NOAA Technical Memorandum NMFS-NE-156

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Proceedings of the Summer Flounder Aging Workshop, 1-2 February 1999, Woods Hole, Massachusetts

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May 2000

NOTE ON SPECIES NAMES

The NMFS Northeast Region's policy on the use of species names in all technical communications is generally to follow the American Fisheries Society's lists of scientific and common names for fishes (*i.e.*, Robins *et al.* 1991[a]), mollusks (*i.e.*, Turgeon *et al.* 1998[b]), and decapod crustaceans (*i.e.*, Williams *et al.* 1989[c]), and to follow the Society for Marine Mammalogy's guidance on scientific and common names for marine mammals (*i.e.*, Rice 1998[d]). Exceptions to this policy occur when there are subsequent compelling revisions in the classifications of species, resulting in changes in the names of species (*e.g.*, Cooper and Chapleau 1998[e], McEachran and Dunn 1998[f]).

[a]*Robins, C.R. (chair); Bailey, R.M.; Bond, C.E.; Brooker, J.R.; Lachner, E.A.; Lea, R.N.; Scott, W.B. 1991. Common and scientific names of fishes from the United States and Canada. 5th ed.* Amer. Fish. Soc. Spec. Publ. *20; 183 p.*

[b]*Turgeon, D.D. (chair); Quinn, J.F., Jr.; Bogan, A.E.; Coan, E.V.; Hochberg, F.G.; Lyons, W.G.; Mikkelsen, P.M.; Neves, R.J.; Roper, C.F.E.; Rosenberg, G.; Roth, B.; Scheltema, A.; Thompson, F.G.; Vecchione, M.; Williams, J.D. 1998. Common and scientific names of aquatic invertebrates from the United States and Canada: mollusks. 2nd ed.* Amer. Fish. Soc. Spec. Publ. *26; 526 p.*

[c]*Williams, A.B. (chair); Abele, L.G.; Felder, D.L.; Hobbs, H.H., Jr.; Manning, R.B.; McLaughlin, P.A.; Pérez Farfante, I. 1989. Common and scientific names of aquatic invertebrates from the United States and Canada: decapod crustaceans.* Amer. Fish. Soc. Spec. Publ. *17; 77 p.*

[d]*Rice, D.W. 1998. Marine mammals of the world: systematics and distribution.* Soc. Mar. Mammal. Spec. Publ. *4; 231 p.*

[e]*Cooper, J.A.; Chapleau, F. 1998. Monophyly and interrelationships of the family Pleuronectidae (Pleuronectiformes), with a revised classification.* Fish. Bull. (U.S.) *96:686-726.*

[f]*McEachran, J.D.; Dunn, K.A. 1998. Phylogenetic analysis of skates, a morphologically conservative clade of elasmobranchs (Chondrichthyes: Rajidae).* Copeia *1998(2):271-290.*

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Acronyms

MDMF	=	Massachusetts Division of Marine Fisheries
NCDMF	=	North Carolina Division of Marine Fisheries
NEFSC	=	Northeast Fisheries Science Center
ODU	=	Old Dominion University

ABSTRACT

A workshop to review summer flounder aging techniques was conducted at the National Marine Fisheries Service's Northeast Fisheries Science Center (NEFSC) in Woods Hole, Massachusetts, on 1 and 2 February 1999. The workshop convened to address: 1) the poor results of comparative readings from a 1997 scale sample exchange between age readers at the NEFSC and North Carolina Division of Marine Fisheries (NCDMF); and 2) concerns over aging accuracy expressed in recent stock assessments and in a review of those assessments by the National Research Council.

The workshop identified three factors which contributed to the poor results of comparative readings. The majority of age determination disagreements were related to differing age-reading conventions used by each agency with regard to the marginal increment (*i.e.*, growth beyond the last annulus) on the scales. Correcting for this discrepancy in convention increased agreement rates from about 53% to over 80%. The origin of the convention problem appears to be differences in the timing of annulus formation between fish inhabiting the Cape Hatteras region (*i.e.*, during January-March) and fish in the Southern New England region (*i.e.*, during May-July).

The second source of disagreement between agencies was related to the choice of a first annulus in some, but not all, fish. The third source of disagreement occurred when NEFSC age readers determined a scale event to be a "check" as opposed to NCDMF age readers determining it to be an annulus.

Workshop participants concluded that future exchanges should occur on a regular basis to ensure uniformity of aging conventions and age interpretations. Additionally, it was agreed that analysis of samples and/or data for young-of-the-year summer flounder (possibly archived by state or university researchers) might resolve uncertainties regarding first-annulus location.

INTRODUCTION

Difficulties in aging summer flounder, *Paralichthys dentatus*, have been ongoing for many years. Aging disagreements for this species were noted in an October 1979 literature review by the Mid-Atlantic Fishery Management Council's State/Federal Summer Flounder Scientific and Statistical Committee, and were discussed in a May 1980 workshop convened by that committee in Woods Hole, Massachusetts (Smith *et al.* 1981), to resolve the noted discrepancies. Investigators from state, federal, and university laboratories participated in the 1980 workshop. Two conclusions reached at that 1980 workshop were: 1) mean length at age 1 was calculated to be 17-18 cm; and 2) great latitudinal variation was found with respect to edge type, length at age, and growth rate. Although six types of scale growth patterns were categorized, the 1980 workshop determined that the limited number of scales available for examination did not allow firm conclusions about growth pattern differences among areas.

In 1989, at the Ninth NEFC Stock Assessment Workshop, members of that workshop's Summer Flounder Working Group raised concerns again regarding differences in aging protocols between state and federal laboratories (Northeast Fisheries Center 1989). A workshop was convened in June 1990 (Almeida *et al.* 1992) to reach consensus regarding the interpretation of scale growth patterns. Several studies (Able *et al.* 1990; Szedlmayer *et al.* 1992) which had been conducted between the 1980 and 1990 workshops determined that summer flounder growth during the first year was much greater than previously thought and could explain some of the confusion in determining the first annulus. Participants at the 1990 workshop examined approximately 150-200 scale samples and agreed upon aging criteria. Noteworthy was the conclusion that annulus formation in the more northerly waters (*i.e.*, Southern New England and New Jersey) occurred in late spring - early summer, while further south it occurred as early as January or February. The 1990 workshop participants recommended that formal age structure exchanges be initiated to achieve consistency.

Accordingly, an exchange of scale impressions occurred in June 1997 between the National Marine Fisheries Service's Northeast Fisheries Science Center (NEFSC) and the North Carolina Division of Marine Fisheries (NCDMF), the only two agencies actively performing production aging of summer flounder at that time. The exchange consisted of two parts: 1) a sample of 50 fish exhibiting temporal and spatial variation which had been selected from NEFSC and Massachusetts Division of Marine Fisheries (MDMF) bottom trawl surveys and from the commercial fishery throughout the Northeast; and 2) a 120-fish sample from the winter commercial fishery in the North Carolina - Virginia region.

Comparative reading results from the exchange indicated a poor level of agreement (*i.e.*, approximately 53%; Tables 1 and 2) between the agencies. Concern regarding the implications of potential aging problems on future stock assessments was raised during a review of the most recent summer flounder assessment at a National Research Council committee meeting on improving the collection and use of fisheries data, held on 25 and 26 January 1999 in Washington, D.C. To determine the cause of, and to resolve, these aging disagreements, age readers from the NEFSC and NCDMF conducted a workshop during 1-2 February 1999 in Woods Hole, Massachusetts. Also present at the 1999 workshop were representatives of Old Dominion University's (ODU's) Fish Age & Growth Laboratory, which had recently been contracted to perform production aging of summer flounder from the Chesapeake Bay region (Table 3).

The objectives of the 1999 workshop were to: 1) identify factors resulting in age determination discrepancies between the NEFSC and NCDMF; 2) resolve, to the extent possible, disagreements in the exchange samples; and 3) initiate a course of action to ensure consistency in aging methods and future age interpretations. This report summarizes the activities and results of the 1999 workshop, and offers recommendations for further consideration.

METHODS

PRECISION

In preparation for the 1999 workshop, NEFSC age readers conducted a blind reading (*i.e.*, sex and length of fish unknown, but date of collection known) of the 120-fish NCDMF samples constituting the 1997 exchange materials to determine levels of precision with respect to the original age determinations. The NCDMF age readers conducted a blind reading of the 50-fish NEFSC sample during the course of the workshop.

AGE DETERMINATIONS

Aging criteria described by Dery (1988) and accepted by the 1990 Summer Flounder Aging Workshop participants (Almeida *et al.* 1992) were reviewed in detail during the 1999 workshop. Annuli generally consist of "cutting-over" marks which must be continuous through the scale's lateral field and into the ctenii (Figure 1). The age of a fish is determined first by counting the number of annuli present and then by considering the amount of growth beyond the last annulus (*i.e.*, "edge" or " + " growth) at the time of sample collection. Age is then determined relative to the convention of the 1 January birthdate used for assessment purposes. For example, a fish which has formed three annuli and has additional growth beyond the third annulus would be considered age 3+ if collected on 31 December, but age 4 on 1 January.

During the 1999 workshop, summer flounder scale impressions (see Penttila *et al.* 1988 for details regarding preparation of scale impressions) were viewed using a Leitz TP 300 Contour Microprojector at a magnification of 50X and occasionally 20X. It was noted that the NCDMF normally views and measures images of summer flounder scale impressions at a magnification of 24X.

Workshop participants agreed to view in its entirety the 50-fish NEFSC exchange sample as the basis for the workshop (hereafter referred to as the "workshop sample"), and as much of the 120-fish NCDMF exchange sample as time allowed.

For each fish, five or six scale impressions were viewed silently by participants until they indicated that an age determination had been made. These age determinations were then compared to those provided by the NEFSC and NCDMF during the exchange exercise, and any discrepancies were discussed until either a consensus age was obtained or an impasse was reached. Additional time was budgeted during the workshop to: 1) view summer flounder otoliths for consideration as an alternative aging structure; 2) view other scale sample images as necessary to illustrate specific points; and 3) to generate annotated images illustrating workshop examples and results using an OPTIMAS Image Analysis System at magnifications of 12.5X and 20X.

RESULTS

PRECISION

A re-reading of the workshop sample by NEFSC age readers resulted in a precision of 92% when compared with their original reading. After further review of this sample, age determinations by the NEFSC age readers were adjusted upward by 1 yr for three fish. One other fish was adjusted downward 1 yr; however, this fish was subsequently discarded from further analysis at the workshop when consensus with NCDMF age readers could not be reached.

Precision of NCDMF age readers was 96% (Table 4). Age determinations by the NCDMF age readers were adjusted downward for two fish.

AGE DETERMINATIONS

Results for the 50-fish workshop sample are listed in Tables 4 and 5, with workshop resolution of disagreements or the specific reason for unresolved disagreements noted in the "Workshop Resolution" column of Table 4.

Scale impression quality was similar in each exchange sample and was not a factor for any disagreements in age determinations. Three factors were identified, though, which contributed to age determination disagreements. The factor which occurred most frequently and had the greatest impact on exchange results was a difference in conventions used by each agency with respect to the marginal increment (*i.e.*, growth beyond the last annulus). NEFSC age readers assume that annulus formation occurs during May-July (Dery 1988); therefore, scale samples collected on winter and spring surveys or during the first and second quarters of the calendar year should have a wide marginal increment prior to annulus formation. The algorithm invoked by the NEFSC for this portion of the year – prior to 1 July – is to count the number of annuli present and also to count the edge. Thus, a fish whose scale contains three annuli would be assigned age 4 during 1 January - 30 June. However, since annuli form in January-March for fish in the North Carolina - Virginia region, NCDMF age readers assign an age based on the number of annuli present, assuming that the last-formed annulus occurred after 1 January of the collection year.

How this observed difference in annulus formation results in age determination "disagreements" is best illustrated through the use of some 1999 workshop samples. Figure 1 shows a scale image from a 34-cm male summer flounder captured in May 1995 during the MDMF spring inshore bottom trawl survey (Table 4, ID 6). Each agency agreed that one annulus was present; however, NEFSC age readers assigned an age of 2 yr based on the width of the marginal increment and the expectation that a second annulus would be forming in the next month or so. NCDMF age readers, who typically age fish which have formed annuli during January-March, interpreted the increment to be current-year growth, and assigned an age of 1 yr. The consensus of workshop participants was that the width of the marginal increment represented nearly 1 yr of growth beyond an annulus formed during the previous May-July, rather than 3-4 mo of growth beyond an annulus formed during January, and thus the scale edge should be counted, resulting in an age of 2 yr. Correcting for this difference in convention accounted for 40% of the age determination disagreements in the original 50-fish NEFSC exchange sample (Table 4).

As the workshop progressed to the 120-fish NCDMF exchange sample, the observed difference in annulus formation discussed in the preceding paragraph was identified as resulting in an opposite type of increment interpretation discrepancy. Figure 2 shows a scale image from a 33-cm fish collected on 4 March 1997 from the Cigar Shoal region off the North Carolina - Virginia border by the winter commercial fishery (Table 2, ID 7). Age readers from the NEFSC assigned an age of 2 yr, and NCDMF 1 yr, for the same reasons stated earlier. However, in this instance, the width of the marginal increment is relatively small, supporting a January annulus formation, and the consensus of the workshop was that growth beyond the annulus represented current year growth and should not be used to increment the age as done by the NEFSC. Although time constraints did not allow the workshop to view the entire NCDMF exchange sample, it is likely that 26 of 51 age determination disagreements (51%; Table 2) resulted from the NEFSC practice of counting the edge during this period of the calendar year.

Given the importance of assumptions about the timing of annulus formation to the 1999 workshop results, participants reviewed samples to verify the observed variability in this phenomenon. A 6-mo range for annulus formation was documented. A 25-fish sample commercially caught in NEFSC Statistical Area 521 (Figure 3) and obtained in Chatham, Massachusetts, on 6 July 1997 (NEFSC commercial fishery weighout document #275249) contained numerous scales on which an annulus had just formed, or was forming, on the scale edge. Similarly, annulus formation just inside scale edges was observed in a 25-fish sample commercially caught in NEFSC Statistical Area 635 and obtained in Virginia on 7 January 1997 (weighout document #600007).

A second source of disagreement between agencies occurred in the choice of a first annulus in some, but not all, fish. In seven instances (14%), NCDMF age readers increased the total age by 1 yr by selecting a first annulus considered by NEFSC age readers to be too small to be a true annulus, and to be a "check" (*i.e.*, temporary halt in growth) marking an early life history event. For example, Figure 4 shows the scale image of a 32-cm male summer flounder captured in March 1996 during the NEFSC spring bottom trawl survey (Table 4, ID 17), in which the NCDMF observed two annuli, but which the NEFSC aged as 1 yr. Figure 5 shows the scale image of a 50-cm fish captured in June 1995 by the Southern New England commercial fishery (Table 4, ID 38), in which, again, the NCDMF observed two annuli, but which the NEFSC aged as 1 yr. In other cases, each agency selected different scale events as the first annulus, which did not alter agreement on a total age, but would bias length-at-age estimates determined from back-calculation analyses.

The third source of age determination disagreements occurred when the two agencies differed as to whether certain scale events constituted an annulus or a check. The NCDMF tended to count such marks if they continued into the lateral scale field, whereas the NEFSC rejected these marks if they were weaker in the lateral field than adjacent marks, or, if their spacing from preceding annuli was not within normal expectations.

CONCLUSIONS AND RECOMMENDATIONS

Workshop participants concluded that, in general and relative to other species, summer flounder is difficult to age, due in part to its extensive range and migratory habits. Annuli in scales are often weak or ambiguous. Review of whole and sectioned otoliths prepared by ODU suggested that otoliths may be useful in some instances, particularly for older fish. However, due to the unavailability of commercial samples because of dealers' preference that fish not be cut, otoliths have not been routinely used. Despite these difficulties, workshop participants agreed that summer flounder **can** be reliably aged using scales, given adequate precautions discussed in succeeding paragraphs.

Workshop participants concluded that the majority of aging disagreements in the two exchange samples arose from the interpretation of marginal scale increments relative to the highly variable timing of annulus formation observed for summer flounder throughout its range. The protracted period of annulus formation, 6 mo or more, is atypical of most species. Additionally, it appears that the biological mechanism for annulus formation in different groups of fish may differ as well; the formation of annuli coincides with the late spring inshore migration of fish in the northern portion of the species' range, but, for fish forming annuli in January-March, the event appears to occur when the fish are offshore. If the phenomenon occurred along a latitudinal gradient, then decisions about growth beyond the last annulus could be simplified to some extent, but the observation from NCDMF tagging studies that fish from different geographical regions are mixing offshore during winter months confounds any simple approach to setting up aging conventions. This confounding poses less of a problem for the NCDMF, for which production aging is based primarily on samples obtained from the winter fishery in that region. However, the NEFSC must exert extreme care in evaluating marginal increment width in each individual sample, given the spatial and temporal nature of the samples they receive from research vessel surveys and the commercial fishery.

The workshop also concluded that more attention must be given to consideration of first-year growth and the location of the first annulus. The NCDMF consistently applies criteria of "cutting-over" and intersection with the ctenii in selecting the first annulus. In order to help locate the first annulus, NEFSC age readers rely more on a pattern of checks thought to mark early life history events. Workshop participants agreed that analyses of material from juvenile fish, possibly archived by state and university researchers, might assist age readers in interpreting first-year growth patterns and first annulus selection.

The following recommendations were made at the conclusion of the workshop:

1. Sample exchanges should continue on a regular basis between the NEFSC and the NCDMF, beginning with samples from North Carolina's 1998 winter fishery and the NEFSC's 1998 winter, spring, and autumn bottom trawl surveys. It was suggested that age readers from ODU also participate in the exchanges to ensure uniformity of aging methods for the species.

2. Appropriate representatives from the NEFSC, NCDMF, and ODU should inquire as to the availability of samples and/or data for young-of-the-year summer flounder in order to conduct analyses of first-year growth.

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Table 1. Number of fish assigned by the NEFSC and NCDMF to various age classes based on original age determinations by each agency of the 50-fish sample of summer flounder scales collected during NEFSC and MDMF bottom trawl surveys in 1997. (Number of assignments in agreement are in bold underlined numerals.)

NCDMF Age Determinations	**NEFSC Age Determinations**					
	0	**1**	**2**	**3**	**4**	**5**
0	**1**	1				
1	1	**11**	5			
2		2	**8**	2		
3			6	**4**		
4				3	**1**	
5				1	2	**1**

Number of fish: 50
Number aged by readers from both agencies: 49
Number of agreements: 26 (53%)

Table 2. Details of the 120-fish NCDMF summer flounder scale sample exchange with the NEFSC, including fish size and original and adjusted (in parentheses) age determinations. All fish were collected on 4 March 1997 from Cigar Shoal off North Carolina.

ID	Total Length (cm)	Age Determinations[a] NCDMF	Age Determinations[a] NEFSC	ID	Total Length (cm)	Age Determinations[a] NCDMF	Age Determinations[a] NEFSC	ID	Total Length (cm)	Age Determinations[a] NCDMF	Age Determinations[a] NEFSC
1	33	2	2	42	37	2	2	83	51	4	3
2	33	1	2[b]	43	38	2	2	84	49	5	4
3	34	2	1	44	37	3	2(3)	85	45	4	4
4	33	2	1	45	36	NA	2	86	51	4	4
5	35	1	1	46	36	1	2[b]	87	47	NA	4
6	36	2	2	47	37	1	2[b]	88	51	4	4
7	33	1	2[b]	48	35	2	3[b]	89	49	NA	3
8	33	2	2	49	35	2	2	90	47	4	4
9	35	2	2	50	41	2	2	91	47	4	4
10	35	2	2	51	34	2	2	92	54	4	4
11	34	2	2	52	41	2	3[b]	93	52	5	3
12	33	NA	2	53	38	1	NA	94	55	3	3
13	34	1	2[b]	54	34	2	2	95	44	3	3
14	33	1	2[b]	55	36	1	2[b]	96	54	4	4
15	35	1	1	56	38	2	2	97	49	4	3
16	36	1	1	57	38	2	3[b]	98	50	5	NA
17	32	2	2	58	40	1	2[b]	99	49	4	3
18	34	2	2	59	37	2	3[b]	100	57	4	4
19	36	1	2[b]	60	39	NA	NA	101	58	5	4
20	33	1	2[b]	61	43	2	3[b]	102	60	5	4
21	34	2	2	62	48	2	3[b]	103	62	5	5
22	36	NA	2	63	46	2	3[b]	104	61	5	5
23	34	2	2	64	49	4	4	105	59	4	4
24	33	1	2[b]	65	47	NA	3	106	58	5	5
25	35	1	2[b]	66	51	4	3(4)	107	60	4	4
26	36	2	2	67	55	4	4	108	57	5	5
27	33	1	1	68	53	5	4	109	54	4	4
28	36	2	2	69	48	4	3	110	55	5	4
29	33	2	2	70	54	6	4	111	56	5	4
30	33	2	2	71	52	4	3	112	56	5	NA
31	35	1	2[b]	72	49	4	4	113	60	5	5
32	36	1	2[b]	73	49	4	3	114	54	6	NA
33	36	2	2	74	51	3	3	115	56	5	5
34	36	2	2	75	47	3	3	116	54	3	4[b]
35	37	2	2	76	48	4	4	117	57	3	4[b]
36	38	1	2[b]	77	54	4	3	118	58	6	5
37	38	2	2	78	45	5	4	119	60	NA	NA
38	37	1	2[b]	79	47	5	3	120	64	6	7(6)
39	38	1	2[b]	80	50	5	4				
40	41	2	2	81	50	4	3				
41	37	2	2	82	54	4	4				

[a]NA = not aged.
[b]Disagreements which were related to NEFSC practice of counting scale edge.

Table 3. List of participants at the Summer Flounder Aging Workshop, held 1-2 February 1999 in Woods Hole, Massachusetts

Name	**Affiliation**
Randy Gregory	North Carolina Division of Marine Fisheries
Rick Monaghan	North Carolina Division of Marine Fisheries
Steve Bobko	Old Dominion University
Steve Wischniowski	Old Dominion University
Frank Almeida	Northeast Fisheries Science Center - Woods Hole Laboratory
George Bolz	Northeast Fisheries Science Center - Woods Hole Laboratory
Jay Burnett	Northeast Fisheries Science Center - Woods Hole Laboratory
Blanche Jackson	Northeast Fisheries Science Center - Woods Hole Laboratory
Kathy Lang	Northeast Fisheries Science Center - Woods Hole Laboratory
Nina Shepherd	Northeast Fisheries Science Center - Woods Hole Laboratory
Mark Terceiro	Northeast Fisheries Science Center - Woods Hole Laboratory

Table 4. Details of the 50-fish NEFSC summer flounder scale sample exchange with the NCDMF, including fish size, month of capture, source of specimens, geographic area of collection, original and adjusted (in parentheses) age determinations, and workshop resolution of, and/or reason for, disagreement between agencies.

ID	Total Length (cm)	Month	Source[a]	Area[b]	Age Determination[c] NEFSC	NCDMF	Workshop Resolution[d]
1	24	Sep	Survey	VA	0	0	
2	32	Sep	Survey	VA	1	1	
3	40	Sep	Survey	DEL	1(2)	2	
4	59	Sep	Survey	SNE	3	3	
5	49	Sep	Survey	NYB	2	2	
6	34	May	MDMF	SNE	2	1	2; count edge
7	45	May	MDMF	SNE	2	1	2; count edge
8	30	May	MDMF	SNE	1	1,0	1; count edge
9	53	May	MDMF	SNE	3(4)	4	
10	56	May	MDMF	SNE	3	2	3; count edge
11	45	Feb	Survey	GB	3	3	
12	37	Feb	Survey	GB	2	2	
13	58	Feb	Survey	GB	4	4	
14	28	Feb	Survey	HAT	1	1	
15	36	Feb	Survey	HAT	2	1	2; count edge
16	40	Mar	Survey	DEL	2	2	
17	32	Mar	Survey	DEL	1	2	Disagree-A
18	49	Mar	Survey	SNE	3	2,3	3; count edge
19	19	Mar	Survey	VA	1	0	1; count edge
20	37	Mar	Survey	HUD	2	2	
21	30	Feb	Survey	DEL	1	1	
22	36	Feb	Survey	DEL	3(2)	2	Omitted
23	48	Feb	Survey	VA	3	3	
24	41	Feb	Survey	SNE	2	3	3; A
25	54	Feb	Survey	GB	2	2	
26	36	Jan	Fishery	HUD	2	2	
27	44	Jan	Fishery	HUD	2	3	Disagree-A
28	56	Jan	Fishery	DEL	3	4	Disagree-B
29	51	Jan	Fishery	DEL	3	4	Disagree-A
30	64	Feb	Fishery	VA	4	5(4)	
31	41	Feb	Fishery	VA	2	3	Disagree-A
32	53	Feb	Fishery	VA	3	5	Disagree-B
33	32	Feb	Fishery	VA	1	1	
34	33	May	Fishery	NJ	1	1	
35	36	May	Fishery	NJ	2	1	2; count edge
36	43	May	Fishery	NJ	2	2	
37	56	Jun	Fishery	SNE	3	3	
38	50	Jun	Fishery	SNE	2	3	Disagree-A
39	38	Jun	Fishery	SNE	2	1	2; count edge
40	32	Aug	Fishery	DEL	0	1	1; A
41	33	Aug	Fishery	DEL	1	1	

Table 4. (Cont.)

ID	Total Length (cm)	Month	Source[a]	Area[b]	Age Determination[c] NEFSC	NCDMF	Workshop Resolution[d]
42	28	Jul	Fishery	DEL	0	NA[e]	
43	40	Sep	Fishery	DEL	1	1	
44	34	Sep	Fishery	DEL	1	1	
45	42	Oct	Fishery	VA	1	1	
46	33	Oct	Fishery	VA	1	1	
47	54	Oct	Fishery	VA	2(3)	3	
48	74	Sep	Fishery	DEL	5	5	
49	68	Sep	Fishery	DEL	4	5(4)	
50	52	Dec	Fishery	DEL	2	2	

[a]Survey = NEFSC winter, spring, or autumn bottom trawl survey; MDMF = MDMF inshore bottom trawl survey; and Fishery = U.S. commercial landings.
[b]GB = Georges Bank; SNE = Southern New England; HUD = Hudson Canyon; NYB = New York Bight; NJ = New Jersey; DEL = Delaware Bay; VA = Virginia; and HAT = Cape Hatteras.
[c]Adjusted ages were obtained during the exercise to determine precision levels. Two ages listed for the NCDMF indicate differences between age readers.
[d]Disagreement reasons: A = choice of first annulus; B = choice of a scale event as a check as opposed to an annulus.
[e]Not aged.

Table 5. Number of fish assigned by the NEFSC and NCDMF to various age classes based on the 1999 workshop re-aging by each agency of the 50-fish sample of summer flounder scales. (Number of assignments in agreement are in bold underlined numerals.)

NCDMF Age Determinations	**NEFSC Age Determinations**					
	0	**1**	**2**	**3**	**4**	**5**
0	**<u>1</u>**					
1		**<u>13</u>**				
2		1	**<u>14</u>**			
3			3	**<u>8</u>**		
4				3	**<u>3</u>**	
5				1	2	**<u>1</u>**

Number of fish: 50
Number aged by readers from both agencies: 48
Number of agreements: 40 (83%)
Number of disagreements: 8 (17%)

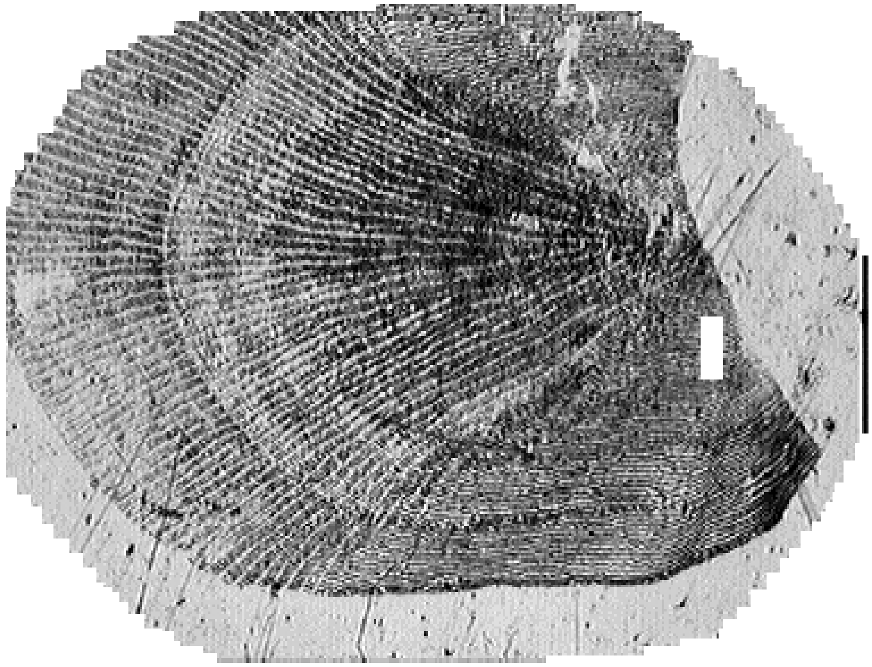

Figure 1. Scale image (magnification 20X) from a 34-cm male summer flounder captured in May 1995 during the MDMF spring inshore bottom trawl survey, which was aged by the NEFSC as age 2 and by the NCDMF as age 1 in the original 50-fish NEFSC exchange sample. The first annulus is indicated. Workshop participants agreed on age 2.

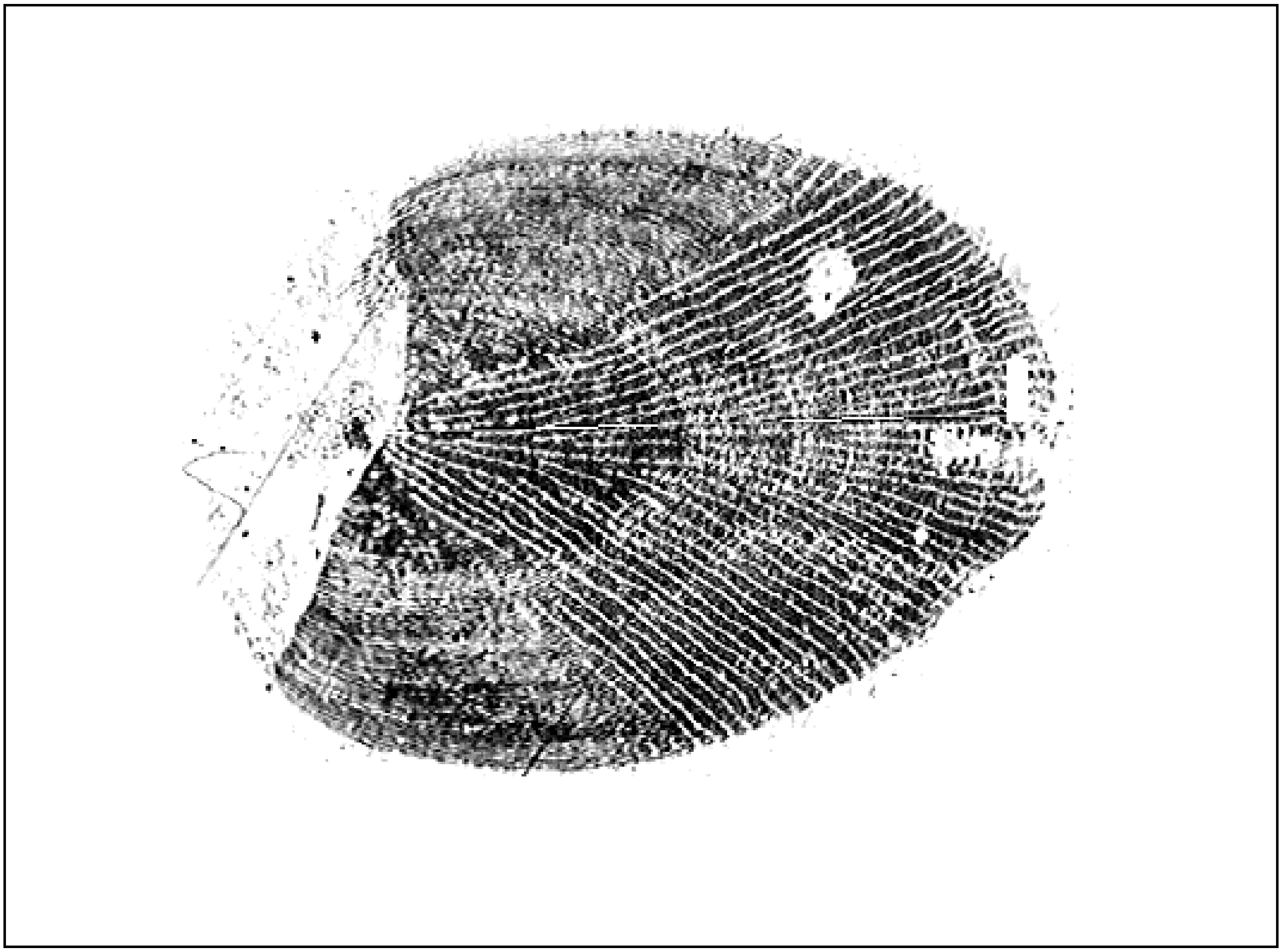

Figure 2. Scale image (magnification 12.5X) from a 33-cm summer flounder collected on 4 March 1997 during the North Carolina winter commercial fishery, which was aged by the NCDMF as age 1 and by the NEFSC as age 2 in the 120-fish NCDMF exchange sample. The first annulus is indicated. Workshop participants agreed on age 1.

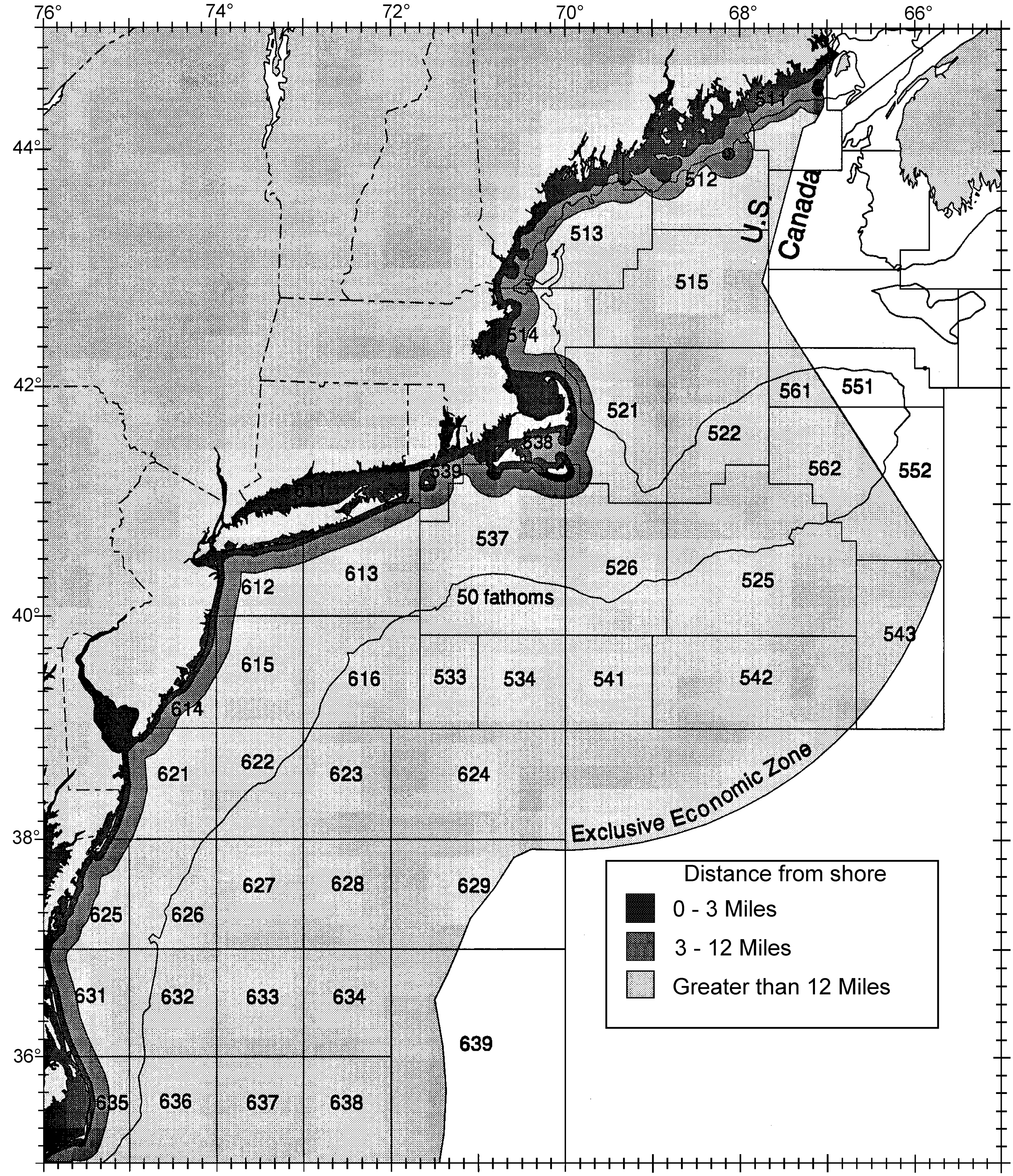

Figure 3. Statistical areas used by the NEFSC for recording the locations of harvests of marine fisheries resources off the northeastern United States.

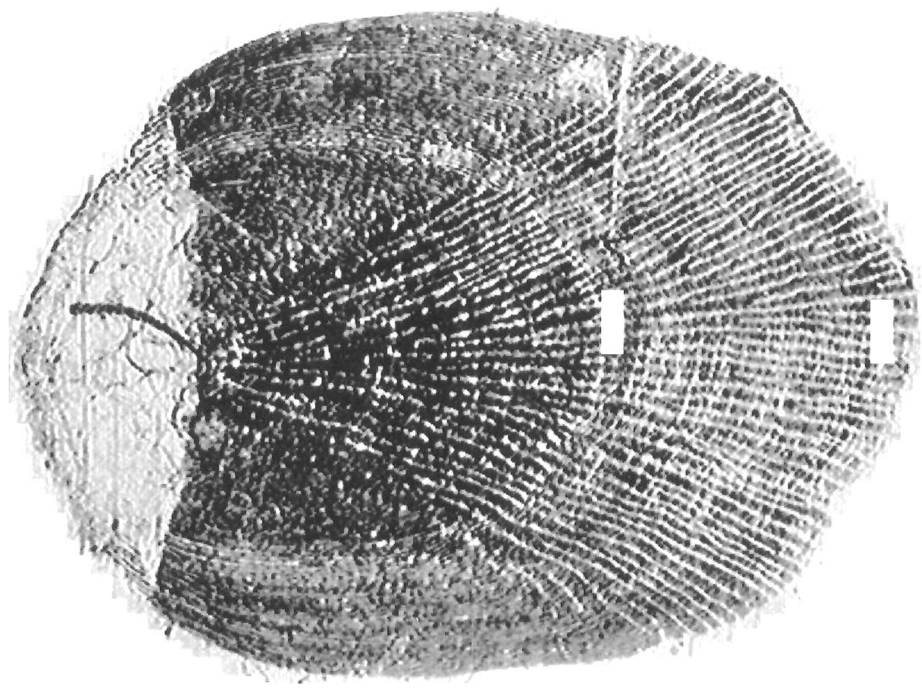

Figure 4. Scale image (magnification 20X) from a 33-cm male summer flounder captured in March 1996 during the NEFSC spring bottom trawl survey, which was aged by the NEFSC as age 1 and by the NCDMF as age 2 in the original 50-fish NEFSC exchange sample. Both NCDMF annuli are indicated; NEFSC considers the first mark to be an early life history event. Workshop participants did not resolve the disagreement.

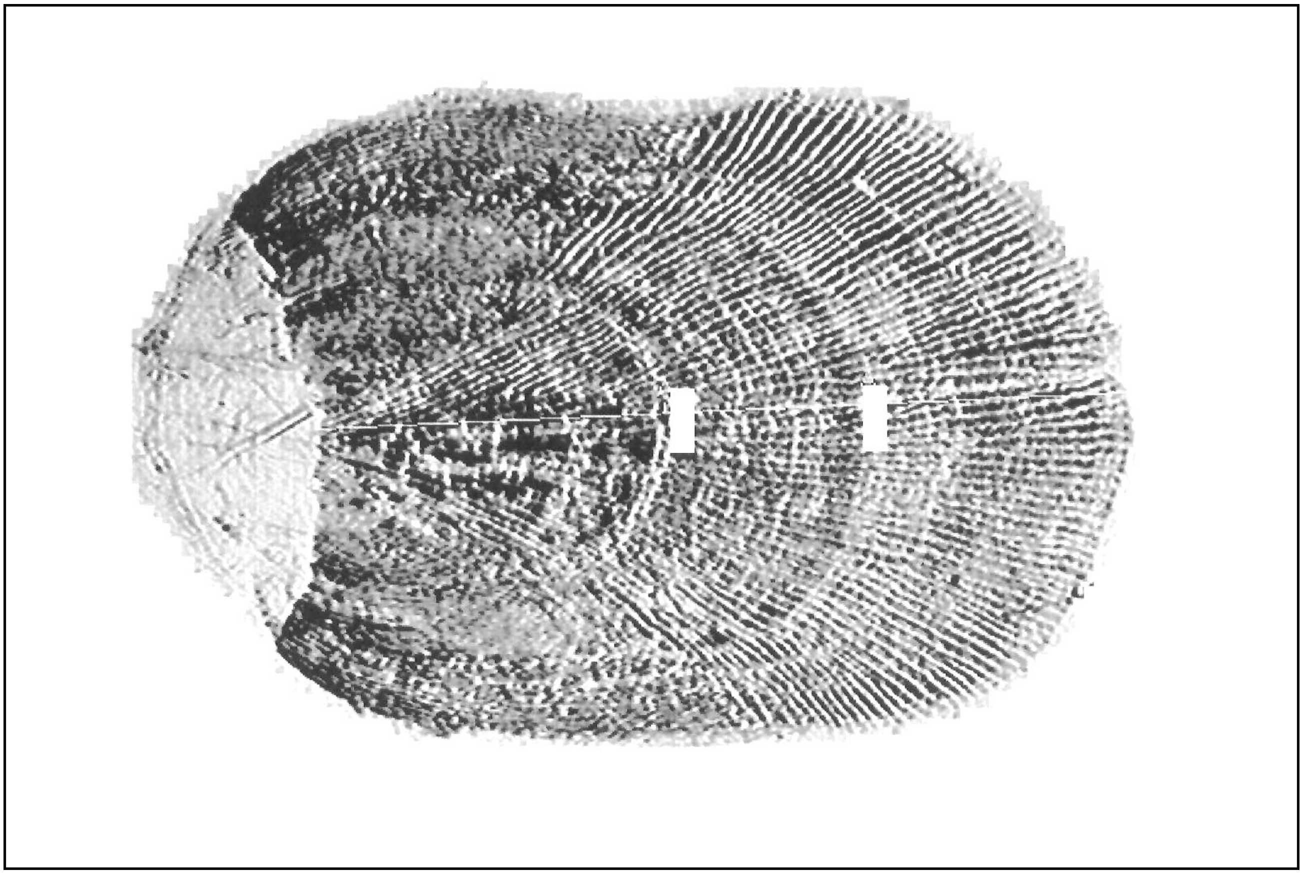

Figure 5. Scale image (magnification 12.5X) from a 50-cm fish collected in June 1995 by the NEFSC from the commercial fishery, which was aged by the NCDMF as age 3 and by the NEFSC as age 2. The first two NCDMF annuli are indicated; NEFSC considers the first mark to be an early life history event. Workshop participants did not resolve the disagreement.