CORRECTED CONVERSION FACTORS OF COD AND FLOUNDER BASED ON THE GERMAN MODEL

by

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Introduction

During the WG BIFS in 2002 different estimates of conversion factors were presented and intensively discussed. New model to estimate the conversion factors were presented by Nielsen et al. (2003). The model included a new type of inter-calibration experiments. Gaskukov (2003) use the Δ-distribution to describe distribution pattern of the conversion factors. Oeberst and Grygiel (2003) compared the catchability of the Polish gear type P 20/25 and the German gear type HG 20/25 using the conversion factors that are based on the Germen model (Oeberst et al. 2001) and hauls which were carried out by Poland and Germany in Subdivision 25 during the different Baltic international trawl surveys (BITS).
Unfortunately, the results of the different studies were presented in different formats. This fact made it difficult to compare them. Nielsen et al. (2003) estimated the conversion factors
CPUE(national gear) = conversion factor * CPUE(TV3#930) for 5 cm length intervals.
Gasjukov (2003) estimated
CPUE(TV3#930) = conversion factors * CPUE(national gear)
for 5 cm length intervals and Oeberst et al. (2001) estimated the same conversion factors for 2 cm length intervals. Furthermore, the studies of Gasjukov suggest that small errors are possible in the realization of the German model (ICES 2001, Oeberst et al. 2001).
To get a more clear picture the conversion factors based on the German model were estimated for 5 cm length intervals. Furthermore, additional studies were carried out to improve the interpretation of the estimates.

Material

The realization of the German model (Oeberst et al. 2001) were checked and conversion factors were estimated for 5 cm length intervals for cod and flounder since estimates of both the species are required for the stock assessment. The evaluation of the used procedures for realizing the German model have shown that an error exists that produce biased estimates. The corrected procedures were used during the studies presented in this paper.
Additional analyses were realized. Mean CPUE values of the new standard gears (TV) were compared with the estimates (TV') that are based on the mean CPUE values of the national gears in combination with the estimates of the mean conversion factors and the influence of the sequence of the gears to assess the quality of the estimates using the equations:
Sequence 1: TV' = CPUE(national gear) / C(t) * CF(t)) (1)
Sequence 2: TV' = CPUE(national gear) * C(t) * CF(t)) (2)

with

C(t) mean influence of the sequence of the gears
CF(t) mean conversion factor.

Furthermore, the mean conversion factors and the standard deviation of the means were estimated using the jackknife or the crossvalidation method.
In many cases the estimated conversion factors are significantly influenced by the low number of available data set and the high variability of the conversion factors of the single inter-calibration experiments CF(t,i) using t as index of the length interval and i as index of the inter-calibration experiment. To reduce the high variability limits of CPUE values were defined in some studies. Only those inter-calibration experiments were used during the presented studies where the CPUE value of both the gears compared were larger than the required limit of 3 individuals.
The minimum and maximum values of CF(t,i) were summarized for different limits of the CPUE value to study the influence of the minimum and maximum CF(t,i).

Results

The corrected procedures were used to estimate conversion factors for all national gears by 5 cm length intervals. **Table 1.1 to 1.7** present the mean conversion factors CF(t)

CPUE(TV3#) = CF(t) * CPUE(national gear)

for cod. The estimates are given for the length range from 5 cm to 54 cm. Beside the ln-transformed estimates of both the gears, the mean influence of the sequence of the gear, C(t), the mean ln-transformed and the back-transformed conversion factors are presented. Furthermore, the standard deviations and the confidence intervals are given as well as the necessary number of available data sets if a required accuracy is given. These estimates depend on two parameters, the error of first kind α and the required level of accuracy. For the analyses presented it was chosen that $\alpha = 0.05$ and that the half of the confidence intervals of the ln-transformed conversion factors should be less or equal than 0.20. For comparing the data with the estimates of Nielsen et al. (2002) the quotient 1/CF(t) must be used.
Tables 2.1 to 2.7 present the mean conversion factors for flounder by 5 cm length intervals for the length range from 15 cm to 49 cm.
To evaluate the used model and the quality of the estimated conversion factors the mean CPUE value of the new standard gear (TV) were compared with the estimates that are based on the Equations 1 and 2 (TV') by sequence of the gears.
Figures 1.1 to 1.7 present the estimates TV and TV' by 5 cm length intervals and the different national gears for both the sequences of the gears. The mean CPUE value of the new standard gear and the recalculated CPUE values (TV') were different when both the sequences of the gear are taken into account. The CPUE values of TV and TV' correspond well for the gear types HG 20/25, TV3#930-TV3#520 and GOV. Large differences were found for at least one length interval for the other gears. One possible reason for these differences is probably the partly high changes of C(t) from one length interval to the neighbouring length interval. As examples the length range from 30 cm to 40 cm in **Table 1.5** as well as from 35 cm to 50 cm in **Table 1.7** can be used. When the selection characteristics

of the different gears that describes the continuous change of the catchability of the gear in relation to the total length is taken into account it can be expected that the changes of C(t) as well as CF(t) are also continuous processes dependent on the length.
Estimates of conversion factors were presented by Nielsen et al. (2002) for all national gears. Gasjukov (2002) presented conversion factors for the gear type HG 20/25 and GOV. Both the different methods were used to estimate CF(TV3#930,TV3#520). Furthermore, estimates of the German model are available. **Figure 2.1 to 2.3** show the different estimates by 5 cm length intervals and gear. Estimates of Gasjukov (2002) and the corrected estimates (Table 1.1 to 1.7) are relative close together. In contrast to this the estimates of Nielsen et al. (2002) are different, spatially the estimates of CF(TV3#930,TV3#520) and CF(TV3#930, GOV).
As second independent check of the estimated conversion factors the jackknife method was used to estimate mean conversion factors and their standard deviation by national gears. **Tables 4.1 to 4.7** show the results using the German model as background. The comparisons of both the estimates of conversion factors are significantly dependent on the national gear. Both the estimates, the mean and the standard deviation are comparable for the national gear types HG 20/25 and GOV as well as for the conversion factor CF(TV3#930,TV3#520). For these gears the difference between both the means is less than 0.04. The mean conversion factors and the standard deviation of both the methods also correspond for the Polish gear type P 20/25. However, in some cases the limit as mentioned above is crossed. Strong differences were observed for the gear types Granton, LBT and Hake 4M. However, it must be taken into the account that the number of available data sets of the gear types LBT and Hake 4M are very low for most of the length intervals (Tables 1.4, 1.6).
To get a more detailed and clear picture of the variability of the available data sets two additional tables were prepared. **Table 5.1** presents the total minimum and maximum of all CF(t,i) by gear types. The conversion factors of each individual inter-calibration experiment and each length interval were only used when the CPUE values of both the compared gears were larger than 3 (as used for the results in Tables 1.1 to 1.7). The minimum and maximum values were separately estimated using 2 cm and 5 cm length intervals.
A decreasing range between the minimum and the maximum of CF(t,i) if length intervals of 5 cm were used instead of 2 cm suggests that the length range from 5 cm to 54 cm is relative uniform covered by the paired hauls and that the stochastic variability of the CPUE values of neighbouring intervals will be balanced as it can be expected. Furthermore, the influence of individual extreme data sets is reduced.
Maximum values of 30.5 and 22.6 as well as minimum values of 0.01 suggest that different populations were sampled by the paired stations and that it seems to be useful that these data sets should be handled as outlier. **Table 5.2** presents the total minimum and maximum of all CF(t,i) by gear types. In this case only those data sets were used where the CPUE values of both the compared gears were larger than 30. That means that experiments with low catches were excluded. Unfortunately, the number of data sets with high catches is low. The studies illustrate that the conversion factors are strongly influenced by the high variability of the CPUE values with low catches.

Table 1.1: Estimates of the inter-calibration experiment between the gears TV3 520 and HG 20/25 for cod
(ln-transformed conversion factors, back-transformed estimates and the necessary number of paired Stations N*)

	Ln-transformed conversion factors							Ln-transformed corrected conversion factors					Back-transformed conversion factors				
	Sequence 1			Sequence 2													
Length	N	Mean	Std	N	Mean	Std	C(t)	N	Mean	Std	Confidence limits		Mean	Std	Confidence limits		N*
5	12	0.45	0.47	2	0.36	1.45	-0.04	14	0.40	0.58	0.07	0.74	1.77	1.33	1.07	2.09	35
10	18	0.41	0.62	12	-0.30	0.75	-0.35	30	0.05	0.66	-0.19	0.30	1.31	1.19	0.83	1.35	44
15	15	0.16	0.56	12	-0.23	0.54	-0.19	27	-0.03	0.53	-0.25	0.18	1.11	0.74	0.78	1.19	30
20	19	0.12	0.72	12	-0.32	0.57	-0.22	31	-0.10	0.64	-0.34	0.13	1.11	0.98	0.71	1.14	42
25	19	-0.01	0.66	12	-0.15	0.43	-0.07	31	-0.08	0.57	-0.28	0.13	1.09	0.78	0.75	1.14	33
30	20	-0.17	0.71	12	-0.02	0.52	0.08	32	-0.09	0.63	-0.32	0.13	1.11	0.94	0.73	1.14	40
35	20	-0.27	0.83	12	-0.30	0.57	-0.02	32	-0.28	0.72	-0.54	-0.02	0.98	1.04	0.58	0.98	52
40	18	-0.13	0.53	10	-0.25	0.63	-0.06	28	-0.19	0.55	-0.40	0.02	0.96	0.66	0.67	1.02	31
45	12	-0.15	0.65	7	-0.10	0.90	0.03	19	-0.12	0.71	-0.47	0.22	1.14	1.19	0.63	1.24	51
50	2	0.06	0.44	0	0.00			2									

Table 1.2: Estimates of the inter-calibration experiment between the gears TV3 930 and TV3 520 for cod
(ln-transformed conversion factors, back-transformed estimates and the necessary number of paired Stations N*)

	Ln-transformed conversion factors							Ln-transformed corrected conversion factors					Back-transformed conversion factors				
	Sequence 1			Sequence 2													
Length	N	Mean	Std	N	Mean	Std	C(t)	N	Mean	Std	Confidence limits		Mean	Std	Confidence limits		N*
5	3	-0.66	1.61	2	-1.42	1.26	-0.38	5	-1.04	1.19	-2.41	0.33	0.72	2.61	0.09	1.39	139
10	7	-0.27	0.85	5	-0.67	1.17	-0.20	12	-0.47	0.90	-1.04	0.10	0.94	1.59	0.35	1.10	81
15	10	-0.27	1.00	9	-0.64	0.63	-0.19	19	-0.46	0.80	-0.84	-0.07	0.87	1.15	0.43	0.93	64
20	7	0.01	0.70	8	-0.18	0.66	-0.10	15	-0.09	0.64	-0.44	0.26	1.12	0.97	0.64	1.30	41
25	8	0.34	0.75	9	-0.30	0.66	-0.32	17	0.02	0.66	-0.32	0.36	1.27	1.18	0.73	1.44	45
30	10	0.21	1.05	10	0.09	0.89	-0.06	20	0.15	0.93	-0.28	0.58	1.79	3.20	0.75	1.79	85
35	10	0.53	0.77	9	-0.05	0.37	-0.29	19	0.24	0.59	-0.04	0.52	1.51	1.17	0.96	1.69	36
40	8	0.56	0.47	8	0.30	0.47	-0.13	16	0.43	0.46	0.19	0.67	1.71	0.91	1.21	1.96	22
45	6	0.51	0.72	6	-0.15	0.42	-0.33	12	0.18	0.56	-0.17	0.53	1.40	0.98	0.85	1.70	32
50	6	0.72	0.51	5	-0.60	0.66	-0.66	11	0.06	0.56	-0.31	0.43	1.25	0.89	0.73	1.54	33

N number of stations. Std standard deviation

Table 1.3: Estimates of the inter-calibration experiment between the gears TV3 930 and Granton for cod
(ln-transformed conversion factors, back-transformed estimates and the necessary number of paired Stations N*)

	Ln-transformed conversion factors							Ln-transformed corrected conversion factors					Back-transformed conversion factors				
	Sequence 1			Sequence 2													
Length	N	Mean	Std	N	Mean	Std	C(t)	N	Mean	Std	Confidence limits		Mean	Std	Confidence limits		N*
5	0	0.00		0	0.00			0									
10	3	1.98	1.31	3	1.60	0.44	-0.19	6	1.79	1.09	0.70	2.88	10.90	30.07	2.01	17.87	117
15	6	1.81	0.84	7	0.96	0.71	-0.42	13	1.38	0.86	0.87	1.90	5.77	8.75	2.38	6.68	73
20	10	1.82	0.49	11	0.70	1.36	-0.56	21	1.26	1.07	0.78	1.74	6.21	15.90	2.17	5.71	111
25	11	2.14	0.56	13	0.45	1.56	-0.84	24	1.29	1.24	0.77	1.81	7.81	31.84	2.16	6.13	149
30	8	1.58	0.70	13	0.26	1.40	-0.66	21	0.92	1.18	0.38	1.46	5.06	17.84	1.47	4.30	137
35	7	1.14	1.61	11	0.64	0.96	-0.25	18	0.89	1.20	0.30	1.49	5.01	18.37	1.35	4.42	140
40	6	1.22	0.58	11	0.61	1.00	-0.30	17	0.92	0.87	0.47	1.36	3.66	5.76	1.60	3.91	76
45	2	0.90	0.12	9	0.24	0.84	-0.33	11	0.57	0.76	0.06	1.07	2.36	2.80	1.06	2.92	58
50	1	0.66		3	0.31	0.48	-0.18	4	0.48	0.45	-0.14	1.11	1.80	0.95	0.87	3.04	22

Table 1.4: Estimates of the inter-calibration experiment between the gears TV3 520 and LBT for cod
(ln-transformed conversion factors, back-transformed estimates and the necessary number of paired Stations N*)

	Ln-transformed conversion factors							Ln-transformed corrected conversion factors					Back-transformed conversion factors				
	Sequence 1			Sequence 2													
Length	N	Mean	Std	N	Mean	Std	C(t)	N	Mean	Std	Confidence limits		Mean	Std	Confidence limits		N*
5	1	-0.41		0	0.00			1									
10	0	0.00		3	-0.13	1.45		3									
15	0	0.00		3	0.69	1.23		3									
20	3	-0.04	0.46	6	0.56	1.04	0.30	9	0.26	0.81	-0.35	0.87	1.80	2.40	0.71	2.39	65
25	4	0.47	0.61	6	0.28	1.08	-0.10	10	0.37	0.85	-0.22	0.97	2.08	3.04	0.80	2.64	71
30	2	-1.13	1.02	5	-0.15	1.01	0.49	7	-0.64	0.94	-1.48	0.20	0.82	1.53	0.23	1.22	87
35	3	-0.98	0.78	6	0.40	0.95	0.69	9	-0.29	0.85	-0.94	0.35	1.08	1.61	0.39	1.43	73
40	2	-1.83	0.84	6	0.75	1.17	1.29	8	-0.54	1.15	-1.48	0.39	1.12	3.59	0.23	1.48	129
45	1	-3.43		4	-0.05	1.05	1.69	5	-1.74	1.62	-3.61	0.12	0.65	8.76	0.03	1.13	255
50	1	0.00		1	0.69		0.35	2	0.35	0.00			1.41	0.00			

N number of stations. Std standard deviation

Table 1.5: Estimates of the inter-calibration experiment between the gears TV3 930 and P 20/25 for cod
(ln-transformed conversion factors, back-transformed estimates and the necessary number of paired Stations N*)

	Ln-transformed conversion factors							Ln-transformed corrected conversion factors					Back-transformed conversion factors				
	Sequence 1			Sequence 2													
Length	N	Mean	Std	N	Mean	Std	C(t)	N	Mean	Std	Confidence limits		Mean	Std	Confidence limits		N*
5	7	0.17	0.14	4	-0.63	0.92	-0.40	11	-0.23	0.49	-0.56	0.09	0.90	0.53	0.57	1.10	26
10	10	0.60	0.87	6	-0.21	0.97	-0.40	16	0.20	0.86	-0.26	0.65	1.76	2.69	0.77	1.92	74
15	6	0.65	1.00	9	-0.29	0.39	-0.47	15	0.18	0.66	-0.18	0.55	1.49	1.38	0.83	1.73	44
20	11	0.61	0.83	8	-0.46	0.64	-0.54	19	0.07	0.73	-0.28	0.42	1.40	1.53	0.76	1.53	54
25	9	0.80	0.72	8	-0.52	0.69	-0.66	17	0.14	0.69	-0.21	0.49	1.46	1.45	0.81	1.64	48
30	12	0.74	0.91	7	-0.13	0.36	-0.43	19	0.30	0.74	-0.05	0.66	1.79	2.02	0.95	1.94	55
35	7	0.07	1.31	10	-0.06	0.48	-0.06	17	0.01	0.85	-0.43	0.44	1.45	2.15	0.65	1.56	72
40	9	1.04	0.67	9	0.18	0.40	-0.43	18	0.61	0.57	0.33	0.90	2.18	1.60	1.39	2.45	34
45	6	1.09	0.35	5	0.47	0.46	-0.31	11	0.78	0.48	0.46	1.10	2.45	1.40	1.59	3.00	24
50	2	1.10	0.00	0	0.00			2									

Table 1.6: Estimates of the inter-calibration experiment between the gears TV3 930 and Hake 4M for cod
(ln-transformed conversion factors, back-transformed estimates and the necessary number of paired Stations N*)

	Ln-transformed conversion factors							Ln-transformed corrected conversion factors					Back-transformed conversion factors				
	Sequence 1			Sequence 2													
Length	N	Mean	Std	N	Mean	Std	C(t)	N	Mean	Std	Confidence limits		Mean	Std	Confidence limits		N*
5	0	0.00		0	0.00			0									
10	0	0.00		0	0.00			0									
15	0	0.00		0	0.00			0									
20	3	0.52	0.44	2	0.45	0.96	-0.04	5	0.49	0.55	-0.15	1.12	1.90	1.32	0.86	3.08	32
25	5	0.71	0.77	4	0.30	1.11	-0.20	9	0.50	0.85	-0.14	1.15	2.38	3.53	0.87	3.14	72
30	6	0.56	0.83	4	0.42	1.37	-0.07	10	0.49	0.97	-0.19	1.17	2.62	5.25	0.82	3.24	93
35	6	0.51	0.90	4	0.87	1.55	0.18	10	0.69	1.07	-0.06	1.45	3.55	9.22	0.94	4.25	112
40	6	0.23	0.88	3	0.26	0.51	0.01	9	0.24	0.70	-0.29	0.77	1.63	1.66	0.75	2.16	50
45	3	0.00	0.28	3	0.28	0.40	0.14	6	0.14	0.28	-0.15	0.42	1.19	0.36	0.86	1.52	10
50	1	0.75		1	0.79		0.02	2	0.77	0.43			2.37	1.17			20

N number of stations. Std standard deviation

Table 1.7: Estimates of the inter-calibration experiment between the gears TV3 930 and GOV for cod
(ln-transformed conversion factors. back-transformed estimates and the necessary number of paired Stations N*)

	Ln-transformed conversion factors							Ln-transformed corrected conversion factors					Back-transformed conversion factors				
	Sequence 1			Sequence 2													
Length	N	Mean	Std	N	Mean	Std	C(t)	N	Mean	Std	Confidence limits		Mean	Std	Confidence limits		N*
5	8	-0.43	1.02	9	-0.46	0.94	-0.01	17	-0.44	0.92	-0.92	0.03	0.98	1.75	0.40	1.03	84
10	12	-0.02	0.76	7	-0.69	0.82	-0.34	19	-0.36	0.73	-0.71	-0.01	0.91	1.01	0.49	0.99	54
15	11	-0.45	0.74	11	0.06	1.27	0.26	22	-0.19	1.00	-0.64	0.25	1.35	2.90	0.53	1.28	98
20	13	-0.17	0.74	14	0.22	1.20	0.19	27	0.03	0.97	-0.36	0.41	1.64	3.27	0.70	1.51	93
25	13	-0.29	0.67	14	0.06	0.91	0.17	27	-0.12	0.78	-0.42	0.19	1.20	1.48	0.66	1.21	60
30	12	-0.34	0.86	15	0.01	0.95	0.17	27	-0.17	0.88	-0.51	0.18	1.24	1.97	0.60	1.20	77
35	10	-0.51	1.11	14	0.20	0.84	0.35	24	-0.15	0.92	-0.54	0.23	1.31	2.32	0.58	1.26	84
40	12	-0.12	0.68	13	-0.08	0.75	0.02	25	-0.10	0.69	-0.38	0.18	1.15	1.14	0.68	1.20	48
45	11	0.03	0.87	12	-0.10	0.90	-0.06	23	-0.03	0.85	-0.40	0.33	1.38	2.02	0.67	1.39	71
50	4	-0.35	0.95	5	0.17	1.10	0.26	9	-0.09	0.92	-0.78	0.61	1.40	2.48	0.46	1.83	84

N number of stations. Std standard deviation

Table 2.1: Estimates of the inter-calibration experiment between the gears TV3 520 and HG 20/25 for flounder (ln-transformed conversion factors, back-transformed estimates and the necessary number of paired Stations N*)

	Ln-transformed conversion factors							Ln-transformed corrected conversion factors					Back-transformed conversion factors				
	Sequence 1			Sequence 2													
Length	N	Mean	Std	N	Mean	Std	C(t)	N	Mean	Std	Confidence limits		Mean	Std	Confidence limits		N*
15	1	-0.51		7	-0.33	0.36	0.09	8	-0.42	0.36	-0.71	-0.13	0.70	0.28	0.49	0.88	15
20	4	0.10	0.69	7	-0.52	0.24	-0.31	11	-0.21	0.40	-0.48	0.05	0.88	0.40	0.62	1.06	18
25	17	0.05	0.52	11	-0.32	0.48	-0.18	28	-0.14	0.48	-0.32	0.05	0.98	0.57	0.72	1.05	25
30	18	-0.14	0.71	12	-0.12	0.51	0.01	30	-0.13	0.62	-0.36	0.10	1.06	0.88	0.70	1.10	39
35	12	-0.01	0.74	12	-0.23	0.59	-0.11	24	-0.12	0.64	-0.39	0.15	1.09	0.95	0.68	1.16	42
40	2	-0.31	0.44	7	-0.19	0.63	0.06	9	-0.25	0.55	-0.67	0.16	0.90	0.62	0.51	1.17	31
45	0	0.00		5	0.08	1.02		5									

N number of stations, Std standard deviation

Table 2.2: Estimates of the inter-calibration experiment between the gears TV3 930 and TV3 520 for flounder (ln-transformed conversion factors, back-transformed estimates and the necessary number of paired Stations N*)

	Ln-transformed conversion factors							Ln-transformed corrected conversion factors					Back-transformed conversion factors				
	Sequence 1			Sequence 2													
Length	N	Mean	Std	N	Mean	Std	C(t)	N	Mean	Std	Confidence limits		Mean	Std	Confidence limits		N*
15	1	-1.53		4	-1.01	0.73	0.26	5	-1.27	0.84	-2.24	-0.30	0.40	0.58	0.11	0.74	71
20	4	-0.08	0.41	8	-0.21	0.76	-0.06	12	-0.15	0.61	-0.53	0.24	1.04	0.85	0.59	1.27	38
25	9	0.87	0.70	9	-0.40	0.55	-0.63	18	0.24	0.63	-0.07	0.55	1.54	1.29	0.93	1.73	40
30	9	0.92	0.42	10	-0.33	1.10	-0.63	19	0.29	0.83	-0.11	0.69	1.90	2.69	0.90	2.00	69
35	5	1.32	0.34	6	-0.04	0.66	-0.68	11	0.64	0.62	0.23	1.06	2.31	1.93	1.26	2.88	40
40	0	0.00		3	0.27	0.41		3									
45	0	0.00		1	0.00			1									

N number of stations, Std standard deviation

Table 2.3: Estimates of the inter-calibration experiment between the gears TV3 930 and Granton for flounder
(ln-transformed conversion factors, back-transformed estimates and the necessary number of paired Stations N*)

	Ln-transformed conversion factors							Ln-transformed corrected conversion factors					Back-transformed conversion factors				
	Sequence 1			Sequence 2													
Length	N	Mean	Std	N	Mean	Std	C(t)	N	Mean	Std	Confidence limits		Mean	Std	Confidence limits		N*
15	0	0.00		0	0.00			0									
20	6	1.68	0.91	6	1.48	0.42	-0.10	12	1.58	0.80	1.08	2.08	6.66	8.57	2.94	8.00	63
25	9	1.65	0.58	7	1.53	0.72	-0.06	16	1.59	0.72	1.21	1.97	6.37	6.86	3.34	7.19	53
30	5	1.14	0.70	5	1.61	0.36	0.24	10	1.38	0.60	0.95	1.80	4.75	3.79	2.59	6.06	37
35	3	1.14	1.03	4	1.36	0.71	0.11	7	1.25	0.83	0.51	1.99	4.90	6.85	1.66	7.29	68
40	0	0.00		1	2.85			1									
45	0	0.00		0	0.00			0									

N number of stations, Std standard deviation

Table 2.4: Estimates of the inter-calibration experiment between the gears TV3 520 and LBT for flounder
(ln-transformed conversion factors, back-transformed estimates and the necessary number of paired Stations N*)

	Ln-transformed conversion factors							Ln-transformed corrected conversion factors					Back-transformed conversion factors				
	Sequence 1			Sequence 2													
Length	N	Mean	Std	N	Mean	Std	C(t)	N	Mean	Std	Confidence limits		Mean	Std	Confidence limits		N*
15	9	0.80	1.79	13	-0.76	0.90	-0.78	22	0.02	1.28	-0.55	0.58	2.30	10.50	0.58	1.79	159
20	14	0.49	1.01	20	-0.30	0.74	-0.39	34	0.10	0.84	-0.20	0.39	1.56	2.24	0.82	1.47	70
25	14	0.37	0.75	21	0.16	1.37	-0.11	35	0.26	1.13	-0.12	0.65	2.48	7.64	0.88	1.92	126
30	12	0.43	0.63	20	-0.06	0.87	-0.24	32	0.18	0.77	-0.09	0.46	1.61	1.94	0.91	1.59	59
35	8	-0.22	0.79	10	0.12	0.93	0.17	18	-0.05	0.82	-0.46	0.36	1.33	1.84	0.63	1.43	67
40	0	0.00		1	-0.69			1									
45	0	0.00		0	0.00			0									

N number of stations, Std standard deviation

Table 2.5: Estimates of the inter-calibration experiment between the gears TV3 930 and P 20/25 for flounder
(ln-transformed conversion factors, back-transformed estimates and the necessary number of paired Stations N*)

	Ln-transformed conversion factors							Ln-transformed corrected conversion factors					Back-transformed conversion factors				
	Sequence 1			Sequence 2													
Length	N	Mean	Std	N	Mean	Std	C(t)	N	Mean	Std	Confidence limits		Mean	Std	Confidence limits		N*
15	7	0.17	0.56	3	-0.30	0.47	-0.24	10	-0.06	0.49	-0.41	0.28	1.06	0.61	0.67	1.32	25
20	11	-0.07	0.93	8	-0.34	0.97	-0.14	19	-0.21	0.89	-0.64	0.22	1.21	1.99	0.53	1.25	79
25	11	0.05	0.74	8	-0.15	0.87	-0.10	19	-0.05	0.75	-0.41	0.31	1.26	1.46	0.66	1.37	57
30	9	-0.16	0.91	5	-0.16	0.18	0.00	14	-0.16	0.70	-0.56	0.24	1.09	1.10	0.57	1.27	49
35	7	-0.10	0.24	3	-0.84	0.55	-0.37	10	-0.47	0.31	-0.69	-0.25	0.66	0.22	0.50	0.78	11
40	0	0.00		0	0.00			0									
45	0	0.00		0	0.00			0									

N number of stations, Std standard deviation

Table 2.6: Estimates of the inter-calibration experiment between the gears TV3 930 and Hake 4M for flounder
(ln-transformed conversion factors. back-transformed estimates and the necessary number of paired Stations N*)

	Ln-transformed conversion factors							Ln-transformed corrected conversion factors					Back-transformed conversion factors				
	Sequence 1			Sequence 2													
Length	N	Mean	Std	N	Mean	Std	C(t)	N	Mean	Std	Confidence limits		Mean	Std	Confidence limits		N*
15	2	0.46	0.56	1	-1.70		-1.08	3	-0.62	0.40	-1.35	0.11	0.58	0.26	0.26	1.12	18
20	6	0.15	0.43	4	-0.97	0.70	-0.56	10	-0.41	0.49	-0.76	-0.06	0.75	0.44	0.47	0.94	26
25	6	-0.17	0.43	4	-0.70	0.50	-0.26	10	-0.44	0.41	-0.73	-0.14	0.70	0.33	0.48	0.87	19
30	6	-0.19	0.39	4	-0.87	0.54	-0.34	10	-0.53	0.41	-0.82	-0.24	0.64	0.30	0.44	0.79	18
35	6	-0.07	0.57	4	-0.77	0.49	-0.35	10	-0.42	0.49	-0.76	-0.08	0.74	0.43	0.47	0.93	25
40	3	0.75	0.16	1	0.49		-0.13	4	0.62	0.36	0.13	1.12	1.99	0.78	1.14	3.06	14
45	0	0.00		0	0.00			0									

N number of stations. Std standard deviation

Table 2.7: Estimates of the inter-calibration experiment between the gears TV3 930 and GOV for flounder
(ln-transformed conversion factors. back-transformed estimates and the necessary number of paired Stations N*)

	Ln-transformed conversion factors							Ln-transformed corrected conversion factors					Back-transformed conversion factors				
	Sequence 1			Sequence 2													
Length	N	Mean	Std	N	Mean	Std	C(t)	N	Mean	Std	Confidence limits		Mean	Std	Confidence limits		N*
15	0	0.00		1	-0.69			1									
20	3	-0.22	0.39	3	-0.20	0.37	0.01	6	-0.21	0.32	-0.53	0.11	0.85	0.29	0.59	1.11	12
25	6	0.10	0.81	2	-0.17	0.59	-0.13	8	-0.04	0.67	-0.59	0.51	1.21	1.15	0.56	1.67	46
30	7	-0.24	0.68	3	-0.27	0.26	-0.02	10	-0.25	0.54	-0.64	0.13	0.90	0.61	0.53	1.14	31
35	1	1.25		2	-0.55	0.53	-0.90	3	0.35	0.70	-0.93	1.63	1.82	1.83	0.40	5.12	49
40	0	0.00		1	-0.62			1									
45	0	0.00		0	0.00			0									

N number of stations. Std standard deviation

Table 4.1: Mean conversion factors and standard deviations of the means based on the direct method (German model) and the Jackknife method of the inter-calibration experiment between the gears TV3#520 and HG 20/25 for cod

Length	Direct estimates		Jackknife	
interval	Mean	Std	Mean	Std
5	1.77	0.24	1.48	1.18
10	1.31	0.13	1.31	0.22
15	1.11	0.10	1.12	0.11
20	1.11	0.11	1.11	0.15
25	1.09	0.10	1.09	0.12
30	1.11	0.10	1.11	0.13
35	0.98	0.10	0.98	0.13
40	0.96	0.09	0.96	0.11
45	1.14	0.15	1.15	0.22
50				

Table 4.2: Mean conversion factors and standard deviations of the means based on the direct method (German model) and the Jackknife method of the inter-calibration experiment between the gears TV3#930 and TV3#520 for cod

Length	Direct estimates		Jackknife	
interval	Mean	Std	Mean	Std
5	0.72	0.27	0.69	0.49
10	0.94	0.18	0.97	0.25
15	0.87	0.12	0.89	0.12
20	1.12	0.16	1.12	0.23
25	1.27	0.17	1.28	0.26
30	1.79	0.25	1.79	0.48
35	1.51	0.18	1.51	0.25
40	1.71	0.18	1.70	0.21
45	1.40	0.20	1.37	0.32
50	1.25	0.19	1.23	0.23

Table 4.3: Mean conversion factors and standard deviations of the means based on the direct method (German model) and the Jackknife method of the inter-calibration experiment between the gears TV3#930 and Granton for cod

Length	Direct estimates		Jackknife	
interval	Mean	Std	Mean	Std
5				
10	10.90	3.43	7.46	6.23
15	5.77	1.02	5.22	1.36
20	6.21	0.88	5.91	1.37
25	7.81	0.99	7.06	2.54
30	5.06	0.71	4.84	1.46
35	5.01	0.76	4.79	2.00
40	3.66	0.56	3.54	0.89
45	2.36	0.43	2.33	0.35
50	1.80	0.39	1.80	0.24

Table 4.4: Mean conversion factors and standard deviations of the means based on the direct method (German model) and the Jackknife method of the inter-calibration experiment between the gears TV3#520 and LBT for cod

Length	Direct estimates		Jackknife	
interval	Mean	Std	Mean	Std
5				
10				
15				
20	1.80	0.38	2.08	0.46
25	2.08	0.43	2.12	0.58
30	0.82	0.22	0.74	0.36
35	1.08	0.24	1.05	0.32
40	1.12	0.29	1.02	0.47
45	0.65	0.25	0.65	0.00
50	1.41	0.00		

Table 4.5: Mean conversion factors and standard deviations of the means based on the direct method (German model) and the Jackknife method of the inter-calibration experiment between the gears TV3#930 and P 20/25 for cod

Length	Direct estimates		Jackknife	
interval	Mean	Std	Mean	Std
5	0.90	0.12	0.90	0.22
10	1.76	0.28	1.82	0.48
15	1.49	0.21	1.47	0.36
20	1.40	0.19	1.16	0.20
25	1.46	0.20	1.45	0.24
30	1.79	0.24	1.84	0.24
35	1.45	0.22	1.46	0.38
40	2.18	0.26	2.13	0.30
45	2.45	0.32	2.37	0.28
50				

Table 4.6: Mean conversion factors and standard deviations of the means based on the direct method (German model) and the Jackknife method of the inter-calibration experiment between the gears TV3#930 and Hake 4M for cod

Length	Direct estimates		Jackknife	
interval	Mean	Std	Mean	Std
5				
10				
15				
20	1.90	0.44	1.86	0.75
25	2.38	0.52	2.28	0.98
30	2.62	0.56	2.47	1.27
35	3.55	0.78	3.27	1.93
40	1.63	0.32	1.61	0.49
45	1.19	0.13	1.20	0.17
50	2.37	0.74		

Table 4.7: Mean conversion factors and standard deviations of the means based on the direct method (German model) and the Jackknife method of the inter-calibration experiment between the gears TV3#930 and GOV for cod

Length	Direct estimates		Jackknife	
interval	Mean	Std	Mean	Std
5	0.98	0.15	1.00	0.22
10	0.91	0.12	0.93	0.17
15	1.35	0.19	1.32	0.45
20	1.64	0.20	1.61	0.49
25	1.20	0.14	1.21	0.21
30	1.24	0.15	1.24	0.28
35	1.31	0.17	1.30	0.36
40	1.15	0.13	1.16	0.18
45	1.38	0.18	1.39	0.30
50	1.40	0.32	1.38	0.58

Table 5.1: Minimum and maximum values of conversion factors of all inter-calibration experiments where the CPUE values of each gear were larger than 3

	2 cm		5 cm	
Gear	Min	Max	Min	Max
HG 20/25	0.01	8.00	0.14	5.07
TV3#520	0.17	12.75	0.21	8.00
Granton	0.01	14.33	0.01	30.50
LBT	0.05	4.50	0.03	3.00
P 20/25	0.14	9.00	0.19	6.75
Hake 4M	0.25	17.93	0.41	22.63
GOV	0.08	7.33	0.09	12.50

Table 5.2: Minimum and maximum values of conversion factors of all inter-calibration experiments where the CPUE values of each gear were larger than 30

	2 cm		5 cm	
Gear	Min	Max	Min	Max
HG 20/25	0.24	3.59	0.28	3.07
TV3#520	0.54	2.40	0.43	6.00
Granton	0.84	5.40	0.84	6.18
LBT	0.10	0.92	0.09	1.17
P 20/25	0.33	4.17	0.37	3.68
Hake 4M	0.55	11.26	0.52	10.59
GOV	0.18	6.54	0.20	5.49

FIGURES

Figure 1: Comparison of mean CPUE values of the new standard gear and the back-calculated mean CPUE values (TV') using the mean CPUE values of the national gears in combination with the conversion factors, CF(t), and the mean influence of the sequence of the gears, C(t), by sequence of the gear (see Equation 1 and 2)

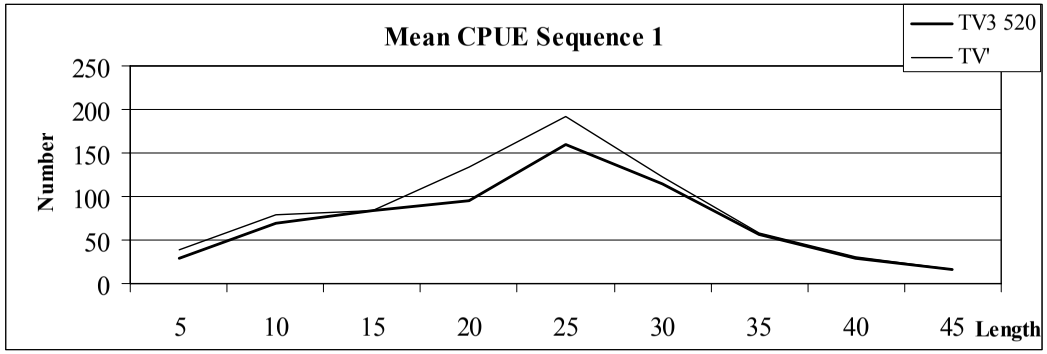
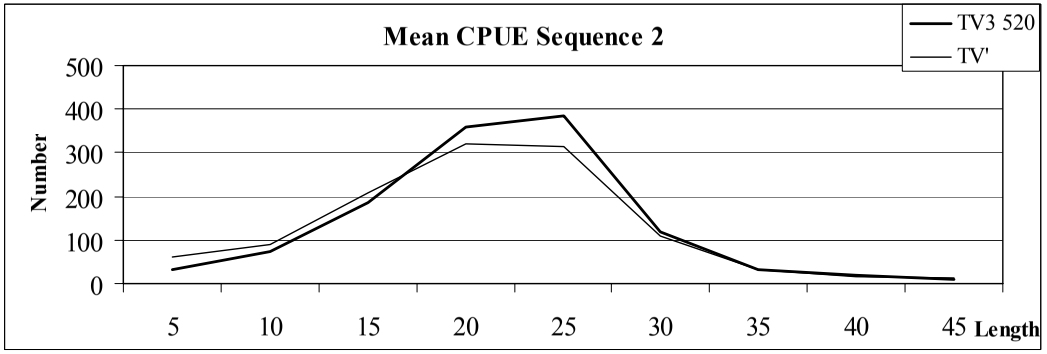


Figure 1.1: Inter-calibration TV3#520 – HG 20/25 – Sequence 1



Inter-calibration TV3#520 – HG 20/25 – Sequence 2

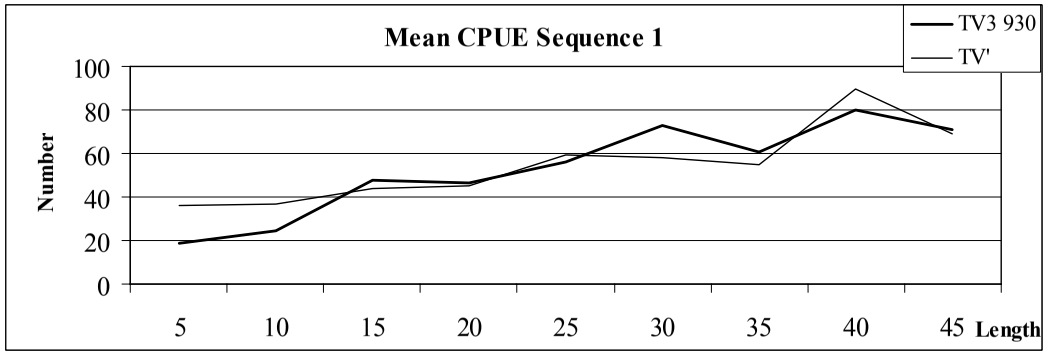
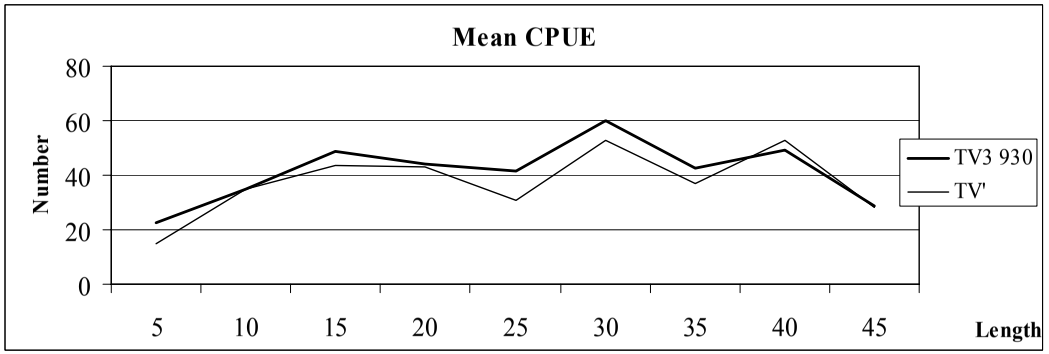


Figure 1.2: Inter-calibration TV3#930 – TV3#520 – Sequence 1



Inter-calibration TV3#930 – TV3#520 – Sequence 2

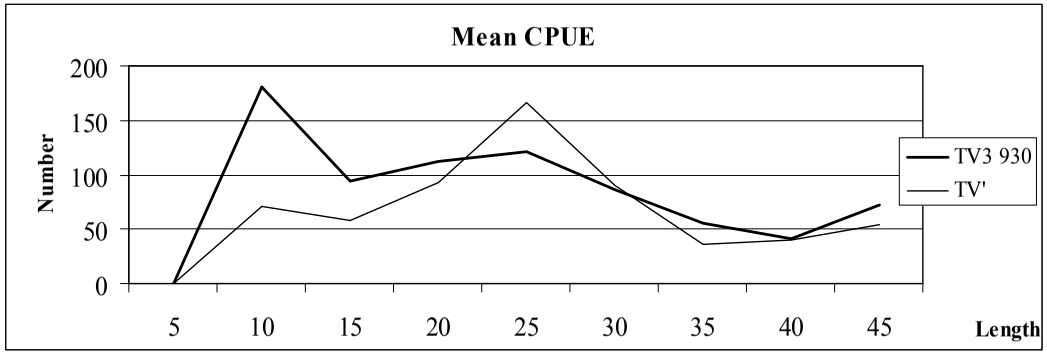
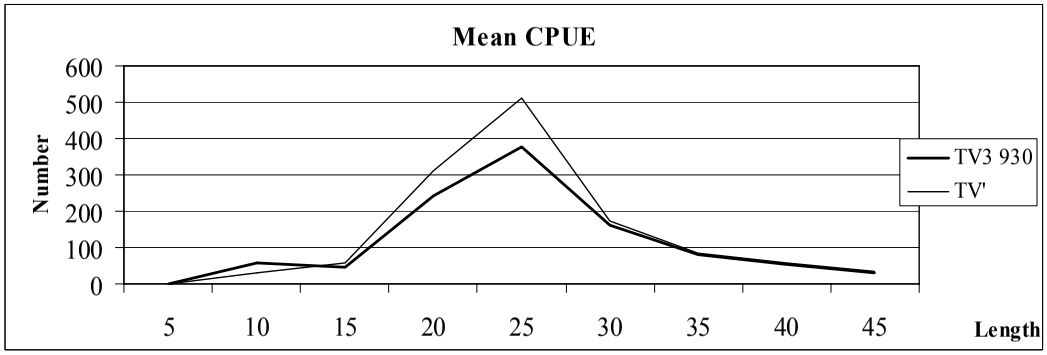


Figure 1.3: Inter-calibration TV3#930 – Granton – Sequence 1



Inter-calibration TV3#930 – Granton – Sequence 2

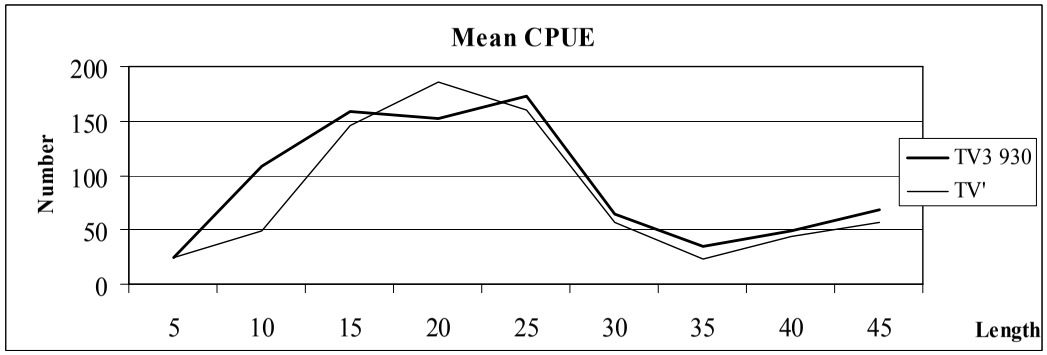
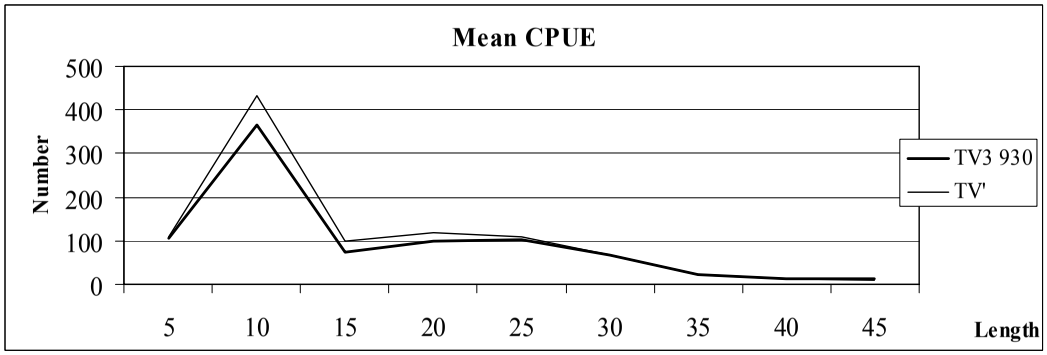


Figure 1.4: Inter-calibration TV3#930 – P 20/25 – Sequence 1



Inter-calibration TV3#930 – P 20/25 – Sequence 2

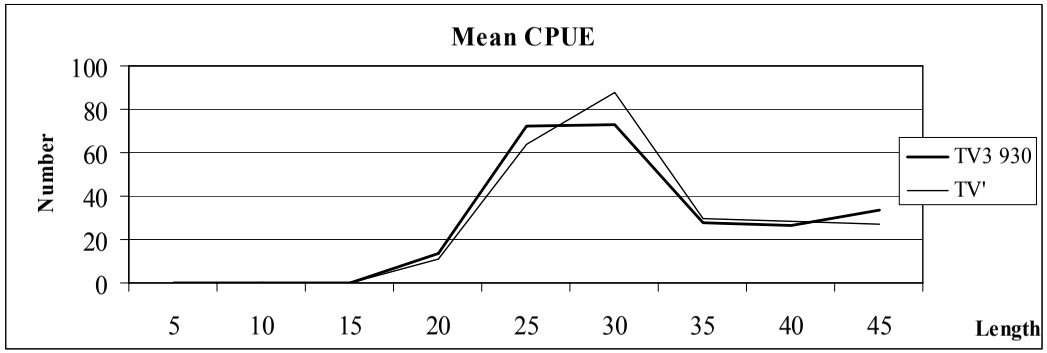
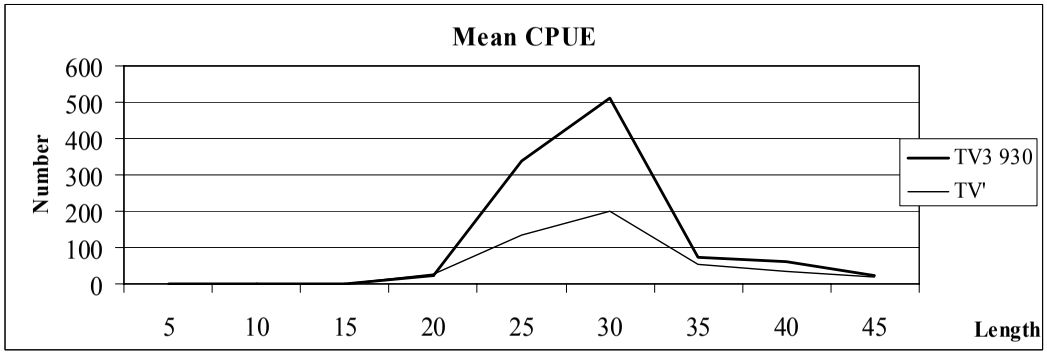


Figure 1.5: Inter-calibration TV3#930 – Hake 4M – Sequence 1



Inter-calibration TV3#930 – Hake 4M – Sequence 2

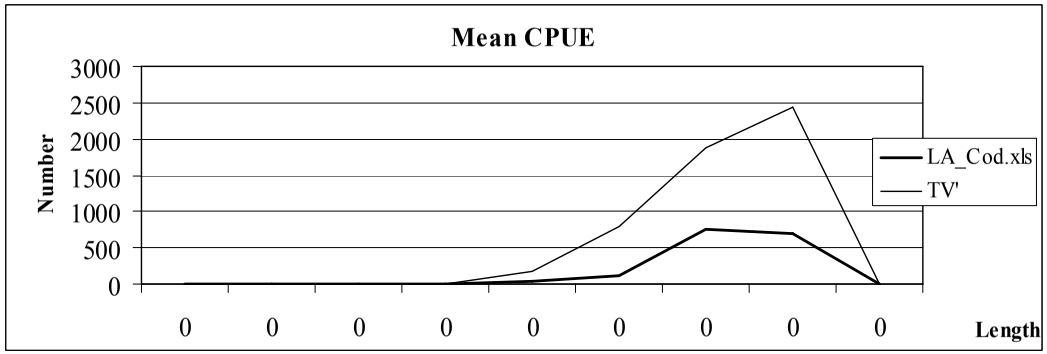
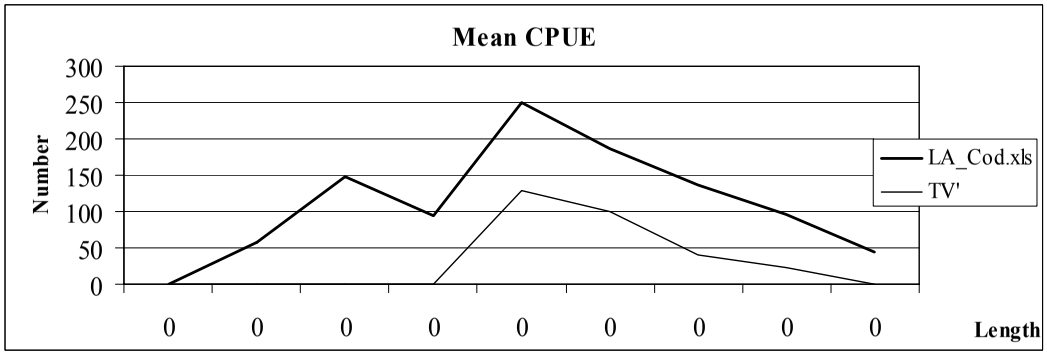


Figure 1.6: Inter-calibration TV3#930 – LBT – Sequence 1



Inter-calibration TV3#930 – LBT – Sequence 2

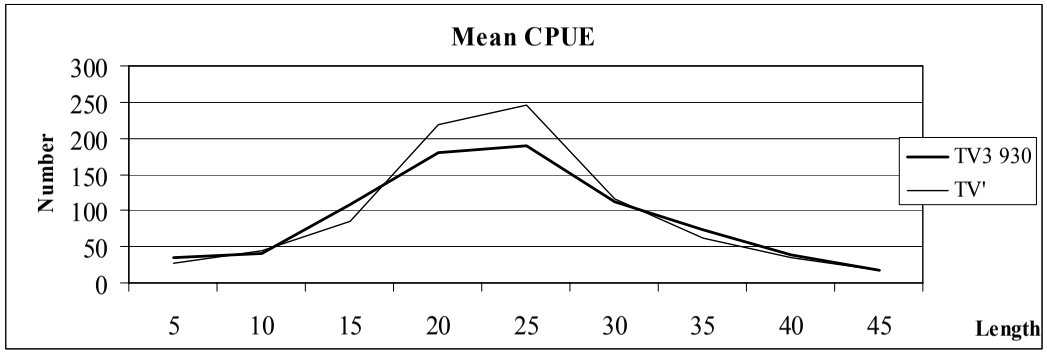
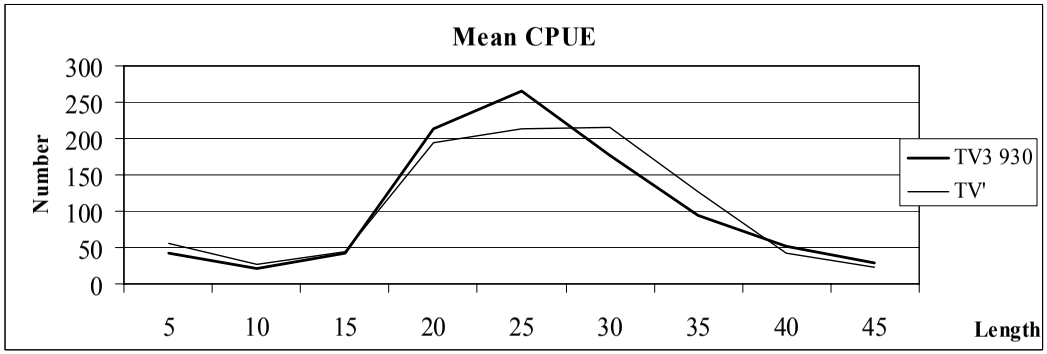


Figure 1.7: Inter-calibration TV3#930 – GOV – Sequence 1



Inter-calibration TV3#930 – GOV – Sequence 2

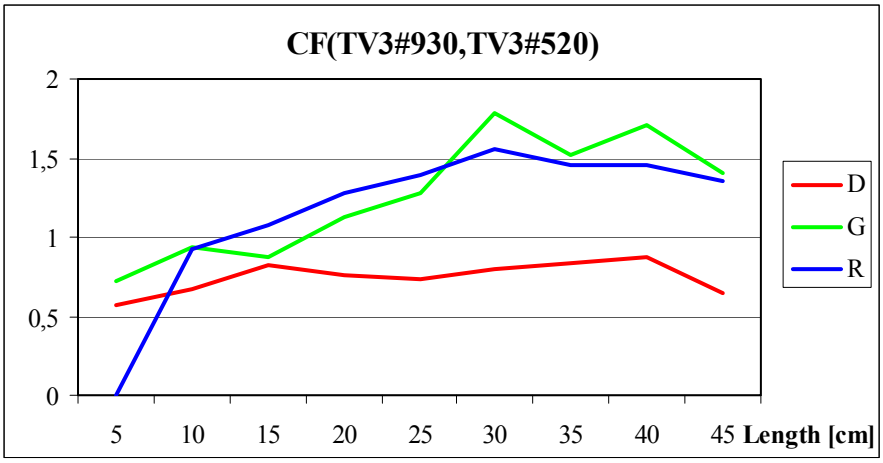


Figure 2.1: Conversion factors between TV3#930 and TV3#520 of cod by the Danish, German and Russian model by length intervals

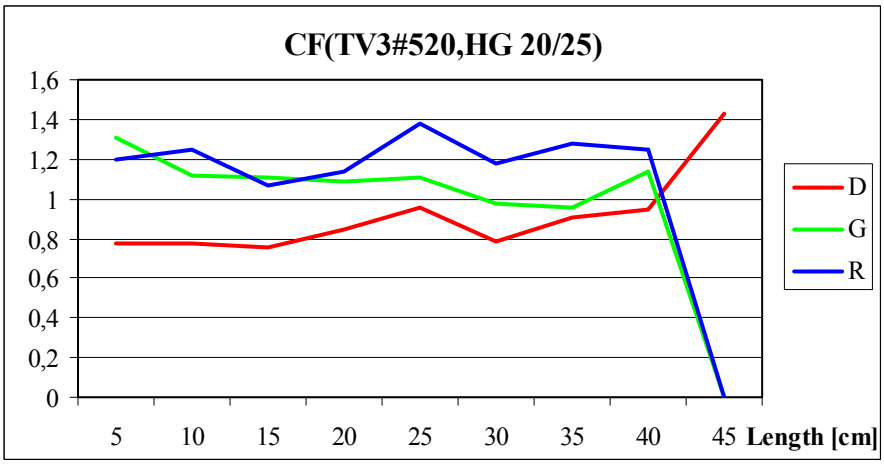


Figure 2.2: Conversion factors between TV3#520 and HG 20/25 of cod by the Danish, German and Russian model by length intervals

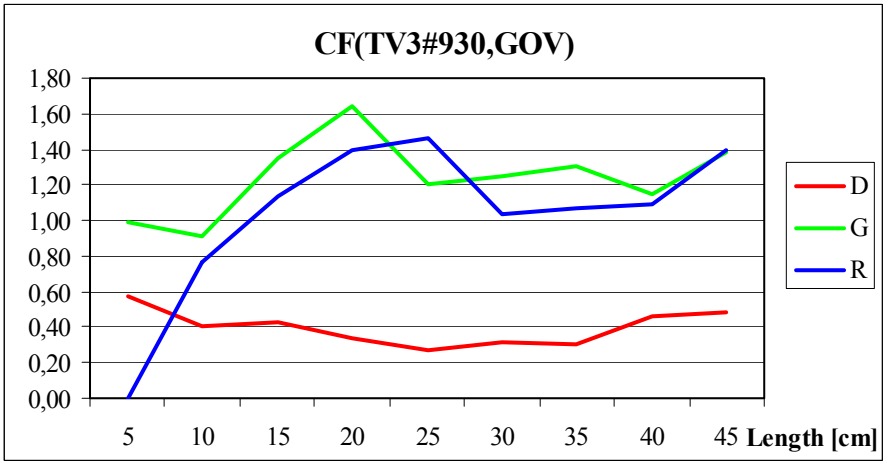


Figure 2.3: Conversion factors between TV3#930 and GOV of cod by the Danish, German and Russian model by length intervals