Concerns About the 2019 Southern Gulf Snow Crab Assessment.

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Major Issue of extended passive phase tow lengths in 2019.

* This issue has been very well and thoroughly dealt with. My largest concern is that no catch rate adjusted biomass estimation has been presented, it would seem the logical thing to do.
* We’ve debated this a lot … the main worry for the moment is the change in 2019 relative to 2018, not whether we should rescale biomasses with respect to the passive phase for the time series. I feel that the passive phase has existed to some (and hopefully more or less constant) degree throughout our times series. However, it has only been characterized for a few recent years. A second point is that the passive phase swept area makes some simplifying assumptions which render it biased with respect to the swept area during the active trawling phase. The third point is that the passive phase catchability may be at issue, given that the trawl geometry is likely warped during this phase (e.g. asymmetric, …).

Major Concern of Increasing survey catchability (q) over the time series, particularly in recent years.

* This concern extends beyond the 2019 extended tow length issue.
* There is now an extended period of a positive residual pattern between the survey and predicted R1 biomass, effectively since about 2012 and constituting near-half of the time series.
* A new survey design was instituted in 2012 with expanded boundaries and new site selection. I feel the recent survey area expansion is a pretty minor issue. The spatial distribution of stations in the period immediately prior to new survey design was fairly uniform, however this was not so the further back in time we go. Kriging partially accounts for this as it generates a local average of proximate stations. The station reshufflings which have periodically occurred could be treated analytically, but this is not presently considered.
* Since 2014, there has been a practice to maintain successful sets from the previous survey and abandon unsuccessful sets in lieu of successfully occupied alternates. I agree that this is an issue, it makes the survey station distribution converge toward trawlable areas. This process could probably be quantified, however, based on rejection rates and distribution of past rejected tows.
* My guess is the successful alternates that become a fixed part of the survey design thereafter would be systematically associated with softer substrates, upon which q would be higher (intro of trawl survey document says footrope digs into soft-sediment and increases q.
* Survey Protocol section of Trawl Document says in 2018 31 stations (= near 10% of total survey) were re-assigned in 2019 survey design. Furthermore, the Characteristics of Tows in 2019 section says an additional 33 sites were completed on additional stations. This is a high rate of attrition, presumably toward softer sediments.
* Figure 7 in the trawling document suggests it’s mostly peripheral areas that are becoming abandoned. This pattern is even more exacerbated in previous assessment documents, such as in 2013-2015 survey years.
* The increasing attrition of shallow/hard bottom areas and increasing prominence of deeper/softer areas would lead to decreased presence of what would typically conform to small crab habitat and increased presence of what would typically conform to larger crab habitat and ultimately increase overall survey q, particularly for large crab (Mullowney review document on crab distribution and migration - Reviews Fish Biology & Fisheries).
* Potential issues of increasing survey q are also consistent with a pattern of increasing vessel horsepower on the survey vessels throughout the time series (ie. Benoit and Cadigan documents on the catchability of the RV vessels).
* There is a flat or negligibly positive slope on the 34-44mm CW crab index since 2006. In contrast, larger crab stages R4-R1, which inform the stage-based model have more strongly increasing slopes. The document claims the model starts at 56-68mm CW because of decreasing trawl catchability at lower sizes, but this would not seem to explain the disconnect between the stages if there is a constant survey q at each stage over time.
* Trends in American Plaice capture in this survey appear consistent with an increasing survey q over the time series.
* Priors used in the stage-based model come from a period of suspected lower survey q.
* Fig. 15 in the fishery document shows a loose positive correlation between biomass and CPUE over the time series (probably significant, not sure). Yet, CPUE in Area 12, the major crab area, has been flat for a decade and actually down in the past two years. This doesn’t appear to be associated with a trap saturation point, as other areas are/have shown higher CPUE.
* If I understand Fig. 11 and Fig 12. correctly, annual m for new-intermediate hard-shelled large adult males would be about 0.2-0.4 = Zm(0.2-0.5). This seems kinda high? I don’t see why a crab in it’s prime physical condition, virtually immune from predation, would have m this high? I could see if it was more relevant to older-shelled or smaller crab. All above points on increasing survey q would suggest exploitation rate is probably higher than suggested.

Other (Minor)

* Why not standardize the CPUE index by time and space and soak time?
* What does mean size index mean?
* Are C2 crab not included in the exploitation rate index? Surely some of them are kept?