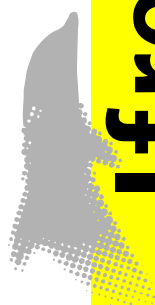


Working Document n°1 contributing to the Workshop on Fishers Sampling of Catches (WKSC), ICES Headquarters, Copenhagen, 10-13 June 2008

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Self-sampling of cod in the Celtic Sea by French trawlers

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Introduction

Since 2003, the application of restrictive TAC for cod in area VIIb-k has led some French Professional Organisations to manage their restrictive quota by limitations of landings by trip or period or by prohibiting the landings of the smallest commercial category. In consequence of that, the level of discarding has increased by high grading practice. In the lack of available and reliable data to estimate the level of discarding and the amount of discarded fish, the assessment of Celtic Sea Cod in Divisions VIIe-k has been in recent years more and more uncertain, especially in estimating younger year classes, for a fishery which can be qualified as a recruitment fishery.

On a Professional Organisation (PMA= Pêcheries Manche-Atlantique) initiative and in the aim to improve the quality of the French database of Celtic Sea cod, a self sampling protocol proposed by Ifremer has been applied by PMA to some bottom trawlers trips. The sampling operations have started in January 2008. The sampling protocol is described in Annex.

This document presents a preliminary analysis of the available samples, aiming at analysing the variability in caught and discarded quantities and in sorting. Results of the validation of the self sampling of retained catch by sampling at landing are also proposed.

Material and methods

The specifications of vessels and gears involved in this study at the time of the WKSC are summarized in Table 1. The trawlers belong to owners which are volunteers to carry out this extra work onboard. Three of them are classified in the metier 'gadoid trawlers' which usually target mainly haddock, whiting, cod and other species of gadoid fish in Celtic Sea. The fourth trawler is classified in the metier 'benthic trawler' as it has targeted benthic species as monkfish, megrim, rays and also john dory in areas of Celtic Sea where cod is less abundant and therefore considered as a by-catch. The duration of the trips can vary between 7 and 14 days at sea.

Because this program was launched few time ago, there is only 4 trawlers involved though the owners and then the crews have been encouraged by their Professional Organisations to carry out this sampling program by an additional individual quota of cod allowed to land by vessel.

	Length overall	Gear	Mesh size of codend	Area covered	quarter	Metier	N of trips sampled
Trawler 1	17.5m	OTT	100 mm	VIIg	1&2	Gadoid	6
Trawler 2	33.8m	OTB	100 mm	VII fgh	1&2	Gadoid	3
Trawler 3	22.55m	OTB	100 mm	VIIg	1&2	Gadoid	2
Trawler 4	23.4m	OTB	105 mm	VIIIh	1	Benthic	3

Table 1. Specifications of vessels, gears and trips sampled

According to the sampling protocol, around every second haul has been sampled except when the fishing gear was damaged or occasional problems occurred. The sampling level for the trawler 4 which did not target cod was different as it has mainly fished on grounds where cod are absent. In fact during the trips of this trawler, every hauls where cod has occurred were sampled

A total of 296 hauls has been sampled from 639 hauls carried out during 14 trips. 220 hauls have been sampled from 460 hauls carried out by gadoid trawlers giving a sampling rate of around 48%. 76 hauls have been

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sampled from 179 hauls carried out by the benthic trawler, giving a sampling rate of around 42% and in this case this means that cod was caught in 42% of the hauls carried out.

On hauls sampled, both discarded and retained cod were weighed and individually measured. Overall 7374 fish have been measured. Table 2 shows the summary of operations in trips sampled.

Trawler	Trip number	Month	Total number of hauls	Number of hauls sampled	Days fishing
1	1	Jan	44	22	9
1	2	Feb	47	24	11
1	3	Mar	24	12	5
1	4	Mar	42	21	10
1	5	Apr	47	21	11
1	14	Apr	37	18	6
2	6	Mar	29	14	6
2	7	Mar	40	19	8
2	8	Apr	64	32	11
3	9	Mar	48	20	10*
3	10	Mar	38	17	7
4	11	Mar	58	27	12
4	12	Mar	58	24	12
4	13	Apr	63	25	12

Table 2. Summary of operations in trips sampled.*and 2 days at Kinsale because a storm

Description of recorded data

Figure 1 shows the total length compositions per trip for hauls sampled by the gadoid trawler 1. The MLS is 35 cm and clearly the level of 'usual' discarding is small. There is a high level of high grading as it is shown by the discarding of fish between 35 and 50-55 cm to manage the quota when the trips 1 to 5 were operated in an area where small cod were rather abundant during the first quarter. A change of fishing area at trip 14 in April has led to reduce strongly the level of discarding.

Figure 2 shows the total length compositions per trip and hauls sampled by the gadoid trawlers 2 and 3. The high grading is also at a high level to manage the quota.

Figure 3 shows the total length compositions per trip and hauls sampled by the benthic trawler 4. Fishing in the South of VIIIh in that period, this trawler had few chance to catch a large amount cod in this area and the discarding level is very small.

Clearly the effective MLS used during both these trips is well above the official MLS (35 cm) as a consequence of the prohibition of landing the smaller commercial category of cod. In Figure 6, the graph of the proportion discarded versus the size of largest discard shows that the discarding around or below MLS has occurred only on 2 hauls (one of trip 8 and one of trip 14) sampled. Though the modal length of discarding is ~50 cm, it can spread up to more than 60 cm. At each haul sampled, the sorting is very determined. That's mean under a given length all fish are discarded. On the other hand, the sorting can vary between hauls within a trip (trips 6&8 for instance).

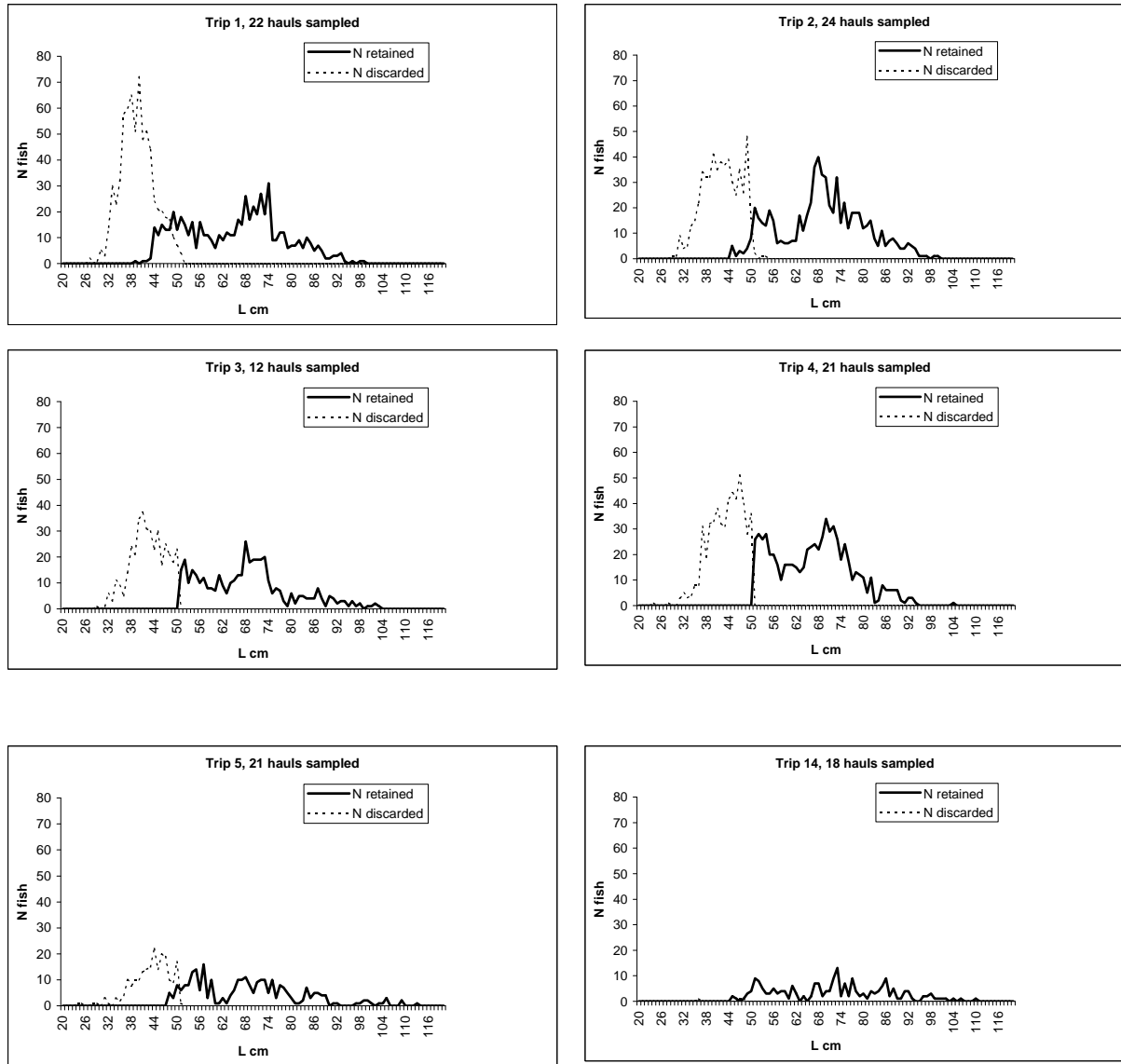
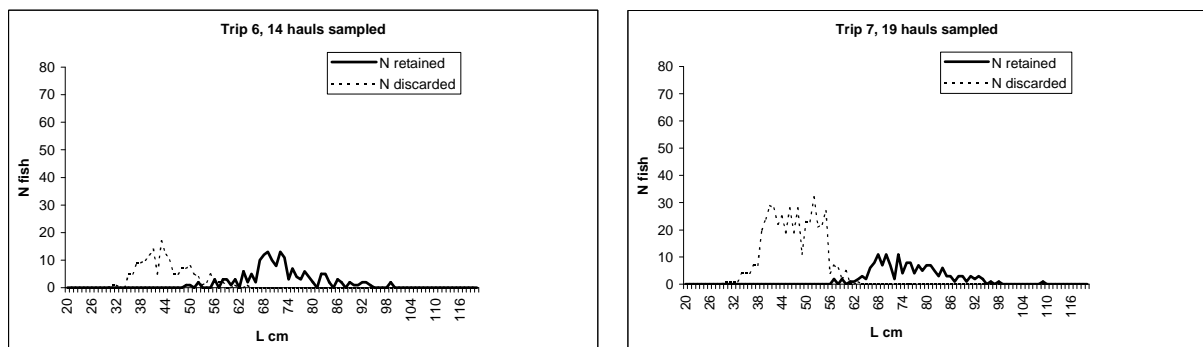


Figure 1. Length composition of unraised sampled catch of cod by Gadoid trawler 1.



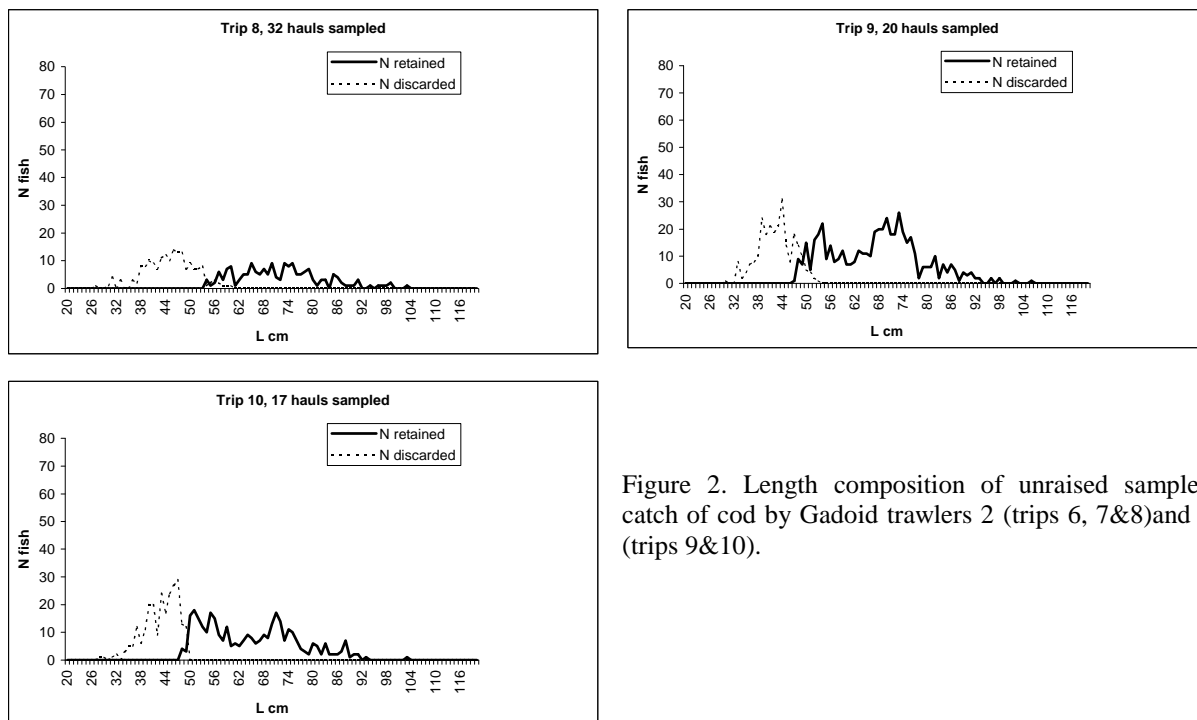


Figure 2. Length composition of unraised sampled catch of cod by Gadoid trawlers 2 (trips 6, 7&8) and 3 (trips 9&10).

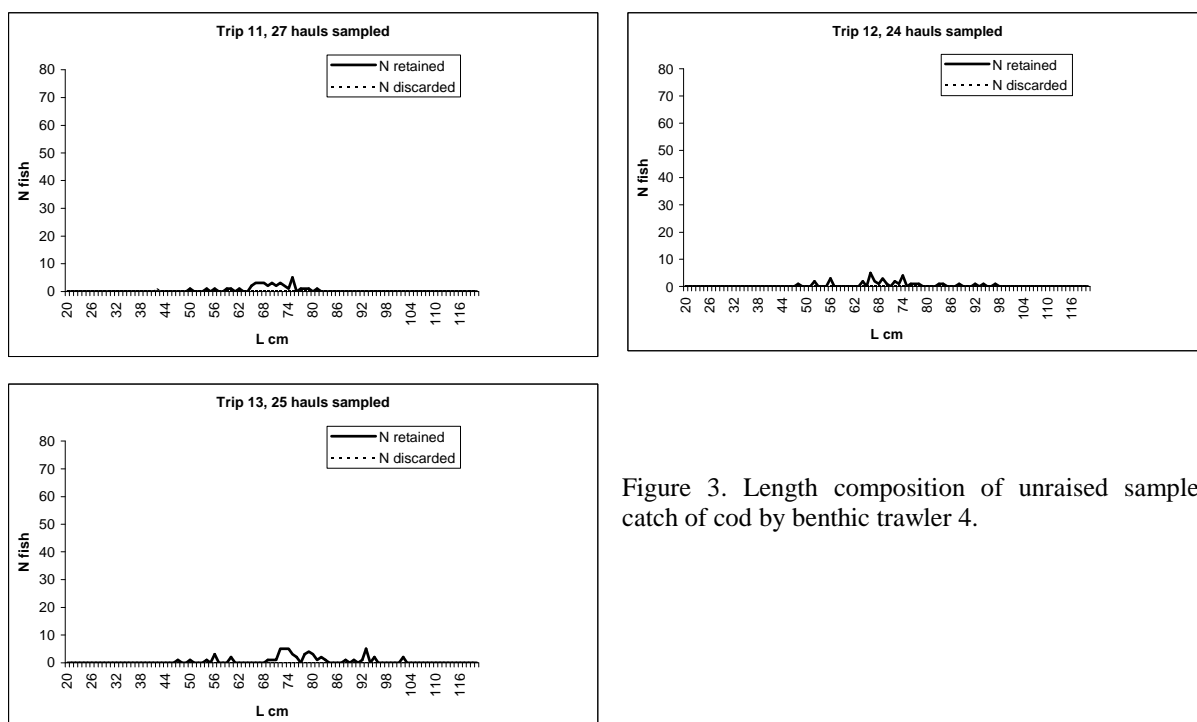


Figure 3. Length composition of unraised sampled catch of cod by benthic trawler 4.

The validation of the self sampling of the retained catch has been carried out by sampling at landing. The landings from trips 1 and 14 have been sampled at fish market by using the standard sampling plan dedicated to estimate the length compositions of the landings of Celtic Sea cod from a trip and shown in the text table below.

Commercial category	Cat 1 very large	Cat 2 large	Cat 3 medium	Cat 4 small	Cat 5 very small
Gutted weight	+7 kg	4 to 7 kg	2 to 4 kg	1 to 2 kg	0.3 to 1 kg

range					
Fish measurements	4 box	3 box	2 box	1 box	1 box
Weight sampled	~180 kg	~120 kg	~80 kg	~40 kg	~40 kg
Weight landed	To record	To record	To record	To record	To record

Obviously, the sampling rate at fish market is small compared to the one obtained in self sampling. Onboard, almost 50% of the fish retained have been measured. At fish market, the proportion of fish measured in landings can vary between 10 and 20% by trip sampled depending on the amount of landings. When landings are more abundant the proportion of fish measured decreases.

Both self sampling data and fish market sampling data have been raised to account for the total landings of the trip 1 and the trip 14.

Because the sorting was knife-edged in almost all hauls, it was not possible to fit standard sorting ogives to these data (Figure 4). Therefore sorting size was estimated as the size of the largest discarded fish.

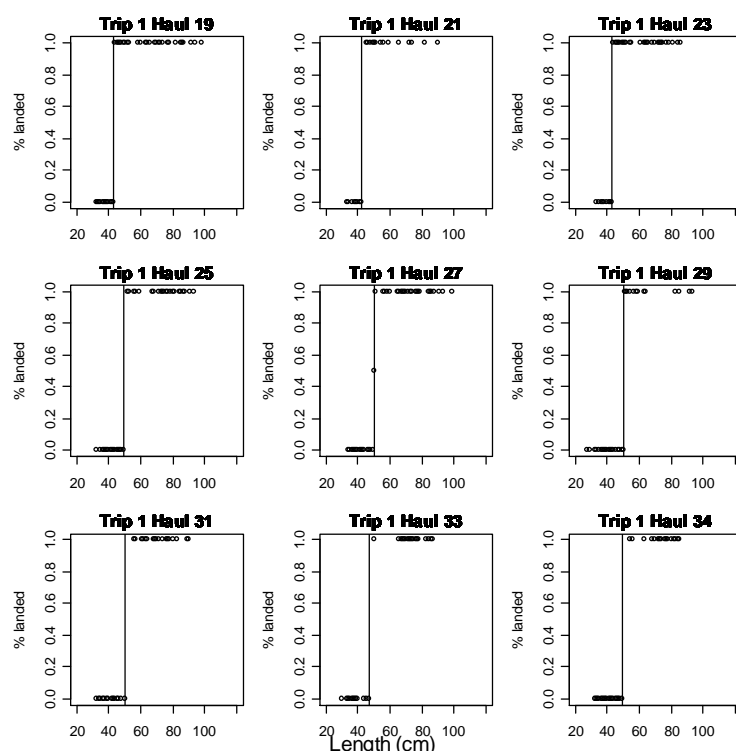


Figure 4: example of sorting “ogives” for a sample of hauls in trip 1. Dots: % landed fish; line: length of the largest discarded fish.

Variance within and among trips was estimated for the following quantities: number and weight caught, landed and discarded, proportion discarded in weight and number, and size of largest discard. Analyses of the variance of the number discarded was performed with trip nested in various factors (vessel, port, fishing area, fishing gear, and metier) to identify the main factors of variability in the amount discarded.

Results

The largest variation was among trips rather than among hauls within trips (Figure 5). The variable with the largest variation among hauls was the size of largest discard (14%).

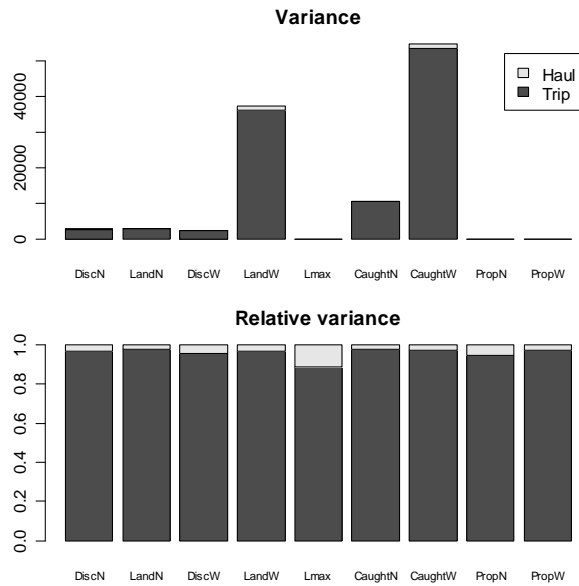


Figure 5: Variance in number landed and discarded, weight landed and discarded, size of largest discard, number and weight caught, proportion discarded in weight and number, within and among trips.

The amounts discarded was positively linked with amount landed (Figure 6). Half of the catch in number was discarded, a much lower proportion in weight. The correlation of discards with landings was higher than half the ratio of their CVs, suggesting that a ratio estimator could be used to estimate discards at the fleet level, with landings as auxiliary variable (Cochran, 1977). This was especially true at the trip level (Table 3).

Analyses of variance revealed that all factors considered (vessel, port, fishing area, fishing gear, and metier) had a significant contribution to variance (results not shown because imbalanced design and small sample; this is an exploratory analysis).

Table 3: Correlation between amount discarded and amount landed at the trip and haul levels, in number and weight, and the ratio of the CVs of these amounts. When the correlation is higher than half the CV ratio, a ratio-estimator can be used.

Level	Quantity	Correlation	Half CV ratio
Haul	number	0.67	0.64
Haul	weight	0.58	0.65
Trip	number	0.84	0.59
Trip	weight	0.79	0.59

Proportion discarded increased with sorting size, indicating that the latter might be adjusted to the catch size.

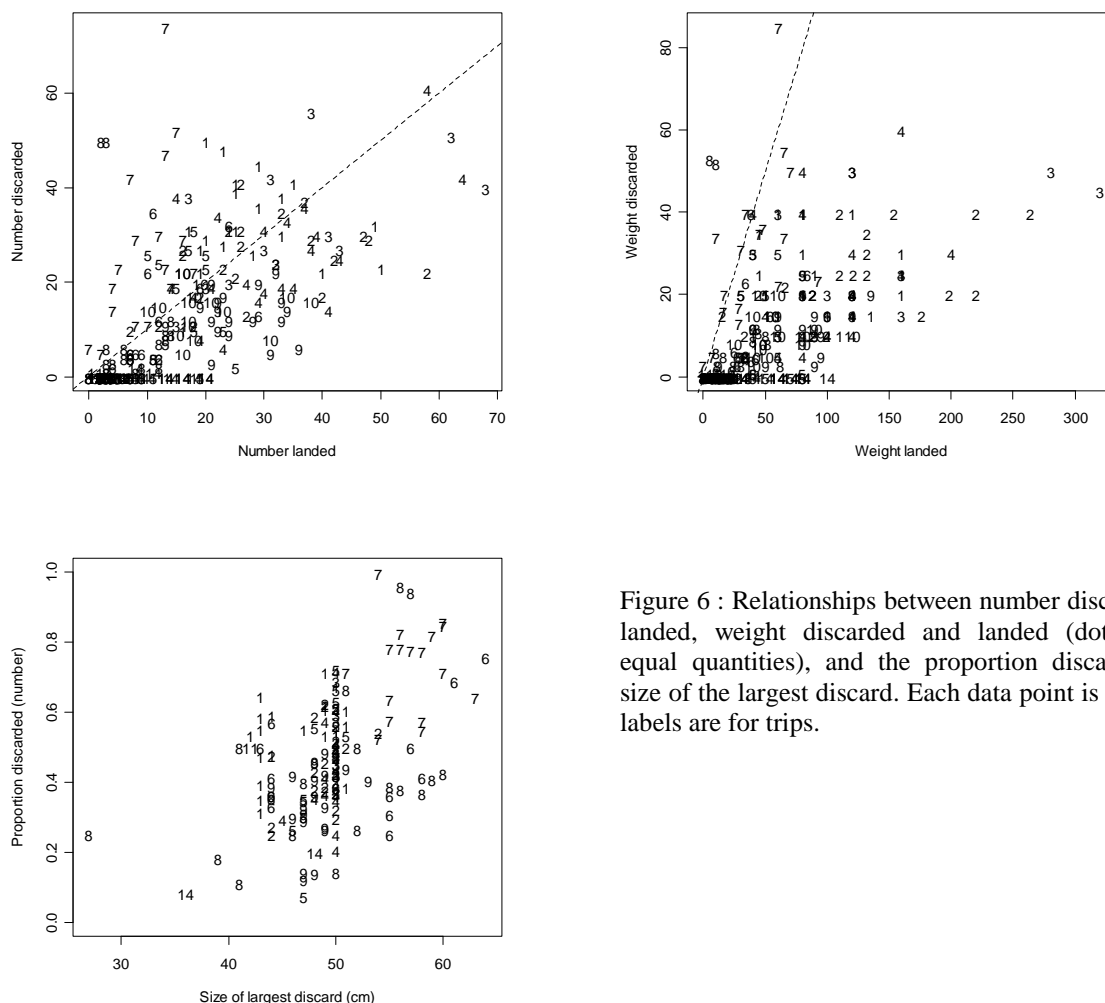


Figure 6 : Relationships between number discarded and landed, weight discarded and landed (dotted lines: equal quantities), and the proportion discarded with size of the largest discard. Each data point is for a haul, labels are for trips.

The comparisons between the length compositions of landings by self sampling of retained catch and by sampling of landings at fish market are shown in figure 7.

For trip 1 which was the first experimentation of self sampling, smaller fish (below 63 cm) seem underestimated in landings and abundances at higher length classes do not match with those from the self sampling. When the shift of estimates by length class is small (1-2 cm), we can consider this acceptable assuming that this is the result of measurement errors. The consistency seems better in the results of trip 14 at least for the smaller fish. Over the two trips examined, the shift of cumulated frequencies can reach a maximum of ~10% for some length classes.

Theoretically, sampling at fish market using a stratification by commercial categories needs less fish measured than a random sampling when each commercial category is assumed homogeneous and exclusive of another one. In fact, sorting fish by commercial category is operated manually and the criterion of sorting is the weight of a fish and not its length. For a given length class of a medium or large fish, the weight of a fish is depending on its condition (thin or fat) and in the first quarter which is the spawning season for Celtic Sea cod, some fish after spawning which in length could belong to the commercial category 2 are sorted in commercial category 3. Consequently, the assumption of homogeneity of each commercial category for length used in our stratified sampling plan is not so realistic. Furthermore the raising factor used for each commercial category to raise the corresponding sampling data can be biased when one of several box can change of commercial category during or after the auction due to complaint of buyers. This is why the data from self sampling could appear to be more credible than those obtained at fish market at least during the spawning season.

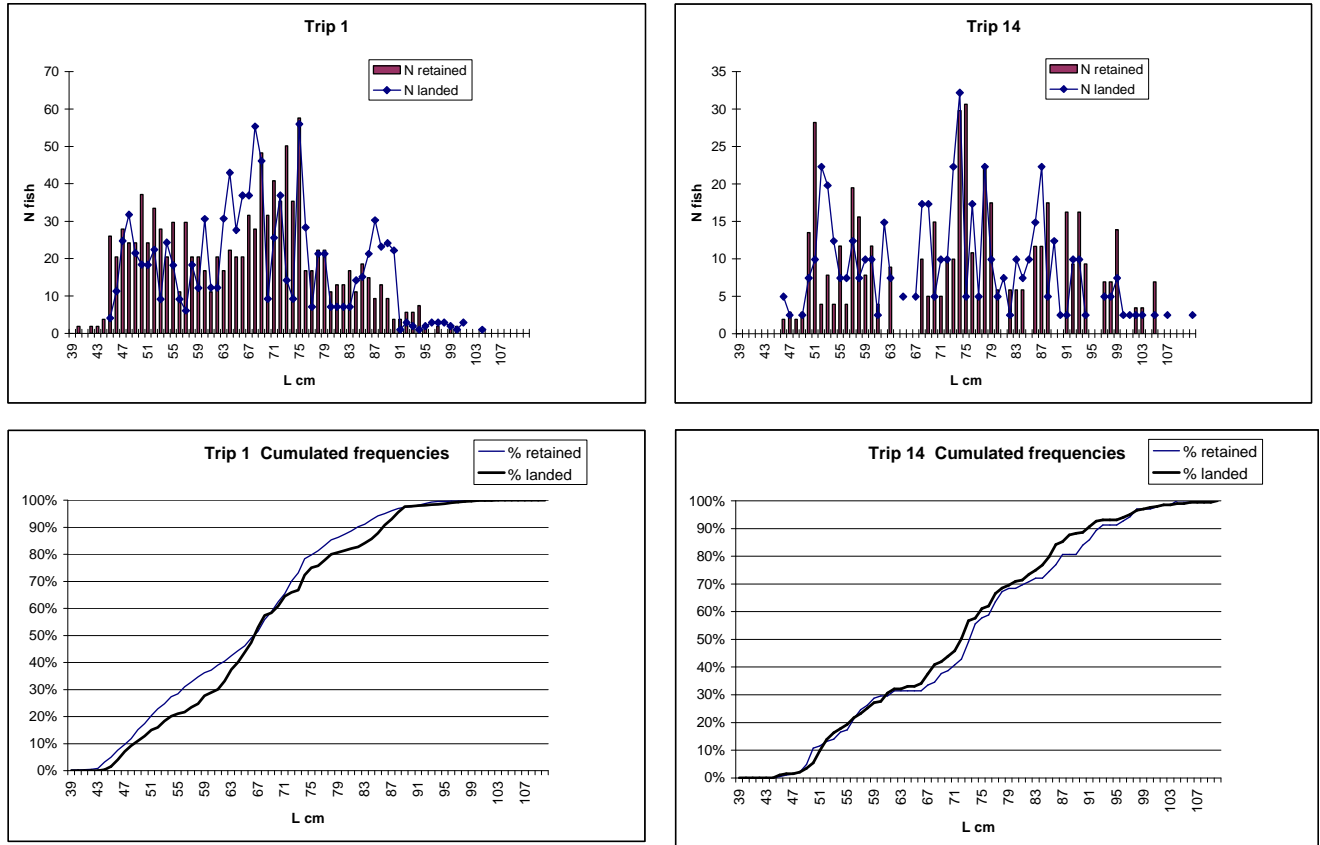


Figure 7. Length compositions and cumulated frequencies of the retained catch and the corresponding landings of 2 selected trips.

Discussion

Discarding under MLS in the trips sampled is small but the high grading is very high as it is used to manage the restrictive quota.

The objective of this collection of data is to estimate the total French catch of Celtic Sea cod in 2008 and also in next years if the self sampling is continuing. Several raising variables should be tested and a ratio estimator using landings as auxiliary variable seems promising; a simple estimator by fishing effort can also be used to estimate the total catch by metier and period displayed by length and age compositions of landings and discards.

In terms of precision and bias of the sampling data, all factors are important and a diversification of the trawlers involved in self sampling is recommended. The sampling rate of hauls within a trip (every second haul) is too high but is considered by the crews easy to use as they are more able to remember if they have sampled the haul just before than the second, third or more haul before.

We can keep in mind that at sea fishers can usually deal with more than 20 commercial species by haul carried out and not only observe the catch of cod. They have told that they can spend half an hour to treat cod of a haul by self sampling.

Validation of discarded samples has not been carried out yet.

Reference

Cochran, W. G. 1977. *Sampling techniques*. Wiley series in probability and mathematical statistics, John Wiley & Sons, New York. 428 pp.

ANNEX

Self Sampling protocol of Celtic Sea Cod for French trawlers in 2008

This document describes the operations of self sampling at sea by the crews to obtain the weights of cod retained and discarded within a trip, the corresponding proportions and length compositions. The sheets used to record the data are in Annex.

I) Frequency of sampling

Feel in the sheet “Marée” for all hauls of a trip, indicating maximum of data:

Date

Serial number of haul

Haul sampled (Yes/No)

Time of shooting and hauling

Day or Night

Mean position of the haul: latitude and longitude

Gear used: feel in a sheet “gear” for each gear used

Species targeted: cod, whiting/haddock, nephrops, monkfish, megrim, rays...

Depth

Nature of ground: sandy, muddy, rocky.

Total weight of cod caught by haul

Remarks: sea, wind, damages...

Measurement of cod from **every second haul** except when it is impossible due to gear damages or occasional problems.

II) Sorting of fish

Sort the catch of the selected haul and **keep all cod**

Separate retained cod and not retained cod (all cod not meant for sale: too small, damaged, thin) and store them in **separated baskets** (when sorting or when gutting)

Count the baskets of both commercial cod and not retained cod

A) write the number of baskets of commercial cod on the sheet ‘échantillonnage morue du trait’ in **Cell A1**

B) write the number of baskets of not retained cod on the sheet ‘échantillonnage morue du trait’ in **Cell B1**

C) write the mean weight of a full basket in cell A3.

Keep only one basket of not retained cod for the measurements.

III) Method of measurement

One person measuring and another one noting and checking

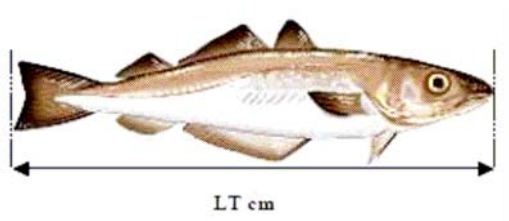
- A) **Measure all commercial cod retained from a haul (all baskets)** and write the data on the sheet 'échantillonnage morue du trait', part 'Morues commerciales débarquées' in cells **A2**
- B) **Measure all cod from 1 basket of not retained cod** and write the data on the sheet 'échantillonnage morue du trait', part 'Morues rejetées non débarquées' in cells **B2**

IV) Measurement technique

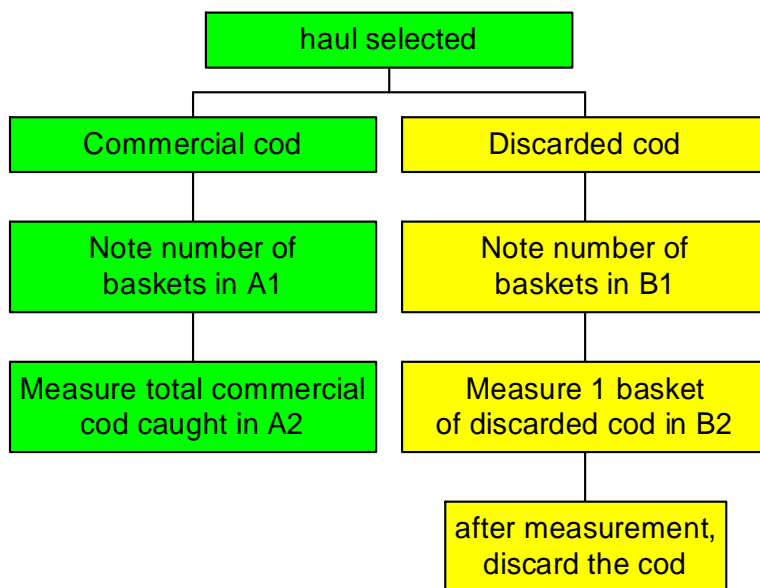
The fish is set on the measuring board, snout against the vertical thrust of the board.

The **total length in cm** is recorded at the tip of the caudal fin.

The length is given at the lower boundary of a 1cm length class. 20.0, 20.1 or 20.9 cm = 20 cm length class



V) Diagram of sampling one haul



1) Gear sheet

Engin N°		<input type="text"/>	
Descriptif Chalut :			
OTB	<input type="text"/>	Type de chalut (GOV/faible OVI/...., simple/jumeaux...Nbr de funes,...) :	
TTB	<input type="text"/>		
TBB	<input type="text"/>		
Espèce cible :		<input type="text"/>	
Nombre de faces :	<input type="text"/>	Maillage	cul
		(mm)	<input type="text"/>
		ailes	<input type="text"/>
Longueur corde de dos (m) :		<input type="text"/>	
Longueur bourrelet (m) :		<input type="text"/>	
Type de bourrelet (diabolo, rockhopper,...) :		<input type="text"/>	
Racasseur :		<input type="text"/>	
Vitesse de traîne (nds) :		<input type="text"/>	
Dispositif sélectif :	Non	<input type="text"/>	si oui, lequel ?
	Oui	<input type="text"/>	
Fourreau :	Non	<input type="text"/>	depuis quand ?
	Oui	<input type="text"/>	
engin : OTB = Chalut fond à panneaux, OTT = Chaluts jumeaux, TBB = chalut à perche;			
si changement engin au cours de la marée remplir autre feuille descriptif chalut			

