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Team Session on Unaccounted Mortality in Fisheries (V)

Potential sources of unaccounted mortality in the fishery for Norwegian spring spawning herring.

By

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ABSTRACT

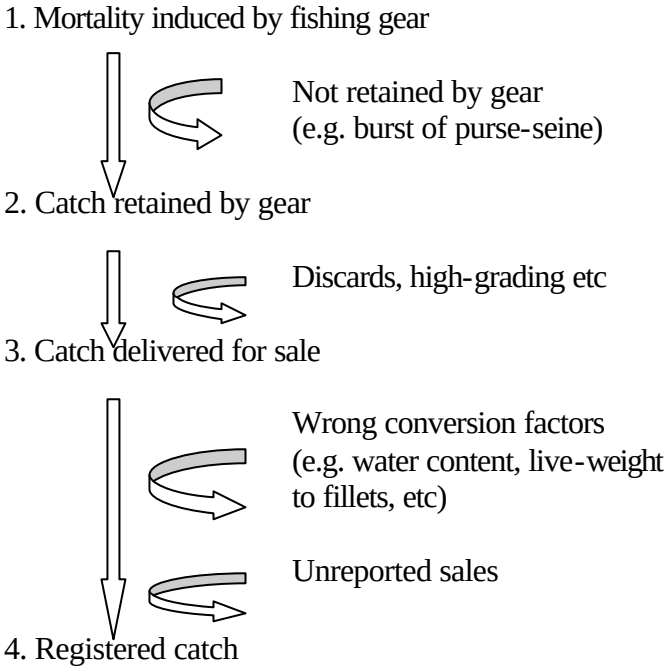
The stock of Norwegian spring spawning herring (NSSH) is managed and fished by 5 different parties. These are the EU, Faroe Islands, Iceland, Norway and Russia. The most common gears are purse seine and pelagic trawl. The fishery is regulated by quota, and to prevent the fishery exceeding the quota, landings are recorded. Taking account of how the fishery is conducted, potential sources of unaccounted mortality may be identified. In this paper we will focus on the possibility of unaccounted mortality caused by errors in the landing figures, error concerning the water content in herring deliveries and errors concerning conversion factors between fillets and live weight of herring.

INTRODUCTION AND IDENTIFICATION OF THE PROBLEM

The fishery statistics are, in combination with the assessed stock, the main source when estimating fishing mortality. Fishery statistics reflect the registered catch, but this catch does not always correspond to the mortality induced by the fishing gear.

First, the fishing gear may induce mortality on fish when in contact with the fish, even though the fish are not retained by the fishing gear. In a purse-seine fishery this may happen when the gear burst during the catch operation. Second, fish may be retained by the gear, but not utilised by the fishermen through various processes of high-grading. Third, as the fish may be processed before its weight has been registered, various conversion factors must be utilised to calculate the live weight of the catch. To the extent that these factors do not reflect the real conversion factors, the live weight may be biased. Fourth, there may be a straightforward underreporting of the catch. Figure 1 illustrates these potential sources of unaccounted mortality:

Figure 1. Sources of unaccounted mortality



To get the best estimate of the true mortality imposed by the various gears, quantitative knowledge of the various sources of unaccounted mortality are required. Especially the two first sources may be of vital importance, but reliable estimates of their magnitude have proven difficult to obtain. At present the ICES Northern Pelagic and Blue Whiting Fisheries working group (WGNPBW) that assesses the NSSH stock does not make adjustments to the official landing figures in order to compensate for additional mortality (ICES 2002). In this paper we will focus upon certain elements in the last two sources, i.e. unreported sales and conversion factors (water content of catches and relation between live weight and fillets). Specifically, we will address the following three questions

1. Do the fishermen agree with the industry on how large the catch is?
2. Factors used to adjust the gross weight to the net weight of products
3. Factors used to convert fillets and live weight of herring

Traditionally, the landings of NSSH have been utilised both for human consumption and for industrial purposes (reduction to fish meal and oil). However, since the latter part of the 1990s, the herring has almost entirely been utilised for human consumption. The three questions we pose are therefore of relevance for landings to human consumption.

DO THE FISHERMEN AGREE WITH THE INDUSTRY IN HOW MUCH FISH IS LANDED?

The live weight of the landing as seen by the skipper on board a purse seiner

In the fishing operation the herring is located by electronic search instrument such sonar and echo sounder. The experienced skipper can to a certain degree assess the amount in the herring school or layer, thus a preliminary quantification of the catch can be done. After the purse seine or operation is done, the gear is pulled to the side of the vessel and a new quantification can be made.

The catch is now pumped on board and into RSW (Refrigerated Sea Water) tanks that are standard on board modern purse seiners. Now the skipper makes a new assessment of the catch, usually in the following way:

- After a while the catch sinks to the bottom and the live weight of the catch can be found by dipping the tanks (often by use of a gauge).

- The RSW tank can be filled completely by water before the catch is taken in. The catch then corresponds to the excess water (which can be pumped to another tank and measured)

- By use of a pump system with laser which measures the amount of fish that is pumped from the catch (This system is still in an experiment stage).

Masters of fishing vessels record catches (by species) in the logbook. Although the methods given above give a fairly accurate indication of the catch, some flexibility is indispensable for estimating the quantity that is recorded in the logbook. The catch kept on board has to correspond to the cumulative quantities recoded in the logbook, and should also correspond to catch reported for sale through the sales organisation. The catch is then sold in an auction system.

The live weight of the herring on the purse seiner as seen from the buyer of the herring catch

In Norway the landing facilities that buy herring are in most cases physically situated in close proximity to a quay. When the fish is discharged, the vessels own vacuum pump is used to pump the catch from the vessel and into a landing container. The volume of the landing container varies according to the production plant in question, but will normally be between 15-30 m^3. The transport of the fish from this container is done by a perforated conveyor belt into the production facility of the factory. Most of the excess water will be drained away while the fish is transported on the conveyor belt.

The fish passes by the belt-weight immediately after the fish is taken into the plant. After having passed the belt-weight, the fish is brought to the grading machine, where the fish is sorted according to size (weight). It is required that the belt-weights must be type-approved and tuned (correctly) by the Norwegian Metrology and Accreditation Service at the plant where they are used before they may be used for the purpose of selling and buying. In

practice, this should ensure that any amount of fish that passes over the belt-weight would be registered with the correct measurement of quantity on the counter of the belt-weight.

The agreement on the weight of the delivered catch – the sales note

Upon completion of the discharge, the buyer receiving the landing is immediately obliged to fill in a "sales note". Both the buyer and seller (the fisherman) are obliged to sign the document, and thereby attesting that the information contained in the sales note is correct. The sales note is thus a contract between buyer and seller and contains, *inter alia*, information on date, name buyer/seller, the vessel name, registration number, catch area, species, price and, of importance in our context, the quantity. The quantity put on the sales note is the accumulative weight recorded on the belt-weight minus 4% for water content (se paragraph below). The weight noted on the sales note is the basis for the official catch figures.

Does the catch estimated by the skipper correspond to the catch recorded as an agreement between skipper and buyer? There has been some discussion on this. In the newspaper "Fiskaren" 12.11.1999 there is an interview with a skipper (anonymous) of a smaller coastal purse seiner. He says: "The hold of my fishing vessel takes almost exactly 100 tonnes of herring. However, when I deliver at plant A I get 91-92 tonnes on the sales note, when I deliver at other plants I get 80-83 tonnes. And when I deliver the herring catch to foreign vessels klondyking in Vestfjorden I get 70-74 tonnes. There is no doubt that large amount of herring goes into the market without being registered". The reason why the fishermen accept the reduced quantity in the sales note is said to be fear of being blacklisted by the buyers.

We have investigated this matter by comparing the amounts reported by the skippers to the auction with the amounts on the corresponding sales notes (all data from the sales organisation). The result is shown in Fig 2. The figure indicates a very good correspondence between the weights given by the skippers and what has been put on the sales note. Thus the experience of the skipper cited in "Fiskaren" cannot representative. It can be seen from the figure that there are just as many getting more compared with those getting less than estimated catch onboard.

If "large amount of herring goes into the market without being registered" there has to be a cooperation between the fisherman and buyer in cheating on the catch. The fisherman has to systematically underreport the amount of the catch, and the buyer has to systematically bypass a part of the catch or manipulate the belt-weights. However, we have no data suggesting this to be of a magnitude that calls for an adjustment of the aggregated catch figures.

FACTORS USED TO COMPENSATE FOR WATER IN THE CATCHES

An important element here is deduction of water. In principle the live weight should be the weight read by the calibrated belt-weights. However, in connection with the use of these belt-weights, a certain amount of water will pass over the weight. This water will be measured and be part of the total weight of each landing.

In Norway the buyer can deduct 4% of the weight recorded on the belt-weights as water content. Danish buyers of Norwegian spring spawning herring can deduct 13%. However, tests of the water content in the weighting of pelagic landings in Denmark and Norway indicate that these percentages are too high (Table 1). In both Norway and Denmark there

seems to be a continuation of earlier practice awaiting the conclusions on ongoing negotiations on standardization.
The consequences of an erroneous factor for water content can be illustrated in the text table below when checking the landing figures for Norway and Denmark:

NSSH landed in Denmark and Norway in 2001. Catch and corresponding water content.[1]

Country	Registered catch	Water content according to official figures	Water content According to experiments	Difference between A and B
Denmark	33.000	4.300 (13%)	700 (2%)	3.600
Norway	555.000	22.200 (4%)	11.100 (2%)	11.100
Total	588.000	26.500	11.800	14.700

The figure shows the quantity of NSSH landed in Denmark and Norway in 2001. According to official factors for water content, the weight of the catch (including water) must have been approximately 26-27.000 tonnes larger. If the correct water content in these catches were 2%, the correct withdrawal of weight caused by water should have been approximately 12.000 tonnes. Hence, the registered catch may be approximately 15.000 tonnes lower than the real catch.

THE LIVE WEIGHT AS SEEN FROM THE FILET PRODUCER

The basis for registration of live weight of herring when fillet production takes place onboard a fishing/factory vessel is a conversion factor. Further, instead of weighting the total catch landed, some filet producers on shore use a conversion factor to estimate the total catch from the amount of produced filets. The conversion factor is set to 50 % regardless of time of year or size composition of the fish. Data collected by the Institute of Marine Research (IMR) and the fishing industry itself suggest that the conversion factor from fillets to total catch should be reduced during the main fishery period from September to March due to the following factors (Slotte 1999).

1) This herring stock does not feed during the period from onset of wintering in September until spawning is finished in March-April (Fig. 3).
2) During this same period the herring is developing gonads based on the energy stored during the summer feeding period (Fig. 4). In herring at 28-30 cm the gonad weight in % of total weight (Gonadosomatic index = GSI) will increase from 5-6 % (both sexes included) in September to 13-14% in March, whereas in herring 36-38 cm the GSI will increase from 9-10 % to 22-23 % during the same period.
3) Due to the non-feeding period and use of energy to swim and produce gonads, the weight of muscular tissues (somatic weight) is reduced throughout the entire period September to March. The weekly weight loss during wintering has been estimated to 3.65 g in 28 cm herring increasing to 7.15 g in 38 cm herring by Slotte (1999). Given the same or higher weight loss until mid March, the total weigh loss relative to start weight in September will be at least 56 % in 28 cm herring and 43 % in 38 cm herring (Fig. 5).

[1] Figures for landings in Denmark are found using the web site of the Danish Directorate of Fisheries. Figures for landings in Norway are taken from the Norwegian Directorate of Fisheries. All preliminary figures.

With regard to conversion from the amount of fillets produced to total weight of a catch, we conclude that the present factor is to high. A factor of 50 % is probably correct at the start of the fishery in the autumn season, but thereafter it is reduced until approximately 35 % at its lowest during spawning in March. It is possible to model the factor based on current information on weight loss and gonad development using information on length group composition in the stock and time (week/month) of year as input variables, but such a model would be difficult to implement in a practical management of the fishery. We suggest that the factor should be the average value in the middle of the main fishing period in autumn/winter. The factor should be set after proper testing at some factories. It is likely that the factor will be close to 40 %.

The importance of the fillet conversion factor when calculating the live weight of products depends on the amount of the landings that are calculated this way. In Norway, only vessels producing fillets onboard are allowed to calculate the catch this way and this represents usually limited quantities of the NSSH catch. However, if this way of calculating the catch is done on a regular basis by other nations or if the method is applied by regular processing plants, error in conversion factors may be important.

According to the Norwegian statistics 6516 tonnes of herring filet were produced from catches of NSSH in 2001. The increase of the live weight of this herring by applying a conversion factor of 40% instead of the official factor of 50% is approximately 3.300 tonnes.

WHAT CATCH FIGURES SHOULD THE ICES WGNPBW USE AS ”TOTAL CATCH AS USED BY THE WORKING GROUP.”?

In this paper we have looked at some elements that are seldom discussed at ICES assessment working group meetings, that is disagreement on size of catch between skipper and buyer, water content of catches and conversion factors. An attempt to quantify the above elements would be as follows:

Element	**Assessment of underreporting**	**Uncertainty factors**
Disagreement	Results do not indicate underreporting	Possible agreement on underreporting between buyer and seller
Water content	14.700 tonnes	
Conversion factor	3.300 tonnes	Conversion factor to high, gives incentive to use conversion factor instead of belt-weights

This assessment of underreporting of live weight gives a total of 18.000 tonnes, which is 3% of the total catch of NSSH landed in Denmark and Norway in 2001 (588.000 tonnes). In the future this underestimation can hopefully to a large degree be avoided. The accuracy of the total landings can be improved by administratively reducing the percentage allowance for deducting water content of the catches, and to carry out a test program in order to assess the filet conversion factor in a satisfactory manner. If such measures are not carried out, the ICES WGNPBW should add minimum 3% to the official landing figures in order to get a more correct assessment of the fishery induced mortality of the NSSH stock.

It should also be kept in mind that the NSSH fishery is international, and it is not know how the arrangement for the above factors are for the other countries fishing for NSSH (Faroes, Iceland; Russia). In additional traditional factors that are believed to cause additional mortality (misreporting, discarding, high-grading, breaking of gear) are to a certain degree operational also in the NSSH fishery.

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TABLE

Table 1 Results of measurements of water content in herring catches carried out in Denmark and Norway (Modified from Fiskeridriektoratet1997, Ministeriet for Fødevarer, Landbruk og Fiskeri 1999 and Anon 1999).

Test location	Date	Type of herring	Water content (%)
Denmark	070699	NSSH	3.8
“	170699	Matjes	1.0
“	180699	Matjes	2.4
“	230699	North Sea	2.6
“	240699	North Sea	1.6
“	290699	NSSH	3.4
“	290699	NSSH	5.3
“	300699	Matjes	2.3
“	010799	North Sea	1.9
“	020999	North Sea	3.4
Norway	260297	NSSH	2.3
“	270297	NSSH	2.0
“	280297	NSSH	2.4
“	050397	NSSH	2.2
“	050397	NSSH	2.8
“	060397	NSSH	2.1
“	120397	NSSH	2.9
“	130397	NSSH	2.8

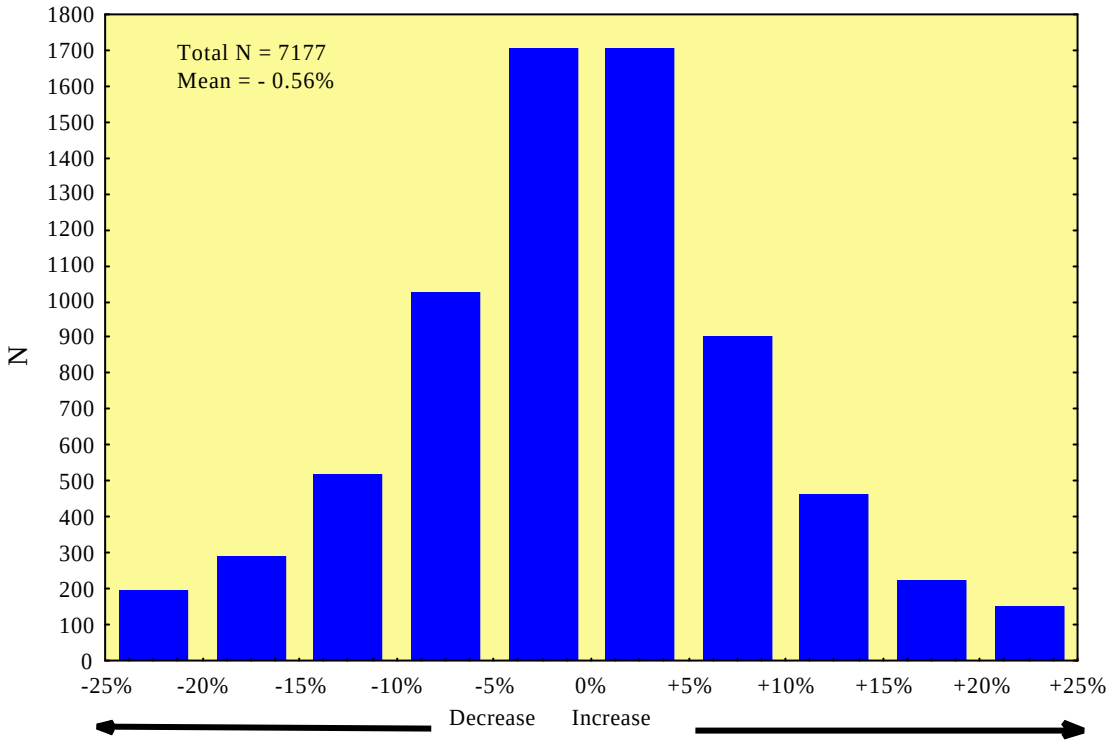

Fig. 2. The decrease or increase in recorded quantum of Norwegian spring spawning herring at the plants relative to that estimated and reported by the vessel at sea, all catches during 1998-99 are included.

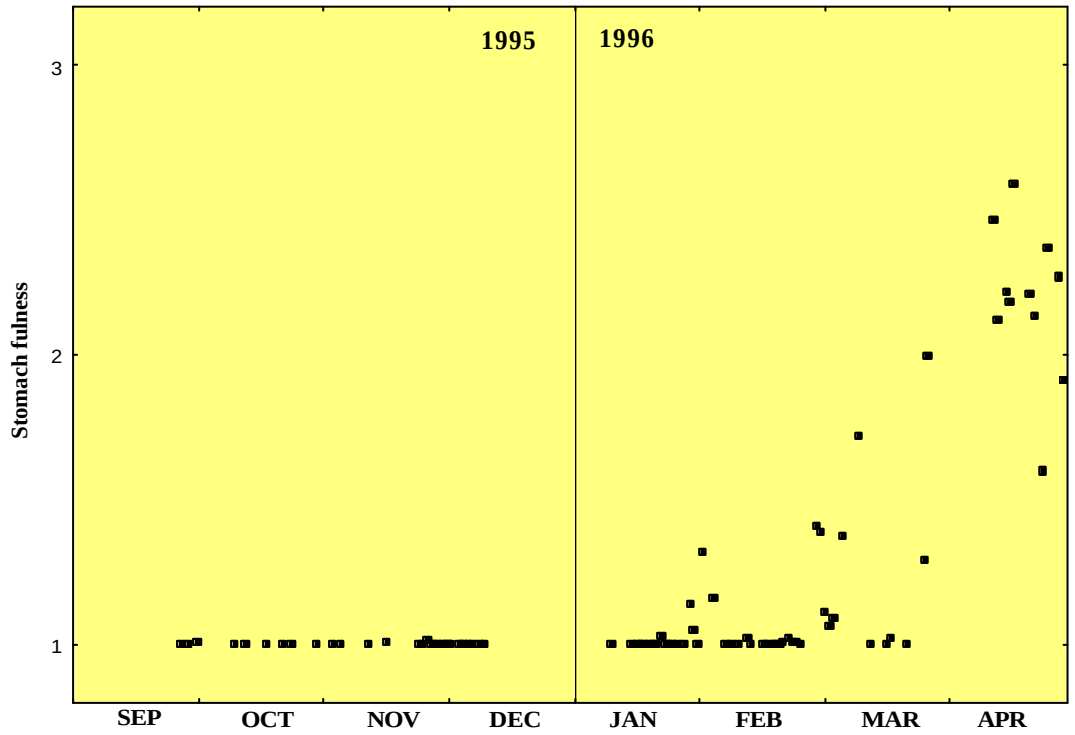

Fig. 3. The mean stomach fullness from September to April 1995-96 on a subjective scale (1 = empty, 2 = some content, often seen when opening the stomach, 3 = content clearly visible without opening stomach, but stomach is not full, 4 = stomach is full, but not stretched and 5 = stomach is full and stretched.

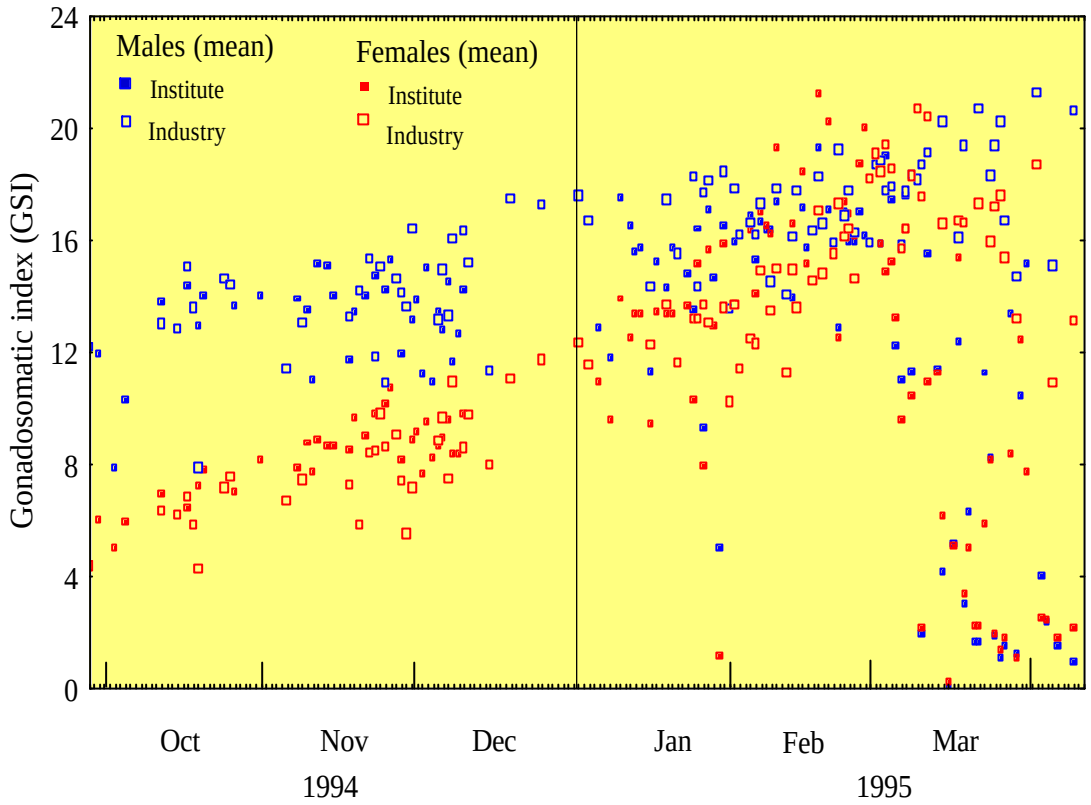

Fig. 4. The gonadosomatic index (gonad weight in % of total weight) for males and females during October to April 1994-1995 based on data from sampling by IMR and the industry (Slotte 1999).

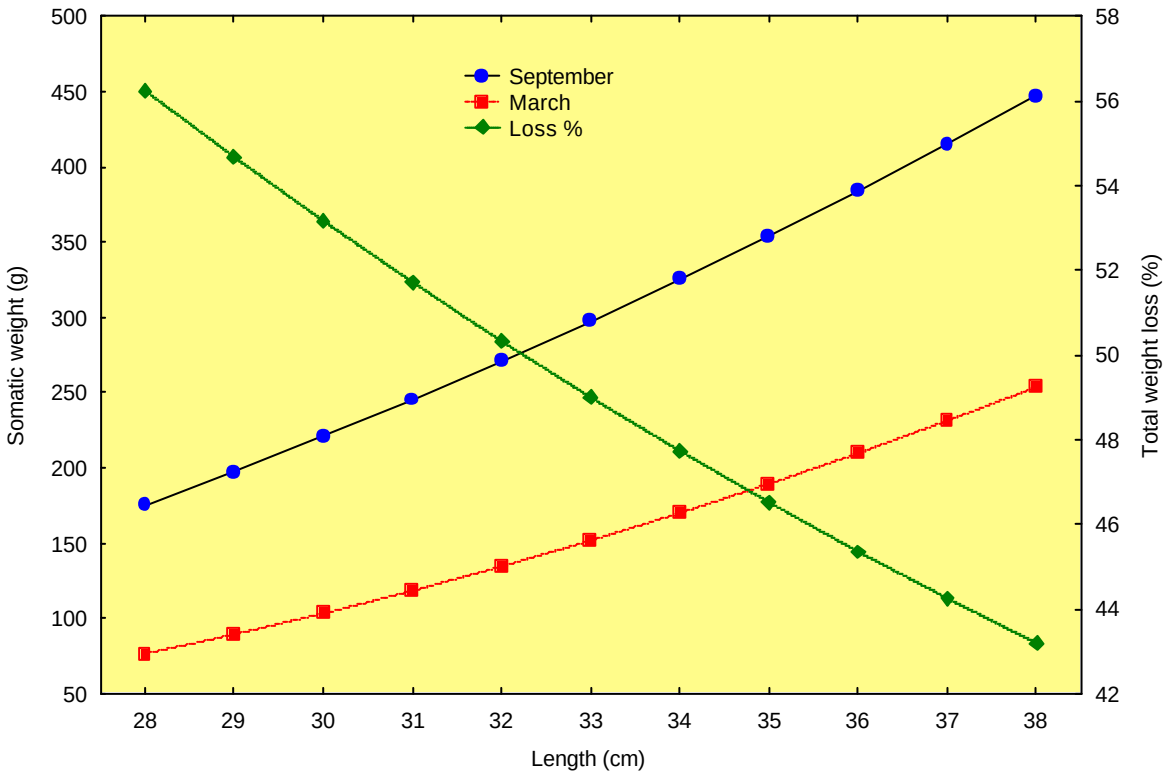

Fig. 5. The somatic weight by length in mid September and mid March, and the total somatic weight loss in % during September to March. Data from the 1995-96 season, males and females grouped (Based on data from Slotte 1999).