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Length-weight Relationships from the Portuguese Commercial Catches in NAFO Regulatory Area, 1998-2003

by

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Abstract

Biological sampling of the Portuguese commercial catches on Divisions 3M, 3N and 3O was carried out over the period 1998-2003 on board of several stern trawlers, fishing all the year round in NAFO Regulatory Area. The 2003 Greenland halibut data were used to compare two methods of computation of the length-weight (LW) relationship. The first calculation was done using all observations, without averaging the observed weights within each length group. The second method used the mean weight at each length. In both methods the LW relationships were calculated from the regression of the log transformed length/weight observations. The second method is better to calculate LW relationships since it gave expected weights closer to the observed ones, namely in the upper limit of the length distributions were fewer observations are available. Length-weight commercial sampling data assembled for several stocks were used to derive the correspondent LW relationships by the two alternate methods.

Introduction

Length – Weight (LW) relationships (equation 1) are one of the most important tools in the assessment of any stock.

$$W = aL^b \quad \text{or} \quad \log W = \log a + b\,(\log L) \qquad (1)$$

where W is weight,
L is length,
a and *b* are the constants

They are incorporated on several steps of the assessment framework and for that reason it is very important to guarantee an adequate fit of a LW relationship to the observed data.

Until now we have been using LW relationships from bibliography in the Portuguese Research Report. In order to improve the quality of our commercial input data, the Portuguese database was been revised and upgraded. We are now in condition to calculate and use our own LW relationships, obtained from the Portuguese fisheries in NAFO Regulatory Area.

Materials and Methods

On behalf of the Portuguese scientific program, biological sampling was carried out over the period 1998-2003 on board of several stern trawlers fishing in Div. 3L, 3M, 3N and 3O all the year round. Apart from species under moratoria, a priority to be sampled whenever they appear in the hauls, biological sampling was conducted for the two most abundant species in each haul, following the NAFO sampling recommendations.

The weight of individual fish were collected at sea, using electronic balances. Total weight was recorded in grams and length (from the tip of the snout to the fork of the tail) was recorded to the cm below except for roughhead grenadier (anal fin length to the half cm below). With the exception of cod and white hake all species were sampled by sex. Data with obvious errors in measurement were removed from the analysis.

The 2003 Greenland halibut data were chosen for a first full comparison of two methods of computation of the LW relationship. On both methods the relation is derived from the regression of the log transformed length-weight pairs of observations. The first method used all observations without averaging the weights within each length group. The second method used the observed mean weight of each length group. The parametric paired t-test is used to detect significant differences from 0 among expected weights at each length. Error terms correspond to 95% confidence limits. Plots of the regressions and curves are presented to visually detect the differences between the two methods. The LW relationship (Bowering and Stansbury, 1984) for Greenland halibut in NAFO Div. 2HJ+3K that has been used so far in the Portuguese Research Report was also tested against the two new LW relationships.

After the analysis of the results for Greenland halibut, LW relationships by the two methods were calculated for several stocks from length/weight commercial Portuguese data. For each stock a t-test was performed to check the difference between the two relations.

Results and Discussion

Table 1 shows the two 2003 Greenland halibut LW relationships and the t-test between them. According to the paired t-test between the two methods the mean pair difference is too high, with zero probability of be near 0. So, the two relationships are significantly different. The plot that shows the linear regression between log L - log W and the retransformed equations (Fig.1) highlight the difference between the curves from the two methods mainly in the upper limit of the length distributions. Table 2 shows the number of measurements by length groups of 5 cm: the bulk of the Greenland halibut data were between 30-60 cm. With the first method, the high number of measurements within this range flattened the curve in the upper limit of the length distribution. If the mean weights by length are used instead this effect is not obvious, and the curve is better fitted to the observed weights in the upper limit of the length distribution, were fewer observations are available. The Bowering and Stansbury LW relationship also show significant differences at large fish sizes (Fig. 1).

The LW relationships for several stocks calculated by the two methods, and the t-test between them are presented in Tables 3 to 11. For most stocks the two LW relationships are significantly different.

Conclusions

The second method was chosen to calculate LW relationships since it gave expected weights closer to the observed ones in the upper limit of the length distributions, were fewer observations are available. The LW relationships obtained from the Portuguese commercial catches improve the quality of the Portuguese data used in NAFO assessments.

Acknowledgements

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References

Bowering, W. R. and Stansbury, D. E., 1984. Regressions of weight on length for Greenland halibut (*Reinhardtius hippoglossoides*) from Canadian waters of Northwest Atlantic. *J. Northw. Atl. Fish. Sci*., **5**(1): 107-108.

Table 1: 2003 Greenland halibut LW relationships using the two methods (1st - all point observed, 2nd - mean weigth per lenght) and the t-test between them.

	Sex	*a*	*b*	r^2	length range		n	n means
					min	max		
first method	F	0.005	3.132	0.950	22	94	5411	-
	M	0.014	2.875	0.936	21	79	5460	-
	T	0.008	3.025	0.943	21	94	10871	-
second method	F	0.002	3.454	0.990	22	94	5411	68
	M	0.007	3.059	0.995	21	79	5460	52
	T	0.002	3.389	0.989	21	94	10871	69

	Sex	Mean paired difference	*P*
Paired t-test (1st *vs* 2nd method)	F	561.3 ± 173.5	0.000
	M	89.0 ± 36.1	0.000
	T	628.2 ± 191.0	0.000

Table 2: 2003 Greenland halibut: number of observations by length group.

		Cumulative frequency	
length group	N	Ascending	Descending
21-25	40	40	10871
26-30	103	143	10831
31-35	563	706	10728
36-40	1981	2687	10165
41-45	2966	5653	8184
46-50	2863	8516	5218
51-55	1469	9985	2355
56-60	497	10482	886
61-65	166	10648	389
66-70	104	10752	223
71-75	56	10808	119
76-80	42	10850	63
81-85	16	10866	21
86-90	4	10870	5
91-95	1	10871	1
Grand Total	10871		

Table 3a - Cod, Div. 3L: Length - Weight relationships calculated by the two methods and t-test between them.

Cod, Div. 3L													
Year	Sex	1st method (all point observed)				2nd method (mean weight per length)				Length range(cm)		Paired t-test 1st *vs* 2nd method	
		a	b	r^2	n	a	b	r^2	n means	min	max	Mean paired diff.	*P*
2001	Total	0.0054	3.1570	0.983	111	0.0054	3.1580	0.994	35	31	80	-0.5 ± 0.1	0.000

Table 3b - Cod, Div. 3M: Length - Weight relationships calculated by the two methods and t-test between them.

Cod, Div. 3M													
Year	Sex	1st method (all point observed)				2nd method (mean weight per length)				Length range(cm)		Paired t-test 1st *vs* 2nd method	
		a	b	r^2	n	a	b	r^2	n means	min	max	Mean paired diff.	*P*
1998	Total	0.0075	3.0543	0.881	3760	0.0084	3.0406	0.993	59	28	100	123.8 ± 26.0	0.000
1999	Total	0.0075	3.0689	0.983	27	0.0079	3.0586	0.993	16	46	67	12.2 ± 0.9	0.000
2000	Total	0.0030	3.3104	0.922	20	0.0022	3.3851	0.946	14	52	82	54.6 ± 27.5	0.002
2001	Total	0.0017	3.4596	0.996	23	0.0016	3.4764	0.997	16	30	82	22.5 ± 16.0	0.013

Table 3c - Cod, Div. 3NO: Length - Weight relationships calculated by the two methods and t-test between them.

Cod, Div. 3NO													
Year	Sex	1st method (all point observed)				2nd method (mean weight per length)				Length range(cm)		Paired t-test 1st *vs* 2nd method	
		a	b	r^2	n	a	b	r^2	n means	min	max	Mean paired diff.	*P*
1998	Total	0.0044	3.1657	0.950	1048	0.0043	3.1675	0.995	50	36	88	-5.8 ± 0.9	0.000
1999	Total	0.0065	3.0980	0.967	1987	0.0043	3.2151	0.996	67	22	90	209.4 ± 61.4	0.000
2000	Total	0.0038	3.2703	0.968	528	0.0039	3.2686	0.992	68	28	112	120.6 ± 30.3	0.000
2001	Total	0.0034	3.3157	0.976	475	0.0032	3.3363	0.994	57	26	103	137.7 ± 45.0	0.000
2002	Total	0.0080	3.0641	0.950	1467	0.0043	3.2364	0.991	70	29	118	601.1 ± 195.1	0.000
2003	Total	0.0123	2.9530	0.950	2809	0.0072	3.1104	0.991	72	23	96	450.3 ± 117.2	0.000

Table 4a - Redfish (*S. mentella*), Div. 3LN: Length - Weight relationships calculated by the two methods and t-test between them.

Redfish (*S. mentella*), Div. 3LN													
Year	Sex	1st method (all point observed)				2nd method (mean weight per length)				Length range(cm)		Paired t-test 1st *vs* 2nd method	
		a	b	r^2	n	a	b	r^2	n means	min	max	Mean paired diff.	*P*
1998	F	0.1002	2.4568	0.792	826	0.0733	2.5655	0.969	23	19	41	32.1 ± 11.2	0.000
	M	0.1335	2.3679	0.787	898	0.1307	2.3862	0.988	23	19	41	19.7 ± 4.8	0.000
	Total	0.1175	2.4077	0.788	1724	0.1115	2.4353	0.984	23	19	41	20.5 ± 5.4	0.000
1999	F	0.0739	2.5256	0.806	2330	0.0927	2.4714	0.991	25	19	43	17.1 ± 1.8	0.000
	M	0.0594	2.5908	0.833	2404	0.0660	2.5711	0.992	28	17	46	18.2 ± 3.5	0.000
	Total	0.0654	2.5622	0.821	4734	0.0689	2.5588	0.992	28	17	46	21.0 ± 4.8	0.000
2000	F	0.1728	2.2947	0.972	361	0.1604	2.3251	0.990	22	22	43	18.0 ± 4.6	0.000
	M	0.1029	2.4375	0.963	365	0.0927	2.4718	0.988	24	20	43	8.6 ± 3.1	0.000
	Total	0.1291	2.3758	0.964	726	0.0979	2.4602	0.988	24	20	43	11.1 ± 5.7	0.001
2001	F	0.0962	2.4634	0.979	269	0.0707	2.5594	0.989	22	17	40	11.3 ± 5.9	0.001
	M	0.0658	2.5614	0.970	257	0.0746	2.5323	0.992	20	24	45	12.8 ± 1.4	0.000
	Total	0.0890	2.4801	0.970	526	0.0769	2.5298	0.991	25	17	45	15.1 ± 5.6	0.000
2002	F	0.0365	2.7374	0.831	1889	0.0423	2.7046	0.989	23	20	43	15.2 ± 2.4	0.000
	M	0.0300	2.7910	0.823	1960	0.0563	2.6229	0.985	23	21	44	16.4 ± 3.8	0.000
	Total	0.0334	2.7616	0.827	3849	0.0447	2.6885	0.992	25	20	44	16.9 ± 1.3	0.000
2003	F	0.0137	3.0161	0.909	2334	0.0182	2.9378	0.997	27	17	44	3.3 ± 2.3	0.007
	M	0.0119	3.0519	0.912	2479	0.0074	3.1943	0.993	29	17	64	29.7 ± 32.1	0.074
	Total	0.0129	3.0310	0.910	4813	0.0095	3.1279	0.994	29	17	64	32.3 ± 26.9	0.023

Table 4b - Redfish (*S. mentella*), Div. 3M: Length - Weight relationships calculated by the two methods and t-test between them.

Redfish (*S. mentella*), Div. 3M													
Year	Sex	1st method (all point observed)				2nd method (mean weight per length)				Length range(cm)		Paired t-test 1st *vs* 2nd method	
		a	b	r^2	n	a	b	r^2	n means	min	max	Mean paired diff.	*P*
1998	F	0.0343	2.7753	0.864	101	0.0119	3.0850	0.979	19	19	39	4.8 ± 11.9	0.435
	M	0.3043	2.1484	0.782	148	0.3803	2.0925	0.957	19	22	42	14.5 ± 0.5	0.000
	Total	0.1075	2.4476	0.812	249	0.0390	2.7401	0.959	21	19	42	4.0 ± 13.3	0.551
1999	F	0.0234	2.8860	0.818	391	0.0295	2.8182	0.992	17	24	43	-4.1 ± 4.2	0.067
	M	0.0611	2.6029	0.797	414	0.0649	2.5861	0.984	21	22	45	0.1 ± 0.8	0.733
	Total	0.0395	2.7312	0.806	805	0.0466	2.6807	0.990	21	22	45	-8.9 ± 4.4	0.001
2000	F	0.0238	2.8601	0.951	206	0.0106	3.0887	0.983	24	17	46	-0.1 ± 10.5	0.983
	M	0.0266	2.8203	0.953	226	0.0117	3.0521	0.971	25	18	43	-1.1 ± 8.4	0.788
	Total	0.0256	2.8351	0.951	432	0.0095	3.1110	0.978	28	17	46	-3.9 ± 10.3	0.461
2001	F	0.0551	2.6347	0.974	421	0.0365	2.7601	0.993	33	17	50	30.1 ± 13.8	0.000
	M	0.0515	2.6372	0.963	393	0.0237	2.8699	0.987	27	16	44	19.5 ± 14.0	0.010
	Total	0.0487	2.6624	0.967	814	0.0243	2.8695	0.992	34	16	50	38.3 ± 19.9	0.001
2002	F	0.0466	2.6703	0.776	1415	0.0572	2.6224	0.990	21	22	43	18.6 ± 2.1	0.000
	M	0.0402	2.7166	0.787	1497	0.0338	2.7713	0.995	22	22	44	12.5 ± 5.3	0.000
	Total	0.0430	2.6960	0.782	2912	0.0433	2.7031	0.994	23	22	44	19.6 ± 4.5	0.000
2003	F	0.0113	3.0672	0.877	1251	0.0216	2.8811	0.985	21	21	43	-1.6 ± 7.7	0.689
	M	0.0128	3.0275	0.872	1264	0.0235	2.8581	0.990	21	22	45	0.2 ± 8.0	0.970
	Total	0.0120	3.0473	0.874	2515	0.0202	2.9025	0.990	23	21	45	0.5 ± 6.3	0.871

Table 4c - Redfish (*S. mentella*), Div. 3O: Length - Weight relationships calculated by the two methods and t-test between them.

Redfish (*S. mentella*), Div. 3O													
Year	Sex	1st method (all point observed)				2nd method (mean weight per length)				Length range(cm)		Paired t-test 1st *vs* 2nd method	
		a	b	r^2	n	a	b	r^2	n means	min	max	Mean paired diff.	*P*
1998	F	0.0862	2.4917	0.911	1575	0.0579	2.6012	0.989	28	16	46	-3.7 ± 3.9	0.071
	M	0.0915	2.4675	0.944	1719	0.0722	2.5389	0.995	27	19	45	9.3 ± 5.0	0.001
	Total	0.0917	2.4700	0.931	3294	0.0590	2.5949	0.992	29	16	46	4.1 ± 6.3	0.197
1999	F	0.0724	2.5121	0.877	3273	0.0269	2.8225	0.994	32	12	44	44.4 ± 22.2	0.000
	M	0.0643	2.5496	0.896	3321	0.0246	2.8414	0.994	33	13	45	33.3 ± 19.0	0.001
	Total	0.0678	2.5329	0.888	6594	0.0245	2.8455	0.995	34	12	45	39.1 ± 21.2	0.001
2000	F	0.0912	2.4750	0.964	387	0.0736	2.5371	0.995	28	18	45	4.3 ± 3.5	0.023
	M	0.0683	2.5446	0.970	369	0.0491	2.6360	0.991	29	16	44	-2.6 ± 2.8	0.072
	Total	0.0779	2.5137	0.964	756	0.0480	2.6512	0.992	30	16	45	2.7 ± 6.1	0.377
2001	F	0.1294	2.3880	0.978	238	0.1000	2.4620	0.993	28	18	46	3.7 ± 4.1	0.087
	M	0.1017	2.4455	0.976	228	0.0725	2.5413	0.993	28	17	46	0.6 ± 4.2	0.791
	Total	0.1131	2.4210	0.975	466	0.0778	2.5272	0.993	29	17	46	2.3 ± 5.1	0.376
2002	F	0.0655	2.5693	0.925	82	0.0394	2.7220	0.989	18	7	34	-0.2 ± 3.6	0.924
	M	0.1172	2.3698	0.893	71	0.1286	2.3436	0.985	17	18	35	1.6 ± 0.3	0.000
	Total	0.0824	2.4887	0.910	153	0.0422	2.6918	0.991	19	7	35	3.2 ± 5.7	0.279
2003	F	0.2676	2.1075	0.890	87	0.0962	2.4346	0.959	19	19	39	32.3 ± 17.4	0.002
	M	0.2595	2.1275	0.896	73	0.1891	2.2268	0.957	14	19	33	2.7 ± 2.8	0.078
	Total	0.2878	2.0898	0.891	160	0.1036	2.4137	0.962	19	19	39	28.9 ± 16.6	0.003

Table 5a - Redfish (*S. marinus*), Div. 3LN: Length - Weight relationships calculated by the two methods and t-test between them.

Redfish (*S. marinus*), Div. 3LN													
Year	Sex	1st method (all point observed)				2nd method (mean weight per length)				Length range(cm)		Paired t-test 1st *vs* 2nd method	
		a	b	r^2	n	a	b	r^2	n means	min	max	Mean paired diff.	*P*
1999	F	0.1685	2.2981	0.960	75	0.1749	2.2913	0.980	15	21	36	5.6 ± 0.8	0.000
	M	0.1866	2.2569	0.957	68	0.1468	2.3336	0.980	18	21	38	10.0 ± 4.3	0.000
	Total	0.1633	2.3022	0.956	143	0.1544	2.3252	0.984	18	21	38	9.8 ± 2.6	0.000
2000	F	0.0406	2.6968	0.953	152	0.0371	2.7282	0.992	17	26	42	11.7 ± 3.4	0.000
	M	0.0223	2.8575	0.979	103	0.0265	2.8106	0.995	14	27	40	3.1 ± 1.0	0.000
	Total	0.0345	2.7397	0.960	255	0.0394	2.7069	0.992	17	26	42	9.0 ± 0.5	0.000
2001	F	0.2803	2.1459	0.938	63	0.2187	2.2244	0.963	17	20	38	6.8 ± 3.9	0.003
	M	0.3585	2.0591	0.890	42	0.2029	2.2363	0.953	17	21	39	18.2 ± 9.5	0.001
	Total	0.3184	2.1025	0.914	105	0.2002	2.2475	0.970	20	20	39	14.9 ± 7.6	0.001

Table 5b - Redfish (*S. marinus*), Div. 3M: Length - Weight relationships calculated by the two methods and t-test between them.

Redfish (*S. marinus*), Div. 3M													
Year	Sex	1st method (all point observed)				2nd method (mean weight per length)				Length range(cm)		Paired t-test 1st *vs* 2nd method	
		a	b	r^2	n	a	b	r^2	n means	min	max	Mean paired diff.	*P*
1998	F	0.0195	2.9208	0.964	21	0.0195	2.9232	0.964	12	20	43	1.6 ± 0.8	0.003
	M	0.0028	3.4888	0.978	12	0.0034	3.4285	0.984	9	21	31	-2.1 ± 1.6	0.037
	Total	0.0111	3.0847	0.962	33	0.0127	3.0417	0.964	14	20	43	-3.0 ± 3.9	0.139
2001	F	0.1920	2.2682	0.977	67	0.1297	2.3870	0.988	21	18	42	9.9 ± 7.0	0.010
	M	0.1378	2.3484	0.956	55	0.1265	2.3792	0.965	16	20	36	7.3 ± 2.3	0.000
	Total	0.1648	2.3052	0.962	122	0.0958	2.4702	0.985	22	18	42	13.8 ± 9.6	0.009

Table 5c - Redfish (*S. marinus*), Div. 3O: Length - Weight relationships calculated by the two methods and t-test between them.

Redfish (*S. marinus*), Div. 3O													
Year	Sex	1st method (all point observed)				2nd method (mean weight per length)				Length range(cm)		Paired t-test 1st *vs* 2nd method	
		a	b	r^2	n	a	b	r^2	n means	min	max	Mean paired diff.	*P*
1998	F	0.1051	2.4565	0.974	33	0.0972	2.4799	0.982	13	21	34	0.3 ± 0.7	0.458
	M	0.0820	2.5134	0.940	87	0.0647	2.5832	0.990	18	20	37	0.6 ± 2.3	0.632
	Total	0.0849	2.5079	0.942	120	0.0658	2.5816	0.989	18	20	37	-1.2 ± 2.1	0.262
1999	F	0.1191	2.4067	0.964	450	0.0570	2.6227	0.981	25	15	40	3.6 ± 8.3	0.389
	M	0.0573	2.6158	0.967	438	0.0305	2.7942	0.984	32	12	45	1.5 ± 7.4	0.694
	Total	0.0752	2.5395	0.964	888	0.0350	2.7582	0.987	32	12	45	6.4 ± 10.3	0.223
2000	F	0.0857	2.4857	0.913	270	0.0356	2.7425	0.967	24	18	42	9.3 ± 11.9	0.130
	M	0.0594	2.5809	0.879	163	0.0686	2.5405	0.997	21	19	41	1.6 ± 1.0	0.005
	Total	0.0702	2.5399	0.899	433	0.0331	2.7586	0.971	24	18	42	6.4 ± 9.6	0.197
2001	F	0.1018	2.4558	0.976	139	0.0871	2.5065	0.990	25	20	44	14.0 ± 5.2	0.000
	M	0.1054	2.4377	0.980	84	0.0768	2.5339	0.989	21	20	41	9.2 ± 5.8	0.005
	Total	0.0980	2.4640	0.978	223	0.0745	2.5484	0.991	25	20	44	14.0 ± 6.6	0.000

Table 6a - American plaice, Div. 3LNO: Length - Weight relationships calculated by the two methods and t-test between them.

American plaice, Div. 3LNO													
Year	Sex	1st method (all point observed)				2nd method (mean weight per length)				Length range(cm)		Paired t-test 1st *vs* 2nd method	
		a	b	r^2	n	a	b	r^2	n means	min	max	Mean paired diff.	*P*
1998	F	0.0077	3.0790	0.893	2501	0.0023	3.3848	0.982	40	22	68	-3.1 ± 24.6	0.805
	M	0.0101	2.9924	0.834	1991	0.0014	3.5257	0.981	31	23	60	45.9 ± 44.6	0.048
	Total	0.0071	3.0974	0.884	4492	0.0018	3.4448	0.981	41	22	68	13.4 ± 31.6	0.400
1999	F	0.0024	3.3753	0.989	984	0.0017	3.4641	0.994	48	10	72	49.4 ± 19.9	0.000
	M	0.0019	3.4341	0.978	619	0.0015	3.4947	0.989	31	11	52	-28.9 ± 6.4	0.000
	Total	0.0022	3.3952	0.987	1603	0.0016	3.4796	0.995	51	10	72	35.7 ± 15.8	0.000
2000	F	0.0014	3.5067	0.983	605	0.0007	3.6999	0.991	51	16	70	53.0 ± 28.4	0.000
	M	0.0004	3.8729	0.968	306	0.0004	3.8330	0.969	33	15	48	-23.4 ± 8.8	0.000
	Total	0.0010	3.6080	0.979	911	0.0006	3.7444	0.990	54	15	70	10.7 ± 12.7	0.098
2001	F	0.0014	3.5243	0.987	688	0.0008	3.6544	0.994	53	16	70	57.6 ± 24.9	0.000
	M	0.0004	3.8468	0.979	309	0.0004	3.8299	0.991	29	19	47	-18.2 ± 6.1	0.000
	Total	0.0010	3.5944	0.986	997	0.0008	3.6817	0.994	53	16	70	30.7 ± 14.6	0.000
2002	F	0.0021	3.4053	0.971	2018	0.0011	3.5845	0.994	49	18	67	16.5 ± 16.5	0.051
	M	0.0017	3.4693	0.949	1402	0.0008	3.6738	0.987	35	21	59	-17.8 ± 6.3	0.000
	Total	0.0020	3.4196	0.966	3420	0.0010	3.6001	0.994	49	18	67	7.7 ± 14.4	0.289
2003	F	0.0035	3.2813	0.969	2333	0.0037	3.2628	0.990	54	10	71	-8.0 ± 3.4	0.000
	M	0.0024	3.3803	0.939	1577	0.0021	3.4082	0.991	41	18	60	-35.5 ± 8.1	0.000
	Total	0.0031	3.3150	0.961	3910	0.0035	3.2769	0.989	54	10	71	-22.2 ± 8.5	0.000

Table 6b - American plaice, Div. 3M: Length - Weight relationships calculated by the two methods and t-test between them.

American plaice, Div. 3M													
Year	Sex	1st method (all point observed)				2nd method (mean weight per length)				Length range(cm)		Paired t-test 1st *vs* 2nd method	
		a	b	r^2	n	a	b	r^2	n means	min	max	Mean paired diff.	*P*
1998	F	0.0057	3.1511	0.940	278	0.0047	3.2065	0.997	25	32	57	3.7 ± 4.0	0.076
	M	0.0035	3.2749	0.950	231	0.0048	3.1897	0.995	23	31	54	-4.9 ± 5.2	0.072
	Total	0.0040	3.2436	0.950	509	0.0041	3.2358	0.998	27	31	57	2.2 ± 0.1	0.000
2001	F	0.0026	3.3550	0.974	191	0.0018	3.4581	0.984	28	30	65	66.7 ± 24.8	0.000
	M	0.0075	3.0582	0.987	81	0.0078	3.0473	0.996	14	31	44	-2.6 ± 0.8	0.000
	Total	0.0029	3.3224	0.985	272	0.0018	3.4602	0.989	32	30	65	58.4 ± 25.7	0.000
2002	F	0.0046	3.1978	0.987	107	0.0030	3.3112	0.994	21	29	55	12.2 ± 8.2	0.008
	M	0.0166	2.8397	0.951	32	0.0097	2.9869	0.986	12	31	42	-2.6 ± 3.3	0.152
	Total	0.0048	3.1845	0.988	139	0.0035	3.2723	0.995	26	29	55	10.8 ± 6.7	0.003
2003	F	0.0058	3.1415	0.952	115	0.0059	3.1388	0.981	19	35	55	5.2 ± 0.9	0.000
	M	0.0072	3.0867	0.940	125	0.0062	3.1276	0.989	23	33	62	4.3 ± 3.8	0.033
	Total	0.0064	3.1155	0.947	240	0.0079	3.0631	0.995	24	33	62	2.9 ± 3.1	0.082

Table 7 - Yellowtail flounder, Div. 3LNO: Length - Weight relationships calculated by the two methods and t-test between them.

Yellowtail flounder, Div. 3LNO													
Year	Sex	1st method (all point observed)				2nd method (mean weight per length)				Length range(cm)		Paired t-test 1st *vs* 2nd method	
		a	b	r^2	n	a	b	r^2	n means	min	max	Mean paired diff.	*P*
1999	F	0.0018	3.4652	0.961	121	0.0016	3.4807	0.984	26	16	49	-20.3 ± 5.1	0.000
	M	0.0001	4.3877	0.955	68	0.0003	3.9680	0.967	13	26	41	-19.1 ± 17.7	0.052
	Total	0.0010	3.6294	0.957	189	0.0015	3.5069	0.983	26	16	49	-31.1 ± 12.9	0.000
2000	F	0.0014	3.5175	0.975	202	0.0016	3.4748	0.978	34	15	51	-23.4 ± 8.4	0.000
	M	0.0006	3.7559	0.951	86	0.0011	3.5655	0.944	21	11	39	-14.5 ± 7.4	0.001
	Total	0.0010	3.6044	0.970	288	0.0020	3.4082	0.976	35	11	51	-32.8 ± 15.8	0.000
2001	F	0.0011	3.5878	0.966	180	0.0005	3.7671	0.976	31	20	56	-18.0 ± 4.2	0.000
	M	0.0004	3.8502	0.942	96	0.0002	4.0390	0.976	17	23	39	-8.0 ± 1.3	0.000
	Total	0.0010	3.6166	0.966	276	0.0005	3.7886	0.979	32	20	56	-27.2 ± 3.8	0.000
2002	F	0.0032	3.2894	0.967	348	0.0023	3.3813	0.977	34	13	50	-5.6 ± 1.6	0.000
	M	0.0026	3.3471	0.960	159	0.0030	3.3093	0.982	26	22	51	-9.7 ± 4.0	0.000
	Total	0.0030	3.3056	0.965	507	0.0023	3.3752	0.978	35	13	51	-10.9 ± 1.4	0.000
2003	F	0.0062	3.1181	0.894	258	0.0052	3.1654	0.984	20	29	51	-4.0 ± 1.2	0.000
	M	0.0078	3.0575	0.893	211	0.0069	3.0956	0.986	19	29	47	7.4 ± 2.8	0.000
	Total	0.0070	3.0873	0.894	469	0.0053	3.1635	0.988	20	29	51	6.5 ± 4.7	0.011

Table 8 - Greenland halibut, Div. 3LMNO: Length - Weight relationships calculated by the two methods and t-test between them.

Greenland halibut, Div. 3LMNO													
Year	Sex	1st method (all point observed)				2nd method (mean weight per length)				Length range(cm)		Paired t-test 1st *vs* 2nd method	
		a	b	r^2	n	a	b	r^2	n means	min	max	Mean paired diff.	*P*
1998	F	0.0027	3.3007	0.958	10698	0.0014	3.4830	0.994	72	24	97	519.5 ± 146.7	0.000
	M	0.0038	3.2059	0.956	10303	0.0019	3.4014	0.995	64	26	89	296.9 ± 88.7	0.000
	Total	0.0031	3.2577	0.957	21001	0.0015	3.4717	0.994	73	24	97	548.9 ± 154.5	0.000
1999	F	0.0025	3.3356	0.958	11006	0.0011	3.5626	0.993	71	22	97	571.1 ± 168.5	0.000
	M	0.0045	3.1703	0.944	10888	0.0026	3.3206	0.997	57	25	85	183.3 ± 58.2	0.000
	Total	0.0032	3.2667	0.952	21894	0.0012	3.5397	0.993	72	22	97	650.2 ± 192.1	0.000
2000	F	0.0006	3.6875	0.994	1353	0.0004	3.7804	0.994	64	29	95	202.0 ± 64.0	0.000
	M	0.0009	3.5800	0.989	1136	0.0029	3.2927	0.963	41	22	91	-59.8 ± 78.9	0.138
	Total	0.0007	3.6768	0.992	2489	0.0009	3.6159	0.978	66	22	95	139.1 ± 22.8	0.000
2001	F	0.0006	3.6918	0.993	1859	0.0006	3.7140	0.994	67	25	92	189.4 ± 48.0	0.000
	M	0.0008	3.6078	0.993	1300	0.0011	3.5375	0.997	35	25	63	-2.4 ± 4.7	0.325
	Total	0.0006	3.6934	0.993	3159	0.0006	3.7320	0.994	67	25	92	221.3 ± 58.1	0.000
2002	F	0.0023	3.3558	0.960	6782	0.0012	3.5518	0.994	70	24	94	508.7 ± 147.2	0.000
	M	0.0051	3.1397	0.932	6605	0.0028	3.3023	0.998	47	24	74	53.0 ± 24.9	0.000
	Total	0.0030	3.2821	0.950	13387	0.0011	3.5721	0.994	70	24	94	628.5 ± 187.9	0.000
2003	F	0.0054	3.1316	0.950	5411	0.0017	3.4544	0.990	68	22	94	561.3 ± 173.5	0.000
	M	0.0143	2.8752	0.936	5460	0.0073	3.0586	0.995	52	21	79	89.0 ± 36.1	0.000
	Total	0.0081	3.0249	0.943	10871	0.0022	3.3895	0.989	69	21	94	628.2 ± 191.0	0.000

Table 9 - Roughhead grenadier, Div. 3LMNO: Length - Weight relationships calculated by the two methods and t-test between them.

Roughhead grenadier, Div. 3LMNO													
Year	Sex	1st method (all point observed)				2nd method (mean weight per length)				Length range(cm)		Paired t-test 1st *vs* 2nd method	
		a	b	r^2	n	a	b	r^2	n means	min	max	Mean paired diff.	*P*
1998	F	0.5535	2.5207	0.923	2945	0.3457	2.7070	0.995	51	7	32	168.8 ± 55.6	0.000
	M	0.6774	2.4474	0.926	2848	0.4407	2.6036	0.993	48	7	31	72.2 ± 29.8	0.000
	Total	0.6138	2.4831	0.924	5793	0.3510	2.6959	0.995	51	7	32	160.4 ± 55.5	0.000
1999	F	0.2195	2.9217	0.994	1405	0.2505	2.8735	0.998	56	7	35.5	-59.2 ± 21.2	0.000
	M	0.1775	2.9877	0.987	1032	0.1374	3.0938	0.997	28	6.5	20	19.6 ± 10.3	0.001
	Total	0.1933	2.9621	0.993	2437	0.2137	2.9229	0.997	57	6.5	35.5	-63.2 ± 21.1	0.000
2000	F	0.2131	2.9187	0.985	551	0.1757	2.9816	0.993	49	7	32.5	18.9 ± 12.7	0.004
	M	0.1885	2.9574	0.957	436	0.1368	3.0894	0.996	26	6.5	19	17.4 ± 10.1	0.002
	Total	0.1978	2.9426	0.981	987	0.1752	2.9822	0.996	51	6.5	32.5	10.6 ± 7.5	0.007
2001	F	0.2260	2.8641	0.987	1417	0.1747	2.9563	0.997	54	6.5	36	74.2 ± 30.1	0.000
	M	0.1872	2.9212	0.965	860	0.1037	3.1441	0.990	24	6.5	18	1.6 ± 7.2	0.657
	Total	0.2024	2.8988	0.986	2277	0.1514	3.0005	0.997	54	6.5	36	71.8 ± 30.8	0.000
2002	F	0.3582	2.7096	0.953	2696	0.3364	2.7548	0.994	56	4	34	125.3 ± 35.8	0.000
	M	0.5723	2.5217	0.943	2194	0.4964	2.5873	0.995	41	5	29.5	41.3 ± 17.1	0.000
	Total	0.3982	2.6657	0.951	4890	0.3409	2.7480	0.994	58	4	34	157.2 ± 47.5	0.000
2003	F	0.6032	2.5381	0.963	1405	0.6888	2.5123	0.995	51	4	29	55.9 ± 12.3	0.000
	M	0.8664	2.3804	0.934	1107	0.6794	2.4713	0.995	41	4.5	27	21.5 ± 12.2	0.001
	Total	0.6376	2.5093	0.956	2512	0.6148	2.5461	0.994	51	4	29	80.0 ± 22.7	0.000

Table 10a - Witch flounder, Div. 3L: Length - Weight relationships calculated by the two methods and t-test between them.

Witch flounder, Div. 3L													
Year	Sex	1st method (all point observed)				2nd method (mean weight per length)				Length range(cm)		Paired t-test 1st *vs* 2nd method	
		a	b	r^2	n	a	b	r^2	n means	min	max	Mean paired diff.	*P*
1998	F	0.0018	3.3499	0.949	186	0.0035	3.1763	0.967	28	28	56	-17.3 ± 10.3	0.002
	M	0.0028	3.2272	0.925	156	0.0013	3.4482	0.953	22	27	48	9.5 ± 7.4	0.018
	Total	0.0020	3.3296	0.942	342	0.0022	3.2955	0.966	29	27	56	-9.2 ± 3.4	0.000
1999	F	0.0006	3.6480	0.961	336	0.0005	3.6871	0.981	33	20	68	20.2 ± 8.4	0.000
	M	0.0059	3.0078	0.906	218	0.0027	3.2288	0.965	21	22	46	11.4 ± 7.1	0.004
	Total	0.0008	3.5537	0.950	554	0.0006	3.6446	0.983	35	20	68	40.7 ± 17.3	0.000
2001	F	0.0004	3.7743	0.961	417	0.0004	3.7893	0.975	32	26	58	19.6 ± 5.7	0.000
	M	0.0140	2.7512	0.893	181	0.0071	2.9431	0.937	17	27	43	5.0 ± 4.2	0.029
	Total	0.0004	3.7244	0.955	598	0.0004	3.7753	0.977	33	26	58	31.0 ± 10.0	0.000
2002	F	0.0006	3.6347	0.943	773	0.0003	3.8734	0.976	34	20	55	23.5 ± 13.9	0.002
	M	0.0009	3.5474	0.922	606	0.0002	3.8959	0.962	30	23	52	6.6 ± 11.1	0.246
	Total	0.0007	3.6071	0.936	1379	0.0002	3.9728	0.975	35	20	55	25.7 ± 18.2	0.008
2003	F	0.0035	3.1835	0.921	573	0.0026	3.2559	0.989	28	27	55	1.0 ± 2.7	0.490
	M	0.0036	3.1670	0.927	524	0.0012	3.4514	0.973	26	29	55	3.5 ± 10.6	0.518
	Total	0.0035	3.1770	0.924	1097	0.0022	3.2998	0.986	29	27	55	2.9 ± 4.8	0.246

Table 10b - Witch flounder, Div. 3NO: Length - Weight relationships calculated by the two methods and t-test between them.

Witch flounder, Div. 3NO													
Year	Sex	1st method (all point observed)				2nd method (mean weight per length)				Length range(cm)		Paired t-test 1st *vs* 2nd method	
		a	b	r^2	n	a	b	r^2	n means	min	max	Mean paired diff.	*P*
1999	F	0.0009	3.5401	0.945	228	0.0016	3.4006	0.969	29	17	57	26.1 ± 2.9	0.000
	M	0.0296	2.5487	0.867	131	0.0038	3.1322	0.931	17	27	44	16.4 ± 13.9	0.031
	Total	0.0012	3.4542	0.930	359	0.0014	3.4355	0.969	30	17	57	41.6 ± 10.3	0.000
2000	F	0.0002	3.9804	0.958	115	0.0002	3.8935	0.971	24	33	60	5.0 ± 3.1	0.004
	M	0.0394	2.4525	0.788	47	0.0136	2.7588	0.916	10	30	43	12.8 ± 7.6	0.008
	Total	0.0001	4.0419	0.962	162	0.0003	3.8428	0.973	26	30	60	9.0 ± 7.1	0.017
2001	F	0.0006	3.6683	0.961	27	0.0008	3.5758	0.969	15	33	52	-3.2 ± 4.0	0.132
	M	0.0493	2.3965	0.858	14	0.0887	2.2346	0.883	7	34	40	0.7 ± 1.9	0.516
	Total	0.0002	3.9206	0.956	41	0.0003	3.8036	0.963	18	33	52	1.6 ± 3.4	0.353
2002	F	0.0008	3.5691	0.945	438	0.0010	3.5194	0.980	31	25	55	25.9 ± 5.1	0.000
	M	0.0176	2.7063	0.831	208	0.0095	2.8836	0.965	18	27	44	9.0 ± 5.1	0.002
	Total	0.0011	3.4933	0.933	646	0.0009	3.5420	0.980	31	25	55	35.8 ± 10.7	0.000
2003	F	0.0013	3.4661	0.940	479	0.0017	3.3852	0.989	35	24	59	-9.4 ± 5.6	0.002
	M	0.0024	3.2892	0.781	138	0.0038	3.1538	0.979	16	28	43	-0.9 ± 2.8	0.538
	Total	0.0013	3.4605	0.933	617	0.0019	3.3552	0.992	35	24	59	-6.6 ± 5.9	0.032

Table 11 - White hake, Div. 3NO: Length - Weight relationships calculated by the two methods and t-test between them.

White hake, Div. 3NO													
Year	Sex	1st method (all point observed)				2nd method (mean weight per length)				Length range(cm)		Paired t-test 1st *vs* 2nd method	
		a	b	r^2	n	a	b	r^2	n means	min	max	Mean paired diff.	*P*
2001	Total	0.0009	3.6330	0.969	247	0.0006	3.7583	0.991	43	21	70	28.4 ± 20.1	0.007
2002	Total	0.0056	3.1695	0.968	523	0.0080	3.0825	0.993	57	22	92	-33.3 ± 22.1	0.004
2003	Total	0.0062	3.1344	0.975	605	0.0042	3.2309	0.995	60	16	87	43.8 ± 23.1	0.000

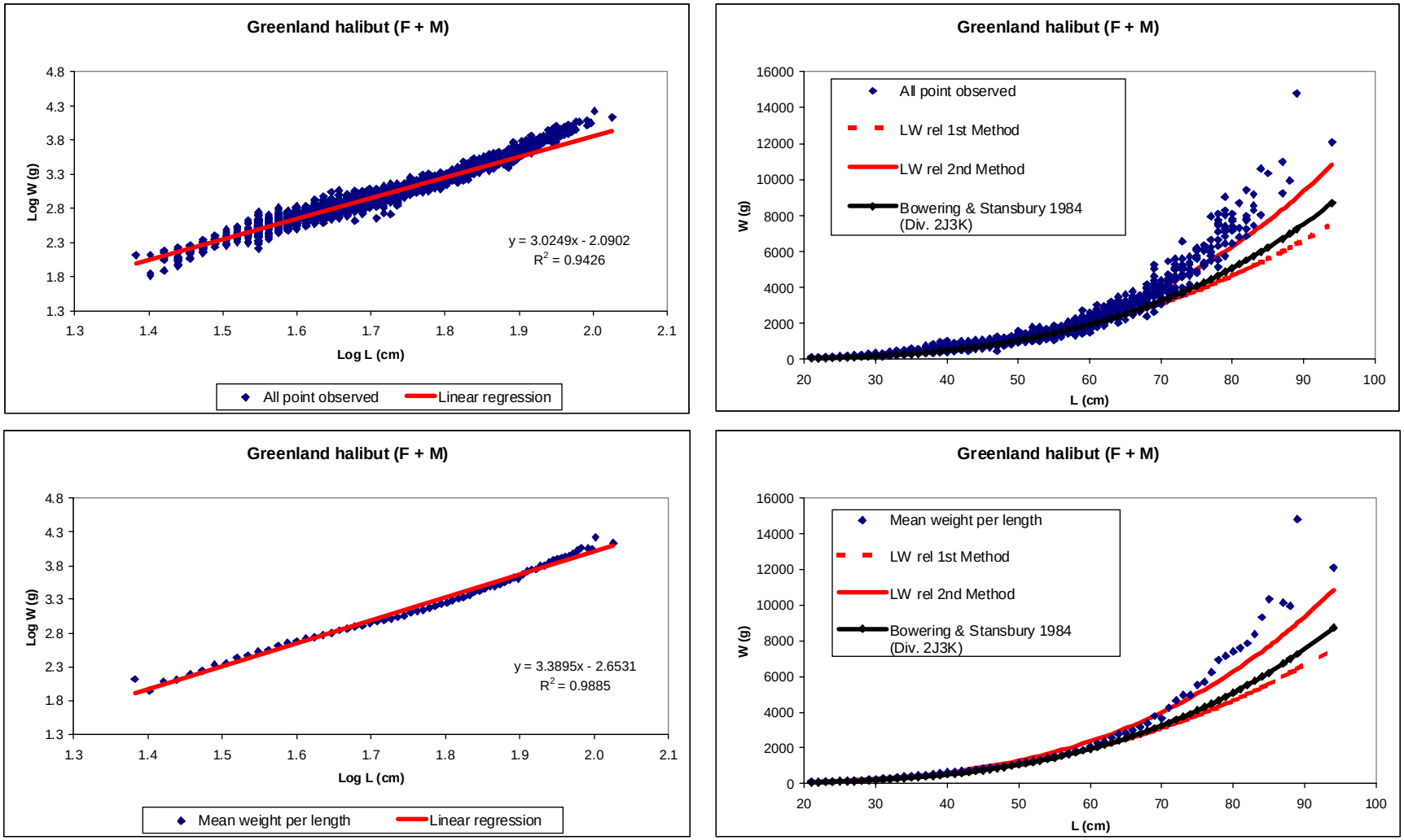

Fig. 1: 2003 Greenland halibut LW relationships: linear regression between log L - log W and the retransformed equations.