Minutes of the Joint Meeting Plan Teams for the Groundfish Fisheries of the Gulf of Alaska (GOA) and Bering Sea Aleutian Islands (BSAI)

North Pacific Fishery Management Council
1007 West Third, Suite 400
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Groundfish Plan Team Membership:

BSAI Team		**GOA Team**	
Grant Thompson	AFSC REFM (co-chair)	Jim Ianelli	AFSC REFM (co-chair)
Steve Barbeaux	AFSC REFM (co-chair)	Chris Lunsford	AFSC ABL (co-chair)
Steve MacLean	NPFMC (coordinator)	Sara Cleaver	NPFMC (coordinator)
Mary Furuness	NMFS AKRO	Obren Davis	NMFS AKRO
Alan Haynie	AFSC REFM	Jennifer Cahalan (substitute for Craig Faunce)	AFSC FMA
Allan Hicks	IPHC	Lisa Hillier	WDFW
Lisa Hillier	WDFW	Pete Hulson	AFSC ABL
Kirstin Holsman	AFSC REFM	Sandra Lowe	AFSC REFM
Andy Kingham	AFSC FMA	Nat Nichols	ADF&G
Kalei Shotwell	AFSC REFM	Jan Rumble	ADF&G
Phil Joy	ADF&G	Paul Spencer	AFSC REFM
Cindy Tribuzio	AFSC ABL	Marysia Szymkowiak	AFSC REFM
vacant	ADF&G	Kresimir Williams	AFSC RACE
		Andrew Olson	ADF&G

Administrative/Intro/Council updates

The Joint meeting for the Groundfish Plan Teams ("Teams") began on Monday, September 20, 2021 at 9:00am PDT. Participation was remote via Adobe Connect. Roughly 115 people attended the meeting, but attendance varied throughout the meeting. All documents provided prior to or during the meeting as well as presentations given during the meeting were posted to the Teams' electronic agenda.

Future meetings: The November Groundfish Plan Team meetings will be held November 15-19, 2021. These will be remote meetings. Tentative dates for 2022 meetings are: September 19-23 and November 14-18.

Team members introduced themselves over video, and Sara Cleaver provided updates on Council activity. Updates included scheduling for upcoming Council meetings, recent Groundfish FMP amendments, updates on the research priorities process and Halibut Discard Mortality Rate (DMR) Working Group recommendations for in-season management of BSAI and GOA Groundfish fisheries for 2022-2023,

which were later approved by the individual Teams. Diana Stram provided updates from the Crab Plan Team meeting.

Fishery Ecosystem Plan (FEP)

Kerim Aydin provided an informational update on the Bering Sea Fishery Ecosystem Plan annual team meeting and updates from the FEP Local Knowledge, Traditional Knowledge, and Subsistence (LKTKS) Task Force and the Climate Change Task Force (CCTF). The FEP Team intended to meet in late August 2020. That meeting was delayed due to the COVID pandemic and instead occurred in May 2021. The next annual meeting is scheduled for March 2022.

The LKTKS Task Force has been working to develop a process to enhance the use of local knowledge, traditional knowledge, and subsistence information in Council management, and considering how to provide input to annual processes such as the Ecosystem Status Report (ESR).

The CCTF is developing tactical and strategic work products for the Council to allow for climate-informed fisheries management. The task force will develop a Climate Fishery Impacts and Adaptation Report, the first section is targeted for fall of 2021, to describe the Council's current state of climate readiness. The remainder of the report is scheduled for 2023, and will assess adaptation tools, key risks, gaps, tipping points, and limits to adaptation.

Kerim provided a description of the reports and products that address the ecosystem, and the distinguishing differences between the ESR, the Ecosystem and Socio-economic Profiles (ESP), and the Bering Sea Ecosystem Health Report (BSEHR) that has been proposed by the FEP Team. Kerim noted that there is some concern about implications associated with the term "health", and suggested that a new name might be developed. The BSEHR is envisioned to show cumulative, multi-species effects of climate variance, inform management strategy, be useful for a diversity of audiences, and monitor the success of EBFM management actions. The BSEHR is currently in initial scoping of indicators to fit under FEP objectives. A draft is expected in early 2022.

The Teams had no questions or discussion and made no recommendations regarding the report.

Electronic Monitoring (EM) Workshop

Cindy Tribuzio gave a presentation to the Teams summarizing the Electronic Monitoring (EM) workshop held on July 8, 2021. The purpose of this workshop was to inform stock assessment authors on EM programs and data streams, including differences between trawl and fixed-gear EM programs. Five areas of concern were identified and presented: 1) loss of haul-level data, 2) biological samples, 3) vessel selection bias, 4) author feedback process, and 5) data access. It was noted that logbooks are available from these fisheries, but currently the logbook data are not accessible to assessment authors. Some additional fields, such as observations of depredation, may be added to the logbooks in the future.

The Teams discussed the four recommendations from the workshop, including a process for assessment authors to provide feedback to the Council and agency divisions responsible for implementing the EM programs. There was agreement that a process should be developed, which may involve Team co-chairs, or others designated by the Teams, querying stock assessment authors and asking for their feedback, concerns, and experience with EM. A summary of these memos would be reported at the Joint Team Meeting, which would be further communicated to the NPFMC advisory bodies and committees. Overall, the EM workshop identified issues related to EM that should be addressed and concluded that communication between stock assessment authors, NPFMC advisory bodies and committees, and the

NMFS divisions involved with EM is important and useful. Resources required for this to happen need to be identified.

The Team recommended continuing work related to the four recommendations from the EM workshop, with the following comments.

1. A process for soliciting and delivering feedback from assessment authors should be developed, making sure to include NPFMC advisory bodies and committees as well as pertinent agency divisions in the delivery.
2. An iterative process will likely be needed to determine the important metrics for assessment authors to report, and whether every assessment should be required to report those metrics.

Observer Program

Jennifer Ferdinand (AFSC FMA) and Geoff Mayhew (PSMFC, AFSC FMA) gave an update on the "Observer and Electronic Monitoring Programs in the Groundfish and Halibut Fisheries off Alaska." The structure of the monitoring programs was reviewed, noting that there is not a single observer program but rather an assembly of several programs: full coverage (90% of monitored sea days), partial coverage (trip selection rates defined in ADP), fixed gear EM (169 vessels, trip selection rates set by policy at 30%), and the pelagic trawl EM EFP (41 and 48 vessels in 2020 and 2021).

The Annual Deployment Plan (ADP) documents how observer and electronic monitoring resources will be deployed to vessels in the partial coverage and EM programs, with proposed deployment schemes evaluated in a draft ADP. In addition to the Fishery Monitoring Science Committee (members from AFSC, AKR, IPHC, and PSMFC), three Council advisory groups (Partial Coverage Fishery Monitoring Committee, the SSC, and the AP) and the Council provide input to the ADP process.

Covid-19 Deployment Disruptions: In March 2020, observer coverage was waived in all fisheries. Full coverage fisheries maintained full coverage largely uninterrupted, but large disruptions to observer coverage occurred for all partial coverage vessels. In June 2020 a redesigned ADP was implemented that reinstated observer coverage for vessels operating from 14 ports. Substantial data loss resulted from the waiver of observer coverage, impacting the data stream from fisheries that are primarily harvested by the partial coverage sector. The Pollock Trawl EM EFP helped mitigate COVID-19 related data loss and additional shoreside observers needed to be deployed to GOA processing plants to ensure COVID-19 protocols could be followed while limiting data loss.

Port-specific coverage for COVID-19 protocols introduced bias, created data gaps, and was not cost efficient. The 2021 ADP continued port-based deployment of observers until changes in Alaska's health advisories and vaccine availability allowed coverage to be expanded to all ports under a mid-year revised 2021 ADP.

The 2022 Draft Annual Deployment Plan: Two of the analytic goals in the draft 2022 ADP are projecting 2022 fishing effort and determining how to allocate afforded samples to sampling strata while remaining within budget. Fishing effort projections were complicated by COVID-19 impacts to 2021 fishing activities; effort is projected to be approximately the same as 2021 (+/- 11%) using methods in Ganz and Faunce (2019; NOAA/AFSC-TM 395) with modification for COVID-19.

Four sample (deployment) allocation schemes were evaluated for use in 2022 in the partial coverage fisheries. Simulation methods were used to compare sampling rates and numbers of sea-days (costs) under the proposed deployment schemes. Additional evaluation of the proposed schemes assess the proximity of observed trips to other observed trips, EM trips, and trips in the zero selection pool (vessels < 40ft) using a similarity index. Proximity scores are assigned at 4 levels: covered trips, within 15 days and the same NMFS reporting area, within 45 days and the same FMP, or greater than 45 days and within the FMP.

Four sample (deployment) allocation schemes were evaluated. For the final ADP, NMFS proposes use of an allocation scheme that allocates sea-days to achieve equal deployment rates across strata up to an adjusted rate so that there is a 95% probability of achieving the 15% deployment threshold (adjusted minimum + optimization). The allocation of additional sea-days afforded is described in the ADP. Under this scheme, the highest deployment rates would be on trawl gear vessels (44.1%) followed by longline and pot (15%) gear vessels, with the added benefit of ensuring that the threshold 15% deployment rate is achieved.

It was noted in public testimony that it is difficult for stakeholders to evaluate the trade-offs in monitoring deployment without variance estimates. The Team concurred and noted that this topic was also discussed at the EM Workshop. The report of variance estimate methods and results is currently in review and will be provided in the forthcoming 2019 Annual Observer Program Report, which was delayed due to COVID-19.

There are several factors that impact the availability of fishery-dependent data: 1) monitoring is funded by industry and budgets have not been stable in recent years; 2) EM is expanding and with this increase there is an expectation of reduced collections of biological specimens (lengths, otoliths) from species discarded at sea and reduced spatial and temporal specificity from retained catch (no haul-specific information); and 3) changes in partial coverage monitoring do not impact all fisheries equally and may affect fishery-dependent data in ways that impact stock assessments. To address these types of changes, stock assessment scientists are in the best position to advocate for the collection of data used in stock assessments.

Ecosystem and Socioeconomic Profiles (ESP)

Kalei Shotwell presented the current status of ESPs and future plans for expansion to a national initiative to include all five NOAA Fisheries Science Centers. Five workshops (data, model, advice, and two follow ups) have been held between 2019 and 2021 which served to bring programs and agencies together under the central focus of the ESPs and allowed for streamlining the ESP process to the priorities of the AFSC. These workshops brought together a wide range of researchers from across disciplines including all AFSC programs, Alaska Regional Office, Council, other science centers, NOAA headquarters, universities, and other state and federal agencies. They also aided in integrating the ESPs into operations at the AFSC and provided building blocks for initializing ESPs at other science centers. Currently there are five ESP teams (sablefish, GOA pollock, Pacific cod, crab, and data limited stocks) working on 7 ESPs (four groundfish and three crab). The process and timelines for development, continuation, and reevaluation of ESPs were described. This included a 5 year cycle for each stock, with an initial full ESP followed by partial ESPs as

new indices are incorporated, as well as the production of annual report cards made available to assessment authors in time for assessments and integration of pertinent information into the risk tables.

Kalei sought the Teams' opinion on the adequacy of the proposed ESP schedule and its January start time. The Teams indicated that the ESP schedule as described appeared adequate. She further inquired whether it would be acceptable to continue with the 7 current ESP stocks for 2022, without initiating new ESPs, as the proposed new cycle is implemented. There are several stocks for which ESPs have been suggested (e.g., BSAI Atka mackerel, GOA other rockfish, arrowtooth, and POP). There was some discussion with feedback sought from AFSC supervisors on the current workload of their staff. AFSC staff are currently fully tasked, with little time to engage in new ESPs, and effort would be better placed in improving current ESPs and the ESP process. The Teams indicated that holding the ESP process at the current stocks while evaluating the process in 2022 would be acceptable. Feedback was sought on the indicators approach used in the ESP and the submission tool developed in AKFIN to report indicator data. It was noted that there does need to be more guidance on the socioeconomic indicators to ensure that they are relevant to stock health and not redundant with the Economic SAFE. In addition, each indicator should be evaluated for relevance and not simply included in the ESP because it is available. The Teams were asked about the adequacy of the three ESP reporting templates (Full, Partial, and Report Card). The Teams indicated that the templates appeared to provide the function required for the ESP, however they emphasized that the functionality of the templates should be evaluated with more use.

Climate Fisheries Initiative (CFI)

Anne Hollowed presented an overview of the NOAA Climate and Fisheries Initiative (CFI). Climate change is a national issue and NOS, NESDIS, OAR, NWS and NOAA Fisheries have come together to provide information, tools, and support for near-term to long-term climate-informed decision making. The CFI is a cross-NOAA effort which aims to build an operational ocean modeling and decision support system, provide state-of-the-art ocean forecasts and projections, climate-informed ecosystem projections, risk assessments and management strategies. These efforts will help reduce impacts and increase resilience of living marine resources (LMRs) and communities and identify the efficacy of adaptation actions and limits to how much change can be attenuated by adaptation and planning. There are three parts to the CFI; 1) science and development, 2) operations and infrastructure, and 3) extension and engagement. Those interdependent parts will provide support (through full-time positions, research funds, technical tool support, and public portals) for five primary outputs of LMR management including enhanced ecosystem foresight, teams and tools to support rapid response, "climate smart" decision support tools, climate-informed monitoring and research, and coordinate science and advice across sectors including fisheries. The CFI implementation plan v4.0 and a summary facts sheet provide additional information and are available on the meeting agenda.

ESR Climate Update

Bridget Ferriss (AFSC) provided an overview of the climate and oceanography sections of the ecosystem status report (ESR) for the Bering Sea (BS), Aleutian Islands (AI), and Gulf of Alaska (GOA). The overview began with climate information on the North Pacific and then covered information specific to each region.

There was a question from the Teams regarding the reference years for the North Pacific climatology and if that was the same for the projections. Bridget said all the climatology and projection figures were anomalies relative to the reference years of 1981-2010. The Teams thanked Bridget and the ESR team for their clear and useful overview of the climate and oceanography of the North Pacific.

Ecosystem Surveys

Ellen Yasumiishi presented a summary of the 2021 ecosystem surveys and research in the BS and GOA in support of ecosystem-based fisheries management. This effort was a cross division/agency collaboration, with many individual staff participating. Objectives of the presentation were: to give updates on surveys, so that this information can be integrated into stock assessment models; and also to get feedback about the most useful data and indicators, to guide future surveys. The author encouraged stock assessment authors to reach out if they have specific questions they need to have answered or suggest indicators that would be important.

Highlighted projects include: 1) predicting gadid year-class strength from larval and age-0 surveys, evaluating the predictive ability of the beach seine survey; 2) climate driven changes to Pacific cod spawning habitat in the Bering Sea, from which to develop indicators for ESPs and future spawning/timing projections.

The Teams inquired about why some of the fall surveys were cancelled. This was due to Covid-19 and vessel repairs. The Teams also asked when the results of the highlighted projects will be presented, because this information would be useful to include in the ESP. The author encouraged members to reach out to the authors who are in charge of these projects to coordinate information transfer as soon as it is available.

Essential Fish Habitat (EFH)

Members of the EFH team (Jodi Pirtle, Ned Laman and John Olson) presented progress on Component 1 (EFH descriptions) and the plan for Component 2 (fishing effects models). The stock author reviews of the Component 1 species distribution models (SDMs) were completed and a summary of results presented. The modeling efforts that are informing the 2022 EFH review were developed in the 2017 Alaska Essential Fish Habitat Research Plan after the completion of the 2017 EFH review. The stock assessment authors were presented with only one performance metric (Spearman's r^2) for their EFH reviews. The EFH team presented three new performance metrics to the Teams: proportion of deviance explained, AUC, and Spearman's rho, which they used to update the EFH descriptions. This information was not included for the assessment authors' reviews, and the EFH team does not plan to provide an opportunity for author review of that information. The presenters showed graphics comparing Spearman's r^2 with the three new performance metrics. The EFH team concluded, after the author reviews, that Spearman's r^2 did not adequately represent the model outputs; for example, a stock could exhibit a poor Spearman's r^2 value, but good-to-excellent model performance in other metrics. The EFH team will replace Spearman's r^2 with Spearman's rho (i.e., dropping the "squared" part) in future EFH drafts. They presented three examples of species EFH models that were considered to exhibit poor performance (GOA Atka mackerel), acceptable performance (GOA Pacific cod), and good performance (EBS arrowtooth flounder). The EFH team also presented an overview of the fishing effects model and the plan for the stock authors to review the results of that model in the spring of 2022.

While many review comments were deemed "positive," some stock models were identified as poor performers. The Teams' discussion focused on the process going forward for the poor performers. The EFH authors stated that, with the exception of both of the Pacific sleeper shark EFH descriptions, all of the stocks were going to be put forward, including the poor performers. Stocks for which the models were poor performers will be reviewed on a case by case basis, and the EFH analysts will present results to the authors for further review. This is expected to occur right after this weeks' Team meetings. The Teams expressed concern over the timing of this, as authors are working on stock assessments. The Teams noted that there is no requirement for this timeline, and expressed concern that the timeline may preclude a sufficient iterative review process with the authors. Overall, authors will not be given a chance to review

the updated EFH descriptions, incorporating the new performance metrics described in the presentation, nor responses to comments that were provided by authors during the review.

During the Sept 2020 JGPT review of EFH Component 1, the Teams requested to see the following two items for the 2021 Sept PT review, and the Teams again recommended that they be provided:

1) authors present each of the ensemble members so reviewers can see the influence or contribution of each ensemble member, and the variability associated with each.
2) see the iterative changes that result from each change or addition.

The Teams also noted that the inclusion of alternative data sources (e.g., AFSC longline survey, IPHC longline survey, ADFG ROV survey) is critical for the definition of EFH for some species. This need, while noted in the 2015 EFH review, was not included in the 2017 EFH research plan.

The Teams recommended that the inclusion of alternative data sources be prioritized for future EFH model developments.

The Teams recommended adding comparison of previous SDMs (when available) to the EFH description documents. For example, how has the spatial extent changed from the previous EFH? Reviewers need to be able to judge if any substantial changes are realistic for species before it can be endorsed.

The Teams also recommended consideration of the time series extent in future modeling efforts, as species distributions and habitat can shift over the 30+ year time series of the data.

Risk Table

Sara Cleaver provided an overview of the Council response to SSC guidance on risk tables. In June, the Council reviewed preliminary SSC guidance on risk tables for assessment authors, provided some additional comments and asked the SSC to present those recommendations for Team review. The SSC will review and revise its preliminary recommendations, considering input from the Teams and provide final recommendations to the Council in October of 2021.

The Teams asked for clarification on Council intent. Council staff clarified that Council discussion was meant to emphasize that risk tables are to be used to incorporate additional uncertainty outside of the stock assessment, as the Council is concerned with potentially double counting uncertainty from that which is already accounted for in the stock assessment and therefore the harvest control rule (to account for the risk of exceeding the OFL), and the additional buffering suggested by the risk table.

Anne Hollowed gave a presentation about the SSC Risk Table workshop that was held in February 2021 and the report that was developed from the results of that workshop. The report includes summaries of the 7 workshop discussion topics: Introduction to risk tables; Frameworks for addressing uncertainty; Quantifying the importance of assessment risk; Population dynamics risk; Risk of external changes in ecosystem conditions; Risk of changes in fishery performance; Comparing P* and decision – theoretic approaches; and Using joint probability to link the risk table to ABC reductions. The objectives of the workshop were to assess the progress and value of species-specific risk tables for all stocks; evaluate risk table consistency among species and highlight challenges; define “risk” and “uncertainty”; compare ABC and OFL buffers for scientific uncertainty with ABC reductions due to the risk table; and discuss future options.

The SSC provided preliminary guidance that was reviewed by the Council in June 2021. The SSC requested Team feedback specifically with respect to the SSC’s recommendations for:

- Inclusion of risk tables for Tiers 4–6 groundfish stocks;
- Selection of indicator species within stock complexes; and
- Reduction from four risk levels to three within each category.

The Teams discussed the challenges of completing a risk table for stocks in Tiers 4-6 due to the lack of available information. Anne suggested that the risk table could be used to describe why the stock is in a lower tier level, by detailing what information is lacking for the stock. A Team member noted that the assessments for Tier 4-6 stocks already contain that information; that is, the assessments discuss what data are available and what data are not available, thereby placing the stock in the appropriate tier. The Teams noted that doing risk tables every year can be excessively time consuming, especially in the lower tiered stocks where information to populate the risk table is lacking, and many of the complexes are in the lower tiers.

The Teams noted that completing a risk table for a stock complex may be difficult when stock trends within the complex are divergent. Anne noted that, if there is a switch in the dominant species for a complex, this would be noteworthy for the risk table and would point to the need to update the risk table. For a complex, the SSC's recommendation would result in two risk tables per assessment – one for the dominant species and one for the most vulnerable species in the complex. The Teams noted that, in some of the larger complexes, there are annual switches in which species are dominant, and the risk tables might just end up tracking noise.

The Teams discussed whether "risk" table is the right term, with some participants noting that this is consistent with the concept of the "risk of exceeding the OFL." The possibility of changing the name to "uncertainty" table, as raised by the SSC, was also discussed.

The Teams discussed the SSC's proposed shift from 4 risk levels to 3 ("normal, increased, extreme") within each category. Anne suggested that differentiating between 3 and 4 levels is difficult and switching to 3 levels may be easier for authors. The Teams agreed that changing to a 3-level system would ultimately be a good idea, because it is simpler, but did not have strong recommendations to make this change based on anything that would affect the overall assessment. The Teams noted that if the change to 3 levels were adopted for the current assessment cycle, this would be the first time that the Teams have endorsed a revision of the risk table template without first reviewing that revision. Therefore, any wholesale changes should be delayed until next year, since authors and ecosystem staff are already preparing 2021 assessments. Delaying implementation would also be consistent with the SSC's characterization of this as a "potential" revision. The Teams would like clarification on who is tasked with making the corresponding changes to the risk table template.

The Teams recommended that risk tables for Tier 4 to 6 stocks should be an optional tool for assessment authors rather than an annual mandate. For those authors choosing not to do a risk table, the Teams recommended that authors provide justification for why they chose not to include a risk table.

The Teams recommended that the selection of indicator species within stock complexes should be optional for assessment authors.

The Teams recommended an eventual reduction from 4 to 3 risk levels within each category, aligned with the SSC recommendation. However, because this reduction will necessitate multiple changes to the risk table template, the Teams recommended delaying its implementation until after the current assessment cycle, so that the Teams will have an opportunity to review any changes to the template prior to their use.

VAST Bottom Trawl Survey

Cecilia O'Leary presented a summary of recent, ongoing, and proposed future work by the Groundfish Assessment Program (GAP) on model-based indices, specifically the Vector Autoregressive Spatio-Temporal (VAST) model. She reminded the Teams of the VAST terms of reference, annual timelines, and the specific groundfish species that have a model-based abundance or age composition index for 2021. A Team member noted an error in the presented timeline and clarified that the final NPFMC meetings occur in December (not Oct-Nov).

Over the last year, VAST research has focused on model comparisons for GOA Pacific ocean perch and EBS Pacific cod, and on updates to the Cold Pool Extent Index (CPI) computations to improve reproducibility. Several alternative methods of kriging were applied to the CPI. Inverse Distance Weighting (IDQ) generally performed poorly most years. Because the Steins Matern method of kriging showed the lowest root squared prediction error across the majority of years, the VAST model will be using it this year. Next steps within this project are: to review and document these methods, potentially accounting for variation in survey timing; produce goodness of fit diagnostics; develop recommendation/rejection criteria with stock assessment authors; and formalize the bridging step between different years' models.

The GAP group proposed a research priority list for model-based indices and requested Team input on the suggested priority ranking and for additional stocks to prioritize. They also requested that the Teams develop criteria for including non-standard samples in the models such as the Norton Sound and NBS bottom trawl survey data. The Teams' discussion focused on these requests, along with general clarifying discussions regarding the VAST indices. Key discussion points are itemized below.

- The Teams agreed that all of the proposed research priorities were important, and the list should perhaps be viewed as more of a "short-term vs. long-term" ranking, rather than a "do or don't do" ranking.
- Priority #5 as presented, regarding diagnostics of fit and formalizing criteria for rejection or acceptance of indices, was identified as being extremely useful/helpful for assessments, and should be higher on the list. One Team member noted that increasing the number of diagnostics will give greater confidence to use of those models that score high consistently. Another suggested that since any work on diagnostics will feed into understanding differences between model- and design-based indices (priority #2 as presented), it should be higher on the list.
- A Team member suggested expanding Item 1b to include Russian data.
- It was noted that alternate runs (priority #3 as presented) would be interesting, but are not the top priority, so the Teams agreed with that item's ranking.
- It was generally agreed that Priority 1a – linking model-based indices to environmental drivers – was indeed a high priority. Some clarifying discussion occurred regarding whether this should be part of the ESPs, but ESPs have not linked any drivers with the VAST models; more have been done within the assessments themselves.
- There was additional clarifying discussion regarding Item 4a (estimation of survey age sampling methods and missing data). Cecilia responded that this item refers to interpolation when there is missing data. Another GAP project member described difficulty in doing their age-length key the same way as the assessment authors, since most authors either use the design-based comps, or use their own scripts to create them. A member suggested that the Teams should support the kind of consistency that would be gained from item 4a.
- BSAI northern rock sole and BSAI Greenland turbot were suggested as stocks to consider for model-based indices in the near-term.
- Regarding the best approach to determining consequences of including/excluding nonstandard data (e.g., abundance CVs, assessment retrospectives), the Teams agreed that they could not provide any recommendations at this time.

Based on this discussion, the Teams recommended altering the proposed research priority list as follows:

1. **Improving indices**
    a. **linking model-based indices with environmental drivers**
    b. **including additional data (ADF&G Norton Sound, etc.)**
    c. **species-specific model settings (could do 1 species/region/year)**
    d. **increase model resolution (# knots)**
2. **Diagnostics of fit and formalizing criteria for rejection or acceptance of indices**
3. **Understand/explain any differences between model- and design-based indices**
    a. **untrawlable habitat interpolation**
    b. **GOA depth cut-off (700 m)**
4. **Alternate index models**
    a. **run suite with alternative estimators: GAM or sdmTMB**
5. **Continued methods research**
    a. **estimation of survey age sampling methods and missing data**
    b. **barrier-SPDE models**
    c. **covariates affecting decorrelation rates**
    d. **accuracy/precision of variance estimates**

The Teams also recommended considering BSAI northern rock sole and Greenland turbot for model-based indices.

Age Composition Estimation

Matt Siskey and Jim Thorson provided an update on an analysis that evaluates how changes in otolith field-sampling during surveys impact input sample sizes and catch recommendation uncertainty in the stock assessment model. The objectives were to see if otolith sampling efforts on surveys can be redistributed across species without increasing survey effort, thereby optimizing age-reading efforts. A simulation analysis using a bootstrap estimator to predict input sample sizes was combined with a multinomial approach to weighting age and length data and then simulated using an age-structured operating model. A relationship between assessment outcomes and monetary cost that associates changes in otolith sampling and ageing efforts with uncertainty in stock assessment recommendations is also being investigated. Three GOA species were used as case studies in this analysis: dusky rockfish, Pacific ocean perch, and walleye pollock. Using these three species provided a data-rich to data-poor perspective for evaluating the effect of re-distributing otolith sampling on input sample sizes. Changing the number of otoliths collected during each tow and changing the number of tows sampled using these methods produced informative results generally indicating input sample size increased when the number of otoliths and hauls sampled increased. The authors requested input from the Teams on identifying what Bering Sea stocks this analysis might be useful for, if this type of analysis should become a routine part of assessments, and if ASFC should have a more formal process to evaluate ageing effort across stocks.

The Teams commend the authors for the work presented, and identified optimizing otolith collections as a priority because of the burden this effort places on AFSC resources. They also suggested that numerous different strategies are currently used to determine input sizes and that a method that can be broadly applied across assessments warrants further investigation.

The Teams recommended expanding this analysis to include species in the Bering Sea, but noted that additional considerations such as stratum-specific analyses and finer detailed information for select species may be warranted.

The Teams recommended that the AFSC initiate development of a "best practices" approach for specifying input sample sizes for compositional data in age-structured assessment models.

The Teams are supportive of a streamlined process to better formalize both collection and ageing efforts across stocks. Further discussion is warranted on who conducts this analysis and how often. Rather than having this done as part of the annual stock assessment, the Teams discussed reviewing otolith sample sizes (both the number collected and the number read) at regular intervals, such as 5 years, or having at least some of this work done as part of the survey planning efforts rather than as part of the stock assessment. It was also noted that this approach may be useful in fishery-dependent situations and with other biological collections.

The Teams recommended further work on this initiative, with a goal of providing specific sample recommendations to guide both survey sampling efforts and age reading efforts, as well as creating streamlined processes that can be done with minimal effort for specific species.

Random Effects-Tier 4/5 Assessment Considerations

Cole Monnahan (AFSC) presented on Tier 4 and 5 assessment considerations developed from efforts of the Tier 4/5 working group (WG) composed of Cole Monnahan, Jane Sullivan, Cindy Tribuzio, Grant Thompson, and Pete Hulson. The WG's goals are to:

1. Collate and summarize the range of Tier 4/5 approaches currently used
2. Identify areas for improvement in the assessment process
3. Get feedback and guidance on how to progress
4. Examine uncertainty calculations given multiple surveys/species
5. Examine survey reduction effect and P* approach potential

The WG found the primary discrepancies in the use of the random effects models in Tier 4 and 5 assessments were in the use of multiple model software versions, in how zeroes in abundance indices were dealt with, and in how estimates were combined if there were more than one index for multiple surveys or species.

Three model software approaches are currently being used:

1. The Random Effects (RE) model, which uses a single biomass time series
2. The Random Effects Multi-area (REM) model, which is a multivariate extension of the RE model
3. The REM with an additional longline survey (REMA), which was developed to include additional index data.

Ignoring zeros in survey indices is the current approach, by either removing them manually or using a model which filters them out. The WG recommends that:

1. Authors use standardized RE software that does not filter out zeros automatically. Under this scenario, the software will produce an error if zeros are used in the input, which will compel authors to be explicit about the treatment of those data.
2. Authors include in their SAFE chapters information about the zero biomass observations (e.g., when and where they occurred), and the method used to handle these (e.g., input as NA value).

The WG looked at combining estimates – model runs for multi-area/single species. Two approaches are used across assessments with authors fitting each index in a separate RE run, or fitting multiple indices in the same REM run. The WG also looked at combining estimates – model runs for multi-area and complexes. Four approaches are currently used among assessments, with authors grouping by natural

mortality (M), lumping due to low biomass or small sample size, lumping due to species ID issues, and estimating all species separately. The WG considered the different approaches used to fit multiple survey inputs for a single stock and recommended:

1. A consistent, well documented, tested, and understood source code be adopted
2. The REM model would be preferred because it is clear and simple to use (only one model run) and has expanded options for calculating uncertainty of the total biomass (see below)

The WG also addressed stock complexes. Their review found that authors use different methods for estimating input biomass and variances and the calculation of reference points for complexes. The WG recommended further analysis of the implications of alternative approaches, with the specific objectives of an analysis to include the following:

1. verify that the custom design-based estimator approach is the same as GAP's design-based estimator,
2. evaluate the differences in variance estimates between the summed GAP estimates and the custom design-based estimator, and
3. quantify the differences in estimates between the weighted-M approach and the method of summing species group ABCs to the complex level.

The WG also addressed the issue of having to determine total biomass uncertainty. Calculating total biomass estimates requires summing indices that are assumed to be lognormal. However, they note that the sum of lognormal variables has an unknown distribution (and is not lognormal). Therefore, uncertainty must be approximated. There are four different approximations and all assume a lognormal distribution for total biomass. The WG determined that it is unclear which method is best, and looked into whether the total biomass is approximately lognormal. However, an assumption of a lognormal distribution has been widely adopted.

The WG conclusions were:

1. The RE model has evolved for individual stocks
2. Zeroes are generally ignored, and it may be unclear what the software does internally
3. Important differences exist in combining multiple indices (mainly with order)
4. Approaches for complexes differ considerably, and
5. The uncertainty of combined lognormal estimates is a challenge

The Teams supported the WG's plan for moving forward, which is to:

1. **Create a consensus version of the RE model code for all Tier 4/5 assessments**
    a. **Based on REM which has several advantages and can handle the suite of cases**
    b. **Documented and version-controlled online**
2. **Encourage consistent approach to zeroes**
    a. **Explore alternative statistical approaches, e.g., delta-models, off-the shelf packages (e.g., GLMMTMB)**
    b. **Recommend that assessments note filtering of zeroes**
3. **Explorations of the preferred method for grouping multivariate models**
4. **Explore complex workflows for input variances and M approaches**
5. **Further tests of the lognormal issue**

The issue of how this model is used for apportionment in Tier 3 and other assessments was raised (e.g., for BSAI Atka mackerel). The Teams noted that these improvements would also apply to the apportionment applications and noted that the working-group title should probably be broadened.

Economic SAFE

Steve Kasperski provided an overview of social science products in the annual NPFMC process, including EPRs, ESPs, ESRs, the Econ SAFE, and ACEPO. The presentation included explanation of these documents, the geographic scale the document focuses on, and how the information in each documents: a) may inform stock health, b) the direction of impacts, and c) whether they indirectly or directly inform stock health. The presentation explained that, while fishing removals have a direct impact on health of stocks, economic, social, and fishery performance metrics can provide indirect information about health of stock, but are also a function of economic drivers. The presentation and discussion then focused on upstream and downstream indicators. Despite attempts at clarification during the meeting there remained some confusion within the Teams on the exact meanings of these terms.

The Teams discussed community information. Community indicators such as fishery participation can provide information on the health of the stock in specific regions, but these would be indirect and would also encompass responses to other factors in the social system (e.g., prices, regulations, etc.) as well as fisheries participants making decisions across the spectrum of their fishing portfolios (and not just a given species/stock). On the other hand, this was questioned in the context of the SSC's conclusions that community indicators could be red flags of stock/ecosystem condition, and that social sciences should not influence ABC recommendations. The presenter noted that the scientific literature needs to point to these causal relationships before they should be included in ESPs.

Ben Fissel provided a presentation on the Groundfish Economic SAFE, and the new platform for accessing data hosted by PSMFC. The Teams noted the utility and user friendliness of the website, and Ben clarified that he will still be doing the EPRs and the economic sections of the ESPs for stock assessment authors.

Relative to 2019, 2020 catch and revenue were down, and the value index was the lowest it has been since 2007, besides 2009 and 2010. The current decline is due to price and quantity, and the revenue impacts from Covid-19 were mostly price-related. There were notable decreases in prices for many products with exports to Asia, and production of fish meal increased for pollock as a result of the small fish size being caught in the pollock fishery.

Some revenue impacts were not Covid related; for example, there were reductions in catch due to reductions in TAC (GOA pollock, Pacific cod in both the BSAI and GOA). BSAI pollock, which is usually harvested very close to its TAC, was harvested at 95% of the TAC. This was because the TAC increased a bit but there was also a decrease in catch of 40-50 tons. Reports from the fleet indicate that this underharvest was a result of the stock being dispersed, leading to difficult fishing conditions, as well as small fish size, which reduced the return on catch.

Economic data for 2020 are still being finalized and validated. Preliminary results indicate that in the BSAI in 2020, volume and price decreased as compared to 2019 across most stocks, which is rare. The value of sablefish in the BSAI was stable due to low prices offsetting the increase in catch.

Decreases in ex-vessel value resulted in a revenue decrease of 16%. A team member noted that this revenue decrease will impact observer coverage for next year, and the importance of preparing for the impacts of that, because all partial coverage EM and observers are going to be funded through that ex-vessel value. There was a question about whether there are funding buffers for this reason. The team member responded that when the ADPs are developed, funding is spread out so that they do not end up with no coverage one year; however, the decrease in 2020 will probably lead to a decrease in coverage rates. The Teams noted that this should be brought to the Council's attention, and while it is beyond the subject matter expertise of the Teams, it should be flagged so that it can be addressed.

Sablefish Longline Survey

Kevin Siwike presented preliminary results from the 2021 longline survey covering the EBS and GOA, and included results of RPNs, sablefish and Pacific cod lengths, whale interactions, subsurface temperatures and reports on experimental slinky pots. New information from the survey included updated area sizes for calculations and variance estimates.

Sablefish continue to be well above long-term trends with recent recruitment. Smaller fish continue to be caught in high numbers, particularly at depth. There continues to be an absence of smaller cod and turbot are still well below long-term averages despite a recent uptick. The Teams noted the decline in thornyheads and the need to monitor this trend, in particular if hook competition could be partly the cause. Kevin explained one analysis they did by comparing the percent of hooks returning with bait as a proxy for hook saturation (the two being inversely related). Based on that aspect, evidence of hook competition appeared insufficient to explain the decline in thornyheads and grenadiers. The Teams noted that there may be other mechanisms besides hook saturation that could drive competition (e.g., the presence of other species impacting foraging effort).

Subsurface temperatures in the Bering Sea were above average but not to an alarming degree. The WGOA was above average, the CGOA was below average and EGOA was about average. No temperatures were noted as extreme.

The slinky pot study demonstrated that the pots caught much less (non-sablefish) bycatch relative to longline skates and sablefish sizes were similar between the two gears. The Teams inquired about the interaction with escape ring sizes (3.5” in the experiment). It was noted that the fishery does modify them to avoid bycatch of other species or smaller fish of the target species and also noted that the pots do catch some halibut. The Teams also asked whether CPUE between skates and pots was comparable and were reminded that the metrics are hard to compare (90 hooks per skate versus one pot).

Sablefish Assessment

Sablefish growth

Katy Echave presented an analysis of sablefish growth. Length, age, and weight data collected on the AFSC longline survey from 1996-2019 were used to update growth in the assessment, which has not been updated since 2008. For both the length-at-age and weight-at-age von Bertalanffy parameters, a k-means cluster analysis was performed to determine if there were significant time-dependent differences in growth. For both males and females, temporal changes in growth were indicated. Females showed a clear cluster break for both length and weight in 2004. However, males did not have such clear clusters, and the clusters that resulted included non-sequential years. The final recommended clusters for both male and female length-at-age and weight-at-age were 1996-2004 and 2005-2019. In general, for both length-at-age and weight-at-age, fish are larger in the recent time block, but growing at a slower rate.

While time-dependent changes in growth may have occurred, the Teams recommended that the assessment model update growth estimates with data through 2019 while further research is conducted to determine the appropriate use of potential changes in growth over time.

The Teams recommended conducting investigations into cohort effects on growth.

The growth modeling produced a constant weight-at-age schedule, which is estimated from recent data (because there are limited observations on weight available in the early years); however, length at age is estimated as varying between two time blocks.

Because time-varying length at age would be expected to produce time-varying weight at age, the Teams recommended modeling weight-at-age in the same time blocks as used for length-at-age. This could be done by applying a length-weight relationship (estimated from the more recent data) to the estimates of length-at-age from the two time blocks.

Finally, updated size-at-age relationships were estimated only with data collected since 1996: the estimated relationships for earlier years (1981-1993) were not updated.

Sablefish maturity

Ben Williams presented investigations into sablefish maturity that he and Cara Rodgveller have been conducting. Currently, the sablefish assessment uses maturity data from 1985 that was derived from macroscopic observations and converted from maturity-at-length to maturity-at-age. Previous research suggests that macroscopic observations are not comparable to microscopic observations, and microscopic observations are more accurate when determining if a fish is mature and will spawn. Field studies have also observed skip spawning in sablefish, which would need to be incorporated in maturity estimation to provide a 'functional' maturity that would more accurately determine the amount of spawning biomass that would be participating in spawning. Simulation analysis was performed to evaluate the impact of skip-spawning on spawning biomass estimates. Results showed that GLM estimates of maturity can result in large bias as compared to GAM estimates of maturity. The authors recommend using the functional maturity curve in the assessment, which accounts for skip spawning and estimates age/length-based maturity within a GAM model.

The Teams agreed with the authors' approach and recommended the following: (1) that field studies to determine sablefish maturity be conducted in areas besides the central GOA, (2) that ageing error and uncertainty in length-at-age be considered in the determination of age/length-based maturity, and (3) that potential year class effects that could skew the functional maturity curve be investigated.

Sablefish stock assessment model

Dan Goethel presented some updates on sablefish modeling, including the Pacific Sablefish Transboundary Assessment Team (PSTAT), data updates for 2021, and assessment model updates. PSTAT is currently developing a sablefish simulation model for the Northeast Pacific, with the aim of better understanding range-wide stock dynamics. A workshop was held in April, 2021, and focused on sablefish management strategy evaluation.

The fixed gear fishery catch per unit effort (CPUE) index will not be updated for 2020 due to limited observer coverage, and lack of funding to support collection and keypunching of logbook data. Additionally, the use of electronic monitoring (EM) has increased, but methods do not currently exist to incorporate EM in the CPUE index. The proportion of catch in pot gear has increased since 2016, and age and length samples in this gear have also increased.

The bulk of the presentation focused on updates and recommended changes to the assessment model, particularly focusing on updated biological information, changes in selectivity and catchability to gears and surveys, and data weighting. These model developments were motivated by overestimation of the survey RPNs and recruitment in recent years, as indicated by a retrospective pattern that decreases the estimated year class strength of the recent 2014 and 2016 cohorts as data are added to the model. Additionally, small/young sablefish are being observed more frequently in the survey, which may indicate increased availability in deeper water. The estimated maturity at age was updated and based on an age/length-based GAM that incorporates skipped spawning. The updated maturity analysis indicated reduced maturity for younger and intermediate ages relative to the current model. Estimated length and

weight were updated with data through 2019, with two time blocks for length at age, but time-invariant weight at age, and indicate slower growth but a larger maximum size relative to previous estimates of size at age. The effect of the maturity and growth updates was a rescaling of the population, with a slight reduction in the terminal year SSB and slight increase in $B_{40\%}$.

Parameterization updates included removing the prior distributions on all catchability parameters, and adding a recent time block for fishery selectivity, survey selectivity, and catchability for fishery CPUE. The effect of these changes has also been to rescale the biomass and lower SSB. However, estimated recruitment strengths of recent year classes are substantially reduced (with recent selectivity increased).

Data weighting with the Francis method was evaluated, and resulted in increased weights for the fishery size composition data and decreased weights for fishery and survey age compositions. The Francis data weighting reduced recent estimated recruitment, improved the fit to the survey RPN index, and produced estimated SSB that did not decline as sharply in the 2010s relative to the 2020 model. Additionally, the retrospective patterns in recruitment and spawning biomass were improved with the Francis data weighting.

The proposed model for 2021 includes all of these changes (updated maturity and growth, removal of priors for catchability, Francis weighting, and the additional time block starting in 2016 for fishery catchability and selectivity, and survey selectivity). This model produces a steadier trend in SSB in recent years, reduced recruitment estimates; increased selectivity at younger ages; improved retrospective pattern in SSB and recruitment; and improved fit to longline survey RPN, trawl survey biomass, and fishery CPUE indices. In the proposed model, the estimated recruitments for recent strong year classes are still among the largest estimated, but are now within the range of historical recruitment estimates.

The Teams support all of these modeling changes, view the proposed model as an improvement relative to the current assessment model, and anticipate seeing comparisons between the proposed and existing models in the November Team meeting. The Teams recommended incorporating updated length and weight at age resulting from the growth modeling recommendations listed above (i.e., modeling growth for all available data, and consistency in modeled time-variation between weight-at-age and length-at-age) into the assessment when these analyses are completed.

Halibut Discard Mortality

The Teams approved the Halibut Discard Mortality Rate (DMR) Working Group recommendations for in-season management of BSAI and GOA Groundfish fisheries for 2022-2023. Note that these were derived from separate considerations within the individual Team meetings.

Adjourn

The Joint Plan Team meeting adjourned at 530 Pacific time.

Minutes of the
Bering Sea/Aleutian Islands Groundfish Plan Team

North Pacific Fishery Management Council
1007 West Third, Suite 400
Anchorage, Alaska 99501

September 22, 2021

Administrative

The BSAI Groundfish Plan Team ("Team") convened on Wednesday, September 22 at 09:00 PST.

Participation was remote via Adobe Connect. Roughly 65 people attended the meeting, attendance varied throughout the meeting.

All documents provided prior to or during the meeting as well as presentations given during the meeting were posted to the Council's electronic agenda.

Arctic Regional Action Plan (RAP)

Jim Thorson presented on the development of the Regional Action Plan (RAP) for the Arctic (US EEZ for the Chukchi and Beaufort Seas). The Arctic RAP is a regional process to implement, envision, discuss, communicate, and track activities responding to the NOAA Fisheries Climate Science Strategy. This is an AFSC-led document with partners (AKRO) that can be used to:

- Prioritize reimbursable funding for activities in the plan (RWP, NCRP, EFH)
- Identify areas where researchers can collaborate with AFSC and with external partners
- Develop agreement regarding key science gaps in the Arctic.

The Arctic RAP is envisioned to be:

- a targeted portfolio of monitoring, process research, and synthesis efforts, including impacts on lower trophic, fish, marine mammal, and human components of the ecosystem that would be expected to occur from 2022-2024.
- developing a collaborative research environment in which discussions and partnerships with Alaska Native communities are a central element, so that the next Arctic RAP can involve components that are co-produced with Alaska Native communities.

The Arctic RAP includes two sections: (1) an inventory of previous and on-going ecosystem monitoring programs, and (2) 11 recommended future activities (described in the presentation). The Team appreciated the presentation and had no recommendations for the Arctic RAP.

Eastern Bering Sea (EBS) RAP

Anne Hollowed presented the updated Alaska Regional Action Plan 2.0 for EBS Climate Science (EBS-RAP). The Team appreciated the overview and explanation of the 3-year plan, the emerging opportunities (e.g., climate fisheries initiative), and the list of key gaps. The Team asked where fisheries monitoring and fishery dependent data fit in, which is highlighted in the appendix, and especially noted the emergence of electronic monitoring technologies. The Team asked about how eDNA methods are being used and the costs. The eDNA can be used to help define the benthic communities, which are notoriously difficult to define. Moorings can be set up to capture samples at time intervals, which cannot be sampled as well from vessels (e.g., winter). Further, eDNA can be an early indicator of species movement. The Team had no recommendations for the EBS-RAP.

ACLIM 2.0

Kirstin Holsman presented an overview of the Alaska Climate Integrated Modeling Project (ACLIM). The main goal of ACLIM is to test the performance of different climate-informed tools to provide information that can be used to decrease the impacts of climate change on Alaska's ecosystems, fisheries, and communities. In collaboration with multiple partners, the project began in 2015 and it is now in its second phase (2.0). During the first phase of the project, downscaling was done to the Southeast Bering Sea and an operational suite of coupled socio-ecological models for climate fisheries hindcasts, forecasts, projections, and Management Strategy Evaluations were evaluated. ACLIM 2.0 builds on this and takes into consideration varying global carbon emission scenarios and allows projections of future warming in the system. This suite of information will help inform management with near-term tactical advice and long-term harvest policies for target species through on-ramps for fisheries management.

Findings from the ACLIM project include:

- Downscaling is needed from global climate models to the Bering Sea.
- Multiple models of biological and socioeconomic dynamics are needed to evaluate structural uncertainty.
- Mitigation is a lower risk scenario.
- Adaptation through fisheries management can forestall climate-induced declines and provide critical time to adapt.

Alan Haynie presented actionable advice and the future direction of ACLIM 2.0. ACLIM 2.0 incorporates economic and management models of different complexity to match the needs of biological/physical models to help inform fisheries management to avoid some of the impacts of climate change as well as possible. Model simulations can be used to determine trade-offs of different harvest control rules in light of predicted climate change under several future socioeconomic scenarios. The goal of this work is to inform the Council about the probability of different potential consequences when considering harvest scenarios or other management changes. ACLIM 2.0 will provide better and more realistic models and provide the best available science about the trade-offs of management alternatives through an integrated system that will be continuously improved.

The Team was impressed with the amount of work that has gone into this project and had no questions. Discussion focused on looking at a range of future management actions to compare and contrast trade-offs.

EBS Pacific Cod ESP

Kalei Shotwell provided a presentation on the development of the Ecosystem and Socioeconomic Profile of Eastern Bering Sea Pacific cod. The SSC prioritized an ESP for the EBS Pacific cod stock in 2019. The team was formed in January 2020, and developed a near-complete draft ESP for the EBS and GOA stocks in November 2020. Constraints caused by the COVID-19 pandemic delayed completion until September 2021. The ESP responds to recommendations from the SSC and Joint and BSAI Teams. The author provided the list of ecosystem and socio-economic indicators used in the ESP, and provided information about how they were scored.

The document concludes by providing an ecosystem and socio-economic summary of the main takeaways of the ESP, and gaps and research priorities. Indicators suggest that conditions for EBS Pacific cod have been poor since 2013: sea ice extent has been decreasing concurrently with surface and bottom temperature increases. The population center has moved northwest, following sea ice retreat. Socioeconomic indicators including ex-vessel value, price/pound, and revenue per unit effort increased from 2015-2019 but were down after 2019.

The ESP team will produce a report card for November that will include the current year ecosystem indicator values, where possible, and socio-economic indicator values from 2020. In 2022, the Team will create a Request for Indicators for all current ESPs. The full ESP report and the report card will be appended to the main SAFE document in November.

The Team had no questions or discussion of the ESP.

EBS Pacific Cod Assessment

Grant Thompson presented the EBS Pacific cod September assessment for 2021, which includes models that could be updated with 2021 data during October for presentation during the November Team and December Council meetings. In addition to responding to Team and SSC requests, the author also presented an overview of the 2021 CIE review of the assessment which took place over 5 days in April 2021. Original terms of reference, plan for conduct of the meeting, background documents, and full reports of the reviewers are available at: https://apps-afsc.fisheries.noaa.gov/Plan_Team/2021_pcod_cie/. In the September assessment, Attachment 2.1.1 summarizes 50 reviewer comments, with responses. These span 18 topics and subtopics, which were prioritized by the reviewers. The CIE review team unanimously agreed that Pacific cod is a good candidate for ensemble modeling. The models developed during the CIE review form the basis for the model suite and ensemble presented in the September assessment.

The September assessment includes data up through 2020, but 2021 data are not yet included in the assessment. Relative to previous years, total catch is lower, and total catch in 2021 remains below the ABC. However, CPUE is up in 2021 relative to last year. Results of satellite tagging studies for Pacific cod tagged in the NBS show movement of Pacific cod across the NBS, Russia, and as far south as the Gulf of Alaska. According to VAST, distributions show a shift from 2014 onward to the north and west.

In this year's assessment, various configurations for the VAST based estimates of survey biomass were evaluated. VAST-based age compositions were updated as well. In 2020, the Team expressed concern with the fishery CPUE index as presented in 2020, so in 2021 a new VAST-based CPUE index was generated from catch (in weight) and effort data from the Jan-Feb longline fishery. This was presented to the CIE reviewers, who recommended including it in one of the models presented in the ensemble for 2021. The author notes that fishery survey indices (numbers) and CPUE index (biomass) are inversely correlated but that is not necessarily inconsistent, as one tracks number and the other weight.

There are 5 models included in the ensemble for the September 2021 assessment: the base model (19.12a) from the 2020 assessment; the base model with the addition of allowing catchability to vary (19.12), allowing domed survey selectivity (M21.1), using a VAST-based fishery CPUE index (M21.2), and one where the survey CV is estimated internally (M21.3). The fits and respective strengths and weaknesses were presented. The retrospective behavior of all 5 ensemble models was good (i.e., acceptable Mohn's Rho). The Team noted that the set of models performed well in retrospective peels.

The model weighting for the ensemble follows the approach outlined in the last two assessments, with Team and SSC approval, where model weights for the ensemble were computed as an emphasis-weighted average of (0,1) scores for each member of a set of ranking criteria. The CIE also generally adopted this approach, with some modifications: some new ranking criteria were added and some old ones were removed and instead of (0,1) scores, (0,1,2) scores were averaged across reviewers. The weighting and ensemble presented in the assessment reflects the recommendations put forth by the CIE team while the full set of criteria (some of which are not included in the weighting) is summarized in the assessment for informational purposes and potential use in the future.

The assessment discusses the strengths and potential concerns with each of the models included in the ensemble and the criteria for their inclusion in the ensemble in order to address multiple structural uncertainties as well as the CIE reviewers' ranking of each model.

Given individual model strengths and caveats, the Team felt that the model ensemble provides insight in the collective that individual models may not be able to address. The Team noted that the ensemble includes a subset of models that address the spread of structural uncertainty in each model formulation and generally agree with the CIE recommendations for the 5 models to be included in the ensemble and corresponding ensemble-based reference points. The Team also agrees with the presented model weights and CIE recommendations regarding ranking and criteria for model weighting.

The ensemble estimates of biomass and recruitment are approximately median to those estimated individually by each model. The ensemble ABC was calculated from the individual harvest control rule applied to the individual model and the ABCs were then averaged to get the corresponding ensemble set.

The Team notes that there has recently been considerable economic pressure on this fishery and the team appreciates the public comments on this stock and ongoing challenges.

The Team recommended advancing the current assessment and ensemble and associated ranking and weights for November.

The Team deeply appreciates the summary of the approach, the CIE review, and commends the author and assessment co-authors on the approach and assessment as it is thorough and addresses novel challenges to the recent climate driven changes.

While the Team recommended the current ensemble weighting, the Team welcomes alternative weighting approaches as the authors see fit to present or explore in November. If alternative weighting scenarios are presented, the Team recommended the authors also provide explanations of alternative weighting schemes.

AI Pacific Cod

Ingrid Spies provided a presentation on the age-structured assessment model for Aleutian Islands (AI) Pacific cod. She began with a history of the AI Pacific cod model as a Tier 5 assessment with initial age structured models being presented at various times between 2012 and 2020. She reviewed the base model (Model 19.0) features and listed three alternative models to be presented in November (Models 19.0a,b,c). Survey biomass for AI Pacific cod declined after 1991 but has been stable since 2010. Fishery catches have remained at a low level since 2011 with the highest catch in the eastern AI. A comparison of length frequencies between the survey and fishery shows that the fishery generally catches larger fish than the survey and usually in the winter and spring. The survey also generally samples younger aged fish and occurs during the summer. The alternative Model 19.0a uses a maturity ogive estimated by Stark (2007) rather than using the maturity estimates from the observer data (consistent with the Gulf of Alaska Pacific cod assessment). The alternative Model 19.0b uses an estimate of M equal to 0.4 which was selected by balancing the M derived from the data (0.56) and Tier 5 methodology (0.34). The alternative Model 19.0c is the same as the base model 19.0 but does not use the fishery length data. All models except Model 19.0c had similar fits to the data. Parameters were different for the selectivity curves and age-at-50% maturity for Models 19.0a and 19.0c than the base Model 19.0 and Model 19.0b.

The Team thanked the author for her presentation and asked why she was bringing forward Model 19.0c in November as the document stated that it was not to be considered for management. The author indicated that the run was a sensitivity run to evaluate the influence of the fishery length information, since the survey and fishery data were telling such a different story.

The Team recommended that Model 19.0c not be included as an alternative, but rather that the information from that model be presented in November either explicitly as a sensitivity run or as supportive evidence for using the fishery length data in all models.

There was a question from the Team regarding Model 19.0d, which was not mentioned in the presentation but was included in the document, and whether that model was going to be put forward as an alternative in November. Ingrid replied that she was not planning to bring it forward this year and will edit the document to reflect this.

Ingrid noted that data weighting seemed to be key for model convergence and asked the Team for feedback on best practices for data weighting. The Team suggested that there were various ways data weighting has been done in North Pacific assessments, but setting input sample size equal to the number of hauls, as done in this assessment, matches many other assessments. The Team also suggested using the Dirichlet-multinomial approach to determine appropriate weighting in composition data. The Team also noted that a standardized practice for data weighting would be useful for all assessments.

The Team recommended that Models 19.0, 19.0a, and 19.0b be brought forward in November, as well as the current Tier 5 model.

The Team suggested that due to the disparity in the maturity information, further investigations to select the appropriate ogive are warranted. The Team suggested including sensitivity runs on the selection of the natural mortality estimate and maturity curve in future assessments.

Impact of altering sampling design and density on survey indices

Jason Conner presented the results of a simulation study that he conducted with coauthors Stan Kotwicki, Kotaro Ono, and Lewis Barnett which examined the sampling design, density, and estimators for the EBS shelf bottom trawl survey. The simulation featured the following factorial configuration:

- 3 sampling designs: systematic sampling (the current design), simple random sampling, and stratified random sampling
- 4 sampling densities: 350 (the current density), 263, 175, and 525 stations
- 4 species: arrowtooth flounder, walleye pollock, Pacific cod, and yellowfin sole

Sample means and various estimators of the standard errors were computed for all simulations. In addition to the conventional standard error estimators for simple random sampling (this one is also used for the current systematic design, as an approximation) and stratified sampling, a pair of "local" estimators (ST4 and LO5) were computed, for use with systematic sampling.

The results suggest that all three sampling designs tend to produce reasonably unbiased estimates of mean CPUE, regardless of species or sampling density. Similarly, the conventional estimators for the standard error work well for simple random and stratified sampling, and, as expected, show that uncertainty increases when sampling density is reduced. However, when the conventional estimator for simple random sampling is applied to results from systematic sampling (as is presently done), the resulting estimates of standard error are biased upward, sometimes substantially so. A possible solution would be to use one of the local estimators instead, which performed much better in the simulation.

The study also considered a "random start" option for the systematic survey design, and found that this yielded even more precise point estimates than random sampling designs.

The following were among the questions and points raised during discussion (note that these represent comments made by individuals, and may or may not reflect Team consensus):

- Has the impact of changing any of the factors or estimators been examined within the context of a stock assessment? Also, one of the characteristics of standard errors generated by model-based approaches is that they tend to be smaller than those generated by the current design-based approach. Have the standard errors generated by one of the local estimators been compared to those generated by model-based approaches? Author's response: Some work that would be relevant to both of these questions has been done with the LO5 estimator, but was not included here, as it was produced by a different author.
- It would be useful if the LO5 estimator were to become a standard output, as this would facilitate comparison with model-based estimators.

Jason also requested feedback from the Team on four questions. While no formal recommendations were made on any of these, the general consensus seemed to be as follows:

1. What would the Team require to adopt an alternative estimator for the variance of the mean in a stock assessment? The impacts of this should be evaluated in the context of one or more actual assessments. At a minimum, the alternative estimator would need to be provided for the entire time series (as opposed to starting in the current year and going forward).
2. Would the Team recommend investigating bias correction for these estimators? Yes, correction would be useful.
3. What does the Team consider an acceptable range of CVs for survey indices? This would likely vary by species, as there is already a wide range under the current approach.
4. Should GAP consider adopting a random-start systematic design in the Bering Sea? This would likely require additional simulation work.

The Team recommended that a GAP representative be added to the Team membership.

Performance of model-based indices given alternative sampling strategies in a climate adaptive survey design

Meaghan Bryan presented the results of a pair of studies that she conducted with coauthor Jim Thorson. The first study was undertaken in response to previous requests from the Team "to investigate the ability of VAST to predict large unobserved areas by omitting some data from the EBS shelf bottom trawl survey in a cross validation type exercise," which was envisioned as a way of evaluating the ability of VAST to interpolate across missing years of the NBS index. The second study was undertaken in response to the ongoing questions of how frequently, and at what density, to survey the NBS.

With a couple of exceptions, the results of the first study showed that dropping large subsets of contiguous stations tended to have little effect on scale or trends. In the cases of yellowfin sole and snow crab, the distributions of which tend to be concentrated in the eastern and northern portions of the survey area, respectively, the "reduced data" version of the model diverged a bit from the "all data" version of the model when data from those respective portions were dropped. As would be expected, standard errors were larger in years with missing subsets of data, for all species; and 95% confidence intervals using reduced data generally included, or were very close to, the estimates using all data.

The results of the second study showed that an annual reduction in NBS sampling density would result in less bias and smaller mean absolute errors, than biennial NBS surveys with no reduction in density.

The following were among the questions and points raised during discussion (note that these represent comments made by individuals, and may or may not reflect Team consensus):

- Was bias examined in the first study? Authors' response: Assuming that the "all data" scenario was true, there were some examples with bias, like yellowfin sole, which was biased high when the eastern stations were dropped.
- It looks like there may have been positive bias in other cases as well. Authors' response: Maybe a little for pollock when the western stations were dropped, but snow crab showed some negative biases when the northern stations were dropped, so it would be difficult to conclude that the bias was always positive; overall, the results showed no evidence of a consistent positive bias.
- The results of both studies are clear and convincing, and the first study is very responsive to the Teams' earlier requests, for which the authors should be commended.
- Is it possible to do the NBS survey annually, even with reduced staffing, without reducing sampling density in the EBS also? Authors' response: A similar analysis could be done for this scenario, but it has not been done yet.
- A study like this could be relevant for GOA, also.

In the event that resources are insufficient to conduct the NBS survey annually at the current sampling density, the Team recommended reducing density rather than alternating years.

BSAI Turbot

Meaghan Bryan provided a summary of the main conclusions and recommendations from the CIE review of the BSAI Greenland turbot assessment. The purposes of the CIE review were to evaluate the models and data, identify strengths and weaknesses, and make recommendations for future changes. Meaghan reported that all three independent reviewers agreed that the most recently accepted model is suitable for management advice, but recommendations were made regarding concerns they had with the assessment. Responses to these recommendations will be coming in the full assessment for 2022. CIE review recommendations consisted of the following:

- Simplify the model.
- Re-evaluate highly parameterized selectivity patterns, particularly the time-blocks used for the survey selectivity: are they needed?
- Estimate catchability; the CIE reviewers expressed concern about the methods used to obtain the value for fixed catchability.
- Conduct sensitivity analyses to address concerns about catch data in the early part of the time series. There was high turbot catch in the 1960s and 1970s, but low fishing mortality. The current model attributes this to high recruitment.
- Request unaged otoliths be aged to help inform the model about recruitment.

The Team noted the amount of work it took in previous meetings to get the selectivity curves to where they are in the current assessment, but the Team agreed that continued effort to simplify and improve the selectivity curves is worthwhile. The Team also noted the strong decrease in catch that occurred in the late 1980s and there was brief discussion about how that decrease has been attributed to the switch from foreign to domestic fishing that occurred around that time.

Overall the Team commended the assessment authors for a "good" CIE review and the "reasonable" set of recommendations they were given by the CIE reviewers.

The Team endorsed the recommendations of the CIE review and will be expecting the authors' responses to them in the next assessment.

EBS Pollock

Acoustic Vessels of Opportunity

Sarah Stienssen presented an update of pending results for the 2021 AVO index. A brief review was given regarding the use of midwater backscatter from the trawl surveys to index pollock abundance. There was no survey in 2020 due to the covid pandemic and results from the 2021 index are expected in early October 2021. The Teams inquired about recent changes being made to the methodology and were informed that the methods were being revamped with a new subsampling methodology that is currently in beta testing.

EBS pollock assessment update

Jim Ianelli presented an update on work conducted for the EBS pollock assessment. Considerable work has been completed in 2021; much of it directly pertinent to recommendations by the SSC from 2020.

- Ongoing genetic studies to determine the relationship between pollock in the NBS and EBS, and nearby GOA and AI regions are underway, and results should be available for the coming assessment.
- Concerning the 2019 BSAI GPT recommendation to revisit and evaluate the treatment of variance parameters within the assessment, for this year's assessment alternative weightings of indices will be evaluated, including variance specification.
- Concerning efforts to quantify pollock movement and abundance along the US-Russia EEZ boundary, efforts to use upward looking echosounders placed along the convention line to track pollock movement and two papers published in 2020 concerning the issue were described. The first paper (by Eisener et al.) examined environmental impacts on pollock distribution and the second (by O'leary et al.) used VAST to combine US and Russian data sets to estimate species availability to the surveys across the US and Russian zones.
- Concerning the recommendation to investigate geostatistical analyses of combined trawl and acoustic data to provide a single time-series, the work by Cole Monnahan on combining acoustic and bottom trawl data was mentioned. It was noted, however, that no new combined data will be available to the assessment until after the 2022 trawl and acoustic data become available.
- Although there has not been an exploration of young-of-year pollock density and quality estimates from NMFS BASIS surveys, work has been done on Yasumiishi's copepod index for this purpose.
- In consideration of whether the observed sensitivity in the SRR to prior specification should constitute an increased risk level specification within the assessment or population dynamics related considerations to justify the use of Tier 3 calculations for harvest specifications, research on alternative impacts as specified through ACLIM research activities are underway, but no conclusions have been made to date.
- To the SSC recommendation that the authors provide a retrospective comparison of the selectivity assumed in projections to that estimated with the addition of new data, further study supports the inclination to make 2021 ABC recommendations below max(ABC)), given the tendency towards smaller (younger) pollock in 2021. Further, alternative diagnostics on how selectivity has changed retrospectively will be attempted.
- As to whether the risk table specifications should account for the importance of pollock as a key forage species in the EBS ecosystem to better justify the use of a Tier 3 ABC determination as a precautionary measure for this Tier 1 stock: Although work on this issue has been limited, the multispecies model CEATTLE includes the importance of pollock as prey. It was also noted that the Ecosystem Considerations section of the stock assessment does consider impacts of (and on) pollock predators.
- In 2020 the SSC recognized the apparent disappearance of large pollock in the B-season and suggested exploration of within-season spatial variation in fishery length composition to evaluate

the fate of the large pollock. It was noted that this pattern of fewer large fish in the fishery continued through 2021, indicating that the larger (older) age-classes continue to be less abundant in the catch. Finding out the mechanism for this change is an ongoing research topic. Generally, fish in the northwest have been smaller than in the southeast Bering Sea. However, this trend has not been the case for the 2020 and 2021 fisheries, with fish from the two areas being much more similar in size than in previous years. The overall lack of larger fish, although noted in the fishery, was not observed in preliminary examination of the 2021 survey data.

Hypotheses generated through ACLIM are also being explored, specific to environmental links to the EBS pollock stock through recruitment, survival, natural mortality, and growth. Model explorations incorporating these links are being conducted and progress was described. Explorations are ongoing, examining temperature impacts on growth and recruitment, age 3 survival related to copepod abundance, and using the output of pollock natural mortality by age and year from the CEATTLE multispecies model as input in a single-species model for pollock. In addition, the application of work being conducted by Paul Spencer on using new approaches for model selection was described.

The exploration of temperature impacts on size resulted in a finding of an inverse relationship between the two. The Team inquired as to whether there were mechanisms that could explain this result, as it was noted that, generally, in laboratory studies growth increases with temperature at the temperatures experienced by pollock in the Bering Sea. One speculation was that it may be forage related, but potential mechanisms had not yet been explored. Jim noted that he had to check which temperature index was being used as this study was from a few months ago.

In the discussion on use of environmental correlates in fitting recruitment, it was suggested that further work could look at environmental thresholds in consideration of recent work suggesting hard environmental limits for successful recruitment in some gadid species related to egg hatch success and temperature.

There was also some discussion on the use of CEATTLE natural mortality output as input in the single species model. This approach is being pioneered for some European fisheries. It was noted that CEATTLE is independent from single species models in that it does not use output from single species models as input. The author noted that the multispecies models used to produce predation mortality estimates were tuned to the same data used to tune the single species models and therefore the use of mortality estimates from the multispecies models could be argued as double dipping, as the same data are fit twice but with less information in the single species models. Results from these attempts for EBS pollock so far have resulted in poorer model performance and further work is needed.

Recognizing that the Teams in joint session agreed that the current number of ESPs should be frozen for 2022, the Team recommended that an ESP for EBS walleye pollock be added to the list of new ESPs to be completed in the future.

It was noted that in 2022 the ESP team expects to hire a postdoc to look at options for indicator analyses within ESPs and help organize a pollock ESP if this species were prioritized.

Blackspotted/Rougheye Genetics and Spatial Issues

Diana Stram reviewed the timeline of previous discussions regarding spatial management in general and spatial management of BSAI blackspotted and rougheye rockfish, in particular. The relevant excerpts from previous minutes and Council actions now span 34 pages. Diana indicated that the Council asked for this item to be included on the Team's agenda because it is looking to move forward in some fashion on this issue, and that, because the most recent workshop on the subject did not lead to any innovative tools, the Council is hoping that the Team can come up with some recommendations on how best to do so. The

Team will also need to give its perspective on the set of comments listed at the end of the SSC's minutes on this topic from December 2020.

Wes Larson (with coauthors Ingrid Spies and Laura Timm) then reported on the results of a recent genetic study of blackspotted rockfish. This is the most comprehensive such study to date, and utilized whole-genome resequencing of samples from 84 fish, involving 5.4 million single nucleotide polymorphisms (SNPs). The main result is that no genetic structure was detected, which was not an unexpected result, given the large population size, long generation time, and dynamic habitat (over evolutionary time, due to glaciation) of blackspotted rockfish. The authors also reviewed the ongoing concerns regarding high exploitation rates in the WAI, including overages of the MSSC, and addressed the question of whether the results of their study imply a degree of demographic connectivity that would be relevant for fisheries management. They noted that, for populations on the scale of blackspotted rockfish, even small migration rates (e.g., 1% per generation) would tend to result in an absence of detectable genetic structure, but this does not necessarily imply demographic connectivity, which typically requires much higher migration rates (e.g., 10% per generation). The authors feel strongly that the results of their study should not be used as justification to adopt less conservative spatial management measures, and that decisions on spatial management should instead be based on "assessment data."

The following were among the questions and points raised during discussion (note that these represent comments made by individuals, and may or may not reflect Team consensus; also, both the comments and any responses from others are paraphrased rather than verbatim quotes):

- What are the effects of high exploitation rates on genetic structure? Authors' response: It is difficult to detect impacts on genetic structure over the comparatively short time scales associated with fishery management.
- The assumptions built into stock assessment models can have a big impact on the results. Did the model that was used to estimate the effects of migration rates address sensitivity to structural assumptions? Authors' response: The software assumes that effective sample sizes will be in the low thousands, so when dealing with effective sample sizes in the *hundreds* of thousands (as in the case of blackspotted rockfish), results are going to be largely insensitive to alternative structural assumptions.
- A few years ago, when the results of a second genetic study tended to contradict those of the first study by demonstrating a lack of genetic structure, the Team was faced with a "split decision" regarding genetics, and instead based its level of concern largely on evidence of demographic structure, while awaiting further genetic evidence. Now that the new study has clarified that there is no appreciable genetic structure, is it reasonable to be less worried than if the new study had reached the opposite conclusion? Authors' response: The results of the second genetic study were already fairly compelling, and the importance of demographic structure should not be under-emphasized; but, yes, the combination of demographic *and* genetic structure would have been more worrisome than the existence of demographic structure alone.
- Does GOA POP, where subarea ABCs were set and genetic structure has been demonstrated, provide an example of how to proceed here? Authors' response: If there are genetic differences, there will likely be demographic differences; but demographic differences could well exist without genetic differences.
- Should the level of concern be greater for GOA POP than here? Authors' response: The stock assessment scientists would be better equipped to answer this.
- The decision to set subarea ABCs for GOA POP was not based on genetics.
- Demographics really do matter, if localized depletion is being considered. The question is whether neighboring populations can replenish a locally depleted substock. Tagging is possible, even for species subject to barotrauma, and perhaps should be a priority. Authors' response: Replenishment will likely come through recruitment rather than movement of adults.

- Simulation studies involving ROMS might help evaluate whether recruitment can replenish a locally depleted substock.
- In this case, genetics cannot inform management. This is the first time whole genome sequencing has found no differences. Absence of evidence is not evidence of absence. Genetics is just not a tool that will be useful in this instance.
- If recruitment is the driver of replenishment, then localized depletion is a bigger concern because of the length of time it could take.
- Migration rates and localized depletion are the larger issues here. Beyond the single-species perspective, attention should also be paid to community structure and ecosystem function, especially given the ecological diversity in the different AI regions.
- Atka mackerel is an example of a species for which evidence of genetic structure was not found, and yet the stock is managed spatially.
- Has there been any work on bycatch avoidance? Industry representative response: Bycatch avoidance has been attempted largely by depth targeting.
- Perhaps the Team should suggest that the Alaska fish tagging group consider a study based on blackspotted rockfish.
- Another recommendation might be to look at larval dispersion. Assessment author response: The different species cannot be distinguished morphologically at those ages.
- It would be good to look at all of the demographic information in the context of a workshop.
- Even if the results of the new genetic study have made the situation less worrisome than would be the case if the opposite result had been reached, the Team's previous ranking of "strong concern" for this stock still seems appropriate, given that the definition of that ranking is, "Steps 2 and 3 of the Council must be activated."
- Given that genetics was the impetus for the Team's concern originally, and now that lack of genetic structure has been demonstrated, shouldn't the Team change its ranking? Assessment author's response: Genetics may have been the impetus 16 years ago, but going back even 10 years, when the stock structure template was completed, the results showed that demographic data were as important as genetics, if not more important, for the time scales of relevance to fishery management. The results of the new genetic study are consistent with what was known back in 2014, when the Team agreed that demographic differences, and disproportionate harvesting, warranted spatial management. Note that some other stocks have subarea ABCs even though they do not exhibit evidence of genetic structure.
- How do subarea catches compare to OFL? Assessment author's response: Catches have been below OFL, but have exceeded subarea ABCs for the WAI/CAI.
- Does the Alaska Region have the ability to manage numbers on the order of the MSSC? Region response: The whole reason behind the MSSC is that managing to a WAI ABC would result in prohibiting retention sooner than managing to the WAI/CAI ABC. This species is retained.

The following are stand-alone statements and questions by Team members during discussion:

- The Team should retain its recommendation from last year.
- The Team was interested in whether any other work was being done on activities recommended by the SSC for this species and if so, would like to receive updates when they are completed.
- With respect to replenishment, the effectiveness of a tagging study for this species is questionable.
- The stock structure template that was completed in 2010 already has lots of information that could help inform decisions.
- The SSC's suggestion to explore the distribution of samples is a good idea, but maybe should be an assignment for GAP rather than the assessment author.
- The Team should support everything on the SSC's list, noting that genetics did not provide info on demographic structure.

- The results from the genetic study imply that work on the rest of the items on the SSC's list should continue.

For blackspotted rockfish, the Team made the following recommendations:

- **The costs and benefits of a tagging study should be evaluated by the AFSC.**
- **The costs and benefits of an IBM specific to answering the questions surrounding blackspotted rockfish larval dispersion and potential stock replenishment rates in the Aleutian Islands should be evaluated by the AFSC.**
- **The Team continues to support the ranking of "strong concern" for this stock.**
- **The Team's retains its recommendation from 2020, *viz.*: "The Team requests guidance from the SSC and Council on how to reduce incidental catch in areas with disproportionate spatial exploitation because the MSSC tool has not provided enough protection."**
- **Except for the genetic study, which has now been completed, the other items on the SSC's list from December 2020 should be pursued, including the convening of another workshop on spatial management, which should address both BSAI blackspotted rockfish in particular and spatial management issues in general. One objective of such a workshop should be the consideration and development of alternative management tools for dealing with stocks or portions of stocks with rankings of "strong concern" due to their prevalence as bycatch.**

2022 and 2023 Harvest Specification Recommendations and Halibut Discard Mortality Rates

The Team noted the compilation of the proposed 2022 and 2023 harvest specification overfishing levels and acceptable biological catch amounts, and recommended their adoption by the SSC.

The Team approved the 2022 and 2023 halibut discard mortality rates, with one change: The Team agreed that the GOA non-pelagic trawl CP sector now has a sample size sufficient to calculate the GOA trawl CP DMR instead of using the BSAI DMR. The revised recommendation using the two-year average is 83%.

Adjourn

The meeting adjourned at approximately 1330 PDT on September 23rd, 2021.

Minutes of the Gulf of Alaska Groundfish Plan Team

North Pacific Fishery Management Council
1007 West Third, Suite 400
Anchorage, Alaska 99501

September 22-23, 2021

Administrative

The GOA Groundfish Plan Team ("Team") convened on Wednesday, September 22, 2021 at 0900 PDT.

Participation was remote via Adobe Connect. Roughly 54 people attended the meeting.

All documents provided prior to or during the meeting as well as presentations given during the meeting were posted to the Council's electronic agenda.

GOA Regional Action Plan (RAP)

Martin Dorn presented the updated GOA Regional Action Plan 2.0. The RAPs are meant to guide climate-oriented research on a regional scale, and are to be updated for an additional three years. Original work on the GOA RAP began in 2017 and was published in 2018. The presentation included the seven climate science objectives, a review of what was included in RAP 1.0, and the goals of the RAP 2.0 updates, which include addressing regional priorities for climate-related information and tools. The presentation also highlighted a few projects that are expected to occur, as well as research gaps and unfunded needs. The sub-leads are working hard on communications and engagement strategies to support efforts to co-produce science with GOA communities and develop bi-directional knowledge to plan for climate change impacts. A small amount of funding associated with the RAPs is available.

The Team discussed engagement with GOA communities, and one of the sub-leads (who is also a Team member) noted that there is planned targeted stakeholder engagement which was impeded by Covid, but they are reaching out to fisheries organizations and have a planned case study across 5 GOA communities. This study, which will be conducted through interviews, focus groups, and workshops, places an emphasis on how communities want to engage in the topic of climate change and may yield information on perception of risk, ecosystem change, and adaptation. The Team suggested engagement with ADF&G and encouraged coordination with them as it would be a good conduit for some of the social structures that could provide useful information for the RAP team.

There was one question about how the prioritization of these projects overlaps with research priorities. The RAP lead responded that these projects were developed by the sub-leads, independent of research priorities, as research priorities focus more on short-term needs of Council.

There were several questions regarding prioritization of certain projects and whether resources should be shifted away from standard surveys for what seem to be peripheral projects. Response: The project lead indicated that climate research priorities are specific to areas affected by climate change including nearshore areas and rather than general groundfish research needs.

The Team appreciated the presentation and had no formal recommendations.

GOA CLIM

Marin Dorn provided an overview of the GOA Climate Integrated Modeling Project (CLIM). CLIM is an ambitious project that could provide insights into how climate and oceanographic changes propagate through the GOA ecosystem, fisheries, and communities. The project includes a wide range of institutional partners, and investigators would like further engagement with the Council and other parties on how to incorporate the potential findings of CLIM into current and future management strategies. The project is closely aligned with ongoing research at AFSC, is closely aligned with the EBS ACLIM Project, and a major component of the GOA RAP.

More practically, the GOA CLIM uses the Regional Ocean Modeling System (ROMS) framework to model ocean circulation in the GOA marine ecosystem. It will allow projections of future conditions and how they relate to physical conditions in the ocean, system-level productivity, and ways that fisheries management can promote resilient fisheries and communities. Three current research pathways include:

- Development and application of an Atlantis model as a component of a multi-model ensemble to evaluate fisheries management strategies with respect to a changing climate.
- Evaluate and predict the impacts of environmental anomalies to the endangered Western DPS of Steller sea lions.
- Develop tools and a knowledge-base to couple the ecosystem models to regional economic models to evaluate the impacts of climate change on fisheries and resource-dependent communities.

Alberto Rovellini provided an in-depth overview of the CLIM project, which uses the Atlantis ecosystem model. This model allows for the creation of a virtual ecosystem, which in turn can be used for scenario evaluation and hypothesis testing. There was an extensive presentation that detailed various technical aspects of the Atlantis model, including model coding and data sources, bathymetry, geometry, ROMS mapping, biological components, spatial distribution, and integration of fisheries data. The next steps in the development of the Atlantis model include calibrating the model via changing input parameters until the model's dynamics match actual observations, output validation, and conducting both hindcast and forecast simulations.

Project investigators are soliciting feedback from the Team about such things as model geometry, species grouping, and assistance from assessment authors with validating model dynamics. Investigators would also like to better understand GOA fishing fleets through expanded dialogue with social scientists and economists.

The Team recommended that the GOA CLIM project investigators consider increasing their dialogue with assessment authors and other relevant scientists through additional meetings or ad hoc communications in the near future, versus waiting until the 2022 September Plan Team meeting.

GOA Bottom Trawl Survey (BTS) results

Wayne Palsson updated the Team on the 2021 Gulf of Alaska bottom trawl survey. Two vessels (F/V *Alaska Provider* and F/V *Ocean Explorer*) participated in the survey this year; F/V *Ocean Explorer* also participated in the 2019 survey.

Effort is currently being assessed by reviewing the amount of time the trawl net was in contact with the bottom. The next steps are to complete the effort review, finalize the database, update age compositions, re-estimate survey biomass, size, and split factor, and then make survey data available on the AFSC

website and the Alaska Fisheries Information Network (AKFIN). Data from this year's survey are anticipated to be uploaded to AKFIN by September 30.

In 2021, 529 stations were successfully occupied out of an initial target of 540 stations. Prior to the survey, an algorithm was used to pre-select random 10-station groups that could be dropped if the survey vessels fell behind schedule. One 10-station group was dropped inseason, making the revised target of 530 stations. Station assignments were also transferred between vessels to keep the slower vessel on schedule. Forty-five total strata were sampled in 2021, which is less than usual. As in 2019, the survey occupied stations in all depth strata except the 700–1000 m stratum. Notably, instead of beginning survey work simultaneously, the vessels started 17 days apart; at this point it's unclear if the staggered start date will have measurable effects on survey results. Due to COVID-19 mitigation measures, the survey vessels only did one crew change instead of the usual four crew changes.

Catch composition was similar to past years with Pacific ocean perch (POP) being the dominant species, followed by arrowtooth flounder (ATF). Over 11,000 age structures were collected; otolith sample targets were achieved for 9 out of 19 species. Otolith samples were collected either randomly or via length/sex stratification. Nearly 186,000 fish lengths were collected. Preliminary estimated Pacific cod biomass decreased slightly from 2019, but catches were well distributed resulting in lower variance than in 2019. Preliminary estimated pollock and sablefish biomasses were higher than in 2019. Sea surface and bottom temperatures returned to near average from record highs observed in recent years.

The Team applauds Wayne and RACE Division staff for successfully completing the 2021 survey under extraordinarily challenging circumstances. Further, the Team thanks Wayne for his years of dedicated service and wish him well in retirement (planned in December).

GOA Bottom Trawl Survey Design

Lewis Barnett (Groundfish Assessment Program, RACE Division) provided an update on multispecies survey design optimization simulation analyses for the Gulf of Alaska bottom trawl survey. Goals of this effort are to increase flexibility and efficiency of the survey design and provide a better understanding of how to maximize survey efficiency in the case of survey effort reductions. The simulation approach used a multivariate spatial temporal model and optimization routine to compare the current design to alternative design elements. The estimation model was used to calculate expected uncertainty and bias in the abundance index for a number of species and to examine how bias and uncertainty changed as a function of sampling effort, the number of strata, and the location of strata boundaries.

Biomass trends are consistent between the design-based and the model-based indices lending confidence to the operating model's performance. The proposed optimized survey design has from 5-20 strata versus the current 59 strata. Optimized strata characteristics were based on depth and longitude and sample allocation criteria were based on a Bethel rather than Neyman allocation scheme. In addition, optimization would be based on 15 species groups rather than 52-57 individual species used in the design-based method. Under the optimized approach, the optimal sampling density places the highest density of survey hauls in the western GOA, where the biomass of many species is highest. Under the optimized scheme there is virtually no bias in abundance estimates except for deep dwelling species, which corresponds to the areas or strata where effort has been removed in reduced survey years. In general, the accuracy of uncertainty estimates are similar or improved compared to the design-based estimates. Overall, the optimized design offers several advantages over the current design. Abundance estimation is improved by reducing bias in estimates and the accuracy of biomass uncertainty estimates can be increased. This tool also allows analysts to utilize user-specified precision constraints to design a survey, thus allowing improved flexibility in responding to survey effort reductions.

The Team noted that the presentation was mainly informational, but the analysts sought feedback. Consequently the Team:

- Agreed that this general approach is acceptable.
- Supported the authors recommendation to focus on area level solutions as they provide unbiased estimates for each management area, whereas the gulf-wide design results in some bias for certain management areas.
- Suggested that the authors explore area-specific species prioritizations.
- Indicated that it would be a potential concern if changes to survey design would affect interpretation and consistency of the survey time series.
- Supports the author's conclusion that the two vessels, 550 stations, and survey design likely provide adequate abundance estimates (outlined in a Technical Memorandum currently in revision).

Shelikof Survey

Taina Honkalehto presented the results of the winter 2021 Shelikof Strait / Marmot Bay pollock pre-spawning acoustic-trawl surveys noting that the 2021 survey was complicated by arduous Covid-19 safety procedures and challenging weather.

Location and timing of the major acoustic surveys was reviewed; the GOA summer survey for age-1 plus pollock are conducted in odd years while the winter per-spawning biomass survey is conducted in Shelikof Strait and the Shumagin Islands every year, and rotating alternate years in the Bogoslof Island area (even years) and Kenai / Prince William Sound (odd years). In 2021, the survey was scheduled to cover Shelikof Strait, Chirikof Island shelf break, Marmot Bay, the Kenai, and Prince William Sound, however the pandemic and poor weather conditions restricted the survey to the Shelikof Strait and Marmot Bay.

The survey was conducted in Shelikof Strait on March 3rd - 10th and Marmot Bay on March 13 - 15, 2021. The presence of a large age-1 year class prompted collection of data from an additional 5 tows conducted between March 10th and 13th to get additional net selectivity data. Over both surveyed areas, approximately 1,300 nmi of trackline were surveyed with 7.5 nmi spacing between transects in Shelikof Strait and 1-2 nmi distancing between transects in Marmot. Of the area surveyed, 75% was between 200m and 350m bottom depth. Survey activities were conducted 24 hrs/day. All species were accommodated in the acoustic backscatter data.

This is the second year the survey used the new LSF1421 midwater trawl net and with the additional available data, the net selectivity corrections were updated. Typically, net selectivity corrections increase the number of smaller fish and decrease the number of larger fish, resulting in a reduction in overall biomass. In Shelikof Strait this reduced the biomass estimate from 602K t to 527K t. However, in Marmot Pass, the net selectivity correction only decreased the biomass estimate slightly from 7.6K t to 7.4K t. This reduction was due to the smaller biomass in Marmot Pass combined with the small number (6) of tows and the use of data for all species to derive the net selectivity correction. In particular, a single tow with a large relative proportion of caplin decreased the relative proportion (amount of backscatter) of pollock. Abundance estimates were generated using the acoustic data (38 kHz acoustic data 16 m from surface to 0.5 m above seafloor) and data from large-trawl "targeted" hauls (LFS1421 midwater trawl tows). Physical oceanographic information was also collected.

Shelikof Strait

The preliminary Shelikof Strait pollock biomass estimate was 526,973 t (8,364.7 million fish) based on 1127 nmi of trackline and 24 LFS tows. The pollock biomass in Shelikof Strait is just under its long-term mean (710,000 t) and is much larger than the biomass in Marmot Pass. Most of the pre-spawning pollock biomass was located mid-Strait near Cape Kekernoi with 88% of adult females (>40cm) in pre-spawning condition (n=219). This large proportion of the stock in pre-spawning condition indicated good survey timing.

The presumed age-1 year class comprised 92% of the numbers of fish but only 13% of the biomass; the number of 8-16 cm pollock was very high relative to other survey years. Pollock greater than 33 cm (~ age 4+) consisted primarily of the 2012 and 2017 year classes. A small proportion of pollock were 2 and 3 year olds (<4%), however this is higher than in 2020.

Length distribution data are available for the Shelikof Strait area from 1995 to present; estimates have been corrected for juvenile escapement since 2008. Survey length distributions trackyear class strengths reliably, particularly the 2012 and 2017 year classes (in biomass). The 2013 and 2018 year classes are not as pronounced. Age class distribution data are available from 1980 to present and are also corrected for juvenile escapement.

Marmot Pass

The preliminary pollock estimate for Marmot Pass was 7,401t (180.5 million fish) based on 157 nmi of trackline and 6 LFS tows. The total biomass in Marmot Pass is small relative to Shelikof Strait. The largest abundance of pre-spawning biomass was found in Spruce Gully between the inner and outer most transect lines with 25% of the adult biomass (>40 cm) in pre-spawning condition (n = 19). The remaining female adults were developing or immature which is unusual.

The size distribution of pollock in Marmot Pass also showed a strong age-1 year class (17% of biomass) and a majority of pollock in the 4+ age classes (85% of biomass). There was no survey in 2020 but compared to 2019 biomass is slightly higher.

2022 Surveys

The 2022 winter survey plan is to survey the Shumigans / Sanak regions between Feb 4 and 15th (12 sea days) and Shelikof Strait from March 2 - 17 (16 sea days, typical number of sea days for a winter survey of this area). The acoustic-trawl summer survey will be in the Bering Sea which was last surveyed in 2018.

Additionally, the testing of an autonomous diesel-powered vehicle to collect acoustic data during the survey, potentially increasing the amount of trackline surveyed for bottom mapping (2022) and for collection of acoustic data (2023) is planned. This effort will build on previous work using autonomous sail-driven acoustic data collection vessels as a method of deploying remotely controlled data collection equipment.

Shelikof Time Series/Summer Acoustics

Shelikof survey time series

Dan McGowan gave a presentation on Evaluating VAST (Vector Autoregressive Spatio-Temporal) as a model-based estimator for acoustic-trawl survey data: winter Shelikof Strait survey.

Dan gave an overview of reasons to consider a model-based estimator for acoustic trawl (AT) surveys, including the ability to estimate biomass within standardized areas, improved interpolation within areas with low or no data, the ability to quantify model uncertainty using an MLE, improved estimates of non-

target species, and ability to provide standardized indexes of relative abundance from multiple data sources. The objectives of the study were to:

1. Identify optimal model specification for spatio-temporal generalized linear mixed models (st-GLMMs) using VAST to analyze acoustic-based measurements of age-1+ pollock biomass density from winter Shelikof Strait survey (1995-2021)
2. Assess model performance by comparing model- and design-based estimates of pollock biomass for an AT survey with coverage
3. Conduct a sensitivity analysis of model performance to examine effects of model structure, extrapolation area, and spatial resolution of estimates

Model-based estimates of pollock biomass closely tracked the design-based index trends ($r > 0.99$) and scale (~6-7% higher than design-based estimates). The differences between model-and design-based estimates were most sensitive to the inclusion of spatial random effects and the boundaries of extrapolation grid, and to a lesser extent, model spatial resolution. Both the length-and age-structured models provided similar biomass indices to the simpler univariate model when estimates were combined over all classes; however, these models are computationally demanding.

There are different roles for each of the different model specifications. Length structured models (Length-stGLMMs) are useful for characterizing distribution patterns by size class and providing preliminary (off-the-boat) assessment of year class strength. Outputs from age structured models (Age-stGLMMs) are useful as inputs in stock assessment models; the variance estimates provide both variance of and correlations between ages. Finally, the simpler univariate models (univariate stGLMMs) are useful for monitoring abundance trends, quantifying changes in distributions, evaluating influence of catchability or habitat covariates, and/or examining effects of changes in sampling on biomass estimates. The Team noted these models are not expected to be used in this year's stock assessment.

Ongoing research will focus on the continued assessment of VAST estimator performance for summer GOA pollock survey (2013–2021). Near term research projects include 1) conducting a simulation analysis to further assess sensitivity of the VAST estimator to a range of model specifications (late-Fall 2021), 2) comparing the sensitivity of model- and design-based biomass estimates for simulated and empirical data to changes in survey design and unplanned reductions in sampling extent and resolution (winter 2021-22), and 3) development of model-based estimates for other non-target species (i.e. capelin, POP) from summer GOA survey (spring 2021-22). Looking to the future, work on the development of the VAST framework to incorporate additional sources of uncertainty in AT surveys is planned for FY23.

The Team supported this ongoing and future planned work. The Team inquired about if depth of fish distribution (e.g., off bottom) was evaluated as part of the work. Dan responded that bottom depth was included in some runs as a covariate and that this might be something worth looking at in the future.

Gulf of Alaska summer acoustic survey

Darin Jones gave preliminary results of the summer 2021 acoustic-trawl survey of walleye pollock in the Gulf of Alaska.

Since 2013, the summer AT survey has been conducted from the beginning of June to mid-August. There were several survey challenges in 2021 including impacts and constraints of Covid-19. Fishing and other operations were significantly reduced, but they were able to still conduct the acoustics work. The 2021 survey was truncated and conducted from June 4 – July 9, 2021. The survey covered the area from the Islands of Four Mountains to Yakutat Trough. The area covered in the 2021 survey contained 98% of the 2019 survey pollock biomass.

Despite the differences in the timing and length of the 2021 survey, the Islands of Four Mountains and Shelikof Strait were surveyed consistent with previous surveys. The 2021 survey was conducted in similar areas to the 2019 survey but with decreased effort. The numbers of fish (>20 cm) in areas 620 and 630 on the shelf were down in 2021 relative to 2019. Generally 90% of the pollock are on the shelf.

The progression of the 2017 and 2012 year classes were evident in the length distributions from the 2019 and 2021 surveys. The 2018 year class was evident in the 2019 survey. However, that year class did not appear at expected levels in the 2021 survey. Age data from the 2021 survey is needed to confirm the presence of the 2018 year class. The 2020 year class (12-21 cm) represented 22% of the 2021 biomass.

Weight-at-length data from the 2021 survey was similar to historic GOA summer data. However, an examination of pollock (≤20 cm) showed that mean length and weight was lower than previous surveys. This explains why biomass of ≤20 cm pollock is down although the numbers are up in 2021. In 2021, the average sea surface temperature (SST) and the average temperature at 100 m depth in Shelikof Strait were down.

Estimates of abundance of POP were almost double the 2019 POP biomass estimates. The POP were found in large numbers in the Snakehead Bank area and east of Kodiak and ranged from 30-45 cm.

A summary of the 2021 survey relative to 2019 showed:

- Pollock <20 cm (age 1) numbers were up 33%
- Pollock age 1+ biomass was down 26%
- POP biomass was up 93%
- Capelin biomass was down 20%

Experimental use of Uncrewed Surface Vehicles (USVs) in tandem with NOAA ships is planned for the summer of 2023 in the GOA. A powered USV working in tandem with a NOAA ship has the potential to reduce ship time requirements for acoustic-trawl and ocean mapping surveys by ~1/3. The USV must be fast enough to keep up with the ship. The USV can survey adjacent transects while freeing up the ship to trawl. The specification and purchase of a suitable USV is in progress in FY2021. Initial testing of an USV will be conducted on the 2023 GOA acoustic survey.

A question was asked whether the differences in the 2021 survey timing and temperatures could be reasons for the differences in length and weight of <20 cm pollock. The differences in temperatures were only observed in Shelikof Strait. But it is acknowledged that temperature and growth could be contributing factors, and there could be population dependence affecting mean body weights of the year classes being sampled.

There was further discussion of the decrease of fish on the shelf observed in the 2021 survey. The 2021 survey showed that the mean depth of adult fish was slightly lower, and the mean height above the seafloor was slightly higher indicating that fish were slightly more off bottom. The fish were on the shelf break over deeper water. The fish could be moving (change in distribution), or there are actually less fish on the shelf. It was asked whether the indication of potential changes in distribution could just be due to the timing of the survey. The response was no, this does not likely have to do with timing. The Islands of Four Mountains and Shelikof Strait were surveyed consistent with previous surveys.

GOA Pollock

Model

Cole Monnahan, the new lead author for GOA Pollock, teamed with Martin Dorn and made a number of evaluations to familiarize himself with the bespoke model that Martin had developed. These mostly revolved around responding to past recommendations from the SSC and Plan Team and are presented below.

One request was to re-evaluate the time-varying fishery selectivity to resolve the poor pattern of residuals in the age composition fits. Presently the fishery selectivity variability only propagates via a random-walk term applied to the parameters of the curve. Cole relaxed the constraint and was able to obtain more variability but this failed to improve the poor residual pattern. The Team noted that there are a wide variety of ways to specify the constraint on the separability (by age) component of fishing mortality within the assessment.

The Team recommended that in future analyses (not necessarily in 2021), alternative smoothers/penalty forms be considered. For example, non-parametric time-varying selectivities-at-age may help resolve this problem.

Another Team recommendation (2019) was to explore better methods for constraining the time varying catchability parameter to be under 1.0 for the Shelikof Strait acoustic survey. In response to this, Cole parameterized the catchability to be in logit space so that it would naturally be bounded (by 0 and 1.0 in this case). He noted that the variance term for this form (as well as for the original model) was subjective and he tested a range of values and selected one that provided reasonable fits to the time series of Shelikof Strait surveys.

The Team and authors discussed variables that affect this survey catchability term from one year to the next. Martin Dorn explained that there were abundances that appeared outside the Shelikof region for a period of years and these had some carryover from one year to the next. Another suggestion was that the Shelikof timing of peak spawning may have impacted the low ATS data in 2007-2009 period (hence a lower catchability during that period).

The Team recommended continuing with this form at the author's discretion. We also recommended that future consideration might include state-space models or fully Bayesian forms be considered so that the variance term can be estimated along with the other processes.

Cole noted he is working with Lauren Rogers who is leading an analysis on survey timing and potential impacts on catchability.

In response to a 2019 Team request to explore combining bottom trawl survey data with acoustics, Cole noted that this would be a long-term research project and would take considerable time and effort. He will discuss data feasibility with the relevant AFSC colleagues. In response to a question posed to the Team, we noted that this work could provide an improved index AND help gain insight on the spatiotemporal vertical availability of pollock.

The GOA Plan Team in its November 2018 minutes recommended investigating model behavior sensitivity to abundance indices by incrementally dropping survey indexes to clarify how the data affect the model(s). Cole presented a set of diagnostics to understand the influence of the different survey time series dropping single surveys and running models with only one survey to show those trends/patterns.

Cole provided likelihood profiles broken down by their components plotted against key parameters. This showed that the BTS survey catchability had a large influence on stock size. The Team suggested

examining the profile with the acoustic survey using the newer formulation as that may avoid some of the conflict among the data as observed.

Cole concluded with responses to the Dec 2020 SSC minutes noting that new maturity estimates are included and also that he's a co-PI on a project linking environmental and other factors on trends in pollock weight-at-age.

The Team commended Cole for being able to adopt the code so quickly and create some useful new diagnostics.

GOA Other Rockfish

Cindy Tribuzio presented continued work regarding the other rockfish spatial management proposal. The demersal shelf rockfish (DSR) complex is only assessed separately in the SE region, whereas the species within the DSR complex are folded into the other rockfish (ORx) complex for the western and central GOA and the west Yakutat regions. In 2015, it was proposed that the DSR species be split out from ORx and that a GOA-wide DSR assessment be conducted. Upon this recommendation, the Team and SSC requested further evaluation. After further evaluation was presented in 2017, the Team and SSC approved Alternative 3a (splitting out DSR from ORx GOA-wide) and moving to NPFMC Spatial Management Policy Step 2. In 2019, the Team and SSC reiterated this support to move to Step 2. Since 2019, recent work to support this proposal includes multivariate analysis of life history and vulnerabilities, and VAST modelling of distribution.

Kristen Omori (VIMS) presented multivariate analysis for spatial management where the data used in the analysis included catch and survey data from both trawl and longline gears. Multivariate analyses resulted in confirmation that DSR species should be separated from the ORx complex gulf-wide. This result was reinforced by the temporal and spatial components of analysis using VAST. The Team noted that the removal of the 7 species of DSR out of the ORx complex as defined by eastern GOA east of 140 would align the FMP with State management policy where DSR is defined and applied for state water fisheries. Thus, joined alignment will make it simpler for users who participate in these fisheries to abide by management regulations and plans. The Team noted that it remains unclear as to where to go and what more is required to split DSR from other rockfish. The Team discussed what the assessment would look like, and it was noted that there would be an ADF&G author that would work on the DSR complex in SE and a Federal author that would work on the Tier 6 tables for the DSR complex in the remainder of the GOA.

The Team recommends, based on the analyses presented, that the DSR complex be split from the ORx complex GOA-wide. The Team requests guidance from the SSC on any further analyses needed to support this proposal.

Pacific Ocean Perch (POP)

Pete Hulson provided a summary of the 2021 GOA POP CIE review highlighting reviewer comments and proposed updates for the November assessment. Overall, reviewer consensus was the assessment model is tracking the population and providing high quality management advice. A number of the recommendations focused on a variety of sensitivity analyses, while others involved more in-depth model development. Several consistent in-depth recommendations included: further exploration of data weighting of compositional data; develop a state-space model to be run in parallel to the current assessment; and, continue to investigate use of VAST estimates of survey biomass, in particular investigating reasons behind the divergence between design-based and model-based estimates of abundance.

The author intends to evaluate the majority of recommendations before the next full assessment in 2023. This includes working with GAP staff in RACE to further examine the VAST model-based index. The author is not putting forth any substantial changes for the upcoming assessment but may bring forth proposed model changes in September 2022.

The Team discussed the utility of tracking CIE review recommendations and being aware of author responses and subsequent changes to the assessment model as this process may take several years. The Team supports further analysis of the CIE recommendations and looks forward to future improvements to the POP model.

The Team recommended the author include the table provided in the November assessment as an appendix and include a column that provides author responses to reviewers.

GOA Flathead Sole

Maia Sosa Kapur will be conducting a partial update for the 2021 assessment. The last full assessment was conducted in 2017 and is being transitioned to the latest version of Stock Synthesis (SS). Estimated survey biomass index through 2019 remains high, and spawning stock biomass remains high and stable suggesting no major conservation concern. Fishery catch since 2010 has consistently been approximately 10% of TACs and has been well below ABCss over the entire time series.

The Team supported the author's recommendation in continuing with a partial update this cycle, agrees there is no major conservation concern, and looks forward to the updated model using the latest version of SS in the next full assessment.

Northern and Southern Rock Sole

Meaghan Bryan presented a preliminary assessment for 2021 and investigative work regarding CIE recommendations. A CIE review workshop was held in April 2021 with contributions from various programs including: Fisheries Monitoring and Analysis, Age and Growth, Groundfish Assessment, and Status of Stocks and Multispecies Assessment. The main CIE recommendations included:

- improving the model for growth;
- investigate the possibility of estimating catchability to relax assumption that survey biomass is an absolute index;
- develop model-based indices and use as an input to partially address survey biomass index concern;
- encourage research of untrawlable habitat to improve understanding of relative abundance of rock soles in these habitats;
- further justification for spliting catch 50/50 for northern and southern rock sole.

Growth data was explored for males and females by year and species where bifurcation trends were observed indicating differences in growth. The differences in growth were more prominent in female NRS compared to males and similar trends were also observed for SRS. The summary of the growth analyses for NRS included significant spatial differences in female growth between the Central and Western regions whereas differences in male growth was less significant. For SRS differences in growth were supported for the model but less prominent compared to NRS.

Differences in growth were most apparent for NRS and further explored using a 2-area model in SS3 for the Central and West regions where recruitment distribution was estimated to determine how the population is distributed between areas. The results showed poor model fits and difficulty in estimating a recruitment distribution parameter. The author noted the poor model fits to males in the west region and

noted that this could be attributed to a fair proportion of NRS escaping the survey trawl net. The author presented further investigative work that included estimating catchability, updating age-error matrices, and sensitive analyses. Estimating catchability was recommended for further research, and to explore additional spatial components and review survey selectivity due to the low proportion of NRS males being caught. Conclusions from the sensitivity analyses showed that improvements can be made to the retrospective pattern with better fitting biomass data (using re-weighting), and iterative re-weighting approaches led to poorer estimation of growth and residual patterns in length and conditional age at length still persisted.

The Team commended the author with the in-depth and exploratory analyses conducted in a limited time frame. The Team recommended the author continue to explore the differences in growth utilizing spatial analyses, examining survey net selectivity, and use a reasonable set of parameters and then bootstrap to get new data and iteratively refit the model.

The Team recommended the author bring forward Models 17.1d (updated age error matrix) and 17.1f (17.1d with estimated catchability and VAST estimate of survey biomass) for November.

GOA Pacific Cod ESP

Kalei Shotwell presented on the GOA Pacific Cod ESP. The SSC recommended a full ESP for all Pacific Cod stocks in 2019 given the economic and community importance of this fishery. The Pacific cod ESP team was formed in January 2020. In November 2020 a draft ESP was developed. The Final ESP has been produced for this Plan Team meeting.

The Pacific cod ESP integrates the SSC's evolving comments on the ESP including the use of traffic lights, aggregating indices into a score, supporting the ESP dashboard, continued re-evaluation of ESPs as the process develops, and continued integration of community and socioeconomic indicators. The SSC's comments specific to this ESP were about expanding the spawning habitat suitability index, exploring indicators to inform other parameters, encouraging developing climate enhanced model 20.1, exploring additional indicators to describe trends in recruitment, separating fishery engagement from dependency, and exploring how coastal communities can provide review of and feedback on the ESP. The economic section of the Pacific cod ESP is a pared down version of the EPR inclusive of product breakdown, stock-specific engagement from ACEPO. SSC supported inclusion of small communities as aggregated, to address confidentiality issues.

Kalei spoke specifically to the dynamics of marine heatwave, habitat suitability, and bottom temperature conditions on Pacific cod, noting a potential lag in continued bottom temperature warming post heatwave which can be detrimental to Pacific cod. There was also strong indication of regional differences in conditions for Pacific cod. Socioeconomic indicators similarly point to declining prices and ex-vessel values for Pacific cod participants.

The Team discussed the utility of socioeconomic indicators within ESPs given the objectives of the ESP to 1) inform risk tables, and 2) provide a proving ground for ecosystem-linked assessments. Specifically, there was concern that the SSC has expressed interest in using the socio-economic indicators as red flags of stock health, given that the socioeconomic indicators are a year behind the current year whereas other ecological indicators are available concurrent to the year of the ESP. Similarly, there was concern expressed that socioeconomic phenomena are driven by a multitude of factors and can reflect more than changes in stock health, and there is yet to be a statistically significant relationship in the peer reviewed literature that links socioeconomic phenomenon directly to the health of *any* stocks in the North Pacific. Given this lack of scientific evidence, it is unclear by what mechanism these phenomena are then determined to be "good" or "bad" or a "red flag" for a particular groundfish or crab stock, or for the ecosystem as a whole.

The SSC's interest in socioeconomic information within ESPs may stem from the potential incorporation of local ecological knowledge to serve as red flags of changing conditions, but this is very different than utilizing existing sources of socioeconomic data available for inclusion in the ESP. Therefore, the Team expressed confusion about whether the SSC's intent for socioeconomic information within ESPs is really in terms of the use of socioeconomic data (prices, revenues, no. of permit holders, etc.) versus near-real time local ecological knowledge. Whereas the former can be calculated for ESPs from available data (with an annual lag), the latter would take concerted, new efforts for systematically gathering LEK focused around a specific species and region. Furthermore, there was concern expressed about the redundancies of socioeconomic indicators within ESPs and information already provided in the Economic SAFE and the new ACEPO documents.

The Team recommended that the SSC provide clarity about how the incorporation of socioeconomic information should be used to meet the objectives of the ESPs. If the SSC's interest in incorporating community information within ESPs is actually in terms of local ecological knowledge that should be clarified and prioritized in terms of species and regions, given that this will necessitate a new data collection.

The Team recommended ESP authors provide clarity around the terminology for socioeconomic indicators given the lack of familiarity of these terms within the Team.

GOA Pacific Cod Model Updates

Steve Barbeaux gave a presentation on GOA Pacific cod, starting with a brief overview of last year's accepted model for reference. The presentation included an outline of several alternate models that were evaluated, and focused on the effects of these proposed models on various model outputs.

Steve evaluated eight models,which were primarily characterized by incremental changes/additions that started with the incorporation of a new age-0 cod index based on the beach seine survey conducted around Kodiak and along the western Alaska Peninsula (in collaboration with University of Alaska Fairbanks). The new models also included explorations of adding environmental links to growth, mortality and recruitment model parameters, data re-weighting, and finally expanding the M parameter block from 2014 - 2016 in the base model to years 2015 - 2020.

Results from the beach seine survey were compared with model estimates of recruitment, which seemed to generally follow similar patterns up to 2016, with an r^2 of 0.67, and were less coherent later on. The addition of the beach seine index to the model for recruitment resulted in good model fits to the seine survey data. However, the fit to other survey indices, including longline and bottom trawl survey, was poorer. The presenter noted that the new index further increased the lack of fit to high biomass in the bottom trawl surveys in 2009-2013, and the extremely low biomass in 2017, from the base model, and similarly failed to fit the rapid recent declines in the longline survey. A suite of other impacts from the addition of the new index were discussed, including reduced variance on reference points and a reduction in M during the 2014-2016 heatwave mortality block.

The next set of models explored the additions of temperature and heatwave information to growth, mortality and recruitment components of the model. The growth component was informed by experimental work by Ben Laurel et al. (2015) that indicated temperature links to larval cod growth rates. The proposed changes to mortality included a link to the annual heatwave index using a logistic function to increase M with the heat wave index value. The effects of this linkage on model estimates of M were compared with the base model and with the final proposed model with the expanded mortality block. Similarly, a heat wave derived index focused on the winter spawning event was used to inform model estimates of recruitment by modifying the Beverton-Holt spawn-recruit function, such that in years which

had a non-zero spawning heatwave index, higher values of the index would result in a reduction in recruits.

Two proposed models explored input data re-weighting/model tuning by modulating survey index CV's and size composition sample sizes. The presenter noted the inability to get a Stock Synthesis modeling software procedure using the Dirichlet method to work for this exercise, and mentioned that after much frustration in this endeavor the issue was due to a misspecification in the software. The tuning exercise resulted in higher CV's for all survey indices and substantial increases to age-length data sample sizes. The suite of models incorporating data re-weighting exhibited higher catchability parameter estimates for the bottom trawl survey (> 1.4), which the presenter noted was not a good outcome.

The next component of the presentation was dedicated to evaluating the different models using various standard metrics, including AIC and retrospective analysis. The best performing model for those that were comparable with AIC was the one with an expanded M block and environmental linkages to growth and recruitment. A series of slides showing the likelihood estimates for individual components of the model, including survey indices, recruitment, age-at-length and length composition across all of the models. In most of the cases the final proposed model had the lowest negative log likelihood (best fit), with the exception of the fit to the bottom trawl survey, which was the poorest for the model with expanded M block and all other modifications, of all compared models. Also highlighted was that the final proposed model with the heat wave linkages, expanded M block, and reweighting resulted in a negative retrospective analysis index (Mohn's rho) as contrasted by positive values (thus positive bias) for all other models. All models showed increased SSB in 2021 relative to 2020.

A sequence of slides then showed the estimates for the environmental (temperature/heatwave index) linked parameters across the models that contained them, which appeared fairly stable across the models. The impacts of data re-weighting on the longline survey catchability were noted, where the reduction in catchability was potentially indicative of less influence of temperature. The time series of new model fits to survey indices showed substantial divergence in models in the last 2-3 survey data points for the bottom trawl and longline surveys. Model outputs for SSB were also different, with best fitting models generally being the least optimistic.

In summary, the inclusion of the beach seine age-0 cod index improved recruitment estimates at the cost of poorer fits to other surveys. The environmentally linked model parameter estimates matched empirical observations (lower recruitment, higher mortality with heat wave conditions, and higher growth with temperature). Data re-weighting/model tuning resulted in a high catchability parameter value (>1.4) for the bottom trawl survey. The presenter listed new data that will be available for the assessment prior to the November Plan Team meeting, and outlined which of the models would be formally presented. The presenter indicated that the recent update of the SS program would allow the data re-weighting models to use the Dirichlet distribution for age length sample size selection process, which was not available for this presentation.

Steve asked the Team which model selection aspects they wanted to be presented in November. An additional slide that generated much interest was the results of the western gulf cod tagging study, which show a majority of the tag returns from individual cod tagged around the Shumagin Islands during spring 2021spawning being recovered in the EBS and even in Russian waters in the summer, which suggests substantial migration of these fish. Steve noted that there is possibly a difference between western and central gulf cod, but that the next round of assessments for cod (EBS, AI and GOA) might have to be more closely coordinated given the potential mixing of the stocks, and potentially examined using an MSE approach as has been proposed by Ingrid Spies who will be taking over the GOA cod assessment next year.

Several questions were raised by Team members. They proposed leave-one-out analyses for model selection might be helpful. A request was made for doing a retrospective analysis on predictions of recruitment with and without the addition of the beach seine index, specifically to identify if high or low year classes are better predicted.

The Team inquired about plans to expand tagging to the central gulf but this was clarified as being a logical next step. Related to cod movement out of the GOA,, there was a question whether linking natural mortality to GOA environmental conditions (i.e., heat waves) was justified. If fish were migrating over large distances they would likely be exposed to different conditions. This led to a discussion on uncertainty in stock delineations and the possibility of more resident components of the GOA stock, possibly in areas such as Prince Williams Sound or around Kodiak. These components may be better understood with genetic studies that are underway.

The Team also inquired as to the availability of the IPHC longline survey data for 2021 given the coronavirus concerns. The survey was conducted but as in previous years, length data for cod and spiny dogfish were unavailable due to limitations in survey time and resources.

The Team asked if any fishery catch-rate data similar to the presentation and analyses done for EBS Pacific cod had been done. Steve showed the available data but noted that the observer collections are fewer and, partly due to the substantial drop of boats participating in each type of cod fishery, inferences from Pacific cod fishery CPUE data are problematic.

The Team recommended that the rationale for increases in the bottom trawl catchability parameter, particularly when re-weighting, should be noted; specifically, compare values with earlier experimental results.

The Team also acknowledged their appreciation for the quality of the overall presentation, and the importance and hard work required to carry out the tagging study.

2022 and 2023 Harvest Specification Recommendations and Halibut Discard Mortality Rates

The Team approved the proposed harvest specifications for 2022 and 2023 by recommending the 2022 GOA final harvest specifications for OFLs and ABCs as published in the Federal Register in February 2021.

The Team approved the 2022 and 2023 halibut discard mortality rates with one change. The Team agreed that the GOA non-pelagic trawl CP sector now has a sufficient sample size to calculate the GOA trawl CP DMR instead of using the BSAI DMR. The revised recommendation using the two year average is 83%.

Adjourn

The meeting adjourned at approximately 1630 Pacific time.