Alaska Hatchery Research Program Science Panel meeting December 14, 2022

Hybrid meeting (in-person meetings in Juneau and Anchorage, and other virtual guests, connected via Microsoft Teams)

Summarized meeting notes and decision points

Attendees

Science Panel

Milo Adkison, ADF&G

John Burke, ADF&G and Southern Southeast Regional Aquaculture Association (SSRAA; retired from both)

Chris Habicht, ADF&G

Jeff Hard, Northwest Fisheries Science Center, National Marine Fisheries Service (NMFS; retired)

Ron Josephson, ADF&G (retired)

Bill Smoker, University of Alaska (retired)

Bill Templin, ADF&G

Alex Wertheimer, NMFS (retired)

Peter Westley, University of Alaska

Other Attendees

Sam Rabung, ADF&G

Chance Gray, Sitka Sound Science Center (SSSC)

Alex McCarrel, SSSC

Kristen Gruenthal, ADF&G

Kyle Shedd, ADF&G

Garold V. "Flip" Pryor, ADF&G

Erica Chenoweth, ADF&G

Mike Wells, Valdez Fisheries Development Association (VFDA)

Tina Fairbanks, Kodiak Regional Aquaculture Association (KRAA)

Ron Heintz, SSSC

Katie Harms, Douglas Island Pink and Chum, Inc (DIPAC)

Eric Prestegard, DIPAC (retired)

Geoff Clark, Prince William Sound Aquaculture Corporation (PWSAC)

Samuel May, Postdoctoral fellow at UAF

Scott Wagner, Northern Southeast Regional Aquaculture Association (NSRAA)

Jennifer R. Morella, ADF&G

Jodi Neil, ADF&G

Jodi Estrada, ADF&G

Sara Gilk-Baumer, ADF&G

Ben Americus, Sea Grant Fellow

Kari M Winkel, ADF&G

Lorna Wilson, ADF&G

Rick Green, ADF&G

Introductions and In Memoriam: John H. Clark

- o Science Panel, staff, contractors, and other attendee introductions
- o John H. Clark, (deceased, former Science Panel member, ADF&G retired)
    - Colleagues shared gratitude for and memories of John H. Clark, a "legend in his own time" whom many appreciated personally and professionally; remembered his work advancing fisheries management in Alaska; he will be missed.

AHRP Meeting Minutes

- o **January 2022 AHRP Meeting Minutes approved**
    - Minutes approved by unanimous consent

Budget Status & Travel Note

- o **Flip P.** reviewed Proforma budget up-to-date and available
    - Project remains solvent through FY24 assuming continued contributions
        - Pink Salmon Disaster funds continue to be applied to pink salmon work (genetics)
        - Most PNP and Processor funds did come in last fiscal year
        - Future contributions are estimated
    - Note: for any future travel expenses for non-employees of the state, submitting an invoice for reimbursement is no longer an option; lots of notice ahead of time will be required to cover travel expenses for future meetings due to new state travel system

2022 Contractor Reports

- o SEAK Stream sampling summary (chum salmon) – SSSC [PowerPoint available]
    - **Alex M.** presented 2022 chum project field report
        - Review of project goals and history
        - Review of survey methods
            - Carcass surveys
            - Mark-recapture surveys
            - Otolith and scale harvest for analysis
        - 2022 Stream Survey results
            - Fish Creek: 1,053 carcasses; 270 tagged; 71 tags retrieved
            - Sawmill Creek: 479 carcasses; 86 tagged; 8 tags retrieved
            - Prospect Creek: 470 carcasses; 35 tagged; 7 tags retrieved
        - sex ratios by stream to evaluate potential bias in all periods of sampling (marking/recapture/carcasses)
            - carcass survey, skewed toward females
            - mark-recapture, skewed toward males
            - overall results differed only slightly from previous years
        - Length of sampled chum, size selectivity was evaluated (marked/recaptured/carcasses)
            - Tagged chum were smaller than carcasses

- Live females and males were smaller than carcass females and males for all three creeks: age at return may be a factor
    - Mark-recapture analysis results (determines estimated proportion of runs sampled for each of the streams)
        - Mean proportion sampled estimates ranged from 25% to 42% depending on creek and sex (lower than last year for all three streams)
- Discussion
    - Attendee noticed the peak dead count date was 2 days before the crew finished sampling and asked about weather impacting sampling. SSSC confirmed that ideally, they would have continued sampling but atmospheric river event forced crew removal early due to unsafe and unsurveyable conditions.
    - Confirmation of figure: chum harvest numbers were up in 2022 to 9.4 million compared to 7.2 million in 2021
    - Observation and clarification that run estimates (unstratified) are lower than live. Reason: live sampling numbers includes recaptures.
    - **Bill T.** inquired if there was any sense of stream life for fish from mark recapture study. **Ron H.** confirmed that there is floy tag data on all individuals marked, so they could go back and look to yield stream life estimates for recovered fish
        - **Decision point**: **Ron H. / SSSC** will review floy tag data of recaptured fish to estimate stream life.
    - Data type confirmation: in addition to length measurements, body depth has been measured for carcass surveys in all study years; added it in 2022 for tagging study but didn't collect body depth data in 2021for tagging portion.

2022 Lab Reports

- o PWS Otolith reading – ADF&G Cordova Lab
    - **Jennifer M.** presented this progress report (PowerPoint available)
    - Great Otolith Debacle (GOD) affected otoliths status update: post-DNA extraction 96-well plate progress
        - 48 unread plates logged and remaining to be read
        - Anticipated completion of first and second reads for all GOD affected plate otoliths is February 2023
            - 91.4% readable post-extraction
        - First reads completed on all other plates of otoliths, completion of second reads anticipated February 2023
        - Cordova Lab will have lots of capacity to help with this project going forward
    - Discussion
        - Confirmation given that this schedule works with downstream analysis
        - New otolith lab manager coming on board soon (Stormy Haught)
- o SEAK Otolith reading – ADF&G Mark, Tag, and Age Lab (MTAL;
    - **Jodi N.** presented this progress report (PowerPoint available)

- 2022 chum otolith status:
  - 1,908 completed currently of total 2,002
    - 70% were Fish Creek, 18% were Prospect Creek and 12% were Sawmill Creek otoliths
- Breakdown of 2022 samples by hatchery mark and year
  - DIPAC 2017, 2018, and 2019 were the majority of samples
  - Others from NSRAA and Port Armstrong
- Discussion
  - **Decision point**: **Jodi N/MTAL** can provide access to the raw sampled otolith counts by hatchery for each stream (requested by SP members); she will email it to the group
  - Given the disparity in sampling fractions over the course of the season, it's important to identify who is responsible for doing the stratified analysis to figure out what the overall percentage of hatchery origin is in each stream (versus unweighted raw counts).
    - **Decision point**: **Ron H. / SSSC** will look at the stratified estimate of hatchery proportions by stream through time (requested by SP member);
  - Raw otolith read results are also available in the mark summary report on the MTAL website (link will be provided in Jodi's email)
- Genetics – Gene Conservation Laboratory (GCL)
  - **Kyle S., and Kristen G.** presented this progress report (PowerPoint available)
  - This update addresses status of data primarily addressing the third question
    - "What is the impact on fitness (productivity) of wild pink and chum salmon stocks due to straying of hatchery pink and chum salmon?"
  - PWS pink salmon
    - Brief overview of complete study design from 2013 to 2020 for all 5 streams originally included in the study representing over 235,000 samples collected
    - Tissues analysis update (those not affected by the Great Otolith Debacle)
      - 154,000 samples have been genotyped; 81,000 samples remain to be genotyped and are estimated to be completed by June of 2023
    - Great Otolith Debacle related tissues analysis update
      - This affected 10,898 otolith/heart pairings
        - Genotyping and modified QC was completed in August of 2022
        - Erb Creek (2016), Paddy Creek (2016-2018) and Gilmour Creek (2015-2018) were most affected Hogan and Stockdale creeks were least affected.
      - Review of Otolith-heart re-pairing analysis methods
      - In summary, all genotype data are now available, and we are going through and painstakingly trying to repair what happened
        - Updated and streamlined analysis code being refined and used in this rematching process
    - Relative Reproductive Success (RRS) update
      - Successful publication, February 2022

- Shedd, K. R., E. A. Lescak, C. Habicht, E. E. Knudsen, T. H. Dann, H. A. Hoyt, D. J. Prince, and W. D. Templin. 2022. Reduced relative fitness in hatchery-origin Pink Salmon in two streams in Prince William Sound, Alaska. Evolutionary Applications 15(3): 429-446
  - Pedigree reconstruction analysis change implemented
    - As part of the effort to utilize multi-stream data all together in analysis looking at pedigree reconstruction across all streams
      - Running analysis on genotype data from all streams per generation instead of stream-by-stream helps account for variability in sampling among streams and enables direction detection of natural-origin straying
    - Single generation (parent-offspring) assignment is using the full muti-stream data set when possible but presents computational challenges
      - Currently troubleshooting with UAF computer cluster; exploring more R packages for this type of analysis
      - More updates to come pending the otolith-heart re-pairing resolution and collaboration with UAF PhD student
  - Heritability update (AHRP offshoot project)
    - Narrow-Sense Heritability
      - Thanks to **Jeff H.** in this process; now have animal model for this
        - Results generated for sample data and body length for BY 2014 so far
      - Gilmour Creek has best triad data available for chance at looking at narrow-sense heritability
      - More on this analysis once otolith-heart repairing completed
  - Mid-Coverage Whole Genome Resequencing update (AHRP-associated project funded by Pink Salmon Disaster Relief awards to the PSMFC)
    - Supports attempts to do multi-generational assessments on impact of hatchery-origin on RRS beyond single generation analysis by detecting potential effects of hatchery background on selective or adaptive and structural variation of the genomes of the fish
    - Brief overview of lab method and data inputs
    - Data processing was completed in August, 2022
    - Analysis of structural and adaptive genomic variation (especially associated with hatchery ancestry) is currently in progress at Perdue University
- SEAK chum salmon
  - Review of chum sampling plan, past, present, and potential future (2013-2023)
    - chum salmon present more analysis challenges for multiple reasons

- o sampling challenges
        - o overlapping age structures
    - Fish Creek is estimated to be the only system with the necessary sample sizes collected for grandparentage (F2) analysis based on PWS pink salmon analysis work
    - This subject will be revisited later in the meeting when discussing future field sampling work
  - SNP discovery and locus selection (GT-seq panel development) update: Brief overview of methods for genetic marker panel development
    - A high-quality SNP panel will increase information power for analysis
    - 10,000 potential SNPs were filtered down to about 600 primer pairs
    - Final set of primer pairs in the panel will be finalized in the coming months.
- 2023 Next steps
  - PWS Pink Salmon
    - Complete otolith-heart re-pairing
    - Complete genotyping of remaining pink salmon and generate lineage-specific multi-stream pedigrees per generation
      - o Re-estimate RS and RRS for all streams and years
      - o (Re)estimate h^2 for all streams and years for each trait of interest
    - Assist in interpretation and publication of whole genome resequencing analysis results
  - SEAK Chum Salmon
    - Optimization of chum salmon GT-seq panel will be completed
    - Begin DNA extraction, genotyping and analysis of tissue samples
- Discussion
  - Confirmed that the estimated timeline for chum analysis is winter 2023-24, at the earliest

Additional 2023 Planning

- o Outreach/presentation opportunities
  - January 23-27, 2023, Alaska Marine Science Symposium, hybrid;
    - Wei Cheng has submitted an abstract for a presentation on the pink salmon population structure (PWS) work
    - Sam May has submitted for presenting a poster on fine-scale population structure within pink salmon populations
  - March 23, 2023, Board of Fisheries Hatchery Committee, Anchorage
    - There will be an abbreviated presentation to the Hatchery Committee Meeting; only one or two new board members unfamiliar with the project
    - **Decision point**: it will not be paired with a public outreach meeting this year
  - March 27-31, 2023, American Fisheries Society Meeting, Fairbanks

- ▪ Not yet ready for abstract submissions
  - ▪ Sam May and others interested will consult with the Science Panel before submitting for presentation
- HWI Public Outreach Meeting Discussion
  - ▪ Not typically done annually; not many new results to share; all presentation materials from the previous meeting are available on the website; need to save funding for larger landing events and results sharing in 2024
  - ▪ **Decision point:** no Public Outreach Meeting planned in 2023
- o Other publications
  - Future RRS manuscripts
    - ▪ Lab work for pinks estimated to be completed by June 2023 and analysis will follow in the Fall of 2023, publication and results release estimated in early to mid 2024
      - ▪ Overcoming computational bottlenecks will be part of that timeline
    - ▪ Chum labwork will begin after pink work completed; will likely push publication schedule in 2025
    - ▪ **Decision point:** plan to convene an in-person meeting of Science Panel members sooner than winter 2023 to plan project finish and landing
      - ▪ Location and date to be discussed by email amongst SP members
  - Webpage updates
    - ▪ These continue to be managed by **Flip P**.; no updates since last spring
      - ▪ AFS presentations (video) and or PDF files will be posted
      - ▪ Feedback on challenges and issues navigating the site from anyone would be helpful
      - ▪ SSSC reports need to be added from 2021 and 2022

<u>Associated research</u>

- o **Sam M.** research presentation – "Quantitative genetic model to examine the effects of hatchery strays on wild population recruitment and resilience" (PowerPoint presentation available)
  - Sam connected with AHRP to help with modeling
    - ▪ This model is primarily concerned with the trait of return timing for salmon (when a salmon returns to spawn is important for fitness and recruitment)
    - ▪ Developed over the last 2 years, the base for this model was just accepted for publication in *Evolutionary Applications*
  - Reproductive timing is important for fitness in salmon
    - ▪ Timing can lead to population sub-structure
      - ▪ Sub-structure can lead to assortative mating
  - Study Objectives
    - ▪ To develop a modeling framework that predicts demographic and evolutionary changes while accounting for assortative mating
    - ▪ To examine the effect of hatchery strays on wild population productivity and resilience

- Individual-Based Model Design
  - Bottom-up simulation technique where individual agents interact with each other in a pre-defined simulated environment; in these steps
    - Initialization
    - Selection
    - Population Size of Next Generation
    - Reproduction
    - Inheritance
    - Output (each generation)
  - Reviewed assumptions of the model (one big one: No 'heritability of fitness')
- Applying the model to questions of Hatchery-Wild Interactions
  - What is the effect of consistent hatchery straying into wild populations on recruitment and resilience?
  - Adding hatchery fish each generation with different run timing from the wild fish
  - Varying the proportion of hatchery origin spawners (pHOS)
  - Parameterizing with empirical values from AHRP Pink Salmon in PWS
  - Reviewed several examples of model running
- Conclusions: according to our models, hatchery straying:
  - Increases wild recruitment
  - Causes rapid introgression of hatchery-origin genes into wild populations
  - Increases synchrony among populations
    - Reduces portfolio effects and therefore resilience
    - Decreases genetic diversity among populations
- Discussion
  - Brief discussion of GCL's Wei Cheng's preliminary analysis results looking at pinks in PWS east side stocks versus west side stock straying rates and timing effects; interesting questions of what drives run timing (ecological: water temperature, local basin dynamics affecting nearshore blooms)
  - Sharing of gratitude that model has come to this point, lots of supporting work by a smaller group to help shape it; it will do what good models do which is help shape future hypotheses, challenge assumptions
  - Brief discussion of challenges in model coding and truncation of lifespan of earliest and latest arriving fish to avoid early and late fish having less reproductive opportunity could be inadvertently happening now
  - Brief discussion of why there is a selective pressure on lifespan in the model; lifespan is held pretty constant but there is a distribution (earlier individuals tend to live longer, later individuals don't live as long)
  - Review of density dependence and how it was coded in the model; density dependent function applied to spawners on spawning grounds every day, controlling expected number of offspring that spawners reproduce; weak effect overall in the model currently in comparison to hatchery effect on overall recruitment; weak effect was surprising; interest in trying to ground truth that empirically more in the future

- **Milo A., Bill T.,** and **Sam M.** interested in getting together to look at improvements on model
- Brief acknowledgment and discussion that empirical evidence has shown that it's not just run timing as the only driving force in reproductive success, though a very important factor, doesn't explain early results we're seeing; more data will come in; next biggest step will be to parameterize the model with more empirical values
- Generally, a good framework; a simplified capture of reality; will collectively talk about tweaks in the future to make it even more realistic
- Interest in seeing what variation exists in selective pressure of run timing; how tight or lose that relationship is (held constant right now); injecting more realism into the model (keeping in mind different scales of selective pressures)

o Data request for **Sam M.** side project
  - Investigating Spatial segregation within populations between intertidal and upstream habitats: fine-scale homing to intertidal or upstream habitats
    - Are homing behaviors within streams stratified by intertidal or upstream natal rearing habitat?
    - Fine-scale population structure can affect gene flow, adaptive capacity, and resilience
      - Particularly interested in mechanisms driving segregation between hatchery and wild fish
    - Spawning Location ~ Natal Location
      - Natal Location = Spawning Location of Parents
    - Currently exploring data from the 5 fitness streams 2014 - 2016
  - Discussion on how SP feels about publishing partial data for this project
    - Reminder to be cautious about which data affected by otolith issue, still being resolved
    - Reminder that a couple years ago discussed how to create formal agreement process rather than case-by-case evaluation;
      - **Decision point: Flip** will remind the SP where this was left last by those working on it and help them pick it back up
    - **Decision point:** SP approved by unanimous consent that this data request should be approved

Additional Items

o Field Sampling Discussion
  - F2's from 2014 spawners at Fish Creek (2023 and 2024)
    - **Kyle S.** assisted discussion with slides
      - Reviewed age classes and total samples by stream by year for chum salmon; challenges for power analysis F1/F2 generations
    - Discussion included little support for sampling another year at Prospect or Sawmill Creeks, but non-unanimous support for Fish Creek (highest numbers; best sampling through years for shot at F2 analysis)
    - Need to weigh the public interest in getting results for chum salmon (F2) with the limitations of results from Fish Creek (high pHOS relative to other streams, so caveats will be needed in interpreting results).

- Sampling one more year demonstrates that this program took measures to get the best shot at answering the F2 question, given the circumstances.
    - **Decision point: Sara GB/ Flip** will confirm Northern Fund grant ($150K) is acceptable to use on only one stream (rather than three originally proposed
    - **Decision point: Chance G.** will get a revised budget to SP for sampling only at Fish Creek by SSSC later this week
    - **Decision point**: **Flip** will distribute new information and coordinate a second vote by email the following week with SP to confirm whether sampling at Fish Creek for chum will go ahead in summer 2023
- o Analysis priorities for SEAK Chum
    - **Kyle S.** reminded SP that GCL hasn't extracted any chum samples for genetic analysis yet; looking for guidance for which streams and years to analyze
        - While some years might seem easy to drop, still might be worthwhile to include if analysis cost is small to squeeze out as much information as possible from large effort
    - SP has a lot of trust that **Kyle S./Kristen G.** know which fish are best for analysis
        - **Decision point: Kyle S.** and **Kristen G.** will work with **Chris H.** to create a rationale for years/samples to study and circulate to SP by email, aiming for week of Dec. 26
- o Planning the end game
    - 2023 potential staff departures and retirement
        - Given that **Chris H**. is retiring and **John C.**'s position on SP is now vacant; do we want to add one or more people to the SP
            - Reminder to consider diversity in what we're looking for; SP expressed low concern since appointment of **Peter W.** and **Milo A.**
                - o Social science perspective is lacking and could be very useful
        - Potential nominees put forward were: **Kristen G., Tommy Sheridan, Tim Joyce**
        - **Decision point**: **Flip** will organize a list and poll by email
        - Others could be good to involve but not necessarily as SP seat holders
            - o **Hannah Harrison** for example
    - Transition from SP into ADF&G policy making activities
        - Important reminder that once results are available and in context, the question of what we are going to do about the it will be asked with increasing urgency; suggesting we think about that or prepare for that moving forward.
    - 2024 certification date
        - **Sam R.** reminded all that MSC certification has nothing to do with this program; they found the study after it was begun; should not add any pressure to work already being done as efficiently as possible
    - **Decision point: Flip** will circulate a poll for the March meeting by email