

Age, growth and removals at age
of Atlantic redfish (Sebastes marinus, mentella)
from the Scotian shelf

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Abstract

Age and growth of redfish (Sebastes marinus mentella) were read by counting the annual rings (dark bands under reflected light) on broken otoliths. The otolith length and otolith weight both gave good regressions with fish length. These two otolith parameters did not, however, give a better relationship with fish age than did fish length. The age (A) length (L) relationship for sexes combined is: $L = 5.022A^{0.630}$ and the von Bertalanffy equation for sexes combined is: $L = 53.32 [1 - e^{-0.047(t+1.26)}]$ both of these regressions have high variability ($R^2 = 0.76, 0.75$ respectively). Age length keys for 1977 and 1978 are included in the paper.

Key words: Redfish, Scotian shelf, age, growth, Sebastes marinus mentella

Résumé

Nous avons déterminé l'âge et la croissance de sébastes (Sebastes marinus mentella) par comptage des anneaux annuels (bandes noires à la lumière réfléchie) sur des otolithes sectionnés. La longueur et le poids de l'otolithe donnent tous deux de bonnes régressions en fonction de la longueur du poisson. La relation entre ces deux paramètres de l'otolithe et l'âge n'est toutefois pas meilleure qu'avec la longueur du poisson. La relation âge (A)-longueur (L) pour les sexes combinés est: $L = 5.022A^{0.630}$, et l'équation de von Bertalanffy pour les sexes combinés est: $L = 53.32 [1 - e^{-0.047(t+1.26)}]$. Ces régressions ont toutes deux une forte variabilité ($R^2 = 0.76$ et 0.75 respectivement). Le présent article contient des clés âge-longueur pour 1977 et 1978.

Mots-clés: sébaste, plateau Scotian, âge, croissance, Sebastes marinus mentella

INTRODUCTION

The age and growth of Atlantic redfish (Sebastes marinus, mentella) has been the subject of controversy for many years. Kotthaus (1958) and some other European authors have claimed that redfish has a relatively rapid growth, early maturity and does not live much past 10 years of age. Sandeman (1961) on the other hand has suggested redfish are long lived (frequently over 60 years old) and not fast growing. Beamish (1979) has found Sebastes alutus on the west coast to be up to 70 years old at length 45 cm, with little or no growth increment over 40 years of age. This slow growth in later life leads to densely packed growth rings which make ageing difficult but not impossible. Kimura et al. (1979) have shown the rings of Sebastes flavidus to be annual and formed during the winter period of slow growth - a similar conclusion to that reached by Sandeman (1961).

An age length key (1975) for Atlantic redfish was completed by the Biological Station, St. John's using research cruise data from the R/V A.T. Cameron cruise A236. This key covered NAFO divisions 4WX and statistical area 5Y and included 717 redfish. It was decided a more up to date key of relevant areas was required for the assessment of 4VWX redfish stocks. In co-operation with the Nova Scotia Provincial Government an age and growth study was initiated during the summer of 1979. Redfish from NAFO divisions 4VWX and statistical area 5Y were aged for the years 1977 and 1978. This paper investigates these results.

METHODS

Redfish otoliths were collected by annual cruises of the R/V A.T. Cameron on the Scotian shelf in July. Each pair of otoliths was stored dry in a labelled envelope during the cruise. The data collected for each fish included fork length to the nearest cm, weight in g, sex, location of capture, and environmental parameters. For this study the otoliths of the cruises during 1977 and 1978 were unpacked, measured in length to the nearest mm and 400 otoliths were weighed to the nearest mg. One otolith was broken in half laterally and mounted in plasticene (broken edge up) for viewing under a 6X Wild M-5A microscope. Every otolith from 1978 was read (984) and one otolith for each 1 cm length group in each set of 1977 (541).

Annular rings (dark bands under reflected light) were counted from the nucleus to the outside edge along the longer radius. The rings along the shorter radius were often so close that counting was difficult, however they served as verification for unclear zones on the longer radius. A drop of alcohol improved the clarity of reading but polishing did not justify the time involved. The otoliths were aged without reference to data on length, weight or area.

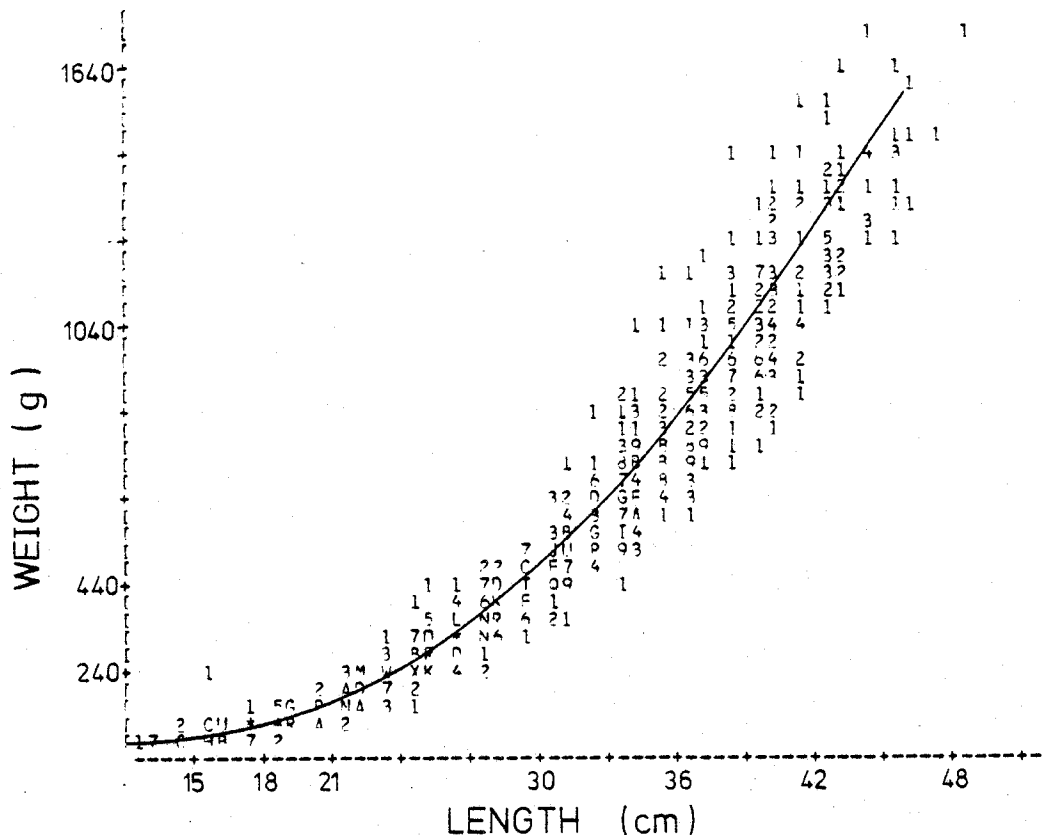


Figure 1. Fork length-weight relationship for Atlantic redfish (sexes combined) from the Scotian shelf (1977 and 1978). All plots in this document are computer scatter graphs - each number and or letter represents the number of observation falling on that point. The numbers 1 to 9 are followed by the letters A to Z (10 to 36) and an * for over 36 observations.

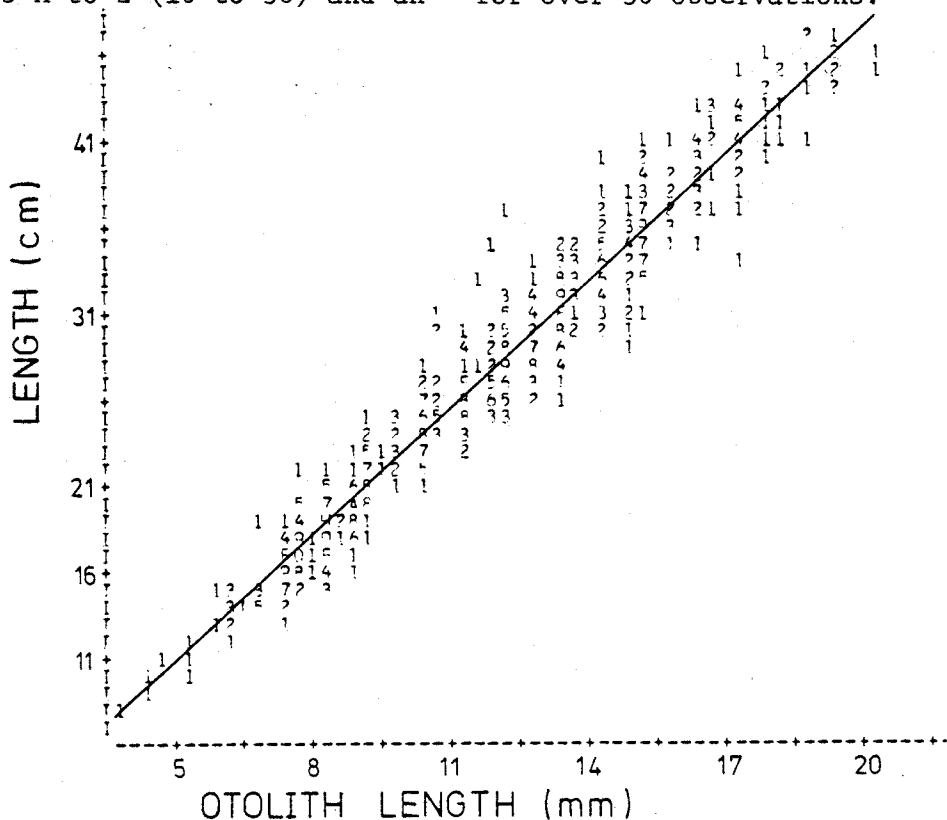


Figure 2. Otolith length-fork length relationship for Atlantic redfish from the Scotian shelf (1978).

Age, fork length, weight, area, sex, fish number, otolith length and otolith weight were coded and stored on computer files for analysis.

RESULTS AND DISCUSSION

Otolith structure

All fish were collected in the month of July and had an outer hyaline zone from the previous winter. A number of older redfish had a region of densely packed rings. This often formed a pointed section at the outer lateral edge of the otolith and occurred between 15 and 18 years of age. This region could contain 20 or more very narrowly spaced rings. This suggests a change of growth, possibly caused by a change of environment. Some workers (Hennemuth and Brown, MS 1964; Gulland, MS 1965) claim larger redfish migrate to deeper waters. The zone of narrow ring spacing on the outer edge of older otoliths may be related to such a migration to colder strata.

Length weight relationship

A linear regression was calculated for the ln transformation of the fork length (cm) and weight (g) of redfish for males, females and sexes combined (Figure 1). The resulting equations for length/weight are:

$$\begin{aligned} \text{Males } W &= .0226 L^{2.902} ; & (n = 708, r^2 = 0.963) \\ \text{Females } W &= .0167 L^{2.998} ; & (n = 742, r^2 = 0.969) \\ \text{Combined } W &= .0188 L^{2.962} ; & (n = 1453, r^2 = 0.968) \end{aligned}$$

There is no sexual dichotomy in the length weight relationship of these fish.

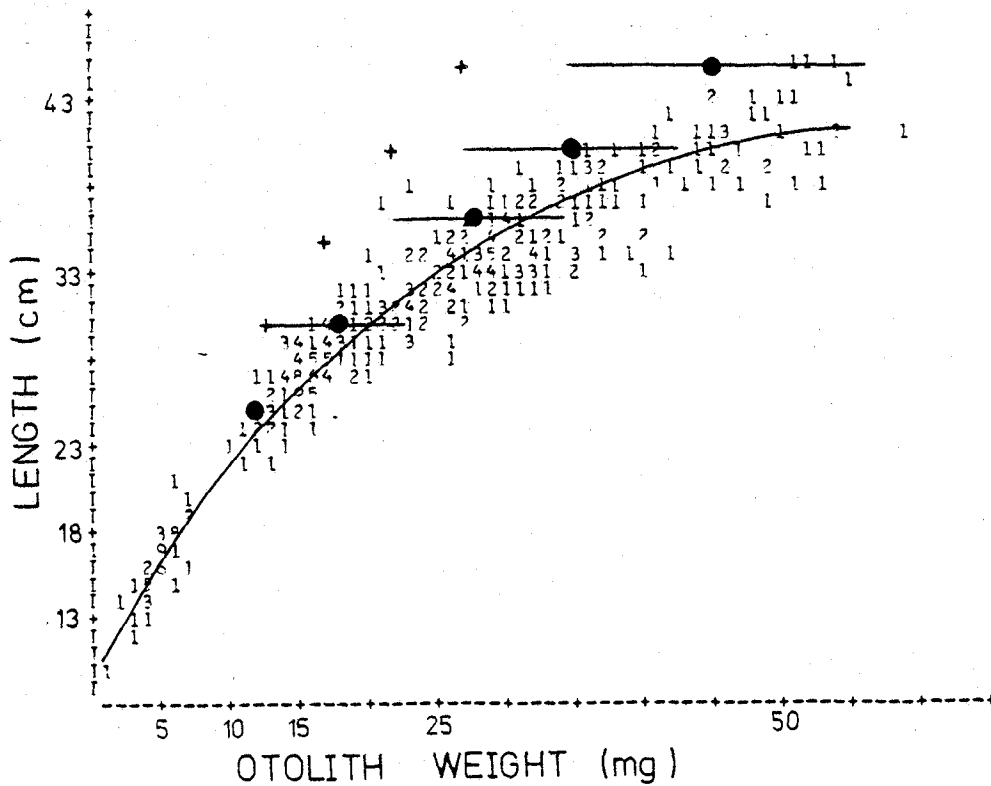
Otolith length vs fish length

The relationship for combined sexes between otolith length (OL in mm) and fork length (L in cm) is linear (Figure 2). The regression equation is:-

$$L = -2.13 + 2.48 OL; \quad (n = 728, r^2 = 0.950)$$

There is no difference between sexes, years, nor NAFO divisions on the Scotian shelf. This suggests the measurement of fork length may not be necessary in the field if otoliths are collected for age determination. It would also permit length frequency sampling of filleted remains from a fish plant when a sample is missed due to timing.

Figure 3. Otolith weight-fork length relationship for Atlantic redfish (*Sebastes marinus mentella*) from the Scotian shelf (1978). The dots and crosses are the mean values (with range) of the otolith weight relationship for *Sebastes mentella* and *Sebastes marinus* respectively from Labrador (Freund, 1961).



Otolith weight vs fish length

Otolith weight (OW in g) is proportional to fork length (L in cm). The linear regression on the ln transformation of the data for combined sexes gives the relationship:

$$L = 54.124 OW^{0.394}; \quad (n = 382, r^2 = 0.952)$$

The plotted data (Figure 3) are within the range of Freund's (1961) data for Sebastes mentella from Labrador and below his data for S. marinus. As for otolith length, otolith weight can be used as a predictive tool for fish length, however the otolith weight can be calculated far more quickly, easily and accurately than otolith length.

Age vs fish length

Redfish have great variability in the relationship between age and length (Figure 4). They are a slow growing, long lived fish and this is reflected in the wide range of ages for fish over 25 cm. A similar pattern was noted in a 1975 age length key produced by the Biological Station, St. John's (see Appendix I). Westrheim (1973) found the variation between age readers increased for the older age groups. He did not, however, mention the variation he found within his fish population. It is possible that age and growth varies between strata but the data available are insufficient to prove such a relationship at present.

The transformation of length (L in cm) and age (A in years) gives the following relationship for males, females and sexes combined: -

$$\text{Males } L = 5.752 A^{0.567}; \quad (n = 689, r^2 = .718)$$

$$\text{Females } L = 4.821 A^{0.657}; \quad (n = 744, r^2 = .790)$$

$$\text{Combined } L = 5.022 A^{0.630}; \quad (n = 1443, r^2 = .760)$$

There does not appear to be any difference between the length/age relationship by sex, strata, nor year.

Otolith weight vs age

It was noted that larger redfish appeared to have proportionally thicker and heavier otoliths than would be expected. It was felt it may be possible to use otolith weight as a predictive tool for age estimation and even in the fabrication of age length keys. To determine the relationship between otolith weight (OW in g) and age (A in years) a group of 400 otoliths were weighed (Figure 5). The regression on the ln transformation of the data gave the equation:-

$$A = 26.856 OW^{0.401}; \quad (n = 349, r^2 = 0.723)$$

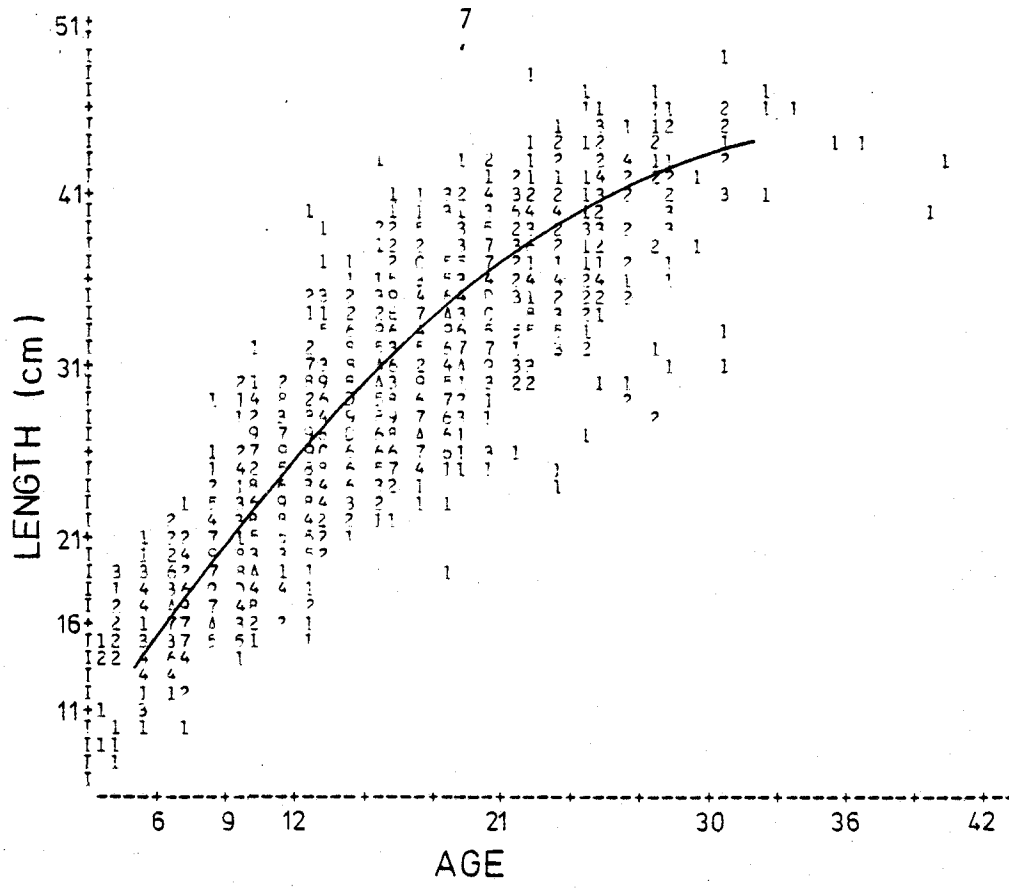


Figure 4. Age-fork length relationship for Atlantic redfish from the Scotian Shelf (1977-1978).

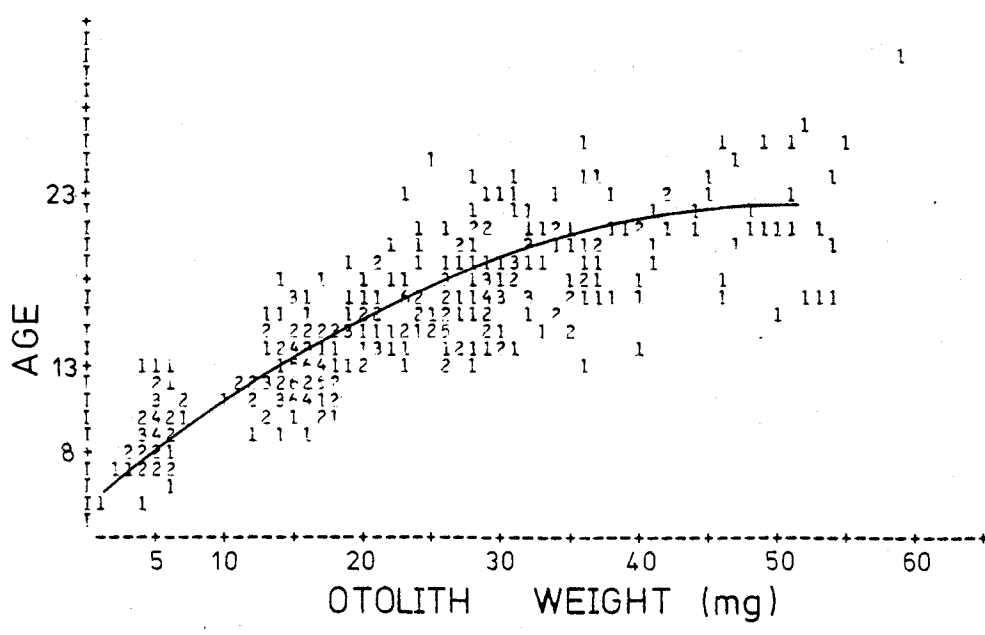


Figure 5. Otolith weight-age relationship for Atlantic redfish from the Scotian shelf (1978).

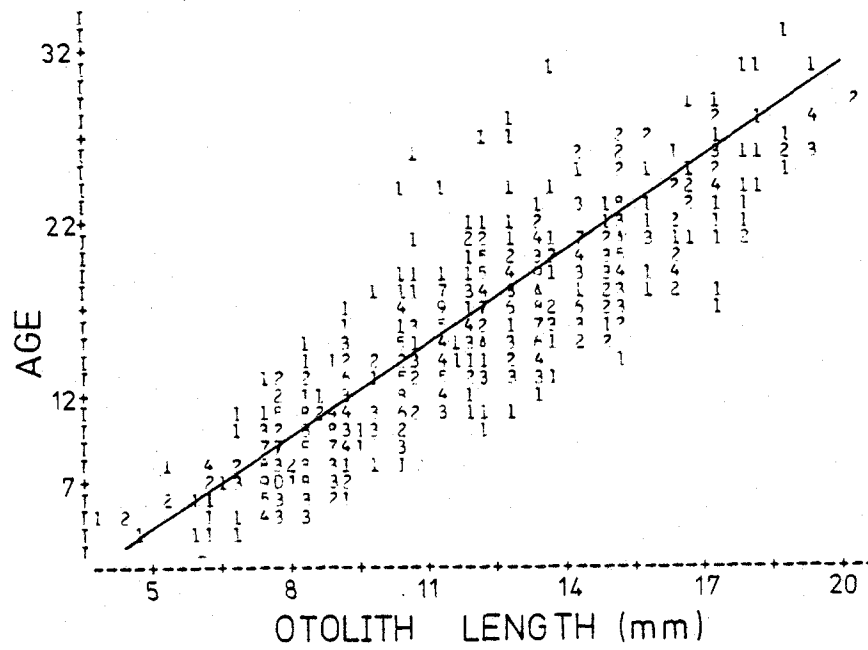


Figure 6. Otolith length-age relationship for Atlantic redfish from the Scotian shelf (1978).

The otolith weight is not as good as was expected for estimating age, in fact it has greater variation than the age length relationship.

Otolith length vs age

The relationship between otolith length (OL in mm) and age (A in years) was investigated next. The relationship is linear over the range of data tested (Figure 6) and the resulting equation is: -

$$A = 0.28 OL^{1.6}; \quad (n = 690, r^2 = 0.78)$$

The coefficient of variation is similar to that obtained between the fish length/age relationship and better than the otolith weight/age relationship.

Von Bertalanffy growth curve

Although the above relationships are probably the best mathematical fit, for many fisheries models a von Bertalanffy growth curve is required. Therefore a curve was fitted by computer program (BGC-2) taken from Tomlinson and Abramson (1961) giving the relationships: -

$$\text{Males } L = 45.2 [1 - e^{-0.056(t+1.61)}] ; (n=689, r^2=0.71)$$

$$\text{Females } L = 55.03 [1 - e^{-0.049(t+0.57)}] ; (n=744, r^2=0.79)$$

$$\text{Combined } L = 53.32 [1 - e^{-0.047(t+1.26)}] ; (n=1443, r^2=0.75)$$

The von Bertalanffy growth curves for males and females are in the same form as those found by other authors (Mayo *et al*, MS 1979; Clay, MS 1979) from the region. However there is a slightly greater absolute value for the L_{∞} although the values for ages less than 30 years of age are comparable.

Age length keys and removals at age and length

The age length keys prepared from this work are presented in Appendix I: Tables 1 and 2. The removals at age are estimated by weighting the Canadian redfish samples collected in the Maritimes region by the appropriate catch. This weighting was done by quarter and NAFO division with sexes combined whenever possible. The catch at length matrix and removals at age are presented for 1979 in Appendix I: Tables 3 and 4.

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APPENDIX I.

Age at length keys , catch at length matrix ,
and age composition of Atlantic redfish (1979).

AGE LENGTH KEY FOR REDFISH

FOR 1977 FOR SEX = COMBIN

TOT LENGTH/AGE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
8 CM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
9 CM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
10 CM	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
11 CM	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
12 CM	0	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0
13 CM	0	0	0	1	4	4	1	0	0	0	0	0	0	0	0	0
14 CM	0	0	0	0	1	3	3	1	2	1	0	0	0	0	0	0
15 CM	0	0	0	0	0	3	2	3	0	2	0	0	0	0	0	0
16 CM	0	0	0	0	1	0	2	3	1	1	0	0	0	0	0	0
17 CM	0	0	0	0	0	1	2	3	3	1	2	0	0	0	0	0
18 CM	0	0	0	0	0	0	1	3	4	2	1	0	0	0	0	0
19 CM	0	0	0	0	0	0	1	5	4	0	2	3	0	0	0	0
20 CM	0	0	0	0	0	0	0	2	0	3	3	3	0	0	0	0
21 CM	0	0	0	0	0	0	0	2	1	6	6	3	1	1	0	0
22 CM	0	0	0	0	0	0	0	2	2	2	6	5	2	1	1	0
23 CM	0	0	0	0	0	0	0	0	1	2	3	6	3	1	1	0
24 CM	0	0	0	0	0	0	0	0	0	0	2	7	3	2	1	1
25 CM	0	0	0	0	0	0	0	0	1	1	0	2	4	3	1	2
26 CM	0	0	0	0	0	0	0	0	0	1	0	1	5	6	1	0
27 CM	0	0	0	0	0	0	0	0	0	0	1	1	1	3	1	1
28 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	5
29 CM	0	0	0	0	0	0	0	0	0	0	0	1	0	1	6	0
30 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	2
31 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1
32 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
33 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
34 CM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2
35 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38 CM	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40 CM	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

AGE LENGTH KEY FOR REDFISH

FOR 1977 FOR SEX = COMBIN

TOT LENGTH/AGE	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
8 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18 CM	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24 CM	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
25 CM	3	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0
26 CM	3	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0
27 CM	3	3	1	1	0	0	0	0	0	0	1	0	0	0	0	0
28 CM	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
29 CM	4	1	0	1	2	2	0	0	0	1	0	0	0	0	0	0
30 CM	1	1	4	4	0	0	0	0	0	0	0	1	0	0	0	0
31 CM	0	4	3	3	1	0	1	2	0	0	1	0	0	0	0	0
32 CM	2	2	2	1	2	2	3	1	0	0	0	0	0	1	0	0
33 CM	3	3	0	3	0	3	3	1	1	0	0	0	0	0	0	0
34 CM	3	3	0	2	2	0	2	0	0	1	0	0	0	0	0	0
35 CM	1	1	0	4	0	1	4	1	2	0	0	1	0	0	0	0
36 CM	3	2	1	2	1	0	0	0	1	1	0	1	0	0	0	0
37 CM	0	0	0	1	2	1	2	0	1	0	2	0	1	0	0	0
38 CM	1	0	1	1	0	1	0	3	1	1	0	3	0	0	0	0
39 CM	0	1	1	1	4	2	1	0	1	0	0	3	0	0	0	0
40 CM	0	0	0	2	2	2	0	0	0	2	0	2	0	2	0	1
41 CM	0	0	0	1	1	0	0	0	3	1	1	1	1	0	0	0
42 CM	0	0	0	0	0	0	0	0	1	4	0	0	0	2	0	0
43 CM	0	0	0	0	0	0	1	1	1	0	0	0	0	1	0	0
44 CM	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0
45 CM	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1
47 CM	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
48 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
TOTAL NUMBER OF AGES READ																

471

AGE COMPOSITION OF REDFISH FOR 1977 FOR SEX = COMBIN
(FISH NUMBERS X 1/1000)

TOT LENGTH	AGE	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
18 CM		0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19 CM		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20 CM		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21 CM		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22 CM		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23 CM		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24 CM		304	0	101	0	0	0	0	0	0	0	0	0	0	0	0	0
25 CM		302	403	0	201	0	0	0	0	0	0	0	0	0	0	0	0
26 CM		348	348	116	0	0	0	0	0	0	0	0	0	0	0	0	0
27 CM		437	437	145	145	0	0	0	0	0	0	145	0	0	0	0	0
28 CM		241	241	241	0	0	0	0	0	0	0	0	0	0	0	0	0
29 CM		380	95	0	95	190	190	0	0	0	95	0	0	0	0	0	0
30 CM		89	89	357	357	0	0	0	0	0	0	0	89	0	0	0	0
31 CM		0	331	248	248	82	0	82	165	0	0	82	0	0	0	0	0
32 CM		155	155	155	77	155	155	233	77	0	0	0	0	0	77	0	0
33 CM		229	229	0	229	0	229	229	76	76	0	0	0	0	0	0	0
34 CM		299	299	0	199	199	0	199	0	0	99	0	0	0	0	0	0
35 CM		112	112	0	450	0	112	450	112	225	0	0	112	0	0	0	112
36 CM		408	272	136	272	136	0	0	0	136	136	0	136	0	0	0	136
37 CM		0	0	0	117	235	117	235	0	117	0	235	0	117	0	0	117
38 CM		118	0	118	118	0	118	0	354	118	118	0	354	0	0	0	0
39 CM		0	84	84	84	336	168	84	0	84	0	0	252	0	0	0	84
40 CM		0	0	0	155	155	155	0	0	0	155	0	155	0	155	0	77
41 CM		0	0	0	73	73	0	0	0	219	73	73	73	73	0	0	73
42 CM		0	0	0	0	0	0	0	0	57	230	0	0	0	115	0	57
43 CM		0	0	0	0	0	0	36	36	36	0	0	0	0	36	0	36
44 CM		0	0	0	0	0	0	0	0	0	0	0	40	0	81	0	40
45 CM		0	0	0	0	0	0	0	27	0	0	0	0	0	27	0	27
46 CM		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	37
47 CM		0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	9
48 CM		0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	4
49 CM		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
50 CM		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
TOT CATCH																	
NUMBERS		3423	3098	1702	2821	1562	1254	1549	848	1069	907	536	1212	191	496	1	829
WT AT AGE(G)		459.	467.	496.	630.	771.	735.	692.	771.	899.	928.	682.	902.	947.	1122.	0.	1042.
BIOMASS(T)		1571.	1448.	843.	1778.	1204.	921.	1071.	654.	961.	842.	366.	1093.	161.	556.	0.	864.
TOTAL NUMBER OF AGES READ					482												

AGE LENGTH KEY FOR REDFISH

FOR 1978 FOR SEX = COMBIN

TOT LENGTH/AGE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
7 CM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
8 CM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
9 CM	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
10 CM	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
11 CM	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
12 CM	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0
13 CM	0	0	2	1	0	2	3	0	1	0	0	0	0	0	0	0
14 CM	0	0	1	2	2	0	4	4	3	0	0	1	0	0	0	0
15 CM	0	0	0	2	1	4	5	7	3	0	2	1	0	0	0	0
16 CM	0	0	0	2	3	10	7	4	3	10	0	2	0	0	0	0
17 CM	0	0	0	1	4	10	4	6	3	3	2	1	0	0	0	0
18 CM	0	0	0	3	3	6	1	4	4	8	0	1	0	0	0	0
19 CM	0	0	0	0	1	2	3	4	4	3	1	2	2	0	0	0
20 CM	0	0	0	0	1	2	2	5	1	2	2	2	2	1	0	0
21 CM	0	0	0	0	0	2	0	2	2	5	2	1	1	1	1	1
22 CM	0	0	0	0	0	0	1	3	1	4	3	3	2	2	1	0
23 CM	0	0	0	0	0	0	0	2	0	6	3	5	1	5	2	2
24 CM	0	0	0	0	0	0	0	1	4	2	3	1	5	4	4	6
25 CM	0	0	0	0	0	0	0	1	1	6	9	7	8	3	5	4
26 CM	0	0	0	0	0	0	0	0	0	8	7	8	3	7	5	8
27 CM	0	0	0	0	0	0	0	0	1	2	2	7	3	6	7	8
28 CM	0	0	0	0	0	0	0	1	1	4	8	2	6	10	2	3
29 CM	0	0	0	0	0	0	0	0	2	1	8	7	9	7	4	3
30 CM	0	0	0	0	0	0	0	0	0	0	0	8	2	6	7	4
31 CM	0	0	0	0	0	0	0	0	0	1	0	2	0	8	3	10
32 CM	0	0	0	0	0	0	0	0	0	0	0	0	5	5	8	5
33 CM	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2	12
34 CM	0	0	0	0	0	0	0	0	0	0	0	2	1	2	3	7
35 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	5
36 CM	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2
37 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
38 CM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	2
39 CM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
40 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
41 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
43 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

AGE COMPOSITION OF REDFISH FOR 1978 FOR SEX = COMBIN
(FISH NUMBERS X 1/1000)

TOT LENGTH	AGE	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
22 CM		43	43	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23 CM		49	0	0	0	0	0	49	0	0	0	0	0	0	0	0	0
24 CM		54	54	0	54	0	0	54	0	0	0	0	0	0	0	0	0
25 CM		168	84	42	42	42	0	0	0	0	0	0	0	0	0	0	0
26 CM		300	128	0	0	0	0	0	42	0	0	0	0	0	0	0	0
27 CM		208	156	104	0	0	0	0	0	0	0	52	0	0	0	0	0
28 CM		168	210	0	42	0	0	0	0	0	84	0	0	0	0	0	0
29 CM		226	181	45	90	0	0	0	0	45	0	0	0	0	0	0	0
30 CM		38	114	228	190	114	114	0	0	0	0	0	0	0	38	0	0
31 CM		176	70	141	141	0	0	70	0	0	0	0	0	0	0	0	0
32 CM		54	189	108	108	81	81	54	0	0	0	0	0	0	0	0	0
33 CM		88	155	66	200	0	111	0	22	0	0	0	0	0	0	0	0
34 CM		24	73	98	270	24	24	0	49	49	24	0	0	0	0	0	0
35 CM		90	181	135	0	90	135	0	45	90	45	0	0	0	0	0	0
36 CM		456	152	203	253	50	50	50	50	0	50	0	0	0	0	0	0
37 CM		118	0	177	355	59	296	0	59	59	0	0	0	0	0	0	0
38 CM		199	0	99	199	99	99	99	0	99	49	0	0	0	0	0	0
39 CM		58	116	0	116	116	116	174	58	58	0	0	0	0	0	0	0
40 CM		53	99	66	66	33	0	66	33	99	0	0	0	0	33	0	0
41 CM		0	0	0	0	50	50	50	50	50	50	50	50	0	0	0	50
42 CM		0	0	29	59	0	29	59	0	29	0	29	29	0	0	0	0
43 CM		0	0	0	0	0	24	24	0	24	0	49	0	0	0	0	24
44 CM		0	0	0	0	0	0	11	0	33	11	11	11	0	0	0	11
45 CM		0	0	0	0	0	0	0	0	21	0	21	21	0	21	0	21
46 CM		0	0	0	0	0	0	0	10	0	0	10	0	0	0	0	10
47 CM		0	0	0	0	0	63	0	0	0	0	0	0	0	0	0	7
48 CM		0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	1
TOT CATCH																	
NUMBERS		2551	2006	1542	2186	759	1193	761	419	657	314	223	112	1	97	1	125
WT AT AGE(G)		532.	529.	639.	687.	746.	831.	827.	813.	937.	740.	1064.	1249.	0.	936.	0.	1328.
BIOMASS(T)		1357.	1061.	985.	1503.	566.	991.	629.	341.	616.	233.	237.	140.	0.	91.	0.	166.
TOTAL NUMBER OF AGES READ					973												
17.57.41.UCLP, L04T1					1.117KLNS.												

AGE COMPOSITION OF REDFISH FOR 1978 FOR SEX = COMBIN
(FISH NUMBERS X 1/1000)

TOT LENGTH AGE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
11 CM	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0
12 CM	0	0	0	0	18	37	0	0	0	0	0	0	0	0	0	0
13 CM	0	0	12	6	0	12	19	0	6	0	0	0	0	0	0	0
14 CM	0	0	4	8	8	0	16	16	12	0	0	4	0	0	0	0
15 CM	0	0	0	25	12	51	64	90	38	0	25	12	0	0	0	0
16 CM	0	0	0	22	34	113	79	45	34	113	0	22	0	0	0	0
17 CM	0	0	0	12	48	120	48	72	120	36	24	12	0	0	0	0
18 CM	0	0	0	49	49	98	16	65	65	131	0	16	0	0	0	0
19 CM	0	0	0	0	31	63	95	127	127	95	31	63	63	0	0	0
20 CM	0	0	0	0	32	64	64	160	32	64	64	64	64	32	0	0
21 CM	0	0	0	0	0	72	0	72	72	181	72	36	36	36	36	36
22 CM	0	0	0	0	0	0	47	142	47	190	142	142	95	95	47	0
23 CM	0	0	0	0	0	0	0	107	0	323	161	269	53	269	107	107
24 CM	0	0	0	0	0	0	0	61	247	123	185	61	309	247	247	371
25 CM	0	0	0	0	0	0	0	50	50	304	456	354	405	152	253	202
26 CM	0	0	0	0	0	0	0	0	0	425	372	425	159	372	265	425
27 CM	0	0	0	0	0	0	0	0	66	132	132	465	199	398	465	531
28 CM	0	0	0	0	0	0	0	55	55	222	445	111	334	557	111	167
29 CM	0	0	0	0	0	0	0	0	124	62	124	435	560	435	248	186
30 CM	0	0	0	0	0	0	0	0	0	0	0	553	138	415	484	276
31 CM	0	0	0	0	0	0	0	0	0	60	0	120	0	481	180	602
32 CM	0	0	0	0	0	0	0	0	0	0	0	0	283	283	452	283
33 CM	0	0	0	0	0	0	0	0	0	0	0	58	58	116	116	696
34 CM	0	0	0	0	0	0	0	0	0	0	0	128	128	128	193	451
35 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	161	161	809
36 CM	0	0	0	0	0	0	0	0	0	0	0	0	380	380	0	761
37 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	434	869
38 CM	0	0	0	0	0	0	0	0	0	0	0	0	239	0	479	479
39 CM	0	0	0	0	0	0	0	0	0	0	0	464	0	0	0	464
40 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	566
41 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42 CM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	296	0
TOT CATCH NUMBERS	1	1	17	123	233	631	463	1063	1096	2462	2234	3815	3504	4558	4575	8282
WT AT AGE(G)	0.	0.	35.	72.	84.	89.	91.	148.	197.	230.	267.	410.	430.	418.	552.	630.
BIOMASS(T)	0.	0.	1.	9.	20.	56.	42.	157.	216.	566.	596.	1563.	1508.	1904.	2626.	5220.
TOTAL NUMBER OF AGES READ			639													