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AGEING AND AGE COMPOSITION OF SILVER SMELT (*ARGENTINA SILUS* ASC.) IN ICELANDIC WATERS

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ABSTRACT

The interpretation of rings in otoliths of *Argentina silus* is described and demonstrated by photographs. Further, the growth and age composition of *A. silus* in Icelandic waters in the years 1986 to 1989 is given.

1. Introduction

Several authors dealing with ageing of silver smelt in Icelandic waters have reported different growth rates (Magnússon 1988). In the age reading by otoliths, it is generally accepted that a hyaline plus an opaque zone represent one year as also stated by Emory & McCracken (1966). However, discrepancies probably arise mainly in the interpretation of the center of the otoliths on one hand and on the other, of splitting the edge zone into years, especially in older specimens.

In this paper, it is intended to demonstrate how the zones should be interpreted. It is also commented upon the age composition of silver smelt in Icelandic waters, in the years 1986 to 1989.

2. Material and methods

The material in this study derives from experimental fishing for *Argentina* and from by-catches in research cruises both carried out in Icelandic waters. It was pooled together for each year separately regardless of area and depth and sex.

The ageing was carried out under a binocular with reflected light on unsectioned otoliths in 50% glycerine solution with thymol for clarification. In the paper, a series of photos of otoliths were presented for demostration (Figs. 1-7). The photos were taken on an OLYMPUS OM-2 camera with an attached MACRO 20 mm lens at f-8/appr. 1 sec. by transparent light.

3. Results and Discussion

Generally, the rings in otoliths of silver smelt in Icelandic waters are rather clear but there are, sometimes, characteristica which may complicate the ageing, e.g. the center, the edge and the change in growth.

3.1. The center

Wood and Raitt (1968) pointed out that by fish which spawn late in the year the first winter-ring was formed in the second winter of life while by those that spawn early in the year, the first winter-ring was laid down during the first winter of life. In Icelandic waters, the silver smelt probably spawn the year round, however, with two periods of more intensive spawning, i.e. in May-June and Sept.-October (Magnússon 1988). We can, thus, expect a rather confused center at times. There should not be any problems with otoliths of fish originating fram Argentina that spawn during the first period of intensive spawning. It is assumed that the opaque center originates from the first summer growth and the first hyaline ring is laid down during the first winter in the life of the fish e.g. Fig. 6. However, the center of those spawned later in the year - and even in the mid winter - appears differently. Frequently, there is a hyaline spot in the center of the otolith which probably represents the "first winter" in the life of the fish (Fig. 1). These fish might originate from spawning in late summer

and autumn, e.g. from the second intensive spawning period. The first winter-ring is then laid down during the second winter in the life of the fish. But we do not only have to deal with otoliths originating from the two named intensive spawning periods but also from the time between them. Probably it is here where the main difficulties in the interpretation arise. One could, e.g. interprete an otolith such as shown in Fig. 5 as being a fish originating from a spawning which has taken place somewhat later than during the main spawning period in spring and the opaque center spot would then represent the remaining summer growth and the narrow hyaline ring would represent the first winter in the life of the fish. In some cases it might be very difficult to find out with certainty to which year class a fish belongs even though the rings in the otoliths are very clear.

3.2. The edge

In younger specimens, the edge of the otolith usually does not create difficulties in the interpretation. When the fish, however, grows older, the opaque zones become very narrow and faint and may often be very difficult to trace (Fig. 7). Frequently, in old fish, the edge appears more or less as one broad hyaline zone impossible to separate into rings representing years.

3.3. Changes in the appearance of zones

During the first four to six years of life, the zones are well defined and broad in particular the opaque zones indicating a rather fast growth (Fig. 2). After that for the next four to six years, the zones are still well defined but the opaque zones get narrower and the hyaline zones broader but after that the zones are very narrow and predominantly hyaline e.g. see Fig. 6. It is assumed that these changes in appearance of the zones reflect changes in the life of the fish. The first change might be connected with the moving of the fish to deeper waters but the next change is definitely in connection with the onset of maturity which has also been suggested by Borodulina (1968).

3.4. Ageing

It is likely that the above described peculiarities of the silver smelt otoliths are the reason for the discrepancies in the age determination. It might also explain the apparent difference in the growth rate in different years (see Fig. 8).

For more precise ageing one has to take into account the before mentioned characteristics of the center of the otolith. In our material, the counting starts with the first clearly visible hyaline ring which in most cases marks the first winter in the life of the fish but in some instances as said before, the zone marks the second winter. Unfortunately, the method used in age reading of e.g. the herring summer spawners by adding one year to the rings cannot be applied for the silver smelt because of its

year round spawning. The proper way might be to continue reading the winter-rings as before but to add one year to those otoliths with a definite hyaline spot in the center. Other variations of the center are less certain but in most cases the plus-one-method would do.

3.5. Age composition

In Fig. 9, the age composition of *A. silus* in four consecutive years (1986-1989) is domonstrated. It shows that there are many year classes present in the samples but the variation in the age composition from year to year is probably caused by sampling since the same area and depth were not covered each year.

The average length by age is shown in Table 1 and Fig. 8 for each of the four years separately. The growth curves for the years 1987 and 1988 match very well while they diverge for 1986 and in particular for 1989. There might be several explanations of this divergence but one should note that the growth curves for the years 1987 and 1988 derive from the most extensive material while that for the year 1989 only from a small sample. Also the composition of "early" and "late" spawners might influence the course of the curves. Finally one should bear in mind that the sex composition was not taken into account in this study.

Acknowledgement

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References

Borodulina, O.D., 1966: 1. *Argentina silus* in the Atlantic Ocean. Cons.Int.Explor. Mer, Rapp. et Proc.-Verb. **158**:54-57.

Emory, A.R. and F.D. McCracken, 1966: Biology of the Atlantic Argentine (*Argentina silus Ascanius*) on the Scotian Shelf. J. Fish. Res. Bd. Canada, **23**(8):1145-1160.

Magnússon, J.V., 1988: On silver Smelt (*Argentina silus Asc.*) in Icelandic Waters. ICES, C.M. 1988/G: 39 12 pp (mimeo).

Wood, R.J. and D.F.S. Raitt, 1968: Some Observations on the Biology of the Greater Silver Smelt, particularly in the North-Eastern Atlantic Ocean. Cons. Int. Explor. Mer. Rapp. et Proc-Verb., **158**:64-73.

Table 1. *A. silus* **Relation age to length (in cm)by years**

Age in	1986		1987		1988		1989	
winter rings	Av.length	No	Av.length	No	Av.length	No	Av.length	No
1	15.5	17	15.5	66	14.0	8	16.8	5
2	18.8	35	21.3	222	19.9	40	20.1	21
3	23.6	24	24.6	146	25.8	88	24.5	14
4	27.3	30	27.3	253	28.7	99	27.5	13
5	30.3	39	31.0	93	31.3	160	29.6	7
6	34.2	42	33.0	148	33.3	233	33.4	14
7	35.6	20	35.5	69	35.4	197	36.2	5
8	37.0	48	37.5	40	37.1	171	37.6	8
9	38.4	32	38.7	159	38.3	108	39.7	6
10	40.7	54	40.5	125	40.1	101	42.5	2
11	41.3	72	41.2	100	40.9	118	41.3	16
12	42.0	94	42.5	113	41.9	122	41.4	5
13	43.1	112	43.2	112	43.0	161	44.2	4
14	42.7	81	44.5	106	44.0	160	45.5	4
15	43.7	55	44.9	112	44.5	187	43.0	2
16	45.0	57	45.3	63	45.0	180	48.0	7
17	45.3	33	45.9	51	45.8	116	48.0	1
18	45.2	35	46.2	46	46.8	111	46.5	2
19	44.9	18	47.4	22	47.3	64	50.2	5
20	45.2	23	47.7	31	48.1	58	51.0	3
21	46.8	18	48.9	16	48.4	46	56.0	1
22	46.9	12	48.5	28	49.1	46	52.0	2
23	47.4	7	48.2	17	48.4	25	-	-
24	47.0	6	48.2	13	49.4	16	52.0	1
25	46.5	6	48.6	10	51.8	4	-	-
26	46.6	5	48.3	13	50.5	2	55.0	1
27	45.8	5	48.8	5	52.0	5	-	-
28	45.5	4	49.9	8	50.0	2	-	-
29	49.0	1	50.0	3	49.5	2	-	-
30	48.0	1	52.5	2	-	-	-	-
Total		986		2192		2630		149

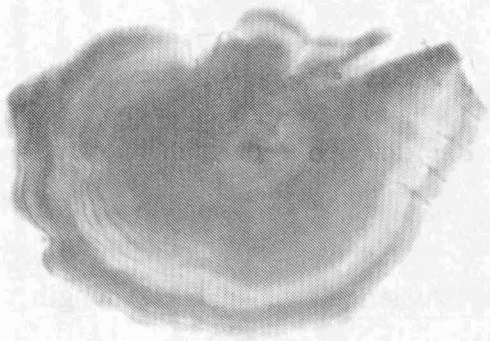

Fig. 1. *A. silus*, 2 years old, 19 cm ♂, March 1988.
Length of otolith: 5 mm.

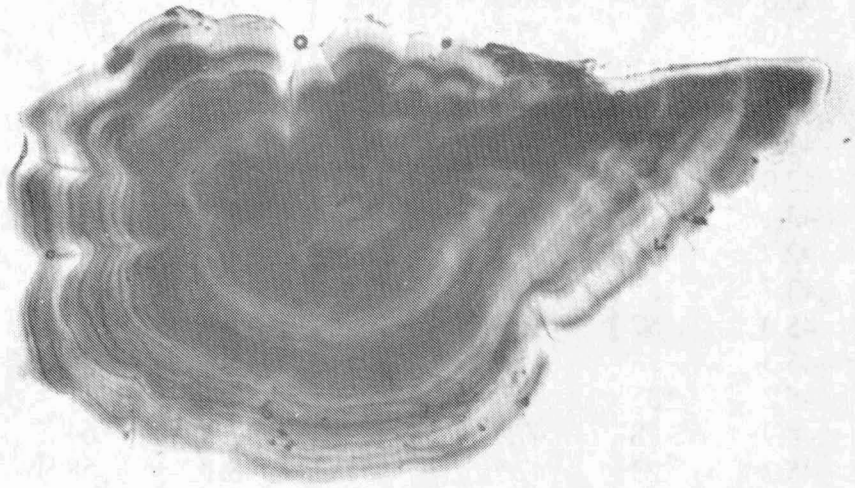

Fig. 2. *A. silus*, 4 years old, 26 cm ♂, March 1988
Length of otolith: 7 mm.

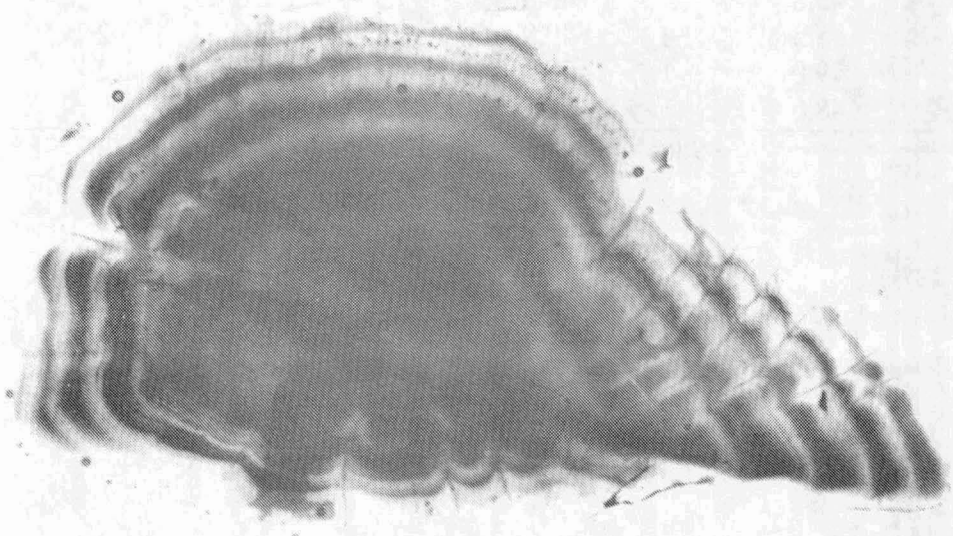

Fig. 3. *A. silus*, 6 years old, 32 cm ♂, March 1988.
Length of otolith: 8 mm.

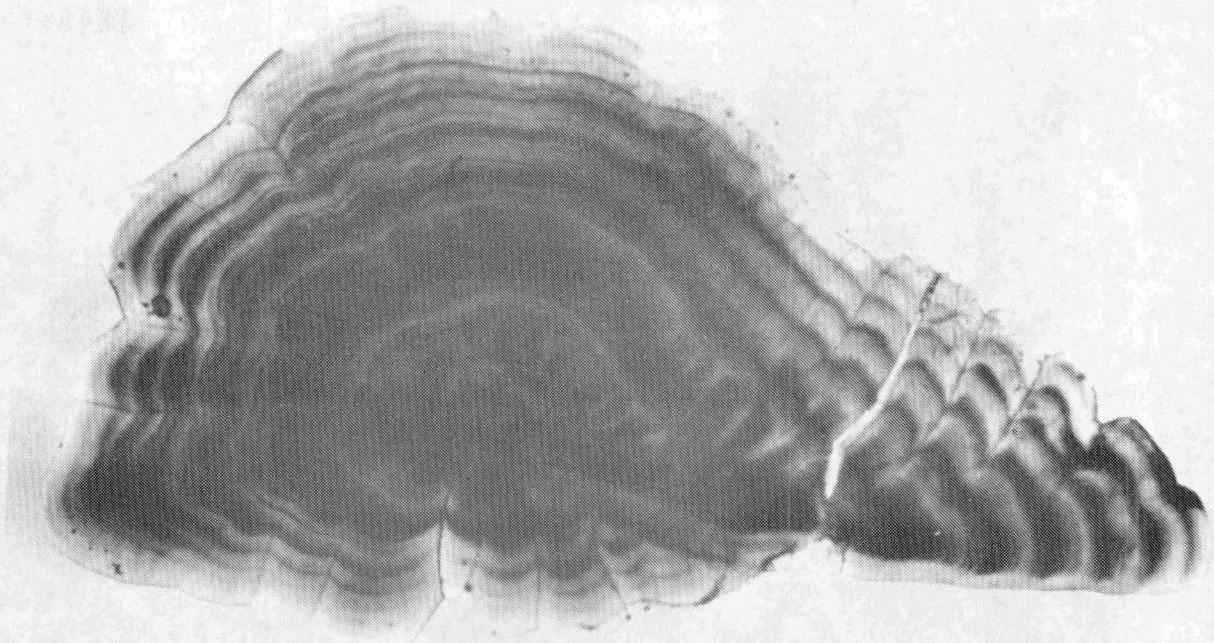

Fig. 4. *A. silus*, 8 years old, 36 cm ♂, March 1988.
Length of otolith 9 mm.

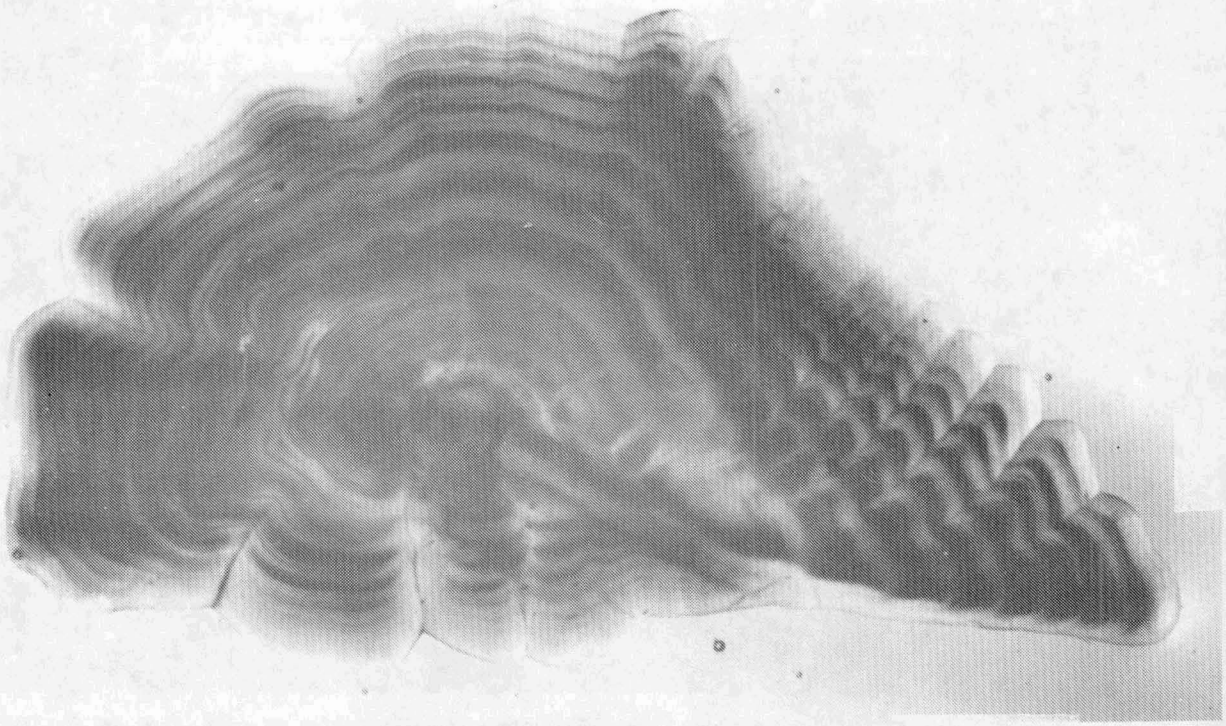

Fig. 5. *A. silus*, 10 years old, 44 cm ♂, March 1988
Length of otolith: 9 mm.

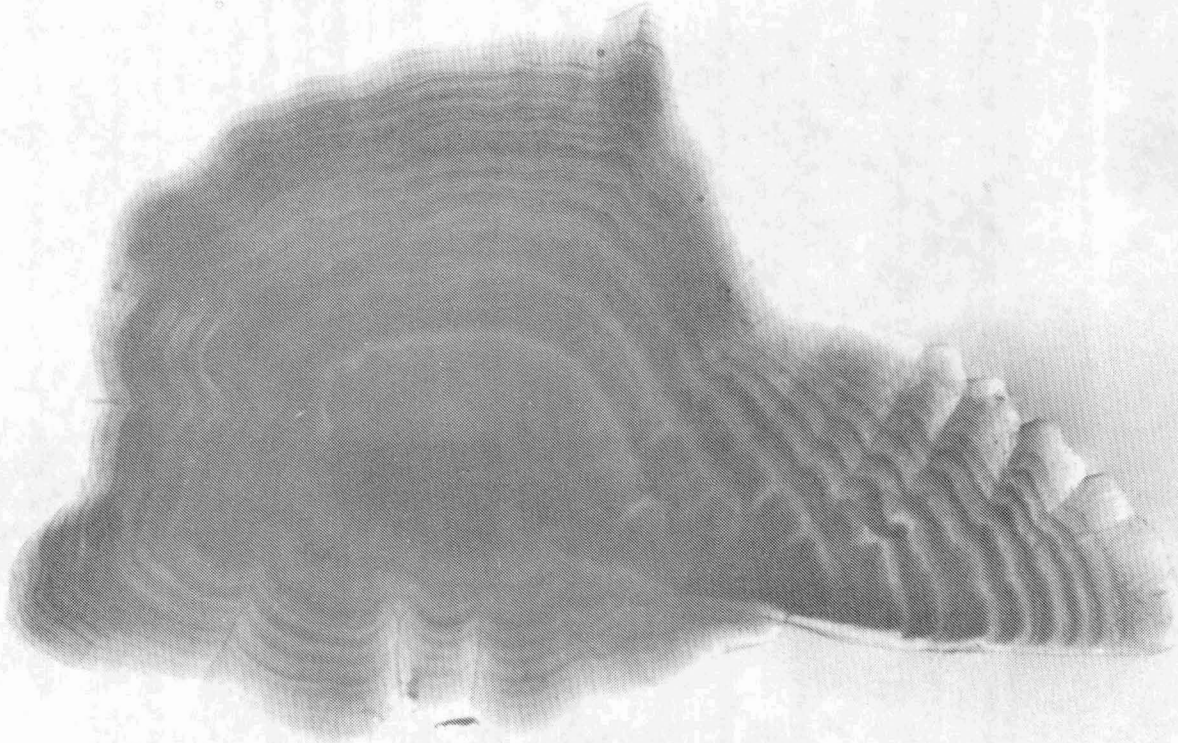

Fig. 6. *A. silus*, 12 years old, 43 cm ♀, Sept. 1989.
Length of otolith: 10 mm.

Fig. 7. *A. silus*, 14 years old, 45 cm ♂, March 1989
Length of otolith: 11 mm.

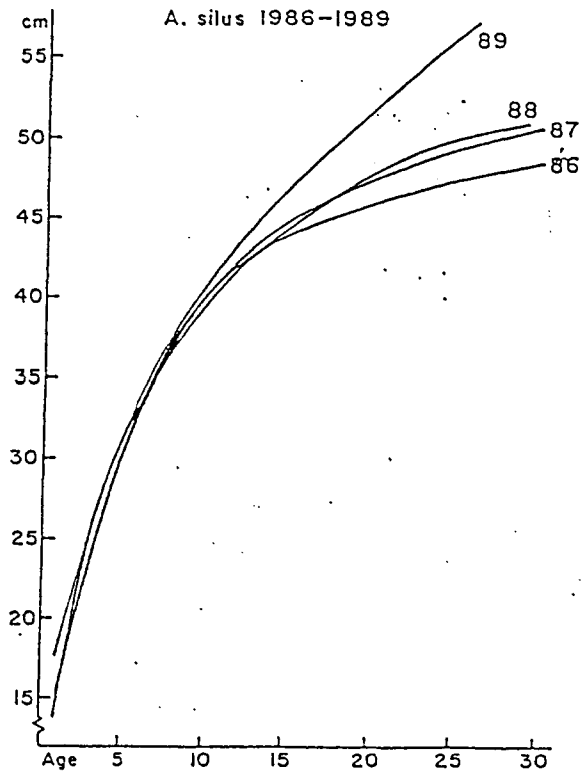

Fig. 8. *Argentina silus*. Relation age to length for both sexes combined, for each year separately, in 1986-1989.

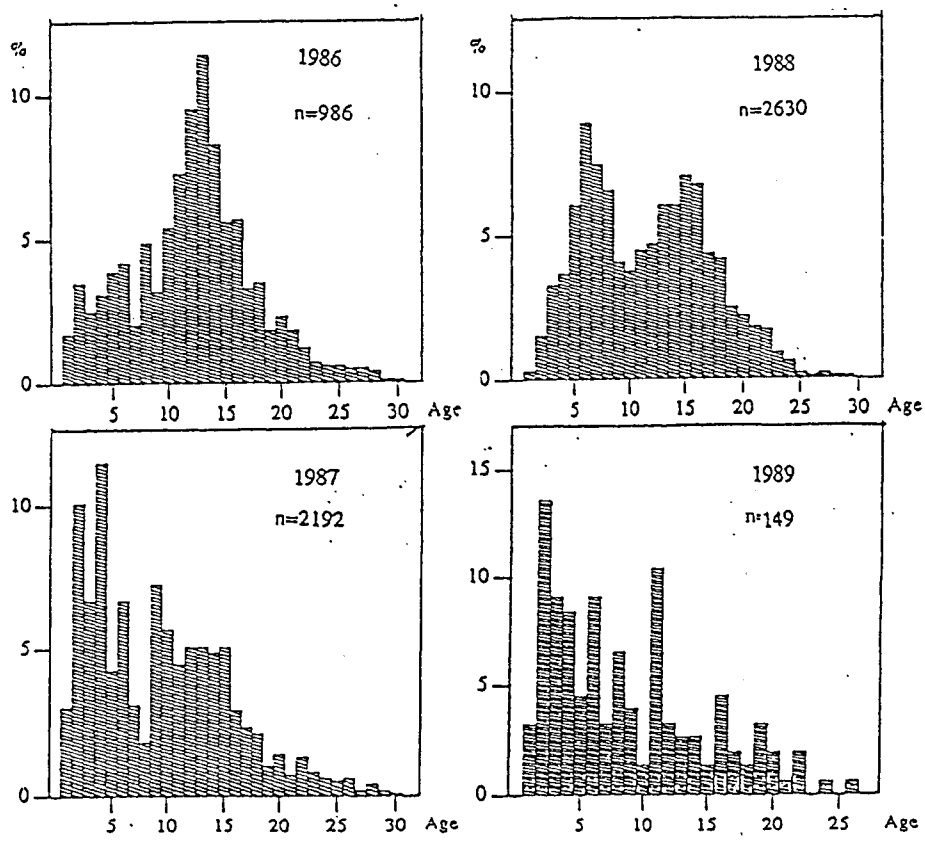

Fig. 9. *Argentina silus*. Age composition. Sexes combined, 1986-1989, for each year separately.