REPORT OF A NORTH PACIFIC FISHERY MANAGEMENT COUNCIL WORKSHOP

CONSIDERATION OF CONSERVATION, MANAGEMENT, AND POLICY IN SPATIAL MANAGEMENT OF CATCH LIMITS

APRIL 16, 2013

Seattle, Washington

Executive Summary

More than 70 people participated in a work shop during Spring 2013 which was designed to assist the North Pacific Council in developing a policy for spatial management of finfish and shellfish stocks under its management authority. Workshop participants: 1) reviewed and discussed a) information on application for groundfish, crab, and scallop stocks of spatial management (i.e., subarea allocations of annual harvest specifications (OFL, ABC, and/or TAC)) and b) case studies where subarea allocations have/have not been adopted and 2) provided the following recommendations for the Council's consideration for next steps in developing policy.

- **Spatial management should encompass management actions (e.g., subarea TACs) other than subarea splits of overfishing level (OFL) and acceptable biological catch (ABC).**
- **The Council should adopt a management policy or policies for spatial management of stocks that have been identified by scientific advisors as being at biological risk of reduced biomass and yield to commercial fisheries.**
- **Stock structure is only one biological parameter that should be considered when determining that a stock is at risk.**
- **Economic impacts on industry of 1) short term costs of more, smaller quotas that are more likely to close earlier with target species left unharvested and 2) long term costs on lost yield should be considered by the Council when adopting its policy.**
- **Council policy should identify a default management action that automatically would be implemented for stocks with insufficient data to determine biological risk.**
- **Several unanswered policy questions were posed for future consideration.**
- **The Council, or its policy, should articulate the role of the stock assessment author(s), plan team(s), and SSC in determining spatial management.**
- **Request that the plan teams review this report at their next meetings and provide comments for SSC and Council consideration during their respective meetings in October 2013.**

Background In December 2012, the Council indicated its intent to hold a public workshop to discuss management and policy implications that result from identification of stock structure when setting annual groundfish harvest specifications. The purpose of the workshop was to discuss the management implications of subarea (i.e., spatial) management on fish stocks, stakeholders, regulators, and managers. The goal of the workshop included, but was not limited to, discussion of management, enforcement, and implementation issues that the Council and its committees should address if annual catch limits (ACLs) or total annual catches (TACs) are recommended by subarea. Management tools for subarea allocations could include those that 1) industry could voluntarily implement, 2) NMFS already has authority to employ, and/or 3) the Council could consider for action.

A one-day (in person and webinar) workshop was held at the Alaska Fishery Science Center in Seattle on April 16, 2013. Council Members John Henderschedt and Bill Tweit facilitated the workshop. Mr. Henderschedt opened the meeting; he identified that the workshop is about improving the current process for determining lit

spatial management for groundfish and shellfish stocks and is not an arena for decision making. The workshop provided an opportunity for discussion and it will be left to the Council and its advisory bodies to raise ideas, issues to be addressed in future, and potential action to consider. He identified an interest in discussing the need for and application of the stock structure template and it would not be an opportunity for scientific or management discussion of particular species.

MORNING SESSION

Mr. Henderschedt identified that this workshop is not intended to be a decision-making forum. The outcomes from this workshop will be reported back to the council for its consideration. And while it is an opportunity to learn more about the process and need for a stock structure template, it is not an arena for debating the scientific merit of identifying spatial stock structures in general or the stock structure of any particular species.

Mr. Henderschedt went on to identify the purpose and goals of the workshop. The identification of unique spatial structure within the broader distribution of a marine species raises the question of the appropriate spatial scale at which to establish harvest limits for that species. This decision making process assumes a tolerance for risk that reflects a fundamental balance of managing for both conservation and yield. This workshop is intended to:

- clarify the process by which stock structure determinations are made in the context of risk, costs, and benefits;
- explore existing and potential management tools that are responsive to discrete spatial catch limits or which can mitigate risk associated with broader stock management; and
- identify a process of incorporating considerations of policy, management, and fishery yield in future stock structure considerations.

Introductions of local and web participants followed, with identification of what each participant hoped to learn and/or accomplish at the workshop. The morning was devoted to summaries of past recommendations and research to update all participants on some of the underlying issues related to spatial management of Federally managed species in the North Pacific, as listed below.

Mr. Henderschedt noted an interest by the Council to ensure a process for bringing science and policy together in an appropriate manner for stock structure determinations. The session started with a discussion of conservation risks under the national standards, principally National Standard 1. A main issue is how to conserve species diversity *while* achieving optimum yield *and* promoting fishery dependent communities. A main goal would be to better understand how to measure and assess risk associated with various spatial management strategies.

Summary of scientific basis of Groundfish Plan Team's stock structure efforts and biological implications of spatial separation of TACs	Paul Spencer
Summary of management frame work for crabs and scallops, available in-season management tools	Diana Stram
Summary of management frame work for groundfish, including available In-Season Management and industry tools	Mary Furuness
Case studies in the spatial management issues of catch limits: Snow crab Scallops GOA Pacific ocean perch BSAI blackspotted rockfish BSAI Pacific cod	 Diana Stram Diana Stram Dana Hanselman Paul Spencer Jane DiCosimo
Application of management strategy evaluations as a spatial management tool for groundfish stocks	Ingrid Spies

TALK 1 Dr. Paul Spencer opened the morning presentations with a summary of application of stock structure templates to groundfish stocks. He provided the following information.

1) Why the Stock Structure Working Group was created and the goals it is trying to achieve. The BSAI Plan Team reviewed stock structure for a number of groundfish species (e.g., Pacific cod, blackspotted/ rougheye rockfish). The team noted inconsistencies in definitions of stock structure and spatial management that may be caused by a lack of consistent criteria for what determines a "stock" and limited expertise in evaluating stock structure information.

The stock structure template was developed to consider different types of information when evaluating spatial structure, such as:

a) Harvest and trends: Is the fishing sufficiently low and spatially dispersed that overexploitation of stock is not a current problem, or unlikely to be a potential problem? Examination of area-specific exploitation rates – proportion of biomass removed from an area within a year. Are the population trends similar across areas? Estimated subarea exploitation rates for BSAI rougheye/blackspotted rockfish and BSAI northern rockfish were presented.

b) Genetic information: Why hasn't genetic information been more directly utilized in definitions of stock structure? It is difficult to infer demographic independence from genetic data and it is difficult to develop meaningful hypothesis tests. He noted the importance of asking the right question in terms of spatial management of stocks. Previously, the team posed the question: "Are fish in area A a separate stock from those in area B?" This resulted in an emphasis on "splitting out" stocks, without being clear on what "splitting out" means or its management implications. Now the team is posing alternative questions: 1) What do our data tell us about the spatial structure of the stock? And 2) are our management areas consistent with this estimated structure? If not, what risks do we face from having a mismatch?

Genetic information reviewed included: 1) Isolation by distance; 2) Dispersal distances; and 3) Pairwise genetic differences between geographically distinct collections. Examples from BSAI northern rockfish and GOA Pacific ocean perch were presented.

c) Barriers and phenotypic characteristics: Are there physical barriers or other mechanisms for limiting connectivity? These include: 1) Growth; 2) Age-size structure; 3) Spawning time differences; 4) Maturity; 5) Morphometrics; and 6) Meristics. Examples from BSAI northern rockfish, GOA Pacific ocean perch, and GOA rougheye/blackspotted rockfishes were presented.

d) Behavior and movement.

2) Summary of evaluation of stock structure for several Alaska rockfish stocks.

3) Risks associated with determination of stock structure. Risk assessment (i.e., description/quantification of the likelihood and consequences of certain outcomes under various management policies) was distinguished from risk management (identification of strategies to minimize risk). The Stock Structure Working Group largely focused on the risk to yield and stock sustainability, but also recognized that a more comprehensive risk assessment would consider the operational costs to management and impacts upon fisheries. Additionally, the relatively common use of subarea ABCs in the GOA and their less common use in the BSAI poses the risk that the scientific advice being communicated to the NPFMC is potentially not consistent between the two groundfish plan teams.

4) It was noted that our current system reflected a hierarchy of flexibility with respect to catch limits. For example, OFL are typically not to be exceeded, but ABCs (i.e., ACLs) may be exceeded with a frequency no greater than once every four years. In this context, it was postulated that it may not be necessary to require that subarea ABCs would never be exceeded, as long as consistently high subarea exploitation rates were avoided.

5) The following conclusions were offered by Dr. Spencer.

a) We have developed and used a template to provide information on stock structure, and which incorporates a variety of types of information.

b) We have improved our communication of the biological implications of stock structure (i.e. biological risk assessment), and will need to improve further.

c) Our management system would benefit from development of consistent risk policies and tools (i.e., risk management) to address spatial management.

d) In cases with complex data sets, or that have broad management implications, it is important to allow time for adequate scientific review.

A brief discussion ensued, raising the following issues.

- As an explanation of hypothesis testing on migration of fish stocks, very small levels of migration may be sufficient to result in an insignificant test of genetic differentiation, but could still represent a degree of spatial structuring that is important at the time scales of interest to fishery managers. A geneticist and assessment author could draw different conclusions from the same data because assessment authors may be interested in shorter time scales than geneticists.
- Investigations continue on the apparent high subarea exploitation rates for some rockfish stocks. No errors have been identified to account for the patterns of catch and survey trends.
- Life history contributes to whether a longer-lived genome would stay in the population longer or would make the population more vulnerable. A longer lived species likely would take more time to rebuild. And lower yields may occur until recruitment recovers. A generation time for a recovery period is an indicator of a high risk of depletion.
- There was general consensus supporting the Council's approach that the definition of spatial management units is, in part, a policy decision, and not solely, a biological one. Therefore the role of the stock assessment authors, Plan Team, and SSC is to inform the policy makers of biological risk.
- The GOA Groundfish Plan Team has recommended more subarea splits than had the BSAI Groundfish Plan Team. In cases with no stock structure data (i.e., GOA dusky rockfish) area management was adopted as a precautionary measure because rockfishes are so long lived. There was general consensus in favor of having the Council define a default policy on spatial management when data is lacking.
- Spatial concentration of (only) catch over a long period of time could be evidence of stock separation. Harvesting in one area with little apparent effect on the dynamics in neighboring areas could indicate spatial structure. In contrast, harvest in one area that did affect the observed dynamics of neighboring areas could indicate that the subareas are more closely linked.
- There was Interest in determining the risk of concentrating harvest in one subarea compared to across multiple subareas, assuming harvest is less than subarea ABC(s). Spatial concentration of catch (which includes scale and amount) is a key component of the stock structure template.

TALK 2 Diana Stram summarized the management framework for the scallop and BSAI crab stocks, which both have shared management with the State of Alaska. BSAI Crab FMP management is divided into category 1 measures, which are fixed in the FMP and require an FMP amendment to change, and category 2 and 3 measures, which are either frameworked in the FMP or at the discretion of the State. Spatial management measures can comprise a mixture of these categories. Category 1 measures include the annual specification of OFLs and ABCs. Currently each of the 10 crab stocks is managed as a single-stock unit with a single OFL and ABC. The spatial specification of target catch levels (TACs and GHLs) are Category 2 measures and can be modified by the State annually under criteria frameworked under the FMP. For example, Tanner crab and AI golden king

crab both have spatially explicit catch quotas despite being managed under a single ABC for the whole stock. Additional spatial management measures are possible at the discretion of the State under Category 3 measures. For instance, multiple closures exist for crab fishing near the Pribilof Islands due to bycatch of the Pribilof Island blue king crab stock, and subsistence fishery closures around St. Lawrence Island, King and Little Diomede Islands and areas near Nome. These closures all serve to modify spatial management of the catch.

The Scallop FMP delegates management to the State under Federal oversight. As for crabs, the specification of the OFL and ABC is a Federal action. Currently, a single OFL and ABC exist for the entire weathervane scallop stock statewide. However, under the discretion of the State, catch is managed at the registration area and smaller spatial scales of districts, subdistricts and sections. Closures for bycatch, low catch-per-unit-effort, or approaching spatial targets for catch limits may be enacted at the discretion of the State in-season.

Additional management tools for crab and scallop management include the rationalization of the 10 crab stocks and a voluntary cooperative structure under a license limitation program for scallop stocks in Federal waters.

TALK 3 Mary Furuness summarized the management framework for groundfish under Annual Catch Limits (ACL) and Accountability Measures (AM). The chart below summarizes the actions taken by the NMFS regional office for each fishery, including additional in-season actions for BSAI and GOA Pacific cod, AI pollock to BS, PSC (rockfish program, BSAI trawl limited access to Amendment 80 co-operatives, flatfish flexibility, non-specified reserves. Three main actions include: 1) Open the directed fishery; 2) Close the directed fishery; and 3) Prohibit retention.

Also, for some fisheries NMFS has authority for inseason reallocations that move unused allocation to other sectors or from the non-specified reserves. NMFS determines whether to open directed fishing depending on if the TAC would support directed fishery and incidental catch in other fisheries. If not, NMFS closes directed fishing, and allows retention up to the Maximum Retainable Amounts (MRAs) listed at 50 CFR part 679 Tables 10 and 11. If so, staff opens the directed fishing, monitors groundfish catch and PSC. Some MRAs are set to account for true incidental catch and some to allow for "topping off."

Closure Basis	Results as approach limit	Result when catch reaches or exceeds limit
TAC	Determine incidental catch allowance and set directed fishing allowance	Prohibit directed fishing
ABC	TAC < ABC	Prohibit retention at TAC
	TAC = ABC	Prohibit retention
OFL	Determine specific area, gear, and target fisheries that catch the species	Area, gear, and target fishery closures for fisheries that catch the species

If a fishery's catch approaches the TAC, NMFS calculates the incidental catch allowance and directed fishing allowance and takes the following actions at attainment of the different benchmarks.

- Reach directed fishing allowance – close directed fishing, MRAs allow retention.
- Reach TAC – prohibit retention, but discarded catch may continue. If TAC = ABC then it is also an ABC closure.
- Reach ABC – retention already prohibited at TAC closure. No other management measures at ABC.

- Approach OFL – discarded catch continues because actual incidental catch in other target fisheries. An OFL closure can be defined by area, gear, species (e.g., (2007 Western Aleutian Pacific ocean perch (POP) fishery for rougheye rockfish OFL) or can prohibit directed fishing for an entire fishery (e.g., 2011 Pacific cod pot fishery for octopus OFL).

As a performance standard, if catch exceeds the ACL (ABC) for a given stock or stock complex more than once in the last four years, the system of ACLs and AMs should be re-evaluated, and modified if necessary, to improve its performance and effectiveness.

There are management measures to avoid exceeding ABC (prohibit directed fishing, prohibit retention). Most catch share programs (e.g., IFQs, CDQs, cooperatives) are prohibited from exceeding their allocations and all closely monitor their allocations. Other than the main quota share recipients, most catch share programs allow for new participants to enter the fishery. Entry level fisheries usually have small allocations and unknown amounts of participants that require more active management.

An OFL area split is the most conservative, and requires ABC/TAC split by the same area. An ABC/TAC area split is less conservative. Changing area management requires (re)programming the Catch Accounting System and may result in increased monitoring and increased closures. More area TACs creates smaller harvest limits that may not allow for directed fishing to open or require closures earlier in the year, which increases regulatory discards of fish, most of which have market value.

There are agency costs of managing more, smaller harvest limits, but there also are costs to industry if splitting results in more intensive management: 1) decrease the target CPUE as a result of moving to another fishing area, 2) increase fuel costs resulting from moving, 3) increase regulatory and social scrutiny due to regulatory discards, 4) potentially increase PSC and constraining species catch if moving results in increased catch rates, and 5) increase discards that increases trip length and decreases revenues over time.

Industry has voluntary tools available to manage their allocations (particularly for Alaska plaice, arrowtooth flounder, Atka mackerel, Greenland turbot, Kamchatka flounder, Pacific cod, Pacific ocean perch, pollock, sablefish, and yellowfin sole).

- Move to another area – added cost
- Voluntary catch share fisheries
- Hotspot reporting
- Hotspot closures
- Works for target or incidental catch species found in discreet areas
- Does not work for all species

Participants raised the following issues during a discussion period that followed the above presentation:

- A single OFL may be associated with one or more area ABCs and TACs, but subarea OFLs must be associated area ABC and TAC that may not exceed the higher level benchmark.
- Short term costs of smaller area specifications and long term costs of lower yields to industry have not been addressed.
- Specific examples of how subarea management was applied to specific fisheries (e.g., Western GOA rockfish) were discussed. First NMFS determines how much is needed to account for incidental catch in other fisheries. Then if TAC remains for a directed fishery NMFS determines the amount of potential effort. Twenty-four hours is the shortest NMFS will open a fishery. If the potential effort in 24 hours would exceed the directed fishing allowance then NMFS would not open the directed fishery.

- More, smaller quotas are difficult to manage and the likelihood of underharvesting TACs (and OY) under conservative management has not been assessed.

TALKS 4-8 Selection of several case studies were intended to demonstrate the wide range of policy choices facing the Council each year in setting annual harvest specifications.

Diana Stram reported on stock structure and spatial considerations for snow crab. Currently snow crab are managed as a single-unit stock. Stock distribution may extend into Russian waters to an unknown degree. Snow crab larvae are considered to drift north and east after hatching in the spring while snow crab appear to move south and west as they age. No tagging studies have been conducted to fully characterize the ontogenetic or annual migration patterns of this stock however. The issue for snow crab is a spatial issue with respect to catch concentration and not specifically related to stock structure, however it could have implications for reproductive viability of the stock as a whole. Diana summarized the catch issues:

- Majority of catch occurs south of 58.5 N., even in years when ice cover did not restrict the fishery moving farther north
- Some movement occurs between the summer survey and the winter fishery.
- Exploitation rate on males south of 58.5 N latitude may exceed the target rate, possibly resulting in localized depletion of males from the southern part of their range.
- High exploitation rates in the southern area may have resulted in a northward shift in snow crab distribution
- Fraction of barren females in the 2003 and 2004 survey S of 58.5 o N latitude was generally higher than N of 58.5 o N latitude
- Laboratory analysis of female snow crab collected in waters colder than 1.5 o C from the Bering Sea have been determined to be biennial spawners
- Future recruitment may be affected by the fraction of biennial spawning females in the population as well as the estimated fecundity of females, which may depend on water temperature.

Merrick Burden asked about the biennial survey in the north, and reports of barren females in the south; this suggested to him the use of management strategy evaluations (MSE) to optimize overall yield. Dr. Jack Turnock reported on a spatial model developed by James Murphy for simulating movement and different harvest strategies, but it was not an MSE. The model identified a number of complicating issues for determining optimal sex ratios. The State could consider separating TACs north and south of 58 N but to date catch (and IFQ) have been managed over the entire EBS area.

Diana Stram summarized stock structure information for weathervane scallop stocks as compiled by the Scallop Plan Team in application of the stock structure template. The primary issues are as follows:

- Growth rates differ between registration areas with faster growing scallops in the Kodiak area, slower growing in eastern GOA, unknown if genetic or environmental
- Similar age structure but size-at-age varies across areas
- Morphometric differences amongst areas
- Weak evidence of genetic differences between BSAI and GOA, no evidence between areas within GOA(limited study)
- Scallops are sessile, and exhibit spawning site fidelity

The team concludes that there likely is stock structure, but also many unknowns with this data-poor stock. The team did not identify an overriding reason to modify current management measures however as information is

considered by individual scallop bed. The SSC has suggested that other tools employed for scallops in different regions could be considered to improve conservative management of these stocks such as rotational closures.

Dana Hanselman summarized evidence of stock structure information for GOA Pacific ocean perch, as follows.

- Harvest is in proportion to perceived abundance and below overall ABC/OFL
- Occasional overage in subareas
- Genetics suggest stock structure at scales smaller than management regions
- Large year classes do not always appear in the same areas at the same time
- Growth differences not biologically significant
- Some morphometric differences on V-shaped cline (probably related to latitude)

Current spatial management of catch limits includes subarea TACs, ABCs and OFLs (WGOA, CGOA, EGOA). Additional management measures include

- Eastern GOA (East of 140 W closed to trawling), no longline catch
- Eastern GOA (between 147 W and 140 E open to trawling)

Participants raised the following issues during a discussion period that followed the above presentation:

- Low biomass in the 1980s was due to overfishing and subsequent low recruitment events; there was no apparent relationship between recruitment and spawning biomass, and recruitment variability is more likely a function of environmental conditions. A single recruitment event recovered the stock over ten years.
- Statistical techniques could be applied to smooth interannual variability across surveys to better estimate biomass distribution.
- The original rationale for creating subarea OFLs when the stock was being overfished no longer appears to be appropriate; this resulted in the author's recommendation to set a single GOA-wide OFL, if it is useful for management. There was no consensus by the GOA Plan Team for such a recommendation to the Council. A new management approach could result in a single OFL and multiple area ABCs.
- Available data makes it difficult to determine if recruitment events are synchronized across areas. Geneticists suggest that a stock can be fished hard in an area and the genetic diversity would not be much reduced, but productivity might be affected. And while some areas recover, others stay flat.

Paul Spencer presented a case study of implications of spatial management on the BSAI blackspotted /rougheye rockfishes complex. This species complex was one of the cases that motivated the formation of the Stock Structure Working Group, and the stock structure template was applied to this complex in 2010. Information on species composition of a complex by area can indicate whether productivity might differ across areas. For example, if the productivity differs between species, and separate areas have different proportions of the high or low productivity species, then the productivity would be expected to differ across areas. For BSAI blackspotted/rougheye rockfish the species composition does differ within the BSAI area, as several genetic and morphometric analyses document the scarcity of rougheye rockfish west of the eastern Aleutian Islands (AI). A relatively high proportion of the catch (~40%) but a low proportion of survey biomass (~10%) occurs in the WAI, which results in high exploitation rates for this area. Differences in growth curves occur between the EBS and AI; however, differences in size at age are not observed for all ages. Significant differences occur in both age and size compositions between the EBS and AI subareas based upon survey data from 2002 to 2008. Genetic information includes 1) significant isolation by distance relationship; 2) estimates of dispersal distances do not exceed 500 km; and 3) significant differences between geographically distinct collections.

Current spatial management of catch limits are: 1) OFL is BSAI-wide; 2) ABC is 1) Western and Central AI and 2) Eastern AI and EBS. There no SSL measures or area closures. The timing of fishery catch is 1) POP is open year-round, although POP harvesting in the western Aleutians now occurs only in summer; 2) blackspotted/rougheye rockfish is on bycatch year-round.

He raised the following discussion questions to address which potential regulatory or voluntary management could be applied.

1) Subarea ABCs that separate areas with high and low exploitation rates would bring the issue of bycatch to the attention of the industry. What are the impediments of doing this?
2) Are there other ways to bring the issue of bycatch to the attention of the industry?
3) Could subarea catches be "rolled over" between years so that the catch within a multi-year period the catch did not exceed the targets?

TALK 8 Jane DiCosimo summarized the management issues surrounding the proposed BSAI Pacific cod split into BS and AI area management. The SSC has noticed the Council and the public that it intends to set separate ACLs for the BS and AI cod populations. She summarized status quo management of BSAI Pacific cod. 1) the stock is managed for the entire BSAI management area under single OFL/ABC; 2) the SSC recommendation to manage as separate EBS and AI stocks beginning in 2014 predated stock structure template, so none was completed; 3) age data are not available for the AI, and no AI model has been accepted yet, so no definitive information is available regarding growth rate or age structure differences; 4) observer data and survey data show a larger proportion of large (e.g., >100 cm) fish in the AI than in the BS; 5) there is comprehensive evidence for genetic distinctiveness and lack of gene flow between the BS and AI; and 6) "hot spot" spawning locations occur throughout the EBS and AI.

Along with the OFL, ABC, and TAC specified area-wide (BSAI), there are numerous Steller sea lion protection measures that affect fisheries for Pacific cod, including management subarea closures (e.g., Area 543) in the BS and AI subareas.

Ms. DiCosimo raised the following issues to address which potential regulatory or voluntary management could be applied 1) identification of stock structure has led the SSC to indicate its intent to set separate OFLs and ABCs for EBS and AI management areas for 2014 and 2) in April 2013 the Council requested a paper to explore regionalized delivery requirement to shore plants in the catcher vessel sector in the AI (Area 541/542) (i.e., Adak and Atka), in preparation for separate ABCs in the BS and AI.

TALK 9 Ingrid Spies summarized her work with Dr. Andre Punt on a management strategy evaluation on spatial management and genetics. She contrasted three management scenarios for managing fish stocks when population structure is present. A two-population model was parameterized for Pacific cod in the BSAI. An isolation-by-distance model was parameterized for blackspotted rockfish in the BSAI:

1) "Combined" - One management unit, one TAC;

2) "Separated" – If a "genetic test" determines that populations are statistically different, then manage separately. Otherwise manage together as "combined;" and

3) "Combined then separated" – populations were managed as "combined" in the past, but a genetics test was done halfway through the simulation. If the test determines that the stocks are distinct, then manage "separately". Otherwise continue to manage "combined".

Conclusions (for 2 population cases parameterized for Pacific cod):

a. When distinct populations or isolation-by-distance exit(s) within a management area, biomass in some populations/spatial areas may decline below target levels depending on relative fishing effort.
b. Management units based on genetic tests result in biomass above target levels (in general).

c. Declines in genetic diversity and age at reproduction are smaller when biomass remains above target levels.
d. Genetic diversity recovers more slowly than biomass; effective size of 5000 considered a threshold.
e. Separated (area) management resulted in 10% higher average annual catch.

Conclusions (for isolation-by-distance case – Blackspotted rockfish):

> Where you draw the line is important; if you create two management units but the line between them is in an area of low fishing pressure, it does little to take the fishing pressure off the region in which higher fishing pressure is taking place.

This presentation triggered a wide ranging discussion (see following bullets).

- There are trade-offs in the MSE analyses compared with management scenarios because it is based on directed fishing for bycatch species without consideration of directed fishery yield.
- Under the scenario of distinct BS and AI cod populations, Pacific cod has low dispersal during spawning.
- NMFS would prohibit directed fishing (by time, area, species) for Pacific ocean perch if the incidental catch of blackspotted/rougheye rockfish in the POP directed fishery approached the specified blackspotted/ rougheye rockfish OFL.
- If the assumptions regarding the sensitivity of the MSE to recruitment variation are flawed then the utility of the results are questionable however recruitment variation is included in the MSE in the same way as in the assessment, and applied to the entire area. If the assumption about a single stock over the same geographic area is questioned, it would result in more variability. Further the MSE is cumulative over a hundred simulations of the same model and accounts for numerous parameters, including the age of the spawning stock and recruitment variability.
- An inbreeding threshold is a measure of how many genes are left in the populations. Absolute numbers to determine an effective size of 5,000 translates into millions of fish. This measure pertains to keeping enough genetic variation so that when environmental conditions change, the populations remain resilient. A really low ratio of 1/2500 occurs in the simulations for Pacific cod when there is a lot of recruitment variability. The data is not split between males and females in the MSE but sex specific responses could be added.
- The accuracy of some of the assumptions incorporated into the MSE simulations should be checked with the industry and managers.
- Fishing down a weaker stock may occur when separate populations (i.e., multiple species or stocks) are managed as a group however no work has been done to incorporate depensation (i.e., population reduced to a low level will have a slower rate of recovery due to fewer fish contributing to the recovery) into the MSE. There has been evidence of depensation with Atlantic cod, but not with Pacific cod. It cost $30,000 to develop the Pacific cod MSE.

Morning Summary

There was a short, general discussion of the risks associated with having an undefined management policy for area management, and questions posed by assessment authors and plan team members regarding risk assessments versus management policy. A specific question as to where do the Plan Teams and authors fit in the management process was posed.

John Henderschedt summarized the morning session. He observed that the case studies identified that are both shared challenges and unique challenges for various groundfish and shellfish stocks. The case studies also identified management and biological risks of area wide v subarea management. And the risks were myriad: biological, economic, long term v short term. The Council has available a variety of management tools to mitigate these risks. And the mission for this group to discuss during the work shop and ultimately for the Council to implement is to find an acceptable balance of where the issues of science and policy meet and how to develop the best ways to develop risk policies for setting harvest specifications.

The following summarizes issues noted during the case study presentations.

- Risk of inconsistent advice and decision making for groundfish area management between BSAI and GOA
- Risk to yield curve of not adopting spatial management
- Risk assessment vs risk management
- Where do assessment scientists and the Plan Teams fit into this process?
- Area-wide ABC vs allowing occasional exceeding of smaller subarea ABCs
- Is the hammer defining the nail? The Plan Team or SSC may identify an issue best addressed by the Council when setting the TAC, but the status quo tends to exclude that tool from its toolbox.

The following questions were posed as a result of the case studies *as recommendations for the Council to consider for follow-up in a future venue*.

- What are the common challenges that are faced throughout these case studies?
- What risks are represented in each of these case studies?
- What management tools are available to manage those risks?
- Where do issues of science and policy meet in these case studies?

AFTERNOON SESSION

Mr. Tweit and Mr. Henderschedt facilitated the afternoon session with on-site and web-based participants. The afternoon was spent reflecting on what was learned in the morning session, followed by identifying existing strengths of the current process for spatial management of groundfish and shellfish and remaining challenges for improvement of the status quo. Participants were asked to develop some ideas for future engagement on the issues of spatial management, and by developing more detail in the form of who, what, where (in the process) and when proposed changes might occur?

Mr. Tweit began the discussion from the Council's perspective. He noted four different zones of risk relative to the general yield curve of fish stocks.

1. Rare species risk. In managing a multi-stock fishery, the Council may overlook protection of a rare stock if it is not explicitly recognized as a separate stock. Rare stocks are typically at the left end of the yield curve, and likely have a low persistence probability as well as yield potential. There is a policy balance between providing additional protection for a stock at the end of its range (because its presence is precarious) or not providing additional protection because its presence there is conditional on varied environmental factors.
2. Robustness/adaptation risk: Stocks that are on the lower end of the yield curve, but have higher persistence probabilities are still subject to definition of overfished if they are recognized as a separate stock. If they are not categorized as a separate stock, there is an elevated risk that the effects of fisheries can be loss of genetic diversity, spatial distribution or life history diversity, particularly due to climate change effects on their environment.
3. Risk to species complexes that have a significant role in the ecosystem (i.e., keystone species). If a stock is managed as part of a complex, even though it has a different importance or role in the ecosystem, the primary risk is in terms of lost ecosystem robustness and diversity.
4. Short or long term yield risk, but failure to recognize stock structure/spatial diversity would not result in persistent or robustness or even ecosystem risks.

A number of views about how North Pacific stocks fit into the above hierarchy were posed: 1) perhaps only snow crab fit the hierarchy; and 2) most stocks are in categories 2-4. There could be a continuum of risks that bring in different inputs.

Mr. Henderschedt posed a number of questions or propositions throughout the afternoon to spur discussion.

- There may be sufficient precaution in the current management process and the current discussion may be confusing risk assessment (scientists: authors, plan teams, SSC) and risk management (managers: Advisory Panel, Council). While the current process adequately addresses risk assessment, the struggle remains with defining the Council's policy of risk management. The Groundfish Plan Teams try to be consistent (at least within a team), but the Council does not have a cohesive policy for the teams to follow. If so desired, the Council should articulate more options than just splitting the OFLs and ABCs by area as a management response.
- More than one decision matrix may be needed for Council determination of its policy towards spatial management (i.e., one size may not fit all). The compressed timeline in which the NPFMC annual harvest specification process currently operates necessitates quick decisions based on policy standards. It may be unreasonable to assume that there is sufficient information each time a risk assessment recommendation is provided to the Council during the annual harvest specification two-meeting cycle, and may require more than one cycle to resolve risk management solutions. The Council could adopt a default policy if sufficient biological information existed, in the absence of economic information.
- The absence of stock structure does not mean that other spatial management considerations may not be needed. The template was established to examine status quo management and to determine if a management emergency existed. It helps determine a common currency for comparing management of different stocks. Then the policy makers (i.e., the Council) would determine a risk management response.
- The Council's perspective is that conservation of the resources is paramount. The Council's record is to uphold conservation-based policies (e.g., groundfish optimal yield) even when faced with increasing biomasses. While the Council's threshold could be lower if conservation concerns were clear; more stocks could be highlighted for risk, with a Plan team request to the SSC/Council seeking additional management direction. The feedback loop between scientists and the Council should be earlier in the annual harvest specification process.

The following points were made in an open discussion.

- Population features that could be characterized for risk include: yield, age-structure, sex-ratio, and genetic diversity. Some stocks are at the end of their northern geographic distributions; where genetics and directional response of stocks is important (e.g., ocean warming). Fringe populations may be, or become, imperiled. An extirpation policy, such as the Canadian wild stock salmon policy, has not been addressed.

- Four steps were identified in the current NPFMC process for setting annual harvest specifications:

    1. Stock structure assessment (template) – process in place, additional Council guidance is welcome; action by authors, review by PTs and SSC. Off cycle review time – Feb meeting?

        a. Scheduling and prioritization

        b. Access to and transparency

    2. Assessment of biological consequences (persistence, diversity, ecosystem function, productivity, genetic diversity) during PT and SSC reviews, stakeholder input, report to Council

        a. how to quantify the potential risk? PTs don't understand the operational costs of splitting/weakness of current process

b. potential management tools

3. Fishery assessment of risk (cost) stakeholder input to NMFS and Council,
    a. are we willing to take more risk on non-target stock v target stock; if we are reaching OY of target stocks then there will be acceptable higher risk of non-targets.
    b. potential management tools
4. Assess management difficulty (small boxes)
5. Policy decision and directive
    - The assumption under #3 (immediately above) that non-target species occur at low bycatch levels, and that if they are not being targeted then they are not income generators, was questioned. The stock structure template was designed to perform the first scientific assessment (#1 in the above list); the decision to set subarea harvest specifications for Pacific cod preceded the development of the template.
    - There is more to determining stock structure than application of the template. The determination of stock structure may be a balance between #2 and #3 (immediately above).

- Risk analysis involves the following steps.
    1. List management options.
    2. List potential outcomes of each.
    3. Assess the problems that each would occur conditional to the management action.
    4. Choose the management action with the lowest expected cost.
- The solution likely requires the Council to set a policy, one based on imperfect knowledge and imperfect expectation of uncertainty.
- Target v non-target species issues may have different scales of relative risk.
- An evaluation of the economic consequences of spatial management cannot be quantified, although the Council routinely assesses those consequences qualitatively through a transparent public process when setting catch limits each year. Transparency could be enhanced under a policy or guidelines for the scientific advisors (i.e., assessment authors, plan teams, SSC). Caution was expressed should economic considerations, in any way, attempt to balance scientific risk. However, not all scientific concerns are significant. An evaluation of risk specifically should address a time frame for recovery of productivity of the stock at issue.

Several unanswered policy questions were posed for future consideration:

- Is there risk to a stock's productivity associated with inconsistent policy within and across stocks/complexes/FMP areas? Where do assessment scientists and plan teams fit into that process?
- What are the shared challenges across fisheries and what are the specific challenges for a given stock?
- What are the risks associated of not adopting spatial management in cases where the need for some type of additional management consideration is otherwise indicated?
- What are the biological, economic, time frames for risk?
- What tools (other than spatial management (i.e., subarea OFLs or ABCs)) are available to mitigate those risks?
- Where do issues of science and policy meet? How do we develop these policies?

- What should be the Council process for 1) scientific assessment of risk, 2) estimation of fishery costs, and 3) management action?

WRAP-UP

Farron Wallace provided a brief wrap-up of the workshop discussion. He noted an overriding interest to create a better feedback loop between the Council and its scientific advisors and to increase the transparency of the process of adopting spatial management of stocks. There was general support that the process used by the Council in determining spatial management should be guided by scientific assessment of the risk, followed by estimation of fishery costs, in developing its policy.

Jane DiCosimo added that the Council should provide additional guidance to each of the advisory bodies to clarify their respective roles in the determination of spatial management in the annual harvest specification process, and whether the teams (and SSC) would be charged with assisting in the development of other management measures.

Mr. Henderschedt recommended that the workshop proceedings first be provided to each of the plan teams at their next meetings for consideration and comment. Then the SSC would review the workshop proceedings and the plan team comments and report to the Council in October 2013. The Council seeks feedback from the teams on this proposed process (e.g., whether each agrees/disagrees) and welcomes additional details or modifications to enhance this process going forward. The Council welcomes additional feedback from stakeholders, as well as from its advisory bodies, during its next meetings.

PARTICIPANTS

(7) Council members: John Henderschedt, Bill Tweit, Duncan Fields, Ed Dersham, Dan Hull, Craig Cross, Nicole Kimball.

(8) SSC members: Anne Hollowed, Pat Livingston, Farron Wallace, George Hunt, Franz Mueter, Bob Clark, Alison Dauble, Steve Martell.

(7) BSAI GPT: Grant Thompson, Mike Sigler, Jane DiCosimo, Dana Hanselman, Dave Barnard, Kerim Aydin, Mary Furuness

(7) GOA GPT: Diana Stram, Jim Ianelli, Sandra Lowe, Paul Spencer, Chris Lunsford, Ian Stewart, Mark Stichert

(4) Crab PT: Diana Stram, Jack Turnock, Karla Bush, Jason Gasper

(2) Scallop PT: Diana Stram, Quinn Smith

(5) AP: Anne Vanderhoeven, Ruth Christiansen, Neil Rodriguez, Ernie Weiss, Joel Peterson

(10): In-person other staff/scientists: Ingrid Spies, Dave Fluharty, Tom Wilderbuer, Martin Dorn, Matt Baker, Susanne McDemott, Athol Whitten, Linsey Arnold, Steve Barbeaux, Chris Oliver

(10) In-person public: Merrick Burden, John Gauvin, Jason Anderson, Ed Richardson, Amanda Stern-Pirlot, Matt Upton, Brent Paine, Donna Parker, Chad See, George Hall

Total webex attendance (which includes participants listed above for Council committees): Allison Dauble, Bob Clark, Bruce Leaman, Dan Hull, Dana Hanselman, Joel Peterson, Kenneth Tippett, Kerim Aydin, Mark Stichert, Quinn Smith, Steve Martell, Mike Sigler, Phil Rigby, Pete Hulsman, Chris Lunsford, Neil Rodriguez, Jason Gasper, Karla Bush, Nicole Kimball, Ernie Weiss, Beth Concepcion, Donna Parker, Dave Barnard, Franz Mueter, Kati Capozzi, Brettny Hardy, Jon Warrenchuk, 3 unidentified others.