REPORT OF THE WORKSHOP ON MACKEREL OTOLITH READING

Vigo, Spain

8–14 February 1995

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1 INTRODUCTION

1.1 Terms of Reference

At the ICES Annual Science Conference in St John's (Canada) in September 1994 it was decided (C. Res. 1994 / 2:37) that a Mackerel Otolith Reading Workshop (Chairman: A. Eltink) will be held at the Instituto Español de Oceanografía (IEO) in Vigo, Spain from 8-14 February 1995 to:

a) evaluate the results of the mackerel otolith exchange carried out in 1994;

b) discuss and standardize age reading methods by preparing a manual and a standard collection;

c) advise on which age groups valid age readings can be achieved.

Financial support for the meeting was obtained from the European Union within the framework of the AIR programme (Grant MAC/13/94).

1.2 Participation

The Workshop met in Vigo from 8–14 February 1995 with the following participants:

Participants taking part in comparative age determination:

Elizabeth Barnwall	Ireland
Jan Beintema	Netherlands
Doug Beveridge	UK (Scotland)
Wendy Dawson	UK (England and Wales)
Helga A. Gill	Norway
Kurt Jensen	Denmark
Maria Manuel Martins	Portugal
Iñaki Rico	Spain (Basque Country)
Elena Seliverstova	Russia
Begoña Villamor	Spain

All above otolith readers participated in the 1994 Mackerel Otolith Exchange except Wendy Dawson who replaced Alec Watson.

Other participants:

Sergei Belikov	Russia
Guus Eltink (Chairman)	Netherlands
Tommy Henriksen	Denmark
Manolo Meixide	Spain
Carmen Piñeiro	Spain
Carmela Porteiro	Spain

2 GENERAL

2.1 Review of mackerel biology

General distribution

Mackerel (*Scomber scombrus L.*) is restricted to the temperate shelf waters, usually less than 200m, of the northeast Atlantic Ocean and it's adjacent seas (Lockwood, 1988). Distribution varies between seasons as the fish migrate between overwintering, spawning and feeding grounds. Three stocks are recognised for assessment purposes in the northeast Atlantic: the North Sea and western stocks (ICES Divisions IIa, IIIa, IVa-c, Vb, VIa,b, VIIa-k, VIIIa,b,d,e) and the southern stock (ICES Divisions VIIIc and IXa).

The current distribution and migration patterns are fully described by Walsh and Martin (1986) and Anon. (1990a). The western mackerel overwinters in the northern North Sea while during the late sixties and throughout the seventies the bulk of the western stock (approximately 3-4 million tonnes) overwintered in the western Channel. It is not understood why these changes took place, although they are assumed to be due to changes in environmental conditions.

An indication of the present mackerel distribution and abundance is given by examining the distribution of the fisheries for each quarter shown in the latest Working Group report (Anon., 1995). Moreover, there are some restrictions on the fishery which should be borne in mind when interpreting the catch data by area. Mackerel can only be taken in Division IVa from 1 August - 31 December, there is no fishing for mackerel in Divisions IIIa and IVb,c at any time of the year and there is a closed area around the Cornish peninsula to protect the juveniles. In spite of these constraints on the fishery the areas where the catches are taken give a good indication of the relative abundance. An exception of the second quarter when mackerel are well dispersed throughout the spawning area and difficult to catch in large quantities. It is important to note that the officially reported distribution of catches were not taken as a reliable guide to where the mackerel were actually caught in all areas and seasons. Therefore, the quarterly distributions of the fishery were estimated by the Working Group based on information from unofficial sources.

Spawning Areas

There are three main spawning areas in the northeast Atlantic. The central North Sea, Skagerrak and Kattegat serve as the spawning ground for the North Sea stock (Hamre, 1980; Coombs and Mitchell 1981; Iversen, 1981). The spawning area of the western stock extends along the continental shelf from the west of Ireland to the Bay of Biscay (Lockwood *et al.*, 1981; Anon., 1993b). The third spawning area of the southern stock lies mainly in the central Cantabrian Sea, off the north and northwest Spanish coast, (Lago de Lanzós *et al.*, 1993). The spawning season extends from March through July with a peak in May/June in the western area and from May through August with a peak at the end of June in the North Sea area. Spawning is earlier for the southern stock from January to June with a peak in January/February in Portuguese waters, (Jorge *et al.*, 1982) and in April in the southern Bay of Biscay Division VIIIc (Solá *et al.*, 1994).

Larval Distribution

After hatching larvae are found mixed with other plankton. Mackerel hatch at about 3.5 mm and feed from the yolk sac attached to their abdomen. When the larvae are a few days old, the yolk sac has been absorbed and the

larvae begin to feed. Initially their diet includes a high proportion of faecal pellets from copepods (Lockwood, 1988). The distribution of mackerel larvae, less than four weeks old, is illustrated by Coombs and Mitchell, (1981), for the area around the British Isles including the North Sea and the Channel over the period 1947-78. The areas of highest abundance were the Celtic Sea area ranging from the Celtic plateau out towards the shelf edge, and the central and Northern North Sea. There are some similarities between the distribution of larvae around the British Isles and of adult Calanus spp which mackerel larvae are known to feed upon (Coombs and Mitchell, 1981).

After a few weeks they have grown to about 30-40 mm and resemble the adult fish. However, very little is known about the distribution and abundance of fish between 4 - 14 cm. Fish of this size appear to be very difficult to catch, but in both the Celtic Sea and the North Sea mackerel of 3 - 8 cm have been caught at the surface. Mackerel of 6 - 8 cm have been caught regularly in mid-water off Norway's North Cape during ICES young fish surveys in the Barents Sea (Lockwood, 1988). In July 1989 several 0-group mackerel were caught off the northeast coast of England between the Farne Islands and Flamborough Head. These fish were of North Sea origin and ranged from 2.5 - 9.0 cm in length.

Nursery Areas

The distribution of juveniles, i.e. first and second winter fish, is fairly well known. In the western area they are concentrated mainly along the shelf edge from Biscay to the west coast of Scotland. High concentrations are also found in the Celtic Sea and large shoals of juveniles have consistently been found off Cornwall since 1981, (Anon., 1995; 1991a; 1990b; 1989; 1988; Dawson *et al.* 1988).

Some of the western stock juveniles are found in the southern North Sea during the winter months. In years of good recruitment the distribution of the western juveniles tends to be more widespread. There are very few North Sea stock juveniles in recent years because of the very low stock size. However, if juveniles are present they tend to be found mainly in the northern North Sea, (Anon., 1991a; 1990b; 1989).

The distribution of juveniles in the southern area is west off the Iberian peninsula during the second half of the year where approximately 80% of the catches (around 1,500 tonnes in 1993) are made up of fish up to age 3 (Anon., 1993a; Anon., 1995). In the third and fourth quarters the catches decrease in Division VIIIc and consist of fish born that year (0-groups). Juveniles (1- and 2-groups) are mainly caught in the central part of Division VIIIc. In sub-division IXa north, catches are comprised mainly of juveniles (0-groups) and catches progressively increase from July to September (Anon., 1991b).

Population Structure

Western stock

The western stock has sustained intensive fishing pressure over the last 15 years even though catches have often well exceeded agreed TACs. While there have been some poor year classes (e.g. 1977, 1982, 1983) recruitment on the whole has been good in some years. When conditions have been favourable, recruitment has been very high, (e.g. 1979, 1980, 1981, 1984 and 1987). However, this high fishing pressure in the early seventies led to a decrease in the spawning stock biomass (SSB), from almost 3.5 million tonnes in 1972 to 2 million tonnes in 1980. The SSB stabilised at around 2.5 million tonnes in the eighties, but has decreased in recent years (Anon., 1995).

North Sea stock

By contrast, the North Sea stock is far from healthy. Catches attained almost 1 million tonnes a year in the late sixties. This excessive fishing level led to the collapse of the stock in the early seventies (Lockwood, 1988). Since then the stock has remained at a very low level due to poor recruitment (only 78,000 tonnes SSB when last estimated in 1990) in spite of fishing restrictions aimed at stock protection.

Southern stock

The mean catch in the last 15 years has been about 20,000 t. with a maximum catch of 26,000 t. (Anon. 1995). The TAC set for southern mackerel (about 36,000 t.) has never been completely taken. The stock size has not yet been estimated.

Age and Growth

Age is determined from the sagittal otoliths. Interpretation of the otoliths is quite straight forward. Growth has been described by Lockwood (1988) from samples taken from the Cornish winter fishery 1975-1980. If fish are sampled on their migration route to and from the spawning ground, biased growth curves will be obtained (Dawson, 1986; Eltink, 1987). This is due to the size-age succession that takes place during migration. The larger fish within an age group are the first to begin their migration to the spawning ground and they are followed by the smaller fish.

Western stock

The age composition of the western stock is given in detail in the Mackerel Working Group Report (Anon., 1995). On average 66% of the population are <4 years old, 32% are between 4-10 years old and about 2% are older than 10. They usually mature at 2 or 3 years old and the maturity ogive is given in the same report. The Working Group assumes that 60% are mature at 2 years old and 90% at 3 years old. Males mature at a slightly smaller size than females, but on average 50% are mature at 28 cm (Lockwood, 1988).

North Sea stock

Because of the low stock size and low catches of the North Sea stock, the age composition of the stock is uncertain. Growth is assumed to be identical to that of the western stock.

Southern stock

The age composition of the southern stock is given in Anon. (1995). Approximately 50 % of the catches in number are composed of fish up to age 4.

The growth rate in sub-division IXa central and south is different from the western stock (Gordo *et al.*, 1982) and

also from the ones caught in the Cantabrian Sea (Cort, 1982). There are some differences between the age of first maturity in Divisions VIIIc and IXa. In Division IXa, mackerel reach maturity between 1 and 2 years old, while in Division VIIIc fish do not mature until they reach the age of 2 or 3 years old.

Stock identity

In the past, stock identification of the North Sea and western mackerel has been attempted. It has been necessary for stock assessment purposes to separate the catches into their respective components when the stocks are known to be mixing. However, stock separation of a mixed catch taken by the commercial fishery into North sea and western components has always presented a problem in stock assessment (Anon., 1987b; 1988; Lockwood 1988). Initially, stock identification was estimated by returns from Norwegian tagging experiments. However, changes in the migration and distribution of the western stock and the collapse of the North Sea stock have rendered this method inappropriate. Mackerel, which have been tagged in the North Sea area in the last few years, have consisted of quite a high proportion of fish from the western stock, making recent tagging data less reliable as a method of stock separation (Dawson, 1991).

Several stock separation techniques have been attempted in later years. These included genetic analysis of population samples (Jamieson and Smith, 1987), biological tags (MacKenzie and Mehl, 1984; MacKenzie, 1990) and otolith L_1 analysis (Dawson, 1991). However, none of these methods have been successful. More recently stock identity has been further complicated by the recognition of a third component, the southern stock. There is presently a tagging programme underway to try and determine to what extent the southern stock mixes with the western stock.

Although three stocks of mackerel are known to exist, to date there has been no way of identifying individual fish.

2.2 Objectives of Workshop

The objectives of this Mackerel Otolith Reading Workshop are:

1) To determine the accuracy of the age readings (their proximity to the actual age). The validation of the age reading method can be achieved by using otoliths from fish of which the actual (probable age) is known, because otolith and dates of capture are available from recaptured tagged fish. The importance of validating the method used to determine the age has been discussed e.g. in Beamish and McFarlane (1983). The use of incorrect growth rates can lead to rather large errors in estimates of stock production (Ricker, 1969).
2) To minimize between-reader bias and variability in the precision of age determinations (i.e., their reproducibility).
3) To advise on what age groups valid age readings can be achieved.
4) To produce guide-lines on the age reading method.
5) To prepare a standard collection of otoliths for comparison purposes in later otolith exchanges and workshops that may be used as a reference.

2.3 Review of previous validations

No previous description of mackerel age determination validation is available. At an earlier Mackerel Age Determination Workshop in 1987 (Anon., 1987a) only a small number of otoliths taken from recaptured tagged mackerel were available which had been at liberty for varying periods up to 9 years. It was concluded that these otoliths were particularly helpful in providing some validation for older fish.

Indications that correct age determination has been applied can be obtained by indirect validation techniques. For example, in the catch in numbers of the western mackerel fishery (Anon., 1995 Table 5.11), the weak 1977 year class can be followed in successive years up to age 11 and the strong 1984 year class can be followed up to age 9 (upto 1993, which is last year of available catch in number data).

2.4 Age determination criteria

The following criteria for age determination were assumed prior to this Workshop:

1) Date of birth is 1 of January.
2) One hyaline and opaque ring constitute an annual growth zone.

3 MATERIAL AND METHODS

3.1 Review of sample processing techniques

The basic method used by most readers is to mount whole otoliths on black slides and to view them under a microscope by reflected light. A few countries routinely view unmounted otoliths submerged in alcohol or glycerine.

There were, however, differences in detail of the mounting techniques as summarized in Table 3.1.

3.2 Available otolith samples

Information on the 6 sets of otoliths used during the 1994 Mackerel Otolith Exchange and during this Workshop, are summarized in Table 3.2.

The VALIDATION COLLECTION (set 1) was compiled of 43 otoliths obtained from tagged fish returns mainly in ICES Division IVa (Norwegian tagging programme). Most of these fish have been tagged and released as 1-year olds in August (length 24 - 29 cm) or as 2-year olds in May (26 - 30 cm). These age groups had distinct modes in the length distributions at the time of tagging. Two fish have been released at the age of 3 and one at the age of 4. These ages have been verified with the age-length-keys collected at the time of tagging. The fish

released at the age of 4 has been included because of the high age of 23 years at its recapture.

The age of these fish at the time of capture can be estimated, since the age at the time of release and the time interval between release and recapture is known.

The otolith sets of the Divisions VIa & VIIb,c (set 2) and of Divisions VIIIc & IXa (set 3) were used in the 1994 Mackerel Otolith Exchange.

The otolith sets of Divisions IVb,c (set 4), of Division IXa (set 5) and of Division IVa (set 6) were new for all readers. Set 4 and 5 were included to cover all areas of mackerel distribution. Division IVa (set 6) is assumed to be a representative sample from an area of high catches. This set was used to estimate the precision of the readings at the end of the Workshop.

3.3 Analysis of the age readings

All readers participating in the 1994 Mackerel Otolith Exchange have provided age reading results to the ICES Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy (Anon., 1995). At this Workshop the same otolith readers participated that took part in the Mackerel Otolith Exchange with the exception of the UK (England and Wales) participant, who was replaced because he retired.

The main lines of the work at the Workshop were as follows. The first set of otoliths to be read was the validation collection, because the readers would discover from this set their errors in age reading. Results and otoliths have been thoroughly discussed. After that the results and the otoliths of the 1994 Mackerel Otolith Exchange have been discussed to improve the agreement in the ageing technique. Two new sets of otoliths were read and thereafter discussed. These sets were from two new areas (Division IXa and Divisions IVb,c) in order to detect specific problems in age reading, which possibly could be related to these areas. After all these discussions on ageing results and on otoliths a better agreement was expected. A second reading of the two sets of the Otolith Exchange should provide an estimate of the improvement in precision and of the decrease in bias. However, when reading the first of the two sets, it appeared that the surface of the resin was that much damaged that another otolith set had to be found, because the damage would reduce the precision. At the Workshop a new set of otoliths from Division IVa was made available and read. After that the precision and bias were determined from the age readings. Results from this last otolith set are assumed to demonstrate the present precision and bias in the age readings, that will be used by the ICES Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy in 1995.

For each set of otoliths the following analysis took place. The modal and the average age were estimated from readings of each pair of otoliths. The difference between the highest and the lowest age was calculated. In the age bias plots the mean recorded age ± 2 standard deviations for each reader and all readers combined is plotted against modal age. CV (%) for each modal age and the percentage agreement to modal age was calculated for each reader as well as all readers. In the sample of the validation collection the actual age was used instead of modal age. To test if modal age is a good estimate of actual age, a regression has been made between both. The Wilcoxson's test was done for each pair of readers to find out bias between readers. The notched box and whisker plot was used as an exploratory data analysis that summarizes a set of observations and is particularly useful for comparing parallel batches of data. These last methods belong to the procedures recommended by the Workshop on Sampling Strategies for age and maturity (Anon., 1994).

3.4 Guide-lines on age reading

The age readers tried to agree on an ageing method by means of discussions during the entire meeting. A draft manual on mackerel otolith reading, which was available at the beginning of the meeting, was constantly open for discussion and improvement. At the end of the Workshop, the guide-lines for mackerel otolith reading were screened and these are presented in section 7.

4 RESULTS OF THE 1994 MACKEREL OTOLITH EXCHANGE

In 1993 the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy agreed to carry out a mackerel otolith exchange programme, because the results of separable VPA of the western mackerel stock suggested difficulties in interpreting ages of old fish. Problems had also appeared in the ages of fish from Division IXa (Anon., 1993a). The exchange was organized by Begoña Villamor, IEO, Santander (Spain). The exchange was carried out in 1994 and involved 10 readers from Denmark, Ireland, Netherlands, Norway, Portugal, Russia, Spain, UK (Scotland) and UK (England and Wales).

A sample of 198 pairs of otoliths (set 2) was prepared from Divisions VIa & VIIb,c (western area). The fish were caught between January and April and covered a length range of 25 to 46 cm. A sample of 198 otoliths (set 3) from Divisions VIIIc & IXa (southern area) included fish with a length range of 18 to 48 cm caught between January and April and in September.

The results of the 1994 Mackerel Otolith Exchange were presented in Villamor & Meixide (1995 WD). The comparison of the otolith readings of the two areas was carried out separately (see section 4.1 and 4.2).

4.1 DIVISIONS VIa & VIIb,c (Set 2)

The results of the readings of 188 otoliths from Divisions VIa & VIIb,c are shown by reader in Table 4.1, including modal age, average age and the difference between the lowest and highest age reading.

Table 4.2 shows by modal age group the mean age recorded, 2stdev, CV, number of age readings and the percentage of agreement with modal age by reader as well as by all readers combined. The agreement with modal age ranged from 20% (reader 8) to 80% (reader 5).

Readers 1, 4, 5, 6, 9 and 10 were above the average agreement for all readers of 62%. Of the 198 otoliths examined, only 33 otoliths were assigned the same age by all readers.

Table 4.3A shows the Wilcoxson's test indicating that only in 6 combinations of readers there was no significant bias between readers.

Figure 4.1 and 4.2 show the age bias plots by reader and all readers combined.

Reader 2 tends to overestimate the ages (especially above age 6). Readers 3 and 7 tend to underestimate the ages (especially above age 8 and 9). Readers 1, 5, 9 and 10 tend to underestimate the older age groups. Reader 8 was underestimating the ages considerably (for the older age groups a factor 2) and did not assign ages above 8.

All readers combined tend to underestimate the ages of the older fish.

The confidence intervals increased from the youngest ages to the oldest ages. Reader 4 did not read the 29 most difficult otoliths (Table 4.1) and achieved therefore probably relatively low intervals for all age groups.

Figure 4.3A showing the notched box and whisker plot summarizes the differences between readers.

4.2 DIVISIONS VIIIc & IXa (Set 3)

The readings of 188 otoliths from Divisions VIIIc & IXa are shown by reader in Table 4.4.

Table 4.5 shows that the agreement with modal age ranged from 20% (reader 8) to 87% (reader 4). Readers 1, 2, 4, 5, 6 and 10 were above the average agreement for all readers of 67%. Of the 188 otoliths examined, only 3 otoliths were assigned the same age by all readers.

Table 4.3B shows the Wilcoxson's test indicating that only in 12 combinations of readers there was no significant bias between readers.

Figure 4.4 and 4.5 show the age bias plots by reader and all readers combined.

Readers 2, 5 and 9 tend to overestimate the ages 9 and 10. Readers 3, 6, 7, 9 and 10 tend to underestimate the older age groups. Reader 8 was underestimating the ages considerably (for the older age groups a factor 2) and did not assign ages above 7.

All readers combined tend to underestimate the ages of the older fish.

The confidence intervals increased from the youngest ages to the oldest ages. Reader 4 did not read the 25 most difficult otoliths (Table 4.4) and achieved therefore probably relatively low intervals for all age groups.

Readers 1, 2, 3, 6, 9 and 10 seem to have problems in ageing young fish of 0, 1 and 2 years old. The mean age recorded differs much from the modal age and the confidence intervals are relatively large for these young fish. However, reader 8 is ageing these young fish correctly.

Figure 4.3B showing the notched box and whisker plot summarizes the differences between readers.

5 RESULTS OF COMPARATIVE AGE READINGS AT THE WORKSHOP

5.1 VALIDATION COLLECTION (Set 1)

The readings of 43 otoliths from the VALIDATION COLLECTION are shown by reader in Table 5.1. This provided for the first time, a validation of the ageing technique for mackerel. The modal age is here replaced by actual age, since these fish are of known age (from Norwegian tagging programme). Information on the tag release date and the fish length at the time of the tag release are also shown.

Table 5.2 shows by actual age group the mean age recorded, 2stdev, CV, number of age readings and the percentage of agreement with modal age by reader as well as by all readers combined. The agreement with the actual age ranged from 55% (reader 2) to 93% (reader 6). Readers 1, 4, 5, 6 and 10 were above the average agreement for all readers of 76%. Considerable differences in age readings were evident and only complete agreement with actual age was achieved on 8 otoliths.

Table 4.3C shows the Wilcoxson's test indicating that in 31 combinations of readers there was no significant bias. Reader 1, 3, 4, 5, 6, 8 and 10 showed no significant bias compared to the actual age.

Figure 5.1 and 5.2 show the age bias plots by reader and all readers combined.

Reader 2 tends to overestimate the ages (especially above age 6). Reader 7 tends to underestimate the ages above age 3. Reader 8 was overestimating the ages 2 and 3 and underestimating the ages 7 and 8.

All readers combined tend to underestimate the ages 9 and 10. Also the fish with actual age 23 got an average age of 20.7 years (Table 5.1).

The confidence intervals increased from the youngest ages to the oldest ages. This is especially evident in the age bias plot of all readers combined.

Figure 4.3C showing the notched box and whisker plot summarizes the differences between readers.

The actual age is plotted against the modal age in Figure 5.3 and shows a clear linear relationship (slope = 0.97 and correlation coefficient = 0.965).

5.2 DIVISION IXa (Set 5)

The readings of 174 otoliths from Division IXa are shown by reader in Table 5.3.

Table 5.4 shows that the agreement with modal age ranged from 64% (reader 3 and 7) to 81% (reader 1). Readers 1, 4, 8 and 10 were above the average agreement for all readers of 71%. Of the 174 otoliths examined, only 34 otoliths were assigned the same age by all readers.

Table 4.3D shows the Wilcoxson's test indicating that only in 9 combinations of readers there was no significant bias between readers.

Figure 5.4 and 5.5 show the age bias plots by reader and all readers combined.

Reader 7 tends to overestimate all ages. Readers 2, 4, 5, 6 and 7 overestimate age 7 and 8. Readers 6 and 7 tend to overestimate most of the ages. Readers 3, 8 and 9 tend to underestimate the ages from age 3 onwards.

Readers 1 and 5 overestimated the ages 1 and 2.

All readers combined tend to underestimate the ages of the older fish.

The confidence intervals increased from the youngest ages to the oldest ages. The confidence limits by reader are comparable, because all readers read all otoliths.

Figure 4.3D showing the notched box and whisker plot summarizes the differences between readers.

5.3 DIVISIONS IVb,c (Set 4)

The age readings of 169 otoliths from Divisions IVb,c are shown by reader in Table 5.5.

Table 5.6 shows that the agreement with modal age ranged from 39% (reader 8) to 75% (reader 2). Readers 1, 2, 4 and 10 were above the average agreement for all readers of 64%. Of the 169 otoliths examined, only 35 otoliths were assigned the same age by all readers.

Table 4.3E shows the Wilcoxson's test indicating that only in 12 combinations of readers there was no significant bias between readers.

Figure 5.6 and 5.7 show the age bias plots by reader and all readers combined.

Readers 4, 5, 6 and 7 tend to overestimate the ages above age 4. Readers 8 and 9 tend to underestimate the ages from age 3 onwards. Readers 1, 3 and 10 tend to underestimate the older age groups.

All readers combined tend to underestimate the ages of the older fish.

The confidence intervals increased from the youngest ages to the oldest ages and are already large from age 3 onwards. Reader 1, who is familiar with this area, achieved low confidence intervals upto age 10.

Figure 4.3E showing the notched box and whisker plot summarizes the differences between readers.

5.4 Second readings DIVISIONS VIa & VIIb,c (Set 2)

The second readings of 200 otoliths from Divisions VIa & VIIb,c are shown by reader in Table 5.7.

Table 5.8 shows that the agreement with modal age ranged from 53% (reader 8) to 71% (reader 3). Readers 1, 3 and 10 were above the average agreement for all readers of 65%. Of the 200 otoliths examined, only 40 otoliths were assigned the same age by all readers.

Table 4.3F shows the Wilcoxson's test indicating that only in 15 combinations of readers there was no significant bias between readers (there were only 6 combinations with no significant bias from the first readings).

Figure 5.8 and 5.9 show the age bias plots by reader and all readers combined.

Readers 4, 5, 7 and 8 tend to overestimate the ages above age 6. Readers 1, 9 and 10 tend to underestimate the ages (especially above age 9).

All readers combined tend to underestimate the ages of the older fish.

The confidence intervals increased from the youngest ages to the oldest ages.

Figure 4.3F showing the notched box and whisker plot summarizes the differences between readers.

5.5 DIVISION IVa (Set 6)

The readings of 148 otoliths from Division IVa are shown by reader in Table 5.9.

Table 5.10 that the agreement with modal age ranged from 67% (reader 5) to 81% (reader 3). Readers 1, 3, 4, 9 and 10 were above the average agreement for all readers of 74%. Of the 148 otoliths examined, 55 otoliths were assigned the same age by all readers.

Table 4.3G shows the Wilcoxson's test indicating that only in 18 combinations of readers there was no significant bias between readers.

Figure 5.10 and 5.11 show the age bias plots by reader and all readers combined.

Readers 2, 5, 7 and 8 tend to overestimate the ages (especially above age 5). Readers 1 and 3 tend to underestimate the older age groups.

All readers combined tend to underestimate the ages 14 and 15. Age readers 1, 3, 4, 5, 6, 9 and 10 were able to achieve small confidence intervals upto ages 10 and 11.

The confidence intervals increased from the youngest ages to the oldest ages.

Figure 4.3G showing the notched box and whisker plot summarizes the differences between readers.

6 DISCUSSION

6.1 Sample processing techniques

At the Workshop the different mounting techniques (Table 3.1) have been discussed. The Workshop concluded that when otoliths are mounted the best results are achieved as follows:

a. Before mounting the otoliths should be cleaned in either hot water or alcohol and left to dry before covering with resin.

b. Both otoliths from a fish should be mounted.

c. The slides should be of opaque black material.

d. The slides should have cavities of approximately 2 mm depth in which the otoliths are placed.

e. It is preferable to limit the number of otoliths mounted on a single slide to 25 pairs.

f. The advantage of using a glass coverslip depends on the type of resin used.

g. If a cover slip is not used the resin covering should have a smooth uniform surface rather than covering individual otoliths with blobs of resin.

6.2 VALIDATION COLLECTION (Set 1)

The objective of the validation collection was to validate the ageing technique. This was done by reading otoliths of known age (obtained from the tagging programme). The accuracy of the age readings can be seen in the age bias plots (Figure 5.1 and 5.2). Some readers showed a bias in their ages (readers 2, 7 and 8) and it is evident that accuracy decreased with age.

The average age recorded by each reader and by all readers combined is close to the actual age. This validates the ageing technique up to age 8. Above age 8 insufficient otoliths were available for validating, but bias was observed in the ages of older fish. The otolith readers appeared to underestimate the age of the older fish. A modal age of 23 years was obtained from all ages of the otoliths from a fish with an actual age of 23 years, while the average age was estimated at 20.7 years. This indicates that older fish tend to be underestimated. However, the considerable differences (only complete agreement on 8 otoliths) emerging cause concern, especially for the older fish. Clear within and between reader bias exists, although there is no obvious trend. Discussions on individual 'problem' otoliths, which took place immediately after the presentation of the results, explained some of these differences.

There appears to be a direct linear relationship between actual age and modal age (Figure 5.3), which indicates that the modal age is most likely to be the correct age. This suggests that in this particular case age readings should be compared to the modal age as was recommended in Anon. (1994). At this Workshop the ages of all individual readers were compared to the modal ages obtained from the ages of all readers (see section 3). Also in the 1994 Mackerel Otolith Exchange the analysis of the age readings was carried out by comparing the ages of the individual age readers with the modal age.

The percentage of agreement with actual age indicates the accuracy, which the otolith readers achieved at the beginning of the Workshop. These otoliths were not read again at the end of the Workshop, since the 43 otoliths were very well discussed. The readers would probably have remembered too well the ages of the otoliths of the older fish.

6.3 Evaluation of the 1994 Mackerel Otolith Exchange

The agreement with modal age of all otolith readers was low (62% and 67% for Division VIa & VIIb,c and Division VIIIc & IXa respectively).

Not all otoliths were examined by all readers, because no clear instruction was given to read all otoliths. Of set 2 only 163 were assigned ages by all readers, while 198 otoliths were examined. Of set 3 only 148 were assigned ages by all readers, while 188 otoliths were examined. The agreement with modal age probably would have been even lower, if all readers would have examined all otoliths.

For all readers except reader 8 the age bias plots (Figure 4.1 and 4.2) of the readings from Division VIa & VIIb,c (set 2) show that small disagreements were found at ages lower than 5 years, disagreement increased in ages 5-9 years and for ages greater than 9 the differences increased. The standard deviations by age groups increased noticeably for age groups over 5 years. The age bias plots show great variability. Bias already occurs from age 3 onwards. The bias increases with age. The older the fish are the more the age is underestimated by most of the readers.

For all readers except reader 8 the age bias plots (Figure 4.4 and 4.5) of the readings from Division VIIIc & IXa (set 3) show that the highest disagreement was found for ages 1-3 years and great variability was observed for the older age groups. The standard deviations for each age group are high for all age groups and increased greatly for ages above 3. The age bias plots present greater variability in older ages in many of the readers. The age bias plot of all readers show that the bias increases with age, and the older fish tend to be underestimated.

Reader 8 interpreted the rings differently compared with the other readers and consistently assigned much younger ages (set 2 and 3).

6.4 DIVISION IXa (Set 5)

After a group discussion, it was discovered that the criteria applied to ring formation on the edge of the otolith were considerably different. It was concluded that an opaque zone, normally interpreted as summers growth, could appear on the edge of the otolith before 1 January in area IXa and is usually detectable in January and February. An opaque edge may appear much later in otoliths collected from the more northern areas, sometimes as late as September and October. Therefore, the probability of misinterpretation of otoliths from area IXa by readers of otoliths from other areas was high. A consensus age was reached on only 7 individual otoliths and some disagreement still remains. Some confusion is caused because a second opaque zone may be observed on the edge of the otolith at the end of the year during one years growth. It was agreed that familiarity with the biology of the fish from this area is required for correct interpretation of the ring structure.

6.5 DIVISIONS IVb,c (Set 4)

The percentage of overall agreement with modal age was low (64%) partly due to a relatively high proportion of old fish in the sample. Unfortunately the preparation of the sample contributed to the large amount of disagreement between readers. Readers found this to be a serious disadvantage when re-examining this sample. The interpretation of the outside edge was not thought to have been a major factor for disagreement. Discussion did not improve the consensus agreement, although it was agreed that experience of otoliths from this area was an advantage (see results reader 1).

Readers did not have much confidence in the ages they assigned to the otoliths in this sample and felt that comparison of results was inappropriate and could be misleading.

6.6 Second readings DIVISIONS VIa & VIIb,c (Set 2)

When the results of the second age readings are compared with the first age readings using the age bias plots, (Figures 4.1 and 5.8) it is clear there was considerable improvement for most readers. Reader 8 had the greatest improvement which was mainly because of the experience gained at the workshop in interpreting otoliths from the western area. There was also a large improvement between the first and second readings for reader 3, however, it is important to note that most otolith readers had changed their views between the first and second readings. Reader 2 and 7 had also significantly improved and had corrected their ageing bias. The precision remained about the same for reader 6, 9 and 10), but for the other three readers (1, 4 and 5) they had actually deteriorated. Reader 1 had wider confidence intervals on the older ages. Reader 4 also had more variability in the ages and her confidence intervals increased on the older ages. The reason for this is that originally difficult otoliths were excluded where as for the second reading readers were encouraged to assign ages to all otoliths if possible. Reader 5 was sure that the reason why her age determinations were less precise for the second reading was because at the first reading (during the otolith exchange) she looked at the sample twice before deciding on the age. At the Workshop there was only enough time for readers to examine the sample once.

All readers expressed concern about the quality of the sample used for these repeat readings. The otoliths had been mounted in resin against a brown background rather than a black one, which most of the readers were used to. Furthermore, the slides did not have a coverslip to protect the resin. Consequently, the resin had become marked and damaged during the handling throughout the exchange. All readers were sure that their readings would have been better if the quality of this sample had been better.

It was originally hoped that this sample might provide the basis for a standard sample that might be used in future exchanges as a reference collection. However, because the sample was badly preserved it was agreed to look at another set of western mackerel otoliths, that were protected with a coverslip. As a result the readers were asked at the Workshop to examine a new sample (set 6) from ICES Division IVa.

6.7 DIVISION IVa (Set 6)

The reasons for introducing this new set of otoliths from Division IVa are explained in section 6.6. The average agreement with modal age (Table 5.10) was between 67% to 81%. The best results were achieved by readers 1 (Netherlands), 3 (England) and 4 (Norway).

Most readers achieved a precision of within a value of 2.00 for 2stdev up to age 11 years (Table 5.10). This was a large improvement compared to the precision achieved by the second readings of the Division VIa and VIIb,c sample where most readers achieved this level of precision for up to age 7 only (Table 5.8).

All readers agreed that the quality of this sample was much better, than any of the otolith samples used previously. This was considered to be the main reason for the improvement observed in agreement. The area from where the sample was taken was also considered to be representative of the otoliths taken from the main western mackerel fishery and therefore more typical of the otoliths most readers are expected to age routinely.

6.8 Edge of the otolith

It was discovered that the onset of the opaque ring formation on the edge of the otolith differed considerably from one area to the other (see section 6.3 and 6.4). Misageing occurred even in very young fish (age 0 - 3 years) because of misinterpretation of the edge of the otolith. It was considered to be useful to collect information in which months the opaque edge and in which months the hyaline edge on the otolith is laid down depending on area and age of the fish (the opaque ring formation is earlier in young fish and more southern areas). This information certainly would help otolith readers with the interpretation of the edge of the otolith.

Therefore the Workshop recommended that otolith readers should collect information on the edge type (e.g. opaque or hyaline) of the otolith for each age group, by month and by area. The method is described in the Appendix of Anon., 1991c. A table showing the number of otoliths with hyaline and opaque edges by age group and by month should be produced for each of the areas:

Southern North Sea	IVb,c
Northern North Sea & Norwegian Sea	IVa, IIa
North and west of Scotland	VIa
West of Ireland, Celtic Sea, Channel & Biscay	VII, VIIIa,b
Southern Biscay	VIIIc
Portuguese coast	IXa

6.9 Reliability of the age readings

The ageing method was validated up to age 8. Above age 8 the estimated modal age was assumed to correspond to actual age (see section 6.2).

Because of the problems associated with the Division VIa and VIIb,c sample (set 2), which are discussed in section 6.6, the results of the repeat readings were not considered to represent an accurate estimate of precision. A more reliable indication of precision is given by the results from set 6, where the otoliths were clearly presented and which were collected from an area where the highest catches of western mackerel are taken.

An appropriate measure of precision was considered to be a value of 2.00 for 2stdev calculated from the modal and assigned age (Table 5.10). With the exception of reader 2, all western area readers could achieve this precision for

age determinations of fish up to and including 11 years. Reader 2 thought his age determinations for this sample were probably not as reliable as they should have been because of the time constraint imposed at the Workshop. The precision was expected to have been higher if the readers would have assigned the ages at their own institute. Therefore, the estimated precision may be an underestimate.

In compliance with the third term of reference, the Mackerel Otolith Workshop recommends that the ICES Assessment Working Group should continue to use age groups for assessment purposes up to and including age 11 years with a 12+ group.

6.10 Reference collection

The 1994 Methods Working Group (Anon., 1994) recommended that at all future Otolith Workshops, wherever possible, a reference collection of otoliths should be agreed by all readers. This reference collection of otoliths could then be used in future otolith exchanges to check reader's accuracy and precision. The reference collection could also be used for training purposes.

It was agreed that the mackerel otolith reference collection should consist of otoliths from Division IVa (set 6) because this set was well prepared and the addition of a coverslip to the surface of the slide would help protect the sample and hence make the slides more durable. It was agreed that only the ages for which all 10 readers agreed (55 out of 148) and the ages for which only 1 reader disagreed by only 1 year difference (7 out of 148) would be used in the reference collection. Although it would have been useful to include other older and more difficult otoliths in the reference set, if agreement could be achieved after discussion of the otolith, complete agreement on additional otoliths could not be achieved, because some of the clarity and resolution of the image was lost when projected onto the monitor. For those otoliths that were clear enough to be discussed, readers tended not to change their minds on the ages they had originally assigned, and therefore no more otoliths were added to the reference collection.

7 GUIDE-LINES ON AGE READING

Viewing the otoliths

It is recommended that the otoliths are viewed with a binocular microscope, using bright reflected light, preferably from a fibre optic light source, with a magnification of between x15 and x40 depending on the size of the otolith.

Age determination criteria

It is essential that all otolith readers are aware of the age determination criteria that should be applied before age determination is attempted (Anon., 1994). The age determination criteria for mackerel are as follows:

1. The date of birth is assumed to be 1 January and the fish is assigned to a year class on this basis. Therefore, the date of capture of the sample should always be available.
2. One opaque zone and one hyaline zone constitutes one year of growth (annulus).
3. The timing of the formation of the opaque zone on the edge of the otolith is heavily dependent on the area from which the sample was taken. When allocating the fish to a year class therefore, the area of capture should also be known.

Other available information

Other information that may be available about the fish will be the total fish length and also sex and maturity stage. There are some schools of thought that believe that length information may influence the decision of the reader when assigning an age. While this may be true, any experienced otolith reader will know from the features of an otolith, the approximate length of the fish. It could be an advantage to have the length available when reading samples of otoliths that are mounted together in large numbers. It is often possible to identify whether otoliths have been mixed up during sampling or preparation.

Otolith interpretation

It is always preferable to have the pair of whole otoliths available when trying to interpret the ring structure. Mackerel otoliths can vary in appearance and therefore it is important to remember that there is no one "correct" position where to count rings. Ideally, the translucent, hyaline rings should be counted and usually the preferred areas include the rostrums and the posteria regions. As many locations as possible on the otoliths should be examined where the ring structure is clear and the annual rings are visible. This usually involves counting both rostrums and both posteria regions until the reader is satisfied that consistent interpretation has been achieved. However, it is sometimes possible that other areas of the otolith are readable, e.g. the anti-rostrum, and interpretation of appropriate parts of the otolith should be considered, especially if one of the otoliths is broken, missing or crystalline.

Often conflicting ages may be achieved, if several parts of the otoliths are examined (usually in older fish). If this happens, the oldest age is probably the correct one, as examination of tagged fish otoliths of known minimum age, has demonstrated that the highest age is more consistent with the information on the history of the fish (Anon., 1987a and section 6.2). Therefore, as a general rule, if in doubt about the interpretation of the rings, assign the fish to the highest age. However, this does not mean that false or split rings should be counted.

False or split rings

It is always difficult to define the appearance of false or split rings on otoliths for any species. Usually these are properly identified only after much experience has been gained for a particular species. False or split rings are usually considered to be those rings that are not as well defined as annual rings. The reason for the deposition of

false or split rings is not certain, but they might be caused by aberrant temperature, feeding or spawning conditions or disease.

Factors affecting annual ring formation

1) Formation of the first winter ring

Mackerel spawn from January to April in (Division IXa), from February to May in southern Biscay (Division VIIIc), March to July in the Celtic Sea and to the west of Ireland, from June to August in the North Sea (Divisions IVb and IIIa) (section 2.1). Therefore the amount of time available for growth and the formation of the opaque zone in the first year will vary within and between areas. It is therefore reasonable to expect a large amount of variation in the length of the L_1 (first years growth on the otolith) and this should be borne in mind when interpreting the first opaque and hyaline zone. In addition to the variation in L_1 between areas, it has also been demonstrated that there is consideruble variation in the L_1 between years for the Celtic Sea and the North Sea (Dawson, 1991). The reader therefore, when interpreting the ring structure should be aware of sources of variation that may affect the nature of annual ring formation in the first year.

2) Age at maturity

In the majority of mackerel otoliths examined, there is a change in the pattern of ring formation that is presumably associated with the onset of maturity. Usually, growth slows down when the fish diverts much of it's energy into gonad maturation. The resultant effect on the otolith is that for juvenile fish a large amount of opaque growth is produced between the much narrower hyaline rings. After maturity, growth slows down and both the opaque and the hyaline rings become more narrow and therefore closer together.

The above description is only a guide to the pattern of ring formation and obviously there is much variation in the age at maturity within an area as well as between areas. It is also quite possible that this change in the pattern of ring formation associated with maturity is not present. Sometimes otoliths may be observed to have very regular, clearly defined ring formation with only a linear decline in growth rate.

3) Reduced growth in very old fish

In most young and middle aged fish the growth pattern is well defined on the otolith with clear contrasting zones of opaque and hyaline. However, in old fish growth slows often down to such an extent that the opaque and hyaline zones become confused and more difficult to distinguish. That portion of the otolith will have a greyish appearance. When this type of ring formation is observed the reader usually finds that the hyaline rings are very close together and difficult to identify. However, usually each narrow hyaline ring and grey ring comprises one years growth.

8 SUMMARY AND CONCLUSIONS

The 6 sets of otolith samples read by 10 otolith readers during the 1994 Mackerel Otolith Exchange and at this Workshop covered the area of the main distribution of the northeast Atlantic mackerel.

The first set of otoliths to be read at the Workshop was a validation set, which contained otoliths of known age. The ageing method was validated up to age 8. Results of the analysis of this validation set showed clearly the errors in the readings. Most readers had to try to correct for underestimation of the age of the older fish. One reader had to correct for overestimation and one for underestimation of most age groups. The assumption that modal age could be used as a best estimate of age was confirmed by a plot of modal age against actual age. This validation set contained one pair of otoliths with an actual age of 23 years. The modal age corresponded with actual age, while the average age was underestimated (20.7 years). After thorough discussions of the validation set the results of the 1994 Mackerel Otolith Exchange were discussed to make the otolith readers aware of their errors in age reading.

New samples from Divisions IXa and IVb,c were read to detect whether special problems occurred in these areas. Due to the relatively early opaque and hyaline ring formation in the otoliths from Division IXa, the rings were misinterpreted (mainly in young fish) by many of the readers, who were not familiar with this area. Information on the edge type of the otolith (e.g. hyaline or opaque) should be collected in future by area and by age group in order to achieve better interpretation of the hyaline and opaque edges.

After thorough discussions on these sets the set from Divisions VIa and VIIb,c was read a second time to estimate the improvement in precision (first time readings were from the 1994 Mackerel Otolith Exchange). However, due to the bad quality of this otolith set (resin was not protected with a glass coverslip) a new set of otoliths from Division IVa was used to measure the precision in the age readings.

The results from this Division IVa set made the Workshop recommend that the Mackerel, Horse Mackerel, Sardine and Anchovy Assessment Working Group should use age groups up to and including age 11 with a 12+ age group. The otolith readers suggest that the results on precision achieved at the Workshop were an underestimate, because of the stress from a strong time schedule, other microscopes, the many otoliths to read, etc.

Guide-lines on mackerel otolith reading were presented in the report. Of 148 otoliths from Division IVa 62 were accepted as a reference set (full agreement on all otoliths).

9 RECOMMENDATIONS

1) The Workshop recommends that the Mackerel, Horse Mackerel, Sardine and Anchovy Assessment Working Group uses age groups up to and including age 11 with a 12+ age group.

2) Mackerel otolith exchanges should be conducted regularly to check for any changes in agreement between readers of the different countries.

3) Only slides with otoliths mounted in resin with glass coverslips should be used in future exchanges / workshops and for reference collections.

4) In future, reference collections of otoliths should include all areas to be used in future exchanges.

5) In future exchanges, the "quality" of each otolith should be indicated by assigning each otolith a number, on a scale of 0 to 3 (0 = not observed; 1 = rings can easily be counted; 2 = rings can not easily be counted; 3 = rings can not be counted).

6) Otolith readers should collect information on the edge type (e.g. opaque or hyaline) of the otolith for each age group, by month and by area.

10 WORKING DOCUMENTS

Villamor, B. and Meixide, M. 1995 WD. Results of the Mackerel Otolith Exchange.

11 REFERENCES

Anon., 1987a. Report of the mackerel age determination workshop, Lowestoft, 1-6 June 1987. Report prepared for EC contract.

Anon. 1987b. Report of the Mackerel Working Group. ICES C.M. 1987/Assess:11, 72 pp.

Anon. 1988. Report of the Mackerel Working Group. ICES C.M. 1988/Assess:12, 82 pp.

Anon. 1989. Report of the Mackerel Working Group. ICES C.M. 1989/Assess:11, 85 pp.

Anon. 1990a. Second report of the EEC-Norwegian Joint Scientific Group on Migration and Area Distribution of Mackerel (Western Stock), Brussels, 12-13 December 1989. ICES C.M. 1990/H:5, 43 pp.

Anon. 1990b. Report of the Mackerel Working Group. ICES C.M. 1990/Assess:19, 109 pp.

Anon. 1991a. Report of the Mackerel Working Group. ICES C.M. 1991/Assess:19, 90 pp.

Anon. 1991b. Report of the Workshop on Mackerel in Divisions VIIIc and IXa. Lisbon, 5-7 March 1991. ICES C.M. 1991/H:47, 63pp.

Anon. 1991c. Report of the Horse Mackerel (Scad) Otolith Reading Workshop. Lisbon, 21-27 November 1990. ICES C.M. 1991/H:59, 59pp.

Anon. 1993a. Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine, and Anchovy. ICES C.M. 1993/Assess:19, 274 pp.

Anon. 1993b. Report of the Mackerel/Horse Mackerel Egg Production Workshop. ICES C.M. 1990/H:4, 142 pp.

Anon., 1994. Report of the Workshop on Sampling Strategies for Age and Maturity. ICES C.M. 1994/D:1, 67pp.

Anon., 1995. Report of the Working Group on the Assessment of Mackerel, Horse mackerel, Sardine and Anchovy. ICES C.M. 1995/Assess: 2, 329 pp.

Beamish, R.J. and McFarlane, G.A. 1983. The forgotten requirement for age validation in fisheries biology. Trans. Am. Fish. Soc. 112: 735-743.

Coombs, S. H. and Mitchell, C. E. 1981. Long-term trends in the distribution, abundance and seasonal occurrence of larvae of mackerel (*Scomber scombrus* L.) around the British Isles, 1948-1978. J. Mar. Biol. Ass. U.K., 61: 343-358.

Cort, J.L. 1982. Biology and fishing of the mackerel, Scomber scombrus L. in the Cantabrian Sea (N. Spain). ICES C.M. 1982/H:35, 15pp.

Dawson, Wendy A. 1991. Otolith measurement as a method of identifying factors affecting first-year growth and stock separation of mackerel (*Scomber scombrus* L.). J. Cons. int. Explor. Mer, 47: 303-317.

Dawson, Wendy A. 1986. Changes in Western mackerel (*Scomber scombrus*) spawning stock composition during the spawning season. J. mar. biol. Ass. U.K., 66: 367-383.

Dawson, Wendy A., Walsh, M., Hopkins, P., Eltink, A. and Molloy, J. 1988. The distribution and abundance of juvenile mackerel (*Scomber scombrus* L.) west and south of the British Isles. ICES C.M. 1988/H:16.

Eltink, A.T.G.W. 1987 Changes in age-size distribution and sex ratio during spawning and migration of Western mackerel (*Scomber scombrus* L.) J. Cons. int. Explor. Mer, 44: 10-22.

Gordo, L.S., Martins, M.M.B. and Jorge I.M. 1982. Preliminary study on the age and growth of mackerel (*Scomber scombrus* L.) in the ICES Sub-area IX. ICES C.M. 1982/H:16.

Hamre, J. 1980. Biology, exploitation and management of the northeast Atlantic mackerel. Rapp. P.-v. Réun. Cons. int. Explor. Mer, 177: 212-242.

Iversen, S. A. 1981. Spawning and trends in spawning stock size of the North Sea mackerel during the period 1973-80. ICES C.M. 1981/H:16, 9 pp.

Jamieson, A. and Smith, P. J. 1987. Atlantic mackerel (*Scomber scombrus* L.) stocks and genes: a review. J. Cons. int. Explor. Mer, 44: 66-72.

Jorge, I.M., Gordo, L.S., Martins, M.M.B., 1982. On the sexual maturation and condition factor of *Scomber scombrus* L. from the occidental coast of Portugal during 1981. ICES C.M. 1982/H:58, 6pp.

Lago de Lanzós, A., Solá, A., L., Motos and Franco, C. 1993. Mackerel (*Scomber scombrus* L.) Egg Distribution and Stage I Egg Production Estimates in Division VIIIb,c and IXa north from 1988, 1990 and 1992. ICES, C.M. 1993/H:44, 11 pp.

Lockwood, S. J. 1988. The mackerel: its biology, assessment and management of a fishery. Fishing News Books, Farnham, UK, 181 pp.

Lockwood, S. J., Nichols, J. H. and Dawson, Wendy A. 1981. The estimation of a mackerel (*Scomber scombrus* L.) spawning stock size by plankton survey. J. Plank. Res., 3: 217-233.

MacKenzie, K. 1990. Cestode parasites as biological tags for mackerel (*Scomber scombrus* L.) in the northeast Atlantic. J. Cons. int. Explor. Mer, 46: 155-166.

MacKenzie, K. and Mehl, S. 1984. The cestode parasite Grillotia angeli as a biological tag for mackerel in the eastern North Atlantic. ICES C.M. 1984/H:52, 13 pp.

Ricker, W.E. 1969. Effects of size-selection mortality and sampling bias on estimates of growth, mortality, production, and yield. Journal of the Fisheries Research Board of Canada 26: 479-541.

Solá, A., Lago de Lanzós A. and Franco, C. 1994. Seasonal occurrence of mackerel and horse mackerel eggs and larvae in the Cantabrian Sea (VIIIc) and Galicia (IXa) from 1990 to 1992. WD 1994. in: ICES C.M. 1994/H:4, 58 pp.

Walsh, M. and Martin, J. H. A. 1986. Recent changes in the distribution and migrations of the Western mackerel stock in relation to hydrographic changes. ICES C.M. 1986/H:17, 24 pp.

Table 3.1 Summary of mackerel otolith preparation techniques used.

Country	Method of cleaning	Preparation techniques for otolith examination	Otoliths per slide
Netherlands	In alcohol	The otoliths are stuck to a black hardboard slide with a drop of gum arabic. The otoliths are then covered with polyester resin a little at a time to allow for shrinkage of the resin. This resin dries to a smooth hard surface and no coverslip is needed.	25
Scotland	In hot water	In the past the otoliths have been mounted on black perspex slides and covered with one layer of resin with no coverslip on the surface. Since 1989, to save time, the otoliths are left unmounted and viewed in a black dish in alcohol. The otoliths are stored for only 2 or 3 years.	10
England	In hot water	The otoliths are stuck to a black perspex slide with a drop of resin. When dry, another layer of resin is used to enable a coverslip to be placed over the slide, while the resin is wet. Before reading the resin is allowed to dry.	25
Norway	In water	Otoliths cleaned in water, dried thouroughly in heating cabinet, placed on black perspex slides and covered with two layers of non plastic resin (Histokit). No coverslip on surface.	25
Spain (IEO)	In water	Otoliths are placed on black perspex slides and covered with resin (Eukit).	10
Spain (AZTI)	In water	Otoliths are mounted on black slides and covered with resin (Eukit).	25
Ireland	In hot water	Otoliths fixed to black perspex slides with resin and then covered with a glass coverslip, while the resin is wet. Before reading the resin was allowed to dry.	25
Denmark	In alcohol	The age is determined from the otoliths submerged in alcohol in the black perspex slides. This method enables turning and adjusting of the otoliths when reading. The otoliths are not stored after reading.	-
Russia	In cold water	For age reading the otoliths are submerged in a mixture of equal parts of 96% alcohol and glycerine. This method was used since 1980, but since 1994 100% glycerine was used. After reading the otoliths are stored in envelopes.	-
Portugal	In water	Otoliths are mounted on black slides and covered with a polyester resin.	10

Table 3.2 Summary of mackerel otolith sets used for age reading.

Set No.	Name of otolith set	Months caught	No. of otoliths	Remarks
1	VALIDATION COLLECTION (Div. IVa)	Jan - Dec	43	Otoliths from fish of 'known' age
2	DIVISION VIa & VIIb,c	Jan - Apr	200	1994 Otolith Exchange Sample
3	DIVISION VIIIc & IXa	Jan - Sept	188	1994 Otolith Exchange Sample
4	DIVISION IVb,c	May - Nov	169	new set
5	DIVISION IXa	Jan - Dec	174	new set
6	DIVISION IVa	January	148	new set

Table 4.1 MACKEREL DIVISIONS VIa & VIIb,c First readings

Year	Sample	Fish no	Fish length	Catch month	Netherl. Reader 1	Scotland Reader 2	England Reader 3	Norway Reader 4	Sp(IEO) Reader 5	Ireland Reader 6	Sp(AZTI) Reader 7	Portugal Reader 8	Denmark Reader 9	Russia Reader 10	Age MODE	Age difference	Age Average
90	4	1	33.4	1	6	6	6	6	6	6	6	5	6	6	6	1	5.90
90	4	2	35.9	1	6	6	6	6	6	6	5	5	4	7	6	3	5.70
90	4	3	35.3	1	3	3	3	3	3	3	3	3	3	3	3	0	3.00
90	4	4	35.9	1	6	7	6	6	6	6	5	5	5	6	6	2	5.80
90	4	5	36.6	1	5	6	5	6	5	6	5	5	5	6	5	1	5.40
90	4	6	36.2	1	4	4	3	4	4	4	3	3	4	5	4	2	3.80
90	4	7	36.3	1	5	5	4	5	5	5	5	4	5	5	5	1	4.80
90	4	8	37.9	1	7	9	7	10	8	10	10	5	9	9	9	5	8.40
90	4	9	38.6	1	5	6	6	6	6	6	5	5	6	6	6	1	5.70
90	4	10	38.7	1	6	6	6	6	6	6	6	4	6	6	6	2	5.80
90	4	11	39.0	1	7	10	6	7	7	8	7	5	-	10	7	5	7.56
90	4	12	39.9	1	5	6	5	6	5	6	5	5	6	6	5	1	5.50
90	4	13	39.1	1	5	6	5	6	6	6	6	5	5	6	6	1	5.80
90	4	14	40.4	1	14	-	13	12	13	-	12	8	12	13	13	6	12.13
90	4	15	40.7	1	5	6	5	5	5	5	5	4	5	5	5	2	5.00
90	4	16	40.6	1	7	15	6	10	9	10	9	5	6	9	9	10	8.60
90	4	17	40.3	1	6	10	7	10	8	9	9	5	10	9	9	5	8.40
90	4	18	40.9	1	-	-	-	-	-	-	-	-	-	-			
90	4	19	41.4	1	6	9	6	10	7	9	7	4	7	8	9	6	7.70
90	4	20	41.6	1	9	9	9	10	9	10	9	6	9	10	9	4	9.00
90	4	21	42.7	1	9	-	9	10	-	-	6	5	7	7	9	5	7.57
90	4	22	42.0	1	6	11	6	9	6	9	7	7	9	9	9	4	8.40
90	4	23	42.4	1	6	14	7	-	12	12	11	6	-	-	12	8	10.14
90	4	24	43.7	1	10	12	4	-	10	11	8	4	9	6	10	8	8.22
90	4	25	46.4	1	12	13	7	-	12	11	8	4	8	10	12	9	9.44
90	11	1	29.8	2	3	3	3	3	3	3	3	3	3	3	3	0	3.00
90	11	2	30.6	2	3	3	3	3	3	3	3	3	3	3	3	0	3.00
90	11	3	29.9	2	2	2	2	2	2	2	2	3	3	3	2	1	2.30
90	11	4	32.1	2	4	6	4	-	4	6	5	3	4	5	4	3	4.56
90	11	5	31.3	2	5	6	5	5	5	5	4	4	5	5	5	2	4.90
90	11	6	31.2	2	3	3	3	3	3	3	3	3	3	3	3	0	3.00
90	11	7	32.2	2	3	3	3	3	3	3	3	3	3	3	3	0	3.00
90	11	8	32.4	2	3	3	3	3	3	3	3	3	3	3	3	0	3.00
90	11	9	32.4	2	3	3	3	3	3	3	3	3	3	3	3	0	3.00
90	11	10	32.4	2	3	3	3	3	3	3	3	3	3	3	3	0	3.00
90	11	11	32.5	2	4	4	4	4	4	4	4	3	4	4	4	1	3.90
90	11	12	35.6	2	4	5	5	5	4	5	4	3	5	5	5	2	4.50
90	11	13	36.4	2	4	6	6	6	6	6	6	4	6	6	6	2	5.80
90	11	14	37.9	2	6	5	4	6	5	6	5	4	6	6	6	2	5.30
90	11	15	38.2	2	5	5	4	6	5	6	4	4	5	6	5	2	5.00
90	11	16	38.2	2	6	6	6	6	6	6	5	4	6	6	6	2	5.70
90	11	17	39.8	2	6	6	6	6	6	6	6	6	6	6	6	0	6.00
90	11	18	40.7	2	8	8	10	9	8	9	8	5	8	9	8	5	8.20
90	11	19	40.7	2	10	10	8	10	10	10	9	-	10	10	10	2	9.67
90	11	20	40.7	2	7	8	9	9	8	9	8	3	8	8	8	6	7.50
90	11	21	40.2	2	8	9	9	8	8	10	8	-	9	8	8	2	8.56
90	11	22	41.1	2	6	6	6	6	6	6	6	5	6	6	6	1	5.90
90	11	23	41.6	2	8	9	8	9	8	9	8	-	8	7	8	2	8.22
90	11	24	43.9	2	12	14	11	14	12	14	11	-	10	10	14	4	12.00
90	11	25	45.3	2	14	-	10	15	15	15	9	4	10	14	15	11	11.78
91	13	1	32.3	2	5	5	5	5	5	5	5	4	5	5	5	1	4.90
91	13	2	34.9	2	4	4	4	4	4	4	4	3	4	4	4	1	3.90
91	13	3	35.2	2	4	4	3	4	4	4	3	3	3	4	4	1	3.60
91	13	4	36.6	2	6	7	6	7	6	7	6	4	6	7	6	3	6.20
91	13	5	36.7	2	4	4	4	4	4	4	4	3	4	4	4	1	3.90
91	13	6	36.2	2	4	4	4	4	4	4	4	3	4	4	4	1	3.90
91	13	7	38.0	2	4	4	4	7	4	4	4	4	4	4	4	3	4.30
91	13	8	39.0	2	7	9	7	7	7	6	5	-	6	-	7	2	6.38
91	13	9	39.8	2	7	7	7	8	7	7	7	5	6	7	7	3	6.80
91	13	10	39.0	2	8	7	7	7	7	7	6	5	7	7	7	3	6.90
91	13	11	38.3	2	7	7	7	8	7	7	7	5	7	6	7	3	6.60
91	13	12	39.6	2	6	8	7	9	7	8	7	4	5	9	8	5	6.90
91	13	13	39.9	2	9	11	9	10	-	10	8	-	8	8	9	3	9.13
91	13	14	40.7	2	11	9	8	-	11	11	9	3	10	9	11	8	9.00
91	13	15	40.6	2	7	8	7	8	6	7	7	3	7	6	7	5	6.60
91	13	16	40.9	2	7	10	7	10	7	8	7	5	7	7	7	5	7.50
91	13	17	41.5	2	12	12	12	15	13	13	14	3	12	14	12	12	12.00
91	13	18	41.2	2	7	8	7	8	7	7	6	4	7	7	7	4	6.80
91	13	19	41.4	2	12	13	11	12	12	11	11	-	11	11	11	2	11.50
91	13	20	42.9	2	8	-	9	10	8	9	7	4	8	8	8	6	7.89
91	13	21	43.3	2	15	-	12	-	-	15	9	4	-	11	15	11	11.00
91	13	22	42.1	2	11	11	10	10	10	11	8	4	12	-	11	9	9.67
91	13	23	43.5	2	12	10	12	13	12	13	10	-	12	12	12	6	12.44
91	13	24	45.1	2	13	14	13	15	13	15	13	-	12	14	13	3	13.56
91	13	25	45.3	2	10	10	14	-	15	-	9	4	15	8	10	12	12.13
91	35	1	37.5	4	8	8	8	7	6	8	8	4	6	6	8	4	6.10
91	35	2	39.0	4	9	11	10	10	10	10	10	5	10	10	10	6	9.50
91	35	3	42.0	4	8	10	8	10	8	10	7	5	8	6	8	5	8.00
91	35	4	41.1	4	11	14	10	-	11	10	10	4	13	11	11	10	10.44
91	35	5	41.7	4	11	11	10	11	11	10	11	5	10	11	11	5	10.20
91	35	6	41.3	4	7	10	8	7	8	7	8	4	8	8	7	6	6.90
91	35	7	43.3	4	13	11	11	12	13	12	11	6	10	11	11	7	11.00
91	35	8	42.6	4	11	11	10	11	11	10	10	6	10	10	10	5	10.00
91	35	9	42.5	4	11	9	9	11	10	10	9	5	9	9	9	6	9.20
91	35	10	42.0	4	11	12	10	11	10	10	9	5	11	11	11	7	10.00
91	35	11	42.5	4	10	15	9	11	9	10	7	6	9	11	9	9	9.70
91	35	12	42.8	4	10	10	11	10	11	10	10	6	10	10	10	5	9.80
91	35	13	42.0	4	9	11	8	10	10	10	9	5	7	7	10	6	8.50
91	35	14	42.4	4	9	10	9	8	8	10	8	5	8	8	8	5	8.40
91	35	15	42.0	4	10	11	8	9	10	10	9	-	10	8	10	3	9.44
91	35	16	43.0	4	10	10	10	10	10	10	10	5	9	10	10	5	9.40
91	35	17	43.6	4	10	11	10	10	9	10	9	6	9	9	10	5	9.30
91	35	18	43.2	4	10	10	10	10	10	9	9	7	9	10	10	3	9.40
91	35	19	43.6	4	7	-	5	-	7	7	6	5	5	7	7	2	6.13
91	35	20	44.0	4	10	11	10	10	10	10	9	5	9	10	10	6	9.40
91	35	21	44.5	4	-	-	-	-	-	-	-	-	-	-			
91	35	22	45.5	4	15	13	12	13	13	12	9	5	12	-	12	10	11.44
91	35	23	45.8	4	13	15	12	13	13	13	9	-	11	12	13	9	12.33
91	35	24	46.0	4	13	14	10	12	13	13	11	-	13	13	13	4	12.44
91	35	25	47.7	4	15	16	11	14	14	14	11	5	13	-	14	11	12.56
92	35	1	25.7	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00

Table 4.1 continued

92	35	2	26.2	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	3	26.6	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	4	26.7	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	5	26.5	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	6	27.3	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	7	27.4	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	8	27.2	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	9	27.3	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	10	27.3	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	11	27.6	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	12	27.8	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	13	28.1	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	14	28.8	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	15	29.1	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	16	29.7	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	17	29.1	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	18	29.7	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	19	29.7	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	20	29.1	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	21	30.7	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	22	30.8	3	3	3	3	3	3	3	3	3	3	3	3	0	3.00
92	35	23	31.0	3	3	3	3	3	3	3	3	3	3	3	3	0	3.00
92	35	24	31.8	3	3	3	3	3	3	3	3	3	3	3	3	0	3.00
92	35	25	36.4	3	6	6	4	6	5	6	4	3	7	6	6	4	5.30
93	6	1	32.8	2	3	3	3	3	3	3	2	2	3	3	3	1	2.60
93	6	2	34.8	2	5	5	5	5	5	5	5	3	6	5	5	3	4.90
93	6	3	34.0	2	4	4	4	4	4	4	4	3	4	4	4	1	3.90
93	6	4	34.3	2	4	4	3	4	4	4	3	3	4	4	4	1	3.70
93	6	5	35.2	2	5	5	5	5	6	5	5	3	5	5	5	2	4.80
93	6	6	36.5	2	4	4	4	4	4	4	3	2	4	4	4	2	3.70
93	6	7	36.3	2	5	5	4	5	5	4	4	4	5	4	5	1	4.50
93	6	8	37.2	2	5	4	3	-	4	4	4	3	4	4	4	2	3.89
93	6	9	37.8	2	8	9	5	9	8	9	8	4	8	9	8	5	7.70
93	6	10	37.5	2	8	7	7	7	7	7	7	5	7	8	7	3	6.60
93	6	11	37.2	2	9	8	9	9	8	9	5	8	9	9	9	4	8.00
93	6	12	38.5	2	6	6	6	-	6	5	6	3	6	6	6	3	5.56
93	6	13	37.3	2	5	5	4	-	5	6	7	4	4	6	5	4	5.33
93	6	14	38.0	2	8	9	7	9	-	8	5	8	8	8	8	4	7.33
93	6	15	39.1	2	10	11	10	12	10	13	7	6	10	11	10	7	10.00
93	6	16	39.0	2	6	5	5	6	6	6	5	4	6	6	6	2	5.50
93	6	17	39.3	2	11	13	12	13	12	13	11	5	13	13	13	8	11.80
93	6	18	40.2	2	9	8	6	9	7	8	7	6	8	9	8	3	7.60
93	6	19	40.8	2	8	8	6	7	6	7	7	5	7	7	7	4	7.10
93	6	20	40.8	2	11	12	8	12	11	12	10	5	11	11	11	7	10.30
93	6	21	40.6	2	9	9	8	8	8	9	8	6	9	9	8	3	8.40
93	6	22	41.3	2	9	10	9	-	9	9	8	7	8	8	8	3	8.88
93	6	23	41.0	2	9	14	8	-	11	9	8	8	8	10	8	8	9.44
93	6	24	43.1	2	11	13	12	13	12	13	11	5	9	13	13	8	11.20
93	6	25	45.8	2	17	-	14	-	18	16	13	7	16	-	16	10	14.14
93	26	1	36.6	3	4	6	5	6	5	6	5	4	5	6	6	2	5.29
93	26	2	37.8	3	5	5	5	5	5	5	4	4	5	5	5	1	4.80
93	26	3	37.9	3	6	6	5	6	6	6	5	4	6	6	6	2	5.60
93	26	4	38.8	3	6	6	6	6	6	6	5	4	6	6	6	2	5.70
93	26	5	38.7	3	6	8	6	7	6	9	5	4	7	6	6	5	6.40
93	26	6	38.3	3	7	8	6	8	7	8	7	5	7	8	7	3	7.10
93	26	7	38.5	3	6	6	6	6	6	6	6	5	7	7	6	2	6.10
93	26	8	39.0	3	6	8	6	8	6	8	7	5	7	8	6	4	7.00
93	26	9	40.0	3	6	6	4	6	6	7	5	4	5	6	6	3	5.50
93	26	10	39.7	3	7	6	6	8	6	9	6	4	8	10	8	8	7.60
93	26	11	40.7	3	7	9	7	8	7	9	7	5	8	8	7	4	7.50
93	26	12	40.4	3	5	5	5	6	5	5	5	4	6	5	5	2	5.10
93	26	13	40.4	3	8	7	8	7	6	6	6	5	7	8	6	2	6.20
93	26	14	40.7	3	8	10	8	-	8	11	11	5	8	9	8	6	8.67
93	26	15	41.3	3	7	9	7	9	7	7	8	5	9	9	7	4	7.70
93	26	16	42.8	3	12	14	7	10	10	13	9	8	9	10	10	6	10.00
93	26	17	42.4	3	13	13	8	13	13	13	11	6	8	13	13	7	11.10
93	26	18	43.5	3	12	15	9	10	12	11	10	4	10	10	10	11	10.30
93	26	19	43.9	3	12	14	11	12	12	12	11	6	11	10	12	8	11.10
93	26	20	43.9	3	12	14	12	13	12	14	12	6	13	13	12	8	12.10
93	26	21	44.0	3	10	11	9	-	12	11	9	5	12	13	11	8	10.22
93	26	22	44.9	3	13	19	11	-	15	15	13	5	15	-	15	14	13.25
93	26	23	45.3	3	15	18	15	-	14	-	15	7	15	14	15	11	14.13
93	26	24	45.3	3	13	10	15	-	15	-	13	5	14	14	13	10	12.38
93	26	25	46.8	3	10	9	8	-	10	11	9	5	8	10	10	8	8.99
93	30	1	35.7	3	5	5	5	5	5	5	5	4	5	5	5	2	5.00
93	30	2	38.8	3	6	6	6	6	5	6	5	4	6	5	6	2	5.50
93	30	3	39.2	3	6	7	6	6	6	7	5	4	7	6	6	3	6.00
93	30	4	38.3	3	9	10	9	9	8	9	8	5	9	9	9	5	8.50
93	30	5	39.1	3	8	10	9	9	9	9	7	5	9	8	9	5	8.30
93	30	6	40.8	3	9	9	9	9	9	9	7	4	9	9	9	5	8.30
93	30	7	40.7	3	9	9	10	9	9	9	8	5	9	9	9	5	8.50
93	30	8	40.5	3	8	9	8	9	8	9	8	5	9	9	9	4	8.20
93	30	9	41.0	3	7	7	7	7	7	7	7	5	9	7	7	3	6.90
93	30	10	40.9	3	7	8	8	7	7	8	7	4	9	7	7	3	6.30
93	30	11	41.2	3	8	8	8	8	8	9	8	4	8	8	8	4	7.60
93	30	12	41.9	3	10	14	14	-	13	13	11	4	14	11	14	10	11.44
93	30	13	42.8	3	9	-	8	-	8	11	7	5	10	7	8	8	8.13
93	30	14	42.3	3	9	8	9	9	9	9	8	5	9	9	9	4	8.50
93	30	15	42.0	3	14	18	14	13	14	14	11	5	13	14	14	11	12.80
93	30	16	42.2	3	9	-	9	-	9	9	8	6	10	9	9	4	8.63
93	30	17	43.6	3	11	15	13	11	11	12	9	-	11	9	11	8	11.33
93	30	18	43.6	3	9	11	9	10	10	12	8	6	10	11	10	6	9.80
93	30	19	44.0	3	12	13	13	12	12	12	12	8	12	13	12	5	11.90
93	30	20	43.3	3	9	5	5	-	7	5	5	4	6	6	5	5	5.78
93	30	21	43.5	3	11	9	9	9	9	9	8	4	9	8	9	7	8.50
93	30	22	44.4	3	15	14	16	-	14	13	9	5	15	11	15	10	11.78
93	30	23	44.2	3	13	17	9	-	10	13	13	5	10	12	13	12	11.22
93	30	24	44.2	3	16	16	16	-	15	15	12	6	14	15	16	10	13.89
93	30	25	45.8	3	20	22	20	-	20	-	13	-	18	-	20	9	16.83
			Total read		198	180	198	169	194	192	198	184	195	190			
			Total NOT read		0	0	0	29	4	6	0	14	3	8			
			Empty rows		2	2	2	2	2	2	2	2	2	2			

Table 4.2 The mean age recorded, 2stdev, CV (%), the number of age readings and the agreement with modal age are presented by modal age for each reader and for all readers combined. The number of age readings and the agreement is given for age groups 0-15 combined.

READER 1	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	3.00	4.08	5.19	5.77	7.06	7.94	8.95	10.13	11.20	12.00	12.67	12.75	14.40	
	2stdev	-	-	0.00	0.00	0.58	2.09	1.17	0.86	1.45	2.05	1.77	1.58	3.21	2.00	4.43	1.79	
	CV (%)	-	-	0%	0%	7%	20%	10%	6%	9%	11%	9%	7%	13%	8%	17%	6%	
	Number of age readings	-	-	22	12	12	16	26	17	18	19	16	10	8	9	4	5	194
	Agreement with modal age	-	-	100%	100%	92%	88%	85%	82%	67%	63%	63%	70%	75%	67%	25%	0%	77%

READER 2	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	3.00	4.17	5.31	6.31	8.00	9.06	10.06	11.13	11.90	13.63	13.63	15.00	17.00	
	2stdev	-	-	0.00	0.00	1.15	0.98	1.58	2.73	2.58	4.55	3.00	3.46	2.38	3.99	2.31	5.29	
	CV (%)	-	-	0%	0%	14%	9%	12%	17%	14%	23%	13%	15%	9%	15%	8%	16%	
	Number of age readings	-	-	22	12	12	16	26	16	16	17	16	10	8	8	4	3	186
	Agreement with modal age	-	-	100%	100%	92%	69%	65%	31%	25%	53%	25%	40%	13%	38%	50%	0%	56%

READER 3	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	3.00	3.87	4.75	5.62	6.71	7.94	8.47	8.88	10.00	10.75	11.56	12.50	11.60	
	2stdev	-	-	0.00	0.00	0.95	0.89	1.39	1.37	2.42	2.15	3.42	2.98	4.75	4.37	3.46	4.15	
	CV (%)	-	-	0%	0%	13%	9%	12%	10%	15%	13%	19%	15%	22%	19%	14%	18%	
	Number of age readings	-	-	22	12	12	16	26	17	16	19	16	10	8	9	4	5	194
	Agreement with modal age	-	-	100%	100%	67%	75%	73%	65%	38%	63%	44%	20%	50%	22%	50%	20%	62%

READER 4	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	3.00	4.30	5.29	6.24	7.69	9.06	9.50	10.14	11.29	12.83	13.00	13.67	15.00	
	2stdev	-	-	0.00	0.00	1.90	0.94	1.05	1.76	1.54	1.46	1.33	1.51	2.34	2.00	1.15	-	
	CV (%)	-	-	0%	0%	22%	9%	8%	11%	9%	8%	7%	7%	9%	8%	4%	-	
	Number of age readings	-	-	22	12	10	14	25	16	16	16	14	7	6	7	3	1	169
	Agreement with modal age	-	-	100%	100%	90%	71%	80%	50%	25%	69%	79%	43%	50%	57%	67%	100%	70%

READER 5	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	3.00	4.00	5.06	5.85	6.94	7.88	8.78	10.19	11.20	12.25	12.67	13.25	14.50	
	2stdev	-	-	0.00	0.00	0.00	1.15	0.74	0.86	0.68	1.76	1.31	1.84	0.93	2.65	1.91	1.15	
	CV (%)	-	-	0%	0%	0%	11%	6%	6%	4%	10%	6%	8%	4%	10%	7%	4%	
	Number of age readings	-	-	22	12	12	16	26	17	16	18	16	10	8	9	4	4	190
	Agreement with modal age	-	-	100%	100%	100%	88%	85%	82%	88%	56%	75%	50%	75%	56%	50%	50%	80%

READER 6	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	3.00	4.17	5.19	6.27	7.24	9.17	9.22	10.63	11.00	12.38	13.14	13.50	14.50	
	2stdev	-	-	0.00	0.00	1.15	1.09	1.56	1.66	2.30	1.10	2.29	3.63	1.83	1.60	2.00	2.00	
	CV (%)	-	-	0%	0%	14%	10%	12%	11%	13%	6%	11%	7%	7%	7%	7%	7%	
	Number of age readings	-	-	22	12	12	16	26	17	18	18	16	10	8	7	4	4	190
	Agreement with modal age	-	-	100%	100%	92%	69%	77%	65%	11%	67%	56%	40%	50%	71%	75%	0%	66%

READER 7	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	2.92	3.75	4.81	5.46	6.71	7.72	7.95	9.06	9.70	10.88	11.56	11.00	11.00	
	2stdev	-	-	0.00	0.58	1.24	1.50	1.29	1.37	2.36	2.45	1.71	2.12	3.77	2.67	0.00	5.66	
	CV (%)	-	-	0%	10%	17%	16%	12%	10%	15%	15%	9%	11%	17%	12%	0%	26%	
	Number of age readings	-	-	22	12	12	16	26	17	18	19	16	10	8	9	4	5	194
	Agreement with modal age	-	-	100%	92%	58%	63%	42%	65%	50%	32%	31%	30%	25%	33%	0%	20%	52%

READER 8	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.05	2.92	3.00	3.94	4.35	4.69	4.67	5.32	5.43	4.75	5.43	5.67	4.67	5.00	
	2stdev	-	-	0.43	0.58	0.85	1.15	1.38	1.20	1.95	1.50	1.70	2.07	3.24	2.42	1.15	2.45	
	CV (%)	-	-	10%	10%	14%	15%	16%	13%	21%	14%	16%	22%	30%	21%	12%	24%	
	Number of age readings	-	-	22	12	12	16	26	16	15	19	14	8	7	6	3	5	181
	Agreement with modal age	-	-	95%	92%	8%	13%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%	20%

READER 9	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.05	3.00	3.92	5.19	6.00	7.00	8.06	8.63	9.31	11.10	11.43	11.33	12.50	13.75	
	2stdev	-	-	0.43	0.00	0.58	1.09	1.50	1.93	2.11	2.13	1.75	1.99	3.24	4.00	3.46	5.00	
	CV (%)	-	-	10%	0%	7%	10%	12%	14%	13%	12%	9%	9%	14%	18%	14%	18%	
	Number of age readings	-	-	22	12	12	16	26	16	16	19	16	10	7	9	4	4	191
	Agreement with modal age	-	-	95%	100%	92%	69%	58%	50%	72%	79%	50%	40%	57%	22%	25%	75%	67%

READER 10	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.05	3.00	4.17	5.38	6.19	7.31	8.17	8.95	9.50	10.78	12.00	13.00	11.67	12.50	
	2stdev	-	-	0.43	0.00	0.78	1.77	1.39	2.16	1.85	1.70	2.73	2.40	3.35	1.41	4.16	3.46	
	CV (%)	-	-	10%	0%	9%	16%	11%	15%	11%	9%	14%	11%	14%	5%	18%	14%	
	Number of age readings	-	-	22	12	12	16	26	16	18	19	16	9	6	9	3	4	186
	Agreement with modal age	-	-	95%	100%	83%	63%	81%	50%	50%	53%	63%	67%	17%	56%	33%	0%	67%

ALL READERS	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.01	2.98	3.92	5.01	5.80	6.93	8.00	8.55	9.48	10.37	11.38	11.96	12.22	12.43	
	2stdev	-	-	0.23	0.26	1.21	1.52	1.72	2.33	3.04	3.29	3.61	4.25	5.11	4.76	5.58	7.33	
	CV (%)	-	-	6%	4%	16%	15%	15%	17%	19%	19%	19%	20%	22%	20%	23%	29%	
	Number of age readings	-	-	320	120	118	156	259	165	171	183	156	94	74	82	37	40	1877
	Agreement with modal age	-	-	99%	98%	77%	66%	65%	55%	43%	54%	49%	40%	42%	43%	38%	20%	62%

Table 4.3A Wilcoxson's test DIVISIONS VIa and VIIb,c First readings

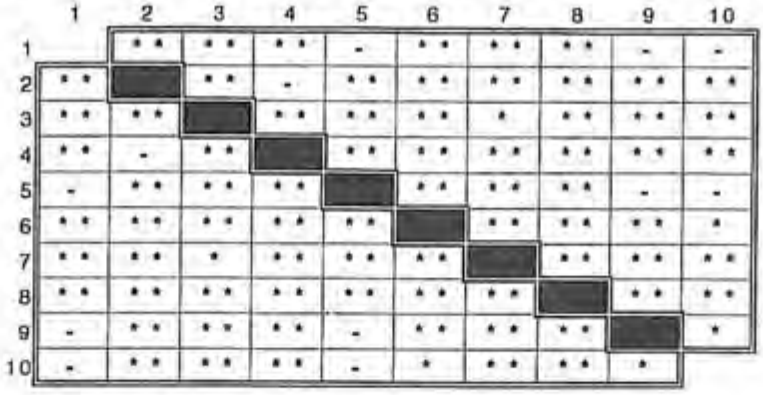


Table 4.3B Wilcoxson's test DIVISIONS VIIIc and IXa

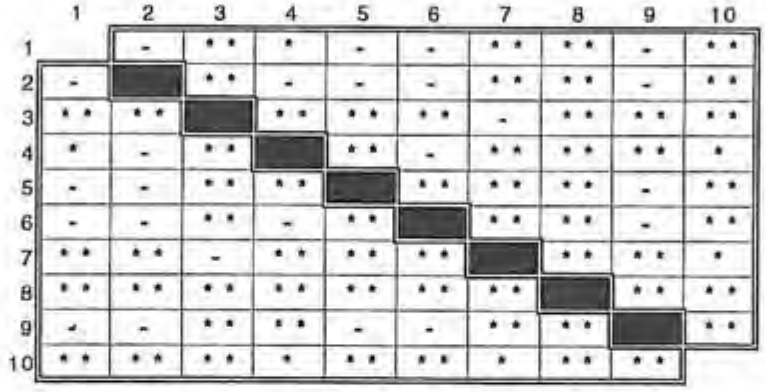


Table 4.3C Wilcoxson's test VALIDATION COLLECTION

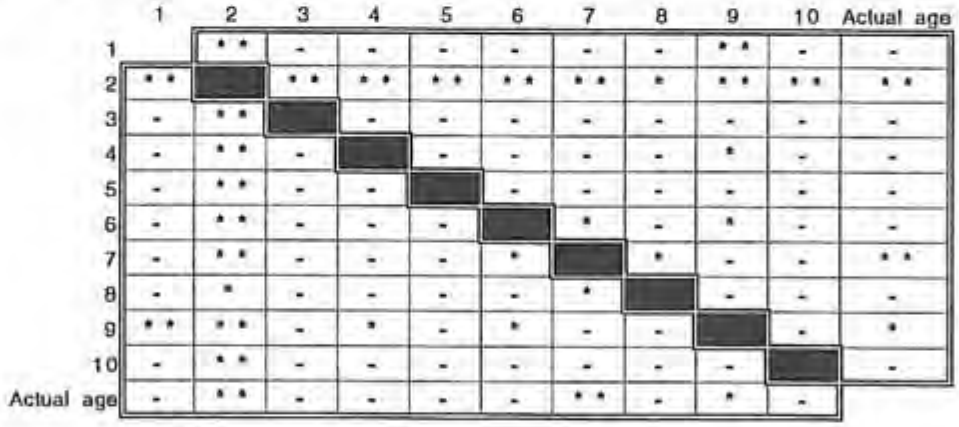


Table 4.3D Wilcoxson's test DIVISION IXa

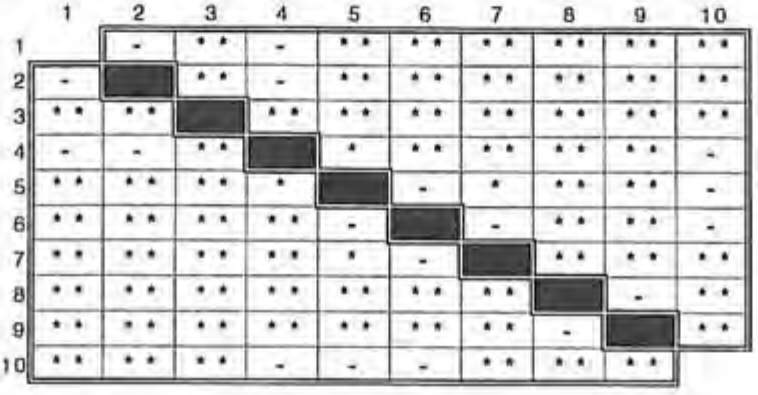


Table 4.3E Wilcoxson's test DIVISIONS IVb,c

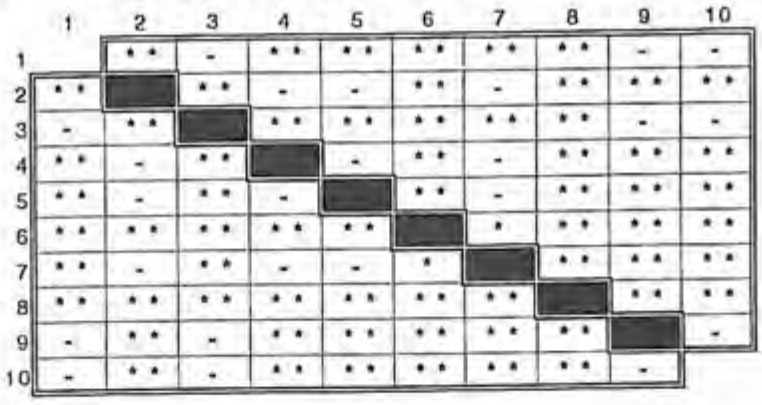


Table 4.3F Wilcoxson's test DIVISIONS VIa and VIIb,c Second readings

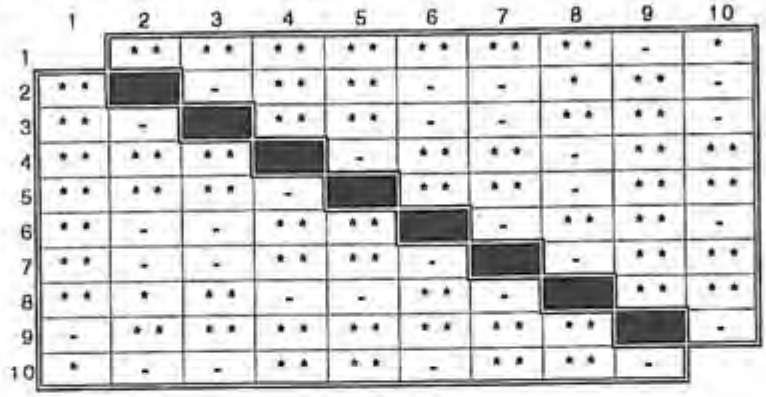
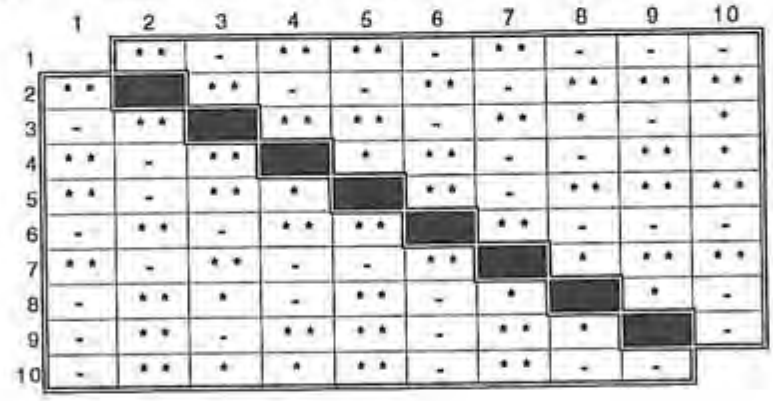


Table 4.3G Wilcoxson's test DIVISION IVa



- : Absence of bias
* : Possibility of bias
* * : Certainty of bias

Table 4.4 MACKEREL DIVISIONS VIIIc & IXa

Year	Sample	Fish no	Fish length	Catch month	Netherl Reader 1	Scotland Reader 2	England Reader 3	Norway Reader 4	Sp(IEO) Reader 5	Ireland Reader 6	Sp(AZTI) Reader 7	Portugal Reader 8	Denmark Reader 9	Russia Reader 10	Age MODE	Age difference	Age Average
93	1	1	24.0	3	2	-	1	2	1	2	1	1	-	3	1	2	1.63
93	1	3	31.0	3	3	3	3	3	3	3	2	2	3	3	3	1	2.80
93	1	4	24.2	3	2	2	1	1	1	2	1	1	2	3	1	2	1.60
93	1	5	30.9	3	3	2	3	2	2	2	2	2	2	3	2	1	2.30
93	1	6	24.6	3	2	2	1	1	1	2	2	1	1	3	1	2	1.60
93	1	7	23.4	3	2	-	1	1	1	2	1	-	-	-	1	1	1.33
93	1	8	23.8	3	2	1	1	1	1	2	1	-	2	1	1	1	1.33
93	1	9	23.2	3	2	1	1	1	1	2	1	-	2	-	1	1	1.38
93	1	10	24.3	3	2	1	1	1	1	2	1	1	2	1	1	1	1.30
93	1	12	23.9	3	2	1	1	1	1	2	1	1	2	1	1	1	1.30
93	1	13	43.8	3	11	9	9	-	11	10	9	-	11	-	11	2	10.00
93	1	14	43.5	3	10	10	9	-	11	11	10	4	13	8	10	9	9.22
93	1	15	43.9	3	9	10	10	10	10	9	10	6	10	10	10	4	9.40
93	1	16	48.2	3	10	13	11	-	15	10	10	3	11	11	10	12	10.44
93	1	17	43.0	3	13	12	11	10	13	9	9	7	10	9	9	6	10.30
93	1	18	44.4	3	12	-	7	-	13	11	10	5	10	-	13	8	9.86
93	1	19	41.4	3	8	-	9	10	10	9	9	4	12	9	9	8	8.67
93	1	20	43.7	3	11	11	11	12	12	11	11	4	11	11	11	8	10.50
93	1	21	41.8	3	10	11	10	10	10	12	10	4	11	10	10	8	9.80
93	1	22	42.1	3	-	-	-	-	-	-	-	-	-	-			
93	1	23	45.4	3	11	14	12	13	15	12	10	5	13	11	11	10	11.60
93	1	24	43.7	3	12	12	12	12	12	12	11	5	12	12	12	7	11.20
93	1	26	43.9	3	11	11	11	11	11	12	9	4	12	11	11	8	10.30
93	1	27	42.4	3	9	13	12	-	13	11	12	3	12	11	12	10	10.67
93	1	28	42.5	3	9	9	9	9	9	8	9	5	8	9	9	4	8.50
93	1	29	42.4	3	9	9	8	9	9	9	9	5	9	9	9	4	8.60
93	1	30	37.0	3	4	4	4	4	4	4	4	3	4	4	4	1	3.90
93	1	31	46.5	3	12	11	11	12	12	12	10	6	10	11	12	6	10.70
93	1	32	41.8	3	12	12	11	12	11	11	9	5	12	12	12	7	10.70
93	1	33	42.9	3	14	11	11	11	12	11	11	4	11	9	11	10	10.50
93	1	34	43.1	3	9	9	9	9	9	9	8	5	9	8	9	4	8.40
93	1	35	35.4	3	4	4	4	4	4	4	3	3	4	3	4	1	3.70
93	1	36	34.3	3	4	4	4	4	4	4	3	2	4	4	4	2	3.70
93	1	37	24.2	3	2	1	1	1	1	2	1	1	2	1	1	1	1.30
93	1	38	25.6	3	2	1	1	1	2	2	1	1	2	1	1	1	1.40
93	1	39	24.6	3	2	1	1	1	1	2	1	1	3	1	1	2	1.40
93	1	40	23.4	3	2	1	1	1	1	2	1	1	2	1	1	1	1.30
93	1	41	44.2	3	-	-	-	-	-	-	-	-	-	-			
93	1	42	44.6	3	15	13	14	-	15	12	14	-	11	8	15	6	12.88
93	1	43	24.6	3	2	1	1	1	1	2	1	1	2	1	1	1	1.30
93	1	44	34.1	3	5	4	4	4	4	4	-	3	8	5	4	3	4.33
93	1	45	34.2	3	5	5	5	5	5	5	5	3	5	5	5	2	4.80
93	1	46	34.6	3	6	6	6	-	6	6	6	4	6	6	6	2	5.78
93	2	1	38.0	2	-	-	-	-	-	-	-	-	-	-			
93	2	2	39.5	2	9	9	9	9	9	9	7	3	9	9	9	6	7.88
93	2	3	38.8	2	-	-	-	-	-	-	-	-	-	-			
93	2	4	36.2	2	-	-	-	-	-	-	-	-	-	-			
93	2	5	40.3	2	9	13	8	-	11	9	8	3	9	8	9	10	8.67
93	2	6	37.5	2	5	5	4	5	5	5	5	4	5	5	5	1	4.80
93	2	7	35.8	2	5	5	5	5	5	5	5	3	5	5	5	2	4.80
93	2	8	39.1	2	6	6	6	6	6	6	6	4	6	6	6	2	5.80
93	2	9	39.8	2	9	11	7	10	10	10	9	4	11	8	10	7	8.90
93	2	10	37.3	2	6	6	5	6	6	6	6	4	6	6	6	2	5.70
93	2	11	38.1	2	6	6	5	6	6	6	6	4	6	6	6	2	5.70
93	2	12	39.1	2	5	-	5	6	6	6	5	4	6	6	6	2	5.44
93	2	13	36.1	2	4	4	3	4	4	4	7	3	4	4	4	4	4.10
93	2	14	36.3	2	4	4	4	4	4	4	4	3	4	4	4	1	3.90
93	2	15	39.7	2	8	8	8	8	8	8	9	6	8	6	8	3	7.90
93	2	16	38.6	3	4	4	4	4	4	4	4	4	4	4	4	0	4.00
93	2	17	38.5	2	6	6	6	6	6	6	6	5	6	6	6	1	5.90
93	2	18	37.0	2	7	7	7	7	7	7	7	4	7	7	7	3	6.70
93	2	20	37.7	2	6	6	5	6	6	6	5	4	6	6	6	2	5.60
93	2	21	33.1	2	4	4	4	4	4	4	4	3	4	4	4	1	3.90
93	2	22	35.5	2	5	4	5	5	6	5	5	4	5	5	5	2	4.90
93	2	23	36.7	2	4	4	4	4	4	4	4	2	4	4	4	2	3.80
93	2	24	36.5	2	4	4	3	4	4	4	4	2	4	4	4	2	3.70
93	2	26	38.4	2	6	6	5	6	6	6	5	4	6	6	6	2	5.60
93	2	27	37.7	2	8	8	7	8	8	8	8	2	8	8	8	6	7.30
93	2	28	41.1	2	7	7	6	7	7	6	6	4	7	6	7	3	6.20
93	2	29	38.7	2	8	8	8	8	8	8	8	5	8	8	8	3	7.70
93	2	30	34.8	2	4	4	3	4	4	4	3	3	4	3	4	1	3.60
93	2	31	36.9	2	4	4	3	4	4	4	5	3	4	3	4	2	3.80
93	2	32	38.6	2	11	-	5	-	10	11	8	3	10	8	11	8	8.25
93	2	33	36.3	2	9	8	9	10	10	9	9	3	10	10	9	7	8.89
93	2	34	35.5	2	4	4	4	4	4	4	4	3	4	4	4	1	3.90
93	2	35	37.0	2	5	5	4	5	6	5	5	3	5	5	5	3	4.80
93	2	36	39.8	2	6	6	4	6	6	6	6	4	6	6	6	2	5.60
93	2	37	38.5	2	5	5	4	5	5	6	6	3	5	5	5	3	4.90
93	2	38	38.9	2	5	5	4	5	5	5	5	4	5	5	5	1	4.80
93	2	39	38.4	2	6	5	5	5	5	5	5	3	5	5	5	3	4.90
93	2	40	36.5	2	5	5	5	5	5	5	5	4	5	5	5	1	4.90
93	2	41	38.1	2	8	7	7	8	8	7	7	3	8	8	8	5	7.10
93	2	42	33.7	2	5	5	4	5	5	5	5	3	4	5	5	2	4.60
93	2	43	36.2	2	4	4	4	4	4	4	4	2	4	4	4	2	3.80
93	2	44	36.0	2	4	4	4	4	4	4	4	3	4	4	4	1	3.90
93	2	45	37.0	2	-	-	-	-	-	-	-	-	-	-			
93	2	46	37.6	2	4	3	3	4	4	4	4	3	4	3	4	1	3.60
93	2	47	36.2	2	8	6	6	7	7	7	8	3	7	7	7	4	6.10
93	2	48	40.1	2	7	7	6	7	7	7	7	4	7	7	7	3	6.60
93	3	1	42.9	3	8	7	8	8	8	8	8	5	8	8	8	3	7.80
93	3	2	42.0	3	9	7	7	8	8	8	4	4	8	7	7	5	7.10
93	3	3	41.9	3	-	-	-	-	-	-	-	-	-	-			
93	3	4	42.2	3	7	-	8	8	9	8	8	4	8	8	8	5	7.67
93	3	5	41.1	3	9	10	8	10	10	9	8	4	11	8	10	7	8.70
93	3	6	41.5	3	7	6	7	8	9	6	-	3	7	6	7	6	6.50
93	3	7	42.4	3	7	7	5	6	8	6	5	4	5	4	5	4	5.70
93	3	8	39.2	3	4	4	4	-	4	5	5	3	4	5	4	2	4.22
93	3	9	42.5	3	7	7	7	7	7	7	6	5	7	6	7	2	6.60
93	3	10	41.2	3	6	-	6	6	-	7	5	4	6	6	6	3	5.75
93	3	11	42.5	3	9	13	13	-	12	9	9	5	12	11	9	8	10.33
93	3	12	41.3	3	8	9	8	-	8	9	8	5	9	8	8	4	8.33

Table 4.4 continued

93	3	13	42.1	3	7	7	7	7	7	7	6	4	7	7	7	3	6.60
93	3	14	40.7	3	6	-	4	-	7	6	6	2	6	7	8	5	5.50
93	3	15	43.4	3	10	13	11	-	14	10	9	-	12	12	10	5	11.38
93	3	16	41.0	3	6	6	5	6	6	6	6	4	6	6	6	2	5.70
93	3	17	37.0	3	3	-	3	3	-	4	3	3	3	3	3	1	3.13
93	3	18	40.0	3	6	6	6	6	6	6	5	3	6	6	6	3	5.70
93	3	19	43.6	3	12	11	8	-	12	11	9	4	10	9	12	8	9.56
93	3	20	44.3	3	-	-	-	-	-	-	-	-	-	-			
93	3	21	41.7	3	6	6	5	6	6	6	5	5	6	6	6	1	5.70
93	3	22	41.8	3	8	-	6	6	7	6	6	6	6	6	6	3	6.67
93	3	23	41.8	3	10	11	10	12	11	11	11	-	10	11	11	2	10.78
93	3	24	42.1	3	10	10	8	9	8	9	7	4	8	9	8	6	8.20
93	3	25	40.8	3	7	7	7	7	7	7	6	4	7	7	7	3	6.60
93	3	26	34.6	3	4	5	4	4	4	4	4	3	4	4	4	2	4.00
93	3	27	41.1	3	7	9	6	-	8	9	8	5	7	8	8	4	7.44
93	3	28	42.0	3	10	9	9	10	10	9	9	5	10	8	10	5	8.80
93	3	29	44.1	3	14	14	13	13	15	13	12	5	14	12	14	10	12.50
93	3	30	44.1	3	6	7	6	6	6	6	6	3	6	5	6	4	5.70
93	3	31	39.8	3	8	6	7	7	8	8	8	3	8	7	8	6	7.10
93	3	32	41.5	3	3	3	3	3	-	4	-	3	3	3	3	1	3.13
93	3	33	37.1	3	4	4	4	4	4	4	4	2	4	4	4	2	3.80
93	3	34	34.6	3	5	6	5	-	5	6	5	2	6	6	5	4	5.11
93	3	35	41.3	3	6	6	7	5	7	6	5	4	7	5	6	3	5.80
93	3	36	40.1	3	12	11	9	-	12	9	10	5	8	8	12	7	9.33
93	3	37	43.4	3	6	6	4	6	6	6	5	4	6	5	5	2	5.40
93	3	38	39.1	3	6	7	6	6	6	6	6	4	6	6	6	4	6.30
93	3	39	39.8	3	4	3	2	3	4	3	3	2	4	3	3	2	3.10
93	3	40	34.5	3	8	6	7	7	8	7	7	4	7	7	7	4	7.00
93	3	41	40.9	3	8	10	7	8	10	8	8	4	7	8	8	6	7.80
93	3	42	42.3	3	15	15	10	-	15	12	11	4	10	11	15	11	11.44
93	3	43	44.5	3	6	6	6	6	6	6	6	5	6	6	6	1	5.90
93	3	44	40.0	3	4	4	3	4	4	4	4	3	4	4	4	1	3.80
93	4	1	40.0	4	9	9	9	9	9	9	8	-	9	9	9	1	8.89
93	4	2	36.0	4	4	4	3	4	4	4	4	3	4	4	4	1	3.80
93	4	3	41.0	4	9	9	9	9	9	9	9	-	9	9	9	0	9.00
93	4	4	36.0	4	6	6	6	6	6	6	5	3	6	6	6	3	5.60
93	4	5	38.0	4	6	5	6	7	6	6	-	-	6	7	6	2	6.13
93	4	6	38.0	4	4	-	4	5	7	6	4	-	5	6	4	3	5.13
93	4	7	37.0	4	5	5	4	5	5	5	5	3	5	5	5	2	4.70
93	4	8	37.0	4	6	6	5	6	6	6	6	4	6	6	6	2	5.70
93	4	9	37.0	4	5	4	4	5	5	5	4	3	4	5	5	2	4.40
93	4	10	37.0	4	6	5	4	5	5	6	6	-	5	-	5	2	5.25
93	4	11	42.0	4	8	11	5	-	11	9	9	4	7	6	9	7	7.56
93	4	12	40.0	4	7	6	5	7	7	6	7	4	7	7	7	3	6.30
93	4	13	38.0	4	6	5	6	6	6	7	6	3	6	6	6	4	5.70
93	4	14	37.0	4	6	6	5	6	6	6	6	4	6	6	6	2	5.70
93	4	15	33.0	4	-	-	-	-	-	-	-	-	-	-			
93	4	16	39.0	4	7	7	7	8	7	6	6	4	7	7	7	4	6.60
93	4	17	36.0	4	7	9	7	8	7	6	5	4	8	8	7	5	6.40
93	4	18	41.0	4	7	9	9	9	8	9	8	-	9	9	9	2	8.67
93	4	19	33.0	4	5	5	4	4	4	4	4	3	4	4	4	2	4.10
93	4	20	34.0	4	6	6	6	6	6	6	6	4	6	6	6	2	5.60
93	4	21	35.0	4	4	4	3	4	4	4	4	3	4	4	4	1	3.80
93	4	22	35.0	4	5	5	5	5	5	5	5	3	5	5	5	2	4.80
93	4	23	38.0	4	-	-	-	-	-	-	-	-	-	-			
93	4	24	40.0	4	9	-	5	-	-	9	5	3	5	-	5	6	6.00
93	4	25	37.0	4	6	5	5	-	-	6	4	-	5	5	5	2	5.14
93	4	26	35.0	4	4	4	4	4	4	4	4	3	4	4	4	1	3.90
93	4	27	34.0	4	4	4	4	4	4	4	4	3	4	4	4	1	3.90
93	4	28	31.0	4	4	-	2	2	2	3	2	2	2	2	2	2	2.33
93	4	29	38.0	4	7	7	4	6	8	6	5	3	7	-	7	4	5.67
93	4	30	34.0	4	5	4	4	4	4	4	-	3	4	-	4	1	3.75
93	4	31	24.0	4	3	-	3	1	1	3	2	1	2	1	1	2	1.89
93	4	32	39.0	4	4	4	4	-	5	4	3	-	4	4	4	2	4.00
93	4	33	39.0	4	4	5	5	5	5	5	4	2	5	5	5	3	4.50
93	4	34	35.0	4	6	7	6	6	8	6	5	4	5	6	6	3	5.80
93	4	35	40.0	4	8	11	7	8	7	9	-	-	9	7	7	4	8.25
93	4	36	36.0	4	3	-	-	-	6	8	-	2	6	6	6	4	4.83
93	4	37	34.0	4	5	4	3	4	4	4	4	3	4	4	4	2	3.90
93	4	38	34.0	4	4	4	4	3	4	4	4	2	4	4	4	2	3.70
93	4	39	39.0	4	6	8	6	6	6	6	6	3	8	6	6	3	5.70
93	4	40	35.0	4	7	7	7	-	6	7	-	-	6	5	7	2	6.43
93	4	41	35.0	4	4	4	4	4	4	4	4	2	4	4	4	2	3.80
93	4	42	36.0	4	5	5	4	5	5	5	4	3	5	6	5	3	4.70
93	4	43	41.0	4	7	8	5	6	8	6	5	3	6	5	6	5	5.70
93	4	44	33.0	4	6	4	3	4	4	4	3	3	4	4	4	2	3.60
93	4	45	34.0	4	4	4	4	4	4	4	4	2	4	4	4	2	3.80
93	5	1	18.0	9	0	0	0	0	0	0	0	0	1	0	0	1	0.10
93	5	2	18.0	9	0	-	0	0	0	0	0	0	1	0	0	1	0.11
93	5	3	18.0	9	0	0	0	0	0	0	0	0	-	0	0	0	0.00
93	5	4	18.0	9	1	0	0	0	0	0	0	0	1	0	0	1	0.20
93	5	5	18.0	9	1	0	0	0	0	0	0	0	1	0	0	1	0.20
93	5	6	19.0	9	0	0	0	0	0	0	0	0	1	0	0	1	0.10
93	5	7	19.0	9	0	0	0	0	0	0	0	0	1	0	0	1	0.10
93	5	8	19.0	9	0	0	0	0	0	0	0	0	1	0	0	1	0.10
93	5	9	19.0	9	0	0	0	0	0	0	0	0	1	0	0	1	0.10
93	5	10	19.0	9	0	0	0	0	0	0	0	0	1	0	0	1	0.10
93	5	11	20.0	9	0	0	0	0	0	0	0	1	1	0	0	1	0.20
93	5	13	20.0	9	1	0	0	0	0	0	0	0	1	0	0	1	0.20
93	5	14	20.0	9	0	0	0	0	0	0	0	0	1	0	0	1	0.10
93	5	15	20.0	9	0	0	0	0	0	0	0	0	1	0	0	1	0.10
93	5	21	23.0	9	1	0	0	0	0	0	0	0	1	0	0	1	0.20
93	5	22	23.0	9	0	-	0	0	0	0	0	0	1	0	0	1	0.11
93	5	23	23.0	9	0	0	0	0	0	0	0	0	1	0	0	1	0.10
93	5	24	23.0	9	0	0	0	0	0	0	0	0	1	0	0	1	0.10
93	5	25	23.0	9	0	0	0	0	0	0	0	0	1	0	0	1	0.10
93	5	27	24.0	9	0	0	0	0	0	0	0	0	1	0	0	1	0.10
-	-	1	-	-	-	-	-	-	-	-	-	-	-	-			
-	-	2	-	-	-	-	-	-	-	-	-	-	-	-			
				Total read	189	170	167	163	163	188	180	171	185	180			
				Total NOT read	0	18	1	25	5	0	6	17	3	8			
				Empty rows	12	12	12	12	12	12	12	12	12	12			

MACKEREL DIVISION VIIIc & IXa

Table 4.5 The mean age recorded, 2stdev, CV (%), the number of age readings and the agreement with modal age are presented by modal age for each reader and for all readers combined. The number of age readings and the agreement is given for age groups 0-15 combined.

READER 1

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	0.20	2.07	3.50	3.25	4.09	5.40	5.97	7.10	8.00	8.92	9.63	11.29	11.50	13.00	14.00	15.00	
2stdev	0.82	0.53	1.41	1.00	0.77	2.09	1.41	1.31	1.63	3.11	1.04	2.51	2.45	-	-	0.00	
CV (%)	205%	13%	20%	15%	9%	19%	12%	9%	10%	17%	5%	11%	11%	-	-	0%	
Number of age readings	20	14	2	4	33	20	31	16	10	13	8	7	6	1	1	2	188
Agreement with modal age	80%	0%	0%	75%	85%	70%	97%	75%	70%	77%	63%	71%	83%	100%	100%	0%	71%

READER 2

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	0.00	1.18	2.00	3.00	4.03	5.05	6.23	7.25	8.33	9.92	10.88	11.17	11.67	-	14.00	14.00	
2stdev	0.00	0.81	-	0.00	0.62	1.24	2.14	2.48	2.24	3.35	2.92	3.20	1.63	-	-	2.83	
CV (%)	-	34%	-	0%	8%	12%	17%	17%	13%	17%	13%	14%	7%	-	-	10%	
Number of age readings	18	11	1	3	32	19	26	16	9	12	8	6	6	-	1	2	170
Agreement with modal age	100%	82%	100%	100%	91%	79%	77%	63%	44%	75%	38%	67%	33%	-	100%	50%	78%

READER 3

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	0.00	1.14	2.50	2.75	3.70	4.55	5.47	6.38	7.40	8.00	9.00	9.86	10.50	7.00	13.00	12.00	
2stdev	0.00	1.07	1.41	1.00	0.93	1.02	1.46	2.05	1.40	3.56	3.70	4.68	3.29	-	-	5.66	
CV (%)	-	47%	28%	18%	13%	11%	13%	16%	9%	20%	21%	24%	16%	-	-	24%	
Number of age readings	20	14	2	4	33	20	30	16	10	13	8	7	6	1	1	2	187
Agreement with modal age	100%	93%	50%	75%	70%	55%	50%	69%	50%	62%	25%	43%	33%	0%	0%	0%	63%

READER 4

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	0.00	1.07	2.00	3.00	4.00	5.06	6.00	7.00	8.00	9.30	10.00	11.80	12.00	-	13.00	-	
2stdev	0.00	0.53	0.00	0.00	0.52	0.49	0.55	1.31	1.00	0.97	0.00	1.67	0.00	-	-	-	
CV (%)	-	25%	0%	0%	6%	5%	5%	9%	6%	5%	0%	7%	0%	-	-	-	
Number of age readings	20	14	2	4	31	17	27	15	9	10	5	5	3	-	1	-	163
Agreement with modal age	100%	93%	100%	100%	94%	94%	93%	60%	78%	70%	100%	40%	100%	-	0%	-	87%

READER 5

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	0.00	1.07	2.00	3.50	4.12	5.29	6.40	7.13	8.40	9.86	11.25	11.71	12.00	13.00	15.00	15.00	
2stdev	0.00	0.53	0.00	1.41	1.09	1.50	2.07	1.44	1.40	2.69	4.11	3.21	1.26	-	-	0.00	
CV (%)	-	25%	0%	20%	13%	14%	16%	10%	8%	14%	18%	14%	5%	-	-	0%	
Number of age readings	20	14	2	2	33	18	30	16	10	13	8	7	6	1	1	2	183
Agreement with modal age	100%	93%	100%	50%	94%	83%	80%	69%	70%	62%	63%	43%	67%	100%	0%	100%	80%

READER 6

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	0.00	2.07	2.50	3.50	4.09	5.45	6.16	7.00	8.10	9.00	10.00	11.14	11.00	11.00	13.00	12.00	
2stdev	0.00	0.53	1.41	1.15	0.77	1.89	1.17	1.03	1.14	0.00	2.14	1.38	2.19	-	-	0.00	
CV (%)	-	13%	28%	16%	9%	17%	9%	14%	7%	0%	11%	6%	10%	-	-	0%	
Number of age readings	20	14	2	4	33	20	31	16	10	13	8	7	6	1	1	2	188
Agreement with modal age	100%	0%	50%	50%	94%	70%	90%	50%	70%	100%	38%	57%	33%	0%	0%	0%	71%

READER 7

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	0.00	1.14	2.00	2.67	4.00	4.90	5.83	6.00	7.80	8.46	9.25	9.86	10.17	10.00	12.00	12.50	
2stdev	0.00	0.73	0.00	1.15	1.46	1.11	1.78	1.83	1.84	1.32	1.77	2.43	2.34	-	-	4.24	
CV (%)	-	32%	0%	22%	18%	11%	15%	15%	12%	8%	10%	12%	11%	-	-	17%	
Number of age readings	20	14	2	3	31	20	29	13	10	13	8	7	6	1	1	2	180
Agreement with modal age	100%	86%	100%	67%	74%	70%	59%	31%	50%	54%	50%	43%	17%	0%	0%	0%	63%

READER 8

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	0.05	1.00	2.00	2.50	2.77	3.17	3.80	3.86	4.10	4.50	4.29	4.00	4.67	5.00	5.00	4.00	
2stdev	0.45	0.00	0.00	1.15	0.99	1.24	1.52	1.07	2.39	2.54	1.90	1.41	2.07	-	-	-	
CV (%)	447%	0%	0%	23%	16%	20%	20%	14%	29%	28%	22%	18%	22%	-	-	-	
Number of age readings	20	11	2	4	31	18	30	14	10	10	7	5	6	1	1	1	171
Agreement with modal age	95%	100%	100%	50%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	20%

READER 9

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	1.00	2.00	2.00	3.25	4.09	4.95	6.13	7.19	7.80	9.54	11.13	11.14	10.67	10.00	14.00	10.50	
2stdev	0.00	0.85	0.00	1.00	0.77	0.79	0.86	1.31	0.84	2.40	1.98	2.14	3.27	-	-	1.41	
CV (%)	0%	21%	0%	15%	9%	8%	7%	9%	5%	13%	9%	10%	15%	-	-	7%	
Number of age readings	19	12	2	4	33	20	31	16	10	13	8	7	6	1	1	2	185
Agreement with modal age	0%	8%	100%	75%	94%	85%	90%	75%	80%	62%	25%	43%	50%	0%	100%	0%	64%

READER 10

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	0.00	1.50	2.50	3.00	4.00	5.06	6.00	6.53	8.00	9.08	9.38	10.17	10.50	-	12.00	10.00	
2stdev	0.00	1.81	1.41	0.00	1.14	0.83	1.15	1.49	0.94	1.52	3.20	2.66	3.28	-	-	2.83	
CV (%)	-	60%	28%	0%	14%	8%	10%	11%	6%	8%	17%	13%	16%	-	-	14%	
Number of age readings	20	12	2	4	32	18	31	15	10	13	8	6	6	-	1	2	160
Agreement with modal age	100%	75%	50%	100%	78%	83%	77%	67%	80%	69%	25%	67%	33%	-	0%	0%	74%

ALL READERS

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	0.12	1.43	2.32	3.03	3.89	4.89	5.79	6.59	7.58	8.84	9.53	10.34	10.39	9.86	12.50	12.12	
2stdev	0.66	1.19	1.16	1.01	1.20	1.78	2.04	2.51	2.84	3.59	4.45	4.72	4.72	5.94	5.60	5.87	
CV (%)	268%	42%	25%	17%	15%	18%	18%	19%	19%	20%	23%	23%	23%	30%	22%	24%	
Number of age readings	197	130	19	36	322	190	296	153	98	123	76	64	57	7	10	17	1795
Agreement with modal age	88%	62%	74%	75%	78%	69%	70%	57%	59%	64%	41%	48%	42%	29%	30%	18%	67%

Table 5.1 **MACKEREL VALIDATION COLLECTION**

Month/Year tag release	Length release	Fish no	Length return	Month/Year tag return	Nethad. Reader 1	Scotland Reader 2	England Reader 3	Norway Reader 4	Sp(IEO) Reader 5	Ireland Reader 6	Sp(AZTI) Reader 7	Portugal Reader 8	Denmark Reader 9	Russia Reader 10	ACTUAL AGE	Age difference	Mode	Average
Aug-85	25	1	32	Oct-86	2	2	2	2	2	2	2	2	2	2	2	0	2	2.00
Aug-85	27	2	32	Oct-86	2	2	2	2	2	2	2	2	2	2	2	0	2	2.00
May-83	28	3	38	Oct-86	5	5	4	5	5	5	5	6	4	5	5	2	5	4.90
May-86	29	4	33	Aug-87	4	3	3	3	3	3	3	4	3	4	3	1	3	3.30
Aug-85	28	5	33	Sep-87	3	3	3	3	3	3	3	3	3	3	3	0	3	3.00
Aug-85	27	6	35	Oct-87	3	3	3	3	3	3	3	3	2	3	3	1	3	2.90
Aug-85	28	7	31	Nov-87	3	3	3	3	3	3	3	3	3	3	3	0	3	3.00
Aug-81	27	8	40	Aug-88	9	9	8	8	8	8	8	8	8	8	8	1	8	8.20
May-83	27	9	40	Aug-89	8	8	8	8	7	7	6	7	7	8	8	2	8	7.40
Aug-85	28	10	36	Sep-89	6	6	4	3	5	5	4	5	6	5	5	3	5	4.90
May-88	28	11	32	Oct-89	2	2	2	2	2	2	2	3	2	2	2	1	2	2.10
Aug-88	27	12	35	Oct-90	3	3	3	3	3	3	3	3	3	3	3	0	3	3.00
Aug-88	28	13	36	Nov-90	3	3	3	3	3	3	3	3	3	3	3	0	3	3.00
May-89	28	14	32	Aug-90	3	3	3	3	3	3	3	4	2	3	3	2	3	3.00
Aug-88	28	15	36	Aug-90	3	3	3	3	3	3	3	3	3	3	3	0	3	3.00
Aug-88	27	16	35	Aug-90	3	3	3	3	3	3	4	3	3	3	3	1	3	3.10
May-92	28	17	34	Dec-90	3	4	3	3	3	3	3	8	3	3	3	3	3	3.40
Aug-85	26	18	37	Dec-90	7	7	6	6	6	6	6	6	6	6	6	1	6	6.20
Aug-85	24	19	37	Sep-90	6	6	6	6	6	6	5	6	6	6	6	1	6	5.90
Aug-89	28	20	35	Jan-91	4	4	4	4	4	4	3	4	4	4	4	1	4	3.90
Aug-89	28	21	34	Nov-91	3	3	3	3	3	3	3	3	3	3	3	0	3	3.00
May-90	27	22	35	Dec-91	3	3	3	3	3	3	3	4	3	3	3	1	3	3.10
Aug-88	29	23	38	Dec-91	4	5	4	4	4	4	4	4	4	5	4	1	4	4.20
Aug-88	27	24	37	Dec-91	4	5	4	4	4	4	4	4	4	4	4	1	4	4.10
May-91	30	25	34	Nov-91	2	2	2	2	2	2	2	3	2	2	2	1	2	2.10
May-90	23	26	33	Jan-92	3	3	3	3	3	3	3	3	2	3	3	1	3	2.90
May-91	28	27	31	Jan-92	3	6	3	3	3	3	3	3	2	3	3	4	3	3.20
Aug-85	28	28	41	Jan-92	8	9	7	8	7	8	8	8	8	8	8	3	8	7.70
Aug-88	27	29	39	Jan-92	5	6	5	5	5	5	5	5	5	5	5	1	5	5.10
May-90	26	30	31	Nov-92	5	5	5	5	5	5	5	6	5	5	5	1	5	5.10
Aug-86	26	31	38	Sep-94	7	8	6	7	6	7	5	5	5	7	7	3	7	6.30
May-90	27	32	37	Sep-94	4	5	4	5	7	4	4	5	4	5	5	3	4	4.70
Aug-87	30	33	40	Sep-94	10	10	10	10	10	10	9	10	9	10	10	1	10	9.80
Aug-88	26	34	37	Sep-94	7	11	7	8	8	7	7	7	7	7	7	4	7	7.60
May-88	31	35	39	Sep-94	9	12	8	8	7	8	9	10	8	8	9	6	9	8.70
May-90	26	36	39	Sep-94	6	7	5	6	6	6	9	6	6	7	6	2	6	6.00
Aug-86	28	37	41	Sep-94	7	8	7	7	7	7	7	7	7	7	7	1	7	7.10
Aug-88	28	38	40	Oct-94	10	10	9	8	9	8	7	8	9	7	8	3	9	8.50
Aug-85	25	39	41	Oct-94	6	13	6	5	10	11	8	9	5	8	10	5	6	9.10
May-89	30	40	41	Oct-94	7	8	7	7	7	7	7	7	7	7	7	1	7	7.10
May-91	29	41	36	Nov-94	6	6	6	6	5	5	5	4	5	6	5	2	6	5.40
Aug-75	35	42	48	Jan-94	19	23	25	23	23	22	21	17	20	14	23	11	23	20.70
May-90	26	43	35	Jan-94	6	7	7	7	8	8	5	7	6	8	6	2	6	6.30
				Total read	43	43	43	43	43	43	43	43	43	43				
				Total NOT read	0	0	0	0	0	0	0	0	0	0				
				Empty rows	157	157	157	157	157	157	157	157	157	157				

MACKEREL VALIDATION COLLECTION

Table 5.2 The mean age recorded, 2stdev, CV (%), the number of age readings and the agreement with actual age are presented by actual age for each reader and for all readers combined. The number of age readings and the agreement is given for age groups 0-15 combined.

READER 1

Actual age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	-	-	2.00	3.07	4.00	5.17	6.25	7.00	8.75	9.00	8.00	-	-	-	-	-	
2stdev	-	-	0.00	0.53	0.00	1.51	1.00	0.00	1.91	-	5.66	-	-	-	-	-	
CV (%)	-	-	0%	9%	0%	15%	6%	0%	11%	-	35%	-	-	-	-	-	
Number of age readings	-	-	4	14	3	6	4	4	4	1	2	-	-	-	-	-	42
Agreement with actual age	-	-	100%	93%	100%	50%	75%	100%	50%	100%	50%	-	-	-	-	-	81%

READER 2

Actual age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	-	-	2.00	3.29	4.67	5.50	6.75	8.75	9.00	12.00	11.50	-	-	-	-	-	
2stdev	-	-	0.00	1.65	1.15	1.10	1.00	3.00	1.63	-	4.24	-	-	-	-	-	
CV (%)	-	-	0%	25%	12%	10%	7%	17%	9%	-	18%	-	-	-	-	-	
Number of age readings	-	-	4	14	3	6	4	4	4	1	2	-	-	-	-	-	42
Agreement with actual age	-	-	100%	86%	33%	50%	25%	0%	25%	0%	50%	-	-	-	-	-	55%

READER 3

Actual age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	-	-	2.00	3.00	4.00	4.67	6.00	6.75	8.00	8.00	8.00	-	-	-	-	-	
2stdev	-	-	0.00	0.00	0.00	1.63	1.63	1.00	1.63	-	5.66	-	-	-	-	-	
CV (%)	-	-	0%	0%	0%	17%	14%	7%	10%	-	35%	-	-	-	-	-	
Number of age readings	-	-	4	14	3	6	4	4	4	1	2	-	-	-	-	-	42
Agreement with actual age	-	-	100%	100%	100%	33%	50%	75%	50%	0%	50%	-	-	-	-	-	74%

READER 4

Actual age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	-	-	2.00	3.00	4.00	4.83	6.25	7.25	8.00	8.00	7.50	-	-	-	-	-	
2stdev	-	-	0.00	0.00	0.00	1.97	1.00	1.00	0.00	-	7.07	-	-	-	-	-	
CV (%)	-	-	0%	0%	0%	20%	8%	7%	0%	-	47%	-	-	-	-	-	
Number of age readings	-	-	4	14	3	6	4	4	4	1	2	-	-	-	-	-	42
Agreement with actual age	-	-	100%	100%	100%	67%	75%	75%	100%	0%	50%	-	-	-	-	-	86%

READER 5

Actual age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	-	-	2.00	3.00	4.00	5.33	5.75	7.00	7.75	7.00	10.00	-	-	-	-	-	
2stdev	-	-	0.00	0.00	0.00	1.63	1.00	1.63	1.91	-	0.00	-	-	-	-	-	
CV (%)	-	-	0%	0%	0%	15%	9%	12%	12%	-	0%	-	-	-	-	-	
Number of age readings	-	-	4	14	3	6	4	4	4	1	2	-	-	-	-	-	42
Agreement with actual age	-	-	100%	100%	100%	83%	75%	50%	25%	0%	100%	-	-	-	-	-	81%

READER 6

Actual age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	-	-	2.00	3.00	4.00	4.83	6.00	7.00	7.75	9.00	10.50	-	-	-	-	-	
2stdev	-	-	0.00	0.00	0.00	0.82	0.00	0.00	1.00	-	1.41	-	-	-	-	-	
CV (%)	-	-	0%	0%	0%	8%	0%	0%	6%	-	7%	-	-	-	-	-	
Number of age readings	-	-	4	14	3	6	4	4	4	1	2	-	-	-	-	-	42
Agreement with actual age	-	-	100%	100%	100%	83%	100%	100%	75%	100%	50%	-	-	-	-	-	93%

READER 7

Actual age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	-	-	2.00	3.07	3.67	4.67	5.50	6.50	7.25	9.00	8.50	-	-	-	-	-	
2stdev	-	-	0.00	0.53	1.15	1.03	1.15	2.00	1.91	-	1.41	-	-	-	-	-	
CV (%)	-	-	0%	9%	16%	11%	10%	15%	13%	-	8%	-	-	-	-	-	
Number of age readings	-	-	4	14	3	6	4	4	4	1	2	-	-	-	-	-	42
Agreement with actual age	-	-	100%	93%	67%	67%	50%	75%	50%	100%	0%	-	-	-	-	-	74%

READER 8

Actual age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	-	-	2.50	3.43	4.00	5.17	6.25	6.50	7.25	10.00	9.50	-	-	-	-	-	
2stdev	-	-	1.15	1.70	0.00	1.51	1.00	2.00	1.91	-	1.41	-	-	-	-	-	
CV (%)	-	-	23%	25%	0%	15%	8%	15%	13%	-	7%	-	-	-	-	-	
Number of age readings	-	-	4	14	3	6	4	4	4	1	2	-	-	-	-	-	42
Agreement with actual age	-	-	50%	71%	100%	50%	75%	75%	50%	0%	50%	-	-	-	-	-	64%

READER 9

Actual age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	-	-	2.00	2.71	4.00	4.83	6.00	6.50	8.00	9.00	7.00	-	-	-	-	-	
2stdev	-	-	0.00	0.94	0.00	1.51	0.00	2.00	1.63	-	5.66	-	-	-	-	-	
CV (%)	-	-	0%	17%	0%	16%	0%	15%	10%	-	40%	-	-	-	-	-	
Number of age readings	-	-	4	14	3	6	4	4	4	1	2	-	-	-	-	-	42
Agreement with actual age	-	-	100%	71%	100%	50%	100%	75%	50%	100%	0%	-	-	-	-	-	71%

READER 10

Actual age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	-	-	2.00	3.07	4.33	5.17	6.25	7.00	7.75	6.00	9.00	-	-	-	-	-	
2stdev	-	-	0.00	0.53	1.15	0.82	1.00	0.00	1.00	-	2.83	-	-	-	-	-	
CV (%)	-	-	0%	9%	13%	8%	8%	0%	6%	-	16%	-	-	-	-	-	
Number of age readings	-	-	4	14	3	6	4	4	4	1	2	-	-	-	-	-	42
Agreement with actual age	-	-	100%	93%	67%	83%	75%	100%	75%	0%	50%	-	-	-	-	-	83%

ALL READERS

Actual age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	-	-	2.05	3.06	4.07	5.02	6.10	7.03	7.95	8.70	8.95	-	-	-	-	-	
2stdev	-	-	0.44	0.90	0.73	1.40	1.09	1.89	1.75	3.27	4.13	-	-	-	-	-	
CV (%)	-	-	11%	15%	9%	14%	9%	13%	11%	19%	23%	-	-	-	-	-	
Number of age readings	-	-	40	140	30	60	40	40	40	10	20	-	-	-	-	-	420
Agreement with actual age	-	-	95%	91%	87%	62%	70%	73%	55%	40%	45%	-	-	-	-	-	76%

Table 5.3 MACKEREL DIVISION IXa

Year	Sample	Fish no	Fish length	Catch month	Nethad. Reader 1	Scotland Reader 2	England Reader 3	Norway Reader 4	Sp(IEO) Reader 5	Ireland Reader 6	Sp(AZTI) Reader 7	Portugal Reader 8	Denmark Reader 9	Russia Reader 10	Age MODE	Age difference	Age Average
90	1	213	38.1	4	5	6	5	6	6	5	7	6	5	6	6	2	5.70
90	1	214	38.5	4	5	6	5	6	7	5	6	6	5	6	6	2	5.70
90	1	215	38.8	4	8	8	7	9	9	9	9	7	8	9	9	2	8.30
90	1	216	38.2	4	5	7	5	6	6	6	9	6	5	6	6	4	6.10
90	1	217	38.5	4	6	6	5	6	6	5	6	6	6	6	6	1	5.70
90	1	218	38.8	4	6	6	5	6	7	6	8	5	5	6	5	3	5.80
90	1	219	38.1	4	5	6	5	6	6	6	8	6	5	6	6	1	5.70
90	1	220	38.4	4	10	8	9	10	10	11	11	9	10	11	10	3	9.90
90	2	231	42.5	4	8	9	7	9	10	10	12	8	7	8	8	5	8.80
90	2	232	42.7	4	8	9	8	9	11	12	11	8	7	9	8	5	9.20
90	2	233	43.1	4	14	15	14	16	18	15	16	13	12	15	15	4	14.50
90	2	234	43.4	4	9	8	8	9	9	10	11	9	8	9	9	3	9.00
90	2	235	44.3	4	9	9	9	9	9	9	9	9	8	9	9	1	8.80
90	2	236	44.0	4	8	9	8	9	9	11	13	8	7	11	8	6	9.30
90	2	237	44.2	4	8	11	8	13	11	10	12	9	7	9	8	5	9.80
90	2	238	26.4	6	1	1	1	1	2	1	1	1	1	1	1	1	1.10
90	2	239	26.8	6	1	1	1	1	2	1	1	1	1	1	1	1	1.10
90	2	240	26.8	6	1	1	1	1	2	1	1	1	1	1	1	1	1.10
90	2	241	27.6	6	1	1	1	1	2	1	1	1	1	1	1	1	1.10
90	2	242	27.7	6	1	1	1	1	2	1	1	1	1	1	1	1	1.10
90	2	243	27.7	6	1	1	1	1	2	1	1	1	1	1	1	1	1.10
90	2	244	27.4	6	1	1	1	1	2	1	1	1	1	1	1	1	1.10
90	2	245	27.9	6	1	1	1	1	2	1	1	1	1	1	1	1	1.10
90	2	246	27.3	6	1	1	1	1	2	1	1	1	1	1	1	1	1.10
90	2	247	27.2	6	1	1	1	1	2	1	1	1	1	1	1	1	1.10
90	2	248	27.3	6	1	1	1	1	2	1	1	2	1	1	1	1	1.20
90	2	249	29.7	6	1	1	1	1	2	1	1	1	1	1	1	1	1.10
90	2	250	29.0	6	1	1	1	1	2	1	1	1	1	1	1	1	1.10
90	3	377	37.0	7	8	5	5	7	8	8	7	6	5	7	6	3	6.20
90	3	378	39.0	7	9	5	5	8	7	10	8	7	6	7	7	5	6.90
90	4	424	22.3	7	0	0	0	0	0	0	0	0	0	0	0	0	0.00
90	4	425	22.4	7	0	0	0	0	0	0	0	0	0	0	0	0	0.00
90	4	426	22.9	7	0	0	0	0	0	0	0	0	0	0	0	0	0.00
90	4	427	22.5	7	0	0	0	0	0	0	0	0	0	0	0	0	0.00
90	4	428	22.0	7	0	0	0	0	0	0	0	0	0	0	0	0	0.00
90	4	429	22.6	7	0	0	0	0	0	0	0	0	0	0	0	0	0.00
90	4	430	22.1	7	0	0	0	0	0	0	0	0	0	0	0	0	0.00
90	4	431	22.3	7	0	0	0	0	0	0	0	0	0	0	0	0	0.00
90	4	432	23.7	7	0	0	0	0	0	0	0	0	0	0	0	0	0.00
90	4	433	23.4	7	0	0	0	0	0	0	0	0	0	0	0	0	0.00
90	4	434	23.0	7	0	0	0	0	0	0	0	0	0	0	0	0	0.00
90	4	435	23.3	7	0	0	0	0	0	0	0	0	0	0	0	0	0.00
90	4	436	23.1	7	0	0	0	0	0	0	0	0	0	0	0	0	0.00
90	4	437	23.4	7	0	0	0	0	0	0	0	0	0	0	0	0	0.00
90	4	438	23.2	7	0	0	0	0	0	0	0	0	0	0	0	0	0.00
90	4	439	23.3	7	0	0	0	0	0	0	0	0	0	0	0	0	0.00
91	1	1	30.2	1	3	3	2	3	2	3	2	2	2	2	2	1	2.40
91	1	2	31.9	1	4	2	2	3	3	4	4	3	2	2	2	2	2.80
91	1	3	31.4	1	3	3	3	3	3	4	3	2	3	3	3	2	3.00
91	1	4	32.9	1	3	3	3	3	3	4	3	2	3	3	3	2	3.00
91	1	5	32.2	1	4	3	3	4	4	4	4	2	4	4	4	2	3.60
91	1	6	32.0	1	3	3	3	3	3	3	3	3	3	3	3	0	3.00
91	1	7	32.3	1	3	4	3	3	3	4	3	3	3	3	3	1	3.20
91	1	8	32.7	1	5	3	4	4	5	5	5	3	5	4	5	2	4.30
91	1	9	33.2	1	3	3	3	3	3	3	3	3	3	3	3	0	3.00
91	1	10	33.7	1	5	4	4	4	4	4	4	4	4	4	4	1	4.10
91	1	11	33.7	1	3	3	3	3	3	4	3	3	3	3	3	1	3.10
91	1	12	33.0	1	4	3	4	4	4	4	4	3	4	4	4	1	3.90
91	1	13	34.4	1	4	3	3	4	6	4	4	3	4	4	4	2	3.80
91	1	14	34.2	1	4	3	3	3	3	4	4	3	3	4	3	1	3.40
91	1	15	30.5	2	3	3	3	3	3	4	3	3	3	3	3	1	3.10
91	1	16	34.2	2	4	4	4	4	5	6	5	3	4	5	4	3	4.40
91	1	17	29.9	2	3	3	3	3	3	3	3	3	3	3	3	0	3.00
91	1	18	29.8	2	2	2	2	2	2	2	2	2	2	2	2	0	2.00
91	1	19	30.1	2	2	2	2	2	2	2	2	2	2	2	2	0	2.00
91	1	20	30.7	2	5	2	2	2	2	3	2	2	2	2	2	3	2.40
92	1	111	38.5	4	5	5	4	5	5	4	5	5	4	5	5	1	4.70
92	1	112	39.6	4	9	11	8	9	8	8	9	7	7	8	8	4	8.30
92	1	113	39.6	4	6	8	6	8	8	8	7	6	8	7	8	2	7.20
92	1	114	39.4	4	5	6	4	6	5	5	5	6	5	5	5	2	5.00
92	1	115	39.0	4	7	8	6	8	6	8	7	6	6	7	6	1	6.30
92	1	116	41.6	4	12	15	11	10	11	13	15	9	11	13	11	6	12.00
92	1	117	41.0	4	7	12	10	13	13	13	12	10	7	11	13	6	10.80
92	1	118	41.3	4	11	11	10	11	11	11	11	11	10	9	11	2	10.60
92	1	119	41.2	4	8	9	8	8	9	9	8	8	8	8	8	1	8.20
92	1	120	41.1	4	8	9	7	8	8	8	9	7	8	8	9	2	8.00
92	1	121	41.9	4	8	7	8	8	8	9	9	8	7	7	8	3	7.70
92	1	122	41.3	4	11	12	8	12	11	12	11	10	12	12	12	4	11.10
92	1	123	42.4	4	5	8	5	7	9	8	7	7	6	8	7	4	7.10
92	2	101	28.3	7	1	1	1	1	1	1	1	1	1	1	1	0	1.00
92	2	102	29.8	7	1	1	1	1	1	1	1	1	1	1	1	0	1.00
92	2	103	33.1	7	1	1	1	-	2	1	1	1	1	1	1	1	1.11
92	2	104	33.9	7	3	4	3	4	4	3	5	3	3	5	3	2	3.70
92	2	105	34.4	7	3	4	3	3	4	3	4	4	3	4	3	1	3.50
92	2	106	34.9	7	3	4	3	4	4	4	4	4	4	5	4	2	3.90
92	2	107	34.4	7	4	4	3	4	4	4	5	4	3	4	4	2	3.90
92	2	108	34.5	7	2	2	2	-	4	2	5	2	2	3	2	3	2.67
92	2	109	34.8	7	3	3	2	3	3	3	3	3	2	3	3	1	2.70
92	2	100	34.9	7	4	4	4	4	5	4	5	3	5	4	4	2	4.20
92	2	101	35.9	7	3	3	2	4	4	3	3	3	3	4	3	2	3.20
92	2	102	35.0	7	4	4	5	5	5	4	5	5	4	6	5	2	4.70
92	2	103	35.4	7	4	3	3	4	3	4	4	4	4	4	4	1	3.70
92	2	104	35.4	7	4	4	3	4	4	4	4	4	3	4	4	1	3.80
92	2	105	35.0	7	5	4	3	5	5	4	5	5	4	5	5	2	4.50
92	2	106	35.0	7	4	4	4	4	4	4	4	4	3	4	4	1	3.90
92	2	107	35.2	7	3	2	2	3	3	3	3	3	3	3	3	1	2.60
92	2	108	35.5	7	3	4	2	4	4	4	4	4	3	4	4	2	3.60
92	2	109	36.0	7	4	4	4	4	4	4	4	4	4	5	4	1	4.10
92	2	200	36.2	7	5	3	4	6	5	5	6	5	5	5	5	3	4.90
92	2	201	36.9	7	8	8	10	8	8	8	7	8	7	7	8	4	7.70
92	2	202	36.3	7	7	7	6	6	7	8	8	6	6	7	7	3	6.90

Table 5.3 Continued

92	2	203	36.0	7	5	5	5	5	5	5	5	5	4	5	5	1	4.90
92	2	204	36.8	7	5	5	5	5	5	5	6	5	4	5	5	2	5.00
92	2	205	37.3	7	2	3	2	3	4	3	3	3	2	3	3	2	2.80
92	2	206	32.4	6	3	3	3	3	3	3	3	3	3	3	3	0	3.00
92	2	207	33.6	6	5	5	5	5	5	5	5	5	5	5	5	0	5.00
92	2	208	34.4	6	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	2	209	34.1	6	4	4	4	4	4	4	4	4	4	4	4	0	4.00
92	2	210	35.3	6	4	5	4	4	5	6	10	4	4	5	4	6	5.10
92	2	211	35.3	6	5	5	5	5	5	5	4	5	4	5	5	1	4.80
92	2	212	36.6	6	3	3	3	3	3	3	3	3	2	3	3	1	2.90
92	2	213	36.0	6	2	2	2	2	2	2	2	2	2	3	2	1	2.10
92	2	214	28.5	7	1	1	1	1	1	1	1	1	1	1	1	0	1.00
92	2	215	30.0	7	1	1	1	1	1	1	2	1	1	1	1	1	1.10
92	2	216	30.7	7	1	1	1	1	1	1	2	1	1	1	1	1	1.10
92	2	217	30.5	7	1	1	1	1	1	1	1	1	2	1	1	1	1.10
92	2	218	30.9	7	1	1	1	1	1	1	3	1	1	1	1	2	1.20
92	2	219	32.1	7	2	1	1	1	2	1	2	2	1	2	2	1	1.50
92	2	220	33.5	7	4	4	4	4	3	4	4	3	4	4	4	1	3.80
92	3	321	35.3	9	5	4	4	5	4	4	6	4	4	5	4	2	4.50
92	3	322	35.1	9	4	1	2	1	3	1	1	2	3	1	1	3	1.90
92	3	323	35.1	9	2	2	2	2	2	2	3	2	2	2	2	1	2.10
92	3	324	35.5	9	4	4	4	4	4	4	4	4	4	4	4	0	4.00
92	3	325	35.5	9	2	2	2	2	4	2	1	2	2	2	2	3	2.10
92	3	326	35.6	9	1	1	2	1	3	1	2	2	2	2	2	2	1.70
92	3	327	35.0	9	5	4	4	5	5	5	5	4	4	5	5	1	4.60
92	3	328	36.1	9	4	2	3	4	4	5	4	3	2	4	4	3	3.50
92	3	329	36.4	9	3	3	3	3	3	3	3	3	3	3	3	0	3.00
92	3	330	36.4	9	4	4	4	4	4	4	4	4	4	5	4	1	4.10
92	4	567	44.9	3	11	12	10	12	11	12	12	7	10	12	12	5	10.00
93	1	21	30.4	1	5	6	5	5	5	5	6	5	5	5	5	4	5.50
93	1	22	30.0	1	6	6	6	6	5	6	7	6	6	6	6	2	6.00
93	1	23	30.6	1	5	6	5	5	5	6	5	5	5	5	5	1	5.20
93	1	24	31.9	2	1	1	1	1	1	1	1	1	1	1	1	0	1.00
93	1	25	31.8	2	1	1	1	1	1	1	1	1	1	1	1	0	1.00
93	1	26	32.8	2	2	2	2	2	3	2	2	2	3	2	2	1	2.10
93	1	27	32.2	2	2	1	1	1	1	1	1	1	1	4	1	3	1.40
93	1	28	32.9	2	2	2	2	2	2	2	2	2	2	2	2	0	2.00
93	1	29	33.8	2	0	2	2	4	4	4	1	2	2	4	2	5	3.10
93	1	30	33.8	2	0	4	4	5	5	5	5	3	5	5	5	3	4.70
93	2	411	37.4	7	5	5	4	4	5	5	6	6	5	5	5	2	5.00
93	2	412	38.5	7	4	5	4	4	7	7	4	4	5	4	4	3	4.60
93	2	413	38.0	7	7	7	7	7	8	9	7	7	7	7	7	3	7.10
93	2	414	39.0	7	6	6	6	6	5	6	6	7	6	6	6	3	6.40
93	2	415	39.8	7	4	5	3	4	4	6	4	4	5	4	4	2	4.20
93	2	416	39.4	7	3	2	1	4	3	4	5	2	3	3	3	4	3.00
93	2	417	40.0	7	4	5	4	5	5	5	10	4	5	5	5	6	5.20
93	2	418	42.0	7	7	8	7	11	9	10	13	8	7	7	7	8	8.70
93	2	419	24.1	6	2	1	1	1	2	1	1	1	1	2	1	1	1.30
93	2	420	25.2	6	3	4	1	1	1	3	1	1	3	5	1	4	2.30
93	3	482	43.2	7	12	12	7	12	9	11	14	9	12	13	12	7	11.10
93	3	484	36.9	7	3	3	1	1	3	1	4	2	3	4	3	3	2.50
93	4	513	28.6	7	2	3	1	2	2	2	2	1	2	3	2	2	2.00
93	4	514	34.8	8	5	8	3	5	5	6	7	3	5	6	5	5	5.30
93	4	515	34.9	8	5	5	4	5	4	5	5	4	5	5	5	1	4.70
93	4	516	35.5	8	5	6	3	5	5	5	6	3	5	6	5	3	4.90
93	4	517	35.0	8	5	5	4	4	4	5	5	4	5	5	5	1	4.60
93	4	518	35.3	8	5	5	5	5	5	5	6	4	5	6	5	2	5.10
93	4	519	35.3	8	5	5	5	5	5	5	5	4	5	5	5	1	4.90
93	4	521	35.6	8	4	4	3	4	4	4	3	4	3	4	4	1	3.70
93	4	522	35.1	8	5	5	5	5	5	5	5	5	5	5	5	0	5.00
93	4	523	35.0	8	4	4	4	8	5	5	6	3	4	5	4	3	4.60
93	4	524	36.3	8	5	4	3	4	4	6	5	4	4	6	4	3	4.50
93	4	525	36.1	8	5	5	4	5	5	5	6	5	4	5	5	2	4.90
93	4	526	36.0	8	3	3	3	3	3	4	4	4	3	4	3	1	3.40
93	4	527	36.4	8	5	5	4	5	5	5	5	5	4	5	5	1	4.80
93	4	528	36.1	8	3	3	2	3	3	3	4	3	2	4	3	2	3.00
93	4	529	36.5	8	4	3	2	4	5	5	6	3	4	5	4	4	4.10
93	4	530	36.9	8	4	3	4	6	7	8	8	4	4	6	4	4	5.00
93	5	621	40.7	12	5	5	5	8	7	8	5	7	7	9	5	4	6.80
93	5	622	40.1	12	4	4	3	3	4	4	4	4	3	4	4	1	3.70
93	5	623	40.0	12	4	4	2	3	7	8	4	2	5	4	4	6	4.30
93	5	624	42.0	12	10	9	9	11	10	11	10	10	9	10	10	2	9.90
93	5	625	45.0	12	8	7	8	10	11	15	9	9	8	7	8	8	9.10

Total read	174	174	174	172	174	174	174	174	174	174
Total NOT read	0	0	0	2	0	0	0	0	0	0
Empty rows	26	26	26	26	26	26	26	26	26	26

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Table 5.4 The mean age recorded, 2stdev, CV (%), the number of age readings and the agreement with modal age are presented by modal age for each reader and for all readers combined. The number of age readings and the agreement is given for age groups 0-15 combined.

READER 1

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	0.00	1.26	2.56	3.00	4.03	4.96	5.67	6.40	7.62	8.67	10.00	11.50	11.33	7.00	-	14.00	
2stdev	0.00	1.42	2.63	0.62	0.84	0.68	1.41	1.79	1.21	1.15	0.00	1.41	1.15	-	-	-	
CV (%)	0%	57%	51%	10%	10%	7%	12%	14%	8%	7%	0%	6%	5%	-	-	-	
Number of age readings	16	27	16	22	29	27	9	5	11	3	2	2	3	1	-	1	174
Agreement with modal age	100%	85%	69%	91%	83%	89%	44%	60%	91%	67%	100%	50%	33%	0%	-	0%	81%

READER 2

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	0.00	1.11	2.00	3.00	3.83	5.11	6.00	7.20	8.62	8.33	8.50	13.00	12.00	12.00	-	15.00	
2stdev	0.00	1.15	1.03	1.07	1.32	2.50	1.00	2.97	2.68	1.15	1.41	5.66	0.00	-	-	-	
CV (%)	0%	52%	26%	18%	17%	24%	8%	21%	15%	7%	8%	22%	0%	-	-	-	
Number of age readings	16	27	16	22	29	27	9	5	11	3	2	2	3	1	-	1	174
Agreement with modal age	100%	96%	75%	73%	66%	56%	78%	40%	18%	33%	0%	50%	100%	0%	-	100%	70%

READER 3

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	0.00	1.04	1.88	2.59	3.41	4.33	5.33	6.00	7.64	8.00	9.00	10.50	8.33	10.00	-	14.00	
2stdev	0.00	0.36	0.68	1.33	1.36	1.36	1.00	2.00	2.24	2.00	0.00	1.41	3.06	-	-	-	
CV (%)	0%	19%	18%	26%	20%	16%	9%	17%	15%	13%	0%	7%	18%	-	-	-	
Number of age readings	16	27	16	22	29	27	9	5	11	3	2	2	3	1	-	1	174
Agreement with modal age	100%	96%	88%	68%	52%	44%	33%	40%	55%	33%	0%	50%	0%	0%	-	0%	64%

READER 4

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	0.00	1.00	2.13	3.05	4.10	5.00	6.33	7.80	9.00	9.00	10.50	10.50	12.00	13.00	-	16.00	
2stdev	0.00	0.00	1.49	1.15	1.24	0.96	1.41	3.85	2.97	0.00	1.41	1.41	0.00	-	-	-	
CV (%)	0%	0%	35%	19%	15%	10%	11%	25%	16%	0%	7%	7%	0%	-	-	-	
Number of age readings	16	26	15	22	29	27	9	5	11	3	2	2	3	1	-	1	172
Agreement with modal age	100%	100%	67%	82%	83%	78%	78%	40%	45%	100%	50%	50%	100%	100%	-	0%	80%

READER 5

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	0.00	1.63	2.56	3.16	4.45	5.07	5.89	7.60	9.18	8.67	10.00	11.00	10.33	13.00	-	16.00	
2stdev	0.00	1.13	1.63	0.79	2.04	1.23	1.20	2.68	2.66	1.15	0.00	0.00	2.31	-	-	-	
CV (%)	0%	35%	32%	12%	23%	12%	10%	18%	14%	7%	0%	0%	11%	-	-	-	
Number of age readings	16	27	16	22	29	27	9	5	11	3	2	2	3	1	-	1	174
Agreement with modal age	100%	41%	63%	82%	62%	85%	67%	40%	45%	67%	100%	100%	0%	100%	-	0%	57%

READER 6

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	0.00	1.07	2.25	3.27	4.86	5.00	6.11	9.00	9.82	9.33	11.00	12.00	11.67	13.00	-	15.00	
2stdev	0.00	0.77	1.71	1.41	2.16	0.96	2.33	2.00	4.37	1.15	0.00	2.83	1.15	-	-	-	
CV (%)	0%	36%	38%	21%	23%	10%	19%	11%	22%	6%	0%	12%	5%	-	-	-	
Number of age readings	16	27	16	22	29	27	9	5	11	3	2	2	3	1	-	1	174
Agreement with modal age	100%	96%	69%	59%	66%	78%	44%	0%	36%	67%	0%	50%	67%	100%	-	0%	68%

READER 7

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	0.00	1.15	2.25	3.41	4.59	5.74	6.78	8.80	9.64	9.67	10.50	13.00	12.33	12.00	-	16.00	
2stdev	0.00	0.91	2.00	1.33	2.59	2.69	1.94	4.98	4.13	2.31	1.41	5.66	3.06	-	-	-	
CV (%)	0%	40%	44%	20%	28%	23%	14%	28%	21%	12%	7%	22%	12%	-	-	-	
Number of age readings	16	27	16	22	29	27	9	5	11	3	2	2	3	1	-	1	174
Agreement with modal age	100%	89%	69%	68%	66%	56%	44%	40%	9%	67%	50%	50%	33%	0%	-	0%	64%

READER 8

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	0.00	1.07	1.94	2.91	3.59	4.59	6.11	7.00	7.55	8.33	9.50	10.00	8.67	10.00	-	13.00	
2stdev	0.00	0.53	0.50	1.05	1.26	1.86	0.87	1.41	1.87	2.31	1.41	2.83	3.06	-	-	-	
CV (%)	0%	25%	13%	18%	18%	20%	5%	10%	12%	14%	7%	14%	18%	-	-	-	
Number of age readings	16	27	16	22	29	27	9	5	11	3	2	2	3	1	-	1	174
Agreement with modal age	100%	93%	94%	73%	66%	56%	89%	60%	55%	67%	50%	50%	0%	0%	-	0%	73%

READER 9

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	0.00	1.19	1.94	2.82	3.86	4.74	5.33	6.40	7.36	8.00	9.50	10.50	11.33	7.00	-	12.00	
2stdev	0.00	1.11	0.50	0.79	1.39	1.31	1.00	1.10	1.01	0.00	1.41	1.41	2.31	-	-	-	
CV (%)	0%	47%	13%	14%	18%	14%	9%	9%	7%	0%	7%	7%	10%	-	-	-	
Number of age readings	16	27	16	22	29	27	9	5	11	3	2	2	3	1	-	1	174
Agreement with modal age	100%	89%	94%	82%	62%	63%	33%	40%	36%	0%	50%	50%	67%	0%	-	0%	70%

READER 10

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	0.00	1.30	2.31	3.36	4.41	5.30	6.22	7.20	8.09	9.00	10.50	11.00	12.33	11.00	-	15.00	
2stdev	0.00	1.91	1.20	1.16	1.26	1.74	0.88	0.89	2.44	0.00	1.41	5.66	1.15	-	-	-	
CV (%)	0%	74%	26%	17%	14%	16%	7%	6%	15%	0%	7%	26%	5%	-	-	-	
Number of age readings	16	27	16	22	29	27	9	5	11	3	2	2	3	1	-	1	174
Agreement with modal age	100%	89%	75%	68%	66%	74%	78%	80%	36%	100%	50%	0%	67%	0%	-	100%	74%

ALL READERS

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	0.00	1.18	2.19	3.06	4.09	4.99	5.98	7.34	8.49	8.70	9.90	11.30	11.03	10.80	-	14.60	
2stdev	0.00	1.11	1.52	1.18	1.79	1.76	1.56	3.07	3.16	1.59	1.70	3.25	3.30	4.60	-	2.70	
CV (%)	0%	47%	35%	19%	22%	18%	13%	21%	19%	9%	9%	14%	15%	21%	-	9%	
Number of age readings	160	269	158	220	290	270	90	50	110	30	20	20	30	10	-	10	1738
Agreement with modal age	100%	87%	75%	75%	67%	68%	59%	44%	43%	60%	45%	50%	47%	30%	-	20%	71%

Table 5.3 Continued

92	2	203	36.6	7	5	5	5	5	5	5	5	5	4	5	5	1	4.90
92	2	204	36.8	7	5	5	5	5	5	5	6	5	4	5	5	2	5.00
92	2	205	37.3	7	2	3	2	3	4	3	3	3	2	3	3	2	2.80
92	2	206	32.4	8	3	3	3	3	3	3	3	3	3	3	3	0	3.00
92	2	207	33.6	8	5	5	5	5	5	5	5	5	5	5	5	0	5.00
92	2	208	34.4	8	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	2	209	34.1	8	4	4	4	4	4	4	4	4	4	4	4	0	4.00
92	2	210	35.3	8	4	5	4	4	5	6	10	4	4	6	4	0	5.10
92	2	211	35.3	8	5	5	5	5	5	5	4	5	4	5	5	1	4.80
92	2	212	36.6	8	3	3	3	3	3	3	3	3	2	3	3	1	2.90
92	2	213	36.0	8	2	2	2	2	2	2	2	2	2	3	2	1	2.10
92	2	214	28.5	7	1	1	1	1	1	1	1	1	1	1	1	0	1.00
92	2	215	30.0	7	1	1	1	1	1	1	2	1	1	1	1	1	1.10
92	2	216	30.7	7	1	1	1	1	1	1	2	1	1	1	1	1	1.10
92	2	217	30.5	7	1	1	1	1	1	1	1	1	2	1	1	1	1.10
92	2	218	30.9	7	1	1	1	1	1	1	3	1	1	1	1	2	1.20
92	2	219	32.1	7	2	1	1	1	2	1	2	2	1	2	2	1	1.50
92	2	220	33.5	7	4	4	4	4	3	4	4	3	4	4	4	1	3.80
92	3	321	35.3	9	5	4	4	5	4	4	6	4	4	5	4	2	4.50
92	3	322	35.1	9	4	1	2	1	3	1	1	2	3	1	1	3	1.90
92	3	323	35.1	9	2	2	2	2	2	2	3	2	2	2	2	1	2.10
92	3	324	35.5	9	4	4	4	4	4	4	4	4	4	4	4	0	4.00
92	3	325	35.5	9	2	2	2	2	4	2	1	2	2	2	2	3	2.10
92	3	326	35.6	9	1	1	2	1	3	1	2	2	2	2	2	2	1.70
92	3	327	35.6	9	5	4	4	5	5	5	5	4	4	5	5	1	4.60
92	3	328	36.1	9	4	2	3	4	4	5	4	3	2	4	4	3	3.50
92	3	329	36.4	9	3	3	3	3	3	3	3	3	3	3	3	0	3.00
92	3	330	36.4	9	4	4	4	4	4	4	4	4	4	5	4	1	4.10
92	4	567	44.9	3	11	12	10	12	11	12	12	7	10	12	12	5	10.90
93	1	21	38.4	1	5	6	5	5	5	5	6	5	5	5	5	4	5.50
93	1	22	39.0	1	6	6	6	6	5	6	7	6	6	6	6	2	6.00
93	1	23	38.6	1	5	6	5	5	5	6	5	5	5	5	5	1	5.20
93	1	24	31.9	2	1	1	1	1	1	1	1	1	1	1	1	0	1.00
93	1	25	31.8	2	1	1	1	1	1	1	1	1	1	1	1	0	1.00
93	1	26	32.6	2	2	2	2	2	3	2	2	2	2	2	2	1	2.10
93	1	27	32.2	2	2	1	1	1	1	1	1	1	1	4	1	3	1.40
93	1	28	32.9	2	2	2	2	2	2	2	2	2	2	2	2	0	2.00
93	1	29	33.8	2	6	2	2	4	4	4	1	2	2	4	2	5	3.10
93	1	30	33.8	2	6	4	4	5	5	5	5	3	5	5	5	3	4.70
93	2	411	37.4	7	5	5	4	4	5	5	6	6	5	5	5	2	5.00
93	2	412	38.5	7	4	5	4	4	7	7	4	4	5	4	4	3	4.80
93	2	413	38.0	7	7	7	7	7	6	9	7	7	7	7	7	3	7.10
93	2	414	39.0	7	6	6	6	8	5	8	6	7	6	6	6	3	6.40
93	2	415	39.8	7	4	5	3	4	4	5	4	4	5	4	4	2	4.20
93	2	416	39.4	7	3	2	1	4	3	4	5	2	3	3	3	4	3.00
93	2	417	40.0	7	4	5	4	5	5	5	10	4	5	5	5	0	5.20
93	2	418	42.0	7	7	8	7	11	9	10	13	8	7	7	7	0	8.70
93	2	419	24.1	6	2	1	1	1	2	1	1	1	1	2	1	1	1.30
93	2	420	26.2	6	3	4	1	1	1	3	1	1	3	5	1	4	2.30
93	3	482	43.2	7	12	12	7	12	9	11	14	9	12	13	12	7	11.10
93	3	484	38.9	7	3	3	1	1	3	1	4	2	3	4	3	3	2.50
93	4	513	28.6	7	2	3	1	2	2	2	2	1	2	3	2	2	2.00
93	4	514	34.8	8	5	8	3	5	5	6	7	3	5	6	5	5	5.30
93	4	515	34.9	8	5	5	4	5	4	5	5	4	5	5	5	1	4.70
93	4	516	35.5	8	5	8	3	5	5	5	6	3	5	6	5	3	4.90
93	4	517	35.0	8	5	5	4	4	4	5	5	4	5	5	5	1	4.60
93	4	518	35.3	8	5	5	5	5	5	5	6	4	5	6	5	2	5.10
93	4	519	35.3	8	5	5	5	5	5	5	5	4	5	5	5	1	4.90
93	4	521	35.6	8	4	4	3	4	4	4	3	4	3	4	4	1	3.70
93	4	522	35.1	8	5	5	5	5	5	5	5	5	5	5	5	0	5.00
93	4	523	35.0	8	4	4	4	6	5	5	6	3	4	5	4	3	4.60
93	4	524	36.3	8	5	4	3	4	4	6	5	4	4	6	4	3	4.50
93	4	525	36.1	8	5	5	4	5	5	5	6	5	4	5	5	2	4.90
93	4	526	36.0	8	3	3	3	3	3	4	4	4	3	4	3	1	3.40
93	4	527	36.4	8	5	5	4	5	5	5	5	5	4	5	5	1	4.80
93	4	528	36.1	8	3	3	2	3	3	3	4	3	2	4	3	2	3.00
93	4	529	36.5	8	4	3	2	4	5	5	6	3	4	5	4	4	4.10
93	4	530	36.8	8	4	3	4	6	7	8	6	4	4	6	4	4	5.00
93	5	621	40.7	12	5	5	5	6	7	6	9	7	7	9	5	4	6.60
93	5	622	40.1	12	4	4	3	3	4	4	4	4	3	4	4	1	3.70
93	5	623	40.0	12	4	4	2	3	7	8	4	2	5	4	4	0	4.30
93	5	624	42.0	12	10	9	9	11	10	11	10	10	9	10	10	2	9.90
93	5	625	45.0	12	8	7	8	10	11	15	9	8	8	7	8	0	9.10
				Total read	174	174	174	172	174	174	174	174	174	174					
				Total NOT read	0	0	0	2	0	0	0	0	0	0					
				Empty rows	26	26	26	26	26	26	26	26	26	26					

Table 5.5 MACKEREL DIVISIONS IVb,c

Year	Sample	Fish no	Fish length	Catch month	Nether. Reader 1	Scotland Reader 2	England Reader 3	Norway Reader 4	Sp(IEO) Reader 5	Ireland Reader 6	Sp(AZTI) Reader 7	Portugal Reader 8	Denmark Reader 9	Russia Reader 10	Age MODE	Age difference	Age Average
93	607	1	42.0	5	13	12	7	16	15	15	12	8	16	10	16	9	12.50
93	607	2	42.1	5	11	13	7	13	14	13	13	8	15	11	13	8	11.80
93	607	3	41.2	5	13	14	8	11	12	12	11	10	13	12	12	6	11.60
93	607	4	43.2	5	11	13	10	13	17	13	14	10	11	9	13	8	12.10
93	607	5	41.0	5	16	17	17	16	19	16	16	14	16	11	16	8	16.40
93	607	6	42.3	5	16	16	16	9	16	17	17	13	17	15	17	10	15.60
93	607	7	41.2	5	10	14	13	11	14	10	14	12	11	12	14	4	12.10
93	607	8	39.0	5	8	7	6	7	6	6	6	5	4	5	6	3	5.80
93	607	9	43.6	5	10	9	10	13	11	13	15	11	8	11	11	7	11.10
93	607	10	41.9	5	8	9	8	16	10	13	9	7	8	8	8	11	9.80
93	607	11	45.7	5	21	18	21	24	24	22	24	20	22	20	24	6	21.60
93	607	12	42.9	5	14	13	15	14	16	20	19	13	16	16	16	7	15.50
93	607	13	40.6	5	13	17	15	16	16	19	16	12	19	13	13	7	15.09
93	607	14	26.5	5	2	3	2	2	2	2	2	1	2	2	2	1	1.90
93	607	15	27.7	5	2	2	2	2	2	2	2	1	2	2	2	1	1.90
93	607	16	39.8	5	10	10	9	10	11	10	10	9	10	10	10	2	9.90
93	607	17	36.6	5	5	11	6	9	10	12	6	5	5	6	5	7	7.50
93	607	18	28.5	5	3	3	2	2	2	2	2	1	2	2	2	2	2.10
93	607	19	44.5	5	19	20	16	20	23	21	21	2	19	12	19	21	17.30
93	607	20	44.2	5	13	14	17	15	15	17	14	2	17	15	17	15	13.90
93	607	21	42.0	5	14	15	12	13	18	15	19	12	12	11	12	8	13.90
93	607	22	42.9	5	12	11	10	14	12	13	12	10	11	13	12	4	11.60
93	607	23	40.0	5	12	14	11	16	16	17	17	10	17	13	17	7	14.30
93	607	24	42.5	5	14	16	17	17	20	17	19	13	15	15	17	7	16.30
93	607	25	41.1	5	10	12	11	12	12	12	12	11	10	11	12	2	11.30
93	714	1	37.3	8	12	12	12	13	12	13	11	8	11	12	12	4	11.70
93	714	2	36.1	8	11	13	8	12	10	13	14	10	14	12	13	5	11.80
93	714	3	34.0	8	8	8	8	8	7	9	9	8	8	8	8	3	8.20
93	714	4	36.5	8	13	14	14	14	13	14	14	8	11	14	14	6	12.90
93	714	5	34.1	8	4	4	3	4	3	5	3	4	3	4	4	2	3.70
93	714	6	34.1	8	8	8	7	8	7	8	8	8	7	8	8	1	7.70
93	714	7	32.9	8	2	2	2	2	2	2	3	3	2	2	2	1	2.10
93	714	8	35.8	8	8	8	8	10	7	10	7	7	9	8	8	3	8.30
93	714	9	33.2	8	2	2	2	2	2	2	2	3	2	2	2	1	2.10
93	714	10	40.4	8	20	22	14	17	18	17	18	12	16	15	17	10	16.90
93	714	11	36.2	8	9	11	10	11	9	11	11	11	10	10	11	2	10.30
93	714	12	35.3	8	7	8	6	7	7	7	8	5	6	9	7	4	7.00
93	714	13	36.2	8	9	13	9	11	9	11	9	5	10	10	9	8	9.60
93	714	14	42.4	8	14	17	15	16	15	17	15	9	12	15	15	8	14.50
93	714	15	37.3	8	8	8	8	9	8	9	9	12	8	9	9	4	9.00
93	714	16	37.9	8	4	4	3	4	3	4	5	8	3	3	4	5	4.10
93	714	17	43.8	8	13	15	12	14	14	15	13	4	12	14	14	11	12.60
93	714	18	33.8	8	4	5	4	4	4	4	4	16	4	4	4	6	4.70
93	714	19	29.2	8	1	1	1	1	1	1	1	4	1	1	1	3	1.30
93	714	20	37.7	8	9	10	8	10	10	10	10	2	11	10	10	9	9.00
93	714	21	34.9	8	12	-	9	-	12	13	13	8	8	13	13	5	11.13
93	714	22	34.1	8	4	4	4	4	3	4	3	4	4	4	4	1	3.80
93	714	23	38.6	8	9	11	8	-	11	11	11	5	10	9	11	6	9.44
93	714	24	37.2	8	13	13	14	15	14	13	13	12	12	14	13	3	13.30
93	714	25	36.4	8	10	11	10	12	11	12	10	8	13	13	10	4	11.00
93	712	1	26.2	8	1	1	1	1	1	1	1	1	1	1	1	0	1.00
93	712	2	27.7	8	1	1	1	1	1	1	1	1	1	1	1	0	1.00
93	712	3	34.6	8	6	6	6	6	6	6	6	5	6	8	6	3	6.10
93	712	4	28.7	8	1	1	1	1	1	1	1	1	1	1	1	0	1.00
93	712	5	32.6	8	2	2	2	2	2	2	2	2	2	2	2	0	2.00
93	712	6	28.7	8	1	1	1	1	1	1	1	1	1	1	1	0	1.00
93	712	7	29.6	8	1	1	1	1	1	1	1	1	1	1	1	0	1.00
93	712	8	25.6	8	1	1	1	1	1	1	1	1	1	1	1	0	1.00
93	712	9	26.1	8	1	1	1	1	1	1	2	1	1	1	1	1	1.10
93	712	10	31.4	8	3	3	3	3	3	3	3	1	3	3	3	2	2.80
93	712	11	26.3	8	1	1	1	1	1	1	1	1	1	1	1	0	1.00
93	712	12	34.6	8	4	4	4	4	4	4	4	4	3	4	4	1	3.90
93	712	13	27.3	8	1	1	1	1	1	1	1	1	1	1	1	0	1.00
93	712	14	26.6	8	1	1	1	1	1	1	1	1	1	1	1	0	1.00
93	712	15	27.5	8	1	1	1	1	1	1	1	1	1	1	1	0	1.00
93	712	16	25.3	8	1	1	1	1	1	1	1	1	1	1	1	0	1.00
93	712	17	32.0	8	7	7	8	7	8	9	7	8	7	7	7	3	7.10
93	712	18	27.3	8	1	1	1	1	1	1	1	1	1	1	1	0	1.00
93	712	19	30.2	8	2	2	2	2	2	2	2	2	2	2	2	0	2.00
93	712	20	26.5	8	1	1	1	1	1	1	1	1	1	1	1	0	1.00
93	712	21	30.8	8	2	2	1	2	2	1	1	1	1	1	1	1	1.40
93	712	22	26.5	8	1	1	1	1	1	1	1	1	1	1	1	0	1.00
93	712	23	32.8	8	3	3	3	3	3	3	3	2	3	3	3	1	2.90
93	712	24	27.6	8	1	1	1	1	1	1	1	1	1	1	1	0	1.00
93	712	25	25.9	8	1	1	1	1	1	1	1	1	1	1	1	0	1.00
93	717	1	39.4	9	7	8	7	7	8	8	8	7	7	8	7	1	7.50
93	717	2	39.1	9	8	9	9	10	9	10	9	7	8	8	9	3	8.70
93	717	3	40.5	9	8	8	8	9	8	9	9	8	8	8	8	1	8.30
93	717	4	38.9	9	13	13	12	13	14	14	14	10	11	12	13	4	12.60
93	717	5	40.1	9	10	10	10	11	10	11	11	8	10	11	10	5	10.00
93	717	6	43.7	9	7	8	9	12	8	13	7	6	8	6	5	7	8.20
93	717	7	41.4	9	7	7	8	7	10	11	13	7	7	8	7	5	8.40
93	717	8	41.5	9	8	7	8	7	9	11	7	7	7	7	7	4	7.80
93	717	9	42.7	9	8	8	8	7	9	13	11	7	9	7	7	7	8.50
93	717	10	41.8	9	10	8	7	8	8	10	12	8	7	9	8	5	8.80
93	717	11	40.4	9	12	12	11	13	13	14	15	9	11	14	12	6	12.40
93	717	12	42.4	9	11	11	9	11	11	10	14	10	9	12	11	5	10.80
93	717	13	40.3	9	11	13	13	12	14	12	15	9	10	11	11	6	12.00
93	717	14	42.2	9	12	9	10	12	16	13	18	11	12	10	12	9	12.30
93	717	15	42.1	9	11	12	12	11	12	13	12	11	12	12	12	2	11.80
93	717	16	42.7	9	11	8	13	11	12	15	13	12	7	10	11	8	11.20
93	717	17	43.3	9	11	11	12	16	14	17	17	13	12	13	12	6	13.50
93	717	18	31.3	9	1	1	1	1	1	1	1	1	1	1	1	0	1.00
93	717	19	28.4	9	1	1	1	1	1	1	1	1	1	1	1	0	1.00
92	804	1	36.5	10	3	3	3	3	3	3	3	3	3	3	3	0	3.00
92	804	2	31.5	10	1	2	2	2	1	1	1	2	2	1	1	1	1.50
92	804	3	34.7	10	6	6	6	6	5	4	6	5	4	6	6	2	5.40
92	804	4	34.1	10	12	12	11	13	13	16	12	4	8	8	12	12	10.50
92	804	5	33.2	10	6	7	8	6	6	7	5	4	6	6	6	3	5.90
92	804	6	36.4	10	11	11	12	12	11	12	12	4	11	10	11	8	10.60
92	804	7	38.9	10	11	11	11	12	11	13	11	7	10	10	11	6	10.70

Table 5.5 Continued

92	804	8	33.3	10	3	3	3	3	3	3	3	2	3	3	3	1	2.90
92	804	9	36.8	10	7	6	6	6	5	6	6	6	5	6	6	2	6.00
92	804	10	37.9	10	9	9	8	8	9	9	10	7	8	9	9	4	8.20
92	804	11	34.7	10	9	10	10	11	10	10	11	7	9	9	10	4	9.60
92	804	12	39.0	10	9	9	9	9	8	10	10	8	8	10	9	2	9.10
92	804	13	35.9	10	9	9	13	8	15	14	14	7	11	10	9	6	11.00
92	804	14	34.0	10	3	3	3	3	3	3	3	3	3	3	3	0	3.00
92	804	15	35.2	10	2	3	3	3	3	3	2	2	3	3	3	1	2.70
92	804	16	34.7	10	11	10	10	10	11	11	12	6	11	7	11	6	9.90
92	804	17	34.5	10	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	804	18	30.9	10	2	2	2	2	2	2	2	1	2	2	2	1	1.90
92	804	19	31.4	10	1	1	1	1	1	1	1	1	1	1	1	0	1.00
92	804	20	29.5	10	1	1	1	1	1	1	1	1	1	1	1	0	1.00
92	804	21	33.1	10	2	2	2	2	2	2	3	2	2	2	2	1	2.10
92	804	22	30.5	10	2	1	2	1	1	1	2	1	1	1	1	1	1.30
92	804	23	23.7	10	0	0	0	0	0	0	0	0	0	0	0	0	0.00
92	804	24	29.4	10	1	1	1	1	1	1	1	1	1	1	1	0	1.00
92	804	25	28.7	10	1	1	1	1	1	1	1	1	1	1	1	0	1.00
92	852	1	28.5	11	1	1	1	1	1	1	1	1	1	1	1	0	1.00
92	852	2	28.9	11	1	1	1	1	1	1	1	1	1	1	1	0	1.00
92	852	3	32.0	11	6	5	6	6	6	6	6	3	6	6	6	3	5.60
92	852	4	33.1	11	6	6	7	6	6	6	6	4	6	6	6	3	5.90
92	852	5	33.0	11	3	3	3	3	3	3	3	2	3	3	3	1	2.90
92	852	6	32.6	11	9	10	9	9	10	10	9	4	9	9	9	6	8.80
92	852	7	32.4	11	3	3	3	3	3	3	3	3	3	3	3	0	3.00
92	852	8	32.6	11	3	2	4	3	3	3	3	3	3	3	3	2	3.00
92	852	9	33.5	11	7	7	7	7	7	7	7	7	7	7	7	0	7.00
92	852	10	33.8	11	3	3	2	3	3	3	3	2	2	3	3	1	2.70
92	852	11	33.0	11	6	6	6	6	7	7	11	4	7	7	6	7	6.70
92	852	12	33.5	11	5	5	5	5	5	5	5	3	5	5	5	2	4.80
92	852	13	34.0	11	13	11	11	13	12	12	11	5	11	9	11	8	10.80
92	852	14	33.6	11	3	5	4	5	5	5	5	3	3	5	6	2	4.30
92	852	15	33.2	11	9	9	9	8	9	9	9	5	9	8	9	4	8.30
92	852	16	34.7	11	10	12	11	12	11	13	11	8	12	10	12	5	11.00
92	852	17	34.9	11	10	11	10	10	10	11	10	9	10	10	10	2	10.10
92	852	18	35.8	11	4	4	3	4	4	4	4	3	4	5	4	2	3.90
92	852	19	35.8	11	12	12	12	13	15	14	12	10	13	13	12	5	12.60
92	852	20	35.3	11	5	5	4	5	5	5	5	4	4	6	5	2	4.80
92	852	21	35.3	11	11	10	10	11	11	11	11	8	11	11	11	3	10.50
92	852	22	35.1	11	5	6	5	5	5	5	5	4	5	5	5	2	5.00
92	852	23	36.2	11	10	10	10	10	10	10	11	9	10	10	10	2	10.00
92	852	24	36.1	11	5	5	5	4	5	5	4	4	5	5	5	1	4.70
92	852	25	37.1	11	5	5	5	5	5	5	6	5	5	6	5	1	5.30
93	806	1	30.5	11	2	2	2	2	2	2	2	2	2	2	2	0	2.00
93	806	2	30.9	11	2	2	2	2	2	2	2	2	2	2	2	0	2.00
93	806	3	33.3	11	8	5	7	7	6	8	7	2	1	6	7	7	5.70
93	806	4	31.3	11	2	2	2	2	2	2	2	2	2	2	2	0	2.00
93	806	5	33.7	11	5	4	6	4	5	6	5	4	4	4	4	2	4.60
93	806	6	35.1	11	11	11	11	12	10	13	12	13	8	10	11	4	11.20
93	806	7	34.5	11	3	3	3	3	3	3	3	3	2	3	3	1	2.90
93	806	8	35.0	11	13	11	13	12	12	13	12	13	11	13	13	2	12.30
93	806	9	35.0	11	11	12	13	13	13	13	11	12	9	14	13	5	12.10
93	806	10	35.7	11	7	7	7	8	7	8	10	6	7	8	7	4	7.50
93	806	11	35.8	11	13	13	11	15	12	14	12	10	12	13	13	5	12.50
93	806	12	35.8	11	10	11	11	10	10	11	9	9	9	11	11	2	10.10
93	806	13	35.1	11	7	7	7	7	8	7	7	7	7	7	7	1	6.90
93	806	14	35.2	11	12	12	10	12	12	13	14	9	11	12	12	5	11.70
93	806	15	36.6	11	8	8	8	9	7	9	8	7	8	8	8	2	7.90
93	806	16	36.1	11	13	14	11	13	13	15	11	12	13	10	13	9	12.90
93	806	17	36.1	11	11	12	11	13	11	11	10	10	11	11	11	3	11.10
93	806	18	36.2	11	12	12	12	13	11	12	13	9	12	11	12	4	11.70
93	806	19	36.4	11	15	17	15	15	16	16	14	10	16	13	15	7	14.70
93	806	20	37.8	11	13	15	15	16	16	15	16	10	15	12	15	6	14.50
93	806	21	37.7	11	16	15	9	16	13	12	12	7	10	10	16	9	12.00
93	806	22	37.8	11	11	12	12	14	13	13	13	8	12	12	12	6	12.00
93	806	23	37.6	11	15	15	15	15	14	14	13	12	14	15	15	3	14.20
93	806	24	38.9	11	12	13	14	13	12	14	14	10	13	14	14	4	12.90
93	806	25	40.7	11	11	11	10	11	10	11	10	5	11	9	11	6	9.90
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
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MACKEREL DIVISION IVb,c

Table 5.6 The mean age recorded, 2stdev, CV (%), the number of age readings and the agreement with modal age are presented by modal age for each reader and for all readers combined. The number of age readings and the agreement is given for age groups 0-15 combined.

READER 1	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	0.00	1.07	2.08	2.81	4.14	4.86	6.22	7.30	8.33	8.89	9.71	10.73	11.73	12.18	12.00	14.25	
	2stdev	-	0.52	0.55	0.60	0.76	1.60	0.80	0.97	1.63	0.67	0.98	1.92	2.07	1.96	2.83	1.91	
	CV (%)	-	24%	13%	10%	9%	18%	7%	7%	10%	4%	5%	9%	9%	8%	12%	7%	
	Number of age readings	1	29	13	11	7	7	9	10	6	9	7	15	15	11	4	4	158
	Agreement with modal age	100%	93%	92%	91%	86%	71%	78%	70%	83%	89%	71%	67%	53%	55%	0%	0%	74%

READER 2	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	0.00	1.07	2.08	2.91	4.14	6.00	6.33	6.90	8.17	9.56	10.29	10.73	12.00	13.20	14.00	16.00	
	2stdev	-	0.52	0.55	0.60	0.76	6.47	1.73	1.75	0.82	2.67	0.96	2.33	2.62	3.10	1.63	2.31	
	CV (%)	-	24%	13%	10%	9%	37%	14%	13%	5%	14%	5%	11%	11%	12%	6%	7%	
	Number of age readings	1	29	13	11	7	7	9	10	6	9	7	15	15	10	4	4	157
	Agreement with modal age	100%	93%	92%	91%	86%	71%	56%	60%	83%	78%	71%	60%	67%	80%	50%	50%	75%

READER 3	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	0.00	1.07	2.00	3.00	3.86	4.86	6.44	7.30	7.83	9.00	9.57	10.67	11.07	11.27	13.25	15.00	
	2stdev	-	0.52	0.00	0.89	2.14	1.38	2.03	1.35	1.51	3.16	1.57	2.68	2.33	4.82	1.91	0.00	
	CV (%)	-	24%	0%	15%	28%	14%	16%	9%	10%	18%	8%	13%	11%	21%	7%	0%	
	Number of age readings	1	29	13	11	7	7	9	10	6	9	7	15	15	11	4	4	156
	Agreement with modal age	100%	93%	100%	82%	43%	57%	78%	50%	50%	44%	71%	33%	47%	18%	50%	100%	64%

READER 4	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	0.00	1.07	2.00	3.00	4.00	5.43	6.78	7.10	10.33	8.78	10.57	11.57	12.80	13.50	13.00	15.50	
	2stdev	-	0.52	0.00	0.00	0.00	3.24	3.97	0.63	7.66	2.79	1.57	2.03	2.53	2.71	2.83	1.15	
	CV (%)	-	24%	0%	0%	0%	30%	29%	4%	37%	16%	7%	9%	10%	10%	11%	4%	
	Number of age readings	1	29	13	11	7	7	9	10	6	9	7	14	15	10	4	4	156
	Agreement with modal age	100%	93%	100%	100%	100%	71%	78%	90%	33%	44%	57%	36%	27%	50%	50%	50%	69%

READER 5	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	0.00	1.03	2.00	3.00	3.71	5.71	6.22	7.50	8.00	9.33	10.29	11.00	12.93	13.55	13.25	15.75	
	2stdev	-	0.37	0.00	0.00	1.51	3.78	1.67	2.67	2.53	4.58	0.98	2.27	3.25	4.59	1.91	3.42	
	CV (%)	-	18%	0%	0%	20%	33%	13%	19%	16%	25%	5%	10%	13%	17%	7%	11%	
	Number of age readings	1	29	13	11	7	7	9	10	6	9	7	15	15	11	4	4	158
	Agreement with modal age	100%	97%	100%	100%	43%	86%	67%	30%	17%	44%	71%	53%	40%	18%	50%	25%	63%

READER 6	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	0.00	1.00	2.00	3.00	4.29	6.00	7.00	8.00	9.67	10.11	10.57	11.80	13.53	14.27	13.25	15.50	
	2stdev	-	0.00	0.00	0.00	0.98	5.29	5.00	4.16	3.72	3.23	1.57	2.53	2.91	4.74	4.43	2.58	
	CV (%)	-	0%	0%	0%	11%	44%	36%	23%	19%	16%	7%	11%	11%	17%	17%	8%	
	Number of age readings	1	29	13	11	7	7	9	10	6	9	7	15	15	11	4	4	158
	Agreement with modal age	100%	100%	100%	100%	71%	86%	44%	30%	33%	44%	57%	47%	20%	64%	50%	0%	64%

READER 7	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	0.00	1.07	2.08	2.91	4.00	5.14	6.56	8.40	8.83	9.78	10.43	11.80	13.47	13.00	13.75	14.50	
	2stdev	-	0.52	0.55	0.60	1.63	1.38	3.46	3.79	3.44	3.28	1.07	3.56	5.23	2.97	1.00	2.58	
	CV (%)	-	24%	13%	10%	20%	13%	27%	23%	19%	17%	5%	15%	19%	11%	4%	9%	
	Number of age readings	1	29	13	11	7	7	9	10	6	9	7	15	15	11	4	4	158
	Agreement with modal age	100%	93%	92%	91%	43%	57%	67%	50%	33%	67%	57%	33%	33%	27%	75%	25%	61%

READER 8	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	0.00	1.14	1.85	2.36	5.29	4.00	4.67	6.10	7.50	6.78	7.29	8.33	9.53	10.64	8.50	10.25	
	2stdev	-	1.16	1.38	1.35	5.26	1.63	2.00	3.19	1.10	4.67	5.26	5.74	3.99	3.36	6.83	2.52	
	CV (%)	-	51%	37%	29%	50%	20%	21%	26%	7%	34%	36%	34%	21%	16%	40%	12%	
	Number of age readings	1	29	13	11	7	7	9	10	6	9	7	15	15	11	4	4	158
	Agreement with modal age	100%	93%	54%	45%	57%	29%	22%	60%	50%	0%	0%	13%	13%	9%	0%	0%	39%

READER 9	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	0.00	1.03	2.00	2.82	3.57	4.57	5.56	6.50	7.83	8.67	10.29	9.87	11.20	12.36	11.75	14.25	
	2stdev	-	0.37	0.00	0.81	1.07	1.57	2.03	4.14	1.51	2.83	1.90	2.49	4.29	5.75	1.91	3.42	
	CV (%)	-	18%	0%	14%	15%	17%	18%	32%	10%	16%	9%	13%	19%	23%	8%	12%	
	Number of age readings	1	29	13	11	7	7	9	10	6	9	7	15	15	11	4	4	158
	Agreement with modal age	100%	97%	100%	82%	57%	71%	56%	70%	50%	33%	57%	40%	47%	9%	0%	25%	61%

READER 10	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	0.00	1.00	2.00	3.00	4.00	5.43	6.00	7.40	8.17	9.00	10.43	10.07	11.60	12.18	13.50	13.75	
	2stdev	-	0.00	0.00	0.00	1.15	1.07	1.00	1.68	0.82	1.73	2.54	2.45	3.00	3.20	2.00	3.00	
	CV (%)	-	0%	0%	0%	14%	10%	8%	11%	5%	10%	12%	12%	13%	13%	7%	11%	
	Number of age readings	1	29	13	11	7	7	9	10	6	9	7	15	15	11	4	4	158
	Agreement with modal age	100%	100%	100%	100%	71%	57%	78%	50%	83%	33%	57%	33%	33%	36%	75%	50%	67%

ALL READERS	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	0.00	1.06	2.01	2.89	4.10	5.20	6.18	7.34	8.47	8.99	9.94	10.65	11.99	12.60	12.63	14.48	
	2stdev	0.00	0.54	0.53	0.73	2.10	3.00	2.85	3.06	3.36	3.46	2.81	3.53	4.02	4.30	4.17	3.87	
	CV (%)	-	26%	13%	13%	26%	29%	23%	21%	20%	19%	14%	17%	17%	17%	17%	13%	
	Number of age readings	10	290	130	110	70	70	90	100	60	90	70	149	150	108	40	40	1577
	Agreement with modal age	100%	95%	93%	86%	66%	66%	62%	56%	52%	48%	57%	42%	38%	34%	40%	33%	64%

Table 5.7 MACKEREL DIVISIONS VIa & VIIb,c Second readings

Year	Sample	Fish no	Fish length	Catch month	Nethell Reader 1	Scotland Reader 2	England Reader 3	Norway Reader 4	Sp(IEO) Reader 5	Ireland Reader 6	Sp(AZTI) Reader 7	Portugal Reader 8	Denmark Reader 9	Russia Reader 10	Age MODE	Age difference	Age Average
90	4	1	33.4	1	6	5	7	6	6	5	6	3	6	4	6	4	5.60
90	4	2	35.9	1	5	5	6	6	6	6	5	3	6	5	6	3	5.50
90	4	3	35.3	1	3	3	3	3	3	3	3	2	3	3	3	1	2.90
90	4	4	35.9	1	6	6	6	6	6	6	6	3	5	6	6	3	5.60
90	4	5	36.6	1	5	6	6	5	6	6	5	5	5	6	5	1	5.50
90	4	6	36.2	1	4	4	4	4	4	4	4	3	3	4	4	1	3.80
90	4	7	36.3	1	5	5	5	5	6	5	5	3	4	5	5	3	4.80
90	4	8	37.9	1	9	9	10	10	10	10	10	3	9	10	10	7	8.90
90	4	9	38.8	1	6	6	6	6	6	5	6	3	5	6	6	3	5.50
90	4	10	38.7	1	6	6	6	6	6	6	6	3	6	6	6	3	5.70
90	4	11	39.6	1	8	9	9	8	9	9	7	9	9	9	9	3	8.30
90	4	12	39.9	1	6	6	6	6	6	6	5	7	8	6	6	2	5.90
90	4	13	39.1	1	5	5	7	7	10	6	5	8	9	6	6	5	6.90
90	4	14	40.4	1	14	14	15	12	15	10	12	13	13	15	15	4	13.90
90	4	15	40.7	1	5	6	6	7	6	5	5	6	5	5	5	2	5.60
90	4	16	40.6	1	7	13	8	11	9	12	11	11	9	9	11	6	10.00
90	4	17	40.3	1	8	10	9	10	9	9	9	11	6	10	9	3	9.20
90	4	18	40.9	1	8	11	10	11	9	10	5	-	9	9	9	3	9.56
90	4	19	41.4	1	8	9	8	9	8	9	8	11	8	10	8	3	8.90
90	4	20	41.8	1	9	11	10	10	10	10	9	11	9	9	9	2	9.80
90	4	21	42.7	1	9	10	10	11	12	10	10	10	8	10	10	4	10.00
90	4	22	42.0	1	8	10	9	12	9	11	8	11	8	9	9	4	9.50
90	4	23	42.4	1	10	12	10	12	12	11	12	14	12	11	12	4	11.60
90	4	24	43.7	1	10	11	13	-	12	11	9	14	12	9	11	5	11.22
90	4	25	46.4	1	10	14	11	-	11	11	10	12	9	10	10	5	10.89
90	11	1	29.8	2	3	3	3	3	3	3	3	3	3	3	3	0	3.00
90	11	2	30.6	2	3	3	3	3	3	3	3	3	3	3	3	0	3.00
90	11	3	29.9	2	3	2	3	3	3	3	2	2	3	2	3	1	2.70
90	11	4	32.1	2	4	3	4	4	5	3	4	3	3	5	4	3	3.70
90	11	5	31.3	2	5	3	5	4	5	4	5	4	5	5	5	2	4.50
90	11	6	31.2	2	3	3	3	3	3	3	3	3	3	3	3	2	3.20
90	11	7	32.2	2	3	3	3	3	3	3	3	3	3	3	3	0	3.00
90	11	8	32.4	2	3	3	3	3	3	3	3	3	3	3	3	0	3.00
90	11	9	32.4	2	3	3	3	3	3	3	3	3	3	3	3	0	3.00
90	11	10	32.4	2	3	3	3	3	3	3	3	3	3	3	3	0	3.00
90	11	11	32.5	2	4	4	4	4	4	3	4	4	4	4	4	1	3.90
90	11	12	35.9	2	5	5	4	5	5	4	5	4	5	5	5	1	4.70
90	11	13	36.4	2	6	6	6	6	6	4	6	-	6	6	6	2	5.78
90	11	14	37.9	2	6	5	5	6	6	5	6	5	5	6	6	1	5.50
90	11	15	38.2	2	5	5	6	6	6	6	5	6	5	6	6	1	5.60
90	11	16	38.2	2	6	6	6	6	6	5	6	6	6	6	6	0	6.00
90	11	17	39.8	2	6	6	6	6	6	6	6	6	6	6	6	0	6.00
90	11	18	40.7	2	8	9	9	9	10	9	8	8	9	9	9	2	8.90
90	11	19	40.7	2	10	10	10	10	10	10	10	10	10	10	10	0	10.00
90	11	20	40.7	2	9	8	9	9	9	9	9	10	8	-	9	2	8.89
90	11	21	40.2	2	8	10	8	10	12	10	9	9	9	8	8	4	9.30
90	11	22	41.1	2	6	6	6	6	6	6	6	6	6	6	6	0	6.00
90	11	23	41.6	2	9	9	9	9	9	6	9	9	9	9	9	1	9.70
90	11	24	43.0	2	11	14	13	11	13	14	12	13	12	14	14	3	12.70
90	11	25	45.3	2	13	14	14	16	15	15	13	16	12	16	13	6	14.60
91	13	1	32.3	2	5	5	5	5	5	5	5	6	5	5	5	1	5.10
91	13	2	34.0	2	4	4	4	4	4	4	5	4	4	4	4	1	4.10
91	13	3	35.2	2	4	3	4	4	4	4	4	4	4	4	4	1	3,90
91	13	4	36.6	2	6	6	6	7	7	7	6	6	6	7	6	1	6.40
91	13	5	36.7	2	4	4	4	4	5	4	4	4	4	4	4	1	4.10
91	13	6	38.2	2	4	4	4	4	4	4	4	4	4	4	4	0	4.00
91	13	7	38.0	2	4	4	4	4	4	4	4	4	4	4	4	0	4.00
91	13	8	39.0	2	6	6	7	7	7	6	7	6	7	6	7	2	6.70
91	13	9	38.8	2	7	7	7	7	7	7	7	7	7	7	7	0	7.00
91	13	10	39.0	2	8	8	8	7	8	8	7	8	7	7	8	1	7.80
91	13	11	38.3	2	7	7	7	7	7	7	7	7	7	8	7	1	6.90
91	13	12	39.6	2	9	9	8	8	8	8	8	8	8	9	8	3	8.00
91	13	13	39.9	2	10	10	10	10	10	10	9	11	10	9	10	2	9.90
91	13	14	40.7	2	10	11	13	11	13	12	10	9	11	11	11	4	11.10
91	13	15	40.6	2	7	10	7	8	9	7	7	9	7	7	7	3	7.70
91	13	16	40.9	2	7	11	10	11	11	8	7	10	7	8	7	4	9.00
91	13	17	41.5	2	12	13	13	12	15	13	13	12	14	14	13	3	13.10
91	13	18	41.2	2	8	7	7	7	9	7	7	8	7	7	7	2	7.40
91	13	19	41.4	2	10	11	11	12	12	11	10	11	12	11	11	2	11.10
91	13	20	42.9	2	8	9	9	10	14	9	9	-	9	9	9	6	9.56
91	13	21	43.3	2	16	14	17	-	-	15	14	12	16	13	14	7	13.88
91	13	22	42.1	2	9	11	10	12	11	11	10	11	12	10	11	4	10.60
91	13	23	43.5	2	11	14	14	12	16	12	12	14	13	13	14	5	13.10
91	13	24	45.1	2	12	17	15	13	15	15	14	14	14	12	15	5	14.10
91	13	25	45.3	2	16	16	17	-	17	16	15	-	16	14	16	4	16.13
91	35	1	37.5	4	6	6	6	9	7	6	7	9	5	6	6	3	6.50
91	35	2	39.8	4	9	9	8	11	10	10	12	10	9	9	9	4	9.70
91	35	3	42.0	4	8	10	9	10	10	9	13	10	7	7	10	6	9.30
91	35	4	41.1	4	15	10	14	15	14	12	15	14	12	13	15	6	13.40
91	35	5	41.7	4	11	10	11	12	11	10	11	13	12	11	11	3	11.20
91	35	6	41.3	4	8	7	7	7	8	7	12	7	6	7	7	6	7.70
91	35	7	43.3	4	12	12	12	12	13	12	15	10	12	11	12	5	12.10
91	35	8	42.6	4	11	11	11	11	10	10	12	10	11	11	11	2	10.80
91	35	9	42.5	4	11	12	10	11	10	10	13	10	11	9	10	4	10.70
91	35	10	42.0	4	11	12	9	12	11	12	11	11	12	9	11	3	11.00
91	35	11	42.5	4	8	9	10	11	12	10	13	11	9	11	11	5	10.40
91	35	12	42.8	4	10	9	10	10	11	10	12	11	9	10	10	3	10.20
91	35	13	42.0	4	7	7	7	7	7	7	9	9	6	7	7	3	7.20
91	35	14	42.4	4	9	9	8	9	9	10	8	10	8	9	9	2	9.00
91	35	15	42.8	4	10	9	11	11	10	9	12	10	9	7	10	5	9.80
91	35	16	43.0	4	10	10	10	10	10	10	10	11	10	10	10	1	10.10
91	35	17	43.9	4	10	10	8	9	11	10	10	12	9	9	10	4	9.80
91	35	18	43.2	4	10	10	10	10	11	10	11	9	10	10	10	2	10.10
91	35	19	43.8	4	7	8	6	-	9	8	8	9	5	6	8	4	7.33
91	35	20	44.0	4	9	11	10	10	10	10	10	10	10	10	10	2	10.00
91	35	21	44.5	4	22	17	23	-	20	22	21	-	17	-	22	6	20.29
91	35	22	45.5	4	15	14	12	13	17	12	16	13	12	13	13	5	13.70
91	35	23	45.8	4	12	13	15	10	19	14	13	13	12	13	13	7	13.70
91	35	24	46.0	4	16	17	14	15	16	13	13	13	13	15	13	4	14.50
91	35	25	47.7	4	14	16	13	16	15	14	12	14	12	15	14	4	14.10
92	35	1	35.7	2	2	2	2	2	2	2	2	2	2	2	2	0	2.00

Table 5.7 Continued

92	35	2	26.2	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	3	26.6	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	4	26.7	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	5	26.5	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	6	27.3	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	7	27.4	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	8	27.2	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	9	27.3	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	10	27.3	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	11	27.0	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	12	27.8	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	13	28.1	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	14	28.8	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	15	28.1	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	16	28.7	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	17	29.1	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	18	29.7	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	19	29.7	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	20	29.1	3	2	2	2	2	2	2	2	2	2	2	2	0	2.00
92	35	21	30.7	3	2	2	2	2	2	2	2	2	2	3	2	1	2.10
92	35	22	30.6	3	3	3	3	3	3	3	3	3	3	3	3	0	3.00
92	35	23	31.0	3	3	3	3	3	3	3	3	3	3	3	3	0	3.00
92	35	24	31.8	3	3	3	3	3	3	3	3	3	3	3	3	0	3.00
92	35	25	36.4	3	6	6	6	6	6	6	6	6	6	7	6	1	6.10
93	6	1	32.8	2	3	3	3	3	3	3	3	3	3	3	3	0	3.00
93	6	2	34.8	2	5	4	5	5	5	5	5	5	5	5	5	1	4.90
93	6	3	34.6	2	4	4	4	4	4	4	5	4	4	4	4	1	4.10
93	6	4	34.3	2	4	4	4	4	4	4	4	4	4	3	4	1	3.90
93	6	5	35.2	2	5	4	5	5	5	5	5	5	5	5	5	1	4.90
93	6	6	36.5	2	4	3	4	4	4	4	4	4	3	4	4	1	3.80
93	6	7	36.3	2	4	4	4	4	5	5	4	5	4	4	4	1	4.30
93	6	8	37.2	2	4	3	4	4	4	5	5	4	4	4	4	2	4.10
93	6	9	37.8	2	8	8	9	8	9	9	9	9	9	9	9	1	8.70
93	6	10	37.5	2	6	6	7	7	8	10	7	8	8	7	7	4	7.20
93	6	11	37.2	2	9	8	9	8	8	9	8	10	9	9	9	2	8.70
93	6	12	38.5	2	6	5	6	6	6	7	8	8	6	6	6	3	6.20
93	6	13	37.3	2	4	4	7	7	5	8	9	5	5	6	5	5	6.00
93	6	14	38.0	2	7	5	9	8	8	8	12	9	9	8	8	7	8.30
93	6	15	39.1	2	9	9	11	12	10	9	15	12	10	12	9	6	10.90
93	6	16	39.0	2	6	6	6	6	6	6	8	6	6	6	6	2	6.20
93	6	17	39.3	2	10	13	13	12	13	11	13	12	11	11	13	3	11.90
93	6	18	40.2	2	8	8	9	9	9	8	9	8	8	7	8	2	8.30
93	6	19	40.8	2	8	7	7	7	8	7	9	8	7	7	7	3	7.30
93	6	20	40.8	2	10	10	11	12	12	10	12	12	11	12	12	2	11.20
93	6	21	40.8	2	9	9	9	9	10	9	8	9	8	8	9	2	8.80
93	6	22	41.3	2	9	8	9	9	10	9	10	10	9	8	9	2	9.10
93	6	23	41.0	2	8	11	9	12	13	9	13	12	12	9	9	5	10.80
93	6	24	43.1	2	10	11	13	13	13	13	12	13	13	12	13	3	12.30
93	6	25	45.8	2	13	15	16	17	19	17	17	16	16	16	16	6	16.40
93	26	1	36.6	3	6	6	6	7	6	6	5	6	5	6	6	2	5.90
93	26	2	37.8	3	5	5	5	5	5	5	5	5	5	5	5	0	5.00
93	26	3	37.9	3	6	6	6	6	6	6	6	7	5	6	6	2	6.00
93	26	4	38.6	3	6	6	6	6	6	6	6	6	6	6	6	0	6.00
93	26	5	38.7	3	6	8	8	7	7	6	7	7	6	6	6	2	6.80
93	26	6	38.3	3	8	7	7	8	7	7	8	8	7	8	7	2	7.30
93	26	7	38.5	3	6	7	6	6	7	6	8	9	6	6	6	3	6.50
93	26	8	39.6	3	6	7	8	9	8	8	7	8	6	8	8	3	7.50
93	26	9	40.0	3	7	7	6	8	7	6	6	7	6	6	6	2	6.60
93	26	10	39.7	3	9	8	8	9	8	8	8	8	8	7	8	2	8.10
93	26	11	40.7	3	8	8	8	9	9	8	7	8	8	9	8	2	8.20
93	26	12	40.4	3	6	6	5	6	6	5	5	6	5	5	6	1	5.50
93	26	13	40.4	3	6	6	6	7	7	6	6	7	6	6	6	1	6.30
93	26	14	40.7	3	8	12	9	12	9	11	10	11	8	9	9	4	9.90
93	26	15	41.3	3	8	9	8	9	9	8	7	8	9	9	9	2	8.40
93	26	16	42.6	3	10	10	10	13	11	13	10	15	10	10	10	5	11.20
93	26	17	42.4	3	13	11	13	13	13	13	13	12	9	13	13	4	12.30
93	26	18	43.5	3	13	11	15	12	10	10	11	14	10	10	10	5	11.60
93	26	19	43.9	3	12	13	11	12	11	11	11	15	10	11	11	5	11.70
93	26	20	43.9	3	13	13	13	14	12	12	12	14	11	12	12	3	12.60
93	26	21	44.0	3	10	11	10	13	13	12	11	15	9	10	10	6	11.40
93	26	22	44.9	3	14	10	10	16	14	17	15	14	14	9	14	9	14.70
93	26	23	45.3	3	19	18	19	17	20	15	16	13	16	14	19	7	16.70
93	26	24	45.3	3	15	17	16	17	15	15	13	12	14	14	15	5	14.80
93	26	25	46.8	3	9	9	9	12	11	10	10	13	8	10	9	5	10.10
93	30	1	35.7	3	5	6	5	5	5	5	6	5	5	5	5	1	5.20
93	30	2	38.8	3	6	6	6	6	6	5	6	6	6	6	6	1	5.90
93	30	3	39.2	3	6	7	6	7	8	6	7	7	6	7	7	2	6.70
93	30	4	38.3	3	9	9	9	9	9	10	9	10	9	9	9	1	9.20
93	30	5	39.1	3	9	10	9	9	11	9	9	10	10	9	9	2	9.50
93	30	6	40.8	3	9	9	10	9	10	10	10	10	9	9	9	1	9.50
93	30	7	40.7	3	9	10	9	9	9	9	8	9	9	8	9	2	8.90
93	30	8	40.5	3	8	9	9	10	9	7	9	10	9	8	9	3	8.80
93	30	9	41.0	3	7	9	8	10	8	6	7	8	7	7	7	4	7.70
93	30	10	40.9	3	7	8	7	13	7	8	8	7	7	7	7	7	7.70
93	30	11	41.2	3	8	8	8	8	8	8	8	8	8	8	8	0	8.00
93	30	12	41.9	3	11	13	12	15	14	13	14	12	14	12	12	4	13.00
93	30	13	42.8	3	10	10	9	7	10	6	11	13	10	9	10	7	9.50
93	30	14	42.3	3	9	9	9	9	9	9	9	12	9	9	9	3	9.30
93	30	15	42.0	3	12	14	13	14	14	13	13	13	11	14	14	3	13.10
93	30	16	42.2	3	10	10	9	11	11	9	10	10	9	9	10	2	9.80
93	30	17	43.8	3	11	10	11	14	17	12	14	14	13	9	14	8	12.50
93	30	18	43.8	3	10	11	11	13	13	13	12	11	10	10	10	3	11.40
93	30	19	44.0	3	12	13	12	13	13	13	13	13	12	12	13	1	12.60
93	30	20	43.3	3	9	8	9	10	10	5	10	11	6	-	10	6	8.67
93	30	21	43.5	3	10	10	10	11	10	13	10	10	9	8	10	5	10.10
93	30	22	44.4	3	15	16	13	13	18	12	15	14	16	11	15	7	14.30
93	30	23	44.2	3	10	12	11	11	14	12	14	12	8	13	12	6	11.70
93	30	24	44.2	3	10	16	13	16	16	16	12	14	14	-	16	6	14.11
93	30	25	45.8	3	23	15	19	19	21	20	13	-	23	-	23	10	19.13
				Total read	200	200	200	194	199	200	200	194	200	195			
				Total NOT read	0	0	0	6	1	0	0	6	0	5			
				Empty rows	0	0	0	0	0	0	0	0	0	0			

MACKEREL DIVISION VIa & VIIb,c Second readings

Table 5.8 The mean age recorded, 2stdev, CV (%), the number of age readings and the agreement with modal age are presented by modal age for each reader and for all readers combined. The number of age readings and the agreement is given for age groups 0-15 combined.

READER 1	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	3.00	4.00	4.91	5.93	6.93	7.56	8.52	9.86	9.80	11.57	12.25	11.86	14.20	
	2stdev	-	-	0.00	0.00	0.00	0.60	0.77	1.46	1.80	1.43	2.03	3.24	3.80	3.82	3.15	2.61	
	CV (%)	-	-	0%	0%	0%	6%	6%	11%	12%	8%	10%	17%	16%	16%	13%	9%	
	Number of age readings	-	-	21	13	13	11	27	14	12	25	21	10	7	8	7	5	194
	Agreement with modal age	-	-	100%	100%	100%	91%	85%	50%	58%	60%	57%	30%	14%	25%	29%	0%	68%

READER 2	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	2.92	3.89	4.82	6.00	7.43	8.08	9.32	10.24	11.20	12.29	13.13	14.29	14.80	
	2stdev	-	-	0.00	0.55	0.96	1.06	1.24	3.01	2.62	2.06	2.44	2.46	2.51	3.77	4.86	5.90	
	CV (%)	-	-	0%	9%	13%	20%	10%	20%	16%	11%	12%	11%	10%	14%	17%	20%	
	Number of age readings	-	-	21	13	13	11	27	14	12	25	21	10	7	8	7	5	194
	Agreement with modal age	-	-	100%	92%	69%	36%	74%	57%	58%	56%	52%	50%	43%	50%	57%	0%	63%

READER 3	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	3.00	4.00	5.27	6.07	7.21	8.08	9.04	10.10	10.70	11.57	13.38	13.86	14.60	
	2stdev	-	-	0.00	0.00	0.00	1.57	1.10	1.79	1.59	1.35	2.68	3.13	1.95	1.83	4.07	2.28	
	CV (%)	-	-	0%	0%	0%	15%	9%	12%	10%	7%	13%	15%	8%	7%	15%	8%	
	Number of age readings	-	-	21	13	13	11	27	14	12	25	21	10	7	8	7	5	194
	Agreement with modal age	-	-	100%	100%	100%	64%	81%	79%	67%	68%	57%	40%	43%	50%	14%	40%	71%

READER 4	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	3.00	4.00	5.27	6.26	8.07	8.91	9.68	10.60	11.56	12.71	13.38	13.83	14.00	
	2stdev	-	-	0.00	0.00	0.00	1.81	1.05	3.80	2.60	2.56	2.06	1.05	2.76	2.82	4.08	4.00	
	CV (%)	-	-	0%	0%	0%	17%	8%	24%	15%	13%	13%	5%	11%	11%	15%	14%	
	Number of age readings	-	-	21	13	13	11	27	14	11	25	20	9	7	8	6	5	190
	Agreement with modal age	-	-	100%	100%	100%	73%	78%	64%	27%	48%	45%	44%	43%	50%	33%	20%	65%

READER 5	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	3.00	4.23	5.27	6.37	8.00	8.75	9.78	10.67	11.20	13.43	14.63	14.83	15.40	
	2stdev	-	-	0.00	0.00	0.88	0.93	1.68	2.35	2.28	2.66	1.93	2.27	3.63	4.27	2.94	3.03	
	CV (%)	-	-	0%	0%	10%	9%	13%	15%	13%	14%	9%	10%	13%	15%	10%	10%	
	Number of age readings	-	-	21	13	13	11	27	14	12	25	21	10	7	8	6	5	193
	Agreement with modal age	-	-	100%	100%	77%	73%	74%	43%	50%	52%	57%	40%	43%	50%	33%	60%	65%

READER 6	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	3.15	3.93	5.18	5.85	7.14	8.50	9.16	10.00	11.00	11.71	13.13	13.86	14.00	
	2stdev	-	-	0.00	1.11	1.52	2.16	1.20	2.05	2.00	1.70	3.90	1.63	1.90	2.25	3.55	3.74	
	CV (%)	-	-	0%	18%	19%	21%	10%	14%	12%	9%	19%	7%	8%	9%	13%	13%	
	Number of age readings	-	-	21	13	13	11	27	14	12	25	21	10	7	8	7	5	194
	Agreement with modal age	-	-	100%	92%	69%	64%	74%	57%	75%	52%	52%	40%	57%	63%	29%	0%	64%

READER 7	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	2.92	4.23	5.45	6.07	7.71	8.33	9.22	10.71	10.60	13.57	12.88	13.14	13.80	
	2stdev	-	-	0.00	0.55	0.88	2.43	1.46	2.77	2.74	3.55	2.20	2.27	3.24	0.71	2.43	2.61	
	CV (%)	-	-	0%	9%	10%	22%	12%	18%	16%	19%	10%	11%	12%	3%	9%	9%	
	Number of age readings	-	-	21	13	13	11	27	14	12	25	21	10	7	8	7	5	194
	Agreement with modal age	-	-	100%	92%	77%	82%	70%	64%	42%	44%	52%	40%	43%	88%	29%	40%	64%

READER 8	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	2.85	3.92	4.82	5.88	7.67	8.75	10.13	10.86	11.50	12.43	13.25	13.43	13.40	
	2stdev	-	-	0.00	0.75	0.89	1.76	3.41	2.18	2.28	2.58	4.95	3.68	2.79	3.96	1.57	1.79	
	CV (%)	-	-	0%	13%	13%	18%	29%	14%	13%	13%	23%	16%	11%	15%	6%	7%	
	Number of age readings	-	-	21	13	13	11	26	14	12	23	21	10	7	8	7	5	191
	Agreement with modal age	-	-	100%	85%	77%	55%	46%	36%	58%	22%	38%	50%	43%	50%	57%	0%	53%

READER 9	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	3.00	3.77	4.91	5.85	6.86	7.67	8.96	9.24	11.00	11.43	12.00	13.00	13.80	
	2stdev	-	-	0.00	0.00	0.88	0.60	1.54	1.07	2.31	1.68	2.27	2.49	3.63	3.02	3.27	2.97	
	CV (%)	-	-	0%	0%	12%	6%	13%	8%	15%	9%	12%	11%	16%	13%	13%	11%	
	Number of age readings	-	-	21	13	13	11	27	14	12	25	21	10	7	8	7	5	194
	Agreement with modal age	-	-	100%	100%	77%	91%	70%	71%	58%	64%	43%	20%	43%	25%	14%	0%	63%

READER 10	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.05	3.00	4.00	5.18	5.93	7.00	8.00	9.04	9.35	10.30	12.00	13.25	12.43	13.00	
	2stdev	-	-	0.44	0.00	0.82	0.81	1.10	1.11	2.26	1.61	1.98	1.90	1.63	3.34	4.86	3.16	
	CV (%)	-	-	11%	0%	10%	8%	9%	8%	14%	9%	11%	9%	7%	13%	20%	12%	
	Number of age readings	-	-	21	13	13	11	27	14	12	24	20	10	7	8	7	5	192
	Agreement with modal age	-	-	95%	100%	85%	82%	81%	71%	33%	71%	60%	60%	43%	25%	29%	20%	69%

ALL READERS	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	2.98	3.98	5.11	6.02	7.39	8.26	9.29	10.16	10.91	12.27	13.13	13.43	14.10	
	2stdev	-	-	0.14	0.50	0.68	1.59	1.61	2.38	2.35	2.35	3.02	2.64	3.06	3.27	3.76	3.34	
	CV (%)	-	-	3%	8%	11%	16%	13%	16%	14%	13%	15%	12%	12%	12%	14%	12%	
	Number of age readings	-	-	210	130	130	110	269	140	119	247	205	99	70	80	68	50	1930
	Agreement with modal age	-	-	100%	96%	83%	71%	74%	59%	53%	54%	52%	41%	41%	48%	32%	18%	65%

Table 5.9 MACKEREL DIVISION IVa

Year	Sample	Fish no	Fish length	Catch month	Netherl. Reader 1	Scotland Reader 2	England Reader 3	Norway Reader 4	Sp(IEO) Reader 5	Ireland Reader 6	Sp(AZTI) Reader 7	Portugal Reader 8	Denmark Reader 9	Russia Reader 10	Age MODE	Age difference	Age Average
95	1	1	43.0	1	9	11	10	10	9	10	11	9	8	9	9	3	9,60
95	1	2	43.0	1	9	11	9	9	9	10	11	8	9	9	9	3	9,30
95	1	3	44.0	1	11	11	11	11	11	11	11	11	11	11	11	0	11,00
95	1	4	42.0	1	11	12	10	11	12	10	15	11	10	10	10	5	11,20
95	1	5	43.0	1	9	9	9	10	9	8	12	10	7	10	9	5	9,30
95	1	6	40.0	1	8	7	7	7	8	8	10	7	6	7	7	4	7,50
95	1	7	36.0	1	7	7	7	7	7	7	7	6	6	7	7	1	6,90
95	1	8	42.0	1	17	12	12	15	20	14	15	-	15	13	15	8	14,78
95	1	9	44.0	1	14	16	13	14	16	10	13	15	11	13	13	6	13,50
95	1	10	42.0	1	9	8	10	9	10	12	9	10	9	9	9	4	9,50
95	1	11	43.0	1	15	13	9	-	12	11	15	11	9	9	9	6	11,56
95	1	12	43.0	1	11	11	11	11	12	10	13	10	9	11	11	4	10,90
95	1	13	34.0	1	4	3	4	4	3	3	3	4	3	3	3	1	3,40
95	1	14	44.0	1	12	12	10	12	14	14	16	13	13	13	12	6	12,90
95	1	15	41.0	1	9	9	9	9	9	9	10	12	9	9	9	3	9,40
95	1	16	42.0	1	10	11	11	10	11	10	12	11	10	11	11	2	10,70
95	1	17	36.0	1	4	6	6	7	7	7	6	4	7	6	6	3	6,00
95	1	18	32.0	1	3	3	3	3	3	3	3	3	3	3	3	0	3,00
95	1	19	26.0	1	2	2	2	2	2	2	2	2	2	2	2	0	2,00
95	1	20	34.0	1	3	3	3	3	3	3	3	3	3	3	3	0	3,00
95	1	21	43.0	1	10	14	14	14	13	13	12	10	13	12	14	4	12,50
95	1	22	36.0	1	6	6	6	6	7	6	6	5	7	6	6	2	6,10
95	1	23	43.0	1	15	15	14	15	14	15	14	13	15	13	15	2	14,30
95	1	24	35.0	1	3	4	3	3	3	3	3	3	3	3	3	1	3,10
95	1	25	39.0	1	8	9	7	8	8	8	7	8	8	7	8	2	7,80
95	2	1	39.0	1	9	10	9	10	10	9	9	10	9	9	9	2	9,30
95	2	2	40.0	1	7	13	8	8	8	9	8	12	8	9	8	6	8,90
95	2	3	41.0	1	8	12	7	9	9	8	8	12	7	7	8	5	8,70
95	2	4	39.0	1	7	7	7	8	7	7	7	10	7	7	7	3	7,40
95	2	5	33.0	1	4	4	4	4	4	4	4	4	4	4	4	0	4,00
95	2	6	35.0	1	5	5	5	5	5	5	5	5	5	5	5	0	5,00
95	2	7	30.0	1	4	4	4	4	4	4	4	5	4	4	4	1	4,10
95	2	8	41.0	1	7	9	7	8	7	8	7	7	6	8	7	3	8,80
95	2	9	32.0	1	5	5	5	5	5	5	5	6	5	5	5	0	5,00
95	2	10	35.0	1	5	5	5	5	6	5	6	5	5	5	5	1	5,20
95	2	11	36.0	1	5	5	5	5	5	5	5	5	5	5	5	0	5,00
95	2	12	38.0	1	11	9	11	10	10	9	11	11	10	8	11	3	10,00
95	2	13	38.0	1	7	8	7	7	7	7	7	7	7	7	7	1	6,90
95	2	14	34.0	1	3	3	3	3	3	3	3	3	3	3	3	0	3,00
95	2	15	34.0	1	4	4	4	4	4	4	4	4	4	4	4	0	4,00
95	2	16	30.0	1	2	2	2	2	2	3	2	2	2	2	2	0	2,08
95	2	17	37.0	1	6	6	6	6	6	6	6	6	6	6	6	0	6,00
95	2	18	34.0	1	4	4	4	4	4	4	4	4	4	4	4	0	4,00
95	2	19	34.0	1	10	9	9	9	10	9	10	9	10	10	10	1	9,50
95	2	20	34.0	1	4	4	4	4	4	4	4	4	4	4	4	0	4,00
95	2	21	33.0	1	4	4	4	4	4	4	4	2	4	4	4	2	3,80
95	2	22	29.0	1	2	2	2	2	2	2	2	2	2	2	2	0	2,00
95	2	23	28.0	1	2	2	2	2	2	2	2	2	2	2	2	0	2,00
95	2	24	29.0	1	2	2	2	2	2	2	2	2	2	2	2	0	2,00
95	2	25	27.0	1	2	2	2	2	2	2	2	2	2	2	2	0	2,00
95	3	1	37.0	1	4	4	4	4	4	4	5	4	4	4	4	1	4,10
95	3	2	38.0	1	6	6	6	6	6	6	6	6	6	6	6	0	6,00
95	3	3	41.0	1	6	6	6	7	7	6	6	6	6	6	6	1	6,20
95	3	4	41.0	1	8	7	7	8	8	7	7	6	7	8	7	2	7,30
95	3	5	42.0	1	9	9	7	9	9	9	9	8	9	9	9	2	8,50
95	3	6	40.0	1	6	6	5	6	6	5	6	6	5	5	6	1	5,60
95	3	7	36.0	1	4	4	4	4	4	4	4	4	4	4	4	0	4,00
95	3	8	40.0	1	5	5	5	5	5	5	5	5	5	5	5	1	5,10
95	3	9	37.0	1	6	6	6	6	6	6	6	6	6	6	6	0	6,00
95	3	10	43.0	1	15	16	14	12	15	14	14	15	12	16	15	4	14,30
95	3	11	37.0	1	6	6	6	6	6	6	6	6	6	6	6	0	6,00
95	3	12	44.0	1	10	9	9	10	11	11	10	11	9	10	10	2	10,00
95	3	13	36.0	1	5	5	5	5	5	5	5	5	5	5	5	0	5,00
95	3	14	39.0	1	10	12	9	9	11	12	10	13	10	10	10	4	10,60
95	3	15	39.0	1	9	9	9	9	11	9	10	11	8	10	9	2	9,60
95	3	16	38.0	1	8	7	7	8	8	8	8	8	8	8	8	1	7,80
95	3	17	38.0	1	6	6	6	6	6	6	6	6	6	6	6	0	6,00
95	3	18	37.0	1	4	4	4	4	5	4	5	4	4	5	4	1	4,30
95	3	19	37.0	1	7	7	7	7	7	7	7	7	7	7	7	0	7,00
95	3	20	36.0	1	5	5	5	5	5	5	5	5	5	5	5	0	5,00
95	3	21	44.0	1	12	13	12	13	15	12	13	13	13	12	13	3	12,90
95	3	22	33.0	1	4	3	3	3	4	3	3	3	4	4	3	1	3,40
95	3	23	39.0	1	10	11	9	10	11	9	9	11	8	10	10	3	9,90
95	3	24	38.0	1	8	8	6	7	8	7	8	7	8	8	8	2	7,50
95	3	25	40.0	1	8	8	8	8	8	8	8	8	8	8	8	0	8,00
95	4	1	42.0	1	11	14	10	11	10	10	10	10	10	11	10	4	10,70
95	4	2	32.0	1	4	4	4	4	4	4	4	4	4	4	4	0	4,00
95	4	3	36.0	1	6	6	6	7	7	7	7	6	6	7	6	1	6,50
95	4	4	42.0	1	8	8	6	8	7	8	8	7	8	8	8	3	7,20
95	4	5	40.0	1	7	11	7	7	7	7	7	8	7	7	7	4	7,60
95	4	6	35.0	1	4	4	4	4	4	4	4	4	4	4	4	0	4,00
95	4	7	35.0	1	4	4	4	4	4	4	4	4	4	4	4	0	4,00
95	4	8	36.0	1	6	6	6	6	6	6	6	6	6	6	6	0	6,00
95	4	9	37.0	1	5	6	5	7	5	6	6	5	5	7	5	2	5,70
95	4	10	40.0	1	13	14	13	14	14	13	12	14	14	14	14	2	13,40
95	4	11	36.0	1	6	7	7	7	8	7	7	7	7	7	7	2	7,00
95	4	12	39.0	1	7	6	8	9	9	7	8	8	8	8	8	3	7,80
95	4	13	39.0	1	9	10	10	10	11	10	9	10	9	11	10	2	9,90
95	4	14	36.0	1	5	5	5	5	5	5	5	5	5	5	5	0	5,00
95	4	15	32.0	1	3	3	3	3	3	3	3	3	3	3	3	0	3,00
95	4	16	40.0	1	8	8	8	8	8	8	8	8	8	8	8	0	8,00
95	4	17	42.0	1	8	10	10	8	11	10	11	10	11	8	10	3	9,70
95	4	18	38.0	1	6	6	6	6	6	5	6	6	5	6	6	1	5,80
95	4	19	36.0	1	7	7	7	7	7	7	7	7	7	8	7	1	7,10
95	4	20	37.0	1	8	8	8	8	8	8	8	8	8	8	8	0	8,00
95	4	21	32.0	1	3	3	3	3	3	3	3	3	3	3	3	0	3,00
95	4	22	33.0	1	4	4	4	4	4	4	4	4	4	4	4	0	4,00
95	4	23	39.0	1	9	9	10	10	9	9	10	9	7	9	9	3	9,10
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
95	5	1	41.0	1	10	12	10	10	10	10	12	12	9	10	10	3	10,50

Table 5.9 Continued

95	5	2	38.0	1	5	5	5	6	5	5	6	5	6	6	5	1	5.30
95	5	3	43.0	1	13	14	12	13	12	12	13	14	13	13	13	2	12.90
95	5	4	38.0	1	4	4	4	4	4	4	4	4	4	4	4	0	4.00
95	5	5	39.0	1	13	15	10	13	12	12	12	9	14	13	13	6	12.30
95	5	6	40.0	1	5	5	5	5	7	4	10	5	5	5	5	6	5.60
95	5	7	33.0	1	4	4	4	4	4	4	4	4	4	4	4	0	4.00
95	5	8	37.0	1	6	7	6	7	7	7	8	6	6	7	7	2	6.70
95	5	9	37.0	1	9	9	9	9	9	9	9	9	9	9	9	0	9.00
95	5	10	37.0	1	6	6	6	6	6	6	6	6	6	6	6	0	6.00
95	5	11	41.0	1	6	6	6	6	6	6	6	5	6	6	6	3	6.30
95	5	12	41.0	1	8	8	8	8	9	7	8	8	8	8	8	2	8.00
95	5	13	35.0	1	5	5	5	6	5	5	5	5	6	6	5	1	5.30
95	5	14	43.0	1	16	16	20	20	21	16	19	14	16	14	16	7	17.40
95	5	15	37.0	1	5	5	5	5	5	5	5	5	5	5	5	0	5.00
95	5	16	38.0	1	7	6	7	7	7	6	7	7	7	7	7	1	6.80
95	5	17	44.0	1	13	12	13	16	13	16	12	14	13	13	13	4	13.50
95	5	18	40.0	1	7	7	8	7	7	7	7	7	7	8	7	1	7.20
95	5	19	43.0	1	10	10	9	10	10	10	11	11	10	10	10	2	10.10
95	5	20	34.0	1	5	5	5	5	5	4	5	5	5	5	5	1	4.90
95	5	21	30.0	1	2	2	2	2	2	2	2	2	2	2	2	0	2.00
95	5	22	35.0	1	4	4	5	5	5	5	5	5	5	5	5	1	4.80
95	5	23	43.0	1	8	8	8	10	10	10	11	8	9	8	8	3	9.00
95	5	24	31.0	1	3	3	3	3	3	3	3	3	3	3	3	0	3.00
95	5	25	34.0	1	4	4	4	4	4	4	4	4	4	4	4	0	4.00
95	6	1	39.0	1	9	11	7	9	10	8	9	8	9	7	9	4	8.70
95	6	2	40.0	1	8	9	7	7	8	7	7	7	8	7	7	3	7.10
95	6	3	41.0	1	10	14	11	11	12	10	12	11	10	11	11	4	11.20
95	6	4	30.0	1	2	2	2	2	2	2	2	2	2	2	2	0	2.00
95	6	5	36.0	1	6	6	6	7	7	6	7	6	6	7	6	1	6.40
95	6	6	41.0	1	9	9	9	9	9	9	8	9	9	7	9	2	8.70
95	6	7	47.0	1	10	13	10	12	11	11	13	12	8	12	12	5	11.20
95	6	8	28.0	1	2	2	2	2	2	2	2	2	2	2	2	0	2.00
95	6	9	44.0	1	12	16	12	14	13	12	14	13	12	14	12	4	13.20
95	6	10	27.0	1	2	2	2	2	2	2	2	2	2	2	2	0	2.00
95	6	11	40.0	1	5	8	6	7	6	5	6	5	6	6	6	3	6.00
95	6	12	38.0	1	6	6	6	5	6	5	6	5	6	5	6	1	5.60
95	6	13	34.0	1	5	5	5	5	5	5	5	5	5	5	5	0	5.00
95	6	14	43.0	1	11	15	12	12	13	12	11	12	12	14	12	4	12.40
95	6	15	41.0	1	7	9	7	7	8	7	7	7	7	7	7	2	7.30
95	6	16	40.0	1	8	10	9	10	9	10	10	10	8	10	10	2	9.40
95	6	17	38.0	1	4	4	4	4	4	4	4	4	4	4	4	0	4.00
95	6	18	37.0	1	8	7	7	7	7	7	7	7	5	7	7	2	6.80
95	6	19	32.0	1	3	3	3	3	3	3	3	3	3	3	3	0	3.00
95	6	20	35.0	1	4	4	4	4	4	4	4	4	4	4	4	0	4.00
95	6	21	32.0	1	3	3	3	3	4	3	4	3	4	3	3	1	3.30
95	6	22	35.0	1	4	4	4	4	4	4	4	4	4	4	4	0	4.00
95	6	23	37.0	1	6	5	6	5	6	6	6	5	6	6	6	1	5.70
95	6	24	35.0	1	6	6	6	6	6	6	6	6	6	6	6	0	6.00
95	6	25	32.0	1	3	3	3	3	3	3	3	3	3	3	3	0	3.00
					-	-	-	-	-	-	-	-	-	-		

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Table 5.10 The mean age recorded, 2stdev, CV (%), the number of age readings and the agreement with modal age are presented by modal age for each reader and for all readers combined. The number of age readings and the agreement is given for age groups 0-15 combined.

READER 1

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	-	-	2.00	3.17	4.00	4.94	5.85	6.81	7.82	9.46	9.73	10.60	11.25	13.00	11.50	15.67	
2stdev	-	-	0.00	0.78	0.00	0.50	0.98	1.50	0.81	3.33	2.02	1.10	1.91	1.41	4.24	2.31	
CV (%)	-	-	0%	12%	0%	5%	8%	11%	5%	16%	10%	5%	9%	5%	18%	7%	
Number of age readings	-	-	10	12	19	16	20	16	11	13	11	5	4	5	2	3	147
Agreement with modal age	-	-	100%	83%	100%	94%	90%	63%	82%	92%	55%	60%	50%	60%	0%	0%	80%

READER 2

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	-	-	2.00	3.08	4.00	5.00	6.20	7.50	8.64	9.69	10.82	11.20	14.00	14.00	14.00	14.33	
2stdev	-	-	0.00	0.58	0.00	0.73	1.67	2.63	4.13	2.87	3.07	3.58	3.65	3.16	0.00	4.16	
CV (%)	-	-	0%	9%	0%	7%	13%	18%	24%	15%	14%	16%	13%	11%	0%	15%	
Number of age readings	-	-	10	12	19	16	20	16	11	13	11	5	4	5	2	3	147
Agreement with modal age	-	-	100%	92%	100%	88%	85%	63%	55%	46%	36%	60%	25%	20%	100%	33%	71%

READER 3

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	-	-	2.00	3.08	4.00	5.00	5.95	7.00	7.55	8.92	9.45	11.00	11.00	12.00	13.00	13.33	
2stdev	-	-	0.00	0.58	0.00	0.00	0.45	0.73	1.38	1.91	1.04	0.00	2.31	2.45	2.83	2.31	
CV (%)	-	-	0%	9%	0%	0%	4%	5%	9%	11%	6%	0%	10%	10%	11%	9%	
Number of age readings	-	-	10	12	19	16	20	16	11	13	11	5	4	5	2	3	147
Agreement with modal age	-	-	100%	92%	100%	100%	95%	88%	64%	62%	45%	100%	50%	40%	50%	0%	81%

READER 4

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	-	-	2.00	3.08	4.00	5.25	6.25	7.06	8.27	9.33	9.82	10.60	12.50	13.80	14.00	14.00	
2stdev	-	-	0.00	0.58	0.00	1.15	1.43	0.89	1.57	0.98	1.75	1.10	2.00	2.61	0.00	3.46	
CV (%)	-	-	0%	9%	0%	11%	11%	8%	10%	5%	9%	5%	8%	9%	0%	12%	
Number of age readings	-	-	10	12	19	16	20	16	11	12	11	5	4	5	2	3	146
Agreement with modal age	-	-	100%	92%	100%	81%	60%	81%	64%	67%	55%	60%	75%	60%	100%	67%	77%

READER 5

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	-	-	2.00	3.17	4.05	5.25	6.40	7.31	8.45	9.62	10.55	11.20	12.75	13.60	13.50	16.33	
2stdev	-	-	0.00	0.78	0.46	1.15	1.20	0.96	1.38	1.92	1.64	1.67	2.52	3.63	1.41	6.43	
CV (%)	-	-	0%	12%	6%	11%	9%	7%	8%	10%	8%	7%	10%	13%	5%	20%	
Number of age readings	-	-	10	12	19	16	20	16	11	13	11	5	4	5	2	3	147
Agreement with modal age	-	-	100%	83%	95%	81%	55%	69%	64%	62%	36%	40%	0%	20%	50%	33%	67%

READER 6

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	-	-	2.00	3.00	4.00	4.94	6.00	6.94	8.00	9.38	10.09	10.00	12.25	12.40	13.00	14.33	
2stdev	-	-	0.00	0.00	0.00	0.89	1.45	0.89	1.79	2.24	1.69	1.41	2.52	4.38	0.00	1.15	
CV (%)	-	-	0%	0%	0%	9%	12%	6%	11%	12%	8%	7%	10%	18%	0%	4%	
Number of age readings	-	-	10	12	19	16	20	16	11	13	11	5	4	5	2	3	147
Agreement with modal age	-	-	100%	100%	100%	81%	65%	81%	55%	54%	64%	20%	50%	0%	0%	0%	70%

READER 7

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	-	-	2.00	3.08	4.11	5.50	6.35	7.25	8.18	10.15	10.64	11.60	13.50	12.60	12.00	14.33	
2stdev	-	-	0.00	0.58	0.63	2.53	1.53	1.55	1.96	3.64	3.38	1.67	4.16	1.10	0.00	1.15	
CV (%)	-	-	0%	9%	8%	23%	13%	11%	12%	18%	16%	7%	15%	4%	0%	4%	
Number of age readings	-	-	10	12	19	16	20	16	11	13	11	5	4	5	2	3	147
Agreement with modal age	-	-	100%	92%	89%	75%	80%	88%	92%	58%	45%	40%	0%	60%	0%	33%	71%

READER 8

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	-	-	2.00	3.08	3.95	5.00	5.70	7.13	8.64	9.54	10.73	10.80	12.50	13.00	12.00	14.00	
2stdev	-	-	0.00	0.58	1.05	0.00	1.31	2.05	3.38	2.53	2.21	0.89	1.15	4.69	5.66	2.83	
CV (%)	-	-	0%	9%	13%	0%	12%	14%	20%	13%	10%	4%	5%	18%	24%	10%	
Number of age readings	-	-	10	12	19	16	20	16	11	13	11	5	4	5	2	2	146
Agreement with modal age	-	-	100%	92%	89%	100%	65%	69%	73%	31%	36%	80%	50%	20%	50%	50%	71%

READER 9

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	-	-	2.00	3.17	4.00	5.13	6.00	6.56	8.00	8.46	9.45	10.00	11.25	12.80	13.50	14.00	
2stdev	-	-	0.00	0.78	0.00	0.68	0.92	1.26	0.89	1.55	1.97	1.41	4.43	2.19	1.41	3.46	
CV (%)	-	-	0%	12%	0%	7%	8%	10%	6%	9%	10%	7%	20%	9%	5%	12%	
Number of age readings	-	-	10	12	19	16	20	16	11	13	11	5	4	5	2	3	147
Agreement with modal age	-	-	100%	83%	100%	88%	80%	63%	82%	62%	45%	20%	50%	60%	50%	67%	75%

READER 10

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	-	-	2.00	3.08	4.05	5.19	6.00	7.13	7.82	8.77	10.00	10.40	13.25	12.80	13.00	14.00	
2stdev	-	-	0.00	0.58	0.46	1.09	0.92	1.00	0.81	1.85	1.55	2.68	1.91	0.89	2.83	3.46	
CV (%)	-	-	0%	9%	6%	10%	8%	7%	5%	11%	8%	13%	7%	3%	11%	12%	
Number of age readings	-	-	10	12	19	16	20	16	11	13	11	5	4	5	2	3	147
Agreement with modal age	-	-	100%	92%	95%	88%	80%	75%	82%	62%	73%	80%	25%	80%	50%	0%	79%

ALL READERS

Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
Mean age recorded	-	-	2.00	3.10	4.02	5.12	6.07	7.07	8.14	9.33	10.13	10.76	12.43	13.00	12.95	14.45	
2stdev	-	-	0.00	0.60	0.44	1.13	1.29	1.51	2.12	2.52	2.27	1.96	3.17	2.91	2.55	3.32	
CV (%)	-	-	0%	10%	5%	11%	11%	11%	13%	13%	11%	9%	13%	11%	10%	11%	
Number of age readings	-	-	100	120	190	160	200	160	110	129	110	50	40	50	20	29	1468
Agreement with modal age	-	-	100%	90%	97%	88%	77%	74%	70%	57%	49%	56%	38%	42%	45%	28%	74%

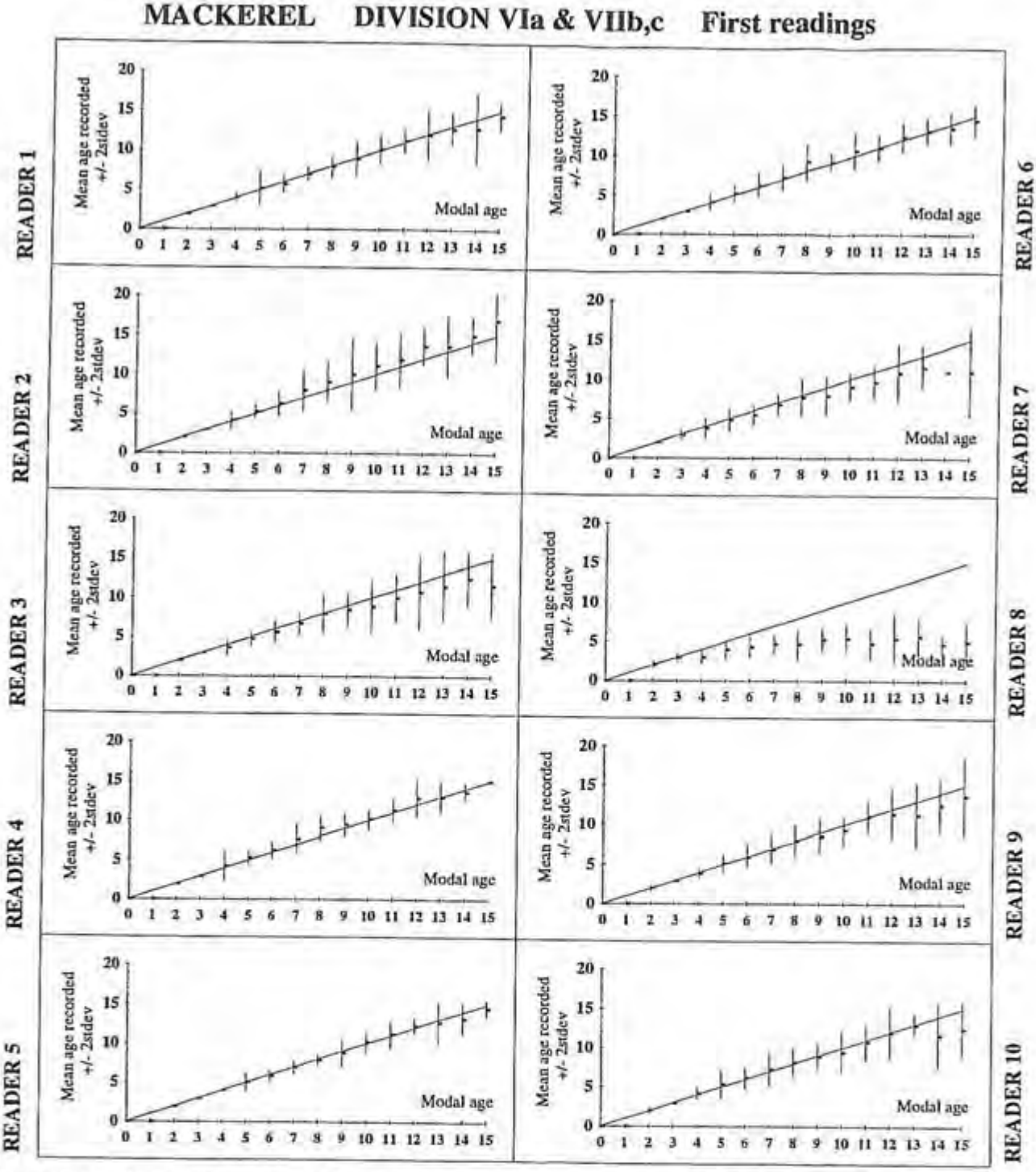

Figure 4.1 In above age bias plots the mean age recorded +/- 2stdev of each age reader is plotted against the modal age.

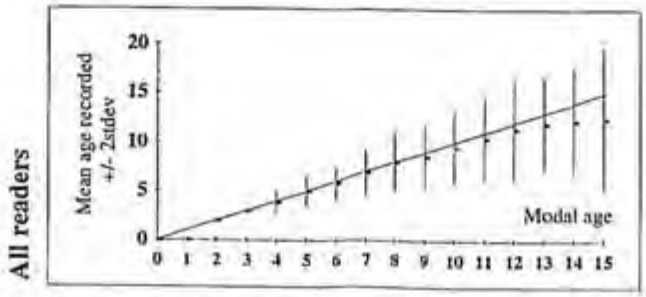

Figure 4.2 In above age bias plot the mean age recorded +/- 2stdev of all age readers is plotted against the modal age.

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Table 5.10 The mean age recorded, 2stdev, CV (%), the number of age readings and the agreement with modal age are presented by modal age for each reader and for all readers combined. The number of age readings and the agreement is given for age groups 0-15 combined.

READER 1	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	3.17	4.00	4.94	5.85	6.81	7.82	9.46	9.73	10.60	11.25	13.00	11.50	15.67	
	2stdev	-	-	0.00	0.78	0.00	0.50	0.98	1.50	0.81	3.33	2.02	1.10	1.91	1.41	4.24	2.31	
	CV (%)	-	-	0%	12%	0%	5%	8%	11%	5%	18%	10%	5%	9%	5%	18%	7%	
	Number of age readings	-	-	10	12	19	16	20	16	11	13	11	5	4	5	2	3	147
	Agreement with modal age	-	-	100%	83%	100%	94%	90%	63%	82%	92%	55%	60%	50%	60%	0%	0%	80%

READER 2	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	3.08	4.00	5.00	6.20	7.50	8.64	9.69	10.82	11.20	14.00	14.00	14.00	14.33	
	2stdev	-	-	0.00	0.58	0.00	0.73	1.67	2.63	4.13	2.87	3.07	3.58	3.65	3.16	0.00	4.16	
	CV (%)	-	-	0%	9%	0%	7%	13%	18%	24%	15%	14%	16%	13%	11%	0%	15%	
	Number of age readings	-	-	10	12	19	16	20	16	11	13	11	5	4	5	2	3	147
	Agreement with modal age	-	-	100%	92%	100%	88%	85%	63%	55%	46%	36%	60%	25%	20%	100%	33%	71%

READER 3	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	3.08	4.00	5.00	5.95	7.00	7.55	8.92	9.45	11.00	11.00	12.00	13.00	13.33	
	2stdev	-	-	0.00	0.58	0.00	0.00	0.45	0.73	1.38	1.91	1.04	0.00	2.31	2.45	2.83	2.31	
	CV (%)	-	-	0%	9%	0%	0%	4%	5%	9%	11%	6%	0%	10%	10%	11%	9%	
	Number of age readings	-	-	10	12	19	16	20	16	11	13	11	5	4	5	2	3	147
	Agreement with modal age	-	-	100%	92%	100%	100%	95%	88%	64%	62%	45%	100%	50%	40%	50%	0%	81%

READER 4	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	3.08	4.00	5.25	6.25	7.06	8.27	9.33	9.82	10.60	12.50	13.80	14.00	14.00	
	2stdev	-	-	0.00	0.58	0.00	1.15	1.43	0.89	1.57	0.98	1.75	1.10	2.00	2.61	0.00	3.46	
	CV (%)	-	-	0%	9%	0%	11%	11%	6%	10%	5%	9%	5%	8%	9%	0%	12%	
	Number of age readings	-	-	10	12	19	16	20	16	11	12	11	5	4	5	2	3	146
	Agreement with modal age	-	-	100%	92%	100%	81%	80%	81%	64%	67%	55%	60%	75%	60%	100%	67%	77%

READER 5	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	3.17	4.05	5.25	6.40	7.31	8.45	9.62	10.55	11.20	12.75	13.60	13.50	16.33	
	2stdev	-	-	0.00	0.78	0.46	1.15	1.20	0.98	1.38	1.92	1.84	1.67	2.52	3.62	1.41	6.43	
	CV (%)	-	-	0%	12%	6%	11%	9%	7%	8%	10%	8%	7%	10%	13%	5%	20%	
	Number of age readings	-	-	10	12	19	16	20	16	11	13	11	5	4	5	2	3	147
	Agreement with modal age	-	-	100%	83%	95%	81%	65%	69%	64%	62%	36%	40%	0%	20%	50%	33%	67%

READER 6	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	3.00	4.00	4.94	6.00	6.94	8.00	9.38	10.09	10.00	12.25	12.40	13.00	14.33	
	2stdev	-	-	0.00	0.00	0.00	0.99	1.45	0.89	1.79	2.24	1.66	1.41	2.52	4.08	0.00	1.15	
	CV (%)	-	-	0%	0%	0%	9%	12%	6%	11%	12%	8%	7%	10%	18%	0%	4%	
	Number of age readings	-	-	10	12	19	16	20	16	11	13	11	5	4	5	2	3	147
	Agreement with modal age	-	-	100%	100%	100%	81%	65%	81%	55%	54%	64%	20%	50%	0%	0%	0%	70%

READER 7	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	3.08	4.11	5.50	6.35	7.25	8.18	10.15	10.64	11.80	13.50	12.60	12.00	14.33	
	2stdev	-	-	0.00	0.58	0.63	2.53	1.63	1.55	1.96	3.64	3.36	1.67	4.16	1.10	0.00	1.15	
	CV (%)	-	-	0%	9%	8%	23%	13%	11%	12%	18%	16%	7%	15%	4%	0%	4%	
	Number of age readings	-	-	10	12	19	16	20	16	11	13	11	5	4	5	2	3	147
	Agreement with modal age	-	-	100%	92%	89%	75%	80%	88%	82%	38%	45%	40%	0%	60%	0%	33%	71%

READER 8	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	3.08	3.95	5.00	5.70	7.13	8.64	9.54	10.73	10.80	12.50	13.00	12.00	14.00	
	2stdev	-	-	0.00	0.58	1.05	0.00	1.31	2.05	3.38	2.53	2.21	0.89	1.15	4.69	5.66	2.83	
	CV (%)	-	-	0%	9%	13%	0%	12%	14%	20%	13%	10%	4%	5%	18%	24%	10%	
	Number of age readings	-	-	10	12	19	16	20	16	11	13	11	5	4	5	2	2	146
	Agreement with modal age	-	-	100%	92%	89%	100%	65%	69%	73%	31%	36%	80%	50%	20%	50%	50%	71%

READER 9	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	3.17	4.00	5.13	6.00	6.56	8.00	8.46	9.45	10.00	11.25	12.80	13.50	14.00	
	2stdev	-	-	0.00	0.78	0.00	0.68	0.92	1.26	0.89	1.55	1.87	1.41	4.43	2.19	1.41	3.46	
	CV (%)	-	-	0%	12%	0%	7%	8%	10%	6%	9%	10%	7%	20%	9%	5%	12%	
	Number of age readings	-	-	10	12	19	16	20	16	11	13	11	5	4	5	2	3	147
	Agreement with modal age	-	-	100%	83%	100%	88%	80%	63%	82%	62%	45%	20%	50%	60%	50%	67%	75%

READER 10	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	3.08	4.05	5.19	6.00	7.13	7.92	8.77	10.00	10.40	13.25	12.80	13.00	14.00	
	2stdev	-	-	0.00	0.58	0.46	1.09	0.92	1.00	0.81	1.85	1.55	2.68	1.91	0.89	2.83	3.46	
	CV (%)	-	-	0%	9%	6%	10%	8%	7%	5%	11%	8%	13%	7%	3%	11%	12%	
	Number of age readings	-	-	10	12	19	16	20	16	11	13	11	5	4	5	2	3	147
	Agreement with modal age	-	-	100%	92%	95%	88%	80%	75%	82%	62%	73%	80%	25%	80%	50%	0%	79%

ALL READERS	Modal age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0-15
	Mean age recorded	-	-	2.00	3.10	4.02	5.12	6.07	7.07	8.14	9.33	10.13	10.76	12.43	13.00	12.95	14.45	
	2stdev	-	-	0.00	0.60	0.44	1.13	1.29	1.51	2.12	2.52	2.27	1.96	3.17	2.91	2.55	3.32	
	CV (%)	-	-	0%	10%	5%	11%	11%	11%	13%	13%	11%	9%	13%	11%	10%	11%	
	Number of age readings	-	-	100	120	190	160	200	160	110	129	110	50	40	50	20	29	1468
	Agreement with modal age	-	-	100%	90%	97%	88%	77%	74%	70%	57%	49%	56%	38%	42%	45%	28%	74%

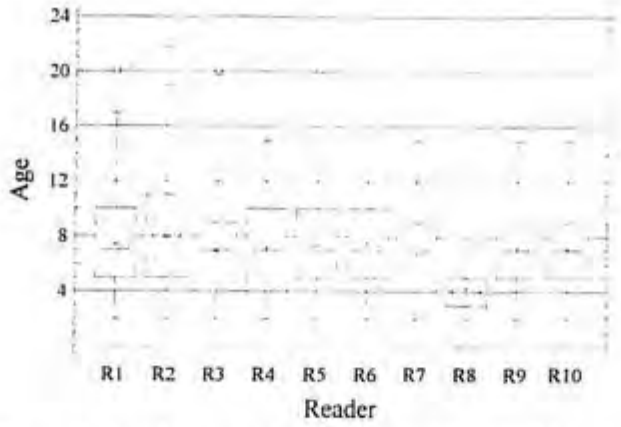

Figure 4.3A **Box and whisker plot DIVISIONS VIa and VIIb,c First readings**

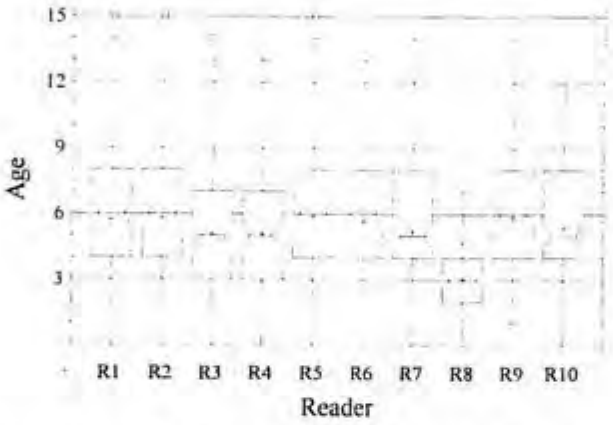

Figure 4.3B **Box and whisker plot DIVISIONS VIIIc and IXa**

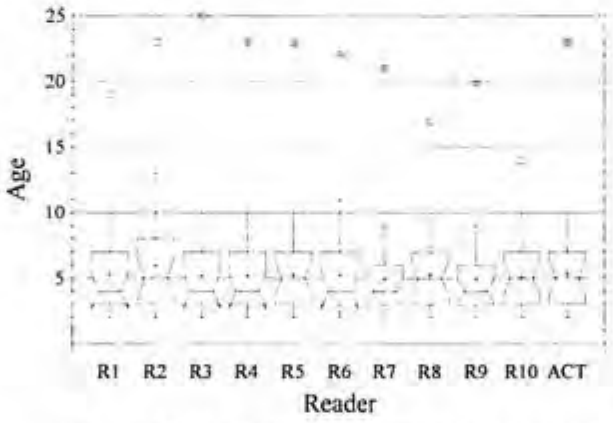

Figure 4.3C **Box and whisker plot VALIDATION COLLECTION**

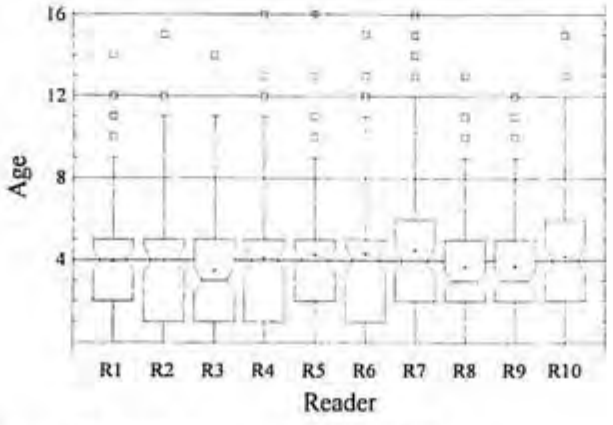

Figure 4.3D **Box and whisker plot DIVISION IXa**

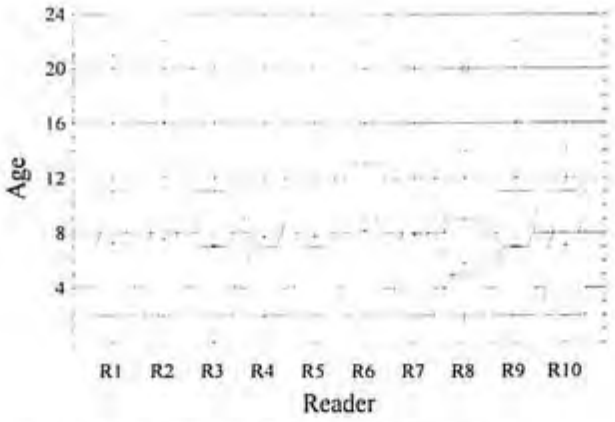

Figure 4.3E Box and whisker plot DIVISIONS IVb,c

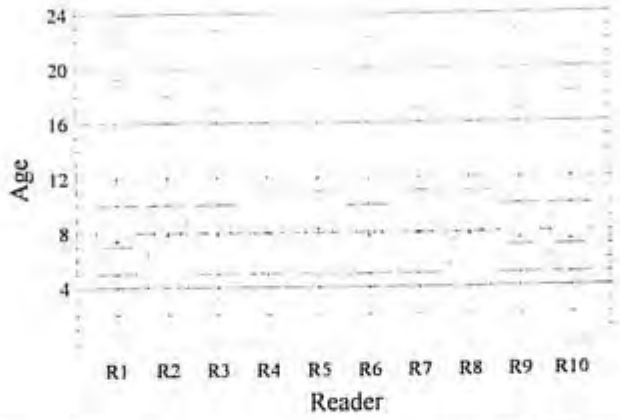

Figure 4.3F Box and whisker plot DIVISIONS VIa and VIIb,c Second readings

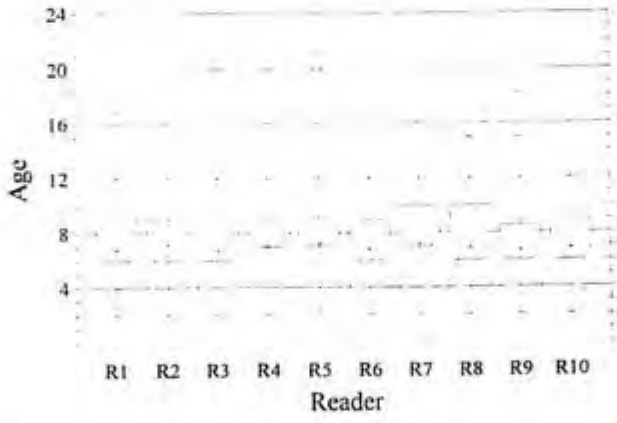

Figure 4.3G Box and whisker plot DIVISION IVa

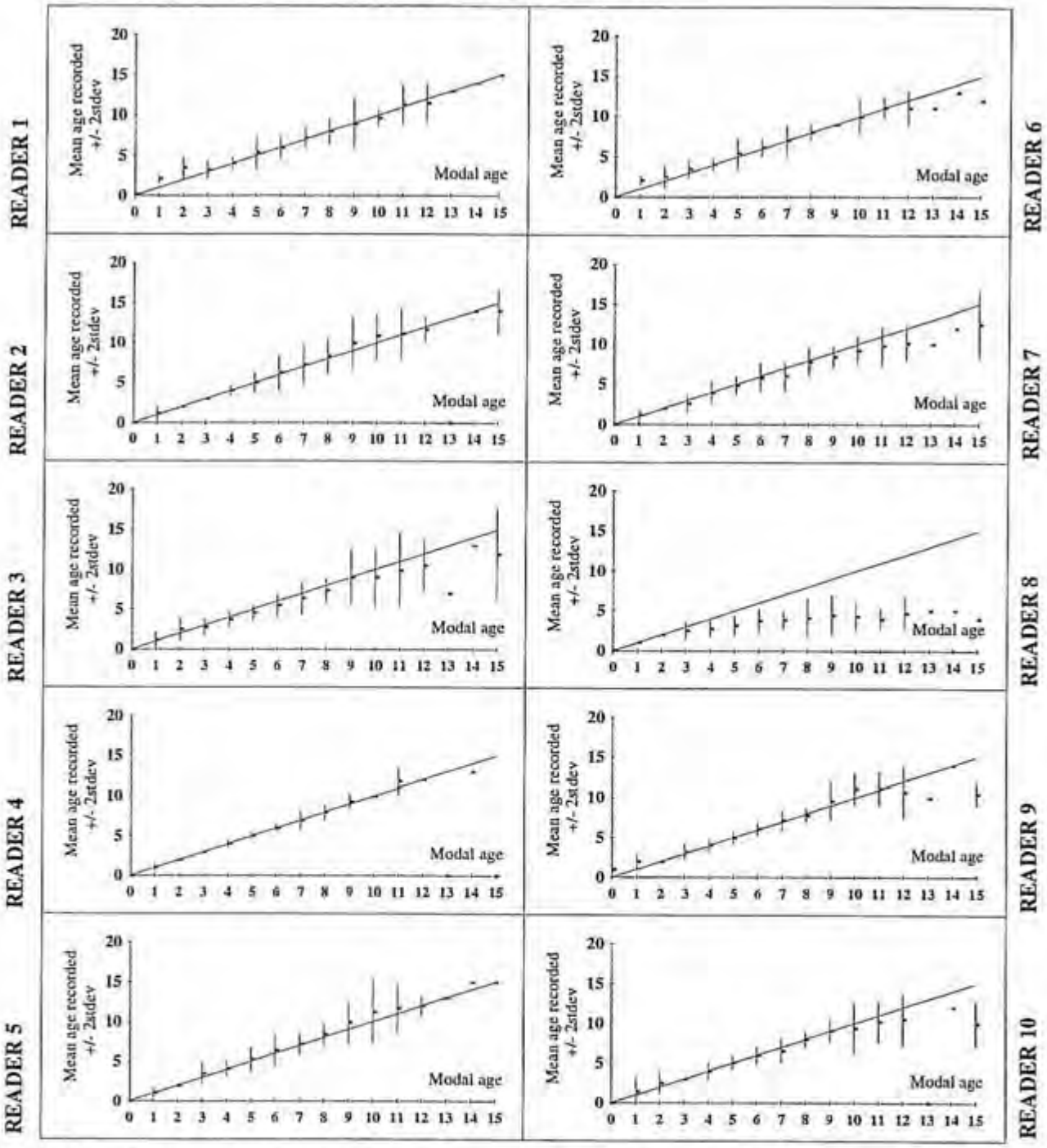

Figure 4.4 In above age bias plots the mean age recorded +/- 2stdev of each age reader is plotted against the modal age.

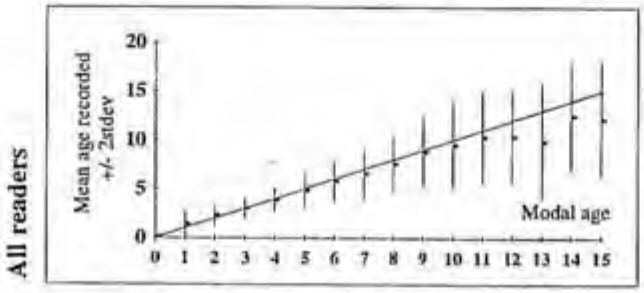

Figure 4.5 In above age bias plot the mean age recorded +/- 2stdev of all age readers is plotted against the modal age.

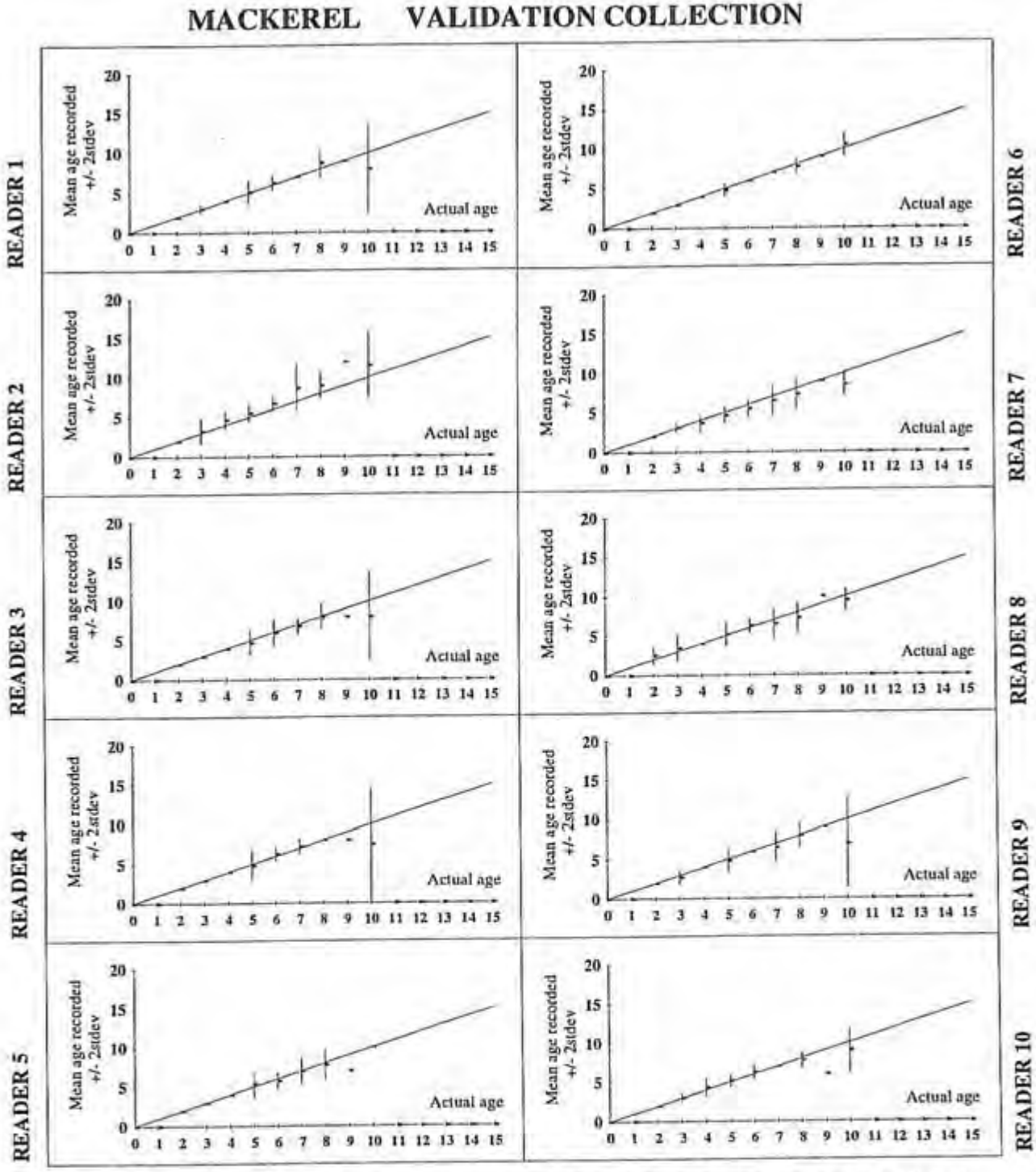

Figure 5.1 In above age bias plots the mean age recorded +/- 2stdev of each age reader is plotted against the actual age.

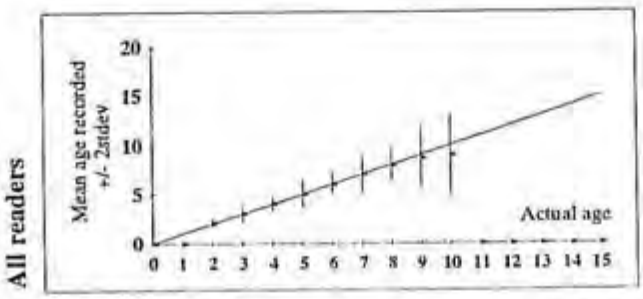

Figure 5.2 In above age bias plot the mean age recorded +/- 2stdev of all age readers is plotted against the actual age.

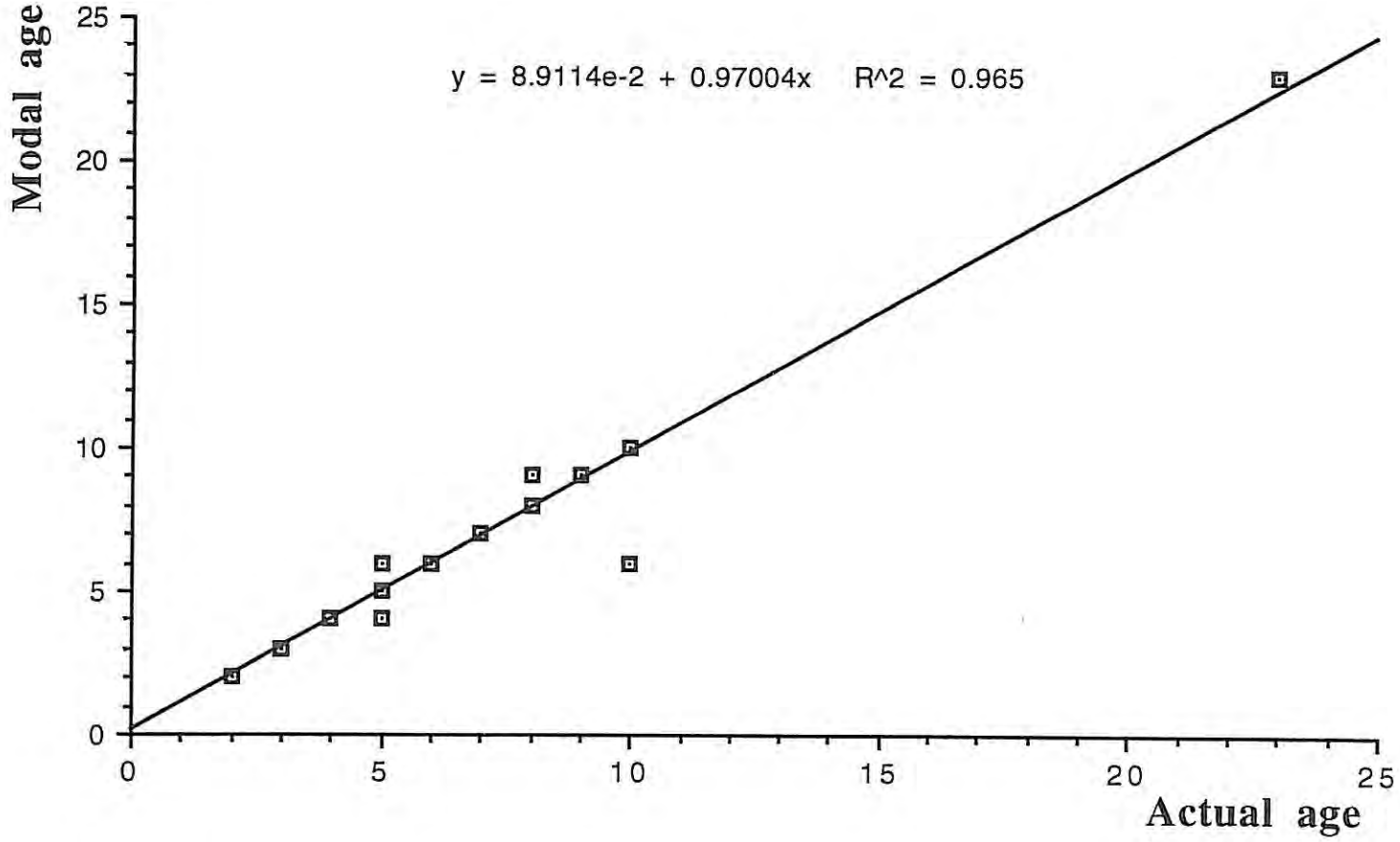

Figure 5.3 The modal age obtained from age readings from 43 otoliths by 10 otolith readers is plotted against the actual age from these otoliths, which were obtained from the Norwegian tagging programme.

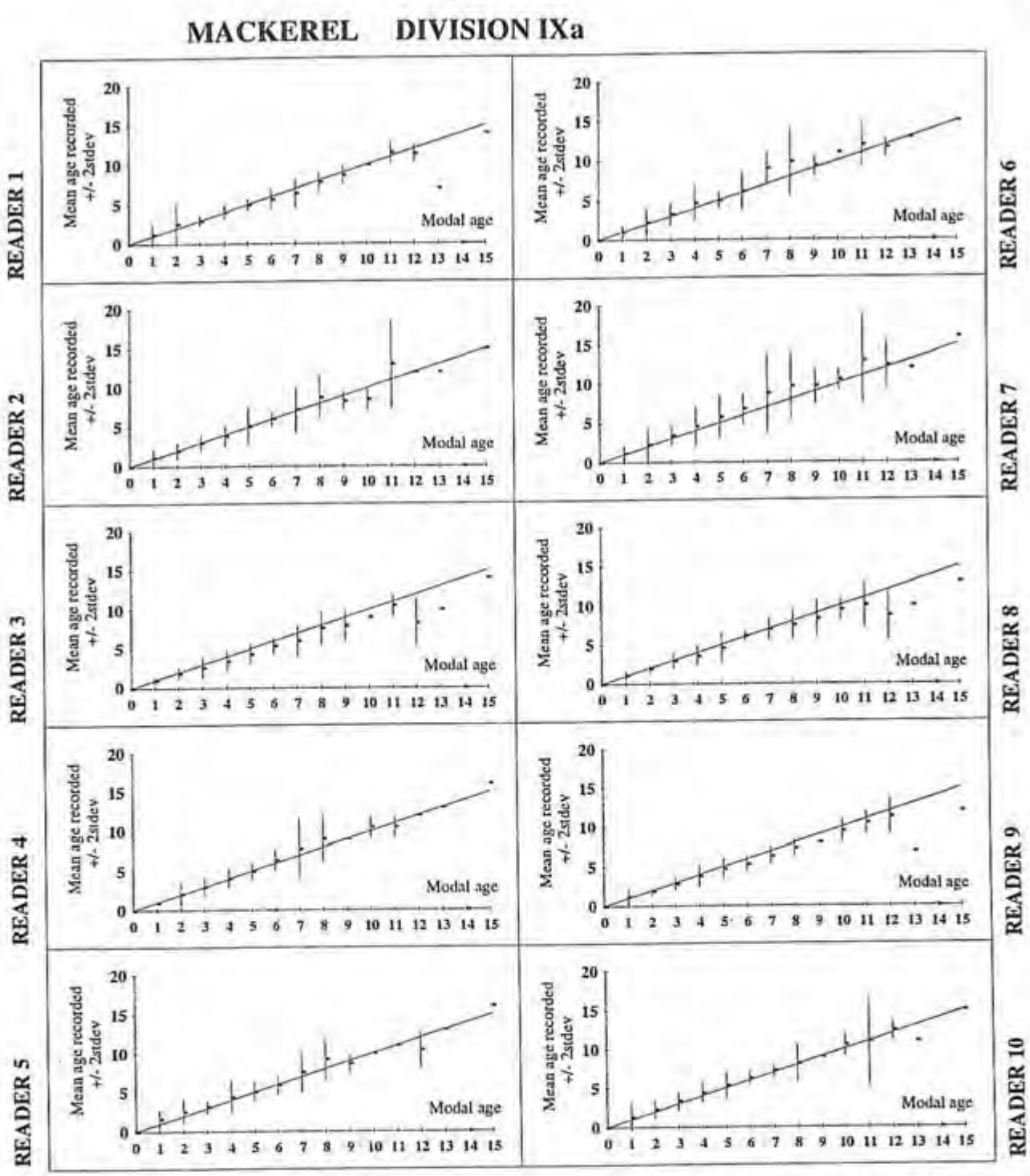

Figure 5.4 In above age bias plots the mean age recorded +/- 2stdev of each age reader is plotted against the modal age.

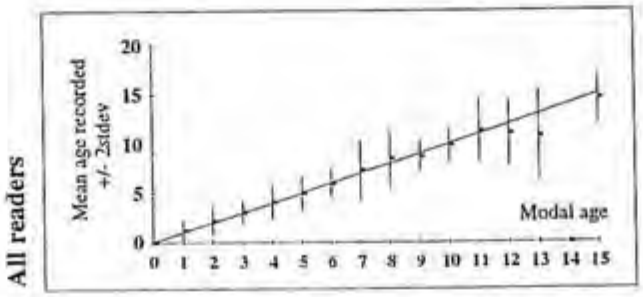

Figure 5.5 In above age bias plot the mean age recorded +/- 2stdev of all age readers is plotted against the modal age.

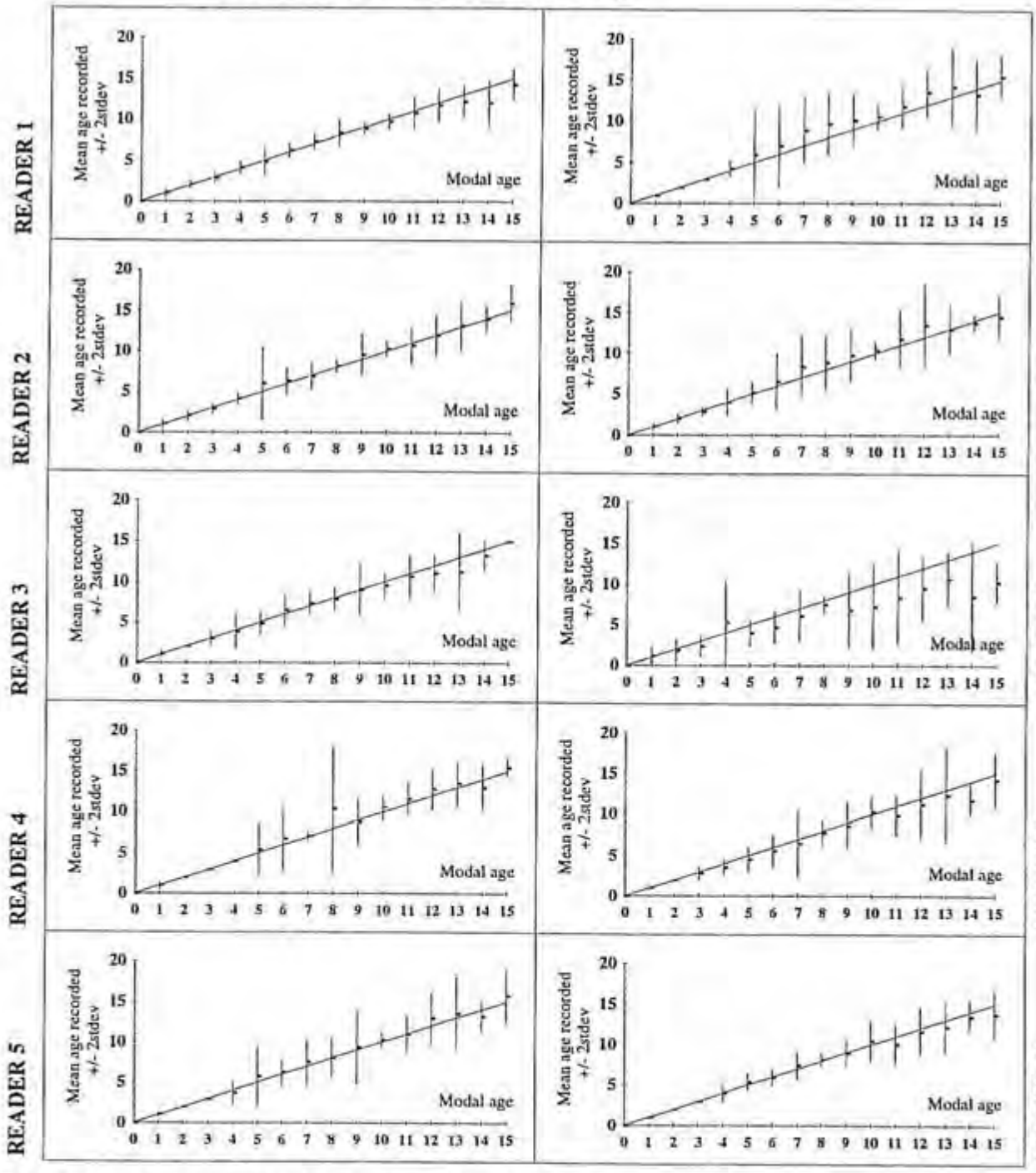

Figure 5.6 In above age bias plots the mean age recorded +/- 2stdev of each age reader is plotted against the modal age.

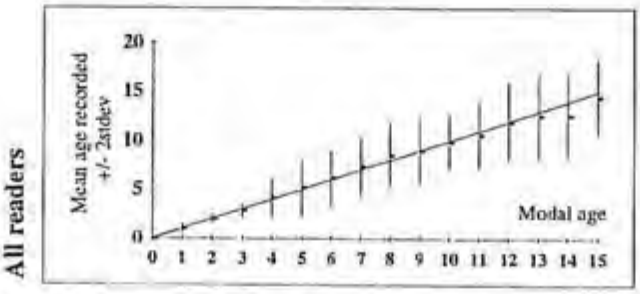

Figure 5.7 In above age bias plot the mean age recorded +/- 2stdev of all age readers is plotted against the modal age.

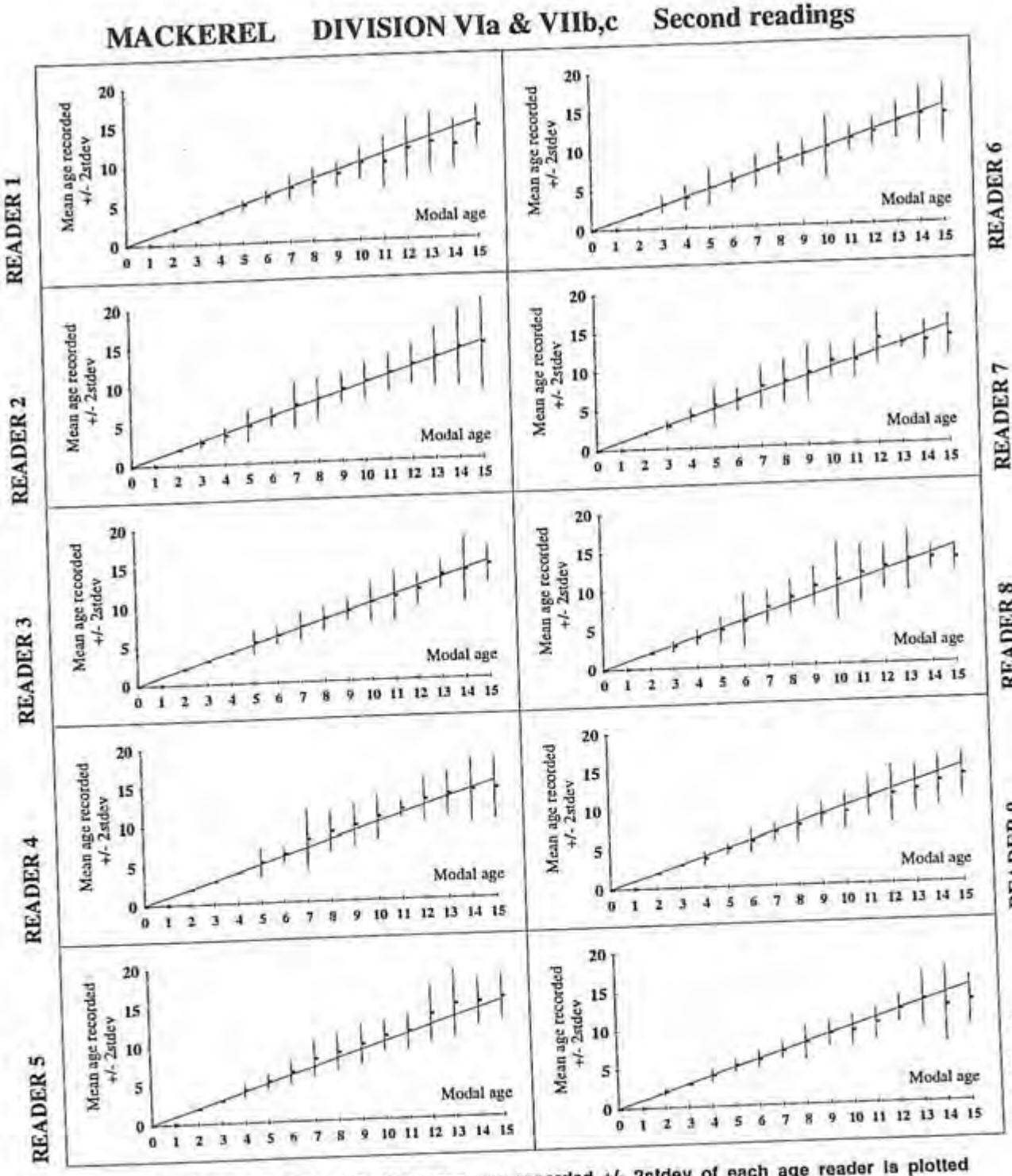

Figure 5.8 In above age bias plots the mean age recorded +/- 2stdev of each age reader is plotted against the modal age.

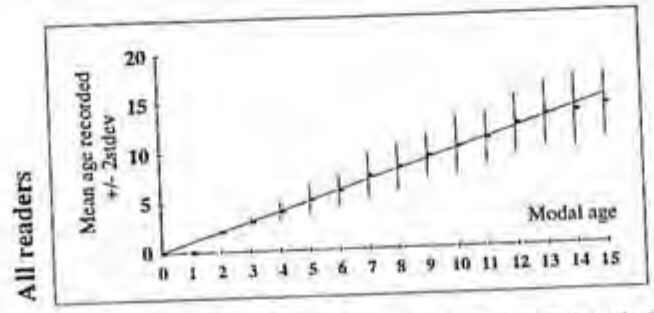

Figure 5.9 In above age bias plot the mean age recorded +/- 2stdev of all age readers is plotted against the modal age.

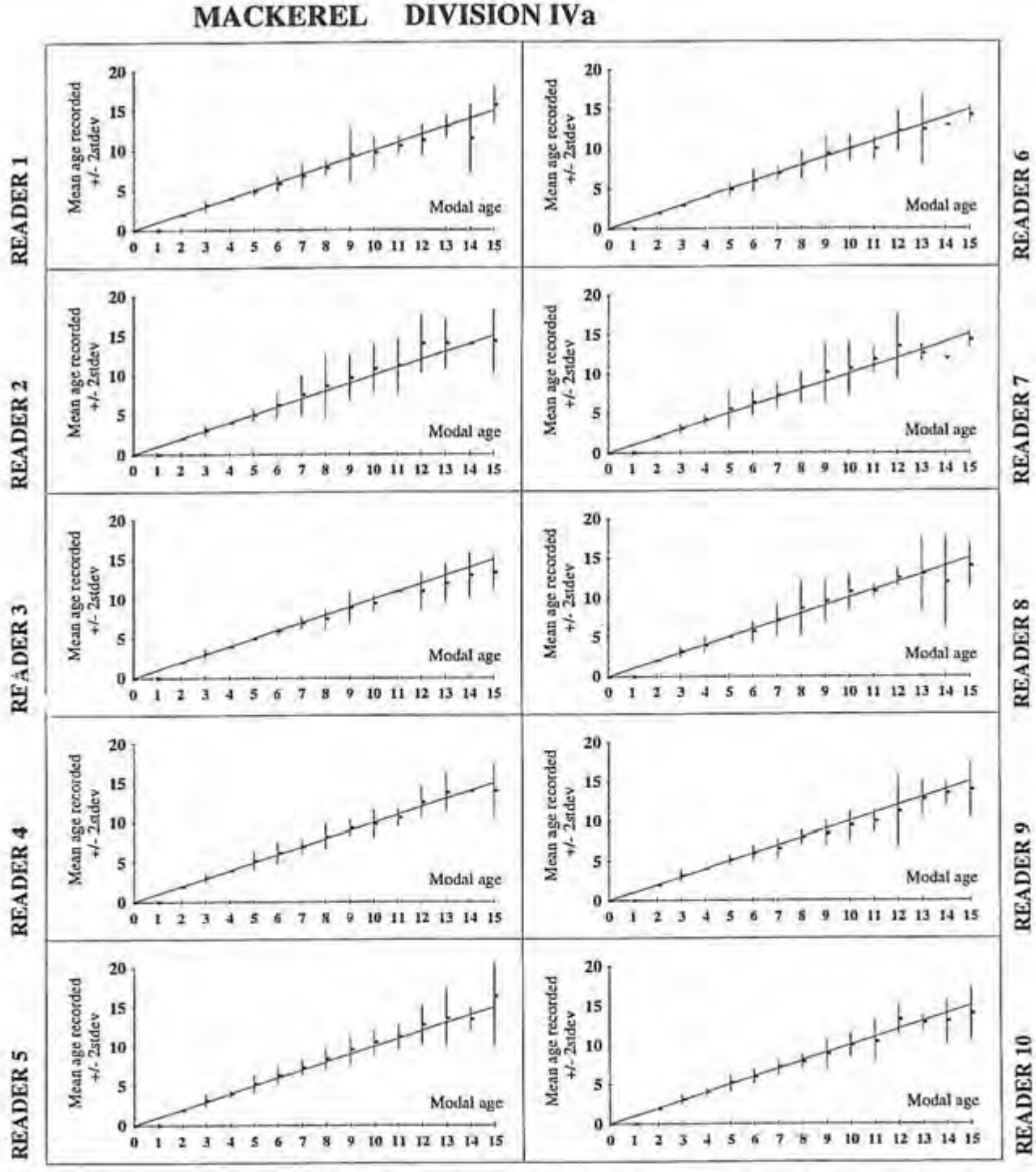

Figure 5.10 In above age bias plots the mean age recorded +/- 2stdev of each age reader is plotted against the modal age.

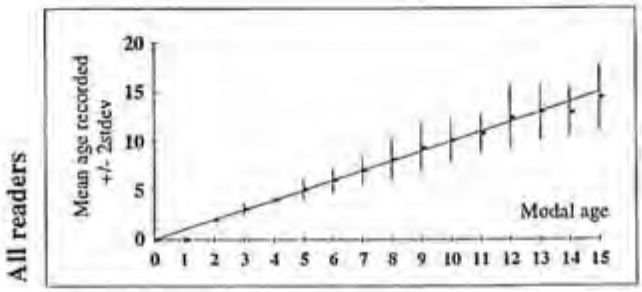

Figure 5.11 In above age bias plot the mean age recorded +/- 2stdev of all age readers is plotted against the modal age.