Independent Peer Review Report on the review of the Catch Accounting and Monitoring System (CAMS)

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for Centre for Independent Experts

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Executive Summary

I have reviewed the Catch Accounting and Monitoring System (CAMS) and found that it can provide a single source of commercial fishery data for users in both the Greater Atlantic Regional Fisheries Office (GARFO) and the Northeast Fisheries Science Center (NEFSC) for the purposes of quota monitoring, stock assessment and other scientific research that may utilize commercial catch data. I thus accept the work I have reviewed.

I have received thorough presentations of data sources and methods for data matching, imputation and estimation, and I find the chosen methods to be appropriate. I have also received presentation of how the software implementation has been scrutinized and tested. I have found that it is adequately tested, and I have found no clear indication of erroneous implementation. The most important outputs are shown to be largely in agreement with those produced by earlier systems, and plausible explanations have been put forward for discrepancies. Sufficient system documentation has been put forward to evaluate the system, and to ensure that necessary information can also be made available to CAMS-users.

CAMS users will be presented with a novel view of continuously updated commercial catch statistics and a harmonized approach to discards estimation as they adapt to CAMS. This may challenge their current perspective on these data sources, and may prompt adaptations in their use. It will therefore be important that sufficient time and effort is put into transitioning to the new system.

CAMS is still under active development, and the review has identified important improvements that should be implemented immediately to ensure efficient utilization of CAMS. These include improvements to user accessible system documentation, support for user transition to CAMS, implementation of change management, and the implementation of a Universal Trip Identifier.

Background

A good quantitative description of the total catch in licensed fisheries is essential for both the active management of fisheries and for research on the ecological impact of fisheries. Quota monitoring and stock assessment thus share very important input data in the data sources available for calculation of total catch. It may therefore be advantageous to share solutions for tracing, checking, processing and archiving data. The Catch Accounting and Monitoring System (CAMS) has been developed by the Greater Atlantic Regional Fisheries Office (GARFO) and the Northeast Fisheries Science Center (NEFSC) in order to provide such shared solutions. Data on total catch must be compiled from a range of underlying sources, each of which may be updated and revised independently. The compiled output that reaches users in quota monitoring and stock assessment must therefore be expected to differ if they are not obtained in a coordinated way for both uses. Such differences may cause concern among stakeholders, as the differing data sets are often representing the exact same real-world quantities. Shared data processing solutions such as CAMS can provide a trace that explains such differences to stakeholders, or even provide completely consistent data sets for both uses. In CAMS-development, the goal of consistency between data deliveries is referred to as the principle of "one set of books". Total catch data may also be of interest for other uses in management, and definitely will be interesting for other uses in scientific research (e.g., socio-economic analysis, ecosystem assessment, protected species bycatch assessment). Such users may also benefit from the development of a general Catch Accounting and

Monitoring System. Lastly, a common system for preparing total catch data may benefit upstream data providers (data stewards), in that it can provide fewer points of contacts for data deliveries and coordinate feedback from error checking.

While the advantages of a shared data processing system are evident, some difference in requirements between users is expected. This presents challenges that do not pertain to independent bookkeeping. For instance, in-season quota monitoring systems have high demands for timeliness of data deliveries and may accept compromises to quality in order to achieve this; such compromises may not be acceptable for stock assessment purposes. Stock assessments on the other hand have high demands for integrity of time-series. For such uses, consistency in which fraction of the fishery is fully documented may be preferred over isolated improvement in reporting for later years.

The total catch of a fishery consists of total kept catch and total discarded catch. Depending on compliance to regulations, the majority of kept catch can be treated as the catch reported on dealers reports, which is census information. Various other censuses (such as vessel trip reports or the vessel monitoring system) provide necessary information for allocating catch to variables of managerial or ecological interest (e.g., time, area, gear). The different censuses provided to CAMS do not always have sufficient information to be brought in exact correspondence with each other, and they may vary in their timeliness of delivery. Some approximate algorithmic approaches (matching or imputation) may therefore be applied to infer data with sufficient resolution for use. The primary source for total discards is not census information, and CAMS provides estimates from samples of trips which independent observers have provided data for. Approximate and generic estimation routines have been identified and reviewed earlier and may be employed to provide discard estimates.

CAMS has thus been developed to provide more than the bookkeeping and automatic combination of relational data that is expected of a database. It also provides advanced data processing that is approximate in nature (estimation, matching and imputation). This sets a high bar for data traceability and transparency, so that users can be confident that derived data is fit for their purpose. This also means that extensive coordination with data providers is needed in order to increase accuracy.

The system is still under active development and was presented to the review panel as a work in progress. The evaluation of the system was done based on its current state, but with the understanding that important issues identified in the review can be addressed immediately as the system is operationalized.

Review Activities

I served as a reviewer on this panel in the capacity of being a computer scientist by training, and having experience in development of both databases for commercial catch data and estimation support systems. Further, I have work experience as a researcher in stock assessment methods and fisheries dependent sampling methods.

I received background material in due time before the panel review meeting and reviewed this prior to the meeting. It contained necessary information, but it I found that it was lacking somewhat in organization, leaving a lot to the reader in terms of sorting out the information pertinent to each Term of Reference. It also lacked the general introduction to stock assessment and fisheries

management in the region that may be necessary to fully utilize external reviewers. These deficiencies in background reading were compensated by clear and informative presentations at the panel review meeting. I find that I was sufficiently informed to conduct the review.

The panel review meeting was conducted via WebEx on January 17-19, 2023. It contained presentations of the context CAMS operates in, its key data sources and all data processing of importance that is done in CAMS (see agenda in Appendix 3). Appropriate time was scheduled to ask clarifying questions and I obtained necessary information about, for instance, regional regulations, to what extend different kinds of historical data will be incorporated in CAMS, plausible explanations for differences in accounting between old and new systems, and change management solutions in place for other systems at NEFSC.

Since it is difficult to gauge what may be omitted from background material, I very much appreciated the open invitation to the public and to stakeholders to give comments during the panel review meeting. A few stakeholders provided illuminating perspectives, but mostly the meeting reaffirmed the impression that the CAMS team had provided a complete picture of the current state of the system in the background material and the presentations at the panel review meeting.

On Monday January 30, 2023 the panel convened online to finalize the Peer Review Summary Report.

I have appreciated this opportunity to get familiar with CAMS and its developers, and appreciate their hard work and commitment to data quality.

Summary of Findings

I will present my findings along with a presentation of the Terms of Reference (ToR) for the review. See also appendix 3b for a complete listing of the Terms of Reference.

ToR 1

ToR 1 is summarized in the following excerpt:

> *Comment on the ability of CAMS to provide a single source of commercial fishery data for users in both GARFO and NEFSC (e.g., for quota monitoring, stock assessment, socio-economic analysis, ecosystem assessment, protected species bycatch assessment, and research).*

Based on background material and information presented at the panel review meeting, I find that CAMS is generally well suited as a single source of commercial fisheries data that meets the needs of both quota monitoring, stock assessment, and research dependent on commercial catch data in general. The conflicting requirements in terms of timeliness and quality of deliveries have been addressed by making CAMS a highly dynamic set of tables that at any given time produces output that is as accurate as possible, and solve incompleteness and lack of correspondence between data sources by a tiered system that applies approximate data matching and imputations as necessary in order of decreasing accuracy. The system is made sufficiently transparent that users can trace the level of speculative processing that has been done and act accordingly if it is not in concord with their quality requirements. The decision to make the system dynamic, rather than compile output at specific times also provides a novel and valuable level of transparency to users about uncertainty in the data. The dynamic nature of the CAMS output may, due to its novelty, not be in line with

current user expectations. It is therefore important in the continued development of CAMS that measures are taken to ensure that users get a full understanding of the new system. It is important that the users receive careful explanations as to why this behavior of the system is correct, and that the CAMS team facilitate checks that users need to perform in order to be confident in adapting the new system. A most central task in this regard is to develop all the relevant information that was presented to the review panel into user documentation.

Some particular aspects were specified for consideration under ToR 1. I will note findings related to each of these below:

a. Documentation at both the conceptual and technical levels

It is essential that the user can understand exactly the provenance of data. The system as presented to the review panel was sufficient to provide a good understanding about where underlying data is coming from, how it is processed, and the sensitivity of output to the date of extraction. Technical details, like algorithms for matching, imputation, and formulas for estimation, are also documented to sufficient detail, but documentation of the tables that users interface is incomplete. In general, documentation is not presented in ways that is easy to navigate for either review panelists or end users. The panel review meeting has still convinced me that the system is well defined, and all questions about documentation could be answered upon request. So assuming that users can expect the same service when they need clarification, the state of the documentation should not be a hindrance to using CAMS.

b. Data source contributions, including the smaller and harder to track data sources (e.g., state of Maine herring data)

It appears that CAMS has been able to integrate most of the relevant data sources for commercial catches. This is reflected in that discrepancies in total catches as compiled by CAMS and compared to previous solutions generally indicate that a slightly higher volume of catch is revealed in CAMS. During the panel review meeting, some remarks were made that indicate that responsibilities for detecting and handling errors in the data may be a bit unclear between CAMS and respective data stewards.

The background information and panel review meeting has not revealed anything of a legal or technical nature that would make it more difficult to track or incorporate any kind of data sources in CAMS than it has been before adapting CAMS, even after that question was explicitly raised by the review panel. In general, I expect that it will be an advantage for harder to track data sources that CAMS can offer a single point of contact that serves several end users.

c. Processes to combine data sources

The methods for matching data sets are well defined and sound, although in some cases they are necessarily approximate. They are implemented in such a way that approximations are only employed when necessary, and in order of decreasing accuracy. If updates to underlying data render approximate data matching unnecessary, this is automatically reflected in the CAMS output. Parallel to implementing these data-matching routines, CAMS has been implemented to support the anticipated Universal Trip Identifier, which will allow data sources to identify the trip associated with their data in a uniform way and thus reduce the need for approximate data matching and

imputations. Apportionment of landed catch and value to variables not reliably available on dealer reports (area, time and gear) is done based on the weight reported on vessel trip reports, which are considered approximate weights. I consider both the matching and apportionment to be sound approaches to address limitations that are inherent in the underlying reporting. It is unclear to me, based on the provided background material, whether the different levels of matching are subject to the same data labeling as imputations. That is, whether it is possible for users to trace which records have been matched in which way, or to monitor the total number of matches performed in different ways to check for differences between years.

Discards are estimated in accordance with recommendations from an earlier review on discard estimation for in-season quota monitoring, and discussions at the panel review meeting indicated that the same methodologies are considered acceptable for stock assessments. Discard estimates are also of interest in other uses envisioned for CAMS, such as protected species bycatch assessment, which was not on the Terms of Reference for this review (see remarks on discards later in this report).

> d. *Comparisons of CAMS outputs with landings and discards provided from previous quota monitoring and stock assessment approaches*

The CAMS team had prepared extensive comparisons between CAMS output and previous approaches to quota monitoring and stock assessment. These comparisons were confined to a single year, and some comparisons revealed large differences, particularly for discards. Differences are to be expected when both data processing and input data are varied between the compared computations. Differences are also particularly expected for discards which are estimates, and which for many of the comparisons were made from a low number of samples that also differed between the systems. So, in order to use these differences as an indicator of the correctness of the CAMS system, one has to consider whether they are reasonably explained from what is known about the differences between data and processing in CAMS and legacy systems.

In general, sensible explanations were put forward for the differences, but their plausibility was not always checked quantitatively. I don't find that the differences presented reveal any clear indication of error on the part of CAMS, but it is clear that users with concerns about time-series integrity may have to perform some analysis to inform them on how to best adapt to CAMS. The CAMS-team presented corrections that had been done based on discrepancies found between CAMS output and earlier approaches, which indicates that these data checks are actively used as a quality assurance mechanism.

> e. *Methods for imputing effort, area, and gear when such data are missing*

The methods for imputing information about effort, area and gear are well described and appropriate. As with the matching algorithms, they are applied in a tiered fashion, so that presumably less accurate imputation methods are only applied when more accurate methods fail, and so that imputation in general is only applied when necessary. The imputed records are also clearly labeled in the data, and appropriate measures of imputation uncertainty are provided. It seems to me that users with different quality concerns will be well informed and have the necessary flexibility to handle imputed cases differently when needed.

f. Approaches to handle conflicts across data sources (e.g., area 514 reported on vessel trip report (VTR) but observer on the trip reports areas 514, 521, and 525)

CAMS generally applies corrections from the more reliable source, and in many cases reports issues back to the data stewards. The responsibilities for corrections did in some cases seem unclear between CAMS and upstream data providers. At the panel review meeting some cases were presented where estimation with corrected data lead to bias, and in general the bias of ratio estimators can increase when corrections are selectively applied to observed trips. The consistent use of the most accurate data is, however, an important mechanism to drive improved quality of reporting, and the estimated quantities in CAMS are also subject to other and probably larger error sources. I consider that exceptions from the norm of correcting to the most reliable information should only be considered when resulting estimation errors can be shown to be a dominant contribution to the total error.

g. Utility of CAMS outputs for operational use, particularly for the primary uses – quota monitoring and stock assessment

I have not identified anything that should preclude CAMS outputs from being used operationally for quota monitoring or stock assessment, but recognize that development will have to continue after adaptation if it is to satisfy users. The system presents users with a radically different view of commercial catch data, that are continuously updated as better information becomes available. While this is an improvement on the users' perspective on these data, it may challenge assumptions that has been implied in downstream use and statistical models or interpretations may have to be revised. CAMS also attempts a broad harmonization of discard estimation which the comparisons presented to the review panel indicate can have unforeseen consequences for specific fisheries. Both of these aspects will require some effort both from the CAMS-team and downstream users in order to ensure a successful transition to the new system.

ToR 2

ToR 2 is summarized in the following excerpt:

Recommend future enhancements for CAMS noting whether each is an immediate need or a longer-term project.

Some specific aspects were specified for consideration under ToR 2. I will note findings related to each of these below:

a. Change management and version control

The CAMS development is supported by state-of-the-art version control systems, and standard semantic versioning has been adopted in development. It is unclear to what extent users are made aware of which version they are using at any given time, which is important for proper data documentation in downstream use. I consider this an **immediate** need.

As CAMS is acquiring users with somewhat different requirements, and as new data sources or software functionality is put forward for inclusion in CAMS, it will be important to develop

principles about the scope of CAMS and about the priority of user needs. In the panel review meeting, the idea of a change control board was put forward, modeled on how change management is implemented for other systems at NEFSC. The exact mandate and composition of a change control board has not been formulated yet, but it could serve as way to manage the scope and priorities of CAMS. As I suspect that users will formulate request for changes to CAMS already in the adaptation phase, I consider it an **immediate** need to implement change control mechanisms.

b. Test environment

A well-functioning test environment has been set up for CAMS which allow for complete system testing in an environment that is not exposed to users. This allows for experimenting with new features and for testing development versions before they are released. This is an important piece of infrastructure, since continued development is anticipated while the system is operationalized. It will be important in that process to shield active users from unstable development versions. It was not clear from background material or presentations at the panel review meeting, whether these systems have been leveraged for automatic tests. Since a test environment can treat otherwise dynamic data as static, the test environment can be developed to implement tests to ascertain that outputs are invariant between software versions. This is an excellent way to monitor that code changes do not have unintended side effects. I consider wider utilization of the test environment as something to be considered for a **longer-term** project.

c. Inclusion of a Universal Trip Identifier once it has been developed and implemented

Referring to findings noted under ToR 2c, the Universal Trip Identifier has the potential to make more speculative data processing superfluous as upstream data become complete. I consider it an **immediate** need to make trips identifiable across relevant data sources.

d. New sources of data

It is clear that CAMS is well positioned to include additional sources of information about commercial fisheries, and it is reasonable to expect that the implementation of processing and quality assurance of new data sources is synergistic to the sources CAMS already support. Critical considerations of the details involved in accommodating new data sources may be necessary to verify that such synergies can be realized. In order to make such considerations, it may be necessary to clarify the scope of CAMS and consider priorities of other user needs. I, therefore, consider inclusion of additional data sources to be a more **longer-term** project, not to be initiated before change control mechanisms are in place (ToR 2a).

CAMS generally supports the processing of a wide range of census information, in addition to discards, which are estimated quantities. While the estimation routines for discards are backed by a thorough process that ensures its applicability across a wide range of uses, the same degree of harmonization across different uses and data providers cannot be expected for estimated quantities in general. Typically, it is necessary to adapt estimation to sampling designs to get high precision estimates, and considerations about the bias of ratio estimators are often informed from specific

uses of data. This may indeed limit the current application of discards estimates to new uses, such as protected species bycatch assessment. A general framework for estimation may therefore require more flexibility than CAMS is prepared to offer. This should be carefully considered if additional estimated quantities are proposed for inclusion in CAMS.

e. User tables or interfaces

The background information and panel review meeting did not reveal any obvious need for additional user tables, but such requirements may be better mapped by closely following the operational use of the system. The system development seems to have been well informed by users, but as new groups of users are brought into direct contact with the system, CAMS development can take advantage of the fact that development will continue and overlap with adaptation of the system. While the system is in active development it is comparatively easy to incorporate user feedback.

The review panel has not been shown a general user interface or point of access to the system. This is important to establish as it allows clarity in communication about which version is used and is a natural way to provide documentation and contact information for support. Also with respect to the design of user interfaces, it will be an advantage to leverage the active development to incorporate user preferences.

Ideally, the active discovery and incorporation of user needs can be a continuous **longer-term** project for CAMS, but some measures should be taken immediately. Since important requirements may be anticipated as users transition to the new system (ToR 1g), I consider it an **immediate** need to define how such requirements can be quickly elaborated, scrutinized, prioritized and implemented. This should be incorporated into the solutions for change management (ToR 2a).

f. Data dictionary and entity relationship diagrams

Clear definitions of every data field accessible to the users are essential to provide a correct user understanding of the system. Currently the CAMS documentation lists technical constraints for most fields (data types and variable names), but semantic definitions (field descriptions) are only provided for some tables. Since many users are used to interpreting the same or similar variables as reported in legacy systems, it would also be an advantage to document any correspondence between fields in different systems. This is a central part of complete system documentation, and I consider it an **immediate** need to develop along with other user documentation (ToR 1a). The inter-relationships between tables are also important to understand, particularly for users that need to merge or cross-reference tables. In that case I consider the development of entity relationship diagrams or similar documentation an **immediate** need. If the system is not intended to support merging and cross-referencing of tables, or if the interrelationships of tables are sufficiently documented by other means, entity relationship diagrams can be considered technical documentation and addressed in **longer-term** projects.

g. Feedback to data providers to improve overall accuracy and utility of data

CAMS already has in place some mechanisms for providing feedback to data providers, but the panel review meeting indicated that there is still a need to clarify responsibilities for quality assurance between CAMS and upstream data providers. I consider it an **immediate** need to define the scope of CAMS also in this respect, while I think that the process of implementing error checking and engaging data stewards about recurring issues are best handled in **longer-term** projects.

> h. *Enhancements for reproducibility of results and/or enhanced utility in assessments, quota monitoring, and research*

CAMS is a part of a data pipeline that needs to be very well documented in order to ensure reproducibility of results. CAMS already provides a lot of detailed data-labeling that make computations traceable, and data processing is generally implemented as deterministic computations, so that reproducibility is in principle ensured and differences due to changes in upstream data are traceable. It will often be of interest to reproduce a partial pipeline. For instance, a stock assessment can want to reproduce a result with new methods, given that input data is unchanged. Since the output of CAMS is input to these processes, it is important that responsibilities at that interface are clearly defined. For instance, it needs to be defined who has the responsibility for archiving CAMS output for future reproduction. At the very least CAMS should provide clear labeling of the version of CAMS and the date and time of extraction for all output data. The panel review meeting indicated that such a service is not yet implemented. I consider that facility an **immediate** need.

In the **longer-term** it may be considered if CAMS should provide additional services to facilitate downstream reproduction efforts. One can consider archiving snapshots of extracted data for a limited time, or implement storing of data-digest information that would allow a user to verify that a data extract is consistent with the data-digest stored at the time of extraction.

Additional findings

Discards

I have reflected some on the approach to discards and the inclusion of estimated quantities in CAMS. In general, estimation is sensitive to changes in sampling such as the manner of sample selection, stratification in allocating sampling effort, intermediate stages of sampling and so on. Such information is rarely conveyed in a structural manner in sample data, and it is therefore typically not incorporated as parameters in estimation routines. Further, assumptions that may be made in the formulation of estimators are often justified based on the intended use of estimation routines, such as knowledge about the species or fisheries they are applied to. In CAMS a harmonized approach has been identified where fine-grained post-stratification is employed to make the bias of estimators robust to variation in sampling effort, and a ratio estimator based on retained catch has been identified to be appropriate for the current uses through a thorough process. I find this to be a good compromise in order to handle discards without manual intervention and with a manageable level of system complexity. I find it important to note, though, that the utility of discard estimates may not be expected to generalize to new use-cases in the same way as the census information. For instance, the catch of rare bycatch species and seabirds are typically considered to

be correlated with fishing effort to a much larger extent than with total retained catch. I also find it worth noting that, unlike census information, where improvements in upstream data are automatically reflected in CAMS output, improvements in the sampling designs for discards cannot be expected to be reflected in higher precision estimates unless the estimator is adapted to the design.

One set of books

A question was brought forward at the panel review meeting about comments to the principle of one-set-of-books that has been central in the CAMS-development. This principle ensures that data extracted at the same time should be the same, independent of which purpose it is extracted for. I also take it to mean that extracts of different subsets of the commercial catches should be consistent. For instance, that total catches extracted for different areas or gear type should sum up to the grand total. I consider this a good principle that is well implemented, but I would like to remark also here that the design principles of CAMS are a bit census-centric. Whenever approximate methods are used to combine data or to estimate quantities, the one-set-of-books principle may be in conflict with the goal of obtaining the most-precise-estimate. For instance, provided that sampling design information is available, a more precise estimate can be made for the design strata than for arbitrary post-stratifications of them, and thus a more precise estimate will in principle be available for more aggregated views than for less aggregated views, and they will not be consistent in the estimated value. A similar hypothetical can be mentioned for matching and imputation. Methods could be considered to attribute total catch to gear or area on more aggregated levels, circumventing the need to approximately match individual dealer reports to individual vessel trip reports. It is not obvious that this would be a better approach in general, but it is obvious that it would lead to different results at different levels of aggregation, and violate the assumption that estimates for parts should sum to estimates for the whole. My point is not to suggest revision of methods for estimation, matching or imputation, but to highlight a potential conflict between the goal of one-set-of-books and the goal of most-precise-estimates that in principle pertains to all approximate calculations.

Conclusions and Recommendations

I conclude that CAMS can provide a single source of commercial fishery data for users in GARFO and NEFSC for the purposes of quota monitoring, stock assessment and other scientific research that may utilize commercial catch data. I thus accept the work I have reviewed.

This conclusion is based on the considerations elaborated in the chapter 'Summary of Findings'. While I make remarks therein about improvements that can be made, and discrepancies that can be further investigated, the background material or the panel review meeting has not revealed anything of convincing character that would lead me to believe that the adaptation of CAMS would constitute a deterioration in the quality of commercial catch data. To the contrary, there is a clear potential for a general improvement in data quality and in user convenience if CAMS development is continued. I find the methods for data matching and imputations to be appropriate, traceable and sufficiently flexible to accommodate various users. The discard estimation has also been implemented in accordance with recommendations from a thorough process. Comparisons with earlier systems reveals that some work is necessary for users to adapt to CAMS, but they do not convincingly indicate any error in the CAMS implementation.

I have considered the current state of the system when reaching conclusions in this review, while also recognizing that CAMS is still under development. I consider continued development necessary to realize the advantages presented by a shared catch accounting system, and I recommend some actions that I deem necessary to implement immediately in order for the system to deliver on the expectation of increased quality and ease of access to commercial catch data. I have also identified some potential in the system that I recommend be considered for more long-term projects. I will enumerate my recommendations in what follows.

Recommendations for immediate action

1. While the documentation that can currently be made available to users is acceptable for responsible operations of CAMS (ToR 1a), I would strongly recommend compiling a complete and well-organized system documentation that is readily available to users and preferably stakeholders in general. This may also be necessary in order to make sure the users have an updated understanding of the system as new features may be added or if corrections to current functionality proves necessary. It is, thus, very important that the user documentation is kept current and that it is clear which version of CAMS it pertains to (ToR 2a). Completeness and accuracy in documentation should take precedence over pedagogical concerns. Once a complete system documentation is in place, introductory material and adaptations of the documentation to improve the user experience can be formulated in collaboration with users.

A satisfactory user documentation should clearly describe all data sources and how they are processed, and it should contain detailed definitions for all choices available to users, all data fields that are exposed in output to users (data dictionaries, ToR 2f), and the relationship between different output tables (e.g., entity-relationship diagrams, ToR 2f).

Since CAMS is exposing users to a new perspective on commercial catch data as dynamic records subject to continuous updates, the user documentation should also introduce this novelty for the user. Likewise, the user documentation should provide guidance on the types of analysis that are necessary to ensure that specific user tasks, such as specific stock assessments, can be migrated to using CAMS data.

2. Recognizing that dealer reports and fishing trips cannot be universally brought into exact correspondence, most sales of fish can be expected to be attributable to a single trip and I support the effort to incorporate necessary trip identifiers in different upstream data sources (The Universal Trip Identifier, ToR 1c and ToR 2c). This will very likely make much of the approximate matching and imputation superfluous once upstream sources are complete, and the quality of the compiled output will increase automatically.

3. As users adapt to CAMS, they need assurance that CAMS is a good solution for their particular needs, and particularly users concerned with the integrity of time-series may need to perform some analysis to inform on how they can best adapt (ToR 1g). I recommend that the CAMS-team make available to users the tools employed in the analysis that was performed for this review in comparing CAMS output to the data sources previously utilized by users (ToR 1d). I also recommend that tools be developed to demonstrate quantitatively that the explanations typically put forward for differences to legacy systems are plausible. For instance, differences in discard estimates may be believed to be explained by a difference in the number of samples available or a difference in the post-stratification

employed. In these cases, users should have tools to inspect that small changes to which samples are available or which stratification is used with the CAMS data have a large enough effect that differences can be plausibly ascribed to these variations.

4. I recommend that user interfaces are developed in such a way that the user can be conscious of which version of CAMS they are using and can incorporate that into their data documentation. I also recommend that data downloaded by users are clearly labeled with both the CAMS version and the date and time of extraction (ToR 2a and 2h).

5. As the development of CAMS progresses into a phase that overlaps with users adapting to the system, it will be important to have clear principles in place for deciding how to accommodate users and delineate responsibilities between CAMS, data providers, and users. The proposed change control board (ToR 2a) seems to be a good candidate to define such principles and make decisions and priorities for system changes based on them. I recommend that some change control management is implemented.

   An early task with respect to change management would be to clearly define the scope of CAMS. I have highlighted some important aspects in this review: responsibilities for error checking and corrections (ToRs 1f and 2g), which kind of data sources to support (ToR 2d), and responsibilities for reproducibility services (2h). With respect to deciding on the scope for data sources, I believe that data that require approximate calculations require some special attention as I have described in the section 'Additional findings'.

   Early on, the change control management needs to be very responsive as development will overlap with active user adaptation (ToR 1g and 2e). The process may become more formal an less work intensive in the longer run. Both in the immediate future and in the longer run, I think it is advisable that both developers and users have representation in the change control management.

6. I recommend that the active development that will be going on in parallel to user adaptation is taken advantage of with respect to incorporating early user response in the specification of CAMS (ToRs 2e and 1g). This experience should be used to inform on how user interfaces and documentation can be improved, and be used to develop a strategy to incorporate user needs in the longer term.

Recommendations for long-term projects

7. As CAMS is receiving data from data providers on behalf of many users, I recommend that this position is leveraged to engage data providers about routines for quality control and timeliness of deliveries (ToRs 1b, 1f and 2g). Since CAMS pulls together different data-streams, I recommend that it is made a responsibility for CAMS to do error checking that is made possible by the cross-referencing of different data sources, and that a clear agreement is made with data stewards about who should followed up such error reports, and about who is responsible for other kinds of quality controls. In general I think it is best to perform corrections as close as possible to the data source, when a definite error has been detected.

8. I commend the effort put into making it traceable for the users to determine which data sources and imputation methods are used for individual rows in tables. I recommend that principle be carried on through development (ToRs 1c and 1e). It can also be considered for

other approximate processing, such as data set matching. It serves users that may have specific quality requirements, so that they can handle these cases separately, and it serves users with demands on time-series integrity to quantify to what extent apparent trends can be attributed to changes in the quality of reporting.

9. I recommend that the test environment that has been developed is maintained and actively used to device tests with controlled static data, so that important system invariants can be assured as code changes (ToR 2b). That is, to verify that a system update does not have unintended side-effects.

Appendix 1 – Bibliography of Materials Provided for Review

Review Documents
Greater Atlantic Regional Fisheries Office (GARFO). 2022. Length Frequency Distributions.

Hocking, D., Lanning, J.M., Galuardi, B., Linden, D., McAfee, B. 2023. MAPS: Production system for matching and monitoring catch at the Greater Atlantic Regional Fisheries Office. R package version 0.5.1-9000.

Legault, C., Adams, C., Boucher, J., Burgess, L., Chute, T., Hu, L., Lucey, S., Wigley, S. 2022. CAMS Discards Comparison.

Linden, D. and Legault, C. 2022. Exploring Contamination of Discard Estimates.

Northeast Fisheries Science Center (NEFSC) Review of CAMS Landings, Value, and Effort. February 2022; 234p.

Northeast Fisheries Science Center Review (NEFSC) of CAMS Discards. November 2022; 22p.

Background Documents
Greater Atlantic Regional Fisheries Office Discard Methodology:
https://www.fisheries.noaa.gov/new-england-mid-atlantic/science-data/discard-methodology

Northeast Fisheries Science Center Data Collection Program Review:
https://www.fisheries.noaa.gov/national/about-us/noaa-fisheries-science-program-review

Standardized Bycatch Reporting Methodology:
https://www.fisheries.noaa.gov/new-england-mid-atlantic/fisheries-observers/fisheries-monitoring-operations-northeast

Lanning, J.M., Hermsen, J., McAfee, B., Linden, D., Sullivan, J., Caless, D., Galuardi, B., Carbonneau, W. 2018. Data Matching and Identification System (DMIS). 32p.

Linden, D. 2021. A predictive model of discarded catch that leverages self-reporting and electronic monitoring on commercial fishing vessels. 23p.

Northeast Fisheries Science Center. 2008. Appendix to the Report of the 3rd Groundfish Assessment Review Meeting (GARM III): Assessment of 19 Northeast Groundfish Stocks through 2007. Northeast Fisheries Science Center, Woods Hole, MA, August 4-8, 2008. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 08-16; 1056p. http://www.nefsc.noaa.gov/publications/

Wigley, S. Hersey, P., Palmer, J. 2008. A description of the allocation procedure applied to the 1994 to 2007 commercial landings data. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 08-18; 61p. http://www.nefsc.noaa.gov/nefsc/publications/

Appendix 2 – Performance Work Statement

Performance Work Statement (PWS)
National Oceanic and Atmospheric Administration (NOAA)
National Marine Fisheries Service (NMFS)
Center for Independent Experts (CIE) Program
External Independent Peer Review

Catch Accounting and Monitoring System (CAMS)
January 17-19, 2023

Background
Prior to the development of the Catch Accounting and Monitoring System (CAMS) project, the Northeast Fisheries Science Center (NEFSC) and the Greater Atlantic Regional Fisheries Office (GARFO) developed and maintained two parallel systems for catch monitoring and accounting. Mission needs for quota monitoring led to GARFO operating one system, while the mission needs for stock assessments and other research activities led to the NEFSC operating the other system. The two systems each integrate data across a wide array of fishery information systems, and each approaches integration and record matching slightly differently, resulting in different outputs that have raised and continue to raise internal and external stakeholder concerns. Additionally, the two independent systems require significant maintenance and upgrading as regulations and data streams change; which illustrates the maintenance of two systems is an inefficient use of resources and is no longer an effective tool to provide the best information for science and management actions.

To address both sets of mission needs and remove system siloes and duplicative operational costs, the NEFSC and GARFO jointly sponsor the development and implementation of the CAMS project. The envisioned end-state of the project is a single comprehensive source for all U.S. northeast commercial fisheries catch (landings and discards) for quota monitoring, stock assessments, protected resources estimation, ecosystem modeling, and other needs of GARFO and NEFSC in a fully documented relational database with appropriate user views and tables. The logic and algorithms supporting CAMS build from previous knowledgebase, while incorporating updated matching and linking processes across the various fishery data sources.[1][2] The outputs of CAMS are an integral asset to the processes and analyses of NEFSC and GARFO missions; therefore, a formal scientific peer review is requested of CAMS components and products to ensure credibility and relevance. External scientific peer reviews have been and continue to be essential to strengthening scientific quality assurance for fishery conservation and management actions.

Scientific peer review is defined as the organized review process where one or more qualified experts review scientific information to ensure quality and credibility. These expert(s) must conduct their peer review impartially, objectively, and without conflicts of interest. Each reviewer must also be independent from the development of the science, without influence from any position that the agency or constituent groups may have. Furthermore, the Office of Management and Budget (OMB), authorized by the Information Quality Act, requires all federal agencies to conduct peer

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[1] Northeast Fisheries Science Center, "Appendix to the Report of the 3rd Groundfish Assessment Review Meeting (GARM III)," Northeast Fisheries Science Center reference document ; 08-16, 2008, https://repository.library.noaa.gov/view/noaa/5210

[2] Northeast Fisheries Science Center, "Summary Report: Northeast Fisheries Science Center Science Data Collection Program Review," Stock Assessment Data Collection Program Review, August 5-8, 2013, https://apps-nefsc.fisheries.noaa.gov/nefsc/program_review/pdfs/nefsc_reviewer_summary_report.pdf

reviews of highly influential and controversial science before dissemination, and that peer reviewers must be deemed qualified based on the OMB Peer Review Bulletin standards[3].

Scope

The formal scientific peer review of CAMS is recommended to follow the same procedures as research track assessment peer reviews, which include a formal multiple-day meeting of stock assessment experts who serve as a panel to peer-review tabled stock assessments and models. The research track peer review is the cornerstone of the Northeast Region Coordinating Council (NRCC) stock assessment process. The process includes assessment development and report preparation, assessment peer review, public presentations, and document publication. The results of the requested peer review will be incorporated into future CAMS development iterations as well as inform stock assessments that serve as the basis for developing fishery management recommendations.

The purpose of this CIE review is an external peer review of the CAMS components: data integration across multiple sources, new methods developed for the project, and documentation of the system. This performance work statement (PWS) provides additional details and clarification of peer review requirements in the following sections: **Annex 1**: CAMS landings and discards Terms of Reference, which are the responsibility of the analysts; **Annex 2:** a draft meeting agenda; **Annex 3:** individual independent review report requirements; and **Annex 4:** peer reviewer summary report requirements.

Requirements

Pursuant to CIE standards, NMFS requires three reviewers to participate in the panel review. Either the New England or Mid-Atlantic Fishery Management Council's Science and Statistical Committee will provide the review panel chair, who is in addition to the three reviewers. Although the chair will be participating in the review, the chair's participation (i.e. labor and travel) is not covered by this CIE review engagement.

Each reviewer will write an individual review report in accordance with the PWS, OMB Guidelines, and the provided terms of reference (TOR). Modifications to the PWS and TORs cannot be made during the peer review, and the Contracting Officer's Representative (COR) and the CIE contractor shall approve any modifications prior to the peer review. All TORs must be addressed in each reviewer's report. The reviewers shall have expertise and experience with developing large-scale databases that require merging of multiple component databases. In addition, the reviewers should have working knowledge and recent experience in the use and application of fishery-dependent data in stock assessment or quota monitoring.

Tasks for Reviewers
- Review the background materials and reports prior to the review meeting
    - Two weeks before the peer review, the project contacts will electronically disseminate all necessary background information and reports to the CIE reviewers for the peer review.
- Attend and participate in the panel review meeting
    - The meeting will consist of presentations by NMFS scientists to facilitate the review, to provide any additional information required by the reviewers, and to answer any questions from reviewers
- Conduct an independent peer review in accordance with the requirements specified in this PWS and TORs, in adherence with the required formatting and content guidelines

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[3] https://www.whitehouse.gov/wp-content/uploads/legacy_drupal_files/omb/memoranda/2005/m05-03.pdf

- Reviewers are not required to reach a consensus. Individual reviewer perspectives should be provided in their individual reports, and any lack of consensus should be clearly described in the panel's summary report.
- Each reviewer shall assist the review panel chair with contributions to the peer review panel's summary report
- Deliver individual independent reviewer reports to NMFS according to the specified milestone dates
- Individual and panel reports each should explain whether each CAMS landings and discards TOR was or was not completed successfully during the peer review meeting, using the criteria specified below in the "Tasks for Peer Review Panel."
- During the meeting, additional questions that are not in the TORs, but that are directly related to the CAMS topics may be raised. Comments on these questions should be included in a separate section at the end of the independent report produced by each reviewer.
- The independent report can also be used to provide greater detail than the peer reviewer summary report on specific TORs or on additional questions raised during the meeting.

Tasks for Review panel
- During the peer review meeting, the panel is to determine whether each TOR was or was not completed successfully. To make this determination, panelists should consider whether the work provides a scientifically credible basis for developing fishery management advice. Criteria to consider include: whether the CAMS data outputs are developed and implemented appropriately, processes and assumptions involved in CAMS are scientifically valid, the resulting data provided are high quality, and the data are provided in a format that is appropriate for use in stock assessments and quota monitoring. Where possible, the Peer Review Panel chair shall identify or facilitate agreement among the reviewers for each TOR.
- Each reviewer shall complete the tasks in accordance with the PWS and Schedule of Milestones and Deliverables below.

Tasks for Peer Review Panel chair and reviewers combined:
Review the CAMS working group report, CAMS Landings and Discards, and CAMS documentation.

The review panel chair, with the assistance from the reviewers, will write the peer reviewer summary report. Each reviewer and the chair will discuss whether they hold similar views on each TOR and whether their opinions can be summarized into a single conclusion for all, or only for some of the TORs of the peer review meeting. For terms where a similar view can be reached, the peer reviewer summary report will contain a summary of such opinions.

The chair's objective during this peer reviewer summary report development process will be to identify or facilitate the finding of an agreement rather than forcing the panel to reach an agreement. Again, the CIE reviewers are not required to reach a consensus. The chair will take the lead in editing and completing this report. The chair may express their opinion on each research track TOR, either as part of the group opinion, or as a separate minority opinion. The peer reviewer summary report will be submitted directly to NEFSC and GARFO; it will not be submitted, reviewed, or approved by the contractor.

The contractor is required to use all appropriate methods to safeguard Personally Identifiable Information (PII).

Place of Performance

The place of performance shall be hybrid at the contractor's facilities, the Northeast Fisheries Science Center in Woods Hole, Massachusetts, and the Greater Atlantic Regional Fisheries Office in Gloucester, Massachusetts, via WebEx video conferencing.

Period of Performance
The period of performance shall be from the date of award through March 2023. Each reviewer's duties shall not exceed **14** days to complete all required tasks.

Schedule of Milestones and Deliverables: The contractor shall complete the tasks and deliverables in accordance with the following schedule.

Milestone Date	Description
Within 2 weeks of award	Contractor selects and confirms reviewers
Approximately 2 weeks later	Contractor provides the pre-review documents to the reviewers
January 17-19, 2023	Panel review meeting
Approximately 2 weeks later	Contractor receives draft reports
Within 2 weeks of receiving draft reports	Contractor submits final reports to the government

* The peer reviewer summary report will not be submitted to, reviewed, or approved by the Contractor.

Applicable Performance Standards
The acceptance of the contract deliverables shall be based on three performance standards:
(1) The reports shall be completed in accordance with the required formatting and content (2) The reports shall address each TOR as specified (3) The reports shall be delivered as specified in the schedule of milestones and deliverables.

Travel
No travel is necessary, as this meeting is being held remotely.

Restricted or Limited Use of Data
The contractors may be required to sign and adhere to a non-disclosure agreement.

NEFSC Project Contact
Chris Legault, NEFSC Assessment Process Lead
Northeast Fisheries Science Center
166 Water Street, Woods Hole, MA 02543
Chris.Legault@noaa.gov

GARFO Project Contact
J. Michael Lanning, GARFO Development Lead
Greater Atlantic Regional Fisheries Office
55 Great Republic Drive, Gloucester, MA 01930
J.Michael.Lanning@noaa.gov

Annex 1. CAMS Landings and Discards Terms of Reference

1. Comment on the ability of CAMS to provide a single source of commercial fishery data for users in both GARFO and NEFSC (e.g., for quota monitoring, stock assessment, socio-economic analysis, ecosystem assessment, protected species bycatch assessment, and research). Consider the following aspects in your review:
   a. Documentation at both the conceptual and technical levels
   b. Data source contributions, including the smaller and harder to track data sources (e.g., state of Maine herring data)
   c. Processes to combine data sources
   d. Comparisons of CAMS outputs with landings and discards provided from previous quota monitoring and stock assessment approaches
   e. Methods for imputing effort, area, and gear when such data are missing
   f. Approaches to handle conflicts across data sources (e.g., area 514 reported on vessel trip report (VTR) but observer on the trip reports areas 514, 521, and 525)
   g. Utility of CAMS outputs for operational use, particularly for the primary uses – quota monitoring and stock assessment

2. Recommend future enhancements for CAMS noting whether each is an immediate need or a longer-term project. Consider the following aspects in your review:
   a. Change management and version control
   b. Test environment
   c. Inclusion of a Universal Trip Identifier once it has been developed and implemented
   d. New sources of data
   e. User tables or interfaces
   f. Data dictionary and entity relationship diagrams
   g. Feedback to data providers to improve overall accuracy and utility of data
   h. Enhancements for reproducibility of results and/or enhanced utility in assessments, quota monitoring, and research

Annex 2. Draft Review Meeting Agenda

{Final Meeting agenda to be provided at time of award}

CAMS Peer Review Meeting
January 17-19, 2023
WebEx link: TBD
DRAFT AGENDA*

*All times are approximate Eastern Standard Time, and may be changed at the discretion of the review panel chair. The meeting is open to the public; however, during the report writing sessions we ask that the public refrain from engaging in discussion with the peer review panel.

Tuesday, January 17, 2023

Time	Topic	Presenter(s)	Notes
9 a.m. - 9:15 a.m.	Welcome/Logistics Introductions/Agenda/Conduct of Meeting	Review Panel Chair, CAMS NEFSC Sponsors	
9:15 a.m. - 9:30 a.m.	Introductions		
9:30 a.m. - 10:30 a.m.	High-level Overview	Chris Legault	
10:30 a.m. - 10:45 a.m.	Break		
10:45 a.m. - 12:15 p.m.	Data Sources and Processes	Michael Lanning	
12:15 p.m. - 1:15 p.m.	Lunch		
1:15 p.m. - 3 p.m.	Data Sources and Processes (Continued)	CAMS Program Team	
3 p.m. - 3:15 p.m.	Break		
3:15 p.m. - 4:45 p.m.	Data Conflict Management	CAMS Program Team	
4:45 p.m. - 5 p.m.	Public Comment	Public	
5 p.m.	Adjourn		

Wednesday, January 18, 2023

Time	Topic	Presenter(s)	Notes
9 a.m. - 9:05 a.m.	Welcome/Logistics	Review Panel Chair	
9:05 a.m. - 9:20 a.m.	Follow-up from Day 1	Review Panel	
9:20 a.m. - 10:50 a.m.	CAMS Stock Assessment Comparisons	CAMS Program Team	
10:50 a.m. - 11:05 a.m.	Break		

Time	Topic	Presenter(s)	Notes
11:05 a.m. - 12:15 p.m.	CAMS Quota Monitoring Comparisons	CAMS Program Team	
12:15 p.m. - 1:15 p.m.	Lunch		
1:15 p.m. – 2:15 p.m.	New Estimations	CAMS Program Team	
2:15 p.m. - 3:15 p.m.	Operationalizing CAMS	CAMS Program Team	
3:15 p.m. - 3:30 p.m.	Break		
3:30 p.m. - 4:45 p.m.	TOR 1 Discussion	Review Panel	
4:45 p.m. - 5 p.m.	Public Comment	Public	
5 p.m.	Adjourn		

Thursday, January 19, 2023

Time	Topic	Presenter(s)	Notes
9 a.m. - 9:05 a.m.	Welcome/Logistics	Review Panel Chair	
9:05 a.m. - 9:20 a.m.	Follow-up from Day 2	Review Panel	
9:20 a.m. - 11:15 a.m.	Future of CAMS	CAMS Program Team	
11:15 a.m. - 11:30 a.m.	Break		
11:30 a.m. - 12:00 p.m.	Key Findings	Review Panel	
12:00 p.m. - 1:00 p.m.	Lunch		
1:00 p.m. - 5 p.m.	Report Writing	Review Panel	
5 p.m.	Adjourn		

Annex 3. Individual Independent Peer Reviewer Report Requirements

1. The independent Peer Reviewer report shall be prefaced with an Executive Summary providing a concise summary of whether they accept or reject the work that they reviewed, with an explanation of their decision (strengths, weaknesses of the analyses, etc.).

2. The report must contain a background section, description of the individual reviewers' roles in the review activities, summary of findings for each TOR in which the weaknesses and strengths are described, and conclusions and recommendations in accordance with the TORs. The independent report shall be an independent peer review, and shall not simply repeat the contents of the Peer Reviewer Summary Report.

   a. Reviewers should describe in their own words the review activities completed during the panel review meeting, including a concise summary of whether they accept or reject the work that they reviewed, and explain their decisions (strengths, weaknesses of the analyses, etc.), conclusions, and recommendations.

   b. Reviewers should discuss their independent views on each TOR even if these were consistent with those of other panelists, but especially where there were divergent views.

   c. Reviewers should elaborate on any points raised in the Peer Reviewer Summary Report that they believe might require further clarification.

   d. The report may include recommendations on how to improve future assessments.

3. The report shall include the following appendices:

   Appendix 1: Bibliography of materials provided for review
   Appendix 2: A copy of this Performance Work Statement
   Appendix 3: Panel membership or other pertinent information from the panel review meeting.

Annex 4. Peer Reviewer Summary Report Requirements

The main body of the report shall consist of an introduction prepared by the Peer Review Panel chair that will include the background and a review of activities and comments on the appropriateness of the process in reaching the goals of the peer review meeting. Following the introduction, for each research topic reviewed, the report should address whether or not each Term of Reference was completed successfully. For each Term of Reference, the Peer Reviewer Summary Report should state why that Term of Reference was or was not completed successfully. It should also include whether they accept or reject the work that they reviewed, with an explanation of their decision (strengths, weaknesses of the analyses, etc.)

To make this determination, the peer review panel chair and reviewers should consider whether or not the work provides a scientifically credible basis for developing fishery management advice. If the reviewers and peer review panel chair do not reach an agreement on a Term of Reference, the report should explain why. It is permissible to express majority as well as minority opinions.

The report shall also include the bibliography of all materials provided during the peer review meeting, and relevant papers cited in the Peer Reviewer Summary Report, along with a copy of the CIE Performance Work Statement.

Appendix 3 – Information from Panel Review Meeting: Review Panel & Meeting Attendees

ASMFC - Atlantic States Marine Fisheries Commission
CIE – Center for Independent Experts
GARFO - Greater Atlantic Regional Fisheries Office
MADMF - Massachusetts Division of Marine Fisheries
MAFMC - Mid Atlantic Fisheries Management Council
NEFMC - New England Fisheries Management Council
NEFSC - Northeast Fisheries Science Center
SEFSC - Southeast Fisheries Science Center
SMAST - University of Massachusetts School of Marine Science and Technology
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Cate O'Keefe - Chair
Steven John Holmes - CIE Panel
Geoff Tingley - CIE Panel
Edvin Fuglebakk - CIE Panel

Alex Dunn - NEFSC
Alex Hansell - NEFSC
Amy Martins - NEFSC
Andy Jones - NEFSC
Angela Forristall - NEFMC
Anna Webb - MADMF
Ashley Asci - GARFO
Ben Duffin - SEFSC
Ben Levy - NEFSC
Benjamin Galuardi - GARFO
Brad Schondelmeier - MADMF
Brant McAfee - NEFSC
Brian Linton - NEFSC
Bridget Harner - NEFSC
Cory Endres - NEFSC
Cameron Day - NEFSC
Charles Adams - NEFSC
Charles Perretti - NEFSC
Chris Legault - NEFSC
Chris McGuire - The Nature Conservancy
Chris Tholke - NEFSC
Connor Buckley - NEFMC
Dan Hennen - NEFSC
Dan Linden - NEFSC
Daniel Caless - GARFO
Daniel Hocking - GARFO
David Gouveia - GARFO
David McCarron - NEFMC
Debra Duarte - NEFSC
Erich Druskat - MADMF
Erin Kupcha - NEFSC
Geoff White - ASMFC
George Lapointe - George Lapointe Consulting

Heather Baertlein - SEFSC
Holly McBride - NEFSC
J. Michael Lanning - GARFO
Jamie Cournane - NEFMC
Jason Boucher - NEFSC
Jeff Kaelin - Lund's Fisheries
Jenny Couture - NEFMC
Jonathon Peros - NEFMC
Jose Montanez - MAFMC
Joshua Lee - NEFSC
Julie Beaty - ASMFC
Julie DeFilippi Simpson - ASMFC
Karson Cisneros - MAFMC
Kathy Sosebee - NEFSC
Kiersten Curti - NEFSC
Kristin Precoda - NEFSC
Kristopher Winiarski - GARFO
Larry Alade - NEFSC
Lee Benaka - NOAA S&T
Leona Burgess - NEFSC
Libby Etrie - Northeast Sector Service Network, Inc.
Maggie Ball - NEFSC
Mark Terceiro - NEFSC
Mary Hughes - NEFSC
Michael Simpkins - NEFSC
Michele Traver - NEFSC
Nick Buchan - MADMF
Paul Nitschke - NEFSC
Robin Frede - NEFMC
Russ Brown - NEFSC
Sam Asci - NEFMC
Sara Turner - GARFO
Sarah Cierpich - NEFSC
Scott Schaffer - SMAST
Stephanie Weiss - NEFSC
Steve Cadrin-SMAST
Susan Wigley - NEFSC
Tara Dolan - MADMF
Taylor Compton - GARFO
Toni Chute - NEFSC
Tony Hooper - Fish Resourcing
Tony Wood - NEFSC
Tori Luu - NEFSC