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PRELIMINARY INVESTIGATIONS ON THE BIOLOGY OF THE GREATER SILVER SMELT ARGENTINA SILUS (ASCANIUS)

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Summary

A survey is given of previously published work on the Greater Silver Smelt, Argentina silus (Ascanius). A preliminary report is made of some joint work now being undertaken on the general biology of this species by the Ministry of Agriculture, Fisheries and Food and the Department of Agriculture and Fisheries for Scotland. During the present investigations otoliths have been used for age determination and age-length keys are given for several areas together with comments on growth-checks on the otoliths and their possible connection with the onset of sexual maturity. The spawning season is either a long one from June to September or takes place at different times in different areas. Although our knowledge of the distribution of this species is limited the commercial potential in the North Atlantic promises to be useful; the flesh is of good quality and experimental marketing in small quantities has already been tried. The possibility of large numbers occurring in mid water and also in deeper waters than those so far investigated is discussed.

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Introduction and survey of previous work

The Greater Silver Smelt (A. silus) - a widely distributed, North Atlantic bathypelagic fish closely related to the salmon family - has in the past been almost entirely neglected by fishery scientists, and only a few papers have appeared which give any information on the life history or biology of this species.

Schmidt (1906) described the eggs which were bathypelagic and except for odd specimens were all taken from depths between 100 and 300 fathoms. He was subsequently able to hatch out a large number of these eggs and reported on the development of the larval and post larval stages. The eggs of A. silus, remarkable for their size (3-3.5 mm in diameter) had a flat oil globule and vacuolated yolk. The length of newly hatched larvae was 6-9 mm and metamorphosis had not occurred even when a length of 5 cms had been reached.

Kendall and Crawford (1922) described the spiral valve in the intestine of A. silus and discussed a number of the characters of this species including its skeletal structure. They stated that it was to be found rather infrequently along the Atlantic coast of the U.S.A. Bigelow and Schroeder (1953), however, reported that occasionally large catches were made round the edges of Georges Bank, and that it was distributed along the American side of the Atlantic from the Nova Scotia Banks to the vicinity of Southern New England.

Hickling (1927) examined the stomach contents of A. silus caught off Ireland and concluded that they fed mainly on salps, but that other important items of food were krill, the pteropod Clio, the hyperiid Themisto and bottom living amphipods. Hickling (1928) reported that during the exploratory voyages of the "Florence Brierley" A. silus had been caught by bottom trawl in the Faroe-Shetland Channel, on the Scottish Atlantic Slope and on Rockall Bank. Catches of this species were made in hauls down to depths varying between 180 and 520 fathoms, but as none of the fish had an everted stomach Hickling concluded that they might well have been caught at some depth considerably above the bottom. There are various other references to the depths at which A. silus were caught by the above authors, and in general it can be said that this species is normally found in water with a depth between 80 and 300 fathoms.

The flesh is edible and in fact Holt (1897), who first reported on its occurrence in British waters, found it to be excellent eating. Commercial landings were made in England at the turn of the century for Jenkins (1925) recalls seeing it frequently for sale on hawkers' barrows in Preston.

A. silus is at present subject to very little commercial exploitation in the north-east Atlantic although Germany and Norway are known to land small quantities for reduction to fish-meal. In the north-west Atlantic, however, a fishery has recently been started by the U.S.S.R., to the south of Newfoundland in I.C.N.A.F. sub-area IV. This is also believed to be for industrial purposes.

A related Pacific species, the Deep Sea Smelt Argentina semifasciata (Kishinouye), is fished commercially in the Japanese deep sea "drag net" fishery which takes place in the Seas of Kumano and Ensyu. Catches in recent years have been at the rate of about 10,000 metric tons per annum. Some work has been done on the biology of this species. Ochiai (1952) examined the relation between body length and weight, and later (Ochiai, 1954), the gonads. Hanyu (1956) investigated age and growth, and found that the otoliths could be used for age determination, but that the probable life span of A. semifasciata was only about 2 years.

During the last 3 years a number of samples of A. silus have been examined from catches made by the research vessels of the Ministry of Agriculture, Fisheries and Food and the Department of Agriculture and Fisheries for Scotland, while fishing in such widely separated areas as Porcupine Bank, Rockall, Iceland, Norway coast and Greenland. This paper describes some of the preliminary results.

Age and growth

Otoliths were used throughout the investigation for age determination. Fig. 1 a) and b) show the otolith and scale from a 7 year old fish from Rockall. Both show distinct growth zones but in older fish the scale edges tend to deteriorate and ring definition is increasingly difficult. Otoliths from more northern fish (e.g. from Iceland and Greenland) tend to have clearer ring structures and are easier to age than fish from warmer more southerly waters such as Porcupine Bank.

Age-length distributions of males and females from Rockall and Porcupine Bank are shown in Tables I and II. The samples from these two areas are not of sufficient size to detect any differences between them but from an early age, in nearly all cases, females were larger than males. The largest fish in each sample were females. The mean length per age of unsexed fish caught off South Iceland in May 1962 is given in Table III. It can be seen that fish over 10 years of age are not uncommon in all areas and the stocks in general seem to have an average life-span of up to 20 years or more. After about seven years of age the Icelandic fish show a tendency to be larger for age than fish from the other two areas.

A growth check is apparent on the otoliths of older fish and usually occurs between the fourth and sixth summers with a few fish showing a check in the third and seventh summers (Table IV). It is not unlikely that this growth check is associated with the onset of sexual maturity since a few maturing fish are found at 3 years of age and virgins occur up to 7 years of age (see Table V).

The first growth zones on otoliths from different fish vary considerably in size suggesting a prolonged spawning season. Figs. 1 a) and d) show, respecti ely, otoliths with a large and small first growth zone. Maturity data from Rockall in June 1961, Porcupine Bank in July 1960, and north-west Scotland in September 1962 (Table VI) also suggest either an extended spawning season starting before June and continuing at least until September, or different spawning times for the three areas. The evidence of Schmidt (1906) is important here for he records large numbers of eggs of A. silus in plankton catches from the west of Scotland in June, south west of Ireland in September and in the Skagerrak (in the neighbourhood of Christianssand) at the end of July. More work is required on maturity and spawning in all areas and at all times of the year before this question can be answered.

Discussion

Our knowledge of the abundance of A. silus is rather limited. We do not yet know very much of its distribution by depth and it is probable that the data available from commercial catches and research ship surveys do not give a true picture of its abundance or of the possible catching rates. Up to 35 baskets per hour were caught by R.V. "Ernest Holt" off Rockall in June 1961 and 10

baskets per hour has been recorded as not unusual during surveys of Porcupine Bank, N.W. Scotland, south Iceland and north Norway. (One basket contains about 100 x 35 cm fish). If these surveys had been extended into deeper water the catches might have been larger. Our knowledge of the geographical distribution of this fish, (Fig. 2), shows that it occurs in many areas from the eastern Atlantic seaboard of North America to the waters north of Norway. Considerable numbers are caught by trawlers fishing for hake off south-west Ireland and are dumped into the sea. Some were landed in Milford Haven after a White Fish Authority experimental trawling trip to Porcupine Bank in 1960 and were smoked and found delicious. Small quantities of fillets are already known to be marketed in France in the Lorient area. The fish give a good-sized fillet. Fig. 3 shows that above a length of 35 cm the weight/length ratio increases very quickly. A silus are also landed in small quantities for reduction to fish-meal by German and Norwegian boats.

Even allowing for our comparative lack of knowledge there promises to be a useful commercial potential for this species. It must be borne in mind that all the catches so far have been made with bottom trawls but the possibility that these fish spend some time off the bottom must not be dismissed. Their well-developed swim-bladders and the often high proportion of pelagic food-species in the stomachs suggest that a considerable proportion of their lives is spent above the sea-bed.

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TABLE I

P.V. ERNEST HOLT CRUISE V JULY 1960 PORCUPINE BANK

Total Length in cms. \ Age in Winter Rings	1 M	1 F	2 M	2 F	3 M	3 F	4 M	4 F	5 M	5 F	6 M	6 F	7 M	7 F	8 M	8 F	9 M	9 F	10 M	10 F	11 M	11 F	12 M	12 F	13 M	13 F	14 M	14 F	15 M	15 F	16 M	16 F	17 M	17 F	18 M	18 F
20	1																																			
21			1																																	
22																																				
23			1		1																															
24																																				
25			1			1																														
26					4	2																														
27					2	4	1																													
28						1		1																												
29									1	1	1																									
30												1																								
31									1		3		1																							
32										1	2						1																			
33												1		1	1		1																			
34													1		2	1	1						2													
35															1								1				1									
36																							2		1		1									
37																									2		1		1		2					
38																									1				2		2		1			
39																										1			1	2	1	1				
40																											1		1		1	1			1	
41																																				
42																																	1			
Totals	1		3		7	8	1	1	2	2	6	2	2	1	4	1	3						5		4	1	3	1	4	3	6	2	1	1	1	
Mean Length M	-		-		26.4		27.5		30.5		31.5		33.0		34.5		33.5		-		-		35.5		37.5		36.5		38.5		38.7		38.5		40.5	
Mean Length F	20.5		23.5		27.1		28.5		31.0		32.0		33.5		34.5		-		-		-		-		39.5		40.5		39.8		40.0		42.5		-	

M = MALE F = FEMALE

TABLE III

F.R.S. 'EXPLORER' S. ICELAND MAY 1962.

Age (Winter Rings)	Mean Length	Age	Mean Length
2	22.11	12	41.75
3	25.35	13	42.00
4	29.30	14	45.25
5	30.93	15	50.00
6	32.38	16	46.67
7	34.20	17	48.00
8	36.18	18	47.15
9	39.00	19	48.00
10	41.00	20	46.50
11	35.71	21	53.00

TABLE IV

Area	Age at which growth check occurs						Mean Growth Check age
	3	4	5	6	7.	8	
Porcupine Bank July 1960	-	3	21	26	5	-	5.6
Rockall June 1961	6	16	54	32	3	-	5.1
N.W. Scotland Sept. 1962	2	17	27	16	1	1	5.0
S. Iceland May 1962	-	18	39	22	2	-	5.1

NOTE The ages in this table are given in growth zones. For example if a growth check is seen at age 5, this is in the growth period following the 4th winter ring, i.e. during the 5th growth period.

TABLE V

Percentage virgin and mature fish.

Rockall June 1961 and Procupine Bank July 1960.

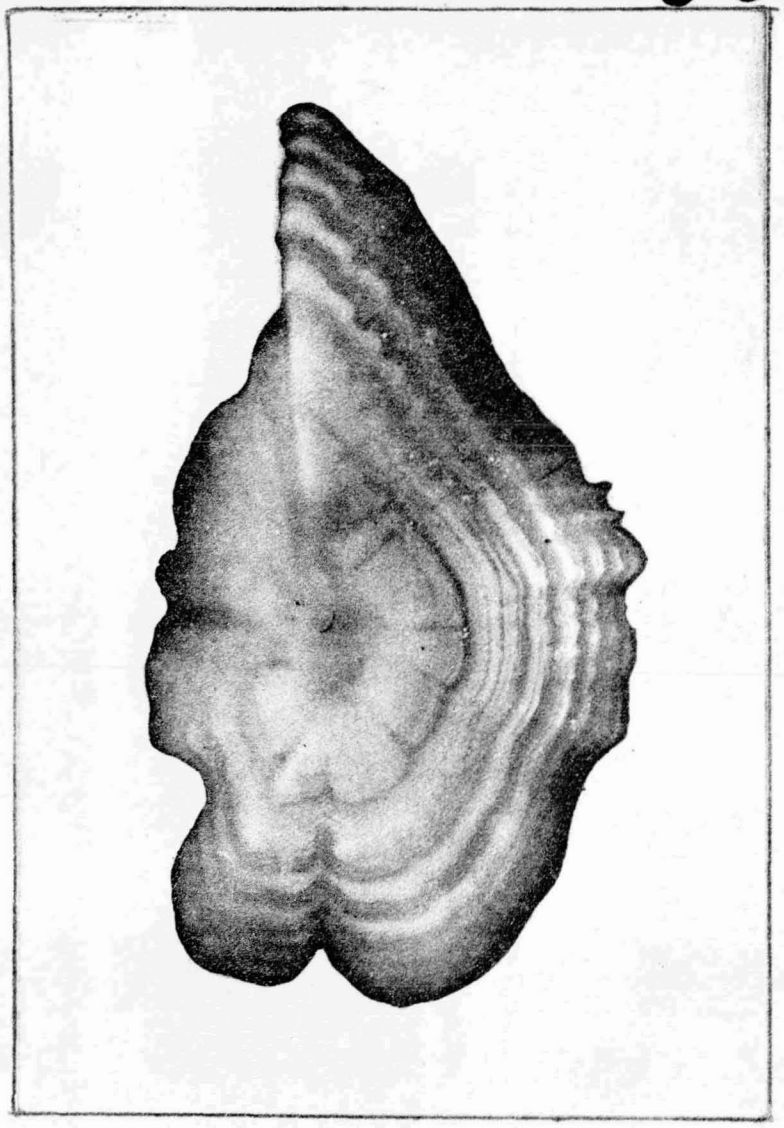
Age 2-6 years.

Age (Winter Rings)	% Virgin	% Mature
2	16	3
3	65	8
4	10	13
5	3	27
6	6	49

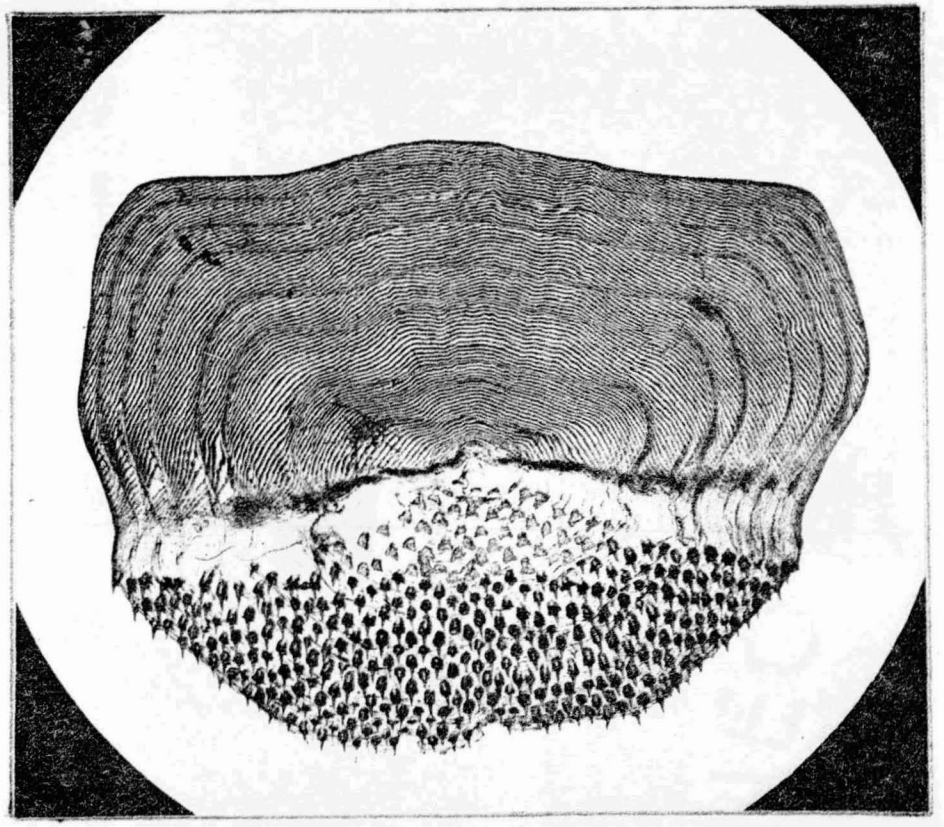
TABLE VI

Percentage maturity distribution. (Virgins excluded)

	% Maturing	% Mature	% Spawning	% Spent
Rockall June 1961	15.1	21.8	14.3	48.7
Porcupine Bank July 1960	24.6	11.5	3.3	60.7
N.W. Scotland Sept. 1962	28.1	-	9.4	62.5

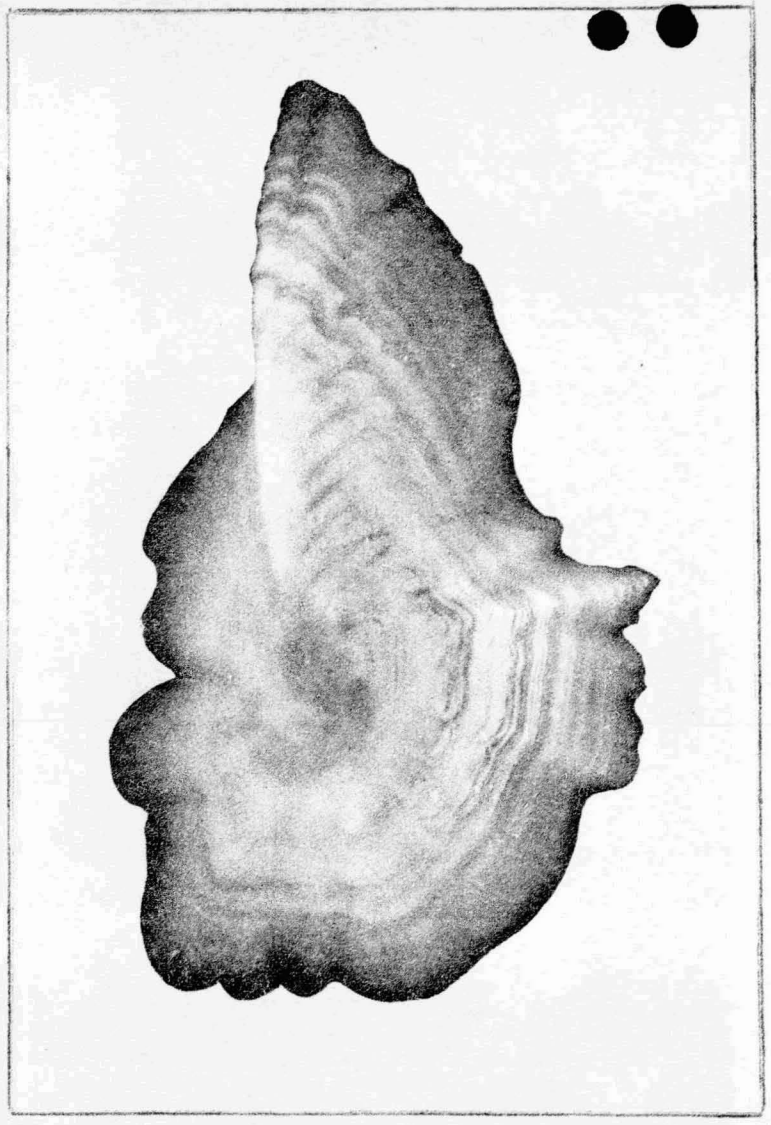


(a) 33 cm. male. Rockall Bank. 7 winter rings

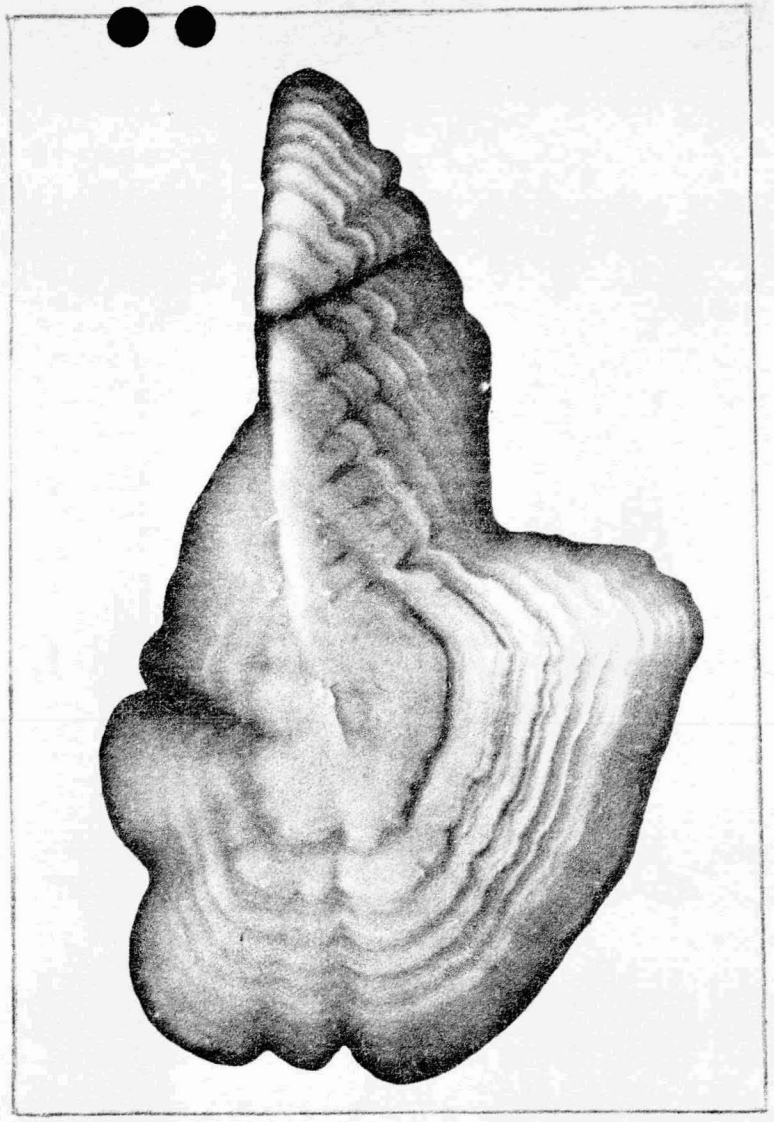


(b) Scale from (a). 7 winter rings.

FIGURE 1.



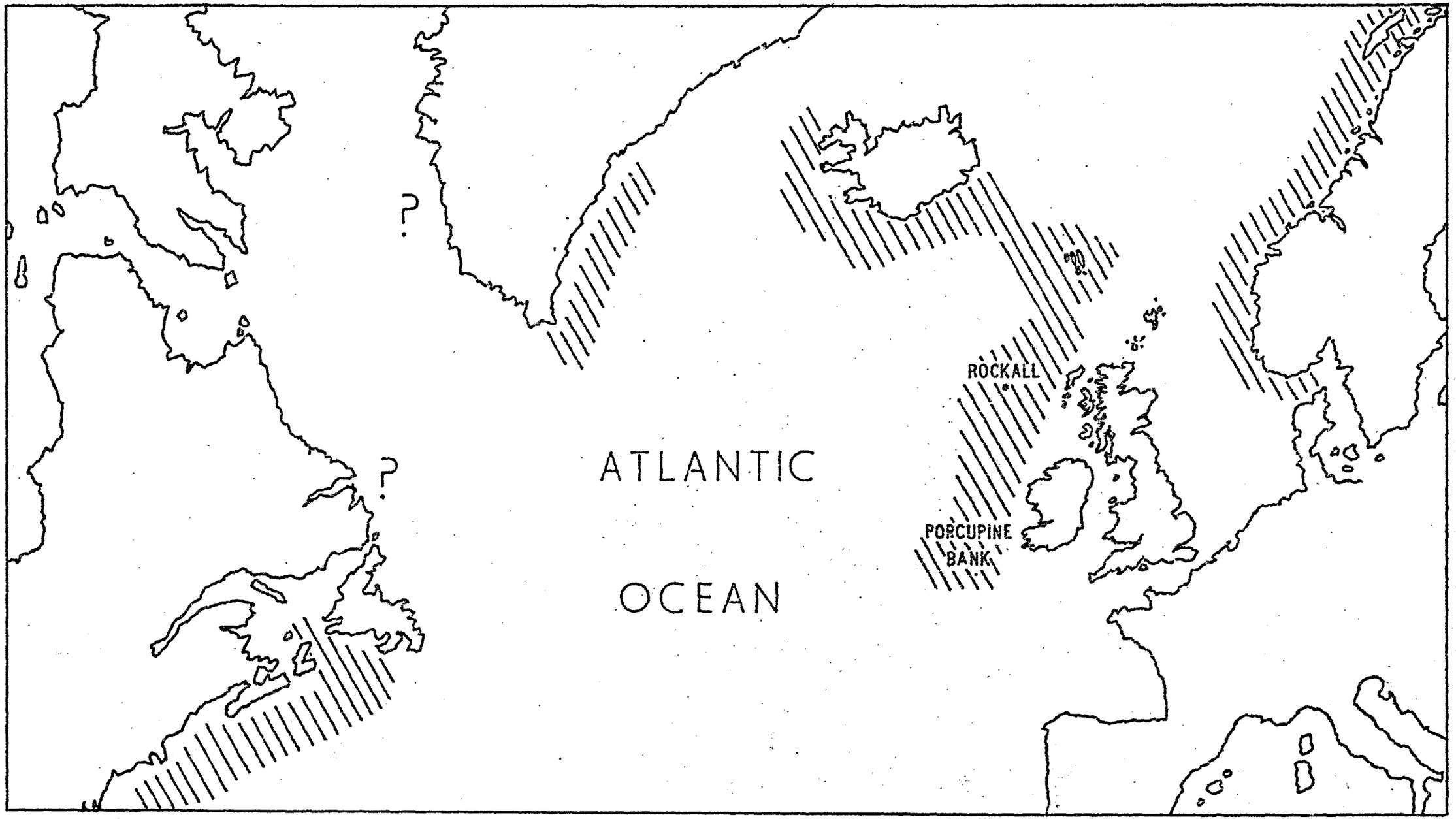
(c) 41 cm. female. Rockall Bank. 13 winter rings.



(d) 39 cm. male. E. Greenland. 11 winter rings.

FIGURE 1.

FIGURE 2. DISTRIBUTION OF ARGENTINA SILUS (ASCANIUS)



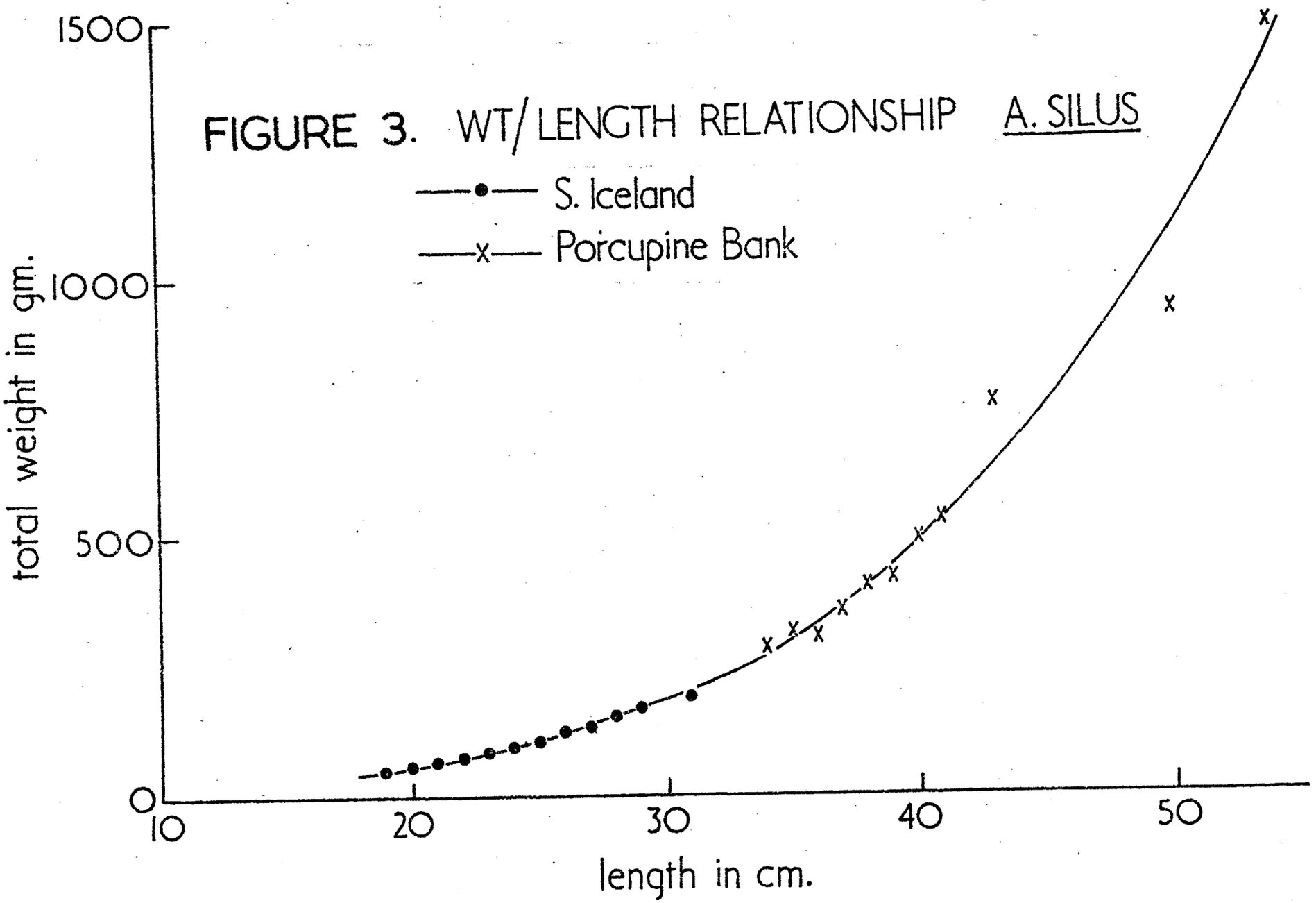


FIGURE 3. WT/LENGTH RELATIONSHIP A. SILUS
S. Iceland
Porcupine Bank
total weight in gm.
1500
1000
500
0
10
20
30
40
50
length in cm.