

**CENTER FOR INDEPENDENT EXPERTS (CIE) REVIEW OF ATLANTIC BLUEFIN
TUNA STATUS REVIEW**

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May 5, 2011

EXECUTIVE SUMMARY

I found the distinct population segment (DPS) analysis for Atlantic bluefin tuna (ABFT) in the Status Review Team (SRT) Status Review document to be well supported and convincing. The analysis of adequacy of harvest regulation seemed a little thin and seemed to stop short of a conclusion. The extinction risk analysis came up lacking, primarily because of under-representation of the effects of uncertainties, unrealistic neglect of the quantitative consequences of small population effects on the risk calculation, and poor documentation and synthesis.

BACKGROUND

In 2010, the US National Marine Fisheries Service (NMFS) was petitioned to list Atlantic bluefin tuna under ESA. NMFS convened a Status Review Team (SRT) which turned in its report in March of 2011. I was contacted by the Center for Independent Experts (CIE) to provide an independent review of the Status Review document. My primary expertise is in population modeling and statistics with particular emphasis on harvest and risk analysis.

REVIEWER'S ROLE

I looked over the materials available on the Northeast Regional Office (NERO) website provided for this review, and selected the items that I thought most revealing for the issues I would pursue. The documents which I studied in some detail are listed under "Documents Studied." I worked on my own, and did not consult with CIE or anyone else in developing the first draft of this review. In this second draft I have expanded my report in response to comments received on the first draft.

SUMMARY OF FINDINGS

Here I provide brief answers, seriatim, to all the questions posed in the TOR, subject to the qualifications which I stated above

- 1. Is the information regarding the life history and population dynamics of the species the best available? If not, please indicate what information is missing and if possible, provide sources.**

The compilation of natural history information provided in the SRT Status Review document impresses me as thorough and conscientious. As indicated below, I have serious reservations about the population dynamics analysis and conclusions.

- 2. Does the information on BFT genetics, physiological, behavioral, and/or morphological variation presented for the species' range represent the best available information? If not, please indicate what information is missing and if possible, provide sources.**

The compilation of information on ABFT genetics, physiological, behavioral and morphological differentiation by geography, and spawning area fidelity impresses me as thorough and conscientious.

- 3. Based on the information presented, are the conclusions regarding species, subspecies, or distinct population segment delineations supported by the information presented? If not, please indicate what information is missing and if possible, provide sources.**

The conclusions drawn in the SRT Status Review document regarding DPS status for the eastern and western stocks are well supported by the information provided. I would caution, however that this same information leads me to conclude that it will be impossible to successfully *manage* the two DPSs independently. Both the stocks are highly migratory, and though they appear not to mix when spawning, they may utilize many common foraging grounds and migratory paths. Therefore, some fisheries in some locales will take both stocks, requiring mixed-stock management. Assessments of the respective stocks will need to take account of the fractions of the two stocks taken in each fishery, both for purposes of accounting for harvest removals and for purposes of assigning CPUE type estimates to each stock. Each stock may appear as “bycatch” in fisheries for the other.

- 4. Information is presented in the report on ABFT habitat requirements. Is this information the best available information? If not, please indicate what information is missing and if possible, provide sources.**

The compilation of ABFT habitat information provided in the SRT Status Review document impresses me as thorough and conscientious. It is sufficient to define some high use areas. Unfortunately, it is not very conclusive in defining narrow habitat characteristics other than general location, but it is as good as can be done with present information. Determination of habitat requirements with greater specificity will have to await future data collection surveys.

- 5. Potential threats to ABFT from harvest, disease and predation, regulatory mechanisms that are used to manage the species and other natural or manmade impacts affecting ABFT (e.g., climate change, oil exploration, and related effects) are presented in the report. Is this information the best available information? If not, please indicate what information is missing and if possible, provide sources.**

The compilation of disease and predation information provided in the SRT Status Review document impresses me as thorough and conscientious; the presentation of harvest and harvest regulation mechanisms is problematic. The report does not explicitly come to a conclusion about *adequacy* of the harvest regulation and it does not directly engage the grave allegations about harvest regulation made in the listing petition (CBD, 2010) or in two prominent publications on the topic (Safina and Klinger, 2008; MacKenzie, Mosegaard and Rosenberg, 2009). My own

reading of the ICCAT SCRS report of the 2010 stock assessment (which I cite as ICCAT 2010b) left me very uneasy about acknowledged harvest reporting issues, regulatory compliance issues, very large uncertainties about the assessments, and indications that advice of the SCRS is not always consistently followed by the Commission. I am not reassured that the SCRS had already warned of high risk of eastern stock collapse in 2006, 2008, and 2009. I thought it a bad sign that the first two bulleted research recommendations in the SCRS report of the 2010 stock assessment begin with the words “the group reiterated...” I found troubling the lack of specificity about the ICCAT “emergency clause” (see the reply to question 7).

6. Is the information presented on ABFT aquaculture/farming the best available? If not, please indicate what information is missing and if possible, provide sources.

The compilation of ABFT fattening operations information provided in the SRT Status Review document impresses me as thorough and conscientious. Nevertheless, the ICCAT SCRS report of the 2010 stock assessment makes clear that the incompleteness of these data, and the influence of these operations on the fishery, introduces additional uncertainties into the assessment which need to be taken into account in the risk analysis (see the reply to question 8).

7. Conservation actions that have been implemented or are likely to be implemented in the future for ABFT are presented in the report. Are all of the conservation actions for the species included and considered in the list? If not, please describe which actions are missing and if possible, sources of information on these actions.

The compilation of conservation actions provided in the SRT Status Review document impresses me as nominally complete, but the assessment of their probable effectiveness is problematic. My concerns about the treatment of harvest management are given in my reply to question 5. The mention, in the SRT Status Review document, of an ICCAT “emergency clause” stating that harvest will be suspended the following year “if SCRS detects a serious threat of stock collapse” sounds grand, but I could not find further details in anything I read. Usually ICCAT assessments are only undertaken every other year. My reading of the ICCAT SCRS report of the 2010 stock assessment did not convince me that assessment mechanisms are in place to provide timely detection of symptoms of impending stock collapse, or that symptoms of a threat of stock collapse have been formally identified by ICCAT for regular monitoring. The ICCAT management has developed around the goal of MSY, and its definitions of overfishing and rebuilding are relative to MSY—stock collapse and the risk of extinction involve further dynamical and estimation considerations. For example, evidence of declining carrying capacity may allow satisfying an MSY goal with a smaller breeding biomass, but management for a smaller breeding biomass may increase other risks related to depensation, increased volatility under harvests with imperfect assessment and imperfect regulatory compliance, and other small population effects. Note also that it looks as if the VPA used for population assessment requires roughly 5 to 10 years worth of data on a brood in order for the estimates to settle down, which would introduce significant lags into the feedback cycle from monitoring, through assessment, to management adjustment. These concerns would best be addressed with a formal MSE (management strategy evaluation), built around an operating model which included the full range of pertinent uncertainties (see the answer to question 8), and which modeled the application of the ICCAT (or other) assessment procedures, and modeled the implementation of proposed

future management rule sets. The results of a thorough MSE would constitute a more conclusive evaluation of whether the present regulatory mechanisms and institutions are adequate relative to an extinction risk performance goal.

8. The extinction risk analysis that is performed in the status review report is based on data and associated projections from the most recent stock assessment for ABFT. Does this analysis consider all of the best available data and are the conclusions appropriate and scientifically sound? If not, please indicate what information is missing and if possible, provide sources.

The extinction risk analysis presented in the SRT Status Review document is not satisfactory. The documentation provided is inadequate: it is not sufficient to retrace all the steps of the analysis back to the raw data, and it does not present a thorough enough accounting of validation procedures for purposes of quantifying uncertainties. In a high-stakes, contentious setting, the gold standard for reviewability should be that the provided documentation would allow for attempts to reproduce any part (or the entirety) of the analysis should reviewers choose to dig that deep.

The extinction risk modeling looks to have been based on a minor retrofit of the ICCAT harvest management VPA model which was designed and developed for other purposes (MSY management). I could not tell from the material provided whether this was carried out by the SRT or the SCRS (perhaps the matter is moot since there are several individuals in common). The description of the ICCAT model in the SCRS report of the 2010 stock assessment bears the hallmark of internal institutional documents written by (and to an extent for) individuals familiar with the long history of the evolving effort—and very difficult for an outsider to parse and synthesize (see my comment about documentation, above).

As best I can understand from my reading of the Status Review document and the ICCAT SCRS report of the 2010 stock assessment, the SRT extinction risk analysis considerably underestimates the probability of extinction for two principal reasons: (1) the modeling did not incorporate a full representation of the acknowledged uncertainties, and (2) the modeling did not incorporate a quasi-extinction threshold reflecting possible depensation (“Allee”) effects associated with spawning area fidelity, spawning aggregation behavior, and other possible small population phenomena. Some of the statements in the ICCAT SCRS report of the 2010 stock assessment which I especially took to heart as indicative of very serious uncertainties beyond what would be accounted for in the bootstrap analysis were:

p 23, re analysis for the western stock--"The conclusions of this assessment do not capture the full degree of uncertainty in the assessments and projections."

p 19, re analysis for the eastern stock--"In general, the fits to the available CPUE indices continue to be poor (similar as past assessments), with heavy temporal trends in the residuals for most of the CPUE indices."

p 26, research recommendations bullet 1-- "The group reiterated the importance of getting fishery independent information, through a large-scale tagging program, and developing fishery

independent indices of abundance to better track trends in biomass and better estimate fishing mortality rates. Fishery-independent information is furthermore crucial to avoid bias due to management regulations in the models based on catch and CPUE.”

p 26, research recommendations bullet 2-- "The group reiterated that it is essential to obtain representative samples of otolith and other tissues from all major fisheries in all areas...."

p 26, research recommendations bullet 3-- "Research about the BFT population structure is also needed to solve key uncertainties in stock assessment. This would imply a large sampling effort that could be performed under the GBYP umbrella."

p 27, under Management Recommendations, regarding the eastern stock-- "The implementation of recent regulations through [Rec. 09-06 and previous recommendations] has clearly resulted in reductions in catch and fishing mortality rates. But, since the fishery is currently adapting to these management measures, the Committee is unable to fully understand the implications of the measures on the stock. The commission might consider a different probability of rebuilding standard than envisaged in Rec. [09.06] considering the unquantified uncertainties....."

p 28, under Management Recommendations, regarding the western stock-- "As noted previously by the Committee, both the productivity of the western Atlantic bluefin and western Atlantic bluefin fisheries are linked to the eastern Atlantic and Mediterranean stock. Therefore management actions taken in the eastern Atlantic and Mediterranean are likely to influence the recovery in the western Atlantic, because even small rates of mixing from East to West can have significant effects on the West due to the fact that Eastern plus Mediterranean resource is much larger than that of the West."

I suspect that adequate risk extinction analysis for this population complex will require a fresh modeling start (though such an effort would surely benefit from the expertise and experience of the SCRS scientists, could build on elements of the current ICCAT assessment modeling procedures, and would need to be cognizant of the SRCS harvest modeling). The SRT Status Review document cites only Boyce (1992) and Ludwig (1999) in its discussion of population viability analysis methodology—a lot has happened since those two papers were published. In 2009 I tasked a graduate student to attempt a survey of the PVA literature: he found roughly 700 peer reviewed publications, perhaps 2 dozen with methodological import, and new papers were appearing at a rate of about 90 per year.

I think the methodological bedrock of good PVA practice is a quantification of the joint uncertainty distributions of all the parameters estimated during the course of retrospective analysis of existing historical data, so that this parameter uncertainty, in its entirety, can be projected forward in the simulations that constitute the prospective risk analysis. In this way, the uncertainty is part of the risk, in contrast to the incomplete assessments which represent some uncertainty as an extraneous qualifier of a risk estimate that omits some of the uncertainty. I think an integrated Bayesian analysis (say, an amalgam of: Millar and Meyer 2000; Liermann and Hilborn 2001; Goodman 2002; Maunder 2004; Gibson and Myers 2004) is the easiest and clearest way to accomplish this, and I expect this approach should prove congenial to the SRCS. This would also provide a natural operating model for extension to a MSE.

A PVA risk analysis prepared under circumstances where considerable scrutiny is expected should be aware of, and describe its stance, vis a vis some ongoing disagreements in the literature over “proper” use of PVA, originating notably in Brook et al. (2000) vs Coulson et al. (2001) and in literature that follows from these two, and should also be aware of, and describe its stance, with respect to the large literature of non-Bayesian approaches to estimating parameter uncertainty in the retrospective analysis, such as: Chen et al. (2002); Dennis et al. (2006); Fagan and Holmes 2006; Holmes et al. (2007); Holland et al. (2009); and Bakker et al. (2009). I personally am not too thrilled by all this literature, but I think that you have to come to grips with it, as a defensive measure, when writing up a PVA risk analysis that has potential to be the center of controversy. That is to say, methodological choices need to be made along the way, and it is best to be prepared to defend your choices.

9. In general, are the scientific conclusions in the report sound and interpreted appropriately from the information? If not, please indicate why not and if possible, provide sources of information on which to rely.

The DPS analysis impressed me as sound; the analysis of adequacy of harvest management impressed me as sketchy and inconclusive; the extinction risk analysis presented in the SRT Status Review document is not satisfactory. My concerns are outlined in my replies to questions 5, 7 and 8.

10. Where available, are opposing scientific studies or theories acknowledged and discussed? If not, please indicate why not and if possible, provide sources of information on which to rely.

It struck me as odd that the SRT Status Review document does not directly engage (confirm or refute) the factual allegations in the petition to list (CDB), the CITES proposal, the two prominent peer-reviewed publications claiming danger of imminent collapse in the two respective stocks (Safina and Klinger, 2008; MacKenzie, Mosegaard and Rosenberg, 2009) or the broader literature giving a perspective on fisheries stock collapse (e.g., Hutchings and Reynolds, 2004).

11. In general, is the best scientific and commercial data available for BFT presented in the report?

I am not prepared to split hairs over the definition of “best scientific and commercial *data*” since these have become legal terms of art. As a scientist, I am comfortable judging *best scientific practice* in terms of documentation and completeness of data and analysis and interpretation of data. By those standards, the DPS analysis in the SRT Status Review document was fine, the analysis of adequacy of harvest regulation seemed a little thin, and the extinction risk analysis came up lacking, as I outlined in my answers to questions 5, 7, and 8.

CONCLUSIONS AND RECOMMENDATIONS

I found the DPS analysis in the SRT Status Review document to be well supported and convincing; the analysis of adequacy of harvest regulation seemed a little thin and seemed to stop short of a conclusion; and the extinction risk analysis came up lacking, as I outlined in my answers to questions 5, 7, and 8.

I suspect that adequate risk extinction analysis for this population complex will require a fresh modeling start with an up-to-date perspective on PVA best practice (though such an effort would surely benefit from the expertise and experience of the SCRS scientists, may build on elements of the current ICCAT assessment modeling, and needs to be cognizant of the SCRS harvest modeling). The extinction risk analysis needs to take full quantitative account of the many uncertainties involved: it is not enough simply to acknowledge that there are uncertainties, the uncertainties need to be quantified and folded into the estimate of risk. Extending the PVA into a MSE will provide a more definitive answer to the question of adequacy of existing regulations. To reduce some of the uncertainties in the future, I think it should be a priority that the SCRS research recommendations be followed.

REFERENCES

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APPENDIX 1: BACKGROUND DOCUMENTS CONSIDERED IN THE REVIEW

AFBT SRT. 2011. Status review report of Atlantic bluefin tuna (*Thunnus thynnus*). 97 pp.

CBD. 2010. Petition to list the Atlantic bluefin tuna (*Thunnus thynnus*) as endangered under the United States Endangered Species Act. 44 pp.

CITES. 2010. Proposal to include Atlantic bluefin tuna (*Thunnus thynnus* (Linnaeus, 1758)) on Appendix I of CITES in accordance with Article II 1 of the Convention. CoP15 Prop. 19. 34 pp.

Hutchings, J.A., and J.D. Reynolds. 2004. Marine fish population collapses: consequences for recovery and extinction risk. *BioScience* 54:297-309

ICCAT. 2010a. Report of the 2010 ICCAT bluefin data preparatory meeting. 65 pp.

ICCAT. 2010b. Report of the 2010 Atlantic bluefin tuna stock assessment session. Downloaded from web, pdf pages 1-132.

ICCAT. 2011 (?). Executive summary BFT of ICCAT Report 2010-2011 (I), Section 8.5, pp 75-99. Downloaded from web.

MacKenzie, B.R., Mosegaard, and A.A. Rosenberg. 2009. Impending collapse of bluefin tuna in the northeast Atlantic and Mediterranean. *Conservation Letters* 2:25-34.

Safina, C. and D.H. Klinger. 2008. Collapse of bluefin tuna in the Western Atlantic. *Conservation Biology* 22:243-246.

APPENDIX 2: STATEMENT OF WORK

External Independent Peer Review by the Center for Independent Experts

Status of Atlantic bluefin tuna (*Thunnus thynnus*) under the Endangered Species Act

Scope of Work and CIE Process: The National Marine Fisheries Service’s (NMFS) Office of Science and Technology coordinates and manages a contract providing external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of NMFS scientific projects. The Statement of Work (SoW) described herein was established by the NMFS Project Contact and Contracting Officer’s Technical Representative (COTR), and reviewed by CIE for compliance with their policy for providing independent expertise that can provide impartial and independent peer review without conflicts of interest. CIE reviewers are selected by the CIE Steering Committee and CIE Coordination Team to conduct the independent peer review of NMFS science in compliance the predetermined Terms of Reference (ToRs) of the peer review. Each CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee and the report is to be formatted with content requirements as specified in **Annex 1**. This SoW describes the work tasks and deliverables of the CIE reviewer for conducting an independent peer review of the following NMFS project. Further information on the CIE process can be obtained from www.ciereviews.org.

Project Description: NOAA’s National Marine Fisheries Service (NMFS) was petitioned to list Atlantic bluefin tuna (*Thunnus thynnus*) under the Endangered Species Act (ESA) on May 24, 2010. As required, NMFS reviewed the petition and made a positive 90-day finding determining that the information in the petition and otherwise available to the agency indicated that the petitioned action may be warranted. As a result of the positive finding, the agency was required to conduct a review of the status of the species to determine if listing under the ESA is warranted.

NMFS organized a status review team (SRT) consisting of federal employees to assemble the facts. In so doing, the team was instructed to organize and review the best available scientific and commercial information on Atlantic bluefin tuna and to then present its factual findings to the agency in a status review report. The report did not need to be based on consensus, and opposing individual viewpoints were welcomed as long as the viewpoints were sound and based on science. Further, the report was not to contain any listing advice or to reach any ESA listing conclusions – such synthesis and analysis is solely within the agency’s purview. NMFS will use the status review report to develop a final ESA determination and will publish its finding in the *Federal Register* on or before May 24, 2011.

NMFS is required to use the best available scientific and commercial data in making determinations and decisions under the ESA. The first question that must be addressed is what the appropriate species delineation is for consideration of conservation status. The ESA defines an endangered species as “any species which is in danger of extinction throughout all or a significant portion of its range,” and a threatened species as “any species which is likely to

become an endangered species within the foreseeable future throughout all or a significant portion of its range.” A species may be determined to be threatened or endangered due to any one of the following factors:

- (1) the present or threatened destruction, modification, or curtailment of its habitat or range;
- (2) overutilization for commercial, recreational, scientific or educational purpose;
- (3) disease or predation;
- (4) the inadequacy of existing regulatory mechanisms; and
- (5) other natural or manmade factors affecting its continued existence.

The scientific and commercial information contained in the status review report will likely contain essential factual elements upon which the agency may base its ESA determination. Accordingly, it is critical that the status review report contain the best available information on the species and the threats, that all relevant information is identified and included, and that all scientific findings be both reasonable, and supported by valid information contained in the document. Therefore, the CIE reviewers will conduct a peer review of the scientific information in the status report on Atlantic bluefin tuna based on the Terms of Reference (ToRs) attached in **Annex 2**.

Requirements for CIE Reviewers: The CIE shall provide three experts to conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. Two CIE reviewers shall have working knowledge and recent experience in fisheries population dynamics, one of which should have expertise in stock assessment and life history of bluefin tuna. The third CIE reviewer shall have expertise in extinction risk analysis. It is desirable that the extinction risk analysis expert be familiar with applications in fisheries, particularly highly migratory species. It is expected that each reviewer’s report shall reflect his/her area(s) of expertise. Each CIE reviewer’s duties shall not exceed a maximum of 10 days to complete all work tasks of the peer review described herein.

Location of Peer Review: The CIE reviewers shall conduct an independent peer review as a desk review, therefore no travel is required.

Statement of Tasks: Each CIE reviewer shall complete the following tasks in accordance with the SoW and Schedule of Milestones and Deliverables herein.

Prior to the Peer Review: Upon completion of the CIE reviewer selection by the CIE Steering Committee, the CIE shall provide the CIE reviewer information (full name, title, affiliation, country, address, email) to the COTR, who forwards this information to the NMFS Project Contact no later than the date specified in the Schedule of Milestones and Deliverables. The CIE is responsible for providing the SoW and ToRs to the CIE reviewers. The NMFS Project Contact is responsible for providing the CIE reviewers with the background documents, reports, and other pertinent information. Any changes to the SoW or ToRs must be made through the COTR prior to the commencement of the peer review.

Pre-review Background Documents: Two weeks before the peer review, the NMFS Project Contact will send (by electronic mail or make available at an FTP site) to the CIE reviewers the necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE Lead Coordinator on where to send documents. CIE reviewers are responsible only for the pre-review documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein. The CIE reviewers shall read all documents in preparation for the peer review.

Each CIE reviewer will be supplied with the status review report prepared by the status review team. Any of the reports and papers cited in the status review report will be made available to the consultants upon their request.

Desk Review: Each CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs, and shall not serve in any other role unless specified herein. **Modifications to the SoW and ToRs cannot be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COTR and CIE Lead Coordinator.** The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements.

Contract Deliverables - Independent CIE Peer Review Reports: Each CIE reviewer shall complete an independent peer review report in accordance with the SoW. Each CIE reviewer shall complete the independent peer review according to required format and content as described in Annex 1. Each CIE reviewer shall complete the independent peer review addressing each ToR as described in Annex 2.

Specific Tasks for CIE Reviewers: The following chronological list of tasks shall be completed by each CIE reviewer in a timely manner as specified in the **Schedule of Milestones and Deliverables**.

- 1) Conduct necessary pre-review preparations, including the review of background material and status review report provided by the NMFS Project Contact in advance of the peer review.
- 2) Conduct an independent peer review in accordance with the ToRs (**Annex 2**).
- 3) No later than 18 April 2011, each CIE reviewer shall submit an independent peer review report addressed to the “Center for Independent Experts,” Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and CIE Regional Coordinator, via email to David Sampson david.sampson@oregonstate.edu. Each CIE report shall be written using the format and content requirements specified in Annex 1, and address each ToR in **Annex 2**.

Schedule of Milestones and Deliverables: CIE shall complete the tasks and deliverables described in this SoW in accordance with the following schedule.

21 March 2011	CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact
22 March 2011	NMFS Project Contact sends the CIE Reviewers the status review report and background documents
28 March - 11 April 2011	Each reviewer conducts an independent peer review as a desk review
18 April 2011	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
2 May 2011	CIE submits the CIE independent peer review reports to the COTR
9 May 2011	The COTR distributes the final CIE reports to the NMFS Project Contact and regional Science Director

Modifications to the Statement of Work: Requests to modify this SoW must be approved by the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the COTR within 10 working days after receipt of all required information of the decision on substitutions. The COTR can approve changes to the milestone dates, list of pre-review documents, and ToRs within the SoW as long as the role and ability of the CIE reviewers to complete the deliverable in accordance with the SoW is not adversely impacted. The SoW and ToRs shall not be changed once the peer review has begun.

Acceptance of Deliverables: Upon review and acceptance of the CIE independent peer review reports by the CIE Lead Coordinator, Regional Coordinator, and Steering Committee, these reports shall be sent to the COTR for final approval as contract deliverables based on compliance with the SoW and ToRs. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (CIE independent peer review reports) to the COTR (William Michaels, via William.Michaels@noaa.gov).

Applicable Performance Standards: The contract is successfully completed when the COTR provides final approval of the contract deliverables. The acceptance of the contract deliverables shall be based on three performance standards:

- (1) each CIE report shall be completed with the format and content in accordance with **Annex 1**,
- (2) each CIE report shall address each ToR as specified in **Annex 2**,
- (3) the CIE reports shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

Distribution of Approved Deliverables: Upon acceptance by the COTR, the CIE Lead Coordinator shall send via e-mail the final CIE reports in *.PDF format to the COTR. The COTR will distribute the CIE reports to the NMFS Project Contact and regional Science Director.

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Annex 1: Format and Contents of CIE Independent Peer Review Report

1. The CIE independent report shall be prefaced with an Executive Summary providing a concise summary of the findings and recommendations, and specify whether the science reviewed is the best scientific information available.
2. The main body of the reviewer report shall consist of a Background, Description of the Individual Reviewer's Role 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.
3. The reviewer report shall include the following appendices:

Appendix 1: Bibliography of materials provided for review

Appendix 2: A copy of the CIE Statement of Work

Annex 2: Terms of Reference for the peer review of

Status of Atlantic bluefin tuna (*Thunnus thynnus*) under the Endangered Species Act

Provide a scientific peer review of the status review report on Atlantic bluefin tuna (BFT) in accordance to the following terms of reference.

1. Is the information regarding the life history and population dynamics of the species the best available? If not, please indicate what information is missing and if possible, provide sources.
2. Does the information on BFT genetics, physiological, behavioral, and/or morphological variation presented for the species' range represent the best available information? If not, please indicate what information is missing and if possible, provide sources.
3. Based on the information presented, are the conclusions regarding species, subspecies, or distinct population segment delineations supported by the information presented? If not, please indicate what information is missing and if possible, provide sources.
4. Information is presented in the report on BFT habitat requirements. Is this information the best available information? If not, please indicate what information is missing and if possible, provide sources.
5. Potential threats to BFT from harvest, disease and predation, regulatory mechanisms that are used to manage the species and other natural or manmade impacts affecting BFT (e.g., climate change, oil exploration, and related effects) are presented in the report. Is this information the best available information? If not, please indicate what information is missing and if possible, provide sources.
6. Is the information presented on BFT aquaculture/farming the best available? If not, please indicate what information is missing and if possible, provide sources.
7. Conservation actions that have been implemented or are likely to be implemented in the future for BFT are presented in the report. Are all of the conservation actions for the species included and considered in the list? If not, please describe which actions are missing and if possible, sources of information on these actions.
8. The extinction risk analysis that is performed in the status review report is based on data and associated projections from the most recent stock assessment for BFT. Does this analysis consider all of the best available data and are the conclusions appropriate and scientifically sound? If not, please indicate what information is missing and if possible, provide sources.
9. In general, are the scientific conclusions in the report sound and interpreted appropriately from the information? If not, please indicate why not and if possible, provide sources of information on which to rely.
10. Where available, are opposing scientific studies or theories acknowledged and discussed? If not, please indicate why not and if possible, provide sources of information on which to rely.
11. In general, is the best scientific and commercial data available for BFT presented in the report?

