Report of the Technical Expert Group on Salmon
–
to Inland Fisheries Ireland (IFI)

The Status of Irish Salmon Stocks in 2017 with Catch Advice for 2018

January 2018

1 Executive summary **3**
2 Introduction **4**
2.1 TEGOS terms of reference 4
2.2 Scope of report 5
3 The status of Irish salmon stocks in 2017 with catch advice for 2018 ..... **6**
3.1 Assessment methodology for 2018 catch advice 8
3.1.1 Information and data 9
3.1.2 Commercial catch data 9
3.1.3 Rod catch data 9
3.1.4 Total traps and counters 9
3.1.5 National coded-wire tagging and tag recovery 11
3.1.6 Catchment-wide electro-fishing 11
3.2 Status of individual rivers relative to conservation limits 11
3.2.1 Estimating the total catch in each river 12
3.2.2 Estimating the returns of adult salmon in each river using rod exploitation rates 12
3.3 Provision of harvest guidelines 13
4 Overview of status of stocks and precautionary catch advice for 2018 ..... **15**
5 Mixed-stock commercial fisheries advice **27**
5.1 Killary Harbour 27
5.2 Tullaghan Bay 27
5.3 Castlemaine Harbour 28
6 Recent trends in salmon stock status **29**
6.1 Fish counter time series 29
6.2 National returns and estimates of spawners relative to CL attainment 31
6.2.1 One-sea-winter returns and spawners 32
6.2.2 Multi-sea-winter returns and spawners 32
7 Advice for stock rebuilding **33**
7.1 International guidance on stock rebuilding 33
7.2 Factors affecting stock rebuilding programmes for Irish salmon stocks 35
7.2.1 Marine survival 35
8 Changes to assessments in future years **37**
9 Conclusions **38**
10 References **39**
11 Appendices **40**
11.1 Appendix I. Members of the Technical Expert Group on Salmon 2017/2018 40
11.2 Appendix II. Rivers assessed by the SSCS where salmon have a qualifying interest in Special Areas of Conservation (EU Habitats Directive) and status relative to conservation limit in 2018. 41
11.3 Appendix III. Summary results from the catchment-wide electro-fishing Programme in 2017. 43

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The Status of Irish Salmon Stocks in 2017 with Catch Advice for 2018

1 Executive summary

The Technical Expert Group on Salmon (TEGOS) advises that in 2018:

- 41 rivers have an advised harvestable surplus as they are exceeding their conservation limits (CLs).
- A further 36 rivers, may be opened on a catch and release only basis, subject to IFI management criteria based on having a high probability of achieving 50% of their conservation limit (CL) or exceeding the management qualifying fry threshold of ≥15 fry (0+) per 5 minute electrofishing (multiple site catchment average) .
- In addition 66 rivers are (a) failing to meet 50% of their CL or (b) recent data to determine their CL attainment status are lacking. Where there is a lack of data, or where catchment-wide electro-fishing surveys indicate juvenile abundance below the fry threshold, the TEGOS assumes that these rivers are failing to meet CL.

There are 16 rivers for which there are significant fisheries on the MSW (spring salmon) component of the stock and a separate assessment is made. Of these:

- 12 have an advised harvestable surplus as they are exceeding their CL.
- Four rivers may be opened on a catch and release only basis subject to IFI management criteria as they are they have a high probability of achieving 50% of their CL or exceeding the minimum fry threshold (15 fry) in catchment-wide electro-fishing.

There are currently 41 rivers or river tributaries of the 141 salmon rivers assessed in Special Areas of Conservation (SACs) where salmon have a qualifying interest under the EU Habitats Directive. Of these, only 22 are above their CL.

2 Introduction

The Standing Scientific Committee on Salmon (SSCS) was established under Section 7.5 (a) of the 2010 Inland Fisheries Act. In late 2017, a North South Standing Scientific Committee on Inland Fish was proposed and this new committee will be responsible for provision of all scientific advice on inland fish stocks across the island of Ireland. A Technical Expert Group on Salmon (TEGOS) was formed by Inland Fisheries Ireland (IFI) in October 2017 to provide technical advice on salmon stock status to the North South Standing Scientific Committee on Inland Fish. The terms of reference of the TEGOS are set out below:

2.1 TEGOS terms of reference

The Technical Expert Group on Salmon (Appendix I) is tasked with providing an annual report (TEGOS Sub-Appendix A) on the status of salmon stocks for the purpose of advising the North South Standing Scientific Committee on Inland Fish on the sustainable management of Irish salmon stocks. The North South Standing Scientific Committee on Inland Fish may request the Technical Expert Group to offer technical or scientific advice on the implications of proposed management decisions or policies on salmon or seek advice on scientific matters in relation to salmon. All advice provided by the Technical Expert Group will be considered as independent advice by the North South Standing Scientific Committee on Inland Fish.

TEGOS Sub-Appendix A

For the purpose of advising the North South Standing Scientific Committee on Inland Fish, the Technical Expert Group on Salmon shall estimate the overall abundance of salmon returning to rivers in the State with reference of river-specific conservation limits (CLs).

The Technical Expert Group on Salmon shall carry out an assessment of salmon stocks using internationally accepted best scientific practice which should demonstrate whether:

a) CLs are being or likely to be attained on an individual river basis; and

b) favourable conservation status is being attained within Special Areas of Conservation (SACs) and nationally as required under the Habitats Directive or otherwise.

The assessment shall take account of mixed-stock fishing on salmon stocks including the potential effects on freshwater salmon populations from rivers other than those targeted.

In cases where stocks are determined to be below CLs, the Technical Expert Group shall advise the level to which catches should be reduced or other measures adopted on a fishery basis in order to ensure a high degree of probability of meeting the CLs.

The Technical Expert Group shall provide the North South Standing Scientific Committee on Inland Fish with an independent annual report, which contains the following information:

a) an annual overview of the status of Irish salmon stocks on an individual river basis.

b) catch advice with an assessment of risks associated with the objective of meeting CLs in all rivers.

c) an evaluation of the effects on salmon stocks and fisheries of management measures or policies.

d) advice on significant developments and other relevant factors which might assist the North South Standing Scientific Committee on Inland Fish and IFI in advising the Minister on methods he or she might adopt for the management of salmon stocks.

e) any other technical or scientific advice relevant to the conservation of salmon.

2.2 Scope of report

The purpose of this report is to provide IFI with the technical and scientific information required in order to meet its terms of reference. This includes information on Irish salmon stocks, the current status of these stocks relative to the objective of meeting biologically referenced "conservation limits" and the catch advice which will allow for a sustainable harvest of salmon in the forthcoming fishing season and into the future.

3 The status of Irish salmon stocks in 2017 with catch advice for 2018

The conservation limit (CL) applied by the Technical Expert Group on Salmon (TEGOS) to establish the status of individual stocks is the "maximum sustainable yield" (MSY) also known as the stock level that maximises the long-term average surplus, as defined and used by the International Council for the Exploration of the Sea (ICES) and the North Atlantic Salmon Conservation Organisation (NASCO). The methodology for establishing CLs was modified for the 2013 catch advice by the former SSCS by deriving new estimates of fecundity, average weights, sex and age ratio for Irish index rivers. Similarly, new wetted areas were derived based on a more robust statistical approach and these were also incorporated into the assessment for 2013. Therefore, on the basis of these modifications and the best information available on catches, counts or other estimates and application of a forecast model to these data, the Technical Expert Group on Salmon advises that in 2018:

- 41 rivers have an advised harvestable surplus as they are exceeding their CLs (Figure 1).
- A further 36 rivers, may be opened on a catch and release only basis, subject to IFI management criteria based on having a high probability of achieving 50% of their CL or exceeding the management qualifying fry threshold of ≥ 15 fry (0+) per 5 minute electro-fishing (multiple site catchment average) .
- In addition 66 rivers are (a) failing to meet 50% of their CL or (b) recent data to determine their CL attainment status are lacking. Where there is a lack of data, or where catchment-wide electro-fishing surveys indicate juvenile abundance below the fry threshold, it is assumed that these rivers are failing to meet CL.

There are 16 rivers for which there are significant fisheries on the MSW (spring salmon) component of the stock and a separate assessment is made. Of these:

- 12 have an advised harvestable surplus as they are exceeding their CLs.
- Four rivers may be opened on a catch and release only basis subject to IFI management criteria as they are they have a high probability of achieving 50% of their CL or exceeding the minimum fry threshold (15 fry) in catchment-wide electro-fishing.

Amongst the stocks being assessed are 54 river stocks where no rod catch data has been available since 2006 and the most recent annual average rod catch (2002-2006) has been less than 10 salmon, making a direct assessment difficult. Although these are insignificant fisheries (accounting for less than 0.5% of the total national rod catch when combined), their stocks are important as spawning populations in their own right, which must be maintained as constituent elements of biodiversity, as required under the EU Habitats Directive. Because there is no recent means of direct salmon stock assessment on these rivers, the TEGOS have not provided an assessment of CL attainment on these rivers for the 2018 advice. The TEGOS advise that these rivers remain closed until additional information is made available to assess stock status relative to their CLs. In effect this means that stocks in 89 salmon rivers are assessed annually.

Despite the considerable reductions in commercial catches, following the closure of the mixed-stock fishery at sea in 2007, only 46% of Irelands 89 assessed salmon rivers are currently estimated to be meeting biologically based CLs. While 36 more rivers could open for catch and release-only angling, as assessments indicate relatively high juvenile abundances or the stocks are meeting >50% of CL, it is clear the overall proportion of Irish rivers with good population status is low.

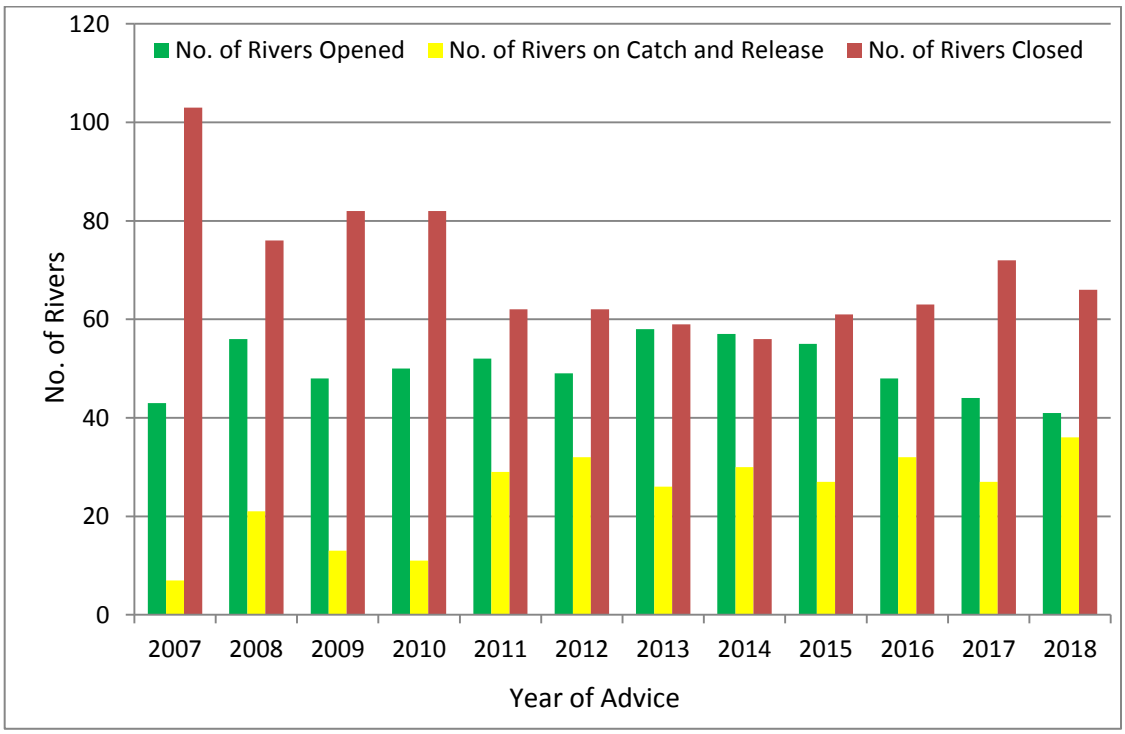

Figure 1 Summary of status of stocks and scientific catch advice provided between 2007 and 2018.

Of the 141 rivers being assessed, there are currently 41 rivers or river tributaries in SACs where salmon have a qualifying interest under the EU Habitats Directive. Of these, only 22 are above their CL (Appendix II). In addition, there are stocks in four major rivers used for hydro power which have been assessed as being below their CLs above the impoundments *i.e.* Upper Liffey (Dublin), Upper Lee (Cork), Upper Shannon (Limerick) and the River Erne (Table 5) and following the scientific advice already provided for other rivers, there should be no harvest fisheries on wild salmon in these specific rivers. It is also recognised however, that the release of hatchery reared salmon has resulted in fishery opportunities within these rivers for these stocks. Restoration programmes should therefore be given precedence until such time as significant improvements to the generation of self-sustaining runs of salmon above these impoundments has been made within the context of agreed restoration plans.

3.1 Assessment methodology for 2018 catch advice

There was no change in principle to the methodology used to provide catch advice in 2017 for the 2018 season. A summary of the approach is shown below in Figure 2. In-river or estuarine measures of abundance are used (*i.e.* fish counter data and rod/net catch data) to provide a primary measure of spawning stocks and attainment of CLs. For the 2012 analyses for 2013 advice, river-specific CLs were updated and these updated CLs will apply in future years. Updates are detailed in the relevant sections below.

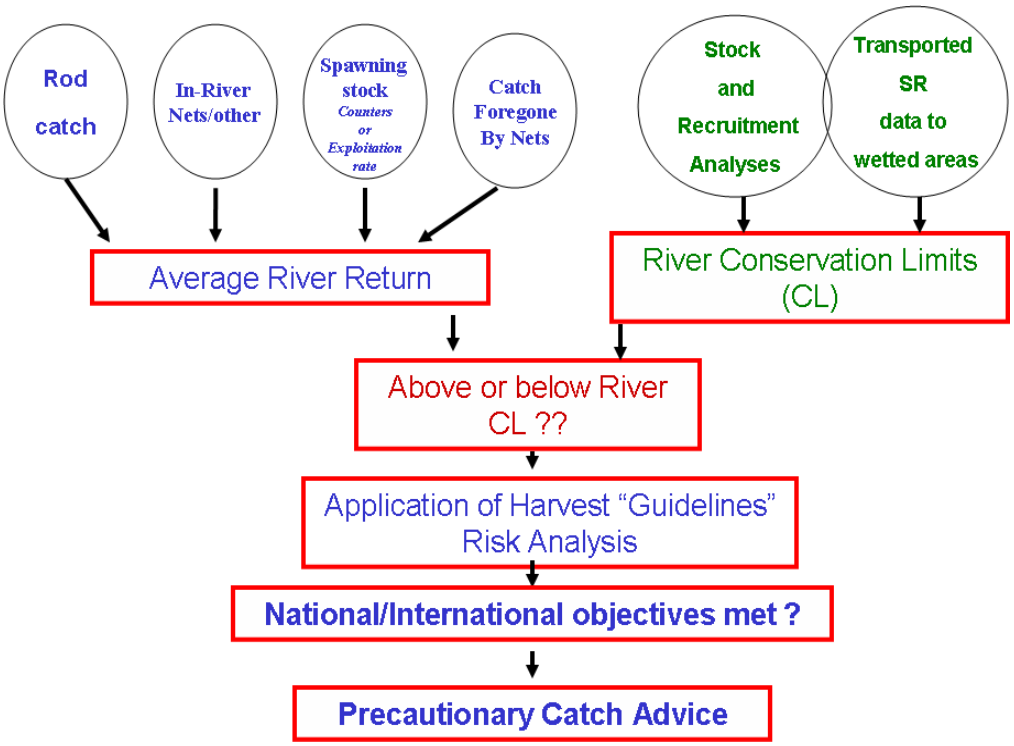

Figure 2 The scientific process for catch advice from 2006 to present.

With the operation of fisheries restricted to estuaries and rivers from 2007, the assessment is now focussed primarily on estimating individual river returns from catch data, counter data (if available) and ranges of rod catch exploitation rates derived from observed values in Irish rivers in recent years.

A more comprehensive description of the data used and the assessment in 2017 for the 2018 fishery is provided in the relevant sections below.

3.1.1 Information and data

Every effort is made to obtain relevant data and monitor the performance of stocks (attainment of CL) at the river level and consequently to assess the status of individual riverine stocks. Several sources of information are used in this process.

3.1.2 Commercial catch data

Despite the closure of the mixed-stock fisheries, the catch statistics derived from the estuarine commercial fisheries (draft nets & snap nets) will remain an important source of quantitative information if fished, particularly in determining the overall size of the returning stock and the attainment of river CLs. Following implementation of the wild salmon and sea trout tagging scheme which commenced in 2001 (Ó Maoiléidigh *et al.,* 2001; Anon 2004), the catch data are derived from the logbook returns of commercial fishermen. Reporting rates are at 100% from this fishery.

3.1.3 Rod catch data

The reported rod catch from the wild salmon and sea trout tagging scheme was adjusted to take into account the numbers of fish that have been caught by anglers who have not returned their logbook. The adjustment follows Small (1991). In some instances, directly reported rod catches from IFI Regional Fisheries officers or rod catch data from managed fisheries (private owners who maintain reliable records), provided these have been vouched for by IFI officers, have also been used. Logbook returns are increasing in recent years and reached a return rate of 71% in 2014 & 2015 and 69% in 2016.

3.1.4 Total traps and counters

Data are available from 34 counters (see below) and salmon traps including the salmon research and monitoring facility on the Burrishoole River in Mayo and the adult salmon trap on the Erriff river (Ballinakill District).

Values for October to December were extrapolated from the mean of the previous five years where appropriate. Any further information received which indicated changes to previous catch or counter estimates were incorporated where indicated by IFI.

Fish counter data are provided by IFI (or ESB/Marine Institute) in the case of the Liffey in Dublin and some private fishery owners. In total, counts from 34 fish counters were used in 2017 assessments for 2018 advice, an increase of 14 counters on the 2011 – 2012 assessment. These are the: *Dee and Fane (Dundalk district); Boyne (Drogheda District); Lower Liffey and Upper Liffey US Leixlip (Dublin District); Upper Lee (Cork District); Blackwater, Waterville/Currane and Maine (Kerry District), Feale, Fergus, Inagh, Mulkear, Maigue and Shannon Upstream Ardnacrusha/Parteen (Limerick District); Corrib and Dunkellin (Galway District); Boulisce, Casla and Ballynahinch (Connemara District), Owenglin, Dawros, Culfin, Erriff, and Bunowen (Ballinakill District); Srahmore/Burrishoole traps, Owenduff/ Glenamong, Owenmore and Carrowmore (Bangor District); Ballysadare (Sligo District), Erne, Eske and Eany (Ballyshannon District); and Clady (Letterkenny District)*.

The following approach has been adopted in interpreting the count data and utilising these to measure the attainment of CL:

- Fish are initially separated into salmon & sea trout by signal strength generated by the fish passing the counting electrodes and video images.
- A process of validation of the numbers of salmon and sea trout is carried out during the year whereby a proportion of the counter data (usually 15-20%) is examined in relation to contemporaneous video footage (resistivity counters) or self-generated infra-red images (infra-red counters).
- The initial numbers of salmon and sea trout are corrected after video verification and this correction factor is applied to the remainder of the data.
- It is assumed that all of the downstream counts up to the end of May represent out-migrating kelts *i.e.* fish ascending the river in the previous year (except for the Corrib, Lee, Shannon and Erne counters).
- The downstream count from June to December is then subtracted from the upstream count in the same period, correcting for fish counted upstream but which may then come back downstream.
- The estimated upstream run of fish from the counter is corrected to include salmon caught and killed downstream of the counter and excludes salmon caught and killed above the counter.

- Raising factors may be applied to those counters where the possibility of fish moving over the weir without being counted has been reported, the recorded count is raised by a further percentage depending on observations. However, it is essential that these observations are based on assessments carried out by local fisheries authorities or the agencies involved in salmon stock assessment. The Dee, Boyne, Corrib and Slaney counts are raised by a factor of two to allow for the partial nature of these counts.
- In the case of the River Slaney where the proportion of MSW salmon to grilse is much higher than most other rivers in Ireland, a specific analysis was carried out which allows the numbers of grilse and MSW salmon to be allocated over the season with greater precision than in previous assessments based on scale analyses.
- Where counters are used the CL relates to the area above the counter. In the event that the count is above or below CL, it is assumed that the overall stock is above or below CL.

3.1.5 National coded-wire tagging and tag recovery

This programme provides an index of marine survival over a long time period and information on exploitation rates in marine and freshwater fisheries. Despite the closure of the mixed stock fisheries in 2007, information from this programme will continue to inform on marine survival rates and exploitation in some estuarine and rod fisheries and more importantly indicates whether fluctuations in the numbers of returning adults are as a result of management measures or changes in factors occurring outside of management control *i.e.* environmental/climate changes. The most recent trends in marine survival are shown in Section 7.2.1.

3.1.6 Catchment-wide electro-fishing

Information on juvenile salmon abundance indices derived from electro-fishing surveys carried out annually by IFI are examined to indicate stock status. This information is used primarily where new information has not been available for rod catches. A summary of the 2017 programme is provided in Appendix III.

3.2 Status of individual rivers relative to conservation limits

In line with international advice on salmon stocks, the TEGOS advise that the best way to meet national and international objectives of conserving salmon stocks in all salmon rivers is to allow fisheries only in rivers or the estuary of that river, where there is a greater probability of targeting only the stocks originating from these rivers (*i.e.*

single stock fisheries). The TEGOS also advise that fisheries should take place only on stocks that are shown to be meeting their CL with the catch restricted to the estimated surplus above CL. This advice follows from International best practice as advised by ICES and NASCO.

The main objective of the scientific advice therefore, is to ensure that there are sufficient spawning salmon remaining after commercial and recreational fisheries to meet the required CL for that river. In order to do this, the number of salmon which will be available before the fishery takes place must be "forecast" for each river annually, based on the average returns in recent years (usually the most recent 5 years provided sufficient information is available). The information required for this forecast is derived from commercial catch data, from extrapolation of rod catch information using exploitation rates or from estimates based on fish counter information.

3.2.1 Estimating the total catch in each river

As stated previously the catch data for draft nets, other commercial engines (snap nets) and rods, derive from mandatory fishing logbooks or from vouched information supplied by the IFI directly. The forecast model requires the inclusion of the fish taken by the commercial fisheries in the estuaries of each river if present.

3.2.2 Estimating the returns of adult salmon in each river using rod exploitation rates

Rod exploitation rates derive from observed exploitation rate values from fish counters or traps on Irish rivers and supported by information from the scientific literature and the National Coded Wire tagging and Tag Recovery Programme. Exploitation by angling on grilse stocks varies but is generally between 10% and 30% of the total river stock available (Milner *et al.*, 2001). These authors quote mean values of 19% for UK rivers, while values for specific Irish grilse (1SW salmon) fisheries have been estimated for the River Erriff at 19% between 1986 and 2000 (Gargan *et al.*, 2001), and 15% for the Burrishoole between 1970 and 2000 (Whelan *et al.*, 2001). Estimates of angling exploitation on multi-sea-winter stocks are generally higher than those reported for grilse (Solomon and Potter 1992) and this has also been observed from Irish fish counter data. In 2008, the SSCS evaluated all existing information on individual rod fisheries made available by IFI, including field observations of fisheries which have known high or low intensity, to derive more precise estimates of the likely rod exploitation rate on a river by river basis. An extensive review of salmon exploitation rates in Irish rivers (Millane *et al*. 2017) using rod catch and fish counter data was

published in 2017 but has not yet been incorporated into estimates of adult salmon return.

Provided the catch in a river is known, the total stock can be estimated by extrapolation using an appropriate exploitation rate in the fishery *e.g.*:

> *If the rod catch of salmon was 150 fish and the exploitation rate in the fishery was 10%, then the total stock of salmon available to generate this catch would be estimated as the catch raised by the exploitation rate:*
>
> *Catch / Exploitation rate * 100*
>
> *In this case 150 / 10 * 100 = 1,500 salmon.*

For most rivers, the specific exploitation rates are not known and therefore a range of values is applied within which the true value is expected to be. Furthermore, as there is now specific rod exploitation data for Irish rivers with fish counters, it has been possible to allocate all rivers into specific groups representing heavily fished (higher exploitation rate) medium fished to lightly fished rivers (low exploitation rate) based on field observations. This restricts the overall range of values being used to a more likely range rather than applying the entire range of values observed. Table 8 provides the exploitation rate range used for each river for the 2018 advice.

3.3 Provision of harvest guidelines

Once estimates of average spawners, average catch, and river-specific CL have been derived, harvest options are provided with the associated probability of meeting CLs. Where estimates were available for both a counter or trap and a rod catch, the values for the counter or trap are used.

Following the procedure used by ICES for the provision of catch advice for West Greenland, the harvest option that provides a 0.75 probability level (or 75% chance) of meeting the CL for a given stock is recommended. Where there is no harvest option which will provide a 75% chance of meeting the CL, then there is no surplus of fish to support a harvest (commercial or rod).

Given the uncertainty in the data and the use of a risk analysis to allow for some of this uncertainty, a further limitation is applied to the recruit per spawner index of each river. A maximum recruit per spawner value is applied to the abundance outputs

derived from the risk assessment of 3 *i.e.* for every one spawner three recruits may be produced. This is considered to reflect better the overall status of salmon stocks both nationally and internationally.

An objective of the catch advice is to ensure that harvest fisheries only take place on river stocks meeting and exceeding CLs. The means to achieve this objective is to allow only harvest fisheries, which can specifically target single stocks, which are meeting their CLs. Where a fishery comprises of more than one stock, the risk analysis is based on the simultaneous attainment of CL for all contributing stocks. For the 2018 advice, only Killary Harbour (Bundorragha and Erriff stocks) and the Castlemaine harbour area (Maine, Laune and Caragh river stocks) were considered as true mixed-stock fisheries. The fisheries in the common estuary of the Owenmore, Carrowmore and Owenduff were reviewed for the 2013 advice and considered to be made up of discrete fisheries with only a small degree of mixing. Separate advice was provided on each stock in this instance.

Mixed-stock fisheries will always present greater risks than when stocks are exploited separately however, because of uncertainties or variability in the proportion of the catch originating from the weaker of the stocks. This is particularly true when there are large differences in the relative numbers of fish in each stock as it may be difficult to estimate the impacts on the smaller stocks. Therefore, to avoid intercepting fish from other rivers, particularly those which are not meeting CLs, the advice is to operate all fisheries within the estuary of the river stock for which the catch advice is being given and not a common bay or estuary where several rivers stocks may be present. Careful consideration must be made of local topography, fishing practices, number of contributing stocks and their status and the ability to discriminate the contributing stocks and manage the fishery effectively.

In a number of rivers the CL will be achieved by the contributions of both 1SW (grilse) and MSW (spring fish). There is conservation of biodiversity and fisheries development value in identifying and protecting both life history types. It is important for the fisheries management to be able to determine how much of the CL is likely to be met by either MSW or 1SW fish and to regulate fisheries for both components separately. More information is required on the proportions of each component of the stock being exploited and the timing of their entry into estuaries and freshwater. Advice has been provided on 1SW and MSW separately where a significant early run component has been identified and can be managed separately on the assumption that all fish counted or caught before 31st May are considered to be MSW fish (except for the Slaney where in-season data are available on proportions of 1SW and MSW salmon).

4 Overview of status of stocks and precautionary catch advice for 2018

Although new CLs were applied in 2013 and the basis for the risk assessment was modified, few changes applied to the actual catch advice procedure for the 2018 season. The present system of updating previous years catch data to reflect official logbook returns was maintained (unless indicated otherwise by local inspectors), while the catch data for the most recent year was based on local inspectors estimates. Data from fish counters were updated for the previous year to include October to December values if available, while provisional counts for the current year were based on estimates to the end of September. Values for October to December were extrapolated from the mean of the previous five years where appropriate. Any further information received, which indicated changes to previous catch or counter estimates, were incorporated where indicated by IFI.

Therefore, counting each of the combined rivers above as one stock, catch advice for the 2018 season is provided for 141 separate rivers and additionally advice is also given separately for the upper Liffey and upper Lee. Furthermore, separate assessments are made on 16 rivers for the early running MSW component of the stock in question.

Of these:

- 32 rivers have counter data (includes rivers with large hydro-electric impoundments)
- 2 rivers have trap data (Burrishoole and Erriff).

Details of the catch advice for 2018 provided by the Technical Expert Group on Salmon are given in Table 1 through to Table 6:

Generally, the Technical Expert Group on Salmon advises that:

- Harvest of salmon should only be allowed on stocks from rivers where there is a surplus above the CL identified and that no more than this surplus should be harvested *i.e.* those rivers detailed in Table 1 and Table 2. (*Note; in some rivers the available surplus is very small and management have decided not to place these rivers in the open category with an exploitable surplus*).

- Harvest fisheries should not take place on stocks from rivers without an identifiable surplus above the CL *i.e.* those rivers identified in Table 3, Table 4, Table 5 & Table 6.
- No harvest fisheries should take place on those stocks from 54 rivers where rod catch data have not been available since 2006 to assess salmon stock status (Table 7). The TEGOS advise that these rivers remain closed to harvest until such time as additional information becomes available to assess the status of these stocks relative to their CLs. Of these rivers, where electro-fishing information is available to show that the electro-fishing threshold has been achieved, these rivers can be open for catch & release to generate a rod catch which can be used for assessment of total salmon stock status.

Owing to the different status of individual stocks within the stock complex, mixed stock fisheries present particular threats to stock status (ICES 2014). The objective of the catch advice is to ensure that harvest fisheries only take place on river stocks meeting and exceeding CLs. The means to achieve this objective is to allow only harvest fisheries which can specifically target single stocks which are meeting their CLs. The TEGOS strongly advise that all fisheries should operate only on the target stock as close to the river mouth or within the river to achieve this.

Even where all exploited stocks in a common estuary are meeting their CLs, mixed stock fisheries introduce greater uncertainty into predicting the effects of management measures and pose a greater threat to small stocks or populations, especially if these are of low relative productivity and/or subject to high exploitation. As the number of stocks (or populations) increases, the number of fish that must be released from the fisheries in order to meet CLs must also increase. When the number of populations is too large, it may be impossible to ensure a high probability of the simultaneous achievement of spawner requirements in each individual unit. The overall objective should be to achieve a flexible but sustainable fishery without compromising conservation goals by fishing only single stocks salmon stocks which are shown to have a harvestable surplus over the CL. The best way to achieve this is to fish within the river or as close to the river as possible (*i.e.* the estuary of that river).

Table 1 Rivers with a forecasted surplus above the required conservation limit for 2018. This is the catch option which provides a 75% chance that the CL will be met. (Note: 1SW and 2SW combined unless otherwise noted).

District	River	CL	Surplus	Prop. CL achieved
Ballina	**Easky**	1399	525	1.38
Ballina	**Moy**	16730	16512	1.99
Ballinakill	**1SW Bundorragha**	95	190	3.00
Ballinakill	**Bunowen**	462	94	1.20
Ballinakill	**Common Embayment Killary**		321	1.00
Ballinakill	**Culfin**	136	197	2.45
Ballinakill	**Dawros**	493	384	1.78
Ballinakill	**Erriff**	1383	254	1.18
Ballinakill	**Owenglin**	423	194	1.46
Ballyshannon	**1 SW Drowes**	1059	2119	3.00
Ballyshannon	**Duff**	1066	7	1.01
Bangor	**1 SW Newport R. (Lough Beltra)**	507	257	1.51
Bangor	**1SW Carrowmore**	232	464	3.00
Bangor	**1SW Owenduff (Glenamong)**	712	578	181
Bangor	**Glenamoy**	623	58	1.09
Connemara	**Ballynahinch**	834	632	1.76
Connemara	**Cashla**	421	182	1.43
Cork	**1SW Ilen**	678	640	1.94
Cork	**Argideen**	467	103	1.22
Cork	**Bandon**	1631	818	1.50
Cork	**Coomhola**	310	62	1.20
Cork	**Glengarriff**	166	332	3.00
Cork	**Lower Lee (Cork)**	1898	1801	1.95
Cork	**Mealagh**	96	191	3.00
Cork	**Owvane**	372	337	1.91
Galway	**Corrib**	7572	6281	1.83
Kerry	**1SW Caragh**	395	789	3.00
Kerry	**1SW Laune and Cottoners**	2072	3513	2.70
Kerry	**1SW Waterville**	119	237	3.00
Kerry	***Common Embayment Castlemaine (Caragh, Laune & Cottoners, Maine)***		3709	1.78
Kerry	**Croanshagh**	274	203	1.74
Kerry	**Maine**	1181	255	1.22
Kerry	**Owenmore**	105	211	3.00
Kerry	**Roughty**	1539	116	1.08
Kerry	**Sheen**	624	1248	3.00
Kerry	**Sneem**	347	695	3.00
Letterkenny	**1SW Gweebarra**	611	133	1.22
Letterkenny	**1SW Lackagh**	236	2	1.01
Letterkenny	**Clady**	345	341	1.99

District	River	CL	Surplus	Prop. CL achieved
Letterkenny	**Gweedore (Crolly R.)**	342	25	1.07
Letterkenny	**Owenea and Owentocker**	1690	24	1.01
Limerick	**1SW Feale, Galey and Brick**	2847	544	1.19
Lismore	**Blackwater, Glenshelane, Finisk**	12024	7677	1.64
Sligo	**1 SW Garvogue (Bonnet)**	2543	351	1.14
Sligo	**Ballysadare**	6363	3549	1.56
Sligo	**Drumcliff**	510	229	1.45
Waterford	**Suir, Clodiagh, Lingaun, Blackwater**	14048	34	1.00

Table 2 Rivers meeting conservation limits and estimated surplus and proportion of CL achieved for MSW stocks only in 2018. (Total surplus for these rivers = 1SW & MSW surplus combined).

District	River	CL	Surplus	Prop. CL achieved
Ballinakill	**2SW Bundorragha**	70	70	2.00
Ballyshannon	**2SW Drowes**	425	535	2.26
Bangor	**2SW Carrowmore**	122	243	3.00
Bangor	**2SW Newport R. (Lough Beltra)**	367	160	1.44
Bangor	**2SW Owenduff (Glenamong)**	403	224	1.56
Cork	**2SW Ilen**	211	143	1.68
Kerry	**2SW Caragh**	281	509	2.82
Kerry	**2SW Laune**	817	918	2.13
Kerry	**2SW Waterville**	83	166	3.00
Letterkenny	**2SW Gweebarra**	116	97	1.84
Limerick	**2SW Feale , Galey and Brick**	865	114	1.13
Sligo	**2SW Garvogue (Bonnet)**	289	86	1.30

Table 3 Rivers below conservation limits in 2018 and the estimated deficits and proportion of CL achieved for 1SW and MSW stocks combined unless otherwise indicated.

District	River	CL	Deficit	Prop. CL achieved
Ballinakill	**Carrownisky**	365	-176	0.52
Ballinakill	**Owenwee (Belclare)**	374	-114	0.69
Ballyshannon	**Bungosteen**	373	-128	0.66
Ballyshannon	**Eany**	1312	-603	0.54
Ballyshannon	**Erne**	16586	-14480	0.13
Ballyshannon	**Eske**	731	-290	0.60
Ballyshannon	**Glen**	1197	-357	0.70
Ballyshannon	**Oily**	629	-333	0.47
Ballyshannon	**Owenwee (Yellow R)**	183	-71	0.61
Bangor	**Owenmore**	2073	-463	0.78
Bangor	**Srahmore (Burrishoole)**	614	-257	0.58
Connemara	**Screebe**	151	-8	0.95
Cork	**Adrigole**	167	-46	0.72
Cork	**Owennacurra**	293	-227	0.22
Cork	**Upper Lee**	2789	-2256	0.19
Drogheda	**Boyne**	10239	-8062	0.21
Dublin	**Lower Liffey Inc Rye**	1703	-1050	0.38
Dublin	**Upper Liffey US Lexlip**	5383	-5155	0.04
Dundalk	**1SW Dee**	945	-720	0.24
Dundalk	**Castletown**	1449	-1429	0.01
Dundalk	**Fane**	1177	-902	0.23
Dundalk	**Glyde**	1856	-706	0.62
Galway	**Owenboliska R (Spiddal)**	598	-422	0.29
Kerry	**Behy**	177	-96	0.45
Kerry	**Blackwater**	437	-278	0.36
Kerry	**Cloonee**	61	-35	0.43
Kerry	**Ferta**	224	-15	0.93
Kerry	**Inney**	629	-175	0.72
Kerry	**Owenascaul**	181	-74	0.59
Letterkenny	**1SW Leannan**	516	-111	0.79
Letterkenny	**Crana**	1074	-467	0.57
Letterkenny	**Ray**	435	-220	0.49
Letterkenny	**Tullaghobegly**	223	-100	0.55
Limerick	**Fergus**	1188	-834	0.30
Limerick	**Maigue**	4632	-4688	0.25
Limerick	**Mulkear**	4214	-719	0.83
Limerick	**Upper Shannon (Above Parteen)**	49638	-47156	0.05
Lismore	**Bride**	1567	-231	0.85
Waterford	**Barrow and Pollmounty**	11737	-9739	0.17
Waterford	**Colligan**	423	-291	0.31
Waterford	**Nore**	10464	-2440	0.77

District	River	CL	Deficit	Prop. CL achieved
Wexford	**1SW Slaney counter**	915	-761	0.17
Wexford	**1SW Slaney rod**	915	-527	0.42
Wexford	**Owenavorragh**	945	-738	0.22

Table 4 Rivers below conservation limits and estimated deficits and proportion of CL achieved for MSW stocks only in 2018. (Total deficit for these rivers = 1SW & MSW deficits combined).

District	River	CL	Deficit	Prop. CL achieved
Dundalk	**2SW Dee**	716	-546	0.24
Letterkenny	**2SW Lackagh**	278	-38	0.86
Letterkenny	**2SW Leannan**	1196	-1076	0.10
Wexford	**2SW Slaney Counter**	2745	-2003	0.27
Wexford	**2SW Slaney Rod**	2745	-1518	0.45

Table 5 Status of salmon stocks above rivers impounded for hydro-electric schemes.

River	Wetted Area u/s of Hydro Station M²	CL	Average Salmon Count 2013-2017	Proportion of CL Achieved
Erne	6,457,264	16,586	2492	15%
Shannon	30,895,619	49,638	990*	2%
Upper Lee	2,370,000	2,789	512	15%
Upper Liffey	2,308,361	5,389	302	5.6%

*Partial count

Table 6 Rivers advised to be open for catch & release-only fishing based on meeting ≥50% CL management threshold or meeting management electro-fishing threshold ≥15 salmon fry/ 5 min catchment-wide average).

District	River	Deficit	Prop. of CL Achieved	Electro-fishing, Average of fry/ 5 min
Ballinakill	**Carrownisky**	-176	0.52	19.2
Ballinakill	**Owenwee (Belclare)**	-114	0.70	
Ballyshannon	**Bungosteen**	-128	0.66	20.1
Ballyshannon	**Duff**	7	1.01	
Ballyshannon	**Eany**	-603	0.54	19.6
Ballyshannon	**Eske**	-290	0.60	15.0
Ballyshannon	**Glen**	-357	0.70	18.9
Ballyshannon	**Oily**	-333	0.47	20.2
Ballyshannon	**Owenwee (Yellow R)**	-71	0.61	16.2
Bangor	**Owenmore**	-465	0.78	27.6
Bangor	**Srahmore (Burrishoole)**	-257	0.58	
Connemara	**Screebe**	-8	0.95	
Cork	**Adrigole**	-46	0.72	2.6
Drogheda	**Boyne**	-8062	0.21	18.5
Dublin	**Lower Liffey Inc Rye**	-1050	0.38	20.3
Dundalk	**1SW Dee**	-719	0.24	15.6
Dundalk	**Castletown**	-1430	0.01	21.0
Dundalk	**Fane**	-903	0.23	19.1
Dundalk	**Glyde**	-726	0.61	14.1
Kerry	**Blackwater**	-278	0.36	19.3
Kerry	**Cloonee**	-35	0.43	24.6
Kerry	**Ferta**	-15	0.93	12.3
Kerry	**Inney**	-175	0.72	22.2
Kerry	**Owenascaul**	-74	0.59	18.7
Letterkenny	**1SW Lackagh**	2	1.01	19.9
Letterkenny	**1SW Leannan**	-111	0.79	19.1
Letterkenny	**Crana**	-467	0.57	15.7
Letterkenny	**Gweedore (Crolly R.)**	25	1.07	13.6
Letterkenny	**Owenea and Owentocker**	24	1.01	20.1
Letterkenny	**Tullaghobegly**	-100	0.55	8.7
Limerick	**Mulkear**	-719	0.83	
Lismore	**Bride**	-231	0.85	15.6
Waterford	**Barrow and Pollmounty**	-9739	0.17	15.8
Waterford	**Nore**	-2440	0.77	15.3
Waterford	**Suir, Clodiagh, Lingaun,**	34	1.00	10.3
Wexford	**1SW Slaney counter**	-761	0.17	15.1

Table 7 Rivers where no rod catch data available since 2006, with exceedance of catchment-wide electro-fishing (CWEF) threshold indicated.

District	River	CL	Meeting CWEF Threshold (Value)
Ballina	**Ballinglen**	411	No (9.3)
Ballina	**Brusna**	1096	No (11.2)
Ballina	**Cloonaghmore**	1323	No (14.6)
Ballina	**Leaffony**	241	No (5.1)
Ballyshannon	**Abbey**	333	Yes (17.7)
Ballyshannon	**Ballintra (Murvagh R).**	548	No (13.9)
Ballyshannon	**Laghy**	448	No (11.5)
Bangor	**Muingnabo**	336	No (1.3)
Bangor	**Owengarve R.**	227	No (4.1)
Connemara	**L. Na Furnace**	71	No (0.0)
Dublin	**Dargle**	734	No (3.9)
Dublin	**Vartry**	274	No (7.9)
Dundalk	**Flurry**	427	No (11.1)
Galway	**Aille (Galway)**	105	No Data
Galway	**Clarinbridge**	487	No (7.2)
Galway	**Knock**	132	No (12.5)
Kerry	**Carhan**	88	No (10.1)
Kerry	**Emlagh**	137	No (5.1)
Kerry	**Emlaghmore**	68	No (1.7)
Kerry	**Feohanagh**	161	No (10.6)
Kerry	**Finnihy**	143	No (3.0)
Kerry	**Kealincha**	128	No (0.0)
Kerry	**Lee**	507	No (0.7)
Kerry	**Lough Fada**	88	No (2.4)
Kerry	**Milltown**	87	No (15.9)
Kerry	**Owenreagh**	87	No (4.6)
Kerry	**Owenshagh**	304	No (5.5)
Letterkenny	**Bracky**	200	No (14.9)
Letterkenny	**Clonmany**	443	No (9.1)
Letterkenny	**Culoort**	252	No (2.0)
Letterkenny	**Donagh**	429	No (2.5)
Letterkenny	**Glenagannon**	377	No (9.3)
Letterkenny	**Glenna**	215	No (8.1)
Letterkenny	**Isle (Burn)**	521	No (2.1)
Letterkenny	**Mill**	312	No (0.0)
Letterkenny	**Owenamarve**	205	No (2.5)
Letterkenny	**Straid**	184	No (0.1)
Letterkenny	**Swilly**	1105	No (10.7)
Limerick	**Annageeragh**	321	No (5.5)

District	River	CL	Meeting CWEF Threshold (Value)
Limerick	**Aughyvackeen**	223	No (1.0)
Limerick	**Deel**	2823	No (0.15)
Limerick	**Doonbeg**	525	Yes (16.1)
Limerick	**Inagh**	1096	No (4.4)
Limerick	**Owenagarney**	630	No (13.5)
Limerick	**Skivaleen**	458	No (13.7)
Lismore	**Lickey**	148	No (13.3)
Lismore	**Tourig**	118	No (5.7)
Lismore	**Womanagh**	368	No (6.4)
Sligo	**Grange**	339	No (4.5)
Waterford	**Corock R**	836	No (14.6)
Waterford	**Mahon**	443	No (5.6)
Waterford	**Owenduff**	300	No (7.1)
Waterford	**Tay**	319	No (4.4)
Wexford	**Avoca**	3945	No (7.3)

Table 8 River rod catch exploitation rates applied for 2018 advice.

District	River	1SW Exploitation rates			MSW Exploitation rates		
		Likely	Minimum	Maximum	Likely	Minimum	Maximum
Ballina	**Easky (2016–2017)**	0.05	0.01	0.12			
Ballina	**Easky (2013–2015)**	0.15	0.07	0.35			
Ballina	**Moy**	0.15	0.07	0.35	0.31	0.15	0.46
Ballinakill	**Bundorragha (Wild Rod)**	0.15	0.07	0.35	0.31	0.15	0.46
Ballinakill	**Carrownisky**	0.05	0.01	0.12			
Ballinakill	**Owenwee (2017)**	0.05	0.01	0.12			
Ballinakill	**Owenwee (2013–2016)**	0.15	0.07	0.35			
Ballyshannon	**Bungosteen**	0.05	0.01	0.12			
Ballyshannon	**Drowes**	0.15	0.07	0.35	0.31	0.15	0.46
Ballyshannon	**Duff**	0.15	0.07	0.35			
Ballyshannon	**Glen (2017)**	0.05	0.01	0.12			
Ballyshannon	**Glen**	0.15	0.07	0.35			
Ballyshannon	**Oily**	0.05	0.01	0.12			
Bangor	**Glenamoy (2013– 2014, 2016–2017)**	0.05	0.01	0.12			
Bangor	**Glenamoy (2015)**	0.15	0.07	0.35			
Bangor	**Newport R. (Lough Beltra)**	0.10	0.05	0.12	0.12	0.06	0.27
Connemara	**Screebe**	0.20	0.12	0.29			
Cork	**Adrigole**	0.05	0.01	0.12			
Cork	**Argideen**	0.05	0.01	0.12			
Cork	**Bandon**	0.28	0.13	0.42	0.28	0.13	0.42
Cork	**Coomhola**	0.15	0.07	0.35			
Cork	**Glengarriff**	0.05	0.01	0.12			
Cork	**Ilen**	0.15	0.07	0.35	0.12	0.06	0.27
Cork	**Lower Lee (Cork)**	0.05	0.01	0.12	0.12	0.06	0.27
Cork	**Mealagh**	0.05	0.01	0.12			
Cork	**Owennacurra**	0.03	0.01	0.05			
Cork	**Owvane**	0.05	0.01	0.12			
Dundalk	**Castletown**	0.05	0.01	0.12	0.12	0.06	0.27
Dundalk	**Fane (2015–2017)**	0.05	0.01	0.12	0.12	0.06	0.27
Dundalk	**Fane (2013 – 2014)**	0.15	0.07	0.35	0.12	0.06	0.27
Dundalk	**Glyde (2014–2017)**	0.15	0.07	0.35	0.12	0.06	0.27
Dundalk	**Glyde (2012, 2013)**	0.05	0.01	0.12	0.12	0.06	0.27
Kerry	**Behy**	0.05	0.01	0.12			
Kerry	**Caragh**	0.15	0.07	0.35	0.31	0.15	0.46

District	River	1SW Exploitation rates			MSW Exploitation rates		
		Likely	Minimum	Maximum	Likely	Minimum	Maximum
Kerry	Cloonee	0.05	0.01	0.12			
Kerry	Croanshagh (Glanmore R.)	0.05	0.01	0.12			
Kerry	Ferta	0.05	0.01	0.12			
Kerry	Inney (2017)	0.05	0.01	0.12			
Kerry	Inney (2013–2016)	0.15	0.07	0.35			
Kerry	Laune and Cottoners	0.15	0.07	0.35	0.31	0.15	0.46
Kerry	Owenascaul	0.05	0.01	0.12			
Kerry	Owenmore	0.05	0.01	0.12			
Kerry	Roughty	0.10	0.05	0.15			
Kerry	Sheen	0.04	0.01	0.10			
Kerry	Sneem	0.05	0.01	0.12			
Letterkenny	Clady (2015–2017)	0.15	0.07	0.35			
Letterkenny	Clady (2014)	0.05	0.01	0.12			
Letterkenny	Clady (2013)	0.03	0.01	0.05			
Letterkenny	Crana (2016–2017)	0.05	0.01	0.12			
Letterkenny	Crana (2013–2015)	0.15	0.07	0.35			
Letterkenny	Gweebarra	0.15	0.07	0.35	0.12	0.06	0.27
Letterkenny	Gweedore (Crolly R.)	0.05	0.01	0.12			
Letterkenny	Lackagh (2013—2017)	0.15	0.07	0.35	0.12	0.06	0.27
Letterkenny	Leannan	0.15	0.07	0.35	0.12	0.06	0.27
Letterkenny	Owenea and Owentocker	0.15	0.07	0.35			
Letterkenny	Ray	0.05	0.01	0.12			
Letterkenny	Tullaghobegly (2014–2017)	0.05	0.01	0.12			
Letterkenny	Tullaghobegly (2013)	0.15	0.07	0.35			
Limerick	Skivaleen	0.05	0.01	0.12			
Lismore	Blackwater Glenshelan & Finisk	0.18	0.12	0.26			
Lismore	Bride	0.05	0.01	0.12			
Sligo	Drumcliff	0.15	0.07	0.35			
Sligo	Garvogue (Bonnet)(2014–2017)	0.05	0.01	0.12	0.12	0.06	0.27
Sligo	Garvogue (Bonnet) (2013)	0.05	0.01	0.12	0.31	0.15	0.46
Waterford	Barrow and Pollmounty	0.05	0.01	0.12	0.12	0.06	0.27
Waterford	Colligan	0.05	0.01	0.12			
Waterford	Nore (2015 –2017)	0.05	0.01	0.12	0.12	0.06	0.27
Waterford	Nore (2012–2014)	0.15	0.7	0.35	0.12	0.06	0.27
Waterford	Suir, Clodiagh, Lingaun & Blackwater (2014 –2017)	0.05	0.01	0.12	0.12	0.06	0.27

District	River	1SW Exploitation rates			MSW Exploitation rates		
		Likely	Minimum	Maximum	Likely	Minimum	Maximum
Waterford	**Suir, Clodiagh, Lingaun & Blackwater (2013)**	0.15	0.7	0.35	0.12	0.06	0.27
Wexford	**Owenavorragh**	0.05	0.01	0.12			
Wexford	**Slaney**	0.12	0.06	0.27	0.12	0.06	0.27

5 Mixed-stock commercial fisheries advice

The objective of the catch advice is to ensure that harvest fisheries operate only in estuaries where stocks in contributing systems meet and exceed CLs. There are potentially three mixed-stock commercial fisheries operating in estuaries.

5.1 Killary Harbour

In the case of the Killary Harbour (Ballinakill District) fishery, there are two contributing stocks (Delphi and Erriff) both of which are meeting and exceeding their CLs in 2018 (Table 1). The TEGOS provide advice on the Killary common embayment based on the CL being met on both rivers simultaneously.

5.2 Tullaghan Bay

The draft net fishery operating in Tullaghan Bay, Bangor District, exploits stocks from the Owenmore, Owenduff and Carrowmore systems, Following a review of this fishery in 2012, the SSCS determined that the main bulk of the catch was made within the estuaries of the individual rivers, so individual catch options were provided rather than a combined common embayment catch option as in previous years. There is a small overlapping fishery which takes some stock from each river but a local arrangement for the quota for this fishery was determined by IFI for 2013. For the 2015 SSCS advice, one of these river stocks, the Owenmore was below CL and no Total Allowable Catch (TAC) was provided for the Tullaghan Bay fishery or the Owenmore River in 2015. This is also the case for the 2018 advice. The Owenduff River had a substantial surplus and a TAC was allocated to the Owenduff estuary since 2015.

Up to 2010, these were the only such mixed-stock fishery situations where advice was provided by the SSCS as in other estuaries there was:

- more than three contributing stocks

and/or

- one or all of the contributing rivers were failing to meet CLs

or

- given the disproportionate size of the contributing stocks, a potential mixed-stock fishery would pose a threat to the attainment of CLs immediately or in the future.

5.3 Castlemaine Harbour

In 2010, the Minister of State at the Department of Communications, Energy & Natural Resources requested advice on how a commercial salmon fishery could be operated on stocks in Castlemaine Harbour in a sustainable manner, maximising the opportunities for commercial fishing whilst ensuring that stocks are not overexploited. In this context, a pilot fishery was operated in Castlemaine Harbour in 2010 to determine the composition of the various stocks in the fishery. The results indicated that at least 94% of the catch in the fishery comprised salmon stocks from rivers entering Castlemaine Harbour (Laune, Caragh and Maine). All three rivers have been above CL since 2011 and a mixed-stock fishery has operated since that time. Advice is provided annually on this common embayment fishery based on all three rivers simultaneously achieving their CLs.

6 Recent trends in salmon stock status

Since 2007, scientific advice has been provided on an individual river basis regarding salmon stock status. While scientific advice will continue to be presented on an individual river basis, data from fish counters has been combined (Figure 3) in order to provide an overview of trends in salmon stock status nationally.

6.1 Fish counter time series

The number of counters installed and used in stock assessments has increased since river-specific advice began. The analysis is based on data from 30-32 fish counters with a reasonable time series of data. The counter time series runs from 2002 to the present year with the number of counters increasing from 9 to 30. Corrected average yearly fish counts can be calculated using a generalised linear model (GLM) to show the overall annual trend across the available counters. This provides a benchmarked comparison of how annual salmon returns have varied in this time period. Figure 3 shows variation in the mean values for numbers of salmon counted through counters from 2002 to 2017, peaking in 2007 which coincided with the closure of offshore drift netting.

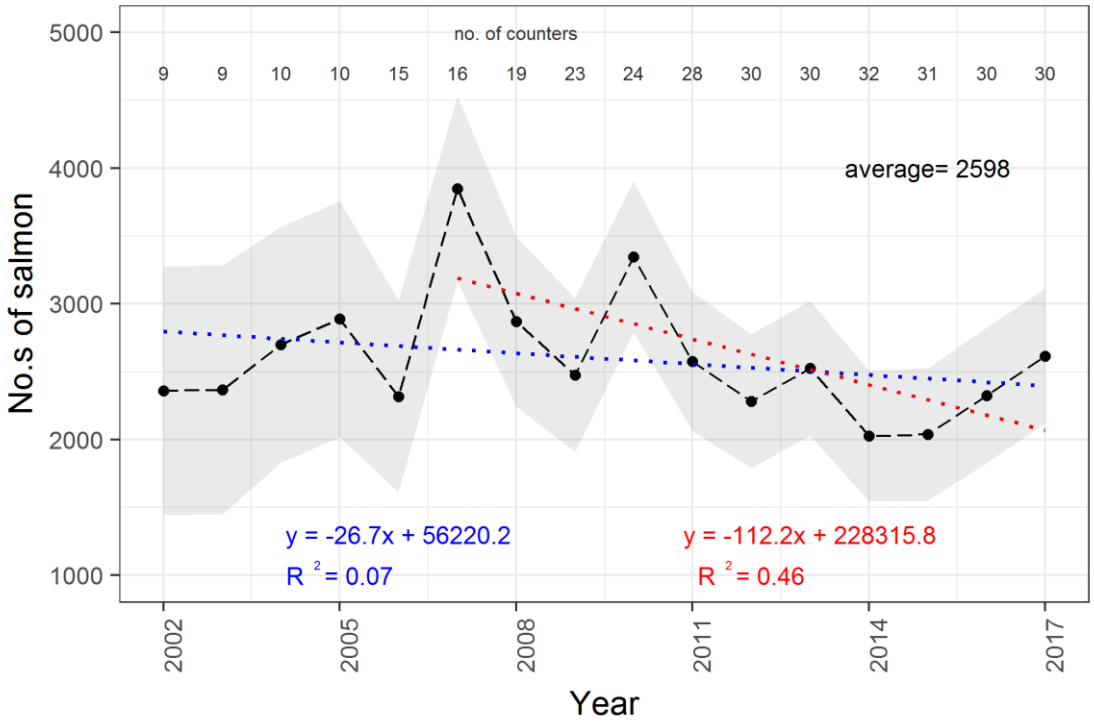

Figure 3 Marginal GLM LS-mean standardized number of salmon counted through counters operated between 2002 and 2017 (± 95% confidence intervals – grey band). The number of counters is shown at the top. The linear trend over the full time period (blue dashed line), and between 2007 and the present (red dashed line) are also indicated. Note that the drift net fishery ceased at the end of the 2006 season. The average over the entire time series is also indicated (Standardised means are calculated as marginal, least squared, means through a Generalised Linear Model).

The linear trend between 2002 and 2014 was fairly stable, however, there has been a decline in the linear trend since 2007, with 2014 being the lowest in the time series. A slight upturn in the mean counter value for 2017 was observed, the third consecutive year when a slight increase in the time series is evident. Figure 4a below shows the run of salmon from June to December inclusive, made up mostly of one-sea-winter fish (grilse) and summer and autumn multi-sea winter fish. As 1SW grilse constitute the majority of the overall salmon stock in Ireland, it is unsurprising that the overall trend and year to year variations in mean stock abundance are very similar for this stock component as was observed for the total salmon stock (Figure 4a). Figure 4b constitutes the early running multi-sea winter 'spring fish' returning from January to May inclusive. A moderately declining trend is evident in this MSW stock component.

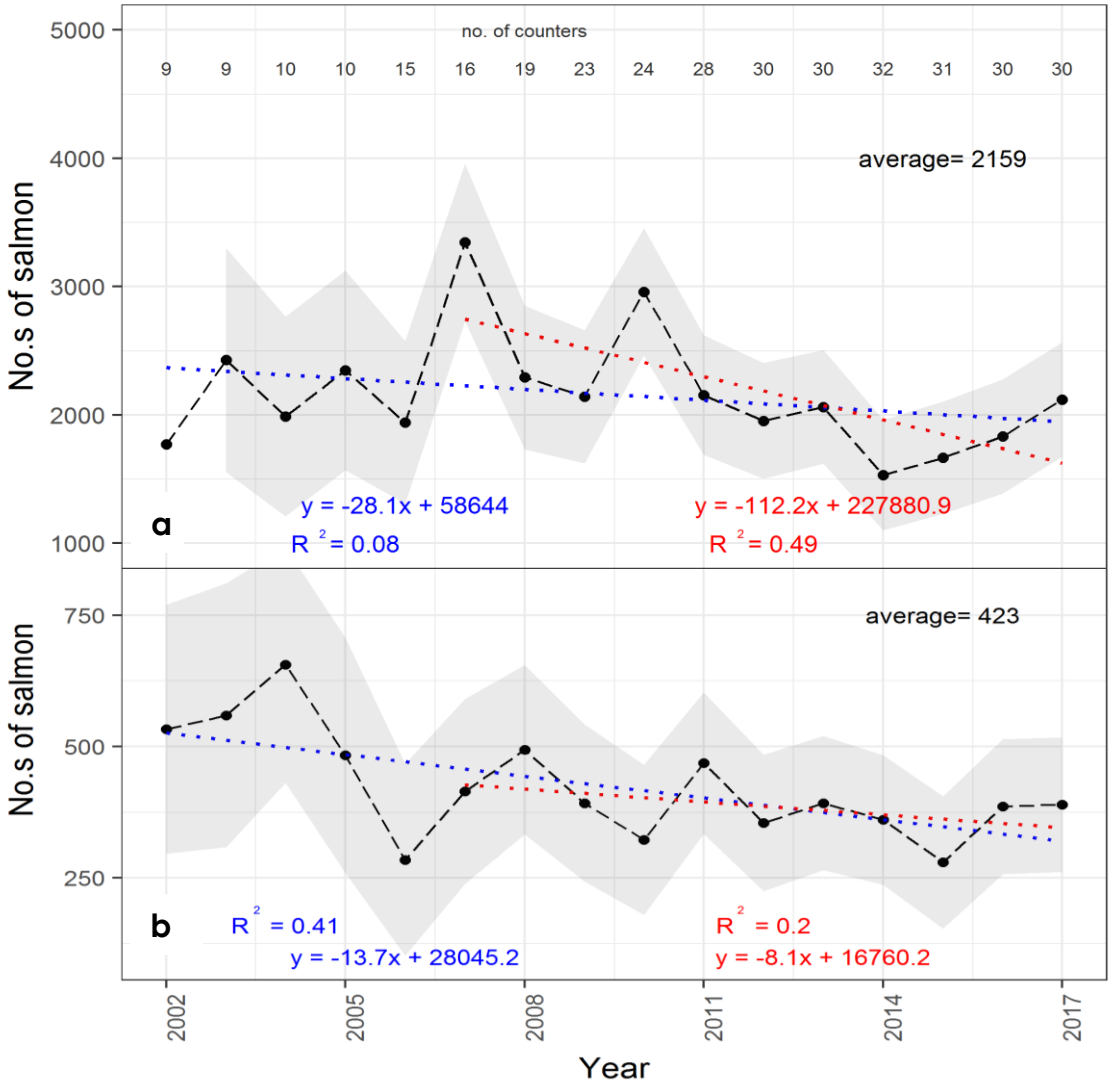

Figure 4 Marginal GLM LS-mean standardized number of (a) 1SW grilse (June to December) and (b) MSW (January to May) counted through counters operated between 2002 and 2017 (± 95% confidence intervals – grey band). The number of counters is shown at the top. The linear trend over the full time period (blue dashed line), and between 2007 and the present (red dashed line) are also indicated. Note that the drift net fishery ceased at the end of the 2006 season. The average over the entire time series is also indicated (Standardised means are calculated as marginal, least squared, means through a Generalised Linear Model).

Overall, 20 of 30 counters estimates are below their mean counts, with 9 falling below the lower 95%cl of their proceeding time series, (Figure 5).

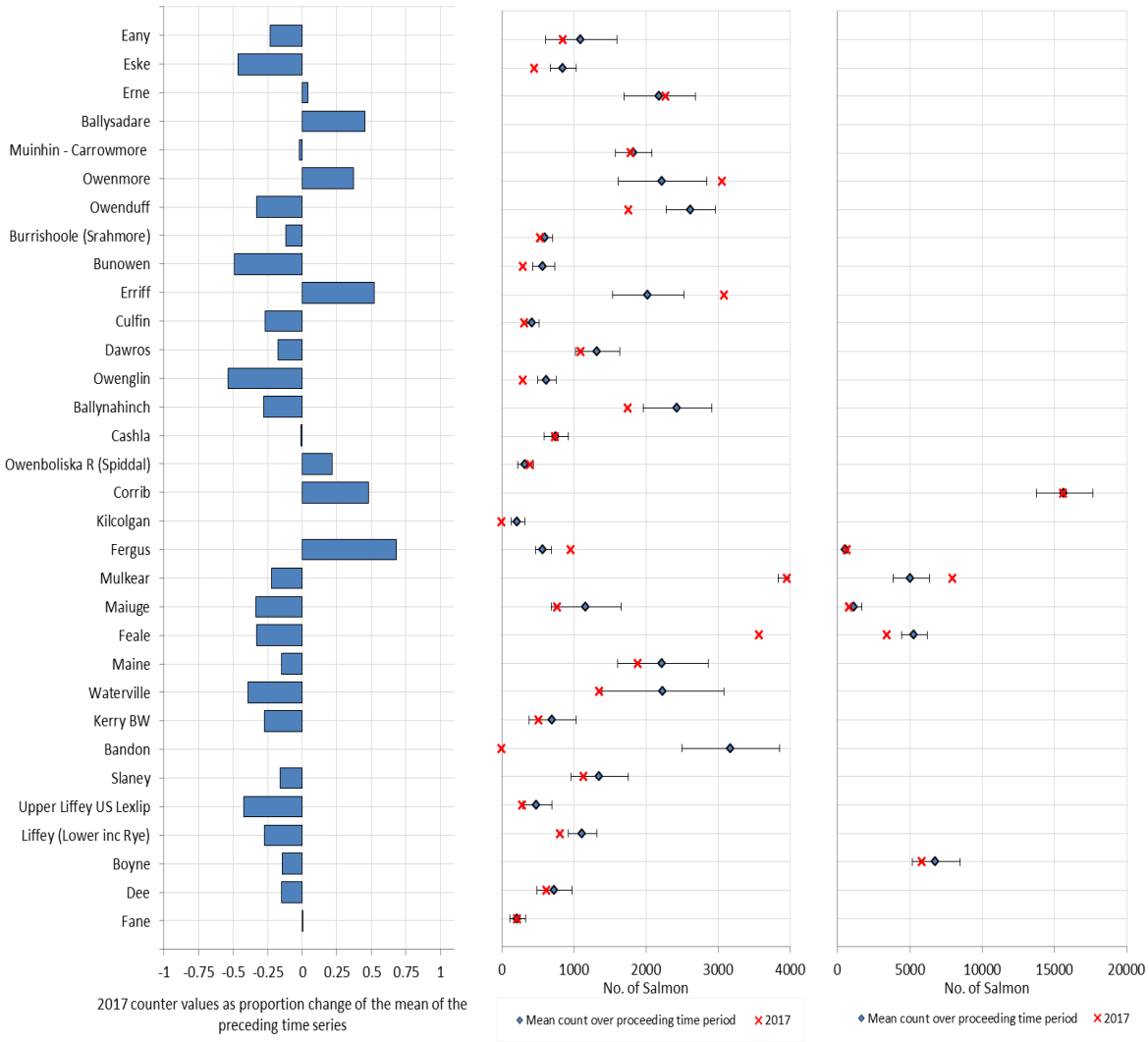

Figure 5 The proportional change in the salmon count in 2017 compared to previous multi-annual means (left panel), and mean salmon counts (± 95% cls) with 2017 value indicated (red X) (middle and right panel – note the different axes scales).

6.2 National returns and estimates of spawners relative to CL attainment

The ICES Working Group on North Atlantic Salmon (WGNAS) provides annual scientific advice to the inter-governmental body NASCO for the management of fisheries in the North Atlantic. In this advice, Irish wild salmon stocks are included as part of the southern complex in the North-east Atlantic region, along with stocks in rivers in France, south-west Iceland and the UK. As part of this, for the southern stock complex and its constituent countries, annual stock assessments and periodic stock forecasts (every one to three years) are undertaken.

6.2.1 One-sea-winter returns and spawners

Based on ICES advice, 1SW returns to Ireland before fisheries take place were above CL from 1971 to 2006, below CL since 2014 and fluctuated around CL in the intervening period (Figure 6). However, following exploitation, spawners have been at or below CL for 21of the 46 years in the time series. In the most recent years, post the cessation of the drift net fishery, the national CL has been exceeded only in four years (2008, 2010, 2011 and 2012) (ICES 2017a)..

6.2.2 Multi-sea-winter returns and spawners

National MSW returns to Ireland exceeded CL until 1990 after which values fluctuated around the CL until 2005. Since then, salmon returns of MSW fish have been well below CL (Figure 6). While the management aim is to ensure that MSW spawners are above CL after any fishery takes place, this has only been achieved once since 1988 (ICES 2017a).

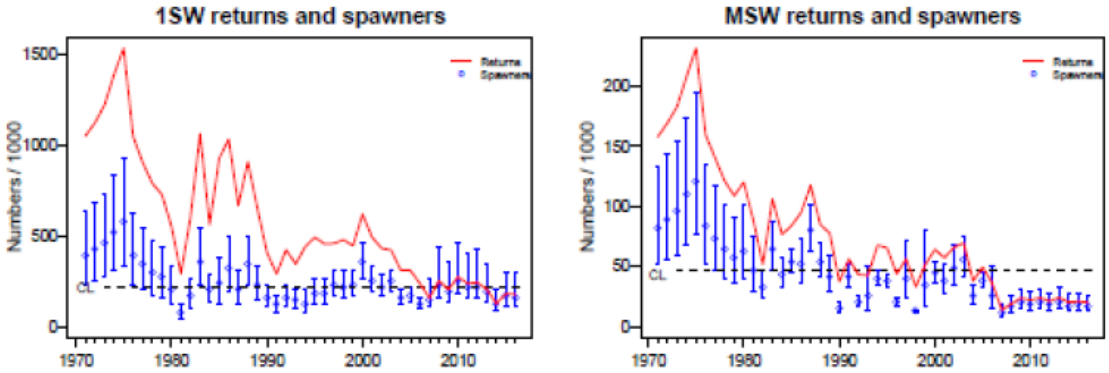

Figure 6 Estimated return of 1SW and MSW salmon to Ireland prior to homewater fisheries (solid red line) and spawners (points including 95% confidence intervals) relative to national conservation limits (dashed line). Source: ICES (2017a).

7 Advice for stock rebuilding

7.1 International guidance on stock rebuilding

The terms of reference of the TEGOS are outlined earlier in this report. One of these relates to salmon stocks below CL.

> *"In cases where stocks are determined to be below the conservation limits the TEGOS shall advise the level to which catches should be reduced or other measures adopted on a fishery basis in order to ensure a high degree of probability of meeting the conservation limits".*

Other measures to be adopted can relate to stock rebuilding programmes for salmon stocks below CL. In 1998, NASCO adopted the "precautionary approach" to fisheries management. The NASCO Agreement on the Adoption of the Precautionary approach states, that:

'*an objective for the management of salmon fisheries is to provide the diversity and abundance of salmon stocks*'

or in other words to maintain both the productive capacity and diversity of salmon stocks. NASCO provides interpretation of how this is to be achieved. Management measures should be aimed at maintaining all stocks above their Conservation Limits by the use of management targets. The precautionary approach is an integrated approach that requires, *inter alia*, that stock rebuilding programmes (including as appropriate, fishery management actions, habitat improvements and stock enhancement) be developed for stocks that are below Conservation Limits.

NASCO developed Guidelines on the Use of Stock Rebuilding Programmes (SRP) in the Context of the Precautionary Management of Salmon Stocks in 2004, CNL(04)55. An SRP is an array of management measures, possibly including habitat restoration/improvement, exploitation control and stocking, which is designed to restore a salmon stock above its conservation limit. The nature and extent of the programme will depend upon the status of the stock and the pressures that it is facing. NASCO guidelines on stock rebuilding programmes notes, that while the short-term response to a stock failing to exceed its conservation limit may be to reduce or eliminate exploitation, there will generally be a need to develop a programme to evaluate and address the causes of the stock decline. In more serious situations, there may be a need for a comprehensive programme of research and management,

involving a wide range of management actions undertaken by a number of user groups.

NASCO's SRP guidelines were developed to *inter alia* provide a link between several other guidance documents developed by NASCO in relation to the application of the Precautionary Approach, including the Decision Structure for the Management of Salmon Fisheries, and the Plan of Action for the Protection and Restoration of Atlantic Salmon Habitats. Since the SRP Guidelines were adopted, NASCO has adopted Guidelines for the Management of Salmon Fisheries, CNL(09)43, Guidelines for the Protection, Restoration and Enhancement of Salmon Habitat, CNL(10)51, and 'Guidance on Best Management Practices to Address Impacts of Sea Lice and Escaped Farmed Salmon on Wild Salmon Stocks', SLG(09)5, which contain elements relevant to stock rebuilding.

Ireland was required to submit an Implementation Plan (IP) to NASCO covering the period 2013 – 2018 to demonstrate what actions are being taken to implement NASCO Resolutions, Agreements and Guidelines. Among the information to be provided are the main threats to wild salmon and challenges for management in relation to fisheries, to estuarine and freshwater habitat, and to aquaculture, introductions and transfers, and transgenics. The IP sets out what actions are planned to address each of the above threats and challenges in the five year period to 2018.

Each year Ireland is required to submit an Annual Progress Report (APR) to NASCO providing information on progress against actions in Ireland's IP relating to management of salmon fisheries, habitat protection and restoration and aquaculture and related activities as well as available information on monitoring the effectiveness of those actions and their enforcement. In addition, details of any significant changes to the status of stocks and any changes to the IP are included in the report. The IP sets out how actions are proposed to address stock rebuilding of salmon stocks below CL and the APR details progress being made to achieve these objectives.

ICES is also addressing the issue of stock rebuilding of salmon across all North Atlantic salmon countries. The ICES Working Group on Effectiveness of Recovery Actions for Atlantic Salmon (WGERAAS) met twice in 2014 and in 2015, and is reviewing and evaluating the effectiveness of the many salmon recovery and rebuilding programmes that have been implemented in the past. This investigation will enable successful approaches, and their situations, to be highlighted and recommendations based upon this for future works to be made.

The group has four Terms of Reference, to:

- Develop a classification system for recovery / re-building programs for Atlantic salmon, including threats to populations, population status, life history attributes, actions taken to re-build populations, program goals, and metrics for evaluating the success of re-building programs;
- Populate the system by collecting data on recovery / re-building programs for Atlantic salmon populations from around the North Atlantic;
- Summarize the resulting data set to determine the conditions under which various recovery / re-building actions are successful and when they are not;
- Provide recommendations on appropriate recovery / rebuilding actions for Atlantic salmon given threats to populations, status and life history.

The findings of this group were reported to NASCO in 2016. (ICES 2017b).

7.2 Factors affecting stock rebuilding programmes for Irish salmon stocks

Closure of marine mixed-stock fisheries for salmon and even complete closure of some salmon rivers to harvest fisheries may not ensure that all rivers will meet or exceed CLs in the short term. There are several identifiable problems militating against immediate recovery and this must be taken into account for future management over and above management of fisheries. In some instances, such as climate changes leading to poorer marine survival of salmon, it may not be possible to tackle the specific problems directly. Some of these specific problems are outlined below.

7.2.1 Marine survival

Although there has been considerable fluctuation, estimates of marine survival prior to 1996 for wild stocks were generally higher compared to more recent years with survival rates in excess of 15% in many years (*i.e.* 15 adult returns to the coast for every 100 smolts migrating, Figure 7).

The current estimates which are amongst the lowest in the time series suggest that based on recent years just over 5% of the wild smolts that go to sea from Irish rivers are surviving (*i.e.* 5 adults returning for every 100 smolts migrating). Survival rates from hatchery fish are lower than for wild fish. The decline in hatchery salmon survival has become more apparent since 2003 and recent values are the lowest in the time series.

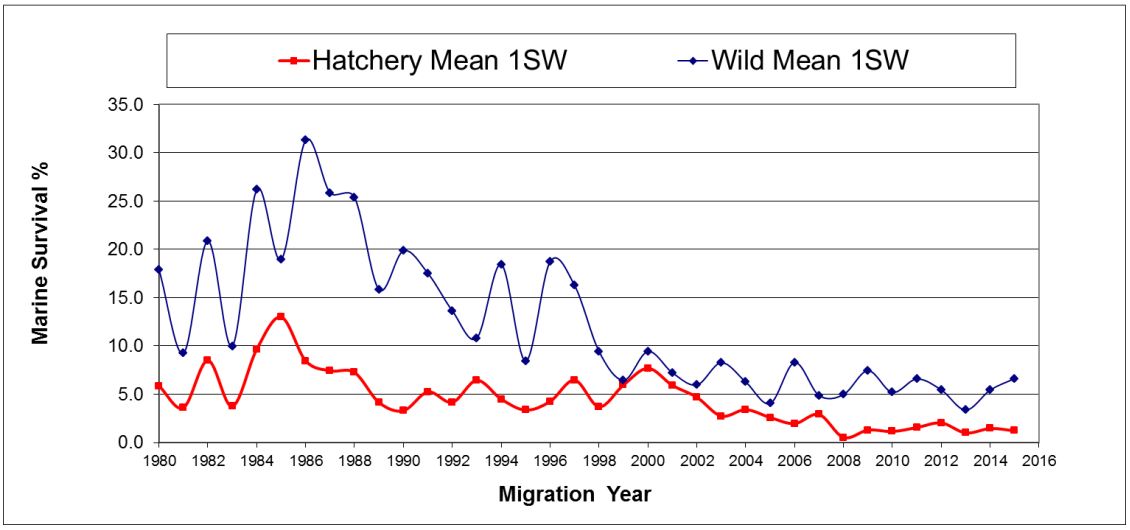

Figure 7 Marine survival (from smolt release to return to the Irish coast) for wild and hatchery salmon.

Marine survival is influenced by many factors (Figure 8). While the main focus of this report is on fisheries and fisheries effects, there are real concerns relating to factors causing mortality at sea such as predation by seals, diseases and parasites, estuarine pollution *etc*. However, there is insufficient empirical information to allow anything other than general advice to be given on these at this stage *i.e.* the more the effects each individual factor can be reduced the more salmon will return to our coasts and rivers. Clearly more directed investigations need to be carried out on these other factors.

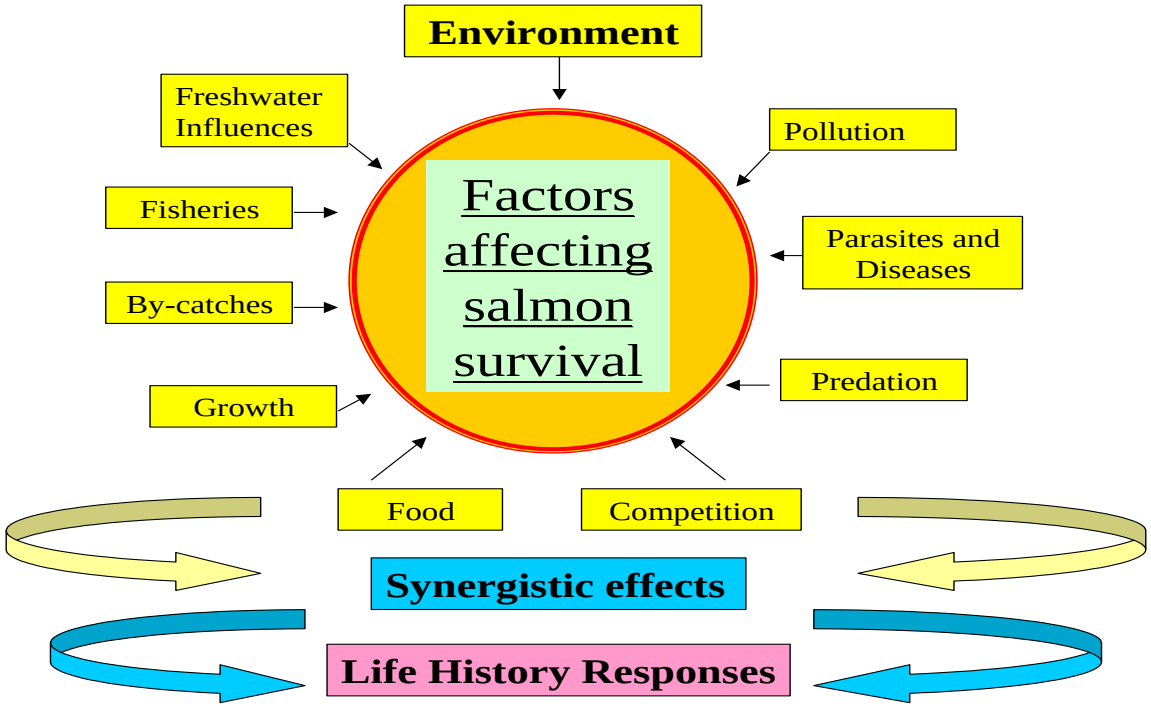

Figure 8 The factors which individually and synergistically affect the marine survival of salmon and which cause significant changes to life history responses such as population structure, fitness and size.

8 Changes to assessments in future years

New developments in the provision of catch advice for international and homewater fisheries have been reported in the context of ICES and EU 7th Framework programmes (ECOKNOWS). The main goals of these programmes are to develop life-history forecast models including production at all life stages of salmon life history. The approaches will allow more data to be included in assessments and underlying assumptions to be tested and validated. It is envisaged that the new approaches for the provision of Irish catch advice will be developed within the next three years.

Until such time as new methods become available the existing forecast model based on fisheries data or count data will be applied using the currently derived conservation limits for the next 5 year period. Data will continue to be updated and where appropriate improved to provide catch advice.

The SSCS examined rod exploitation rates on rivers with counters in 2008 to derive estimates of the likely range of exploitation by anglers on salmon stocks. Since then, new counters have been installed on many rivers and a time series of rod exploitation has been generated on a range of rivers nationally. The TEGOS intend to review available data on rod exploitation rates and refine the rod exploitation rates currently being used to provide estimates of salmon stock status.

9 Conclusions

Despite the considerable reductions in catches, following the closure of the mixed-stock fishery at sea in 2007, only 46% of Irelands 89 assessed salmon rivers are currently estimated to be meeting biologically-based conservation limits. While 36 more rivers could open for catch and release-only angling as assessments indicate relatively high juvenile densities or the stocks are meeting ≥50% of CL, it is clear the overall proportion of rivers with good population status is low. Fish counters provide the most direct assessment of salmon stock status in rivers. The number of counters installed and used in stock assessments has increased from 9 in 2002 to 30 in 2017. There has been variation in the mean count since 2002, with highest numbers recorded in 2007 coinciding with the closure of offshore drift netting. However, there has been a marked decline in salmon counts subsequently with 2014 and 2015 being the two lowest values in the entire time series. A minor improvement was seen in the 2016 and again in the 2017 counter data. These counter data can be considered as an index for other rivers nationally and probably reflect the national trend.

Marine survival values in the past 5 years are amongst the lowest recorded since the coded wire tagging programme commenced in 1980. Changes in oceanic conditions leading to poor recruitment of salmon have been implicated by NASCO following international investigations into the decline of salmon stocks (e.g. SALSEA Merge). Recent stock forecasts from ICES for stocks in the southern range of the North East Atlantic, indicate that this low stock situation will prevail at least until 2018. Given the current poor survival, the expectation of large catches is unrealistic at present and priority should be given to conservation objectives rather than catch increases until there is a noticeable improvement in stock abundance.

In this regard, the ongoing management policy of adopting the scientific advice to only allow exploitation on stocks above CL is central to aid the recovery of salmon stocks nationally. With this policy in place, any improvement in marine survival would be reflected in greater numbers of rivers achieving CL. This will contribute to meeting ICES & NASCO advice of providing for the diversity and abundance of salmon stocks.

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11 Appendices

11.1 Appendix I. Members of the Technical Expert Group on Salmon 2017/2018

Dr Paddy. Gargan, (Chair) - Inland Fisheries Ireland
Dr Colm Fitzgerald - Inland Fisheries Ireland
Dr Michael Millane - Inland Fisheries Ireland
Dr Niall Ó Maoiléidigh - Marine Institute
Dr Hugo Maxwell - Marine Institute
Dr Jonathan White - Marine Institute

11.2 Appendix II. Rivers assessed by the SSCS where salmon have a qualifying interest in Special Areas of Conservation (EU Habitats Directive) and status relative to conservation limit in 2018.

Table 9 Rivers assessed by the SSCS where salmon have a qualifying interest in Special Areas of Conservation (EU Habitats Directive) and status relative to conservation limit in 2018.

District	River	Above /below CL in 2018	SAC
Drogheda	**Boyne**	Below	River Boyne and River Blackwater SAC
Wexford	**Slaney**	Below	Slaney River Valley SAC
Waterford	**Barrow**	Below	River Barrow and River Nore SAC
Waterford	**Nore**	Below	River Barrow and River Nore SAC
Waterford	**Suir**	Above	Lower River Suir SAC
Lismore	**Blackwater**	Above	Blackwater River (Cork/Waterford) SAC
Kerry	**Mealagh**	Above	Killarney Nat Park, Macgillycuddy's Reeks & Caragh R. Cat SAC
Kerry	**Kerry Blkwater**	Below	Blackwater River (Kerry) SAC
Kerry	**Emlagh**	Below	Castlemaine Harbour SAC
Kerry	**Owenascaul**	Below	Castlemaine Harbour SAC
Kerry	**Owenreagh**	Below	Killarney Nat Park, Macgillycuddy's Reeks & Caragh R Cat SAC
Kerry	**Caragh**	Above	Killarney Nat Park, Macgillycuddy's Reeks & Caragh R Cat SAC
Kerry	**Ferta**	Below	Killarney Nat Park, Macgillycuddy's Reeks & Caragh R Cat SAC
Limerick	**Shannon**	Below	Lower River Shannon SAC
Galway	**Owenboliska**	Below	Connemara Bog Complex SAC
Galway	**Corrib**	Above	Lough Corrib SAC
Galway	**Corrib**	Above	Maumturk Mountains
Connemara	**Cashla**	Above	Connemara Bog Complex SAC
Ballinakill	**Culfin**	Above	The Twelve Bens/Garraun Complex SAC
Ballinakill	**Dawros**	Above	The Twelve Bens/Garraun Complex SAC
Ballinakill	**Bundorragh**	Above	Mweelrea/Sheeffry/Erriff Complex SAC
Ballinakill	**Bunowen**	Above	Mweelrea/Sheeffry/Erriff Complex SAC
Ballinakill	**Carrownisky**	Below	Mweelrea/Sheeffry/Erriff Complex SAC
Ballinakill	**Erriff**	Above	Mweelrea/Sheeffry/Erriff Complex SAC
Bangor	**Srahmore**	Below	Owenduff/Nephin Complex SAC
Bangor	**Owenduff**	Above	Mweelrea/Sheeffry/Erriff Complex SAC
Bangor	**Owenmore**	Below	Mweelrea/Sheeffry/Erriff Complex SAC
Bangor	**Glenamoy**	Above	Glenamoy Bog Complex SAC
Bangor	**Muingnabo**	Below	Glenamoy Bog Complex SAC
Bangor	**Newport**	Above	Newport River SAC
Ballina	**Moy**	Above	River Moy SAC
Sligo	**Garavogue**	Above	Lough Gill SAC
Sligo	**Ballysadare**	Above	Unshin River SAC
Ballyshannon	**Eske**	Below	Lough Eske and Ardnamona Wood SAC
Ballyshannon	**Glen**	Below	Slieve Tooey/Tormore Island/Loughros Beg Bay SAC
Ballyshannon	**Drowes**	Above	Lough Melvin SAC

District	River	Above /below CL in 2018	SAC
Letterkenny	**Leannan**	Below	Leannan River SAC
Letterkenny	**Gweebarra**	Above	West Of Ardara/Maas Road SAC
Letterkenny	**Owenea**	Above	West Of Ardara/Maas Road SAC
Letterkenny	**Owennamarve**	Below	Cloghernagore Bog and Glenveagh National Park SAC
Letterkenny	**Clady**	Above	Lough Eske and Ardnamona Wood SAC

11.3 Appendix III. Summary results from the catchment-wide electro-fishing programme in 2017.

Analysis of salmon fry index

In cases where the scientific forecast of returning salmon recruits to a river provides a catch option resulting in less than a 75% chance of the river meeting its conservation limit (CL), the scientific advice recommends that the river is closed for fishing. As a separate recommendation, Inland Fisheries Ireland (IFI) advise that if a river is meeting 50% or more of its CL the river can open for catch and release-only angling (C&R). There are many rivers where a direct assessment is not possible due to a very low or inconsistent reported angling catch (*i.e.* less than 10 on average annually). Therefore, advised closures of rivers with very low rod catches, or which have been closed over a period due to the absence of new and alternative information (e.g. fish counter information, redd count or other population indicator) poses a problem for assessing the status of the rivers salmon population and CL attainment over time as there are no new data for updating the forecast and risk analysis method currently employed by the TEGOS.

A relative index of fry abundance based on semi-quantitative electrofishing technique (Crozier and Kennedy 1994; and Gargan et al. 2008) was developed in 2009 and 2010 to provide an alternative method for assessing attainment of CLs in rivers closed for angling or where there was no counting facility. Electrofishing of juveniles presents an alternative (and fisheries independent) source of population information as the numbers of juveniles should be a good reflection of the number of adults which produced them and the relative productive capacity of that river. This method is based on a relationship between fry abundance (which may be measurable annually) and adult returns for rivers with information on rod catches or counters over a number of years was available. Although the scientific advice is that assessments should preferentially be based on a recent five-year average and to date the results from the catchment-wide electro-fishing provide an assessment for a single year for some rivers, it is expected that more robust assessments can be made over the coming years as more surveys are carried out.

The method is primarily used for rivers where there is no other index of stock. Some catchments are electro-fished annually as index catchments. Until the 2018 advice, an index of at least 17 salmon fry per 5 minute standardised electro-fishing has been used as the cut-off between rivers below this threshold where the stock is clearly below CL and those rivers above the threshold where it is more likely that the stock is

meeting CLs. If the fry index is above the threshold only catch and release fishing in the following year is advised. (For the 2018 fishery, management adopted an average fry threshold of 15 salmon fry allowing rivers to be open for catch & release angling). The information from this fishery, when combined with the other most recent catch data allows a forecast of adult returns to be made in the next fishing season. This provides a safeguard against opening a river prematurely, while still allowing some fishery activity and the subsequent collection of catch data.

Catchment-wide electro-fishing is also important in providing managers with information on the distribution and abundance of salmon fry and to identify management issues in a catchment or tributary. The absence or low density of salmon fry may be related to water quality issues, obstructions, or habitat damage and areas of low abundance can be investigated.

During 2017, catchment-wide electro-fishing was undertaken in 35 catchments or sub-catchments to assess abundance and distribution of salmon fry (Figure 9). A number of catchments, primarily in the west and northwest, had persistently high water levels throughout the summer preventing the completion of a number of surveys. However, 22 catchments were surveyed completely. Planned surveys of certain sub-catchments were also completed as follows: the Brown Flesk on the Maine system, and the Groody, Kilmastula, Blackwater and old main channel on the Lower Shannon, and the Annalee on the upper Erne. A total of 854 sites were visited. In the first ten years of the programme (2007-2017) 412 catchment surveys in 146 catchments have been undertaken comprising 9,473 site surveys.

For the catchments surveyed in 2017, the salmon fry abundance for this year alone ranged from an average of zero fry/5min on the Annalee on the Upper Erne, to a catchment average of 24.1 salmon fry per 5 min on the Cloonee. The Cloonee, Lackagh, Leannan, Laune, Oily, Doonbeg and Duff recorded an annual catchment wide average of >17 fry.

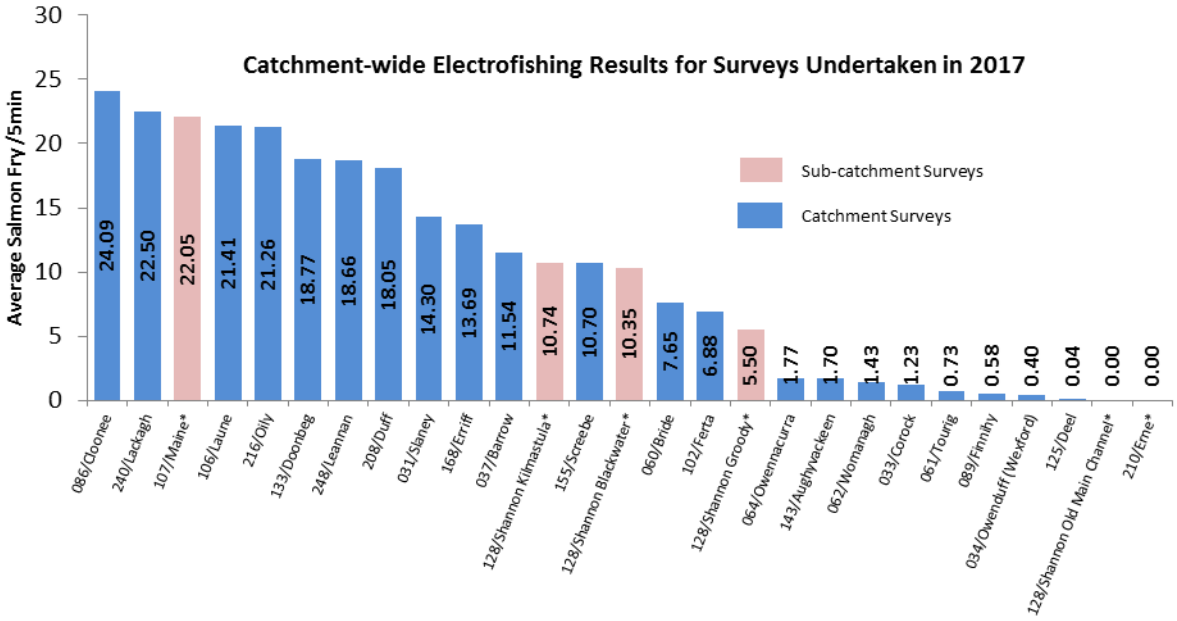

Figure 9 Results of catchment wide electro-fishing during 2017.

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