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Canadian Atlantic Fisheries
Scientific Advisory Committee

Comité scientifique consultatif des
pêches canadiennes dans l'Atlantique

CAFSAC Research Document 92/119

CSCPCA Document de recherche 92/ 119

Georges Bank Cod and Haddock Ageing Workshop

September 10-13, 1991
St. Andrews, N. B.

by[2]

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[2]In alphabetical order

ABSTRACT

Age readers from the Marine Fish Division at St. Andrews, N.B. and the NorthEast Fisheries Science Center at Woods Hole, Mass. met in St. Andrews on September 10-13, 1991 to discuss age determination of Georges Bank cod and haddock. The workshop began with a review of ageing protocols and preparation methods, followed by discussions and work sessions on topics specific to each of the two species.

For cod, the objectives were clarification of characteristics such as shifting, settling check and edge types, and documentation of the first comparison reading between these two age readers. As a result of these discussions on cod ageing, it was recommended that incidence of shifting should be noted by the Canadian age reader, that the effect of sectioning otoliths offcentre on settling check appearance should be studied in more detail, and that each otolith from a pair used for exchange should be prepared by the ager's own method.

Discussions on haddock ageing were focused on the reliability of using scales for age determinations, especially in older fish. An apparent truncation in recent years of USA survey age-length keys may be an indication of a problem. Otoliths and scales from the Canadian 5Z haddock fishery were examined by the USA and Canadian age readers and the results compared. Because of the discrepancies observed between otolith and scale ages, it was recommended that the USA re-examine the use of otoliths to age larger haddock.

General workshop conclusions included the review of the Canadian birthdate convention of Feb. 1; the continued annual exchange of age material ; the assertion of the benefits of regular workshops; and the need to document the results of future age material exchanges.

RÉSUMÉ

Les spécialistes de la détermination de l'âge de la Division des poissons de mer à St. Andrews (N.-B.) et ceux du North East Fisheries Science Center de Woods Hole, au Massachusets, se sont réunis à St. Andrews, du 10 au 13 septembre 1991, pour discuter de la détermination de l'âge de la morue et de l'aiglefin du banc Georges. Leur atelier a commencé par un examen du protocole de détermination de l'âge et des méthodes de préparation qui y sont associées, et s'est poursuivi par des séances de travail axées sur chacune des deux espèces considérées.

En ce qui a trait à la morue, il s'agissait de clarifier certaines notions comme le décalage, la marque de transition à la vie benthique et les types de bord, et de documenter les premières déterminations comparatives entre les spécialistes des deux pays. Par suite de ces discussions, il a été recommandé que les spécialistes canadiens relèvent les cas de décalage, que l'on étudie plus en détail les effets d'une coupe décentrée des otolithes sur l'aspect de la marque de transition et que chaque otolithe provenant d'une paire utilisée dans le programme d'échange soit préparé par le spécialiste de la détermination de l'âge, selon sa propre méthode.

Quant aux discussions sur la détermination de l'âge de l'aiglefin, elles ont surtout porté sur la fiabilité de l'utilisation des écailles pour déterminer l'âge, en particulier celui des plus vieux spécimens. La troncature apparente ces dernières années des rapports âge-longueur provenant des campagnes d'évaluation américaines pourrait être l'indice d'un problème. Les spécialistes canadiens et américains ont examiné des otolithes et des écailles du hareng de 5Z et ont comparé leurs résultats. Compte tenu des écarts observés entre les âges déterminés respectivement d'après les otolithes et d'après les écailles, il a été recommandé que les États-Unis envisagent à nouveau d'utiliser les premiers pour établir l'âge du plus gros aiglefin.

L'atelier général a débouché sur la révision de la convention canadienne sur la date de naissance (datée du 1^er^ février) et sur la décision de poursuivre l'échange annuel en matière de détermination de l'âge. On y a également confirmé l'utilité de tenir des ateliers réguliers et la nécessité de documenter les résultats futurs des échanges en matière de détermination de l'âge.

I. INTRODUCTION

Age readers from the Marine Fish Division at St. Andrews, N.B. and the NorthEast Fisheries Science Center at Woods Hole, Mass. met in St. Andrews to discuss age determination of Georges Bank cod and haddock. The primary objective of the meeting was the comparison and documentation of readings between the Canadian and USA age readers. The meeting also included the status of historic samples and preparation techniques, and the identification and discussion of topics specific to each species. The list of participants and the agenda for the workshop are shown in Appendix 1.

II. REVIEW OF AGEING PROTOCOLS

A review of ageing protocols was presented by each country for discussion prior to examination of ageing material.

1. Woods Hole

1.1 Preparation of ageing material

Haddock are aged from plastic laminate impressions of scales. Before 1986, otoliths were collected from haddock larger than 65 cm and used to verify scale ages or when scales could not be read. Haddock otoliths were broken on the sulcus, set in clay and read with water over the surface before the thin-sectioning method was developed. In 1986, collection of otoliths from large haddock was suspended although otoliths were collected intermittently since then for Canadian-USA ageing exchanges. (Subsequent to this workshop, beginning in autumn 1991, otolith collection was resumed for haddock >50 cm.)

Cod are aged from baked and broken cross sections of otoliths.

1.2 Verification procedures

Two readers are assigned to each species aged by Fishery Biology Investigation staff. The first reader is responsible for ensuring that all age samples are processed, aged, data entered into computer files, audited and summarized in accordance with predetermined time tables. The second age reader's responsibilities are to re-age a random sample of about 20% of the total and to age with the first reader any samples which are identified as difficult to interpret.

Data summaries include age length keys from bottom trawl survey or quarterly commercial data for each species/stock. The standard summaries also provide estimates of mean length at age and variances. These statistics are very useful for comparing current ages with those from previous years. Samples that are identified as outliers are re-examined by both readers and either verified, corrected or discarded. Before the audited data are processed to the master file, all summaries are reviewed by the Investigation Chief.

1.3 Documentation

Documentation of processing and ageing methods for all species aged at the NEFSC Woods Hole Laboratory are provided in Penttila, J. and L.M. Dery (eds). 1988.

1.4 Video Systems

Video systems are not routinely used for age determination, however, an Image Analysis System (IAS) is available.

1.5 Status of historic samples

Samples collected during USA bottom trawl surveys and from the USA commercial fisheries are summarized for cod in Table 1 and 2 and for haddock in Table 3 and 4.

2. St. Andrews

2.1 Preparation

Both cod and haddock ages are now assigned from otolith cross sections. Cod otoliths are occasionally baked prior to sectioning. Otoliths are embedded in a resin and then sectioned with a high speed diamond saw.

2.2 Verification procedures

A random sample of about 100 otoliths for each reader is re-aged each quarter to assess intra-reader agreement.

Readers are responsible for entering ages to both the survey and commercial database. Access to age length keys and summaries is available to readers. General guidelines require readers to complete ageing no later than the end of the quarter following the quarter in which the samples were collected (ie. Jan-Mar samples aged no later than the end of June).

2.3 Documentation

An unpublished report by Hunt summarizes age techniques used at St. Andrews, and Strong et al. (1985) describe methods used for otolith sectioning.

2.4 Video systems

A BioSonics compatible IAS is used on a routine basis by age readers for discussion of interpretations. Images are annotated and stored on Hi-8mm video recording media.

2.5 Status of historic samples

Georges Bank cod survey samples from 1986 are summarized in Table 5 and cod samples from commercial landings are available since 1968 (Table 6). Similar listings for haddock are contained in Table 7 and 8. Table 9 and 10 summarize previous Canada/USA ageing exchanges for the two species.

III. DISCUSSION BY SPECIES

1. GEORGES BANK COD

Nancy Munroe, Woods Hole, Mass.
Maria-Ines Buzeta, St. Andrews, N.B.

This workshop served to clarify definitions and characteristics of various otolith structures of specific interest to 5Zj,m cod and to document the first comparison reading between these two age readers.

The USA age readers include annotations of otolith characteristics which are atypical and the reasons why these were not aged. It was agreed that Canada should also include annotations with otoliths which are not aged. Presently the Canadian Commercial Groundfish Samples (CGS) data base has only code "C" to represent otoliths that are not aged. This leads to loss of information which later may be useful.

The USA lab has an IAS that may be compatible with the Canadian system. Further information will be exchanged to ascertain if this is so. The possibility exists that images of annotated aged material may be exchanged along with the traditional prepared samples. This would facilitate clarification of ageing disparities.

1.1 Visual Introduction to Selected Topics

Examples of settling checks, different edge types and serial sections were introduced. It was agreed that settling checks are recognized by the Canadian ager. Other settling check examples were later discussed in more detail.

Different edge types were annotated; some confusion remained regarding a narrow hyaline (NH) edge and this topic was revisited later.

Canadian serial sections were examined and examples of the best cut through the center were agreed on as well as the importance of this with respect to determination of the settling check.

1.2 Review of Canadian Preparation Methods

Canadian methods were briefly demonstrated and included a discussion of the effects that they may have on final ageing. Specifically discussed was the importance of the otolith being cut directly through the center in order to obtain the best age (Mike Strong, pers. com.) Further description of methods are given in Strong et al, 1985.

1.3 Shifting

"Shifting" was identified as a feature commonly coded by the USA and not presently annotated by Canada; it was flagged as an item for discussion at this workshop.
This session began with the use of the dual scope. Specific examples were later taped with the IAS. Otoliths used for this topic were from the 1990 Canadian/USA exchange sample (Canadian spring survey N133). This sample had a large number of shifted otoliths and the agreement between age readers was documented as 89% (Munroe and Robicheau unpub.)

USA criteria for classification of shifted otoliths are:

- usually occur in intermediate and large fish (>60cm)
- increments are bunched
- defined in Pentilla and Dery (1988), p.5 "moved in the sacculus; recognized by additional growth occurring along a different axis from previous growth. Annuli may thus be present only on certain parts of a shifted otolith and absent on others"
- about 10% of occurrences are not aged
- decision when to "omit" is subjective, even if an age can be assigned, as disruptions may occlude some of the annuli.

Conclusions

The USA age reader will forward a summary for 1988, 3rd quarter, where the incidence of shifting was about 20%. Summary will include numbers caught, numbers sampled, numbers aged, and numbers with no age assigned due to shifting.

The Canadian age reader will begin to note extreme cases of shifting especially on otoliths used in exchanges. The effect of omitting these cases from an age-length key should be studied.

1.4 Settling Check

A definition for this feature given in Penttila and Dery (1988) states that "it occurs just outside the nucleus and is believed to form when the fish first become benthic in habit". Additional criteria for visual identification were given by Munroe as:

- hugs the center, stands alone
- may appear to have opaque zone to the outside and be opaque (or clear) to the inside
- no other checks around it
- pencil thin zone.

Two groups of samples were examined: 1985 Canadian commercial samples (aged prior to the 1986 workshop), and the Canadian 1991 spring survey (N148), representing recent age determinations by the former Canadian age reader. This would show if any change in recognition of settling checks (SC) had occurred.

Examination of two otoliths from a 1985 sample (850367) of a clear age 2 with a 3-way consensus showed that the SC had not been counted in the original age estimate. A check along the edge of another otolith also had not been counted further confirming correct interpretation.

Examination of three 1990 (N148) otoliths showed 3 different cases:

a. One otolith aged 8 by consensus of Munroe and Buzeta had the SC counted by the former Canadian age reader and therefore had added a year to the determination.

b. The second sample was similar to the above but in this case the SC had not been counted in the past. It had a 3-way agreement of age 6. Only one otolith in this pair showed the SC and the 1st annulus.

c. The third example showed slow winter growth inside the SC as described by Munroe. A 3-way consensus was reached with much discussion on the characteristics of the 1st annulus.

Conclusions

Settling checks were looked for in all samples aged during the workshop and generally it was agreed that there is no problem recognizing them. The effect of sectioning otoliths offcentre on settling check appearance should be studied in more detail.

1.5 Serial Sections

There was not always a consensus in recognition of the 1st annulus versus a small center or a split 1st annulus. Both USA and Canadian serial sections were looked at in order to ascertain if being cut offcenter can cause 'artifacts' such as a small 1st annulus or the omission of an annulus.

Thirteen USA sections taken serially from a single otolith were examined first in order to evaluate these effects. The age assigned to the different sections of the same otolith varied from 2 to 6. As the sections progressed it became apparent that not all annuli and checks are observed unless the section is directly through the center. The 1st annulus was noted as being a check until the sulcus section, where it became apparent that there were more annuli within and therefore should be counted. The true age of this otolith was assigned as age 6. Three Canadian sections of one otolith were examined next where only one was cut through the center; this resulted in a consensus of age 9. Two sections from another otolith showed that the SC plus a 4th annulus were only visible on the sulcus section.

Of the 24 otoliths examined, next all but three were in consensus (Table 11). These samples were not discussed until both agers had assigned the ages to the otoliths. Three were not agreed upon because of the characteristics of the 1st annulus and whether it constituted more than one year's growth. One disagreement was due to not assigning an age by the USA reader due to shifting of the otolith even though an easy consensus was reached on the number of annuli counted.

Conclusions

The effect of sectioning otoliths off centre on 1st annulus appearance should be studied.

1.6 Edge Types and Conventions

Six otoliths were specifically flagged as examples of difficult edge types. The narrow hyaline (NH) edge is not always detected by the Canadian ager even though it is automatically counted after the Feb 1 birthdate. The difference in birthdate conventions was discussed. The Canadian convention places the birthdate closer to the biological birthdate, but in doing so the growth between Jan.1 and Feb.1 must be taken into consideration (Kohler,1958) by adjustment of the age assigment depending on month of capture and otolith edge type (Table 12). For example, a 7 annuli otolith with a WH edge type from an Aug. sample will be assigned an age of 7 years; a 7 annuli otolith with a WH or NH edge type from a Sept. sample will be assigned an age of 6 years; and a 7 annuli otolith with a NH edge type from a Sept. sample will be assigned an age of 6 years. These conventions are based on the assumption that 1991 winter's hyaline growth could be seen as early as Aug. 1990 and as late as Apr. 1991.

The USA agers, using Jan. 1 as a birthdate, need not make the fine distinctions of edge types as must the Canadian agers. The USA convention counts the edge during the first two quarters and does not count it on the last two quarters. For example, the same 7 annuli otolith will be assigned an age of 8 years during the 1st and 2nd quarters (Jan/Jun) and an age of 7 years on the 3rd and 4th quarters (Jul/Dec). Therefore if edge type is incorrectly assigned, age interpretation using the Canadian convention could lead to more significant age discrepancies than if the USA convention had been used.

Conclusions

A change in the Canadian birthdate convention from Feb. 1 to Jan. 1 should be considered. The table currently used in Canada to assign ages based on edge type should be verified, if possible, through documentation of seasonal patterns in edge formation.

1.7 Comparison Between USA and Canadian Methods

Two pairs of otoliths from the 1991 exchange (Canadian 1990 spring survey, N133) were examined. Each pair consisted of one otolith examined by the USA "baked" method, and one prepared by the Canadian "sectioned" method. The USA Baked method refers to the baking of cod otoliths (3-3.5 min, 525 deg. F, caramel colour) and subsequent cracking (with pliers) along the sulcus. The otolith half is then manually held under the scope. The Canadian Sectioned method also refers to the baking of cod otoliths (4-5 min, 540 deg. F) but with subsequent embedding in resin and sectioning by saw. The otolith sections are then mounted on a Plexiglas plate.

Conclusions

Discussion of methods and their possible effects on age determination and % agreement of an exchange resulted in the following conclusions:

- Each otolith from a pair used for exchange should be prepared by the ager's own method.

- Structural peculiarities may exist between the 2 otoliths of a single pair and, as each ager sees only one of the pair, age assignment could vary. This could be the case especially when one of the pair is considered shifted or crystallized. Otolith pairs should not be included if one of the pair is crystallized or shifted.

- If a disagreement can not be resolved, each ager should see both otoliths of the pair. Ages should be assigned to both otoliths and possible reasons for discrepancies should be noted (structural differences between pairs, mixing of samples, preparation methods, etc). A consensus should be reached as to the inclusion of an otolith pair exhibiting such a mismatch.

- Canada will annotate more of baked/sectioned comparisons on video if the IAS of both labs proves to be compatible.

2. GEORGES BANK HADDOCK

Nancy Munroe, Woods Hole, Mass.
Lou Van Eeckhaute, St. Andrews, N.B.

The reliability of using scales to age 5Z haddock, especially older haddock, was the main issue addressed during this exchange.

An exchange in 1988 using scales and otoliths of 5Z haddock from that year's fall USA survey resulted in very good agreement, however, very few fish older than 5 years were examined (Strong, 1989). Results from an exchange using scales and otoliths collected from the 1989 USA fall survey, Delaware 89-06, also showed very good agreement at 93% (Table 13). Again, the majority of fish were under age 5, mostly ages 2 or 4; the oldest age of 8 and was determined from the otoliths. The next exchange, using scales and otoliths from the July 1990 Canadian survey, N139, had only a 57% agreement (Table 14 and 15). The ages in the otolith sample ranged from 1 to 12 while the scale sample ages ranged from 1 to 6.

An apparent truncation in recent years of USA survey age-length keys when compared to the comparable Canadian age-length keys may be an indication of a problem in using scales for older haddock. Older ages were given to fish in the Canadian keys than in the USA keys for fish from the same length range.

2.1 Methods

For this exchange a special request was made from the Canadian port samplers for approximately 100 otolith and scale samples from Georges Bank haddock. They were instructed to take the scale samples using the methods employed by the USA samplers. One longline sample of 60 scales and otoliths from Georges Basin and one otter trawl sample of 48 fish from the Fundian Channel, both collected on Aug. 28, 1991 were obtained. The Georges Basin sample was taken from a depth of 130-150 fathoms and the Fundian Channel sample from 140 to 160 fathoms. The scales were sent directly to the Woods Hole lab where 5-6 scales per fish were prepared and read before the exchange. The otoliths were sent to the St. Andrews Biological Station, mounted, sectioned in resin and aged.

The first materials examined were scales and otoliths from the Canadian survey cruise N139. These samples came from sets 60, 61, 62 and 64 made at depths of 49 to 77 fathoms in Canadian survey strata 5Z1 and 5Z2 near the eastern part of the bank. These samples were taken from the area below the dorsal fin and above the lateral line which is not the location preferred by USA agers and may have resulted in a high proportion of irregularly-shaped scales.

Six otoliths and the corresponding scales were interpreted and the annotated images documented on video cassette. This analysis concentrated on samples which showed disagreement in ages.

A similar approach was taken with the 2 commercial samples from Georges Basin and the Fundian Channel. Six otoliths and scales from the former and one from the latter were documented and recorded on video tape.

To further assess the validity of the otolith ages, the USA ager then interpreted most of the otoliths from Georges Basin which were in disagreement with the scale ageing.

2.2 Results

N139 sample:

The following otoliths and scales were examined jointly by the Canadian and USA agers and the annotated images recorded on video tape:

Fish No.	Length (cm)	Otolith Age	Scale Age	Difference (Otol.-Scale)
462	57	5	4	1
463	64	12	5	7
464	73	12	5	7
465	72	12	5	7
489	74	7	4	3
513	61	5	4	1

The otoliths and scales were interpreted by the Canadian and USA ager together without disagreement. In all of the above cases outer annuli which were seen on the otoliths were not evident on the scales. Erosion at the scale edge was seen,especially in the older fish.

Georges Basin (GB) and Fundian Channel (FC) samples:

A comparison of ages given to otoliths and scales from the Georges Basin sample is given in Table 16 and the Fundian Channel sample in Table 17. Table 18 combines the results of both commercial samples.

Details of ageing structures recorded on video tape are as follows:

Fish No.	Length (cm)	Otolith Age	Scale Age	Difference (Otol.-Scale)
GB 1	56	4	4	0
2	71	8	6	2
5	65	6	6	0
6	63	6	5	1
14	61	8	5	3
45	69	8	8	0
FC 3	78	13	8	5

Observations on specific otoliths follow:

GB 2: Erosion was seen along some of the outer winter annuli.

GB 14: Under high magnification the scales showed two areas containing poorly discernible winter-type circuli each consisting of a single row. These areas were beyond the 5th annulus within what appeared to be the next summers growth (6th summer). These zones could not be counted as annuli because of insufficient width.

Ages given by the USA ager to the Georges Basin otoliths which were in disagreement with scale ages are summarized below:

Fish No.	Length (cm)	Otolith Age Can.	Otolith Age USA	Scale Age
3	62	8?	8	6
6	63	6	6	5
7	67	8	8	7
13	60	8	8	5
14	61	8	8	5
18	62	6	6	5
19	58	5	6(5)	4
20	68	8	8	6
26	58	6	6	4
27	49	4	4	3
29	70	13	13	omit
30	60	6 cry[1]	cry	5
34	56	6	6	4
55	63	6	6	omit
57	55	6	6	4
60	49	4	4	3

[1]crystallized

Scales which were omitted often had the comment "mixed scales". The USA ager used this term to refer to samples which contained scales that gave more than one age. The USA ager felt that the high occurrence of "mixed" samples indicated that scales from one sample may have come from different fish rendering age determinations tenuous at best. However, "mixed" scales could also result from varying rates of erosion of the scales, thereby resulting in scales from the same fish giving different ages.

2.3 Discussion

It is recommended that the USA lab re-examine the use of otoliths to age larger haddock and investigate the extent of scale versus otolith age discrepancies. This workshop has demonstrated that the USA policy of using scales to age 5Z haddock may result in underageing haddock 5 years and older in some samples. The discrepancies become more severe as age increases.

It is possible that erosion during winter growth may cause annuli to become reduced in width and for some to disappear altogether. The slow growth of haddock after the 5th or 6th year may also reduce the width of annuli on scales and this combined with erosion could obliterate or significantly reduce circuli. Problems with using scales for ageing haddock were noted by Kohler and Clark (1958) who reported that for Subarea 5 haddock, scale readings were consistently lower than otolith readings for fish greater than 7 years and that the clarity of annuli in the edges of scales diminished in older fish. Jensen and Wise (1962) reporting on New England haddock stated that "The exposed posterior edges of some scales, particularly from fish more than 7 years old are ragged and appear to be eroded, suggesting that some annuli may be missing." The slow growth rate of older 5Z haddock could cause the effect of erosion on the scales to be significant.

Since some samples showed good agreement and others not, the effect of origin of the sample on results of exchanges should be examined.

The lengths at which fish were underaged started as low as 48 cm. Table 19 contains length frequencies of unit area 5Zj and 5Zm haddock caught by the commercial USA fishery for 3 recent years. The effect of errors in ageing on the USA catch at age could be substantial based on the lengths of fish caught by the USA fishery. These results indicate possible problems with USA age-length keys during the period when scales were only being read. They should be examined to ascertain the effect on mean size at age and yearclass strength when compared with the Canadian keys.

V. WORKSHOP CONCLUSIONS AND RECOMMENDATIONS

1. 5Ze Cod

i. Exchanges should include both otoliths of a pair and both should be examined in those cases of ager disagreement. Preparation of an otolith from each sample should be done by each lab, according to the lab's standard methods.

ii. A copy of this workshop's video will be sent to the Wood's Hole lab once the IAS of both labs are shown to be compatible.

iii. The Canadian ager should begin to annotate cases of "shifting" especially for exchange material.

iv. The USA ager will forward more information on the incidence of shifting.

v. The effect of assigning ages from material cut offcenter should be studied by the Canadian ager. Changes in the SC and the 1st annulus should be noted.

2. 5Ze Haddock

i. It is recommended by the Canadian ager that the USA lab investigate the effects of using scales to age older haddock.

ii. Subsequent to the workshop, the USA reintroduced the requirement to collect otoliths from larger haddock and is collecting these for haddock >50 cm. Further studies comparing otolith and scale ages are being undertaken. Scales and otoliths will be collected during the Canadian spring and USA fall survey to investigate the effect of fishing location on ageing discrepancies. Preliminary results are given in Appendix II.

iii. To validate the use of otoliths for ageing haddock and interlab agreement it is recommended that the USA ager read several otolith samples to compare with the Canadian ages.

3. Other

i. A change of the Canadian birthdate convention from Feb. 1 to Jan. 1 should be considered.

Subsequent to this workshop the Statistics Sampling and Surveys Subcommittee of CAFSAC recommended that regions using the Feb. 1 convention investigate the possibility of this change and the required database conversions.

ii. There was agreement that exchanges should be continued on an annual basis and that results would be enhanced if annotated video images could be provided as well as age material. Alternatively, the readers should provide a coded summary of their interpretation. Exchanges should be temporally distributed to include:

- USA samples from their fall survey
- Canadian samples from their spring survey
- Canadian and USA commercial samples from each quarter

iii. Material should encompass the entire length range available.

iv. Participants concurred that a workshop format has many benefits and that these should be attempted every 2-3 years with rotation between the two laboratories.

v. It was also recommended that results of exchanges and workshops should be documented in an agreed report and circulated to individuals who use the results of age determination.

ACKNOWLEDGMENTS

We would like to extend thanks to G. Donaldson and D. Lyon for obtaining the Canadian commercial haddock samples for this workshop especially in view of the fact that very little time was available to them to collect and forward them to the appropriate labs.

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Table 1. Summary of NEFSC research vessel sample collections off the northeast coast of the USA for Atlantic cod.

	Vessel	Gear/Survey Type	Season	Col.	Aged*	Age Reader
1966	Albatross IV	Bottom Trawl	Autumn	1	0	-
1967	Albatross IV	Bottom Trawl	Autumn	40	0	-
1968	Albatross IV	Bottom Trawl	Spring	246	0	-
1968	Albatross IV	Bottom Trawl	Autumn	269	0	-
1969	Albatross IV	Bottom Trawl	Spring	228	0	-
1969	Albatross IV	Bottom Trawl	Summer	256	0	-
1969	Albatross IV	Bottom Trawl	Autumn	247	0	-
1970	Albatross IV	Bottom Trawl	Spring	610	610	Penttila
1970	Albatross IV	Bottom Trawl	Autumn	2	2	Penttila
1970	Albatross IV	Bottom Trawl	Autumn	429	429	Penttila
1971	Albatross IV	Bottom Trawl	Spring	723	723	Penttila
1971	Albatross IV	Bottom Trawl	Autumn	477	477	Penttila
1972	Albatross IV	Bottom Trawl	Spring	357	357	Penttila
1972	Albatross IV	Bottom Trawl	Spring	1109	778	Penttila
1972	Albatross IV	Bottom Trawl	Autumn	887	855	Penttila
1973	Albatross IV	Bottom Trawl	Spring	1366	1330	Penttila
1973	Albatross IV	Bottom Trawl	Autumn	811	811	Penttila
1974	Albatross IV	Bottom Trawl	Spring	972	972	Penttila
1974	Albatross IV	Bottom Trawl	Autumn	777	777	Penttila
1975	Albatross IV	Bottom Trawl	Spring	605	601	Penttila
1975	Albatross IV	Bottom Trawl	Autumn	757	670	Penttila
1976	Albatross IV	Bottom Trawl	Spring	765	765	Penttila
1976	Albatross IV	Bottom Trawl	Autumn	460	460	Penttila
1977	Albatross IV	Bottom Trawl	Spring	563	563	Penttila
1977	Alb/Del	Bottom Trawl	Summer	697	477	Penttila
1977	Delaware II	Bottom Trawl	Autumn	873	868	Penttila
1978	Albatross IV	Bottom Trawl	Spring	688	652	Penttila
1978	Delaware II	Bottom Trawl	Autumn	1183	1166	Penttila
1978	Alb/Del	Bottom Trawl	Summer	498	392	Penttila
1978	Francis Elizabeth	Inshore BT	Spring	343	242	Penttila
1978	Francis Elizabeth	Inshore BT	Autumn	20	20	Penttila
1979	Alb/Del	Bottom Trawl	Spring	1021	1002	Penttila
1979	Alb/Del	Bottom Trawl	Summer	507	506	Penttila
1979	Alb/Del	Bottom Trawl	Autumn	1146	1137	Penttila
1979	Francis Elizabeth	Inshore BT	Spring	121	120	Penttila
1979	Francis Elizabeth	Inshore BT	Autumn	53	53	Penttila
1980	Alb/Del	Bottom Trawl	Spring	613	611	Penttila
1980	Delaware II	Bottom Trawl	Autumn	664	627	Penttila
1980	Alb/Del	Bottom Trawl	Summer	554	530	Penttila
1980	Francis Elizabeth	Inshore BT	Spring	80	80	Penttila
1980	Francis Elizabeth	Inshore BT	Autumn	22	22	Penttila
1981	Delaware II	Bottom Trawl	Winter	74	56	Penttila
1981	Delaware II	Bottom Trawl	Spring	954	944	Penttila
1981	Delaware II	Bottom Trawl	Summer	319	315	Penttila
1981	Alb/Del	Bottom Trawl	Autumn	721	717	Penttila
1981	Francis Elizabeth	Inshore BT	Spring	224	224	Penttila
1981	Francis Elizabeth	Inshore BT	Autumn	67	67	Penttila
1982	Delaware II	Herring	Winter	486	486	Gifford
1982	Delaware II	Bottom Trawl	Spring	900	807	Gifford
1982	Delaware II	Gear Comp.	Autumn	17	17	Gifford
1982	Albatross IV	Bottom Trawl	Autumn	465	465	Gifford
1982	Gloria Michelle	Inshore BT	Spring	214	214	Gifford
1982	Gloria Michelle	Inshore BT	Autumn	35	35	Gifford
1983	Albatross IV	Bottom Trawl	Spring	788	788	Gifford
1983	Delaware II	Herring	Winter	32	32	Gifford
1983	Albatross IV	Bottom Trawl	Autumn	636	541	Gifford
1983	Gloria Michelle	Inshore BT	Spring	189	189	Gifford
1983	Gloria Michelle	Inshore BT	Autumn	13	13	Gifford
1984	Albatross IV	Bottom Trawl	Spring	551	543	Munroe

Table 1. continued.

	Vessel	Gear/Survey Type	Season	Col.	Aged*	Age Reader
1984	Albatross IV	Bottom Trawl	Autumn	523	522	Munroe
1984	Delaware II	Bottom Trawl	Autumn	11	11	Munroe
1984	Gloria Michelle	Inshore BT	Spring	139	137	Munroe
1984	Gloria Michelle	Inshore BT	Autumn	23	23	Munroe
1985	Albatross IV	Gear Comp.	Winter	1	1	Munroe
1985	Albatross IV	Bottom Trawl	Spring	864	859	Munroe
1985	Albatross IV	Bottom Trawl	Autumn	424	370	Munroe
1985	Gloria Michelle	Inshore BT	Spring	85	85	Munroe
1985	Gloria Michelle	Inshore BT	Autumn	14	14	Munroe
1986	Albatross IV	Bottom Trawl	Spring	658	658	Munroe
1986	Delaware II	Bottom Trawl	Autumn	357	357	Munroe
1986	Delaware II	Gear Comp.	Autumn	23	23	Munroe
1986	Gloria Michelle	Inshore BT	Spring	107	107	Munroe
1986	Gloria Michelle	Inshore BT	Autumn	40	40	Munroe
1987	Alb/Del	Bottom Trawl	Spring	566	559	Munroe
1987	Alb/Del	Bottom Trawl	Autumn	608	545	Munroe
1987	Gloria Michelle	Inshore BT	Spring	111	111	Munroe
1987	Gloria Michelle	Inshore BT	Autumn	150	133	Munroe
1988	Albatross IV	Bottom Trawl	Spring	832	805	Munroe
1988	Alb/Del	Bottom Trawl	Autumn	594	583	Munroe
1988	Gloria Michelle	Inshore BT	Spring	127	124	Munroe
1988	Gloria Michelle	Inshore BT	Autumn	70	70	Munroe
1989	Delaware II	Bottom Trawl	Spring	639	623	Munroe
1989	Delaware II	Bottom Trawl	Autumn	555	549	Munroe
1989	Gloria Michelle	Inshore BT	Spring	254	253	Munroe
1989	Gloria Michelle	Inshore BT	Autumn	15	15	Munroe
1990	Delaware II	Gear Comp.	Autumn	500	0	-
1990	Delaware II	Bottom Trawl	Spring	715	681	Munroe
1990	Delaware II	Bottom Trawl	Autumn	713	712	Munroe
1990	Gloria Michelle	Inshore BT	Spring	163	149	Munroe
1990	Gloria Michelle	Inshore BT	Autumn	47	47	Munroe
1991	Gloria Michelle	Inshore BT	Spring	286	286	Munroe
1991	Delaware II	Bottom Trawl	Spring	695	690	Munroe
1991	Delaware II	Bottom Trawl	Summer	183	0	-
1991	Delaware II	Bottom Trawl	Autumn	267	267	Munroe

*Where numbers aged is 0, ages were not put on a computerized data base.

Table 2. Summary of age sample collections for Atlantic cod off the northeast coast of the USA from the domestic commercial fishery.

	Jan-Mar		Apr-Jun		Jul-Sep		Oct-Dec		Annual Total		Age Reader
	Col	Aged*	Col	Aged*	Col	Aged*	Col	Aged*	Col	Aged*	
1961	147	0	0	0	0	0	0	0	147	0	-
1962	190	0	180	0	374	0	315	0	1059	0	-
1963	183	0	360	0	317	0	175	0	1035	0	-
1964	170	0	0	0	157	0	236	0	563	0	-
1965	170	0	152	0	286	0	141	0	749	0	-
1966	30	0	0	0	0	0	0	0	30	0	-
1970	20	0	0	0	0	0	0	0	20	0	-
1971	0	0	14	0	29	0	0	0	43	0	-
1972	0	0	0	0	0	0	20	0	20	0	-
1973	40	0	100	0	142	0	227	0	509	0	-
1974	20	0	127	0	85	0	34	0	266	0	-
1975	41	0	51	0	20	0	20	0	132	0	-
1976	0	0	60	0	0	0	10	0	70	0	-
1977	151	150	746	748	1125	1059	1088	761	3110	2718	Penttila
1978	756	497	722	570	533	543	276	271	2287	1881	Penttila
1979	240	215	533	522	574	537	515	514	1862	1788	Penttila
1980	421	392	474	474	267	266	65	64	1227	1196	Penttila
1981	236	235	449	449	555	555	260	258	1500	1497	Gifford
1982	447	437	976	971	1451	1436	660	654	3534	3498	Gifford
1983	624	569	1503	1490	1583	1526	775	750	4485	4335	Gifford
1984	1086	1083	1035	1023	745	732	866	846	3732	3684	Munroe
1985	1003	1001	1018	1008	1123	1117	746	740	3890	3866	Munroe
1986	829	751	908	903	1065	1062	823	790	3625	3506	Munroe
1987	684	683	724	704	641	611	708	707	2757	2705	Munroe
1988	661	643	618	586	606	575	510	485	2395	2289	Munroe
1989	489	469	607	525	562	550	480	469	2138	2013	Munroe
1990	621	592	846	517	645	622	384	375	2496	2106	Munroe
1991	591	562	1070	1034	789	778	521	502	2971	2876	Munroe

*Where numbers aged is 0, ages were not put on a coputerized data base.

Table 3. Summary of NEFSC research vessel age sample collections off the northeast coast of the USA for haddock.

	Vessel	Gear/Survey Type	Season	Col.	Aged*	Age Reader
1935	Atlantis	-	-	1010	0	-
1935	Atlantis	-	-	311	0	-
1935	Atlantis	-	-	18	0	-
1936	Atlantis	-	-	3386	0	-
1948	Albatross III	-	-	693	0	-
1948	Albatross III	Bottom Trawl	Summer	357	0	-
1948	Albatross III	Bottom Trawl	Summer	63	0	-
1948	Albatross III	Bottom Trawl	Summer	73	0	-
1948	Albatross III	Bottom Trawl	Autumn	407	0	-
1948	Albatross III	Bottom Trawl	Autumn	75	0	-
1948	Albatross III	Bottom Trawl	Autumn	46	0	-
1949	Albatross III	Tagging	Summer	1306	0	-
1949	Albatross III	Bottom Trawl	Summer	795	0	-
1950	Albatross III	Bottom Trawl	Spring	3032	0	-
1950	Albatross III	Bottom Trawl	Spring	642	0	-
1950	Albatross III	Bottom Trawl	Spring	82	0	-
1950	Albatross III	Bottom Trawl	Summer	2189	0	-
1950	Albatross III	Tagging	Autumn	134	0	-
1951	Delaware	Bottom Trawl	Summer	455	0	-
1951	Delaware	Bottom Trawl	Summer	229	0	-
1955	Albatross III	Bottom Trawl	Summer	727	0	-
1955	Albatross III	Bottom Trawl	Summer	49	0	-
1955	Delaware	Bottom Trawl	Autumn	60	0	-
1955	Delaware	Bottom Trawl	Autumn	62	0	-
1955	Delaware	Bottom Trawl	Autumn	414	0	-
1955	Delaware	Bottom Trawl	Summer	104	0	-
1955	Albatross III	Bottom Trawl	Winter	62	0	-
1958	Delaware	Bottom Trawl	Autumn	1063	0	-
1960	Albatross III	Bottom Trawl	Autumn	506	0	-
1960	Delaware	Bottom Trawl	Summer	442	0	-
1960	Delaware	Bottom Trawl	Autumn	75	0	-
1961	Delaware	Bottom Trawl	Summer	378	0	-
1961	Delaware	Bottom Trawl	Autumn	23	0	-
1961	Delaware	Bottom Trawl	Autumn	74	0	-
1962	Delaware	Bottom Trawl	Spring	455	0	-
1962	Delaware	Bottom Trawl	Autumn	915	0	-
1962	Delaware	Bottom Trawl	Autumn	126	0	-
1963	Albatross IV	Bottom Trawl	Summer	1451	1186	Nichy
1963	Albatross IV	Bottom Trawl	Autumn	1819	1333	Nichy
1964	Albatross IV	Bottom Trawl	Winter	1336	814	Nichy
1964	Albatross IV	Bottom Trawl	Spring	380	0	-
1964	Albatross IV	Tagging	Spring	411	0	-
1964	Albatross IV	Bottom Trawl	Summer	1500	803	Nichy
1964	Albatross IV	Bottom Trawl	Autumn	921	896	Nichy
1965	Albatross IV	Bottom Trawl	Winter	867	867	Nichy
1965	Albatross IV	Bottom Trawl	Summer	822	757	Nichy
1965	Albatross IV	Bottom Trawl	Autumn	1027	1027	Nichy
1966	Albatross IV	Bottom Trawl	Winter	1948	1270	Nichy
1966	Albatross IV	Bottom Trawl	Autumn	1078	1048	Nichy
1967	Albatross IV	Bottom Trawl	Autumn	1011	1003	Nichy
1968	Albatross IV	Bottom Trawl	Spring	123	0	-
1968	Albatross IV	Bottom Trawl	Spring	1074	795	Nichy
1968	Albatross IV	Bottom Trawl	Autumn	956	932	Nichy
1969	Albatross IV	Bottom Trawl	Spring	690	620	Nichy
1969	Albatross IV	Bottom Trawl	Summer	671	655	Nichy
1969	Albatross IV	Bottom Trawl	Autumn	599	574	Nichy
1970	Albatross IV	Bottom Trawl	Spring	1009	705	Stimpson
1970	Albatross IV	Bottom Trawl	Autumn	928	910	Stimpson
1971	Albatross IV	Bottom Trawl	Spring	1540	1456	Stimpson

Table 3. continued.

	Vessel	Gear/Survey Type	Season	Col.	Aged*	Age Reader
1971	Albatross IV	Bottom Trawl	Autumn	780	780	Stimpson
1972	Albatross IV	Bottom Trawl	Spring	929	712	Gifford
1972	Albatross IV	Bottom Trawl	Autumn	1004	1004	Gifford
1972	Albatross IV	Bottom Trawl	Summer	493	0	-
1973	Albatross IV	Bottom Trawl	Spring	1186	1103	Gifford
1973	Albatross IV	Bottom Trawl	Autumn	1065	1039	Gifford
1974	Albatross IV	Bottom Trawl	Spring	8	0	-
1974	Albatross IV	Bottom Trawl	Spring	851	822	Gifford
1974	Albatross IV	Bottom Trawl	Autumn	1031	812	Gifford
1975	Albatross IV	Bottom Trawl	Spring	677	662	Gifford
1975	Albatross IV	Bottom Trawl	Autumn	1130	1130	Gifford
1976	Albatross IV	Bottom Trawl	Spring	1229	1158	Gifford
1976	Albatross IV	Bottom Trawl	Autumn	701	683	Gifford
1977	Albatross IV	Bottom Trawl	Spring	830	813	Gifford
1977	Alb/Del	Bottom Trawl	Summer	503	503	Gifford
1977	Delaware II	Bottom Trawl	Autumn	1107	1107	Gifford
1978	Albatross IV	Bottom Trawl	Spring	1048	1048	Andrade
1978	Delaware II	Bottom Trawl	Autumn	2202	1863	Andrade
1978	Alb/Del	Bottom Trawl	Summer	325	224	Andrade
1978	Francis Elizabeth	Inshore BT	Spring	14	0	-
1979	Alb/Del	Bottom Trawl	Spring	1243	1198	Andrade
1979	Alb/Del	Bottom Trawl	Summer	458	357	Andrade
1979	Alb/Del	Bottom Trawl	Autumn	1443	1332	Andrade
1979	Francis Elizabeth	Inshore BT	Spring	12	0	-
1979	Francis Elizabeth	Inshore BT	Autumn	28	0	-
1980	Alb/Del	Bottom Trawl	Spring	763	722	Andrade
1980	Delaware II	Bottom Trawl	Autumn	875	775	Andrade
1980	Alb/Del	Bottom Trawl	Summer	823	380	Andrade
1980	Francis Elizabeth	Inshore BT	Spring	10	0	-
1981	Delaware II	Bottom Trawl	Winter	22	22	Andrade
1981	Delaware II	Bottom Trawl	Spring	837	837	Andrade
1981	Delaware II	Bottom Trawl	Summer	275	238	Andrade
1981	Alb/Del	Bottom Trawl	Autumn	1107	1094	Andrade
1981	Francis Elizabeth	Inshore BT	Spring	14	0	-
1982	Delaware II	Herring	Winter	64	64	Andrade
1982	Delaware II	Bottom Trawl	Spring	628	621	Andrade
1982	Albatross IV	Bottom Trawl	Autumn	625	558	Andrade
1983	Albatross IV	Bottom Trawl	Spring	671	590	Andrade
1983	Delaware II	Herring	Winter	66	65	Andrade
1983	Albatross IV	Bottom Trawl	Autumn	719	701	Andrade
1983	Gloria Michelle	Inshore BT	Spring	19	19	Andrade
1983	Gloria Michelle	Inshore BT	Autumn	18	0	-
1984	Albatross IV	Bottom Trawl	Spring	586	570	Andrade
1984	Albatross IV	Bottom Trawl	Autumn	635	603	Andrade
1984	Gloria Michelle	Inshore BT	Spring	16	0	-
1985	Albatross IV	Bottom Trawl	Spring	638	632	Munroe
1985	Albatross IV	Bottom Trawl	Autumn	718	574	Munroe
1985	Gloria Michelle	Inshore BT	Spring	9	9	Munroe
1986	Albatross IV	Bottom Trawl	Spring	583	561	Munroe
1986	Alb/Del	Bottom Trawl	Autumn	534	534	Munroe
1986	Delaware II	Gear Comp.	Autumn	1	1	Munroe
1987	Albatross IV	Bottom Trawl	Spring	190	154	Munroe
1987	Delaware II	Gear Comp.	Spring	4	4	Munroe
1987	Albatross IV	Bottom Trawl	Autumn	850	696	Munroe
1987	Delaware II	Gear Comp.	Autumn	15	15	Munroe
1987	Gloria Michelle	Inshore BT	Autumn	31	0	-
1988	Albatross IV	Bottom Trawl	Spring	236	214	Munroe
1988	Albatross IV	Bottom Trawl	Autumn	422	414	Munroe
1988	Delaware II	Gear Comp.	Autumn	52	0	-
1988	Gloria Michelle	Inshore BT	Spring	3	0	-

Table 3. continued.

	Vessel	Gear/Survey Type	Season	Col.	Aged*	Age Reader
1989	Delaware II	Bottom Trawl	Spring	295	0	-
1989	Delaware II	Bottom Trawl	Autumn	392	369	Munroe
1989	Gloria Michelle	Bottom Trawl	Spring	2	0	-
1990	Gloria Michelle	Inshore BT	Autumn	2	0	-
1990	Delaware II	Bottom Trawl	Spring	309	293	Munroe
1991	Delaware II	Bottom Trawl	Autumn	451	451	Munroe
1991	Delaware II	Gear Comp.	Spring	585	0	-
1991	Delaware II	Bottom Trawl	Spring	216	203	Munroe
1991	Delaware II	Bottom Trawl	Autumn	252	246	Munroe

*Where numbers aged is 0, ages were not put on a computerized data base.

Table 4. Summary of age sample collections for haddock off the northeast coast of the USA from the domestic commercial fishery.

	Jan-Mar		Apr-Jun		Jul-Sep		Oct-Dec		Annual Total		
	Col	Aged*	Col	Aged*	Col	Aged*	Col	Aged*	Col	Aged*	Age Reader
1931	820	0	825	0	820	0	825	0	3290	0	-
1932	76	0	0	0	0	0	0	0	76	0	-
1933	180	0	180	0	180	0	180	0	720	0	-
1934	1440	0	1244	0	488	0	632	0	3804	0	-
1935	1841	0	840	0	1179	0	332	0	4192	0	-
1936	1600	0	220	0	659	0	860	0	3339	0	-
1937	3160	0	780	0	1773	0	2018	0	7731	0	-
1938	304	0	1169	0	1412	0	947	0	3832	0	-
1939	358	0	1299	0	1370	0	841	0	3868	0	-
1940	669	0	593	0	800	0	280	0	2342	0	-
1941	1255	0	1143	0	600	0	570	0	3568	0	-
1942	941	0	429	0	519	0	449	0	2338	0	-
1943	880	0	899	0	399	0	719	0	2897	0	-
1944	440	0	538	0	0	0	844	0	1822	0	-
1945	604	0	517	0	340	0	380	0	1841	0	-
1946	1624	0	1963	0	640	0	940	0	5167	0	-
1947	1009	0	889	0	1215	0	1052	0	4165	0	-
1948	1594	0	1100	0	1617	0	1359	0	5670	0	-
1949	2659	0	3052	0	1496	0	1256	0	8463	0	-
1950	2567	0	3582	0	2151	0	820	0	9120	0	-
1951	1715	0	1929	0	2031	0	1315	0	6990	0	-
1952	2191	0	1762	0	1949	0	1283	0	7185	0	-
1953	1596	0	2186	0	1306	0	1500	0	6588	0	-
1954	652	0	1286	0	1033	0	806	0	3777	0	-
1955	891	0	1286	0	1377	0	1174	0	4728	0	-
1956	1643	0	2365	0	2294	0	2291	0	8593	0	-
1957	1688	0	2087	0	2217	0	1503	0	7495	0	-
1958	2230	0	1983	0	2322	0	1829	0	8364	0	-
1959	2378	0	3155	0	2291	0	1408	0	9232	0	-
1960	2100	0	3194	0	2950	0	1445	0	9689	0	-
1961	2425	0	3590	0	2740	0	1280	0	10035	0	-
1962	1620	0	1510	0	1500	0	1475	0	6105	0	-
1963	1645	0	1575	0	1480	0	1480	0	6180	0	-
1964	1501	0	1496	0	1572	0	1461	0	6030	0	-
1965	1005	0	1072	845	1570	1124	1250	1014	4897	2983	Nichy
1966	861	695	1045	1159	1315	885	972	882	4193	3621	Nichy
1967	1062	1062	1878	1878	1377	1377	1292	1292	5609	5609	Nichy
1968	2028	2028	1894	1894	1976	1976	710	470	6608	6368	Nichy
1969	770	705	690	128	1154	1154	716	716	3330	2703	Nichy
1970	446	446	587	397	530	502	176	176	1739	1521	Stimpson
1971	443	397	875	706	521	500	945	856	2784	2459	Stimpson
1972	350	346	593	593	220	214	250	250	1413	1403	Gifford
1973	405	385	505	350	345	332	292	286	1547	1353	Gifford
1974	338	338	329	323	238	238	308	308	1213	1207	Gifford
1975	781	773	626	626	179	158	21	21	1607	1578	Gifford
1976	384	384	330	327	121	76	75	75	910	862	Gifford
1977	545	545	789	745	1397	1397	1164	1091	3895	3778	Andrade
1978	1045	1007	1037	1037	824	791	326	326	3232	3161	Andrade
1979	687	687	524	487	771	731	717	717	2699	2622	Andrade
1980	659	651	736	719	608	608	333	303	2336	2281	Andrade
1981	183	171	616	597	513	513	478	475	1790	1756	Andrade
1982	461	446	580	572	1085	1062	462	459	2588	2539	Andrade
1983	551	476	1023	989	1061	1038	482	473	3117	2976	Andrade
1984	514	501	380	377	437	425	386	377	1717	1680	Andrade
1985	520	515	343	310	401	387	227	219	1491	1431	Munroe

Table 4. Continued.

	Jan-Mar		Apr-Jun		Jul-Sep		Oct-Dec		Annual Total		Age Reader
	Col	Aged*	Col	Aged*	Col	Aged*	Col	Aged*	Col	Aged*	
1986	278	242	306	299	452	433	268	234	1304	1208	Munroe
1987	241	206	291	258	562	488	521	373	1615	1325	Munroe
1988	481	412	434	369	271	252	346	306	1532	1339	Munroe
1989	470	412	314	238	252	236	201	162	1237	1048	Munroe
1990	370	339	380	323	173	163	240	216	1163	1041	Munroe
1991	138	116	245	199	189	184	194	180	766	679	Munroe

*Where numbers aged is 0, ages were not put on a computerized data base.

Table 5. Summary of Canadian research survey collections of 5Ze cod.

Year	Cruise	Month	Ages	Age Reader
1986	N059	Mar	398	Robicheau
1987	N077	Mar	319	Robicheau
1988	N097	Mar	453	Robicheau
1989	N116	Mar	500	Robicheau
1990	N133	Mar	1337	Robicheau
1990	N139	Jul	114	Robicheau
1991	N148	Mar	548	Robicheau

Table 6. Summary of Canadian commercial catch samples of 5Ze cod landings.

Year	Number of Samples	Number of Lengths	Number Aged	Age Reader
1968	3	1046	145	Robicheau
1969	3	903	147	Robicheau
1970	0	-	-	
1971	0	-	-	
1972	2	279	64	Robicheau
1973	1	269	51	Robicheau
1974	0	-	-	
1975	2	637	111	Robicheau
1976	2	461	99	Robicheau
1977	10	2944	378	Robicheau
1978	29	7684	1308	Robicheau
1979	13	3991	658	Robicheau
1980	10	2784	536	Robicheau
1981	17	4147	842	Robicheau
1982	17	4756	858	Robicheau
1983	15	3822	604	Robicheau
1984	7	1889	385	Robicheau
1985	18	7644	1062	Robicheau
1986	19	5745	888	Robicheau
1987	33	9477	1288	Robicheau
1988	40	14116	2362	Robicheau
1989	35	8726	1561	Robicheau
1990	39	9901	1672	Robicheau

Table 7. Summary of haddock aged from Georges Bank Canadian spring and summer stratified random surveys.

Year	Season	Cruise Number	Number Aged	Ager(s)
1986	Spring	N059	471	N. McFarlane
1987	Spring	N077	277	M. Strong
1988	Spring	N097	638	M. Strong
1989	Spring	N116	682	M. Strong
1989	Summer	N123	222	M. Strong
1990	Spring	N133	1052	M. Strong and L. Van Eeckhaute
1990	Summer	N139	93	L. Van Eeckhaute
1991	Spring	N148	1045	L. Van Eeckhaute

Table 8. Georges Bank Canadian commercial haddock age samples summary.

YEAR	GEAR	SAMPLES	NUMBER AGED	AGER	YEAR	GEAR	NUMBER SAMPLES	NUMBER AGED	AGER
1962	OTS	1	91	RT	1979	OTS	7	202	RT
1963	OTS	8	442	RT	1980	OTB	16	441	RT
1964	OTS	7	722	RT		OTS	9	243	RT
1965	OTS	9	525	RT	1981	LL	2	56	RT
1966	OTS	8	290	RT		OTB	14	406	RT
1967	OTS	5	193	RT		OTS	2	70	RT
1968	OTB	4	124	RT	1982	OTB	17	500	RT
	OTS	4	131	RT	1983	OTB	7	218	CN
1969	OTB	1	35	RT	1984	LL	3	84	NM
1970	OTB	2	69	RT	1985	LL	9	298	NM
	OTS	3	112	RT		OTB	17	500	NM
1972	LL	1	30	RT	1986	LL	3	107	NM
1973	OTS	3	110	RT		OTB	17	469	NM
1974	OTB	4	114	RT	1987	GN	1	24	MS
	OTS	1	29	RT		LL	6	187	MS
1975	OTB	4	130	RT		OTB	30	896	MS
	OTS	1	33	RT	1988	GN	1	26	MS
1976	OTB	7	247	RT		LL	7	239	MS
	OTS	1	39	RT		OTB	21	597	MS
1977	OTB	6	200	RT	1989	LL	13	418	MS
	OTS	4	115	RT		OTB	17	525	MS
1978	OTB	10	269	RT	1990	LL	8	258	LVE
	OTS	8	211	RT		OTB	26	714	LVE
1979	OTB	7	180	RT					

OTS = Otter trawl, side
OTB = Otter trawl, bottom
LL = Longline
GN = Gillnet

RT = R. Thurber
CN = C. Nelson
NM = N. McFarlane
MS = M. Strong
LVE = L. Van Eeckhaute

Table 9. Summary of ageing exchanges of Georges Bank cod between NEFSC, Woods Hole, Mass. and St. Andrews Biological Station, St. Andrews, New Brunswick.

Exchange Date	Participants	Material	Otoliths Examined	Agreement %
May 1986	R Robicheau	Canadian sample #103,Apr 85	78	71
	C Smith	Canadian sample #207,May 85	62	81
June 1990	R Robicheau N Munroe	USA Delaware 8906,fall 89	110	92
March 1991	R Robicheau N Munroe	Canadian Survey N133,Mar 90	102	89
Sept 1991	M-I Buzeta N Munroe	Canadian Commercial samples Jun/Jul 91	24	87

Table 10. Summary of ageing exchanges of Georges Bank haddock between NEFSC, Woods Hole, Mass. and St. Andrews Biological Station, St. Andrews, New Brunswick.

Year	Participants	Material	N
1986[1]	V. Gifford (NEFC) N. McFarlane (Can)	Can. commercial samples, June & Aug., otoliths. (850220, 850275, 850360),	107
	N. Munroe (NEFC)	AL85-08, acetate scale impressions	101
	N. McFarlane (Can)	AL85-08, otoliths, wax-mounted, sectioned	101
	N. Munroe (NEFC) N. McFarlane (Can)	N059, 1986 Can. May survey, hand-broken otoliths	100
1988[2]	N. Munroe	AL88-09, acetate scale impressions	281
	M. Strong	AL88-09, otoliths, sectioned in resin	281
1989[3]	N. Munroe (NEFC)	DE89-06, acetate scale impressions	123
	L. Van Eeckhaute (Can)	DE89-06, otoliths, sectioned in resin	123
1990[3]	N. Munroe (NEFC)	N139, acetate scale impressions	54
	L. Van Eeckhaute (Can)	N139, otoliths, sectioned in resin	54
1991[3]	N. Munroe (NEFC)	Can. comm. samples, Aug. 28/91, scales	108
	L. Van Eeckhaute (Can)	Can. comm. samples, Aug. 28/91, otoliths	108

[1]Waiwood et al. (1986).
[2]Strong (1989).
[3]Documented in this report.

Table 11. Canadian/USA ageing comparison of Georges Bank cod otoliths collected from the Canadian commercial fishery in 1991.

Nancy Munroe (USA ager)

	0	1	2	3	4	5	6	7	8	9	TOT
0											
1											
2			1								1
3				3							3
4					7						7
5						3					3
6						1	5				6
7							1	1		1	3
8											
9										1	1
TOT			1	3	7	4	6	1		2	24

M. Buzeta (Canadian ager)

Total = 24
Agreement = 21/24 = 87%
Overaged by Canadian reader vs. USA reader = 2/24 = 8%
Underaged by Canadian reader vs. USA reader = 1/24 = 4%

Table 12. Canadian convention for cod and haddock age assignment according to capture date and edge type. Example given is for a 7 annuli otolith.

Edge Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
WO	7	8	8	8	7	7	7	7	7	7	7	7
NO	7	7	7	7	7	7	7	7	7	7	7	7
WH	6	7	7	7	7	7	7	7	6	6	6	6
NH	6	7	7	7	7	7	7	6	6	6	6	6

WO = wide opaque　　WH = wide hyaline
NO = narrow opaque　　NH = narrow hyaline

Table 13. Canada/USA ageing comparison of Georges Bank haddock otoliths versus scales from samples collected during the US 1989 fall survey, 89-06.

Nancy Munroe (US ager, scales)

	0	1	2	3	4	5	6	7	OMIT	TOT
0	7									7
1		3								3
2			73						2	75
3										
4				6	26	2				34
5										
6							3			3
7										
8							1			1
OMIT										
TOT	7	3	73	6	26	2	4		2	123

L. Van Eeckhaute (Canadian ager, otoliths)

Total = 123
Scales omitted = 2
Otoliths omitted = 0
Total aged = 121
Agreement = 112/121 = 93%
Comments: Sample is dominated by 2 and 4 yearolds.
Three fish lengths > 65 cm.

Table 14. Canada/USA ageing comparison of haddock otoliths versus scales from samples collected during the Canadian 1990 July survey, N139, on Georges Bank.

Fish No.	Length	Otolith	Scale	Comments (on scales)
458	30	1	1	
459	32	1	1	
460	32	1	1	
461	45	3	3	weak 1
>462*	57	5	4	
>463*	64	5	4	
>464*	73	12	5 (4)	check 3, poor scales
>465*	72	12 ?poor	5	split 3,5, poor scales, edge
>466	80	7	5	weak 1
>467	72	12	5	all scales from wrong part of fish
>468	67	12	5	poor scales
>469	65	10	5 (6)	poor edges
470	46	3	3	poor scales
471	35	1	1	
472	33	1	1	
473	45	3	3	
474	48	3	3	weak 1
475	43	3	3	
476	32	1	1	check 1
477	33	1	1	
478	46	1	omit	poor quality, scales from wrong part of fish
479	33	1	1	most scales from wrong part of fish
480	32	1	1	
481	33	1	1	
482	32	1	1	
483	35	1	1	weak 1, scales from wrong part of fish
>485	57	5	4	split 4
>486	73	12	6	weak 1, check 4, poor edge, mixed scales
>488	67	5	4	
>489*	74	7 (8)	4	check 2
>490	59	5	4	
>491	63	7	4	split 4
>492	61	8 (7)	5	poor scales
>493	62	7	5	weak 1, poor scales
>494	66	7	5 (4)	weak 1, poor and mixed scales
495	69	7	omit	poor scales
497	45	3	3	
498	32	1	1	
502	45	3	3	check 2,3
503	44	3	3	
504	57	5	5	
>505	61	6	3	check 2, poor and mixed scales
506	49	3	3	
>507	55	5	4	mixed scales
508	41	3	omit	poor scales
509	43	3	3	poor scales
511	42	3	3	
512	48	3	3	
>513*	61	5	4	
>514	57	5	4	poor scales
515	53	3	3	
516	51	3	3	poor scales
517	52	5	omit	poor and mixed scales
518	52	7	omit	poor scales

General comments:

5 omits due to poor quality scales

Scales in general were in poor condition (dirty, regenerated and mixed)

* annotated on video tape

> disagreement between otolith and scale ages

Table 15. Canada/USA ageing comparison of haddock otoliths versus scales from samples collected during the Canadian 1990 July survey, N139, on Georges Bank.

Nancy Munroe (USA ager, scales)

	1	2	3	4	5	6	7	8	9	10	11	12	OMIT	TOT
1	13												1	14
2														0
3			14										1	15
4														0
5				8	1								1	10
6			1											1
7				2	3								2	7
8					1									1
9														0
10					1									1
11														
12					4	1								5
OMIT														
TOT	13	0	15	10	10	1							5	54

L. Van Eeckhaute (Canadian ager, otoliths)

Total = 54
Scales omitted = 5
Otoliths omitted = 0
Total aged = 49
Agreement = 28/49 = 57%
Comments: No agreement after age 5.
Agreement for age 5 is 1/9.

Table 16. Canada/USA ageing comparison of haddock otoliths versus scales from a commercial longline catch from Georges Basin on Aug. 28, 1991.

Fish No.	Length (cm)	Otolith	Scale	Comments on scales
1*	56	4	4	wk 1st yr check 2
> 2*	71	8	6	
> 3	62	8?	6	
4	56	4	4	
5*	65	6	6	close 3,4,5,6
> 6*	63	6	5	split 2,3 mixed scales
> 7	67	8	7	wk 1st split 4
8	55	4	4	wk 4 mixed scales
9	56	4	4	check 2
10	52	4	4	check 1, check 1 mixed scales
11	61	4	4	
12	57	4	4	check 2
>13	60	8	5	check 2,3,4 mixed scales
>14*	61	8	5	
15	54	4	4	
16	56	4	4	
17	57	4	4	
>18	62	6	5	split 3
>19	58	5	4	split 2
>20	68	8	6	check 1
21	52	4	4	checky 1
22	68	6	6	
23	53	4	4	weak 1st
24	58	6	6	
25	50	4	4	
>26	58	6	4	checky 2
>27	49	4	3	split 2
28	64	6	6	check 2
29	70	13	omit	mixed scales
>30	60	6 cry	5	split 5
31	58	4	4	check 1
32	49	4	4	
33	48	2	2	
>34	56	6	4	
35	59	6	6	
36	54	4	4	
37	51	4	4	check 2
38	52	4	4	
39	55	4	4	check 2
40	60	5	5	split 3
41	48	4	4	split 2,4
42	50	4	4	
43	53	4	4	
44	46	2	2	
45*	69	8	8	
46	58	4	4	
47	53	4	4	weak 1
48	53	4	4	weak 1
49	61	6	6	
50	60	4	4	
51	53	4	4	
52	59	4	4	
53	61	6	6	
54	53	4	4	
55	63	6	omit	mixed scales
56	56	4	4	
>57	55	6	4	
>58	52	6	5	check 2, split 2
59	64	4	4	mixed scales
>60	49	4	3	check 1

* annotated on video tape
> disagreement between otolith and scale ages

Table 17. Canada/USA ageing comparison of haddock otoliths versus scales from a commercial otter trawl catch from the Fundian Channel on Aug. 28, 1991.

Fish No.	Length (cm)	Otolith	Scale	Comments on scales
1	64	4	4	mixed scales
2	52	4	4	
3*	78	13	omit	poor scales
4	57	4	4	
5	53	4	4	
> 6	55	4	3	
7	48	4	4	check 2
8	59	4	4	mixed scales
9	61	4	4	mixed scales
10	62	8	8	poor scales
11	52	2 (3)	2	length in error?
12	54	4	4	
13	60	4	4	
14	63	6	6	weak 3
15	58	4	4	
16	64	8?	omit	mixed scales
17	50	4	4	mixed scales
>18	46	5	4	
19	53	4	4	checky 1, check 2, split 2
20	51	4	4	
21	59	4	4	
22	60	4	4	weak 1
23	62	8	omit (7,8)	mixed scales
>24	65	8	5	mixed scales
>25	62	6	5	split 3
26	73	13	omit	poor scales
27	56	4 C2	4	wide 2nd, close 3,4
>28	55	4	3	split 2
29	58	4	4	
30	54	4	4	
>31	61	8	7	mixed scales
>32	67	6	5	mixed scales
>33	57	6	5	split 2
34	56	4	4	
35	70	8	omit	poor scales
36	65	15	omit	mixed scales
>37	69	8 (9)	6	poor scales
>38	66	6	5	
39	51	4	4	
40	70	6	6	mixed scales
41	63	-	omit	mixed scales
42	66	-	5	mixed scales
43	79	-	omit	poor scales
44	74	-	omit	poor scales
45	49	-	4	
46	69	-	5	split 2
47	71	-	omit	poor scales
48	68	-	6	split 5

* annotated on video tape

> disagreement between otolith and scale ages

Table 18. Canada/USA ageing comparison of haddock otoliths versus scales from a commercial longline catch from Georges Basin (60 samples) and an otter trawl catch from the Fundian Channel (40 samples) on Aug. 28, 1991.

Nancy Munroe (USA ager, scales)

	1	2	3	4	5	6	7	8	OMIT	TOT
1										
2		3								3
3										
4			4	51						55
5				2	1					3
6				3	8	9			1	21
7										
8					3	4	3	1	3	14
9										
10										
11										
12										
13									3	3
14										
15									1	1
OMIT										
TOT		3	4	56	12	13	3	1	8	100

L. Van Eeckhaute (Canadian ager, otoliths)

Total = 100
Scales omitted = 8
Otoliths omitted = 0
Total aged = 92
Agreement = 65/92 = 71%
Comments: Ages 5 and older with very poor agreement (11/28 = 39%).
All scales older than age 8 omitted.

Table 19. Length frequencies (numbers) of haddock from the USA commercial fishery samples caught in unit areas 5Zj and 5Zm in 1988, 1989 and 1990.

Length (cm)	1990	1989	1988
36.5	554	0	0
38.5	2215	0	0
40.5	5538	0	0
42.5	10719	366	0
44.5	25694	2368	15911
46.5	32201	5694	58169
48.5	47295	12612	89441
50.5	62500	19124	67134
52.5	52023	29039	92661
54.5	53557	34521	118982
56.5	58667	37060	92584
58.5	53115	40570	110640
60.5	58338	38420	73645
62.5	27544	37097	58511
64.5	37020	26526	43337
66.5	32032	20718	36125
68.5	20377	17608	16285
70.5	18292	15014	15100
72.5	13137	9652	14453
74.5	13567	7195	10265
76.5	7535	4327	4347
78.5	3364	2389	3212
80.5	4920	1804	1335
82.5	1182	645	185
84.5	591	409	20
86.5	0	0	59
88.5	136	0	59

Appendix I.

Agenda

1. Protocol
    - historic review of age readers and species/stocks
    - preparation of ageing material
    - in-house verification/validation procedures
    - summary of available documentation
    - description and compatibility of video systems
    - availability and status of historic samples

2. Required materials
    - video system, microscopes, scale projector
    - examples of serial sections
    - previously exchanged otoliths/scales
    - new samples for examination
    - length at age summaries
    - annotated video images/photographs

3. Specific issues
    - preparation techniques
        - location of center and 'best' section
    - settling check for cod
        - description, frequency, conventions
    - shifting in cod otoliths
    - otolith/scale consistency for haddock
        - zone intensity, maximum age/size
    - edge classification
        - seasonality, conventions
    - code for summarizing reading (SC, 1, S2, C, 3, NO)
    - frequency and type of exchanges

4. Comparison readings for cod and haddock

5. Documentation and distribution of exchange results

6. Workshop report summarizing results, agreements, conclusions

    - draft material to be prepared prior to workshop by representative for each country

List of participants

Maria-Ines Buzeta	St. Andrews, N.B
Joseph Hunt	St. Andrews, N.B.
Nancy Munroe	Woods Hole, Mass.
Lou Van Eeckhaute	St. Andrews, N.B.

Appendix II.

Further post workshop studies

As recommended on page 12, section v.2.i, haddock otoliths and scales were collected during the USA fall survey and ages determined from both structures by USA age readers. Of the 96 samples aged 87 had the same age for scales and otolith. Ages ranged from 2-10 with 70% at ages 3 and 4. A significant finding by the USA readers was an apparent lag between annulus formation in otoliths and scales which could account for a one year discrepancy between structures.

Samples will be examined by Canadian readers as part of a continuing exchange program and/or workshops and results included in a subsequent report.