Committee of Age Reading Experts

Eighteenth Biennial Meeting

CARE Meeting Minutes

AFSC Sandpoint Facility, Seattle, WA, USA

Jim Traynor Conference Room

April 14 – 17, 2015

Tuesday, 14 April

Crustacean age determination workshop began with instructor Dr. Raouf Kilada.

Wednesday, 15 April

I. Welcome and Opening Statements for CARE business meeting

A. Call to Order (Elisa Russ – ADF&G, 2015 CARE Chairperson):

Elisa Russ called the committee meeting to order on April 15, 2015, at 8:35 a.m., in the Jim Traynor Conference Room and announced the CARE officers for 2015, as follows:

1. Chairperson – Elisa Russ (ADF&G − Homer)
2. Vice Chairperson – Chris Gburski (AFSC)
3. Secretary – Lance Sullivan (NWFSC – PSMFC)

Russ also mentioned that a social event was planned for Wednesday evening, at the Elliot Bay Brewing Company, Seattle, WA. Russ thanked AFSC for hosting the 2015 CARE meeting and acknowledged the contributions of the Crustacean Age Determination Workshop to CARE, and proposed partnerships with not just West Coast affiliates, but also with East Coast groups. Russ concluded by thanking CARE

members for submitting their PowerPoint and poster presentations for the 2015 CARE meeting.

B. Host Statements:

1. Opening Statements (Dr. Thomas Helser – AFSC, Age and Growth Program Manager)

Dr. Tom Helser began with an introduction and housekeeping statements. Helser mentioned that he has kept track of the status of stock assessments and economic studies throughout the years, and that the Data Analysis Lab has been using the micromill for bomb radiocarbon studies. Helser concluded by thanking Elisa Russ, Craig Kastelle, and Chris Gburski for security clearance approval; Crustacean Age Determination Workshop participants; and Mark Blaisdell and Sherrie Wennberg for IT assistance.

2. Host Information (Chris Gburski – AFSC, CARE Host)

Chris Gburski announced that there are lunch possibilities off-site and a cafeteria on-site, government-issued IDs are required to be shown to the security guard, and that directions to the Elliot Bay Brewing Company (social event) are located at the back of the room.

C. Introductions:

1. Round-table Introductions

CARE attendees/members introduced themselves by stating agency information, as well as a brief statement about the work they are doing for their agency.

2. Attendance, Address, Phone, and E-mail

Attendance sign-in sheet was passed around for all attendees/members to provide their name, agency, e-mail, and office phone number (**Table 1:** 2015 CARE Attendance List).

D. Approval of the 2015 Agenda:

Elisa Russ announced that there was a change to the 2015 CARE Agenda, which comprised Joanne Groot (CDFO) giving the overview for her agency instead of Steve Wischniowski. After this change the 2015 CARE Agenda was approved (**Appendix I:** 2015 CARE Agenda).

II. Agency Overviews and Updates

A. Canadian Department of Fisheries & Oceans (CDFO) – Joanne Groot:

Joanne Groot began discussing the current staffing at the CDFO (9 full-time staff, including 8 age readers and 1 database technician; 1 casual, part-time employee hired via Strategic Program for Ecosystem-based Research and Advice [SPERA] funding)

and mentioned that Shayne MacLellan and Darlene Gillespie are still working with the agency under an alumnus status, although Darlene has also retired. Groot was placed in the Acting Senior Lab Technician position after Darlene retired in mid-January. CDFO's organization is broken down into 2 senior level positions (one at a Biologist level [research/administrative/supervisory]; the other at an upper level technician level [lab administration/organization/production ageing]) and the others are at the technical level (production ageing). Groot mentioned that the CDFO is continuing to age a variety of species (N = 13,000 groundfish, N = 83,000 salmon, N = 25,000 herring, and N = 1000 shellfish); in the last two years, the lab has aged N = 6000 arrowtooth flounder (last aged in 2005) and N = 3500 petrale sole (last aged in 2003); and was asked to age new species (Pacific cod, shortraker rockfish [*Sebastes borealis*], dover sole, and shortspine thornyhead).

The SPERA project uses dendrochronology techniques to develop a series of multi-decadal chronologies from herring (shallow depth), Pacific hake (mid-depth), and sablefish (demersal). The chronologies compare and contrast growth patterns across species, habitats and spatial scales to identify patterns of synchrony and the underlying oceanographic drivers of ecosystem productivity. The CDFO recently purchased a micromill for isotope analysis and acquired a new Leica DMS 1000 camera/microscope set-up to replace the ageing "Neopromar" projectors used for salmon scale ageing. The CDFO has investigated the break-and-bake vs. break-and-burn methods for ageing flatfish, Pacific hake, and sablefish, but has mainly focused on break-and-baking all flatfish species for production ageing. Another project CDFO currently pursues involves experimenting with the thin-section method for shortraker rockfish and shortspine thornyhead. Over the past two years, the CDFO has also published a series of technical manuals outlining the CDFO Lab's ageing methods and procedures, including a Chinook Salmon Scale Age Determination manual, and has drafted a Pacific hake ageing manual which is near completion, and also is currently compiling an otolith atlas of species from the British Columbia coast. Groot said that three CDFO staff attended the 2014 Western Groundfish workshop, where two posters were presented. Darlene went to Shimizu, Japan, to attend the Tuna Ageing Workshop and was involved with the Tuna age exchange. Furthermore, Shayne and Darlene attended the Chinook Salmon Ageing Workshop in Juneau, Alaska, to standardize the criteria used to age Chinook salmon scales between agencies. Lastly, CDFO participated in a shortraker rockfish exchange with NMFS and ADF&G for the 2015 CARE meeting.

B. International Pacific Halibut Commission (IPHC) – Joan Forsberg:

Joan Forsberg began with staffing and stated that Dana Rudy started working for the IPHC last year and became a full-fledged, onsite production age reader; four other age readers are employed (onsite – Robert Tobin, Chris Johnston, Joan Forsberg; Linda Gibbs-offsite); all readers age full time during "otolith season," which is from June to October. Forsberg mentioned that the IPHC typically ages N = 30,000-35,000 otoliths per year (e.g., commercial samples, setline and NMFS trawl survey samples, tag recoveries and ADF&G sport fish samples) with an extra N = 12,000 aged in 2014 from archived setline survey collection that had previously only been surface-aged. These archive collection samples were re-aged in 2014 by both surface and break-and- bake

method. In regards to collection techniques, Forsberg said that commercial samples were transferred from pill boxes (in the field) to Tray Biens in the office; setline and NMFS trawl survey samples were collected directly into Tray Biens; and tag recovery and ADF&G sport fish otoliths stored in dry coin envelopes (in the field) and transferred into Tray Biens in the office.

Forsberg also mentioned that all of the otoliths to be aged were cleared and stored in glycerin-thymol solution and most otoliths were stored offsite, at the National Archives on Sand Point Way, Seattle WA. Forsberg further stated that a couple of collections were stored dry for various reasons. First, a new collection of otoliths (target of N = 100 otoliths per year per IPHC regulatory area) started in 2010 was stored dry while not coming into contact with water or other solutions for future elemental work. Second, archived juvenile otoliths from 1926 to 1986 were removed from glycerin-thymol, cleaned with water, and stored dry upon discovering that samples ≤2 years old were deteriorating. Current techniques that IPHC employs include the break-and-bake (for surface-aged trawl survey fish aged >5 years and all setline survey, commercial AK sport, and tag recovery otoliths) and surface-reading (for trawl survey fish aged <5 years) methods.

Forsberg reported that the IPHC is pursuing three projects, as follows: 1) re-ageing break-and-bake samples collected between the 1920s and 1990s that were previously only surface aged (results published in IPHC annual in-house Report of Assessment and Research Activities); 2) an increment study investigating changes in size at age (SAA) in Pacific halibut; and 3) entering age data from earlier survey years, namely from the early 1900s through the 1960s (ongoing for last three years). The IPHC found the following, in regards to re-ageing break-and-bake samples: 1) historic and new surface ages were similar due to no apparent changes in ageing protocols or differences due to equipment; 2) historic versus present-day biases in surface and break-and-bake ages were similar; 3) there were very few Pacific halibut over 15 years old in samples from earlier decades; SAA changes are not an artifact of changes in ageing methodology; and 4) no additional re-ageing is currently necessary. For the increment study, samples from three different regions (Bering Sea, Gulf of Alaska, and southeast Alaska/British Columbia) and four different birth years (1977, 1987, 1992, and 2002) were used to determine the trend in Pacific halibut SAA. Indeed, the IPHC found that for the two birth years compared so far, the data indicate a decline in SAA between 1977 and 1992. Also, Pacific halibut were found to be larger in the Bering Sea than in the Gulf of Alaska for both years. Baked otolith sections were mounted on slides and polished using a MetaServ 250 polish/grinder, photographed with a Leica DFC290 digital camera, and increments were measure with Image Pro Premier software.

C. Alaska Fisheries Science Center (AFSC) – Dr. Tom Helser:

Dr. Tom Helser first discussed the staffing at the AFSC Age and Growth Program, which includes 13 full-time employees (FTEs), 1 contractor, a PhD student currently working on walleye pollock, and others studying otolith microchemistry. Equipment is being used in the Wet/Prep Lab includes a new Struers high speed sectioning saw and Buehler dual-wheel polishing instrument. The AFSC has five imaging systems and a computer-aided micromill (Carpenter Microsystems CM-2) in the Image Analysis Lab.

Helser stated that the Age and Growth Program uses an age data exploration tool to show growth data-spatial variation and reported that AFSC successfully moved samples to University of Washington's Burke Museum. Helser also reported that the AFSC uses a web-based tool, called the Age and Growth Prioritization System (AGPS), for that populates and prioritizes age requests (N = 50,000 to 60,000; approximately N = 35,000 requests are completed annually. Bomb radiocarbon age validation was performed on Pacific cod and walleye pollock collected in the 1970s and on big and longose skates. Helser also mentioned that the AFSC has been working with the IPHC on Pacific halibut age validation and the Age and Growth Program has submitted a third manuscript for bomb radiocarbon studies. Several studies on otolith trace element microchemistry are currently in progress: 1) validation of ageing criteria in eulachon; 2) discrimination among juvenile Pacific cod nursery areas, and 3) ontogenetic shifts in habitat use of giant grenadier. Other active research projects include ageing arctic species (Arctic cod and saffron cod), performing NPRB-funded stable oxygen isotope, ^{18}O, studies, and applying sclerochronology methods to archived finfishes in the Eastern Bering Sea, Gulf of Alaska and Arctic Sea. Biochronologies are being developed for Bering Sea flatfish, Pacific Ocean perch (POP) and Arctic surf clams, and Gulf of Alaska black rockfish, northern rockfish, and POP.

D. Alaska Department of Fish and Game (ADF&G) – Elisa Russ, Sonya El Mejjati, Kevin McNeel:

Elisa Russ began with the report for the ADF&G – Homer, Commercial Fisheries Division (CFD – Central Region) lab and giving a small introduction about what her job entails. Russ stated that she works with commercial fisheries in the Prince William Sound (PWS) and Cook Inlet (CI) management areas, overseeing the groundfish age determination, port sampling, and observer programs for her region; her duties also focus on fisheries management; and she also mentioned that she ages scallops. Andy Pollak is the primary production age reader and works primarily with walleye pollock and demersal and pelagic shelf rockfish (DSR, PSR) species. Russ provides training, precision testing, resolves ages, and does production age reading as needed. Russ stated that the Homer CFD staff collects N = 1200 pollock otoliths per year from the PWS trawl fishery and a new CI experimental seine fishery; and has sampling goals of N = 550 each from each management area for sablefish, lingcod, and rockfish species, including DSR species (primarily yelloweye and quillback rockfish), PSR species (primarily black rockfish), and slope species (primarily rougheye and shortraker rockfish). Precision testing is done on 20% of ages produced. PSR rockfish samples come from the CI directed rockfish fishery while remaining rockfish samples are collected from bycatch retained to other directed fisheries (e.g. longline sablefish and Pacific halibut). Russ mentioned that there was disagreement in ageing criteria for Pacific cod within ADF&G but there may be future resolution to this issue; currently N = 10 Pacific cod samples are collected per landing but all age structures are currently being archived until age criteria and budget constraints are resolved to allow tackling the backlog. All pollock, DSR and PSR collected from commercial fisheries are aged at the Homer lab. Homer CFD transitioned to collecting lingcod otoliths from fin rays several years ago and all lingcod, sablefish, and slope rockfish otoliths collected from commercial fisheries, as well as those species and some DSR and PSR collected from

fishery-independent surveys, are sent to Kevin McNeel at the ADU for age determination. The Homer CFD lab uses break-and-bake method to age their otoliths.

Russ also gave a report for the ADF&G – Homer, Sport Fish Division (SFD), stating that no one was able to attend the 2015 CARE meeting. The Gulf of Alaska Bottomfish Assessment program employs two seasonal age readers for a total of approximately eight months annually. Willy Dunne (Fishery Biologist I) is responsible for age interpretation of all rockfish species caught in recreational fisheries. Marian Ford (Fish and Wildlife Technician III) is responsible for the processing, mounting and ageing of all lingcod structures. Barbi Failor (SFD program supervisor) ages salmon sharks as needed.

Joan Brodie (substituting for Sonya El Mejjati), stated that the ADF&G – Kodiak branch has three full-time agers (Mike Knutson went to graduate school and was replaced by Kayla Bevaart). Age determination is generally completed between January-April (3-4 months annually). Species aged in 2015 were black rockfish, dark rockfish, Pacific cod, lingcod, and a small number of walleye pollock (due to a new fishery), and dusky rockfish. For rockfish species, the break and burn method is used. For Pacific cod and walleye pollock, both halves are utilized for the break-and-bake method – in 2015, the method was changed (formerly break-and-burned one half) to using break-and-bake, which has saved a great deal of time. Precision testing is completed on 40% of the majority of samples and at 100% for new age readers. All differences from precision tests are resolved.

Kevin McNeel gave the report for the ADF&G – Juneau Age Determination Unit (ADU). The ADU employs two primary production age readers, April Rebert and Kristin Politano, who production age sablefish, lingcod, yelloweye rockfish, shortraker rockfish, shortspine thornyhead, and other species. Additionally, Rob Dinneford provides second age reads, morphometric measurements, and support, including specimen processing and preparation. Dion Oxman was also present at the CARE Conference and is the program supervisor for the ADF&G Mark, Tag, and Age Laboratory under which the ADU is housed. The ADU is the groundfish and invertebrate age reading program. Kevin provides training, production age reading, as needed, and precision testing. The ADU received N = 8484 specimens in 2014, representing 11 groundfish species from statewide commercial and survey sampling efforts. Sablefish and yelloweye rockfish (N = 4158 and N = 1060 final ages were produced, respectively) were the only groundfish species processed in 2014 due to the availability of calibrated age readers. Age data quality was assessed through precision testing of approximately 30% of reads along with comparing measured fish lengths and otolith weights at age to estimated ranges for 100% of age data produced. With training, quality control, and data production, ADU age readers evaluated N = 10,803 groundfish specimens in total. To collect objective data used in quality control procedures, a minimum of one age structure from each groundfish was measured for length, height, and weight. Measurements were used to identify errors arising from specimen handling, data entry, species misidentifications, or age assignments. The derivation of morphometric-age models and evaluation of measurement data utility was presented at the 2014 Western Groundfish Conference. To further develop the ADU's

ability to take precision age structure measurements, four ADU members attended a two-day training workshop on image analysis using Image Pro Premier software. In total, N = 7509 age structures were measured as part of production procedures in 2014. To evaluate, standardize, and advance age estimation processes for both commercial and sport state fisheries, the ADU hosted a two-day meeting with the four State of Alaska groundfish age labs. The ADU continued to participate in CARE, and exchanged data and specimens regarding bomb radiocarbon validation studies and the identification of signature years with other CARE agencies, and also participated in age structure exchanges, including shortraker rockfish and lingcod. The ADU was also involved in planning the 2015 CARE crustacean age determination workshop. McNeel stated that an Isomet 5000 high-speed saw was recently purchased to increase production ageing for geoduck and shortraker rockfish. The ADU gave two oral presentations during the 2015 CARE presentation sessions on April 15th and one poster was presented. The Juneau ADU also provided a laptop with access to an Oracle database and expressed a desire to make data accessible.

E. Northwest Fisheries Science Center (NWFSC-PSMFC) – Patrick McDonald:

Patrick McDonald discussed changes to e-mail systems (using NOAA- versus PSMFC-issued e-mail addresses) and mentioned that there are currently six age readers now (5 FTE agers and a team lead, Patrick McDonald). Original staffing included 6 FTE agers and a team lead, but Brooke Higgins left. The NWFSC intends to provide PSMFC the funding necessary to backfill the vacant position in May/June 2015. He also mentioned that the NWFSC continues to production age mostly the same species, namely sablefish, Pacific hake, darkblotched rockfish, canary rockfish, Pacific Ocean perch, petrale sole, and dover sole. The NWFSC-PSMFC lab began ageing new species to support the current year's NWFSC stock assessment, such as black, widow, and China rockfish (never aged before). McDonald reported that the lab ages N = 20,000 to 25,000 structures per year. Currently, the lab mainly does surface reads before the break-and-burn procedure. The break-and-bake method is not presently employed, although it was used to age arrowtooth flounder many years ago. Otolith weight data is recorded for all or a subsample of the specimens that are production aged. The lab also prepares spiny dogfish spines and lingcod fin rays for other agencies to age. NWFSC purchased a New Age micromill and polisher for age validation studies. Canary and black rockfish have been discussed as initial candidates for the coring and subsequent validation work. In May, Cassie Whiteside and Lance Sullivan will be trained to use the micromill by Craig Kastelle and seek guidance from the Micromilling Lab at Oregon State University. Dr. Tom Helser asked about nearshore support (SWFSC vs. NWFSC). Elisa Russ mentioned initiating CARE age structure exchanges for new species (black rockfish); Lisa Kautzi (ODFW) mentioned that she has been working with Patrick on black rockfish. Patrick mentioned that NWFSC had an unofficial exchange with Sandy Rosenfield (WDFW) on China rockfish. Russ stated that, ultimately, exchanges between agencies should, actually need to be, documented for CARE so the entire group can benefit from that information, since that is a core objective of CARE in order to achieve the mission.

F. Southwest Fisheries Science Center (SWFSC):

No report; Patrick McDonald (NWFSC − PSMFC) mentioned that he sends Pacific sanddab and bocaccio rockfish samples to John Field, SWFSC Supervisory Fish Biologist.

G. Washington Department of Fish and Wildlife (WDFW) – Andrew Claiborne:

Andrew Claiborne discussed organizational changes, which include Lance Campbell being elected unit lead for both the Fish Ageing and Otolith Thermal Mark Labs; Andrew is the new team lead for the Fish Ageing Lab; there is one new age reader (Anna Hildebrandt), three other full-time employees (Sandra Rosenfield, Jennifer Topping, and Lucinda Morrow), and one part-time employee. Otolith microchemistry work has been done with species caught in the Puget Sound and Columbia River. The WDFW ageing lab has also worked on validating laser ablation and back-calculation models. Overall, the ageing lab produces between N = 60,000 and 120,000 ages per year (N = 10,000 ages per year for groundfish stock assessment and management; N = 5000 to 10,000 ages per year for freshwater species stock assessment, management, and invasive species control; and N = 45,000 to 100,000 ages per year for salmonid forecasting, run reconstruction, research, management). Andrew currently works on steelhead trout, Chinook, and sockeye salmon for forecasting, along with Lance. The WDFW's age database is being initiated, making a transition to a digital barcode system, although there has been difficulty in agreeing on the format. The WDFW ageing lab has a new microscope that uses Image Pro. Andrew reported that a new species, eulachon, is being aged for otolith microchemistry studies; a juvenile survival history project is being started by Lance and Anna; black, China, yelloweye, and rougheye rockfish continue to be aged by the lab. The Salish Sea Marine Survival Study involves otolith chemistry and scale morphology work for Puget Sound and coastal populations of Chinook salmon. This work will describe juvenile life history strategies in surviving adults and compare early marine growth between populations, years, and ocean conditions. In addition to eulachon, the WDFW ageing lab may potentially age Puget Sound Pacific cod and John Day River smallmouth bass. Andrew mentioned that Bethany Stevick is working with shellfish (Bethany stated that she has been working on geoduck and has aged N = 800 specimens in the last 5 months). The WDFW purchased an Isomet 5000 high speed saw for improving production ageing efficiency. Andrew asked if anyone has done rock scallop ageing and Joanne Groot asked about species exchanged from the Puget Sound, namely for toxin studies.

H. Oregon Department of Fish and Wildlife (ODFW) – Lisa Kautzi:

Lisa Kautzi reported that she is the only age reader at ODFW, and for the past two years has been ageing commercial and sport black rockfish and kelp greenling. She mentioned that she changed from using break-and-burn to the break-and-bake ageing method for black rockfish, with break-and-burn used as a backup. Lisa stated that kelp greenling were very challenging and she has aged N = 3800 structures in 2014. Lisa has fulfilled age requests for special projects on blue rockfish, copper rockfish, and

kelp greenling, with N = 7400 ages produced during this time. Kautzi would like to move the otolith collection out of its current location, because it is in a tsunami zone, and to the new agency building in Salem, OR. Questions were raised on the logistics for long-distance storage; Dr. Tom Helser suggested that she talk with Katherine Maslenikov (museum curator) at the Burke Museum for archiving and database suggestions.

I. California Department of Fish and Wildlife (CDFW):

No report; McDonald (NWFSC − PSMFC) stated that Brenda Erwin is the contact person for the CDFW.

III. CARE to CARE Recommendations from 2013 – Review

A. Recommends the manual working group post-archived editions of the CARE Manual on the website with a link to the year of publication.

Manual for post-archived editions has not happened yet. It will be left on the docket for the next CARE meeting. Betty Goetz mentioned she could not answer if digital archives exist. The committee agreed to modify old techniques to clean up the document; create an acknowledgments section; and re-examine the CARE Manual.

B. Recommends the Manual/Glossary committee continue revision and expansion of the CARE Manual on Generalized Age Determination.

Continue revisions of CARE Manual; CARE recommended the following:

1. Lingcod Otolith Ageing – finalize draft and incorporate into manual.

   Kevin McNeel and Shayne MacLellan edited the final document and the manual committee will review tomorrow.

2. Thin Sectioning Method – edit updated draft.

   The CARE Manual working group edited the updated draft during the 2013 CARE meeting. Charles Hutchinson submitted the section on Thin Sectioning for rockfish otoliths and it needs to be generalized to include techniques for all species.

3. Rockfish Ageing Procedures

   a. Edit to avoid redundancy with Thin Sectioning section – will continue to be revised to avoid redundancy.

   b. Revise/move some information to Otolith Ageing Procedures where appropriate.

4. Add section on baking otoliths under General Ageing Procedures

   Elisa Russ (ADF&G – Homer; CARE Chair) started by asking if any agencies use break-and-bake procedures and requested that agencies e-mail which species are broken-and-baked, as well as any other techniques used, such as surface reading. Russ brought up the CARE website to look at the record for certain species and proposed a change to the code for break-and-burn (B&BN) vs. break-and-bake

(B&BK) technique; Dr. Tom Helser (AFSC) suggested changing the format of the tables for species on the CARE website. Kevin McNeel (ADF&G – Juneau) mentioned including a statement in the manual that refers to the table on the CARE website. Russ would like to have production numbers by the end of April. Jon Short (AFSC) mentioned that modifying the table format would be difficult and suggested listing current methods and contacting agency about updated techniques. Russ asked if listing all methods would be acceptable for the last 10 years. Craig Kastelle (AFSC) said it would be useful to look at changes in techniques from a stock assessment perspective. Goetz mentioned changing the title of the section on baking otoliths to simplify things – motion was accepted. Helser asked if any publication information could be provided for species; Short mentioned there is a reference list on the CARE website; Russ said an update on publications would be recommended. McNeel stated that Tim Frawley (ADF&G – Juneau [offsite]) would be willing to help with hyperlinking references on the CARE website. Russ asked who would like to meet with Short to work on the website – Helser (AFSC) and Dion Oxman (ADF&G − Juneau) volunteered. Sandy Rosenfield (WDFW) asked if any stock assessors have visited the CARE website; Russ recommended adding a counter to keep track of visitors to the website.

5. Ergonomics – write short section to be included with general information on equipment.

   A section was submitted (Betty Goetz [AFSC] mentioned that she has a copy); Elisa Russ (ADF&G – Homer) asked for volunteers to work on the ergonomics section (Goetz accepted the task).

6. Walleye Pollock Ageing Procedures – draft new section; collaborate between agencies.

7. Sablefish Ageing Procedures Section – revise.

   Delsa Anderl (AFSC) said 2017 will be the end date for revisions and mentioned that several people have retired, which has delayed the process.

8. Remove documentation sections in the beginning of manual as is – incomplete.

   a. See Recommendation A to post archived editions.

   b. Add Acknowledgments Section.

C. Recommends CARE Forum be continued.

   Elisa Russ mentioned that activity on the forum typically increases immediately after CARE meetings and recommended revising the notification process.

D. Recommends the Website committee load a new version of Joomla for the CARE website, or other recommended CMF (e.g., WordPress or Drupal).

   Future plans include:

   1. Edits such as consistent capitalization on Species Information page.

Jon Short (AFSC) stated that he has not had time to work with the program to update the website and Dion Oxman (ADF&G – Juneau) said that he will recruit new people to help out.

2. Update agency production numbers.

   Jon Short mentioned that he is compiling new production numbers using a specific Excel template that was distributed this year which he recommended; said compiling information can be time-consuming when provided with different formats. Russ referred to prior discussion about using hyperlinks to Species Information page; Sandy Rosenfield (WDFW) recommended adding links to agency websites.

3. Add webpage for age structure inventories.

   Elisa Russ made a recommendation for moving forward with adding webpage for age structure inventories (for agencies that choose to participate) for this year and suggested that CARE members can agree to the website section by e-mail.

E. Recommends further study of otoliths stored long term in glycerin-thymol.

1. Report on observations regarding the media in 2015,

   Reports and discussion scheduled on agenda for this meeting.

2. Provide recommendation to manual committee in 2015 regarding storage.

   CARE will save the recommendation on glycerin-thymol storage to manual committee in 2015 for Working Group Reports (See **Section VII**).

F. Recommends to the Charter Working Group to expand charter to include timelines for reports and meetings for possible additions to the charter pending CARE membership approval.

   Russ and Goetz will work together and bring the recommendation to make additions to the charter, on Friday, April 17th.

IV. CARE to TSC Recommendations from 2013

At the 2013 CARE meeting, the manual working group drafted a section of Ergonomics for inclusion in the CARE Manual on Generalized Age Determination. It is important that agency leaders recognize the health risks associated with age reading and equipment options that may be available to mitigate these risks.

CARE members recommended making TSC aware of ergonomics (motion was acknowledged by TSC). Safety and ergonomics were topics addressed by agency leads.

V. TSC to CARE Recommendations from 2013

TSC acknowledges CARE's concerns regarding ergonomic injuries caused by extended period of ageing fish and has recommended that the Parent Committee request agencies to investigate ergonomic remedies to minimize ergonomic injuries.

Dr. Tom Helser (AFSC) mentioned that his agency has purchased ergonomic equipment, such as adjustable-height desks, foot operated focusing, and ergonomic eyepieces, and that the use of ergonomic equipment has been addressed by other departments at the AFSC. He also pointed out that a doctor's recommendation for ergonomics is required by AFSC. Patrick McDonald (NWFSC – PSMFC) mentioned that the Newport Ageing Lab has adjustable work stations, as well as ergonomic eyepieces and baffles for the scopes. Elisa Russ (ADF&G – Homer) said that her agency has ergonomic eyepieces. Andrew Claiborne (WDFW) stated that his agency is slowly purchasing ergonomic equipment for the ageing lab. Joan Forsberg (IPHC) said that her agency has ergonomic equipment, and that they are not just for age readers. Russ then asked if a doctor's note was required for agencies to purchase ergonomic equipment – all agencies, except for the AFSC, do not require a doctor's note. Lisa Kautzi (ODFW) said her agency has purchased an adjustable work station for only one employee due to medical reasons; other work stations are stationary. Joanne Groot (CDFO) said her agency has purchased adjustable tables and chairs, as well as ergonomics for scopes and their usage was approved by upper level staff. Kevin McNeel (ADF&G – Juneau) said that his agency also purchased height-adjustable workstations, ergonomic eyepieces, and standing stress mats for their microscopes.

VI. TSC to CARE Recommendations from 2014

A. Held over ergonomic injury recommendation from 2013 and TSC suggested looking at ergonomic injuries and solutions in similar assembly-type work (e.g. circuit boards) and medical pathology (e.g. microscope slide reading).

   Ergonomic injury recommendation from 2013 was accepted by CARE.

B. The TSC understands that CARE is looking into issues surrounding long-term storage of otoliths. TSC suggests that CARE researchers document their findings and develop a set of best practices for short and long term otolith preservation and storage.

   In regards to the issue of storing otoliths long-term, it has been difficult to gain agreement due to varying opinions among agencies. For the IPHC, Pacific halibut are stored in glycerin solution; either in vials (collected 1920s through 2000) or Tray Biens (2001-present). The IPHC has stored otoltihs in glycerin solution since the 1920s, with thymol added as a preservative for at least the past 40 years; the agency does not have documentation on exactly when thymol began to be routinely added to the glycerin solution. In 2014, IPHC agers re-aged over 8,000 otoliths collected between 1926 and 1985; Dana Rudy (IPHC) removed these otoliths, which were stored in vials, and transferred them to Tray Biens prior to re-ageing. Forsberg reported that most of the otoliths examined were in good condition. Some of the otoliths from the 1920s and 1930s (≤5%) had a chalky coating that obscured surface growth patterns, however, most of the otoliths with chalky coatings were still readable when broken and baked. However, the IPHC age readers were unsure about the cause of chalkiness, whether it was due to partially dissolved otolith material, mold, combination of both or other factors; surface staining on otoliths from tannins in corks did not obscure patterns on the surface or in baked sections. Age zero- and 1-year otolith collections (juvenile Pacific halibut) retrieved in early 2000s after 40 years of storage in glycerin solution were washed and dried for bomb radiocarbon studies, and were found to be decalcified;

however, otoliths from larger Pacific halibut stored in that medium for a similar time period were not degraded. The IPHC's small fish otolith collection was consequently transitioned from storage in glycerin solution to dry storage. Forsberg also stated that the IPHC continues to use glycerin-thymol for long-term storage; it takes about 4 weeks to rehydrate a dry otolith; and clearing using glycerin-thymol solution helps with the contrast when using the break-and-bake and/or surface-ageing methods.

Delsa Anderl (AFSC) said that her agency's collection is archived at the University of Washington's Burke Museum. She mentioned that, since 2009, the AFSC converted to storing all otoliths exclusively in glycerin-thymol versus some species in ethanol due to flammability and associated transportation issues. Anderl also addressed the matter of chalky otoliths, a topic brought up during the 2013 CARE meeting by Sandra Rosenfield (WDFW). Anderl reported that the AFSC chose to review otoliths for two flatfish species (arrowtooth flounder and yellowfin sole) and two roundfish species (sablefish and walleye pollock) from collection years ranging from 1980s to present; flatfish were historically stored in glycerin-thymol while roundfish were stored in ethanol until 2009, then stored in glycerin-thymol (therefore, some earlier roundfish otolith samples taken for this review were stored in ethanol). These otoliths were randomly sampled and scored based on a scale of four criteria ranging from pristine to deteriorated with surface pattern discernment (and presence of chalkiness/degradation) as a guide. Analyses attempted to determine whether otoliths exhibited a species-specific condition, whereby some years were pristine while other years were not, and/or processor-dependent condition, in which vials and otoliths may have been cleaned improperly. Anderl wanted to know what the Japanese used to preserve sablefish otoliths because the clarity of the annuli was the best she has seen, and would like to do further studies to determine what factors could contribute to chalkiness. She mentioned that she received mixture information for glycerin-thymol from IPHC and Elisa Russ (ADF&G – Homer) stated that Lance Sullivan (NWFSC – PSMFC [CARE Secretary]) will include the glycerin-thymol recipe in the 2015 CARE minutes.

Reports submitted by AFSC and IPHC are contained in **Appendix II**, and recipe for glycerin-thymol solution provided by IPHC is **Appendix III**.

Joanne Groot (CDFO) stated that her agency currently stores otoliths in 50:50 solution of glycerin:water with added thymol because the otoliths became brittle when stored in ethanol, while team leads from WDFW, ODFW, ADF&G, and NWFSC conveyed that their agencies store otoliths dry. Rosenfield said that Shayne MacLellan reported that Pacific hake otoliths had no problem with glycerin-thymol, but there was a problem with juvenile sablefish otoliths. To preserve the integrity of juvenile sablefish otoliths, WDFW stored them dry. Russ asked a final question to the group about rehydration (for clearing otoliths for surface ageing); Lisa Kautzi (ODFW) suggested rehydration well ahead of ageing without using water, due to the risk of bacterial growth, or glycerin-thymol because it takes too long; Lisa recommended using ethanol in Tray Biens once otoliths are transferred into the cells to allow structures to rehydrate quickly (at least a week) without concerns about bacterial growth. Kevin McNeel (ADF&G – ADU) said the Juneau lab would sometimes use ethanol to rehydrate difficult-to-age specimens and/or to evaluate otolith edge.

Dr. Tom Helser (AFSC) stated that evidence is inconclusive regarding the long-term effects of glycerin-thymol on otolith integrity and emphasized that studying such long-term effects would be a significant undertaking that is not a priority. Elisa Russ (Chair) agreed and polled the group and determined the best course of action was to create a 2015 CARE to TSC recommendation to remove the 2014 TSC to CARE recommendation, to create a set of best practices for otolith storage, due to no consensus on best storage protocol within CARE.

VII. Working Group Reports/Activity Since CARE 2013

A. 2014 TSC Meeting (Elisa Russ)

1. Replies to TSC regarding 2013/2014 recommendations.
    a. Note in Section VI that prior recommendations were reviewed and 2014 TSC to CARE discussed.
2. Long-term otolith storage; review from 2013; glycerin-thymol observation reports.
    a. Reports were presented during 2014 TSC to CARE review; **Section VI. B.**

B. Age structure exchanges (Chris Gburski)

Ten age structure exchanges for six species by six agencies were completed and documented. Exchanges initiated in 2014 can be documented through June, and agencies will be provided CASE (CARE Age Structure Exchange) IDs by the Vice-Chair and may submit CASE documentation (Excel file) when completed. It was suggested that agencies look into utilizing CASEs for training as well as calibration on any given species. Discussion revealed that there had been a few age structure exchanges that had occurred but had not been catalogued in the CASE system. Elisa Russ (Chair) expressed the importance of participating in as well as documenting exchanges, especially so that information is available to CARE members. Craig Kastelle (AFSC) said that age structure exchanges were essential for CARE's mandate, and the importance was stressed in the early development of CARE, and shows work of CARE members as a useful product, thereby allowing stock assessors to compare age determination between agencies. Dr. Kray Van Kirk (ADF&G – Juneau) mentioned that a conversion matrix is implemented for sablefish, in terms of determining the extent to which agencies age similarly and developing a proxy for age reader precision.

C. Website (Jon Short)

Dion Oxman (ADF&G – Juneau) and Dr. Tom Helser (AFSC) agreed to join the group for discussion tomorrow. The progress of archived structures being added to the CARE website will be addressed, as well as updating the website with agency location, contacts, and links.

D. Forum (Nikki Atkins)

Although Atkins was absent from the meeting, the CARE Forum will still be maintained by her.

E. CARE manual (Elisa Russ)

CARE manual committee tasks will be discussed tomorrow and current submitted drafts will be reviewed by the working group. Current members Elisa Russ (ADF&G – Homer), Betty Goetz (AFSC), and Barb Campbell (DFO) will be joined by new members Lisa Kautzi (ODFW) and Chris Gburski (AFSC).

F. Charter Committee (Elisa Russ)

Elisa Russ (ADF&G – Homer) and Betty Goetz (AFSC) will review the charter tomorrow.

G. Sablefish (Delsa Anderl)

Working group meeting and final results tabled until CARE 2017, however, input on sablefish manual section will be provided during this meeting. Current sablefish ad hoc working group members are Delsa Anderl (AFSC), Patrick McDonald (NWFSC – PSMFC), Kevin McNeel (ADF&G – Juneau), Barb Campbell (DFO), and John Brogan (AFSC).

VIII. Topics for Discussion/New Business

A. Summary of 5th International Otolith Symposium (IOS) 2014 – Craig Kastelle (AFSC)

Craig Kastelle gave a brief summary of the 5th IOS, which was held October 20 – 24, 2014, in Peguera, Mallorca, Spain. There were over 300 scientists in attendance, with more than 300 presentations (e.g., oral, poster, speed [5-minute talks], and continuous slide shows) given. Some of the main points from the presentations were as follows:

- Large diversity of uses and science based on otoliths
- Otolith studies go beyond fisheries management
- Otoliths are often centered around the black box concept (i.e., analogous to a flight recorder)
- Otolith studies involved four themes (environmental, population, community, and individual indicators)

Also during the symposium, two workshops were held, in which age validation and otolith morphometrics (i.e., shape analysis) techniques were demonstrated. A majority of the groups focused on otolith morphology and microchemistry. Key ideas from the symposium included: 1) bomb radiocarbon chronologies have a lag at depth; 2) efforts to validate the first year's growth; 3) cyclical patterns in magnesium (Mg) and rubidium (Rb) across the lifespan of an individual fish; 4) Mg in otoliths may be related to temperature; and 5) a new species identification key from otoliths is soon to be published (by Nolf). Future work on Atlantic cod will be performed, based on findings that future growth and survivability of an individual can be determined by early otolith size and growth rates, and interestingly, Atlantic cod from two adjacent geographic regions had translucent growth zone formation 6 months apart (by Gronkjaer).

B. Other conferences since 2013 that members attended – no other conferences attended

C. Species information on the website – need Agency updates and verification

Discussion regarding how to tie together species, agency, and age determination techniques on the website perhaps linked with contact information.

D. Additional topics – none proposed

E. Non-agenda items – none proposed

IX. Oral Presentations – Abstracts located in **Appendix IV**.

A. Topic Session 1: New Techniques in Age Determination Methods

1. Dr. Raouf Kilada (crustacean workshop presenter) – *Finally, We Can Say How Old This Crab Is.* (45 minutes)

Dr. Raouf Kilada gave a presentation on age determination of crustaceans. Historically, work on other hard structures (i.e., otoliths, vertebrae and shells) can determine age. Molting prevents accurate ageing, thereby requiring methods in ageing crustaceans to be indirect. Growth studies are done in captivity, using mark-release experiments via tagging (PIT, etc.); length-frequency analysis (e.g., fish ectoparasites); and lipofuscin (LF) concentration via fluorescence intensity and a LF index (which requires a lot of training on a spectrophotometer). Direct age determination of crustaceans is done via the use of eyestalks, which requires dissection and removal of brain tissue. Cutting axes for processing eyestalks are perpendicular (longitudinally and latitudinally). The base of the eyestalk funnel gave the best age estimates. Cuticle layers (epi-, exo-, and endocuticle) making up the eyestalk are clear for snow crab. For red king crab, Tanner crab, squat lobsters (red and yellow), swimming blue crab, red swamp crayfish, American lobster, and snow crab, the gastric mill ossicles (uro-, zygo-, and mesocardiac) were used as another direct ageing method. Dr. Kilada confirmed that gastric mills have cuticle layers (endocuticle), therefore validating their use as structures to be directly aged. Ageing errors were addressed using endocuticle bands, with validation performed via calcein stain and correlating the instar to band counts using length-frequency analysis. Upon the conclusion of his presentation, Dr. Kilada answered questions from the CARE members. The first question concerned whether growth zones are retained after molting. Dr. Kilada stated that, given using calcein as a marker for birth year, the exuviae of gastric mill ossicles are not molted, as seen in American lobster. Furthermore, he pointed out that the size-at-age using carapace length for snow crab, American lobster, and Northern shrimp (a hermaphroditic species) validated that growth bands are the actual age of crustaceans. He also mentioned that the zygocardiac is used for determining the age of swimming blue crabs, although a strong correlation may not yield enough evidence to age crustaceans using this method. Studies for Lakes Bardaweel and Timsah species may estimate age at 3 years instead of 2 years. Dr. Kilada stated that there was a corroboration of band counts in red king crab species from Canada and Norway; other species studied included nephrops, krill (results were inconclusive), rock crab, and

European lobster; and future studies on core isotope (i.e., strontium) ratios between marine and freshwater will be addressed. Dr. Tom Helser asked about what "guesstimates" imply; Dr. Kilada replied that they are used to distinguish from estimates. Helser also asked if bomb radiocarbon has been used; Dr. Kilada said that ^{14}C has been obtained from clams, but he is hesitant to use ^{14}C dating techniques on eyestalks and gastric mill ossicles, which are apatitic not aragonitic.

2. **Irina Benson – *Preliminary Results on the Use of Otolith Microchemistry for Developing Ageing Criteria for Eulachon (Thaleichthys pacificus).*** (20 minutes)

Irina Benson presented preliminary results on the otolith microchemistry of Eulachon (*T. pacificus*). Trace elemental analysis is used as a temporal record of ambient water temperature, in which barium (Ba) was the primary element of interest. The Ba concentrations fluctuate with season (summer upwelling brings a seasonal increase in Ba concentrations, as well as an uptake increase). When analyzing trace element concentrations, peaks involving barium-to-calcium (Ca) ratios were used to age eulachon (via the Clark hypothesis). Three geographical regions (Bering Sea, SE Alaska, and Oregon) were selected as the sampling areas. Laser ablation inductively-coupled plasma mass spectrometry (LA-ICP-MS) was used to take rasters (scanning lines) of material from thin sections, going from the core to the proximal edge. Benson said that the analysis was corrected for background noise and instrument drift. Using Ba:Ca peaks to determine age varied with geographical region and sometimes it made interpreting graphs difficult. Another problem that Benson encountered involved the surface having a clear age, but the graph did not correlate; there was some uncertainty about not counting the first year. She also pointed out that the otoliths may have had either a smaller first year or non-annular marks (shown on the graph), which further complicated interpreting the results. Canonical discriminant analysis (CDA) compared the elemental ratio signatures in otoliths from three separate geographical areas (coefficient of each elemental ratio) and was used to measure its discrimination power. Benson concluded by giving the preliminary conclusions, as follows: 1) CDA – specimens from three areas were different based on elemental profiles, 2) Ba signatures suggested annular fluctuations due to summer upwelling – elemental signatures may be useful as annual markers, 3) additional oceanographic studies needed to determine seasonality of chemical signatures in different areas, and 4) the size of first annulus on eulachon otoliths may be variable in different geographical areas. There were no questions posed by CARE members.

B. Topic Session 2: Age Validation Studies

1. **Tom Helser – *Estimation of Ageing Bias Using Bomb Radiocarbon $\Delta^{14}C$ Signatures in Fish Otoliths: Beyond Plot and Cluck.*** (30 minutes)

Dr. Tom Helser presented his research on the estimation of ageing bias using bomb radiocarbon signatures in otoliths from pre-1990s fish capture dates. Helser also published articles that pertained to age validation of otoliths from fish that absorbed ^{14}C from atomic bomb testing, whereby it entered the hydrologic cycle via river influx and upwelling. He reported that ^{14}C increased in the 1950s and decreased in the 1960s and radiocarbon dating techniques were used to validate ages of canary

rockfish using reference chronologies for Gulf of Alaska (GOA) Pacific halibut and Pacific Ocean perch (POP). Sources of error included: 1) ageing error due to a shift in points, 2) measurement error (i.e., small variances that were controlled for); and 3) process error (i.e., mixing species in the same environment). Helser developed a robust tool to investigate the assumption of process error. Objectives of the study involved fitting the functional response to the GOA Pacific halibut reference chronology and rockfish test samples, estimating ageing bias and its uncertainty, and testing for the effects of oceanographic factors on upwelling, latitude, and wind stress, the latter of which creates stability. Statistical methods involved using Bayesian inference via a Markov Chain Monte Carlo (MCMC) simulation for diagnostics, where the unbiased sample was centered on 0 (determines probability of ageing bias). The results consisted of functional responses indicating no significant differences in pulse between the reference and test species. When the functional response was centered on zero, there was no bias between the reference chronology and POP. On the other hand, the functional response was not centered on zero for canary rockfish, which may not be indicative of bias due to a difference in the geographical regions. Helser concluded his presentation by saying that using the correct reference chronology with test samples is necessary for bomb radiocarbon dating; a multi-level Bayesian approach provided the framework for hypothesis testing; and the functional form of $\Delta^{14}C$ signatures vary by species, latitude, upwelling, and other factors. There were no questions.

2. **Stephen Wischniowski (presented by Tom Helser) – *Incorporation of Bomb-Produced ^{14}C into Fish Otoliths: An Example of Basin-Specific Rates from the North Pacific Ocean.*** (15 minutes)

Dr. Tom Helser presented in place of Stephen Wischniowski on the incorporation of bomb-produced ^{14}C into otoliths. The method assumptions included species used for the reference chronology that received radiocarbon from the same system or source as the test species to be validated. Only the first year's material was measured. The goal of the research was to develop a new known-age bomb-produced ^{14}C reference for eastern Bering Sea Pacific halibut and other species, when compared to GOA Pacific halibut. Helser concluded by stating that regional differences in ^{14}C incorporation were likely due to basin-specific oceanographic processes (latitudinal gradient) and mixing rates. No questions were posed for Helser.

3. **Craig Kastelle – *Use of the Stable Oxygen Isotope, ^{18}O, in Otoliths as an Indicator of Fish Life History Events and Age Validation.*** (25 minutes)

Craig Kastelle presented his research on the use of stable oxygen isotope, ^{18}O, as an indicator of fish life history events and age validation, including habitat usage, estimating water temperature, developing age determination criteria, estimating probability of ageing error, and investigating climate change effects. Four species (Pacific cod [PCOD], saffron cod, small yellow croaker, and yellow fin sole) were used in the study. In regards to the age validation of PCOD, the peaks of ^{18}O determined age, as well as life history. By estimating the probability of ageing error (bias), cycle of ^{18}O used to determine the "true age"; ageing error was

determined by age, for 2 to 5 years, and all ages combined using a sample size of N = 40 over the age range with four replicate age readings. Kastelle found that fractionation in otoliths is inversely related to temperature. As ^{18}O was measured sequentially across an otolith, the readings spanned the fish's life history and a seasonal cycle, or trend, should be seen. To obtain ^{18}O samples, Kastelle micromilled material along specific trajectories, where each track goes progressively from center to edge, representing life history. Once the micromilled otolith was sampled, the resultant powder's ^{18}O content was analyzed with secondary ion mass spectrometry (SIMS), a high resolution sampling technique. Several factors affecting ^{18}O in otoliths included the ^{18}O content of water, fish migration, and milling resolution (especially in later years). The ^{14}C milling on PCOD otoliths yielded results that differed from GOA Pacific halibut reference, so an ^{18}O plot was made to confirm life history or ontogenetic migrations. Upon concluding his presentation, Dr. Tom Helser mentioned that as a fish descends the water column, ^{14}C signal and uptake declines. Beth Matta confirmed that juveniles reside in shallow regions, which could result in the trend of ^{14}C seen in the plot, relative to the Pacific halibut reference curve.

*(**Note:** Due to time constraints, Kevin McNeel's and Kristin Politano's presentations were rescheduled for Thursday, April 16, 2015.)*

C. Topic Session 3: Age-Based Models for Fisheries Stock Assessment and Management

1. **Dr. Kray Van Kirk – *Ageing and Stock Assessment: Uncertainty in Data and Analyses*** (20 minutes)

Dr. Kray Van Kirk gave a presentation on ageing and stock assessment, with respect to uncertainty in data and analyses. He reviewed the meaning of stock assessment, which is defined as an effort to determine the response of a given population (stock) to fishing. Stock assessors analyze commercial catch, biological, and survey data. Dr. Van Kirk stated that the stock assessment model predicts a response when changing parameter values; parameter values are changed to match model output to observed data. He also said that although the stock assessment construct shows trends in abundance, catch, and exploitation rates, it is meaningless without the age structure. For example, in confounding scenarios where catch and exploitation rate increase while abundance decreases, stock assessors need to answer "Why?" by looking at recruitment, fishery selectivity, and mortality. Stock assessors are able to track cohort strength and attempt to quantify recruitment (birth), growth, fisheries removals, and death, which in turn may inform fisheries management decisions and regulations based on factors learned (e.g., recruitment, maturity, gear selectivity, and senescence). Age variability occurs when there are discrepancies when agers have a difficult time ageing otoliths (e.g., sablefish extremely variable relative to length). Dr. Van Kirk stressed the importance of second reads and age validation, which are critical to stock assessment. The real-world effects of obtaining precise age estimates is palpable, whereby including ageing error highly impacts fish populations. Ignoring ageing error has huge impacts on management since ageing is a critical, pivotal foundation for stock

assessments. After Dr. Van Kirk concluded his presentation, he answered questions from the audience. Delsa said the AFSC has an ageing error matrix and emphasized importance of interagency exchanges. Dr. Van Kirk said exchanges would help eliminate ageing error for species. Dr. Raouf Kilada said the ageing error matrix is not relevant to crustaceans, which was confirmed by Dr. Van Kirk. Dr. Tom Helser asked about comparing two subsamples of length-at-age from commercial samples. In response, Dr. Van Kirk could not distinguish between precision and accuracy if the known length-at-age has not been determined. Sandy Rosenfield asked Dr. Van Kirk if he sends outliers back to ageing agencies to re-examine (e.g., to distinguish sampler error versus ageing error); Kray questioned whether or not to throw out such an age. Rosenfield followed this question by asking if the level of ageing difficulty is included in the ageing error matrix and Dr. Van Kirk's answer was that the difficulty is inherent as there needs to be a separate ageing error matrix for each species and it needs to be recalculated every time a new age reader is added to the mix. Russ mentioned her agency has encountered variability in age data with fish at a given length. Irina Benson suggested looking at the same samples Helser mentioned and conduct analyses after plotting normalized distribution and for these analyses age readers should have minimum of 10 years' experience for that species.

Thursday, 16 April

X. Working Groups and Workshops

A. Crustacean Workshop (Age and Growth Laboratory)

Interest from the CARE membership resulted in a special workshop being organized for the 2015 CARE Conference that focused on a new age determination technique developed by Dr. Raouf Kilada from the University of New Brunswick, Saint John. Dr. Joel Webb (ADF&G – Juneau) assisted Elisa Russ (CARE Chair) in the organization and planning of the workshop, and also assisted Dr. Kilada in conducting the workshop. Some CARE members have already been involved with shellfish age determination for bivalves (e.g. geoduck clams, weathervane scallops) and TSC was consulted for approval prior to planning the crustacean workshop. The workshop focused on Dungeness crab, snow crab, and spot shrimp (prawn), and participants provided specimens. The AFSC had excellent facilities and equipment to host the workshop and aspects included dissection of the age structures – eyestalks and gastric mills (crab only), embedding in resin, sectioning, and imaging. Participants in the workshop were able to successfully prepare specimens for age determination. There were a total of 20 participants from AFSC, ADF&G, CDFO, ODFW, and WDFW. Participants anticipate future age structure exchanges and calibration work as techniques are further developed and implemented.

B. Working groups (Traynor Room or Room 2079)

1. CARE Manual/Glossary Subcommittee

The members of the manual working group are lead Elisa Russ (ADF&G – Homer), Betty Goetz (AFSC), and new members Lisa Kautzi (ODFW) and Chris Gburski (AFSC). Barbara Campbell (CDFO) is also a member although she was unable to attend the working group meeting at the 2015 CARE meeting due to a conflict with the sablefish working group. The Manual/Glossary Committee working group members develop and update age-reading chapter sections and definitions for age-reading terms as suggested and contributed by CARE members. These chapter sections and definitions are subsequently approved by CARE members and added to the CARE Manual/Glossary.

The subcommittee addressed 2013 manual recommendations, drafted 2015 recommendations, and delegated tasks. Tasks include compiling edits and finalizing the lingcod section that the ADF&G – Juneau (ADU) staff submitted, incorporate thin sectioning methods and edit rockfish ageing section (Elisa), compile information from all agencies on baking otoliths and draft section (Elisa, Betty, Lisa), revise draft of ergonomics section to be included with equipment information (Betty) [Julie Pearce (AFSC) attended the manual working group meeting, provided additional suggestions/information on ergonomic equipment from the perspective of a new age reader and will supply equipment list to Betty by end of April], and draft the walleye pollock section (research and provide draft at 2017 meeting – Elisa).

An Acknowledgments Section will be prepared for manual version generated after the 2015 CARE meeting and the manual subcommittee will work with the website subcommittee to post archived editions of the manual. The manual working group will review the sablefish section once submitted by the sablefish working group. The manual working group will work with Dr. Cindy Tribuzio (AFSC/NMFS – ABL) on a new spiny dogfish section for the manual since she has drafted an age determination manual for that species in process of publication. After review and approval by the manual working group, all revisions will be submitted to the full CARE membership for final review and approval followed by incorporation into the CARE manual. Recommendations are included in CARE to CARE 2015.

2. CARE Website Subcommittee

The CARE Website Subcommittee members are Jon Short (AFSC) lead webmaster, Nikki Atkins (NWFSC – not present), and new members Dr. Thomas Helser (AFSC) and Dion Oxman (ADF&G – Juneau). The CARE website (http://care.psmfc.org/) working group administers the website including appearance, operation, and access to the site, through the cooperation of the PSMFC website and webmaster. Short requested 2014 production numbers and will update the CARE website with 2014 production numbers, 2014 age structure exchanges, and the 2015 CARE meeting minutes once approved. Atkins continued to maintain the CARE Forum in 2014 (link on website).

The website subcommittee meeting also included Tim Frawley (ADF&G – Juneau; recruited by Dion Oxman) by teleconference to discuss the future of the existing website. The website working group discussed the possibility of adding

publications of fish ageing and validation to the website so that relevant information is more accessible to the age reading community and stock assessors. One option was to add links to the existing species information page and the ageing method table. Another option is to create a more sophisticated database back-end that would allow users to search by species, ageing technique, validation method, author, etc. Publication entries could be added by agency representatives into an online form that would populate the database back end, and automatically link to appropriate species information pages. ADF&G staff expressed interest in building the web application if they would be able to employ their expert knowledge of ASP.NET and IIS Web Services on the project. The existing web technology of Joomla that utilizes mySQL and PHP is not a technology they support.

The CARE website is on a Joomla 1.0 document management system (DMS) that was implemented in 2008 on a PSMFC server. The Joomla version is past its supported lifespan and the current version of Joomla is 3.4. It is a major undertaking to update the website to the current version of Joomla, so we discussed the possibility of converting the site and the CARE Forum to a different technology. Tim expressed willingness to support the effort to move to an ASP.NET website if that option is available on the PSMFC web server. Jon Short agreed to research options with PSMFC to see what choices are available. As of 2012, PSMFC themselves had switched from Joomla to a WordPress website, so that is one option if CARE decides to leave Joomla for another open source DMS. Both Jon and Tim expressed concern about committing to a major project such as converting the CARE website, but both are willing to assist on the project as time allows.

3. **Charter Subcommittee** – Elisa Russ (ADFG) and Betty Goetz (AFSC)

   The Charter, initiated in 2000, provides a framework in which the original intent of CARE may continue. It also familiarizes new CARE members to the function of CARE and the responsibilities of its officers and members. The subcommittee is responsible for facilitating changes and updates to the Charter, and the charter was revised following the 2008 CARE meeting.

   The charter working group reviewed the charter and made recommendations to CARE to edit information on timelines including TSC report preparation following same year CARE meeting, add information on submission of production numbers (species aged table), and coordination with the Chair and host agency regarding meeting logistics. The revised charter will be submitted to the membership for approval by June 2015.

4. **Sablefish ad hoc Working Group**

   Current members are Delsa Anderl (AFSC) as the lead and other members include Patrick McDonald (NWFSC – PSMFC), Kevin McNeel (ADF&G – Juneau), Barbara Campbell (CDFO), John Brogan (AFSC) and new members Lance Sullivan (NWFSC – PSMFC) and Kristin Politano (ADF&G – Juneau). Due to some past members leaving their positions, tasks were reassigned with plans to update the Sablefish section in the age determination manual with the draft complete by the end of 2015 and submission to the manual subcommittee by summer 2016, with

review and approval by the membership prior to the 2017 CARE meeting. Additionally, some members of the group reviewed Sablefish otoliths to continue work on calibration and age determination criteria.

5. Shortraker Rockfish ad hoc Working Group

This is a new ad hoc working group formed for the 2015 CARE meeting with exchanges completed prior to the meeting. Working group members are Charles Hutchinson (AFSC) as the lead and Kevin McNeel (ADF&G – Juneau), Joanne Groot (CDFO), Delsa Anderl (AFSC), and Stephen Wischniowski (CDFO – absent). The Shortraker Rockfish working group convened in 2015 and discussed the age structure exchange (N = 46; 2 exchanges GOA & Canadian stocks) that was initiated in 2014 between 5 members of the working group from AFSC, ADF&G, & CDFO. The group utilized camera microscopes and imaging software during a mini-workshop to discuss the sectioned shortraker otoliths and pattern interpretation in detail.

AFSC members have the most experience ageing shortraker rockfish and the working group was utilized for calibration and training for the less experienced age readers. In addition to the members of the working group, three additional CARE members from AFSC and ADF&G participated for training on pattern interpretation. Shortraker rockfish growth patterns exhibit many checks during the early years up until approximately age of 20 years and then uneven growth increments after age 20. The Shortraker Rockfish working group made a recommendation to continue work on pattern interpretation through future exchanges of age structures (otoliths) and images culminating in a final Shortraker Rockfish workshop at the 2017 CARE meeting with the intention of developing the ageing criteria.

C. Hands-on microscope work and calibration (Traynor Room)

1. Sign up for dual scope station use (**Table 2:** 2015 CARE Hands-On "Scope Time" Session), microscope imaging station and micromill demonstration (**Table 3:** Microscope Imaging Station and Micromill Demo Sign Ups).

D. Poster Session – Poster presentations available for viewing all day and formal session with presenters will be 3 – 4 p.m. Abstracts are in **Appendix IV**.

XI. Oral Presentations – continued from April 15, 2015 (Abstracts in **Appendix IV**.)

A. **Topic Session 2: Age Validation Studies**

1. Kevin McNeel – ***Assessing Yearly Growth Increment Criteria Used to Assign Ages for Groundfish at the Alaska Department of Fish and Game Age Determination Unit Using Bomb Radiocarbon ^{14}C.*** (20 minutes)

Kevin McNeel presented his study on assessing yearly growth increment criteria, using bomb radiocarbon. He went over precision and accuracy diagrams, as well as methods to prepare otoliths for ^{14}C analyses via accelerator mass spectrometry. A yelloweye rockfish and Pacific halibut reference curve were both used due to

reference curve shape likely depending on various biotic and abiotic factors. McNeel stated that the results indicate an overall agreement of ages with ^{14}C data, but sample size must be adequate, or large enough to compare with the reference curve. Dr. Raouf Kilada asked about using the reference curve for a benthic versus pelagic species and that the minimum sample size was nine samples or individuals; McNeel said that the reference curve should match the species found at a given depth of the water column. Elisa Russ asked about whether specimens were of a known age which McNeel confirmed for the halibut reference curve, but not for the yelloweye rockfish.

2. **Kristin Politano – *Using Otolith Measurements to Refine Quality Control Procedures.*** (20 minutes)

Kristin Politano presented research done by the ADU on using otolith measurements to refine quality control procedures. Measurements of length, height, and weight were taken from otoliths after at least 2 weeks of drying and prior to age reading. The data was entered into the Oracle database via digital integration (with noted features), N > 250,000 structures. Politano mentioned that taking otolith measurements will improve quality control, which involves two stages. **Stage I** aims to develop a better age proxy using otolith morphometric analysis versus somatic length (change in fish length slows with age). It was determined that mean otolith length and height at age exhibit a similar relationship to somatic length, however mean otolith weight at age exhibits a nearly continual increase and is therefore a better proxy. **Stage II** aims to identify outlying age estimates, assuming that morphometric data is accurate. Data filter models of otolith weight and somatic length at age were developed and a "Goldilocks" method used to identify the correct standard deviation (±2) as a cutoff for detection of outliers that would include natural variability of population, as well as identify most gross outliers (transcription, translation, and calibration errors). These quality control procedures have been implemented to screen 100% of primary ages for yelloweye rockfish, sablefish, lingcod, shortraker rockfish, rougheye rockfish, and geoduck. Outliers are flagged for a blind reading by primary reader and if error per specimen exceeds species-specific control limits, the specimen is flagged for resolution. The next steps are to refine the model, evaluate it against validated specimens, explore other uses for otolith morphometrics (species ID), and report the data in OceanAK (ADF&G centralized portal for fisheries management data). Politano concluded by saying that otolith weights are useful in quality control procedures, data and database structure information are available, and models need to be refined. Bethany Stevick (WDFW) asked about age-at-length error being included in the model; Politano said that error is not included. Bethany also asked if error checking is done to account for human error; Politano confirmed this and referred to quality control procedures and re-reads for outliers. Colin Jones (WDFW) asked about collecting consistent data from a particular otolith side and Politano said that examining otolith morphology for each species is a goal of the project. Dion Oxman (ADF&G – Juneau) also mentioned environmental factors would be good to look at for comparison for a given otolith side. Dr. Raouf Kilada

asked about using the relationship between age and somatic growth; McNeel said a multivariate model would be useful.

Friday, 17 April

XII. Recommendations

2015 CARE to CARE

To start off the 2015 recommendations, Betty Goetz (AFSC) suggested updating the CARE website on the history of CARE after each meeting by highlighting key accomplishments. Goetz mentioned a focus was included in the history of CARE and also recommended the CARE Secretary might take responsibility for recording the history of CARE. Elisa Russ (ADF&G – Homer) suggested that she, Lance Sullivan (NWFSC – PSMFC), and Chris Gburski (AFSC) could work together to document the 2015 meeting's key notes. Gburski confirmed that working as a small group would be helpful to put together the 2015 record of the CARE meeting.

Russ then finalized the following 2015 CARE to CARE recommendations with the group:

A. Recommends the Manual/Glossary subcommittee continue the revision and expansion of the CARE Manual on Generalized Age Determination with the following sections:

   1. Lingcod Otolith Ageing section – finalize the draft in May 2015 (*thanks to ADF&G – Juneau ADU staff*) and submit to membership for approval in 2015;
   2. Thin Sectioning Method section – add a section under the General Ageing Procedures; finish the draft, finalize edits, and submit to membership for approval prior to 2017 meeting;
   3. Rockfish Ageing Procedures section – finish draft, finalize and submit to membership for approval prior to 2017 meeting,
      a. Edit to avoid redundancy with Thin Sectioning section,
      b. Revise/move some information to General Otolith Ageing Procedures section where appropriate;
   4. Add section on baking otoliths under General Otolith Ageing Procedures – research methodologies with agencies where techniques are employed and submit draft for 2017 meeting;
   5. Ergonomics section to be included with general information on equipment with included list of ergonomic equipment recommendations for age readers; finish draft, finalize, and submit to membership for approval in 2015;

      *(**Note**: Goetz added that she is soliciting input on the risks of age reading and prevention measures using ergonomics);*
   6. Walleye Pollock Ageing Procedures section (new) – collaborate between agencies and submit draft at 2017 meeting (use the AFSC manual as a starting point);

7. Sablefish Ageing Procedures section – draft will be completed by the Sablefish working group by end of 2015 then, after edits and revision, it will be submitted to the CARE Manual working group by June 2016 for finalization with submission to membership for approval prior to 2017 meeting;
8. Spiny Dogfish Ageing Procedures section (new) – prepare draft for 2017 meeting (following publication of CARE member's, Dr. Cindy Tribuzio, spiny dogfish age determination manuscript and use techniques described); and
9. Remove documentation sections regarding changes to CARE Manual (also incomplete),
    a. Add Acknowledgements section – submit to membership for approval for 2017 meeting;
    b. See Recommendation B to post archived editions.

B. Recommends the CARE Manual working group submit archived editions of the CARE Manual to the website committee for posting on the CARE website to preserve historical records.

C. Recommends that the CARE Forum be continued.

D. Recommends the website committee research the possibility and process of adding publications of fish ageing and validation to the website so that relevant information is more accessible to the age reading community and stock assessors,
    1. One option is to add links to the existing species information page and the ageing method table;
    2. Another option is to create a more sophisticated database back-end that would allow users to search by species, ageing techniques, validation method, author, etc.;
    3. Publication entries could be added by agency representatives into an online form that would populate the database back-end, and automatically link to appropriate species information pages.

E. Additional recommendations for the website to be completed prior to 2017 meeting are as follows:
    1. Add information at the top of the Species Information page to "Check with specific agency about changes in historical techniques"; report that "Methods listed are for most recent reporting year," or adjust in conjunction with changes incorporated in Recommendation F;
        a. Consider how to document changes in methods and age reading techniques by agencies for specific species and the process to report this information (e.g., website through species-specific methods, addendum to manual, and/or new document) – discuss at 2017 meeting by agency.
    2. Edits such as consistent capitalization on the Species Information page;
    3. Update agency production numbers annually
        a. Include methods for current year and use appropriate codes (B&BN = Break-and-burn, B&BK = Break-and-bake);

b. Update Species Information page to include new codes;

4. Add table for agency contacts with e-mail address – if possible, hyperlink from Ageing Method table (Agency field);

5. Add a webpage for age structure inventories (links may be in a spreadsheet or hyperlinks) for participating agencies, including protocol (*not everyone will have inventories*).

F. Recommends the Website committee research the possibility of converting the CARE website and CARE Forum to a different technology (Joomla is out-of-date and it requires a major undertaking to update to new version), as follows:

1. Consider moving to an ASP.NET website and research options available on the PSMFC web server; however, the amount of work involved and cost will be assessed prior to implementation;

2. Another option is to consider a WordPress website (as of 2012, PSMFC switched from a Joomla to a WordPress website); if, instead CARE website committee decides to leave Joomla for another open-source DMS, load a new version of Joomla for the CARE website, or other recommended CMF (e.g., WordPress or Drupal)

G. Recommends the Charter Working Group revise the charter and submit it to CARE membership for approval in 2015; changes to include:

1. Information on timelines including preparation of TSC report following same year CARE meeting;

2. Submission of production numbers (species aged table); and

3. Chair coordination with host agency regarding meeting logistics.

*(**Note:** It was noted that the Chair has to have executive summary completed immediately upon conclusion of the 2015 CARE meeting).*

2015 CARE to TSC

A. Recommend removing the TSC to CARE 2014 recommendation to produce a set of best practices for short- and long-term otolith preservation and storage. Currently, there is no consensus on the best storage protocol between, or even within, agencies because method suitability may be dependent on species, fish age, and/or archive space availability;

1. Reports from agencies using glycerin-thymol, including recommended recipe for solution, will be included in TSC report;

2. Agencies will continue to research whether current methods of long-term storage are adequate for preserving otolith integrity.

B. Recommend that new age readers are oriented to available ergonomic equipment, and its proper use for minimum strain. Further recommend that the purchase and use of ergonomic equipment should continue to be implemented and supported by agency managers, and proactive standard operating procedures be in place to prevent workplace injuries;

1. Reports on the use of ergonomic equipment were provided by CARE member agencies in 2015, and
    a. Most upgrades were implemented after requests by age reading staff or local project managers;
    b. Although some agencies have preventative and proactive protocols in place through either self-evaluation (see **Appendix V**) or ergonomic specialists Available for evaluation of workstation, need to ensure that is available for all agencies.

C. Recommend that CARE continues to explore and develop new methods of shellfish age determination.

D. Recommends that the TSC schedule their odd-year meetings (same year as CARE meeting) no earlier than the last week of April (preferably later) in order to allow the CARE Chair adequate time to prepare the report to TSC.

*(**Note:** CARE meeting for 2017 has been scheduled for the first week of April to allow at least two weeks to prepare the CARE report to TSC (if the TSC meeting is scheduled no earlier than the last week of April)* – **See XIII. B.**

XIII. Concluding CARE Business

A. Administration nominations

1. Nominate Chris Gburski (AFSC) as Chair – Accepted
2. Nominate Lance Sullivan (NWFSC – PSMFC) as Vice Chair – Accepted
3. Nominate Kevin McNeel (ADF&G – Juneau) as Secretary – Accepted

B. Schedule and location of 2017 meeting

1. CARE meeting will be held during the first week of April in 2017.
    a. It was recommended that the 2017 CARE meeting be held as early as possible, due to TSC meeting being held during last week of April, and CARE Chair must prepare CARE report prior to the TSC meeting. Elisa Russ (ADF&G – Homer) initiated the CARE recommendation to TSC that they consider having their meeting no earlier than the last week of April. Russ also suggested having the meeting in Seattle (Craig Kastelle [AFSC] recommended having the meeting in a different location; Delsa Anderl [AFSC] recommended the IPHC facility, but Joan Forsberg said that space is limited).
2. CARE 2017 meeting will be held at AFSC, in Seattle, WA.
    a. Russ gave thanks to AFSC for providing and ensuring the availability of facilities; Anderl and Kastelle will spread responsibility to ensure AFSC will host CARE meeting in 2017.

XIV. Working Groups and Hands-on Workshop

A. Working groups – additional time available to meet and schedule tasks for 2017
B. Hands-on Workshop – dual microscopes available for calibration work until noon

XV. CARE Business Meeting Adjourned by outgoing CARE Chair Elisa Russ.

XVI. Crustacean Age Determination Workshop Resumes until end of day.

A. May adjourn earlier depending on student needs.
B. Workshop final report located in **Appendix VI**.

Table 1. 2015 CARE Attendance List (April 14 – 17, 2015, Seattle, Washington, U.S.A.)

Last name	First name	Agency	Location	Country	Email
Pollak	Andrew	ADF&G	Homer	USA	andrew.pollak@alaska.gov
Russ	Elisa	ADF&G	Homer	USA	elisa.russ@alaska.gov
Dinneford	Rob	ADF&G	Juneau	USA	rob.dinneford@alaska.gov
Frawley	Tim	ADF&G	Juneau	USA	tim.frawley@alaska.gov
McNeel	Kevin	ADF&G	Juneau	USA	kevin.mcneel@alaska.gov
Oxman	Dion	ADF&G	Juneau	USA	dion.oxman@alaska.gov
Politano	Kristin	ADF&G	Juneau	USA	kristin.politano@alaska.gov
Smith	Quinn	ADF&G	Juneau	USA	quinn.smith@alaska.gov
Van Kirk	Kray	ADF&G	Juneau	USA	kray.vankirk@alaska.gov
Webb	Joel	ADF&G	Juneau	USA	joel.webb@alaska.gov
Bevaart	Kayla	ADF&G	Kodiak	USA	kayla.bevaart@alaska.gov
Brodie	Joan	ADF&G	Kodiak	USA	Joan.brodie@alaska.gov
El Mejjati	Sonya	ADF&G	Kodiak	USA	sonya.elmejjati@alaska.gov
Tribuzio	Cindy	AFSC/NMFS - ABL	Juneau	USA	cindy.tribuzio@noaa.gov
Anderl	Delsa	AFSC	Seattle	USA	delsa.anderl@noaa.gov
Benson	Irina	AFSC	Seattle	USA	irina.benson@noaa.gov
Brogan	John	AFSC	Seattle	USA	john.brogan@noaa.gov
Gburski	Chris	AFSC	Seattle	USA	christopher.gburski@noaa.gov
Goetz	Betty	AFSC	Seattle	USA	betty.goetz@noaa.gov
Helser	Thomas	AFSC	Seattle	USA	thomas.helser@noaa.gov
Hutchinson	Charles	AFSC	Seattle	USA	charles.hutchinson@noaa.gov
Kastelle	Craig	AFSC	Seattle	USA	craig.kastelle@noaa.gov
Matta	Beth	AFSC	Seattle	USA	beth.matta@noaa.gov
Pearce	Julie	AFSC	Seattle	USA	julie.pearce@noaa.gov
Piston	Charlie	AFSC	Seattle	USA	charlie.piston@noaa.gov
Short	Jon	AFSC	Seattle	USA	jon.short@noaa.gov
Tenbrink	Todd	AFSC	Seattle	USA	todd.tenbrink@noaa.gov
White	Vanessa	AFSC	Seattle	USA	vanessa.white@noaa.gov
Campbell	Barbara	CDFO	Nanaimo	Canada	Barbara.Campbell@dfo-mpo.gc.ca
Dunham	Jason	CDFO	Nanaimo	Canada	Jason.Dunham@dfo-mpo.gc.ca
Fong	Ken	CDFO	Nanaimo	Canada	Ken.Fong@dfo-mpo.gc.ca
Gillespie	Graham	CDFO	Nanaimo	Canada	Graham.Gillespie@dfo-mpo.gc.ca
Groot	Joanne	CDFO	Nanaimo	Canada	Joanne.Groot@dfo-mpo.gc.ca
Rutherford	Dennis	CDFO	Nanaimo	Canada	dennis.rutherford@dfo-mpo.gc.ca

Table 1 (continued). 2015 CARE Attendance List (April 14 – 17, 2015, Seattle, Washington)

Last name	First name	Agency	Location	Country	Email
Forsberg	Joan	IPHC	Seattle	USA	joan@iphc.int
Gibbs	Linda	IPHC	Seattle	USA	linda@iphc.int
Johnston	Chris	IPHC	Seattle	USA	chris@iphc.int
Rudy	Dana	IPHC	Seattle	USA	dana@iphc.int
McDonald	Patrick	NWFSC	Newport	USA	patrick.mcdonald@noaa.gov
Sullivan	Lance	NWFSC	Newport	USA	lance.sullivan@noaa.gov
Whiteside	Cassandra	NWFSC	Newport	USA	cassandra.whiteside@noaa.gov
Kautzi	Lisa	ODFW	Newport	USA	lisa.a.kautzi@state.or.us
Claiborne	Andrew	WDFW	Olympia	USA	andrew.claiborne@dfw.wa.gov
Hildebrandt	Anna	WDFW	Olympia	USA	Anna.Hildebrandt@dfw.wa.gov
Jones	Colin	WDFW	Olympia	USA	Colin.Jones@dfw.wa.gov
Rosenfield	Sandy	WDFW	Olympia	USA	greenthumb51@hughes.net
Stevick	Bethany	WDFW	Olympia	USA	Bethany.Stevick@dfw.wa.gov
Topping	Jennifer	WDFW	Olympia	USA	toppijat@dfw.wa.gov

Table 2. 2015 CARE Hands-On "Scope Time" Session

Dual Microscope Station 1			
Thursday, April 16, 2015			
Time:	**Species:**	**Participants/Agencies:**	**Comments:**
8:30 a.m. – 10:30 a.m.	China Rockfish	Cassandra Whiteside (NWFSC)	Calibration
	Quillback Rockfish	Andy Pollak (ADF&G)	
	Yelloweye Rockfish		
1:30 p.m. – 3:30 p.m.	Rex Sole	Chris Johnston (IPHC)	Calibration
		Joan Brodie (ADF&G)	
		Linda Gibbs (IPHC)	
		Dana Rudy (IPHC)	
		John Brogan (AFSC)	
	Greenland Turbot	Chris Johnston (IPHC)	Calibration
		Joan Brodie (ADF&G)	
		Linda Gibbs (IPHC)	
		Dana Rudy (IPHC)	
		John Brogan (AFSC)	
4:30 p.m. – 5:30 p.m.	Pacific Tomcod	Rob Dinneford (ADF&G)	Calibration
		Andy Pollak (ADF&G)	
		Craig Kastelle (AFSC)	
		Lance Sullivan (NWFSC)	
Friday, April 17, 2015			
Time:	**Species:**	**Participants/Agencies:**	**Comments:**
1:30 p.m. – 3:30 p.m.	Canary Rockfish	Andy Pollak (ADF&G)	Calibration
		Patrick McDonald (NWFSC)	

Table 2 (continued). 2015 CARE Hands-On "Scope Time" Session

Dual Microscope Station 2			
Thursday, April 16, 2015			
Time:	**Species:**	**Participants/Agencies:**	**Comments:**

8:30 a.m. – 10:30 a.m.	Mixed Species	Chris Johnston (IPHC)	Calibration
		Dana Rudy (IPHC)	
		Linda Gibbs (IPHC)	
10:30 a.m. – 12:00 p.m.	Pollock	Andy Pollak (ADF&G)	Calibration
		Sonya El Mejjati (ADF&G)	
		Betty Goetz (AFSC)	
		Chris Gburski (AFSC)	
		Joan Brodie (ADF&G)	

Dual Microscope Station 3			
Thursday, April 16, 2015			
Time:	**Species:**	**Participants/Agencies:**	**Comments:**
8:30 a.m. – 10:30 a.m.	Lingcod	Joan Brodie (ADF&G)	Calibration
		Kristin Politano (ADF&G)	
		Sonya El Mejjati (ADF&G)	
10:30 a.m. – 12:00 p.m.	Sablefish	Patrick McDonald (NWFSC)	Calibration
		Kevin McNeel (ADF&G)	
		Lance Sullivan (NWFSC)	
		John Brogan (AFSC)	
		Kristin Politano (ADF&G)	
1:30 p.m. – 3:30 p.m.	Goeduck	Kristin Politano (ADF&G)	Calibration
		Bethany Stevick (WDFW)	
		Colin Jones (WDFW)	

Table 2 (continued). 2015 CARE Hands-On "Scope Time" Session

Dual Microscope Station 4			
Thursday, April 16, 2015			
Time:	**Species:**	**Participants/Agencies:**	**Comments:**

8:30 a.m. – 10:30 a.m.	Pollock	Chris Gburski (AFSC)	Calibration
		Joan Brodie (ADF&G)	
		Sony El Mejjati (ADF&G)	
		Betty Goetz (AFSC)	
10:30 a.m. – 12:00 p.m.	Lingcod	Kristin Politano (ADF&G)	Calibration
		Joan Brodie (ADF&G)	
		Rob Dinneford (ADF&G)	
1:30 p.m. – 3:30 p.m.	Lingcod	Sonya El Mejjati (ADF&G)	Calibration
		Rob Dinneford (ADF&G)	
		Sandra Rosenfield (WDFW)	
		Lance Sullivan (NWFSC)	
		Patrick McDonald (NWFSC)	
3:30 p.m. – 4:30 p.m.	None Reported	None Reported	None Reported

Table 3. 2015 CARE Microscope Imaging Station and Micromill Demo Sign Ups

Microscope Imaging Station – Shortraker Rockfish Ad Hoc Working Group			
Thursday, April 16, 2015			
Time:	**Species:**	**Participants/Agencies:**	**Comments:**
8:30 a.m. – 10:30 a.m.	Shortraker Rockfish	Kevin McNeel (ADF&G)	Calibration, exchange, and Training
		Charles Hutchinson (AFSC)	
		Elisa Russ (ADF&G)	
		Betty Goetz (AFSC)	
		Kristin Politano (ADF&G)	
		Joanne Groot (CDFO)	

		Delsa Anderl (AFSC)	

Micromill Demonstration by Craig Kastelle (AFSC)			
Friday, April 17, 2015			
Time:	**Participants:**	**Agencies:**	**Comments:**
10:30 p.m. – 11:30 p.m.	Andrew Claiborne	WDFW	None
	Bethany Stevick	WDFW	
	Joanne Groot	CDFO	
	Barb Campbell	CDFO	
	Rob Dinneford	ADF&G	
	Lance Sullivan	NWFSC	
	Patrick McDonald	NWFSC	
	Andy Pollak	ADF&G	
	Elisa Russ	ADF&G	

Appendix I: 2015 CARE Agenda

Eighteenth Biennial Meeting of the
Committee of Age Reading Experts

Working Group of the Canada – US Groundfish Committee TSC

AFSC Sand Point Facility, NOAA Western Regional Center
7600 Sand Point Way, NE, Seattle, WA, USA
Bldg. #4, Jim Traynor Conference Room
April 14 – 17, 2015

C.A.R.E. Agenda

Tuesday April 14, 2015

Crustacean age determination workshop – see workshop agenda[1]

Wednesday April 15, 2015

I. Welcome and Opening Statements for C.A.R.E. 2015 Meeting (8:30 a.m. – 9:00 a.m.)

A. Call to Order (Elisa Russ, CARE Chair)

1. Minutes will be taken by Lance Sullivan, CARE Secretary

B. Host Statements

1. Opening statements (Thomas Helser)
2. Host information (Chris Gburski, CARE Vice-Chair)

C. Introductions

1. Round-table introductions (name, agency, location)
2. Attendance, address, phone, email (written list)

D. Approval of the 2015 agenda

II. Agency Overviews and Updates[2] (9:00 a.m. – 9:45 a.m.)

A. CDFO (Steve Wischniowski)
B. IPHC (Joan Forsberg)
C. AFSC (Tom Helser)
D. ADFG (Elisa Russ, Sonya El Mejjati, Kevin McNeel)
E. NWFSC (Patrick McDonald)
F. SWFSC
G. WDFW (Andrew Claiborne)
H. ODFW (Lisa Kautzi)
I. CDFG

III. CARE to CARE recommendations from 2013 – Review (9:45 a.m. – 10:15 a.m.)

[1] Participation in the Crustacean Age Determination Workshop was limited – workshop full
[2] No PowerPoint; 5 minute updates (staffing, organizational, new species/projects, etc.)

A. Recommends the manual working group post archived editions of the CARE Manual on the website with a link to the year of publication.

B. Recommends the Manual/Glossary committee continue revision and expansion of the C.A.R.E. Manual on Generalized Age Determination with the following sections:

1. Lingcod Otolith Ageing – finalize draft and incorporate into manual.
2. Thin Sectioning Method – edit updated draft
3. Rockfish Ageing Procedures
    a. Edit to avoid redundancy with Thin Sectioning section.
    b. Revise/move some info to Otoliths Ageing Procedures where appropriate.
4. Add section on baking otoliths under General Ageing Procedures.
5. Ergonomics – write short section to be included with general information on equipment.
6. Walleye Pollock Ageing Procedures – draft new section – collaborate between agencies.
7. Sablefish Ageing Procedures Section – revise.
8. Remove documentation sections in beginning of manual as is incomplete:
    a. See Recommendation A to post archived editions.
    b. Add Acknowledgements Section.

C. Recommends that the CARE Forum be continued.

D. Recommends the Website committee load a new version of Joomla for the CARE website, or other recommended CMF (e.g. WordPress or Drupal).

1. Future plans include:
    a. Edits such as consistent capitalization on Species Info page,
    b. Update agency production numbers,
    c. Add webpage for age structure inventories.

E. Recommend further study of otoliths stored long term in glycerin-thymol,

1. Report on observations regarding the media in 2015,
2. Provide recommendation to manual committee in 2015 regarding storage.

F. Recommend to the Charter Working Group to expand charter to include timelines for reports and meetings for possible additions to the charter pending CARE membership approval.

IV. CARE to TSC recommendations from 2013

A. At the 2013 CARE meeting, the manual working group drafted a section on Ergonomics for inclusion in the CARE Manual on Generalized Age Determination. It is important that agency leaders recognize the health risks associated with age reading and equipment options that may be available to mitigate these risks.

V. TSC to CARE recommendations from 2013

A. TSC acknowledges CARE's concerns regarding ergonomic injuries caused by extended period ageing fish and has recommended that the Parent Committee request Agencies to investigate ergonomic remedies to minimize ergonomic injuries.

VI. TSC to CARE recommendations from 2014

A. Held over ergonomic injury recommendation from 2013 and TSC suggested looking at ergonomic injuries and solutions in similar assembly type work (circuit boards) and medical pathology (microscope slide reading).

B. The TSC understands that CARE is looking into issues surrounding long-term storage of otoliths. TSC suggests that CARE researchers document their findings and develop a set of best practices for short and long term otolith preservation and storage.

Break (10:15 a.m. – 10:30 a.m.) – Posters may be set up prior to the meeting commencement or during breaks today.

VII. Working Group Reports / Activity Since CARE 2011 (10:30 a.m. – 11:30 a.m.)

A. 2014 TSC Meeting (Elisa Russ)

1. Replies to TSC regarding 2013/2014 recommendations.
2. Long-term otolith storage; review from 2013; glycerin-thymol observation reports.

B. Age structure exchanges (Chris Gburski)
C. Website (Jon Short)

1. Archived structures added to website - progress? Location, agency contacts, links (AFSC)

D. Forum (Nikki Atkins – written report since absent)
E. CARE Manual (Elisa Russ)
F. Charter Committee (Elisa Russ)
G. Sablefish (Delsa Anderl) – tabled until CARE 2017

VIII. Topics for Discussion / New Business (11:30 a.m. – 12:00 p.m.)

A. Summary of 5th International Otolith Symposium 2014 (Helser)
B. Other Conferences since 2013 that members attended?
C. Species Info on the website - need Agency updates & verification
D. Additional topics
E. Non-agenda items

Lunch (12:00 p.m. – 1:15 p.m.)

IX. Oral Presentations – 3 Topics (1:15 a.m. – 5:00 a.m.)

A. Topic Session 1: New techniques in age determination methods

1. Dr. Raouf Kilada (crustacean workshop presenter), *Finally, we can say how old this crab is.* (45 minutes)
2. Irina Benson, *Preliminary Results on the Use of Otolith Microchemistry for Developing Ageing Criteria for Eulachon (Thaleichthys pacificus).* (20 min)

B. Topic Session 2: Age Validation Studies

1. Dr. Thomas Helser, *Estimation of Ageing Bias Using Bomb Radiocarbon $\Delta^{14}C$ Signatures in Fish Otoliths: Beyond Plot and Cluck.* (30 min)
2. Craig Kastelle, *Use of the stable oxygen isotope, ^{18}O, in otoliths as an indicator of fish life history events and age validation.* (25 min)

Break (3:15 a.m. – 3:30 a.m.)

3. Stephen Wischniowski, *Incorporation of bomb-produced ^{14}C into fish otoliths. An example of basin-specific rates from the North Pacific Ocean.* (15 min)
4. Kevin McNeel, *Assessing yearly growth increment criteria used to assign ages for groundfish at the Alaska Department of Fish and Game Age Determination Unit using bomb radiocarbon.* (20 min)
5. Kristin Politano, *Using otolith measurements to refine quality control procedures.* (20 min)

C. Topic Session 3: Age-based models for fisheries stock assessment and management

1. Dr. Kray Van Kirk, *The use of age data in contemporary fisheries stock assessment and management.* (20 min)

Dinner at Elliott Bay Brewing Company, 12537 Lake City Way NE, Seattle (5:30 p.m. – ?)

Thursday, April 16, 2015

X. Working groups & Workshops (8:30 a.m. – 5:00 p.m., schedule lunch as appropriate for respective groups)

A. Crustacean workshop – see workshop agenda
B. Working Groups (Traynor Room or Room 2079)

1. Meet and discuss activity since 2013
2. Formulate written recommendations and prepare for presentation Friday morning

C. Hands-on microscope work and calibration (Traynor Room)

1. Sign up for dual scope station use (time)

D. Poster Session – posters available for viewing during breaks from other tasks all day

Friday April 17, 2015

XI. Recommendations (8:30 a.m. – 9:00 a.m.)

A. 2015 CARE to CARE
B. 2015 CARE to TSC

XII. Concluding CARE business (9:00 a.m. – 10:00 a.m.)

A. Administration nominations
B. Schedule and location of 2017 meeting

XIII. Working groups & Hands-on Workshop (10:00 a.m. – 12:00 p.m.)

A. Working Groups – additional time available to meet and schedule tasks for 2017
B. Hands-on Workshop – dual microscopes available for calibration work until noon

XIV. CARE Business Meeting Adjourns (12:00 p.m.)

XV. Crustacean Workshop Resumes (1:00 p.m. – 5:00 p.m.)

A. May adjourn earlier depending on student needs

Appendix II: Long-Term Storage of Otoliths in Glycerin-Thymol Solution[3]

I. Results of a Preliminary Review on the Condition of Whole Otoliths Stored in Glycerin Thymol from Archived Collections at the Alaska Fisheries Science Center

Delsa M. Anderl, Age & Growth Program, Alaska Fisheries Science Center

At the 2013 Committee of Age Reading Experts (CARE) workshop, Sandra Rosenfeld, age reader from Washington Department of Fish and Game, presented a problem she had recently observed with their historic otolith collection stored in glycerin thymol. Some otoliths appeared to show signs of deterioration. She questioned whether glycerin thymol is a proper medium for long-term otolith storage. Currently, a number of ageing labs use glycerin thymol including the Alaska Fisheries Science Center.

Two agencies, the International Pacific Halibut Commission (IPHC) and the Alaska Fisheries Science Center (AFSC) volunteered to do a cursory review of samples from their archived otolith collections. The IPHC has an extensive archive of halibut otoliths stored in glycerin thymol. AFSC stores flatfish otoliths in glycerin thymol and all other species in ethanol until 2009–2010 when all otoliths thereafter were stored exclusively in glycerin thymol.

AFSC otoliths are archived at the Burke Museum storage facility located within the Fisheries Building complex at the University of Washington. Collection years range from the 1980s to present and include specimens collected from scientific field surveys and from fishery observers. Otoliths are stored in glass or plastic vials in collection boxes holding up to 140 otoliths and organized in cells of 10 columns and 14 rows. For this preliminary review, only survey collected otoliths were examined.

[3] Reports by A. Delsa Anderl, AFSC, and B. Joan Forsberg, IPHC

Two flatfish species were chosen to review: arrowtooth flounder (N = 231), yellowfin sole (N = 221) and two roundfish species: sablefish (N = 276) and walleye pollock (N = 246). Collection years chosen spanned from 1984 to 2011. See **Tables 1 – 4** for the breakdown of collection years per species.

At the Burke Museum storage facility, otolith boxes are stacked on metal shelves according to collection year followed by species. Boxes for examination were chosen from the top-most box down from a collection year of the chosen species. Otoliths to be ranked for degree of deterioration were chosen from each box starting with the first cell in the first column followed by every other cell down the same column. Typically, 7 otoliths were examined from each box until a total between 200 – 250 otoliths per species were ranked.

Criteria used to rank the amount of observed otolith deterioration were as follows:

1 = Otolith appeared pristine with no apparent deterioration and surface pattern was clear.

2 = Otolith appeared slightly dull but the surface pattern is apparent (**Figure 1**). This is considered good condition and will not affect cross-section ageing.

3 = Strong appearance of a cloudy/chalky surface so that any pattern (if a surface pattern was ever discrete) is obscured by the cloudy appearance (**Figure 2**). This may be early signs of deterioration.

4 = Surface layers are easily scraped/rubbed off the otolith (**Figure 3**).

The findings of this preliminary review are summarized in the following tables:

ARROWTOOTH FLOUNDER						
	Ranks				n	Rank 3-4
Years	1	2	3	4		
1984		30	5		35	14.3%
1987	10	16	8	3	37	29.7%
1993		23	14	3	40	42.5%
1999		16	5		21	23.8%
2005	3	39			42	0.0%
2009	4	38			42	0.0%
2010		14			14	0.0%
Rank totals	17	176	32	6	231	16.5%

Table 1. Results of the total number of arrowtooth flounder otolith deterioration ranked according to collection year. Blank cells represent no specimens found for that rank.

YELLOWFIN SOLE						
	Ranks				n	Rank 3-4
Years	1	2	3	4		
1987	4	21	17		42	40.5%
1993		14	17		31	54.8%
1999	3	22	16		41	39.0%
2005	4	31	7		42	16.7%
2009		32	10		42	23.8%
2010	9	11	3		23	13.0%
Rank totals	20	131	70	0	221	31.7%

Table 2. Results of the total number of yellowfin sole otolith deterioration ranked according to collection year. Blank cells represent no specimens found for that rank.

SABLEFISH						
	Ranks				n	Rank 3-4
Years	1	2	3	4		
1985	36	9	9		54	16.7%
1987	6	35	1		42	2.4%
1993	18	24			42	0.0%
1999	20	20	1		41	2.4%
2005	13	29			42	0.0%
2009	20	16	7		43	16.3%
2011	7	2	3		12	25.0%
Rank totals	120	135	21	0	276	7.6%

Table 3. Results of the total number of sablefish otolith deterioration ranked according to collection year. Blank cells represent no specimens found for that rank. Samples collected before 2009 were stored in ethanol.

WALLEYE POLLOCK						
	Ranks				n	Rank 3-4
Years	1	2	3	4		
1987	3	32			35	0.0%
1993		42			42	0.0%
1999		41	1		42	2.4%
2005		42			42	0.0%
2009	2	41			43	0.0%
2011	5	37			42	0.0%
Rank totals	10	235	1	0	246	0.4%

Table 4. Results of the total number of walleye pollock otolith deterioration ranked according to collection year. Blank cells represent no specimens found for that rank. Samples collected before 2009 were stored in ethanol.

Figure 1. Example of an otolith condition assigned a rank 2.

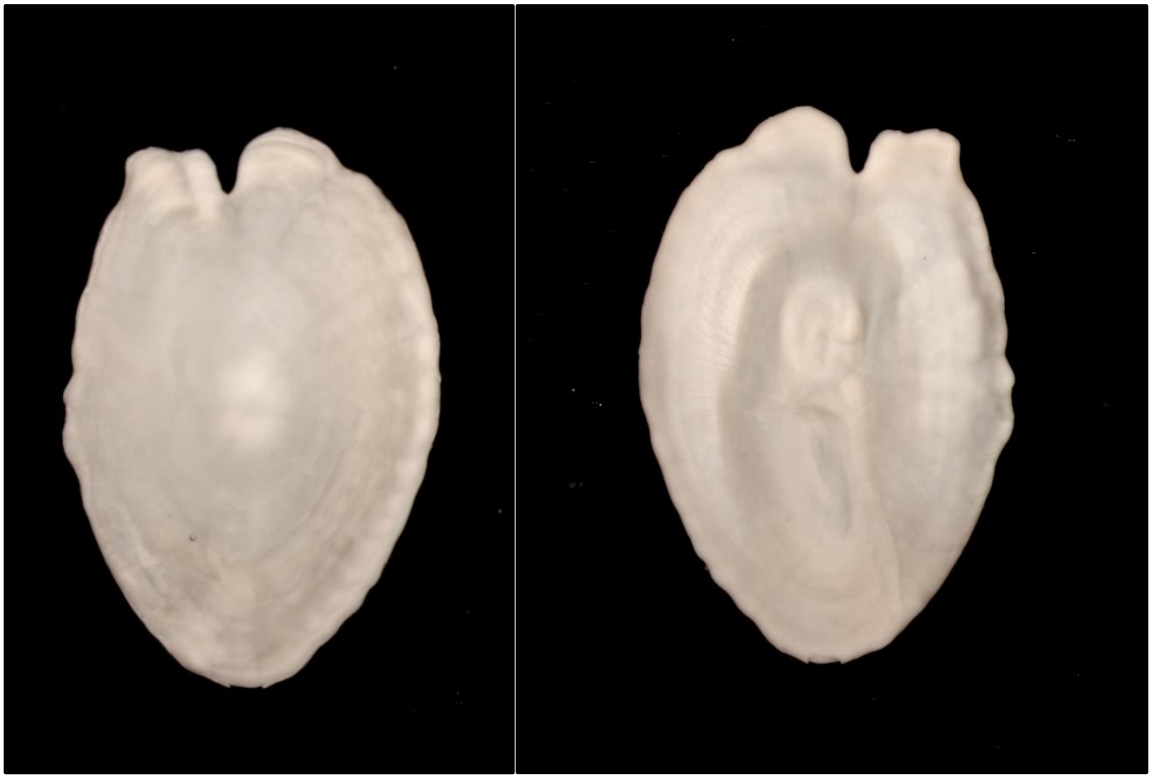

Figure 2. Example of an otolith condition assigned a rank 3.

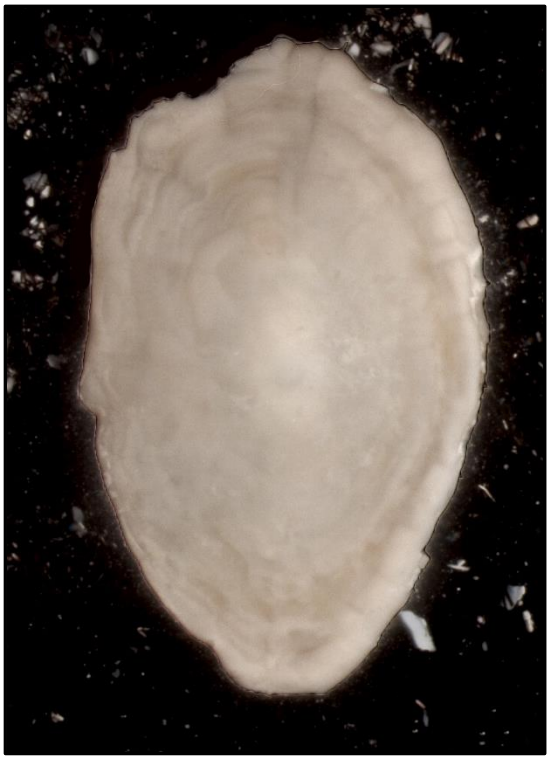

Figure 3. Example of an otolith condition assigned a rank 4.

II. Longterm storage of otoliths in Glycerin Solution at the IPHC

Joan Forsberg, International Pacific Halibut Commission (IPHC)

Background

Pacific halibut otoliths have been cleared in glycerin solution (50% glycerin/50% water) to increase readability of the growth patterns since the 1920s. Otoliths are also stored in glycerin solution after reading. Prior to 2002, otoliths were kept in open trays with individual cells while they were being aged. After otoliths were aged, they were stored in vials that held around N = 25 otoliths, stacked one on top of the other, with numbered paper labels between to separate and identify individual otoliths. The vials were then filled with glycerin solution to completely cover the otoliths. After the transition to the break-and-bake method for all otoliths, stacking in vials was no longer a suitable storage method because the otolith halves could become separated. Baked and aged otoliths are now stored in plastic trays that have individual cells to keep otoliths separate and lids that fit over the trays. The cells of the plastic trays are filled with enough glycerin solution to cover the otoliths. Vials from the historical collection were topped up with glycerin solution periodically; most recently in the early 1980s and again in 2010. Until the late 1980s, glass vials with cork stoppers were used for otolith storage. The corks did not provide an airtight seal so water evaporated from the glycerin solution over time. Thymol (an antifungal agent) has been added to the glycerin solution used for clearing and storing otoliths at IPHC for many years, but it is not clear when it began to be added routinely. The oldest samples in the IPHC's archives (collected in 1925) have been in glycerin solution for almost 90 years.

Observations of otolith condition

In 2014, IPHC agers re-aged over N = 8,000 otoliths collected between 1926 and 1985:

Year(s)	Regulation Area(s)	Number aged
1926	2B	567
1929 - 1930	3B/4A	943
1936	2B	471
1947	2B	562
1951	2B/3A	1,320
1964 - 1965	2B/3A/4A	1,595
1976 - 1977	2B/3A/4A	1,551
1985	2B/3A	1,061

Most of the otoliths examined were in good condition. Some of the otoliths from the 1920s and 1930s (≤5%) had a chalky coating that obscured surface growth patterns. However, most of the otoliths with chalky coatings were still readable when broken and baked. The chalky coating could be partially dissolved otolith material, mold growth, or a combination of both. In one vial from the 1926 *F/V Scandia*, the otoliths appeared to have decalcified and consolidated into small, round lumps. There was also mold growth in the vial (**Figure 4**).

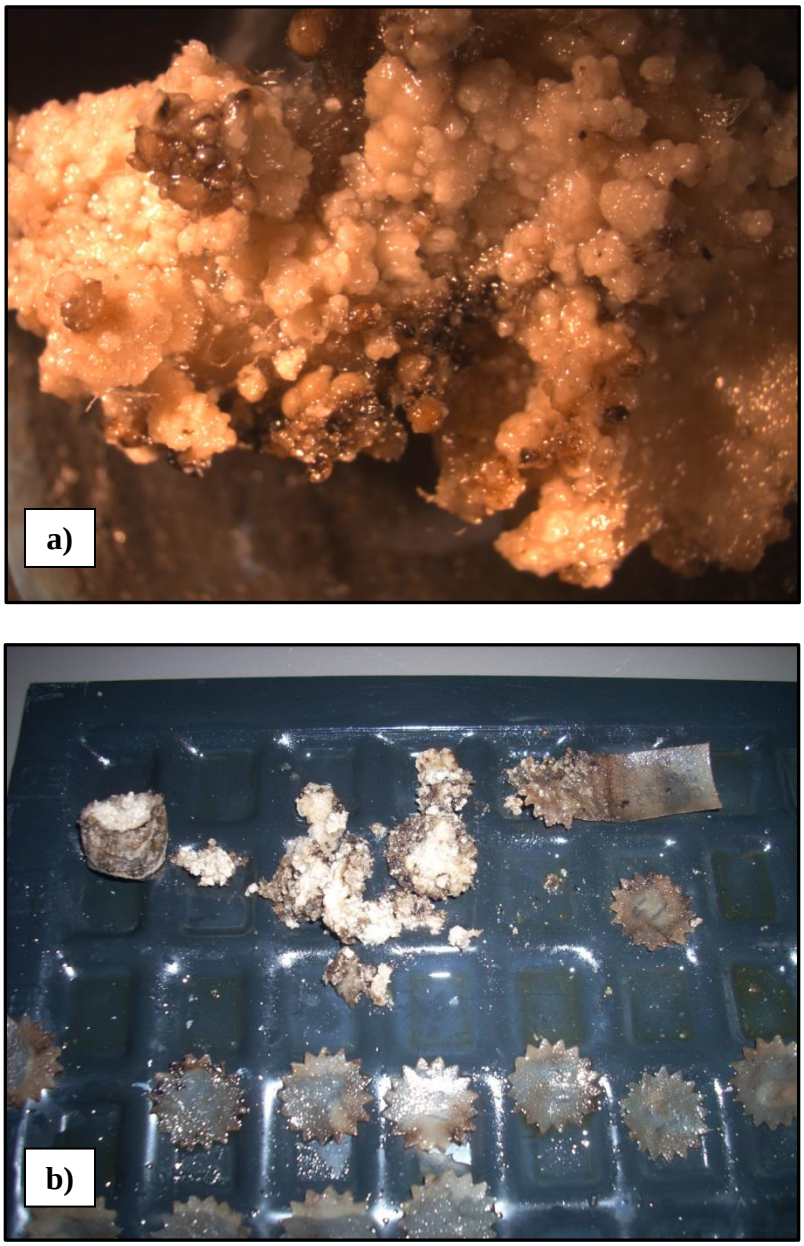

Figure 4. a) 'Blobs' from dissolved otoliths in vial with heavy mold. b) The paper labels between the dissolved otoliths had also dissolved.

Some of the otoliths stored in glass vials with cork stoppers had significant surface staining from the tannins in the cork, but were still very legible both in surface and baked section views (**Figure 5**).

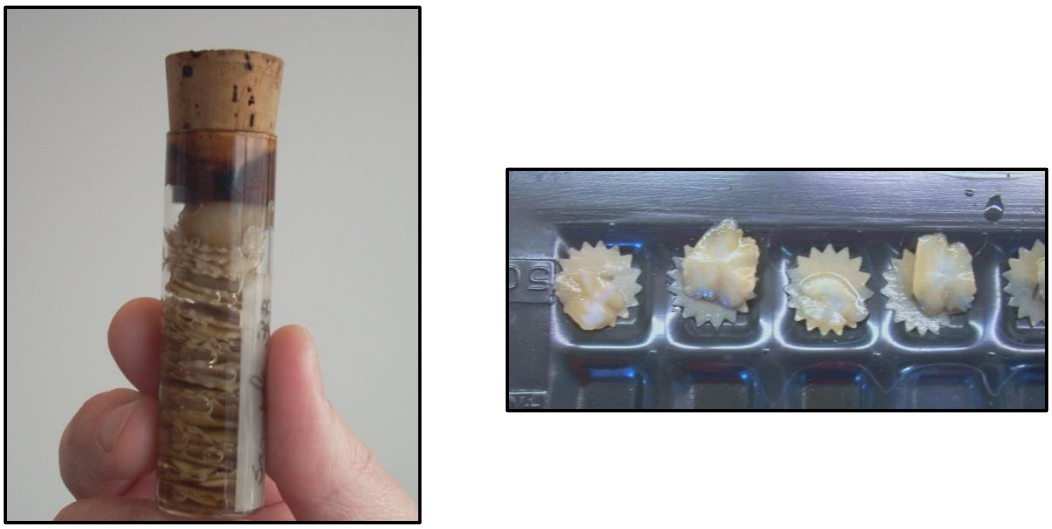

Figure 5. Otoliths with surface staining from cork stopper.

Below are some images of otoliths stored in glycerin for 89, 79, and 68 years (**Figures 6 – 8**, respectively). Surfaces and baked sections are clear and show no signs of deterioration.

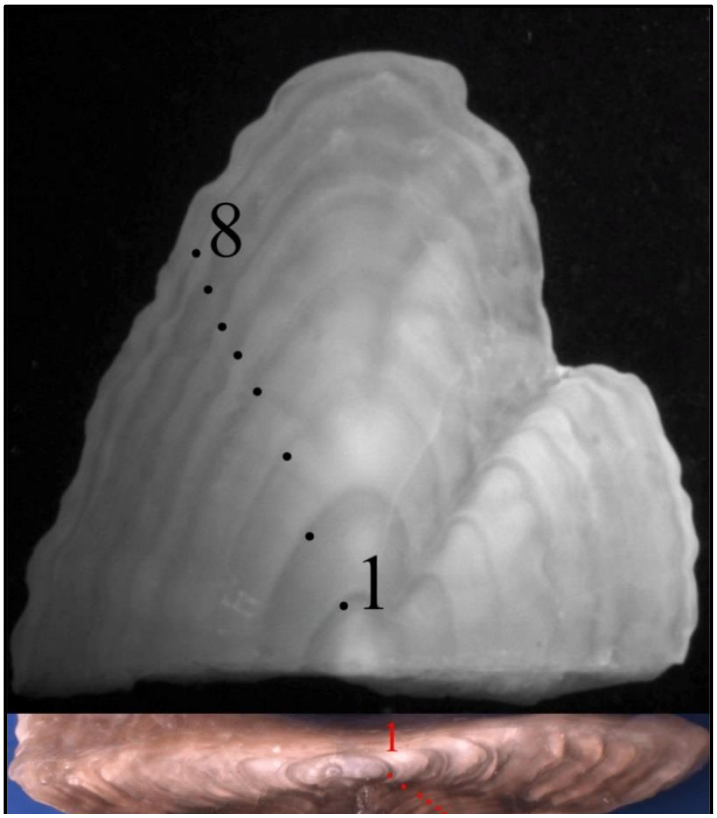

Figure 6. Unbaked and baked halves of an 8-year-old otolith from 1926.

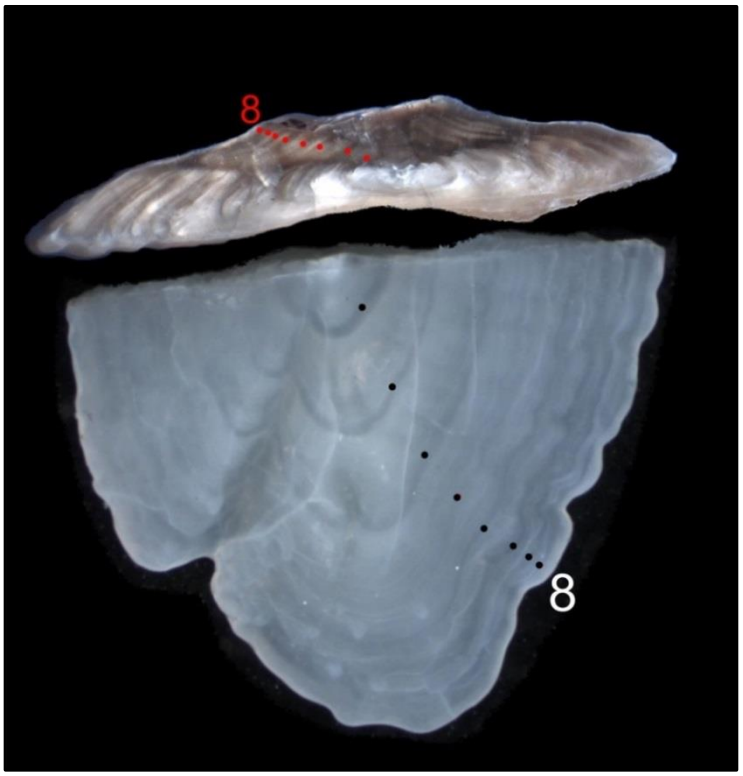

Figure 7. Unbaked and baked halves of an 8-year-old otolith from 1936.

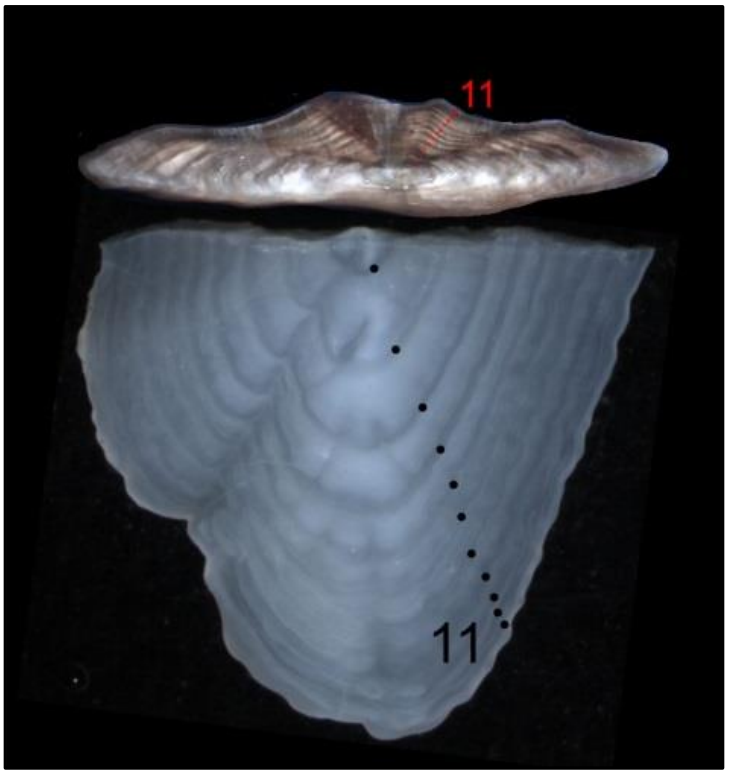

Figure 8. Unbaked and baked halves of an 11-year-old otolith from 1947.

Otoliths from juvenile halibut that had been stored in glycerin solution for up to 40 years and were retrieved for a study in the early 2000s were found to be decalcified; however, the condition of otoliths from larger halibut stored in glycerin for similar periods of time did not appear to be degraded. The IPHC's small fish otolith collection was consequently transitioned from storage in glycerin solution to dry storage.

Clearing in glycerin solution is necessary for surface ageing and since readers still rely on the surface to assist with interpretation of baked patterns, storage in glycerin solution is necessary at least until otoliths have been aged. Baked sections of cleared otoliths also have better contrast between growth zones than baked sections made from dry otoliths.

Fading of burn patterns

In 2013, IPHC readers also re-aged over N = 3,000 otoliths collected in 1998, most of which had previously only been surface-aged. Readers looked at some of the otoliths that had been broken and burned in 1998 and found that quite a few of the burnt sections had faded. We looked at otoliths collected more recently (2001 and 2007) and found that the otoliths broken and burned or baked in those years had not faded and still had good contrast.

Conclusion

The otoliths we examined were from setline surveys, which tend to catch halibut >40 cm. Most of the otoliths observed were from age classes ≥4 years and these appear to hold up well after long term storage in glycerin solution (with thymol). We observed otoliths from N = 24 halibut between 2 and 3 years of age among the re-aged samples and they were still legible and not deteriorating.

Appendix III: Glycerin-Thymol Recipe

Below are the materials and instructions to make glycerin-thymol solution (courtesy of Joan Forsberg, IPHC):

Materials needed:

1/2 gallon glycerin
1/2 gallon water
5.5 grams thymol (crushed)
20 ml ethanol

Instructions:

1. Crush thymol into coarse powder.
2. Dissolve thymol in ethanol by stirring/agitating mixture.
3. When dissolved, add thymol/alcohol solution to glycerin.[4]
4. Shake vigorously to mix.
5. Add water to the glycerin mixture and shake to mix.

[4] Do not add the thymol solution to the water first or the thymol will precipitate out of solution.

Appendix IV: 2015 CARE Oral and Poster Presentation Abstracts

Eighteenth Biennial Meeting of the Committee of Age Reading Experts

Working Group of the Canada – US Groundfish Committee TSC
AFSC Sand Point Facility, NOAA Western Regional Center
April 14 – 17, 2015

Oral Presentations – 3 Topics

A. Topic Session 1: New techniques in age determination methods

1. Dr. Raouf Kilada (crustacean workshop presenter), *Finally, we can say how old this crab is.* (45 minutes)
2. Irina Benson, *Preliminary Results on the Use of Otolith Microchemistry for Developing Ageing Criteria for Eulachon (Thaleichthys pacificus).* (20 min)

B. Topic Session 2: Age Validation Studies

1. Dr. Thomas Helser, *Estimation of Ageing Bias Using Bomb Radiocarbon $\Delta^{14}C$ Signatures in Fish Otoliths: Beyond Plot and Cluck.* (30 min)
2. Craig Kastelle, *Use of the stable oxygen isotope, ^{18}O, in otoliths as an indicator of fish life history events and age validation.* (25 min)
3. Stephen Wischniowski, *Incorporation of bomb-produced ^{14}C into fish otoliths. An example of basin-specific rates from the North Pacific Ocean.* (15 min)
4. Kevin McNeel, *Assessing yearly growth increment criteria used to assign ages for groundfish at the Alaska Department of Fish and Game Age Determination Unit using bomb radiocarbon.* (20 min)
5. Kristin Politano, *Using otolith measurements to refine quality control procedures.* (20min)

C. Topic Session 3: Age-based models for fisheries stock assessment and management

1. Dr. Kray Van Kirk, *The use of age data in contemporary fisheries stock assessment and management.* (20 min)

Poster Presentations – See abstracts for author and agency info.

A. *A 200 year archeozoological record of Pacific cod life history as revealed through Ion Microprobe oxygen isotope ratios in otoliths.*
B. *Modeling Environmental Factors Affecting Assimilation of Bomb-produced Δ14C in the North Pacific Ocean: Implications for age validation studies.*
C. *Age validation of Pacific cod (Gadus macorcephalus) using high resolution stable oxygen isotope (δ 18O) signatures in otoliths.*
D. *What to do when dogfish lie about their age?*
E. *Bomb Dating and Age Estimates of Big Skate (Beringraja binoculata) and Longnose Skate (Raja rhina).*
F. *Changes in Pacific cod otolith weight over time.*
G. *Re-ageing of archived otoliths from the 1920s to the 1990s.*
H. *Preparing baked thick sections of Pacific halibut otoliths*

Oral Presentation Abstracts

Direct determination of age in shrimps, crabs, and lobsters

Raouf Kilada[a], Bernard Sainte-Marie[c], Rémy Rochette[b], Neill Davis[b], Caroline Vanier[d], Steven Campana[e]

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[b]University of New Brunswick – Saint John, 100 Tucker Park Road, Saint John, NB E2L 4L5, Canada.
[c]Marine Invertebrate Biology and Conservation, Maurice Lamontagne Institute, Fisheries and Oceans Canada, 850 route de la Mer, C.P. 1000, Mont-Joli, QC G5H 3Z4, Canada.
[d]Institut des sciences de la mer de Rimouski (ISMER), Université du Québec à Rimouski, 300 allée des Ursulines, Rimouski, QC G5L 3A1, Canada.
[e]Bedford Institute of Oceanography, Fisheries and Oceans Canada, P.O. Box 1006, Dartmouth, NS B2Y 4A2, Canada.

Abstract

The detection and measurement of annual growth bands preserved in calcified structures underlies the assessment and management of exploited fish populations around the world. However, the estimation of growth, mortality, and other age-structured processes in crustaceans has been severely limited by the apparent absence of permanent growth structures. Here, we report the detection of growth bands in calcified regions of the eyestalk or gastric mill in shrimps, crabs, and lobsters. Comparison of growth band counts with reliable, independent estimates of age strongly suggests that the bands form annually, thus providing a direct and accurate method of age determination in all of the species examined. Chemical tags in the lobster cuticle were retained through one or two molts that occurred over the duration of an experiment, as apparently was the mesocardiac ossicle containing the growth bands in the gastric mill. Growth bands are not the previously documented lamellae of the endocuticle, and their formation was not associated with molting. Sex-specific growth curves were readily

developed from growth band examination in multiple species, suggesting that routine measurement of growth and mortality in decapod crustaceans may now be possible.

Preliminary Results on the Use of Otolith Microchemistry for Developing Ageing Criteria for Eulachon (*Thaleichthys pacificus*)

Irina Benson, Craig Kastelle, Thomas E. Helser, Jon Short, Delsa M. Anderl
NOAA Fisheries, Alaska Fisheries Science Center, 7600 Sand Point Way, NE., Seattle, WA

Abstract

Laser ablation inductively-coupled plasma mass spectrometry (LA-ICP-MS) was used to analyze the temporal change of Ba/Ca ratios in the otoliths of eulachon (*Thaleichthys pacificus*). Specimens were collected off the coast of Oregon, in the coastal areas and rivers of Southeast Alaska, and in the southeastern Bering Sea. Annual upwelling along the Pacific Coast causes fluctuation of barium concentration in surface water and may leave distinct chemical signatures in the otoliths. Attempts to age eulachon using otolith surfaces proved to be difficult. We used trace element analysis to help interpret otolith surface patterns and to develop ageing criteria for eulachon. For each otolith thin section, a continuous scan started at the core and proceeded to the proximal margin. The Ba/Ca ratios along this transect were plotted for each specimen. For the Oregon specimens Ba/Ca signature fluctuations appeared consistent with annuli in most but not all cases. Analysis of the Ba/Ca oscillations was not as straightforward as expected. Therefore, further studies need to be done to evaluate the usefulness of otolith chemistry as a tool for developing ageing criteria for eulachon.

Estimation of Ageing Bias Using Bomb Radiocarbon $\Delta^{14}C$ Signatures in Fish Otoliths: Beyond Plot and Cluck

Thomas E. Helser and Craig Kastelle

NOAA Fisheries, Alaska Fisheries Science Center, 7600 Sand Point Way, NE., Seattle, WA

Abstract

Atomic bomb testing during the 1950s and 1960s produced atmospheric radiocarbon, which after a slight delayed response, diffused into the marine environment and became incorporated into fish otoliths alive during that time. In recent years, measured bomb-produced radiocarbon ($\Delta^{14}C$) was developed as an age validation tool which compares the $\Delta^{14}C$ signature from test specimens to the $\Delta^{14}C$ of known age fish (reference chronology). To date, calcium carbonate structures in dozens of animals across different taxa have been measured for $\Delta^{14}C$, but only a handful of true reference chronologies have been developed with which to compare the $\Delta^{14}C$ signatures. In addition, a variety of statistical models and methods have been proposed to describe the functional form of radiocarbon chronologies and provide a quantitative means to compare them. However, none have been completely satisfactory in quantifying ageing bias and its uncertainty. We developed a multi-level Bayesian model and used Markov Chain Monte Carlo Simulation to estimate parameters of different functional response models and to derive a

statistical framework for hypothesis tests concerning ageing bias. The model incorporates both observation and process errors and provides framework to estimate the probability of ageing bias overall from a given sample but also the probability conditional on the animal's age. Results presented are based on a comparison of canary rockfish (*Sebastes pinniger*) and Pacific Ocean perch (*Sebastes alutus*) $\Delta^{14}C$ data to the Gulf of Alaska halibut reference chronology. Canary rockfish showed a high probability of being under aged with as high as a 95% probability that under aging was occurring by as much as 6 years. In contrast, the mean ageing bias for Pacific Ocean perch was +1.4 years but considerable density of the marginal posterior encompassed zero suggesting the evidence was weak to conclude any bias. Finally, we extended the complexity of the Bayesian model by incorporating over a dozen different $\Delta^{14}C$ chronologies from California to the Gulf of Alaska into a hierarchically structured model and tested for the effects of different oceanographic factors on the functional response of the radiometric curves. The index of ocean upwelling was negatively related to the overall magnitude of ^{14}C measured in calcified structures of marine animals while the parameter commonly used to test bias was weakly positively correlated. This suggests the potential for age bias interpretations to be confounded when $\Delta^{14}C$ test samples are compared to reference chronologies derived from different oceanographic regions.

Use of the stable oxygen isotope, ^{18}O, in otoliths as an indicator of fish life history events and age validation

Craig Kastelle[a], Tom Helser[a], Jennifer McKay[b], Delsa Anderl[a], Beth Matta[a], Chris Collins-Larsen[c], Sukyung Kang[d]

[a]Alaska Fisheries Science Center, USA
[b]Oregon State University, USA
[c]University of Washington, USA
[d]National Fisheries Research and Development Institute, Republic of Korea

Abstract

The isotopic or elemental content of otoliths provides a view into the life history of fish. The stable oxygen isotope (^{18}O) in seawater is thought to be in equilibrium with marine calcium carbonate ($CaC0_3$) structures such as otoliths. We applied the principle that $\delta^{18}O$ variability in marine $CaC0_3$ is inversely related to water temperature. This presentation is an overview of what can be learned by microsampling otoliths and measuring $\delta^{18}O$ by mass spectrometry. We analyzed $\delta^{18}O$ from three species of fish from three regions in the North Pacific: Pacific cod (*Gadus macrocephalus*) from the Eastern Bering Sea, saffron cod (*Eleginus gracilis*) from the Chukchi Sea, and small yellow croaker (*Larimichthys polyactis*) from the Yellow Sea. Up to 10 microsamples were extracted from any one year's otolith deposition, and up to N = 42 microsamples from a 5-year-old otolith, representing the life history of the fish. We confirmed the relationship between water temperature and $\delta^{18}O$ in the otoliths ($r^2 = 0.74$) using otoliths with a known temperature history. In the larger body of our study, we saw evidence of seasonal temperature fluctuations, ontogenetic migrations, and possibly a tool to investigate temperature trends over time. In exploited populations of Pacific cod, the life-history $\delta^{18}O$ signal provided a method of developing a more accurate age reading criteria and an age validation. A comparison

between Pacific cod and saffron cod $\delta^{18}O$ signals indicated different life history strategies in terms of temperature preference and possibly differences in habitat usage.

Incorporation of bomb-produced ^{14}C into fish otoliths. An example of basin-specific rates from the North Pacific Ocean

Stephen G. Wischniowski[1], Craig R. Kastelle[3], Timothy Loher[2], and Thomas E. Helser[3]

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[2]International Pacific Halibut Commission, 2320 West Commodore Way, Suite 300, Seattle, WA 98199, U.S.A.
[3]National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center, 7600 Sand Point Way, Seattle, WA 98115, U.S.A.

Abstract

Sagittal otoliths from juvenile Pacific halibut (*Hippoglossus stenolepis*) of known age were used to create a bomb-produced radiocarbon reference chronology for the eastern Bering Sea (EBS) by fitting a coupled-function model to $\Delta^{14}C$ values from each specimen's birth year. The newly-created EBS reference chronology was then compared to a reference chronology previously created for Pacific halibut from the Gulf of Alaska (GOA). Adult Pacific halibut age-validation samples from the EBS were also analyzed for ^{14}C and modeled to validate age- estimation accuracy. A Bayesian model was developed and Markov Chain Monte Carlo simulation was used to estimate model parameters and adult Pacific halibut ageing bias. Differences in reference chronologies between ocean basins were reflected in large (deviance information criterion) (ΔDIC) between models, supporting the hypothesis that two separate coupled-function models were required to adequately describe the data, one each for the EBS and GOA. We determined that regionally specific GOA and EBS oceanography plays a considerable role in the $\Delta^{14}C$ values, and must be taken into consideration when selecting a reference chronology for bomb-produced ^{14}C age-validation studies. The age-validation samples indicated that the current ageing methodology used in Pacific halibut assessments is accurate and has provided accurate age assignments for Pacific halibut in the EBS.

Assessing yearly growth increment criteria used to assign ages for groundfish at the Alaska Department of Fish and Game Age Determination Unit using bomb radiocarbon

Kevin McNeel

Alaska Department of Fish and Game, Age Determination Unit, Juneau, Alaska

Abstract

To address the accuracy of yearly increment assignment, the Alaska Department of Fish and Game Age Determination Unit (ADU) has directed, collaborated on, and participated in several

age validation studies. Published validations have addressed many high profile teleosts, but direct or indirect age validation should be conducted on all species and criteria. Rises in atmospheric ^{14}C due to atomic bomb testing between 1950 and 1960, and otolith reference curves have proven useful for estimating the birth year from otolith core samples (targeting the first year of growth). Predicted and estimated birth years can be compared to validate yearly increment criteria or suggest biases. To address unvalidated criteria and concerns regarding age estimation criteria at the ADU, approximately N = 220 otolith cores (representing 23 groundfish species) were sent to the Lawrence Livermore National Laboratory to be processed for carbon isotope concentrations using accelerator mass spectrometry. Otoliths were selected based on availability of known-age specimens and estimated birth years between 1958 and 1965. Corrected ^{14}C fractions for each otolith core along with the expected year at age 1 (using increment counts) were compared with known age and validated reference $\Delta^{14}C$ curves to validate age criteria, identify biases between estimated and expected ages, or highlight future research needs. Preliminary analysis shows that tested values follow trends established by reference curves and suggest that some species need further studies. These findings also stress the need to target specimens between optimal birth years and providing adequate samples to target rises in $\Delta^{14}C$ values.

Using otolith measurements to refine quality control procedures

Kristin Politano, Kevin McNeel, April Rebert

Alaska Department of Fish and Game, Age Determination Unit, Juneau, AK

Abstract

Age data quality control is typically done utilizing somatic length at age correlations. For many of the species aged by the Alaska Department of Fish and Game Age Determination Unit (ADU), however, the relationship between somatic length and age is asymptotic. Therefore, as long-lived fishes get older, length is no longer a reliable proxy for age. To improve quality control procedures, we examined the relationship between age and otolith length, weight, and height for groundfish and developed a protocol to test for outlying age estimates. Our initial analysis revealed a continual change in otolith weight at age after fish reached $L\infty$ in sablefish (*Anoplopoma fimbria)*, yelloweye rockfish (*Sebastese ruberrimus*), rougheye rockfish (*S. aleutianus*), shortraker rockfish (*S. borealis)*, and lingcod (*Ophiodon elongatus*), suggesting it may be an appropriate parameter for use in quality control procedures. To establish a protocol for identifying outlying age estimates, data were modeled with otolith weight and somatic length using sigmoidal or exponential regression. An expected otolith weight and somatic length range for a given age and species was established using predicted mean and standard deviation. Models for a given species were separated by geographic location and gender given adequate sample size. After evaluating the models with a separate set of age data, mean ± 2 SD was indicated as a reasonable cut off for the detection of gross outliers. The utility and feasibility of incorporating this process into age production needs to be evaluated, and more complex models should be tested. However, otolith weight has proven useful in improving data quality at the ADU and our findings support the further use and analysis of otolith morphometrics in a production setting to refine data quality control and identify unique or difficult growth patterns that may have been previously misidentified.

Poster Abstracts

A 200 year archeozoological record of Pacific cod life history as revealed through Ion Microprobe oxygen isotope ratios in otoliths

Thomas E. Helser[1](presenter), Craig Kastelle[1], John Valley[2], Aron L. Crowell[3], Ian Orland[2], Reinhard Kozdon[2], and Takayuki Ushikubo[4]

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Abstract

Fish otolith oxygen isotope ratios ($\delta^{18}O$) are considered "flight recorders," providing records of sea water temperature and habitat use over the animal's life span. We measured $\delta^{18}O$ values in modern and archeological Pacific cod otoliths using a high precision ion microprobe. Values of $\delta^{18}O$ were measured in as many as eighty 10-micron spots along transects from the otolith core to its margin with high spot-to-spot analytical precision ($\delta^{18}O$ ±0.3‰). We obtained sample densities along a linear transect that were at least 2 to 3 times greater than micromilling/conventional mass spectrometry techniques. From modern Pacific cod otoliths (using *in situ* temperatures from electronic archive tags) we calibrated the fractionation equation of aragonite (r^2 = 0.75, p<0.001, $\delta^{18}O_A = 2.13 - 0.25T^oC$) to predict sea water temperature. Sinuous variability of $\delta^{18}O$ values along core-to-margin transects likely reflect seasonal temperature changes and suggest similar longevity between modern and archeological cod. Generally increasing $\delta^{18}O$ values from the otolith core to the margin revealed an ontogenetic migration from warmer near shore habitat during the first year of life to cooler deeper waters at later ages, a behavior that has not changed over the past 200 years. A decline in the average $\delta^{18}O$ of core spot samples from archeological (200+, 100+ YBP) to modern otoliths suggest increasing sea surface temperatures from the late Little Ice Age to present. Temperatures calculated from the $\delta^{18}O$ in aragonite suggest a 2-3^{o}C rise in coastal marine sea surface temperatures in the Gulf of Alaska over the last 200 years.

Modeling Environmental Factors Affecting Assimilation of Bomb-produced $\Delta^{14}C$ in the North Pacific Ocean: Implications for age validation studies

Thomas E. Helser[1](presenter), Craig R. Kastelle[1], and Han-lin Lai[2]

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Abstract

The bomb radiocarbon ^{14}C chronometer has become the gold standard for assessing the accuracy of age estimates of fish based on otolith growth rings. In the northeast Pacific Ocean, nearly a dozen age validation studies have been conducted, ranging from California to Alaska, most of which have relied on a single reference chronology from the Gulf of Alaska. As such, it seems quite likely that oceanographic factors affecting the uptake and assimilation of ^{14}C in marine carbonates can lead to a misinterpretation of age determination error when the test samples and reference curve are not from the same region. To explore this possibility, we developed a hierarchical Bayesian meta-analysis using bomb-produced radiocarbon from data sets in the northeast Pacific Ocean. We investigated whether latitude and upwelling exerts an influence on the parameters that describe the rapid radiocarbon $\Delta^{14}C$ increase in marine calcium carbonates. Models incorporating both latitude and upwelling as linear covariates of a 4-parameter logistic model were favored based on ΔDIC statistics. There was substantial evidence to support that the timing of the $\Delta^{14}C$ pulse was advanced and that total $\Delta^{14}C$ uptake increased with increasing latitude. In contrast, increased oceanographic upwelling resulted in lower total radiocarbon input as well as a delay in the timing of the pulse curve, as is characteristic of the upwelling dominated California Current System. The Gulf of Alaska appears to be more tightly coupled to atmospheric radiocarbon input with greater surface mixing, and less upwelling, than other regions in the northeast Pacific, resulting in earlier timing of $\Delta^{14}C$ rise and greater total radiocarbon input into the marine environment.

Age validation of Pacific cod (*Gadus macorcephalus*) using high resolution stable oxygen isotope ($\delta^{18}O$) signatures in otoliths

Craig R. Kastelle[1](presenter), Thomas E. Helser[1], Jennifer McKay[2], Chris G. Johnston[3], Delsa M. Anderl[1], and Mary E. Matta[1].

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Abstract

Pacific cod (*Gadus macrocephalus*) is the second most important fishery in the North Pacific. However, Pacific cod age determination has historically been difficult, so uncertainty may exist in biological reference points. To address ageing inaccuracy, we conducted an age validation study using the stable isotope ^{18}O ($\delta^{18}O$). This approach is based upon the principle that variability in marine carbonate $\delta^{18}O$ is inversely related to water temperature, and thus seasonal changes in temperature would be reflected in otolith $\delta^{18}O$ values. We sequentially microsampled

Pacific cod otoliths, from the core to the margin, to measure ^{18}O ($\delta^{18}O$). This provided up to ten $\delta^{18}O$ measurements per posited annual growth zone, and approached 45 sequential samples per specimen. We developed individual life history signatures of $\delta^{18}O$ from N = 40 Pacific cod otoliths with estimated ages of 2 to 5 years. Our goals were to identify the annual seasonal variation (cyclical pattern of otolith $\delta^{18}O$ values) and determine if the number of $\delta^{18}O$ maxima and minima was consistent with the age derived from growth zone counts. We also estimated the probability of age reading bias by treating the number of $\delta^{18}O$ maxima and minima as an indication of "true fish age." The relationship between $\delta^{18}O$ in Pacific cod otoliths and known water temperature was also independently verified (r^2 = 0.74). Age reading bias in specimens from ages 2 to 5 was, on average, estimated to be relatively small. The probability of an age reader assigning an age based on visual growth zone counts equal to the true age was approximately 64%, whereas the probabilities of assigning an age greater to or less than the true age by one year were approximately 19% and 17%, respectively. However, there did appear to be an age-specific bias at age 5; the probability density was non-symmetric and indicated a probability of assigning the true age was 49%, with a 51% probability of under-ageing true age by one or more years.

What to do when dogfish lie about their age?

Cindy A. Tribuzio[1](presenter), Beth Matta[2], Chris Gburski[2], Cal Blood[3], Walter Bubley[4], Gordon H. Kruse[5], William Bechtol[6]

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[3]Resource Ecology and Fisheries Management, AFSC, NMFS, Seattle, Washington
[4]South Carolina Department of Natural Resources, Marine Resources Research Institute, Charleston, SC
[5]School of Fisheries and Ocean Sciences, UAF, Juneau, Alaska, USA
[6]Bechtol Research, Homer, Alaska, USA

Abstract

Historical methods for ageing spiny dogfish (*Squalus suckleyi*) result in low precision of age estimates, particularly for older fish exhibiting spine erosion, prompting a search for improved methods of ageing. Spiny dogfish were aged by historical methods and by a new method involving vertebral thin sections obtained from the same specimens. We estimated inter-reader precision and variance associated with each structure. The two structures yielded similar ages for younger animals but not for older animals. Similar to other ageing structures, individual variability can impact thin section quality, particularly in larger older animals. Each method has advantages and disadvantages. The fin spine method was validated previously by both oxytetracycline and bomb radiocarbon dating, but between-reader agreement is poor. Moreover, worn or broken fin spines require another step, where lost annuli are estimated through regression methods, which introduce an additional source of error into age estimation. In comparison, the vertebral thin section method substantially improved between-reader agreement and does not require the additional regression step, but processing of vertebrae is time consuming, the quality of the thin section impacts the age estimates, and validation of ages for

larger animals has not yet been realized. In summary, the vertebrae thin section method is promising, but more work is required to examine individual variability in thin sections (i.e. quality) and ages need to be compared among the two methods from a larger sample size of large, old fish that have been age validated by bomb radiocarbon dating.

Bomb Dating and Age Estimates of Big Skate (*Beringraja binoculata*) and Longnose Skate (*Raja rhina*)

Jacquelynne King[1], Thomas Helser[2], Christopher Gburski[2] (presenter), David Ebert[3], Craig Kastelle[2], and Gregor Cailliet[3]

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[3]Pacific Shark Research Center, Moss Landing Marine Laboratories, Moss Landing, CA, 95039, USA

Abstract

Age and growth curve estimates have been produced for big skate (*Beringraja binoculata* [formerly *Raja binoculata*]) and longnose skate (*Raja rhina*) populations in the Gulf of Alaska, British Columbia and California. Age estimation for these two skate species relies on growth band counts of sectioned vertebrae. However, these studies have not produced similar results for either species, highlighting the need for age validation. Archived large specimens of big skate and longnose skate collected in 1980 and 1981 had minimum age estimates old enough to suggest that radiocarbon (^{14}C) signals from bomb testing conducted in the late-1960s could be used to establish dates of growth band formation. Accelerator mass spectrometry provided measures of $\Delta^{14}C$ associated with a year of growth band formation based on skate age estimates. We used Bayesian statistics to compare these values to reference $\Delta^{14}C$ a marine teleost otolith chronology produced that exists for California.

Changes in Pacific cod otolith weight over time

Rob Dinneford (presenter) and Kristin Politano

Alaska Department of Fish & Game, Age Determination Unit, Juneau, AK

Abstract

Variability of otolith weight over time merits attention as otolith measurements including weight are used in quality control procedures, specimen verification, and age studies at the Alaska Department of Fish & Game's Age Determination Unit. Sagittal otoliths of Pacific cod (*Gadus macrocephalus*) have a relatively high surface area to weight ratio, and are likely to highlight trends in otolith weight variability. Weekly weight measures were taken from N = 84 dry stored *G. macrocephalus* otoliths for 31 – 46 weeks on and following extraction days. Scale performance and environmental conditions including ambient temperature, in-situ temperature & humidity, were also examined. Week of measurement and environmental conditions show slight significance with otolith weight within observed weight variance; however scale performance

also possibly accounts for 4% to 86% of observed variation (scale SD = ±0.00037 g). Otolith weights universally decreased between 1.1% and 1.9% from extraction days to the following week over a range of 0.0041 – 0.0111 g. Samples' otolith weight varied from SD = ±0.0006 g (CV = 0.10% for data set without extraction day) to SD = ±0.0015 g (CV = 0.28% for data sets including extraction day). Results suggest most otolith weights are stable (excluding extraction week measures), yet small-scale variations over time and conditions should be considered in pertinent models, etc. Analyses and reporting should be limited to 0.001 g to account for scale variance beyond this resolution. Sagittal otoliths for other species and size ranges should be analyzed to see if results are similar.

Re-ageing of archived otoliths from the 1920s to the 1990s

Joan E. Forsberg (presenter) and Ian J. Stewart

IPHC 2320 W. Commodore Way, Seattle, WA 98199

Abstract

The International Pacific Halibut Commission has collected otoliths for age determination since 1925. After otoliths are aged, they are stored and archived. The Commission's otolith collection contains samples from over 1.6 million halibut. Age determination techniques used for halibut have changed over time; prior to 1992, all otoliths were surface aged. Beginning in 1992, otoliths that met certain criteria (high surface age, difficult pattern, etc.) were also aged by break-and-burn or break-and-bake method in addition to surface aging. The break-and-burn/bake method was determined to provide more accurate ages. Therefore beginning in 2002, all otoliths collected from setline surveys or the commercial catch were aged by break-and-bake. To provide information on the bias and imprecision of historical surface ages relative to age data from the 1990s onward, subsets of otoliths from each decade from the 1920s to the 1980s were re-aged by both the surface and break-and-bake technique and original surface ages were compared to the ages made in 2014. Additionally, systematic subsamples of otoliths collected in 1992, 1993, and 1998 that were previously only surface-aged were re-aged by break-and-bake and included in this analysis. Results indicated that historical samples contained very few fish aged older than 15 years by either method. Based on simultaneous estimation of bias and imprecision for up to four unique ages per otolith, the properties of historical surface ageing methods were found to be very similar to current methods, becoming increasingly biased and imprecise beyond 15 years.

Preparing baked thick sections of Pacific halibut otoliths

Chris Johnston

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Abstract

Halibut otoliths from several different collection years were selected for an increment study looking at changes in size at age. Measurements were made on baked transverse "thick" sections

of blind-side sagittal otoliths. The procedure for preparing baked thick sections is described. The posterior end of the otolith was the preferred end to bake since it leaves the anterior end for surface reading. Some otoliths had already been aged by break-and-bake technique while others had only been surface-aged. Previously-baked otolith halves were cut about 1.5 to 2 mm below the reading surface and mounted onto individual glass slides, reading surface facing up, and polished. Whole otoliths were cut transversely either side of the 1st year, baked for 10 minutes at 500° F then mounted anterior end up on individual glass slides. The sections were then polished down to expose the nucleus using the polishing procedure described above. Polishing progress was monitored using a stereomicroscope. Polished sections were submerged in water to eliminate glare and photographed under 12X to 25X magnification.

Appendix V: Laboratory Ergonomics Checklist

Reducing Ergonomic Risks in Laboratories

Employee education and training is essential for prevention of laboratory injuries. Workers should have a basic understanding of ergonomic principles, and be able to recognize risk factors symptoms. The design of the job itself (work/rest schedules, job rotation), work tools and the workstation (dimension/layout) also has a direct impact on the risk of injury. Incorporating ergonomic principles into the design of laboratory tools and workstations, and reviewing work processes to maximize efficiencies can help prevent work related injuries. Periodic review of the work environment, tools and procedures helps to assure that necessary modifications are made as processes change.

Laboratory Checklist

This document will help you identify risk factors associated with laboratory environments. Designed for use by both safety specialists and laboratory workers, the checklist also includes information to help eliminate or reduce identified risks.

How to Use the Checklist

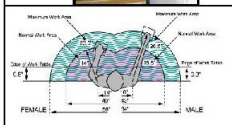
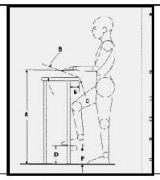
Step One: If you work with a safety specialist or safety committee, see if the following information if available for your laboratory: (1) list of musculoskeletal injuries; and (2) worker complaints or concerns about performing specific tasks.

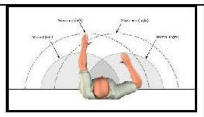
Step Two: Contact the workers and supervisor and discuss the purpose for performing the ergonomic survey. Ask the supervisors and workers if there are any issues or concerns that they have regarding laboratory work tasks.

Step Three: Complete the Laboratory Checklist for the tasks being completed in the laboratory. Answer N/A if the question does not apply to the task.
Include all meaningful comments for each area.

Step Four: *Each "NO" answer indicates a risk of injury or sub-optimal condition*. For each "NO" answer, concerning changes or modifications to the workstation or task to result in a yes response. When considering changes, obtain input from the workers, supervisors, and other safety specialists if available. Whenever possible, evaluate equipment before making purchases and before modifying the work areas or tasks. This process will help increase product acceptance, test product usability, and durability, and take advantage of worker experience.

Laboratory Ergonomics Checklist

		Yes	No	Change/Modification	Comments
	Standing Bench				
	1. Is the height of the bench appropriate for the work performed? a. Work can be positioned close to elbow height (~ 36-40") b. Work can be performed with shoulders relaxed	☐	☐	☐ Adjustable height benches ☐ Adjustable chair ☐ Temporary standing platforms ☐ Move the task to a seated bench with adjustable chair	
	2. Are primary work tools and supplies located within arm's reach (4-18") from table edge?	☐	☐	☐ Reposition tools and supplies within 18" distance ☐ Provide tool organizers, turntable workstations, turntables, storage bins, pipette holders and carousels	
	3. Is there knee and foot clearance when completing standing tasks in front of the bench? a. 4" deep knee clearance b. 4" high and 4"deep foot clearance	☐	☐	☐ Work at open bench cut outs ☐ Remove supplies and equipment from bench cut out areas ☐ Modify bench surface with clamp on cut out extensions to increase knee and foot clearance	
	4. Is a foot rail or prop available (6" from floor)	☐	☐	☐ Install rails or foot props ☐ Use footrest ☐ If bench has undersurface cabinet, open or remove door and place foot on lower shelf	
	5. Are there floor mats in areas where prolonged standing tasks are completed?	☐	☐	☐ Provide floor mats ☐ Use cushioned shoes and in-soles	

		Yes	No	Change/Modification	Comments
	6. Does the bench have rounded or padded edges to reduce contact stress?	☐	☐	☐ Add edge rests and protectors to eliminate sharp edges ☐ Use gel pads on surface to protect elbows ☐ Wear custom padded sleeves under lab coat	
	7. Is standing bench available for tasks requiring frequent movement between workstations?	☐	☐	☐ Redesign work to reduce movement between stations to optimize workflow	
	Seated Bench				
	8. Are bench cutouts available for seated workers? a. Minimum 15" depth b. Minimum 20" width	☐	☐	☐ Redesign benches to provide cut-outs for seated work ☐ Provide sit-stand chairs to improve knee clearance when working ☐ Clear out cutouts if cluttered with supplies or equipment	
	9. Are work items within close reach? a. Maximum 24"	☐	☐	☐ Reposition tools and supplies within 24" distance ☐ Provide tool organizers, turntable workstations, turntables, storage bins, pipette holders and carousels	
	10. Is seated bench available for tasks requiring precision and close inspection?	☐	☐	☐ Provide arm supports for stability if not available ☐ Provide sit-stand stools ☐ Provide adjustable work platforms to position work at optimal height	
	Laboratory Chairs				

		Yes	No	Change/Modification	Comments
	11. Can the laboratory chairs be adjusted to accommodate all workers? a. Seat height appropriate for work at height of benches? b. Feet supported on floor, ring or footrest?	☐	☐	☐ Provide chairs with adjustable height and angle seats and backrests ☐ Provide chairs with foot rings ☐ Provide footrests	
	12. Are armrests adjustable or removable if they interfere with work?	☐	☐	☐ Adjust armrests to provide support with shoulders in neutral postures ☐ Remove armrests	
	13. Are appropriate footrests or footrings provided?	☐	☐	☐ Provide industrial footrest ☐ Install foot ring on chair ☐ Install rail or platform	
	14. Do employees know how to adjust chairs?	☐	☐	☐ Train employees to adjust chair	
	Microscopes				
	15. Can employees view the eyepiece with neutral neck, shoulder and back postures? (Neck flexion < 25°, shoulders relaxed, back upright and supported by chair?)	☐	☐	☐ Reposition microscope ☐ Adjust height ☐ Adjust angle ☐ Reposition worker ☐ Adjust posture ☐ Adjust seat height ☐ Adjust seat angle ☐ use arm support/pad	

		Yes	No	Change/Modification	Comments
	16. Is the microscope positioned within easy reach of the worker? (Generally close to the edge of the workbench)	☐	☐	☐ Reposition microscope ☐ Move closer to front of counter ☐ Reposition worker ☐ Adjust posture ☐ Sit closer to bench	
	17. Can the microscope be positioned to promote neutral head, neck, shoulders and arm postures when used?	☐	☐	☐ Reposition microscope ☐ Use microscope adapters ☐ Positioning plate ☐ Ergo adapter ☐ Scopease ☐ Optical wedge ☐ Extended eyetube ☐ Eyepiece adapter ☐ Use video system	
	18. Are arms supported by worksurface, chair armrests, or pads for prolonged work?	☐	☐	☐ Use arm supports ☐ Use pads ☐ Adjust armrests ☐ Adjust worker position	
	19. Can the worker use the microscope controls with arms supported and relaxed?	☐	☐	☐ Reposition microscope ☐ Use microscope adapters ☐ Use arm supports/pads ☐ Adjust armrests ☐ Adjust worker position	
	20. Is there sufficient legroom and foot support when using the microscope?	☐	☐	☐ Work at bench cut-out ☐ Clear cut-out of clutter ☐ Provide footrest ☐ Provide foot ring	
	21. Are microscope work breaks provided?	☐	☐	☐ Institute work rotation ☐ Institute work breaks	

		Yes	No	Change/Modification	Comments
	Pipettes				
	22. Is manual pipette use limited to less than 4 hours per day?	☐	☐	☐ Institute work rotation ☐ Institute work breaks ☐ Consider use of alternative pipettes	
	23. If pipette use is more than 4 hours per day, are multi-channel, electronic or latch mode pipettes available?	☐	☐	☐ Evaluate use of alternative pipettes ☐ Electronic ☐ Latch-mode ☐ Multi-channel	
	24. Have employees been trained to select appropriate pipettes for pipetting task?	☐	☐	☐ Employee training	
	25. Are racks, trays, beakers and supplies available and placed within easy reach?	☐	☐	☐ Provide racks and trays ☐ Position supplies within close reach ☐ Use pipette racks and organizers	
	26. Are vials, tubes and receptacles as low profile as possible?	☐	☐	☐ Provide short beakers and vials ☐ Provide short tips and tubes ☐ provide short/angled waste receptacles	

Appendix VI: Crustacean Age Determination Workshop Final Report

Crustacean Age Determination Workshop

April 14-17, 2015 – Seattle, Washington

With support from: BSFRF Bering Sea Fisheries Research Foundation

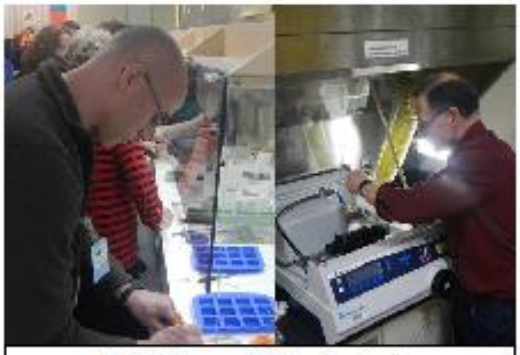
Workshop Report

The Crustacean Age Determination Workshop sponsored by the Committee of Age Reading Experts (CARE) with support from the Bering Sea Fisheries Research Foundation was held at the Alaska Fisheries Science Center in Seattle, Washington April 2015 in association with the biennial CARE meeting. Twenty-one biologists and sclerochronologists from the Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife, Department of Fisheries and Oceans Canada, Alaska Department of Fish and Game, and NOAA National Marine Fisheries Service participated in the workshop facilitated by Dr. Raouf Kilada of the University of New Brunswick. The objective of the workshop was to train participants to process calcified structures and identify growth bands for age determination in shrimp, crab, and lobster.

The workshop consisted of three phases: 1) dissecting and preparing structures, 2) removing thin-sections, and 3) band detecting and interpretation. This method was applied to three species – spot shrimp, snow crab, and, for the first time, Dungeness crab. Structures included spot shrimp eyestalks, snow crab zygocardiac ossicles, and Dungeness crab eyestalks and zygocardiac ossicles. Growth bands were visible in thin-sections of all structures (see images on the following page).

The workshop organizers would like to thank the following individuals and organizations who made the workshop possible:

Structure Preparation



Embedding and Thin Sectioning

Imaging and Interpretation

- **Dr. Raouf Kilada**, for sharing his expertise and conducting a successful workshop
- **The Bering Sea Fisheries Research Foundation**, for supporting Dr. Kilada's participation in the workshop.
- **The NOAA Alaska Fisheries Science Center – Age and Growth Laboratory**, particularly **Craig Kastelle** and **Chris Gburski**, for hosting the workshop.
- **The Committee of Age Reading Experts**, chaired by **Elisa Russ**, for their time and assistance in organizing the workshop.
- **The Technical Subcommittee of the Canada-USA Groundfish Committee,** for supporting integration of the workshop with the biennial CARE meeting.