea lice on sea trout.

The only consistent factors, therefore, to emerge from the research carried out to date are the premature return of both smolts and kelts to the estuaries in early to late May and the presence of abnormal numbers of juvenile lice. A number of additional key points have also emerged from the sea lice research (Anon, 1991b and 1993, Tully and Whelan 1993, Tully et al. 1993a, Tully et al. 1993b):

* In the western region during 1991, 95% of the total nauplius larval production of *L. salmonis* was from farmed salmon

* The smolts and kelts were infested with juvenile lice within two to three weeks of migrating to sea

* The morphological and physiological impact of the lice on sea trout was significant and sufficient to cause mortality

* Fish caught in estuaries sharing the same embayment generally had similar infestation levels

* There was a suggested correlation in both April 1991 and 1992 between larval production from the farms and subsequent infestation levels on the sea trout three weeks later

* The production of larvae from salmon farms in Killary Harbour in spring 1992 fell to zero due to fallowing of the salmon farm and the infestation levels on sea trout was subsequently reduced by 75%.

* Daily larval production in Clew Bay increased from zero in 1991 (farms fallow) to significant levels in May 1992 with the reintroduction of the salmon farms and the subsequent levels of lice on sea trout increased from a median of 5.5 per fish in 1991 to over 55 in 1992.

* Following the establishment of salmon farms, south of Ballinskelligs Bay, in 1989/90, there was evidence in 1991 and particularly 1992, of sea trout

problems in the south west. Significant numbers of prematurely returning post-smolts and adult sea trout, heavily infested with sea lice, were recorded from the estuaries of the Inny R. and L. Currane.

SEA TROUT SURVIVAL IN THE BURRISHOOLE SYSTEM

Sea trout survival, both before and during the period of the stock collapse has been quantitatively assessed at the Salmon Research Agency's traps (Fig 1). The survival of smolt to first return as finnock in the same year has historically ranged from 11.4% to 32.4% (Fig 2). In 1988 the survival fell below the previous recorded minimum to 8.5% and in 1989 to a minimum of 1.5%. There were increases in 1990 and 1991 to 5.1% and 10.0% respectively (Whelan, 1993). However, in 1992, the survival fell to 3.7%; the second lowest marine survival recorded to date (Anon, 1993).

These events closely follow the presence or absence of salmon farms in inner Clew Bay. Salmon farming commenced in Clew Bay in the mid-1980's, reaching a peak in 1989, when three farms were in operation. Due to disease problems the bay was fallowed from April 1990 until January 1992 when 50,000, 1kg+, salmon were towed into inner Clew Bay.

DISCUSSION

Although many of the research results relating to the sea trout stock collapse have been available in report form over the past three years, to date, no critical analysis of the problem and the overall response to the problem has been attempted.

It is our belief that the scale of the sea trout problem and the longterm implications for the stocks and their attendant fisheries, is only now generally being realised and perhaps it is timely to review the course of the problem and to draw from it the lessons which should be learned in order to deal more effectively with similar ecological disasters in the future.

Basic to the initial ineffective response to the problem in 1989 and 1990 was ignorance. Too little was known of the complex biology of the sea trout in either the freshwater or marine environments and even less was known regarding the biology of the parasite which was manifestly a major component of the problem.

Sea trout research has been on-going for many years but in the main it has been poorly funded and was often carried out as a bye-product of salmon research. In Ireland the species is not generally considered of true economic importance since it does not support a full commercial fishery. However, in terms of angling tourism it plays a pivotal role and its presence, even in a mixed salmon and sea trout fishery, is an integral part of the west of Ireland angling experience.

While the extent of the research effort may have been confined over the years we were fortunate in that the quality of the work carried out was excellent. This provided a sound basis on which to assess the relative age structure of the various stock components and in the case of the Burrishoole, provided census data on the survival of both smolts and the older age classes of sea trout. However, we know little of the population dynamics of the stocks and are still unable to answer the vital question: What makes a sea trout? The trout's life at sea was a mystery and we could only speculate on the factors affecting marine survival.

Our ignorance of the biology of the sea louse was even more profound and to date it has proved impossible to locate in any quantity, in the wild, the first free-living larval stage (Nauplius I). Without a method to locate and quantify this life stage of the sea louse it would seem difficult if not impossible to conclusively demonstrate a causal link between the production of juvenile lice from sea farms and subsequent infestation levels on sea trout.

As outlined previously the major sea trout stock collapse occurred in 1989, at a time when little sea trout research was taking place. When the Sea Trout Action Group was formalised in the autumn of that year one of the first tasks undertaken was to compile a list of possible causative factors or events leading to the sea trout collapse. Some eighteen separate factors were listed and chief amongst these was a sharp decline in elver numbers (known to be a food of sea trout) and an increase in seal numbers.

STAG also decided that a broadly based research programme was required to address the problem and to define more clearly the factors involved in the stock collapse.

It is important to stress that STAG was a voluntary group encompassing all of the groups, agencies and individuals with an interest in the welfare of the west coast sea trout. It is also worth noting that the original group had no official representative from the fish farming industry since, at that time, no evidence existed to link fish farming activities with the sea trout stock collapse.

As a voluntary group STAG had no research funds available to it nor were there emergency funds available from Central Government. STAG therefore launched a major and very successful fund raising campaign to which the Department of the Marine and many hundreds of other individuals and groups subscribed.

The publication in report form of the results from the first year's research and the subsequent publication of the STAG Reports (Anon 1991a and 1992), in which it was hypothesised for the first time that sea lice emanating from salmon farms were a major factor in the sea trout collapse, were pivotal to subsequent events.

STAG was hoping for action based on the precautionary principle, to deal in a co-ordinated fashion with the lice problem on salmon farms. The group was very conscious of the critical stock situation in many mid-western sea trout fisheries; in addition to the loss of the adult stocks in 1989, the majority of fisheries had lost two year classes of post-smolts in 1989 and 1990.

It was argued that by dealing with the lice problem the salmon farming industry would benefit and that in the view of STAG the sea trout would also show improved survival. If STAG were proved wrong then the salmon farming industry would have accrued the benefits of reduced lice infestations.

Unfortunately, the preliminary research data available was judged insufficient to warrant a fully co-ordinated lice control campaign and as outlined previously it was recommended that an expanded research programme should be undertaken to consider the four areas of: physiology, lice, disease and environmental factors. The results from this programme were to be assessed by the Department of the Marine's Sea Trout Working Group.

It was also agreed that conservation measures were required to protect the remaining stocks of sea trout in the mid-west and bye-laws were introduced banning the killing of sea trout both in the commercial and sport fisheries.

The Salmon Research Agency has consistently argued since the publication of its first sea trout report in 1990 that enhancement of sea trout stocks should be considered a priority area (Salmon Research Agency, unpublished). Conscious of the long life cycle of the sea trout and the lack of appropriate enhancement techniques the Agency sought sponsorship for a novel kelts and finnock reconditioning programme. Funding was not available from either STAG or government sources but thanks to the support of the Electricity Supply Board and BP Nutrition this programme has been funded since the spring of 1991. It has proved very successful (Poole et al., 1993) and some 110,000 ova were stripped from 93 re-conditioned sea trout in the past few months (December 1992 to January 1993).

In recent months there have been considerable efforts made to co-ordinate the management of bays containing fish farms and to promote the concepts of single bay management and fallowing. We have no doubt that such initiatives, if implemented speedily and effectively, will reduce organic loadings and also help to control disease and lice problems on salmon farms.

It has also been agreed that a National Sea Trout Enhancement Programme will be initiated and that central to this programme will be the techniques of sea trout kelt re-conditioning and the on-rearing of sea trout juveniles in sea cages. Initially, some three separate stocks will be available to the programme and their progeny will ensure the availability of a native 'living gene bank', with which to re-seed the affected fisheries in the mid-west.

The Report of the Sea Trout Working Group (Anon, 1993) has also recommended that the existing bye-laws, banning the killing of sea trout taken either on rod and line or in the draft net fishery and restricting the areas and seasons for commercial drift netting, should remain in place.

What then are the lessons to be learned from the past four traumatic years? Firstly we have a graphic demonstration of the need for basic research in advance of a serious ecological problem.

There is also a clear need for an emergency ***'Eco-fund'*** to deal with such problems. A sum of IR£250,000 should be allocated to the fund, on a yearly basis, over the next four years. The fund would assist with the mitigation of damage arising as a result of ecological disasters, such as the sea trout stock collapse. The management of the ***Eco-fund*** should be assigned to a small expert group of biologists and administrators. The situation should not be repeated where donations from abroad are required to fund emergency research and protection programmes for native Irish species.

Finally we would suggest that the difficulties and risks of applying the precautionary principle in all situations where a species is at risk must be accepted, without qualification, whether or not that species is of perceived economic value.

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TABLE 1: Annual Sea Trout Catches from Mid-Western Fisheries, 1985 - 1992

Fishery	1985	1986	1987	1988	1989	1990*	1991*	1992*
Kylemore	2411	1099	543	1116	198	10	450	200
Culfin	298	173	222	235	36	8	175	60
Erriff	770	433	450	308	120	60	235	293
Delphi	2150	1281	832	675	309	112	437	494
Carrowniskey	135	97	90	160	45	N/R	65	10
Bunowen	475	110	146	340	88	10	120	25
Clifden R.	95	70	98	20	4	N/R	6	N/R
Belclare	95	70	98	400	0	6	60	20
Ardbear	86	75	36	27	5	N/R	15	N/R
Newport	1155	1485	783	1049	135	51	268	30
Burrishoole	497	614	237	245	41	39	106	25
Inagh	N/R	N/R	1369	824	29	10	7	45
Inver Beg	254	220	67	18	0	0	10	50
Ballynahinch Upr.	378	398	306	173	10	0	0	N/R
Ballynahinch Mid.	202	150	224	75	5	0	30	45
Ballynahinch Lwr.	2300	2000	1500	850	20	90	200	50
Gowla	1035	967	266	210	0	0	0	0
Doohulla	200	150	100	20	1	N/R	N/R	N/R
Crumlin	328	222	261	26	0	N/R	N/R	30
Invermore	1481	1345	325	199	48	0	0	0
Carna	60	180	100	60	3	N/R	N/R	N/R
Costello & Fermoyle	2745	2316	1698	1851	462	140	234	375
Letermuckoo	74	50	100	30	2	0	0	N/R

N/R = Not Recorded

* 1990 to 1992 - all sea trout taken on a catch and release basis

* 1992 - Provisional Figures

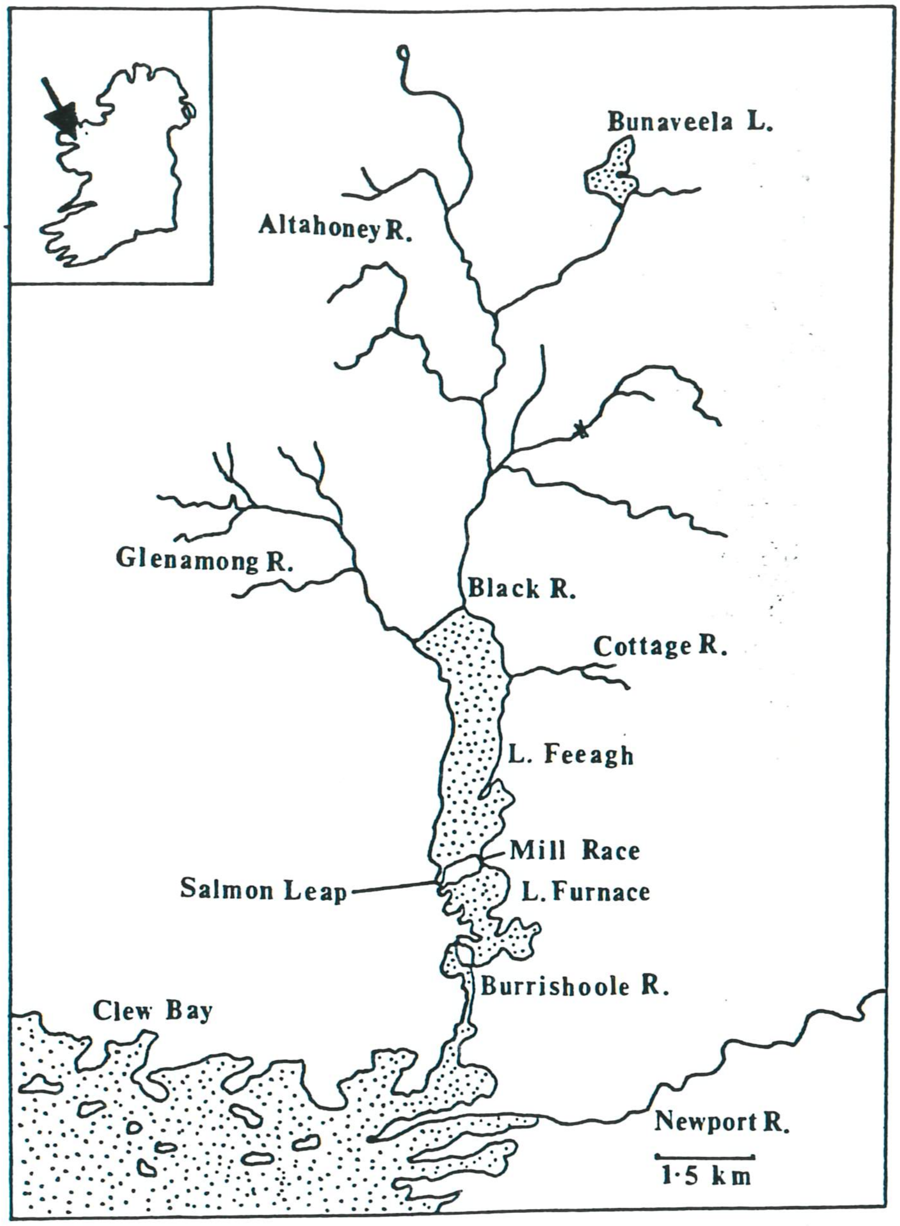

Fig. 1. The Burrishoole Fishery, Co. Mayo.

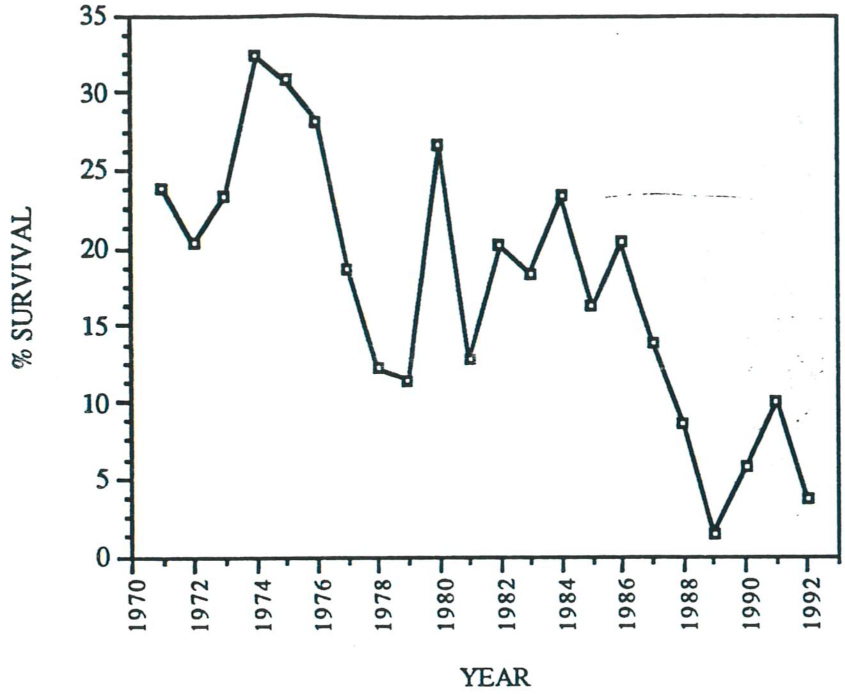

Fig. 2. Annual marine survival of smolts to finnock in the Burrishoole system.