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AGE-LENGTH KEY STUDIES

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Introduction

Preliminary analysis of the 1961-63 data indicated that, even between keys constructed by the same country in the same month, there were statistical differences in the distribution of ages within a length group. This is not surprising when one considers the number of factors that could contribute to the overall variability within a key.

The main objective of this project was to investigate the extent to which the various age-length keys which have been compiled can satisfactorily be applied to length distributions from other areas or seasons and on the consistency of the keys compiled by different workers.

A glance at the number of factors involved would indicate that some of them could be eliminated as basis for comparisons since differences are to be expected. Hence no comparisons are being attempted between

a/ species
b/ years
c/ ICNAF Subareas

Three stages of analysis were envisaged, viz.:

a/ Comparison of the mean ages within length groups and the distribution of ages within length groups;

b/ To compare the age distributions which result from applying different age-length keys to the same length distribution;

and a possible

c/ The examination of the effect of the keys on the parameters such as mortality rates and recruitment rates which are derived from the age distribution.

Limitations of the Data

Table 1 shows the distribution of the keys according to countries, species, and gear. It is obvious that no comparisons are possible for redfish, silver hake, and herring, as USSR is the only supplier of keys. The keys for haddock came from USSR and USA, but no comparisons were attempted as the samples were taken in areas widely apart and hence any differences seemed to be due to area and season. Thus, all the following tables and results pertain to cod only.

Preliminary Selection of Keys for Comparison

As numerous factors were involved in the total variation within a key /area, depth, time of fishing, ageing technique, etc./, it was decided first to eliminate as far as possible all extraneous variations and select keys for which as many factors as possible were common. The hypothesis was that for keys produced by different countries from samples taken in the same area, time, and gear /some comparisons with different gears were attempted/, the age distribution within a length group should be the same /except for sampling differences/ provided the ageing techniques were not widely different. In this report, each length group within a selected key is analysed in detail.

In formulating a method of approach to tackle this problem, K.R. Allen has argued that while the length distribution within an age group may not represent a random sample, the age distribution within a length group could be considered as a random sample. A computer program was therefore developed to calculate the mean age and variance of age and per cent distribution of age within a length group, the overall mean age and mean length for the entire key, and a regression of length on age as a crude index of the growth parameter. The results for a number of keys are given in Table 2 /omitting overall mean age and mean length/.

Age Composition of Hypothetical Catch

One of the major aims of this study was to investigate the extent of disagreement between the age-length keys produced by different countries. The distribution of ages within a length group was considered a reasonable criterion to test this phenomenon as assuming all other factors /area, period, and gear/ being similar, the differences most likely are due to differences in ageing techniques. A length distribution /Table 3/ was applied to the keys already shown in Table 2, and the results are in Table 4. It is obvious that the age distribution within selected length groups varies widely.

Comparison of Year-Class Strength

Since the age composition of samples from catches is the main basis for arriving at such population characteristics as mortality, growth, the overall age distribution of the age-length key was used to arrive at the year-class strength of a hypothetical population using the length sample in Table 3. The results are presented in Table 5.

Discussion and Conclusions

This study is still not conclusive evidence that the age-length keys cannot be pooled as we have not investigated the effects of pooling on the population parameters such as mortality and growth. The material available for consideration was scanty in that much of it was not comparable. However, bearing this in mind, the information presented in this report indicates in some cases that either ageing techniques or sampling methods between countries are different. This is by no means new information, but lends support to the need for an attempt to standardize ageing and sampling techniques.

Table 1. Classification of keys by country, species, and gear.

Country	Species	Gear	No. of keys
USSR	Cod	Otter trawl	44
	Haddock	"	5
	Redfish	"	160
	Silver Hake	"	36
	Herring	"	5
			250
Denmark	Cod	Greenlander	27
		Longline	23
		Handline	28
		Otter trawl	13
		Shrimp trawl	1
			92
Germany	Cod	Otter trawl	71
Portugal	Cod	Otter trawl	63
U.K.	Cod	Otter trawl	14
Norway	Cod	Various	14
France	Cod	Otter trawl	9
Poland	Cod	Otter trawl	4
USA	Haddock	Various	12
USA/Canada	Haddock	Otter trawl	8
TOTAL			541

Table 1(a). Classification of keys according to gear.

Otter trawl	80%
Greenlander	5
Longline	4
Handline	5
Various	6
	100%

Table 2. Mean age for selected range of length groups in age-length keys.

Country	Area	Period & Gear	Length group	Mean age	Var. of age	Slope
Germany (1000)	1D	Jan 61 OT	75(140)	8.6	2.69	
			78(144)	9.1	3.57	
			81(120)	8.0	0.14	2.78
			84(109)	8.8	3.80	
Denmark (91)	1D	Jan 61 LL	75(14)	10.2	3.14	
			78(13)	10.1	9.14	
			81(8)	11.0	7.71	3.20
			84(4)	13.7	20.25	
Germany (1000)	1F	July 61 OT	54(215)	5.2	0.39	
			57(164)	5.4	0.66	
			60(97)	5.4	0.68	
			63(39)	6.6	1.40	4.26
Denmark (198)	1F	July 61 Greenl.	54(47)	5.0	0.15	
			57(51)	4.9	0.07	6.91
			60(42)	5.0	0.04	
			63(20)	5.2	0.30	
Portugal (605)	3Ps	Apr 61 OT	54(45)	5.7	0.40	
			57(105)	6.0	0.37	3.13
			60(50)	6.4	0.65	
			63(55)	6.6	0.79	
France (89)	3Ps	Apr 61 OT	54(17)	5.0	0.05	
			57(13)	5.9	0.07	9.05 (?)
			60(10)	6.0	0.00	
			63(10)	6.0	0.22	
France (255)	4R	Mar 61 OT	51(29)	6.3	1.88	
			54(37)	6.1	0.99	
			57(28)	6.2	1.36	4.71
			60(24)	6.2	0.73	
Portugal (515)	4R	Mar 61 OT	51(75)	5.6	0.63	
			54(30)	5.8	0.49	
			57(45)	6.2	0.63	4.75
			60(25)	6.4	0.25	
France (82)	4T	Apr 61 OT	45(11)	5.1	0.56	
			48(14)	6.0	0.15	4.66
			51(7)	6.5	0.29	
			54(13)	6.5	1.27	
Portugal (563)	4T	Apr 61 OT	45(20)	4.5	0.26	
			48(60)	5.8	0.14	
			51(120)	6.7	0.53	3.42
			54(100)	6.6	1.05	

continued

Table 2 (continued)

Country	Area	Period & Gear	Length group	Mean age	Var. of age	Slope
Canada (NF) (980)	3L	Mar 61	58(63)	6.0	0.05	
			61(61)	6.0	0.08	6.76
			64(40)	6.3	0.33	
			67(27)	6.6	0.69	
Portugal (567)	3L	Apr 61	57(56)	6.0	0.00	
			60(50)	6.7	2.66	3.72
			63(91)	6.0	0.44	
			66(50)	6.6	0.45	
Canada (NF) (1003)	3M	Mar 61	37(64)	3.2	0.19	
			40(62)	3.9	0.24	7.19
			43(72)	4.0	0.09	
			46(67)	4.3	0.22	
USSR (757)	3M	Mar 61	36(5)	4.0	0.00	
			39(14)	3.8	0.13	4.05
			42(37)	4.3	0.35	
			45(51)	4.8	0.54	
Denmark (185)	Green-land	Aug 62 Greenl.	66(20)	6.0	0.05	
			69(19)	6.1	0.09	
			72(28)	6.6	1.35	3.90
			75(22)	6.7	1.16	
Germany (1000)	Green-land	Aug 62 OT	66(22)	5.3	0.22	
			69(52)	6.0	0.00	
			72(66)	5.9	0.30	3.47
			75(108)	6.1	1.37	
Portugal (396)	1D	May 62 LL	54(20)	4.6	0.24	
			57(47)	5.0	0.00	
			60(27)	5.2	0.20	4.20
			63(87)	5.0	0.07	
USSR (900)	1D	May 62 OT	54(70)	4.2	0.19	
			57(41)	4.6	0.29	
			60(67)	5.0	0.08	4.57
			63(61)	5.1	0.23	
Denmark (226)	1B	July 62 HL	54(29)	4.6	0.23	
			57(27)	4.9	0.07	
			60(32)	5.0	0.00	5.75
			63(29)	5.0	0.00	
Portugal (430)	1B	July 62 LL	54(30)	5.0	0.00	
			57(67)	4.9	0.04	4.91
			60(90)	5.0	0.03	
			63(76)	5.2	0.27	
Canada (NF) (995)	2J	Sept 62	49(42)	5.0	0.00	
			52(42)	5.4	0.25	1.27
			55(75)	6.5	1.39	
			58(99)	7.7	2.35	
USSR (300)	2J	Oct 62	48(48)	5.7	0.34	
			51(48)	6.4	3.19	2.10
			54(40)	6.8	1.45	
			57(25)	7.6	4.33	

Continued

Table 2 (continued)

Country	Area	Period & Gear	Length group	Mean age	Var. of age	Slope
Germany (1000)	1D	May 63 OT	59(34)	4.3	0.22	
			62(67)	5.2	0.56	
			65(67)	5.5	0.25	6.68
			68(118)	5.4	0.42	
Norway (49)	1D	May 63 OT	57(7)	5.0	0.33	
			60(7)	5.7	0.24	5.89
			63(10)	5.9	0.10	
			66(5)	6.0	0.00	
USSR (299)	1D	Aug 63 OT	60(13)	5.2	0.19	
			63(44)	5.6	0.32	
			66(38)	5.8	0.26	5.13
			69(53)	6.0	0.19	
Germany (1000)	1D	Aug 63 OT	59(30)	5.3	0.63	
			62(41)	5.3	0.69	
			65(80)	5.2	0.19	4.01
			68(103)	6.0	0.00	
Norway (44)	1D	May 63 LL	54(5)	4.8	0.20	
			57(3)	5.0	0.00	
			60(4)	5.0	0.67	3.89
			63(6)	5.6	0.27	
Denmark (212)	1D	May 63 HL	54(23)	4.6	0.77	
			57(30)	4.8	0.32	
			60(26)	5.2	0.18	7.18
			63(21)	5.5	0.36	
Germany (1000)	1E	Apr 63 OT	56(80)	5.1	0.12	
			59(145)	5.2	0.20	4.56
			62(132)	5.5	0.49	
			65(162)	5.9	0.21	
Iceland (197)	1E	Apr 63 OT	57(32)	5.1	0.24	
			60(25)	5.3	0.31	5.16
			63(27)	5.7	0.43	
			66(24)	5.7	0.39	
Iceland (194)	1E	May 63 OT	63(21)	6.5	1.46	
			66(28)	6.5	0.40	
			69(19)	6.4	0.60	3.49
			72(24)	6.7	0.82	
Germany (1000)	1E	May 63 OT	62(54)	6.0	0.18	
			65(129)	6.2	0.76	
			68(208)	6.2	0.25	1.35 (?)
			71(205)	6.3	0.70	
Portugal (299)	2J	May 63 OT	45(23)	7.2	1.35	
			48(33)	8.6	5.08	
			51(40)	9.1	5.36	2.27
			54(45)	10.8	11.66	

continued

Table 2 (continued)

Country	Area	Period & Gear	Length group	Mean age	Var. of age	Slope
Canada (NF) (985)	2J	Apr 63	46(100)	6.1	0.44	
			49(75)	6.2	0.41	
			52(74)	6.9	1.09	4.17
			55(93)	7.0	1.68	
USSR (944)	2J	Apr 63	45(136)	6.8	0.49	
			48(170)	7.0	0.88	
			51(141)	7.3	1.02	3.26
			54(101)	7.6	1.39	
Canada (NF) (1009)	2J	May 63	46(88)	6.0	0.18	
			49(82)	6.2	0.42	
			52(78)	6.5	0.95	4.34
			55(63)	6.7	1.90	
Portugal (328)	2J	May 63	45(23)	6.5	0.44	
			48(33)	6.4	0.69	
			51(40)	7.1	1.48	2.27
			54(45)	7.2	1.35	
Canada (1003)	2J	Sept 63	46(98)	5.4	0.56	
			49(91)	5.7	0.67	
			52(57)	5.7	0.52	4.20
			55(55)	6.3	1.35	
Portugal (398)	2J	Sept 63	45(45)	5.5	0.71	
			48(54)	5.7	0.64	
			51(62)	6.2	0.98	2.67
			54(55)	6.4	1.21	
USSR (797)	2J	May 63 OT	45(92)	7.1	0.30	
			48(106)	7.6	1.16	
			51(89)	8.4	1.99	2.56
			54(107)	9.0	2.19	

NOTE: (a) Numbers in ( ) under country represent the total number of fish in the key.

(b) Numbers in ( ) on the right side of mean age represent the number of fish in the length group.

Table 3. Length distribution used on selected keys to obtain hypothetical age composition. (Sample from Canada)

Length group	Frequency	Length group	Frequency
21	39	57	869
24	76	60	616
27	216	63	399
30	435	66	274
33	591	69	183
36	1364	72	104
39	1753	75	90
42	1759	78	51
45	2405	81	28
48	2605	84	27
51	1688	87	19
54	1179	90	11
			16781

Table 4. Distribution of fish from sample in Table 3 into age groups by using different age-length keys.

Country	Factors common for countries	Length group in sample	No. of fish	Distribution of ages according to age-length keys												
				4	5	6	7	8	9	10	11	12	13	14	15	16
Germany	1D	75	90				4	70			8	4		4		
	OT	78	51					54	3	1	8			5		
	Jan	81	28				1	24	3							
	1961	84	27					21	2				2	2		
Denmark	1D	75	90					13	26	7	33		6	6		
	LL	78	51													>16
	Jan	81	28					21	9	4	13	4				
	1961	84	27					9						18		
Germany	1F	54	1179		993	164			22							
	OT	57	869		572	228	48		21							
	July	60	616		406	171	19		20							
	1961	63	399		102	72	102	123								
Denmark	1F	54	1179	25	1104	25	25									
	Greenlander	57	869	51	801	17										
	July	60	616		587	29										
	1961	63	399		319	60	20									
Portugal	3Ps	54	1179		393	655	131									
	OT	57	869		124	538	207									
	Apr	60	616		62	308	185	62								
	1961	63	399			218	145		36							
France	3Ps	54	1179		1110	69										
	OT	57	869		67	802										
	Apr	60	616			616										
	1961	63	399		40	319	40									

Continued

Table 4 (continued)

Country	Factors common for countries	Length group in sample	No. of fish	Distribution of ages according to age-length keys												
				4	5	6	7	8	9	10	11	12	13	14	15	16
France	4R	51	1688	58	349	815	116	116	233							
	OT	54	1179		255	605	223	32	64							
	Mar	57	869		279	279	218	31	62							
	1961	60	616		105	282	180	51								
Portugal	4R	51	1688		788	788		113								
	OT	54	1179		393	590	197									
	Mar	57	869		195	290	386									
	1961	60	616			370	246									
France	4T	45	2405	219	1750	219	219									
	OT	48	2605		186	2233	186									
	Apr	51	1688			723	965									
	1961	54	1179		181	455	365	91	91							
Portugal	4T	45	2405	1203	1202											
	OT	48	2605		434	2171										
	Apr	51	1688		141	281	1125	141								
	1961	54	1179		236	236	472	236								
Denmark	Greenland	66	274			260	14									
	Greenlander	69	185			164	19									
	Aug	72	104			67	22	7	4		4					
	1962	75	90			53	20	4	12							
Germany	Greenland	66	274		187	87										
	OT	69	183			183										
	Aug	72	104	6		92	6									
	1962	75	90		29	36	8	13	4							
Portugal	1D	54	1179	413	766											
	LL	57	869		869											
	May	60	616		456	160										
	1962	63	399		367	32										
USSR	1D	54	1179	893	286											
	OT	57	869	360	487	22										
	May	60	616	9	561	46										
	1962	63	399	7	340	39	13									

Continued

Table 4 (continued)

Country	Factors common for countries	Length group in sample	No. of fish	Distribution of ages according to age-length keys												
				4	5	6	7	8	9	10	11	12	13	14	15	16
Denmark	1B	54	1179	366	813											
	HL	57	869	64	805											
	July	60	616		616											
	1962	63	399		399											
Portugal	1B	54	1179		1179											
	LL	57	869	39	830											
	July	60	616		595	21										
	1962	63	399		315	68	16									
Norway	1D	54	1179	236	943											
	LL	57	869		869											
	May	60	616	154	308	154										
	1963	63	399		133	266										
Denmark	1D	54	1179	615	359	154	51									
	HL	57	869	203	580	86										
	May	60	616		474	142										
	1963	63	399		209	171	19									
Portugal	2J	45	2405		209	732	1464									
	OT	48	2605		237	1263	789	316								
	May	51	1688			549	760	169	169			42				
	1963	54	1179			262	550	236	77		52					
USSR	2J	45	2405			235	1673	497								
	OT	48	2605			98	1327	885	74	172	25		25			
	May	51	1688			57	398	588	322	152	95	76				
	1963	54	1179				165	309	264	286	77	33	44			

Table 5. Age composition of samples in Table 3 using the keys from different countries.

Age	1961 1D Jan		1961 1F July		1961 3Ps Apr	
	Germany	Denmark	Germany	Denmark	Portugal	France
3					134	
4	17	3121		839	1796	738
5	2064	168	9598	14650	2484	5453
6	1006	906	1980	755	5672	6024
7	1107	168	587	168	2484	2450
8	8742	3121	252	252	1930	1879
9	856	1983	973		1242	
10	234	536	386		553	164
11	1342	2567	554	84	134	
12	184	352	50		134	
13	285	536			134	
14	923	1983	117			
15	33	-				
>15	165	704				

Age	1961 4R Mar		1961 4T Apr		1962 * Aug		1962 1D May	
	France	Portugal	France	Portugal	Denmark	Germany	USSR	Portugal
3	50						17	
4	1376	1410	604	285	168	470	5554	1174
5	3222	6830	3474	1778	621	889	3625	9011
6	5655	4397	7367	3574	8877	4178	1712	3423
7	3608	1627	873	5957	2349	2081	1040	285
8	1108	638	1225	2383	537	671	705	285
9	839		201	1208	2618	5084	2903	1947
10	319		604	654	537	1275	268	-
11	386	151		839	168	67	268	-
12	50		604		537	1359	251	285
13					-	285	17	285
14					84	-	119	-
15					84	318	136	-
>15					84	84	68	-

* Greenland

Continued

Table 5 (continued)

Age	1961 3L Canada Mar.	Portugal Apr.	1961 3M Mar Canada	USSR	1962 2J Canada Sept.	USSR Oct.
1			1661	252		
2			1460	117		
3	2718		4581	923		
4	4614	436	3205	1326	134	554
5	2097	1913	2466	1879	1543	4581
6	4078	6125	17	705	2098	7317
7	570	1762	1661	5336	2517	1611
8	1057	1476	1258	4246	2919	772
9	419	1325	17	503	1947	654
10	369	1175	50	385	1661	319
11	134	1175	50	318	402	151
12	117	436	134	503	1393	100
13	117	738	17	101	-	218
14	67			34	554	151
15	34	134		17	554	50
>15	151				889	151

Age	1962 1B July Denmark	Portugal	1963 2J May USSR	Portugal	1963 2J May Norway	Denmark
3	436	218				470
4	3339	889	201	50	2282	4581
5	11276	11344	554	722	4950	5135
6	285	856	1057	3977	4195	5051
7	436	453	4447	4648	1896	1175
8	218	1006	5239	2467	369	235
9	436	654	1745	1108	755	67
10	67	536	1779	1006	1141	
11	-	100	805	889	569	
12	134	100	940	503	-	
13	-	-	453	385	-	
14	-	218	352	218	-	
15	67	336	268	268	369	
>15	-	100	1056	456	369	

Table 5 (continued)

Age	1963 2J Apr Canada	USSR	1963 2J May Canada	Portugal	1963 2J Sept. Canada	Portugal
1						
2	403		638		101	34
3	772	67	571		1611	34
4	3071	1259	5088	50	5789	873
5	1963	1208	2131	722	3021	2567
6	5152	2769	5555	3977	4279	7165
7	2014	6477	2165	4648	805	3574
8	923	2450	705	2467	436	839
9	688	1074	285	1108	84	537
10	487	453	385	1007	185	201
11	352	252	369	889	101	285
12	101	167	101	503		167
13	168	151	185	386	84	117
14	117	67	67	218	17	34
15	185	34	134	268	17	168
>15	268	252	134	436	34	84