

CSRF Urchin Meeting

Legend

Green = Management questions

Red = Needed

Blue = Action Items

- Management questions (what they want to see tested)
 - Green: expansion
 - How can they expand and still meet conservation goals
 - Interested in moving north and west coast
 - Are there other index sites?
 - Can they use the timeseries of the current 2 index sites to understand management for other areas
 - Current using biomass dynamic model with long time series
 - Can open fishery using different approach in north for instance which won't have long time series. Is there a different way to do that especially to allow first nations
 - A lot of requests for killing urchins (urchin culling) coast wide as part of kelp restoration projects
 - Does this change the management of the urchin fishery? If DFO is funding/permitting urchin culls
 - Eliminate the size limit and change the quotas
 - Why limit the commercial fishery if this isn't needed
 - Fishery on size limit only, no quotas
 - Can they meet conservation demands under this
 - In Urchin fishery quality is a limiting factor (conservation measure), i.e. won't take low quality
 - Lots of Chris Pierce's work for that (greens), correlating factors of colour and hardness - crack them under the water to see if they fish there
 - Tom asked what the ideal size was, 60mm for test diameter size limit is 55
 - For fishstocks provision, looking at a coast wide stock (because of coastwide range) but doesn't align with scale of management
 - Is there another definition they could use
 - Is the south coast one unit? If so, how dealing with north coast. Uncertain.
 - Management wants to know where trajectory of stock definition will go, don't want unit to be too small to have to do regulations all the time, but also coastwide is not a good fit
 - High density and highly fished areas are used as reference points currently, want to look into reference points that are more biologically focused
 - Sea urchins typically found in pockets of high abundance ("patchy")
 - Urchins are being driven shallower on walls due to pressure from pycnophodia (Sunflower stars) which makes them more exposed
- Smaller densities up north (smaller urchins)

- Just from observations on the surveys
- Smaller size limit for north coast? Hard to manage
- Urchins Are not processed here, they get shipped overseas as whole organisms
- Size limit is based on serving size, presentation when consuming is in mind during processing
- Mostly red urchin local live markets on the mainland
- First nations fishery
 - Not a lot of record for harvesting green urchins for food
 - No size limit
- Fishery up north would likely follow size limit
- Not a significant green urchin recreational fishery

Tom arrives

- BC Green Sea Urchin Reference Case Operating Model Development, updated dated, models and example results
- Updating Tom on discussion above:
 - Applicable index sites for Northern fishery
 - Interest in moving north
 - Operating with only a size limit
 - Quality affecting harvest
 - Fish stock provisions
 - Coast wide definition
 - Current LRPs
 - Move to more biological focus
 - Smaller urchins and smaller densities up North
- Northern area means a new area not already managed
- Multi species survey is providing evidence for smaller urchins and densities further North
- Historically fished up north near rupert (3 - 4 years)
- Criteria for re-opening an area
 - Lumped into assessment currently used
 - Have an exploratory quota
 - SPill over that absorbs quota,
 - Not an expansion to the fishery
- What management system would meet fish stocks provisions for North area
 - Want to be able to expand fishery including adding new quota to areas haven't been before
- The Spawning biomass is below the minimum size limit
- Biomass dynamics model is not really relevant because of selectivity (most of spawning biomass is below size limit)
- Better using unfinished reference points
 - Reference points should not be related to BSMY
- Urchins are boom bust, but is it like this across a management area? It's not irrelevant but unit matters
 - Can specify a stress test for this

- Size limits are really robust to carrying capacity, uncertainty in scale
 - But NEED enforcement
 - COmbination of enforcement and high selectivity allows for size limits to be very powerful in this model in addition to lack of discards
 - Biomass dynamics model is likely not appropriate because likely not capturing age and size structure, also reference points might need to be on different scale
 - Industry started to question survey data
 - Confusing to explain the biomass model
 - Its not reflecting what they see on the ground
 - Overall good relationship with industry
 - NEEDED: more detail about the biomass model, other than what is on the IFMP
 - LYANNE: sent an email, with data and r script
 - Tom hasn't gotten around to it yet
 - Will provide him with more details
 - Zayne wrote the R code
 - In JAGS
 - 2005
 - Still current
 - LRP based on legal size on urchin habitat
 - Any trends can't be reconciled with stock size
 - Tom doesn't know the actual size
 - CONCERN: How is the model finding scale?
 - Assume landing correlate with natural biomass
 - This is what the model is currently doing
 - Is this accurate?
 - They are assuming effort is the same
 - Likely not true. Keep hearing they are increasing effort because quality has gone down
 - LYANNE: believes effort should be going up
 - Models assumes they are mature on the same age curve as they are selected
 - NEEDED: R script for the model, he wants the r script more reproducible
 - Quota is coming from scale, Tom has no idea how the model is getting is scale
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- REquests and feedback from last meeting
 - Less reliable data before 95
 - Addressed
 - Catch rate data wasn't stable
 - No contrast in the data to estimate scale
 - One way trip data but in a positive direction but means there's no contract
 - Standardize the CPUE? MACKENZIE TO DO
 - Somatic growth parameter range
 - Can monitor isotopes, but doesn't work well
 - Hard to mark them

- Need high K (growth rate) and high M (natural mortality) in order to explain density increases in areas 18 and 19
- Tom Doesn't have Linf, M, K but struggling with Linf (100mm is largest seen, but these are still wanted by industry), likely more than 130 is absolute max (assumption by Lyanne)
- Life history
 - Tom doesn't like this method
 - Ratio of growth of species within a taxonomic group
 - Meghan is looking at in general
 - Tom did it by Phylum instead of by family by accident
- Sea otter M
 - Influx and growth possibly more of an issue in the North
 - Experimental area in Tofino (for Reds) 2005
 - Sea otter came in and cause a decline in red urchins
 - LYANEE: not convinced greens would decline as fast as reds
 - Urchins harder to eat when currents are higher
 - Still sea greens in Alaska where otter have been for awhile
 - All based just on literature
- NEEDED: impact and magnitude of Sea otter issue
 - From Christine, there is maybe an interactive model for Haida Gwaii
 - Phd (Honka, and Linda Nichol) central coast, but reds
 - Cited in Tofino paper
- Absolute biomass
 - Comes from biomass dynamics model
- Biomass density comes out of analysis program that Meghan has been translating
- NEEDED: Any bounds to put on scale would be helpful
 - Hard to control to 'very high' end of the scale
 - Won't affect the conclusions
 - It doesn't tell you how much is out there in mass
- El Nino recruitment pulse
 - Be careful with climate pulses, there are highly localized
 - Regional differences
 - Not sure if this can be extracted coast wide
 - Haven't done cohort analysis
- 3-resolution sensitivity analysis
 - Tom did this
- Densities increasing as sea stars die off
- Cryptic behavior at lower densities
 - Could be causing the lack of lag between responses of size classes (disconnected)
 - Observation process not being accounted for in the data
- Multibenthic survey
 - Would it be worth doing
- Scaling to a coast wide reference point - may be able to deal with this using the 3-resolution sensitivity analysis that Tom is doing
- Resource availability for ontogenetics

- Areas for development in the use of OMs
 - How to evaluate the success of re-opening areas
- Uncertainties
 - Recruitment Pulses
 - Relisilience
- What happens when we cull an area
 - Want to know what the tolerance for that would be
 - Not size selective
 - Impacts to stock
 - By area, it would require growth rates
 - Coast wide could be extracted
 - What is the risk to the coast wide
 - A subtraction from what you have already
 - Require an estimate of the relative magnitude, which we don't have
- Trying to get to habitat for sea cukes, but why not urchins
 - They are on urchin habitat, but no definition really for what that is
- Hasn't been interest from industry for more surveys
- Reds used historical landings to determine what urchin habitat was
- Having a value for urchin habitat area would be very helpful to Tom even if it is VERY vague
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- Don't model the culling, monitor it by looking at the raw data, and removing it from the population
 - Might be good to have an absolute biomass/area in order to get at culling data
 - Might be able to get it through logbook data shapefiles from providers
- Benthic habitat mapping
 - NEEDED
 - Ashley Park is doing species distribution model presence/absence (coastwide)
 - Even if model is bad, habitat footprint might be stable and might work
 - Would combine habitat mapping information with log book information in order to figure out urchin habitat/density
- Not a lot of nearshore data coast wide
 - Presence absence model coast wide for benthic habitat
 - Use this for determining habitable ground
- Generally rocky areas with an exposure range (urchin habitats)
 - NEEDED: a habitat definition that Tom could use to expand out density to absolute biomass estimate
- ASSUMPTIONS
- Able to estimate length weight relationships
 - Basically the same everywhere
- Data updates

- Landings to 2020
- Survey sixe data
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Model inputs

- Same length/weight relationship/shape of curve in all areas
- See if we could get to a natural mortality rate (ratio of M to K)
- Does K value change based on area because data evidence from Maine suggests you might be able to
 - They are very variable
- Tom kept the original K range (0.125-0.2)
 - Searched for this K range in Fishbase for all echinodermata (Phylum)
 - Sampled from this, and used ratio sample to guess M
- Possibly Had some reduction in M due to Pycnopodia could be the cause of recent increases in density, otherwise the explanation is high K high M
- Natural mortality rate
- 72-84mm - Asymptotic length (a guess, NEEDED: other guesses)
- vB growth K between .1 and .2
 - Most of the asymptotic growth by age 10
 - But there is actually no age data so he's showing the curves based on his estimated parameters but it's not acutally fit to any data
- Steepness isn't useful to get stock to rebound, whcih is surprising
- Seaxual maturity around 25mm
 - From literature
- Large amount of predictive spawning biomass that is not touched
 - Probably fishing a small relative amount of total biomass
 - Should superimpose survey sizes over fishery sizes
 - They are quite different
- A fishery that is operating on large fecund, and not a large part of the actual biomass
- What is the impact of urchin barrens, where there are animals but they have no roe or reproductive potential because they have no food. Sometimes hard to tell if they have no food or not
- Assumption: Beverton-Holt
 - Should robustness test because maybe a **Ricker** makes more sense
 - Is there an average decline in spawning output with size
- Do we have this information: fraction of population mature as they grow
 - There might be information from California MPA studies
- Data update for this roun
 - Calc total density
 - Results on this
- Urchins per m² from the multispecies
 - Can then generate observation on the same scale as the observations
- Can test harvest advice tha tuse densities
- Two types of data - multispecies
 - Areas 12 and 19 - data rich
 - 13, 18, 19 missing time series

- Two areas with great data for modeling (these are the ones that relative biomass index)
 - Using these two areas to make assumptions about others
 - Landing history is used as well
 - Quotas are then divided out
- Sum of quadrats used as the unit of measure
 - Possibly use transect?
 - Science uses transects (for multispecies survey)
- The data that Tom has does not look right
 - They have transect ID and quadrats ID
 - Tom has combined them to get the unit nq
 - CHECK: the data table that TOM has for the multi species survey
- CHECK: the code that Tom has for this table
- NEEDED: share Tom's code on how he gets the urchins/m²
- Get Tom the urchin per square meter estimates from the Survey
- Data sources
 - 12 and 19
 - Complete catches
 - Nominal fleet CPUE
 - Ignoring cause tom does not trust it
 - Putting it in as a place holder
 - Two densities (MSS) - placeholders
 - Survey relative biomass for legal and sublegal
 - Survey length composition - includes all creatures
- 13, 18, 20
 - Trying to get everything from length-comp data which is not informative
 - Having nominal CPUE would be the only thing that would anchor this in reality to do a long term trend
- Recent catches and data
 - Areas 12 and 13 have highest total landings in pounds
 - 13 doesn't have the density
 - 12 and 13 trends match each other so likely okay because basically just one stock assessment
- REvised models
 - 19 and 12
 - Red line is the model
 - The composition data had to be resized so it wasn't dominating the estimation
 - NEEDED: What happened in 2006?
 - Possibly didn't sample that much
- Estimating the selectivity of the survey
 - In the first two length bins, something weird happens
 - Data was higher than the model in those age categories
 - Residual looks bad but it is actually a very small amount
 - Low frequency of samples
 - Juveniles are hard to find when they are not abundant (abundant = 100's)
 - External pressures?

- 55 cm is in the descending tail of all of these curves
 - Not fishing a lot of the population
- Survey split into legal and sublegal
 - Two specified selectivities
 - Legal is a better approximation
- The lag is not there (4-6 year lag)
 - Both cases show increases that can't be explained
 - Maybe M has declined?
- K and M are not time varying but they can be made to
 - Can add degrees of freedom
 - Cannot explain with steepness
 - Pointing to a stock that needs to rebuild back up quickly
- Steeper K = less lag
 - Indicative of a high K for this model?
- Urchins barren change overtime
- At the start of the model, the 'tail fan' shows that we don;t know if there was a small stock that was brought down quickly, or a large stock that was not brought down at all
 - This is where the model struggles because there is no catch data

Area 12

- Model does fit the data, not perfect but well
- Spawning biomass
 - Could be anything
- spawning depletion
 - Reasonably certain
- Struggling to account for the increase by a factor of four
- Fitting survey trends using catch data
 - Catches alone don't account for the uptick
- Should we be looking at K again ?
- Fishing mortality pattern is causing the issues
- Cannot do it all with F
- Uncertainty in landings
 - Change overtime
 - NEEDED: a much higher uncertainty prior to 1995
 - Fishery started in 1987
- Size limit was 40 in 1987
 - Only for that year, then changed to 55
 - Not an issue
- Maybe an issue with species reporting,

Area 19

- Misses some of the peaks in the composition data
- Some of this could be a sample size issue
- Composition data is more noisy and less of it

12 and 19 have index sites

- Chosen based on density
- Area surveyed in 19 is smaller physically then in 12, the substrates are also different
 - 19 is rocky reef

- 12 is islets
 - Can change the spread in length and age, Tom will look into it for 19, might improve the fit to the “peakiness” in the model
- Legal is again more stable than the sublegal index
 - Similar problem to area 12
- Estimate for 19
 - Better handle on depletion again
 - using recruitment not just catches, struggling to get low to get back up again
 - Issues of scale
- Scale issues
 - Put constraints on maximum fraction that could be taken
- **NEEDED: constraints on the fraction you can take to help with scale**
- Area 12 does the survey after the fishery hits it
- Area 19 gets surveyed before the fishery gets to it

Lunch Break

- Stat area comparison
- 12 and 19 are data rich
- Both depletion mean estimates are around 1
- SSBMY/ssB0
 - 60-70%
 - Catching them so late
 - So much biomass has to already exist
 - **CONCERN: existing UMSY is probably way off**
 - **Estimates are also high**
 - Point to the important consideration of size
 - Fishing the tail of distribution
- Trends are all increasing over the past 20 years
- Indices indicate increase in biomass, legal and sub legal, following high exploitation
 - Things are optimistic
 - More than adequate precautionary management
- **NEEDED: What is the maximum fraction that can be taken?**
 - **Historically: possible that they took 80% (of all individuals above 55mm)? (for the big catch years 1989-93)**
 - **No one is sure**
- They were definitely catching more in the past
 - Possible that they were catching too much, enlisted restrictions afterwards
- There definitely was a concern
 - Hence the new measures and index sites that were put in place
 - The possibility to deplete the stock exists
- Population refuges at deeper depths
 - Increased effort for deeper dive limits (rumours)
 - There is definitely a refuge
- 120 permits issued

- Double
- Landings from 1986
- If management regime was different back then, would the analyses be split into two parts?
 - Would that separate the uncertainty?
 - SHANNON: crank up the uncertainty as Lyanne mentioned prior
- Pre 1995
 - CV = 30%
- LYANNE: Tried doing it with just 1995 and newer?
 - Initializing a model with only increases causes more issues
 - Tom: It makes the problem worse
- Pre-Russian market?
 - Lyanne
- Both of these areas, these populations look very healthy
 - Not surprising to Tom
- **NEEDED: latest data**
 - **Standardized CPUE (Mackenzie)**
- **NEEDED: Tom is imposing a massive CV, he wants a more defensible value**
- Accounting for spatial effects could make a big difference
- Look at the biomass dynamic model (meghan w Tom)
- Area 12, steepness impact on fit
 - RELIABLY estimating the recruitment
- Aggregating stat areas
 - Adding 12 and 13 to make northern area
 - Adding in catches
 - Similar pictures
 - Conclusion of moving to a northern area, just adding more catches to area 12
- 18 19 and 20
 - Slightly different than 19 only but roughly the same
 - Not gonna see the spatial aggregation being a factor affecting major conclusions
- Example uses
 - Density based harvest control rules
 - Size limits
 - Sketching natural survival scenarios
- Density based harvest control rules
 - Taken two years with density
 - Model relating to the true numbers from those observations
 - Makes a new observation
 - Can adjust to new data by just adding a new year of data
 - Follows hockey stick DFO observations
- FOUR MPs were defined with varying control points
 - HCR 0 1
 - HCR 0 2
 - HCR 1 2
 - HCR 2 3
- **NEEDED: better handle on the observed densities**

- Results in area 12
 - 50 year projection
 - Strong implications for catch very little for stock status
- Size limits for area 12
 - Drop to 35mm
 - Substantially more yield
- QUESTION: If effort is jacked all the way up, what size limits do you need to not crash the stock?
- How important is it to sustain these small pockets?
- Is there a lot of weight being put on keeping these small pockets or is it spread out over the larger area
- What is the risk of dropping the size limit down by 5mm
 - The model could help answer this and provide an explanation to industry
- Geoduck thought experiment
 - Sea otter doubling times
 - Mortality caused by sea otters
 - Invented values
 - Can we use this, some sort of stress test for sea otters
- Models for monitoring the influx of otters
- NEEDED: ability to sketch a model with sea otter influxes
- Only need a few males in an area for 3-5 years for them to start impacting the urchins
- TO DO: tom - re-create the geoduck thought experiment with urchin, Lyanne says it should be easy with the literature that is out there
- It is hard to get sea otter data
- Not a density of otters or doubling time,
- Otter pressure as a unit of measure
- SHANNON: follow up with Linda about otter operating models
- Productivity susceptibility analysis
 - Came back to a reference that they couldn't find
 - Used everywhere
 - No one knows where it came from
 - Baseless
 - Used around the globe
- Next steps
 - Data finilization
 - Aras for operating model refinement
 - Managemnet questions
 - RObustness
 - Performance metrics

• NEEDED: Visualization

- Charts, plots, images etc...
 - Helps to report on
 - Science response
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- NEEDED: Send Tom what we want to have in the reports visually
 - Establish a standard
- SHANNON: check Hake for decision tables, same author as arrowtooth
- NEEDED: how did they calculate the MSY from the table that harvesters use
 - Tom doesn't think that the values are meaningful
- The biological risk is what the index site says
- We don't have a way to monitor LRP coast wide
- It is designed to be yield optimizing, not measure biological risk
 - Not really a decision table that links management decision to biological risk
- Plot their percent above MSY against biological risk
- Use numerical tables and visual plots
 - Both help understand the relationship
- NEEDED: Send Tom all of the tables and plots wanted
- Is it appropriate to continue using the table if it is irrelevant
 - LYANNE: just because we have been using it in the past is not a good enough reason to keep using
- Not based on a projection
 - Not a risk
 - Superimposed distribution of yields
- What gets produced for geoduck
 - No risk level
 - Summing up advice that is given
 - Summary of overall stock status
- Desire to standardize the reports
- Easier to run R code
- Might be the way all reports look across the board
 - For CSAS reports
- TOM thinks using an existing framework for a document would be better, then we can justify why it was used
- Meghan replicated what was used already, not an effort towards standardization
 - Conservation of code is very helpful
- Does everyone want to see them look the same?
 - Standard decision table
- TOM: giving a table with helpful columns followed by four figures
 - As it progresses, the yield and biological risk will change
 - Seeing this visually and numerically can help

- Pauline thinks it would be useful
- ACTION: Tom said he will create a table like this for Pauline to look at
- Help eliminate cross-referencing
- Have everything in one place
- Arrowtooth flounder paper
 - Decision table
 - Visual representation

Management questions

- Rules for opening and closing areas
 - Density rules for opening and closing
 - Industry had to do a survey first on an area reopening
 - Could it have a similar rule as in cukes?
 - COuld do an effort calculator to proximate new areas
- Tom suggests that if you want to open an area you should make it a condition that you need to do a survey
 - This allows the model to have scale
 - It will be a survey that lets you know unfished
- Standardize the approach of reopening
 - Avoids political issues in the future
- Survey in a new area would be randomized, whereas the index sites are targeted on high density areas
- Get multiple observations and set it as your base
 - From new northern area
- Push for more observations done with the new culling as well
- How quickly can they get a baseline from a new area
 - Relative to the processors
 - More intensive as you get closer
 - More fishing done in are 12 then anywhere else
- Quota increase requests for area 13
- No trend info, assuming its the same as area 12
- Tom thinks we should be getting this data anyways
- Tom thinks we should make the argument that a surray needs to be done if an area is to be reopened
 - Use the fish stock provisions as their reason
- LRP is not applicable coast wide but it should be
 - NEEDED: new LRP that can
- Use the lowest density
- Why can't we have regionally defined LRP
 - They are 'Operational control points'
- Coast wide we are below the LRP so it wouldn't work
 - If whole coast avg was below LRP then the coast would close (from surveys)
- Different surveys for different reasons
 - Stock monitoring vs the assessment
- LRP is the lowest density the stock got to when the fishing was high
- Tom - why not use $\frac{1}{4}$ of density as the LRP

- Up for debate
 - **LYANNE: wants to develop biologically relevant LRP**
 - System that can deal with a relative LRP as opposed to a hard numerical value as the LRP
 - SHANNON: LRP should be system failure not local failure
 - The starting density does matter
- Areas that have low biomass/density, is there evidence that they do not recover as well?
 - Why are they low density?
 - Environmental factors
 - Smaller in size
- Define LRP by:
 - Biomass estimate relative to unfished
- Stress test at a local level
- Tom - do the coast wide assessment
- Appropriate harvest levels
 - Need a handle on magnitude
 - **Maybe standardized CPUE will help**
- Coast wide LRP that is much lower, and an expansion occurs, would you use the LRP until an index site is set up
 - Industry probably wouldn't want it open...
 - What is the level of urchin that will cause industry to not fish
- How even is the processing plant distribution
- Reduces risk by drawing more activity to the new area and decreasing pressures on current fished locations
- The reference points don't need to be used, we can change them
 - If they are not helpful
- The LRPs will be used to evaluate risk
- Should not use density as coast wide LRP because we don't know how much and in what areas
- Use a standardized LRP and then do localized management
- MACKENZIE: can we combine units like they do with Pacific salmon
 - General approach in regards to how the stock is defined
- **NEEDED: relative surveyed areas of 12 and 19**
- SIMSAM for biomass dynamic model
- TODO: put papers from LYANNE on github - Travis
- Local recruitment is more prevalent than we think
-