

June 1, 2021

Subject: Response to email from Greg DiDomenico on behalf of Lunds Fisheries, Cape Seafoods, The Town Dock, NORPEL, and Seafreeze

Dear Greg,

Thanks for your email of 5/21/2021 on behalf of the squid industry and request for comments about most recent deliberations of the Scientific and Statistical Committee (SSC) on the *Illex* quota. I appreciate the longstanding support of the industry for advancing the underlying science. I believe this has been productive and look forward to its continuation.

Please note that while my response is based on the findings of the SSC and relies heavily on our report to the Council, it has not been vetted through the SSC as an official response. I'm not sure how formal requests to the SSC have been handled in the past but I think they would normally come as a request through the Council. For the sake of timeliness, I've prepared a response that may later be refined via a more formal Council process.

Your letter addresses many different levels of the process for providing scientific advice to management. I'll start with the philosophical issues. You question why we don't list "Sources of Certainty" in our summaries. It's a good question. For most business decisions you would prepare a list of pros and cons. The pros might come mostly from the marketing department while the cons would come from the tax accountants. For SSC decisions, the reports often look like they came from the tax accountants. However, I think there is a symmetry in the presentation that is not always self-evident. Discussions about ABCs are governed by the Terms of Reference (TOR) which usually comprise a review of the evidence in support of a decision, recommendations for monitoring the response of the stock, measures of scientific uncertainty, a listing of the evidence considered, and a certification of best scientific information available.

The first Term of Reference can be viewed as the list of "Pros" in support of the recommended decision. Our SSC also will typically provide some context for the decision process and include a detailed summary of the points made by presenters and the subsequent discussions. I copied you and all contributors to the May 11-12 SSC meeting report to the Council (dated May 28, 2021). In that report there are five full pages of discussions prior to the section where the SSC begins deliberation of the TOR. I will summarize later how the SSC viewed the evidence leading to its decision.

Continuing the philosophical thread, the pursuit of scientific truth is an ongoing process, and always vulnerable to the emergence of new facts or revised theories. Fisheries scientists, are or should be acutely aware of the pitfalls of hubris. Hence the "Sources of Uncertainty" TOR provides a reminder of how limited our understanding actually is. Most of the evidence does point to partial availability of the stock to the US fishing areas over the year. However, it's also clear that we know of only one spawning area and know very little about their early life history dynamics. The overall importance of the US shelf as a nursery area is unknown. Since there is no generational overlap between fishing seasons, the recognition that we are fishing on the grandchildren of the current cohort does cause some concern. The current period (2017-2020) of

apparent high availability has not been seen for several decades. But fishermen will be the first to acknowledge that good times don't last forever. Scientists join them in this sentiment, but perhaps don't appreciate the periods of high abundance as much.

In your letter you request that the SSC prepare a list entitled "Sources of Certainty" and provide a list of suggestions for consideration. This may be possible at a future meeting of the SSC but I cannot generate one unilaterally. My responsibility as SSC Chair is to faithfully summarize the presentations, the evidence in working papers, and the discussions of the SSC. I can't introduce new information not discussed or available to the group prior to or during the meeting. To do so after the fact would damage the integrity of the process since it would introduce suppositions about how the SSC would have interpreted such information in plenary, had it been a subject of discussion.

As an alternative, I would direct you to the discussion portion of the report which does address many of the issues you noted. Your sources of uncertainty (condensed) include:

1. Status of *Illex* in the NAFO assessment
2. Presence of refugia because of small footprint of the fishery (less than 900 sq nautical miles)
3. Presence of fixed gear in key fishing areas
4. Large fraction of population is unfished

The SSC did not discuss the status of *Illex* in the most recent NAFO assessment, but the publication that reports those findings Hendrickson L.C. and M. A. Showell. 2019. 2019 Assessment of Northern Shortfin Squid (*Illex illecebrosus*) in Subareas 3+4. NAFO SCR Doc 19/042, Serial No. N6973. 38 p., is cited in my working paper to the SSC. Items 2 to 4 were addressed to varying degrees by the following statements, extracted from the SSC report to the Council. The following *italicized* list shows the scope of the discussion by the SSC:

Manderson Section

- *Neither approach accounts for the fraction of the stock that occurs outside the survey sampling areas so the estimates are considered minimal estimates of total *Illex* habitat.*
- *Analyses of spatial footprint of the commercial fishery from VTR records suggested that fishing activity occurs in less than 1.2% of the habitat area for the period 2008-2019.*
- *Using estimates of the overall *Illex* habitat, the NEFSC fall survey covers about 43% of the stock area while the spring survey covers only about 29% of the habitat because many of squid are thought to be still offshore.*
- *Interviews with fishermen were used to obtain ball park estimates of gear efficiency. Harvester inferences are based on patterns of squid behavior revealed by sonar. Median estimates of net efficiency were 0.363 and 0.121 for commercial and research trawls, respectively.*

Rago Section

- *Paul Rago presented an overview of several indirect methods for bounding the historical range of biomass and fishing mortality estimates and assessing the implications of alternative quotas for 2021 and 2022. ...In this context, the analyses summarized by Manderson and colleagues were essential for advancing this evaluation.*
- *Results of the standard depletion analyses revealed severe violations of the underlying assumptions, particularly those related to closed population. The failures of the [depletion] models to fit the underlying data in most years were interpreted by the SSC in 2020 as evidence of low fishing mortality and/or high rates of migration.*
- *Results suggested the average escapement rates over the 1997-2019 period ranged from 0.36 to 0.95, over a large range of parameter values. Moreover, when hypothetical values of historical catch of 30,000 mt or 33,000 mt were assumed, the average escapement was above 40% over a broad range of plausible values for M and catchability.*
- *The spatial footprint of the fishery is highly concentrated with nearly all fishing activity occurring in an area less than 900 nm² in 2019. In 2017 and 2018 the fishery footprint was less than 550 nm².*
- *Estimates of area swept by vessels suggest rates of fishing mortality that would not be sustainable or profitable unless the population was continuously replenished by migrations. This conclusion is directly supported by the results of the mass balance model, even though the models are completely independent of each other and share no common data or parameters.*
- *The VMS analyses were further extended to consider the effective fishing mortality on the entire in the US stock area. ...Based on these assumptions the estimated maximum total fishing mortality on the population would range from 0.001 to 0.038 (i.e., 0.013/24 to 0.912/24) week⁻¹. The high value of 0.038 is approximately an order of magnitude below the candidate fishing mortality reference points reported in Hendrickson and Hart (2006).*
- *The system of indirect methods can be refined by incorporating the results of Manderson et al. and the results of the VMS analyses. With these updates, the average biomass estimates for the 1997-2019 period ranged from 137 to 652 kt using the Envelope Method. The corresponding average escapement values ranged from 0.66 to 0.97 given the observed catches. Given a hypothetical annual catch of 33 kt over this same period, the range of average escapements was 0.42 to 0.92. Finally, the range of feasible effective F_s for 2017-2019 was 0.082/24 to 0.167/24 or 0.003 to 0.007 week⁻¹.*

- *These observations suggest lower overall q values and therefore higher swept areas biomass estimates. By consistently overestimating q the resulting estimates of F are also overestimated.*
- *During preparation of this report, several harvesters noted that many fishable areas are inaccessible due to gear conflicts. This would in fact lead to increased escapement.*

Public Comments Section

- *An industry member asked whether the risk of overfishing for *Illex* was less than that afforded other species under management in the Mid-Atlantic region. In response, it was noted that direct comparisons of risk were not possible but that all of the analyses suggested that the risk of overfishing was low across the full range of plausible parameter values.*
- *Industry members appreciated the quality of the work and the uniqueness of the *Illex* fishery. Commenters noted that the robust life history of squid, the relatively small fleet, low discards, and concentration of fishing mortality into relatively short season all suggest low risk of overfishing.*
- *Another industry representative noted that fishermen reduce transit and search times as much as possible by focusing on known areas of abundance*
- *The valuable collaboration with industry and their provision of data and expert judgement was also highlighted.*

The excerpts above suggest that while the absolute magnitude of F and stock biomass are not known, the available lines of evidence suggest that F is low and biomass available to the survey and fishery areas likely high but not consistently so across years.

Your second set of questions are related to the sources of uncertainty listed by the SSC. For completeness the list is summarized below:

“The SSC notes the following important sources of scientific uncertainty:

- a) The extent, distribution and magnitude of the *Illex* stock remains poorly defined.
- b) We lack biomass and exploitation rate estimates for this species.
- c) The extent to which catch is driven by variation in availability to the fishery as opposed to variation in underlying abundance remains largely unknown.
- d) Whether a 40% escapement B_{MSY} proxy is appropriate as a foundation for management of *Illex* is uncertain.
- e) The level, extent and inter-annual variability in immigration into, emigration from and recruitment to the stock are poorly described.
- f) Despite progress from the analyses presented, the relative catchability between fishing fleets and the survey remains poorly quantified.”

Lists of uncertainty often precede lists research recommendation so your follow-up questions are appropriate. You asked:

1. “What sources of uncertainty could be evaluated by our current knowledge of the species?”
2. What sources of uncertainty cannot be evaluated in a way that satisfies SSC standards?
3. Why have these sources of uncertainty remained uncertain, unidentified, unpursued or unknown?”

Many of these topics will be addressed during the Research Track Assessment (RTA) currently underway. Some will rely on reexamination of historical data in light of new hypotheses while other will require new data. The Terms of Reference for the RTA as well as those for the Council’s *Illex* Quota Working Group lay out a fairly long list of research topics. I can’t predict which ones will be addressed fully or those that will pass muster when the research products are reviewed by the Peer Review Panel. Various investigations of oceanographic data may provide insights on factor controlling migration rates. Ageing, maturation, and statolith microchemistry analyses may help refine the development of assessment models and identify aspects of inshore vs offshore migrations. Growth rates are thought to be highly dependent on environmental conditions, but a revised growth model will be crucial for understanding the historical patterns of average size composition revealed in the weekly samples of *Illex* landings.

Pelagic species as whole are difficult to assess, not only in the Northeast but around the world. Most textbooks devote a special chapter to pelagics or even entire books to highlight such difficulties. I don’t think the question relates to satisfying “SSC standards” as much as scientific or peer-review standards. These tend to be quite high either way.

Finally, you ask “Why have these sources of uncertainty remained uncertain, unidentified, unpursued or unknown?” The short answer, “because they are hard” may seem flippant, but it is not intended to be. Assessments of pelagic species as a general rule tend to be more uncertain than groundfish or sessile species because population closure is a difficult or untenable assumption. As a sub-annual species, squid complicate things further because the signal obtained from overlapping year class compositions is not available. A review of squid assessments worldwide has not revealed many success stories.

Various real-time metrics of relative stock size may be possible and the *Illex* Quota WG has examined several candidate measures (reviewed by the SSC in May 2020). Real-time management approaches that characterize the state of the population during the fishing season may ultimately prove useful for *Illex* but much will depend on the costs of collecting relevant information. Ideally the profits of the fishery should exceed the costs of monitoring, irrespective of who bears the burden.

In summary, I recognize this is a lengthy response but I thought it was important to address your concerns as thoroughly as possible. I’m hopeful that the Research Track Assessment will help further refine our understanding of *Illex* population dynamics and the livelihoods it supports.

Best regards,


Paul Rago