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DFO Atlantic Fisheries
Research Document 96/85

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MPO Document de recherche sur les pêches dans
l'Atlantique 96/85

Development, Evaluation and Monitoring of New Age Readers for 4VWX5Zc Pollock

by

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Abstract

The procedure for training, evaluating and monitoring new age readers for the pollock (*Pollachius virens*) resource occurring in Maritime waters is described. Training was mainly through review of interpretations of age provided by the previous age reader, enhanced by the use of annotated videotape images which provided an archive of previous age determinations. Evaluation and monitoring was completed by a range of procedures designed to measure within-reader precision and among-reader agreement. It was concluded that both age readers had achieved suitable levels of competence, and production ageing for this resource could commence.

Résumé

Cet article décrit les méthodes employées pour former et évaluer les personnes chargées de déterminer l'âge des goberges (*Pollachius virens*) trouvées dans les eaux des provinces Maritimes, ainsi que pour contrôler leur travail. Pour une bonne partie de leur formation, les candidats ont étudié les évaluations de leur prédécesseur; ils ont examiné aussi des images sur bande magnétoscopique portant des annotations et qui constituent des archives. L'évaluation et le contrôle des nouveaux évaluateurs ont été complétés par un ensemble de procédures destinées à mesurer la précision du nouvel évaluateur d'une évaluation à l'autre et la concordance des résultats obtenus par les différents évaluateurs. On est parvenu à la conclusion que les deux évaluateurs avaient atteint un degré de compétence adéquat et qu'il était possible de commencer à évaluer l'âge de goberges dans un cadre de production.

Introduction

The previous age reader for pollock was Mr. Harry Sampson, over the period 1991 to 1995. The early retirement of Mr. Sampson prompted an accelerated program of development for the replacement age reader. This document describes the process of training, evaluation and ongoing monitoring to ensure that the age interpretations of the new age reader are consistent with those of the previous reader. In addition, we describe the performance of a secondary age reader. The role of the secondary age reader is to provide periodic re-examination of material aged by the primary age reader to help ensure that there has been no long term change in the interpretations provided. The secondary age reader also provides backup in the event of illness or other circumstances which lead to a backlog of work. In addition, the secondary age reader is expected to complete about 20% of the production ages on an annual basis.

Training

Before the departure of the previous age reader, twenty samples of approximately 30 otoliths were examined jointly by the three readers, with the aim of understanding how Mr. Sampson interpreted the structures. Further, to provide an archive of how the previous age reader interpreted otoliths, 122 annotated images of otoliths were stored on videotape for future reference. The annotations were made using an image analysis system. The previous age reader marked annuli using an overlay feature of the IAS software, and the images thus annotated were stored on videotape. From time to time, both age readers reviewed the videotape archive to reacquaint themselves with the method of otolith interpretation employed by the previous age reader.

The videotape record also proved useful in studies of the first annulus, since the location of the first annulus is often contentious among age readers. Mr. Sampson's annotated images allowed us to quantify his interpretations of the first few annulus lengths. As shown on Fig. 1, the lengths of the first annuli do not overlap those of the second annulus in otoliths collected in 4X, thus that criterion becomes useful in identification of the first annulus. The archived images occasionally included otoliths from very small fish (Fig. 2). Based on examination of length-frequency distributions, such fish were likely age one (Fig. 2). It is therefore possible to conclude that the structure assumed to be the first annulus in older fish is probably correct.

Evaluation

To evaluate the performance of the new age readers compared with the previous reader, the age readers were asked to age three samples previously aged by Mr. Sampson on a given day (totaling about 90-120 otoliths) on a regular basis. It was considered that the new age readers had reached an acceptable level of performance when they achieve percent agreements ($PA=(n_{agree}/n)x100$) of about 80%, when the three samples were combined. The choice of the standard of 80% was arbitrary. Furthermore, no appreciable bias was expected. Bias was measured by summing the differences in ages. We elected to focus on material from NAFO Div. 4X first, since the bulk of the samples in 1995 originated from there. Also, preliminary readings indicated that the otoliths from samples taken in NAFO Div. 4VW were somewhat more difficult to interpret. Therefore, we elected to focus on the Div. 4X material first, while the readers gained experience and confidence to deal with the more difficult samples.

Initial results were positive with regard to percent agreement, but indicated a bias for the primary age reader (see example below):

Comparison tests between new age reader and previous reader

		PRIMARY AGER												
		1	2	3	4	5	6	7	8	9	10	11	12	Totals
	1													0
Previous	2													0
	3													0
A	4				19	2								21
G	5					17	1	1						19
E	6					2	10	2						14
R	7							9	5					14
	8													0
	9										1			1
	10										1			1
	11													0
	12													0
	Totals	0	0	0	19	21	11	12	5	0	2	0	0	

80% agreement

The above comparison was completed Dec. 13, 1995, and is typical of the pattern observed in 1995 with the primary age reader tending to overage relative to Mr. Sampson.

Over time, however, and with re-evaluations of archived materials and discussions among the two age readers and the research scientist for the stock, the bias has decreased substantially (Fig. 3). The primary age reader has tended to overage relative to Mr. Sampson, but this difference has diminished. The secondary age reader has tended to overage compared with Mr. Sampson during the February to April period, then overcorrected and now is producing results comparable to Mr. Sampson's. Percentage agreement has fluctuated, but has recently exceeded the 80% target (Fig. 4). Interestingly, even within samples originating from NAFO Div. 4X, there appears to be considerable variation in difficulty among samples, as the agers tended to score either relatively high or low when the same material was examined.

A further method of displaying results from comparative age determination studies are age bias plots, as suggested by Campana et al. (1995). Such graphic representations, where the mean age as determined by the new ager is shown on an age-by-age basis, have utility for assessing if there are systematic problems in age determination, such as certain ages being consistently under or over-aged relative to the previous reader. Results of the age determination from two samples are shown on Figs. 5 and 6. These results reveal no systematic bias for either age reader.

Conclusions

Both the primary and secondary age readers have achieved suitable levels of agreement and bias when compared with the previous age reader. We conclude that production age determinations should commence immediately for the 1995 commercial samples from 4X. The production ageing, however, must include an element of monitoring and re-evaluation. We therefore recommend that after completion of 400 production ages, each reader follow the MFD-SABS protocol (Trippel, unpublish.) for measuring both contemporary and historic intra-reader agreement and inter-reader agreement (measured against the current secondary reader and Mr. Sampson). The frequency of conducting such tests after 400 production ages is somewhat higher than the protocol which calls for evaluations twice annually, and may be adjusted downwards as satisfactory results are obtained.

Concurrent with the production ageing for the material from 4X, a similar training and evaluation program will be pursued for 4VW pollock age determinations.

Acknowledgments

We thank Drs. S. Campana, and E. Trippel for their helpful comments on an earlier version of this manuscript.

Literature Cited

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Trippel, E.A. 1996. SABS Workshop on Age Determination Methodology for Fish Stock Assessments. Unpublished Document.

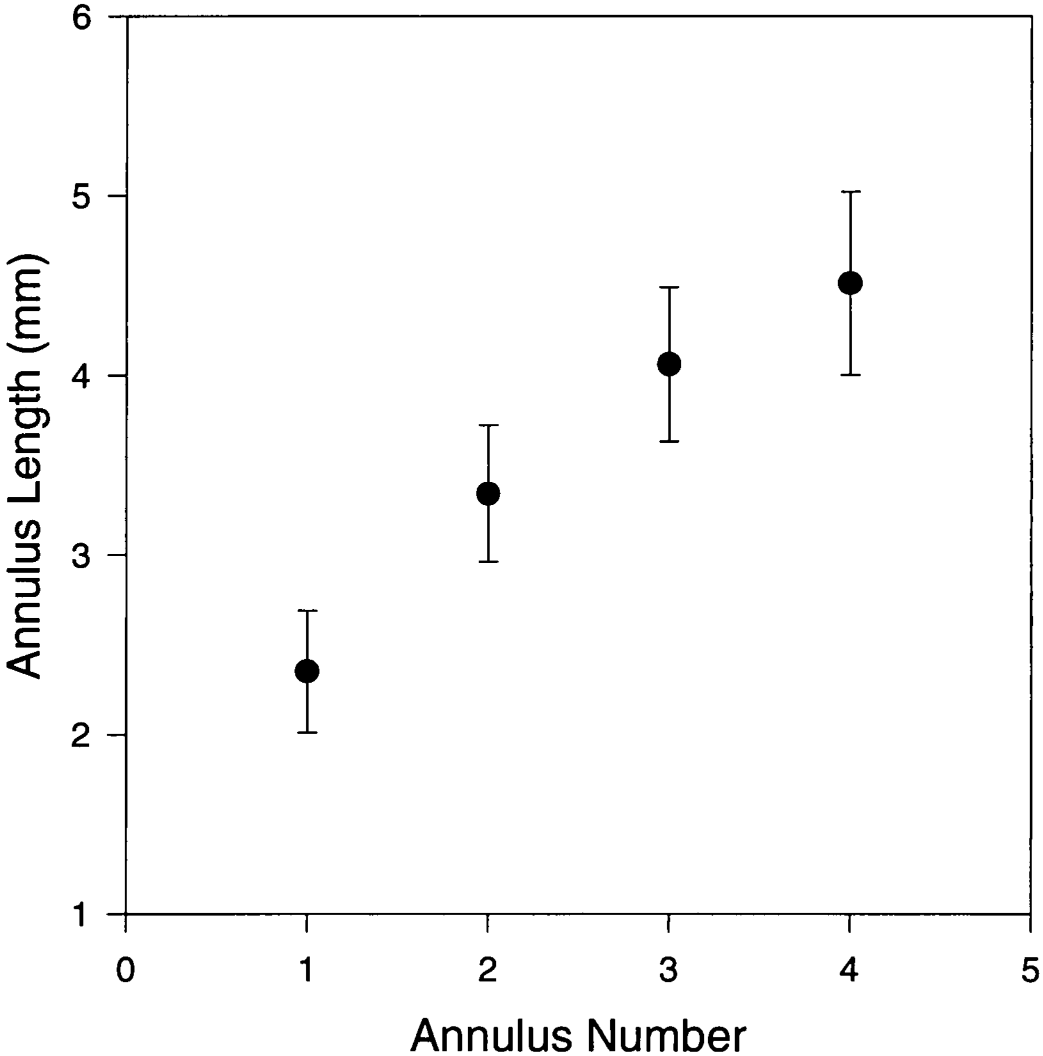


Fig. 1. Annulus length (mm) measured along the longest axis in cross-sections of sagittal otoliths of pollock from NAFO Div. 4X, $n = 59$. Error bars are plus or minus one standard deviation.

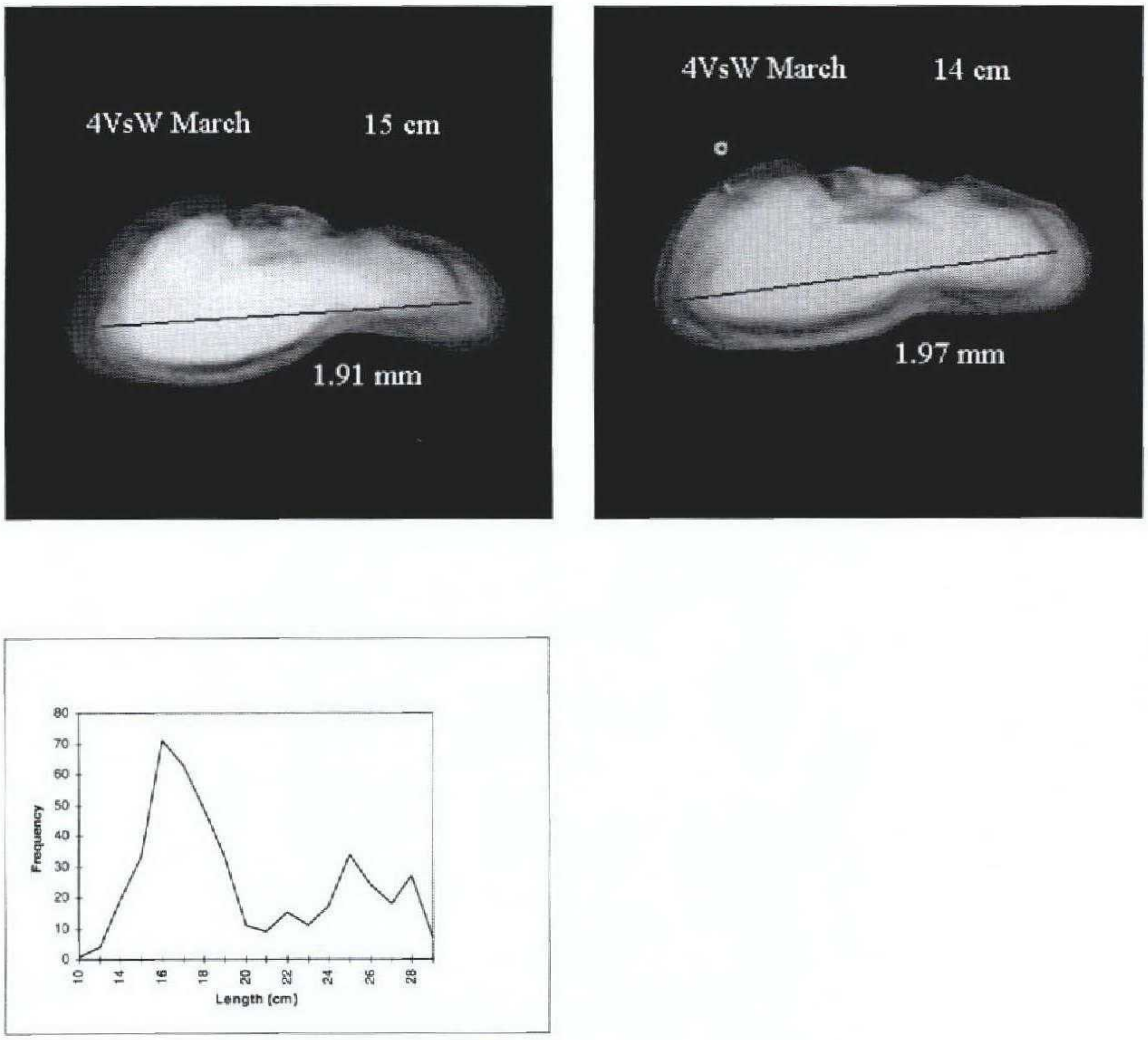


Fig. 2. Small pollock otolith cross-sections from the 4VsW research vessel surveys, showing the first annulus length as indicated by previous age reader. The bottom graph shows cumulative length frequency for pollock < 31 cm from the 4VsW March surveys for the years 1987-96

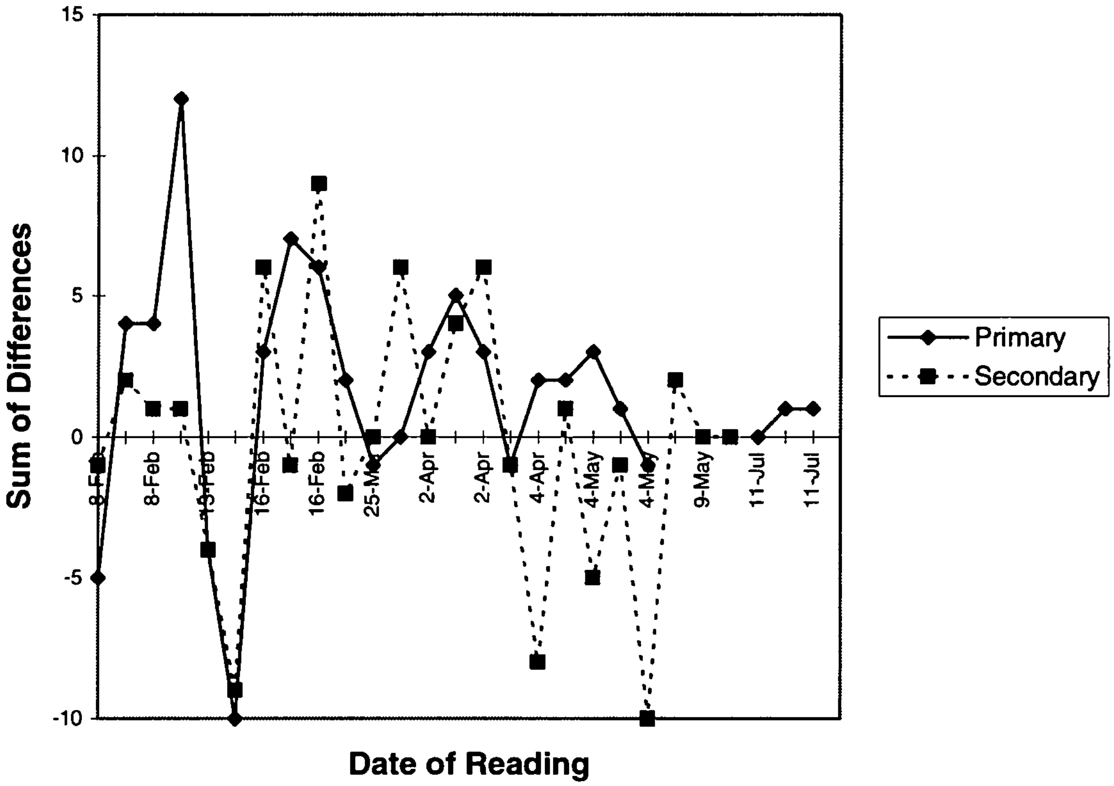


Fig. 3. Trend in the sum of differences of age determinations (previous ager - new ager) over time, for both the primary and secondary ager.

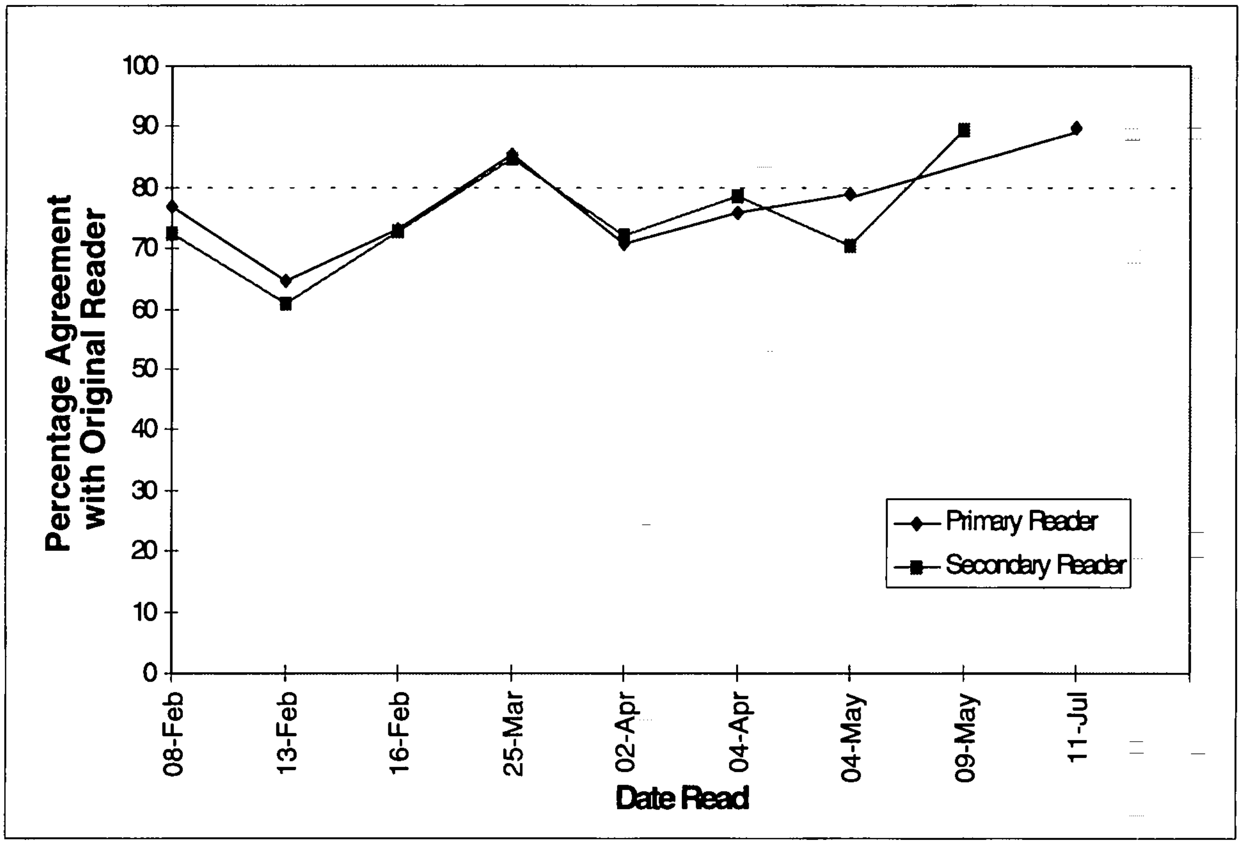


Fig. 4. Trend in percent agreement with samples re-aged by new age readers when compared with ages obtained by previous age reader. Each point is an average of three samples (n = 30-45 for each sample) aged on the same day.

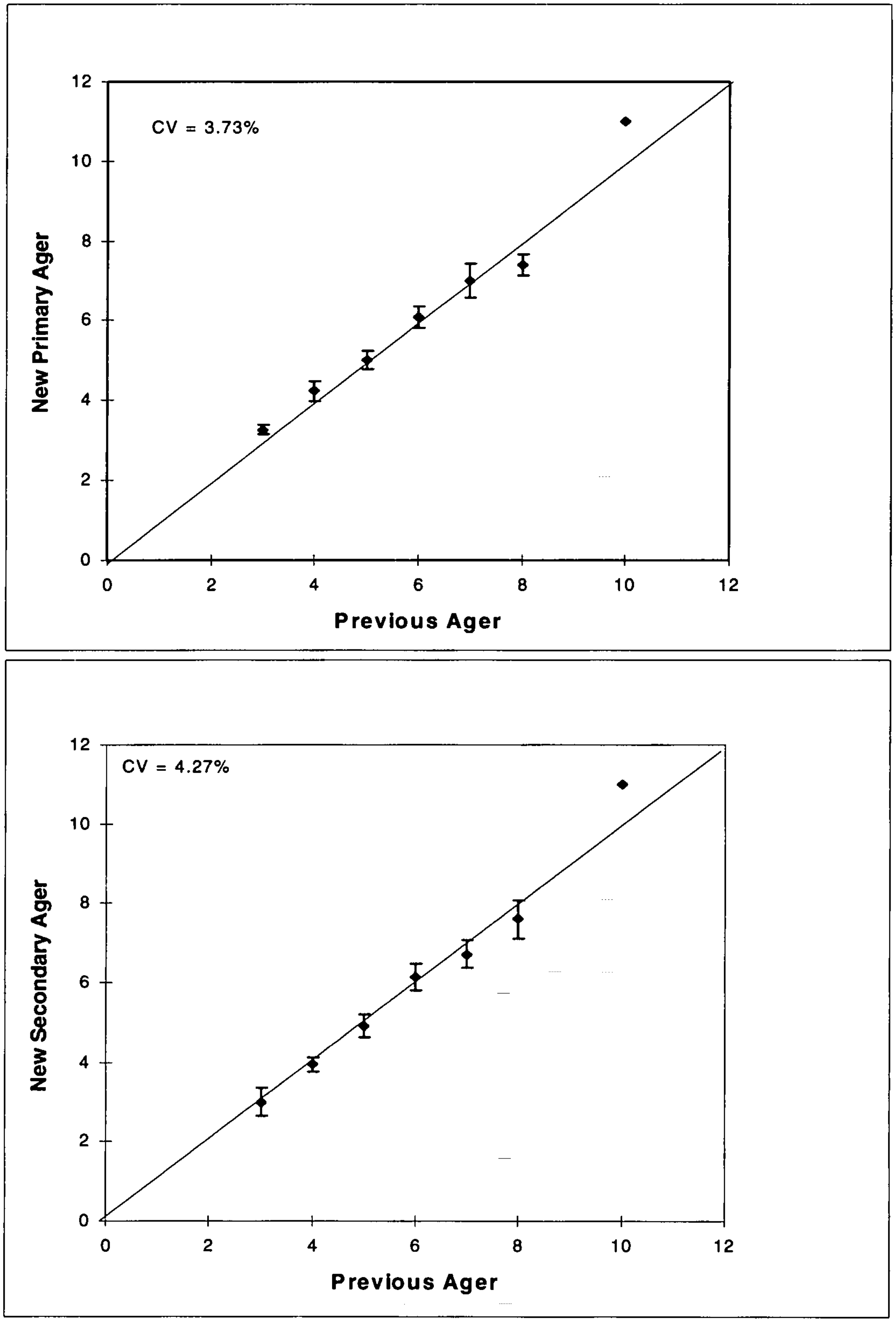
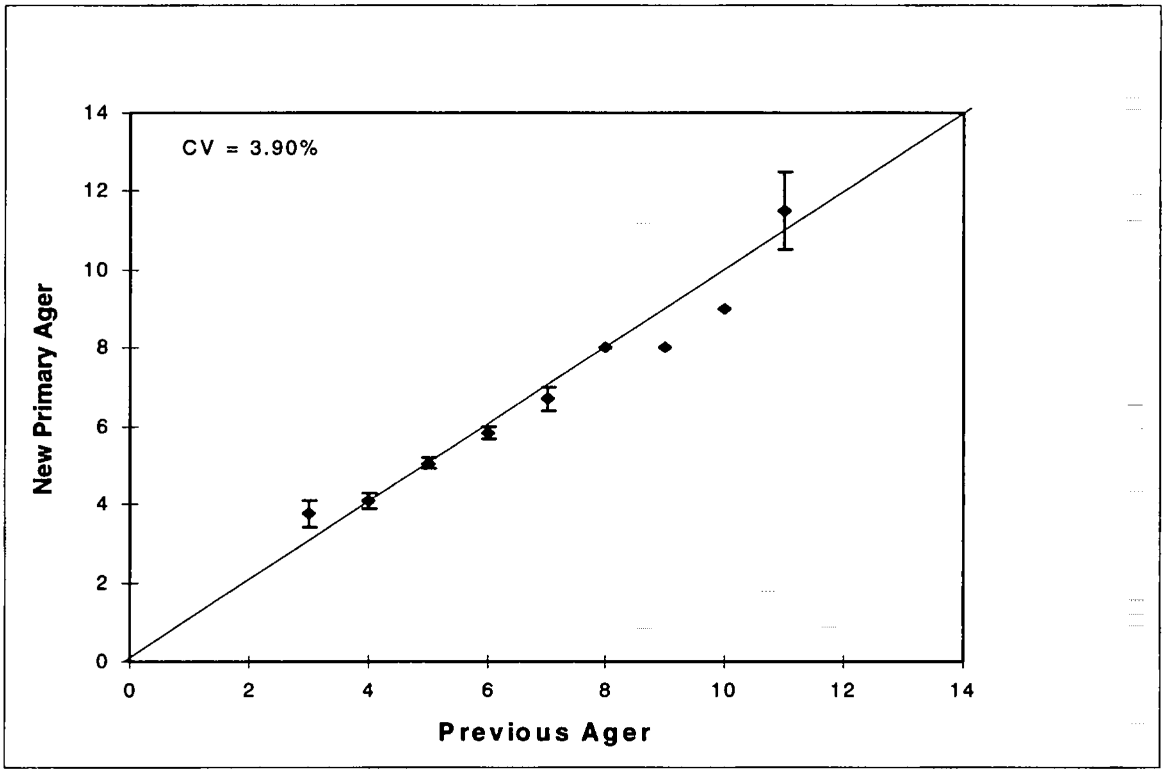


Fig. 5. Age bias graphs for a sample of pollock otoliths aged February 8, 1996 (n = 77). The mean age (with the 95% confidence interval) obtained by the new age readers is shown relative to all ages 3 to 11, as determined by the previous age reader.



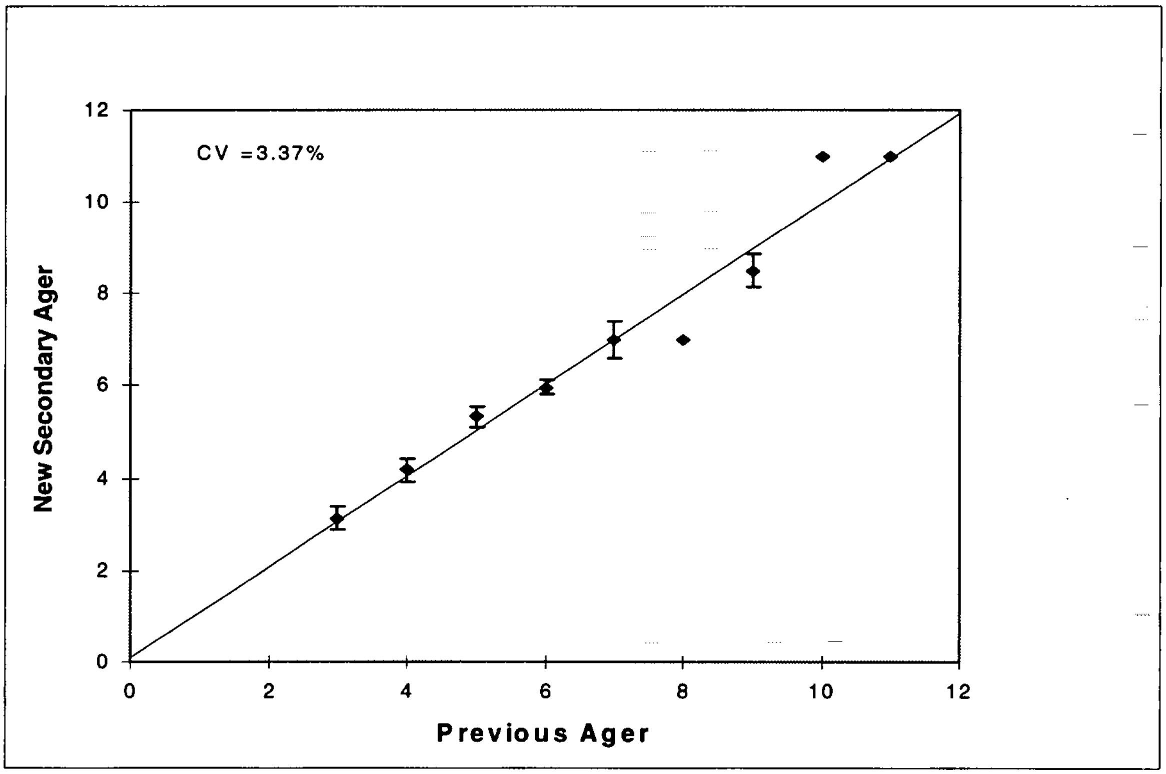


Fig. 6. Age bias graphs for a sample of pollock otoliths aged April 4, 1996 (n = 83). The mean age (with the 95% confidence interval) obtained by the new age readers is shown relative to all ages 3 to 11, as determined by the previous age reader.