Dynamic Assessment Report created by ShinyTropFish

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Contents

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Package version numbers

This report was created with by ShinyTropFish (version `0.9.1`) based on the **`TropFishR`** package (version 1.7.0; Mildenberger et al., 2017).

Data

The results in this report are based on the data set labelled 'alba'. The columns from the uploaded data set shown in Table 1 were used in the analysis (first 10 rows displayed). The complete data set is included in the appendix of this report.

Table 1: First 10 rows of the input data.

midLengths	1976-04-17	1976-07-02	1976-09-19	1976-12-15	1977-02-18	1977-04-30	1977-06-24
1.5	0	0	0	2	0	2	0
2.5	0	1	9	1	1	1	0
3.5	0	1	34	3	0	1	0
4.5	1	0	96	3	0	1	0
5.5	1	1	68	4	2	1	0
6.5	1	0	50	21	4	5	0
7.5	3	0	16	33	9	7	1
8.5	9	3	2	47	26	12	5
9.5	5	3	1	34	30	14	10
10.5	0	6	1	16	14	3	3

The length frequency (LFQ) data spans following year(s): 1976, 1977. It comprises 675 length measurements, which are aggregated over 7 sampling times (Figure 1). The figure shows the raw LFQ data (Fig. 1a) and after restructuring with among others a moving average of 5 (Fig. 1b).

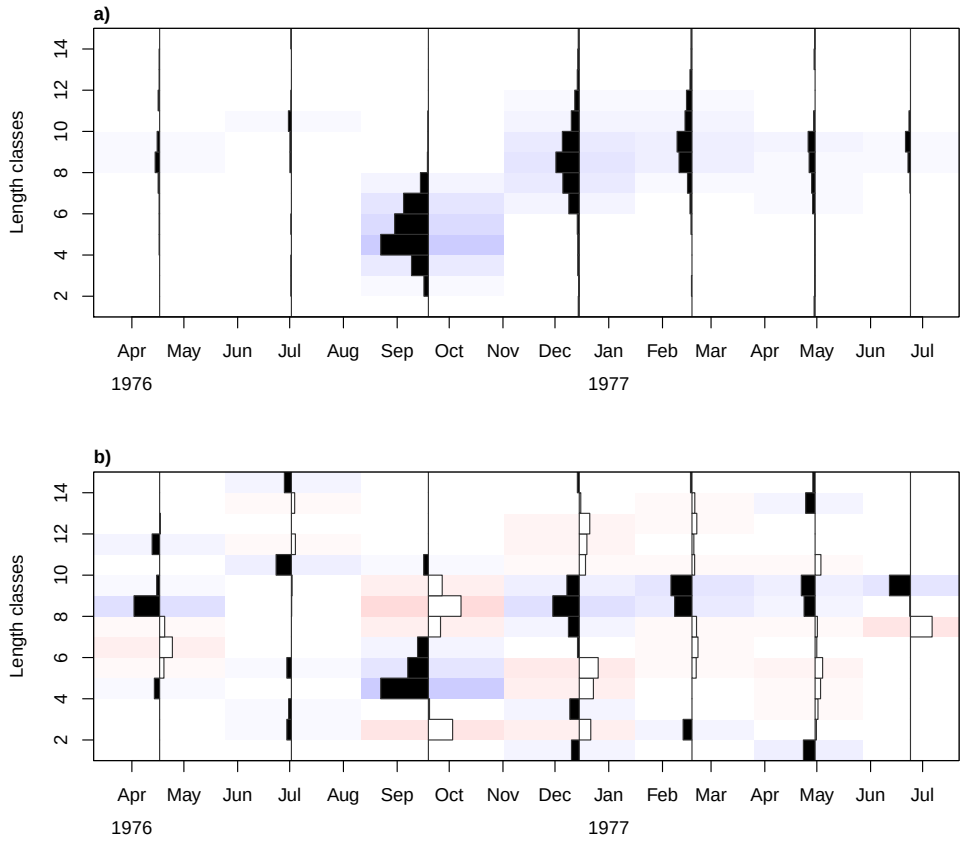

Figure 1: Raw (a) and restructured (b) length frequency data

Growth

The Electronic LEngth Frequency ANalysis (ELEFAN; Pauly and David, 1981) allows the estimation of the parameters of the (seaosnalised) von Bertlanffy growth equation: the asymptotic length L_∞ (Linf), the growth coefficient K, and the anchor point t_a (ta). The quantity ϕ_L (phiL) is the growth performance index ($\phi_L = log_{10}(K) + 2log_{10}(L_\infty)$). The quantity Rn is the score value of the ELEFAN fitting procedure. It can be used to compare fits for the same data set with different settings, but not between different data sets or the same data set with different bin sizes. The data used for ELEFAN spans the time period from Apr 17, 1976 to Jun 24, 1977. Estimated values for the data set 'alba' are given in Table 2.

Table 2: Estimated growth parameters.

Linf	K	ta	phiL	Rn
15.244	0.883	0.285	2.312	0.375

Figure 2 shows the score function of the ELEFAN_GA fitting procedure over time (generations) and thus, allows to evaluate the sufficiency of the number of generations in finding optimum parameters.

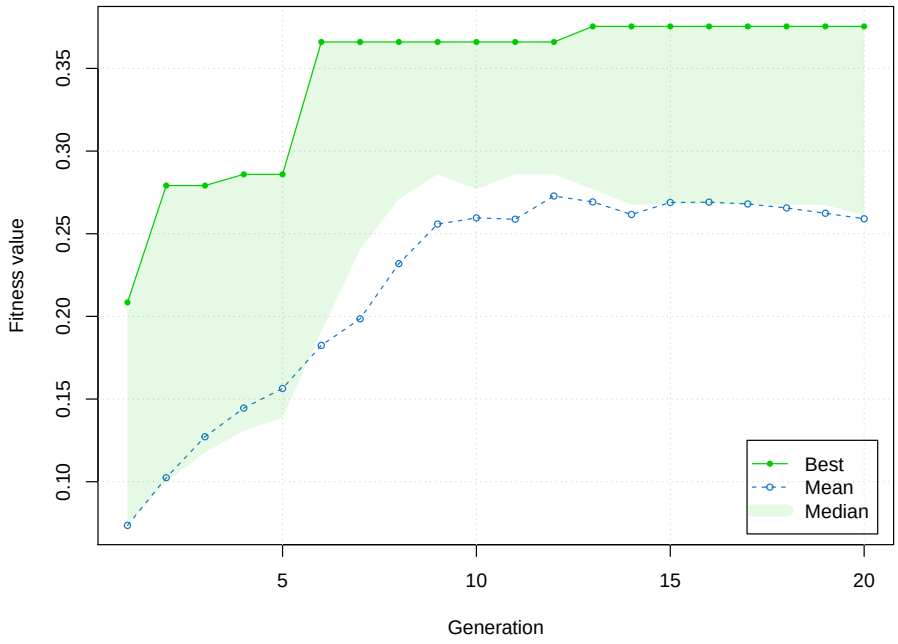

Figure 2: ELEFAN score plot

Figure 3 depicts estimated growth curves fit through the restructured LFQ data.

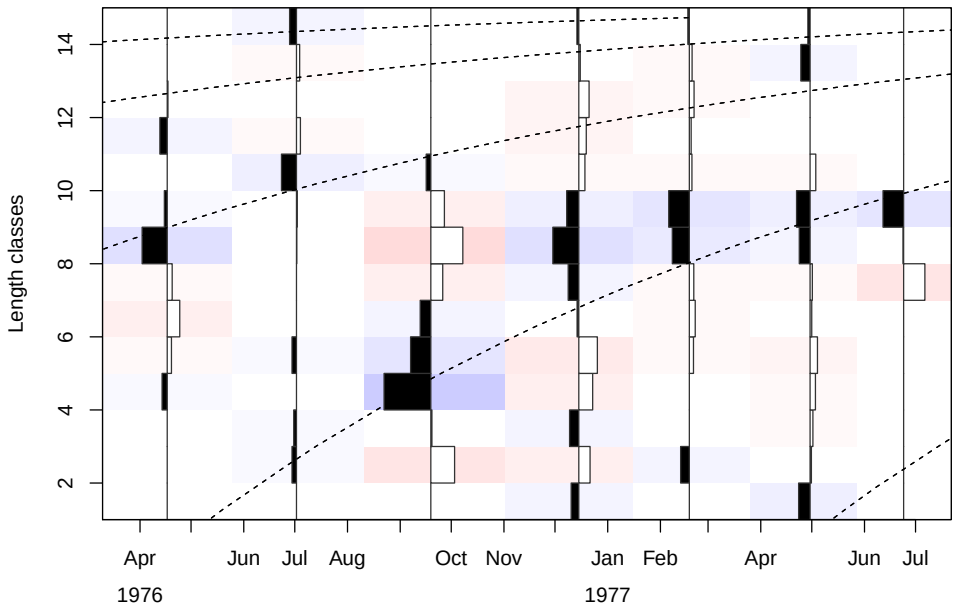

Figure 3: Length frequency data with fitted growth curves

Estimated growth curves allow to allocate the difference length classes at different times to potential cohorts (Fig. 4).

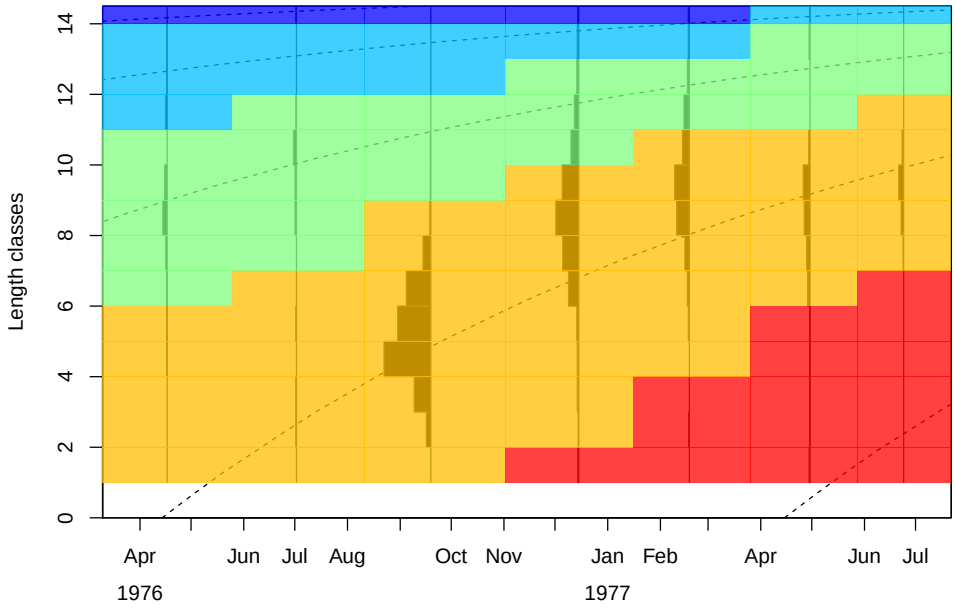

Figure 4: Length frequency data with interpolated cohorts in different colours.

Given the growth parameters the LFQ data can be extrapolated backwards onto the time axis and such indicate the relative recruitment pattern (Table 3 and Fig. 5). The pattern can not be interpreted in absolute terms as information about the length at age 0 is lacking (L_0).

Table 3: Relative recruitment pattern.

Relative month	Number	Density
1	133	0.197
2	4	0.006
3	159	0.236
4	118	0.175
5	88	0.130
6	11	0.016
7	43	0.064
8	23	0.034
9	14	0.021
10	21	0.031
11	39	0.058
12	22	0.033

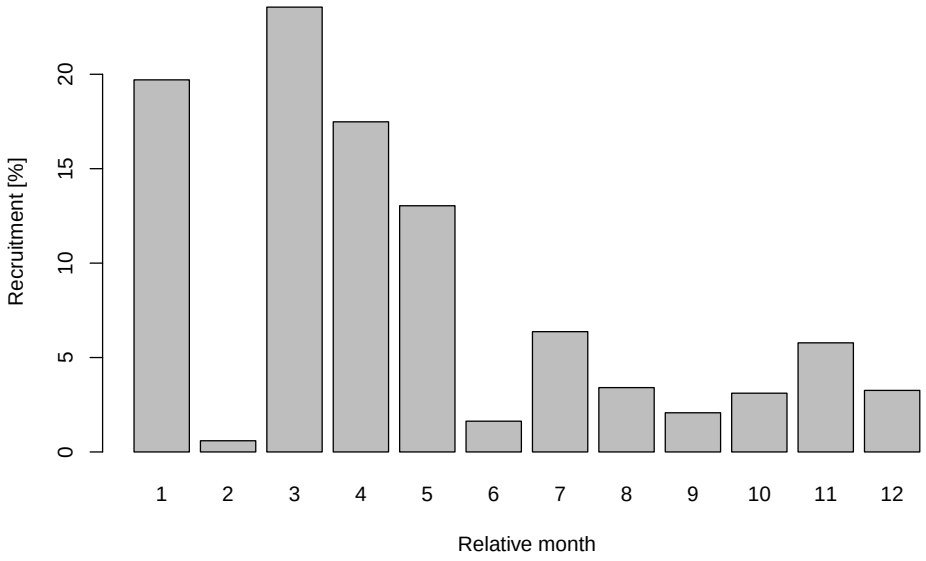

Figure 5: Relative recruitment pattern.

Mortality & Selectivity

The length-converted catch curve (LCCC; Pauly, 1990) allows the estimation of the mortality rates and gear selectivity parameters. Estimated quantities for the year(s) 1977 are given in Table 4. GOTCHA describes an

alternative catch curve approach, which aggregates the data by cohorts rather than length classes. If applied, the results are included in Table 4.

Table 4: Mortality and selectivity parameters based on the length-converted catch curve.

Z	M	F	E	L50	L75
2.319	1.531	0.788	0.34	6.527	6.998

The catch curve with the selected data points for the regression analysis is shown in Figure 6.

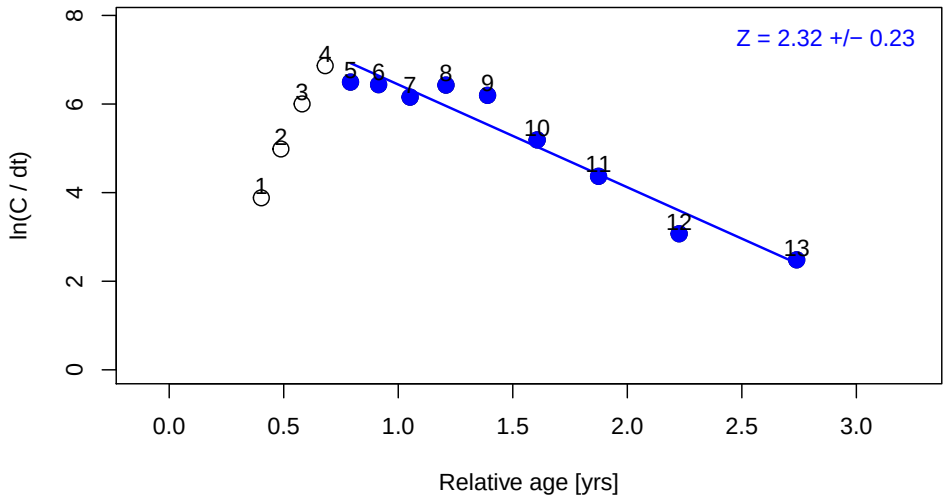

Figure 6: Length-converted catch curve.

Based on the non-selected data points in the catch curve, the trawl-like gear selectivity can be estimated (Fig. 7).

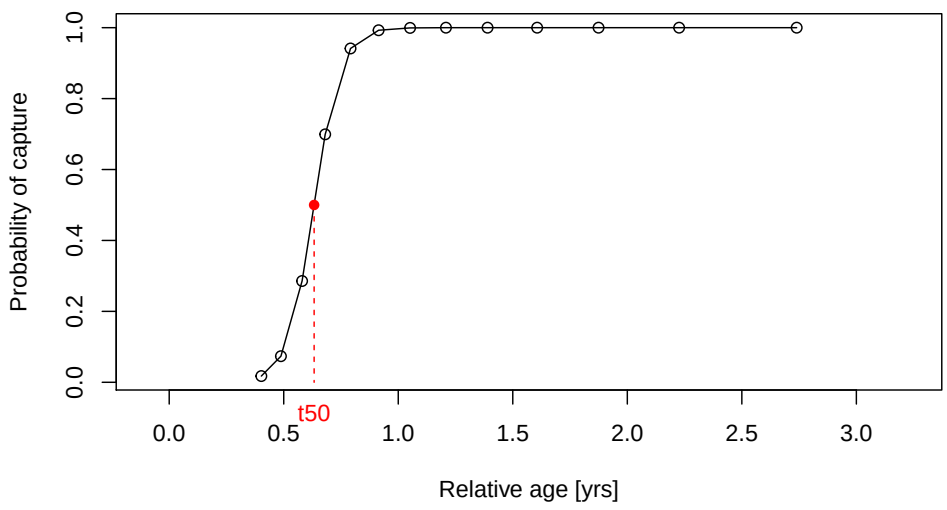

Figure 7: Selectivity curve based on the length-converted catch curve.

Reference levels

The estimtation of the biological reference levels is based on the length-based yield per recruit model (Thompson and Bell, 1934). Estimated levels for the year(s) 1977 are given in Table 5.

Table 5: Referenve levels.

F01	Fmax	F05	E01	Emax	E05
1.224	2.653	1.02	0.444	0.634	0.4

Figure 8 shows the yield per recruit curve, where the black and blue solid lines show the yield and biomass per reruit for a range of fishing mortality values, respectively. The colorful dashed lines show the reference levels, where green dipicts the $F_{0.1}$ reference level. The black dashed line indicates the current fishing mortality based on the catch curve analysis.

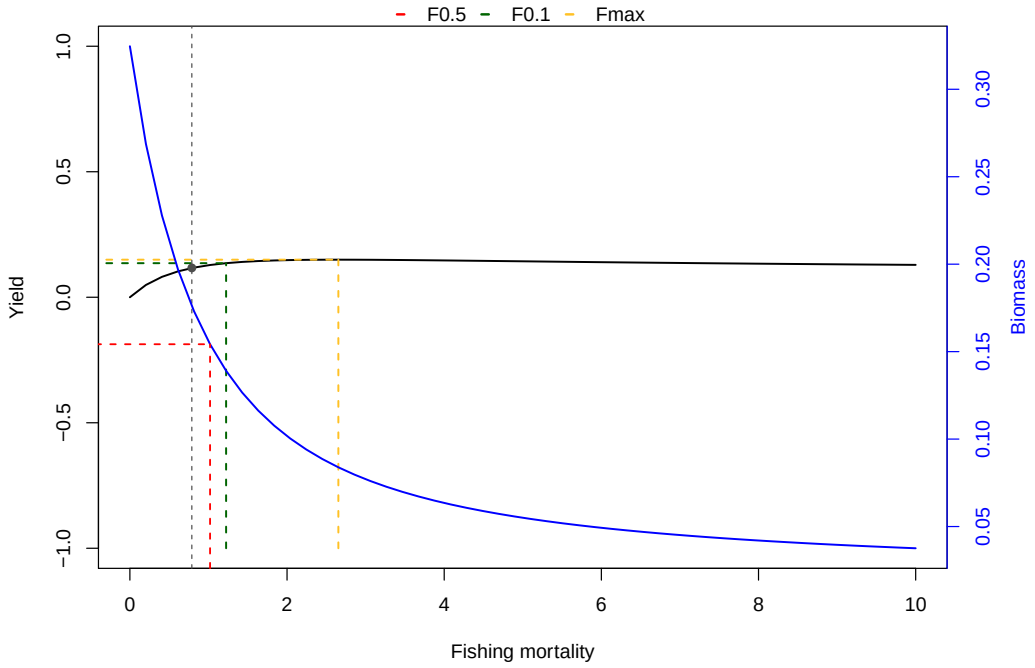

Figure 8: Yield per recruit curve.

Figure 9 shows the yield per recruit isopleth graph. The color indicates the yield per recruit from low (blue) to high (red) values. The black solid lines are the isopleths indicating different areas of the same yield. The black dashed line indicates the current fishing mortality and selectivity based on the catch curve analysis.

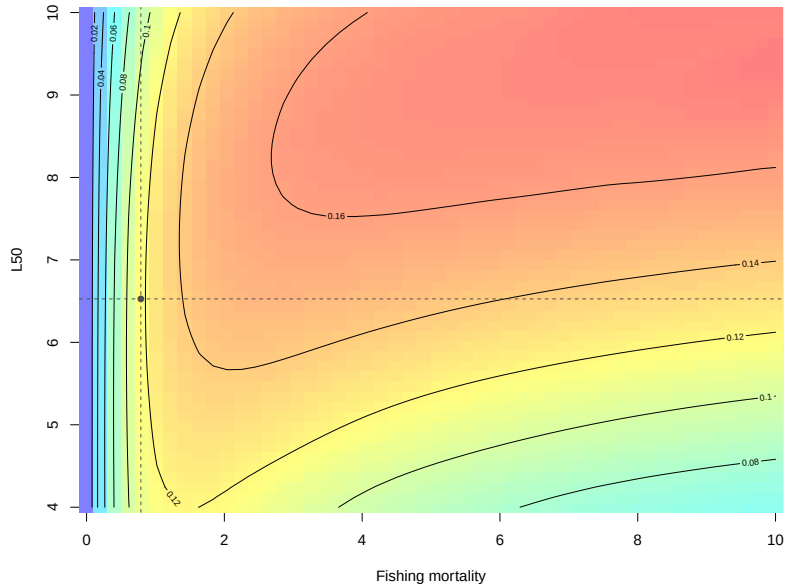

Figure 9: Yield per recruit ispleth grapth.

Figure 10 shows the biomass per recruit isopleth graph. The color indicates the biomass per recruit from low (red) to high (blue) values. The black solid lines are the isopleths indicating different areas of the same biomass. The black dashed line indicates the current fishing mortality and selectivity based on the catch curve analysis.

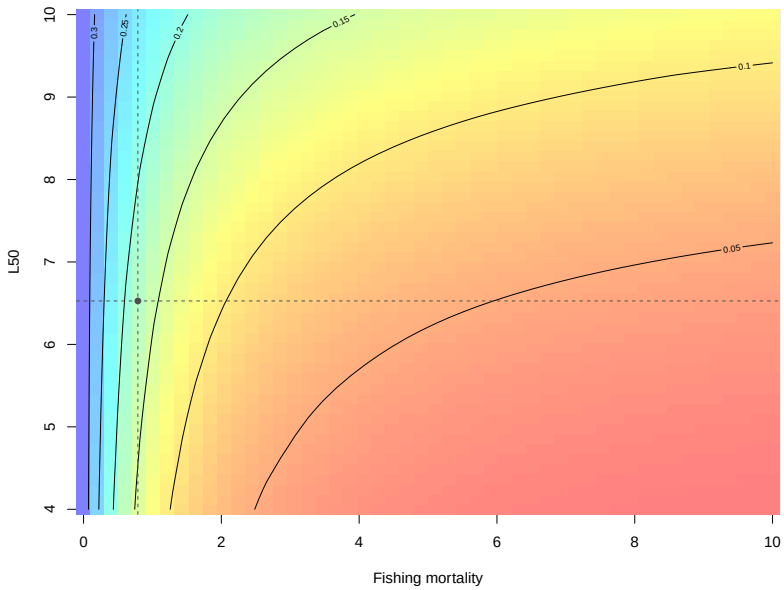

Figure 10: Biomass per recruit isopleth grapth.

Summary

The length-based stock assessment based on ELEFAN, the length-converted catch curve, and the lenth-based yield per recruit model included in the R package **TropFishR** (Mildenberger et al., 2017) is based on 675 length measurements representing the time period from Apr 17, 1976 to Jun 24, 1977. The exploitation rate (F/Z = 0.34) indicates that the stock is `r stockstatusExploi` based on the length-converted catch curve. The current fishing mortality (F = 0.79) is smaller than the reference level ($F_{0.1}$ = 1.22) and thus indicates that the stock is not overfished ($F/F_{0.1}$ = 0.64) based on the yield per recruit analysis.

Author's comment

If you have comments or questions please write an email or post an issue at GitHub. You can follow the development of `TropFishR` on ResearchGate.

References

Mildenberger, T. K., Taylor, M. H., & Wolff, M. (2017). TropFishR: an R package for fisheries analysis with length-frequency data. Methods in Ecology and Evolution, 8(11), 1520-1527.

Pauly, D. (1990). Length-converted catch curves and the seasonal growth of fishes. Fishbyte, 8(3), 33-38.

Pauly, D., & David, N. (1981). ELEFAN I, a BASIC program for the objective extraction of growth parameters from length-frequency data. Meeresforschung, 28(4), 205-211.

Thompson, W. F., & Bell, F. H. (1934). Effect of changes in intensity upon total yield and yield per unit of gear. Report of the International Fisheries Commission, 8, 7-49.

Appendix

Raw data

The complete data set used for the analysis is given below.

Table 6: Full uploaded data.

midLengths	1976-04-17	1976-07-02	1976-09-19	1976-12-15	1977-02-18	1977-04-30	1977-06-24
1.5	0	0	0	2	0	2	0
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4.5	1	0	96	3	0	1	0
5.5	1	1	68	4	2	1	0
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7.5	3	0	16	33	9	7	1
8.5	9	3	2	47	26	12	5
9.5	5	3	1	34	30	14	10
10.5	0	6	1	16	14	3	3
11.5	3	1	0	9	11	0	0
12.5	1	0	0	4	4	0	0
13.5	1	0	0	3	2	2	0
14.5	0	1	0	2	2	1	0