PLEASE ADD ANY TOPIC YOU WANT TO DISCUSS

PLEASE ALSO INDICATE ANY TOPIC ALREADY LISTED YOU HAVE INTEREST IN

Stock Assessment Topics List

* **What are the parts of a stock assessment document? (03/22-05/22)**
  + **Executive summary**
  + **Understanding Kobe plots**
* **How do we determine what a stock is? (11/5/21; 12/3/21)**
  + What types of studies are preferred to address this, and how many studies are needed to confirm
* **Stock prioritization (6/22)**
* How does a stock assessment work?
* Understanding stock assessment inputs
  + Temporal and spatial differences between (ex. what temporal scale is needed/desired for each input, e.g. do we need to estimate maturity every year?)
  + **Life-history values (7/22)**
    - **Natural mortality**
    - **Growth**
    - **Reproduction**
  + **Data types (7/22)**
    - Catches/removals
    - Biological data
      * Lengths
      * Ages (+ aging error)
    - Indices of Abundance
      * Surveys (fishery-independent)
      * Fishery-dependent CPUE
        + How index standardization (e.g., data from only a subset of months) can still provide valuable information.
    - Other Research Collection
      * + Things addressed that don’t fit these data, movement, diet etc.
    - Given the growing importance of incorporating climate impacts, are there ways in which environmental/climate data can be incorporated into stock assessments (especially for long-term output projections)?
    - What do the different data types tell us in a stock assessment
      * Where do the signals in an assessment come from?
      * How do we know good from bad data?
      * Representative data
      * The role of catch versus composition data
      * Data that is not used directly in the model but to inform the assessment outside, why and how is that choice made?
  + Data collection and processing (PacFIN/RecFIN/state agencies)
    - Can we collect data more efficiently and in a better way? Standardization?
    - Guidance for Port sampling objectives in space and time across species especially sample sizes that are adequate or maybe just a little more than adequate
      * How many samples per gear type/area/quarter are adequate for an individual species?
      * How are species composition samples (from catch) and logbook data used in the stock assessments?
      * How many age vs length (no ages collected) samples should be collected per species?
      * Sex determination - important or not? What sample sizes are need.
      * How do you account for the uncertainty when 20 fish are sampled to represent 200-20,000+ lbs of landed fish? Do you account for the proportion of sampled to landed pounds?
      * How to sample the live-fish fishery
  + Data formats and associated documentation requested for data inputs
    - Fully processed data vs raw data with code
    - Complete published report vs in house report
* **What is selectivity (9/22)**
* **Different types of stock assessments (10/22)**
  + **Data poor vs Data-moderate vs data rich**
* **How do we determine management objectives? (11/22)**
  + What are reference points and control rules?
* Is B0 re-evaluated and/or updated each time a stock is assessed (e.g., current B0 may not be the same as B0 in the 1960’s due to ocean/climate conditions or distribution shift)?
  + Do any stock assessments internally account for a shifting baseline B0 driven by environmental/non-fishery factors? Something I think the hake MSE is currently trying to evaluate.
* How fleet structure decisions are made. Why/how stock assessments often present a simplified fishery structure and the trade-offs between lumping versus splitting in stock assessment.
* **How do we interpret stock assessments? (1/22,2/22)**
  + **How do we interpret uncertainty in an assessment? For example, this from the 2021 spiny dogfish assessment: The Sigma value associated with the 2021 OFL (calculated from the normal approximation and converted to the log-standard deviation of a lognormal distribution) is 0.19, well below the minimum 1.0 value associated with Category 2, the most likely classification for this assessment.**
  + Understanding SS outputs/r4ss plots
* **How do we determine uncertainty? (1/22)**
  + Likelihood profiles
  + **Sensitivity analysis (1/22)**
  + **States of Nature and Decision tables (5/22)**
  + Ensemble modelling
* How do we determine catch limits?
  + Where do OFLs come from?
    - 40-10 control rule
    - **P\*, Buffers (11/22)**
    - **Sigma (1/22)**
  + Where do ABCs come from?
  + Where do ACLs come from?
  + How do these work in a stock complex?
* **How do we read a stock assessment report? (3/22-5/22)**
* Why don’t stock assessments match what we see on the water?
* Data weighting
* Model selection
* Connection to BSIA mandate
* Do stock assessments account for anticipated (or current) changing ocean conditions? I think the answer is “some” - would love to use one as an example to explore how. Is it possible to do so in more assessments, and what data would be needed?
* How can fishers help collect data?
* Cross-jurisdictional stock assessments (e.g. US + Canada +\_ Mexico)

NOTES

# 11/5/21- What is a stock?

What is a stock?

* **It has a unique attribute**
* Spatial component
  + Political boundaries
    - Exploitation history.
      * Fleets are different/selectivities
      * History of removals are different
      * Management could create demographic units
  + Life history
    - * Size at age/growth
      * Reproductive biology/timing
      * Natural mortality
      * Dispersal/Movement patterns
* Genetic component
  + Evolutionary scale
  + Ecological scale: If there is no genetic difference, doesn’t mean there isn’t a meaningful ecological difference
  + Demographic connectivity- if one area is depleted, could it be recolonized
  + Adaptive qualities
* A forced stock complex (e.g., vermilion/sunset)
* Management considerations
  + May choose to combine stocks into a different management unit
* Data availability
* Biogeography/habitat
* EEZ/state waters

NEXT UP:

The difference between management and stock units?

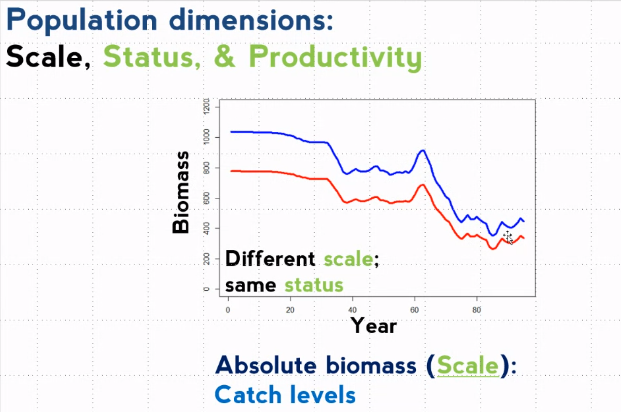
# 12/3/21- Stock structure

Management versus assessment scale?

* If assessment areas are combined for status determination on the management level (e.g., vermilion Oregon and Washington models combined in 2021), how do we ensure that effort by area is consistent with the biomass within each area?
  + Assessment authors rely on sensitivity analyses to explore uncertainty within an assessment. Ideally, we would like to explore sensitivities that examine questions like “what if areas are assessed as one area?“ Unfortunately, the data processing workload to create the data to conform to these alternative model structures is extremely high, preventing these types of analyses to date.
* Combing results post assessment:
  + John Budrick: Combine areas at the end range of a stock (e.g., Washington for vermilion rockfish) where there are limited data.
    - Corey Niles: The range of vermilion rockfish extends all the way into Alaska
  + Greg: Ideally, the decision of how to post-assessment treat the assessment results (combine or keep separate) should be decided prior to seeing the results.
    - This should be something that is discussed at the pre-assessment data workshop
  + Diane Pleschner-Steele: Need to do something to account for "southern" stock sardines in California. Assessments now subtract any sardines found in water temp. above 16.7 deg. C from the biomass estimates, but management considers ALL sardines caught in US waters as "northern" sardines, which have been declared overfished. So fishermen in CA, esp. S.CA., are now penalized -- catch limits and incidental catch allowances are sharply reduced regardless of water temp. because the Council manages only the "northern" stock
  + Gretchen Hanshew - NOAA Federal: I think of it this way: The Council prioritizes stock assessments, they get species assessments, and then, without standardized procedures, are left stuck trying to figure out how to make a policy decision to describe a stock in a way that is based on BISA.
  + Maggie Sommer: Good to discuss area(s) at pre-assessment workshop, and OK if changes occur later during assessment data exploration and modeling. Key would be that a science-based recommendation on pooling for status determination (and/or other purposes) is made at the same time assessment results are presented, to avoid the perception that a decision on pooling is driven by the assessment results (i.e., one area overfished, so let's lump with another area so that it's status is "better").
  + Greg: Need to go into the pre-assessment meeting with a standard hierarchical structure to assist in making these decisions around the assessment area versus the management area.
  + Jason: There is no right answer to this question but we as a group need to find a consensus at how to handle these issues now which can be revised and refined in the future.
  + Corey Niles: We are managing stocks on a shorter time-scale compared to evolutionary time (~1,000s of years) where genetic differences would like to be detected. We should consider these shorter timelines that can create fundamental changes in populations by area.
  + John Budrick: More sensitive genetic markers may be able to give better ecological considerations for stock structure. Getting ahead on the stock prioritization may leave an opportunity to talk more about stock structure.

# 1/7/22 - Uncertainty

Where does uncertainty within a stock assessment come from and the incorporation of this uncertainty into management?

* Two sources of uncertainty: 1) Measurement Error and 2) Process Error
  + Measurement Error: length measurement, ageing, catch histories, indices of abundance, or potentially lack of observations entirely
  + Process Error: Naturally occurring variability (e.g., size-of-fish at age, annual recruitment). With process error even if we measure everything perfectly, we would still have natural variability.
* Bias vs. Precision
  + Bias - Getting an estimate wrong in a specific direction (e.g., estimating a lower value than the true population value).
  + Precision - How variable is the estimate?
* Maggie Sommer: Addressing uncertainty that arises from data gaps. How could losing data impact the uncertainty of estimates?
  + The loss of data will have different impacts on assessment estimates depending upon the robustness of other available data sets and the uncertainty around specific parameters.
  + Rebuilding conundrum: If fishery removals are strongly limited due to rebuilding restrictions, this results in a loss of data, challenging the ability to monitor changes in the stock during rebuilding.
    - Corey N.: On the point about losing data/feedback, it's not just with rebuilding. We're seeing that with the nearshore stocks and our recreational fishery. Maggie just said it...
  + If the fishery is changing relative to the past, the impact of losing recent data would be larger relative to stable unchanging fishery.
* Greg K.: Natural mortality when estimated often appears to be a large source of uncertainty with an assessment model.
  + Sensitivity analysis within assessments is one way to understand the impact of specific parameter assumptions or treatment within a model.
  + Decision tables are another way assessments present the potential implication of management actions if the reference model was not the “true” state of the population.
* Lynn M: How much data is needed to fill in existing data gaps (i.e., growth estimates)?
  + It depends on the life history, the variability of growth within a species, and how easy it is to get samples across ages and sizes. Also, the amount of data needed depends upon the objectives? Are you collecting data to create a growth curve or are you collecting data to estimate fishery selectivity?
* Merit McCrea: What if most of the data are fishery data? Lack of survey observations to account for segments of the population that the fishery may not be exploiting.
  + In these situations we rely on the fishery data to be fully representative of the whole population which may or may not be true. If the data are unrepresentative of the whole population but you are treating it as if it is a representation of the full population you are going to get a biased answer. One recommendation to deal with this would be to develop additional survey tools to provide a fuller picture of the population.
    - Gerry Richter: Critical need for ROV data especially for these nearshore stocks in closed areas. Seems like we're trying to get there but various issues are slowing down the process (covid, funding, etc)
    - Greg K.: One of the bigger issues with assessments that rely entirely on fishery data may be able to capture trends but could be biased in the scale of the population.
  + Where is this type of uncertainty entering into the assessment results? Across stock assessments you will often notice there is higher uncertainty around the size of the stock relative to the estimates of relative stock status. A good example of this would be the 2015 kelp greenling assessment that had very good information showing the population was well above the management target (40%) but the assessment was highly uncertain about the scale of the stock which made selecting an appropriate OFL challenging. 
  + Owen Hamel: Note that the increase in OFL with scale may not be directly related to the scale given the complexity of relative productivity of the stocks under the alternative model assumptions and or estimates.
* Sigma
  + Sigma values are typically based on stock assessment categories (category 1, 2, or 3) where sigma is considered a representation of the uncertainty around stock size at the end of the model. Often due to needing to fix parameters within an assessment the uncertainty within the assessment may be biased low relative to our true uncertainty around stock status. In these instances we default to a category specific sigma value to account for population uncertainty when determining buffer values. Additionally, uncertainty in our estimates of stock size increases the further out from the assessment year we are. This is accounted for in time-varying sigma values that increase over time representing our increased uncertainty around stock size.
  + James Phillips: Out of curiosity are there plans for any future work or revisiting sigma?
    - Corey Niles: Time is short, and along the lines of what James asks, from the Council seat we have asked a couple of times now about what can be done to better evaluate sigma for category 2 and 3 stocks.
    - Owen: There is less information on category 2 and 3 stocks to inform estimation of a category specific default sigma value. However, there have been discussions on how we could improve the default sigma values for category 2 and 3 stocks using life history attributes.

# 2/4/2022 - Uncertainty (cont.)

* Gretchen Hanshew -
  + The issue at hand is that within the FMP we do not define the areas that status will be determined.
  + NMFS headquarters gave the guidance that they are unable to accept the status determinations for all 2021 stock assessments since the area for status determination is not within the FMP. This does not impact assessment results from previous years. As example, the stock status for Dover sole was not accepted by NMFS since the FMP does not explicitly state that status is determined on a coastwide basis.
  + This question arose due to the results of the California quillback assessment which estimated that the stock in this area was below the management threshold (25 percent).
  + FMP are required to describe the stocks that are in need of management and conservation. There is a mismatch between stock identified in need of management and conservation within the FMP and the area stratifications from stock assessments (e.g., vermilion rockfish is in the FMP but there is no language about the areas to determine status, coastwide or by assessment areas?)
  + Tom & Mary Marking: Please clarify, does that mean the overfishing status of Copper/QB for 2021 has been set aside? and they are status quo at the 2020 determination?
    - The SSC recommended that copper rockfish in California status should be determined across the state with results in a coastwide stock status that would not be below the management target (not overfished). However, the SSC recommend that status of quillback rockfish within California should be accepted which could result in NMFS declaring the stock overfished and in need of rebuilding.
  + Stocks that range across the coast, does not mean that there is not state/area specific exploitation history, sampling variances, and/or biological differences. These are the type of things that area based assessments attempt to account for.
  + The WCR is working on potential avenues through the Council process to resolve this issue. If curious, please follow the Council meetings this spring and summer.
* Sigma and P\* - Did not get to discussion on this topic today.
* Maggie: How should someone reading a stock assessment understand the level of uncertainty in that assessment for stock size and status?
  + Example the Dover sole 2021 stock assessment
  + Stock assessments characterize uncertainty in two separate ways: 1) the uncertainty within the base (also called a reference) model and 2) uncertainty across alternative models (see decision tables).
  + Reference/base model uncertainty: this is called within model uncertainty. Example figure ii in the Dover sole assessment shows the mean spawning biomass estimate (solid line) and the model estimated uncertainty (dashed line) above and below the mean. This within model uncertainty is a combination of fixed (no uncertainty) and estimated parameters (uncertainty will be included). The more fixed parameters within a model, the lower within model uncertainty that will be shown in Figure ii. However, if parameters are fixed that does not mean we are not uncertain about those values.
  + Exploring alternative models with different assumptions around fixed model parameters is one way we attempt to understand the uncertainty across alternative models. These model runs that explore uncertainty around fixed parameters or model assumptions are shown via Sensitivity Analysis. The decision table often selects a single parameter or assumption that the analysts feel the model is most sensitive to (greatest impact to the model results that could impact management decisions).
  + STAR panel reports also provide useful information on what the scientific reviews identified as key sources of uncertainty or modeling (or data) challenges. In this report the STAR panel often identifies items that should be examined for the next assessment of this stock. This is a great place to see areas of research, data collection, or modeling suggestions that could improve the next assessment.
  + In the assessment documents there is a required section “Unresolved Problems and Major Uncertainties”. This is a great place to see what the assessors identified as key sources of uncertainty.
  + Corey Niles: Ultimately management decisions are based on the reference/base model. In contrast at the International Pacific Halibut Commission they have a suite of base models that are then combined (ensemble model) that then give recommendations to management. What do you think about this approach?
    - Owen: The SSC is interested in this approach; however, it is challenging for reporting to NMFS which expects a single set of answers, not multiple model results. These challenges can be overcome. Moving to this approach requires you to identify the appropriate suite of alternative models and what weight to give to each where weights reflect the probability that the model is the correct representation of the population. The alternative models and weights should be carefully considered because those decisions can impact the management advice.
    - Greg Krutzikowsy: Ensemble models are often used in other NOAA work, specifically weather forecasting, and if I recall correctly this was in part some of the rationale for examining its use in assessment models for fisheries. Not sure how much cross pollination has occurred?
      * True. There is a big difference in the amount of data available for climate models versus what we have for fish stocks which makes the challenge of assessing stocks larger relative to climate predictions.
  + If a model has a large number of fixed parameters, you should expect a long list of model sensitivities shown in the assessment report.
  + Merit McCrea: So despite appearances, it's likely we actually know a lot less about cowcod than dover, and this should be considered, the number of parameters fixed only because we lack the support of data and had to make a best guess.
    - Correct.

# March/4/2022-Understanding stock assessment documents

Would it be useful to chat about Stock definitions? Some of the different parameters that go into deciding them, biological, political boundaries? Species assemblages?

* **Terminology**
  + **Species** - Refers to the genus and species; the unit as it is included in the FMP off the U.S. West Coast [could be logically interpreted as coastwide].
  + **Stock** - a delineation of a species (or group of species) that is made at the discretion of the Council (e.g. a policy decision), based on BSIA and other relevant management needs; stocks should be defined in the FMP (i.e. subject to deliberative public process and Secretarial approval), per NS1 guidelines. This is the unit at which status determinations are made and OFLs should be set.
  + **Assessment unit** or **assessment model** - The area at which the assessment is conducted/modeled. Assessors often refer to this as **the “stock”**. The stock may be assessed across areas that only comprise segments of the coast or coastwide depending upon the species biology, data availability, exploitation history, etc.
  + **Management unit -** The range across the coast that management decisions are made. The management unit may align with the assessment unit, the stock, or be another breakdown by geography or sector or the assessment unit may be over a range less than the full management unit (e.g., two management units that separate the species north and south of the California/Oregon border but three assessment units: California, Oregon, and Washington) -
  + Sablefish is a great example - coastwide assessment unit and OFL, management unit is N and S of 36 because of long-standing sector allocation structures

**How to read and find information in an assessment document:**

* The 2021 assessment of Dover sole as an example:
* Executive summary:
  + Stock - defines the assessment area as defined by the stock assessment
  + Landings - a brief verbal description of the history of landings within the assessment area and the fleets defined within the model.
  + Data and assessment - description of the data used within the assessment model, how those data are worked up, and the general structure of the assessment model (e.g., fleets, time-period modeled)
  + Stock biomass and dynamics: estimate of spawning biomass and the fraction unfished with the uncertainty intervals.
    - Spawning output versus spawning biomass - Spawning output is commonly used when the number of eggs produced by size is not equal to the fish weight (often observed for rockfish stocks). Spawning biomass can equal spawning output if the number of eggs produced by size is equal to weight.
    - Whitney: Have assessments accounted for potential changes in unfished biomass over-time given changing ocean conditions?
      * This is often referred to as dynamic B0. This estimates the unfished biomass if fishing stopped. The level of B0 could theoretically change over time due to changes (positive or negative) ocean conditions. Alternatively, there is a term that is commonly heard called “shifting baseline”. Shifting baseline and dynamic B0 are not the same thing. Assessments in some regions do not go back to the start of fishing. In these types of situations it needs to be clear that the “initial population size” at the start of the model likely does not represent the unfished biomass size since the stock was likely already reduced to some extent. This can result in a shifting baseline
    - Greg?: Is there consideration of dynamics apart from B0. Groundfish uses this but others do not. For example CPS species dont rely on this value but on estimates from the survey.
      * B0 need not always be use. CPS is a great example because population dynamics are so variable. Other assessments use reference points other than B0 like BMSY. The concept we discussed early about the effects of changing dynamics also affects these, since if productivity is altered, it would affect the value of BMSY. There is work underway within NOAA to discuss how to define and deal with reference points that change over time.
    - Recruitment - Section describing the annual estimated recruitment and if annual recruitment deviations are estimated. Often the last few years in the model recruitment deviations may be equal to 0, no deviation in recruitment from the stock recruit relationship. This is because there are often limited observations of young fish at the end of a time period, so there is limited data to say whether incoming recruitment is above or below average.
      * Leif: Do they not estimate recruitment because the model cannot or is a choice of the assessor?
        + The answer is varied. In general its a process the assessor goes through. Length compositions and ages are sources of information about recruitment. Recruitment deviations generally capture process error in the model. High catches (assuming selectivity hasn’t changed) can also be interpreted as high recruitment, maybe correctly or incorrectly. The short of it is that there are a number of pieces of information that can support the choice to estimate recruitment deviations.
        + **Something to discuss more about at later time**
      * Merit McCrea: There are some sampling programs conducted by research institutions (USB, SMURFS?) that sample young-of-year recruitment for rockfish stocks. See a lot of hopkinsi (squarespot) Are these data incorporated into the assessments?
        + These data can be used within an assessment but it depends if the sampling area can be scaled to the assessment area (is the small area sampled representative of all areas?). Additionally, there are questions when mortality occurs during these young stages. If large mortality occurs after the young-of-the-year observations then large pulses of positive recruitments may not materialize in fish entering the fishery. Plus, the key periods of mortality could vary among species.
        + **Leif (chat): discussion of recruitment in larval settlement context versus recruitment to the fishery context would be useful (something more for later too)**

# April/1/2022 - Assessment Document - Executive Summary Walk-Through (cont’d from last session)

* **Exploitation Status:** Reports the estimates of fishing intensity, often in terms of 1-SPR. SPR stands for spawning potential ratio which is a measure of the reduced spawning potential under different fishing intensity levels.
  + How much fishing pressure a fish population can sustain depends on the biology (how productive is a stock) where more productive stocks can be fished harder sustainably relative to a more unproductive population.
* Merit McCrea: How do relative results from SPR, e.g. percentage of unfished, get translated into metric tons -- the back calculation to unfished spawning stock biomass from a benchmark population estimate at some point. It's coming up with this starting point benchmark that seems would be very challenging to estimate.
  + Spawning biomass and Spawning Potential Ratio are related but are not the same. Spawning biomass is the measure often in biomass (mt) of how many mature female fish are in the population.
  + How do we estimate the unfished spawning biomass size? If we know the unfished population size and we know how much catch has been removed from the population, then you can determine the current spawning biomass. The unfished spawning biomass is determined by the estimate of unfished recruitment and natural mortality. Estimating the unfished spawning biomass can be challenging to determine and often is estimated with uncertainty. This uncertainty around unfished spawning biomass translates to uncertainty around the relative stock size (e.g. depletion, fraction unfished). The fraction unfished across time is calculated as the spawning biomass by year divided by the unfished spawning biomass at the start of the time series.
  + Uncertainty around the unfished spawning biomass translates into uncertainty around the maximum catch at the target depletion (OFL) since the OFL is calculated relative to the unfished spawning biomass.
  + Merit: How do you determine where the initial unfished spawning biomass is? It seems there are a lot of assumptions to get there.
    - Within a stock assessment data and assumptions are both applied. The more data available for use in an assessment, the fewer assumptions may be needed (assumptions about natural mortality, growth) since important processes could be estimated based on the data. In contrast, in models with more limited data, estimates of unfished spawning biomass often relies more on assumptions combined with known historical catch removals (the unfished population will need to at least be of a certain size for all the known catches to be removed from the population).
    - Length and age compositions also can tell us about the length- and age-structure of the population which can provide additional information based on catches to understand annual recruitment sizes and the relative stock status (depletion).
    - Sometimes different pieces of data used in models may give different signals about the unfished population size, the current stock size, of biological parameters. This then leads to the question about what data should be the most informative which is an ongoing area of discussion and research.
  + Leif Rasmuson: This is independent of assumptions about the data? I.e. these are assumptions about the population/species.
    - The estimated unfished population size is based on data (catches, length compositions, indices) and assumptions (natural mortality, growth). In models with more data often more of these assumptions about biology may be estimated based on the available data.
  + Bob Dooley - We sometimes hear that the estimates of carrying capacity of single species may not be possible if both populations are high. This is often heard when talking about sardines and anchovies where one is high and one is at low stock size
    - Gregg k: This is not always true where there have been times (based on scale deposits) where both species have been observed to be high
    - The spirit of Bob’s question is a good one where single species do not live in a vacuum and there can be trade-offs between species in the ecosystem. One example is when MPAs are put in place the assumption is often that these areas will return to high biomass. However, what is sometimes observed is that a specific species will increase in biomass, particularly if it is a predator species (lingcod), the population of other species may decline within the MPA due to more predation from a predator species. The “natural mortality” parameter is a combination of death by senescence and mortality of predation and natural mortality if often a difficult parameter to estimate within a stock assessment.
    - When populations have been reduced below a specific threshold may be due to numerous factors: catches, low recruitment, increase in natural mortality. Oceanographic conditions appear to play an important role in recruitment success or failure. Rockfish are a good example where there are often specific years where we have observed large recruitment events (e.g. 1999, 2008) while many other years recruitment events are much smaller.
* Unfished recruitment (log(R0)) is closely related to unfished spawning biomass. If you look at the figure looking at the population levels across different levels of unfished recruitment (example Dover sole 2021 assessment, figure 156 and 157). Often if unfished recruitment is assumed to be higher, the estimate of fraction unfished will change based upon the associated stock size and the known catches. The larger affect on changes in unfished recruitment values will be in resulting OFL calculations because of changes in the scale of the population.
* Leif Rasmuson: When we see log(R0) in these figures does that refer to natural log or log 10?
  + It is actually natural log (e.g., ln(R0).
* Question of Jason to group: How do we officially measure that overfishing is occurring?
  + **Overfished is the current state of the whole population (e.g. is the fraction unfished below the management threshold).**
  + **Overfishing occurs when the OFL set by management is exceeded within a specific year.** Sometimes when a new assessment is conducted new estimates of unfished biomass and current stock status we can see in hindsight, given the current data and biological parameters, we were fishing too hard (SPR too high). This would not be defined as overfishing.
    - Given that how hard we fished change over time as assessments are redone, changes in the log(R0) parameter, which affects scale, can result in a change to whether overfishing would have occurred

Possible topic for next meeting: Kobe plots!!

# May/6/2022 - Kobe plots, Executive Summary (concluded)

Today’s Topic Suggestions:

* Assessing stocks that are in a complex (Louie Zimm)

June Topic Suggestion

* Stock assessment prioritization and how the Council selects stock for assessment

Executive Summary (continuing/finishing discussion from April)

* Kobe Plot (also sometimes called quad plot, phase plot)
* General background: If a stock is being exploited by fishery there would be some expected level of decline in the population. Fisheries management have pre-defined metrics of where a population should be maintained for approximate maximum yield called the “management target” (PFMC specifies this as 40 percent of unfished biomass for roundfish, elasmobranchs, and rockfish; and 25 percent for flatfish). Additionally, management has defined a threshold that there could be risk to the stock if the population was below called the “minimum stock size threshold” (PFMC species this as 25 percent of unfished for roundfish, elasmobranchs, and rockfish; and 12.5 percent for flatfish).
* In stock assessments fishing pressure is often shown in terms of fishing rate (e.g. 1-SPR) where if the fishing rate was greater than a certain point the population could be experiencing overfishing. Noting that the way NMFS tracks overfishing is based on exceeding the overfishing limit (OFL)
* Dover sole example from the 2021 assessment (Figure vii in the executive summary)
  + Plot show a time-series of fraction unfished along the x-axis with a time-series of fishing intensity along the y-axis
  + The reference point for the management target (25 percent for flatfish) is shown as a grey dashed vertical line.
  + The maximum fishing intensity (SPR) is shown as a horizontal dashed line
* These two categories divide the plot into four general areas
  + Bottom right - population above the management target and fishing intensity well below the target
  + Top right - population above the management target and fishing intensity above the management target
  + Top left - population is below the management target and fishing intensity above the management target (stock at risk of being declared overfished)
  + Bottom left - population is below the management target and fishing intensity below the management target (stock may be overfishing but rebuilding)

* Sablefish example from the 2021 assessment (Figure in the executive summary)
  + Start with unfished population and no fishing intensity. As fishing intensity builds, population gets fished down (with fluctuations). Nears a reference point on the x-axis after a while (green points), fishing intensity declines and with added recruitment event the population starts to increase. Eventually as fishing intensity increases near the y-axis reference point, the population starts to decline again and approaches the x-axis reference point and finishes. Uncertainty bounds for the last year are shown in gray.
* Quillback phase plot from the 2021 assessment (Figure 56) should have horizontal line (on y-axis) at 1-SPR value of 0.5. The plot shows a steady increase in fishing intensity driving population towards reference point. Fishing intensity is very high and declines into 2000s bringing population back a bit but still to the left of the management target.
  + Aspects of life history can contribute to amount of response of fish stock to increasing or decreasing fishing intensity.
  + Louie Zimm: increase in fishing intensity may correlate with increasing amount of live fish fishery, and movement off the shelf into nearshore areas
  + There are often differences in growth rates and maturity across the West coast and exploring uncertainty around these estimates is important as is obtaining localized information.
    - Merit notes varying values within literature
* Vermillion south phase plot (Figure vii in the executive summary) from the 2021 assessment
  + The trajectory of vermilion/sunset rockfish south of Point Conception moves across all four quadrants with the stock having a median estimate of the population above the management target, however, the model has a large amount of uncertainty around the current stock status (reflected by the grey ellipsoid around the final point)
* Dover sole surplus production figure (Figure viii)
  + Figure shows the change in surplus production across fraction unfished. Population dynamic theory, says that there is a fraction unfished that will result in the largest surplus production which is related to the stock productivity (e.g., steepness).

Decision Table

* The intent of the decision tables is to show the risk of “getting things wrong” depending upon alternative management decisions.
* Example Dover sole decision table.
  + Across the top columns there are three states of nature defined (i.e., alternative modeling assumptions). In Dover sole, the parameter that had the largest impact on the population was natural mortality (very common in groundfish stocks). The middle column represents the natural mortality assumed in the base model.
    - The left columns show the most pessimistic view of the population (e.g. what if the spawning biomass or fraction unfished was lower than estimated in the base model). The right columns show the most optimistic view of the population.
  + Across the four row sections in this table shows the potential changes to the spawning biomass and fraction unfished depending upon the alternative catch streams.
* Comment that for sablefish in 2021, the sablefish stock size was above the high states of nature from previous models. This can happen as the decision table bounds uncertainty and things can fall below or above.
  + We welcome comments on how to better convey the information within the decision tables in easy to understand ways.

On first Friday in June:

* Stock prioritization process
* Assessing stocks in a complex

# June/3/2022- Stock prioritization

Opening question: How long does it take to run a model?

* Depends on the model (more data and parameters takes longer). Typically ranges between a few minutes and up to an hour. If run without estimating variance (no hessian) then run time is much quicker.

Today’s topic suggestion:

* Stock prioritization process

Link to council briefing book (<https://www.pcouncil.org/june-2022-briefing-book/>) Agenda item F3 (excel sheet is F.3.Attachment 2, and documentation is in F.3.Attachment3

* Process is discussed in spring and decision are made at June council meeting
* 10 different factors used to prioritize stocks (each has a tab in the worksheet)
  + Commercial - revenue of catches across 5 year period
    - most revenue gets highest rank
  + Recreational - expert opinion on relative weight for desirability of fish compared to other fish in that state and multiplied by retained landings

Rec. Relative weights: Some questions about rankings within the group, specifically some surprise on where some species are relative to others. Likely need to be revisited

* + Tribal - similar to recreational in that expert opinion on subsistence scores for how important a species is relative to others.
  + Constituent demand - consideration of whether a species limits the ability to catch other species. Provides ability to differentiate by state

Scores can change. Would it be useful to identify section that could benefit from regular ‘review’ by the GAP or other body.

There are some relative weights within the prioritization process that are fixed. Robust conversations about these can be done but take time to address well.

* + Rebuilding - is the species needing to be rebuilt. Quillback is listed there although was not declared overfish.
  + Stock status - rated based on most recent fraction of unfished. If dont have fraction unfished, then vulnerability score (PSA) is used
    - Lower status gets higher ranking.
  + Fishing mortality - based on percent of OFL attainment with
    - higher percentages gets higher ranking
  + Ecosystem component - output from the Atlantis ecosystem model that categorizes bottom up or top-down contributions
  + New information - qualitative determination on whether new information exists compared to last assessment
  + Assessment frequency - prioritizes stocks that have not been assessed recently
  + Constituent demand - Recently added factor (in 2020) that considers the constraint on catches imposed by new SPECs
  + Data availability -
* Factor summary (F.3.Attachment 2 worksheet “Factor Summary”): Summarizes the above 10 factors into a top priority list (worksheet “Factor Summary”)
* Question: Why is our process of setting which species are assessed so different from how AFSC does it, which has a more fixed schedule?
  + Assessment process between our centers are different in terms of resources needed and resources available.
    - Many of our assessments are full assessments which take longer, whereas many at AFSC are what we would consider updates.
    - There are more people working on it at AFSC.
    - The review processes are different as well and ours require many resources to review too
* Question: Why is brown rockfish not chosen, despite it being ranked high?
  + Some concerns with data availability
* Also of note, that if a species is rated high it does not necessarily mean that we now how to address some of the challenges with assessing it. For example black rockfish female mortality remains a challenge.

# July/1/2022- Putting together a stock assessment

Initial walkthrough of putting together a stock assessment

* Talked through general data types
* Talked through general life history values
* Ran models that changed data weighting, recruitment and compared to model with no data weighting and rec dev estimates

# AUGUST 5/2022

Topic suggestions:

* Selectivity
* Discard function

# SEPTEMBER 2/2022- Selectivity

Continued walkthrough of assessment components

* Selectivity
  + Logistic selectivity compared to dome-shaped - logistic reflects catch of older/larger fish whereas dome-shaped reflects a refugia from catch for older/larger fish.
  + See effect of various selectivity shapes (a - fixed to maturity ogive, b - estimate selectivity (turns out to be logistic), c - fix dome shaped)
  + The shape of selectivity matters most for the main fisheries. If a fishery is removing only small amounts of fish relative to other fleets in the model, there will be very little impact of alternative selectivity shapes for this fleet since it is not the main source of removals.

Lesson 1: Can possibly get really different population estimates based on different selectivity choices

* Age-based selectivity - Selectivity being aged-based could occur due to various factors: gear, or if cohorts are moving together.
* SS3 can translate length-based selectivity to age based, which could be less than 1 based on the among of variability in age-length curve.
* Looking at model fits gives the user a sense of which selectivity choice is best fit by the data

Question: Under the assumption that selectivity is dome-shaped, the population size is much larger, and thus fishing does not bring down the population very much. How does this make sense.

-Dome shaped selectivity means there are larger fish that are not being caught (so they are living and reproducing). There needs to be higher biomass to meet the catch value now that a smaller range of the population is being caught.

-If fishing is really high, fish may not make it through to be large enough to escape selectivity (to reach sizes where selectivity is reduced due to the dome-shape)

Questions: The concept of big fish contributing more to the population is similar to the effect of bigger fish escaping fishing mortality due to dome-shaped selectivity. How is the effect of “big females matter more” accounted for?

-The often greater contributions of bigger females than smaller females is accounted for in fecundity

Question: Is there an empirical way to determine whether selectivity is dome-shaped or logistic?

-Plug: There is a [CAPAM workshop](http://www.capamresearch.org/sites/default/files/Draft_Agenda_CAPAM.pdf) on best practices and Rick Methot is giving a talk on selectivity.

-Its not so straightforward. A mix of good understanding of the stock behavior (e.g. big fish moving out of the fishery) is one way, as well as looking at model performance (e.g. fits to data), and consideration of risk profiles (e.g. if you assume dome but are wrong, then likely overestimating biomass, versus assuming logistic but are wrong, then likely underestimating biomass). Having alternative data collection (e.g. fishery independent surveys) could help inform whether big fish are there that aren’t being seen in by the fisheries

# OCTOBER 7, 2022 (Spooooky Stock Assessments)- Different types of stock assessments

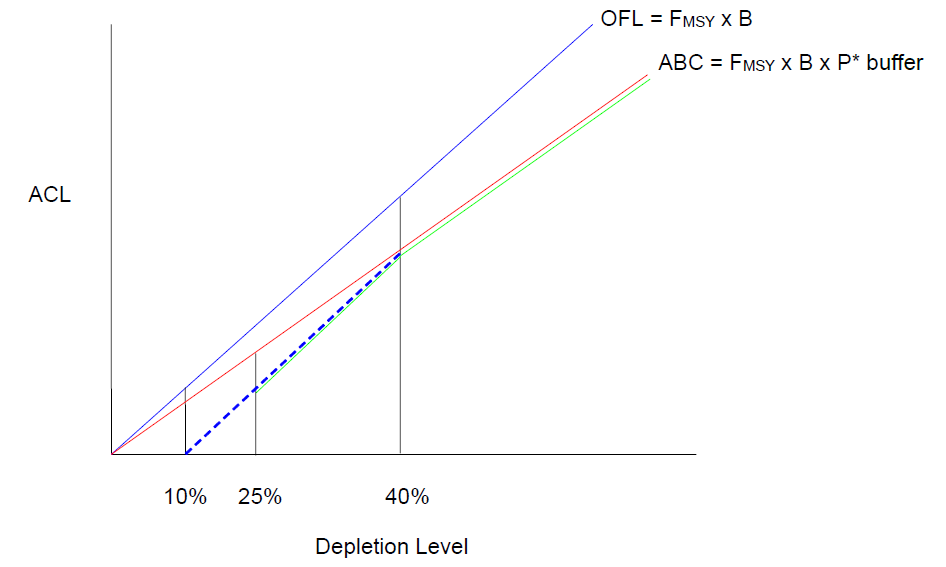
* General announcements:
  + Harvest limits from the 2021 stock assessments are expected to be published next week.
* MSA Reauthorization (Amendment) Update Inquiry
  + If the MSA is not amended then the MSA stands as adopted (Corey Niles).
  + [Related story](https://www.nationalfisherman.com/national-international/magnuson-stevens-reauthorization-steams-on-amid-partisan-shoals/?utm_source=marketo&utm_medium=email&utm_campaign=newsletter&utm_content=newsletter&mkt_tok=NzU2LUZXSi0wNjEAAAGHBdB6bqtiJ_tG-F1tEefr1Ba7_RJaTCJ5pYqxdOdMcVvcgE0F6gg-_a6m8yq1o8zKqN5ikl8lcwL3rviJGanrUG0L_NSe9-UUVIGM5r2YGOIipQ), [section-by-section summary](https://huffman.house.gov/imo/media/doc/Sustaining%20America%27s%20Fisheries%20for%20the%20Future_SxS_7.26.2021.pdf)
  + Climate and communities work is carrying over to other related initiatives with the current administration (Lynn Mattes)
* Questions about 2023 stock assessments: species, data, other items?
  + Copper rockfish is selected for a full assessment off of California. What are the potential differences between the 2021 data-moderate and a potential full assessment.
  + What are the general differences between a data-moderate and a full assessment (see also [TORs](https://www.pcouncil.org/documents/2022/06/terms-of-reference-for-the-methodology-review-process-for-groundfish-and-coastal-pelagic-species-for-2023-2024-june-2022.pdf/))?
    - Data that are generally used in a full assessment are: time-series of removals from all fishery sectors, indices (survey or fishery CPUE), length, and age data. For many species we may not have all types of potential data.
    - The SSC has defined 3 assessment categories: category 1 (data-rich more complex full assessment models), category 2 (data-moderate or less complex assessments with limited data), and category 3 (data-limited that do not estimate a stock status and only provide a catch limit).
    - In 2020 there was a choice to attempt data-moderate assessments for species that may not have all data types available to incorporate into an assessment or only limited data (e.g., limited age data). Conducting these data-moderate assessments, in theory, could be quicker than conducting a full category 1 assessment
    - John Field - In hindsight, it may have been more advantageous to have selected species with survey data that fell within the data-moderate ToR. Additionally, there is hope that as the use of the CCFRP survey in assessment becomes more frequent, that this could fall within the data-moderate ToR.
    - Melissa Monk - Working with industry to collect additional data that may be used in the 2023 assessment that could inform maturity and fecundity.
    - Leif - Is the application of data-moderate assessments to different species going to be revised in the future based on the 2021 experience?
      * Strategically, we could select the assessment type based on the data available by species that we think would be likely to be the most informative about stock status.
      * May not be strategic select vulnerable species for DM assessment because we want to use the most robust assessment possible for status determination.
    - Corey - When data-moderate assessments were first suggested for West Coast groundfish assessments (~2012ish) there was a flow chart that highlighted if a data-moderate assessment indicated a low stock size then a full assessment would be conducted on that species.
      * The catch-length data-moderate assessments for use in 2021 were endorsed for stock status determination by the SSC.
      * Corey - In theory, risk-based assessment, would predicate that we should look at species that are estimated to be at higher risk
      * Check out <https://www.youtube.com/watch?v=f9wQvw_vf0Y&list=PLL6tmlU3fRsm7eD4PzV6wdn3NBXKeci4f>

# NOVEMBER 4, 2022 (Gobble Gobble)

Requested topics for November:

* How do we determine management objectives?
* Is B0 re-evaluated and/or updated each time a stock is assessed (e.g., current B0 may not be the same as B0 in the 1960’s due to ocean/climate conditions or distribution shift)?
* Multi-area models or “fleets as areas models.”
* “Staleness penalty”
* What do different data tell the stock assessment.
* -Time-varying sigma
  + Scientific uncertainty (“sigma”) determines the sigma used in the P\* buffer. This is relevant to groundfishes and CPS stocks.
  + The “staleness penalty” adds to the scientific uncertainty based on a drifting away from the latest stock assessment. More years away from the latest assessment, more addition of uncertainty added to the sigma.
  + It is also important to consider the life history of an animal, where faster populations (e.g., sardine) may drift further over time than slower populations (e.g., rockfishes)
  + Wetzel and Hamel work was based on biomass (like Ralston et al); Privitera-Johnson and Punt based on OFL.
  + Wetzel and Hamel focused on groundfishes; needs to be extended to CPS. Not many species for the analysis, so may need to include non-PFMC species in the analysis.
  + Possible breakdown in the environmental based control rule for sardine
* Management objectives and reference points
  + - Gave overview of what management objectives are and how reference points are linked to management objectives
    - Showed the OFL equation to breakout where uncertainty comes from and what can be reconsidered for what reason’
      * If productivity changes, it may change both biomass estimates and the reference point (e.g, FMSY)
* Fleets-as-areas
  + Explained the differences and specifics between coastwide, coastwide with fleets as areas and separate stock assessments by areas.
  + This is very hard to do as a sensitivity given the data processing load, but is a desirable thing to do.

# December 2, 2022 - Ho Ho Harvest control rules



* [Harvest control rules](https://www.pcouncil.org/documents/2022/08/pacific-coast-groundfish-fishery-management-plan.pdf/) (page 42 of the Groundfish FMP, because everyone loves rules) - Starting with an initial example of the 40-10 rule
  + Harvest specifications have three components: OFL, ABC, and ACL with the harvest control rule dictating how the ABC and the ACL is determined. The order of these is OFL > ABC >= ACL
    - OFL - The overfishing limit (OFL) is determined based on the model estimated spawning biomass and a pre-specified harvest rate (often called Fmsy which is specified for groundfish based on a SPR harvest rate proxy, rockfish SPR = 0.50, flatfish SPR = 0.3, roundfish (e.g., sablefish) = 0.45)
      * SPR - spawning potential rate. Assessment models also estimate a SPR harvest rate, however, these estimates are considered to not be well estimated and the estimated values are closely linked to the assumed biology and can vary across subsequent assessments and across different species assessments).
      * Bill Clark’s research [publication](https://afspubs.onlinelibrary.wiley.com/doi/full/10.1577/1548-8675%282002%29022%3C0251%3AFRTYL%3E2.0.CO%3B2) that helped inform the selection of a SPR rate for rockfish.
      * Do not want to go over OFL because then we are over the MFMT (Maximum fishing mortality target) and we are overfishing (based on the stated OFL).
    - ABC - The acceptable biological catch (ABC) accounts for the amount of risk desired in being near the OFL
      * The ABC’s are determined by the SSC that define a sigma value based on the stock assessment category (category 1-3). The sigma combines with the Council selected P\* value (maximum value of 0.45 defined in the FMP) to determine the buffer which is the reduction between the OFL and the ABC.
        + Category 1 default sigma is 0.50, a sigma = 1.0 for category 2, and a sigma equal to 2.0 for category 3.
        + The sigmas increase during the 10 year projection (called time-varying sigma) period to account for additional uncertainty the further out we are from the last assessment.
    - ACL - The annual catch limit (ACL) - the default harvest control rule (40-10 for rockfish, roundfish, and elasmobranchs, 25-5 for flatfish) determines the maximum ACL value relative to the ABC and where the estimated stock status is in relation to the the target biomass (40 or 25%) and the cut-off point for fishing (10 or 5%).
      * If a population is well above the biomass target (e.g., Dover sole) the ACL based on the harvest control rule can exceed the single estimated maximum sustainable yield value in order to “fish down” the population to the biomass target. However, the ACL for Dover sole is currently set equal to a constant catch value below the ACL estimated from the 25-5 rule for flatfish.
      * The harvest control rule for flatfish stocks was updated around 2010 (ish) from a 40-10 rule to a 25-5 rule given that flatfish are considered to have a significantly different life-history with greater productivity compared to other groundfish species in the FMP.
      * The harvest control rule (40-10 or 25-5) adjusts the ACL downward from the ABC when the stock status is between the minimum stock size threshold (MSST) and the target biomass, called the precautionary zone. If a population is estimated to be below the MSST the stock is declared overfished and a rebuilding plan is implemented. It is important to note that under a formal rebuilding plan the ACL is determined in a distinctly different approach (typically constant SPR harvest rate) compared to the default harvest control rule.
  + When the various terms and values are utilized vary:
    - Things set before assessment
      * Fmsy - historically defined for us to use
      * Maximum P\* of 0.45 was defined in past
      * ACL control rule
    - Things from stock assessment
      * B, uncertainty around B
    - The SSC selects the sigma
    - Things selected by the Council
      * P\* value
  + Where is precaution coming in in this process
    - P\* - activation precaution from sigma and accounting for a level of uncertainty
    - Uncertainty can come in during modeling with ensemble modeling (but this is not yet being done)
    - ACL control rule - addition precaution when stocks are depleted
  + Another useful schematic (below) on OFL, ABC, and ACL can be found on [NMFS’s website](https://www.fisheries.noaa.gov/southeast/sustainable-fisheries/frequent-questions-annual-catch-limit-monitoring#:~:text=ACLs%20are%20set%20less%20than,scientific%20uncertainty%20in%20the%20OFL.).
  + 