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2006 ANCHOVY OTOLITH WORKSHOP

In AZTI, PASAIA, Basque Country, Spain.

from 14 to 15 November 2006

By

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2006 ANCHOVY OTOLITH WORKSHOP:

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Extended Summary:
This Document reports on the results of the workshop carried out in AZTI-Tecnalia (Pasaia) from 14 to 15 November 2006 to analyse the results of the exchange exercise on anchovy otoliths performed in 2005 and to solve the problems detected in anchovy age determination based on the examination of otoliths. This works followed the recommendations of the former ICES Planning Group on Commercial Catch, Discards and Biological Sampling (PGCCDBS) (ICES CM 2005/ACFM:15).

6 atendees participated in the meeting 2 per institute dealing with anchovy in the Bay of Biscay (AZTI, IEO and IFREMER) (Annex 1). The results of the 2005 exchange programme were discussed and served as a starting point for the development of this workshop on anchovy age determination in 2006. A Review of the criteria for age determination of anchovy otoliths in the Bay of Biscay was presented, following past practices (Uriarte et al. 2002). And in addition a new quick exercise of age reading on the otoliths of the 2005, and part from the 2001, exchange programmes was made in order to evaluate the improvements in ageing precision among institutes by the end of the meeting (see objectives in section 3 and the complete agenda in Annex 2). The concrete procedure of age readings and the otoliths examined are presented in section 4 (material and methods).

Results (section 5) show that the overall level of agreement and precision in anchovy age determinations are satisfactory: Most of the anchovy otoliths were well classified by most of the readers during the 2006 workshop (with an average agreement of 92.7 % and a CV of 9.2%). CVs were on average smaller than 15% for any age, although individual CVs for ages or readers might be as high as 30-35% in particular ages. However, the percentage of agreement of the new readings and the coefficient of determination are similar to those achieved during the 2005 otolith exchange programme: no neat improvement was achieved. This may well be due to the fact that the agreement during the exchange otolith programme was already high and hence the expectation of improving was a matter of solving the most difficult otoliths. In addition, current years readers have nowadays acquired quite a long experience in age reading in comparison with the workshop carried out in 2002 and some of their criteria are quite well established, hence polishing discrepancies in the most difficult otoliths is certainly a hard issue.

In the 2006 otolith workshop as in the 2005 exchange programme the difficulties become more relevant for the otoliths from the second half of the year (Percentage of agreement of 90.7 % and CV of 14.1%). It is unclear by how much errors of individual readers can propagate to the age determinations of catches or suveys. Maximum errors detected in the workshop of about 50% in the percentage of age 2 during the second half of the year are probably an overestimate of the error induced in the catches for that period of the year.

The workshop served to make explicit that major difficulties encountered refer to the discrimination between true winter rings from summer and autumn checks: There are marks after the first winter ring which could be interpreted as checks formed during summer or autumn time, C15 or C18, or as additional winter rings. This is hard to be elucidated for fishes caught at summer and autumn time when the expected total annual growth is not yet achieved and it is difficult of being assessed. This makes confounding ages 1 with older. In this circumstances the criteria of complete annual growth to judge different potential interpretations of the otoliths become of a lesser support than in Spring and some subjective judgement of the strength of the marks observed and their distance to the first winter ring become the sole criteria which can be applied. Spring otoliths, prior to the start of the annual white growth band, are easier to be aged.

The problems encountered for the second half of the year are confirmed with the results of the subset of otoliths for the same half of the year from the 2001 anchovy exchange programme. Several photos of otoliths of simple and straightforward age determination and others of major difficulties are presented and discussed in the report.

Further research for solving some difficulties in discriminating between 0 and 1 year old otoliths are suggested by the examination of daily microincrements.

Next workshop is suggested to be carried out in 4 years.

1- INTRODUCTION:

In the Ostende meeting (1-4 March 2005) of the ICES Planning Group on Commercial Catch, Discards and Biological Sampling (PGCCDBS) (ICES CM 2005/ACFM:15) it was agreed (section for Planning of future age-reading workshops) to carry out exchange programmes for otolith reading for anchovy in 2005 and a workshop in 2006 (in Spain).

The exchange programme of anchovy otoliths was organized in 2005 between AZTI, IEO and IFREMER, coordinated by the former institute. The results of this exchange programme were reported in a Working Document to the 2006 ICES Planning Group on Commercial Catch, Discards and Biological Sampling (PGCCDBS) (Uriarte et al. 2006) and briefly to the ICES assessment working group MHSAWG (ICES 2006). Major results of the 2005 otolith were that the average percentage of agreement (90.9 %) and CV (13.9%) was quite good and quite similar to the results achieved in the 2002 workshop (where an agreement of 92% with a CV of 10% was achieved) . However, during the second half of the year the percentage of agreement was lower (87.7%). The ultimate reasons of these discrepancies along with the examination of individual otolith cases of disagreement was left for the current workshop.

This document reports on the results of the workshop carried out in AZTI-Tecnalia (Pasaia) from 14 to 15 November 2006 to analyse the results of the exchange exercise on anchovy otoliths performed in 2005 and to solve the problems detected in anchovy age determination based on the examination of otoliths. The results of the 2005 exchange programme were discussed and served as a starting point for the development of this

workshop on anchovy age determination in 2006. The last workshop on anchovy determination took place in 2001 (Uriarte 2002).

2- ATTENDEES: Uriarte, A. (Coordinator, AZTI)
Rico, I. (AZTI)
Dueñas, C. (IEO)
Villamor, B. (IEO)
Grellier, P. (IFREMER)
Duhamel, E. (IFREMER)

Observers: Astoreca, A. (AZTI, part time)
Cotano U. (AZTI, part time)

See complete list and addresses in Annex 1.
C. Dueñas had never made age determination of anchovy otoliths before and she was at a first training stage, while the other have a long experience in reading anchovy otoliths.

3- OBJECTIVES:

The objective agreed among the participants were:

1- Present and analyse the results concerning age and precision of the exchange programme on anchovy otoliths from subarea VIII and Identify major difficulties in the age determination concerning observed disagreements.
2- Discuss the agreements and disagreements of the exchange according to current practices for ageing anchovy otoliths from the Bay of Biscay and agree, if possible, on most likely interpretation of disagreements.
3- Perform a new quick exercise of age reading on the otoliths of the exchange and Evaluate improvements in ageing precision among institutes by the end of the meeting.
4- Examine difficulties in age reading determination of otoliths in PELGAS06
5- Outline of Future Research

4- MATERIAL AND METHODS:

4.1 Workshop development:
The workshop developed through presentation and discussions of the results of the exchange programme, which was followed by a joint common examination and discussion of the interpretation of a sub set of otoliths of the exchange programme, for both the agreed and conflictive otoliths (morning of day 14)
Subsequently a new quick exercise of age reading was performed on a subset of the exchange programme otolith (afternoon of day 14).
The analysis of the new reading exercise for evaluation of improvements in ageing precision among institutes was performed during the morning of the second day (day 15).

This was followed by a further discussion of the conflictive otoliths. The meeting ended with the discussion of PELGAS05 otoliths and about the future perspective of research and the subsequent reporting process of the workshop (afternoon of the second day).
See complete agenda of work in Annex 2.

4.2 Reading exercise during the worshop
For the new age determination performed during the meeting a sub set of 220 OTOLITHS from the past exchange exercise were read again: a 100 from the first half of the year and 120 from the second half. In addition a collection of 100 otoliths from the second half of the year 2000 were read again since this is the period of greatest discrepancies in the age determination.

SET A) IEO 120 otoliths from the second half of the year, 60 from the south of the Bay in July August 2004 and 60 from the north of VIIIb in September and October 2003, covering as much as possible all range of lengths (and hence ages).

SET B) 100 otoliths from the first half of 2004: 60 from spring in the south of the Bay and 40 from the VIIIb north.

100 otoliths from the second half of the year 2000, assuring all range of lengths (and hence ages).

- 100 otoliths from the summer autumn fisheries (99/00)
  IEO supply 30, AZTI 30 and IFREMER 40 (in the latter case only from 1999)

All data were analysed using the Workbook Age Reading comparisons of Eltink (2000) and following the recommendations of the Guideliness and tools for age reading comparisons (Eltink et al 2000)

Preparation of the sets of otoliths:
As for the previous exchanges, anchovy otoliths were mounted entire within Eukit on black slides of 10 pairs of otoliths each. Otoliths are mounted with the sulkus facing down.

Each black slide with otoliths was labelled by a unique code to which all otoliths were referred (The code of the sample for instance). For each selected otolith the accompanying information required was:

- Slide identification code where it is contained
- Month of capture

And Optionally: Length, weight and sex

Although the otoliths had already been aged before the workshop in the exchange programme, the new readings were made without looking at the previous age readings performed in the past.

4,3 Ageing methodology of anchovy otoliths

For the exchange programme as well as for the workshop the Minimum knowledge for age determination was:

a) Conventional birth dates for increasing in one year the age of an anchovy, when trespassing that date, is 1st of January.
b) Spawning time is usually in spring (or secondarily in Autumn in IXa) and maximum growth in spring and summer.
c) True Annual rings will be those formed in winter each year. Other rings may be present or appear throughout the year and cause problems in age determination (checks).

Prior to any discussion a description about the major pattern of annual growth (a), edge formation along the year (b) and concerning typical checks present in the otoliths of the Bay of Biscay anchovy was presented along with the procedure for age determination as agreed in the last workshop (Uriarte et al. 2002).

The procedure being followed nowadays for anchovy age determination was established and validated at AZTI (Uriarte ms): The method is based on the knowledge of the annual growth pattern of the anchovy otoliths, of the seasonal growth of otolith edge by ages and of the most typical checks.

- Typical annual growth of the otoliths is established, by which growth during the first, second and third years of life (corresponding to 0, 1 and 2 years old groups) diminish to about ½ or 1/3 of the growth performed during the previous year of life. Older ages (4 and 5 years old present a rather similar growth to the one experienced at age 3). See examples of typical Spring otoliths in the **Photo.1** and **.2** for ages 1 to 5 and see **Photo.3** and **.4** for ages 3 and 4 examined in the exchange programme.
- Maximum otolith growth (opaque white band formation) is in summer months, and growth detentions (with hyaline rings) in winter time. However the starting of the white edge during spring time changes with ages, being remarkably sooner at age 1 than at older ages. As a result of this, in spring 1 year old anchovy have typically already started the deposition of the opaque growth band, whereas 2 years old or older fishes have mostly hyaline edges (or at the end of the spring in early formation of the opaque band).
- Typical checks occur before and after the first winter ring is formed, during age 0 and age 1 of this anchovy. The most typical one is that formed during June/July in many of the one years old anchovy at the peak of their first spawning period, which is considered to be a spawning check (**Photo.5**). According to its position in relation to the total expected annual growth this checks are named C15 or C18 if laid down around 50% or 80% of expected annual growth (see further examples in **Photo.6** &**_.7** and**_.8**, for the way they are seen at Spring time and look at **Photo 12** for a clear example of their formation at summer time. Not all the years, neither all anchovies lay down the same amount of checks and many of them may not show any. Usually checks tend to be weaker or more diffuse than true annual rings and often they are not completely formed all otolith around, their position will often differ from the expected position of the true annual rings. When doubts occur its

assumption should allow for a better fitting to the typical annual (and seasonal marginal) growth of the otolith than in the alternative of assuming that it is a true annual ring.

Age determination procedure based on the examination of the otoliths of the Bay of Biscay anchovy is obtained according to the above knowledge of growth pattern of anchovy otoliths and knowledge of the date of capture, so that the following two criteria are satisfied:

a. Criteria of complete growth zones in conformity with the typical annual growth pattern: Age equals the number of complete opaque growth zones corresponding to the expected annual growth pattern of the otoliths and excluding the marginal edge development of the year. In case the number of opaque zones do not correspond with the typical expected annual growth pattern the existence of some checks can be suspected and evaluated.
b. Criteria of the edge in conformity with the expected seasonal edge growth by age: If the edge of the otolith do not correspond with the expected otolith edge of the age derived from above (a) criteria, then alternative interpretations should be considered (such as presence of checks). This may be relevant for instance to differentiate between ages 1 and older during the first half of the year, etc. In those cases a decision can be taken about the most likely age of the fish or alternatively the otolith can be rejected for age determinations.

5. RESULTS

5.1 Difficulties in ageing this anchovy according to the Exchange results:

The results of the otolith exchange programme performed in 2005 can be summarised as follows (Uriarte et al. 2005):

- The Average percentage of agreement (90.9 %) and CV (13.9%) was quite good and quite similar to the results achieved in the 2002 workshop (where an agreement of 92% with a CV of 10% was achieved)
- During the first half of the year the percentage of agreement is high (93%) and precision is high (CV low - 8.1%-) with a small amount of bias (0.03). There was only a small negative bias detected on ages 3 and 4 which deserved further discussion for the next workshop.
- During the second half of the year the percentage of agreement was lower (87.7%) and precision decreased (CV of 22%) with a small amount of bias (0.04), but already noticeable since age 2: there were two sets of readers symmetrically diverging during the second half of the year on the allocation of a certain amount of otoliths either to age 1 or 2. Depending on the correct reading of those otoliths the percentage in catches of the 2 years old could doubled or halved for the second half of the year.

- The ultimate reasons of these discrepancies along with the examination of individual otolith cases of disagreement was left for this workshop.

A general discussion about the reasons that might explain the agreements and discrepancies appearing in the exchange report was made at the beginning of the workshop leading to identify two major reasons for disagreements:

a) Difficulties in differentiating between true annual rings and false rings (or checks).

b) Insufficient typical annual growth pattern recognition and Insufficient criteria about the otolith edge that can be expected to be seen along the year

Between these two sources the major discrepancies were originated from the first reason, since the other reason affects mainly to readers recently introduced in the interpretation of anchovy otoliths (which was not the case for most of the participants).

Several examples of disagreements occurring in the exchange report can be seen in the series of Photos made available at the end of the report. Most of them share the above reasons explained above, but particularly the mater of the interpretation of otolith hyaline marks either as false annuli (checks) or as true winter rings lead to different age determinations. A common discussion about the nature of the uncertainties when allocating ages to otoliths will here be presented after presentation of the results on the new reading exercise performed at the workshop (section 5.2):

5.2 Checking Improvements by a Second reading of a subset of the 2005 exchanged otoliths and second half of years 1999/2000:

A new reading of a subset of 220 otoliths from the ones analysed in the 2005 exchange programme was performed during the workshop and after the initial discussion trying to implement the standard methodology summarised above. The set of otoliths reviewed were those listed in Material and methods. Although all participants read the otoliths, for the purposes of analysing the results C. Dueñas was excluded from the analysis given that she was at a first training stage of making age determinations with anchovy otoliths.

Table 5.2.1 details the length, sex and month of landing of the set of otoliths selected for the 2005 exchange programme along with the ageing produced by each reader. The last two columns give the Modal age, the percent of agreement relative to Modal age and the Precision of reading as the Coefficient of Variation in relation to the average age. The Average percentage of agreement across all ages and readers is 92.7 % and the average CV equals 9.2 % (see also **Figure 5.2.1** for the mean values per ages). This result if very similar to that arising from the exchange exercise for the same subset of otoliths, which had an APE of 92.5 % and an average CV of 10.2%).

Table 5.2.2 shows that most of participants read almost all otoliths. CV was minimum at age 0 and a bit higher at older ages as the percentage of agreement diminishes with age. However these levels of CV (of about 8-15%) are quite similar to those of the 2005 exchange programme. There is a slight improvement for ages 0, 1 and 2 but a bit worsening for ages 3 and 4 (although that age was almost marginal). A similar improvement for the age determination of younger ages but worsening of the older ones is also observed in the

percentage of agreement. The sub-table of relative bias indicates general negligible bias, except for age 3 where some underestimation is noticeable (–0.22). This underestimation of age 3 did not occur in the 2005 exchange exercise. **Figures 5.2.2 & .3** also show that the precision is acceptable and the amount of bias rather low. **Figure 5.2.4** also shows the rather low amount of bias by ages for each reader.

Due probably to the little improvement, the consistency between readers globally has not improved. During the Exchange programme there were statistically significant differences between the age reading of the different readers and during the workshop those inconsistencies have changed in one or other directions (**Table 5.2.3**). Reader 3 (Ifremer P.G) has become consistent with the age readings of the readers 1 and 2 (from AZTI), they all working with the spring samples. But readers 4 and 5 have deviated from all the rest of readers for different reasons and are not either compatible between them. Reader 4 (Ifremer E.D) has assigned less ages 1 and more ages 2 than the rest. And reader 5 (IEO B.V) has at the contrary assigned more ages 0 and 1 and less ages 2 than the rest. Best readers in relation to Modal age appeared to be AZTI readers who have the longest experience in reading this otoliths (this being true during the exchange and workshop exercises and regardless of reader selected for the first column of reporting results in the excel workbook).

Tables 5.2.4 and **.5** show that the degree of agreements diminish particularly during the last months of the year (September and November). There are some improvements in the percentage of agreement of ages 1 and 2 for the first half of the year, but nor for ages 3 and 4. However, there is some loss of percentage and precision during the second half of the year for ages 2 and 3 which drop from the 83% and 95% percentage of agreement in the 2005 exchange programme to 76% and 83% in the workshop exercise for these two ages respectively. In **Table 5.2.3** as in **Figure 5.2.5** it is shown that mean length at age increases with age, except for the few ages 4 (2 otoliths in total) which are certainly anecdotic.

Tables 5.2.6 and **.7** show the summary results by readers concerning the age determinations of otoliths from the 2005 exchange programme, but solely for the second half of the year: the former comments about the drop in the percentage of agreements particularly for ages 2, 3 and 4 are further detailed concerning readers. The differences appearing among readers for ages 2 and 3 particularly for the second half of the year may lead to difference of a maximum of 50% in the percentage of age 2 (negative bias regarding the modal age, see table **Table 5.2.2** and **5.2.6** and **5.2.7**).

Table 5.2.8 and **5.2.9** shows the results of the age determinations performed during the 2006 workshop on the subset of otoliths from the second half of 1999/2000 (July to September). Here the percentage agreements is around 91.6 with a CV of 12.7. The same negative bias and discrepancies appear for ages 2 and 3 for this different set of otoliths. All these results are thus very similar to the ones obtained for the otoliths from the 2005 exchange programme from second half of the year. This means that the results are quite invariant regardless the concrete set of otoliths analysed for the second half of the year.

Discussion of the Results on the new readings of a subset of the 2005 exchange programme of otoliths:

The series of photos attached to this report illustrate some homogeneous interpretation of typical otoliths as well as the types of discrepancies which arise in the interpretations of some difficult otoliths which were not fully solved:

- ***In Spring time:***

Photo.6 shows a case in April 2004 where a likely check laid down at about 80% of the expected second annual growth (C18) led a reader to assign age 3 instead of the modal age 2 which arises when the mark is considered as check C18. After discussion this otolith was fully assigned to age 2 in the workshop. A rather similar case appears in **Photo.7** but due to the fact that the discontinuity caused by that mark was a bit stronger the divergent positions were kept even after discussion in the workshop.
Photo.8 presents the case in spring where several marks appear with potential different interpretations which can lead to age determinations of 2, 3 and 4 y.o.. After the worshop the two most likely interpretations were ages 2 or 4 (with 40% of agreement each), while in the exchange programme the received modal age was 3 y.o. If all marks are taken as true winter marks then a 4 years old is straightforward interpretation. However the potential case of two checks in summer time C15 and C18 leads to assign an age of 2 years old. No agreement was achieved in the group.

- ***In summer time***

The interpretation becomes more difficult due to the fact that a new white growth band is being formed at the edge of the otoliths and there is an incomplete perspective of the total length that the new annual growth band will have by the end of the year. Therefore any summer check depending on the time past since formation will be seen at a different relative position of the unknown total annual growth for that year and can therefore, depending on the intensity of its formation, be as well confounded with a winter hyaline ring. Presence of well formed marks quite close to the edge, which is in continuous growth during summer and autumn, often followed by a changing of colour, can either be interpreted as checks, C15 or C18, or as true winter rings followed by the summer growth. Some of the readers (particularly from AZTI) tend to think that they are checks but their position and strength make sometimes good candidates to be interpreted as second winter ring, leading to allocating ages 2 or even more, instead of age 1. In AZTI readers tend to think that, by analogy with others showing strong checks 15 put in the middle of the summer growth band, most of them will be of age 1 with checks, C15 or C18, however this remains an unsolved issue. Examples are discussed below:

Photos .9 and **.10** shows two quite similar otoliths of 1 y.o. modal age with a wide white growth at the edge, caught in July 2004. The interpretation of the most recent mark as a check 15 or as a winter ring leads to assign 1 or 2 years old. No unique neat solution can be deduced. The weak discontinuity of the most recent mark has led to 3 out of the 5 readers to interpret it as a check. In addition, it might be advocated that the overall size and the shape reminds more that of a young than of an old anchovy, but this shape features have not been quantified or properly described elsewhere before.

Photos .11 and **.12** show another two cases where the interpretation of the most recent marks close to the opaque edge during summer time seem to be more easily interpreted. In both cases the close position of those marks to the first winter ring led all readers after some discussion in the workshop to agree that they could be taken as checks and therefore a 1 y.o. interpretation was preferred over the alternative one of 2 y.o.
Further examples in summer time (September 2003) of 1 and 2 years olds are presented in **Photos .13** and **.14**. IN the first case only the first winter ring is seen followed by a continuous white wide band, certainly laid down during summer. The edge is semi hyaline. In the second case two alternative interpretations led to the same modal age determination of 2 year old otolith: A1, C18 and A2 followed by a very thin opaque edge of a small summer growth band or A1 and A2 (at C18 of the former interpretation) followed by a wider growth band and a check just before the edge (at the A2 of the former interpretation). For the former interpretation the C18 mark forms some discontinuity in the otolith but is not taken as a true winter detention of growth (or ring) due to the weak intensity of that hyaline mark. The alternative was just a simple 1 y.o. with A1, C15, C18. For both otolith cases almost complete agreements were achieved in the 2005 exchange and in the 2006 workshop. A trouble of the second otolith is that two different interpretation leads to the same age allocation.

Ages 0 also cause some problems, despite the 100% of agreement on the modal age determination, there were some otoliths in September with modal allocation to age 1 for which half of the readers allocated them to age 0 (**Photo .15**). These were otoliths without any clear winter ring and had some hyaline edge. They were doubtful otoliths, some of them certainly of age 0, but others less clear. There was no clear patter of growth nor of neat winter rings. The inner marks might well be checks C06 instead of a weak winter ring. Each assumption lead to age 0 or 1 respectively. Since such weak winter rings are not expected to occur, by ortodoxy age 0 could be the default option. However, it should be noticed as well that the big sizes of those anchovies (154 and 141 mm) are hardly to the expected lower growth of juveniles at that time of the year (Uriarte et al. 2001), and therefore there is the potential of being 1 year old with a weak winter ring deposition.
In November, **Photo .16**, shows an otolith age 0, with no neat mark (except for a weak C06), which corresponds to a small fish of a 131 mm for which a 100% of agreement was achieved. In the next photo (**.17**) an otolith showing a neat mark was allocated to age 1 by 75% and 50% of agreement during the exchange and workshop respectively. The potential interpretation of that mark as C06 led the rest of the readers to allocate it to age 0. No obvious solution is achieved, since both interpretations were compatible with the expected growth pattern.

Finally, an otolith of quite easy interpretation caught in November 2003 is presented in **Photo.18**.. This is a 1 year old otolith with a neat check laid down at the middle of summer time (C15), corresponding to a big fish of 175 mm. In the 2005 exchange programme, the otolith was partly allocate to 2 years old, but after discussion during the 2006 workshop it was agreed that a 1 y.o. allocation was more likely, otherwise the typical growth pattern would not be achieved at all for this otolith.

Problems with otoliths in PELGAS 2006:
Some otoliths of small anchovies (less than 13 cm), caught in PELGAS06 (the acoustic survey performed in May 2006 by IFREMER) showed some inner hyaline marks putting doubts about the possibility of them being just 1 years old but 2 years old instead. Some of these otoliths were examined jointly at the workshop (**Photo.19** and **20)** and the general conclusion was that, with some remarkable exceptions(perhaps Photo 19a), several of those otoliths showed marks which could be due to checks formed during the growth corresponding to their first year of life, particularly because in several cases they were quite weak of diffuse (see Photo.20). In addition the type of white band growth shown at the edge of the otolith was too relevant for the expected growth of the two years old in May (which should basically still have a hyaline edge). Finally the alternative interpretation assuming them as true winter ring lead to a bit smaller growth for the resulting second year of growth than the a priori expect one to see at the 2 years old.

5.1.5 Discussion: unsolved problems and future quality assurance and research.
General level of agreement and major problems:
If in the past 2002 anchovy otolith workshop the adoption and following of AZTI's procedures for the ageing of bay of Biscay anchovy otoliths (overview in section 4.3) led to a noticeable improvement in consistency and precision of age determinations in comparison with the results of the otolith exchange programme (Uriarte 2002), this has not be the case this time. It clear that Most of the typical and most common anchovy otoliths were well classified by most of the readers during the 2005 exchange programme and in the 2006 workshop (APE 92.7 %). But overall, we have to admit that there has been no neat improvement during the application of the workshop. This may well be due to the fact that the agreement during the exchange otolith programme was already high and hence the expectation of improving was a matter of solving the most difficult otoliths. In addition, current years readers have nowadays acquired quite a long experience in age reading in comparison with the workshop carried out in 2002 and some of their criteria are quite well established, hence polishing discrepancies in the most difficult otoliths is certainly a hard issue. The partial reduction of the Coefficient of variation reflects some reduction of the heterogeneous interpretation, but no so much as to induce a higher homogeneity in the overall age determinations.

The difficulties turned out to be a bit higher for the otoliths examined for the second half of the year (Percentage of agreement of 90.7 % and CV of 14.1%). Similar results arise with the age determinations performed during the 2006 workshop on the subset of otoliths from the second half of 1999/2000 (July to September). This means that the results and problems for the second half of the year are quite invariant regardless the concrete set of otoliths analysed. As discussed earlier this arises from the formation and presence of marks after the first winter ring which could be interpreted as checks formed during summer time, C15 or C18, or as additional winter rings. This is hard to be elucidated for fishes caught at summer and autumn time when the expected total annual growth is not yet achieved and it is difficult of being assessed. In this circumstances the criteria of complete annual growth to judge different potential interpretations of the otoliths become of a lesser support than in spring, and the strength of the marks observed and their distance to the first winter ring

become the sole criteria which can be applied. Spring otoliths, prior to the start of the annual white growth band, are easier to be aged.

In the past 2002 workshop attention was paid to the identification of post spawning check (or C15). However in the current workshop major discrepancies appeared by the possible presence in some otoliths of additional types of checks either prior the first ring (C06 or C08) or during the second summer of life (as C18).

Major difficulties still present at the end of the workshop seem to refer therefore to discriminating between true winter rings from checks, as exemplified above. To this point the prior knowledge of the expected annual growth and of the most frequent and typical checks, as well as the individual experience of each reader is very valuable. There we reiterate the advice given in the 2002 workshop report (Uriarte et al. 2002), despite some obvious exceptions to this rule: "When doubts occur, the criteria of complete growth zones in conformity with the typical annual growth pattern should be helpful: if the doubtful rings are checks then their assumption should allow for a better fitting to the typical annual (and seasonal expected marginal) growth of the otolith than in the alternative of assuming that they are true annual rings."

Readers , problems with the otoliths they read.
The readers which have the better ranking and the major agreement are readers 1,2 & 3 from AZTI and Ifremer (P.G) they all work mainly (or entirely) with otoliths of the first half of the year (from the fishery and surveys). The readers diverging the most (4 & 5) have the responsibility of the total French fishery (R4 E.D. Ifremer) and part (about 15%) of the Spanish fishery (R5, B.V. IEO). The differences appearing among readers for ages 2 and 3 particularly for the second half of the year may lead to difference of a maximum of 50% in the percentage of age 2 (positive bias regarding the modal age, see table **Table 5.2.3b and 5.2.6 and 7**) for the French Fishery for instance. However, this difference was not such during the 2005 exchange programme and therefore it is quite uncertain that this change in their reading during the workshop will propagate to the new coming age determinations. Certainly more exchanges or workshops will be required in future. IN any case on average CVs were smaller than 15% for any age, although individual CVs for ages or readers might be as high as 30-35%.

Further research:
At the 2002 workshop it was agree to produce an agreed collections of otoliths: "a CD will be produce with the validation report and the methodology for age reading with photos from several cohorts followed for years.". This has not been done. The coordinator of the workshop agrees to promote the generation of that CD during 2007.

Problems arising from a correct distinction between checks formed during the first year of life and the first true winter ring can lead to incorrect distinction between ages 0 and 1 in summer time and between age 1 and 2 in spring and summer time. Solving this problem can be the subject of some direct research, by using the microincrements formed in the otoliths of juveniles with daily rythm during the first year of life of these anchovies (Cermeño et al 2001). In this way checks corresponding to the first early growth of

juveniles phases can be identified with certainty at the microscope and doubts about the nature of the first marks as checks or true winter ring can be solved.
Further research: Selecting some well agreed otoliths or particularly problematic ones and read the daily rings as way for resolving the badly age allocated otoliths.

However the marks formed after the first winter ring seem not to be tractable in this way.

Next coming workshop.
IN order to continue tracing the quality in anchovy age determinations for the Bay of Biscay area: the workshop members recommended to perform workshops on anchovy otoliths Every 4 years.

CONCLUSIONS:

- Review of the results of the past 2005 otolith exchange programme was made along with a discussion of the major difficulties in age determination.
- Review of the criteria for age determination of anchovy otoliths in the Bay of Biscay is presented, following past practices (Uriarte et al. 2002).
- The overall level of agreement and precision in anchovy age reading determinations seems to be satisfactory: Most of the anchovy otoliths were well classified by most of the readers during the 2006 workshop (with an average agreement of 92.7 % and a CV of 9.2%). CVs were on average smaller than 15% for any age, although individual CVs for ages or readers might be as high as 30-35%.
- The percentage of agreement of the new readings and the coefficient of determination are similar to those achieved during the 2005 otolith exchange programme: no neat improvement was achieved.
- In the 2006 otolith workshop as in the 2005 exchange programme the difficulties become more relevant for the otoliths from the second half of the year (Percentage of agreement of 90.7 % and CV of 14.1%). It is unclear by how much errors of individual readers can propagate to the age determinations of catches or suveys. Maximum errors detected in the workshop of about 50% in the percentage of age 2 during the second half of the year are probably an overestimate of the error induced in the catches for that period of the year.
- The workshop served to make explicit that major difficulties encountered refer to the discrimination between true winter rings from summer and autumn checks: There are marks after the first winter ring which could be interpreted as checks formed during summer or autumn time, C15 or C18, or as additional winter rings. This is hard to be elucidated for fishes caught at summer and autumn time when the expected total annual growth is not yet achieved and it is difficult of being assessed. This makes confounding ages 1 with older. In this circumstances the strength of the marks observed and their distance to the first winter ring become the criteria which can be applied.
- Spring otoliths, prior to the start of the annual white growth band, are easier to be aged.

AKNOWLEDGEMENTS

The Coordination made by AZTI of the otolith Exchange programme as well as of the workshop on age determination of anchovy otoliths and their reporting were supported by the Department of Agriculture and Fisheries of the Basque Government (Basque Country, Spain).

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LIST of TABLES:

Table 5.2.7: For otoliths read during the workshop corresponding to the second half year: The age compositions estimated by each age reader and all age readers combined. Middle table: The estimated mean length at age by age reader and by all age readers combined. Lower table: Bias tests: non-parametrically with a one-sample Wilcoxon rank sum test. The inter-reader bias test and the reader against MODAL age bias test. And percentage of agreement between readers.

Table 5.2.8: For otoliths read during the workshop corresponding to the subset of the second half year of the otoliths coming from the 2001 exchange programme: The number of age readings, the coefficient of variation (CV), the percent agreement and the RELATIVE bias are presented by MODAL age for each age reader and for all readers combined. A weighted mean CV and a weighted mean percent agreement are given by reader and all readers combined. The CV's by MODAL age for each individual age reader and all readers combined indicate the precision in age reading by MODAL age.

Table 5.2.9: For otoliths read during the workshop corresponding to the subset of the second half year of the otoliths coming from the 2001 exchange programme: The age compositions estimated by each age reader and all age readers combined. Middle table: The estimated mean length at age by age reader and by all age readers combined. Lower table: Bias tests: non-parametrically with a one-sample Wilcoxon rank sum test. The inter-reader bias test and the reader against MODAL age bias test. And percentage of agreement between readers.

LIST of FIGURES:

Figure 5.2.1: The coefficient of variation (CV%), percent agreement and the standard deviation (STDEV) are plotted against MODAL age.

Figure 5.2.2: The distribution of the age reading errors in percentage by MODAL age as observed from the whole group of age readers in an age reading comparison to MODAL age. The achieved precision in age reading by MODAL age group is shown by the spread of the age readings errors. There appears to be no RELATIVE bias, if the age reading errors are normally distributed. The distributions are skewed, if RELATIVE bias occurs.

Figure 5.2.3: The RELATIVE bias by MODAL age as estimated by all age readers combined.

Figure 5.2.4: In the age bias plots below the mean age recorded +/- 2stdev of each age reader and all readers combined are plotted against the MODAL age. The estimated mean age corresponds to MODAL age, if the estimated mean age is on the 1:1 equilibrium line (solid line). RELATIVE bias is the age difference between estimated mean age and MODAL age.

Figure 5.2.5: Plot of the mean length at age as estimated by each age reader.

LIST of PHOTOS:

Photo .1: Typical otoliths of ages 1 and 2 at spring time: Left photos (ages 1, April2004 - 210403-3_15- and May 1990) and Right photos (ages 2, from April 2004: 210403-3_10 and _11).

Photo.2: Typical otoliths of ages 3, 4 and 5 at spring time: Otoliths type III (April 85), IV (May 86) & V (May 1987)

Photo.3: Typical 3 years old otoliths at spring time: 210404-3_17 (april 2004)

Photo.4: Typical 4 years old otoliths at spring time: 210404-3_17 (april 2004)

Photo.5: Two anchovy Otoliths of 2 years old (left, from April 2004 -210403-3_07 and _20) and one of 3 years old (right, from spring 1985), showing several checks before and after the first annual ring and before the hyaline edge fo the 2 years old of April 2004). See further examples in Figure 4.3.2 (left)

Photo.6: Ageing anchovy otoliths in Spring: Modal Interpretation (left): 2 years old: A1. First winter ring, C18 Late summer check, A2, 2nd winter ring (at the edge). (Caught April 2004) (id.code: 210403-3_19, length of 165 mm) (80% of agreement in the exchange programme and in the workshop. Total agreement after discussion at the end of the workshop). Right: Alternative interpretations of 3 y.o.

Photo.7: Ageing anchovy otoliths in Spring: workshop Modal Interpretation (left): 2 years old: A1. First winter ring, C18 Late summer check, A2, 2nd winter ring (at the edge). (Caught April 2004) (id.code: 210403-3_20, length of 165 mm). Right: Alternative interpretations of 3 y.o. (The alternative 3 y.o. interpretation had a 80% of agreement in the exchange and the Modal interpretation in the workshop concited only 60% of agreement in the workshop.

Photo.8: Ageing anchovy otoliths in Spring: Two Modal Interpretations (left): 2 years old: A1. First winter ring, C15 Spawning check, A2, 2nd winter ring ,and A3 third winter (at the edge). (Caught April 2004) (id.code: ANEBIO04-5067_54, length of 141 mm). Right: Alternative interpretations of 4 y.o. (or 3) In the workshop both interpretations (2 or 4) concited 40% of agreement, while in the exchange 3 y.o. was the Modal interpetation.

Photo.9: Ageing anchovy otoliths in Summer: Dual Interpretation leading to the Modal age determination (left): 1 year old: C06 Potential Check at 60% of the 0 y.o. growth. A1. First winter ring, C15 Summer post spawning check, with an opaque edge. (Caught July 2004) (id.code: 210704-10, length of 157 mm). Right: Alternative interpretations of 2 y.o. (Similar 60% agreement for age 1 interpretation achieved in the exchange and in the workshop)

Photo.10: Ageing anchovy otoliths in Summer: Modal Interpretation (left): 1 year old: A1. First winter ring, C18 Summer post spawning check, with an opaque edge. (Caught July 2004) (id.code: 210704-18, length of 167 mm) Right: Alternative interpretations of 2 y.o.

(75% of agreement for age 1 interpretation achieved in the exchange and 60% in the workshop)

Photo.11: Ageing anchovy otoliths in Summer: Modal Interpretation (left): 1 year old: A1. First winter ring, C18 Summer post spawning check, with an opaque edge. (Caught July 2004) (id.code: 210704-19, length of 155 mm) Right: Alternative interpretations of 2 y.o. (80% agreement for age 1 interpretation during the exchange and a 100% in the workshop).

Photo.12: Ageing anchovy otoliths in Summer: Modal Interpretation (left): 1 year old: A1. First winter ring, C15 Summer post spawning check, with an opaque edge. (Caught August 2004) (id.code: 180804-14, length of 163 mm) Right: Alternative interpretations of 2 y.o. (80% of agreement in the exchange for the alternative interpretation, but after discussion a 100% agreement for age 1 interpretation was achieved in the workshop).

Photo.13: Ageing anchovy otoliths in Summer: Modal Interpretation (left): 1 year old: A1. First winter ring, with a wide opaque edge. (Caught September 2003) (id.code: 110903-01, length of 163 mm). (80% of agreement in the exchange for the alternative interpretation, but after discussion a 100% agreement for age 1 interpretation was achieved in the workshop). The alternative interpretations of 2 y.o is not shown.

Photo.14: Ageing anchovy otoliths in Summer: Modal Interpretation (left): 2 year old: A1. First winter ring, A2 second winter ring, plus the current year growth. (Caught September 2003) (id.code: 110903-02, length of 169 mm) Right: Alternative interpretations of 1 y.o. (100% agreement in the exchange for the modal interpretation, and 80% in the workshop).

Photo .15: Ageing anchovy otoliths in Summer: Divergent age radings in September with 50% of readings for 1 year old and 50% to age 0. Otoliths 110903.19 and 20 (154 and 141 mm). Certainly no clear winter ring is seen in the otolith the and the inner marks might well be checks C06 instead of a weak winter ring. Each assumption lead to age 0 or 1 respectively. Since such weak winter rings are not expect to occur, by ortodoxy age 0 could be the default option.

Photo 16: 181103_27: Age 0 100% agreement in the workshop and in the exchange programme. It has no mark deposition, although a weak check can be presumed (C06) in the left otolith.

Photo .17: Otolith 181103_28: Modal Age 1 y.o.: 75% agreement in the exchange programme and 50% agreement in the workshop 155 mmm. The alternative was a 0 y.o. with a check 06. Potential interpretations are obvious.

Photo .18: Otolith 181103_30: Modal age 1 y.o. with check C15: 60% agreement in the exchange programme but a 100% in the workshop; 175 mm. Alternative interpretation for a 2 y.o. arises from considering C15 as A2 but was discarded in the workshop.

Photo .19: Spring Otoliths from french acoustic survey PELGAS06: A- Modal age 2 y.o. with small opaque edge (125 mm). B- Two year old, with a relevant with a hyaline edge (130 mm). C- One year old, with a hyaline edge (130 mm). The fishes were caught

04/05/2006 during the first fornight of May at 44°27.4N and 1°26.9 W. close to the coast of Arcachon (Trawl nº7).

Photo .20: Otoliths from french acoustic survey PELGAS06: A- K0289 Chalut 08 10 cms 9 grs. B- K0305 Chalut 16 8.5 cms 4 grs . Probably 1 y.o. with a check C08 . C- K0301 Chalut 15: 14cms, 20grs , probably a 1 year old with check C08 and a starting white edge.

ANNEXES:

Annex 1- COMPLETE ADDRESSES OF ATTENDEES: (Iñaki 5/2/06)

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Annex 2- AGENDA OF WORK:
The preparation of the sets of otoliths and submission to the coordinator was completed during January 2005 and the exchange programme was completed by the end of July. Workshop Meeting in November 2006 and final Report February 2007.

Agenda of the workshop:

Tuesday 14th November.
9:00 -09:30 Revision and adoption of the agenda and Organization of the workshop
9:30 -11:00 Presentation of ageing results from the otolith exchange programme concerning the Bay of Biscay anchovy otoliths: Comparisons of precision and accuracy against modal age. Evaluate current levels of ageing agreement (precision) among institutes. And Identify major difficulties in age determination concerning observed disagreements. (Presentation A. Uriarte).
11:00 Café
11:30- 12:30 Review the agreements and the current practice for ageing anchovy otoliths from the Bay of Biscay. (Presentation A. Uriarte).
12:30- 13:30 Review and discuss the otoliths with disagreements for the exchange programme, particularly those from the second half of the year.
15:00-18:30 Perform a new quick exercise of age reading

a) On the otoliths of the exchange and Evaluate improvements in ageing precision among institutes by the end of the meeting.
b) On some additional otoliths from the second half of the year (IFREMER to bring them???).

Wednesday 15th of November:
9:00 -11:00 Examine difficulties in age reading determination in PELGAS06 and discuss them and Centinele survey in autumn 2005.
11:00 Café
11:30- 12:30 Evaluate improvements in ageing precision among institutes: Presentation of ageing results of the exercise of the day before and comparisons of precision and accuracy in comparison with the former Exchange programme.
12:30 13:30 Common discussion on remaining disagreements for the old and new set of otoliths.

15:00 Open discussion and conclusions about:
Reporting the workshop results and dissemination.
Unsolved issues?
Revising future agenda of work for continuous tracing of quality in anchovy age determinations for the Bay of Biscay area
Future research?
Establish a digitalized agreed collection of otoliths for the Bay of Biscay anchovy???

Table 5.2.1 ANCHOVY 2006 workshop reading of otoliths from the exchange

Stratum	Sample year	Sample no	Plaque n°	Fish no	Fish length	Sex	Landing month	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-PG Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5	RANGE r. 0-5 MODAL age	Percent agreement	Precision CV
Semestre 1	2004	ANE-210404-3	1	164	1	4	2	2	2	2	2	2	100%	0%
Semestre 1	2004	ANE-210404-3	2	158	1	4	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-210404-3	3	169	2	4	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-210404-3	4	190	2	4	2	2	2	2	2	2	100%	0%
Semestre 1	2004	ANE-210404-3	5	174	2	4	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-210404-3	6	172	1	4	2	2	2	2	2	2	100%	0%
Semestre 1	2004	ANE-210404-3	7	175	2	4	2	2	2	2	2	2	100%	0%
Semestre 1	2004	ANE-210404-3	8	163	1	4	2	2	2	2	2	2	100%	0%
Semestre 1	2004	ANE-210404-3	9	178	2	4	2	2	2	2	2	2	100%	0%
Semestre 1	2004	ANE-210404-3	10	179	1	4	2	2	2	2	2	2	100%	0%
Semestre 1	2004	ANE-210404-3	11	174	2	4	2	2	2	2	2	2	100%	0%
Semestre 1	2004	ANE-210404-3	12	149	1	4	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-210404-3	13	179	1	4	3	3	3	3	3	3	100%	0%
Semestre 1	2004	ANE-210404-3	14	165	1	4	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-210404-3	15	150	1	4	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-210404-3	16	169	2	4	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-210404-3	17	175	1	4	4	4	4	4	4	4	100%	0%
Semestre 1	2004	ANE-210404-3	18	166	2	4	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-210404-3	19	165	2	4	2	2	2	3	2	2	80%	20%
Semestre 1	2004	ANE-210404-3	20	159	1	4	2	2	3	3	2	2	60%	23%
Semestre 1	2004	ANE-210404-3	21	178	2	4	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-210404-3	22	161	2	4	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-210404-3	23	180	2	4	2	2	2	2	2	2	100%	0%
Semestre 1	2004	ANE-210404-3	24	163	2	4	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-210404-3	25	184	2	4	2	2	2	2	2	2	100%	0%
Semestre 1	2004	ANE-210404-3	26	171	2	4	1	1	1	-	1	1	100%	0%
Semestre 1	2004	ANE-210404-3	27	170	1	4	2	2	2	2	2	2	100%	0%
Semestre 1	2004	ANE-210404-3	28	170	2	4	2	2	2	2	2	2	100%	0%
Semestre 1	2004	ANE-210404-3	29	187	2	4	2	3	3	3	2	3	60%	21%
Semestre 1	2004	ANE-210404-3	30	164	1	4	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5067	31	135	1	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5067	32	136	1	5	3	3	2	2	3	3	60%	21%
Semestre 1	2004	ANE-BIO04-5067	33	112	1	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5067	34	138	1	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5067	35	110	1	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5067	36	127	1	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5067	37	151	1	5	3	3	3	3	3	3	100%	0%
Semestre 1	2004	ANE-BIO04-5067	38	102	1	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5067	39	127	1	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5067	40	144	1	5	3	3	3	3	3	3	100%	0%
Semestre 1	2004	ANE-BIO04-5067	41	152	1	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5067	42	118	1	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5067	43	121	1	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5067	44	109	1	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5067	45	145	1	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5067	46	156	1	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5067	47	110	1	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5067	48	133	1	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5067	49	118	1	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5067	50	102	1	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5067	51	147	1	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5067	52	146	1	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5067	53	171	1	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5067	54	141	1	5	2	2	4	3	4	2	40%	33%
Semestre 1	2004	ANE-BIO04-5067	55	147	1	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5067	56	136	1	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5067	57	98	1	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5067	58	137	1	5	3	3	3	3	3	3	100%	0%
Semestre 1	2004	ANE-BIO04-5067	59	149	1	5	3	3	2	2	1	3	40%	38%
Semestre 1	2004	ANE-BIO04-5067	60	116	1	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5068	1	145	2	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5068	2	155	2	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5068	3	144	2	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5068	4	159	2	5	3	3	3	3	3	3	100%	0%
Semestre 1	2004	ANE-BIO04-5068	5	158	2	5	2	3	3	3	2	3	60%	21%
Semestre 1	2004	ANE-BIO04-5068	6	170	2	5	-	-	-	-	-			
Semestre 1	2004	ANE-BIO04-5068	7	182	2	5	2	2	2	2	2	2	100%	0%
Semestre 1	2004	ANE-BIO04-5068	8	155	2	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5068	9	144	2	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5068	10	148	2	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5068	11	171	2	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5068	12	149	2	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5068	13	162	2	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5068	14	129	2	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5068	15	165	2	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5068	16	149	2	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5068	17	163	2	5	1	-	-	-	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5068	18	171	2	5	2	2	2	3	2	2	80%	20%
Semestre 1	2004	ANE-BIO04-5068	19	157	2	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5068	20	139	2	5	1	1	1	2	1	1	80%	37%
Semestre 1	2004	ANE-BIO04-5068	21	154	2	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5068	22	154	2	5	5	4	4	-	4	4	75%	12%
Semestre 1	2004	ANE-BIO04-5068	23	148	2	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5068	24	154	2	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5068	25	191	2	5	3	3	2	3	3	3	80%	16%

Table 5.2.1 ANCHOVY 2006 workshop reading of otoliths from the exchange

RANGE r. 0-5

Stratum	Sample year	Plaque no	Plaque n°	Fish no	Fish length	Sex	Landing month	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-PG Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5	MODAL age	Percent agreement	Precision CV
Semestre 1	2004	ANE-BIO04-5068		26	148	2	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5068		27	178	2	5	2	2	2	2	2	2	100%	0%
Semestre 1	2004	ANE-BIO04-5068		28	162	2	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5068		29	159	2	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-BIO04-5068		30	165	2	5	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-020604-1		1	135	1	6	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-020604-1		2	154	1	6	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-020604-1		3	170	2	6	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-020604-1		4	166	2	6	1	1	1	2	1	1	80%	37%
Semestre 1	2004	ANE-020604-1		5	158	2	6	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-020604-1		6	165	1	6	2	2	3	3	3	3	60%	21%
Semestre 1	2004	ANE-020604-1		7	150	1	6	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-020604-1		8	158	1	6	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-020604-1		9	145	1	6	1	1	1	1	1	1	100%	0%
Semestre 1	2004	ANE-020604-1		10	136	1	6	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	210704		1	163	2	7	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	210704		2	172	2	7	2	2	1	2	1	2	60%	34%
SEMESTRE 2	2004	210704		3	156	2	7	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	210704		4	161	2	7	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	210704		5	158	2	7	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	210704		6	161	2	7	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	210704		7	165	2	7	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	210704		8	136	1	7	1	1	1	1	0	1	80%	56%
SEMESTRE 2	2004	210704		9	169	2	7	1	1	1	-	1	1	100%	0%
SEMESTRE 2	2004	210704		10	157	1	7	1	1	2	2	1	1	60%	39%
SEMESTRE 2	2004	210704		11	174	2	7	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	210704		12	172	2	7	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	210704		13	161	2	7	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	210704		14	167	2	7	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	210704		15	163	2	7	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	210704		16	168	2	7	1	1	-	1	1	1	100%	0%
SEMESTRE 2	2004	210704		17	156	1	7	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	210704		18	167	2	7	1	1	2	2	1	1	60%	39%
SEMESTRE 2	2004	210704		19	155	1	7	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	210704		20	147	1	7	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	210704		21	165	2	7	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	210704		22	169	1	7	2	2	2	2	1	2	80%	25%
SEMESTRE 2	2004	210704		23	176	2	7	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	210704		24	164	2	7	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	210704		25	161	2	7	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	210704		26	157	1	7	1	1	1	2	1	1	80%	37%
SEMESTRE 2	2004	210704		27	153	1	7	2	2	2	2	1	2	80%	25%
SEMESTRE 2	2004	210704		28	174	2	7	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	210704		29	151	1	7	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	210704		30	150	2	7	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		1	145	1	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		2	160	2	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		3	155	1	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		4	158	2	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		5	162	2	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		6	143	2	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		7	136	1	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		8	155	2	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		9	155	2	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		10	162	1	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		11	150	1	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		12	161	2	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		13	145	1	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		14	168	2	8	1	2	2	2	1	2	60%	34%
SEMESTRE 2	2004	180804		15	154	2	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		16	166	2	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		17	155	2	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		18	166	2	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		19	152	2	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		20	156	2	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		21	163	2	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		22	147	1	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		23	160	2	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		24	150	1	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		25	146	1	8	1	1	-	-	1	1	100%	0%
SEMESTRE 2	2004	180804		26	153	1	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		27	148	2	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		28	143	1	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		29	165	2	8	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2004	180804		30	154	2	8	1	1	1	2	1	1	80%	37%
SEMESTRE 2	2003	110903		1	163	2	9	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2003	110903		2	169	1	9	2	2	2	2	1	2	80%	25%
SEMESTRE 2	2003	110903		3	153	1	9	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2003	110903		4	160	1	9	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2003	110903		5	153	1	9	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2003	110903		6	147	2	9	1	1	2	2	1	1	60%	39%
SEMESTRE 2	2003	110903		7	150	1	9	1	1	-	1	1	1	100%	0%
SEMESTRE 2	2003	110903		8	144	1	9	1	1	2	-	1	1	75%	40%
SEMESTRE 2	2003	110903		9	159	1	9	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2003	110903		10	165	2	9	2	2	2	2	1	2	80%	25%

Table 5.2.1 ANCHOVY 2006 workshop reading of otoliths from the exchange

Stratum	Sample year	Sample no	Plaque n°	Fish no	Fish length	Sex	Landing month	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-PG Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5	RANGE r. 0-5 MODAL age	Percent agreement	Precision CV
SEMESTRE 2	2003	110903		11	157	1	9	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2003	110903		12	153	1	9	1	1	-	1	0	1	75%	67%
SEMESTRE 2	2003	110903		13	171	1	9	3	3	2	3	3	3	80%	16%
SEMESTRE 2	2003	110903		14	162	1	9	1	1	2	2	1	1	60%	39%
SEMESTRE 2	2003	110903		15	166	1	9	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2003	110903		16	154	1	9	1	1	-	1	0	1	75%	67%
SEMESTRE 2	2003	110903		17	148	1	9	1	1	2	2	1	1	60%	39%
SEMESTRE 2	2003	110903		18	150	2	9	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2003	110903		19	154	2	9	1	1	0	-	0	1	50%	115%
SEMESTRE 2	2003	110903		20	141	1	9	1	1	0	-	0	1	50%	115%
SEMESTRE 2	2003	110903		21	170	2	9	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2003	110903		22	149	2	9	1	1	1	2	1	1	80%	37%
SEMESTRE 2	2003	110903		23	155	1	9	1	1	1	2	1	1	80%	37%
SEMESTRE 2	2003	110903		24	146	1	9	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2003	110903		25	150	1	9	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2003	110903		26	149	1	9	1	1	1	-	1	1	100%	0%
SEMESTRE 2	2003	110903		27	149	1	9	1	1	2	2	1	1	60%	39%
SEMESTRE 2	2003	110903		28	164	1	9	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2003	110903		29	146	1	9	1	1	1	-	1	1	100%	0%
SEMESTRE 2	2003	110903		30	156	2	9	1	1	1	2	1	1	80%	37%
SEMESTRE 2	2003	181103		1	176	2	11	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2003	181103		2	150	2	11	1	1	1	2	1	1	80%	37%
SEMESTRE 2	2003	181103		3	171	2	11	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2003	181103		4	206	2	11	3	3	3	3	1	3	80%	34%
SEMESTRE 2	2003	181103		5	175	1	11	1	1	1	2	1	1	80%	37%
SEMESTRE 2	2003	181103		6	162	1	11	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2003	181103		7	192	2	11	3	3	2	3	3	3	80%	16%
SEMESTRE 2	2003	181103		8	197	2	11	3	3	3	3	3	3	100%	0%
SEMESTRE 2	2003	181103		9	149	2	11	0	0	0	0	0	0	100%	0%
SEMESTRE 2	2003	181103		10	181	2	11	1	1	2	2	1	1	60%	39%
SEMESTRE 2	2003	181103		11	201	2	11	3	3	2	3	3	3	80%	16%
SEMESTRE 2	2003	181103		12	169	1	11	1	1	2	2	1	1	60%	39%
SEMESTRE 2	2003	181103		13	183	2	11	3	3	2	3	3	3	80%	16%
SEMESTRE 2	2003	181103		14	187	2	11	2	2	2	2	1	2	80%	25%
SEMESTRE 2	2003	181103		15	162	1	11	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2003	181103		16	119	3	11	0	0	0	0	0	0	100%	0%
SEMESTRE 2	2003	181103		17	155	2	11	1	1	1	1	0	1	80%	56%
SEMESTRE 2	2003	181103		18	191	2	11	3	3	2	3	3	3	80%	16%
SEMESTRE 2	2003	181103		19	177	1	11	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2003	181103		20	160	1	11	1	1	1	1	1	1	100%	0%
SEMESTRE 2	2003	181103		21	162	2	11	3	1	1	1	1	1	80%	64%
SEMESTRE 2	2003	181103		22	179	2	11	2	3	3	3	3	3	80%	16%
SEMESTRE 2	2003	181103		23	171	1	11	2	2	1	2	2	2	80%	25%
SEMESTRE 2	2003	181103		24	174	2	11	1	2	2	2	1	2	60%	34%
SEMESTRE 2	2003	181103		25	172	1	11	2	2	2	2	2	2	100%	0%
SEMESTRE 2	2003	181103		26	154	1	11	1	1	2	1	1	1	80%	37%
SEMESTRE 2	2003	181103		27	132	2	11	0	0	0	0	0	0	100%	0%
SEMESTRE 2	2003	181103		28	155	1	11	1	1	-	0	0	1	50%	115%
SEMESTRE 2	2003	181103		29	140	2	11	0	0	0	0	0	0	100%	0%
SEMESTRE 2	2003	181103		30	175	1	11	1	1	1	1	1	1	100%	0%
							Total read	219	218	212	209	219		**92,7%**	**9,2%**
							Total NOT read	0	1	7	10	0			

Table 5.2.2 ANCHOVY 2006 workshop reading of otoliths

Subset of otoliths from the exchange 2005

The number of age readings, the coefficient of variation (CV), the percent agreement and the RELATIVE bias are presented by MODAL age for each age reader and for all readers combined. A weighted mean CV and a weighted mean percent agreement are given by reader and all readers combined. The CV's by MODAL age for each individual age reader and all readers combined indicate the precision in age reading by MODAL age. The weighted mean CV's over all MODAL age groups combined indicate the precision in age reading by reader and for all age readers combined.

NUMBER OF AGE READINGS

	MODAL age	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-PG Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5	TOTAL
	0	4	4	4	4	4	**20**
	1	166	165	159	157	166	**813**
	2	28	28	28	28	28	**140**
	3	19	19	19	19	19	**95**
	4	2	2	2	1	2	**9**
	5	-	-	-	-	-	**-**
Total	**0-15**	**219**	**218**	**212**	**209**	**219**	**1077**

COEFFICIENT OF VARIATION (CV)

	MODAL age	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-PG Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5	ALL Readers
	0	0%	0%	0%	0%	0%	**0,0%**
	1	15%	0%	26%	29%	21%	**8,3%**
	2	14%	0%	25%	17%	35%	**12,4%**
	3	15%	8%	20%	11%	25%	**14,1%**
	4	16%	0%	0%	-	0%	**5,9%**
	5	-	-	-	-	-	**-**
Weighted mean	**0-15**	**14,8%**	**0,7%**	**24,4%**	**25,3%**	**22,6%**	**9,2%**
	RANKING	**2**	**1**	**4**	**5**	**3**	

PERCENTAGE AGREEMENT

	MODAL age	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-PG Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5	ALL
	0	100%	100%	100%	100%	100%	**100%**
	1	99%	100%	92%	89%	96%	**95%**
	2	93%	100%	86%	86%	68%	**86%**
	3	79%	95%	58%	89%	79%	**80%**
	4	50%	100%	100%	100%	100%	**89%**
	5	-	-	-	-	-	**-**
Weighted mean	**0-15**	**96,3%**	**99,5%**	**88,7%**	**88,5%**	**90,9%**	**92,9%**
	RANKING	**2**	**1**	**4**	**5**	**3**	

RELATIVE BIAS — BIAS RELATIVE TO MODAL AGE

	MODAL age	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-PG Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5	ALL
	0	0,00	0,00	0,00	0,00	0,00	**0,00**
	1	0,01	0,00	0,05	0,10	-0,04	**0,02**
	2	-0,07	0,00	0,04	0,14	-0,21	**-0,02**
	3	-0,21	-0,05	-0,42	-0,11	-0,32	**-0,22**
	4	0,50	0,00	0,00	0,00	0,00	**0,11**
	5	-	-	-	-	-	**-**
Weighted mean	**0-15**	**-0,01**	**-0,00**	**0,00**	**0,09**	**-0,09**	**-0,00**
	RANKING	**3**	**1**	**2**	**4**	**5**	

Overall ranking

	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-PG Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5
Ranking Coefficient of Variation	2	1	4	5	3
Ranking Percentage Agreement	2	1	4	5	3
Ranking Relative bias	3	1	2	4	5
OVERALL RANKING	**2**	**1**	**3**	**5**	**4**
Mean Ranking	2,33	1,00	3,33	4,67	3,67
absolute value of the bias	0,01	0,00	0,00	0,09	0,09

Table 5.2.3 ANCHOVY 2006 workshop reading of otoliths

Subset of otoliths from the exchange 2005

Upper table: The age compositions estimated by each age reader and all age readers combined.
Midle table: The estimated mean length at age by age reader and by all age readers combined.
Lower table: Bias tests: non-parametrically with a one-sample Wilcoxon rank sum test.The inter-reader bias test and the reader against MODAL age bias test. And percentage of agreement between readers.

AGE COMPOSITION

	Age	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-P Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5	TOTAL
	0	4	4	6	5	11	**30**
	1	167	165	149	139	169	**789**
	2	30	29	42	43	21	**165**
	3	16	18	12	21	15	**82**
	4	1	2	3	1	3	**10**
	5	1	-	-	-	-	**1**
Tota	**0-15**	**219**	**218**	**212**	**209**	**219**	**1077**

MEAN LENGTH AT AGE

	Age	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-P Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5	ALL
	0	135,0	135,0	139,2	139,0	144,4	**139,9**
	1	153,2	153,0	152,9	152,4	154,2	**153,2**
	2	171,4	171,0	170,1	165,7	173,4	**169,8**
	3	171,8	172,8	168,4	172,7	171,7	**171,8**
	4	175,0	164,5	156,7	175,0	156,7	**161,9**
	5	154,0	-	-	-	-	**154,0**
Weighted mean	**0-15**	**156,8**	**156,8**	**156,8**	**157,0**	**156,8**	**156,8**

Percentage of Agreement and Inter-reader bias test

	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-P Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5
Reader 1		–	–	* *	* *
Reader 2	**96,8%**		–	* *	* *
Reader 3	**84,9%**	**88,2%**		* *	*
Reader 4	**85,2%**	**88,0%**	**87,6%**		* *
Reader 5	**90,9%**	**90,4%**	**84,9%**	**81,8%**	
MODAL age	–	–	–	* *	* *

Bias test signs		
	–	= no sign of bias (p>0.05)
	*	= possibility of bias (0.01<p<0.05)
	* *	= certainty of bias (p<0.01)

ANCHOVY 2006 workshop reading of otoliths from the exchange 2005

Table 5.2.4 Otoliths read, CV's, percentage agreement and relative bias by month and by MODAL age

NUMBER OF OTOLITHS

MODAL age	1 Jan	2 Feb	3 Mar	4 Apr	5 May	6 Jun	7 Jul	8 Aug	9 Sep	10 Oct	11 Nov	12 Dec	Nr of otoliths
0	-	-	-	-	-	-	-	-	-	-	4	-	**4**
1	-	-	-	13	46	9	27	29	27	-	15	-	**166**
2	-	-	-	14	4	-	3	1	2	-	4	-	**28**
3	-	-	-	2	8	1	-	-	1	-	7	-	**19**
4	-	-	-	1	1	-	-	-	-	-	-	-	**2**
5	-	-	-	-	-	-	-	-	-	-	-	-	**0**
TOTAL	**0**	**0**	**0**	**30**	**59**	**10**	**30**	**30**	**30**	**0**	**30**	**0**	**219**

COEFFICIENT OF VARIATION (CV)

MODAL age	1 Jan	2 Feb	3 Mar	4 Apr	5 May	6 Jun	7 Jul	8 Aug	9 Sep	10 Oct	11 Nov	12 Dec	Mean CV
0	-	-	-	-	-	-	-	-	-	-	0%	-	**0,0%**
1	-	-	-	0%	1%	4%	6%	1%	25%	-	28%	-	**8,3%**
2	-	-	-	3%	13%	-	28%	34%	25%	-	21%	-	**12,4%**
3	-	-	-	11%	12%	21%	-	-	16%	-	16%	-	**14,1%**
4	-	-	-	0%	12%	-	-	-	-	-	-	-	**5,9%**
5	-	-	-	-	-	-	-	-	-	-	-	-	**-**
Mean CV	**-**	**-**	**-**	**2,1%**	**3,4%**	**5,8%**	**8,5%**	**2,4%**	**24,6%**	**-**	**20,8%**	**-**	**9,2%**
Weighted													

Note: Higher CV's might be expected during months of opaque material deposition and during the juvenile phase, when false rings might occur!

PERCENTAGE AGREEMENT

MODAL age	1 Jan	2 Feb	3 Mar	4 Apr	5 May	6 Jun	7 Jul	8 Aug	9 Sep	10 Oct	11 Nov	12 Dec	Agree-ment
0	-	-	-	-	-	-	-	-	-	-	100%	-	**100,0%**
1	-	-	-	100%	100%	98%	95%	99%	86%	-	85%	-	**95,3%**
2	-	-	-	96%	80%	-	73%	60%	80%	-	80%	-	**86,4%**
3	-	-	-	80%	80%	60%	-	-	80%	-	83%	-	**80,0%**
4	-	-	-	100%	75%	-	-	-	-	-	-	-	**88,9%**
5	-	-	-	-	-	-	-	-	-	-	-	-	**-**
Mean CV	**-**	**-**	**-**	**96,7%**	**95,2%**	**94,0%**	**93,3%**	**98,0%**	**85,2%**	**-**	**85,9%**	**-**	**92,9%**
Weighted				**+**	**-**			**+**	**-**				

RELATIVE BIAS

MODAL age	1 Jan	2 Feb	3 Mar	4 Apr	5 May	6 Jun	7 Jul	8 Aug	9 Sep	10 Oct	11 Nov	12 Dec	Mean bias
0	-	-	-	-	-	-	-	-	-	-	0,00	-	**0,00**
1	-	-	-	0,00	0,00	0,02	0,03	0,01	0,05	-	0,08	-	**0,02**
2	-	-	-	0,04	0,30	-	-0,27	-0,40	-0,20	-	-0,20	-	**-0,02**
3	-	-	-	-0,20	-0,23	-0,40	-	-	-0,20	-	-0,20	-	**-0,22**
4	-	-	-	0,00	0,25	-	-	-	-	-	-	-	**0,11**
5	-	-	-	-	-	-	-	-	-	-	-	-	**-**
Mean	**-**	**-**	**-**	**0,01**	**-0,00**	**-0,02**	**0,00**	**-0,01**	**0,02**	**-**	**-0,03**	**-**	**-0,00**
Weighted													

ANCHOVY 2006 workshop reading of otoliths from the exchange 2005

Table 5.2.5 Otoliths read, CV's, percentage agreement and RELATIVE bias by stratum and MODAL age

NUMBER OF OTOLITHS

MODAL age	SAMPLING STRATA												Nr of otoliths
	hestre 1	hestre 2	C	D	E	F	G	H	I	J	K	L	
0	-	4	-	-	-	-	-	-	-	-	-	-	4
1	68	98	-	-	-	-	-	-	-	-	-	-	166
2	18	10	-	-	-	-	-	-	-	-	-	-	28
3	11	8	-	-	-	-	-	-	-	-	-	-	19
4	2	-	-	-	-	-	-	-	-	-	-	-	2
5	-	-	-	-	-	-	-	-	-	-	-	-	0
TOTAL	99	120	0	0	0	0	0	0	0	0	0	0	219

COEFFICIENT OF VARIATION (CV)

MODAL age	SAMPLING STRATA												Mean CV
	estre 1	estre 2	C	D	E	F	G	H	I	J	K	L	
0	-	0%	-	-	-	-	-	-	-	-	-	-	0,0%
1	1%	13%	-	-	-	-	-	-	-	-	-	-	8,3%
2	5%	25%	-	-	-	-	-	-	-	-	-	-	12,4%
3	13%	16%	-	-	-	-	-	-	-	-	-	-	14,1%
4	6%	-	-	-	-	-	-	-	-	-	-	-	5,9%
5	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean CV	3,2%	14,1%	-	-	-	-	-	-	-	-	-	-	9,2%

Weighted

PERCENTAGE AGREEMENT

MODAL age	SAMPLING STRATA												Agree-ment
	estre 1	estre 2	C	D	E	F	G	H	I	J	K	L	
0	-	100%	-	-	-	-	-	-	-	-	-	-	100,0%
1	99%	92%	-	-	-	-	-	-	-	-	-	-	95,3%
2	92%	76%	-	-	-	-	-	-	-	-	-	-	86,4%
3	78%	83%	-	-	-	-	-	-	-	-	-	-	80,0%
4	89%	-	-	-	-	-	-	-	-	-	-	-	88,9%
5	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean CV	95,5%	90,7%	-	-	-	-	-	-	-	-	-	-	92,9%

Weighted

RELATIVE BIAS

MODAL age	SAMPLING STRATA												Mean bias
	estre 1	estre 2	C	D	E	F	G	H	I	J	K	L	
0	-	0,00	-	-	-	-	-	-	-	-	-	-	0,00
1	0,01	0,04	-	-	-	-	-	-	-	-	-	-	0,02
2	0,10	-0,24	-	-	-	-	-	-	-	-	-	-	-0,02
3	-0,24	-0,20	-	-	-	-	-	-	-	-	-	-	-0,22
4	0,11	-	-	-	-	-	-	-	-	-	-	-	0,11
5	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	-0,00	-0,00	-	-	-	-	-	-	-	-	-	-	-0,00

Weighted

Table 5.2.6 ANCHOVY 2006 workshop reading of otoliths

Subset of otoliths from the exchange 2005 just for the second half of the year

The number of age readings, the coefficient of variation (CV), the percent agreement and the RELATIVE bias are presented by MODAL age for each age reader and for all readers combined. A weighted mean CV and a weighted mean percent agreement are given by reader and all readers combined. The CV's by MODAL age for each individual age reader and all readers combined indicate the precision in age reading by MODAL age. The weighted mean CV's over all MODAL age groups combined indicate the precision in age reading by reader and for all age readers combined.

NUMBER OF AGE READINGS

	MODAL age	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-PG Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5	TOTAL
	0	4	4	4	4	4	20
	1	98	98	92	91	98	477
	2	10	10	10	10	10	50
	3	8	8	8	8	8	40
	4	-	-	-	-	-	-
	5	-	-	-	-	-	-
Total	0-15	120	120	114	113	120	587

COEFFICIENT OF VARIATION (CV)

	MODAL age	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-PG Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5	ALL Readers
	0	0%	0%	0%	0%	0%	0,0%
	1	20%	0%	32%	34%	28%	13,3%
	2	23%	0%	23%	0%	35%	25,2%
	3	12%	12%	22%	0%	26%	16,9%
	4	-	-	-	-	-	-
	5	-	-	-	-	-	-
Weighted mean	0-15	18,9%	0,8%	29,8%	27,4%	27,4%	14,1%
	RANKING	2	1	5	3	4	

PERCENTAGE AGREEMENT

	MODAL age	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-PG Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5	ALL
	0	100%	100%	100%	100%	100%	100%
	1	99%	100%	87%	82%	93%	92%
	2	80%	100%	80%	100%	20%	76%
	3	88%	88%	38%	100%	88%	80%
	4	-	-	-	-	-	-
	5	-	-	-	-	-	-
Weighted mean	0-15	96,7%	99,2%	83,3%	85,8%	86,7%	90,5%
	RANKING	2	1	5	4	3	

RELATIVE BIAS **BIAS RELATIVE TO MODAL AGE**

	MODAL age	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-PG Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5	ALL
	0	0,00	0,00	0,00	0,00	0,00	0,00
	1	0,02	0,00	0,09	0,15	-0,07	0,04
	2	-0,20	0,00	-0,20	0,00	-0,80	-0,24
	3	-0,13	-0,13	-0,63	0,00	-0,25	-0,23
	4	-	-	-	-	-	-
	5	-	-	-	-	-	-
Weighted mean	0-15	-0,01	-0,01	0,01	0,12	-0,14	-0,01
	RANKING	1	2	3	4	5	

Overall ranking

	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-PG Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5
Ranking Coefficient of Variation	2	1	5	3	4
Ranking Percentage Agreement	2	1	5	4	3
Ranking Relative bias	1	2	3	4	5
OVERALL RANKING	**2**	**1**	**5**	**3**	**4**
Mean Ranking	1,67	1,33	4,33	3,67	4,00
absolute value of the bias	0,01	0,01	0,01	0,12	0,14

Table 5.2.7 ANCHOVY 2006 workshop reading of otoliths

Subset of otoliths from the exchange 2005 just for the second half of the year

Upper table: The age compositions estimated by each age reader and all age readers combined.
Midle table: The estimated mean length at age by age reader and by all age readers combined.
Lower table: Bias tests: non-parametrically with a one-sample Wilcoxon rank sum test.The inter-reader bias test and the reader against MODAL age bias test. And percentage of agreement between readers.

AGE COMPOSITION

	Age	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-PI Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5	TOTAL
	0	4	4	6	5	11	**30**
	1	99	98	82	75	100	**454**
	2	9	11	23	25	2	**70**
	3	8	7	3	8	7	**33**
	4	-	-	-	-	-	**-**
	5	-	-	-	-	-	**-**
Tota	**0-15**	**120**	**120**	**114**	**113**	**120**	**587**

MEAN LENGTH AT AGE

	Age	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-PI Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5	ALL
	0	135,0	135,0	139,2	139,0	144,4	**139,9**
	1	157,9	157,7	158,5	158,3	159,7	**158,4**
	2	170,8	170,8	168,4	163,0	171,5	**167,3**
	3	187,9	191,6	194,0	190,0	187,7	**189,7**
	4	-	-	-	-	-	**-**
	5	-	-	-	-	-	**-**
Weighted mean	**0-15**	**160,1**	**160,1**	**160,4**	**160,7**	**160,1**	**160,3**

Percentage of Agreement and Inter-reader bias test

	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-PI Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5
Reader 1		–	–	* *	* *
Reader 2	97,5%		–	* *	* *
Reader 3	79,8%	82,5%		* *	*
Reader 4	82,3%	85,0%	82,3%		* *
Reader 5	86,7%	85,8%	77,2%	75,2%	
MODAL age	–	–	–	* *	* *

Bias test signs		
	–	= no sign of bias (p>0.05)
	*	= possibility of bias (0.01<p<0.05)
	* *	= certainty of bias (p<0.01)

Table 5.2.8 ANCHOVY 2006 workshop reading of otoliths from 2001

Subset of otoliths from the 2001 exchange program just for the second half of the year

The number of age readings, the coefficient of variation (CV), the percent agreement and the RELATIVE bias are presented by MODAL age for each age reader and for all readers combined. A weighted mean CV and a weighted mean percent agreement are given by reader and all readers combined. The CV's by MODAL age for each individual age reader and all readers combined indicate the precision in age reading by MODAL age. The weighted mean CV's over all MODAL age groups combined indicate the precision in age reading by reader and for all age readers combined.

NUMBER OF AGE READINGS

	MODAL age	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-PG Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5	TOTAL
	0	33	33	33	33	33	165
	1	42	42	42	41	42	209
	2	21	21	21	21	21	105
	3	4	4	4	4	4	20
	4	-	-	-	-	-	-
	5	-	-	-	-	-	-
Total	0-15	100	100	100	99	100	499

COEFFICIENT OF VARIATION (CV)

	MODAL age	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-PG Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5	ALL Readers
	0	0%	0%	0%	574%	0%	6,8%
	1	22%	22%	38%	34%	16%	15,3%
	2	0%	0%	11%	0%	36%	17,5%
	3	18%	0%	0%	0%	23%	9,3%
	4	-	-	-	-	-	-
	5	-	-	-	-	-	-
Weighted mean	0-15	10,0%	9,3%	18,3%	205,4%	15,2%	12,7%
	RANKING	2	1	4	5	3	

PERCENTAGE AGREEMENT

	MODAL age	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-PG Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5	ALL
	0	100%	100%	100%	97%	100%	99%
	1	95%	95%	76%	80%	98%	89%
	2	100%	100%	95%	100%	33%	86%
	3	75%	100%	100%	100%	50%	85%
	4	-	-	-	-	-	-
	5	-	-	-	-	-	-
Weighted mean	0-15	97,0%	98,0%	89,0%	90,9%	83,0%	91,6%
	RANKING	2	1	4	3	5	

RELATIVE BIAS **BIAS RELATIVE TO MODAL AGE**

	MODAL age	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-PG Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5	ALL
	0	0,00	0,00	0,00	0,03	0,00	0,01
	1	0,00	0,00	0,19	0,20	-0,02	0,07
	2	0,00	0,00	0,05	0,00	-0,67	-0,12
	3	-0,25	0,00	0,00	0,00	-0,50	-0,15
	4	-	-	-	-	-	-
	5	-	-	-	-	-	-
Weighted mean	0-15	-0,01	0,00	0,09	0,09	-0,17	0,00
	RANKING	2	1	3	4	5	

Overall ranking

	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-PG Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5
Ranking Coefficient of Variation	2	1	4	5	3
Ranking Percentage Agreement	2	1	4	3	5
Ranking Relative bias	2	1	3	4	5
OVERALL RANKING	**2**	**1**	**3**	**4**	**5**
Mean Ranking	2,00	1,00	3,67	4,00	4,33
absolute value of the bias	0,01	0,00	0,09	0,09	0,17

Table 5.2.9 ANCHOVY 2006 workshop reading of otoliths from 2001

Subset of otoliths from the 2001 exchange program just for the second half of the year

Upper table: The age compositions estimated by each age reader and all age readers combined.
Midle table: The estimated mean length at age by age reader and by all age readers combined.
Lower table: Bias tests: non-parametrically with a one-sample Wilcoxon rank sum test.The inter-reader bias test and the reader against MODAL age bias test. And percentage of agreement between readers.

AGE COMPOSITION

	Age	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-PI Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5	TOTAL
	0	34	34	34	32	34	**168**
	1	40	40	32	34	55	**201**
	2	23	22	29	29	9	**112**
	3	3	4	5	4	2	**18**
	4	-	-	-	-	-	**-**
	5	-	-	-	-	-	**-**
Tota	0-15	**100**	**100**	**100**	**99**	**100**	**499**

MEAN LENGTH AT AGE

	Age	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-PI Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5	ALL
	0	123,6	123,6	124,5	123,0	124,5	**123,9**
	1	158,3	158,3	159,4	159,4	161,0	**159,4**
	2	171,3	171,1	165,5	164,6	170,6	**168,0**
	3	153,7	159,0	160,2	159,0	156,0	**158,1**
	4	-	-	-	-	-	**-**
	5	-	-	-	-	-	**-**
Weighted mean	0-15	**149,4**	**149,4**	**149,4**	**149,1**	**149,4**	**149,3**

Percentage of Agreement and Inter-reader bias test

	AZTI-AU Reader 1	AZTI-IR Reader 2	IFREMER-PI Reader 3	IFREMER-ED Reader 4	IEO-BV Reader 5
Reader 1		–	*	*	* *
Reader 2	**99,0%**		*	*	* *
Reader 3	**86,0%**	**87,0%**		–	* *
Reader 4	**87,9%**	**88,9%**	**91,9%**		* *
Reader 5	**82,0%**	**81,0%**	**74,0%**	**73,7%**	

MODAL age	–	–	*	* *	* *

Bias test signs	–	**= no sign of bias (p>0.05)**
	*	**= possibility of bias (0.01<p<0.05)**
	* *	**= certainty of bias (p<0.01)**

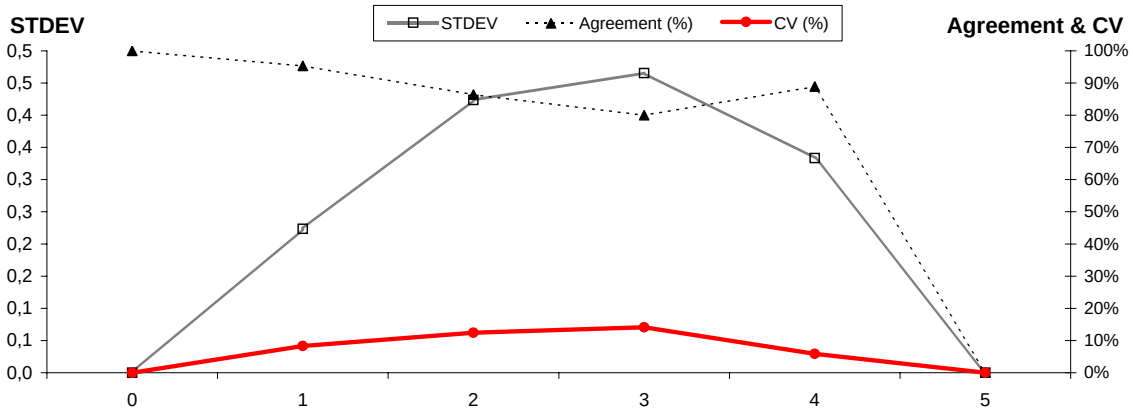


Figure 5.2.1 The coefficient of variation (CV%), percent agreement and the standard deviation (STDEV) are plotted against MODAL age.
CV is much less age dependent than the standard deviation (STDEV) and the percent agreement. CV is therefore a better index for the precision in age reading. Problems in age reading are indicated by relatively high CV's at age.

ANCHOVY 2006 workshop reading of otoliths from the exchange 2005

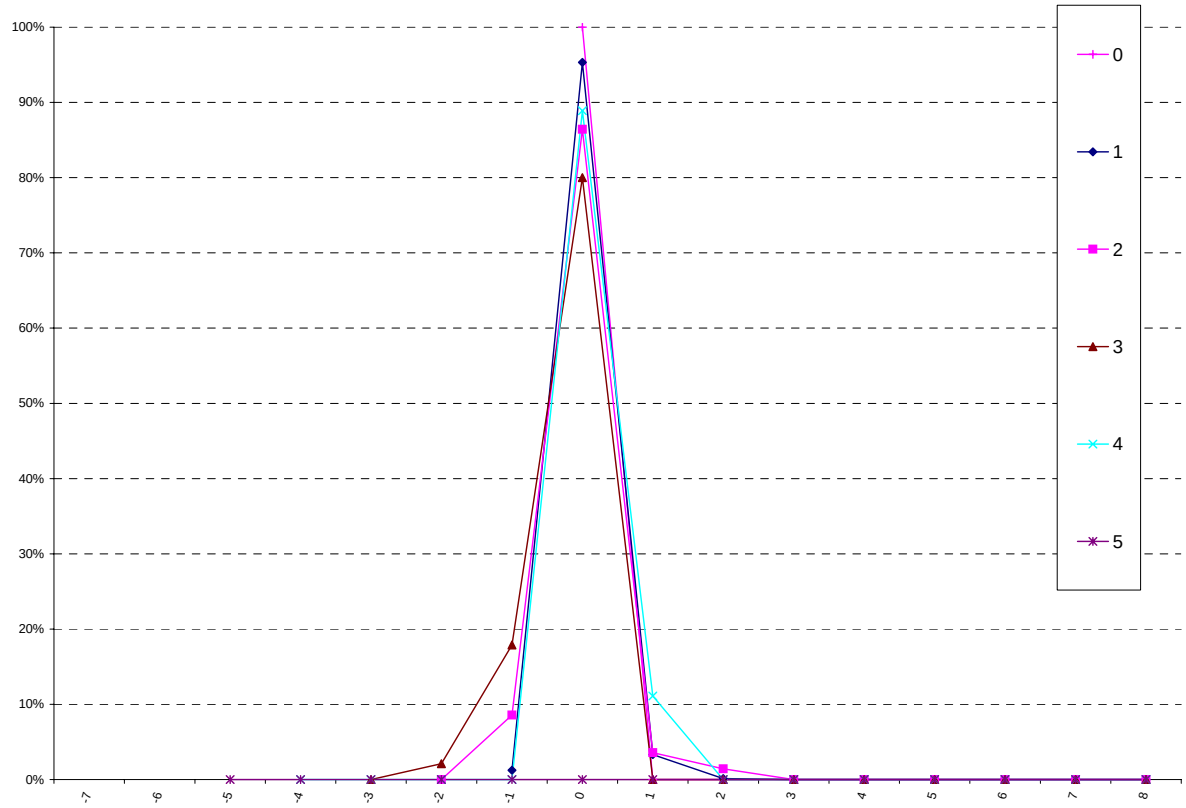


Figure 5.2.2 The distribution of the age reading errors in percentage by MODAL age as observed from the whole group of age readers in an age reading comparison to MODAL age. The achieved precision in age reading by MODAL age group is shown by the spread of the age readings errors. There appears to be no RELATIVE bias, if the age reading errors are normally distributed. The distributions are skewed, if RELATIVE bias occurs.

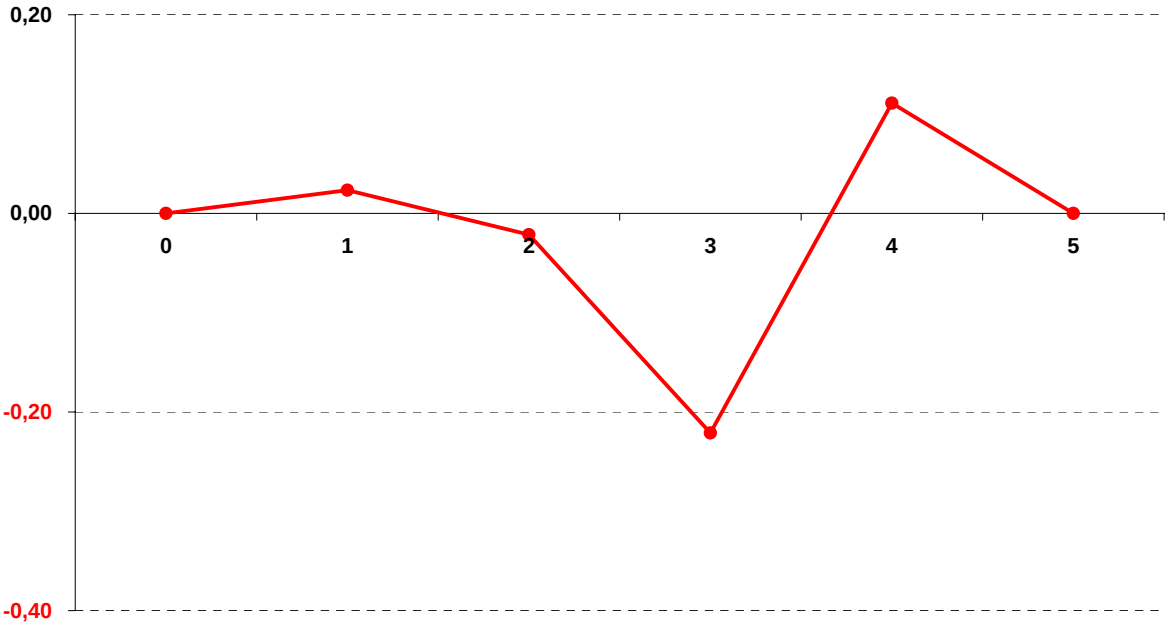
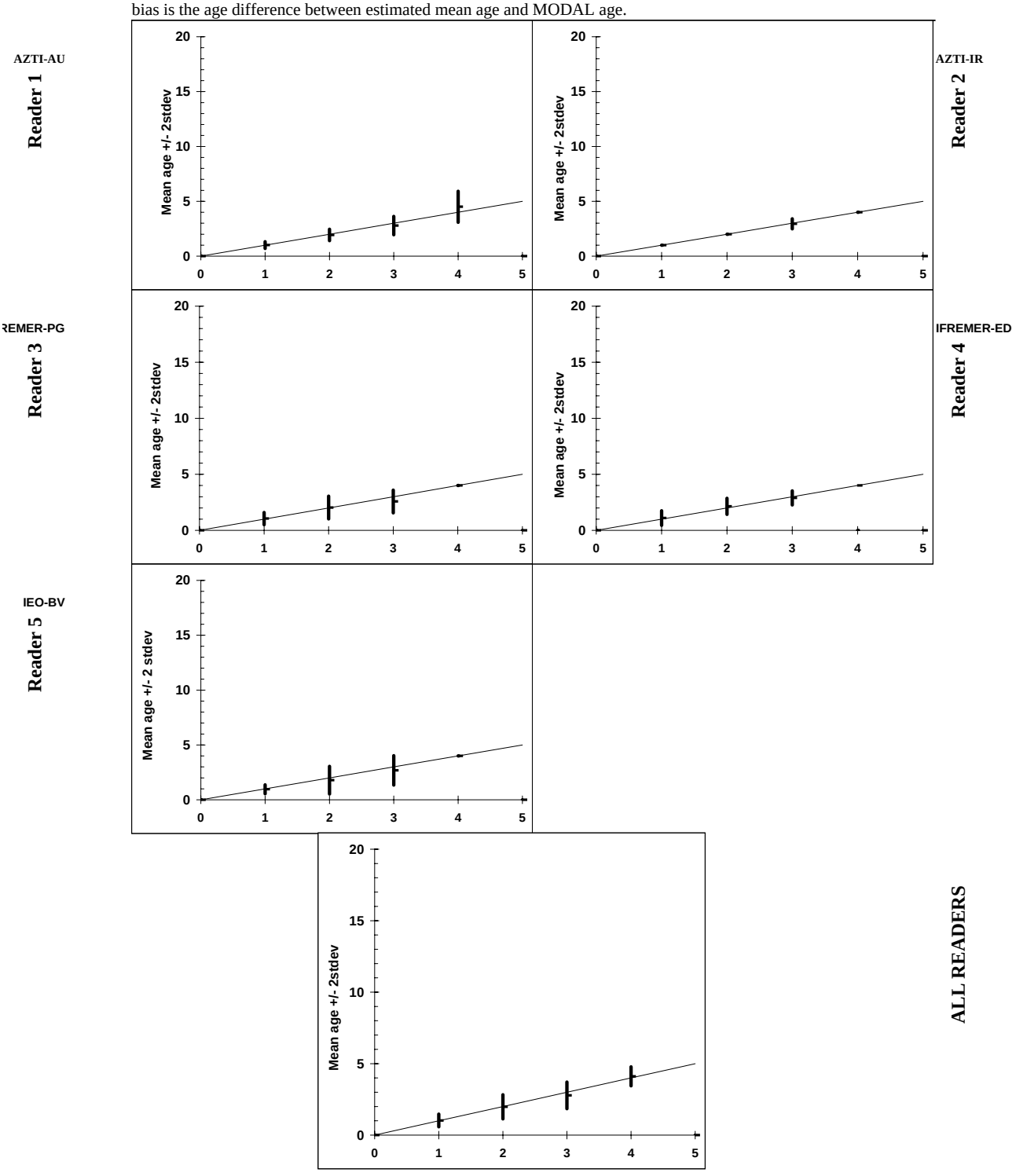


Figure 5.2.3 The RELATIVE bias by MODAL age as estimated by all age readers combined.

ANCHOVY 2006 workshop reading of otoliths from the exchange 2005

Figure 5.2.4 In the age bias plots below the mean age recorded +/- 2stdev of each age reader and all readers combined are plotted against the MODAL age. The estimated mean age corresponds to MODAL age, if the estimated mean age is on the 1:1 equilibrium line (solid line). RELATIVE bias is the age difference between estimated mean age and MODAL age.



ANCHOVY 2006 workshop reading of otoliths from the exchange 2005

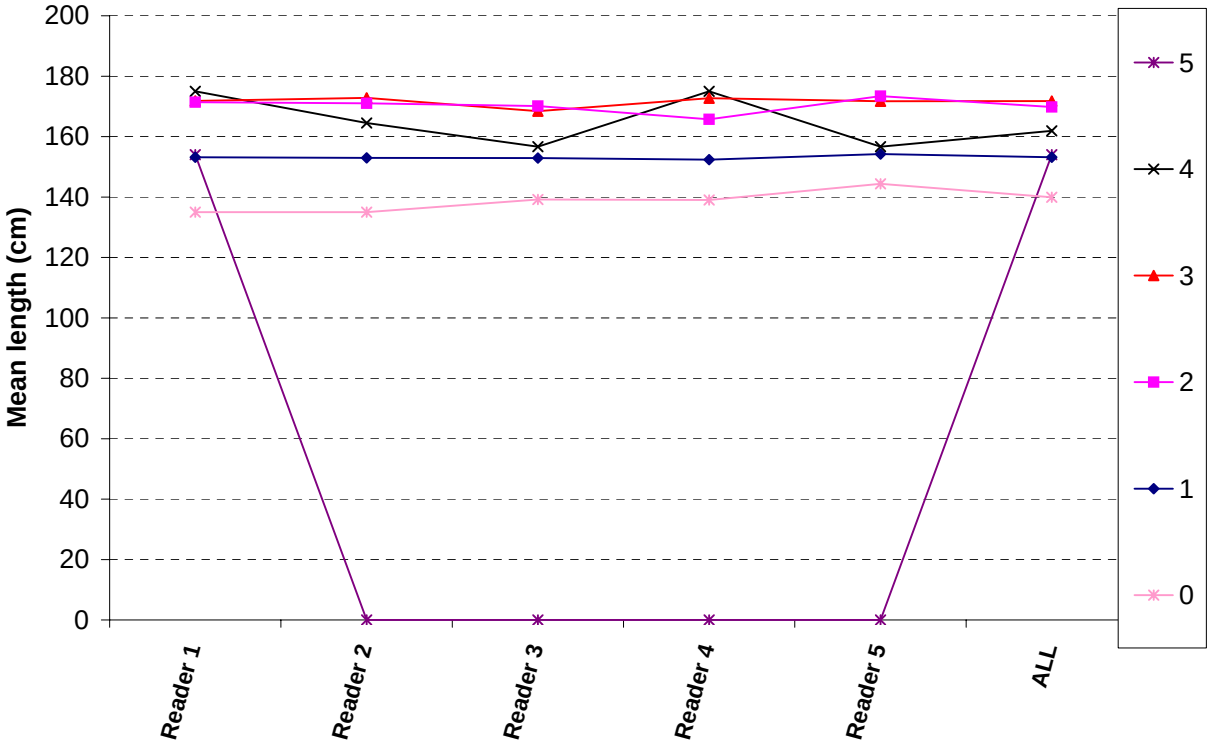


Figure 5.2.5 The mean length at age as estimated by each age reader.

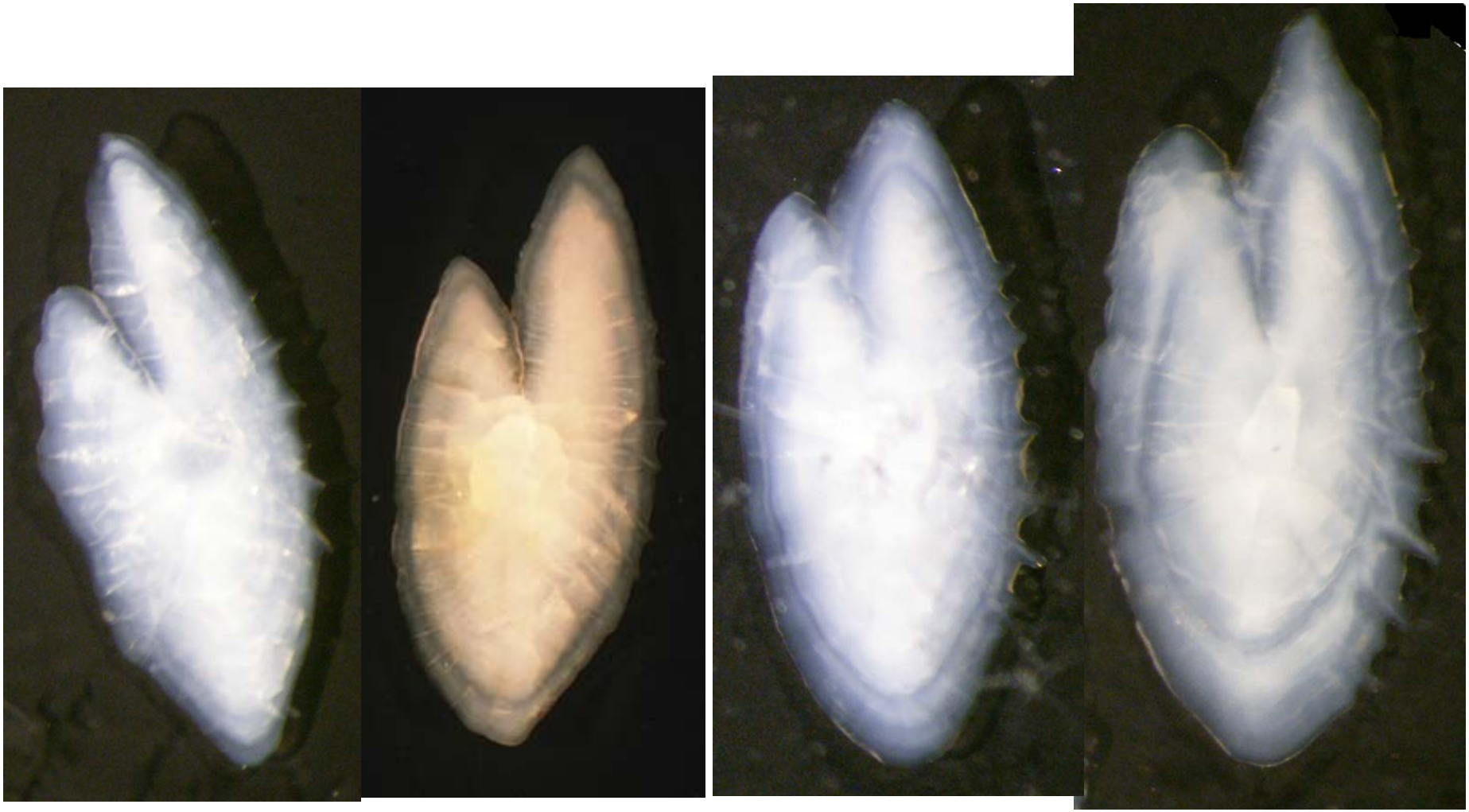


Photo .1: Typical otoliths of ages 1 and 2 at spring time: Left photos (ages 1, April2004 - 210403-3_15- and May 1990) and Right photos (ages 2, from April 2004: 210403-3_10 and _11).

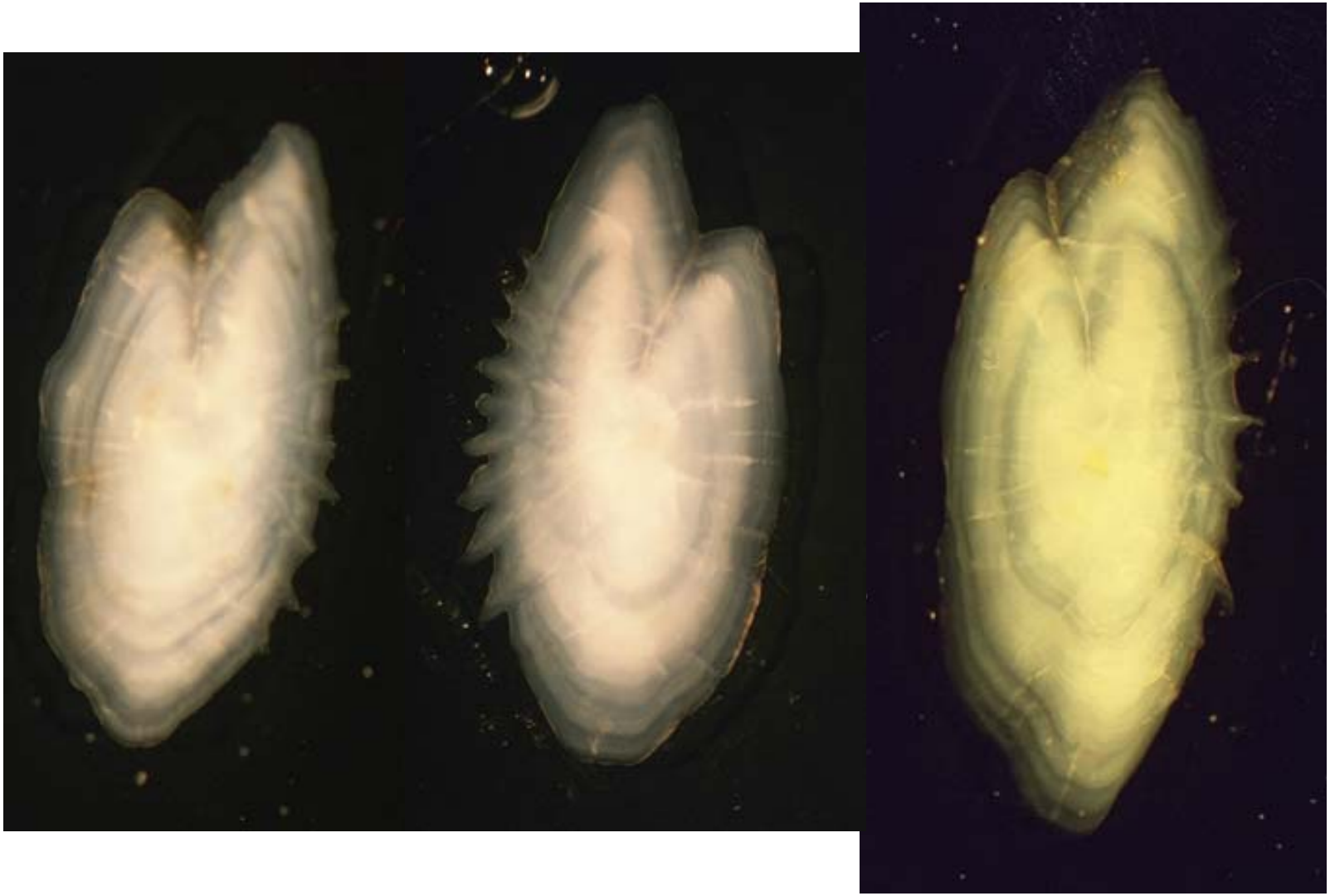


Photo.2: Typical otoliths of ages 3, 4 and 5 at spring time:

Otoliths type III (April 85), IV (May 86) & V (May 1987)

Photo.3: Typical 3 years old otoliths at spring time:

210404-3_17 (april 2004)

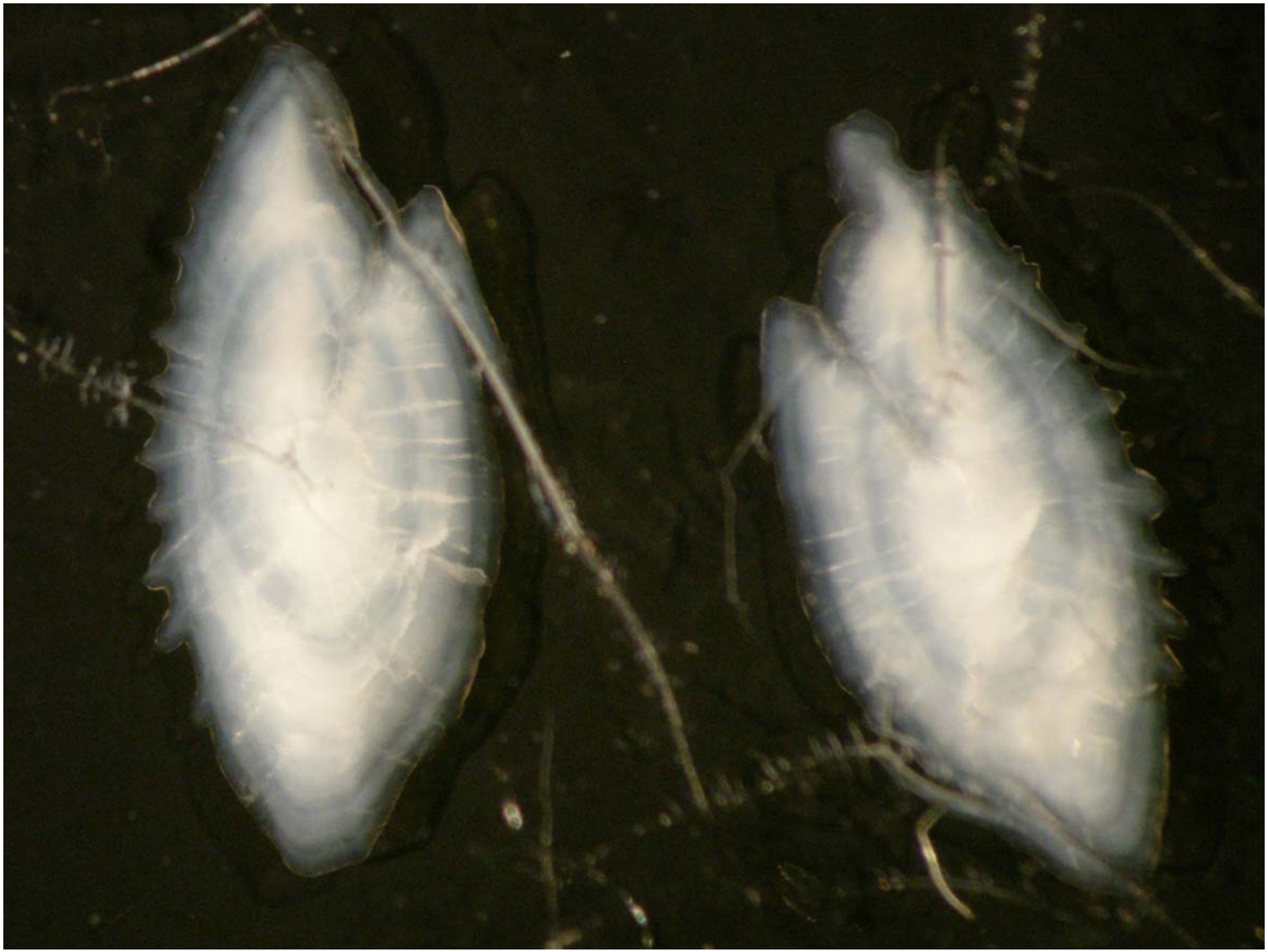


Photo.4: Typical 4 years old otoliths at spring time:

210404-3_17 (april 2004)

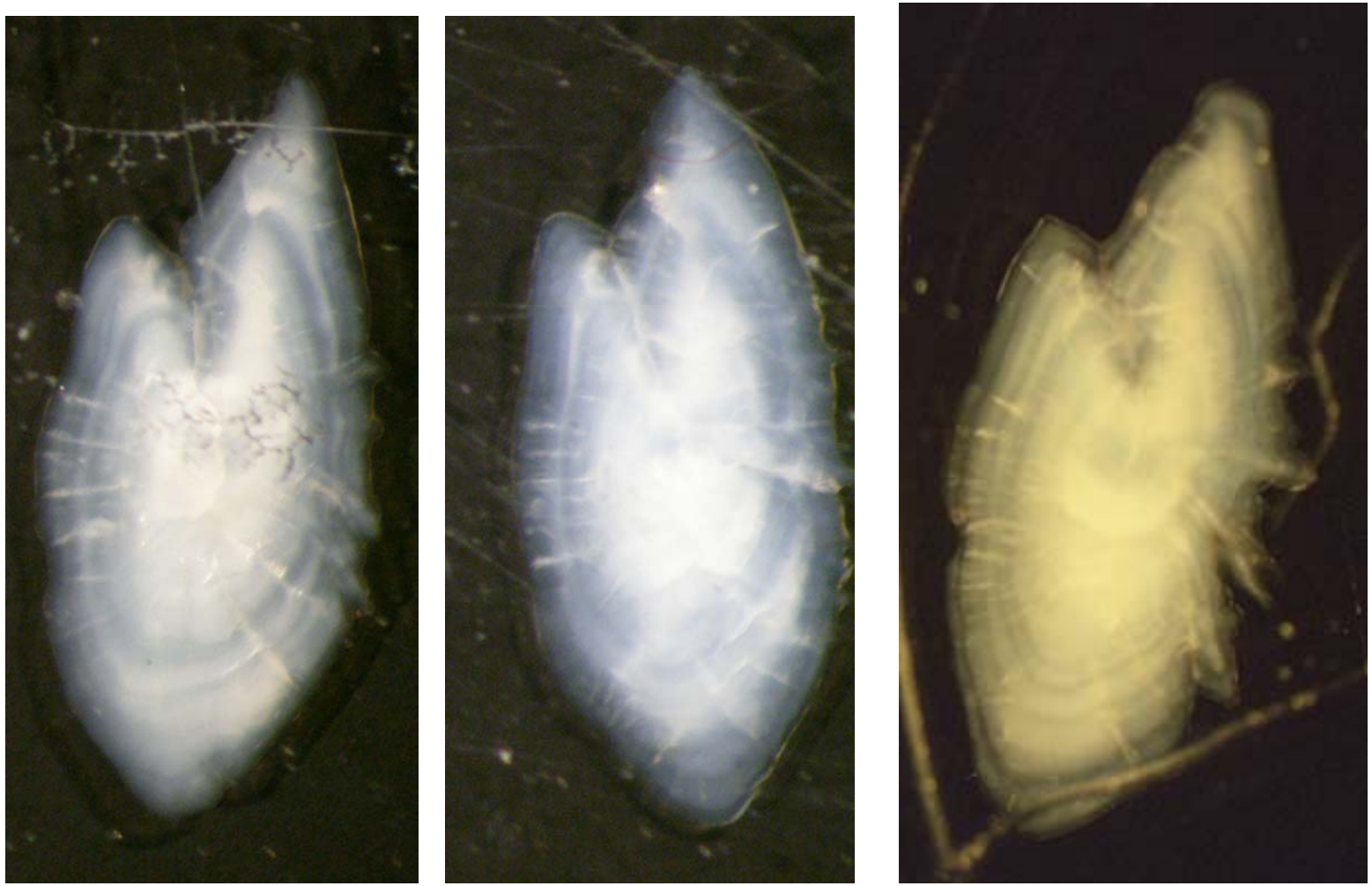


Photo.5: Two anchovy Otoliths of 2 years old (left, from April 2004 -210403-3_07 and _20) and one of 3 years old (right, from spring 1985), showing several checks before and after the first annual ring and before the hyaline edge fo the 2 years old of April 2004). See further examples in Figure 4.3.2 (left)

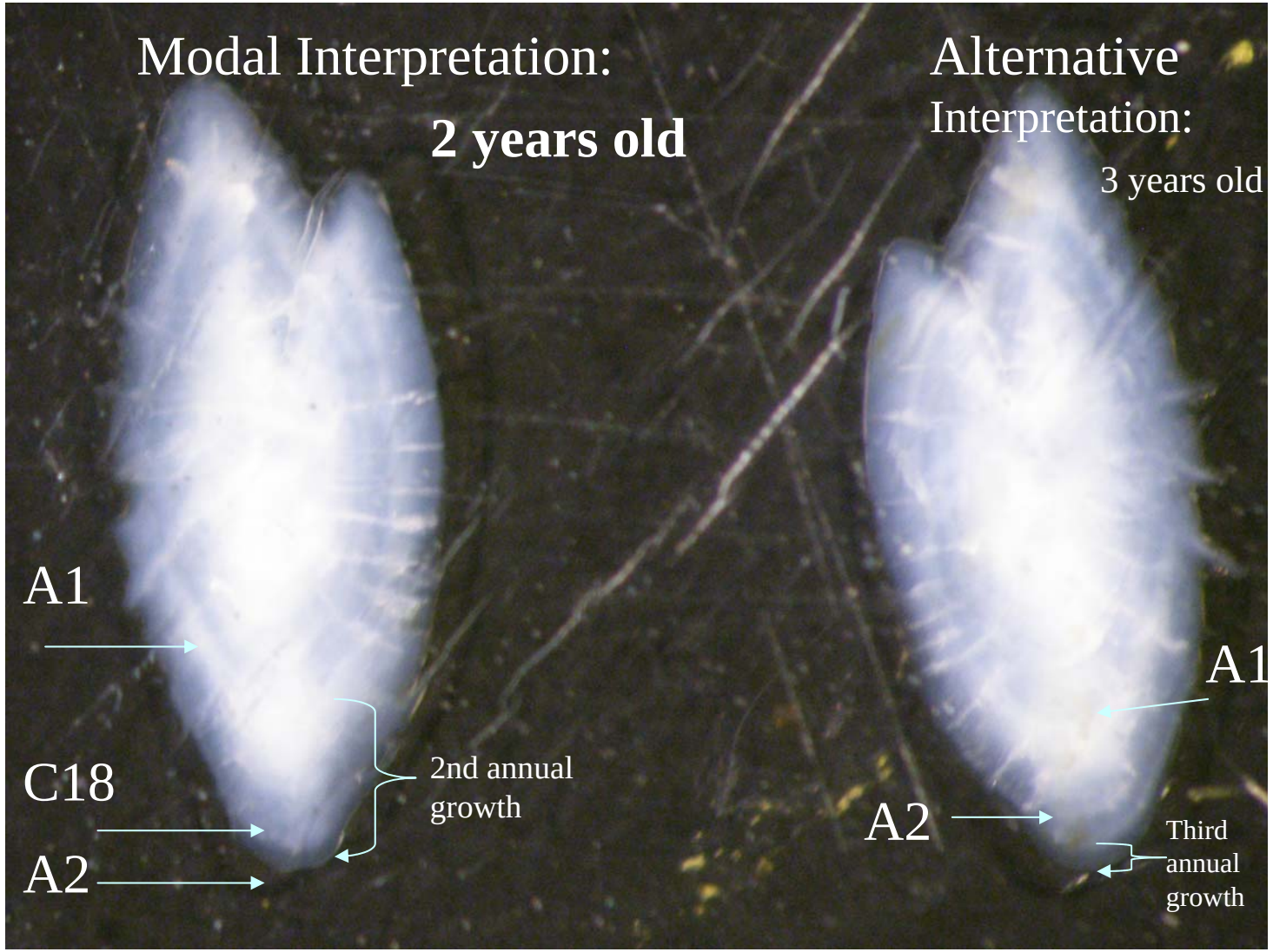


Photo.6: Ageing anchovy otoliths in Spring: Modal Interpretation (left): 2 years old: A1. First winter ring, C18 Late summer check, A2, 2nd winter ring (at the edge). (Caught April 2004) (id.code: 210403-3_19, length of 165 mm) (80% of agreement in the exchange programme and in the workshop. Total agreement after discussion at the end of the workshop). Right: Alternative interpretations of 3 y.o.

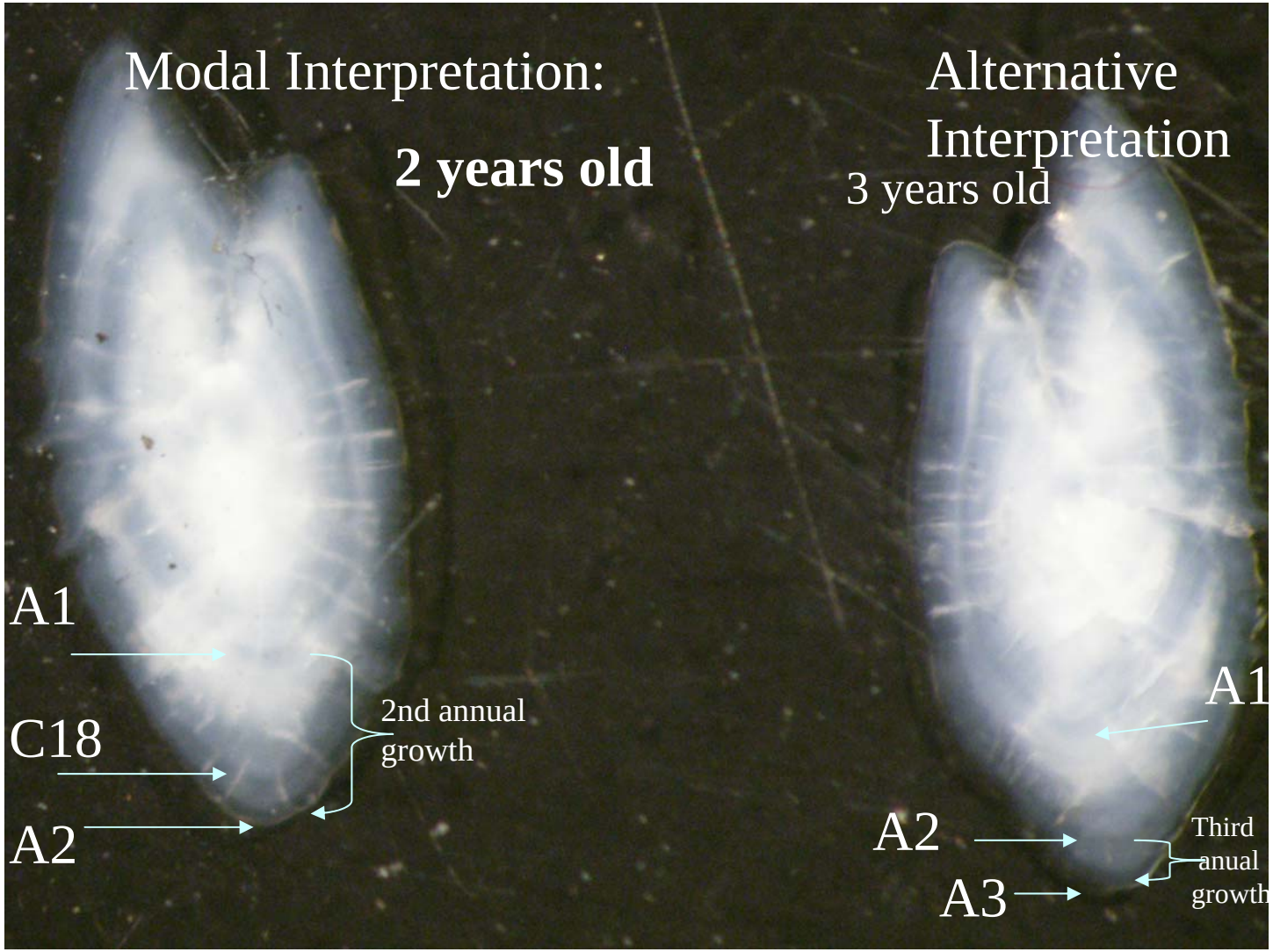


Photo.7: Ageing anchovy otoliths in Spring: workshop Modal Interpretation (left): 2 years old: A1. First winter ring, C18 Late summer check, A2, 2nd winter ring (at the edge). (Caught April 2004) (id.code: 210403-3_20, length of 165 mm). Right: Alternative interpretations of 3 y.o. (The alternative 3 y.o. interpretation had a 80% of agreement in the exchange and the Modal interpretation in the workshop concited only 60% of agreement in the workshop.

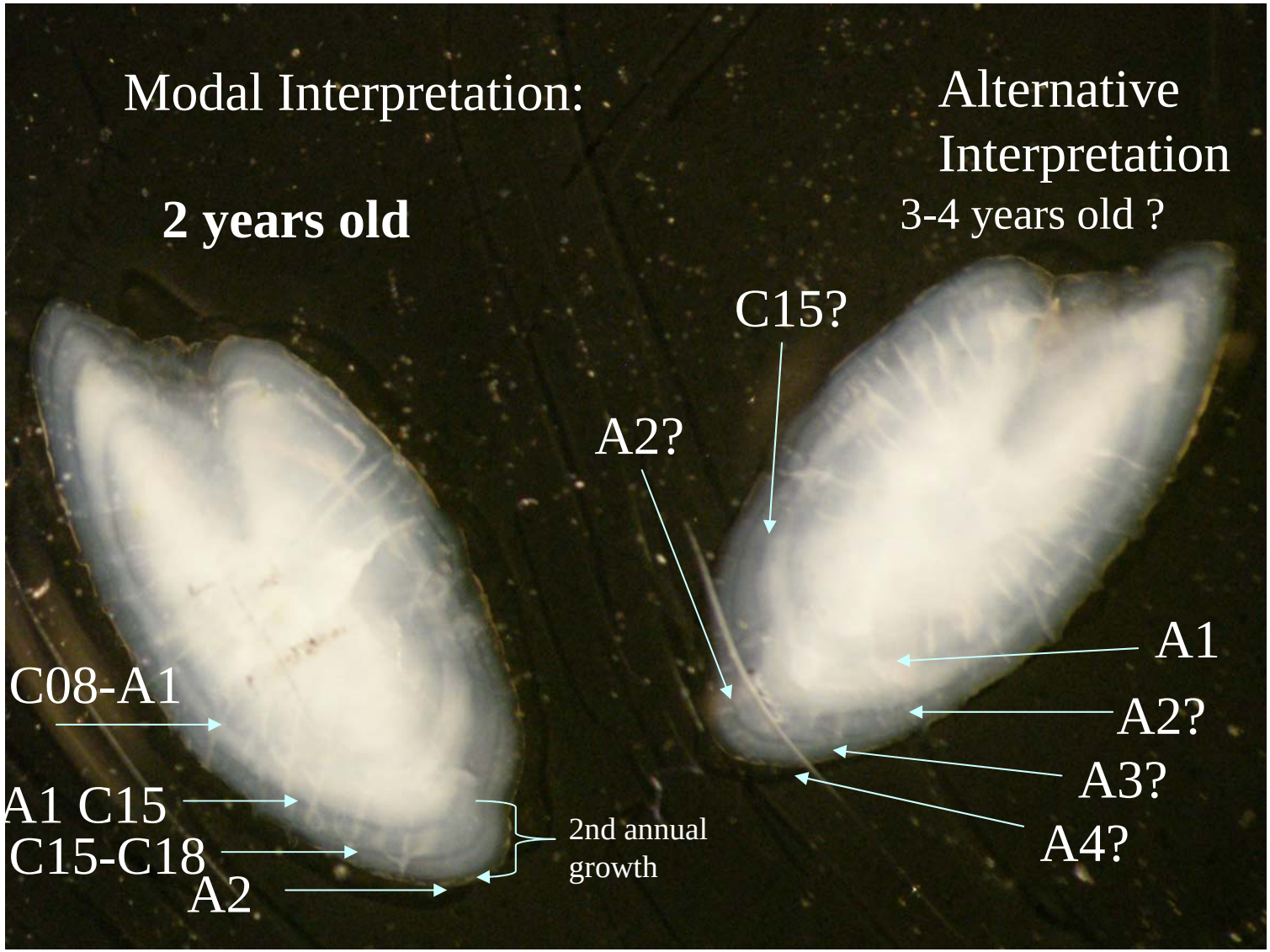


Photo.8: Ageing anchovy otoliths in Spring: Two Modal Interpretations (left): 2 years old: A1. First winter ring, C15 Spawning check, A2, 2nd winter ring ,and A3 third winter (at the edge). (Caught April 2004) (id.code: ANEBIO04-5067_54, length of 141 mm). Right: Alternative interpretations of 4 y.o. (or 3) In the workshop both interpretations (2 or 4) concited 40% of agreement, while in the exchange 3 y.o. was the Modal interpetation.

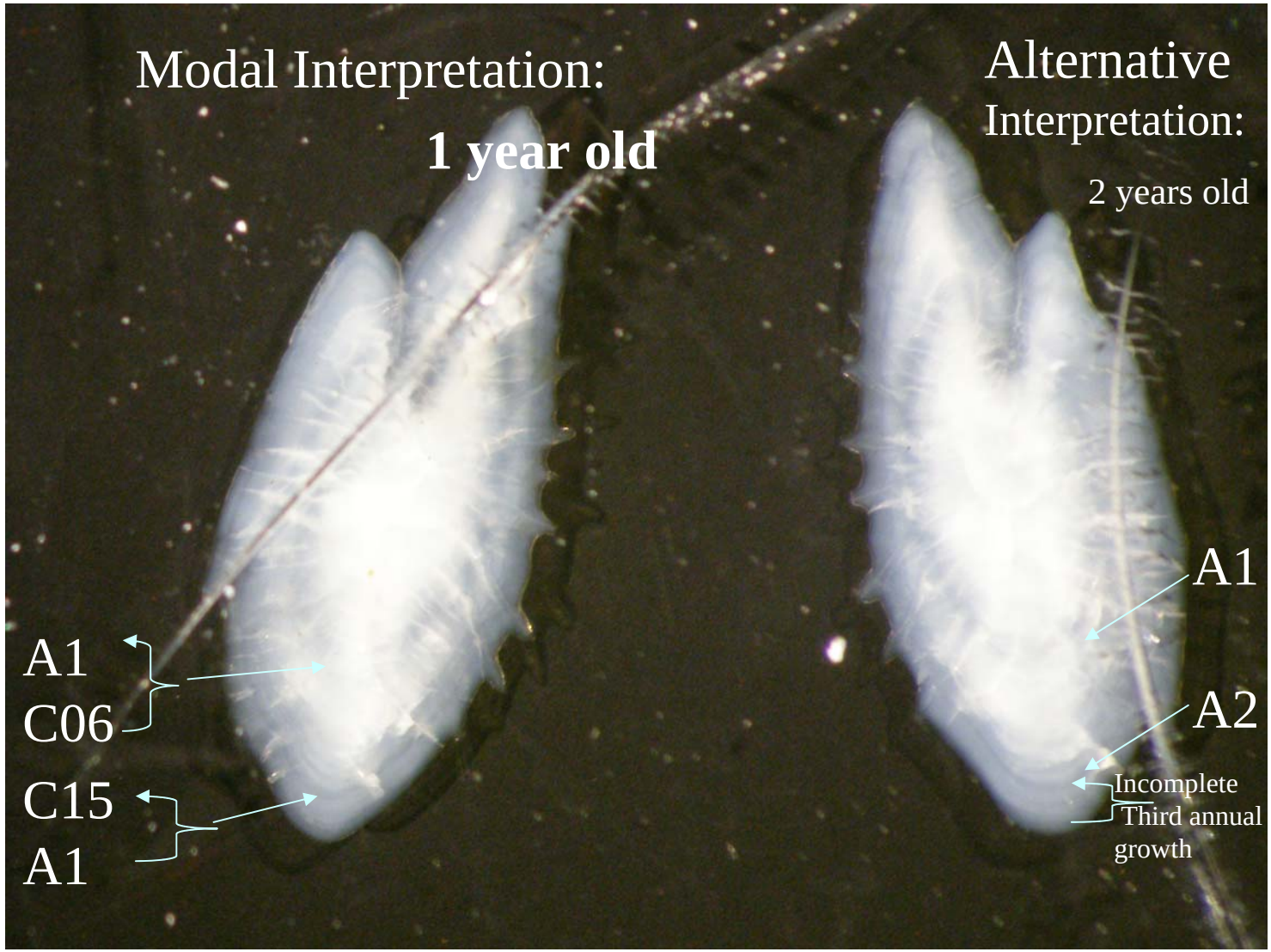


Photo.9: Ageing anchovy otoliths in Summer: Dual Interpretation leading to the Modal age determination (left): 1 year old: C06 Potential Check at 60% of the 0 y.o. growth. A1. First winter ring, C15 Summer post spawning check, with an opaque edge. (Caught July 2004) (id.code: 210704-10, length of 157 mm). Right: Alternative interpretations of 2 y.o. (Similar 60% agreement for age 1 interpretation achieved in the exchange and in the workshop)

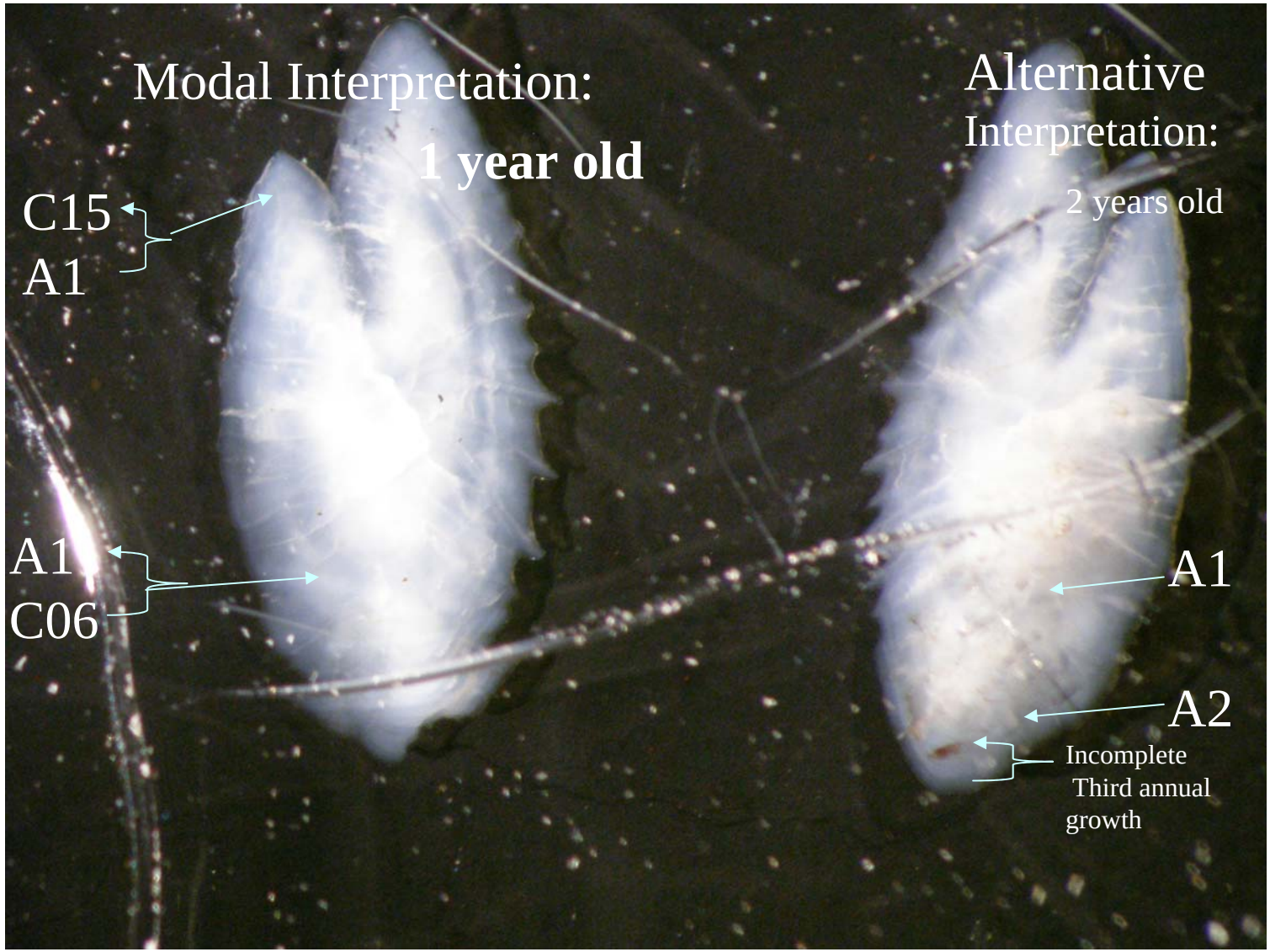


Photo.10: Ageing anchovy otoliths in Summer: Modal Interpretation (left): 1 year old: A1. First winter ring, C18 Summer post spawning check, with an opaque edge. (Caught July 2004) (id.code: 210704-18, length of 167 mm) Right: Alternative interpretations of 2 y.o. (75% of agreement for age 1 interpretation achieved in the exchange and 60% in the workshop)

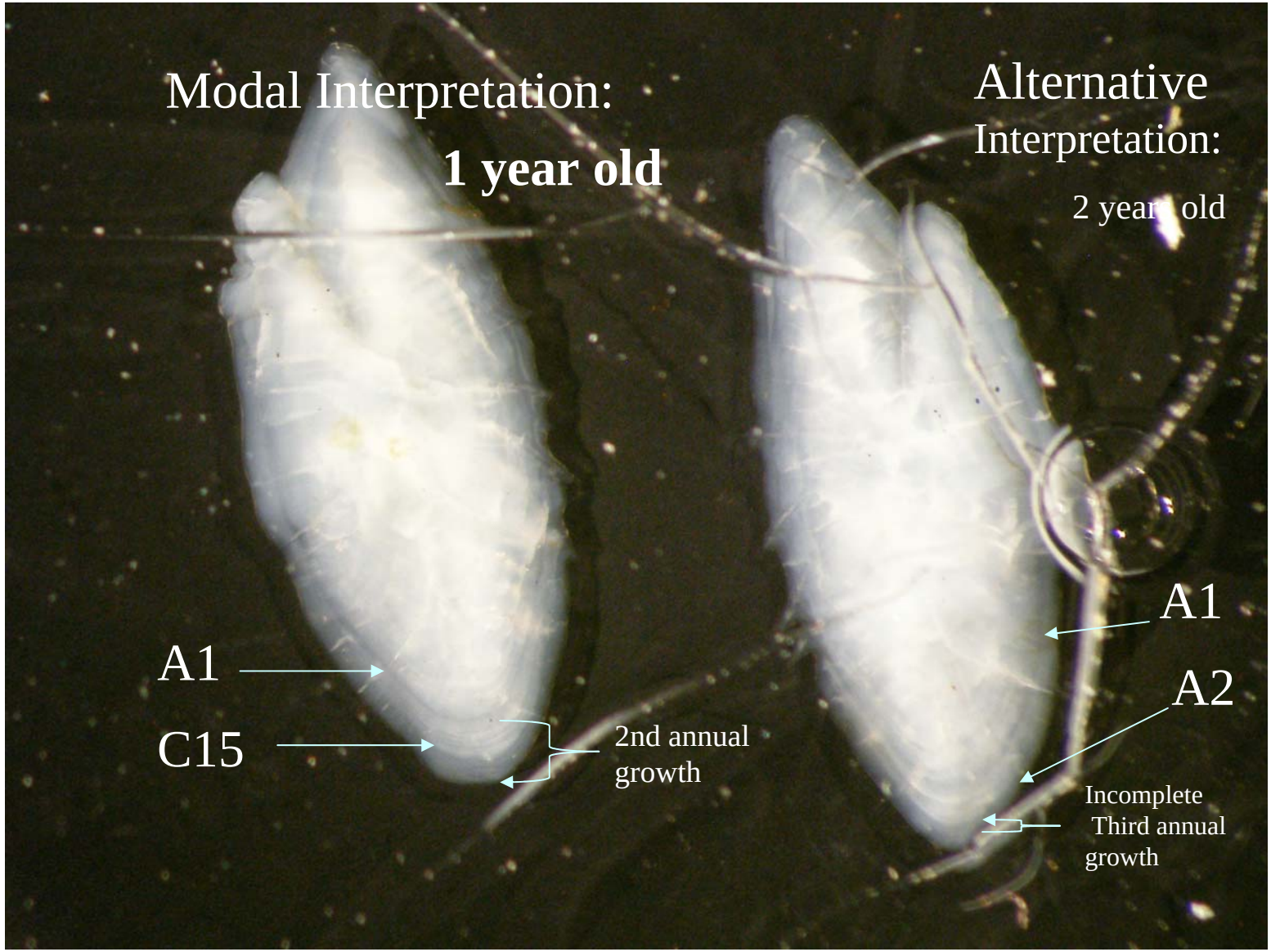


Photo.11: Ageing anchovy otoliths in Summer: Modal Interpretation (left): 1 year old: A1. First winter ring, C18 Summer post spawning check, with an opaque edge. (Caught July 2004) (id.code: 210704-19, length of 155 mm) Right: Alternative interpretations of 2 y.o. (80% agreement for age 1 interpretation during the exchange and a 100% in the workshop).

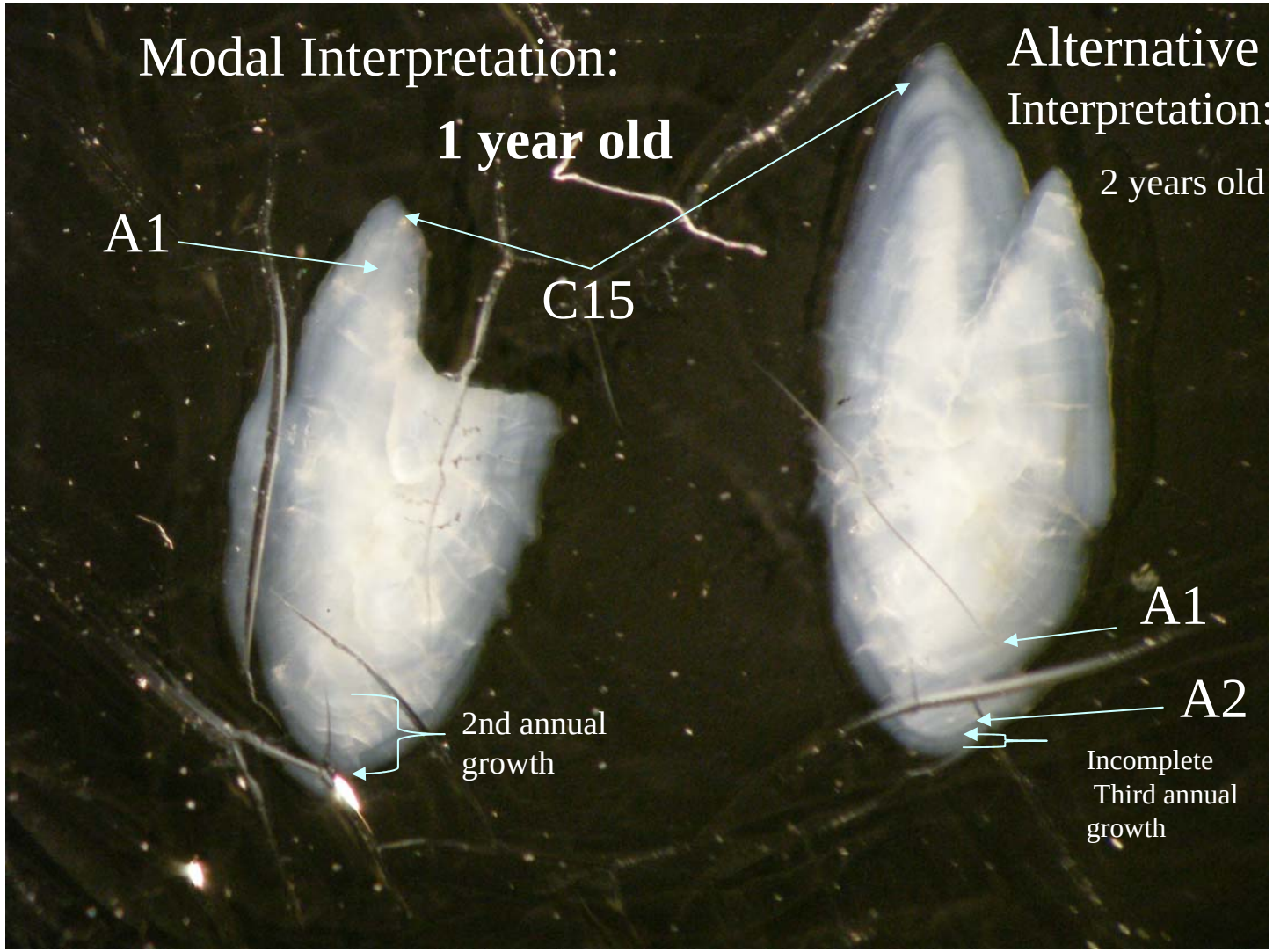


Photo.12: Ageing anchovy otoliths in Summer: Modal Interpretation (left): 1 year old: A1. First winter ring, C15 Summer post spawning check, with an opaque edge. (Caught August 2004) (id.code: 180804-14, length of 163 mm) Right: Alternative interpretations of 2 y.o. (80% of agreement in the exchange for the alternative interpretation, but after discussion a 100% agreement for age 1 interpretation was achieved in the workshop).

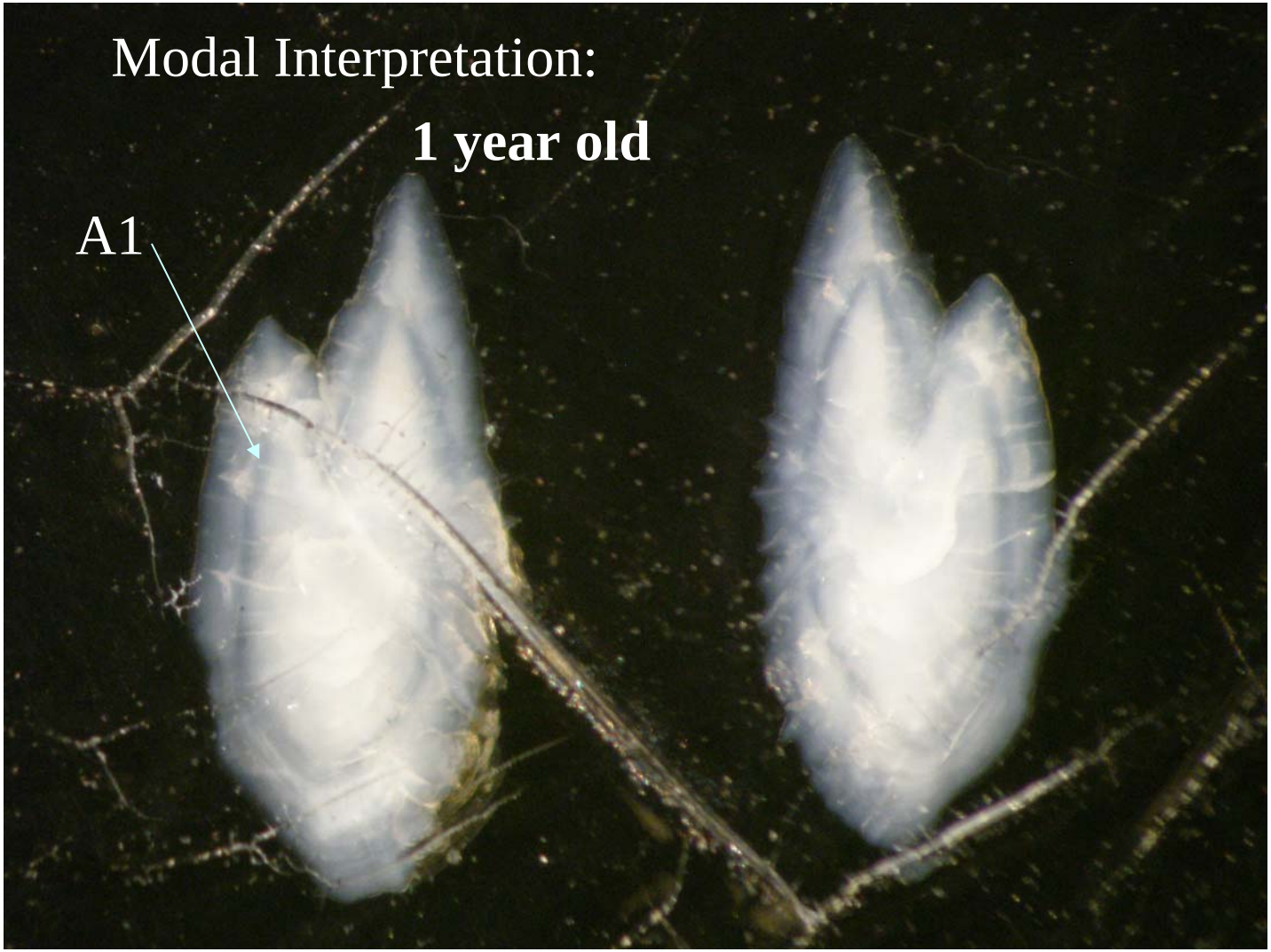


Photo.13: Ageing anchovy otoliths in Summer: Modal Interpretation (left): 1 year old: A1. First winter ring, with a wide opaque edge. (Caught September 2003) (id.code: 110903-01, length of 163 mm). (80% of agreement in the exchange for the alternative interpretation, but after discussion a 100% agreement for age 1 interpretation was achieved in the workshop). The alternative interpretations of 2 y.o is not shown.

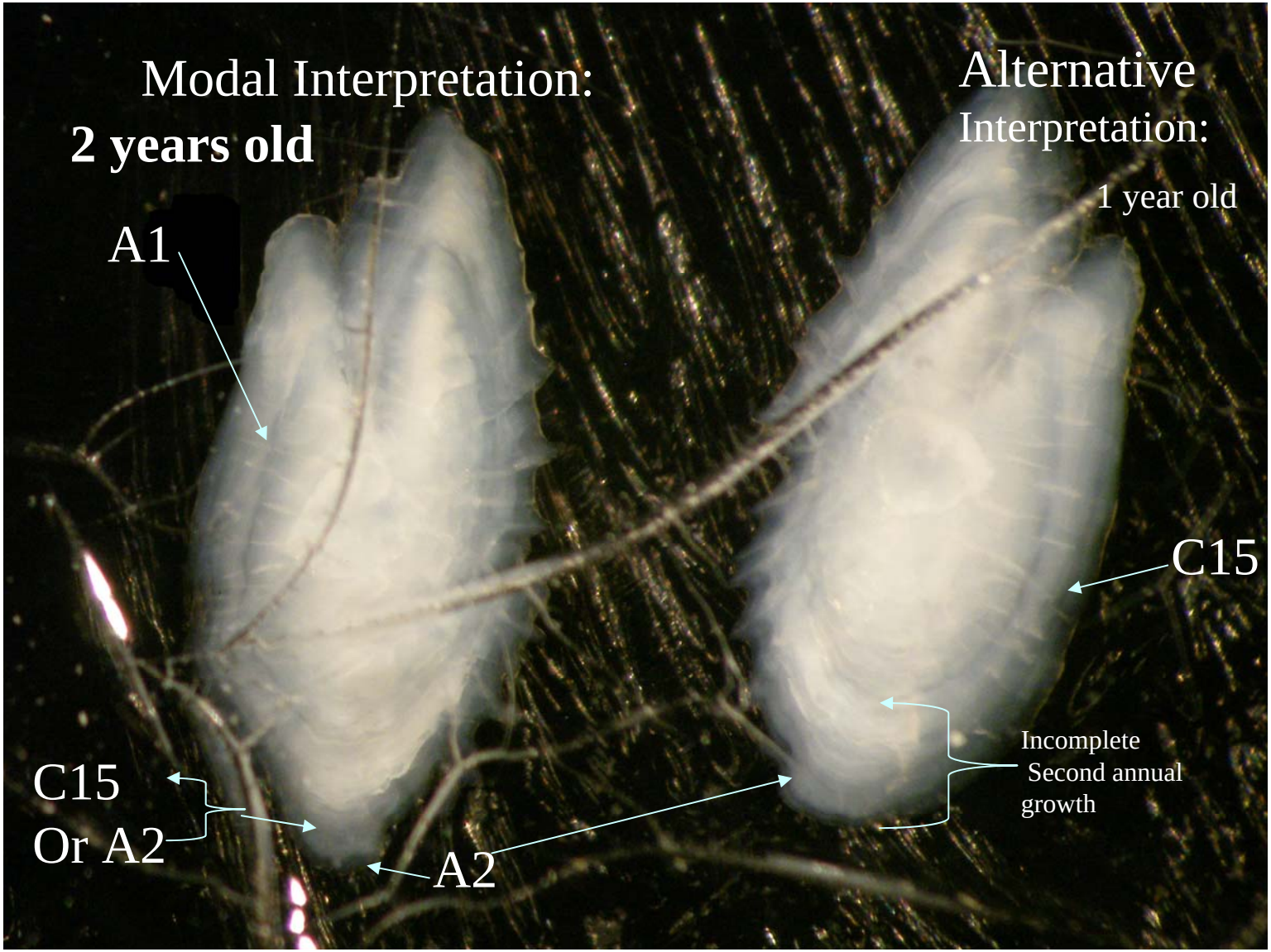


Photo.14: Ageing anchovy otoliths in Summer: Modal Interpretation (left): 2 year old: A1. First winter ring, A2 second winter ring, plus the current year growth. (Caught September 2003) (id.code: 110903-02, length of 169 mm) Right: Alternative interpretations of 1 y.o. (100% agreement in the exchange for the modal interpretation, and 80% in the workshop).

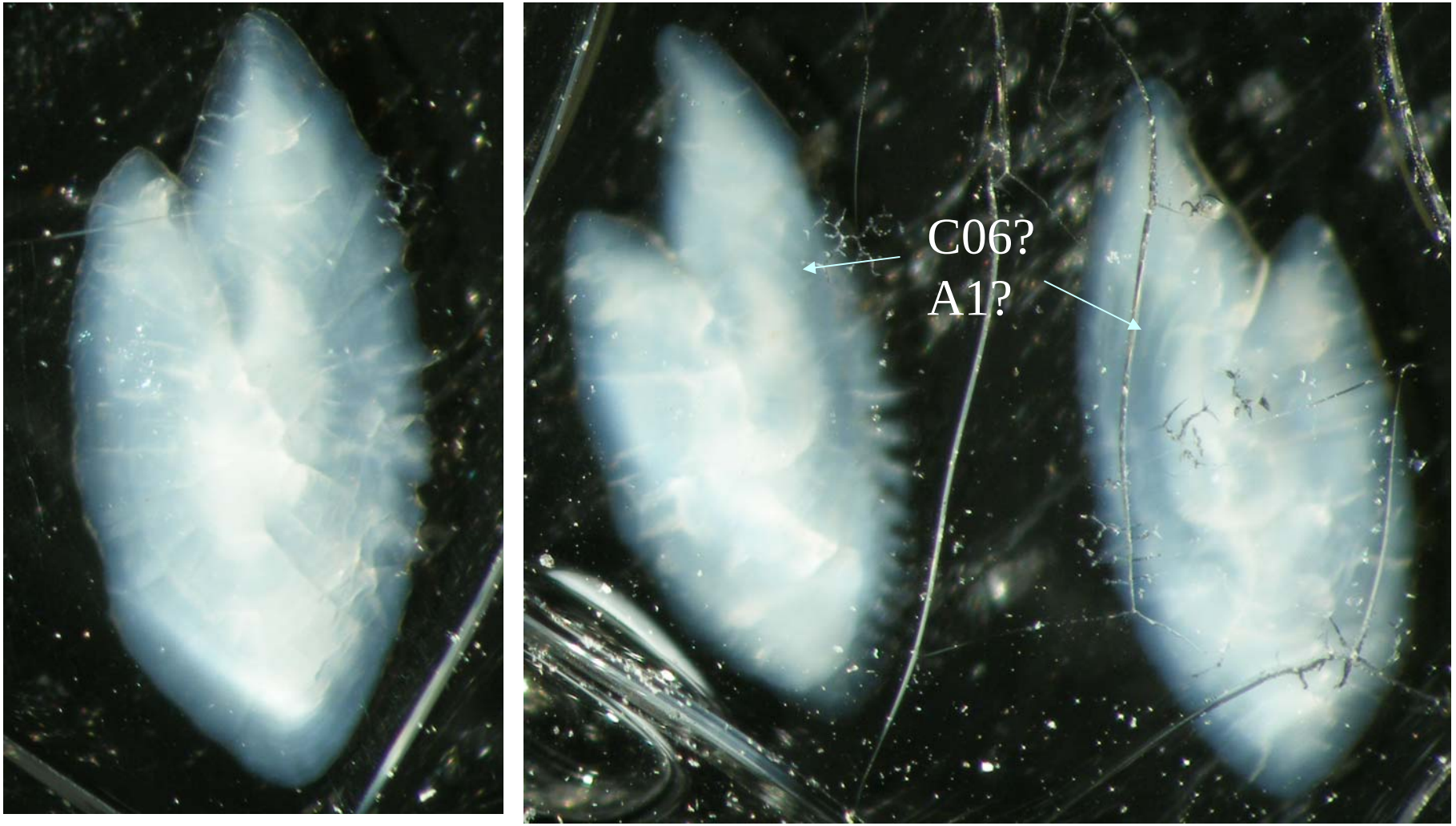


Photo .15: Ageing anchovy otoliths in Summer: Divergent age radings in September with 50% of readings for 1 year old and 50% to age 0. Otoliths 110903.19 and 20 (154 and 141 mm). Certainly no clear winter ring is seen in the otolith the and the inner marks might well be checks C06 instead of a weak winter ring. Each assumption lead to age 0 or 1 respectively. Since such weak winter rings are not expect to occur, by ortodoxy age 0 could be the default option.

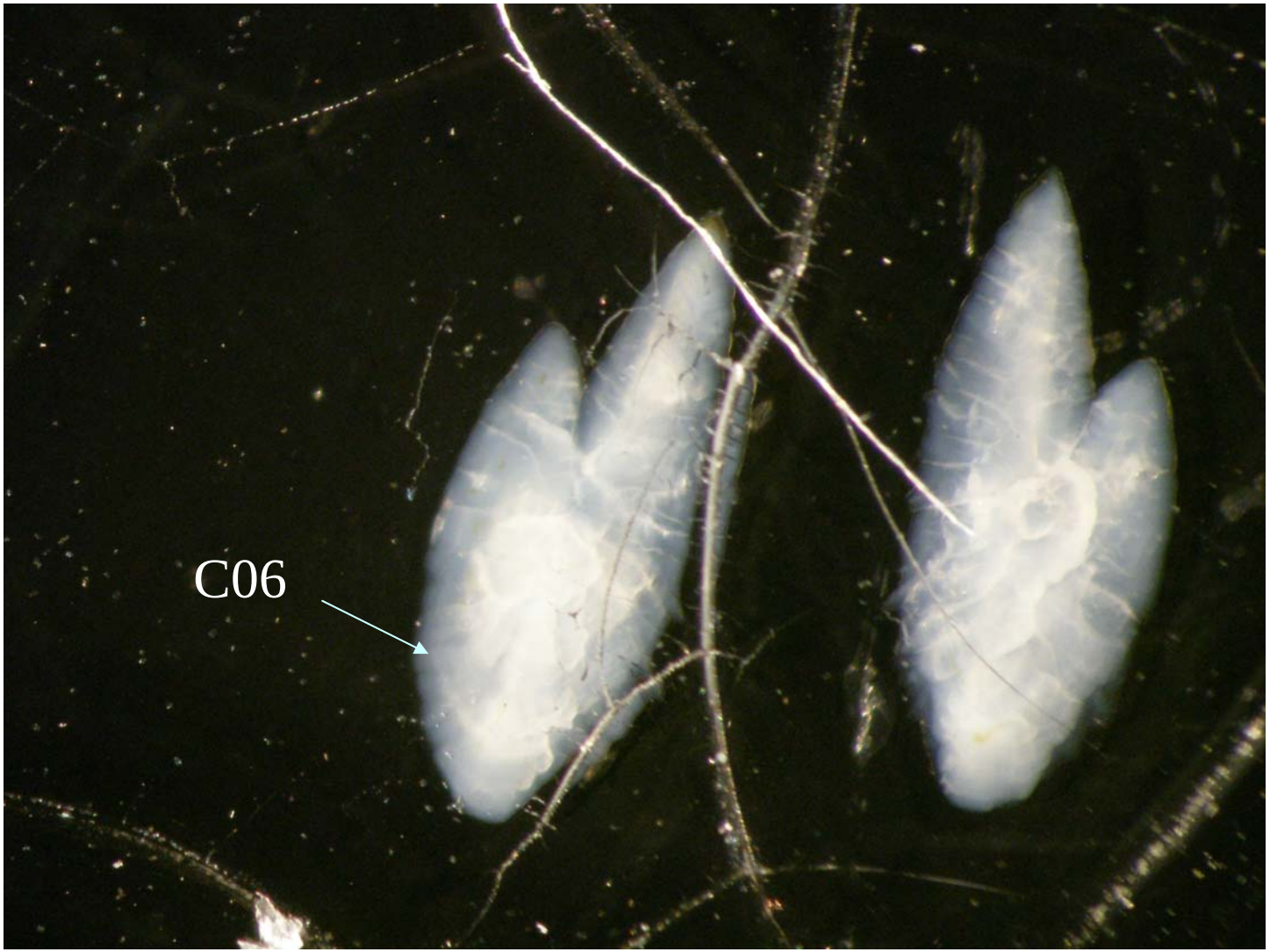


Photo 16: 181103_27: Age 0 100% agreement in the workshop and in the exchange programme. It has no mark deposition, although a weak check can be presumed (C06) in the left otolith.

Photo .17: Otolith 181103_28: Modal Age 1 y.o.: 75% agreement in the exchange programme and 50% agreement in the workshop 155 mmm. The alternative was a 0 y.o. with a check 06. Potential interpretations are obvious.

Photo .18: Otolith 181103_30: Modal age 1 y.o. with check C15: 60% agreement in the exchange programme but a 100% in the workshop; 175 mm. Alternative interpretation for a 2 y.o. arises from considering C15 as A2 but was discarded in the workshop.

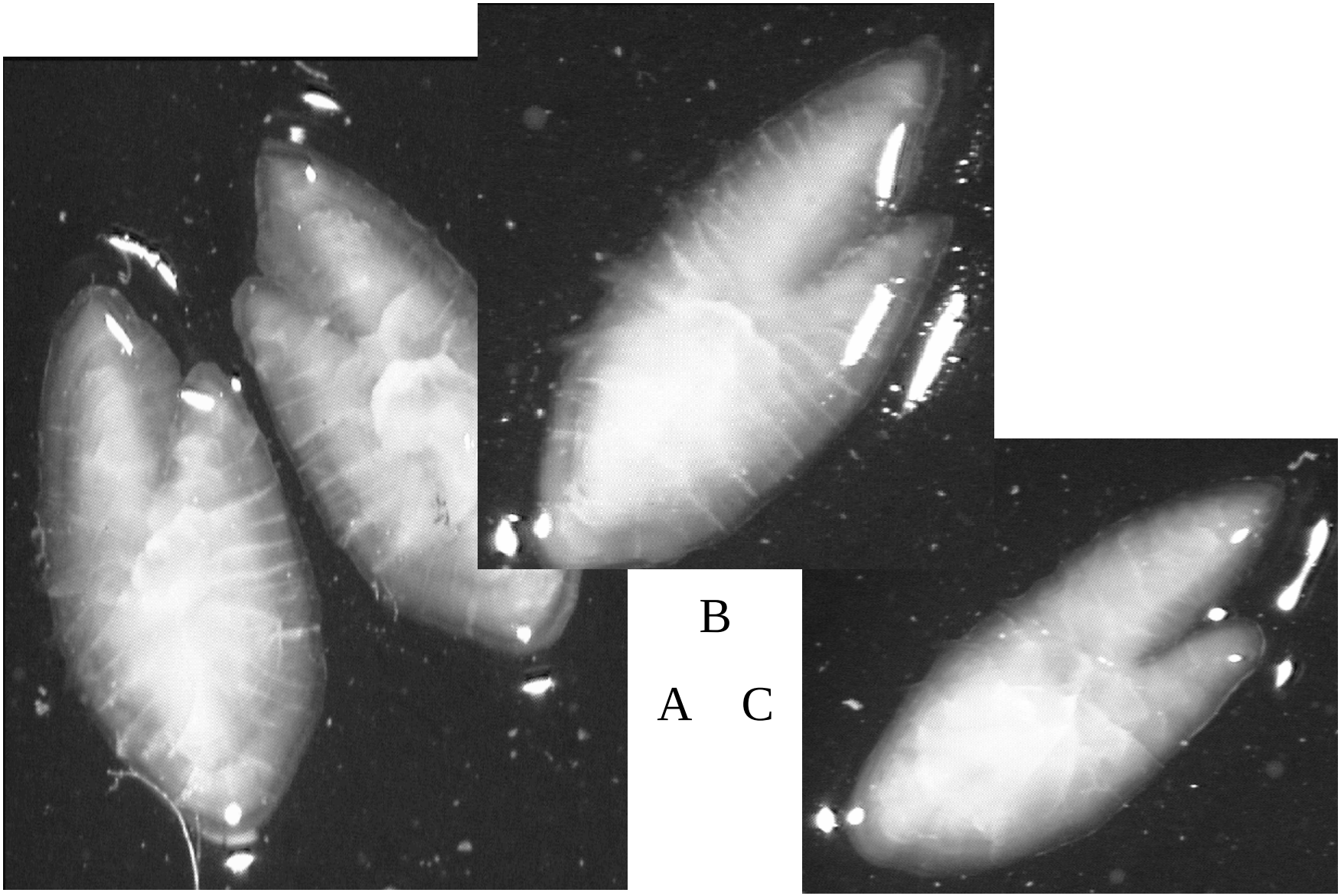


Photo .19: Spring Otoliths from french acoustic survey PELGAS06: A- Modal age 2 y.o. with small opaque edge (125 mm). B- Two year old, with a relevant with a hyaline edge (130 mm). C- One year old, with a hyaline edge (130 mm). The fishes were caught 04/05/2006 during the first fornight of May at 44°27.4N and 1°26.9 W. close to the coast of Arcachon (Trawl nº7).

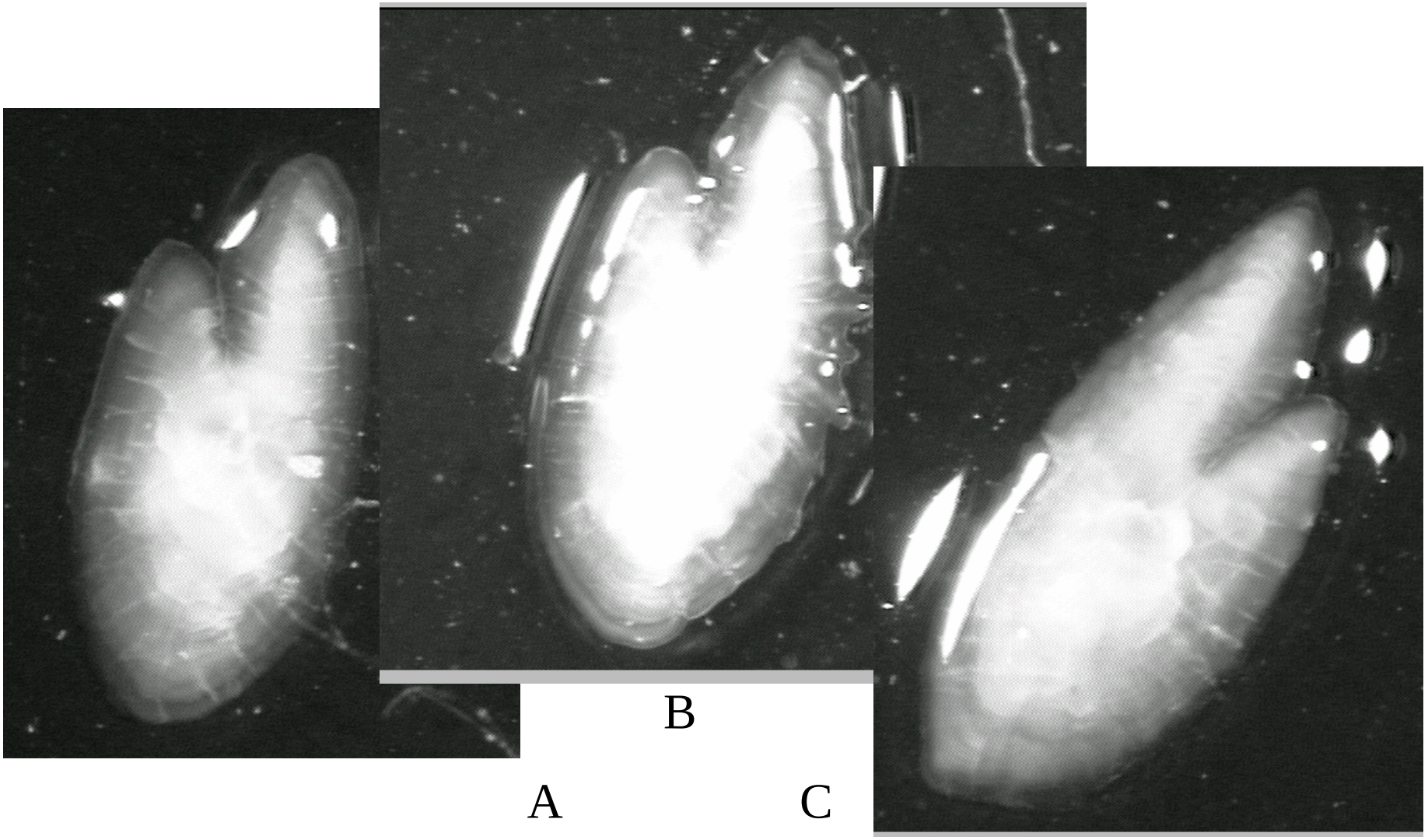


Photo .20: Otoliths from french acoustic survey PELGAS06: A- K0289 Chalut 08 10 cms 9 grs.

B- K0305 Chalut 16 8.5 cms 4 grs . Probably 1 y.o. with a check C08 .

C- K0301 Chalut 15: 14cms, 20grs , probably a 1 year old with check C08 and a starting white edge.

FIN