Draft Terms of Reference for *Illex* Quota Working Group  
August 28, 2019

The *Illex* Working Group will address two closely related problems. The first is to develop an approach for in-year quota adjustments. The second is to lay the basis for a benchmark stock assessment (Research Track) in 2021. To some extent the data needs and analyses overlap. Each task will require involvement of scientists, industry, and managers. Both tasks are focused on the challenge of identifying appropriate catch limits for a dynamic, short-lived species whose survival, growth and abundance on the US shelf are driven by a complex interplay of environmental conditions. The relationship between removals and stock abundance is poorly understood; as a result no stock assessment model has been developed for this stock. The potential data needs and approaches for *Illex* are numerous, so the working group has first identified several topics/tasks that can potentially be addressed in a 4-8 month timeframe and might produce information useful for in-year quota adjustments. More complex and longer-term data collection and research projects are described second.

**Short-Term Topics/Tasks**

In the short term, the only currently-identified practicable process would be for the SSC to identify certain measurable conditions that would be hard-wired into the specifications to automatically adjust the ABC. For example, the existing quota might be adjusted upwards or downwards depending on the real-time trend in CPUE after X% of the quota had been taken. Alternatively, a swept-area biomass estimate from a stratified survey conducted after catching Y% of the quota might also serve as a basis for adjusting the quota within previously defined bounds. Environmental conditions could also be used as a basis for adjustment if such information can help estimate stock availability. A sequence requiring an SSC evaluation of performance in-season, followed by a Council meeting and NMFS rulemaking does not appear practicable given the required timelines. Hardwiring in-year quota adjustments is feasible within current specifications processes if a justification can be made and if the necessary data will be available.

1. Review assessment and management approaches for ommastrephid squid populations (like *Illex illecebrosus*) used worldwide and summarize previous attempts for real-time management (RTM) in Northeast US.

2. List key existing available data sources for *Illex*  
   -Sources: Dealer, VTR, observer, surveys, Study Fleet, fishery participants, environmental data  
   -Elements: data fields that are recorded and available for analysis  
   -Metadata: design elements like duration, area covered, etc.
Timeliness of data reporting and availability
-Cost and burden

3. Describe what we know (highlight our relative confidence) and don’t know, about typical patterns of Illex growth and distribution on the NE shelf. Describe the fine-scale changes in average size-at-capture over the fishing season and in NEFSC spring and fall bottom trawl surveys, and relevant differences among years.

4. Use samples collected by industry in 2019 to expand knowledge of Illex aging and growth. Council staff requested sample collection by several fishery participants and is exploring options for processing and aging.

5. Identify a meaningful measure of effort for each component (freezer, RSW, fresh/ice) of the Illex fleet, or identify a path toward doing so. Evaluate utility of CPUE by fleet for estimation of Illex productivity.

6. Evaluate CPUE and environmental parameters as potential real-time predictors of defined relative abundance conditions (e.g., poor, average, good). Examples include, but are not limited to Markov and hierarchical models. Can system state {poor, average, good} be identified with partial year empirical data? What fraction of year is required to determine system state?

7. Consider (and if appropriate design) pilot pre- and/or mid- and/or post-season industry-platform based surveys (any or all) to inform in-year quota adjustments.

**Long-Term Topics/Tasks**

1. Explore use of acoustics for Illex assessment.

2. Explore alternative processes for in-year quota adjustments.

   a. Define the ideal management timeline. With respect to this timeline, address the following questions regarding needed data (any type):
      i. What will be collected?
      ii. Who will collect?
      iii. Who will process?
      iv. Who will monitor (at-sea observers and quota or effort monitoring)?
      v. What are the costs?
      vi. When are the data needed?
      vii. What can we do under the applicable law

   b. Address impacts of
      i. Imprecise data (i.e. responding to noise versus actual situation)
ii. Lagged data (i.e., time between data collection and availability for scientific use)

iii. Non-biological factors, especially market effects

iv. Delayed Decisions (e.g., close too early or too late)

v. Assumption about self-regulated effort during low abundance years

3. Describe the in-season dynamics of fishing effort and catch with a particular focus on:
   a. Market prices
   b. Species abundance/availability on the U.S. shelf
   c. Influence of pending quota decisions and other regulations
   d. Using the above factors and others, distinguish between poor, average and good abundance years.
   e. From an economic perspective, determine magnitude of acceptable change (e.g., +/- 10%, +/-20%). associated with potential in-season catch adjustments.

4. Address influence of harvesting on stock dynamics.

5. Systematically determine age composition of catches prior to, during and after the fishery using a structured sampling design to identify the cohorts (and seasonal and spatial differences in age composition). Also determine age composition of NEFSC spring and fall survey catches.

6. Explore other real-time management approaches, e.g. tow-based real-time e-VTR data and biological data (similar to NEFSC 1999-2001 Illex RTM project).

7. Determine persistence of linkages (CPUE, environmental) to abundance across years. Consider the same for effort (e.g. market conditions).

8. Develop a prototype model of Illex immigration/emigration dynamics on the US shelf during the fishing season that includes seasonal changes in relative abundance as influenced by oceanographic conditions. Much of this work will be speculative, but it will help to piece together different perspectives of stock dynamics. A key concern will be evaluation of feasibility of migration of large squid to spawning areas.
   a. Determine if meaningful biological reference points (e.g., target of 40% spawner escapement) can be developed, especially with respect to critical biomass levels.
   b. Estimate Illex fecundity and reproductive state by size and age (age data are critical).