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Fishery Biology Investigation

1982 Annual Report

by

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National Marine Fisheries Service

Northeast Fisheries Center

Woods Hole Laboratory

Woods Hole, Massachusetts 02543

Fishery Biology Investigation

1982 Annual Report

The Fishery Biology Investigation is one of seven major subunits in the Northeast Fisheries Center's Resource Assessment Division. The role of the investigation is to estimate various biological parameters required for stock assessments. These include age, growth, fecundity, and behavioral aspects (e.g., migration, feeding, reproduction, and distribution) needed to understand the population dynamics of stocks. A major emphasis is on ageing samples in order to estimate the age structure of commercially important fish and bivalve mollusks. Specific studies focus on growth analysis, age validation, development of anatomical hard structures used for ageing, size and age at sexual maturity, sex ratios, electro-optics image sensing of age structures, and examining the relationship between sub-annual growth increments on larval fish age structures and the number of days lived.

Staff

The Fishery Biology Investigation has a staff of more than 20 individuals (Table 1), who are classified as professional or technical. The work of these individuals is subject to important constraints which are difficult to monitor and frustrate the application of any given management scheme. There is a high degree of coordination of personnel required, both within and outside the investigation, for the preparation and ageing of specimens. Much of the work involved in processing age samples and data is routine and repetitive with an attendant high degree of boredom. Many of the personnel are student temporaries, with a high

rate of turnover, which means that permanent personnel must, by necessity, spend considerable time and effort training temporaries and other employees. While such use of student temporaries has budget, EEO advantages, and avoids the problem of permanent personnel in lower grade, limited advancement positions, it also creates other management stresses. This high turnover rate of personnel is both emotionally and physically taxing. Due to the demand for accuracy and precision in every aspect of the work, from data collection to data summary, constant training and close supervision is required.

A summary of the major duties of the technical and professional staff is given in Table 2. This table alone does not give a clear indication of the labor intensive aspect of ageing fish and shellfish.

In spite of these constraints, the Fishery Biology Investigation manages to produce timely age determinations for Resource Assessment utilization and continues to make significant contributions to the "state of the art" in fisheries science.

Facilities and Equipment

The offices and laboratories of the Fishery Biology Investigation are located in a small renovated cottage which lends itself well to minimizing the tedium of the necessary routine tasks. Besides the adjacent NEFC main Woods Hole Laboratory building, where the Investigation Chief's office is located, and which contains a freezer room and dissecting room, Investigation scientists and technicians have access to many kinds of equipment in the Center's Aquarium and in the other laboratories located in Woods Hole.

Since the bulk of the work is performed on preparing ageing structures and/or age determinations, important resources are as follows: microprojectors for scale ageing; various microscopes ranging from simple binocular dissecting types to high powered dissecting scopes with video cameras which allow better viewing for teaching and demonstration purposes and simultaneous age reading by more than one reader when ageing and measuring fish and shellfish anatomical hard parts (e.g., otoliths and valves); an array of cutting machines for sectioning age structures such as otoliths and bivalve shells; a CRT-CI101 terminal which allows for remote entry and editing of age data on the VAX computer; and a darkroom for photographic processing.

The majority of field collections of age samples are made by the RAD's Survey Investigation during the bottom trawl and shellfish research surveys. The Fishery Biology Investigation provides the various apparatus and supplies needed for collecting and storing age samples on the Center research vessels. Many of the Investigation's staff members also participate in the research cruises as members of the scientific party. The bulk of age samples from commercial landings are provided by Statistics Investigation port samplers.

Contract Ageing

Contracts have been issued to two state organizations and three academic institutions with established marine science and/or related programs. Both state and university contract agreements are for age determinations of fish/shellfish of joint concern between the contractee and the NEFC. State contracts are primarily for production age determination

of high priority fish. Contracts with the academic institutions are primarily research oriented, with production age determinations being of secondary importance. Basic, as well as applied, biological aspects of specific fish are examined to develop new research techniques having possible usefulness in obtaining the objective of greater ageing accuracy and precision. Fishery Biology Investigation personnel continually monitor the work done by both state organizations and academic institutions in order to verify the accuracy of the age data produced and the usefulness of the research completed. This requires knowledge of the physiology of growth and of the life history of the species, and the analysis and comparison of data from several sources to validate the ageing (e.g., comparing growth of the age structure to fish growth in length, comparisons with modes in length frequencies, observations on time of spawning and geographical distribution in relation to temperature, feeding and behavior).

Contractual agreements are as follows:

State

Massachusetts Division of Marine Fisheries

1. Provide personnel, facilities, apparatus and materials for production age determination of Cod and Pollock.
2. The saggita pair of the otoliths is used for age determination.
3. Performance of work is at the Division's Cat Cove Marine Laboratory, Salem, Massachusetts.

Maine Department of Marine Resources

1. Provide personnel, facilities, apparatus and materials for age determination of Herring.
2. The saggita pair of the otoliths is used for age determination.
3. Performance of work is at the Department's Boothbay Harbor Laboratory, Boothbay Harbor, Maine.

Academic Institutions

Rutgers University - Cook College, New Brunswick, NJ.

1. Provide personnel, facility, apparatus and materials for research on stock identification of weakfish. Specific objectives include completion of stock delineation of weakfish from the Mid-Atlantic Bight begun in 1981 by use of starch gel electrophoresis techniques and assemblage of information gained for issuance to appropriate sources for formulation of a plan to rationally manage weakfish.
2. NEFC provides samples for research.
3. Principle Investigator is C. B. Grimes, Ph.D.

University of Maryland Eastern Shore, Princess Anne, Maryland

1. Provide personnel, facility, apparatus and materials for processing surf clam for age determination and growth analysis. Processing includes measuring, cleaning, sectioning, chondrophore removal and photographing of sections.
2. NEFC provides samples and training when needed.
3. Principle Investigator is T. F. Hopkins, Ph.D.

Hampton Institute, Hampton, Virginia

1. Provide personnel, facility, apparatus and materials for processing and age determination of sea scallop. Processing includes measuring, cleaning, examining for comparative ring count both the resilium and shells for each individual.
2. NEFC provides samples and training when needed.
3. Principle Investigator is C. L. Ruddell, Ph.D.

Activities

The age determinations completed in 1982 are summarized by species in Table 3 for the two principal sources of samples (i.e., research surveys and commercial landings). Coordination of the efforts of many employees (i.e., biologists, technicians and aids, both within and outside the Investigation) is required for the various procedures necessary to process age data. Table 4 details the steps involved in processing age data by the Fishery Biology Investigation. A breakdown of the time involved in processing age data for three selected species is given in Table 5. Table 6 gives an idea of the steps involved in ageing a new species, or when a new Age Reader begins ageing a species.

The following includes a brief summary of the steps listed in Table 4. Age samples received are organized and catalogued for storage. Whole frozen fish which are received, are processed for biological data and age samples. Depending upon the age structure, various methods are used to prepare it for age reading. Fish scales are impressed on laminated plastic slides. Fish otoliths may be baked, mounted on tabs and thin-sectioned, or whole otoliths may be embedded in resin. Surf clam and

scallop shells are cleaned for storage. Surf clam shells are processed by excising and thin-sectioning a part of the hinge. Ocean quahog shells must be sectioned, embedded, polished, and etched before acetate peels can be prepared for age determinations. Age/growth lines can then be identified and counted during microscopic examinations or enlargement of the preparations from projection equipment. The amount of time spent evaluating and re-evaluating an age structure before an age can be assigned may be considerable. The final age of each specimen is determined from a minimum of two independent readings by one person or, for many specimens, by readings by two different Age Readers. Data on ages are then coded, summarized, and audited. Once age data is on tape, it is available for assessment biologists to use in constructing age-length keys which serve as a basis for estimating numbers and catch at age in the population.

Professional biologists and technicians may also utilize age determinations for special studies on age and growth, age validation, or the development of new methods of age analysis. It should be emphasized that none of this would be possible without the efforts of technical aids, student trainees, volunteer students, and contractual agreements. Their attention to careful preparation of specimens for ageing, initial age determinations of some species, and assembling data are indispensable.

Members of the Investigation staff also spend a substantial amount of time at sea on research cruises (Table 7).

Other Activities

Accomplishments during 1982 in work other than routine ageing are briefly summarized by the principle investigators responsible for the specific projects.

Ambrose Jearld consulted with S. Almeida of VPI and State University, Blacksburg, Virginia, to discuss research possibilities using Optical Fourier transforms of laser optical images for automatic age analysis of scales and otoliths. He also wrote a chapter on Age Determination for a forthcoming book published under the auspices of the American Fisheries Society. Review of Gary Shepherd's analysis of surf clam data from the Delmarva Peninsula to examine the growth and age structure of commercially caught clams was also accomplished. Ambrose assembled information on the growth of several species of fish in the Northwest Atlantic necessary for the preparation of material in support of the United States' position in the World Court case involving the East Coast maritime boundary issue with Canada. Ambrose served as chairperson of the Black History Month Committee and met with B. Jackson during his information gathering trip to examine discrimination issues. Ambrose also acted as Cooperative Education liaison for the following schools: South Carolina State College; Lincoln University, Pennsylvania; UMES, Princess Anne, Maryland; University of District of Columbia, Washington, DC; Morgan State University, Baltimore, Maryland; Savannah State College, Georgia; Rutgers University, New Jersey; VPI and State University of Virginia, Blacksburg, Virginia; and University of Massachusetts, Amherst, Massachusetts. Ambrose also examined aspects of the development of winter flounder otoliths with Sherry Sass.

John Ropes spent many hours teaching Investigation personnel to use photographic equipment and showing them the basic techniques for photographing biological specimens. John also provided guidance, service, and training for a number of the Investigation staff, visiting students, and scientists

in the preparation techniques, and age determinations, for shellfish. As a senior scientist, John has an impressive research and publication record for 1982.

Judy Penttila, who worked in the Investigation for only one month, compiled data on the age and growth of yellowtail flounder, cod, and haddock from several areas of the Northwest Atlantic for use in the United States-Canadian boundary dispute.

Through a cooperative effort, Louise Dery visited the Instituto Espanol de Oceanografia, Vigo, Spain, from 29 May to 26 June to work with their biologists on ageing three important ICES finfish: European hake, horse mackerel, and the blue whiting. This extended collaboration with S. Iglesias, a Spanish biologist, who had visited the Woods Hole Laboratory from November 1980 through February 1981. By working directly with four biologists at the Institute, problems in defining annuli in otolith specimens were identified and criteria were established that resulted in considerable progress toward more objective age assessments. Louise and Ambrose Jearld, assisted by John Trautman and Detra Green, completed an otolith inventory for S. Saila of the University of Rhode Island for silver hake, cod, and pollock. Louise also developed photographic techniques for photographing fish scale impressions. She also located new sources for, and tested new samples of, laminated plastics for scale impressions.

Gary Shepherd, who worked in the Investigation for eleven months, established programs for the VAX computer system useful in age analyses and trained several Investigation biologists, technicians, and Co-op

students in the use of the VAX system. Gary analyzed surf clam data from the Delmarva Peninsula to show geographic and density related growth variations and the growth and age structure of commercial landings. He also compiled age and growth information for several species related to the United States-Canadian boundary dispute. In June, Gary received an M.S. in ecology from Rutgers University.

Brenda Fields worked seven months in the Investigation. During the summer, she seined local waters for young-of-the-year summer flounder for a study of otolith ring patterning.

As lead technician, Vi Gifford, assisted by Kris Andrade, implemented a reorganization in late 1982 of sample storage, processing, and ageing of all species under study. This was undertaken to promote coordination between all personnel in the Fishery Biology Investigation. The goal was to provide orderly processing of samples on a timely basis and increased accuracy of age data consistent with the needs of principle investigators.

Sherry Sass spent nine months working in the Fishery Biology Investigation. She was primarily responsible for maintaining aquarium-held larval winter flounder, collecting data on growth relative to rings that form in the minute otoliths, and examining and photographing the otoliths under light microscopy and SEM. This effort was to assist Ambrose Jearld in evaluating the possibility of a daily periodicity of ring deposition.

Presentations

S. Sass — First year growth and otolith development of winter flounder. Presented at AFS, Northeast Division Annual Meeting, Cherry Hill, NJ, on 12-15 April.

J. Ropes — Poster presentation - Documentation of annual growth lines in the ocean quahog. National Shellfisheries Association Meeting, Baltimore, Maryland, from 15-17 June.

G. Shepherd — Geographic variations in age and growth and reproduction in weakfish. Presented at American Society Ichthyologists and Herpetologists, DeKalb, IL, on 19-24 June.

Publications

Miller, R. J., and A. Jearld, Jr. 1982. Behavior and phylogeny of fishes of the genus Colisa and the family Belontiidae. Behaviour 83 (pt. 1-2):155-185.

Jearld, A., Jr. 1982. Age Determination. Fisheries Techniques Manual, edited by L. A. Nielsen and D. L. Johnson. American Fisheries Society Education Publication Project (Accepted) October 15, 1982.

Murawski, S. A., J. W. Ropes, and F. M. Serchuk. 1982. Growth of the ocean quahog, Arctica islandica, in the Middle Atlantic Bight. Fish. Bull. 80:21-34.

Ropes, J. W., and D. Pyoas. 1982. Preliminary age and growth observations of ocean quahogs, Arctica islandica Linné, from Georges Bank. Inter. Con. Explor. Sea, Shellfish Comm., C.M. 1982/K:15, 6 p.

Ropes, J. W. 1982. The Atlantic Coast surf clam fishery, 1965-1974. Mar. Fish. Rev. 44(8):1-14.

Ropes, J. W. 1982. Procedures for preparing acetage peels of embedded valves for Arctica islandica for ageing. Woods Hole Lab. Ref. Doc. No. 82-18, 8 p.

Ropes, J. W. 1982. Hermaphroditism, sexuality, and sex ratio in the surf clam, Spisula solidissima, and soft-shell clam, Mya arenaria. Nautilus 96:141-146.

Ropes, J. W., C. N Shuster, Jr., L. O'Brien, and R. Mayo. 1982. Data on the occurrence of horseshoe crabs, Limulus polyphemus L., in NMFS-NEFC survey samples. Woods Hole Lab. Ref. Doc. No. 82-23, 40 p.

Serchuk, F. M., R. S. Rak, and J. Penttila. 1982. Status of the Georges Bank and Gulf of Maine Atlantic cod stocks - 1982. Woods Hole Lab. Ref. Doc. No. 82-33, 46 p.

Consultations

Domestic

K. Andrade G. Shepherd B. Fields	R. Simmons and J. Strube of Normandeau Assoc., Inc., Portsmouth, NH Early growth of winter flounder
L. Dery G. Shepherd	D. Ryan, Univ. New England student Age and growth of black crappie
L. Dery	P. Howell, Connecticut Dept. Environ. Protection Winter flounder ageing methods
L. Dery B. Fields	J. Castleman, Millstone Environ. Lab. Scale impression methods
L. Dery	P. Diodati, Mass. Div. Mar. Fish. Striped bass scale preparation methods
L. Dery B. Fields V. Gifford A. Jearld	G. Hirschhorn and Greg Smith of NMFS, NWAFC, Seattle, WA General age and growth methods
A. Jearld	S. Almeida, Virginia Polytechnic Inst. and State Univ., Blacksburg, VA - Automatic age determinations of fish

Foreign

G. Shepherd V. Gifford L. Dery	A. Tomo and E. Barrera of Instituto Antarctico de Argentina Otolith growth patterns of Antarctic fishes
G. Shepherd	F. Cardardor, Instituto Nacional Investigacio, Lisbon, Portugal - Ageing methods for European hake
L. Dery	J. Hunt, Biol. Sta., St. Andrews, N.B., Canada Mackerel ageing

Foreign Consultations by Phone or Correspondence

L. Dery	Anonymous Polish Age Reader Mackerel Ageing
J. Ropes	T. McLande and D. Chaisson of Research Branch, Dept. Fish and Oceans, Halifax, NS, Canada - Interpreting gonadal development in ocean quahogs and procedures for preparing shells for ageing.

Training

L. Dery	Human Relations Seminar, USGS, 11-12 March. Personnel Management for EEO Staffs. OPM Boston, 19-23 April.
M. Grace & I. Palmer	Attended classes on "An Introduction to VAX".
A. Jearld	Calculus with Analytic Geometry, Bridgewater State College, 2/1-4/5.
A. Jearld	Self-development Strategies for Black Managers, American Management Assoc., 6/14-6/16.
M. Crawford	LWOP 2/7/82 to attend Rutgers Univ.
B. Fields	LWOP through May 1982 to attend Univ. of Wash.
G. Shepherd	Attended Rutgers Univ. through 2/7/82.

Meetings

S. Sass G. Shepherd A. Jearld	NE Amer. Fish. Soc., Cherry Hill, NJ, 12-15 Apr. " " " " " " " " " " " " " " " " " "
I. Palmer S. Sass A. Mitchell	AFS-local meeting, New Bedford, 9 June. " " " " " " " " " " " " " "
J. Ropes	National Shellfisheries Association Meeting in Baltimore, MD, 15-17 June.
G. Shepherd	Amer. Soc. Ichthyologists & Herpetologists, DeKalb, IL, 19-24 June, and paper presented on Life History Strategies of Weakfish in the Middle Atlantic Bight.
A. Jearld & B. Fields	Annual Amer. Fish. Soc. Hilton Head, SC, 22-24 Sept.
B. Fields L. Dery D. McGruder	Amer. Fish. Soc., Kingston, RI, 15 Dec. " " " " " " " " " " " "
L. Dery & S. Sass	EEO Meetings and FWP Meetings, Woods Hole Lab.
A. Jearld	Attended the 7th National Conference on Blacks in Higher Education, National Association for Equal Opportunity in Higher Education, Washington, DC, 3/25/82 - 3/29/82.
A. Jearld	First National Conference on Issues Facing Black Administrators at Predominantly White Colleges and Universities. Massachusetts Institute of Technology, Cambridge, Massachusetts.

ACKNOWLEDGEMENTS

I have benefitted from the discussion, editorial suggestions and records from the entire Fishery Biology Investigation Staff. Most of all, I recognize that without the dedication and hard work of the Investigation's staff in general and the permanent members in particular, the outstanding quality and quantity of age determination service provided to the Northeast Fisheries Center would not be possible. For your invaluable contributions, thanks to each of you.

Table 1. Fishery Biology Investigation Workforce - 1982

Permanent Employees

Professional

Ambrose Jearld, Jr.	Supervisory Fishery Biologist (Research)
John Ropes	Fishery Biologist (Research)
*Judy Penttila	Fishery Biologist (Research)
Louise Dery	Fishery Biologist (Research)
*Gary Shepherd	Fishery Biologist (General)
*Brenda Fields	Fishery Biologist (General)
*Maurice Crawford	Fishery Biologist (General)

Technical

Vi Gifford	Lead Biological Laboratory Technician (Fisheries)
Kris Andrade	Biological Laboratory Technician (Fisheries)

Temporary Employees

Professional

*Sherry Sass	Fishery Biologist
*Melinda Davis	Faculty Summer Appointment

Technical

Blanche White	Biological Technician(Indefinite Appointment)
*Melinda Grace	Biological Technician (TAPER)
*Mark Costa	Biological Technician (TAPER)
*Ira Palmer	Student Trainee -Biological Science (College Coop
*Annette Mitchell	" " " " " "
*Detra Green	" " " " " "
*David Pyoas	" " " " " "
*Jacob Richardson	" " " " " "
*Di John McGruder	" " " " " "
*Roberta Bruce-Delany	" " " " " "
*John Trautman (VOLUNTEER)	" " " " " "
*James Fletcher	Stay-In-School (High School Student)
*Alicia Kelly	" " " " " "
*Leslie DeFilippis	" " " " " "
*Tracy Williams	" " " " " "
*Wendy Sylvia	" " " " " "
*Melissa Baptiste	CETA (High School Student)
*2 Student Volunteers -	Fairfield University
*2 Student Volunteers -	Smith College

*worked only part of the year.

Table 2. Fishery Biology Investigation - Chief (Supervisory Fishery Biologist (Research))

Two major components

Technical (Technicians)

1. Receive samples
2. Prepare samples
3. Age samples
4. Maintain files of completed data records
5. Organize data in suitable summaries usable by investigation biologist and/or assessment scientist
6. Issue age data reports to Biologist in investigation and/or directly to assessment scientist
7. Assist investigation biologist in validation and research studies
8. Training and supervision by senior technicians of junior technicians, biologist and contract personnel
9. Participate in ageing workshops

Professional (Fishery Biologist)

1. Age samples
2. Organize data in suitable summaries usable by assessment scientist
3. Reports age data to assessment scientist
4. Develops ageing methods and validates methodology
5. Conducts research designed to better provide accurate age structure for stocks (most research is relevant to growth)
6. Provide both published and oral reports of findings
7. Train technicians and other biologists
8. Conduct workshops to exchange ageing knowledge
9. Assist outside groups on age and growth problems

Table 3. Age determinations - 1982.

Species	First Age Reader	Second Age Reader	Type of Sample Preparation	No. of Survey Specimens	Total* Age Readings	No. of Commercial Specimens	Total* Age Readings	No. of Hrs. Processing Age Data**
Redfish	Gifford	Andrade	Section oto's	532	1,064	2,247	4,494	1,112
Cod	(MA)	Gifford Grace Penttila	None	2,278	4,556	3,102	7,602	416
Haddock	Andrade	White	Impress scales	1,895	3,790	2,555	6,172	690
Pollock	(MA)	Andrade	None	681	1,362	1,568	3,136	150
Mackerel	Dery	Dery	Embed oto's***	1,377	1,721	155	194	343
Herring	(ME)	Dery	Embed oto's****	2,008	2,276	2,968	3,200	591
Summer flounder	Fields	Fields	Impress scales	1,750	3,500	2,854	4,500	458
Winter flounder	Fields	Fields	Impress scales	2,351	5,000	-	-	723
Yellowtail	Shepherd Penttila	Gifford Penttila	Impress scales	2,305	4,610	501	1,503	583
Butterfish	Sass	Dery	None	1,931	2,581	-	-	228
Red hake	Dery	Dery	Section oto's	750	1,000	-	-	277
Silver hake	Dery	Dery	Section oto's	984	1,200	-	-	337
Total finfish				18,842	32,660	15,950	30,801	5,908
Sea scallop	Gifford	Palmer	Scrub shells	3,179	600	-	-	220
Surf clams	Shepherd	Palmer	Section shells	60	120	1,190	2,380	838
Ocean quahogs	Ropes	Ropes	Prepare shells	246	82	-	-	?
Total shellfish				3,485	802	1,190	2,380	1,058+

TOTAL NUMBER OF AGE READINGS DONE = 66,643

*Total age readings = number of specimens X number of times aged.

**Includes time spent by Fishery Biology Investigation personnel in performing the following tasks: sample preparation, ageing, putting ages on sheets, coding age sheets, summarizing data, checking data.

***Includes measuring, weighing, and sexing whole fish, and then removing otoliths and embedding them in resin.

****Includes measuring, weighing, and sexing whole fish, and then removing otoliths and embedding them in resin for survey specimens only (commercial specimens are pcoressed by ME personnel).

Table 4. Processing of Age Data by the Fishery Biology Investigation

I. Survey Cruise Data

1. Samples are unloaded from survey vessels by Age and Growth personnel. Fish samples frozen at sea are processed for biological and age data.
2. Age samples are separated by species, arranged in consecutive station order, and logged in books.
3. Samples are prepared for ageing-
   scales are impressed
   otoliths may be baked, sectioned, mounted, etc.
   shells are cleaned, sectioned, etc.
4. Ageing is simplified considerably if the geographical location of the age samples is known. Therefore, we do not age the samples until we have received either the cruise track charts or the STA/STR/TOW listing from the Survey Unit. Either of these will give the geographical location for each station surveyed. (Prefer STA/STR/TOW listing).
5. Age sample data is put on sheets.
6. Age sample sheets are coded. A listing, from the Survey Unit, is necessary for proper determination of cruise, stratum, and tow codes for each station.
7. Age data is summarized by strata groups.
8. Age data summaries are sent to assessment personnel.
9. Age sample sheets are sent to ADP for keypunching.
10. Listings of age data from ADP are audited for errors in keypunching.
11. Corrected listings are returned to ADP.
12. Final listings received from ADP are checked to be sure corrections were properly made. ADP is then notified that the age data is OK.

II. Commercial Data

1. Samples received from port samplers are separated by species, arranged in consecutive date order, and logged in books. Fish samples frozen at sea are processed for biological and age data.
2. Samples are prepared for ageing-
   scales are impressed
   otoliths may be baked, sectioned, mounted, etc.
   shells are cleaned, sectioned, etc.
3. Samples are aged and the age data are put on sheets.
4. Age sample sheets are coded. Missing information is obtained from interview records in the Biostatistics Unit.
5. Age data are summarized by area.
6. Age data summaries are sent to assessment personnel.
7. Age sample sheets are sent to the Biostatistics Unit for sample number coding, etc.

Table 5. Time involved in processing age data for three species.

Species:	Redfish	Haddock	Surf clams
Age Structure:	otoliths	scales	chondrophore
Type of Prep.,	sections	impressions	sections
Average Number of Specimens Processed Per 8 Hour Day:			
Preparation:	80	120	48
First Ageing:	35	125	90
Second Ageing:	50	200	100
Put on Sheets, Summarize, Check data:	125	175	250
Number of Days to Process 1,000 Specimens:			
Preparation:	12.5	8.3	20.8
First Ageing:	28.6	8.0	11.1
Second Ageing:	20.0	5.0	10.0
Put on sheets, Summarize, Check data:	8.0	5.7	4.0
Total Days:	69.1	27.0	45.9
Approximate Number of Specimens Processed Per Day:	14.5	37.0	21.8

Table 6. Steps in ageing a "new" species.

1. Literature search.
2. Meet with others who have experience in ageing that, or similar, species.
3. Look at different age structures which have been used for ageing.
4. Try different methods of preparation for each structure.
5. Look at small, YOY specimens to help define crtieria for first annulus.
6. Compare growth from different geographical areas.

Validation of Ageing Method (most of the time this is done in an informal way)

1. Examine specimens from different months of the year to determine time of year annuli are formed.
2. Establish relationship between length of age structure and length of fish.
3. Do back-calculations to determine lengths at age to compare with age-length keys.
4. Compare age key with length-frequency modes from research surveys.
5. Compare age determinations from different Age Readers.
6. Compare repeated age determinations from the same Age Reader.

Table 7. Fishery Biology Investigation Staff Sea Duty

NAME	CRUISE	DATE	DAYS AT SEA
Mark Costa	ALB 82-06	Jun 1-June 11	11 days
Robert Bruce-Delaney	DEL 82-07	Oct 18-Oct 29	11 days
Brenda Fields	DEL 82-07	Oct 4 -Oct 15	11 days
Ambrose Jearld	ALB 82-11	Oct 18-Oct 29	11 days
Alicia Kelly	ALB 82-08	Jul 12-Jul 23	11 days
	ALB 82-11	Sep 13-Oct 1	18 days
DiJohn McGruder	ALB 82-11	Oct 4-Oct 15	11 days
Ira Palmer	ALB 82-08	Jul 26-Aug 6	12 days
David Pyoas	DEL 82-05	Jul 22	1 day
	DEL 82-05	Jul 26-Oct 6	18 days
Jacob Richardson	ALB 82-08	Jul 26-Oct 6	12 days
	DEL 82-01	Feb 1-Feb 12	12 days
	Kiyo Maru 82-01	Aug 26-Sep 9	14 days
John Ropes	ALB 82-11	Nov 1-Nov 12	12 days
Sherry Sass	DEL 82-02	Apr 27-May 8	13 days
Gary Shepherd	DEL 82-02	Apr 27-May 8	13 days
	DEL 82-01	Jan 21-Jan 29	9 days
	ALB 82-08	Sep. 12-Oct 1	18 days
John Trautman	DEL 82-01	Jan 21-Jan 29	9 days
	DEL 82-02	Apr 12-Apr 23	11 days
	DEL 82-05	Jul 22	1 day
	DEL 82-05	Aug 17-Sep. 3	13 days
	Kiyo Maru 82-01	Sep 10-Sep. 26	16 days
		TOTAL	268 days