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Report of the Silver Hake Ageing Workshop
St. Andrews, Canada, 14-18 March 1977

INTRODUCTION

In the report of an earlier workshop (Summ. Doc. 76/VI/21), problems in interpretation and different methods of examining silver hake otoliths were identified as the main sources of differing ages and age length keys. These problems were not resolved and a further workshop was identified as a prerequisite for age determination of silver hake. The participants agreed that a second workshop be held in the fall of 1976, but the expert from the USSR was not available at that time. Subsequently, at the request of STACRES, a workshop was arranged in St. Andrews, Canada and Mr. J. J. Hunt (Canada) appointed co-ordinator. This workshop was successfully completed from March 14-18, 1977, with ageing experts from the USSR, USA and Canada attending.

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OBJECTIVES

Comparative examinations by experts actively engaged in ageing silver hake was recognized as the key to identifying and resolving differing estimates of age in this species. It was agreed that definition of terminology identification of characteristic otolith types with respect to rings and geographic area, and detailed examination of possible and preferred interpretation of individual otoliths were the first and most important steps in assuring overall acceptability of age length keys. As well, a further examination of potential differences in interpreting whole glycerine-stored otoliths and cross sections was felt necessary. In addition, discussion of planned age validation studies and/or other studies related to ageing should be considered to avoid duplication and, where possible, to provide for joint participation.

RESULTS

Technique

After careful examination of a number of otoliths, one in glycerine and one sectioned, and discussion of previously compared samples, participants reached agreement on several points. First, that in some cases, the cross-section provided a clearer and more detailed picture of the center or early growth of the otolith, particularly for older fish where over-growth tends to obscure the center. Second, that in some cases, the two techniques have different interpretations -- a weak ring in the whole otolith may appear very strong in the section as well as the converse. Third, that prolonged storage in glycerine (3+ years) tends to turn many otoliths translucent and unacceptable for ageing and that ageing by this method should be completed as soon after collection as possible. Fourth, that in the majority of cases, interpretation from either method was consistent with the other and choice of method could be left to preference but that familiarity and ability to age by both methods should be maintained.

Scales were not examined at this workshop but the USA expert noted that he had found scales and otoliths to be usually inconsistent in older fish with the third and subsequent annuli frequently absent in the scale. It was agreed that a study of scales should be conducted and the USSR representative indicated a planned study in this field.

Other structures with potential for ageing were not examined but the need to evaluate these for age validation purposes was identified.

Ring Formation

Formation of hyaline rings unique to silver hake were identified as contiribuling factors in differing estimates of age. It was agreed that a "pelagic zone" (PZ) is present in the otolith and frequently could be counted as an annulus by inexperienced readers. Participants felt this pelagic zone was formed when juveniles change from a pelagic environment to a demersal existence. Separation of this zone from the first annulus is difficult under some conditions. For example, a large pelagic zone and small annulus can be almost co-incident, a large pelagic zone and large annulus can be interpreted as two annuli,and a very small pelagic zone and annulus can result in not counting the center zone as an annulus. However, in general, the size of the first annulus and pelagic zone are characteristic of geographic areas and experienced readers can take this into consideration.

Formation of a strong "spring-summer check" (SSC) between the first and second annulus was frequently observed and readers were cautioned to expect this zone and to exclude it from counting. The cause of this check could not at present be explained completely but an assumption can be made that this check is formed in spring which co-incides with changes of environmental conditions due to migration of one-year old hake from winter areas into major feeding areas in spring time, and the need for further study was recognized. In addition, the common occurrence of checks between most annuli and the presence of split rings were contributing factors in making interpretation difficult.

The time of formation of summer and winter zones could not be defined except in very general terms. All participants agreed that any edge type could be observed at any time of year and that, in some cases, it was necessary to infer the presence of an annulus. For example, a fish caught in early February with an opaque edge on the otolith would, in most cases, be assumed to have a winter zone and aged accordingly.

To standardize classification of edge type and age, the codes suggested by Jensen (ICNAF Res. Bull #2, 1965) were modified to the following:

HYALINE ≡ WINTER GROWTH

VNH - very narrow hyaline ≡ winter edge barely visible

NH ≡ narrow hyaline (winter growth starting)

H ≡ hyaline (winter growth well formed)

WH ≡ wide hyaline(winter zone almost completed)

OPAQUE = SUMMER GROWTH

VNO ≡ very narrow opaque (summer just starting)

NO ≡ narrow opaque (summer growth thin but clear)

O ≡ opaque (summer growth well formed)

WO ≡ wide opaque (wide summer, just before winter edge usually starts forming)

The above is with reflected light.

PZ pelagic zone
SPL split
C check
SSC spring-summer check

6(5) to indicate preference
2? to indicate an age inconsistent with fish size or other criterion

These codes should be used by all readers to facilitate discussion both within laboratories and in exchange samples.

One additional source of differing interpretations was attributed to the region of the otolith used to count annuli. It was generally agreed that the checks in the posterior (narrow) end could be stronger and appear as annuli while in the anterior (rounded) end the check would be weak or co-incident with the annulus. Both Canada and the USA indicated a preference for giving more weight to the age counted on the anterior end and all participants agreed that the entire otolith should be observed before deciding on an age and that caution should be used in separating checks from annuli in the posterior end.

Comparison Age Readings

Samples were considered from Subareas 4, 5 and 6 but were small in number to permit more detailed explanation of participants respective interpretations. Whole otoliths,as well as sections,were available for most examples.

The first sample consisted of 25 fish taken in July of 1976 in Div. 4WX by a Canadian research vessel. Ages ranged from 1 to 5 years with 16% four years or older. In general, the otoliths were easy to interpret but some were difficult. All readers agreed on the age of each fish and 100% agreement on the sample was obtained.

It should be noted that in some cases, however, discussion of the otolith prior to assigning an age occurred but that all readers agreed on the final interpretation. It is also significant that,in all cases,ages were assigned on the basis of the same interpretation - annuli were always identified as annuli and checks as checks. It was also agreed that the first annulus is characteristically large in this area and that the size of subsequent annuli imply a rapid growth rate.

The second sample considered was provided by the USSR and consisted of 10 otoliths from SA 4 and 5 caught in April, July and September. All readers noted that one otolith, a 37 cm male, was exceptionally clear and assigned age 5 with complete agreement. Variation in the remainder of the sample was attributed to differing interpretations of checks and the location of the pelagic zone. However, after discussion of specific otoliths, readers agreed that interpretations other than their individual one were possible. In one case (#629), the Canadian and USA reader assigned a definite age 3 from the whole otolith but a definite age 4 from the section,while the USSR reader assigned age 4 from the whole otolith as well as the section. In most examples, readers agreed that a 3 (4) or 4 (3) age was equivalent and that they might age specific otoliths either as one or the other age on different occasions. Photographs of these otoliths with possible interpretations are appended.

The third sample was provided by the USA and consisted of 8 fish from SA5 caught in October of 1976. These otoliths had been stored dry and one was sectioned. To provide the equivalent of a glycerine-stored otolith, the unsectioned one of the pair was immersed in a 20% ammonia solution for about five hours. Readers agreed that this treatment cleared the otolith but was not as satisfactory as glycerine-stored examples.

Unfortunately, three of the otoliths were broken and could not be aged by the USSR reader. Of the 5 examined by all readers, 4 were assigned the same age and one rejected as too inconsistent to be aged. Canada and the USA reached agreement on seven otoliths. In general, it was agreed that a very small first annulus was characteristic of otoliths from 5ZW and SA 6 while those from 5Y had a moderate size first year. The problem of distinguishing a fast growing first year from a slow growing second year was considered the main source of differing ages. Also, in some cases, the edge type was inconsistent with the time of year - the anticipated hyaline edge had not started to form.

The fourth sample was collected by the USSR in 1974 from 5Ze and had been part of a previous exchange study. Fourteen otoliths were examined and agreement on all was reached after discussion but, as in previous samples, a 3 (4) and 4 (3) were considered equivalent. In several otoliths, the USA and Canada felt that becuase of prolonged storage in glycerine, as well as frequent handling, the quality of the section had deteriorated.

DISCUSSION

All participants agreed that the opportunity to discuss silver hake ageing and to rationalize their interpretation had been very beneficial. Increased confidence, as well as awareness of ageing problems unique to this species, were the most significant accomplishments of the workshop. It was agreed that further discussion, research and exchange of samples can reduce disagreements.

As a result of this workshop the following conclusions and/or recommendations can be made:

1. Either whole glycerine-stored otoliths or sections from dry-stored otoliths are acceptable for ageing silver hake but age readers should

be familiar with both techniques and able to age with reasonable consistency using either method.

2. Age validation studies are required and other potential ageing structures (scales, etc.) should be evaluated. Correlation of age readings with length frequency analysis should also be completed.

3. A more detailed description of characteristic otolith types, size of first annulus, etc. with respect to geographic location is required. Inherent in this study would be analysis of potential variation in size of the otolith at 1 and 2 years.

4. In some cases, the differences in ageing stem from different interpretation of the first annual ring or when preference was given only to the anterior or posterior end of whole otoliths.

5. An exchange of otoliths should be a continuing part of ageing studies. It is anticipated such exchanges will take place in 1977 of at least 100 fish with sections, whole otoliths and photographs available. Canada has agreed to provide the first sample early in May of 1977.

6. Considering the difficulty of ageing silver hake and planned studies, it is recommended that a further workshop be convened in the first quarter of 1978. Time and place to be arranged by mutual agreement.

7. Other member countries anticipating ageing of silver hake will require expert training by established readers to ensure conformity to presently accepted

Sample 1. July 1976, Div. 4WX by Canada.

Number	Sex	Length	Age		
			USSR	USA	Canada
5	F	23	1	1	1
8	M	19	1	1	1
15	F	47	5	5?	5
20	F	29	2	2	2
21	F	28	2	2	2
22	F	31	2	2	2
23	F	32	2	2	2
26	F	33	2	2	2
27	F	25	1	1?	1
28	F	24	1	1?	1
30	F	27	2	2	2
35	M	22	-	1?	1
43	F	33	4	4	4
44	M	29	2	2	2
46	F	32	2	2	2
47	F	38	4	4	4
49	F	39	4	4	4
53	F	21	1	1	1
54	F	20	1	1	1
55	M	27	2	2	2
57	M	20	1	1	1
59	F	32	2?	2	2
60	F	32	2	2	2
61	F	30	2	2	2
62	F	20	1	1	1
63	F	21	1	1	1?

Sample 2. April 1976, Subareas 4 and 5 by USSR.

Number	Sex	Length	Div.	Age			Comments
				USSR	USA	Canada	
805	M	35	4W	3(4)	3	3	
757	F	44	5Z	7	6	6(7?)	
629	M	33	5Z	4(3)	3(4)	3(4)	
807	F	39	4W	5	4	4	
656	M	27	5Z	2	2	2	
809	M	20	5Z	1	2	2	
653	F	26	5Z	2	3?	2	
799	M	27	4W	2	2	2	
819	F	36	4W	3(4)	3	3	
120	M	36	5Z	5	5	5	Very clear

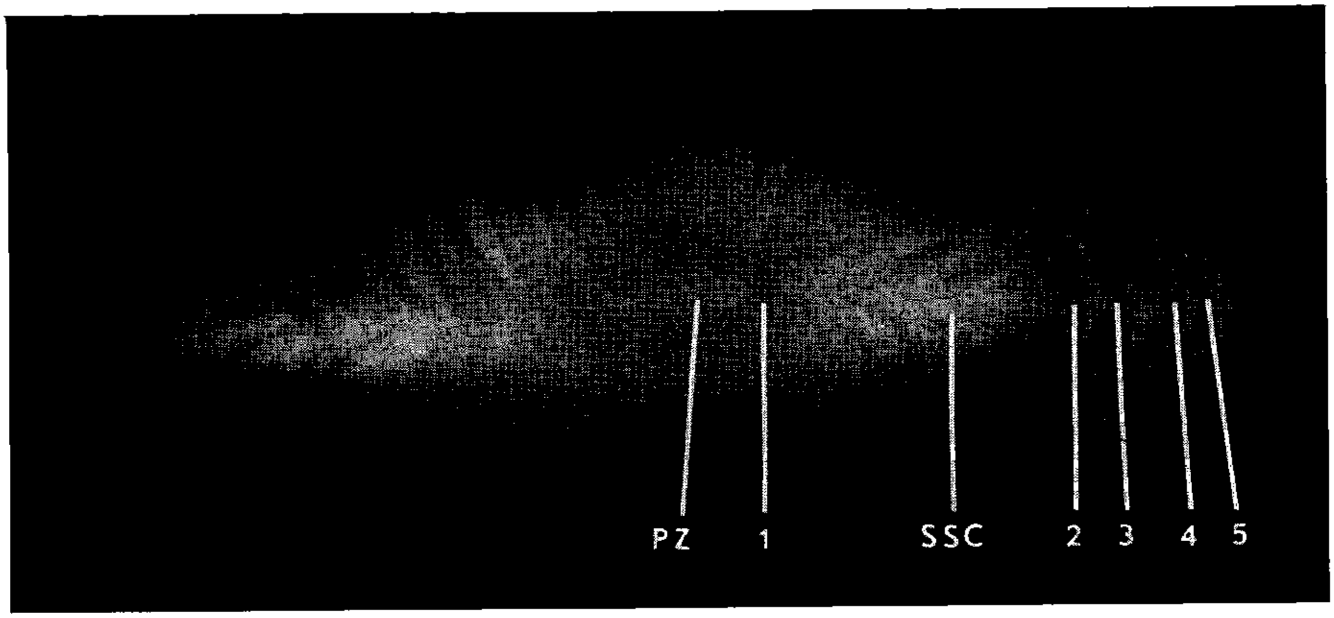
Sample 3. October 1976, Subarea 5 by USA.

Number	Sex	Length	Div.	Age			Comments
				USSR	USA	Canada	
5	F	33	5Z	-	3(4)	3	
5	F	34	5Z	-	2	2	
5	F	40	5Z	5(6)	3(4)	3	Too difficult
6	F	25	5Z	1	1	1	
7	M	31	5Z	2	2?	2	
10	F	48	5Z	-	5(4)	4(5)	
297	F	23	5Y	2	2?	2	
297	M	28	5Y	3	3	3	

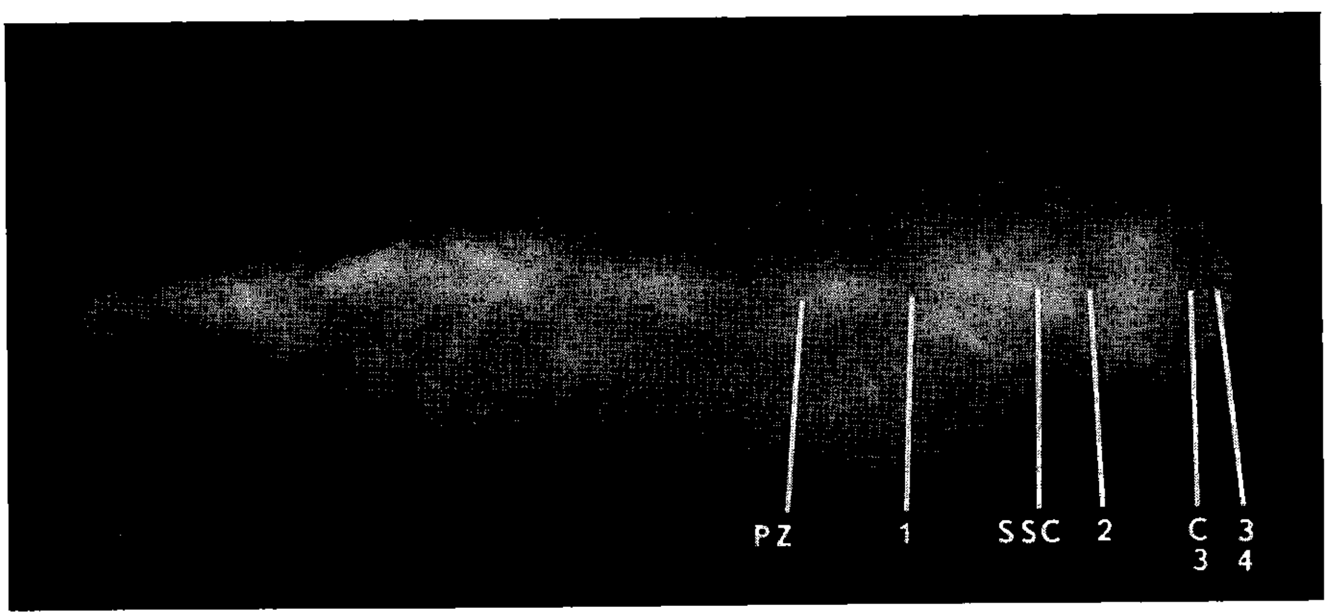
Sample 4. 1974, Subarea 5 by USSR.

Number	Sex	Length	Age USSR	Age USA	Age Canada	Previous USSR	Previous USA
26	F	36	3	3?	3(4)	5	3
13	F	40	5(6)	5	5(6)	6	7(6)
21	F	34	3	3	3	4	3
8	F	24	2	2	2	2	2
1	-	14	1	1	1	1	1
77	M	26	3	3	3	3?	3
42	F	24	2	2	2	2	2
71	F	32	3(4)	4(3)	3(4)	4	3
63	F	34	4	4?	4	5	4
68	M	33	5	5(4)	5	5	5
64	F	46	7(6)	6(7)	7(6)	8	7
57	F	30	4	4?	4	4	4
55	M	26	2	2	2	2	2
51	F	36	3(4)	3	3	5	3

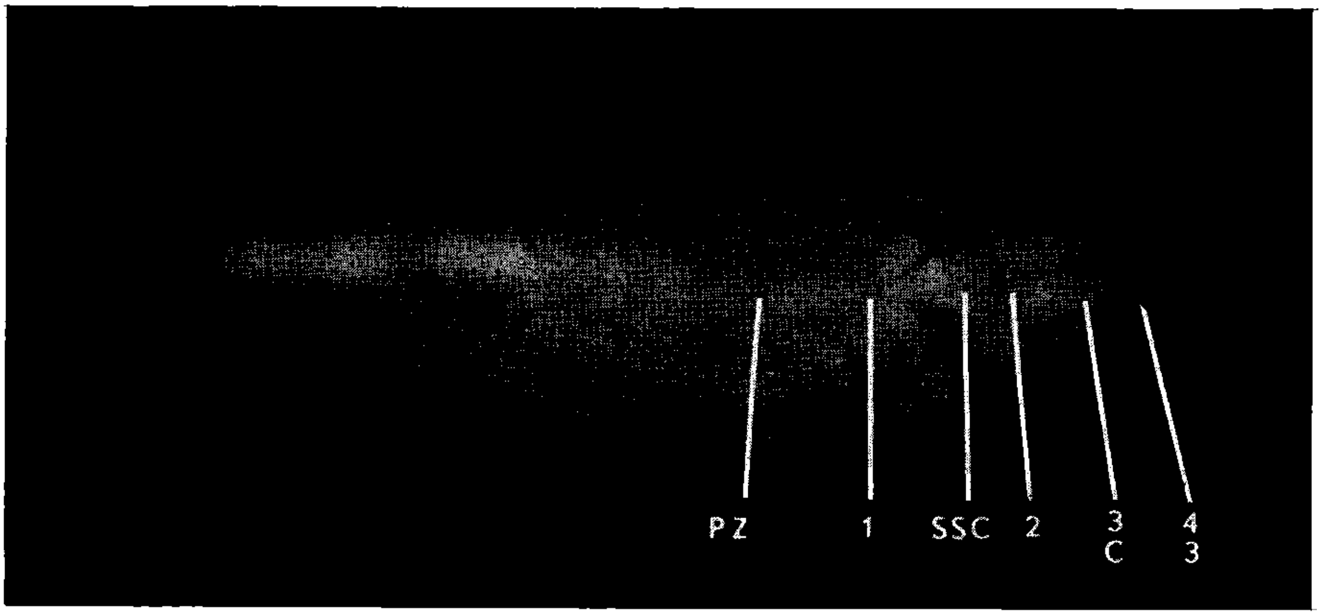
Otolith photographs with possible interpretations. Numbers refer to Sample 4.



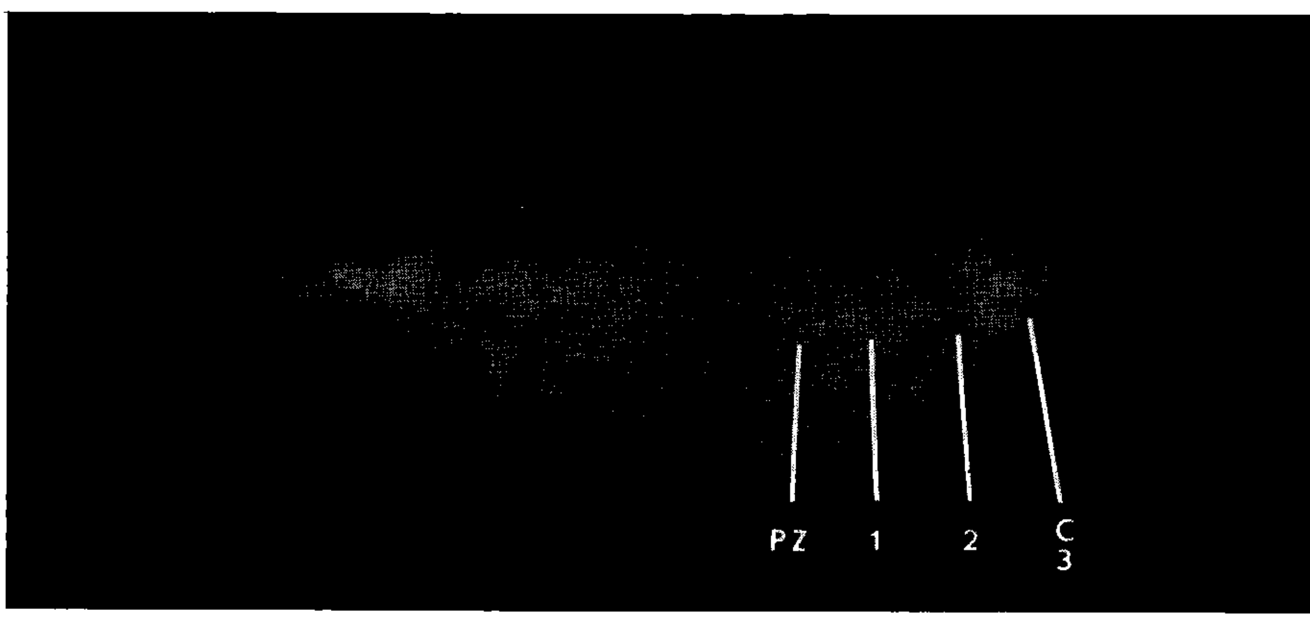
120. 36 cm male.



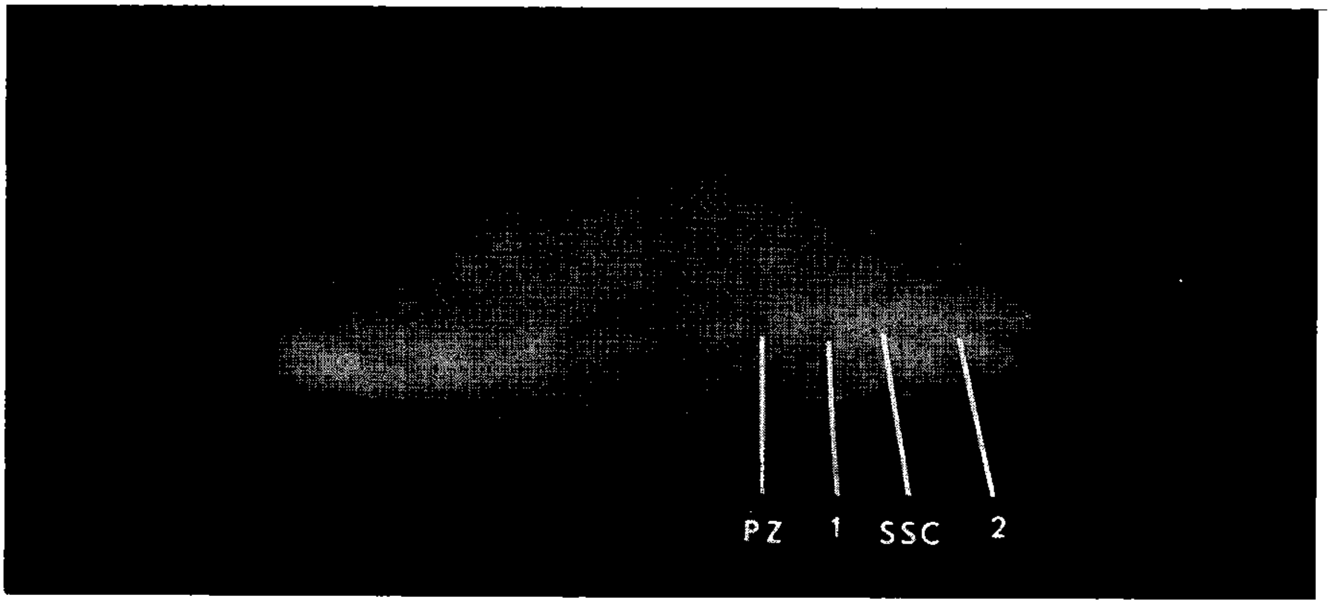
819. 36 cm female.



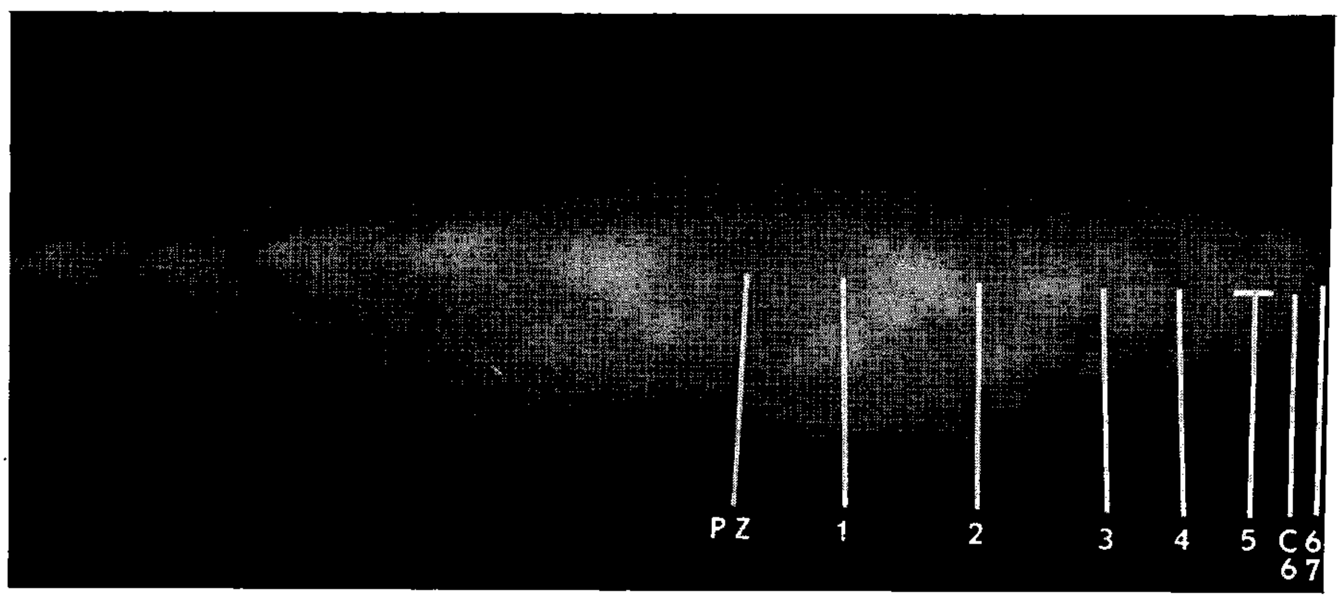
629. 33 cm male.



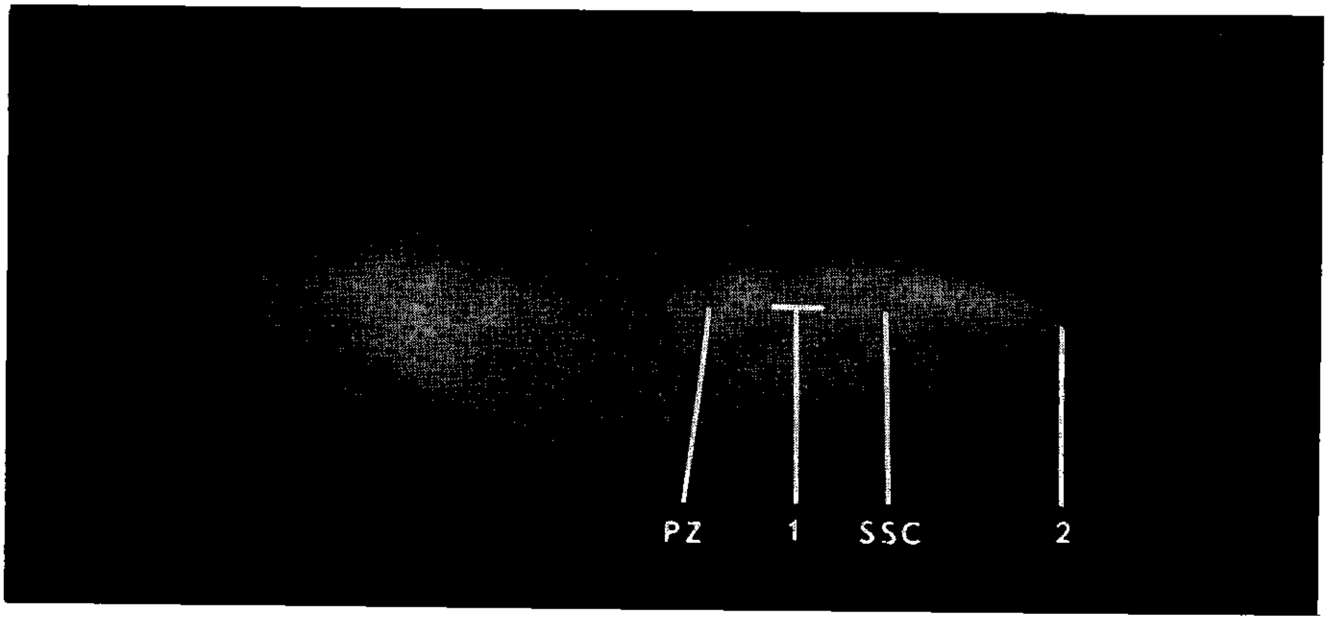
653. 26 cm female.



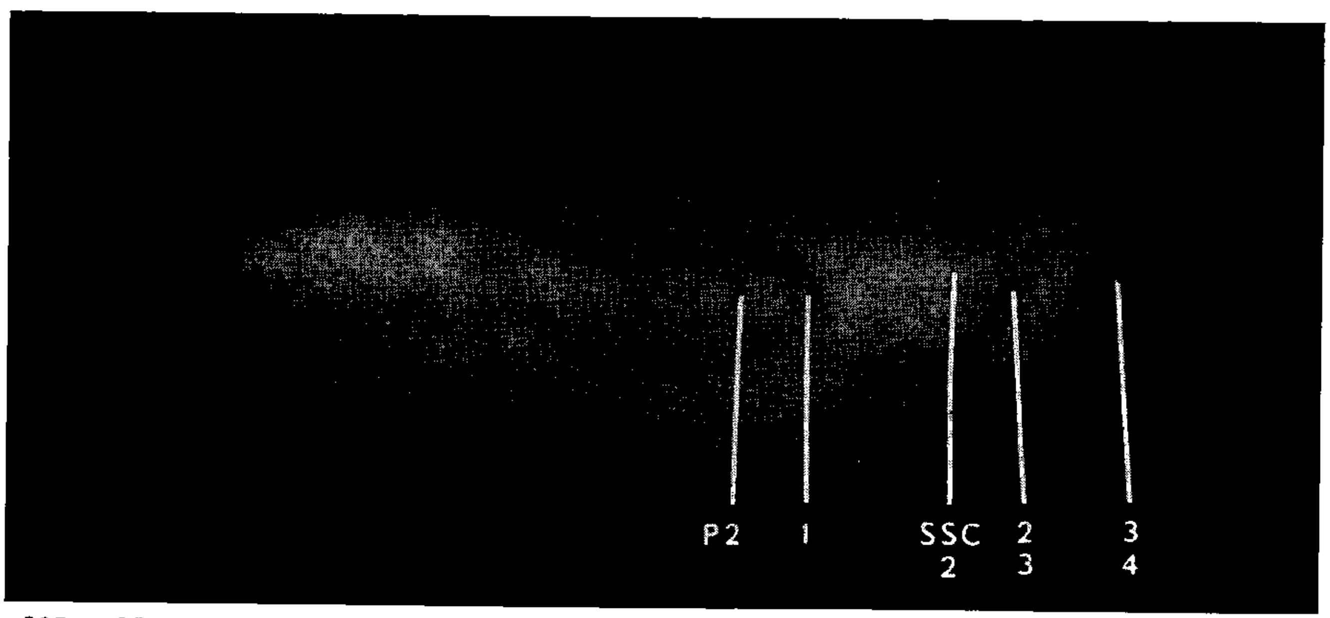
656. 27 cm male.



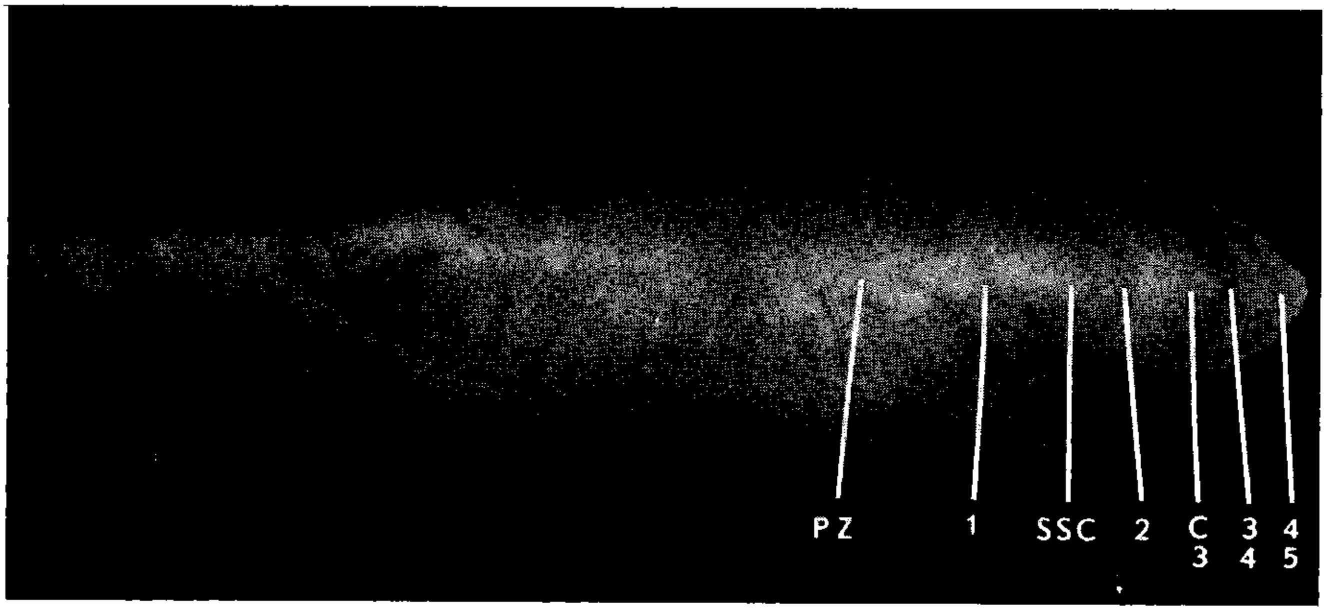
757. 44 cm female.



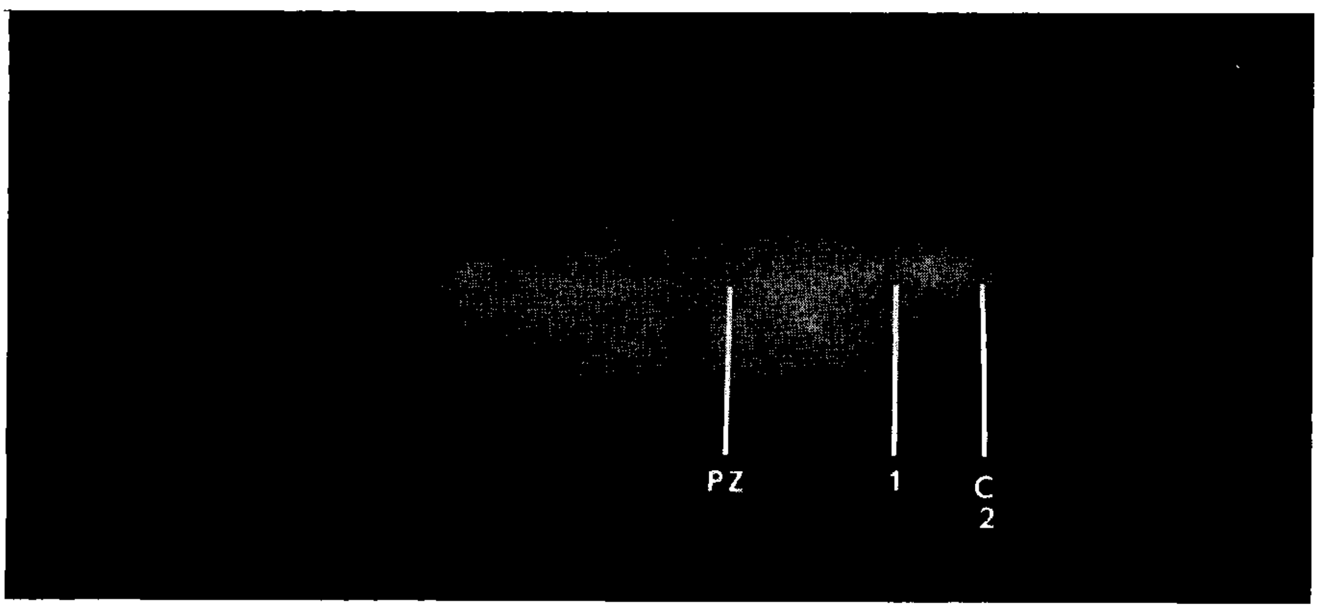
799. 27 cm male.



805. 35 cm male.



807. 39 cm female.



809. 20 cm male.