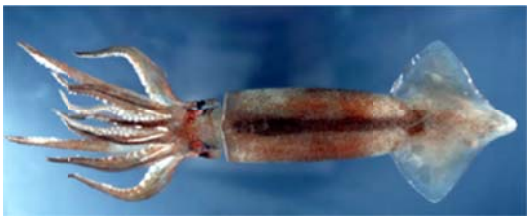
MID-ATLANTIC FISHERY MANAGEMENT COUNCIL

www.mafmc.org

Squid Management Workshop Summary

January 15-17, 2013 - Riverhead, NY



Northern shortfin squid
(*Illex illecebrosus*)

Loligo[1]/Longfin inshore squid
(*Doryteuthis (Amerigo) pealeii*)

Introduction and overview

The Mid-Atlantic Fishery Management Council (Council) convened a workshop on squid management, January 15-17, 2013 in Riverhead, NY. The workshop primarily considered whether harvest strategies that are more responsive to current stock conditions are feasible and appropriate for optimizing yield in the longfin inshore squid (*Doryteuthis (Amerigo) pealeii*) and/or Northern shortfin squid (*Illex illecebrosus*) fisheries. There was also preliminary discussion of what such strategies would entail in terms of science and monitoring. This meeting was prompted by industry concerns over the appropriate management responses to variable squid abundance, including conditions that led to the 2012 Trimester 2 longfin squid fishery closure.

Participants included fishermen and industry representatives from both squid fisheries, representing vessels and processors from a variety of geographic locations. Other participants included Council members, Council staff, and invited speakers from NOAA Fisheries (NMFS) and the academic and research communities. Workshop discussions were facilitated by the Fisheries Leadership & Sustainability Forum. This summary was developed by Council and Fisheries Forum staff and is not intended to signify consensus; rather it is meant to capture the major themes of discussion and demonstrate the range of ideas shared at the workshop. The workshop participants had a chance to review a draft report and a variety of clarifications were made based on the comments received.

[1] There has been a scientific name change from *Loligo pealeii* to *Doryteuthis (Amerigo) pealeii* (same animal). To avoid confusion, this document utilizes the common name "longfin squid."

Box 1. Workshop objectives

- Review the harvest strategies currently used to manage longfin and *Illex*, consider the challenges of assessing and managing squid, and discuss the rationale for a management approach that is more responsive to fluctuations in abundance;
- Characterize the challenges that the industry faces under current management, including interactions between species;
- Consider the different forms that a responsive harvest strategy could take;
- Examine lessons learned from past work on in-season data collection and assessment in the *Illex* fishery, and explore the models, information inputs, data collection platforms, costs, and coordination required to implement more responsive harvest strategy in both squid fisheries;
- Investigate the Falkland Islands model of real-time management of their squid fishery for *Doryteuthis (D.) gahi* (formerly "*Loligo gahi*")
- Characterize the problems for which a responsive harvest strategy may or may not provide a solution; and
- Assess the feasibility and appropriateness of more responsive harvest strategies, and identify key tradeoffs, information needs, and opportunities for further discussion.

The workshop objectives (Box 1) were designed to convene fishermen, managers, and scientists to explore ways to improve squid management. The workshop included presentations, Q&A sessions, and full-group facilitated discussions. Workshop presentations addressed: why squid are difficult to assess; the current process for assessing each squid stock; current management approaches; current monitoring mechanisms for squid catch; past work on in-season data collection and applications to real-time management; and programs and research areas that involve cooperative research and advanced data collection in the squid and related fisheries. A stock assessment scientist from the Falkland Islands Fisheries Department also provided an overview of real-time management of that country's fishery for *D. gahi* squid.

Workshop discussions focused on the longfin squid fishery and addressed current challenges and potential solutions, culminating in recommendations and next steps. This summary is intended to capture the main ideas, themes of discussion, and recommendations from the workshop. Supporting materials are available online at http://www.mafmc.org/events/SquidWorkshop.htm. This summary includes a full participant list (Appendix 1) and the final workshop agenda (Appendix 2).

Responsive management

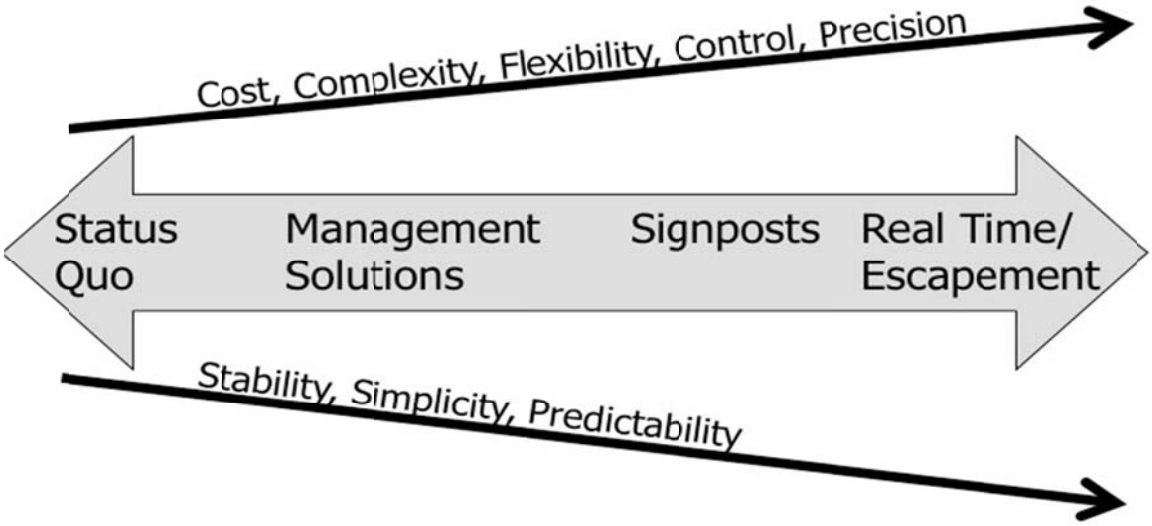
Jason Didden (the Mackerel-Squid-Butterfish Fishery Management Plan coordinator) presented a brief history of management of the *Illex* and longfin squid fisheries. He noted that the primary management measure for both squid stocks is an annual catch quota. For the longfin squid stock, annual quotas were partitioned into quarterly quotas during 2001-2006 and trimester quotas during 2000 and 2007 to current. Didden presented the trends in landings in relation to the annual quotas and noted that landings have exceeded the annual quota only once, but that in-season trimester quotas have resulted in numerous fishery closures, most recently, a Trimester 2 closure in 2012.

As sub-annual species, squid are not subject to requirements to set annual catch limits (ACLs) or implement rigid accountability measures (AMs), and there is considerable regulatory flexibility to allow for "responsive harvest strategies." For the purposes of this workshop, the term "responsive harvest strategies" included a broad spectrum of management strategies for responding to the widely variable seasonal and year to year fluctuations in squid abundance. Management measures and assessment methods are closely linked in the most responsive harvest strategies, and at least somewhat disconnected in the least responsive harvest strategies.

Didden provided the group with a working definition of responsive management, and introduced some of the basic forms that a responsive harvest strategy could take. On the less responsive end of this range are management-based solutions that could improve the industry's ability to utilize the current longfin squid annual landings quota but would not affect the process for assessing the resource or setting quotas. On the more responsive end of the range are "cohort-based" and "real-time" strategies, which consider harvests in relation to cohort size for one or more sub-annual cohorts (individuals hatched during a similar time). The goal of cohort-based and real-time management strategies is to make an in-season determination of the level of fishing that ensures sufficient spawner escapement to create the next generation (or in other words to avoid "recruitment overfishing"). These approaches are more data-intensive and can involve identifying and responding to both high and low squid abundance during the fishing season.

These broad categories of responsive harvest approaches were used as the frame of reference for later discussions. They fall along a spectrum from least to most responsive, and each involves advantages, disadvantages, and different inputs and outputs. Tradeoffs between higher and lower responsiveness can include: cost, complexity, flexibility, control, precision, stability, simplicity, and predictability (Figure 1, next page). Other factors to consider include assessment and management data needs (e.g., fishery and research survey data) assessment model types, and differing implementation timelines.

Figure 1. Potential tradeoffs between harvest strategies.



Less responsive

More responsive

Status quo/no change: The current constant-harvest strategy is stable and does not require new information, but does not take advantage of changes in longfin squid abundance. Periods of low abundance could experience recruitment overfishing, but there is no evidence that this has happened yet. This method does not take into account potential productivity differences between the seasonal cohorts.

In-season allocation changes: While the annual quota for longfin squid is rarely met, the trimester allocations can be constraining. Adjusting the trimester allocations could enable fishermen to catch more of the current quota. Options could include allocating catch equally between trimesters, adjusting rollover provisions, reducing from three to two quota periods, eliminating the trimester allocations altogether, etc. This method may not protect against recruitment overfishing and but could reduce the amount of forgone yield.

Signposts: The ABC for longfin squid appears conservative for high biomass periods according to the last assessment. If there are indicators of high biomass in-season, it may be possible to adjust catch quotas within the general parameters of the current stock assessment. This method may not protect against recruitment overfishing and but could reduce the amount of forgone yield.

Real-time management*:* Under real-time management (as implemented in the Falklands Islands), the fishery closes when a pre-determined spawner escapement threshold (the percentage of biomass needed for one seasonal cohort to spawn the next cohort) is believed to remain. Information needs can include: a pre-season survey estimate of biomass; daily electronic logbook submittals of catch, effort, and fishing location data; observers to obtain daily or weekly biological data; and a post-season assessment. While real-time management is extremely responsive to in-season changes in stock size, it is also more data and resource intensive, and can lead to fluctuating catch limits. This method, if executed accurately, would protect against recruitment overfishing and forgone yield.

Real-time management

US efforts

NOAA Fisheries' Northeast Fisheries Science Center has conducted research that could contribute to a future real-time management system. Lisa Hendrickson, the squid stock assessment scientist at the Northeast Fisheries Science Center described her cooperative research work since 1995 that has explored the feasibility of implementing real-time management in the US *Illex* squid fishery. She explained the relationships between in-season data collection, stock assessment, and management, and described the implementation of a real-time, tow-based fishery data collection program in 1999, which culminated in a real-time management workshop for the industry. Continuing to the present (2013) she has conducted a variety of projects including a depletion-type, in-season *Illex* assessment model, a pre-season *Illex* survey on industry-chartered vessels, electronic at-sea *Illex* catch data collection, estimation of weekly *Illex* natural mortality rates, and a multi-fleet Falklands-type in-season assessment model for the US longfin squid stock. Dr. Eric Powell (Univ S. Mississippi) expanded on past research on in-season, at-sea catch and effort reporting in the *Illex* fishery, and the challenges of creating a metric for effort/catch per unit of effort.

The Falkland Islands example

The workshop included a presentation by Dr. Andreas Winter, a stock assessment scientist with the Falkland Islands Fishery Department. The Falkland Islands squid fishery for *D. gahi* is the only squid fishery worldwide that is currently managed using a true real-time management approach. Managers conduct a pre-season biomass survey, and assess the resource in-season using: tow-by-tow catch, effort, catch size composition, location data supplied via VMS, daily electronic logbook reporting, and observer coverage. A DeLury depletion model is used to monitor the rate at which catch-per-unit of effort (CPUE) is decreasing, and to determine when to close the fishery in order to preserve a minimum biomass threshold of 10,000 tons. There is close communication within the industry and between industry and management.

While the Falkland Islands' approach may not be directly adaptable to the Mid-Atlantic region, this case study stimulated valuable discussion about real-time management. The workshop participants noted multiple significant differences between the fishery characteristics and management of the Falklands and Mid-Atlantic squid fisheries. Notably, in contrast to the large fleet size and diverse levels of fishing power of the Mid-Atlantic longfin squid fishery, the Falklands is a concentrated fishery involving a small number of large factory trawlers (16 in 2012), managed by joint venture corporations under a system of 25-year individual transferable quotas (ITQs). Also, the Falklands fisheries are managed using effort controls (by limiting the fishing seasons and fleet size) while the Mid-Atlantic longfin squid fishery is managed with catch quotas. The Falklands situation is relatively conducive to the close communication and coordination needed to support their particular system of real-time management. However, the components of in-season management and assessment could potentially be adapted to meet the needs of the Mid-Atlantic region.

Defining the issue

At the beginning of the workshop, participants engaged in two facilitated discussions to share their perspectives on current challenges in the squid fishery, and to discuss expectations for successful responsive management. These initial discussions provided the foundation for later discussions focusing on potential solutions and recommendations. Again, these discussions focused primarily on the longfin squid fishery.

Discussion: Influences of regulatory and non-regulatory factors on fishing effort

This discussion provided managers with insights into the regulatory and non-regulatory factors that influence fishing effort and decision-making. Industry participants were encouraged to share the information they felt was most important for managers to be aware of when considering management solutions for the squid fisheries. The group felt strongly that regulatory factors limit the industry's versatility and flexibility, and constrain utilization of the longfin squid quota. The Mid-Atlantic is a multi-fishery region and most participants in the longfin squid fishery are also involved in other fisheries. Ideally the industry can switch opportunistically between species, and consider factors including availability, price, costs, weather, turnaround time, and repairs to make profitable business decisions. Within the industry, participants also communicate and share information. Regulatory factors influence how the industry weighs and responds to all of these factors, and can lead to disincentives to target longfin squid.

Regulatory issues such as the 2012 Trimester 2 fishery closure and the 48-hour observer notification requirement for a longfin squid trip were reported to have the greatest negative impact on fishing effort and quota utilization. In-season closures when a trimester quota is reached prevent the industry from targeting longfin squid when they are perceived to be most abundant and/or available. The call-in requirement also creates a delay that deters fishermen from making longfin trips and makes it difficult to target longfin squid opportunistically. The butterfish bycatch cap, which can cause the longfin squid fishery to close, also discourages fishermen from searching and fishing for longfin squid when their abundance is perceived as low. Finally, participants felt that challenges within the longfin squid fishery are compounded by a loss of flexibility and access to other Mid-Atlantic and New England fisheries.

Regulatory and non-regulatory factors impact processors and dealers, as well as harvesters. From a processing perspective, the group explained that longfin squid landings are part of an international market, and that domestic squid are considered a premium product with a valuable market share. Processors have to consider demand, inventory, and import prices, and determine how to sell imported and domestic products relative to one another. Current management encourages pulse fishing, which equates to pulse processing (processing large amounts of squid quickly) and presents challenges to maintaining product quality, staff, and marketing relationships. Some participants felt that a steady flow of product is preferable.

Discussion: Challenges and expectations for responsive management

The second discussion focused on current challenges and potential solutions for management of the longfin squid fishery. Participants explored the attributes of successful management from industry, scientific, and management perspectives, and shared their expectations for responsive harvest strategies. Several prominent themes and expectations emerged from this discussion:

> Improve access and utilization of the existing quota, and support a flexible, stable, and responsive industry. Enable the industry to harvest longfin when they're available and abundant. Re-evaluate constraints on where and when participants are able to fish. Allow participants to make decisions to fish when it's most profitable, taking into account factors such as fuel costs and participation in other fisheries.
>
> Optimize yield by responding opportunistically to stock conditions. Avoid forgone yield and capitalize on high abundance in-season, without doing any harm to the resource. Don't close the fishery when longfin are available and abundant. Managers should recognize that effort will decrease in years of low abundance when it is less profitable to target longfin squid so there is no need to constrain effort unnecessarily.
>
> Continue to improve the scientific justification for catch levels, and build confidence and industry investment in science and management. Work on better aligning reference points, data collection, and decision-making processes with the short life cycle of squid. An industry commitment to consistent, high quality data collection should yield results in terms of access to the fishery and an improved understanding of the stock.
>
> Utilize new technology and resources. Take advantage of technological improvements and in-season data collection capabilities. Explore sources of capacity including the e-VTR (Electronic-Vessel Trip Report) study fleet, cooperative research programs, and other resources.
>
> Improve understanding of the broader ecosystem. Anticipate and prepare for future management priorities. Improve understanding of the environmental and ecological drivers of abundance in the longfin squid fishery.
>
> Approach any changes strategically. Recognize that the current management process is the product of cumulative changes over time. Consider incremental or smaller adjustments in the short term, and improve the science (including the science underlying cohort-based management) in the longer term. Start by addressing information gaps. Consider the costs of any changes relative to forgone yield. Managers should be clear about management goals ("What goals or purposes are we managing for?")

Recommendations and next steps

The workshop included several facilitated discussions during which the group developed ideas and recommendations in response to the challenges identified at the beginning of the workshop. First, the group identified the resources, constraints, and design considerations that could be involved in the construction of a responsive harvest strategy for the longfin squid fishery. Then, the group considered whether or not responsive harvest strategies would in fact resolve the challenges identified at the beginning of the workshop. Finally, the group generated a set of specific recommendations for the Council to explore and considered next steps following the workshop.

Over the course of the workshop, the group expanded on the working definition of responsive management. "Responsiveness" is not a fixed attribute and does not have to be defined in the context of a single decision or management action. Rather, responsiveness is a flexible attribute that can accommodate changing priorities, resources, and availability of information. Management can become more responsive over time, and the definition of responsiveness ("responsive to what?') can become more encompassing over time. Participants felt strongly that in all circumstances, responsive management should involve stability when possible, take advantage of high productivity, and not result in an unnecessary loss of access or an unnecessary reduction of catch.

Participants suggested that in the near term, managers should focus on enabling the industry to catch the existing longfin squid quota. The group generally felt that real-time management (i.e., the depletion-based approach used in the Falkland Islands) is not a feasible near term solution for the Mid-Atlantic. Real-time management is a data and resource intensive commitment, and requires an in-depth understanding of complex population dynamics. Given these resource and information needs, participants felt that it would be premature to consider real-time management as a viable option. Furthermore, many participants felt that a stable catch limit (under the current approach for setting ABC) may be preferable to the more responsive, but potentially more volatile catch limits that could result from real-time management. Some participants also believed the existing quotas to be precautionary. Participants deemed real-time management worthy of continuing research, as long as the industry is a full partner in exploring its strengths and limitations.

While the group generally did not support directly pursuing implementation of real-time management as an option at this time, participants felt that there are multiple other pathways for improving the management and scientific basis for managing longfin squid. Moreover, there doesn't need to be a decision between management solutions (i.e., how the current quota is utilized) and science solutions (what should the quota be?); both can be explored simultaneously. Participants generally believed that management solutions are a logical starting point, but the end goal should be to improve confidence in the science underlying longfin squid management.

The group recommended improving responsiveness along multiple concurrent timelines:

- Short term: improve responsiveness to management challenges.
- Medium term: improve responsiveness to stock conditions, within the parameters of the current assessment.
- Long term: improve responsiveness to stock conditions with an improved assessment, and improve responsiveness to ecological and environmental conditions.

The group's recommendations are discussed below and categorized as short, medium, and long term. Participants agreed that it would be beneficial to further explore the timelines, regulatory mechanisms, and legal requirements associated with potential solutions, as well as to eventually prioritize resources toward the highest impact issues.

Short-term recommendations

The group felt that a practical first step is to consider regulatory impediments to the industry's utilization of the current longfin squid quota, and provide greater flexibility for fishermen to catch and land longfin squid when they encounter them. Participants recommended a suite of solutions that could be implemented quickly to improve utilization of the longfin quota in the short term. Council staff further suggested diagnosing and prioritizing the operational challenges that present the greatest obstacle to achieving the quota. The group emphasized that "one size doesn't fit all" and felt it was worthwhile to further examine the feasibility, potential consequences, process, and timelines associated with each solution. These recommendations could impact participants in the fishery differently depending on their role (e.g., harvester, processor), vessel size, and level of participation within the longfin squid fishery.

Recommendation: Improve flexibility to catch longfin squid when they're available, by a) adjusting trimester allocations (and related provisions); and/or b) holding some portion of the annual quota in reserve that would be released during the first trimester (be it 1, 2, or 3) that achieved its quota.

The annual longfin squid quota is currently allocated between trimesters. In a period of high availability and/or abundance, the industry may catch the entire trimester allocation and trigger a temporary closure in the fishery, as happened in the summer of 2012. In this situation, the trimester allocation was constraining, while the overall annual quota was not. There are several ways the trimester system could be modified to potentially provide the industry with greater flexibility to catch longfin squid when they're most abundant:

- Eliminate trimester allocations altogether, as was the case prior to 2000 ("catch them when you can");
- Allocate catch evenly between trimesters;
- Reduce the number of quota periods to 2;
- Adjust existing roll-over provisions; and
- Set aside a portion of the annual longfin squid quota (e.g., 10%) as a "reserve" that can be added to any trimester as needed.

The trimester closures also impact fishermen differently depending on vessel size, what time of year they target longfin squid, and other factors. The group felt it would be important to evaluate any options further, to consider the possible effects and any unintended consequences (for harvesters and processors/dealers). Participants noted that while adjustments to the trimester system could improve flexibility, this alone would not necessarily allow full utilization of the quota given other constraints, addressed below.

Recommendation: Reconsider the 48-hour notification requirement for a longfin squid trip (this notification is part of the butterfish cap system).

Participants felt strongly that while moving from a 72-hour to 48-hour notification was a step in the right direction, the 48-hour longfin squid trip notification requirement still constrains targeted effort in the longfin fishery and prevents utilization of the full annual quota. The requirement compartmentalizes fishing effort by limiting the industry's flexibility to make timely decisions and switch opportunistically between fisheries, especially while at sea. The requirement also affects vessels differently depending on size, trimester fished, and whether participants are active in other fisheries. There may be solutions that would achieve a better compromise between the needs of the industry and those of the observer program. The group felt that it would be valuable to consider how trip notifications are handled in other fisheries, including length of the waiting period, provisions for flexibility, and the potential for at-sea notifications. Initial follow-up discussions with the Observer program suggest that they currently require 48 hours to successfully deploy observers, but the Council will continue to investigate this issue.

Recommendation: Increase the 2,500 lb. trigger for requiring a longfin squid trip notification.

The group felt that the 2,500 lb. trigger, which is linked to the 48-hour observer notification requirement, constrains utilization of the longfin squid quota and excludes part of the industry by decreasing on-the-water flexibility. In particular, fishermen who encounter longfin squid while targeting another species are unable to shift their effort to target squid and/or retain more of the catch. Since fishermen are required to discard any catch over the 2,500 bycatch limit if they have not notified, the combination of the low trigger and the current notification requirements create an unnecessary regulatory discard problem. The group felt that a higher threshold such as 5,000 or 7,000 lbs. would improve utilization of the quota, and provide greater access to the fishery. Options to have different triggers by season could accommodate differences in the fleet/fishery based on how the fishery operates in different seasons.

Recommendation: Re-evaluate the purpose and effectiveness of the scup, lobster, and Tilefish Essential Fish Habitat gear restricted areas (GRAs)

These GRAs serve bycatch, gear conflict, and Essential Fish Habitat (EFH) goals, respectively. Participants felt that these GRAs either may no longer serve their intended purpose or could be modified to serve their designed purpose more effectively while minimizing impacts on squid fishing. Participants suggested that each be re-evaluated. Staff noted that these measures were implemented in other plans, and would have to be modified by other plans (and for lobster by the New England Fishery Management Council).

Recommendation: Identify short-term steps to improve data availability in support of medium and long-term outcomes.

The group emphasized that managers should plan now to begin building the capacity and collecting the data needed to support medium and long-term solutions described below, and in particular to improve stock assessment capabilities. Workshop speakers pointed out that assessment improvements take time, and recommended identifying and prioritizing the data needed to yield a substantial impact on the assessment process.

The group discussed potential benefits of participating in the Northeast Cooperative Research study fleet, as well as other opportunities for collaboration with the Squid Trawl Network and with the broader ocean observing community. The group expressed their support for "harnessing the power of the fleet" to improve fishery dependent and independent information, and generally agreed that finer-resolution and timelier catch and effort information would be valuable to support a range of medium and long term solutions. However, participants felt that before committing to advanced data collection they would want a better understanding of what data is needed, who would use it, how databases are maintained, and how this information supports management outcomes. The group felt that an industry commitment to enhanced data collection should support increased access, flexibility, and yield from the fishery.

Looking ahead, participants wanted more clarity regarding some of the concepts and types of information that were introduced by speakers and/or discussed by the group. In particular, participants wanted better understand how catch per unit effort (CPUE) and tow-by-tow data might be used to support the management and science-based solutions below. The group also felt that it would be valuable to look at the performance of the fishery over time to answer questions such as: "How often was a trimester limit or annual quota reached, and why?"

Medium term recommendations

Recommendation: Identify in-season indicators of abundance that could support a scientifically justified increase to the longfin squid acceptable biological catch (ABC).

The group recommended exploring in-season increases to the current longfin squid ABC—within the constraints of the current stock assessment—in response to in-season indicators or "signposts" of abundance. The ABC for longfin squid is currently set at 23,400 mt, based on the maximum mortality ratio approach (ratio of catch relative to estimated biomass) in the context of the last assessment's (2010) finding of generally light fishing mortality over 1987-2009. No overfishing level has been determined for longfin squid, and scientific uncertainty around maximum sustainable yield (MSY) is considered very high. If indicators such as early season catches or survey results suggest that the longfin stock is particularly robust, it may be possible to set a higher, yet still relatively precautionary yield in some years using the same approach that is currently used to set the ABC.

The group felt that this approach could provide some of the benefits of real time management, without some of the costs and disadvantages (e.g., data collection, a less stable quota from year to year). The ability to set a higher ABC, within the constraints of the current stock assessment, could potentially provide a limited amount of flexibility to safely capitalize on periods of high longfin squid abundance. In years of lower apparent abundance, participants believed that the quota would not need to fall below the level established through the current multi-year specifications process as catches up to 23,400 mt do not appear to have caused any problems so far.

Participants acknowledged that the current longfin squid quota is underutilized, and agreed that management solutions are a first step toward optimizing yield from the fishery. A higher quota overall would also provide additional flexibility to ensure that quota is available when longfin are most abundant, and also provide the industry with more flexibility to shift opportunistically between fisheries. For example, the increase in ABC could be used as a buffer to allow higher catch in one trimester. In this case the buffer could provide harvesters with more flexibility to participate, and mitigate the "race to fish" that occurs when longfin are abundant and harvesters have an incentive to maximize their harvest-per-day in anticipation of a possible trimester closure.

This approach would require further consideration by the Council, its Scientific and Statistical Committee, and NOAA Fisheries. An in-season ABC adjustment provision would have to be adopted by the Council’s Scientific and Statistical Committee (SSC), and would require scientific justification. The group questioned what would constitute "best available scientific information" as the trigger for increasing the ABC, and whether this process could be supported using currently collected fishery dependent or independent data. Furthermore, this approach could supplement but not replace the management solutions discussed under "short term solutions" above.

Long-term recommendations

The group agreed that while management solutions can achieve more responsive management in the near term, a longer-term objective should be to improve the scientific foundation for managing squid and other short-lived species. Participants felt that an important dimension of "responsiveness" is to anticipate future information needs, and to prepare for the Council's transition to ecosystem-based management. The group emphasized working with the industry to enhance data collection relatively quickly, recognizing that improving the science behind squid management may require a period of additional data collection to take place first.

Recommendation: Continue to work with the industry to improve stock assessment capabilities for short-lived species.

The most prominent theme throughout workshop discussions was the industry's desire for greater confidence in the scientific basis for quota setting. While the most recent longfin assessment in 2010 suggested that the population is lightly exploited, there is insufficient information to determine how much the quota could safely be increased. Industry participants wanted to better understand the weaknesses of the current assessment, and identify opportunities for the industry to support achievable improvements. They felt that the squid fleet is a critical source of on-the-water capacity, and industry support would be needed for any real time data collection. The group was particularly interested in the industry's capacity to support an at-sea survey to estimate in-season abundance. Participants also wanted to continue to stay informed about stock assessment advancements and opportunities to contribute to the stock assessment process.

There existed several perspectives on what would constitute an improvement to the stock assessment process. Some participants emphasized that advancing the stock assessment capabilities for squid requires a breakthrough in scientists' understanding of squid population dynamics, and that this breakthrough would likely support more of a real-time management approach. Others did not necessarily envision an improved stock assessment as a means to achieve real time management, but rather as an effort to fill information gaps and have a fuller understanding of what is generally happening with the stock. Many felt that an improved stock assessment would yield a higher quota, at least in some years. Participants were interested in ongoing work taking place at the NOAA Fisheries' Northeast Fishery Science Center and requested that fishery participants be included in the development of any new assessment methodologies.

Discussions about the industry's role in data collection highlighted several important considerations of a survey or other enhanced data collection program, particularly resource constraints. While this information would be used in support of a long-term goal, managers need to make shorter-term decisions about what information to collect, and how. Survey information is most valuable when collected reliably and consistently over a long period of time. However, a sustained commitment also requires continuous funding. Collaboration between the industry and other organizations and cooperative research groups could be one way to optimize access to and use of limited resources.

Participants and speakers both emphasized that any enhanced data collection should be targeted and sustainable over time. Managers and scientists should first consider: what is the long-term goal or outcome? This question should inform what data is collected, and how. Improving the stock assessment process takes time and information. Participants noted that it is important to plan now to begin collecting information that will support improvements 5-10 years down the line.

Recommendation: Continue to investigate the ecological drivers of squid population dynamics.

The responsive management solutions discussed at the workshop focus on identifying, responding to, and accommodating fluctuations in the squid resources. A longer term priority should be to understand the environmental and ecological drivers of squid abundance and productivity. The squid resource is an important part of the Mid-Atlantic ecosystem, and as the Council transitions toward ecosystem based management, it will be important to consider how to manage a resilient fishery in a complex and dynamic environment.

Conclusion - Looking ahead

For any effective solution to any issue, managers need to consider the broader context in which the fishery operates. Participants mentioned several other concerns they felt the Council should be aware of, including latent effort. Increased participation in the squid fisheries, or a shift of effort from other fisheries, might undermine the benefits of some of the solutions proposed by the group. Participants also expressed concern about potential conflicts with other ocean uses, including offshore energy development.

Participants commented that this workshop could be a useful step toward improving management, and that actually improving management would continue to build trust between the industry, NOAA Fisheries, and the Council. This group felt that within the industry there is a dedicated and involved contingent of "first responders" willing to consider new ideas. The industry wants managers to recognize and appreciate their willingness to provide information in support of innovative solutions for the fishery. Moreover, the industry wants to continue to build a more positive and supportive management environment, and to see support for a resilient and profitable industry from managers. The group hoped to see improved and more frequent cooperation to ensure that new ideas can gain traction, and that the industry, managers, and scientists are able to communicate effectively. Some participants were frustrated that there was not more focus and progress specifically on implementation of real time assessment and management, but still saw the workshop and related ongoing research as steps in the right direction.

Since changes in management can impact different locations and different types of vessels differently, the fishery participants in the group were strongly supportive of the Council vetting the results of the workshop (and potential management changes) with a broader group. For example, the Council could reach out through meetings in key ports to facilitate the involvement of additional fishery participants, who are often unable to travel far from their homeports due to work or family obligations.

Appendix 1 - Participant List & Agenda

January 15-17, 2013 Squid Workshop Participant List

Name	Affiliation
Dick Grachek	FV Anne Kathryn (CT/RI)
Jim Lovgren	Fisherman's Dock Cooperative, NJ
William Bright	FV Retreiver (NJ)
Peter Hughes	Atlantic Capes Fisheries, NJ
Stefan Axelson	FVs Dyrsten/Flicka (NJ)
Greg DiDomenico	Garden State Seafood Assoc, NJ, Workshop Advisory Group
Dave Lofstad	FV Viking Pride (NY)
Ken Raynor	FV Dorothy M (NY)
Hank Lackner	FV Jason & Danielle (NY), Workshop Advisory Group
Dan Farnham	FV Megan-Marie (NY)
Geir Monsen	Seafreeze (FVs Relentless/Persistence) (RI), Workshop Advisory Group
Donald Fox	FV Lightning Bay (RI)
Mike Roderick	Town Dock, RI
Chris Lee	Handrigan's Seafood, RI
Chris Roebuck	FV Karen Elizabeth (RI), Workshop Advisory Group
Phil Ruhle, Jr.	FV SeaBreeze Too (RI)
Eric Reid	Deep Sea (RI), Workshop Advisory Group
Peg Parker	Commercial Fisheries Research Foundation (RI), Workshop Advisory Group
Jimmy Ruhle	FV Darana R (NC/VA), Workshop Advisory Group
Lucy VanHook	Maine Coast Fishermen's Assoc.
Peter Christopher	NOAA Fisheries, NERO
Hannah Goodale	NOAA Fisheries, NERO (via webinar) (only days 1-2 because webinar was not available on day 3)
Dr. Lisa Hendrickson	NOAA Fisheries, NEFSC (via webinar) (only days 1-2 because webinar was not available on day 3)
Dr. Paul Rago	NOAA Fisheries, NEFSC (via webinar) (only days 1-2 because webinar was not available on day 3)

January 15-17, 2013 Squid Workshop Participant List

Name	Affiliation
Dr. John Hoey	NOAA Fisheries, NEFSC
Dr. John Manderson	NOAA Fisheries, NEFSC
Jim Gartland	Virginia Institute Marine Science (VIMS), NEAMAP Survey
Chris Bonzek	Virginia Institute Marine Science (VIMS), NEAMAP Survey
Howard King	MAFMC - Mackerel-Squid-Butterfish (MSB) Committee Chair (MD)
Erling Berg	MAFMC - MSB Committee Vice-Chair (NJ)
Steve Heins	MAFMC, NY DEC
Dr. Chris Moore	MAFMC - Staff - Exec Director
Jason Didden	MAFMC - Staff, Mackerel-Squid-Butterfish Plan Coordinator, co-organizer
Mary Clark	MAFMC - Staff, Communications
Dr. Andreas Winter	Falklands Islands Fisheries
Dr. Eric Powell	Univ S. Mississippi
Emerson Hasbrouck	Cornell Cooperative Extension, Squid Trawl Network, Workshop Advisory Group
John Scotti	Cornell Cooperative Extension, Squid Trawl Network
Tare Froehlich	Cornell Cooperative Extension, Squid Trawl Network
Kristin Gerbino	Cornell Cooperative Extension, Squid Trawl Network
Dr. Josh Kohut	School of Environmental and Biological Sciences, Rutgers
Katie Latanich	Fisheries Forum (co-organizer, facilitator)
John Henderschedt	Fisheries Forum (facilitator)
Whitney Tome	Fisheries Forum (facilitator)
Kim Gordon	Fisheries Forum (facilitator)

Squid Management Workshop Goals and Agenda
January 15-17, 2013

Workshop goals:
The purpose of the workshop is to consider options for improving management of the longfin and *Illex* squid fisheries, with a focus on responsive harvest strategies that account for changing stock conditions over the course of the year. The Council intends for managers, scientists, and fishermen to collaboratively consider if responsive harvest strategies are feasible and appropriate for optimizing yield in these fisheries.

For the purposes of this workshop, the term "responsive harvest strategy" may refer to a range of management strategies such as "adaptive" or "in-season" management. Discussion and public comment will be incorporated throughout the workshop.

Specifically, workshop participants will:

- Review the harvest strategies currently used to manage longfin and *Illex*, consider the challenges of assessing and managing squid, and discuss the rationale for a management approach that is more responsive to fluctuations in abundance;
- Characterize the challenges that the industry faces under current management, including interactions between species;
- Consider the different forms that a responsive harvest strategy could take;
- Examine lessons learned from past work on in-season data collection and assessment in the *Illex* fishery, and explore the models, information inputs, data collection platforms, costs, and coordination required to implement more responsive harvest strategy in both squid fisheries;
- Investigate the Falkland Islands model of real-time management of their squid fishery for *Doryteuthis gahi* (formerly "*Loligo gahi*")
- Characterize the problems for which a responsive harvest strategy may or may not provide a solution; and
- Assess the feasibility and appropriateness of more responsive harvest strategies, and identify key tradeoffs, information needs, and opportunities for further discussion.

Agenda begins on next page

Day 1/Tuesday, January 15th: Defining the issue

1:00 – 1:30 pm **Introductions and opening remarks**

- Chris Moore, MAFMC Executive Director
- Katie Latanich and John Henderschedt, Fisheries Leadership & Sustainability Forum
- Participants and invited speakers

1:30 – 2:30 pm **Panel session: Where are we now?**

Objective: Describe how the unique biology and life history of longfin and *Illex* have contributed to the current management approach, provide an overview of the current management and monitoring framework, and discuss the rationale and regulatory considerations behind a responsive harvest strategy.

Challenges of assessing the longfin and *Illex* stocks
Lisa Hendrickson, Illex and longfin squid stock assessment scientist, NOAA Fisheries/Northeast Fisheries Science Center

Regulatory considerations and short-lived species
Peter Christopher, Team Supervisor, Sustainable Fisheries Division, NOAA Fisheries/Northeast Regional Office

Current management of the longfin and *Illex* resources
Jason Didden, Squid, Mackerel and Butterfish FMP Coordinator, Mid-Atlantic Fishery Management Council

Landings monitoring in the longfin and *Illex* squid fisheries
Hannah Goodale, Chief, Analysis and Program Support Division, NOAA Fisheries/Northeast Regional Office

2:30 – 3:30 pm **Industry perspectives: How do regulatory and non-regulatory factors influence effort in the longfin and *Illex* fisheries?**

Objective: Provide managers and scientists with insight into the regulatory and non-regulatory factors that currently influence fishing behavior and effort in the squid fisheries.
Fisheries Forum facilitators

Discussion questions:

- What do you think is most important for managers and scientists to understand about the factors that influence fishing effort? How do these factors vary by perspective (e.g. fishermen, dealer, processor), vessel size, holding method (fresh/refrigerated sea water and frozen), and other characteristics?
- How are your fishing decisions influenced by the behavior and performance of the rest of the longfin and *Illex* fleets? By other

fisheries? By global markets?
- Do you make these decisions independently, or as a leader or employee of a larger corporation? What relationships or processes are involved?
- How do current regulatory measures, including the butterfish cap, affect your fishing effort?

3:30 – 3:45 pm **BREAK**

3:45 – 5:30 pm **Interactive presentation and discussion: Why consider a responsive harvest strategy?**

Types of responsive harvest strategies and implementation needs
Objective: Outline some of the different forms that a responsive harvest strategy could take, and identify the basic components of each.
Jason Didden and Lisa Hendrickson

Full group discussion: Current challenges and expectations for a responsive harvest strategy
Objective: Identify current challenges in the longfin and *Illex* fisheries, assess reasons for moving toward a responsive harvest strategy, and share strategy definitions and expectations.
Fisheries Forum facilitators

Discussion questions:
- From your perspective, what are some of the current challenges facing each of the squid industries?
- How do you define "responsive harvest strategy"? What are your expectations?
- What are the attributes of successful management from a legal and biological standpoint? From an industry and business planning standpoint?

Day 2/Wednesday, January 16th: Responsive management: Past experience and future possibilities

8:30 – 8:45 am **Recap of Day 1**
Fisheries Forum facilitators

8:45 – 9:30 am **A short history of in-season assessment of the *Illex* stock and a new in-season assessment method for the longfin stock**
Objective: Review the evolution of stock assessment methods and information inputs for the longfin and *Illex* stocks, including an overview of previous feasibility studies for implementation of in-season

management of the *Illex* resource. Describe the relationship between in-season assessment, management, and data collection.
Lisa Hendrickson

9:30 – 10:15 am **Advances in in-season data collection**
Objective: Describe past research on in-season, at-sea catch and effort reporting, and the challenge of creating a metric for effort/CPUE. Review basic sampling and data collection considerations.
Dr. Eric Powell, Director, Gulf Coast Research Laboratory, University of Southern Mississippi

10:15 – 10:30 am **BREAK**

10:30 – 12:00 pm **Presentation and discussion: Real-time management in the Falkland Islands squid fishery for *Doryteuthis gahi* (formerly "*Loligo gahi*")**
Objective: Introduce the Falkland Islands model for real-time squid management, including assessment model, information inputs, and coordination between managers, scientists and industry. Discuss similarities and differences between the Falklands and Mid-Atlantic squid fisheries.
Dr. Andreas Winter, Stock Assessment Scientist, Directorate of Natural Resources, Falkland Islands Government

Q&A/Discussion

12:00 – 1:00 pm **LUNCH**

1:00 – 2:00 pm **Research roundtable: Introduction to other squid-related research and collaborations**
Objective: Provide participants with a common frame of reference regarding research and projects related to the squid fisheries, in order to support discussions about the feasibility and utility of responsive management in the broader context of the SMB fisheries.

Short presentations:

- The Northeast Cooperative Research study fleet and tow-by-tow electronic reporting – *John Hoey, Director, Northeast Cooperative Research Program, NOAA Fisheries/Northeast Fisheries Science Center*
- The NorthEast Area Monitoring and Assessment Program - *Jim Gartland, Multispecies Surveys Leader, NEAMAP/Virginia Institute of Marine Science*
- Squid Trawl Network – *Emerson Hasbrouck, Director, Cornell Cooperative Extension Marine Program and Principal Investigator, Squid Trawl Network*
- OpenOcean. 2013. A multi-disciplinary & institutional collaboration

among academic, government and industry partners in the application of an ecosystem based approach to the assessment of small forage species central to the mid-Atlantic Bight food web. – *Dr. John Manderson, Research Fishery Biologist, NOAA Fisheries/Northeast Fisheries Science Center*

Q&A/Discussion

2:00 – 3:30 pm **Building a responsive harvest strategy**
Part I: What do we have, and what do we need?
Objective: Identify inputs that could contribute to the construction of one or more options for responsive management of longfin and/or *Illex* squid.
Fisheries Forum facilitators

Discussion questions:

- Based on your perspective and area of expertise (Council, agency, industry, scientists, other), what are some of the known resources (e.g., models, information, experiences) we could draw on to construct a responsive harvest strategy?
- What are some of the questions, conditions, and information needs associated with these resources? Who can address these needs?
- Of the range of resources and needs discussed, which factors help advance the development of a responsive harvest strategy? Which are constraints?

3:30 – 3:45 pm **BREAK**

3:45 – 5:00 pm **Building a responsive harvest strategy**
Part II: How do we get started?
Objective: Explore the interdependence between the resources and needs identified in Part I, and how these relationships shape the options for responsive management of the longfin and/or *Illex* squid fisheries. Identify key questions, concerns, and decision points that could help the region make progress toward building a responsive harvest strategy.
Fisheries Forum facilitators

Discussion questions:

- From your perspective, what do you think should be the starting point or the most important consideration in designing a responsive harvest strategy? Why?
- How do the resources and needs identified in Part I influence or constrain one another?
- Given the resources and needs identified in Part I, and the relationships between them, what do you see as the potential pathways toward a responsive harvest strategy for longfin and/or *Illex?*
- What additional feedback and information could help the Mid-Atlantic continue exploring these possible pathways?

Day 3/Thursday, January 17th: Looking ahead

8:30 – 8:45 am **Recap of Day 1 and 2**
Fisheries Forum facilitators

8:45 – 10:15 am **Industry roundtable discussion: Is a more responsive harvest strategy a solution for challenges in the longfin and *Illex* fisheries?**
Objective: Discuss whether one or more of the responsive harvest strategies discussed on Day 2 would address the industry challenges identified in Day 1.

Discussion questions:

- How do you think a more responsive harvest strategy might impact your participation and role in the fishery (harvesting, processing, distributing, marketing, etc.)?
- Moving forward, what additional questions, concerns, and information might influence your support for a responsive harvest strategy?
- Of the challenges identified on Day 1, which do you think could be fully or partially resolved through responsive harvest strategies? Which do you think could not? What other issues could be addressed through the specifications, framework, or amendment processes?

10:15 – 10:30 am **BREAK**

10:30 – 12:00 pm **Full group discussion: Recommendations and next steps**
Objective: Review the procedural requirements and timeline for moving forward with a more responsive harvest strategy, and share perspectives on whether the Council should continue to explore one or more of the pathways discussed. Identify the questions and information that should be captured in a workshop report, and communicated back to the industry for further discussion via follow-up port meetings.
Fisheries Forum facilitators

Discussion questions:

- From your perspective as a scientist, manager, Council member, or industry participant, what questions do you still have? What insight or recommendations can you share based on your role in the management process?
- What was your most significant take-away from this workshop? Has your view on a responsive harvest strategy changed?
- How would you like to see the information and themes from this discussion captured in a report, and communicated back to the Council and to the industry?

12:00 – 12:30 pm **Closing remarks**