Notes on the Management of Salmon in Ireland

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September 2007 (V. 1.1)

Introduction

The sport fishing lobbyism has has worked hard to reduce the commercial harvest of Atlantic salmon ever since the early seventies . This has been done by stopping net- trap- and and line fishery by buyout and other means. This was driven by the believe that reduced commercial harvest would increase the sport fishery, increase the spawning stock in the rivers, which in turn would stabilize and increase the salmon runs. That has not happened. The runs into the rivers have not increased in proportion to the reduction in commercial harvest, rather the contrary.

On a larger scale, governmental institutions, now also pushed by environmentalist groups, are implementing management methods that are based on the hypothesis that sustainability is in relation to the size of the spawning stock. In their opinion, low spawning stock is dangerous, large spawning stock secures sustainability. Other factors are hardly mentioned.

The emphasis is put on calculating or estimating the size of a spawning stock that in their opinion gives MSY (maximum sustainable yield), called Conservation Limit or CL. Less attention is paid to the actual situation in the rivers, status of parr stock, pollution, obstructions, nursery areas, other species (competitors, predators) etc. In order to reach the CL reduction of the fishery is recommended.

In this paper some comments are given on the past experience of reducing the fishing effort on salmon. Also, information is given on some biological facts that makes the "fish less" management method doubtful.

Summary

- Reduction in salmon runs cannot be explained by to heavy fishing. There are other factors to consider.

- The theory of CL, to low spawning stock, threatening the sustainability of salmon stocks is not supported by empiric data. It is a hypotheses.

- It is impossible to calculate a CL using mathematic formulae and geographical data (wetted area, catchment area). It has to be evaluated for each river and based on field research.

- It remains to be proven that fishing (drift net fishing) has caused lower salmon runs. More likely, lower catches of salmon is a result of the management method which is to reduce fishing effort.

Catch of Atlantic Salmon

Catch of Atlantic Salmon has decreased from 12,000 tons in 1974 to 2,200 tons in 2005, according to official statistics (fig1). This is a factor of 6.

Since 1970, the sport fishery lobbyism has worked hard to reduce commercial harvesting in the sea. The Greenland drift net fishery and the Faroe long line fishery (lowest part of fig. 1) was stopped in the early nineties. The reduction in Salmon landings in North America coincides with the reduction in the cod fisheries off Canada which resulted in cod moratorium in 1994. Both the reduction of cod and salmon can be related to adverse sea condition in the same period. This may also explain the great reduction in general catches of multi winter salmon.

Drift net fishery off Norway has been stopped. In Iceland, no sea fishery for salmon has been allowed for a long time and netting in major river system has been vastly reduced during the last 15-20 years, and so on and on. In general, harvesting by other methods than rod and reel has been reduced considerably. In the sports fishery, catch and release becomes increasingly popular.

Despite all this reduction in commercial fishery, salmon catches in rivers, and maybe also runs into the rivers, have not increased to the degree as expected. Therefore, the argument that was used to stop the commercial fisheries, that spawning stock were to small. is at the best doubtful, most likely wrong.

If the catches are reflecting changes in the salmon production, there must be other explanations to the reduction than shortage of spawners.

Despite bad experience and limited knowledge in this field, the main management method is to **reduce catches** in order to (try to) increase the spawning stock.

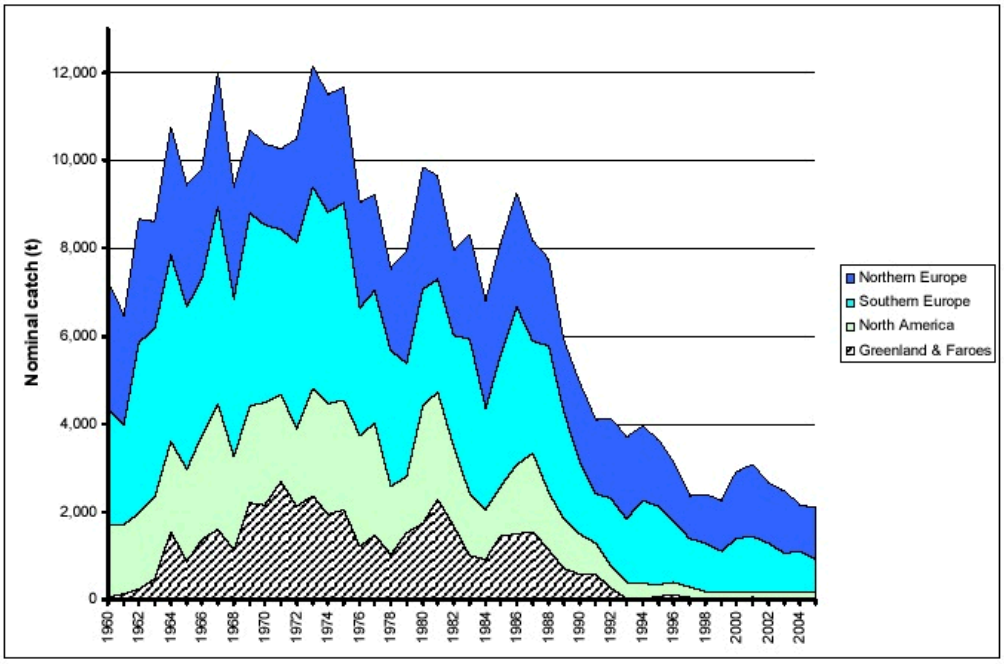


Fig 1. Atlantic Salmon landings 1960-2005 (from ICES 2006)

Salmon in Ireland

Introduction

There has been a reduction in the salmon fishery in Ireland. Scientists maintain that some stocks are endangered, they judge it so because some of them are below the so called CL level. The CL 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"*(SSC report, 2006).

The International Council for the Exploration of the Sea (ICES) has provided the following general advice to NASCO for homewater fisheries:

- *Stocks should be maintained above Conservation Limits*
- *The only fisheries for salmon should be on river stocks that are shown to be above Conservation Limits*
- *For stocks below Conservation Limits catches should be reduced to increase the probability of meeting the CL.*
- *Due to the different status of individual stocks within regions, mixed stock fisheries present particular threats to stock status.* (SSC report, 2006)

The recommendation of reduction of the fishery is thus quite clear. The drift net fishery has been closed from 2007 and fishing in rivers, by draft net and rod is not allowed where the spawning stock is below the CL level.

It is thus evident that **the main concern as regards the salmon stocks is over fishing.**

Depletion of the spawning stocks should lead to reduction or depletion of the parr populations in the rivers, which eventually would put an end to the salmon runs. N**o such cases have been reported.**

Until such information is available, lack of spawners is to be regarded as unsupported hypothesis.

Very little attention seems to be paid to the conditions in the rivers like status of salmon parr, pollution, obstructions, other fish species or predation from birds.

Mixed stock fisheries (MSF) are considered to be a special threat to the stock status. This is an unsupported theory. Internationally it may represent a problem in that native stocks in one country are harvested in another country. That can be solved by decreasing the outer limit for drift netting. That MSF should be a **threat** for the individual stocks is however doubtful.

Until it has been proven by solid evidence that one or more stocks have been wiped out by fishery resulting in lack of spawners, this thesis is unsupported.

It is also worth noting that all major fisheries are MSF.

The salmon catch

The salmon catch in Ireland 1970-2005 is shown in fig. 2. The estimated number of spawners is also shown and the CL for all rivers. There has been a downward trend in the whole period. **This probably reflects the great reduction of fishing pressure from 1970**, culminating now in closure of the drift net fishery.

If the decline in salmon catch is a result of the reduction in fishing effort, overfishing (lack of spawners) can not be the cause. Other explanations must be looked for.

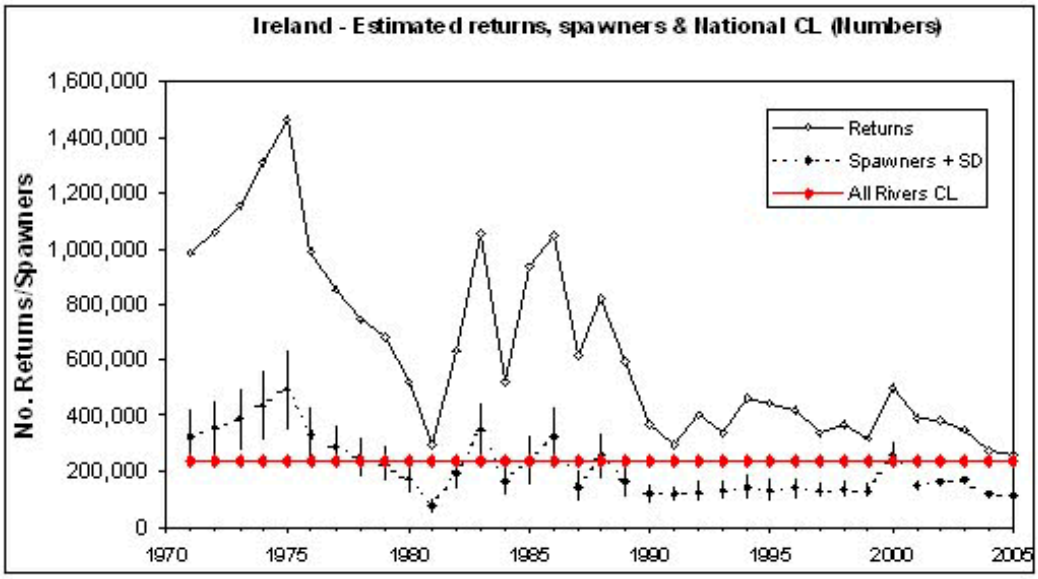


Fig. 2. Salmon catch in Ireland 1970-2005, n.of spawners and CL for all rivers (From: Report of the Standing Scientific Committee of the National Salmon Commission (SSC report) 2006, fig 7.)

Survival of smolts and smolt production.

Survival of natural and hatchery smolts has been measured since 1980. The main result is that survival of natural smolts has decreased considerably since 1986. Survival of hatchery smolts is stable low, but lower that in 1985 and 1986, fig 3. Low survival is equivalent to high mortality.

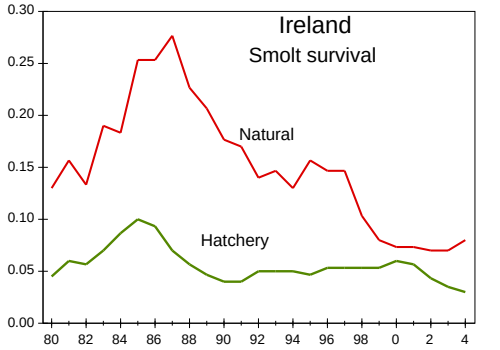


Fig 3. Survival of natural and hatchery smolts 1980-2005. Smoothed (3 year running average), constructed from fig. 9 in SSC 2006 report.

Mortality is caused by predation and other things like food supply and unfavourable conditions generally. Cod is effective predator on smolts, experiments in Norway have manifested that.

Fishing pressure has been reduced on cod and other whitefish species in an attempt to "rebuild" the stocks. Both in the North sea and the Irish sea, low quotas and decommission has brought the fishing activity to a very low level. The reduction in fishing effort puts increased predation pressure on the cod's prey, - salmon post smolt included.

It is quite possible that the fishing reductions (modern management) that started in late eighties is responsible for lower returns of natural smolts. Generally, hatchery smolts have lower return rate than natural smolts, but their quality is now better than it was in the early days of smolt production. That may explain the constant return rate since 1990.

It is interesting to note that decrease in salmon smolt survival coincides with the official cod landings from the Irish Sea. Fig. 4 shows the return rate of natural smolts superimposed on the landings of cod from the Irish sea.

It is my opinion that landings of cod do not reflect reduction of the cod stock, rather reduced fishing effort. The size of the cod stock is unknown, and there are other predators like hake and whiting.

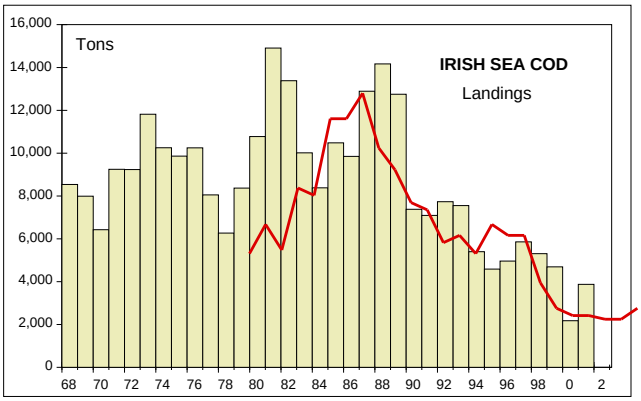


Fig. 4. Smolt survival superimposed on graph of Irish Sea cod landings. Cod landings decline **as a result** of fishery management, i.e. reduced quotas and general effort. Is increased predation from whitefish affecting the smolt survival?

Theoretically, if the salmon run and the return rate of smolts are known, the gross smolt production can be calculated. Fig. 5 shows the calculated smolt production 1980-2004

The smolt production is more important in reflecting the state of the rivers /stocks than the sole return of grown fish.

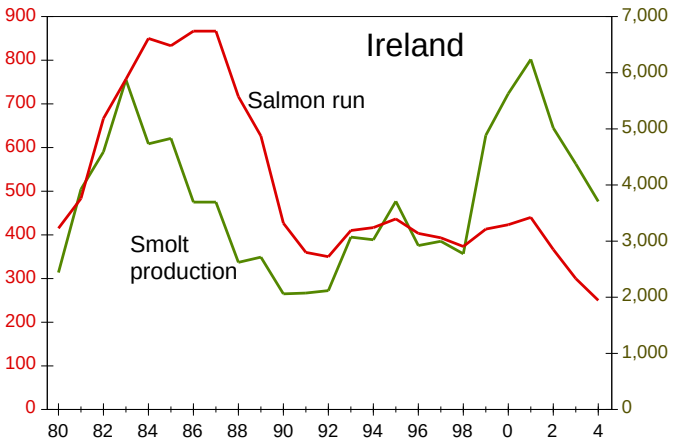


Fig. 5. Smolt production seems normal at present, or oscillating in a normal way. Is decreased survival responsible for decline in salmon runs?

It seems that the smolt production 1999- 2004 is of the same magnitude as in the early eighties, suggesting that there might be other factors to consider than the supposed lack of spawners.

Salmon managers should be requested to bring up more arguments and proofs when so drastic "management" measures as to reduce heavily or close down the fishery, are taken.

The Conservation Limit, CL

When setting CL to the rivers in Ireland the value is **calculated** by using a mathematical model. It is generally accepted that each river /stock has its individual characteristic. Despite that, the input parameters for the model are from other rivers, even from other countries. As far as I know It has not been verified by field observations weather the CL values are close to be be correct.

One parameter used in the calculation of CL is wetted area which is computed from catchment area and length of the river:

"The wetted area is computed from statistically combined parameters: the length of upstream river, upstream catchment area, stream order, and local gradient interpolated from aerial photography within a GIS platform "(SSC report 2006 pg. 11).

Not all parts of river are suitable nursery areas for salmon parr. Slow flowing parties are not suited for salmon, there brown trout and other species are dominating. The best areas for salmon are stretches with coarse stony bottom and swift current. That means that each river has to be mapped and the salmon production areas measured and added up, all this supported by parr survey. **Otherwise, the modelled CL level is a guesswork that bears little relation to reality.**

What will probably happen from now is: Despite the closure of the drift net fishery, the salmon runs will be much the same or will even be still lower in the future. The CL conditions will in many instances not be met, which in turn **will lead to further restrictions on fishing effort,** rod fishing included.

It is interesting to see in the SSC 2006 report that electrofishing is suggested as a method to get information on juvenile abundance:

"Other data - Information on juvenile abundance indices derived from electro fishing surveys carried out annually may also be a useful surrogate of stock performance and will be developed in the future."

This means that electrofishing surveys are not carried out. That is very strange because this has been a standard procedure in many countries for a long time.

No plan has been set up to manage the stock on river to river basis, even though it was used as an argument for closing down the drift net fishery.

Questionable assumptions

If the assumption, that decreased fishing pressure in the sea would increase the runs into the rivers was correct, then runs into the rivers should have increased considerably. This has not been the case.

As the harvest from road fishery is considered to be a constant fraction of the run, then if runs have increased, the spawning stock would also have increased.

According to the recent management theories the spawning stock in many rivers has been below CV for a long time. This - to increase the spawning stock - is one of the reasons behind the recommendation to reduce the harvest. Has the massive reduction of the salmon harvest in recent years lead to changes (increase) in the spawning stock?

Are there available data to manifest that increase in spawning stock in any particular river has lead to increased runs or increased production of smolts?

Is there information on any river where the salmon stock has been reduced considerably or wiped out as a result of over fishing?

Salmon management in Iceland

River monitoring

Modern electrofishing was introduced in Iceland in the early seventies. We mainly use 300-600V DC units, 350-1200W, driven by portable and semi-portable motor generators. Pulsating battery units, which is the main gear used in Europe, are not used due to bad experience, mainly due to bad taxis, that is they do not attract the fish very well to the anode (fish badly).

For 35 years this technique has been extensively used to assess the salmon parr populations in the rivers. It has been found that the parr population is remarkably stable in each and every river, but it differs from one river to another. Also, parr seems to grow better and have a higher survival when environmental conditions are favourable, i.e. long mild summers.

In the seventies, release of hatchery parr was very popular to enhance salmon production. It was almost a religion that rivers had to be stocked. Parr assessment by electrofishing was used to evaluate the releases, the survival of the hatchery fish. Also, growth and survival is a function of density, fewer fish grow better, there is more available food for the individual fish.

Thanks to the knowledge gained by electrofishing, all release of hatchery parr was abandoned during the seventies, except on stretches that were impassable for salmon, i.e. where no natural spawning took place. The electro- surveys have shown that **there is always surplus of parr in all rivers at all times**. No sign of shortage due to poor spawning, rather the contrary; many rivers were overpopulated with parr, leading to poor growth, poor survival and as a result, reduced smolt production.

Parr survival and growth is highly density dependant, reduction in numbers is quickly compensated for by increased survival and growth. In an experiment to reduce the spawning stock in a relatively small stream, shallow 8-10 m wide, it was not possible, all known fishing method taken into use, to reduce the spawners to a level that a reduction of parr number became significant.

Main results over 35 years is: **Shortage of spawners is never a limiting factor in smolt production.**

Examples

Long time monitoring

Table 1 shows the **result of parr survey** for 10 consecutive years in an Icelandic river. The stability is remarkable, very small differences are observed in parr density, mean lengths and numbers at age during the period.

Area	Mean length,cm, at age. (no.fish)				Density	Year	Date
(m^2)	0+	1+	2+	3+	No/100 m^2		
70	3.7 (7)	6.1 (5)	7.8 (4)	9.7 (4)	29	1994	12/9
50	3.4 (6)	6.3 (7)	8.5 (2)	10.2 (2)	38	1995	10/9
50	3.3 (12)	5.9 (6)	7.4 (5)	9.6 (3)	52	1996	23/7
50	3.4 (15)	5.5 (11)	7.9 (6)	9.4 (1)	66	1997	16/8
50	3.8 (5)	6.0 (3)	8.2 (10)	10.4 (2)	46	1998	22/8
30	3.6 (1)	6.5 (8)	9.0 (4)	12.3 (2)	45	1999	16/9
60	4.0 (9)	6.8 (5)	8.7 (6)	-	33	2000	25/8
40	4.0 (17)	6.8 (19)	10.0 (8)	-	110	2001	1/9
80	-	6.0 (16)	8.2 (12)	9.8 (4)	38	2002	1/8
40	3.8 (19)	6.4 (7)	9.1 (20)	10.5 (3)	123	2003	11/8

Table 1. Mean length at age, and number of salmon parr caught in the upper part of Haffjardara Iceland, 1994-2003. Number of fish in brackets. Numbers are high in years 2001 and 2003 in very low water resulting in high concentration of parr.

Parr survey

A result of parr survey in an Icelandic river is shown in fig. 6, In this river, some 900 salmon are caught by rod each year. Four year-classes are distinguished. This represents a normal situation, sign of a healthy population, smolts leave the river at 12-14 cm length.

The assessment is performed each year, the river is electro- fished annually at 6-10 sites. The operation takes 2 days with 2 people.

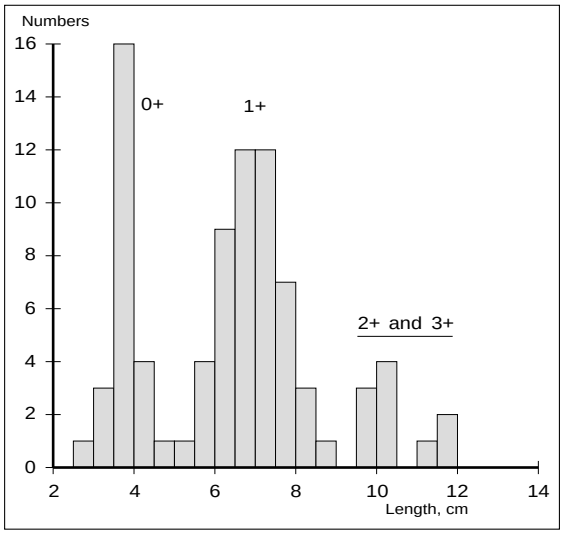
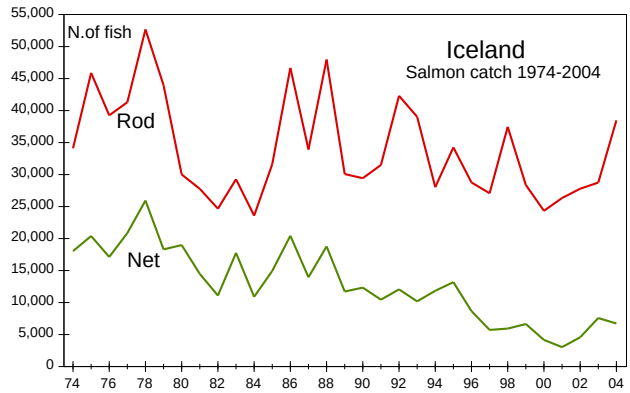


Fig 6. Length distribution of parr caught by electrofishing in the lower part of Haffjardara in August 1999. Fish of age 0+ were hatched in the spring of 1999. Age 2+ and 3+ fish are the smolt candidates for the year 2000 smolt run. Number of two and three year old parr is lower than in 1998 but one year old parr are numerous and the growth is good.

Result of decreased fishing effort

There is no fishery allowed in the sea around Iceland - by law from 1970. Netting in rivers was intensive but is greatly reduced. This is because of buy- outs of net fishing rights.



This summer, 2007 net fishery was bought out in one of the glacial rives system, where the largest fishery took place.

The salmon catch 1974-2004 is shown in fig. 7. Despite the reduction in the net fishery, there is a downwards trend in the rod fishery.

Fig. 7. Salmon catch in Iceland 1974-2004, separated into net fishing and rod fishing.

Density effects, a theoretical example

Growth and survival of salmon parr are highly density dependant. Salmon parr grow faster at low densities and survival is better. This is shown below in a theoretical example.

In the example in fig. 8 the spawning stock is large, resulting in 80 fry, 3.5 cm long the first autumn. Smolt age is 4 years, common in Icelandic rivers. The biomass is high. Behind each produced smolt are 80 parr which may have resulted from 200 eggs.

In the example shown in fig. 9 the spawning stock is low, fewer eggs result in faster growth, smolt age is 2 years. Biomass is low. This growth rate is sometimes seen in Icelandic rivers.
Behind each produced smolt are 5 parr which may have resulted from 10-20 eggs. The difference in spawning stock is in this case 10-20 fold.

The examples are to illustrate how difficult it may be to decide or calculate the CV values, and how uncertain or wrong they may be.

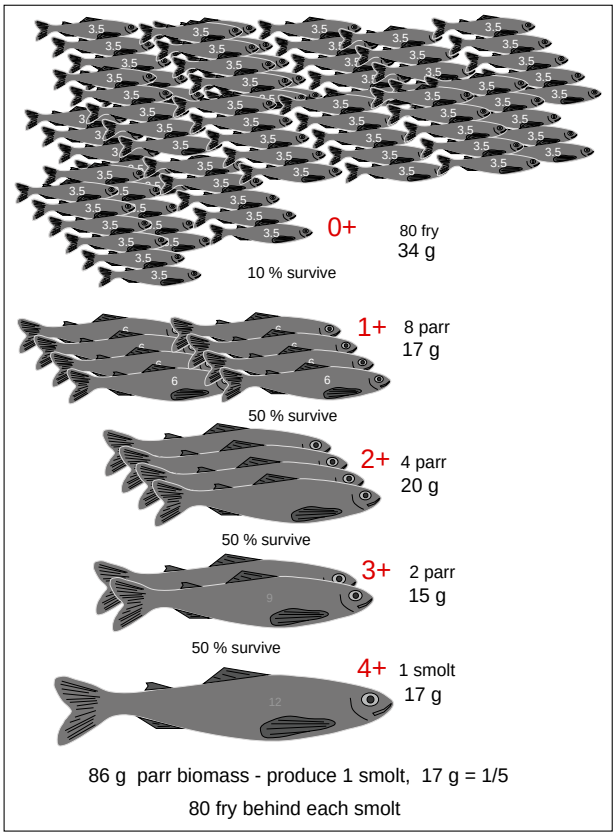


Fig. 8. Calculated example from ample or excessive spawning. High density of slow growing fry and parr. High biomass and low production.

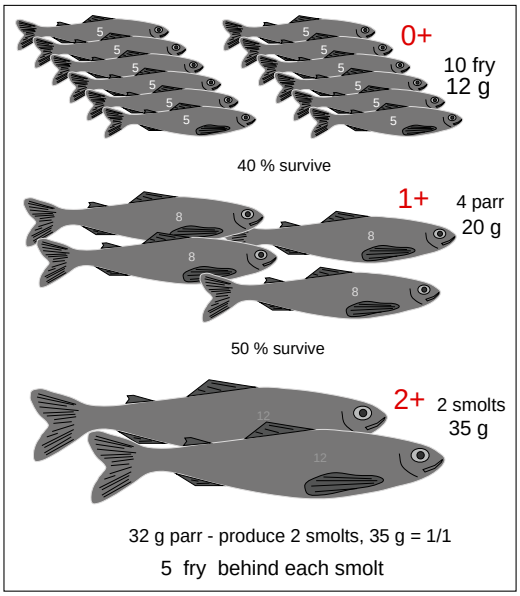


Fig. 9. Calculated example from poor spawning. Low density of fast growing fry and parr. Low biomass and high production.

References:
Report of the Standing Scientific Committee of the National Salmon Commission.
The Status of Irish Salmon Stocks in 2005 and Precautionary Catch Advice for 2006.

ICES ADVICE 2006, Book 10, North Atlantic Salmon Stocks (www.ices.dk)