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Some notes on the seasonal growth of soles in the North Sea, Celtic Sea and Irish Sea

R. De Clerck
Fisheries Research Station, Ankerstraat, 1,
Ostend, Belgium

ABSTRACT

Seasonal differences in the weight at age in the sole of the Southern North Sea, the Celtic Sea and the Irish Sea were studied. Substantial losses up to 30 % of the body weight due to spawning activities occur for both sexes. Some differences in the growth between the three sole stocks were noted.

RESUME

Les différences saisonnières du poids à l'âge de la sole ont été étudiées pour la Mer du Nord méridionale, la Mer Celtique et la Mer d'Irlande. Des pertes substantielles jusqu'à 30 % du poids total dues aux activités reproductrices interviennent pour les deux sexes. Quelques différences dans la croissance ont été notées pour les trois stocks de soles.

INTRODUCTION

The main objective of this contribution is to investigate the seasonal differences in the weight at age in the sole stocks of the Southern North Sea, the Celtic Sea and the Irish Sea.

Initially this contribution was intended as a working document to the flatfish assessment working groups but the results could also be useful to all people involved in assessments. Recently a special effort has been made to enhance the assessment work, mostly as regards the determination of the terminal F array(Anon, 1981). The SOP difference has up to now in most cases been solved only by changing the weight at age data. Moreover the fixed set of weight data practically never changed throughout the years in the reports of the different ICES Working Groups. Giving special attention to a better assessment of the stock number without improving the weight data is in fact a most unsatisfactory approach. The results of catch forecasts, being the product of individual numbers and weight, can be largely biased by the weight data used. Although weight changes considerably during the course of the year, a mean weight value was generally chosen as VPA and

catch forecasts are still worked out on a yearly basis. When the fishery is concentrated on specific seasons or when large yearly differences in the seasonal pattern occur, the accuracy of weight data is essential.

MATERIAL AND METHODS

The data basis was derived from the weekly market sampling of sole landings in the Belgian ports over the period 1970-1980. The sampling provided individual measurements of length, weight, sex, age and weight of the ovary.

A total of 22,518 measurements was processed in the calculations of which 8,846 from the Southern North Sea ; 6,649 from the Irish Sea and 7,023 from the Celtic Sea.

The results of weight at age were grouped per quarter providing mean weights per age group and per sex. An additionnal set of weight data was calculated for the eviscerated weight of females (e.g. total weight-ovary weight). All weights are gutted weights.

The weight at age array was set up to 15 year-old soles because the mean weight values of the 15+ soles showed increasing inconsistant variations due to the increasing scantity in the number of observations.

The weight data per quarter for males and females are plotted on figures 1, 2 and 3. Procentual differences per quarter are given in tables 1-6.

RESULTS AND DISCUSSION

Figures 1, 2 and 3 show clear differences in weight per quarter. The sharp decreases of the weight from the first to the second quarter of each year are of course due to the energy loss by spawning activities. The spawning season for the Celtic Sea is March-April (De Clerck, 1974) and for the Irish Sea and Southern North Sea April-May (Anon. 1965, De Clerck, 1974).

For females the highest total individual weight over the year cycle occurs during the first quarter for all ages (figure 1). A severe drop in weight follows during the second and partially the third quarter in the North Sea and Irish Sea. For the Celtic Dea sole the drop in weight is limited to the second quarter only. A total weight increase starts from the third to the fourth quarter and continues during the first quarter of the following year.

While small differences will be explained later the general pattern is rather identical for the three areas. On the slope of the yearly growth increase the weight of the Irish Sea sole per age group is about 25 % lower to the one noted for the North Sea. With increasing age this difference remains but is reduced to about 10 %. Celtic Sea sole has up to an age of 9 years a lower weight than the North Sea sole but this difference decreases with increasing age. Moreover from the age of 10 to 15 years the Celtic Sea sole has an increasing higher weight up to about

10 % compared to the oldest age groups of the North Sea sole.

In figure 2, giving the eviscerated weights of the female soles, a similar pattern as in figure 1 is obtained.

In figure 3 the weight of the males is as in the case of the females changing very much throughout the year cycle. A severe drop in weight occurs in the 2nd quarter for the North Sea and the Irish Sea. The decrease of the Celtic male sole however starts already in the first quarter and continues during the second as spawning in that area starts earlier than for the two other stocks.

In tables 1-6 the procentual increase or decrease during the year in relation to the first quarter is given for males and females. The initial weight during the first quarter has been fixed at 100 %. Although the general pattern is similar for all areas, viz. a drop in weight after spawning followed by an increase in weight till the next spawning period, some differences are noteworthy.

A. Procentual differences for females (tables 1 - 3).

1. Weight composition during the first quarter.

As for females information was available on the individual weight of the ovary a split up was made of the two weight components, e.g. the total weight and the weight of the ovary during the four quarters. In all areas the eviscerated weight comprises about 10 % of the body weight. There seems to be a higher proportion of the ovary weight in the North Sea (up to 11.4 %) compared to the Celtic Sea (10.6 %) and the Irish Sea (9.4 %).

2. Decrease in weight from the 1st to the 2nd quarter.

In the Irish Sea and to a lesser extent in the North Sea the weight of the ovary remained similar during the 1st and the 2nd quarter, but at the same time more than 10 % of the eviscerated weight was consumed in the Irish Sea and more than 15 % in the North Sea. As in the Celtic Sea a major proportion of the eggs are already released in the 2nd quarter the ovary weight accounted in that period only for about 3 %. The loss in eviscerated weight amounted to about 20 %.

These findings confirm the previous statements on the spawning period in the three areas (1st alinea of this section).

3. Weight during the 3rd and 4th quarter.

A recovery in the eviscerated weight starts from the 3rd quarter onwards in all areas. This recovery is much more pronounced in the Celtic Sea where the losses caused by spawning activities seem to have been regained already during the 3rd quarter. However the total weight remains 10 % lower than the initial weight of the 1st quarter as the ovary accounts only for

about 1-2 % during the 3rd quarter. In the North Sea and the Celtic Sea the total weight in the 3rd quarter is still about 20 % lower than the initial weight of the 1st quarter.

This recovery trend in weight continues during the 4th quarter and most of the female soles are of the same total weight as at the beginning of the year. In the eviscerated weight a gain of about 5 % is noted over the whole period.

4. Weight increase on a year basis.

In all areas total annual weight increase is decreasing with age from about 25 % in the youngest ages to about 2 % in the oldest ages. The same values are obtained for the eviscerated weights.

When applying the different sets of weight at age per quarter quite different values of W_∞ are obtained. These values are mentioned at the bottom of each set in the table 1-6. This excercise was only meant to express the importance of the choice of the set of weight data for the determination of W_∞. Moreover each set of weight values can substantially change the yield curve.

B. Procentual differences for males (tables 4-6).

The data basis for males shows a trend similar to the one observed for females. However the decrease in total weight due to spawning activities differs substantially from one area to another. The smallest decrease occurs in the Celtic Sea where the drop in weight amounts to 9-14 %. In the North Sea a loss in weight of about 20 % was noted whereas in the Irish Sea the drop amounted to 30 % for the oldest age groups. No substantial differences were found in the yearly gain in weight.

CONCLUSIONS

The final conclusions of this contribution can be summarized as follows :

1. Substantial losses up to 30 % of the body weight due to spawning activities occur for both sexes.

2. For females.

   2.a. A yearly temporary decrease in weight of about 30 % is noted in all areas. About 20 % is used from body flesh and about 10 % disapeared as sole eggs.

   2.b. During the 3rd and 4th quarter of the year the eviscerated weight as well as the ovary weight increases again.

   2.c. When comparing the first quarter of year n and n+1 the total yearly increase decreases from 20 % in the youngest age groups to about 2 % in the oldest age groups.

3. For males.
   The highest drop in weight occurs in the Irish Sea, amounting to about 30 % in the oldest age groups.

4. The results show the vital importance of using correct weight data when applied to catch and stock biomass calculation. A stock assessment on a quarterly basis will undoubtedly enlarge the degree of accuracy of the calculations. This has already been suggested by De Veen and Panhorst (1976).

REFERENCES

ANON, 1965 - Cooperative Research Report no. 5. ICES.

ANON, 1981 - Report of the ad hoc working group on the use of effort data in assessments. ICES, CM 1981/G:5.

DE CLERCK, 1974 - A note on the spawning season of soles in the Irish Sea, the Bristol Channel and the Southern Bight. ICES C.M. 1974/F:31.

DE VEEN and PANHORST, 1976 - Prognosis of catch and stock of North Sea sole by quarters of the year. ICES, CM 1976/F:18.

Table 1 - Procentual increase or decrease in weight in North Sea sole (females) per quarter.

Age	I			II			III			IV			I (n+1)		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
2	100	100,0	-	117,8	117,8	-	135,6	135,6	-	214,1	206,6	7,5	230,9	218,7	12,2
3	100	94,8	5,2	84,3	80,6	3,7	100,0	97,2	2,8	130,0	127,6	2,4	144,2	133,2	11,0
4	100	92,5	7,5	78,1	73,6	4,5	90,8	87,7	3,1	111,6	107,9	3,7	124,5	113,2	11,3
5	100	91,0	9,0	76,6	71,1	5,5	86,0	83,1	2,9	103,7	99,8	3,9	115,4	104,1	11,3
6	100	90,3	9,7	76,8	70,5	6,3	83,2	80,5	2,7	99,8	95,7	4,1	110,4	99,3	11,1
7	100	89,9	10,1	77,7	70,6	7,1	81,2	78,8	2,4	97,7	93,5	4,2	107,7	96,3	11,4
8	100	89,5	10,5	78,8	71,0	7,8	79,6	77,3	2,3	96,4	92,0	4,4	105,5	94,1	11,4
9	100	89,3	10,7	80,2	71,6	8,6	78,5	76,4	2,1	96,0	91,0	5,0	104,1	92,5	11,6
10	100	88,9	11,1	81,4	72,4	9,0	77,7	75,7	2,0	59,7	90,4	5,3	103,0	91,6	11,4
11	100	89,0	11,0	82,8	73,2	9,6	76,9	75,3	1,6	95,5	90,1	5,4	102,4	90,9	11,5
12	100	88,8	11,2	84,2	74,0	10,2	76,4	74,8	1,6	95,6	89,9	5,7	101,9	90,2	11,7
13	100	88,6	11,4	85,4	74,7	10,7	75,8	74,4	1,4	95,7	89,7	6,0	101,4	89,8	11,6
14	100	88,6	11,4	86,5	75,4	11,1									
15															
W∞	762			738			561			741					

A = total weight
B = eviscerated weight
C = ovary weight

Table 2 - Procentual increase or decrease in weight in Celtic Sea sole (females) per quarter.

Age	I			II			III			IV			I (n+1)		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
2															
3	100	96,6	3,4	81,7	79,7	2,0	116,3	115,4	0,9	130,7	128,8	1,9	149,0	138,7	10,3
4	100	93,1	6,9	84,1	80,8	3,3	104,7	103,0	1,7	117,6	114,0	3,6	127,9	117,3	10,6
5	100	91,7	8,3	84,9	81,1	3,8	99,5	98,0	1,5	111,1	107,3	3,8	119,0	108,1	10,9
6	100	90,9	9,1	84,7	80,8	3,9	96,7	95,2	1,5	106,8	103,3	3,5	113,8	102,9	10,9
7	100	90,4	9,6	84,3	80,5	3,8	95,0	93,3	1,7	103,6	100,4	3,2	110,4	99,5	10,9
8	100	90,1	9,9	83,7	80,0	3,7	93,9	92,4	1,5	101,2	98,3	2,9	108,2	97,1	11,1
9	100	89,8	10,2	83,0	79,5	3,5	93,1	91,5	1,6	99,2	96,7	2,5	106,5	95,4	11,1
10	100	89,6	10,4	82,3	79,0	3,3	92,4	91,1	1,3	97,4	95,4	2,0	105,2	94,1	11,1
11	100	89,6	10,4	81,9	78,6	3,3	92,2	90,8	1,4	96,1	94,3	1,8	104,4	93,3	11,1
12	100	89,4	10,6	81,2	78,1	3,1	91,9	90,5	1,4	94,9	93,4	1,5	103,5	92,6	10,9
13	100	89,5	10,5	80,7	77,8	2,9	91,7	90,5	1,2	93,9	92,7	1,2	102,8	92,1	10,7
14	100	89,5	10,5	80,3	77,5	2,8	91,7	90,5	1,2	93,1	92,1	1,0	102,6	91,7	10,9
15	100	89,4	10,6	79,8	77,1	2,7	91,5	90,3	1,2	92,2	91,5	0,7			
W∞	908			689			834			794					

Table 3 : Procentual increase or decrease in weight in Irish Sea sole (females) per quarter.

Age	I			II			III			IV			I (n+1)		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
2															
3	100	100,0		105,2	104,4	0,8	159,5	158,7	0,8	178,4	175,0	3,4	191,4	180,2	11,2
4	100	94,2	5,8	91,4	84,3	7,1	112,2	111,3	0,9	123,4	120,8	2,6	139,7	129,3	10,4
5	100	92,6	7,4	88,1	79,1	9,0	97,7	96,5	1,2	107,4	104,9	2,5	123,3	112,9	10,4
6	100	91,7	8,3	87,2	77,5	9,7	91,1	89,8	1,3	100,8	97,9	2,9	115,7	105,5	10,2
7	100	91,2	8,8	86,9	77,0	9,9	87,3	86,0	1,3	97,3	94,4	2,9	111,1	101,2	9,9
8	100	91,1	8,9	87,2	77,2	10,0	85,1	83,5	1,6	95,5	92,7	2,8	108,4	98,4	10,0
9	100	90,8	9,2	87,6	77,7	9,9	83,5	82,0	1,5	94,5	91,6	2,9	106,4	96,5	9,9
10	100	90,7	9,3	88,2	78,3	9,9	82,5	81,0	1,5	94,2	91,2	3,0	105,0	95,1	9,9
11	100	90,6	9,4	88,7	79,0	9,7	81,6	80,2	1,4	94,1	90,9	3,2	103,7	94,1	9,6
12	100	90,8	9,2	89,4	79,9	9,5	81,3	79,7	1,6	94,5	91,3	3,2	103,1	93,5	9,6
13	100	90,7	9,3	90,1	80,7	9,4	80,9	79,4	1,5	94,8	91,4	3,4	102,6	93,0	9,6
14	100	90,7	9,3	90,6	81,5	9,1	80,6	79,0	1,6	95,2	91,6	3,6	102,0	92,4	9,6
15	100	90,6	9,4	91,1	82,1	9,0	80,4	78,8	1,6	95,6	91,9	3,7			
W_∞	725			699			582			739					

Table 4 - Procentual increase or decrease in wright in North Sea sole (males) per quarter.

Age	I	II	III	IV	I (n+1)
2	100	102,6	111,3	151,3	152,2
3	100	86,9	96,0	114,3	127,4
4	100	81,2	90,6	100,9	117,1
5	100	79,0	88,5	94,7	111,2
6	100	78,3	87,6	92,8	108,3
7	100	78,1	87,3	92,1	105,8
8	100	78,6	87,7	92,5	104,6
9	100	79,0	87,9	93,7	103,2
10	100	79,6	88,3	95,3	102,6
11	100	80,4	88,9	97,0	101,9
12	100	81,1	89,4	99,2	101,6
13	100	81,6	89,8	101,1	101,4
14	100	82,1	89,9	103,2	100,8
15	100	82,8	90,5	105,2	
W_∞	401	349	375	578	

Table 5 - Procentual increase or decrease in weight in Celtic Sea sole (males) per quarter.

Age	I	II	III	IV	I (n+1)
2	100	106,9	119,6	143,1	-
3	100	97,3	117,6	130,4	127,1
4	100	93,6	115,4	123,9	118,7
5	100	91,9	113,5	119,7	113,5
6	100	91,3	111,9	116,6	110,3
7	100	91,4	110,0	114,7	107,9
8	100	91,7	108,6	113,3	106,4
9	100	92,5	107,5	111,9	105,4
10	100	92,9	105,4	110,7	104,2
11	100	91,6	103,1	110,0	103,7
12	100	94,2	104,1	109,1	102,8
13	100	95,2	103,5	108,6	102,7
14	100	95,6	102,3	107,8	102,1
15	100	96,2	101,8	107,4	
W_∞	442	475	425	459	

Table 6 - Procentual increase or decrease in weight in Irish Sea sole (males) per quarter.

Age	I	II	III	IV	I (n+1)
3	100	90,6	111,0	120,5	122,1
4	100	87,7	103,2	116,1	116,2
5	100	86,2	98,3	112,8	113,4
6	100	83,3	94,1	108,8	110,3
7	100	81,8	91,1	105,8	108,9
8	100	79,6	88,6	102,4	107,4
9	100	77,9	85,9	99,6	106,1
10	100	76,3	84,2	97,1	105,8
11	100	74,6	82,4	94,2	104,4
12	100	73,4	80,8	92,5	104,3
13	100	72,0	73,4	90,3	103,8
14	100	70,6	78,1	88,3	103,3
15	100	69,5	77,0		
W_∞	462	259	295	315	

Figure 1. Total weight per quarter of female soles from the Southern North Sea, the Celtic Sea and the Irish Sea. (mean value for the period 70-80).

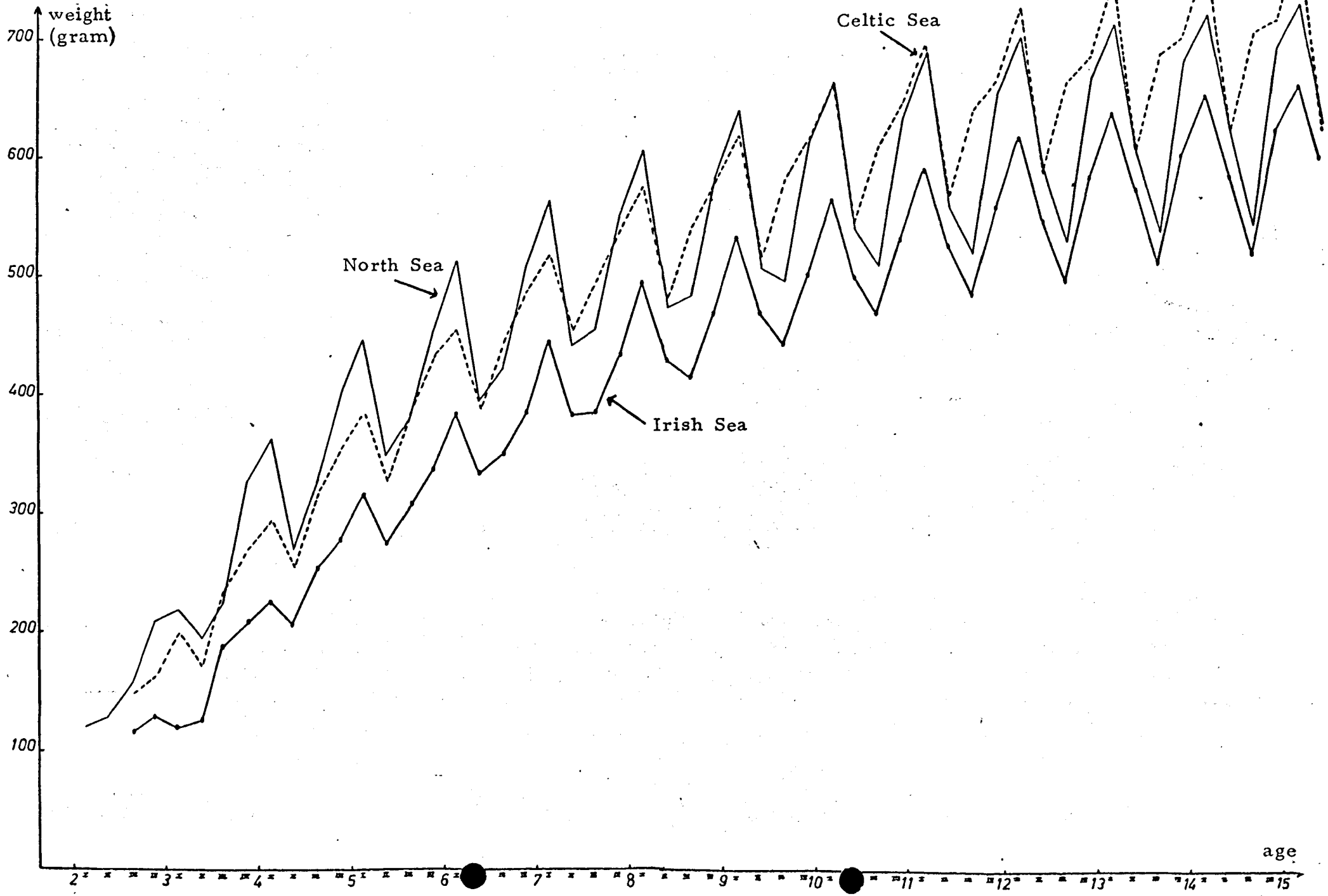

Figure 2. Eviscerated weight per quarter of female soles from the Southern North Sea, the Celtic Sea and the Irish Sea. (mean value for the period 70-80).

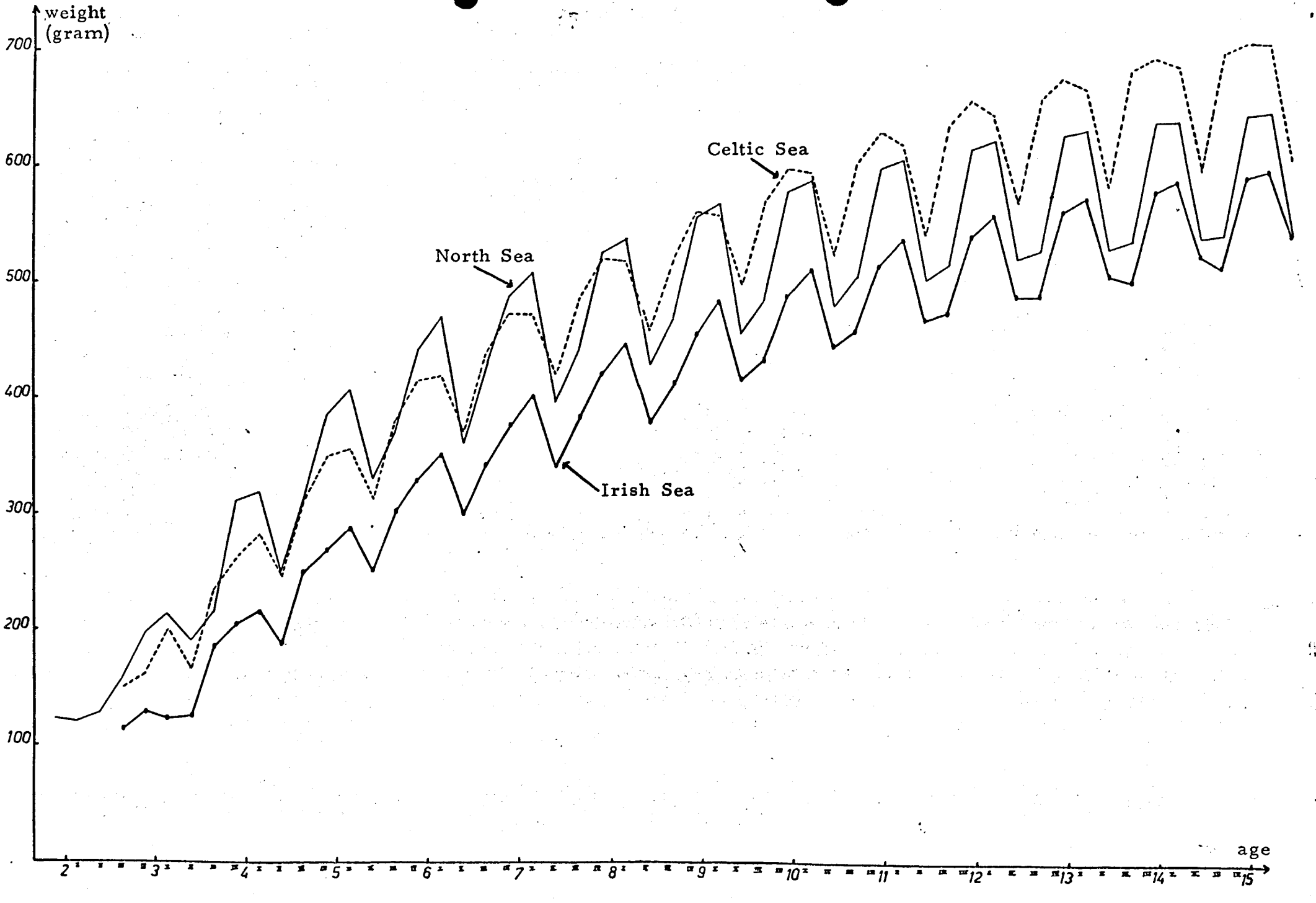

Figure 3. Total weight per quarter of male soles from the Southern North Sea, the Celtic Sea and the Irish Sea. (mean value for the period 70-80).