Mid-Atlantic Fishery Management Council
800 North State Street, Suite 201, Dover, DE 19901
Phone: 302-674-2331 | FAX: 302-674-5399 | www.mafmc.org
Michael P. Luisi, Chairman | G. Warren Elliott, Vice Chairman
Christopher M. Moore, Ph.D., Executive Director

MEMORANDUM

Date: May 5, 2020

To: SSC

From: J. Didden, P. Rago

Subject: Co-Chairs' *Illex* Working Group Update/Short Term Tasks Results Summary

Since May 2019, the *Illex* working group (WG) has been meeting and working to explore options for alternative *Illex* ABCs and/or ABC-setting processes. Efforts were divided into short, medium, and long-term terms of reference (TORs) (https://www.mafmc.org/s/2019-10-*Illex*-WG.pdf).

Short-term TORs included reviewing squid management approaches, listing key data sources, summarizing growth/industry sampling data, initiating analysis of growth and age from 2019 samples provided by industry, conducting CPUE analyses, and exploring implications of the NAFO assessment. The goal was to address these to the extent possible for the May 2020 Scientific and Statistical Committee (SSC) meeting. All of these tasks have been initiated and most have produced some results.

Medium-term TORs include considering additional surveys, developing details on in-season dynamics, and incorporating environmental parameters into analyses of CPUE. Even longer-term tasks include exploring acoustics, developing alternative processes for in-year quota adjustments, considering the influence of harvesting on stock dynamics, identifying cohorts in-season, developing other real-time management approaches, determining the persistence of linkages (CPUE, environmental) to abundance, and developing a prototype model of *Illex* immigration/emigration dynamics. Work on short-term TORs has started to at least inform possible explorations of some medium and longer-term TORs.

Documents were prepared by the WG to address the short-term terms of reference. They should be considered preliminary analyses unless otherwise noted. In addition, a summary document from the *Illex* Summit [S1], held in November 2019, was influential in guiding various investigations of the WG. Many of the WG members participated in the Summit, which reflected on perspectives of harvesters, processors, scientists, and managers. Collectively the working papers represent a broad overview of the current state of the *Illex* fishery, its management, and either underlying or developing science. The methodologies described in these papers may prove useful for addressing future needs related to real-time management of the *Illex* resource and/or ABC-setting in the meantime. Integration of industry-based information is a common theme throughout the reports. The Mackerel, Squid, and Butterfish (MSB) Advisory Panel (AP) was incorporated at the initiation of the WG, and asked for input periodically in 2019. Beginning in 2020 the MSB AP was formally

convened when the workgroup met. There is also an MSB AP meeting scheduled for May 11 for a final round of input from the AP after they had a chance to review the working group documents.

As a starting point, five papers (3,4,5,6,7) address either current conditions in the U.S. fishery and/or other assessment/management approaches. All assessment approaches identify the difficulties of dealing with short-lived species. These difficulties have been addressed using a variety of approaches whose utility seems to depend on the magnitude and value of the fishery which in turn affects the availability and timing of information for updating current harvest recommendations. Few assessment or monitoring approaches seem to exist that have proven track records of accurately predicting outcomes.

Available data include survey data from both federal and NEAMAP bottom trawl surveys [6] , comprehensive Vessel Trip Reports [17, 9, 10, 13, 8, 6] and Vessel Monitoring Systems [11]. Quota monitoring data collected by GARFO was used to examine its use for real-time monitoring [16a]. Industry-sponsored data include biological samples from harvesters [6, 10, 13, 14, 16b] and information from study fleets [8]. A research project on aging of *Illex* [15] is ongoing but incomplete.

The process of providing information for real-time management of *Illex* can be conceptualized as three distinct steps: Identification, Estimation and Detection. First is identifying the relative status of the fishery and the resource in a given year (Identification). “Status” can be determined on an ordinal or ratio scale and can be done on a post hoc basis. Catch per unit effort from the commercial fleet was investigated in paper [10] and for a subset of study fleet data in paper [8]. Both [10] and [8] used advanced state of the art generalized linear models to account for differences associated with year, season, vessel type and permit. Further comparisons of the results in [10] and [8] would be useful to evaluate the representativeness of the study fleet data. Crude rates of CPUE estimation were combined with other metrics of fishery performance, average weight, price, and survey data to examine the potential utility of multivariate methods for identifying system state [13]. Survey data from several sources were combined with information from VTRs to estimate probability of occurrence over the entire resource area and measures of overlap with the fishing fleet [9]. The model-based survey estimation methodology could be valuable for refining the overall distribution of *Illex*.

One of the central tenets of current management is that the fishery has had a modest or low effect on stock dynamics (Estimation). Nothing produced by the WG has suggested otherwise. Under this premise, upward adjustments to the quota are assumed to have a low effect on the potential for overfishing if “good years” can be identified. Depletion models are used in many squid fisheries around the world and have been applied to *Illex* in earlier NEFSC assessments. The Leslie-Davis version of the depletion model was applied to 1997 to 2018 data base in [14]. Results suggested a high degree of indeterminacy owing to failures to satisfy many of the underlying model assumptions. An alternative approach, using assumptions about minimum and maximum values of assumed fishing mortality and trawl capture efficiency was used to develop an “envelope” of potential biomass levels that are constrained by the extremes of each assumption [12]. A similar range of potential fishing mortality rates can then be compared to a suite of possible biological reference points for fishing mortality. Additional confirmation of the low potential mortality rates for *Illex* was obtained by examining VMS records for 2017-2019 [11]. VMS reveals that overall fishing effort is highly concentrated along the shelf break. The consequences for the magnitude of

fishing mortality were investigated in terms of necessary replenishment of squid from adjacent areas and exploration of overlap with the total resource area as estimated in working paper [9].

Detection is the third essential component for real-time management of *Illex*. Currently, there are no accepted procedures for estimating or projecting pre-season abundance of *Illex*. Post hoc determination of system state {poor, average, good} is not useful if real time measures are desired. A methodology developed for statistical process control, known as Cusum was modified to test whether the system state could be determined within the year. This approach was tested by applying it to weekly landings data collected by GARFO for the period 1996-2019 [16a]. Fishermen and processors reported that changes in average size of landed squid were also important factors in characterizing the season. The Cusum method was also applied to the industry-supplied weekly average weight data for 1997-2019 [16b]. The Cusum approach appears promising for identification of system state using either approach and may serve as a basis for testing in the 2020 fishing year. The process for collecting weekly landings data is already in place. If the weekly changes in average weight in the fishery were judged acceptable, rapid processing of representative biological samples by industry would be necessary.

2019 landings totaled 27,163.5 metric tons. In order to facilitate the same landings, an ABC of 28,449.4 MT would be needed (4.52% of the ABC is set aside for expected discards). Given A) the current approach of setting the ABC around the highest observed catch as long as no ill effects have been observed, B) the WG results, and C) that the fall 2019 survey was within the range of typical variability, 28,449.4 MT could be an option for a 2020/2021 ABC. The only other option that appears close to shelf-ready would be to use the Cusum approach for average weight per landed squid, total landing by week, or both variables to modify the quota in-season. Given the generally early detection of non-poor and above average status in good years (weeks 22, 20, 28, 22, 22), data through July 1 (week 26) could potentially be used to determine the existence of a “non-poor and above average” year, and a quota modification be made. This would by nature be experimental to some degree, and an incremental approach might be warranted. The only way for such an experiment to run in 2020 would be for the three major processors to supply weight data on a voluntary basis in an electronic format supplied by GARFO. GARFO already has the authority to make in-season adjustments to the *Illex* quota, in consultation with the MAFMC, during the fishing year by publishing notification in the Federal Register. A particular weight-based statistical trigger criterion would need to be identified. A combined approach, starting at 28,449.4 MT, and followed by a potential modification based on the weight-based Cusum approach could also be utilized. Given timing and regulatory issues, the most that that 2020 ABC could practically be increased to is 30,000 MT. There is substantially more flexibility for 2021, and the results of any 2020 processes could be evaluated post-season and integrated into final 2021 specifications through GARFO’s in-season adjustment authority or expedited regulatory measures, if appropriate.