REVIEW OF THE RIVER SLANEY SALMON FISHERY WITH PROPOSED MEASURES FOR CONSERVATION AND RECOVERY

Report to:

Slaney River Trust
and
Inland Fisheries Ireland

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EXECUTIVE SUMMARY

1. The Recovery Plan of 2002 is briefly reviewed listing the principal recommendations with subsequent actions and outcomes listed. Considerable progress has been made, notably in the formation of the Slaney River Trust and the Slaney River Foundation Ltd, and the appointment of full-time Project Officer for the duration of the Interreg project.

2. The current status of the salmon stock is reviewed using data from rod and net catches, juvenile electrofishing surveys, redd counts and fish counter records. The adjustment of fish counter records to produce estimates of the total annual runs of MSW and 1SW is described. It is clear that while juvenile stocks appear to be maintained at a reasonable level in most key areas of the catchment, adult returns of MSW fish in particular are at a low level, probably due to poor natural survival at sea.

3. Salmon life history is discussed with regard to the complex relationship between different generations due to the various stock components in a river with different sea age groupings. The relationship between different generations is described along with the importance of scale reading in understanding the age structure of the adult run in each year.

4. The calculation of conservation limits for the Slaney and the derivation of annual catch advice by the Standing Scientific Committee are described in some detail. This information is then used to construct a simple survival model for Slaney salmon which illustrates that, if the current data is correct, at current rates of marine survival and without any exploitation, the MSW stock is unsustainable while the 1SW stock is only marginally sustainable.

5. Data on sea trout catches are presented to illustrate that the Slaney stock has been in decline over the last 15 years or so. Details of the recently commenced Celtic Sea Trout Project are outlined – this initiative should facilitate a greater understanding of the stock and may lead to specific catchment management measures aimed at enhancement and development of sea trout stocks.

6. Biological river quality monitoring of the Slaney by EPA is outlined with attention drawn to areas defined as *Slightly polluted* or worse. It is noted that all unsatisfactory sites invariably show signs of enrichment from sewage and agricultural sources with evidence of excessive siltation also recorded. Sources of nutrient enrichment and diffuse silt are discussed.

7. Pressure on the river from water abstraction for domestic and industrial supplies is highlighted, and it is noted that the demand for water is likely to increase with concomitant increases in the level of abstraction being sought by local authorities. The potential impacts of climate change are outlined with regard to rising water temperatures and more concentrated periods of rainfall. It is noted that a recent EPA study revealed that the greatest reductions in predicted runoff for 2041–2070 were found to be in the south-east of the country, and that an annual reduction in effective runoff of approximately 25% of the baseline flow, was observed for the River Slaney.

8. Predation on salmon smolts by cormorants is highlighted as a potentially major factor in limiting the recovery of stocks and it is stressed that robust data is required on the level of predation before any action can be taken. Predation by seals on adult fish may also be a significant factor which needs further investigation. It is noted that a Joint Working Group has recently been established to address these issues and that the Slaney has been selected as one of the key rivers in this initiative.

9. The significance of the designation of the Slaney as a Special Area of Conservation is outlined, particularly as many of the principal selection features of the site are freshwater species including the salmon. Recent survey work would suggest that most of these species are currently endangered on the Slaney.

10. The potential for intervention through artificial stocking to restore the MSW salmon stock is discussed in some detail. Successful stocking initiatives from other rivers are cited and the biological issues which must be considered are highlighted including freshwater and marine survival rates, genetic factors and management issues. Rather than imposing additional pressures on a wild salmon population experiencing climate change by releasing captive-bred fish, it is recommended that conservation efforts should focus on optimising conditions for adaptation of the wild stock by reducing exploitation and protecting key habitats in the catchment.

11. The limits on hatchery potential on the Slaney are described and it is concluded that a stocking programme would not be appropriate at this time, but might be considered at a later stage if the MSW stock declines further to a dangerously low level. Although the current level of the salmon stock is a serious concern, the initiation of a hatchery project would be costly and unlikely to have any significant positive impact.

12. A series of 27 recommended measures are proposed with the aim of providing the best possible conditions for stock recovery. These measures are based on maintaining reduced exploitation through all stages of the freshwater system in order to maximise productivity, and on continued and improved monitoring of fish stocks. The recommendations are prioritised as low, medium or high according to their current relevance and urgency with regard to stock status and the current economic situation. (See below).

13. Potential sources of funding for future projects are summarised in the light of current and previous programmes.

HIGH PRIORITY RECOMMENDATIONS:

Fish counter

- Top priority should be given to the development of a new full river counter at a new location.
- The new counting station should be based on established technology using a Logie counter at a new crump weir which offers good quality results with minimal work beyond the initial investment.
- If the existing counter is retained the relative proportions of fish using the fish pass and by-passing the counter must be determined using the PIT tagging resources already in place.

Juvenile fish surveys

- Continuation of on-going triennial stock assessment programme supplemented with annual catchment-wide semi-quantitative survey over 150-200 sites across the Slaney catchment.

Scale sampling

- Additional data on the age structure of returning adult fish is urgently required through an annual scale sampling programme.

Habitat protection and enhancement

- Sections of river should be prioritised for further habitat enhancement works notably in known or historic MSW salmon spawning/nursery areas following consultation with IFI.

Genetic research

- Analysis of existing genetic samples should be completed while juvenile fish samples should be collected from additional tributaries to identify principal MSW and 1SW spawning areas.

Salmon habitat assessment

- A full salmonid habitat survey of the Slaney should be carried out by local IFI staff to develop a habitat map for the catchment.

Cormorant predation

- It is recommended that robust information be gathered on the level of predation by cormorants in the Slaney catchment so that a strong case for control can be promoted if necessary.

1 INTRODUCTION

The Slaney is one of the most celebrated spring salmon rivers in Ireland but has suffered a serious decline in stocks in recent years in common with other spring salmon rivers in Ireland and Britain. In spite of stringent conservation measures including closure of the fishery to both net and rod fishing, the river has yet to show an upturn in the return of adult fish. Juvenile stocks appear to be at a reasonable level and the indications are that the problem is related to declining rates of survival during the marine phase of the life cycle.

This study was commissioned by the Eastern Regional Fisheries Board (ERFB) and the Slaney River Trust (SRT) as a follow-up to an original recovery plan for the river developed in 2002. The study is based largely on a combination of catch records and survey data supplied by the Eastern and Central Fisheries Boards, while drawing heavily on stock status data and catch advice formulated by the Standing Scientific Committee to the Department of Communications, Energy and Natural Resources (DCENR). Consultations have been held with many individuals directly or indirectly involved with the river.

In the latter stages of writing this report the new Inland Fisheries Ireland (IFI) was established as a single national inland fisheries authority, replacing the existing Central and Regional Fisheries Boards. This has caused some difficulty in editing a final version of the report which is, as far as possible, up to date in referring to the correct fisheries authority both historically and with regard to current and future administration. We apologise for any inconsistency or confusion arising from interchange between the terms IFI, ERFB and CFB.

2 REVIEW OF RECOVERY PLAN 2002

The principal recommendations of 2002 Report and subsequent outcomes / actions are summarised below:

2.1 Draft net compensation proposal

Recommendation - A voluntary buy-out scheme was proposed for the permanent retirement of the draft nets

Outcomes / actions

Annual quotas for the commercial salmon fishery in Ireland (and the rod fishery) were introduced in 2002 and reduced annually until 2007 when the government closed the mixed stock fishery at sea. At this time a Salmon Hardship Scheme was introduced for drift net fishermen and all other commercial fishermen (including draft net) wishing to exit the fishery. We understand that 30 of the 75 licensed draft nets on the Slaney applied to avail of the scheme.

Harvest fisheries are now only permitted where stocks are shown to have a surplus of fish over the conservation limit. As this is not the case on the Slaney, there has been no fishing activity by the remaining draft nets since 2006.

2.2 Angling conservation measures

Recommendation – it was recommended that exploitation by angling should be reduced through a combination of measures including:

- Strict adherence to catch limitation regulations
- Adoption of catch and release practices
- Shortening of the season to end on 30 June
- Restriction of fishing methods to fly only from 7 April and ban on the use of bubble float

Outcomes / actions

The closure of the fishery in 2007 included the rod fishery which has remained closed apart from 2008 when the river was opened for catch and release.

2.3 Acquisition of scientific data

Recommendation – A programme of research to accumulate sound biological data on the salmon stocks including:

- Up-grading of fish counting facilities to produce accurate data on annual runs to the river
- A scale sampling programme to clarify the age breakdown of the salmon stock
- The identification of key spawning areas
- Regular juvenile fish stock surveys
- An assessment of predation impacts

Outcomes / actions

Some progress has been made in each of these areas but there is still a significant shortage of fundamental data on the salmon stock.

- Counting system has not been upgraded – it provides a partial count of the total return and the proportion of fish passing through the counter is not known. Considerable

resources have been expended on trying to address this deficiency but obtaining sufficient fish to tag has been a problem and the project was suspended.

- A scale sampling programme was established based on rod and net caught fish but no samples have been available since closure of the fishery
- Quantitative juvenile fish stock surveys, undertaken by CFB/ERFB, have continued every 2-3 years and a catchment-wide semi-quantitative monitoring programme was initiated in 2007 and repeated on a larger scale in 2009.
- A recent study of cormorant predation on fish in Irish rivers has recently been commissioned with the Slaney selected as one of the pilot studies

2.4 Formation of a Trust or Foundation

Recommendation – The formation of a River Slaney Trust or Foundation was proposed to act as a vehicle to attract funding for the project

Outcomes / actions –

The River Slaney Trust was incorporated in 2005 to represent clubs, fishery owners and anglers on the river. The Slaney River Foundation Ltd was set up as the fundraising arm of the Trust, and both have been approved by the Revenue Commissioners as charitable organisations.

2.5 Management

Recommendation – It was recommended that a Manager/Development Officer be appointed to co-ordinate the project.

Outcomes / actions – A full-time Project Officer was recruited and funded through the INTERREG programme.

2.6 EU INTERREG Programme

Recommendation – it was suggested that EU Structural Funds could be secured through the INTERREG programme if the project could be linked with a similar initiative in another region e.g. the existing partnership scheme between Southeast Ireland and West Wales.

Outcomes / actions – A formal link was established with the Pembrokeshire Rivers Trust in 2004 to form the Celtic Rivers Trust Partnership, a joint Irish/Welsh project supported by the EU INTERREG IIIA Programme. To date INTERREG funding of €252,000 has been expended on the Slaney.

3 CURRENT STATUS OF SALMON STOCKS

3.1 Rod and net catches

Recent figures for the annual catch of salmon by rods and nets from 1993 are shown in Table 1.

Year	Nets	Rods
1993	2027	210
1994	2714	615
1995	2882	450
1996	2548	550
1997	1616	175
1998	3181	400
1999	3090	1200
2000	962	220
2001	794	391
2002	850	400
2003	874	320
2004	1097	365
2005	434	249
2006	365	343
2007	closed	closed
2008	closed	222*
2009	closed	closed

Table 1 Catches by draft net and rod, 1993-2009; *angling in 2008 was mandatory catch and release (Source: IFI)

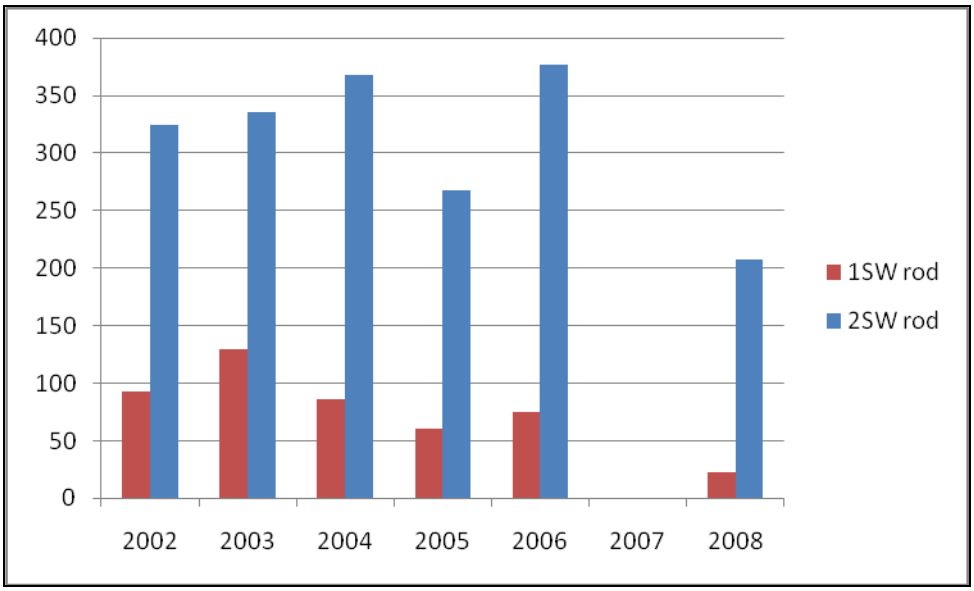

Figure 1 Reported rod catch, 2002-08 (Source: CFB reports on Wild Salmon and Sea Trout Statistics, 2004-2008 - data includes fish caught and released)

The rod catch has declined significantly over a long period but has not fluctuated greatly in this time series, apart from a very large take of 1200 fish in 1999. The nets on the other hand have recorded a marked decline in this period, notably since 1999. It is understood that in some years since the introduction of Total Allowable Catch (TAC) in 2002, the nets actually failed to attain their full quota allocation. The rod catch can be broken down into Spring salmon (MSW) and grilse (1SW) from angling log book returns as illustrated in Figure 1.

3.2 Juvenile salmon stocks

Electrofishing surveys have been carried out by CFB/ERFB since 1991 when a 3-year study was initiated to gain information on the distribution and density of juvenile salmonids throughout the catchment. A total of 89 sites were surveyed during 1991-93. This has been succeeded by follow-up surveys on an average of 20 sites in 1995, 1997 and 2000 as reported in the Recovery Plan of 2002. The monitoring programme has been continued with further surveys in 2003 (17 sites), 2005 (19 sites), and 2007 (16 sites). A map of the principal 25 sampling sites throughout this period is shown in Figs 2a and 2b, indicating those sites sampled in 2007.

A preliminary CFB report for the 2007 survey includes the following summary remarks:

- *Large channels: Salmon fry densities in the Slaney main channel, the Derreen River and the Bann River are moderate to good with good densities recorded in the Derry River. Salmon parr densities are also moderate to good.*
- *In the upper reaches of the catchment/ medium sized channels the Carrigower River and the Little Slaney had low to moderate densities of salmon fry and salmon parr. The Knickeen had moderate densities of salmon fry and good densities of salmon parr. The Douglas (Barnhill/Kiltegan) River had good densities of salmon fry and moderate to good densities of salmon parr.*

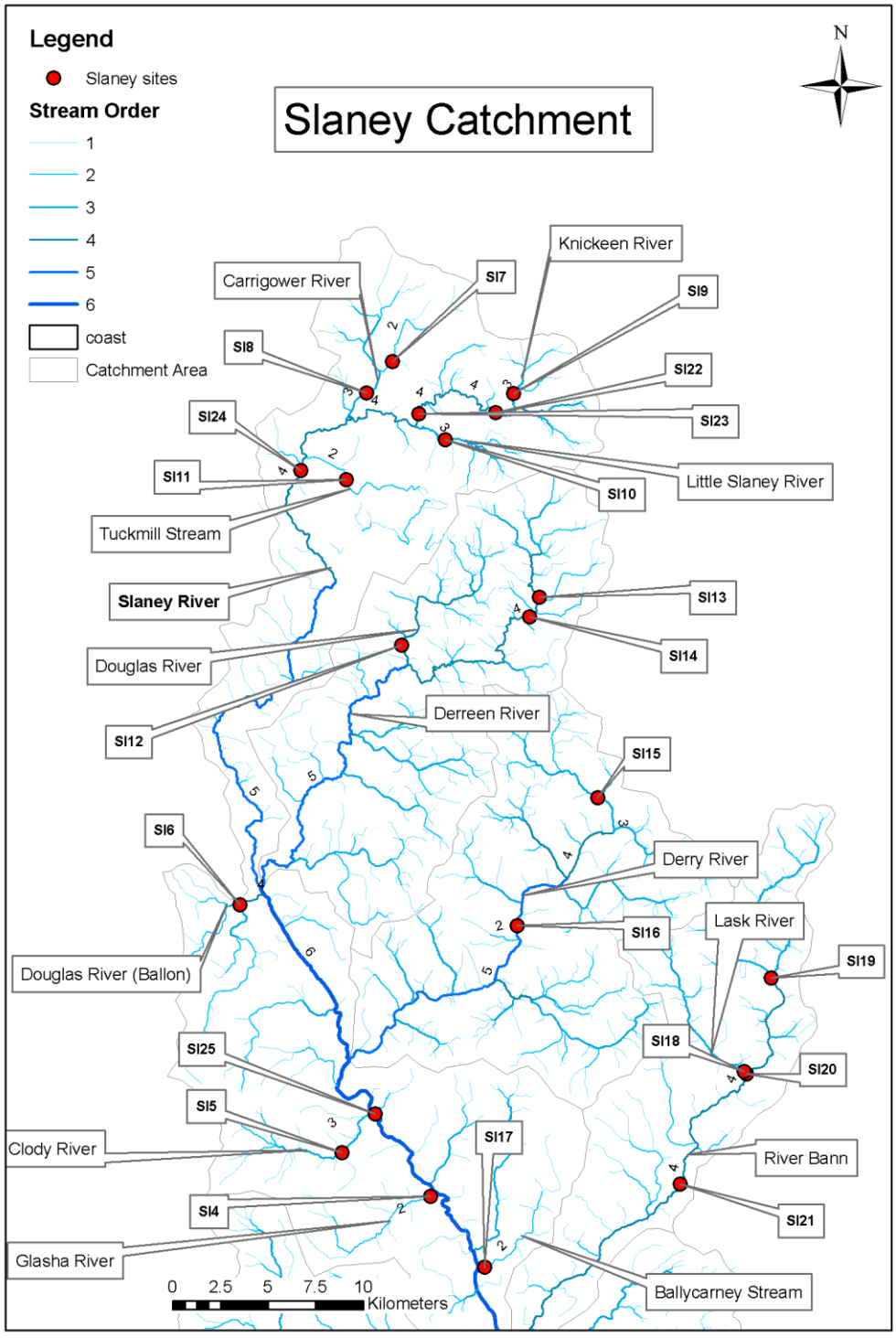

Fig 2a CFB electrofishing sites on the Slaney – upper and middle catchment (reproduced from CFB preliminary report 2007)

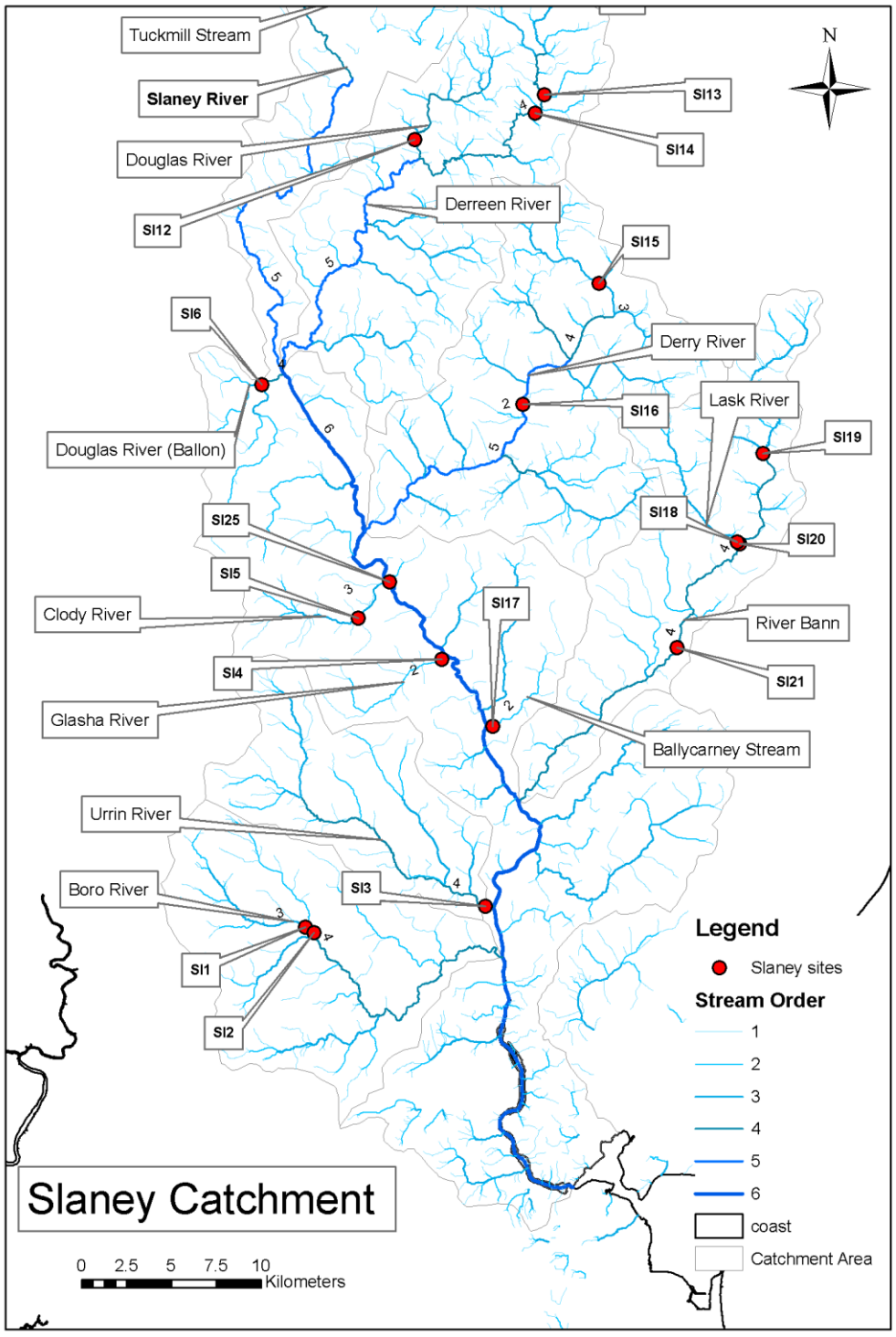

Fig 2b CFB electrofishing sites on the Slaney –middle and lower catchment (reproduced from CFB preliminary report 2007)

In order to present the full series of results from 1993 – 2007 in a digestible format, the results for fish density have been compressed into 5 broad-range density categories for both salmon fry (0+)

and salmon parr (1+) as shown in Table 2 with the addition of colour coding. This is loosely based on a similar classification system developed by Crozier & Kennedy (1994) for 0+ salmon.

Fry (0+)		Parr (1+)	
Density (no/m²)	***Classification***	**Density (no/m²)**	***Classification***
> 0.9	***Excellent***	> 0.2	***Excellent***
0.6 - 0.89	***Good***	0.1-0.199	***Good***
0.3 - 0.59	***Fair***	0.05-0.099	***Fair***
0.001 - 0.29	***Poor***	0.001 - 0.049	***Poor***
0	***Absent***	0	***Absent***

Table 2 Broad-range density classification system for salmon fry and parr

The sampling sites have been divided up into different sections of the catchment:

- Area 1 - upper catchment (main channel & tributaries)
- Area 2 - Derreen & Derry rivers
- Area 3 - middle catchment (main channel and small tributaries)
- Area 4 - lower catchment (Urrin, Boro & Bann rivers)

The full series of results is shown in Tables 3-6 and may be related to water quality through reference to a map of EPA Q-values for the catchment as illustrated in Fig 8 – Section 7.

3.2.1 Area 1: upper catchment (Table 3)

Location		**Little Slaney R**	**Knickeen R**	**Slaney (main channel)**			**Carri-gower R**	**Donard stream**	**Tuckmill stream**
Site no.		***SL10***	***SL9***	***SL22***	***SL23***	***SL24***	***SL8***	***SL7***	***SL11***
0+	***1993***								
	1995	**Poor**	**Fair**	**Good**	**Good**	**Fair**	**Poor**	**Absent**	**Absent**
	1997	**Poor**		**Fair**	**Fair**	**Poor**	**Fair**	**Absent**	**Absent**
	2000	**Poor**	**Fair**	**Fair**	**Good**	**Fair**	**Poor**		
	2003	**Poor**	**Fair**	**Good**	**Good**	**Fair**	**Poor**		
	2005	**Poor**	**Good**	**Good**	**Fair**	**Fair**	**Poor**		
	2007	**Poor**	**Fair**	**Fair**	**Fair**	**Poor**	**Poor**		
1+	***1993***								
	1995	**Poor**	**Fair**	**Fair**	**Fair**	**Good**	**Poor**	**Absent**	**Poor**
	1997	**Fair**		**Excellent**	**Good**	**Excellent**	**Excellent**	**Poor**	**Absent**
	2000	**Poor**	**Good**	**Fair**	**Fair**	**Absent**	**Excellent**		
	2003	**Poor**	**Excellent**	**Good**	**Fair**	**Good**	**Fair**		
	2005	**Poor**	**Excellent**	**Good**	**Poor**	**Poor**	**Poor**		
	2007	**Poor**	**Excellent**	**Good**	**Poor**	**Fair**	**Good**		

Table 3 Density classifications for salmon fry and parr; Area 1, 1993-2007

The main channel of the Slaney and the Knickeen are clearly of major importance as key spawning and nursery areas of the catchment with Fair to Good fry densities and generally Fair to Excellent parr densities. Biological quality in these streams is High status as indicated by Q-values of 4 or better (Fig 8). It is difficult to define any trends in abundance during this period – the Knickeen appears to have improved while there is evidence of some decline at site SL23 on the Slaney and on the Carrigower.

Fish densities in the Carrigower may be limited to some degree by biological quality with Q-values of 3/4 - recent studies by Champ *et al* (2007) have shown that the abundance of 1+ and older salmon can be significantly different between moderate (Q3/4) and good quality (Q4) sites. Examination of historic EPA data indicates that there has been some deterioration in the Carrigower from High quality in 1991-98.

3.2.2 Area 2: Derreen & Derry rivers (Table 4)

Location		Derreen R		Douglas R (Kiltegan)	Derry R	
Site no.		*SL13*	*SL14*	*SL12*	*SL15*	*SL16*
0+	*1993*				Absent	Poor
	1995	Fair	Fair	Poor	Absent	
	1997	Absent	Poor	Fair	Poor	Fair
	2000	Fair	Good	Good	Absent	Good
	2003	Poor	Fair	Good		Excellent
	2005	Fair	Poor	Fair		Excellent
	2007	Fair	Poor	Good		Good
1+	*1993*				Absent	Fair
	1995	Poor	Fair	Poor	Poor	
	1997	Absent	Fair	Excellent	Poor	Good
	2000	Poor	Poor	Fair	Absent	Good
	2003	Poor	Poor	Poor		Good
	2005	Good	Poor	Good		Excellent
	2007	Fair	Poor	Good		Good

Table 4 Density classifications for salmon fry and parr; Area 2, 1993-2007

Both of these rivers are important tributaries in terms of juvenile fish production. The Derry in particular exhibits consistent Good to Excellent densities of both fry and parr at the lower site SL16. The upper site appears to produce few if any salmon although it is rated as High quality at Q4 – the relative absence of salmon may indicate that this section of the river is upstream of the normal range of salmon distribution as trout were found at consistently good densities in this area.

The Derreen system appears to be relatively consistent but a decline in both fry and parr densities at SL14 may be related to a deterioration in water quality with a fall in quality from Q5 in

1998 to Q3/4 in 2007. However a similar decline in quality on the Douglas tributary has not been reflected in lower salmon densities – on the contrary, it appears that there has been some improvement on fish numbers.

3.2.3 Area 3: middle catchment - main channel and small tributaries (Table 5)

The main waters in this area of the catchment - Slaney, Glashagh and Clody, have exhibited Poor to Fair fry densities and generally Fair to Good parr numbers. The Clody should give some cause for concern as parr numbers have declined steadily from Excellent in 1997 to zero (Absent) in 2007, in spite of consistent High quality Q- values.

Salmon have been virtually absent from the Douglas River in the 4 sampling occasions since 1993 to 2007 – this stream is known to suffer from moderate pollution with consistent Q-values of 3 and 3-4 since 1991. Eutrophication as a result of sewage and agricultural activities is suspected.

Location		Slaney R (main channel)	Glashagh R	Clody R	Ballycarney stream	Douglas R (Ballon)
Site no.		*SL25*	*SL4*	*SL5*	*SL17*	*SL6*
0+	*1993*	Poor	Poor	Poor	Good	Absent
	1995		Poor	Poor	Poor	
	1997	Poor	Poor		Poor	Poor
	2000		Fair	Absent		
	2003			Fair		
	2005	Fair	Poor	Poor		Absent
	2007		Fair	Poor		Absent
1+	*1993*	Good	Fair	Good	Poor	Absent
	1995		Fair	Excellent	Good	
	1997	Good	Fair		Good	Absent
	2000		Good	Good		
	2003			Fair		
	2005	Fair	Good	Fair		Absent
	2007		Good	Absent		Absent

Table 5 Density classifications for salmon fry and parr; Area 3, 1993-2007

3.2.4 Area 4: lower catchment - Urrin, Boro & Bann rivers (Table 6)

Salmon fry numbers have been relatively stable in these tributaries with Poor to Fair densities - occasional Excellent ratings are possibly attributable to spawning peaks in the Boro and the Bann. Parr numbers in these waters range from Poor to Good density – there seems to have been some improvement in the Urrin while fluctuating numbers in the Bann may again reflect spawning peaks.

Location		Lask R (Bann)	Bann R			Boro R		Urrin R
Site no.		*SL18*	*SL19*	*SL20*	*SL21*	*SL1*	*SL2*	*SL3*
0+	*1993*		Fair	Poor	Poor	Poor	Poor	
	1995		Poor		Poor		Excellent	Poor
	1997	Poor		Poor	Poor		Poor	Poor
	2000	Poor		Poor	Excellent	Poor	Poor	Poor
	2003	Poor		Poor	Poor	Poor	Poor	Poor
	2005			Poor	Excellent	Poor	Poor	Fair
	2007				Fair		Fair	Poor
1+	*1993*		Fair	Poor	Fair	Good	Poor	
	1995		Good		Good		Good	Fair
	1997	Poor		Fair	Fair		Fair	Fair
	2000	Poor		Fair	Good	Poor	Poor	Fair
	2003	Poor		Fair	Poor	Poor	Poor	Good
	2005			Fair	Good	Fair	Fair	Good
	2007				Poor		Poor	Good

Table 6 Density classifications for salmon fry and parr; Area 4, 1993-2007

3.2.5 Overview

Salmon fry (Age 0+)

Trends in 0+ abundance are examined by considering the frequency of each density classification throughout the sampling period, 1995-2007 (Fig 3). From these sequences it can be seen that there has been:

- a clear reduction the frequency of sites with no fry present and some decline in the frequency of sites of *Poor* fry density
- a steady increase in the number of sites with *Fair* fry densities
- a trend towards an increasing frequency of Good fry densities, although recent figures have been declining
- an increasing frequency of Excellent fry densities, although no sites attained this classification in 2007

There is therefore an overall trend indicating an increase in salmon fry densities in the catchment although, given the extent of good quality habitat available, there should be a higher frequency of sites reaching *Good* to *Excellent* levels of stock.

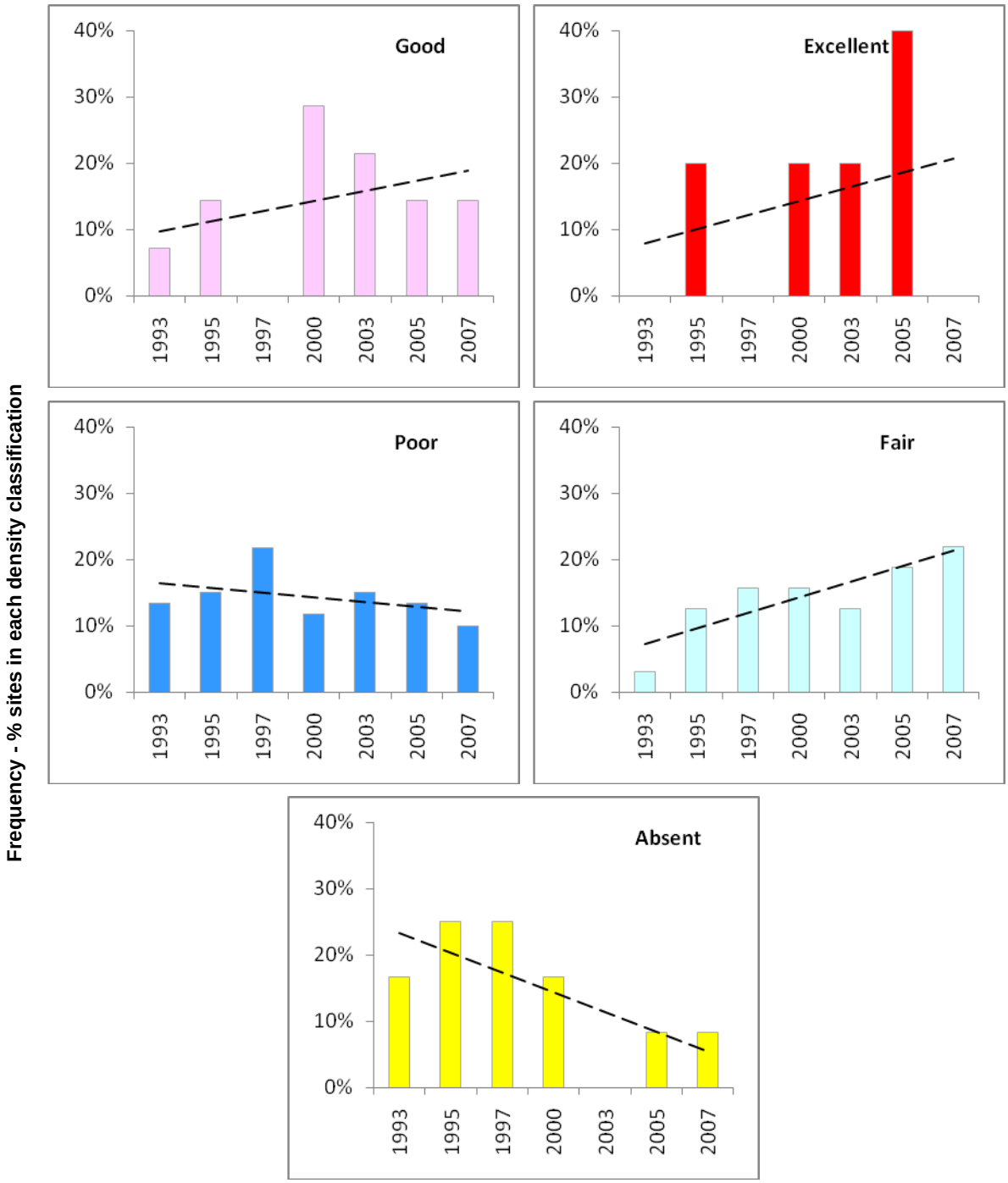

Figure 3 Trends in 0+ salmon density classifications, 1993-2007

Salmon parr (Age 1+)

In general terms parr densities are more satisfactory than fry densities with a higher frequency of Good/Excellent classifications throughout the sampling period. Trends in 1+ abundance may be examined by considering the frequency of each density classification throughout the sampling period, 1993-2007 (Fig 4).

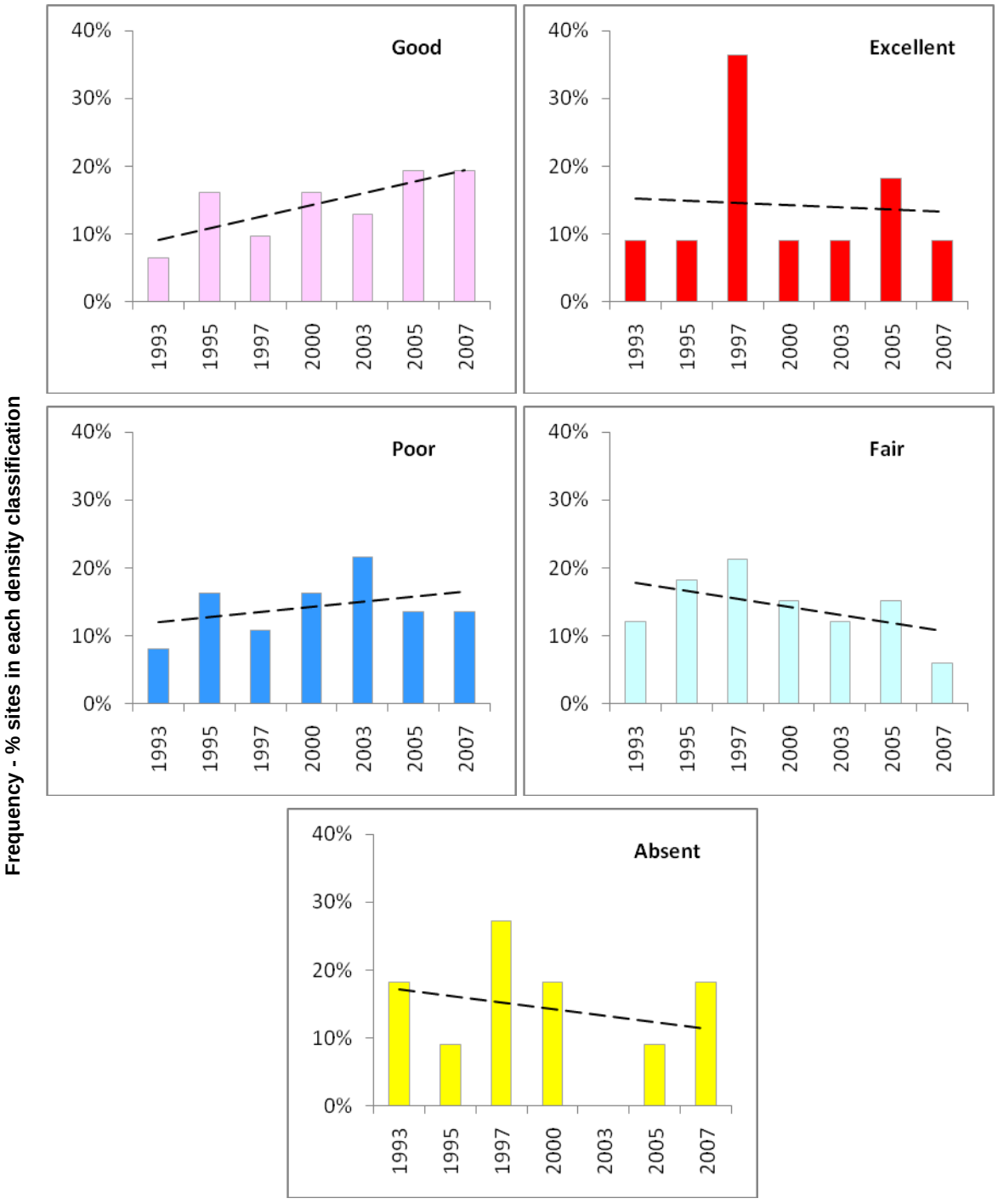

Figure 4 Trends in 1+ salmon density classifications, 1993-2007

From these sequences it can be seen that:

- parr densities have been more stable during this period
- there is evidence of a decline in the proportion of sites with no parr present but some increase in Poor densities

- there is clear evidence of an increase in Good parr densities but some decline in Fair densities
- the frequency of Excellent parr density has been relatively constant apart from an exceptionally good year in 1997

A survey in 2009 would have been valuable to assess the increased spawning escapement of 2007 following the introduction of conservation measures to reduce exploitation by nets and rods. There is now an urgent need for up-to-date information on the level of juvenile stocks and a continuation of the survey programme in 2010 would be highly desirable.

3.3 Spawning stock and total runs

3.3.1 Redd counts

Estimates of spawning stock are carried out each year by local IFI staff. The efficiency of redd counting is somewhat limited by prevailing water conditions during the spawning season and the method can be highly subjective. However IFI have adopted a consistent approach to the procedure since 1994 (M Kelly, IFI *pers comm.*) and this has been highly commended as providing a good relative index of the status of the spawning stock (W Roche, IFI, *pers comm*.). Counts since 1994 are illustrated in Fig 5.

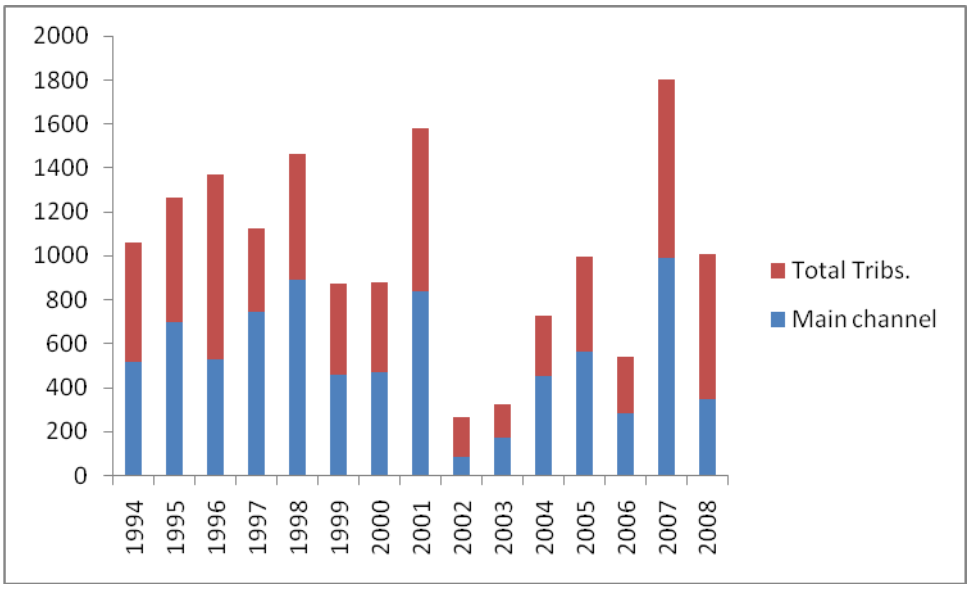

Figure 5 Spawning redd counts, 1994-2008 (Source: IFI)

Redd counts from 1994 to 2001 were reasonably encouraging but since 1998, the count has exceeded 1000 only twice. Normally a high proportion of the redds (up to two thirds) may be found in the main channel upstream of Baltinglass, where spring fish are believed to spawn. It is noted that only 30-35% redds were detected in the main channel in 2002 and 08, but it is reported that high water levels in these years prevented a full count and the main channel may have been largely inaccessible.

The high count in 2001 was probably due largely to reduced exploitation as a result of the restrictions on angling imposed during the Foot and Mouth disease precautions in force through

the early part of the season. Similarly the high count in 2007 was probably due to an increased escapement of fish resulting from the suspension of draft netting and curtailment of angling as conservation measures.

3.3.2 Fish counter

The resistivity fish counter at Clohamon weir has been in operation since August 1998. Although this facility permits only a partial count for the system, it has provided a very useful relative index of the total run of fish each year. It has therefore been the major tool in gauging the annual run and in regulating exploitation with respect to the conservation limits set by the Standing Scientific Committee of the National Salmon Commission. The raw data from the counter requires considerable processing to produce final estimates of the annual runs of 1SW and MSW to the system. The counter records upstream and downstream movements of fish in excess of 40cm long - an example dataset for 2004 is shown in Table 7.

Column:	1	2	3	4		5	6
Month	Up	Down	Net upstream movement	Video analysis:		Escapement	
						Salmon	Sea trout
Jan	31	9	31	Salmon	1,113	20	11
Feb	8	3	8	Sea trout	585	5	3
Mar	129	15	129	Ratio Sal:ST	0.66	85	44
Apr	128	14	128			84	44
May	68	3	68			45	23
Jun	420	49	371			74	297
Jul	88	13	75			15	60
Aug	99	20	79			16	63
Sep	229	23	206			41	165
Oct	290	106	184			121	63
Nov	75	17	58			38	20
Dec	133	30	103			68	35
Total	**1698**	**302**	**1,440**			**611**	**829**

Table 7 Calculation of monthly escapement of salmon and sea trout from fish counter records

To calculate escapement of salmon and sea trout through the fish counter

This is based on a number of adjustments/assumptions which are applied to the basic up stream / downstream records (cols 1 & 2):

- all downstream movements during Jan – May are assumed to be kelts (col 2) - downstream movements are therefore not subtracted
- downstream movements after May are assumed to be movements of the currents year's fish and are therefore subtracted from column 1 to produce figures for net upstream movement (col 3)
- the ratio of salmon to sea trout is determined each year from video analysis (col 4)

- the salmon to sea trout ratio is applied to the net upstream movement (col 3) to calculate the split between salmon and sea trout for Jan-May and Oct-Dec (col 5/6)
- the salmon to sea trout ratio for Jun to Sept is assumed to be 1:4 (i.e. 80% sea trout) – this is applied to the net upstream movement for Jun-Sept (col 3) to calculate the split between salmon and sea trout for this period (col 5/6)

To estimate numbers of 1SW / MSW salmon and the total salmon run to river

The figures for salmon escapement (col 5) are adjusted according to the following assumptions:

- all net upstream movements (col 3) during Jan-Jun are MSW
- all net upstream movements (col 3) during Jul-Sep are 1SW
- net upstream movements (col 3) during Oct-Dec are 75% MSW / 25% 1SW

Having made these adjustments, the final figure is then scaled up by doubling to provide the final figures for annual runs of MSW and 1SW fish to the river. For 2004 this information can be summarised as follows:

COUNTER	TOTAL RUN
MSW	**MSW**
482	965
1SW	**1SW**
129	257
Proportion MSW	**TOTAL**
79%	1222

Based on the fish counter, the final stock abundance indices used by the Standing Scientific Committee for the years 2002-09 are shown in Table 8. Full data for each year 2002-09 is included in the Appendix (2008 & 09 figures are provisional)

Year	1SW	MSW	Total
2002	608	2028	2636
2003	339	2149	2488
2004	257	965	1222
2005	381	715	1096
2006	136	614	750
2007	864	1390	2254
2008	240	838	1078
2009	258	1072	1331

Table 8 Stock abundance indices for MSW and 1SW components of Slaney stock, 2004-09 (Source: SSC Advice for 2009; CFB)

3.3.3 Catchment wide electrofishing

The potential for using semi-quantitative electrofishing on a catchment-wide basis is being investigated by IFI to see if a relationship can be established between fry abundance and adult

returns. The original methodology was developed in N Ireland by Crozier & Kennedy (1994) as an alternative to using stop nets and successive fishings as required for fully quantitative electrofishing surveys, and is based on 5-minute spot surveys at each selected location. Rather than the determination of highly accurate fish densities for a limited number of sites, it results in approximate abundance indices for a large number of sites across the catchment to provide useful data on spawning distribution and relative abundance of fry.

CFB/IFI has developed a sampling methodology and protocols for a national programme of catchment wide electrofishing which was first rolled out in 2007. This was tested on a series of rivers in 2007 including the Slaney, which was found to have *Good* fry abundance. This was an interesting result since the assessment based on the counter had estimated that the 2SW stock was below CL while the 1SW stock was above.

This method is routinely used in N Ireland and the Foyle area, and has also been adopted widely in Britain. In some respects this type of data may be more valuable in the long term than the counting of adult fish.

4 SALMON LIFE HISTORY CONSIDERATIONS

4.1 Outline

This section emphasises the importance of scale reading in understanding the age structure of the adult run in each year, and also outlines the complex relationship between different generations due to the various stock components in a river with different sea age groupings.

4.2 Population age structure

A total of 52 scale samples have been collected by IFI and the Trust in 2002 (24 samples) and 2006 (28 samples), of which 45 yielded conclusive determinations of individual life history in terms of smolt age and sea age. These results are summarised in Table 9.

Type	Smolt age; sea age	2002	2006	Combined	%	Mean wt (lbs)
2SW	1;2	8	8	16	89	10.5
	2;2	9	13	22		
	3;2	1	1	2		
1SW (grilse)	1;1	1	0	1	11	6.9
	2;1	3	1	4		

Table 9 Summary of scale reading indicating numbers of fish in each age category, % 1SW / 2SW and mean weight (Source: IFI; Slaney River Trust)

These results indicate a clear majority of 2SW fish in the sample, although this may be biased towards this sector of the stock as sampling was based on the rod and net fisheries, and only 1 sample was collected after mid-July.

It would appear that a considerable number of juveniles smoltify at age 1 as a significant proportion of 2SW scales indicate migration from the river at this age - this would be anticipated at this latitude. On the other hand it appears that there is also a small number of juveniles remaining in the river until age 3.

This information is fundamental to an understanding of the life history and stock breakdown of salmon in the Slaney, and is essential for proper management of the river. There is an urgent need to expand this database on an annual basis so that any changes in stock breakdown can be detected and management measures adjusted if necessary. Indeed it is both unfortunate and ironic that, at a time when this information is required most urgently, the sources of the data in the form of both rod and net fisheries are not available.

4.3 Generation history

The relationship between different generations of salmon is complex due to the life history of the various stock components, particularly in a river such as the Slaney with at least 2 smolt age groups and 2 adult stock components, 1SW and 2SW. The relationship between different parental years and subsequent generations is illustrated in Table 10.

The eggs deposited by adult fish returning in a particular year (year X) will hatch in year X+1, and will give rise to age 1 smolts (S1) in year X+2, and age 2 smolts (S2) in year X+3. Subsequently, age 1 smolts may return to the river as grilse (1SW) in year X+3 or as salmon (2SW) in year X+4. Similarly, age 2 smolts may return to the river as grilse (1SW) in year X+4 or as salmon (2SW) in year X+5.

For example the adult run of 2010 will originate from 3 different parental years – 2005, 06 and 07. Similarly the 2011 year class arising from the 2010 run will return over a period of 3 years as different components of the run in 2013, 14 and 15.

Parental year (adult run)	***Eggs hatch***	***Smolts***		***Adults (next generation)***			
				1SW		**2SW**	
		S1	**S2**	**S1**	**S2**	**S1**	**S2**
Year (x)	**(x+1)**	**(x+2)**	**(x+3)**	**(x+3)**	**(x+4)**	**(x+4)**	**(x+5)**
2000	2001	2002	2003	2003	2004	2004	2005
2001	2002	2003	2004	2004	2005	2005	2006
2002	2003	2004	2005	2005	2006	2006	2007
2003	2004	2005	2006	2006	2007	2007	2008
2004	2005	2006	2007	2007	2008	2008	2009
2005	2006	2007	2008	2008	2009	2009	**2010**
2006	2007	2008	2009	2009	**2010**	**2010**	2011
2007	2008	2009	2010	**2010**	2011	2011	2012
2008	2009	2010	2011	2011	2012	2012	2013
2009	2010	2011	2012	2012	2013	2013	2014
2010	**2011**	**2012**	**2013**	**2013**	**2014**	**2014**	**2015**

Table 10 Generation history of River Slaney salmon, 2000-10

This illustration could be further complicated by consideration of:

- Age 3 smolts, a small number of which were observed through scale reading
- 3SW adults which were probably a significant feature in the past but have virtually disappeared from Irish stocks
- Returns of “previous spawners” which are likely to be a small proportion of the overall run in any year

5 MANAGEMENT OF SALMON STOCKS

5.1 Estimation of conservation limits

Salmon stocks in Ireland are now managed on an individual river basis with the objective that each river must exceed its Conservation Limit for there to be any exploitation of fish to be permitted either by nets or rods.

The conservation limit for Atlantic salmon is defined by NASCO as:

the spawning stock level that produces long term average maximum sustainable yield as derived from the adult to adult stock and recruitment relationship.

In simpler terms the Conservation Limit (CL) for a river is the number of spawning salmon required to ensure that salmon are reproducing in sufficient quantities to produce the next generation of fish.

The procedure for defining CLs is described in some detail in the Report of the Scientific Sub-Committee (Anon., 2008). In essence, this involves the transportation of established stock and recruitment parameters from 13 monitored rivers in the North-east Atlantic area to Irish rivers using a Bayesian hierarchical stock and recruitment analysis (BHSRA) model. The model generates a CL based on the size of the river (wetted area) and its latitude, which is taken as the mid-point of the catchment area.

The model "forecasts" the CL as a rate of projected egg deposition which, in the case of the Slaney, is equivalent to 4.189 eggs/m². This is converted to a total egg requirement for the system by multiplying by the wetted area of the catchment available to salmon:

CL = 4.189 eggs/m² x 4,925,255 m²

= 20,715,673 eggs

This value is then converted to the number of adult fish required through the following calculation:

If the total number of adult fish required to meet CL is N, then:

$$CL = (Prop_{1SW} \times Prop_{1SW\ Female} \times Eggs_{1SW} \times N) + (Prop_{MSW} \times Prop_{MSW\ Female} \times Eggs_{MSW} \times N)$$

where: $Prop_{1SW}$ / $Prop_{MSW}$ in Slaney = 75% MSW / 25% 1SW - based on counter and scale reading data from Slaney, 2002-07

$Prop_{1SW\ Female}$ = 0.6 (60%), $Prop_{MSW\ Female}$ = 0.85 (85%) - based on observations of returning wild salmon in Irish rivers (Ó Maoiléidigh *et al*., 2004)

Average egg production for 1SW female ($Eggs_{1SW}$) = 3,400

Average egg production for MSW female ($Eggs_{MSW}$) = 8,000

- based on average fecundities for 1SW and MSW of returning wild salmon in Irish rivers (Ó Maoiléidigh *et al.*, 2004)

Applying these values to the equation, it follows:

20,715,673 = (0.25 x 0.6 x 3,400 x N) + (0.75 x 0.85 x 8,000 x N)

20,715,673 = (510N) + (5,100N) = 5,610N

Therefore, N = 20,715,673 / 5,610 = 3692 adult fish to meet CL

consisting of 2,769 MSW (75%) and 923 1SW (25%)

Clearly the fish counts outlined in Table 3 fall some distance short of the CLs for both stock components and there is serious concern, particularly with regard to the MSW spring stock. The figures for the last 3 years are particularly alarming as there has been no exploitation by rods or nets during this period. Continuation of the policy of reduced exploitation to maximise spawning numbers is therefore of the utmost importance during this phase of low abundance.

5.2 Derivation of annual catch advice

The SSC provides annual advice on harvest options for individual rivers in order to ensure that there are sufficient spawning salmon remaining in each system to meet the required CL. This means that the number of salmon which will be available before any exploitation takes place must be "forecast" for each river, based on the average returns over the most recent 5 year period. The information required is:

Total return = Total reported catch + Total spawners.

Projections of the total return include net catch data up to 2006 which was the last year of the commercial fishery. On the Slaney this was also the last year in which the river was open for salmon angling exploitation (in 2008 catch & release was permitted). The catch data for commercial nets and angling are available from the IFI Salmon Carcass and Tagging Logbook Scheme. For the Slaney this would include data from the draft net fishery along with the rod catch from the river.

With estimates of the average spawning stock, average catch and the CL, harvest options are provided along with the associated probability of meeting the CL. The harvest option that provides a 0.75 probability level (or 75% chance) of meeting the CL is recommended. If there is no harvest option which will provide a 75% chance of meeting the Conservation Limit, then there is no surplus of fish to support a harvest, by either nets or rods.

The forecast total return for the Slaney in 2009 was 956 1SW fish and 1025 MSW fish. In the case of the MSW stock, the projected return was only 37% of the CL and therefore was well below a level at which any harvest could be recommended. The projected grilse (1SW) return was slightly above the CL for this component of the stock (104%) with an estimated surplus of only 33 fish. The river therefore remained closed for 2009.

5.3 Survival model for the Slaney salmon

Using the above CLs, sex ratios and ova production rates for MSW and 1SW fish, it is possible to construct a simple survival model for the Slaney salmon based on typical freshwater survival rates to smolt and marine survival rates to adult return (Table 11). In the illustration the model assumes an initial spawning stock equivalent to the estimated CL for both MSW and 1SW components.

A freshwater survival rate to smolt of 1% is applied is this is regarded as realistic average for Irish rivers based on data from the Bush and Burrishoole systems (Whelan, Roche & Ó Maoiléidigh, 1989). The marine survival rates are taken from the Corrib and based on recent 10-year averages of 1% for MSW and 5.7% for 1SW (ICES, 2009). The model assumes no exploitation by either nets or rods.

For each of the stock components to be sustainable, the adult return (bottom line) should be at least equal to the original parental stock i.e. in order to maintain stocks at prescribed conservation limits. However it is clear that, at current rates of marine survival and without any exploitation, the MSW stock is unsustainable while the 1SW stock is only marginally sustainable. On the basis of these figures an increase in MSW marine survival rate to 1½% could lead to the achievement of the CL for this stock with a projected return of 2,824 fish, still without any exploitable surplus. On the other hand, an increase to early 1980s marine survival rates of 2½% could produce a return of 4,700 with an exploitable surplus of over 1,500 fish.

Total conservation limit = 3,692 adult fish		
Stock	**MSW**	**1SW**
Parental stock (at conservation limit)	**2,769**	**923**
% female	*85%* ↓	*60%* ↓
No. females	**2,354**	**554**
Ova/female	*8,000* ↓	*3,400* ↓
Ova production	**18,829,200**	**1,882,920**
Survival to smolt	*1.0%* ↓	*1.0%* ↓
Smolt production	**188,292**	**18,829**
Marine survival	*1.0%* ↓	*5.7%* ↓
Adult return	**1,883**	**1,073**

Table 11 Survival model for Slaney salmon

This model may be an over-simplification and should be treated with caution – for example, the model assumes complete segregation of the MSW and 1SW stock components in terms of breeding and subsequent life history. However the basic figures applied to the different life stages are based largely on the current data utilised in computation of conservation limits and the derivation of catch advice – the model may therefore be a reasonable approximation of projected returns at this time of low marine survival and serves to highlight the precarious state of the MSW stock in particular. It also emphasises the importance of maximising freshwater production in terms of ova deposition and smolt output.

6 SEA TROUT

6.1 Background

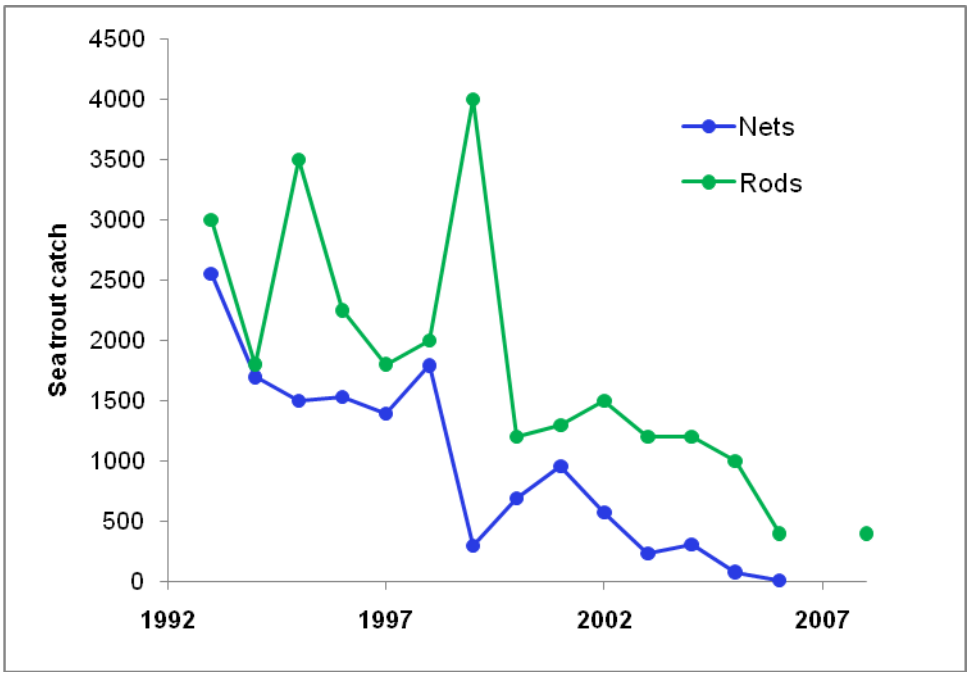

Figure 6 Sea trout catches on the River Slaney, 1993-2008 (Source: IFI)

The Slaney is best known as a salmon river but it also has a history as a productive sea trout fishery with the main run from late June to mid July. The Boro, Urrin and Bann rivers have a reputation as the main sea trout waters with good fishing also in parts of the main channel up to Bunclody. However catch records would suggest a significant decline in recent years in both the net and rod fisheries (Fig 6). This may be somewhat misleading with regard to the net catch in the latter years in which declining catches may have been partly due to reduced fishing effort leading up to the closure of the fishery in 2007. However there is a notable correlation between net and rod catches apart from in 2 years, 1995 and 99, when particularly large rod catches were recorded.

The decline in recorded catch from the Slaney appears to have been in contrast with the pattern on other leading sea trout waters in the old ERFB region which have exhibited a more stable return with an increase in some cases (Fig 7).

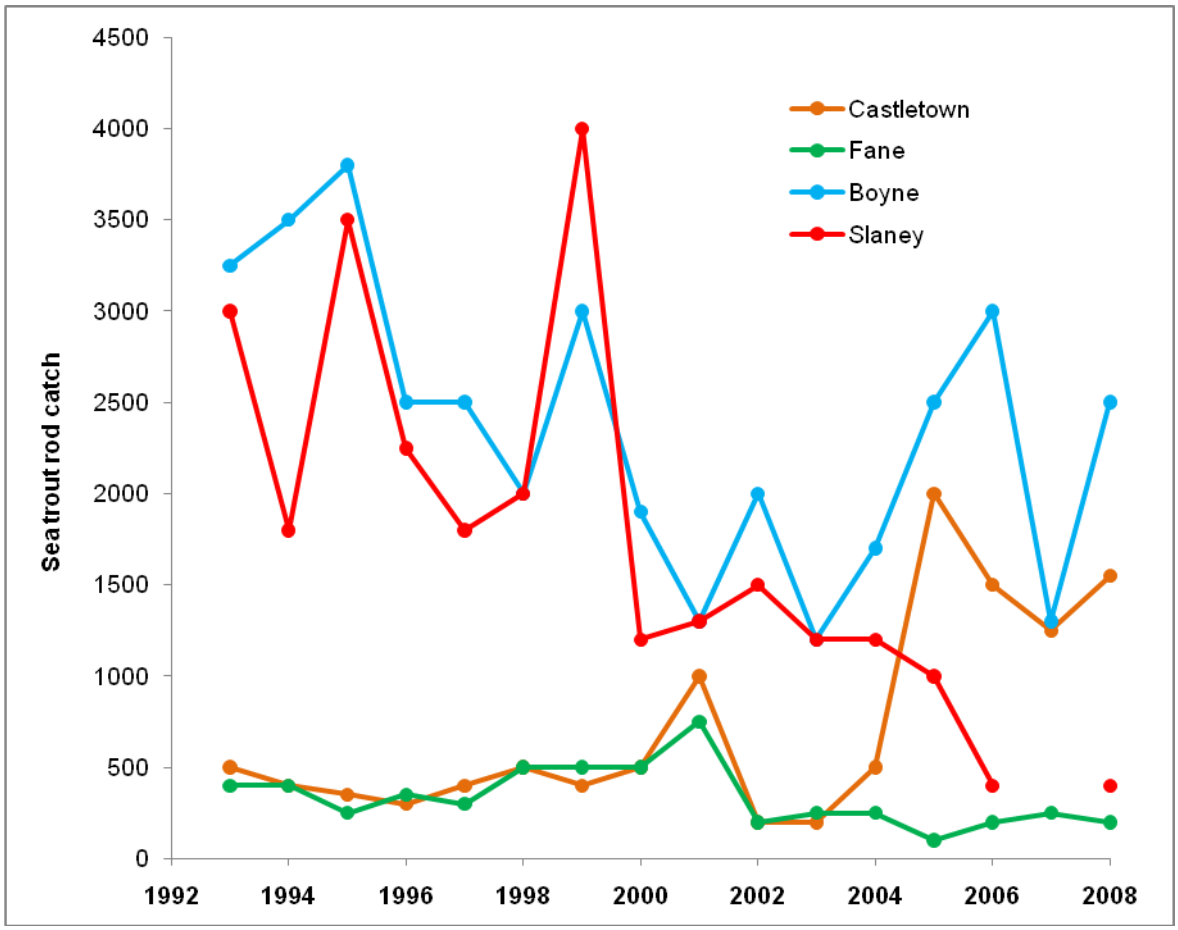

Figure 7 Sea trout catches by nets and rods, 1993-2008 (Source: IFI)
Net data based on fishermen's returns/log books; rod data is all fish caught i.e. ><40cm

6.2 Celtic Sea Trout Project

The Celtic Sea Trout Project is a new, multi-agency partnership investigation into the sea trout stocks of rivers discharging to the Irish Sea. The project is part-funded by the EU INTERREG 1VA Ireland-Wales Programme with additional support from government agencies, voluntary bodies and private fishery interests in Wales, Ireland Southwest Scotland, Northwest England and the Isle of Man.

The stated aims of the project are:

- To further the pro-active conservation of trout biodiversity (including genetic diversity) and to enable the better management of the sea trout stocks in their freshwater and marine environments so as to strengthen their social, economic and cultural benefits to local and regional communities.

- To promote cooperative working, the effective dissemination of knowledge and a wider general awareness of management needs and options for the conservation and sustainable management of sea trout stocks and fisheries.

Within this framework the project sets out to address a series of specific questions:

- What happens to sea trout after they have migrated to sea and how are the various stocks structured and interlinked?
- What is their marine ecology in terms of their feeding behaviour, diet and life history variation?
- What environmental and other pressures are they exposed to?
- How do their life histories respond to environmental variation in terms of stock structure and composition and, therefore, the subsequent quality of the fisheries?
- Can sea trout life history variation be used as a tool to detect and understand the effects of climate change?

The project will require data collection from up to 80 rivers along with associated estuaries and coastal areas throughout the Irish Sea region. It is also understood that the study will focus on specific rivers and that this is likely to include the Slaney. Several aspects to the investigation will be of major relevance to the Slaney including:

- the development of a genetic database of juvenile sea trout and brown trout populations from individual catchments which will provide a tool for determining the river of origin of adult fish caught in estuarine and coastal waters
- evaluation of the distribution, quality and availability of spawning and rearing habitats for juvenile trout in selected catchments, with projection of freshwater production capacity in terms of smolt yield, and examination of the potential for modelling sea trout production using habitat features

The extensive programme of fieldwork will take place over a 3-year period and is due to commence in April 2010. This project is likely to lead to specific catchment management measures aimed at enhancement and development of sea trout stocks. Further details are available from www.celticseatrout.com

7 ENVIRONMENTAL ISSUES

7.1 Biological River Quality

The EPA has monitored biological quality as part of the National Biological River Quality Monitoring Programme which is described by Lucey *et al*, (1997). On the Slaney the scheme was introduced initially at 10 sites on the main channel but now extends to over 60 sites throughout the catchment. Biotic indices (Q-values) reflect average water quality at any location as follows:

Q Value	*Pollution Status*	*WFD Status*
Q5, Q4-5	Unpolluted	High
Q4	Unpolluted	Good
Q3-4	Slightly polluted	Moderate
Q3, Q2-3	Moderately polluted	Poor
Q2, Q1-2, Q1	Seriously polluted	Bad

Q-values are based primarily on the relative proportions of pollution sensitive to tolerant macroinvertebrates (the young stages of insects primarily but also snails, worms, shrimps etc.) resident at a river site.

The most recent Q-values for the Slaney are illustrated on a catchment map in Fig 8. Basically any shade of blue or green indicates that the site is unpolluted and reflects *Good* or *High* status according to the Water Framework Directive; yellow/orange indicates various degrees of pollution and reflects *Moderate* to *Bad* WFD status.

Among the areas of concern (Q3-4 or less; yellow/orange) are:

- Carrigower
- Derreen - generally satisfactory, problems upstream and downstream of Hacketstown;
  Douglas R - generally unsatisfactory; decline in the upper reaches
  Blacklion trib - upper reaches
- Derry - generally satisfactory, but slight pollution downstream of Shillelagh
- Douglas (Ballon) - moderate pollution downstream of Ballon and slight pollution in other areas.
- Ballycarney stream - enrichment in lower reaches
- Corbally stream - moderate pollution in the upper reaches.
- Boro - slight pollution in lower reaches; moderate pollution in Chapel stream downstream of Clonroche.
- Slaney main channel - mostly satisfactory but slight pollution in middle and lower reaches.

Comments by the EPA (2008) almost invariably refer to enrichment from sewage and agricultural sources with excessive siltation also noted at all unsatisfactory sites.

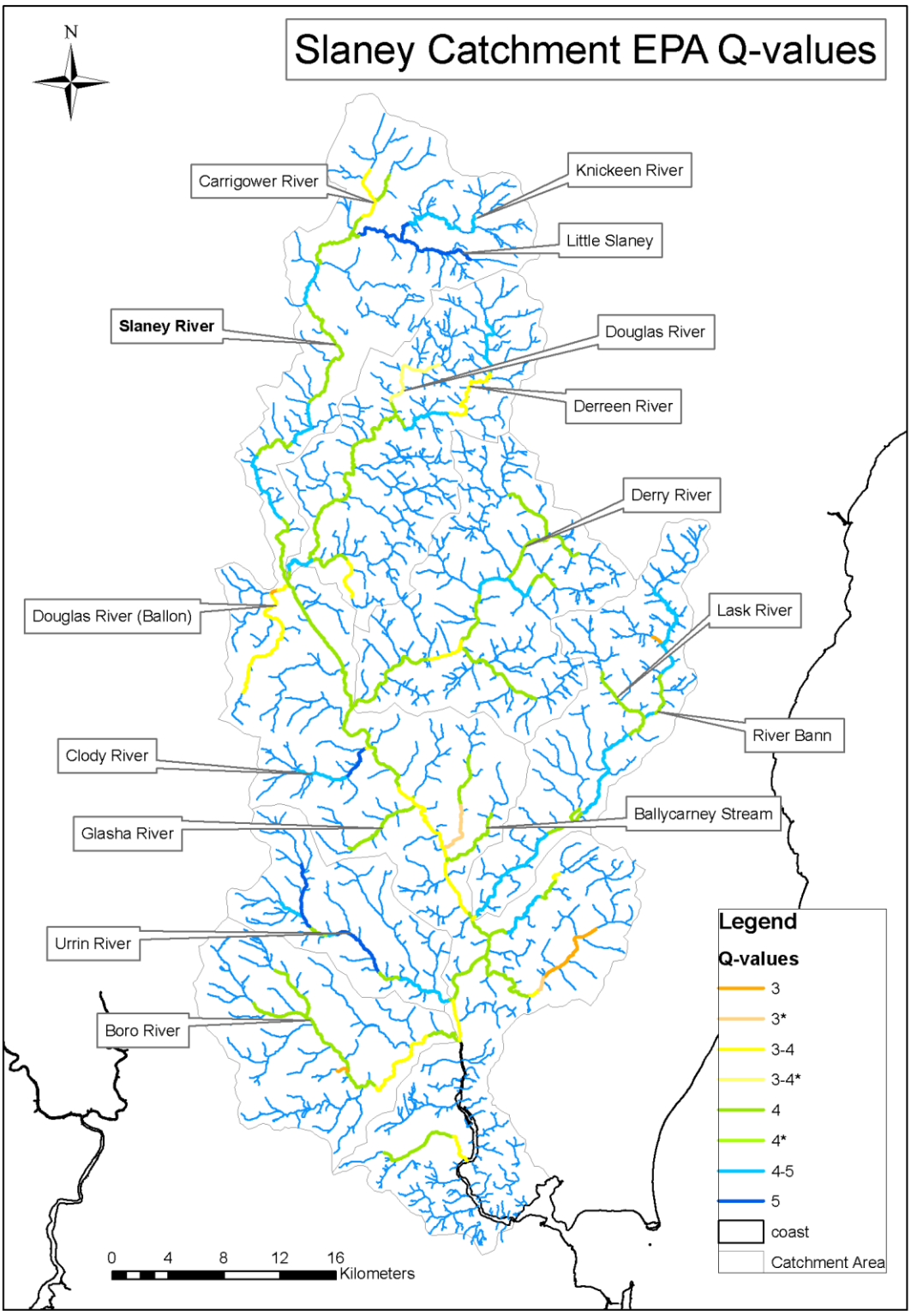

Fig 8 Plot of EPA Q-values for the Slaney catchment for 2007 derived by CFB (Extracted from CFB preliminary report on fisheries survey 2008)

7.2 Factors impacting on water quality

7.2.1 Nutrient enrichment

The input of nutrients from agricultural and sewage sources are the main contributory factors causing various levels of pollution in the Slaney system as evidenced from the observations and comments by EPA (2008). Diffuse run-off from agriculture is probably the more significant but a major issue in recent years has been housing development within Co Wexford. With no spare capacity in existing WWTWs the County Council has permitted the development of housing in small clusters throughout the county, although the soils of the area are unsuitable for discharge to ground water. Many Section 4 licences have been granted under the Local Government Water Pollution Act, 1977, with discharge to small watercourses. The actual impact of these developments on the Slaney has not been quantified but the EPA comments, in some instances, reflect a level of enrichment which may be related.

A new WWTW facility at Bunclody is currently under construction and should have a positive impact as previous treatment of town waste was only basic. Elsewhere two smaller WWTWs on the Douglas (Ballon) have been upgraded with P removal also installed which should lead to an improvement – problems in this catchment may also be associated with a meat plant at Ballon.

7.2.2 Diffuse silt

The input of silt from diffuse sources appears to be an increasing problem in the catchment. This has an impact on water quality in terms of suspended solids but also leads to siltation of the riverbed with impacts on invertebrate and fish habitats.

Any practice that leads to exposure of bare ground can increase the fine sediment and nutrient load to the river. On the Derreen River the major sources of diffuse silt were identified as *Improved grassland, Grazing, Arable* and *Housing* (Anon, 2009). Much of the catchment is subject to arable farming and in general, buffer zones are minimal or non-existent.

7.3 Water abstraction

In comparison with much of Europe, Ireland is relatively well endowed with water resources, although regional shortages can occur at certain times of the year. The rapid expansion of urban areas, such as Dublin, Cork and Limerick, associated with recent economic development, is putting an increasing strain on the water supply infrastructure. The increased demand for water comes mainly from the industrial and domestic sectors, with domestic demand increasing both as a result of population growth and rising water consumption per capita. Most of the present water supply in Ireland comes from surface water, with between 20% and 25% coming from groundwater.

Water is abstracted from the Slaney at Rathvilly and from the upper reaches of the Bann tributary. In terms of potential impact on water flows in the catchment the difference between these two facilities is that there is a productive aquifer underlying the area of the upper Bann,

which reduces the impact, whereas there are no similar resources in the upper reaches of the Slaney. Without doubt the demand for water is going to increase and it seems likely that increases in the level of abstraction from the Slaney will be sought by local authorities.

7.4 Climate change

Although a number of studies have investigated the impact of future predicted climate scenarios on water resources for Britain, little work had been carried out for Ireland, until a recent EPA study (Sweeney, *et al*, 2003). To investigate the impacts on rainfall-runoff and hydrological water resources a simulation model HYSIM was employed - this is the standard model used by the UK Environment Agency. HYSIM uses rainfall and potential evaporation data to simulate river flow and parameters for hydrology and hydraulics that define the river basin and channels in a realistic way.

The predicted run-off for 2041–2070 was compared with the predicted runoff from a baseline period and the greatest reductions in predicted runoff were found to be in the south-east of the country. Moreover the greatest change, an annual reduction in effective runoff of approximately 25% of the baseline flow, was observed for the River Slaney. Among fish species the salmon was highlighted along with Arctic char as being particularly susceptible to climate change by 2055 with a negative response to changes in temperature and rainfall, and a vulnerability rank of *Medium-High*.

Clearly these are major concerns for the future and will have the potential to impact not only on water quality through reduced dilution, but will also have implications for salmon in other ways. Increasing water temperatures will lead to alterations in the aquatic community in general. With regard to salmon higher temperatures may reduce egg survival, retard fish growth, and increase stress and susceptibility to disease. There is also evidence that smolts are leaving rivers earlier and it has been suggested that this may be a factor in reduced marine survival rates. Moreover, changing rainfall patterns are leading to more concentrated periods of rain resulting in flash floods which has resulted in the wash-out of spawning gravels and salmon redds in some Scottish rivers. At the other end of the scale, longer periods without rain could limit the distribution of spawning fish throughout river catchments.

In addition to the prediction that the south-east will incur the greatest impacts of global warming, the country’s population is concentrated in the greater Dublin and outlying areas, with ever-increasing demands for water. The sustainability of increased levels of abstraction from the Slaney must be seriously questioned.

8 PREDATION

At a time when the salmon stock is at a dangerously low level concern has been expressed that a significant proportion of healthy juvenile salmon may be lost through predation by cormorants, with further losses of returning adult fish which may be consumed by seals.

8.1 Cormorants

Cormorants are fish-eating predators and although generally regarded as seabirds, are known to feed actively in both standing and running freshwaters occupied by salmonids. Several studies on cormorant feeding in freshwater have been carried out and while most have indicated that salmonids do feature in the diet, few studies have taken place during the period of the salmon smolt run, when downstream migrating juvenile fish are considered to be particularly vulnerable.

One investigation carried out during the period of the smolt run on the River Bush, Co Antrim (Kennedy & Greer, 1988) found that up to 264 birds fed on the river at least once a day, with an average individual daily consumption rate of 5.1 salmon smolts, 3.3 trout and 0.5 sticklebacks. It was estimated that the total daily consumption ranged from 653 to 1214 smolts and 422 to 785 age 1 and 2 trout. When scaled up for the entire period of the smolt run this amounted to a loss of 19,600 to 36,400 smolts, equivalent to 51%-66% of the total wild smolt run.

More recent research on cormorant diets on the River Bush using stable isotope analysis has indicated that the consumption rate by individual birds may have increased to 7 salmon smolts per day although it has been suggested that this may be due to the greater numbers of hatchery-reared fish now released (S Brown, *pers. comm*). Nevertheless it is clear that a high level of predation continues during the period of the smolt run.

A limited study of cormorant feeding on the Slaney during December to February found that salmonids composed 96.9%, by biomass, of the birds' diet (O'Kane, 2007). Based on an estimated cormorant population of 887 birds (Kelly, 2007) it was calculated that the annual consumption of salmonids could amount to over 900,000 fish with a biomass of 63.9 tonnes. Clearly the level of predation needs further investigation to establish the numbers of birds feeding on the river and their consumption rates, particularly during the period of the smolt migration.

If there is a significant level of predation impacting on the salmon stock in the Slaney, there is also likely to be some level of impact on the trout stock. This aspect should not be overlooked particularly in view of the sea trout stock which may in future become a more significant feature of the Slaney as a recreational fishery.

8.2 Seals

As with cormorants, seals have attracted much attention as predators on fish and there has been much speculation about their impact on salmon stocks. Most studies on seal diets have concluded that salmonids, relative to other marine fish species, form only a minor part of the diet. However, although salmon may not be an essential feature of their diet, it is possible that seals

may have a significant local impact on salmon stocks which are already severely depleted. Carter *et al,* (2001) carried out an investigation of seal predation on salmonids in the estuaries of the rivers Dee and Don in Scotland, both well-known spring salmon fisheries. In this study it was found that the seals' diet consisted mainly of salmon, sea trout, unidentified roundfish and flounder. It was estimated that the average minimum annual consumption of large salmonids was 178 from the Don and 698 from the Dee; although these numbers are considerable, the authors point out that they represent only 8.8% and 10.7% of the total salmon and sea trout caught by rod and line in the 2 rivers.

Both common seal and grey seal are frequent visitors to the Slaney estuary originating from the Saltee Islands (L Scott, NPWS *pers comm*). We understand that a NPWS survey of the southeast coastal area is currently underway to assess numbers of both species, and that a report should be available during 2010. Although the Slaney estuary in particular is not subject to this survey, it will cover one of the principal haul-out areas at Raven Point near Wexford Harbour. At present it would appear that NPWS have no evidence or concern that numbers of seal in the estuary are a particular problem with implications for local salmon stocks (L Scott, NPWS *pers comm*). However it is hoped that the survey should provide some valuable information on the local populations from which levels of predation may be implied.

8.3 Current initiatives

A Joint Working Group has recently been established to investigate the impacts of predation on salmon by both cormorants and seals. The group will include representatives from:

- Central Fisheries Board
- National Parks & Wildlife Service
- Marine Institute
- BirdWatch Ireland

The terms of reference have not been finalised but the level of predation will be investigated within a number of different catchments; we understand that it is intended that a pilot project be established on the Slaney and that work will commence in 2010 (P Gargan, *pers. comm*.).

9 SLANEY RIVER VALLEY SAC

9.1 Background

Special Areas of Conservation (SACs) are those which have been given greater protection under the European legislation of The Habitat's Directive (92/43/EEC). The legal basis on which SACs are selected and designated is the EU Habitats Directive, transposed into Irish law in the European Union (Natural Habitats) Regulations, 1997 as amended in 1998 and 2005. The Directive lists certain habitats and species that must be protected within SACs. These have been designated because of a possible threat to the special habitats or species which they contain and to provide increased protection to a variety of animals, plants and habitats of importance to biodiversity both on a national and international scale.

The original SAC designation of the Slaney covered most of the main channel of the river from Aghade Bridge downstream. NPWS has since extended the limits of designation for the site to include most of the major tributaries, although we understand that the width of the "corridor" has been reduced from the nearest field boundary to a short strip of 1½-2½ metres on either side of the channel.

9.2 Annex II species

The Habitats Directive directs member states to designate and manage sites for listed species or habitats as part of a wider range of measures to ensure the conservation of the habitats and species. Selection features of the Slaney SAC include Atlantic salmon, Sea Lamprey, River Lamprey, Brook Lamprey, Freshwater Pearl Mussel, Twaite Shad, and Otter.

In 2003 NPWS engaged the CFB to undertake investigations on the use of the Slaney SAC by the designated fish species – shad and the 3 species of lamprey (sea lamprey, river lamprey & brook lamprey). The Munster Blackwater was included in this study which was outlined in a report by King & Linnane (2004), with the main findings in relation to the Slaney summarised below.

9.3 Shad

The greater part of the life cycle of both the allis and the twaite shad is spent at sea, returning to freshwater only to breed. Adult shad migrate upstream during the spring and early summer to spawn in gravel substrates above the tidal limits, and it appears that the adults return to sea immediately after spawning. The newly hatched juveniles move downstream within some days of spawning, and may remain in estuarine waters for up to 12 months. Little is known about the behaviour or preferred habitats of juvenile shad during this estuarine phase in Irish channels.

There has been a substantial run of shad in the Barrow/Nore system supporting a traditional rod fishery at St Mullins in May each year, although this has declined in recent times. Both species are encountered by commercial salmon nets and this was the source of samples from the Slaney for the study. However no juvenile shad were found during estuarine surveys. The status of both

shad species was considered to be very vulnerable in the Slaney with estuarine water quality and obstructions to migration identified as potential threats (King & Linnane, 2004).

9.4 Lamprey

Sea lamprey (*Petromyzon marinus*)

Mature adult sea lamprey enter the estuaries of rivers from April onwards, and migrate some distance upstream to spawn provided there are no physical barriers to migration and no pollution problems.

Spawning usually takes place in late May or June and the nests are normally built in shallow gravel areas. After hatching the larvae, called *ammocoetes*, leave the nest and drift downstream, distributing themselves among suitable silt beds. After an average of 5 years metamorphosis to the adult form takes place over a period of a few weeks between July and September. The timing of the main migration downstream seems to vary and relatively little is known about the adults after they reach the sea, where they have been found in both shallow coastal and deep offshore waters.

River Lamprey (*Lampetra fluviatilis*) & Brook lamprey (*Lampetra planeri*)

The adults of both species spawn in areas of small stones and gravel during March and April. After an incubation period of 2-3 weeks the ammocoetes hatch and drift downstream before burrowing into soft sediments of sandy silt in slack areas of the river. They live and feed within the substrate for up to 5 or 6 years before metamorphosing into fully formed adults. River lamprey then migrate out to sea to feed while brook lamprey remain in freshwater and do not feed as adults.

Juvenile river and brook lamprey were found to be widespread in the Slaney SAC while juvenile sea lamprey were more limited in both numbers and distribution (King & Linnane, 2004). Although spawning of sea lamprey was observed, the authors expressed concern on the status of the species in the system.

9.5 Freshwater Pearl Mussel (*Margaritifera margaritifera*)

Pearl mussel can grow to very large sizes for invertebrates (up to 145mm), building up thick calcareous shells, in most cases in rivers that have soft water with low levels of calcium. Shell building is consequently very slow, and individuals can live for more than 100 years. The larval stage, glochidia, are released by adults during July to September and depend on being inhaled by young trout of salmon, to facilitate attachment to the gills, on which they live and grow until the following June. The young mussels then detach from the host fish and bury into gravel, remaining buried for about five years, until large enough to withstand the flow of open water and moving stones. Pearl mussels mature between 7 and 15 years of age and can have a prolonged fertile period lasting into old age.

There are 93 populations of pearl mussels in the state, 27 of which have been designated within 19 SAC areas including the Slaney. None of the 93 populations is considered to be in favourable conservation status, as reproduction and juvenile survival is not matching adult mortality rates and populations are declining annually.

The only viable population remaining in the Slaney SAC appears to be in the Derreen River. Moorkens (1995) estimated that 3,000 mussels were present in a 3km stretch upstream of Hacketstown. However a subsequent survey over a greater length of the river by NPWS in 2005 and Ross in 2006 found only around 500 mussels remaining. The conservation status of the population in the Derreen is now considered to be very poor with intensive agriculture identified as the most significant pressure which is posing a high risk to this stock. Isolated individual mussels are also reported from the Bann tributary but this population is considered to be even more depleted (Moorkens, *pers comm*.)

10 THE POTENTIAL FOR INTERVENTION THROUGH STOCKING

10.1 Background

The traditional Slaney spring salmon stock appears to be at a dangerously low level with forecast figures for 2009 predicting that the MSW stock was likely to achieve only 37% of the CL for this component of the stock (Roche, 2009). In this situation it is inevitable that the use of artificial stocking is put forward as a measure to address the decline and initiate a recovery. This is not a straightforward issue and there are many factors which should be considered before the introduction of a stocking programme. It is clear that a hatchery could facilitate the production of large numbers of salmon eggs, fry or parr, but it does not necessarily follow that there will be any net gain to the system in comparison to leaving adult fish to spawn naturally.

The biological background to stocking and the use of hatcheries has become increasingly complex, particularly in view of recent advances in genetic studies. It is clearly important to weigh any potential short-term gain in numbers against the possibility of any long term damage to the overall viability of the stock. The many considerations involved with this issue have been evaluated by Youngson (2007) who encapsulates the argument as follows:

As viewed by the opposing faction, the views of hatchery supporters are seen as hopelessly optimistic and ill-informed while the views of those against hatcheries are seen as idealistic and backward. As usual, the most supportable position probably falls somewhere in the difficult middle ground.

With this approach in mind, this section airs the major issues for discussion in the consideration of whether or not stocking should be viewed as an appropriate intervention for the Slaney during the current phase of low marine survival and diminishing spring runs.

As part of the consultation process on this important subject for the Slaney the CFB hosted a workshop in their Dublin HQ on 25 February 2009 attended by various experts in this field and representatives from the Slaney salmon angling community. The conclusions from the workshop are reflected in this section of the report. A list of the presentations and the attendees is presented in Appendix ii.

10.2 Salmon stocking in Britain and Ireland

The basic technology required in production of salmon has been known for many years and is relatively simple and straightforward. Adult fish would be collected from the river annually and held until mature, when they would be stripped of ova and milt for artificial fertilisation and subsequent incubation for stocking as eyed eggs or unfed fry, for on-growing to stock as fed fry, parr or smolts.

The largest facilities in Ireland have been developed by ESB to mitigate the impacts of major hydroelectric developments, but their success in terms of rates of return have been limited. On a smaller scale, hatcheries aimed specifically at enhancement of spring salmon stocks are currently

operated privately on the Delphi and Caragh fisheries. In both cases the operators claim a reasonable degree of success although a proportion of returns to the Delphi appear to be grilse/1SW fish (McDermott *et al*, 1996). The ESB breeding programme on the Shannon found that the optimum cross of MSW male with MSW female resulted in the most MSW offspring but still gave a great preponderance of grilse/1SW (Wilkins & O'Farrell, 1996).

In Scotland several hatcheries of different scales are in operation across many of the leading salmon rivers, several run by District Salmon Fishery Boards. However it is difficult to gauge the success of these operations and there does not appear to be a consistent approach; for example, there is no hatchery on the Tweed mainly because it is acknowledged that natural production in the system is much greater than anything that could be produced through the use of a hatchery.

Two recent major successes in Scotland have been the restoration of the west coast rivers Carron and Lochy in which salmon stocks had been decimated by sea lice from farming operations in nearby lochs. In both cases re-stocking programmes were part of a series of measures leading to recovery of salmon stocks and the re-development of angling from very low levels of catch. Similarly on the River Tyne a re-stocking programme was introduced as mitigation for lost production after construction of Kielder reservoir and the river now has the largest rod catch in England and Wales. In this case salmon stocks had been severely depleted by industrial pollution in the estuary during the 1950s but water quality subsequently improved through a reduction in industrial activity and improvements in effluent treatment. While stocking had an accelerating effect on recovery, it is considered that natural recovery in response to improving conditions was the more dominant process (Milner, 2006).

10.3 Biological issues

As noted above the biological background to stocking and the use of hatcheries has become increasingly complex - some of the major issues for consideration are outlined below.

10.3.1 Survival rates in the hatchery

Hatching success in both the hatchery and in the wild is normally very high, in the range of 80-90%. It is beyond this point that a hatchery can yield much higher survival rates as a further 80-90% typically dies off in the wild. On-growing to a later stage from a given number of eggs can therefore result in the production of more parr or smolts than would be the case in the wild – up to 90% survival to smolt can be achieved compared with around 1% in the wild.

10.3.2 Survival rates: post-release

Freshwater survival

It may be possible to improve the standard survival rates in freshwater through judicious stocking in good quality habitat at lower density than occurs naturally. The distribution of spawning salmon, even when conservation limits are being exceeded, tends to be uneven with local concentrations of fish, and the inevitable result that some areas of suitable juvenile habitat may contain sub-optimal densities of young fish. Habitat uptake is therefore limited by the original

distribution of spawners/redds, and by the limited ability of fry to move into suitable habitat remote from spawning areas. Stocking can potentially produce significant gains by reducing density-dependent mortality among stocked fry and by allowing more uniform distribution through all suitable habitats. This approach would require continual monitoring of spawning and juvenile distribution in the catchment to identify suitable under-stocked areas.

Marine survival

The survival of hatchery-reared fish after stocking is generally lower than that of equivalent wild fish; clearly this factor has to be weighed against the benefits of better survival rates in the hatchery. However, any initiative on the Slaney would probably be targeted at spring-run 2SW fish which have a particularly low rate of return as illustrated by the diminishing return rates by Corrib 2SW fish to homewaters which have mostly been less than 2% with a recent 10-year average of under 1% (Fig 9).

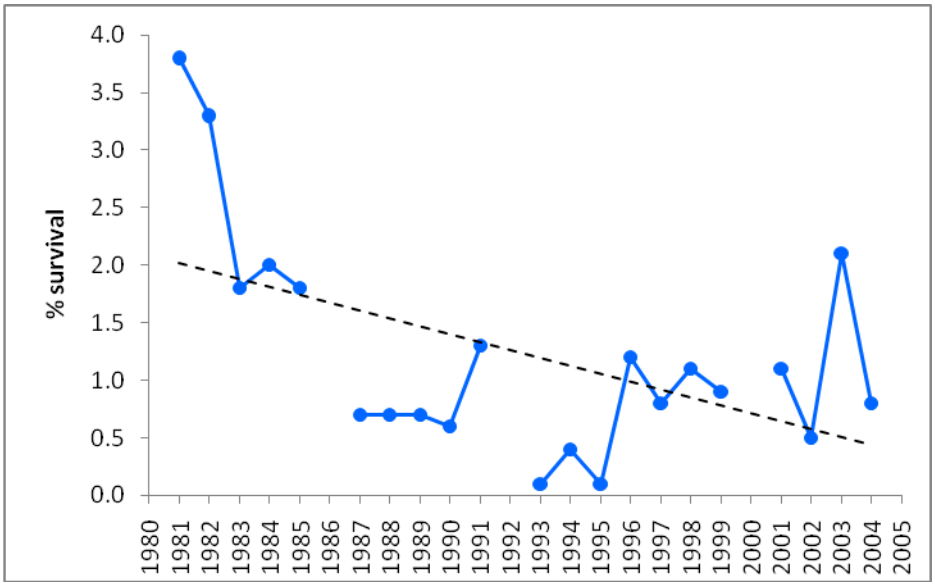

Figure 9 Return rates to homewaters by 2SW Corrib salmon, 1981-2004 (Source: ICES)

Survival rates of wild R Bush 2SW fish returning to the river have also been low with a 10-year average of just 1.37% up to 2002. Based on these figures the stocking of 100,000 eggs or unfed fry might result in 1,500 smolts at best (1½%), which in turn might yield a return of only 15 adult 2SW fish (1%).

Therefore, to have the potential of a significant return it would be necessary to maximise output by rearing to a later stage of development i.e. parr or smolt. However, returns as 2SW adults are likely to be particularly poor in the current phase of low marine survival.

10.3.3 Genetic factors

Artificial selection

The main purpose of a hatchery venture would be to optimise the freshwater production of fish while ensuring that the viability and diversity of the natural stock is not impaired. Artificial rearing

introduces domestic selection and the longer fish are held, the greater the degree of artificial selection and this tend to reduce the fitness of the fish for life in the wild after release, as is borne out by reduced survival rates of reared stocks.

Genetic population structuring

Genetic studies have shown that spawning salmon, by homing to their natal rivers, separate into more-or-less isolated reproductive units or populations (Youngson, 2007). These differences have been detected in juveniles sampled from different rivers and, at a finer scale, multiple populations have been identified in different parts of the same river, notably in large or medium sized systems such as the Slaney.

Moreover different characteristics of local stock units are believed to be genetically determined e.g. run-timing and the suitability of different stock components to spawning in particular parts of the river or tributaries. Similarly, different types of juvenile fish may be genetically adapted and suited to life any particular tributaries or areas of the catchment.

The removal of adult fish from different parts of the catchment for artificial propagation has the potential to disrupt the established genetic population structure that has evolved naturally over many centuries. To avoid this possibility any hatchery venture would need to be based on the removal fish from individual tributaries for breeding of discreet lines of progeny which should be returned to the original tributaries. This introduces a practical difficulty in determining whether fish sourced from different parts of the river are of the desired type to meet the aims of the re-stocking project i.e. spring run 2SW fish.

Genetic variability

There is also an issue over the potential to generate stock of reduced genetic variability through failure to mimic the complex mating patterns that take place in the wild. It is now clear that the number of half-sib families (families sharing one parent) that results from multiple pairings of adults and from fertilisation by precocious male parr, greatly exceeds the number of full-sib families (Youngson, 2007). The genetic material represented in the resulting eggs exhibits a much greater range of diverse combinations than in the case of single pair mating.

It has often been standard practice in hatcheries to fertilise the eggs of several females with the milt from more than one male in the belief that this will meet the above criteria. However, it is now known that, as a result of sperm competition, only one of the males may actually be successful in fertilising the eggs.

A stocking programme is not simply a case of obtaining as many brood fish as possible, generating a large pool of eggs/fry and re-introducing them to the wild. Any such venture would require careful planning and considerable resources to carry out

10.3.4 Climate change implications for stock enhancement

A recently published paper examining the effects of spawning by captive-bred salmon on wild populations in the Burrishoole system has raised concerns that the release of hatchery fish may

have serious implications for long term survival of the species in the light of climate change projections (McGinnity *et al*, 2009).

This study analysed the 37-year history of salmon ranching on the Burrishoole system where fish from a captive-bred population represented a variable but sometimes substantial proportion of salmon spawning naturally each winter. Analysis of historical data on surface water temperature and precipitation indicated that the proportion of eggs from ranched fish had had a significant negative impact on survival from egg to smolt.

Future climate modelling of predicted changes in the Burrishoole catchment was applied to the analysis and demonstrated that the proportion of ranched eggs would have a major impact on recruitment and would disrupt the capacity of the natural population to adapt to higher winter water temperatures associated with climate variability. Indeed, the model predicts that the release of captive-bred fish substantially increases the risk of extinction for the Burrishoole population within 20 generations due to failure of the hybrid stock to adapt to projected climate changes.

This study emphasises that wild populations should have the capacity to adapt to changing conditions through natural selection. The potential of a population to adapt to environmental change can be impaired by recurrent genetic changes in the wild population through hybridisation with captive-bred fish, which have been subject to a level of domestication and a range of selective pressures dissimilar from the wild. Rather than imposing additional pressures on a wild salmon population experiencing climate change by releasing captive-bred fish, the authors recommend that conservation efforts should focus on optimising conditions for adaptation of the wild stock by reducing exploitation and protecting key habitats in the catchment.

10.4 Management issues

10.4.1 Risk management

There are many risks associated with the introduction of a hatchery operation and to take this step, these risks must be outweighed by the potential benefits of the project. The major issues have been outlined with regard to artificial selection, genetic variability and population structuring and how inappropriate practices could impact on run timing, fish distribution and fitness of the stock.

In addition there is the basic risk of taking wild fish into captivity in that any loss of brood stock or progeny prior to release represents an initial *deficit* in overall potential which will have to be compensated for in terms of potentially greater from the remaining stock. A major loss would have more serious consequences in terms of the validity of the hatchery operation.

In summary the risks of intervention must be assessed against the potential benefits of any proposal before a decision is taken to proceed.

10.4.2 Limits on hatchery potential

As a general rule wild salmon production is significantly greater than the potential production from any hatchery, particularly on a river as large as the Slaney.

By way of an illustration let us assume a relatively large facility based on the removal of 100 2SW hen fish - at an average production rate of 8,000 eggs these fish should produce 800,000 eggs. The conservation limit (CL) for the Slaney is 20.7 million eggs of which 18.8 million are attributed to the 2SW stock (see Section 4). This level of hatchery production would only amount to 4.4% of the 2SW CL or 3.9% of the overall CL for the combined 1SW and 2SW stocks. During the recent phase of low returns this level of hatchery output still only amounts to 14% of the average natural deposition of eggs by 2SW fish. Even a substantial operation on a river of this size is therefore likely to have only minimal impact of returns of adult fish runs.

This illustration should also emphasise that there is little point in embarking in a piecemeal operation involving small numbers of brood stock.

10.5 Conclusion

In the current context it is our view that whilst the level of stock is a serious concern, the initiation of a hatchery project would be costly and unlikely to have any significant positive impact. However there may come a time when the very survival of a spring stock outweighs the genetic and biodiversity arguments, and the deployment of a hatchery should therefore remain under review. This view is consistent with the opinions expressed by Dick Shelton, then Research Director of the Atlantic Salmon Trust, in a letter to Trout & Salmon magazine in August 2007:

Hatcheries are but one of the tools available to the fishery manager of today. Employed in a carefully focussed way to address otherwise intractable problems, and using broodstock that poses no long term danger to the genetic integrity of indigenous salmon populations, hatcheries can make a useful contribution to management plans. Atlantic Salmon Trust firmly believes that stocking should be a last and not a first resort. If salmon runs are poor and not enough smolts are getting to sea, managers should find out why and try to remedy the problem. Only if it becomes clear that nothing can be realistically done to restore the natural production of smolts should stocking using local brood stocks be considered.

11 PROPOSED MEASURES FOR CONSERVATION AND RECOVERY

Given the current status of the salmon stock it is imperative that all proposals be aimed at maximising spawning and the survival of juvenile fish, and at maintaining reduced exploitation through all stages in the freshwater system in order to maximise the number of smolts going to sea. It is also of key importance that monitoring of stock status is maintained and upgraded in specific areas, notably the assessment of annual adult salmon runs. With these central objectives in mind, a series of recommendations is outlined aimed at providing the best possible conditions for stock recovery. These proposals are prioritised as low, medium or high according to their current relevance and urgency with regard to stock status and the current economic situation.

11.1 Slaney Valley SAC

- **It is vital for the future of the salmon that the provisions of the Habitats Directive are rigorously enforced to ensure adequate protection for the site and its featured habitats and species.** ***Priority: MEDIUM***

In this context it is important that the salmon is not seen in isolation as the sole species of interest; protection must also be provided for the other listed freshwater species and the Trust can do much to state the case for proactive measures to preserve and restore these additional species namely, lamprey, shad and freshwater pearl mussel. In terms of environmental conditions these species have much in common with the salmon, and all will benefit from specific measures or Action Plans developed for individual species. Ultimately however, responsibility for enforcement of the Habitats Directive rests with the Government acting through NPWS, and their role with regard to the Slaney will be crucial to the future of the salmon and the other listed species.

- **SAC status and selection of the salmon and other species as features of the site can be advantageous in seeking funding from EU Funding Programmes**

  Priority: LOW/MEDIUM

11.2 Reduced exploitation of stock

All measures for the foreseeable future should be based on minimisation of exploitation to afford the MSW salmon stock maximum opportunity for recovery in the light of current low levels of marine survival and projected climate changes which are likely to increase the pressure on salmon.

- **If stocks do return to an exploitable level it is recommended that angling be based on catch and release through at least one 5-year life cycle to ensure maximum spawning of returning fish.** ***Priority: MEDIUM***

In terms of netting we understand that only 30 of the 75 licensed draft nets have applied to avail of the hardship scheme being administered by BIM. It is therefore likely that a significant number

of nets will be retained and will be in a position to resume operations if stocks reach a sustainable level.

- **The Trust may wish to consider other initiatives in terms of funding to remove the remaining draft nets on a permanent basis.** ***Priority: LOW***

This might involve the introduction of a new buy-out or hardship scheme and the valuation carried out by ERFB (2005) could be used as a guide for negotiations with the netsmen.

11.3 Fish counting facilities

11.3.1 Priorities

The importance of an accurate method of assessing the annual runs of salmon in the river cannot be over-stated. Currently the counter facility at Clohamon is the source of this information, upon which key decisions on the management of the fishery are based with regard to the probability of meeting conservation limits and the regulation of exploitation in the forthcoming season.

We are assured that the counter is both efficient and accurate in terms of the fish that actually move upstream or downstream through the facility, but an unknown portion of the run by-passes the counter at other points on the weir. The counter figures are doubled to provide an estimate of the total but this has never been evaluated as an accurate assumption, a factor which is acknowledged by the SSC who state ***that this may result in either an overestimate or an underestimate***. However, as the situation stands, there is a highly significant margin for error in the overall assessment of the fish stock and a lot rests on by how much the verified counter total is scaled up.

- **Top priority should be given to the development of a new full river counter at a new location.** ***Priority: HIGH***

Aside from the limitations of the current system, construction of the proposed rock ramp at Clohamon will require removal of the Denil pass which accommodates the existing fish counter. If this development proceeds the river would be without any counting system.

- **Construction of the rock ramp at Clohamon should not proceed until an alternative fish counting station has been developed at a new location.**

  Priority: MEDIUM

11.3.2 Preferred technology

Resistivity counter (Logie)

Resistivity counters operate by detecting changes in electrical resistance of the surrounding water; Logie resistivity units are the most commonly used counting system throughout Ireland. As there are no existing weirs on the lower river other than Clohamon which might accommodate a new Logie counter, the only alternative for this technology would be to develop a new purpose-built facility involving the construction of a full river-width crump weir. A new counter is currently being installed in the River Suir by IFI Clonmel involving construction of a crump weir in a very

wide channel, similar to what would be required for the Slaney. Given the SAC status of the Slaney, it is important that any new weir structure should include specific features to facilitate the passage of those species that may be impacted e.g. lamprey, shad, eel.

Hydroacoustic counter (DIDSON)

An alternative fish counting technology which is less intrusive in that it does not require major engineering to the channel is a relatively new system based on ultrasound, the DIDSON. This system uses high-definition sonar and acoustic lenses to produce near-photographic quality images of fish, even in dark turbid waters. It has been trialled on the River Deel in the Moy catchment by Louise Brennan of the Marine Institute as the subject of a PhD project. The results have been very encouraging although it would appear that this system requires interpretation via a dedicated technician which would suggest that it is an extremely expensive long-term option and remains somewhat experimental. The DIDSON equipment is also relatively expensive in comparison to Logie although does not require the same initial investment in hard engineering in the form of a crump weir.

- **The development of a new fish counting station based on established technology using a Logie counter at a new crump weir offers good quality results with minimal work beyond the initial investment.** ***Priority: HIGH***
- **DIDSON may be worth consideration as an alternative if a suitable site for a Logie installation cannot be developed.**

11.3.3 Determination of proportion of fish passing through existing counter

If funding cannot be secured for development of a new fish counting station it is likely that the assessment of annual runs will continue to be based on the existing fish counting facility Clohamon. This installation generates excellent data on the timing of fish runs and the split between salmon and sea trout; in association with scale readings, the unit also provides important information on the 1SW / 2SW breakdown of the annual run. However, as noted above, the major limitation in the use of this data is that it is equivalent to an unknown proportion of the overall return.

Considerable resources (PIT tagging etc) have been expended on trying to determine the numbers of salmon by-passing the counter. A PIT reader was installed in the fish pass at Clohamon in 2008 by ERFB/CFB to determine the proportion of tagged salmon using the fish pass. Obtaining sufficient fish to tag was a problem and the project was suspended. However if the river is re-opened for angling at may be possible to tag an adequate number of fish for this purpose.

- **If the existing counter is retained the relative proportions of fish using the fish pass and by-passing the counter must be determined using the PIT tagging resources already in place.** ***Priority: HIGH***

This would instil greater confidence in the process applied by the SSC, not least among the stakeholders involved directly with the river. In addition the new multiplier could be used retrospectively to adjust stock abundance indices (run totals) from previous years.

PIT tagging could also facilitate an assessment of the overall impact of the weir on upstream migration, particularly with regard to spring run fish which are believed to be limited by water temperature at such structures. In addition this equipment might be used in the determination of spawning areas used by MSW fish.

11.4 Habitat protection and enhancement

An extensive habitat restoration scheme has been implemented by ERFB/IFI with technical support from CFB in different parts of the catchment and this has been considered very successful. However there is further scope for improvements many areas of the catchment.

- **Sections of river should be prioritised for further habitat enhancement works notably in known or historic MSW salmon spawning/nursery areas following consultation with IFI.** ***Priority: HIGH***

- **Prioritisation should be given to bank stabilisation works and fencing programmes in order to develop buffer strips and to reduce the input of silt**
  Priority: MEDIUM

There will also be a need for maintenance of works completed during Phase 1 of the programme.

- **Consideration should also be given to specific measures aimed at negating the effects of climate change, such as the planting of southerly banks to provide shading of the channel. An extensive water temperature monitoring programme should be established prior to planting. Substrate stabilisation measures may also be appropriate to counteract the potential impact of washouts resulting from projected storm rainfall events.** ***Priority: MEDIUM***

11.5 Genetic research

A national salmon genetic stock identification project has recently been completed by the Marine Institute and University College Cork in association with the CFB and regional boards. The primary aim of the study was to examine the contributions of salmon rivers throughout the country to commercial catches in coastal areas by means of genetic stock identification. The programme of research included the genetic analysis of juvenile fish from different sections and tributaries of major rivers reflecting the distribution of spawning salmon across the country.

The national project prioritised the main spawning areas and funding limitations precluded all samples from being analysed - Slaney main channel and Derry samples have been processed while Bann and Dereen samples remain in storage. This information may have important implications for our understanding of the genetics and distribution of salmon within the Slaney

catchment, in particular with regard to the spring run MSW stock and the identification principal spawning areas in the system.

Additional funding would facilitate completion of this work with the addition of more samples from a wider spread of tributaries. However, priority should be given to funding an original MSW v 1SW proposal developed by CFB/UCC in order to discriminate MSW areas from 1SW areas. This would allow targeting of scarce resources towards MSW areas for conservation, habitat restoration, protection etc.

- **Analysis of existing samples should be completed while juvenile fish samples should be collected from additional tributaries to identify principal MSW and 1SW spawning areas.** ***Priority: HIGH***

11.6 Juvenile fish surveys

The CFB/IFI survey carried out every 2 to 3 years provides a very valuable baseline in the monitoring of stock levels. In addition we understand that the catchment-wide semi-quantitative approach trialled in 2007 and 09 is now an important feature of the Slaney monitoring suite.

Clearly it is difficult for the fisheries boards to commit the necessary staff resources to this type of project in a single catchment, particularly in view of impending cuts in both staff and budgets. However this may be an area of work in which the Trust could become actively involved in the provision of manpower to assist IFI.

- **Continuation of on-going triennial stock assessment programme supplemented with annual catchment-wide semi-quantitative survey over 150-200 sites across the Slaney catchment.** ***Priority: HIGH***

11.7 Scale sampling

The importance of scale sampling in developing an understanding of the life history and stock breakdown of salmon in the Slaney has been outlined in Section 3.2. This information is essential for proper management of the river but there is a shortage of scale sample data. There is therefore an urgent need to expand this database on an annual basis so that any changes in stock breakdown can be detected and management measures adjusted if necessary. However it will be difficult to obtain scale samples as both rod and net fisheries are currently closed.

A limited number of samples may be available from fish captured for radio-tracking investigations at Clohamon weir. Alternatively the board might consider engaging a draft net fisherman to fish on a catch-and-release basis to collect scale samples and the necessary associated data on fish length etc. This could be carried out one day per week throughout the season but would require board supervision.

- **Additional data on the age structure of returning adult fish is urgently required through an annual scale sampling programme.** ***Priority: HIGH***

11.8 Salmon habitat assessment

There is substantial level of qualitative knowledge among the local IFI staff on the type (spawning, nursery etc) and distribution of salmon habitats within the Slaney catchment. This information could be developed through the application of a more detailed habitat survey technique which would facilitate mapping of the entire system over a period of time. Several survey techniques of varying degrees of detail are used in salmonid biology - the Life Cycle Unit method described by Kennedy (1984) outlines a simple approach to the mapping or rivers as spawning, nursery or holding water with grades applied as a measure of quality. Habitat type is recorded as:

- Nursery (shallow rock/cobble riffle areas for juvenile fish - fry/parr)
- Holding (deeper pools/runs for adult fish)
- Spawning (shallow gravel areas for fish spawning)
- Unclassified (areas unsuitable for fish – usually shallow bedrock areas or heavily modified sections of channel)

Each stretch of a particular habitat type is also graded 1 to 3 according to its quality. Habitat maps can be developed for different sections of river and various tributaries until the whole catchment has been surveyed – this may take place over 2 to 3 years. This approach has been applied throughout the Foyle system and is used to project potential productivity and carrying capacity for each sub-catchment based on target ova/fry densities applied to the 3 grades of nursery habitat. In combination with catchment-wide electrofishing, a habitat survey can readily identify those areas of the catchment which have significant potential but may be under-utilised by spawning fish.

- **A full salmonid habitat survey of the Slaney should be carried out by local IFI staff to develop a habitat map for the catchment - this will also identify any previously unknown barriers to migration.** ***Priority: HIGH***

SRT members could assist be by providing information on known obstructions within the system e.g. photo (scaled) and a location (GPS or similar).

11.9 Predation

The advent of salmon quotas in 2002 and subsequent legislation to reduce exploitation in 2007 through the removal of coastal netting and river closures has brought salmon management under very strict controls based on individual river conservation limits. With stocks under such pressure and now tightly regulated it is imperative that survival rates at all life stages are maximised to provide the species with the best possible opportunity for stabilisation and potential recovery. This is particularly important for MSW stocks which are now at seriously low numbers in many of the leading rivers including the Slaney.

Cormorants have recently been de-designated by the EU and can now be managed by individual governments. Control of cormorant predation could be a key factor in stocks achieving conservation limits within a reasonable timescale.

- **It is recommended that robust information be gathered on the level of predation by these birds in the Slaney catchment so that a strong case for control can be promoted if necessary.** ***Priority: HIGH***

The recent formation of a Joint Working Group to investigate predation by cormorants and seals is a welcome initiative, and a study has recently been commenced with the Slaney as one of the rivers for pilot study. The objective of the study is to determine feeding preferences and carry out an assessment of the impact of cormorant predation on fish stocks in four rivers catchments.

- **Similar information should be sought on the impact of seal predation with a view to appropriate action, if required, to protect salmon and other Annexe II species in the SAC.** ***Priority: MEDIUM***

11.10 Removal of obstructions / barriers to migration

Sullivan (2006) has assessed the impact of Clohamon, Tullow and Baltinglass weirs on the migration of all native aquatic fauna within the River Slaney and has outlined a series of mitigation proposals.

The study focussed on Clohamon Weir and concluded that the current structure limits the upstream migration of salmon, lamprey and shad, all of which are selection features of the Slaney SAC and therefore should receive protection within the designated area (it is likely that sea trout are similarly affected). In addition it was considered that although the Denil pass is providing access to salmon, it does not satisfy the requirements for movement of all the native fish species in the river and does not facilitate the ascent of micro-organisms and benthic fauna; the effectiveness of the pool pass was also called into question. It was suggested that a low gradient rock ramp fish pass would address these issues. We understand that a rock ramp was scheduled for construction at Clohamon in 2010 but was suspended due to financial cutbacks in the current economic climate. It may also be prudent to delay any works at this location until a new fish station has been developed.

The weirs at Tullow and Baltinglass were considered to present similar barriers to the migration of native fish species and aquatic fauna while also interrupting river connectivity, and it was recommended that they could both be removed. This should also increase production in the newly-created shallow areas and may be aided by de-silting of the impounded area upstream. In the case of Baltinglass it was suggested that the weir could be replaced with a series of low level riffles to enhance the aesthetics of the local community amenity area – this would also improve nursery habitat in this part of the channel.

Although only one of the weirs is currently in use for an industrial purpose (hydro generation), it is likely that there will be issues relating to water rights at the other locations, and these may be difficult to resolve.

- **It is recommended that the works specified for Clohamon, Tullow and Baltinglass weirs be advanced to improve access for salmon and aquatic fauna in general while restoring longitudinal connectivity throughout the channel.**
  Priority: MEDIUM

- **Any additional barriers to migration at remote locations may be identified from discussions with local IFI staff or through a fisheries habitat survey in remote channels (see 11.8).** ***Priority: LOW***

11.11 Smolt investigations

While a good database has been assembled with regard to juvenile salmonid stocks in the Slaney, there is no information on smolts and their outward migration from the river. Smolts can now be sampled using rotary screw traps which are relatively inexpensive in comparison to traditional fixed smolt trapping installations. This equipment is used elsewhere in Ireland by the Marine Institute and the Loughs Agency, and is used throughout Scotland on a number of catchments to obtain data on salmon and sea trout smolts including measurement of size and age determination.

- **Juvenile fish stock data could be supplemented through deployment of a rotary screw trap to obtain key information on smolt runs.** ***Priority: LOW***

This method would also provide information on the timing and duration of the smolt run.

11.12 Stocking initiatives

The use of hatcheries and the potential for an artificial stocking programme has been discussed at length.

- **The initiation of a stocking programme would not be appropriate at this time but could be considered at a later stage if the MSW stock declines further to a dangerously low level.** ***Priority: LOW***

11.13 Biological survey

Biological quality in the Slaney is assessed by the EPA as part of the National Biological River Quality Monitoring Programme based on the Q Index system. In this assessment procedure benthic macroinvertebrates are divided into 5 arbitrary Indicator Groups according to their perceived susceptibility to pollution. Currently the river is surveyed every 3 years at over 60 fixed locations distributed throughout the catchment.

The programme provides excellent data on biological quality and indicates areas of the catchment which may be under some degree of biological stress through enrichment or other

forms of pollution. However the 3-year interval between surveys means that any problems which may be developing at an insidious level may remain undetected in the interim period.

- **Supplementary biological surveys could be focused on known problem areas identified through the EPA results and on other areas of perceived high risk. This could be carried out by IFI or a specialist aquatic ecologist.**

  Priority: MEDIUM

11.14 Sea Trout Development

The potential for sea trout development should be fully investigated – the Slaney is considered to have excellent potential in this respect and, as a large river, would not be subject to the water level limitations of many small river sea trout fisheries (W Roche, pers comm.). Both IFI and the Slaney River Trust are listed as partners in the Celtic Sea Trout Project and it is recommended that both should engage fully with this project. Individual members of the Trust in particular are likely to have much to offer in terms of local knowledge and angling experience in different areas of the catchment.

- **IFI and Slaney River Trust are encouraged to engage fully in the Celtic Sea Trout Project.** ***Priority: MEDIUM***

11.15 Protection

In discussion with IFI staff it is clear that here are no major problems at present with regard to fisheries protection in the Slaney catchment. However there is a potential problem with the use of gill nets for illegal capture of bass in the Wexford Harbour area.

- **A bye-law to prevent netting in Wexford Harbour would assist in the protection of salmon and sea trout as well as bass.** ***Priority: MEDIUM***

IFI have limited staff resources available to cover a substantial local region. However we understand that there are now 36 private water keepers based in the Slaney catchment who could provide considerable support to IFI protection staff.

- **SRT should assume a role in coordination of the activities of private water keepers to ensure more efficient vigilance and to provide a level of support to local IFI staff. This would facilitate a higher degree of cooperation and sharing of information.**

  Priority: MEDIUM

11.16 Fisheries administration and cooperative ventures

The re-structuring of the inland fisheries sector as Inland Fisheries Ireland, a single authority replacing the existing Central and seven Regional Fisheries Boards, took place during the writing of this report. IFI is organised on a regional basis focussed on six different river basin districts. The Slaney is located in the South Eastern River Basin District and will in future be administered on a different regional basis to the original area covered by ERFB. In addition we understand that there will soon be 3 River Trusts in the SERBD area with considerable scope for cooperation on a

range of issues including conservation projects and opportunities for funding. These factors raise the potential for the development of new relationships between voluntary groups and statutory bodies with the possibility of public-private partnership in the delivery of fisheries projects.

- **SRT should move to establish relationships with IFI and the other River Trusts in the SERBD with a view to increased cooperation and the exploration of public-private partnership on forthcoming projects.** ***Priority: MEDIUM***

11.17 Raising public awareness

There is much to be gained from public interest in the river in terms of support for the objectives and activities of IFI and the Trust. The new website recently launched by the Trust will be a significant addition in achieving this objective.

- **SRT should take full advantage of the local press and media opportunities to publicise the conservation activities on the river.** ***Priority: LOW***

In addition the Something Fishy programme has been rolled out by ERFB/IFI over the last five years. This initiative was developed by the CFB in collaboration with Blackrock Education Centre – the aim is to inform and educate primary school fifth and sixth classes on water quality, fish, the environment and angling. A total of 13 schools have been visited in 2010.

- **Uptake of the Something Fishy programme by schools throughout the region should be encouraged.** ***Priority: MEDIUM***

Riverbank visits could be included as part of the programme to further inform children on the life history of the salmon and other features of interest in the river. This could involve:

- Electrofishing demonstrations for fish identification
- Kick samples for invertebrate identification

12 FUNDING FOR FUTURE PROJECTS

We understand that the Slaney River Trust have built up extensive files on future funding options. This section gives a brief outline of available funding options, based on discussions with SRT Directors.

12.1 Donations under Charitable Status

Both Slaney River Trust and its associated fundraising organisation, Slaney River Foundation, have been granted charitable status by the Revenue Commissioners. This means that donations to either organisation from corporations and self-employed individuals should attract tax relief. In the case of donations from those on PAYE, they cannot claim tax relief in their own hands but SRT / SRF should be able to claim relief on the underlying tax paid. While the river remains closed to salmon angling it is likely to be difficult to attract donations.

12.2 Atlantic Salmon Trust

AST makes grants available for salmon conservation projects in the UK and Ireland - SRT were successful in an application for £5000 of funding in 2006. AST sets out requirements for support as follows:

The Trust encourages applications by organisations or individuals for assistance in carrying out research projects whose object, directly or indirectly, is the conservation of wild salmon and sea trout stocks and / or the improvement of salmon and sea trout fisheries management. The Trust will seldom be able to provide more than £5,000 pa, up to a total of £15,000 for a three year project but this limit may be exceeded in exceptional cases. In general the Trust will not support projects whose results will be of purely local relevance and will favour those with a potentially wider application. The Trust may provide grants to supplement grants by other authorities. Applications should generally be received by the start of 2Q each year.

Dr Ken Whelan has recently taken up the post of Research Director of AST.

12.3 EU LIFE+ programme

LIFE is the environmental funding mechanism for the EU and we understand that SRT are at an early stage of investigating the possibility of securing funds from this programme. In 2003 LIFE provided £2.3 million for eight Scottish salmon rivers under the CASS Project which included the following objectives:

- removal and mitigation of man-made obstacles to fish migration
- improvement of the extent and quality of spawning and juvenile habitat

- improvement of riverbank woodland habitat
- restocking of re-connected or improved areas of juvenile habitat with hatchery-reared local salmon
- purchase of netting rights

In 2008 the Mulkear R., its communities and angling clubs, backed by Shannon Regional Fisheries Board raised LIFE funding of €0.87m. The project is based on the Lower Shannon SAC and focuses on the protection of three threatened species in the river environment - salmon, otter and sea lamprey.

It is understood the Blackwater Salmon Development Group (soon to be renamed Blackwater River Trust) submitted a LIFE application in November 2009, aimed at protection of salmon and also kingfisher, otter, dipper and freshwater pearl mussel.

It appears that a LIFE application requires much time to prepare and is management intensive. It may therefore be prudent for Slaney River Trust to join forces with other salmon rivers in the area such as the Nore, Suir and Barrow. These rivers also contain a range of threatened species including salmon, pearl mussel, shad, lamprey, otter and kingfisher which might be included in an application under the LIFE+ programme. The current LIFE programme runs from 2007 to 2013 and applications must be submitted by mid-September each year. The grant rate is usually 50% and across the programme the average grant is €1m. In 2009 Ireland's allocation under LIFE+ was just under €4m.

12.4 Interreg IVA

Slaney River Trust received EU funding of €252,000 under the Interreg 111A Ireland - Wales programme. A new programme, Interreg IVA, was launched in 2007 and runs until 2013. Slaney River Trust considered in depth whether to bid under this new programme but decided against on the basis that the emphasis had changed substantially from Interreg IIIA and it would be very difficult to construct a bid that would match the Trust's objectives. The emphasis in the new programme is on climate change and sustainable regeneration of communities. Rural development, which was a major feature of Interreg IIIA, was omitted under Interreg IVA. There are other Interreg programmes, involving a number of countries, and it would be worth monitoring these to see if a more suitable theme is introduced.

12.5 Heritage Council

In 2007 Slaney River Trust was awarded a €4,000 grant by the Heritage Council under their Biodiversity Grants Scheme for works to improve the spawning beds on two upper Slaney tributaries. Their grant scheme has now been restructured under three separate headings including Heritage Management, which includes conservation planning and habitat or wildlife site management. Possible projects on the Slaney could include management works to restore important habitats and also implementation of work recommended in an earlier conservation

report or wildlife management plan. This might include some of the sub-projects outlined in this report.

The Heritage Council emphasise local volunteer labour is a plus point and can be counted as *In Kind* in assessing the non-grant proportion of project costs. Grants are generally 30 to 50% of project costs. Two other important requirements are that the project must be supervised by a competent individual and grants cannot be given for work which is a public body's statutory responsibility. The allocation under Heritage Management for 2010 is €700,000 and individual grants are unlikely to exceed €20,000. Detailed applications must be submitted by 20 November each year and local Heritage Officers are available to help with preparation of the application if required.

12.6 LEADER

LEADER is part of the Rural Development Programme for Ireland 2007–2013 which provides funding for local rural development projects. The programme is part funded by the EU and is administered by the Department for Community, Rural and Gaeltacht Affairs. It has recently been restructured and is now operated at local level by 36 Local Action Groups, established to promote the development of their own specific rural area which generally coincides with the county boundary. The focus is on supporting small rural businesses and strengthening facilities and services for rural communities. In the past LEADER has supported a predecessor organisation of Slaney River Trust. It would be worth making contact with the local LEADER groups for Carlow, Wexford and Wicklow.

12.7 Other potential sources

- The World Wildlife Fund has financed fisheries projects in N Ireland, notably the Ballinderry River Enhancement Association. WWF no presence in the south.
- National Lottery
- Dept. of Environment, NPWS, Dept. of Marine, County Councils occasionally make direct grants available or will co-fund for particularly worthwhile projects
- There are several private environmental trusts and foundations which occasionally fund fisheries projects
- An indirect source of funding is the Salmon Conservation Stamp Fund. This is co-ordinated by the Central Fisheries Board, which receives proposals for salmon river rehabilitation from Regional Fisheries Boards, which are responsible for implementing the projects on the ground. In 2008 the Fund totalled €700,000. In 2007-8, €8,000 was spent on the rivers Bann and Urrin in the Slaney catchment.

There may be other EU grant programmes which could be approached for funds.

REFERENCES

Anon (2008) The Status of Irish Salmon Stocks in 2008 and Precautionary Catch Advice for 2009. Draft Report of the Scientific Sub-Committee to the Department of Communications, Energy and Natural Resources.

Anon (2009) Report on Morphological Monitoring and Catchment Walkover Risk Assessments in the Derreen Catchment. Freshwater Pearl Mussel Sub-Basin Management Plans - Programmes of measures for River Basin Management Plans. http://www.wfdireland.ie/docs/5_FreshwaterPearlMusselPlans/Background%20Documents/Morphology/Derreen/Dereen%20Morphology%20Field%20Work%20Report%202009.pdf

Carter TJ, Pierce GJ, Hislop JRG, Houseman JA & Boyle PR (2001) Predation by seals on salmonids in two Scottish estuaries. Fisheries Management and Ecology, 8, 207-225.

CFB (2008) River Slaney Catchment Survey 2007 - Preliminary Report.

Crozier WW & Kennedy GJA (1994) Application of semi-quantitative electrofishing to juvenile salmonid stock surveys. *Journal of Fish Biology* 45, 159-164.

EPA (2008) 2007 River Water Quality Report; Annual report on biological quality of Irish rivers.

ERFB (2005) The value of the River Slaney Draft Net Fishery based on recent catches.

ICES (2009) Report of the Working Group on North Atlantic Salmon (WGNAS), 30 March–8 April, Copenhagen, Denmark. ICES CM 2009/ACOM:06. 282 pp.

Kelly A (2005) Cormorant populations on the River Slaney. Slaney River Trust. http://www.slaneyrivertrust.ie/Files/RiverSlaneyCormorants2005Oct.pdf

Kennedy GJA (1984) The ecology of salmon habitat re-instatement following river drainage schemes. *IFM Annual Study Course*, Magee College, Londonderry, 18pp.

Kennedy G.J.A. & Greer J.E. (1988). Predation by cormorants, *Phalacrocorax carbo* (L.), on the salmonid populations of an Irish river. Aquaculture and Fisheries Management, 19, 159-170

King JJ & Linnane SM (2004) The status and distribution of lamprey and shad in the Slaney and Munster Blackwater SACs. Irish Wildlife Manuals No 14. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government.

Lucey J, Bowman JJ, Clabby KJ, Cunningham P, Lehane M, MacCarthaigh M, McGarrigle M & Toner PF (1997) Water Quality in Ireland 1995-1997. EPA Report, Dublin.

McDermott TJ, Wills SE & Mantle P (1996) Spring salmon enhancement on the Delphi Fishery, Ireland. Enhancement of Spring Salmon. Linnean Society of London.

McGinnity P, Jennings E, deEyto E, Allott N, Samuelsson P, Rogan G, Whelan K & Cross T (2009). Impact of naturally spawning captive-bred Atlantic salmon on wild populations: depressed recruitment and increased risk of climate-mediated extinction. Proc. R. Soc. B (2009) 276, 3601–3610.

Milner NJ (2006) The role of stocking in recovery of the River Tyne salmon fishery. 15th International Salmonid Conference; Salmonids in the 21st Century, Newcastle.

Moorkens, E. A. (1995). Mapping of proposed SAC rivers for *Margaritifera margaritifera*. Volumes 1 & 2. Unpublished report for NPWS.

O'Kane JI (2007) The diet of cormorant, *Phalacrocorax carbo*, on the River Slaney SAC, and the potential impact on salmonid stocks. Moderatorship Thesis. Zoology Department, University of Dublin, Trinity College.

Ó Maoiléidigh N, McGinnity P, Prévost E, Potter ECE, Gargan P, Crozier WW, Mills P and Roche W (2004) Application of pre-fishery abundance modelling and Bayesian hierarchical stock and recruitment analysis to the provision of precautionary catch advice for Irish salmon (Salmo salar L.) fisheries. ICES Journal of Marine Science, 61:1370-1378.

Paul Johnston Associates (2002) A Recovery Plan for the River Slaney Salmon Fishery. A report to Slaney Anglers Development Association Ltd & Eastern Regional Fisheries Board.

Roche W (2009) Recent trends in Slaney salmon stocks. Unpublished presentation to Slaney Seminar, Feb 2009.

Sullivan A (2006) Overview of the Impact of Clohamon, Tullow and Baltinglass Weirs on Native Fish Migration on the River Slaney.

Sweeney J, Brereton T, Byrne C, Charlton R, Emblow C, Fealy R, Holden N, Jones M, Donnelly A, Moore S, Purser P, Byrne K, Farrell E, Mayes E, Minchin D, Wilson J & Wilson J (2003) Climate Change: Scenarios & Impacts for Ireland; (2000-LS-5.2.1-M1). Report prepared for EPA; Departmentof Geography, NUI, Maynooth.

Whelan KF, Roche W & Ó Maoiléidigh N (1989) A pre-impoundment survey of the River Feale catrchmnet. Kerry County Council Commissioned Report. Central Fisheries Board, Glasnevin, Dublin.

Wilkins N & O'Farrell M (1996) Grilse and Multi-Sea-Winter Salmon: Some Smoke and a Few Mirrors. Enhancement of Spring Salmon. Linnean Society of London.

Youngson A (2007) Hatchery Work in Support of Salmon Fisheries. Scottish Fisheries Research Report, Number 65; ISSN 0308 8022. The Scottish Executive and Rural Affairs Department.

APPENDIX i: COUNTER DATA 2002-09

		Up	Down	Escapement	Video analysis:		Esc. Salmon	Esc. Sea Trout
2002	Jan	33	0	33	Salmon		22	11
	Feb	6	0	6	Sea trout		4	2
	Mar	72	0	72	Ratio Sal:ST	0.68	49	23
	Apr	125	0	125			85	40
	May	53	0	53			36	17
	Jun	104	0	104			21	83
	Jul	84	0	84			17	67
	Aug	56	0	56			11	45
	Sep	50	0	50			10	40
	Oct	1408	0	1,408			953	455
	Nov	29	0	29			20	9
	Dec	133	0	133			90	43
		2153	**0**	**2,153**			**1318**	**835**

COUNTER	TOTAL RUN
2SW	**2SW**
1014	2028
1SW	**1SW**
304	608
Prop 2SW	**TOTAL**
77%	2635

		Up	Down	Escapement	Video analysis:		Esc. Salmon	Esc. Sea Trout
2003	Jan	50	14	50	Salmon	2,209	35	15
	Feb	87	15	87	Sea trout	952	61	26
	Mar	67	22	67	Ratio Sal:ST	0.70	47	20
	Apr	377	70	377			263	114
	May	188	56	188			131	57
	Jun	582	126	456			91	365
	Jul	58	4	54			11	43
	Aug	31	3	28			6	22
	Sep	35	13	22			4	18
	Oct	216	75	141			99	42
	Nov	1363	697	666			465	201
	Dec	107	63	44			31	13
		3161	**1158**	**2,180**			**1244**	**936**

COUNTER	TOTAL RUN
2SW	**2SW**
1075	2149
1SW	**1SW**
169	339
Prop 2SW	**TOTAL**
86%	2488

		Up	Down	Escapement	Video analysis:		Esc. Salmon	Esc. Sea Trout
2004	Jan	31	9	31	Salmon	1,113	20	11
	Feb	8	3	8	Sea trout	585	5	3
	Mar	129	15	129	Ratio Sal:ST	0.66	85	44
	Apr	128	14	128			84	44
	May	68	3	68			45	23
	Jun	420	49	371			74	297
	Jul	88	13	75			15	60
	Aug	99	20	79			16	63
	Sep	229	23	206			41	165
	Oct	290	106	184			121	63
	Nov	75	17	58			38	20
	Dec	133	30	103			68	35
		1698	**302**	**1,440**			**611**	**829**

COUNTER	TOTAL RUN
2SW	**2SW**
482	965
1SW	**1SW**
129	257
Prop 2SW	**TOTAL**
79%	1222

		Up	Down	Escapement	Video analysis:		Esc. Salmon	Esc. Sea Trout
2005	Jan	221	84	221	Salmon	820	79	142
	Feb	35	12	35	Sea trout	1,469	13	22
	Mar	82	31	82	Ratio Sal:ST	0.36	29	53
	Apr	59	4	59			21	38
	May	74	3	74			27	47
	Jun	579	17	562			112	450
	Jul	771	45	726			145	581
	Aug	19	4	15			3	12
	Sep	89	5	84			17	67
	Oct	242	18	224			80	144
	Nov	20	13	7			3	4
	Dec	98	44	54			19	35
		2289	**280**	**2,143**			**548**	**1595**

COUNTER	TOTAL RUN
2SW	**2SW**
358	715
1SW	**1SW**
191	381
Prop 2SW	**TOTAL**
65%	1096

		Up	Down	Escapement	Video analysis:		Esc. Salmon	Esc. Sea Trout
2006	Jan	93	36	93	Salmon	618	49	44
	Feb	32	16	32	Sea trout	548	17	15
	Mar	41	23	41	Ratio Sal:ST	0.53	22	19
	Apr	0	0	0			0	0
	May	126	6	126			67	59
	Jun	114	6	108			22	86
	Jul	84	6	78			16	62
	Aug	3	0	3			1	2
	Sep	43	1	42			8	34
	Oct	96	53	43			23	20
	Nov	534	248	286			152	134
	Dec	0	2	2			-1	-1
		1166	**397**	**850**			**374**	**476**

COUNTER	TOTAL RUN
2SW	**2SW**
306	613
1SW	**1SW**
68	136
Prop 2SW	**TOTAL**
82%	749

		Up	Down	Escapement	Video analysis:		Esc. Salmon	Esc. Sea Trout
2007	Jan	3	1	3	Salmon	1,285	2	1
	Feb	34	9	34	Sea trout	1,079	18	16
	Mar	20	4	20	Ratio Sal:ST	0.54	11	9
	Apr	84	11	84			46	38
	May	49	11	49			27	22
	Jun	487	104	383			77	306
	Jul	151	29	122			24	98
	Aug	811	237	574			115	459
	Sep	467	146	321			64	257
	Oct	97	25	72			39	33
	Nov	1482	826	656			357	299
	Dec	168	89	79			43	36
		3853	**1492**	**2,397**			**822**	**1575**

COUNTER	TOTAL RUN
2SW	**2SW**
509	1018
1SW	**1SW**
313	626
Prop 2SW	**TOTAL**
62%	1644

		Up	Down	Escapement	Video analysis:		Esc. Salmon	Esc. Sea Trout
2008	Jan	33	10	33	Salmon		19	14
	Feb	16	8	16	Sea trout		9	7
	Mar	40	15	40	Ratio Sal:ST	0.58	23	17
	Apr	29	3	29			17	12
	May	31	3	31			18	13
	Jun	65	6	59			12	47
	Jul	16	3	13			3	10
	Aug	13	2	11			2	9
	Sep	46	5	41			8	33
	Oct	**392**	**46**	345			199	146
	Nov	**584**	**300**	284			164	120
	Dec	**107**	**38**	69			40	29
		1371	**439**	**971**			**513**	**457**

COUNTER	TOTAL RUN
2SW	**2SW**
400	800
1SW	**1SW**
114	227
Prop 2SW	**TOTAL**
78%	1027

		Up	Down	Escapement	Video analysis:		Esc. Salmon	Esc. Sea Trout
2009	Jan	104	49	104	Salmon		60	44
	Feb	39	18	39	Sea trout		23	16
	Mar	23	3	23	Ratio Sal:ST	0.58	13	10
	Apr	90	27	90			52	38
	May	96	38	96			55	41
	Jun	432	277	155			31	124
	Jul	41	30	11			2	9
	Aug	15	4	11			2	9
	Sep	**152**	**31**	121			24	97
	Oct	**392**	**46**	345			199	146
	Nov	**584**	**300**	284			164	120
	Dec	**107**	**38**	69			40	29
		2074	**862**	**1,347**			**665**	**682**

COUNTER	TOTAL RUN
2SW	**2SW**
536	1072
1SW	**1SW**
129	258
Prop 2SW	**TOTAL**
81%	1331

Highlighted figures are provisional estimates based on average monthly figures for 2002-08 (Actual data could not be obtained)

APPENDIX ii: SLANEY SEMINAR – WEDNESDAY 25th FEBRUARY 2009

CFB, Swords Business Campus, Swords, Co. Dublin

TITLE OF SEMINAR

Is the Slaney salmon at a critically low level? Discussion on measures for its recovery.

Introduction: Derek Nally, Chairman, Slaney River Trust

Presentations:

Dr Willie Roche, Central Fisheries Board: Recent trends in Slaney salmon numbers.

Dr Paul Johnston, Fisheries Consultant: Spring salmon restoration experience elsewhere

John Carroll, Director, Slaney River Trust: Positive Aspects Of Hatcheries

Dr Philip McGinnity, UCC: Hatcheries And Genetics

Pat Doherty, CEO, Eastern Regional Fisheries Board: ERFB Policy towards the Slaney

Attendees:

Dr Willie Roche (Central Fisheries Board)

Martin Kelly, Pat Doherty, William Walsh (Eastern Regional Fisheries Board)

Vincent Duigan, Derek Nally, Peter Wilson, Jill Mellon, John Carroll (Slaney River Trust)

Dr Paul Johnston (Paul Johnston Associates)

Dr Philip McGinnity (University College Cork)