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.