Center for Independent Experts (CIE) Independent Peer Reviewer Report of the Catch Accounting and Monitoring System (CAMS)

January 17-19, 2023

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Executive Summary

This report provides an independent peer review of the Catch Accounting and Monitoring System (CAMS).

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. The goal for CAMS 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.

By consensus, the review panel concluded that CAMS can be implemented for operational use for the primary purposes of quota monitoring and stock assessment, with some caveats and recommended immediate improvements. We noted that CAMS landings are already operational and were applied in stock assessments conducted in 2022. Caveats centered on the inconsistency between discard estimates from CAMS and the legacy systems, especially if the cause of these differences were not identified and the limited scope of comparisons to date (one year of data). Most urgent actions identified were need for software version identifiers in tables and documentation (including date stamp in output tables), implementation of a Universal Trip Identifier and establishment of the envisaged 'Change Control Board' with the authority to make decisions on change management, version control and data source contributions. Also important are the need to complete documentation of the operational version of CAMS, to make that documentation publicly available and to develop a strategy for user experience testing, so that user needs are fulfilled by adjusted or new output and tailored documentation if necessary.

The review panel was able to reach consensus on all recommendations, and so I endorse all recommendations made in that report. Recommendations in this report are restricted to ToR2 and only made where I feel one made by the panel is worth re-emphasizing or the recommendation is in some sense new or more specific.

Introduction

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. The NEFSC employed a system generating Area Allocated (AA) tables for landings and the 'StockEff' application to estimate discards. The outputs fulfilled the mission needs for stock assessments (and other research activities). The GARFO employed the Data matching and Identification System (DMIS), optimized for quota monitoring.

The two systems each integrated data across a wide array of fishery information systems, but approached integration and record matching slightly differently, resulting in different outputs that raised and continue to raise internal and external stakeholder concerns. Both systems required

significant maintenance and upgrading as regulations and data streams changed, an inefficient use of resources given the commonality of data sources between the two systems.

To address both sets of mission needs, the NEFSC and GARFO have jointly sponsored 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. Initial project scoping and formation of working groups started in November 2019 with system development occurring over the course of three years.

Landings, value, and effort outputs from CAMS were reviewed by the NEFSC in February 2022. These outputs were approved for use in stock assessments conducted in 2022. Discards outputs from CAMS were reviewed by the NEFSC in November 2022. The discards review found problems common across stocks as well as stock specific differences in discard estimates but concluded "Overall, no red flags were found that prevent the Center for Independent Experts (CIE) review of CAMS from occurring".

The Working Group (WG) provided the reports of the NEFSC reviews of CAMS landings and CAMS discards together with results from a simulation study on the consequences for discard estimates of correcting voyage trip report (VTR) data for area using observer records given different levels of observer coverage. Summary tables comparing CAMS landings and discards compared to results using the GARFO DMIS system were provided. In addition, web based (html) documents were made available: the current CAMS documentation as contained within the Monitoring Analysis Program System (MAPS) and three products related to the NEFSC CAMS discards review detailing a) The discards comparisons b) comparisons of length frequency distributions from CAMS compared to those from the StockEff system and c) electronic monitoring (EM) length frequency distributions for those groundfish stocks currently covered by EM. Background documents were also provided, primarily covering the legacy systems. The list of materials provided for review is given in Appendix 1.

The CAMS Peer Review Panel met via WebEx on January 17-19, 2023. The Panel was composed of three scientists selected by the Center for Independent Experts (CIE): Edvin Fuglebakk (Institute of Marine Research Norway), Steven Holmes (National Institute of Water and Atmospheric Research Limited, New Zealand), and Geoffrey Tingley (Gingerfish Ltd). The Panel was chaired by Cate O'Keefe (Fishery Applications Consulting Team), as a member of the New England Fisheries Management Council Scientific and Statistical Committee. The Performance Work Statement for CIE reviewers is included as Appendix 2 and CAMS peer review attendance list in Appendix 3.

The review panel was able to reach consensus on all recommendations, and so I endorse all recommendations made in that report. Recommendations in this report are restricted to ToR2 and only made where I feel one made by the panel is worth re-emphasizing or the recommendation is in some sense new or more specific.

Overall Comments and Comments by TOR

I congratulate the CAMS team on both the development of the CAMS system and the effort and thought put into the review meeting. There was an abundance of review material and presentations were all useful and sometimes very enlightening. All members of the WG were helpful and responsive to questions and requests for additional information. A special thank you to the rapporteurs who were able to produce remarkably comprehensive notes.

Given the large number of stocks to be monitored and assessed and the complex nature of fisheries management in the USA with multiple data sources originating from both federal and state agencies (necessarily leading to quite involved data integration), it was always going to be difficult for reviewers from outside of the system to review the CAMS system in detail. The situation was exacerbated by:

- Documentation that was not summarized. Summaries of findings tended to be given in the review meeting presentations with the presentations available on the day of the meeting.
- The still rapidly evolving code base meant summaries of landings and discards comparisons that were provided ahead of the meeting came with the caveat that totals may have changed by the time of the meeting, making it impossible to know the current significance of any miss-matches.
- The length of the meeting was compressed. I believe this was done for the reviewers' benefit (because of the difficulty of accommodating very different time zones) but, because of the large amount of information to absorb, the condensed format probably made the reviewers' job more difficult.

As a result, the review has had to focus on systems and procedures more than technical details.

Most comments and recommendations are made against each ToR (providing a 'check list' of points to consider for the review panel is very useful), however three points I wish to highlight here are:

We learnt how CAMS is ready to make use of a Universal Trip Identifier (UTID), and it was clear from presentations that the introduction of a UTID would be very beneficial. It will become much easier to make direct links between different records (e.g., Dealer and VTR) avoiding potential errors or biases. The fact such an identifier was identified as a primary need over 10 years ago suggests the obstacles to its introduction have not just been technical, but now, with momentum behind the implementation of a new and better system for data collation and processing, would be an opportune time to get the UTID operational.

Frequent reference was made to an anticipated Change Control Board (CCB). It was referenced with respect to:

- Oversight of version control of the CAMS system.
- Decisions on actions to be taken with respect to data conflicts.
- Decisions over inclusion of new sources of data.
- Disseminating information on CAMS changes to end users and data providers.
- Receiving feedback from end users about desired changes.

- Providing feedback to data providers about data quality and possibly facilitating feedback from end users to data providers.

All members of the review panel considered the CCB a good idea. Given the important and quite diverse nature of its anticipated roles and responsibilities, membership of the board needs to be considered carefully; however, it needs to be set up without undue delay. Until it is established there is potential for 'drift', i.e., decisions not taken because it is felt that these decisions are something that should be left to the Control Board.

Looking ahead I believe one of the key ingredients to enhanced utility of CAMS (in fulfilling its primary purposes including the ability to adapt to future regulatory or fisheries changes) is to maintain the development team and the working relationship between GARFO and NEFSC. In one of the presentations a CAMS development success was listed as the establishment of a large, committed team and that sense of commitment came across during the meeting. The team can feel justifiably proud of bringing a complex database to operational status. It was stated by the CAMS team they recognized arriving at a 'version 1' was not the end of the story and they were committed to long term development and support. I hope that understanding is presented to the top of each organization.

TOR 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).

By consensus, the review panel concluded that CAMS can be implemented for operational use for the primary purposes of quota monitoring and stock assessment, with some caveats and recommended immediate improvements. Most importantly:

- A universal trip identifier is implemented as soon as possible.
- The CAMS discard estimates for stock assessments need to be considered on a stock-by-stock basis, preferably as a ToR of the assessment process. If differences are large with no clear explanation, then it may be necessary to delay the assessment until the differences are eliminated/explained or the previous system is employed for discard estimation.
- Documentation of the operational version of CAMS is completed.
- The 'Change Control Board' proposed by the CAMS development team is established as soon as possible.

Consider the following aspects in your review:

a. Documentation at both the conceptual and technical levels

The system set up for use by those internal to GARFO and NEFSC, the Monitoring Analysis Program System (MAPS), is appropriate. The CAMS development team noted that the documentation on MAPS is incomplete because the emphasis has been on the development of the code base with rapid changes to data treatment processes. The structure of CAMS should become more settled from now and this suggests a greater proportion of development effort can be devoted to documentation. I recognize such documentation is a living document because CAMS will

continue to evolve. As a part of version control the documentation needs to outline changes between versions.

The MAPS system documentation seems aimed at a highly technical audience (co-developers and 'power users') and it seems necessary to develop complimentary documentation aimed at those requiring less technical detail but who still need to pull tables from the system, or users who may request and be provided end user tables. Tailoring documentation to user needs is best done through liaison with end users (the panel recommended user experience testing). As a first step, the review panel report recommends development of a universal list of end users which I strongly endorse.

It is still unclear to me what end users might exist that are unable to access the MAPS. I strongly endorse the idea that a publicly accessible site be made available. Any areas deemed sensitive can be password protected.

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

As far as I am aware, all data sources used in the legacy databases have been incorporated into CAMS. Data sources the CAMS team would like to incorporate, and which seem very appropriate to the goals of CAMS, are lobster fishery vessel trip reports (VTR), state vessel trip reports and VMS landings reports. From the presentations on combining data sources, it seemed the lobster fishery vessel trip reports would be beneficial in reducing complexity in the data cleaning and imputation process.

A 'Change Control Board' is proposed to control version management and issues related to data contributions. All review panel members agreed establishing the board was a good idea.

c. Processes to combine data sources

The processes to combine data sources in CAMS are well-described. They are as used in the Data Matching Imputation System (DMIS) previously used by GARFO, which is good for continuity. Introduction of the UTID would help to minimize uncertainty and errors (see general comments and ToR 2c). As a panel we suggested the CAMS team may want to consider alternative methods for apportioning catch and raising discards, but I consider these longer-term considerations. If such changes produced large changes in resulting end data for a given stock, there would be an issue of a break in the data time series unless re-processing could be performed sufficiently far back in time.

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

CAMS landings appeared reasonably well-matched to the previously used Area Allocation (AA) tables for stock assessment and to the previously used DMIS system for quota monitoring for the comparison year of 2019. For discards there seemed to be potentially concerning discrepancies between CAMS discards and those from the previous methods. As noted in the panel report, differences in outputs between CAMS and previous methods do not necessarily indicate a problem,

especially if resulting from a known improvement introduced in CAMS but it is essential that differences can be explained. Differences in results can be for multiple reasons (mesh size categories, area stratification and the ability to match between data sources were given as examples). If there are significant differences in results for a given stock hopefully it is possible to re-compile data just for that stock with changes from the legacy system applied in sequence, e.g., new data source matching but old gear meshes and area stratification, new data matching and mesh categories but old areas, etc.

There is concern the comparisons of outputs between CAMS and the legacy systems have only been conducted for one year (2019). I agree that a difference in results that appears minor in one year may prove to be more significant in other years because of changes in fleet behaviors, responses of fish to environmental drivers etc. The CAMS team stated it was possible to create CAMS discards results for 2016-2018. I would recommend a project to compare results over the four years 2016-2019. Analyses could be prioritized according to a) stocks giving the single biggest discrepancy in any one year or over the four years in total and/or b) stocks with the nearest assessment update.

One example given showed how the statistical areas used to define a stock are different in CAMS compared to the previous stock assessment approach. This raises the prospect of a discontinuity in the time series of landings and/or discards for that stock. This may not be too great an issue for quota monitoring where the emphasis, I presume, is on the uptake of current fishing year quota, but for a stock assessment could affect the perception of the status of the stock, which is usually determined with reference to past values. One solution suggested was to allow analysts flexibility in what data treatments are applied to a given stock. This would be sensible in some instances, e.g., selecting for no imputations of catch when extracting data for CPUE analyses, but in other cases, such as the stock area definition, would perpetuate the problem of differences between stock assessment and QM data summaries. Again, the essential requirement is to be able to explain differences. CAMS landings data is available from 2005, so if a discontinuity in time series cannot be avoided, the best option may be to replace old landings data.

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

I agree with the rest of the review panel that the methods for imputing missing effort, area, and gear data were well-described and appropriate. It is also possible for imputed records to be identified by end users. The point was made during the review that ideally imputation is not needed because data is complete. Introduction of the UTID would help to minimize the need for imputations (see general comments and ToR 2c). See also ToR 1f.

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)

The approaches to handle currently identified data conflicts all seemed appropriate, e.g., to transition to Integrated Taxonomic Information System (ITIS) codes for species and separate species code from code for market category. Decisions on how to best resolve data conflicts in future was suggested as another task of the proposed Change Control Board. This is sensible for issues where the effects of changes made need to be evaluated to be fully understood (the example given being the VTR vs. observer level of area reporting) but other issues, such as reducing

'orphan' records by improving naming convention consistency within the database, are better dealt with outside such a formal process.

The point was made by the review panel (and I'm sure fully understood by the CAMS team) that sometimes a change in data collection protocol (possibly in combination with new technology) is better than attempts to improve imputation or data conflict handling within the database. The introduction of electronic VTRs (eVTR) might be seen as an example. The Change Control Board might be the means to allow data providers to benchmark best practices and to ensure consistency of data collection protocol across state and federal agencies.

Best practice data collection may imply alignment of legislation between states (or between vessels fishing in state or federal waters). While such issues would be beyond the authority of the Change Control Board it could provide the opportunity for the CAMS team to highlight where greater consistency would be beneficial for data completeness and quality.

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

I agree that CAMS can be implemented for operational use for the primary purposes of quota monitoring and stock assessment. The application of CAMS discards for stock assessments and in-season quota monitoring will have to proceed with caution. I would suggest NEFSC retains the ability to run the old Standardized Bycatch Reporting Methodology (SBRM) approach in cases (if they occur) where results are significantly different in the comparison year and the reason has not been adequately identified.

Potentially the reason(s) for discrepancies between CAMS and legacy system results have been identified but the problem is one of a large discontinuity and difficulty in adjusting the treatment of older data. An example given of a known change was estimation of cod catch in lobster pots from CAMS that was not present from the SBRM system. If confirmed as a previously unrecognized source of discards, it may be necessary to estimate lobster pot catches in years where it is not sensible to apply the CAMS process. In this instance a delay in the assessment until a new data series can be compiled would be preferable to reverting to the old system of discard estimation.

There was discussion during the review of the dynamic nature of the CAMS database and the difficulty of version control on the input data. For stock assessments this does not seem such an issue. As Chris Legault pointed out, the 'terminal year' data for stock assessments was probably never completely final. When a stock assessment is performed in subsequent years, the data from the previous terminal year (possibly slightly further back) can be re-extracted and an assessment re-run with the same assumptions to assess whether perceptions of the stock alter. If data for the terminal year is taken not too close to the end of the calendar year one would not expect a major impact from updated input data. Changes in treatment methodology either are already or can be tracked.

In the long term the 'single set of books' approach is likely to prove beneficial. An example of its benefits was the use of a standard definition for statistical areas for both QM and stock assessment for a given stock (differences between the previous systems had existed and gone unnoticed).

TOR 2. Recommend future enhancements for CAMS noting whether each is an immediate need or a longer-term project.

Comments specific to the aspects suggested for consideration.

h. Change management and version control

The CAMS team noted the use of lookup tables is a positive feature of the CAMS approach and I agree. They allow for changes to treatment of data without the need for processing code changes. Version control of the CAMS will need to include tracking of any changes to lookup tables.

The CAMS development team has clearly found the Jira system very useful so its use should continue.

It was recommended a date stamp be added to data tables and it was agreed by the CAMS development team a date stamp on end user tables (through a column giving the date of table generation) could be readily implemented.

In operational use CAMS doesn't necessarily rerun entire time series of input data. It was proposed that CAMS be made to rerun full data series after the introduction of any major changes in data treatment. Deciding what constitutes a significant change in CAMS methodology is envisaged as a responsibility of the Change Control Board.

Recommendations:

Immediate: Introduce a 'date stamp' on end user tables and version information on lookup tables.

Immediate: Establish Change Control Board (see also general comments and ToR2d).

Near term: Inclusion in CAMS documentation of changes between versions.

Near term: Establish a protocol for when to run a full data time series, as informed by the Change Control Board.

b. Test environment

The test environment is appropriate and fit for purpose. It is especially useful when considering changes in data treatment with potentially wide-ranging implications. I have no suggestions on this aspect of the project other than its use should continue.

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

From the presentations on the CAMS system and general discussions it was clear the introduction of a Universal Trip Identifier would be very beneficial. It will become much easier to make direct links between different records (e.g., Dealer and VTR) avoiding potential errors or biases. All organizations involved in bringing the Universal Trip Identifier into operation are urged to do so as quickly as is practically possible.

Recommendations:

Immediate: Introduction of a UTID as soon as is practically possible (see also under general comments).

d. New sources of data

I agree with the CAMS development team and the rest of the review panel that new data sources are hard to predict. That said, CAMS appears to have the flexibility to accommodate new data sources. I endorse the opinion new data sources should be tied to the objectives of CAMS, i.e., that it does not become a repository for data sources with large storage requirements and little or no relevance to the primary purposes of quota monitoring and stock assessment.

The intention I believe is to make decisions on new sources of data the responsibility of the Change Control Board. This I consider a good idea so long as the board is established as soon as is practically possible and has an appropriate membership (see under general comments).

Data envisaged for future inclusion in CAMS is state collected data. It was made clear the Atlantic Coastal Cooperative Statistics Program (ACCSP) is a vital organization for ensuring state data quality is good and an important strategic partner for GARFO. Much of the complexity of making CAMS operational and robust does seem to stem from the federal plus state nature of data collection and delivery to GARFO. It was good to hear initiatives (outside of the CAMS development team) to try to streamline data delivery. Formal collaboration between the proposed Change Control Board and ACCSP would hopefully sustain momentum toward such a goal.

Recommendations:

Immediate: Establish Change Control Board. Include as a part of this formal cross-collaboration with the ACCSP.

e. User tables or interfaces

Contributions from the public suggested employees from the state administrations are currently unsure of what type of interface will be available to them. Different types of interfaces and access may be needed depending on the role (state data manager required to use database queries was given as an example). Outreach is important at this point to make sure the different users are provided with products that meets their needs (see 'Communication and Outreach'). Making publicly accessible documentation pages should also be a priority.

Adding a date stamp on user tables and version numbering on lookup tables has already been mentioned.

Recommendations:

Immediate: Make CAMS system documentation publicly available.

Immediate: Add date stamp to user tables and version information on lookup tables.

Near term: As part of a Communication and Outreach Plan, inform stakeholders on the types of tables and interfaces available and elicit feedback on end user needs.

f. Data dictionary and entity relationship diagrams

The data dictionary (DD) and entity relationship diagrams (ERD) are certainly a good idea. Not being complete at the time of this review is understandable given the rapid changes in code base leading to CAMS version 1.0. The CAMS team seems to fully understand it is important to now place more emphasis on completing the DD and ERDs. Version control has been raised at many points in this review. The DD and ERD will almost certainly be living documents, so it needs to be possible to consult versions (snapshots) of DD and ERD relating to each significant version change of CAMS.

A request from one end user was for tables giving the link between old and new field names. I certainly support this; it will potentially save users much time and frustration. I believe it is on the CAMS team's 'to do' list.

This reviewer would request a much more comprehensive table of acronyms and their explanation. The current documentation has a list of 3 acronyms, I believe the number that should be explained is much higher.

Recommendations:

Immediate: Include tables linking old and new field names as part of the data dictionary.

Immediate: Include data dictionary and entity relationship diagrams as part of publicly available CAMS documentation.

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

I think feedback goes hand in hand with outreach. I suspect data providers are more likely to take on board suggestions for enhanced QA/QC if they feel 'included'. The presentations and other materials compiled for the CIE review act as good source material for presentations tailored for data providers, for example emphasizing the importance of complete records to avoid imputations and the inherent risk of introducing biases. Opportunities for outreach are possibly best identified in cooperation with organizations such as the Atlantic States Marine Fisheries Commission.

A member of the CAMS development team commented that CAMS should not have to carry the burden of all quality assurance responsibilities for federal or state data. The proposed Control Board could be used to agree quality assurance responsibilities with data providers. The CAMS team noted the cross checks and linking within CAMS allow for testing of completeness of data sources and consistency between data sources and this information can be fed back through the Control Board. As is stated in the panel report, the board needs to consist of CAMS developers from both GARFO and NEFSC and representatives from end users and data providers.

I'm unsure on the current level of informal links between CAMS developers and data providers. Strong links (working relationships) should be encouraged as much as possible. During the review a CAMS developer described how the CAMS project had led to new working relationships

between GARFO and NEFSC employees and a greater understanding on both sides of the other organization's needs.

Recommendations:

Immediate: Establish Change Control Board. Include as a part of this formal cross-collaboration with the ACCSP.

Near term: Develop a Communication and Outreach Plan, including identification of user groups and how to connect with them (see also 'Communication and Outreach').

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

Reproducibility of results is linked to good version control. The need for version tracking (including date stamps) has already been mentioned.

As I understand the situation, some smaller data sources were used in stock assessments but not included in the legacy databases. If these data sources are included in CAMS that should enhance utility for stock assessments.

There was brief discussion on using the data from vessels using electronic monitoring (EM) to cross check the discard rate of non-EM vessels. The CAMS team noted the EM vessels are treated as a separate fleet requiring specialized handling, that the number of EM vessels is small currently and that EM data is not currently used to cross check the discard rate of non-EM vessels. It may be valuable to consider the utility of such cross checks in the future, especially if the number of vessels using EM increases.

Enhancing utility in large part comes from knowing what end users need. The strong communication and cooperation between GARFO and NEFSC should mean user needs from within these organizations are easily enough identified, assuming points of contact for requests are well advertised internally. For outside users, the CAMS communication and outreach is key; see 'Communication and Outreach'.

Recommendations:

Immediate: Ensure the initial point of contact for enquiries from within GARFO and NEFSC is well advertised within the organizations.

Near term: work with data providers, preferably through the Change Control Board, to identify and integrate smaller data sources.

Long term: Consider the possibility of using electronic monitoring (EM) data to cross check other sources of data.

Long term: Consider alternative approaches for apportioning catch in cases where data are missing and consider alternative approaches for raising discards. Given the expected reduction in missing data with the introduction of a UTID, the need to consider alternative approaches should be considered only after introduction of the UTID.

Communication and Outreach

The Panel was asked to provide recommendations about the communication and outreach strategies for CAMS. The CAMS team are clearly fully aware of the need for communication and outreach to end users, data providers and other stakeholders. It was also clear from questions and comments from the public attendees that a push is needed in this area. The term 'roadshow' comes to mind, although in this era of virtual meetings that doesn't necessarily mean members of the CAMS team physically travelling to stakeholder venues. What I mean by roadshow are events similar to the CIE review in that presentations are given with time for questions between each presentation (but minus the formal review aspect). Presentations would need to be adjusted for each audience and one full day is probably the maximum sensible event length, but hopefully the presentations prepared for the CIE review would make good base material.

As mentioned in the panel review, opportunities for outreach are possibly best identified in cooperation with organizations such as the Atlantic States Marine Fisheries Commission and Atlantic Coastal Cooperative Statistics Program.

Any such roadshows or other near-term opportunities would be to bring stakeholders up to speed and are not envisaged to repeat. Ideally, by the time all necessary events were completed the Change Control Board would be established. The Board should then take charge of receiving requests from stakeholders and facilitating feedback to data providers.

Any outreach events would be equally about disseminating information and receiving feedback on user/data provider needs, including on documentation. By necessity, CAMS documentation to date has been aimed at developers and technical reviewers. As stated already this documentation needs to be made public and more tailored material developed on the back of the outreach program.

Recommendations:

> Near term: Develop a Communication and Outreach Plan, including identification of user groups and how to connect with them.

Request

The team organizing the CIE reviews do a great job in getting reviewers 'up to speed', e.g., by keeping them informed on how to access materials. Going forward, I suggest one useful tool might be a master list of acronyms and their meanings. This review may have been extreme in the number of acronyms in use given the need to reference the many organizations involved in fisheries data collection, both the legacy and the new database systems and the varied data sources that contribute to them and only some entries from a master list would be relevant to any particular meeting, but an alphabetical list does not take long to reference and might remove one distraction for reviewers not already familiar with the organizational, procedural or system acronyms of the region.

Appendix 1. Materials provided for review

Review Documents

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

Hocking D, Lanning J, Galuardi B, 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/

Greater Atlantic Regional Fisheries Office and Northeast Fisheries Science Center. Catch Accounting and Monitoring System (CAMS) CAMS_flow_charts.pptx - Google Slides

Appendix 2. Performance Work Statement for CIE reviewers for the Catch Accounting and Monitoring System (CAMS).

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.

[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

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 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.

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

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
- 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.

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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	

Time	Topic	Presenter(s)	Notes
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		
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. Attendees for CAMS peer review meeting.

CAMS Peer Review Attendance
January 17-19, 2023

ASMFC - Atlantic States Marine Fisheries Commission
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
Geoffrey Allan 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
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David Gouveia - GARFO
David McCarron - NEFMC
Debra Duarte - NEFSC
Erich Druskat - MADMF
Erin Kupcha - NEFSC
Geoff White - ASMFC
George Lapointe - George Lapointe Consul□ng
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