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Proximate composition of New Zealand albacore tuna

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The following analyses have been carried out to date on albacore tuna caught in the New Zealand Exclusive Economic Zone:

1. Proximate composition (levels of oil, moisture, crude protein and ash) of the fillet, head, viscera, frame and skin of 6 fish. The results are shown in Appendix 1, and include body measurements and catch data, body weight proportions of the 5 parts, the proximate composition of the parts and of the whole fish calculated from the weight and composition of the parts, and the contribution of the 5 parts to the composition of the fish.

The data enable calculations of the quantities of oil, moisture, crude protein and ash present in a given quantity of fish.

2. The fatty acid composition of the white and red muscle of the 6 fish (Appendix 1) was determined and is given in Appendix 2. The total omega-3 fatty acid content expressed as the sum of the 2 principal fatty acids in this category (20:5 and 22:6) is higher in the red muscle than in the white.

3. The distribution of the oil in the fillet of the 6 fish was determined from 25 mm wide cross sections taken from the centre of the body, which were concentrically divided in 5 mm wide strips. The results are shown in Appendix 3. The results on the distribution of oil in skipjack tuna muscle

are shown in Appendix 4. Inner layers of albacore tuna muscle appear oilier compared to skipjack tuna muscle at depths of 10 mm and more.

4. Oil contents of the white and red muscle of 24 specimens selected for the range of white muscle oil content were compared and given in Appendix 5. At values of 6% or more, the white muscle oil content is higher than the corresponding red muscle oil content. Where white muscle contents are 5% or less, the situation is reversed. The pattern is similar in skipjack tuna for white muscle oil contents of 7% or higher and 4% or less respectively (Appendix 6).

The object of these comparisons was to correct impressions that the oil content of the red muscle of these fish is always higher compared to the corresponding white muscle.

5. The correlation between moisture and oil contents of white muscle of skipjack tuna was found to be strong. The formula for the regression line for skipjack tuna is:  $Y (\text{oil}) = 81.33 - 1.14X (\text{moisture})$ ;  $r = -0.93$ . This correlation in some 70 albacore tuna analysed to date for the calculation suggests an even stronger relationship, according to the regression line formula  $Y = 88.2 - 1.22X$ ;  $r = -0.97$ . These formulae can be used in calculations of the oil content of the fish flesh once the moisture content is known. As the ash contents are relatively small with little variation ( $1.2 \pm 0.15\%$ ), the crude protein content can be found by difference. The formulae indicate that albacore muscle contains approximately 1.5% less crude protein than skipjack muscle of equal oil content.

6. The relationship between moisture and oil contents of the white and the red muscle of the fish described above (Appendix 5) were compared in

Appendix 7. Red muscle appears to contain approximately 4% less crude protein compared to white muscle of equal oil content.

7. Insufficient fish have to date been analysed to measure the relationships of oil content and body length, sea surface temperature or other seasonal or environmental factors. Preliminary results of plotting oil content v. body length regardless of catch data gave the formula:

$$\text{oil\%} = -6.88 + 0.18 \text{ length}; \quad r = 0.53$$

and for oil content v. s.s.t. the formula was:

$$\text{s.s.t.} = 19.3 - 0.23 \text{ oil\%}; \quad r = -0.55$$

which suggest a weak relationship. Appendix 8 gives the oil content, body length and s.s.t. for days that data on 5 fish or more are at present available.

Lower s.s.t.'s appear to result in higher oil contents, as was found in skipjack tuna (Appendix 9). The oil content of smaller fish appears less than that of large ones, but whether these factors can be used in predicting the composition and condition of albacore tuna is not yet clear.

Data on all fish analysed to date are as follows:

		Oil	Length	s.s.t.
	n	(%)	(cm)	(°C)
01/86	21	6.3±2.6	73±5.4	15.8-19.7
K03/86	48	4.8±3.6	64±8.9	16.5-19.4
K05/86	51	2.8±1.7	54±9.2	17.9-21.4

The mean values indicate that regardless of other factors - larger body length coincides with higher oil contents. The S.D. indicate that these differences are probably not significant.

# Appendix 1

## Compositional data of albacore tuna

Fish in sample	Length (cm)	Weight (g)	Date of Catch	Location
6	61±3.4	4881±717.1	26 February 1985	41°46.32'S, 170°48.58'E

## Proportion of body weight of dissected fish by 5 parts (g/100 g wet wt; mean and S.D.)

Head	Viscera	Frame	Skin	Fillet
23.9±1.77	6.1±0.99	19.0±1.17	4.2±0.59	46.9±1.63

## Proximate composition of 5 parts and whole fish (g/100 g wet wt; mean and S.D.)

Component	Head	Viscera	Frame	Skin	Fillet	Whole fish
Protein	19.5±1.18	29.2±7.53	22.9±8.64	22.5±3.02	26.4±1.28	24.0±0.77
Oil	13.6±2.55	4.1±1.22	9.2±2.65	26.4±5.86	4.7±2.91	8.6±2.37
Moisture	61.2±1.79	65.3±6.79	63.8±2.92	46.4±4.83	67.5±1.76	64.3±1.74
Ash	5.7±0.52	1.4±0.12	4.0±0.85	4.7±1.08	1.2±0.08	3.1±0.33

## The proportions of protein, oil, moisture and ash in the whole fish contained in the constituent parts (g/100 g wet wt; mean and S.D.)

Component	Head	Viscera	Frame	Skin	Fillet
Protein	19.4±2.14	7.2±1.23	18.7±1.63	3.9±0.52	50.8±3.07
Oil	38.8±6.37	3.0±1.16	20.9±2.00	13.2±3.45	24.0±8.33
Moisture	22.7±1.59	6.3±1.54	19.6±2.18	3.0±0.60	48.5±2.96
Ash	44.1±2.13	2.8±0.85	25.3±3.29	6.3±0.61	2.5±2.74

## Appendix 2

Fatty acid composition of white and red muscle of albacore tuna  
(% of total fatty acids)

<u>n-Saturated</u>	<u>White muscle</u>	<u>Red muscle</u>
14:0	2.7	1.7
15:0	0.7	0.5
16:0	21.2	16.9
17:0	1.3	1.2
18:0	7.1	11.3
20:0	0.1	0.1
<u>n-Unsaturated</u>		
14:1 b	0.2	tra <sup>a</sup>
15:1 b	0.4	0.3
16:1 b	4.9	3.4
17:1 b	1.2	0.9
18:1	21.2	16.1
18:2	1.3	1.3
20:1 c	2.5	2.0
20:5	5.9	6.0
22:1 d	2.3	2.9
22:4	1.4	1.9
22:5	1.0	1.1
22:6	22.3	29.6

% unsaturated

a Trace (less than 0.1%)

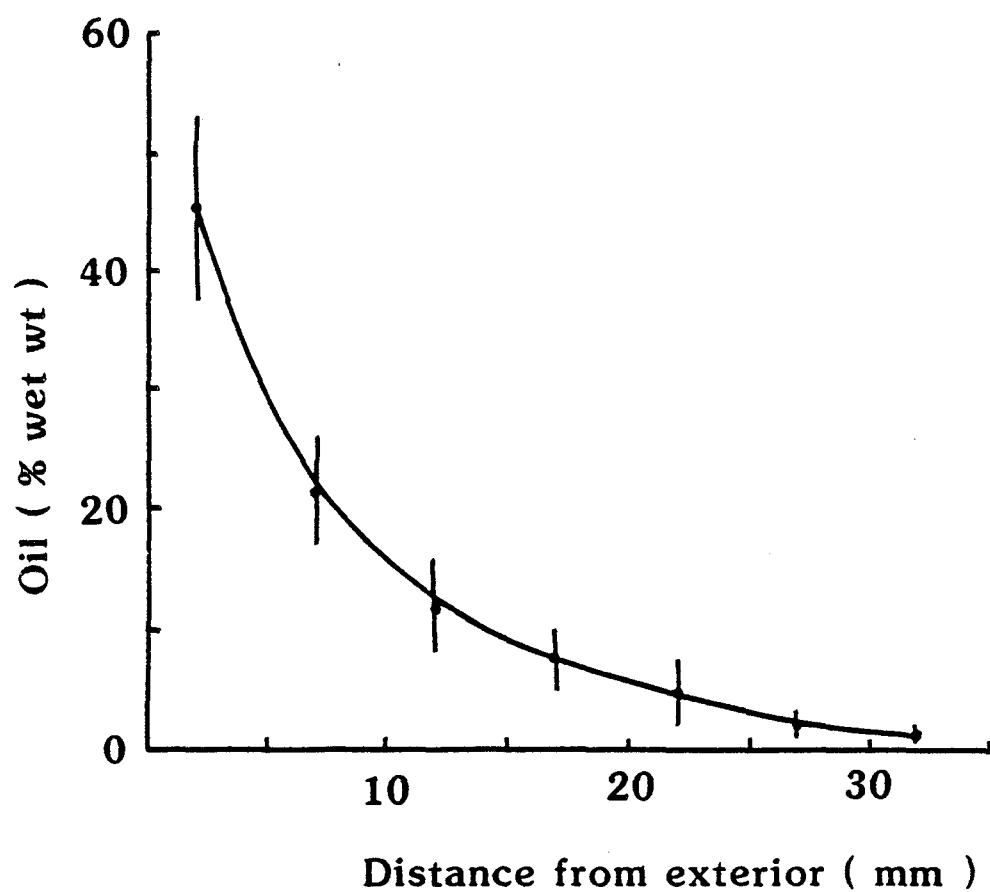
b Contains traces of branched-chain isomers

c Contains low levels of 18:3

d Contains low levels of 20:4

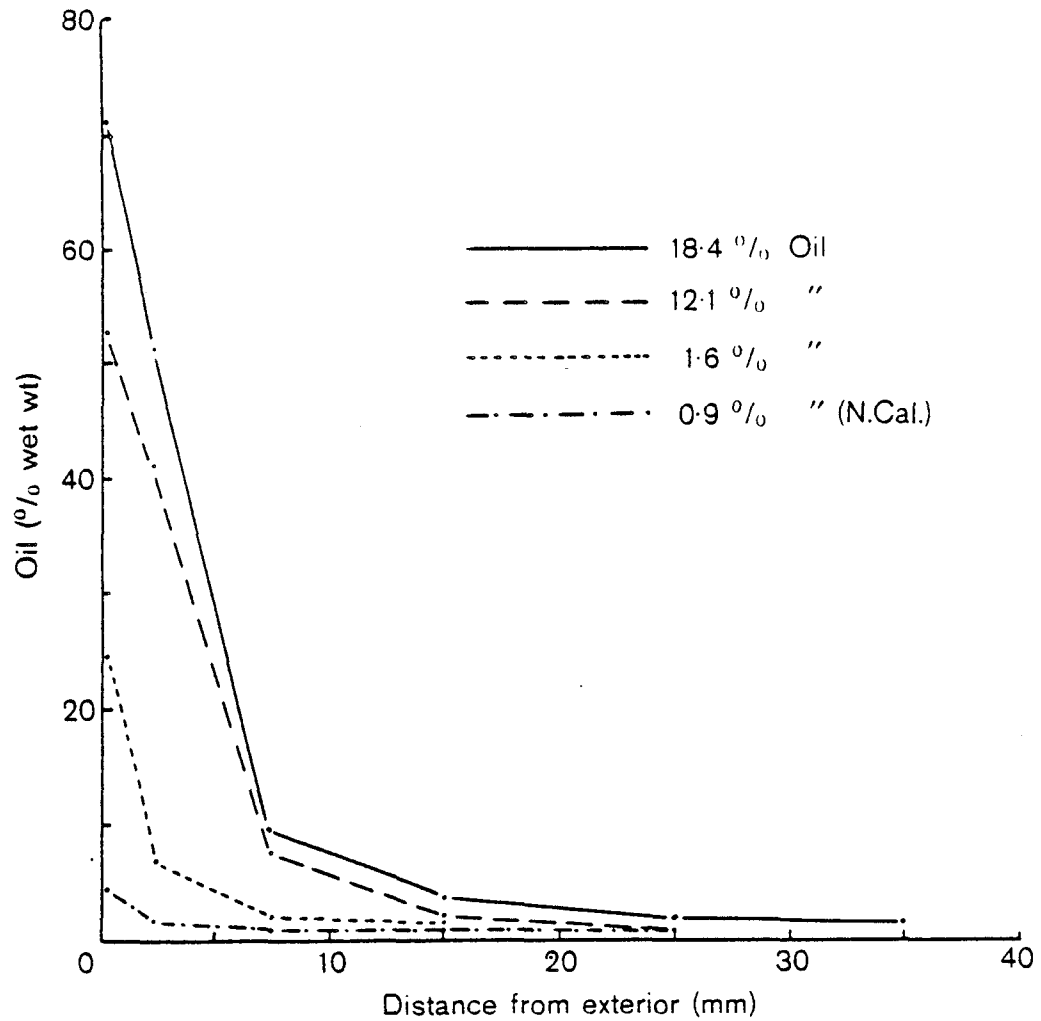
Appendix 3

Oil content of skin and underlying white muscle of albacore tuna



#### Appendix 4

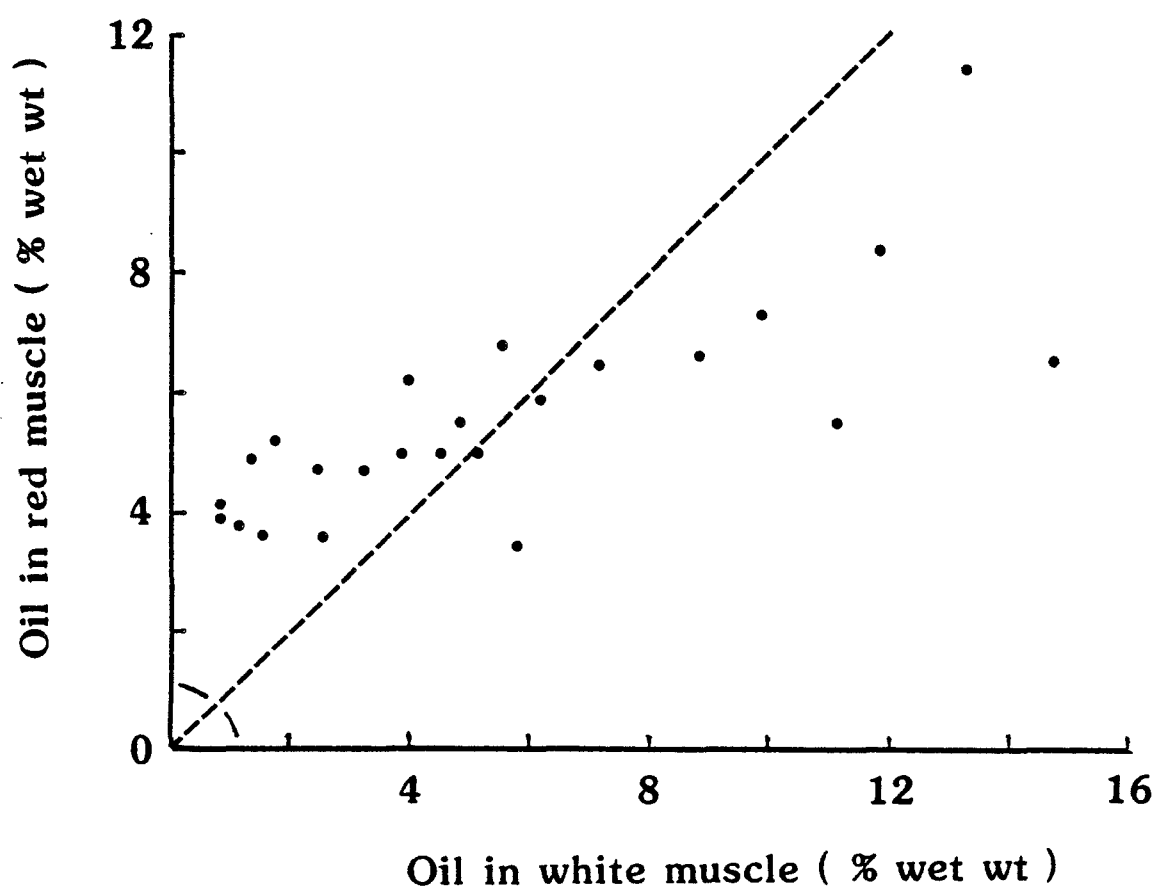
Oil content of skin and underlying white muscle of oily, medium oily and low-oil skipjack tuna from New Zealand and New Caledonian waters.





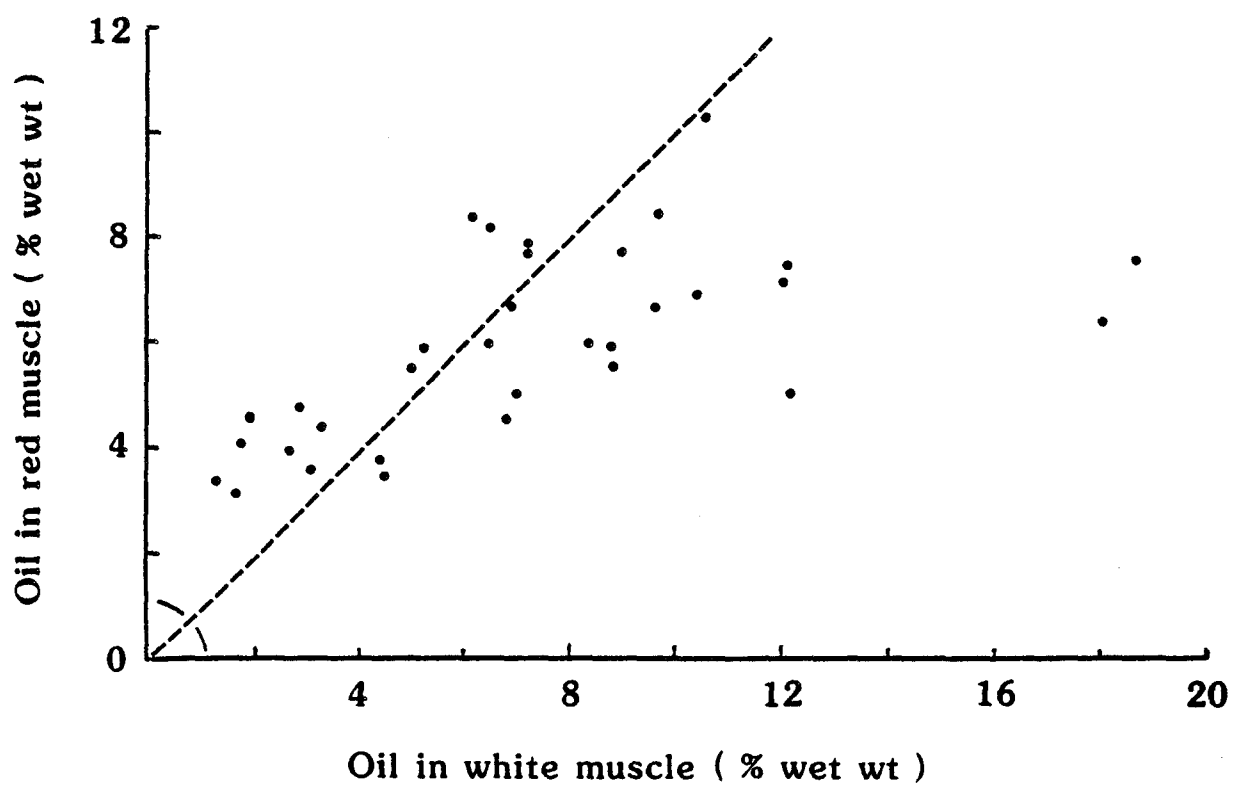
Appendix 5

Oil contents of white muscle and the corresponding red muscle of albacore tuna.



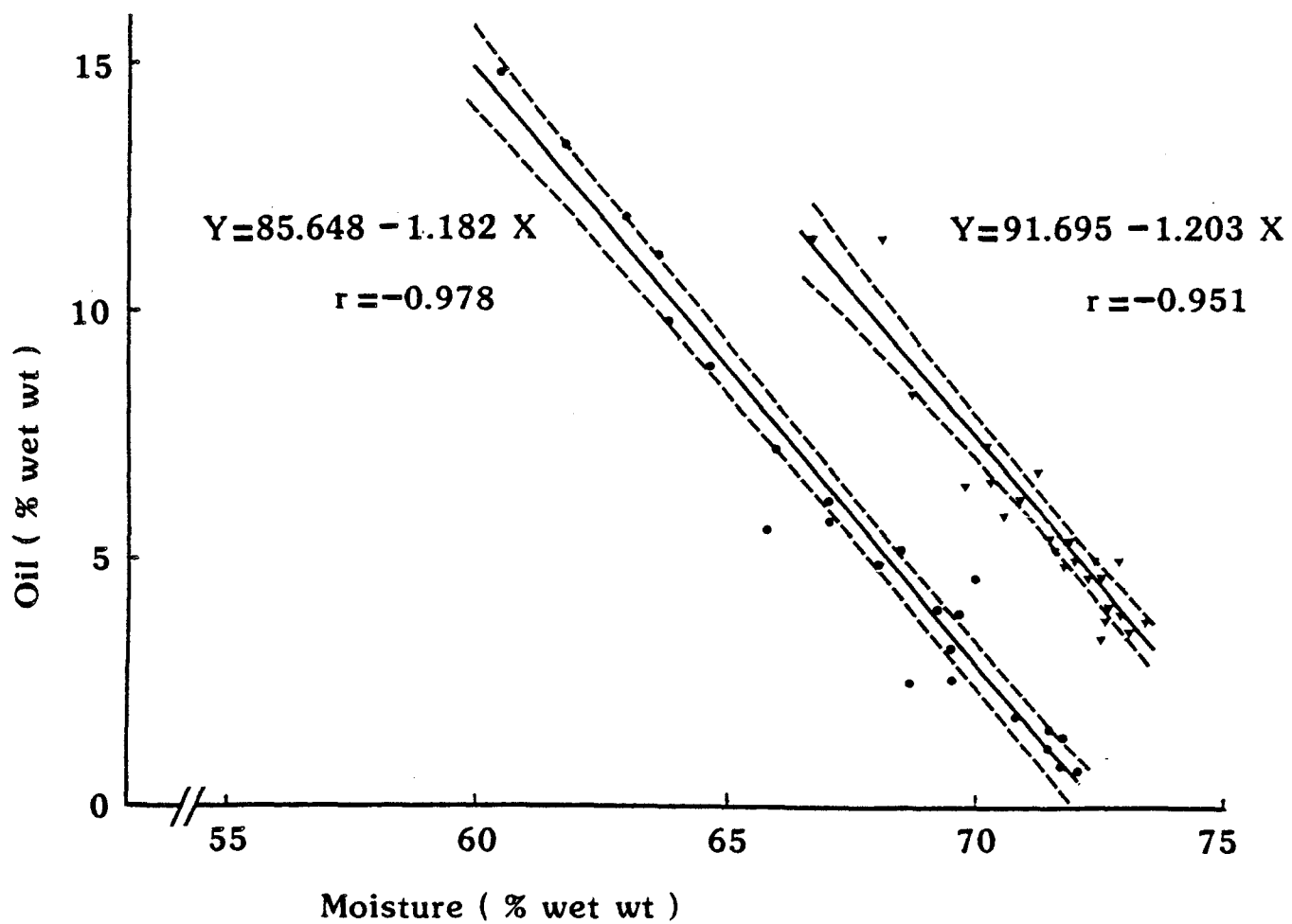
Appendix 6

Oil contents of white muscle and the corresponding red muscle of skipjack tuna.



Appendix 7

Regression lines and 95% confidence limits of the oil and water content relationships for the white(●) and the red muscle(▼) of albacore tuna.



## Appendix 8

Oil content and body length (mean and S.D.) and sea surface temperatures (range) of albacore tuna.

### 01/86 Townsend Cromwell 9-22 Feb. 1986

Date	n	Oil (%)	Length (cm)	s.s.t. (°C)
17/2	5	7.8±3.4	72±3.1	17.2
19/2	5	7.2±1.6	70±2.3	17.2
21/2	5	6.1±1.6	76±9.0	18.2

### K03/86 5-24 Feb 1986

Date	n	Oil (%)	Length (cm)	s.s.t. (°C)
6/2	8	7.0±2.6	69±2.7	16.6
15/2	8	6.6±2.9	71±3.6	16.8-17.3
16/2	7	1.7±0.5	57±6.0	17.7-17.9
24/2	10	4.7±2.7	68±4.9	18.1-18.2

### K05/86 10-28 March 1986

Date	n	Oil (%)	Length (cm)	s.s.t. (°C)
10/3	6	1.3±0.37	48±1.4	21.4
16/3	9	3.2±1.4	73±2.6	20.6
25/3	7	0.9±0.19	50±0.69	20.7
28/3	24	3.8±1.5	52±2.7	17.9-18.8

Appendix 9

Oil content of white muscle of skipjack tuna in relation to sea surface temperature at catching times (mean and S.D.).

